

gdsI

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Chapter 1

gdsl

1.1 Introduction

This is the gdsl (Release 1.8) documentation.

1.2 About

The Generic Data Structures Library (GDSL) is a collection of routines for generic data structures manipulation. It is a portable and re-entrant library fully written from scratch in pure ANSI C. It is designed to offer for C programmers common data structures with powerful algorithms, and hidden implementation. Available structures are lists, queues, stacks, hash tables, binary trees, binary search trees, red-black trees, 2D arrays, permutations, heaps and interval heaps.

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Nicolas Darnis <ndarnis@free.fr>: all GDSL modules excepted the ones listed below.

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Nicolas Darnis <ndarnis@free.fr>.

1.3 Thanks

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- Benny Pasternak <bennypk>

For his is bug report in `gdsl_rbtrees_map_infix` function.

The GDSDL Team.

Chapter 2

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Chapter 4

Module Documentation

4.1 Low level binary tree manipulation module

Typedefs

- `typedef struct _gdsI_bintree * _gdsI_bintree_t`
GDSL low-level binary tree type.
- `typedef int(* _gdsI_bintree_map_func_t)(const _gdsI_bintree_t TREE, void *USER_DATA)`
GDSL low-level binary tree map function type.
- `typedef void(* _gdsI_bintree_write_func_t)(const _gdsI_bintree_t TREE, FILE *OUTPUT_FILE, void *USER_DATA)`
GDSL low-level binary tree write function type.

Functions

- `_gdsI_bintree_t _gdsI_bintree_alloc (const gdsI_element_t E, const _gdsI_bintree_t LEFT, const _gdsI_bintree_t RIGHT)`
Create a new low-level binary tree.
- `void _gdsI_bintree_free (_gdsI_bintree_t T, const gdsI_free_func_t FREE_F)`
Destroy a low-level binary tree.
- `_gdsI_bintree_t _gdsI_bintree_copy (const _gdsI_bintree_t T, const gdsI_copy_func_t COPY_F)`
Copy a low-level binary tree.
- `bool _gdsI_bintree_is_empty (const _gdsI_bintree_t T)`
Check if a low-level binary tree is empty.
- `bool _gdsI_bintree_is_leaf (const _gdsI_bintree_t T)`
Check if a low-level binary tree is reduced to a leaf.
- `bool _gdsI_bintree_is_root (const _gdsI_bintree_t T)`

Check if a low-level binary tree is a root.

- **gdsl_element_t _gdsl_bintree_get_content** (const _gdsl_bintree_t T)
Get the root content of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_parent** (const _gdsl_bintree_t T)
Get the parent tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_left** (const _gdsl_bintree_t T)
Get the left sub-tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_right** (const _gdsl_bintree_t T)
Get the right sub-tree of a low-level binary tree.
- **_gdsl_bintree_t * _gdsl_bintree_get_left_ref** (const _gdsl_bintree_t T)
Get the left sub-tree reference of a low-level binary tree.
- **_gdsl_bintree_t * _gdsl_bintree_get_right_ref** (const _gdsl_bintree_t T)
Get the right sub-tree reference of a low-level binary tree.
- **ulong _gdsl_bintree_get_height** (const _gdsl_bintree_t T)
Get the height of a low-level binary tree.
- **ulong _gdsl_bintree_get_size** (const _gdsl_bintree_t T)
Get the size of a low-level binary tree.
- **void _gdsl_bintree_set_content** (_gdsl_bintree_t T, const gdsl_element_t E)
Set the root element of a low-level binary tree.
- **void _gdsl_bintree_set_parent** (_gdsl_bintree_t T, const _gdsl_bintree_t P)
Set the parent tree of a low-level binary tree.
- **void _gdsl_bintree_set_left** (_gdsl_bintree_t T, const _gdsl_bintree_t L)
Set left sub-tree of a low-level binary tree.
- **void _gdsl_bintree_set_right** (_gdsl_bintree_t T, const _gdsl_bintree_t R)
Set right sub-tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_left** (_gdsl_bintree_t *T)
Left rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_right** (_gdsl_bintree_t *T)
Right rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_left_right** (_gdsl_bintree_t *T)
Left-right rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_right_left** (_gdsl_bintree_t *T)
Right-left rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_map_prefix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in prefixed order.
- **_gdsl_bintree_t _gdsl_bintree_map_infix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in infix order.
- **_gdsl_bintree_t _gdsl_bintree_map_postfix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in postfix order.

- void **_gdsI_bintree_write** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of all nodes of a low-level binary tree to a file.
- void **_gdsI_bintree_write_xml** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a low-level binary tree to a file into XML.
- void **_gdsI_bintree_dump** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a low-level binary tree to a file.

4.1.1 Typedef Documentation

4.1.1.1 typedef struct **_gdsI_bintree*** **_gdsI_bintree_t**

GDSL low-level binary tree type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 55 of file **_gdsI_bintree.h**.

4.1.1.2 typedef int(* **_gdsI_bintree_map_func_t**)(const **_gdsI_bintree_t** TREE, void *USER_DATA)

GDSL low-level binary tree map function type.

Parameters

| | |
|------------------|--|
| <i>TREE</i> | The low-level binary tree to map. |
| <i>USER_DATA</i> | The user datas to pass to this function. |

Returns

GDSL_MAP_STOP if the mapping must be stopped.
GDSL_MAP_CONT if the mapping must be continued.

Definition at line 64 of file **_gdsI_bintree.h**.

4.1.1.3 typedef void(* **_gdsI_bintree_write_func_t**)(const **_gdsI_bintree_t** TREE, FILE *OUTPUT_FILE, void *USER_DATA)

GDSL low-level binary tree write function type.

Parameters

| | |
|--------------------|--|
| <i>TREE</i> | The low-level binary tree to write. |
| <i>OUTPUT_FILE</i> | The file where to write TREE. |
| <i>USER_DATA</i> | The user datas to pass to this function. |

Definition at line 74 of file `_gdsl_bintree.h`.

4.1.2 Function Documentation

4.1.2.1 `_gdsl_bintree_t _gdsl_bintree_alloc(const gdsl_element_t E, const _gdsl_bintree_t LEFT, const _gdsl_bintree_t RIGHT)`

Create a new low-level binary tree.

Allocate a new low-level binary tree data structure. Its root content is set to E and its left son (resp. right) is set to LEFT (resp. RIGHT).

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|--------------|--|
| <i>E</i> | The root content of the new low-level binary tree to create. |
| <i>LEFT</i> | The left sub-tree of the new low-level binary tree to create. |
| <i>RIGHT</i> | The right sub-tree of the new low-level binary tree to create. |

Returns

the newly allocated low-level binary tree in case of success.
NULL in case of insufficient memory.

See also

`_gdsl_bintree_free()` (p. 11)

Examples:

`examples/main_llbintree.c`.

4.1.2.2 void `_gdsI_bintree_free(_gdsI_bintree_t T, const gdsI_free_func_t FREE_F)`

Destroy a low-level binary tree.

Flush and destroy the low-level binary tree T. If `FREE_F != NULL`, `FREE_F` function is used to deallocate each T's element. Otherwise nothing is done with T's elements.

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|---------------|---|
| <i>T</i> | The low-level binary tree to destroy. |
| <i>FREE_F</i> | The function used to deallocate T's nodes contents. |

See also

`_gdsI_bintree_alloc()` (p. 10)

Examples:

`examples/main_llbintree.c`.

4.1.2.3 `_gdsI_bintree_t _gdsI_bintree_copy(const _gdsI_bintree_t T, const gdsI_copy_func_t COPY_F)`

Copy a low-level binary tree.

Create and return a copy of the low-level binary tree T using `COPY_F` on each T's element to copy them.

Note

Complexity: $O(|T|)$

Precondition

`COPY_F != NULL`

Parameters

| | |
|---------------|---|
| <i>T</i> | The low-level binary tree to copy. |
| <i>COPY_F</i> | The function used to copy T's nodes contents. |

Returns

a copy of T in case of success.
NULL if `_gdsI_bintree_is_empty(T) == TRUE` or in case of insufficient memory.

See also

`_gdsI_bintree_alloc()` (p. 10)
`_gdsI_bintree_free()` (p. 11)
`_gdsI_bintree_is_empty()` (p. 12)

Examples:

`examples/main_llbintree.c.`

4.1.2.4 `bool _gdsI_bintree_is_empty(const _gdsI_bintree_t T)`

Check if a low-level binary tree is empty.

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------|-------------------------------------|
| <i>T</i> | The low-level binary tree to check. |
|----------|-------------------------------------|

Returns

TRUE if the low-level binary tree T is empty.
FALSE if the low-level binary tree T is not empty.

See also

`_gdsI_bintree_is_leaf()` (p. 12)
`_gdsI_bintree_is_root()` (p. 13)

4.1.2.5 `bool _gdsI_bintree_is_leaf(const _gdsI_bintree_t T)`

Check if a low-level binary tree is reduced to a leaf.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bintree_t`.

Parameters

| | |
|----------------|-------------------------------------|
| <code>T</code> | The low-level binary tree to check. |
|----------------|-------------------------------------|

Returns

TRUE if the low-level binary tree T is a leaf.
FALSE if the low-level binary tree T is not a leaf.

See also

[`_gdsl_bintree_is_empty\(\)`](#) (p. 12)

[`_gdsl_bintree_is_root\(\)`](#) (p. 13)

4.1.2.6 `bool _gdsl_bintree_is_root(const _gdsl_bintree_t T)`

Check if a low-level binary tree is a root.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bintree_t`.

Parameters

| | |
|----------------|-------------------------------------|
| <code>T</code> | The low-level binary tree to check. |
|----------------|-------------------------------------|

Returns

TRUE if the low-level binary tree T is a root.
FALSE if the low-level binary tree T is not a root.

See also

[`_gdsl_bintree_is_empty\(\)`](#) (p. 12)

[`_gdsl_bintree_is_leaf\(\)`](#) (p. 12)

4.1.2.7 `gdsi_element_t gdsi_bintree_get_content(const _gdsi_bintree_t T)`

Get the root content of a low-level binary tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------|-----------------------------------|
| <i>T</i> | The low-level binary tree to use. |
|----------|-----------------------------------|

Returns

the root's content of the low-level binary tree T.

See also

`_gdsi_bintree_set_content()` (p. 18)

Examples:

`examples/main_llbintree.c`.

4.1.2.8 `_gdsi_bintree_t gdsi_bintree_get_parent(const _gdsi_bintree_t T)`

Get the parent tree of a low-level binary tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------|-----------------------------------|
| <i>T</i> | The low-level binary tree to use. |
|----------|-----------------------------------|

Returns

the parent of the low-level binary tree T if T isn't a root.
NULL if the low-level binary tree T is a root (ie. T has no parent).

See also

`_gdsl_bintree_is_root()` (p. 13)
`_gdsl_bintree_set_parent()` (p. 19)

4.1.2.9 `_gdsl_bintree_t _gdsl_bintree_get_left(const _gdsl_bintree_t T)`

Get the left sub-tree of a low-level binary tree.

Return the left subtree of the low-level binary tree T (noted l(T)).

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bintree_t`.

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the left sub-tree of the low-level binary tree T if T has a left sub-tree.
NULL if the low-level binary tree T has no left sub-tree.

See also

`_gdsl_bintree_get_right()` (p. 15)
`_gdsl_bintree_set_left()` (p. 19)
`_gdsl_bintree_set_right()` (p. 20)

4.1.2.10 `_gdsl_bintree_t _gdsl_bintree_get_right(const _gdsl_bintree_t T)`

Get the right sub-tree of a low-level binary tree.

Return the right subtree of the low-level binary tree T (noted r(T)).

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bintree_t`

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the right sub-tree of the low-level binary tree T if T has a right sub-tree.
NULL if the low-level binary tree T has no right sub-tree.

See also

`_gdsI_bintree_get_left()` (p. 15)
`_gdsI_bintree_set_left()` (p. 19)
`_gdsI_bintree_set_right()` (p. 20)

4.1.2.11 `_gdsI_bintree_t* _gdsI_bintree_get_left_ref(const _gdsI_bintree_t T)`

Get the left sub-tree reference of a low-level binary tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bintree_t`.

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the left sub-tree reference of the low-level binary tree T.

See also

`_gdsI_bintree_get_right_ref()` (p. 17)

4.1.2.12 `_gdsl_bintree_t* _gdsl_bintree_get_right_ref(const _gdsl_bintree_t T)`

Get the right sub-tree reference of a low-level binary tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bintree_t`.

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the right sub-tree reference of the low-level binary tree T.

See also

`_gdsl_bintree_get_left_ref()` (p. 16)

4.1.2.13 `ulong _gdsl_bintree_get_height(const _gdsl_bintree_t T)`

Get the height of a low-level binary tree.

Compute the height of the low-level binary tree T (noted $h(T)$).

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the height of T.

See also

`_gdsi_bintree_get_size()` (p. 18)

4.1.2.14 `ulong _gdsi_bintree_get_size(const _gdsi_bintree_t T)`

Get the size of a low-level binary tree.

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|----------------|-----------------------------------|
| <code>T</code> | The low-level binary tree to use. |
|----------------|-----------------------------------|

Returns

the number of elements of T (noted $|T|$).

See also

`_gdsi_bintree_get_height()` (p. 17)

4.1.2.15 `void _gdsi_bintree_set_content(_gdsi_bintree_t T, const gdsi_element_t E)`

Set the root element of a low-level binary tree.

Modify the root element of the low-level binary tree T to E .

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------------|--------------------------------------|
| <code>T</code> | The low-level binary tree to modify. |
| <code>E</code> | The new T 's root content. |

See also

`_gdsI_bintree_get_content` (p. 14)

4.1.2.16 `void _gdsI_bintree_set_parent(_gdsI_bintree_t T, const _gdsI_bintree_t P)`

Set the parent tree of a low-level binary tree.

Modify the parent of the low-level binary tree T to P.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bintree_t`.

Parameters

| | |
|----------|--------------------------------------|
| <i>T</i> | The low-level binary tree to modify. |
| <i>P</i> | The new T's parent. |

See also

`_gdsI_bintree_get_parent()` (p. 14)

4.1.2.17 `void _gdsI_bintree_set_left(_gdsI_bintree_t T, const _gdsI_bintree_t L)`

Set left sub-tree of a low-level binary tree.

Modify the left sub-tree of the low-level binary tree T to L.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bintree_t`.

Parameters

| | |
|----------|--------------------------------------|
| <i>T</i> | The low-level binary tree to modify. |
| <i>L</i> | The new T's left sub-tree. |

See also

`_gdsi_bintree_set_right()` (p. 20)
`_gdsi_bintree_get_left()` (p. 15)
`_gdsi_bintree_get_right()` (p. 15)

4.1.2.18 `void _gdsi_bintree_set_right(_gdsi_bintree_t T, const _gdsi_bintree_t R)`

Set right sub-tree of a low-level binary tree.

Modify the right sub-tree of the low-level binary tree T to R.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------|--------------------------------------|
| <i>T</i> | The low-level binary tree to modify. |
| <i>R</i> | The new T's right sub-tree. |

See also

`_gdsi_bintree_set_left()` (p. 19)
`_gdsi_bintree_get_left()` (p. 15)
`_gdsi_bintree_get_right()` (p. 15)

4.1.2.19 `_gdsi_bintree_t _gdsi_bintree_rotate_left(_gdsi_bintree_t * T)`

Left rotate a low-level binary tree.

Do a left rotation of the low-level binary tree T.

Note

Complexity: $O(1)$

Precondition

T & r(T) must be non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------|--------------------------------------|
| <i>T</i> | The low-level binary tree to rotate. |
|----------|--------------------------------------|

Returns

the modified T left-rotated.

See also

`_gdsl_bintree_rotate_right()` (p. 21)
`_gdsl_bintree_rotate_left_right()` (p. 22)
`_gdsl_bintree_rotate_right_left()` (p. 22)

Examples:

`examples/main_llbintree.c.`

4.1.2.20 `_gdsl_bintree_t _gdsl_bintree_rotate_right(_gdsl_bintree_t * T)`

Right rotate a low-level binary tree.

Do a right rotation of the low-level binary tree T.

Note

Complexity: $O(1)$

Precondition

T & l(T) must be non-empty `_gdsl_bintree_t`.

Parameters

| | |
|----------------|--------------------------------------|
| <code>T</code> | The low-level binary tree to rotate. |
|----------------|--------------------------------------|

Returns

the modified T right-rotated.

See also

`_gdsl_bintree_rotate_left()` (p. 20)
`_gdsl_bintree_rotate_left_right()` (p. 22)
`_gdsl_bintree_rotate_right_left()` (p. 22)

Examples:

`examples/main_llbintree.c.`

4.1.2.21 `_gdsi_bintree_t _gdsi_bintree_rotate_left_right(_gdsi_bintree_t * T)`

Left-right rotate a low-level binary tree.

Do a double left-right rotation of the low-level binary tree T.

Note

Complexity: $O(1)$

Precondition

T & l(T) & r(l(T)) must be non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------------|--------------------------------------|
| <code>T</code> | The low-level binary tree to rotate. |
|----------------|--------------------------------------|

Returns

the modified T left-right-rotated.

See also

`_gdsi_bintree_rotate_left()` (p. 20)
`_gdsi_bintree_rotate_right()` (p. 21)
`_gdsi_bintree_rotate_right_left()` (p. 22)

4.1.2.22 `_gdsi_bintree_t _gdsi_bintree_rotate_right_left(_gdsi_bintree_t * T)`

Right-left rotate a low-level binary tree.

Do a double right-left rotation of the low-level binary tree T.

Note

Complexity: $O(1)$

Precondition

T & r(T) & l(r(T)) must be non-empty `_gdsi_bintree_t`.

Parameters

| | |
|----------------|--------------------------------------|
| <code>T</code> | The low-level binary tree to rotate. |
|----------------|--------------------------------------|

Returns

the modified T right-left-rotated.

See also

`_gdsl_bintree_rotate_left()` (p. 20)
`_gdsl_bintree_rotate_right()` (p. 21)
`_gdsl_bintree_rotate_left_right()` (p. 22)

4.1.2.23 `_gdsl_bintree_t _gdsl_bintree_map_prefix(const _gdsl_bintree_t T, const
_gdsl_bintree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary tree in prefixed order.

Parse all nodes of the low-level binary tree T in prefixed order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then `_gdsl_bintree_map_prefix()` (p. 23) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

MAP_F != NULL

Parameters

| | |
|------------------|-----------------------------------|
| <i>T</i> | The low-level binary tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas. |

Returns

the first node for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

`_gdsl_bintree_map_infix()` (p. 24)
`_gdsl_bintree_map_postfix()` (p. 24)

Examples:

`examples/main_llbintree.c`.

4.1.2.24 `_gdsl_bintree_t_gdsl_bintree_map_infix(const_gdsl_bintree_t T, const_gdsl_bintree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary tree in infix order.

Parse all nodes of the low-level binary tree T in infix order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then `_gdsl_bintree_map_infix()` (p. 24) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

MAP_F != NULL

Parameters

| | |
|------------------|-----------------------------------|
| <i>T</i> | The low-level binary tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas. |

Returns

the first node for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

`_gdsl_bintree_map_prefix()` (p. 23)
`_gdsl_bintree_map_postfix()` (p. 24)

Examples:

`examples/main_llbintree.c.`

4.1.2.25 `_gdsl_bintree_t_gdsl_bintree_map_postfix(const_gdsl_bintree_t T, const_gdsl_bintree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary tree in postfix order.

Parse all nodes of the low-level binary tree T in postfix order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then `_gdsl_bintree_map_postfix()` (p. 24) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

`MAP_F != NULL`

Parameters

| | |
|------------------|-----------------------------------|
| <i>T</i> | The low-level binary tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas. |

Returns

the first node for which `MAP_F` returns `GDSL_MAP_STOP`.
 NULL when the parsing is done.

See also

`_gdsl_bintree_map_prefix()` (p. 23)

`_gdsl_bintree_map_infix()` (p. 24)

Examples:

`examples/main_llbintree.c`.

4.1.2.26 `void _gdsl_bintree_write (const _gdsl_bintree_t T, const
 _gdsl_bintree_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of all nodes of a low-level binary tree to a file.

Write the nodes contents of the low-level binary tree `T` to `OUTPUT_FILE`, using `WRITE_F` function. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|T|)$

Precondition

`WRITE_F != NULL & OUTPUT_FILE != NULL`

Parameters

| | |
|--------------------|-------------------------------------|
| <i>T</i> | The low-level binary tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsi_bintree_write_xml()` (p. 26)

`_gdsi_bintree_dump()` (p. 27)

4.1.2.27 void `_gdsi_bintree_write_xml(const _gdsi_bintree_t T, const
_gdsi_bintree_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of a low-level binary tree to a file into XML.

Write the nodes contents of the low-level binary tree T to OUTPUT_FILE, into XML language. If WRITE_F != NULL, then uses WRITE_F function to write T's nodes content to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|-------------------------------------|
| <i>T</i> | The low-level binary tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsi_bintree_write()` (p. 25)

`_gdsi_bintree_dump()` (p. 27)

Examples:

`examples/main_llbintree.c.`

4.1.2.28 void `_gdsi_bintree_dump`(const `_gdsi_bintree_t` *T*, const
`_gdsi_bintree_write_func_t` *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of a low-level binary tree to a file.

Dump the structure of the low-level binary tree *T* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then use *WRITE_F* function to write *T*'s nodes contents to *OUTPUT_FILE*. - Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|T|)$

Precondition

OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|--|
| <i>T</i> | The low-level binary tree to dump. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>T</i> 's nodes. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

`_gdsi_bintree_write()` (p. 25)
`_gdsi_bintree_write_xml()` (p. 26)

Examples:

`examples/main_llbintree.c`.

4.2 Low-level binary search tree manipulation module

Typedefs

- typedef **_gdsl_bintree_t _gdsl_bstree_t**
GDSL low-level binary search tree type.
- typedef int(* **_gdsl_bstree_map_func_t**)(_gdsl_bstree_t TREE, void *USER_DATA)
GDSL low-level binary search tree map function type.
- typedef void(* **_gdsl_bstree_write_func_t**)(_gdsl_bstree_t TREE, FILE *OUTPUT_FILE, void *USER_DATA)
GDSL low-level binary search tree write function type.

Functions

- **_gdsl_bstree_t _gdsl_bstree_alloc** (const **gdsl_element_t** E)
Create a new low-level binary search tree.
- void **_gdsl_bstree_free** (_gdsl_bstree_t T, const **gdsl_free_func_t** FREE_F)
Destroy a low-level binary search tree.
- **_gdsl_bstree_t _gdsl_bstree_copy** (const _gdsl_bstree_t T, const **gdsl_copy_func_t** COPY_F)
Copy a low-level binary search tree.
- **bool _gdsl_bstree_is_empty** (const _gdsl_bstree_t T)
Check if a low-level binary search tree is empty.
- **bool _gdsl_bstree_is_leaf** (const _gdsl_bstree_t T)
Check if a low-level binary search tree is reduced to a leaf.
- **gdsl_element_t _gdsl_bstree_get_content** (const _gdsl_bstree_t T)
Get the root content of a low-level binary search tree.
- **bool _gdsl_bstree_is_root** (const _gdsl_bstree_t T)
Check if a low-level binary search tree is a root.
- **_gdsl_bstree_t _gdsl_bstree_get_parent** (const _gdsl_bstree_t T)
Get the parent tree of a low-level binary search tree.
- **_gdsl_bstree_t _gdsl_bstree_get_left** (const _gdsl_bstree_t T)
Get the left sub-tree of a low-level binary search tree.
- **_gdsl_bstree_t _gdsl_bstree_get_right** (const _gdsl_bstree_t T)
Get the right sub-tree of a low-level binary search tree.
- **ulong _gdsl_bstree_get_size** (const _gdsl_bstree_t T)
Get the size of a low-level binary search tree.
- **ulong _gdsl_bstree_get_height** (const _gdsl_bstree_t T)
Get the height of a low-level binary search tree.
- **_gdsl_bstree_t _gdsl_bstree_insert** (_gdsl_bstree_t *T, const **gdsl_compare_func_t** COMP_F, const **gdsl_element_t** VALUE, int *RESULT)
Insert an element into a low-level binary search tree if it's not found or return it.

- **gds_l_element_t gds_l_bstree_remove** (**gds_l_bstree_t** *T, const **gds_l_compare_func_t** COMP_F, const **gds_l_element_t** VALUE)

Remove an element from a low-level binary search tree.

- **gds_l_bstree_t gds_l_bstree_search** (const **gds_l_bstree_t** T, const **gds_l_compare_func_t** COMP_F, const **gds_l_element_t** VALUE)

Search for a particular element into a low-level binary search tree.

- **gds_l_bstree_t gds_l_bstree_search_next** (const **gds_l_bstree_t** T, const **gds_l_compare_func_t** COMP_F, const **gds_l_element_t** VALUE)

Search for the next element of a particular element into a low-level binary search tree, according to the binary search tree order.

- **gds_l_bstree_t gds_l_bstree_map_prefix** (const **gds_l_bstree_t** T, const **gds_l_bstree_map_func_t** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in prefixed order.

- **gds_l_bstree_t gds_l_bstree_map_infix** (const **gds_l_bstree_t** T, const **gds_l_bstree_map_func_t** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in infix order.

- **gds_l_bstree_t gds_l_bstree_map_postfix** (const **gds_l_bstree_t** T, const **gds_l_bstree_map_func_t** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in postfix order.

- **void gds_l_bstree_write** (const **gds_l_bstree_t** T, const **gds_l_bstree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of all nodes of a low-level binary search tree to a file.

- **void gds_l_bstree_write_xml** (const **gds_l_bstree_t** T, const **gds_l_bstree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a low-level binary search tree to a file into XML.

- **void gds_l_bstree_dump** (const **gds_l_bstree_t** T, const **gds_l_bstree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a low-level binary search tree to a file.

4.2.1 Typedef Documentation

4.2.1.1 typedef gds_l_bintree_t gds_l_bstree_t

GDSL low-level binary search tree type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 53 of file `gds_l_bstree.h`.

4.2.1.2 typedef int(* gds_l_bstree_map_func_t)(gds_l_bstree_t TREE, void *USER_DATA)

GDSL low-level binary search tree map function type.

Parameters

| | |
|------------------|--|
| <i>TREE</i> | The low-level binary search tree to map. |
| <i>USER_DATA</i> | The user datas to pass to this function. |

Returns

GDSDL_MAP_STOP if the mapping must be stopped.
 GDSDL_MAP_CONT if the mapping must be continued.

Definition at line 62 of file `_gdsl_bstree.h`.

4.2.1.3 `typedef void(* _gdsl_bstree_write_func_t)(_gdsl_bstree_t TREE, FILE *OUTPUT_FILE, void *USER_DATA)`

GDSDL low-level binary search tree write function type.

Parameters

| | |
|--------------------|--|
| <i>TREE</i> | The low-level binary search tree to write. |
| <i>OUTPUT_FILE</i> | The file where to write TREE. |
| <i>USER_DATA</i> | The user datas to pass to this function. |

Definition at line 72 of file `_gdsl_bstree.h`.

4.2.2 Function Documentation

4.2.2.1 `_gdsl_bstree_t _gdsl_bstree_alloc(const gdsl_element_t E)`

Create a new low-level binary search tree.

Allocate a new low-level binary search tree data structure. Its root content is sets to E and its left and right sons are set to NULL.

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------|---|
| <i>E</i> | The root content of the new low-level binary search tree to create. |
|----------|---|

Returns

the newly allocated low-level binary search tree in case of success.
NULL in case of insufficient memory.

See also

`_gdsI_bstree_free()` (p. 31)

Examples:

`examples/main_llbstree.c`.

4.2.2.2 void `_gdsI_bstree_free(_gdsI_bstree_t T, const gdsI_free_func_t FREE_F)`

Destroy a low-level binary search tree.

Flush and destroy the low-level binary search tree T. If `FREE_F` \neq NULL, `FREE_F` function is used to deallocate each T's element. Otherwise nothing is done with T's elements.

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|---------------|---|
| <i>T</i> | The low-level binary search tree to destroy. |
| <i>FREE_F</i> | The function used to deallocate T's nodes contents. |

See also

`_gdsI_bstree_alloc()` (p. 30)

Examples:

`examples/main_llbstree.c`.

4.2.2.3 `_gdsI_bstree_t _gdsI_bstree_copy(const _gdsI_bstree_t T, const gdsI_copy_func_t COPY_F)`

Copy a low-level binary search tree.

Create and return a copy of the low-level binary search tree T using `COPY_F` on each T's element to copy them.

Note

Complexity: $O(|T|)$

Precondition

`COPY_F != NULL`.

Parameters

| | |
|---------------------|---|
| <code>T</code> | The low-level binary search tree to copy. |
| <code>COPY_F</code> | The function used to copy T's nodes contents. |

Returns

a copy of T in case of success.
 NULL if `_gdsi_bstree_is_empty(T) == TRUE` or in case of insufficient memory.

See also

`_gdsi_bstree_alloc()` (p. 30)
`_gdsi_bstree_free()` (p. 31)
`_gdsi_bstree_is_empty()` (p. 32)

4.2.2.4 `bool _gdsi_bstree_is_empty(const _gdsi_bstree_t T)`

Check if a low-level binary search tree is empty.

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------------|--|
| <code>T</code> | The low-level binary search tree to check. |
|----------------|--|

Returns

TRUE if the low-level binary search tree T is empty.
 FALSE if the low-level binary search tree T is not empty.

See also

`_gdsl_bstree_is_leaf()` (p. 33)

`_gdsl_bstree_is_root()` (p. 34)

4.2.2.5 `bool _gdsl_bstree_is_leaf(const _gdsl_bstree_t T)`

Check if a low-level binary search tree is reduced to a leaf.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bstree_t`.

Parameters

| | |
|----------------|--|
| <code>T</code> | The low-level binary search tree to check. |
|----------------|--|

Returns

TRUE if the low-level binary search tree T is a leaf.

FALSE if the low-level binary search tree T is not a leaf.

See also

`_gdsl_bstree_is_empty()` (p. 32)

`_gdsl_bstree_is_root()` (p. 34)

4.2.2.6 `gdsl_element_t _gdsl_bstree_get_content(const _gdsl_bstree_t T)`

Get the root content of a low-level binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsl_bstree_t`.

Parameters

| | |
|----------------|--|
| <code>T</code> | The low-level binary search tree to use. |
|----------------|--|

Returns

the root's content of the low-level binary search tree T.

Examples:

examples/main_llbstree.c.

4.2.2.7 bool _gdsi_bstree_is_root(const _gdsi_bstree_t T)

Check if a low-level binary search tree is a root.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty _gdsi_bstree_t.

Parameters

| | |
|----------|--|
| <i>T</i> | The low-level binary search tree to check. |
|----------|--|

Returns

TRUE if the low-level binary search tree T is a root.
FALSE if the low-level binary search tree T is not a root.

See also

_gdsi_bstree_is_empty() (p. 32)
_gdsi_bstree_is_leaf() (p. 33)

4.2.2.8 _gdsi_bstree_t _gdsi_bstree_get_parent(const _gdsi_bstree_t T)

Get the parent tree of a low-level binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty _gdsi_bstree_t.

Parameters

| | |
|----------|--|
| <i>T</i> | The low-level binary search tree to use. |
|----------|--|

Returns

the parent of the low-level binary search tree *T* if *T* isn't a root.
NULL if the low-level binary search tree *T* is a root (ie. *T* has no parent).

See also

`_gdsI_bstree_is_root()` (p. 34)

4.2.2.9 `_gdsI_bstree_t _gdsI_bstree_get_left(const _gdsI_bstree_t T)`

Get the left sub-tree of a low-level binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bstree_t`.

Parameters

| | |
|----------|--|
| <i>T</i> | The low-level binary search tree to use. |
|----------|--|

Returns

the left sub-tree of the low-level binary search tree *T* if *T* has a left sub-tree.
NULL if the low-level binary search tree *T* has no left sub-tree.

See also

`_gdsI_bstree_get_right()` (p. 35)

4.2.2.10 `_gdsI_bstree_t _gdsI_bstree_get_right(const _gdsI_bstree_t T)`

Get the right sub-tree of a low-level binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a non-empty `_gdsI_bstree_t`.

Parameters

| | |
|----------------|--|
| <code>T</code> | The low-level binary search tree to use. |
|----------------|--|

Returns

the right sub-tree of the low-level binary search tree T if T has a right sub-tree.
 NULL if the low-level binary search tree T has no right sub-tree.

See also

`_gdsI_bstree_get_left()` (p. 35)

4.2.2.11 `ulong _gdsI_bstree_get_size(const _gdsI_bstree_t T)`

Get the size of a low-level binary search tree.

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|----------------|--|
| <code>T</code> | The low-level binary search tree to compute the size from. |
|----------------|--|

Returns

the number of elements of T (noted $|T|$).

See also

`_gdsI_bstree_get_height()` (p. 36)

4.2.2.12 `ulong _gdsI_bstree_get_height(const _gdsI_bstree_t T)`

Get the height of a low-level binary search tree.

Compute the height of the low-level binary search tree T (noted $h(T)$).

Note

Complexity: $O(|T|)$

Precondition

nothing.

Parameters

| | |
|----------|--|
| <i>T</i> | The low-level binary search tree to compute the height from. |
|----------|--|

Returns

the height of *T*.

See also

`_gdsI_bstree_get_size()` (p. 36)

4.2.2.13 `_gdsI_bstree_t _gdsI_bstree_insert (_gdsI_bstree_t * T, const gdsI_compare_func_t COMP_F, const gdsI_element_t VALUE, int * RESULT)`

Insert an element into a low-level binary search tree if it's not found or return it.

Search for the first element *E* equal to *VALUE* into the low-level binary search tree *T*, by using *COMP_F* function to find it. If an element *E* equal to *VALUE* is found, then it's returned. If no element equal to *VALUE* is found, then *E* is inserted and its root returned.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

Precondition

COMP_F != NULL & *RESULT* != NULL.

Parameters

| | |
|---------------|---|
| <i>T</i> | The reference of the low-level binary search tree to use. |
| <i>COMP_F</i> | The comparison function to use to compare <i>T</i> 's elements with <i>VALUE</i> to find <i>E</i> . |
| <i>VALUE</i> | The value used to search for the element <i>E</i> . |
| <i>RESULT</i> | The address where the result code will be stored. |

Returns

the root containing E and RESULT = GDSL_INSERTED if E is inserted.
 the root containing E and RESULT = GDSL_ERR_DUPLICATE_ENTRY if E is not inserted.
 NULL and RESULT = GDSL_ERR_MEM_ALLOC in case of failure.

See also

`_gdsl_bstree_search()` (p. 39)
`_gdsl_bstree_remove()` (p. 38)

Examples:

`examples/main_llbstree.c.`

4.2.2.14 `gdsl_element_t _gdsl_bstree_remove(_gdsl_bstree_t * T, const gdsl_compare_func_t COMP_F, const gdsl_element_t VALUE)`

Remove an element from a low-level binary search tree.

Remove from the low-level binary search tree T the first founded element E equal to VALUE, by using COMP_F function to compare T's elements. If E is found, it is removed from T.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$
 The resulting T is modified by examining the left sub-tree from the founded e.

Precondition

COMP_F != NULL.

Parameters

| | |
|---------------|--|
| <i>T</i> | The reference of the low-level binary search tree to modify. |
| <i>COMP_F</i> | The comparison function to use to compare T's elements with VALUE to find the element e to remove. |
| <i>VALUE</i> | The value that must be used by COMP_F to find the element e to remove. |

Returns

the first founded element equal to VALUE in T.
 NULL if no element equal to VALUE is found or if T is empty.

See also

`_gdsi_bstree_insert()` (p. 37)
`_gdsi_bstree_search()` (p. 39)

4.2.2.15 `_gdsi_bstree_t _gdsi_bstree_search(const _gdsi_bstree_t T, const
gdsi_compare_func_t COMP_F, const gdsi_element_t VALUE)`

Search for a particular element into a low-level binary search tree.

Search the first element E equal to VALUE in the low-level binary search tree T, by using COMP_F function to find it.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

Precondition

COMP_F != NULL.

Parameters

| | |
|---------------|--|
| <i>T</i> | The low-level binary search tree to use. |
| <i>COMP_F</i> | The comparison function to use to compare T's elements with VALUE to find the element E. |
| <i>VALUE</i> | The value that must be used by COMP_F to find the element E. |

Returns

the root of the tree containing E if it's found.
NULL if VALUE is not found in T.

See also

`_gdsi_bstree_insert()` (p. 37)
`_gdsi_bstree_remove()` (p. 38)

4.2.2.16 `_gdsi_bstree_t _gdsi_bstree_search_next(const _gdsi_bstree_t T, const
gdsi_compare_func_t COMP_F, const gdsi_element_t VALUE)`

Search for the next element of a particular element into a low-level binary search tree, according to the binary search tree order.

Search for an element E in the low-level binary search tree T, by using COMP_F function to find the first element E equal to VALUE.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

Precondition

COMP_F != NULL.

Parameters

| | |
|---------------|--|
| <i>T</i> | The low-level binary search tree to use. |
| <i>COMP_F</i> | The comparison function to use to compare T's elements with VALUE to find the element E. |
| <i>VALUE</i> | The value that must be used by COMP_F to find the element E. |

Returns

the root of the tree containing the successor of E if it's found.
 NULL if VALUE is not found in T or if E has no successor.

4.2.2.17 `_gdsi_bstree_t _gdsi_bstree_map_prefix(const _gdsi_bstree_t T, const _gdsi_bstree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary search tree in prefixed order.

Parse all nodes of the low-level binary search tree T in prefixed order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns - GDSL_MAP_STOP, then `_gdsi_bstree_map_prefix()` (p. 40) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

MAP_F != NULL.

Parameters

| | |
|------------------|--|
| <i>T</i> | The low-level binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F. |

Returns

the first node for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

See also

`_gdsl_bstree_map_infix()` (p. 41)
`_gdsl_bstree_map_postfix()` (p. 42)

4.2.2.18 `_gdsl_bstree_t _gdsl_bstree_map_infix(const _gdsl_bstree_t T, const
 _gdsl_bstree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary search tree in infix order.

Parse all nodes of the low-level binary search tree T in infix order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns - GDSL_MAP_STOP, then `_gdsl_bstree_map_infix()` (p. 41) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

MAP_F != NULL.

Parameters

| | |
|------------------|--|
| <i>T</i> | The low-level binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F. |

Returns

the first node for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

See also

`_gdsl_bstree_map_prefix()` (p. 40)
`_gdsl_bstree_map_postfix()` (p. 42)

4.2.2.19 `_gdsl_bstree_t_gdsl_bstree_map_postfix(const _gdsl_bstree_t T, const _gdsl_bstree_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level binary search tree in postfix order.

Parse all nodes of the low-level binary search tree T in postfix order. The MAP_F function is called on each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **`_gdsl_bstree_map_postfix()`** (p. 42) stops and returns its last examined node.

Note

Complexity: $O(|T|)$

Precondition

MAP_F != NULL.

Parameters

| | |
|------------------|--|
| <i>T</i> | The low-level binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F. |

Returns

the first node for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

`_gdsl_bstree_map_prefix()` (p. 40)
`_gdsl_bstree_map_infix()` (p. 41)

4.2.2.20 `void _gdsl_bstree_write(const _gdsl_bstree_t T, const _gdsl_bstree_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of all nodes of a low-level binary search tree to a file.

Write the nodes contents of the low-level binary search tree T to OUTPUT_FILE, using WRITE_F function. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

`WRITE_F != NULL & OUTPUT_FILE != NULL.`

Parameters

| | |
|--------------------|--|
| <i>T</i> | The low-level binary search tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsi_bstree_write_xml()` (p. 43)

`_gdsi_bstree_dump()` (p. 44)

4.2.2.21 `void _gdsi_bstree_write_xml(const _gdsi_bstree_t T, const
_gdsi_bstree_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of a low-level binary search tree to a file into XML.

Write the nodes contents of the low-level binary search tree T to OUTPUT_FILE, into XML language. If WRITE_F != NULL, then use WRITE_F function to write T's nodes contents to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

`OUTPUT_FILE != NULL.`

Parameters

| | |
|--------------------|--|
| <i>T</i> | The low-level binary search tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsi_bstree_write()` (p. 42)
`_gdsi_bstree_dump()` (p. 44)

Examples:

`examples/main_llbstree.c`.

4.2.2.22 void `_gdsi_bstree_dump`(const `_gdsi_bstree_t` *T*, const
`_gdsi_bstree_write_func_t` *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of a low-level binary search tree to a file.

Dump the structure of the low-level binary search tree *T* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then use *WRITE_F* function to write *T*'s nodes content to *OUTPUT_FILE*. Additional *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|T|)$

Precondition

OUTPUT_FILE != NULL.

Parameters

| | |
|--------------------|--|
| <i>T</i> | The low-level binary search tree to dump. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>T</i> 's nodes. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

`_gdsi_bstree_write()` (p. 42)
`_gdsi_bstree_write_xml()` (p. 43)

4.3 Low-level doubly-linked list manipulation module

Typedefs

- typedef **_gdsl_node_t _gdsl_list_t**
GDSL low-level doubly-linked list type.

Functions

- **_gdsl_list_t _gdsl_list_alloc** (const **gdsl_element_t** E)
Create a new low-level list.
- void **_gdsl_list_free** (**_gdsl_list_t** L, const **gdsl_free_func_t** FREE_F)
Destroy a low-level list.
- **bool _gdsl_list_is_empty** (const **_gdsl_list_t** L)
Check if a low-level list is empty.
- **ulong _gdsl_list_get_size** (const **_gdsl_list_t** L)
Get the size of a low-level list.
- void **_gdsl_list_link** (**_gdsl_list_t** L1, **_gdsl_list_t** L2)
Link two low-level lists together.
- void **_gdsl_list_insert_after** (**_gdsl_list_t** L, **_gdsl_list_t** PREV)
Insert a low-level list after another one.
- void **_gdsl_list_insert_before** (**_gdsl_list_t** L, **_gdsl_list_t** SUCC)
Insert a low-level list before another one.
- void **_gdsl_list_remove** (**_gdsl_node_t** NODE)
Remove a node from a low-level list.
- **_gdsl_list_t _gdsl_list_search** (**_gdsl_list_t** L, const **gdsl_compare_func_t** COMP_F, void *VALUE)
Search for a particular node in a low-level list.
- **_gdsl_list_t _gdsl_list_map_forward** (const **_gdsl_list_t** L, const **_gdsl_node_map_func_t** MAP_F, void *USER_DATA)
Parse a low-level list in forward order.
- **_gdsl_list_t _gdsl_list_map_backward** (const **_gdsl_list_t** L, const **_gdsl_node_map_func_t** MAP_F, void *USER_DATA)
Parse a low-level list in backward order.
- void **_gdsl_list_write** (const **_gdsl_list_t** L, const **_gdsl_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all nodes of a low-level list to a file.
- void **_gdsl_list_write_xml** (const **_gdsl_list_t** L, const **_gdsl_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all nodes of a low-level list to a file into XML.
- void **_gdsl_list_dump** (const **_gdsl_list_t** L, const **_gdsl_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a low-level list to a file.

4.3.1 Typedef Documentation

4.3.1.1 typedef `_gdsl_node_t _gdsl_list_t`

GDSL low-level doubly-linked list type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 55 of file `_gdsl_list.h`.

4.3.2 Function Documentation

4.3.2.1 `_gdsl_list_t _gdsl_list_alloc(const gdsl_element_t E)`

Create a new low-level list.

Allocate a new low-level list data structure which have only one node. The node's content is set to E.

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------------|--|
| <code>E</code> | The content of the first node of the new low-level list to create. |
|----------------|--|

Returns

the newly allocated low-level list in case of success.
NULL in case of insufficient memory.

See also

`_gdsl_list_free()` (p. 46)

Examples:

`examples/main_llist.c`.

4.3.2.2 `void _gdsl_list_free(_gdsl_list_t L, const gdsl_free_func_t FREE_F)`

Destroy a low-level list.

Flush and destroy the low-level list *L*. If *FREE_F* != NULL, then the *FREE_F* function is used to deallocated each *L*'s element. Otherwise, nothing is done with *L*'s elements.

Note

Complexity: $O(|L|)$

Precondition

nothing.

Parameters

| | |
|---------------|--|
| <i>L</i> | The low-level list to destroy. |
| <i>FREE_F</i> | The function used to deallocated <i>L</i> 's nodes contents. |

See also

`_gdsI_list_alloc()` (p. 46)

Examples:

`examples/main_IIIlist.c`.

4.3.2.3 bool _gdsI_list_is_empty(const _gdsI_list_t *L*)

Check if a low-level list is empty.

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------|------------------------------|
| <i>L</i> | The low-level list to check. |
|----------|------------------------------|

Returns

TRUE if the low-level list *L* is empty.

FALSE if the low-level list *L* is not empty.

4.3.2.4 `ulong _gdsi_list_get_size(const _gdsi_list_t L)`

Get the size of a low-level list.

Note

Complexity: $O(|L|)$

Precondition

nothing.

Parameters

| | |
|----------|----------------------------|
| <i>L</i> | The low-level list to use. |
|----------|----------------------------|

Returns

the number of elements of *L* (noted $|L|$).

Examples:

examples/main_llist.c.

4.3.2.5 `void _gdsi_list_link(_gdsi_list_t L1, _gdsi_list_t L2)`

Link two low-level lists together.

Link the low-level list *L2* after the end of the low-level list *L1*. So *L1* is before *L2*.

Note

Complexity: $O(|L1|)$

Precondition

L1 & *L2* must be non-empty `_gdsi_list_t`.

Parameters

| | |
|-----------|---|
| <i>L1</i> | The low-level list to link before <i>L2</i> . |
| <i>L2</i> | The low-level list to link after <i>L1</i> . |

Examples:

examples/main_llist.c.

4.3.2.6 void `_gdsI_list_insert_after`(`_gdsI_list_t L`, `_gdsI_list_t PREV`)

Insert a low-level list after another one.

Insert the low-level list L after the low-level list PREV.

Note

Complexity: $O(|L|)$

Precondition

L & PREV must be non-empty `_gdsI_list_t`.

Parameters

| | |
|-------------|--|
| <i>L</i> | The low-level list to link after PREV. |
| <i>PREV</i> | The low-level list that will be linked before L. |

See also

`_gdsI_list_insert_before`() (p. 49)

`_gdsI_list_remove`() (p. 50)

4.3.2.7 void `_gdsI_list_insert_before`(`_gdsI_list_t L`, `_gdsI_list_t SUCC`)

Insert a low-level list before another one.

Insert the low-level list L before the low-level list SUCC.

Note

Complexity: $O(|L|)$

Precondition

L & SUCC must be non-empty `_gdsI_list_t`.

Parameters

| | |
|-------------|---|
| <i>L</i> | The low-level list to link before SUCC. |
| <i>SUCC</i> | The low-level list that will be linked after L. |

See also

`_gdsI_list_insert_after`() (p. 49)

`_gdsI_list_remove`() (p. 50)

4.3.2.8 void `_gdsi_list_remove(_gdsi_node_t NODE)`

Remove a node from a low-level list.

Unlink the node `NODE` from the low-level list in which it is inserted.

Note

Complexity: $O(1)$

Precondition

`NODE` must be a non-empty `_gdsi_node_t`.

Parameters

| | |
|-------------------|--|
| <code>NODE</code> | The low-level node to unlink from the low-level list in which it's linked. |
|-------------------|--|

See also

`_gdsi_list_insert_after()` (p. 49)

`_gdsi_list_insert_before()` (p. 49)

4.3.2.9 `_gdsi_list_t _gdsi_list_search(_gdsi_list_t L, const gdsi_compare_func_t COMP_F, void * VALUE)`

Search for a particular node in a low-level list.

Research an element `e` in the low-level list `L`, by using `COMP_F` function to find the first element `e` equal to `VALUE`.

Note

Complexity: $O(|L|)$

Precondition

`COMP_F` != NULL

Parameters

| | |
|---------------------|---|
| <code>L</code> | The low-level list to use |
| <code>COMP_F</code> | The comparison function to use to compare <code>L</code> 's elements with <code>VALUE</code> to find the element <code>e</code> |
| <code>VALUE</code> | The value that must be used by <code>COMP_F</code> to find the element <code>e</code> |

Returns

the sub-list starting by `e` if it's found.
 NULL if `VALUE` is not found in `L`.

4.3.2.10 `_gdsl_list_t_gdsl_list_map_forward(const _gdsl_list_t L, const
 _gdsl_node_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level list in forward order.

Parse all nodes of the low-level list `L` in forward order. The `MAP_F` function is called on each node with the `USER_DATA` argument. If `MAP_F` returns `GDSL_MAP_STOP`, then `_gdsl_list_map_forward()` (p. 51) stops and returns its last examined node.

Note

Complexity: $O(|L|)$

Precondition

`MAP_F != NULL`.

Parameters

| | |
|------------------------|---------------------------|
| <code>L</code> | Th low-level list to map. |
| <code>MAP_F</code> | The map function. |
| <code>USER_DATA</code> | User's datas. |

Returns

the first node for which `MAP_F` returns `GDSL_MAP_STOP`.
 NULL when the parsing is done.

See also

`_gdsl_list_map_backward()` (p. 51)

Examples:

`examples/main_llist.c`.

4.3.2.11 `_gdsl_list_t_gdsl_list_map_backward(const _gdsl_list_t L, const
 _gdsl_node_map_func_t MAP_F, void * USER_DATA)`

Parse a low-level list in backward order.

Parse all nodes of the low-level list *L* in backward order. The *MAP_F* function is called on each node with the *USER_DATA* argument. If *MAP_F* returns *GDSL_MAP_STOP*, then ***_gdsl_list_map_backward()*** (p. 51) stops and returns its last examined node.

Note

Complexity: $O(2 |L|)$

Precondition

L must be a non-empty *_gdsl_list_t* & *MAP_F* != NULL.

Parameters

| | |
|------------------|---------------------------|
| <i>L</i> | Th low-level list to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas. |

Returns

the first node for which *MAP_F* returns *GDSL_MAP_STOP*.
NULL when the parsing is done.

See also

_gdsl_list_map_forward() (p. 51)

Examples:

examples/main_llist.c.

4.3.2.12 `void _gdsl_list_write(const _gdsl_list_t L, const _gdsl_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write all nodes of a low-level list to a file.

Write the nodes of the low-level list *L* to *OUTPUT_FILE*, using *WRITE_F* function. -
Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|L|)$

Precondition

WRITE_F != NULL & *OUTPUT_FILE* != NULL.

Parameters

| | |
|--------------------|------------------------------------|
| <i>L</i> | The low-level list to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write L's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsl_list_write_xml()` (p. 53)

`_gdsl_list_dump()` (p. 54)

Examples:

`examples/main_llist.c`.

4.3.2.13 `void _gdsl_list_write_xml (const _gdsl_list_t L, const
_gdsl_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write all nodes of a low-level list to a file into XML.

Write the nodes of the low-level list L to OUTPUT_FILE, into XML language. If WRITE_F != NULL, then uses WRITE_F function to write L's nodes to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|L|)$

Precondition

OUTPUT_FILE != NULL.

Parameters

| | |
|--------------------|------------------------------------|
| <i>L</i> | The low-level list to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write L's nodes. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

`_gdsi_list_write()` (p. 52)
`_gdsi_list_dump()` (p. 54)

Examples:

`examples/main_llist.c`.

4.3.2.14 `void _gdsi_list_dump(const _gdsi_list_t L, const _gdsi_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a low-level list to a file.

Dump the structure of the low-level list `L` to `OUTPUT_FILE`. If `WRITE_F` != `NULL`, then uses `WRITE_F` function to write `L`'s nodes to `OUTPUT_FILE`. Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|L|)$

Precondition

`OUTPUT_FILE` != `NULL`.

Parameters

| | |
|--------------------------|--|
| <code>L</code> | The low-level list to dump. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write <code>L</code> 's nodes. |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

`_gdsi_list_write()` (p. 52)
`_gdsi_list_write_xml()` (p. 53)

Examples:

`examples/main_llist.c`.

4.4 Low-level doubly-linked node manipulation module

Typedefs

- typedef struct _gdsI_node * **_gdsI_node_t**
GDSL low-level doubly linked node type.
- typedef int(* **_gdsI_node_map_func_t**)(const **_gdsI_node_t** NODE, void *USER_DATA)
GDSL low-level doubly-linked node map function type.
- typedef void(* **_gdsI_node_write_func_t**)(const **_gdsI_node_t** NODE, FILE *OUTPUT_FILE, void *USER_DATA)
GDSL low-level doubly-linked node write function type.

Functions

- **_gdsI_node_t _gdsI_node_alloc** (void)
Create a new low-level node.
- **gdsI_element_t _gdsI_node_free** (_gdsI_node_t NODE)
Destroy a low-level node.
- **_gdsI_node_t _gdsI_node_get_succ** (const **_gdsI_node_t** NODE)
Get the successor of a low-level node.
- **_gdsI_node_t _gdsI_node_get_pred** (const **_gdsI_node_t** NODE)
Get the predecessor of a low-level node.
- **gdsI_element_t _gdsI_node_get_content** (const **_gdsI_node_t** NODE)
Get the content of a low-level node.
- void **_gdsI_node_set_succ** (_gdsI_node_t NODE, const **_gdsI_node_t** SUC-C)
Set the successor of a low-level node.
- void **_gdsI_node_set_pred** (_gdsI_node_t NODE, const **_gdsI_node_t** PRE-D)
Set the predecessor of a low-level node.
- void **_gdsI_node_set_content** (_gdsI_node_t NODE, const **gdsI_element_t** -CONTENT)
Set the content of a low-level node.
- void **_gdsI_node_link** (_gdsI_node_t NODE1, **_gdsI_node_t** NODE2)
Link two low-level nodes together.
- void **_gdsI_node_unlink** (_gdsI_node_t NODE1, **_gdsI_node_t** NODE2)
Unlink two low-level nodes.
- void **_gdsI_node_write** (const **_gdsI_node_t** NODE, const **_gdsI_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write a low-level node to a file.
- void **_gdsI_node_write_xml** (const **_gdsI_node_t** NODE, const **_gdsI_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write a low-level node to a file into XML.

- `void _gdsl_node_dump (const _gdsl_node_t NODE, const _gdsl_node_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)`

Dump the internal structure of a low-level node to a file.

4.4.1 Typedef Documentation

4.4.1.1 `typedef struct _gdsl_node* _gdsl_node_t`

GDSL low-level doubly linked node type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 51 of file `_gdsl_node.h`.

4.4.1.2 `typedef int(* _gdsl_node_map_func_t)(const _gdsl_node_t NODE, void *USER_DATA)`

GDSL low-level doubly-linked node map function type.

Parameters

| | |
|------------------------|--|
| <code>NODE</code> | The low-level node to map. |
| <code>USER_DATA</code> | The user datas to pass to this function. |

Returns

GDSL_MAP_STOP if the mapping must be stopped.
GDSL_MAP_CONT if the mapping must be continued.

Definition at line 60 of file `_gdsl_node.h`.

4.4.1.3 `typedef void(* _gdsl_node_write_func_t)(const _gdsl_node_t NODE, FILE *OUTPUT_FILE, void *USER_DATA)`

GDSL low-level doubly-linked node write function type.

Parameters

| | |
|--------------------------|--|
| <code>TREE</code> | The low-level doubly-linked node to write. |
| <code>OUTPUT_FILE</code> | The file where to write NODE. |
| <code>USER_DATA</code> | The user datas to pass to this function. |

Definition at line 70 of file `_gdsl_node.h`.

4.4.2 Function Documentation

4.4.2.1 `_gdsl_node_t _gdsl_node_alloc(void)`

Create a new low-level node.

Allocate a new low-level node data structure.

Note

Complexity: $O(1)$

Precondition

nothing.

Returns

the newly allocated low-level node in case of success.
NULL in case of insufficient memory.

See also

`_gdsl_node_free()` (p. 57)

4.4.2.2 `gdsl_element_t _gdsl_node_free(_gdsl_node_t NODE)`

Destroy a low-level node.

Deallocate the low-level node NODE.

Note

$O(1)$

Precondition

`NODE != NULL`

Returns

the content of NODE (without modification).

See also

`_gdsl_node_alloc()` (p. 57)

4.4.2.3 `_gdsi_node_t _gdsi_node_get_succ(const _gdsi_node_t NODE)`

Get the successor of a low-level node.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|-------------------|---|
| <code>NODE</code> | The low-level node which we want to get the successor from. |
|-------------------|---|

Returns

the successor of the low-level node `NODE` if `NODE` has a successor.
NULL if the low-level node `NODE` has no successor.

See also

`_gdsi_node_get_pred()` (p. 58)

`_gdsi_node_set_succ()` (p. 59)

`_gdsi_node_set_pred()` (p. 60)

4.4.2.4 `_gdsi_node_t _gdsi_node_get_pred(const _gdsi_node_t NODE)`

Get the predecessor of a low-level node.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|-------------------|---|
| <code>NODE</code> | The low-level node which we want to get the predecessor from. |
|-------------------|---|

Returns

the predecessor of the low-level node `NODE` if `NODE` has a predecessor.
NULL if the low-level node `NODE` has no predecessor.

See also

`_gdsi_node_get_succ()` (p. 58)

`_gdsi_node_set_succ()` (p. 59)

`_gdsi_node_set_pred()` (p. 60)

4.4.2.5 `gdsi_element_t _gdsi_node_get_content(const _gdsi_node_t NODE)`

Get the content of a low-level node.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|-------------------|---|
| <code>NODE</code> | The low-level node which we want to get the content from. |
|-------------------|---|

Returns

the content of the low-level node `NODE` if `NODE` has a content.

`NULL` if the low-level node `NODE` has no content.

See also

`_gdsi_node_set_content()` (p. 60)

Examples:

`examples/main_llist.c`.

4.4.2.6 `void _gdsi_node_set_succ(_gdsi_node_t NODE, const _gdsi_node_t SUCC)`

Set the successor of a low-level node.

Modifie the sucessor of the low-level node `NODE` to `SUCC`.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|-------------|---|
| <i>NODE</i> | The low-level node which want to change the successor from. |
| <i>SUCC</i> | The new successor of <i>NODE</i> . |

See also

`_gdsl_node_get_succ()` (p. 58)

4.4.2.7 `void _gdsl_node_set_pred(_gdsl_node_t NODE, const _gdsl_node_t PRED)`

Set the predecessor of a low-level node.

Modifie the predecessor of the low-level node *NODE* to *PRED*.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|-------------|---|
| <i>NODE</i> | The low-level node which want to change the predecessor from. |
| <i>PRED</i> | The new predecessor of <i>NODE</i> . |

See also

`_gdsl_node_get_pred()` (p. 58)

4.4.2.8 `void _gdsl_node_set_content(_gdsl_node_t NODE, const gdsl_element_t CONTENT)`

Set the content of a low-level node.

Modify the content of the low-level node *NODE* to *CONTENT*.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL`

Parameters

| | |
|----------------|---|
| <i>NODE</i> | The low-level node which want to change the content from. |
| <i>CONTENT</i> | The new content of NODE. |

See also

`_gdsI_node_get_content()` (p. 59)

4.4.2.9 void `_gdsI_node_link(_gdsI_node_t NODE1, _gdsI_node_t NODE2)`

Link two low-level nodes together.

Link the two low-level nodes NODE1 and NODE2 together. After the link, NODE1's successor is NODE2 and NODE2's predecessor is NODE1.

Note

Complexity: $O(1)$

Precondition

`NODE1 != NULL & NODE2 != NULL`

Parameters

| | |
|--------------|---|
| <i>NODE1</i> | The first low-level node to link to NODE2. |
| <i>NODE2</i> | The second low-level node to link from NODE1. |

See also

`_gdsI_node_unlink()` (p. 61)

4.4.2.10 void `_gdsI_node_unlink(_gdsI_node_t NODE1, _gdsI_node_t NODE2)`

Unlink two low-level nodes.

Unlink the two low-level nodes NODE1 and NODE2. After the unlink, NODE1's successor is NULL and NODE2's predecessor is NULL.

Note

Complexity: $O(1)$

Precondition

`NODE1 != NULL & NODE2 != NULL`

Parameters

| | |
|--------------|---|
| <i>NODE1</i> | The first low-level node to unlink from <i>NODE2</i> . |
| <i>NODE2</i> | The second low-level node to unlink from <i>NODE1</i> . |

See also

`_gdsi_node_link()` (p. 61)

4.4.2.11 `void _gdsi_node_write (const _gdsi_node_t NODE, const
_gdsi_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write a low-level node to a file.

Write the low-level node *NODE* to *OUTPUT_FILE*, using *WRITE_F* function. Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(1)$

Precondition

`NODE != NULL & WRITE_F != NULL & OUTPUT_FILE != NULL`

Parameters

| | |
|--------------------|---|
| <i>NODE</i> | The low-level node to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>NODE</i> . |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

`_gdsi_node_write_xml()` (p. 62)

`_gdsi_node_dump()` (p. 63)

4.4.2.12 `void _gdsi_node_write_xml (const _gdsi_node_t NODE, const
_gdsi_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write a low-level node to a file into XML.

Write the low-level node `NODE` to `OUTPUT_FILE`, into XML language. If `WRITE_F` \neq `NULL`, then uses `WRITE_F` function to write `NODE` to `OUTPUT_FILE`. Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(1)$

Precondition

`NODE` \neq `NULL` & `OUTPUT_FILE` \neq `NULL`

Parameters

| | |
|--------------------------|---|
| <code>NODE</code> | The low-level node to write. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write <code>NODE</code> . |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

`_gdsI_node_write()` (p. 62)

`_gdsI_node_dump()` (p. 63)

4.4.2.13 `void _gdsI_node_dump (const _gdsI_node_t NODE, const
_gdsI_node_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a low-level node to a file.

Dump the structure of the low-level node `NODE` to `OUTPUT_FILE`. If `WRITE_F` \neq `NULL`, then uses `WRITE_F` function to write `NODE` to `OUTPUT_FILE`. Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(1)$

Precondition

`NODE` \neq `NULL` & `OUTPUT_FILE` \neq `NULL`

Parameters

| | |
|--------------------------|---|
| <code>NODE</code> | The low-level node to dump. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write <code>NODE</code> . |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

[_gdsi_node_write\(\)](#) (p. 62)

[_gdsi_node_write_xml\(\)](#) (p. 62)

4.5 Main module

Functions

- `const char * gdsI_get_version (void)`
Get GDSL version number as a string.

4.5.1 Function Documentation

4.5.1.1 `const char* gdsI_get_version (void)`

Get GDSL version number as a string.

Note

Complexity: $O(1)$

Precondition

nothing.

Postcondition

the returned string MUST NOT be deallocated.

Returns

the GDSL version number as a string.

4.6 2D-Arrays manipulation module

Typedefs

- typedef struct gdsi_2darray * **gdsi_2darray_t**
GDSL 2D-array type.

Functions

- **gdsi_2darray_t gdsi_2darray_alloc** (const char *NAME, const **ulong** R, const **ulong** C, const **gdsi_alloc_func_t** ALLOC_F, const **gdsi_free_func_t** FREE_F)
Create a new 2D-array.
- void **gdsi_2darray_free** (**gdsi_2darray_t** A)
Destroy a 2D-array.
- const char * **gdsi_2darray_get_name** (const **gdsi_2darray_t** A)
Get the name of a 2D-array.
- **ulong gdsi_2darray_get_rows_number** (const **gdsi_2darray_t** A)
Get the number of rows of a 2D-array.
- **ulong gdsi_2darray_get_columns_number** (const **gdsi_2darray_t** A)
Get the number of columns of a 2D-array.
- **ulong gdsi_2darray_get_size** (const **gdsi_2darray_t** A)
Get the size of a 2D-array.
- **gdsi_element_t gdsi_2darray_get_content** (const **gdsi_2darray_t** A, const **ulong** R, const **ulong** C)
Get an element from a 2D-array.
- **gdsi_2darray_t gdsi_2darray_set_name** (**gdsi_2darray_t** A, const char *NEW_NAME)
Set the name of a 2D-array.
- **gdsi_element_t gdsi_2darray_set_content** (**gdsi_2darray_t** A, const **ulong** R, const **ulong** C, void *VALUE)
Modify an element in a 2D-array.
- void **gdsi_2darray_write** (const **gdsi_2darray_t** A, const **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a 2D-array to a file.
- void **gdsi_2darray_write_xml** (const **gdsi_2darray_t** A, const **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a 2D array to a file into XML.
- void **gdsi_2darray_dump** (const **gdsi_2darray_t** A, const **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a 2D array to a file.

4.6.1 Typedef Documentation

4.6.1.1 typedef struct gdsl_2darray* gdsl_2darray_t

GDSDL 2D-array type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 51 of file gdsl_2darray.h.

4.6.2 Function Documentation

4.6.2.1 gdsl_2darray_t gdsl_2darray_alloc(const char * *NAME*, const ulong *R*, const ulong *C*, const gdsl_alloc_func_t *ALLOC_F*, const gdsl_free_func_t *FREE_F*)

Create a new 2D-array.

Allocate a new 2D-array data structure with *R* rows and *C* columns and its name is set to a copy of *NAME*. The functions pointers *ALLOC_F* and *FREE_F* could be used to respectively, alloc and free elements in the 2D-array. These pointers could be set to NULL to use the default ones:

- the default *ALLOC_F* simply returns its argument
- the default *FREE_F* does nothing

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|----------------|---|
| <i>NAME</i> | The name of the new 2D-array to create |
| <i>R</i> | The number of rows of the new 2D-array to create |
| <i>C</i> | The number of columns of the new 2D-array to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in a 2D-array |
| <i>FREE_F</i> | Function to free element when removing it from a 2D-array |

Returns

the newly allocated 2D-array in case of success.
NULL in case of insufficient memory.

See also

gdsI_2darray_free() (p. 68)

gdsI_alloc_func_t (p. 235)

gdsI_free_func_t (p. 235)

4.6.2.2 void gdsI_2darray_free(gdsI_2darray_t A)

Destroy a 2D-array.

Flush and destroy the 2D-array A. The FREE_F function passed to **gdsI_2darray_alloc()** (p. 67) is used to free elements from A, but no check is done to see if an element was set (ie. != NULL) or not. It's up to you to check if the element to free is NULL or not into the FREE_F function.

Note

Complexity: $O(R \times C)$, where R is A's rows count, and C is A's columns count

Precondition

A must be a valid gdsI_2darray_t

Parameters

| | |
|---|-------------------------|
| A | The 2D-array to destroy |
|---|-------------------------|

See also

gdsI_2darray_alloc() (p. 67)

4.6.2.3 const char* gdsI_2darray_get_name(const gdsI_2darray_t A)

Get the name of a 2D-array.

Note

Complexity: $O(1)$

Precondition

A must be a valid gdsI_2darray_t

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|----------|--|
| A | The 2D-array from which getting the name |
|----------|--|

Returns

the name of the 2D-array A.

See also

gdsI_2darray_set_name() (p. 71)

4.6.2.4 `ulong gdsI_2darray_get_rows_number(const gdsI_2darray_t A)`

Get the number of rows of a 2D-array.

Note

Complexity: $O(1)$

Precondition

A must be a valid `gdsI_2darray_t`

Parameters

| | |
|----------|--|
| A | The 2D-array from which getting the rows count |
|----------|--|

Returns

the number of rows of the 2D-array A.

See also

gdsI_2darray_get_columns_number() (p. 69)

gdsI_2darray_get_size() (p. 70)

4.6.2.5 `ulong gdsI_2darray_get_columns_number(const gdsI_2darray_t A)`

Get the number of columns of a 2D-array.

Note

Complexity: $O(1)$

Precondition

A must be a valid `gdsI_2darray_t`

Parameters

| | |
|----------|---|
| A | The 2D-array from which getting the columns count |
|----------|---|

Returns

the number of columns of the 2D-array A.

See also

`gdsI_2darray_get_rows_number()` (p. 69)

`gdsI_2darray_get_size()` (p. 70)

4.6.2.6 `ulong gdsI_2darray_get_size(const gdsI_2darray_t A)`

Get the size of a 2D-array.

Note

Complexity: $O(1)$

Precondition

A must be a valid `gdsI_2darray_t`

Parameters

| | |
|----------|----------------------|
| A | The 2D-array to use. |
|----------|----------------------|

Returns

the number of elements of A (noted $|A|$).

See also

`gdsI_2darray_get_rows_number()` (p. 69)

`gdsI_2darray_get_columns_number()` (p. 69)

4.6.2.7 `gdsI_element_t gdsI_2darray_get_content(const gdsI_2darray_t A, const ulong R, const ulong C)`

Get an element from a 2D-array.

Note

Complexity: $O(1)$

Precondition

A must be a valid `gdsi_2darray_t` & $R \leq \text{gdsi_2darray_get_rows_number}(A)$ & $C \leq \text{gdsi_2darray_get_columns_number}(A)$

Parameters

| | |
|----------|---|
| <i>A</i> | The 2D-array from which getting the element |
| <i>R</i> | The row index of the element to get |
| <i>C</i> | The column index of the element to get |

Returns

the element of the 2D-array A contained in row R and column C.

See also

`gdsi_2darray_set_content()` (p. 72)

4.6.2.8 `gdsi_2darray_t gdsi_2darray_set_name(gdsi_2darray_t A, const char * NEW_NAME)`

Set the name of a 2D-array.

Change the previous name of the 2D-array A to a copy of NEW_NAME.

Note

Complexity: $O(1)$

Precondition

A must be a valid `gdsi_2darray_t`

Parameters

| | |
|-----------------|---------------------------------|
| <i>A</i> | The 2D-array to change the name |
| <i>NEW_NAME</i> | The new name of A |

Returns

the modified 2D-array in case of success.
 NULL in case of failure.

See also

gdsl_2darray_get_name() (p. 68)

4.6.2.9 **gdsl_element_t gdsl_2darray_set_content(gdsl_2darray_t A, const ulong R, const ulong C, void * VALUE)**

Modify an element in a 2D-array.

Change the element at row R and column C of the 2D-array A, and returns it. The new element to insert is allocated using the ALLOC_F function passed to gdsl_2darray_create() applied on VALUE. The previous element contained in row R and in column C is NOT deallocated. It's up to you to do it before, if necessary.

Note

Complexity: $O(1)$

Precondition

A must be a valid gdsl_2darray_t & $R \leq \text{gdsl_2darray_get_rows_number}(A)$ & $C \leq \text{gdsl_2darray_get_columns_number}(A)$

Parameters

| | |
|--------------|--|
| <i>A</i> | The 2D-array to modify on element from |
| <i>R</i> | The row number of the element to modify |
| <i>C</i> | The column number of the element to modify |
| <i>VALUE</i> | The user value to use for allocating the new element |

Returns

the newly allocated element in case of success.
 NULL in case of insufficient memory.

See also

gdsl_2darray_get_content() (p. 70)

4.6.2.10 **void gdsl_2darray_write(const gdsl_2darray_t A, const gdsl_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)**

Write the content of a 2D-array to a file.

Write the elements of the 2D-array *A* to *OUTPUT_FILE*, using *WRITE_F* function. -
 Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(R \times C)$, where *R* is *A*'s rows count, and *C* is *A*'s columns count

Precondition

WRITE_F != NULL & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|--|
| <i>A</i> | The 2D-array to write |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write <i>A</i> 's elements |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> |

See also

gdsi_2darray_write_xml() (p. 73)

gdsi_2darray_dump() (p. 74)

4.6.2.11 void **gdsi_2darray_write_xml**(const **gdsi_2darray_t** *A*, const
gdsi_write_func_t *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Write the content of a 2D array to a file into XML.

Write all *A*'s elements to *OUTPUT_FILE*, into XML language. If *WRITE_F* != NULL,
 then uses *WRITE_F* to write *A*'s elements to *OUTPUT_FILE*. Additionnal *USER_DATA*
 argument could be passed to *WRITE_F*.

Note

Complexity: $O(R \times C)$, where *R* is *A*'s rows count, and *C* is *A*'s columns count

Precondition

A must be a valid **gdsi_2darray_t** & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|--|
| <i>A</i> | The 2D-array to write |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write <i>A</i> 's elements |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> |

See also

gdsI_2darray_write() (p. 72)
gdsI_2darray_dump() (p. 74)

4.6.2.12 **void gdsI_2darray_dump(const gdsI_2darray_t A, const gdsI_write_func_t
WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)**

Dump the internal structure of a 2D array to a file.

Dump A's structure to OUTPUT_FILE. If WRITE_F != NULL, then uses WRITE_F to write A's elements to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(R \times C)$, where R is A's rows count, and C is A's columns count

Precondition

A must be a valid gdsI_2darray_t & OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|--------------------------------------|
| <i>A</i> | The 2D-array to dump |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write A's elements |
| <i>USER_DATA</i> | User's datas passed to WRITE_F |

See also

gdsI_2darray_write() (p. 72)
gdsI_2darray_write_xml() (p. 73)

4.7 Binary search tree manipulation module

Typedefs

- typedef struct gds_l_bstree * **gds_l_bstree_t**
GDSL binary search tree type.

Functions

- **gds_l_bstree_t gds_l_bstree_alloc** (const char *NAME, **gds_l_alloc_func_t** ALL-OC_F, **gds_l_free_func_t** FREE_F, **gds_l_compare_func_t** COMP_F)
Create a new binary search tree.
- void **gds_l_bstree_free** (**gds_l_bstree_t** T)
Destroy a binary search tree.
- void **gds_l_bstree_flush** (**gds_l_bstree_t** T)
Flush a binary search tree.
- const char * **gds_l_bstree_get_name** (const **gds_l_bstree_t** T)
Get the name of a binary search tree.
- bool **gds_l_bstree_is_empty** (const **gds_l_bstree_t** T)
Check if a binary search tree is empty.
- **gds_l_element_t gds_l_bstree_get_root** (const **gds_l_bstree_t** T)
Get the root of a binary search tree.
- **ulong gds_l_bstree_get_size** (const **gds_l_bstree_t** T)
Get the size of a binary search tree.
- **ulong gds_l_bstree_get_height** (const **gds_l_bstree_t** T)
Get the height of a binary search tree.
- **gds_l_bstree_t gds_l_bstree_set_name** (**gds_l_bstree_t** T, const char *NEW_NAME)
Set the name of a binary search tree.
- **gds_l_element_t gds_l_bstree_insert** (**gds_l_bstree_t** T, void *VALUE, int *RESULT)
Insert an element into a binary search tree if it's not found or return it.
- **gds_l_element_t gds_l_bstree_remove** (**gds_l_bstree_t** T, void *VALUE)
Remove an element from a binary search tree.
- **gds_l_bstree_t gds_l_bstree_delete** (**gds_l_bstree_t** T, void *VALUE)
Delete an element from a binary search tree.
- **gds_l_element_t gds_l_bstree_search** (const **gds_l_bstree_t** T, **gds_l_compare_func_t** COMP_F, void *VALUE)
Search for a particular element into a binary search tree.
- **gds_l_element_t gds_l_bstree_map_prefix** (const **gds_l_bstree_t** T, **gds_l_map_func_t** MAP_F, void *USER_DATA)
Parse a binary search tree in prefixed order.
- **gds_l_element_t gds_l_bstree_map_infix** (const **gds_l_bstree_t** T, **gds_l_map_func_t** MAP_F, void *USER_DATA)

Parse a binary search tree in infix order.

- **gdsl_element_t** **gdsl_bstree_map_postfix** (const **gdsl_bstree_t** T, **gdsl_map_func_t** MAP_F, void *USER_DATA)

Parse a binary search tree in postfix order.

- void **gdsl_bstree_write** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the element of each node of a binary search tree to a file.

- void **gdsl_bstree_write_xml** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a binary search tree to a file into XML.

- void **gdsl_bstree_dump** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a binary search tree to a file.

4.7.1 Typedef Documentation

4.7.1.1 typedef struct **gdsl_bstree*** **gdsl_bstree_t**

GDSL binary search tree type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 54 of file **gdsl_bstree.h**.

4.7.2 Function Documentation

4.7.2.1 **gdsl_bstree_t** **gdsl_bstree_alloc** (const char * NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F, **gdsl_compare_func_t** COMP_F)

Create a new binary search tree.

Allocate a new binary search tree data structure which name is set to a copy of NAME. The function pointers ALLOC_F, FREE_F and COMP_F could be used to respectively alloc, free and compares elements in the tree. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing
- the default COMP_F always returns 0

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|----------------|--|
| <i>NAME</i> | The name of the new binary tree to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in a binary tree |
| <i>FREE_F</i> | Function to free element when removing it from a binary tree |
| <i>COMP_F</i> | Function to compare elements into the binary tree |

Returns

the newly allocated binary search tree in case of success.
NULL in case of insufficient memory.

See also

gdsI_bstree_free() (p. 77)
gdsI_bstree_flush() (p. 78)
gdsI_alloc_func_t (p. 235)
gdsI_free_func_t (p. 235)
gdsI_compare_func_t (p. 236)

Examples:

examples/main_bstree.c.

4.7.2.2 void gdsI_bstree_free (gdsI_bstree_t T)

Destroy a binary search tree.

Deallocate all the elements of the binary search tree T by calling T's FREE_F function passed to **gdsI_bstree_alloc()** (p. 76). The name of T is deallocated and T is deallocated itself too.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_bstree_t

Parameters

| | |
|----------|--------------------------------------|
| <i>T</i> | The binary search tree to deallocate |
|----------|--------------------------------------|

See also

gdsI_bstree_alloc() (p. 76)

gdsI_bstree_flush() (p. 78)

Examples:

examples/main_bstree.c.

4.7.2.3 void gdsI_bstree_flush(gdsI_bstree_t T)

Flush a binary search tree.

Deallocate all the elements of the binary search tree T by calling T's FREE_F function passed to **gdsI_rbtrees_alloc()** (p.204). The binary search tree T is not deallocated itself and its name is not modified.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_bstree_t

Parameters

| | |
|----------|---------------------------------|
| T | The binary search tree to flush |
|----------|---------------------------------|

See also

gdsI_bstree_alloc() (p. 76)

gdsI_bstree_free() (p. 77)

Examples:

examples/main_bstree.c.

4.7.2.4 const char* gdsI_bstree_get_name(const gdsI_bstree_t T)

Get the name of a binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsl_bstree_t`

Postcondition

The returned string **MUST NOT** be freed.

Parameters

| | |
|----------------|---|
| <code>T</code> | The binary search tree to get the name from |
|----------------|---|

Returns

the name of the binary search tree T.

See also

`gdsl_bstree_set_name` (p. 81) ()

4.7.2.5 `bool gsdl_bstree_is_empty(const gsdl_bstree_t T)`

Check if a binary search tree is empty.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gsdl_bstree_t`

Parameters

| | |
|----------------|---------------------------------|
| <code>T</code> | The binary search tree to check |
|----------------|---------------------------------|

Returns

TRUE if the binary search tree T is empty.
FALSE if the binary search tree T is not empty.

Examples:

`examples/main_bstree.c`.

4.7.2.6 `gdsl_element_t gdsl_bstree_get_root(const gdsl_bstree_t T)`

Get the root of a binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsl_bstree_t`

Parameters

| | |
|----------------|---|
| <code>T</code> | The binary search tree to get the root element from |
|----------------|---|

Returns

the element at the root of the binary search tree T.

Examples:

`examples/main_bstree.c`.

4.7.2.7 `ulong gdsl_bstree_get_size(const gdsl_bstree_t T)`

Get the size of a binary search tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsl_bstree_t`

Parameters

| | |
|----------------|---|
| <code>T</code> | The binary search tree to get the size from |
|----------------|---|

Returns

the size of the binary search tree T (noted $|T|$).

See also

gdsI_bstree_get_height() (p. 81)

Examples:

examples/main_bstree.c.

4.7.2.8 `ulong gdsI_bstree_get_height(const gdsI_bstree_t T)`

Get the height of a binary search tree.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsI_bstree_t`

Parameters

| | |
|----------------|---|
| <code>T</code> | The binary search tree to compute the height from |
|----------------|---|

Returns

the height of the binary search tree T (noted $h(T)$).

See also

gdsI_bstree_get_size() (p. 80)

Examples:

examples/main_bstree.c.

4.7.2.9 `gdsI_bstree_t gdsI_bstree_set_name(gdsI_bstree_t T, const char * NEW_NAME)`

Set the name of a binary search tree.

Change the previous name of the binary search tree T to a copy of NEW_NAME.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsl_bstree_t`

Parameters

| | |
|-----------------|---|
| <i>T</i> | The binary search tree to change the name |
| <i>NEW_NAME</i> | The new name of T |

Returns

the modified binary search tree in case of success.
 NULL in case of insufficient memory.

See also

`gdsl_bstree_get_name()` (p. 78)

4.7.2.10 `gdsl_element_t` **`gdsl_bstree_insert(gsdl_bstree_t T, void * VALUE, int * RESULT)`**

Insert an element into a binary search tree if it's not found or return it.

Search for the first element E equal to VALUE into the binary search tree T, by using T's COMP_F function passed to `gdsl_bstree_alloc` to find it. If E is found, then it's returned. If E isn't found, then a new element E is allocated using T's ALLOC_F function passed to `gdsl_bstree_alloc` and is inserted and then returned.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

Precondition

T must be a valid `gdsl_bstree_t` & `RESULT != NULL`

Parameters

| | |
|---------------|---|
| <i>T</i> | The binary search tree to modify |
| <i>VALUE</i> | The value used to make the new element to insert into T |
| <i>RESULT</i> | The address where the result code will be stored. |

Returns

the element E and `RESULT = GDSL_OK` if E is inserted into T.
 the element E and `RESULT = GDSL_ERR_DUPLICATE_ENTRY` if E is already present in T.

NULL and RESULT = GDSL_ERR_MEM_ALLOC in case of insufficient memory.

See also

gdsl_bstree_remove() (p. 83)

gdsl_bstree_delete() (p. 83)

Examples:

examples/main_bstree.c.

4.7.2.11 **gdsl_element_t** **gdsl_bstree_remove**(**gdsl_bstree_t** *T*, void * *VALUE*)

Remove an element from a binary search tree.

Remove from the binary search tree *T* the first founded element *E* equal to *VALUE*, by using *T*'s *COMP_F* function passed to **gdsl_bstree_alloc()** (p. 76). If *E* is found, it is removed from *T* and then returned.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

The resulting *T* is modified by examining the left sub-tree from the founded *E*.

Precondition

T must be a valid **gdsl_bstree_t**

Parameters

| | |
|--------------|--|
| <i>T</i> | The binary search tree to modify |
| <i>VALUE</i> | The value used to find the element to remove |

Returns

the first founded element equal to *VALUE* in *T* in case is found.

NULL in case no element equal to *VALUE* is found in *T*.

See also

gdsl_bstree_insert() (p. 82)

gdsl_bstree_delete() (p. 83)

4.7.2.12 **gdsl_bstree_t** **gdsl_bstree_delete**(**gdsl_bstree_t** *T*, void * *VALUE*)

Delete an element from a binary search tree.

Remove from the binary search tree the first founded element E equal to VALUE, by using T's COMP_F function passed to **gdsi_bstree_alloc()** (p. 76). If E is found, it is removed from T and E is deallocated using T's FREE_F function passed to **gdsi_bstree_alloc()** (p. 76), then T is returned.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$
the resulting T is modified by examining the left sub-tree from the founded E.

Precondition

T must be a valid gdsi_bstree_t

Parameters

| | |
|--------------|--|
| <i>T</i> | The binary search tree to remove an element from |
| <i>VALUE</i> | The value used to find the element to remove |

Returns

the modified binary search tree after removal of E if E was found.
NULL if no element equal to VALUE was found.

See also

gdsi_bstree_insert() (p. 82)
gdsi_bstree_remove() (p. 83)

Examples:

examples/main_bstree.c.

4.7.2.13 gdsi_element_t gdsi_bstree_search (const gdsi_bstree_t T, gdsi_compare_func_t COMP_F, void * VALUE)

Search for a particular element into a binary search tree.

Search the first element E equal to VALUE in the binary search tree T, by using COMP_F function to find it. If COMP_F == NULL, then the COMP_F function passed to **gdsi_bstree_alloc()** (p. 76) is used.

Note

Complexity: $O(h(T))$, where $\log_2(|T|) \leq h(T) \leq |T|-1$

Precondition

T must be a valid `gdsl_bstree_t`

Parameters

| | |
|---------------|--|
| <i>T</i> | The binary search tree to use. |
| <i>COMP_F</i> | The comparison function to use to compare T's element with VALUE to find the element E (or NULL to use the default T's COMP_F) |
| <i>VALUE</i> | The value that must be used by COMP_F to find the element E |

Returns

the first founded element E equal to VALUE.
 NULL if VALUE is not found in T.

See also

gdsl_bstree_insert() (p. 82)
gdsl_bstree_remove() (p. 83)
gdsl_bstree_delete() (p. 83)

Examples:

examples/main_bstree.c.

4.7.2.14 `gdsl_element_t gdsl_bstree_map_prefix (const gdsl_bstree_t T, gdsl_map_func_t MAP_F, void * USER_DATA)`

Parse a binary search tree in prefixed order.

Parse all nodes of the binary search tree T in prefixed order. The MAP_F function is called on the element contained in each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsl_bstree_map_prefix()** (p. 85) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsl_bstree_t` & MAP_F != NULL

Parameters

| | |
|------------------|--------------------------------|
| <i>T</i> | The binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

See also

gdsl_bstree_map_infix() (p. 86)
gdsl_bstree_map_postfix() (p. 87)

4.7.2.15 `gsdl_element_t gsdl_bstree_map_infix(const gsdl_bstree_t T,
 gsdl_map_func_t MAP_F, void * USER_DATA)`

Parse a binary search tree in infix order.

Parse all nodes of the binary search tree T in infix order. The MAP_F function is called on the element contained in each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gsdl_bstree_map_infix()** (p. 86) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gsdl_bstree_t & MAP_F != NULL

Parameters

| | |
|------------------|--------------------------------|
| <i>T</i> | The binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

See also

gsdl_bstree_map_prefix() (p. 85)
gsdl_bstree_map_postfix() (p. 87)

4.7.2.16 **gdsI_element_t gdsI_bstree_map_postfix(const gdsI_bstree_t T,
gdsI_map_func_t MAP_F, void * USER_DATA)**

Parse a binary search tree in postfix order.

Parse all nodes of the binary search tree T in postfix order. The MAP_F function is called on the element contained in each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsI_bstree_map_postfix()** (p. 87) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_bstree_t & MAP_F != NULL

Parameters

| | |
|------------------|--------------------------------|
| <i>T</i> | The binary search tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

gdsI_bstree_map_prefix() (p. 85)
gdsI_bstree_map_infix() (p. 86)

4.7.2.17 **void gdsI_bstree_write(const gdsI_bstree_t T, gdsI_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)**

Write the element of each node of a binary search tree to a file.

Write the nodes elements of the binary search tree T to OUTPUT_FILE, using WRITE_F function. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsl_bstree_t` & `WRITE_F` != NULL & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>T</i> | The binary search tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsl_bstree_write_xml()` (p. 88)

`gdsl_bstree_dump()` (p. 89)

Examples:

`examples/main_bstree.c`.

4.7.2.18 `void gdsl_bstree_write_xml(const gdsl_bstree_t T, gdsl_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of a binary search tree to a file into XML.

Write the nodes elements of the binary search tree T to `OUTPUT_FILE`, into XML language. If `WRITE_F` != NULL, then use `WRITE_F` to write T's nodes elements to `OUTPUT_FILE`. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsl_bstree_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>T</i> | The binary search tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

gdsI_bstree_write() (p. 87)

gdsI_bstree_dump() (p. 89)

Examples:

examples/main_bstree.c.

4.7.2.19 void **gdsI_bstree_dump**(const **gdsI_bstree_t** *T*, **gdsI_write_func_t** *WRITE_F*,
FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of a binary search tree to a file.

Dump the structure of the binary search tree *T* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then use *WRITE_F* to write *T*'s nodes elements to *OUTPUT_FILE*. Additional *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid **gdsI_bstree_t** & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|---|
| <i>T</i> | The binary search tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>T</i> 's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

gdsI_bstree_write() (p. 87)

gdsI_bstree_write_xml() (p. 88)

Examples:

examples/main_bstree.c.

4.8 Hashtable manipulation module

Typedefs

- typedef struct hash_table * **gdsi_hash_t**
GDSL hashtable type.
- typedef const char *(* **gdsi_key_func_t**)(void *VALUE)
GDSL hashtable key function type.
- typedef ulong(* **gdsi_hash_func_t**)(const char *KEY)
GDSL hashtable hash function type.

Functions

- **ulong gdsi_hash** (const char *KEY)
Computes a hash value from a NULL terminated character string.
- **gdsi_hash_t gdsi_hash_alloc** (const char *NAME, **gdsi_alloc_func_t** ALLOC_F, **gdsi_free_func_t** FREE_F, **gdsi_key_func_t** KEY_F, **gdsi_hash_func_t** HASH_F, **ushort** INITIAL_ENTRIES_NB)
Create a new hashtable.
- **void gdsi_hash_free** (**gdsi_hash_t** H)
Destroy a hashtable.
- **void gdsi_hash_flush** (**gdsi_hash_t** H)
Flush a hashtable.
- **const char * gdsi_hash_get_name** (const **gdsi_hash_t** H)
Get the name of a hashtable.
- **ushort gdsi_hash_get_entries_number** (const **gdsi_hash_t** H)
Get the number of entries of a hashtable.
- **ushort gdsi_hash_get_lists_max_size** (const **gdsi_hash_t** H)
Get the max number of elements allowed in each entry of a hashtable.
- **ushort gdsi_hash_get_longest_list_size** (const **gdsi_hash_t** H)
Get the number of elements of the longest list entry of a hashtable.
- **ulong gdsi_hash_get_size** (const **gdsi_hash_t** H)
Get the size of a hashtable.
- **double gdsi_hash_get_fill_factor** (const **gdsi_hash_t** H)
Get the fill factor of a hashtable.
- **gdsi_hash_t gdsi_hash_set_name** (**gdsi_hash_t** H, const char *NEW_NAME)
Set the name of a hashtable.
- **gdsi_element_t gdsi_hash_insert** (**gdsi_hash_t** H, void *VALUE)
Insert an element into a hashtable (PUSH).
- **gdsi_element_t gdsi_hash_remove** (**gdsi_hash_t** H, const char *KEY)
Remove an element from a hashtable (POP).
- **gdsi_hash_t gdsi_hash_delete** (**gdsi_hash_t** H, const char *KEY)

Delete an element from a hashtable.

- **gdsi_hash_t gdsi_hash_modify** (gdsi_hash_t H, ushort NEW_ENTRIES_NB, ushort NEW_LISTS_MAX_SIZE)

Increase the dimensions of a hashtable.

- **gdsi_element_t gdsi_hash_search** (const gdsi_hash_t H, const char *KEY)

Search for a particular element into a hashtable (GET).

- **gdsi_element_t gdsi_hash_map** (const gdsi_hash_t H, gdsi_map_func_t MAP_F, void *USER_DATA)

Parse a hashtable.

- void **gdsi_hash_write** (const gdsi_hash_t H, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write all the elements of a hashtable to a file.

- void **gdsi_hash_write_xml** (const gdsi_hash_t H, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a hashtable to a file into XML.

- void **gdsi_hash_dump** (const gdsi_hash_t H, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a hashtable to a file.

4.8.1 Typedef Documentation

4.8.1.1 typedef struct hash_table* gdsi_hash_t

GDSL hashtable type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 55 of file gdsi_hash.h.

4.8.1.2 typedef const char*(* gdsi_key_func_t)(void *VALUE)

GDSL hashtable key function type.

Postcondition

Returned value must be != "" && != NULL.

Parameters

| | |
|--------------|------------------------------------|
| VALUE | The value used to get the key from |
|--------------|------------------------------------|

Returns

The key associated to the VALUE.

Definition at line 63 of file gdsi_hash.h.

4.8.1.3 `typedef ulong(* gdsi_hash_func_t)(const char *KEY)`

GDSL hashtable hash function type.

Parameters

| | |
|------------|--|
| KEY | the key used to compute the hash code. |
|------------|--|

Returns

The hashed value computed from KEY.

Definition at line 71 of file `gdsi_hash.h`.

4.8.2 Function Documentation

4.8.2.1 `ulong gdsi_hash (const char * KEY)`

Computes a hash value from a NULL terminated character string.

This function computes a hash value from the NULL terminated KEY string.

Note

Complexity: $O (|key|)$

Precondition

KEY must be NULL-terminated.

Parameters

| | |
|------------|--|
| KEY | The NULL terminated string to compute the key from |
|------------|--|

Returns

the hash code computed from KEY.

4.8.2.2 `gdsi_hash_t gdsi_hash_alloc (const char * NAME, gdsi_alloc_func_t ALLOC_F, gdsi_free_func_t FREE_F, gdsi_key_func_t KEY_F, gdsi_hash_func_t HASH_F, ushort INITIAL_ENTRIES_NB)`

Create a new hashtable.

Allocate a new hashtable data structure which name is set to a copy of NAME. The new hashtable will contain initially INITIAL_ENTRIES_NB lists. This value could be (only) increased with **`gdsi_hash_modify()`** (p. 101) function. Until this function is called, then all H's lists entries have no size limit. The function pointers ALLOC_F and FREE_F

could be used to respectively, alloc and free elements in the hashtable. The KEY_F function must provide a unique key associated to its argument. The HASH_F function must compute a hash code from its argument. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing
- the default KEY_F simply returns its argument
- the default HASH_F is **gdsI_hash()** (p. 92) above

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|---------------------------|--|
| <i>NAME</i> | The name of the new hashtable to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in the hashtable |
| <i>FREE_F</i> | Function to free element when deleting it from the hashtable |
| <i>KEY_F</i> | Function to get the key from an element |
| <i>HASH_F</i> | Function used to compute the hash value. |
| <i>INITIAL_ENTRIES_NB</i> | Initial number of entries of the hashtable |

Returns

the newly allocated hashtable in case of success.
NULL in case of insufficient memory.

See also

gdsI_hash_free() (p. 94)
gdsI_hash_flush() (p. 94)
gdsI_hash_insert() (p. 99)
gdsI_hash_modify() (p. 101)

Examples:

examples/main_hash.c.

4.8.2.3 void gdsI_hash_free(gdsI_hash_t H)

Destroy a hashtable.

Deallocate all the elements of the hashtable H by calling H's FREE_F function passed to **gdsI_hash_alloc()** (p. 92). The name of H is deallocated and H is deallocated itself too.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_hash_t

Parameters

| | |
|----------|--------------------------|
| <i>H</i> | The hashtable to destroy |
|----------|--------------------------|

See also

gdsI_hash_alloc() (p. 92)

gdsI_hash_flush() (p. 94)

Examples:

examples/main_hash.c.

4.8.2.4 void gdsI_hash_flush(gdsI_hash_t H)

Flush a hashtable.

Deallocate all the elements of the hashtable H by calling H's FREE_F function passed to **gdsI_hash_alloc()** (p. 92). H is not deallocated itself and H's name is not modified.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_hash_t

Parameters

| | |
|----------|------------------------|
| <i>H</i> | The hashtable to flush |
|----------|------------------------|

See also

gdsI_hash_alloc() (p. 92)

gdsI_hash_free() (p. 94)

Examples:

examples/main_hash.c.

4.8.2.5 `const char* gdsI_hash_get_name(const gdsI_hash_t H)`

Get the name of a hashtable.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_hash_t`

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|----------|------------------------------------|
| <i>H</i> | The hashtable to get the name from |
|----------|------------------------------------|

Returns

the name of the hashtable H.

See also

gdsI_hash_set_name() (p. 98)

4.8.2.6 `ushort gdsI_hash_get_entries_number(const gdsI_hash_t H)`

Get the number of entries of a hashtable.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsl_hash_t`

Parameters

| | |
|----------|-----------------------|
| <i>H</i> | The hashtable to use. |
|----------|-----------------------|

Returns

the number of lists entries of the hashtable H.

See also

gdsl_hash_get_size() (p. 97)
`gdsl_hash_fill_factor()`

4.8.2.7 `ushort gdsl_hash_get_lists_max_size (const gdsl_hash_t H)`

Get the max number of elements allowed in each entry of a hashtable.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsl_hash_t`

Parameters

| | |
|----------|-----------------------|
| <i>H</i> | The hashtable to use. |
|----------|-----------------------|

Returns

0 if no lists max size was set before (ie. no limit for H's entries).
the max number of elements for each entry of the hashtable H, if the function **gdsl_hash_modify()** (p. 101) was used with a `NEW_LISTS_MAX_SIZE` greather than the actual one.

See also

`gdsl_hash_fill_factor()`
gdsl_hash_get_entries_number() (p. 95)
gdsl_hash_get_longest_list_size() (p. 97)
gdsl_hash_modify() (p. 101)

4.8.2.8 `ushort gdsI_hash_get_longest_list_size(const gdsI_hash_t H)`

Get the number of elements of the longest list entry of a hashtable.

Note

Complexity: $O(L)$, where $L = \text{gdsI_hash_get_entries_number}(H)$

Precondition

H must be a valid `gdsI_hash_t`

Parameters

| | |
|----------|-----------------------|
| <i>H</i> | The hashtable to use. |
|----------|-----------------------|

Returns

the number of elements of the longest list entry of the hashtable H.

See also

`gdsI_hash_get_size()` (p. 97)
`gdsI_hash_fill_factor()`
`gdsI_hash_get_entries_number()` (p. 95)
`gdsI_hash_get_lists_max_size()` (p. 96)

4.8.2.9 `ulong gdsI_hash_get_size(const gdsI_hash_t H)`

Get the size of a hashtable.

Note

Complexity: $O(L)$, where $L = \text{gdsI_hash_get_entries_number}(H)$

Precondition

H must be a valid `gdsI_hash_t`

Parameters

| | |
|----------|------------------------------------|
| <i>H</i> | The hashtable to get the size from |
|----------|------------------------------------|

Returns

the number of elements of H (noted $|H|$).

See also

gdsI_hash_get_entries_number() (p. 95)
gdsI_hash_fill_factor()
gdsI_hash_get_longest_list_size() (p. 97)

4.8.2.10 `double gdsI_hash_get_fill_factor (const gdsI_hash_t H)`

Get the fill factor of a hashtable.

Note

Complexity: $O(L)$, where $L = \text{gdsI_hash_get_entries_number}(H)$

Precondition

H must be a valid `gdsI_hash_t`

Parameters

| | |
|----------|----------------------|
| <i>H</i> | The hashtable to use |
|----------|----------------------|

Returns

The fill factor of H, computed as $|H| / L$

See also

gdsI_hash_get_entries_number() (p. 95)
gdsI_hash_get_longest_list_size() (p. 97)
gdsI_hash_get_size() (p. 97)

Examples:

examples/main_hash.c.

4.8.2.11 `gdsI_hash_t gdsI_hash_set_name (gdsI_hash_t H, const char * NEW_NAME)`

Set the name of a hashtable.

Change the previous name of the hashtable H to a copy of NEW_NAME.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsl_hash_t`

Parameters

| | |
|-----------------|----------------------------------|
| <i>H</i> | The hashtable to change the name |
| <i>NEW_NAME</i> | The new name of H |

Returns

the modified hashtable in case of success.
 NULL in case of insufficient memory.

See also

gdsl_hash_get_name() (p. 95)

4.8.2.12 `gdsl_element_t gdsl_hash_insert(gdsl_hash_t H, void * VALUE)`

Insert an element into a hashtable (PUSH).

Allocate a new element E by calling H's `ALLOC_F` function on `VALUE`. The key K of the new element E is computed using `KEY_F` called on E. If the value of `gdsl_hash_get_lists_max_size(H)` is not reached, or if it is equal to zero, then the insertion is simple. Otherwise, H is re-organized as follow:

- its actual `gdsl_hash_get_entries_number(H)` (say N) is modified as $N * 2 + 1$
- its actual `gdsl_hash_get_lists_max_size(H)` (say M) is modified as $M * 2$ The element E is then inserted into H at the entry computed by `HASH_F(K) modulo gdsl_hash_get_entries_number(H)`. `ALLOC_F`, `KEY_F` and `HASH_F` are the function pointers passed to **gdsl_hash_alloc()** (p. 92).

Note

Complexity: $O(1)$ if `gdsl_hash_get_lists_max_size(H)` is not reached or if it is equal to zero

Complexity: $O(gdsl_hash_modify(H))$ if `gdsl_hash_get_lists_max_size(H)` is reached, so H needs to grow

Precondition

H must be a valid `gdsl_hash_t`

Parameters

| | |
|--------------|---|
| <i>H</i> | The hashtable to modify |
| <i>VALUE</i> | The value used to make the new element to insert into H |

Returns

the inserted element E in case of success.
NULL in case of insufficient memory.

See also

gdsI_hash_alloc() (p. 92)
gdsI_hash_remove() (p. 100)
gdsI_hash_delete() (p. 101)
gdsI_hash_get_size() (p. 97)
gdsI_hash_get_entries_number() (p. 95)
gdsI_hash_modify() (p. 101)

Examples:

examples/main_hash.c.

4.8.2.13 gdsI_element_t gdsI_hash_remove(gdsI_hash_t H, const char * KEY)

Remove an element from a hashtable (POP).

Search into the hashtable H for the first element E equal to KEY. If E is found, it is removed from H and then returned.

Note

Complexity: $O(M)$, where M is the average size of H's lists

Precondition

H must be a valid gdsI_hash_t

Parameters

| | |
|------------|--|
| <i>H</i> | The hashtable to modify |
| <i>KEY</i> | The key used to find the element to remove |

Returns

the first founded element equal to KEY in H in case is found.
NULL in case no element equal to KEY is found in H.

See also

gdsI_hash_insert() (p. 99)
gdsI_hash_search() (p. 102)
gdsI_hash_delete() (p. 101)

Examples:

examples/main_hash.c.

4.8.2.14 **gdsI_hash_t gdsI_hash_delete(gdsI_hash_t H, const char * KEY)**

Delete an element from a hashtable.

Remove from the hashtable H the first founded element E equal to KEY. If E is found, it is removed from H and E is deallocated using H's FREE_F function passed to **gdsI_hash_alloc()** (p. 92), then H is returned.

Note

Complexity: $O(M)$, where M is the average size of H's lists

Precondition

H must be a valid gdsI_hash_t

Parameters

| | |
|------------|--|
| <i>H</i> | The hashtable to modify |
| <i>KEY</i> | The key used to find the element to remove |

Returns

the modified hashtable after removal of E if E was found.
NULL if no element equal to KEY was found.

See also

gdsI_hash_insert() (p. 99)
gdsI_hash_search() (p. 102)
gdsI_hash_remove() (p. 100)

4.8.2.15 **gdsI_hash_t gdsI_hash_modify(gdsI_hash_t H, ushort NEW_ENTRIES_NB, ushort NEW_LISTS_MAX_SIZE)**

Increase the dimensions of a hashtable.

The hashtable *H* is re-organized to have `NEW_ENTRIES_NB` lists entries. Each entry is limited to `NEW_LISTS_MAX_SIZE` elements. After a call to this function, all insertions into *H* will make *H* automatically growing if needed. The grow is needed each time an insertion makes an entry list to reach `NEW_LISTS_MAX_SIZE` elements. In this case, *H* will be reorganized automatically by **`gdsI_hash_insert()`** (p. 99).

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_hash_t` & `NEW_ENTRIES_NB > gdsI_hash_get_entries_number(H)` & `NEW_LISTS_MAX_SIZE > gdsI_hash_get_lists_max_size(H)`

Parameters

| | |
|---------------------------------|-------------------------|
| <i>H</i> | The hashtable to modify |
| <code>NEW_ENTRIES_NB</code> | |
| <code>NEW_LISTS_MAX_SIZE</code> | |

Returns

the modified hashtable *H* in case of success
 NULL in case of failure, or in case `NEW_ENTRIES_NB ≤ gdsI_hash_get_entries_number(H)` or in case `NEW_LISTS_MAX_SIZE ≤ gdsI_hash_get_lists_max_size(H)` in these cases, *H* is not modified

See also

`gdsI_hash_insert()` (p. 99)
`gdsI_hash_get_entries_number()` (p. 95)
`gdsI_hash_get_fill_factor()` (p. 98)
`gdsI_hash_get_longest_list_size()` (p. 97)
`gdsI_hash_get_lists_max_size()` (p. 96)

4.8.2.16 `gdsI_element_t gdsI_hash_search(const gdsI_hash_t H, const char * KEY)`

Search for a particular element into a hashtable (GET).

Search the first element *E* equal to *KEY* in the hashtable *H*.

Note

Complexity: $O(M)$, where *M* is the average size of *H*'s lists

Precondition

H must be a valid `gdsI_hash_t`

Parameters

| | |
|------------|--|
| <i>H</i> | The hashtable to search the element in |
| <i>KEY</i> | The key to compare H's elements with |

Returns

the founded element E if it was found.

NULL in case the searched element E was not found.

See also

`gdsI_hash_insert()` (p. 99)

`gdsI_hash_remove()` (p. 100)

`gdsI_hash_delete()` (p. 101)

Examples:

`examples/main_hash.c`.

4.8.2.17 `gdsI_element_t gdsI_hash_map(const gdsI_hash_t H, gdsI_map_func_t MAP_F, void * USER_DATA)`

Parse a hashtable.

Parse all elements of the hashtable H. The MAP_F function is called on each H's element with USER_DATA argument. If MAP_F returns GDSL_MAP_STOP then **`gdsI_hash_map()`** (p. 103) stops and returns its last examined element.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_hash_t` & MAP_F != NULL

Parameters

| | |
|------------------|------------------------------|
| <i>H</i> | The hashtable to map |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

4.8.2.18 void **gdsl_hash_write**(const **gdsl_hash_t** *H*, **gdsl_write_func_t** *WRITE_F*,
 FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Write all the elements of a hashtable to a file.

Write the elements of the hashtable *H* to *OUTPUT_FILE*, using *WRITE_F* function. -
 Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid **gdsl_hash_t** & *OUTPUT_FILE* != NULL & *WRITE_F* != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The hashtable to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>H</i> 's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

gdsl_hash_write_xml() (p. 104)

gdsl_hash_dump() (p. 105)

Examples:

examples/main_hash.c.

4.8.2.19 void **gdsl_hash_write_xml**(const **gdsl_hash_t** *H*, **gdsl_write_func_t**
WRITE_F, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Write the content of a hashtable to a file into XML.

Write the elements of the hashtable *H* to *OUTPUT_FILE*, into XML language. If *WRITE_F* != NULL, then uses *WRITE_F* to write *H*'s elements to *OUTPUT_FILE*. Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_hash_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The hashtable to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write H's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

`gdsI_hash_write()` (p. 104)

`gdsI_hash_dump()` (p. 105)

Examples:

`examples/main_hash.c`.

4.8.2.20 `void gdsI_hash_dump(const gdsI_hash_t H, gdsI_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a hashtable to a file.

Dump the structure of the hashtable H to `OUTPUT_FILE`. If `WRITE_F` != NULL, then uses `WRITE_F` to write H's elements to `OUTPUT_FILE`. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_hash_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---------------------------------------|
| <i>H</i> | The hashtable to write |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write H's elements |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> |

See also

gdsI_hash_write() (p. 104)

gdsI_hash_write_xml() (p. 104)

Examples:

examples/main_hash.c.

4.9 Heap manipulation module

Typedefs

- typedef struct heap * **gdsI_heap_t**
GDSL heap type.

Functions

- **gdsI_heap_t gdsI_heap_alloc** (const char *NAME, **gdsI_alloc_func_t** ALLOC_F, **gdsI_free_func_t** FREE_F, **gdsI_compare_func_t** COMP_F)
Create a new heap.
- void **gdsI_heap_free** (**gdsI_heap_t** H)
Destroy a heap.
- void **gdsI_heap_flush** (**gdsI_heap_t** H)
Flush a heap.
- const char * **gdsI_heap_get_name** (const **gdsI_heap_t** H)
Get the name of a heap.
- **ulong gdsI_heap_get_size** (const **gdsI_heap_t** H)
Get the size of a heap.
- **gdsI_element_t gdsI_heap_get_top** (const **gdsI_heap_t** H)
Get the top of a heap.
- **bool gdsI_heap_is_empty** (const **gdsI_heap_t** H)
Check if a heap is empty.
- **gdsI_heap_t gdsI_heap_set_name** (**gdsI_heap_t** H, const char *NEW_NAME)
Set the name of a heap.
- **gdsI_element_t gdsI_heap_set_top** (**gdsI_heap_t** H, void *VALUE)
Substitute the top element of a heap by a lesser one.
- **gdsI_element_t gdsI_heap_insert** (**gdsI_heap_t** H, void *VALUE)
Insert an element into a heap (PUSH).
- **gdsI_element_t gdsI_heap_remove_top** (**gdsI_heap_t** H)
Remove the top element from a heap (POP).
- **gdsI_heap_t gdsI_heap_delete_top** (**gdsI_heap_t** H)
Delete the top element from a heap.
- **gdsI_element_t gdsI_heap_map_forward** (const **gdsI_heap_t** H, **gdsI_map_func_t** MAP_F, void *USER_DATA)
Parse a heap.
- void **gdsI_heap_write** (const **gdsI_heap_t** H, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of a heap to a file.
- void **gdsI_heap_write_xml** (const **gdsI_heap_t** H, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a heap to a file into XML.

- void **gdsl_heap_dump** (const **gdsl_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a heap to a file.

4.9.1 Typedef Documentation

4.9.1.1 typedef struct heap* **gdsl_heap_t**

GDSL heap type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 55 of file `gdsl_heap.h`.

4.9.2 Function Documentation

4.9.2.1 **gdsl_heap_t** **gdsl_heap_alloc** (const char * NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F, **gdsl_compare_func_t** COMP_F)

Create a new heap.

Allocate a new heap data structure which name is set to a copy of NAME. The function pointers ALLOC_F, FREE_F and COMP_F could be used to respectively, alloc, free and compares elements in the heap. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing
- the default COMP_F always returns 0

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|---------|---|
| NAME | The name of the new heap to create |
| ALLOC_F | Function to alloc element when inserting it in the heap |
| FREE_F | Function to free element when removing it from the heap |
| COMP_F | Function to compare elements into the heap |

Returns

the newly allocated heap in case of success.
NULL in case of insufficient memory.

See also

gdsI_heap_free() (p. 109)
gdsI_heap_flush() (p. 109)

Examples:

examples/main_heap.c.

4.9.2.2 void gdsI_heap_free(gdsI_heap_t H)

Destroy a heap.

Deallocate all the elements of the heap H by calling H's FREE_F function passed to **gdsI_heap_alloc()** (p. 108). The name of H is deallocated and H is deallocated itself too.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_heap_t

Parameters

| | |
|----------|---------------------|
| <i>H</i> | The heap to destroy |
|----------|---------------------|

See also

gdsI_heap_alloc() (p. 108)
gdsI_heap_flush() (p. 109)

Examples:

examples/main_heap.c.

4.9.2.3 void gdsI_heap_flush(gdsI_heap_t H)

Flush a heap.

Deallocate all the elements of the heap H by calling H's FREE_F function passed to **gdsI_heap_alloc()** (p. 108). H is not deallocated itself and H's name is not modified.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsl_heap_t`

Parameters

| | |
|----------|-------------------|
| <i>H</i> | The heap to flush |
|----------|-------------------|

See also

`gdsl_heap_alloc()` (p. 108)

`gdsl_heap_free()` (p. 109)

Examples:

`examples/main_heap.c`.

4.9.2.4 `const char* gdsl_heap_get_name(const gdsl_heap_t H)`

Get the name of a heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsl_heap_t`

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|----------|-------------------------------|
| <i>H</i> | The heap to get the name from |
|----------|-------------------------------|

Returns

the name of the heap H.

See also

gdsI_heap_set_name() (p. 112)

Examples:

examples/main_heap.c.

4.9.2.5 `ulong gdsI_heap_get_size(const gdsI_heap_t H)`

Get the size of a heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_heap_t`

Parameters

| | |
|----------|-------------------------------|
| <i>H</i> | The heap to get the size from |
|----------|-------------------------------|

Returns

the number of elements of H (noted $|H|$).

4.9.2.6 `gdsI_element_t gdsI_heap_get_top(const gdsI_heap_t H)`

Get the top of a heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_heap_t`

Parameters

| | |
|----------|------------------------------|
| <i>H</i> | The heap to get the top from |
|----------|------------------------------|

Returns

the element contained at the top position of the heap *H* if *H* is not empty. The returned element is not removed from *H*.
NULL if the heap *H* is empty.

See also

gdsI_heap_set_top() (p. 113)

Examples:

examples/main_heap.c.

4.9.2.7 bool gdsI_heap_is_empty(const gdsI_heap_t *H*)

Check if a heap is empty.

Note

Complexity: $O(1)$

Precondition

H must be a valid gdsI_heap_t

Parameters

| | |
|----------|-------------------|
| <i>H</i> | The heap to check |
|----------|-------------------|

Returns

TRUE if the heap *H* is empty.
FALSE if the heap *H* is not empty.

Examples:

examples/main_heap.c.

4.9.2.8 gdsI_heap_t gdsI_heap_set_name(gdsI_heap_t *H*, const char * *NEW_NAME*)

Set the name of a heap.

Change the previous name of the heap *H* to a copy of *NEW_NAME*.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_heap_t`

Parameters

| | |
|-----------------|-----------------------------|
| <i>H</i> | The heap to change the name |
| <i>NEW_NAME</i> | The new name of H |

Returns

the modified heap in case of success.
NULL in case of insufficient memory.

See also

`gdsI_heap_get_name()` (p. 110)

4.9.2.9 `gdsI_element_t gdsI_heap_set_top(gdsI_heap_t H, void * VALUE)`

Substitute the top element of a heap by a lesser one.

Try to replace the top element of a heap by a lesser one.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsI_heap_t`

Parameters

| | |
|--------------|--|
| <i>H</i> | The heap to substitute the top element |
| <i>VALUE</i> | the value to substitute to the top |

Returns

The old top element value in case *VALUE* is lesser than all other H elements.
NULL in case of *VALUE* is greather or equal to all other H elements.

See also

gdsl_heap_get_top() (p. 111)

Examples:

examples/main_heap.c.

4.9.2.10 **gsdl_element_t** gsdl_heap_insert(**gsdl_heap_t** *H*, void * *VALUE*)

Insert an element into a heap (PUSH).

Allocate a new element *E* by calling *H*'s `ALLOC_F` function on *VALUE*. The element *E* is then inserted into *H* at the good position to ensure *H* is always a heap.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid **gsdl_heap_t**

Parameters

| | |
|--------------|--|
| <i>H</i> | The heap to modify |
| <i>VALUE</i> | The value used to make the new element to insert into <i>H</i> |

Returns

the inserted element *E* in case of success.
NULL in case of insufficient memory.

See also

gsdl_heap_alloc() (p. 108)

gsdl_heap_remove()

gsdl_heap_delete()

gsdl_heap_get_size() (p. 111)

Examples:

examples/main_heap.c.

4.9.2.11 **gsdl_element_t** gsdl_heap_remove_top(**gsdl_heap_t** *H*)

Remove the top element from a heap (POP).

Remove the top element from the heap *H*. The element is removed from *H* and is also returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsi_heap_t`

Parameters

| | |
|----------|--------------------|
| <i>H</i> | The heap to modify |
|----------|--------------------|

Returns

the removed top element.
NULL if the heap is empty.

See also

`gdsi_heap_insert()` (p. 114)

`gdsi_heap_delete_top()` (p. 115)

4.9.2.12 `gdsi_heap_t gdsi_heap_delete_top(gdsi_heap_t H)`

Delete the top element from a heap.

Remove the top element from the heap H. The element is removed from H and is also deallocated using H's `FREE_F` function passed to **`gdsi_heap_alloc()`** (p. 108), then H is returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsi_heap_t`

Parameters

| | |
|----------|--------------------|
| <i>H</i> | The heap to modify |
|----------|--------------------|

Returns

the modified heap after removal of top element.
NULL if heap is empty.

See also

gdsl_heap_insert() (p. 114)
gdsl_heap_remove_top() (p. 114)

Examples:

examples/main_heap.c.

4.9.2.13 **gdsl_element_t** **gdsl_heap_map_forward**(**const** **gdsl_heap_t** *H*,
gdsl_map_func_t *MAP_F*, **void ****USER_DATA*)

Parse a heap.

Parse all elements of the heap *H*. The *MAP_F* function is called on each *H*'s element with *USER_DATA* argument. If *MAP_F* returns *GDSL_MAP_STOP* then *gdsl_heap_map()* stops and returns its last examined element.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid *gdsl_heap_t* & *MAP_F* != NULL

Parameters

| | |
|------------------|-------------------------------------|
| <i>H</i> | The heap to map |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to <i>MAP_F</i> |

Returns

the first element for which *MAP_F* returns *GDSL_MAP_STOP*.
 NULL when the parsing is done.

Examples:

examples/main_heap.c.

4.9.2.14 **void** **gdsl_heap_write**(**const** **gdsl_heap_t** *H*, **gdsl_write_func_t** *WRITE_F*,
FILE **OUTPUT_FILE*, **void ****USER_DATA*)

Write all the elements of a heap to a file.

Write the elements of the heap *H* to *OUTPUT_FILE*, using *WRITE_F* function. -
 Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_heap_t` & `OUTPUT_FILE` != NULL & `WRITE_F` != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The heap to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write H's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsI_heap_write_xml()` (p. 117)

`gdsI_heap_dump()` (p. 118)

4.9.2.15 **`void gdsI_heap_write_xml(const gdsI_heap_t H, gdsI_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`**

Write the content of a heap to a file into XML.

Write the elements of the heap H to `OUTPUT_FILE`, into XML language. If `WRITE_F` != NULL, then uses `WRITE_F` to write H's elements to `OUTPUT_FILE`. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_heap_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The heap to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write H's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

gdsI_heap_write() (p. 116)
gdsI_heap_dump() (p. 118)

Examples:

examples/main_heap.c.

**4.9.2.16 void gdsI_heap_dump(const gdsI_heap_t H, gdsI_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)**

Dump the internal structure of a heap to a file.

Dump the structure of the heap H to OUTPUT_FILE. If WRITE_F != NULL, then uses WRITE_F to write H's elements to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_heap_t & OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|--------------------------------------|
| <i>H</i> | The heap to write |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write H's elements |
| <i>USER_DATA</i> | User's datas passed to WRITE_F |

See also

gdsI_heap_write() (p. 116)
gdsI_heap_write_xml() (p. 117)

Examples:

examples/main_heap.c.

4.10 Interval Heap manipulation module

Typedefs

- typedef struct heap * **gdsI_interval_heap_t**
GDSL interval heap type.

Functions

- **gdsI_interval_heap_t gdsI_interval_heap_alloc** (const char *NAME, **gdsI_alloc_func_t** ALLOC_F, **gdsI_free_func_t** FREE_F, **gdsI_compare_func_t** COMP_F)
Create a new interval heap.
- void **gdsI_interval_heap_free** (**gdsI_interval_heap_t** H)
Destroy an interval heap.
- void **gdsI_interval_heap_flush** (**gdsI_interval_heap_t** H)
Flush an interval heap.
- const char * **gdsI_interval_heap_get_name** (const **gdsI_interval_heap_t** H)
Get the name of an interval heap.
- **ulong** **gdsI_interval_heap_get_size** (const **gdsI_interval_heap_t** H)
Get the size of a interval heap.
- void **gdsI_interval_heap_set_max_size** (const **gdsI_interval_heap_t** H, **ulong** size)
Set the maximum size of the interval heap.
- **bool** **gdsI_interval_heap_is_empty** (const **gdsI_interval_heap_t** H)
Check if an interval heap is empty.
- **gdsI_interval_heap_t** **gdsI_interval_heap_set_name** (**gdsI_interval_heap_t** H, const char *NEW_NAME)
Set the name of an interval heap.
- **gdsI_element_t** **gdsI_interval_heap_insert** (**gdsI_interval_heap_t** H, void *VALUE)
Insert an element into an interval heap (PUSH).
- **gdsI_element_t** **gdsI_interval_heap_remove_max** (**gdsI_interval_heap_t** H)
Remove the maximum element from an interval heap (POP).
- **gdsI_element_t** **gdsI_interval_heap_remove_min** (**gdsI_interval_heap_t** H)
Remove the minimum element from an interval heap (POP).
- **gdsI_element_t** **gdsI_interval_heap_get_min** (const **gdsI_interval_heap_t** H)
Get the minimum element.
- **gdsI_element_t** **gdsI_interval_heap_get_max** (const **gdsI_interval_heap_t** H)
Get the maximum element.

- **gdsI_interval_heap_t gdsI_interval_heap_delete_min** (gdsI_interval_heap_t H)
Delete the minimum element from an interval heap.
- **gdsI_interval_heap_t gdsI_interval_heap_delete_max** (gdsI_interval_heap_t H)
Delete the maximum element from an interval heap.
- **gdsI_element_t gdsI_interval_heap_map_forward** (const gdsI_interval_heap_t H, gdsI_map_func_t MAP_F, void *USER_DATA)
Parse a interval heap.
- void **gdsI_interval_heap_write** (const gdsI_interval_heap_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of an interval heap to a file.
- void **gdsI_interval_heap_write_xml** (const gdsI_interval_heap_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of an interval heap to a file into XML.
- void **gdsI_interval_heap_dump** (const gdsI_interval_heap_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of an interval heap to a file.

4.10.1 Typedef Documentation

4.10.1.1 typedef struct heap* gdsI_interval_heap_t

GDSL interval heap type.

This type is voluntary opaque. Variables of this kind couldn't be directly used, but by the functions of this module.

Definition at line 54 of file gdsI_interval_heap.h.

4.10.2 Function Documentation

4.10.2.1 gdsI_interval_heap_t gdsI_interval_heap_alloc (const char * NAME, gdsI_alloc_func_t ALLOC_F, gdsI_free_func_t FREE_F, gdsI_compare_func_t COMP_F)

Create a new interval heap.

Allocate a new interval heap data structure which name is set to a copy of NAME. The function pointers ALLOC_F, FREE_F and COMP_F could be used to respectively, alloc, free and compares elements in the interval heap. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing
- the default COMP_F always returns 0

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|----------------|--|
| <i>NAME</i> | The name of the new interval heap to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in the interval heap |
| <i>FREE_F</i> | Function to free element when removing it from the interval heap |
| <i>COMP_F</i> | Function to compare elements into the interval heap |

Returns

the newly allocated interval heap in case of success.
NULL in case of insufficient memory.

See also

gdsI_interval_heap_free() (p. 121)
gdsI_interval_heap_flush() (p. 122)

Examples:

examples/main_interval_heap.c.

4.10.2.2 void gdsI_interval_heap_free(gdsI_interval_heap_t H)

Destroy an interval heap.

Deallocate all the elements of the interval heap H by calling H's FREE_F function passed to **gdsI_interval_heap_alloc()** (p. 120). The name of H is deallocated and - H is deallocated itself too.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_interval_heap_t

Parameters

| | |
|----------|------------------------------|
| <i>H</i> | The interval heap to destroy |
|----------|------------------------------|

See also

gdsI_interval_heap_alloc() (p. 120)

gdsI_interval_heap_flush() (p. 122)

Examples:

examples/main_interval_heap.c.

4.10.2.3 void gdsI_interval_heap_flush(gdsI_interval_heap_t *H*)

Flush an interval heap.

Deallocate all the elements of the interval heap *H* by calling *H*'s `FREE_F` function passed to **gdsI_interval_heap_alloc()** (p. 120). *H* is not deallocated itself and *H*'s name is not modified.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsI_interval_heap_t

Parameters

| | |
|----------|-------------------|
| <i>H</i> | The heap to flush |
|----------|-------------------|

See also

gdsI_interval_heap_alloc() (p. 120)

gdsI_interval_heap_free() (p. 121)

Examples:

examples/main_interval_heap.c.

4.10.2.4 const char* gdsI_interval_heap_get_name(const gdsI_interval_heap_t *H*)

Get the name of an interval heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|----------|--|
| <i>H</i> | The interval heap to get the name from |
|----------|--|

Returns

the name of the interval heap H.

See also

`gdsI_interval_heap_set_name()` (p. 125)

4.10.2.5 `ulong gdsI_interval_heap_get_size(const gdsI_interval_heap_t H)`

Get the size of a interval heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|--|
| <i>H</i> | The interval heap to get the size from |
|----------|--|

Returns

the number of elements of H (noted $|H|$).

Examples:

`examples/main_interval_heap.c`.

4.10.2.6 `void gdsI_interval_heap_set_max_size(const gdsI_interval_heap_t H,
ulong size)`

Set the maximum size of the interval heap.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|-------------|--|
| <i>H</i> | The interval heap to get the size from |
| <i>size</i> | The new maximum size |

Returns

the number of elements of H (noted $|H|$).

4.10.2.7 `bool gdsI_interval_heap_is_empty(const gdsI_interval_heap_t H)`

Check if an interval heap is empty.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|----------------------------|
| <i>H</i> | The interval heap to check |
|----------|----------------------------|

Returns

TRUE if the interval heap *H* is empty.
 FALSE if the interval heap *H* is not empty.

4.10.2.8 `gdsI_interval_heap_t gdsI_interval_heap_set_name (`
`gdsI_interval_heap_t H, const char * NEW_NAME)`

Set the name of an interval heap.

Change the previous name of the interval heap *H* to a copy of *NEW_NAME*.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|-----------------|--------------------------------------|
| <i>H</i> | The interval heap to change the name |
| <i>NEW_NAME</i> | The new name of <i>H</i> |

Returns

the modified interval heap in case of success.
 NULL in case of insufficient memory.

See also

`gdsI_interval_heap_get_name()` (p. 122)

4.10.2.9 `gdsI_element_t gdsI_interval_heap_insert(gdsI_interval_heap_t H, void`
`* VALUE)`

Insert an element into an interval heap (PUSH).

Allocate a new element *E* by calling *H*'s `ALLOC_F` function on *VALUE*. The element *E* is then inserted into *H* at the good position to ensure *H* is always an interval heap.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|--------------|---|
| <i>H</i> | The interval heap to modify |
| <i>VALUE</i> | The value used to make the new element to insert into H |

Returns

the inserted element E in case of success.
NULL in case of insufficient memory.

See also

`gdsI_interval_heap_alloc()` (p. 120)
`gdsI_interval_heap_remove()`
`gdsI_interval_heap_delete()`
`gdsI_interval_heap_get_size()` (p. 123)

Examples:

`examples/main_interval_heap.c`.

4.10.2.10 `gdsI_element_t gdsI_interval_heap_remove_max (gdsI_interval_heap_t H)`

Remove the maximum element from an interval heap (POP).

Remove the maximum element from the interval heap H. The element is removed from H and is also returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|-----------------------------|
| <i>H</i> | The interval heap to modify |
|----------|-----------------------------|

Returns

the removed top element.
NULL if the interval heap is empty.

See also

gdsI_interval_heap_insert() (p. 125)
gdsI_interval_heap_delete_max() (p. 129)

Examples:

examples/main_interval_heap.c.

4.10.2.11 gdsI_element_t gdsI_interval_heap_remove_min(gdsI_interval_heap_t H)

Remove the minimum element from an interval heap (POP).

Remove the minimum element from the interval heap H. The element is removed from H and is also returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid gdsI_interval_heap_t

Parameters

| | |
|----------|-----------------------------|
| <i>H</i> | The interval heap to modify |
|----------|-----------------------------|

Returns

the removed top element.
NULL if the interval heap is empty.

See also

gdsI_interval_heap_insert() (p. 125)
gdsI_interval_heap_delete_max() (p. 129)

Examples:

examples/main_interval_heap.c.

4.10.2.12 `gdsI_element_t gdsI_interval_heap_get_min (const gdsI_interval_heap_t H)`

Get the minimum element.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|--|
| <i>H</i> | The interval heap to get the size from |
|----------|--|

Returns

The smallest element in H

4.10.2.13 `gdsI_element_t gdsI_interval_heap_get_max (const gdsI_interval_heap_t H)`

Get the maximum element.

Note

Complexity: $O(1)$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|--|
| <i>H</i> | The interval heap to get the size from |
|----------|--|

Returns

The largest element in H

4.10.2.14 `gdsI_interval_heap_t gdsI_interval_heap_delete_min (` `gdsI_interval_heap_t H)`

Delete the minimum element from an interval heap.

Remove the minimum element from the interval heap *H*. The element is removed from *H* and is also deallocated using *H*'s `FREE_F` function passed to **gdsI_interval_heap_alloc()** (p. 120), then *H* is returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|-----------------------------|
| <i>H</i> | The interval heap to modify |
|----------|-----------------------------|

Returns

the modified interval heap after removal of top element.
NULL if interval heap is empty.

See also

gdsI_interval_heap_insert() (p. 125)
`gdsI_interval_heap_remove_top()`

4.10.2.15 **gdsI_interval_heap_t gdsI_interval_heap_delete_max (gdsI_interval_heap_t *H*)**

Delete the maximum element from an interval heap.

Remove the maximum element from the interval heap *H*. The element is removed from *H* and is also deallocated using *H*'s `FREE_F` function passed to **gdsI_interval_heap_alloc()** (p. 120), then *H* is returned.

Note

Complexity: $O(\log(|H|))$

Precondition

H must be a valid `gdsI_interval_heap_t`

Parameters

| | |
|----------|-----------------------------|
| <i>H</i> | The interval heap to modify |
|----------|-----------------------------|

Returns

the modified interval heap after removal of top element.
 NULL if interval heap is empty.

See also

gdsl_interval_heap_insert() (p. 125)
 gdsl_interval_heap_remove_top()

**4.10.2.16 gdsl_element_t gdsl_interval_heap_map_forward(const
 gdsl_interval_heap_t H, gdsl_map_func_t MAP_F, void * USER_DATA)**

Parse a interval heap.

Parse all elements of the interval heap H. The MAP_F function is called on each H's element with USER_DATA argument. If MAP_F returns GDSL_MAP_STOP then gdsl_interval_heap_map() stops and returns its last examined element.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid gdsl_interval_heap_t & MAP_F != NULL

Parameters

| | |
|------------------|------------------------------|
| <i>H</i> | The interval heap to map |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
 NULL when the parsing is done.

**4.10.2.17 void gdsl_interval_heap_write(const gdsl_interval_heap_t H,
 gdsl_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)**

Write all the elements of an interval heap to a file.

Write the elements of the interval heap H to OUTPUT_FILE, using WRITE_F function. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_interval_heap_t` & `OUTPUT_FILE` != NULL & `WRITE_F` != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The interval heap to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write H's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsI_interval_heap_write_xml()` (p. 131)

`gdsI_interval_heap_dump()` (p. 132)

4.10.2.18 `void gdsI_interval_heap_write_xml(const gdsI_interval_heap_t H,
gdsI_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of an interval heap to a file into XML.

Write the elements of the interval heap H to `OUTPUT_FILE`, into XML language. -
If `WRITE_F` != NULL, then uses `WRITE_F` to write H's elements to `OUTPUT_FILE`.
Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid `gdsI_interval_heap_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>H</i> | The interval heap to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write H's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

gdsI_interval_heap_write() (p. 130)

gdsI_interval_heap_dump() (p. 132)

4.10.2.19 void **gdsI_interval_heap_dump** (const **gdsI_interval_heap_t** *H*,
gdsI_write_func_t *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of an interval heap to a file.

Dump the structure of the interval heap *H* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then uses *WRITE_F* to write *H*'s elements to *OUTPUT_FILE*. Additional *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|H|)$

Precondition

H must be a valid **gdsI_interval_heap_t** & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|--|
| <i>H</i> | The interval heap to write |
| <i>WRITE_F</i> | The write function |
| <i>OUTPUT_FILE</i> | The file where to write <i>H</i> 's elements |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> |

See also

gdsI_interval_heap_write() (p. 130)

gdsI_interval_heap_write_xml() (p. 131)

4.11 Doubly-linked list manipulation module

Typedefs

- typedef struct _gdsl_list * **gdsl_list_t**
GDSDL doubly-linked list type.
- typedef struct _gdsl_list_cursor * **gdsl_list_cursor_t**
GDSDL doubly-linked list cursor type.

Functions

- **gdsl_list_t gdsl_list_alloc** (const char *NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F)
Create a new list.
- void **gdsl_list_free** (**gdsl_list_t** L)
Destroy a list.
- void **gdsl_list_flush** (**gdsl_list_t** L)
Flush a list.
- const char * **gdsl_list_get_name** (const **gdsl_list_t** L)
Get the name of a list.
- **ulong gdsl_list_get_size** (const **gdsl_list_t** L)
Get the size of a list.
- **bool gdsl_list_is_empty** (const **gdsl_list_t** L)
Check if a list is empty.
- **gdsl_element_t gdsl_list_get_head** (const **gdsl_list_t** L)
Get the head of a list.
- **gdsl_element_t gdsl_list_get_tail** (const **gdsl_list_t** L)
Get the tail of a list.
- **gdsl_list_t gdsl_list_set_name** (**gdsl_list_t** L, const char *NEW_NAME)
Set the name of a list.
- **gdsl_element_t gdsl_list_insert_head** (**gdsl_list_t** L, void *VALUE)
Insert an element at the head of a list.
- **gdsl_element_t gdsl_list_insert_tail** (**gdsl_list_t** L, void *VALUE)
Insert an element at the tail of a list.
- **gdsl_element_t gdsl_list_remove_head** (**gdsl_list_t** L)
Remove the head of a list.
- **gdsl_element_t gdsl_list_remove_tail** (**gdsl_list_t** L)
Remove the tail of a list.
- **gdsl_element_t gdsl_list_remove** (**gdsl_list_t** L, **gdsl_compare_func_t** COMP_F, const void *VALUE)
Remove a particular element from a list.
- **gdsl_list_t gdsl_list_delete_head** (**gdsl_list_t** L)
Delete the head of a list.

- **gdsi_list_t gdsi_list_delete_tail** (gdsi_list_t L)
Delete the tail of a list.
- **gdsi_list_t gdsi_list_delete** (gdsi_list_t L, gdsi_compare_func_t COMP_F, const void *VALUE)
Delete a particular element from a list.
- **gdsi_element_t gdsi_list_search** (const gdsi_list_t L, gdsi_compare_func_t COMP_F, const void *VALUE)
Search for a particular element into a list.
- **gdsi_element_t gdsi_list_search_by_position** (const gdsi_list_t L, ulong POS)
Search for an element by its position in a list.
- **gdsi_element_t gdsi_list_search_max** (const gdsi_list_t L, gdsi_compare_func_t COMP_F)
Search for the greatest element of a list.
- **gdsi_element_t gdsi_list_search_min** (const gdsi_list_t L, gdsi_compare_func_t COMP_F)
Search for the lowest element of a list.
- **gdsi_list_t gdsi_list_sort** (gdsi_list_t L, gdsi_compare_func_t COMP_F)
Sort a list.
- **gdsi_element_t gdsi_list_map_forward** (const gdsi_list_t L, gdsi_map_func_t MAP_F, void *USER_DATA)
Parse a list from head to tail.
- **gdsi_element_t gdsi_list_map_backward** (const gdsi_list_t L, gdsi_map_func_t MAP_F, void *USER_DATA)
Parse a list from tail to head.
- void **gdsi_list_write** (const gdsi_list_t L, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of a list to a file.
- void **gdsi_list_write_xml** (const gdsi_list_t L, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a list to a file into XML.
- void **gdsi_list_dump** (const gdsi_list_t L, gdsi_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a list to a file.
- **gdsi_list_cursor_t gdsi_list_cursor_alloc** (const gdsi_list_t L)
Create a new list cursor.
- void **gdsi_list_cursor_free** (gdsi_list_cursor_t C)
Destroy a list cursor.
- void **gdsi_list_cursor_move_to_head** (gdsi_list_cursor_t C)
Put a cursor on the head of its list.
- void **gdsi_list_cursor_move_to_tail** (gdsi_list_cursor_t C)
Put a cursor on the tail of its list.
- **gdsi_element_t gdsi_list_cursor_move_to_value** (gdsi_list_cursor_t C, gdsi_compare_func_t COMP_F, void *VALUE)

Place a cursor on a particular element.

- **gdsI_element_t gdsI_list_cursor_move_to_position** (gdsI_list_cursor_t C, ulong POS)

Place a cursor on a element given by its position.

- void **gdsI_list_cursor_step_forward** (gdsI_list_cursor_t C)

Move a cursor one step forward of its list.

- void **gdsI_list_cursor_step_backward** (gdsI_list_cursor_t C)

Move a cursor one step backward of its list.

- **bool gdsI_list_cursor_is_on_head** (const gdsI_list_cursor_t C)

Check if a cursor is on the head of its list.

- **bool gdsI_list_cursor_is_on_tail** (const gdsI_list_cursor_t C)

Check if a cursor is on the tail of its list.

- **bool gdsI_list_cursor_has_succ** (const gdsI_list_cursor_t C)

Check if a cursor has a successor.

- **bool gdsI_list_cursor_has_pred** (const gdsI_list_cursor_t C)

Check if a cursor has a predecessor.

- void **gdsI_list_cursor_set_content** (gdsI_list_cursor_t C, gdsI_element_t E)

Set the content of the cursor.

- **gdsI_element_t gdsI_list_cursor_get_content** (const gdsI_list_cursor_t C)

Get the content of a cursor.

- **gdsI_element_t gdsI_list_cursor_insert_after** (gdsI_list_cursor_t C, void *VALUE)

Insert a new element after a cursor.

- **gdsI_element_t gdsI_list_cursor_insert_before** (gdsI_list_cursor_t C, void *VALUE)

Insert a new element before a cursor.

- **gdsI_element_t gdsI_list_cursor_remove** (gdsI_list_cursor_t C)

Remove the element under a cursor.

- **gdsI_element_t gdsI_list_cursor_remove_after** (gdsI_list_cursor_t C)

Remove the element after a cursor.

- **gdsI_element_t gdsI_list_cursor_remove_before** (gdsI_list_cursor_t C)

Remove the element before a cursor.

- **gdsI_list_cursor_t gdsI_list_cursor_delete** (gdsI_list_cursor_t C)

Delete the element under a cursor.

- **gdsI_list_cursor_t gdsI_list_cursor_delete_after** (gdsI_list_cursor_t C)

Delete the element after a cursor.

- **gdsI_list_cursor_t gdsI_list_cursor_delete_before** (gdsI_list_cursor_t C)

Delete the element before the cursor of a list.

4.11.1 Typedef Documentation

4.11.1.1 typedef struct _gdsl_list* **gdsl_list_t**

GDSL doubly-linked list type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 52 of file `gdsl_list.h`.

4.11.1.2 typedef struct _gdsl_list_cursor* **gdsl_list_cursor_t**

GDSL doubly-linked list cursor type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 60 of file `gdsl_list.h`.

4.11.2 Function Documentation

4.11.2.1 **gdsl_list_t** `gdsl_list_alloc (const char * NAME, gdsl_alloc_func_t ALLOC_F, gdsl_free_func_t FREE_F)`

Create a new list.

Allocate a new list data structure which name is set to a copy of *NAME*. The function pointers *ALLOC_F* and *FREE_F* could be used to respectively, alloc and free elements in the list. These pointers could be set to NULL to use the default ones:

- the default *ALLOC_F* simply returns its argument
- the default *FREE_F* does nothing

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|----------------|---|
| <i>NAME</i> | The name of the new list to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in the list |
| <i>FREE_F</i> | Function to free element when removing it from the list |

Returns

the newly allocated list in case of success.
NULL in case of insufficient memory.

See also

gdsI_list_free() (p. 137)
gdsI_list_flush() (p. 137)

Examples:

examples/main_list.c.

4.11.2.2 void gdsI_list_free(gdsI_list_t L)

Destroy a list.

Flush and destroy the list L. All the elements of L are freed using L's FREE_F function passed to **gdsI_list_alloc()** (p. 136).

Note

Complexity: $O(|L|)$

Precondition

L must be a valid gdsI_list_t

Parameters

| | |
|----------|---------------------|
| L | The list to destroy |
|----------|---------------------|

See also

gdsI_list_alloc() (p. 136)
gdsI_list_flush() (p. 137)

Examples:

examples/main_list.c.

4.11.2.3 void gdsI_list_flush(gdsI_list_t L)

Flush a list.

Destroy all the elements of the list L by calling L's FREE_F function passed to **gdsI_list_alloc()** (p. 136). L is not deallocated itself and L's name is not modified.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid `gdsi_list_t`

Parameters

| | |
|-----|-------------------|
| L | The list to flush |
|-----|-------------------|

See also

`gdsi_list_alloc()` (p. 136)

`gdsi_list_free()` (p. 137)

Examples:

`examples/main_list.c`.

4.11.2.4 `const char* gdsi_list_get_name(const gdsi_list_t L)`

Get the name of a list.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsi_list_t`

Postcondition

The returned string **MUST NOT** be freed.

Parameters

| | |
|-----|-------------------------------|
| L | The list to get the name from |
|-----|-------------------------------|

Returns

the name of the list L .

See also

gdsI_list_set_name() (p. 141)

Examples:

examples/main_list.c.

4.11.2.5 `ulong gdsI_list_get_size(const gdsI_list_t L)`

Get the size of a list.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsI_list_t`

Parameters

| | |
|----------------|-------------------------------|
| <code>L</code> | The list to get the size from |
|----------------|-------------------------------|

Returns

the number of elements of the list L (noted $|L|$).

Examples:

examples/main_list.c.

4.11.2.6 `bool gdsI_list_is_empty(const gdsI_list_t L)`

Check if a list is empty.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsI_list_t`

Parameters

| | |
|----------------|-------------------|
| <code>L</code> | The list to check |
|----------------|-------------------|

Returns

TRUE if the list L is empty.
FALSE if the list L is not empty.

Examples:

examples/main_list.c.

4.11.2.7 `gdsi_element_t gdsi_list_get_head(const gdsi_list_t L)`

Get the head of a list.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsi_list_t`

Parameters

| | |
|----------|-------------------------------|
| L | The list to get the head from |
|----------|-------------------------------|

Returns

the element at L's head position if L is not empty. The returned element is not removed from L.
NULL if the list L is empty.

See also

`gdsi_list_get_tail()` (p. 140)

4.11.2.8 `gdsi_element_t gdsi_list_get_tail(const gdsi_list_t L)`

Get the tail of a list.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsi_list_t`

Parameters

| | |
|----------|-------------------------------|
| <i>L</i> | The list to get the tail from |
|----------|-------------------------------|

Returns

the element at L's tail position if L is not empty. The returned element is not removed from L.

NULL if L is empty.

See also

gdsI_list_get_head() (p. 140)

4.11.2.9 **gdsI_list_t gdsI_list_set_name(gdsI_list_t *L*, const char * *NEW_NAME*)**

Set the name of a list.

Changes the previous name of the list L to a copy of NEW_NAME.

Note

Complexity: O(1)

Precondition

L must be a valid gdsI_list_t

Parameters

| | |
|-----------------|-----------------------------|
| <i>L</i> | The list to change the name |
| <i>NEW_NAME</i> | The new name of L |

Returns

the modified list in case of success.

NULL in case of failure.

See also

gdsI_list_get_name() (p. 138)

4.11.2.10 **gdsI_element_t gdsI_list_insert_head(gdsI_list_t *L*, void * *VALUE*)**

Insert an element at the head of a list.

Allocate a new element E by calling L's ALLOC_F function on VALUE. ALLOC_F is the function pointer passed to **gdsi_list_alloc()** (p. 136). The new element E is then inserted at the header position of the list L.

Note

Complexity: $O(1)$

Precondition

L must be a valid gdsi_list_t

Parameters

| | |
|--------------|---|
| <i>L</i> | The list to insert into |
| <i>VALUE</i> | The value used to make the new element to insert into L |

Returns

the inserted element E in case of success.
NULL in case of failure.

See also

gdsi_list_insert_tail() (p. 142)
gdsi_list_remove_head() (p. 143)
gdsi_list_remove_tail() (p. 144)
gdsi_list_remove() (p. 144)

Examples:

examples/main_list.c.

4.11.2.11 gdsi_element_t gdsi_list_insert_tail(gdsi_list_t L, void * VALUE)

Insert an element at the tail of a list.

Allocate a new element E by calling L's ALLOC_F function on VALUE. ALLOC_F is the function pointer passed to **gdsi_list_alloc()** (p. 136). The new element E is then inserted at the footer position of the list L.

Note

Complexity: $O(1)$

Precondition

L must be a valid gdsi_list_t

Parameters

| | |
|--------------|---|
| <i>L</i> | The list to insert into |
| <i>VALUE</i> | The value used to make the new element to insert into L |

Returns

the inserted element E in case of success.
NULL in case of failure.

See also

gds_l_list_insert_head() (p. 141)
gds_l_list_remove_head() (p. 143)
gds_l_list_remove_tail() (p. 144)
gds_l_list_remove() (p. 144)

Examples:

examples/main_list.c.

4.11.2.12 **gds_l_element_t gds_l_list_remove_head(gds_l_list_t L)**

Remove the head of a list.

Remove the element at the head of the list L.

Note

Complexity: O(1)

Precondition

L must be a valid gds_l_list_t

Parameters

| | |
|----------|----------------------------------|
| <i>L</i> | The list to remove the head from |
|----------|----------------------------------|

Returns

the removed element in case of success.
NULL in case of L is empty.

See also

gdsi_list_insert_head() (p. 141)
gdsi_list_insert_tail() (p. 142)
gdsi_list_remove_tail() (p. 144)
gdsi_list_remove() (p. 144)

4.11.2.13 **gdsi_element_t gdsi_list_remove_tail(gdsi_list_t L)**

Remove the tail of a list.

Remove the element at the tail of the list L.

Note

Complexity: $O(1)$

Precondition

L must be a valid gdsi_list_t

Parameters

| | |
|----------|----------------------------------|
| L | The list to remove the tail from |
|----------|----------------------------------|

Returns

the removed element in case of success.
 NULL in case of L is empty.

See also

gdsi_list_insert_head() (p. 141)
gdsi_list_insert_tail() (p. 142)
gdsi_list_remove_head() (p. 143)
gdsi_list_remove() (p. 144)

4.11.2.14 **gdsi_element_t gdsi_list_remove(gdsi_list_t L, gdsi_compare_func_t COMP_F, const void * VALUE)**

Remove a particular element from a list.

Search into the list L for the first element E equal to VALUE by using COMP_F. If E is found, it is removed from L and then returned.

Note

Complexity: $O(|L|/2)$

Precondition

L must be a valid `gds_l_list_t` & `COMP_F` != NULL

Parameters

| | |
|---------------|--|
| <i>L</i> | The list to remove the element from |
| <i>COMP_F</i> | The comparison function used to find the element to remove |
| <i>VALUE</i> | The value used to compare the element to remove with |

Returns

the founded element E if it was found.
NULL in case the searched element E was not found.

See also

`gds_l_list_insert_head()` (p. 141)
`gds_l_list_insert_tail()` (p. 142)
`gds_l_list_remove_head()` (p. 143)
`gds_l_list_remove_tail()` (p. 144)

4.11.2.15 `gds_l_list_t gds_l_list_delete_head(gds_l_list_t L)`

Delete the head of a list.

Remove the header element from the list L and deallocates it using the `FREE_F` function passed to **`gds_l_list_alloc()`** (p. 136).

Note

Complexity: $O(1)$

Precondition

L must be a valid `gds_l_list_t`

Parameters

| | |
|----------|-----------------------------------|
| <i>L</i> | The list to destroy the head from |
|----------|-----------------------------------|

Returns

the modified list L in case of success.
NULL if L is empty.

See also

gdsl_list_alloc() (p. 136)
gdsl_list_destroy_tail()
gdsl_list_destroy()

Examples:

examples/main_list.c.

4.11.2.16 **gdsl_list_t gdsl_list_delete_tail(gdsl_list_t L)**

Delete the tail of a list.

Remove the footer element from the list L and deallocates it using the **FREE_F** function passed to **gdsl_list_alloc()** (p. 136).

Note

Complexity: $O(1)$

Precondition

L must be a valid **gdsl_list_t**

Parameters

| | |
|----------|-----------------------------------|
| <i>L</i> | The list to destroy the tail from |
|----------|-----------------------------------|

Returns

the modified list L in case of success.
NULL if L is empty.

See also

gdsl_list_alloc() (p. 136)
gdsl_list_destroy_head()
gdsl_list_destroy()

Examples:

examples/main_list.c.

4.11.2.17 **gdsl_list_t gdsl_list_delete(gdsl_list_t L, gdsl_compare_func_t COMP_F, const void * VALUE)**

Delete a particular element from a list.

Search into the list *L* for the first element *E* equal to *VALUE* by using *COMP_F*. If *E* is found, it is removed from *L* and deallocated using the *FREE_F* function passed to **gdsi_list_alloc()** (p. 136).

Note

Complexity: $O(|L| / 2)$

Precondition

L must be a valid *gdsi_list_t* & *COMP_F* != NULL

Parameters

| | |
|---------------|---|
| <i>L</i> | The list to destroy the element from |
| <i>COMP_F</i> | The comparison function used to find the element to destroy |
| <i>VALUE</i> | The value used to compare the element to destroy with |

Returns

the modified list *L* if the element is found.
NULL if the element to destroy is not found.

See also

gdsi_list_alloc() (p. 136)
gdsi_list_destroy_head()
gdsi_list_destroy_tail()

Examples:

examples/main_list.c.

4.11.2.18 *gdsi_element_t* **gdsi_list_search** (*const gdsi_list_t* *L*,
gdsi_compare_func_t *COMP_F*, *const void ***VALUE*)

Search for a particular element into a list.

Search the first element *E* equal to *VALUE* in the list *L*, by using *COMP_F* to compare all *L*'s element with.

Note

Complexity: $O(|L| / 2)$

Precondition

L must be a valid *gdsi_list_t* & *COMP_F* != NULL

Parameters

| | |
|---------------|--|
| <i>L</i> | The list to search the element in |
| <i>COMP_F</i> | The comparison function used to compare L's element with VALUE |
| <i>VALUE</i> | The value to compare L's element with |

Returns

the first founded element E in case of success.
NULL in case the searched element E was not found.

See also

gdsI_list_search_by_position() (p. 148)
gdsI_list_search_max() (p. 149)
gdsI_list_search_min() (p. 150)

Examples:

examples/main_list.c.

4.11.2.19 gdsI_element_t gdsI_list_search_by_position(const gdsI_list_t L, ulong POS)

Search for an element by its position in a list.

Note

Complexity: $O(|L| / 2)$

Precondition

L must be a valid gdsI_list_t & $POS > 0$ & $POS \leq |L|$

Parameters

| | |
|------------|---|
| <i>L</i> | The list to search the element in |
| <i>POS</i> | The position where is the element to search |

Returns

the element at the POS-th position in the list L.
NULL if $POS > |L|$ or $POS \leq 0$.

See also

gdsI_list_search() (p. 147)
gdsI_list_search_max() (p. 149)
gdsI_list_search_min() (p. 150)

Examples:

examples/main_list.c.

4.11.2.20 **gdsI_element_t gdsI_list_search_max(const gdsI_list_t L, gdsI_compare_func_t COMP_F)**

Search for the greatest element of a list.

Search the greatest element of the list L, by using COMP_F to compare L's elements with.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid gdsI_list_t & COMP_F != NULL

Parameters

| | |
|---------------|--|
| <i>L</i> | The list to search the element in |
| <i>COMP_F</i> | The comparison function to use to compare L's element with |

Returns

the highest element of L, by using COMP_F function.
NULL if L is empty.

See also

gdsI_list_search() (p. 147)
gdsI_list_search_by_position() (p. 148)
gdsI_list_search_min() (p. 150)

Examples:

examples/main_list.c.

4.11.2.21 `gdsi_element_t gdsi_list_search_min (const gdsi_list_t L, gdsi_compare_func_t COMP_F)`

Search for the lowest element of a list.

Search the lowest element of the list L, by using COMP_F to compare L's elements with.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid `gdsi_list_t` & `COMP_F` != NULL

Parameters

| | |
|---------------|--|
| <i>L</i> | The list to search the element in |
| <i>COMP_F</i> | The comparison function to use to compare L's element with |

Returns

the lowest element of L, by using COMP_F function.
NULL if L is empty.

See also

`gdsi_list_search()` (p. 147)
`gdsi_list_search_by_position()` (p. 148)
`gdsi_list_search_max()` (p. 149)

4.11.2.22 `gdsi_list_t gdsi_list_sort (gdsi_list_t L, gdsi_compare_func_t COMP_F)`

Sort a list.

Sort the list L using COMP_F to order L's elements.

Note

Complexity: $O(|L| * \log(|L|))$

Precondition

L must be a valid `gdsi_list_t` & `COMP_F` != NULL & L must not contains elements that are equals

Parameters

| | |
|---------------|--|
| <i>L</i> | The list to sort |
| <i>COMP_F</i> | The comparison function used to order L's elements |

Returns

the sorted list L.

Examples:

examples/main_list.c.

4.11.2.23 `gdsI_element_t gdsI_list_map_forward(const gdsI_list_t L,
gdsI_map_func_t MAP_F, void * USER_DATA)`

Parse a list from head to tail.

Parse all elements of the list L from head to tail. The MAP_F function is called on each L's element with USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsI_list_map_forward()** (p. 151) stops and returns its last examined element.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid gdsI_list_t & MAP_F != NULL

Parameters

| | |
|------------------|---|
| <i>L</i> | The list to parse |
| <i>MAP_F</i> | The map function to apply on each L's element |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

gdsI_list_map_backward() (p. 152)

4.11.2.24 `gdsi_element_t gdsi_list_map_backward(const gdsi_list_t L, gdsi_map_func_t MAP_F, void * USER_DATA)`

Parse a list from tail to head.

Parse all elements of the list L from tail to head. The MAP_F function is called on each L's element with USER_DATA argument. If MAP_F returns GDSL_MAP_STOP then **`gdsi_list_map_backward()`** (p. 152) stops and returns its last examined element.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid `gdsi_list_t` & MAP_F != NULL

Parameters

| | |
|------------------|---|
| <i>L</i> | The list to parse |
| <i>MAP_F</i> | The map function to apply on each L's element |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

`gdsi_list_map_forward()` (p. 151)

Examples:

`examples/main_list.c`.

4.11.2.25 `void gdsi_list_write(const gdsi_list_t L, gdsi_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write all the elements of a list to a file.

Write the elements of the list L to OUTPUT_FILE, using WRITE_F function. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid `gdsl_list_t` & `OUTPUT_FILE` != NULL & `WRITE_F` != NULL

Parameters

| | |
|--------------------|---|
| <i>L</i> | The list to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write L's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsl_list_write_xml()` (p. 153)

`gdsl_list_dump()` (p. 154)

4.11.2.26 `void gdsl_list_write_xml(const gdsl_list_t L, gdsl_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of a list to a file into XML.

Write the elements of the list L to `OUTPUT_FILE`, into XML language. If `WRITE_F` != NULL, then uses `WRITE_F` to write L's elements to `OUTPUT_FILE`. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid `gdsl_list_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>L</i> | The list to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write L's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsl_list_write()` (p. 152)

`gdsl_list_dump()` (p. 154)

Examples:

examples/main_list.c.

4.11.2.27 void **gdsi_list_dump**(const **gdsi_list_t** *L*, **gdsi_write_func_t** *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of a list to a file.

Dump the structure of the list *L* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then uses - *WRITE_F* to write *L*'s elements to *OUTPUT_FILE*. Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|L|)$

Precondition

L must be a valid **gdsi_list_t** & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|---|
| <i>L</i> | The list to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>L</i> 's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

gdsi_list_write() (p. 152)

gdsi_list_write_xml() (p. 153)

Examples:

examples/main_list.c.

4.11.2.28 **gdsi_list_cursor_t** **gdsi_list_cursor_alloc**(const **gdsi_list_t** *L*)

Create a new list cursor.

Note

Complexity: $O(1)$

Precondition

L must be a valid `gdsl_list_t`

Parameters

| | |
|----------|---|
| L | The list on wich the cursor is positionned. |
|----------|---|

Returns

the newly allocated list cursor in case of success.
NULL in case of insufficient memory.

See also

`gdsl_list_cursor_free()` (p. 155)

Examples:

`examples/main_list.c`.

4.11.2.29 void `gdsl_list_cursor_free(gsdl_list_cursor_t C)`

Destroy a list cursor.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsI_list_cursor_t`.

Parameters

| | |
|----------|-----------------------------|
| C | The list cursor to destroy. |
|----------|-----------------------------|

See also

`gdsI_list_cursor_alloc()` (p. 154)

Examples:

`examples/main_list.c`.

4.11.2.30 void `gdsi_list_cursor_move_to_head(gdsi_list_cursor_t C)`

Put a cursor on the head of its list.

Put the cursor C on the head of C's list. Does nothing if C's list is empty.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|---|-------------------|
| C | The cursor to use |
|---|-------------------|

See also

`gdsi_list_cursor_move_to_tail()` (p. 156)

Examples:

`examples/main_list.c`.

4.11.2.31 void `gdsi_list_cursor_move_to_tail(gdsi_list_cursor_t C)`

Put a cursor on the tail of its list.

Put the cursor C on the tail of C's list. Does nothing if C's list is empty.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|---|-------------------|
| C | The cursor to use |
|---|-------------------|

See also

`gdsi_list_cursor_move_to_head()` (p. 156)

4.11.2.32 gdsI_element_t gdsI_list_cursor_move_to_value(gdsI_list_cursor_t C, gdsI_compare_func_t COMP_F, void * VALUE)

Place a cursor on a particular element.

Search a particular element E in the cursor's list L by comparing all list's elements to VALUE, by using COMP_F. If E is found, C is positionned on it.

Note

Complexity: $O(|L| / 2)$

Precondition

C must be a valid gdsI_list_cursor_t & COMP_F != NULL

Parameters

| | |
|--------|--|
| C | The cursor to put on the element E |
| COMP_F | The comparison function to search for E |
| VALUE | The value used to compare list's elements with |

Returns

the first founded element E in case it exists.
NULL in case of element E is not found.

See also

gdsI_list_cursor_move_to_position() (p. 157)

Examples:

examples/main_list.c.

4.11.2.33 gdsI_element_t gdsI_list_cursor_move_to_position(gdsI_list_cursor_t C, ulong POS)

Place a cursor on a element given by its position.

Search for the POS-th element in the cursor's list L. In case this element exists, the cursor C is positionned on it.

Note

Complexity: $O(|L| / 2)$

Precondition

C must be a valid `gdsl_list_cursor_t` & $POS > 0$ & $POS \leq |L|$

Parameters

| | |
|------------|---|
| <i>C</i> | The cursor to put on the POS-th element |
| <i>POS</i> | The position of the element to move on |

Returns

the element at the POS-th position
 NULL if $POS \leq 0$ or $POS > |L|$

See also

`gdsl_list_cursor_move_to_value()` (p. 157)

4.11.2.34 `void gdsl_list_cursor_step_forward(gdsl_list_cursor_t C)`

Move a cursor one step forward of its list.

Move the cursor C one node forward (from head to tail). Does nothing if C is already on its list's tail.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsl_list_cursor_t`

Parameters

| | |
|----------|-------------------|
| <i>C</i> | The cursor to use |
|----------|-------------------|

See also

`gdsl_list_cursor_step_backward()` (p. 158)

Examples:

`examples/main_list.c`.

4.11.2.35 `void gdsl_list_cursor_step_backward(gdsl_list_cursor_t C)`

Move a cursor one step backward of its list.

Move the cursor `C` one node backward (from tail to head.) Does nothing if `C` is already on its list's head.

Note

Complexity: $O(1)$

Precondition

`C` must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|----------------|-------------------|
| <code>C</code> | The cursor to use |
|----------------|-------------------|

See also

`gdsi_list_cursor_step_forward()` (p. 158)

Examples:

`examples/main_list.c`.

4.11.2.36 `bool gdsi_list_cursor_is_on_head(const gdsi_list_cursor_t C)`

Check if a cursor is on the head of its list.

Note

Complexity: $O(1)$

Precondition

`C` must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|----------------|---------------------|
| <code>C</code> | The cursor to check |
|----------------|---------------------|

Returns

TRUE if `C` is on its list's head.
FALSE if `C` is not on its list's head.

See also

`gdsi_list_cursor_is_on_tail()` (p. 160)

4.11.2.37 bool gdsI_list_cursor_is_on_tail(const gdsI_list_cursor_t C)

Check if a cursor is on the tail of its list.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsI_list_cursor_t

Parameters

| | |
|---|---------------------|
| C | The cursor to check |
|---|---------------------|

Returns

TRUE if C is on its lists's tail.

FALSE if C is not on its list's tail.

See also

gdsI_list_cursor_is_on_head() (p. 159)

4.11.2.38 bool gdsI_list_cursor_has_succ(const gdsI_list_cursor_t C)

Check if a cursor has a successor.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsI_list_cursor_t

Parameters

| | |
|---|---------------------|
| C | The cursor to check |
|---|---------------------|

Returns

TRUE if there exists an element after the cursor C.

FALSE if there is no element after the cursor C.

See also

gdsI_list_cursor_has_pred() (p. 161)

4.11.2.39 **bool gdsI_list_cursor_has_pred(const gdsI_list_cursor_t C)**

Check if a cursor has a predecessor.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsI_list_cursor_t

Parameters

| | |
|---|---------------------|
| C | The cursor to check |
|---|---------------------|

Returns

TRUE if there exists an element before the cursor C.

FALSE if there is no element before the cursor C.

See also

gdsI_list_cursor_has_succ() (p. 160)

4.11.2.40 **void gdsI_list_cursor_set_content(gdsI_list_cursor_t C,
gdsI_element_t E)**

Set the content of the cursor.

Set C's element to E. The previous element is **NOT** deallocated. If it must be deallocated, **gdsI_list_cursor_get_content()** (p. 162) could be used to get it in order to free it before.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsI_list_cursor_t

Parameters

| | |
|----------|---|
| <i>C</i> | The cursor in which the content must be modified. |
| <i>E</i> | The value used to modify <i>C</i> 's content. |

See also

gdsi_list_cursor_get_content() (p. 162)

4.11.2.41 **gdsi_element_t gdsi_list_cursor_get_content(const gdsi_list_cursor_t *C*)**

Get the content of a cursor.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsi_list_cursor_t

Parameters

| | |
|----------|-------------------------------------|
| <i>C</i> | The cursor to get the content from. |
|----------|-------------------------------------|

Returns

the element contained in the cursor *C*.

See also

gdsi_list_cursor_set_content() (p. 161)

Examples:

examples/main_list.c.

4.11.2.42 **gdsi_element_t gdsi_list_cursor_insert_after(gdsi_list_cursor_t *C*, void * *VALUE*)**

Insert a new element after a cursor.

A new element is created using `ALLOC_F` called on *VALUE*. `ALLOC_F` is the pointer passed to **gdsi_list_alloc()** (p. 136). If the returned value is not NULL, then the new element is placed after the cursor *C*. If *C*'s list is empty, the element is inserted at the head position of *C*'s list.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|-------|---|
| C | The cursor after which the new element must be inserted |
| VALUE | The value used to allocate the new element to insert |

Returns

the newly inserted element in case of success.
NULL in case of failure.

See also

`gdsi_list_cursor_insert_before()` (p. 163)
`gdsi_list_cursor_remove_after()` (p. 165)
`gdsi_list_cursor_remove_before()` (p. 165)

Examples:

`examples/main_list.c`.

4.11.2.43 `gdsi_element_t gdsi_list_cursor_insert_before(gdsi_list_cursor_t C, void * VALUE)`

Insert a new element before a cursor.

A new element is created using `ALLOC_F` called on `VALUE`. `ALLOC_F` is the pointer passed to **`gdsi_list_alloc()`** (p. 136). If the returned value is not NULL, then the new element is placed before the cursor C. If C's list is empty, the element is inserted at the head position of C's list.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|-------|--|
| C | The cursor before which the new element must be inserted |
| VALUE | The value used to allocate the new element to insert |

Returns

the newly inserted element in case of success.
NULL in case of failure.

See also

gdsI_list_cursor_insert_after() (p. 162)
gdsI_list_cursor_remove_after() (p. 165)
gdsI_list_cursor_remove_before() (p. 165)

Examples:

examples/main_list.c.

4.11.2.44 gdsI_element_t gdsI_list_cursor_remove(gdsI_list_cursor_t C)

Removec the element under a cursor.

Note

Complexity: $O(1)$

Precondition

C must be a valid gdsI_list_cursor_t

Postcondition

After this operation, the cursor is positionned on to its successor.

Parameters

| | |
|---|--|
| C | The cursor to remove the content from. |
|---|--|

Returns

the removed element if it exists.
NULL if there is not element to remove.

See also

gdsI_list_cursor_insert_after() (p. 162)
gdsI_list_cursor_insert_before() (p. 163)
gdsI_list_cursor_remove() (p. 164)
gdsI_list_cursor_remove_before() (p. 165)

4.11.2.45 `gdsl_element_t` `gdsl_list_cursor_remove_after`(`gdsl_list_cursor_t` *C*)

Removec the element after a cursor.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsl_list_cursor_t`

Parameters

| | |
|----------|--|
| <i>C</i> | The cursor to remove the successor from. |
|----------|--|

Returns

the removed element if it exists.
NULL if there is not element to remove.

See also

`gdsl_list_cursor_insert_after()` (p. 162)
`gdsl_list_cursor_insert_before()` (p. 163)
`gdsl_list_cursor_remove()` (p. 164)
`gdsl_list_cursor_remove_before()` (p. 165)

4.11.2.46 `gdsl_element_t` `gdsl_list_cursor_remove_before`(`gdsl_list_cursor_t` *C*)

Remove the element before a cursor.

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsl_list_cursor_t`

Parameters

| | |
|----------|--|
| <i>C</i> | The cursor to remove the predecessor from. |
|----------|--|

Returns

the removed element if it exists.
 NULL if there is not element to remove.

See also

gdsI_list_cursor_insert_after() (p. 162)
gdsI_list_cursor_insert_before() (p. 163)
gdsI_list_cursor_remove() (p. 164)
gdsI_list_cursor_remove_after() (p. 165)

4.11.2.47 gdsI_list_cursor_t gdsI_list_cursor_delete(gdsI_list_cursor_t C)

Delete the element under a cursor.

Remove the element under the cursor C. The removed element is also deallocated using FREE_F passed to **gdsI_list_alloc()** (p. 136).

Complexity: O(1)

Precondition

C must be a valid gdsI_list_cursor_t

Parameters

| | |
|---|-----------------------------------|
| C | The cursor to delete the content. |
|---|-----------------------------------|

Returns

the cursor C if the element was removed.
 NULL if there is not element to remove.

See also

gdsI_list_cursor_delete_before() (p. 167)
gdsI_list_cursor_delete_after() (p. 166)

4.11.2.48 gdsI_list_cursor_t gdsI_list_cursor_delete_after(gdsI_list_cursor_t C)

Delete the element after a cursor.

Remove the element after the cursor C. The removed element is also deallocated using FREE_F passed to **gdsI_list_alloc()** (p. 136).

Complexity: O(1)

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|---|--|
| C | The cursor to delete the successor from. |
|---|--|

Returns

the cursor C if the element was removed.
NULL if there is not element to remove.

See also

`gdsi_list_cursor_delete()` (p. 166)
`gdsi_list_cursor_delete_before()` (p. 167)

Examples:

`examples/main_list.c`.

4.11.2.49 `gdsi_list_cursor_t gdsi_list_cursor_delete_before(gdsi_list_cursor_t C)`

Delete the element before the cursor of a list.

Remove the element before the cursor C. The removed element is also deallocated using `FREE_F` passed to **`gdsi_list_alloc()`** (p. 136).

Note

Complexity: $O(1)$

Precondition

C must be a valid `gdsi_list_cursor_t`

Parameters

| | |
|---|--|
| C | The cursor to delete the predecessor from. |
|---|--|

Returns

the cursor C if the element was removed.
NULL if there is not element to remove.

See also

`gdsI_list_cursor_delete()` (p. 166)

`gdsI_list_cursor_delete_after()` (p. 166)

4.12 Various macros module

Defines

- #define **GDSL_MAX**(X, Y) (X>Y?X:Y)
Give the greatest number of two numbers.
- #define **GDSL_MIN**(X, Y) (X>Y?Y:X)
Give the lowest number of two numbers.

4.12.1 Define Documentation

4.12.1.1 #define **GDSL_MAX**(X, Y) (X>Y?X:Y)

Give the greatest number of two numbers.

Note

Complexity: O(1)

Precondition

X & Y must be basic scalar C types

Parameters

| | |
|---|------------------------|
| X | First scalar variable |
| Y | Second scalar variable |

Returns

X if X is greather than Y.
Y if Y is greather than X.

See also

GDSL_MIN() (p. 169)

Definition at line 54 of file gdsI_macros.h.

4.12.1.2 #define **GDSL_MIN**(X, Y) (X>Y?Y:X)

Give the lowest number of two numbers.

Note

Complexity: O(1)

Precondition

X & Y must be basic scalar C types

Parameters

| | |
|---|------------------------|
| X | First scalar variable |
| Y | Second scalar variable |

Returns

Y if Y is lower than X.
X if X is lower than Y.

See also

GDSL_MAX() (p. 169)

Definition at line 71 of file gdsl_macros.h.

4.13 Permutation manipulation module

Typedefs

- typedef struct gdsl_perm * **gdsl_perm_t**
GDSL permutation type.
- typedef void(* **gdsl_perm_write_func_t**)(ulong E, FILE *OUTPUT_FILE, **gdsl_location_t** POSITION, void *USER_DATA)
GDSL permutation write function type.
- typedef struct gdsl_perm_data * **gdsl_perm_data_t**

Enumerations

- enum **gdsl_perm_position_t**{ **GDSL_PERM_POSITION_FIRST** = 1, **GDSL_PERM_POSITION_LAST** = 2 }
- This type is for gdsl_perm_write_func_t.*

Functions

- **gdsl_perm_t gdsl_perm_alloc** (const char *NAME, const ulong N)
Create a new permutation.
- void **gdsl_perm_free** (gdsl_perm_t P)
Destroy a permutation.
- **gdsl_perm_t gdsl_perm_copy** (const gdsl_perm_t P)
Copy a permutation.
- const char * **gdsl_perm_get_name** (const gdsl_perm_t P)
Get the name of a permutation.
- ulong **gdsl_perm_get_size** (const gdsl_perm_t P)
Get the size of a permutation.
- ulong **gdsl_perm_get_element** (const gdsl_perm_t P, const ulong INDIX)
Get the (INDIX+1)-th element from a permutation.
- ulong * **gdsl_perm_get_elements_array** (const gdsl_perm_t P)
Get the array elements of a permutation.
- ulong **gdsl_perm_linear_inversions_count** (const gdsl_perm_t P)
Count the inversions number into a linear permutation.
- ulong **gdsl_perm_linear_cycles_count** (const gdsl_perm_t P)
Count the cycles number into a linear permutation.
- ulong **gdsl_perm_canonical_cycles_count** (const gdsl_perm_t P)
Count the cycles number into a canonical permutation.
- **gdsl_perm_t gdsl_perm_set_name** (gdsl_perm_t P, const char *NEW_NAME)
Set the name of a permutation.
- **gdsl_perm_t gdsl_perm_linear_next** (gdsl_perm_t P)

Get the next permutation from a linear permutation.

- **gdsI_perm_t gdsI_perm_linear_prev** (gdsI_perm_t P)

Get the previous permutation from a linear permutation.

- **gdsI_perm_t gdsI_perm_set_elements_array** (gdsI_perm_t P, const ulong *-ARRAY)

Initialize a permutation with an array of values.

- **gdsI_perm_t gdsI_perm_multiply** (gdsI_perm_t RESULT, const gdsI_perm_t ALPHA, const gdsI_perm_t BETA)

Multiply two permutations.

- **gdsI_perm_t gdsI_perm_linear_to_canonical** (gdsI_perm_t Q, const gdsI_perm_t P)

Convert a linear permutation to its canonical form.

- **gdsI_perm_t gdsI_perm_canonical_to_linear** (gdsI_perm_t Q, const gdsI_perm_t P)

Convert a canonical permutation to its linear form.

- **gdsI_perm_t gdsI_perm_inverse** (gdsI_perm_t P)

Inverse in place a permutation.

- **gdsI_perm_t gdsI_perm_reverse** (gdsI_perm_t P)

Reverse in place a permutation.

- **gdsI_perm_t gdsI_perm_randomize** (gdsI_perm_t P)

Randomize a permutation.

- **gdsI_element_t * gdsI_perm_apply_on_array** (gdsI_element_t *V, const gdsI_perm_t P)

Apply a permutation on to a vector.

- void **gdsI_perm_write** (const gdsI_perm_t P, const gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the elements of a permutation to a file.

- void **gdsI_perm_write_xml** (const gdsI_perm_t P, const gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the elements of a permutation to a file into XML.

- void **gdsI_perm_dump** (const gdsI_perm_t P, const gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a permutation to a file.

4.13.1 Typedef Documentation

4.13.1.1 typedef struct gdsI_perm* gdsI_perm_t

GDSL permutation type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 51 of file gdsI_perm.h.

4.13.1.2 `typedef void(* gdsI_perm_write_func_t)(ulong E, FILE *OUTPUT_FILE,
gdsI_location_t POSITION, void *USER_DATA)`

GDSL permutation write function type.

Parameters

| | |
|--------------------|--|
| <i>E</i> | The permutation element to write |
| <i>OUTPUT_FILE</i> | The file where to write E |
| <i>POSITION</i> | is an or-ed combination of <code>gdsI_perm_position_t</code> values to indicate where E is located into the <code>gdsI_perm_t</code> mapped. |
| <i>USER_DATA</i> | User's datas |

Definition at line 75 of file `gdsI_perm.h`.

4.13.1.3 `typedef struct gdsI_perm_data* gdsI_perm_data_t`

Definition at line 81 of file `gdsI_perm.h`.

4.13.2 Enumeration Type Documentation

4.13.2.1 `enum gdsI_perm_position_t`

This type is for `gdsI_perm_write_func_t`.

Enumerator:

GDSL_PERM_POSITION_FIRST When element is at first position

GDSL_PERM_POSITION_LAST When element is at last position

Definition at line 56 of file `gdsI_perm.h`.

4.13.3 Function Documentation

4.13.3.1 `gdsI_perm_t gdsI_perm_alloc (const char * NAME, const ulong N)`

Create a new permutation.

Allocate a new permutation data structure of size N wich name is set to a copy of NAME.

Note

Complexity: $O(N)$

Precondition $N > 0$ **Parameters**

| | |
|-------------|--|
| <i>N</i> | The number of elements of the permutation to create. |
| <i>NAME</i> | The name of the new permutation to create |

Returns

the newly allocated identity permutation in its linear form in case of success.
NULL in case of insufficient memory.

See also

gdsI_perm_free() (p. 174)
gdsI_perm_copy() (p. 175)

Examples:

examples/main_bstree.c, **examples/main_list.c**, **examples/main_llbstree.c**,
examples/main_perm.c, and **examples/main_rbtrees.c**.

4.13.3.2 void gdsI_perm_free (gdsI_perm_t P)

Destroy a permutation.

Deallocate the permutation P.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid gdsI_perm_t

Parameters

| | |
|----------|----------------------------|
| <i>P</i> | The permutation to destroy |
|----------|----------------------------|

See also

gdsI_perm_alloc() (p. 173)

gdsI_perm_copy() (p. 175)

Examples:

examples/main_bstree.c, **examples/main_list.c**, **examples/main_llbstree.c**,
examples/main_perm.c, and **examples/main_rbstree.c**.

4.13.3.3 **gdsI_perm_t gdsI_perm_copy (const gdsI_perm_t *P*)**

Copy a permutation.

Create and return a copy of the permutation *P*.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid **gdsI_perm_t**.

Postcondition

The returned permutation must be deallocated with **gdsI_perm_free**.

Parameters

| | |
|----------|--------------------------|
| <i>P</i> | The permutation to copy. |
|----------|--------------------------|

Returns

a copy of *P* in case of success.

NULL in case of insufficient memory.

See also

gdsI_perm_alloc (p. 173)

gdsI_perm_free (p. 174)

4.13.3.4 **const char* gdsI_perm_get_name (const gdsI_perm_t *P*)**

Get the name of a permutation.

Note

Complexity: $O(1)$

Precondition

P must be a valid `gdsl_perm_t`

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|----------|--------------------------------------|
| <i>P</i> | The permutation to get the name from |
|----------|--------------------------------------|

Returns

the name of the permutation P.

See also

`gdsl_perm_set_name()` (p. 180)

4.13.3.5 `ulong gdsl_perm_get_size(const gdsl_perm_t P)`

Get the size of a permutation.

Note

Complexity: $O(1)$

Precondition

P must be a valid `gdsl_perm_t`

Parameters

| | |
|----------|---------------------------------------|
| <i>P</i> | The permutation to get the size from. |
|----------|---------------------------------------|

Returns

the number of elements of P (noted $|P|$).

See also

gdsI_perm_get_element() (p. 177)

gdsI_perm_get_elements_array() (p. 177)

4.13.3.6 `ulong gdsI_perm_get_element(const gdsI_perm_t P, const ulong INDIX)`

Get the (INDIX+1)-th element from a permutation.

Note

Complexity: $O(1)$

Precondition

P must be a valid `gdsI_perm_t` & $0 \leq \text{INDIX} < |P|$

Parameters

| | |
|--------------|--------------------------------|
| <i>P</i> | The permutation to use. |
| <i>INDIX</i> | The index of the value to get. |

Returns

the value at the INDIX-th position in the permutation P.

See also

gdsI_perm_get_size() (p. 176)

gdsI_perm_get_elements_array() (p. 177)

Examples:

examples/main_bstree.c, **examples/main_list.c**, **examples/main_llbstree.c**,
and **examples/main_rbstree.c**.

4.13.3.7 `ulong* gdsI_perm_get_elements_array(const gdsI_perm_t P)`

Get the array elements of a permutation.

Note

Complexity: $O(1)$

Precondition

P must be a valid `gdsI_perm_t`

Parameters

| | |
|-----|------------------------------------|
| P | The permutation to get datas from. |
|-----|------------------------------------|

Returns

the values array of the permutation P .

See also

gdsI_perm_get_element() (p. 177)

gdsI_perm_set_elements_array() (p. 181)

4.13.3.8 `ulong gdsI_perm_linear_inversions_count(const gdsI_perm_t P)`

Count the inversions number into a linear permutation.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid linear `gdsI_perm_t`

Parameters

| | |
|-----|--------------------------------|
| P | The linear permutation to use. |
|-----|--------------------------------|

Returns

the number of inversions into the linear permutation P .

Examples:

examples/main_perm.c.

4.13.3.9 `ulong gdsI_perm_linear_cycles_count(const gdsI_perm_t P)`

Count the cycles number into a linear permutation.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid linear `gdsl_perm_t`

Parameters

| | |
|----------|--------------------------------|
| <i>P</i> | The linear permutation to use. |
|----------|--------------------------------|

Returns

the number of cycles into the linear permutation P.

See also

`gdsl_perm_canonical_cycles_count()` (p. 179)

Examples:

`examples/main_perm.c.`

4.13.3.10 `ulong gsdl_perm_canonical_cycles_count(const gsdl_perm_t P)`

Count the cycles number into a canonical permutation.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid canonical `gdsI_perm_t`

Parameters

| | |
|----------|-----------------------------------|
| <i>P</i> | The canonical permutation to use. |
|----------|-----------------------------------|

Returns

the number of cycles into the canonical permutation P.

See also

`gdsI_perm_linear_cycles_count()` (p. 178)

Examples:

`examples/main_perm.c.`

4.13.3.11 `gdsi_perm_t gdsi_perm_set_name (gdsi_perm_t P, const char * NEW_NAME)`

Set the name of a permutation.

Change the previous name of the permutation P to a copy of NEW_NAME.

Note

Complexity: $O(1)$

Precondition

P must be a valid `gdsi_perm_t`

Parameters

| | |
|-----------------|------------------------------------|
| <i>P</i> | The permutation to change the name |
| <i>NEW_NAME</i> | The new name of P |

Returns

the modified permutation in case of success.
NULL in case of insufficient memory.

See also

`gdsi_perm_get_name()` (p. 175)

4.13.3.12 `gdsi_perm_t gdsi_perm_linear_next (gdsi_perm_t P)`

Get the next permutation from a linear permutation.

The permutation P is modified to become the next permutation after P.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid linear `gdsi_perm_t` & $|P| > 1$

Parameters

| | |
|----------|----------------------------------|
| <i>P</i> | The linear permutation to modify |
|----------|----------------------------------|

Returns

the next permutation after the permutation P.
 NULL if P is already the last permutation.

See also

gdsI_perm_linear_prev() (p. 181)

4.13.3.13 gdsI_perm_t gdsI_perm_linear_prev(gdsI_perm_t P)

Get the previous permutation from a linear permutation.

The permutation P is modified to become the previous permutation before P.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid linear gdsI_perm_t & $|P| \geq 2$

Parameters

| | |
|----------|----------------------------------|
| <i>P</i> | The linear permutation to modify |
|----------|----------------------------------|

Returns

the previous permutation before the permutation P.
 NULL if P is already the first permutation.

See also

gdsI_perm_linear_next() (p. 180)

4.13.3.14 gdsI_perm_t gdsI_perm_set_elements_array(gdsI_perm_t P, const ulong * ARRAY)

Initialize a permutation with an array of values.

Initialize the permutation P with the values contained in the array of values ARRAY. If ARRAY does not design a permutation, then P is left unchanged.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid `gdsI_perm_t` & $V \neq \text{NULL}$ & $|V| == |P|$

Parameters

| | |
|--------------|-------------------------------------|
| <i>P</i> | The permutation to initialize |
| <i>ARRAY</i> | The array of values to initialize P |

Returns

the modified permutation in case of success.
 NULL in case V does not design a valid permutation.

See also

`gdsI_perm_get_elements_array()` (p. 177)

4.13.3.15 `gdsI_perm_t gdsI_perm_multiply (gdsI_perm_t RESULT, const gdsI_perm_t ALPHA, const gdsI_perm_t BETA)`

Multiply two permutations.

Compute the product of the permutations ALPHA x BETA and puts the result in RESULT without modifying ALPHA and BETA.

Note

Complexity: $O(|\text{RESULT}|)$

Precondition

RESULT, ALPHA and BETA must be valids `gdsI_perm_t` & $|\text{RESULT}| == |\text{ALPHA}| == |\text{BETA}|$

Parameters

| | |
|---------------|--|
| <i>RESULT</i> | The result of the product ALPHA x BETA |
| <i>ALPHA</i> | The first permutation used in the product |
| <i>BETA</i> | The second permutation used in the product |

Returns

RESULT, the result of the multiplication ALPHA x BETA.

4.13.3.16 `gdsI_perm_t gdsI_perm_linear_to_canonical(gdsI_perm_t Q, const gdsI_perm_t P)`

Convert a linear permutation to its canonical form.

Convert the linear permutation P to its canonical form. The resulted canonical permutation is placed into Q without modifying P.

Note

Complexity: $O(|P|)$

Precondition

P & Q must be valids `gdsI_perm_t` & $|P| == |Q|$ & $P \neq Q$

Parameters

| | |
|---|--|
| Q | The canonical form of P |
| P | The linear permutation used to compute its canonical form into Q |

Returns

the canonical form Q of the permutation P.

See also

`gdsI_perm_canonical_to_linear()` (p. 183)

Examples:

`examples/main_perm.c`.

4.13.3.17 `gdsI_perm_t gdsI_perm_canonical_to_linear(gdsI_perm_t Q, const gdsI_perm_t P)`

Convert a canonical permutation to its linear form.

Convert the canonical permutation P to its linear form. The resulted linear permutation is placed into Q without modifying P.

Note

Complexity: $O(|P|)$

Precondition

P & Q must be valids `gdsI_perm_t` & $|P| == |Q|$ & $P \neq Q$

Parameters

| | |
|-----|--|
| Q | The linear form of P |
| P | The canonical permutation used to compute its linear form into Q |

Returns

the linear form Q of the permutation P .

See also

gdsI_perm_linear_to_canonical() (p. 183)

Examples:

examples/main_perm.c.

4.13.3.18 **gdsI_perm_t gdsI_perm_inverse(gdsI_perm_t P)**

Inverse in place a permutation.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid gdsI_perm_t

Parameters

| | |
|-----|---------------------------|
| P | The permutation to invert |
|-----|---------------------------|

Returns

the inverse permutation of P in case of success.
NULL in case of insufficient memory.

See also

gdsI_perm_reverse() (p. 185)

Examples:

examples/main_perm.c.

4.13.3.19 `gdsI_perm_t gdsI_perm_reverse(gdsI_perm_t P)`

Reverse in place a permutation.

Note

Complexity: $O(|P| / 2)$

Precondition

P must be a valid `gdsI_perm_t`

Parameters

| | |
|----------|----------------------------|
| <i>P</i> | The permutation to reverse |
|----------|----------------------------|

Returns

the mirror image of the permutation P

See also

`gdsI_perm_inverse()` (p. 184)

Examples:

`examples/main_perm.c`.

4.13.3.20 `gdsI_perm_t gdsI_perm_randomize(gdsI_perm_t P)`

Randomize a permutation.

The permutation P is randomized in an efficient way, using inversions array.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid `gdsI_perm_t`

Parameters

| | |
|----------|------------------------------|
| <i>P</i> | The permutation to randomize |
|----------|------------------------------|

Returns

the mirror image $\sim P$ of the permutation of P in case of success.
 NULL in case of insufficient memory.

Examples:

examples/main_bstree.c, **examples/main_list.c**, **examples/main_llbstree.c**,
examples/main_perm.c, and **examples/main_rbtrees.c**.

4.13.3.21 `gdsI_element_t* gdsI_perm_apply_on_array(gdsI_element_t* V, const gdsI_perm_t P)`

Apply a permutation on to a vector.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid `gdsI_perm_t` & $|P| == |V|$

Parameters

| | |
|-----|--|
| V | The vector/array to reorder according to P |
| P | The permutation to use to reorder V |

Returns

the reordered array V according to the permutation P in case of success.
 NULL in case of insufficient memory.

Examples:

examples/main_perm.c.

4.13.3.22 `void gdsI_perm_write(const gdsI_perm_t P, const gdsI_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the elements of a permutation to a file.

Write the elements of the permutation P to `OUTPUT_FILE`, using `WRITE_F` function.
 Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid `gdsi_perm_t` & `WRITE_F` != NULL & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>P</i> | The permutation to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write P's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsi_perm_write_xml()` (p. 187)

`gdsi_perm_dump()` (p. 188)

Examples:

`examples/main_perm.c`.

4.13.3.23 `void gdsi_perm_write_xml (const gdsi_perm_t P, const gdsi_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the elements of a permutation to a file into XML.

Write the elements of the permutation P to `OUTPUT_FILE`, into XML language. If `WRITE_F` != NULL, then uses `WRITE_F` function to write P's elements to `OUTPUT_FILE`. Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid `gdsi_perm_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---|
| <i>P</i> | The permutation to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write P's elements. |
| <i>USER_DATA</i> | User's datas passed to <code>WRITE_F</code> . |

See also

gdsI_perm_write() (p. 186)

gdsI_perm_dump() (p. 188)

4.13.3.24 **void gdsI_perm_dump** (const gdsI_perm_t *P*, const gdsI_write_func_t *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Dump the internal structure of a permutation to a file.

Dump the structure of the permutation *P* to *OUTPUT_FILE*. If *WRITE_F* != NULL, then uses *WRITE_F* function to write *P*'s elements to *OUTPUT_FILE*. Additionnal *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|P|)$

Precondition

P must be a valid gdsI_perm_t & *OUTPUT_FILE* != NULL

Parameters

| | |
|--------------------|---|
| <i>P</i> | The permutation to dump. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>P</i> 's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

gdsI_perm_write() (p. 186)

gdsI_perm_write_xml() (p. 187)

4.14 Queue manipulation module

Typedefs

- typedef struct _gdsI_queue * **gdsI_queue_t**
GDSL queue type.

Functions

- **gdsI_queue_t gdsI_queue_alloc** (const char *NAME, **gdsI_alloc_func_t** ALL-OC_F, **gdsI_free_func_t** FREE_F)
Create a new queue.
- void **gdsI_queue_free** (**gdsI_queue_t** Q)
Destroy a queue.
- void **gdsI_queue_flush** (**gdsI_queue_t** Q)
Flush a queue.
- const char * **gdsI_queue_get_name** (const **gdsI_queue_t** Q)
Gets the name of a queue.
- **ulong gdsI_queue_get_size** (const **gdsI_queue_t** Q)
Get the size of a queue.
- **bool gdsI_queue_is_empty** (const **gdsI_queue_t** Q)
Check if a queue is empty.
- **gdsI_element_t gdsI_queue_get_head** (const **gdsI_queue_t** Q)
Get the head of a queue.
- **gdsI_element_t gdsI_queue_get_tail** (const **gdsI_queue_t** Q)
Get the tail of a queue.
- **gdsI_queue_t gdsI_queue_set_name** (**gdsI_queue_t** Q, const char *NEW_NAME)
Set the name of a queue.
- **gdsI_element_t gdsI_queue_insert** (**gdsI_queue_t** Q, void *VALUE)
Insert an element in a queue (PUT).
- **gdsI_element_t gdsI_queue_remove** (**gdsI_queue_t** Q)
Remove an element from a queue (GET).
- **gdsI_element_t gdsI_queue_search** (const **gdsI_queue_t** Q, **gdsI_compare_func_t** COMP_F, void *VALUE)
Search for a particular element in a queue.
- **gdsI_element_t gdsI_queue_search_by_position** (const **gdsI_queue_t** Q, **ulong** POS)
Search for an element by its position in a queue.
- **gdsI_element_t gdsI_queue_map_forward** (const **gdsI_queue_t** Q, **gdsI_map_func_t** MAP_F, void *USER_DATA)
Parse a queue from head to tail.
- **gdsI_element_t gdsI_queue_map_backward** (const **gdsI_queue_t** Q, **gdsI_map_func_t** MAP_F, void *USER_DATA)

Parse a queue from tail to head.

- void **gdsi_queue_write** (const **gdsi_queue_t** Q, **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write all the elements of a queue to a file.

- void **gdsi_queue_write_xml** (const **gdsi_queue_t** Q, **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a queue to a file into XML.

- void **gdsi_queue_dump** (const **gdsi_queue_t** Q, **gdsi_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a queue to a file.

4.14.1 Typedef Documentation

4.14.1.1 typedef struct **gdsi_queue*** **gdsi_queue_t**

GDSL queue type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 56 of file `gdsi_queue.h`.

4.14.2 Function Documentation

4.14.2.1 **gdsi_queue_t** **gdsi_queue_alloc** (const char * *NAME*, **gdsi_alloc_func_t** *ALLOC_F*, **gdsi_free_func_t** *FREE_F*)

Create a new queue.

Allocate a new queue data structure which name is set to a copy of *NAME*. The functions pointers *ALLOC_F* and *FREE_F* could be used to respectively, alloc and free elements in the queue. These pointers could be set to NULL to use the default ones:

- the default *ALLOC_F* simply returns its argument
- the default *FREE_F* does nothing

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------------|--|
| <i>NAME</i> | The name of the new queue to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in a queue |
| <i>FREE_F</i> | Function to free element when deleting it from a queue |

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Returns

the newly allocated queue in case of success.
NULL in case of insufficient memory.

See also

gdsl_queue_free() (p. 191)
gdsl_queue_flush() (p. 191)

Examples:

examples/main_queue.c.

4.14.2.2 void gsdl_queue_free(gsdl_queue_t Q)

Destroy a queue.

Deallocate all the elements of the queue Q by calling Q's FREE_F function passed to **gsdl_queue_alloc()** (p. 190). The name of Q is deallocated and Q is deallocated itself too.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid gsdl_queue_t

Parameters

| | |
|---|----------------------|
| Q | The queue to destroy |
|---|----------------------|

See also

gsdl_queue_alloc() (p. 190)
gsdl_queue_flush() (p. 191)

Examples:

examples/main_queue.c.

4.14.2.3 void gsdl_queue_flush(gsdl_queue_t Q)

Flush a queue.

Deallocate all the elements of the queue Q by calling Q's FREE_F function passed to **gsdl_queue_alloc()**. Q is not deallocated itself and Q's name is not modified.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid `gdsl_queue_t`

Parameters

| | |
|---|--------------------|
| Q | The queue to flush |
|---|--------------------|

See also

`gdsl_queue_alloc()` (p. 190)

`gdsl_queue_free()` (p. 191)

Examples:

`examples/main_queue.c`.

4.14.2.4 `const char* gdsl_queue_get_name(const gdsl_queue_t Q)`

Getsthe name of a queue.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gdsl_queue_t`

Postcondition

The returned string **MUST NOT** be freed.

Parameters

| | |
|---|--------------------------------|
| Q | The queue to get the name from |
|---|--------------------------------|

Returns

the name of the queue Q.

See also

gdsl_queue_set_name() (p. 195)

Examples:

examples/main_queue.c.

4.14.2.5 `ulong gsdl_queue_get_size(const gsdl_queue_t Q)`

Get the size of a queue.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gsdl_queue_t`

Parameters

| | |
|---|--------------------------------|
| Q | The queue to get the size from |
|---|--------------------------------|

Returns

the number of elements of Q (noted $|Q|$).

4.14.2.6 `bool gsdl_queue_is_empty(const gsdl_queue_t Q)`

Check if a queue is empty.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gsdl_queue_t`

Parameters

| | |
|---|--------------------|
| Q | The queue to check |
|---|--------------------|

Returns

TRUE if the queue Q is empty.
FALSE if the queue Q is not empty.

Examples:

examples/main_queue.c.

4.14.2.7 gdsI_element_t gdsI_queue_get_head(const gdsI_queue_t Q)

Get the head of a queue.

Note

Complexity: $O(1)$

Precondition

Q must be a valid gdsI_queue_t

Parameters

| | |
|---|--------------------------------|
| Q | The queue to get the head from |
|---|--------------------------------|

Returns

the element contained at the header position of the queue Q if Q is not empty. The returned element is not removed from Q.
NULL if the queue Q is empty.

See also

gdsI_queue_get_tail() (p. 194)

Examples:

examples/main_queue.c.

4.14.2.8 gdsI_element_t gdsI_queue_get_tail(const gdsI_queue_t Q)

Get the tail of a queue.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gdsl_queue_t`

Parameters

| | |
|---|--------------------------------|
| Q | The queue to get the tail from |
|---|--------------------------------|

Returns

the element contained at the footer position of the queue Q if Q is not empty. The returned element is not removed from Q.
NULL if the queue Q is empty.

See also

`gdsl_queue_get_head()` (p. 194)

Examples:

`examples/main_queue.c`.

4.14.2.9 `gdsl_queue_t` `gdsl_queue_set_name` (`gdsl_queue_t` Q, const char * *NEW_NAME*)

Set the name of a queue.

Change the previous name of the queue Q to a copy of *NEW_NAME*.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gdsl_queue_t`

Parameters

| | |
|-----------------|------------------------------|
| Q | The queue to change the name |
| <i>NEW_NAME</i> | The new name of Q |

Returns

the modified queue in case of success.
NULL in case of insufficient memory.

See also

gdsl_queue_get_name() (p. 192)

4.14.2.10 **gdsl_element_t** **gdsl_queue_insert**(**gdsl_queue_t** *Q*, void * *VALUE*)

Insert an element in a queue (PUT).

Allocate a new element *E* by calling *Q*'s **ALLOC_F** function on *VALUE*. **ALLOC_F** is the function pointer passed to **gdsl_queue_alloc()** (p. 190). The new element *E* is then inserted at the header position of the queue *Q*.

Note

Complexity: $O(1)$

Precondition

Q must be a valid **gdsl_queue_t**

Parameters

| | |
|--------------|--|
| <i>Q</i> | The queue to insert in |
| <i>VALUE</i> | The value used to make the new element to insert into <i>Q</i> |

Returns

the inserted element *E* in case of success.
NULL in case of insufficient memory.

See also

gdsl_queue_remove() (p. 196)

Examples:

examples/main_queue.c.

4.14.2.11 **gdsl_element_t** **gdsl_queue_remove**(**gdsl_queue_t** *Q*)

Remove an element from a queue (GET).

Remove the element at the footer position of the queue *Q*.

Note

Complexity: $O(1)$

Precondition

Q must be a valid `gdsl_queue_t`

Parameters

| | |
|---|-----------------------------------|
| Q | The queue to remove the tail from |
|---|-----------------------------------|

Returns

the removed element in case of success.
NULL in case of Q is empty.

See also

`gdsl_queue_insert()` (p. 196)

Examples:

`examples/main_queue.c`.

**4.14.2.12 `gdsl_element_t` `gdsl_queue_search` (`const` `gdsl_queue_t` Q,
`gdsl_compare_func_t` COMP_F, `void *` VALUE)**

Search for a particular element in a queue.

Search for the first element E equal to VALUE in the queue Q, by using COMP_F to compare all Q's element with.

Note

Complexity: $O(|Q| / 2)$

Precondition

Q must be a valid `gdsl_queue_t` & COMP_F != NULL

Parameters

| | |
|--------|--|
| Q | The queue to search the element in |
| COMP_F | The comparison function used to compare Q's element with VALUE |
| VALUE | The value to compare Q's elements with |

Returns

the first founded element E in case of success.
NULL in case the searched element E was not found.

See also

gdsl_queue_search_by_position (p. 198)

4.14.2.13 **gdsl_element_t** **gdsl_queue_search_by_position**(**const** **gdsl_queue_t** *Q*,
ulong *POS*)

Search for an element by its position in a queue.

Note

Complexity: $O(|Q| / 2)$

Precondition

Q must be a valid **gdsl_queue_t** & $POS > 0$ & $POS \leq |Q|$

Parameters

| | |
|------------|---|
| <i>Q</i> | The queue to search the element in |
| <i>POS</i> | The position where is the element to search |

Returns

the element at the *POS*-th position in the queue *Q*.
NULL if $POS > |L|$ or $POS \leq 0$.

See also

gdsl_queue_search() (p. 197)

Examples:

examples/main_queue.c.

4.14.2.14 **gdsl_element_t** **gdsl_queue_map_forward**(**const** **gdsl_queue_t** *Q*,
gdsl_map_func_t *MAP_F*, **void** * *USER_DATA*)

Parse a queue from head to tail.

Parse all elements of the queue *Q* from head to tail. The *MAP_F* function is called on each *Q*'s element with *USER_DATA* argument. If *MAP_F* returns **GDSL_MAP_STOP**, then **gdsl_queue_map_forward()** (p. 198) stops and returns its last examined element.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid `gdsi_queue_t` & `MAP_F` != NULL

Parameters

| | |
|-----------|---|
| Q | The queue to parse |
| MAP_F | The map function to apply on each Q's element |
| USER_DATA | User's datas passed to MAP_F |

Returns

the first element for which `MAP_F` returns `GDSL_MAP_STOP`.
NULL when the parsing is done.

See also

`gdsi_queue_map_backward()` (p. 199)

Examples:

`examples/main_queue.c`.

4.14.2.15 `gdsi_element_t gdsi_queue_map_backward(const gdsi_queue_t Q, gdsi_map_func_t MAP_F, void * USER_DATA)`

Parse a queue from tail to head.

Parse all elements of the queue Q from tail to head. The `MAP_F` function is called on each Q's element with `USER_DATA` argument. If `MAP_F` returns `GDSL_MAP_STOP`, then **`gdsi_queue_map_backward()`** (p. 199) stops and returns its last examined element.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid `gdsi_queue_t` & `MAP_F` != NULL

Parameters

| | |
|-----------|--|
| Q | The queue to parse |
| MAP_F | The map function to apply on each Q's element |
| USER_DATA | User's datas passed to MAP_F Returns the first element for which MAP_F returns GDSL_MAP_STOP. Returns NULL when the parsing is done. |

See also

gdsl_queue_map_forward() (p. 198)

4.14.2.16 void **gdsl_queue_write** (const **gdsl_queue_t** *Q*, **gdsl_write_func_t** *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Write all the elements of a queue to a file.

Write the elements of the queue *Q* to *OUTPUT_FILE*, using *WRITE_F* function. -
Additional USER_DATA argument could be passed to *WRITE_F*.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid **gdsl_queue_t** & *OUTPUT_FILE* != NULL & *WRITE_F* != NULL

Parameters

| | |
|--------------------|---|
| <i>Q</i> | The queue to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write <i>Q</i> 's elements. |
| <i>USER_DATA</i> | User's datas passed to <i>WRITE_F</i> . |

See also

gdsl_queue_write_xml() (p. 200)

gdsl_queue_dump() (p. 201)

4.14.2.17 void **gdsl_queue_write_xml** (const **gdsl_queue_t** *Q*, **gdsl_write_func_t** *WRITE_F*, FILE * *OUTPUT_FILE*, void * *USER_DATA*)

Write the content of a queue to a file into XML.

Write the elements of the queue *Q* to *OUTPUT_FILE*, into XML language. If *WRITE_F* != NULL, then uses *WRITE_F* to write *Q*'s elements to *OUTPUT_FILE*. Additional USER_DATA argument could be passed to *WRITE_F*.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid `gdsi_queue_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------------|---|
| <code>Q</code> | The queue to write. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write Q's elements. |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsi_queue_write()` (p. 200)

`gdsi_queue_dump()` (p. 201)

Examples:

`examples/main_queue.c`.

4.14.2.18 `void gdsi_queue_dump(const gdsi_queue_t Q, gdsi_write_func_t
WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a queue to a file.

Dump the structure of the queue Q to `OUTPUT_FILE`. If `WRITE_F` != NULL, then uses `WRITE_F` to write Q's elements to `OUTPUT_FILE`. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|Q|)$

Precondition

Q must be a valid `gdsi_queue_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------------|---|
| <code>Q</code> | The queue to write. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write Q's elements. |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

gdsI_queue_write() (p. 200)

gdsI_queue_write_xml() (p. 200)

Examples:

examples/main_queue.c.

4.15 Red-black tree manipulation module

Typedefs

- typedef struct gdsI_rbtree * **gdsI_rbtree_t**

Functions

- **gdsI_rbtree_t gdsI_rbtree_alloc** (const char *NAME, **gdsI_alloc_func_t** ALL-OC_F, **gdsI_free_func_t** FREE_F, **gdsI_compare_func_t** COMP_F)
Create a new red-black tree.
- void **gdsI_rbtree_free** (**gdsI_rbtree_t** T)
Destroy a red-black tree.
- void **gdsI_rbtree_flush** (**gdsI_rbtree_t** T)
Flush a red-black tree.
- char * **gdsI_rbtree_get_name** (const **gdsI_rbtree_t** T)
Get the name of a red-black tree.
- bool **gdsI_rbtree_is_empty** (const **gdsI_rbtree_t** T)
Check if a red-black tree is empty.
- **gdsI_element_t gdsI_rbtree_get_root** (const **gdsI_rbtree_t** T)
Get the root of a red-black tree.
- **ulong gdsI_rbtree_get_size** (const **gdsI_rbtree_t** T)
Get the size of a red-black tree.
- **ulong gdsI_rbtree_height** (const **gdsI_rbtree_t** T)
Get the height of a red-black tree.
- **gdsI_rbtree_t gdsI_rbtree_set_name** (**gdsI_rbtree_t** T, const char *NEW_NAME)
Set the name of a red-black tree.
- **gdsI_element_t gdsI_rbtree_insert** (**gdsI_rbtree_t** T, void *VALUE, int *RESULT)
Insert an element into a red-black tree if it's not found or return it.
- **gdsI_element_t gdsI_rbtree_remove** (**gdsI_rbtree_t** T, void *VALUE)
Remove an element from a red-black tree.
- **gdsI_rbtree_t gdsI_rbtree_delete** (**gdsI_rbtree_t** T, void *VALUE)
Delete an element from a red-black tree.
- **gdsI_element_t gdsI_rbtree_search** (const **gdsI_rbtree_t** T, **gdsI_compare_func_t** COMP_F, void *VALUE)
Search for a particular element into a red-black tree.
- **gdsI_element_t gdsI_rbtree_map_prefix** (const **gdsI_rbtree_t** T, **gdsI_map_func_t** MAP_F, void *USER_DATA)
Parse a red-black tree in prefixed order.
- **gdsI_element_t gdsI_rbtree_map_infix** (const **gdsI_rbtree_t** T, **gdsI_map_func_t** MAP_F, void *USER_DATA)
Parse a red-black tree in infix order.

- **gdsl_element_t gsdl_rbtrees_map_postfix** (const **gsdl_rbtrees_t** T, **gsdl_map_func_t** MAP_F, void *USER_DATA)

Parse a red-black tree in postfix order.

- void **gsdl_rbtrees_write** (const **gsdl_rbtrees_t** T, **gsdl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the element of each node of a red-black tree to a file.

- void **gsdl_rbtrees_write_xml** (const **gsdl_rbtrees_t** T, **gsdl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a red-black tree to a file into XML.

- void **gsdl_rbtrees_dump** (const **gsdl_rbtrees_t** T, **gsdl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a red-black tree to a file.

4.15.1 Typedef Documentation

4.15.1.1 typedef struct gsdl_rbtrees* gsdl_rbtrees_t

GDSL red-black tree type.

This type is voluntary opaque. Variables of this kind could not be directly used, but by the functions of this module.

Definition at line 53 of file gsdl_rbtrees.h.

4.15.2 Function Documentation

4.15.2.1 **gsdl_rbtrees_t gsdl_rbtrees_alloc** (const char * NAME, **gsdl_alloc_func_t** ALLOC_F, **gsdl_free_func_t** FREE_F, **gsdl_compare_func_t** COMP_F)

Create a new red-black tree.

Allocate a new red-black tree data structure which name is set to a copy of NAME. The function pointers ALLOC_F, FREE_F and COMP_F could be used to respectively, alloc, free and compares elements in the tree. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing
- the default COMP_F always returns 0

Note

Complexity: $O(1)$

Precondition

nothing

Parameters

| | |
|----------------|---|
| <i>NAME</i> | The name of the new red-black tree to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in a r-b tree |
| <i>FREE_F</i> | Function to free element when removing it from a r-b tree |
| <i>COMP_F</i> | Function to compare elements into the r-b tree |

Returns

the newly allocated red-black tree in case of success.
NULL in case of failure.

See also

gdsI_rbtree_free() (p. 205)
gdsI_rbtree_flush() (p. 206)

Examples:

examples/main_rbtree.c.

4.15.2.2 void gdsI_rbtree_free(gdsI_rbtree_t T)

Destroy a red-black tree.

Deallocate all the elements of the red-black tree T by calling T's **FREE_F** function passed to **gdsI_rbtree_alloc()** (p. 204). The name of T is deallocated and T is deallocated itself too.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_rbtree_t

Parameters

| | |
|----------|----------------------------------|
| <i>T</i> | The red-black tree to deallocate |
|----------|----------------------------------|

See also

gdsI_rbtree_alloc() (p. 204)

gdsI_rbtree_flush() (p. 206)

Examples:

examples/main_rbtree.c.

4.15.2.3 void gdsI_rbtree_flush(gdsI_rbtree_t T)

Flush a red-black tree.

Deallocate all the elements of the red-black tree T by calling T's FREE_F function passed to **gdsI_rbtree_alloc()** (p. 204). The red-black tree T is not deallocated itself and its name is not modified.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_rbtree_t

See also

gdsI_rbtree_alloc() (p. 204)

gdsI_rbtree_free() (p. 205)

Examples:

examples/main_rbtree.c.

4.15.2.4 char* gdsI_rbtree_get_name(const gdsI_rbtree_t T)

Get the name of a red-black tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid gdsI_rbtree_t

Postcondition

The returned string **MUST NOT** be freed.

Parameters

| | |
|----------|---|
| <i>T</i> | The red-black tree to get the name from |
|----------|---|

Returns

the name of the red-black tree *T*.

See also

gdsI_rbtree_set_name() (p. 209)

4.15.2.5 bool gdsI_rbtree_is_empty(const gdsI_rbtree_t *T*)

Check if a red-black tree is empty.

Note

Complexity: $O(1)$

Precondition

T must be a valid gdsI_rbtree_t

Parameters

| | |
|----------|-----------------------------|
| <i>T</i> | The red-black tree to check |
|----------|-----------------------------|

Returns

TRUE if the red-black tree *T* is empty.
FALSE if the red-black tree *T* is not empty.

Examples:

examples/main_rbtree.c.

4.15.2.6 gdsI_element_t gdsI_rbtree_get_root(const gdsI_rbtree_t *T*)

Get the root of a red-black tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsi_rbtrees_t`

Parameters

| | |
|----------------|---|
| <code>T</code> | The red-black tree to get the root element from |
|----------------|---|

Returns

the element at the root of the red-black tree T.

Examples:

examples/main_rbtrees.c.

4.15.2.7 `ulong gdsi_rbtrees_get_size(const gdsi_rbtrees_t T)`

Get the size of a red-black tree.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsi_rbtrees_t`

Parameters

| | |
|----------------|---|
| <code>T</code> | The red-black tree to get the size from |
|----------------|---|

Returns

the size of the red-black tree T (noted $|T|$).

See also

`gdsi_rbtrees_get_height()`

Examples:

examples/main_rbtrees.c.

4.15.2.8 `ulong gdsI_rbtree_height(const gdsI_rbtree_t T)`

Get the height of a red-black tree.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsI_rbtree_t`

Parameters

| | |
|----------|---|
| <i>T</i> | The red-black tree to compute the height from |
|----------|---|

Returns

the height of the red-black tree T (noted $h(T)$).

See also

`gdsI_rbtree_get_size()` (p. 208)

Examples:

`examples/main_rbtree.c`.

4.15.2.9 `gdsI_rbtree_t gdsI_rbtree_set_name(gdsI_rbtree_t T, const char *
NEW_NAME)`

Set the name of a red-black tree.

Change the previous name of the red-black tree T to a copy of `NEW_NAME`.

Note

Complexity: $O(1)$

Precondition

T must be a valid `gdsI_rbtree_t`

Parameters

| | |
|-----------------|---------------------------------------|
| <i>T</i> | The red-black tree to change the name |
| <i>NEW_NAME</i> | The new name of T |

Returns

the modified red-black tree in case of success.
 NULL in case of insufficient memory.

See also

gdsI_rbtree_get_name() (p. 206)

4.15.2.10 **gdsI_element_t gdsI_rbtree_insert(gdsI_rbtree_t T, void * *VALUE*, int * *RESULT*)**

Insert an element into a red-black tree if it's not found or return it.

Search for the first element E equal to VALUE into the red-black tree T, by using T's COMP_F function passed to gdsI_rbtree_alloc to find it. If E is found, then it's returned. If E isn't found, then a new element E is allocated using T's ALLOC_F function passed to gdsI_rbtree_alloc and is inserted and then returned.

Note

Complexity: $O(\log(|T|))$

Precondition

T must be a valid gdsI_rbtree_t & RESULT != NULL

Parameters

| | |
|---------------|---|
| <i>T</i> | The red-black tree to modify |
| <i>VALUE</i> | The value used to make the new element to insert into T |
| <i>RESULT</i> | The address where the result code will be stored. |

Returns

the element E and RESULT = GDSL_OK if E is inserted into T.
 the element E and RESULT = GDSL_ERR_DUPLICATE_ENTRY if E is already present in T.
 NULL and RESULT = GDSL_ERR_MEM_ALLOC in case of insufficient memory.

See also

gdsI_rbtree_remove() (p. 211)
gdsI_rbtree_delete() (p. 211)

Examples:

examples/main_rbtree.c.

4.15.2.11 `gdsI_element_t gdsI_rbtrees_remove(gdsI_rbtrees_t T, void * VALUE)`

Remove an element from a red-black tree.

Remove from the red-black tree T the first founded element E equal to VALUE, by using T's COMP_F function passed to **`gdsI_rbtrees_alloc()`** (p. 204). If E is found, it is removed from T and then returned.

Note

Complexity: $O(\log(|T|))$

Precondition

T must be a valid `gdsI_rbtrees_t`

Parameters

| | |
|--------------|--|
| <i>T</i> | The red-black tree to modify |
| <i>VALUE</i> | The value used to find the element to remove |

Returns

the first founded element equal to VALUE in T in case is found.
NULL in case no element equal to VALUE is found in T.

See also

`gdsI_rbtrees_insert()` (p. 210)
`gdsI_rbtrees_delete()` (p. 211)

4.15.2.12 `gdsI_rbtrees_t gdsI_rbtrees_delete(gdsI_rbtrees_t T, void * VALUE)`

Delete an element from a red-black tree.

Remove from the red-black tree the first founded element E equal to VALUE, by using T's COMP_F function passed to **`gdsI_rbtrees_alloc()`** (p. 204). If E is found, it is removed from T and E is deallocated using T's FREE_F function passed to **`gdsI_rbtrees_alloc()`** (p. 204), then T is returned.

Note

Complexity: $O(\log(|T|))$

Precondition

T must be a valid `gdsI_rbtrees_t`

Parameters

| | |
|--------------|--|
| <i>T</i> | The red-black tree to remove an element from |
| <i>VALUE</i> | The value used to find the element to remove |

Returns

the modified red-black tree after removal of E if E was found.
 NULL if no element equal to VALUE was found.

See also

gdsI_rbtrees_insert() (p. 210)
gdsI_rbtrees_remove() (p. 211)

Examples:

examples/main_rbtrees.c.

4.15.2.13 **gdsI_element_t gdsI_rbtrees_search (const gdsI_rbtrees_t T,
 gdsI_compare_func_t COMP_F, void * VALUE)**

Search for a particular element into a red-black tree.

Search the first element E equal to VALUE in the red-black tree T, by using COMP_F function to find it. If COMP_F == NULL, then the COMP_F function passed to **gdsI_rbtrees_alloc()** (p. 204) is used.

Note

Complexity: $O(\log(|T|))$

Precondition

T must be a valid gdsI_rbtrees_t

Parameters

| | |
|---------------|--|
| <i>T</i> | The red-black tree to use. |
| <i>COMP_F</i> | The comparison function to use to compare T's element with VALUE to find the element E (or NULL to use the default T's COMP_F) |
| <i>VALUE</i> | The value that must be used by COMP_F to find the element E |

Returns

the first founded element E equal to VALUE.
 NULL if VALUE is not found in T.

See also

gdsl_rbtrees_insert() (p. 210)
gdsl_rbtrees_remove() (p. 211)
gdsl_rbtrees_delete() (p. 211)

Examples:

examples/main_rbtrees.c.

4.15.2.14 **gdsl_element_t** **gdsl_rbtrees_map_prefix**(**const** **gdsl_rbtrees_t** *T*,
gdsl_map_func_t *MAP_F*, **void** * *USER_DATA*)

Parse a red-black tree in prefixed order.

Parse all nodes of the red-black tree *T* in prefixed order. The *MAP_F* function is called on the element contained in each node with the *USER_DATA* argument. If *MAP_F* returns **GDSL_MAP_STOP**, then **gdsl_rbtrees_map_prefix()** (p. 213) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid **gdsl_rbtrees_t** & *MAP_F* != **NULL**

Parameters

| | |
|------------------|-------------------------------------|
| <i>T</i> | The red-black tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to <i>MAP_F</i> |

Returns

the first element for which *MAP_F* returns **GDSL_MAP_STOP**.
NULL when the parsing is done.

See also

gdsl_rbtrees_map_infix() (p. 214)
gdsl_rbtrees_map_postfix() (p. 214)

Examples:

examples/main_rbtrees.c.

4.15.2.15 `gdsi_element_t gdsi_rbtrees_map_infix(const gdsi_rbtrees_t T, gdsi_map_func_t MAP_F, void * USER_DATA)`

Parse a red-black tree in infix order.

Parse all nodes of the red-black tree T in infix order. The MAP_F function is called on the element contained in each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsi_rbtrees_map_infix()** (p. 214) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsi_rbtrees_t & MAP_F != NULL

Parameters

| | |
|------------------|------------------------------|
| <i>T</i> | The red-black tree to map. |
| <i>MAP_F</i> | The map function. |
| <i>USER_DATA</i> | User's datas passed to MAP_F |

Returns

the first element for which MAP_F returns GDSL_MAP_STOP.
NULL when the parsing is done.

See also

gdsi_rbtrees_map_prefix() (p. 213)
gdsi_rbtrees_map_postfix() (p. 214)

Examples:

examples/main_rbtrees.c.

4.15.2.16 `gdsi_element_t gdsi_rbtrees_map_postfix(const gdsi_rbtrees_t T, gdsi_map_func_t MAP_F, void * USER_DATA)`

Parse a red-black tree in postfix order.

Parse all nodes of the red-black tree T in postfix order. The MAP_F function is called on the element contained in each node with the USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsi_rbtrees_map_postfix()** (p. 214) stops and returns its last examined element.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsl_rbtrees_t` & `MAP_F` != NULL

Parameters

| | |
|--------------|---|
| T | The red-black tree to map. |
| MAP_F | The map function. |
| $USER_DATA$ | User's datas passed to <code>MAP_F</code> |

Returns

the first element for which `MAP_F` returns `GD_SL_MAP_STOP`.
NULL when the parsing is done.

See also

`gdsl_rbtrees_map_prefix()` (p. 213)

`gdsl_rbtrees_map_infix()` (p. 214)

Examples:

`examples/main_rbtrees.c`.

4.15.2.17 `void gdsl_rbtrees_write(const gdsl_rbtrees_t T, gdsl_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)`

Write the element of each node of a red-black tree to a file.

Write the nodes elements of the red-black tree T to `OUTPUT_FILE`, using `WRITE_F` function. Additionnal `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid `gdsl_rbtrees_t` & `WRITE_F` != NULL & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------|---------------------------------------|
| <i>T</i> | The red-black tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's elements. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

gdsI_rbtrees_write_xml() (p. 216)

gdsI_rbtrees_dump() (p. 217)

Examples:

examples/main_rbtrees.c.

4.15.2.18 void gdsI_rbtrees_write_xml(const gdsI_rbtrees_t T, gdsI_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)

Write the content of a red-black tree to a file into XML.

Write the nodes elements of the red-black tree T to OUTPUT_FILE, into XML language. If WRITE_F != NULL, then use WRITE_F to write T's nodes elements to OUTPUT_FILE. Additional USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsI_rbtrees_t & OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|---------------------------------------|
| <i>T</i> | The red-black tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's elements. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

gdsI_rbtrees_write() (p. 215)

gdsI_rbtrees_dump() (p. 217)

Examples:

examples/main_rbtrees.c.

4.15.2.19 `void gdsi_rbtrees_dump(const gdsi_rbtrees_t T, gdsi_write_func_t WRITE_F,
FILE * OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a red-black tree to a file.

Dump the structure of the red-black tree T to OUTPUT_FILE. If WRITE_F != NULL, then use WRITE_F to write T's nodes elements to OUTPUT_FILE. Additional USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|T|)$

Precondition

T must be a valid gdsi_rbtrees_t & OUTPUT_FILE != NULL

Parameters

| | |
|--------------------|---------------------------------------|
| <i>T</i> | The red-black tree to write. |
| <i>WRITE_F</i> | The write function. |
| <i>OUTPUT_FILE</i> | The file where to write T's elements. |
| <i>USER_DATA</i> | User's datas passed to WRITE_F. |

See also

gdsi_rbtrees_write() (p. 215)

gdsi_rbtrees_write_xml() (p. 216)

Examples:

examples/main_rbtrees.c.

4.16 Sort module

Functions

- void **gdsI_sort** (**gdsI_element_t** *T, **ulong** N, **const gdsI_compare_func_t** COMP_F)

Sort an array in place.

4.16.1 Function Documentation

4.16.1.1 void **gdsI_sort** (**gdsI_element_t** * T, **ulong** N, **const gdsI_compare_func_t** COMP_F)

Sort an array in place.

Sort the array T in place. The function COMP_F is used to compare T's elements and must be user-defined.

Note

Complexity: $O(N \log(N))$

Precondition

$N == |T|$ & $T \neq \text{NULL}$ & $\text{COMP_F} \neq \text{NULL}$ & for all $i \leq N$: $\text{sizeof}(T[i]) == \text{sizeof}(\text{gdsI_element_t})$

Parameters

| | |
|---------------|---|
| <i>T</i> | The array of elements to sort |
| <i>N</i> | The number of elements into T |
| <i>COMP_F</i> | The function pointer used to compare T's elements |

Examples:

examples/main_sort.c.

4.17 Stack manipulation module

Typedefs

- typedef struct _gdsI_stack * **gdsI_stack_t**
GDSL stack type.

Functions

- **gdsI_stack_t gdsI_stack_alloc** (const char *NAME, **gdsI_alloc_func_t** ALLOC_F, **gdsI_free_func_t** FREE_F)
Create a new stack.
- void **gdsI_stack_free** (**gdsI_stack_t** S)
Destroy a stack.
- void **gdsI_stack_flush** (**gdsI_stack_t** S)
Flush a stack.
- const char * **gdsI_stack_get_name** (const **gdsI_stack_t** S)
Get the name of a stack.
- **ulong gdsI_stack_get_size** (const **gdsI_stack_t** S)
Get the size of a stack.
- **ulong gdsI_stack_get_growing_factor** (const **gdsI_stack_t** S)
Get the growing factor of a stack.
- **bool gdsI_stack_is_empty** (const **gdsI_stack_t** S)
Check if a stack is empty.
- **gdsI_element_t gdsI_stack_get_top** (const **gdsI_stack_t** S)
Get the top of a stack.
- **gdsI_element_t gdsI_stack_get_bottom** (const **gdsI_stack_t** S)
Get the bottom of a stack.
- **gdsI_stack_t gdsI_stack_set_name** (**gdsI_stack_t** S, const char *NEW_NAME)
Set the name of a stack.
- void **gdsI_stack_set_growing_factor** (**gdsI_stack_t** S, **ulong** G)
Set the growing factor of a stack.
- **gdsI_element_t gdsI_stack_insert** (**gdsI_stack_t** S, void *VALUE)
Insert an element in a stack (PUSH).
- **gdsI_element_t gdsI_stack_remove** (**gdsI_stack_t** S)
Remove an element from a stack (POP).
- **gdsI_element_t gdsI_stack_search** (const **gdsI_stack_t** S, **gdsI_compare_func_t** COMP_F, void *VALUE)
Search for a particular element in a stack.
- **gdsI_element_t gdsI_stack_search_by_position** (const **gdsI_stack_t** S, **ulong** POS)
Search for an element by its position in a stack.

- **gdsI_element_t gdsI_stack_map_forward** (const **gdsI_stack_t** S, **gdsI_map_func_t** MAP_F, void *USER_DATA)

Parse a stack from bottom to top.

- **gdsI_element_t gdsI_stack_map_backward** (const **gdsI_stack_t** S, **gdsI_map_func_t** MAP_F, void *USER_DATA)

Parse a stack from top to bottom.

- void **gdsI_stack_write** (const **gdsI_stack_t** S, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write all the elements of a stack to a file.

- void **gdsI_stack_write_xml** (**gdsI_stack_t** S, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a stack to a file into XML.

- void **gdsI_stack_dump** (**gdsI_stack_t** S, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a stack to a file.

4.17.1 Typedef Documentation

4.17.1.1 typedef struct _gdsI_stack* gdsI_stack_t

GDSL stack type.

This type is voluntary opaque. Variables of this kind could'nt be directly used, but by the functions of this module.

Definition at line 54 of file gdsI_stack.h.

4.17.2 Function Documentation

4.17.2.1 **gdsI_stack_t gdsI_stack_alloc** (const char * NAME, **gdsI_alloc_func_t** ALLOC_F, **gdsI_free_func_t** FREE_F)

Create a new stack.

Allocate a new stack data structure which name is set to a copy of NAME. The functions pointers ALLOC_F and FREE_F could be used to respectively, alloc and free elements in the stack. These pointers could be set to NULL to use the default ones:

- the default ALLOC_F simply returns its argument
- the default FREE_F does nothing

Note

Complexity: $O(1)$

Precondition

nothing.

Parameters

| | |
|----------------|--|
| <i>NAME</i> | The name of the new stack to create |
| <i>ALLOC_F</i> | Function to alloc element when inserting it in a stack |
| <i>FREE_F</i> | Function to free element when deleting it from a stack |

Returns

the newly allocated stack in case of success.
NULL in case of insufficient memory.

See also

gdsI_stack_free() (p. 221)
gdsI_stack_flush() (p. 222)

Examples:

examples/main_stack.c.

4.17.2.2 void gdsI_stack_free (gdsI_stack_t S)

Destroy a stack.

Deallocate all the elements of the stack S by calling S's FREE_F function passed to **gdsI_stack_alloc()** (p. 220). The name of S is deallocated and S is deallocated itself too.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid gdsI_stack_t

Parameters

| | |
|---|----------------------|
| S | The stack to destroy |
|---|----------------------|

See also

gdsI_stack_alloc() (p. 220)
gdsI_stack_flush() (p. 222)

Examples:

examples/main_stack.c.

4.17.2.3 void **gdsI_stack_flush**(gdsI_stack_t S)

Flush a stack.

Deallocate all the elements of the stack S by calling S's FREE_F function passed to **gdsI_stack_alloc()** (p. 220). S is not deallocated itself and S's name is not modified.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid gdsI_stack_t

Parameters

| | |
|---|--------------------|
| S | The stack to flush |
|---|--------------------|

See also

gdsI_stack_alloc() (p. 220)

gdsI_stack_free() (p. 221)

Examples:

examples/main_stack.c.

4.17.2.4 const char* **gdsI_stack_get_name**(const gdsI_stack_t S)

Getsthe name of a stack.

Note

Complexity: $O(1)$

Precondition

Q must be a valid gdsI_stack_t

Postcondition

The returned string MUST NOT be freed.

Parameters

| | |
|---|--------------------------------|
| S | The stack to get the name from |
|---|--------------------------------|

Returns

the name of the stack S.

See also

gdsl_stack_set_name() (p. 226)

Examples:

examples/main_stack.c.

4.17.2.5 `ulong gsdl_stack_get_size(const gsdl_stack_t S)`

Get the size of a stack.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gsdl_stack_t`

Parameters

| | |
|---|--------------------------------|
| S | The stack to get the size from |
|---|--------------------------------|

Returns

the number of elements of the stack S (noted $|S|$).

4.17.2.6 `ulong gsdl_stack_get_growing_factor(const gsdl_stack_t S)`

Get the growing factor of a stack.

Get the growing factor of the stack S. This value is the amount of cells to reserve for next insertions. For example, if you set this value to 10, each time the number of elements of S reaches 10, then 10 new cells will be reserved for next 10 insertions. It is a way to save time for insertions. This value is 1 by default and can be modified with **gsdl_stack_set_growing_factor()** (p. 226).

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsI_stack_t`

Parameters

| | |
|---|--|
| S | The stack to get the growing factor from |
|---|--|

Returns

the growing factor of the stack S.

See also

`gdsI_stack_insert()` (p. 227)

`gdsI_stack_set_growing_factor()` (p. 226)

4.17.2.7 `bool gdsI_stack_is_empty(const gdsI_stack_t S)`

Check if a stack is empty.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsI_stack_t`

Parameters

| | |
|---|--------------------|
| S | The stack to check |
|---|--------------------|

Returns

TRUE if the stack S is empty.

FALSE if the stack S is not empty.

Examples:

`examples/main_stack.c`.

4.17.2.8 `gdsl_element_t gdsl_stack_get_top(const gdsl_stack_t S)`

Get the top of a stack.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsl_stack_t`

Parameters

| | |
|---|-------------------------------|
| S | The stack to get the top from |
|---|-------------------------------|

Returns

the element contained at the top position of the stack S if S is not empty. The returned element is not removed from S.

NULL if the stack S is empty.

See also

`gdsl_stack_get_bottom()` (p. 225)

Examples:

`examples/main_stack.c`.

4.17.2.9 `gdsl_element_t gdsl_stack_get_bottom(const gdsl_stack_t S)`

Get the bottom of a stack.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsl_stack_t`

Parameters

| | |
|---|----------------------------------|
| S | The stack to get the bottom from |
|---|----------------------------------|

Returns

the element contained at the bottom position of the stack S if S is not empty. The returned element is not removed from S.
 NULL if the stack S is empty.

See also

gdsI_stack_get_top() (p. 225)

4.17.2.10 **gdsI_stack_t gdsI_stack_set_name(gdsI_stack_t S, const char * NEW_NAME)**

Set the name of a stack.

Change the previous name of the stack S to a copy of NEW_NAME.

Note

Complexity: $O(1)$

Precondition

S must be a valid gdsI_stack_t

Parameters

| | |
|-----------------|------------------------------|
| S | The stack to change the name |
| NEW_NAME | The new name of S |

Returns

the modified stack in case of success.
 NULL in case of insufficient memory.

See also

gdsI_stack_get_name() (p. 222)

4.17.2.11 **void gdsI_stack_set_growing_factor(gdsI_stack_t S, ulong G)**

Set the growing factor of a stack.

Set the growing factor of the stack S. This value is the amount of cells to reserve for next insertions. For example, if you set this value to 10, each time the number of elements of S reaches 10, then 10 new cells will be reserved for next 10 insertions. It is a way

to save time for insertions. To know the actual value of the growing factor, use **gdsI_stack_get_growing_factor()** (p. 223)

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsI_stack_t`

Parameters

| | |
|---|--|
| S | The stack to get the growing factor from |
| G | The new growing factor of S. |

Returns

the growing factor of the stack S.

See also

gdsI_stack_insert() (p. 227)

gdsI_stack_get_growing_factor() (p. 223)

4.17.2.12 gdsI_element_t gdsI_stack_insert(gdsI_stack_t S, void * VALUE)

Insert an element in a stack (PUSH).

Allocate a new element E by calling S's `ALLOC_F` function on `VALUE`. `ALLOC_F` is the function pointer passed to **gdsI_stack_alloc()** (p. 220). The new element E is the inserted at the top position of the stack S. If the number of elements in S reaches S's growing factor (G), then G new cells are reserved for future insertions into S to save time.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsI_stack_t`

Parameters

| | |
|-------|---|
| S | The stack to insert in |
| VALUE | The value used to make the new element to insert into S |

Returns

the inserted element E in case of success.
NULL in case of insufficient memory.

See also

gdsI_stack_set_growing_factor() (p. 226)
gdsI_stack_get_growing_factor() (p. 223)
gdsI_stack_remove() (p. 228)

Examples:

examples/main_stack.c.

4.17.2.13 gdsI_element_t gdsI_stack_remove(gdsI_stack_t S)

Remove an element from a stack (POP).

Remove the element at the top position of the stack S.

Note

Complexity: $O(1)$

Precondition

S must be a valid gdsI_stack_t

Parameters

| | |
|---|----------------------------------|
| S | The stack to remove the top from |
|---|----------------------------------|

Returns

the removed element in case of success.
NULL in case of S is empty.

See also

gdsI_stack_insert() (p. 227)

Examples:

examples/main_stack.c.

4.17.2.14 `gdsI_element_t gdsI_stack_search(const gdsI_stack_t S,
gdsI_compare_func_t COMP_F, void * VALUE)`

Search for a particular element in a stack.

Search for the first element E equal to VALUE in the stack S, by using COMP_F to compare all S's element with.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid `gdsI_stack_t` & `COMP_F` != NULL

Parameters

| | |
|--------|--|
| S | The stack to search the element in |
| COMP_F | The comparison function used to compare S's element with VALUE |
| VALUE | The value to compare S's elements with |

Returns

the first founded element E in case of success.
NULL if no element is found.

See also

`gdsI_stack_search_by_position()` (p. 229)

4.17.2.15 `gdsI_element_t gdsI_stack_search_by_position(const gdsI_stack_t S,
ulong POS)`

Search for an element by its position in a stack.

Note

Complexity: $O(1)$

Precondition

S must be a valid `gdsI_stack_t` & `POS` > 0 & `POS` <= |S|

Parameters

| | |
|-----|---|
| S | The stack to search the element in |
| POS | The position where is the element to search |

Returns

the element at the POS-th position in the stack S.
 NULL if $POS > |L|$ or $POS \leq 0$.

See also

gdsl_stack_search() (p. 229)

Examples:

examples/main_stack.c.

4.17.2.16 **gdsl_element_t** **gdsl_stack_map_forward**(const **gdsl_stack_t** S,
gdsl_map_func_t MAP_F, void * *USER_DATA*)

Parse a stack from bottom to top.

Parse all elements of the stack S from bottom to top. The MAP_F function is called on each S's element with USER_DATA argument. If MAP_F returns GDSL_MAP_STOP, then **gdsl_stack_map_forward()** (p. 230) stops and returns its last examined element.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid **gdsl_stack_t** & MAP_F != NULL

Parameters

| | |
|------------------|--|
| <i>S</i> | The stack to parse |
| <i>MAP_F</i> | The map function to apply on each S's element |
| <i>USER_DATA</i> | User's datas passed to MAP_F Returns the first element for which MAP_F returns GDSL_MAP_STOP. Returns NULL when the parsing is done. |

See also

gdsl_stack_map_backward() (p. 231)

Examples:

examples/main_stack.c.

4.17.2.17 `gdsl_element_t` **gdsl_stack_map_backward**(`const` `gdsl_stack_t` *S*,
`gdsl_map_func_t` *MAP_F*, `void *` *USER_DATA*)

Parse a stack from top to bottom.

Parse all elements of the stack *S* from top to bottom. The *MAP_F* function is called on each *S*'s element with *USER_DATA* argument. If *MAP_F* returns `GDSL_MAP_STOP`, then **gdsl_stack_map_backward()** (p. 231) stops and returns its last examined element.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid `gdsl_stack_t` & *MAP_F* != NULL

Parameters

| | |
|------------------|---|
| <i>S</i> | The stack to parse |
| <i>MAP_F</i> | The map function to apply on each <i>S</i> 's element |
| <i>USER_DATA</i> | User's datas passed to <i>MAP_F</i> |

Returns

the first element for which *MAP_F* returns `GDSL_MAP_STOP`.
NULL when the parsing is done.

See also

gdsl_stack_map_forward() (p. 230)

4.17.2.18 `void` **gdsl_stack_write**(`const` `gdsl_stack_t` *S*, `gdsl_write_func_t` *WRITE_F*,
`FILE *` *OUTPUT_FILE*, `void *` *USER_DATA*)

Write all the elements of a stack to a file.

Write the elements of the stack *S* to *OUTPUT_FILE*, using *WRITE_F* function. -
Additional *USER_DATA* argument could be passed to *WRITE_F*.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid `gdsl_stack_t` & `OUTPUT_FILE` != NULL & `WRITE_F` != NULL

Parameters

| | |
|--------------------------|---|
| <code>S</code> | The stack to write. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write S's elements. |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsl_stack_write_xml()` (p. 232)

`gdsl_stack_dump()` (p. 233)

4.17.2.19 `void gdsl_stack_write_xml(gdsl_stack_t S, gdsl_write_func_t WRITE_F, FILE * OUTPUT_FILE, void * USER_DATA)`

Write the content of a stack to a file into XML.

Write the elements of the stack S to `OUTPUT_FILE`, into XML language. If `WRITE_F` != NULL, then uses `WRITE_F` to write S's elements to `OUTPUT_FILE`. Additional `USER_DATA` argument could be passed to `WRITE_F`.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid `gdsl_stack_t` & `OUTPUT_FILE` != NULL

Parameters

| | |
|--------------------------|---|
| <code>S</code> | The stack to write. |
| <code>WRITE_F</code> | The write function. |
| <code>OUTPUT_FILE</code> | The file where to write S's elements. |
| <code>USER_DATA</code> | User's datas passed to <code>WRITE_F</code> . |

See also

`gdsl_stack_write()` (p. 231)

`gdsl_stack_dump()` (p. 233)

Examples:

examples/main_stack.c.

4.17.2.20 `void gdsi_stack_dump(gdsi_stack_t S, gdsi_write_func_t WRITE_F, FILE
* OUTPUT_FILE, void * USER_DATA)`

Dump the internal structure of a stack to a file.

Dump the structure of the stack S to OUTPUT_FILE. If WRITE_F != NULL, then uses WRITE_F to write S's elements to OUTPUT_FILE. Additionnal USER_DATA argument could be passed to WRITE_F.

Note

Complexity: $O(|S|)$

Precondition

S must be a valid gdsi_stack_t & OUTPUT_FILE != NULL

Parameters

| | |
|-------------|---------------------------------------|
| S | The stack to write. |
| WRITE_F | The write function. |
| OUTPUT_FILE | The file where to write S's elements. |
| USER_DATA | User's datas passed to WRITE_F. |

See also

gdsi_stack_write() (p. 231)

gdsi_stack_write_xml() (p. 232)

Examples:

examples/main_stack.c.

4.18 GDSL types

Typedefs

- typedef void * **gdsl_element_t**
GDSL element type.
- typedef **gdsl_element_t**(* **gdsl_alloc_func_t**)(void *USER_DATA)
GDSL Alloc element function type.
- typedef void(* **gdsl_free_func_t**)(**gdsl_element_t** E)
GDSL Free element function type.
- typedef **gdsl_element_t**(* **gdsl_copy_func_t**)(const **gdsl_element_t** E)
GDSL Copy element function type.
- typedef int(* **gdsl_map_func_t**)(const **gdsl_element_t** E, **gdsl_location_t** LOCATION, void *USER_DATA)
GDSL Map element function type.
- typedef long int(* **gdsl_compare_func_t**)(const **gdsl_element_t** E, void *VALUE)
GDSL Comparison element function type.
- typedef void(* **gdsl_write_func_t**)(const **gdsl_element_t** E, FILE *OUTPUT_FILE, **gdsl_location_t** LOCATION, void *USER_DATA)
GDSL Write element function type.
- typedef unsigned long int **ulong**
- typedef unsigned short int **ushort**

Enumerations

- enum **gdsl_constant_t** { **GDSL_ERR_MEM_ALLOC** = -1, **GDSL_MAP_STOP** = 0, **GDSL_MAP_CONT** = 1, **GDSL_INSERTED**, **GDSL_FOUND** }
GDSL Constants.
- enum **gdsl_location_t** { **GDSL_LOCATION_UNDEF** = 0, **GDSL_LOCATION_HEAD** = 1, **GDSL_LOCATION_ROOT** = 1, **GDSL_LOCATION_TOP** = 1, **GDSL_LOCATION_TAIL** = 2, **GDSL_LOCATION_LEAF** = 2, **GDSL_LOCATION_BOTTOM** = 2, **GDSL_LOCATION_FIRST** = 1, **GDSL_LOCATION_LAST** = 2, **GDSL_LOCATION_FIRST_COL** = 1, **GDSL_LOCATION_LAST_COL** = 2, **GDSL_LOCATION_FIRST_ROW** = 4, **GDSL_LOCATION_LAST_ROW** = 8 }
- enum **bool** { **FALSE** = 0, **TRUE** = 1 }

4.18.1 Typedef Documentation

4.18.1.1 typedef void* **gdsl_element_t**

GDSL element type.

All GDSL internal data structures contains a field of this type. This field is for GDSL users to store their data into GDSL data structures.

Definition at line 128 of file `gdsl_types.h`.

4.18.1.2 `typedef gdsI_element_t(* gdsI_alloc_func_t)(void *USER_DATA)`

GDSDL Alloc element function type.

This function type is for allocating a new `gdsI_element_t` variable. The `USER_DATA` argument should be used to fill-in the new element.

Parameters

| | |
|------------------------|---|
| <code>USER_DATA</code> | user data used to create the new element. |
|------------------------|---|

Returns

the newly allocated element in case of success.
NULL in case of failure.

See also

`gdsI_free_func_t` (p. 235)

Definition at line 142 of file `gdsI_types.h`.

4.18.1.3 `typedef void(* gdsI_free_func_t)(gdsI_element_t E)`

GDSDL Free element function type.

This function type is for freeing a `gdsI_element_t` variable. The element must have been previously allocated by a function of `gdsI_alloc_func_t` type. A free function according to `gdsI_free_func_t` must free the resources allocated by the corresponding call to the function of type `gdsI_alloc_func_t`. The GDSDL functions doesn't check if `E != NULL` before calling this function.

Parameters

| | |
|----------------|----------------------------|
| <code>E</code> | The element to deallocate. |
|----------------|----------------------------|

See also

`gdsI_alloc_func_t` (p. 235)

Definition at line 160 of file `gdsI_types.h`.

4.18.1.4 `typedef gdsI_element_t(* gdsI_copy_func_t)(const gdsI_element_t E)`

GDSDL Copy element function type.

This function type is for copying `gdsI_element_t` variables.

Parameters

| | |
|----------|---|
| <i>E</i> | The <code>gdsl_element_t</code> variable to copy. |
|----------|---|

Returns

the copied element in case of success.
 NULL in case of failure.

Definition at line 173 of file `gdsl_types.h`.

4.18.1.5 `typedef int(* gdsl_map_func_t)(const gdsl_element_t E, gdsl_location_t LOCATION, void *USER_DATA)`

GDSL Map element function type.

This function type is for mapping a `gdsl_element_t` variable from a GDSL data structure. The optional `USER_DATA` could be used to do special thing if needed.

Parameters

| | |
|------------------|---|
| <i>E</i> | The actually mapped <code>gdsl_element_t</code> variable. |
| <i>LOCATION</i> | The location of <i>E</i> in the data structure. |
| <i>USER_DATA</i> | User's datas. |

Returns

`GDSL_MAP_STOP` if the mapping must be stopped.
`GDSL_MAP_CONT` if the mapping must be continued.

Definition at line 190 of file `gdsl_types.h`.

4.18.1.6 `typedef long int(* gdsl_compare_func_t)(const gdsl_element_t E, void *VALUE)`

GDSL Comparison element function type.

This function type is used to compare a `gdsl_element_t` variable with a user value. The *E* argument is always the one in the GDSL data structure, *VALUE* is always the one the user wants to compare *E* with.

Parameters

| | |
|--------------|---|
| <i>E</i> | The <code>gdsl_element_t</code> variable contained into the data structure to compare from. |
| <i>VALUE</i> | The user data to compare <i>E</i> with. |

Returns

- < 0 if E is assumed to be less than VALUE.
- 0 if E is assumed to be equal to VALUE.
- > 0 if E is assumed to be greather than VALUE.

Definition at line 211 of file gdsl_types.h.

4.18.1.7 `typedef void(* gdsI_write_func_t)(const gdsI_element_t E, FILE *OUTPUT_FILE, gdsI_location_t LOCATION, void *USER_DATA)`

GDSL Write element function type.

This function type is for writing a `gdsI_element_t` E to `OUTPUT_FILE`. Additional `USER_DATA` could be passed to it.

Parameters

| | |
|--------------------|--|
| <i>E</i> | The gdsI element to write. |
| <i>OUTPUT_FILE</i> | The file where to write E. |
| <i>LOCATION</i> | The location of E in the data structure. |
| <i>USER_DATA</i> | User's datas. |

Definition at line 227 of file gdsl_types.h.

4.18.1.8 `typedef unsigned long int ulong`

Definition at line 240 of file gdsl_types.h.

4.18.1.9 `typedef unsigned short int ushort`

Definition at line 244 of file gdsl_types.h.

4.18.2 Enumeration Type Documentation

4.18.2.1 `enum gdsI_constant_t`

GDSL Constants.

Enumerator:

- GDSL_ERR_MEM_ALLOC*** Memory allocation error
- GDSL_MAP_STOP*** For stopping a parsing function
- GDSL_MAP_CONT*** For continuing a parsing function
- GDSL_INSERTED*** To indicate an inserted value

GDSL_FOUND To indicate a founded value

Definition at line 46 of file gdsl_types.h.

4.18.2.2 enum gdsl_location_t

Enumerator:

GDSL_LOCATION_UNDEF Element position undefined
GDSL_LOCATION_HEAD Element is at head position
GDSL_LOCATION_ROOT Element is on leaf position
GDSL_LOCATION_TOP Element is at top position
GDSL_LOCATION_TAIL Element is at tail position
GDSL_LOCATION_LEAF Element is on root position
GDSL_LOCATION_BOTTOM Element is at bottom position
GDSL_LOCATION_FIRST Element is the first
GDSL_LOCATION_LAST Element is the last
GDSL_LOCATION_FIRST_COL Element is on first column
GDSL_LOCATION_LAST_COL Element is on last column
GDSL_LOCATION_FIRST_ROW Element is on first row
GDSL_LOCATION_LAST_ROW Element is on last row

Definition at line 67 of file gdsl_types.h.

4.18.2.3 enum bool

GDSL boolean type. Defines `_NO_LIBGDSL_TYPES_` at compilation time if you don't want them.

Enumerator:

FALSE FALSE boolean value
TRUE TRUE boolean value

Definition at line 265 of file gdsl_types.h.

Chapter 5

File Documentation

5.1 `_gdsl_bintree.h` File Reference

Typedefs

- typedef struct `_gdsl_bintree` * **`_gdsl_bintree_t`**
GDSL low-level binary tree type.
- typedef int(* **`_gdsl_bintree_map_func_t`**)(const **`_gdsl_bintree_t`** TREE, void *USER_DATA)
GDSL low-level binary tree map function type.
- typedef void(* **`_gdsl_bintree_write_func_t`**)(const **`_gdsl_bintree_t`** TREE, FILE *OUTPUT_FILE, void *USER_DATA)
GDSL low-level binary tree write function type.

Functions

- **`_gdsl_bintree_t _gdsl_bintree_alloc`** (const **`gdsl_element_t`** E, const **`_gdsl_bintree_t`** LEFT, const **`_gdsl_bintree_t`** RIGHT)
Create a new low-level binary tree.
- void **`_gdsl_bintree_free`** (**`_gdsl_bintree_t`** T, const **`gdsl_free_func_t`** FREE_F)
Destroy a low-level binary tree.
- **`_gdsl_bintree_t _gdsl_bintree_copy`** (const **`_gdsl_bintree_t`** T, const **`gdsl_copy_func_t`** COPY_F)
Copy a low-level binary tree.
- bool **`_gdsl_bintree_is_empty`** (const **`_gdsl_bintree_t`** T)
Check if a low-level binary tree is empty.
- bool **`_gdsl_bintree_is_leaf`** (const **`_gdsl_bintree_t`** T)
Check if a low-level binary tree is reduced to a leaf.
- bool **`_gdsl_bintree_is_root`** (const **`_gdsl_bintree_t`** T)

Check if a low-level binary tree is a root.

- **gdsl_element_t _gdsl_bintree_get_content** (const _gdsl_bintree_t T)
Get the root content of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_parent** (const _gdsl_bintree_t T)
Get the parent tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_left** (const _gdsl_bintree_t T)
Get the left sub-tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_get_right** (const _gdsl_bintree_t T)
Get the right sub-tree of a low-level binary tree.
- **_gdsl_bintree_t * _gdsl_bintree_get_left_ref** (const _gdsl_bintree_t T)
Get the left sub-tree reference of a low-level binary tree.
- **_gdsl_bintree_t * _gdsl_bintree_get_right_ref** (const _gdsl_bintree_t T)
Get the right sub-tree reference of a low-level binary tree.
- **ulong _gdsl_bintree_get_height** (const _gdsl_bintree_t T)
Get the height of a low-level binary tree.
- **ulong _gdsl_bintree_get_size** (const _gdsl_bintree_t T)
Get the size of a low-level binary tree.
- **void _gdsl_bintree_set_content** (_gdsl_bintree_t T, const gdsl_element_t E)
Set the root element of a low-level binary tree.
- **void _gdsl_bintree_set_parent** (_gdsl_bintree_t T, const _gdsl_bintree_t P)
Set the parent tree of a low-level binary tree.
- **void _gdsl_bintree_set_left** (_gdsl_bintree_t T, const _gdsl_bintree_t L)
Set left sub-tree of a low-level binary tree.
- **void _gdsl_bintree_set_right** (_gdsl_bintree_t T, const _gdsl_bintree_t R)
Set right sub-tree of a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_left** (_gdsl_bintree_t *T)
Left rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_right** (_gdsl_bintree_t *T)
Right rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_left_right** (_gdsl_bintree_t *T)
Left-right rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_rotate_right_left** (_gdsl_bintree_t *T)
Right-left rotate a low-level binary tree.
- **_gdsl_bintree_t _gdsl_bintree_map_prefix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in prefixed order.
- **_gdsl_bintree_t _gdsl_bintree_map_infix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in infix order.
- **_gdsl_bintree_t _gdsl_bintree_map_postfix** (const _gdsl_bintree_t T, const _gdsl_bintree_map_func_t MAP_F, void *USER_DATA)
Parse a low-level binary tree in postfix order.

- void **_gdsI_bintree_write** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of all nodes of a low-level binary tree to a file.
- void **_gdsI_bintree_write_xml** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a low-level binary tree to a file into XML.
- void **_gdsI_bintree_dump** (const **_gdsI_bintree_t** T, const **_gdsI_bintree_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a low-level binary tree to a file.

5.2 _gdsI_bstree.h File Reference

Typedefs

- typedef **_gdsI_bintree_t** **_gdsI_bstree_t**
GDSL low-level binary search tree type.
- typedef int(* **_gdsI_bstree_map_func_t**)(**_gdsI_bstree_t** TREE, void *USER_DATA)
GDSL low-level binary search tree map function type.
- typedef void(* **_gdsI_bstree_write_func_t**)(**_gdsI_bstree_t** TREE, FILE *OUTPUT_FILE, void *USER_DATA)
GDSL low-level binary search tree write function type.

Functions

- **_gdsI_bstree_t** **_gdsI_bstree_alloc** (const **gdsI_element_t** E)
Create a new low-level binary search tree.
- void **_gdsI_bstree_free** (**_gdsI_bstree_t** T, const **gdsI_free_func_t** FREE_F)
Destroy a low-level binary search tree.
- **_gdsI_bstree_t** **_gdsI_bstree_copy** (const **_gdsI_bstree_t** T, const **gdsI_copy_func_t** COPY_F)
Copy a low-level binary search tree.
- bool **_gdsI_bstree_is_empty** (const **_gdsI_bstree_t** T)
Check if a low-level binary search tree is empty.
- bool **_gdsI_bstree_is_leaf** (const **_gdsI_bstree_t** T)
Check if a low-level binary search tree is reduced to a leaf.
- **gdsI_element_t** **_gdsI_bstree_get_content** (const **_gdsI_bstree_t** T)
Get the root content of a low-level binary search tree.
- bool **_gdsI_bstree_is_root** (const **_gdsI_bstree_t** T)
Check if a low-level binary search tree is a root.
- **_gdsI_bstree_t** **_gdsI_bstree_get_parent** (const **_gdsI_bstree_t** T)
Get the parent tree of a low-level binary search tree.
- **_gdsI_bstree_t** **_gdsI_bstree_get_left** (const **_gdsI_bstree_t** T)

Get the left sub-tree of a low-level binary search tree.

- **`_gdsi_bstree_t _gdsi_bstree_get_right`** (const **`_gdsi_bstree_t`** T)

Get the right sub-tree of a low-level binary search tree.

- **`ulong _gdsi_bstree_get_size`** (const **`_gdsi_bstree_t`** T)

Get the size of a low-level binary search tree.

- **`ulong _gdsi_bstree_get_height`** (const **`_gdsi_bstree_t`** T)

Get the height of a low-level binary search tree.

- **`_gdsi_bstree_t _gdsi_bstree_insert`** (**`_gdsi_bstree_t`** *T, const **`gdsi_compare_func_t`** COMP_F, const **`gdsi_element_t`** VALUE, int *RESULT)

Insert an element into a low-level binary search tree if it's not found or return it.

- **`gdsi_element_t _gdsi_bstree_remove`** (**`_gdsi_bstree_t`** *T, const **`gdsi_compare_func_t`** COMP_F, const **`gdsi_element_t`** VALUE)

Remove an element from a low-level binary search tree.

- **`_gdsi_bstree_t _gdsi_bstree_search`** (const **`_gdsi_bstree_t`** T, const **`gdsi_compare_func_t`** COMP_F, const **`gdsi_element_t`** VALUE)

Search for a particular element into a low-level binary search tree.

- **`_gdsi_bstree_t _gdsi_bstree_search_next`** (const **`_gdsi_bstree_t`** T, const **`gdsi_compare_func_t`** COMP_F, const **`gdsi_element_t`** VALUE)

Search for the next element of a particular element into a low-level binary search tree, according to the binary search tree order.

- **`_gdsi_bstree_t _gdsi_bstree_map_prefix`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_map_func_t`** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in prefixed order.

- **`_gdsi_bstree_t _gdsi_bstree_map_infix`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_map_func_t`** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in infix order.

- **`_gdsi_bstree_t _gdsi_bstree_map_postfix`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_map_func_t`** MAP_F, void *USER_DATA)

Parse a low-level binary search tree in postfix order.

- **`void _gdsi_bstree_write`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_write_func_t`** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of all nodes of a low-level binary search tree to a file.

- **`void _gdsi_bstree_write_xml`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_write_func_t`** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a low-level binary search tree to a file into XML.

- **`void _gdsi_bstree_dump`** (const **`_gdsi_bstree_t`** T, const **`_gdsi_bstree_write_func_t`** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a low-level binary search tree to a file.

5.3 `_gdsi_list.h` File Reference

Typedefs

- typedef **`_gdsi_node_t _gdsi_list_t`**
GDSL low-level doubly-linked list type.

Functions

- **_gdsi_list_t _gdsi_list_alloc** (const **gdsi_element_t** E)
Create a new low-level list.
- **void _gdsi_list_free** (_gdsi_list_t L, const **gdsi_free_func_t** FREE_F)
Destroy a low-level list.
- **bool _gdsi_list_is_empty** (const _gdsi_list_t L)
Check if a low-level list is empty.
- **ulong _gdsi_list_get_size** (const _gdsi_list_t L)
Get the size of a low-level list.
- **void _gdsi_list_link** (_gdsi_list_t L1, _gdsi_list_t L2)
Link two low-level lists together.
- **void _gdsi_list_insert_after** (_gdsi_list_t L, _gdsi_list_t PREV)
Insert a low-level list after another one.
- **void _gdsi_list_insert_before** (_gdsi_list_t L, _gdsi_list_t SUCC)
Insert a low-level list before another one.
- **void _gdsi_list_remove** (_gdsi_node_t NODE)
Remove a node from a low-level list.
- **_gdsi_list_t _gdsi_list_search** (_gdsi_list_t L, const **gdsi_compare_func_t** COMP_F, void *VALUE)
Search for a particular node in a low-level list.
- **_gdsi_list_t _gdsi_list_map_forward** (const _gdsi_list_t L, const **gdsi_node_map_func_t** MAP_F, void *USER_DATA)
Parse a low-level list in forward order.
- **_gdsi_list_t _gdsi_list_map_backward** (const _gdsi_list_t L, const **gdsi_node_map_func_t** MAP_F, void *USER_DATA)
Parse a low-level list in backward order.
- **void _gdsi_list_write** (const _gdsi_list_t L, const **gdsi_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all nodes of a low-level list to a file.
- **void _gdsi_list_write_xml** (const _gdsi_list_t L, const **gdsi_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all nodes of a low-level list to a file into XML.
- **void _gdsi_list_dump** (const _gdsi_list_t L, const **gdsi_node_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a low-level list to a file.

5.4 _gdsi_node.h File Reference

Typedefs

- **typedef struct _gdsi_node * _gdsi_node_t**
GDSL low-level doubly linked node type.

- `typedef int(* _gdsi_node_map_func_t)(const _gdsi_node_t NODE, void *USER_DATA)`
GDSL low-level doubly-linked node map function type.
- `typedef void(* _gdsi_node_write_func_t)(const _gdsi_node_t NODE, FILE *OUTPUT_FILE, void *USER_DATA)`
GDSL low-level doubly-linked node write function type.

Functions

- `_gdsi_node_t _gdsi_node_alloc (void)`
Create a new low-level node.
- `gdsi_element_t _gdsi_node_free (_gdsi_node_t NODE)`
Destroy a low-level node.
- `_gdsi_node_t _gdsi_node_get_succ (const _gdsi_node_t NODE)`
Get the successor of a low-level node.
- `_gdsi_node_t _gdsi_node_get_pred (const _gdsi_node_t NODE)`
Get the predecessor of a low-level node.
- `gdsi_element_t _gdsi_node_get_content (const _gdsi_node_t NODE)`
Get the content of a low-level node.
- `void _gdsi_node_set_succ (_gdsi_node_t NODE, const _gdsi_node_t SUC-C)`
Set the successor of a low-level node.
- `void _gdsi_node_set_pred (_gdsi_node_t NODE, const _gdsi_node_t PRE-D)`
Set the predecessor of a low-level node.
- `void _gdsi_node_set_content (_gdsi_node_t NODE, const gdsi_element_t -CONTENT)`
Set the content of a low-level node.
- `void _gdsi_node_link (_gdsi_node_t NODE1, _gdsi_node_t NODE2)`
Link two low-level nodes together.
- `void _gdsi_node_unlink (_gdsi_node_t NODE1, _gdsi_node_t NODE2)`
Unlink two low-level nodes.
- `void _gdsi_node_write (const _gdsi_node_t NODE, const _gdsi_node_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)`
Write a low-level node to a file.
- `void _gdsi_node_write_xml (const _gdsi_node_t NODE, const _gdsi_node_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)`
Write a low-level node to a file into XML.
- `void _gdsi_node_dump (const _gdsi_node_t NODE, const _gdsi_node_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)`
Dump the internal structure of a low-level node to a file.

5.5 gdsl.h File Reference

Functions

- **const char * gdsl_get_version** (void)
Get GDSL version number as a string.

5.6 gdsl_2darray.h File Reference

Typedefs

- **typedef struct gdsl_2darray * gdsl_2darray_t**
GDSL 2D-array type.

Functions

- **gdsl_2darray_t gdsl_2darray_alloc** (const char *NAME, const **ulong** R, const **ulong** C, const **gdsl_alloc_func_t** ALLOC_F, const **gdsl_free_func_t** FREE_F)
Create a new 2D-array.
- **void gdsl_2darray_free** (gdsl_2darray_t A)
Destroy a 2D-array.
- **const char * gdsl_2darray_get_name** (const gdsl_2darray_t A)
Get the name of a 2D-array.
- **ulong gdsl_2darray_get_rows_number** (const gdsl_2darray_t A)
Get the number of rows of a 2D-array.
- **ulong gdsl_2darray_get_columns_number** (const gdsl_2darray_t A)
Get the number of columns of a 2D-array.
- **ulong gdsl_2darray_get_size** (const gdsl_2darray_t A)
Get the size of a 2D-array.
- **gdsl_element_t gdsl_2darray_get_content** (const gdsl_2darray_t A, const **ulong** R, const **ulong** C)
Get an element from a 2D-array.
- **gdsl_2darray_t gdsl_2darray_set_name** (gdsl_2darray_t A, const char *NEW_NAME)
Set the name of a 2D-array.
- **gdsl_element_t gdsl_2darray_set_content** (gdsl_2darray_t A, const **ulong** R, const **ulong** C, void *VALUE)
Modify an element in a 2D-array.
- **void gdsl_2darray_write** (const gdsl_2darray_t A, const **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a 2D-array to a file.

- void **gdsl_2darray_write_xml**(const **gdsl_2darray_t** A, const **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a 2D array to a file into XML.

- void **gdsl_2darray_dump**(const **gdsl_2darray_t** A, const **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a 2D array to a file.

5.7 gdsl_bstree.h File Reference

Typedefs

- typedef struct **gdsl_bstree** * **gdsl_bstree_t**

GDSL binary search tree type.

Functions

- **gdsl_bstree_t** **gdsl_bstree_alloc**(const char *NAME, **gdsl_alloc_func_t** ALL-OC_F, **gdsl_free_func_t** FREE_F, **gdsl_compare_func_t** COMP_F)

Create a new binary search tree.

- void **gdsl_bstree_free**(**gdsl_bstree_t** T)

Destroy a binary search tree.

- void **gdsl_bstree_flush**(**gdsl_bstree_t** T)

Flush a binary search tree.

- const char * **gdsl_bstree_get_name**(const **gdsl_bstree_t** T)

Get the name of a binary search tree.

- bool **gdsl_bstree_is_empty**(const **gdsl_bstree_t** T)

Check if a binary search tree is empty.

- **gdsl_element_t** **gdsl_bstree_get_root**(const **gdsl_bstree_t** T)

Get the root of a binary search tree.

- **ulong** **gdsl_bstree_get_size**(const **gdsl_bstree_t** T)

Get the size of a binary search tree.

- **ulong** **gdsl_bstree_get_height**(const **gdsl_bstree_t** T)

Get the height of a binary search tree.

- **gdsl_bstree_t** **gdsl_bstree_set_name**(**gdsl_bstree_t** T, const char *NEW_NAME)

Set the name of a binary search tree.

- **gdsl_element_t** **gdsl_bstree_insert**(**gdsl_bstree_t** T, void *VALUE, int *RESULT)

Insert an element into a binary search tree if it's not found or return it.

- **gdsl_element_t** **gdsl_bstree_remove**(**gdsl_bstree_t** T, void *VALUE)

Remove an element from a binary search tree.

- **gdsl_bstree_t** **gdsl_bstree_delete**(**gdsl_bstree_t** T, void *VALUE)

Delete an element from a binary search tree.

- **gdsl_element_t gdsl_bstree_search** (const **gdsl_bstree_t** T, **gdsl_compare_func_t** COMP_F, void *VALUE)
Search for a particular element into a binary search tree.
- **gdsl_element_t gdsl_bstree_map_prefix** (const **gdsl_bstree_t** T, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a binary search tree in prefixed order.
- **gdsl_element_t gdsl_bstree_map_infix** (const **gdsl_bstree_t** T, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a binary search tree in infix order.
- **gdsl_element_t gdsl_bstree_map_postfix** (const **gdsl_bstree_t** T, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a binary search tree in postfix order.
- **void gdsl_bstree_write** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the element of each node of a binary search tree to a file.
- **void gdsl_bstree_write_xml** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a binary search tree to a file into XML.
- **void gdsl_bstree_dump** (const **gdsl_bstree_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a binary search tree to a file.

5.8 gdsl_hash.h File Reference

Typedefs

- **typedef struct hash_table * gdsl_hash_t**
GDSL hashtable type.
- **typedef const char *(* gdsl_key_func_t)(void *VALUE)**
GDSL hashtable key function type.
- **typedef ulong(* gdsl_hash_func_t)(const char *KEY)**
GDSL hashtable hash function type.

Functions

- **ulong gdsl_hash** (const char *KEY)
Computes a hash value from a NULL terminated character string.
- **gdsl_hash_t gdsl_hash_alloc** (const char *NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F, **gdsl_key_func_t** KEY_F, **gdsl_hash_func_t** HASH_F, **ushort** INITIAL_ENTRIES_NB)
Create a new hashtable.
- **void gdsl_hash_free** (**gdsl_hash_t** H)
Destroy a hashtable.

- void **gdsI_hash_flush** (gdsI_hash_t H)
Flush a hashtable.
- const char * **gdsI_hash_get_name** (const gdsI_hash_t H)
Get the name of a hashtable.
- ushort **gdsI_hash_get_entries_number** (const gdsI_hash_t H)
Get the number of entries of a hashtable.
- ushort **gdsI_hash_get_lists_max_size** (const gdsI_hash_t H)
Get the max number of elements allowed in each entry of a hashtable.
- ushort **gdsI_hash_get_longest_list_size** (const gdsI_hash_t H)
Get the number of elements of the longest list entry of a hashtable.
- ulong **gdsI_hash_get_size** (const gdsI_hash_t H)
Get the size of a hashtable.
- double **gdsI_hash_get_fill_factor** (const gdsI_hash_t H)
Get the fill factor of a hashtable.
- gdsI_hash_t **gdsI_hash_set_name** (gdsI_hash_t H, const char *NEW_NAME)
Set the name of a hashtable.
- gdsI_element_t **gdsI_hash_insert** (gdsI_hash_t H, void *VALUE)
Insert an element into a hashtable (PUSH).
- gdsI_element_t **gdsI_hash_remove** (gdsI_hash_t H, const char *KEY)
Remove an element from a hashtable (POP).
- gdsI_hash_t **gdsI_hash_delete** (gdsI_hash_t H, const char *KEY)
Delete an element from a hashtable.
- gdsI_hash_t **gdsI_hash_modify** (gdsI_hash_t H, ushort NEW_ENTRIES_NB, ushort NEW_LISTS_MAX_SIZE)
Increase the dimensions of a hashtable.
- gdsI_element_t **gdsI_hash_search** (const gdsI_hash_t H, const char *KEY)
Search for a particular element into a hashtable (GET).
- gdsI_element_t **gdsI_hash_map** (const gdsI_hash_t H, gdsI_map_func_t MAP_F, void *USER_DATA)
Parse a hashtable.
- void **gdsI_hash_write** (const gdsI_hash_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of a hashtable to a file.
- void **gdsI_hash_write_xml** (const gdsI_hash_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a hashtable to a file into XML.
- void **gdsI_hash_dump** (const gdsI_hash_t H, gdsI_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a hashtable to a file.

5.9 gdsl_heap.h File Reference

Typedefs

- typedef struct heap * **gdsl_heap_t**
GDSL heap type.

Functions

- **gdsl_heap_t gdsl_heap_alloc** (const char *NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F, **gdsl_compare_func_t** COMP_F)
Create a new heap.
- void **gdsl_heap_free** (**gdsl_heap_t** H)
Destroy a heap.
- void **gdsl_heap_flush** (**gdsl_heap_t** H)
Flush a heap.
- const char * **gdsl_heap_get_name** (const **gdsl_heap_t** H)
Get the name of a heap.
- **ulong gdsl_heap_get_size** (const **gdsl_heap_t** H)
Get the size of a heap.
- **gdsl_element_t gdsl_heap_get_top** (const **gdsl_heap_t** H)
Get the top of a heap.
- **bool gdsl_heap_is_empty** (const **gdsl_heap_t** H)
Check if a heap is empty.
- **gdsl_heap_t gdsl_heap_set_name** (**gdsl_heap_t** H, const char *NEW_NAME)
Set the name of a heap.
- **gdsl_element_t gdsl_heap_set_top** (**gdsl_heap_t** H, void *VALUE)
Substitute the top element of a heap by a lesser one.
- **gdsl_element_t gdsl_heap_insert** (**gdsl_heap_t** H, void *VALUE)
Insert an element into a heap (PUSH).
- **gdsl_element_t gdsl_heap_remove_top** (**gdsl_heap_t** H)
Remove the top element from a heap (POP).
- **gdsl_heap_t gdsl_heap_delete_top** (**gdsl_heap_t** H)
Delete the top element from a heap.
- **gdsl_element_t gdsl_heap_map_forward** (const **gdsl_heap_t** H, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a heap.
- void **gdsl_heap_write** (const **gdsl_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of a heap to a file.
- void **gdsl_heap_write_xml** (const **gdsl_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a heap to a file into XML.

- void **gdsI_heap_dump** (const **gdsI_heap_t** H, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a heap to a file.

5.10 gdsI_interval_heap.h File Reference

Typedefs

- typedef struct heap * **gdsI_interval_heap_t**

GDSL interval heap type.

Functions

- **gdsI_interval_heap_t gdsI_interval_heap_alloc** (const char *NAME, **gdsI_alloc_func_t** ALLOC_F, **gdsI_free_func_t** FREE_F, **gdsI_compare_func_t** COMP_F)

Create a new interval heap.

- void **gdsI_interval_heap_free** (**gdsI_interval_heap_t** H)

Destroy an interval heap.

- void **gdsI_interval_heap_flush** (**gdsI_interval_heap_t** H)

Flush an interval heap.

- const char * **gdsI_interval_heap_get_name** (const **gdsI_interval_heap_t** H)

Get the name of an interval heap.

- **ulong gdsI_interval_heap_get_size** (const **gdsI_interval_heap_t** H)

Get the size of a interval heap.

- void **gdsI_interval_heap_set_max_size** (const **gdsI_interval_heap_t** H, **ulong** size)

Set the maximum size of the interval heap.

- **bool gdsI_interval_heap_is_empty** (const **gdsI_interval_heap_t** H)

Check if an interval heap is empty.

- **gdsI_interval_heap_t gdsI_interval_heap_set_name** (**gdsI_interval_heap_t** H, const char *NEW_NAME)

Set the name of an interval heap.

- **gdsI_element_t gdsI_interval_heap_insert** (**gdsI_interval_heap_t** H, void *VALUE)

Insert an element into an interval heap (PUSH).

- **gdsI_element_t gdsI_interval_heap_remove_max** (**gdsI_interval_heap_t** H)

Remove the maximum element from an interval heap (POP).

- **gdsI_element_t gdsI_interval_heap_remove_min** (**gdsI_interval_heap_t** H)

Remove the minimum element from an interval heap (POP).

- **gdsl_element_t gdsl_interval_heap_get_min** (const **gdsl_interval_heap_t** H)
Get the minimum element.
- **gdsl_element_t gdsl_interval_heap_get_max** (const **gdsl_interval_heap_t** H)
Get the maximum element.
- **gdsl_interval_heap_t gdsl_interval_heap_delete_min** (**gdsl_interval_heap_t** H)
Delete the minimum element from an interval heap.
- **gdsl_interval_heap_t gdsl_interval_heap_delete_max** (**gdsl_interval_heap_t** H)
Delete the maximum element from an interval heap.
- **gdsl_element_t gdsl_interval_heap_map_forward** (const **gdsl_interval_heap_t** H, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a interval heap.
- void **gdsl_interval_heap_write** (const **gdsl_interval_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of an interval heap to a file.
- void **gdsl_interval_heap_write_xml** (const **gdsl_interval_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of an interval heap to a file into XML.
- void **gdsl_interval_heap_dump** (const **gdsl_interval_heap_t** H, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of an interval heap to a file.

5.11 gdsl_list.h File Reference

Typedefs

- typedef struct _gdsl_list * **gdsl_list_t**
GDSL doubly-linked list type.
- typedef struct _gdsl_list_cursor * **gdsl_list_cursor_t**
GDSL doubly-linked list cursor type.

Functions

- **gdsl_list_t gdsl_list_alloc** (const char *NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F)
Create a new list.
- void **gdsl_list_free** (**gdsl_list_t** L)
Destroy a list.
- void **gdsl_list_flush** (**gdsl_list_t** L)
Flush a list.

- **const char * gdsi_list_get_name** (const **gdsi_list_t** L)
Get the name of a list.
- **ulong gdsi_list_get_size** (const **gdsi_list_t** L)
Get the size of a list.
- **bool gdsi_list_is_empty** (const **gdsi_list_t** L)
Check if a list is empty.
- **gdsi_element_t gdsi_list_get_head** (const **gdsi_list_t** L)
Get the head of a list.
- **gdsi_element_t gdsi_list_get_tail** (const **gdsi_list_t** L)
Get the tail of a list.
- **gdsi_list_t gdsi_list_set_name** (**gdsi_list_t** L, const char *NEW_NAME)
Set the name of a list.
- **gdsi_element_t gdsi_list_insert_head** (**gdsi_list_t** L, void *VALUE)
Insert an element at the head of a list.
- **gdsi_element_t gdsi_list_insert_tail** (**gdsi_list_t** L, void *VALUE)
Insert an element at the tail of a list.
- **gdsi_element_t gdsi_list_remove_head** (**gdsi_list_t** L)
Remove the head of a list.
- **gdsi_element_t gdsi_list_remove_tail** (**gdsi_list_t** L)
Remove the tail of a list.
- **gdsi_element_t gdsi_list_remove** (**gdsi_list_t** L, **gdsi_compare_func_t** COMP_F, const void *VALUE)
Remove a particular element from a list.
- **gdsi_list_t gdsi_list_delete_head** (**gdsi_list_t** L)
Delete the head of a list.
- **gdsi_list_t gdsi_list_delete_tail** (**gdsi_list_t** L)
Delete the tail of a list.
- **gdsi_list_t gdsi_list_delete** (**gdsi_list_t** L, **gdsi_compare_func_t** COMP_F, const void *VALUE)
Delete a particular element from a list.
- **gdsi_element_t gdsi_list_search** (const **gdsi_list_t** L, **gdsi_compare_func_t** COMP_F, const void *VALUE)
Search for a particular element into a list.
- **gdsi_element_t gdsi_list_search_by_position** (const **gdsi_list_t** L, ulong POS)
Search for an element by its position in a list.
- **gdsi_element_t gdsi_list_search_max** (const **gdsi_list_t** L, **gdsi_compare_func_t** COMP_F)
Search for the greatest element of a list.
- **gdsi_element_t gdsi_list_search_min** (const **gdsi_list_t** L, **gdsi_compare_func_t** COMP_F)
Search for the lowest element of a list.
- **gdsi_list_t gdsi_list_sort** (**gdsi_list_t** L, **gdsi_compare_func_t** COMP_F)
Sort a list.

- **gdsl_element_t gdsl_list_map_forward** (const **gdsl_list_t** L, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a list from head to tail.
- **gdsl_element_t gdsl_list_map_backward** (const **gdsl_list_t** L, **gdsl_map_func_t** MAP_F, void *USER_DATA)
Parse a list from tail to head.
- void **gdsl_list_write** (const **gdsl_list_t** L, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write all the elements of a list to a file.
- void **gdsl_list_write_xml** (const **gdsl_list_t** L, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a list to a file into XML.
- void **gdsl_list_dump** (const **gdsl_list_t** L, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a list to a file.
- **gdsl_list_cursor_t gdsl_list_cursor_alloc** (const **gdsl_list_t** L)
Create a new list cursor.
- void **gdsl_list_cursor_free** (**gdsl_list_cursor_t** C)
Destroy a list cursor.
- void **gdsl_list_cursor_move_to_head** (**gdsl_list_cursor_t** C)
Put a cursor on the head of its list.
- void **gdsl_list_cursor_move_to_tail** (**gdsl_list_cursor_t** C)
Put a cursor on the tail of its list.
- **gdsl_element_t gdsl_list_cursor_move_to_value** (**gdsl_list_cursor_t** C, **gdsl_compare_func_t** COMP_F, void *VALUE)
Place a cursor on a particular element.
- **gdsl_element_t gdsl_list_cursor_move_to_position** (**gdsl_list_cursor_t** C, **ulong** POS)
Place a cursor on a element given by its position.
- void **gdsl_list_cursor_step_forward** (**gdsl_list_cursor_t** C)
Move a cursor one step forward of its list.
- void **gdsl_list_cursor_step_backward** (**gdsl_list_cursor_t** C)
Move a cursor one step backward of its list.
- **bool gdsl_list_cursor_is_on_head** (const **gdsl_list_cursor_t** C)
Check if a cursor is on the head of its list.
- **bool gdsl_list_cursor_is_on_tail** (const **gdsl_list_cursor_t** C)
Check if a cursor is on the tail of its list.
- **bool gdsl_list_cursor_has_succ** (const **gdsl_list_cursor_t** C)
Check if a cursor has a successor.
- **bool gdsl_list_cursor_has_pred** (const **gdsl_list_cursor_t** C)
Check if a cursor has a predecessor.
- void **gdsl_list_cursor_set_content** (**gdsl_list_cursor_t** C, **gdsl_element_t** E)
Set the content of the cursor.

- **gdsl_element_t gsdl_list_cursor_get_content** (const **gsdl_list_cursor_t** C)
Get the content of a cursor.
- **gsdl_element_t gsdl_list_cursor_insert_after** (**gsdl_list_cursor_t** C, void *VALUE)
Insert a new element after a cursor.
- **gsdl_element_t gsdl_list_cursor_insert_before** (**gsdl_list_cursor_t** C, void *VALUE)
Insert a new element before a cursor.
- **gsdl_element_t gsdl_list_cursor_remove** (**gsdl_list_cursor_t** C)
Remove the element under a cursor.
- **gsdl_element_t gsdl_list_cursor_remove_after** (**gsdl_list_cursor_t** C)
Remove the element after a cursor.
- **gsdl_element_t gsdl_list_cursor_remove_before** (**gsdl_list_cursor_t** C)
Remove the element before a cursor.
- **gsdl_list_cursor_t gsdl_list_cursor_delete** (**gsdl_list_cursor_t** C)
Delete the element under a cursor.
- **gsdl_list_cursor_t gsdl_list_cursor_delete_after** (**gsdl_list_cursor_t** C)
Delete the element after a cursor.
- **gsdl_list_cursor_t gsdl_list_cursor_delete_before** (**gsdl_list_cursor_t** C)
Delete the element before the cursor of a list.

5.12 gsdl_macros.h File Reference

Defines

- #define **GDSL_MAX**(X, Y) (X>Y?X:Y)
Give the greatest number of two numbers.
- #define **GDSL_MIN**(X, Y) (X>Y?Y:X)
Give the lowest number of two numbers.

5.13 gsdl_perm.h File Reference

Typedefs

- typedef struct gsdl_perm * **gsdl_perm_t**
GDSL permutation type.
- typedef void(* **gsdl_perm_write_func_t**)(ulong E, FILE *OUTPUT_FILE, **gsdl_location_t** POSITION, void *USER_DATA)
GDSL permutation write function type.
- typedef struct gsdl_perm_data * **gsdl_perm_data_t**

Enumerations

- enum **gdsl_perm_position_t** { **GDSL_PERM_POSITION_FIRST** = 1, **GDSL_PERM_POSITION_LAST** = 2 }

This type is for `gdsl_perm_write_func_t`.

Functions

- **gdsl_perm_t** **gdsl_perm_alloc** (const char *NAME, const **ulong** N)
Create a new permutation.
- void **gdsl_perm_free** (**gdsl_perm_t** P)
Destroy a permutation.
- **gdsl_perm_t** **gdsl_perm_copy** (const **gdsl_perm_t** P)
Copy a permutation.
- const char * **gdsl_perm_get_name** (const **gdsl_perm_t** P)
Get the name of a permutation.
- **ulong** **gdsl_perm_get_size** (const **gdsl_perm_t** P)
Get the size of a permutation.
- **ulong** **gdsl_perm_get_element** (const **gdsl_perm_t** P, const **ulong** INDIX)
Get the (INDIX+1)-th element from a permutation.
- **ulong** * **gdsl_perm_get_elements_array** (const **gdsl_perm_t** P)
Get the array elements of a permutation.
- **ulong** **gdsl_perm_linear_inversions_count** (const **gdsl_perm_t** P)
Count the inversions number into a linear permutation.
- **ulong** **gdsl_perm_linear_cycles_count** (const **gdsl_perm_t** P)
Count the cycles number into a linear permutation.
- **ulong** **gdsl_perm_canonical_cycles_count** (const **gdsl_perm_t** P)
Count the cycles number into a canonical permutation.
- **gdsl_perm_t** **gdsl_perm_set_name** (**gdsl_perm_t** P, const char *NEW_NAME)
Set the name of a permutation.
- **gdsl_perm_t** **gdsl_perm_linear_next** (**gdsl_perm_t** P)
Get the next permutation from a linear permutation.
- **gdsl_perm_t** **gdsl_perm_linear_prev** (**gdsl_perm_t** P)
Get the previous permutation from a linear permutation.
- **gdsl_perm_t** **gdsl_perm_set_elements_array** (**gdsl_perm_t** P, const **ulong** *ARRAY)
Initialize a permutation with an array of values.
- **gdsl_perm_t** **gdsl_perm_multiply** (**gdsl_perm_t** RESULT, const **gdsl_perm_t** ALPHA, const **gdsl_perm_t** BETA)
Multiply two permutations.
- **gdsl_perm_t** **gdsl_perm_linear_to_canonical** (**gdsl_perm_t** Q, const **gdsl_perm_t** P)
Convert a linear permutation to its canonical form.

- **gdsl_perm_t gsdl_perm_canonical_to_linear** (gsdl_perm_t Q, const gsdl_perm_t P)
Convert a canonical permutation to its linear form.
- **gsdl_perm_t gsdl_perm_inverse** (gsdl_perm_t P)
Inverse in place a permutation.
- **gsdl_perm_t gsdl_perm_reverse** (gsdl_perm_t P)
Reverse in place a permutation.
- **gsdl_perm_t gsdl_perm_randomize** (gsdl_perm_t P)
Randomize a permutation.
- **gsdl_element_t * gsdl_perm_apply_on_array** (gsdl_element_t *V, const gsdl_perm_t P)
Apply a permutation on to a vector.
- void **gsdl_perm_write** (const gsdl_perm_t P, const gsdl_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the elements of a permutation to a file.
- void **gsdl_perm_write_xml** (const gsdl_perm_t P, const gsdl_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the elements of a permutation to a file into XML.
- void **gsdl_perm_dump** (const gsdl_perm_t P, const gsdl_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a permutation to a file.

5.14 gsdl_queue.h File Reference

Typedefs

- typedef struct _gsdl_queue * **gsdl_queue_t**
GDSL queue type.

Functions

- **gsdl_queue_t gsdl_queue_alloc** (const char *NAME, gsdl_alloc_func_t ALL_OC_F, gsdl_free_func_t FREE_F)
Create a new queue.
- void **gsdl_queue_free** (gsdl_queue_t Q)
Destroy a queue.
- void **gsdl_queue_flush** (gsdl_queue_t Q)
Flush a queue.
- const char * **gsdl_queue_get_name** (const gsdl_queue_t Q)
Get the name of a queue.
- **ulong gsdl_queue_get_size** (const gsdl_queue_t Q)
Get the size of a queue.
- **bool gsdl_queue_is_empty** (const gsdl_queue_t Q)

Check if a queue is empty.

- **gdsI_element_t gdsI_queue_get_head** (const **gdsI_queue_t** Q)

Get the head of a queue.

- **gdsI_element_t gdsI_queue_get_tail** (const **gdsI_queue_t** Q)

Get the tail of a queue.

- **gdsI_queue_t gdsI_queue_set_name** (**gdsI_queue_t** Q, const char *NEW_NAME)

Set the name of a queue.

- **gdsI_element_t gdsI_queue_insert** (**gdsI_queue_t** Q, void *VALUE)

Insert an element in a queue (PUT).

- **gdsI_element_t gdsI_queue_remove** (**gdsI_queue_t** Q)

Remove an element from a queue (GET).

- **gdsI_element_t gdsI_queue_search** (const **gdsI_queue_t** Q, **gdsI_compare_func_t** COMP_F, void *VALUE)

Search for a particular element in a queue.

- **gdsI_element_t gdsI_queue_search_by_position** (const **gdsI_queue_t** Q, **ulong** POS)

Search for an element by its position in a queue.

- **gdsI_element_t gdsI_queue_map_forward** (const **gdsI_queue_t** Q, **gdsI_map_func_t** MAP_F, void *USER_DATA)

Parse a queue from head to tail.

- **gdsI_element_t gdsI_queue_map_backward** (const **gdsI_queue_t** Q, **gdsI_map_func_t** MAP_F, void *USER_DATA)

Parse a queue from tail to head.

- void **gdsI_queue_write** (const **gdsI_queue_t** Q, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write all the elements of a queue to a file.

- void **gdsI_queue_write_xml** (const **gdsI_queue_t** Q, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a queue to a file into XML.

- void **gdsI_queue_dump** (const **gdsI_queue_t** Q, **gdsI_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a queue to a file.

5.15 gdsI_rbtrees.h File Reference

Typedefs

- typedef struct **gdsI_rbtrees** * **gdsI_rbtrees_t**

Functions

- **gdsl_rbtrees_t gsdl_rbtrees_alloc** (const char *NAME, gsdl_alloc_func_t ALL-OC_F, gsdl_free_func_t FREE_F, gsdl_compare_func_t COMP_F)
Create a new red-black tree.
- void **gsdl_rbtrees_free** (gsdl_rbtrees_t T)
Destroy a red-black tree.
- void **gsdl_rbtrees_flush** (gsdl_rbtrees_t T)
Flush a red-black tree.
- char * **gsdl_rbtrees_get_name** (const gsdl_rbtrees_t T)
Get the name of a red-black tree.
- bool **gsdl_rbtrees_is_empty** (const gsdl_rbtrees_t T)
Check if a red-black tree is empty.
- gsdl_element_t **gsdl_rbtrees_get_root** (const gsdl_rbtrees_t T)
Get the root of a red-black tree.
- ulong **gsdl_rbtrees_get_size** (const gsdl_rbtrees_t T)
Get the size of a red-black tree.
- ulong **gsdl_rbtrees_height** (const gsdl_rbtrees_t T)
Get the height of a red-black tree.
- gsdl_rbtrees_t **gsdl_rbtrees_set_name** (gsdl_rbtrees_t T, const char *NEW_NAME)
Set the name of a red-black tree.
- gsdl_element_t **gsdl_rbtrees_insert** (gsdl_rbtrees_t T, void *VALUE, int *RESULT)
Insert an element into a red-black tree if it's not found or return it.
- gsdl_element_t **gsdl_rbtrees_remove** (gsdl_rbtrees_t T, void *VALUE)
Remove an element from a red-black tree.
- gsdl_rbtrees_t **gsdl_rbtrees_delete** (gsdl_rbtrees_t T, void *VALUE)
Delete an element from a red-black tree.
- gsdl_element_t **gsdl_rbtrees_search** (const gsdl_rbtrees_t T, gsdl_compare_func_t COMP_F, void *VALUE)
Search for a particular element into a red-black tree.
- gsdl_element_t **gsdl_rbtrees_map_prefix** (const gsdl_rbtrees_t T, gsdl_map_func_t MAP_F, void *USER_DATA)
Parse a red-black tree in prefixed order.
- gsdl_element_t **gsdl_rbtrees_map_infix** (const gsdl_rbtrees_t T, gsdl_map_func_t MAP_F, void *USER_DATA)
Parse a red-black tree in infix order.
- gsdl_element_t **gsdl_rbtrees_map_postfix** (const gsdl_rbtrees_t T, gsdl_map_func_t MAP_F, void *USER_DATA)
Parse a red-black tree in postfix order.
- void **gsdl_rbtrees_write** (const gsdl_rbtrees_t T, gsdl_write_func_t WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the element of each node of a red-black tree to a file.

- void **gdsl_rbtrees_write_xml** (const **gdsl_rbtrees_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Write the content of a red-black tree to a file into XML.
- void **gdsl_rbtrees_dump** (const **gdsl_rbtrees_t** T, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)
Dump the internal structure of a red-black tree to a file.

5.16 gdsl_sort.h File Reference

Functions

- void **gdsl_sort** (**gdsl_element_t** *T, **ulong** N, const **gdsl_compare_func_t** COMP_F)
Sort an array in place.

5.17 gdsl_stack.h File Reference

Typedefs

- typedef struct _gdsl_stack * **gdsl_stack_t**
GDSL stack type.

Functions

- **gdsl_stack_t** **gdsl_stack_alloc** (const char *NAME, **gdsl_alloc_func_t** ALLOC_F, **gdsl_free_func_t** FREE_F)
Create a new stack.
- void **gdsl_stack_free** (**gdsl_stack_t** S)
Destroy a stack.
- void **gdsl_stack_flush** (**gdsl_stack_t** S)
Flush a stack.
- const char * **gdsl_stack_get_name** (const **gdsl_stack_t** S)
Get the name of a stack.
- **ulong** **gdsl_stack_get_size** (const **gdsl_stack_t** S)
Get the size of a stack.
- **ulong** **gdsl_stack_get_growing_factor** (const **gdsl_stack_t** S)
Get the growing factor of a stack.
- **bool** **gdsl_stack_is_empty** (const **gdsl_stack_t** S)
Check if a stack is empty.
- **gdsl_element_t** **gdsl_stack_get_top** (const **gdsl_stack_t** S)
Get the top of a stack.
- **gdsl_element_t** **gdsl_stack_get_bottom** (const **gdsl_stack_t** S)

Get the bottom of a stack.

- **gdsl_stack_t** **gdsl_stack_set_name** (**gdsl_stack_t** S, const char *NEW_NAME)

Set the name of a stack.

- void **gdsl_stack_set_growing_factor** (**gdsl_stack_t** S, **ulong** G)

Set the growing factor of a stack.

- **gdsl_element_t** **gdsl_stack_insert** (**gdsl_stack_t** S, void *VALUE)

Insert an element in a stack (PUSH).

- **gdsl_element_t** **gdsl_stack_remove** (**gdsl_stack_t** S)

Remove an element from a stack (POP).

- **gdsl_element_t** **gdsl_stack_search** (const **gdsl_stack_t** S, **gdsl_compare_func_t** COMP_F, void *VALUE)

Search for a particular element in a stack.

- **gdsl_element_t** **gdsl_stack_search_by_position** (const **gdsl_stack_t** S, **ulong** POS)

Search for an element by its position in a stack.

- **gdsl_element_t** **gdsl_stack_map_forward** (const **gdsl_stack_t** S, **gdsl_map_func_t** MAP_F, void *USER_DATA)

Parse a stack from bottom to top.

- **gdsl_element_t** **gdsl_stack_map_backward** (const **gdsl_stack_t** S, **gdsl_map_func_t** MAP_F, void *USER_DATA)

Parse a stack from top to bottom.

- void **gdsl_stack_write** (const **gdsl_stack_t** S, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write all the elements of a stack to a file.

- void **gdsl_stack_write_xml** (**gdsl_stack_t** S, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Write the content of a stack to a file into XML.

- void **gdsl_stack_dump** (**gdsl_stack_t** S, **gdsl_write_func_t** WRITE_F, FILE *OUTPUT_FILE, void *USER_DATA)

Dump the internal structure of a stack to a file.

5.18 gdsl_types.h File Reference

Typedefs

- typedef void * **gdsl_element_t**
GDSL element type.
- typedef **gdsl_element_t**(* **gdsl_alloc_func_t**)(void *USER_DATA)
GDSL Alloc element function type.
- typedef void(* **gdsl_free_func_t**)(**gdsl_element_t** E)
GDSL Free element function type.
- typedef **gdsl_element_t**(* **gdsl_copy_func_t**)(const **gdsl_element_t** E)

GDSL Copy element function type.

- typedef int(* **gdsl_map_func_t**)(const **gdsl_element_t** E, **gdsl_location_t** LOCATION, void *USER_DATA)

GDSL Map element function type.

- typedef long int(* **gdsl_compare_func_t**)(const **gdsl_element_t** E, void *VALUE)

GDSL Comparison element function type.

- typedef void(* **gdsl_write_func_t**)(const **gdsl_element_t** E, FILE *OUTPUT_FILE, **gdsl_location_t** LOCATION, void *USER_DATA)

GDSL Write element function type.

- typedef unsigned long int **ulong**
- typedef unsigned short int **ushort**

Enumerations

- enum **gdsl_constant_t** { **GDSL_ERR_MEM_ALLOC** = -1, **GDSL_MAP_STOP** = 0, **GDSL_MAP_CONT** = 1, **GDSL_INSERTED**, **GDSL_FOUND** }

GDSL Constants.

- enum **gdsl_location_t** { **GDSL_LOCATION_UNDEF** = 0, **GDSL_LOCATION_HEAD** = 1, **GDSL_LOCATION_ROOT** = 1, **GDSL_LOCATION_TOP** = 1, **GDSL_LOCATION_TAIL** = 2, **GDSL_LOCATION_LEAF** = 2, **GDSL_LOCATION_BOTTOM** = 2, **GDSL_LOCATION_FIRST** = 1, **GDSL_LOCATION_LAST** = 2, **GDSL_LOCATION_FIRST_COL** = 1, **GDSL_LOCATION_LAST_COL** = 2, **GDSL_LOCATION_FIRST_ROW** = 4, **GDSL_LOCATION_LAST_ROW** = 8 }
- enum **bool** { **FALSE** = 0, **TRUE** = 1 }

5.19 mainpage.h File Reference

Chapter 6

Example Documentation

6.1 examples/main_bstree.c

This is an example of how to use `gdsl_bstree` module.

```
/*
 * This file is part of the Generic Data Structures Library (GDSL).
 * Copyright (C) 1998-2017 Nicolas Darnis <ndarnis@free.fr>.
 *
 * GDSL is free software: you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation, either version 3 of the License, or
 * (at your option) any later version.
 *
 * GDSL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with GDSL. If not, see <http://www.gnu.org/licenses/>.
 *
 * $RCSfile: main_bstree.c,v $
 * $Revision: 1.19 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#include "gdsl_perm.h"
#include "gdsl_bstree.h"
#include "_strings.h"
#include "_integers.h"
```

```
#define N 100

int main (int argc, char *argv[])
{
    int choice;
    char name[50];
    gds_l_bstree_t t = gds_l_bstree_alloc ("MY BSTREE", alloc_string, free_string
        , compare_strings);

    do
    {
        printf ("\t\tMENU - BSTREE\n\n");
        printf ("\t 1> Insert\n");
        printf ("\t 2> Remove\n");
        printf ("\t 3> Flush\n");
        printf ("\t 4> Root content\n");
        printf ("\t 5> Size\n");
        printf ("\t 6> Height\n");
        printf ("\t 7> Search\n");
        printf ("\t 8> Display\n");
        printf ("\t 9> XML display\n");
        printf ("\t10> Dump\n");
        printf ("\t11> Insertion of a random permutation\n");
        printf ("\t 0> Quit\n\n");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choice);

        switch (choice)
        {
            case 1:
            {
                int rc;

                printf ("Enter a string: ");
                scanf ("%s", name);

                gds_l_bstree_insert (t, (void*) name, &rc);

                if (rc == GDSL_FOUND)
                {
                    printf ("%s' is already into the tree\n", name);
                }
                else if (rc == GDSL_ERR_MEM_ALLOC)
                {
                    printf ("memory allocation error\n");
                }
            }
            break;

            case 2:
            if (gds_l_bstree_is_empty (t))
            {
                printf ("The tree is empty.\n");
            }
            else
            {
                printf ("Enter a string: ");
                scanf ("%s", name);

                if (gds_l_bstree_delete (t, (void *) name))
```



```
        {
            printf ("String '%s' removed from the tree\n", name);
        }
        else
        {
            printf ("String '%s' not found\n", name);
        }
    }
    break;

case 3:
    gdsl_bstree_flush (t);
    break;

case 4:
    if (gdsl_bstree_is_empty (t))
    {
        printf ("The tree is empty.\n");
    }
    else
    {
        print_string (gdsl_bstree_get_root (t), stdout,
GDSL_LOCATION_UNDEF, " \n");
    }
    break;

case 5:
    printf ("Tree's size: %lu\n", gdsl_bstree_get_size (t));
    break;

case 6:
    printf ("Tree's height: %lu\n", gdsl_bstree_get_height (t));
    break;

case 7:
    printf ("Enter a string: ");
    scanf ("%s", name);

    if (gdsl_bstree_search (t, NULL, (void *) name))
    {
        printf ("String '%s' found\n", name);
    }
    else
    {
        printf ("String '%s' not found\n", name);
    }
    break;

case 8:
    if (gdsl_bstree_is_empty (t))
    {
        printf ("The tree is empty.\n");
    }
    else
    {
        printf ("Tree's content: ");
        gdsl_bstree_write (t, print_string, stdout, NULL);
        printf ("\n");
    }
    break;

case 9:
```

```

        gds1_bstree_write_xml (t, print_string, stdout, NULL);
        break;

    case 10:
        gds1_bstree_dump (t, print_string, stdout, NULL);
        break;

    case 11:
        {
            int i;
            int rc;
            gds1_perm_t p = gds1_perm_alloc ("p", N);
            gds1_bstree_t nt = gds1_bstree_alloc ("INTEGERS", alloc_integer,
            free_integer, compare_integers);

            gds1_perm_randomize (p);

            for (i = 0; i < N; i++)
            {
                int n = gds1_perm_get_element (p, i);
                gds1_bstree_insert (nt, &n, &rc);
            }

            printf ("Tree's height: %lu\n", gds1_bstree_get_height (nt));
            gds1_bstree_dump (nt, print_integer, stdout, (void*) "");

            gds1_bstree_free (nt);
            gds1_perm_free (p);
        }
        break;
    }
}
while (choice != 0);

gds1_bstree_free (t);

exit (EXIT_SUCCESS);
}

```

6.2 examples/main_hash.c

This is an example of how to use gds1_hash module.

```

/*
 * This file is part of the Generic Data Structures Library (GDSL).
 * Copyright (C) 1998-2017 Nicolas Darnis <ndarnis@free.fr>.
 *
 * GDSL is free software: you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation, either version 3 of the License, or
 * (at your option) any later version.
 *
 * GDSL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
 * GNU General Public License for more details.
 *

```

```
* You should have received a copy of the GNU General Public License
* along with GDSDL.  If not, see <http://www.gnu.org/licenses/>.
*
* $RCSfile: main_hash.c,v $
* $Revision: 1.25 $
* $Date: 2015/02/17 12:33:16 $
*/

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <mcheck.h>

#include "gdsl_types.h"
#include "gdsl_hash.h"
#include "_strings.h"

#define SIZE 11 /* Should be prime number !! */

struct _my_struct
{
    int integer;
    char*string;
};
typedef struct _my_struct* my_struct;

static gdsl_element_t
my_struct_alloc (void* d)
{
    static int n = 0;

    my_struct e = (my_struct) malloc (sizeof (struct _my_struct));
    if (e == NULL)
    {
        return NULL;
    }

    e->integer = n++;
    e->string = strdup ((char*) d);

    return (gdsl_element_t) e;
}

static void
my_struct_free (gdsl_element_t e)
{
    my_struct s = (my_struct) e;
    free (s->string);
    free (s);
}

static void
my_struct_printf (gdsl_element_t e, FILE* file, gdsl_location_t location, void*
d)
{

```

```

    my_struct s = (my_struct) e;
    fprintf (file, "%d:%s ", s->integer, s->string);
}

const char*
my_struct_key (gds1_element_t e)
{
    my_struct s = (my_struct) e;
    return s->string;
}

int main (void)
{
    int          choice;
    gds1_hash_t ht;

    mtrace ();

    ht = gds1_hash_alloc ("MY HASH TABLE", my_struct_alloc, my_struct_free,
        my_struct_key, NULL, SIZE);
    if (ht == NULL)
    {
        fprintf (stderr, "%s:%d: %s - gds1_hash_alloc(): NULL",
            __FILE__, __LINE__, __FUNCTION__);
        exit (EXIT_FAILURE);
    }

    do
    {
        printf ("\t\tMENU - HASH\n\n");
        printf ("\t1> Insert\n");
        printf ("\t2> Search\n");
        printf ("\t3> Remove\n");
        printf ("\t4> Display\n");
        printf ("\t5> Flush\n");
        printf ("\t6> Fill factor\n");
        printf ("\t7> Dump\n");
        printf ("\t8> XML display\n");
        printf ("\t0> Quit\n\n");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choice);

        switch (choice)
        {
        case 1:
            {
                char nom[50];

                printf ("String: ");
                scanf ("%s", nom);

                if (gds1_hash_insert (ht, (void*) nom) == NULL)
                {
                    printf ("ERROR: Insert failed!\n");
                }
            }
            break;

        case 2:
            {
                char nom[50];
                gds1_element_t e;

```

```
    printf ("String: ");
    scanf ("%s", nom);

    e = gdsl_hash_search (ht, nom);
    if (e == NULL)
    {
        printf ("String '%s' doesn't exist\n", nom);
    }
    else
    {
        printf ("String '%s' found\n", nom);
    }
}
break;

case 3:
{
    char nom[50];
    gdsl_element_t e;

    printf ("String: ");
    scanf ("%s", nom);

    e = gdsl_hash_remove (ht, nom);
    if (e == NULL)
    {
        printf ("String '%s' doesn't exist\n", nom);
    }
    else
    {
        free_string (e);
    }
}
break;

case 4:
    gdsl_hash_write (ht, my_struct_printf, stdout, " ");
    printf ("\n");
    break;

case 5:
    gdsl_hash_flush (ht);
    break;

case 6:
    printf ("Fill factor: %g\n", gdsl_hash_get_fill_factor (ht));
    break;

case 7:
    gdsl_hash_dump (ht, my_struct_printf, stdout, NULL);
    break;

case 8:
    gdsl_hash_write_xml (ht, my_struct_printf, stdout, NULL);
    break;
}
while (choice != 0);

gdsl_hash_free (ht);
```

```

    exit (EXIT_SUCCESS);
}

```

6.3 examples/main_heap.c

This is an example of how to use gds_l_heap module.

```

/*
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 *
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 * along with GDSL. If not, see <http://www.gnu.org/licenses/>.
 *
 * $RCSfile: main_heap.c,v $
 * $Revision: 1.13 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "gds_l_types.h"
#include "gds_l_heap.h"

#include "_integers.h"

static int
my_display_integer (const gds_l_element_t e, gds_l_location_t location,
                   void* user_infos)
{
    printf ("%s%s%ld ",
            (location & GDSL_LOCATION_ROOT) ? "[root]: " : "",
            (location & GDSL_LOCATION_LEAF) ? "[leaf]: " : "",
            *(long int*) e);
    return GDSL_MAP_CONT;
}

int main (void)

```

```

{
    int choix = 0;
    gdsl_heap_t h = gdsl_heap_alloc ("H", alloc_integer, free_integer,
        compare_integers);

    do
    {
        printf ("\t\tMENU - HEAP\n\n");
        printf ("\t1> Push: insert an element\n");
        printf ("\t2> Pop: remove max element\n");
        printf ("\t3> Get: peek max element\n");
        printf ("\t4> Set: substitute max element\n");
        printf ("\t5> Flush\n");
        printf ("\t6> Remove: *** NOT YET IMPLEMENTED ***\n");
        printf ("\t7> Display\n");
        printf ("\t8> Dump\n");
        printf ("\t9> XML display\n");
        printf ("\t0> Quit\n\n");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choix);

        switch (choix)
        {
            case 1:
            {
                int value;

                printf ("Enter integer value: ");
                scanf ("%d", &value);
                gdsl_heap_insert (h, (void*) &value);
            }
            break;

            case 2:
                if (!gdsl_heap_is_empty (h))
                {
                    gdsl_heap_delete_top (h);
                }
                else
                {
                    printf ("The heap '%s' is empty\n", gdsl_heap_get_name (h));
                }
                break;

            case 3:
            {
                long int* top;

                if (!gdsl_heap_is_empty (h))
                {
                    top = (long int*) gdsl_heap_get_top (h);
                    printf ("Value = %ld\n", *top);
                }
                else
                {
                    printf ("The heap '%s' is empty\n", gdsl_heap_get_name (h));
                }
            }
            break;

            case 4:
            {

```

```

int value;
long int* v;

printf ("Enter integer value: ");
scanf ("%d", &value);
v = (long int*) gds1_heap_set_top (h, (void*) &value);
if (v == NULL)
{
    printf ("value is greather than all other heap ones\n");
}
else
{
    printf ("old value was: %ld\n", *v);
    free_integer (v);
}
}
break;

case 5:
if (gds1_heap_is_empty (h))
{
    printf ("The heap '%s' is empty\n", gds1_heap_get_name (h));
}
else
{
    gds1_heap_flush (h);
}
break;
/*
case 6:
{
    int pos;
    long int* value;
    printf ("Enter an integer value to search: ");
    scanf ("%d", &pos);

    value = (long int*) gds1_heap_remove (h, &pos);
    if (value == NULL)
    {
        printf ("Not found\n");
    }
    else
    {
        printf ("Value removed %ld\n", *value);
        free_integer (value);
    }
}
break;
*/
case 7:
if (gds1_heap_is_empty (h))
{
    printf ("The heap '%s' is empty\n", gds1_heap_get_name (h));
}
else
{
    printf ("%s = ( ", gds1_heap_get_name (h));
    gds1_heap_map_forward (h, my_display_integer, NULL);
    printf (")\n");
}
break;

```



```

        case 8:
            gdsl_heap_dump (h, print_integer, stdout, NULL);
            break;

        case 9:
            gdsl_heap_write_xml (h, print_integer, stdout, NULL);
            break;
    }
}
while (choix != 0);

gdsl_heap_free (h);

exit (EXIT_SUCCESS);
}

```

6.4 examples/main_interval_heap.c

This is an example of how to use `gdsl_interval_heap` module.

```

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 *
 * $RCSfile: main_interval_heap.c,v $
 * $Revision: 1.3 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <assert.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "gdsl_types.h"
#include "gdsl_interval_heap.h"

#include "_integers.h"

```

```

static int
my_display_integer (const gds_l_element_t e, gds_l_location_t location,
                    void* user_infos)
{
    //printf ("user_info: %d\n", *(int *)user_infos);
    printf ("%s%s%d ",
            (location & GDSL_LOCATION_ROOT) ? "[root]: " : "",
            (location & GDSL_LOCATION_LEAF) ? "[leaf]: " : "",
            *(long int*) e);
    return GDSL_MAP_CONT;
}

void insert_value(gds_l_interval_heap_t h, long int a) {
    //int value = rand() % 20;
    long int *value = malloc(sizeof(int));
    //value = rand() % 20;
    *value = a;
    //printf("inserting value: %d\n", *value);
    gds_l_interval_heap_insert(h, (void *) value);
    //gds_l_raw_heap_dump(h);
    //gds_l_check_interval_heap_integrity(h);
}

long *remove_max(gds_l_interval_heap_t h) {
    long *value;
    //printf("removing max\n");
    //gds_l_raw_heap_dump(h);
    value = gds_l_interval_heap_remove_max(h);
    //printf("removed value: %x %d\n", value, *value);
    //gds_l_raw_heap_dump(h);
    //gds_l_check_interval_heap_integrity(h);

    return value;
}

long *remove_min(gds_l_interval_heap_t h) {
    long *value;
    //printf("removing min\n");
    //gds_l_raw_heap_dump(h);
    value = gds_l_interval_heap_remove_min(h);
    //printf("removed value: %x %d\n", value, *value);
    //gds_l_raw_heap_dump(h);
    //gds_l_check_interval_heap_integrity(h);

    return value;
}

void test1() {
    gds_l_interval_heap_t h = gds_l_interval_heap_alloc ("H", alloc_integer,
        free_integer, compare_integers);

    insert_value(h, 2);
    insert_value(h, 30);
    insert_value(h, 3);
    insert_value(h, 20);
    insert_value(h, 4);
    insert_value(h, 25);
    insert_value(h, 8);
    insert_value(h, 16);
    insert_value(h, 4);
    //exit(0);
}

```

```
insert_value(h, 10);
insert_value(h, 10);
insert_value(h, 15);
insert_value(h, 5);
insert_value(h, 12);
insert_value(h, 8);
insert_value(h, 16);
insert_value(h, 9);
insert_value(h, 15);
insert_value(h, 5);

insert_value(h, 1);
insert_value(h, 25);

remove_min(h);

remove_max(h);

remove_min(h);
remove_min(h);
remove_min(h);
remove_min(h);

gdsl_interval_heap_flush(h);

assert(gdsl_interval_heap_get_size(h) == 0);

gdsl_interval_heap_free (h);
}

void test2() {
    gdsl_interval_heap_t h = gdsl_interval_heap_alloc ("H", alloc_integer,
        free_integer, compare_integers);

    gdsl_interval_heap_flush(h);

    insert_value(h, 2);
    insert_value(h, 2);
    insert_value(h, 2);

    //remove_min(h);
    remove_max(h);
    remove_max(h);
    remove_max(h);
    //remove_min(h);
    //remove_min(h);

    assert(gdsl_interval_heap_get_size(h) == 0);

    gdsl_interval_heap_free (h);
}

void check_removed(long **removed, int len) {
    int i, j;
    for (i = 0; i < len; i++) {
        for (j = i+1; j < len; j++) {
            assert(removed[i] != removed[j]);
        }
    }

    //printf("checked removed\n");
}
```

```
}

void test3() {
    int i, len=2000;
    long *e;
    gds1_interval_heap_t h = gds1_interval_heap_alloc ("H", alloc_integer,
        free_integer, compare_integers);
    gds1_interval_heap_flush(h);
    long **removed = malloc(len * sizeof(long *));

    for (i = 0; i < len; i++) {
        insert_value(h, rand() % 20);
    }

    for (i = 0; i < len/2; i++) {
        if (i % 2 == 0)
            e = remove_min(h);
        else
            e = remove_max(h);

        removed[i] = e;
    }

    check_removed(removed, len/2);

    for (i = 0; i < len/2; i++) {
        insert_value(h, rand() % 20);
    }

    for (i = 0; i < len; i++) {
        if (i % 2 == 0)
            e = remove_min(h);
        else
            e = remove_max(h);

        removed[i] = e;
    }

    check_removed(removed, len/2);

    assert(gds1_interval_heap_get_size(h) == 0);
    gds1_interval_heap_free (h);
}

int test4() {
    int i = 0, len = 20000;

    gds1_interval_heap_t h = gds1_interval_heap_alloc ("H", alloc_integer,
        free_integer, compare_integers);
    gds1_interval_heap_flush(h);

    for (i = 0; i < len; i++) {
        if (rand() % 2 == 0) {
            insert_value(h, rand() % 40);
        } else {
            if (gds1_interval_heap_get_size(h) > 1) {
                if (rand() % 2 == 0)
                    remove_min(h);
                else
                    remove_max(h);
            }
        }
    }
}
```

```
    }

}

//assert(gdsl_interval_heap_get_size(h) == 0);
gdsl_interval_heap_free (h);
}

int main (void)
{
    //test2();
    //test3();
    test4();
    exit (EXIT_SUCCESS);
}
```

6.5 examples/main_list.c

This is an example of how to use `gdsl_list` module.

```
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 *
 * $RCSfile: main_list.c,v $
 * $Revision: 1.19 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "gdsl_perm.h"
#include "gdsl_types.h"
#include "gdsl_list.h"
#include "_strings.h"
#include "_integers.h"
```

```
#define PERMUTATION_NB 26

static void
affiche_liste_chaines_fwd (gdsl_list_t l)
{
    gdsl_element_t e;
    gdsl_list_cursor_t c = gdsl_list_cursor_alloc (l);

    printf ("%s (->) = ( ", gdsl_list_get_name (l));

    for (gdsl_list_cursor_move_to_head (c); (e = gdsl_list_cursor_get_content (
        c)); gdsl_list_cursor_step_forward (c))
    {
        print_string (e, stdout, GDSL_LOCATION_UNDEF, (void*) " ");
    }

    printf (")\n");

    gdsl_list_cursor_free (c);
}

static int
my_display_string (gdsl_element_t e, gdsl_location_t location, void* d)
{
    print_string (e, stdout, location, d);
    return GDSL_MAP_CONT;
}

static void
affiche_liste_chaines_bwd (gdsl_list_t l)
{
    printf ("%s (<-) = ( ", gdsl_list_get_name (l));

    gdsl_list_map_backward (l, my_display_string, (void*) " ");

    printf (")\n");
}

int main (void)
{
    int choix = 0;

    gdsl_list_t l = gdsl_list_alloc ("MY LIST", alloc_string, free_string);

    do
    {
        printf ("\t\tMENU - LIST\n\n");
        printf ("\t 1> Create a cell\n");
        printf ("\t 2> Remove the first cell\n");
        printf ("\t 3> Remove the last cell\n");
        printf ("\t 4> Remove a cell\n");
        printf ("\t 5> Display list in forward order\n");
        printf ("\t 6> Display list in backward order\n");
        printf ("\t 7> Flush list\n");
        printf ("\t 8> Size of list\n");
        printf ("\t 9> Dump list\n");
        printf ("\t10> XML dump of list\n");
        printf ("\t11> Search for a place\n");
        printf ("\t12> Search for an element\n");
        printf ("\t13> Sort of list\n");
    }
```

```

printf ("\t14> Greatest element of list\n");
printf ("\t 0> Quit\n\n");
printf ("\t\tYour choice: ");
scanf ("%d", &choix);

switch (choix)
{
case 1:
{
char nom[100];
int done = 0;

printf ("Nom: ");
scanf ("%s", nom);

do
{
int choix;

printf ("\t\tMENU - CELL INSERTION\n\n");
printf ("\t1> Insert cell at the beginning of the list\n");
printf ("\t2> Insert cell at end of list\n");
printf ("\t3> Insert cell after another cell\n");
printf ("\t4> Insert cell before another cell\n");
printf ("\t5> Display the list\n");
printf ("\t0> RETURN TO MAIN MENU\n\n");
printf ("\t\tYour choice: ");
scanf ("%d", &choix );

switch (choix)
{
case 1:
{
gdsl_list_insert_head (l, nom);
done = 1;
}
break;

case 2:
{
gdsl_list_insert_tail (l, nom);
done = 1;
}
break;

case 3:
if (gdsl_list_is_empty (l))
{
printf ("The list is empty.\n");
}
else
{
char Nom[100];
gdsl_list_cursor_t c = gdsl_list_cursor_alloc (l);

printf ("Name of cell after which you want to insert: ");

scanf ("%s", Nom);

if (!gdsl_list_cursor_move_to_value (c, compare_strings
, Nom))
{

```

```

        printf ("The cell '%s' doesn't exist\n", Nom);
    }
    else
    {
        gdsl_list_cursor_insert_after (c, nom);
        done = 1;
    }
    gdsl_list_cursor_free (c);
}
break;

case 4:
if (gdsl_list_is_empty (l))
{
    printf ("The list is empty.\n");
}
else
{
    char Nom[100];
    gdsl_list_cursor_t c = gdsl_list_cursor_alloc (l);

    printf ("Name of cell before which you want to insert:
");

    scanf ("%s", Nom);

    if (!gdsl_list_cursor_move_to_value (c, compare_strings
, Nom))
    {
        printf ("The cell '%s' doesn't exist\n", Nom);
    }
    else
    {
        gdsl_list_cursor_insert_before (c, nom);
        done = 1;
    }
    gdsl_list_cursor_free (c);
}
break;

case 5:
if (gdsl_list_is_empty (l))
{
    printf ("The list is empty.\n");
}
else
{
    affiche_liste_chaines_fwd (l);
}
break;

case 0:
done = 1;
break;
}
}
while (!done);
}
break;

case 2:
if (gdsl_list_is_empty (l))
{

```



```
        printf ("The list is empty.\n");
    }
    else
    {
        gdsl_list_delete_head (l);
    }
    break;

case 3:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        gdsl_list_delete_tail (l);
    }
    break;

case 4:
    {
        char nom[100];

        if (gdsl_list_is_empty (l))
        {
            printf ("The list is empty.\n");
        }
        else
        {
            printf ("Name of cell to remove: ");
            scanf ("%s", nom);

            if (!gdsl_list_delete (l, compare_strings, nom))
            {
                printf ("The cell '%s' doesn't exist\n", nom);
            }
            else
            {
                printf ("The cell '%s' is removed from list\n", nom);
            }
        }
    }
    break;

case 5:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        affiche_liste_chaines_fwd (l);
    }
    break;

case 6:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {

```

```
        affiche_liste_chaines_bwd (l);
    }
    break;

case 7:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        gdsl_list_flush (l);
    }
    break;

case 8:
    printf ("Card( %s ) = %ld\n", gdsl_list_get_name (l),
gdsl_list_get_size (l));
    break;

case 9:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        gdsl_list_dump (l, print_string, stdout, NULL);
    }
    break;

case 10:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        gdsl_list_write_xml (l, print_string, stdout, NULL);
    }
    break;

case 11:
    {
        int pos;
        gdsl_element_t e;

        printf ("Enter the position of the place to search for: ");
        scanf ("%d", & pos);

        e = gdsl_list_search_by_position (l, (ulong) pos);
        if (e != NULL)
        {
            print_string (e, stdout, GDSL_LOCATION_UNDEF, NULL);
        }
    }
    break;

case 12:
    {
        char nom [100];
        gdsl_element_t e;
```

```

printf ("Name of cell to search for: ");
scanf ("%s", nom);

e = gdsl_list_search (l, compare_strings, nom);
if (e == NULL)
{
    printf ("The cell '%s' doesn't exist\n", nom);
}
else
{
    printf ("The cell '%s' was found: ", nom);
    print_string (e, stdout, GDSL_LOCATION_UNDEF, NULL);
    printf ("\n");
}
}
break;

case 13:
    gdsl_list_sort (l, compare_strings);
    break;

case 14:
    if (gdsl_list_is_empty (l))
    {
        printf ("The list is empty.\n");
    }
    else
    {
        printf ("Max Element: %s\n", (char*) gdsl_list_search_max (l,
compare_strings));
    }
    break;

case 15: /* case for my own tests... */
{
    int i;
    gdsl_perm_t p = gdsl_perm_alloc ("p", PERMUTATION_NB);
    gdsl_list_t g = gdsl_list_alloc ("MY LIST 2", alloc_string,
free_string);

    gdsl_perm_randomize (p);

    for (i = 0; i < PERMUTATION_NB; i++)
    {
        char c[2];
        c[0] = 65 + gdsl_perm_get_element (p, i);
        c[1] = '\0';
        gdsl_list_insert_tail (g, c);
    }

    gdsl_perm_free (p);
    affiche_liste_chaines_fwd (g);
    affiche_liste_chaines_bwd (g);
    printf ("SORT\n");
    gdsl_list_sort (g, compare_strings);
    affiche_liste_chaines_fwd (g);
    affiche_liste_chaines_bwd (g);
    gdsl_list_free (g);
}

{

```

```

        int i = 0;
        gdsl_list_cursor_t c = gdsl_list_cursor_alloc (1);

        for (gdsl_list_cursor_move_to_head (c); gdsl_list_cursor_get_content
(c); gdsl_list_cursor_step_forward (c))
        {
            char toto[50];
            sprintf (toto, "%d", i++);

            gdsl_list_cursor_insert_before (c, toto);

            gdsl_list_cursor_step_backward (c);
            gdsl_list_cursor_delete_after (c);
        }

        gdsl_list_cursor_free (c);
    }
    break;
}
}
while (choix != 0);

gdsl_list_free (l);

exit (EXIT_SUCCESS);
}

```

6.6 examples/main_llbintree.c

This is an example of how to use `_gdsl_bintree` module.

```

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 *
 * $RCSfile: main_llbintree.c,v $
 * $Revision: 1.14 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

```

```

#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#include "_gdsl_bintree.h"
#include "_strings.h"

static void
my_write_string (const _gdsl_bintree_t tree, FILE* file, void* d)
{
    gdsl_element_t e = _gdsl_bintree_get_content (tree);

    if (d == NULL)
    {
        fprintf (file, "%s", (char*) e);
    }
    else
    {
        fprintf (file, "%s%s", (char*) e, (char*) d);
    }
}

static int
my_map_string (const _gdsl_bintree_t t, void* d)
{
    my_write_string (t, stdout, d);
    return GDSL_MAP_CONT;
}

int main (void)
{
    _gdsl_bintree_t g, d, t, t1, t2, copy;

    g = _gdsl_bintree_alloc ((gdsl_element_t) "b", NULL, NULL);
    d = _gdsl_bintree_alloc ((gdsl_element_t) "o", NULL, NULL);
    t1 = _gdsl_bintree_alloc ((gdsl_element_t) "n", g, d);
    g = _gdsl_bintree_alloc ((gdsl_element_t) "j", NULL, NULL);
    d = _gdsl_bintree_alloc ((gdsl_element_t) "o", NULL, NULL);
    t2 = _gdsl_bintree_alloc ((gdsl_element_t) "u", g, d);
    t = _gdsl_bintree_alloc ((gdsl_element_t) "r", t1, t2);

    printf ("T:\n");
    _gdsl_bintree_write_xml (t, my_write_string, stdout, NULL);

    copy = _gdsl_bintree_copy (t, copy_string);
    printf ("COPY OF T: \n");
    _gdsl_bintree_dump (copy, my_write_string, stdout, NULL);

    _gdsl_bintree_rotate_left (&t);
    _gdsl_bintree_rotate_right (&t);
    _gdsl_bintree_rotate_right (&t);
    _gdsl_bintree_rotate_left (&t);

    printf ("\nT in prefixed order: ");
    _gdsl_bintree_map_prefix (t, my_map_string, (void*) " ");
    printf ("\nT in infix order: ");
    _gdsl_bintree_map_infix (t, my_map_string, (void*) " ");
    printf ("\nT in postfix order: ");
    _gdsl_bintree_map_postfix (t, my_map_string, (void*) " ");
}

```

```

    printf ("\n\nCOPY OF T in prefixed order: ");
    _gdsl_bintree_map_prefix (copy, my_map_string, (void*) " ");
    printf ("\nCOPY OF T in infix order: ");
    _gdsl_bintree_map_infix (copy, my_map_string, (void*) " ");
    printf ("\nCOPY OF T in postfix order: ");
    _gdsl_bintree_map_postfix (copy, my_map_string, (void*) " ");
    printf ("\n\n");

    _gdsl_bintree_free (copy, free_string);
    _gdsl_bintree_free (t, NULL);

    exit (EXIT_SUCCESS);
}

```

6.7 examples/main_llbtree.c

This is an example of how to use `_gdsl_bstree` module.

```

/*
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 *
 * $RCSfile: main_llbtree.c,v $
 * $Revision: 1.13 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#include "gdsl_perm.h"
#include "_gdsl_bstree.h"
#include "_integers.h"
#include "_strings.h"

#define N 100

```

```

static void
my_write_string (const _gdsl_bstree_t tree, FILE* file, void* d)
{
    gdsl_element_t e = _gdsl_bstree_get_content (tree);

    if (d == NULL)
    {
        fprintf (file, "%s", (char*) e);
    }
    else
    {
        fprintf (file, "%s%s", (char*) e, (char*) d);
    }
}

static void
my_write_integer (const _gdsl_bstree_t tree, FILE* file, void* d)
{
    gdsl_element_t e = _gdsl_bstree_get_content (tree);
    long int** n = (long int**) e;

    if (d == NULL)
    {
        fprintf (file, "%ld", (long int) *n);
    }
    else
    {
        fprintf (file, "%ld%s", (long int) *n, (char*) d);
    }
}

int main (void)
{
    int rc;
    _gdsl_bstree_t t;

    printf ("Inserting 'a' in T... ");
    t = _gdsl_bstree_alloc ((gdsl_element_t) "a");
    if (t != NULL)
    {
        printf ("OK\n");
    }

    printf ("Inserting 'b' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "b", &rc);
    if (rc == 0)
    {
        printf ("OK\n");
    }

    /* Voluntary insertion of an existing element: */
    printf ("Inserting ALREADY EXISTING 'a' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "a", &rc);
    if (rc == GDSL_FOUND)
    {
        printf ("KO: a already exists in T\n");
    }

    printf ("Inserting 'c' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "c", &rc);
    if (rc == 0)
    {

```

```

        printf ("OK\n");
    }

    printf ("Inserting 'd' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "d", &rc);
    if (rc == 0)
    {
        printf ("OK\n");
    }

    printf ("Inserting 'e' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "e", &rc);
    if (rc == 0)
    {
        printf ("OK\n");
    }

    printf ("Inserting 'f' in T... ");
    _gdsl_bstree_insert (&t, compare_strings, "f", &rc);
    if (rc == 0)
    {
        printf ("OK\n");
    }

    printf ("T:\n");

    _gdsl_bstree_write_xml (t, my_write_string, stdout, NULL);
    _gdsl_bstree_free (t, NULL);

    {
        int i;
        gdsl_perm_t p = gdsl_perm_alloc ("p", N);
        _gdsl_bstree_t t = NULL;

        gdsl_perm_randomize (p);

        for (i = 0; i < N; i++)
        {
            int n = gdsl_perm_get_element (p, i);

            _gdsl_bstree_insert (&t, compare_integers, alloc_integer (&n), &rc);
        }

        _gdsl_bstree_write_xml (t, my_write_integer, stdout, "");
        _gdsl_bstree_free (t, free_integer);
        gdsl_perm_free (p);
    }

    exit (EXIT_SUCCESS);
}

```

6.8 examples/main_llist.c

This is an example of how to use `_gdsl_list` module.

```

/*
 * This file is part of the Generic Data Structures Library (GDSL).

```



```

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*
* $RCSfile: main_lllist.c,v $
* $Revision: 1.13 $
* $Date: 2015/02/17 12:33:16 $
*/

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "_gdsl_list.h"
#include "_strings.h"

static void
my_node_write (const _gdsl_node_t n, FILE* file, void* data)
{
    gdsl_element_t e = _gdsl_node_get_content (n);

    if (data == NULL)
    {
        fprintf (file, "%s", (char*) e);
    }
    else
    {
        fprintf (file, "%s%s", (char*) e, (char*) data);
    }
}

static int
my_node_map (const _gdsl_node_t n, void* data)
{
    my_node_write (n, stdout, data);
    return GDSL_MAP_CONT;
}

int main (void)
{
    _gdsl_list_t a = _gdsl_list_alloc (alloc_string ("a"));
    _gdsl_list_t b = _gdsl_list_alloc (alloc_string ("b"));
    _gdsl_list_t c = _gdsl_list_alloc (alloc_string ("c"));

    _gdsl_list_link (a, b);

```

```

_gdsl_list_link (b, c);

printf ("WRITE (%ld elements):\n", _gdsl_list_get_size (a));
_gdsl_list_write (a, my_node_write, stdout, NULL);

printf ("\n\nDUMP:\n");
_gdsl_list_dump (a, my_node_write, stdout, NULL);

printf ("\nWRITE XML:\n");
_gdsl_list_write_xml (a, my_node_write, stdout, NULL);

printf ("\nMAP FORWARD:\n");
_gdsl_list_map_forward (a, my_node_map, NULL);
printf ("\n");

printf ("\nMAP BACKWARD:\n");
_gdsl_list_map_backward (a, my_node_map, NULL);
printf ("\n");

_gdsl_list_free (a, free_string);

exit (EXIT_SUCCESS);
}

```

6.9 examples/main_perm.c

This is an example of how to use `gdsl_perm` module.

```

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 *
 * $RCSfile: main_perm.c,v $
 * $Revision: 1.19 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <stdlib.h>

```

```

#include "gdsl_types.h"
#include "gdsl_perm.h"
#include "_integers.h"

static void
usage (void)
{
    printf ("Usage: perm <n>\n");
}

static void
write (const gds_l_element_t e, FILE* file, gds_l_location_t pos, void* user_data
)
{
    ulong n = * (ulong*) e;

    if (pos & GDSL_LOCATION_FIRST)
    {
        fprintf (file, "( ");

        if (pos & GDSL_LOCATION_LAST)
        {
            fprintf (file, "%ld )\n", n);
        }
    }

    if (pos & GDSL_LOCATION_LAST)
    {
        fprintf (file, "%ld )\n", n);
    }
    else
    {
        fprintf (file, "%ld, ", n);
    }
}

int main (int argc, char* argv [])
{
    ulong i, n;
    gds_l_perm_t l_alpha;
    gds_l_perm_t c_alpha;

    if (argc < 2)
    {
        usage ();
        return EXIT_FAILURE;
    }

    n = atoi (argv[1]);

    c_alpha = gds_l_perm_alloc ("c_alpha", n);

    l_alpha = gds_l_perm_alloc ("l_alpha", n);
    gds_l_perm_randomize (l_alpha);

    printf ("alpha          = ");
    gds_l_perm_write (l_alpha, write, stdout, NULL);
    printf ("          %ld cycles, %ld inversions\n\n",
        gds_l_perm_linear_cycles_count (l_alpha),
        gds_l_perm_linear_inversions_count (l_alpha));
}

```

```

gdsl_perm_reverse (l_alpha);

printf ("~alpha      = ");
gdsl_perm_write (l_alpha, write, stdout, NULL);
printf ("          %ld cycles, %ld inversions\n\n",
        gdsl_perm_linear_cycles_count (l_alpha),
        gdsl_perm_linear_inversions_count (l_alpha));

gdsl_perm_reverse (l_alpha);
gdsl_perm_inverse (l_alpha);

printf ("alpha^-1     = ");
gdsl_perm_write (l_alpha, write, stdout, NULL);
printf ("          %ld cycles, %ld inversions\n\n",
        gdsl_perm_linear_cycles_count (l_alpha),
        gdsl_perm_linear_inversions_count (l_alpha));

gdsl_perm_inverse (l_alpha);

printf ("alpha          = ");
gdsl_perm_write (l_alpha, write, stdout, NULL);
printf ("          %ld cycles, %ld inversions\n\n",
        gdsl_perm_linear_cycles_count (l_alpha),
        gdsl_perm_linear_inversions_count (l_alpha));

gdsl_perm_linear_to_canonical (c_alpha, l_alpha);
printf ("cycles(alpha) = ");
gdsl_perm_write (c_alpha, write, stdout, NULL);
printf ("          %ld cycles\n\n",
        gdsl_perm_canonical_cycles_count (c_alpha));

gdsl_perm_canonical_to_linear (l_alpha, c_alpha);

printf ("alpha          = ");
gdsl_perm_write (l_alpha, write, stdout, NULL);
printf ("          %ld cycles, %ld inversions\n\n",
        gdsl_perm_linear_cycles_count (l_alpha),
        gdsl_perm_linear_inversions_count (l_alpha));

gdsl_perm_free (l_alpha);
gdsl_perm_free (c_alpha);

{
  ulong v [] = {0, 2, 3, 1, 4, 5, 6, 7, 8};
  ulong n = sizeof (v) / sizeof (v [0]);
  gdsl_perm_t a = gdsl_perm_alloc ("a", n);

  printf ("initial array: ");
  for (i = 0; i < n; i++)
    {
      printf ("%ld ", v [i]);
    }
  printf ("\n");

  gdsl_perm_randomize (a);
  printf ("applying permutation: ");
  gdsl_perm_write (a, write, stdout, NULL);
  gdsl_perm_apply_on_array ((gdsl_element_t*) v, a);
  gdsl_perm_free (a);

  printf ("modified array: ");

```

```

    for (i = 0; i < n; i++)
    {
        printf ("%ld ", v [i]);
    }
    printf ("\n");
}

exit (EXIT_SUCCESS);
}

```

6.10 examples/main_queue.c

This is an example of how to use `gdsl_queue` module.

```

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 *
 * $RCSfile: main_queue.c,v $
 * $Revision: 1.13 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "gdsl_types.h"
#include "gdsl_queue.h"

#include "_integers.h"

static void
my_write_integer (gdsl_element_t e, FILE* file, gdsl_location_t location, void*
d)
{
    int value = * (int*) e;

```

```

        if (location & GDSL_LOCATION_HEAD)
        {
            fprintf (file, "( %d", value);
        }
        else
        {
            fprintf (file, " %d", value);
        }

        if (location & GDSL_LOCATION_TAIL)
        {
            fprintf (file, " )\n");
        }
    }

static int
my_display_integer (gdsl_element_t e, gdsl_location_t location, void* d)
{
    my_write_integer (e, stdout, location, d);
    return GDSL_MAP_CONT;
}

int main (void)
{
    int choice = 0;
    gdsl_queue_t q = gdsl_queue_alloc ("Q", alloc_integer, free_integer);

    do
    {
        printf ("\t\tMENU - QUEUE\n\n");
        printf ("\t1> Put\n");
        printf ("\t2> Pop\n");
        printf ("\t3> Get Head\n");
        printf ("\t4> Get Tail\n");
        printf ("\t5> Flush\n");
        printf ("\t6> Search\n");
        printf ("\t7> Display\n");
        printf ("\t8> Dump\n");
        printf ("\t9> XML display\n");
        printf ("\t0> Quit\n\n ");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choice );

        switch (choice)
        {
            case 1:
            {
                int value;
                printf ("Enter an integer value: ");
                scanf ("%d", &value);
                gdsl_queue_insert (q, (void*) &value);
            }
            break;

            case 2:
            if (!gdsl_queue_is_empty (q))
            {
                int* value = (int*) gdsl_queue_remove (q);
                printf ("Value: %d\n", *value);
                free_integer (value);
            }
        }
    }

```

```
        else
        {
            printf ("The queue '%s' is empty\n", gdsl_queue_get_name (q));
        }
        break;

    case 3:
    {
        if (!gdsl_queue_is_empty (q))
        {
            int head = *(int*) gdsl_queue_get_head (q);
            printf ("Head = %d\n", head);
        }
        else
        {
            printf ("The queue '%s' is empty\n", gdsl_queue_get_name (q));
        }
    }
    break;

    case 4:
    {
        if (!gdsl_queue_is_empty (q))
        {
            int tail = *(int*) gdsl_queue_get_tail (q);
            printf ("Tail = %d\n", tail);
        }
        else
        {
            printf ("The queue '%s' is empty\n", gdsl_queue_get_name (q));
        }
    }
    break;

    case 5:
    {
        if (gdsl_queue_is_empty (q))
        {
            printf ("The queue '%s' is empty\n", gdsl_queue_get_name (q));
        }
        else
        {
            gdsl_queue_flush (q);
        }
    }
    break;

    case 6:
    {
        int pos;
        int* value;
        printf ("Enter an integer value to search an element by its\nposition: ");
        scanf ("%d", &pos);

        value = (int*) gdsl_queue_search_by_position (q, pos);
        if (value != NULL)
        {
            printf ("Value found at position %d = %d\n", pos, *value);
        }
    }
    break;

    case 7:
```

```

        if (gdsl_queue_is_empty (q))
        {
            printf ("The queue '%s' is empty\n", gdsl_queue_get_name (q));
        }
        else
        {
            printf ("%s = ", gdsl_queue_get_name (q));
            gdsl_queue_map_forward (q, my_display_integer, NULL);
        }
        break;

    case 8:
        gdsl_queue_dump (q, my_write_integer, stdout, NULL);
        break;

    case 9:
        gdsl_queue_write_xml (q, my_write_integer, stdout, NULL);
        break;
    }
}
while (choice != 0);

gdsl_queue_free (q);

exit (EXIT_SUCCESS);
}

```

6.11 examples/main_rbtrees.c

This is an example of how to use gdsl_rbtrees module.

```

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 *
 * $RCSfile: main_rbtrees.c,v $
 * $Revision: 1.20 $
 * $Date: 2015/02/17 12:33:16 $
 */

#include <config.h>

```



```

#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#include "gdsl_perm.h"
#include "gdsl_types.h"
#include "gdsl_rbtrees.h"
#include "_strings.h"
#include "_integers.h"

#define N 100

static int
infix_map_f (const gdsl_element_t e,
             gdsl_location_t location,
             void* user_data)
{
    printf ("%s ", (char*) e);
    if (strcmp ((char*) e, "STOP") == 0) return GDSL_MAP_STOP;
    return GDSL_MAP_CONT;
}

int main (void)
{
    int choice;
    char name[50];
    gdsl_rbtrees_t t = gdsl_rbtrees_alloc ("STRINGS", alloc_string, free_string,
                                           compare_strings);

    do
    {
        printf ("\t\tMENU - RBTREE\n\n");
        printf ("\t 1> Insert\n");
        printf ("\t 2> Remove\n");
        printf ("\t 3> Flush\n");
        printf ("\t 4> Root's content\n");
        printf ("\t 5> Size\n");
        printf ("\t 6> Height\n");
        printf ("\t 7> Search\n");
        printf ("\t 8> Display\n");
        printf ("\t 9> XML display\n");
        printf ("\t10> Dump\n");
        printf ("\t11> Insertion of a random permutation\n");
        printf ("\t12> Prefix parse (stop if 'STOP' is found as a value)\n");
        printf ("\t13> Infix parse (stop if 'STOP' is found as a value)\n");
        printf ("\t14> Postfix parse (stop if 'STOP' is found as a value)\n");
        printf ("\t 0> Quit\n\n");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choice);

        switch (choice)
        {
            case 1:
            {
                int rc;

                printf ("Enter a string: ");
                scanf ("%s", name);

                gdsl_rbtrees_insert (t, (void *) name, &rc);
            }
        }
    }
    while (choice != 0);
}

```

```
    if (rc == GDSDL_FOUND)
    {
        printf ("'%s' is already into the tree\n", name);
    }

    if (rc == GDSDL_ERR_MEM_ALLOC)
    {
        printf ("memory allocation error\n");
    }
}
break;

case 2:
    if (gdsl_rbtrees_is_empty (t))
    {
        printf ("The tree is empty\n");
    }
    else
    {
        printf ("Enter a string: ");
        scanf ("%s", name);

        if (gdsl_rbtrees_delete (t, (void*) name))
        {
            printf ("String '%s' removed from the tree\n", name);
        }
        else
        {
            printf ("String '%s' not found\n", name);
        }
    }
    break;

case 3:
    gdsl_rbtrees_flush (t);
    break;

case 4:
    if (gdsl_rbtrees_is_empty (t))
    {
        printf ("The tree is empty\n");
    }
    else
    {
        print_string ((char*) gdsl_rbtrees_get_root (t), stdout,
GDSDL_LOCATION_ROOT, (void*) "\n");
    }
    break;

case 5:
    printf ("Tree's size: %lu\n", gdsl_rbtrees_get_size (t));
    break;

case 6:
    printf ("Tree's height: %lu\n", gdsl_rbtrees_height (t));
    break;

case 7:
    printf ("Enter a string: ");
    scanf ("%s", name );
```

```

        if (gdsl_rbtrees_search (t, NULL, (void*) name))
        {
            printf ("String '%s' found\n", name);
        }
        else
        {
            printf ("String '%s' not found\n", name);
        }
        break;

    case 8:
        if (gdsl_rbtrees_is_empty (t))
        {
            printf ("The tree is empty\n");
        }
        else
        {
            printf ("Tree's content: ");
            gdsl_rbtrees_write (t, print_string, stdout, (void*) " ");
            printf ("\n");
        }
        break;

    case 9:
        gdsl_rbtrees_write_xml (t, print_string, stdout, NULL);
        break;

    case 10:
        gdsl_rbtrees_dump (t, print_string, stdout, NULL);
        break;

    case 11:
        {
            int i;
            int rc;
            gdsl_perm_t p = gdsl_perm_alloc ("p", N);
            gdsl_rbtrees_t nt = gdsl_rbtrees_alloc ("INTEGERS", alloc_integer,
            free_integer, compare_integers);

            gdsl_perm_randomize (p);

            for (i = 0; i < N; i++)
            {
                int n = gdsl_perm_get_element (p, i);
                gdsl_rbtrees_insert (nt, &n, &rc);
            }

            printf ("Tree's height: %lu\n", gdsl_rbtrees_height (nt));
            gdsl_rbtrees_dump (nt, print_integer, stdout, "");

            gdsl_rbtrees_free (nt);
            gdsl_perm_free (p);
        }
        break;

    case 12:
        gdsl_rbtrees_map_prefix (t, infix_map_f, NULL);
        break;

    case 13:
        gdsl_rbtrees_map_infix (t, infix_map_f, NULL);
        break;

```

```
        case 14:
            gds_l_rbtree_map_postfix (t, infix_map_f, NULL);
            break;
        }
    }
    while (choice != 0);

    gds_l_rbtree_free (t);

    exit (EXIT_SUCCESS);
}
```

6.12 examples/main_sort.c

This is an example of how to use gds_l_sort module.

```
/*
 * This file is part of the Generic Data Structures Library (GDSL).
 * Copyright (C) 1998-2017 Nicolas Darnis <ndarnis@free.fr>.
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 *
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 *
 * $RCSfile: main_sort.c,v $
 * $Revision: 1.2 $
 * $Date: 2015/02/17 12:33:17 $
 */

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/time.h>

#include "gds_l_types.h"
#include "gds_l_sort.h"

#define N 100
#define M 26
```

```

static long int
comp_char (const gdsl_element_t i, void* j)
{
    return (long int) i - (long int) j;
}

int main (void)
{
    int i;
    long int numbers [N];
    struct timeval tv;

    gettimeofday (&tv, NULL);
    srand (tv.tv_usec);

    printf ("Array of %d elements not sorted:\n", N);
    for (i = 0; i < N; i++)
    {
        numbers [i] = 'a' + (long int) ((double) M * rand() / (RAND_MAX + 1.0))
        ;
        printf ("%c ", (char) numbers [i]);
    }
    printf ("\n");

    gdsl_sort ((gdsl_element_t*) numbers, N, comp_char);

    printf ("Array sorted:\n");
    for (i = 0; i < N; i++)
    {
        printf ("%c ", (char) numbers [i]);
    }
    printf ("\n");

    exit (EXIT_SUCCESS);
}

```

6.13 examples/main_stack.c

This is an example of how to use gdsl_stack module.

```

/*
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```

```
*
* $RCSfile: main_stack.c,v $
* $Revision: 1.14 $
* $Date: 2015/02/17 12:33:17 $
*/

#include <config.h>

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "gdsl_types.h"
#include "gdsl_stack.h"

#include "_integers.h"

static int
my_display_integer (gdsl_element_t e, gdsl_location_t location, void *
                    user_infos)
{
    int* f = (int*) e;
    printf ("%d ", *f);
    return GDSL_MAP_CONT;
}

int main (void)
{
    int choix = 0;
    gdsl_stack_t s = gdsl_stack_alloc ("S", alloc_integer, free_integer);

    do
    {
        printf ("\t\tMENU - STACK\n\n");
        printf ("\t1> Push\n");
        printf ("\t2> Pop\n");
        printf ("\t3> Get\n");
        printf ("\t4> Flush\n");
        printf ("\t5> Search\n");
        printf ("\t6> Display\n");
        printf ("\t7> Dump\n");
        printf ("\t8> XML display\n");
        printf ("\t0> Quit\n\n");
        printf ("\t\tYour choice: ");
        scanf ("%d", &choix);

        switch (choix)
        {
        case 1:
            {
                int value;

                printf ("Enter integer value: ");
                scanf ("%d", &value);
                gdsl_stack_insert (s, (void*) &value);
            }
            break;
        }
    }
}
```

```
case 2:
    if (!gdsl_stack_is_empty (s))
    {
        free_integer (gdsl_stack_remove (s));
    }
    else
    {
        printf ("The stack '%s' is empty\n", gdsl_stack_get_name (s));
    }
    break;

case 3:
    {
        int* top;

        if (!gdsl_stack_is_empty (s))
        {
            top = (int*) gdsl_stack_get_top (s);
            printf ("Value = %d\n", *top);
        }
        else
        {
            printf ("The stack '%s' is empty\n", gdsl_stack_get_name (s));
        }
    }
    break;

case 4:
    if (gdsl_stack_is_empty (s))
    {
        printf ("The stack '%s' is empty\n", gdsl_stack_get_name (s));
    }
    else
    {
        {
            gdsl_stack_flush (s);
        }
    }
    break;

case 5:
    {
        int pos;
        int* value;
        printf ("Enter an integer value to search an element by its
position: ");
        scanf ("%d", &pos);

        value = (int*) gdsl_stack_search_by_position (s, pos);
        if (value != NULL)
        {
            printf ("Value found at position %d = %d\n", pos, *value);
        }
    }
    break;

case 6:
    if (gdsl_stack_is_empty (s))
    {
        printf ("The stack '%s' is empty\n", gdsl_stack_get_name (s));
    }
    else
    {

```

```
        printf ("%s = ( ", gdsl_stack_get_name (s));
        gdsl_stack_map_forward (s, my_display_integer, NULL);
        printf (")\n");
    }
    break;

    case 7:
        gdsl_stack_dump (s, print_integer, stdout, NULL);
        break;

    case 8:
        gdsl_stack_write_xml (s, print_integer, stdout, NULL);
        break;
    }
}
while (choix != 0);

gdsl_stack_free (s);

exit (EXIT_SUCCESS);
}
```


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