

tAltris  
v1.0

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# Chapter 1

## Data Structure Index

### 1.1 Data Structures

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## Chapter 2

# File Index

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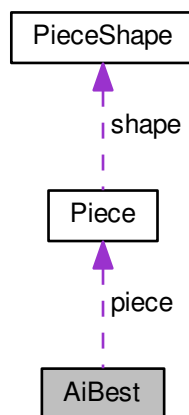
## Chapter 3

# Data Structure Documentation

### 3.1 AiBest Struct Reference

```
#include <engine.h>
```

Collaboration diagram for AiBest:



#### Data Fields

- **Piece** \* **piece**
- double **score**

#### 3.1.1 Field Documentation

#### 3.1.1.1 piece

**Piece\*** piece

#### 3.1.1.2 score

double score

The documentation for this struct was generated from the following file:

- src/ai/genetic/ **engine.h**

## 3.2 AiCoefs Struct Reference

```
#include <engine.h>
```

### Data Fields

- double **agg\_height**
- double **holes**
- double **clears**
- double **bumpiness**

### 3.2.1 Field Documentation

#### 3.2.1.1 agg\_height

double agg\_height

#### 3.2.1.2 bumpiness

double bumpiness

#### 3.2.1.3 clears

```
double clears
```

#### 3.2.1.4 holes

```
double holes
```

The documentation for this struct was generated from the following file:

- src/ai/genetic/ **engine.h**

## 3.3 Board Struct Reference

```
#include <board.h>
```

### Data Fields

- int **width**
- int **height**
- **Cell** \* **cells**

### 3.3.1 Field Documentation

#### 3.3.1.1 cells

```
Cell* cells
```

#### 3.3.1.2 height

```
int height
```

### 3.3.1.3 width

```
int width
```

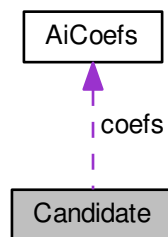
The documentation for this struct was generated from the following file:

- src/engine/ **board.h**

## 3.4 Candidate Struct Reference

```
#include <candidate.h>
```

Collaboration diagram for Candidate:



### Data Fields

- **AiCoefs** \* **coefs**
- double **fitness**

### 3.4.1 Field Documentation

#### 3.4.1.1 coefs

```
AiCoefs* coefs
```



### 3.4.1.2 fitness

```
double fitness
```

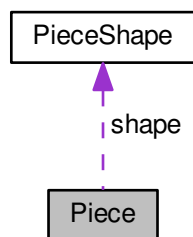
The documentation for this struct was generated from the following file:

- `src/ai/genetic/ candidate.h`

## 3.5 Piece Struct Reference

```
#include <piece.h>
```

Collaboration diagram for Piece:



### Data Fields

- **PieceType** type
- **const PieceShape \*** shape
- **int** x
- **int** y
- **Angle** angle

### 3.5.1 Field Documentation

#### 3.5.1.1 angle

**Angle** angle

### 3.5.1.2 shape

```
const PieceShape* shape
```

### 3.5.1.3 type

```
PieceType type
```

### 3.5.1.4 x

```
int x
```

### 3.5.1.5 y

```
int y
```

The documentation for this struct was generated from the following file:

- src/engine/piece/ **piece.h**

## 3.6 PieceQueue Struct Reference

```
#include <piece_queue.h>
```

### Data Fields

- unsigned int **seed**
- size\_t **length**
- **PieceType** \* **data**

### 3.6.1 Field Documentation

#### 3.6.1.1 data

```
PieceType* data
```

### 3.6.1.2 length

```
size_t length
```

### 3.6.1.3 seed

```
unsigned int seed
```

The documentation for this struct was generated from the following file:

- src/engine/piece/ **piece\_queue.h**

## 3.7 PieceShape Struct Reference

```
#include <piece_shape.h>
```

### Data Fields

- int **shape** [ **ANGLE\_ESIZE**][ **PIECE\_SHAPE\_HEIGHT**][ **PIECE\_SHAPE\_WIDTH**]
- Cell **fill**

### 3.7.1 Field Documentation

#### 3.7.1.1 fill

```
Cell fill
```

#### 3.7.1.2 shape

```
int shape[ ANGLE_ESIZE][ PIECE_SHAPE_HEIGHT][ PIECE_SHAPE_WIDTH]
```

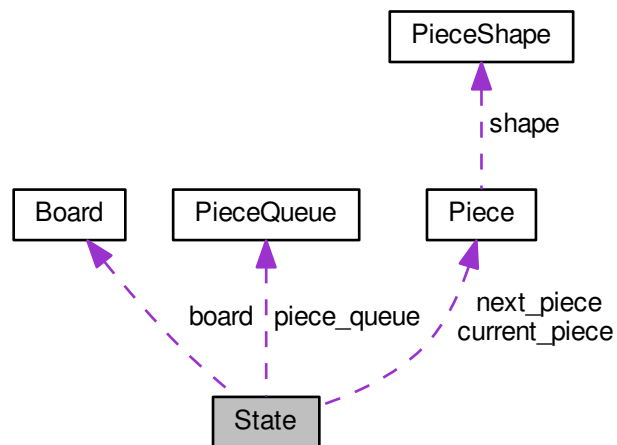
The documentation for this struct was generated from the following file:

- src/engine/piece/ **piece\_shape.h**

### 3.8 State Struct Reference

```
#include <state.h>
```

Collaboration diagram for State:



#### Data Fields

- unsigned int **score**
- unsigned int **level**
- unsigned int **broken\_lines**
- unsigned int **step**
- unsigned int **input\_counts**
- **Board** \* **board**
- **PieceQueue** \* **piece\_queue**
- size\_t **piece\_queue\_index**
- **Piece** \* **current\_piece**
- **Piece** \* **next\_piece**

#### 3.8.1 Field Documentation

##### 3.8.1.1 board

**Board**\* board

### 3.8.1.2 broken\_lines

unsigned int broken\_lines

### 3.8.1.3 current\_piece

**Piece\*** current\_piece

### 3.8.1.4 input\_counts

unsigned int input\_counts

### 3.8.1.5 level

unsigned int level

### 3.8.1.6 next\_piece

**Piece\*** next\_piece

### 3.8.1.7 piece\_queue

**PieceQueue\*** piece\_queue

### 3.8.1.8 piece\_queue\_index

size\_t piece\_queue\_index

### 3.8.1.9 score

unsigned int score

### 3.8.1.10 step

unsigned int step

The documentation for this struct was generated from the following file:

- src/engine/ **state.h**



## Chapter 4

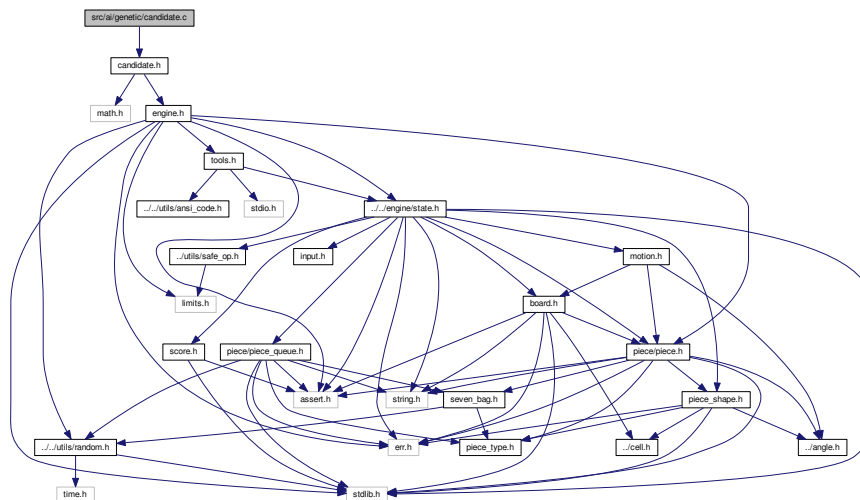
# File Documentation

### 4.1 src/ai/genetic/candidate.c File Reference

**Candidate** (p. 8).

```
#include "candidate.h"
```

Include dependency graph for candidate.c:



### Functions

- **Candidate \*** `genetic_candidate_create ()`
- **Candidate \*** `genetic_candidate_create_random ()`
- void `genetic_candidate_free (Candidate *candidate)`
- void `genetic_candidate_normalize (Candidate *candidate)`
- **Candidate \*** `genetic_candidate_crossover (Candidate *cdt1, Candidate *cdt2)`
- void `genetic_candidate_mutate (Candidate *cdt)`
- void `array_shift_left (int *tab, size_t *len, size_t pos)`
- **Candidate \*\*** `genetic_tournament_select_pair (Candidate **cdt, size_t ways)`

### 4.1.1 Detailed Description

**Candidate** (p. 8).

Author

S4MasterRace

Version

2.0

### 4.1.2 Function Documentation

#### 4.1.2.1 array\_shift\_left()

```
void array_shift_left (
    int * tab,
    size_t * len,
    size_t pos )
```

#### 4.1.2.2 genetic\_candidate\_create()

```
Candidate* genetic_candidate_create ( )
```

#### 4.1.2.3 genetic\_candidate\_create\_random()

```
Candidate* genetic_candidate_create_random ( )
```

#### 4.1.2.4 genetic\_candidate\_crossover()

```
Candidate* genetic_candidate_crossover (
    Candidate * cdt1,
    Candidate * cdt2 )
```



## 4.1.2.5 genetic\_candidate\_free()

```
void genetic_candidate_free (
    Candidate * candidate )
```

## 4.1.2.6 genetic\_candidate\_mutate()

```
void genetic_candidate_mutate (
    Candidate * cdt )
```

## 4.1.2.7 genetic\_candidate\_normalize()

```
void genetic_candidate_normalize (
    Candidate * candidate )
```

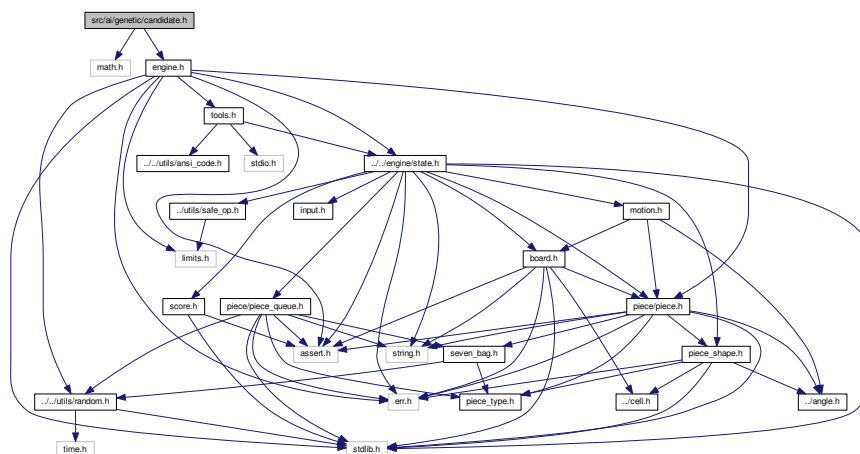
## 4.1.2.8 genetic\_tournament\_select\_pair()

```
Candidate** genetic_tournament_select_pair (
    Candidate ** cdt,
    size_t ways )
```

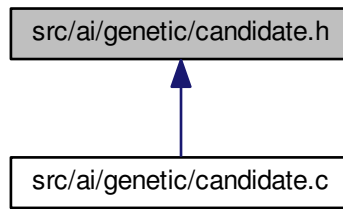
## 4.2 src/ai/genetic/candidate.h File Reference

**Candidate** (p. 8).

```
#include <math.h>
#include "engine.h"
Include dependency graph for candidate.h:
```



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **Candidate**

## Functions

- **Candidate** \* **genetic\_candidate\_create** ( )
- **Candidate** \* **genetic\_candidate\_create\_random** ( )
- void **genetic\_candidate\_free** ( **Candidate** \*candidate)
- void **genetic\_candidate\_normalize** ( **Candidate** \*candidate)
- **Candidate** \* **genetic\_candidate\_crossover** ( **Candidate** \*cdt1, **Candidate** \*cdt2)
- void **genetic\_candidate\_mutate** ( **Candidate** \*cdt)

### 4.2.1 Detailed Description

**Candidate** (p. 8).

Author

S4MasterRace

Version

2.0

### 4.2.2 Function Documentation

#### 4.2.2.1 **genetic\_candidate\_create**( )

```
Candidate* genetic_candidate_create ( )
```

## 4.2.2.2 genetic\_candidate\_create\_random()

```
Candidate* genetic_candidate_create_random ( )
```

## 4.2.2.3 genetic\_candidate\_crossover()

```
Candidate* genetic_candidate_crossover (
    Candidate * cdt1,
    Candidate * cdt2 )
```

## 4.2.2.4 genetic\_candidate\_free()

```
void genetic_candidate_free (
    Candidate * candidate )
```

## 4.2.2.5 genetic\_candidate\_mutate()

```
void genetic_candidate_mutate (
    Candidate * cdt )
```

## 4.2.2.6 genetic\_candidate\_normalize()

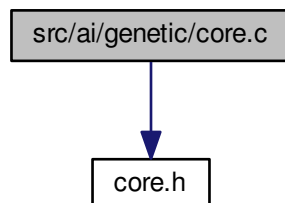
```
void genetic_candidate_normalize (
    Candidate * candidate )
```

## 4.3 src/ai/genetic/core.c File Reference

Core of the genetic algorithm.

```
#include "core.h"
```

Include dependency graph for core.c:



### 4.3.1 Detailed Description

Core of the genetic algorithm.

Author

S4MasterRace

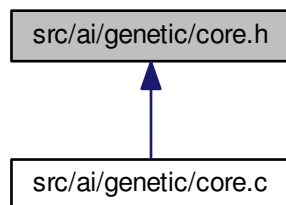
Version

2.0

## 4.4 src/ai/genetic/core.h File Reference

Core of the genetic algorithm.

This graph shows which files directly or indirectly include this file:



### 4.4.1 Detailed Description

Core of the genetic algorithm.

Author

S4MasterRace

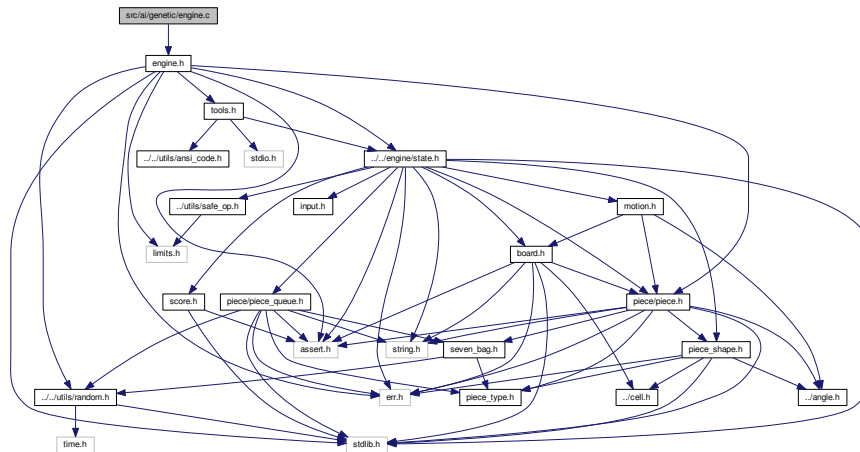
Version

2.0

## 4.5 src/ai/genetic/engine.c File Reference

Engine for the genetic algorithm.

```
#include "engine.h"
Include dependency graph for engine.c:
```



### Functions

- **AiCoefs \*** `genetic_aicoefs_get ()`
- **AiCoefs \*** `genetic_aicoefs_random ()`
- **void** `genetic_aicoefs_free ( AiCoefs *coefs)`
- **AiBest \*** `genetic_aibest_create ( Piece *p, double s)`
- **void** `genetic_aibest_free ( AiBest *ab)`
- **double** `genetic_get_rank (const State *state)`
- **AiBest \*** `_genetic_best (const State *state, int current, int max)`
- **Piece \*** `genetic_best (const State *state)`

#### 4.5.1 Detailed Description

Engine for the genetic algorithm.

Author

S4MasterRace

Version

2.0

#### 4.5.2 Function Documentation

#### 4.5.2.1 \_genetic\_best()

```
AiBest* _genetic_best (
    const State * state,
    int current,
    int max )
```

#### 4.5.2.2 genetic\_aibest\_create()

```
AiBest* genetic_aibest_create (
    Piece * p,
    double s )
```

#### 4.5.2.3 genetic\_aibest\_free()

```
void genetic_aibest_free (
    AiBest * ab )
```

#### 4.5.2.4 genetic\_aicoefs\_free()

```
void genetic_aicoefs_free (
    AiCoefs * coefs )
```

#### 4.5.2.5 genetic\_aicoefs\_get()

```
AiCoefs* genetic_aicoefs_get ( )
```

#### 4.5.2.6 genetic\_aicoefs\_random()

```
AiCoefs* genetic_aicoefs_random ( )
```

#### 4.5.2.7 genetic\_best()

```
Piece* genetic_best (
    const State * state )
```

#### 4.5.2.8 genetic\_get\_rank()

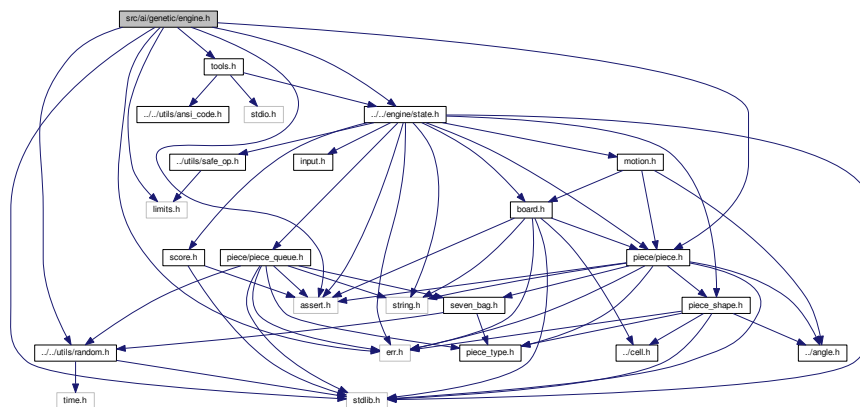
```
double genetic_get_rank (
    const State * state )
```

## 4.6 src/ai/genetic/engine.h File Reference

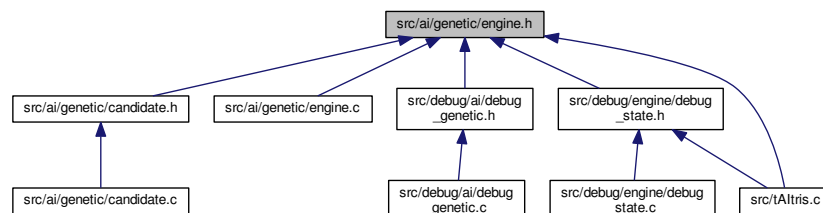
Engine for the genetic algorithm.

```
#include <stdlib.h>
#include <assert.h>
#include <err.h>
#include <limits.h>
#include "tools.h"
#include "../engine/state.h"
#include "../engine/piece/piece.h"
#include "../utils/random.h"
```

Include dependency graph for engine.h:



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **AiBest**
- struct **AiCoefs**

## Functions

- **AiCoefs** \* **genetic\_aicoefs\_get** ()
- **AiCoefs** \* **genetic\_aicoefs\_random** ()
- void **genetic\_aicoefs\_free** ( **AiCoefs** \*coefs)
- **AiBest** \* **genetic\_aibest\_create** ( **Piece** \*p, double s)
- void **genetic\_aibest\_free** ( **AiBest** \*ab)
- double **genetic\_get\_rank** (const **State** \*state)
- **Piece** \* **genetic\_best** (const **State** \*state)

### 4.6.1 Detailed Description

Engine for the genetic algorithm.

Author

S4MasterRace

Version

2.0

### 4.6.2 Function Documentation

#### 4.6.2.1 **genetic\_aibest\_create()**

```
AiBest* genetic_aibest_create (
    Piece * p,
    double s )
```

#### 4.6.2.2 **genetic\_aibest\_free()**

```
void genetic_aibest_free (
    AiBest * ab )
```

#### 4.6.2.3 **genetic\_aicoefs\_free()**

```
void genetic_aicoefs_free (
    AiCoefs * coefs )
```



## 4.6.2.4 genetic\_aicoefs\_get()

```
AiCoefs* genetic_aicoefs_get ( )
```

## 4.6.2.5 genetic\_aicoefs\_random()

```
AiCoefs* genetic_aicoefs_random ( )
```

## 4.6.2.6 genetic\_best()

```
Piece* genetic_best (
    const State * state )
```

## 4.6.2.7 genetic\_get\_rank()

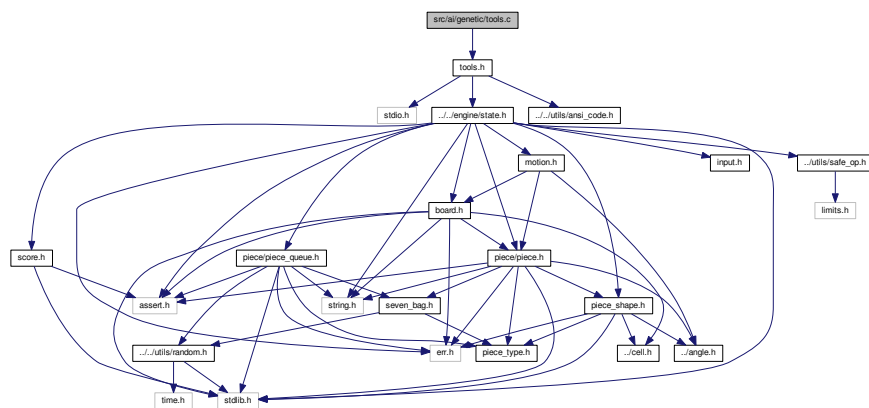
```
double genetic_get_rank (
    const State * state )
```

## 4.7 src/ai/genetic/tools.c File Reference

Tools for the genetic algorithm.

```
#include "tools.h"
```

Include dependency graph for tools.c:



## Functions

- int **genetic\_tools\_height** (const **State** \*state, int x)
- void **genetic\_tools\_heights** (const **State** \*state, int \*heights)
- int **genetic\_tools\_bumpiness** (const **State** \*state)
- int **genetic\_tools\_aggregate\_height** (const **State** \*state)
- int **genetic\_tools\_hole** (const **State** \*state, int x)
- int **genetic\_tools\_holes** (const **State** \*state)
- int **genetic\_tools\_clears** (const **State** \*state)

### 4.7.1 Detailed Description

Tools for the genetic algorithm.

#### Author

S4MasterRace

#### Version

2.0

### 4.7.2 Function Documentation

#### 4.7.2.1 genetic\_tools\_aggregate\_height()

```
int genetic_tools_aggregate_height (  
    const State * state )
```

#### 4.7.2.2 genetic\_tools\_bumpiness()

```
int genetic_tools_bumpiness (  
    const State * state )
```

#### 4.7.2.3 genetic\_tools\_clears()

```
int genetic_tools_clears (  
    const State * state )
```

## 4.7.2.4 genetic\_tools\_height()

```
int genetic_tools_height (
    const State * state,
    int x )
```

## 4.7.2.5 genetic\_tools\_heights()

```
void genetic_tools_heights (
    const State * state,
    int * heights )
```

## 4.7.2.6 genetic\_tools\_hole()

```
int genetic_tools_hole (
    const State * state,
    int x )
```

## 4.7.2.7 genetic\_tools\_holes()

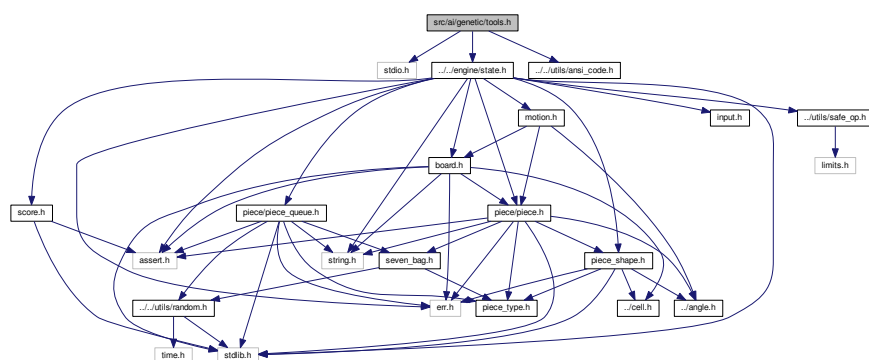
```
int genetic_tools_holes (
    const State * state )
```

## 4.8 src/ai/genetic/tools.h File Reference

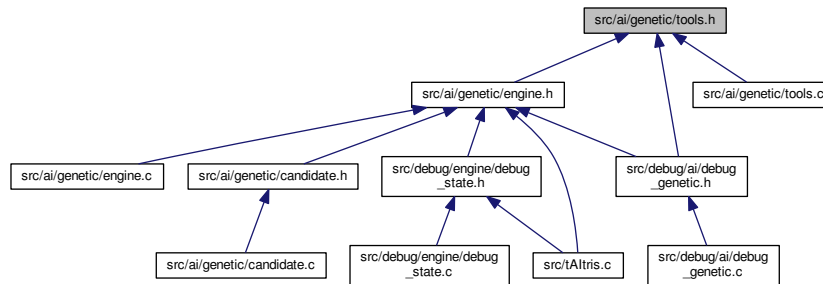
Tools for the genetic algorithm.

```
#include <stdio.h>
#include "../engine/state.h"
#include "../utils/ansi_code.h"
```

Include dependency graph for tools.h:



This graph shows which files directly or indirectly include this file:



## Macros

- `#define ABS(X) (((X) < 0) ? (-1 * (X)) : (X))`

## Functions

- `int genetic_tools_height (const State *state, int x)`
- `void genetic_tools_heights (const State *state, int *heights)`
- `int genetic_tools_bumpiness (const State *state)`
- `int genetic_tools_aggregate_height (const State *state)`
- `int genetic_tools_hole (const State *state, int x)`
- `int genetic_tools_holes (const State *state)`
- `int genetic_tools_clears (const State *state)`

### 4.8.1 Detailed Description

Tools for the genetic algorithm.

#### Author

S4MasterRace

#### Version

2.0

### 4.8.2 Macro Definition Documentation

#### 4.8.2.1 ABS

```
#define ABS(  
    X )  (((X) < 0) ?  (-1 * (X)) : (X))
```

### 4.8.3 Function Documentation

#### 4.8.3.1 genetic\_tools\_aggregate\_height()

```
int genetic_tools_aggregate_height (
    const State * state )
```

#### 4.8.3.2 genetic\_tools\_bumpiness()

```
int genetic_tools_bumpiness (
    const State * state )
```

#### 4.8.3.3 genetic\_tools\_clears()

```
int genetic_tools_clears (
    const State * state )
```

#### 4.8.3.4 genetic\_tools\_height()

```
int genetic_tools_height (
    const State * state,
    int x )
```

#### 4.8.3.5 genetic\_tools\_heights()

```
void genetic_tools_heights (
    const State * state,
    int * heights )
```

#### 4.8.3.6 genetic\_tools\_hole()

```
int genetic_tools_hole (
    const State * state,
    int x )
```



## 4.9.2.1 debug\_genetic\_print\_stats()

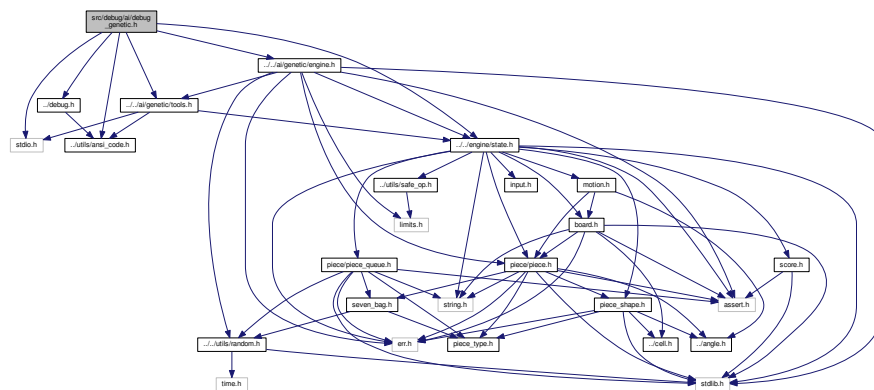
```
void debug_genetic_print_stats (
    const State * state )
```

## 4.10 src/debug/ai/debug\_genetic.h File Reference

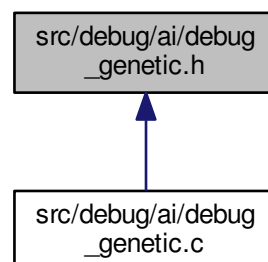
Genetic algorithm debugging.

```
#include <stdio.h>
#include "../debug.h"
#include "../../utils/ansi_code.h"
#include "../../engine/state.h"
#include "../../ai/genetic/tools.h"
#include "../../ai/genetic/engine.h"
```

Include dependency graph for debug\_genetic.h:



This graph shows which files directly or indirectly include this file:



## Macros

- `#define DEBUG_STATE_NAME "Genetic"`
- `#define DEBUG_STATE_COLOR ANSI_FG_BLUE`
- `#define DEBUG_STATE_TAG DEBUG_TAG( DEBUG_STATE_NAME, DEBUG_STATE_COLOR)`

## Functions

- void **debug\_genetic\_print\_stats** (const **State** \*state)

### 4.10.1 Detailed Description

Genetic algorithm debugging.

#### Author

S4MasterRace

#### Version

2.0

### 4.10.2 Macro Definition Documentation

#### 4.10.2.1 **DEBUG\_STATE\_COLOR**

```
#define DEBUG_STATE_COLOR ANSI_FG_BLUE
```

#### 4.10.2.2 **DEBUG\_STATE\_NAME**

```
#define DEBUG_STATE_NAME "Genetic"
```

#### 4.10.2.3 **DEBUG\_STATE\_TAG**

```
#define DEBUG_STATE_TAG DEBUG_TAG( DEBUG_STATE_NAME, DEBUG_STATE_COLOR)
```

### 4.10.3 Function Documentation



## 4.10.3.1 debug\_genetic\_print\_stats()

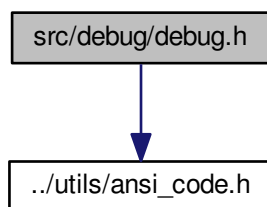
```
void debug_genetic_print_stats (
    const State * state )
```

## 4.11 src/debug/debug.h File Reference

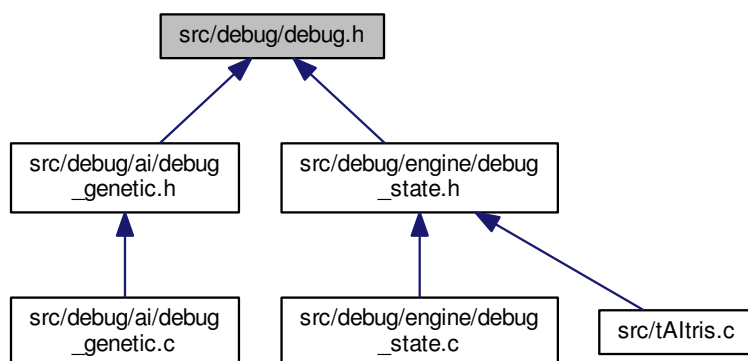
Debug.

```
#include "../utils/ansi_code.h"
```

Include dependency graph for debug.h:



This graph shows which files directly or indirectly include this file:



## Macros

- #define **DEBUG\_TAG**(\_name\_, \_color\_)



## Functions

- void **debug\_state\_print\_line\_number** (const **Board** \*brd, int y)
- void **debug\_state\_print\_cell** ( **Cell** c)
- void **debug\_state\_print\_infos** (const **State** \*state, int y)
- void **debug\_state\_print\_next\_piece** (const **Piece** \*pc, int y)
- void **debug\_state\_print** (const **State** \*state)

### 4.12.1 Detailed Description

Debug state.

Author

S4MasterRace

Version

2.0

### 4.12.2 Function Documentation

#### 4.12.2.1 debug\_state\_print()

```
void debug_state_print (
    const State * state )
```

#### 4.12.2.2 debug\_state\_print\_cell()

```
void debug_state_print_cell (
    Cell c )
```

#### 4.12.2.3 debug\_state\_print\_infos()

```
void debug_state_print_infos (
    const State * state,
    int y )
```

#### 4.12.2.4 debug\_state\_print\_line\_number()

```
void debug_state_print_line_number (
    const Board * brd,
    int y )
```

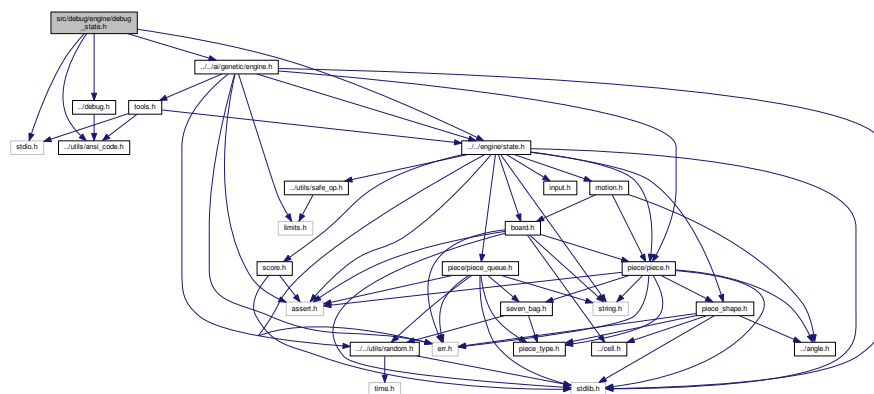
#### 4.12.2.5 debug\_state\_print\_next\_piece()

```
void debug_state_print_next_piece (
    const Piece * pc,
    int y )
```

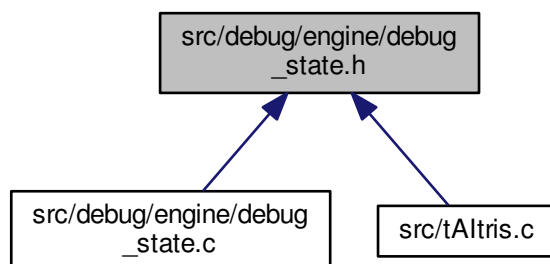
### 4.13 src/debug/engine/debug\_state.h File Reference

Debug state.

```
#include <stdio.h>
#include "../debug.h"
#include "../../engine/state.h"
#include "../../utils/ansi_code.h"
#include "../../ai/genetic/engine.h"
Include dependency graph for debug_state.h:
```



This graph shows which files directly or indirectly include this file:



## Macros

- `#define DEBUG_STATE_NAME "State"`
- `#define DEBUG_STATE_COLOR ANSI_FG_MAGENTA`
- `#define DEBUG_STATE_TAG DEBUG_TAG( DEBUG_STATE_NAME, DEBUG_STATE_COLOR)`

## Functions

- `void debug_state_print (const State *state)`

### 4.13.1 Detailed Description

Debug state.

#### Author

S4MasterRace

#### Version

2.0

### 4.13.2 Macro Definition Documentation

#### 4.13.2.1 **DEBUG\_STATE\_COLOR**

```
#define DEBUG_STATE_COLOR ANSI_FG_MAGENTA
```



## Macros

- `#define ANGLE_ESIZE 4`

## Enumerations

- enum **Angle** { **ANGLE\_UP**, **ANGLE\_RIGHT**, **ANGLE\_DOWN**, **ANGLE\_LEFT** }
- enum **Rotation** { **ROTATE\_LEFT** = -1, **ROTATE\_RIGHT** = 1 }

### 4.14.1 Detailed Description

Angle.

Author

S4MasterRace

Version

2.0

### 4.14.2 Macro Definition Documentation

#### 4.14.2.1 ANGLE\_ESIZE

```
#define ANGLE_ESIZE 4
```

### 4.14.3 Enumeration Type Documentation

#### 4.14.3.1 Angle

enum **Angle**

Enumerator

ANGLE_UP	
ANGLE_RIGHT	
ANGLE_DOWN	
ANGLE_LEFT	

#### 4.14.3.2 Rotation

enum **Rotation**

Enumerator

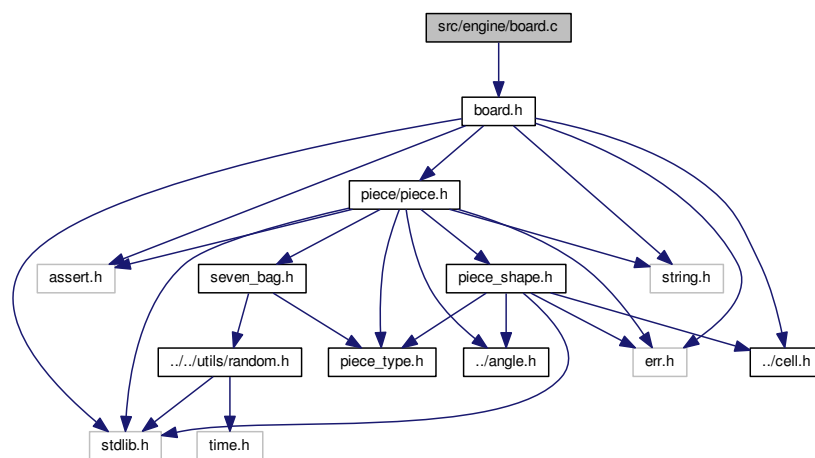
ROTATE_LEFT	
ROTATE_RIGHT	

### 4.15 src/engine/board.c File Reference

**Board** (p. 7).

```
#include "board.h"
```

Include dependency graph for board.c:



### Functions

- **Board** \* **board\_create** (int width, int height)
- void **board\_init** ( **Board** \*brd)
- void **board\_free** ( **Board** \*brd)
- **Board** \* **board\_copy** ( **Board** \*brd)
- size\_t **board\_get\_completed\_lines** (const **Board** \*brd, int \*hist)
- void **board\_break\_lines** ( **Board** \*brd, const int \*hist)
- int **board\_merge\_piece** ( **Board** \*brd, const **Piece** \*pc)



### 4.15.1 Detailed Description

**Board** (p. 7).

Author

S4MasterRace

Version

2.0

### 4.15.2 Function Documentation

#### 4.15.2.1 board\_break\_lines()

```
void board_break_lines (
    Board * brd,
    const int * hist )
```

#### 4.15.2.2 board\_copy()

```
Board* board_copy (
    Board * brd )
```

#### 4.15.2.3 board\_create()

```
Board* board_create (
    int width,
    int height )
```

#### 4.15.2.4 board\_free()

```
void board_free (
    Board * brd )
```

#### 4.15.2.5 board\_get\_completed\_lines()

```
size_t board_get_completed_lines (
    const Board * brd,
    int * hist )
```

#### 4.15.2.6 board\_init()

```
void board_init (
    Board * brd )
```

#### 4.15.2.7 board\_merge\_piece()

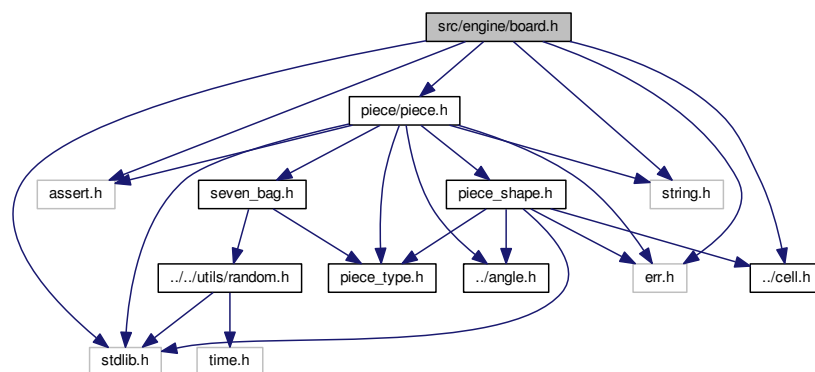
```
int board_merge_piece (
    Board * brd,
    const Piece * pc )
```

## 4.16 src/engine/board.h File Reference

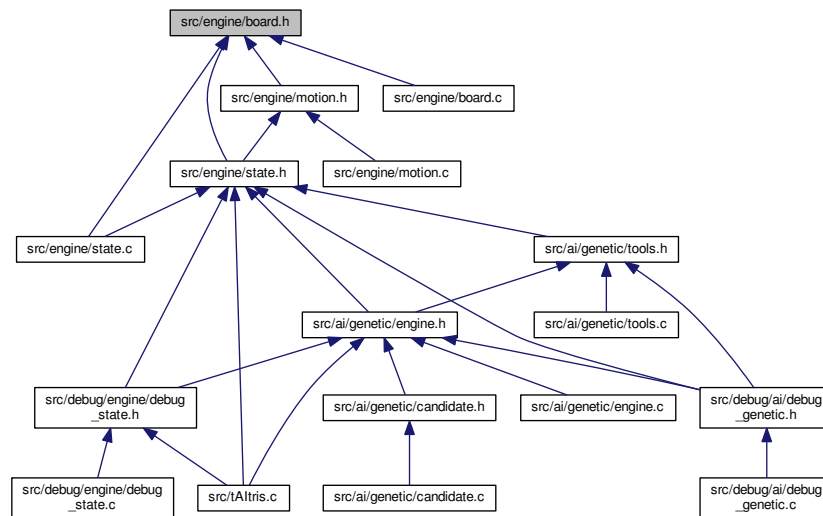
**Board** (p. 7).

```
#include <stdlib.h>
#include <assert.h>
#include <string.h>
#include <err.h>
#include "piece/piece.h"
#include "cell.h"
```

Include dependency graph for board.h:



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **Board**

## Macros

- `#define BOARD_WIDTH 10`
- `#define BOARD_HEIGHT 20`
- `#define BOARD_HIDDEN 2`
- `#define board_reverse_y(_brd_, _y_) ((_brd_)->height - 1 - (_y_))`

## Functions

- **Board** \* **board\_create** (int width, int height)
- void **board\_init** ( **Board** \*brd)
- void **board\_free** ( **Board** \*brd)
- **Board** \* **board\_copy** ( **Board** \*brd)
- size\_t **board\_get\_completed\_lines** (const **Board** \*brd, int \*hist)
- void **board\_break\_lines** ( **Board** \*brd, const int \*hist)
- int **board\_merge\_piece** ( **Board** \*brd, const **Piece** \*pc)

### 4.16.1 Detailed Description

**Board** (p. 7).

Author

S4MasterRace

Version

2.0

## 4.16.2 Macro Definition Documentation

### 4.16.2.1 BOARD\_HEIGHT

```
#define BOARD_HEIGHT 20
```

### 4.16.2.2 BOARD\_HIDDEN

```
#define BOARD_HIDDEN 2
```

### 4.16.2.3 board\_reverse\_y

```
#define board_reverse_y(  
    _brd_,  
    _y_ ) ((_brd_)->height - 1 - (_y_))
```

### 4.16.2.4 BOARD\_WIDTH

```
#define BOARD_WIDTH 10
```

## 4.16.3 Function Documentation

### 4.16.3.1 board\_break\_lines()

```
void board_break_lines (  
    Board * brd,  
    const int * hist )
```

### 4.16.3.2 board\_copy()

```
Board* board_copy (  
    Board * brd )
```

#### 4.16.3.3 board\_create()

```
Board* board_create (
    int width,
    int height )
```

#### 4.16.3.4 board\_free()

```
void board_free (
    Board * brd )
```

#### 4.16.3.5 board\_get\_completed\_lines()

```
size_t board_get_completed_lines (
    const Board * brd,
    int * hist )
```

#### 4.16.3.6 board\_init()

```
void board_init (
    Board * brd )
```

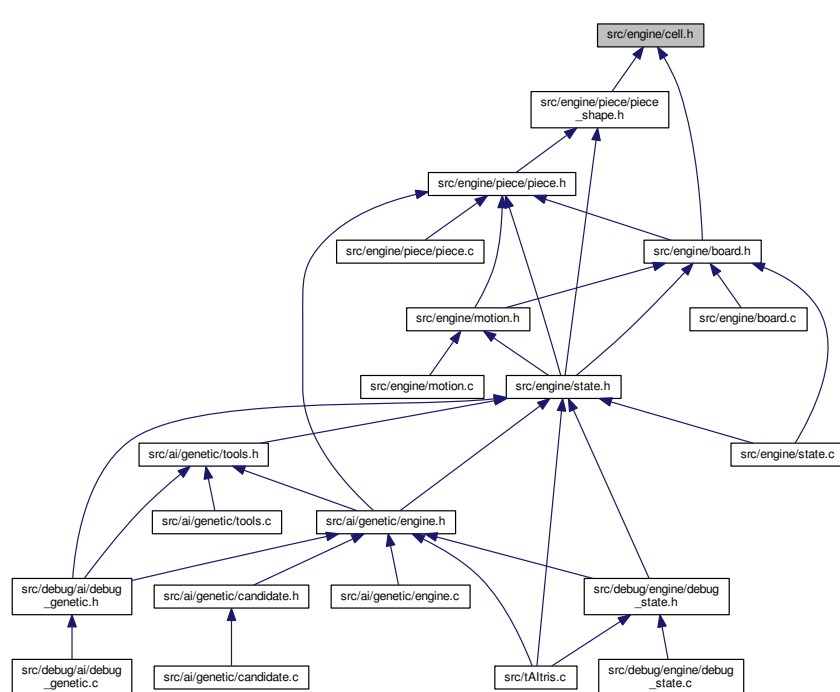
#### 4.16.3.7 board\_merge\_piece()

```
int board_merge_piece (
    Board * brd,
    const Piece * pc )
```

## 4.17 src/engine/cell.h File Reference

Cell.

This graph shows which files directly or indirectly include this file:



### Macros

- `#define CELL_ESIZE 8`

### Enumerations

- `enum Cell {`  
`CELL_EMPTY, CELL_CYAN, CELL_YELLOW, CELL_PURPLE,`  
`CELL_GREEN, CELL_RED, CELL_BLUE, CELL_ORANGE }`

#### 4.17.1 Detailed Description

Cell.

Author

S4MasterRace

Version

2.0

## 4.17.2 Macro Definition Documentation

### 4.17.2.1 CELL\_ESIZE

```
#define CELL_ESIZE 8
```

## 4.17.3 Enumeration Type Documentation

### 4.17.3.1 Cell

```
enum Cell
```

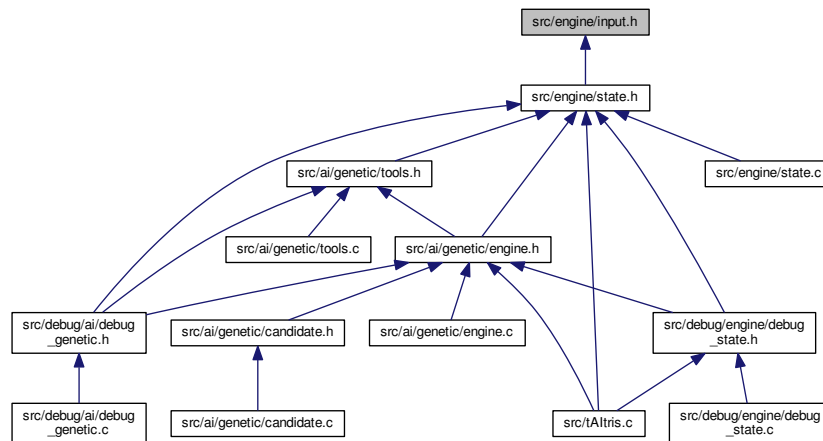
Enumerator

CELL_EMPTY	
CELL_CYAN	
CELL_YELLOW	
CELL_PURPLE	
CELL_GREEN	
CELL_RED	
CELL_BLUE	
CELL_ORANGE	

## 4.18 src/engine/input.h File Reference

Input.

This graph shows which files directly or indirectly include this file:



## Macros

- `#define INPUT_ESIZE 6`

## Enumerations

- enum **Input** {  
**INPUT\_MOVE\_LEFT**, **INPUT\_MOVE\_RIGHT**, **INPUT\_ROTATE\_RIGHT**, **INPUT\_ROTATE\_LEFT**,  
**INPUT\_SOFT\_DROP**, **INPUT\_HARD\_DROP** }

### 4.18.1 Detailed Description

Input.

Author

S4MasterRace

Version

2.0

### 4.18.2 Macro Definition Documentation

#### 4.18.2.1 INPUT\_ESIZE

```
#define INPUT_ESIZE 6
```



### 4.18.3 Enumeration Type Documentation

#### 4.18.3.1 Input

enum **Input**

Enumerator

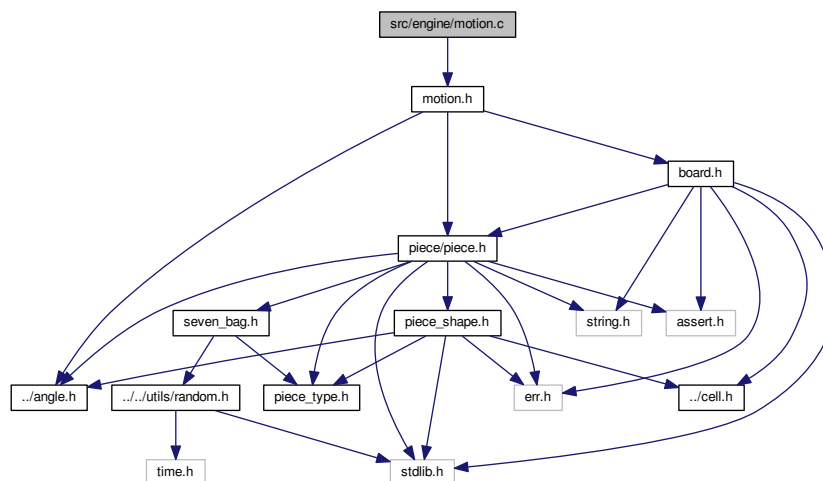
INPUT_MOVE_LEFT	
INPUT_MOVE_RIGHT	
INPUT_ROTATE_RIGHT	
INPUT_ROTATE_LEFT	
INPUT_SOFT_DROP	
INPUT_HARD_DROP	

## 4.19 src/engine/motion.c File Reference

Motion.

```
#include "motion.h"
```

Include dependency graph for motion.c:



### Functions

- int **motion\_is\_valid** (const **Piece** \*pc, const **Board** \*brd)
- int **motion\_try\_move** ( **Piece** \*pc, const **Board** \*brd, int dx, int dy)
- int **motion\_try\_down** ( **Piece** \*pc, const **Board** \*brd)
- int **motion\_try\_rotate** ( **Piece** \*pc, const **Board** \*brd, **Rotation** r)
- int **motion\_can\_move** (const **Piece** \*pc, const **Board** \*brd, int dx, int dy)
- int **motion\_can\_rotate** (const **Piece** \*pc, const **Board** \*brd, **Rotation** r)

### 4.19.1 Detailed Description

Motion.

Author

S4MasterRace

Version

2.0

### 4.19.2 Function Documentation

#### 4.19.2.1 motion\_can\_move()

```
int motion_can_move (
    const Piece * pc,
    const Board * brd,
    int dx,
    int dy )
```

#### 4.19.2.2 motion\_can\_rotate()

```
int motion_can_rotate (
    const Piece * pc,
    const Board * brd,
    Rotation r )
```

#### 4.19.2.3 motion\_is\_valid()

```
int motion_is_valid (
    const Piece * pc,
    const Board * brd )
```

#### 4.19.2.4 motion\_try\_down()

```
int motion_try_down (
    Piece * pc,
    const Board * brd )
```

## 4.19.2.5 motion\_try\_move()

```
int motion_try_move (
    Piece * pc,
    const Board * brd,
    int dx,
    int dy )
```

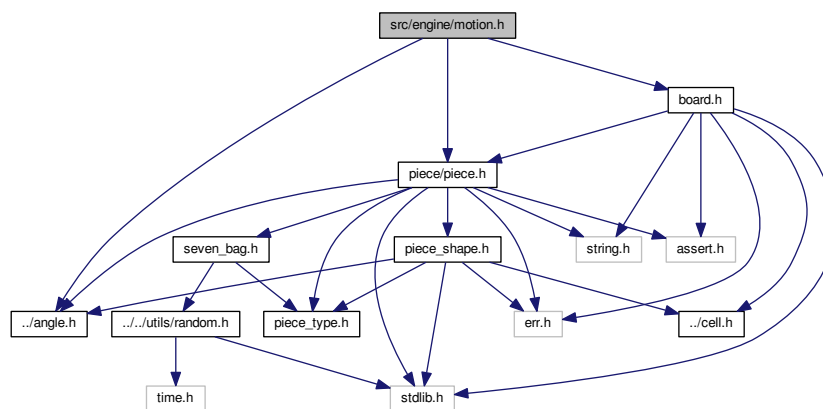
## 4.19.2.6 motion\_try\_rotate()

```
int motion_try_rotate (
    Piece * pc,
    const Board * brd,
    Rotation r )
```

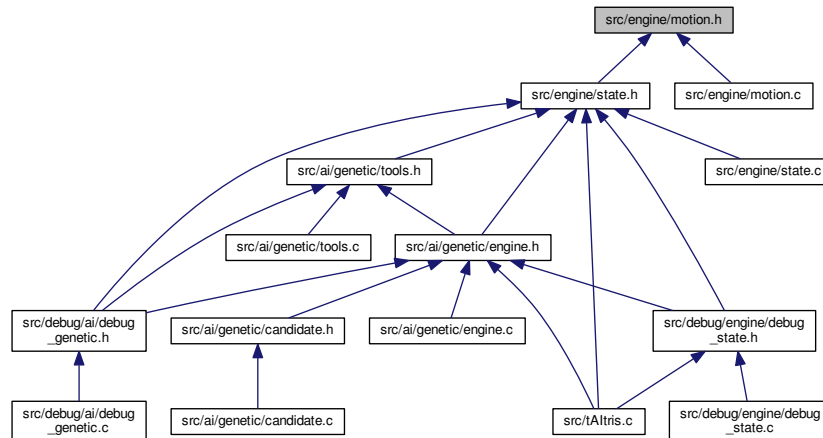
## 4.20 src/engine/motion.h File Reference

Motion.

```
#include "piece/piece.h"
#include "board.h"
#include "angle.h"
Include dependency graph for motion.h:
```



This graph shows which files directly or indirectly include this file:



## Functions

- int **motion\_is\_valid** (const **Piece** \*pc, const **Board** \*brd)
- int **motion\_try\_move** ( **Piece** \*pc, const **Board** \*brd, int dx, int dy)
- int **motion\_try\_rotate** ( **Piece** \*pc, const **Board** \*brd, **Rotation** r)
- int **motion\_try\_down** ( **Piece** \*pc, const **Board** \*brd)
- int **motion\_can\_move** (const **Piece** \*pc, const **Board** \*brd, int dx, int dy)
- int **motion\_can\_rotate** (const **Piece** \*pc, const **Board** \*brd, **Rotation** r)

### 4.20.1 Detailed Description

Motion.

Author

S4MasterRace

Version

2.0

### 4.20.2 Function Documentation

#### 4.20.2.1 motion\_can\_move()

```

int motion_can_move (
    const Piece * pc,
    const Board * brd,
    int dx,
    int dy )
  
```

## 4.20.2.2 motion\_can\_rotate()

```
int motion_can_rotate (
    const Piece * pc,
    const Board * brd,
    Rotation r )
```

## 4.20.2.3 motion\_is\_valid()

```
int motion_is_valid (
    const Piece * pc,
    const Board * brd )
```

## 4.20.2.4 motion\_try\_down()

```
int motion_try_down (
    Piece * pc,
    const Board * brd )
```

## 4.20.2.5 motion\_try\_move()

```
int motion_try_move (
    Piece * pc,
    const Board * brd,
    int dx,
    int dy )
```

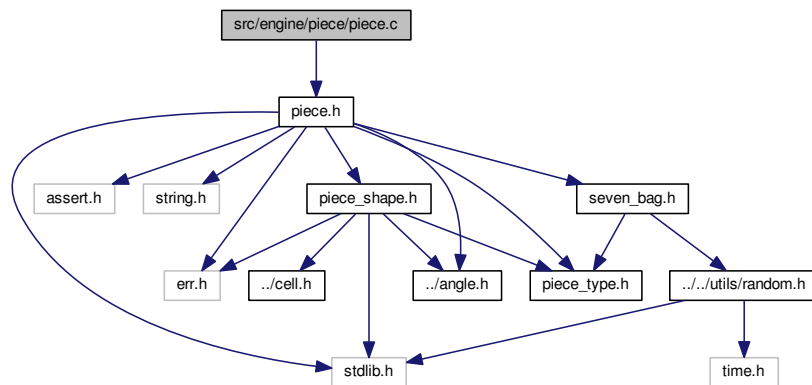
## 4.20.2.6 motion\_try\_rotate()

```
int motion_try_rotate (
    Piece * pc,
    const Board * brd,
    Rotation r )
```

## 4.21 src/engine/piece/piece.c File Reference

**Piece** (p. 9).

```
#include "piece.h"
Include dependency graph for piece.c:
```



### Functions

- **Piece \* piece\_create** ( **PieceType** type, int x, int y, **Angle** angle)
- void **piece\_free** ( **Piece** \*pc)
- **Piece \* piece\_copy** (const **Piece** \*pc)
- **Piece \* piece\_random** (int x, int y, **Angle** angle)

### 4.21.1 Detailed Description

**Piece** (p. 9).

Author

S4MasterRace

Version

2.0

### 4.21.2 Function Documentation

## 4.21.2.1 piece\_copy()

```
Piece* piece_copy (
    const Piece * pc )
```

## 4.21.2.2 piece\_create()

```
Piece* piece_create (
    PieceType type,
    int x,
    int y,
    Angle angle )
```

## 4.21.2.3 piece\_free()

```
void piece_free (
    Piece * pc )
```

## 4.21.2.4 piece\_random()

```
Piece* piece_random (
    int x,
    int y,
    Angle angle )
```

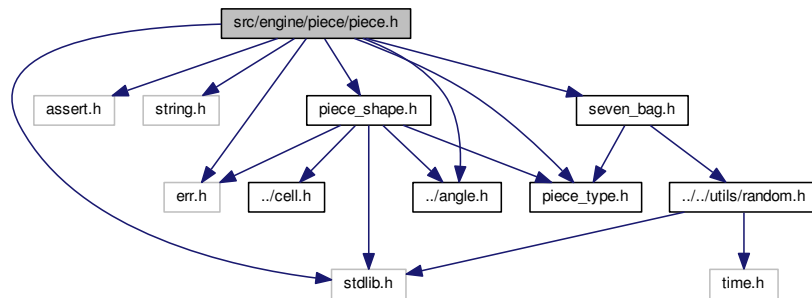
## 4.22 src/engine/piece/piece.h File Reference

**Piece** (p. 9).

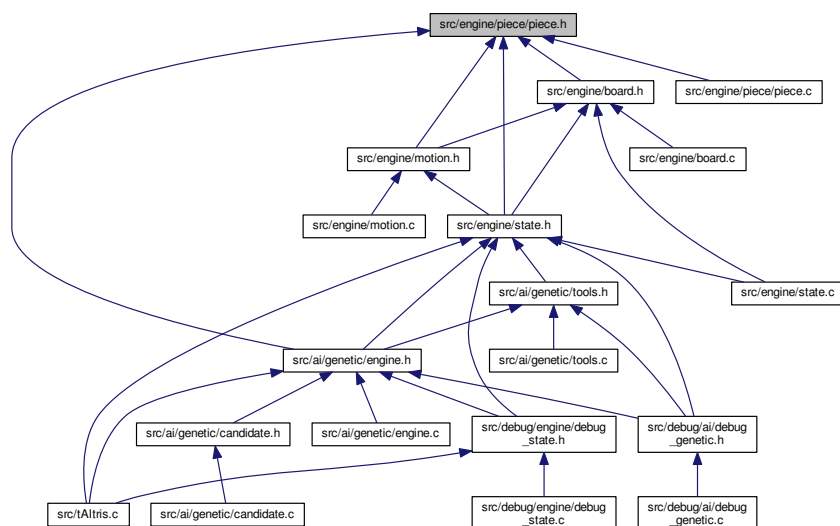
```
#include <stdlib.h>
#include <assert.h>
#include <string.h>
#include <err.h>
#include "piece_type.h"
#include "piece_shape.h"
#include "../angle.h"
```

```
#include "seven_bag.h"
```

Include dependency graph for piece.h:



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **Piece**

## Functions

- **Piece \*** **piece\_create** ( **PieceType** type, int x, int y, **Angle** angle)
- void **piece\_free** ( **Piece** \*pc)
- **Piece \*** **piece\_copy** (const **Piece** \*pc)
- **Piece \*** **piece\_random** (int x, int y, **Angle** angle)



### 4.22.1 Detailed Description

**Piece** (p. 9).

Author

S4MasterRace

Version

2.0

### 4.22.2 Function Documentation

#### 4.22.2.1 piece\_copy()

```
Piece* piece_copy (
    const Piece * pc )
```

#### 4.22.2.2 piece\_create()

```
Piece* piece_create (
    PieceType type,
    int x,
    int y,
    Angle angle )
```

#### 4.22.2.3 piece\_free()

```
void piece_free (
    Piece * pc )
```

#### 4.22.2.4 piece\_random()

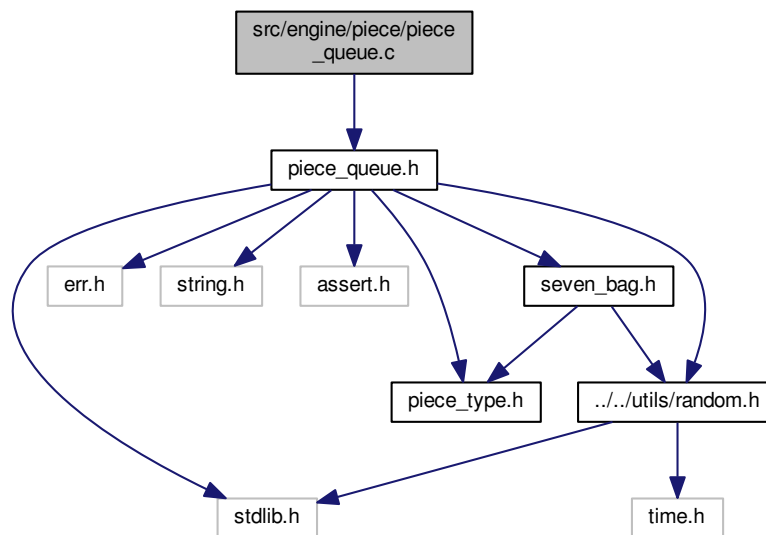
```
Piece* piece_random (
    int x,
    int y,
    Angle angle )
```

## 4.23 src/engine/piece/piece\_queue.c File Reference

**Piece** (p. 9) queue.

```
#include "piece_queue.h"
```

Include dependency graph for piece\_queue.c:



### Functions

- **PieceQueue \* piece\_queue\_create** (unsigned int seed)
- void **piece\_queue\_free** ( PieceQueue \*q)
- void **piece\_queue\_fill\_data** ( PieceType \*data, size\_t length)
- void **piece\_queue\_extend** ( PieceQueue \*q)
- **PieceType piece\_queue\_get** ( PieceQueue \*q, size\_t index)

### 4.23.1 Detailed Description

**Piece** (p. 9) queue.

Author

S4MasterRace

Version

2.0

## 4.23.2 Function Documentation

### 4.23.2.1 piece\_queue\_create()

```
PieceQueue* piece_queue_create (
    unsigned int seed )
```

### 4.23.2.2 piece\_queue\_extend()

```
void piece_queue_extend (
    PieceQueue * q )
```

### 4.23.2.3 piece\_queue\_fill\_data()

```
void piece_queue_fill_data (
    PieceType * data,
    size_t length )
```

### 4.23.2.4 piece\_queue\_free()

```
void piece_queue_free (
    PieceQueue * q )
```

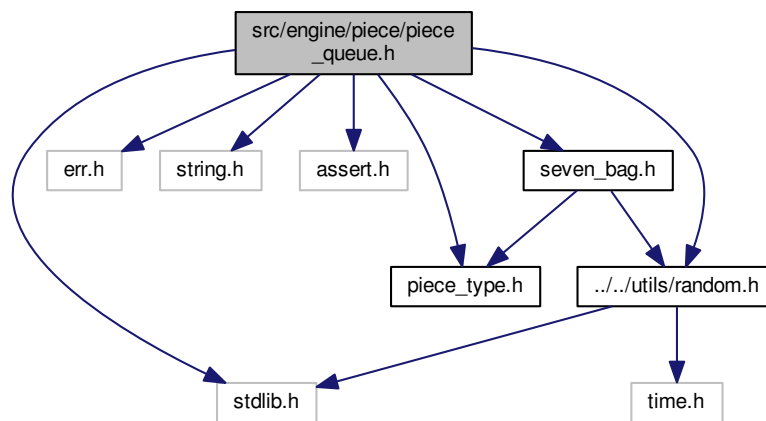
### 4.23.2.5 piece\_queue\_get()

```
PieceType piece_queue_get (
    PieceQueue * q,
    size_t index )
```

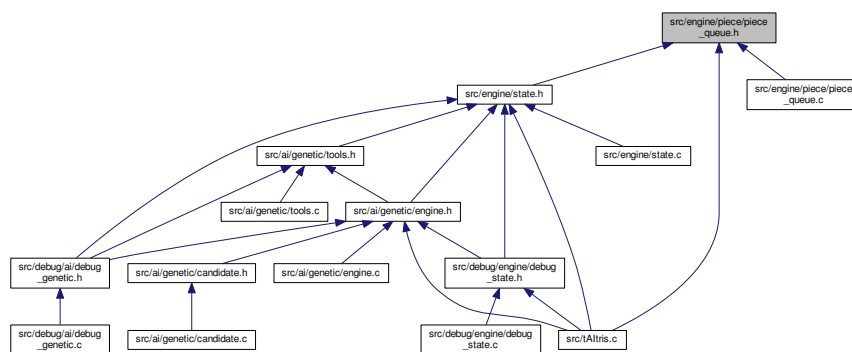
## 4.24 src/engine/piece/piece\_queue.h File Reference

**Piece** (p. 9) queue.

```
#include <stdlib.h>
#include <err.h>
#include <string.h>
#include <assert.h>
#include "piece_type.h"
#include "seven_bag.h"
#include "../../utils/random.h"
Include dependency graph for piece_queue.h:
```



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **PieceQueue**

## Macros

- `#define PIECE_QUEUE_LENGTH 100`

## Functions

- **PieceQueue** \* **piece\_queue\_create** (unsigned int seed)
- void **piece\_queue\_free** ( **PieceQueue** \*q)
- void **piece\_queue\_fill\_data** ( **PieceType** \*data, size\_t length)
- void **piece\_queue\_extend** ( **PieceQueue** \*q)
- **PieceType** **piece\_queue\_get** ( **PieceQueue** \*q, size\_t index)

### 4.24.1 Detailed Description

**Piece** (p. 9) queue.

#### Author

S4MasterRace

#### Version

2.0

### 4.24.2 Macro Definition Documentation

#### 4.24.2.1 **PIECE\_QUEUE\_LENGTH**

```
#define PIECE_QUEUE_LENGTH 100
```

### 4.24.3 Function Documentation

#### 4.24.3.1 **piece\_queue\_create()**

```
PieceQueue* piece_queue_create (  
    unsigned int seed )
```

#### 4.24.3.2 piece\_queue\_extend()

```
void piece_queue_extend (  
    PieceQueue * q )
```

#### 4.24.3.3 piece\_queue\_fill\_data()

```
void piece_queue_fill_data (  
    PieceType * data,  
    size_t length )
```

#### 4.24.3.4 piece\_queue\_free()

```
void piece_queue_free (  
    PieceQueue * q )
```

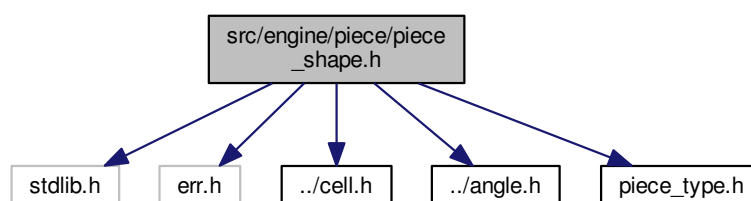
#### 4.24.3.5 piece\_queue\_get()

```
PieceType piece_queue_get (  
    PieceQueue * q,  
    size_t index )
```

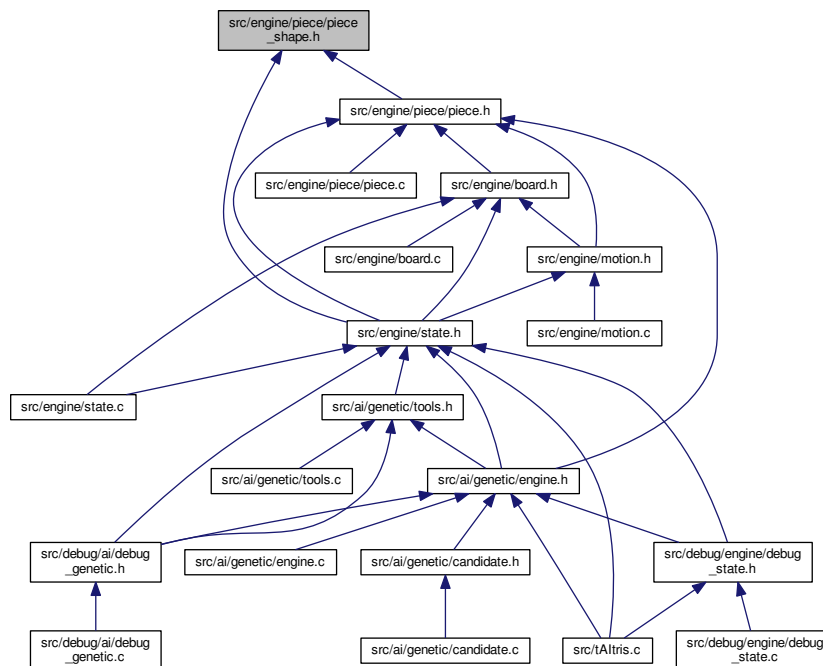
### 4.25 src/engine/piece/piece\_shape.h File Reference

**Piece** (p. 9) shape.

```
#include <stdlib.h>  
#include <err.h>  
#include "../cell.h"  
#include "../angle.h"  
#include "piece_type.h"  
Include dependency graph for piece_shape.h:
```



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **PieceShape**

## Macros

- #define **PIECE\_SHAPE\_WIDTH** 4
- #define **PIECE\_SHAPE\_HEIGHT** 4

### 4.25.1 Detailed Description

**Piece** (p. 9) shape.

Author

S4MasterRace

Version

2.0

### 4.25.2 Macro Definition Documentation

#### 4.25.2.1 PIECE\_SHAPE\_HEIGHT

```
#define PIECE_SHAPE_HEIGHT 4
```

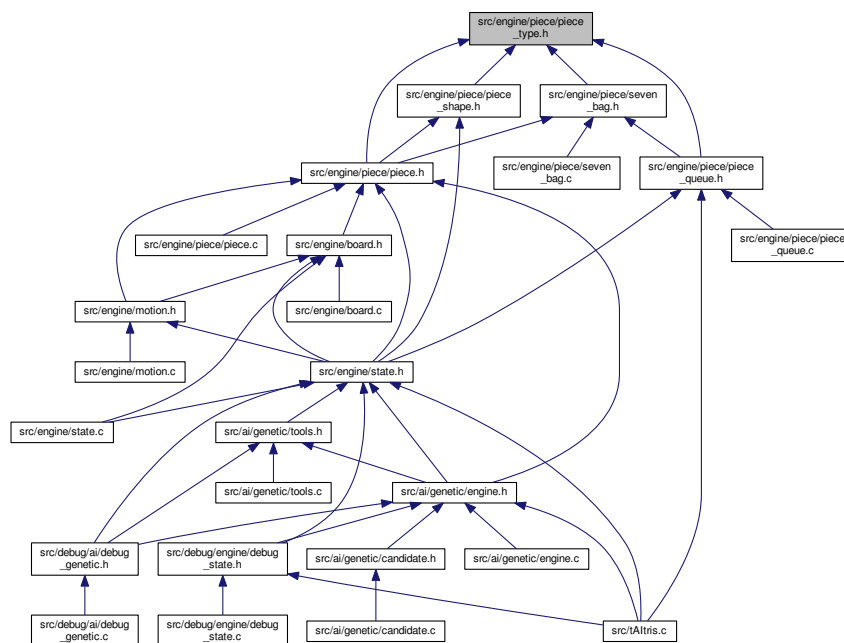
#### 4.25.2.2 PIECE\_SHAPE\_WIDTH

```
#define PIECE_SHAPE_WIDTH 4
```

## 4.26 src/engine/piece/piece\_type.h File Reference

**Piece** (p. 9) type.

This graph shows which files directly or indirectly include this file:



### Macros

- `#define PIECE_TYPE_ESIZE 7`

### Enumerations

- `enum PieceType {  
 PIECE_TYPE_I, PIECE_TYPE_O, PIECE_TYPE_T, PIECE_TYPE_L,  
 PIECE_TYPE_J, PIECE_TYPE_Z, PIECE_TYPE_S }`



### 4.26.1 Detailed Description

**Piece** (p. 9) type.

Author

S4MasterRace

Version

2.0

### 4.26.2 Macro Definition Documentation

#### 4.26.2.1 PIECE\_TYPE\_ESIZE

```
#define PIECE_TYPE_ESIZE 7
```

### 4.26.3 Enumeration Type Documentation

#### 4.26.3.1 PieceType

enum **PieceType**

Enumerator

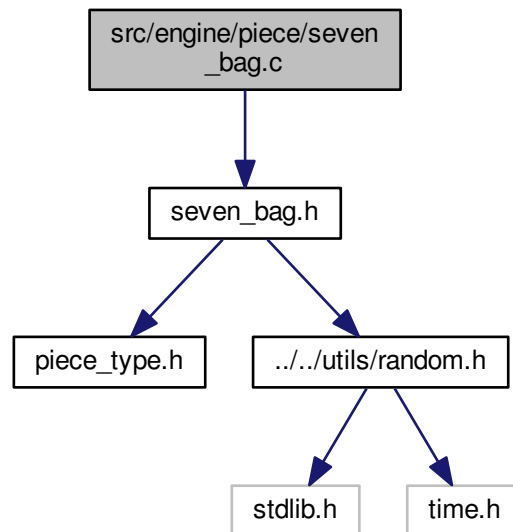
PIECE_TYPE_I	
PIECE_TYPE_O	
PIECE_TYPE_T	
PIECE_TYPE_L	
PIECE_TYPE_J	
PIECE_TYPE_Z	
PIECE_TYPE_S	

## 4.27 src/engine/piece/seven\_bag.c File Reference

7-Bag generator

```
#include "seven_bag.h"
```

Include dependency graph for seven\_bag.c:



### Functions

- void **seven\_bag\_init** ( **PieceType** \*bag)
- void **seven\_bag\_swap** ( **PieceType** \*a, **PieceType** \*b)
- void **seven\_bag\_shuffle** ( **PieceType** \*bag)
- **PieceType** **seven\_bag\_draw** ()

### 4.27.1 Detailed Description

7-Bag generator

Author

S4MasterRace

Version

2.0

## 4.27.2 Function Documentation

### 4.27.2.1 seven\_bag\_draw()

```
PieceType seven_bag_draw ( )
```

### 4.27.2.2 seven\_bag\_init()

```
void seven_bag_init (
    PieceType * bag )
```

### 4.27.2.3 seven\_bag\_shuffle()

```
void seven_bag_shuffle (
    PieceType * bag )
```

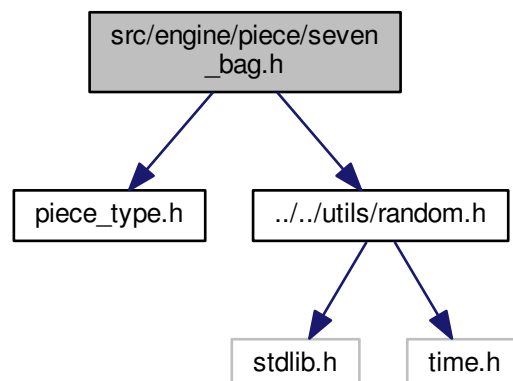
### 4.27.2.4 seven\_bag\_swap()

```
void seven_bag_swap (
    PieceType * a,
    PieceType * b )
```

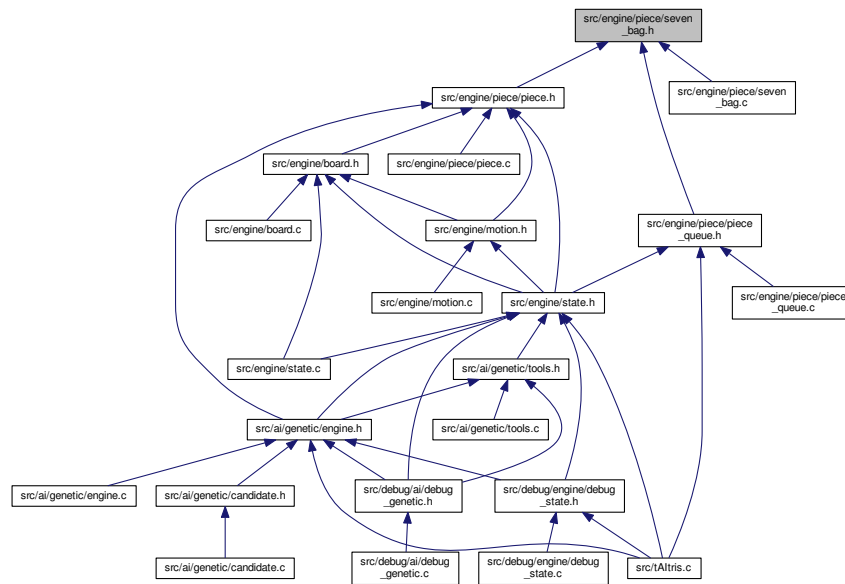
## 4.28 src/engine/piece/seven\_bag.h File Reference

7-Bag generator

```
#include "piece_type.h"
#include "../utils/random.h"
Include dependency graph for seven_bag.h:
```



This graph shows which files directly or indirectly include this file:



## Functions

- void **seven\_bag\_init** ( **PieceType** \*bag)
- void **seven\_bag\_swap** ( **PieceType** \*a, **PieceType** \*b)
- void **seven\_bag\_shuffle** ( **PieceType** \*bag)
- **PieceType** **seven\_bag\_draw** ( )

### 4.28.1 Detailed Description

7-Bag generator

Author

S4MasterRace

Version

2.0

### 4.28.2 Function Documentation

#### 4.28.2.1 seven\_bag\_draw()

**PieceType** seven\_bag\_draw ( )

## 4.28.2.2 seven\_bag\_init()

```
void seven_bag_init (
    PieceType * bag )
```

## 4.28.2.3 seven\_bag\_shuffle()

```
void seven_bag_shuffle (
    PieceType * bag )
```

## 4.28.2.4 seven\_bag\_swap()

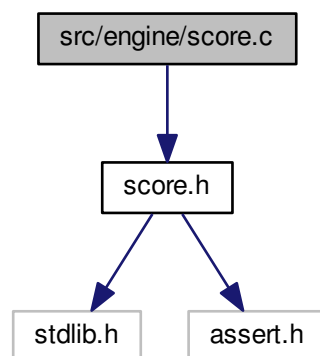
```
void seven_bag_swap (
    PieceType * a,
    PieceType * b )
```

## 4.29 src/engine/score.c File Reference

Scoring system.

```
#include "score.h"
```

Include dependency graph for score.c:



## Functions

- unsigned int **score\_compute\_break** (const int hist[], size\_t len, unsigned int level)

### 4.29.1 Detailed Description

Scoring system.

Author

S4MasterRace

Version

2.0

### 4.29.2 Function Documentation

#### 4.29.2.1 `score_compute_break()`

```
unsigned int score_compute_break (  
    const int hist[],  
    size_t len,  
    unsigned int level )
```

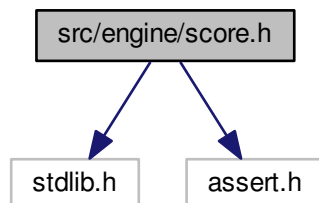
## 4.30 `src/engine/score.h` File Reference

Scoring system.

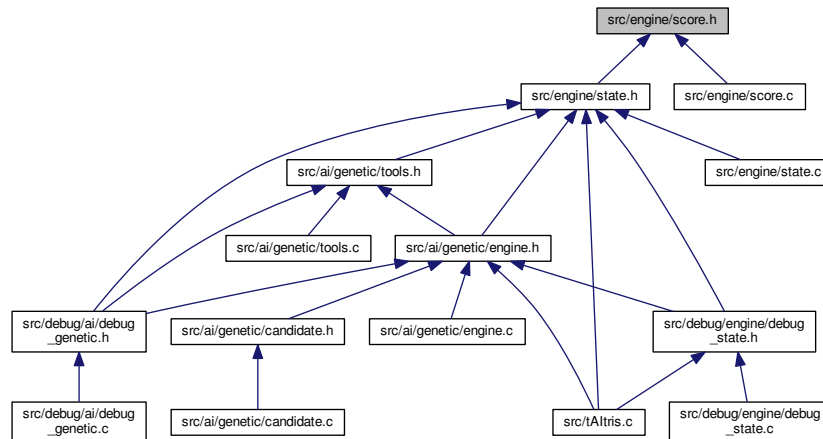
```
#include <stdlib.h>
```

```
#include <assert.h>
```

Include dependency graph for `score.h`:



This graph shows which files directly or indirectly include this file:



## Macros

- `#define SCORE_SINGLE 100`
- `#define SCORE_DOUBLE 300`
- `#define SCORE_TRIPLE 500`
- `#define SCORE_TETRIS 800`
- `#define SCORE_SDROP 1`
- `#define SCORE_HDROP 2`
- `#define SCORE_LVL_PER_LINE 10`

## Functions

- unsigned int **score\_compute\_break** (const int hist[], size\_t len, unsigned int level)

### 4.30.1 Detailed Description

Scoring system.

#### Author

S4MasterRace

#### Version

2.0

### 4.30.2 Macro Definition Documentation

#### 4.30.2.1 SCORE\_DOUBLE

```
#define SCORE_DOUBLE 300
```

#### 4.30.2.2 SCORE\_HDROP

```
#define SCORE_HDROP 2
```

#### 4.30.2.3 SCORE\_LVL\_PER\_LINE

```
#define SCORE_LVL_PER_LINE 10
```

#### 4.30.2.4 SCORE\_SDROP

```
#define SCORE_SDROP 1
```

#### 4.30.2.5 SCORE\_SINGLE

```
#define SCORE_SINGLE 100
```

#### 4.30.2.6 SCORE\_TETRIS

```
#define SCORE_TETRIS 800
```

#### 4.30.2.7 SCORE\_TRIPLE

```
#define SCORE_TRIPLE 500
```

### 4.30.3 Function Documentation



## 4.30.3.1 score\_compute\_break()

```

unsigned int score_compute_break (
    const int hist[],
    size_t len,
    unsigned int level )

```

## 4.31 src/engine/state.c File Reference

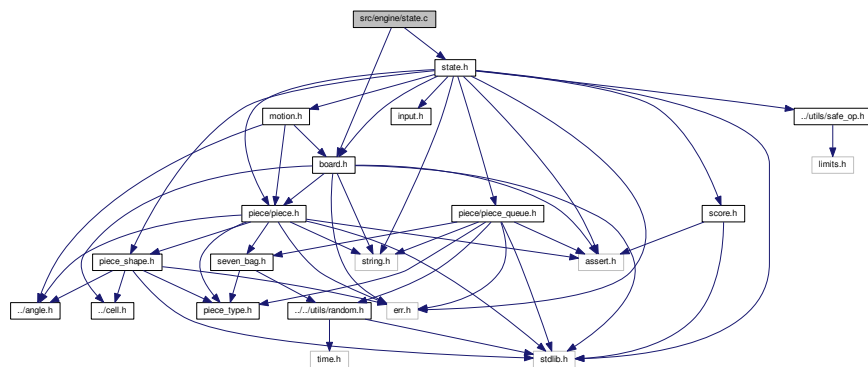
**State** (p. 12).

```

#include "state.h"
#include "board.h"

```

Include dependency graph for state.c:



## Functions

- **State \* state\_create** ()
- void **state\_init** ( **State** \*state, **PieceQueue** \*q)
- void **state\_free** ( **State** \*state)
- **State \* state\_copy** (const **State** \*state)
- **Piece \* state\_create\_piece** ( **State** \*state)
- void **state\_next\_piece** ( **State** \*state)
- int **state\_step** ( **State** \*state)
- int **state\_apply\_input** ( **State** \*state, **Input** input)
- int **state\_apply\_inputs** ( **State** \*state, **Input** input[], size\_t len)

## 4.31.1 Detailed Description

**State** (p. 12).

Author

S4MasterRace

Version

2.0

## 4.31.2 Function Documentation

### 4.31.2.1 state\_apply\_input()

```
int state_apply_input (
    State * state,
    Input input )
```

### 4.31.2.2 state\_apply\_inputs()

```
int state_apply_inputs (
    State * state,
    Input input[],
    size_t len )
```

### 4.31.2.3 state\_copy()

```
State* state_copy (
    const State * state )
```

### 4.31.2.4 state\_create()

```
State* state_create ( )
```

### 4.31.2.5 state\_create\_piece()

```
Piece* state_create_piece (
    State * state )
```

### 4.31.2.6 state\_free()

```
void state_free (
    State * state )
```

## 4.31.2.7 state\_init()

```
void state_init (
    State * state,
    PieceQueue * q )
```

## 4.31.2.8 state\_next\_piece()

```
void state_next_piece (
    State * state )
```

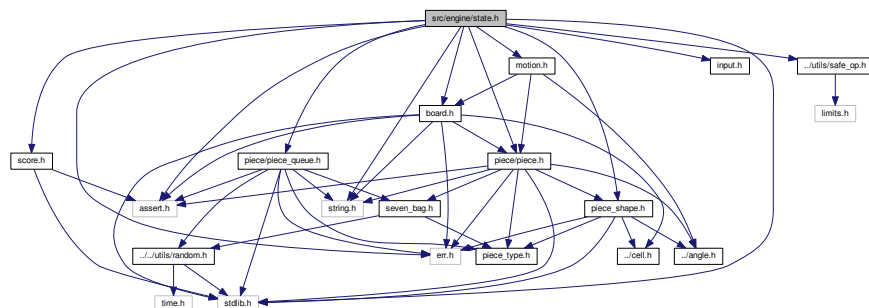
## 4.31.2.9 state\_step()

```
int state_step (
    State * state )
```

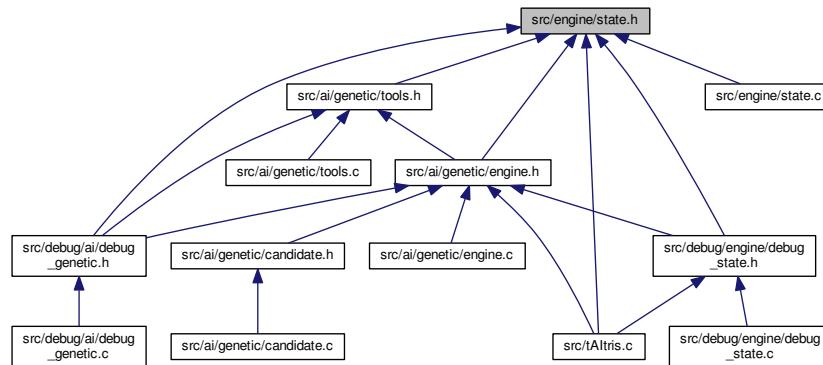
## 4.32 src/engine/state.h File Reference

**State** (p. 12).

```
#include <stdlib.h>
#include <err.h>
#include <string.h>
#include <assert.h>
#include "board.h"
#include "piece/piece.h"
#include "piece/piece_shape.h"
#include "piece/piece_queue.h"
#include "motion.h"
#include "input.h"
#include "score.h"
#include "../utils/safe_op.h"
Include dependency graph for state.h:
```



This graph shows which files directly or indirectly include this file:



## Data Structures

- struct **State**

## Functions

- **State** \* **state\_create** ()
- void **state\_init** ( **State** \*state, **PieceQueue** \*q)
- void **state\_free** ( **State** \*state)
- **State** \* **state\_copy** (const **State** \*state)
- **Piece** \* **state\_create\_piece** ( **State** \*state)
- void **state\_next\_piece** ( **State** \*state)
- int **state\_step** ( **State** \*state)
- int **state\_apply\_input** ( **State** \*state, **Input** input)
- int **state\_apply\_inputs** ( **State** \*state, **Input** input[], size\_t len)

### 4.32.1 Detailed Description

**State** (p. 12).

Author

S4MasterRace

Version

2.0

### 4.32.2 Function Documentation

## 4.32.2.1 state\_apply\_input()

```
int state_apply_input (
    State * state,
    Input input )
```

## 4.32.2.2 state\_apply\_inputs()

```
int state_apply_inputs (
    State * state,
    Input input[],
    size_t len )
```

## 4.32.2.3 state\_copy()

```
State* state_copy (
    const State * state )
```

## 4.32.2.4 state\_create()

```
State* state_create ( )
```

## 4.32.2.5 state\_create\_piece()

```
Piece* state_create_piece (
    State * state )
```

## 4.32.2.6 state\_free()

```
void state_free (
    State * state )
```

#### 4.32.2.7 state\_init()

```
void state_init (
    State * state,
    PieceQueue * q )
```

#### 4.32.2.8 state\_next\_piece()

```
void state_next_piece (
    State * state )
```

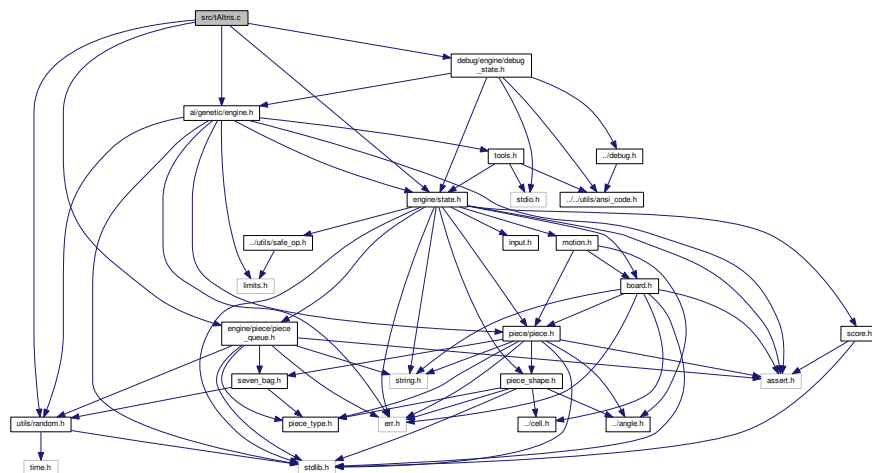
#### 4.32.2.9 state\_step()

```
int state_step (
    State * state )
```

### 4.33 src/tAltris.c File Reference

Main file.

```
#include "utils/random.h"
#include "engine/piece/piece_queue.h"
#include "engine/state.h"
#include "ai/genetic/engine.h"
#include "debug/engine/debug_state.h"
Include dependency graph for tAltris.c:
```



## Functions

- int **main** ()

### 4.33.1 Detailed Description

Main file.

Author

S4MasterRace

Version

2.0

### 4.33.2 Function Documentation

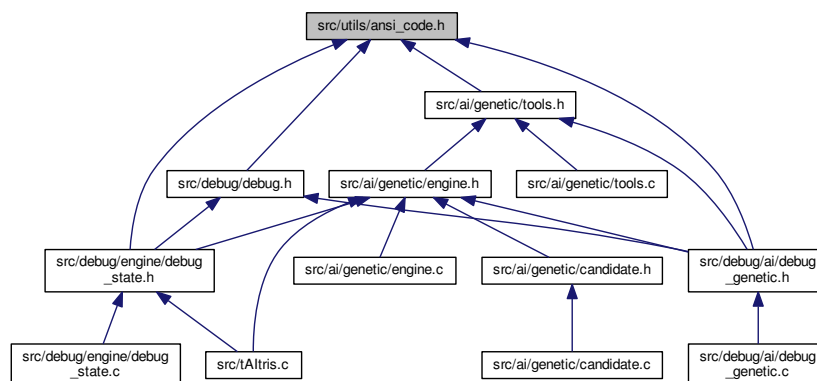
#### 4.33.2.1 main()

```
int main ( )
```

## 4.34 src/utils/ansi\_code.h File Reference

ANSI escape code.

This graph shows which files directly or indirectly include this file:



## Macros

- `#define ANSI_ESC "\x1b"`
- `#define ANSI_SGR(_code_) ANSI_ESC "[" #_code_ "m"`
- `#define ANSI_RESET ANSI_SGR(0)`
- `#define ANSI_BOLD ANSI_SGR(1)`
- `#define ANSI_FAINT ANSI_SGR(2)`
- `#define ANSI_ITALIC ANSI_SGR(3)`
- `#define ANSI_UNDERLINE ANSI_SGR(4)`
- `#define ANSI_SBLINK ANSI_SGR(5)`
- `#define ANSI_RBLINK ANSI_SGR(6)`
- `#define ANSI_CROSSEDOUT ANSI_SGR(9)`
- `#define ANSI_FRAMED ANSI_SGR(51)`
- `#define ANSI_ENCIRCLED ANSI_SGR(52)`
- `#define ANSI_OVERLINED ANSI_SGR(53)`
- `#define ANSI_FG_DEFAULT ANSI_SGR(39)`
- `#define ANSI_FG_BLACK ANSI_SGR(30)`
- `#define ANSI_FG_RED ANSI_SGR(31)`
- `#define ANSI_FG_GREEN ANSI_SGR(32)`
- `#define ANSI_FG_YELLOW ANSI_SGR(33)`
- `#define ANSI_FG_BLUE ANSI_SGR(34)`
- `#define ANSI_FG_MAGENTA ANSI_SGR(35)`
- `#define ANSI_FG_CYAN ANSI_SGR(36)`
- `#define ANSI_FG_WHITE ANSI_SGR(37)`
- `#define ANSI_FG_BBLACK ANSI_SGR(90)`
- `#define ANSI_FG_BRED ANSI_SGR(91)`
- `#define ANSI_FG_BGREEN ANSI_SGR(92)`
- `#define ANSI_FG_BYELLOW ANSI_SGR(93)`
- `#define ANSI_FG_BBLUE ANSI_SGR(94)`
- `#define ANSI_FG_BMAGENTA ANSI_SGR(95)`
- `#define ANSI_FG_BCYAN ANSI_SGR(96)`
- `#define ANSI_FG_BWHITE ANSI_SGR(97)`
- `#define ANSI_BG_DEFAULT ANSI_SGR(49)`
- `#define ANSI_BG_BLACK ANSI_SGR(40)`
- `#define ANSI_BG_RED ANSI_SGR(41)`
- `#define ANSI_BG_GREEN ANSI_SGR(42)`
- `#define ANSI_BG_YELLOW ANSI_SGR(43)`
- `#define ANSI_BG_BLUE ANSI_SGR(44)`
- `#define ANSI_BG_MAGENTA ANSI_SGR(45)`
- `#define ANSI_BG_CYAN ANSI_SGR(46)`
- `#define ANSI_BG_WHITE ANSI_SGR(47)`
- `#define ANSI_BG_BBLACK ANSI_SGR(100)`
- `#define ANSI_BG_BRED ANSI_SGR(101)`
- `#define ANSI_BG_BGREEN ANSI_SGR(102)`
- `#define ANSI_BG_BYELLOW ANSI_SGR(103)`
- `#define ANSI_BG_BBLUE ANSI_SGR(104)`
- `#define ANSI_BG_BMAGENTA ANSI_SGR(105)`
- `#define ANSI_BG_BCYAN ANSI_SGR(106)`
- `#define ANSI_BG_BWHITE ANSI_SGR(107)`



### 4.34.1 Detailed Description

ANSI escape code.

#### Author

S4MasterRace

#### Version

2.0

### 4.34.2 Macro Definition Documentation

#### 4.34.2.1 ANSI\_BG\_BBLACK

```
#define ANSI_BG_BBLACK ANSI_SGR(100)
```

#### 4.34.2.2 ANSI\_BG\_BBLUE

```
#define ANSI_BG_BBLUE ANSI_SGR(104)
```

#### 4.34.2.3 ANSI\_BG\_BCYAN

```
#define ANSI_BG_BCYAN ANSI_SGR(106)
```

#### 4.34.2.4 ANSI\_BG\_BGREEN

```
#define ANSI_BG_BGREEN ANSI_SGR(102)
```

#### 4.34.2.5 ANSI\_BG\_BLACK

```
#define ANSI_BG_BLACK ANSI_SGR(40)
```

#### 4.34.2.6 ANSI\_BG\_BLUE

```
#define ANSI_BG_BLUE    ANSI_SGR(44)
```

#### 4.34.2.7 ANSI\_BG\_BMAGENTA

```
#define ANSI_BG_BMAGENTA ANSI_SGR(105)
```

#### 4.34.2.8 ANSI\_BG\_BRED

```
#define ANSI_BG_BRED    ANSI_SGR(101)
```

#### 4.34.2.9 ANSI\_BG\_BWHITE

```
#define ANSI_BG_BWHITE  ANSI_SGR(107)
```

#### 4.34.2.10 ANSI\_BG\_BYELLOW

```
#define ANSI_BG_BYELLOW ANSI_SGR(103)
```

#### 4.34.2.11 ANSI\_BG\_CYAN

```
#define ANSI_BG_CYAN    ANSI_SGR(46)
```

#### 4.34.2.12 ANSI\_BG\_DEFAULT

```
#define ANSI_BG_DEFAULT ANSI_SGR(49)
```

#### 4.34.2.13 ANSI\_BG\_GREEN

```
#define ANSI_BG_GREEN    ANSI_SGR(42)
```

#### 4.34.2.14 ANSI\_BG\_MAGENTA

```
#define ANSI_BG_MAGENTA  ANSI_SGR(45)
```

#### 4.34.2.15 ANSI\_BG\_RED

```
#define ANSI_BG_RED  ANSI_SGR(41)
```

#### 4.34.2.16 ANSI\_BG\_WHITE

```
#define ANSI_BG_WHITE  ANSI_SGR(47)
```

#### 4.34.2.17 ANSI\_BG\_YELLOW

```
#define ANSI_BG_YELLOW  ANSI_SGR(43)
```

#### 4.34.2.18 ANSI\_BOLD

```
#define ANSI_BOLD  ANSI_SGR(1)
```

#### 4.34.2.19 ANSI\_CROSSEDOUT

```
#define ANSI_CROSSEDOUT  ANSI_SGR(9)
```

#### 4.34.2.20 ANSI\_ENCIRCLED

```
#define ANSI_ENCIRCLED  ANSI_SGR(52)
```

#### 4.34.2.21 ANSI\_ESC

```
#define ANSI_ESC  "\x1b"
```

#### 4.34.2.22 ANSI\_FAINT

```
#define ANSI_FAINT ANSI_SGR(2)
```

#### 4.34.2.23 ANSI\_FG\_BBLACK

```
#define ANSI_FG_BBLACK ANSI_SGR(90)
```

#### 4.34.2.24 ANSI\_FG\_BBLUE

```
#define ANSI_FG_BBLUE ANSI_SGR(94)
```

#### 4.34.2.25 ANSI\_FG\_BCYAN

```
#define ANSI_FG_BCYAN ANSI_SGR(96)
```

#### 4.34.2.26 ANSI\_FG\_BGREEN

```
#define ANSI_FG_BGREEN ANSI_SGR(92)
```

#### 4.34.2.27 ANSI\_FG\_BLACK

```
#define ANSI_FG_BLACK ANSI_SGR(30)
```

#### 4.34.2.28 ANSI\_FG\_BLUE

```
#define ANSI_FG_BLUE ANSI_SGR(34)
```

#### 4.34.2.29 ANSI\_FG\_BMAGENTA

```
#define ANSI_FG_BMAGENTA ANSI_SGR(95)
```

#### 4.34.2.30 ANSI\_FG\_BRED

```
#define ANSI_FG_BRED    ANSI_SGR(91)
```

#### 4.34.2.31 ANSI\_FG\_BWHITE

```
#define ANSI_FG_BWHITE  ANSI_SGR(97)
```

#### 4.34.2.32 ANSI\_FG\_BYELLOW

```
#define ANSI_FG_BYELLOW ANSI_SGR(93)
```

#### 4.34.2.33 ANSI\_FG\_CYAN

```
#define ANSI_FG_CYAN    ANSI_SGR(36)
```

#### 4.34.2.34 ANSI\_FG\_DEFAULT

```
#define ANSI_FG_DEFAULT ANSI_SGR(39)
```

#### 4.34.2.35 ANSI\_FG\_GREEN

```
#define ANSI_FG_GREEN   ANSI_SGR(32)
```

#### 4.34.2.36 ANSI\_FG\_MAGENTA

```
#define ANSI_FG_MAGENTA ANSI_SGR(35)
```

#### 4.34.2.37 ANSI\_FG\_RED

```
#define ANSI_FG_RED     ANSI_SGR(31)
```

#### 4.34.2.38 ANSI\_FG\_WHITE

```
#define ANSI_FG_WHITE  ANSI_SGR(37)
```

#### 4.34.2.39 ANSI\_FG\_YELLOW

```
#define ANSI_FG_YELLOW  ANSI_SGR(33)
```

#### 4.34.2.40 ANSI\_FRAMED

```
#define ANSI_FRAMED  ANSI_SGR(51)
```

#### 4.34.2.41 ANSI\_ITALIC

```
#define ANSI_ITALIC  ANSI_SGR(3)
```

#### 4.34.2.42 ANSI\_OVERLINED

```
#define ANSI_OVERLINED  ANSI_SGR(53)
```

#### 4.34.2.43 ANSI\_RBLINK

```
#define ANSI_RBLINK  ANSI_SGR(6)
```

#### 4.34.2.44 ANSI\_RESET

```
#define ANSI_RESET  ANSI_SGR(0)
```

#### 4.34.2.45 ANSI\_SBLINK

```
#define ANSI_SBLINK  ANSI_SGR(5)
```

## 4.34.2.46 ANSI\_SGR

```
#define ANSI_SGR(  
    _code_ )  ANSI_ESC "[" #_code_ "m"
```

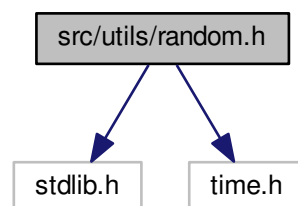
## 4.34.2.47 ANSI\_UNDERLINE

```
#define ANSI_UNDERLINE  ANSI_SGR(4)
```

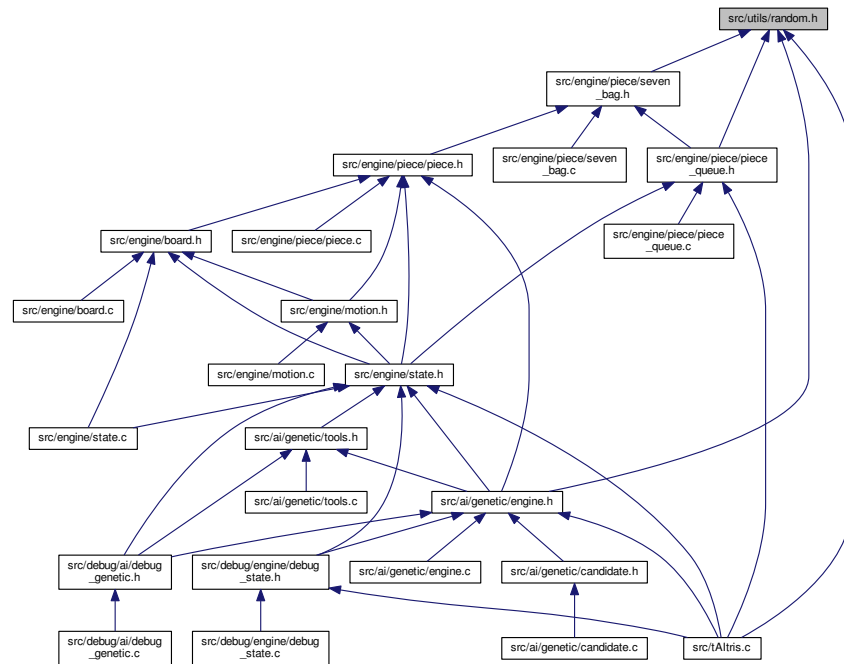
## 4.35 src/utils/random.h File Reference

Random number generation.

```
#include <stdlib.h>  
#include <time.h>  
Include dependency graph for random.h:
```



This graph shows which files directly or indirectly include this file:



#### 4.35.1 Detailed Description

Random number generation.

Author

S4MasterRace

Version

2.0

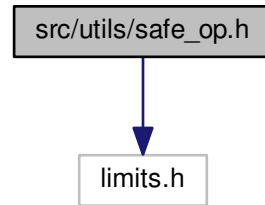
#### 4.36 src/utils/safe\_op.h File Reference

Safe operations.

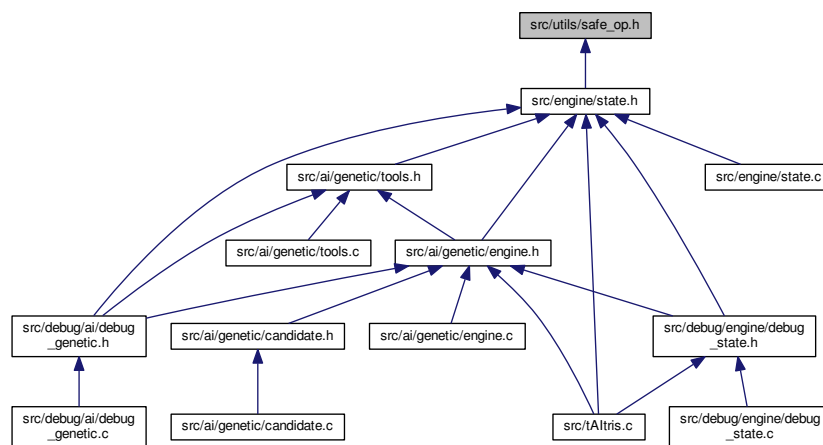


```
#include <limits.h>
```

Include dependency graph for safe\_op.h:



This graph shows which files directly or indirectly include this file:



## Macros

- `#define SAFE_OP_SUCCESS 0`
- `#define SAFE_OP_OVERFLOW 1`
- `#define SAFE_OP_UNDERFLOW (-1)`

### 4.36.1 Detailed Description

Safe operations.

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Version

2.0

## 4.36.2 Macro Definition Documentation

### 4.36.2.1 SAFE\_OP\_OVERFLOW

```
#define SAFE_OP_OVERFLOW 1
```

### 4.36.2.2 SAFE\_OP\_SUCCESS

```
#define SAFE_OP_SUCCESS 0
```

### 4.36.2.3 SAFE\_OP\_UNDERFLOW

```
#define SAFE_OP_UNDERFLOW (-1)
```

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