# Tabu Search TEA Reference Manual

Tabu search implementation to break TEA1 cipher algorithm

Generated by Doxygen 1.4.7

Sat Jul 1 18:40:18 2006

# **Contents**

1	Tabu	search TEA Data Structure Index	1
	1.1	Tabu Search TEA Data Structures	1
2	Tabu	search TEA File Index	3
	2.1	Tabu Search TEA File List	3
3	Tabu	Search TEA Data Structure Documentation	5
	3.1	best_result Struct Reference	5
	3.2	container_node Struct Reference	7
	3.3	final_report Struct Reference	8
	3.4	full_test_input_opt Struct Reference	12
	3.5	generate_options Struct Reference	16
	3.6	input_opt Struct Reference	18
	3.7	output_report Struct Reference	21
	3.8	paranoid_level Struct Reference	24
	3.9	tabu_list Struct Reference	25
	3.10	tabu_movement Struct Reference	27
	3.11	tabu_search_params Struct Reference	28
	3.12	test_input_opt Struct Reference	30
4	Tabu	Search TEA File Documentation	33
	4.1	/Users/freddy/Documents/Research_proyects/TEA/code/generate.c File Reference	33
	4.2	/Users/freddy/Documents/Research_proyects/TEA/code/io.c File Reference	35
	4.3	/Users/freddy/Documents/Research_proyects/TEA/code/io.h File Reference	45
	4.4	/Users/freddy/Documents/Research_proyects/TEA/code/main.c File Reference	56
	4.5	/Users/freddy/Documents/Research_proyects/TEA/code/tabu_search.c File Reference	57
	4.6	/Users/freddy/Documents/Research_proyects/TEA/code/tabu_search.h File Reference	63
	4.7	/Users/freddy/Documents/Research_proyects/TEA/code/tea.c File Reference	71
	4.8	/Users/freddy/Documents/Research proyects/TEA/code/tea.h File Reference	74

ii CONTENTS

4.9	/Users/freddy/Documents/Research_proyects/TEA/code/test.c File Reference	78
4.10	$/Users/freddy/Documents/Research\_proyects/TEA/code/ts\_full\_test.c\ File\ Reference \ .\ .\ .$	79
4.11	/Users/freddy/Documents/Research_proyects/TEA/code/ts_full_test.h File Reference $$ . $$ .	81
4.12	/Users/freddy/Documents/Research provects/TEA/code/types.h File Reference	84

# **Chapter 1**

# **Tabu Search TEA Data Structure Index**

# 1.1 Tabu Search TEA Data Structures

Here are the data structures with brief descriptions:

best_result (Tabu Search best result implementation Best result for tabu search) container_node (Input data structure Data structure that contains the input data (plain,	5
cipher) )	7
final_report (Final report for tabu search Structure that support data for final report gen-	
eration )	8
full_test_input_opt (Structure that support input options for full test tabu search input	
options for full test tabu search )	12
generate_options (Generate plain-cipher input options Container for options in generation	
of random plain-cipher)	16
input_opt (Tabu search input options General Tabu search input options data structure ) .	18
output_report (Structure to support report and debug generation Support for report gener-	
ation (initial al final report), and support for debugging options, function pointer	
aids change the function for each different context )	21
paranoid_level (Paranoid debug support Structure that support paranoid debug for tabu	
search operations, in order to work each attribute has a different meaning for each	
different context )	24
tabu_list (Tabu List implementation data structure The tabu list, its a circular linked list	
which contains forbidden movements )	25
tabu_movement (Structure to support tabu search morphic movement Function pointer	
aids to support multiple tabu search movements, this structure provides the mech-	
anism to link movement and tabu search call )	27
tabu_search_params (Tabu Search parameters A set of parameters to perform tabu search )	28
test_input_opt (Cipher Test input options Cipher Test input options data )	30

Tahu	Search	TEA	Data	Structure	Index
141711	ocal CII	I IVA	Data	SHUCLUIE	HIUCZ

# Chapter 2

# **Tabu Search TEA File Index**

# 2.1 Tabu Search TEA File List

Here is a list of all documented files with brief descriptions:

/Users/freddy/Documents/Research_proyects/TEA/code/generate.c (Generation of test set for	
TEA Tabu Search )	33
/Users/freddy/Documents/Research_proyects/TEA/code/io.c (Input output functions )	35
/Users/freddy/Documents/Research_proyects/TEA/code/io.h (Input output constant and func-	
tions definition)	45
/Users/freddy/Documents/Research_proyects/TEA/code/main.c (Main Tabu Search program )	56
/Users/freddy/Documents/Research_proyects/TEA/code/tabu_search.c (Tabu Search func-	
tions )	57
/Users/freddy/Documents/Research_proyects/TEA/code/tabu_search.h (Tabu search con-	
stants and function prototypes )	63
/Users/freddy/Documents/Research_proyects/TEA/code/tea.c (TEA Implementation )	71
/Users/freddy/Documents/Research_proyects/TEA/code/tea.h (TEA constant and functions	
definitions )	74
	78
/Users/freddy/Documents/Research_proyects/TEA/code/ts_full_test.c (Full test for tabu	
search)	79
/Users/freddy/Documents/Research_proyects/TEA/code/ts_full_test.h (Tabu Search full test	
constants)	81
/Users/freddy/Documents/Research_proyects/TEA/code/types.h (Types definition for all com-	
ponents of TS application )	84

# **Chapter 3**

# **Tabu Search TEA Data Structure Documentation**

## 3.1 best\_result Struct Reference

Tabu Search best result implementation Best result for tabu search.

#include <types.h>

#### **Data Fields**

- unsigned long key [2]
- float value
- unsigned int bit

#### 3.1.1 Detailed Description

Tabu Search best result implementation Best result for tabu search.

Definition at line 172 of file types.h.

#### 3.1.2 Field Documentation

#### 3.1.2.1 unsigned int best\_result::bit

bit modified for this result

Definition at line 175 of file types.h.

Referenced by tabusearch().

#### 3.1.2.2 unsigned long best\_result::key[2]

key value for this result

Definition at line 173 of file types.h.

Referenced by print\_end(), print\_end\_test\_matrix(), print\_iteration(), and tabusearch().

#### 3.1.2.3 float best\_result::value

evalutation value for this result

Definition at line 174 of file types.h.

 $Referenced\ by\ print\_end(),\ print\_end\_test\_matrix(),\ print\_iteration(),\ and\ tabusearch().$ 

## 3.2 container\_node Struct Reference

input data structure Data structure that contains the input data (plain, cipher)

```
#include <types.h>
```

#### **Data Fields**

- unsigned long plain\_message [2]
- unsigned long cipher\_message [2]
- int size\_array

#### 3.2.1 Detailed Description

input data structure Data structure that contains the input data (plain, cipher) Definition at line 39 of file types.h.

#### 3.2.2 Field Documentation

#### 3.2.2.1 unsigned long container\_node::cipher\_message[2]

64 bits cipher message splited in two 32 bits blocks

Definition at line 41 of file types.h.

Referenced by read\_input().

#### 3.2.2.2 unsigned long container\_node::plain\_message[2]

64 bits message splited in two 32 bits blocks

Definition at line 40 of file types.h.

Referenced by read\_input().

#### 3.2.2.3 int container\_node::size\_array

number of container nodes

Definition at line 42 of file types.h.

Referenced by evaluate(), main(), and read\_input().

## 3.3 final\_report Struct Reference

Final report for tabu search Structure that support data for final report generation.

#include <types.h>

#### **Data Fields**

- best result \* left
- best\_result \* right
- time\_t init\_left
- time\_t init\_right
- time\_t init\_global
- time\_t end\_left
- time\_t end\_right
- time\_t end\_global
- clock\_t clock\_left
- clock\_t clock\_right
- clock\_t clock\_global
- · unsigned int change\_left\_count
- unsigned int change\_right\_count
- unsigned int restart\_left\_control
- unsigned int restart\_right\_control
- unsigned int left\_iter
- unsigned int right\_iter

#### 3.3.1 Detailed Description

Final report for tabu search Structure that support data for final report generation.

Definition at line 208 of file types.h.

#### 3.3.2 Field Documentation

#### 3.3.2.1 unsigned int final\_report::change\_left\_count

movement change for left block

Definition at line 220 of file types.h.

Referenced by print\_end().

#### 3.3.2.2 unsigned int final\_report::change\_right\_count

movement change for right block

Definition at line 221 of file types.h.

Referenced by print\_end().

#### 3.3.2.3 clock\_t final\_report::clock\_global

global program clock

Definition at line 219 of file types.h.

Referenced by print\_end().

#### 3.3.2.4 clock\_t final\_report::clock\_left

program clock for left block

Definition at line 217 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.5 clock\_t final\_report::clock\_right

program clock for right block

Definition at line 218 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.6 time\_t final\_report::end\_global

end global time

Definition at line 216 of file types.h.

Referenced by print\_end().

#### 3.3.2.7 time\_t final\_report::end\_left

end time for left block

Definition at line 214 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.8 time\_t final\_report::end\_right

end time for right block

Definition at line 215 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.9 time\_t final\_report::init\_global

initial global time

Definition at line 213 of file types.h.

Referenced by print\_end().

#### 3.3.2.10 time\_t final\_report::init\_left

initial time for left block

Definition at line 211 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.11 time\_t final\_report::init\_right

initial time for right block

Definition at line 212 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.12 best\_result\* final\_report::left

best result for left block

Definition at line 209 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.13 unsigned int final\_report::left\_iter

iterations for left block

Definition at line 224 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.14 unsigned int final\_report::restart\_left\_control

restarts for left block

Definition at line 222 of file types.h.

Referenced by print\_end().

#### 3.3.2.15 unsigned int final\_report::restart\_right\_control

restarts for right block

Definition at line 223 of file types.h.

Referenced by print\_end().

#### 3.3.2.16 best\_result\* final\_report::right

best result for left block

Definition at line 210 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

#### 3.3.2.17 unsigned int final\_report::right\_iter

iterations for right block

Definition at line 225 of file types.h.

Referenced by print\_end(), and print\_end\_test\_matrix().

## 3.4 full\_test\_input\_opt Struct Reference

Structure that support input options for full test tabu search input options for full test tabu search.

#include <types.h>

#### **Data Fields**

- char inputfile [255]
- char outfile [255]
- int save\_output
- int have\_input
- unsigned long long max\_tabu\_list\_length
- unsigned long long max\_tabu\_iterations
- unsigned long long max\_tabu\_max\_decrease
- unsigned long long max\_change\_move\_limit
- unsigned long long init\_tabu\_list\_length
- unsigned long long init\_tabu\_iterations
- unsigned long long init\_tabu\_max\_decrease
- unsigned long long init\_change\_move\_limit
- unsigned long long var\_tabu\_list\_length
- unsigned long long var\_tabu\_iterations
- unsigned long long var\_tabu\_max\_decrease
- unsigned long long var\_change\_move\_limit
- float min key eval percent
- float var\_key\_eval\_percent

#### 3.4.1 Detailed Description

Structure that support input options for full test tabu search input options for full test tabu search.

Definition at line 102 of file types.h.

#### 3.4.2 Field Documentation

#### 3.4.2.1 int full\_test\_input\_opt::have\_input

if save output to a file

Definition at line 106 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.2 unsigned long long full\_test\_input\_opt::init\_change\_move\_limit

initial number of mistakes to change movement

Definition at line 114 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.3 unsigned long long full\_test\_input\_opt::init\_tabu\_iterations

initial tabu iterations

Definition at line 112 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.4 unsigned long long full\_test\_input\_opt::init\_tabu\_list\_length

initial tabu list lenght

Definition at line 111 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.5 unsigned long long full\_test\_input\_opt::init\_tabu\_max\_decrease

initial performance max decrease

Definition at line 113 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.6 char full\_test\_input\_opt::inputfile[255]

name for the input file

Definition at line 103 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.7 unsigned long long full\_test\_input\_opt::max\_change\_move\_limit

maximal number of mistakes to change movement

Definition at line 110 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.8 unsigned long long full\_test\_input\_opt::max\_tabu\_iterations

maximal tabu iterations

Definition at line 108 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.9 unsigned long long full\_test\_input\_opt::max\_tabu\_list\_length

maximal tabu list lenght

Definition at line 107 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.10 unsigned long long full\_test\_input\_opt::max\_tabu\_max\_decrease

maximal tabu performance max decrease

Definition at line 109 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.11 float full\_test\_input\_opt::min\_key\_eval\_percent

initial percent for evaluation key

Definition at line 119 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_full\_test\_arguments().

#### 3.4.2.12 char full\_test\_input\_opt::outfile[255]

name for the output file

Definition at line 104 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), and parse\_full\_test\_arguments().

#### 3.4.2.13 int full\_test\_input\_opt::save\_output

if save output to a file

Definition at line 105 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), and parse\_full\_test\_arguments().

#### 3.4.2.14 unsigned long long full\_test\_input\_opt::var\_change\_move\_limit

variation of mistakes number to change movement

Definition at line 118 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.15 float full\_test\_input\_opt::var\_key\_eval\_percent

variation of percent for evaluation key

Definition at line 120 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.16 unsigned long long full\_test\_input\_opt::var\_tabu\_iterations

variation of tabu iterations

Definition at line 116 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### 3.4.2.17 unsigned long long full\_test\_input\_opt::var\_tabu\_list\_length

variation of tabu list lenght

Definition at line 115 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

#### ${\bf 3.4.2.18} \quad unsigned\ long\ long\ full\_test\_input\_opt::var\_tabu\_max\_decrease$

variation of tabu performance max decrease

Definition at line 117 of file types.h.

Referenced by main(), and parse\_full\_test\_arguments().

# 3.5 generate\_options Struct Reference

generate plain-cipher input options Container for options in generation of random plain-cipher
#include <types.h>

#### **Data Fields**

- char outfile [255]
- · int userandom
- int usefile
- int usekey
- · unsigned long seed
- unsigned long amount
- unsigned long key [4]

#### 3.5.1 Detailed Description

generate plain-cipher input options Container for options in generation of random plain-cipher Definition at line 133 of file types.h.

#### 3.5.2 Field Documentation

#### 3.5.2.1 unsigned long generate\_options::amount

amount of plain-cipher messages

Definition at line 139 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.2 unsigned long generate\_options::key[4]

if no randomd key, the key needs to be given

Definition at line 140 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.3 char generate\_options::outfile[255]

output filename

Definition at line 134 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.4 unsigned long generate\_options::seed

seed for random

Definition at line 138 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.5 int generate\_options::usefile

if outfile would be used, if not use STDOUT

Definition at line 136 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.6 int generate\_options::usekey

if key would be given

Definition at line 137 of file types.h.

Referenced by main(), and parse\_generate\_arguments().

#### 3.5.2.7 int generate\_options::userandom

if the key is random generated

Definition at line 135 of file types.h.

Referenced by parse\_generate\_arguments().

# 3.6 input\_opt Struct Reference

Tabu search input options General Tabu search input options data structure.

#include <types.h>

#### **Data Fields**

- int have\_input
- int generate\_report
- int save\_output
- int paranoid leve
- int middle\_op
- int print\_iter
- char inputfile [255]
- char outfile [255]
- · unsigned long long tabu\_list\_length
- unsigned long long tabu\_iterations
- unsigned long long tabu\_max\_decrease
- unsigned long long change\_move\_limit
- float key\_eval\_percent

#### 3.6.1 Detailed Description

Tabu search input options General Tabu search input options data structure.

Definition at line 55 of file types.h.

#### 3.6.2 Field Documentation

#### 3.6.2.1 unsigned long long input\_opt::change\_move\_limit

tabu number of mistakes to change movement

Definition at line 67 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), create\_params(), main(), and parse\_ts\_arguments().

#### 3.6.2.2 int input\_opt::generate\_report

if generate report (ALWAYS TRUE)

Definition at line 57 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), and parse\_ts\_arguments().

#### 3.6.2.3 int input\_opt::have\_input

if have input file

Definition at line 56 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), and parse\_ts\_arguments().

#### 3.6.2.4 char input\_opt::inputfile[255]

name for the input file

Definition at line 62 of file types.h.

Referenced by main(), parse\_ts\_arguments(), and print\_init().

#### 3.6.2.5 float input\_opt::key\_eval\_percent

percer for evaluation key

Definition at line 68 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), create\_params(), main(), and parse\_ts\_arguments().

#### 3.6.2.6 int input\_opt::middle\_op

if it's necessary to print middle operations

Definition at line 60 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), open\_report(), and parse\_ts\_arguments().

#### 3.6.2.7 char input\_opt::outfile[255]

name for the output file

Definition at line 63 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), open\_report(), parse\_ts\_arguments(), and print\_init().

#### 3.6.2.8 int input\_opt::paranoid\_leve

wich paranoid level would be used (DEFAULT 0)

Definition at line 59 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), evaluate(), move\_alpha(), move\_beta(), open\_report(), parse\_ts\_arguments(), and tabusearch().

#### 3.6.2.9 int input\_opt::print\_iter

if it's necessary to print iteration operations

Definition at line 61 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), open\_report(), and parse\_ts\_arguments().

#### 3.6.2.10 int input\_opt::save\_output

if save output to a file

Definition at line 58 of file types.h.

Referenced by close\_report(), convert\_full\_test\_opt\_to\_gen(), main(), open\_report(), parse\_ts\_arguments(), print\_init(), and tabusearch().

#### 3.6.2.11 unsigned long long input\_opt::tabu\_iterations

tabu iterations (DEFAULT 0)

Definition at line 65 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), create\_params(), main(), and parse\_ts\_arguments().

#### 3.6.2.12 unsigned long long input\_opt::tabu\_list\_length

tabu list lenght (DEFAULT 0)

Definition at line 64 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), create\_params(), main(), and parse\_ts\_arguments().

#### 3.6.2.13 unsigned long long input\_opt::tabu\_max\_decrease

tabu performance max decrease (DEFAULT 0)

Definition at line 66 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), create\_params(), main(), and parse\_ts\_arguments().

## 3.7 output\_report Struct Reference

Structure to support report and debug generation Support for report generation (initial al final report), and support for debugging options, function pointer aids change the function for each different context.

```
#include <types.h>
```

#### **Data Fields**

- input\_options \* options
- paranoid \* par
- paranoid \* pardeb
- FILE \* report\_file
- void(\* print\_init )(ts\_params \*, input\_options \*, FILE \*)
- void(\* print\_end )(final\_report \*, FILE \*)
- void(\* print\_middle )(unsigned long, float, unsigned int, int, int, FILE \*)
- void(\* print\_iteration )(best\_result \*, int, int, FILE \*)
- void(\* print\_paranoid )(paranoid \*, FILE \*)
- void(\* print paranoid move)(paranoid \*, FILE \*)
- void(\* print\_paranoid\_eval )(paranoid \*, FILE \*)
- void(\* print\_paranoid\_all )(paranoid \*, FILE \*)

#### 3.7.1 Detailed Description

Structure to support report and debug generation Support for report generation (initial al final report), and support for debugging options, function pointer aids change the function for each different context.

Definition at line 265 of file types.h.

#### 3.7.2 Field Documentation

#### 3.7.2.1 input options\* output report::options

input options for this tabu serach program

Definition at line 266 of file types.h.

Referenced by close\_report(), evaluate(), move\_alpha(), move\_beta(), open\_report(), and tabusearch().

#### 3.7.2.2 paranoid\* output\_report::par

Paranoid container for misc purpose

Definition at line 267 of file types.h.

Referenced by move\_alpha(), move\_beta(), and tabusearch().

#### 3.7.2.3 paranoid\* output\_report::pardeb

Paranoid container for misc purpose

Definition at line 268 of file types.h.

Referenced by evaluate().

#### 3.7.2.4 void(\* output\_report::print\_end)(final\_report \*, FILE \*)

print final report

Referenced by open\_report(), and report\_use\_test\_matrix().

#### 3.7.2.5 void(\* output report::print init)(ts params \*, input options \*, FILE \*)

print the initial report

Referenced by open\_report(), report\_use\_test\_matrix(), and tabusearch().

#### 3.7.2.6 void(\* output\_report::print\_iteration)(best\_result \*, int, int, FILE \*)

print tabu search iteration resutls

Referenced by open\_report(), and tabusearch().

#### 3.7.2.7 void(\* output\_report::print\_middle)(unsigned long, float, unsigned int, int, int, FILE \*)

print tabu search middle operations

Referenced by open\_report().

#### 3.7.2.8 void(\* output\_report::print\_paranoid)(paranoid \*, FILE \*)

paranoid debug level 1, print tabu op

Referenced by open\_report(), and tabusearch().

#### 3.7.2.9 void(\* output\_report::print\_paranoid\_all)(paranoid \*, FILE \*)

paranoid debug level 4, print key kegeneration for key eval

Referenced by evaluate(), and open\_report().

#### 3.7.2.10 void(\* output\_report::print\_paranoid\_eval)(paranoid \*, FILE \*)

paranoid debug level 3, print evaluation function

Referenced by evaluate(), and open\_report().

#### 3.7.2.11 void(\* output\_report::print\_paranoid\_move)(paranoid \*, FILE \*)

paranoid debug level 2, print movement

Referenced by move\_alpha(), move\_beta(), and open\_report().

#### 3.7.2.12 FILE\* output\_report::report\_file

where to write reports

Definition at line 269 of file types.h.

Referenced by close\_report(), main(), open\_report(), and tabusearch().

# 3.8 paranoid\_level Struct Reference

Paranoid debug support Structure that support paranoid debug for tabu search operations, in order to work each attribute has a different meaning for each different context.

#include <types.h>

#### **Data Fields**

- unsigned long key
- float score
- int block
- unsigned long evalkey
- tabu\_list \* list
- unsigned int tabu
- unsigned int bit
- unsigned int percent
- unsigned int zeros
- · unsigned int ones
- unsigned int element

#### 3.8.1 Detailed Description

Paranoid debug support Structure that support paranoid debug for tabu search operations, in order to work each attribute has a different meaning for each different context.

Definition at line 239 of file types.h.

## 3.9 tabu\_list Struct Reference

Tabu List implementation data structure The tabu list, its a circular linked list which contains forbidden movements.

#include <types.h>

#### **Data Fields**

- unsigned long key
- unsigned int bit\_position
- float value
- unsigned int name
- $tabu\_list * next$

#### 3.9.1 Detailed Description

Tabu List implementation data structure The tabu list, its a circular linked list which contains forbidden movements.

Definition at line 153 of file types.h.

#### 3.9.2 Field Documentation

#### 3.9.2.1 unsigned int tabu\_list::bit\_position

bit modification for this tabu

Definition at line 155 of file types.h.

Referenced by create\_tabu\_list(), move\_alpha(), move\_beta(), print\_paranoid(), and restart\_tabu().

#### 3.9.2.2 unsigned long tabu\_list::key

key value for this tabu

Definition at line 154 of file types.h.

Referenced by create\_tabu\_list(), print\_paranoid(), and restart\_tabu().

#### 3.9.2.3 unsigned int tabu\_list::name

name for this element

Definition at line 157 of file types.h.

Referenced by create\_tabu\_list(), free\_tabu(), print\_paranoid(), and restart\_tabu().

#### 3.9.2.4 struct tabu\_list\* tabu\_list::next

next element in the tabu list

Definition at line 158 of file types.h.

Referenced by create\_tabu\_list(), free\_tabu(), move\_alpha(), move\_beta(), print\_paranoid(), and restart\_tabu().

#### 3.9.2.5 float tabu\_list::value

evaluation value for this tabu

Definition at line 156 of file types.h.

 $Referenced\ by\ create\_tabu\_list(),\ print\_paranoid(),\ and\ restart\_tabu().$ 

## 3.10 tabu\_movement Struct Reference

Structure to support tabu search morphic movement Function pointer aids to support multiple tabu search movements, this structure provides the mechanism to link movement and tabu search call.

```
#include <types.h>
```

#### **Data Fields**

• void(\* move )(unsigned long \*, tabu\_list \*, unsigned long \*, unsigned int \*, unsigned int \*, best\_result \*, ts\_params \*, output\_report \*, cipher\_cont \*, int)

#### 3.10.1 Detailed Description

Structure to support tabu search morphic movement Function pointer aids to support multiple tabu search movements, this structure provides the mechanism to link movement and tabu search call.

Definition at line 291 of file types.h.

#### 3.10.2 Field Documentation

3.10.2.1 void(\* tabu\_movement::move)(unsigned long \*, tabu\_list \*, unsigned long \*, unsigned int \*, unsigned int \*, best\_result \*, ts\_params \*, output\_report \*, cipher\_cont \*, int)

Tabu search movement

Referenced by tabusearch().

# 3.11 tabu\_search\_params Struct Reference

Tabu Search parameters A set of parameters to perform tabu search.

#include <types.h>

#### **Data Fields**

- unsigned long long tabu\_list\_length
- · unsigned long long tabu\_iterations
- unsigned long long tabu\_max\_decrease
- unsigned long long change\_move\_limit
- float key\_eval\_percent

#### 3.11.1 Detailed Description

Tabu Search parameters A set of parameters to perform tabu search.

Definition at line 189 of file types.h.

#### 3.11.2 Field Documentation

#### 3.11.2.1 unsigned long long tabu\_search\_params::change\_move\_limit

mistakes for change the movement

Definition at line 193 of file types.h.

Referenced by create\_params(), print\_init(), and tabusearch().

#### 3.11.2.2 float tabu\_search\_params::key\_eval\_percent

percent of equality of key bits

Definition at line 194 of file types.h.

Referenced by create\_params(), evaluate(), print\_init(), and print\_init\_test\_matrix().

#### 3.11.2.3 unsigned long long tabu\_search\_params::tabu\_iterations

maximal number of iterations

Definition at line 191 of file types.h.

Referenced by create\_params(), print\_init(), print\_init\_test\_matrix(), and tabusearch().

#### 3.11.2.4 unsigned long long tabu\_search\_params::tabu\_list\_length

tabu list length

Definition at line 190 of file types.h.

Referenced by create\_params(), create\_tabu\_list(), move\_alpha(), move\_beta(), print\_init(), print\_init\_test\_matrix(), and restart\_tabu().

#### 3.11.2.5 unsigned long long tabu\_search\_params::tabu\_max\_decrease

performance decreace limit

Definition at line 192 of file types.h.

 $Referenced\ by\ create\_params(),\ print\_init(),\ and\ print\_init\_test\_matrix().$ 

# 3.12 test\_input\_opt Struct Reference

Cipher Test input options Cipher Test input options data.

#include <types.h>

#### **Data Fields**

- char inputfile [255]
- char outfile [255]
- int save\_output
- int have\_input
- unsigned long long key1
- unsigned long long key2
- unsigned long long key3
- unsigned long long key4

#### 3.12.1 Detailed Description

Cipher Test input options Cipher Test input options data.

Definition at line 81 of file types.h.

#### 3.12.2 Field Documentation

#### 3.12.2.1 int test\_input\_opt::have\_input

if have input file

Definition at line 85 of file types.h.

Referenced by main(), and parse\_test\_arguments().

#### 3.12.2.2 char test\_input\_opt::inputfile[255]

name for the input file

Definition at line 82 of file types.h.

Referenced by main(), and parse\_test\_arguments().

#### 3.12.2.3 unsigned long long test\_input\_opt::key2

< block 1 for input key

Definition at line 87 of file types.h.

Referenced by main(), and parse\_test\_arguments().

#### 3.12.2.4 unsigned long long test\_input\_opt::key3

< block 2 for input key

Definition at line 88 of file types.h.

Referenced by main(), and parse\_test\_arguments().

#### 3.12.2.5 unsigned long long test\_input\_opt::key4

< block 3 for input key

Definition at line 89 of file types.h.

Referenced by main(), and parse\_test\_arguments().

#### 3.12.2.6 char test\_input\_opt::outfile[255]

name for the output file

Definition at line 83 of file types.h.

Referenced by parse\_test\_arguments().

#### 3.12.2.7 int test\_input\_opt::save\_output

if save output to a file

Definition at line 84 of file types.h.

Referenced by parse\_test\_arguments().

32

## **Chapter 4**

## **Tabu Search TEA File Documentation**

# 4.1 /Users/freddy/Documents/Research\_proyects/TEA/code/generate.c File Reference

Generation of test set for TEA Tabu Search.

```
#include <stdio.h>
#include <stdlib.h>
#include "tea.h"
#include "io.h"
#include "types.h"
```

## **Functions**

• int main (int argc, char \*\*argv)

## 4.1.1 Detailed Description

Generation of test set for TEA Tabu Search.

## Author:

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file generate.c.

## **4.1.2** Function Documentation

## 4.1.2.1 int main (int argc, char \*\* argv)

Generate a test set with TEA cipher

## **Parameters:**

arcg number of input arguments
argv input argument string

Definition at line 19 of file generate.c.

References generate\_options::amount, generate\_options::key, MALLOC, generate\_options::outfile, parse\_generate\_arguments(), print\_generate\_options(), generate\_options::seed, tea\_encrypt(), generate\_options::usefile, and generate\_options::usekey.

## 4.2 /Users/freddy/Documents/Research\_proyects/TEA/code/io.c File Reference

## input output functions

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "io.h"
#include "types.h"
#include "tabu search.h"
```

## **Functions**

- cipher\_cont \* read\_input (char \*filename)
- input\_options \* convert\_full\_test\_opt\_to\_gen (full\_test\_input\_options \*options)
- void parse\_full\_test\_arguments (int argc, char \*\*argv, full\_test\_input\_options \*options)
- void parse\_test\_arguments (int argc, char \*\*argv, test\_input\_options \*options)
- void parse\_generate\_arguments (int argc, char \*\*argv, generate\_options \*options)
- void parse\_ts\_arguments (int argc, char \*\*argv, input\_options \*options)
- void print\_full\_test\_options (char \*name)
- void print\_ts\_options (char \*name)
- void print\_test\_options (char \*name)
- void print\_generate\_options (char \*name)
- output\_report \* open\_report (input\_options \*options)
- void close\_report (output\_report \*report)
- void report\_use\_test\_matrix (output\_report \*report)
- void print init (ts params \*params, input options \*options, FILE \*file)
- void print\_init\_test\_matrix (ts\_params \*params, input\_options \*options, FILE \*file)
- void print\_end\_test\_matrix (final\_report \*report, FILE \*file)
- void print\_mold\_test\_matrix (FILE \*file)
- void print\_end (final\_report \*report, FILE \*file)
- void print\_middle (unsigned long key, float score, unsigned int bit, int block, int tabuname, FILE \*file)
- void print\_iteration (best\_result \*best, int iter, int block, FILE \*file)
- void print\_paranoid (paranoid \*paranoid, FILE \*file)
- void print\_paranoid\_move (paranoid \*paranoid, FILE \*file)
- void print\_paranoid\_eval (paranoid \*paranoid, FILE \*file)
- void print\_paranoid\_all (paranoid \*paranoid, FILE \*file)
- $\bullet$  void void\_print\_middle (unsigned long key, float score, unsigned int bit, int block, int tabuname, FILE \*fp)
- void void print iteration (best result \*best, int block, int iter, FILE \*fp)
- void void\_print\_paranoid (paranoid \*paranoid, FILE \*fp)
- void void\_print\_paranoid\_move (paranoid \*paranoid, FILE \*fp)
- void void\_print\_paranoid\_eval (paranoid \*paranoid, FILE \*fp)
- void void print paranoid all (paranoid \*paranoid, FILE \*fp)

## 4.2.1 Detailed Description

input output functions

**Author:** 

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file io.c.

#### 4.2.2 Function Documentation

**4.2.2.1** void close\_report (output\_report \* report)

Close output file for given report

**Parameters:** 

report Report generator

Definition at line 662 of file io.c.

References output\_report::options, output\_report::report\_file, and input\_opt::save\_output.

Referenced by main().

4.2.2.2 input\_options\* convert\_full\_test\_opt\_to\_gen (full\_test\_input\_options \* options)

Convert full\_test\_input\_options to input\_options

**Parameters:** 

options Tabu Serach general input options

Definition at line 80 of file io.c.

References input\_opt::change\_move\_limit, FALSE, input\_opt::generate\_report, input\_opt::have\_input, full\_test\_input\_opt::have\_input, full\_test\_input\_opt::init\_change\_move\_limit, full\_test\_input\_opt::init\_tabu\_iterations, full\_test\_input\_opt::init\_tabu\_list\_length, full\_test\_input\_opt::init\_tabu\_max\_decrease, input\_opt::key\_eval\_percent, MALLOC, input\_opt::middle\_op, full\_test\_input\_opt::min\_key\_eval\_percent, input\_opt::outfile, full\_test\_input\_opt::outfile, input\_opt::paranoid\_leve, input\_opt::print\_iter, input\_opt::save\_output, full\_test\_input\_opt::save\_output, input\_opt::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_decrease, and TRUE.

Referenced by main().

4.2.2.3 output report\* open report (input options \* options)

Create a new report creator and bind the correct function in accord with options

#### **Parameters:**

options Tabu Search general input options

Definition at line 580 of file io.c.

References MALLOC, input\_opt::middle\_op, output\_report::options, input\_opt::outfile, input\_opt::paranoid\_leve, output\_report::print\_end, print\_end(), output\_report::print\_init, print\_init(), input\_opt::print\_iter, output\_report::print\_iteration, print\_iteration(), output\_report::print\_middle, print\_middle(), output\_report::print\_paranoid, print\_paranoid(), output\_report::print\_paranoid\_eval(), output\_report::print\_paranoid\_eval(), output\_report::print\_paranoid\_eval(), output\_report::print\_paranoid\_move(), output\_report::report\_file, input\_opt::save\_output, void\_print\_iteration(), void\_print\_middle(), void\_print\_paranoid(), void\_print\_paranoid\_move().

Referenced by main().

4.2.2.4 void parse\_full\_test\_arguments (int argc, char \*\* argv, full\_test\_input\_options \* options)

Parse full test input arguments and mold it into full test input options structure

#### **Parameters:**

argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters

Definition at line 108 of file io.c.

References FALSE, full\_test\_input\_opt::have\_input, full\_test\_input\_opt::init\_change\_move\_limit, full\_test\_input\_opt::init\_tabu\_iterations, full\_test\_input\_opt::init\_tabu\_list\_length, full\_test\_input\_opt::init\_tabu\_max\_decrease, full\_test\_input\_opt::inputfile, full\_test\_input\_opt::max\_change\_move\_limit, full\_test\_input\_opt::max\_tabu\_iterations, full\_test\_input\_opt::max\_tabu\_list\_length, full\_test\_input\_opt::max\_tabu\_max\_decrease, full\_test\_input\_opt::min\_key\_eval\_percent, full\_test\_input\_opt::var\_change\_move\_limit, full\_test\_input\_opt::var\_key\_eval\_percent, full\_test\_input\_opt::var\_tabu\_iterations, full\_test\_input\_opt::var\_tabu\_list\_length, and full\_test\_input\_opt::var\_tabu\_max\_decrease.

Referenced by main().

4.2.2.5 void parse\_generate\_arguments (int *argc*, char \*\* *argv*, generate\_options \* *options*)

Parse TEA generation input arguments and mold it into generate\_iptions structure

#### **Parameters:**

argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters

Definition at line 330 of file io.c.

References generate\_options::amount, FALSE, generate\_options::key, generate\_options::outfile, print\_generate\_options(), generate\_options::seed, TRUE, generate\_options::usefile, generate\_options::usekey, and generate\_options::userandom.

Referenced by main().

4.2.2.6 void parse\_test\_arguments (int argc, char \*\* argv, test\_input\_options \* options)

Parse cipher test input arguments and mold it into test\_input\_options structure

#### **Parameters:**

```
argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters
```

Definition at line 278 of file io.c.

References FALSE, test\_input\_opt::have\_input, test\_input\_opt::inputfile, test\_input\_opt::key1, test\_input\_opt::key2, test\_input\_opt::key3, test\_input\_opt::key4, test\_input\_opt::outfile, test\_input\_opt::save\_output, and TRUE.

Referenced by main().

4.2.2.7 void parse ts arguments (int argc, char \*\* argv, input options \* options)

Parse Tabu Search input arguments and mold it into input\_options structure

#### **Parameters:**

```
argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters
```

Definition at line 392 of file io.c.

References input\_opt::change\_move\_limit, FALSE, input\_opt::generate\_report, input\_opt::have\_input, input\_opt::inputfile, input\_opt::key\_eval\_percent, input\_opt::middle\_op, input\_opt::outfile, input\_opt::paranoid\_leve, input\_opt::print\_iter, input\_opt::save\_output, input\_opt::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_decrease, and TRUE.

Referenced by main().

```
4.2.2.8 void print_end (final_report * report, FILE * file)
```

Print final report of Tabu Search

#### **Parameters:**

```
report Report generator file File to print
```

Definition at line 741 of file io.c.

References final\_report::change\_left\_count, final\_report::change\_right\_count, final\_report::clock\_global, final\_report::clock\_left, final\_report::clock\_right, final\_report::end\_global, final\_report::end\_left, final\_report::end\_right, final\_report::init\_global, final\_report::init\_left, final\_report::init\_right, best\_result::key, final\_report::left, final\_report::left\_iter, final\_report::restart\_left\_control, final\_report::right\_iter, and best\_result::value.

**4.2.2.9** void print\_end\_test\_matrix (final\_report \* report, FILE \* file)

Print each step Tabu Search for test matrix

**Parameters:** 

```
report Report generator file File to print
```

Definition at line 718 of file io.c.

References final\_report::clock\_left, final\_report::clock\_right, final\_report::end\_left, final\_report::end\_right, final\_report::init\_left, final\_report::left, final\_report::left, final\_report::left, final\_report::right\_iter, and best\_result::value.

Referenced by report\_use\_test\_matrix().

```
4.2.2.10 void print_full_test_options (char * name)
```

Print full test usage and options

**Parameters:** 

name Name for executable

Definition at line 500 of file io.c.

Referenced by main().

**4.2.2.11** void print\_generate\_options (char \* name)

Print generate usage and options

**Parameters:** 

name Name for executable

Definition at line 573 of file io.c.

Referenced by main(), and parse\_generate\_arguments().

4.2.2.12 void print\_init (ts\_params \* params, input\_options \* options, FILE \* file)

Print initial asignation for Tabu Search

**Parameters:** 

```
params Paramenter of Tabu Search options Tabu Search general input options file File to print
```

Definition at line 683 of file io.c.

References tabu\_search\_params::change\_move\_limit, FALSE, input\_opt::inputfile, tabu\_search\_params::key\_eval\_percent, input\_opt::outfile, input\_opt::save\_output, tabu\_search\_params::tabu\_iterations, tabu\_search\_params::tabu\_list\_length, and tabu\_search\_params::tabu\_max\_decrease.

4.2.2.13 void print\_init\_test\_matrix (ts\_params \* params, input\_options \* options, FILE \* file)

Print initial asignation for Tabu Search in output text matrix

#### Parameters:

```
params Paramenter of Tabu Search
options Tabu Search general input options
file File to print
```

Definition at line 709 of file io.c.

References tabu\_search\_params::key\_eval\_percent, tabu\_search\_params::tabu\_iterations, tabu\_search\_params::tabu\_list\_length, and tabu\_search\_params::tabu\_max\_decrease.

Referenced by report use test matrix().

4.2.2.14 void print\_iteration (best\_result \* best, int iter, int block, FILE \* file)

**Print iteration step values** 

#### **Parameters:**

```
best Best result until this iteration
iter Iteration number
block Block for this iteration {LEFT,RIGHT}
file File to print
```

Definition at line 781 of file io.c.

References best\_result::key, and best\_result::value.

Referenced by open\_report().

4.2.2.15 void print\_middle (unsigned long key, float score, unsigned int bit, int block, int tabuname, FILE \* file)

Print step by step middle operation for Tabu Search

#### **Parameters:**

```
key Key in given step
score Score for given step
bit Bit changed in this step
block Block for this step {LEFT,RIGHT}
```

Definition at line 770 of file io.c.

**4.2.2.16 void print\_mold\_test\_matrix (FILE** \* *file*)

Print initial significant keyswords for test matrix

**Parameters:** 

file File to print

Definition at line 732 of file io.c.

Referenced by main().

4.2.2.17 void print\_paranoid (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug, include key movement values, and tabu list

**Parameters:** 

```
paranoid Paranoid data file File to print
```

Definition at line 790 of file io.c.

References tabu\_list::bit\_position, paranoid\_level::block, paranoid\_level::key, tabu\_list::key, paranoid\_level::list, tabu\_list::name, tabu\_list::next, paranoid\_level::tabu, and tabu\_list::value.

Referenced by open\_report().

**4.2.2.18** void print\_paranoid\_all (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug for evaluation function, include block key generation

**Parameters:** 

```
paranoid Paranoid data file File to print
```

Definition at line 826 of file io.c.

References paranoid\_level::bit, paranoid\_level::block, paranoid\_level::evalkey, and paranoid\_level::key.

Referenced by open\_report().

4.2.2.19 void print\_paranoid\_eval (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug for evaluation function

Parameters:

```
paranoid Paranoid data file File to print
```

Definition at line 817 of file io.c.

References paranoid\_level::bit, paranoid\_level::element, paranoid\_level::ones, paranoid\_level::percent, and paranoid\_level::zeros.

**4.2.2.20** void print\_paranoid\_move (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug, include movement middle key values and evaluation value

## **Parameters:**

```
paranoid Paranoid data
file File to print
```

Definition at line 808 of file io.c.

References paranoid\_level::bit, paranoid\_level::block, paranoid\_level::key, and paranoid\_level::score.

Referenced by open\_report().

**4.2.2.21** void print\_test\_options (char \* name)

Print cipher test usage and options

#### **Parameters:**

name Name for executable

Definition at line 559 of file io.c.

Referenced by main().

**4.2.2.22** void print\_ts\_options (char \* name)

Print Tabu Search usage and options

## Parameters:

name Name for executable

Definition at line 529 of file io.c.

Referenced by main().

4.2.2.23 cipher\_cont\* read\_input (char \* filename)

Read input file and put the content into corresponding structure

## **Parameters:**

filename Filename of input file

Definition at line 20 of file io.c.

References container\_node::cipher\_message, MAX\_FILE\_LINES, NMALLOC, container\_node::plain\_message, and container\_node::size\_array.

Referenced by main().

**4.2.2.24** void report\_use\_test\_matrix (output\_report \* report)

Change report binding to use test matrix

### **Parameters:**

```
report Report generator
```

Definition at line 672 of file io.c.

 $References \ output\_report::print\_end, \ print\_end\_test\_matrix(), \ output\_report::print\_init, \ and \ print\_init\_test\_matrix().$ 

Referenced by main().

4.2.2.25 void void\_print\_iteration (best\_result \* best, int block, int iter, FILE \* fp)

## DO NOTHING!

## **Parameters:**

```
best Best result until this iteration
iter Iteration number
block Block for this iteration {LEFT,RIGHT}
file File to print
```

Definition at line 849 of file io.c.

Referenced by open\_report().

4.2.2.26 void void\_print\_middle (unsigned long key, float score, unsigned int bit, int block, int tabuname, FILE \* fp)

## DO NOTHING!

## **Parameters:**

```
key Key in given stepscore Score for given stepbit Bit changed in this stepblock Block for this step {LEFT,RIGHT}
```

Definition at line 839 of file io.c.

Referenced by open\_report().

4.2.2.27 void void\_print\_paranoid (paranoid \* paranoid, FILE \* fp)

## DO NOTHING!

## **Parameters:**

```
paranoid Paranoid data file File to print
```

```
Definition at line 857 of file io.c.
Referenced by open_report().
4.2.2.28 void void_print_paranoid_all (paranoid * paranoid, FILE * fp)
DO NOTHING!
Parameters:
    paranoid Paranoid data
   file File to print
Definition at line 881 of file io.c.
Referenced by open_report().
4.2.2.29 void void_print_paranoid_eval (paranoid * paranoid, FILE * fp)
DO NOTHING!
Parameters:
    paranoid Paranoid data
   file File to print
Definition at line 873 of file io.c.
Referenced by open_report().
4.2.2.30 void void_print_paranoid_move (paranoid * paranoid, FILE * fp)
DO NOTHING!
Parameters:
    paranoid Paranoid data
   file File to print
Definition at line 865 of file io.c.
```

## 4.3 /Users/freddy/Documents/Research\_proyects/TEA/code/io.h File Reference

## input output constant and functions definition

```
#include "types.h"
```

### **Defines**

• #define MAX\_FILE\_LINES 6000

#### **Functions**

```
cipher_cont * read_input (char *)
void parse_ts_arguments (int, char **, input_options *)
void parse_test_arguments (int_char **, test_input_options *)
```

 $\bullet \ \ void\ parse\_test\_arguments\ (int, char\ **, test\_input\_options\ *)\\$ 

 $\bullet \ \ void\ parse\_full\_test\_arguments\ (int,\ char\ **,\ full\_test\_input\_options\ *)\\$ 

• void parse\_generate\_arguments (int, char \*\*, generate\_options \*)

void print\_ts\_options (char \*)

• void print\_test\_options (char \*)

• void print\_full\_test\_options (char \*)

• void print\_generate\_options (char \*)

• void print\_init (ts\_params \*, input\_options \*, FILE \*)

void print\_end (final\_report \*, FILE \*)

void print\_init\_test\_matrix (ts\_params \*, input\_options \*options, FILE \*)

• void print\_end\_test\_matrix (final\_report \*, FILE \*)

void print\_middle (unsigned long, float, unsigned int, int, FILE \*)

void print\_iteration (best\_result \*, int, int, FILE \*)

void print\_paranoid (paranoid \*, FILE \*)

• void print\_paranoid\_move (paranoid \*, FILE \*)

void print\_paranoid\_eval (paranoid \*, FILE \*)

void print\_paranoid\_all (paranoid \*, FILE \*)

• void void print middle (unsigned long, float, unsigned int, int, int, FILE \*)

void void\_print\_iteration (best\_result \*, int, int, FILE \*)

void void print paranoid (paranoid \*, FILE \*)

void void\_print\_paranoid\_move (paranoid \*, FILE \*)

• void void\_print\_paranoid\_eval (paranoid \*, FILE \*)

void void\_print\_paranoid\_all (paranoid \*, FILE \*)

• output\_report \* open\_report (input\_options \*options)

void close\_report (output\_report \*)

void report\_use\_test\_matrix (output\_report \*)

• void print\_mold\_test\_matrix (FILE \*)

• input options \* convert full test opt to gen (full test input options \*)

## 4.3.1 Detailed Description

input output constant and functions definition

**Author:** 

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file io.h.

## **4.3.2** Define Documentation

## 4.3.2.1 #define MAX\_FILE\_LINES 6000

Maximal number of lines in input file

Definition at line 16 of file io.h.

Referenced by read\_input().

#### **4.3.3** Function Documentation

**4.3.3.1** void close\_report (output\_report \* report)

Close output file for given report

**Parameters:** 

report Report generator

Definition at line 662 of file io.c.

 $References\ output\_report:: report\_file,\ and\ input\_opt:: save\_output.$ 

Referenced by main().

4.3.3.2 input\_options\* convert\_full\_test\_opt\_to\_gen (full\_test\_input\_options \* options)

Convert full\_test\_input\_options to input\_options

**Parameters:** 

options Tabu Serach general input options

Definition at line 80 of file io.c.

References input\_opt::change\_move\_limit, FALSE, input\_opt::generate\_report, full\_test\_input\_opt::have\_input, input\_opt::have\_input, full\_test\_input\_opt::init\_change\_move\_limit, full\_test\_input\_opt::init\_tabu\_iterations, full\_test\_input\_opt::init\_tabu\_list\_length, full\_test\_input\_opt::init\_tabu\_max\_decrease, input\_opt::key\_eval\_percent, MALLOC, input\_opt::middle\_op,

full\_test\_input\_opt::min\_key\_eval\_percent, full\_test\_input\_opt::outfile, input\_opt::outfile, input\_opt::paranoid\_leve, input\_opt::print\_iter, full\_test\_input\_opt::save\_output, input\_opt::save\_output, input\_opt::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_decrease, and TRUE.

Referenced by main().

**4.3.3.3** output\_report\* open\_report (input\_options \* options)

Create a new report creator and bind the correct function in accord with options

#### **Parameters:**

options Tabu Search general input options

Definition at line 580 of file io.c.

References MALLOC, input\_opt::middle\_op, output\_report::options, input\_opt::outfile, input\_opt::paranoid\_leve, print\_end(), output\_report::print\_end, print\_init(), output\_report::print\_init, input\_opt::print\_iter, print\_iteration(), output\_report::print\_iteration, print\_middle(), output\_report::print\_middle(), output\_report::print\_paranoid\_all(), output\_report::print\_paranoid\_all(), output\_report::print\_paranoid\_eval(), output\_report::print\_paranoid\_eval(), output\_report::print\_paranoid\_eval(), output\_report::report\_file, input\_opt::save\_output, void\_print\_iteration(), void\_print\_middle(), void\_print\_paranoid(), void\_print\_paranoid\_move().

Referenced by main().

4.3.3.4 void parse full test arguments (int argc, char \*\* argv, full test input options \* options)

Parse full test input arguments and mold it into full\_test\_input\_options structure

## **Parameters:**

argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters

Definition at line 108 of file io.c.

References FALSE, full\_test\_input\_opt::have\_input, full\_test\_input\_opt::init\_change\_move\_limit, full\_test\_input\_opt::init\_tabu\_iterations, full\_test\_input\_opt::init\_tabu\_list\_length, full\_test\_input\_opt::init\_tabu\_max\_decrease, full\_test\_input\_opt::inputfile, full\_test\_input\_opt::max\_tabu\_list\_length, full\_test\_input\_opt::max\_tabu\_list\_length, full\_test\_input\_opt::max\_tabu\_max\_decrease, full\_test\_input\_opt::min\_key\_eval\_percent, full\_test\_input\_opt::outfile, full\_test\_input\_opt::var\_change\_move\_limit, full\_test\_input\_opt::var\_key\_eval\_percent, full\_test\_input\_opt::var\_tabu\_iterations, full\_test\_input\_opt::var\_tabu\_list\_length, and full\_test\_input\_opt::var\_tabu\_max\_decrease.

Referenced by main().

4.3.3.5 void parse\_generate\_arguments (int argc, char \*\* argv, generate\_options \* options)

Parse TEA generation input arguments and mold it into generate\_iptions structure

#### **Parameters:**

```
argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters
```

Definition at line 330 of file io.c.

References generate\_options::amount, FALSE, generate\_options::key, generate\_options::outfile, print\_generate\_options(), generate\_options::seed, TRUE, generate\_options::usefile, generate\_options::usekey, and generate\_options::userandom.

Referenced by main().

```
4.3.3.6 void parse_test_arguments (int argc, char ** argv, test_input_options * options)
```

Parse cipher test input arguments and mold it into test\_input\_options structure

#### **Parameters:**

```
argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters
```

Definition at line 278 of file io.c.

References FALSE, test\_input\_opt::have\_input, test\_input\_opt::inputfile, test\_input\_opt::key1, test\_input\_opt::key2, test\_input\_opt::key3, test\_input\_opt::key4, test\_input\_opt::outfile, test\_input\_opt::save\_output, and TRUE.

Referenced by main().

```
4.3.3.7 void parse_ts_arguments (int argc, char ** argv, input_options * options)
```

Parse Tabu Search input arguments and mold it into input\_options structure

## **Parameters:**

```
argc ANSI C program input parameters countargv ANSI C program input stringoptions Where to put options in parameters
```

Definition at line 392 of file io.c.

References input\_opt::change\_move\_limit, FALSE, input\_opt::generate\_report, input\_opt::have\_input, input\_opt::inputfile, input\_opt::key\_eval\_percent, input\_opt::middle\_op, input\_opt::outfile, input\_opt::paranoid\_leve, input\_opt::print\_iter, input\_opt::save\_output, input\_opt::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_decrease, and TRUE.

Referenced by main().

```
4.3.3.8 void print_end (final_report * report, FILE * file)
```

Print final report of Tabu Search

#### **Parameters:**

```
report Report generator file File to print
```

Definition at line 741 of file io.c.

References final\_report::change\_left\_count, final\_report::change\_right\_count, final\_report::clock\_global, final\_report::clock\_left, final\_report::clock\_right, final\_report::end\_global, final\_report::end\_left, final\_report::end\_right, final\_report::init\_global, final\_report::init\_left, final\_report::init\_right, best\_result::key, final\_report::left, final\_report::left\_iter, final\_report::restart\_left\_control, final\_report::right\_iter, and best\_result::value.

Referenced by open\_report().

```
4.3.3.9 void print_end_test_matrix (final_report * report, FILE * file)
```

Print each step Tabu Search for test matrix

#### **Parameters:**

```
report Report generator file File to print
```

Definition at line 718 of file io.c.

References final\_report::clock\_left, final\_report::clock\_right, final\_report::end\_left, final\_report::end\_right, final\_report::init\_left, final\_report::left, final\_report::left, final\_report::right, final\_report::right\_iter, and best\_result::value.

Referenced by report\_use\_test\_matrix().

```
4.3.3.10 void print full test options (char * name)
```

Print full test usage and options

#### **Parameters:**

name Name for executable

Definition at line 500 of file io.c.

Referenced by main().

**4.3.3.11** void print\_generate\_options (char \* name)

Print generate usage and options

#### **Parameters:**

name Name for executable

Definition at line 573 of file io.c.

Referenced by main(), and parse\_generate\_arguments().

4.3.3.12 void print\_init (ts\_params \* params, input\_options \* options, FILE \* file)

Print initial asignation for Tabu Search

#### **Parameters:**

```
params Paramenter of Tabu Search
options Tabu Search general input options
file File to print
```

Definition at line 683 of file io.c.

References tabu\_search\_params::change\_move\_limit, FALSE, input\_opt::inputfile, tabu\_search\_params::key\_eval\_percent, input\_opt::outfile, input\_opt::save\_output, tabu\_search\_params::tabu\_iterations, tabu\_search\_params::tabu\_list\_length, and tabu\_search\_params::tabu\_max\_decrease.

Referenced by open\_report().

4.3.3.13 void print\_init\_test\_matrix (ts\_params \* params, input\_options \* options, FILE \* file)

Print initial asignation for Tabu Search in output text matrix

#### **Parameters:**

```
params Paramenter of Tabu Search
options Tabu Search general input options
file File to print
```

Definition at line 709 of file io.c.

References tabu\_search\_params::key\_eval\_percent, tabu\_search\_params::tabu\_iterations, tabu\_search\_params::tabu\_list\_length, and tabu\_search\_params::tabu\_max\_decrease.

Referenced by report\_use\_test\_matrix().

4.3.3.14 void print iteration (best result \* best, int iter, int block, FILE \* file)

Print iteration step values

## **Parameters:**

```
best Best result until this iteration
iter Iteration number
block Block for this iteration {LEFT,RIGHT}
file File to print
```

Definition at line 781 of file io.c.

References best\_result::key, and best\_result::value.

4.3.3.15 void print\_middle (unsigned long *key*, float *score*, unsigned int *bit*, int *block*, int *tabuname*, FILE \* *file*)

Print step by step middle operation for Tabu Search

## **Parameters:**

```
key Key in given step
score Score for given step
bit Bit changed in this step
block Block for this step {LEFT,RIGHT}
```

Definition at line 770 of file io.c.

Referenced by open report().

**4.3.3.16** void print\_mold\_test\_matrix (FILE \* *file*)

Print initial significant keyswords for test matrix

#### **Parameters:**

```
file File to print
```

Definition at line 732 of file io.c.

Referenced by main().

4.3.3.17 void print\_paranoid (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug, include key movement values, and tabu list

#### **Parameters:**

```
paranoid Paranoid data
file File to print
```

Definition at line 790 of file io.c.

 $References\ tabu\_list::bit\_position,\ paranoid\_level::block,\ tabu\_list::key,\ paranoid\_level::key,\ paranoid\_level::list,\ tabu\_list::name,\ tabu\_list::next,\ paranoid\_level::tabu,\ and\ tabu\_list::value.$ 

Referenced by open\_report().

4.3.3.18 void print\_paranoid\_all (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug for evaluation function, include block key generation

## **Parameters:**

```
paranoid Paranoid data
file File to print
```

Definition at line 826 of file io.c.

References paranoid\_level::bit, paranoid\_level::block, paranoid\_level::evalkey, and paranoid\_level::key.

Referenced by open\_report().

4.3.3.19 void print\_paranoid\_eval (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug for evaluation function

#### **Parameters:**

```
paranoid Paranoid data file File to print
```

Definition at line 817 of file io.c.

References paranoid\_level::bit, paranoid\_level::element, paranoid\_level::ones, paranoid\_level::percent, and paranoid\_level::zeros.

Referenced by open\_report().

4.3.3.20 void print\_paranoid\_move (paranoid \* paranoid, FILE \* file)

Print really paranoid step debug, include movement middle key values and evaluation value

## Parameters:

```
paranoid Paranoid data file File to print
```

Definition at line 808 of file io.c.

References paranoid\_level::bit, paranoid\_level::block, paranoid\_level::key, and paranoid\_level::score.

Referenced by open\_report().

4.3.3.21 void print\_test\_options (char \* name)

Print cipher test usage and options

## **Parameters:**

name Name for executable

Definition at line 559 of file io.c.

Referenced by main().

4.3.3.22 void print\_ts\_options (char \* name)

Print Tabu Search usage and options

## **Parameters:**

name Name for executable

Definition at line 529 of file io.c.

Referenced by main().

4.3.3.23 cipher\_cont\* read\_input (char \* filename)

Read input file and put the content into corresponding structure

## **Parameters:**

filename Filename of input file

Definition at line 20 of file io.c.

References container\_node::cipher\_message, MAX\_FILE\_LINES, NMALLOC, container\_node::plain\_message, and container\_node::size\_array.

Referenced by main().

**4.3.3.24** void report\_use\_test\_matrix (output\_report \* report)

Change report binding to use test matrix

## **Parameters:**

report Report generator

Definition at line 672 of file io.c.

 $References \ output\_report::print\_end, \ print\_end\_test\_matrix(), \ output\_report::print\_init, \ and \ print\_init\_test\_matrix().$ 

Referenced by main().

4.3.3.25 void void\_print\_iteration (best\_result \* best, int block, int iter, FILE \* fp)

## DO NOTHING!

## **Parameters:**

best Best result until this iteration

iter Iteration number

 ${\it block} \ \ {\it Block for this iteration \{LEFT,RIGHT\}}$ 

file File to print

Definition at line 849 of file io.c.

4.3.3.26 void void\_print\_middle (unsigned long key, float score, unsigned int bit, int block, int tabuname, FILE \* fp)

## DO NOTHING!

```
Parameters:
```

```
key Key in given stepscore Score for given stepbit Bit changed in this stepblock Block for this step {LEFT,RIGHT}
```

Definition at line 839 of file io.c.

Referenced by open\_report().

4.3.3.27 void void\_print\_paranoid (paranoid \* paranoid, FILE \* fp)

## DO NOTHING!

#### **Parameters:**

```
paranoid Paranoid data
file File to print
```

Definition at line 857 of file io.c.

Referenced by open\_report().

4.3.3.28 void void\_print\_paranoid\_all (paranoid \* paranoid, FILE \* fp)

## DO NOTHING!

## **Parameters:**

```
paranoid Paranoid data
file File to print
```

Definition at line 881 of file io.c.

Referenced by open\_report().

4.3.3.29 void void\_print\_paranoid\_eval (paranoid \* paranoid, FILE \* fp)

## DO NOTHING!

#### **Parameters:**

```
paranoid Paranoid data file File to print
```

Definition at line 873 of file io.c.

4.3.3.30 void void\_print\_paranoid\_move (paranoid \* paranoid, FILE \* fp)

## DO NOTHING!

## **Parameters:**

paranoid Paranoid data
file File to print

Definition at line 865 of file io.c.

# 4.4 /Users/freddy/Documents/Research\_proyects/TEA/code/main.c File Reference

## Main Tabu Search program.

```
#include <stdio.h>
#include <stdlib.h>
#include "tea.h"
#include "tabu_search.h"
#include "io.h"
#include "types.h"
```

## **Functions**

• int main (int argc, char \*\*argv)

## 4.4.1 Detailed Description

Main Tabu Search program.

#### **Author:**

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file main.c.

## **4.4.2** Function Documentation

## 4.4.2.1 int main (int argc, char \*\* argv)

Main Tabu Search for TEA application execution program.

## **Parameters:**

```
arcg number of input argumentsargv input argument string
```

Definition at line 20 of file main.c.

References close\_report(), FALSE, input\_opt::have\_input, input\_opt::inputfile, MALLOC, open\_report(), parse\_ts\_arguments(), print\_ts\_options(), read\_input(), and tabusearch().

## 4.5 /Users/freddy/Documents/Research\_proyects/TEA/code/tabu\_-search.c File Reference

#### Tabu Search functions.

```
#include <stdio.h>
#include <stdlib.h>
#include <limits.h>
#include <time.h>
#include "tabu_search.h"
#include "tea.h"
#include "io.h"
#include "types.h"
```

#### **Functions**

- void move\_alpha (unsigned long \*key, tabu\_list \*list, unsigned long \*mistakes, unsigned int \*control, unsigned int \*founded, best\_result \*best, ts\_params \*params, output\_report \*report, cipher\_cont \*cpmess, int block)
- void move\_beta (unsigned long \*key, tabu\_list \*list, unsigned long \*mistakes, unsigned int \*control, unsigned int \*founded, best\_result \*best, ts\_params \*params, output\_report \*report, cipher\_cont \*cpmess, int block)
- float evaluate (unsigned long key, cipher\_cont \*cpmess, int block, output\_report \*report, ts\_params \*params)
- void tabusearch (cipher\_cont \*cpmess, input\_options \*options, output\_report \*report)
- void generate\_initial\_solution (unsigned long \*key)
- void restart\_left (unsigned long \*key)
- void restart\_right (unsigned long \*key)
- ts\_params \* create\_params (input\_options \*options)
- tabu\_list \* create\_tabu\_list (ts\_params \*params)
- void restart\_tabu (tabu\_list \*tabu\_t, ts\_params \*params)
- void free tabu (tabu list \*tabu, unsigned int name)

## 4.5.1 Detailed Description

Tabu Search functions.

## Author:

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file tabu\_search.c.

## **4.5.2** Function Documentation

**4.5.2.1** ts\_params\* create\_params (input\_options \* options)

Create Tabu Search Params from Tabu Search general options

### **Parameters:**

options Tabu Search general options

Definition at line 854 of file tabu search.c.

References input\_opt::change\_move\_limit, tabu\_search\_params::change\_move\_limit, CHANGE\_-MOVE\_LIMIT, DEFAULT\_TABU\_CYCLES, DEFAULT\_TABU\_LIST\_LENGTH, DEFAULT\_-TABU\_RESTART\_LIMIT, input\_opt::key\_eval\_percent, tabu\_search\_params::key\_eval\_percent, MALLOC, PERCENT\_MULTI, input\_opt::tabu\_iterations, tabu\_search\_params::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_-decrease, and tabu\_search\_params::tabu\_max\_decrease.

Referenced by tabusearch().

4.5.2.2 tabu\_list\* create\_tabu\_list (ts\_params \* params)

Create a new empty Tabu list with lenght specified in parameters

## **Parameters:**

params Parameters for this tabu search

Definition at line 912 of file tabu\_search.c.

References tabu\_list::bit\_position, tabu\_list::key, MALLOC, tabu\_list::name, tabu\_list::next, POST\_LIMIT, tabu\_search\_params::tabu\_list\_length, and tabu\_list::value.

Referenced by tabusearch().

**4.5.2.3** float evaluate (unsigned long *key*, cipher\_cont \* *cpmess*, int *block*, output\_report \* *report*, ts\_params \* *params*)

In order to accomplish the evalutaion for key generation its necesary to compare the mirror bits from right to left, and select the worst score betwen all comparision of all keys it's means if a key have 3 points and another 2, our best score is 2 with some percent of accuracy.

(remember the best score is the worst one)

also its necesary that the bits be in correlative order that means

10100100001

& 10101011011

10100000001 < — this have just one bit of coincidences

10100100001

& 10101011001

\_\_\_\_

#### 10100000001

## & 01010000110

11110000111 < — this have three bit of coincidence

take just the equals bits (no matters if 0 or 1), its must be equals and correlatives.

#### **Parameters:**

key Key to evaluate

cpmess Ciphers and Plain messages

block Name for this block (LEFT OR RIGHT)

report Report generator

params General parameter for tabu search

Definition at line 340 of file tabu\_search.c.

References paranoid\_level::bit, paranoid\_level::block, delta\_tea(), paranoid\_level::element, paranoid\_level::evalkey, gamma\_tea(), paranoid\_level::key, tabu\_search\_params::key\_eval\_percent, LEFT, MALLOC, NMALLOC, paranoid\_level::ones, output\_report::options, input\_opt::paranoid\_leve, output\_report::paranoid\_level::percent, output\_report::print\_paranoid\_all, output\_report::print\_paranoid\_eval, container\_node::size\_array, and paranoid\_level::zeros.

Referenced by move\_alpha(), move\_beta(), and tabusearch().

4.5.2.4 void free\_tabu (tabu\_list \* tabu, unsigned int name)

Free all memory used by tabu list elements

## Parameters:

tabu Tabu list

name name for the initial element of tabu list

Definition at line 969 of file tabu\_search.c.

References free\_tabu(), tabu\_list::name, and tabu\_list::next.

Referenced by free\_tabu().

4.5.2.5 void generate\_initial\_solution (unsigned long \* key)

Generate a random initial key solution.

## **Parameters:**

key where to put the new key

Definition at line 780 of file tabu\_search.c.

Referenced by tabusearch().

4.5.2.6 void move\_alpha (unsigned long \* key, tabu\_list \* list, unsigned long \* mistakes, unsigned int \* control, unsigned int \* founded, best\_result \* best, ts\_params \* params, output\_report \* report, cipher\_cont \* cpmess, int block)

Tabus Search movement alpha: change the ith bit of one 32 bit key block, it also get the value for evaluation function and put the best movement value into tabu list.

#### first movement:

generate only 32 bits movements for 32 bits block key[1] and key[3] moving with left bits shift XOR. example:

010101010101

^ **000000000001** 

010101010100

000000000001 << 1 = 000000000010

010101010101

^ 000000000010

010101010111

and so on.

## **Parameters:**

key Key for this movement (a 128 bit key in 4 blocks of 32 bits)

list Tabu list for this move, corresponding to current key block

mistakes Mistakes counter tracker

control Control wich element is the next in the tabu list

founded If the element was founded

best The current best result

params General parameter for tabu search

report Report generator

cpmess Ciphers and Plain messages

block name for this block (LEFT OR RIGHT)

Definition at line 48 of file tabu search.c.

References paranoid\_level::bit, tabu\_list::bit\_position, paranoid\_level::block, evaluate(), FALSE, paranoid\_level::key, LEFT, tabu\_list::next, output\_report::options, output\_report::par, input\_opt::paranoid\_leve, POST\_LIMIT, output\_report::print\_paranoid\_move, paranoid\_level::score, paranoid\_level::tabu, tabu\_search\_params::tabu\_list\_length, TEA\_DUAL\_BLOCK, and TRUE.

Referenced by tabusearch().

4.5.2.7 void move\_beta (unsigned long \* key, tabu\_list \* list, unsigned long \* mistakes, unsigned int \* control, unsigned int \* founded, best\_result \* best, ts\_params \* params, output\_report \* report, cipher\_cont \* cpmess, int block)

Tabus Search movement beta: swap ith bit with ith+1 bit of one 32 bit key block, it also get the value for evaluation function and put the best movement value into tabu list.

second movement:

generate only 31 bits movements for 32 bits block key[1] and key[3] swaping different bits.

(if two bits are equals, then no move... bit pairs 00 or 11 generate no move)

example:

010101010101

swap 1

010101010110

010101010101

swap 2

010101010011

and so on.

everything in this movement its like fisrt movement, but the movement it self changes.

#### **Parameters:**

key Key for this movement (a 128 bit key in 4 blocks of 32 bits)

list Tabu list for this move, corresponding to current key block

mistakes Mistakes counter tracker

control Control wich element is the next in the tabu list

founded If the element was founded

best The current best result

params General parameter for tabu search

report Report generator

cpmess Ciphers and Plain messages

block Name for this block (LEFT OR RIGHT)

Definition at line 193 of file tabu\_search.c.

References paranoid\_level::bit, tabu\_list::bit\_position, paranoid\_level::block, evaluate(), FALSE, paranoid\_level::key, LEFT, tabu\_list::next, output\_report::options, output\_report::par, input\_opt::paranoid\_leve, POST\_LIMIT, output\_report::print\_paranoid\_move, paranoid\_level::score, paranoid\_level::tabu, tabu\_search\_params::tabu\_list\_length, and TRUE.

Referenced by tabusearch().

4.5.2.8 void restart left (unsigned long \* kev)

Restart the left key block with a random key

#### **Parameters:**

key where to put the new key

Definition at line 808 of file tabu search.c.

4.5.2.9 void restart right (unsigned long \* kev)

Restart the right key block with a random key

#### **Parameters:**

key where to put the new key block

Definition at line 831 of file tabu search.c.

4.5.2.10 void restart\_tabu (tabu\_list \* tabu\_t, ts\_params \* params)

Change all values of Tabu list to empty default values

#### **Parameters:**

```
tabu_t Tabu list
params Parameters for this tabu search
```

Definition at line 952 of file tabu search.c.

References tabu\_list::bit\_position, tabu\_list::key, tabu\_list::name, tabu\_list::next, POST\_LIMIT, tabu\_search\_params::tabu\_list\_length, and tabu\_list::value.

Referenced by tabusearch().

4.5.2.11 void tabusearch (cipher\_cont \* cpmess, input\_options \* options, output\_report \* report)

General Tabu Search, it triggers the movements, and perform each iteration (include convergency if condition)

## **Parameters:**

```
cpmess Ciphers and Plain messagesoptions Tabu Search general optionsreport Report generator
```

Definition at line 457 of file tabu search.c.

References best\_result::bit, paranoid\_level::block, tabu\_search\_params::change\_move\_limit, create\_params(), create\_tabu\_list(), evaluate(), FALSE, generate\_initial\_solution(), best\_result::key, paranoid\_level::key, LEFT, paranoid\_level::list, MALLOC, tabu\_movement::move, move\_alpha(), move\_beta(), output\_report::options, output\_report::par, input\_opt::paranoid\_leve, output\_report::print\_init, output\_report::print\_iteration, output\_report::print\_paranoid, output\_report::report\_file, restart\_tabu(), RIGHT, input\_opt::save\_output, paranoid\_level::tabu, TABU\_END\_LIMIT, tabu\_search\_params::tabu\_iterations, TRUE, and best\_result::value.

Referenced by main().

## 4.6 /Users/freddy/Documents/Research\_proyects/TEA/code/tabu\_-search.h File Reference

## tabu search constants and function prototypes

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

## **Defines**

- #define DEFAULT\_TABU\_LIST\_LENGTH 16
- #define DEFAULT TABU CYCLES 2000
- #define CHANGE\_MOVE\_LIMIT 2
- #define PERCENT MULTI 0.99
- #define DEFAULT\_TABU\_RESTART\_LIMIT 64
- #define POST\_LIMIT LONG\_MAX
- #define TEA\_DUAL\_BLOCK 32
- #define TABU\_END\_LIMIT 32
- #define LEFT -1
- #define RIGHT 1

## **Functions**

- void move\_alpha (unsigned long \*, tabu\_list \*, unsigned long \*, unsigned int \*, unsigned int \*, best\_result \*, ts\_params \*, output\_report \*, cipher\_cont \*, int)
- void move\_beta (unsigned long \*, tabu\_list \*, unsigned long \*, unsigned int \*, unsigned int \*, best\_result \*, ts\_params \*, output\_report \*, cipher\_cont \*, int)
- float evaluate (unsigned long, cipher\_cont \*, int, output\_report \*, ts\_params \*)
- $\bullet \ \ void\ tabusearch\ (cipher\_cont\ *, input\_options\ *, output\_report\ *)\\$
- void generate\_initial\_solution (unsigned long \*)
- void restart\_left (unsigned long \*)
- void restart\_right (unsigned long \*)
- ts\_params \* create\_params (input\_options \*)
- tabu\_list \* create\_tabu\_list (ts\_params \*)
- void restart\_tabu (tabu\_list \*, ts\_params \*)
- void free\_tabu (tabu\_list \*, unsigned int)

## 4.6.1 Detailed Description

tabu search constants and function prototypes

#### **Author:**

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file tabu\_search.h.

## 4.6.2 Define Documentation

## 4.6.2.1 #define CHANGE\_MOVE\_LIMIT 2

Default Limit for change the movement, the same limit would be used to return to original movement Definition at line 30 of file tabu\_search.h.

Referenced by create\_params().

## 4.6.2.2 #define DEFAULT\_TABU\_CYCLES 2000

Default number of cycles which perform tabu search

Definition at line 25 of file tabu\_search.h.

Referenced by create\_params().

## 4.6.2.3 #define DEFAULT\_TABU\_LIST\_LENGTH 16

Default tabu list lenght

Definition at line 19 of file tabu\_search.h.

Referenced by create\_params().

## 4.6.2.4 #define DEFAULT\_TABU\_RESTART\_LIMIT 64

Default number of allowed bad results consecutives before restart.

Definition at line 40 of file tabu\_search.h.

Referenced by create\_params().

## 4.6.2.5 #define LEFT -1

Left direction/block constant definition.

Definition at line 64 of file tabu\_search.h.

Referenced by evaluate(), move\_alpha(), move\_beta(), and tabusearch().

## 4.6.2.6 #define PERCENT\_MULTI 0.99

Default percent of bits that the keys in the universe will have in common

Definition at line 35 of file tabu\_search.h.

Referenced by create\_params().

## 4.6.2.7 #define POST\_LIMIT LONG\_MAX

alias for LONG\_MAX

Definition at line 46 of file tabu\_search.h.

Referenced by create\_tabu\_list(), move\_alpha(), move\_beta(), and restart\_tabu().

#### **4.6.2.8** #define RIGHT 1

Right direction/block constant definition

Definition at line 69 of file tabu\_search.h.

Referenced by tabusearch().

## 4.6.2.9 #define TABU\_END\_LIMIT 32

Value that the best result have to reach to finish.

Definition at line 58 of file tabu search.h.

Referenced by tabusearch().

## 4.6.2.10 #define TEA\_DUAL\_BLOCK 32

Size of one key block (a key is composed of 4 key blocks)

Definition at line 52 of file tabu\_search.h.

Referenced by move\_alpha().

## 4.6.3 Function Documentation

## **4.6.3.1** ts\_params\* create\_params (input\_options \* options)

Create Tabu Search Params from Tabu Search general options

## **Parameters:**

options Tabu Search general options

Definition at line 854 of file tabu search.c.

References CHANGE\_MOVE\_LIMIT, tabu\_search\_params::change\_move\_limit, input\_opt::change\_move\_limit, DEFAULT\_TABU\_CYCLES, DEFAULT\_TABU\_LIST\_LENGTH, DEFAULT\_TABU\_RESTART\_LIMIT, tabu\_search\_params::key\_eval\_percent, input\_opt::key\_eval\_percent, MALLOC, PERCENT\_MULTI, tabu\_search\_params::tabu\_iterations, input\_opt::tabu\_iterations, tabu\_search\_params::tabu\_list\_length, input\_opt::tabu\_list\_length, tabu\_search\_params::tabu\_max\_decrease, and input\_opt::tabu\_max\_decrease.

Referenced by tabusearch().

#### 4.6.3.2 tabu\_list\* create\_tabu\_list (ts\_params \* params)

Create a new empty Tabu list with lenght specified in parameters

## **Parameters:**

params Parameters for this tabu search

Definition at line 912 of file tabu search.c.

References tabu\_list::bit\_position, tabu\_list::key, MALLOC, tabu\_list::name, tabu\_list::next, POST\_LIMIT, tabu\_search\_params::tabu\_list\_length, and tabu\_list::value.

Referenced by tabusearch().

**4.6.3.3** float evaluate (unsigned long *key*, cipher\_cont \* *cpmess*, int *block*, output\_report \* *report*, ts\_params \* *params*)

In order to accomplish the evalutaion for key generation its necessary to compare the mirror bits from right to left, and select the worst score betwen all comparision of all keys it's means if a key have 3 points and another 2, our best score is 2 with some percent of accuracy.

(remember the best score is the worst one)

also its necesary that the bits be in correlative order that means

10100100001

& 10101011011

10100000001 < — this have just one bit of coincidences

10100100001

& 10101011001

10100000001

& 01010000110

11110000111 < — this have three bit of coincidence

take just the equals bits (no matters if 0 or 1), its must be equals and correlatives.

## **Parameters:**

key Key to evaluate

cpmess Ciphers and Plain messages

block Name for this block (LEFT OR RIGHT)

report Report generator

params General parameter for tabu search

Definition at line 340 of file tabu\_search.c.

References paranoid\_level::bit, paranoid\_level::block, delta\_tea(), paranoid\_level::element, paranoid\_level::evalkey, gamma\_tea(), paranoid\_level::key, tabu\_search\_params::key\_eval\_percent, LEFT, MALLOC, NMALLOC, paranoid\_level::ones, output\_report::options, input\_opt::paranoid\_leve, output\_report::paranoid\_level::percent, output\_report::print\_paranoid\_all, output\_report::print\_paranoid\_eval, container\_node::size\_array, and paranoid\_level::zeros.

Referenced by move\_alpha(), move\_beta(), and tabusearch().

4.6.3.4 void free\_tabu (tabu\_list \* tabu, unsigned int name)

Free all memory used by tabu list elements

#### **Parameters:**

tabu Tabu list

name name for the initial element of tabu list

Definition at line 969 of file tabu search.c.

References free\_tabu(), tabu\_list::name, and tabu\_list::next.

Referenced by free\_tabu().

**4.6.3.5** void generate\_initial\_solution (unsigned long \* *key*)

Generate a random initial key solution.

## **Parameters:**

key where to put the new key

Definition at line 780 of file tabu\_search.c.

Referenced by tabusearch().

4.6.3.6 void move\_alpha (unsigned long \* key, tabu\_list \* list, unsigned long \* mistakes, unsigned int \* control, unsigned int \* founded, best\_result \* best, ts\_params \* params, output\_report \* report, cipher\_cont \* cpmess, int block)

Tabus Search movement alpha: change the ith bit of one 32 bit key block, it also get the value for evaluation function and put the best movement value into tabu list.

first movement:

generate only 32 bits movements for 32 bits block key[1] and key[3] moving with left bits shift XOR. example:

010101010101

^ 000000000001

010101010100

000000000001 << 1 = 000000000010

010101010101

^ 00000000010

010101010111

and so on.

#### **Parameters:**

key Key for this movement (a 128 bit key in 4 blocks of 32 bits)

list Tabu list for this move, corresponding to current key block

mistakes Mistakes counter tracker

control Control wich element is the next in the tabu list founded If the element was founded best The current best result params General parameter for tabu search report Report generator cpmess Ciphers and Plain messages block name for this block (LEFT OR RIGHT)

Definition at line 48 of file tabu\_search.c.

References paranoid\_level::bit, tabu\_list::bit\_position, paranoid\_level::block, evaluate(), FALSE, paranoid\_level::key, LEFT, tabu\_list::next, output\_report::options, output\_report::par, input\_opt::paranoid\_leve, POST\_LIMIT, output\_report::print\_paranoid\_move, paranoid\_level::score, paranoid\_level::tabu, tabu\_search\_params::tabu\_list\_length, TEA\_DUAL\_BLOCK, and TRUE.

Referenced by tabusearch().

4.6.3.7 void move\_beta (unsigned long \* key, tabu\_list \* list, unsigned long \* mistakes, unsigned int \* control, unsigned int \* founded, best\_result \* best, ts\_params \* params, output\_report \* report, cipher\_cont \* cpmess, int block)

Tabus Search movement beta: swap ith bit with ith+1 bit of one 32 bit key block, it also get the value for evaluation function and put the best movement value into tabu list.

## second movement:

generate only 31 bits movements for 32 bits block key[1] and key[3] swaping different bits.

(if two bits are equals, then no move... bit pairs 00 or 11 generate no move)

example:

010101010101

swap 1

010101010110

010101010101

swap 2

010101010011

and so on.

everything in this movement its like fisrt movement, but the movement it self changes.

#### **Parameters:**

key Key for this movement (a 128 bit key in 4 blocks of 32 bits) list Tabu list for this move, corresponding to current key block mistakes Mistakes counter tracker control Control wich element is the next in the tabu list founded If the element was founded

best The current best resultparams General parameter for tabu searchreport Report generatorcpmess Ciphers and Plain messagesblock Name for this block (LEFT OR RIGHT)

Definition at line 193 of file tabu\_search.c.

References paranoid\_level::bit, tabu\_list::bit\_position, paranoid\_level::block, evaluate(), FALSE, paranoid\_level::key, LEFT, tabu\_list::next, output\_report::options, output\_report::par, input\_opt::paranoid\_leve, POST\_LIMIT, output\_report::print\_paranoid\_move, paranoid\_level::score, paranoid\_level::tabu, tabu\_search\_params::tabu\_list\_length, and TRUE.

Referenced by tabusearch().

**4.6.3.8** void restart\_left (unsigned long \* key)

Restart the left key block with a random key

#### **Parameters:**

key where to put the new key

Definition at line 808 of file tabu search.c.

**4.6.3.9** void restart\_right (unsigned long \* key)

Restart the right key block with a random key

#### **Parameters:**

key where to put the new key block

Definition at line 831 of file tabu search.c.

4.6.3.10 void restart\_tabu (tabu\_list \* tabu\_t, ts\_params \* params)

Change all values of Tabu list to empty default values

#### **Parameters:**

tabu\_t Tabu list

params Parameters for this tabu search

Definition at line 952 of file tabu\_search.c.

References tabu\_list::bit\_position, tabu\_list::key, tabu\_list::name, tabu\_list::next, POST\_LIMIT, tabu\_search\_params::tabu\_list\_length, and tabu\_list::value.

Referenced by tabusearch().

4.6.3.11 void tabusearch (cipher\_cont \* cpmess, input\_options \* options, output\_report \* report)

General Tabu Search, it triggers the movements, and perform each iteration (include convergency if condition)

## **Parameters:**

cpmess Ciphers and Plain messagesoptions Tabu Search general optionsreport Report generator

Definition at line 457 of file tabu\_search.c.

References best\_result::bit, paranoid\_level::block, tabu\_search\_params::change\_move\_limit, create\_params(), create\_tabu\_list(), evaluate(), FALSE, generate\_initial\_solution(), paranoid\_level::key, best\_result::key, LEFT, paranoid\_level::list, MALLOC, tabu\_movement::move, move\_alpha(), move\_beta(), output\_report::options, output\_report::par, input\_opt::paranoid\_leve, output\_report::print\_init, output\_report::print\_iteration, output\_report::print\_paranoid, output\_report::report\_file, restart\_tabu(), RIGHT, input\_opt::save\_output, paranoid\_level::tabu, TABU\_END\_LIMIT, tabu\_search\_params::tabu\_iterations, TRUE, and best\_result::value.

Referenced by main().

## 4.7 /Users/freddy/Documents/Research\_proyects/TEA/code/tea.c File Reference

## **TEA Implementation.**

```
#include "tea.h"
```

## **Functions**

- void tea\_encrypt (unsigned long \*v, unsigned long \*w, const unsigned long \*k)
- void tea\_decrypt (unsigned long \*v, unsigned long \*w, const unsigned long \*k)
- void alpha\_tea (unsigned long \*plain, unsigned long \*cipher, unsigned long \*key)
- void beta\_tea (unsigned long \*plain, unsigned long \*cipher, unsigned long \*key)
- void gamma\_tea (unsigned long \*plain, unsigned long \*cipher, unsigned long \*key)
- void delta\_tea (unsigned long \*plain, unsigned long \*cipher, unsigned long \*key)

## 4.7.1 Detailed Description

**TEA Implementation.** 

#### **Author:**

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file tea.c.

#### 4.7.2 Function Documentation

4.7.2.1 void alpha\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

#### Parameters:

## 4.7.2.2 void beta\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for right key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

Definition at line 75 of file tea.c.

References TEA\_DELTA\_KEY.

#### 4.7.2.3 void delta\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for right key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

#### 4.7.2.4 void gamma\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for left key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

Referenced by evaluate().

## 4.7.2.5 void tea\_decrypt (unsigned long \* $\nu$ , unsigned long \* w, const unsigned long \* k)

TEA decipher implementation BASE TEA CODE FROM: http://www.simonshepherd.supanet.com/

#### Parameters:

```
w Cipher message
v Where to put plain message
k Key

Definition at line 33 of file tea.c.
References TEA_CYCLES, TEA_DELTA_KEY, and TEA_SUM.
Referenced by main().
```

## 4.7.2.6 void tea\_encrypt (unsigned long \* $\nu$ , unsigned long \* w, const unsigned long \* k)

TEA cipher implementation BASE TEA CODE FROM: http://www.simonshepherd.supanet.com/sc

#### Parameters:

 $\nu$  Plain message

```
{\it w} Where to put cipher message {\it k} Key

Definition at line 16 of file tea.c.

References TEA_CYCLES, and TEA_DELTA_KEY.

Referenced by main().
```

# 4.8 /Users/freddy/Documents/Research\_proyects/TEA/code/tea.h File Reference

TEA constant and functions definitions.

#### **Defines**

- #define TEA\_CYCLES 1
- #define TEA\_DELTA\_KEY 0x9E3779B9
- #define TEA\_SUM TEA\_DELTA\_KEY << 5

#### **Functions**

- void tea\_encrypt (unsigned long \*, unsigned long \*, const unsigned long \*)
- void tea\_decrypt (unsigned long \*, unsigned long \*, const unsigned long \*)
- void alpha\_tea (unsigned long \*, unsigned long \*, unsigned long \*)
- void beta\_tea (unsigned long \*, unsigned long \*, unsigned long \*)
- void gamma\_tea (unsigned long \*, unsigned long \*, unsigned long \*)
- void delta\_tea (unsigned long \*, unsigned long \*, unsigned long \*)

## 4.8.1 Detailed Description

TEA constant and functions definitions.

## Author:

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

#### Date:

Autumn 2006
This code can be re-distributed under MIT License

Definition in file tea.h.

## 4.8.2 Define Documentation

## 4.8.2.1 #define TEA\_CYCLES 1

Cycles for TEA

Definition at line 15 of file tea.h.

Referenced by tea\_decrypt(), and tea\_encrypt().

## 4.8.2.2 #define TEA\_DELTA\_KEY 0x9E3779B9

TEA cypher key schedule

Definition at line 20 of file tea.h.

Referenced by alpha\_tea(), beta\_tea(), delta\_tea(), gamma\_tea(), tea\_decrypt(), and tea\_encrypt().

#### 4.8.2.3 #define TEA\_SUM TEA\_DELTA\_KEY << 5

TEA cypher sum

Definition at line 25 of file tea.h.

Referenced by tea\_decrypt().

## 4.8.3 Function Documentation

#### 4.8.3.1 void alpha\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for left key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/ $\sim$ frmunoz/research/tea

#### Parameters:

Definition at line 53 of file tea.c.

References TEA\_DELTA\_KEY.

## 4.8.3.2 void beta\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for right key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

Definition at line 75 of file tea.c.

References TEA\_DELTA\_KEY.

### 4.8.3.3 void delta\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for right key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

*plan* Plain Message

#### 4.8.3.4 void gamma\_tea (unsigned long \* plain, unsigned long \* cipher, unsigned long \* key)

TEA1 key descomposition for left key block, its calculate the recidual key part (with minus noise) and mold it into key structure a justification for the operation involved in this function can be found in http://www.inf.utfsm.cl/~frmunoz/research/tea

#### Parameters:

## 4.8.3.5 void tea\_decrypt (unsigned long \* $\nu$ , unsigned long \* w, const unsigned long \* k)

TEA decipher implementation BASE TEA CODE FROM: http://www.simonshepherd.supanet.com/

## Parameters:

```
v Where to put plain message
k Key

Definition at line 33 of file tea.c.
References TEA_CYCLES, TEA_DELTA_KEY, and TEA_SUM.
Referenced by main().
```

## 4.8.3.6 void tea\_encrypt (unsigned long \* v, unsigned long \* w, const unsigned long \* k)

TEA cipher implementation BASE TEA CODE FROM: http://www.simonshepherd.supanet.com/sc

## ${\tt Parameters}:$

```
\nu Plain message
```

w Cipher message

w Where to put cipher message

```
\pmb{k} Key
```

Definition at line 16 of file tea.c.

References TEA\_CYCLES, and TEA\_DELTA\_KEY.

Referenced by main().

# 4.9 /Users/freddy/Documents/Research\_proyects/TEA/code/test.c File Reference

```
Test a key in TEA.

#include <stdio.h>
#include <stdlib.h>
#include "tea.h"

#include "io.h"

#include "types.h"
```

#### **Functions**

• int main (int argc, char \*\*argv)

## 4.9.1 Detailed Description

```
Test a key in TEA.
```

#### Author:

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

#### Date:

```
Autumn 2006
This code can be re-distributed under MIT License
Definition in file test.c.
```

## 4.9.2 Function Documentation

## 4.9.2.1 int main (int argc, char \*\* argv)

Key test program for TEA cipher. (given a key, it's will test the key over a set of cipher-plain messages)

## **Parameters:**

```
arcg number of input argumentsargv input argument string
```

Definition at line 19 of file test.c.

References FALSE, test\_input\_opt::have\_input, test\_input\_opt::inputfile, test\_input\_opt::key1, test\_input\_opt::key2, test\_input\_opt::key3, test\_input\_opt::key4, MALLOC, parse\_test\_arguments(), print\_test\_options(), read\_input(), container\_node::size\_array, tea\_decrypt(), and tea\_encrypt().

# 4.10 /Users/freddy/Documents/Research\_proyects/TEA/code/ts\_full\_test.c File Reference

#### Full test for tabu search.

```
#include <stdio.h>
#include <stdlib.h>
#include "tea.h"
#include "tabu_search.h"
#include "io.h"
#include "types.h"
#include "ts_full_test.h"
```

#### **Functions**

• int main (int argc, char \*\*argv)

## 4.10.1 Detailed Description

Full test for tabu search.

## **Author:**

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

#### Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file ts\_full\_test.c.

## 4.10.2 Function Documentation

```
4.10.2.1 int main (int argc, char ** argv)
```

Generate a test matrix for tabu search over TEA1, varying Tabu Search parameters

#### **Parameters:**

```
arcg number of input arguments
argv input argument string
```

Definition at line 23 of file ts\_full\_test.c.

References input\_opt::change\_move\_limit, close\_report(), convert\_full\_test\_opt\_to\_gen(), FALSE, full\_test\_input\_opt::have\_input, full\_test\_input\_opt::init\_change\_move\_limit, full\_test\_input\_opt::init\_tabu\_iterations, full\_test\_input\_opt::init\_tabu\_list\_length, full\_test\_input\_opt::init\_tabu\_max\_decrease, full\_test\_input\_opt::inputfile, input\_opt::key\_eval\_percent, MALLOC,

full\_test\_input\_opt::max\_change\_move\_limit, full\_test\_input\_opt::max\_tabu\_iterations, full\_test\_input\_opt::max\_tabu\_list\_length, full\_test\_input\_opt::max\_tabu\_max\_decrease, full\_test\_input\_opt::min\_key\_eval\_percent, open\_report(), parse\_full\_test\_arguments(), print\_full\_test\_options(), print\_mold\_test\_matrix(), read\_input(), output\_report::report\_file, report\_use\_test\_matrix(), input\_opt::save\_output, input\_opt::tabu\_iterations, input\_opt::tabu\_list\_length, input\_opt::tabu\_max\_decrease, tabusearch(), TRUE, TS\_CHM\_INCREMENT, TS\_CHM\_MAX, TS\_INIT\_CHM, TS\_INIT\_ITER, TS\_INIT\_LIST, TS\_INIT\_MAX\_DEC, TS\_INIT\_PERCENT, TS\_ITER\_INCREMENT, TS\_ITER\_MAX, TS\_LIS\_MAX, TS\_LIST\_INCREMENT, TS\_MAX\_DEC\_INCREMENT, TS\_MAX\_DEC\_MAX, TS\_PERCENT\_INCREMENT, full\_test\_input\_opt::var\_change\_move\_limit, full\_test\_input\_opt::var\_key\_eval\_percent, full\_test\_input\_opt::var\_tabu\_iterations, full\_test\_input\_opt::var\_tabu\_list\_length, and full\_test\_input\_opt::var\_tabu\_max\_decrease.

# 4.11 /Users/freddy/Documents/Research\_proyects/TEA/code/ts\_full\_test.h File Reference

Tabu Search full test constants.

#### **Defines**

- #define TS\_LIST\_INCREMENT 2
- #define TS\_ITER\_INCREMENT 100
- #define TS\_PERCENT\_INCREMENT 5
- #define TS\_MAX\_DEC\_INCREMENT 1
- #define TS\_CHM\_INCREMENT 1
- #define TS\_LIS\_MAX 31
- #define TS\_ITER\_MAX 5000
- #define TS\_MAX\_DEC\_MAX 64
- #define TS\_CHM\_MAX 4
- #define TS\_INIT\_LIST 2
- #define TS\_INIT\_ITER 1000
- #define TS\_INIT\_MAX\_DEC 64
- #define TS\_INIT\_CHM 4
- #define TS\_INIT\_PERCENT 10

## 4.11.1 Detailed Description

Tabu Search full test constants.

## **Author:**

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

## Date:

Autumn 2006

This code can be re-distributed under MIT License

Definition in file ts\_full\_test.h.

## 4.11.2 Define Documentation

#### 4.11.2.1 #define TS\_CHM\_INCREMENT 1

Tabu search change movement increment

Definition at line 30 of file ts\_full\_test.h.

Referenced by main().

#### 4.11.2.2 #define TS\_CHM\_MAX 4

Tabu search max change movement limit Definition at line 46 of file ts\_full\_test.h. Referenced by main().

## 4.11.2.3 #define TS\_INIT\_CHM 4

Tabu search initial change movement limit Definition at line 62 of file ts\_full\_test.h. Referenced by main().

## 4.11.2.4 #define TS\_INIT\_ITER 1000

Tabu search initial iterations

Definition at line 54 of file ts\_full\_test.h.

Referenced by main().

#### 4.11.2.5 #define TS\_INIT\_LIST 2

Tabu list initial lenght

Definition at line 50 of file ts\_full\_test.h.

Referenced by main().

## 4.11.2.6 #define TS\_INIT\_MAX\_DEC 64

Tabu search initial performance decrement limit Definition at line 58 of file ts\_full\_test.h. Referenced by main().

## 4.11.2.7 #define TS\_INIT\_PERCENT 10

Tabu search initial key evaluation percent Definition at line 66 of file ts\_full\_test.h. Referenced by main().

## 4.11.2.8 #define TS\_ITER\_INCREMENT 100

Tabu search iteration increment

Definition at line 18 of file ts\_full\_test.h.

Referenced by main().

#### 4.11.2.9 #define TS\_ITER\_MAX 5000

Tabu search max iteration number

Definition at line 38 of file ts\_full\_test.h.

Referenced by main().

## 4.11.2.10 #define TS\_LIS\_MAX 31

Tabu search max list lenght number
Definition at line 34 of file ts\_full\_test.h.
Referenced by main().

## 4.11.2.11 #define TS\_LIST\_INCREMENT 2

Tabu list lenght increment

Definition at line 14 of file ts\_full\_test.h.

Referenced by main().

## 4.11.2.12 #define TS\_MAX\_DEC\_INCREMENT 1

Tabu search decrement performance increment Definition at line 26 of file ts\_full\_test.h.

Referenced by main().

## 4.11.2.13 #define TS\_MAX\_DEC\_MAX 64

Tabu search max performance decremente Definition at line 42 of file ts\_full\_test.h. Referenced by main().

## 4.11.2.14 #define TS\_PERCENT\_INCREMENT 5

Tabu search evaluation key percent increment Definition at line 22 of file ts\_full\_test.h. Referenced by main().

# 4.12 /Users/freddy/Documents/Research\_proyects/TEA/code/types.h File Reference

#### types definition for all components of TS application

#include <time.h>

#### **Data Structures**

#### struct container\_node

input data structure Data structure that contains the input data (plain, cipher)

#### struct input\_opt

Tabu search input options General Tabu search input options data structure.

#### struct test\_input\_opt

Cipher Test input options Cipher Test input options data.

#### struct full\_test\_input\_opt

Structure that support input options for full test tabu search input options for full test tabu search.

#### struct generate\_options

generate plain-cipher input options Container for options in generation of random plain-cipher

#### • struct tabu\_list

Tabu List implementation data structure The tabu list, its a circular linked list which contains forbidden movements.

## struct best\_result

Tabu Search best result implementation Best result for tabu search.

#### • struct tabu\_search\_params

Tabu Search parameters A set of parameters to perform tabu search.

## • struct final\_report

Final report for tabu search Structure that support data for final report generation.

#### struct paranoid\_level

Paranoid debug support Structure that support paranoid debug for tabu search operations, in order to work each attribute has a different meaning for each different context.

## struct output\_report

Structure to support report and debug generation Support for report generation (initial al final report), and support for debugging options, function pointer aids change the function for each different context.

#### • struct tabu\_movement

Structure to support tabu search morphic movement Function pointer aids to support multiple tabu search movements, this structure provides the mechanism to link movement and tabu search call.

## **Defines**

- #define TRUE 1
- #define FALSE 0
- #define MALLOC(type) (type \*)malloc(sizeof(type))
- #define NMALLOC(n, type) (type \*)malloc(n\*sizeof(type))

## **Typedefs**

• typedef container\_node cipher\_cont

```
alias for container_node (p. 7)
```

• typedef input\_opt input\_options

```
alias for input_opt (p. 18) structure
```

• typedef test\_input\_opt test\_input\_options

```
alias for test_input_opt (p. 30)
```

• typedef full\_test\_input\_opt full\_test\_input\_options

```
alias for full_test_input_opt (p. 12)
```

• typedef generate\_options generate\_options

```
alias for generate_options (p. 16)
```

• typedef tabu\_list tabu\_list

```
alias for tabu_list (p. 25)
```

• typedef best\_result best\_result

```
alias for best_result (p. 5)
```

• typedef tabu\_search\_params ts\_params

```
alias for tabu_search_params (p. 28)
```

• typedef final report final report

```
alias for final_report (p. 8)
```

• typedef paranoid\_level paranoid

```
alias for paranoid_level (p. 24)
```

• typedef output\_report output\_report

```
alias for output_report (p. 21)
```

• typedef tabu\_movement movement

```
alias for tabu_movement (p. 27)
```

## 4.12.1 Detailed Description

types definition for all components of TS application

**Author:** 

Freddy Mun~oz Ramirez <frmunoz(at)inf.utfsm.cl>

Date:

Autumn 2006

This code can be re-distributed under MIT Licence

Definition in file types.h.

#### **4.12.2** Define Documentation

#### 4.12.2.1 #define FALSE 0

False constant definition.

Definition at line 21 of file types.h.

Referenced by convert\_full\_test\_opt\_to\_gen(), main(), move\_alpha(), move\_beta(), parse\_full\_test\_arguments(), parse\_generate\_arguments(), parse\_test\_arguments(), parse\_ts\_arguments(), print\_init(), and tabusearch().

## **4.12.2.2** #define MALLOC(type) (type \*)malloc(sizeof(type))

Memory allocation of size sizeof(type).

Definition at line 26 of file types.h.

 $Referenced \ by \ convert\_full\_test\_opt\_to\_gen(), \ create\_params(), \ create\_tabu\_list(), \ evaluate(), \\ main(), open\_report(), and \ tabusearch().$ 

## **4.12.2.3** #define NMALLOC(n, type) (type \*)malloc(n\*sizeof(type))

Memory allocation of size n\*sizeof(type).

Definition at line 31 of file types.h.

Referenced by evaluate(), and read\_input().

#### 4.12.2.4 #define TRUE 1

True constant definition.

Definition at line 16 of file types.h.

 $Referenced\ by\ convert\_full\_test\_opt\_to\_gen(),\ main(),\ move\_alpha(),\ move\_beta(),\ parse\_full\_test\_arguments(),\ parse\_test\_arguments(),\ parse\_ts\_arguments(),\ and\ tabusearch().$ 

## Index

/Users/freddy/Documents/Research	tabu_list, 25
proyects/TEA/code/generate.c, 33	,
/Users/freddy/Documents/Research	change_left_count
proyects/TEA/code/io.c, 35	final_report, 8
/Users/freddy/Documents/Research	CHANGE_MOVE_LIMIT
proyects/TEA/code/io.h, 45	tabu_search.h, 64
/Users/freddy/Documents/Research	change_move_limit
proyects/TEA/code/main.c, 56	input_opt, 18
/Users/freddy/Documents/Research	tabu_search_params, 28
proyects/TEA/code/tabu_search.c,	change_right_count
57	final_report, 8
/Users/freddy/Documents/Research	cipher_message
proyects/TEA/code/tabu_search.h,	container_node, 7
63	clock_global
/Users/freddy/Documents/Research	final_report, 8
proyects/TEA/code/tea.c, 71	clock_left
/Users/freddy/Documents/Research	final_report, 9
proyects/TEA/code/tea.h, 74	clock_right
/Users/freddy/Documents/Research	final_report, 9
proyects/TEA/code/test.c, 78	close_report
/Users/freddy/Documents/Research	io.c, 36
proyects/TEA/code/ts_full_test.c,	io.h, 46
79	container_node, 7
/Users/freddy/Documents/Research	cipher_message, 7
proyects/TEA/code/ts_full_test.h,	plain_message, 7
81	size_array, 7
/Users/freddy/Documents/Research	convert_full_test_opt_to_gen
proyects/TEA/code/types.h, 84	io.c, 36
	io.h, 46
alpha_tea	create_params
tea.c, 71	tabu_search.c, 58
tea.h, 75	tabu_search.h, 65
amount	create_tabu_list
generate_options, 16	tabu_search.c, 58
hard married 5	tabu_search.h, 65
best_result, 5	DEFAULT MADIL CYCLES
bit, 5	DEFAULT_TABU_CYCLES
key, 5	tabu_search.h, 64
value, 6	DEFAULT_TABU_LIST_LENGTH
beta_tea	tabu_search.h, 64
tea.c, 71	DEFAULT_TABU_RESTART_LIMIT
tea.h, 75	tabu_search.h, 64
bit	delta_tea
best_result, 5 bit position	tea.c, 72
กเราคอรเกอน	tea.h, 75

end_global	tea.c, 72
final_report, 9	tea.h, 76
end_left	generate.c
final_report, 9	main, 34
end_right	generate_initial_solution
final_report, 9	tabu_search.c, 59
evaluate	tabu_search.h, 67
tabu_search.c, 58	generate_options, 16
tabu_search.h, 66	amount, 16
FALSE	key, 16
	outfile, 16
types.h, 86	seed, 16
final_report, 8	usefile, 17
change_left_count, 8	usekey, 17
change_right_count, 8	userandom, 17
clock_global, 8	generate_report
clock_left, 9	input_opt, 18
clock_right, 9	hava immut
end_global, 9	have_input
end_left, 9	full_test_input_opt, 12
end_right, 9	input_opt, 18
init_global, 9	test_input_opt, 30
init_left, 9	init_change_move_limit
init_right, 10 left, 10	full_test_input_opt, 12
	init_global
left_iter, 10	final_report, 9
restart_left_control, 10	init_left
restart_right_control, 10	final_report, 9
right, 10	init_right
right_iter, 10	final_report, 10
free_tabu	init_tabu_iterations
tabu_search.c, 59	full_test_input_opt, 12
tabu_search.h, 66 full_test_input_opt, 12	init_tabu_list_length
<b>_ _ _ _ _ ,</b>	full_test_input_opt, 13
have_input, 12 init_change_move_limit, 12	init tabu max decrease
_	full_test_input_opt, 13
init_tabu_iterations, 12 init_tabu_list_length, 13	input_opt, 18
init_tabu_nst_iength, 13 init_tabu_max_decrease, 13	change_move_limit, 18
inputfile, 13	generate_report, 18
max_change_move_limit, 13	have_input, 18
max_tabu_iterations, 13	inputfile, 18
max_tabu_list_length, 13	key_eval_percent, 19
max_tabu_max_decrease, 13	middle_op, 19
min_key_eval_percent, 14	outfile, 19
outfile, 14	paranoid_leve, 19
save_output, 14	print_iter, 19
var_change_move_limit, 14	save_output, 19
var_change_move_mmt, 14 var_key_eval_percent, 14	tabu_iterations, 19
var_tabu_iterations, 14	tabu_list_length, 20
var_tabu_list_length, 14	tabu_max_decrease, 20
var_tabu_max_decrease, 15	inputfile
, u1_unnu_111112_utt1t110t1 10	full_test_input_opt, 13
gamma_tea	input_opt, 18
o	

	test_input_opt, 30	<pre>print_test_options, 52</pre>
io.c		print_ts_options, 52
	close_report, 36	read_input, 53
	convert_full_test_opt_to_gen, 36	report_use_test_matrix, 53
	open_report, 36	void_print_iteration, 53
	parse_full_test_arguments, 37	void_print_middle, 53
	parse_generate_arguments, 37	void_print_paranoid, 54
	parse_test_arguments, 37	void_print_paranoid_all, 54
	parse_ts_arguments, 38	void_print_paranoid_eval, 54
	print_end, 38	void_print_paranoid_move, 54
	print_end_test_matrix, 38	- <b>-</b> ,
	print_full_test_options, 39	key
	print_generate_options, 39	best_result, 5
	print_init, 39	generate_options, 16
	print_init_test_matrix, 39	tabu list, 25
	print_iteration, 40	key2
	print_middle, 40	test_input_opt, 30
	print_mold_test_matrix, 40	key3
	print_paranoid, 41	test_input_opt, 30
	print_paranoid_all, 41	key4
	print_paranoid_eval, 41	test_input_opt, 31
	print_paranoid_move, 41	key_eval_percent
	print_test_options, 42	input_opt, 19
	print_ts_options, 42	tabu_search_params, 28
	read_input, 42	tabu_search_params, 20
	- ·	LEFT
	report_use_test_matrix, 42	tabu_search.h, 64
	void_print_iteration, 43	left
	void_print_middle, 43	
	void_print_paranoid, 43	final_report, 10
	void_print_paranoid_all, 44	left_iter
	void_print_paranoid_eval, 44	final_report, 10
	void_print_paranoid_move, 44	main
io.h		
	close_report, 46	generate.c, 34
	convert_full_test_opt_to_gen, 46	main.c, 56
	MAX_FILE_LINES, 46	test.c, 78
	open_report, 47	ts_full_test.c, 79
	parse_full_test_arguments, 47	main.c
	parse_generate_arguments, 47	main, 56
	parse_test_arguments, 48	MALLOC
	parse_ts_arguments, 48	types.h, 86
	print_end, 48	max_change_move_limit
	print_end_test_matrix, 49	full_test_input_opt, 13
	print_full_test_options, 49	MAX_FILE_LINES
	print_generate_options, 49	io.h, 46
	print_init, 49	max_tabu_iterations
	print_init_test_matrix, 50	full_test_input_opt, 13
	print_iteration, 50	max_tabu_list_length
	print_middle, 50	full_test_input_opt, 13
	print_mold_test_matrix, 51	max_tabu_max_decrease
	print_paranoid, 51	full_test_input_opt, 13
	print_paranoid_all, 51	middle_op
	print_paranoid_eval, 52	input_opt, 19
	print_paranoid_move, 52	min_key_eval_percent
	/	- <del>-</del>

full_test_input_opt, 14	parse_test_arguments
move	io.c, 37
tabu_movement, 27	io.h, 48
move_alpha	parse_ts_arguments
tabu_search.c, 59	io.c, 38
tabu_search.h, 67	io.h, 48
move_beta	PERCENT_MULTI
tabu_search.c, 60	tabu_search.h, 64
tabu_search.h, 68	plain_message
	container_node, 7
name	POST_LIMIT
tabu_list, 25	tabu_search.h, 64
next	print_end
tabu_list, 25	io.c, 38
NMALLOC	io.h, 48
types.h, 86	output_report, 21
••	print_end_test_matrix
open_report	io.c, 38
io.c, 36	io.h, 49
io.h, 47	print_full_test_options
options	io.c, 39
output_report, 21	io.h, 49
outfile	print_generate_options
full_test_input_opt, 14	io.c, 39
generate_options, 16	io.h, 49
input_opt, 19	print_init
test_input_opt, 31	io.c, 39
output_report, 21	io.h, 49
options, 21	output_report, 22
par, 21	print_init_test_matrix
part, 21 pardeb, 21	io.c, 39
print_end, 21	ŕ
<u>-</u>	io.h, 50
print_init, 22	print_iter
print_iteration, 22	input_opt, 19
print_middle, 22	print_iteration
print_paranoid, 22	io.c, 40
print_paranoid_all, 22	io.h, 50
print_paranoid_eval, 22	output_report, 22
print_paranoid_move, 22	print_middle
report_file, 22	io.c, 40
	io.h, 50
par	output_report, 22
output_report, 21	print_mold_test_matrix
paranoid_leve	io.c, 40
input_opt, 19	io.h, 51
paranoid_level, 24	print_paranoid
pardeb	io.c, 41
output_report, 21	io.h, 51
parse_full_test_arguments	output_report, 22
io.c, 37	print_paranoid_all
io.h, 47	io.c, 41
parse_generate_arguments	io.h, 51
io.c, 37	output_report, 22
io.h, 47	print_paranoid_eval

in a 41	innut and 10
io.c, 41 io.h, 52	input_opt, 19 tabu_search_params, 28
output_report, 22	tabu_searcn_params, 26 tabu_list, 25
print_paranoid_move	bit_position, 25
io.c, 41	key, 25
io.h, 52	name, 25
output_report, 22	next, 25
print_test_options	value, 26
io.c, 42	tabu_list_length
io.h, 52	input_opt, 20
print_ts_options	tabu_search_params, 28
io.c, 42	tabu_searcn_params, 20 tabu_max_decrease
io.h, 52	input_opt, 20
10.11, 32	tabu_search_params, 28
read_input	tabu_movement, 27
io.c, 42	move, 27
io.h, 53	tabu_search.c
report_file	create_params, 58
output_report, 22	create tabu list, 58
report_use_test_matrix	evaluate, 58
io.c, 42	free_tabu, 59
io.h, 53	generate_initial_solution, 59
restart_left	move_alpha, 59
tabu_search.c, 61	move_beta, 60
tabu_search.h, 69	restart_left, 61
restart_left_control	restart_right, 62
final_report, 10	restart_tabu, 62
restart_right	tabusearch, 62
tabu_search.c, 62	tabu_search.h
tabu_search.h, 69	CHANGE_MOVE_LIMIT, 64
restart_right_control	create_params, 65
final_report, 10	create_tabu_list, 65
restart_tabu	DEFAULT_TABU_CYCLES, 64
tabu_search.c, 62	DEFAULT_TABU_LIST_LENGTH, 64
tabu_search.h, 69	DEFAULT_TABU_RESTART_LIMIT, 64
RIGHT	evaluate, 66
tabu search.h, 64	free_tabu, 66
right	generate_initial_solution, 67
final_report, 10	LEFT, 64
right_iter	move_alpha, 67
final_report, 10	move_beta, 68
·· = · <b>F</b> · · · · ·	PERCENT_MULTI, 64
save_output	POST_LIMIT, 64
full_test_input_opt, 14	restart_left, 69
input_opt, 19	restart_right, 69
test_input_opt, 31	restart_tabu, 69
seed	RIGHT, 64
generate_options, 16	TABU_END_LIMIT, 65
size_array	tabusearch, 69
container_node, 7	TEA_DUAL_BLOCK, 65
	tabu_search_params, 28
TABU_END_LIMIT	change_move_limit, 28
tabu_search.h, 65	key_eval_percent, 28
tabu_iterations	tabu_iterations, 28

tabu_list_length, 28	ts_full_test.h
tabu_max_decrease, 28	TS_CHM_INCREMENT, 81
tabusearch	TS_CHM_MAX, 81
tabu_search.c, 62	TS_INIT_CHM, 82
tabu_search.h, 69	TS_INIT_ITER, 82
tea.c	TS_INIT_LIST, 82
alpha_tea, 71	TS_INIT_MAX_DEC, 82
beta_tea, 71	TS_INIT_PERCENT, 82
delta_tea, 72	TS_ITER_INCREMENT, 82
gamma_tea, 72	TS_ITER_MAX, 82
tea_decrypt, 72	TS_LIS_MAX, 83
tea_encrypt, 73	TS_LIST_INCREMENT, 83
tea.h	TS_MAX_DEC_INCREMENT, 83
alpha_tea, 75	TS_MAX_DEC_MAX, 83
beta_tea, 75	TS_PERCENT_INCREMENT, 83
delta_tea, 75	TS_INIT_CHM
gamma_tea, 76	ts_full_test.h, 82
TEA_CYCLES, 74	TS_INIT_ITER
tea_decrypt, 76	ts_full_test.h, 82
TEA_DELTA_KEY, 74	TS_INIT_LIST
tea_encrypt, 76	ts_full_test.h, 82
TEA_SUM, 74	TS_INIT_MAX_DEC
TEA_CYCLES	
tea.h, 74	ts_full_test.h, 82
tea_decrypt	TS_INIT_PERCENT
* =	ts_full_test.h, 82
tea.c, 72	TS_ITER_INCREMENT
tea.h, 76	ts_full_test.h, 82
TEA_DELTA_KEY	TS_ITER_MAX
tea.h, 74	ts_full_test.h, 82
TEA_DUAL_BLOCK	TS_LIS_MAX
tabu_search.h, 65	ts_full_test.h, 83
tea_encrypt	TS_LIST_INCREMENT
tea.c, 73	ts_full_test.h, 83
tea.h, 76	TS_MAX_DEC_INCREMENT
TEA_SUM	ts_full_test.h, 83
tea.h, 74	TS_MAX_DEC_MAX
test.c	ts_full_test.h, 83
main, 78	TS_PERCENT_INCREMENT
test_input_opt, 30	ts_full_test.h, 83
have_input, 30	types.h
inputfile, 30	FALSE, 86
key2, 30	MALLOC, 86
key3, 30	NMALLOC, 86
key4, 31	TRUE, 86
outfile, 31	1102,00
save_output, 31	usefile
TRUE	generate_options, 17
types.h, 86	usekey
TS_CHM_INCREMENT	generate_options, 17
ts_full_test.h, 81	userandom
TS_CHM_MAX	
ts_full_test.h, 81	generate_options, 17
ts_full_test.c	value
main, 79	best_result, 6

tabu\_list, 26 var\_change\_move\_limit full\_test\_input\_opt, 14 var\_key\_eval\_percent full\_test\_input\_opt, 14 var\_tabu\_iterations full\_test\_input\_opt, 14 var\_tabu\_list\_length full\_test\_input\_opt, 14  $var\_tabu\_max\_decrease$ full\_test\_input\_opt, 15 void\_print\_iteration io.c, 43 io.h, 53  $void\_print\_middle$ io.c, 43 io.h, 53 void\_print\_paranoid io.c, 43 io.h, 54 void\_print\_paranoid\_all io.c, 44 io.h, 54 void\_print\_paranoid\_eval io.c, 44 io.h, 54 void\_print\_paranoid\_move io.c, 44 io.h, 54