Markov Model of Keyboard Tokens

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Chapter 4

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Here is a list of all files with brief descriptions:

Chapter 5

Namespace Documentation

5.1 Package components

Classes

- class Chain

  Markov Chain built using keyboard tokens.
- class Distribution

  Used to compute and store max, min, std_deviation, and average for a list of Touch.
- class Token

  This class represents a token within the model.
- class Touch

  This class represents a touch event.
- class Window

  This class will store and provide functions for a single window within the model.

5.2 Package data_analysis

Classes

- class Model_compare

  Analysis class used to compare and analyze data gathered from users.
- class Model_compare_thread

  Compare Markov Chains on their own thread.
- class Statistics

  Generates statistics on results generated by model_compare.java.

5.3 Package gui

Classes

- class Marcov_console_panel

  Displays messages printed to stdout.
- class Marcov_file_display_panel

  Displays files relavant to test code.
- class Marcov_frame

  Display frame to contain buttons for running test code and panels to view results.
- class Marcov_options_panel
- class StartGUI

  GUI useful for testing.

5.4 Package junit

Classes

- class Unit_CompareChainsRank

  goal is to test compare chains rank functionality
- class Unit_CompleteProbability

  unit test demonstrating how to compute probility

5.5 Package rank

Classes

- class CompareChainsRank

  Use PageRank algorithm (library) to compare chains.
- class CompleteProbability

  This class computes probability in a different way from what is contained in the Chain class.

5.6 Package runtime

Classes

- class ChainBuilder

  Wrapper around Chain used to make using the model easier in a real application.
- class CompareChains

  Use the compare method of the Chain class to determine an authetnication probability between 0 and 1.
- class Operation_thread

  UNUSED.

5.7 Package test

Classes

- class Main

  This class is used to test that the model is being built correctly.
- class Print_model

  This class will print out the model constructed form the designated file.
- class UnitCompareChainsRank

  JUnit test for testing PageRank version of compairason Not that the PageRank implementation is not currently functional.
- class UnitRankCompare

  Test the compairason with ranks.

5.8 Package trie

Classes

- class Trie

  Implementation of Prefix Tree.
- class TrieList

  Wrapper around Trie used to maintain an ordering among the stored elements.

Chapter 6

Class Documentation

6.1 components.Chain Class Reference

Markov Chain built using keyboard tokens.

Public Member Functions

- Chain (int window, int token, int threshold, int model_size)
- Chain (Chain c)

  copy constructor. New chain object should have the same state as the old with differant object references.
- void add_touch (Touch touch)
- void add_touch_list (List< Touch > t)
- void set_distribution (Distribution distribution, List< Distribution > key_distribution)

  allows distribution to be set.
- double get_touch_probability (Window w, Touch t)

  returns the probability of a given touch (at the i'th index) based on the model. This will depend on the preceeding touches, in Window. A request for one probability will necessarily result in all of the probabilities being computed.
- Distribution get_distribution ()

  returns the distribution of the data as a whole
- List< Distribution > get_key_distribution ()

  returns a list of distributions for each key
- int get_window ()
- int get_token ()
- int get_model_size ()
- int get_threshold ()
- void reset ()

  resets the object.. this is the same as constructing a new chain, but faster
- void compute_uncomputed ()

  computes all uncomputed aspects of the chain
- double compare_to (Chain auth_chain)

  returns the percent difference between this chain and auth_chain.
- boolean is_touch_in_key_distribution (Touch touch)

  returns true if a touch is within 2 sigma for it's key distribution
- List< Window > get_windows ()

  handle requests for windows

- List< Token > get_tokens ()

  handle requests for tokens
- List< Touch > get_touches ()

  get a list of all touches in the chain
- String toString ()

  prints out all of the touches in order
- void output_to_csv (String file_name)

  NOT USEFUL IN ANDROID. This is used for debugging purposes. Outputs the model to a csv file in a readable format.

6.1.1 Detailed Description

Markov Chain built using keyboard tokens.

This class was designed to be used with the keyboard of a mobile phone. The soft keyboard of this device produces (key, pressure) values. These (key, pressure) values become the tokens in our Marcov Chain.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 components.Chain.Chain (int *window,* int *token,* int *threshold,* int *model_size*)

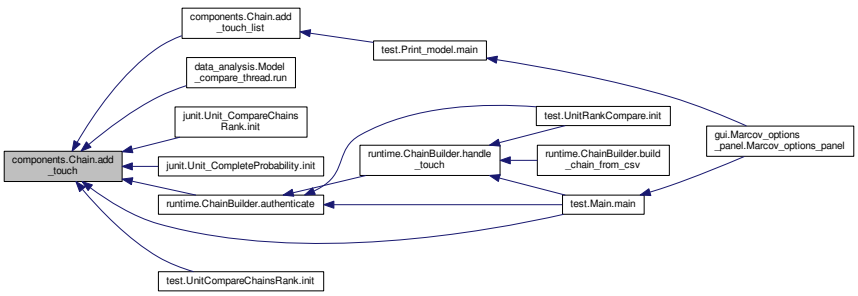
6.1.2.2 components.Chain.Chain (Chain *c*)

copy constructor. New chain object should have the same state as the old with differant object references.

6.1.3 Member Function Documentation

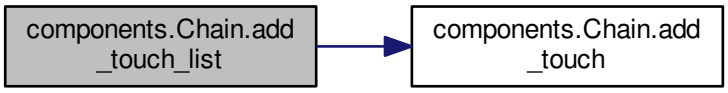
6.1.3.1 void components.Chain.add_touch (Touch *touch*)

Here is the caller graph for this function:

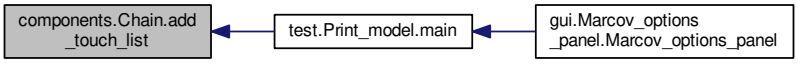


6.1.3.2 void components.Chain.add_touch_list (List< Touch > *t*)

Here is the call graph for this function:



Here is the caller graph for this function:

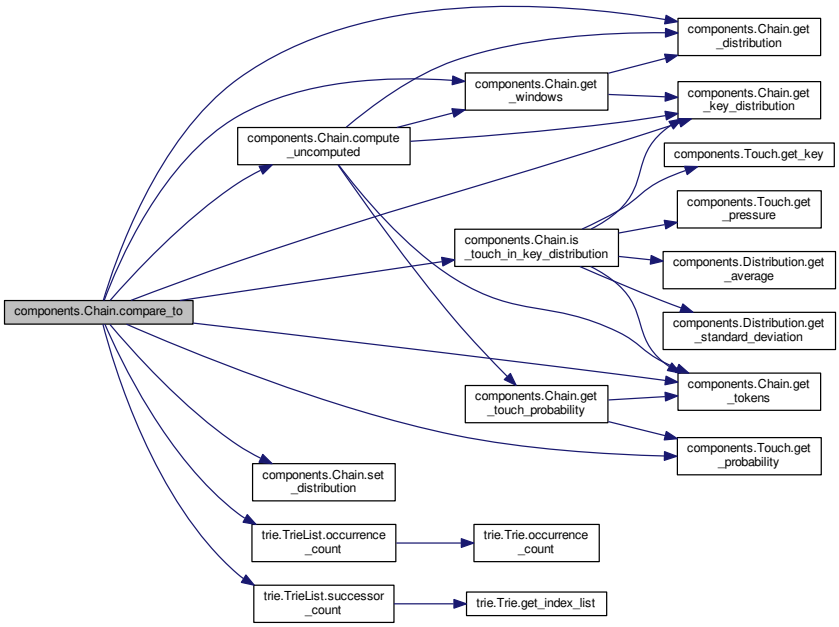


6.1.3.3 double components.Chain.compare_to (Chain *auth_chain*)

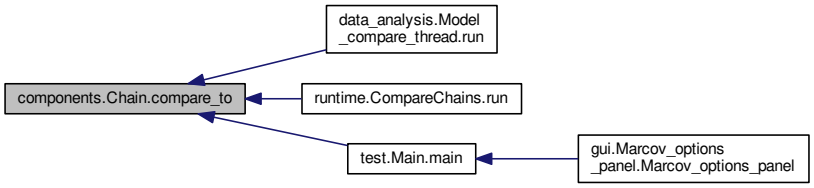
returns the percent difference between this chain and auth_chain.

the value returned will be between 0 and 1 0 indicates there is no difference 1 indicates there is a large difference

Here is the call graph for this function:



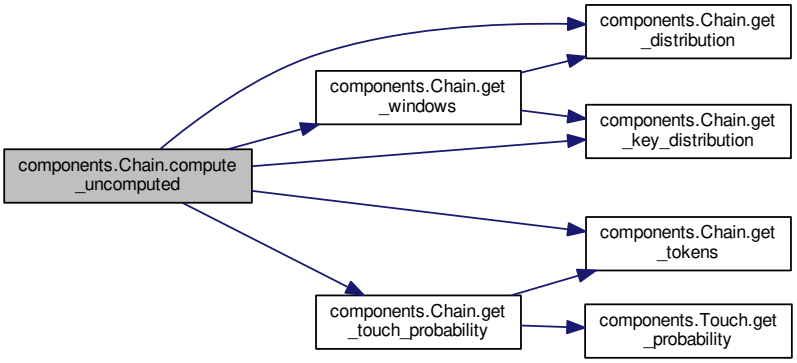
Here is the caller graph for this function:



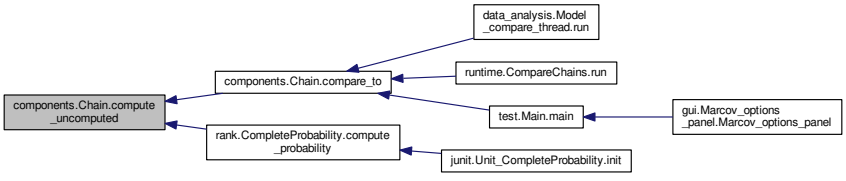
6.1.3.4 void components.Chain.compute_uncomputed ( )

computes all uncomputed aspects of the chain

Here is the call graph for this function:



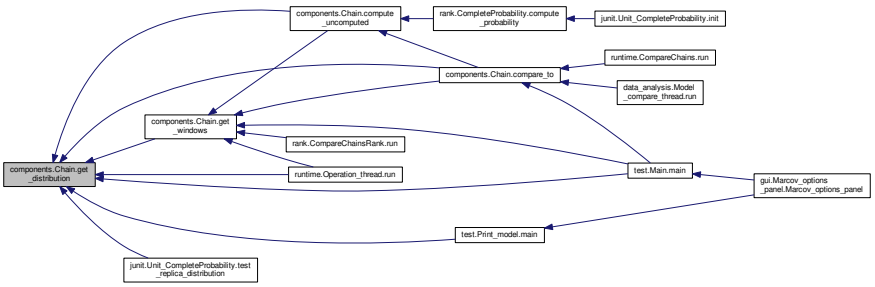
Here is the caller graph for this function:



6.1.3.5 Distribution components.Chain.get_distribution ( )

returns the distribution of the data as a whole

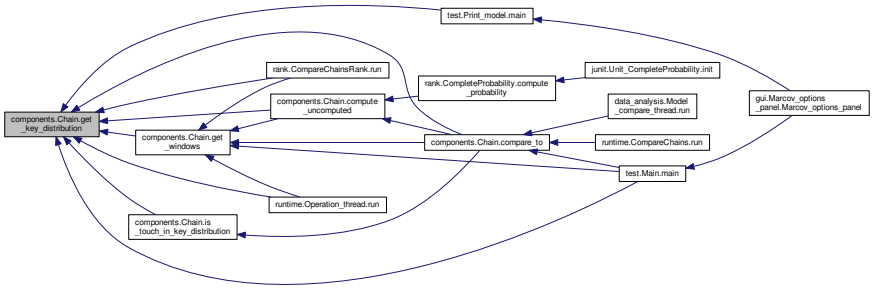
Here is the caller graph for this function:



6.1.3.6 List<Distribution> components.Chain.get_key_distribution ( )

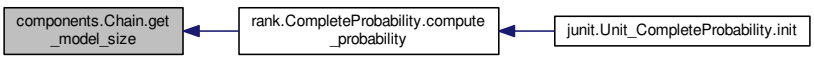
returns a list of distributions for each key

Here is the caller graph for this function:



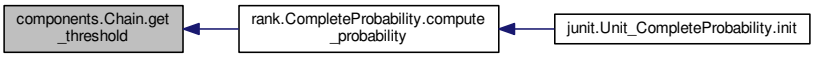
6.1.3.7 int components.Chain.get_model_size ( )

Here is the caller graph for this function:



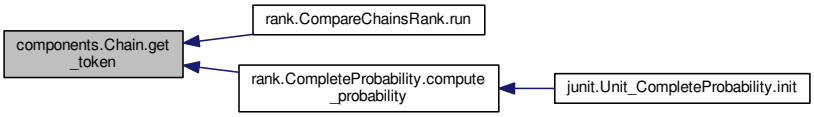
6.1.3.8 int components.Chain.get_threshold ( )

Here is the caller graph for this function:



6.1.3.9 int components.Chain.get_token ( )

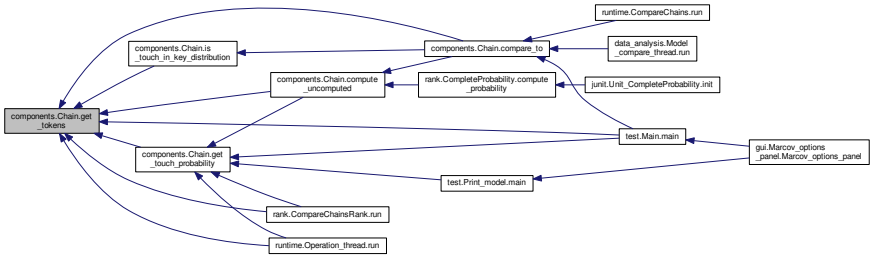
Here is the caller graph for this function:



6.1.3.10 List<Token> components.Chain.get_tokens ( )

handle requests for tokens

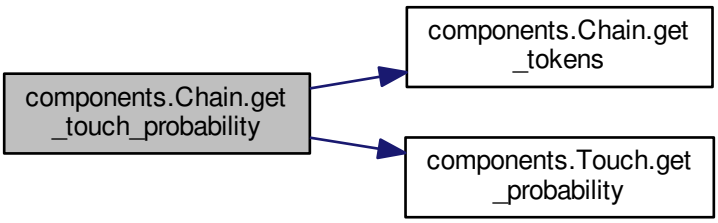
Here is the caller graph for this function:



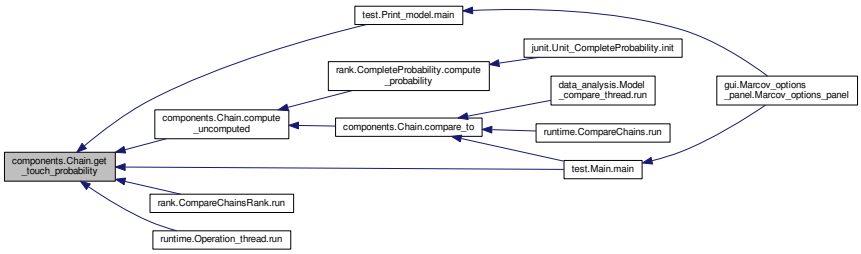
6.1.3.11 double components.Chain.get_touch_probability (Window *w*, Touch *t*)

returns the probability of a given touch (at the i'th index) based on the model. This will depend on the preceeding touches, in Window. A request for one probability will necessarily result in all of the probabilities being computed.

Here is the call graph for this function:



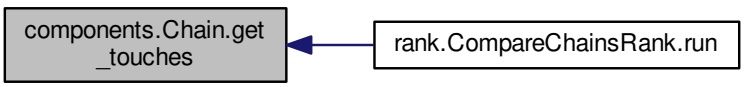
Here is the caller graph for this function:



6.1.3.12 List<Touch> components.Chain.get_touches ( )

get a list of all touches in the chain

Here is the caller graph for this function:

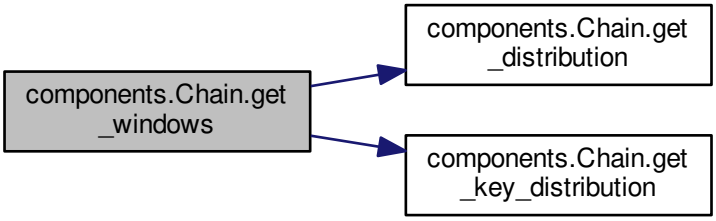


6.1.3.13 int components.Chain.get_window ( )

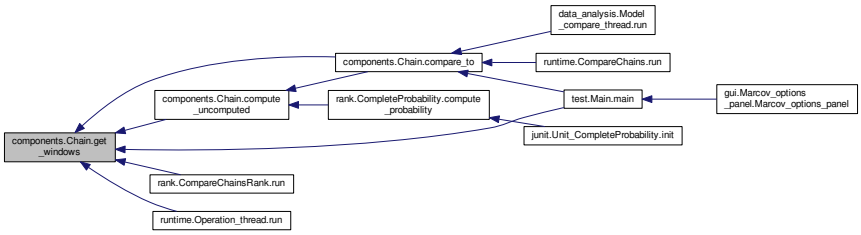
6.1.3.14 List<Window> components.Chain.get_windows ( )

handle requests for windows

Here is the call graph for this function:



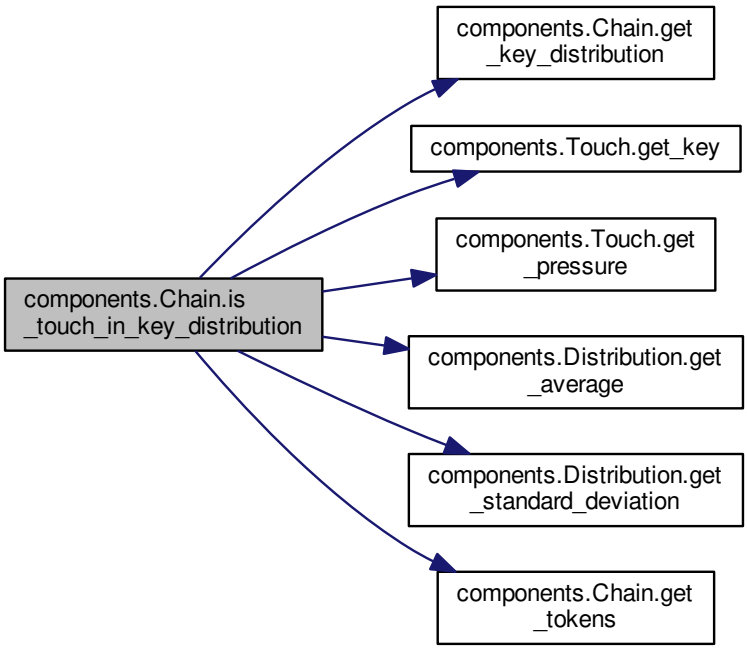
Here is the caller graph for this function:



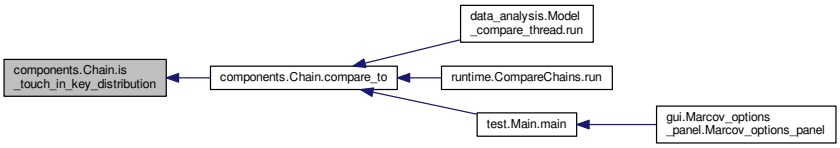
6.1.3.15 boolean components.Chain.is_touch_in_key_distribution (Touch *touch*)

returns true if a touch is within 2 sigma for it's key distribution

Here is the call graph for this function:



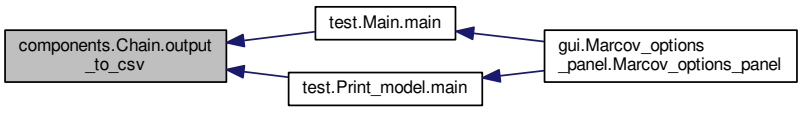
Here is the caller graph for this function:



6.1.3.16 void components.Chain.output_to_csv (String *file_name*)

NOT USEFUL IN ANDROID. This is used for debugging purposes. Outputs the model to a csv file in a readable format.

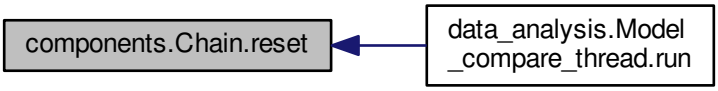
Here is the caller graph for this function:



6.1.3.17 void components.Chain.reset ( )

resets the object.. this is the same as constructing a new chain, but faster

Here is the caller graph for this function:

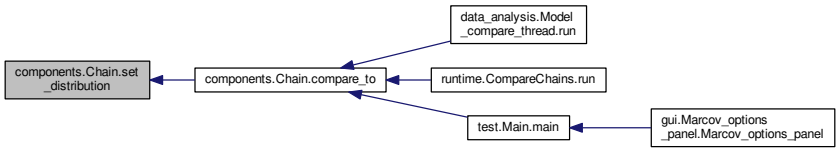


6.1.3.18 void components.Chain.set_distribution (Distribution *distribution,* List< Distribution > *key_distribution*)

allows distribution to be set.

If no distribution is set, the distribution for this chain of touches is computed. NOTE the distribution is not maintained when new touches are added.

Here is the caller graph for this function:



6.1.3.19 String components.Chain.toString ( )

prints out all of the touches in order

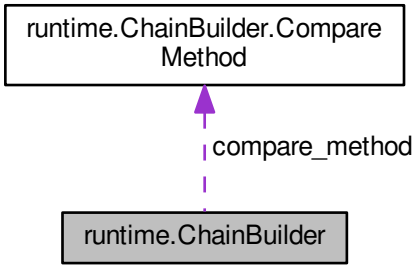
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Chain.java

6.2 runtime.ChainBuilder Class Reference

Wrapper around Chain used to make using the model easier in a real application.

Collaboration diagram for runtime.ChainBuilder:



Classes

- enum CompareMethod
- enum State

Public Member Functions

- ChainBuilder ()
- ChainBuilder (int window, int token, int threshold, int user_model_size, int auth_model_size)

  allow model size, window, token values to be specified.
- void handle_touch (Touch touch)

  this method should be called in some way whenever there is a touch event in android.
- void authenticate ()

  allow forced authentication from outside of ChainBuilder.
- CompareChains get_authenticate_thread ()

  return the thread which is preforming the authentication.
- State get_authenticate_state ()

  handle requests for the current state of the authentication
- void build_chain_from_csv (File file)

  this code will NOT BE USEFULL ON ANDROID.

Static Public Member Functions

- static List< Touch > parse_csv (File file)

  parse the csv file NOT USEFULL ON ANDROID

6.2.1 Detailed Description

Wrapper around Chain used to make using the model easier in a real application.

This class will construct a model with the given parameters. Calling authenticate will cause the newest [user↩ _model_size] touches to be compared against [auth_model_size] touches which immediatly precede the touches used in the user_model.

6.2.2 Constructor & Destructor Documentation

6.2.2.1 runtime.ChainBuilder.ChainBuilder ( )

6.2.2.2 runtime.ChainBuilder.ChainBuilder (int *window,* int *token,* int *threshold,* int *user_model_size,* int *auth_model_size*)

allow model size, window, token values to be specified.

This is mainly for testing purposes

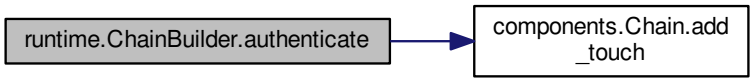
6.2.3 Member Function Documentation

6.2.3.1 void runtime.ChainBuilder.authenticate ( )

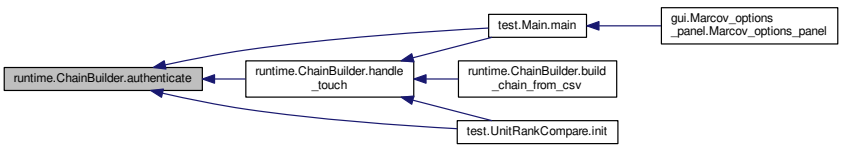
allow forced authentication from outside of ChainBuilder.

this involves starting the CompareChains. this method starts the authentication

Here is the call graph for this function:



Here is the caller graph for this function:

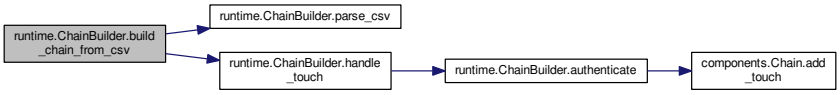


6.2.3.2 void runtime.ChainBuilder.build_chain_from_csv (File *file*)

this code will NOT BE USEFULL ON ANDROID.

It will build the model from a csv file in the current working directory. It will however utilize the handle_touch() method to add new touches to the chain. It is simply a matter of where the touches are coming from. TODO move this method to another place. it is only by convience that it exists here now.

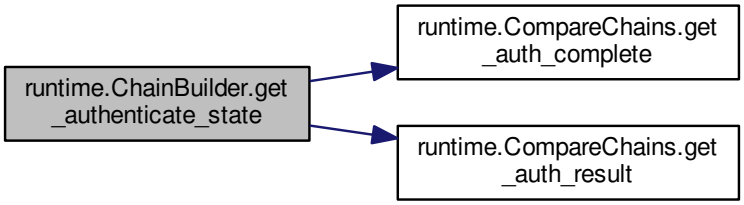
Here is the call graph for this function:



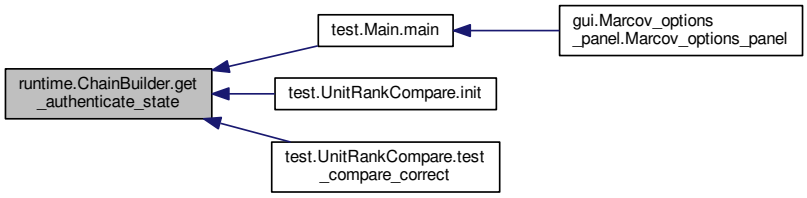
6.2.3.3 State runtime.ChainBuilder.get_authenticate_state ( )

handle requests for the current state of the authentication

Here is the call graph for this function:



Here is the caller graph for this function:

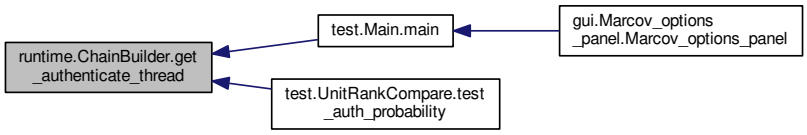


6.2.3.4 CompareChains runtime.ChainBuilder.get_authenticate_thread ( )

return the thread which is preforming the authentication.

This method provides no guarentees about the state of the thread. It may even be null!

Here is the caller graph for this function:



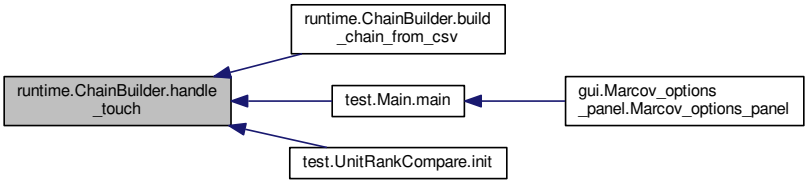
6.2.3.5 void runtime.ChainBuilder.handle_touch (Touch *touch*)

this method should be called in some way whenever there is a touch event in android.

There should be minimal amounts of processing done here so the input to the device doesn't lag. I don't know by what method percicely this will need to be called in the android souce. It could be another class which simply handles touch events, or from the pre-existing android archetecture.

Here is the call graph for this function:

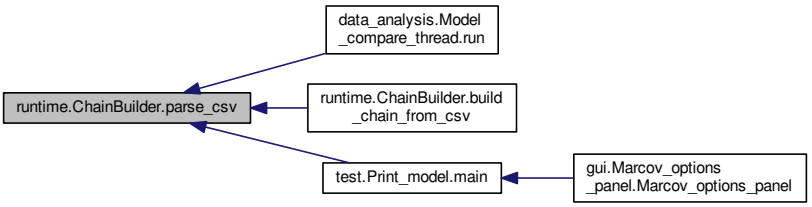
Here is the caller graph for this function:



6.2.3.6 static List<Touch> runtime.ChainBuilder.parse_csv (File *file*) [static]

parse the csv file NOT USEFULL ON ANDROID

Here is the caller graph for this function:



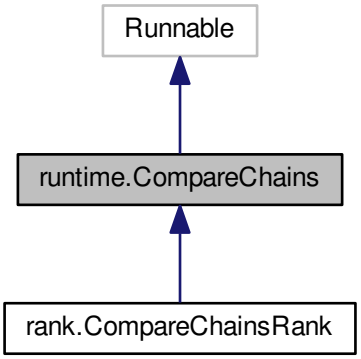
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/ChainBuilder.java

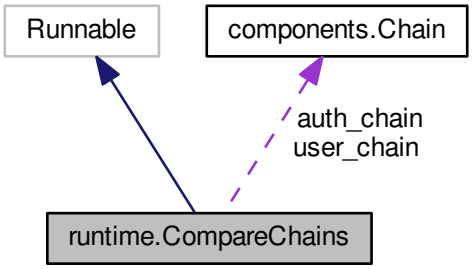
6.3 runtime.CompareChains Class Reference

Use the compare method of the Chain class to determine an authetnication probability between 0 and 1.

Inheritance diagram for runtime.CompareChains:



Collaboration diagram for runtime.CompareChains:



Public Member Functions

- CompareChains (Chain user_chain, Chain auth_chain)

  will need to make copies of the chains passed in so they do not get updated by something else during the comparason
- void run ()

  compare user_chain and auth_chain and choose what to do with the result
- double get_auth_probability ()

  returns the probability with which the
- boolean get_auth_result ()

  returns the result of the authentication.
- boolean get_auth_complete ()

Protected Attributes

- volatile boolean is_authentic
- volatile boolean complete
- Chain user_chain
- Chain auth_chain
- volatile double authentication_probability

6.3.1 Detailed Description

Use the compare method of the Chain class to determine an authetnication probability between 0 and 1.

This class was designed to allow for comparing chains to happen on a different thread.

6.3.2 Constructor & Destructor Documentation

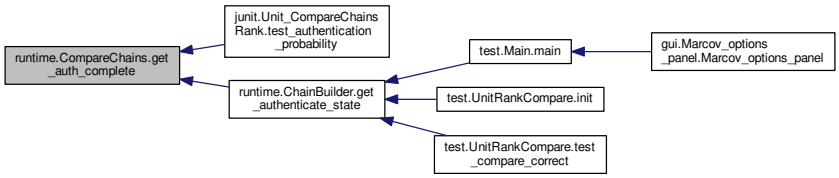
6.3.2.1 runtime.CompareChains.CompareChains (Chain *user_chain*, Chain *auth_chain*)

will need to make copies of the chains passed in so they do not get updated by something else during the comparason

6.3.3 Member Function Documentation

6.3.3.1 boolean runtime.CompareChains.get_auth_complete ( )

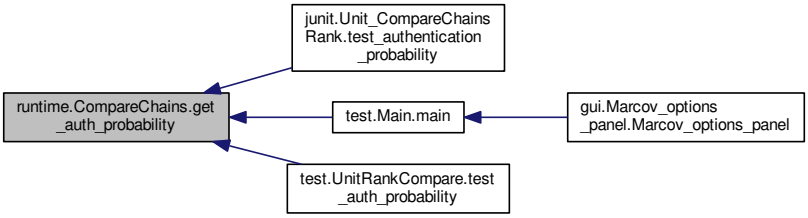
Here is the caller graph for this function:



6.3.3.2 double runtime.CompareChains.get_auth_probability ( )

returns the probability with which the

Here is the caller graph for this function:

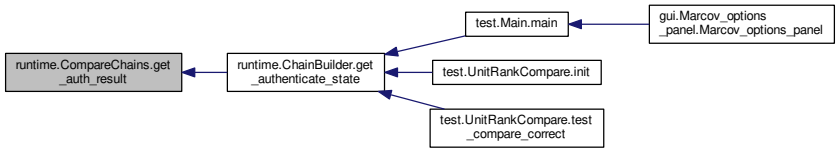


6.3.3.3 boolean runtime.CompareChains.get_auth_result ( )

returns the result of the authentication.

This method does not provide any guarentees that the compairason has finsihed yet. If the compairason has not yet finished it will return false;

Here is the caller graph for this function:

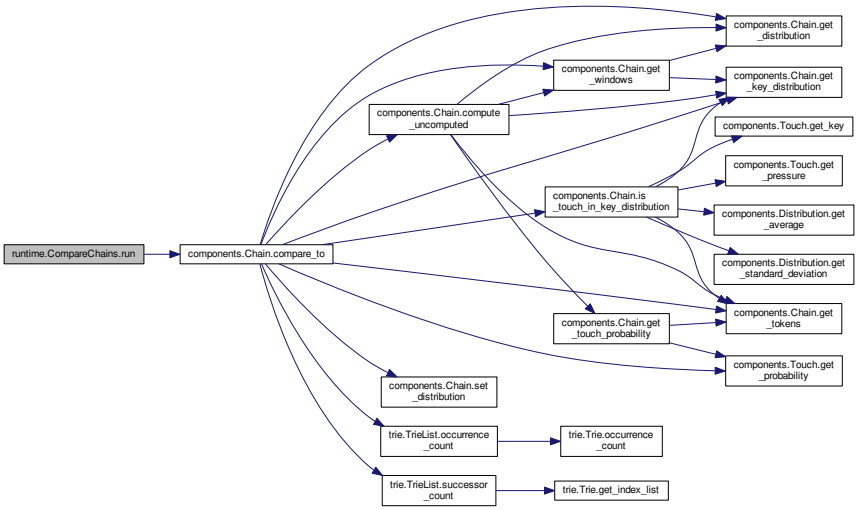


6.3.3.4 void runtime.CompareChains.run ( )

compare user_chain and auth_chain and choose what to do with the result

perform the comparison now that the values are cached in the Chain's

Here is the call graph for this function:



6.3.4 Member Data Documentation

6.3.4.1 Chain runtime.CompareChains.auth_chain [protected]

6.3.4.2 volatile double runtime.CompareChains.authentication_probability [protected]

6.3.4.3 volatile boolean runtime.CompareChains.complete [protected]

6.3.4.4 volatile boolean runtime.CompareChains.is_authentic [protected]

6.3.4.5 Chain runtime.CompareChains.user_chain [protected]

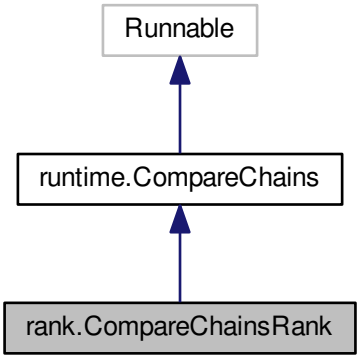
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/CompareChains.java

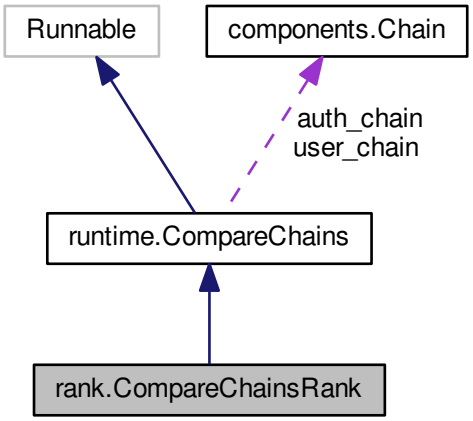
6.4 rank.CompareChainsRank Class Reference

Use PageRank algorithm (library) to compare chains.

Inheritance diagram for rank.CompareChainsRank:



Collaboration diagram for rank.CompareChainsRank:



Public Member Functions

- CompareChainsRank (Chain user_chain, Chain auth_chain)
- void run ()

  overrides the run method to implement the authentication with a page-rank style algorithm.

Additional Inherited Members

6.4.1 Detailed Description

Use PageRank algorithm (library) to compare chains.

Provides an implementation of CompareChains which can be used in place of the chain compairason implemented in the Chain class.

NOTE: this is still a work in progress and does not have very good results yet.

6.4.2 Constructor & Destructor Documentation

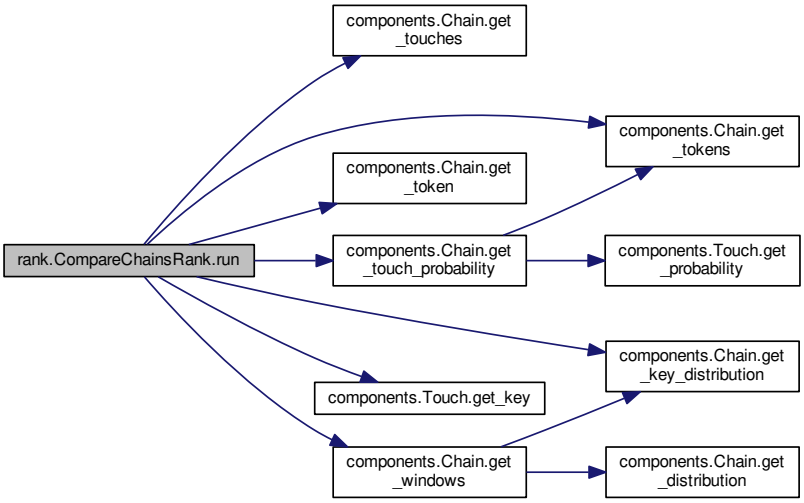
6.4.2.1 rank.CompareChainsRank.CompareChainsRank (Chain *user_chain,* Chain *auth_chain*)

6.4.3 Member Function Documentation

6.4.3.1 void rank.CompareChainsRank.run ( )

overrides the run method to implement the authentication with a page-rank style algorithm.

Here is the call graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/rank/CompareChainsRank.java

6.5 runtime.ChainBuilder.CompareMethod Enum Reference

Public Attributes

- PROBABILITY_VECTOR_DIFFERANCE

6.5.1 Member Data Documentation

6.5.1.1 runtime.ChainBuilder.CompareMethod.PROBABILITY_VECTOR_DIFFERANCE

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/ChainBuilder.java

6.6 rank.CompleteProbability Class Reference

This class computes probability in a different way from what is contained in the Chain class.

Public Member Functions

- CompleteProbability (Chain chain)
- Chain compute_probability ()

  make a replica of the chain with a window size of 1 and compute the probability.

6.6.1 Detailed Description

This class computes probability in a different way from what is contained in the Chain class.

This class looks at all of the touches to try to determine the probability that from any given touch, it transitions to another.

this is similar to having a window size of 1?

Author

element

6.6.2 Constructor & Destructor Documentation

6.6.2.1 rank.CompleteProbability.CompleteProbability (Chain *chain*)

6.6.3 Member Function Documentation

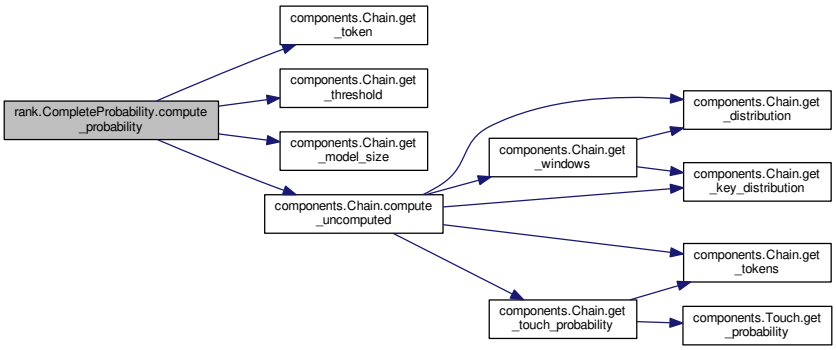
6.6.3.1 Chain rank.CompleteProbability.compute_probability ( )

make a replica of the chain with a window size of 1 and compute the probability.

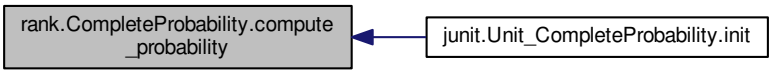
Returns

replica chain

Here is the call graph for this function:



Here is the caller graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/rank/CompleteProbability.java

6.7 runtime.Operation_thread.Computation Enum Reference

Public Attributes

- DISTRIBUTION
- KEY_DISTRIBUTION
- WINDOW
- TOKEN
- PROBABILITY

6.7.1 Member Data Documentation

6.7.1.1 runtime.Operation_thread.Computation.DISTRIBUTION

6.7.1.2 runtime.Operation_thread.Computation.KEY_DISTRIBUTION

6.7.1.3 runtime.Operation_thread.Computation.PROBABILITY

6.7.1.4 runtime.Operation_thread.Computation.TOKEN

6.7.1.5 runtime.Operation_thread.Computation.WINDOW

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/Operation_thread.java

6.8 test.Main.TestFiles.Concentration Enum Reference

Public Member Functions

- Concentration (String description, int identifier, double value)
- String toString ()
- int get_identifier ()
- double get_value ()

Public Attributes

- HIGH =("High, [std deviation]", 0, 0)
- MEDIUM =("Medium, [std deviation]", 1, 0)
- LOW

6.8.1 Constructor & Destructor Documentation

6.8.1.1 test.Main.TestFiles.Concentration.Concentration (String *description,* int *identifier,* double *value*)

6.8.2 Member Function Documentation

6.8.2.1 int test.Main.TestFiles.Concentration.get_identifier ( )

6.8.2.2 double test.Main.TestFiles.Concentration.get_value ( )

6.8.2.3 String test.Main.TestFiles.Concentration.toString ( )

6.8.3 Member Data Documentation

6.8.3.1 test.Main.TestFiles.Concentration.HIGH =("High, [std deviation]", 0, 0)

6.8.3.2 test.Main.TestFiles.Concentration.LOW

Initial value:

```
=("Low, [std deviation]", 2,
                    0)
```

6.8.3.3 test.Main.TestFiles.Concentration.MEDIUM =("Medium, [std deviation]", 1, 0)

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Main.java

6.9 test.Main.TestFiles.Distribution Enum Reference

Public Member Functions

- Distribution (String description, int identifier, double value)
- String toString ()
- int get_identifier ()
- double get_value ()

Public Attributes

- NORMAL =("Normal, centered about pressure median", 0, 0)
- ABNORMAL
- RANDOM =("Random, completly and utterly random", 2, 0)

6.9.1 Constructor & Destructor Documentation

6.9.1.1 test.Main.TestFiles.Distribution.Distribution (String *description,* int *identifier,* double *value*)

6.9.2 Member Function Documentation

6.9.2.1 int test.Main.TestFiles.Distribution.get_identifier ( )

6.9.2.2 double test.Main.TestFiles.Distribution.get_value ( )

6.9.2.3 String test.Main.TestFiles.Distribution.toString ( )

6.9.3 Member Data Documentation

6.9.3.1 test.Main.TestFiles.Distribution.ABNORMAL

Initial value:

```
=(
                    "Abnormal, centered about pressure median, but inverted", 1,
                    0)
```

6.9.3.2 test.Main.TestFiles.Distribution.NORMAL =("Normal, centered about pressure median", 0, 0)

6.9.3.3 test.Main.TestFiles.Distribution.RANDOM =("Random, completly and utterly random", 2, 0)

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Main.java

6.10 components.Distribution Class Reference

Used to compute and store max, min, std_deviation, and average for a list of Touch.

Public Member Functions

- Distribution (List< Touch > touches)
- Distribution (List< Touch > touches, int keycode)

  this constructor allows a keycode to be associated with the distribution
- Distribution (Distribution d)

  copy constructor. This exists because computations are done in the constructor. Copying in this way avoids recomputation.
- void update (List< Touch > touches)

  updates the distribution using a list of touches. This update has nothing to do with the old values in the distribution. It is synonomous to creating a new Distribution object with this list of touches.
- double get_min ()
- double get_max ()
- double get_average ()
- double get_standard_deviation ()
- int get_keycode ()

  returns the keycode associated with this distribution. If the distribution does not have an associated keycode, this method will return -1.
- boolean equals (Object o)

  determine if this distribution is exactly equal to another distribution

6.10.1 Detailed Description

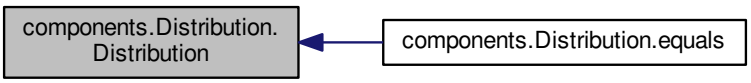
Used to compute and store max, min, std_deviation, and average for a list of Touch.

In addition to computing these metrics, Distribution allows a keycode to be associated with the list of touches.

6.10.2 Constructor & Destructor Documentation

6.10.2.1 components.Distribution.Distribution (List< Touch > *touches*)

Here is the caller graph for this function:



6.10.2.2 components.Distribution.Distribution (List< Touch > *touches,* int *keycode*)

this constructor allows a keycode to be associated with the distribution

6.10.2.3 components.Distribution.Distribution (Distribution *d*)

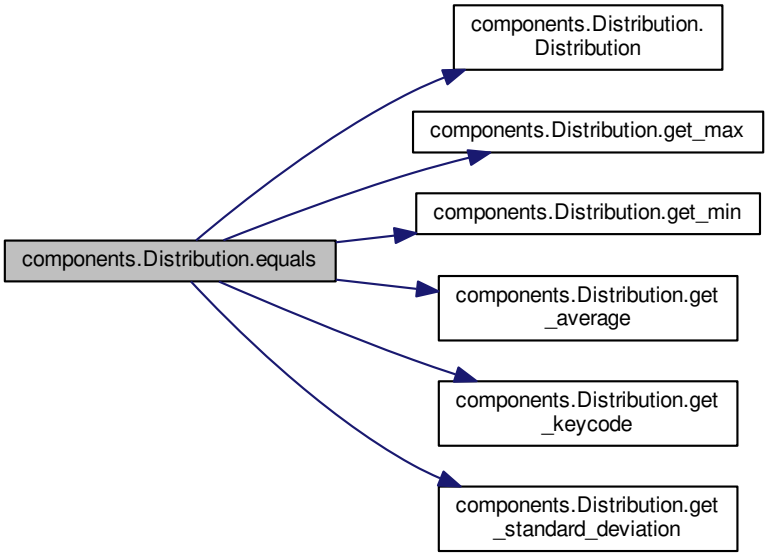
copy constructor. This exists because computations are done in the constructor. Copying in this way avoids recomputation.

6.10.3 Member Function Documentation

6.10.3.1 boolean components.Distribution.equals (Object *o*)

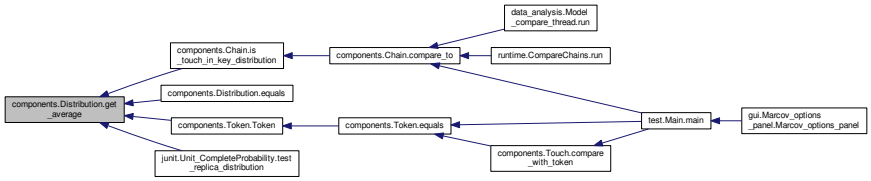
determine if this distribution is exactly equal to another distribution

Here is the call graph for this function:



6.10.3.2 double components.Distribution.get_average ( )

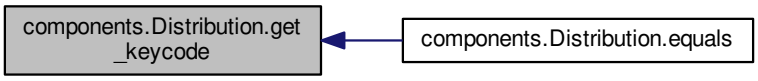
Here is the caller graph for this function:



6.10.3.3 int components.Distribution.get_keycode ( )

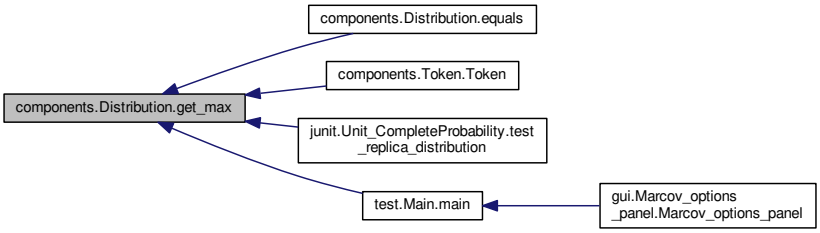
returns the keycode associated with this distribution. If the distribution does not have an associated keycode, this method will return -1.

Here is the caller graph for this function:



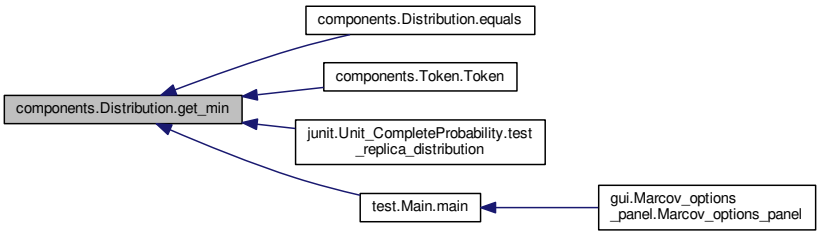
6.10.3.4 double components.Distribution.get_max ( )

Here is the caller graph for this function:



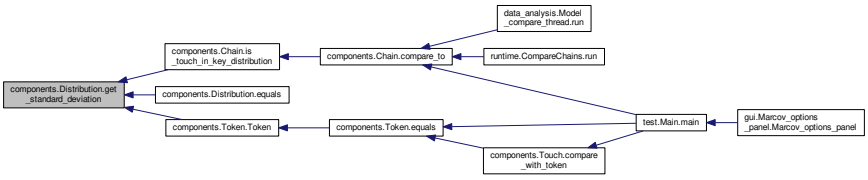
6.10.3.5 double components.Distribution.get_min ( )

Here is the caller graph for this function:



6.10.3.6 double components.Distribution.get_standard_deviation ( )

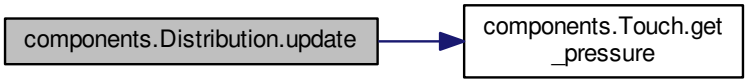
Here is the caller graph for this function:



6.10.3.7 void components.Distribution.update (List< Touch > *touches*)

updates the distribution using a list of touches. This update has nothing to do with the old values in the distribution. It is synonomous to creating a new Distribution object with this list of touches.

Here is the call graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Distribution.java

6.11 test.Main Class Reference

This class is used to test that the model is being built correctly.

Static Public Member Functions

- static void main (String args[ ])

6.11.1 Detailed Description

This class is used to test that the model is being built correctly.

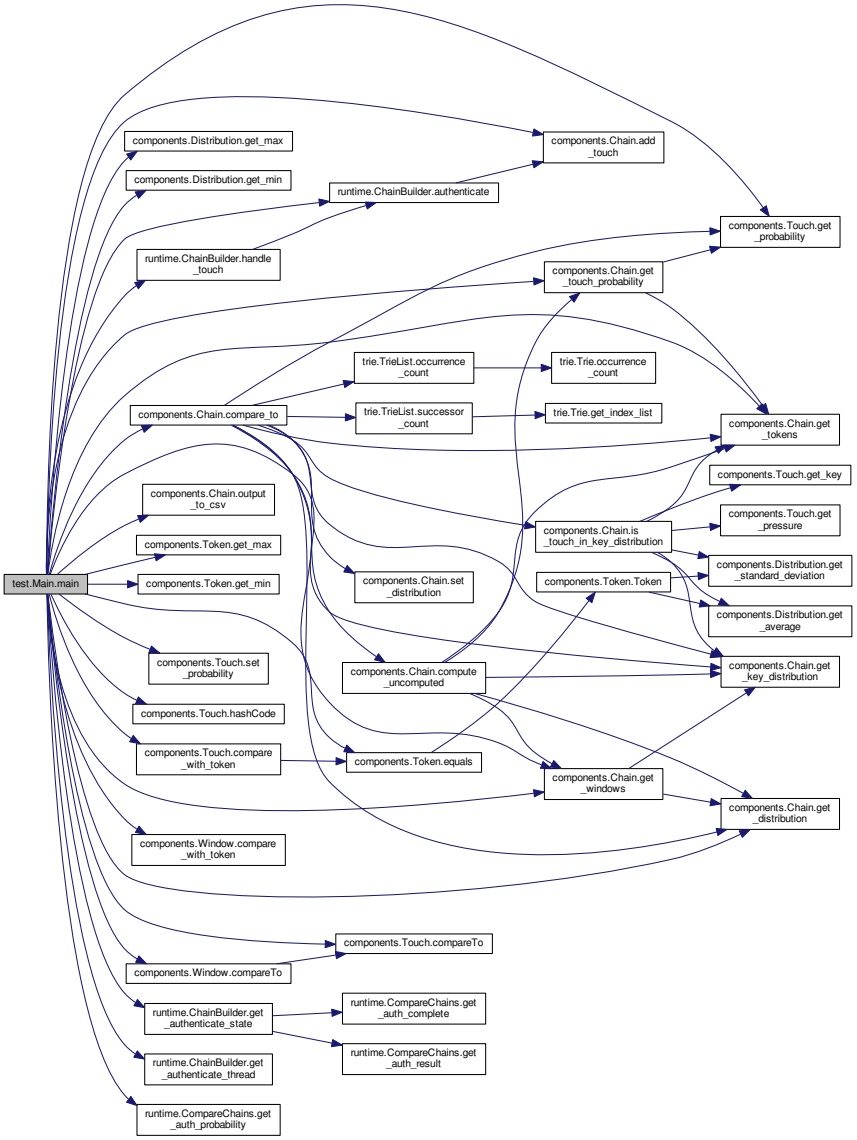
Also tested is the model compairason. and various classes used in model creating. The idea is to print out the tests which fail. This class should have to do no actual work if the program is designed well.

NOTE: A few tests fail. This is not an issue as This is expected. The reason for this is that this test code is somewhat out of date.

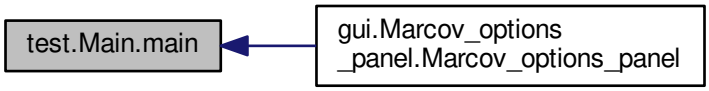
6.11.2 Member Function Documentation

6.11.2.1 static void test.Main.main (String *args[ ]*) [static]

Here is the call graph for this function:



Here is the caller graph for this function:



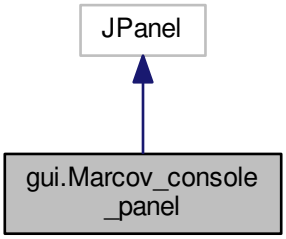
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Main.java

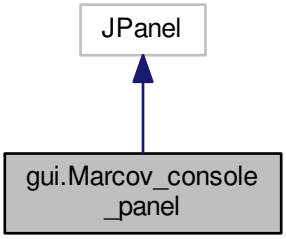
6.12 gui.Marcov_console_panel Class Reference

Displays messages printed to stdout.

Inheritance diagram for gui.Marcov_console_panel:



Collaboration diagram for gui.Marcov_console_panel:



Public Member Functions

- Marcov_console_panel ()

6.12.1 Detailed Description

Displays messages printed to stdout.

6.12.2 Constructor & Destructor Documentation

6.12.2.1 gui.Marcov_console_panel.Marcov_console_panel ( )

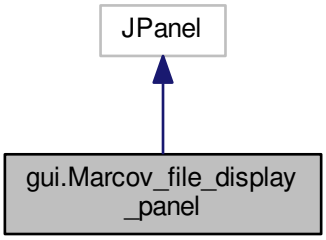
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_console_panel.java

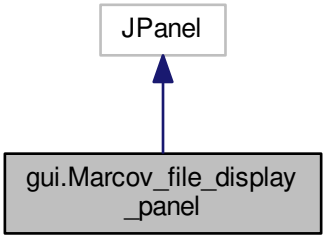
6.13 gui.Marcov_file_display_panel Class Reference

Displays files relavant to test code.

Inheritance diagram for gui.Marcov_file_display_panel:



Collaboration diagram for gui.Marcov_file_display_panel:



Public Member Functions

- Marcov_file_display_panel ()

6.13.1 Detailed Description

Displays files relavant to test code.

6.13.2 Constructor & Destructor Documentation

6.13.2.1 gui.Marcov_file_display_panel.Marcov_file_display_panel ( )

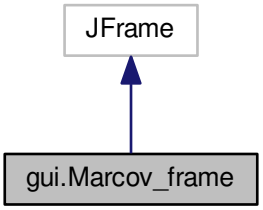
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_file_display_panel.java

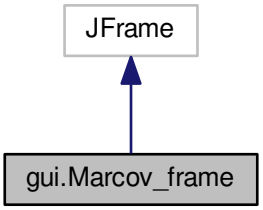
6.14 gui.Marcov_frame Class Reference

Display frame to contain buttons for running test code and panels to view results.

Inheritance diagram for gui.Marcov_frame:



Collaboration diagram for gui.Marcov_frame:



Public Member Functions

- Marcov_frame ()
- void close ()

6.14.1 Detailed Description

Display frame to contain buttons for running test code and panels to view results.

6.14.2 Constructor & Destructor Documentation

6.14.2.1 gui.Marcov_frame.Marcov_frame ( )

6.14.3 Member Function Documentation

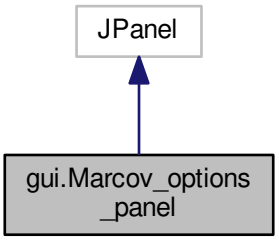
6.14.3.1 void gui.Marcov_frame.close ( )

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

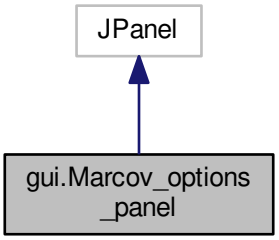
- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_frame.java

6.15 gui.Marcov_options_panel Class Reference

Inheritance diagram for gui.Marcov_options_panel:



Collaboration diagram for gui.Marcov_options_panel:



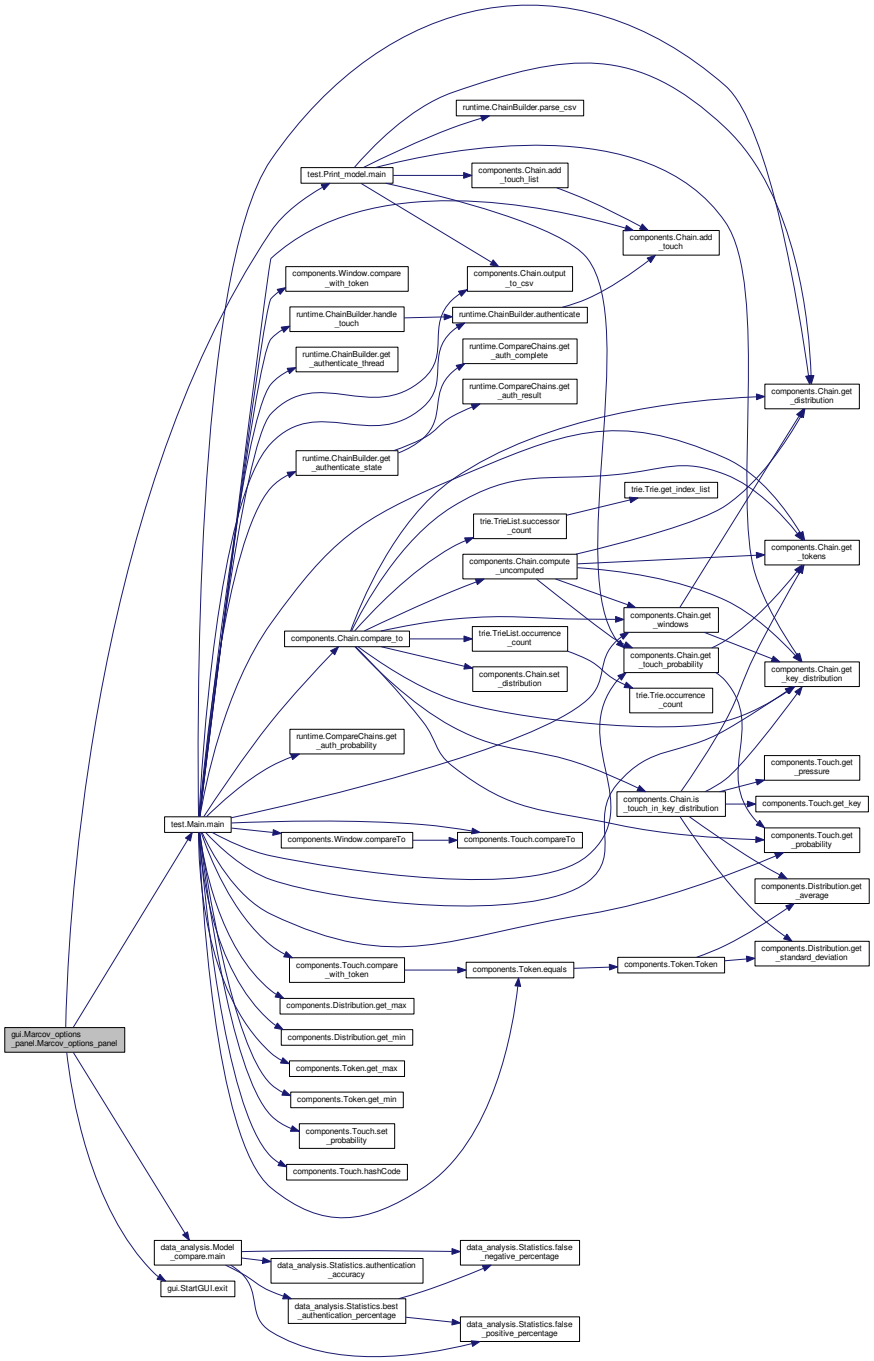
Public Member Functions

- Marcov_options_panel ()

6.15.1 Constructor & Destructor Documentation

6.15.1.1 gui.Marcov_options_panel.Marcov_options_panel ( )

Here is the call graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_options_panel.java

6.16 data_analysis.Model_compare Class Reference

Analysis class used to compare and analyze data gathered from users.

Static Public Member Functions

- static void main (String[ ] args)

6.16.1 Detailed Description

Analysis class used to compare and analyze data gathered from users.

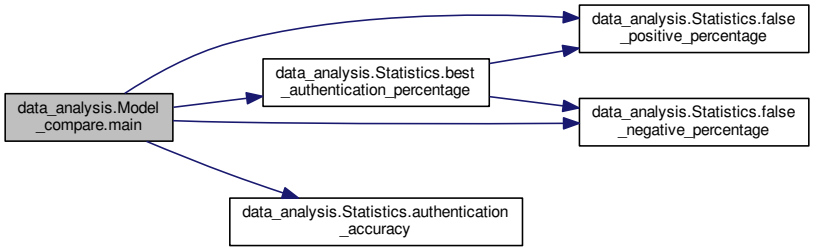
The purpose of this class is to test out the model compare process on data that has been collected The data to used will be contained in the data_sets folder input: data_sets folder output: model_compare_output.txt

6.16.2 Member Function Documentation

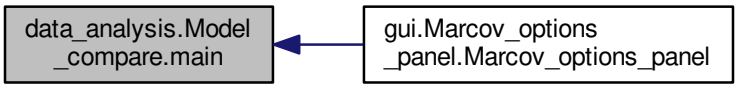
6.16.2.1 static void data_analysis.Model_compare.main (String[ ] *args*) [static]

create a number of tests with different parameters

Here is the call graph for this function:



Here is the caller graph for this function:



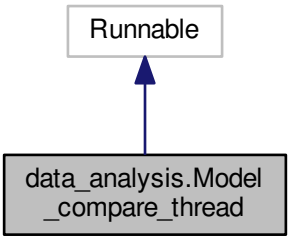
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/Model_compare.java

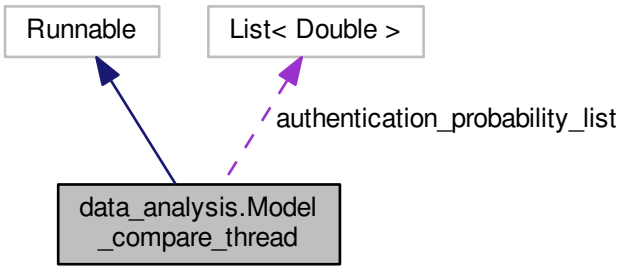
6.17 data_analysis.Model_compare_thread Class Reference

Compare Markov Chains on their own thread.

Inheritance diagram for data_analysis.Model_compare_thread:



Collaboration diagram for data_analysis.Model_compare_thread:



Public Member Functions

- Model_compare_thread (String base_data_path, String auth_data_path, int base_model_size, int auth_↩ model_size, int window_size, int token_size, int threshold)

  constructor, allowing user to set different probperties of the model compairason for testing
- void run ()
- String get_base_data_path ()
- String get_auth_data_path ()
- int get_window_size ()
- int get_token_size ()
- int get_threshold ()
- int get_base_model_size ()
- int get_auth_model_size ()
- List< Double > get_auth_probability_list ()

Public Attributes

- double max_authentication_probability
- double min_authentication_probability
- double average_authentication_probability

6.17.1 Detailed Description

Compare Markov Chains on their own thread.

This class was used to help speed up testing primarily. this thread allows the preforming of a test compairason. when the compairason is finished, an instance variable will be set indicating different results.

6.17.2 Constructor & Destructor Documentation

6.17.2.1 data_analysis.Model_compare_thread.Model_compare_thread (String *base_data_path,* String *auth_data_path,* int *base_model_size,* int *auth_model_size,* int *window_size,* int *token_size,* int *threshold*)

constructor, allowing user to set different probperties of the model compairason for testing

6.17.3 Member Function Documentation

6.17.3.1 String data_analysis.Model_compare_thread.get_auth_data_path ( )

6.17.3.2 int data_analysis.Model_compare_thread.get_auth_model_size ( )

6.17.3.3 List<Double> data_analysis.Model_compare_thread.get_auth_probability_list ( )

6.17.3.4 String data_analysis.Model_compare_thread.get_base_data_path ( )

6.17.3.5 int data_analysis.Model_compare_thread.get_base_model_size ( )

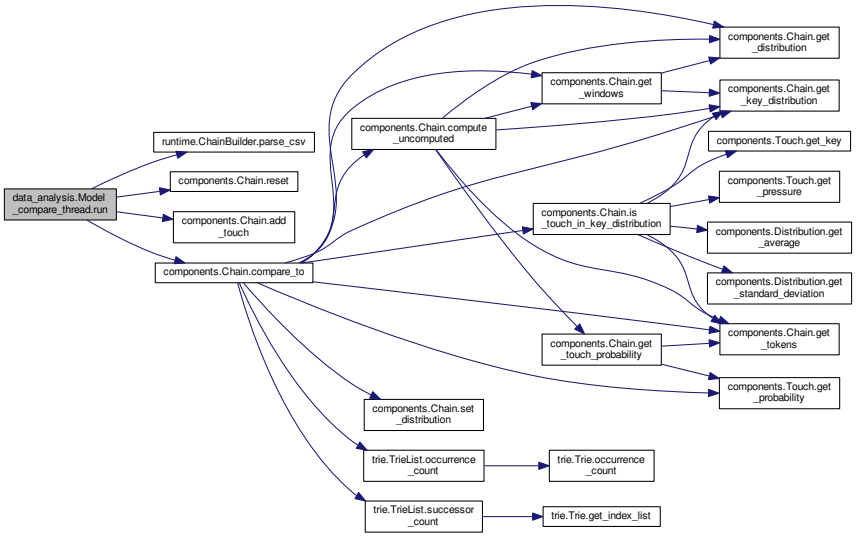
6.17.3.6 int data_analysis.Model_compare_thread.get_threshold ( )

6.17.3.7 int data_analysis.Model_compare_thread.get_token_size ( )

6.17.3.8 int data_analysis.Model_compare_thread.get_window_size ( )

6.17.3.9 void data_analysis.Model_compare_thread.run ( )

Here is the call graph for this function:



6.17.4 Member Data Documentation

6.17.4.1 double data_analysis.Model_compare_thread.average_authentication_probability

6.17.4.2 double data_analysis.Model_compare_thread.max_authentication_probability

6.17.4.3 double data_analysis.Model_compare_thread.min_authentication_probability

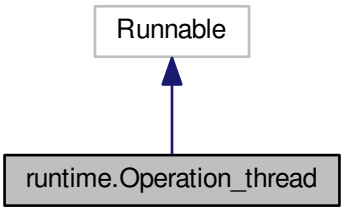
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/Model_compare_↩ thread.java

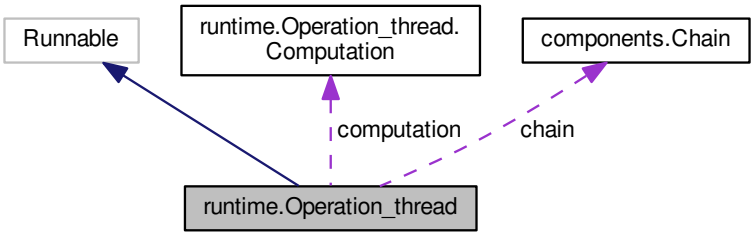
6.18 runtime.Operation_thread Class Reference

UNUSED.

Inheritance diagram for runtime.Operation_thread:



Collaboration diagram for runtime.Operation_thread:



Classes

- enum Computation

Public Member Functions

- Operation_thread (Chain chain, Computation computation)
- void run ()

6.18.1 Detailed Description

UNUSED.

The Intent of this class was to run specific computations on a differant thread. It is unused in the current implementation because there is never a need to run one computation independent from the others.

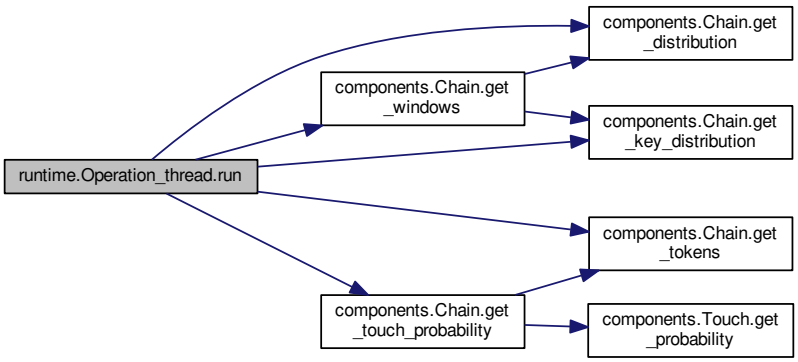
6.18.2 Constructor & Destructor Documentation

6.18.2.1 runtime.Operation_thread.Operation_thread (Chain *chain,* Computation *computation*)

6.18.3 Member Function Documentation

6.18.3.1 void runtime.Operation_thread.run ( )

Here is the call graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/Operation_thread.java

6.19 test.Main.TestFiles.PressureAmount Enum Reference

Public Member Functions

- PressureAmount (String description, int identifier, double value)
- String toString ()
- int get_identifier ()
- double get_value ()

Public Attributes

- HIGH =("High pressure, 0.75", 0, .75)
- MEDIUM =("Medium Pressure, 0.5", 1, .5)
- LOW

6.19.1 Constructor & Destructor Documentation

6.19.1.1 test.Main.TestFiles.PressureAmount.PressureAmount (String *description,* int *identifier,* double *value*)

6.19.2 Member Function Documentation

6.19.2.1 int test.Main.TestFiles.PressureAmount.get_identifier ( )

6.19.2.2 double test.Main.TestFiles.PressureAmount.get_value ( )

6.19.2.3 String test.Main.TestFiles.PressureAmount.toString ( )

6.19.3 Member Data Documentation

6.19.3.1 test.Main.TestFiles.PressureAmount.HIGH =("High pressure, 0.75", 0, .75)

6.19.3.2 test.Main.TestFiles.PressureAmount.LOW

Initial value:

```
=("Low Pressure, 0.25", 2,
                    .25)
```

6.19.3.3 test.Main.TestFiles.PressureAmount.MEDIUM =("Medium Pressure, 0.5", 1, .5)

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Main.java

6.20 test.Print_model Class Reference

This class will print out the model constructed form the designated file.

Static Public Member Functions

- static void main (String[ ] args)

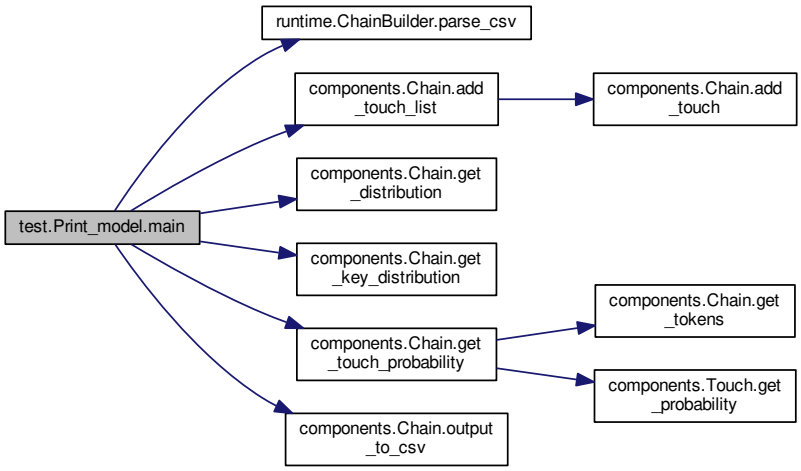
6.20.1 Detailed Description

This class will print out the model constructed form the designated file.

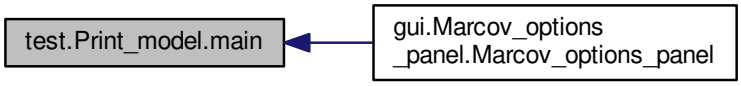
6.20.2 Member Function Documentation

6.20.2.1 static void test.Print_model.main (String[ ] *args*) [static]

Here is the call graph for this function:



Here is the caller graph for this function:



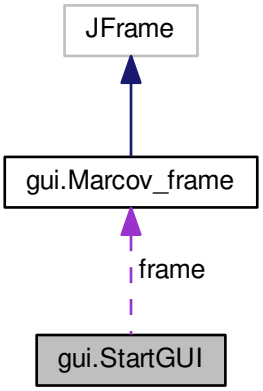
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Print_model.java

6.21 gui.StartGUI Class Reference

GUI useful for testing.

Collaboration diagram for gui.StartGUI:



Static Public Member Functions

- static void main (String[ ] args)
- static void exit ()

  causes the frame to close

6.21.1 Detailed Description

GUI useful for testing.

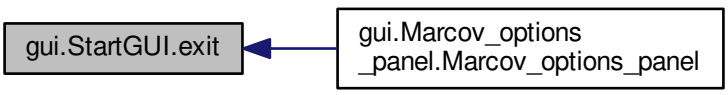
Contains functionality to run test code and view results.

6.21.2 Member Function Documentation

6.21.2.1 static void gui.StartGUI.exit ( ) [static]

causes the frame to close

Here is the caller graph for this function:



6.21.2.2 static void gui.StartGUI.main (String[ ] *args*) [static]

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/StartGUI.java

6.22 runtime.ChainBuilder.State Enum Reference

Public Attributes

- IN_PROGRESS
- SUCCESS

6.22.1 Member Data Documentation

6.22.1.1 runtime.ChainBuilder.State.IN_PROGRESS

6.22.1.2 runtime.ChainBuilder.State.SUCCESS

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/ChainBuilder.java

6.23 data_analysis.Statistics Class Reference

Generates statistics on results generated by model_compare.java.

Static Public Member Functions

- static void main (String args[ ])
- static double false_positive_percentage (double authentication_percentage, List< Double > should_↩ authenticate_percentages, List< Double > should_not_authenticate_percentages)
- static double false_negative_percentage (double authentication_percentage, List< Double > should_↩ authenticate_percentages, List< Double > should_not_authenticate_percentages)
- static double best_authentication_percentage (List< Double > should_authenticate_percentages, List< Double > should_not_authenticate_percentages)
- static double minimize_false_positive_authentication_percentage (List< Double > should_authenticate_↩ percentages, List< Double > should_not_authenticate_percentages)
- static double equal_false_positive_negative_authentication_percentage (List< Double > should_↩ authenticate_percentages, List< Double > should_not_authenticate_percentages)
- static double authentication_accuracy (double authentication_percentage, List< Double > should_↩ authenticate_percentages, List< Double > should_not_authenticate_percentages)

6.23.1 Detailed Description

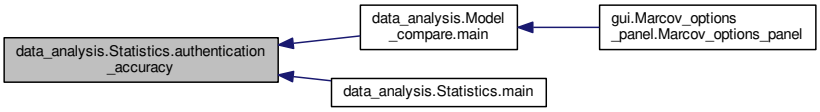
Generates statistics on results generated by model_compare.java.

NOTE: there are bugs in the maximize, minimize functions for authentication accuracy. I did min/max authentication accuracy analysis in another program after the fact. The results on authentication accuracy, false positive, and false negative may be trusted though.

6.23.2 Member Function Documentation

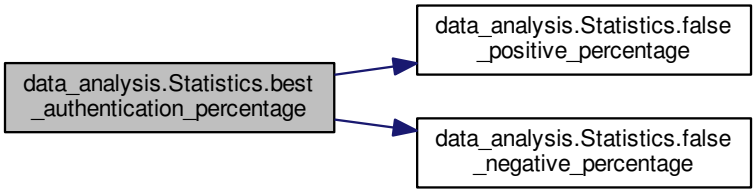
6.23.2.1 static double data_analysis.Statistics.authentication_accuracy (double *authentication_percentage,* List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the caller graph for this function:

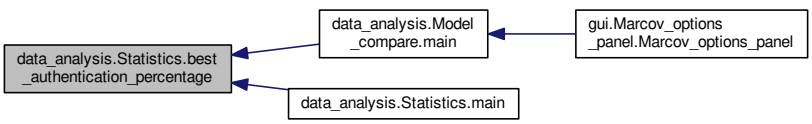


6.23.2.2 static double data_analysis.Statistics.best_authentication_percentage (List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the call graph for this function:

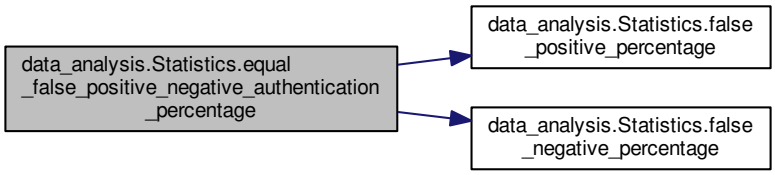


Here is the caller graph for this function:

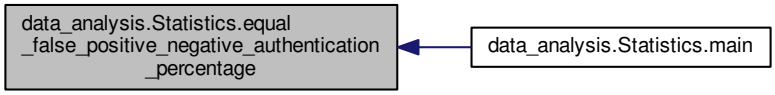


6.23.2.3 static double data_analysis.Statistics.equal_false_positive_negative_authentication_percentage (List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the call graph for this function:

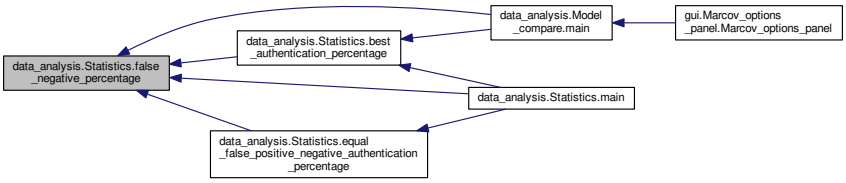


Here is the caller graph for this function:



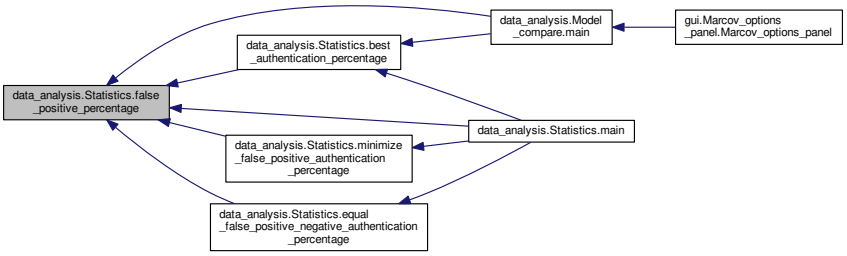
6.23.2.4 static double data_analysis.Statistics.false_negative_percentage (double *authentication_percentage,* List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the caller graph for this function:



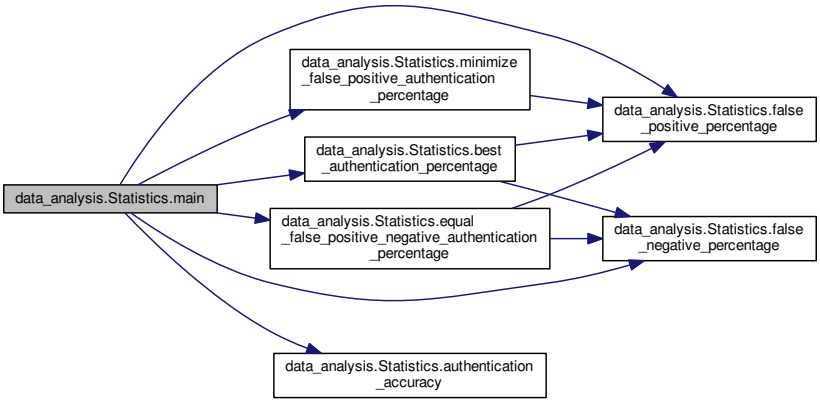
6.23.2.5 static double data_analysis.Statistics.false_positive_percentage (double *authentication_percentage,* List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the caller graph for this function:



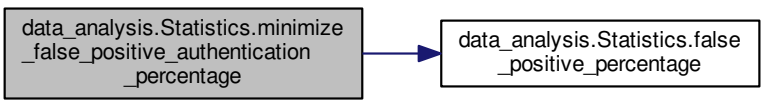
6.23.2.6 static void data_analysis.Statistics.main (String *args[ ]*) [static]

Here is the call graph for this function:

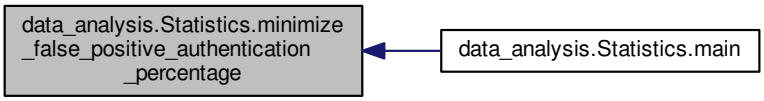


6.23.2.7 static double data_analysis.Statistics.minimize_false_positive_authentication_percentage (List< Double > *should_authenticate_percentages,* List< Double > *should_not_authenticate_percentages*) [static]

Here is the call graph for this function:



Here is the caller graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/Statistics.java

6.24 components.Token Class Reference

This class represents a token within the model.

Classes

- enum Type

  specify the type of token we want to build

Public Member Functions

- Token (Distribution distribution, int total_tokens, int token_index, double standard_deviations, Type type)

  allow tokens to be created making each touch mu for its keycode, or in a linear fashion over the distribution for the keycode
- Token (Distribution distribution, int total_tokens, int token_index, Type type)

  allow for creation of tokens over a distribution
- Token (double range_min, double range_max, int total_tokens, int token_index, Type type)

  Implemented in the constructor is the clustering algorithm.
- boolean contains (Touch touch)

  determines if a touch is within this token based on its pressure value this will return true if a touches pressure equals max or min, so if max of one token is min of another token, both will return true
- boolean is_high_wildcard (Touch touch)

  determine if a touch is a high_wildcard
- boolean is_low_wildcard (Touch touch)

  determine if a touch is a low wildcard
- void increment_high_wildcards ()

  adds the the number of high wildcards
- void increment_low_wildcards ()

  adds the the number of high wildcards
- int get_total_wildcards ()

  returns the total number of wildcards
- int get_acceptable_wildcards (int total_items)

returns the acceptable number of wildcards

- double get_min ()

  returns true if there are more than an acceptable number of wildcards

- double get_max ()

  return the maximum

- boolean equals (Object o_t)

  compares This token to another to determine if they are the same

6.24.1 Detailed Description

This class represents a token within the model.

Essentially this is a range of values. A touch is defined to be within a token if the pressure value of the touch falls within this range. This class is designed to abstract away the clustering algorithm. This makes the rest of the code far simpler to think about Something to look at in the future may be a clustering algorithm that is not equally distributed

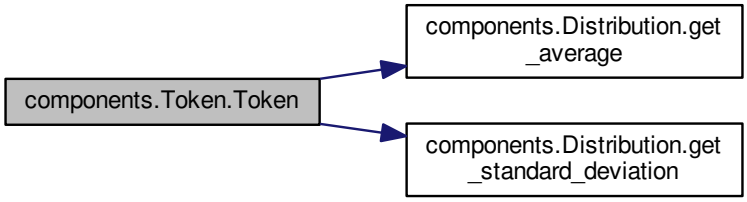
6.24.2 Constructor & Destructor Documentation

6.24.2.1 components.Token.Token (Distribution *distribution,* int *total_tokens,* int *token_index,* double *standard_deviations,* Type *type*)

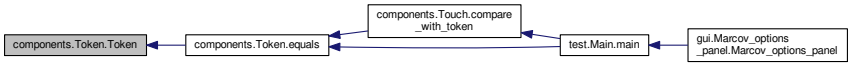
allow tokens to be created making each touch mu for its keycode, or in a linear fashion over the distribution for the keycode

allow for creation of tokens with-in some number of standard deviations of a distribution

Here is the call graph for this function:



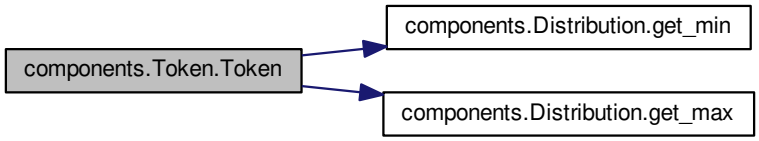
Here is the caller graph for this function:



6.24.2.2 components.Token.Token (Distribution *distribution,* int *total_tokens,* int *token_index,* Type *type*)

allow for creation of tokens over a distribution

Here is the call graph for this function:



6.24.2.3 components.Token.Token (double *range_min,* double *range_max,* int *total_tokens,* int *token_index,* Type *type*)

Implemented in the constructor is the clustering algorithm.

This determines how to split up the range into a number of tokens.

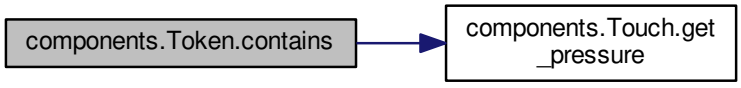
range_min, minimum of the token range range_max, maximum of the token range total_tokens total number of tokens to split range into token_index, integer between 0 and total_tokens-1 indicating into which range this token falls

6.24.3 Member Function Documentation

6.24.3.1 boolean components.Token.contains (Touch *touch*)

determines if a touch is within this token based on its pressure value this will return true if a touches pressure equals max or min, so if max of one token is min of another token, both will return true

Here is the call graph for this function:

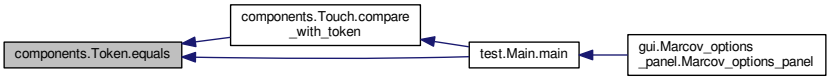


6.24.3.2 boolean components.Token.equals (Object *o_t*)

compares This token to another to determine if they are the same

Here is the call graph for this function:

Here is the caller graph for this function:



6.24.3.3 int components.Token.get_acceptable_wildcards (int *total_items*)

returns the acceptable number of wildcards

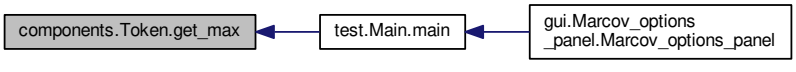
Parameters

total_items	is the total number of items in the distribution

6.24.3.4 double components.Token.get_max ( )

return the maximum

Here is the caller graph for this function:

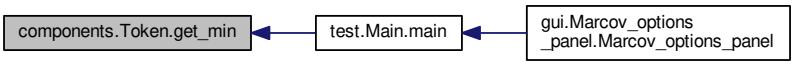


6.24.3.5 double components.Token.get_min ( )

returns true if there are more than an acceptable number of wildcards

return minimum

Here is the caller graph for this function:



6.24.3.6 int components.Token.get_total_wildcards ( )

returns the total number of wildcards

6.24.3.7 void components.Token.increment_high_wildcards ( )

adds the the number of high wildcards

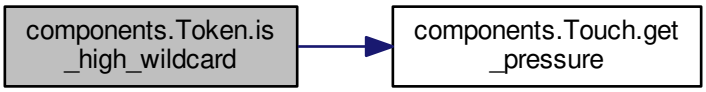
6.24.3.8 void components.Token.increment_low_wildcards ( )

adds the the number of high wildcards

6.24.3.9 boolean components.Token.is_high_wildcard (Touch *touch*)

determine if a touch is a high_wildcard

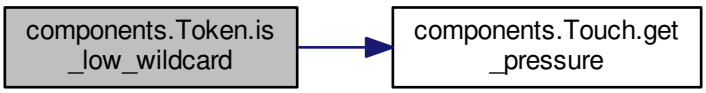
Here is the call graph for this function:



6.24.3.10 boolean components.Token.is_low_wildcard (Touch *touch*)

determine if a touch is a low wildcard

Here is the call graph for this function:



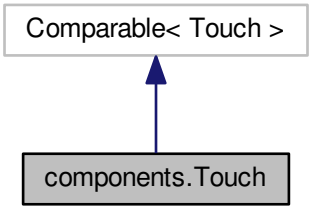
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Token.java

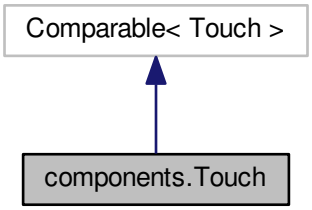
6.25 components.Touch Class Reference

This class represents a touch event.

Inheritance diagram for components.Touch:



Collaboration diagram for components.Touch:



Public Member Functions

- Touch (int keycode, double pressure, long timestamp)
- Touch (Touch t)

  copy constructor
- void set_probability (Window preceeding_window, double p)

  sets the probability that this touch succeeds a given sequence. Reccord the sequence and the probability
- double get_probability (Window preceeding_window)

  returns the probability of the touch occurring after a given window w. If the window does not exist return (TODO) currently returning 0
- double get_pressure ()
- int get_key ()
- long get_timestamp ()
- boolean compare_with_token (List< Token > tokens, Touch other_touch)

  compares the touches with the given token list.
- int hashCode ()

  implement hash function for the touch class
- int compareTo (Touch other_touch)

  compare touches to one another. return negative if this touch is less than other_touch
- String toString ()

6.25.1 Detailed Description

This class represents a touch event.

Touch evens have an associated key, pressure, and time from the raw data. From the Markov Chain we derive the probability and predecessor_window attributes. The probability is a value between 0 and 1 representing the percent change this token follows the predecessor window.

6.25.2 Constructor & Destructor Documentation

6.25.2.1 components.Touch.Touch (int *keycode,* double *pressure,* long *timestamp*)

6.25.2.2 components.Touch.Touch (Touch *t*)

copy constructor

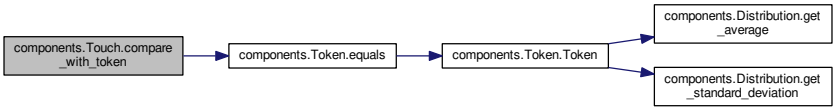
6.25.3 Member Function Documentation

6.25.3.1 boolean components.Touch.compare_with_token (List< Token > *tokens,* Touch *other_touch*)

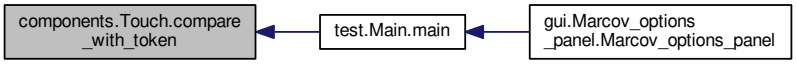
compares the touches with the given token list.

this function will return true if the touches are contained within the smae token

Here is the call graph for this function:



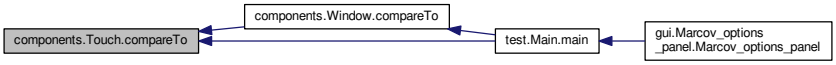
Here is the caller graph for this function:



6.25.3.2 int components.Touch.compareTo (Touch *other_touch*)

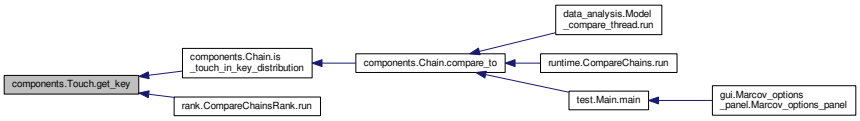
compare touches to one another. return negative if this touch is less than other_touch

Here is the caller graph for this function:



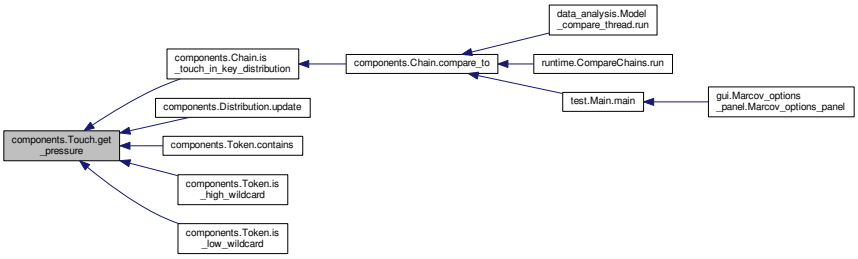
6.25.3.3 int components.Touch.get_key ( )

Here is the caller graph for this function:



6.25.3.4 double components.Touch.get_pressure ( )

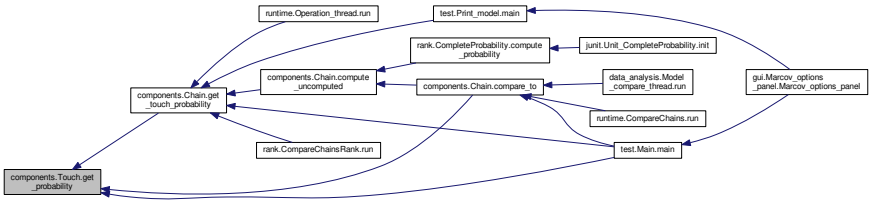
Here is the caller graph for this function:



6.25.3.5 double components.Touch.get_probability (Window *preceeding_window*)

returns the probability of the touch occurring after a given window w. If the window does not exist return (TODO) currently returning 0

Here is the caller graph for this function:



6.25.3.6 long components.Touch.get_timestamp ( )

6.25.3.7 int components.Touch.hashCode ( )

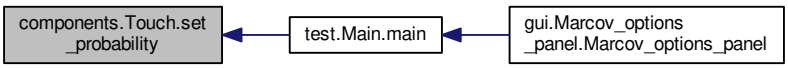
implement hash function for the touch class

Here is the caller graph for this function:

6.25.3.8 void components.Touch.set_probability (Window *preceeding_window,* double *p*)

sets the probability that this touch succeeds a given sequence. Reccord the sequence and the probability

Here is the caller graph for this function:



6.25.3.9 String components.Touch.toString ( )

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Touch.java

6.26 trie.Trie Class Reference

Implementation of Prefix Tree.

Classes

- class **TrieNode**

Public Member Functions

- Trie ()

  sets up the tree so that everything will be added to trienode root?
- Trie (Trie t)

  creates a copy trie
- void clear ()

  removes all elements from the trie
- void insertString (String s, int index)
- int occurrence_count (String s)

  retrieves the number of occurrences of a given string in the tree
- List< Integer > get_index_list (String s)

  returns a list of indexes containing the given window
- void printSorted (TrieNode node, String s)

  prints the elements in a sorted order

6.26.1 Detailed Description

Implementation of Prefix Tree.

This benefits the efficiency of the program. This class is used primarily to figure out information about windows needed in the probability computation.

6.26.2 Constructor & Destructor Documentation

6.26.2.1 trie.Trie.Trie ( )

sets up the tree so that everything will be added to trienode root?

6.26.2.2 trie.Trie.Trie (Trie *t*)

creates a copy trie

6.26.3 Member Function Documentation

6.26.3.1 void trie.Trie.clear ( )

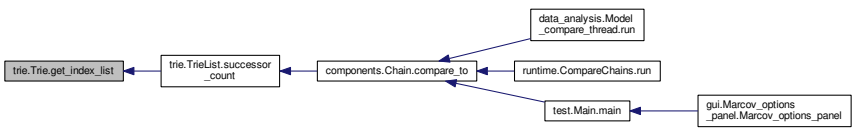
removes all elements from the trie

Here is the caller graph for this function:

6.26.3.2 List<Integer> trie.Trie.get_index_list (String *s*)

returns a list of indexes containing the given window

Here is the caller graph for this function:



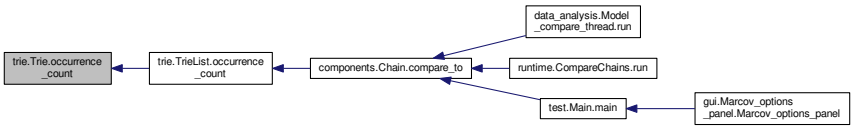
6.26.3.3 void trie.Trie.insertString (String *s*, int *index*)

Here is the caller graph for this function:

6.26.3.4 int trie.Trie.occurrence_count (String *s*)

retrieves the number of occurrences of a given string in the tree

Here is the caller graph for this function:



6.26.3.5 void trie.Trie.printSorted (TrieNode *node*, String *s*)

prints the elements in a sorted order

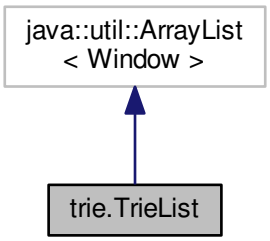
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/trie/Trie.java

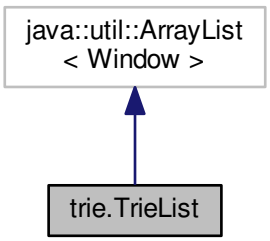
6.27 trie.TrieList Class Reference

Wrapper around Trie used to maintain an ordering among the stored elements.

Inheritance diagram for trie.TrieList:



Collaboration diagram for trie.TrieList:



Public Member Functions

- TrieList ()
- TrieList (TrieList t)
- boolean add (Window arg0)
- void add (int arg0, Window arg1)
- boolean addAll (Collection<?extends Window > arg0)
- boolean addAll (int arg0, Collection<?extends Window > arg1)
- void clear ()
- boolean remove (Object arg0)
- Window remove (int arg0)
- boolean removeAll (Collection<?> arg0)
- boolean retainAll (Collection<?> arg0)
- Window set (int arg0, Window arg1)
- int successor_count (List< Touch > successor_list, Window window, Touch touch)

  counts the number of times a given touch comes after a given window. in the given window, succesors list
- int occurrence_count (Window w)

  return the number of occurrences of w in window_list TODO I think this method needs to be faster.
- void set_tokens (List< Token > tokens)

  sets the tokens that will be used when encoding the window

6.27.1 Detailed Description

Wrapper around Trie used to maintain an ordering among the stored elements.

This class uses some additional space to store elements in both an ArrayList and the prefix tree. NOTE: This was done for speed of implementation. It would be good if in the future only a prefix tree was used.

6.27.2 Constructor & Destructor Documentation

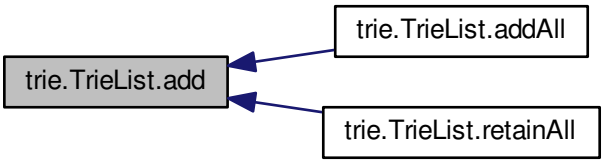
6.27.2.1 trie.TrieList.TrieList ( )

6.27.2.2 trie.TrieList.TrieList (TrieList *t*)

6.27.3 Member Function Documentation

6.27.3.1 boolean trie.TrieList.add (Window *arg0*)

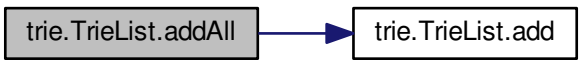
Here is the caller graph for this function:



6.27.3.2 void trie.TrieList.add (int *arg0,* Window *arg1*)

6.27.3.3 boolean trie.TrieList.addAll (Collection<?extends Window > *arg0*)

Here is the call graph for this function:



6.27.3.4 boolean trie.TrieList.addAll (int *arg0*, Collection<?extends Window > *arg1*)

Here is the call graph for this function:

6.27.3.5 void trie.TrieList.clear ( )

Here is the call graph for this function:

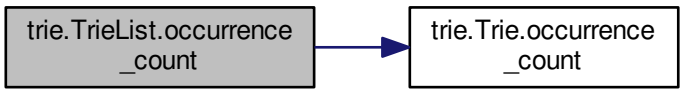
Here is the caller graph for this function:

6.27.3.6 int trie.TrieList.occurrence_count (Window *w*)

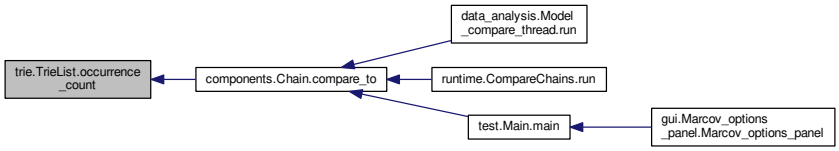
return the number of occurrences of w in window_list TODO I think this method needs to be faster.

Storing windows in a prefix tree would allow for this

Here is the call graph for this function:



Here is the caller graph for this function:



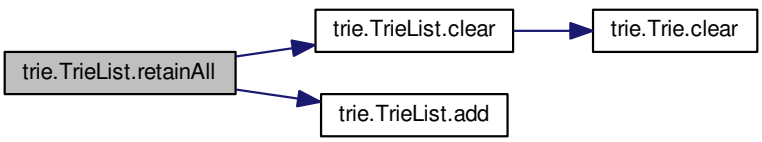
6.27.3.7 boolean trie.TrieList.remove (Object *arg0*)

6.27.3.8 Window trie.TrieList.remove (int *arg0*)

6.27.3.9 boolean trie.TrieList.removeAll (Collection<?> *arg0*)

6.27.3.10 boolean trie.TrieList.retainAll (Collection<?> *arg0*)

Here is the call graph for this function:

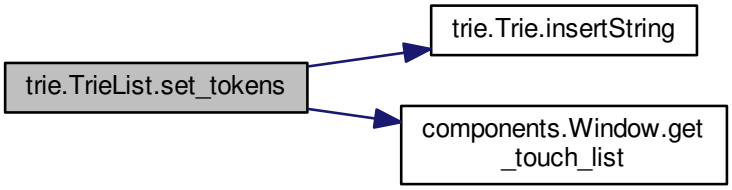


6.27.3.11 Window trie.TrieList.set (int *arg0,* Window *arg1*)

6.27.3.12 void trie.TrieList.set_tokens (List< Token > *tokens*)

sets the tokens that will be used when encoding the window

Here is the call graph for this function:

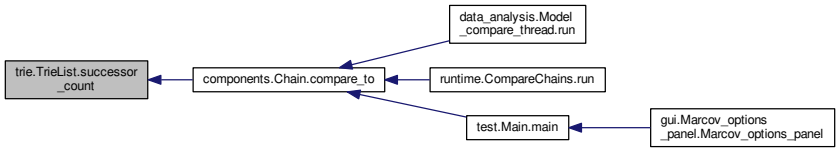


6.27.3.13 int trie.TrieList.successor_count (List< Touch > *successor_list,* Window *window,* Touch *touch*)

counts the number of times a given touch comes after a given window. in the given window, succesors list

Here is the call graph for this function:

Here is the caller graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/trie/TrieList.java

6.28 components.Token.Type Enum Reference

specify the type of token we want to build

Public Attributes

- linear
- keycode_mu
- combined

6.28.1 Detailed Description

specify the type of token we want to build

6.28.2 Member Data Documentation

6.28.2.1 components.Token.Type.combined

6.28.2.2 components.Token.Type.keycode_mu

6.28.2.3 components.Token.Type.linear

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Token.java

6.29 junit.Unit_CompareChainsRank Class Reference

goal is to test compare chains rank functionality

Public Member Functions

- void init ()
- void test_authentication_probability ()

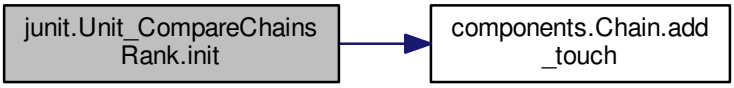
6.29.1 Detailed Description

goal is to test compare chains rank functionality

6.29.2 Member Function Documentation

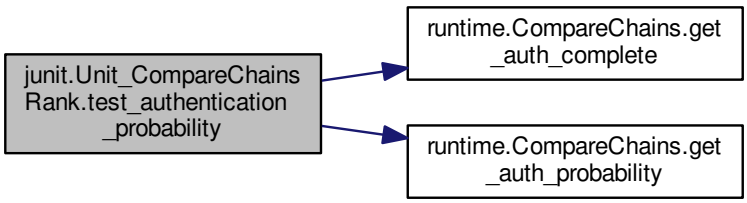
6.29.2.1 void junit.Unit_CompareChainsRank.init ( )

Here is the call graph for this function:



6.29.2.2 void junit.Unit_CompareChainsRank.test_authentication_probability ( )

Here is the call graph for this function:



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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/junit/Unit_CompareChainsRank.java

6.30 junit.Unit_CompleteProbability Class Reference

unit test demonstrating how to compute probility

Public Member Functions

- void init ()
- void test_replica_distribution ()

  test different properties of replica chain to see if this works as expected.

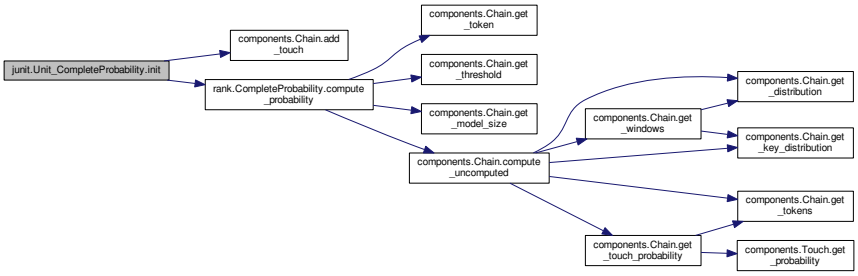
6.30.1 Detailed Description

unit test demonstrating how to compute probility

6.30.2 Member Function Documentation

6.30.2.1 void junit.Unit_CompleteProbability.init ( )

Here is the call graph for this function:

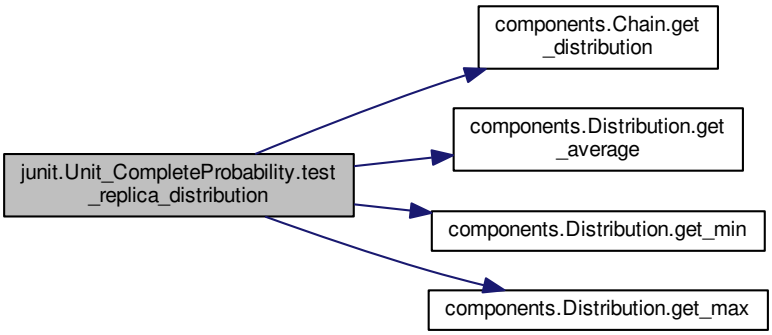


6.30.2.2 void junit.Unit_CompleteProbability.test_replica_distribution ( )

test different properties of replica chain to see if this works as expected.

Replica chain should contain the probabilities for when window is equal to 1.

Here is the call graph for this function:



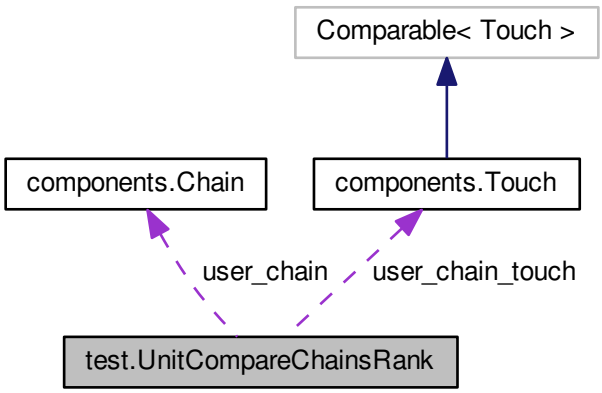
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/junit/Unit_CompleteProbability.java

6.31 test.UnitCompareChainsRank Class Reference

JUnit test for testing PageRank version of compairason Not that the PageRank implementation is not currently functional.

Collaboration diagram for test.UnitCompareChainsRank:



Public Member Functions

- void init ()
- void test_chain_to_graph ()

  tests chain_to_graph method to make sure the chain is converted to a StateGraph correctly.
- void test_touch_index ()

  make sure touch index returns the correct index in the list
- void test_touch_window ()

  make sure the touch_window() returns the correct window in chain.
- void test ()

  example test

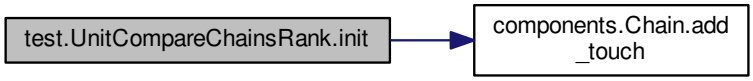
6.31.1 Detailed Description

JUnit test for testing PageRank version of compairason Not that the PageRank implementation is not currently functional.

6.31.2 Member Function Documentation

6.31.2.1 void test.UnitCompareChainsRank.init ( )

Here is the call graph for this function:



6.31.2.2 void test.UnitCompareChainsRank.test ( )

example test

6.31.2.3 void test.UnitCompareChainsRank.test_chain_to_graph ( )

tests chain_to_graph method to make sure the chain is converted to a StateGraph correctly.

6.31.2.4 void test.UnitCompareChainsRank.test_touch_index ( )

make sure touch index returns the correct index in the list

6.31.2.5 void test.UnitCompareChainsRank.test_touch_window ( )

make sure the touch_window() returns the correct window in chain.

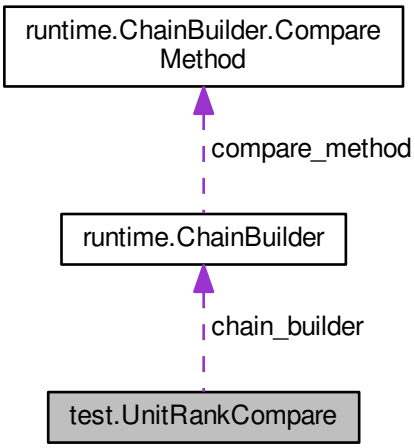
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/UnitCompareChainsRank.java

6.32 test.UnitRankCompare Class Reference

Test the compairason with ranks.

Collaboration diagram for test.UnitRankCompare:



Public Member Functions

- void init ()
- void test_compare_correct ()

  checks that the probabilities are correct
- void test_auth_probability ()

  check the test that the compare vectors are correct
- void test ()

  example test

6.32.1 Detailed Description

Test the compairason with ranks.

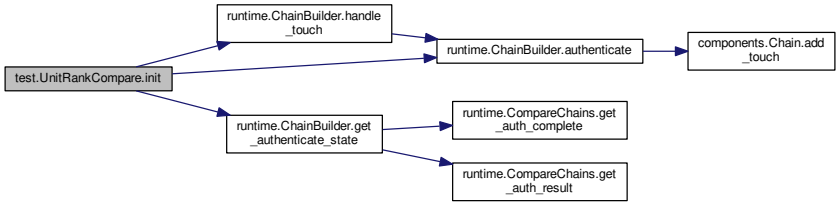
Author

element

6.32.2 Member Function Documentation

6.32.2.1 void test.UnitRankCompare.init ( )

Here is the call graph for this function:



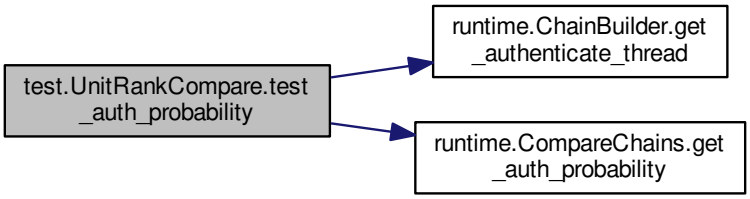
6.32.2.2 void test.UnitRankCompare.test ( )

example test

6.32.2.3 void test.UnitRankCompare.test_auth_probability ( )

check the test that the compare vectors are correct

Here is the call graph for this function:



6.32.2.4 void test.UnitRankCompare.test_compare_correct ( )

checks that the probabilities are correct

Here is the call graph for this function:

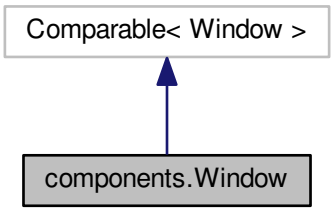
The documentation for this class was generated from the following file:

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/UnitRankCompare.java

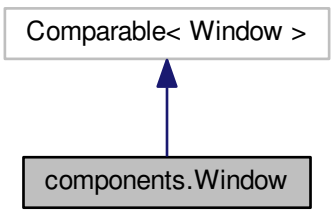
6.33 components.Window Class Reference

This class will store and provide functions for a single window within the model.

Inheritance diagram for components.Window:



Collaboration diagram for components.Window:



Public Member Functions

- Window (List< Touch > touches)
- Window (Window w)

  copy constructor
- boolean compare_with_token (List< Token > tokens, Window other_window)

  used for compairason of windows with a given token set.
- int size ()

  returns the number of touches in the window
- List< Touch > get_touch_list ()

  returns the window in the form of a touch list
- int hashCode ()

  implement a hash function which returns the hash of the current window
- int compareTo (Window other_window)

  compare this window to another window. Return negative if this window is less than the other window. Comparason is based on touches' pressure. Returns 0 if they are equal.
- String toString ()

6.33.1 Detailed Description

This class will store and provide functions for a single window within the model.

Windows are a list of n touches for a window of size n. When this class is used, The token which comes after the window is stored. It is this token which comes after the window which we compute the probability for.

6.33.2 Constructor & Destructor Documentation

6.33.2.1 components.Window.Window (List< Touch > *touches*)

6.33.2.2 components.Window.Window (Window *w*)

copy constructor

6.33.3 Member Function Documentation

6.33.3.1 boolean components.Window.compare_with_token (List< Token > *tokens,* Window *other_window*)

used for compairason of windows with a given token set.

return true if this window is equal to auth window.

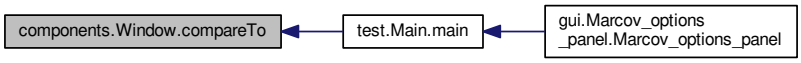
Here is the caller graph for this function:

6.33.3.2 int components.Window.compareTo (Window *other_window*)

compare this window to another window. Return negative if this window is less than the other window. Comparason is based on touches' pressure. Returns 0 if they are equal.

Here is the call graph for this function:

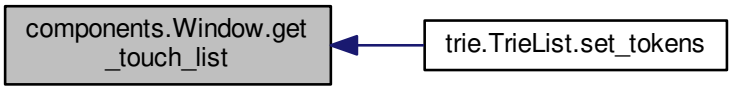
Here is the caller graph for this function:



6.33.3.3 List<Touch> components.Window.get_touch_list ( )

returns the window in the form of a touch list

Here is the caller graph for this function:



6.33.3.4 int components.Window.hashCode ( )

implement a hash function which returns the hash of the current window

6.33.3.5 int components.Window.size ( )

returns the number of touches in the window

6.33.3.6 String components.Window.toString ( )

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

- /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/Window.java

Chapter 7

File Documentation

7.1 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/↩ Chain.java File Reference

Classes

- class components.Chain

  Markov Chain built using keyboard tokens.

Packages

- package components

7.2 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/↩ Distribution.java File Reference

Classes

- class components.Distribution

  Used to compute and store max, min, std_deviation, and average for a list of Touch.

Packages

- package components

7.3 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/↩ Token.java File Reference

Classes

- class components.Token

  This class represents a token within the model.
- enum components.Token.Type

  specify the type of token we want to build

Packages

- package components

7.4 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/↩ Touch.java File Reference

Classes

- class components.Touch

  This class represents a touch event.

Packages

- package components

7.5 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/components/↩ Window.java File Reference

Classes

- class components.Window

  This class will store and provide functions for a single window within the model.

Packages

- package components

7.6 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/↩ Model_compare.java File Reference

Classes

- class data_analysis.Model_compare

  Analysis class used to compare and analyze data gathered from users.

Packages

- package data_analysis

7.7 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/↩ Model_compare_thread.java File Reference

Classes

- class data_analysis.Model_compare_thread

  Compare Markov Chains on their own thread.

Packages

- package data_analysis

7.8 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/data_analysis/↩ Statistics.java File Reference

Classes

- class data_analysis.Statistics

  Generates statistics on results generated by model_compare.java.

Packages

- package data_analysis

7.9 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_↩ console_panel.java File Reference

Classes

- class gui.Marcov_console_panel

  Displays messages printed to stdout.

Packages

- package gui

7.10 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_↩ file_display_panel.java File Reference

Classes

- class gui.Marcov_file_display_panel

  Displays files relavant to test code.

Packages

- package gui

7.11 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_frame.java File Reference

Classes

- class gui.Marcov_frame

  Display frame to contain buttons for running test code and panels to view results.

Packages

- package gui

7.12 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/Marcov_options_panel.java File Reference

Classes

- class gui.Marcov_options_panel

Packages

- package gui

7.13 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/gui/StartGUI.java File Reference

Classes

- class gui.StartGUI

  GUI useful for testing.

Packages

- package gui

7.14 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/junit/Unit_↩ CompareChainsRank.java File Reference

Classes

- class junit.Unit_CompareChainsRank

  goal is to test compare chains rank functionality

Packages

- package junit

7.15 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/junit/Unit_↩ CompleteProbability.java File Reference

Classes

- class junit.Unit_CompleteProbability

  unit test demonstrating how to compute probility

Packages

- package junit

7.16 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/rank/Compare↩ ChainsRank.java File Reference

Classes

- class rank.CompareChainsRank

  Use PageRank algorithm (library) to compare chains.

Packages

- package rank

7.17 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/rank/Complete↩ Probability.java File Reference

Classes

- class rank.CompleteProbability

  This class computes probability in a different way from what is contained in the Chain class.

Packages

- package rank

7.18 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/ChainBuilder.java File Reference

Classes

- class runtime.ChainBuilder

  Wrapper around Chain used to make using the model easier in a real application.
- enum runtime.ChainBuilder.State
- enum runtime.ChainBuilder.CompareMethod

Packages

- package runtime

7.19 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/CompareChains.java File Reference

Classes

- class runtime.CompareChains

  Use the compare method of the Chain class to determine an authetnication probability between 0 and 1.

Packages

- package runtime

7.20 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/runtime/Operation_thread.java File Reference

Classes

- class runtime.Operation_thread

  UNUSED.
- enum runtime.Operation_thread.Computation

Packages

- package runtime

7.21 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Main.java File Reference

Classes

- class test.Main

  This class is used to test that the model is being built correctly.
- enum test.Main.TestFiles.PressureAmount
- enum test.Main.TestFiles.Distribution
- enum test.Main.TestFiles.Concentration

Packages

- package test

7.22 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Print_model.java File Reference

Classes

- class test.Print_model

  This class will print out the model constructed form the designated file.

Packages

- package test

7.23 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/UnitCompareChainsRank.java File Reference

Classes

- class test.UnitCompareChainsRank

  JUnit test for testing PageRank version of compairason Not that the PageRank implementation is not currently functional.

Packages

- package test

7.24 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/UnitRankCompare.java File Reference

Classes

- class test.UnitRankCompare

  Test the compairason with ranks.

Packages

- package test

7.25 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/test/Utilities.java File Reference

7.26 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/trie/Trie.java File Reference

Classes

- class trie.Trie

  Implementation of Prefix Tree.
- class **trie.Trie.TrieNode**

Packages

- package trie

7.27 /home/element/PUF/Keyboard/java_scripts/java_marcov_model/src/trie/TrieList.java File Reference

Classes

- class trie.TrieList

  Wrapper around Trie used to maintain an ordering among the stored elements.

Packages

- package trie

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