epiworld

0.0-1

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Chapter 1

Main Page

1.1 epiworld

This C++ template-header-only library provides a general framework for epidemiologic simulation. The main features of the library are:

1. Four key classes: `Model`, `Person`, `Tool`, and `Virus`.
2. The model features a social networks of `Persons`.
3. `Persons` can have multiple `Tools` as a defense system.
4. `Tools` can reduce contagion rate, transmissibility, death rates, and improve recovery rates.
5. `Viruses` can mutate (generating new variants).
6. `Models` can feature multiple states, e.g., `HEALTHY`, `SUSCEPTIBLE`, etc.
7. `Models` can have an arbitrary number of parameters.
8. **REALLY FAST** About 6.5 Million person/day simulations per second.

1.2 Hello world

Here is a simple SIRS model implemented with

```
#include "../include/epiworld/epiworld.hpp"
using namespace epiworld;
int main()
{
        // Creating a model
    Model<> model;
    // Adding the tool and virus
    Virus<> virus("covid 19");
    virus.set_post_immunity(1.0);
    model.add_virus_n(virus, 5);

    Tool<> tool("vaccine");
    model.add_tool(tool, .5);
    // Generating a random pop
    model.pop_from_random(100000);
    // Initializing setting days and seed
    model.init(100, 123);
```

```
    // Running the model
    model.run();
    model.print();

}
```

And you should get something like the following:

```
Running the model...
_____________________________________________________________________________
|||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||| done.
_____________________________________________________________________________
SIMULATION STUDY
Population size    : 100000
Days (duration)    : 100 (of 100)
Number of variants : 1
Last run elapsed t : 280.00ms
Rewiring           : off
Virus(es):
 - covid 19 (baseline prevalence: 5 seeds)
Tool(s):
 - vaccine (baseline prevalence: 50.00%)
Model parameters:
Distribution of the population at time 100:
 - Total healthy (S)   :   99995 -> 97390
 - Total recovered (S) :       0 -> 2554
 - Total infected (I)  :       5 -> 56
 - Total removed (R)   :       0 -> 0
(S): Susceptible, (I): Infected, (R): Recovered
_____________________________________________________________________________
```

Which took about 0.280 seconds.

1.2.1 Tools

1.2.2 Contagion

Susceptible individuals can acquire a virus from any of their infected connections. The probability that susceptible individual `i` gets the virus `v` from individual `j` depends on how three things:

1. The transmissibility of the virus, Pv in [0,1],
2. The contagion reduction factor of `i`, Cr in [0,1], and
3. The host's transmission reduction factor, Tr [0,1].

The last two are computed from `i` and `j`'s tools. Ultimately, the probability of `i` getting virus `v` from `j` equals:

```
P(Virus v) = Pv * (1 - Cr) *(1 - Tr)
```

Nonetheless, the default behavior of the simulation model is to assume that individuals can acquire only one disease at a time, if any. This way, the actual probability is:

```
P(Virus v| at most one virus) = Prcond(i,v,j)
```

The latter is calculated using Bayes' rule

```
Prcond(i,v,j) = P(at most one virus|Virus v) * P(Variant v) / P(at most one virus)
              = P(Only Virus v)/P(Virus v) * P(Virus v) / P(at most one virus)
              = P(Only Virus v)/P(at most one virus)
```

Where

```
P(Vnly Virus V)      = P(Virus V) * Prod(m!=V) (1 - P(Virus m))
P(at most one virus) = P(None) + Sum(k in viruses) P(Virus k) * Prod(m != k) (1 - P(Virus m))
P(None)              = Prod(k in Viruses) (1 - P(Virus k))
```

This way, viruses with higher transmissibility will be more likely to be acquired when competing with other variants.

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

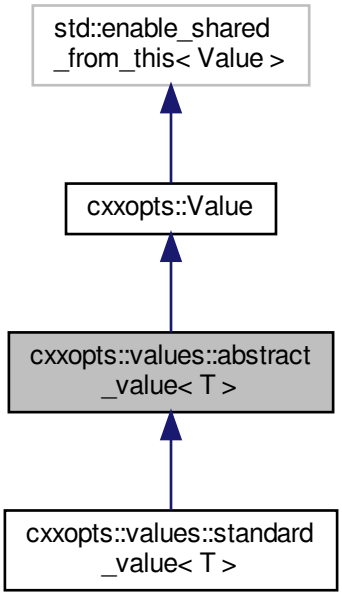
Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

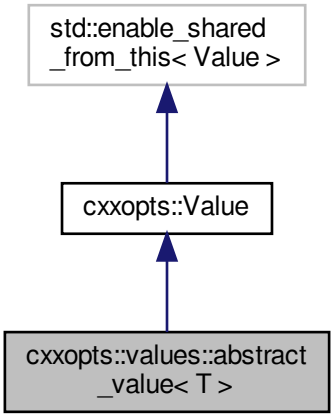
Class Documentation

4.1 cxxopts::values::abstract_value< T > Class Template Reference

Inheritance diagram for cxxopts::values::abstract_value< T >:



Collaboration diagram for cxxopts::values::abstract_value< T >:



Public Member Functions

- **abstract_value** (T *t)
- abstract_value & **operator=** (const abstract_value &)=default
- **abstract_value** (const abstract_value &rhs)
- void **parse** (const std::string &text) const override
- bool **is_container** () const override
- void **parse** () const override
- bool **has_default** () const override
- bool **has_implicit** () const override
- std::shared_ptr< Value > **default_value** (const std::string &value) override
- std::shared_ptr< Value > **implicit_value** (const std::string &value) override
- std::shared_ptr< Value > **no_implicit_value** () override
- std::string **get_default_value** () const override
- std::string **get_implicit_value** () const override
- bool **is_boolean** () const override
- const T & **get** () const

Protected Attributes

- std::shared_ptr< T > **m_result** {}
- T * **m_store** {}
- bool **m_default** = false
- bool **m_implicit** = false
- std::string **m_default_value** {}
- std::string **m_implicit_value** {}

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

- include/cxxopts/cxxopts.hpp

4.2 AdjList Class Reference

Public Member Functions

- AdjList (const std::vector< unsigned int > &source, const std::vector< unsigned int > &target, bool directed, int min_id=-1, int max_id=-1)

  Construct a new Adj List object.
- void **read_edgelist** (std::string fn, int skip=0, bool directed=true, int min_id=-1, int max_id=-1)
- std::map< unsigned int, unsigned int > **operator()** (unsigned int i) const
- void **print** (unsigned int limit=20u) const
- unsigned int **get_id_max** () const
- unsigned int **get_id_min** () const
- size_t **vcount** () const
- size_t **ecount** () const
- std::map< unsigned int, std::map< unsigned int, unsigned int > > & **get_dat** ()
- bool **is_directed** () const

4.2.1 Constructor & Destructor Documentation

4.2.1.1 AdjList()

```
AdjList::AdjList (
            const std::vector< unsigned int > & source,
            const std::vector< unsigned int > & target,
            bool directed,
            int min_id = -1,
            int max_id = -1 )  [inline]
```

Construct a new Adj List object.

It will create an adjacency list object with `maxid - minid + 1` nodes. If min_id and max_id are not specified (both < 0), then the program will try to figure them out automatically by looking at the range of the observed ids.

Parameters

source	Unsigned int vector with the source
target	Unsigned int vector with the target
directed	Bool true if the network is directed
min_id	int min id.
max_id	int max id.

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

- include/epiworld/adjlist-bones.hpp
- include/epiworld/adjlist-meat.hpp

4.3 cxxopts::values::parser_tool::ArguDesc Struct Reference

Public Attributes

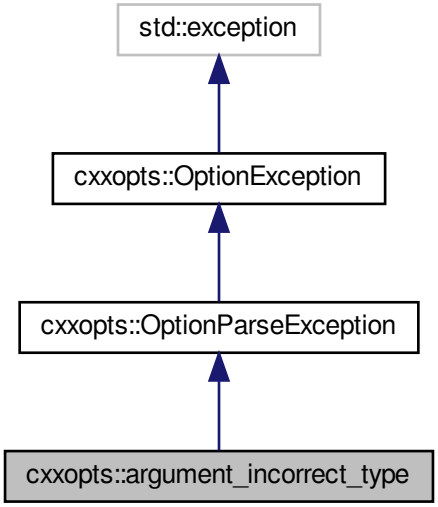
- std::string **arg_name** = ""
- bool **grouping** = false
- bool **set_value** = false
- std::string **value** = ""

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

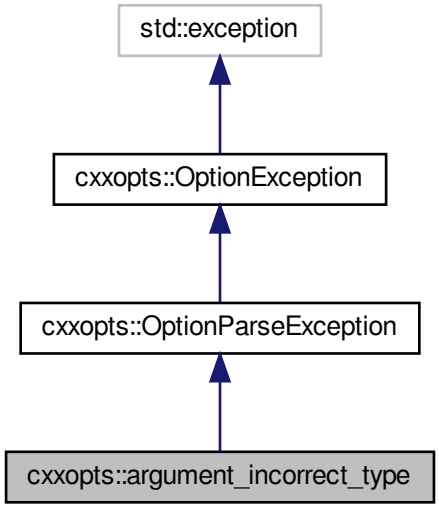
- include/cxxopts/cxxopts.hpp

4.4 cxxopts::argument_incorrect_type Class Reference

Inheritance diagram for cxxopts::argument_incorrect_type:



Collaboration diagram for cxxopts::argument_incorrect_type:



Public Member Functions

- **argument_incorrect_type** (const std::string &arg)

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

- include/cxxopts/cxxopts.hpp

4.5 DataBase< TSeq > Class Template Reference

Statistical data about the process.

`#include <database-bones.hpp>`

Public Member Functions

- **DataBase** (int freq=1)
- void record_variant (Virus< TSeq > *v)

  Registering a new variant.
- void **set_seq_hasher** (std::function< std::vector< int >(TSeq)> fun)
- void **set_model** (Model< TSeq > &m)
- Model< TSeq > * **get_model** ()
- void **record** ()
- const std::vector< TSeq > & **get_sequence** () const
- const std::vector< int > & **get_nexposed** () const

- size_t **size** () const
- void **up_exposed** (Virus< TSeq > *v, epiworld_fast_uint new_status)
- void **down_exposed** (Virus< TSeq > *v, epiworld_fast_uint prev_status)
- void **state_change** (epiworld_fast_uint prev_status, epiworld_fast_uint new_status)
- void **record_transition** (epiworld_fast_uint from, epiworld_fast_uint to)
- int get_today_total (std::string what) const

  Get recorded information from the model.
- int **get_today_total** (epiworld_fast_uint what) const
- void **get_today_total** (std::vector< std::string > *status=nullptr, std::vector< int > *counts=nullptr) const
- void **get_today_variant** (std::vector< std::string > &status, std::vector< int > &id, std::vector< int > &counts) const
- void **get_hist_total** (std::vector< int > *date, std::vector< std::string > *status, std::vector< int > *counts) const
- void **get_hist_variant** (std::vector< int > &date, std::vector< int > &id, std::vector< std::string > &status, std::vector< int > &counts) const
- void write_data (std::string fn_variant_info, std::string fn_variant_hist, std::string fn_total_hist, std::string fn_transmission, std::string fn_transition) const

  @]
- void **record_transmission** (int i, int j, int variant)
- size_t **get_nvariants** () const
- void **reset** ()
- void **set_user_data** (std::vector< std::string > names)
- void **add_user_data** (std::vector< epiworld_double > x)
- void **add_user_data** (unsigned int j, epiworld_double x)
- UserData< TSeq > & **get_user_data** ()

Friends

- class **Model**< **TSeq** >

4.5.1 Detailed Description

template<**typename TSeq**>
class DataBase< **TSeq** >

Statistical data about the process.

Template Parameters

TSeq	

4.5.2 Member Function Documentation

4.5.2.1 get_today_total()

```
template<typename TSeq >
int DataBase< TSeq >::get_today_total (
```

```
            std::string what ) const  [inline]
```

Get recorded information from the model.

Parameters

what	std::string, The status, e.g., 0, 1, 2, ...

Returns

In `get_today_total`, the current counts of `what`.

In `get_today_variant`, the current counts of `what` for each variant.

In `get_hist_total`, the time series of `what`

In `get_hist_variant`, the time series of what for each variant.

In `get_hist_total_date` and `get_hist_variant_date` the corresponding dates @[

4.5.2.2 record_variant()

```
template<typename TSeq >
void DataBase< TSeq >::record_variant (
            Virus< TSeq > * v )  [inline]
```

Registering a new variant.

Parameters

v	Pointer to the new variant. Since variants are originated in the host, the numbers simply move around. From the parent variant to the new variant. And the total number of infected does not change.

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

- include/epiworld/database-bones.hpp
- include/epiworld/database-meat.hpp

4.6 cxxopts::HelpGroupDetails Struct Reference

Public Attributes

- std::string **name** {}
- std::string **description** {}
- std::vector< HelpOptionDetails > **options** {}

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

- include/cxxopts/cxxopts.hpp

4.7 cxxopts::HelpOptionDetails Struct Reference

Public Attributes

- std::string **s**
- std::string **l**
- String **desc**
- bool **has_default**
- std::string **default_value**
- bool **has_implicit**
- std::string **implicit_value**
- std::string **arg_help**
- bool **is_container**
- bool **is_boolean**

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

- include/cxxopts/cxxopts.hpp

4.8 cxxopts::values::parser_tool::IntegerDesc Struct Reference

Public Attributes

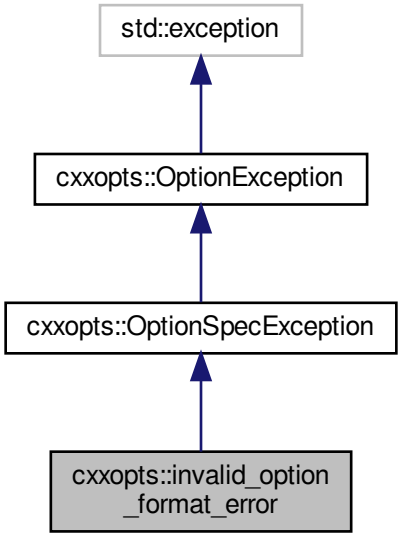
- std::string **negative** = ""
- std::string **base** = ""
- std::string **value** = ""

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

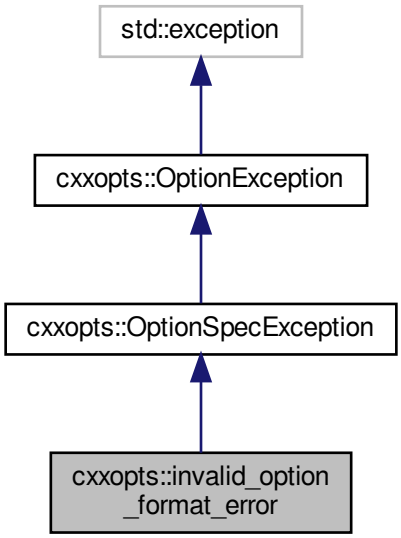
- include/cxxopts/cxxopts.hpp

4.9 cxxopts::invalid_option_format_error Class Reference

Inheritance diagram for cxxopts::invalid_option_format_error:



Collaboration diagram for cxxopts::invalid_option_format_error:



Public Member Functions

- **invalid_option_format_error** (const std::string &format)

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

- include/cxxopts/cxxopts.hpp

4.10 cxxopts::ParseResult::Iterator Class Reference

Public Types

- using **iterator_category** = std::forward_iterator_tag
- using **value_type** = KeyValue
- using **difference_type** = void
- using **pointer** = const KeyValue *
- using **reference** = const KeyValue &

Public Member Functions

- **Iterator** (const Iterator &)=default
- **Iterator** (const ParseResult *pr, bool end=false)
- Iterator & **operator++** ()
- Iterator **operator++** (int)
- bool **operator==** (const Iterator &other) const
- bool **operator!=** (const Iterator &other) const
- const KeyValue & **operator*** ()
- const KeyValue * **operator->** ()

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

- include/cxxopts/cxxopts.hpp

4.11 cxxopts::KeyValue Class Reference

Public Member Functions

- **KeyValue** (std::string key_, std::string value_)
- CXXOPTS_NODISCARD const std::string & **key** () const
- CXXOPTS_NODISCARD const std::string & **value** () const
- template<typename T >
  T **as** () const

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

- include/cxxopts/cxxopts.hpp

4.12 LFMCMC< TData > Class Template Reference

Likelihood-Free Markov Chain Monte Carlo.

`#include <lfmcmc.hpp>`

Public Member Functions

- void **run** (VEC(epiworld_double) param_init, size_t n_samples_, epiworld_double epsilon_)
- **LFMCMC** (TData &observed_data_)
- void **set_observed_data** (TData &observed_data_)
- void **set_proposal_fun** (FUN< void(VEC(epiworld_double)&, LFMCMC< TData > *)> fun)
- void **set_simulation_fun** (FUN< TData(VEC(epiworld_double)&, LFMCMC< TData > *)> fun)
- void **set_summary_fun** (FUN< VEC(epiworld_double)(TData &, LFMCMC< TData > *)> fun)
- void **set_kernel_fun** (FUN< epiworld_double(VEC(epiworld_double)&, epiworld_double, LFMCMC< TData > *)> fun)
- void set_rand_engine (std::mt19937 &eng)

  Random number generation.
- std::mt19937 * **get_rand_endgine** ()
- void **seed** (unsigned int s)
- void **set_rand_gamma** (epiworld_double alpha, epiworld_double beta)
- epiworld_double **runif** ()
- epiworld_double **rnorm** ()
- epiworld_double **rnorm** (epiworld_double mean, epiworld_double sd)
- epiworld_double **rgamma** ()
- epiworld_double **rgamma** (epiworld_double alpha, epiworld_double beta)
- const size_t get_n_samples ()

  @]
- const size_t **get_n_statistics** ()
- const size_t **get_n_parameters** ()
- const epiworld_double **get_epsilon** ()
- const **VEC** (epiworld_double) &get_params_now()
- const **VEC** (epiworld_double) &get_params_prev()
- const **VEC** (epiworld_double) &get_params_init()
- const **VEC** (epiworld_double) &get_statistics_obs()
- const **VEC** (epiworld_double) &get_statistics_hist()
- const **VEC** (bool) &get_statistics_accepted()
- const **VEC** (epiworld_double) &get_posterior_lf_prob()
- const **VEC** (epiworld_double) &get_acceptance_prob()
- const **VEC** (epiworld_double) &get_drawn_prob()
- **VEC** (TData) *get_sampled_data()

4.12.1 Detailed Description

template<typename TData>
class LFMCMC< TData >

Likelihood-Free Markov Chain Monte Carlo.

Template Parameters

TData	Type of data that is generated

4.12.2 Member Function Documentation

4.12.2.1 set_rand_engine()

```
template<typename TData >
void LFMCMC< TData >::set_rand_engine (
            std::mt19937 & eng )  [inline]
```

Random number generation.

Parameters

eng	@[

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

- include/epiworld/math/lfmcmc.hpp

4.13 Location< TSeq > Class Template Reference

Public Member Functions

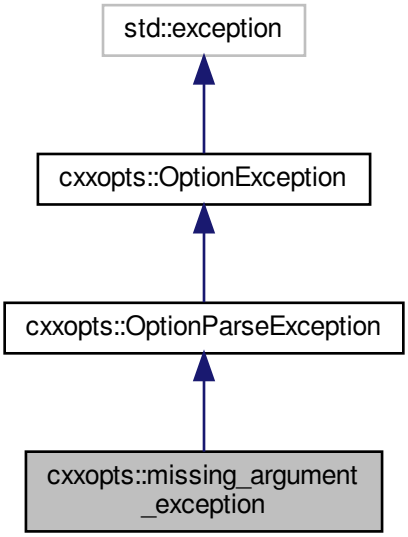
- add_person (Person< TSeq > &p)
  @]
- **add_person** (Person< TSeq > *p)
- size_t **count** () const
- void **reset** ()

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

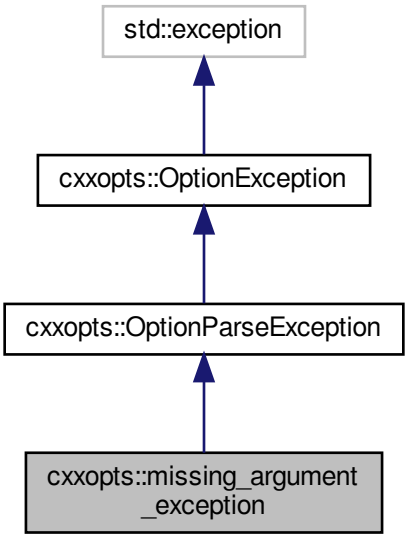
- include/epiworld/location-bones.hpp

4.14 cxxopts::missing_argument_exception Class Reference

Inheritance diagram for cxxopts::missing_argument_exception:



Collaboration diagram for cxxopts::missing_argument_exception:



Public Member Functions

- **missing_argument_exception** (const std::string &option)

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

- include/cxxopts/cxxopts.hpp

4.15 Model< TSeq > Class Template Reference

Public Member Functions

- **Model** (const Model< TSeq > &m)
- **Model** (Model< TSeq > &&m)
- Model< TSeq > & **operator=** (const Model< TSeq > &m)
- void **clone_population** (std::vector< Person< TSeq > > &p, std::map< int, int > &p_ids, bool &d, Model< TSeq > *m=nullptr) const
- void **clone_population** (const Model< TSeq > &m)
- void set_backup ()

  Set the backup object.
- void **restore_backup** ()
- DataBase< TSeq > & get_db ()

  @]
- epiworld_double & **operator()** (std::string pname)
- size_t **size** () const
- void set_rand_engine (std::mt19937 &eng)

  Random number generation.
- std::mt19937 * **get_rand_endgine** ()
- void **seed** (unsigned int s)
- void **set_rand_gamma** (epiworld_double alpha, epiworld_double beta)
- epiworld_double **runif** ()
- epiworld_double **rnorm** ()
- epiworld_double **rnorm** (epiworld_double mean, epiworld_double sd)
- epiworld_double **rgamma** ()
- epiworld_double **rgamma** (epiworld_double alpha, epiworld_double beta)
- void add_virus (Virus< TSeq > v, epiworld_double preval)

  @]
- void **add_virus_n** (Virus< TSeq > v, unsigned int preval)
- void **add_tool** (Tool< TSeq > t, epiworld_double preval)
- void **add_tool_n** (Tool< TSeq > t, unsigned int preval)
- void pop_from_adjlist (std::string fn, int skip=0, bool directed=false, int min_id=-1, int max_id=-1)

  Accessing population of the model.
- void **pop_from_adjlist** (AdjList al)
- bool **is_directed** () const
- std::vector< Person< TSeq > > * **get_population** ()
- void **pop_from_random** (unsigned int n=1000, unsigned int k=5, bool d=false, epiworld_double p=.01)
- void init (unsigned int ndays, unsigned int seed)

  @]
- void **update_status** ()
- void **mutate_variant** ()
- void **next** ()

- void **run** ()
- void **run_multiple** (unsigned int nexperiments, std::function< void(Model< TSeq > *)> fun, bool reset, bool verbose)
- void record_variant (Virus< TSeq > *v)

  @]
- int **get_nvariants** () const
- unsigned int **get_ndays** () const
- unsigned int **get_n_replicates** () const
- void **set_ndays** (unsigned int ndays)
- bool **get_verbose** () const
- void **verbose_off** ()
- void **verbose_on** ()
- int **today** () const
- void set_rewire_fun (std::function< void(std::vector< Person< TSeq >> *, Model< TSeq > *, epiworld_double)> fun)

  Rewire the network preserving the degree sequence.
- void **set_rewire_prop** (epiworld_double prop)
- epiworld_double **get_rewire_prop** () const
- void **rewire** ()
- void set_update_susceptible (UpdateFun< TSeq > fun)

  @]
- void **set_update_exposed** (UpdateFun< TSeq > fun)
- void **set_update_removed** (UpdateFun< TSeq > fun)
- void write_data (std::string fn_variant_info, std::string fn_variant_hist, std::string fn_total_hist, std::string fn_transmission, std::string fn_transition) const

  Wrapper of `DataBase::write_data`
- void write_edgelist (std::string fn) const

  Export the network data in edgelist form.
- void **write_edgelist** (std::vector< unsigned int > &source, std::vector< unsigned int > &target) const
- std::map< std::string, epiworld_double > & params ()

  @]
- void reset ()

  Reset the model.
- void **print** () const
- Model< TSeq > && **clone** () const
- void add_status_susceptible (epiworld_fast_uint s, std::string lab)

  Adds extra statuses to the model.
- void **add_status_exposed** (epiworld_fast_uint s, std::string lab)
- void **add_status_removed** (epiworld_fast_uint s, std::string lab)
- void **add_status_susceptible** (std::string lab)
- void **add_status_exposed** (std::string lab)
- void **add_status_removed** (std::string lab)
- const std::vector< epiworld_fast_uint > & **get_status_susceptible** () const
- const std::vector< epiworld_fast_uint > & **get_status_exposed** () const
- const std::vector< epiworld_fast_uint > & **get_status_removed** () const
- const std::vector< std::string > & **get_status_susceptible_labels** () const
- const std::vector< std::string > & **get_status_exposed_labels** () const
- const std::vector< std::string > & **get_status_removed_labels** () const
- void **print_status_codes** () const
- epiworld_fast_uint **get_default_susceptible** () const
- epiworld_fast_uint **get_default_exposed** () const
- epiworld_fast_uint **get_default_removed** () const
- void reset_status_codes (std::vector< epiworld_fast_uint > codes, std::vector< std::string > names, bool verbose=true)

@]

- epiworld_double add_param (epiworld_double initial_val, std::string pname)

  Setting and accessing parameters from the model.
- epiworld_double **set_param** (std::string pname)
- epiworld_double **get_param** (unsigned int k)
- epiworld_double **get_param** (std::string pname)
- epiworld_double **par** (unsigned int k)
- epiworld_double **par** (std::string pname)
- void get_elapsed (std::string unit="auto", epiworld_double *last_elapsed=nullptr, epiworld_double *total_↩ elapsed=nullptr, std::string *unit_abbr=nullptr, bool print=true) const

  @]
- void set_user_data (std::vector< std::string > names)

  Set the user data object.
- void **add_user_data** (unsigned int j, epiworld_double x)
- void **add_user_data** (std::vector< epiworld_double > x)
- UserData< TSeq > & **get_user_data** ()
- void add_global_action (std::function< void(Model< TSeq > *)> fun, int date)

  @]
- void **run_global_actions** ()
- void **clear_status_set** ()
- void **toggle_visited** ()
- void **queuing_on** ()
- void **queuing_off** ()
- bool **is_queuing_on** () const
- Queue< TSeq > & **get_queue** ()

Public Attributes

- std::vector< epiworld_double > **array_double_tmp**
- std::vector< Virus< TSeq > * > **array_virus_tmp**
- epiworld_double * **p0**
- epiworld_double * **p1**
- epiworld_double * **p2**
- epiworld_double * **p3**
- epiworld_double * **p4**
- epiworld_double * **p5**
- epiworld_double * **p6**
- epiworld_double * **p7**
- epiworld_double * **p8**
- epiworld_double * **p9**
- epiworld_double * **p10**
- epiworld_double * **p11**
- epiworld_double * **p12**
- epiworld_double * **p13**
- epiworld_double * **p14**
- epiworld_double * **p15**
- epiworld_double * **p16**
- epiworld_double * **p17**
- epiworld_double * **p18**
- epiworld_double * **p19**
- epiworld_double * **p20**
- epiworld_double * **p21**
- epiworld_double * **p22**

- epiworld_double * **p23**
- epiworld_double * **p24**
- epiworld_double * **p25**
- epiworld_double * **p26**
- epiworld_double * **p27**
- epiworld_double * **p28**
- epiworld_double * **p29**
- epiworld_double * **p30**
- epiworld_double * **p31**
- epiworld_double * **p32**
- epiworld_double * **p33**
- epiworld_double * **p34**
- epiworld_double * **p35**
- epiworld_double * **p36**
- epiworld_double * **p37**
- epiworld_double * **p38**
- epiworld_double * **p39**
- unsigned int **npar_used** = 0u

Friends

- class **Person**< **TSeq** >
- class **DataBase**< **TSeq** >
- class **Queue**< **TSeq** >

4.15.1 Member Function Documentation

4.15.1.1 add_param()

```
template<typename TSeq = bool>
epiworld_double Model< TSeq >::add_param (
             epiworld_double initial_val,
             std::string pname )
```

Setting and accessing parameters from the model.

Tools can incorporate parameters included in the model. Internally, parameters in the tool are stored as pointers to an std::map<> of parameters in the model. Using the `unsigned int` method directly fetches the parameters in the order these were added to the tool. Accessing parameters via the `std::string` method involves searching the parameter directly in the std::map<> member of the model (so it is not recommended.)

The function `set_param()` can be used when the parameter already exists in the model.

The `par()` function members are aliases for `get_param()`.

Parameters

initial_val	
pname	Name of the parameter to add or to fetch

Returns

The current value of the parameter in the model. @[

4.15.1.2 add_status_susceptible()

```
template<typename TSeq = bool>
void Model< TSeq >::add_status_susceptible (
             epiworld_fast_uint s,
             std::string lab )
```

Adds extra statuses to the model.

Adding values of `s` that are already present in the model will result in an error.

The functions `get_status_*` return the current values for the statuses included in the model.

Parameters

s	`unsigned int` Code of the status
lab	`std::string` Name of the status.

Returns

`add_status*` returns nothing.

`get_status_*` returns a vector of pairs with the statuses and their labels. @[

4.15.1.3 init()

```
template<typename TSeq = bool>
void Model< TSeq >::init (
             unsigned int ndays,
             unsigned int seed )
```

@]

Functions to run the model

Parameters

seed	Seed to be used for Pseudo-RNG.
ndays	Number of days (steps) of the simulation.
fun	In the case of `run_multiple`, a function that is called after each experiment. @[

4.15.1.4 pop_from_adjlist()

```
template<typename TSeq = bool>
void Model< TSeq >::pop_from_adjlist (
            std::string fn,
            int skip = 0,
            bool directed = false,
            int min_id = -1,
            int max_id = -1 )
```

Accessing population of the model.

Parameters

fn	std::string Filename of the edgelist file.
skip	int Number of lines to skip in `fn`.
directed	bool Whether the graph is directed or not.
min_id	int Minimum id number (if negative, the program will try to guess from the data.)
max_id	int Maximum id number (if negative, the program will try to guess from the data.)
al	AdjList to read into the model. @[

4.15.1.5 reset()

```
template<typename TSeq = bool>
void Model< TSeq >::reset ( )
```

Reset the model.

Resetting the model will:

- clear the database
- restore the population (if `set_backup()` was called before)
- re-distribute tools
- re-distribute viruses
- set the date to 0

4.15.1.6 reset_status_codes()

```
template<typename TSeq = bool>
void Model< TSeq >::reset_status_codes (
            std::vector< epiworld_fast_uint > codes,
            std::vector< std::string > names,
            bool verbose = true )
```

@]

Reset all the status codes of the model

The default values are those specified in the enum STATUS.

Parameters

codes	In the following order: Susceptible, Infected, Removed
names	Names matching the codes
verbose	When `true`, it will print the new mappings.

4.15.1.7 set_backup()

```
template<typename TSeq = bool>
void Model< TSeq >::set_backup ( )
```

Set the backup object.

`backup` can be used to restore the entire object after a run. This can be useful if the user wishes to have individuals start with the same network from the beginning. @[

4.15.1.8 set_rand_engine()

```
template<typename TSeq = bool>
void Model< TSeq >::set_rand_engine (
            std::mt19937 & eng )
```

Random number generation.

Parameters

eng	@[

4.15.1.9 set_rewire_fun()

```
template<typename TSeq = bool>
void Model< TSeq >::set_rewire_fun (
            std::function< void(std::vector< Person< TSeq >> *, Model< TSeq > *, epiworld↩
_double)> fun )
```

Rewire the network preserving the degree sequence.

This implementation assumes an undirected network, thus if {(i,j), (k,l)} -> {(i,l), (k,j)}, the reciprocal is also true, i.e., {(j,i), (l,k)} -> {(j,k), (l,i)}.

Parameters

proportion	Proportion of ties to be rewired.

Returns

A rewired version of the network. @[

4.15.1.10 set_user_data()

```
template<typename TSeq = bool>
void Model< TSeq >::set_user_data (
            std::vector< std::string > names )
```

Set the user data object.

Parameters

names	[@

4.15.1.11 write_data()

```
template<typename TSeq = bool>
void Model< TSeq >::write_data (
            std::string fn_variant_info,
            std::string fn_variant_hist,
            std::string fn_total_hist,
            std::string fn_transmission,
            std::string fn_transition ) const
```

Wrapper of DataBase::write_data

Parameters

fn_variant_info	Filename. Information about the variant.
fn_variant_hist	Filename. History of the variant.
fn_total_hist	Filename. Aggregated history (status)
fn_transmission	Filename. Transmission history.
fn_transition	Filename. Markov transition history.

4.15.1.12 write_edgelist()

```
template<typename TSeq = bool>
void Model< TSeq >::write_edgelist (
            std::string fn ) const
```

Export the network data in edgelist form.

Parameters

fn	std::string. File name.
source	Integer vector
target	Integer vector

When passing the source and target, the function will write the edgelist on those. [@

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

- include/epiworld/config.hpp
- include/epiworld/model-bones.hpp

4.16 cxxopts::Option Struct Reference

Public Member Functions

- **Option** (std::string opts, std::string desc, std::shared_ptr< const Value > value=::cxxopts::value< bool >(), std::string arg_help="")

Public Attributes

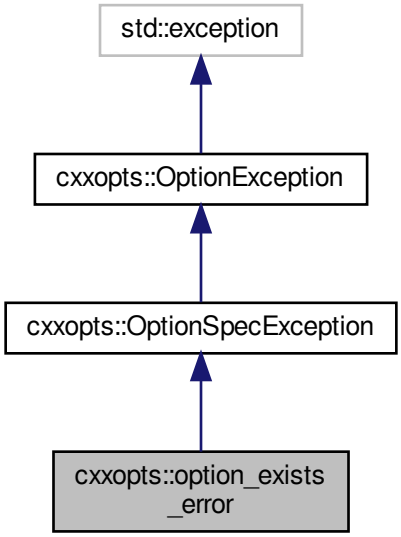
- std::string **opts_**
- std::string **desc_**
- std::shared_ptr< const Value > **value_**
- std::string **arg_help_**

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

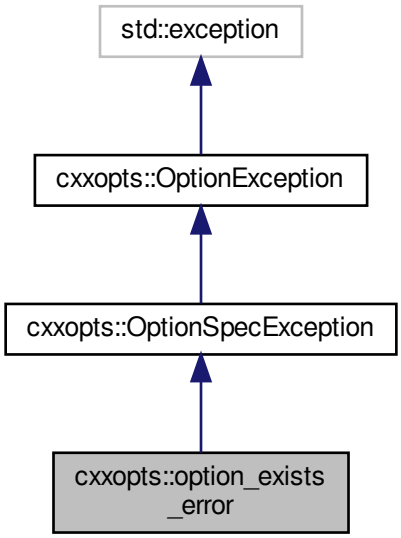
- include/cxxopts/cxxopts.hpp

4.17 cxxopts::option_exists_error Class Reference

Inheritance diagram for cxxopts::option_exists_error:



Collaboration diagram for cxxopts::option_exists_error:



Public Member Functions

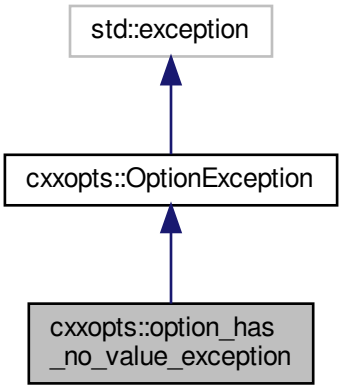
- **option_exists_error** (const std::string &option)

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

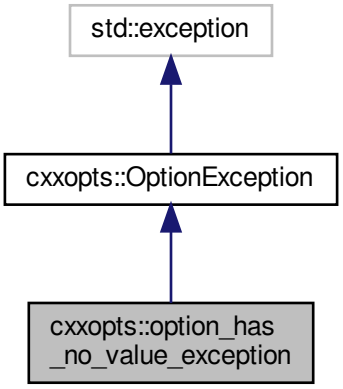
- include/cxxopts/cxxopts.hpp

4.18 cxxopts::option_has_no_value_exception Class Reference

Inheritance diagram for cxxopts::option_has_no_value_exception:



Collaboration diagram for cxxopts::option_has_no_value_exception:



Public Member Functions

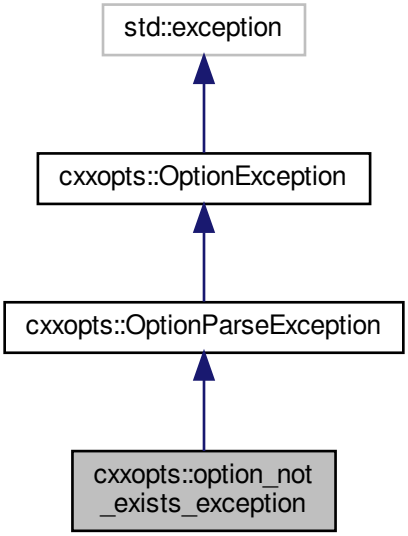
- **option_has_no_value_exception** (const std::string &option)

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

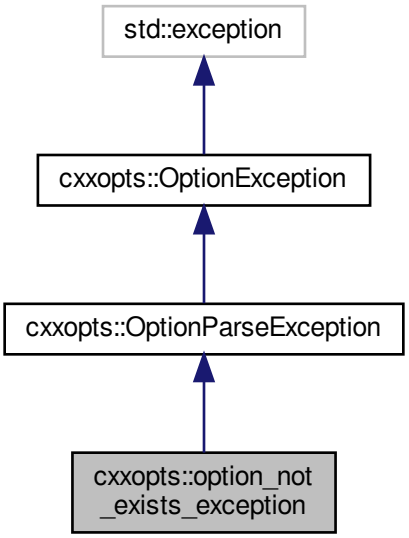
- include/cxxopts/cxxopts.hpp

4.19 cxxopts::option_not_exists_exception Class Reference

Inheritance diagram for cxxopts::option_not_exists_exception:



Collaboration diagram for cxxopts::option_not_exists_exception:



Public Member Functions

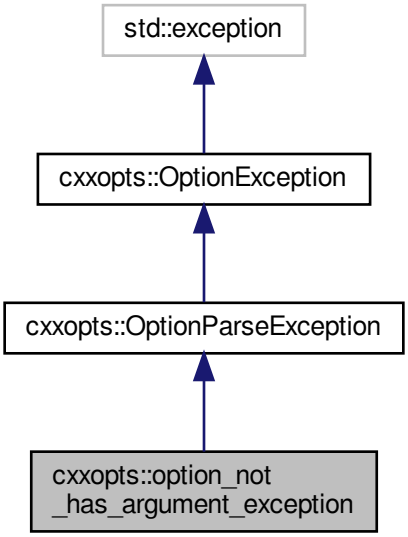
- **option_not_exists_exception** (const std::string &option)

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

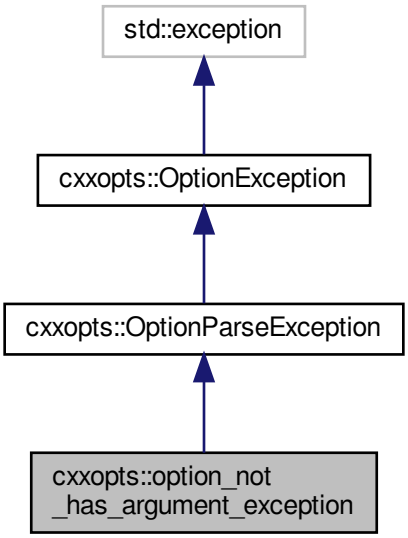
- include/cxxopts/cxxopts.hpp

4.20 cxxopts::option_not_has_argument_exception Class Reference

Inheritance diagram for cxxopts::option_not_has_argument_exception:



Collaboration diagram for cxxopts::option_not_has_argument_exception:



Public Member Functions

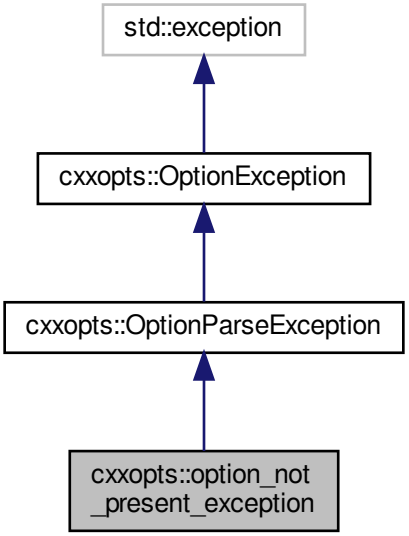
- **option_not_has_argument_exception** (const std::string &option, const std::string &arg)

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

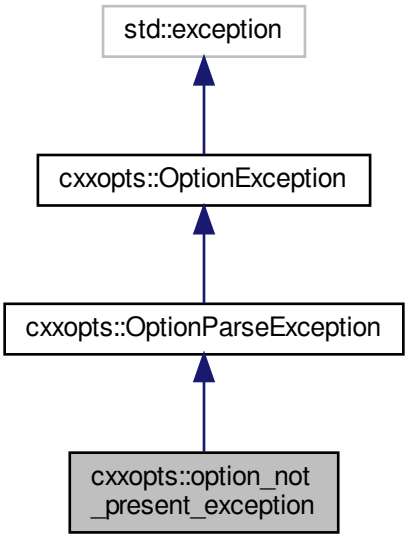
- include/cxxopts/cxxopts.hpp

4.21 cxxopts::option_not_present_exception Class Reference

Inheritance diagram for cxxopts::option_not_present_exception:



Collaboration diagram for cxxopts::option_not_present_exception:



Public Member Functions

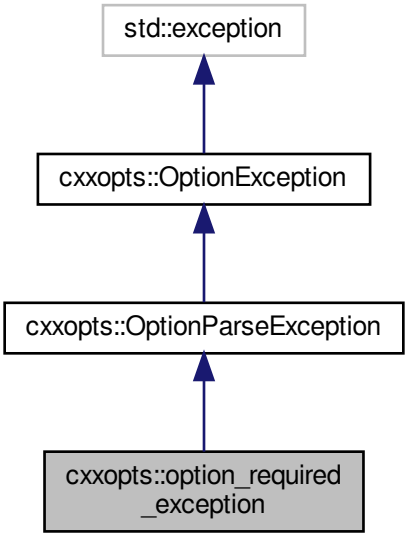
- **option_not_present_exception** (const std::string &option)

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

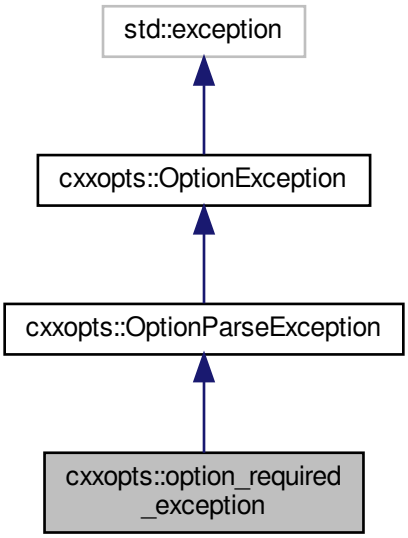
- include/cxxopts/cxxopts.hpp

4.22 cxxopts::option_required_exception Class Reference

Inheritance diagram for cxxopts::option_required_exception:



Collaboration diagram for cxxopts::option_required_exception:



Public Member Functions

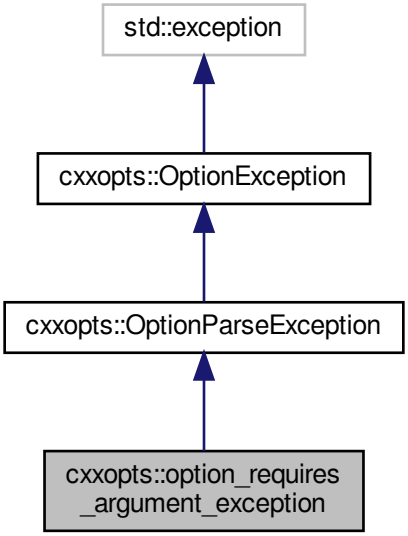
- **option_required_exception** (const std::string &option)

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

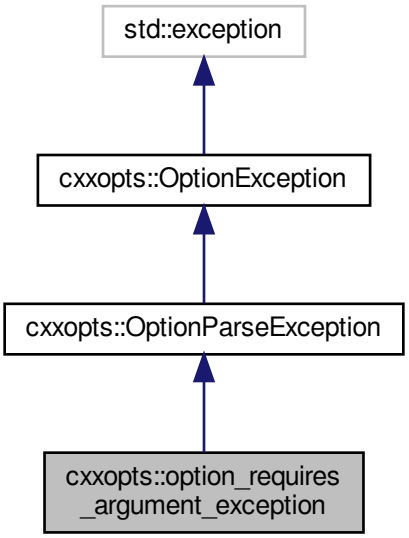
- include/cxxopts/cxxopts.hpp

4.23 cxxopts::option_requires_argument_exception Class Reference

Inheritance diagram for cxxopts::option_requires_argument_exception:



Collaboration diagram for cxxopts::option_requires_argument_exception:



Public Member Functions

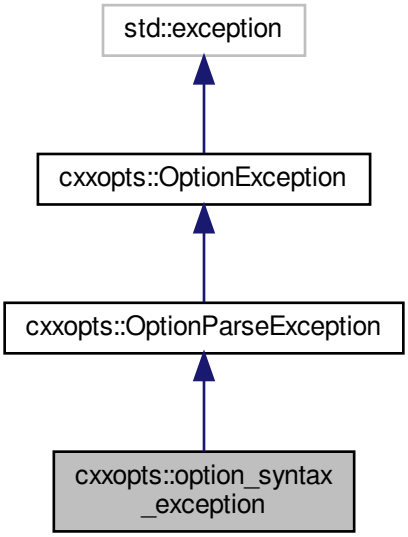
- **option_requires_argument_exception** (const std::string &option)

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

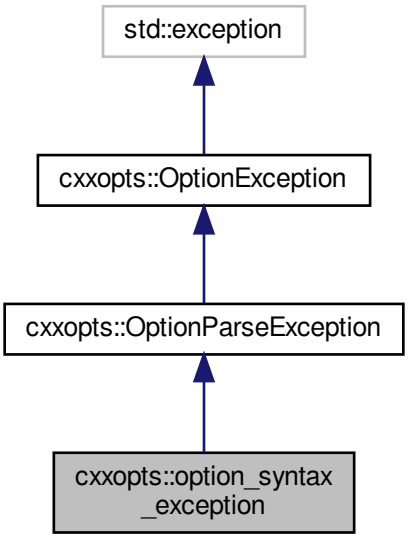
- include/cxxopts/cxxopts.hpp

4.24 cxxopts::option_syntax_exception Class Reference

Inheritance diagram for cxxopts::option_syntax_exception:



Collaboration diagram for cxxopts::option_syntax_exception:



Public Member Functions

- **option_syntax_exception** (const std::string &text)

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

- include/cxxopts/cxxopts.hpp

4.25 cxxopts::OptionAdder Class Reference

Public Member Functions

- **OptionAdder** (Options &options, std::string group)
- OptionAdder & **operator()** (const std::string &opts, const std::string &desc, const std::shared_ptr< const Value > &value=::cxxopts::value< bool >(), std::string arg_help="")

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

- include/cxxopts/cxxopts.hpp

4.26 cxxopts::OptionDetails Class Reference

Public Member Functions

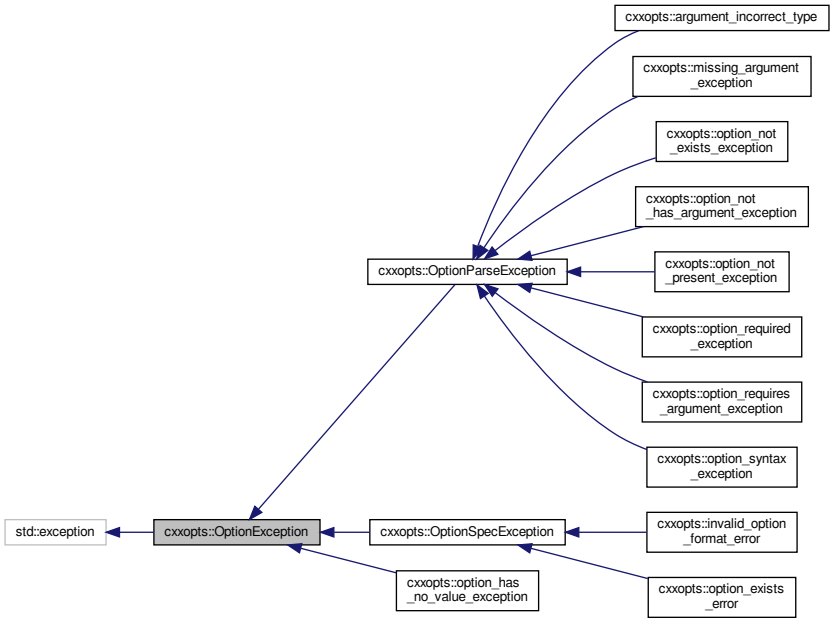
- **OptionDetails** (std::string short_, std::string long_, String desc, std::shared_ptr< const Value > val)
- **OptionDetails** (const OptionDetails &rhs)
- **OptionDetails** (OptionDetails &&rhs)=default
- CXXOPTS_NODISCARD const String & **description** () const
- CXXOPTS_NODISCARD const Value & **value** () const
- CXXOPTS_NODISCARD std::shared_ptr< Value > **make_storage** () const
- CXXOPTS_NODISCARD const std::string & **short_name** () const
- CXXOPTS_NODISCARD const std::string & **long_name** () const
- size_t **hash** () const

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

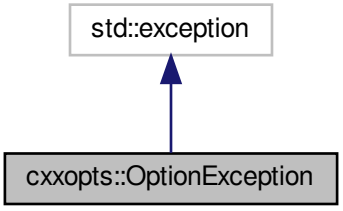
- include/cxxopts/cxxopts.hpp

4.27 cxxopts::OptionException Class Reference

Inheritance diagram for cxxopts::OptionException:



Collaboration diagram for cxxopts::OptionException:



Public Member Functions

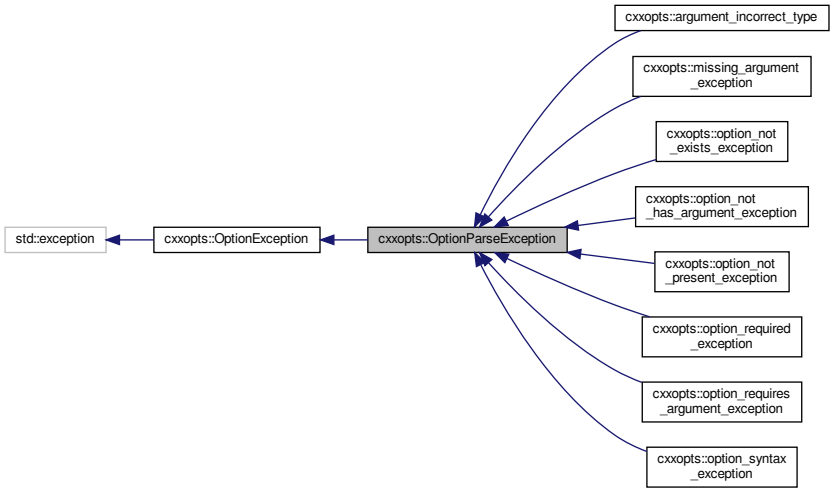
- **OptionException** (std::string message)
- CXXOPTS_NODISCARD const char ∗ **what** () const noexcept override

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

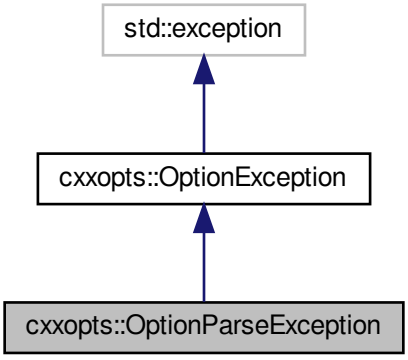
- include/cxxopts/cxxopts.hpp

4.28 cxxopts::OptionParseException Class Reference

Inheritance diagram for cxxopts::OptionParseException:



Collaboration diagram for cxxopts::OptionParseException:



Public Member Functions

- **OptionParseException** (const std::string &message)

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

- include/cxxopts/cxxopts.hpp

4.29 cxxopts::OptionParser Class Reference

Public Member Functions

- **OptionParser** (const OptionMap &options, const PositionalList &positional, bool allow_unrecognised)
- ParseResult **parse** (int argc, const char *const *argv)
- bool **consume_positional** (const std::string &a, PositionalListIterator &next)
- void **checked_parse_arg** (int argc, const char *const *argv, int &current, const std::shared_ptr< OptionDetails > &value, const std::string &name)
- void **add_to_option** (OptionMap::const_iterator iter, const std::string &option, const std::string &arg)
- void **parse_option** (const std::shared_ptr< OptionDetails > &value, const std::string &name, const std::string &arg="")
- void **parse_default** (const std::shared_ptr< OptionDetails > &details)
- void **parse_no_value** (const std::shared_ptr< OptionDetails > &details)

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

- include/cxxopts/cxxopts.hpp

4.30 cxxopts::Options Class Reference

Public Member Functions

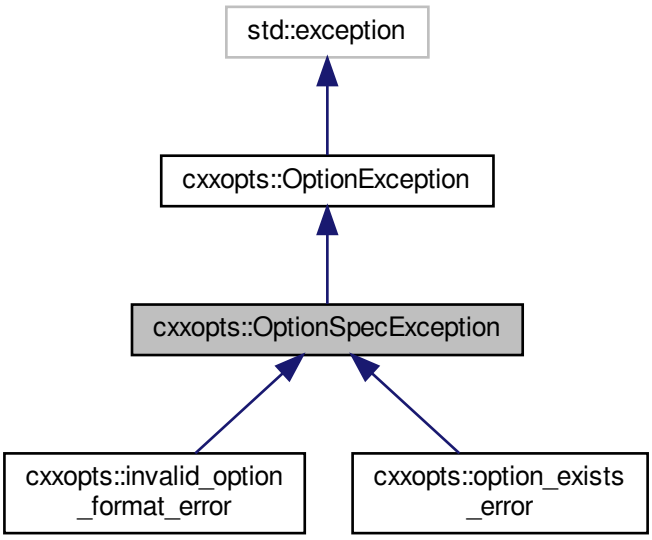
- **Options** (std::string program, std::string help_string="")
- Options & **positional_help** (std::string help_text)
- Options & **custom_help** (std::string help_text)
- Options & **show_positional_help** ()
- Options & **allow_unrecognised_options** ()
- Options & **set_width** (size_t width)
- Options & **set_tab_expansion** (bool expansion=true)
- ParseResult **parse** (int argc, const char *const *argv)
- OptionAdder **add_options** (std::string group="")
- void **add_options** (const std::string &group, std::initializer_list< Option > options)
- void **add_option** (const std::string &group, const Option &option)
- void **add_option** (const std::string &group, const std::string &s, const std::string &l, std::string desc, const std::shared_ptr< const Value > &value, std::string arg_help)
- void **parse_positional** (std::string option)
- void **parse_positional** (std::vector< std::string > options)
- void **parse_positional** (std::initializer_list< std::string > options)
- template<typename Iterator >
  void **parse_positional** (Iterator begin, Iterator end)
- std::string **help** (const std::vector< std::string > &groups={}) const
- std::vector< std::string > **groups** () const
- const HelpGroupDetails & **group_help** (const std::string &group) const
- const std::string & **program** () const

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

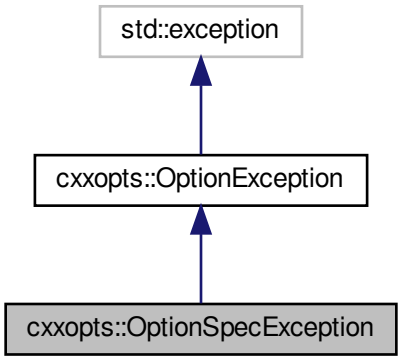
- include/cxxopts/cxxopts.hpp

4.31 cxxopts::OptionSpecException Class Reference

Inheritance diagram for cxxopts::OptionSpecException:



Collaboration diagram for cxxopts::OptionSpecException:



Public Member Functions

- **OptionSpecException** (const std::string &message)

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

- include/cxxopts/cxxopts.hpp

4.32 cxxopts::OptionValue Class Reference

Public Member Functions

- void **parse** (const std::shared_ptr< const OptionDetails > &details, const std::string &text)
- void **parse_default** (const std::shared_ptr< const OptionDetails > &details)
- void **parse_no_value** (const std::shared_ptr< const OptionDetails > &details)
- CXXOPTS_NODISCARD size_t **count** () const noexcept
- CXXOPTS_NODISCARD bool **has_default** () const noexcept
- template<typename T >
  const T & **as** () const

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

- include/cxxopts/cxxopts.hpp

4.33 cxxopts::ParseResult Class Reference

Classes

- class Iterator

Public Member Functions

- **ParseResult** (const ParseResult &)=default
- **ParseResult** (NameHashMap &&keys, ParsedHashMap &&values, std::vector< KeyValue > sequential, std::vector< KeyValue > default_opts, std::vector< std::string > &&unmatched_args)
- ParseResult & **operator=** (ParseResult &&)=default
- ParseResult & **operator=** (const ParseResult &)=default
- Iterator **begin** () const
- Iterator **end** () const
- size_t **count** (const std::string &o) const
- const OptionValue & **operator[ ]** (const std::string &option) const
- const std::vector< KeyValue > & **arguments** () const
- const std::vector< std::string > & **unmatched** () const
- const std::vector< KeyValue > & **defaults** () const
- const std::string **arguments_string** () const

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

- include/cxxopts/cxxopts.hpp

4.34 Person< TSeq > Class Template Reference

Public Member Functions

- void **init** (epiworld_fast_uint baseline_status)
- void **add_tool** (int d, Tool< TSeq > tool)
- void **add_virus** (Virus< TSeq > *virus)
- void **rm_virus** (Virus< TSeq > *virus)
- epiworld_double **get_susceptibility_reduction** (Virus< TSeq > *v)
- epiworld_double **get_transmission_reduction** (Virus< TSeq > *v)
- epiworld_double **get_recovery_enhancer** (Virus< TSeq > *v)
- epiworld_double **get_death_reduction** (Virus< TSeq > *v)
- int **get_id** () const
- unsigned int **get_index** () const
- std::mt19937 * **get_rand_endgine** ()
- Model< TSeq > * **get_model** ()
- Virus< TSeq > & **get_virus** (int i)
- PersonViruses< TSeq > & **get_viruses** ()
- Tool< TSeq > & **get_tool** (int i)
- PersonTools< TSeq > & **get_tools** ()
- void **mutate_variant** ()
- void **add_neighbor** (Person< TSeq > *p, bool check_source=true, bool check_target=true)
- std::vector< Person< TSeq > * > & **get_neighbors** ()
- void **update_status** ()
- void **update_status** (epiworld_fast_uint new_status)
- const epiworld_fast_uint & **get_status** () const
- const epiworld_fast_uint & **get_status_next** () const
- void **reset** ()
- void **set_update_susceptible** (UpdateFun< TSeq > fun)
- void **set_update_exposed** (UpdateFun< TSeq > fun)
- void **set_update_removed** (UpdateFun< TSeq > fun)
- bool **has_tool** (unsigned int t) const
- bool **has_tool** (std::string name) const
- bool **has_virus** (unsigned int t) const
- bool **has_virus** (std::string name) const
- bool **visited** () const
- void **toggle_visited** ()

Friends

- class **Model< TSeq >**
- class **Tool< TSeq >**
- class **Queue< TSeq >**

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

- include/epiworld/config.hpp
- include/epiworld/person-bones.hpp
- include/epiworld/person-meat.hpp

4.35 PersonTools< TSeq > Class Template Reference

List of tools available for the individual to.

`#include <persontools-bones.hpp>`

Public Member Functions

- void add_tool (int date, Tool< TSeq > tool)
  @]
- epiworld_double **get_susceptibility_reduction** (Virus< TSeq > *v)
- epiworld_double **get_transmission_reduction** (Virus< TSeq > *v)
- epiworld_double **get_recovery_enhancer** (Virus< TSeq > *v)
- epiworld_double **get_death_reduction** (Virus< TSeq > *v)
- void **set_susceptibility_reduction_mixer** (MixerFun< TSeq > fun)
- void **set_transmission_reduction_mixer** (MixerFun< TSeq > fun)
- void **set_recovery_enhancer_mixer** (MixerFun< TSeq > fun)
- void **set_death_reduction_mixer** (MixerFun< TSeq > fun)
- size_t **size** () const
- Tool< TSeq > & **operator()** (int i)
- Person< TSeq > * **get_person** ()
- Model< TSeq > * **get_model** ()
- void **reset** ()
- bool **has_tool** (unsigned int t) const
- bool **has_tool** (std::string name) const

Friends

- class **Person< TSeq >**
- class **Model< TSeq >**

4.35.1 Detailed Description

template<typename TSeq = bool>
class PersonTools< TSeq >

List of tools available for the individual to.

Template Parameters

TSeq	

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

- include/epiworld/config.hpp
- include/epiworld/persontools-bones.hpp
- include/epiworld/persontools-meat.hpp

4.36 PersonViruses< TSeq > Class Template Reference

Set of viruses in host.

`#include <personviruses-bones.hpp>`

Public Member Functions

- void **add_virus** (epiworld_fast_uint new_status, Virus< TSeq > v)
- size_t **size** () const
- int **size_active** () const
- Virus< TSeq > & **operator()** (int i)
- void **mutate** ()
- void **reset** ()
- void **deactivate** (Virus< TSeq > &v)
- Person< TSeq > * **get_host** ()
- bool **has_virus** (unsigned int v) const
- bool **has_virus** (std::string vname) const

Friends

- class **Person**< **TSeq** >
- class **Model**< **TSeq** >

4.36.1 Detailed Description

template<**typename TSeq = bool**>
class PersonViruses< **TSeq** >

Set of viruses in host.

Template Parameters

TSeq	

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

- include/epiworld/person-bones.hpp
- include/epiworld/personviruses-bones.hpp
- include/epiworld/personviruses-meat.hpp

4.37 Progress Class Reference

A simple progress bar.

`#include <progress.hpp>`

Public Member Functions

- **Progress** (int n_, int width_)
- void **start** ()
- void **next** ()
- void **end** ()

4.37.1 Detailed Description

A simple progress bar.

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

- include/epiworld/progress.hpp

4.38 Queue< TSeq > Class Template Reference

Controls which agents are verified at each step.

```
#include <queue-bones.hpp>
```

Public Member Functions

- void **operator+=** (Person< TSeq > *p)
- void **operator-=** (Person< TSeq > *p)
- epiworld_fast_int **operator[ ]** (unsigned int i) const
- void **set_model** (Model< TSeq > *m)
- void **update** ()

4.38.1 Detailed Description

template<typename TSeq = bool>
class Queue< TSeq >

Controls which agents are verified at each step.

The idea is that only agents who are either in an infected state or have an infected neighbor should be checked. Otherwise it makes no sense (no chance to recover or capture the disease).

Template Parameters

TSeq	

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

- include/epiworld/model-bones.hpp
- include/epiworld/queue-bones.hpp

4.39 RandGraph Class Reference

Public Member Functions

- **RandGraph** (int N_)
- void **init** (int s)
- void **set_rand_engine** (std::mt19937 &e)
- epiworld_double **runif** ()

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

- include/epiworld/random_graph.hpp

4.40 cxxopts::values::detail::SignedCheck< T, B > Struct Template Reference

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

- include/cxxopts/cxxopts.hpp

4.41 cxxopts::values::detail::SignedCheck< T, false > Struct Template Reference

Public Member Functions

- template<typename U >
  void **operator()** (bool, U, const std::string &) const

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

- include/cxxopts/cxxopts.hpp

4.42 cxxopts::values::detail::SignedCheck< T, true > Struct Template Reference

Public Member Functions

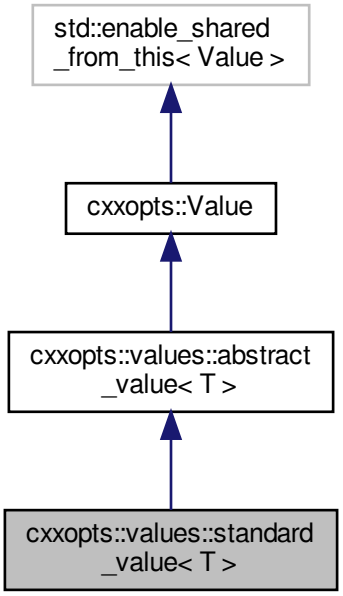
- template<typename U >
  void **operator()** (bool negative, U u, const std::string &text)

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

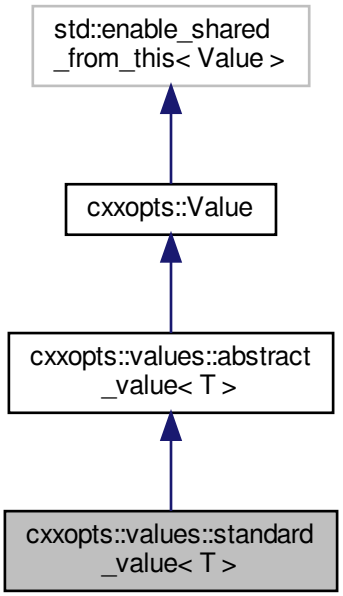
- include/cxxopts/cxxopts.hpp

4.43 cxxopts::values::standard_value< T > Class Template Reference

Inheritance diagram for cxxopts::values::standard_value< T >:



Collaboration diagram for cxxopts::values::standard_value< T >:



Public Member Functions

- CXXOPTS_NODISCARD std::shared_ptr< Value > **clone** () const override

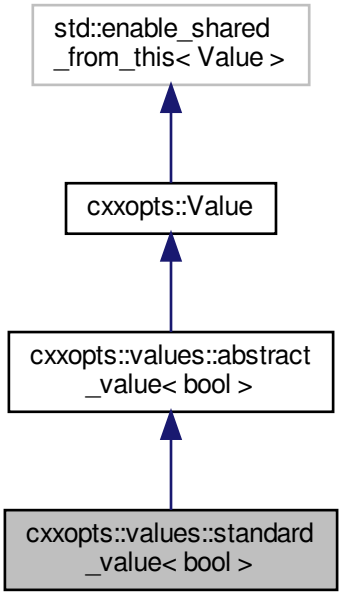
Additional Inherited Members

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

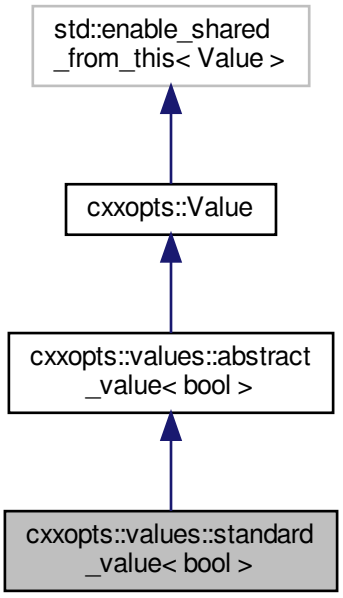
- include/cxxopts/cxxopts.hpp

4.44 cxxopts::values::standard_value< bool > Class Reference

Inheritance diagram for cxxopts::values::standard_value< bool >:



Collaboration diagram for cxxopts::values::standard_value< bool >:



Public Member Functions

- **standard_value** (bool *b)
- std::shared_ptr< Value > **clone** () const override

Additional Inherited Members

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

- include/cxxopts/cxxopts.hpp

4.45 Tool< TSeq > Class Template Reference

Tools for defending the host against the virus.

```
#include <tools-bones.hpp>
```

Public Member Functions

- **Tool** (std::string name="unknown tool")
- void **set_sequence** (TSeq d)
- void **set_sequence_unique** (TSeq d)
- void **set_sequence** (std::shared_ptr< TSeq > d)
- std::shared_ptr< TSeq > **get_sequence** ()
- TSeq & **get_sequence_unique** ()
- epiworld_double get_susceptibility_reduction (Virus< TSeq > *v)

  Get and set the tool functions.
- epiworld_double **get_transmission_reduction** (Virus< TSeq > *v)
- epiworld_double **get_recovery_enhancer** (Virus< TSeq > *v)
- epiworld_double **get_death_reduction** (Virus< TSeq > *v)
- void **set_susceptibility_reduction_fun** (ToolFun< TSeq > fun)
- void **set_transmission_reduction_fun** (ToolFun< TSeq > fun)
- void **set_recovery_enhancer_fun** (ToolFun< TSeq > fun)
- void **set_death_reduction_fun** (ToolFun< TSeq > fun)
- void **set_susceptibility_reduction** (epiworld_double *prob)
- void **set_transmission_reduction** (epiworld_double *prob)
- void **set_recovery_enhancer** (epiworld_double *prob)
- void **set_death_reduction** (epiworld_double *prob)
- void **set_susceptibility_reduction** (epiworld_double prob)
- void **set_transmission_reduction** (epiworld_double prob)
- void **set_recovery_enhancer** (epiworld_double prob)
- void **set_death_reduction** (epiworld_double prob)
- void set_name (std::string name)

  @]
- std::string **get_name** () const
- Person< TSeq > * **get_person** ()
- unsigned int **get_id** () const

Friends

- class **PersonTools< TSeq >**
- class **Person< TSeq >**
- class **Model< TSeq >**

4.45.1 Detailed Description

template<typename TSeq = bool>
class Tool< TSeq >

Tools for defending the host against the virus.

Template Parameters

TSeq	Type of sequence

4.45.2 Member Function Documentation

4.45.2.1 get_susceptibility_reduction()

```
template<typename TSeq >
epiworld_double Tool< TSeq >::get_susceptibility_reduction (
            Virus< TSeq > * v )  [inline]
```

Get and set the tool functions.

Parameters

v	The virus over which to operate
fun	the function to be used

Returns

epiworld_double @[

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

- include/epiworld/config.hpp
- include/epiworld/tools-bones.hpp
- include/epiworld/tools-meat.hpp

4.46 cxxopts::values::type_is_container< T > Struct Template Reference

Static Public Attributes

- static constexpr bool **value** = false

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

- include/cxxopts/cxxopts.hpp

4.47 cxxopts::values::type_is_container< std::vector< T > > Struct Template Reference

Static Public Attributes

- static constexpr bool **value** = true

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

- include/cxxopts/cxxopts.hpp

4.48 UserData< TSeq > Class Template Reference

Public Member Functions

- **UserData** (std::vector< std::string > names)
- void **add** (std::vector< epiworld_double > x)
- void **add** (unsigned int j, epiworld_double x)
- epiworld_double & **operator()** (unsigned int i, unsigned int j)
- epiworld_double & **operator()** (unsigned int i, std::string name)
- std::vector< std::string > & **get_names** ()
- std::vector< int > & **get_dates** ()
- std::vector< epiworld_double > & **get_data** ()
- void **get_all** (std::vector< std::string > *names=nullptr, std::vector< int > *date=nullptr, std::vector< epiworld_double > *data=nullptr)
- unsigned int **nrow** () const
- unsigned int **ncol** () const
- void **write** (std::string fn)
- void **print** () const

Friends

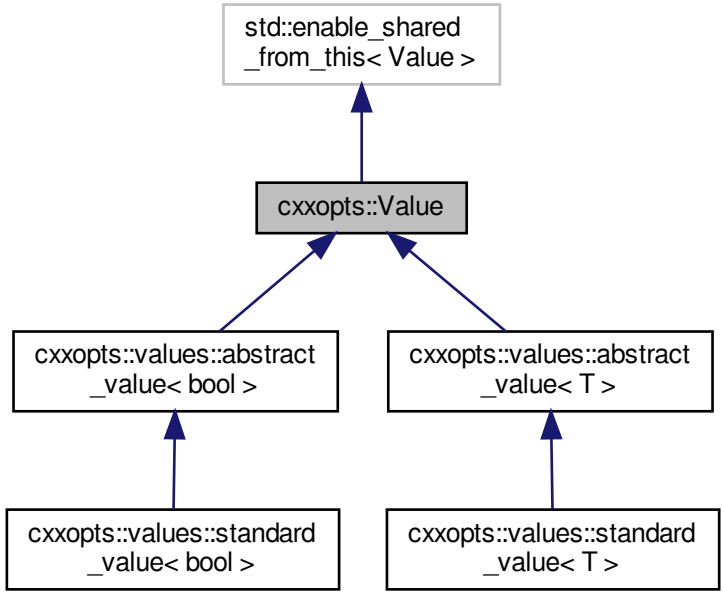
- class **Model**< **TSeq** >
- class **DataBase**< **TSeq** >

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

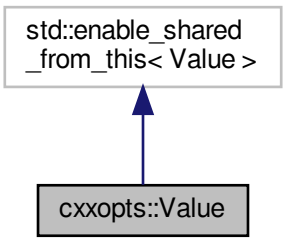
- include/epiworld/database-bones.hpp
- include/epiworld/userdata-bones.hpp
- include/epiworld/userdata-meat.hpp

4.49 cxxopts::Value Class Reference

Inheritance diagram for cxxopts::Value:



Collaboration diagram for cxxopts::Value:



Public Member Functions

- virtual std::shared_ptr< Value > **clone** () const =0
- virtual void **parse** (const std::string &text) const =0
- virtual void **parse** () const =0
- virtual bool **has_default** () const =0

- virtual bool **is_container** () const =0
- virtual bool **has_implicit** () const =0
- virtual std::string **get_default_value** () const =0
- virtual std::string **get_implicit_value** () const =0
- virtual std::shared_ptr< Value > **default_value** (const std::string &value)=0
- virtual std::shared_ptr< Value > **implicit_value** (const std::string &value)=0
- virtual std::shared_ptr< Value > **no_implicit_value** ()=0
- virtual bool **is_boolean** () const =0

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

- include/cxxopts/cxxopts.hpp

4.50 vecHasher< T > Struct Template Reference

Public Member Functions

- std::size_t **operator()** (std::vector< T > const &dat) const noexcept

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

- include/epiworld/misc.hpp

4.51 Virus< TSeq > Class Template Reference

Virus.

`#include <virus-bones.hpp>`

Public Member Functions

- **Virus** (std::string name="unknown virus")
- void **mutate** ()
- void **set_mutation** (MutFun< TSeq > fun)
- const TSeq * **get_sequence** ()
- void **set_sequence** (TSeq sequence)
- Person< TSeq > * **get_host** ()
- Model< TSeq > * **get_model** ()
- void **set_date** (int d)
- int **get_date** () const
- void **set_id** (int idx)
- int **get_id** () const
- bool **is_active** () const
- void **deactivate** ()
- epiworld_double get_prob_infecting ()

  Get and set the tool functions.
- epiworld_double **get_prob_recovery** ()

- epiworld_double **get_prob_death** ()
- void **post_recovery** ()
- void **set_post_recovery** (PostRecoveryFun< TSeq > fun)
- void **set_post_immunity** (epiworld_double prob)
- void **set_post_immunity** (epiworld_double *prob)
- void **set_prob_infecting_fun** (VirusFun< TSeq > fun)
- void **set_prob_recovery_fun** (VirusFun< TSeq > fun)
- void **set_prob_death_fun** (VirusFun< TSeq > fun)
- void **set_prob_infecting** (epiworld_double *prob)
- void **set_prob_recovery** (epiworld_double *prob)
- void **set_prob_death** (epiworld_double *prob)
- void set_name (std::string name)

  @]
- std::string **get_name** () const
- std::vector< epiworld_double > & **get_data** ()

Friends

- class **Person**< **TSeq** >
- class **Model**< **TSeq** >
- class **PersonViruses**< **TSeq** >
- class **DataBase**< **TSeq** >

4.51.1 Detailed Description

template<**typename TSeq = bool**>
class Virus< **TSeq** >

Virus.

Template Parameters

TSeq	

Raw transmisibility of a virus should be a function of its genetic sequence. Nonetheless, transmisibility can be reduced as a result of having one or more tools to fight the virus. Because of this, transmisibility should be a function of the host.

4.51.2 Member Function Documentation

4.51.2.1 get_prob_infecting()

```
template<typename TSeq >
epiworld_double Virus< TSeq >::get_prob_infecting  [inline]
```

Get and set the tool functions.

Parameters

v	The virus over which to operate
fun	the function to be used

Returns

epiworld_double @[

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

- include/epiworld/config.hpp
- include/epiworld/virus-bones.hpp
- include/epiworld/virus-meat.hpp

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