marathon

0.31

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Contents

Chapter 1

Hierarchical Index

1.1 Class Hierarchy

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

Chapter 2

Class Index

2.1 Class List

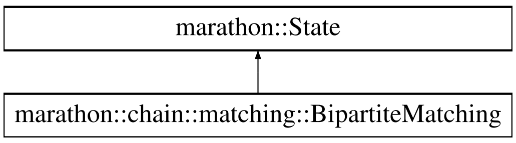
Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

Class Documentation

3.1 marathon::chain::matching::BipartiteMatching Class Reference

Inheritance diagram for marathon::chain::matching::BipartiteMatching:



Public Member Functions

- **BipartiteMatching** (const BipartiteMatching &s)
- **BipartiteMatching** (int n, int k, int unmatched[2], int $*$matching)
- void **addEdge** (int u, int v)
- void **removeEdge** (int u, int v)
- void **operator=** (BipartiteMatching const &s)
- bool **operator==** (const BipartiteMatching &s) const
- bool **operator**$<$ (const BipartiteMatching &s) const
- size_t hash_value () const
- int compare_to (const State $*$) const
- std::string to_string () const
- bool **is_perfect** () const
- bool **is_near_perfect** () const

Public Attributes

- int **n**
- int **k**
- int **unmatched** [2]
- int $*$ **mates**

3.1.1 Detailed Description

Definition at line 21 of file BipartiteMatching.h.

3.1.2 Member Function Documentation

3.1.2.1 int marathon::chain::matching::BipartiteMatching::compare_to (const State $*$ *s*) const [virtual]

Compare this and s by structural properties.

If this$<$s : return -1. If this==s: return 0. If this$>$s : return 1.

Implements marathon::State.

3.1.2.2 size_t marathon::chain::matching::BipartiteMatching::hash_value ( ) const [virtual]

Virtual Hash Function for State Type.

Implements marathon::State.

3.1.2.3 std::string marathon::chain::matching::BipartiteMatching::to_string ( ) const [virtual]

Return a string representation of the state.

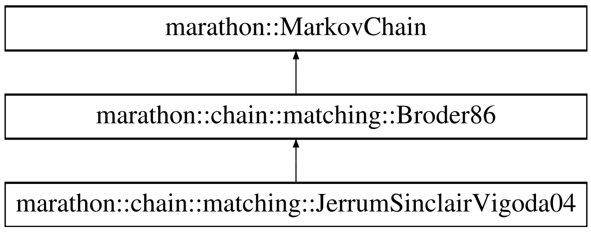
Implements marathon::State.

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

- include/marathon/chain/matching/BipartiteMatching.h

3.2 marathon::chain::matching::Broder86 Class Reference

Inheritance diagram for marathon::chain::matching::Broder86:


marathon::MarkovChain
marathon::chain::matching::Broder86
marathon::chain::matching::JerrumSinclairVigoda04

Public Member Functions

- **Broder86** (const std::string &instance)
- virtual State $*$ computeArbitraryState ()
- virtual void computeNeighbours (const State $*$s, std::vector$<$ std::pair$<$ State $*$, rational $>>$ &neighbors) const

Protected Member Functions

- void parseInstance (const std::string &inst)

Protected Attributes

- SparseBipartiteGraph $*$ **g** = nullptr

Friends

- class **JS89Path**

3.2.1 Detailed Description

Definition at line 21 of file Broder86.h.

3.2.2 Member Function Documentation

3.2.2.1 virtual State∗ marathon::chain::matching::Broder86::computeArbitraryState ( ) [virtual]

Computes an arbitrary state and store it the state object s.

Returns

A pointer to a state object or nullptr if state space is empty.

Implements marathon::MarkovChain.

3.2.2.2 virtual void marathon::chain::matching::Broder86::computeNeighbours (const State ∗ *s*, std::vector< std::pair< State ∗, rational >> & *neighbors*) const [virtual]

Compute the set of adjacent states of s with corresponding proposal probability.

Parameters

s	A pointer to the state for which its neighbours are to be computed.
neighbors	A vector with pointers to adjacent state objects that and their proposal probabilities.

Implements marathon::MarkovChain.

Reimplemented in marathon::chain::matching::JerrumSinclairVigoda04.

3.2.2.3 void marathon::chain::matching::Broder86::parseInstance (const std::string & *inst*) [protected]

Instances have the form "110101011". Such a 0-1-String is interpreted as a biadjacency matrix of a bipartite graph, flattened to a single line. Thus, the input string above corresponds to the biadjacency matrix

1 1 0 1 0 1 0 1 1

which is the graph

u1 u2 u3 |\ / \ /| | X X | |/ \ / | v1 v2 v3

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

- include/marathon/chain/matching/Broder86.h

3.3 marathon::chain::bipgraph::KannanPath::cycle_comparator Struct Reference

Public Member Functions

- bool **operator()** (const std::vector< int > &c1, const std::vector< int > &c2)

3.3.1 Detailed Description

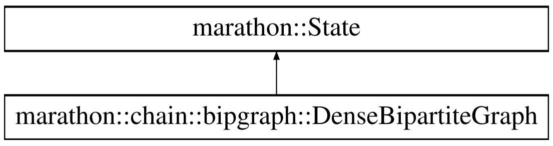
Definition at line 33 of file KannanCanPath.h.

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

- include/marathon/chain/bipgraph/KannanCanPath.h

3.4 marathon::chain::bipgraph::DenseBipartiteGraph Class Reference

Inheritance diagram for marathon::chain::bipgraph::DenseBipartiteGraph:



Public Member Functions

- **DenseBipartiteGraph** (int nrows, int ncols, const bool ∗bits=nullptr)
- **DenseBipartiteGraph** (int nrows, int ncols, const std::string &str)
- **DenseBipartiteGraph** (const DenseBipartiteGraph &s)
- int **get_nrows** () const
- int **get_ncols** () const
- bool **has_edge** (int u, int v) const
- void **flip_edge** (int u, int v)
- void **set_edge** (int u, int v, bool)
- bool **is_switchable** (int u1, int u2, int v1, int v2) const
- void **switch_4_cycle** (int u1, int u2, int v1, int v2)
- void **get_row** (int u, boost::dynamic_bitset<> &row) const
- size_t hash_value () const
- int compare_to (const State ∗x) const
- std::string to_string () const
- void **operator=** (const DenseBipartiteGraph &s)
- bool **operator<** (const DenseBipartiteGraph &rhs) const
- bool **operator==** (const DenseBipartiteGraph &rhs) const

Static Public Member Functions

- static int **COORD_TRANSFORM** (const int x, const int y, const int ld)

Public Attributes

- int **nrows**
- int **ncols**
- boost::dynamic_bitset **M**

3.4.1 Detailed Description

Definition at line 21 of file DenseBipartiteGraph.h.

3.4.2 Member Function Documentation

3.4.2.1 int marathon::chain::bipgraph::DenseBipartiteGraph::compare_to (const State ∗ *s*) const [virtual]

Compare this and s by structural properties.

If this$<$s : return -1. If this==s: return 0. If this$>$s : return 1.

Implements marathon::State.

3.4.2.2 size_t marathon::chain::bipgraph::DenseBipartiteGraph::hash_value ( ) const [virtual]

Virtual Hash Function for State Type.

Implements marathon::State.

3.4.2.3 std::string marathon::chain::bipgraph::DenseBipartiteGraph::to_string ( ) const [virtual]

Return a string representation of the state.

Implements marathon::State.

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

- include/marathon/chain/bipgraph/DenseBipartiteGraph.h

3.5 marathon::State::Equal Class Reference

Public Member Functions

- bool **operator()** (State ∗x1, State ∗x2) const

3.5.1 Detailed Description

Definition at line 77 of file State.h.

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

- include/marathon/State.h

3.6 marathon::State::Hash Class Reference

```
#include <State.h>
```

Public Member Functions

- size_t **operator()** (State ∗x) const

3.6.1 Detailed Description

Wrapper Class for the use in std::unordered_maps.

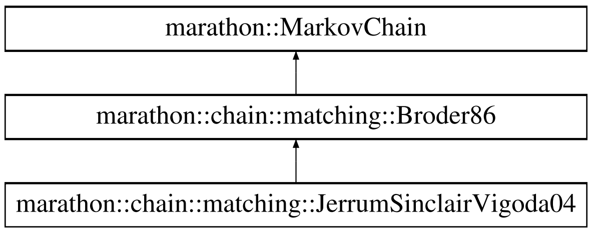
Definition at line 66 of file State.h.

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

- include/marathon/State.h

3.7 marathon::chain::matching::JerrumSinclairVigoda04 Class Reference

Inheritance diagram for marathon::chain::matching::JerrumSinclairVigoda04:


marathon::MarkovChain
marathon::chain::matching::Broder86
marathon::chain::matching::JerrumSinclairVigoda04

Public Member Functions

- **JerrumSinclairVigoda04** (const std::string &input)
- void computeNeighbours (const State $*$s, std::vector$<$ std::pair$<$ State $*$, rational $>>$ &neighbors) const
- void computeWeights (const std::vector$<$ const State $*$ $>$ &states, std::vector$<$ rational $>$ &weights)

Protected Member Functions

- rational **getWeight** (const State $*$s) const

Protected Attributes

- uint **num_perfect_matching**
- uint $*$ **num_near_perfect_matching**

3.7.1 Detailed Description

Definition at line 19 of file JSV04.h.

3.7.2 Member Function Documentation

3.7.2.1 void marathon::chain::matching::JerrumSinclairVigoda04::computeNeighbours (const State $*$ *s*, std::vector$<$ std::pair$<$ State $*$, rational $>>$ & *neighbors*) const [virtual]

Compute the set of adjacent states of s with corresponding proposal probability.

Parameters

s	A pointer to the state for which its neighbours are to be computed.
neighbors	A vector with pointers to adjacent state objects that and their proposal probabilities.

Reimplemented from marathon::chain::matching::Broder86.

3.7.2.2 void marathon::chain::matching::JerrumSinclairVigoda04::computeWeights (const std::vector$<$ const State $*$ $>$ & *states*, std::vector$<$ rational $>$ & *weights*) [virtual]

Computes weights for each state.

Parameters

states	The Vector of states.
weights	The Vector of weights. After calling the method, this vector must have the same size as states and is filled with rationals.

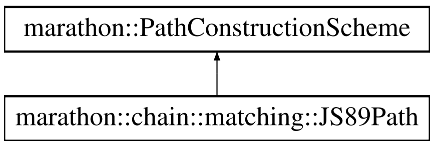
Reimplemented from marathon::MarkovChain.

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

- include/marathon/chain/matching/JSV04.h

3.8 marathon::chain::matching::JS89Path Class Reference

Inheritance diagram for marathon::chain::matching::JS89Path:


marathon::PathConstructionScheme
marathon::chain::matching::JS89Path

Additional Inherited Members

3.8.1 Detailed Description

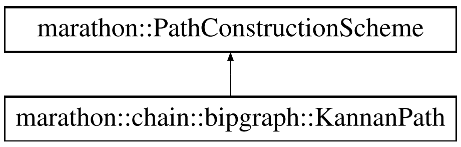
Definition at line 18 of file JS89CanPath.h.

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

- include/marathon/chain/matching/JS89CanPath.h

3.9 marathon::chain::bipgraph::KannanPath Class Reference

Inheritance diagram for marathon::chain::bipgraph::KannanPath:


marathon::PathConstructionScheme
marathon::chain::bipgraph::KannanPath

Classes

- struct cycle_comparator

Public Member Functions

- virtual void construct (const StateGraph $*$sg, const int s, const int t, std::list$<$ int $>$ &path) const

Protected Member Functions

- int **next_red_edge** (int col, bool ∗red_edges, int m, int n) const
- int **next_blue_edge** (int row, bool ∗blue_edges, int m, int n) const
- void **trace_cycle** (bool ∗blue_edges, bool ∗red_edges, int m, int n, int i, int j, std::vector< int > &cycle) const
- void **splice_cycle** (std::vector< int > cycle, std::list< std::vector< int > > &cycles, const int m, const int n) const
- void **cycle_decomposition** (const DenseBipartiteGraph &x, const DenseBipartiteGraph &y, std::list< std::vector< int > > &cycles) const

3.9.1 Detailed Description

Definition at line 18 of file KannanCanPath.h.

3.9.2 Member Function Documentation

3.9.2.1 virtual void marathon::chain::bipgraph::KannanPath::construct (const StateGraph ∗ *sg,* const int *s,* const int *t,* std::list< int > & *path*) const [virtual]

Construct a path between states s and t in Graph sg.

Parameters

sg	A pointer to a state graph object at which the path is embedded.
s	The index of the paths start state.
t	The index of the paths final state.
path	A list of state indices that represent the path.

Implements marathon::PathConstructionScheme.

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

- include/marathon/chain/bipgraph/KannanCanPath.h

3.10 marathon::State::Less Class Reference

Public Member Functions

- bool **operator()** (State ∗x1, State ∗x2) const

3.10.1 Detailed Description

Definition at line 88 of file State.h.

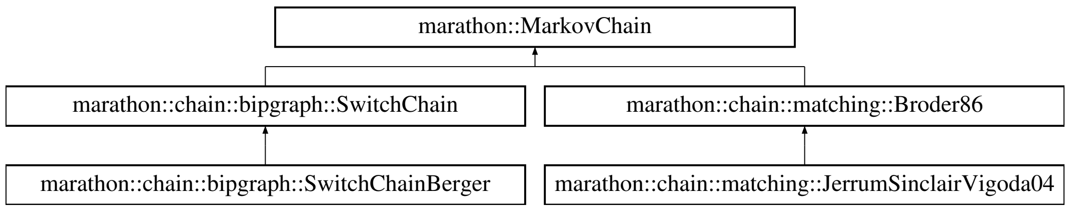
The documentation for this class was generated from the following file:

- include/marathon/State.h

3.11 marathon::MarkovChain Class Reference

```
#include <MarkovChain.h>
```

Inheritance diagram for marathon::MarkovChain:


marathon::MarkovChain
marathon::chain::bipgraph::SwitchChain
marathon::chain::matching::Broder86
marathon::chain::bipgraph::SwitchChainBerger
marathon::chain::matching::JerrumSinclairVigoda04

Public Member Functions

- MarkovChain (const std::string &s, int seed=0)
- const std::string & getInstance () const
- std::string getName () const
- virtual State ∗ computeArbitraryState ()=0
- virtual void computeNeighbours (const State ∗s, std::vector< std::pair< State ∗, rational >> &neighbors) const =0
- virtual void computeWeights (const std::vector< const State ∗ > &states, std::vector< rational > &weights)
- State ∗ randomWalk (const int t)
- virtual void randomize (State ∗s) const

Protected Attributes

- std::string **instance**

3.11.1 Detailed Description

Virtual Markov chain base class.

Definition at line 27 of file MarkovChain.h.

3.11.2 Constructor & Destructor Documentation

3.11.2.1 marathon::MarkovChain::MarkovChain (const std::string & *s*, int *seed* = 0)

Create A Markov Chain Object for the input s.

Parameters

s	input string of the markov chain. false if is to be constructed by Omega^2 procedure.

3.11.3 Member Function Documentation

3.11.3.1 virtual State∗ marathon::MarkovChain::computeArbitraryState ( ) [pure virtual]

Computes an arbitrary state and store it the state object s.

Returns

A pointer to a state object or nullptr if state space is empty.

Implemented in marathon::chain::matching::Broder86, and marathon::chain::bipgraph::SwitchChain.

3.11.3.2 virtual void marathon::MarkovChain::computeNeighbours (const State $*$ *s*, std::vector$<$ std::pair$<$ State $*$, rational $>>$ & *neighbors*) const [pure virtual]

Compute the set of adjacent states of s with corresponding proposal probability.

Parameters

s	A pointer to the state for which its neighbours are to be computed.
neighbors	A vector with pointers to adjacent state objects that and their proposal probabilities.

Implemented in marathon::chain::matching::Broder86, marathon::chain::bipgraph::SwitchChain, marathon::chain-::matching::JerrumSinclairVigoda04, and marathon::chain::bipgraph::SwitchChainBerger.

3.11.3.3 virtual void marathon::MarkovChain::computeWeights (const std::vector< const **State** * > & *states*, std::vector< **rational** > & *weights*) [virtual]

Computes weights for each state.

Parameters

states	The Vector of states.
weights	The Vector of weights. After calling the method, this vector must have the same size as states and is filled with rationals.

Reimplemented in marathon::chain::matching::JerrumSinclairVigoda04.

3.11.3.4 const std::string& marathon::MarkovChain::getInstance ( ) const

Returns

A reference to the string instance.

3.11.3.5 std::string marathon::MarkovChain::getName ( ) const

Return a human readable name (identifier) of the Markov chain.

3.11.3.6 virtual void marathon::MarkovChain::randomize (**State** * *s*) const [virtual]

Apply a random transition to the state. Used to simulate a random walk.

Parameters

s	A pointer to a state, which is randomly modified by the method.

Reimplemented in marathon::chain::bipgraph::SwitchChain.

3.11.3.7 **State*** marathon::MarkovChain::randomWalk (const int *t*) [inline]

Apply a random walk and return the current state at the end of the walk.

Parameters

t	The number of steps in the walk.

Returns

A state, randomly selected from the probability distribution p^(t)_s, where s is the state that is constructed via the computeArbitraryState method.

Definition at line 93 of file MarkovChain.h.

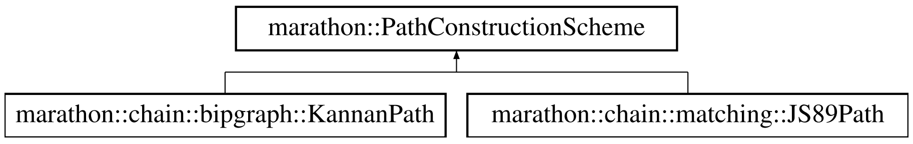
The documentation for this class was generated from the following file:

- include/marathon/MarkovChain.h

3.12 marathon::PathConstructionScheme Class Reference

`#include <PathConstructionScheme.h>`

Inheritance diagram for marathon::PathConstructionScheme:


marathon::PathConstructionScheme
marathon::chain::bipgraph::KannanPath
marathon::chain::matching::JS89Path

Public Member Functions

- virtual void construct (const StateGraph ∗sg, const int s, const int t, std::list< int > &path) const =0

3.12.1 Detailed Description

A virtual base class for construction schemes of Canonical Paths.

Definition at line 18 of file PathConstructionScheme.h.

3.12.2 Member Function Documentation

3.12.2.1 virtual void marathon::PathConstructionScheme::construct (const StateGraph ∗ *sg*, const int *s*, const int *t*, std::list< int > & *path*) const `[pure virtual]`

Construct a path between states s and t in Graph sg.

Parameters

sg	A pointer to a state graph object at which the path is embedded.
s	The index of the paths start state.
t	The index of the paths final state.
path	A list of state indices that represent the path.

Implemented in marathon::chain::bipgraph::KannanPath.

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

- include/marathon/PathConstructionScheme.h

3.13 marathon::rational Class Reference

`#include <Rational.h>`

Public Member Functions

- **rational** (const rational &o)
- **rational** (boost::multiprecision::cpp_rational r)
- **rational** (int n)
- **rational** (int num, int denom)
- void **operator=** (const rational &o)
- bool **operator==** (const rational &o) const

- bool **operator!=** (const rational &o) const
- void **operator+=** (const rational &o)
- void **operator-=** (const rational &o)
- void **operator*=** (const rational &o)
- void **operator/=** (const rational &o)
- rational **operator*** (const rational &o) const
- rational **operator-** (const rational &o) const
- rational **operator+** (const rational &o) const
- rational **operator/** (const rational &o) const
- bool **operator<** (const rational &o) const
- bool **operator>** (const rational &o) const
- void **stream_to** (std::ostream &os) const
- template<typename T >
  T **convert_to** () const

3.13.1 Detailed Description

just a wrapper around boost rational data type

Definition at line 19 of file Rational.h.

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

- include/marathon/Rational.h

3.14 marathon::chain::matching::SparseBipartiteGraph Class Reference

Public Member Functions

- **SparseBipartiteGraph** (const SparseBipartiteGraph &b)
- **SparseBipartiteGraph** (size_t n)
- **SparseBipartiteGraph** (std::string hash)
- unsigned int **getNumberOfNodes** () const
- unsigned int **getNumberOfEdges** () const
- void **getEdges** (edgelist &edges) const
- void **addEdge** (int u, int v)
- bool **hasEdge** (int u, int v) const
- void **removeEdge** (int u, int v)
- void **getNeighbors** (int v, std::vector< int > &neighbors) const
- void **cardmax_matching** (std::vector< int > &mates) const
- std::string **toString** () const
- void **convert_to_bitset** (boost::dynamic_bitset<> &) const

Friends

- std::ostream & **operator<<** (std::ostream &os, const SparseBipartiteGraph &bip)

3.14.1 Detailed Description

Definition at line 26 of file SparseBipartiteGraph.h.

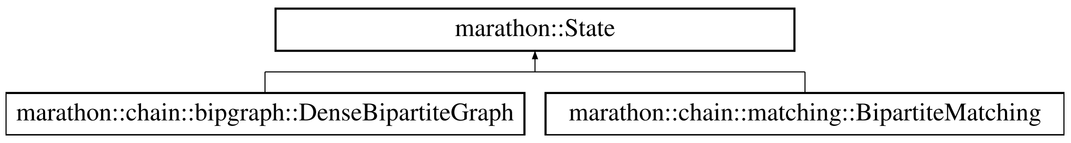
The documentation for this class was generated from the following file:

- include/marathon/chain/matching/SparseBipartiteGraph.h

3.15 marathon::State Class Reference

`#include <State.h>`

Inheritance diagram for marathon::State:


marathon::State
marathon::chain::bipgraph::DenseBipartiteGraph
marathon::chain::matching::BipartiteMatching

Classes

- class Equal
- class Hash
- class Less

Public Member Functions

- virtual size_t hash_value () const =0
- virtual int compare_to (const State ∗s) const =0
- virtual std::string to_string () const =0

Friends

- std::ostream & operator<< (std::ostream &out, const State &s)
- std::ostream & operator<< (std::ostream &out, const State ∗s)

3.15.1 Detailed Description

Abstract Base Class for States.

Definition at line 20 of file State.h.

3.15.2 Member Function Documentation

3.15.2.1 virtual int marathon::State::compare_to (const State ∗ *s*) const `[pure virtual]`

Compare this and s by structural properties.

If this<s : return -1. If this==s: return 0. If this>s : return 1.

Implemented in marathon::chain::bipgraph::DenseBipartiteGraph, and marathon::chain::matching::BipartiteMatching.

3.15.2.2 virtual size_t marathon::State::hash_value ( ) const `[pure virtual]`

Virtual Hash Function for State Type.

Implemented in marathon::chain::bipgraph::DenseBipartiteGraph, and marathon::chain::matching::BipartiteMatching.

3.15.2.3 virtual std::string marathon::State::to_string ( ) const `[pure virtual]`

Return a string representation of the state.

Implemented in marathon::chain::bipgraph::DenseBipartiteGraph, and marathon::chain::matching::Bipartite-Matching.

3.15.3 Friends And Related Function Documentation

3.15.3.1 std::ostream& operator<< (std::ostream & *out*, const State & *s*) `[friend]`

To output into streams.

Definition at line 50 of file State.h.

3.15.3.2 std::ostream& operator<< (std::ostream & *out*, const State ∗ *s*) `[friend]`

To output into streams.

Definition at line 58 of file State.h.

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

- include/marathon/State.h

3.16 marathon::StateGraph Class Reference

`#include <StateGraph.h>`

Public Member Functions

- StateGraph (MarkovChain ∗mc, const int limit=INT_MAX)
- virtual ∼StateGraph ()
- void expand (const int limit=INT_MAX, const bool verbose=false)
- MarkovChain ∗ getMarkovChain () const
- int addLoopArc (const int u, const rational &p)
- int addArc (const int u, const int v, const rational &p)
- int addArc (Transition ∗t)
- Transition ∗ getArc (int u, int v) const
- size_t getNumStates () const
- size_t getNumTransitions () const
- rational getTransitionProbability (int u, int v) const
- void setTransitionProbability (int u, int v, rational p)
- void addTransitionProbability (int u, int v, rational p)
- void setWeight (const int i, const rational p)
- rational getWeight (const int i) const
- rational getMinWeight () const
- rational getZ () const
- const std::vector< rational > & getWeights () const
- const std::vector< Transition ∗ > & getOutArcs (int v) const
- const std::vector< Transition ∗ > & getInArcs (int v) const
- const std::vector< Transition ∗ > & getArcs () const
- Transition ∗ getArc (const int i) const
- int getNumOutArcs (int v) const

- virtual void clear ()
- int addState (State $*$s)
- const State $*$ getState (int i) const
- const std::vector$<$ const State $*$ $>$ & getStates () const
- int indexOf (State $*$s) const

Protected Member Functions

- void expandState (const int i, const int limit, const int lastStop, const bool verbose)

Protected Attributes

- MarkovChain $*$ **mc**
- std::vector$<$ const State $*$ $>$ **states**
- std::vector$<$ rational $>$ **weights**
- std::unordered_map$<$ State
  $*$, int, State::Hash,
  State::Equal $>$ **indices**
- std::vector$<$ Transition $*$ $>$ **arcs**
- std::vector$<$ std::vector
  $<$ Transition $*$ $>$ $>$ **outArcs**
- std::vector$<$ std::vector
  $<$ Transition $*$ $>$ $>$ **inArcs**
- int **nextIndex** = 0
- std::set$<$ int $>$ **reexpand**

3.16.1 Detailed Description

State Graph representation. A State Graph is a directed, weighted graph that represents a instance of a Markov Chain for a certain input instance.

Definition at line 32 of file StateGraph.h.

3.16.2 Constructor & Destructor Documentation

3.16.2.1 marathon::StateGraph::StateGraph (**MarkovChain** $*$ *mc*, const int *limit* = `INT_MAX`)

Standard Constructor. Creates an empty State Graph.

Parameters

mc	A pointer to the Markov Chain Object that defines transition rules, etc.
limit	A limit on the number of states of the graph. The graph can later on be expanded by the expand() method.

3.16.2.2 virtual marathon::StateGraph::∼StateGraph ( ) `[virtual]`

Standard Destructor. Remove everything.

3.16.3 Member Function Documentation

3.16.3.1 int marathon::StateGraph::addArc (const int *u*, const int *v*, const rational & *p*)

Adds a transition arc to the graph. Precondition: The state graph does not already contain an arc between state u and state v.

Returns

Returns the index of the new transition.

3.16.3.2 int marathon::StateGraph::addArc (Transition ∗ *t*)

Adds a transition arc to the graph. Precondition: The state graph does not already contain an arc between state t.u and state t.v.

Returns

Returns the index of the new transition.

3.16.3.3 int marathon::StateGraph::addLoopArc (const int *u*, const rational & *p*)

Add a new transition to the state graph that represents a loop.

3.16.3.4 int marathon::StateGraph::addState (State ∗ *s*)

Add a new State to the state graph.

Parameters

s	The State to insert.

Returns

The index of the state after insertion.

3.16.3.5 void marathon::StateGraph::addTransitionProbability (int *u*, int *v*, rational *p*)

Increases P(u,v) by an amount of p.

3.16.3.6 virtual void marathon::StateGraph::clear ( ) `[virtual]`

Removes all States and Transitions and re-initializes the state graph.

3.16.3.7 void marathon::StateGraph::expand (const int *limit* = `INT_MAX`, const bool *verbose* = `false`)

Expands an existing state graph to a given maximum of states.

Parameters

limit	The maximal number of states after the expansion
verbose	Enables or disables additional debug output

Returns

the number of states that has been added during the expansion

3.16.3.8 void marathon::StateGraph::expandState (const int *i*, const int *limit*, const int *lastStop*, const bool *verbose*) [protected]

This is a private method that is called during state graph expansion. It computes all neighbouring states of state s and insert them into the state graph repectively into the leftover structures that store the states and arcs for next expandStateGraph().

Parameters

i	The index of the state that is to be expanded.
limit	The maximal number of states.
lastStop	The size of the state graph when this expansion has been triggered.
verbose	If true, additional debug information is printed.
True,if	all adjacent states could be inserted in the state graph.

3.16.3.9 Transition∗ marathon::StateGraph::getArc (int *u*, int *v*) const

Return a pointer to the arc that connects u with v or nullptr, if no such arc exists.

3.16.3.10 Transition∗ marathon::StateGraph::getArc (const int *i*) const

Return a pointer to arc with index i.

Parameters

i	The index of the arc.

Returns

A pointer to the i'th transition.

3.16.3.11 const std::vector<Transition∗>& marathon::StateGraph::getArcs ( ) const

Returns a reference to the vector of all arcs in the state graph.

3.16.3.12 const std::vector<Transition∗>& marathon::StateGraph::getInArcs (int *v*) const

Returns a reference to the ingoing arcs of state v.

3.16.3.13 MarkovChain∗ marathon::StateGraph::getMarkovChain ( ) const

Return a pointer to the corresponding Markov Chain Object.

3.16.3.14 rational marathon::StateGraph::getMinWeight ( ) const

Return the minimal weight of a state.

3.16.3.15 int marathon::StateGraph::getNumOutArcs (int *v*) const

Returns the number of adjacent states of state[v]

3.16.3.16 size_t marathon::StateGraph::getNumStates ( ) const

Returns the number of states of the state graph

3.16.3.17 size_t marathon::StateGraph::getNumTransitions ( ) const

Returns the number of Transitions/Arcs of the state graph

3.16.3.18 const std::vector<Transition∗>& marathon::StateGraph::getOutArcs (int *v*) const

Returns a reference to the outgoing arcs of state v.

3.16.3.19 const State∗ marathon::StateGraph::getState (int *i*) const

Returns a reference to the State with index i.

3.16.3.20 const std::vector<const State∗>& marathon::StateGraph::getStates ( ) const

Returns a reference to a vector of States.

3.16.3.21 rational marathon::StateGraph::getTransitionProbability (int *u*, int *v*) const

Returns the transition probability P_uv for going from states[u] to states[v]

3.16.3.22 rational marathon::StateGraph::getWeight (const int *i*) const

Return the weight of state i.

3.16.3.23 const std::vector<rational>& marathon::StateGraph::getWeights ( ) const

Return a vector of weights for each state.

3.16.3.24 rational marathon::StateGraph::getZ ( ) const

Return the sum of all weights.

3.16.3.25 int marathon::StateGraph::indexOf (State ∗ *s*) const

Returns the index of a state or -1 if the state graph does not contain this state.

3.16.3.26 void marathon::StateGraph::setTransitionProbability (int *u*, int *v*, rational *p*)

Set P(u,v) to p

3.16.3.27 void marathon::StateGraph::setWeight (const int *i*, const rational *p*)

Sets the weight of state[i] to p.

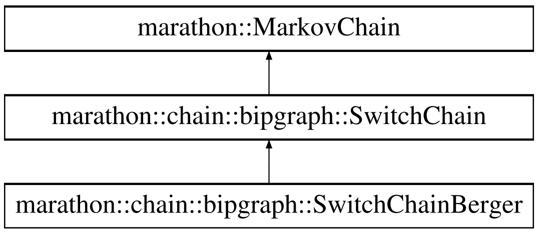
The documentation for this class was generated from the following file:

- include/marathon/StateGraph.h

3.17 marathon::chain::bipgraph::SwitchChain Class Reference

```
#include <SwitchChain.h>
```

Inheritance diagram for marathon::chain::bipgraph::SwitchChain:


marathon::MarkovChain
marathon::chain::bipgraph::SwitchChain
marathon::chain::bipgraph::SwitchChainBerger

Public Member Functions

- **SwitchChain** (const std::string &inst, int seed=0)
- virtual State ∗ computeArbitraryState ()
- virtual void computeNeighbours (const State ∗s, std::vector< std::pair< State ∗, rational >> &neighbors) const
- virtual void randomize (State ∗s) const

Protected Member Functions

- virtual void parseInstance (const std::string &line)

Protected Attributes

- std::vector< int > **u**
- std::vector< int > **v**
- int **sum**

Friends

- class **KannanPath**

3.17.1 Detailed Description

Implements the Markov chain defined by Kannan et al.

Definition at line 24 of file SwitchChain.h.

3.17.2 Member Function Documentation

3.17.2.1 virtual State$*$ marathon::chain::bipgraph::SwitchChain::computeArbitraryState ( ) [virtual]

Computes an arbitrary state and store it the state object s.

Returns

A pointer to a state object or nullptr if state space is empty.

Implements marathon::MarkovChain.

3.17.2.2 virtual void marathon::chain::bipgraph::SwitchChain::computeNeighbours (const State $*$ *s*, std::vector$<$ std::pair$<$ State $*$, rational $>>$ & *neighbors*) const [virtual]

Compute the set of adjacent states of s with corresponding proposal probability.

Parameters

s	A pointer to the state for which its neighbours are to be computed.
neighbors	A vector with pointers to adjacent state objects that and their proposal probabilities.

Implements marathon::MarkovChain.

Reimplemented in marathon::chain::bipgraph::SwitchChainBerger.

3.17.2.3 virtual void marathon::chain::bipgraph::SwitchChain::parseInstance (const std::string & *line*) [protected], [virtual]

Instances have the form "2,2,2;1,2,1,2". The semicolon separates two degree sequences of both bipartition sets.

3.17.2.4 virtual void marathon::chain::bipgraph::SwitchChain::randomize (State $*$ *s*) const [virtual]

Randomize the state s by applying a single transition.

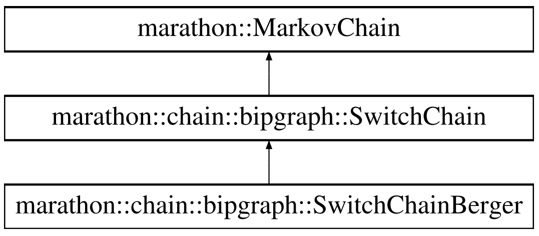
Reimplemented from marathon::MarkovChain.

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

- include/marathon/chain/bipgraph/SwitchChain.h

3.18 marathon::chain::bipgraph::SwitchChainBerger Class Reference

Inheritance diagram for marathon::chain::bipgraph::SwitchChainBerger:


marathon::MarkovChain
marathon::chain::bipgraph::SwitchChain
marathon::chain::bipgraph::SwitchChainBerger

Public Member Functions

- **SwitchChainBerger** (const std::string &input)

Protected Member Functions

- virtual void computeNeighbours (const State ∗s, std::vector< std::pair< State ∗, rational >> &neighbors) const

Additional Inherited Members

3.18.1 Detailed Description

Definition at line 17 of file SwitchChainBerger.h.

3.18.2 Member Function Documentation

3.18.2.1 virtual void marathon::chain::bipgraph::SwitchChainBerger::computeNeighbours (const State ∗ *s*, std::vector< std::pair< State ∗, rational >> & *neighbors*) const `[protected]`, `[virtual]`

Compute the set of adjacent states of s with corresponding proposal probability.

Parameters

s	A pointer to the state for which its neighbours are to be computed.
neighbors	A vector with pointers to adjacent state objects that and their proposal probabilities.

Reimplemented from marathon::chain::bipgraph::SwitchChain.

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

- include/marathon/chain/bipgraph/SwitchChainBerger.h

3.19 marathon::Transition Class Reference

```
#include <Transition.h>
```

Public Member Functions

- **Transition** (uint u, uint v, rational p)

Public Attributes

- uint **u**
- uint **v**
- rational **p**

3.19.1 Detailed Description

Transition Arc Representation of State Graph

Definition at line 21 of file Transition.h.

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

- include/marathon/Transition.h

3.20 marathon::TransitionComparator Struct Reference

Public Member Functions

- bool **operator()** (const Transition &a, const Transition &b)

3.20.1 Detailed Description

Definition at line 33 of file Transition.h.

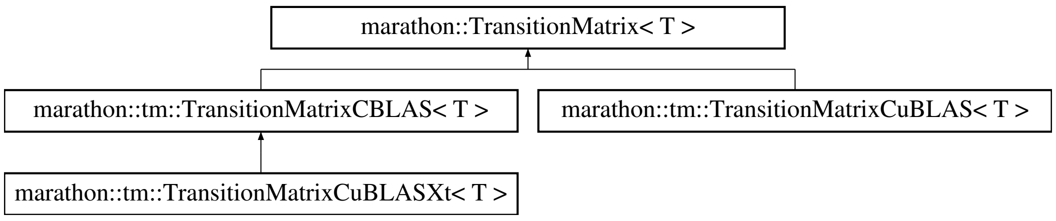
The documentation for this struct was generated from the following file:

- include/marathon/Transition.h

3.21 marathon::TransitionMatrix< T > Class Template Reference

```
#include <TransitionMatrix.h>
```

Inheritance diagram for marathon::TransitionMatrix< T >:


marathon::TransitionMatrix< T >
marathon::tm::TransitionMatrixCBLAS< T >
marathon::tm::TransitionMatrixCuBLAS< T >
marathon::tm::TransitionMatrixCuBLASXt< T >

Public Member Functions

- size_t getN () const
- size_t getLeadDimension () const
- T ∗ getData () const
- virtual void copy (const TransitionMatrix< T > ∗P)=0
- virtual void setEye ()=0
- virtual void setZero ()=0
- virtual void mult (const TransitionMatrix< T > ∗A, const TransitionMatrix< T > ∗B)=0
- void pow (const TransitionMatrix< T > ∗P, const int k)
- virtual std::string to_string () const =0
- virtual void variationDistance (const T ∗pi, T ∗dist) const =0
- virtual T totalVariationDistance (const T ∗pi) const =0
- void swap (TransitionMatrix< T > ∗P)

Protected Member Functions

- virtual TransitionMatrix< T > ∗ generateSubTypeInstance (const int n)=0

Protected Attributes

- size_t **n**
- size_t **ld**
- T ∗ **data**

Friends

- std::ostream & operator<< (std::ostream &out, const TransitionMatrix< T > &s)
- std::ostream & operator<< (std::ostream &out, const TransitionMatrix< T > *s)

3.21.1 Detailed Description

template<typename T = double>class marathon::TransitionMatrix< T >

Virtual Base Class for Transition Matrix.

Definition at line 19 of file TransitionMatrix.h.

3.21.2 Member Function Documentation

3.21.2.1 template<typename T = double> virtual void marathon::TransitionMatrix< T >::copy (const TransitionMatrix< T > * *P*) `[pure virtual]`

Copy the content of matrix P to this.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.2 template<typename T = double> virtual TransitionMatrix<T>* marathon::TransitionMatrix< T >::generateSubTypeInstance (const int *n*) `[protected], [pure virtual]`

Return a pointer to a Transition matrix of an appropriate subtype.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.3 template<typename T = double> T* marathon::TransitionMatrix< T >::getData ( ) const `[inline]`

Return a pointer to the data.

Definition at line 55 of file TransitionMatrix.h.

3.21.2.4 template<typename T = double> size_t marathon::TransitionMatrix< T >::getLeadDimension ( ) const `[inline]`

Return lead dimension of the matrix.

Definition at line 48 of file TransitionMatrix.h.

3.21.2.5 template<typename T = double> size_t marathon::TransitionMatrix< T >::getN ( ) const `[inline]`

Return size of the matrix.

Definition at line 41 of file TransitionMatrix.h.

3.21.2.6 template<typename T = double> virtual void marathon::TransitionMatrix< T >::mult (const TransitionMatrix< T > * *A*, const TransitionMatrix< T > * *B*) `[pure virtual]`

Multiply A with B and write the result to this.

Parameters

A	A pointer to matrix A. Will not be changed.
B	A pointer to matrix B. Will not be changed.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, marathon::tm::TransitionMatrixCBLAS< T >, and marathon::tm::TransitionMatrixCuBLASXt< T >.

3.21.2.7 template<typename T = double> void marathon::TransitionMatrix< T >::pow (const TransitionMatrix< T > * *P*, const int *k*) [inline]

Compute P^k and write the result to this.

Parameters

P	A pointer to a Transition Matrix.
k	Exponent.

Definition at line 87 of file TransitionMatrix.h.

3.21.2.8 template<typename T = double> virtual void marathon::TransitionMatrix< T >::setEye ( ) [pure virtual]

Overwrite the current matrix with unity matrix.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.9 template<typename T = double> virtual void marathon::TransitionMatrix< T >::setZero ( ) [pure virtual]

Overwrite the current matrix with zeroes.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.10 template<typename T = double> void marathon::TransitionMatrix< T >::swap (TransitionMatrix< T > * *P*) [inline]

Swap the content of the Matrix with another matrix.

Definition at line 162 of file TransitionMatrix.h.

3.21.2.11 template<typename T = double> virtual std::string marathon::TransitionMatrix< T >::to_string ( ) const [pure virtual]

Return a string that represents the matrix.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.12 template<typename T = double> virtual T marathon::TransitionMatrix< T >::totalVariationDistance (const T * *pi*) const [pure virtual]

Compute the total variation distance to the distribution.

Parameters

pi	A probability distribution.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.2.13 template<typename T = double> virtual void **marathon::TransitionMatrix**< T >::variationDistance (const T ∗ *pi,* T ∗ *dist*) const [pure virtual]

Compute the variation distance of each state to the distribution pi

Parameters

pi	A pointer to a probability distribution.
dist	Out parameter.

Implemented in marathon::tm::TransitionMatrixCuBLAS< T >, and marathon::tm::TransitionMatrixCBLAS< T >.

3.21.3 Friends And Related Function Documentation

3.21.3.1 template<typename T = double> std::ostream& operator<< (std::ostream & *out,* const **TransitionMatrix**< T > & *s*) [friend]

To output into streams.

Definition at line 171 of file TransitionMatrix.h.

3.21.3.2 template<typename T = double> std::ostream& operator<< (std::ostream & *out,* const **TransitionMatrix**< T > ∗ *s*) [friend]

To output into streams.

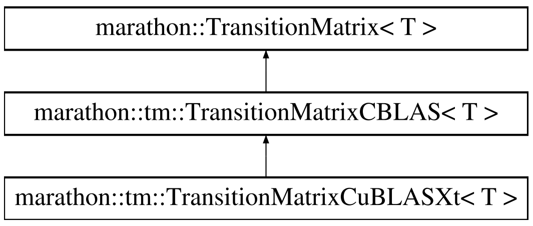
Definition at line 180 of file TransitionMatrix.h.

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

- include/marathon/TransitionMatrix.h

3.22 marathon::tm::TransitionMatrixCBLAS< T > Class Template Reference

Inheritance diagram for marathon::tm::TransitionMatrixCBLAS< T >:


marathon::TransitionMatrix< T >
marathon::tm::TransitionMatrixCBLAS< T >
marathon::tm::TransitionMatrixCuBLASXt< T >

Public Member Functions

- **TransitionMatrixCBLAS** (const int n)
- **TransitionMatrixCBLAS** (const StateGraph ∗sg)
- virtual void setEye ()
- virtual void setZero ()

- virtual std::string to_string () const
- virtual void mult (const TransitionMatrix< T > ∗A, const TransitionMatrix< T > ∗B)
- virtual void variationDistance (const T ∗pi, T ∗dist) const
- virtual T totalVariationDistance (const T ∗pi) const

Protected Member Functions

- virtual void copy (const TransitionMatrix< T > ∗P)
- virtual TransitionMatrix< T > ∗ generateSubTypeInstance (const int n)

Additional Inherited Members

3.22.1 Detailed Description

template<typename T>class marathon::tm::TransitionMatrixCBLAS< T >

Definition at line 17 of file TransitionMatrixCBLAS.h.

3.22.2 Member Function Documentation

3.22.2.1 template<typename T> virtual void marathon::tm::TransitionMatrixCBLAS< T >::copy (const TransitionMatrix< T > ∗ *P*) [inline], [protected], [virtual]

Copy the content of matrix P to this.

Implements marathon::TransitionMatrix< T >.

Definition at line 24 of file TransitionMatrixCBLAS.h.

3.22.2.2 template<typename T> virtual TransitionMatrix<T>∗ marathon::tm::TransitionMatrixCBLAS< T >::generateSubTypeInstance (const int *n*) [inline], [protected], [virtual]

Return a pointer to a Transition matrix of subtype instance.

Implements marathon::TransitionMatrix< T >.

Definition at line 34 of file TransitionMatrixCBLAS.h.

3.22.2.3 template<typename T> virtual void marathon::tm::TransitionMatrixCBLAS< T >::mult (const TransitionMatrix< T > ∗ *A*, const TransitionMatrix< T > ∗ *B*) [virtual]

Multiply A with B and write the result to this.

Parameters

A	A pointer to matrix A. Will not be changed.
B	A pointer to matrix B. Will not be changed.

Implements marathon::TransitionMatrix< T >.

Reimplemented in marathon::tm::TransitionMatrixCuBLASXt< T >.

3.22.2.4 template<typename T> virtual void marathon::tm::TransitionMatrixCBLAS< T >::setEye ( ) [inline], [virtual]

Overwrite the current matrix with unity matrix.

Implements marathon::TransitionMatrix< T >.

Definition at line 64 of file TransitionMatrixCBLAS.h.

3.22.2.5 template<typename T> virtual void marathon::tm::TransitionMatrixCBLAS< T >::setZero ( ) [inline], [virtual]

Overwrite the current matrix with zeroes.

Implements marathon::TransitionMatrix< T >.

Definition at line 74 of file TransitionMatrixCBLAS.h.

3.22.2.6 template<typename T> virtual std::string marathon::tm::TransitionMatrixCBLAS< T >::to_string ( ) const [inline], [virtual]

Return a string that represents the matrix.

Implements marathon::TransitionMatrix< T >.

Definition at line 82 of file TransitionMatrixCBLAS.h.

3.22.2.7 template<typename T> virtual T marathon::tm::TransitionMatrixCBLAS< T >::totalVariationDistance (const T * *pi*) const [inline], [virtual]

Compute the total variation distance to the distribution.

Parameters

pi	A probability distribution.

Implements marathon::TransitionMatrix< T >.

Definition at line 133 of file TransitionMatrixCBLAS.h.

3.22.2.8 template<typename T> virtual void marathon::tm::TransitionMatrixCBLAS< T >::variationDistance (const T * *pi*, T * *dist*) const [inline], [virtual]

Compute the variation distance of each state to the distribution pi

Parameters

pi	A pointer to a probability distribution.
dist	Out parameter.

Implements marathon::TransitionMatrix< T >.

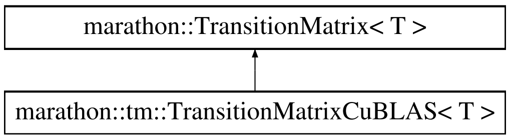
Definition at line 118 of file TransitionMatrixCBLAS.h.

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

- include/marathon/TransitionMatrixCBLAS.h

3.23 marathon::tm::TransitionMatrixCuBLAS< T > Class Template Reference

Inheritance diagram for marathon::tm::TransitionMatrixCuBLAS< T >:


marathon::TransitionMatrix< T >
marathon::tm::TransitionMatrixCuBLAS< T >

Public Member Functions

- **TransitionMatrixCuBLAS** (const int n)
- **TransitionMatrixCuBLAS** (const StateGraph ∗sg)
- virtual void setEye ()
- virtual void setZero ()
- virtual std::string to_string () const
- virtual void mult (const TransitionMatrix< T > ∗A, const TransitionMatrix< T > ∗B)
- virtual void variationDistance (const T ∗pi, T ∗dist) const
- virtual T totalVariationDistance (const T ∗pi) const

Protected Member Functions

- virtual void copy (const TransitionMatrix< T > ∗P)
- virtual TransitionMatrix< T > ∗ generateSubTypeInstance (const int n)

Additional Inherited Members

3.23.1 Detailed Description

template<typename T>class marathon::tm::TransitionMatrixCuBLAS< T >

Definition at line 32 of file TransitionMatrixCuBLAS.h.

3.23.2 Member Function Documentation

3.23.2.1 template<typename T> virtual void **marathon::tm::TransitionMatrixCuBLAS< T >::copy** (const **TransitionMatrix< T > ∗ *P***) `[inline], [protected], [virtual]`

Copy the content of matrix P to this.

Implements marathon::TransitionMatrix< T >.

Definition at line 39 of file TransitionMatrixCuBLAS.h.

3.23.2.2 template<typename T> virtual **TransitionMatrix<T>∗ marathon::tm::TransitionMatrixCuBLAS< T >::generateSubTypeInstance** (const int *n*) `[inline], [protected], [virtual]`

Return a pointer to a Transition matrix of subtype instance.

Implements marathon::TransitionMatrix< T >.

Definition at line 53 of file TransitionMatrixCuBLAS.h.

3.23.2.3 template<typename T> virtual void **marathon::tm::TransitionMatrixCuBLAS< T >::mult** (const **TransitionMatrix< T > ∗ *A*,** const **TransitionMatrix< T > ∗ *B***) `[virtual]`

Multiply A with B and write the result to this.

Parameters

A	A pointer to matrix A. Will not be changed.
B	A pointer to matrix B. Will not be changed.

Implements marathon::TransitionMatrix< T >.

3.23.2.4 template<typename T> virtual void marathon::tm::TransitionMatrixCuBLAS< T >::setEye ( ) [inline], [virtual]

Overwrite the current matrix with unity matrix.

Implements marathon::TransitionMatrix< T >.

Definition at line 86 of file TransitionMatrixCuBLAS.h.

3.23.2.5 template<typename T> virtual void marathon::tm::TransitionMatrixCuBLAS< T >::setZero ( ) [inline], [virtual]

Overwrite the current matrix with zeroes.

Implements marathon::TransitionMatrix< T >.

Definition at line 99 of file TransitionMatrixCuBLAS.h.

3.23.2.6 template<typename T> virtual std::string marathon::tm::TransitionMatrixCuBLAS< T >::to_string ( ) const [inline], [virtual]

Return a string that represents the matrix.

Implements marathon::TransitionMatrix< T >.

Definition at line 109 of file TransitionMatrixCuBLAS.h.

3.23.2.7 template<typename T> virtual T marathon::tm::TransitionMatrixCuBLAS< T >::totalVariationDistance (const T * *pi*) const [inline], [virtual]

Compute the total variation distance to the distribution.

Parameters

pi	A probability distribution.

Implements marathon::TransitionMatrix< T >.

Definition at line 143 of file TransitionMatrixCuBLAS.h.

3.23.2.8 template<typename T> virtual void marathon::tm::TransitionMatrixCuBLAS< T >::variationDistance (const T * *pi*, T * *dist*) const [inline], [virtual]

Compute the variation distance of each state to the distribution pi

Parameters

pi	A pointer to a probability distribution.
dist	Out parameter.

Implements marathon::TransitionMatrix< T >.

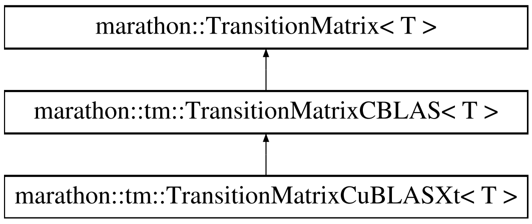
Definition at line 133 of file TransitionMatrixCuBLAS.h.

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

- include/marathon/TransitionMatrixCuBLAS.h

3.24 marathon::tm::TransitionMatrixCuBLASXt< T > Class Template Reference

Inheritance diagram for marathon::tm::TransitionMatrixCuBLASXt< T >:


marathon::TransitionMatrix< T >
marathon::tm::TransitionMatrixCBLAS< T >
marathon::tm::TransitionMatrixCuBLASXt< T >

Public Member Functions

- **TransitionMatrixCuBLASXt** (const int n)
- **TransitionMatrixCuBLASXt** (const StateGraph ∗sg)
- virtual void mult (const TransitionMatrix< T > ∗A, const TransitionMatrix< T > ∗B)

Additional Inherited Members

3.24.1 Detailed Description

template< typename T > class marathon::tm::TransitionMatrixCuBLASXt< T >

Definition at line 17 of file TransitionMatrixCuBLASXt.h.

3.24.2 Member Function Documentation

3.24.2.1 template< typename T > virtual void **marathon::tm::TransitionMatrixCuBLASXt< T >::mult** (const **TransitionMatrix< T > ∗ *A*,** const **TransitionMatrix< T > ∗ *B***) [virtual]

Multiply A with B and write the result to this.

Parameters

A	A pointer to matrix A. Will not be changed.
B	A pointer to matrix B. Will not be changed.

Reimplemented from marathon::tm::TransitionMatrixCBLAS< T >.

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

- include/marathon/TransitionMatrixCuBLASXt.h

Index