Multilevel Prediction

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Contents

Chapter 1

Main Page

This program is a toolbox to compute optimal predictors of Markov chains, and in particular multilevel agent-based systems, by using the information bottleneck method. For details regarding the formal grounds of this method, please refer to:

Robin Lamarche-Perrin, Sven Banisch, and Eckehard Olbrich. The Information Bottleneck Method for Optimal Prediction of Multilevel Agent-based Systems. Technical Report MIS-Preprint 55/2015, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, 2015.

http://www.mis.mpg.de/publications/preprints/2015/prepr2015-55.html

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

File Index

4.1 File List

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

Chapter 5

Class Documentation

5.1 ChainExperiment Class Reference

Public Member Functions

- **ChainExperiment** (int size, double contrarian, bool ring, double time, double delay, SpecMeasurementSet ∗preMeasurements, SpecMeasurementSet ∗postMeasurements)

Public Attributes

- int id
- UpdateProcess update
- double threshold
- bool **withAggregation**
- bool **ring**
- int **sizeMin**
- int **sizeMax**
- int **sizeStep**
- double contrarianMin
- double contrarianMax
- double contrarianStep
- int timeMin
- int timeMax
- int timeStep
- int delayMin
- int delayMax
- int delayStep
- SpecMeasurementSet ∗ preMeasurements
- SpecMeasurementSet ∗ postMeasurements

Static Public Attributes

- static int **id_number** = 0

5.1.1 Member Data Documentation

5.1.1.1 double ChainExperiment::contrarianMax

The contrarian rate of nodes within community 1 in the last experiment

5.1.1.2 double ChainExperiment::contrarianMin

The contrarian rate of nodes within community 1 in the first experiment

5.1.1.3 double ChainExperiment::contrarianStep

The contrarian rate of nodes within community 1 between two consecutive experiments

5.1.1.4 int ChainExperiment::delayMax

The delay before post-measurement in the last experiment

5.1.1.5 int ChainExperiment::delayMin

The delay before post-measurement in the first experiment

5.1.1.6 int ChainExperiment::delayStep

The delay before post-measurement between two consecutive experiments

5.1.1.7 int ChainExperiment::id

A unique experiment number

5.1.1.8 SpecMeasurementSet$*$ ChainExperiment::postMeasurements

A set of post-measurement to be predicted

5.1.1.9 SpecMeasurementSet$*$ ChainExperiment::preMeasurements

A set of pre-measurement for prediction

5.1.1.10 double ChainExperiment::threshold

The precision threshold to compute the stationary distribution of the Markov chain (see computeStationary-Distribution method in MarkovProcess class)

5.1.1.11 int ChainExperiment::timeMax

The time of pre-measurement (-1 for stationary distribution) in the last experiment

5.1.1.12 int ChainExperiment::timeMin

The time of pre-measurement (-1 for stationary distribution) in the first experiment

5.1.1.13 int ChainExperiment::timeStep

The time of pre-measurement (-1 for stationary distribution) between two consecutive experiments

5.1.1.14 UpdateProcess ChainExperiment::update

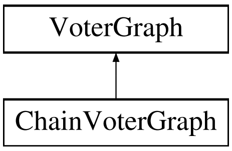
The update process of the built Voter Model

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

- /home/lamarche/programming/multilevel_prediction/src/voter_experiment.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_experiment.cpp

5.2 ChainVoterGraph Class Reference

Inheritance diagram for ChainVoterGraph:



Public Member Functions

- **ChainVoterGraph** (int size, double contrarian=0, bool ring=false, int update=UPDATE_EDGES)

Public Attributes

- int **size**
- double **contrarian**
- VoterNode ∗∗ **nodeArray**
- bool **ring**

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

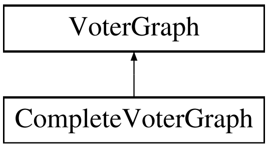
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.3 CompleteVoterGraph Class Reference

An interaction graph with edges between each pair of nodes (in both direction, with equal weight for each edge)

```
#include <voter_graph.hpp>
```

Inheritance diagram for CompleteVoterGraph:



Public Member Functions

- CompleteVoterGraph (int size, int update=UPDATE_EDGES, double contrarian=0)

    Constructor.

Additional Inherited Members

5.3.1 Detailed Description

An interaction graph with edges between each pair of nodes (in both direction, with equal weight for each edge)

5.3.2 Constructor & Destructor Documentation

5.3.2.1 CompleteVoterGraph::CompleteVoterGraph (int *size*, int *update* = UPDATE_EDGES, double *contrarian* = `0`)

Constructor.

Parameters

size	: Size of the graph
update	: How the system evolves at each simulation step (UPDATE_NODES or UPDATE_EDGES)
contrarian	: The contrarian rate of each node

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.4 DataPointStruct Struct Reference

The computation time and memory consumption associated to an experiment of a given size.

```
#include <timer.hpp>
```

Public Attributes

- int **size**
- float **time**
- int **memory**

5.4.1 Detailed Description

The computation time and memory consumption associated to an experiment of a given size.

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

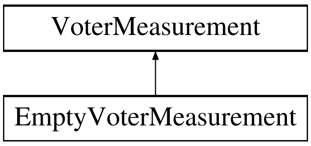
- /home/lamarche/programming/multilevel_prediction/src/timer.hpp

5.5 EmptyVoterMeasurement Class Reference

A measurement without any probe (no observation)

```
#include <voter_graph.hpp>
```

Inheritance diagram for EmptyVoterMeasurement:



Public Member Functions

- EmptyVoterMeasurement (VoterGraph ∗graph)

    Constructor.

Additional Inherited Members

5.5.1 Detailed Description

A measurement without any probe (no observation)

5.5.2 Constructor & Destructor Documentation

5.5.2.1 EmptyVoterMeasurement::EmptyVoterMeasurement (VoterGraph ∗ *graph*)

Constructor.

Parameters

graph	: The interaction graph to be observed

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

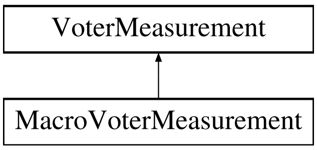
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.6 MacroVoterMeasurement Class Reference

A measurement consisting in one probe observing all nodes of the interaction graph.

```
#include <voter_graph.hpp>
```

Inheritance diagram for MacroVoterMeasurement:



Public Member Functions

- MacroVoterMeasurement (VoterGraph ∗graph, std::set< VoterMetric > metrics)

    Constructor.

Additional Inherited Members

5.6.1 Detailed Description

A measurement consisting in one probe observing all nodes of the interaction graph.

5.6.2 Constructor & Destructor Documentation

5.6.2.1 MacroVoterMeasurement::MacroVoterMeasurement (**VoterGraph** ∗ *graph,* std::set< **VoterMetric** > *metrics*)

Constructor.

Parameters

graph	: The interaction graph to be observed
metrics	: The set of metrics associated to the macro-probe

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.7 MarkovDataSet Class Reference

Public Member Functions

- **MarkovDataSet** (MarkovProcess ∗process, int size, int time, int length)
- double **computeScore** (Partition ∗preP, Partition ∗postP, int delay, int trainingLength)

Public Attributes

- MarkovProcess ∗ **process**
- int **size**
- int **time**
- int **length**
- MarkovTrajectory ∗∗ **trajectories**

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

- /home/lamarche/programming/multilevel_prediction/src/markov_process.hpp
- /home/lamarche/programming/multilevel_prediction/src/markov_process.cpp

5.8 MarkovProcess Class Reference

A finite Markov chain described by a discrete state space, an initial distribution, and a transition kernel.

```
#include <markov_process.hpp>
```

Public Member Functions

- MarkovProcess (int size)

  Constructor.

- ∼MarkovProcess ()

  Destructor.
- void print ()

  Print the Markov chain structure and details.
- void setDistribution (double ∗array)

  Set the initial distribution.
- void setTransition (double ∗array)

  Set the transition kernel.
- void setTransition (int i, double ∗array)

  Set one line of the transition kernel.
- double ∗ getDistribution (int time)

  Get the state distribution at a given time (-1 for the stationary distribution)
- double ∗ getTransition (int delay)

  Get the transition kernel for a given number of simulation steps (delay)
- void computeStationaryDistribution (double threshold)

  Compute the stationary distribution of the Markov chain by iterating the transition kernel.
- MarkovTrajectory ∗ computeTrajectory (int time, int length)

  Compute a possible trajectory of the Markov chain.
- double getProbability (int individual, int currentTime)

  Get the probability to be in a given state at a given time (-1 for the stationary distribution)
- double getProbability (Part ∗part, int currentTime)

  Get the probability to be in a given subset of states at a given time (-1 for the stationary distribution)
- double getNextProbability (int nextIndividual, int currentIndividual, int delay)

  Get the probability to be in a given state after a given delay knowing the current state.
- double getNextProbability (Part ∗nextPart, int currentIndividual, int delay)

  Get the probability to be in a given subset of states after a given delay knowing the current state.
- double getNextProbability (Part ∗nextPart, Part ∗currentPart, int delay, int time)

  Get the probability to be in a given subset of states after a given delay knowing the current subset of states at a given time (-1 for the stationary distribution)
- double getEntropy (Partition ∗partition, int currentTime)

  Get the Shannon entropy of the state distribution at a given time (-1 for the stationary distribution) when lumped according to a given partition of the state space.
- double getMutualInformation (Partition ∗nextPartition, Partition ∗currentPartition, int delay, int time)

  Get the mutual information between the state distribution at a given time (-1 for the stationary distribution) and the state distribution after a given delay, when both are lumped according to a given partition of the state space.
- double **getPartMutualInformation** (Partition ∗nextPartition, Part ∗currentPart, int delay, int time)
- double getNextEntropy (Partition ∗partition, bool micro, int delay, int time)

  Get the Shannon entropy of the next state distribution knowing the current state distribution at a given time (-1 for the stationary distribution), when the next distribution is lumped according to a given partition of the state space, and when the current partition is also lumped by the same partition (when micro is false)
- double getInformationFlow (Partition ∗partition, int delay, int time)

  Get the information flow at a given time (-1 for the stationary distribution) between the Markov chain lumped according to a given partition of the state space and the microscopic Markov chain.
- int ∗ **getOptimalCut** (int microSize, double ∗macroEntropy, double ∗macroInformation, double beta)
- std::set< OrderedPartition ∗ > ∗ **getOptimalOrderedPartition** (Partition ∗nextPartition, Partition ∗currentPartition, int delay, int time, double threshold)

Public Attributes

- int size
- double $*$ distribution
- std::vector$<$ double $*$ $>$ $*$ distributions
- int lastTime
- double $*$ transition
- std::vector$<$ double $*$ $>$ $*$ transitions
- int lastDelay

5.8.1 Detailed Description

A finite Markov chain described by a discrete state space, an initial distribution, and a transition kernel.

5.8.2 Constructor & Destructor Documentation

5.8.2.1 MarkovProcess::MarkovProcess (int *s*)

Constructor.

Parameters

size	: The size of the Markov chain state space

Author

Robin Lamarche-Perrin

Date

22/01/2015

5.8.3 Member Function Documentation

5.8.3.1 void MarkovProcess::computeStationaryDistribution (double *threshold*)

Compute the stationary distribution of the Markov chain by iterating the transition kernel.

Parameters

threshold	: Determines stationarity by giving the minimal difference between two probability values in two different but consecutive distributions

Warning

Will endlessly loop for periodic Markov chains

5.8.3.2 MarkovTrajectory $*$ MarkovProcess::computeTrajectory (int *time,* int *length*)

Compute a possible trajectory of the Markov chain.

Parameters

length	: Length of the trajectory

5.8.3.3 void MarkovProcess::setDistribution (double * *array*)

Set the initial distribution.

Parameters

array	: An array of probabilities (summing to 1) with the size of the Markov chain state space

5.8.3.4 void MarkovProcess::setTransition (double * *array*)

Set the transition kernel.

Parameters

array	: A 2D-array of probabilities (summing to 1 within each row) with the square of the size of the Markov chain state space

5.8.3.5 void MarkovProcess::setTransition (int *i,* double * *array*)

Set one line of the transition kernel.

Parameters

j	: The index of the row to be set
array	: An array of probabilities (summing to 1) with the size of the Markov chain state space

5.8.4 Member Data Documentation

5.8.4.1 double* MarkovProcess::distribution

The initial probability distribution of the system state (time 0)

5.8.4.2 std::vector<double*>* MarkovProcess::distributions

A vector of probability distributions through time (from 0 to lastTime)

5.8.4.3 int MarkovProcess::lastDelay

The delay of the furthest computed transition kernel in the transitions vector

5.8.4.4 int MarkovProcess::lastTime

The time of the furthest computed probability distribution in the distributions vector

5.8.4.5 int MarkovProcess::size

The size of the Markov chain state space

5.8.4.6 double∗ MarkovProcess::transition

The transition kernel of the Markov chain (1 step)

5.8.4.7 std::vector<double∗>∗ MarkovProcess::transitions

A vector of transition kernels for several steps (from 1 to lastDelay)

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

- /home/lamarche/programming/multilevel_prediction/src/markov_process.hpp
- /home/lamarche/programming/multilevel_prediction/src/markov_process.cpp

5.9 MarkovTrajectory Class Reference

Public Member Functions

- **MarkovTrajectory** (MarkovProcess ∗process, int time, int length)
- void **print** (int binary=0)

Public Attributes

- MarkovProcess ∗ **process**
- int **time**
- int **length**
- int ∗ **states**

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

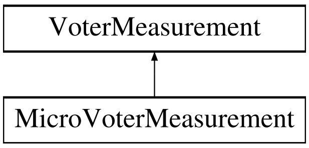
- /home/lamarche/programming/multilevel_prediction/src/markov_process.hpp
- /home/lamarche/programming/multilevel_prediction/src/markov_process.cpp

5.10 MicroVoterMeasurement Class Reference

A measurement consisting in one probe for each node of the interaction graph.

```
#include <voter_graph.hpp>
```

Inheritance diagram for MicroVoterMeasurement:



Public Member Functions

- MicroVoterMeasurement (VoterGraph ∗graph, std::set< VoterMetric > metric)

  Constructor.

Additional Inherited Members

5.10.1 Detailed Description

A measurement consisting in one probe for each node of the interaction graph.

5.10.2 Constructor & Destructor Documentation

5.10.2.1 MicroVoterMeasurement::MicroVoterMeasurement (**VoterGraph** $*$ *graph,* std::set$<$ **VoterMetric** $>$ *metric*)

Constructor.

Parameters

graph	: The interaction graph to be observed
metric	: The set of metric associated to the micro-probe

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.11 OrderedPartition Class Reference

Public Member Functions

- **OrderedPartition** (int s, double p)
- void **print** ()

Public Attributes

- int **microSize**
- int $*$ **optimalCut**
- double **param**
- double **beta**
- std::string **string**
- double **entropy**
- double **information**

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

- /home/lamarche/programming/multilevel_prediction/src/partition.hpp

5.12 Part Class Reference

A part of a partition (i.e., a set of individuals)

```
#include <partition.hpp>
```

Public Member Functions

- Part ()
- **Part** (Part ∗part)
- void **addIndividual** (int i, bool front=false, int value=-1)
- bool **contains** (int i)
- bool **equal** (Part ∗p)
- void **print** (bool endl=false)
- int **printSize** ()

Public Attributes

- int **id**
- int **size**
- int **value**
- std::list< int > ∗ **individuals**

5.12.1 Detailed Description

A part of a partition (i.e., a set of individuals)

5.12.2 Constructor & Destructor Documentation

5.12.2.1 Part::Part ( )

Author

Robin Lamarche-Perrin

Date

22/01/2015

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

- /home/lamarche/programming/multilevel_prediction/src/partition.hpp
- /home/lamarche/programming/multilevel_prediction/src/partition.cpp

5.13 Partition Class Reference

A partition (i.e., a set of disjoint and covering parts)

```
#include <partition.hpp>
```

Public Member Functions

- **Partition** (Partition ∗partition)
- void **addPart** (Part ∗p, bool front=false)
- Part ∗ **findPart** (int individual)
- Part ∗ **getPartFromValue** (int value)
- bool **equal** (Partition ∗p)
- void **print** (bool endl=false)

Public Attributes

- int **size**
- std::list< Part ∗ > ∗ **parts**

5.13.1 Detailed Description

A partition (i.e., a set of disjoint and covering parts)

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

- /home/lamarche/programming/multilevel_prediction/src/partition.hpp
- /home/lamarche/programming/multilevel_prediction/src/partition.cpp

5.14 Timer Class Reference

A timer mesuring computation times and memory consumption during the program execution.

```
#include <timer.hpp>
```

Public Member Functions

- **Timer** (char ∗file=0)
- void **start** (int size, std::string text="")
- void **startTime** ()
- void **startMemory** ()
- void **stop** (std::string text="")
- void **stopTime** ()
- void **stopMemory** ()
- void **step** (std::string text="")

5.14.1 Detailed Description

A timer mesuring computation times and memory consumption during the program execution.

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

- /home/lamarche/programming/multilevel_prediction/src/timer.hpp
- /home/lamarche/programming/multilevel_prediction/src/timer.cpp

5.15 TwoCommunitiesExperiment Class Reference

Programming a prediction experiment on a two-communities Voter Model.

```
#include <voter_experiment.hpp>
```

Public Member Functions

- TwoCommunitiesExperiment (int size1, int size2, double intraR1, double intraR2, double interR1, double interR2, double contrarian1, double contrarian2, double time, double delay, SpecMeasurementSet ∗preMeasurements, SpecMeasurementSet ∗postMeasurements)

  Constructor.
- ∼TwoCommunitiesExperiment ()

  Destructor.

Public Attributes

- int id
- UpdateProcess update
- double threshold
- bool compactModel
- bool **withAggregation**
- bool **partDecomposition**
- int size1Min
- int size1Max
- int size1Step
- int size2Min
- int size2Max
- int size2Step
- bool equalSize
- double intraR1Min
- double intraR1Max
- double intraR1Step
- double intraR2Min
- double intraR2Max
- double intraR2Step
- double interR1Min
- double interR1Max
- double interR1Step
- double interR2Min
- double interR2Max
- double interR2Step
- bool equalIntraRate
- bool equalInterRate
- bool oppositeInterRate
- double contrarian1Min
- double contrarian1Max
- double contrarian1Step
- double contrarian2Min
- double contrarian2Max
- double contrarian2Step
- bool equalContrarian
- int timeMin
- int timeMax
- int timeStep
- int delayMin
- int delayMax
- int delayStep
- SpecMeasurementSet $*$ preMeasurements
- SpecMeasurementSet $*$ postMeasurements

Static Public Attributes

- static int id_number = 0

5.15.1 Detailed Description

Programming a prediction experiment on a two-communities Voter Model.

5.15.2 Constructor & Destructor Documentation

5.15.2.1 TwoCommunitiesExperiment::TwoCommunitiesExperiment (int *size1,* int *size2,* double *intraR1,* double *intraR2,* double *interR1,* double *interR2,* double *contrarian1,* double *contrarian2,* double *time,* double *delay,* SpecMeasurementSet ∗ *preMeasurements,* SpecMeasurementSet ∗ *postMeasurements*)

Constructor.

Parameters

size1	: The size of community 1 in all experiments
size2	: The size of community 2 in all experiments
intraR1	: The weight of edges within community 1 in all experiments
intraR2	: The weight of edges within community 2 in all experiments
interR1	: The weight of edges from community 1 to community 2 in all experiments
interR2	: The weight of edges from community 2 to community 1 in all experiments
contrarian1	: The contrarian rate of nodes within community 1 in all experiments
contrarian2	: The contrarian rate of nodes within community 2 in all experiments
time	: The time of pre-measurement (-1 for stationary distribution) in all experiments
delay	: The delay before post-measurement in all experiments
preMeasurements	: A set of pre-measurement for prediction
postMeasurements	: A set of post-measurement to be predicted

5.15.3 Member Data Documentation

5.15.3.1 bool TwoCommunitiesExperiment::compactModel

If true, the computed microscopic Markov chain is lumped according to the macro-state of community 1, the macro-state of community 2, and the state of the first agent in community 1

5.15.3.2 double TwoCommunitiesExperiment::contrarian1Max

The contrarian rate of nodes within community 1 in the last experiment

5.15.3.3 double TwoCommunitiesExperiment::contrarian1Min

The contrarian rate of nodes within community 1 in the first experiment

5.15.3.4 double TwoCommunitiesExperiment::contrarian1Step

The contrarian rate of nodes within community 1 between two consecutive experiments

5.15.3.5 double TwoCommunitiesExperiment::contrarian2Max

The contrarian rate of nodes within community 2 in the last experiment

5.15.3.6 double TwoCommunitiesExperiment::contrarian2Min

The contrarian rate of nodes within community 2 in the first experiment

5.15.3.7 double TwoCommunitiesExperiment::contrarian2Step

The contrarian rate of nodes within community 2 between two consecutive experiments

5.15.3.8 int TwoCommunitiesExperiment::delayMax

The delay before post-measurement in the last experiment

5.15.3.9 int TwoCommunitiesExperiment::delayMin

The delay before post-measurement in the first experiment

5.15.3.10 int TwoCommunitiesExperiment::delayStep

The delay before post-measurement between two consecutive experiments

5.15.3.11 bool TwoCommunitiesExperiment::equalContrarian

If true, the contrarian rate of nodes within community 2 is the same than the contrarian rate of nodes within community 1 in all experiments

5.15.3.12 bool TwoCommunitiesExperiment::equalInterRate

If true, the weight of edges from community 2 to community 1 is the same than the weight of edges from community 1 to community 2 in all experiments

5.15.3.13 bool TwoCommunitiesExperiment::equalIntraRate

If true, the weight of edges within community 2 is the same than the weight of edges within community 2 in all experiments

5.15.3.14 bool TwoCommunitiesExperiment::equalSize

If true, the size of community 2 is the same than the size of community 1 in all experiments

5.15.3.15 int TwoCommunitiesExperiment::id

A unique experiment number

5.15.3.16 int TwoCommunitiesExperiment::id_number = 0 [static]

Author

Robin Lamarche-Perrin

Date

22/01/2015

5.15.3.17 double TwoCommunitiesExperiment::interR1Max

The weight of edges from community 1 to community 2 in the last experiment

5.15.3.18 double TwoCommunitiesExperiment::interR1Min

The weight of edges from community 1 to community 2 in the first experiment

5.15.3.19 double TwoCommunitiesExperiment::interR1Step

The weight of edges from community 1 to community 2 between two consecutive experiments

5.15.3.20 double TwoCommunitiesExperiment::interR2Max

The weight of edges from community 2 to community 1 in the last experiment

5.15.3.21 double TwoCommunitiesExperiment::interR2Min

The weight of edges from community 2 to community 1 in the first experiment

5.15.3.22 double TwoCommunitiesExperiment::interR2Step

The weight of edges from community 2 to community 1 between two consecutive experiments

5.15.3.23 double TwoCommunitiesExperiment::intraR1Max

The weight of edges within community 1 in the last experiment

5.15.3.24 double TwoCommunitiesExperiment::intraR1Min

The weight of edges within community 1 in the first experiment

5.15.3.25 double TwoCommunitiesExperiment::intraR1Step

The weight of edges within community 1 between two consecutive experiments

5.15.3.26 double TwoCommunitiesExperiment::intraR2Max

The weight of edges within community 2 in the last experiment

5.15.3.27 double TwoCommunitiesExperiment::intraR2Min

The weight of edges within community 2 in the first experiment

5.15.3.28 double TwoCommunitiesExperiment::intraR2Step

The weight of edges within community 2 between two consecutive experiments

5.15.3.29 bool TwoCommunitiesExperiment::oppositeInterRate

If true, the weight of edges from community 2 to community 1 is the opposite of the weight of edges from community 1 to community 2 in all experiments (w2 = 1 - w1)

5.15.3.30 SpecMeasurementSet∗ TwoCommunitiesExperiment::postMeasurements

A set of post-measurement to be predicted

5.15.3.31 SpecMeasurementSet∗ TwoCommunitiesExperiment::preMeasurements

A set of pre-measurement for prediction

5.15.3.32 int TwoCommunitiesExperiment::size1Max

The size of community 1 in the last experiment

5.15.3.33 int TwoCommunitiesExperiment::size1Min

The size of community 1 in the first experiment

5.15.3.34 int TwoCommunitiesExperiment::size1Step

The size of community 1 between two consecutive experiments

5.15.3.35 int TwoCommunitiesExperiment::size2Max

The size of community 2 in the last experiment

5.15.3.36 int TwoCommunitiesExperiment::size2Min

The size of community 2 in the first experiment

5.15.3.37 int TwoCommunitiesExperiment::size2Step

The size of community 2 between two consecutive experiments

5.15.3.38 double TwoCommunitiesExperiment::threshold

The precision threshold to compute the stationary distribution of the Markov chain (see computeStationary-Distribution method in MarkovProcess class)

5.15.3.39 int TwoCommunitiesExperiment::timeMax

The time of pre-measurement (-1 for stationary distribution) in the last experiment

5.15.3.40 int TwoCommunitiesExperiment::timeMin

The time of pre-measurement (-1 for stationary distribution) in the first experiment

5.15.3.41 int TwoCommunitiesExperiment::timeStep

The time of pre-measurement (-1 for stationary distribution) between two consecutive experiments

5.15.3.42 UpdateProcess TwoCommunitiesExperiment::update

The update process of the built Voter Model

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

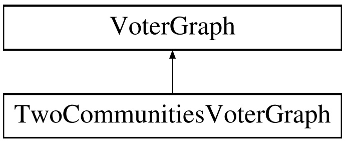
- /home/lamarche/programming/multilevel_prediction/src/voter_experiment.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_experiment.cpp

5.16 TwoCommunitiesVoterGraph Class Reference

An interaction graph consisting in two communities of nodes (complete graph within each community, complete interaction between the two communities, possibly with different weights)

```
#include <voter_graph.hpp>
```

Inheritance diagram for TwoCommunitiesVoterGraph:



Public Member Functions

- TwoCommunitiesVoterGraph (int size1, int size2, double intraRate1, double intraRate2, double interRate1, double interRate2, double contrarian1, double contrarian2, int update=UPDATE_EDGES)

  Constructor.
- ∼TwoCommunitiesVoterGraph ()

  Destructor.
- MarkovProcess ∗ getCompactMarkovProcess ()

  Build the Markov chain associated to the graph, lumped according to the macro-state of community 1, the macro-state of community 2, and the state of the first agent in community 1.
- Partition ∗ getCompactMarkovPartition (VoterProbe ∗probe, VoterMetric metric)

  Build the partition of the lumped Markov chain state space (see getCompactMarkovProcess) associated to a probe with a given metric (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)
- Partition ∗ getCompactMarkovPartition (VoterMeasurement ∗measurement)

  Build the partition of the lumped Markov chain state space (see getCompactMarkovProcess) associated to a measurement (i.e., a set of probes)

Public Attributes

- int size1
- int size2
- double intraRate1
- double intraRate2
- double interRate1
- double interRate2
- double contrarian1
- double contrarian2
- std::set< VoterNode ∗ > ∗ community1
- std::set< VoterNode ∗ > ∗ community2

5.16.1 Detailed Description

An interaction graph consisting in two communities of nodes (complete graph within each community, complete interaction between the two communities, possibly with different weights)

5.16.2 Constructor & Destructor Documentation

5.16.2.1 TwoCommunitiesVoterGraph::TwoCommunitiesVoterGraph (int *size1,* int *size2,* double *intraRate1,* double *intraRate2,* double *interRate1,* double *interRate2,* double *contrarian1,* double *contrarian2,* int *update* = UPDATE_EDGES)

Constructor.

Parameters

size1	: The size of community 1
size2	: The size of community 2
intraRate1	: The weight of edges within community 1
intraRate2	: The weight of edges within community 2
interRate1	: The weight of edges from community 1 to community 2
interRate2	: The weight of edges from community 2 to community 1
contrarian1	: The contrarian rate of nodes in community 1
contrarian2	: The contrarian rate of nodes in community 2
update	: How the system evolves at each simulation step (UPDATE_NODES or UPDATE_EDGES)

5.16.3 Member Function Documentation

5.16.3.1 Partition ∗ TwoCommunitiesVoterGraph::getCompactMarkovPartition (VoterProbe ∗ *probe,* VoterMetric *metric*)

Build the partition of the lumped Markov chain state space (see getCompactMarkovProcess) associated to a probe with a given metric (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)

Parameters

probe	: The probe used to partition the lumped state space
metric	: The metric of the probe (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)

Returns

The computed partition over the lumped state space

5.16.3.2 Partition ∗ TwoCommunitiesVoterGraph::getCompactMarkovPartition (VoterMeasurement ∗ *measurement*)

Build the partition of the lumped Markov chain state space (see getCompactMarkovProcess) associated to a measurement (i.e., a set of probes)

Parameters

measurement	: The measurement used to partition the lumped state space

Returns

The computed partition over the lumped state space

5.16.3.3 MarkovProcess ∗ TwoCommunitiesVoterGraph::getCompactMarkovProcess ( )

Build the Markov chain associated to the graph, lumped according to the macro-state of community 1, the macro-state of community 2, and the state of the first agent in community 1.

Returns

The computed lumped Markov chain

5.16.4 Member Data Documentation

5.16.4.1 std::set< VoterNode∗ >∗ TwoCommunitiesVoterGraph::community1

The set of nodes in community 1

5.16.4.2 std::set< VoterNode∗ >∗ TwoCommunitiesVoterGraph::community2

The set of nodes in community 2

5.16.4.3 double TwoCommunitiesVoterGraph::contrarian1

The contrarian rate of nodes in community 1

5.16.4.4 double TwoCommunitiesVoterGraph::contrarian2

The contrarian rate of nodes in community 2

5.16.4.5 double TwoCommunitiesVoterGraph::interRate1

The weight of edges from community 1 to community 2

5.16.4.6 double TwoCommunitiesVoterGraph::interRate2

The weight of edges from community 2 to community 1

5.16.4.7 double TwoCommunitiesVoterGraph::intraRate1

The weight of edges within community 1

5.16.4.8 double TwoCommunitiesVoterGraph::intraRate2

The weight of edges within community 2

5.16.4.9 int TwoCommunitiesVoterGraph::size1

The size of community 1

5.16.4.10 int TwoCommunitiesVoterGraph::size2

The size of community 2

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.17 VoterBinning Class Reference

Public Member Functions

- **VoterBinning** (VoterDataSet ∗data)
- void **print** (bool verbose=false)

Public Attributes

- VoterDataSet ∗ **data**
- int **size**
- int **binNumber**
- int ∗ **cuts**
- double **score**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.18 VoterDataSet Class Reference

Public Member Functions

- **VoterDataSet** (VoterGraph ∗graph, int time, int delay, int trainSize, int testSize, int trainLength, int testLength)
- void **estimateTransitionMap** (VoterMeasurement ∗preM, VoterMeasurement ∗postM)
- void **printTransitionMap** ()
- double **getLogScore** (VoterMeasurement ∗preM, VoterMeasurement ∗postM, int prior=0)
- double **getQuadScore** (VoterMeasurement ∗preM, VoterMeasurement ∗postM, int prior=0)
- VoterBinning ∗ **getOptimalBinning** (VoterMeasurement ∗preM, VoterMeasurement ∗postM, int prior=0, int realTrainSize=-1, bool verbose=false)

Public Attributes

- VoterGraph ∗ **graph**
- int **time**
- int **delay**
- int **trainSize**
- int **testSize**
- int **trainLength**
- int **testLength**
- VoterTrajectory ∗∗ **trajectories**
- TransitionMap ∗ **transMap**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.19 VoterEdge Class Reference

An edge of the interaction graph.

```
#include <voter_graph.hpp>
```

Public Member Functions

- VoterEdge (VoterNode ∗node1, VoterNode ∗node2, double weight=1)

  Constructor.
- ∼VoterEdge ()

  Destructor.

Public Attributes

- VoterNode ∗ node1
- VoterNode ∗ node2
- double weight

5.19.1 Detailed Description

An edge of the interaction graph.

5.19.2 Constructor & Destructor Documentation

5.19.2.1 VoterEdge::VoterEdge (VoterNode ∗ *node1,* VoterNode ∗ *node2,* double *weight* = 1)

Constructor.

Parameters

node1	: Incoming node
node2	: Outcoming node
weight	: Determines the probability to select this edge (relatively to other edges) at each simulation step when the updateProcess variable of the graph is set to UPDATE_EDGES

5.19.3 Member Data Documentation

5.19.3.1 VoterNode∗ VoterEdge::node1

Incoming node

5.19.3.2 VoterNode∗ VoterEdge::node2

Outcoming node

5.19.3.3 double VoterEdge::weight

Determines the probability to select this edge (relatively to other edges) at each simulation step when the updateProcess variable of the graph is set to UPDATE_EDGES

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

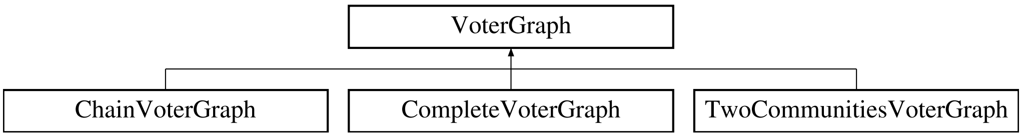
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.20 VoterGraph Class Reference

The interaction graph describing a Voter Model.

```
#include <voter_graph.hpp>
```

Inheritance diagram for VoterGraph:



Public Member Functions

- VoterGraph (int update=UPDATE_EDGES)

  Constructor.
- virtual ∼VoterGraph ()

  Destructor.
- void print ()

  Print the graph structure and details.
- VoterNode ∗ addNode (double weight=1, double contrarian=0)

  Add a node to the graph.
- VoterEdge ∗ addEdge (VoterNode ∗node1, VoterNode ∗node2, double weight=1)

  Add an edge to the graph.
- void fillEdges ()

  Add an edge between each pair of nodes in the graph (in both direction, with equal weight for each edge)
- VoterNode ∗ **getRandomNode** ()
- VoterNode ∗ **getUniformRandomNode** ()
- VoterEdge ∗ **getRandomEdge** (VoterNode ∗node)
- MarkovProcess ∗ getMarkovProcess ()

  Build the Markov chain associated to the described Voter Model.
- Partition ∗ getMarkovPartition (VoterProbe ∗probe, VoterMetric metric)

  Build the partition of the Markov chain state space associated to a probe with a given metric (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)
- Partition ∗ getMarkovPartition (VoterMeasurement ∗measurement)

  Build the partition of the Markov chain state space associated to a measurement (i.e., a set of probes)

Public Attributes

- int updateProcess
- int **complete**
- int nodeNumber
- int edgeNumber
- double nodeWeight
- double edgeWeight
- std::map< int, VoterNode ∗ > ∗ nodeMap
- std::set< VoterNode ∗ > ∗ nodeSet
- std::set< VoterEdge ∗ > ∗ edgeSet
- MarkovProcess ∗ process

5.20.1 Detailed Description

The interaction graph describing a Voter Model.

5.20.2 Constructor & Destructor Documentation

5.20.2.1 VoterGraph::VoterGraph (int *update* = UPDATE_EDGES)

Constructor.

Parameters

update	: How the system evolves at each simulation step (UPDATE_NODES or UPDATE_EDGES)

5.20.3 Member Function Documentation

5.20.3.1 VoterEdge ∗ VoterGraph::addEdge (VoterNode ∗ *node1,* VoterNode ∗ *node2,* double *weight* = 1)

Add an edge to the graph.

Parameters

node1	: Incoming node
node2	: outcoming node
weight	: Determines the probability to select the edge to be added (relatively to other edges) at each simulation step when the updateProcess variable of the graph is set to UPDATE_EDGES

Returns

The added edge

5.20.3.2 VoterNode ∗ VoterGraph::addNode (double *weight* = 1, double *contrarian* = 0)

Add a node to the graph.

Parameters

weight	: Determines the probability to select the node to be added (relatively to other nodes) at each simulation step when the updateProcess variable of the graph is set to UPDATE_NODES
contrarian	: The contrarian rate of the node to be added

Returns

The added node

5.20.3.3 Partition ∗ VoterGraph::getMarkovPartition (VoterProbe ∗ *probe,* VoterMetric *metric*)

Build the partition of the Markov chain state space associated to a probe with a given metric (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)

Parameters

probe	: The probe used to partition the state space
metric	: The metric of the probe (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)

Returns

The computed partition

5.20.3.4 Partition ∗ VoterGraph::getMarkovPartition (VoterMeasurement ∗ *measurement*)

Build the partition of the Markov chain state space associated to a measurement (i.e., a set of probes)

Parameters

measurement	: The measurement used to partition the state space

Returns

The computed partition

5.20.3.5 MarkovProcess ∗ VoterGraph::getMarkovProcess ( )

Build the Markov chain associated to the described Voter Model.

Returns

The computed Markov chain

5.20.4 Member Data Documentation

5.20.4.1 int VoterGraph::edgeNumber

The total number of edges in the graph

5.20.4.2 std::set<VoterEdge∗>∗ VoterGraph::edgeSet

The set of all edges

5.20.4.3 double VoterGraph::edgeWeight

The sum of the weight of all edges

5.20.4.4 std::map<int,VoterNode∗>∗ VoterGraph::nodeMap

The map of all nodes organized by id

5.20.4.5 int VoterGraph::nodeNumber

The total number of nodes in the graph

5.20.4.6 std::set<VoterNode∗>∗ VoterGraph::nodeSet

The set of all nodes

5.20.4.7 double VoterGraph::nodeWeight

The sum of the weight of all nodes

5.20.4.8 MarkovProcess∗ VoterGraph::process

The Markov chain associated to the described Voter Model

5.20.4.9 int VoterGraph::updateProcess

How the system evolves at each simulation step (UPDATE_NODES or UPDATE_EDGES)

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

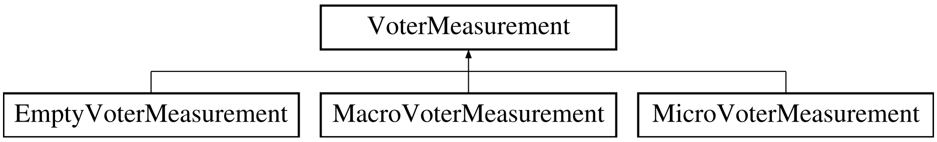
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.21 VoterMeasurement Class Reference

A measurement to observe the Voter Model according set of probes.

`#include <voter_graph.hpp>`

Inheritance diagram for VoterMeasurement:



Public Member Functions

- VoterMeasurement (VoterGraph ∗graph, std::string type)

  Constructor.
- ∼VoterMeasurement ()

  Destructor.
- void addProbe (VoterProbe ∗probe, VoterMetric metric, int binning=0)

  Add a probe to the measurement.
- int **getCardinality** ()
- VoterMeasurementState ∗ **getState** (VoterState ∗state)
- void print (bool endl=false)

  Print the measurement details.

Public Attributes

- VoterGraph ∗ graph
- std::string type
- Partition ∗ partition
- int probeNumber
- std::map< int, VoterProbe ∗ > ∗ probeMap
- std::map< int, VoterMetric > ∗ metricMap
- std::map< int, int > ∗ **binningMap**

5.21.1 Detailed Description

A measurement to observe the Voter Model according set of probes.

5.21.2 Constructor & Destructor Documentation

5.21.2.1 VoterMeasurement::VoterMeasurement (**VoterGraph** ∗ *graph*, std::string *type*)

Constructor.

Parameters

graph	: The interaction graph to be observed
type	: The name of the measurement

5.21.3 Member Function Documentation

5.21.3.1 void VoterMeasurement::addProbe (**VoterProbe** ∗ *probe*, **VoterMetric** *metric*, int *binning* = `0`)

Add a probe to the measurement.

Parameters

node	: The probe to be added
metric	: The metric associated to the added probe (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES)

5.21.3.2 void VoterMeasurement::print (bool *endl* = `false`)

Print the measurement details.

Parameters

endl	: Line break after printing if true

5.21.4 Member Data Documentation

5.21.4.1 **VoterGraph**∗ VoterMeasurement::graph

The interaction graph to be observed

5.21.4.2 std::map<int,**VoterMetric**>∗ VoterMeasurement::metricMap

The map of metrics (e.g., METRIC_MACRO_STATE of METRIC_ACTIVE_EDGES) associated to each constituting probe organized by probe numbers

5.21.4.3 **Partition**∗ VoterMeasurement::partition

The partition of the Markov chain state space corresponding to the measurement

5.21.4.4 std::map<int,**VoterProbe**∗>∗ VoterMeasurement::probeMap

The map of constituting probes organized by probe numbers

5.21.4.5 int VoterMeasurement::probeNumber

The number of probes constituting the measurement

5.21.4.6 std::string VoterMeasurement::type

The name of the measurement

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.22 VoterMeasurementState Class Reference

Public Member Functions

- **VoterMeasurementState** (VoterMeasurement ∗measurement)
- void **init** (int value)
- bool **isEqual** (VoterMeasurementState ∗state)
- void **print** ()

Public Attributes

- VoterMeasurement ∗ **measurement**
- int **size**
- int ∗ **probeStates**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.23 VoterMeasurementTrajectory Class Reference

Public Member Functions

- **VoterMeasurementTrajectory** (VoterMeasurement ∗measurement, VoterTrajectory ∗trajectory)
- void **print** ()

Public Attributes

- VoterMeasurement ∗ **measurement**
- VoterGraph ∗ **graph**
- int **length**
- VoterMeasurementState ∗∗ **states**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.24 VoterNode Class Reference

A node of the interaction graph.

```
#include <voter_graph.hpp>
```

Public Member Functions

- VoterNode (int id, double weight=1, double contrarian=0)

  Constructor.
- ∼VoterNode ()

  Destructor.

Public Attributes

- int id
- double weight
- double contrarian
- int inEdgeWeight
- int inEdgeNumber
- std::set< VoterEdge ∗ > ∗ inEdgeSet
- int outEdgeWeight
- int outEdgeNumber
- std::set< VoterEdge ∗ > ∗ outEdgeSet

5.24.1 Detailed Description

A node of the interaction graph.

5.24.2 Constructor & Destructor Documentation

5.24.2.1 VoterNode::VoterNode (int *i*, double *w* = 1, double *c* = 0)

Constructor.

Parameters

id	: Unique id within the graph
weight	: Determines the probability to select this node (relatively to other nodes) at each simulation step when the updateProcess variable of the graph is set to UPDATE_NODES
contrarian	: Contrarian rate of the node

Author

Robin Lamarche-Perrin

Date

22/01/2015

5.24.3 Member Data Documentation

5.24.3.1 double VoterNode::contrarian

Contrarian rate of the node

5.24.3.2 int VoterNode::id

Unique id within the graph

5.24.3.3 int VoterNode::inEdgeNumber

Sum of the weight of incoming edges

5.24.3.4 std::set<VoterEdge∗>∗ VoterNode::inEdgeSet

Set of incoming edges

5.24.3.5 int VoterNode::inEdgeWeight

Sum of the weight of incoming nodes

5.24.3.6 int VoterNode::outEdgeNumber

Sum of the weight of outcoming edges

5.24.3.7 std::set<VoterEdge∗>∗ VoterNode::outEdgeSet

Set of outcoming edges

5.24.3.8 int VoterNode::outEdgeWeight

Sum of the weight of outcoming nodes

5.24.3.9 double VoterNode::weight

Determines the probability to select this node (relatively to other nodes) at each simulation step when the updateProcess variable of the graph is set to UPDATE_NODES

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.25 VoterProbe Class Reference

A probe to observe the Voter Model according to a subset of nodes.

```
#include <voter_graph.hpp>
```

Public Member Functions

- VoterProbe (VoterGraph ∗graph)

  Constructor.
- ∼VoterProbe ()

  Destructor.

- void setNodeSet (std::set< VoterNode ∗ > ∗set)

  Set the set of observed nodes.
- void addNode (VoterNode ∗node)

  Add an observed node to the probe.
- void addNodes (unsigned long int i)

  Add a set of observed nodes to the probe.
- int **getCardinality** (VoterMetric metric, int binning=0)
- int **getState** (VoterState ∗state, VoterMetric metric, int binning=0)
- void print (bool endl=false)

  Print the probe details.

Public Attributes

- VoterGraph ∗ graph
- int nodeNumber
- std::set< VoterNode ∗ > ∗ nodeSet

5.25.1 Detailed Description

A probe to observe the Voter Model according to a subset of nodes.

5.25.2 Constructor & Destructor Documentation

5.25.2.1 VoterProbe::VoterProbe (**VoterGraph** ∗ *graph*)

Constructor.

Parameters

graph	: The interaction graph to be observed

5.25.3 Member Function Documentation

5.25.3.1 void VoterProbe::addNode (**VoterNode** ∗ *node*)

Add an observed node to the probe.

Parameters

node	: The node to be added

5.25.3.2 void VoterProbe::addNodes (unsigned long int *i*)

Add a set of observed nodes to the probe.

Parameters

graph	: A binary number indicating for each node of the graph if it should (1) or should not (0) be added (the nodes are ordered according to their unique id)

5.25.3.3 void VoterProbe::print (bool *endl* = `false`)

Print the probe details.

Parameters

endl	: Line break after printing if true

5.25.3.4 void VoterProbe::setNodeSet (std::set< VoterNode * > * *set*)

Set the set of observed nodes.

Parameters

node	: The set to be associated

5.25.4 Member Data Documentation

5.25.4.1 VoterGraph* VoterProbe::graph

The interaction graph to be observed

5.25.4.2 int VoterProbe::nodeNumber

The number of observed nodes

5.25.4.3 std::set<VoterNode*>* VoterProbe::nodeSet

The set of observed nodes

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.26 VoterState Class Reference

Public Member Functions

- **VoterState** (VoterGraph *graph)
- **VoterState** (VoterState *state)
- void **print** ()
- void **setFromMicroUniform** ()
- void **setFromMacroUniform** ()
- VoterState * **getNextState** ()

Public Attributes

- VoterGraph * **graph**
- int **size**
- bool * **agentStates**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

5.27 VoterTrajectory Class Reference

Public Member Functions

- **VoterTrajectory** (VoterGraph ∗graph, int time, int length)
- void **print** ()

Public Attributes

- VoterGraph ∗ **graph**
- int **time**
- int **length**
- VoterState ∗∗ **states**

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

- /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp
- /home/lamarche/programming/multilevel_prediction/src/voter_graph.cpp

Chapter 6

File Documentation

6.1 /home/lamarche/programming/multilevel_prediction/src/csv_tools.hpp File Reference

Tools to handle input and output CSV files.

```
#include <vector>
#include <string>
#include <time.h>
```

Typedefs

- typedef std::vector< std::string > **CSVLine**

Functions

- void deleteCSV (std::string fileName)
- void **openInputCSV** (std::ifstream &file, std::string fileName)
- bool **isInputCSVEmpty** (std::ifstream &file)
- bool **hasCSVLine** (std::ifstream &file)
- void **getCSVLine** (std::ifstream &file, CSVLine &line, int sizeMax=8)
- void **printCSVLine** (CSVLine &line)
- void **parseCSVFile** (std::string fileName)
- int **getCSVSize** (std::string fileName)
- void **closeInputCSV** (std::ifstream &file)
- void **openOutputCSV** (std::ofstream &file, std::string fileName, bool erase=false)
- void **addCSVLine** (std::ofstream &file, CSVLine &line)
- void **addCSVField** (std::ofstream &file, int field, bool endField=true)
- void **addCSVField** (std::ofstream &file, double field, bool endField=true, int prec=0)
- void **addCSVField** (std::ofstream &file, std::string field, bool endField=true)
- void **addCSVNAField** (std::ofstream &file, bool endField=true)
- void **addCSVNULLField** (std::ofstream &file, bool endField=true)
- void **endCSVField** (std::ofstream &file)
- void **endCSVLine** (std::ofstream &file)
- void **closeOutputCSV** (std::ofstream &file)
- double **string2double** (std::string str)
- std::string **int2string** (int value)
- std::string **float2string** (float value, int prec=10)
- std::string **double2string** (double value, int prec=10)
- time_t **date2time** (std::string date)

Variables

- bool VERBOSE
- int **VERBOSE_TAB**
- const bool **CSV_QUOTES** = false
- const char **QUOTE_CHAR** = ’"’
- const char **ESCAPE_CHAR** = ’\\’
- const char **FIELD_DELIM** = ’,’
- const char **LINE_DELIM** = ’\n’
- const int **DATE_INDEX** = 3
- const int **TITLE_INDEX** = 4
- const int **BODY_INDEX** = 5
- const int **MAX_INDEX** = 17

6.1.1 Detailed Description

Tools to handle input and output CSV files.

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.1.2 Function Documentation

6.1.2.1 void deleteCSV (std::string *fileName*)

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.1.3 Variable Documentation

6.1.3.1 bool VERBOSE

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.2 /home/lamarche/programming/multilevel_prediction/src/main.hpp File Reference

Main program to run tests and experiments (see for example class VoterExperiment)

```
#include "csv_tools.hpp"
#include "voter_graph.hpp"
#include "markov_process.hpp"
```

Functions

- void **computeInformationMeasures** ()
- void **testScoreFunctions** ()
- void **testMarkovProcess** ()
- void **testVoterGraph** ()
- void **testMeasuresWithAggregation** ()
- long unsigned int **nChoosek** (int n, int k)

6.2.1 Detailed Description

Main program to run tests and experiments (see for example class VoterExperiment)

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.3 /home/lamarche/programming/multilevel_prediction/src/markov_process.hpp File Reference

Class to build a finite Markov chain.

```
#include <vector>
#include "partition.hpp"
```

Classes

- class MarkovProcess

  A finite Markov chain described by a discrete state space, an initial distribution, and a transition kernel.
- class MarkovTrajectory
- class MarkovDataSet

6.3.1 Detailed Description

Class to build a finite Markov chain.

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.4 /home/lamarche/programming/multilevel_prediction/src/partition.hpp File Reference

Classes to build partitions of the state space of Markov chains.

```
#include <set>
#include <list>
```

Classes

- class Part

    A part of a partition (i.e., a set of individuals)
- class Partition

    A partition (i.e., a set of disjoint and covering parts)
- class OrderedPartition

Typedefs

- typedef std::set< Part ∗ > **PartSet**
- typedef std::list< Partition ∗ > **PartitionList**

6.4.1 Detailed Description

Classes to build partitions of the state space of Markov chains.

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.5 /home/lamarche/programming/multilevel_prediction/src/timer.hpp File Reference

Tools to mesure computation times and memory consumption during the program execution.

```
#include <list>
#include <time.h>
```

Classes

- struct DataPointStruct

    The computation time and memory consumption associated to an experiment of a given size.
- class Timer

    A timer mesuring computation times and memory consumption during the program execution.

Typedefs

- typedef struct DataPointStruct DataPoint

    The computation time and memory consumption associated to an experiment of a given size.

Functions

- int **getMemory** ()

6.5.1 Detailed Description

Tools to mesure computation times and memory consumption during the program execution.

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.6 /home/lamarche/programming/multilevel_prediction/src/voter_experiment.hpp File Reference

Tools to run prediction experiments on Voter Models.

```
#include <fstream>
#include "csv_tools.hpp"
#include "partition.hpp"
#include "voter_graph.hpp"
#include "markov_process.hpp"
```

Classes

- class TwoCommunitiesExperiment

  Programming a prediction experiment on a two-communities Voter Model.
- class ChainExperiment

Typedefs

- typedef std::set < TwoCommunitiesExperiment ∗ > **TwoCommunitiesExperimentSet**
- typedef std::set < ChainExperiment ∗ > **ChainExperimentSet**

Functions

- void twoCommunitiesExperiment (TwoCommunitiesExperimentSet ∗expSet, std::string fileName)

  Run a set of programmed experiments.
- void **chainExperiment** (ChainExperimentSet ∗expSet, std::string fileName)
- void **addMeasurement** (MeasurementSet ∗set, VoterGraph ∗VG, MeasurementType type, VoterMetric metric)
- void **addMultiMeasurement** (MeasurementSet ∗set, VoterGraph ∗VG, MeasurementType type, VoterMetric metric)
- VoterMeasurement ∗ **getMeasurement** (VoterGraph ∗VG, MeasurementType type, VoterMetric metric=MACRO_STATE, int binning=0)
- void **addTwoCommunitiesHeaderToCSV** (std::string fileName)
- void **addTwoCommunitiesPartHeaderToCSV** (std::string fileName, std::string type)
- void **computeTwoCommunitiesMeasures** (std::ofstream &csvFile, MarkovProcess ∗MP, std::string type, int update, int size1, int size2, double intraR1, double intraR2, double interR1, double interR2, double contrarian1, double contrarian2, VoterMeasurement ∗preM, VoterMeasurement ∗postM, int time, int delay, Partition ∗microP)

- void **computeTwoCommunitiesMeasuresWithAggregation** (std::ofstream &csvFile, MarkovProcess ∗MP, std::string type, int update, int size1, int size2, double intraR1, double intraR2, double interR1, double interR2, double contrarian1, double contrarian2, VoterMeasurement ∗preM, VoterMeasurement ∗postM, int time, int delay, double threshold)
- void **computeTwoCommunitiesPartMeasures** (std::ofstream &csvFile, MarkovProcess ∗MP, int size1, int size2, VoterMeasurement ∗preM, VoterMeasurement ∗postM, int time, int delay)

6.6.1 Detailed Description

Tools to run prediction experiments on Voter Models.

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.6.2 Function Documentation

6.6.2.1 void twoCommunitiesExperiment (TwoCommunitiesExperimentSet ∗ *expSet,* std::string *fileName*)

Run a set of programmed experiments.

Parameters

expSet	: Experiment set
fileName	: Output file name

6.7 /home/lamarche/programming/multilevel_prediction/src/voter_graph.hpp File Reference

Classes to build an interaction graph (nodes and edges) describing a Voter Model and some observation tools (probes and measurements)

```
#include <map>
#include <cstdlib>
#include "markov_process.hpp"
#include "partition.hpp"
```

Classes

- class VoterNode

  A node of the interaction graph.
- class VoterEdge

  An edge of the interaction graph.
- class VoterGraph

  The interaction graph describing a Voter Model.
- class CompleteVoterGraph

  An interaction graph with edges between each pair of nodes (in both direction, with equal weight for each edge)
- class TwoCommunitiesVoterGraph

An interaction graph consisting in two communities of nodes (complete graph within each community, complete interaction between the two communities, possibly with different weights)

- class ChainVoterGraph
- class VoterProbe

  A probe to observe the Voter Model according to a subset of nodes.
- class VoterMeasurement

  A measurement to observe the Voter Model according set of probes.
- class MacroVoterMeasurement

  A measurement consisting in one probe observing all nodes of the interaction graph.
- class MicroVoterMeasurement

  A measurement consisting in one probe for each node of the interaction graph.
- class EmptyVoterMeasurement

  A measurement without any probe (no observation)
- class VoterState
- class VoterMeasurementState
- class VoterTrajectory
- class VoterMeasurementTrajectory
- class VoterDataSet
- class VoterBinning

Typedefs

- typedef std::set
  < VoterMeasurement ∗ > **MeasurementSet**
- typedef std::set< std::pair
  < MeasurementType, VoterMetric > > **SpecMeasurementSet**
- typedef std::map
  < VoterMeasurementState ∗, int ∗ > **ProbabilityMap**
- typedef std::pair
  < ProbabilityMap ∗, int ∗ > **ProbabilityPair**
- typedef std::map
  < VoterMeasurementState
  ∗, ProbabilityPair ∗ > **TransitionMap**

Enumerations

- enum VoterMetric {
  MACRO_STATE, MAJORITY, **MAJ_1PC**, **MAJ_2PC**,
  MAJ_3PC, **MAJ_4PC**, **MAJ_5PC**, **MAJ_6PC**,
  MAJ_7PC, **MAJ_8PC**, **MAJ_9PC**, **MAJ_10PC**,
  MAJ_20PC, **MAJ_30PC**, **MAJ_40PC**, **MAJ_50PC**,
  MAJ_60PC, **MAJ_70PC**, **MAJ_80PC**, **MAJ_90PC**,
  MAJ_2B, **MAJ_3B**, **MAJ_4B**, **MAJ_6B**,
  MAJ_8B, **MAJ_10B**, **MAJ_12B**, **MAJ_20B**,
  MAJ_40B, ACTIVE_EDGES }

  A metric associated to a probe.
- enum UpdateProcess { UPDATE_NODES, UPDATE_EDGES }

  The way a Voter Model evolves at each simulation step, by randomly choosing a node or an edge for interaction.
- enum MeasurementType {
  M_MICRO, M_AGENT1, M_MESO1, M_MESO2,
  M_MACRO, M_EMPTY, M_ALLSIZES1, M_SOMESIZES1,
  M_AGENT1_ALLSIZES1, M_AGENT1_SOMESIZES1, **M_ALLNEIGHBORHOODS**, M_AGENT1_MESO1,
  M_AGENT1_MESO2, M_AGENT1_MACRO, M_AGENT1_MESO1_MESO2, M_MESO1_MESO2 }

  A specific measurement in the case of a two-communities interaction graphs.

6.7.1 Detailed Description

Classes to build an interaction graph (nodes and edges) describing a Voter Model and some observation tools (probes and measurements)

Author

Robin Lamarche-Perrin

Date

22/01/2015

6.7.2 Enumeration Type Documentation

6.7.2.1 enum MeasurementType

A specific measurement in the case of a two-communities interaction graphs.

Enumerator

M_MICRO Microscopic state

M_AGENT1 State of the first node in community 1

M_MESO1 Aggregated state of all nodes in community 1

M_MESO2 Aggregated state of all nodes in community 2

M_MACRO Aggregated state of nodes in both communities

M_EMPTY No observation

M_ALLSIZES1 Aggregated state of node subsets of all sizes within community 1

M_SOMESIZES1 Aggregated state of node subsets of some sizes within community 1

M_AGENT1_ALLSIZES1 Join measurement (see above)

M_AGENT1_SOMESIZES1 Join measurement (see above)

M_AGENT1_MESO1 Join measurement (see above)

M_AGENT1_MESO2 Join measurement (see above)

M_AGENT1_MACRO Join measurement (see above)

M_AGENT1_MESO1_MESO2 Join measurement (see above)

M_MESO1_MESO2 Join measurement (see above)

6.7.2.2 enum UpdateProcess

The way a Voter Model evolves at each simulation step, by randomly choosing a node or an edge for interaction.

Enumerator

UPDATE_NODES Node-driven interactions: A node is chosen at each simulation step, it acts on one of its outcoming nodes

UPDATE_EDGES Edge-driven interactions: An edge is chosen at each simulation step, its incoming node acts on its outcoming node

6.7.2.3 enum VoterMetric

A metric associated to a probe.

Enumerator

MACRO_STATE The probe returns the number of observed nodes in state 1

MAJORITY The probe returns 0 (resp. 1) if the majority of agents are in state 0 (resp. 1), and NA if there is a strict equality

ACTIVE_EDGES The probe returns the probability that one of the observed nodes will change during the next simulation step

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