

PGM Projects

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1 Sampling and Querying Belief Networks

1. Takes as input a BN DAG (only the adjacency matrix but without the conditional probability tables), and a collection (a dataset) of samples. It should be able to estimate all the conditional probability tables.
2. Takes as input a BN DAG as an adjacency matrix as well as the conditional Probability tables. and samples from the joint distributions and from arbitrary marginals.
3. Takes as input the BN DAG as an adjacency matrix as well as the conditional Probability tables. Given a conditional probability query, it outputs the probability. For e.g. for a BN over X, Y, Z it should be able to compute queries of the type $P(X|Z)$

Remark 1.

1. The implementation need not be optimized, and can be exponential time.
2. The project should be made into a public github repo, with proper readme files. Also provide a test file with a few example runs of your model. You will have to give a demo of the application.

2 Bayes Ball

Implement a program, which

1. Given a BN or a joint distribution, as well as input nodes X, Y, Z , checks for conditional independence, i.e. “is set X independent of set Y given set Z ? using d-separation (linear time Bayes Ball algorithm). (Shachter, R. D. (1998). Bayes-ball: The rational pastime. In Proc. 14th Conference on Uncertainty in Artificial Intelligence (UAI))

Any example from the textbook can be given as test cases. Provide an easy to use interface for inputting queries

2. Describe the Bayes Ball algorithm alongwith time complexity analysis in a latex scribe notes.

3. Prove equivalence of independence and d-separability rules I.e. for 3 groups of random variables X, Y, Z , X is independent of Y given Z iff X and Y are d -separable given Z .
4. Expectations are latex scribe and viva.

3 Variable Elimination in Clique Trees and Chordal Graphs and Junction Tree Algorithm

1. Present the Variable Elimination algorithm for Clique Trees and Chordal Graphs (chapter 10 Probabilistic Graphical Models by Koller and Friedman).
2. Present the Junction Tree Algorithm for marginalization. (Chapter 6 of David Barber)

4 Pick one from the following papers and present

- i. MNet : <https://pdfs.semanticscholar.org/6314/2e3f05bfc1e1394a0f46af341837a40fe3b8.pdf>
- ii. Ancestral Graph Markov Model: https://projecteuclid.org/download/pdf_1/euclid.aos/1031689015
- iii. Causality and do calculus (see <http://bayes.cs.ucla.edu/WHY/>)
- iv. Expert Systems in Medical Field: <https://projecteuclid.org/euclid.ss/1177010888>