275B: Projects and paper presentations Belief Networks - Spring, 2005

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Please feel free to propose your own projects. Here are some projects ideas.

Note: Many of the proposed projects clearly cannot be accomplished in 3 weeks. But any significant start that can be accomplished in 3 weeks is acceptable and will be evaluated accordingly. Finally, if you are more seriously interested in any of these you can continue beyond the class deadline.

1. Apply exact and approximate algorithms to solve linkage analysis instances. (You may want to get in touch with Radu Marinescu (*radum@ics.uci.edu*) and Vibhav Gogate (*vgogate@ics.uci.edu*) to work on this.): Here are some subtasks: 1. Make Linkage analysis instances accessible through the REES tool. 2. Then apply algorithms available on REES and compare the results using REES. You can use IJGP, IBP, Sampling, Mini-Clustering and more.

2. The SUPERLINK software (*http://bioinfo.cs.technion.ac.il/superlink/*) of linkage analysis uses an algorithm that alternates between inference and conditioning. It also uses a particular scheme for restricted variable ordering for the task. Read the relevant papers by Geiger et. al (see my 280 class web page, *http://www.ics.uci.edu/d̃echter/ics-280/spring-2005/*), implement the algorithm and run on selected linkage instances and other benchmarks.

3. Can importance sampling algorithm benefit from the AND/OR search space structure? Propose and experiment with a sampling algorithm (consult with Bozhena Bidyuk - *bbidyuk@ics.uci.edu*).

4. **Knowledge engineering**
   Describe a domain and model it using a Bayesian network. It has to have around 50 variables to be considered substantial enough. Subsequently run a variety of algorithms for querying. Make your model usable as a benchmark on the UAI repository. You can use any one of the tools available (REES, HUGIN, Javabayes).

5. **Investigating algorithms for belief updating using REES**

- Use REES to compare IBP, BTE, Mini-Clustering (MC) and IJGP on all the repository networks.

- Based on your empirical work can you characterize when IBP is superior? when IJGP is superior?

- Can you justify your hypothesis theoretically?

- Implement the best sampling methods and compare.

6. **Experiment with exact algorithms for MPE using REES**

   - Use REES to compare BTE, BBBT and BBMB.

   - Implement your favorite MPE algorithm and compare.

   - Get recent algorithms developed by Radu Marinescu (*radum@ics.uci.edu*), add to REES and compare.

7. **Investigate additional graph questions**
   Find a good algorithm for optimal pseudo-tree generation.

8. Improve the partitioning of mini-buckets for the same i and m by using the KL measure. Experiment with random networks and some applications. Implement Generalized Mini-Bucket algorithm and compare.

9. Any theoretical or empirical question you may want to suggest?