EE595A – DGMs – Winter 2010

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Dynamic Readings

- readings: "k_best.pdf", description of the k-best algorithm for HMMs.
- readings: "island.pdf", description of the island algorithm for DGMs.

Readings are in a directory "`reading_drafts`" off of our main web page. uid and pwd are named after this class. If not clear, ask me now.

Class Road Map

We need to find two makeup lectures this term. We'll spread them over two weeks.

- L1 (1/13): overview, intro, Markov
- L2 (1/15): Markov + HMM-I
- L3 (1/20): HMM-II
- L4 (1/22): HMM-III
- L5 (1/27): HMM-IV
- L6 (1/29): HMM k-best
- L7 (2/3): HMM k-best
- L8 (2/5): island, DBN-I
- L9 (2/10):
- L10 (2/12):
- L11 (2/17):
- L12 (2/19):
- L13 (2/24):
- L14 (2/26):
- L15 (3/3):
- L16 (3/5):
- L17 (3/10):
- L18 (3/12):
- L19 (makeup):
- L20 (makeup):
- L21 (3/15): Final Presentations

Final Project Due Dates

- L1 (1/13):
- L2 (1/15):
- L3 (1/20):
- L4 (1/22):
- L5 (1/27):
- L6 (1/29):
- L7 (2/3):
- L8 (2/5): Today
- L9 (2/10): Proposal **1-page** PDF
- L10 (2/12):
- L11 (2/17): Revision 1 **1-page** PDF
- L12 (2/19):
- L13 (2/24): Status 1 **1-page** PDF
- L14 (2/26):
- L15 (3/3): Status 2 **1-page** PDF
- L16 (3/5):
- L17 (3/10): Status 3 **1-page** PDF
- L18 (3/12):
- L19 (makeup):
- L20 (makeup):
- L21 (3/15): Final Presentations

On Final Project

- Project should ideally be on some aspect of the material we have learnt, some aspect of dynamic graphical models. Possible good projects include:
  - an implementation (i.e., a fast implementation of some DGMs algorithm) and reporting and experience that you gain in doing this. Application to real data.
  - A paper summary, of papers that we are not going to cover in this class.
  - A new idea of your own, new algorithms and/or theoretical results. (e.g., approximation error for a sequential model).
  - Application of a DGM to a data domain (e.g., application of dynamic Bayesian networks to speech/language/biology/surgery or some other sequential data domain).
  - Applied use of GMTK on new applications domain.

On Final Project (cont. II)

- The ideal project should be research-oriented, it is not acceptable to propose whatever machine learning task you are currently working on (e.g., "An application of SVMs to protein folding" would not be acceptable).
- should be dynamic
- Ideal project would lead to a conference and/or journal paper.
- Fine to combine it with your own research.

Final Project

- GMTK (the graphical models toolkit) is a C++ system for expressing and using dynamic Bayesian networks and generalizations on data.
- It is highly optimized in C++ and has many features, but the documentation is currently scattered about (combination latex and wiki).
- I'll be working to fix up the documentation the end of February.
- Possible project would be to use GMTK for some novel project.
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Review

- HMM typicality in the posterior $p(q_{1:T}|\bar{x}_{1:T})$.
- Posterior Sampling
- k-best
- k-best via forward-backwards pass.
- k-best via domain partitioning

Lecture

Like last time, most of today's lectures comes from the board. What we covered:

- Board lecture on the island algorithm and the writeup from today on island.
- ppt animation slides on the island algorithmn, one level recursion.
- analysis of this algorithm
- Interaction of island algorithm and k-best algorithms.
- Case study on hierarchical model for speech recognition, a step towards DBNs.

Towards DBNs

We've been talking about HMMs so far, many of the algorithms for them (k-best, etc.). All of the algorithms generalize to DBNs.
The key-idea is expandable models:

- static graphical model, the graph is static and we can use properties of the graph to inference how costly it is to do inference
- simple plate models: repeat a model within a plate (graph node expansion).
- dynamic graphical model: a template plus rules for template expansion. Template & rules are sufficient to infer computational properties of the model at any expansion length.
- general template models: $\exists$ other template + rules models (e.g., PRMs, Markov logic) but there the expanded models can have such flexibility and complexity that it is not possible to infer complexity for any possible expansion based only on the template.