Reflection - Project Progress Report
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Work done to-date

I have explored the Dirichlet process (DP), hierarchical Dirichlet process (HDP) and hierarchical Dirichlet process for hidden Markov models (HDP-HMM) literature. To assist my understanding of the DP, I wrote a generative model of a mixture of 4 Gaussians and I have written a basic Stan model for inference over the parameters (with a stick breaking prior). The implementation marginalizes over the cluster assignments (z_i) for compatability with the NUTS sampler and uses a posterior predictive step to make the cluster assignments to data. The Stan implementation is exceedingly slow but the implementation was useful for my understanding. I used a truncated DP here for inference.

I have also implemented a blocked Gibbs sampler for the sticky hierarchical Dirichlet process for Hidden Markov Models (HDP-HMM) as specified in Algorithm 2 of [1] and discussed further in [3]. I have run a test on a small generated time series where sequential data are generated from three Gaussian modes. The sticky HDP-HMM recovers the cluster assignments and regime means as is presented in [1].

Plan for rest of project

The rest of the project aims to implement the Gibbs samplers for the HDP-SLDS and HDP-AR-HMM models from [2]. I will begin by implementing and reproducing the tests on generated data for the HDP-AR-HMM model. If time permits, I will expand this implementation to that for the HDP-SLDS.

1. Implement the forward and backward recursions for the SSM (the ones for the HMM have already been done).

2. Write the Gibbs sampler that is presented for [2] for the HDP-AR-HMM model.

3. Expand upon (2) to develop a Gibbs sampler for the HDP-SLDS model (if time permits).

4. Reproduce the tests from [2] on their generated data.

References

[1] E. Fox, E. Sudderth, M. Jordan, and A. Willsky. Developing a tempered hdp-hmm for systems with state persistence. *MIT Laboratory for Information and Decision Systems, Tech. Rep.*, 2007.

[2] E. Fox, E. B. Sudderth, M. I. Jordan, and A. S. Willsky. Bayesian nonparametric inference of switching dynamic linear models. *IEEE Transactions on Signal Processing*, 59(4):1569–1585, 2011.

[3] E. B. Fox, E. B. Sudderth, M. I. Jordan, and A. S. Willsky. An hdp-hmm for systems with state persistence. In *Proceedings of the 25th international conference on Machine learning*, pages 312–319. ACM, 2008.