

Modules

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The modules below are in no particular order (except for the Basics, of course).

1 Basics

- What is a posterior? \rightarrow recap of Bayes' rule
- Example problems: Factorial HMMs, Bayesian Mixture Models (show GMs)
- ELBO derivation I: from KL divergence
- ELBO derivation II: with Jensen's inequality
- Mean Field inference
- Application to example problems (show GMs)

2 Conjugate Models

- Exponential families
- Gaussian-Gaussian conjugacy
- Example: Gaussian Mixture Model
- Dirichlet-multinomial conjugacy
- Example: Multinomial Mixture Model (maybe even LDA?)
- Conjugate VI in the general case

3 Nonconjugate Models

- Laplace Approximation
- Gradient methods
- Problem: cannot simply differentiate an MC average
- Idea: transform $\frac{d}{dq}\mathbb{E}_q[\cdot]$ into $\mathbb{E}[\frac{d}{dq}\cdot]$
- Score function gradient \rightarrow Black Box VI
- Reparametrisation gradient

4 Nonparametric Models

- Intro to stick-breaking processes
- VI for HDP/PYP
- Intro to GPs
- VI for GPs

5 Bayesian Neural Networks

- Putting priors on weights
- The old stuff by Neal, MacKay and Hinton
- The new stuff by DeepMind
- Bayesian Interpretation of Dropout

6 Deep Generative Models

- Review of generative models
- Exact case: EM with features
- Variational Autoencoders
- Example models: ???
- Code snippet ???
- Extra: The Deep Generative CRF (the Ryan Adams paper from NIPS)

7 Reparametrisation Gradients

- Recap: Gaussian reparametrisation
- Extension to general location-scale families
- ADVI (depending on the audience only go until here; the next two are way more complicated)
- Generalised Reparametrisation Gradient
- Rejection Sampling VI

8 Extensions [Advanced]

- Auxiliary variables
- Hierarchical Variational models

9 Beyond KL [Advanced]

- α -divergence (make connection to EP)
- Stein VI
- Implicit models
- Hoelder bound