02477 Bayesian Machine Learning - Exam information

Document is subject to minor changes until the last lecture on the 10th of May 2021.

Exam topics

- Exercise 1
  1. Bayesian inference, estimators and posterior summaries
  2. Conjugacy
  3. The beta-binomial model
- Exercise 2
  1. Bayesian linear regression
  2. Model selection using the marginal likelihood
- Exercise 3
  1. Generative and discriminative classication
  2. Logistic regression
  3. Laplace approximations
- Exercise 4
  1. Covariance functions and the squared exponential kernel
  2. Gaussian processes

Addition week4:
Generelized linear model

- Exercise 5
  1. Multi-class classification
  2. Generalization
  3. Decision theory
- Exercise 6
  1. Markov Chain Monte Carlo Methods
  2. Metropolis-Hasting algorithm
- Exercise 7
  1. MCMC and Convergence diagnostics
  2. Gibbs sampling
  3. Change point detection
- Exercise 8
  1. Variational inference (KL divergence and ELBO)
  2. Bayesian formulation of the Gaussian mixture model
- Exercise 9
  1. Exercise 9 cannot be drawn as an exam topic, but is still part of the curriculum
- Exercise 10
  1. Black-box variational inference
  2. Stochastic optimization
- Exercise 11
  1. The Erdös-Rényi model
  2. The infinite relational model

Addition week11:
The stochastic block model
to emphasize and explain
the IR model.

- Exercise 12
  1. T.B.A

Models

- The beta-binomial model
- Linear regression models
- Logistic regression
- Generalized linear models
- Gaussian process models
- Generative models for classification
- Multi-class soft-max classification
- Change point model for time series
- Gaussian mixture model
- Latent Dirichlet Allocation
- Robust regression with student's likelihood
- The Erdös-Rényi model
- The infinite relational model

Inference methodology and related concepts

- Prior, likelihood, posterior, marginal likelihood
- Prior predictive distribution and posterior predictive distribution
- Maximum likelihood
- Maximum a posteriori inference
- Exact Bayesian inference & conjugacy
- Sampling and Markov Chain Monte Carlo
- Metropolis-Hastings algorithm
- Gibbs sampling
- Variational inference (Free-form, fixed-form, mean-field)
- Black-box variational inference
- Decision theory

Mean-field: Independent factorization of variables

Free form: No specific functional form assumptions. Derived from joint distribution and often demands local conjugacy

Fixed form: Specific functional form assumptions

Suggestions for exam preparation

If you can explain the following bullets for each of the models, then you are already in a very good position

- Motivation for the model - what type of data can we model
- Prior distribution
- Likelihood
- Any hyperparameters?
- How did we compute the posterior distribution? (e.g. exact inference, Metroposlis-Hastings, Gibbs, variational inference)
- How did we compute the predictive distribution?