BayesML
0. Motivation and Logistics

DataLab CSIC

Motivation

- Last year of AXA Chair @ICMAT
- Aihub connection interdisciplinary discussions
- Consulting for other CSIC intitutes
- CSIC statistical courses kind of oldies
- Internal needs within ICMAT and some of our sponsors

Brief description

- Bayesian inference provides a unified and coherent approach to problems of interest in Statistics, inference, prediction and decision support. In particular to ML problems
- Yet mainstream ML focuses on MLE or MLE+regularization, but things are changing…
- Bayesian ML leads to complex computational problems, some of which yet to be solved. An introduction of what is known and what is yet to be known
- But also intro to key concepts
- And key models in applications

Objectives

- Introduce key concepts in Bayesian inference as well as key models motivated by real problems
- Introduce key computational methods
- Showcase methods in realistic problems
- A Bayesian view on popular ML models

Contents

1. Intro
2. Approximate methods based on normality
3. Markov change Monte Carlo
4. Computational methods for decision support
5. Large scale computational methods
6. Bayesian ML smorgasbord (Bartmachine, Gaussian processes, Neural networks, Mixture models, Bayesian optimization, Variational autoencoders)

   Alternatives? Just shout

R, Stan

Slides images from bib proposed

Basic bib

- Gelman, Carlin, Stern, Dunson, Vehtari (2013) Bayesian Data Analysis, CRC.
- French, S., Ríos Insua, D. (2000) Statistical Decision Theory, Wiley.
- Hoff, P. (2009). A First Course in Bayesian Statistical Methods, Springer.
- Barber, R. (202*) Bayesian Reasoning and ML,
- Murphy, K. (2022, 2023) Probabilistic machine learning (Intro, Advanced topics)
- Various papers for more recent stuff

Comp bib

- Bishop (2006) Pattern Recognition and Machine Learning. Springer
- Garnett, R. (202*) Bayesian Optimization, MIT Press
- Gelman, Hill, Vehtari (2020) Regression and other stories, Cambridge UP
- Goodfellow, Bengio, Courville (2017) Deep Learning, MIT Press.
- Ríos Insua, Ruggeri, Wiper (2010) Bayesian Analysis of Stochastic Processes, Wiley.
- Robert, C., Casella, G. (2010) Tools for Statistical Inference, Springer.
- Efron, Hastie (2019) Computer Age Statistical Inference

Bib Bayes and R

- Albert (2009) Bayesian Computation with R. Springer
- Kruschke (2011) Doing Bayesian Analysis. Ac Press
- Marin, Robert (2013) Bayesian Essentials with R. Springer
- McElreath (2019) Statistical Rethinking. CRC
- Stan Manual

Meeting

Fridays (until May 5) 12

Fridays (after May 12) 10

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Stuff at

https://datalab-icmat.github.io/courses_stats.html