Bayesian Learning

M2 Data Science
1st semester

Audience

Minimal background in mathematics and statistic
- analysis and calculus (integral, derivatives, study of functions, …)
- basic statistical concepts (expectation, median, covariance, distributions, …)

Minimal knowledge of statistical modeling
- e.g. regression (for many concepts we will see a new formulations)

Basic expertise with Python and Jupyter Notebook
- installing new packages
- writing basic code and running pipelines
- knowledge of standard libraries (numpy, pandas, scikit-learn)
- use of git

The course

Based on lessons and notebooks

Additional reading material and references are provided at each lesson

All the material available at the course website

https://marcolorenzi.github.io/teaching.html

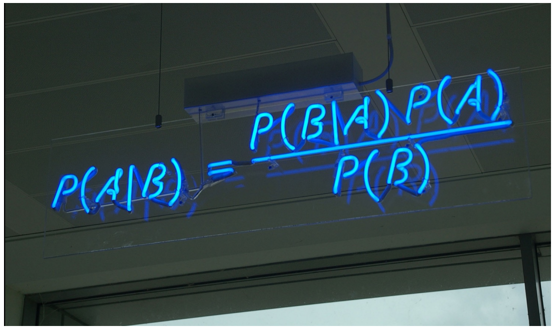
10 lessons

Mid-term assessment

Final oral exam

- theory, exercises, paper discussion

Why Bayesian modeling?



Practical methods for making inference from data using probability models for:

- Quantities we observe
- Quantities we wish to learn

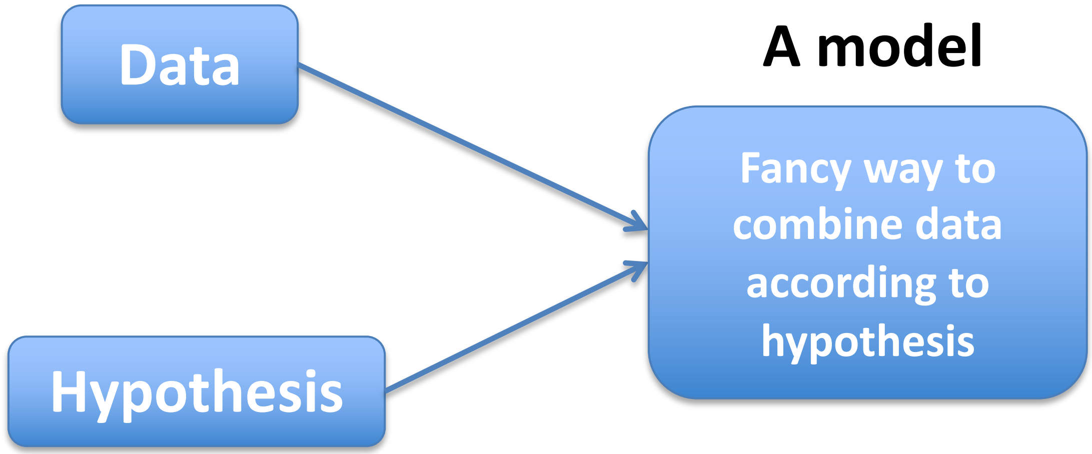
Explicit use of probability for quantifying uncertainty in inference

Portrait of Bayes used in a 1936 book, but it is doubtful whether the portrait is actually of him.

Pierre-Simon Laplace

From wikipedia

The common denominator



Uncertainty quantification

prediction,
data relationship, …

An increasing success in several disciplines

- Important whenever uncertainty is critical
  healthcare, weather forecast, sociology, epidemiology, …

- Principles tools to integrate hypothesis about the world

- Today many theoretical and computational approaches available to solve Bayesian problems

  Maths and calculus: closed forms, variational approximations

  Computational methods: sampling

Course overview

Basics of Probability and Bayesian Modeling

Basic models and distribution families

A practical take on Bayesian inference

regression, classification

Model Approximation

Sampling methods

Questions?