Rady School of Management
UNIVERSITY OF CALIFORNIA SAN DIEGO

MGTA495: Bayesian Machine Learning

MSBA
Spring 2021

PROFESSOR: Karsten T. Hansen
EMAIL: karstenhansen@ucsd.edu

TA: Aditya Mamidi aditya.v.mamidi@gmail.com

DESCRIPTION

This is a course about Bayesian approaches to Machine Learning. No prior knowledge Bayesian statistics is required. The motivation behind this course is the increasing popularity of fully probabilistic or generative models in Machine Learning. A complete analysis of these models require a Bayesian approach. This is the only coherent methodology if the goal is to both train the models *and* characterize the inherent uncertainty about the unknown weights in the model. Traditional Machine Learning only accomplishes the first part.

Prerequisites: Basic concepts from an undergraduate statistics class will be assumed known. Linear Algebra will also be assumed known by students. Students are also expected to be comfortable with both Python and R.

INSTRUCTIONAL METHODS

The course will conducted as a mixture of lectures and in-class data analysis.

OBJECTIVES

At the close of this couse, students will have an in-depth understanding of Bayesian methods in Machine Learning and will be able to apply these frameworks in real-life large scale applicatins.

MATERIALS

Lecture notes and code will be distributed before and during class meetings.

Required text book: **Bayesian Data Analysis** by by Andrew Gelman, John Carlin, Hal Stern, David Dunson, Aki Vehtari, and Donald Rubin. Available as a free download here: http://www.stat.columbia.edu/~gelman/book/BDA3.pdf

Additional recommended text books (not required but useful if students want different perspectives on some of the material):

- **Bayesian Reasoning and Machine Learning**, David Barber
- **Pattern Recognition and Machine Learning**, Christoper M. Bishop,
- **Machine Learning: A Probabilistic Perspective**, Kevin P. Murphy

Rady School of Management
UNIVERSITY OF CALIFORNIA SAN DIEGO

SOFTWARE

We will be using a combination of R, Python ((in particular PyTorch) and Stan (https://mc-stan.org/ - a general purpose probalistic language for training Bayesian models)

PRELIMINARY COURSE SCHEDULE

Session	Date	Topic(s)
1	March 29	Course Introduction Introduction to Bayesian Reasoning
2	April 5	Hiearchical Models Shrinkage Estimation Bayesian Decision Theory
3	April 13	Team Project Meetings
4	April 19	Bayesian Computation Markov Chain Monte Carlo Algorithms
5	April 26	Bayesian Classification Naïve Bayes
6	May 3	Bayesian Mixture Models and Clustering
7	May 10	Applications of Probabilistic Non-Negative TensorFactorization: Topic Models, Poisson Factorization, Recommendation Systems
8	May 17	Bayesian Deep Learning

9	May 24	Variational Autoencoders
10	May 31	Memorial Day – No class!
Finals Week	June 7	Team Presentations

ASSIGNMENTS & DELIVERABLES

The main work load for this course are a series of assigments plus one team project

Exams

There will be no final or midterm exam for this course.

GRADING

Exams and Deliverables	Points [or percentage]
Team Project	45
Assignments	45
Class Participation	10
Total	100

ACADEMIC INTEGRITY

Integrity of scholarship is essential for an academic community. As members of the Rady School, we pledge ourselves to uphold the highest ethical standards. The University expects that both faculty and students will honor this principle and in so doing protect the validity of University intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind.

The complete UCSD Policy on Integrity of Scholarship can be viewed at:
http://senate.ucsd.edu/manual/appendices/appendix2.pdf

STUDENTS WITH DISABILITIES

A student who has a disability or special need and requires an accommodation in order to have equal access to the classroom must register with the Office for Students with Disabilities (OSD). The OSD will determine what accommodations may be made and provide the necessary documentation to present to the faculty member.

Rady School of Management
UNIVERSITY OF CALIFORNIA SAN DIEGO

The student must present the OSD letter of certification and OSD accommodation recommendation to the appropriate faculty member in order to initiate the request for accommodation in classes, examinations, or other academic program activities. **No accommodations can be implemented retroactively.**

Please visit the OSD website for further information or contact the Office for Students with Disabilities at (858) 534-4382 or fosorio@ucsd.edu.