TIME/VENUE
MW 3:30 – 4:50 pm EDT
ONLINE

INSTRUCTOR
Prakash Narayan
Room AVW 2353
Phone: (301) 405 3661
E-mail: prakash@umd.edu

OFFICE HOURS
MW 2:00 – 3:15 pm (But please, please make an appointment to avoid idling Zoom sessions.) Also at other times by appointment.

COURSE WEBSITE (coming soon)
http://www.ece.umd.edu/class/enee729T

OVERVIEW
The course covers an assortment of information theoretic methods of interest in statistical inference and learning. Topics include: (i) information geometry leading to the EM algorithm and application to maximum likelihood estimation; (ii) measure concentration methods; (iii) correlated multiarmed bandits including in parameter estimation and probability distribution learning from partially sampled observations (finding an arm or a small set of arms that yield information about other correlated arms); and (iv) data privacy vs function computation utility tradeoffs.

PREREQUISITES
ENEE 620 (Random processes) or equivalent, ENEE 627 (Information theory), or permission of the instructor.

COURSE OUTLINE
I. Information geometry
Kullback-Leibler divergence, Pythagorean inequality, I-projection on linear families, iterative algorithm for finding the minimum divergence between two convex sets of distributions, EM algorithm, application to maximum likelihood estimation.

II. Concentration of measure
Concentration inequalities as basic tools: Markov, Chebyshev, Chernoff bounding, Hoeffding, Bennett, Bernstein, Efron-Stein, Azuma; Entropy method, tensorization, Han’s inequalities for entropy and divergence, log Sobolev inequalities, Vapnik-Chervonenkis dimension and entropy. Some applications.
III. Correlated multiarmed bandits

Prediction and parameter estimation problems will be considered in which an estimator is able to assess self-reward or -loss based on local measurements but is unaware of the consequences of estimation from unseen measurements. However, correlation among measurements affords a new latitude in learning. Stochastic and nonstochastic (or adversarial) multiarmed bandit problems will be considered.

IV. Data privacy

Various notions of data privacy: Differential privacy, distribution privacy, divergence-based privacy; data privacy vs function computation utility tradeoffs.

COURSE GRADE

The course grade will be determined on the basis of individual or (small) team projects and in-class presentations. Specifically, an individual’s or a team’s performance will be evaluated by means of a (i) a midterm assessment of progress on a term project, and (ii) a final assessment of the completed term project. A term project can consist of (a) work on a chosen or assigned topic involving open issues or (b) a critical examination of a pertinent topic or topics in the existing literature – in both cases combined with a comprehensive oral presentation at the end of the semester.

Problems to be addressed in a term project will be fixed at the end of approximately four (4) weeks into the semester.

REFERENCES

There is no required or recommended text. The course material will be drawn largely from a selection of books and publications that are listed below. Some of this material will be posted at the course website (marked by (*)).

0. Sine qua non

The following two classics are shining sources of enlightenment in information theory.


I. Information geometry


**II. Concentration of measure**


**III. Multiarmed bandits**


**IV. Data privacy**


