

Biostatistics 830-003: Machine Learning for Health Sciences

Winter 2018

Instructor: Xiaoquan (William) Wen

Lectures: TTH 11:30am - 1:00pm, 1152 SPH II

Office Hours: TBD or by appointment, 4517 SPH I

Required Text

None. Relevant lecture notes, slides and reading materials will be made available on Canvas.

Recommended References

1. Foundations of Machine Learning. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar. The MIT Press, 2012
2. A Course in Machine Learning. Hal Daume III. Available online at <http://ciml.info/>
3. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Edition 2, Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Springer, 2009 (This book is freely available online through SpringerLink to UM students and staff)
4. Pattern Recognition and Machine Learning. Christopher M. Bishop. Springer New York, 2006

Prerequisites

BIOS 601, 602 or consent of instructor. A background in statistical programming will also be necessary; specifically students are expected to be familiar with R. Experience in C/C++ or Python programming may be helpful, but is not required.

Materials and Topics

This class aims to bridge the gap between the classic materials covered in graduate level Biostatistics courses and the influential new ideas and statistical techniques. Instead going in depth in a set of particular topics, we will try cover the new fields of machine learning in breadth. We will be

approaching these topics, traditionally in the overlapped domains of computer science and statistics, from the point of view of Biostatistics. Specifically, we will cover the following topics:

- Learning Theory
- Probabilistic Graphical Models
- Linear Methods and Regularization
- Kernel Methods
- Support Vector Machines
- Ensemble Methods and Boosting
- Neural Networks and Deep learning
- Clustering
- Latent Variable Models

We will cover each topic through lectures, assigned readings and discussions. All students are expected to actively participate in class discussions.

Course Format and Grading

- Homework (40%). There will be periodic homework on the theoretical topics of the lectures. Homework should be completed individually. Solutions will be graded on both correctness and clarity. If you cannot solve a problem completely, you will get more partial credit by identifying the gaps in your argument than by attempting to cover them up.
- Projects (50%). There will be 3 projects. These projects are data analysis problems arising from real scientific researches. The projects should be completed by a team of two students.
- Class participation (10%). All students are expected to attend lectures and participate class discussions.
- No exams.

Competency

The student will learn and will be tested on the following competencies:

- Describe advanced concepts of probability and commonly used statistical probability distributions and stochastic processes.
- Master the mathematical techniques in modeling and inference of correlated random variables.
- Applying advanced probability and statistical theory in Biostatistical applications.
- Build mathematical foundations for advanced studies in survival, longitudinal and time-series data analysis.
- Study and implement advanced computational techniques for applications in Biostatistics.

Academic Integrity:

The faculty of the School of Public Health believes that the conduct of a student registered or taking courses in the School should be consistent with that of a professional person. Courtesy, honesty and respect should be shown by students toward faculty members, guest lecturers, administrative support staff and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. The preparation of reports, papers, and examinations, assigned on an individual basis, must represent each student's own effort. Reference sources should be indicated clearly. The use of assistance from other students or aids of any kind during a written examination, except when the use of aids such as electronic devices, books or notes has been approved by an instructor, is a violation of the standard of academic conduct.

Student Well-being:

If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with University services, please contact the instructor or the Office of Academic Affairs. Please visit <http://www.sph.umich.edu/students/current/#wellness> for more information.

Student Accommodations:

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students can also visit the Office of Academic Affairs for assistance in

coordinating communications around accommodations. Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit <http://ssd.umich.edu/accommodations> for more information on student accommodations. Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. The complete University of Michigan policy can be found at http://www.provost.umich.edu/calendar/religious_holidays.html#conflicts.

Diversity, Equity, and Inclusion (DEI):

SPH upholds the expectations that all courses will (1) be inclusive, (2) promote honest & respectful discussions, (3) follow multicultural ground rules and (4) abide by UM policies and procedures.