Syllabus

CS 6316 – Machine Learning

Fall 2017

Lecture

Monday & Wednesday: 3:30 – 4:45pm Thornton E303
Duration (Fall semester): August 22, 2017 – December 5, 2017

Contact

The best way to have a question answered is by asking it in class, or during office hours (Instructor and TAs).

PROF. NADA BASIT

Office: Rice 405

Email: basit@virginia.edu *(best way to get in touch!)*

Office Hours:

Tuesday: 1:00pm – 3:00pm *Wednesday: 11:30am-12:30pm*

Other times: Available by appointment only.

May change slightly… (If so an announcement will be sent)

Teaching Assistants:
TA information (names & office hours) will be available on the Home tab of the CS 6316 Collab page.

Course Material

Textbook: *Predictive Learning*, V. Cherkassky, 2013. (available at the UVA bookstore)
Additional reading: *The Problems of Philosophy.* B. Russell. (Available online: http://www.ditext.com/russell.html)
Lecture notes: *Lecture notes (and any supplemental material) will be posted in the Resources section of our class's* ***Collab*** *page)*

Course Description

Machine Learning is concerned with computer programs that automatically improve their performance through experience. Advances in computer and database technology motivate the need for estimating dependences (models) from available data. Often the main goal is to estimate a model providing *generalization*, i.e. good prediction for future (unseen) data. Such methods have been traditionally explored in such diverse fields as: Statistics (multivariate regression and classification), Engineering (pattern recognition, system identification), and Computer Science (artificial intelligence, machine learning, data mining.) This course presents description of predictive data-analytic modeling methods on several different levels: conceptual/mathematical, technical, and philosophical.

The course consists of three related parts:

1. Conceptual/Theoretical Part deals with fundamental concepts and principles important for estimating predictive data-analytic models. These issues are addressed by the mathematical theory called Statistical Learning Theory, which is introduced in this course.

2. Technical/Practical Part focuses on constructive learning methods and applications. Representative learning methods include methods developed in machine learning and statistics. These methods include Decision Trees, K-nearest neighbors, linear regression, Support Vector Machines, and Multilayer Perceptrons. These methods are illustrated via practical applications.

3. Philosophical Part explores the connection between mathematical principles presented in Part 1, and the *Philosophy of Science*, which is concerned with general conditions for judging the validity (truthfulness) of scientific theories. Similarly, the fundamental principles of inference from data (discussed in Part 1) underlying machine learning algorithms (in Part 2) will be also related to mechanisms of human learning and intelligence.

Note, the course will present various components of these three parts, but not necessarily in this order.

Course Schedule

The course schedule (along with reading assignments) can be accessed via a link on the **Home** tab of the **CS 6316 Collab page**. As with the syllabus, the course schedule is considered a reference document that can be adjusted through the course of the semester to address changing needs. An overall course outline can be found next

Course Topic Details

A high-level list of topics covered in this course include the following. These topics are also presented in the approximate order in which they will be taught.

- Introduction
- Brief Probability Review (incl. Bayesian Decision Theory
- Basic Learning Approaches: Concepts and Theory
- Philosophical Perspectives
- Statistical Learning Theory and Learning Methods
- Classification and Regression
- Support Vector Machines
- Connectionism and Neural Networks
- Brief introduction to Deep Learning

This list of topics is to be considered a reference that can be adjusted through the course of the semester to address changing needs.

Course Requirements

As a prerequisite to this course you should have taken courses in the following areas:

1. Calculus
2. Linear Algebra
3. Probability
4. Algorithms

Statistics is recommended. Students should already have good programming skills (required!)

Assessment

A weighted average grade will be calculated as follows

- **Homework Assignments** – 45%
- **Written Assignments** – 15%
- **Project** – 20%
- **Exam** – 20%

Your final letter grade will be determined by the following scale:

Grade	Minimum	Maximum
A+	98.0	100
A	93.0	97.999
A–	90.0	92.999
B+	87.0	89.999
B	83.0	86.999
B–	80.0	82.999
C+	77.0	79.999
C	73.0	76.999
C–	70.0	72.999
D+	67.0	69.999
D	63.0	66.999
D–	60.0	62.999
F	0.0	59.999

Class Management

General

- Please feel free to stop by my office if you have any issues to discuss. If you cannot make it to my office hours we can arrange a mutually agreeable time when you can stop by.
- Email is the best way to get in touch with me. I check it regularly. [basit@virginia.edu *please include the following in your email subject line*: "CS 6316"]
- Please don't hesitate to contact me if you have any problems, concerns, questions, or issues regarding the course, material, or anything else in the class.
- Please don't hesitate to talk to me if there are situations in your life that are affecting your performance in the class or your life here at UVa. I might not be able to help, but I might know of some things that might help, and I'm a good listener.
- Being active, participating in class discussions, participating in group activities, and asking questions will increase your chances of success in this class.

Homework Assignments

- There will be a number of homework assignments given throughout the semester. Specific grading criteria will be provided with each homework assignment.
- A given homework assignment may require you to either work individually or allow you to work as a pair.
- Unless stated otherwise, please type your homework assignments and submit in PDF format. (If you don't know how to convert a file into PDF format, don't hesitate to ask one of the TAs.)
- When submitting homework assignments, don't forget to write the assignment title, your name, date, and computing ID at the top of each assignment.

Exam and Project

- There will be one exam and one final project.
- The **exam** is tentatively scheduled to be held on **Nov. 15** (during class time).
- **Project** submission (write-up and code) is due on **Nov. 27**. See Collab for submission details.
- **Project presentations:** There will be *three* rounds of project presentations, each one building on one another until the final (third) project presentations that takes place the last days of the semester. All three presentations will be graded.
- **Project presentation –** Round 1: Tentatively scheduled for **Sept. 25 & 27** *(5%)*
- **Project presentation –** Round 2: Tentatively scheduled for **Nov. 1 & 6** *(5%)*
- **Final Project Presentation –** Tentatively scheduled for **Nov. 27 – Dec. 4** *(10%)*
- If you know in advance that you will miss the exam or be absent for the project presentations, you must make arrangements in advance with me. (*The sooner the better!)*

This syllabus is to be considered a reference document that can and will be adjusted through the course of the semester to address changing needs. This syllabus can be changed at any time without notification. It is up to the student to monitor the Collab page for any changes. Final authority on any decision in this course rests with the professor, not with this document.

Academic Integrity

The School of Engineering and Applied Science relies upon and cherishes its community of trust. We firmly endorse, uphold, and embrace the University's Honor principle that students will not lie, cheat, or steal, nor shall they tolerate those who do. We recognize that even one honor infraction can destroy an exemplary reputation that has taken years to build. Acting in a manner consistent with the principles of honor will benefit every member of the community both while enrolled in the Engineering School and in the future.

Students are expected to be familiar with the university honor code, including the section on academic fraud (`http://www.student.virginia.edu/~honor/proc/fraud.html`). Each assignment will describe allowed collaborations, and deviations from these will be considered Honor violations. If you have questions on what is allowable, ask! Unless otherwise noted, exams and individual assignments will be considered pledged that you have neither given nor received help. (Among other things, this means that you are not allowed to describe problems on an exam to a student who has not taken it yet. You are not allowed to show exam papers to another student or view another student's exam papers while working on an exam.) Sending, receiving or otherwise copying electronic files that are part of course assignments are not allowed collaborations (except for those explicitly allowed in assignment instructions).

Assignments or exams where honor infractions or prohibited collaborations occur will receive a zero grade for that entire assignment or exam. Such infractions will also be submitted to the Honor Committee if that is appropriate. Students who have had prohibited collaborations may not be allowed to work with partners on remaining homework assignments.

SDAC and Other Special Circumstances

If you have been identified as a **Student Disability Access Center (SDAC)** student, please let the Center know you are taking this class. If you suspect you should be an SDAC student, please schedule an appointment with them for an evaluation. I happily and discretely provide the recommended accommodations for those students identified by the SDAC. Please contact your instructor one week before an exam so we can make appropriate accommodations.

Website: `http://www.virginia.edu/studenthealth/sdac/sdac.html`

If you are affected by a situation that falls within issues addressed by the SDAC and the instructor and staff are **not** informed about this in advance, this prevents us from helping during the semester, and it is unfair to request special considerations at the end of the term or after work is completed. So we request you inform the instructor as early in the term as possible your circumstances. If you have other special circumstances (athletics, other university-related activities, etc.) please contact your instructor and/or TA as soon as you know these may affect you in class.