Introduction The chief objective of this course is to teach methods in pattern classification and machine learning. Key components include statistical learning approaches, including but not limited to various parametric and nonparametric methods for supervised and unsupervised learning problems. Particular focuses on the theoretical understanding of these methods, as well as their computational implications.

Recommended preparation Undergraduate level training or coursework in linear algebra, calculus and multivariate calculus, basic probability and statistics; an undergraduate level course in Artificial Intelligence may be helpful but is not required.

Teaching assistants Farhad Pourtaran (pourtara@usc.edu), Taha Bahadori (mohammab@usc.edu), Wenzhe Li (wenzheli@usc.edu) and Yuan Shi (yuanshi@usc.edu).

Special note At the first meeting of the class, a special entrance quiz will be administered. The quiz will *not* count toward to the final grade. It will be completely closed-book (and consulting internet or other electronic resources is not permitted).

The quiz will be graded and assessed by the instructor and the TAs. Students who do not meet the passing threshold are not permitted to take the course and will need to withdraw from the class. Furthermore, students who have expectation of certain grades or above (for instance, in order to improve their GPAs) should exercise their cautions in taking this course, if the quiz appears challenging and leads to a less ideal initial assessment.

Please do come to the first meeting if you intend to take the course, whether you were already registered or are still on the waiting list. Due to sitting limitations, it is a good strategy to take the quiz on Monday 8/25 at MRF 340 and consider to take the quiz on Tuesday at GFS 116 as a backup plan — while contents are different, the two quizzes are at the same difficulty level.

Programming requirement Students are required to use Matlab for programming exercises/components. Homework assignments are required to be typeset with LaTeX(various TeXeditors and compiling environment on Windows, Mac OS X and Unix/Linux are available, including WYSIWYG ones), or Microsoft Word (with equations and mathematical symbols typeset too).

Format classroom lectures, homework, in-class two quizzes. Homework assignments include programming components for algorithmic implementation and mini-projects.

Preparation If you would like to prepare or refresh your skills in relevant maths, the followings would be good starting points

- For calculus, please check Prof. Strang's free online textbook

  http://ocw.mit.edu/resources/res-18-001-calculus-online-textbook-spring-2005/

- For linear algebra, please check (again) Prof. Strang's OpenCourseWare site

  http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index.htm

- Probability and statistics, please check

  MIT course

Grading 6 homework assignments and mini-project (total 60%), two quizzes (total 35%) and class participation (5%).

Policy on homework assignments

- Extension and late turn-in: one two-day extension or two one-day extensions for the whole semester; other late turn-in will be penalized with half of the credit.
- Working in group: permitted but each member needs to write up solutions separately. Standards on academic integrity are strictly enforced.

Required textbooks There will be no required textbooks. However, we suggest one of the following to help you to study:

- Kevin Murphy's *Machine Learning: A Probabilistic Perspective*
- *Elements of Statistical Learning* by Hastie, Tibshirani and Friedman
  http://statweb.stanford.edu/~tibs/ElemStatLearn/

We will mark suggested readings from these two books.

Tentative Schedule Please see the last page of this document.

Other optional references

- *A course in machine learning* by Hal Daumé III http://ciml.info
- *Bayesian reasoning and machine learning* by David Barber
  http://web4.cs.ucl.ac.uk/staff/D.Barber/pmwiki/pmwiki.php?n=Brml.HomePage
- *Pattern Recognition and Machine Learning* by C Bishop (available from online and campus bookstores)
- Andrew Moore's Tutorial http://www.autonlab.org/tutorials/
- Andrew Ng's free online course http://ml-class.org/ (started 8/20/2012 for this semester) and lecture material http://cs229.stanford.edu/

- Erik Sudderth's Course and Collection of Resources
  http://cs.brown.edu/courses/csci1950-f/spring2011/resources.html
- *Pattern Classification* by Duda, Hart and Stork
- *All of Statistics* by L. Wasserman

References for frequently used maths

- *The Matrix cookbook*
  http://orion.uwaterloo.ca/~hwolkowi/matrixcookbook.pdf
- Chris Burges's note on applied maths for machine learning
  Click here
- The Wisconsin collection http://pages.cs.wisc.edu/~andrzeje/lmml.html
- Khan Academy: http://www.khanacademy.org/

Statement for Students with Disabilities Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect ones own academic work from misuse by others as well as to avoid using anothers work as ones own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

The schedule is based on Prof. Sha's instruction days. Prof. Liu's instruction days will be one day behind.

- MLaPP refers to Murphy's textbook
- ESL refers to Elements of Statistical Learning

For the most recent schedule, please visit the website:
http://www-bcf.usc.edu/~feisha/csci567_fall2014/

Date	Topics to be covered	Notes
8/25	Entrance Exam	
8/27	Overview of ML; Review of Basic Math Topics	
9/1	No class	Labor Day
9/3	Nearest neighbors, Decision trees [MLaPP] 1.4.1-1.4.3, 16.2 [ESL] 9.2, 13.3	
9/8	Naive Bayes [MLaPP] 3.5 [ESL] 6.6.3	
9/10	Logistic regression [MLaPP] 1.4.6, 8.1-8.3 [ESL] 4.1-4.2, 4.4	HW1 out
9/15	Linear discriminant analysis, Perceptron [MLaPP] 4.2.1-4.2.5, 8.5.1-8.5.4 [ESL] 4.3, 4.5	
9/17	Linear regression [MLaPP] 1.4.5, 7.1-7.3, 7.5.1, 7.5.2, 7.5.4, 7.6 [ESL] 3.1-3.2	HW2 out
9/22	Overfitting, bias/variance tradeoff, regularization [MLaPP] 1.4.7, 1.4.8 [ESL] 7.1, 7.2, 7.3, 7.10	
9/24	Kernel methods [MLaPP] 14.1, 14.2.1-14.2.4, 14.4.1, 14.4.3 [ESL] 5.8, 6.3, 6.7	
9/29	SVM [MLaPP] 14.5.2-14.5.4 [ESL] 12.1-12.3	
10/1	Neural networks and deep learning [MLaPP] 16.5.1-16.5.6, 28 [ESL] 11.3-11.7	HW3 out
10/6	Boosting [MLaPP] 16.4.1-16.4.5, 16.4.8, 16.4.9 [ESL] 16.3	
10/8	Other ensemble learning methods [MLaPP] 16.6 [ESL] 8.7	
10/13	Pragmatics: comparing and evaluating classifiers [MLaPP] 16.7, 16.8	TAs teaching
10/15	Clustering, mixture models	HW4 out

Date	Topics to be covered	Notes
10/20		Quiz 1
10/22	Dimensionality reduction and visualization	
10/27	Matrix factorization	
10/29	Recommender systems and other applications	HW5 out
11/3	Hidden Markov models (HMMs)	
11/5	Example applications of HMMs	
11/10	Introduction to Bayesian network	
11/12	Introduction to Markov random fields	HW6 out
11/17	Introduction to Bayesian inference	
11/19	Large-scale learning for Big Data	
11/24	Other current and trendy topics	
11/26	No class	Thanksgiving
12/1	Course review/summary	
12/3	Quiz 2 (cumulative)	