Pattern Recognition

CAP 5638, Fall 2009
Department of Computer Science Florida State University

Class time and location

Tuesday and Thursday, 11:00AM - 12:15 PM at LOV 103.

Instructor

- Instructor: Xiuwen Liu.
- Email: liux@cs.fsu.edu.
- Home page: http://www.cs.fsu.edu/~liux.
- Office: 166 Love Building (LOV) Phone: (850) 644-0050.
- Office hours: Tuesday and Thursday, 9:30 - 10:45 AM and by appointments.

Teaching Assistant

- Teaching assistant: TBA.
- Email: TBA.
- Office hours: TBA.

Course Home Page

http://www.cs.fsu.edu/~liux/courses/cap5638-2009/index.html.
This web site contains the up-to-date information related to this class such as news, announcements, assignments, lecture notes, and useful links to resources that are helpful to this class. Announcements on this web page are OFFICIAL for this class. Besides the course home page, this class will also use Blackboard for class communication and management and you need to make sure that your email address on record is actively used.

Rationale

With the advances in software and hardware and sensor technologies, intelligent components have become the most important factor in many applications. From daily news and experience, intelligent systems, including intelligent software (such as spam filtering, stock price prediction, and visual inference), smart phones, intelligent vehicles, smart houses, to active environment, are playing more and more important roles in our society; these exciting new challenges present opportunities for new and better jobs. A common feature for these intelligent systems is that they need to make decisions based on the sensor inputs as we as humans do even without knowing, which is the primary problem of pattern recognition. This class covers the basic principles underlying commonly used intelligent components to gain better understandings of the state-of-the-art intelligent system designs and lay a foundation for doing research in related areas.

Course Description

This course covers various aspects of pattern recognition and pattern discovery techniques, including statistical pattern classification, parameter estimation, and classification algorithms (including linear discriminant functions, neural networks, support vector machines, decision trees, and Adaboost algorithms),

and unsupervised clustering algorithms. It also establishes links between pattern recognition techniques and those in related areas such as data mining and machine learning.

Prerequisites

Senior or graduate standing in science or engineering or permission of the instructor. Some familiarity with basic concepts in linear algebra and probability theory. Some basic knowledge of algorithm designs and some experience with C/C++, JAVA, or MATLAB programming (at least one programming language for programming assignments).

Course Objectives

Upon successful completion of this course of study, a student should:

- Have a solid understanding of basic pattern recognition techniques,
- Know how to implement and use the following pattern recognition and clustering algorithms.
    - Bayesian decision rule.
    - Linear discriminant functions.
    - Multiple layer perceptron neural networks.
    - Decision trees.
    - Support vector machines.
    - Adaboost.
    - K-means.
- Understand maximum likelihood estimation.
- Understand the fundamental issues in pattern recognition (such as generalization performance).
- Understand computational issues with pattern recognition problems.
- Have had some research experience in pattern recognition.

Textbook and Class Materials

"Pattern Classification" by Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd Edition, Wiley-Interscience (ISBN: 0471056693) and papers from the literature.

Student Responsibilities

Unless you obtain prior consent of the instructor, unexcused absences will be used as bases for attendance grading. Participation of in-class discussions and activities is also required and will be used as bases for attendance grading also. Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Assignments and Projects

About six homework assignments will be given along the lectures. There will be two programming projects related to pattern recognition, which can be implemented in C/C++, JAVA, MATLAB, or other programming language. There will be a midterm exam. There will also be a final project intended as a research oriented assignment (.i.e., you propose/choose your own topic for your final project).

Grading Policy

Grades will be determined as follows:

Assignments	Points
Attendance and Class Participation	10 %
Homework Assignments	25 %
Programming Project I	10 %
Programming Project II	10 %
Midterm Exam	30 %
Final project	15 %

Grading will be based on the following scale, where *S* is the weighted average according to the above table:

Score	Grade	Score	Grade	Score	Grade
93 <= *S*	A	80 <= *S* < 83	B-	67 <= *S* < 70	D+
90 <= *S* < 93	A-	77 <= *S* < 80	C+	63 <= *S* < 67	D
87 <= *S* < 90	B+	73 <= *S* < 77	C	60 <= *S* < 63	D-
83 <= *S* < 87	B	70 <= *S* < 73	C-	*S* < 60	F

Assignment Due Time and Late Penalties

Assignments are due in class on the specified due date. Assignments turned in after the due date, but by the beginning of the next scheduled class will be penalized by 10 %. Assignment submissions will **NOT** be accepted that are more than one class period late. Note that for the assignment due right before the midterm exam review and the final project, no late submission will be accepted.

Submission and Return Policy

Unless specified otherwise, **HARDCOPY** submission is required for all the homework assignments and programming projects. All the exams/assignments will be returned as soon as possible after grading but no later than two weeks from the submission date.

Tentative Schedule

- Week 1: Introduction (Chapter 1).
- Week 2: Bayesian decision theory (Chapter 2).
- Week 3: Maximum-likelihood estimation (Chapter 3).
- Weeks 4-5: Non-parametric techniques (Chapter 4).
- Week 6: Linear discriminant functions (Chapter 5).
- Week 7: Support vector machines (Chapter 5).
- Week 8: Multi-layer neural networks (Chapter 6).
- Week 9: Decision trees (Chapter 8).
- Week 10: Algorithm-independent machine learning (Chapter 9).
- Week 11: Adaboost and other boosting algorithms (Chapter 9 and papers from the literature).
- Week 12: Midterm review/exam.
- Week 13: Unsupervised learning and clustering (Chapter 10).

- Week 14: Syntactic pattern recognition (Sections 8.6, 8.7, and papers from the literature).
- Week 15: Case studies (Papers from the literature).
- Final week: Final project due, 5:00pm, Friday, December 11, 2009.

Academic Honor Code

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at http://dof.fsu.edu/honorpolicy.htm)

Assignments/projects/exams are to be done individually, unless specified otherwise. It is a violation of the Academic Honor Code to take credit for the work done by other people. It is also a violation to assist another person in violating the Code (See the FSU Student Handbook for penalties for violations of the Honor Code). The judgment for the violation of the Academic Honor Code will be done by the instructor and a third party member (another faculty member in the Computer Science Department not involved in this course). Once the judgment is made, the case is closed and no arguments from the involved parties will be heard. Examples of cheating behaviors include:

- Discuss the solution for a homework question.
- Copy programs for programming assignments.
- Use and submit existing programs/reports on the world wide web as written assignments.
- Submit programs/reports/assignments done by a third party, including hired and contracted.
- Plagiarize sentences/paragraphs from others without giving the appropriate references. Plagiarism is a serious intellectual crime and the consequences can be very substantial.

Penalty for violating the Academic Honor Code: A 0 grade for the particular assignment/quiz/exam and a reduction of one letter grade in the final grade for all parties involved for each occurrence. A report will be sent to the department chairman for further administrative actions.

Accommodation for Disabilities

Students with disabilities needing academic accommodations should: 1) register with and provide documentation to the Student Disability Resource Center (SDRC), and 2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done within the first week of class. *This syllabus and other class materials are available in alternative format upon request.*

For more information about services available to FSU students with disabilities, contact the Assistant Dean of Students:

Student Disability Resource Center	(850) 644-9566 (voice)
97 Woodward Avenue, South	(850) 644-8504 (TDD)
108 Student Services Building	sdrc@admin.fsu.edu
Florida State University	http://www.disabilitycenter.fsu.edu/
Tallahassee, FL 32306-4167	