CSE 5523 (Approved): Machine Learning and Statistical Pattern Recognition

Course Description

Introduction to basic concepts of machine learning and statistical pattern recognition; techniques for classification, clustering and data representation and their theoretical analysis.

Prior Course Number: CSE 735
Transcript Abbreviation: Machine Learning
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: (CSE 3521 or CSE 5521 or CSE 5243) and (CSE 5522 or Stat 3460 or Stat 3470)
Exclusions: Not open to students with credit for CSE 735
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.0901
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
BS CSE	BS Computer Science and Engineering
MS CSE	MS Computer Science and Engineering
PhD CSE	PhD Computer Science and Engineering

Course Goals

Master basic techniques of machine learning, including linear methods, prototype-based methods, and kernel methods.
Master the statistical framework of machine learning and basic concepts, such as Bayes optimal classifier.
Be competent with theoretical analysis of complexity and other properties of statistical learning techniques.

Be familiar with the broad spectrum of methods for classification, regression and clustering, including boosting, spectral clustering, and other methods.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Basics of statistical pattern recognition. Probability and statistical inference. Bayes decision theory.	8.0							
Overview of techniques for regression and classification, parametric and non-parametric methods including prototype-based methods, linear and kernel methods.	9.0							
Analysis of statistical algorithms. Empirical risk minimization and VC-theory. Generalization bounds.	6.0							
Clustering. k-means algorithm. Gaussian mixture models and the EM algorithm. Spectral clustering.	5.0							
Dimensionality reduction. Principal Components Analysis and Multidimensional Scaling.	4.0							
Advanced topics in machine learning.	4.0							
Discussion of applications, e.g. speech, language, and vision.	4.0							

Grades

Aspect	Percent
Homework	25%
Project	40%
Exam	30%
Participation	5%

Representative Textbooks and Other Course Materials

Title	Author
Pattern Recognition	S. Theodoridis, K. Koutroumbas,

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
***	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
**	c	An ability to design a system, component, or process to meet desired needs.
*	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.

Course Contribution		College Outcome
	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

BS CSE Program Outcomes

Course Contribution		Program Outcome
***	a	an ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, and engineering;
***	b	an ability to design and conduct experiments, as well as to analyze and interpret data;
**	c	an ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints such as memory, runtime efficiency, as well as appropriate constraints related to economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations;
*	d	an ability to function on multi-disciplinary teams;
**	e	an ability to identify, formulate, and solve engineering problems;
	f	an understanding of professional, ethical, legal, security and social issues and responsibilities;
*	g	an ability to communicate effectively with a range of audiences;
*	h	an ability to analyze the local and global impact of computing on individuals, organizations, and society;
	i	a recognition of the need for, and an ability to engage in life-long learning and continuing professional development;
	j	a knowledge of contemporary issues;
**	k	an ability to use the techniques, skills, and modern engineering tools necessary for practice as a CSE professional;
**	l	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
***	m	an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;
**	n	an ability to apply design and development principles in the construction of software systems of varying complexity.

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