Engineering Division Course Syllabus

Course Title: Selected Topics in Information and Computational Systems - Machine Learning

Course Number **ENGR-UH 4560**

Course Description: Machine Learning is the basis for the most exciting careers in data analysis today. This course introduces students to the concepts of machine learning and deep learning. This course covers a broad introduction to machine learning techniques, which include both supervised learning and unsupervised learning techniques such as classification, support vector machines, decision trees, ensemble learning and random forests, dimensionality reduction, and neural networks and deep learning. In addition to learning about the most effective machine learning techniques, you will gain the practical implementation of applying these techniques to real engineering problems.

Credits 4

Prerequisite Courses Recommended: ENGR-AD-202 Computer System Programming

Instructor Information

Instructor(s) Prof. Yi Fang (Instructor)

Contact Information: A1-007
Email: yfang@nyu.edu
Phone: 056-3190302

Intended Learning Outcomes: Upon successful completion of this course, students will be able to:

- Develop the programming skills using python to implement the basic machine learning algorithms [(a.3), (e.3)];
- Understand the fundamental concepts of machine learning algorithms for them: classification, clustering, regression, SVMs, decision trees, dimensionality reduction, and neural networks and deep learning [(b.3)];
- Develop a solution to an engineering problem based on learned machine learning algorithms [(c.2), (k.1)];

Course Materials

Textbook: Hands-On Machine Learning with Scikit-Learning & TensorFlow, Aurelien Geron

Teaching and Learning Methodologies: Students are expected to arrive at class with an understanding of the basic definitions, concepts, and applications of relevant topics. Class time will be devoted to in-depth discussions of course topics. Lab project assignments are dedicated for reinforcing course topics via solving representative problem sets and holding class discussions.

Assignments and Grades: The course will provide with two tracks of assignments and grades. Student may choose one of two tracks for the class. The first track will be based on five mini-projects, one large deep learning project, two presentations and the second track will be based on five mini-projects and three deep learning projects. The distribution of grades is subject to some revision at the discretion of the instructor. Typical weighting values are given below:

Track 1	Track 2
Mini Projects: 5*10%	Mini Projects: 5*10%
Large Deep Learning Project: 1*40%	Deep Learning Project One : 1*15%
Two Presentations: 2*5%	Deep Learning Project Two: 1*15%
	Deep Learning Project Three:1*20%

Course Schedule: A typical schedule for course topics, projects, and exam dates is given in the table below (The actual schedule might be slightly different from this).

Week	Lecture Topics
1	▪ Introduction
2	▪ Regression
3	▪ Classification
4	▪ Support Vector Machine (SVM)
5	▪ Tree
6	▪ Ensemble Machine Learning
7	• K-Nearest Neighbors (KNN)
8	• Midterm Presentation
9	• Dimensionality Reduction
10	▪ Unsupervised Learning: Clustering
11	▪ Intro. To neural networks
12	▪ Deep Learning and its Application
13	▪ Deep Learning and its Application
14	▪ Final Presentation

Course Structure: 14 weeks course, 2 lectures per week (75 minutes each) + 155 minutes lab per week

Relationship to Outcomes:

	Shared Engineering Outcomes					Program Specific Criteria				
	(1)	(2)	(3)	(4)	(5)	CivE	CmpE	ElecE	MechE	GenE
Lectures		x	x	x	x		X			x
Labs		x	x	x	x		x			x

	Student Learning Outcomes												
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
Lectures	x	x	x		x						x		
Labs	x	x	x		x						x		

Shared Engineering Outcomes:

(1) Apply techniques in the practice of leadership and innovation [(l), (m)];
(2) Identify social, economic, ethical and other factors that shape engineering solutions and incorporate them in conjunction with engineering principles in problem solving and designing systems, components, or processes to meet desired needs within realistic constraints [(a), (c), (e), (f), (h)];
(3) Recognize and respond respectfully to cultural concerns and differences when solving problems both physical and ethical [(a), (e), (f), (h)];
(4) Exhibit guidance and organizational effectiveness in multidisciplinary teams as a participant and a leader [(d), (l)];
(5) Demonstrate competence in writing and speaking effectively, and in communicating significant technical information in a clear and concise manner [(g)].

Program Specific Criteria:

- CivE: Civil Engineering graduates will be able to work professionally in four of the technical areas of the civil engineering discipline (structural, geotechnical, transportation, and environmental), design systems, components, and processes in more than one civil engineering context, and apply the principles of project management.
- CompE: Computer Engineering graduates will be able to analyze and design complex computing and network devices and systems containing hardware and software components.
- ElecE: Electrical Engineering graduates will be able to analyze and design complex electrical, electronic, and communication devices and systems.
- MechE: Mechanical Engineering graduates will be able to analyze and design systems, components, and processes, and work professionally in both thermal and mechanical systems areas.
- GenE: General Engineering graduates will be able to analyze and design devices and systems in an interdisciplinary engineering area related to: Biomedical and Health Systems; Information, Communication, and Electronic Systems; or Urban Systems.

Student Learning Outcomes:

(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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

(d) an ability to function on multidisciplinary 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, economic, environmental, and societal context;

(i) a recognition of the need for, and an ability to engage in life-long learning;

(j) a knowledge of contemporary issues;

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;

(l) an ability to apply leadership skills including risk and project management and decision making;

(m) an ability to apply innovation skills.

Assessment Plan for ENGR-UH 4560: Selected Topics in Information and Computational Systems - Machine Learning

Performance Indicators	Assessment Tools		
	Project	**Midterm Presentation**	**Final Presentation**
(a.3) Apply knowledge and practices of engineering in solving problems.	✓	✓	
(b.3) Analyze and interpret data related to engineering experiments.	✓	✓	✓
(c.2) Design a component to meet desired needs within realistic constraints.	✓		✓
(e.3) Demonstrate the ability to solve engineering problems using appropriate methods.	✓	✓	✓
(k.1) Apply modern computational tools in design and analysis of engineering system.	✓		✓
CompE: ***Criteria satisfied by outcomes above and degree curricular requirements.***			
GenE: ***Criteria satisfied by outcomes above and degree curricular requirements.***			