MACHINE LEARNING
CS 412 - Spring 2022

Instructor: Onur Varol, PhD	**Email**: onur.varol@sabanciuniv.edu
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All course related communication will be carried out using "cs412.fens@sabanciuniv.edu" email address, so please DO NOT send emails to any other email addresses.	
Time and location - Wednesday 16:40 – 17:30, **Online on Zoom** (except the first class on March 2nd) - Fridays 14:40 – 16:30, FENS G077 **Recitations** (Thursday 12:40 – 14:30, Online): About every three weeks to cover basic tools and techniques for hands-on experience.	
Website: SUCourse platform will be used to share course material and information.	
Office hours: - Onur Varol: By email appointment - Özgür Can Seçkin: Wednesday 12:40 – 13:30 https://sabanciuniv.zoom.us/j/6949395373 - Deren Ege Turan: Monday 15:40 – 16:30 https://sabanciuniv.zoom.us/j/2418220668 - Fırat Kızılırmak: Tuesday 12:40 – 13:30 https://sabanciuniv.zoom.us/j/3434417065	

Main references: This is a restricted list of various interesting and useful books that will be used during the course. You may need to consult them occasionally, but none of them are require.

- Ethem Alpaydın, *Introduction to Machine Learning*, 2010
- Tom Mitchell, Machine Learning, 1997
- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, 2011 (Available online here)
- Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, *The Elements of Statistical Learning*, 2001 (Available online here)
- Jure Leskovec, *Mining of Massive Datasets*, 2020 (Available online here)

Course summary: This is an introductory machine learning course that will aim a solid understanding of the fundamental issues in machine learning (overfitting, bias/variance), together with several state-of-art approaches such as decision trees, linear regression, k-nearest neighbor, Bayesian classifiers, neural networks, logistic regression, and classifier combination. In addition to supervised approaches, unsupervised approaches will be covered, and model evaluations strategies will be introduced for different tasks.

Objectives and learning outcomes:

Objectives	Outcomes
Understand the basic concepts, issues, assumptions and limitations in machine learning (e.g. overfitting, error measures, curse of dimensionality).	Have a solid understanding of the basic concepts, issues, assumptions, and limitations in machine learning and how they apply to various machine learning techniques.
Have a working knowledge of the basic background on probability and linear algebra, and algorithms behind common machine learning techniques; together with their suitability in given situations.	Have a working knowledge of the basic mathematics and algorithms behind common machine learning techniques; together with their suitability in given situations.
Given a machine learning problem, be able to implement and evaluate one of the standard machine learning algorithms.	Given a machine learning problem, select, implement and evaluate one of the appropriate machine learning algorithms using Python.

Tentative Course Outline:

Week 1		Introduction to ML concepts
Week 2		Feature extraction (timeseries, text, image, and graphs)
Week 3		Decision tree learning and ensemble learning
Week 4		Nearest neighbor classifier
Week 5		Linear and logistic regression
Week 6		Bayesian approaches
Week 7	Homework #1 due	Kernel methods and support vector machines
Week 8		Midterm exam
Week 9		Neural networks
Week 10		Introduction to deep learning
Week 11		Practical issues (imbalance, missing values, model calibration)
Week 12	Homework #2 due	Feature selection techniques
Week 13		Unsupervised learning - Dimensionality reduction
Week 14		Unsupervised learning - Clustering

Grading Policy: These percentages are tentative and subject to change.

- **Midterm and Final exams (25% and 25%)**: Exams will be help in person (or following the universities guidelines).
- **Homeworks (20%)**: Mix of programming and written questions will be given, and responses will be provided as a report for each assignment.
- **Quizzes (10%)**: Short quizzes will be online on Wednesdays.
- **Project (20%)**: Project will be chosen among few alternative tasks. Teamwork is encouraged and groups can consist of 3-5, but each student will be evaluated individually. Project may involve data collection, annotation, feature extraction, model building and reporting.

Late submissions will cause 5 points reduction for each day and no assignment will be accepted after 7 days.

To pass the course your grade as calculated following the above criteria **must be at least 35** and this is not subject to change or negotiation and **final exam score also must be above 29/100**. If you take the final but get a failing grade (<30), you need to take the makeup as well, in which case the average of the final and the makeup will be considered as your final exam grade. Attendance and class participation will be considered in border-line grades.

Academic honesty: All students must follow the university guidelines of academic integrity. https://www.sabanciuniv.edu/en/academic-integrity-statement