Course program and reading list

Semester 2 Year 2022

School: Efi Arazi School of Computer Science M.Sc.

Advance Machine Learning

Lecturer:
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Tutors:
Mr. Abraham Israeli    Abraham.Israeli@post.idc.ac.il
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Course No.: 3603
Course Type: Lecture
Weekly Hours: 3
Credit: 3

Course Requirements: Final Paper
Group Code: 222360301
Language: English

Prerequisites

Prerequisite:
52 - Calculus I
53 - Calculus II
54 - Linear Algebra I
55 - Linear Algebra II
Course Description

Introduction

Learning is a process by which a system improves performance from experience, and machine learning is the field in computer science that study and formalize learning processes. From a practical standpoint, machine learning is the leading technology used to extract information from a raw data and transform it to a knowledge that provides a real (business) value. In recent years, the use of machine learning methods is gaining momentum in many domains, and the technology is massively applied over Big Data.

The Course

In this course we will cover advanced topics in machine learning, such as Information Theory meets Machine Learning, Bayesian Networks, Temporal Models (Markov Models, LSTM), Text Analytics and Language Modelling, Active Learning, and Learning Theory.

The approach employed in the course is a blend of statistical inference, optimization, and computer science, thus providing the theoretical intuition behind modern machine learning methods as well as practical knowledge.

The course assumes a prior knowledge in the basics of Machine Learning, knowledge in probability and linear algebra, and basic deep learning knowledge. Background knowledge in statistics is an advantage.

The course will include both theoretical and practical exercises and a final project. For the practical assignments we will use Python.

56 - Discrete Mathematics
59 - Data Structures
69 - Logic And Set Theory
417 - Introduction To Computer Science
3141 - Machine Learning from Data
## Schedule

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
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| 1-4     | Information Theory meets ML  
• Measurements (Entropy, MI, KL, JS)  
• Data compression and classification  
• Max Entropy and model selection  
• Information Bottleneck and clustering  
• Application to deep learning |
| 5-7     | Bayesian Networks  
• Representation  
• Exact Inference  
• Parameter Learning and EM |
| 8       | Variational Inference  
• Variational Autoencoders (VAE) |
| 9       | Hidden Markov Models (HMM) |
| 10      | Text Analytics |
| 11      | Deep Learning meets NLP |
| 12      | Active Learning |

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### Course Goals

The course is intended for students who would like to extend their knowledge and capabilities beyond introductory level and master advanced ML topics and techniques.
• Submission of all exercises (60% of grade)
  ◦ Practical exercises can be submitted in pairs
• Final project (40% of grade)

Lecturer Office Hours
Office hours: By appointment. Please send an email to schedule.

Reading List
Will be provided in class, on a topic by topic basis