



## *The Hebrew University of Jerusalem*

### *Syllabus*

## *Machine Learning - 55807*

*Last update 11-11-2019*

*HU Credits:* 3

*Degree/Cycle:* 2nd degree (Master)

*Responsible Department:* Business Administration

*Academic year:* 0

*Semester:* 1st Semester

*Teaching Languages:* Hebrew

*Campus:* Mt. Scopus

*Course/Module Coordinator:* Lev Muchnik

*Coordinator Email:* [lev.muchnik@huji.ac.il](mailto:lev.muchnik@huji.ac.il)

*Coordinator Office Hours:* By appointment

*Teaching Staff:*

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Prof Lev Muchnik

Course/Module description:

*This course will introduce the students to many concepts and techniques used in machine learning with the emphasis on application of the learned material to common problems faced by modern businesses. The course provides hands-on experience and trains students to pick the best tools for the specific problem in hand. Beyond application of the machine learning algorithms and interpretation of the results, the students will acquire skills necessary to collect, manage, clean and prepare the data for the analysis.*

Course/Module aims:

Learning outcomes - On successful completion of this module, students should be able to:

*On successful completion of this course, the students should be able to identify opportunities for application of machine learning techniques to real-world problems, define research questions and plan the study, organize and prepare the data for the analysis, select the most adequate technique, interpret and visualize the obtained results. Finally, the students will learn to establish data-driven decision-making procedure that will culminate in actionable steps aimed at improving company's performance.*

Attendance requirements(%):

80

*Teaching arrangement and method of instruction: The course will combine lectures demonstrating variety of machine-learning techniques with practical assignments that leverage these methods.*

Course/Module Content:

*Classical Classification Algorithms*

- *Support Vector Machine (SVM)*
  - *Naïve Base classifier*
  - *XGBoost*
- Intro to Deep Learning (Neural Networks):*
- *Perceptron*
  - *Back propagation*
  - *Fully Connected layer*

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- *Types of networks:*
  - *Feed forward*
  - *Convolutional Neural Networks (CNN)*
  - *Long-Short Term Memory (LSTM)*
  - *Transfer learning*
  - *Attention learning*
  - *Classifying texts and images*
  - *Packages: ImageNet, Keras*
  - *Video: Object detection & tracking - YOLO*

#### *Natural Language Processing (NLP)*

- *TF-IDF*
- *Word Cloud*
- *Mutual Information*
- *Topic Modelling*
- *Word embedding (genism)*
- *Preprocessing text*
- *Stemming & Lemmatizing*
- *Cleaning (number, punctuation)*
- *BeautifulSoup*
- *MS Office Documents*
- *Text Classification*
- *Text Summarization*
- *Packages: SPACY/ NLTK/textextract*
- *Recent Algorithms (BERT, XLNet)*

#### *Numerical Optimization - Heuristic Methods*

- *Gradient Descent*
- *Simulated Annealing*
- *Genetic Algorithm*
- *Ant Colony*

#### *Modelling and Numerical Simulations for hypothesis testing*

- *Agent-based modelling*

#### *Time series analysis & Prediction*

- *fbProphet*

#### *Anomaly (Outlier) Detection*

#### *Network Analysis*

- *NetworkX*

#### *Databases:*

*Structured Query Language (SQL)*

*Document Databases (MongoDB)*

*Crawling: Scrapy / Web APIs*

*Parsing: regex, xpath*

*Parallel Code: Multiprocessing*

*Logging*

*Large (binary) files*

*Git & code management*

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*Additional topics*

- *Biases in data*
- *Causal Inference*
- *Unbalanced classes & missing data*
- *Distance Measures*
- *Confidence intervals, bootstrapping*
- *Grid Search*
- *Model Validation*
- *Ethics of Data Science*

*Required Reading:*

*The reading material will be provided in the class.*

*Additional Reading Material:*

*Course/Module evaluation:*

*End of year written/oral examination 0 %*

*Presentation 0 %*

*Participation in Tutorials 10 %*

*Project work 0 %*

*Assignments 50 %*

*Reports 0 %*

*Research project 40 %*

*Quizzes 0 %*

*Other 0 %*

*Additional information:*

*Room 5102B*

*School of Business Administration*

*The Hebrew University of Jerusalem*

*Mt. Scopus*