SUBJECT: Machine Learning

PROFESSOR: Giuseppe Ragusa

LANGUAGE: English

COURSE FORMATIVE OBJECTIVES:

This course gives an overview of many techniques, and algorithms in machine learning, beginning with topics such as linear regression and classification and ending up with more recent topics such as boosting, support vector machines, random forests and and unsupervised learning techniques. The course will give the student the ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work. The module will use primarily the R programming language.

INTENDED LEARNING OUTCOMES

By the end of the course, students should:

- develop an appreciation for what is involved in learning from data.

- understand a wide variety of learning algorithms.

- understand how to apply a variety of learning algorithms to data understand how to perform evaluation of learning algorithms and model selection.

- Improve their computer programming skills.

PREREQUISITES

Statistics, econometrics, and knowledge of at least an advanced computer program (R, Julia, Python).

COURSE CONTENTS

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 1, DATE

Supervised and Unsupervised learning

HTF, Chapter 1 and Chapter 2

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 2, DATE

Linear methods for regression and classification

HTF, Chapter 3

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 3, DATE

Regularization and shrinkage. Ridge, lasso, and Elastic Net

HTF, Chapter 3/4

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 4, DATE

Kernel smoothing methods.

HTF Chapter 6

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 5, DATE

Model assessment and selection: cross-validation and bootstrap

HTF Chapter 7

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 6, DATE

Tree based models

HTF Chapter 9

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 7, DATE

Boosting and additive trees

HTF Chapter 10

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 8, DATE

Random forests

HTF Chapter 15

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 9, DATE

Neural network

HTF Chapter 11

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 10, DATE

Support vector machines

HTF Chapter 12

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 11, DATE

Cluster Analysis

HTF Chapter 14

EXTENDED PROGRAM AND REFERENCE READING MATERIAL: LESSON 12, DATE

Dimensionality reduction techniques: SVD/PCA

HTF Chapter 14

REFERENCE MATERIALS

[HTF] Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. *The elements of statistical learning*. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.

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