MCSE 6309 And EMoS 6309: Machine Learning

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Course Information

1. **Course Instructor**: Dina Machuve(PhD)
2. **Course Assistant**: Neema Mduma

1 Course Description

The goal of this course is to provide an overview of the state-of-art algorithms used in machine learning. In recent years, many successful applications of machine learning have been developed, ranging from data-mining programs that learn to detect fraudulent credit card transactions, to autonomous vehicles that learn to drive on public highways, and computer vision programs that can recognize thousands of different object types. At the same time, there have been important advances in the theory and algorithms that form the foundation of this field. This course is divided into three parts, a)the Mathematical Foundations for Machine Learning b) Machine Learning, and c) Practicals. This course brings the mathematical foundations of basic machine learning concepts will provide the mathematical background, applied to four central machine learning problems, to make it easier to read other machine learning textbooks.

2 Course Outline

Part 1: Mathematical Foundations

1. Linear Algebra
2. Analytic Geometry
3. Vector Calculus
4. Statistics and Probability Theory
5. Optimization

Part 2: Machine Learning

1. Linear Regression
2. Classification with Logistic Regression
3. Graphical Models
4. Dimensionality Reduction with Principal Component Analysis
5. Model Selection
6. Gaussian Process Regression
7. Bayesian Optimization
8. Sampling

Part 3: Practicals

1. Python, Pandas and Jupyter Tutorial
2. Statistics of datasets
3. Linear regression
4. Logistic regression
5. Principal component analysis

3 Prerequisites

Basic knowledge of Python programming language is required. Basic knowledge of probability/statistics, calculus and linear algebra is required.

References

1. Marc Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", *https://mml-book.com/*, To be published by Cambridge University Press.
2. Simon Rogers, Mark Girolami, "A First Course in Machine Learning", 2nd Edition, CRC 2016
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
4. Paul Barry, "Head First Python", O'Reilly, 2010

4 Academic Integrity

The NM-AIST upholds the standards of honesty and integrity from all members of the academic community. The policy covers:

- Plagiarism: intentionally or unintentionally representing the words or ideas of another person as your own; failure to properly cite references; manufacturing references.
- Submitting a paper written (entirely or even a small part) by another person or obtained from the Internet.
- Plagiarism is plagiarism: it does not matter if the source being copied is on the Internet, from a book or textbook, or from quizzes or problem sets written up by other students.
- The penalties for violation of the policy may include a failing grade on the assignment/project and/or a failing grade in the course.

5 Homework Assignments and Term Project

There will be four homework assignments, one class test, an open-ended course project, and final university examination. All homework assignments are **INDIVIDUAL**! You may discuss the problems with your classmates, but you must submit individual homework assignments. Please acknowledge all sources you use in the assignments (papers, code or ideas from someone else).

- Each homework assignment will include written and programing portions.
- Both written and programming assignments will be submitted electronically.
- Programming assignments will be in Python.
- In the term project, each group of two students will investigate some interesting aspect of machine learning or apply machine learning to a problem that interests you.

6 Grading breakdown

The course grades will be broken down as follows: Four homework assignments with written and programming components: 20%; Midterm examination: 10%; Final project: 10%; and Final university examination: 60%.