Syllabus: ECGR 4105/5105 - Introduction to Machine Learning

Introduction to Machine Learning (ML)

Instructor: **Hamed Tabkhi** - htabkhiv@uncc.edu
Office Hour: Mondays 3:45pm-4:45pm

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Course Overview and Objectives

Machine learning is a sub-field of Artificial Intelligence that allows computers to learn and/or act without being explicitly programmed. This course introduces machine learning principles and provides foundations on a data-driven approach for machine intelligence and decision making. The topics include variously supervised, unsupervised learning approaches (including deep learning), optimization procedures, and statistical inference. During this course, The students will digest and practice their knowledge and skills by class discussion, homework and exams, as well as obtain in-depth experience with a particular topic through a final project.

Course Topics:

(Minor changes may occur)

1. Linear regression and logistic regression
2. Probabilistic classification (Naïve Bayes)
3. Support vector machine (SVM) and kernel approach
4. Sparse coding, sparse and collaborative representation
5. Deep learning
   a) Feedforward neural networks
   b) Convolutional neural networks
   c) Recurrent neural networks
   d) Good practice of deep neural networks implementation
6. Deep learning applications
   - low-level image processing
   - object detection
   - semantic segmentation
   - action recognition, etc.
7. Emerging topics in Machine Learning and Computer Vision (e.g., Generative Adversarial Networks, DeepFake, Adversarial Robustness, Fairness, etc.)

Prerequisites

Background on programming (Python) and familiarity with basic linear algebra and signal processing principles

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Textbook

This course does not follow any textbook closely. But most topics will follow the following textbook:

1. **Introduction to Machine Learning with Python,** by Andreas C. Müller & Sarah Guido, O'Reilly. 2019. PDF provided in Canvas.
2. Introduction to Machine Learning, Ethem Alpaydin (2014), MIT Press.
3. https://www.cmpe.boun.edu.tr/~ethem/i2ml3e/
4. Artificial Intelligence: A Modern Approah, (Third edition) by Stuart Russell and Peter Norvig.
5. Pattern Recognition and Machine Learning, Christopher M. Bishop (2006). [A Bayesian view]
6. Linear Algebra and its Applications, Gilbert Strang (1988). [For those who want to simply keep a concise reference for linear algebra, my best recommendation is The Matrix Cookbook]
7. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville (2016), MIT Press. https://www.deeplearningbook.org/
8. Bayesian Reasoning and Machine Learning, David Barber Free online:
9. http://web4.cs.ucl.ac.uk/staff/D.Barber/pmwiki/pmwiki.php?n=Brml.Online
10. Diving into Deep Learning, Aston Zhang, Zack Lipton, Mu Li and Alex Smola (2019). [Specially Recommended] (Online version: https://d2l.ai/)

Grading

Homework and individual assignments (about ~5)	40%
Surprise Quizzes (about ~5)	30%
Final group project (report + results + presentation):	30%

Homework assignments and final project will all be based on Google Colab and Nvidia Jetson Nano platform.

Points:

90 - 100	=>	A
80 - 89	=>	B
70 - 79	=>	C
60 - 69	=>	D

Final project

Final project is conducted independently or collaboratively as a team. The project presentation, report and codes should be all submitted via Canvas.

It's important that you work on a real machine learning project, or a real problem in some relevant domain, so that you earn first-hand experience. The instructor will provide a few sample project topics/ideas. The instructor is available to discuss and shape the project. By the end of the semester, you should submit your code and data for this project, write a project report, and prepare a class presentation.

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Specific for Graduate Students: The graduate students will be obligated to submit one additional homework assignment. Also, the final project reequipment and standard is higher for them.

Academic Honesty

Plagiarism, cheating, and any form of unauthorized collaboration will not be tolerated and will be handled in accordance with University policies described in the Student Handbook. You are expected to be familiar with the University's policies about academic honesty: The Code of Student Academic Integrity.

Although students are encouraged to discuss some homework assignments and work together to develop a deeper understanding of the topics presented in this course, submission of others' work, efforts, or ideas as your own is not permitted. Each student is expected to prepare and submit his/her own programs, reports, drawings, and other materials unless otherwise designated.
Copying and sharing of student work such as computer files, documents, spreadsheets, or drawings is not allowed. If multiple students' work is suspiciously similar, a penalty may be assessed to all students involved. If a situation arises in which you are uncertain whether cooperation with another student would constitute cheating or some other violation of the honor code, please ask the instructor for guidance and clarification of these rules. Any evidence of cheating will be referred to the Office of Student Conduct.

Enjoy the course!