

Course Admin

EL-GY 6143: INTRODUCTION TO MACHINE LEARNING

PROF. PEI LIU



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People

- ❑ Professor: Pei Liu, peiliu@nyu.edu
 - 370 Jay Street 9th Floor (Only available on Zoom during Fall 2021)

- ❑ Head TA:
 - Mustafa Ozkoc, mfo254@nyu.edu
 - Host office hours regarding homeworks and labs

- ❑ There will be several other graders as well



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Course Learning Objectives

- ❑ Formulate a task as a machine learning problem
 - Identify learning objectives, source of data, models, ...
- ❑ Load, pre-process and extract features from common data sources
 - images, text, audio, ...
- ❑ Mathematically describe simple models of the data
- ❑ Fit the models to data and use models for prediction and estimation
 - Use common tools
- ❑ Evaluate goodness of fit and refine models
- ❑ Evaluate the performance of methods using statistical techniques



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Grad vs Undergrad

- ❑ Class is simultaneously offered at the graduate and undergraduate level
- ❑ Undergrad EE-UY/CSE-UY 4563: Intro to Machine Learning
 - Covers fundamental algorithms and some analysis
 - In depth coverage of software tools including python, Google Cloud, Tensorflow
 - Python-based lab exercises + mandatory project
- ❑ Grad EL-GY 6143: Intro to Machine Learning
 - More algorithms and more mathematical analysis. Faster paced.
 - Software tools must be learned at home. Less coverage in class
 - Python-based lab exercises + optional project
- ❑ Lecture notes are mostly common with supplementary material for grad students indicated
- ❑ Many labs are common



Texts and Other Resources

- ❑ Undergrad: James, Witten, Hastie and Tibshirani, “An Introduction to Statistical Learning”,
 - <http://www-bcf.usc.edu/~gareth/ISL/ISLR%20First%20Printing.pdf>
 - Very clear explanation of concepts.
 - But examples are in R. And there is no review of probability
- ❑ Grad: Hastie, Tibshirani, Friedman, “Elements of Statistical Learning”
 - <https://web.stanford.edu/~hastie/Papers/ESLII.pdf>
 - More advanced text with more analysis
- ❑ Raschka, “Python Machine Learning”, 2015.
 - <http://file.allitebooks.com/20151017/Python%20Machine%20Learning.pdf>
 - Excellent examples of using Python
- ❑ Bishop, “Pattern Recognition and Machine Learning” (more advanced)
- ❑ Coursera course: Generally do not cover probability
- ❑ Undergrad probability



More Resources

- ❑ Entertaining and very good deep learning lectures by Siraj Raval
 - <https://www.youtube.com/channel/UCWN3xxRkmTPmbKwht9FuE5A>
- ❑ Universite de Paris labs:
 - <https://github.com/m2dsupsdclass/lectures-labs>
 - Focus on deep learning
 - Similar format to this class
- ❑ Andrew Ng's machine learning class:
 - <https://www.coursera.org/learn/machine-learning>
 - A little less mathematical than this class
- ❑ Many, many others online...



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Pre-Requisites

- ❑ Undergrad probability required for both UG and Grad version:
 - Basics of random variables, densities, Gaussian distributions, correlation, expectation, conditional densities, Bayes' theorem
 - Will provide a short review
 - NYU classes: Data analysis or Intro Probability are sufficient
- ❑ Undergraduate calculus and linear algebra
 - Vectors, matrices, partial derivatives, gradients.
 - Again, we will provide a brief review
 - A good review of linear algebra by 3Blue1Brown
https://youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab
- ❑ No machine learning experience is necessary
 - If you have ML experience, do NOT take this class.
 - Take Graduate probability (Fall) then Advanced machine learning (Spring)



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Pre-Requisites Programming

□ Python

- All labs are in python, similar to object-oriented MATLAB, but many more libraries.
- And free!

□ What you need to know

- You do not need to know python before class. But, we will go over it quickly.
- You should have experience in some programming language (eg. MATLAB).
- You should know or being willing to learn object oriented programming

□ Resources:

- Installing python and ipython notebook (make sure you install Version 3.6)
<http://jupyter-notebook-beginner-guide.readthedocs.io/en/latest/index.html>
- Python tutorial: <https://docs.python.org/3/tutorial/>
- Numpy: <http://cs231n.github.io/python-numpy-tutorial/>



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Grading: Graduate

- ❑ Midterm 30%, Final 30%, Labs, HW 20%, Project: 20%
- ❑ Labs: Simple python exercises
 - Given as jupyter notebook that you complete.
- ❑ Midterms & final
 - Each over approx. 6-7 weeks
 - Close book and no electronic aids.
 - Follows homework and quiz problems + some very basic python questions
- ❑ Final project:
 - Use machine learning in some interesting way.
 - Must use data and python analysis.
 - Provide final report.



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Machine Learning Project

- ☐ Perform an interesting machine learning task of your choice
- ☐ Many possible areas:
 - Machine vision, brain-computer interfaces, natural language processing, sentiment analysis, ...
 - Anything that interests you
- ☐ Groups of 2 preferred
 - In NYU Classes, join a group “project1, project2, ...”
 - Submit all material as that group
- ☐ Use real data
 - UCI ML repository
 - Google BigQuery data
 - etc
- ☐ Write code
- ☐ Place all material in a github repo (including documentation) and submit only github repo



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Project Grading

❑ Formulation

- How well did you formulate the problem? Was it clear? Was that tied to the right objective?

❑ Approach

- Does your approach properly solve your problem? Was that made clear?

❑ Evaluation and Interpretation

- Did you comprehensively test the results? How well did you select / create the data?
- Did you test against alternative approaches?

❑ Presentation

- Were the ideas clear? Were all the details conveyed. Did you highlight the main points?
- You can select a number of formats. Whatever makes sense. A github page

❑ Bonus

- Given for particularly hard / novel research



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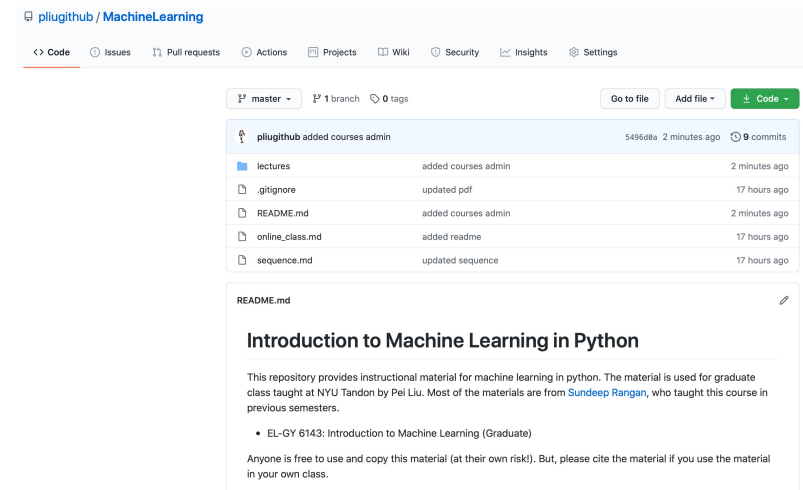
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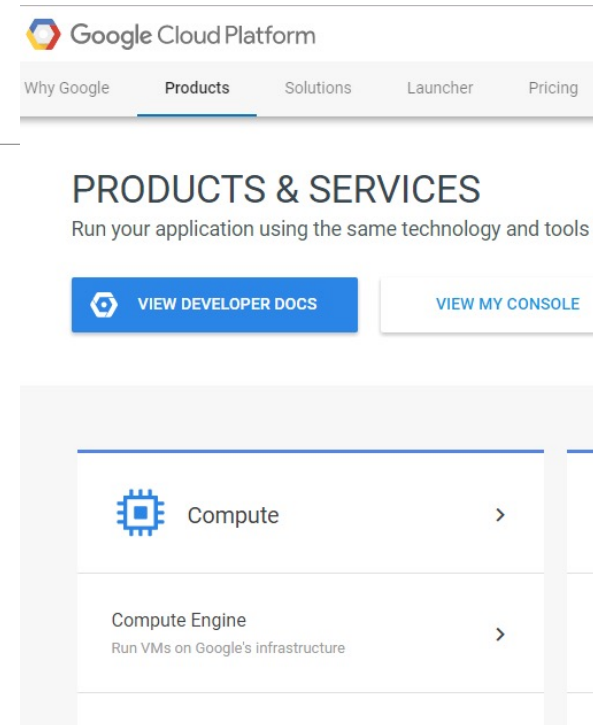
Github

- ❑ Labs and demo posted on github
- ❑ <https://github.com/pliugithub/MachineLearning>
- ❑ Also includes instruction for installing software
- ❑ Several tutorials of github on the web.
- ❑ Available on Windows, Mac and Unix.
- ❑ But, you can just clone the repo



Google Cloud Platform

- ❑ All labs in this class can be run on either:
 - Your own computer: Windows, MAC
 - Google Cloud Platform (GCP)
- ❑ GCP pros and cons:
 - Access to powerful machines / large storage for projects. Includes GPUs
 - Access to many services such as BigQuery
 - Can scale your computational resources
 - But, somewhat harder to sync editors / debuggers
- ❑ Getting started: <https://cloud.google.com/>
- ❑ Instructions on <https://github.com/pliugithub/MachineLearning/tree/master/GCP>



Other Software

❑ On your machine (local or GCP), you will need to install several pieces of software:

❑ Python with various packages

- Make sure you get 3.7
- Anaconda
- Jupyter notebook
- See notes in NYU Classes

❑ Tensorflow and Keras (needed only later in the class)

❑ Git hub

- Guides: <https://guides.github.com/>
- Available on Windows, Mac or Linux (including GCP instances)
- All demos will be available on: <https://github.com/pliugithub/MachineLearning>



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Grading: Undergraduate

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- ❑ Labs: Simple python exercises
 - Given as jupyter notebook that you complete.
- ❑ Midterms
 - Each over approx. 3-4 weeks of material
 - Closed book with cheat sheet.
 - Follows homework and quiz problems + some very basic python questions
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