

# Course Admin

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EL-GY 6143/CS-GY 6923: INTRODUCTION TO MACHINE LEARNING

PROF. PEI LIU

# People

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- ❑ Professor: Pei Liu, [peiliu@nyu.edu](mailto:peiliu@nyu.edu)
  - 370 Jay Street 9<sup>th</sup> Floor (Only available on Zoom during Fall 2021)
  
- ❑ Head TA:
  - Mustafa Ozkoc, [mfo254@nyu.edu](mailto: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

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- ❑ 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

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- ❑ 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

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- ❑ 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

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- ❑ 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

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- ❑ 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](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

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## □ 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

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- ❑ 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

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- ☐ 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

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## ☐ 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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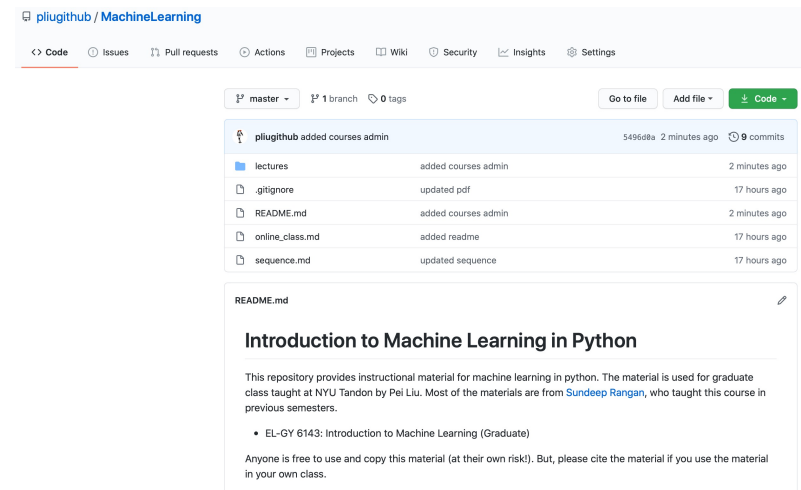
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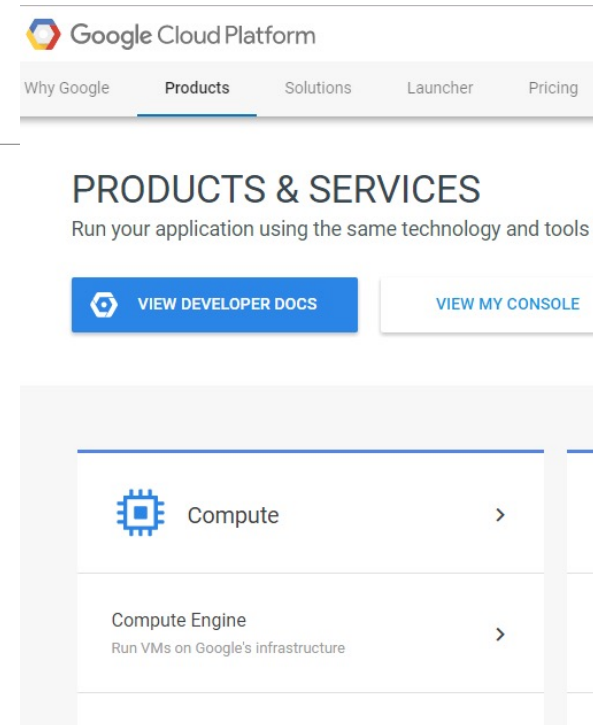
# Github

- ❑ 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

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❑ 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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- ❑ Midterm 1: 25%, Midterm 2: 25%, Labs, HW: 25%, Final project: 25%
- ❑ 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
- ❑ Final project:
  - Use machine learning in some interesting way.
  - Must use data and python analysis.
  - Provide final report.



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