11-695: AI Engineering
Introduction

Spring 2019

Logistics

Carnegie Mellon

- Course staff:
  - Instructors:
    - Hai Pham
    - Michael Shamos
  - TAs:
    - Yashovardhan Chaturvedi
    - Liang Zhang
- Class website: `http://www.cs.cmu.edu/~htpham/11695`
  - Syllabus
  - Lecture slides
  - Assignments
- Piazza: `https://piazza.com/cmu/spring2019/cs11695`
  - Announcements
  - Discussions

What is this class about?

Deep Learning.

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And how to implement Deep Learning.

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And how to implement Deep Learning.

(in Tensorflow, for some essential models)

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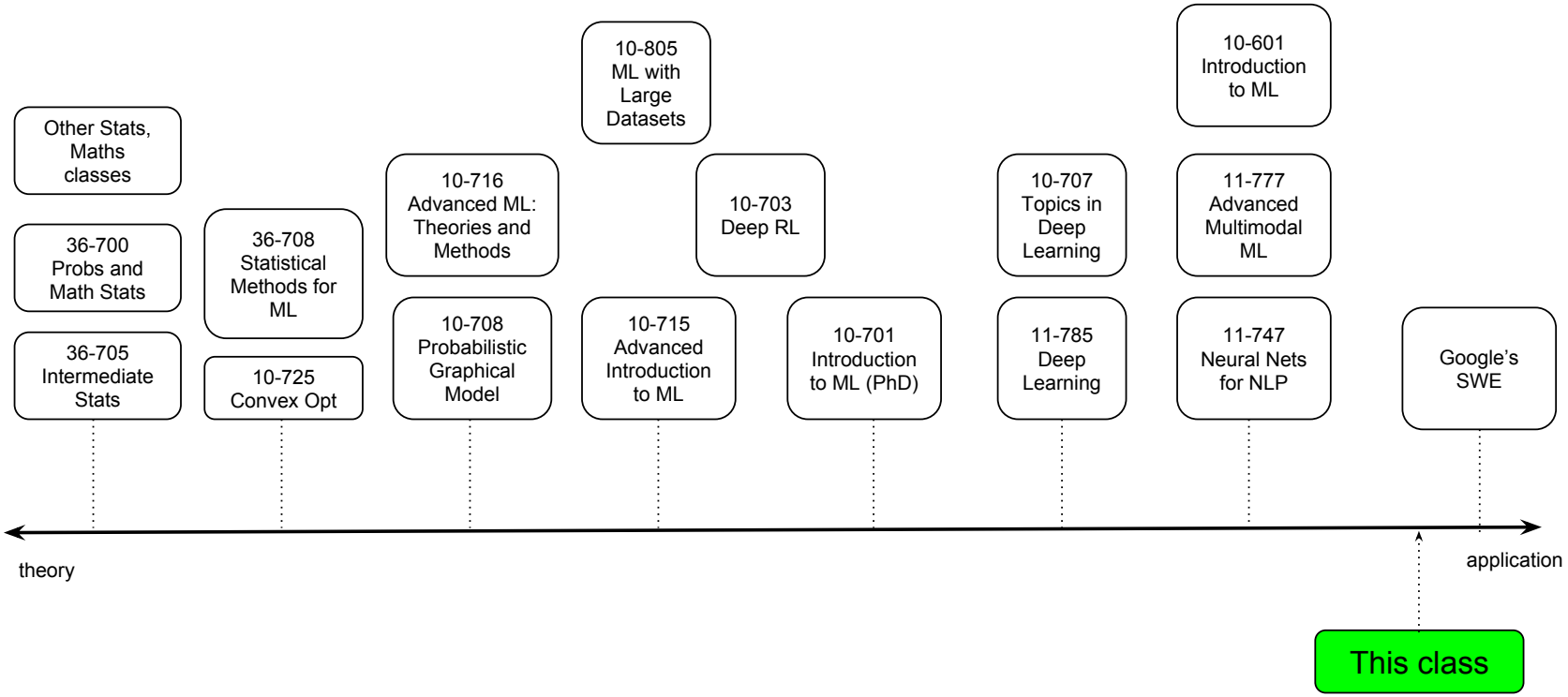

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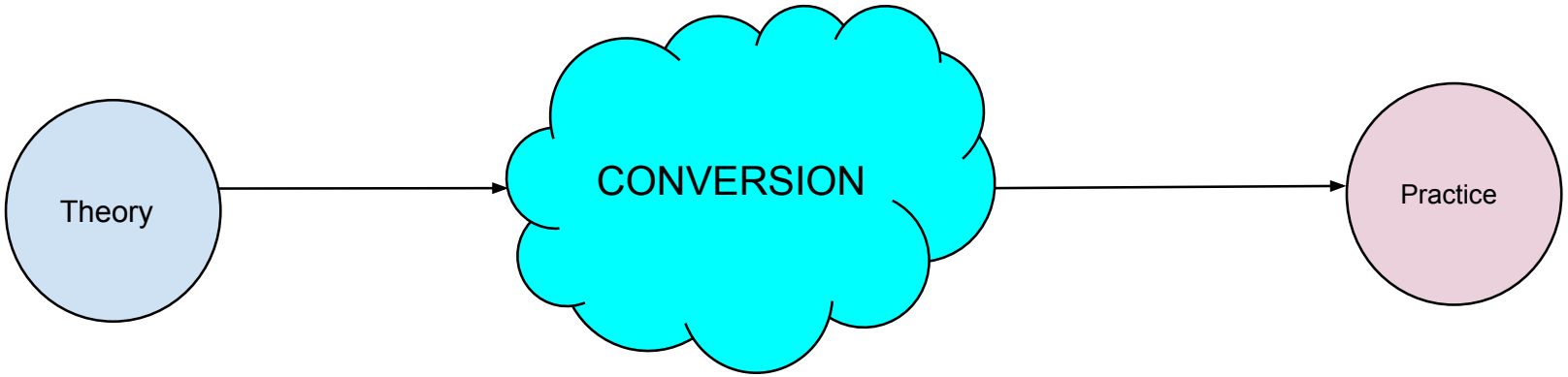

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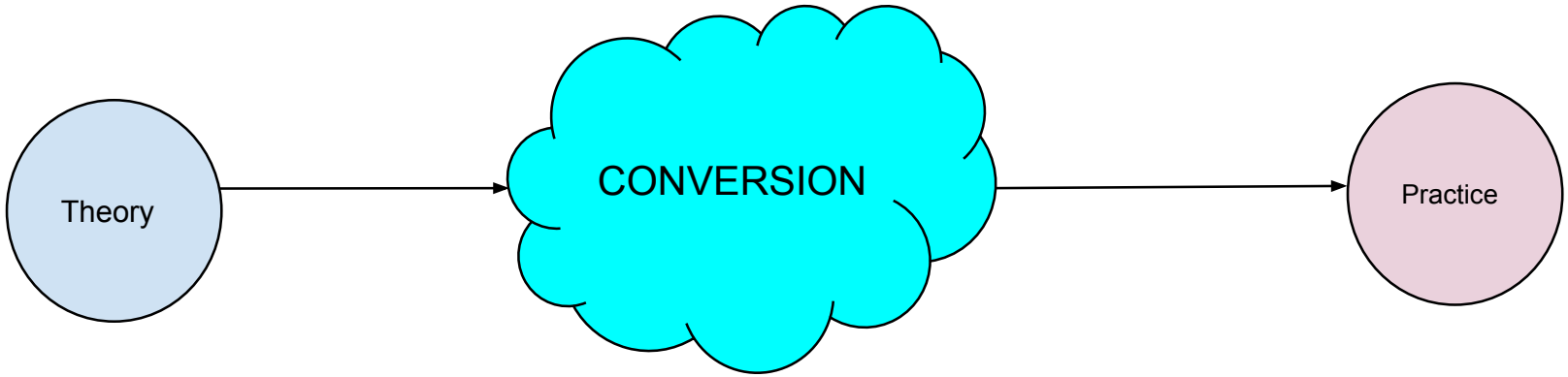

- Focus on **implementation** and **software engineering**
  - You will learn `TensorFlow` and its subtleties
- Boost your understanding of **(essential) deep learning models and algorithms**
  - Nothing redundant.

Prerequisites

- Proficiency in Python

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- Statistics, Optimization, Linear Algebra, Calculus

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- Statistics, Optimization, Linear Algebra, Calculus
- But we will help review fundamental knowledge if required

Object Detection

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- Really works with Deep Learning[1]

[1] TensorFlow Object Detection API

Semantic Segmentation

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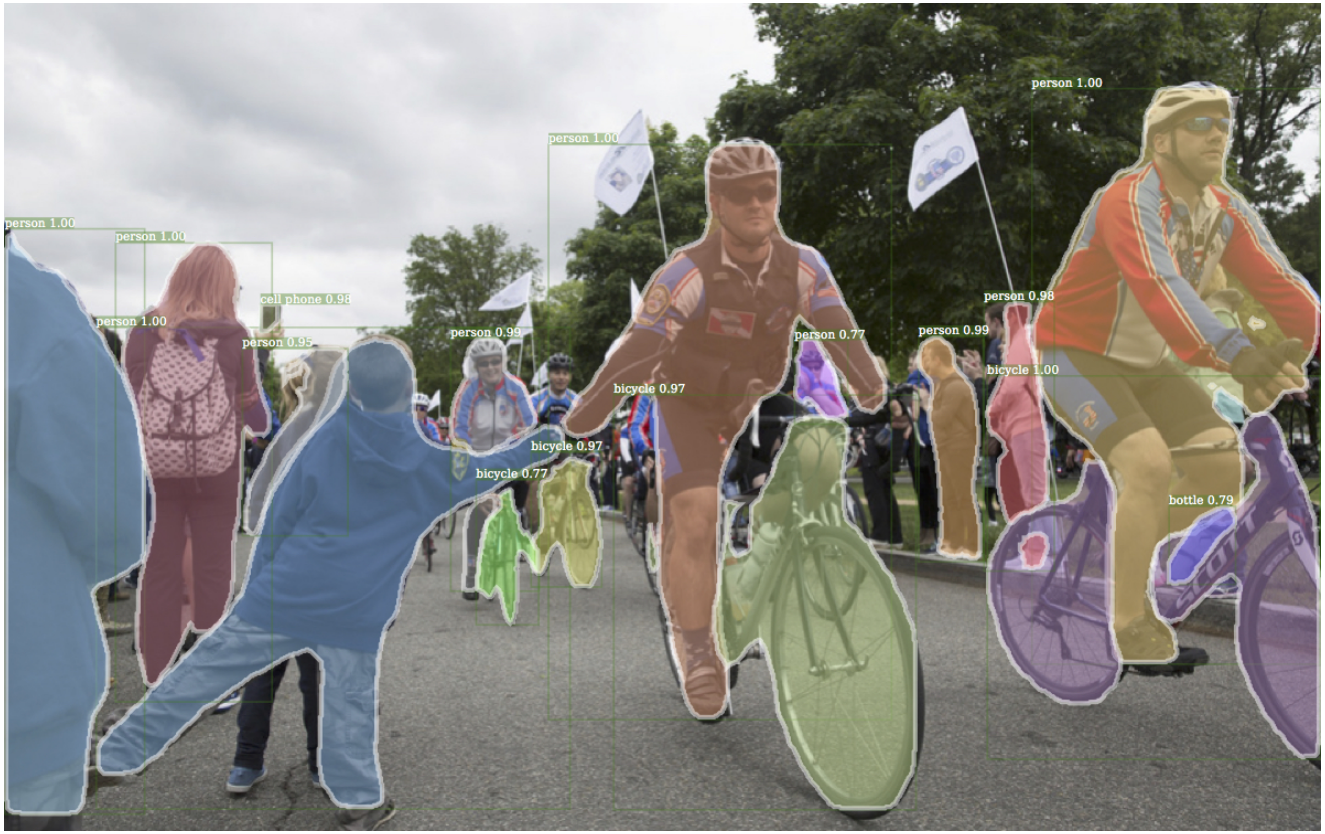

- Really works with Deep Learning[2]

[2] FAIR Detectron

Machine Translation

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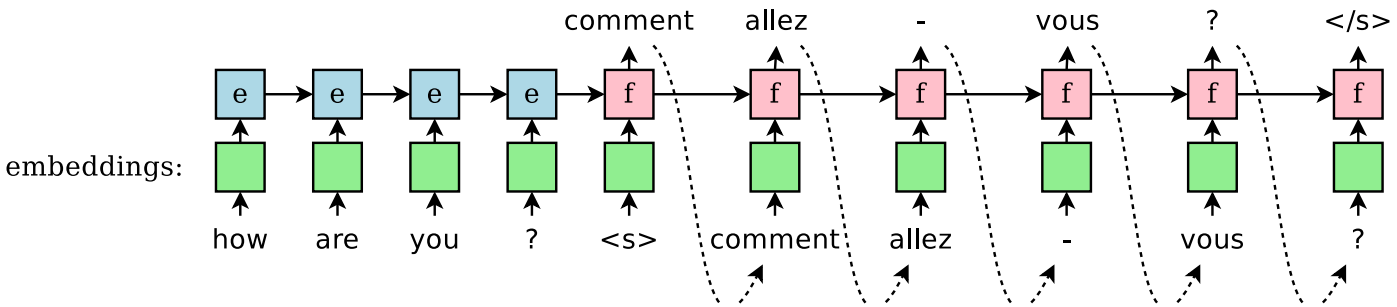
Virtually all popular automatic translation software

- Google, Facebook, Bing, Baidu



Speech Recognition

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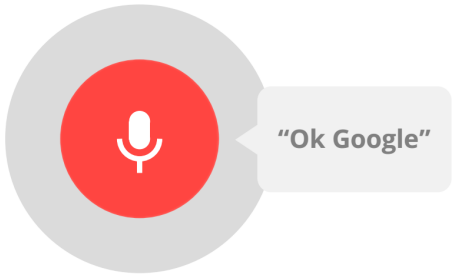
If you use one of these



Then you're using deep learning

Replicate Van Gogh

(a) Content and Style (b) (0.9, 0.1) (c) (0.7, 0.3) (d) (0.5, 0.5) (e) (0.3, 0.7) (f) (0.1, 0.9)

Li, Wang, Liu, Hou. *Demystifying Neural Style Transfer*. IJCAI 2017.

Defeat the World Champion in Go

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Source: https://www.cnet.com/

Healthcare

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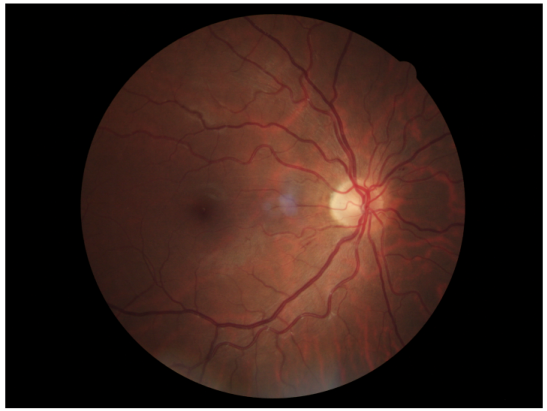
ImageNet classifcation task:

(a) Healthy



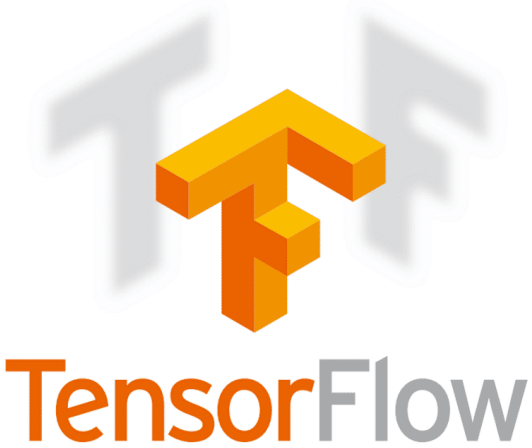
(b) Mild NPDR

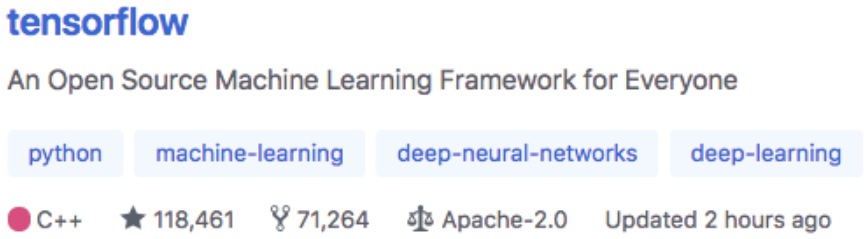
(c) Moderate NPDR

(d) Severe NPDR

Guan, Gulshan, Dai, Hinton. *Who Said What: Modeling Individual Labelers Improves Classification.* AAAI 2018.

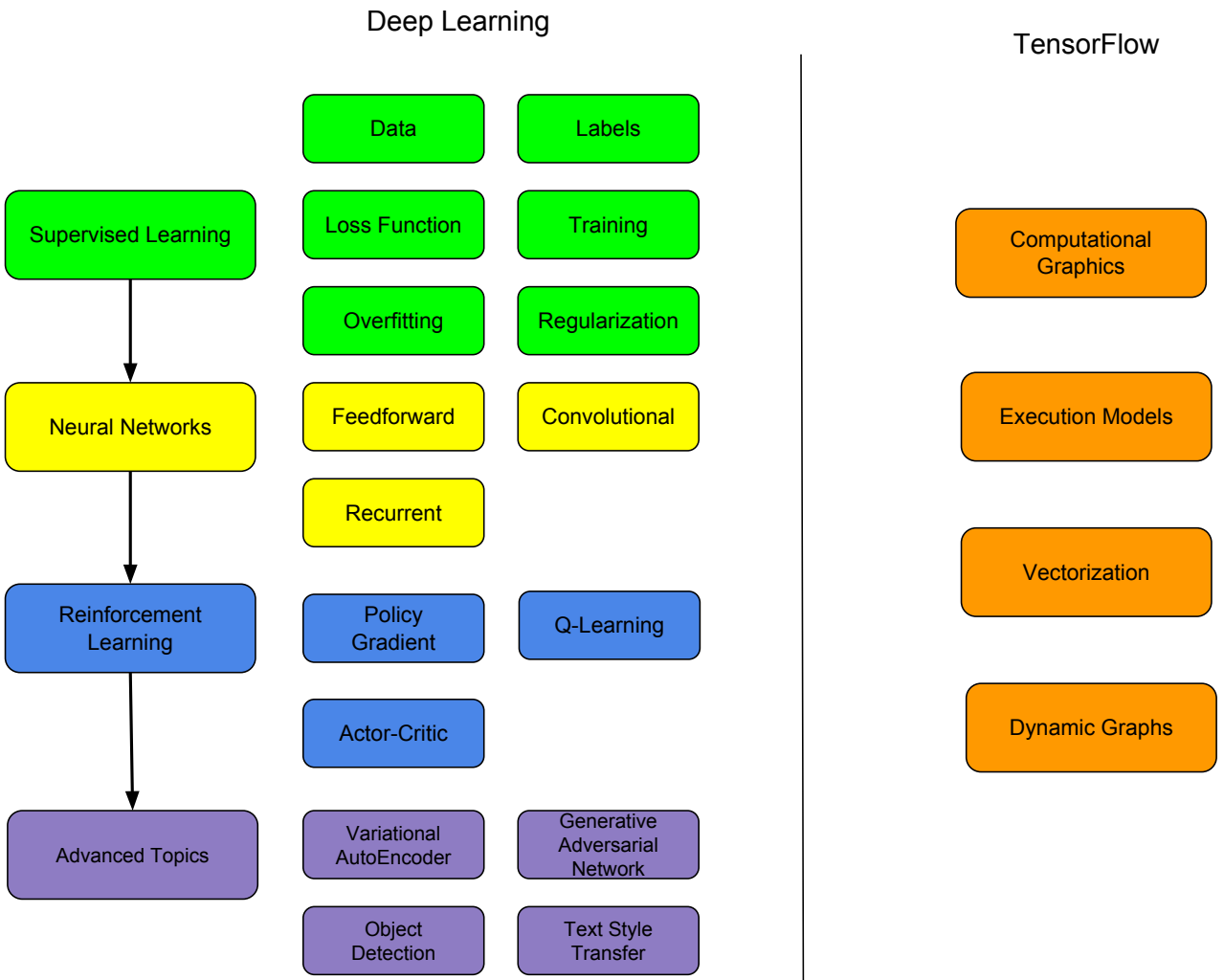
Why TensorFlow?





- Still a leading deep learning platform
  - Strong GPU (+TPU) support, seamless distributed computing, etc.
  - Active online community, from academia to industry
- Teaches important insights
  - Modular designs, computational graphs, static vs dynamics, etc.

Roadmap


Deep Learning
TensorFlow
Data
Labels
Supervised Learning
Loss Function
Training
Overfitting
Regularization
Neural Networks
Feedforward
Convolutional
Recurrent
Reinforcement Learning
Policy Gradient
Q-Learning
Actor-Critic
Advanced Topics
Variational AutoEncoder
Generative Adversarial Network
Object Detection
Text Style Transfer
Computational Graphics
Execution Models
Vectorization
Dynamic Graphs

Gradings

- All Quizzes and Individual Coding Assignments
  - Weekly Quizzes: 25%
  - 3-4 Coding Assignments: 75%
- Each assignment will have only 1 grace day period. After that:
  - 1 late day: -30/100 points
  - 2 late days: -60/100 points

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- Extra credits will be awarded to top 3 students for each assignment. But first, their models have to exceed the assignment's baseline.

Weekly Quizzes

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- Tests knowledge *from the last week*
  - Multiple choices (mostly); Fill in the blank; Short answers.
  - 10-15 minutes, at the end of Thursday lectures.
- Sample quizzes:

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1. What is the Regularization effect towards bias?
   A. Increase B. Decrease C. No effect.

2. In a feed-forward neural network, layer 5 has 128 units, and layer 6 has 256 units. What is the size of $\mathbf{W}^{5,6}$? (assuming no bias included)
   A. 5x128 B.6x256 C.128x256 D. 256x256

3. If bias is included in question 2., what is the answer instead?

4. Find $f'(x)$ where $f(x) = x \cdot \text{sigmoid}(\beta x)$.

Programming Assignments

- Python: `NumPy` and `TensorFlow`
- Download starter code, download datasets and submit assignment via a shared instructor email.
- Assignments are **hard,** but:
  - We believe it's fun and helpful for honing your skill in Deep Learning
  - You will have enough time if you **start early**
  - You will be provided enough resources
- Make use of Piazza discussions, you will learn a lot from them.
  - Extra credits will be given to the top 3 most active students on Piazza.

Policy on Cheating

- We will *mostly stay outside of the classroom* during your quizzes
  - So please keep yourselves honorable (simply, for we are CMU SCS).
  - If you get caught, things are out of your control.
- Plagiarism check is run *for each assignment*
  - Violations of the Academic Integrity Policy are taken very seriously
  - Instructors MUST report any violations as provided by policy

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