

# CS230

Winter 2019  
Andrew Ng & Kian Katanforoosh

## Teaching Team

Instructor



Andrew Ng

Instructor



Kian Katanforoosh

Course coordinator



Swati Dube

Course advisor



Younes Bensouda Mourri

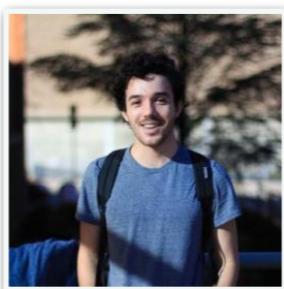
Head TAs



Abhijeet Shenoi



Shervine Amidi



Daniel Kunin



Cristian Aramburu



Hoormazd Rezaei



Sarah Najmark



Weini Yu



Ahmad-reza Momeni



Hojat Ghorbani  
(remote)



Sagar Honnunag  
(remote)



Ishan Patil  
(remote)

Kian Katanforoosh, Andrew Ng, Younes Bensouda Mourri

## Today's outline

I. What is deep learning? (25min)

II. Course Logistics (15min)

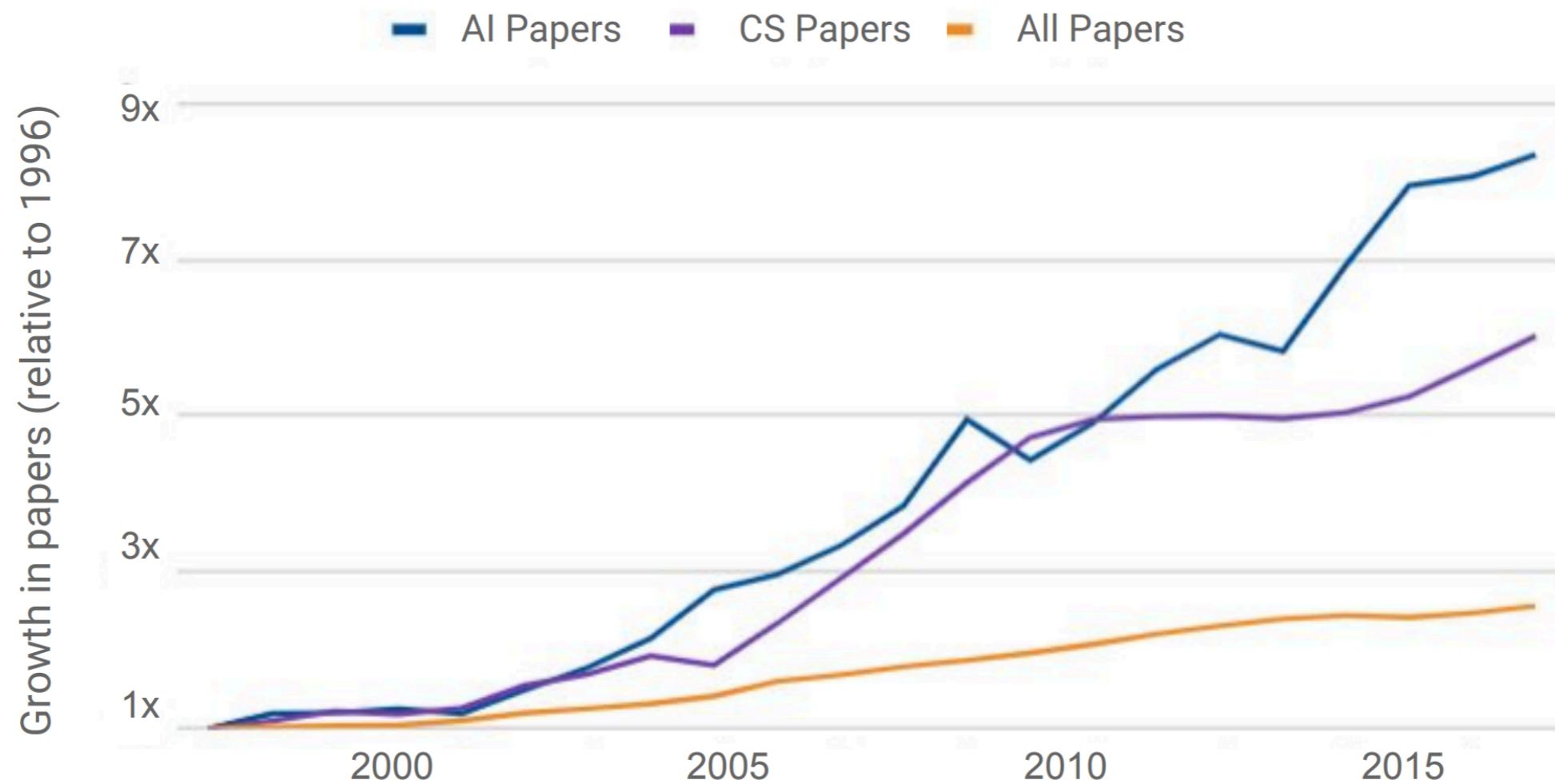
III. Introduction to Deep Learning Applications (20min)

IV. Examples of student projects (10min)

## What is deep learning?

Growth of annually published papers by topic (1996–2017)

Source: Scopus

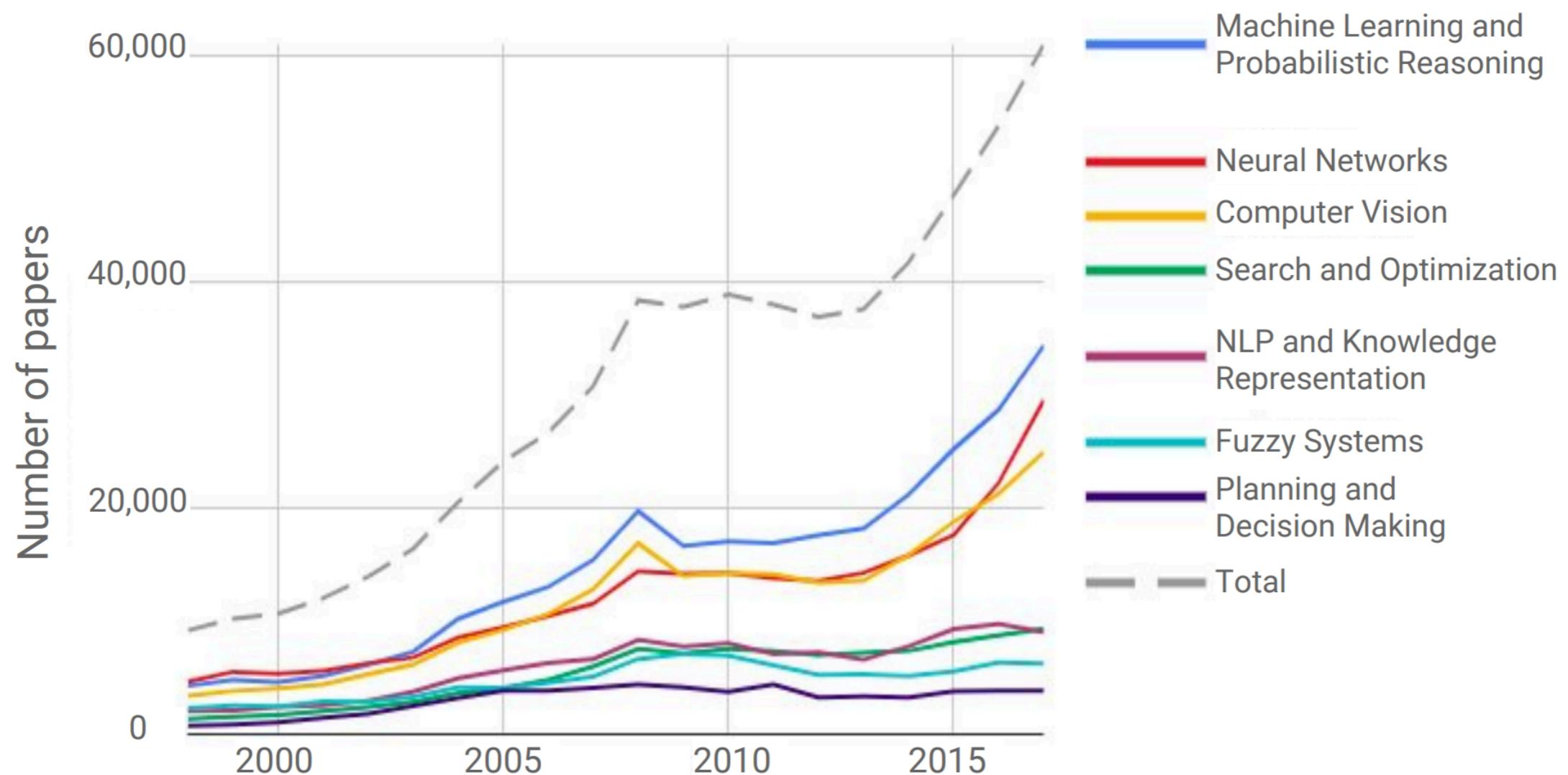


- The growth in annually published papers in AI has outpaced that of CS.
- A growing number of AI publications by researchers from other scientific fields (Physics, Chemistry, Astronomy, Material Science, etc.)

## What is deep learning?

Number of AI papers on Scopus by subcategory (1998–2017)

Source: Elsevier



- The number of Scopus papers on Neural Networks had a compound annual growth rate of 37% from 2014 to 2017.
- It has notably driven the growth of #papers published in ML and CV.

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## Course Logistics

5 “courses”:

**C1:** Neural Networks and Deep Learning

**C2:** Improving Deep Neural Networks

**C3:** Strategy for Machine Learning Projects

**C4:** Convolutional Neural Networks

**C5:** Sequence Models

Example: C2M3: Course 2 Module 3

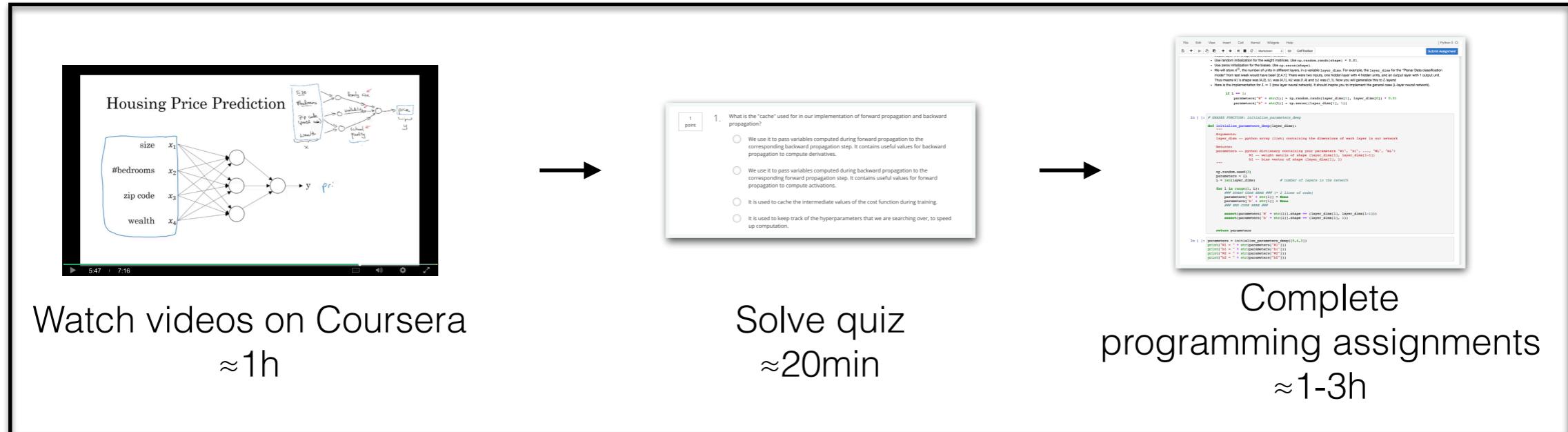
Schedule is on <http://cs230.stanford.edu/syllabus/>

We are going to use the Coursera Platform: [www.coursera.org](https://www.coursera.org)

The class forum is on Piazza: [piazza.com/stanford/winter2019/cs230](https://piazza.com/stanford/winter2019/cs230)

# One week in the life of a CS230 student

1 module



1 week of class  $\approx$  2 modules + Go to in-class lecture  $\approx 1\text{h}20$  + TA sections on Fridays  $\approx 1$  hour + 15min project mentorship with TA

Assignments and Quizzes are due every Tuesday at 10am  
Do not follow the deadlines displayed on Coursera!!!

## Grading Formula

$$Grade = 0.02A + 0.08Q + 0.25Pa + 0.25M + 0.40Pr$$

A = Attendance

Q = Quizzes

Pa = (Programming) assignments

M = Midterm

Pr = Final-project

*Active Piazza participation = 1% bonus*

## Late days

Example: For next Tuesday at 10am you have to complete the following assignments:

- 2 Quizzes:
  - ★ Introduction to deep learning
  - ★ Neural Network Basics
- 2 Programming assignments:
  - ★ Python Basics with Numpy
  - ★ Logistic Regression with a neural network mindset

**At 9am on Tuesday**: you submit 1 quiz and the 1 PA.

**At 3pm on Tuesday**: you submit the second quiz.

**At 2pm on Wednesday**: you submit the second PA.

How many late days did you use?

3 late days

## Today's outline

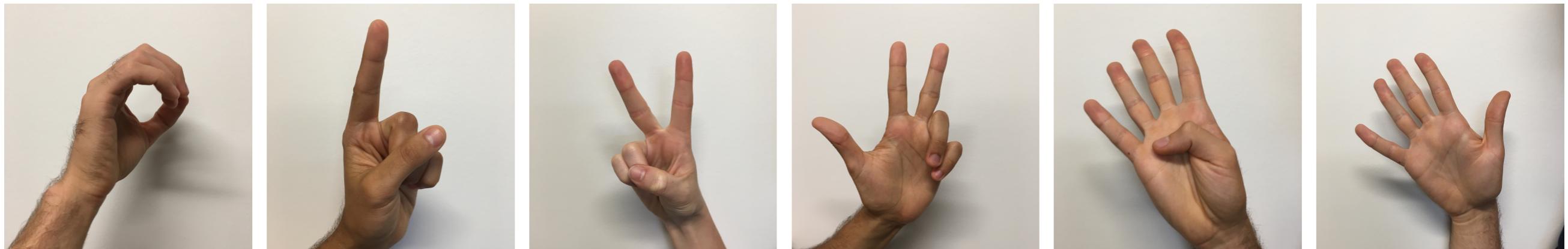
I. What is deep learning? (25min)

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# Projects: SIGN language detection



$$y = 0$$

$$\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$y = 1$$

$$\begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$y = 2$$

$$\begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$y = 3$$

$$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$y = 4$$

$$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

$$y = 5$$

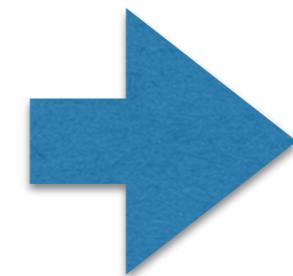
$$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

## Assignment: The Happy House

$y = 0$



$y = 0$

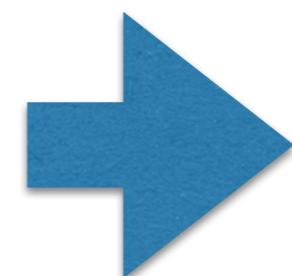
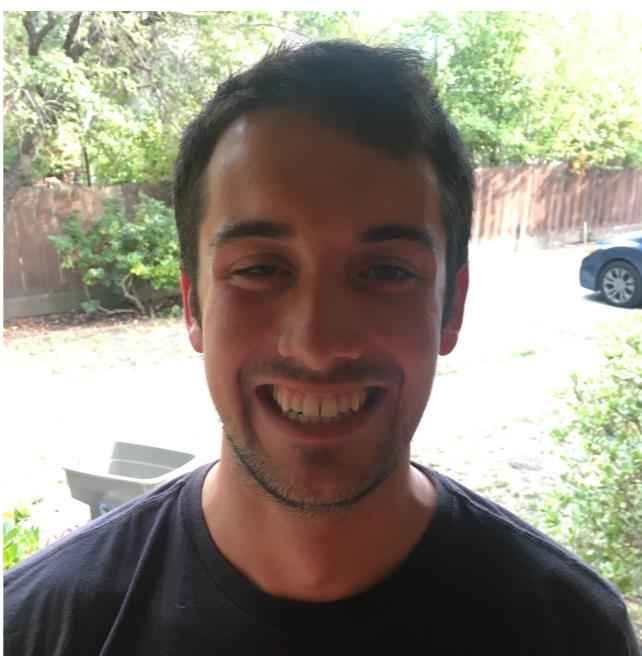


can't enter  
the Happy House

$y = 1$

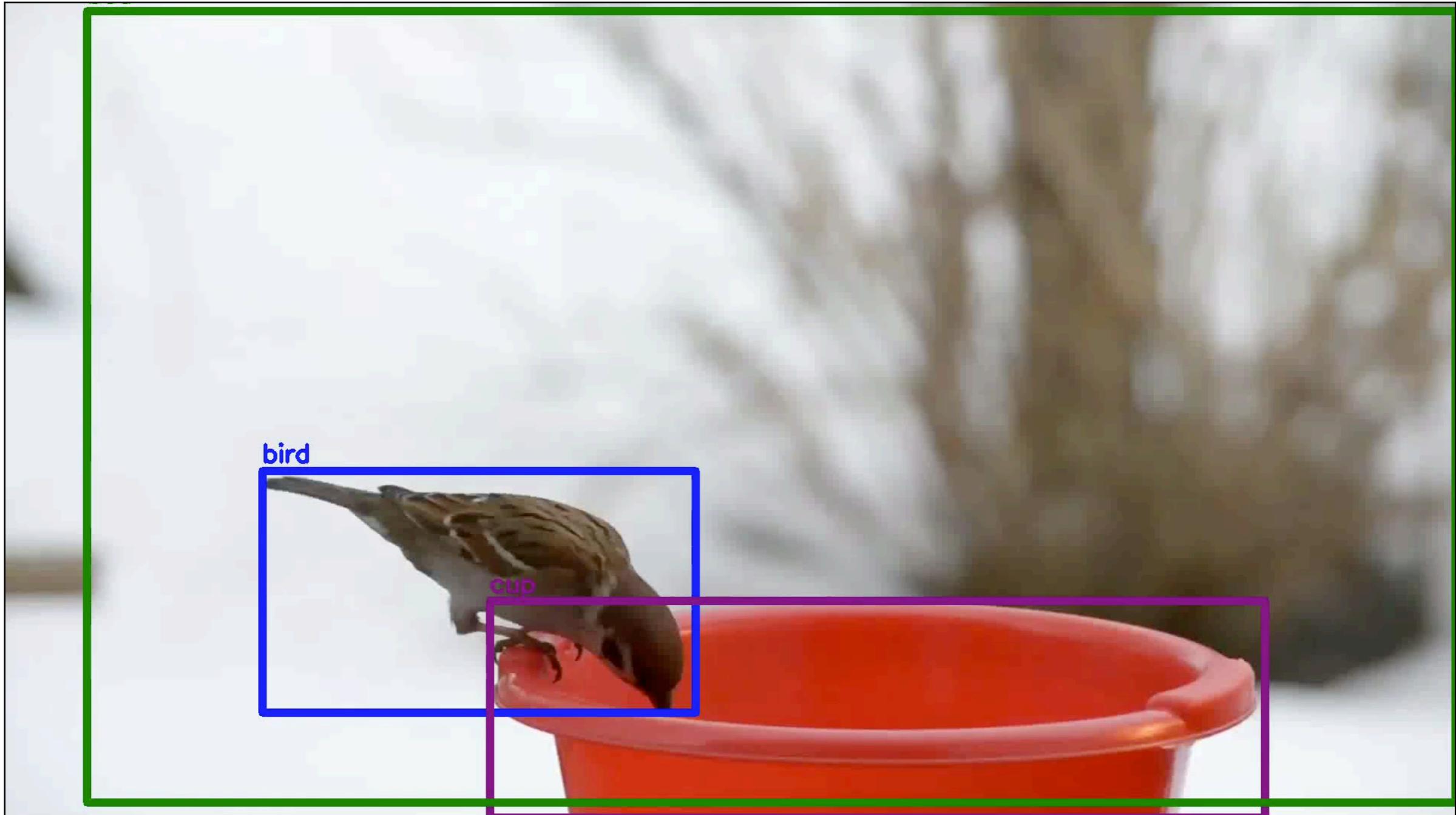


$y = 1$



can enter  
the Happy House!

## Assignment: Object detection



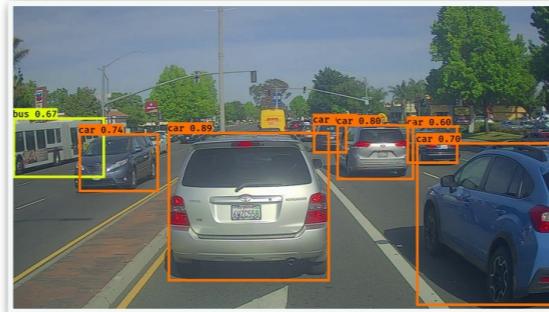
[Joseph Redmon, Ali Farhadi: YOLO9000: Better, Faster, Stronger, 2016]

[Another fun video generated with YOLOv2 by J. Redmon: <https://youtu.be/VOC3huKjns>] Kian Katanforoosh, Andrew Ng, Younes Bensouda Mourri

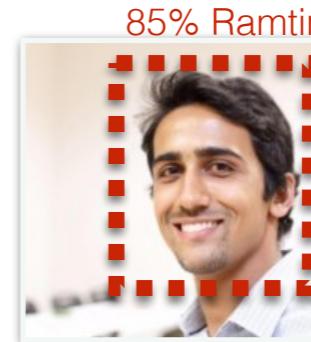
## Projects: others



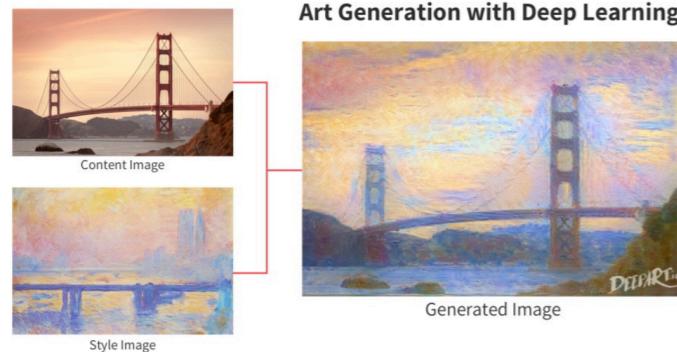
Optimal goalkeeper shoot prediction



Car detection



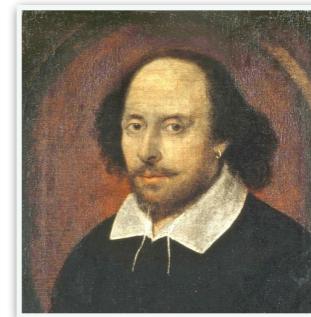
Face recognition



Art generation



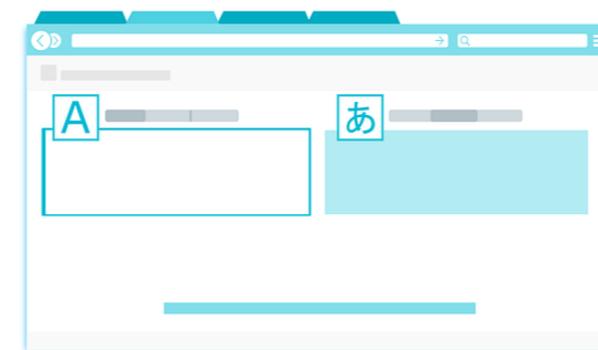
Music generation



Text generation

“I love you”  
↓

Emojifier



Machine translation



Trigger word detection

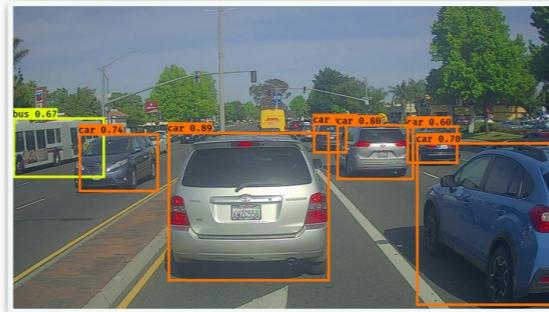
## Assignment: Car detection for autonomous driving



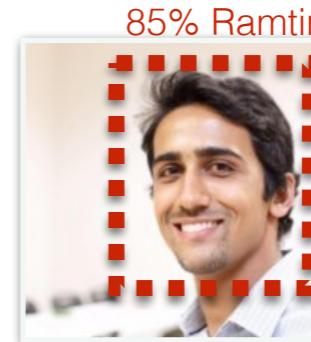
## Projects: others



Optimal goalkeeper shoot prediction



Car detection



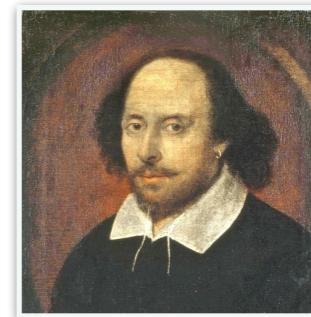
Face recognition



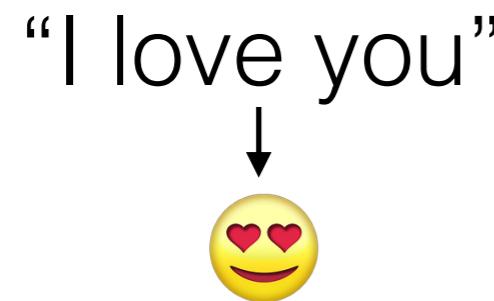
Art generation



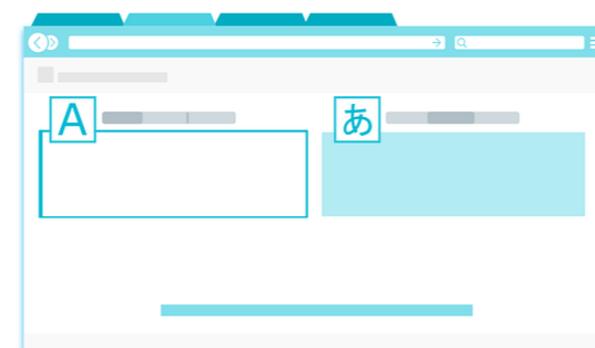
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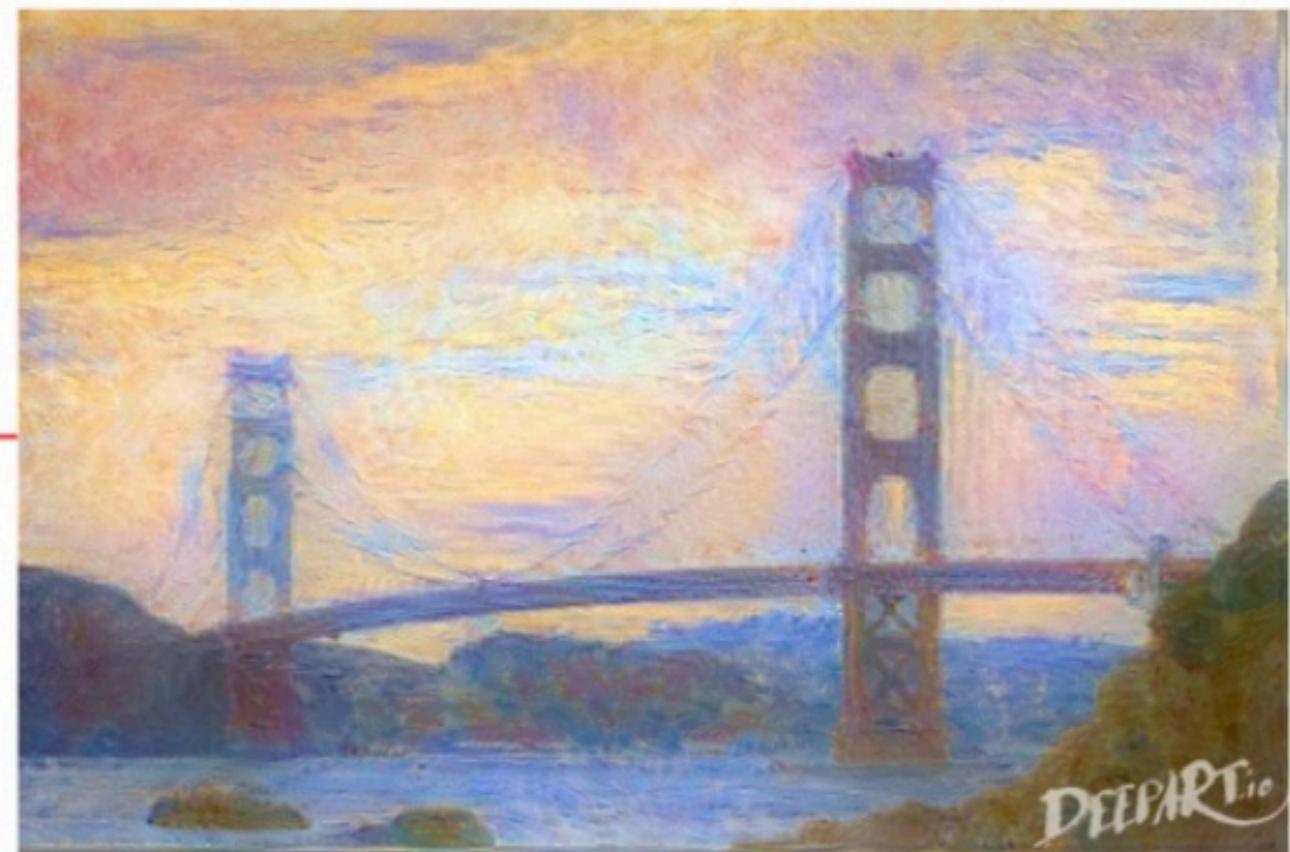
## Art Generation with Deep Learning



Content Image



Style Image

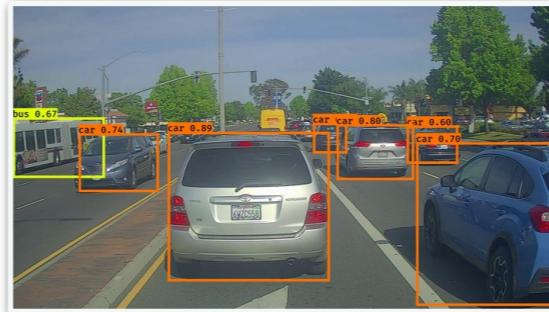


Generated Image

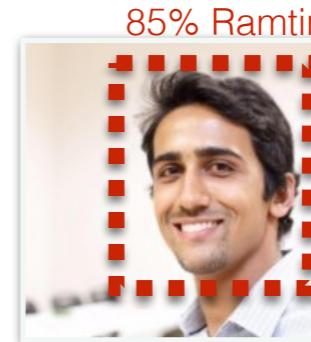
## Projects: others



Optimal goalkeeper shoot prediction



Car detection



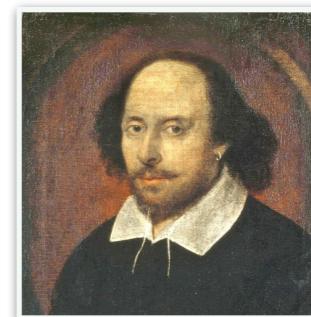
Face recognition



Art generation



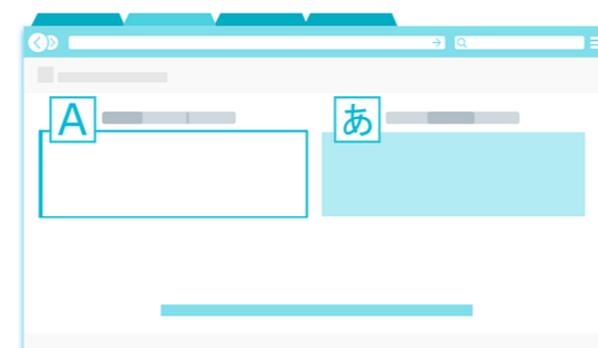
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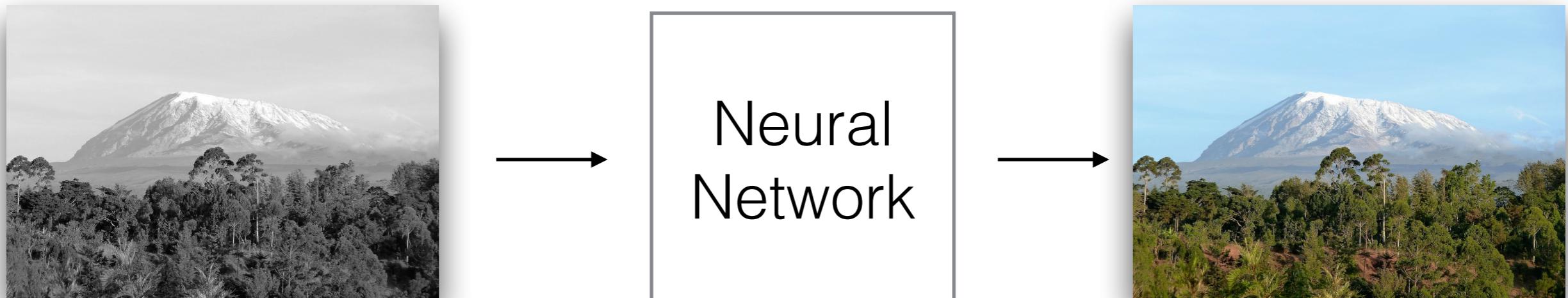


Trigger word detection

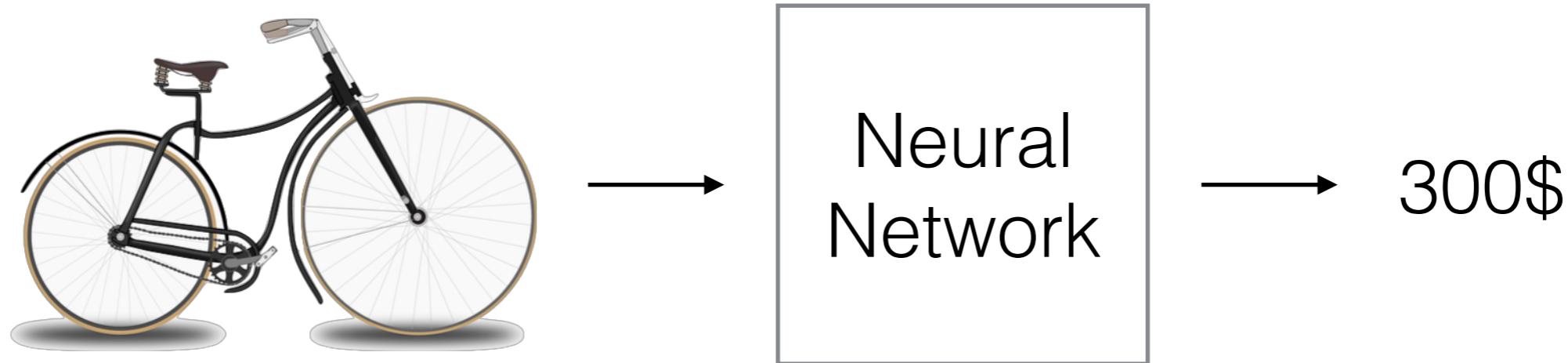
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# Coloring Black&White pictures with Deep Learning



Predicting price of an object from a picture



# Image-to-Image translation with Conditional-GAN

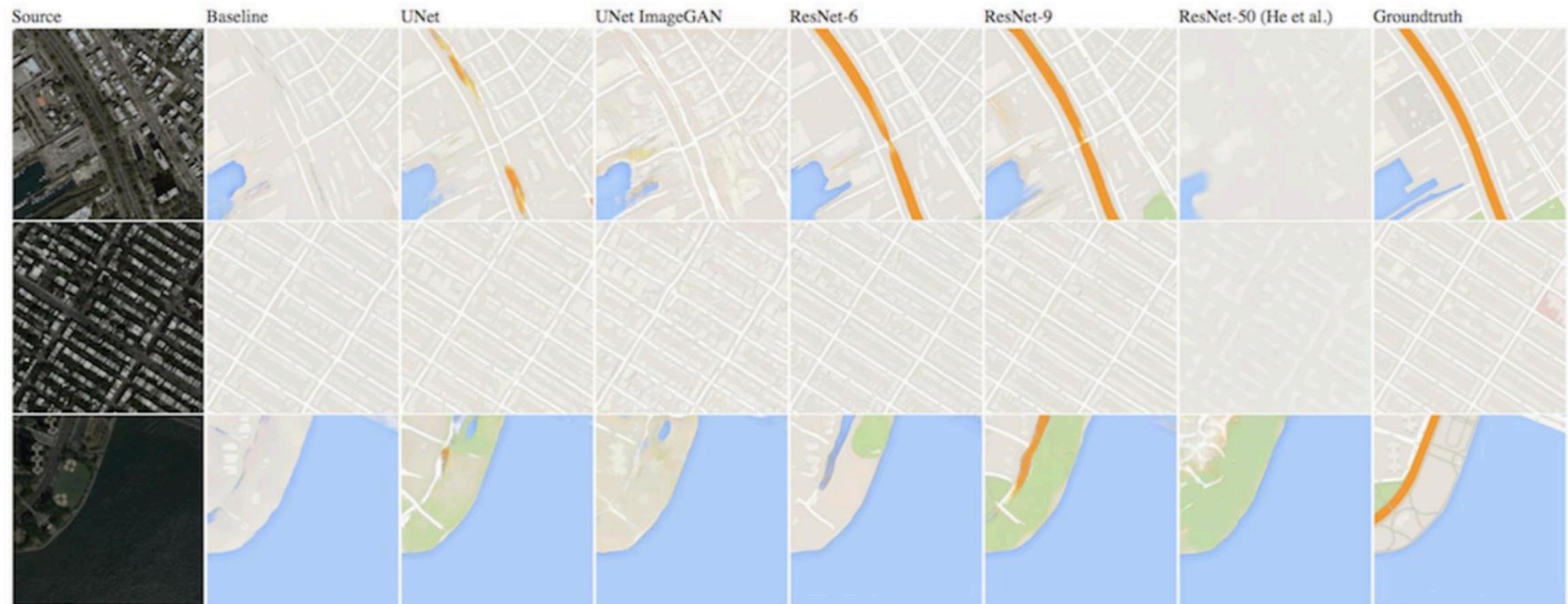
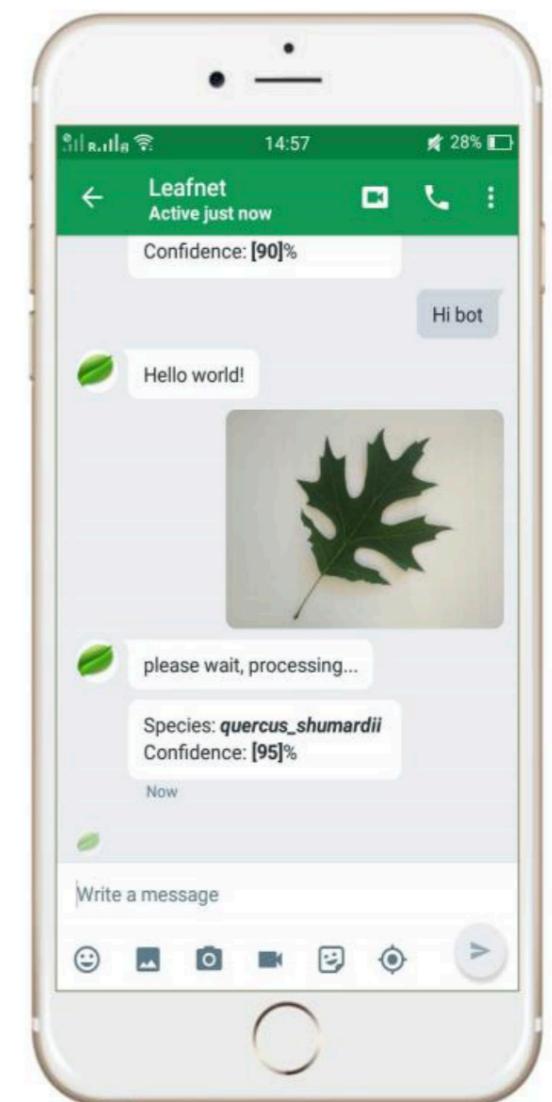
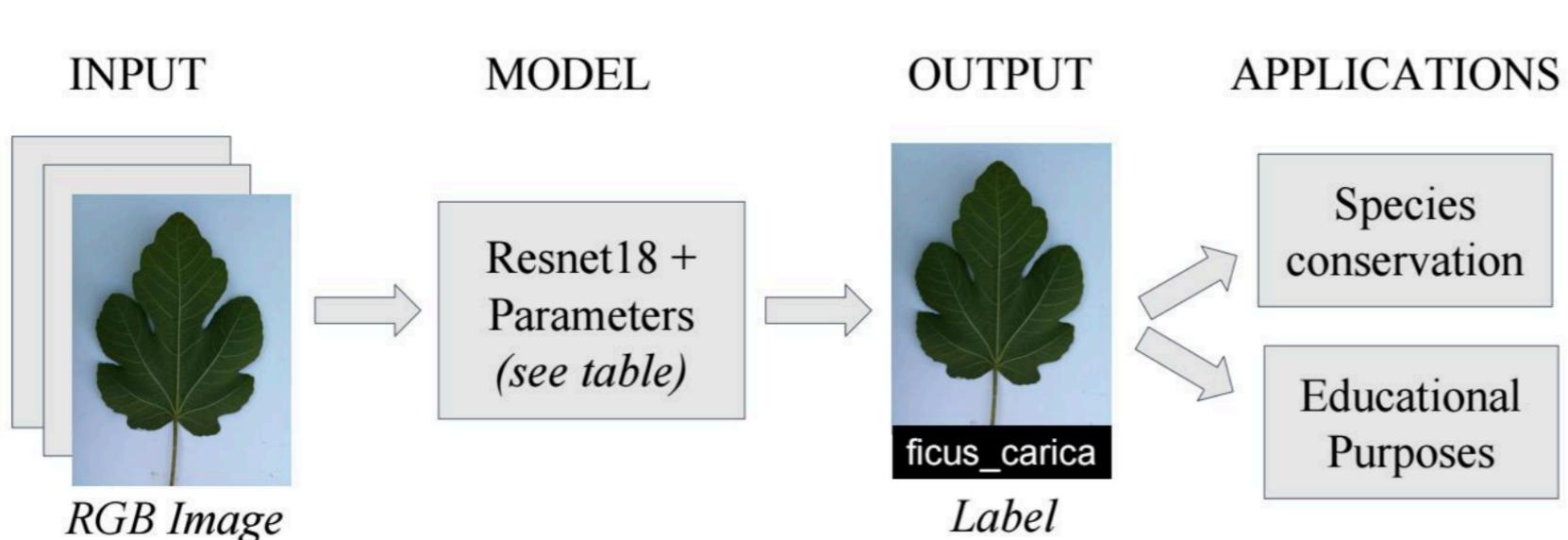


Figure 3: Generated map images of different architecture and hyperparameters. From left to right are source aerial images, baseline, U-Net, U-Net with ImageGAN, ResNet-6, ResNet-9, ResNet-50, and ground truth map images

## Projects: others

# LeafNet: A Deep Learning Solution to Tree Species Identification



**And many more...**

Predicting atom energy based on atomic-structure

Visual Question Answering

Cancer/Parkinson/Alzheimer detection

Activity recognition in video

Music genre classification / Music Compression

Accent transfer in a speech

Generating images based on a given legend

Detecting earthquake precursor signals

...

## To sum up

1. You will learn about wide range of deep learning topics
2. The course is very applied, you will code these applications
3. You have access to mentorship to build an outstanding project in 10 weeks

### For next Tuesday (01/15) 10am:

- Create Coursera account and join the private session using the invitation
- Finish **C1M1 & C1M2**
- 2 Quizzes:
  - ★ Introduction to deep learning
  - ★ Neural Network Basics
- 2 Programming assignments:
  - ★ Python Basics with Numpy
  - ★ Logistic Regression with a neural network mindset
- Find project team-mates and fill-in the Google form that will be posted on Piazza.

### This Friday (01/11):

- TA section “Deep Learning Applications”

Download your notebooks after you finished them!  
Follow only the website deadlines!