What is different between category 1 and category 2 images? Type your answer in the chat.
Class 1 [09/02/2020]. Introduction to Vision
Class 2 [09/14/2020]. Natural image statistics and the retina
Class 3 [09/21/2020]. The Phenomenology of Vision
Class 4 [09/28/2020]. Learning from Lesions
Class 5 [10/05/2020]. Primary Visual Cortex
October 12th: University Holiday
Class 6 [10/19/2020]. Adventures into terra incognita
Class 7 [10/26/2020]. From the Highest Echelons of Visual Processing to Cognition
Class 8 [11/02/2020]. First Steps into in silico vision
Class 9 [11/09/2020]. Teaching Computers how to see
Class 10 [11/16/2020]. Computer Vision
FINAL EXAM, PAPER DUE 12/14/2020. No extensions.
Generative adversarial networks (GANs)


Goodfellow 2014
Deep Dreaming

A Channel 209 (labrador)

B Channel 527 (desk)

C

D

nonyan et al 2014
Kreiman 2019
Xdream: Discovering neuronal tuning preferences

Ponce, Xiao, et al 2019
Style transfer

Gatys
2015
The portrait of Edmond de Belamy

Sold at Christie’s auction: $432,500
Predicting the next video frames
PredNet captures neurophysiological properties!

William Lotter, David Cox
The Turing test for vision

How far are the ladies with a red garment?

Are there people riding bikes?

Are there any dogs?

How many people are there?

What color are the signs?

What is the man with the black hat doing?
Adversarial examples

- schoolbus
- add this “noise”
- ostrich

Szegedy 2013
Example visual reasoning tasks

A

B

C

Same/different

Inside/outside

Large in middle

Fleuret et al 2011
Kim et al 2018
Answering questions on an image

How many chairs are at the table?

Is there a pedestrian in my lane?

Is the person with the blue hat touching the bike in the back?

Is there a matte cube that has the same size as the red metal object?
What color is the object with the same size as the blue metallic cylinder?
Answering questions on an image

What color is the object with the same size as the blue metallic cylinder?

Green
Sequential tasks

What color is the object with the same size as the blue metallic cylinder?
How many objects are the same size as the ball?
Sequential tasks

What color is the object with the same size as the blue metallic cylinder?

Find blue metallic cylinder

Compare sizes

Describe color

Green

How many objects are the same size as the ball?

Find ball

Compare sizes

Count

Four
Sequential tasks

What color is the object with the same size as the blue metallic cylinder? Green

How many objects are the same size as the ball? Four
Does the blue cylinder have the same material as the big block on the right side of the red metallic thing?
Computer vision to help the blind
Image captioning

A: I think it’s a person sitting at a table and she seems : |

B: I think it’s a group of people standing next to a body of water

C: I can’t really describe line drawings : (

D: I think it’s a group of people standing in front of a building and they seem : )
Summary

1. We have power image generators (→entertainment + science!)

2. Self-supervised predictive models mimic computational properties in neuroscience

3. We aspire to build a machine that can pass the Turing test for vision

4. State-of-the-art computer vision still has a long way to go (e.g., adversarial images, simple tasks that machines cannot solve, image captioning, etc.)

5. Compositional visual routines can connect perception to cognition

6. A computer vision system can help patients with severe visual deficits
Kreiman, G. & Serre, T. Beyond the feedforward sweep: feedback computations in the visual cortex. *This Year in Cognitive Neuroscience* (2020).
Visual Object Recognition  
Computational Models and Neurophysiological Mechanisms  
Neuro 130/230. Harvard College/GSAS 78454

Web site: http://tinyurl.com/visionclass  
Class notes, Class slides, Readings Assignments  
Location: Biolabs 2062  
Time: Mondays 03:00 – 05:00  
Lectures:  
Faculty: Gabriel Kreiman (and invited guests)  
TA: Will Xiao  
Contact information:  
Gabriel Kreiman  
Will Xiao  
gabriel.kreiman@tch.harvard.edu  
xiaow@fas.harvard.edu  
617-919-2530  
Office Hours: Before class (Mondays 2pm), after class (Mondays 5pm). By appointment