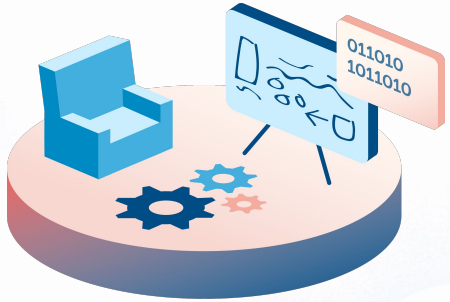


Intro to Computer Vision

Object detection with Detectron2

Heyo!

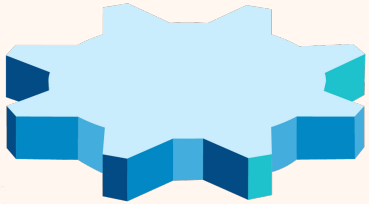
Kristy Gao

3B Computer Science @ UWaterloo

Cockroach, Ex Google, PayPal SWE

@gaoxuexuek

Agenda



1. Today’s Goals
2. What is CV?
3. CV Problems
4. Traditional Solutions
5. Deep Learning Solutions
6. Detectron2 Example

Today’s Goals

Today’s Goals

We will

- Discuss Computer Vision
  - Concepts
  - Problems
  - Highlevel solutions
- Use an existing model for object detection

We will NOT:

- Train our own models
- Do an in depth guide on machine learning tools

What is Computer Vision?

What is vision?

Meme thicc

muscle

exercise

Dog

shiba

Real World

Sensing

Interpreting

Meaning

What does a computer see?

170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136

What do we see?

- Topical Meme
- Sad, white, fluffy cat
- Laptop in mid ground
- Laptop is on a website
- Room has white lighting
- Room has shutters

… and more!

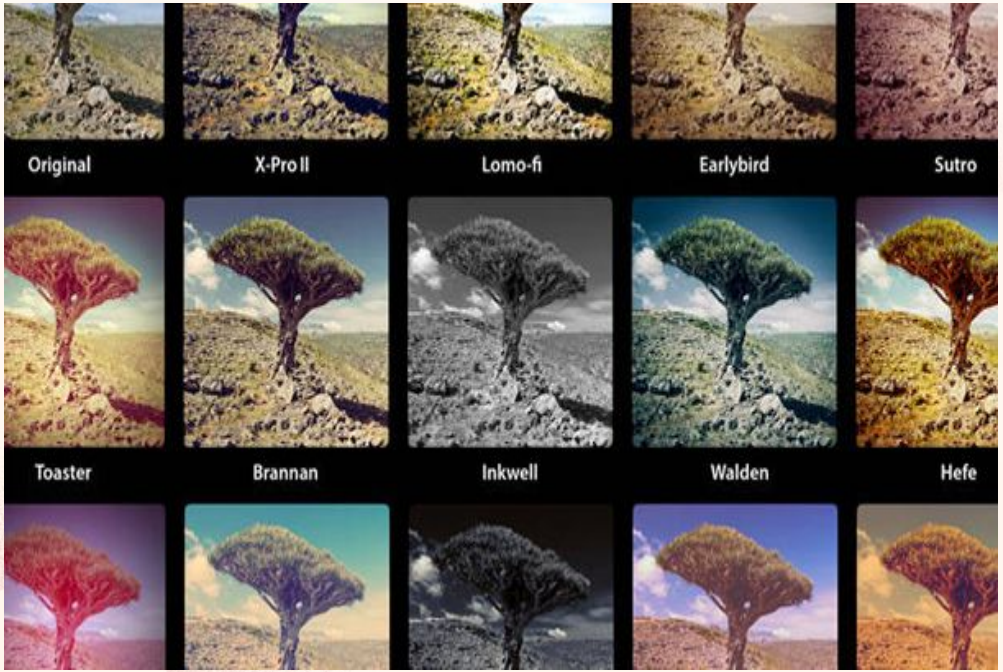
Computer Vision Problems

Computer Vision Problems

- Filtering
- Transformations
- Depth maps
- 3D model from image
- Semantic segmentation
- And many more!

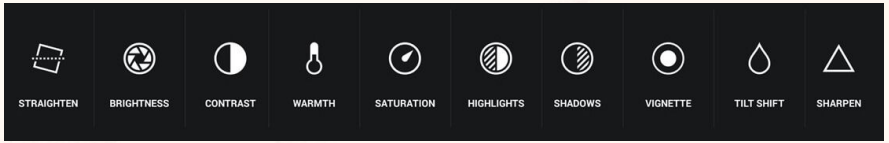
Computer Vision Problems

Filtering



Computer Vision Problems

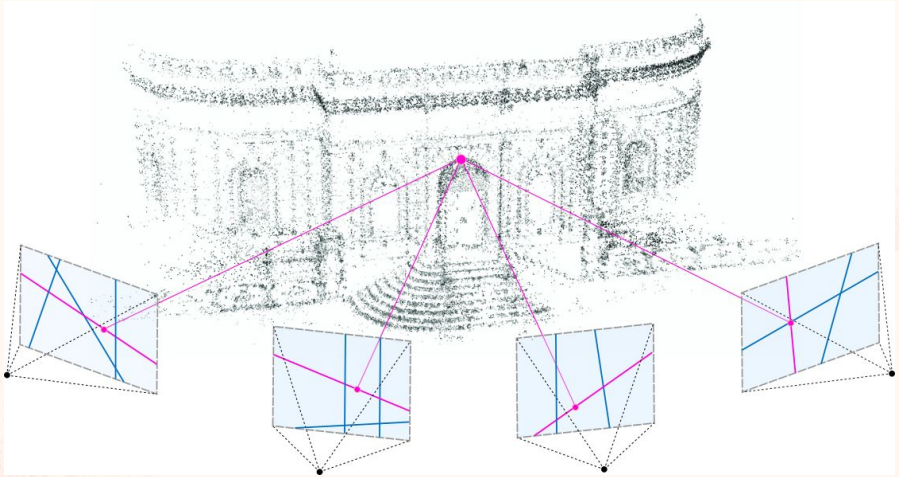
Transformations



ooo wow panorama

Computer Vision Problems

Structure From Motion



Computer Vision Problems

Depth

left image (reference)

right image (smaller baseline)

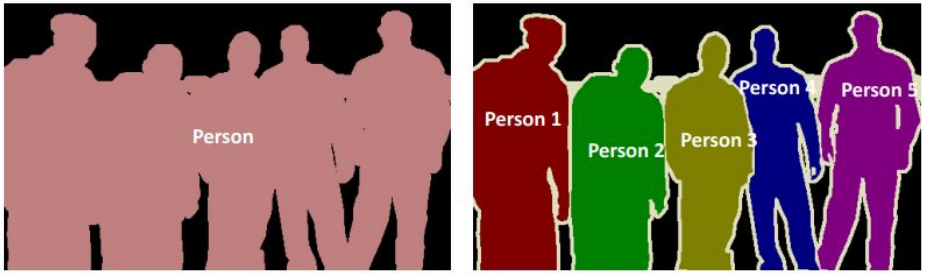
(scaled) ground truth disparity map

Computer Vision Problems

Segmentation

Computer Vision Problems

Segmentation



Semantic Segmentation

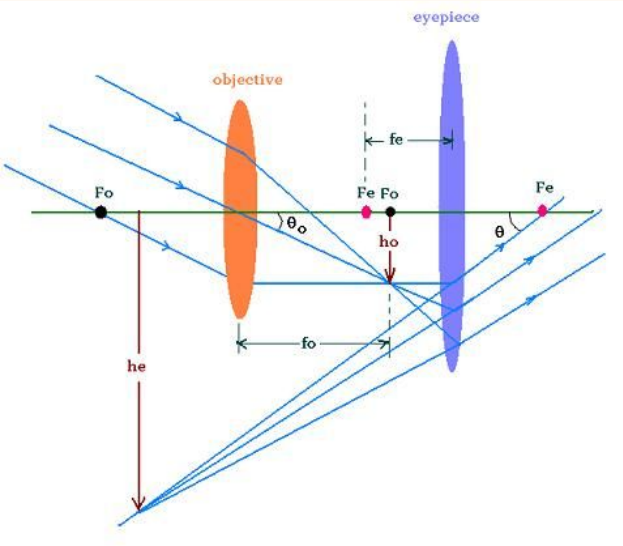
Instance Segmentation

Any Questions?

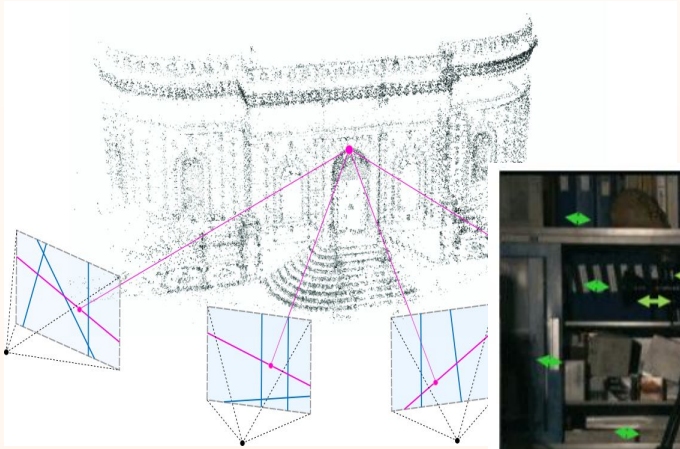
Traditional Solutions

Traditional Solutions

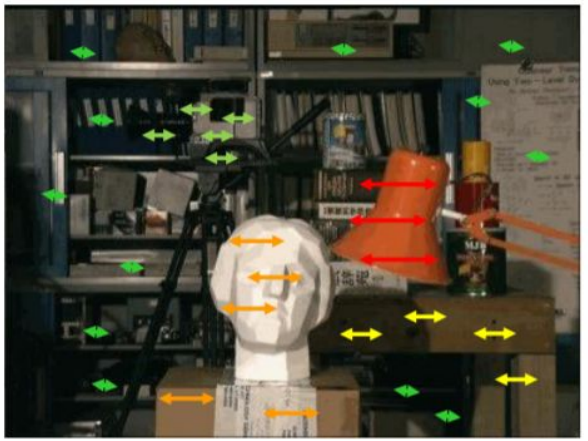
Take advantage of real world geometry and m a t h



Real world has reliable geometry!



Clever math!



Closer objects ‘move’ more

Traditional Solutions

Take advantage of real world geometry and m a t h

Edges can be detected with math

Face Detection

Traditional Solutions

Take advantage of real world geometry and m a t h

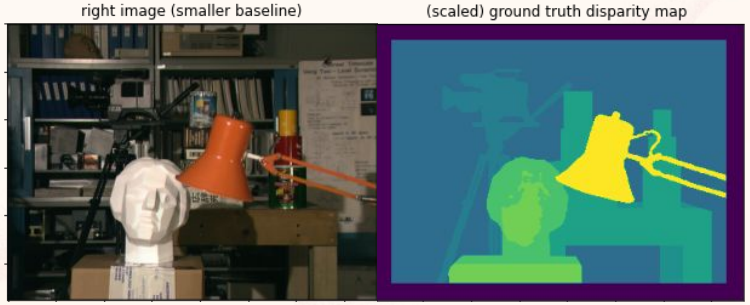
Group ‘similar’ stuff together

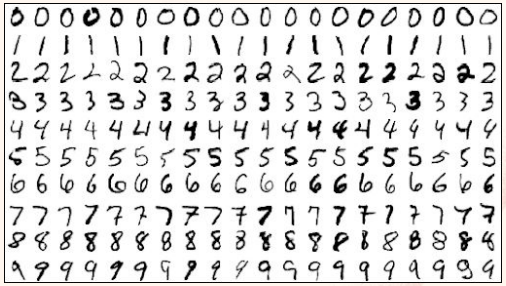
Deep Learning Solutions

Deep Learning Solutions

Models (grossly oversimplified)

- Training Data
  - Input & target solution
- Loss functions
  - Cat vs Dog has different loss functions!
- N number of weights
- Find weights that minimize loss over training data
- Active area of research

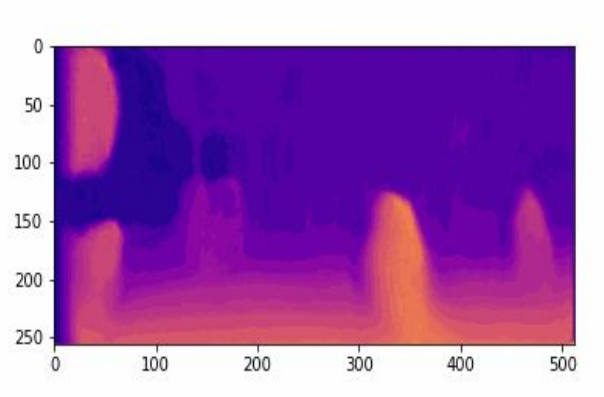




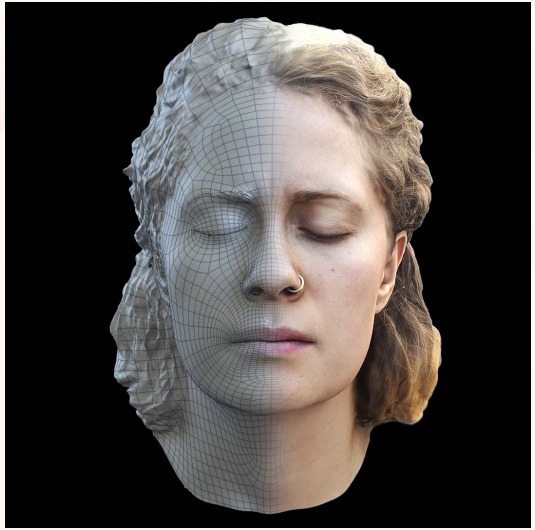
Handwritten digit detection model (1989)

Deep Learning Solutions

- Improved technology enable training!
- Clever loss functions improve solutions to existing problems



Single view depth estimation

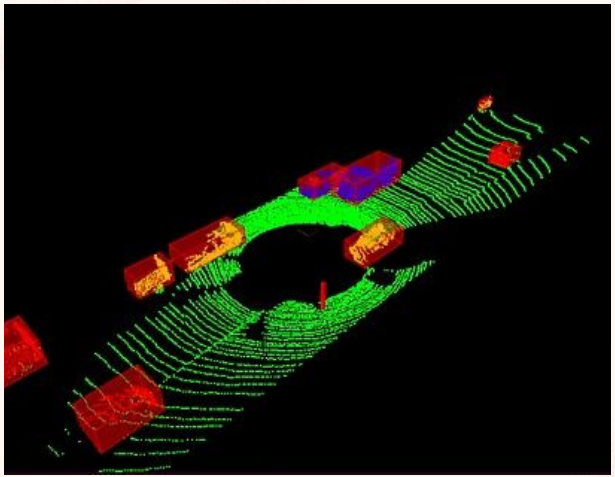


Single view photogrammetry
(structure from no motion)

Deep Learning Solutions

- Classification/regression problems

Object Classification



3d Lidar object classification

Deep Learning Solutions

Lighting Prediction

Generative Art

Any Questions?

U can also slide into my dms too lol

Detectron2 Example

What is Detectron2?

- Trained model
  - “Plug and play”
- State-of-the-art object detection
- Made by Facebook AI

What is PyTorch?

- Machine Learning Framework
  - Make, train, load models
  - Helpful torch.functional utilities
- Tensors
  - Similar to numpy!
  - Matrix algebra > looping over arrays
- Similar to TensorFlow
  - More pythonic

What is Jupyter Notebook and CoLab?

Jupyter Notebook

- Machine learning + Data Sci Python tool
- Not important, just fast to prototype

CoLab

- Cloud notebook platform
- Clean environment
- Free GPU for training models

Let’s open up CoLab!

How do I actually put this all together!?

- Using Detectron2:
  - “Intro to API’s”, make python API and directly respond to requests with Detectron2
- Not interested in object detection for hackathon project?
  - <list of suggested models>
  - You can load most industry/research standard models into pytorch
- Making your own model:
  - Warning: Might spend the entire hackathon training your model!
  - “Establishing a Productive Machine Learning Workflow” Wed Jan 13th
  - Implementing papers directly is a good exercise

Any Questions?

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e: gaoxuekristy@gmail.com

Psst…. This is a WIP

Workshop will take place mid Jan :)