

Intro to Computer Vision

Object detection with Detectron2



Heyo!

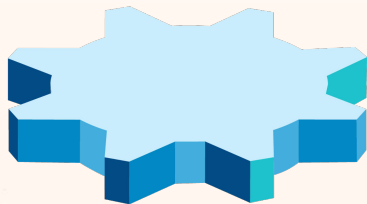
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Cockroach, Ex Google, PayPal SWE



@gaoxuexuek

Agenda



1. Today's Goals
2. What is CV?
3. CV Problems
4. Traditional Solutions
5. Deep Learning Solutions
6. Detectron2 Example
7. Putting it together
8. Further Reading

Today's Goals

The background of the slide features several stylized, fluffy clouds in a light blue color, scattered across a white background. The clouds have a soft, painterly texture.

Today's Goals

We will

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

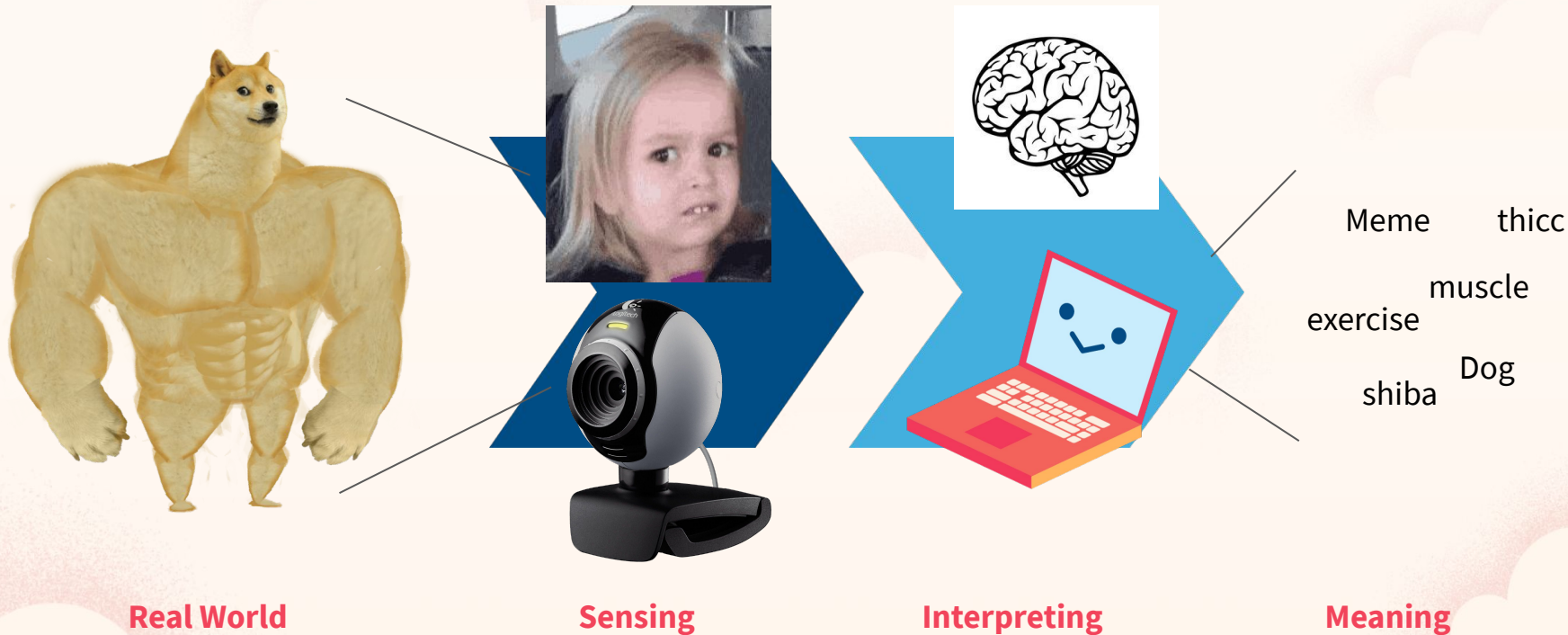
We will NOT:

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

What is Computer Vision?

The background of the slide features a light blue, stylized gear-like pattern that resembles a series of interlocking clouds or a soft-focus mechanical design. The pattern is composed of rounded, overlapping shapes that create a sense of depth and movement. The overall color palette is a soft, pastel blue, giving the slide a clean and modern aesthetic.

What is vision?



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

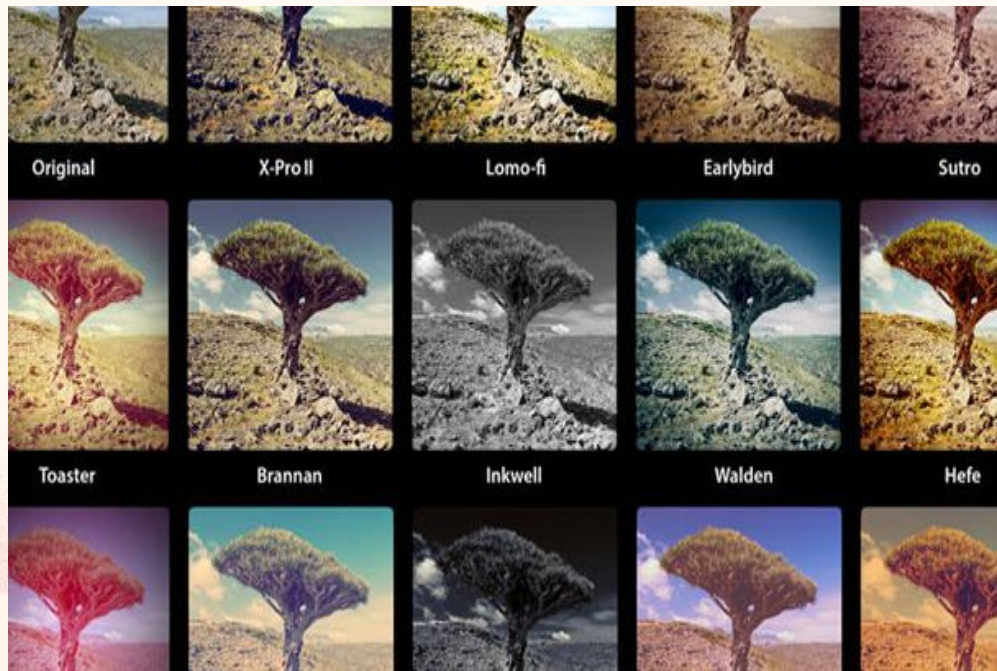
The background of the slide is white and features a decorative pattern of stylized, light blue clouds. These clouds are arranged in a way that they appear to be part of a larger, repeating pattern, with some clouds partially visible at the edges. The clouds have a soft, textured appearance, giving the background a clean yet visually interesting look.

Computer Vision Problems

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

Computer Vision Problems

Filtering

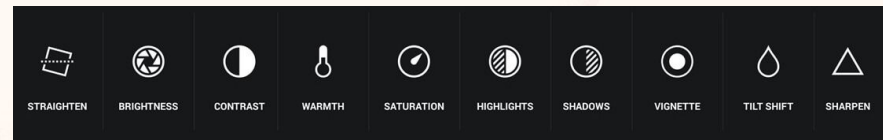


Computer Vision Problems

Transformations

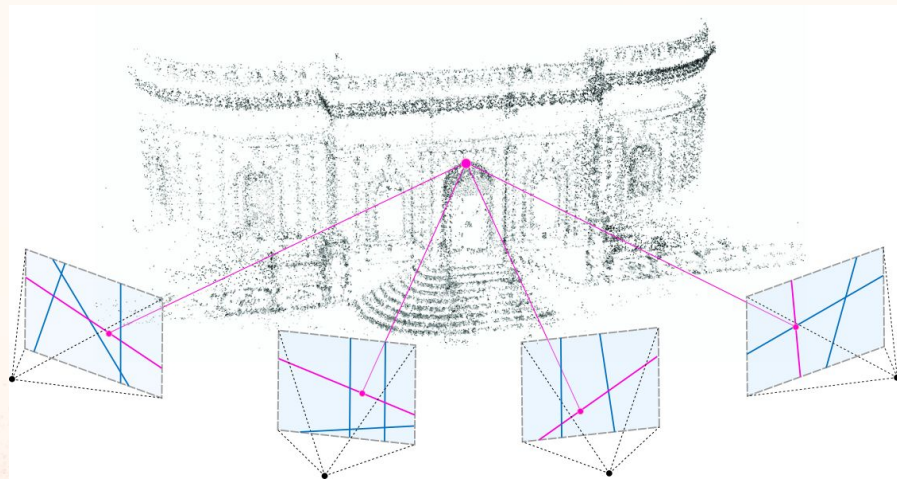


ooo wow panorama



Computer Vision Problems

Structure From Motion



Computer Vision Problems

Depth

left image (reference)



right image (smaller baseline)



(scaled) ground truth disparity map



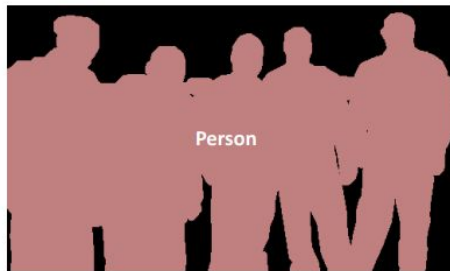
Computer Vision Problems

Segmentation

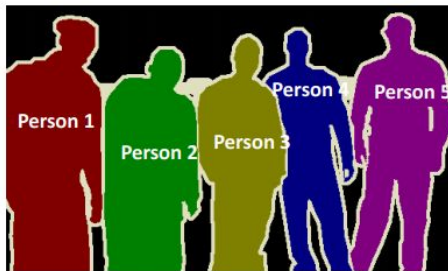


Computer Vision Problems

Segmentation



Semantic Segmentation



Instance Segmentation



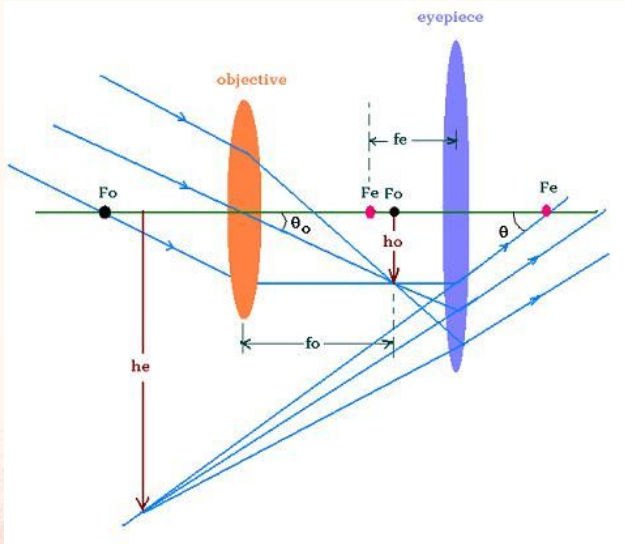
Any Questions?



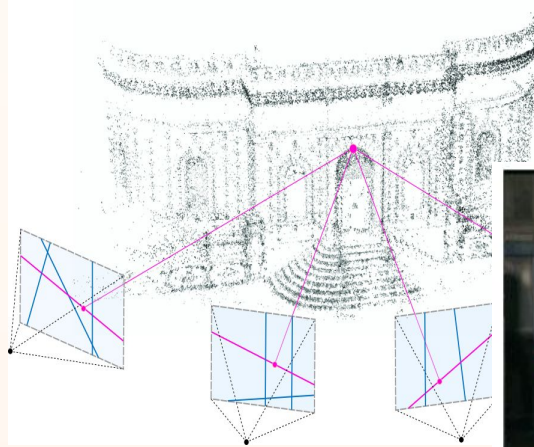
Traditional Solutions

Traditional Solutions

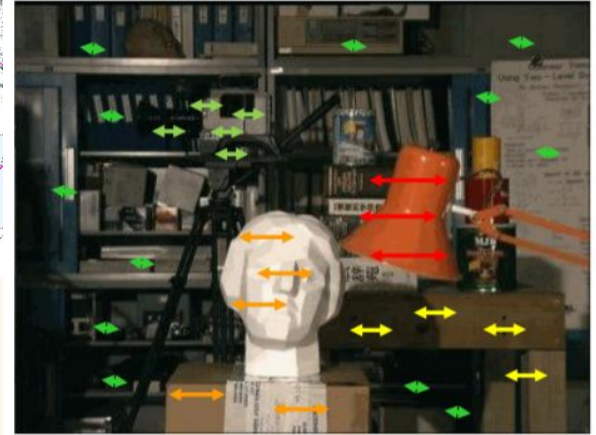
Take advantage of real world geometry and math



Real world has reliable geometry!



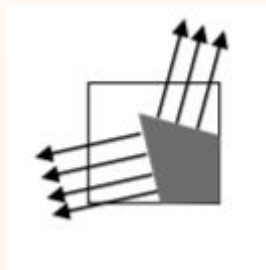
Clever math!



Closer objects 'move' more

Traditional Solutions

Take advantage of real world geometry and math



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



Zoom backgrounds

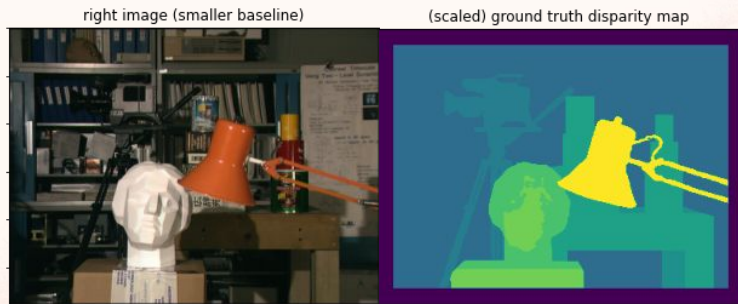
Deep Learning Solutions

The background of the slide is white and features a decorative pattern of stylized, light blue clouds. These clouds are arranged in a way that creates a gear-like or interlocking effect across the entire surface. The clouds have a soft, pixelated or grainy texture, giving them a modern, digital appearance.

Deep Learning Solutions

Models (grossly oversimplified)

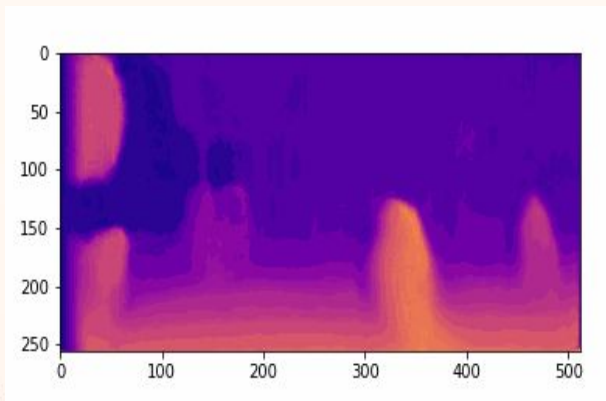
- Training Data
 - Input & target solution
- Loss functions
 - Cat vs Dog has different loss functions!
- N number of weights
- Find weights that minimize loss over training data
- Active area of research



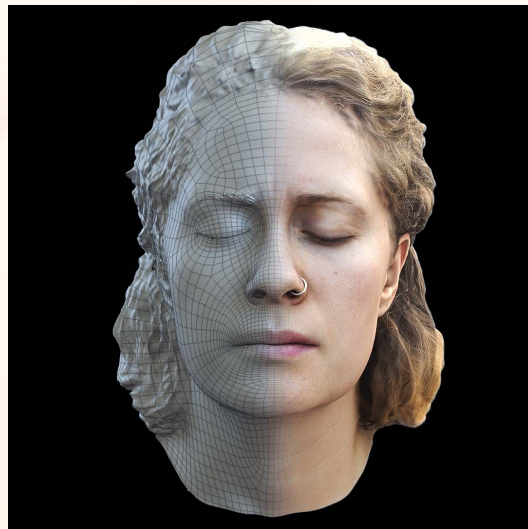
Handwritten digit detection model
(1989)

Deep Learning Solutions

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



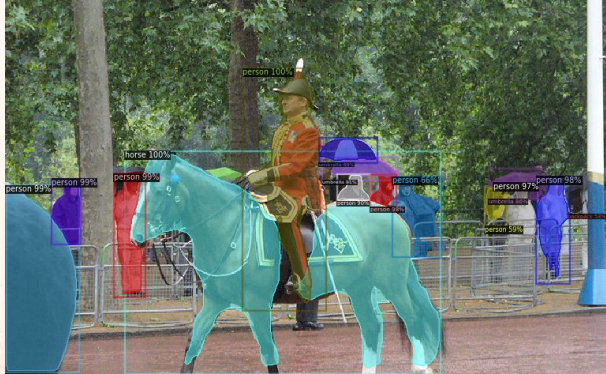
Single view depth estimation



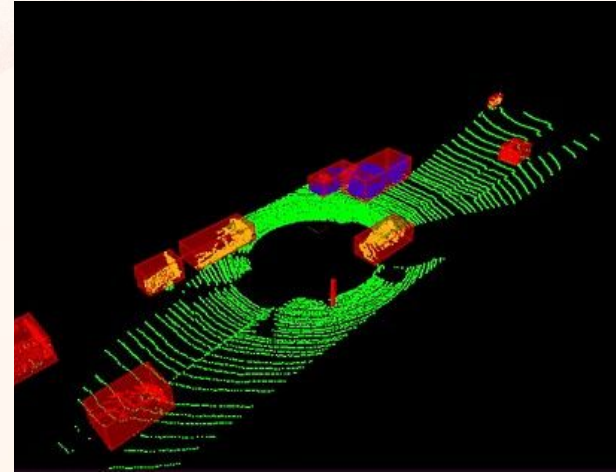
Single view photogrammetry
(structure from no motion)

Deep Learning Solutions

- Classification/regression problems



Object Classification

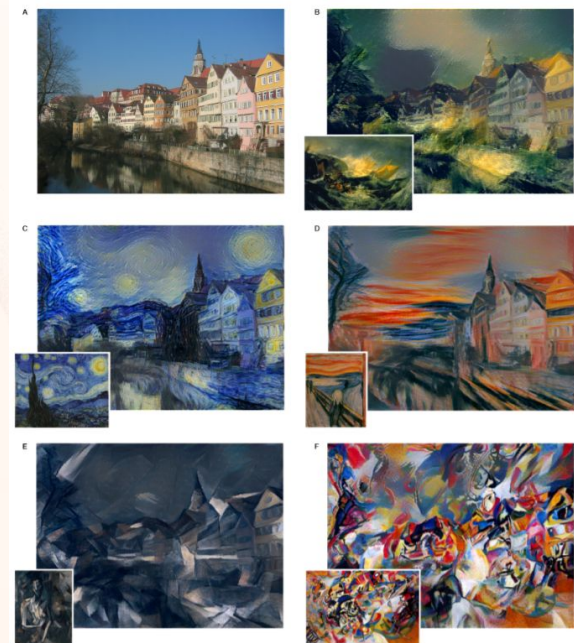


3d Lidar object classification

Deep Learning Solutions



Lighting Prediction



Generative Art

Any Questions?

U can also slide into my dms too lol



Detectron2 Example

The background of the slide features several stylized, light blue clouds with a soft, pixelated or grainy texture. These clouds are scattered across the white background, with some appearing in the upper corners and others along the bottom edge, creating a clean and modern aesthetic.

What is Detectron2?

- Trained model
 - “Plug and play”
- Open source
- State-of-the-art object detection
 - And more! See their [/projects](#)
- Made by Facebook AI



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!

(or jupyter notebook)

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?
 - Detectron2 can be used in **pose estimation** and **panoptic segmentation**
 - See /detectron2/projects/
 - [Monocular depth estimation](#)
 - [3D Semantic Segmentation](#)
 - [Pose estimation](#)
 - Much more at [paperswithcode.com](#)
 - Read repos carefully - each model has it's own set up
- 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

Further Reading (see HackPack!)

[Advanced CoLab tutorial from authors](#). They go into detail how you can use Detectron2 as the basis for a new model to be trained.

Other Ready-To-Use Models

[Browse papers alongside pretrained models](#).

- [Pytorch](#) will be crucial in loading these models.

Computer Vision Courses

UWaterloo: [CS484](#), prereqs (AMATH 242/CS 371 or CS 370) and STAT 230 or STAT 240. Strong linear algebra background will be valuable.

[Udacity](#)

[Coursera](#)

Interesting Papers

There's a great [reddit thread](#) with tons of papers I am also slowly getting through!

There are also lists on github:

- [terryum's "Awesome Deep Learning Papers"](#)
- [Floodsong's "Deep Learning Papers Reading Roadmap"](#)

Any Questions?

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