

# Intro to Computer Vision

Object detection with Detectron2



# Heyo!

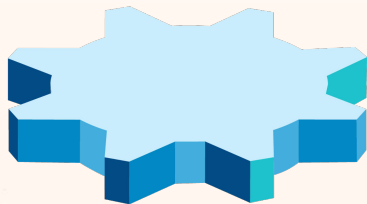
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3B Computer Science @ UWaterloo  
Cockroach, Ex Google, PayPal SWE



@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

The background of the slide features several stylized, fluffy white clouds with soft blue outlines and a light blue gradient fill. These clouds are scattered across the white background, creating a clean and airy aesthetic.

# Today's Goals

We will

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

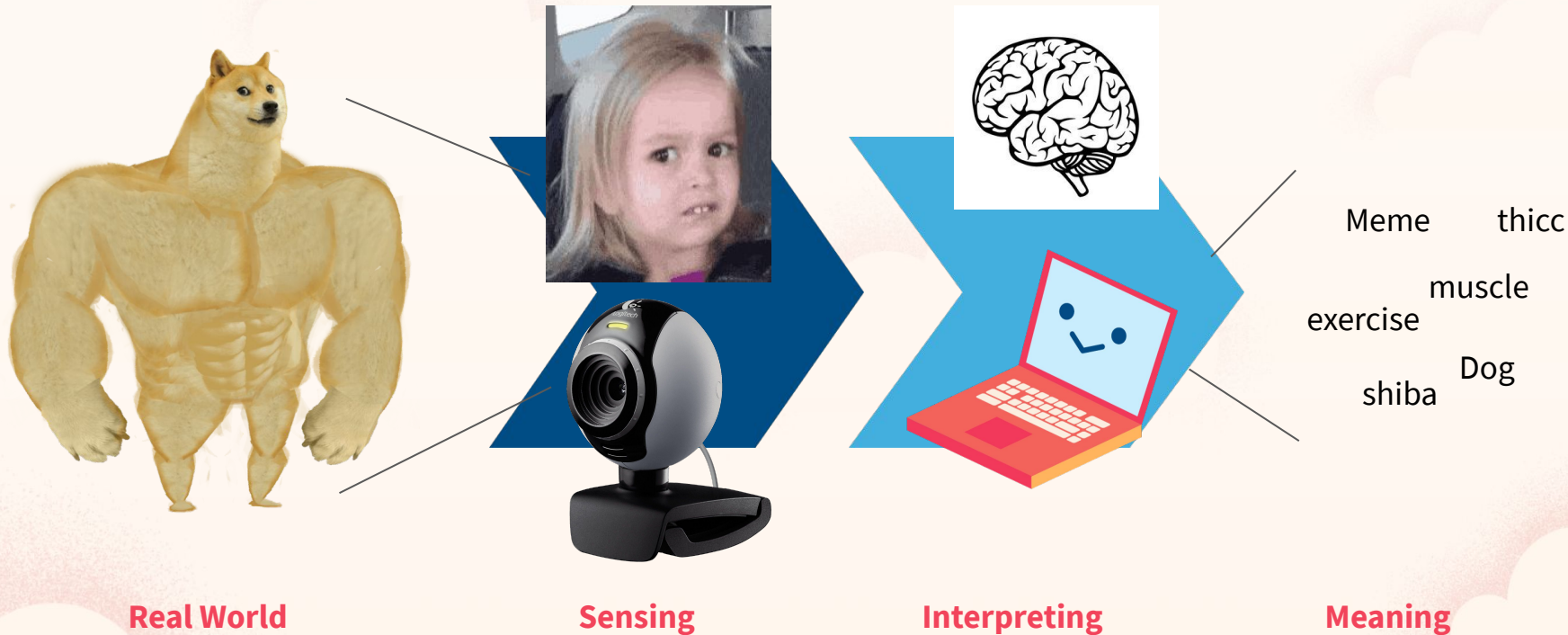
We will NOT:

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

# **What is Computer Vision?**

The background of the slide 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 frame. The clouds have a soft, textured appearance with a slight gradient from light blue to white.

# 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**

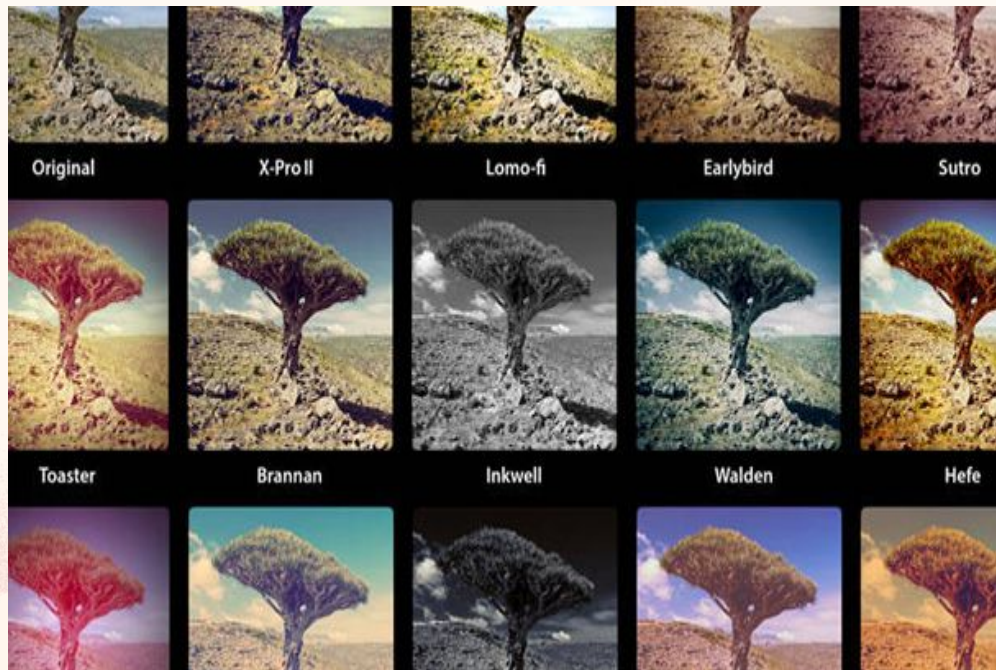
The background features a light blue, stylized gear-like pattern that resembles a series of interlocking clouds or a soft-focus mechanical design. The pattern is composed of rounded, overlapping shapes that create a sense of depth and movement. The overall color palette is a soft, pastel blue, giving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

# Computer Vision Problems

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

# Computer Vision Problems

## Filtering

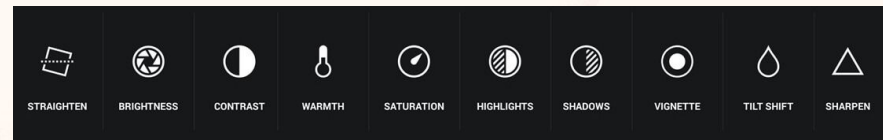


# Computer Vision Problems

## Transformations



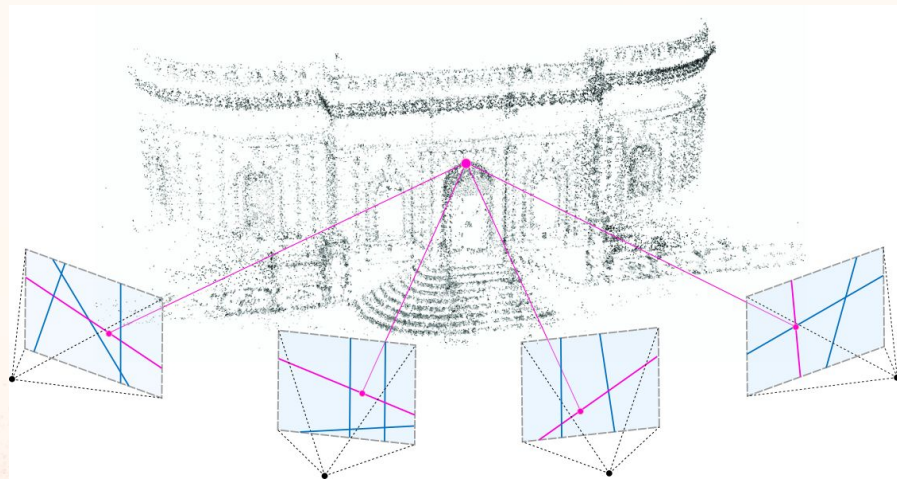
ooo wow panorama





# Computer Vision Problems

## Structure From Motion



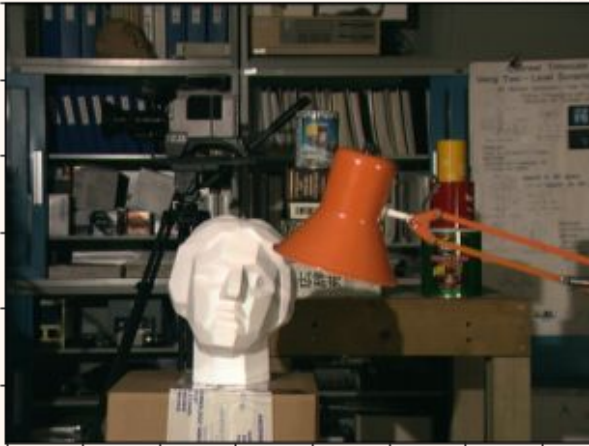
# Computer Vision Problems

## Depth

left image (reference)



right image (smaller baseline)



(scaled) ground truth disparity map



# Computer Vision Problems

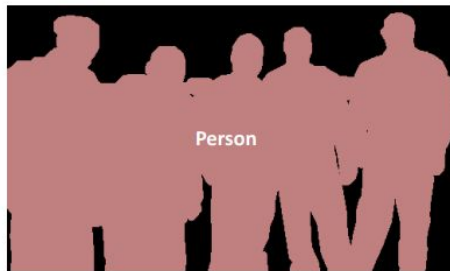
## Segmentation



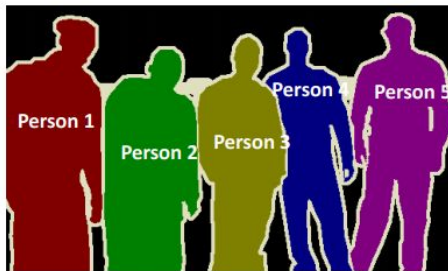


# Computer Vision Problems

## Segmentation



Semantic Segmentation



Instance Segmentation



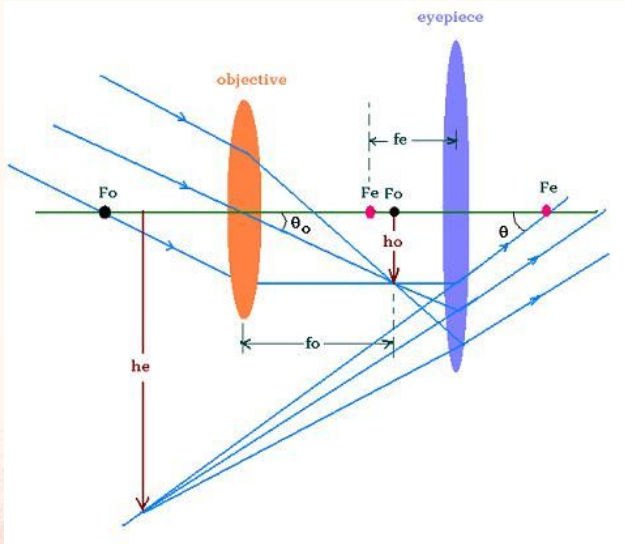
# Any Questions?



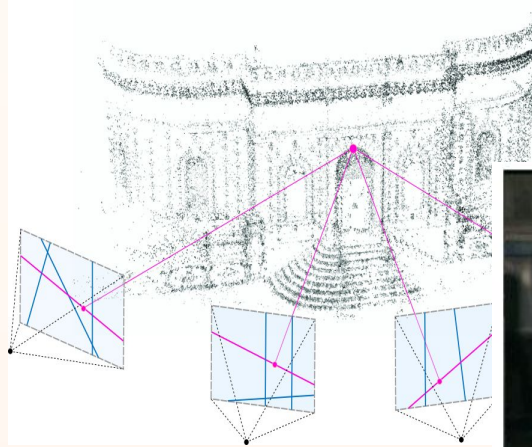
# **Traditional Solutions**

# Traditional Solutions

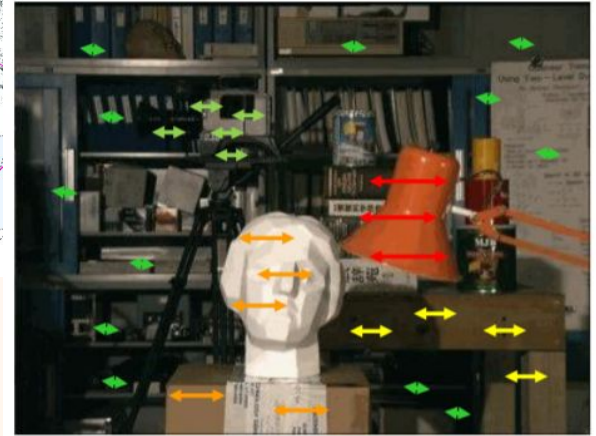
Take advantage of real world geometry and math



Real world has reliable geometry!



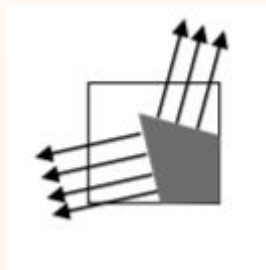
Clever math!



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



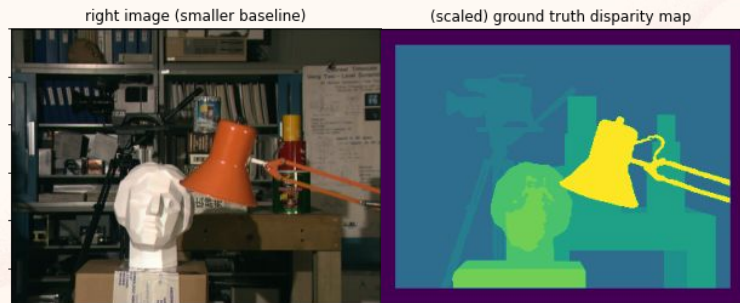
# **Deep Learning Solutions**

The background features a light blue and white color scheme. It includes several stylized, fluffy clouds in white and light blue. A faint, larger-scale pattern resembling interlocking gears or a mesh is visible in the background, rendered in a very light blue color.

# 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

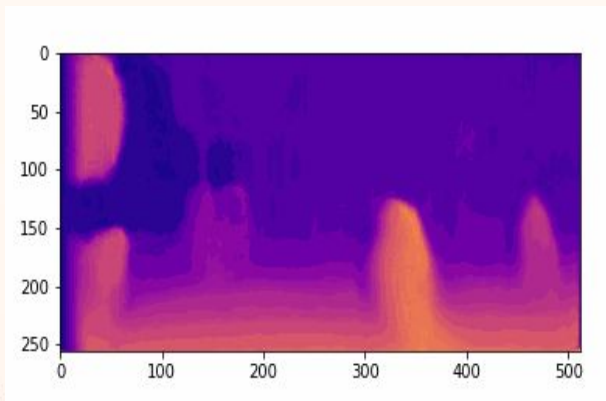


Handwritten digit detection model  
(1989)

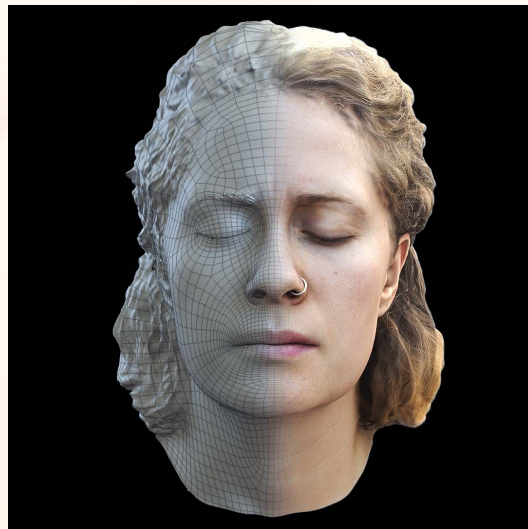


# Deep Learning Solutions

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



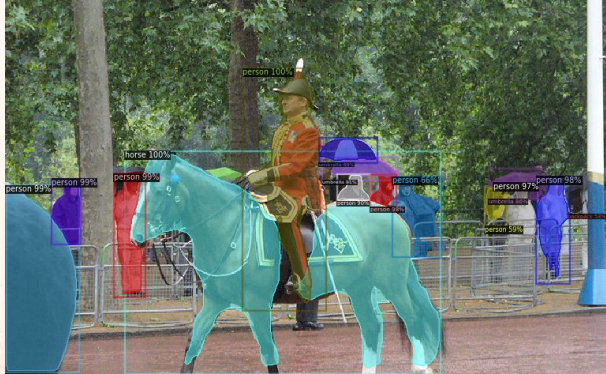
Single view depth estimation



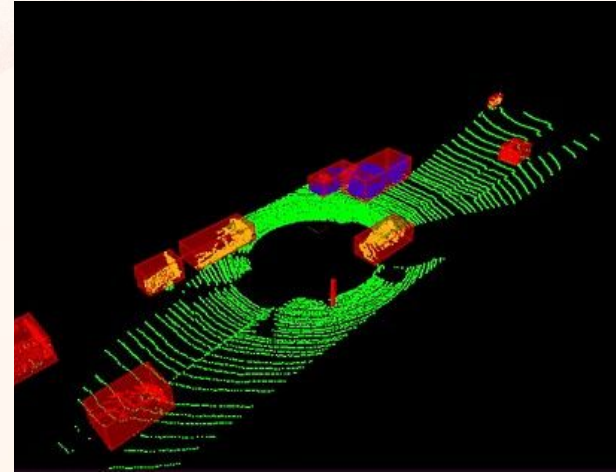
Single view photogrammetry  
(structure from no motion)

# 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, fluffy clouds in a light blue color, scattered across a white background. The clouds have a soft, painterly texture.

# 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



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.

**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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Psst.... This is a WIP

**Workshop will take place mid Jan :)**

