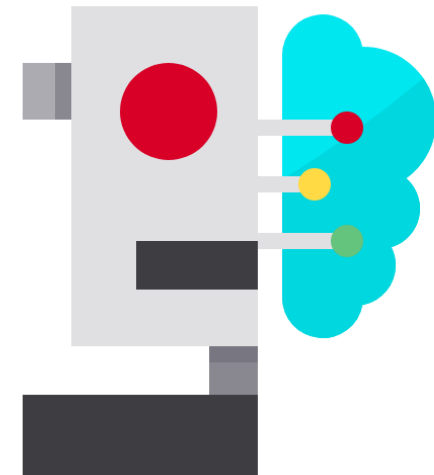


Neural Networks for Images

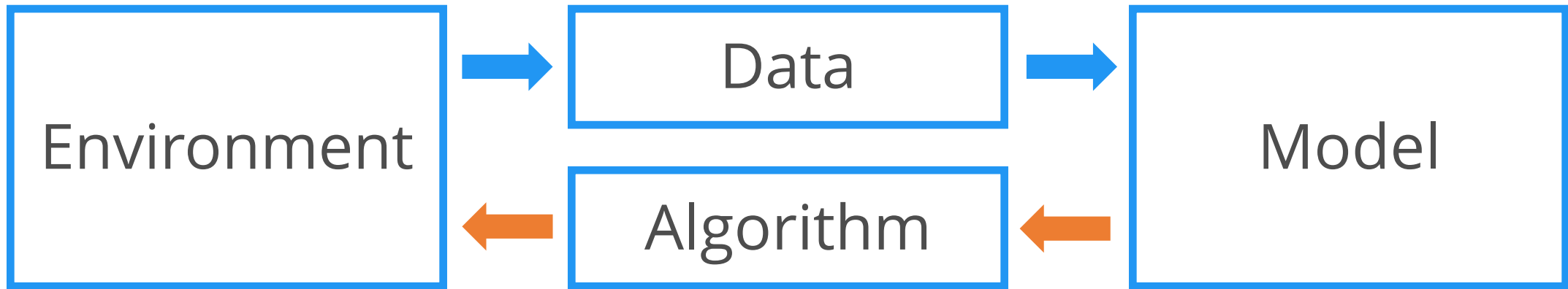
How to see like a human

Yordan Darakchiev
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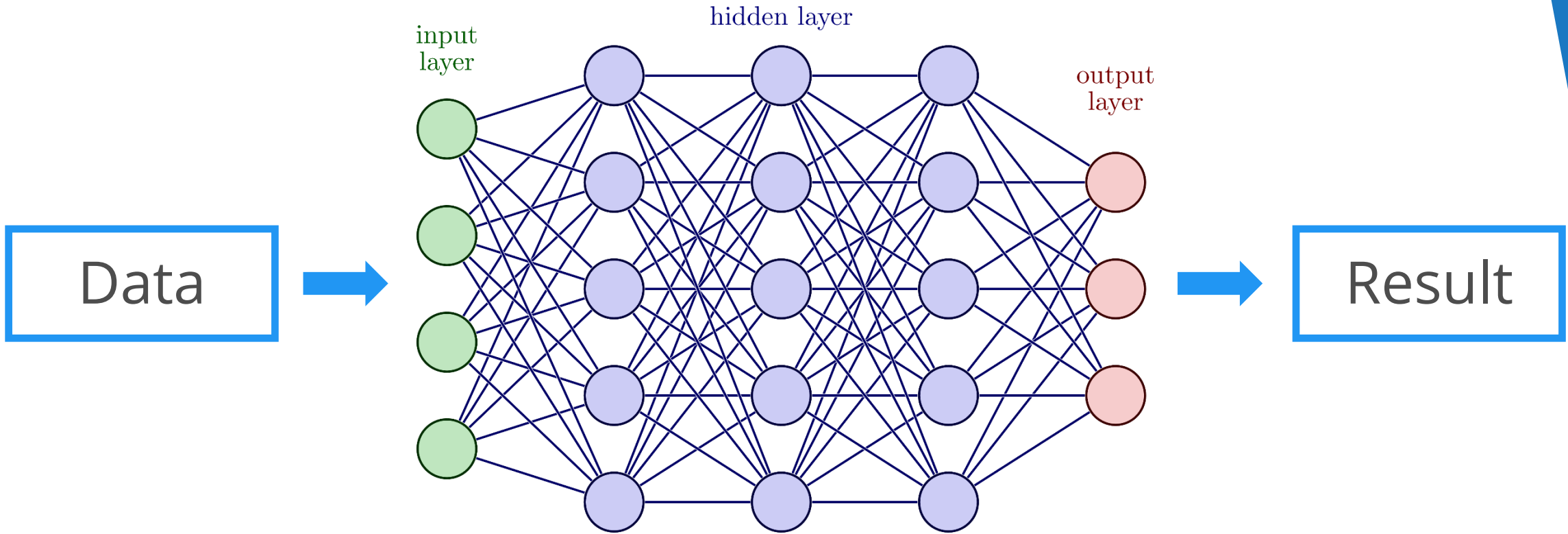
Machine Learning

- Making a **program** which performs a **task** *without* explicitly programming it
 - Like the way people learn

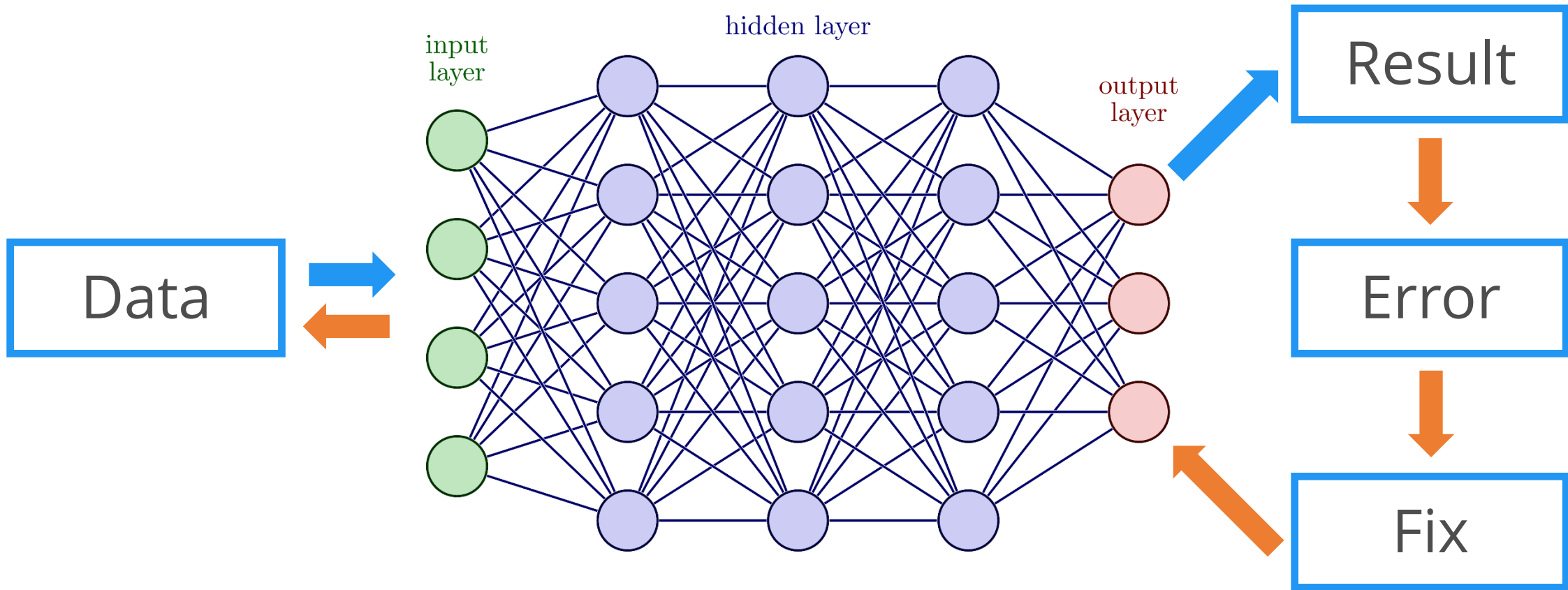


- Seeing new things
- Learning

Neural Network



Neural Network Learning



Convolution

I(0,0)	I(1,0)	I(2,0)	I(3,0)	I(4,0)	I(5,0)	I(6,0)
I(0,1)	I(1,1)	I(2,1)	I(3,1)	I(4,1)	I(5,1)	I(6,1)
I(0,2)	I(1,2)	I(2,2)	I(3,2)	I(4,2)	I(5,2)	I(6,2)
I(0,3)	I(1,3)	I(2,3)	I(3,3)	I(4,3)	I(5,3)	I(6,3)
I(0,4)	I(1,4)	I(2,4)	I(3,4)	I(4,4)	I(5,4)	I(6,4)
I(0,5)	I(1,5)	I(2,5)	I(3,5)	I(4,5)	I(5,5)	I(6,5)
I(0,6)	I(1,6)	I(2,6)	I(3,6)	I(4,6)	I(5,6)	I(6,6)

Input image

×

H(0,0)	H(1,0)	H(2,0)
H(0,1)	H(1,1)	H(2,1)
H(0,2)	H(1,2)	H(2,2)

Filter

=

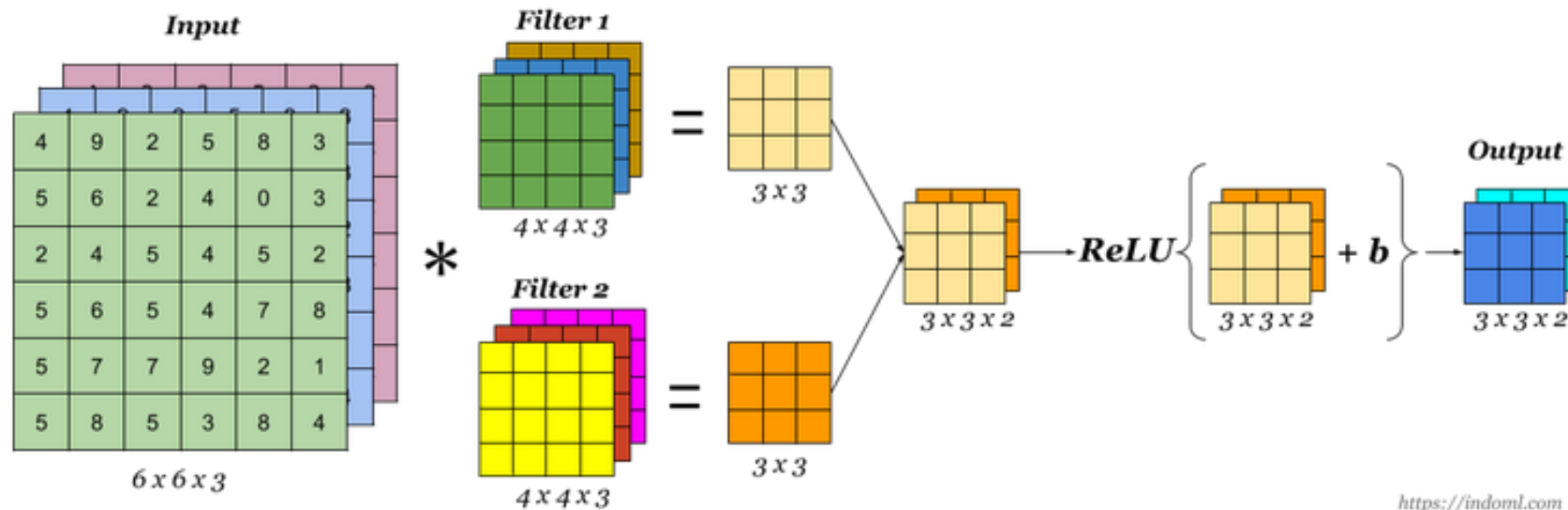
O(0,0)				

Output image

- How about *many* convolutions?

Convolution Layer

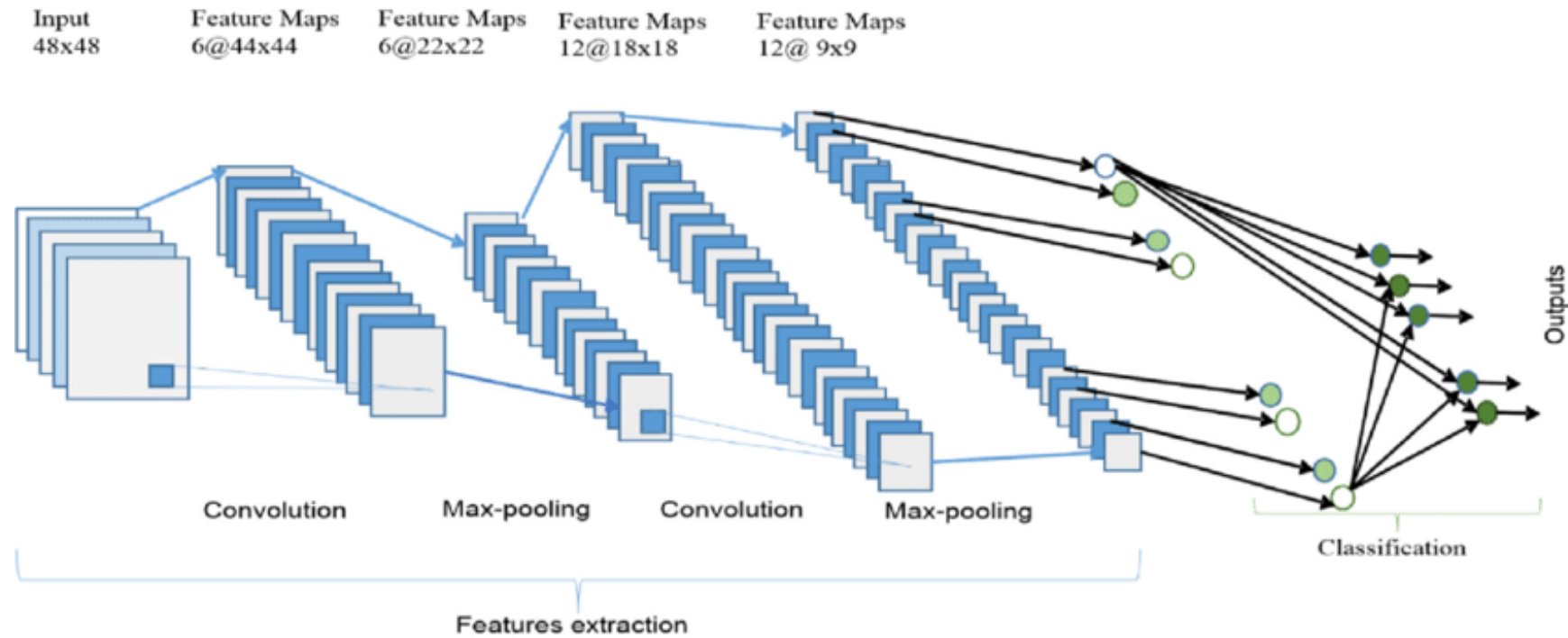
- Many channels
- Many filters (kernels)



- Looks just like a "usual" NN!
 - But works perfectly on images!

A Complete Model

- Convolution layers
- Pooling layers
- "Standard" layers



How Deep Can We Go?

- Inception ResNet V2
- Each rectangle is a layer

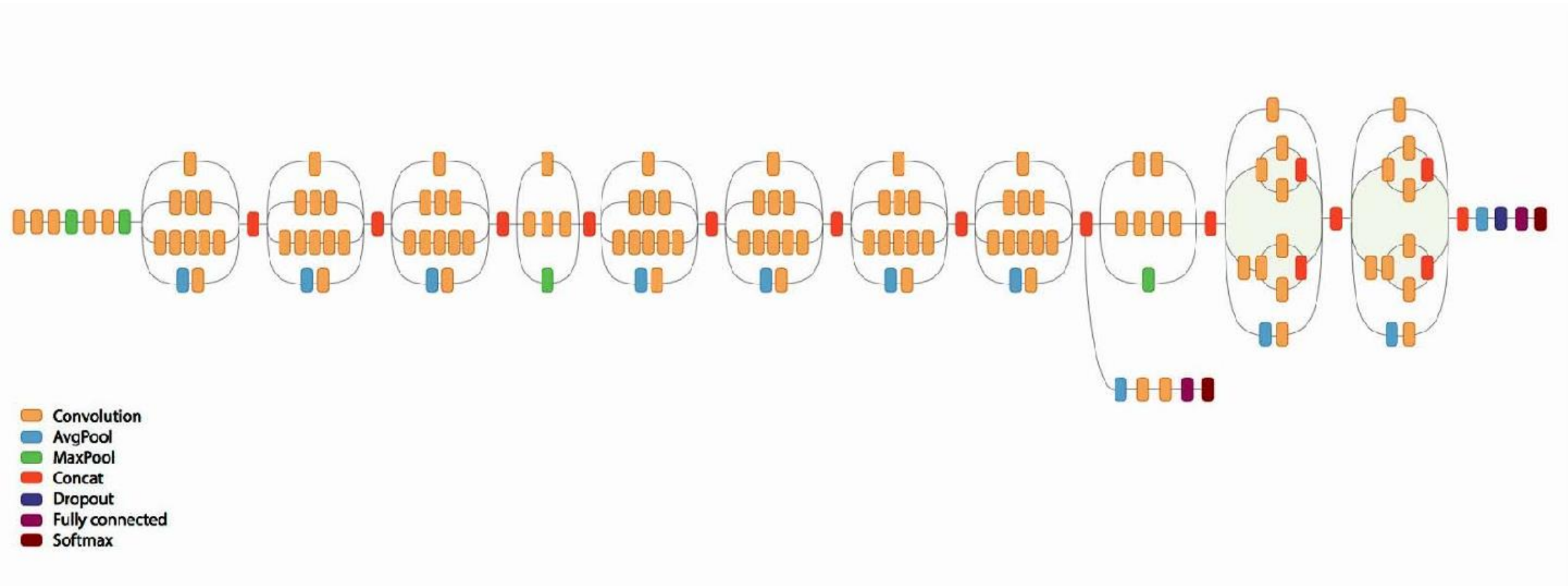


Fig. 1. Architecture of Inception Resnet V2 Network

How Deep Can We Go?

- Inception ResNet V2
- Each rectangle is a layer

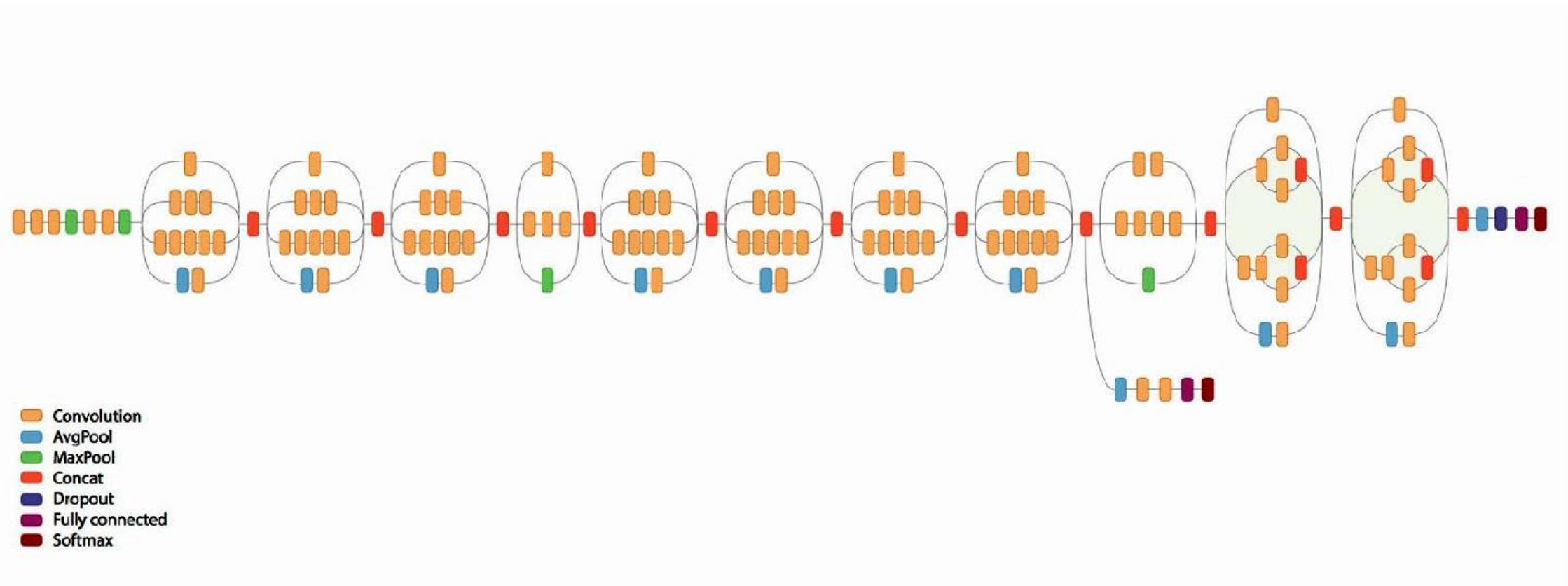


Fig. 1. Architecture of Inception Resnet V2 Network

The Gritty Details

- Activation function
- Hyperparameters
- Batch normalization
- Regularization
- Function optimization

- ... and other "-ations"

The Applications

- Image classification & friends

Semantic Segmentation



GRASS, CAT,
TREE, SKY

No objects, just pixels

Classification + Localization



CAT

Single Object

Object Detection



DOG, DOG, CAT

Multiple Object

Instance Segmentation

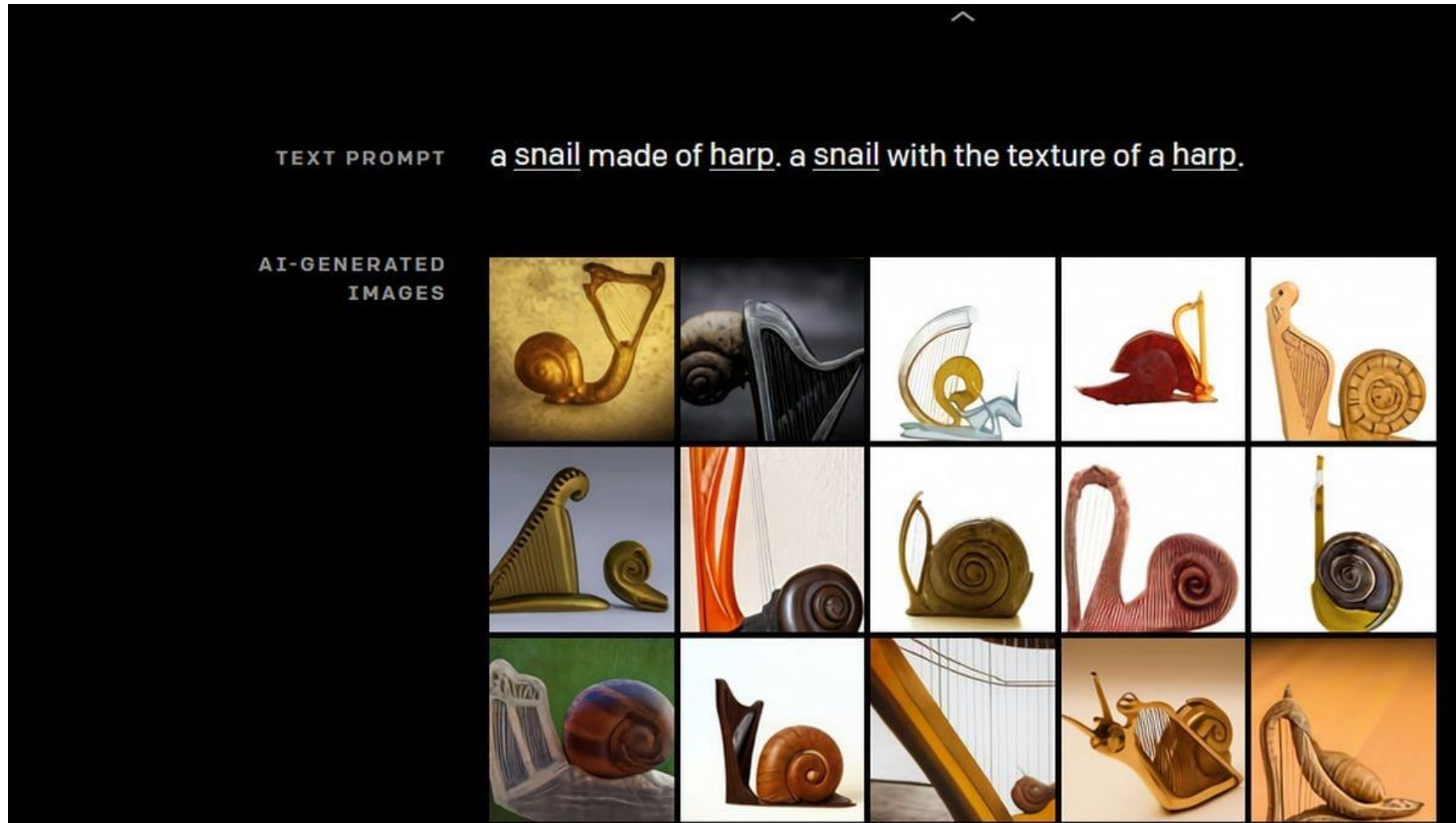


DOG, DOG, CAT

This image is CC0 public domain

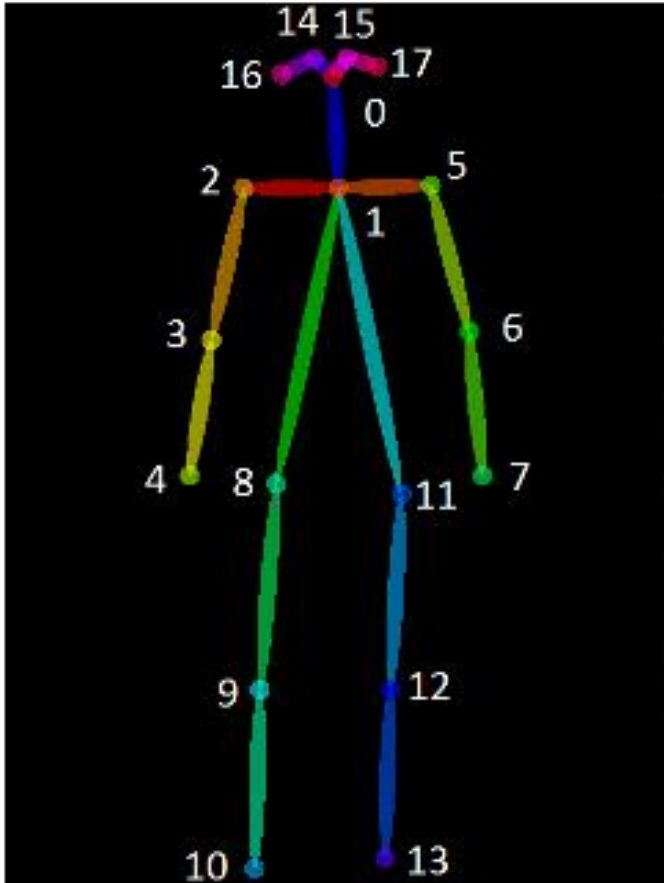
The Applications (2)

- Image captioning & generation



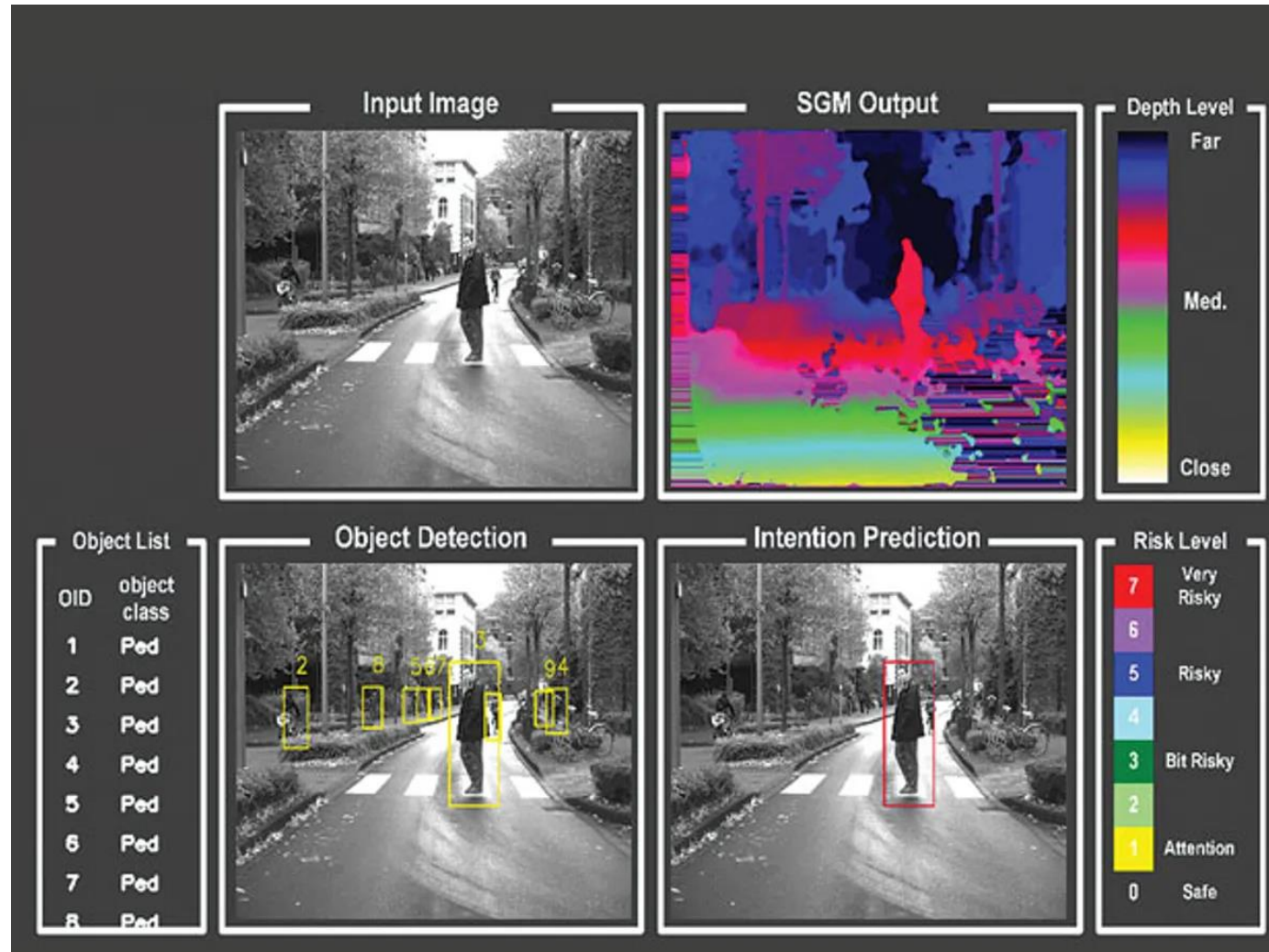
The Applications (3)

- Keypoint detection, pose estimation, activity recognition



The Applications (4)

- Robotic control, autonomous vehicles



In Real Life

- Lots of data
 - Data quality
 - Finding biases
 - Producing metrics
 - Fine-tuning models
-
- Explainability
 - Responsibility

Thank you!