Intro to Deep Learning and Transfer Learning

How to quickly employ deep learning in my Hackathon project

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Co-founder and ex-president of Chinese Engineering Society (CES) at UC San Diego
Master Student in Computer Science at UC San Diego
Research Areas: Deep Learning, Reinforcement Learning, Safe Autonomous Driving

9/4/2020

Outline

- What is Deep Learning
- What's "wrong" with training a model from scratch
- What is Transfer Learning (with Demo)
- What else can Deep Learning do

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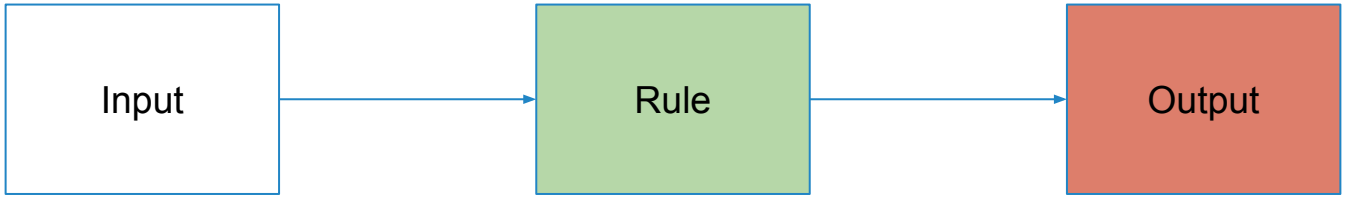

Traditionally: Rule is Known

What is Deep Learning

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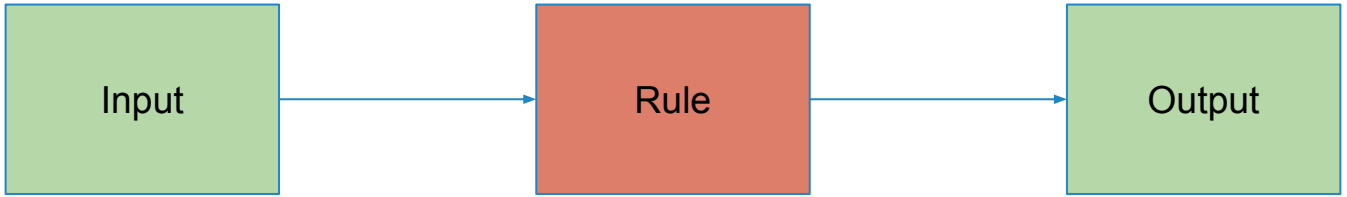

Deep Learning: Learn the rule

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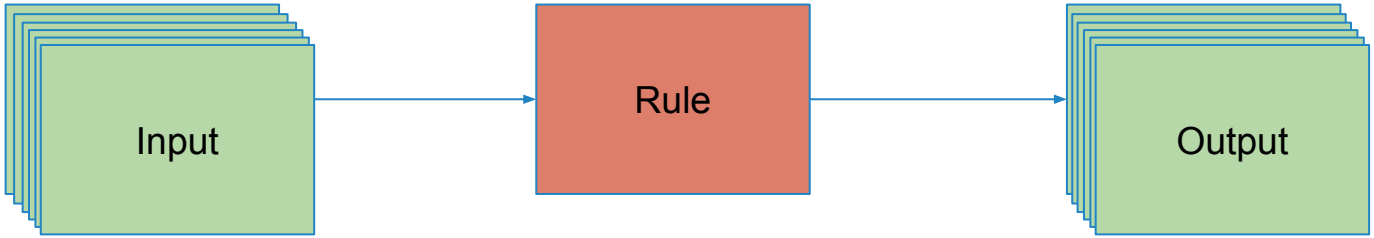

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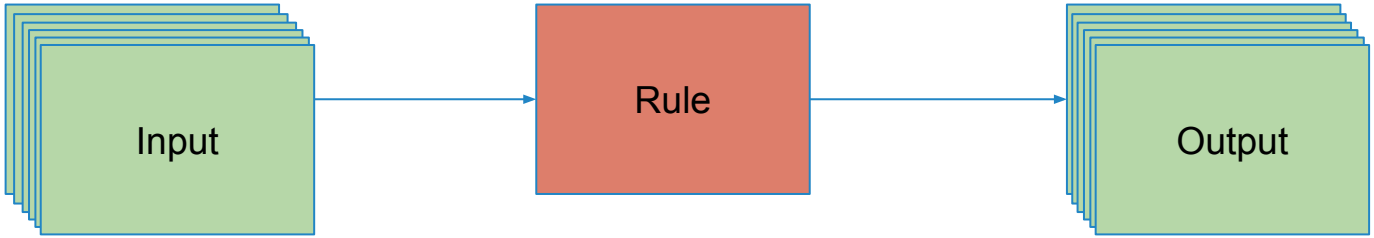
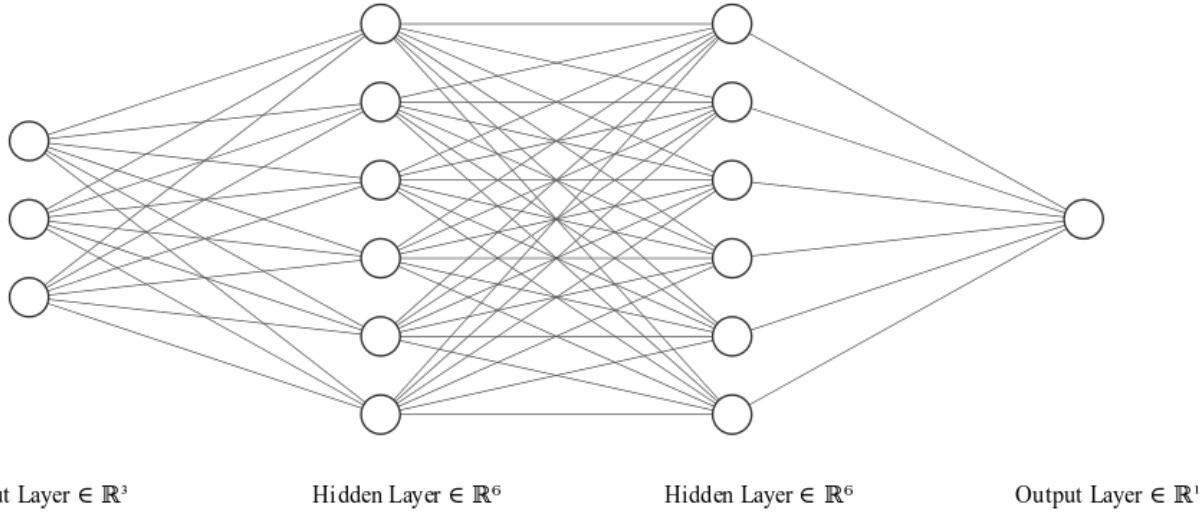


Deep Learning: Learn the rule

How is this "Rule" represented?

What is Deep Learning

The rule: Neural Network



* Image taken from: http://alexlenail.me/NN-SVG/

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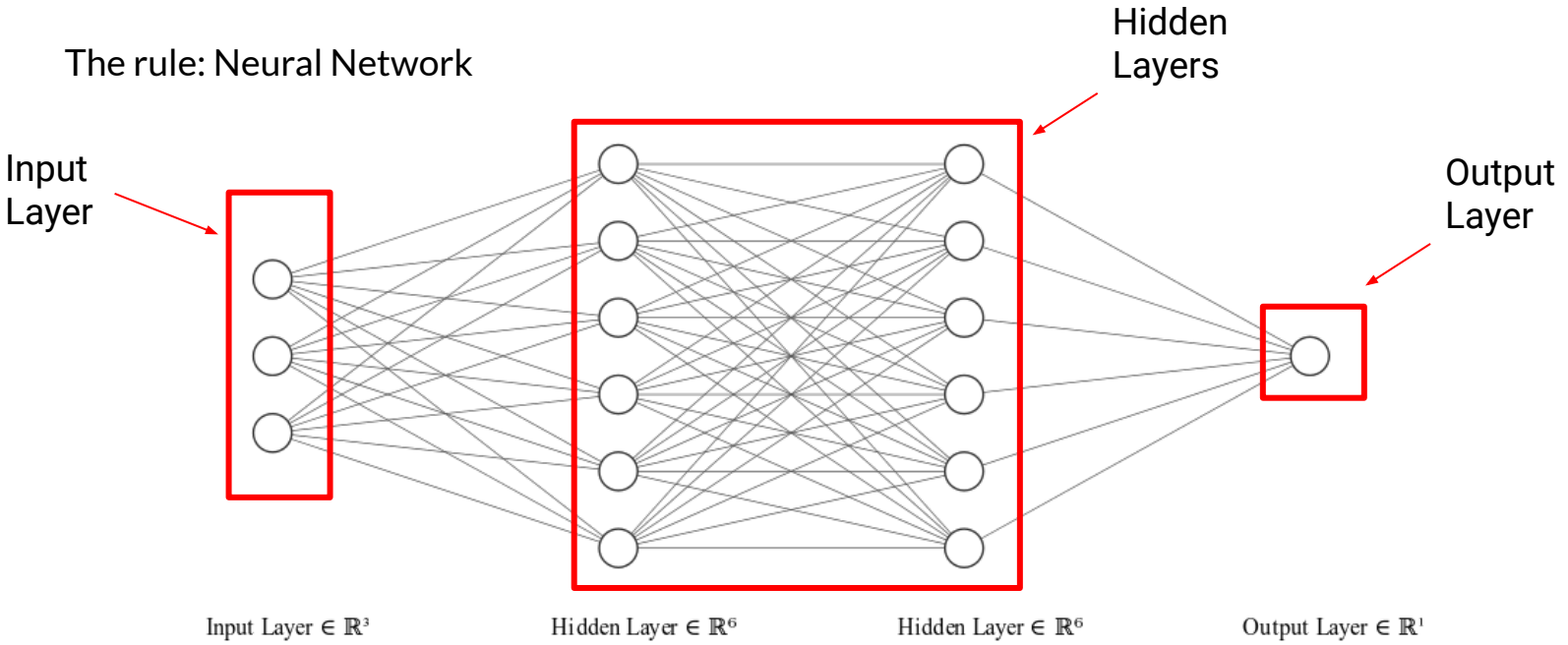
The rule: Neural Network



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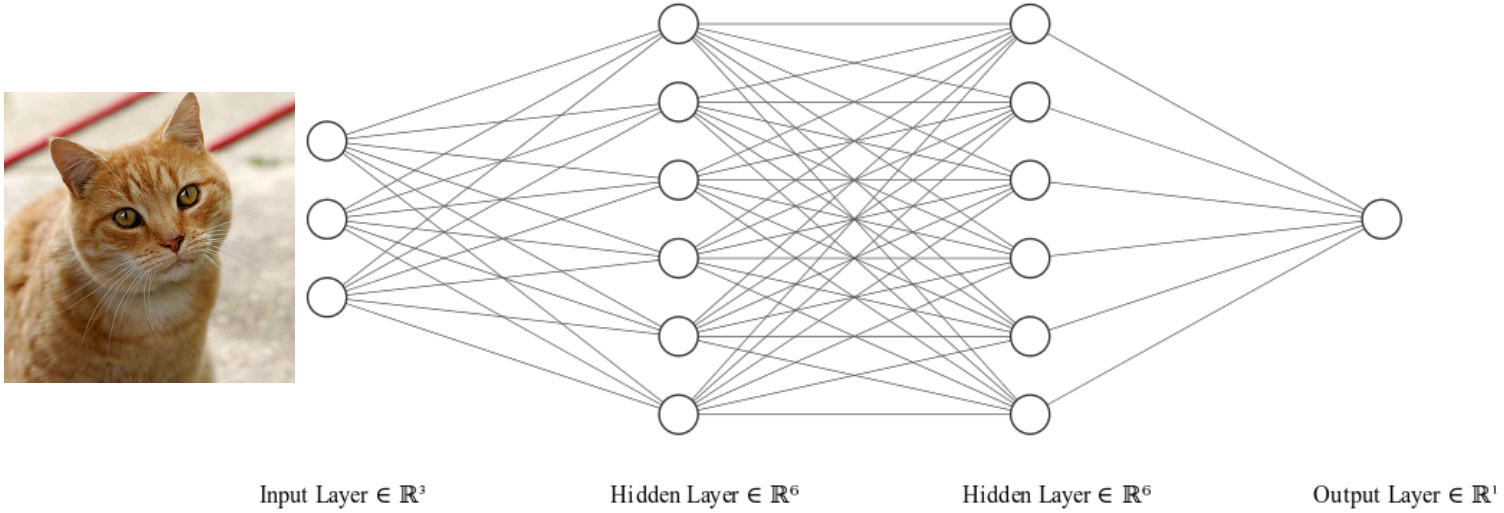
What is Deep Learning

Forward Propagation



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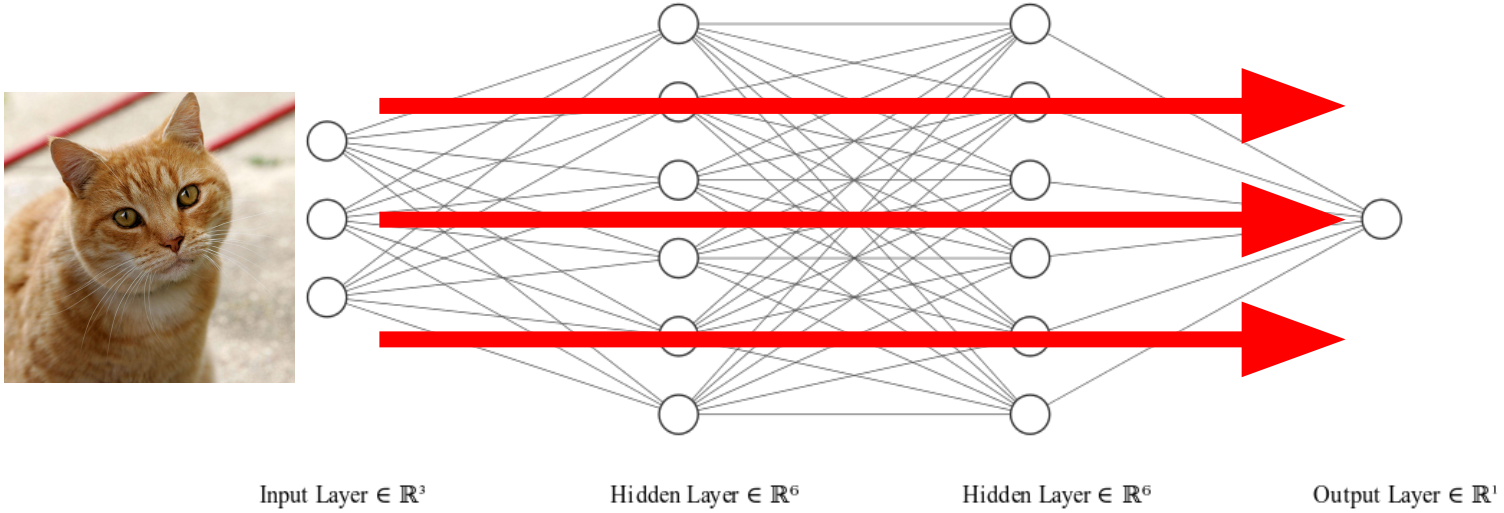

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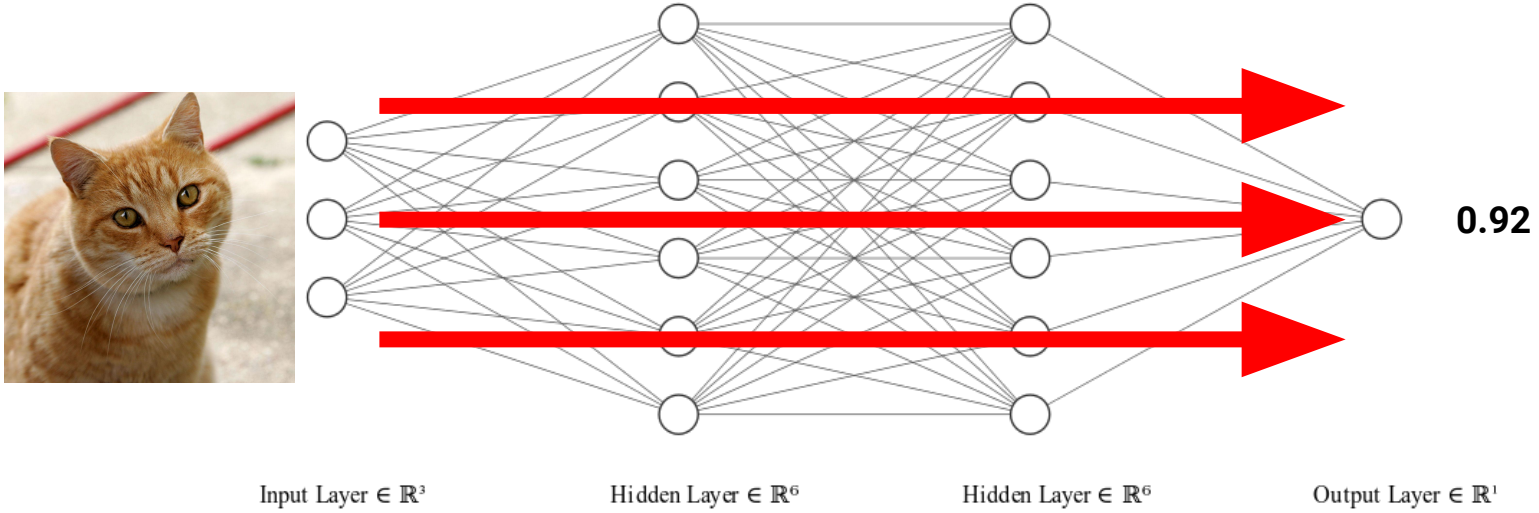

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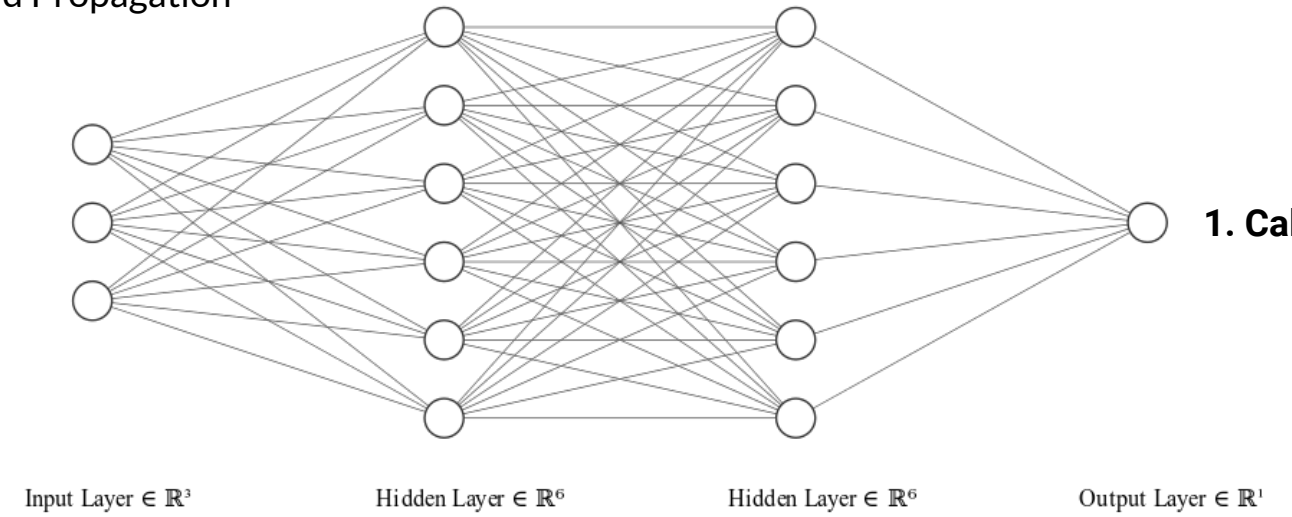

1. Calculate error

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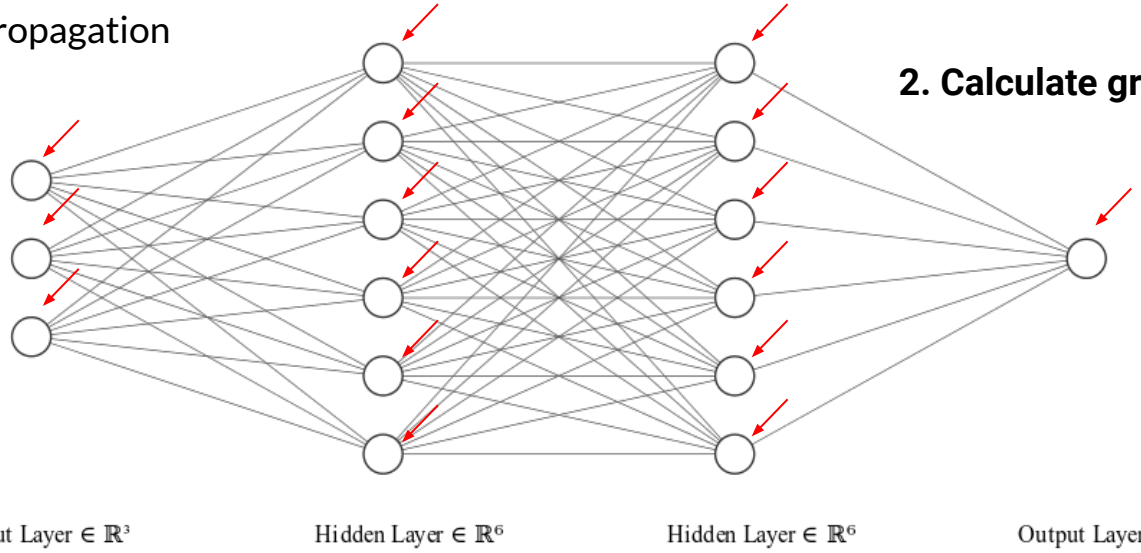

2. Calculate gradients for parameters

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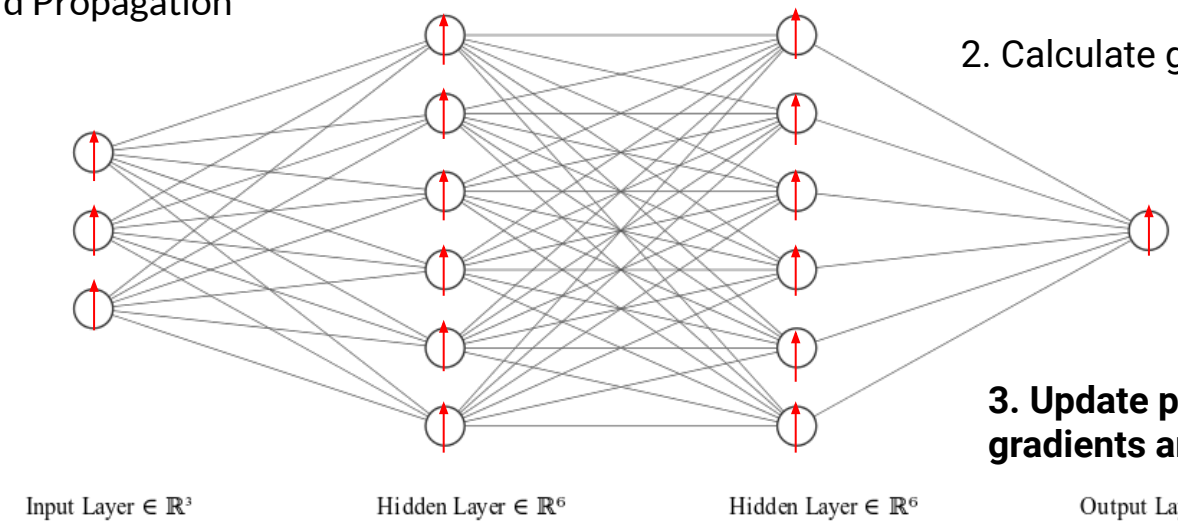

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3. Update parameters based on gradients and learning rate

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What is Deep Learning

After many forward/backward propagations (oftentimes tens of thousands), the network (rule) is able to accurately perform the classification.

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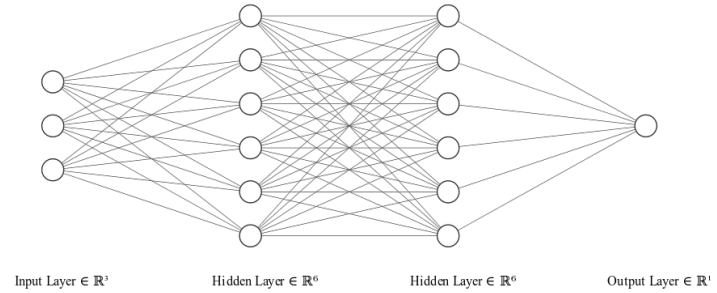

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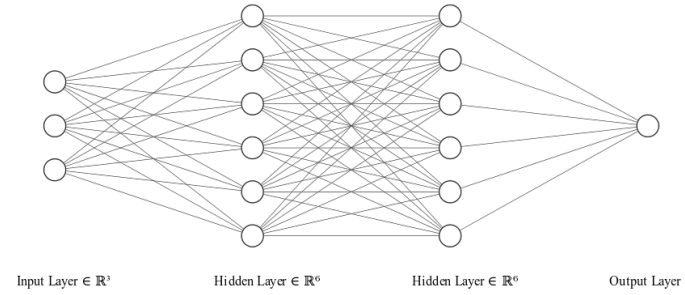

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In fact, to get a good model for image

- 256*256 image -> 65536 pixels
- 10 categories -> 10 output units
- 4 layers, with 1024 hidden units each
- Total number of parameters: 65536 * 1024 + 1024 * 1024 + 1024 * 1024 + 1024 * 1024 + 1024 * 10 = **70,264,832**

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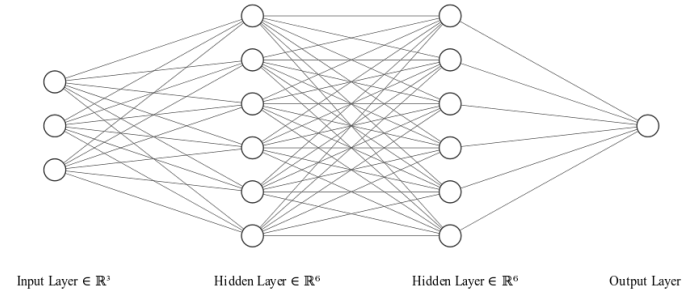

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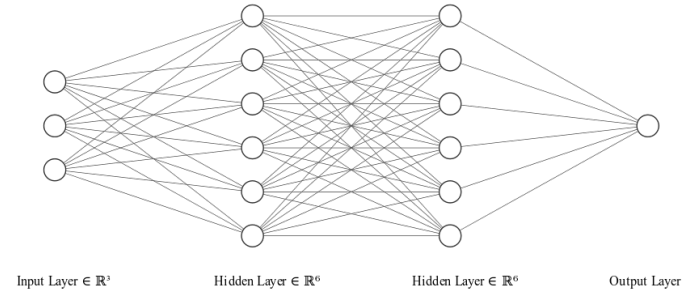

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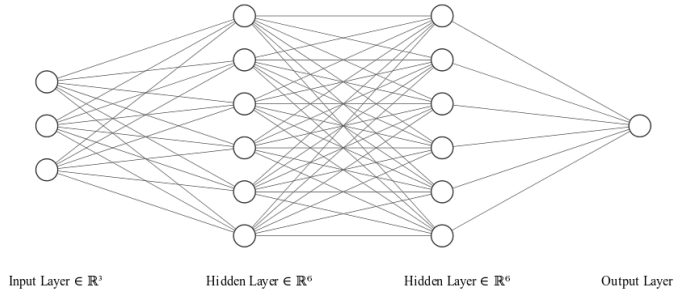

This leaves us with a long time to properly train the model...

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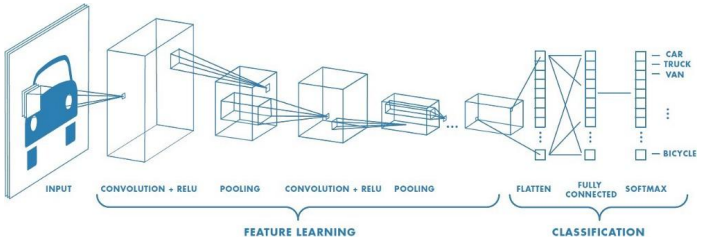
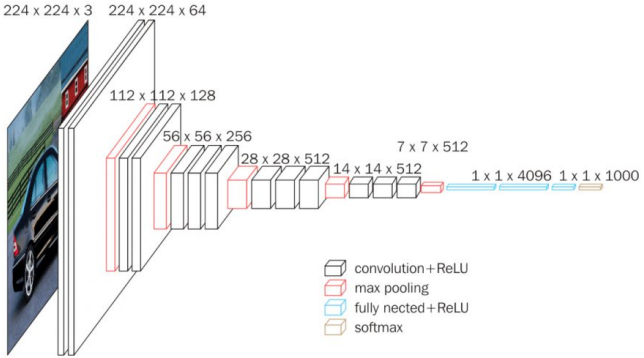
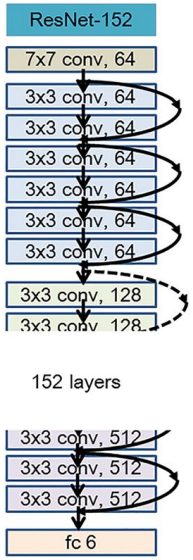
- Variations of models

Convolutional Neural Network (CNN)



VGG-19





ResNet-152

Images: https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53 (CNN), https://neurohive.io/en/popular-networks/vgg16/ (VGG-19), https://www.researchgate.net/figure/The-representation-of-model-architecture-image-for-ResNet-152-VGG-19-and-two-layered_fig2_322621180 (ResNet-152)

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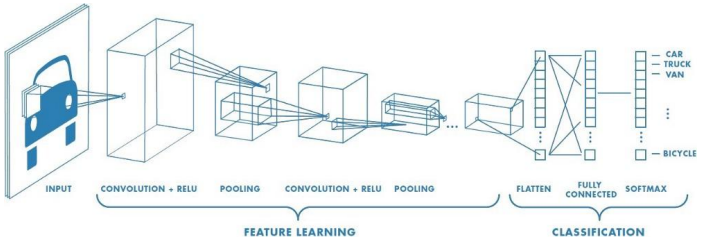

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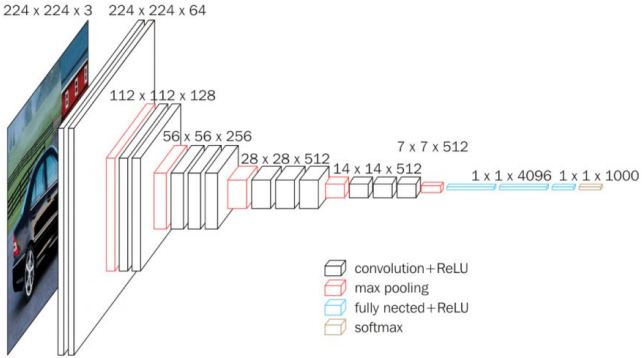

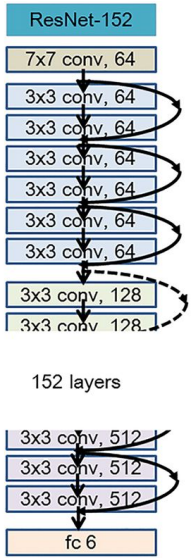

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Typically, to train a neural network accurately classifies images, we would typically need at least thousands of samples

Doheny
vs
Geisel

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Key idea: Take someone else's pretrained model and use it for my application

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Advantage: the pretrained model has a solid knowledge on the features of objects.

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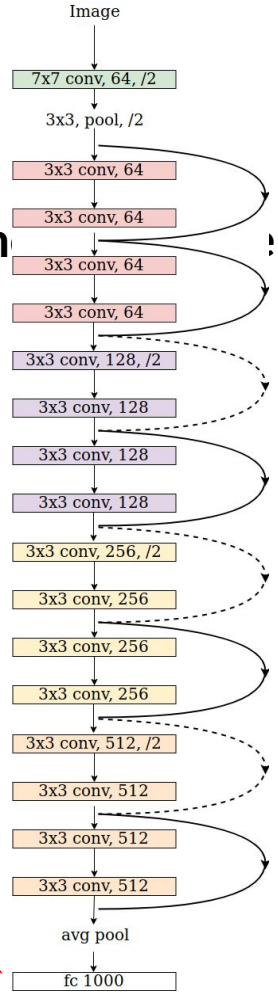

ResNet-18

This layer was for "categorizing 1000 classes"

Image: https://ai.stackexchange.com/questions/13842/what-do-the-numbers-in-this-cnn-architecture-stand-for

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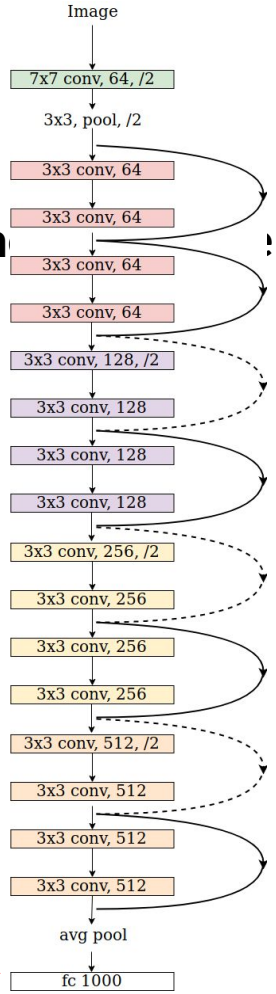

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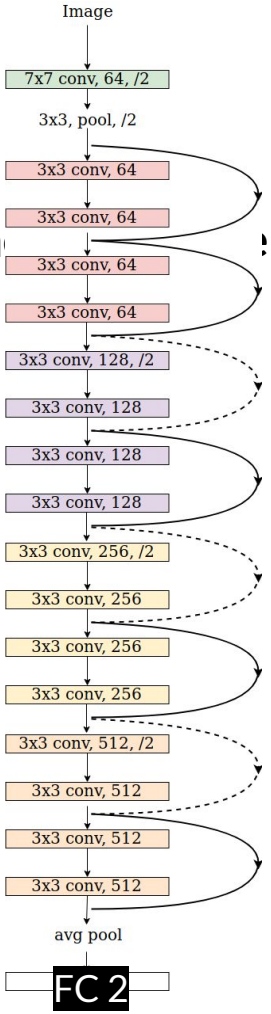

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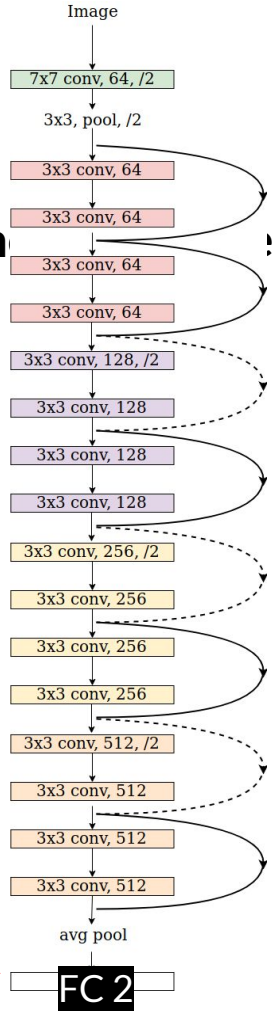

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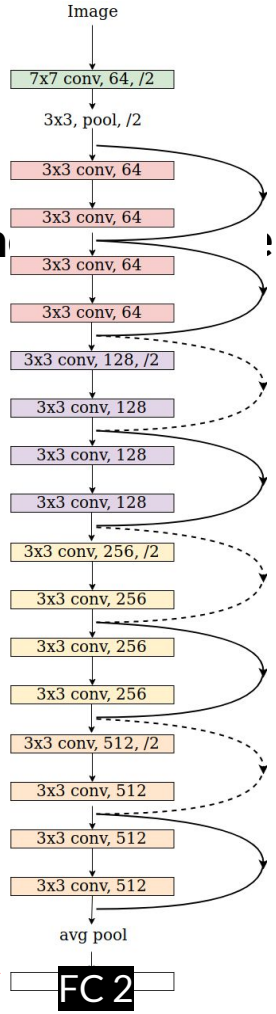

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Then, we can freeze all other layers, and train only this layer **with less data and less iterations**

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Even easier why: inside PyTorch: https://pytorch.org/docs/stable/torchvision/models.html

DEMO

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What else can Deep Learning do

Compute Vision

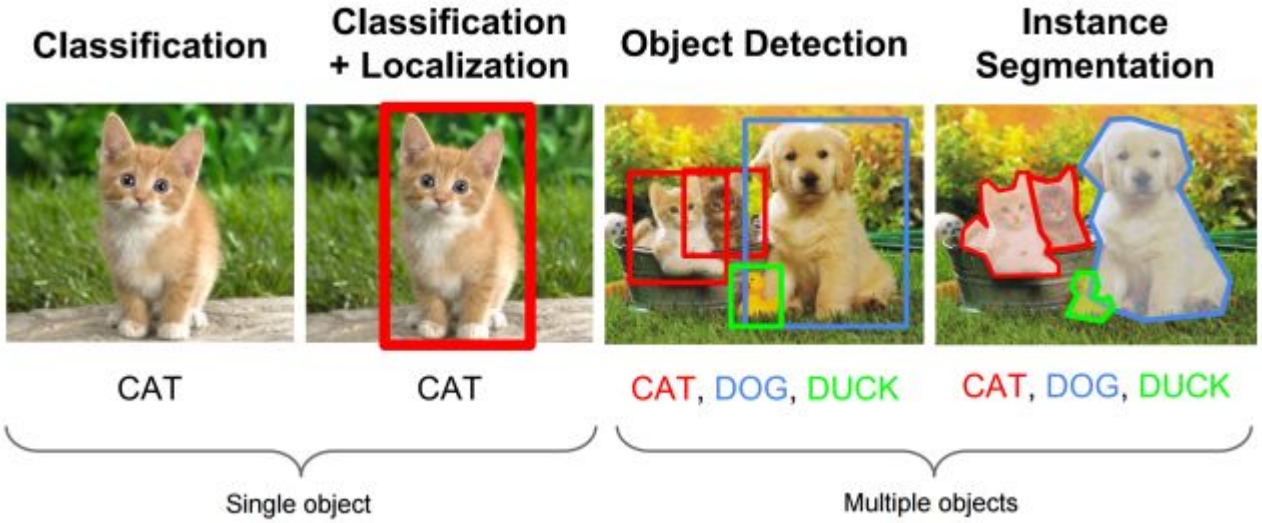
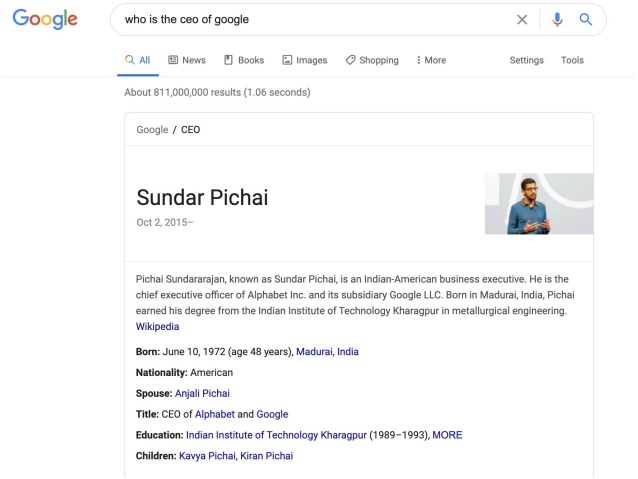


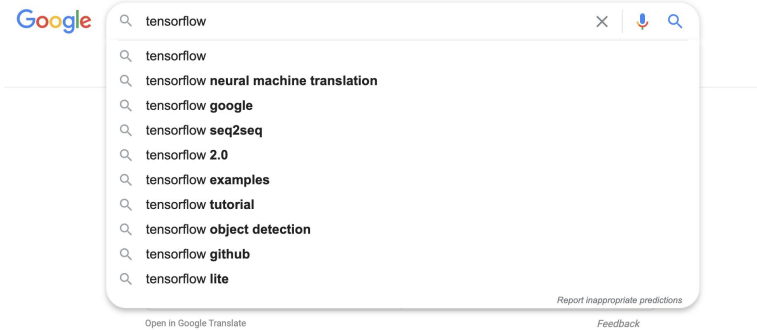
Image taken from: https://www.kdnuggets.com/2018/09/object-detection-image-classification-yolo.html

What else can Deep Learning do

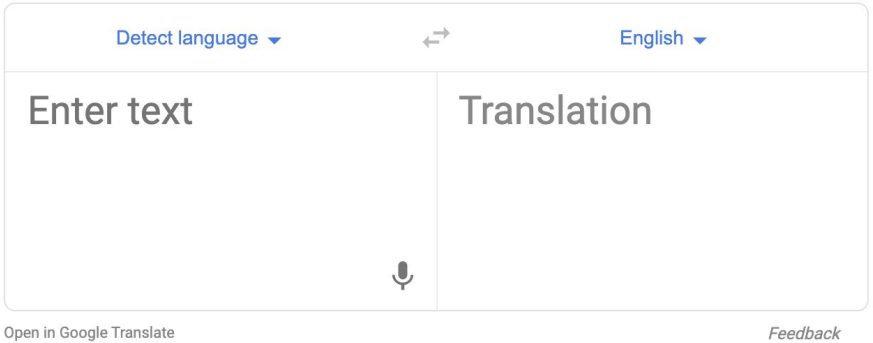
Natural Language Processing



Question and Answering



Auto-Completion



Machine Translation

What else can Deep Learning do

Reinforcement Learning

(e.g. play video games, autonomous driving, robotics, etc.)

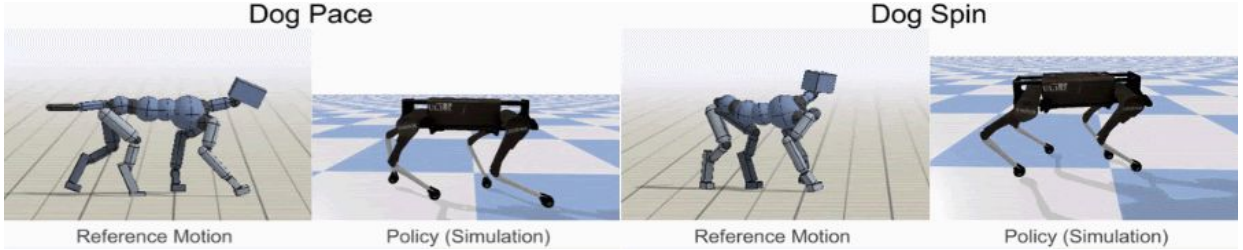


Image taken from: https://gfycat.com/gifs/search/reinforcement+learning (left), https://ai.googleblog.com/2020/04/exploring-nature-inspired-robot-agility.html (right)

Thanks!

Questions?

Zhizhen Qin

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Email: zhizhenqin@ucsd.edu