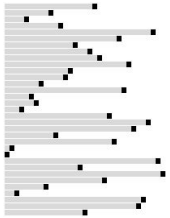
Introduction to Convolutional Neural Networks

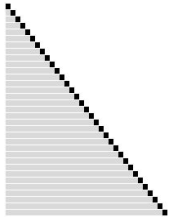
Farhood Farahnak
November 2018

Algorithm



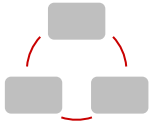
Input

Programmable Computer



Output

http://arkitus.com/research/



Algorithm

Search Engine

“Horse”

Input

Programmable Computer

Output

http://arkitus.com/research/

Image Classification

?

Algorithm

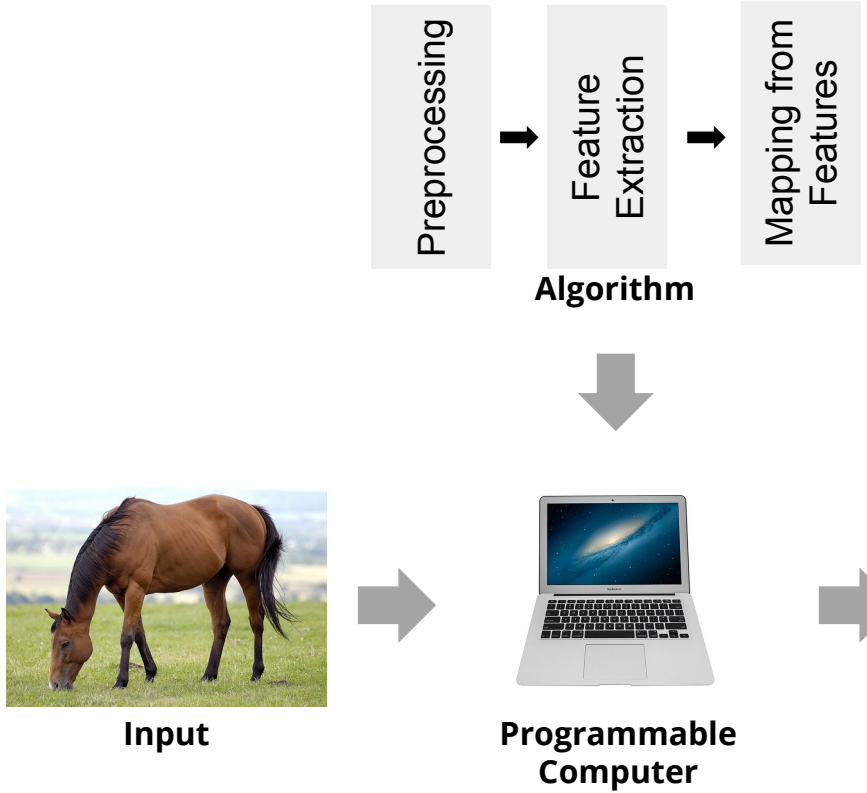
Input

Programmable Computer

Horse

Output

http://arkitus.com/research/



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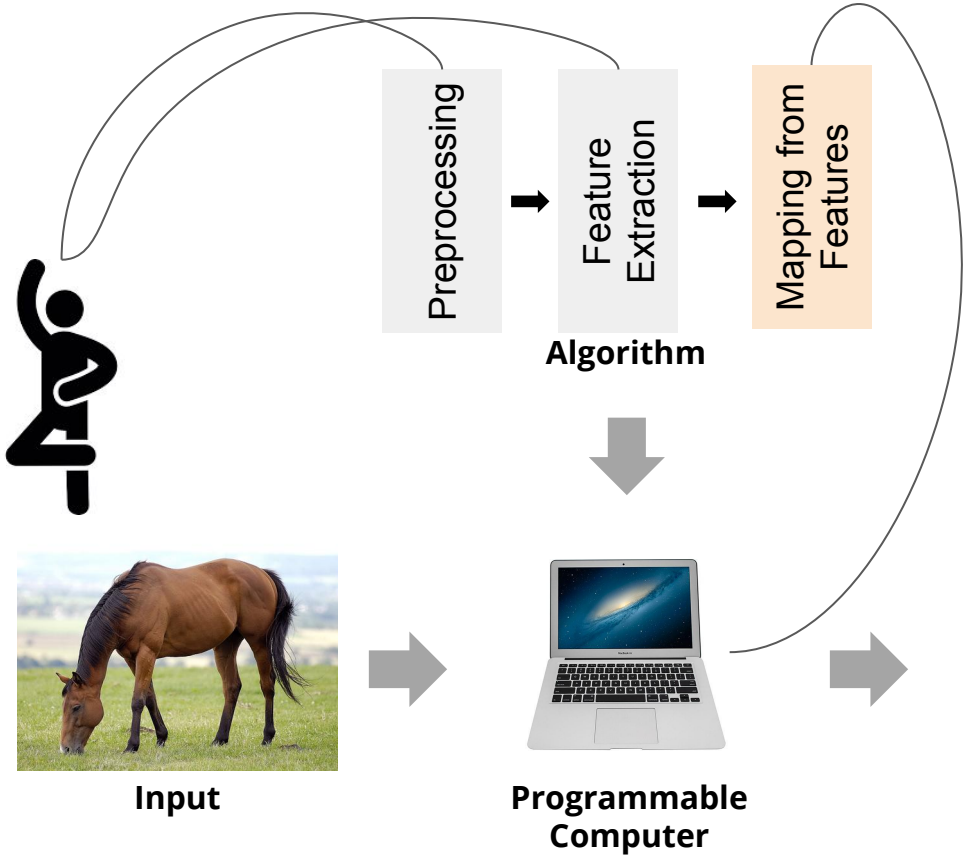

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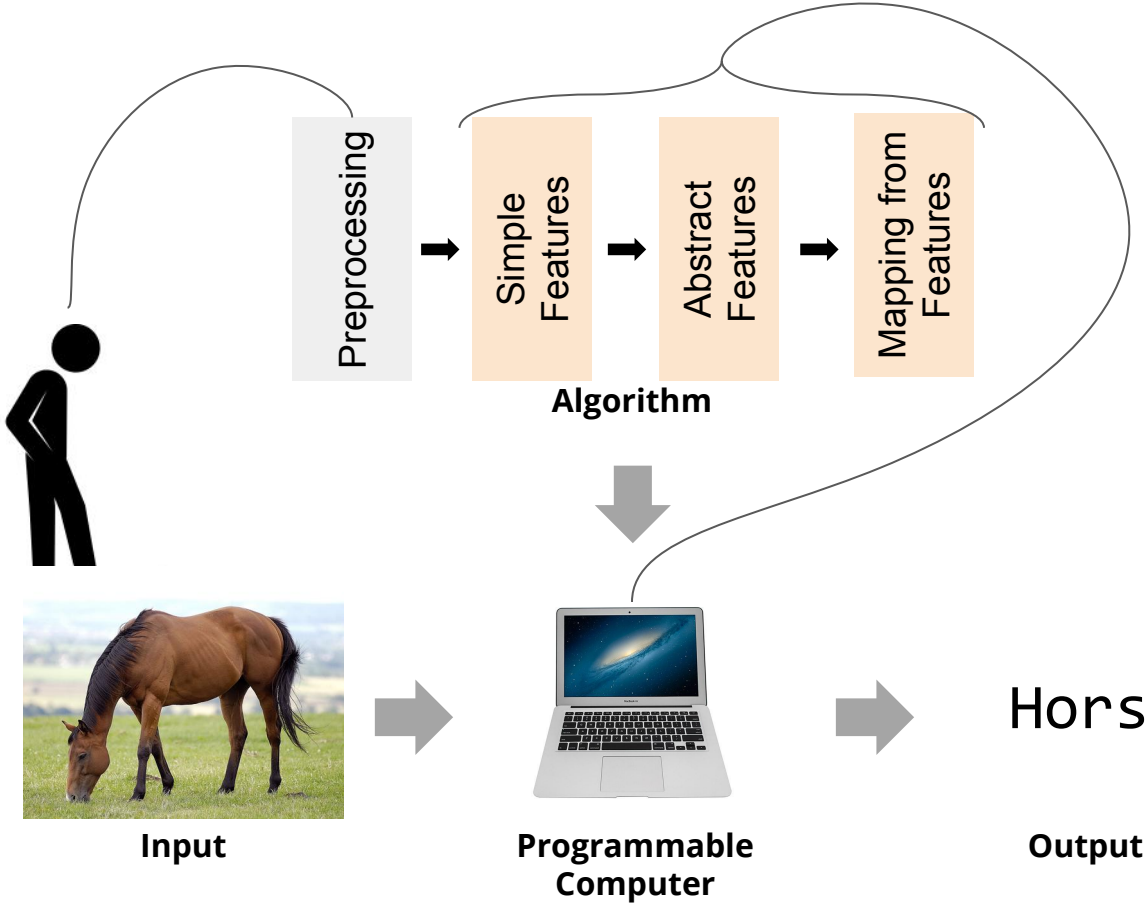

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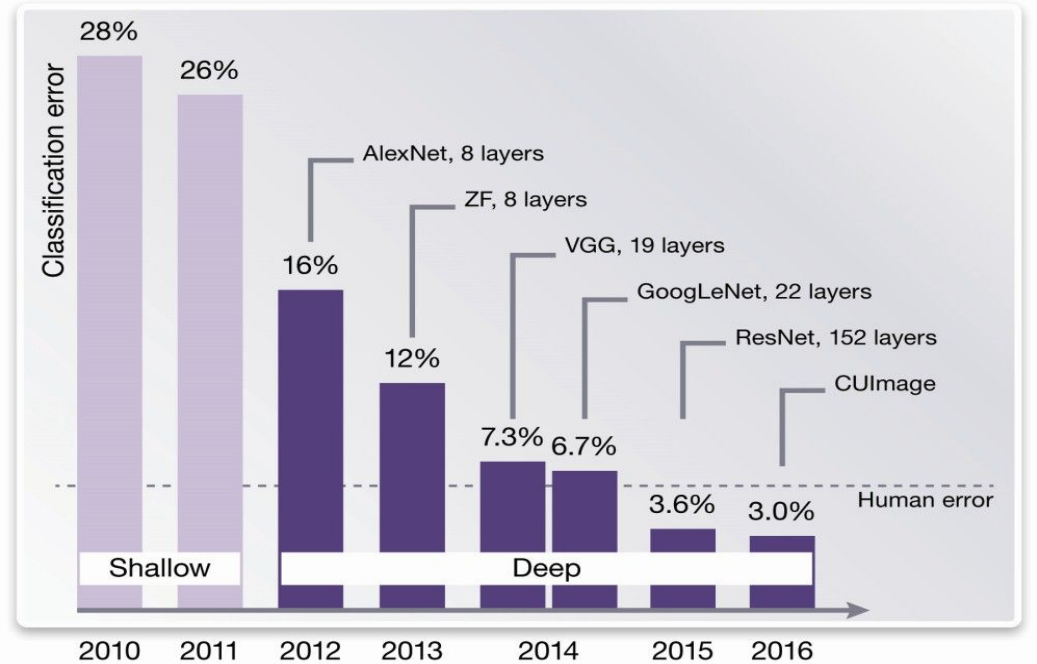
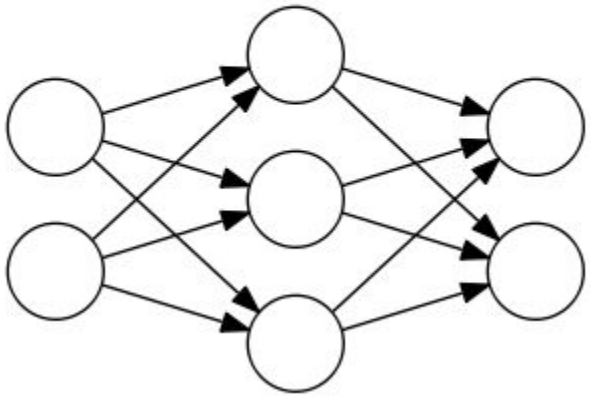
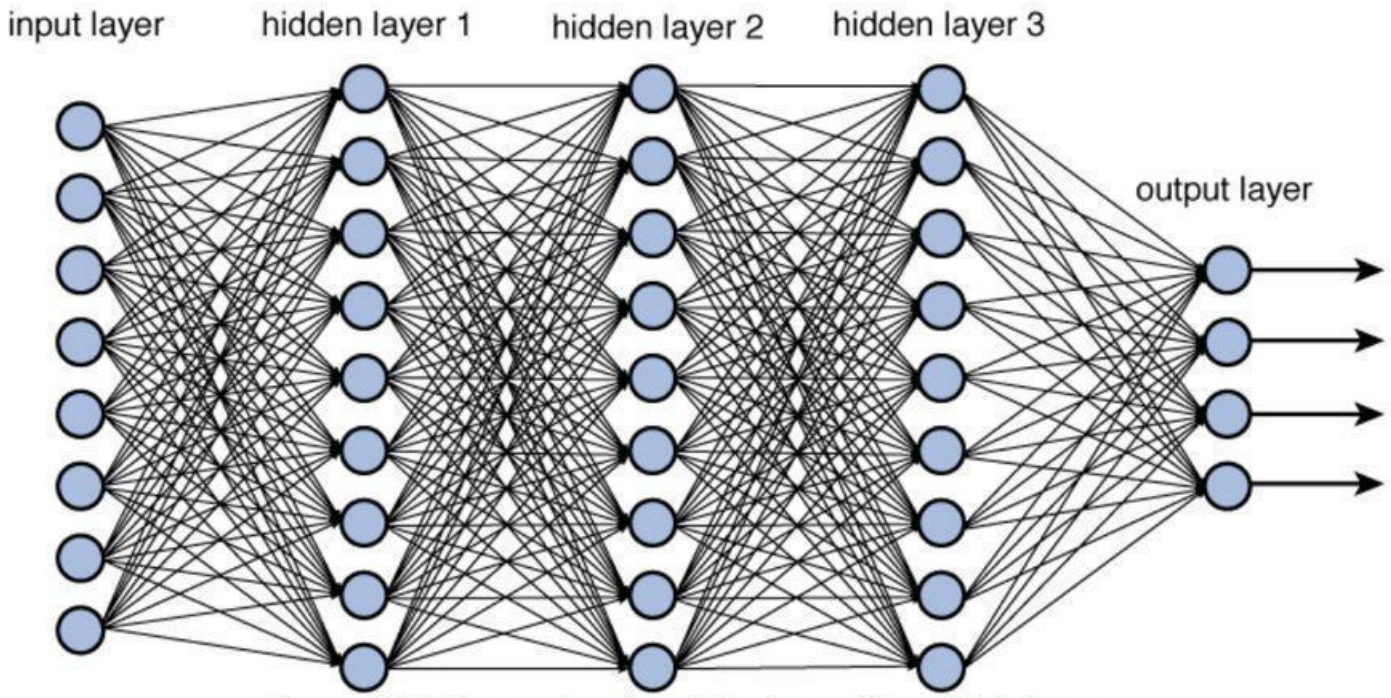


semiengineering.com/software-framework-requirements-for-embedded-vision/

Neural Network

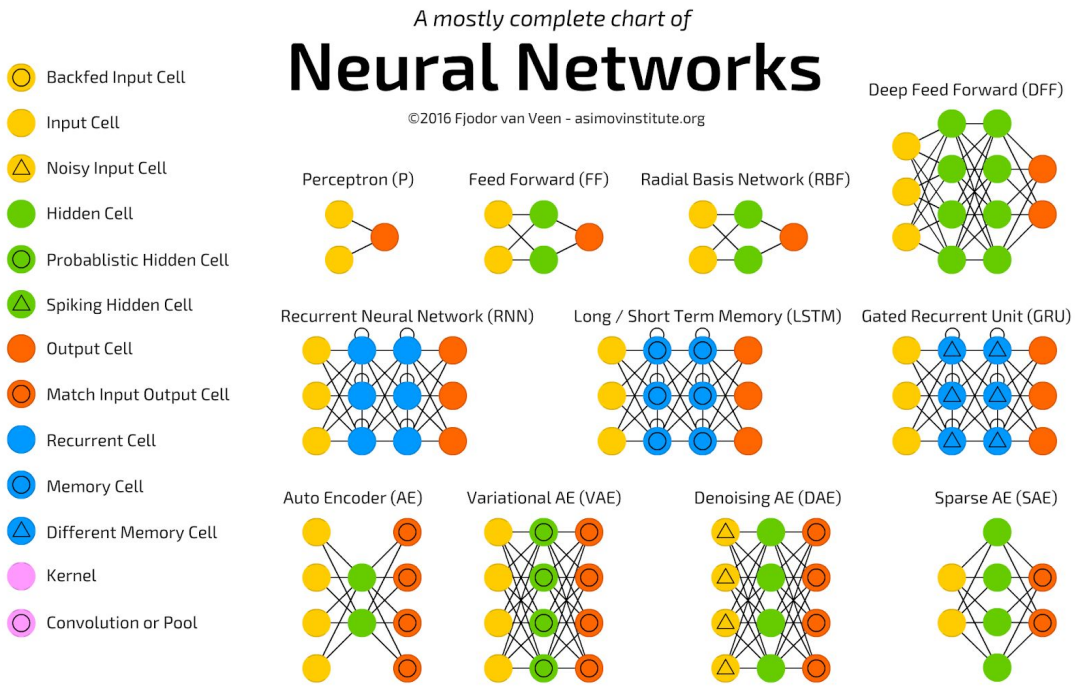


Deep Neural Network



https://towardsdatascience.com/training-deep-neural-networks-9fdb1964b964

Neural Networks Architectures



http://www.asimovinstitute.org/neural-network-zoo/

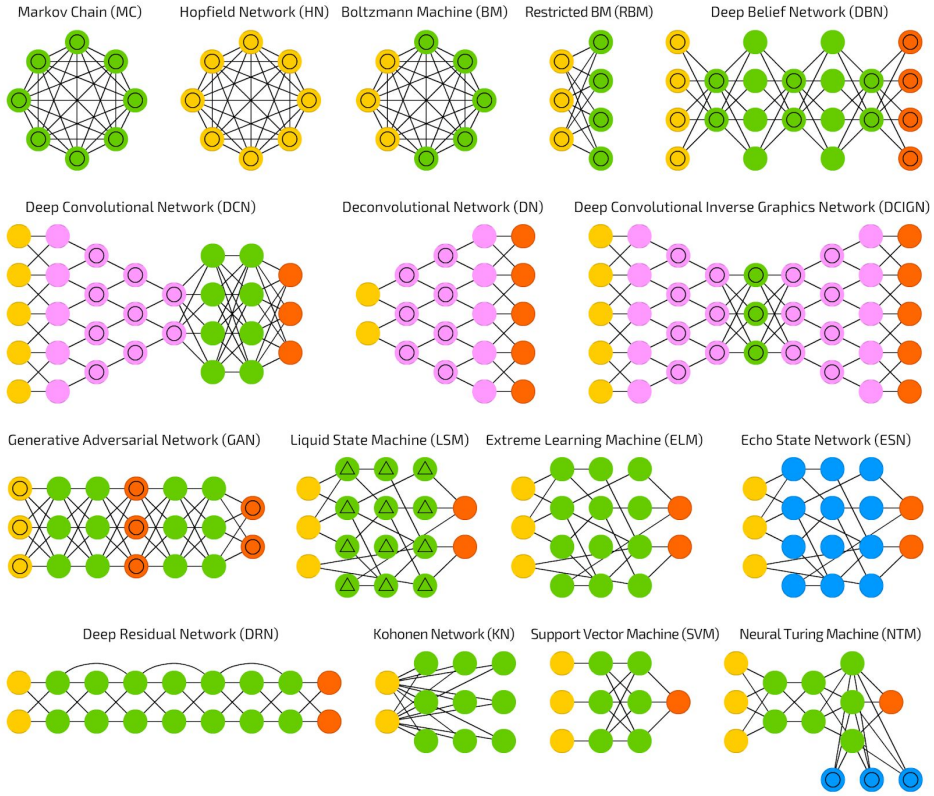


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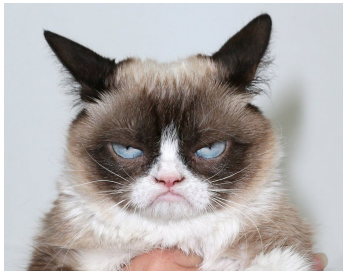
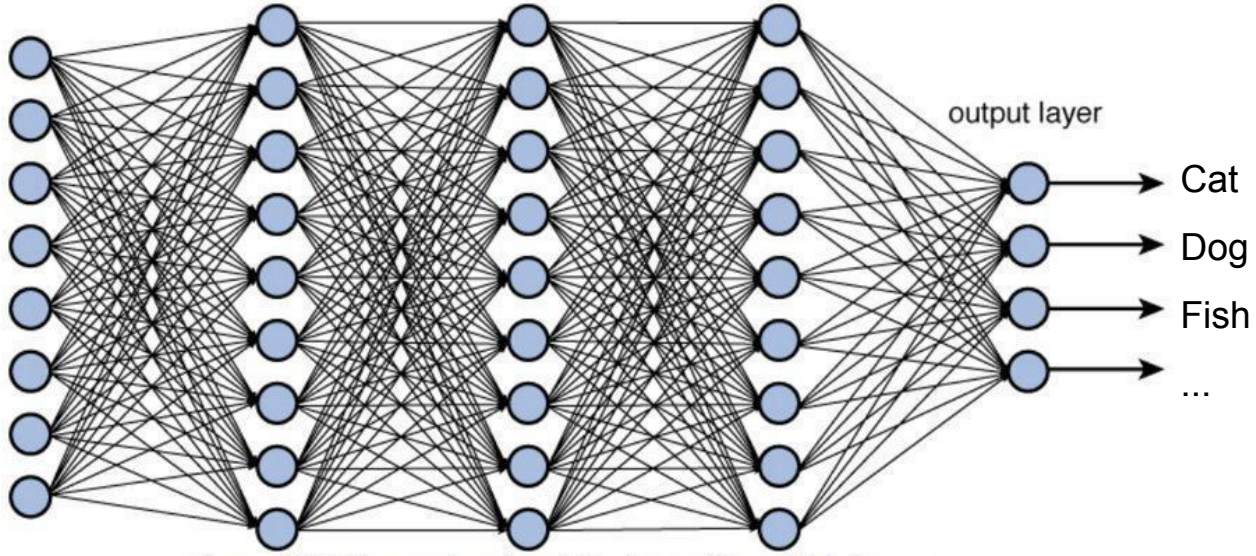
Image Classification





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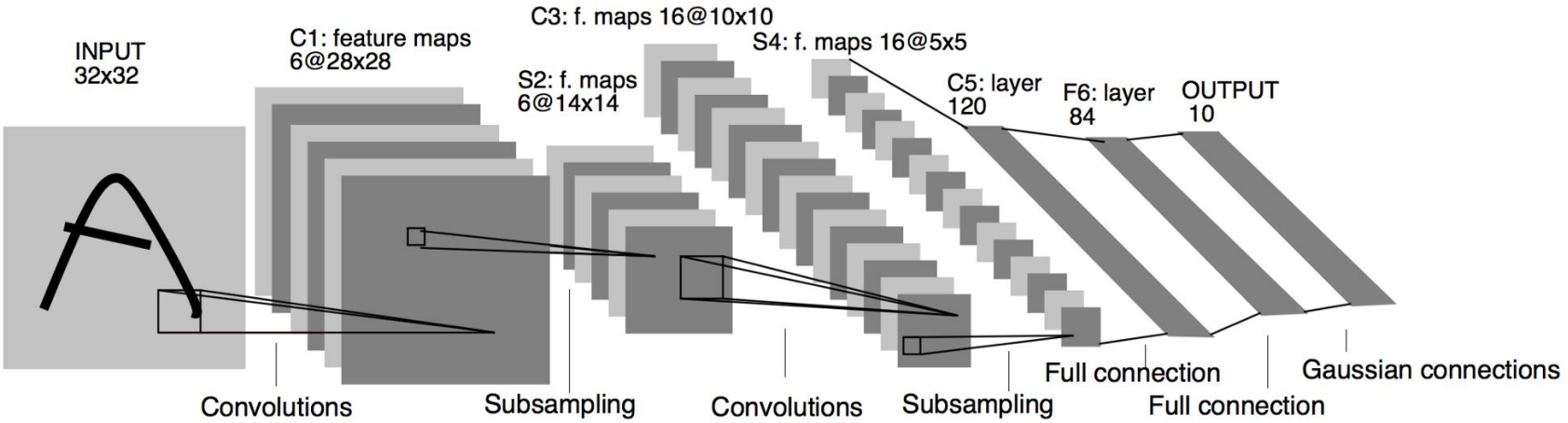
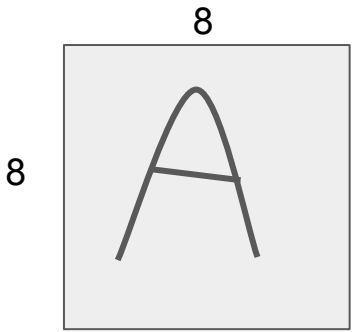
Convolutional Neural Networks

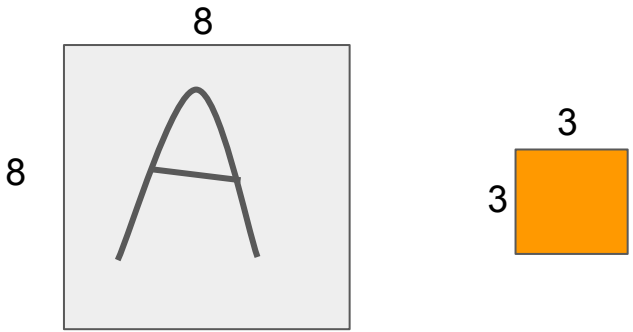


LeNet-5, LeCun 1980

Convolutional Neural Networks



Convolutional Neural Networks



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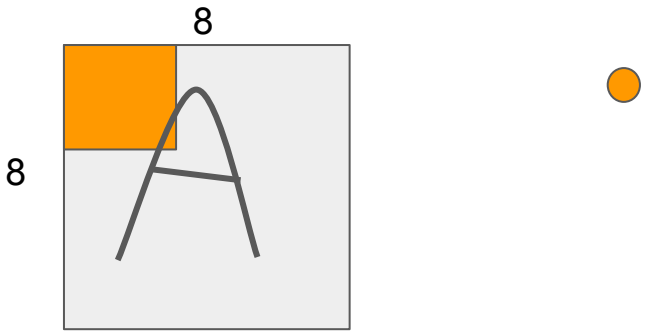
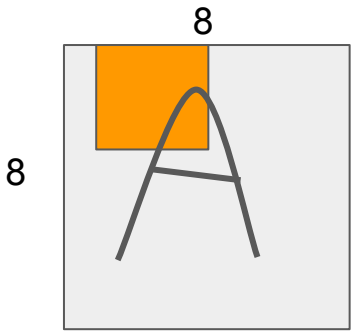
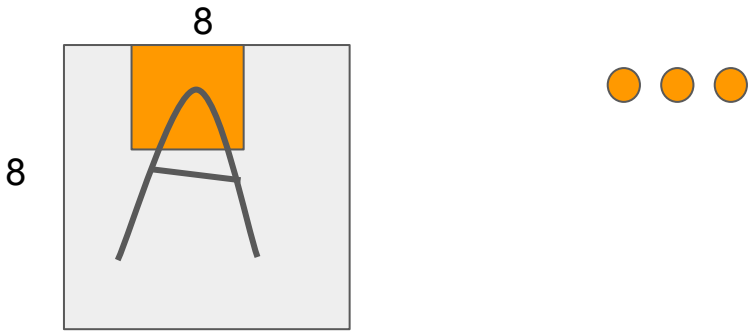


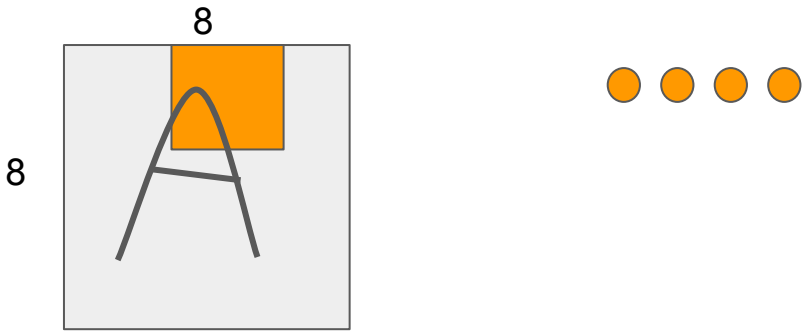
Convolutional Neural Networks



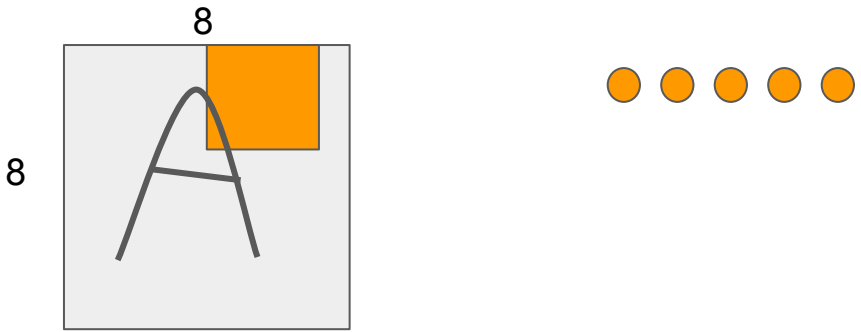
Convolutional Neural Networks



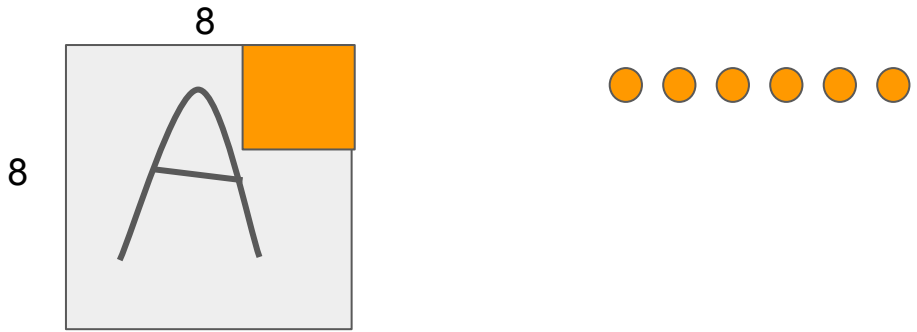
Convolutional Neural Networks



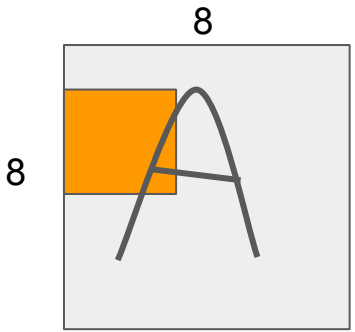
Convolutional Neural Networks



Convolutional Neural Networks



Convolutional Neural Networks



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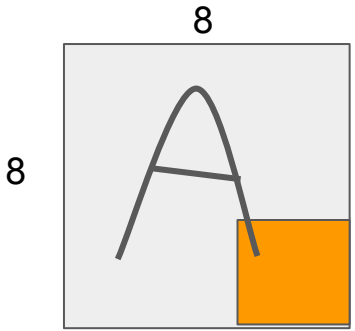
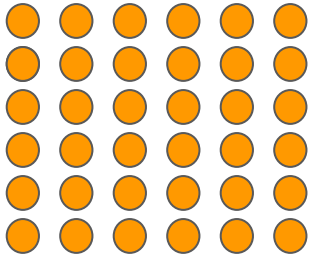
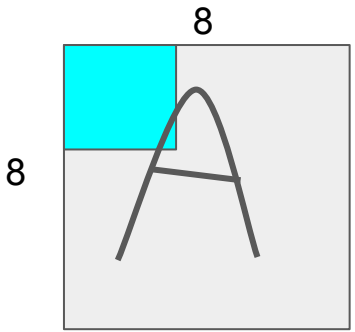
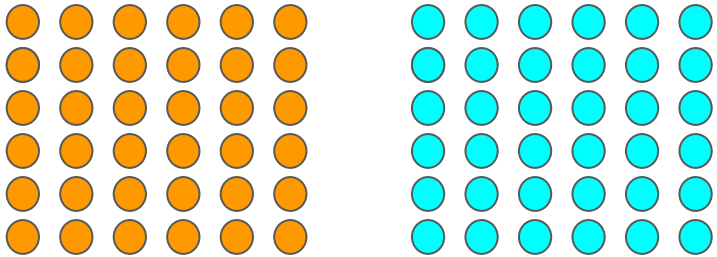


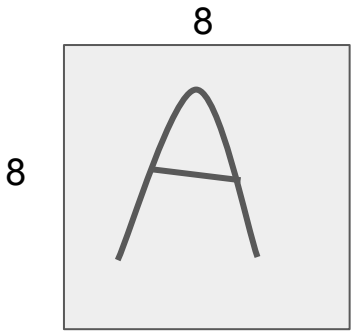


Convolutional Neural Networks





Convolutional Neural Networks



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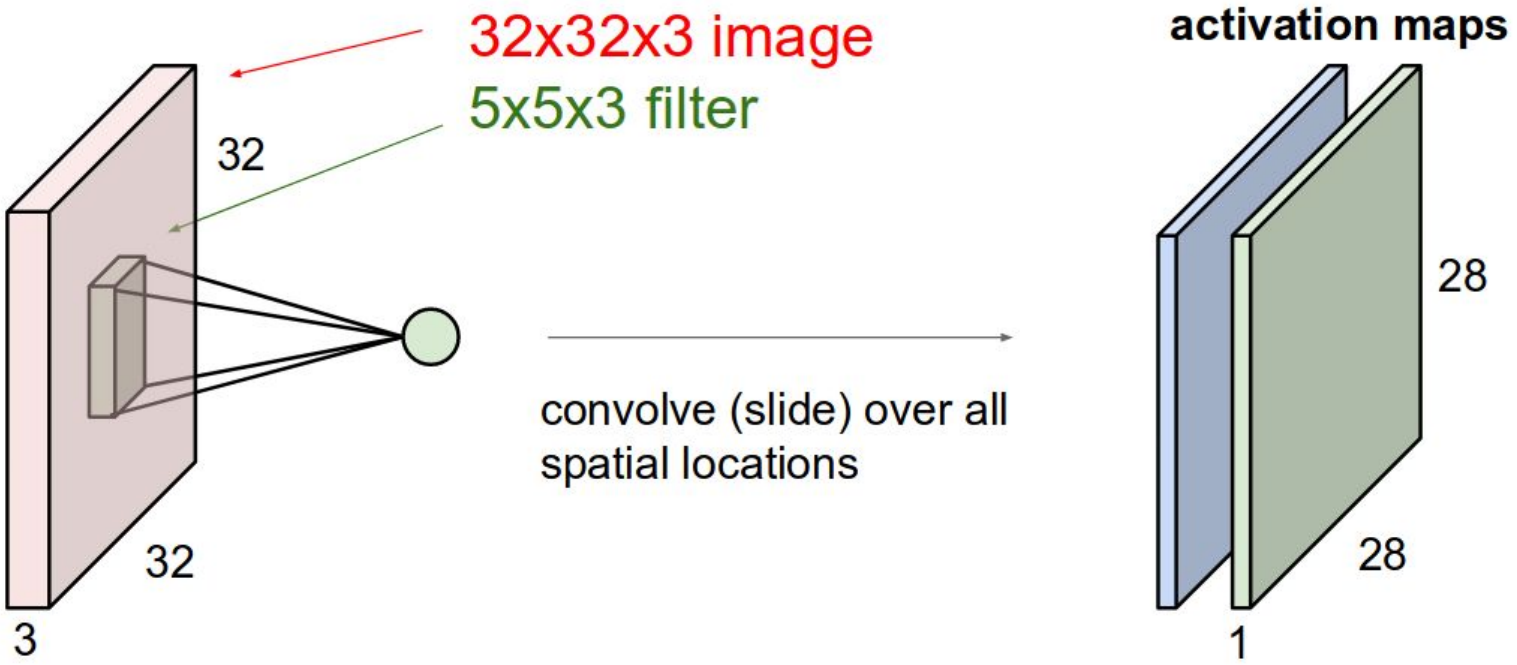
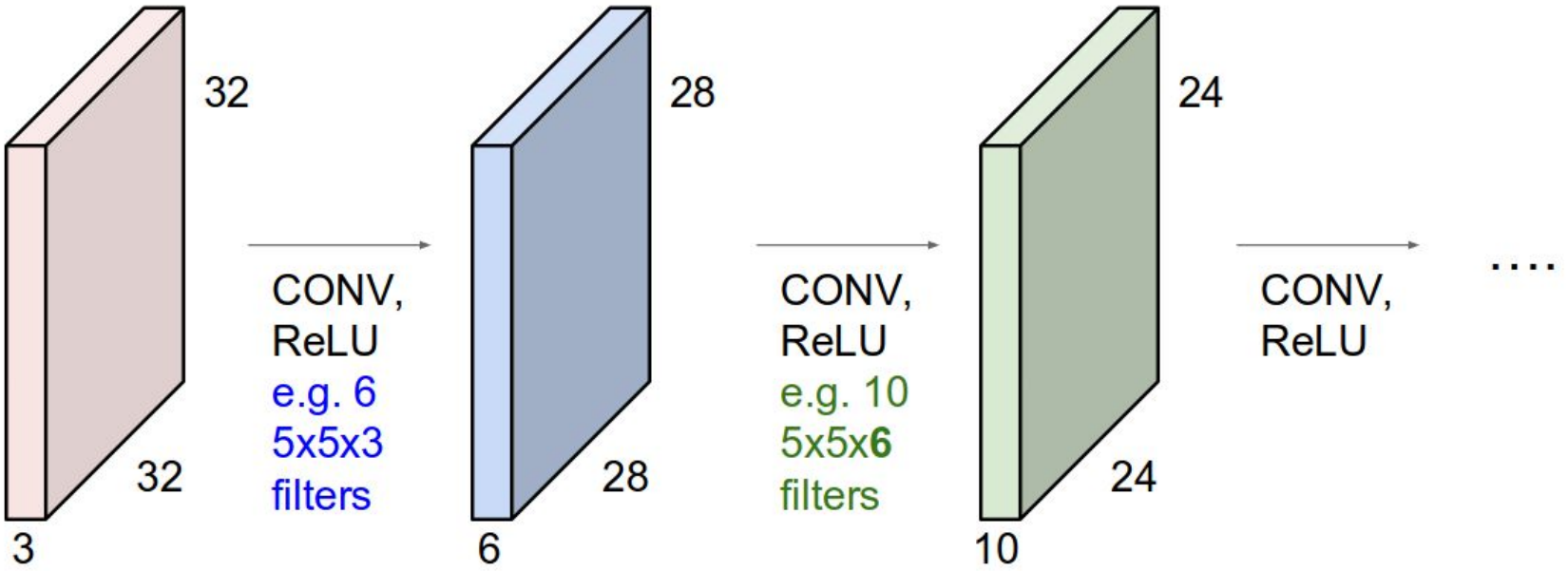
0	1	5	5	1	0
0	1	2	2	1	0
0	0	0	0	0	0

0	1	3	0	0	0
0	2	5	2	0	0
0	3	5	2	0	0
0	5	3	0	0	0
0	5	2	0	0	0
1	0	0	0	0	0

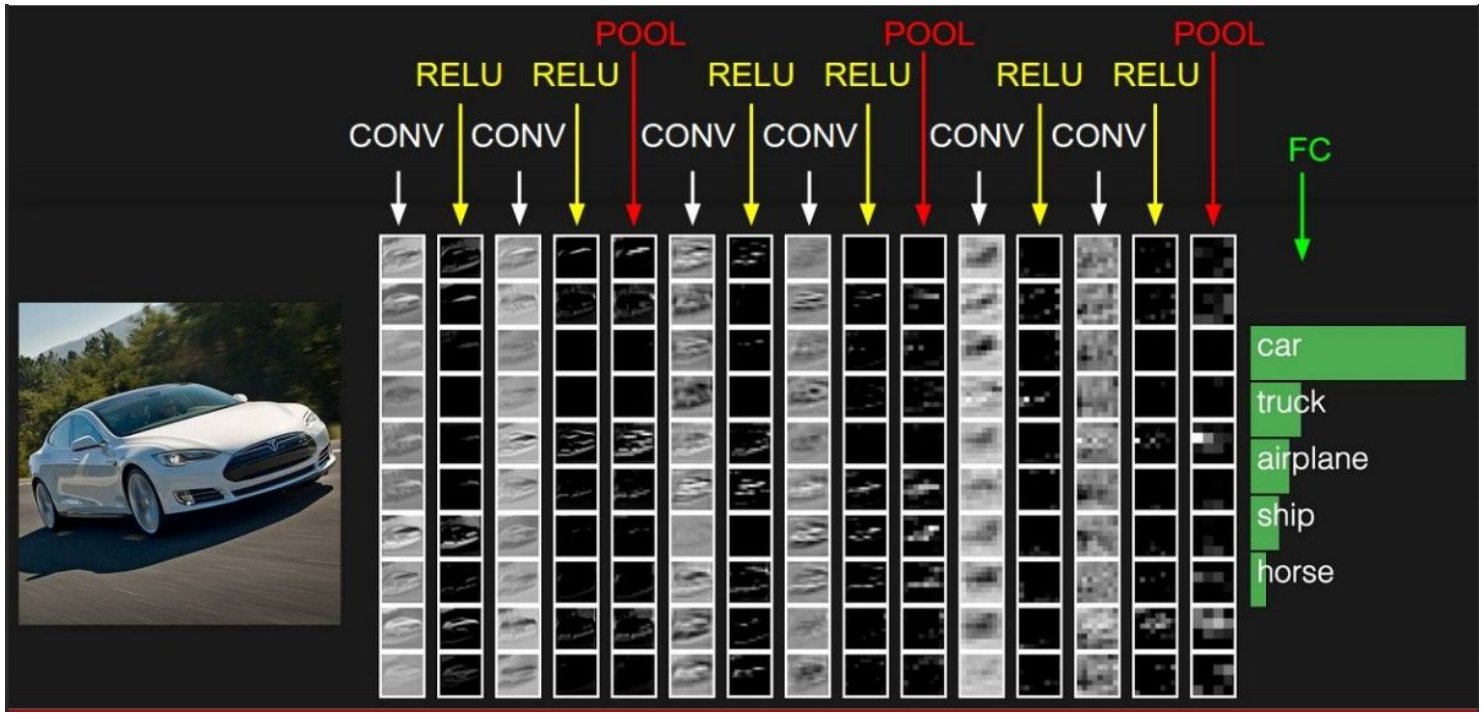
Convolutional Neural Networks



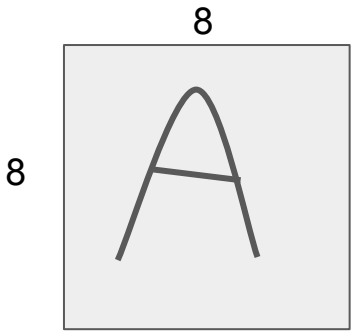
Convolutional Neural Networks



Convolutional Neural Networks



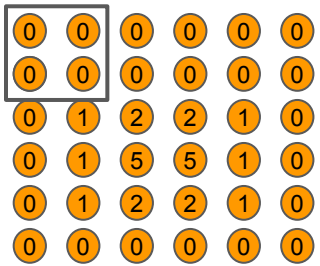
Max Pooling



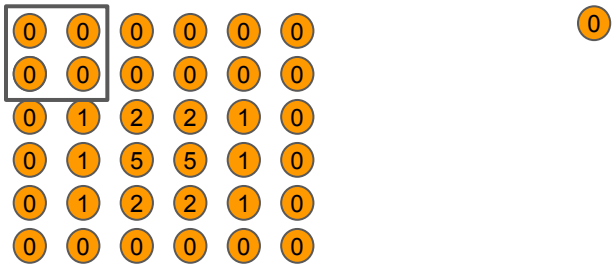
0	0	0	0	0	0
0	0	0	0	0	0
0	1	2	2	1	0
0	1	5	5	1	0
0	1	2	2	1	0
0	0	0	0	0	0

0	1	3	0	0	0
0	2	5	2	0	0
0	3	5	2	0	0
0	5	3	0	0	0
0	5	2	0	0	0
1	0	0	0	0	0

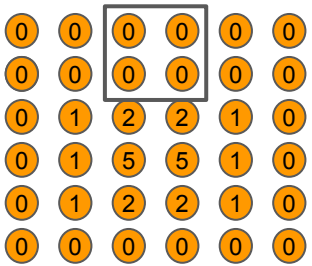
Max Pooling



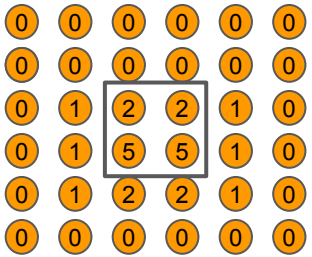
Max Pooling

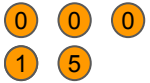


Max Pooling

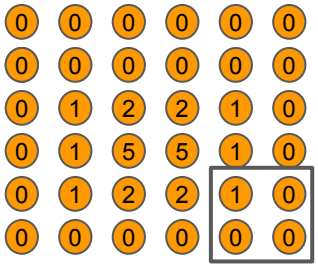


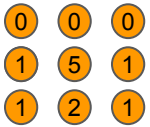
Max Pooling



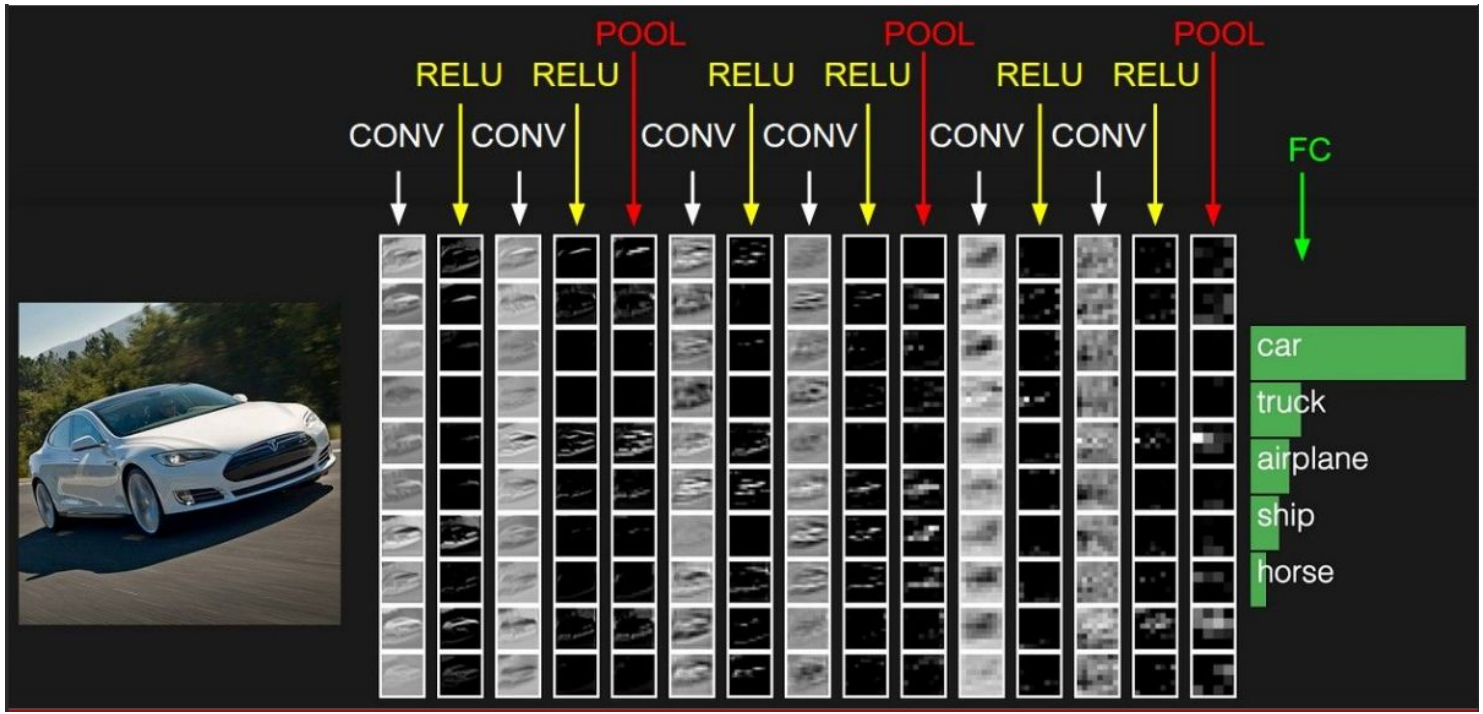


Max Pooling

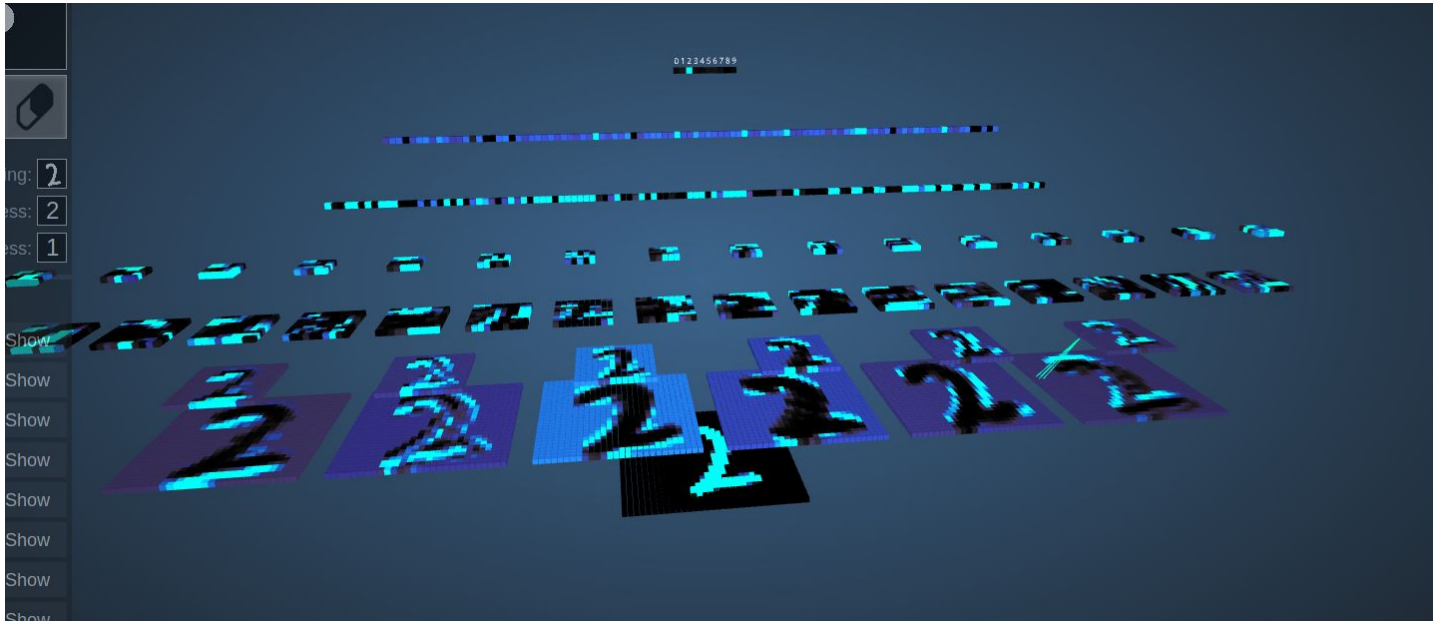




Convolutional Neural Networks



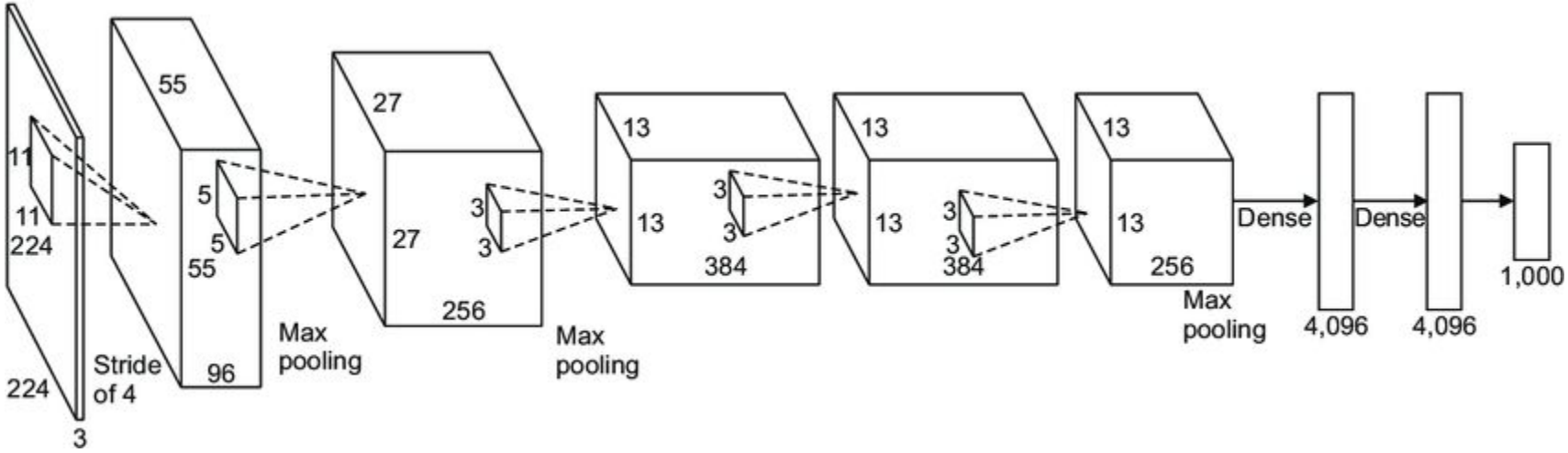
Demo Time



http://www.cs.cmu.edu/~aharley/vis/fc/
http://www.cs.cmu.edu/~aharley/vis/conv/
http://www.cs.cmu.edu/~aharley/vis/conv/flat.html

Case Study

Caffenet (Modified AlexNet)

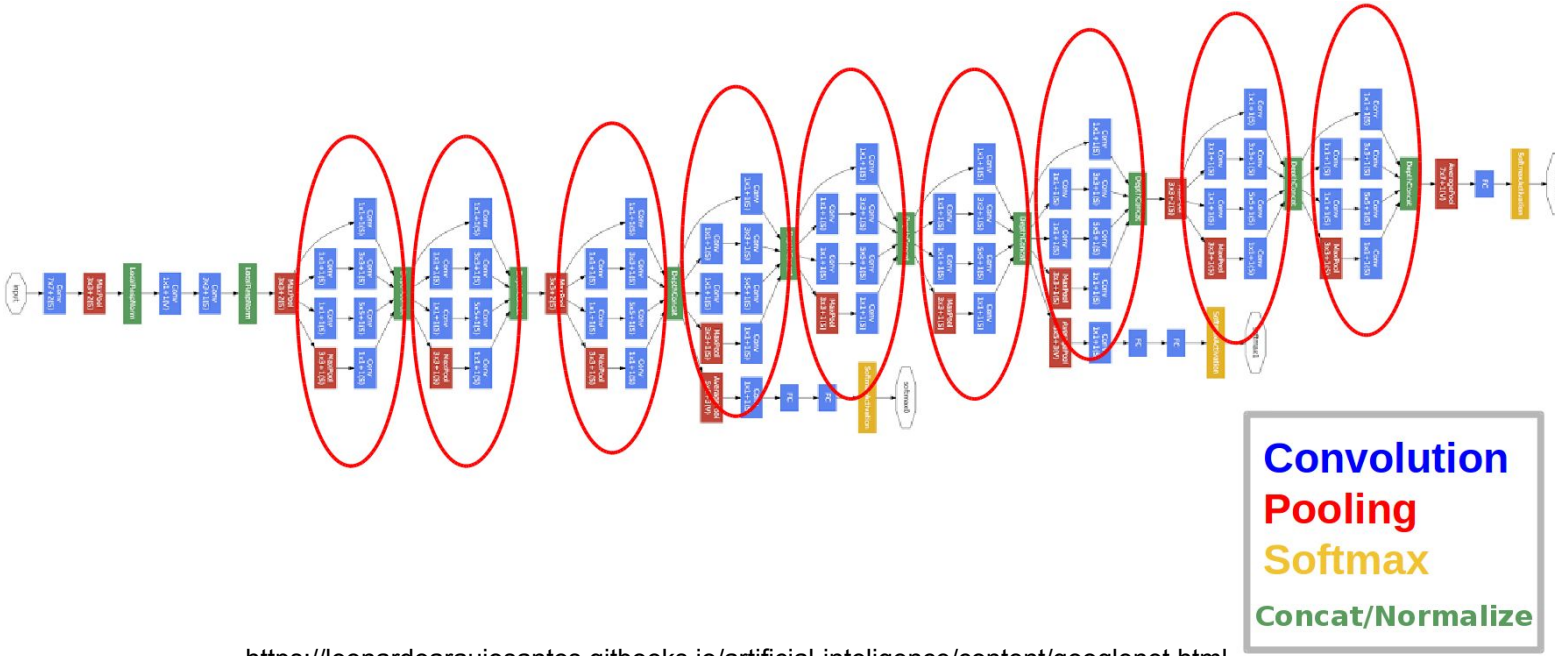


Case Study

VGG-16

Case Study

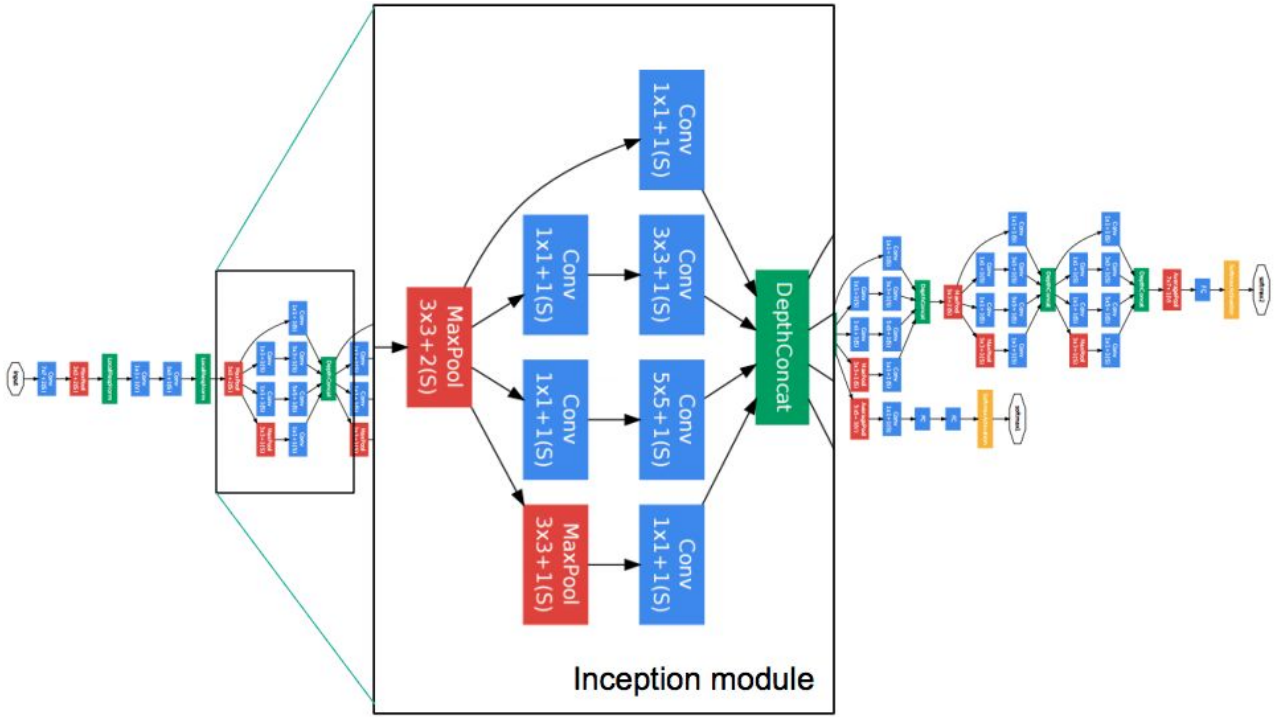
GoogleNet



https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/googlenet.html

Case Study

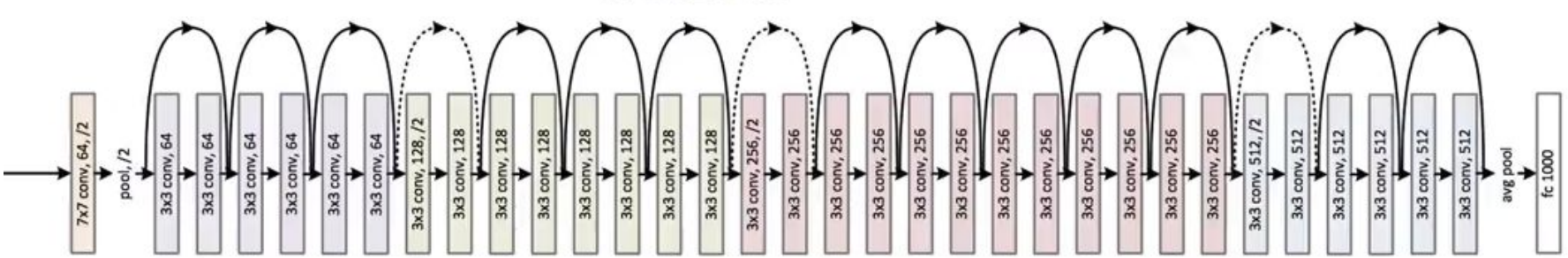
GoogleNet



https://medium.com/@RaghavPrabhu/cnn-architectures-lenet-alexnet-vgg-googlenet-and-resnet-7c81c017b848

Case Study

ResNet



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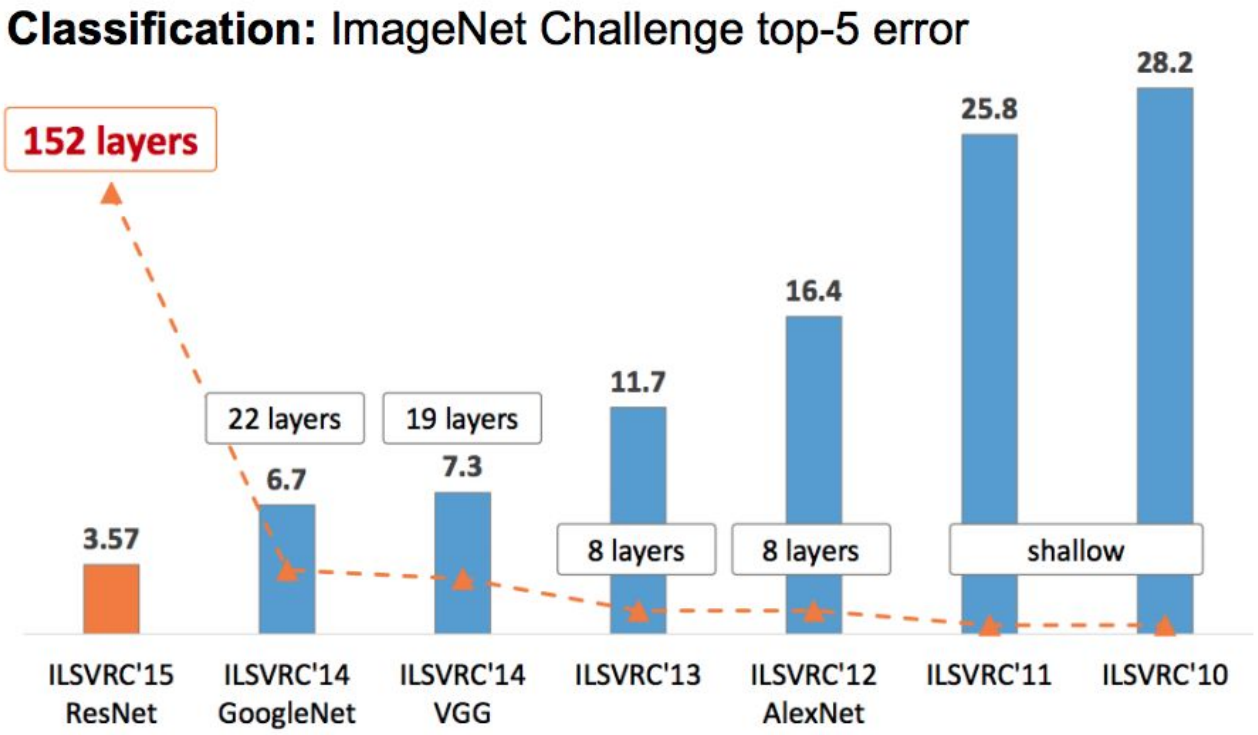
Case Study



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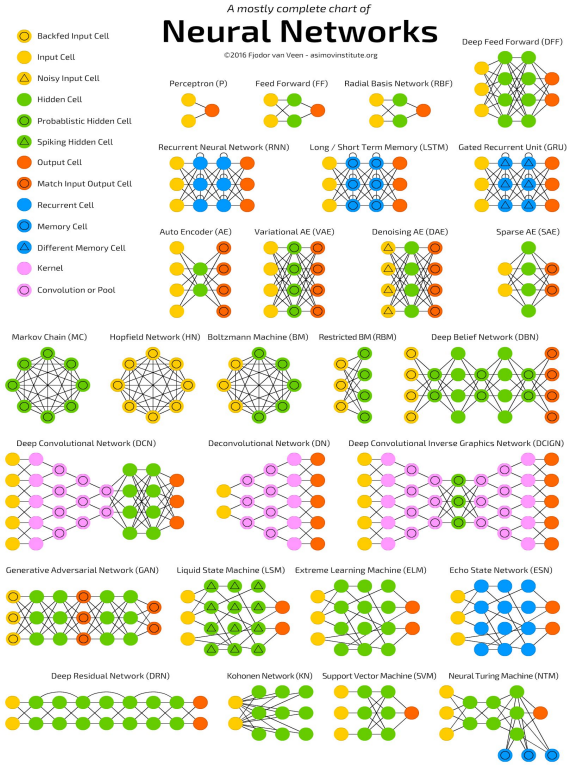
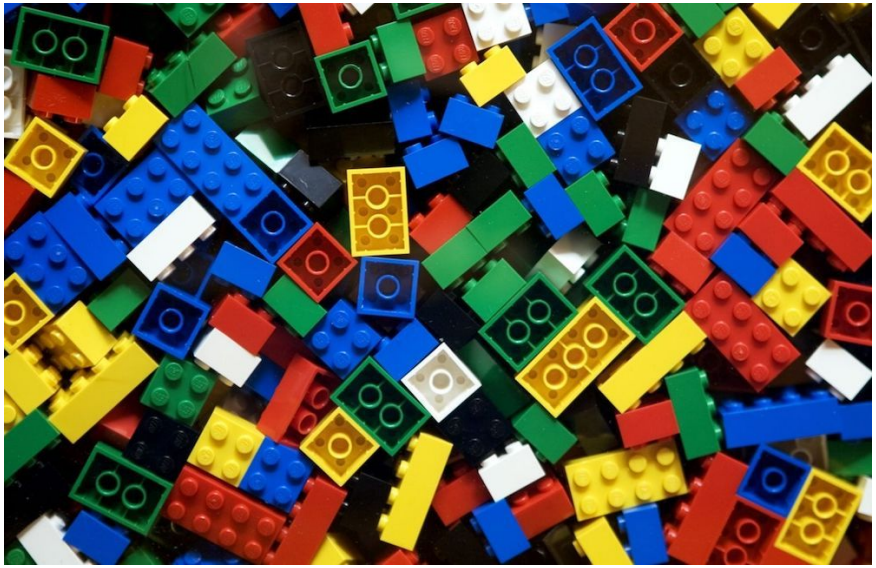
Fine Tuning

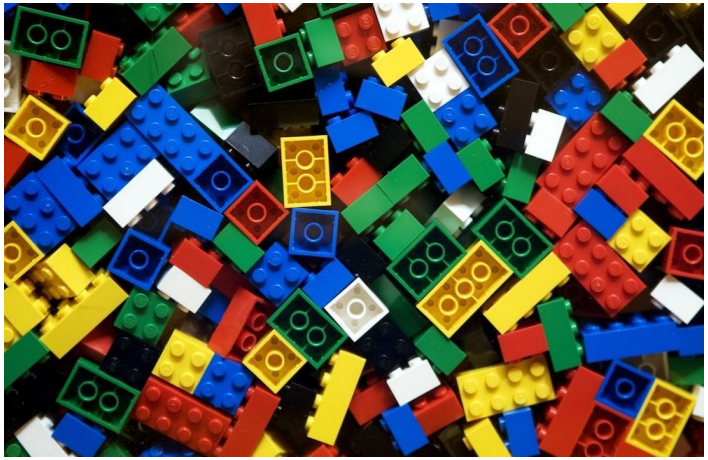

Conv 1-1
Conv 1-2
Pooing
Conv 2-1
Conv 2-2
Pooing
Conv 3-1
Conv 3-2
Conv 3-3
Pooing
Conv 4-1
Conv 4-2
Conv 4-3
Pooing
Conv 5-1
Conv 5-2
Conv 5-3
Pooing
Dense
Dense
Dense

Playing Time





Playing Time



Cool Stuff

Neural Style

https://github.com/jcjohnson/neural-style

Fooling CNNs

[Intriguing properties of neural networks, Szegedy et al., 2013]

DeepDream

https://deepdreamgenerator.com/

Image Captioning

"man in black shirt is playing guitar."

"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."

"boy is doing backflip on wakeboard."

"a young boy is holding a baseball bat."

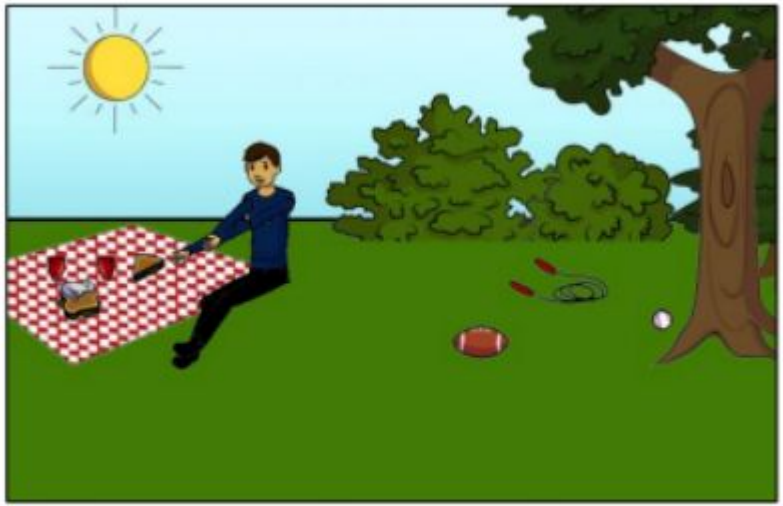
"a cat is sitting on a couch with a remote control."

"a woman holding a teddy bear in front of a mirror."

"a horse is standing in the middle of a road."

Visual Question Answering

What color are her eyes?
What is the mustache made of?



Is this person expecting company?
What is just under the tree?

http://www.visualqa.org/

Object Detection

https://technostacks.com/blog/yolo-vs-ssd/

Image Segmentation

https://blogs.nvidia.com/blog/2016/01/05/eyes-on-the-road-how-autonomous-cars-understand-what-theyre-seeing/