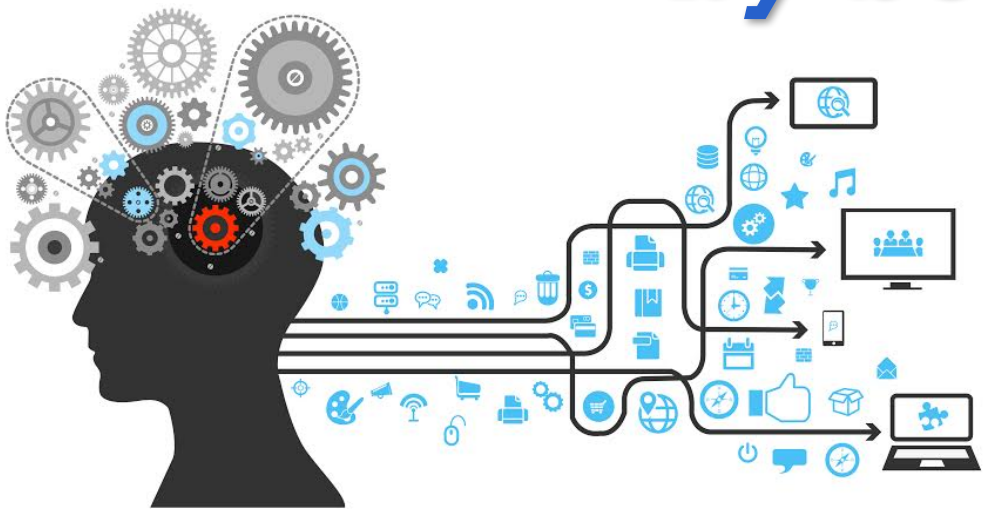
Learning AI by Seeing AI



By Kent Yu

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A Platform For Senior IT Professionals

IBM BIG DATA UNIVERSITY

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AI - My First Impression



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Bach Music Test

1

2



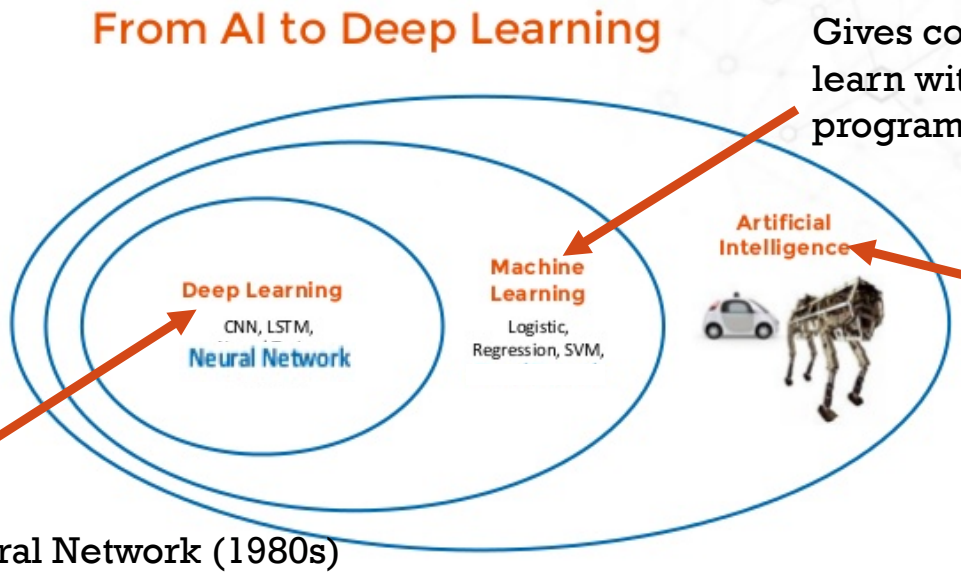
Source:
https://www.youtube.com/watch?v=QiBM7-5hA6o
https://www.youtube.com/watch?v=VKBfV-HKeIc

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AI and Deep Learning



A Few Concepts

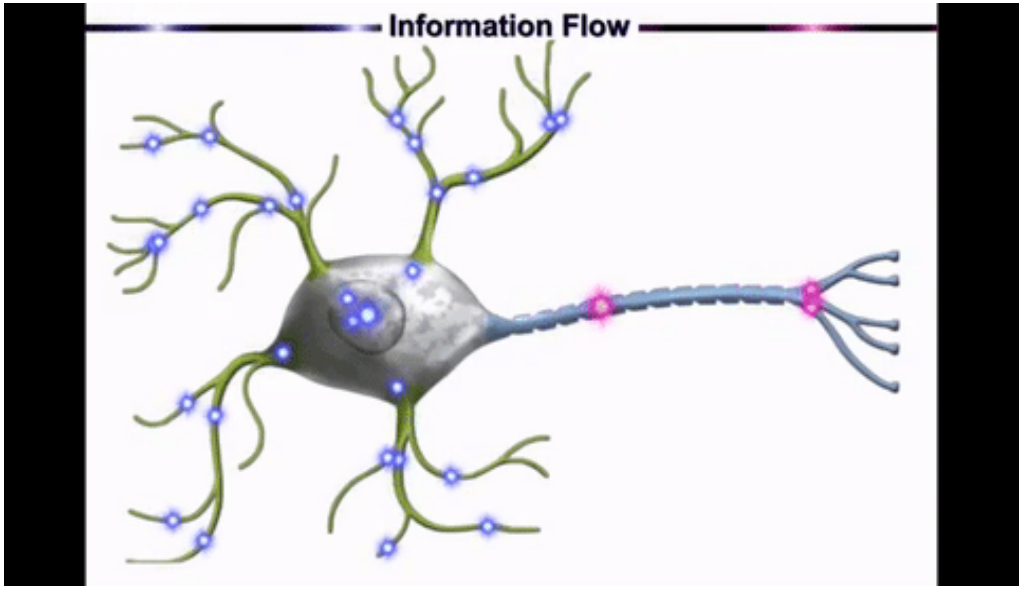


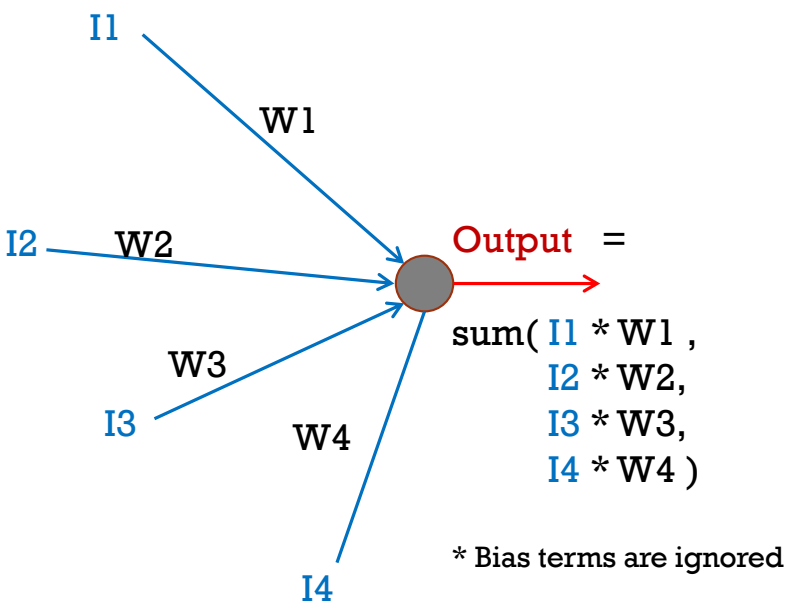
Gives computers the ability to learn without being explicitly programmed (1970s)

Interact with environment to achieve a goal.

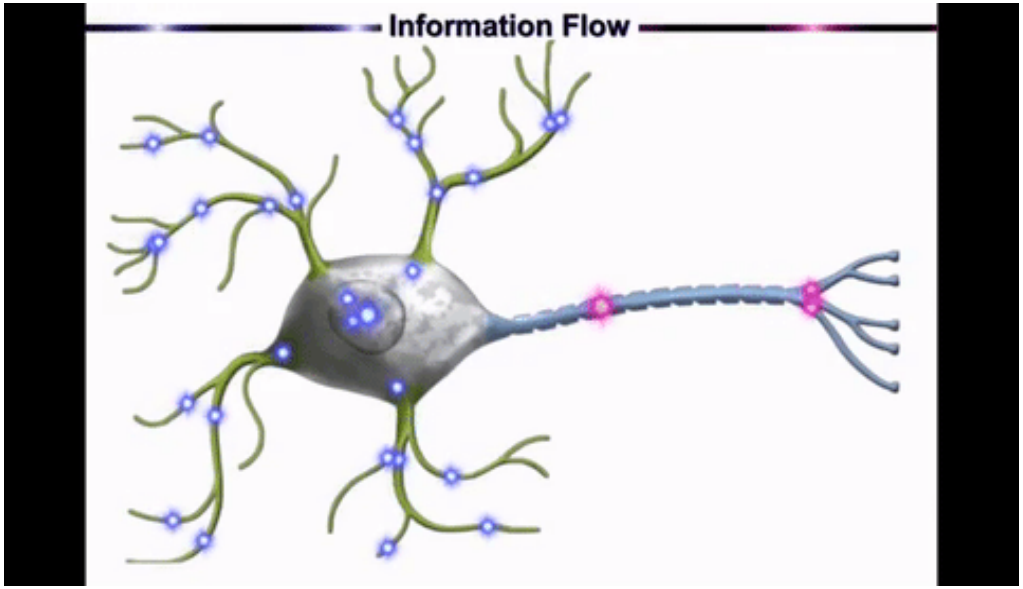
Artificial Neural Network (1980s)

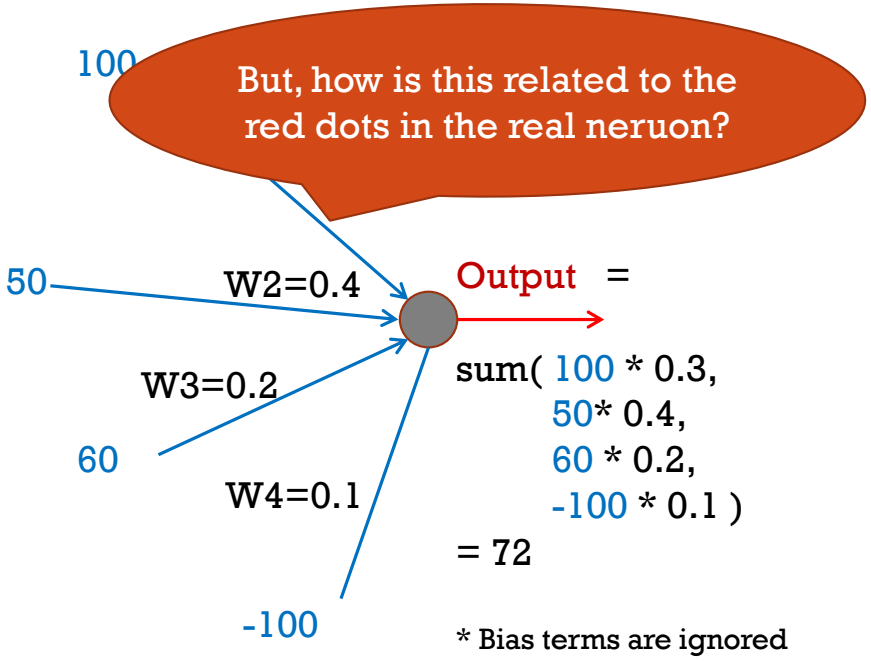
Human Neuron vs. Artificial Neuron





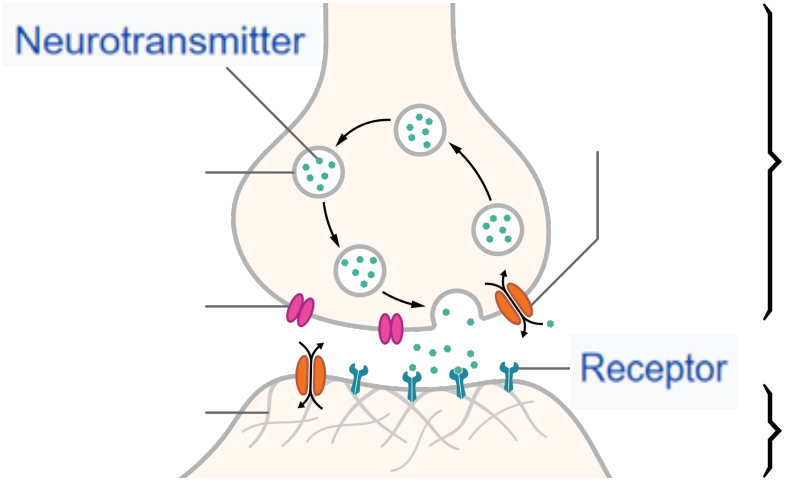
Human Neuron vs. Artificial Neuron

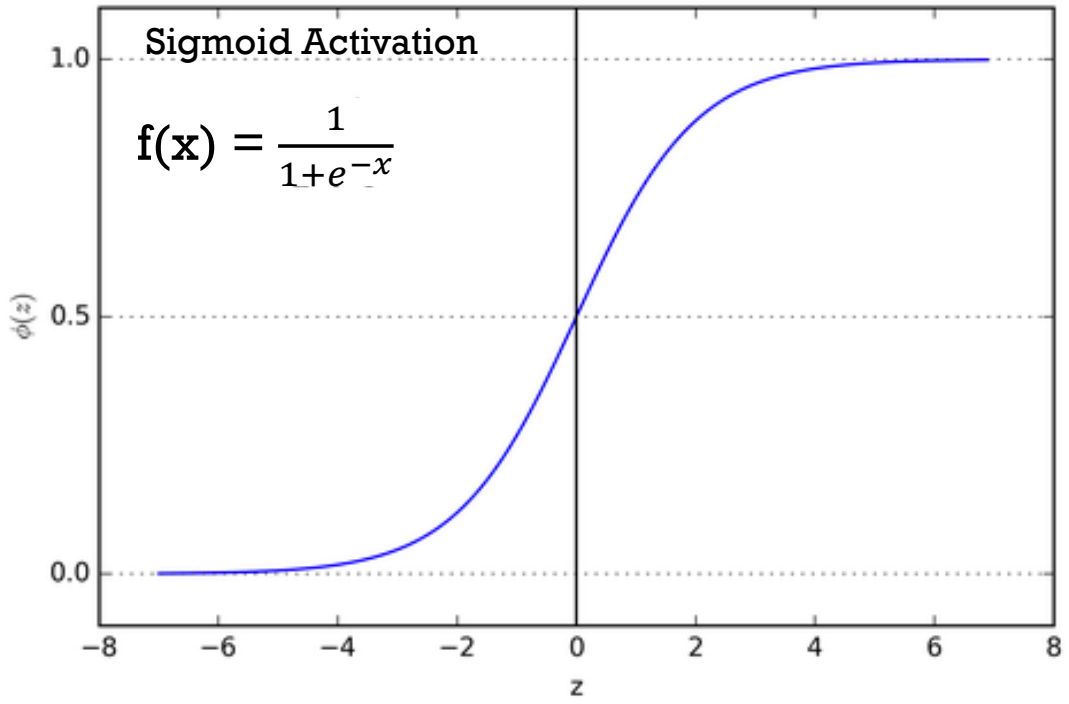




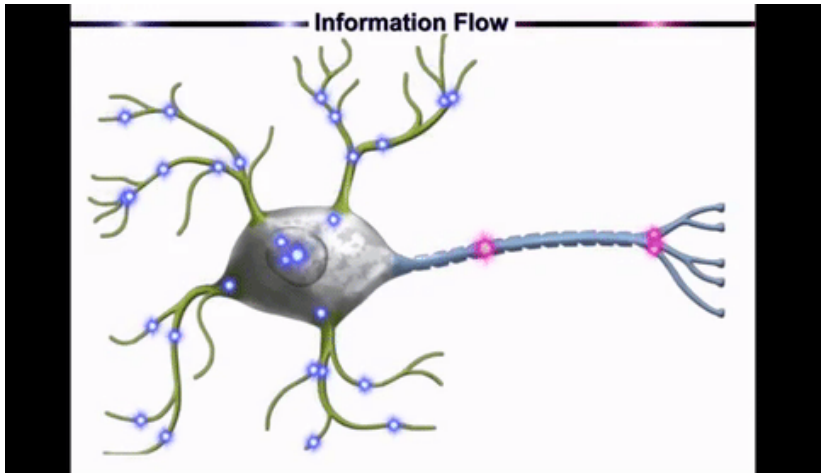
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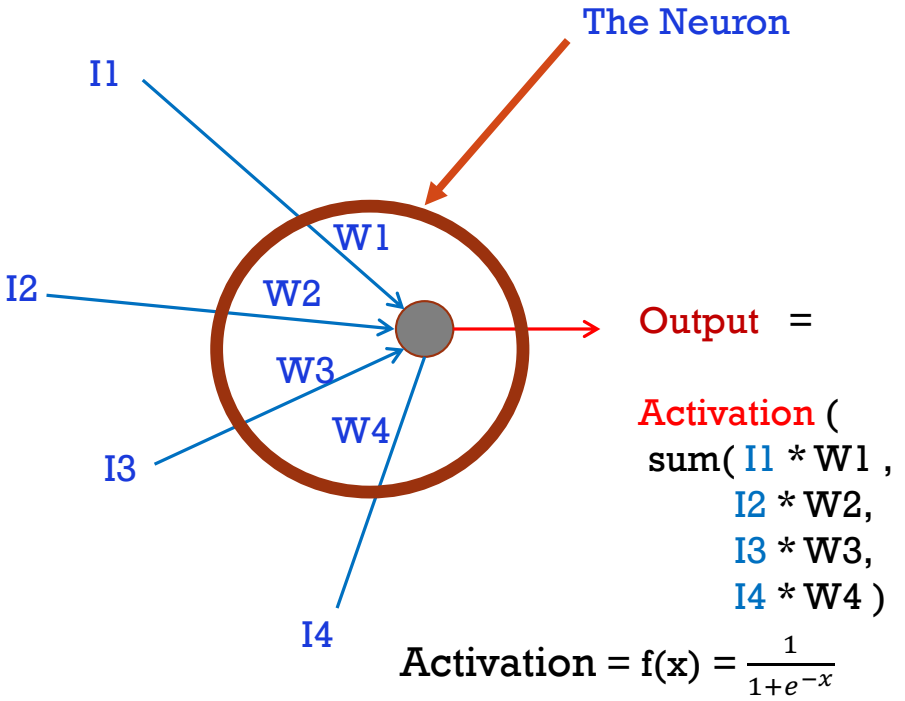
Activation Function - Synapse & Receptor



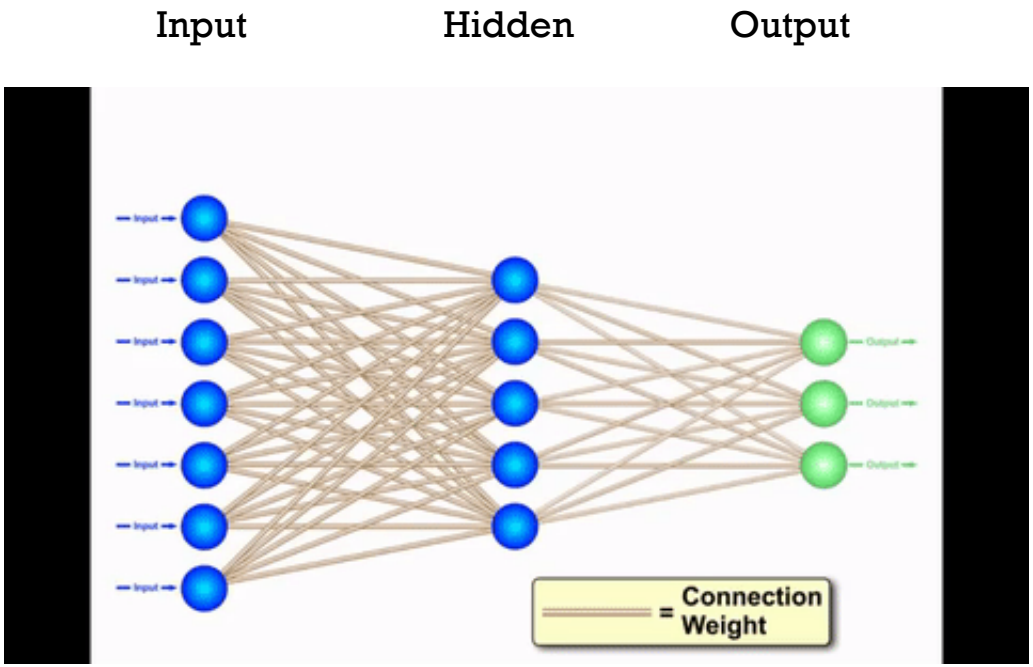


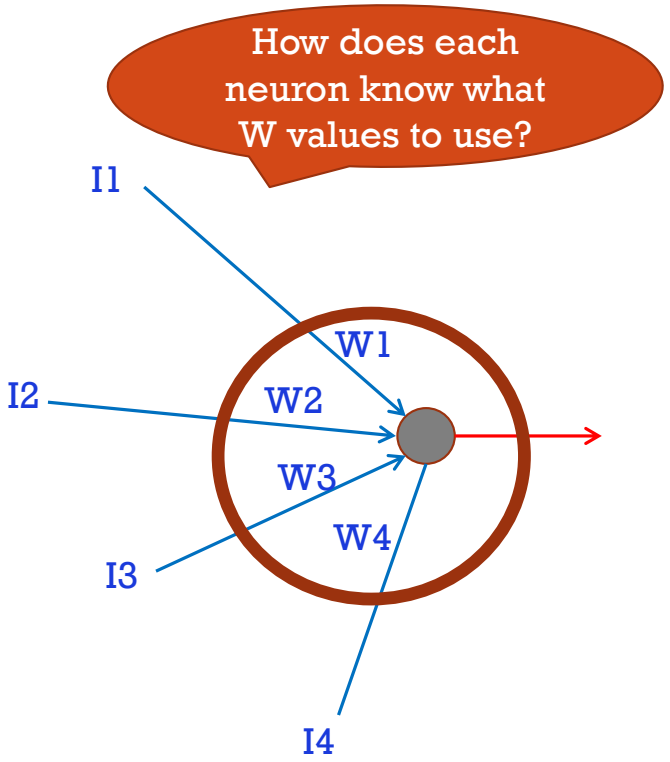
The Full Neuron





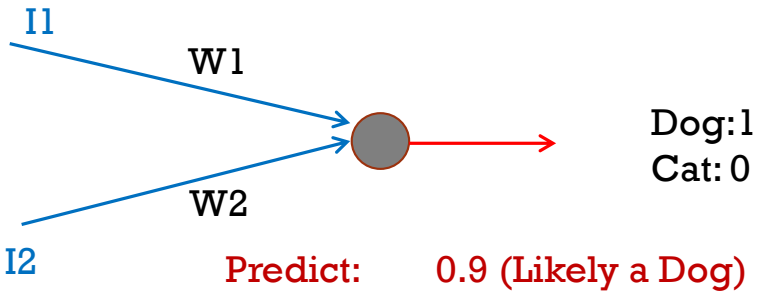
A Basic Neural Network (Fully Connected)





Training: Gradient Descent



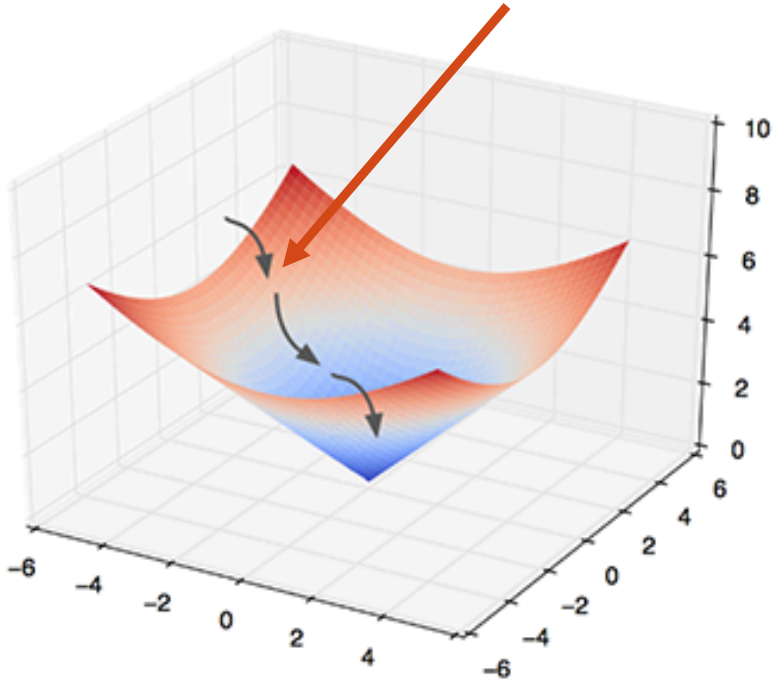


Predict: 0.9 (Likely a Dog)
Actual: 0 (Actually a Cat)

Error (Loss): 0.9

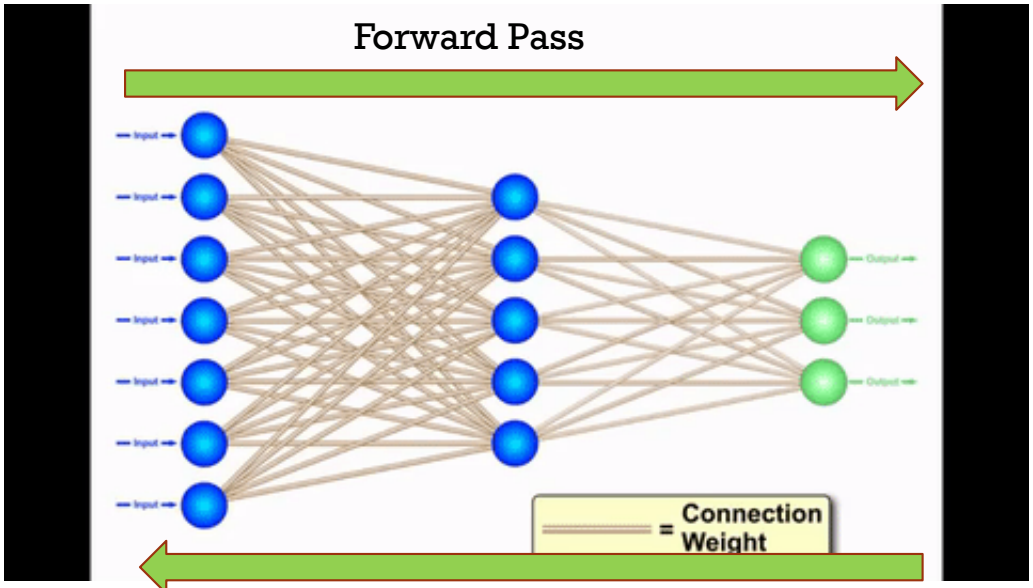
Training With Gradient Decent

Steepness of decline = derivatives of loss function $\frac{\partial Loss}{\partial W}$



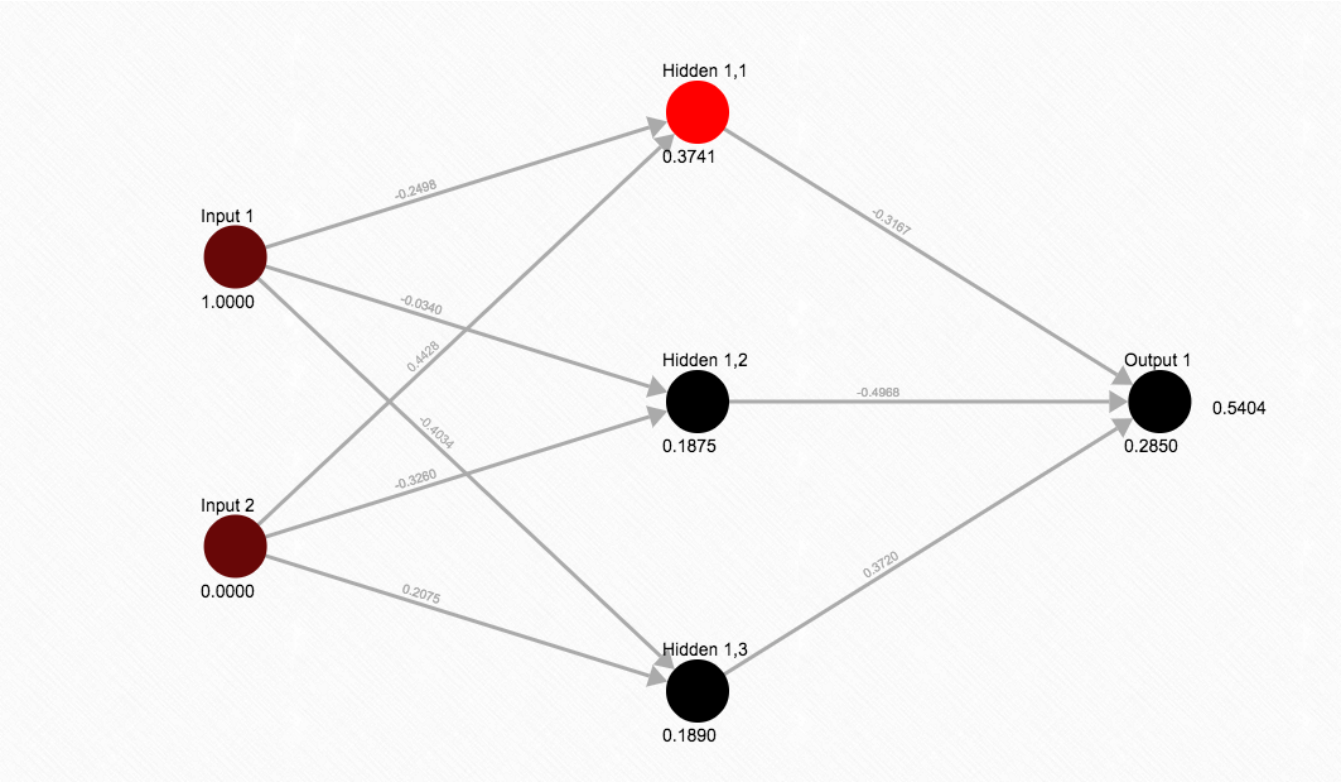
	-5	-4	-3	-2	-1	0	1	2	3	4	5
5	50	41	34	29	26	25	26	29	34	41	50
4	41	32	25	20	17	16	17	20	25	32	41
3	34	25	29	13	10	9	10	13	18	25	34
2	29	20	13	8	5	4	5	8	13	20	29
1	26	17	10	5	2	1	2	5	10	17	26
0	25	16	9		1	0	1	4	9	16	25
-1	26	17	10	5	2	1	2	5	10	17	26
-2	29	20	13	8	5	4	5	8	13	20	29
-3	34	25	18	13	10	9	10	13	18	25	34
-4	41	32	25	20	17	16	17	20	25	32	41
-5	50	41	34	29	26	25	26	29	34	41	50

Neural Network Training (Supervised)



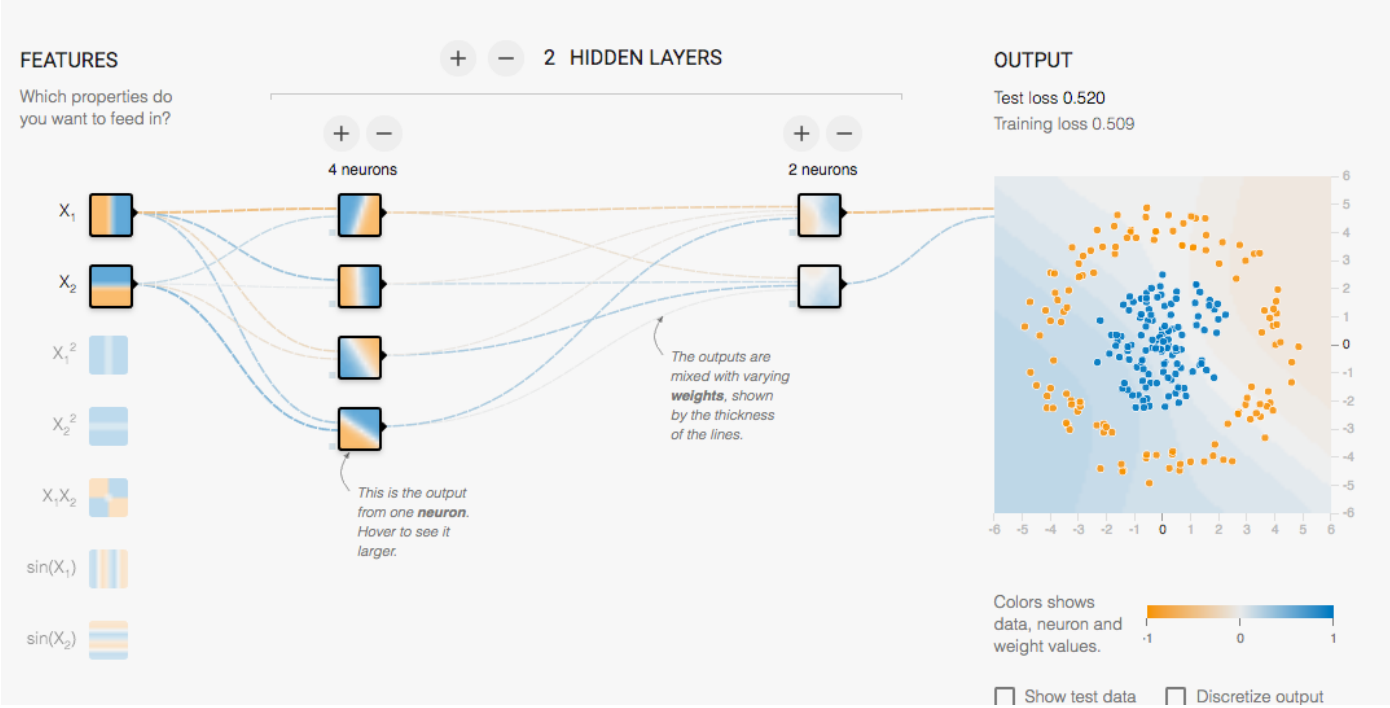
Back Propagation (Tweaking Neuron Weights)

DEMO – How Neural Training Works



Source: http://experiments.mostafa.io/public/ffbpann/

Demo – How Neural Training Works



Source: http://playground.tensorflow.org/

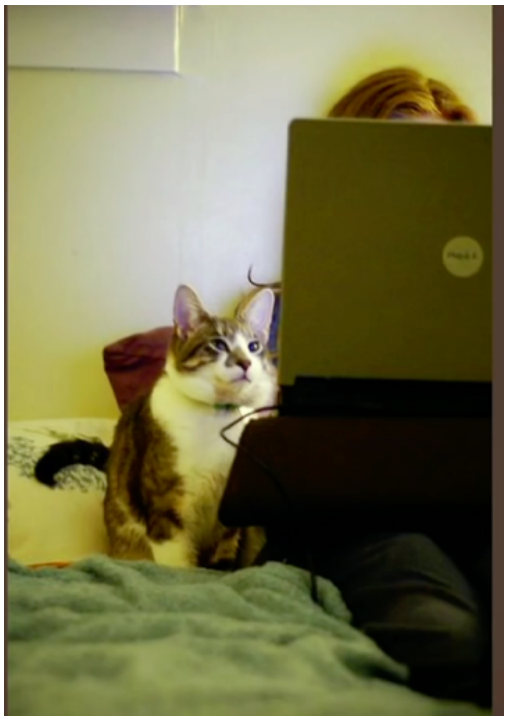
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Computer Vision
- Convolutional Neural Network (CNN)



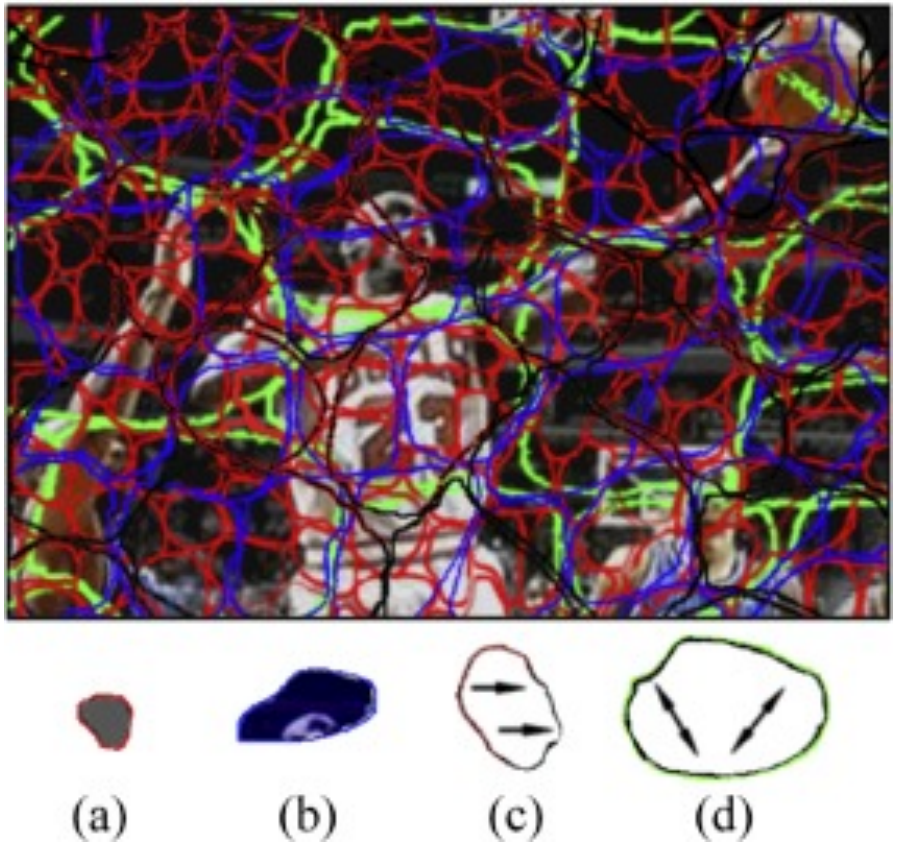
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Computer Vision – What a 3 Year Old Can Do



Source: https://www.youtube.com/watch?v=40riCqvRoMs&t=908s

Different Types of Retinal Cells



a) Intensity contrasts
b) Color coded
c) Motion Detection
d) Moving Directions

Image Kernels / Filters



$$\left(\begin{matrix} 158 \times -1 \\ + 181 \times -1 \\ + 156 \times -1 \end{matrix} + \begin{matrix} 36 \times -1 \\ + 53 \times 8 \\ + 63 \times -1 \end{matrix} + \begin{matrix} 70 \times -1 \\ + 115 \times -1 \\ + 130 \times -1 \end{matrix} \right) = -485$$

kernel: outline

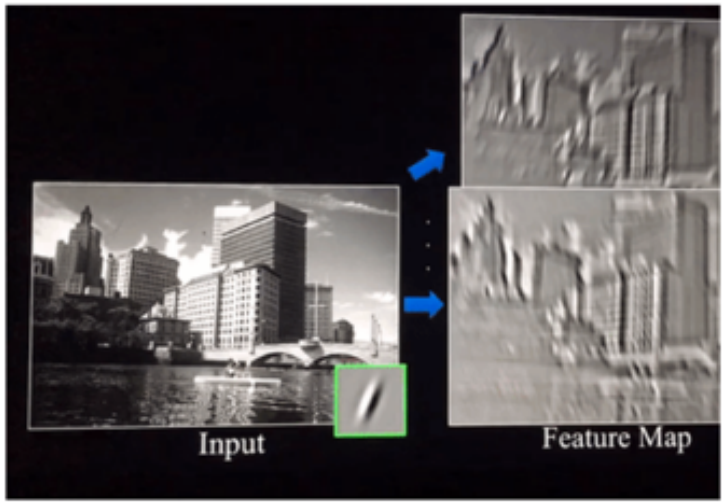


input image

output image

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Convolutional Network



$1_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	0	0
$0_{\times 0}$	$1_{\times 1}$	$1_{\times 0}$	1	0
$0_{\times 1}$	$0_{\times 0}$	$1_{\times 1}$	1	1
0	0	1	1	0
0	1	1	0	0

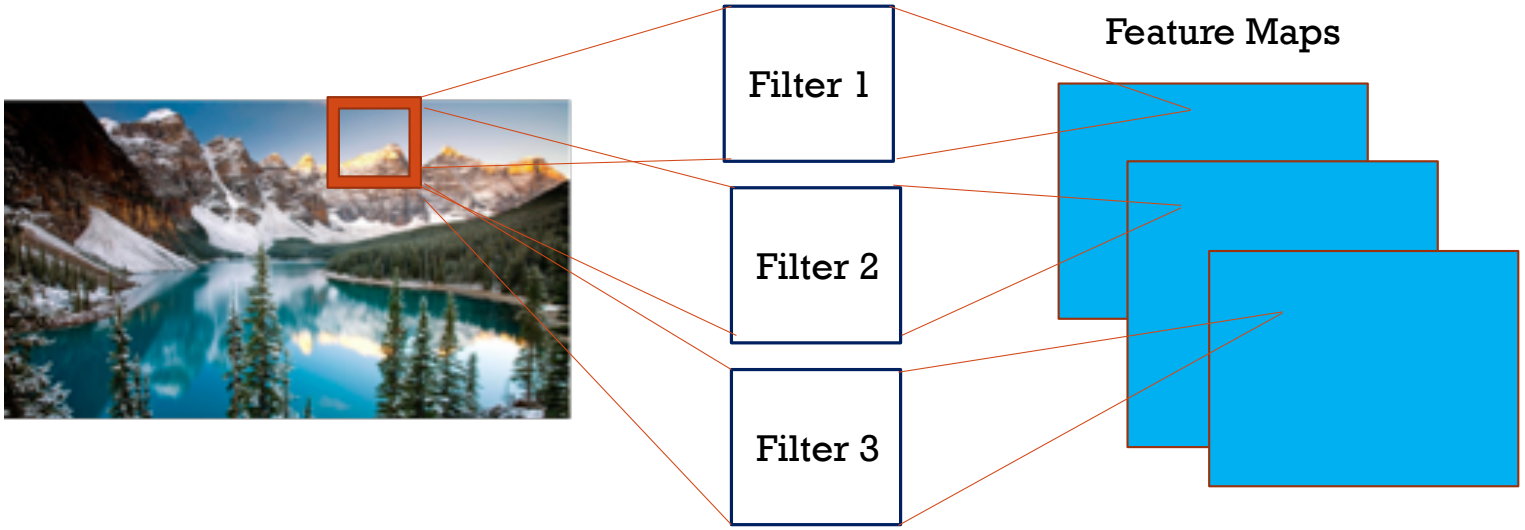
Image

4		

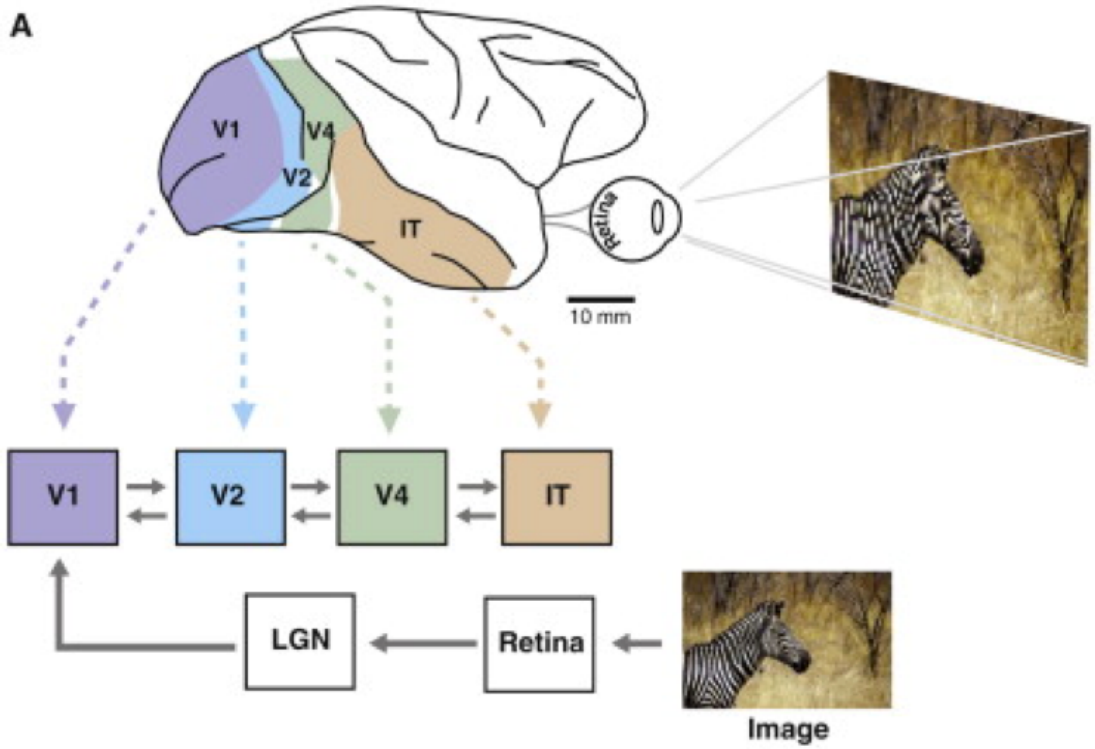
Convolved Feature

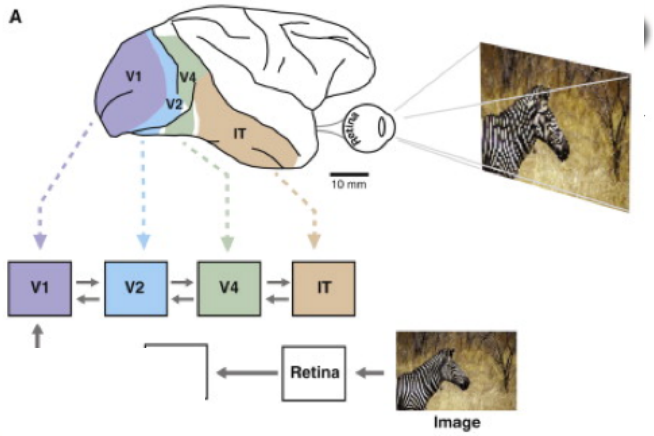


Multiple Kernels / Filters

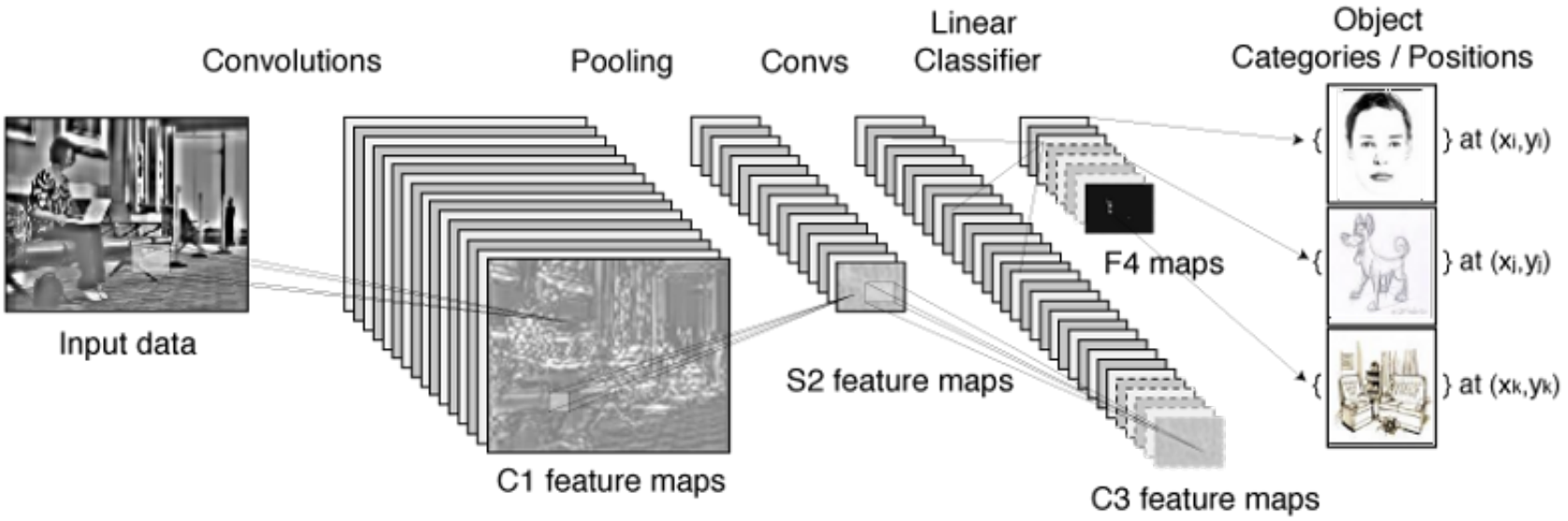


Multiple Filters & Layers

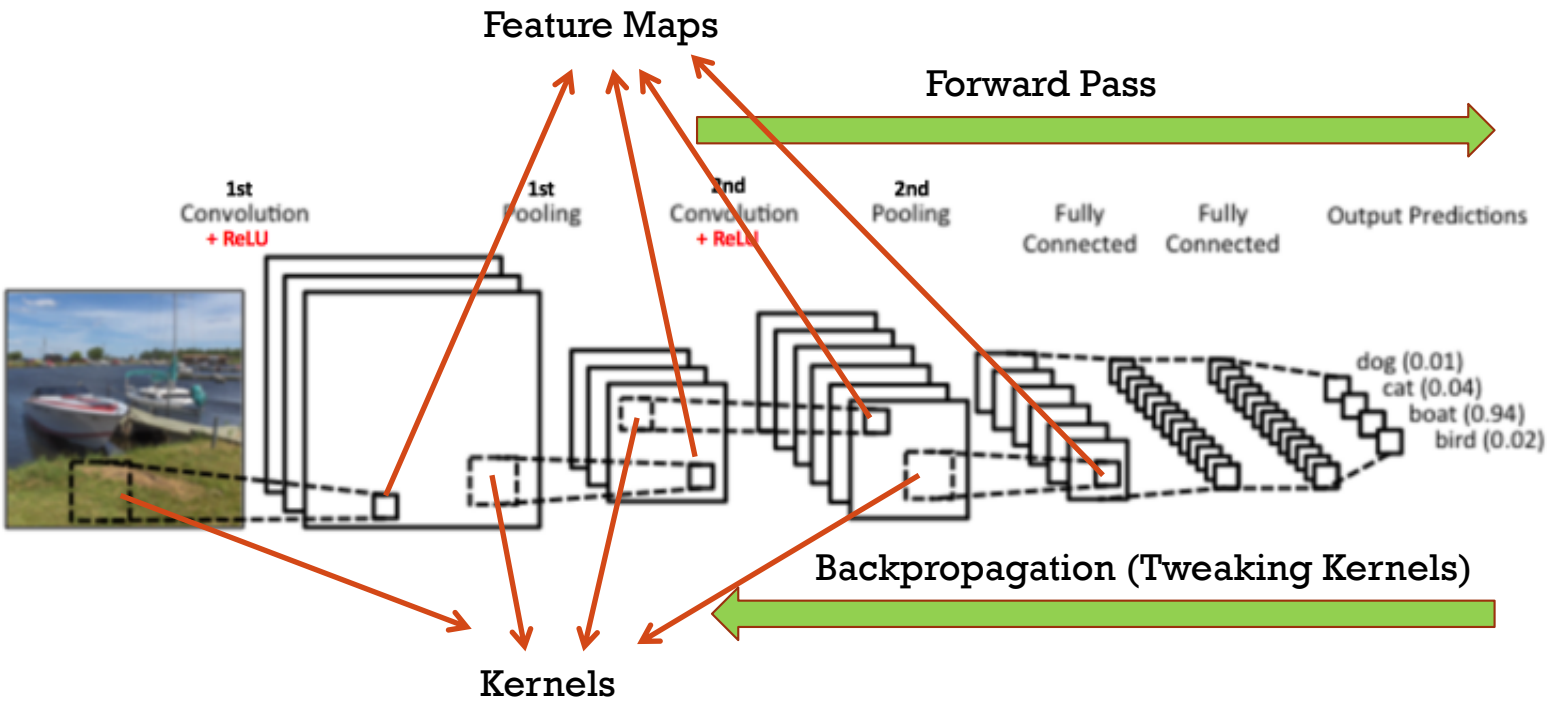




Multiple Filters & Layers



Convolutional Network Architecture (CNN)



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Computer Vision – Image To Text

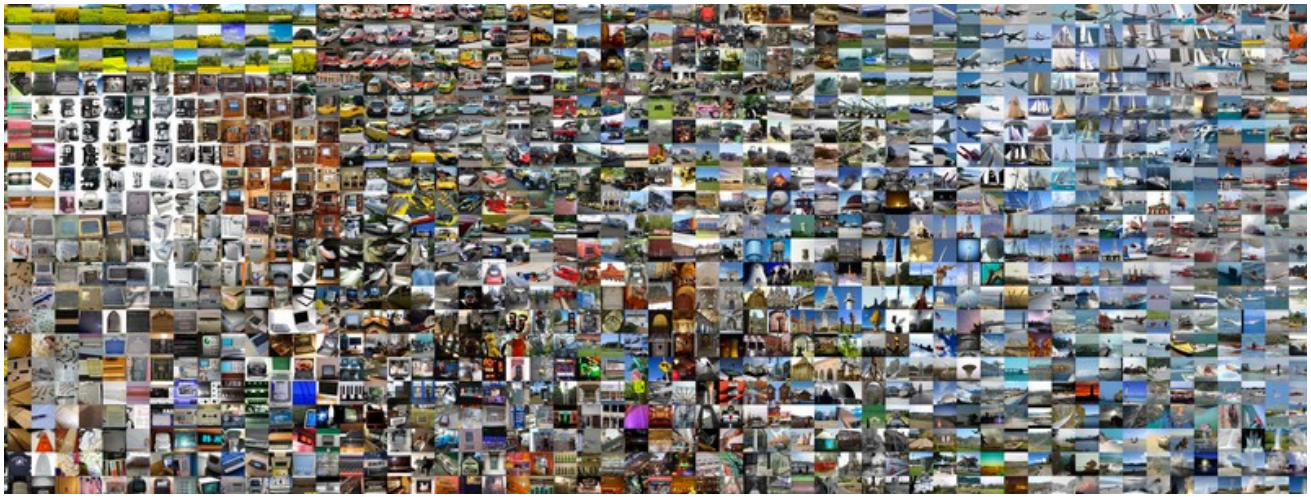


Source: https://www.youtube.com/watch?v=40riCqvRoMs&t=908s

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What Computer Vision Can Do Today

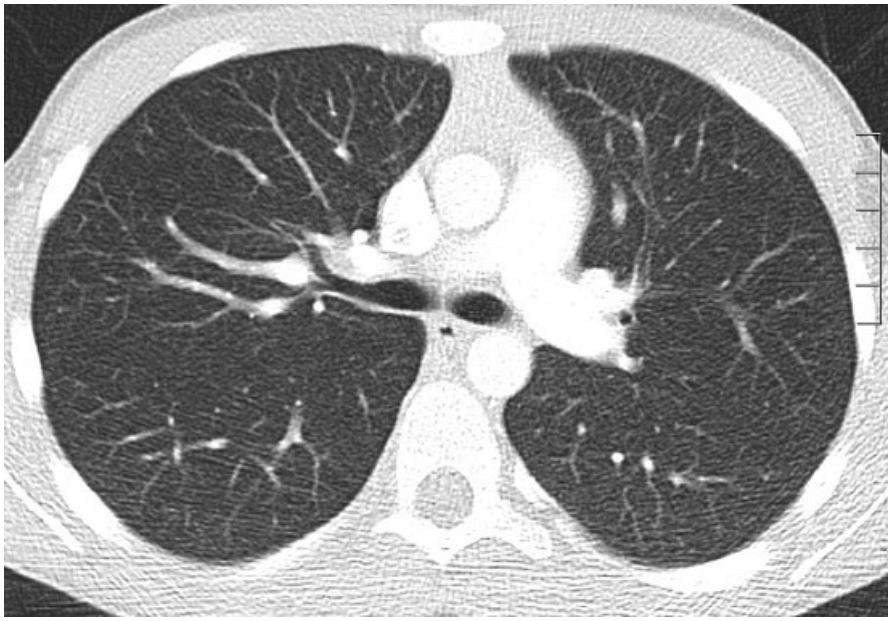
- ImageNet – Passing Human Being – 4.94% vs 5.1% (2015)



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What Computer Vision Can Do Today

- Lung CT Scan – Passing Human Radiologists (2015, 7% Missed vs 0%)



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What Computer Vision Can Do Today

- Uber's Driverless Truck Made First Delivery (2016)



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What Computer Vision Can Do Today

- Baidu Human vs AI Face Recognition (Jan 2017, AI Won by 0.01%)







Computer vision Does Not Always Work



* Example from Feifei Li's TED Talks Video

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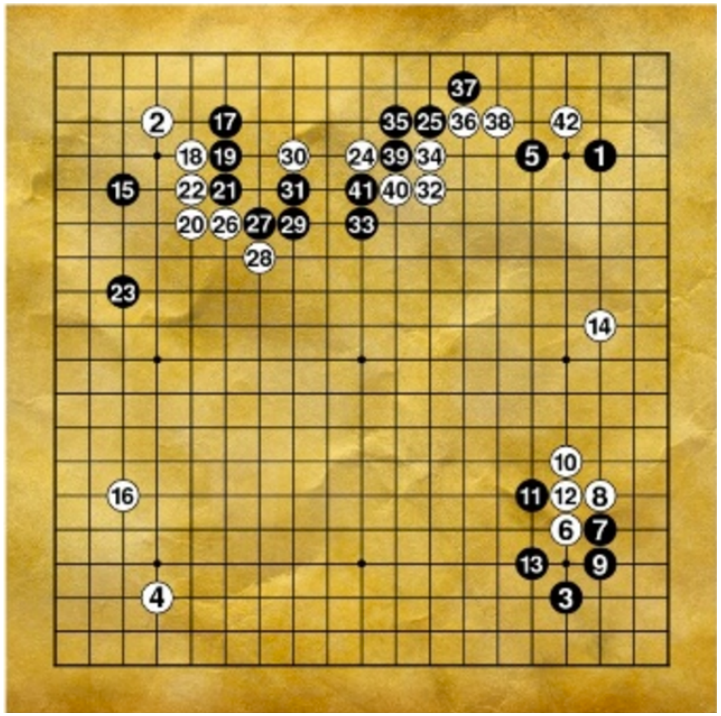
Computer vision Does Not Always Work



* Example from Feifei Li's TED Talks Video

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AlphaGO (Master) – Why Is It So Hard?



Atoms In The Universe:

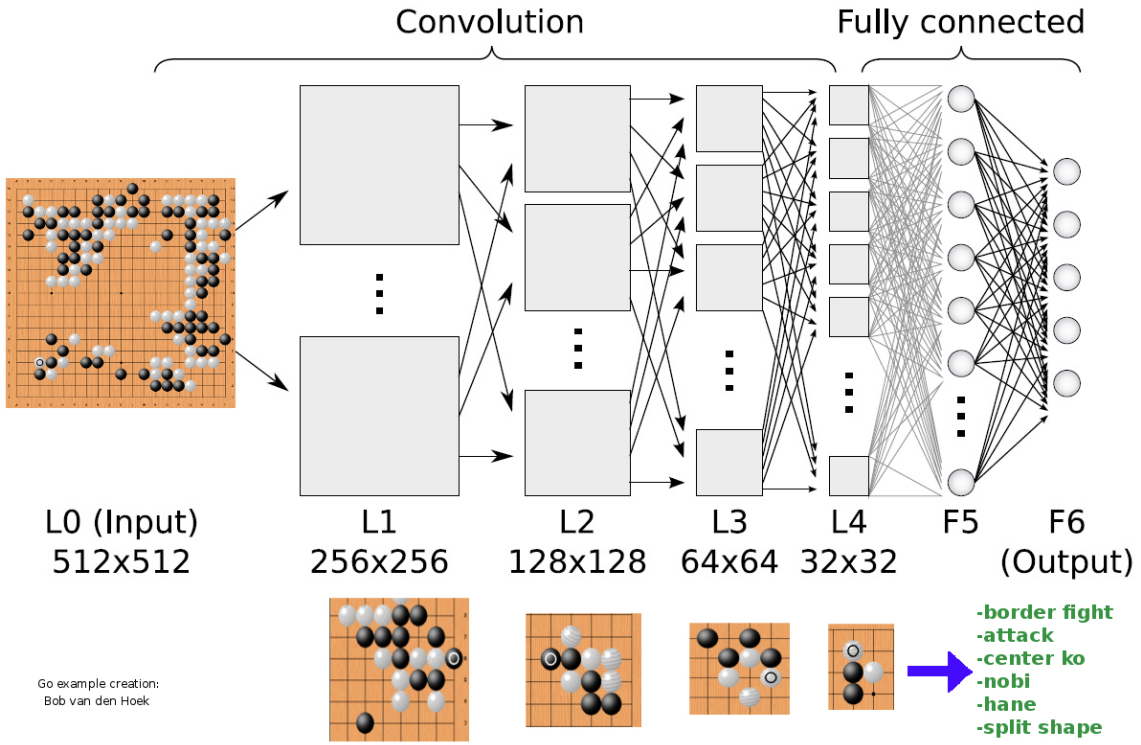
10^{80}

V.S.

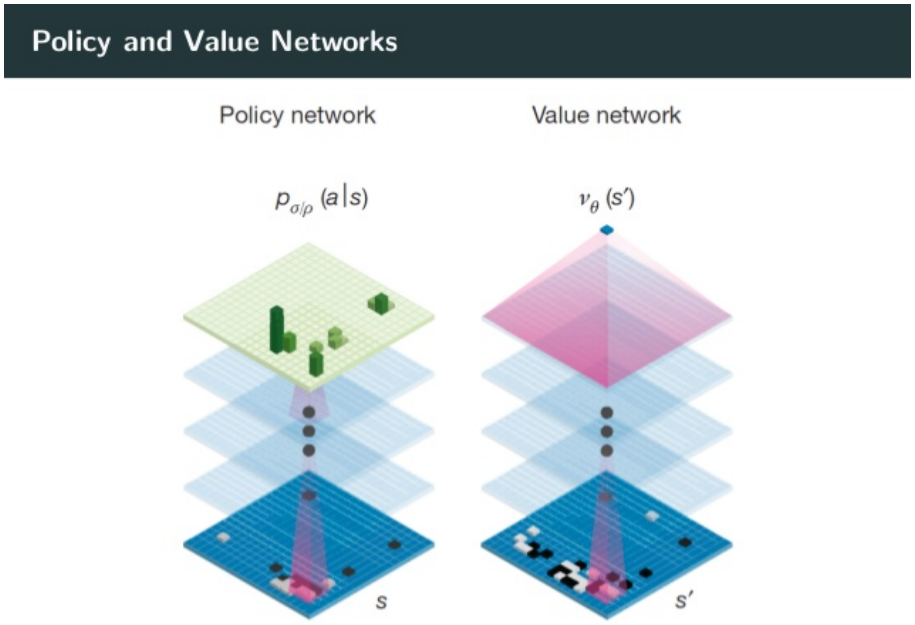
Legal positions:

$2 * 10^{170}$

AlphaGO and Computer Vision

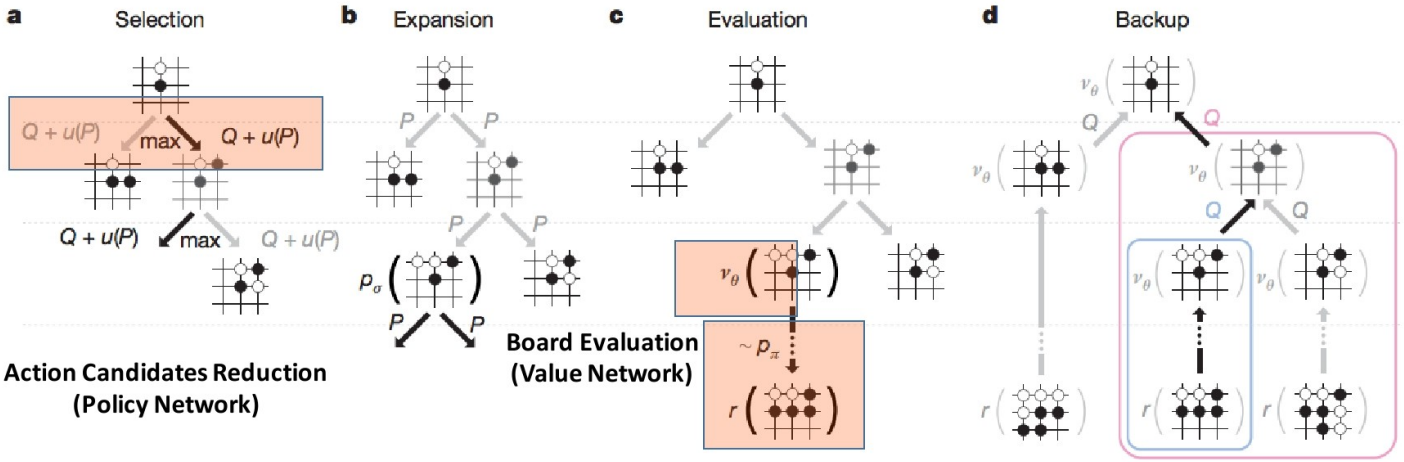


AlphaGO – Policy & Value Networks



AlphaGO – Reinforcement Learning

Looking ahead (w/ Monte Carlo Search Tree)



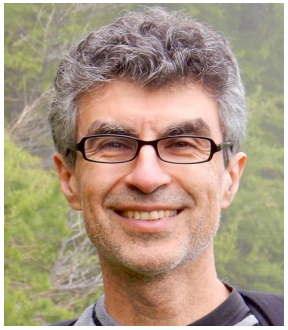
(Rollout): Faster version of estimating p(a|s)
→ uses shallow networks (3 ms → 2µs)

Why Here?

- Canadian Institute for Advanced Research (CIFAR)
  - Investing into AI in 1980s.
- The Big Three
  - Geffrey Hinton (Google)
    - "Godfather of Deep Learning" – Invention of Back Propagation in 1986
    - Came to Canada in 1987
  - Yosha Bengio (University of Montreal)
  - Yann LuCun (Facebook)





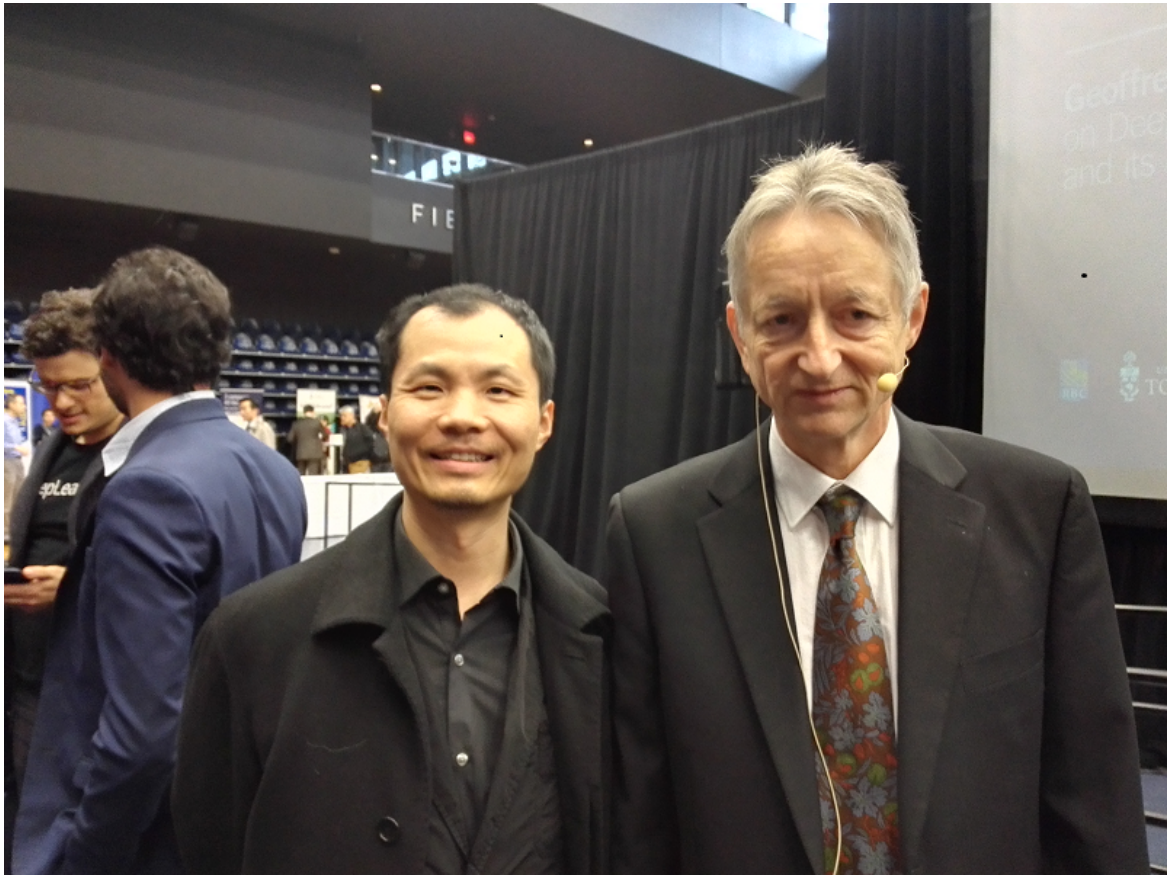


Why Now?


Geoffrey Hinton
VECTOR INSTITUTE
Northern Exposure: Vector Institute Our Latest Bet on AI in Canada

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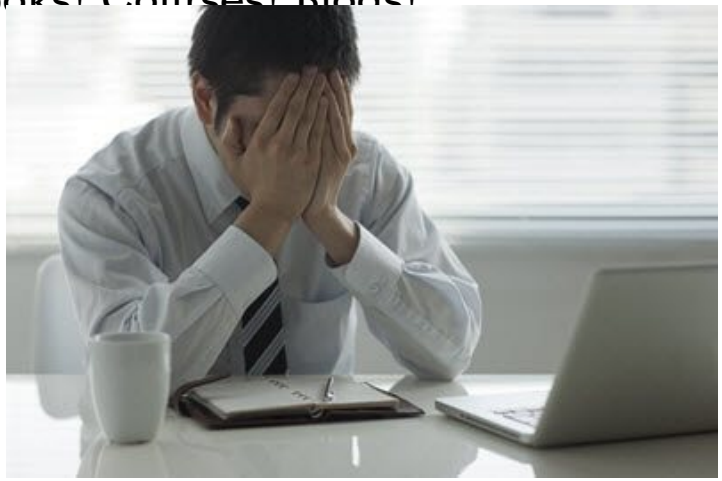
Asking Geoffrey Hinton



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How To Start?

- Math: Statistics? Probabilities? Linear Algebra? Calculus?
- Language: R? Python? MatLab? Scala? Java?
- Platform: Tensorflow? Caffee? Torch? Theano? Keras? MXNet?
- Hardware: GPU? Parallelization? Cloud vs Building Your Own GPU Machine?
- Academic Papers? Books? Courses? Blogs?



NOPE!

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Focus on Your Strengths

- For Myself: I can read codes faster than reading papers!
- Demo: Deep Tesla
  - http://selfdrivingcars.mit.edu/deepteslajs/
- Example – a model for ANY photo categorization tasks (97% accuracy dogs vs cats)

```
from vgg16 import vgg16
vgg = vgg16()
Batches = vgg.get_batches("~/training", batch_size=16)
valudation_batches = vgg.get_batches("~/validation",batch_size=16)
vgg.finetune(batches)
vgg.fit(batches,validation_batches, nb_epoch=3)
```

Above source code uses a library provided by Jeremy Howard



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Moving Forward

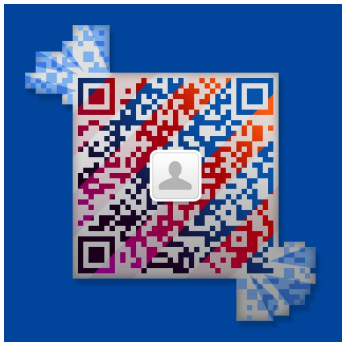
- Series of Deep Learning Seminars
- Deep Learning Workshops (Hands-on in smaller groups)
- Study Groups (Weekly meet-up for progress)
- Competitions (Kaggle etc.)
- Paper Study And Implementations
- AI Startup Discussions



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