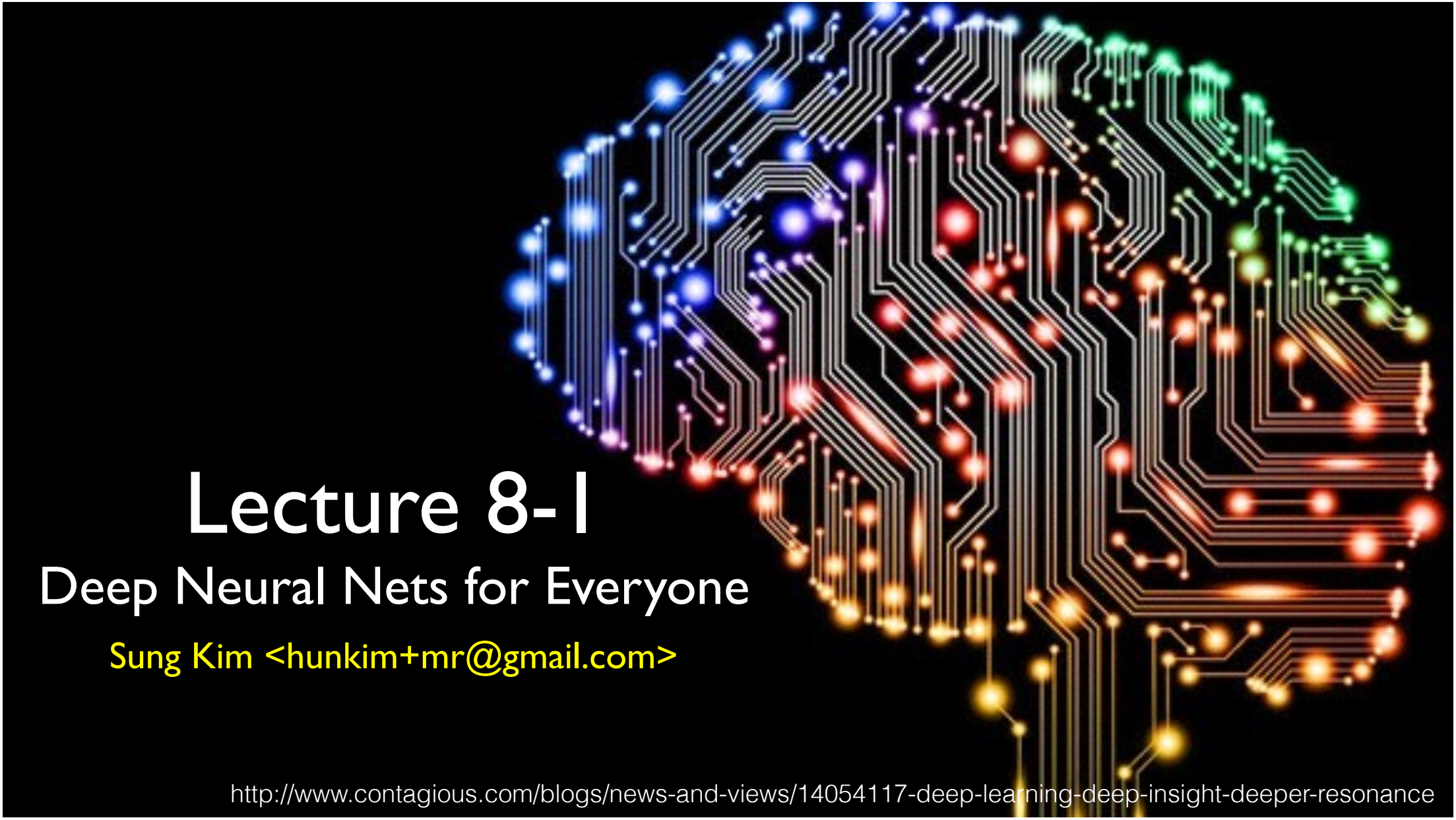


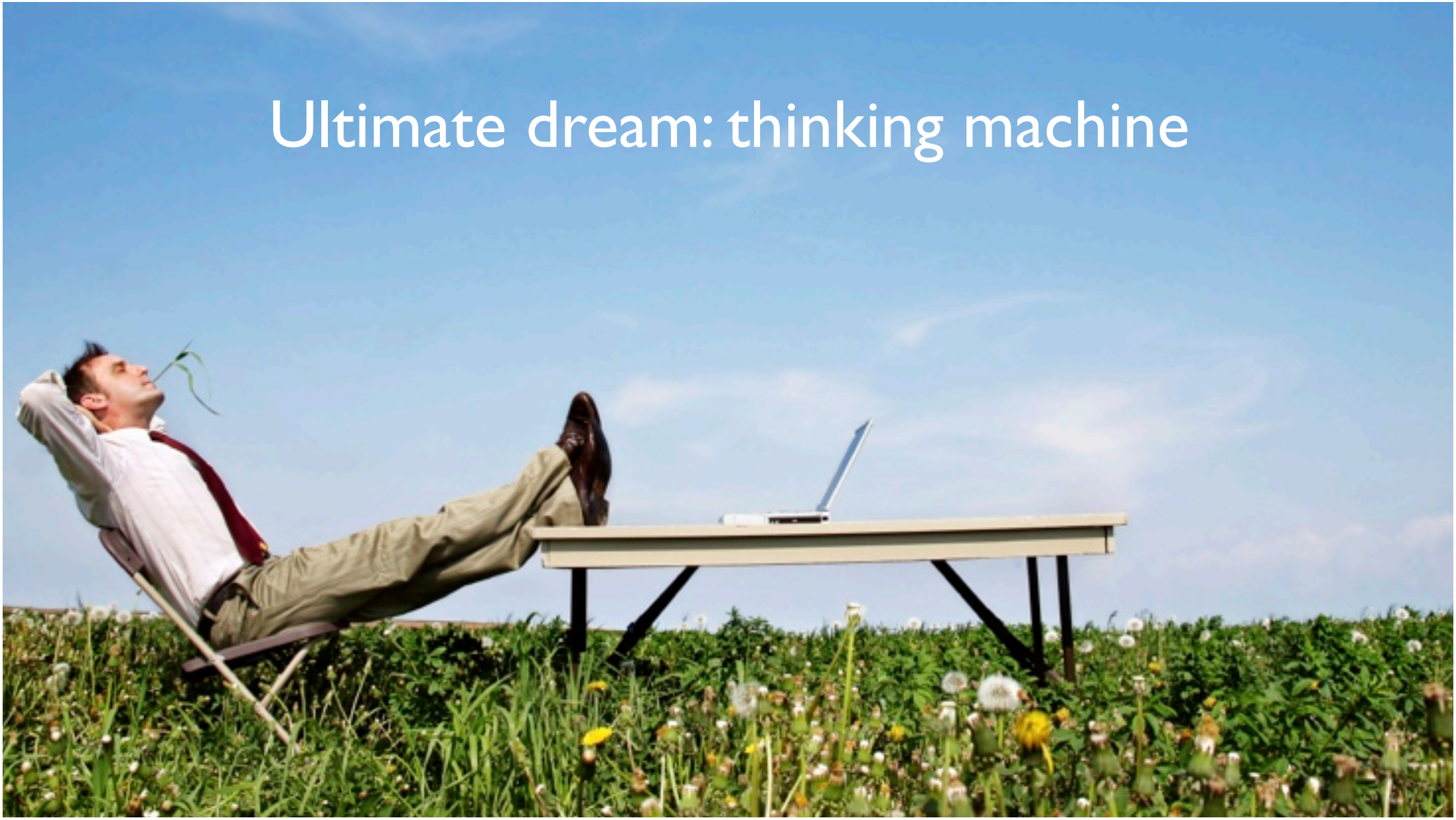
Lecture 8-1

Deep Neural Nets for Everyone

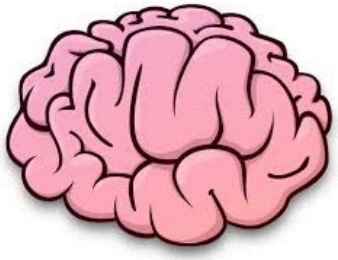
Sung Kim <hunkim+mr@gmail.com>

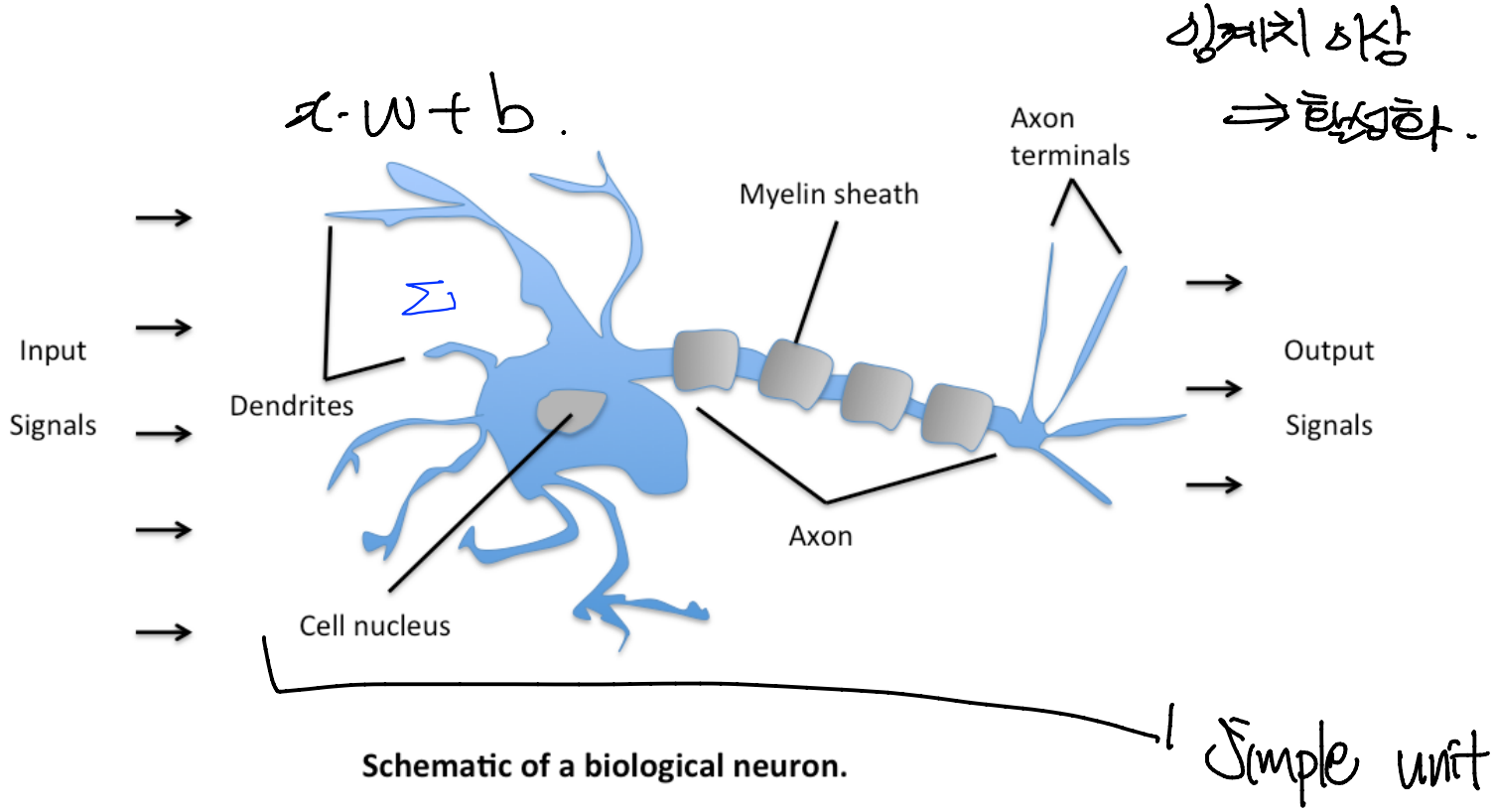
http://www.contagious.com/blogs/news-and-views/14054117-deep-learning-deep-insight-deeper-resonance

Ultimate dream: thinking machine



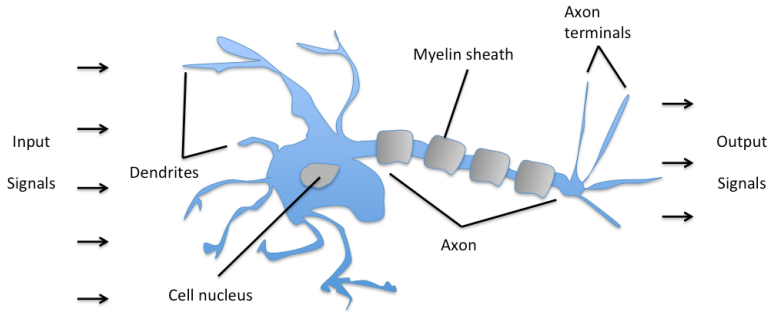
Ultimate dream: thinking machine



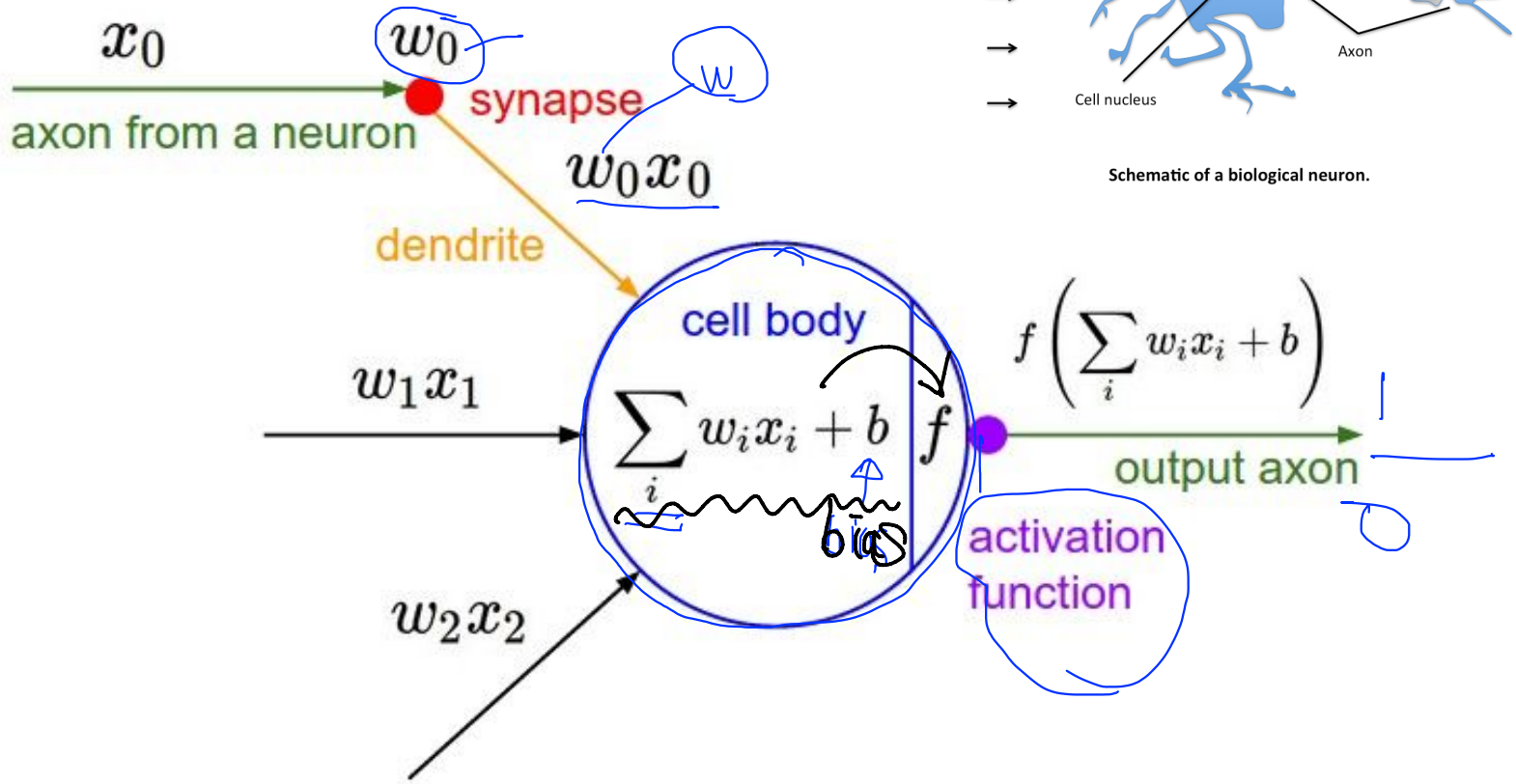


http://sebastianraschka.com/

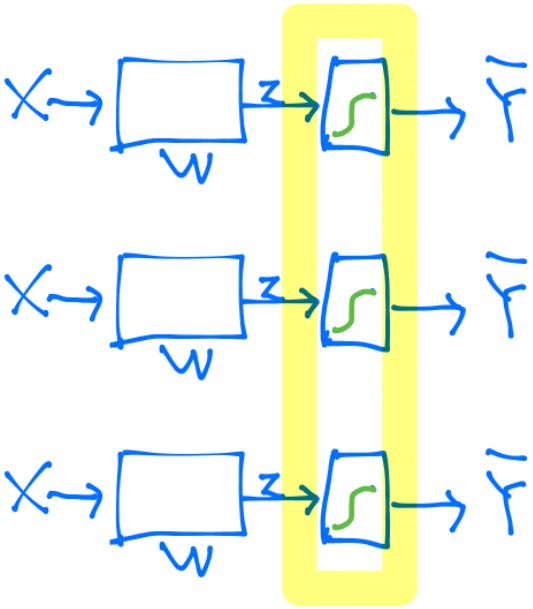
Activation Functions

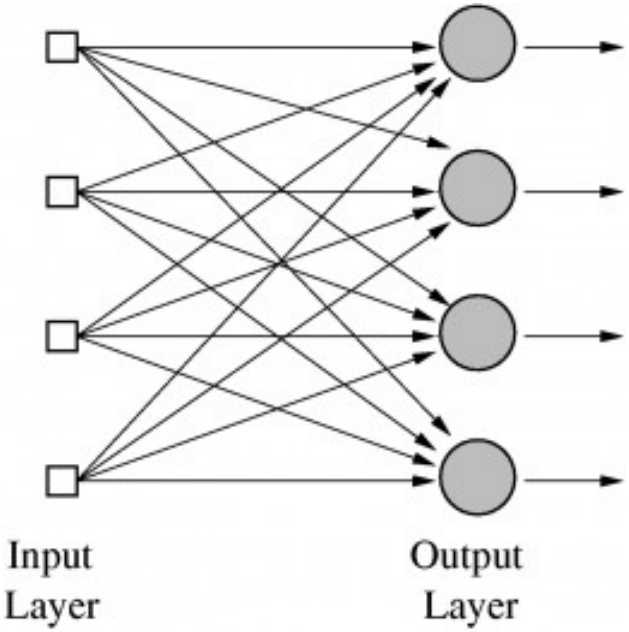


Schematic of a biological neuron.



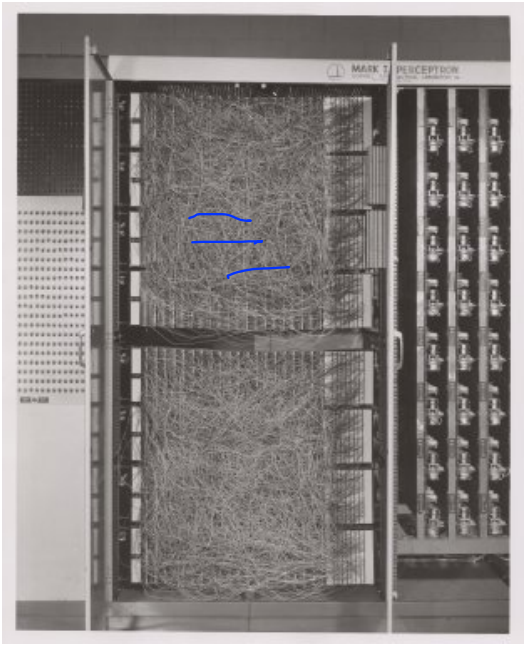
Logistic regression units



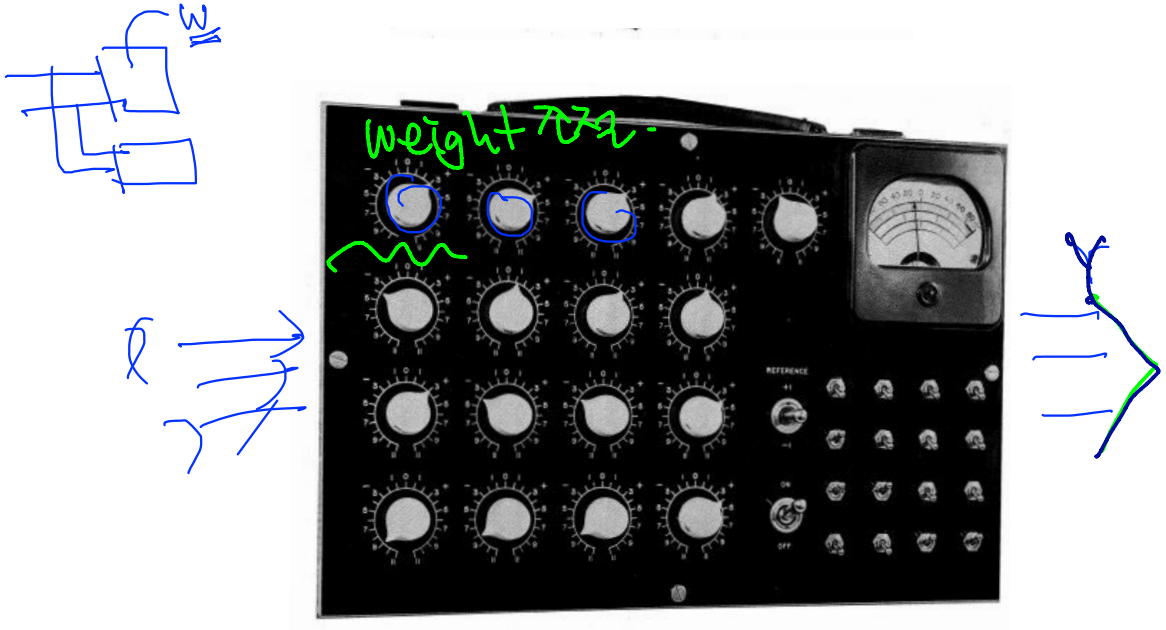


http://www.andreykurenkov.com/writing/a-brief-history-of-neural-nets-and-deep-learning/

Hardware implementations



Frank Rosenblatt, ~1957: Perceptron



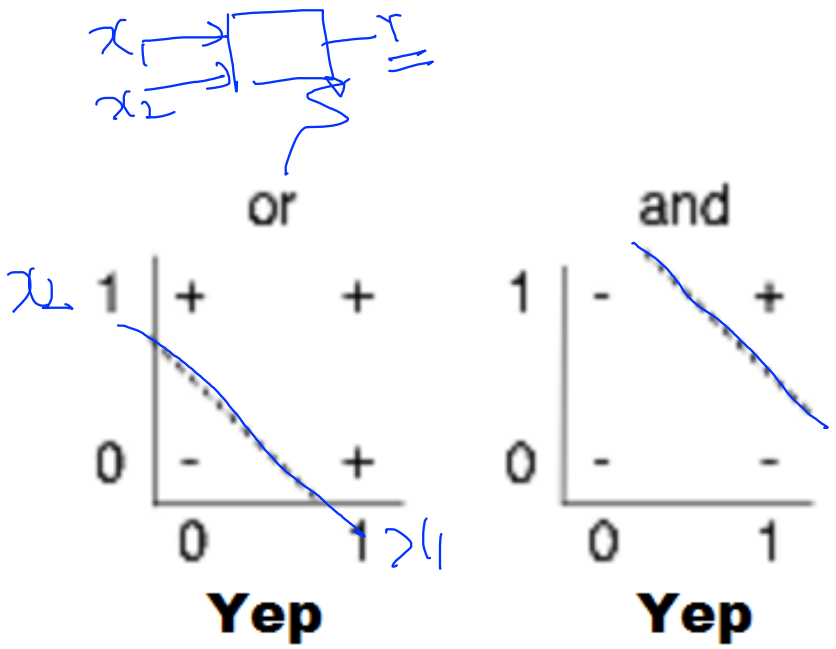
Widrow and Hoff, ~1960: Adaline/Madaline

False Promises

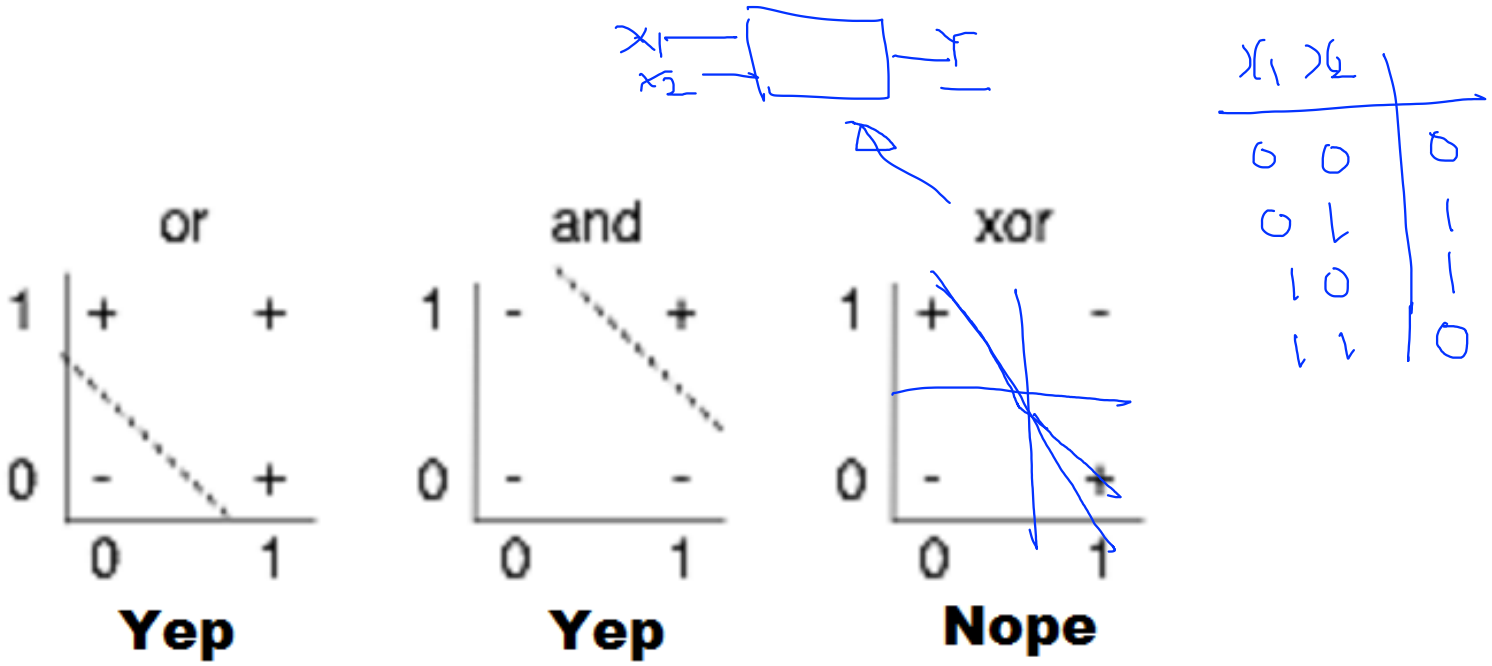
"The Navy revealed the embryo of an electronic computer today that *it expects will be able to walk, talk, see, write, reproduce itself* an be conscious of its existence … Dr. Frank Rosenblatt, a research psychologist at the Cornell Aeronautical Laboratory, Buffalo, said Perceptrons might be fired to the planets as mechanical space explorers" The New York Times July 08, 1958

http://query.nytimes.com/gst/abstract.html?res=9D01E4D8173DE53BBC4053DFB1668383649EDE

(Simple) AND/OR problem: linearly separable?

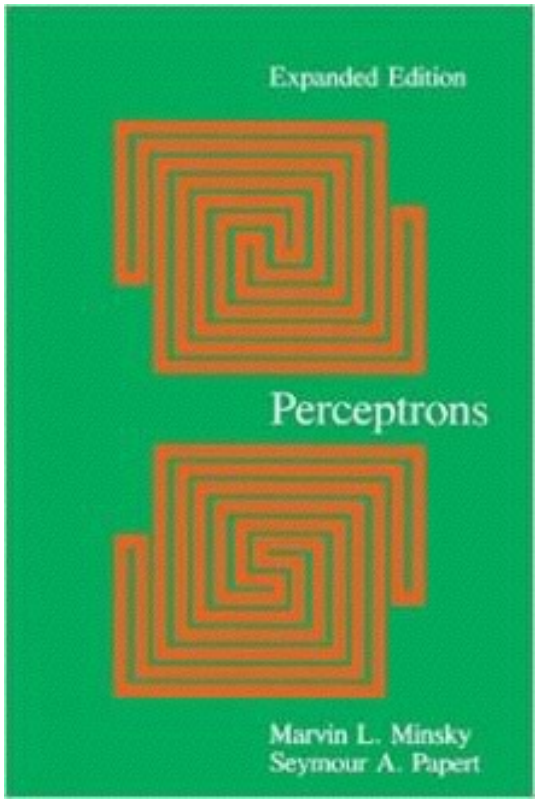


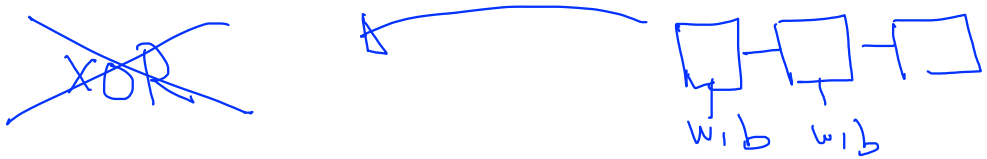
(Simple) XOR problem: linearly separable?



Perceptrons (1969)

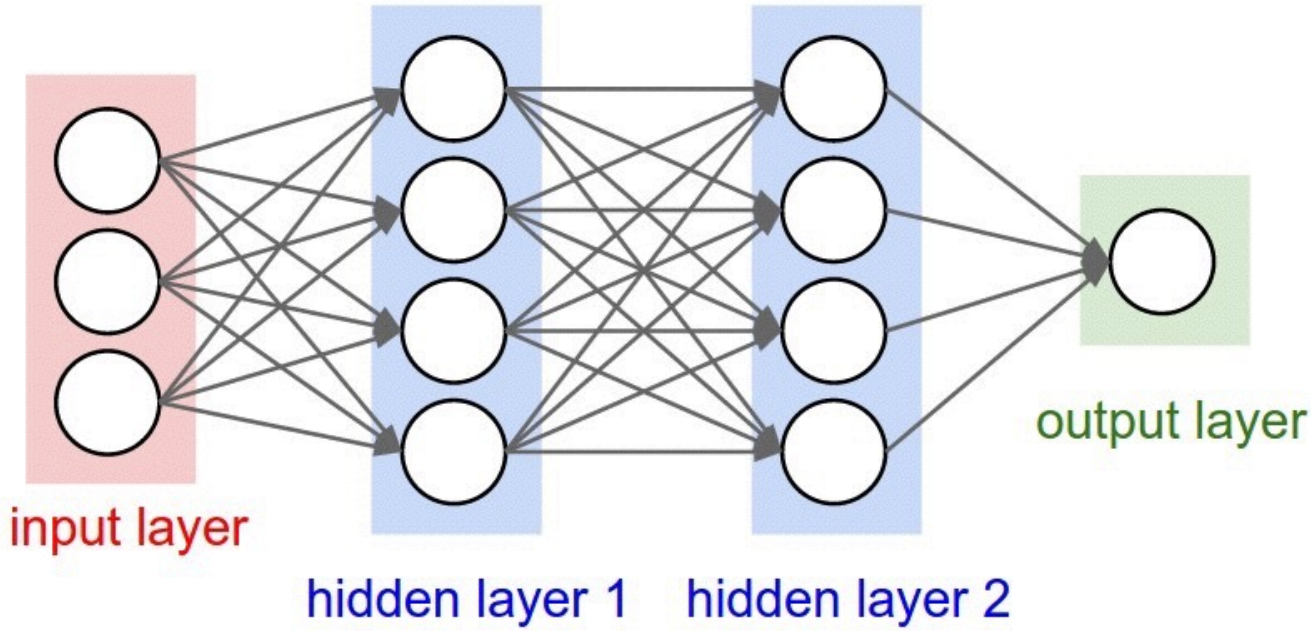
by Marvin Minsky, founder of the MIT AI Lab





- We need to use MLP, multilayer perceptrons (multilayer neural nets)
- No one on earth had found a viable way to train MLPs good enough to learn such simple functions.

“No one on earth had found a viable way to train*”

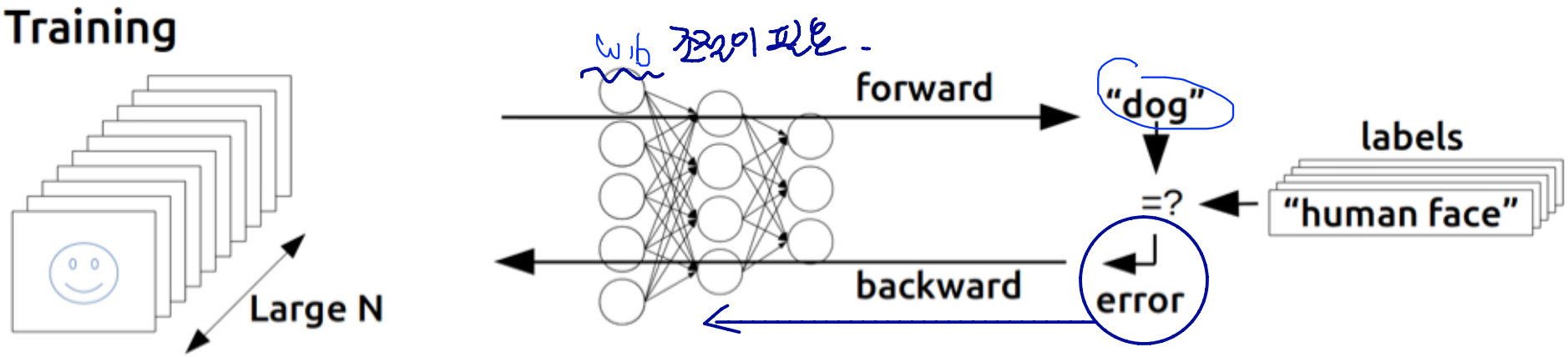


*Marvin Minsky, 1969

http://cs231n.github.io/convolutional-networks/

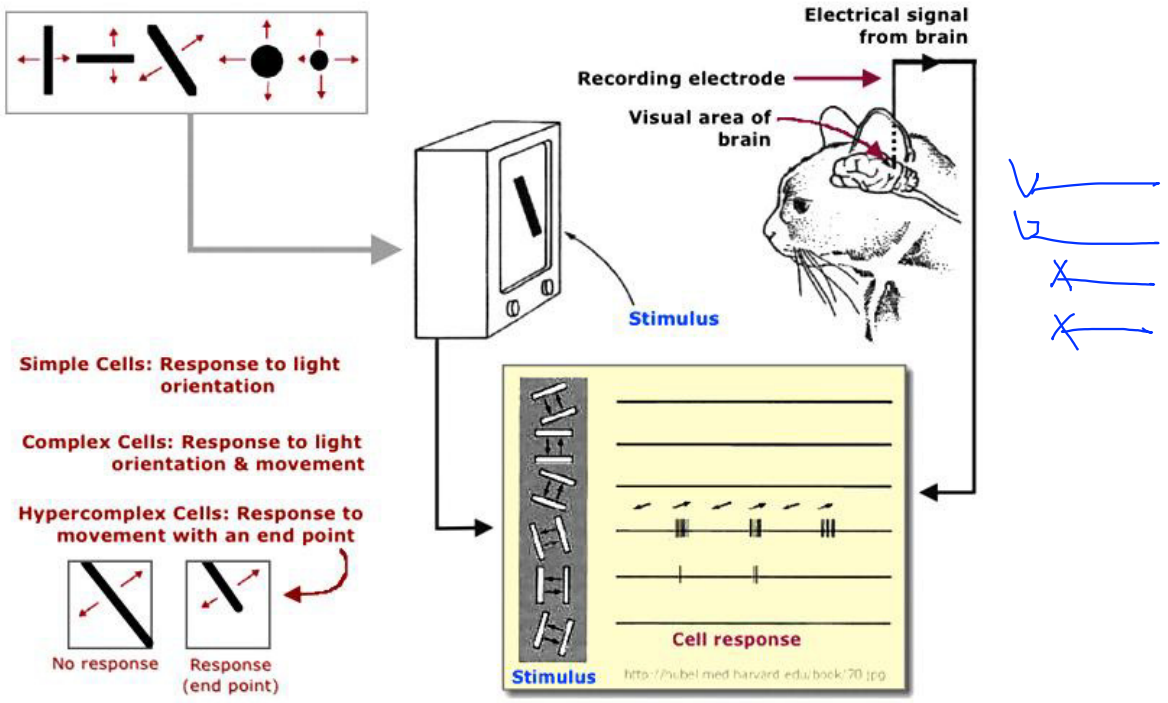
Backpropagation

(1974, 1982 by Paul Werbos, 1986 by Hinton)



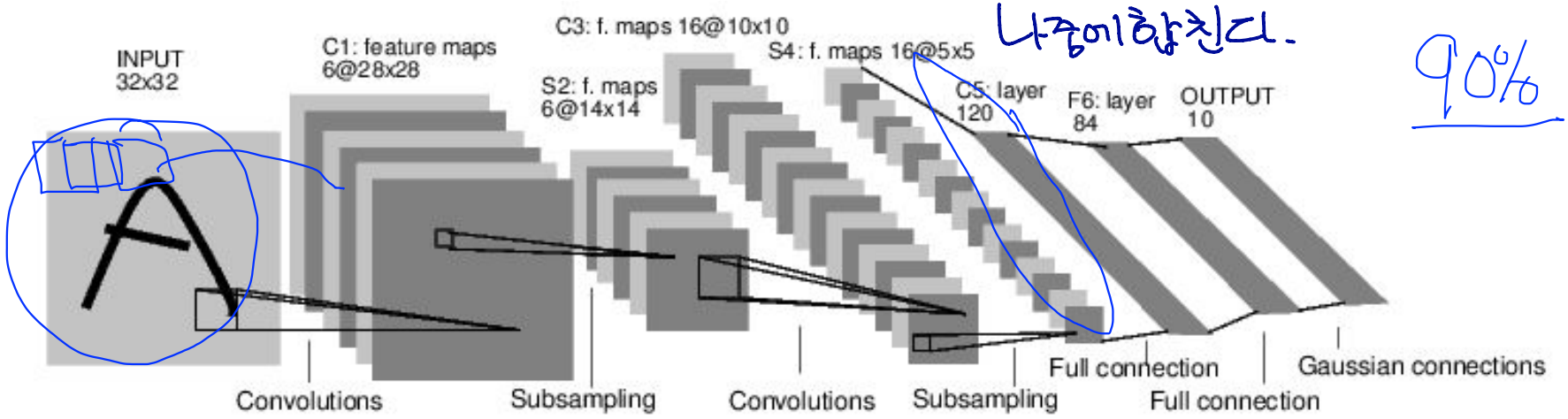
https://devblogs.nvidia.com/parallelforall/inference-next-step-gpu-accelerated-deep-learning/

Convolutional Neural Networks



Hubel & Wiesel, 1959

Convolutional Neural Networks



"At some point in the late 1990s, one of these systems was reading 10 to 20% of all the checks in the US."

[LeNet-5, LeCun 1980]

“Alvinn: An autonomous land vehicle in a neural network”

Terminator 2 (1991)

JOHN: Can you learn? So you can be... you know. More human. Not such a dork all the time.

TERMINATOR: My CPU is a neural-net processor... a learning computer. But **Skynet** presets the switch to "read-only" when we are sent out alone.

...

We'll learn how to **set** the neural net

TERMINATOR Basically. (starting the engine, backing out) The **Skynet** funding bill is passed. The system goes on-line August 4th, 1997. Human decisions are removed from strategic defense. **Skynet** begins to learn, at a geometric rate. It becomes **self-aware** at 2:14 a.m. eastern time, August 29. In a panic, they try to pull the plug.

SARAH: And **Skynet** fights back.

TERMINATOR: Yes. It launches its ICBMs against their targets in Russia.

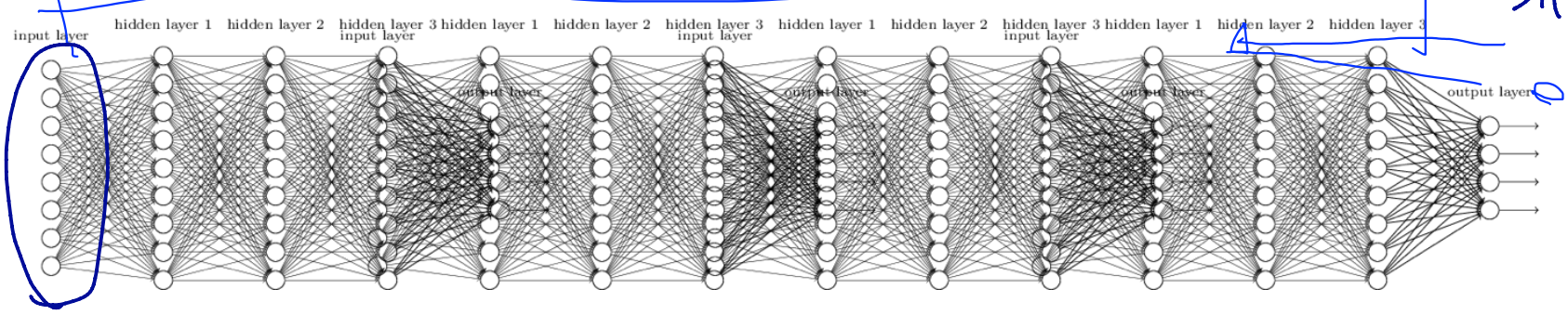
SARAH: Why attack Russia?

TERMINATOR: Because **Skynet** knows the Russian counter-strike will remove its enemies here.

http://pages.cs.wisc.edu/~jerryzhu/cs540/handouts/neural.pdf

A BIG problem

- Backpropagation just did not work well for normal neural nets with many layers
- Other rising machine learning algorithms: SVM, RandomForest, etc.
- **1995** "Comparison of Learning Algorithms For Handwritten Digit Recognition" by LeCun et al. found that this new approach worked better



http://neuralnetworksanddeeplearning.com/chap6.html

Next

To be continued…

CIFAR

- Canadian Institute for Advanced Research (CIFAR)
- CIFAR encourages basic research *without direct application*, was what motivated **Hinton** to move to Canada in 1987, and funded his work afterward.

CIFAR

CANADIAN INSTITUTE
for ADVANCED RESEARCH

http://www.andreykurenkov.com/writing/a-brief-history-of-neural-nets-and-deep-learning-part-4/

“Everyone else was doing something different"

- “It was the *worst possible time*,” says Bengio, a professor at the Université de Montréal and co-director of the CIFAR program since it was renewed last year. “Everyone else was doing something different. Somehow, Geoff convinced them.”
- “We should give (CIFAR) a lot of credit for *making that gamble*.”
- CIFAR “had a huge impact in forming a community around deep learning,” adds LeCun

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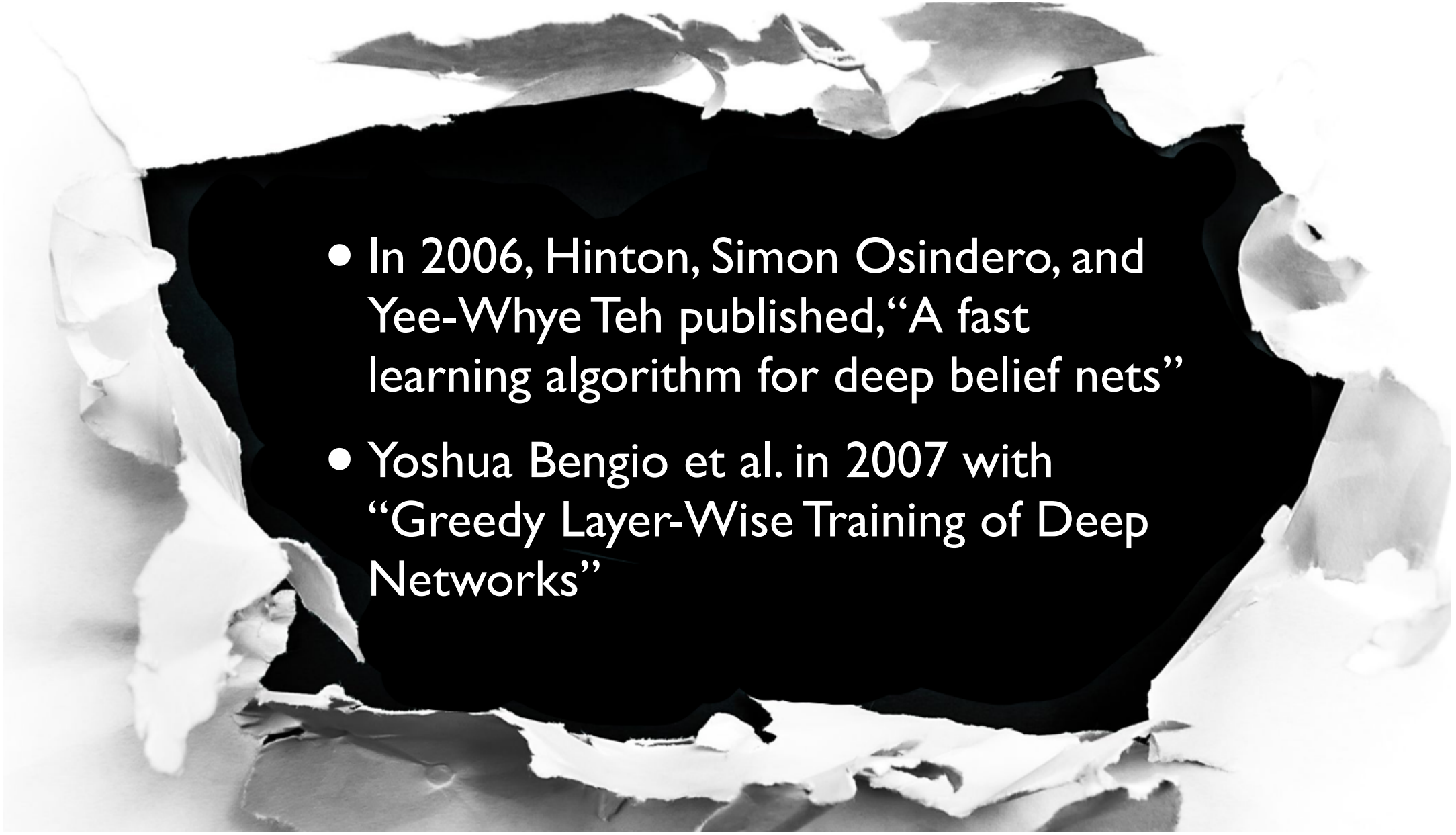
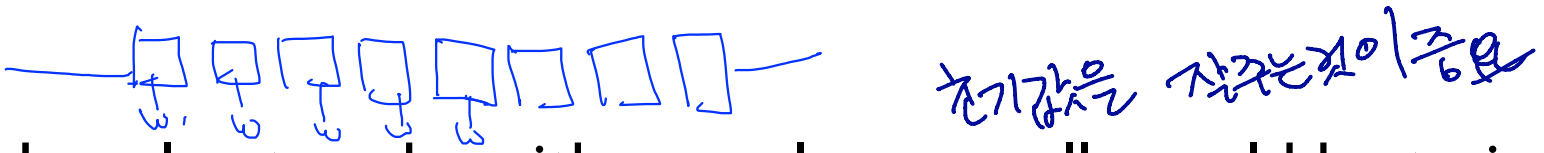

• In 2006, Hinton, Simon Osindero, and Yee-Whye Teh published,"A fast learning algorithm for deep belief nets"
• Yoshua Bengio et al. in 2007 with "Greedy Layer-Wise Training of Deep Networks"

Breakthrough

in 2006 and 2007 by Hinton and Bengio



- Neural networks with many layers really could be trained well, *if the weights are initialized in a clever way* rather than randomly.
- Deep machine learning methods are more efficient for difficult problems than shallow methods.
- Rebranding to ***Deep Nets***, ***Deep Learning***

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IMAGENET Large Scale Visual Recognition Challenge

Steel drum

The Image Classification Challenge:
1,000 object classes
1,431,167 images

Whole Picture

Output:
Scale
T-shirt
<u>Steel drum</u>
Drumstick
Mud turtle

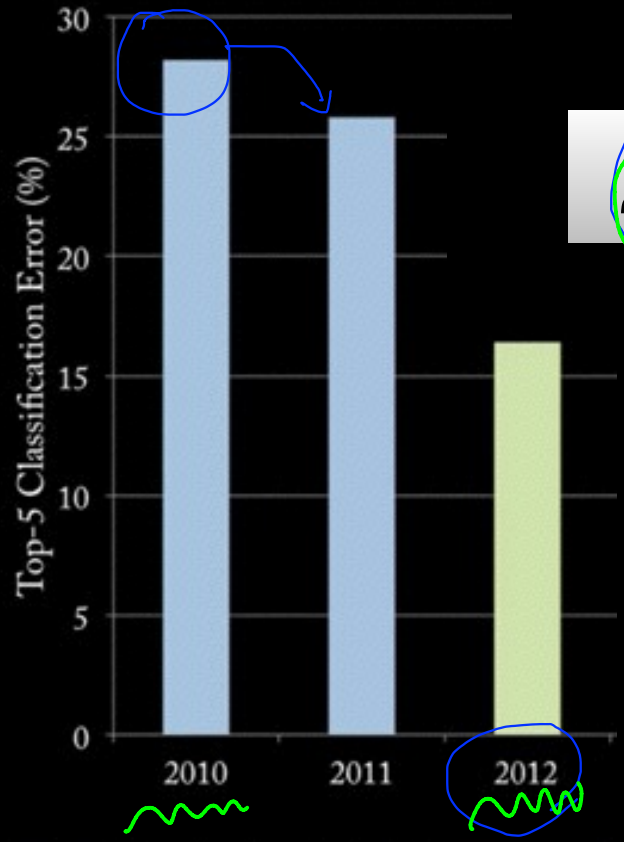
✔

Output:
Scale
T-shirt
Giant panda
Drumstick
Mud turtle

✗

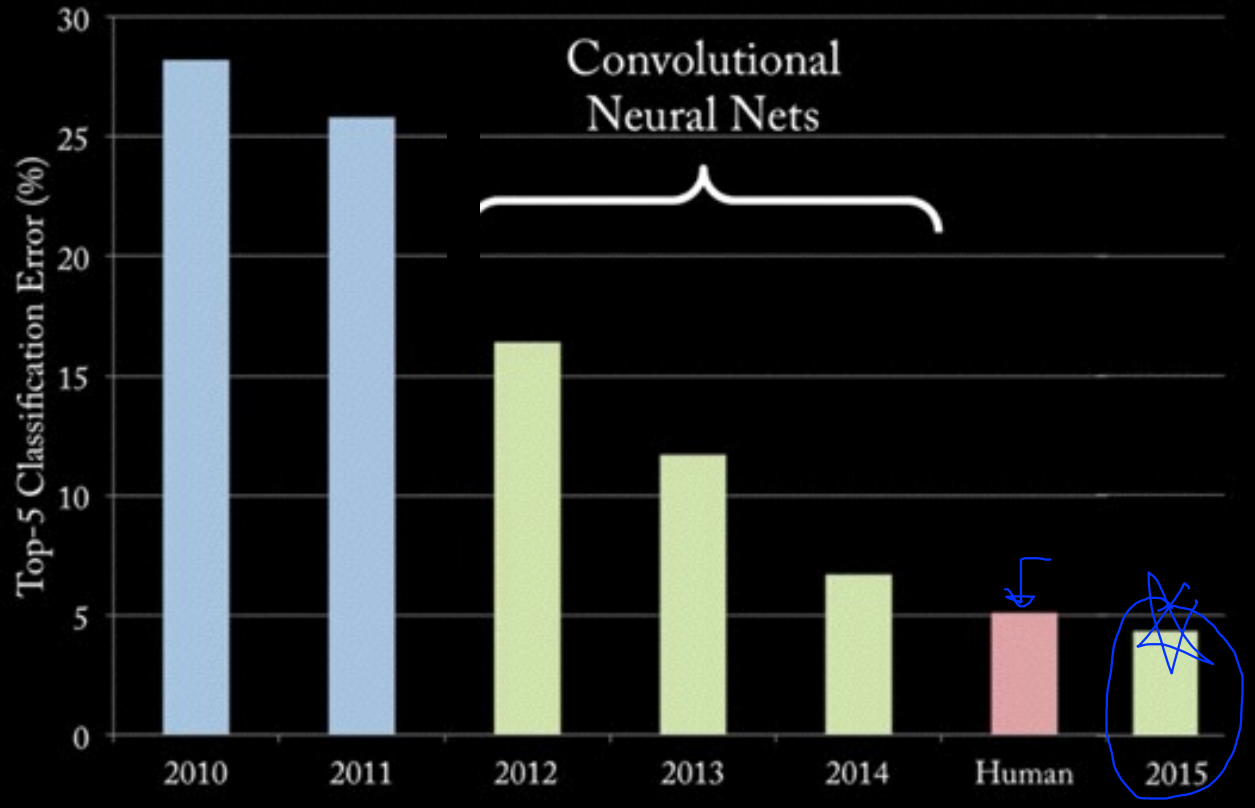
Russakovsky et al. arXiv, 2014

ImageNet Classification (2010 –

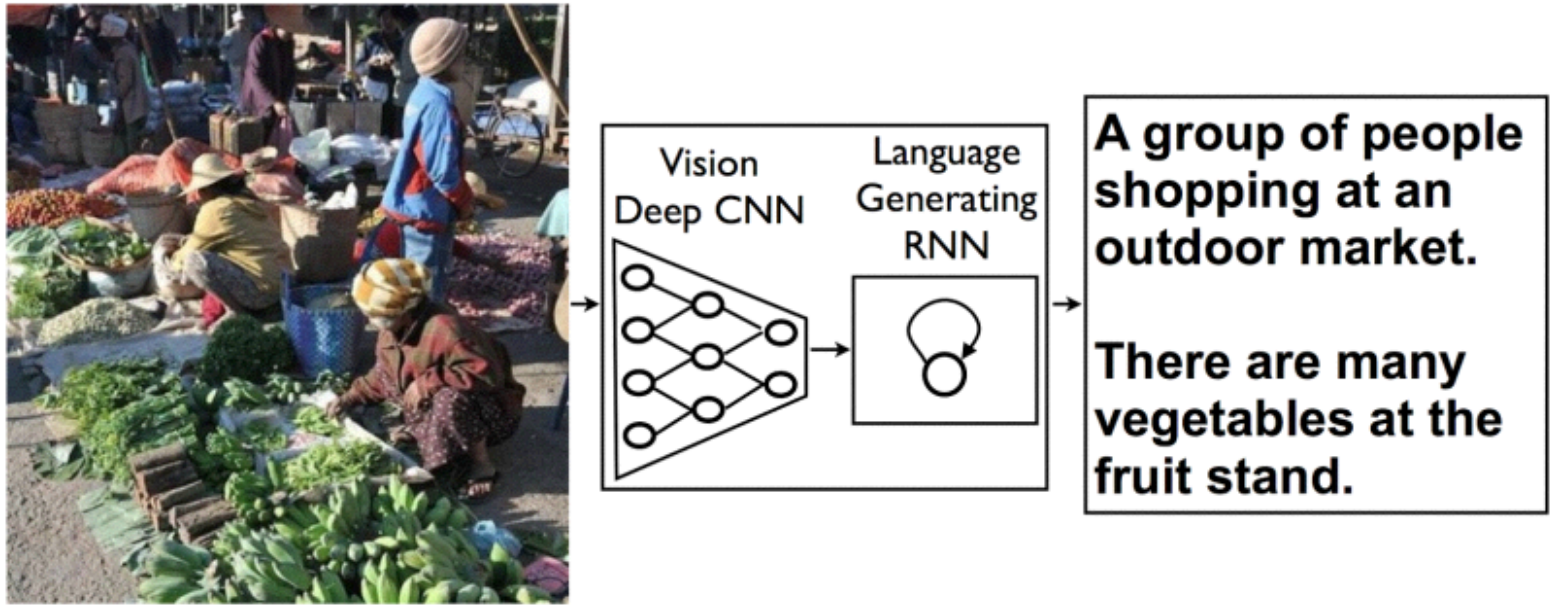


26.2% to 15.3%

ImageNet Classification (2010 – 2015)



Neural networks that can explain photos



https://gigaom.com/2014/11/18/google-stanford-build-hybrid-neural-networks-that-can-explain-photos/

Deep API Learning*

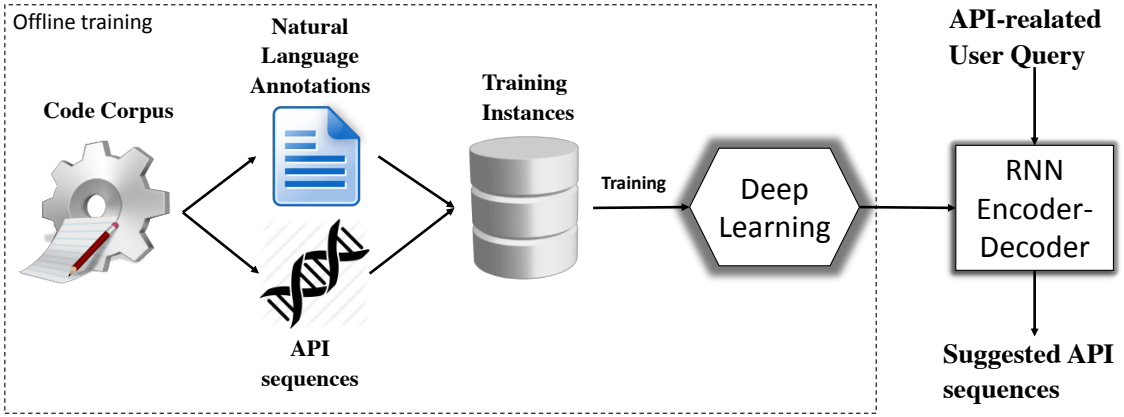


Figure 3: The Overall Workflow of DeepAPI

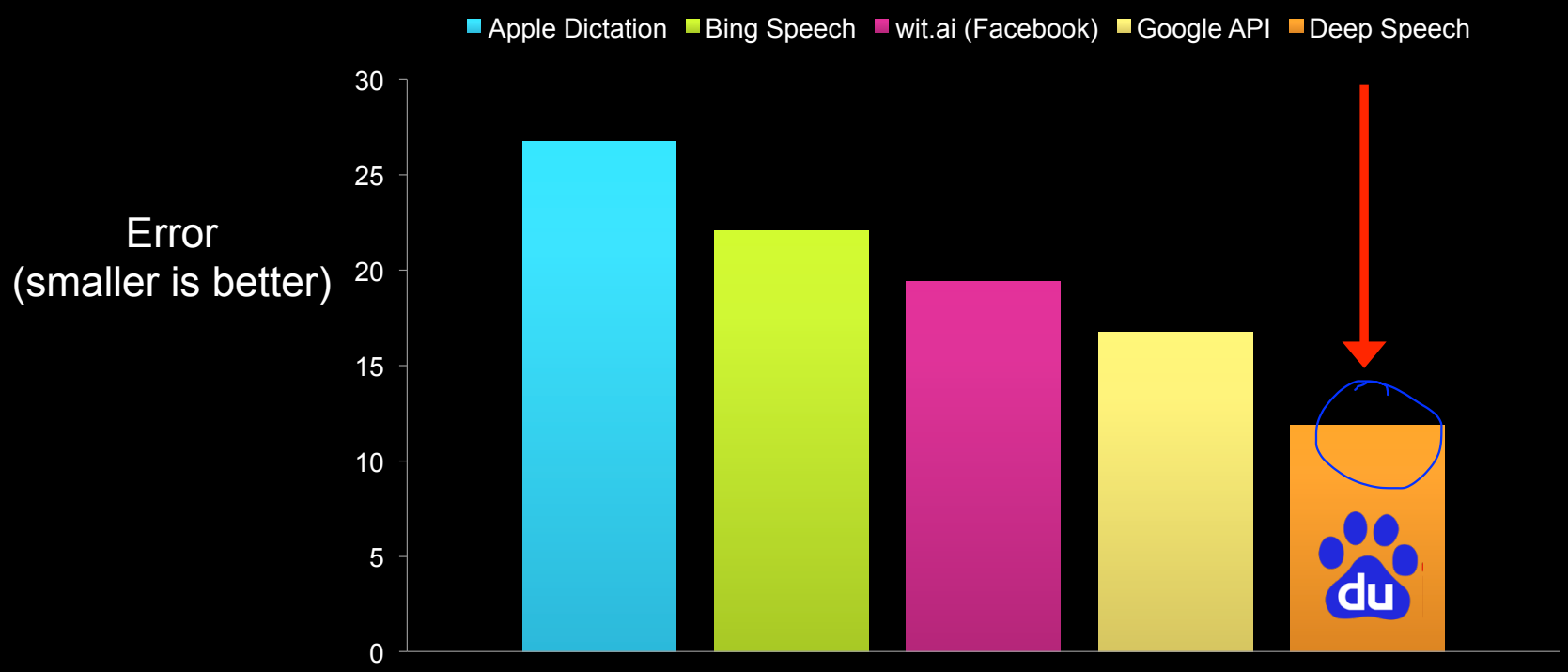
"copy a file and save it to -your destination path"

NLP

FileInputStream.new FileOutputStream.new FileInputStream.getChannel FileOutputStream.getChannel FileChannel.size FileChannel.transferTo FileInputStream.close FileOutputStream.close FileChannel.close FileChannel.close

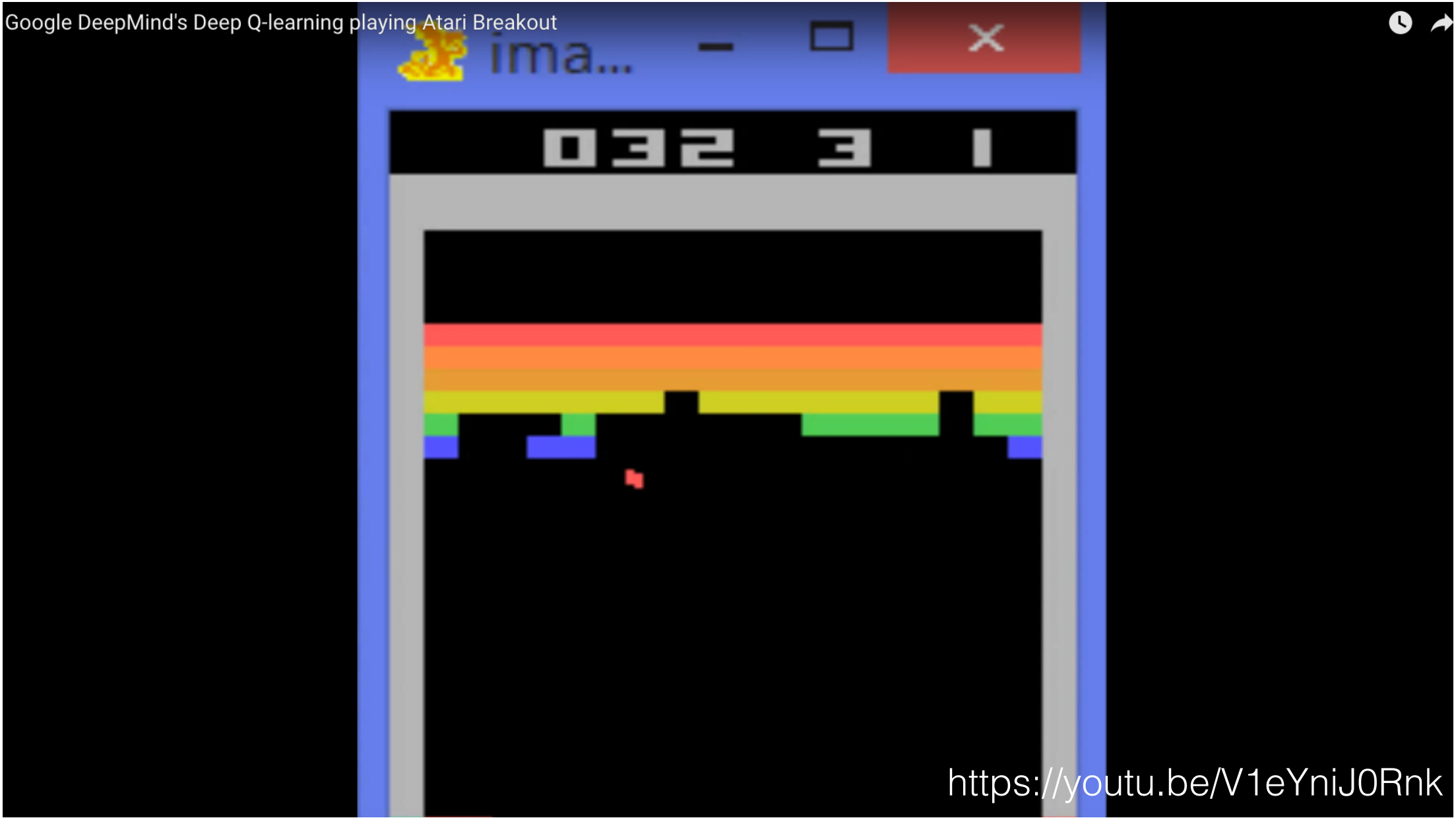
*GU et al. at HKUST with MSRA

Speech recognition errors



Baidu Research

Andrew Ng


Google DeepMind's Deep Q-learning playing Atari Breakout
ima...
032 3 1
https://youtu.be/V1eYniJ0Rnk


ALPHAGO
01:58:30
LEE SEDOL
01:59:11
Mind
Match
AlphaGo
Lee Sedol

Geoffrey Hinton's summary of findings up to today

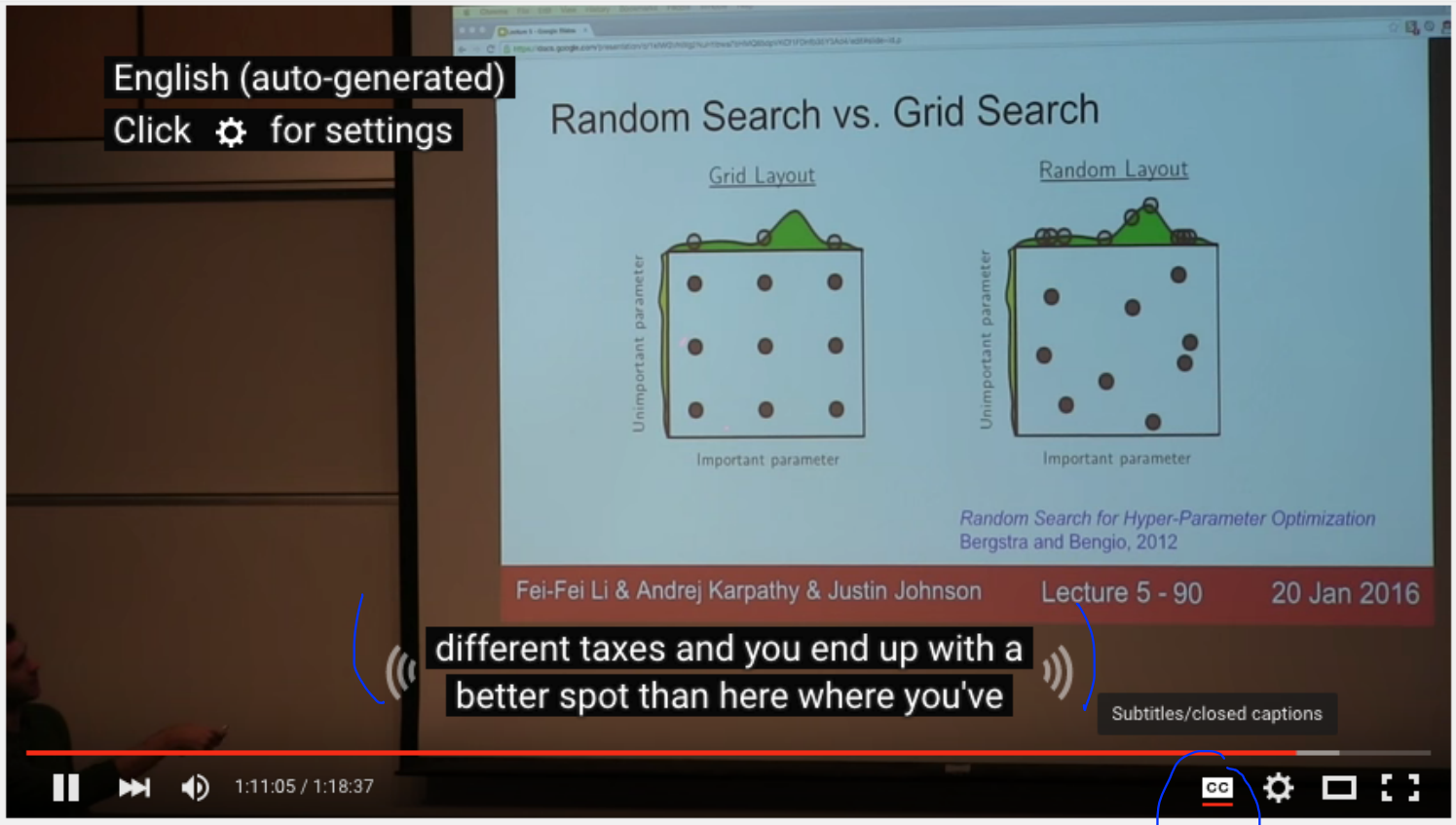
- Our labeled datasets were thousands of times too small.
- Our computers were millions of times too slow.
- We initialized the weights in a stupid way.
- We used the wrong type of non-linearity.

http://www.andreykurenkov.com/writing/a-brief-history-of-neural-nets-and-deep-learning-part-4/

Why should I care?

- *I am not a researcher, not a computer scientist!*

- Do you have data?
- Do you sell something?
- Are doing any business?



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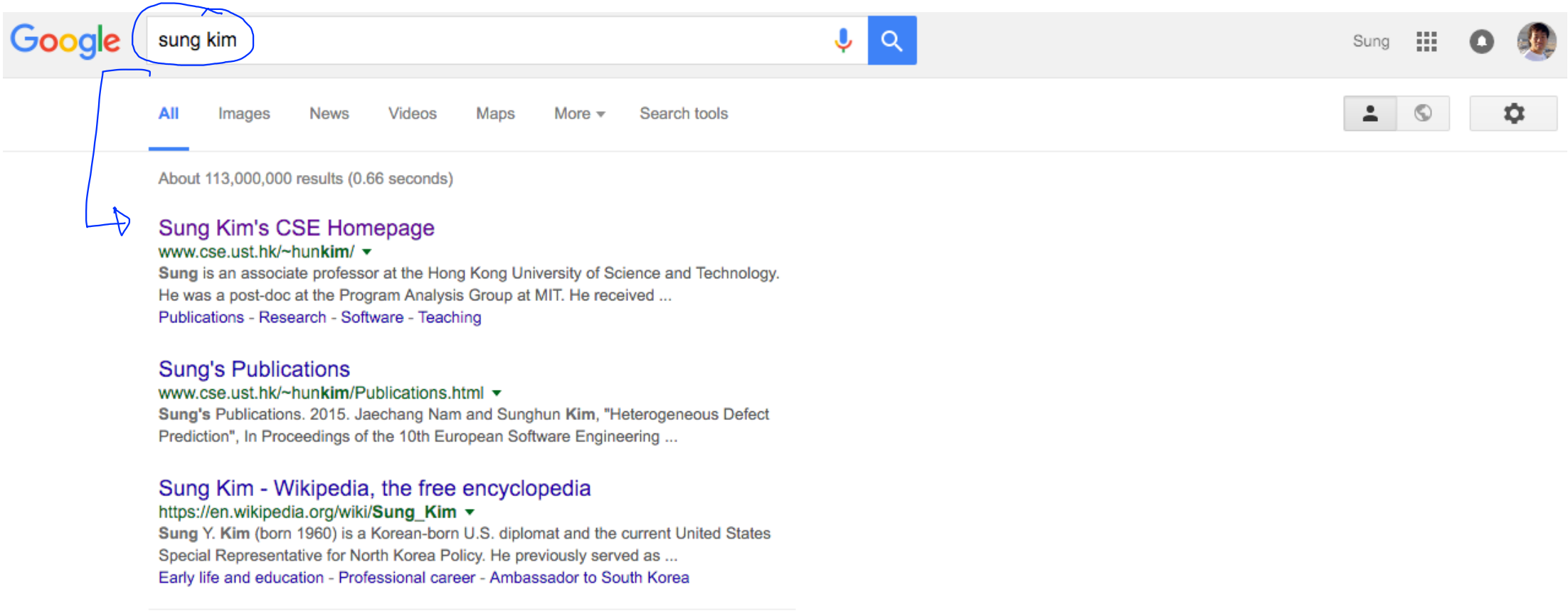
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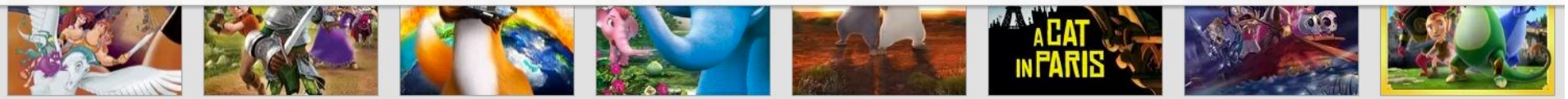
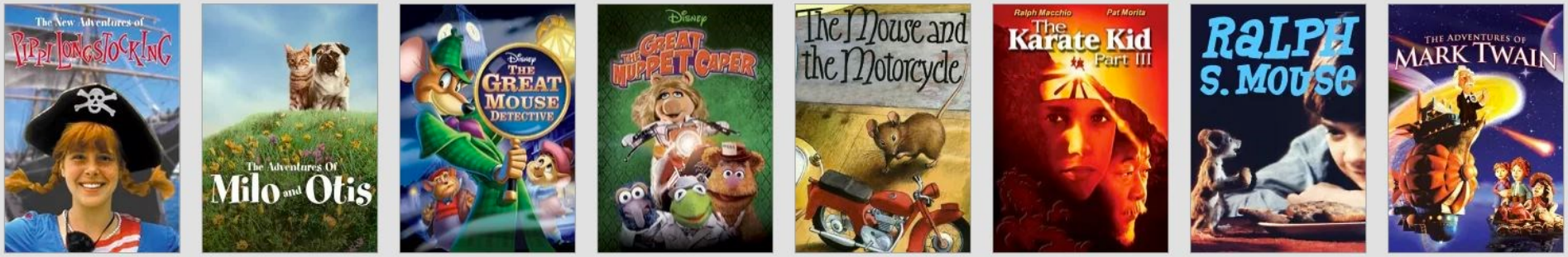


Family Adventures from the 1980s

Based on your interest in...



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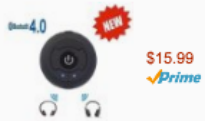

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  - many ready-to-use tools such as TensorFlow
  - Many easy/simple programming languages such as Python
- **After all, it is fun!**

Next

Neural Nets Basic with XOR!