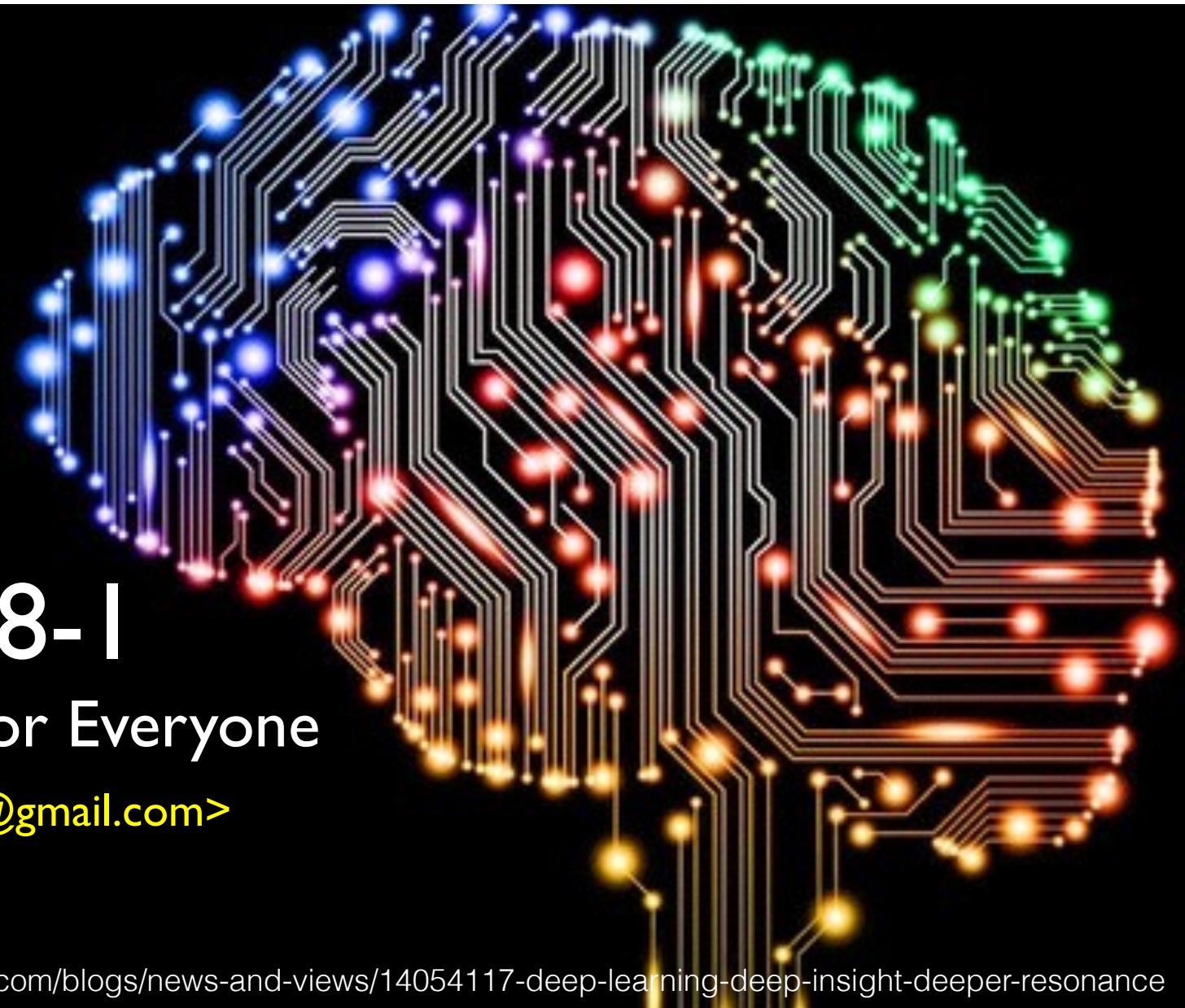


Lecture 8-1

Deep Neural Nets for Everyone

Sung Kim <hunkim+mr@gmail.com>

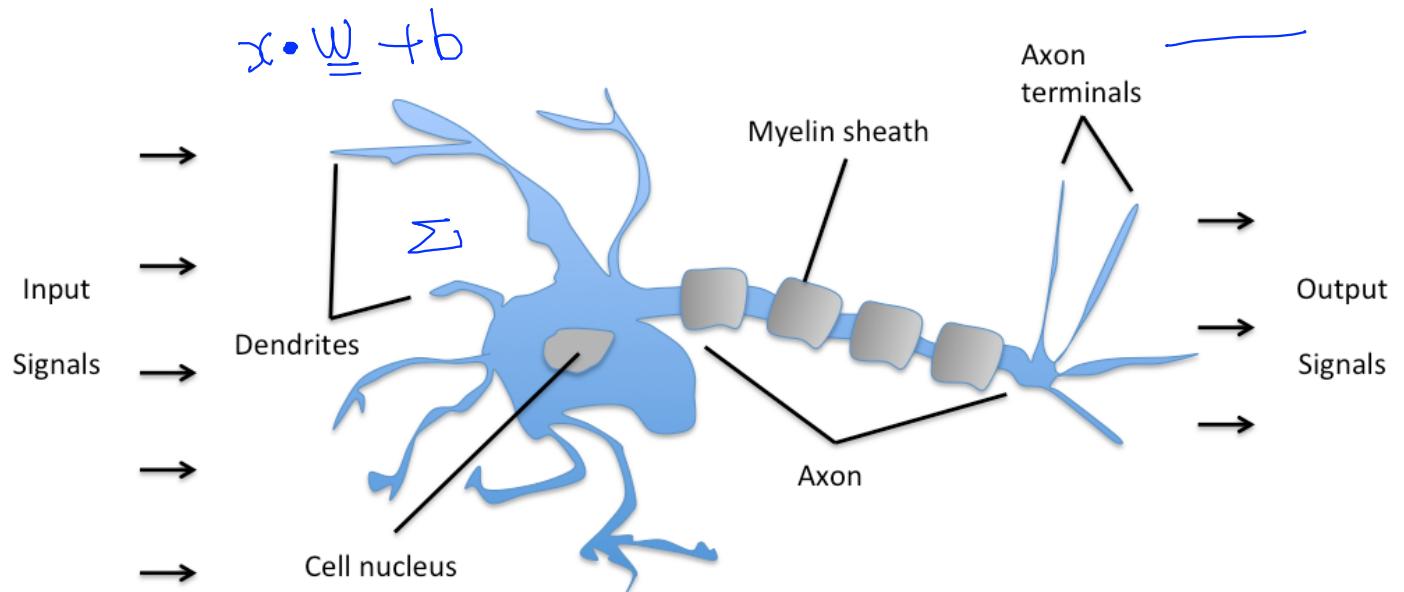
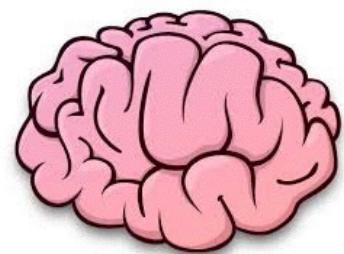
<http://www.contagious.com/blogs/news-and-views/14054117-deep-learning-deep-insight-deeper-resonance>



Ultimate dream: thinking machine

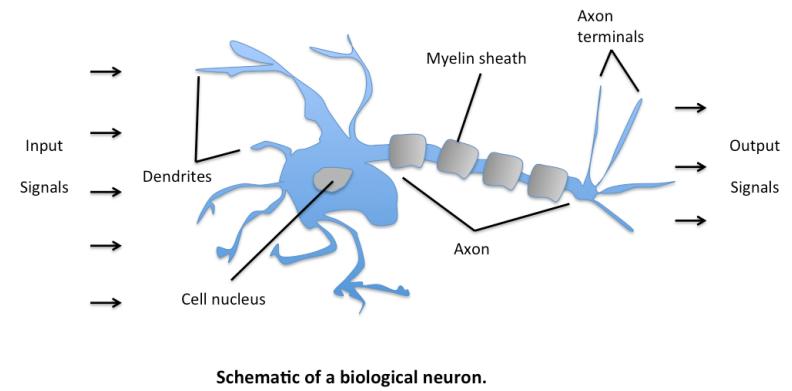
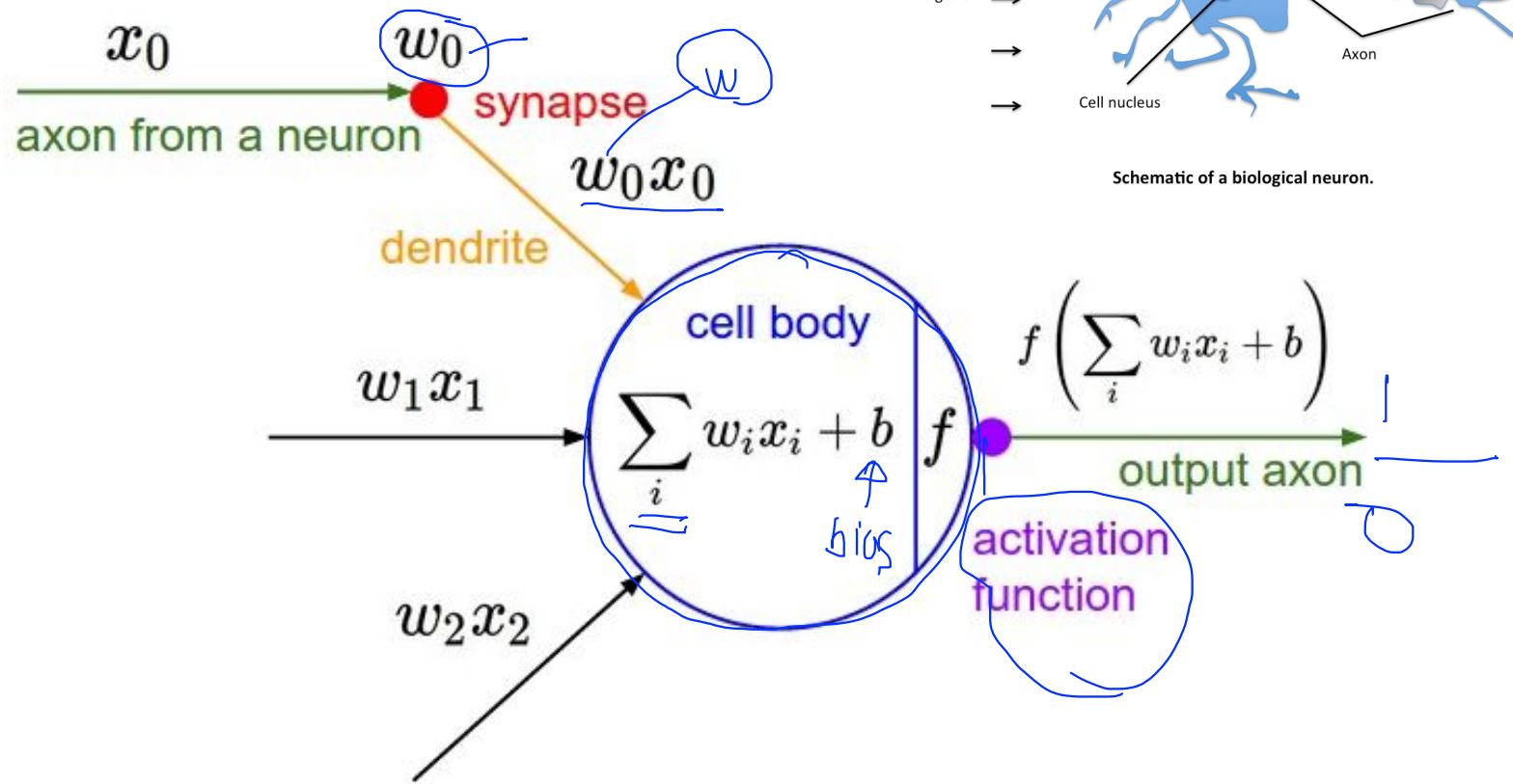


Ultimate dream: thinking machine



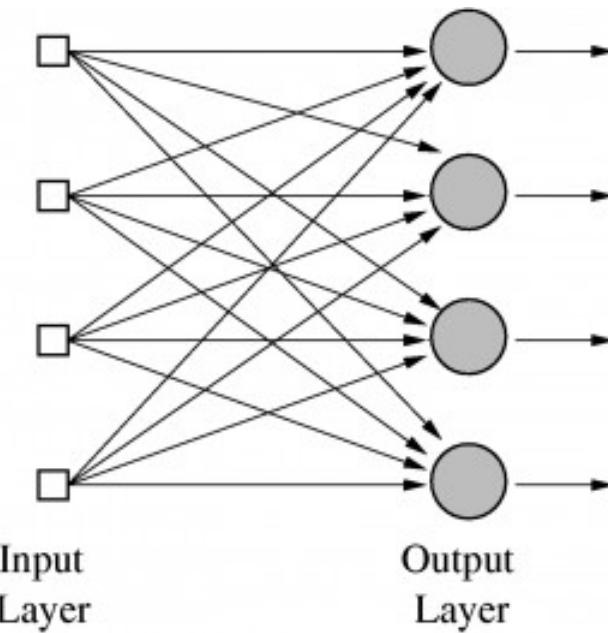
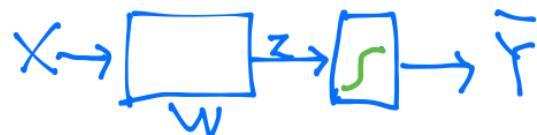
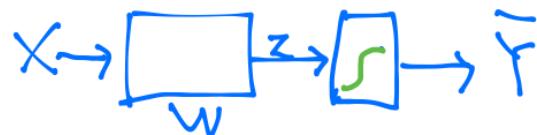
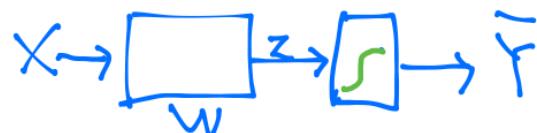
Schematic of a biological neuron.

Activation Functions

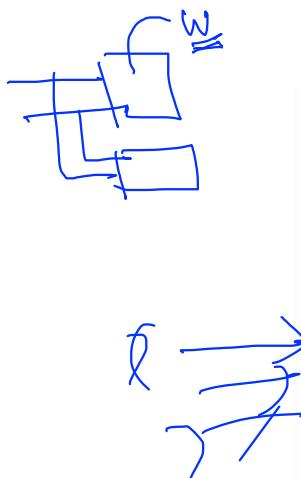
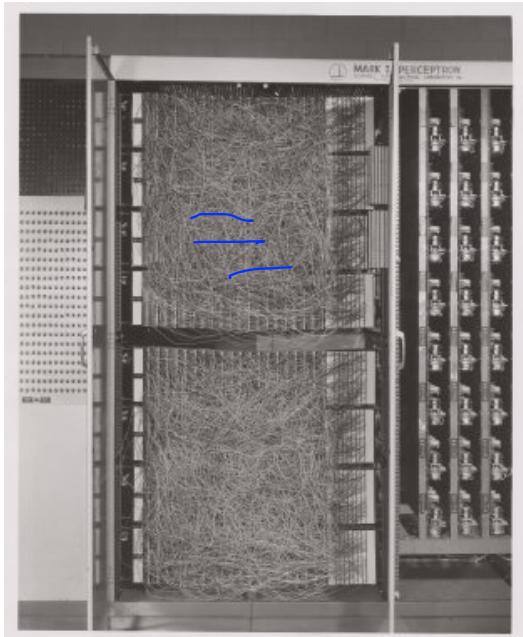


Schematic of a biological neuron.

Logistic regression units



Hardware implementations



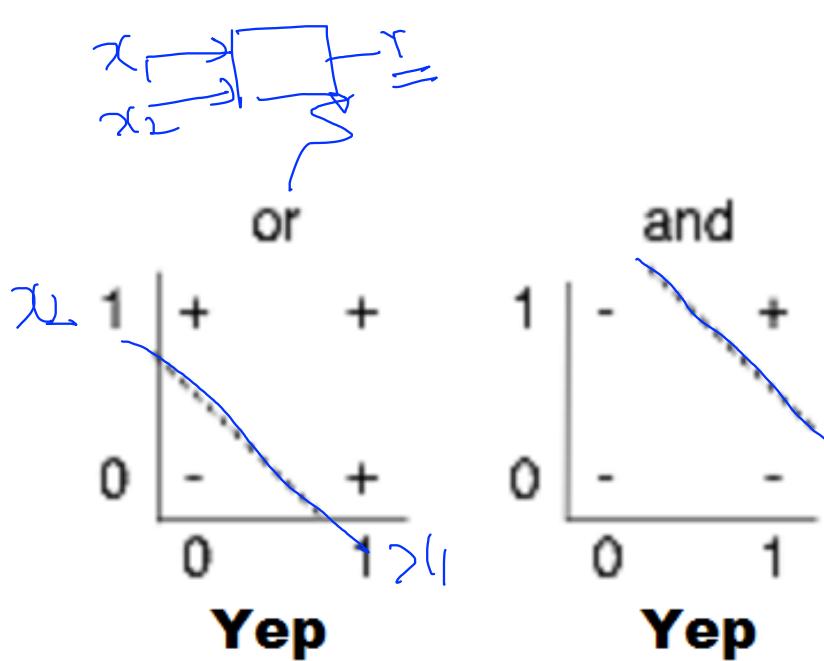
Frank Rosenblatt, ~1957: Perceptron

Widrow and Hoff, ~1960: Adaline/Madaline

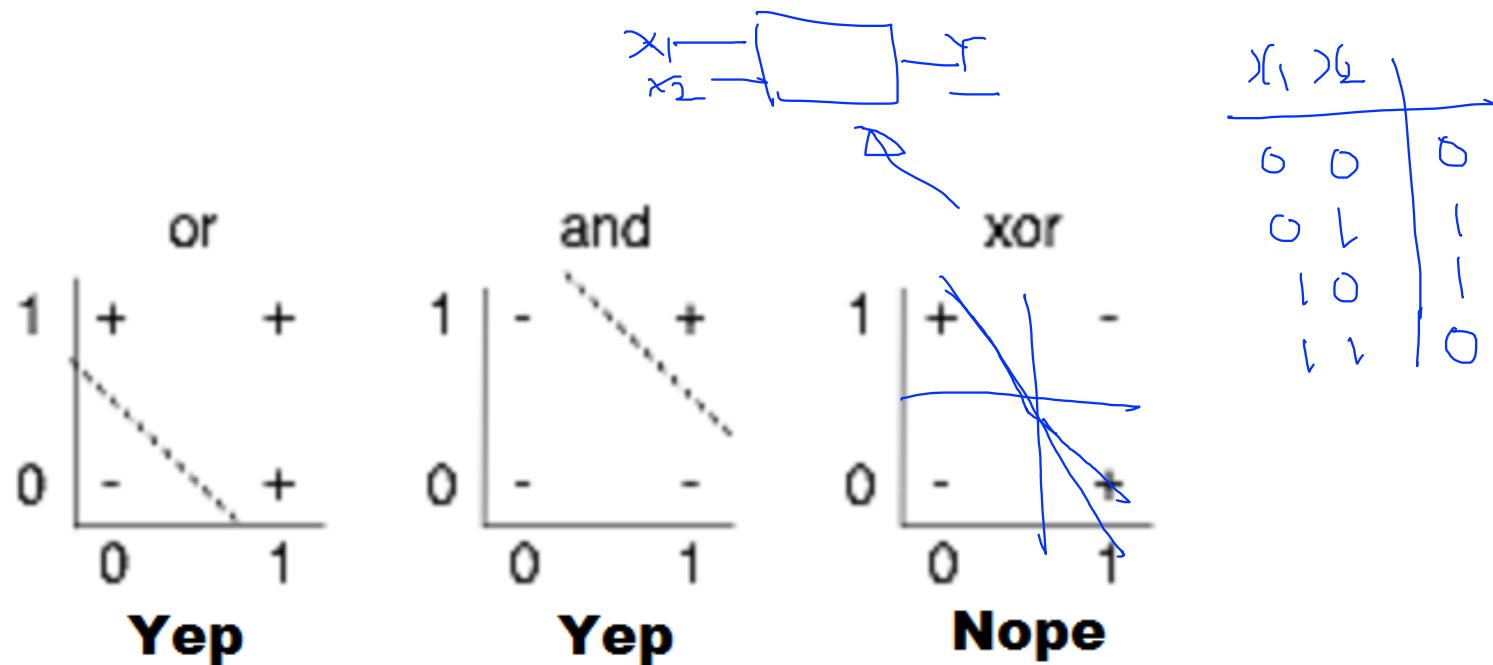
False Promises

“The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be ~~conscious~~ 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

(Simple) AND/OR problem: linearly separable?

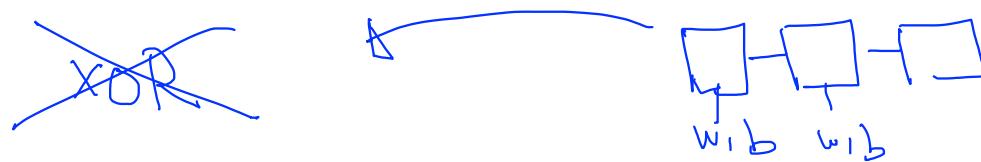
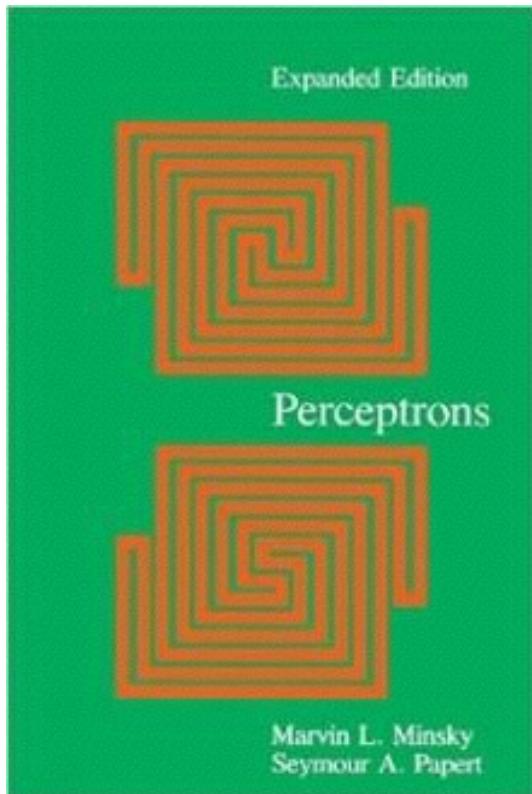


(Simple) XOR problem: linearly separable?



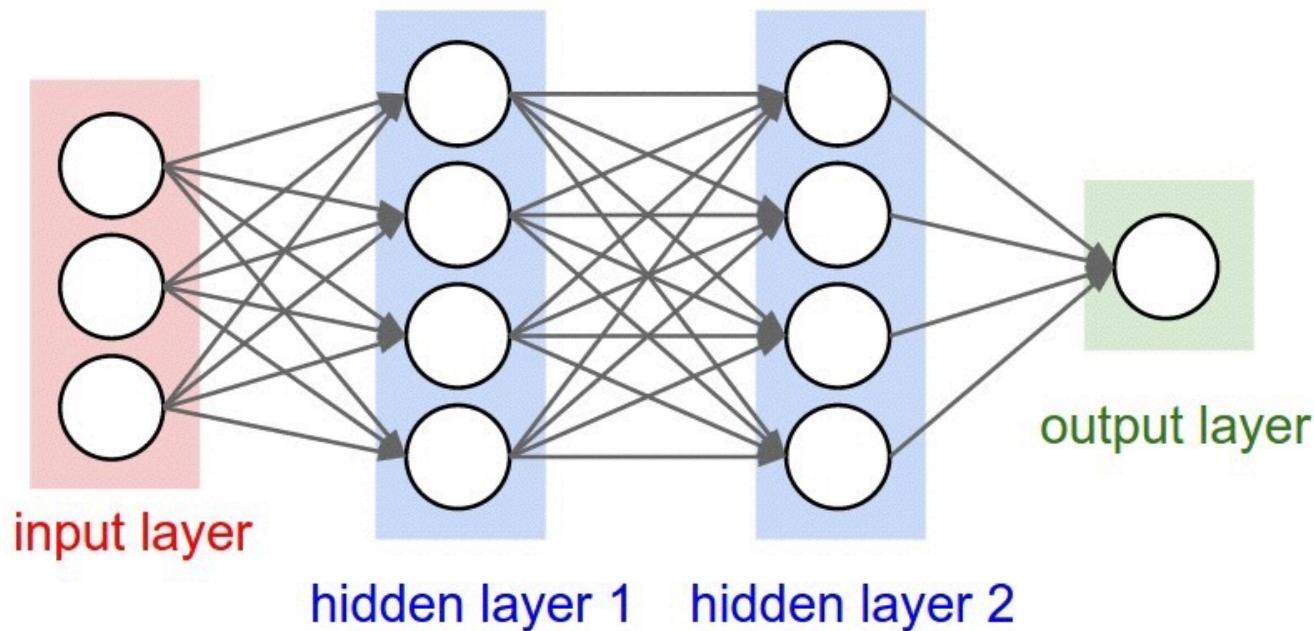
Perceptrons (1969)

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

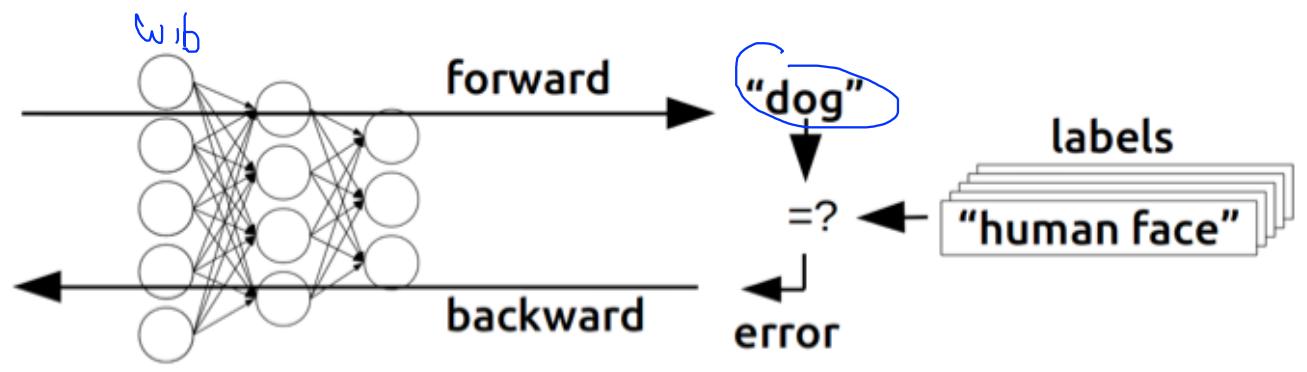
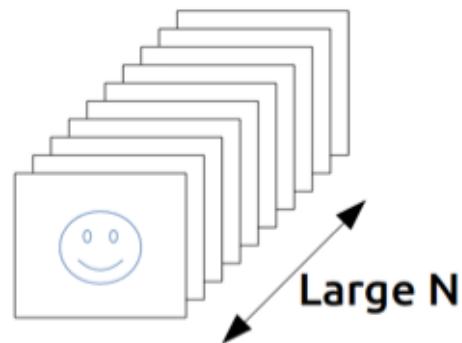
<http://cs231n.github.io/convolutional-networks/>

Backpropagation

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

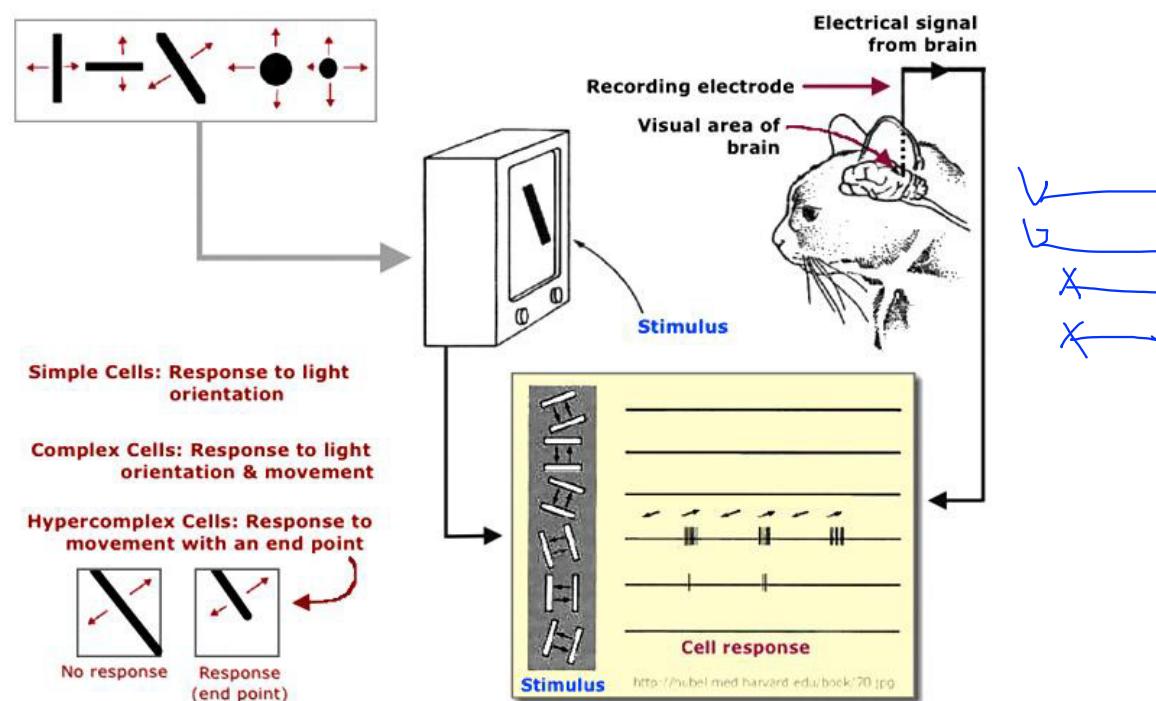


Training



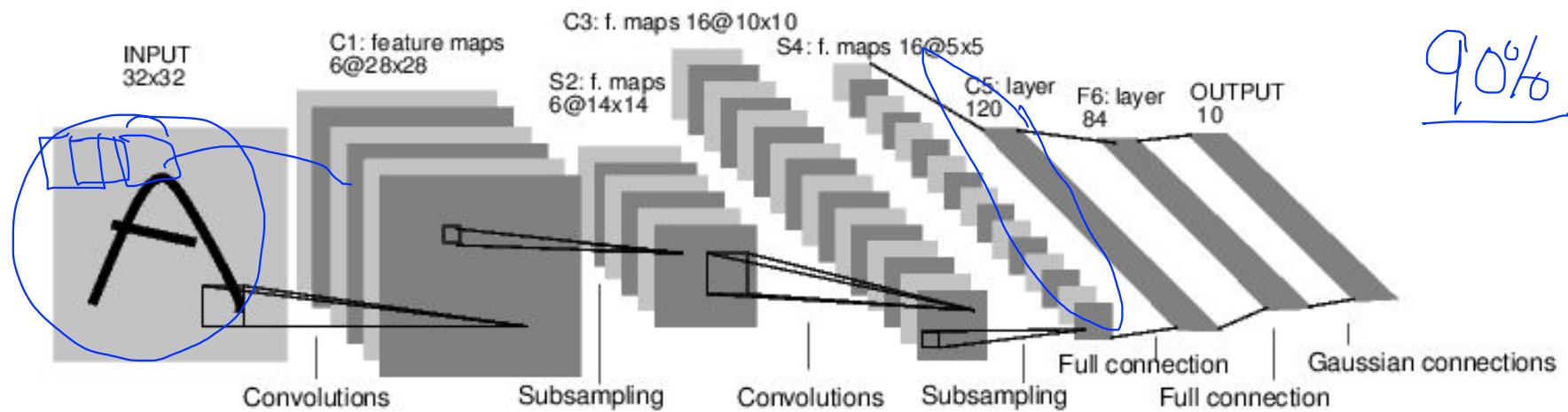
<https://devblogs.nvidia.com/parallelforall/inference-next-step-gpu-accelerated-deep-learning/>

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]

NavLab 1984 - 1994



“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.

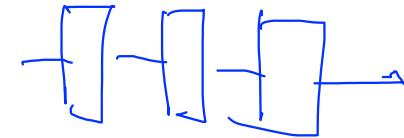
SARAH: And **Skynet** fights back.

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

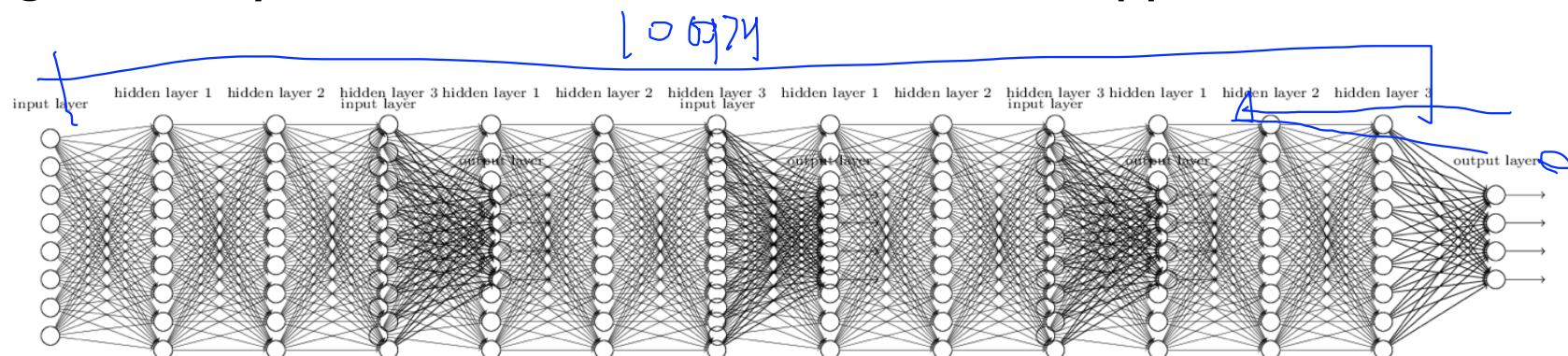
SARAH: Why attack Russia?

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

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/>

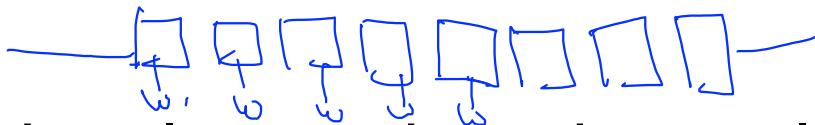
“Everyone else was doing something different”

- “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

- 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

IMAGENET Large Scale Visual Recognition Challenge

Steel drum

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



Output:
Scale
T-shirt
Steel drum
Drumstick
Mud turtle

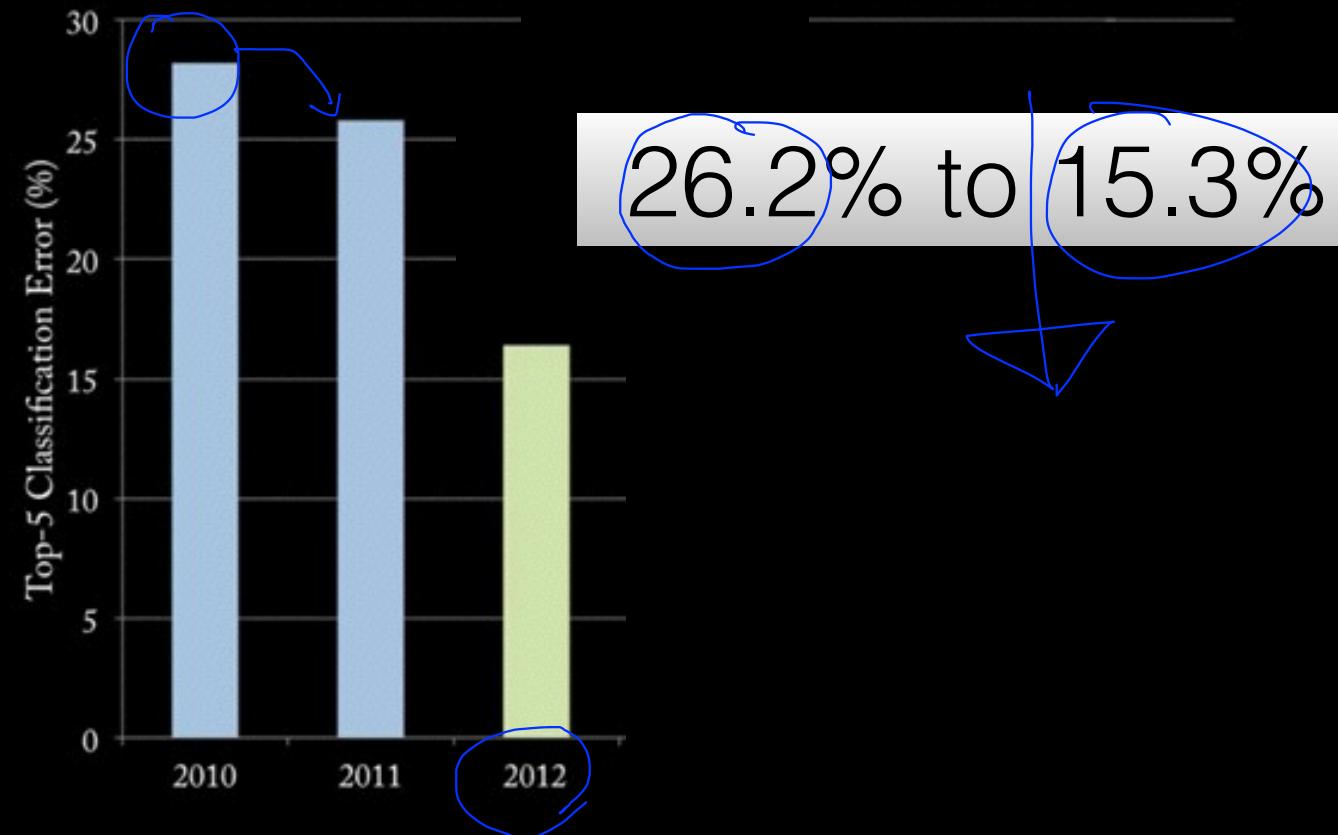


Output:
Scale
T-shirt
Giant panda
Drumstick
Mud turtle

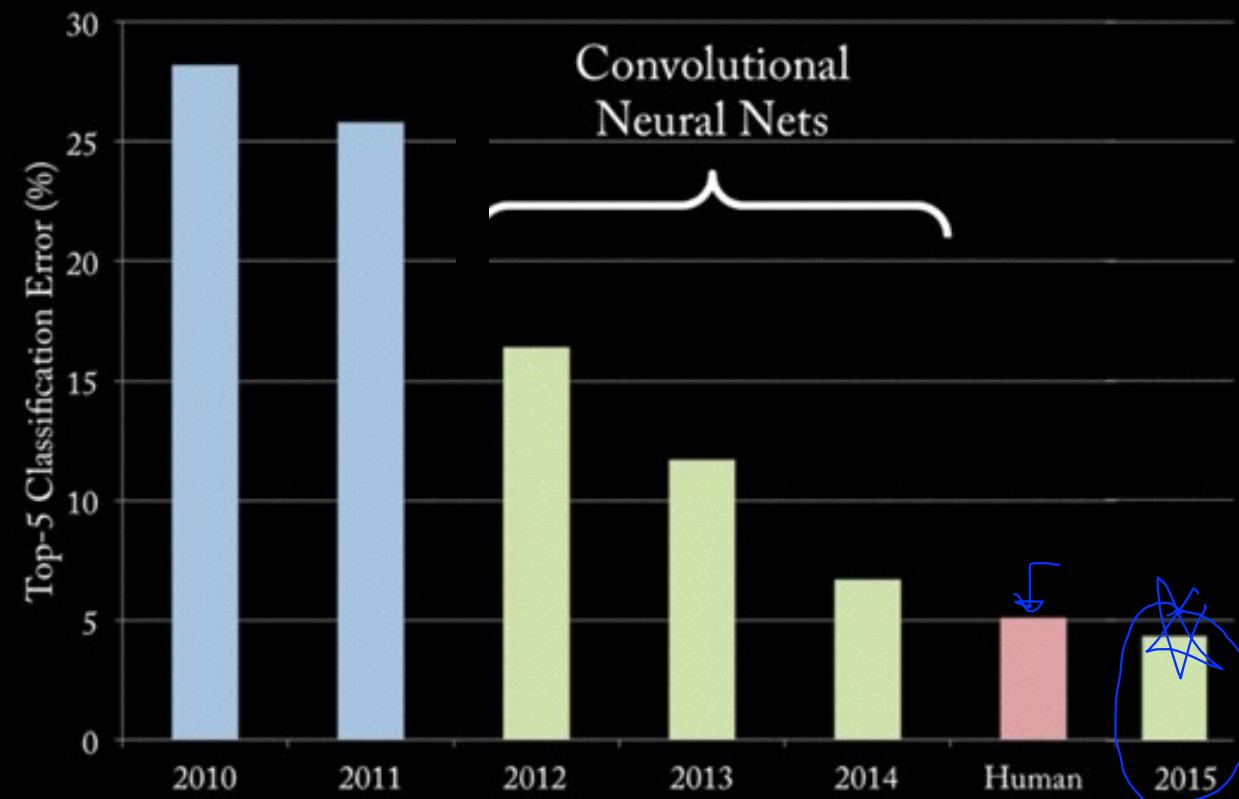


Russakovsky et al. arXiv, 2014

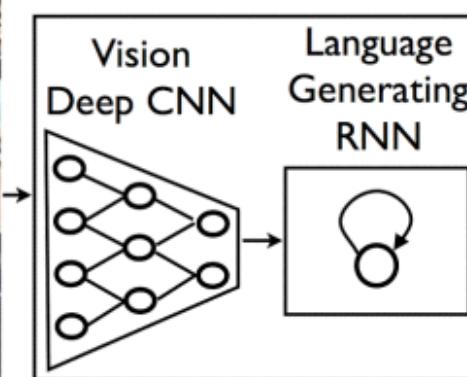
ImageNet Classification (2010 -



ImageNet Classification (2010 – 2015)



Neural networks that can explain photos



**A group of people
shopping at an
outdoor market.**

**There are many
vegetables at the
fruit stand.**

Deep API Learning*

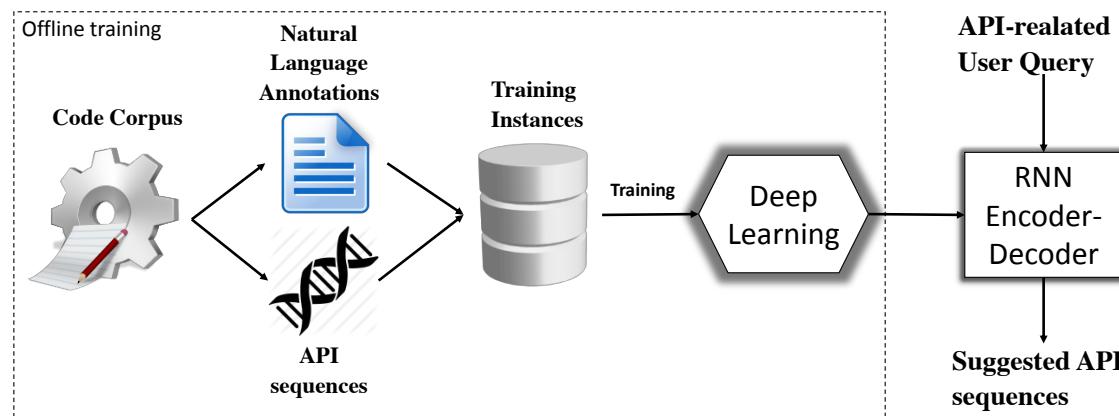
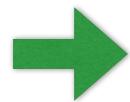


Figure 3: The Overall Workflow of DEEPAPI

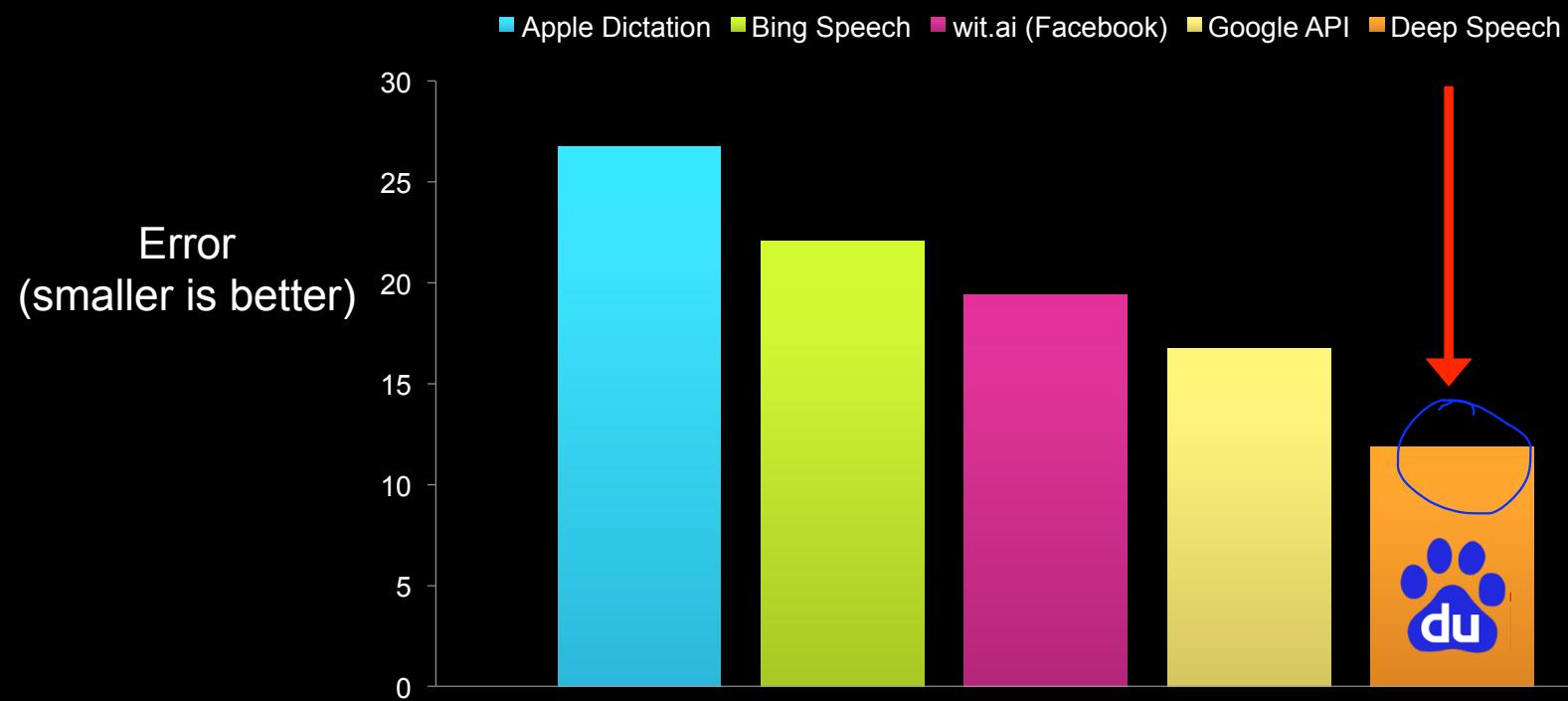
copy a file and save it to
-your destination path ↗



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

*GU et al. at HKUST with MSRA

Speech recognition errors



Google DeepMind's Deep Q-learning playing Atari Breakout



<https://youtu.be/V1eYniJ0Rnk>



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.

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?

English (auto-generated)
Click for settings

Random Search vs. Grid Search

Random Search for Hyper-Parameter Optimization
Bergstra and Bengio, 2012

Fei-Fei Li & Andrej Karpathy & Justin Johnson Lecture 5 - 90 20 Jan 2016

different taxes and you end up with a better spot than here where you've

Subtitles/closed captions

CC

1:11:05 / 1:18:37

CS231n Winter 2016: Lecture 5: Neural Networks Part 2

Andrej Karpathy

Subscribed 2,608

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11,097

87 1

Up next



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Andrej Karpathy
9,821 views



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Convolutional Neural Networks
Andrej Karpathy
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Visualization, Deep Dream, Neural Style,
Andrej Karpathy
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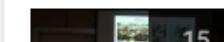
CS231n Winter 2016: Lecture 15: Invited
Talk by Jeff Dean
Andrej Karpathy
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Introducing arxiv-sanity
Andrej Karpathy
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CS231n Winter 2016: Lecture 3: Linear
Classification 2, Optimization
Andrej Karpathy
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CS231n Winter 2016



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Sung Kim

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15

Events

Photos

소프트웨어스토리

ISSTA

2

I'm a runner

누가 이법안을 발의 했나?

1

시와 날씨

Top Photos

1

TensorFlow KR

Saved

11

PAGES

IEEE Transactions... 20+

Like Pages

14

Pages Feed

20+

Create Page

Create Ad

Update Status

Add Photos/Video

Create Photo Album



What's on your mind?

Public

Post



ISSTA

Published by Andreas Zeller [?] · 45 mins ·

Doing a PhD in Software Testing and Analysis? Submit to the ISSTA 2016 Doctoral Symposium by April 22! Featuring a keynote by Alex Orso! Details: <https://issta2016.cispa.saarland/doctoralsymposium/>

Call for doctoral symposium submissions

ISSTA is the leading research symposium in software testing and analysis, bringing together academics, industrial researchers, and practitioners to exchange new ideas, problems, and experiences on how to test and analyze software systems. The ISSTA Doctoral Symposium is a forum for PhD students work...

ISSTA2016.CISPA.SAARLAND

38 people reached

Boost Post

Stevão Andrade



YOUR ADS

누가 이법안을 발의 했나? 1

This Week

3

Post Reach

1

People Engaged

Recent Posts

 각 의원님들 보실때 이름 밑의 bar로 표시된 처...

Boost Post

 누가 이법안을 발의 했나? updated their co...

▼ See More

Ads Shortcuts

2 event invites

Sungjin Kim's birthday is today

INVITE FRIENDS TO LIKE PAGES

 HKUST Water Sports Center
Sports Center
Invite Friends

Amazon Web Services

A screenshot of a Google search results page. The search bar at the top contains the query "sung kim". Below the search bar are several navigation links: All (highlighted with a blue bracket and arrow), Images, News, Videos, Maps, More ▾, and Search tools. To the right of these are user profile icons for "Sung" and other account options. The main content area shows search results. At the top of the results is a snippet for "Sung Kim's CSE Homepage" from the URL www.cse.ust.hk/~hunkim/. Below this, there is a brief description of Sung Kim as an associate professor at Hong Kong University of Science and Technology, mentioning his post-doc work at MIT. Further down, there is a link to "Sung's Publications" from the same URL, listing a publication from 2015. At the bottom of the results is a link to "Sung Kim - Wikipedia, the free encyclopedia" with the URL https://en.wikipedia.org/wiki/Sung_Kim.

About 113,000,000 results (0.66 seconds)

Sung Kim's CSE Homepage

www.cse.ust.hk/~hunkim/ ▾

Sung is an associate professor at the Hong Kong University of Science and Technology.

He was a post-doc at the Program Analysis Group at MIT. He received ...

Publications - Research - Software - Teaching

Sung's Publications

www.cse.ust.hk/~hunkim/Publications.html ▾

Sung's Publications. 2015. Jaechang Nam and Sunghun Kim, "Heterogeneous Defect Prediction", In Proceedings of the 10th European Software Engineering ...

Sung Kim - Wikipedia, the free encyclopedia

https://en.wikipedia.org/wiki/Sung_Kim ▾

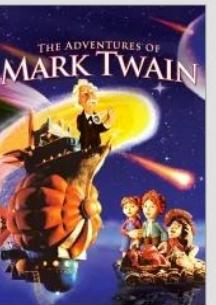
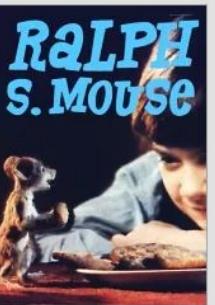
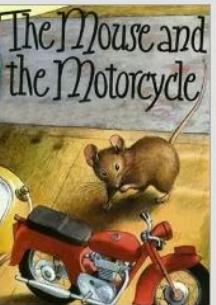
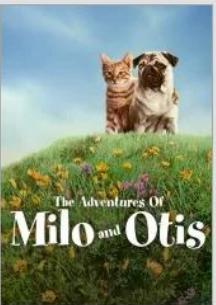
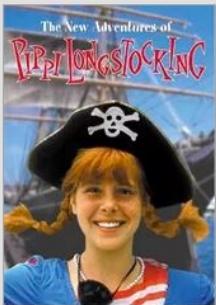
Sung Y. Kim (born 1960) is a Korean-born U.S. diplomat and the current United States Special Representative for North Korea Policy. He previously served as ...

Early life and education - Professional career - Ambassador to South Korea



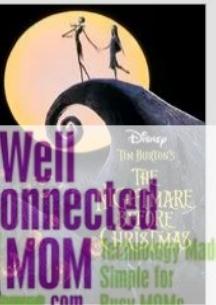
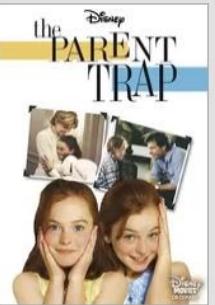
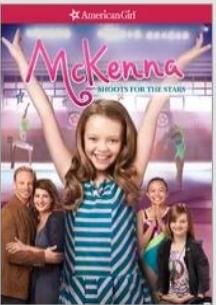
Family Adventures from the 1980s

Based on your interest in...



Family Comedies

Based on your interest in...



amazon Prime

All ▾

Departments ▾ Shopping History ▾ Sung's Amazon.com Today's Deals Gift Cards Sell Help

Hello, Sung
Your Account ▾ Prime ▾ Lists ▾

Cart Subtotal: \$15.99 ▾

1 Cart

66 recent changes in Cart

Proceed to checkout

fire TV \$99⁹⁹

NOW WITH 4K ULTRA HD AND ALEXA

Hi, Sung

On Order 0 items Alexa Shopping List 2 items ▾ Audible Limited Time Offer Get 3 free audiobooks ▾ Customer Since 1999

More items to consider See more

New for you See more

Get set for spring

Best of Prime Music See playlist

Best-selling laptops

The image shows the Amazon homepage with a dark header. At the top left is the 'amazon Prime' logo. To its right is a search bar with a magnifying glass icon. Further right are account details ('Hello, Sung'), account management links ('Your Account ▾ Prime ▾ Lists ▾'), and a shopping cart icon with a '1' and a subtotal of '\$15.99 ▾'. Below the header is a large promotional banner for the Fire TV, showing a remote and a device, with the text 'fire TV \$99⁹⁹' and 'NOW WITH 4K ULTRA HD AND ALEXA'. Below this are several user-specific sections: 'Hi, Sung', 'On Order 0 items', 'Alexa Shopping List 2 items ▾', 'Audible Limited Time Offer Get 3 free audiobooks ▾', and 'Customer Since 1999'. Underneath these are two main promotional sections: 'More items to consider' (with a 'See more' link) and 'New for you' (with a 'See more' link). The 'More items to consider' section shows images of a drawing tablet and stylus, a pen, and a smartphone. The 'New for you' section shows book covers for 'The Travelers' by Helen Simonson, 'SPRINT: SOLVE BIG PROBLEMS AND TEST NEW IDEAS IN JUST FIVE DAYS' by Mike Kotch, and 'SUMMARY & ANALYSIS THE BOYS IN THE BOAT' by Daniel James Brown. To the right of these are two more sections: 'Get set for spring' (showing a flower cart) and 'Best of Prime Music' (showing a photo of One Direction). At the bottom right is a section for 'Best-selling laptops'.



Why Now?

- Students/Researchers
 - Not too late to be a world expert
 - Not too complicated (mathematically)
- Practitioner]
 - Accurate enough to be used in practice
 - 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!

