Fascinating Tales of a Strange Tomorrow

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Pop-up Loft
TEL AVIV

1956

Dartmouth Summer Research Project

John McCarthy

Coined the term “Artificial Intelligence”

Invented LISP (1958)

Received Turing Award (1971)

Forbidden Planet

Robbie the Robot

Predictions

- 1958 H. A. Simon and Allen Newell: "*within 10 years a digital computer will be the world's chess champion*" and "*within 10 years a digital computer will discover and prove an important new mathematical theorem*"
- 1965 H. A. Simon: "*machines will be capable, within 20 years, of doing any work a man can do*"
- 1967 Marvin Minsky: "*Within a generation ... the problem of creating 'artificial intelligence' will substantially be solved*."
- 1970 Marvin Minsky: "*In from 3 to 8 years we will have a machine with the general intelligence of an average human being*"

https://en.wikipedia.org/wiki/History_of_artificial_intelligence

“It’s 2001. Where is HAL?”

Marvin Minsky
Co-founded the MIT AI lab (1959)
Advised Kubrick on 2001: A Space Odyssey (1968)
Received Turing Award (1969)

HAL 9000
HAL Laboratories (1992)

Meanwhile, on the US West Coast…

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Millions of users… Mountains of data… Commodity hardware…
Bright engineers… Need to make money….

Gasoline waiting for a match!

The Machine Learning explosion

- 12/2004 - Google publishes Map Reduce paper
- 04/2006 - Hadoop 0.1

- 05/2009 – Yahoo sorts a Terabyte in 62 seconds
- The rest is history

Fast forward a few years

- ML is now a commodity
- Great, but still no HAL in sight
- Traditional Machine Learning doesn't work well with complex problems such as computer vision, computer speech or natural language processing
- Another AI winter, then?

Neural networks

- Through training, a neural network self-organizes and discovers features automatically: the more data, the better (unlike traditional ML)

- "Universal approximation machine" (Andrew Ng)
  - Artificial Intelligence is the New Electricity https://www.youtube.com/watch?v=21EiKfQYZXc

- Not new technology!
  - Perceptron (Rosenblatt, 1958)
  - Backpropagation (Werbos, 1975)

- They failed back then because
  - data sets were too small
  - computing power was not available

Why it's different this time

- Large data sets are available
  - Imagenet : 14M+ images http://www.image-net.org/
- GPUs and FPGAs deliver unprecedented amounts of computing power.
  - It's now possible to train networks that have hundreds of layers
- Scalability and elasticity are key assets for Deep Learning
  - Grab a lot of storage and compute resources for training, then release them
  - Using a DL model is lightweight: you can do it on a Raspberry Pi!

I for one welcome our new Deep Learning Overlords

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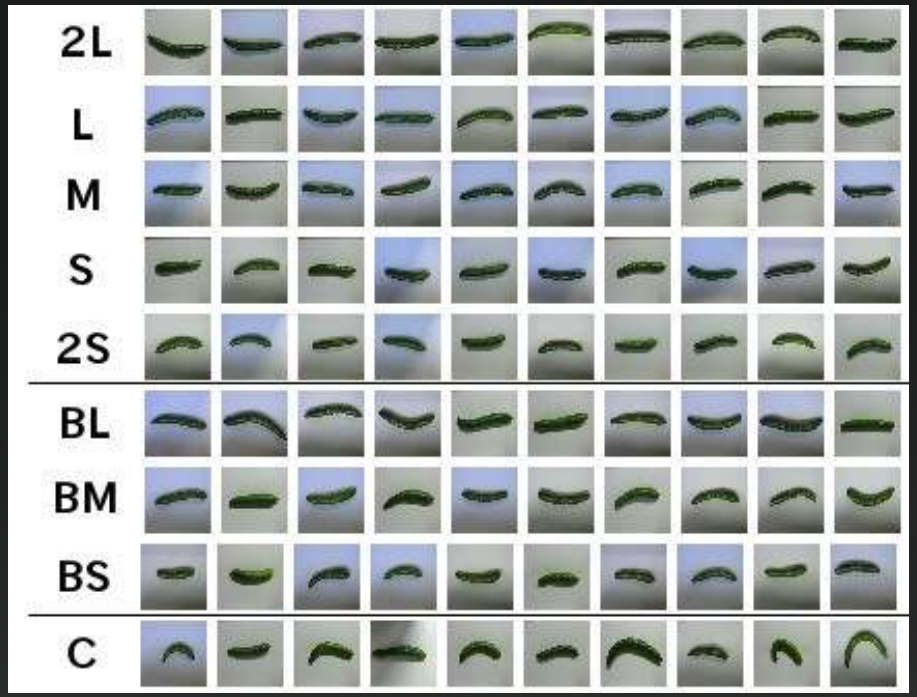
Sorting cucumbers in Japan



https://cloud.google.com/blog/big-data/2016/08/how-a-japanese-cucumber-farmer-is-using-deep-learning-and-tensorflow

Detecting plant diseases

https://blogs.nvidia.com/blog/2016/12/13/ai-fights-plant-disease/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5032846/

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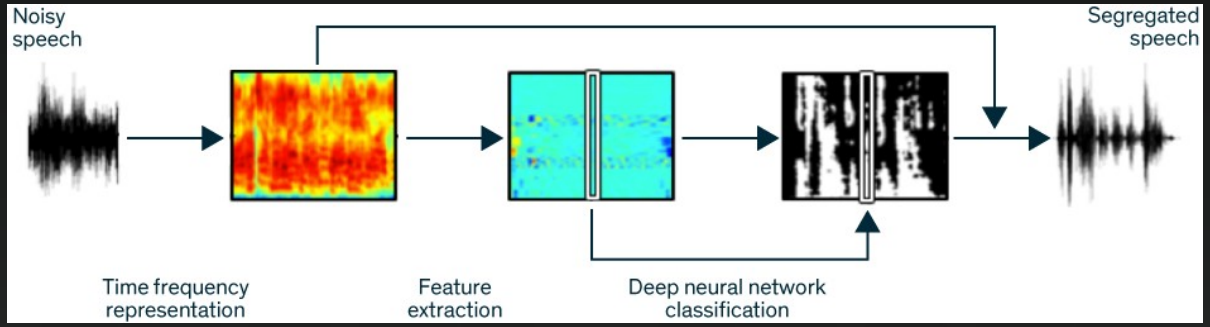
Improving hearing aids



http://spectrum.ieee.org/consumer-electronics/audiovideo/deep-learning-reinvents-the-hearing-aid

Flipping burgers

Flippy

http://misorobotics.com/

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Amazon Echo

Now what?

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Dive as deep as you need to

AWS GPU Instances

- g2 (2xlarge, 8xlarge)
  - 32 vCPUs, 60 GB RAM
  - 4 NVIDIA K520 GPUs
  - 16 GB of GPU memory, 6144 CUDA cores
- p2 (xlarge, 8xlarge, 16xlarge)
  - 64 vCPUs, 732 GB RAM
  - 16 NVIDIA GK210 GPUs
  - 192 GB of GPU memory, 39936 CUDA cores
  - 20 Gbit/s networking

EC2 Instance Type	Total
g2.2xlarge	$0.65/hr
g2.8xlarge	$2.60/hr
p2.8xlarge	$7.20/hr
p2.xlarge	$0.90/hr
p2.16xlarge	$14.40/hr

https://aws.amazon.com/blogs/aws/new-g2-instance-type-with-4x-more-gpu-power/
https://aws.amazon.com/blogs/aws/new-p2-instance-type-for-amazon-ec2-up-to-16-gpus/
https://aws.amazon.com/ec2/Elastic-GPUs/

AWS Deep Learning AMI

- Deep Learning Frameworks – 5 popular Deep Learning Frameworks (mxnet, Caffe, Tensorflow, Theano, and Torch) all prebuilt and pre-installed
- Pre-installed components – Nvidia drivers, cuDNN, Anaconda, Python2 and Python3
- AWS Integration – Packages and configurations that provide tight integration with Amazon Web Services like Amazon EFS (Elastic File System)
- Amazon Linux & Ubuntu

https://aws.amazon.com/about-aws/whats-new/2017/03/deep-learning-ami-release-v2-0-now-available-for-amazon-linux/

mxnet

mxnet resources

http://mxnet.io/
https://github.com/dmlc/mxnet
https://github.com/dmlc/mxnet-notebooks

http://www.allthingsdistributed.com/2016/11/mxnet-default-framework-deep-learning-aws.ht

https://github.com/awslabs/deeplearning-cfn

mxnet demo

Deep Learning AMI on p2.16xlarge
Training and predicting the MNIST data set

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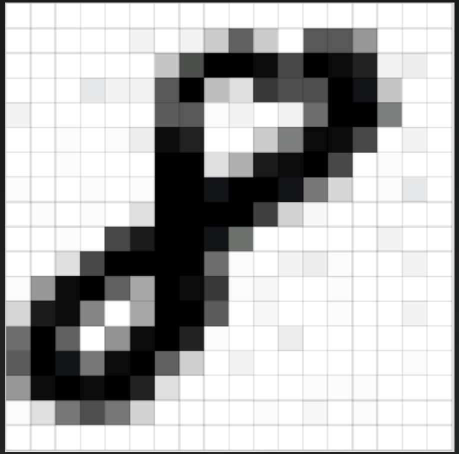
MNIST dataset

http://yann.lecun.com/exdb/mnist/

70,000 handwritten digits

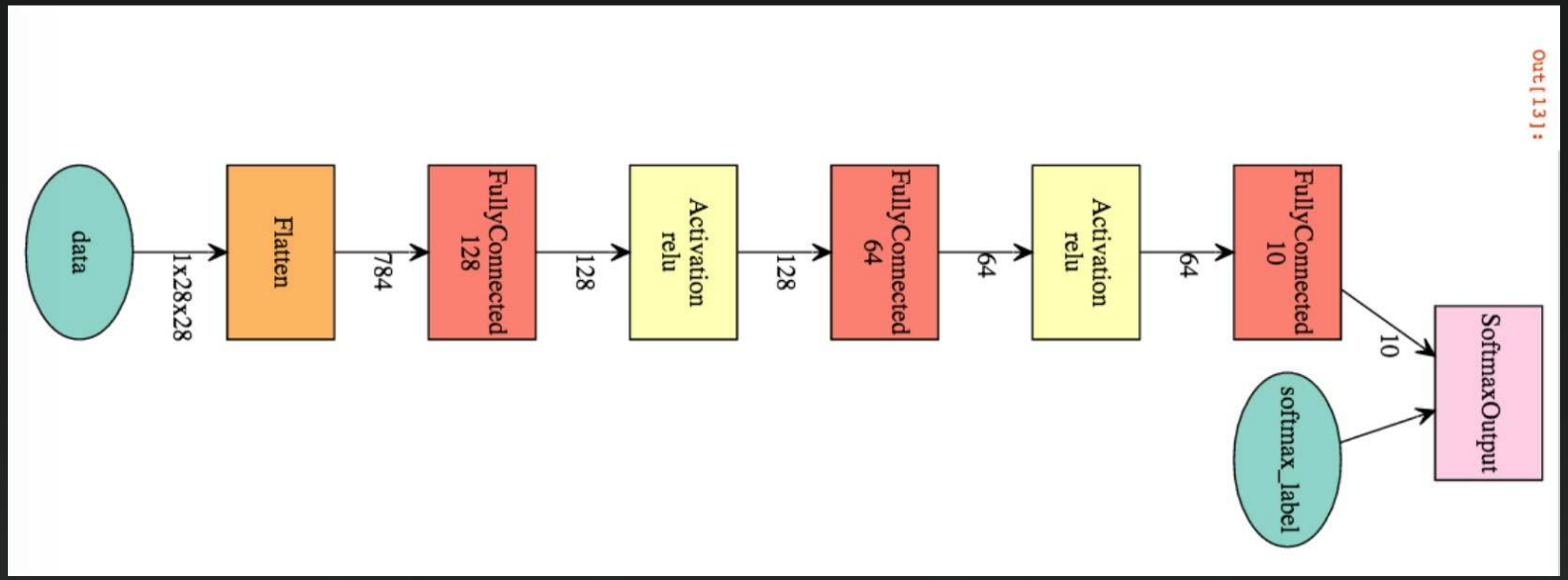
28x28 pixels

Greyscale (0 to 255)



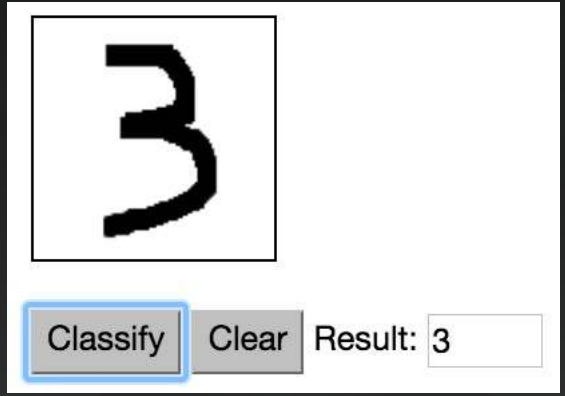
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	12	0	11	39	137	37	0	152	147	84	0	0	0
0	0	1	0	0	0	41	160	250	255	235	162	255	238	206	11	13	0
0	0	0	16	9	9	150	251	45	21	184	159	154	255	233	40	0	0
10	0	0	0	0	0	145	146	3	10	0	11	124	253	255	107	0	0
0	0	3	0	4	15	236	216	0	0	38	109	247	240	169	0	11	0
1	0	2	0	0	0	253	253	23	62	224	241	255	164	0	5	0	0
6	0	0	4	0	3	252	250	228	255	255	234	112	28	0	2	17	0
0	2	1	4	0	21	255	253	251	255	172	31	8	0	1	0	0	0
0	0	4	0	163	225	251	255	229	120	0	0	0	0	0	11	0	0
0	0	21	162	255	255	254	255	126	6	0	10	14	6	0	0	9	0
3	79	242	255	141	66	255	245	189	7	8	0	0	5	0	0	0	0
26	221	237	98	0	67	251	255	144	0	8	0	0	7	0	0	11	0
125	255	141	0	87	244	255	208	3	0	0	13	0	1	0	1	0	0
145	248	228	116	235	255	141	34	0	11	0	1	0	0	0	1	3	0
85	237	253	246	255	210	21	1	0	1	0	0	6	2	4	0	0	0
6	23	112	157	114	32	0	0	0	0	2	0	8	0	7	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

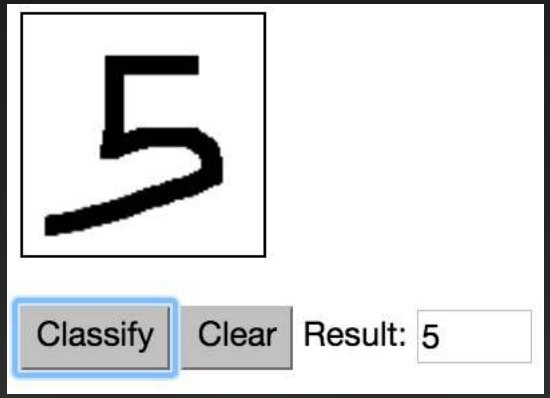
Multilayer perceptron



Train and test

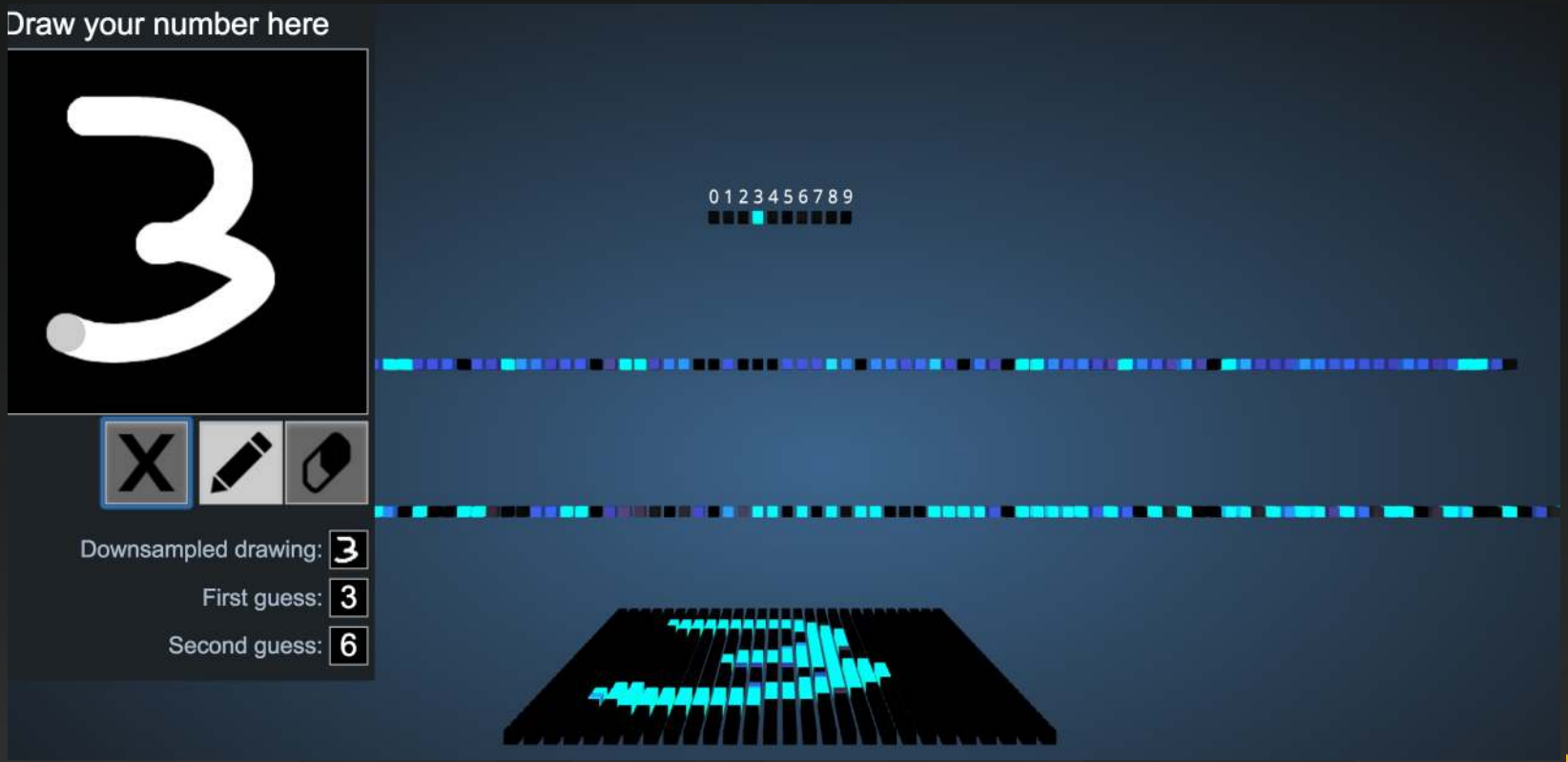
```
INFO:root:Epoch[9] Batch [5600]    Speed: 6475.51 samples/sec    Train-accuracy=0.987500
INFO:root:Epoch[9] Batch [5800]    Speed: 6541.05 samples/sec    Train-accuracy=0.988000
INFO:root:Epoch[9] Batch [6000]    Speed: 6481.38 samples/sec    Train-accuracy=0.988000
INFO:root:Epoch[9] Resetting Data Iterator
INFO:root:Epoch[9] Time cost=9.317
INFO:root:Epoch[9] Validation-accuracy=0.963600
```





Web visualization

http://scs.ryerson.ca/~aharley/vis/fc/



Now the hard questions…

- Can my business benefit from Deep Learning?
  - DL : “solving the tasks that are easy for people to perform but hard to describe formally”
- Should I build my own network?
  - Do I have the expertise?
  - Do I have enough time, data & compute to train it?
- Or should I use a pre-trained model?
  - How well does it fit my use case?
  - On what data was it trained?
- Or should I use a high-level service?

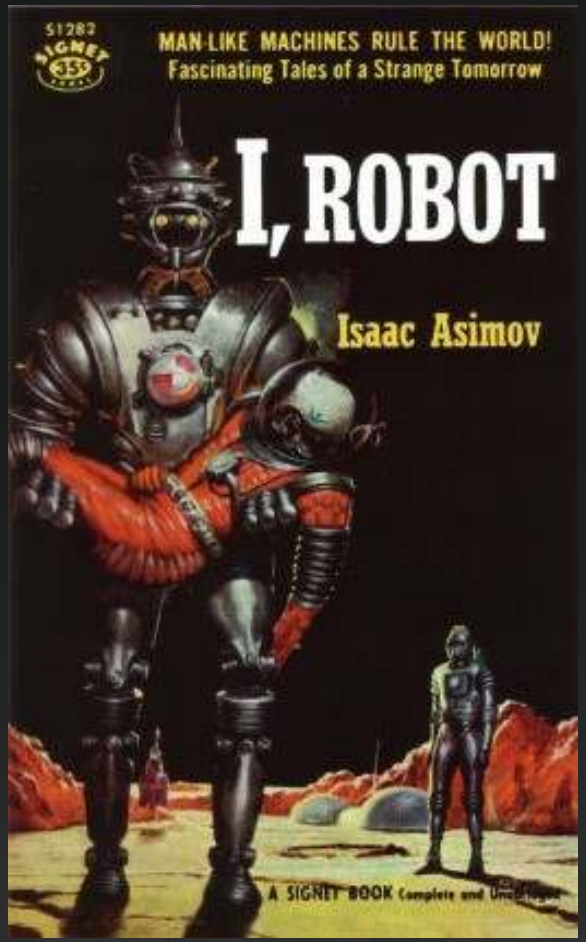
- Same questions as ML years ago ☺

Science catching up with Fiction ?

October 2014: Tesla Autopilot

October 2015: 30,000 robots in Amazon Fulfillment Centers

May 2016: AI defeats Lee Sedol, Go world champion



Will man-like machines rule the world?

Who knows?

Whatever happens, these will be fascinating tales of a strange tomorrow.

Thank You

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Your feedback is important to us!

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