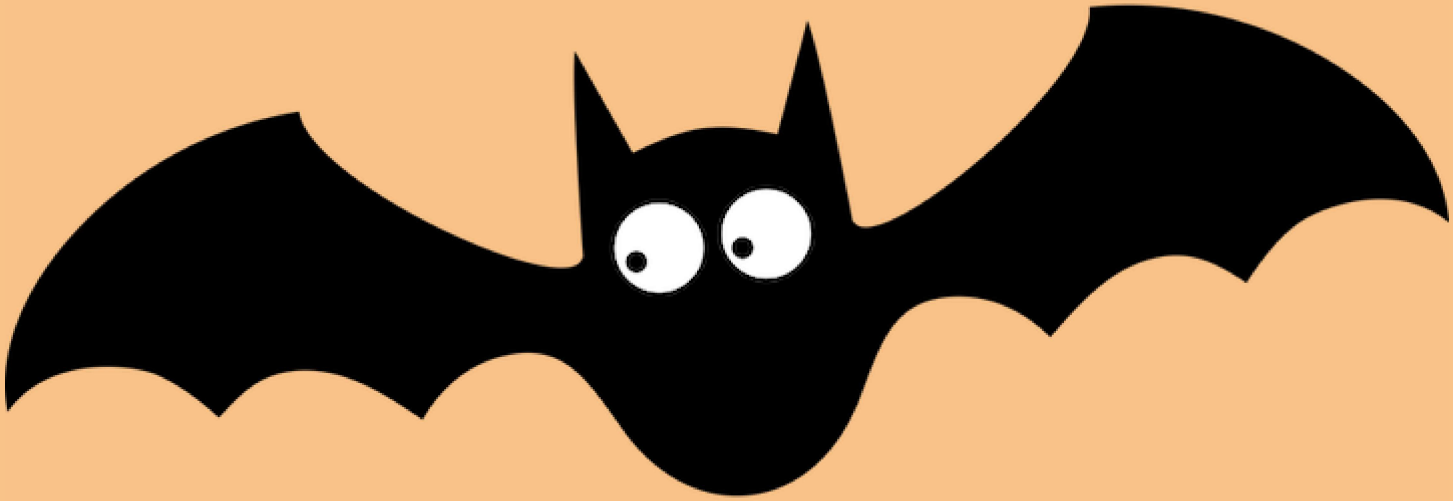


Deep Learning

Son Nguyen

Agenda

- Deep learning revolution
- Python Example
  - Apple diseases Detection: CNN vs. Gradient Boosting
  - Pneumonia X-ray detection
  - GAN
- Define neural networks

Deep Learning

Artificial Intelligence

Any technique that enables computers to mimic human behavior

Machine Learning

Ability to learn without explicitly being programmed

Deep Learning

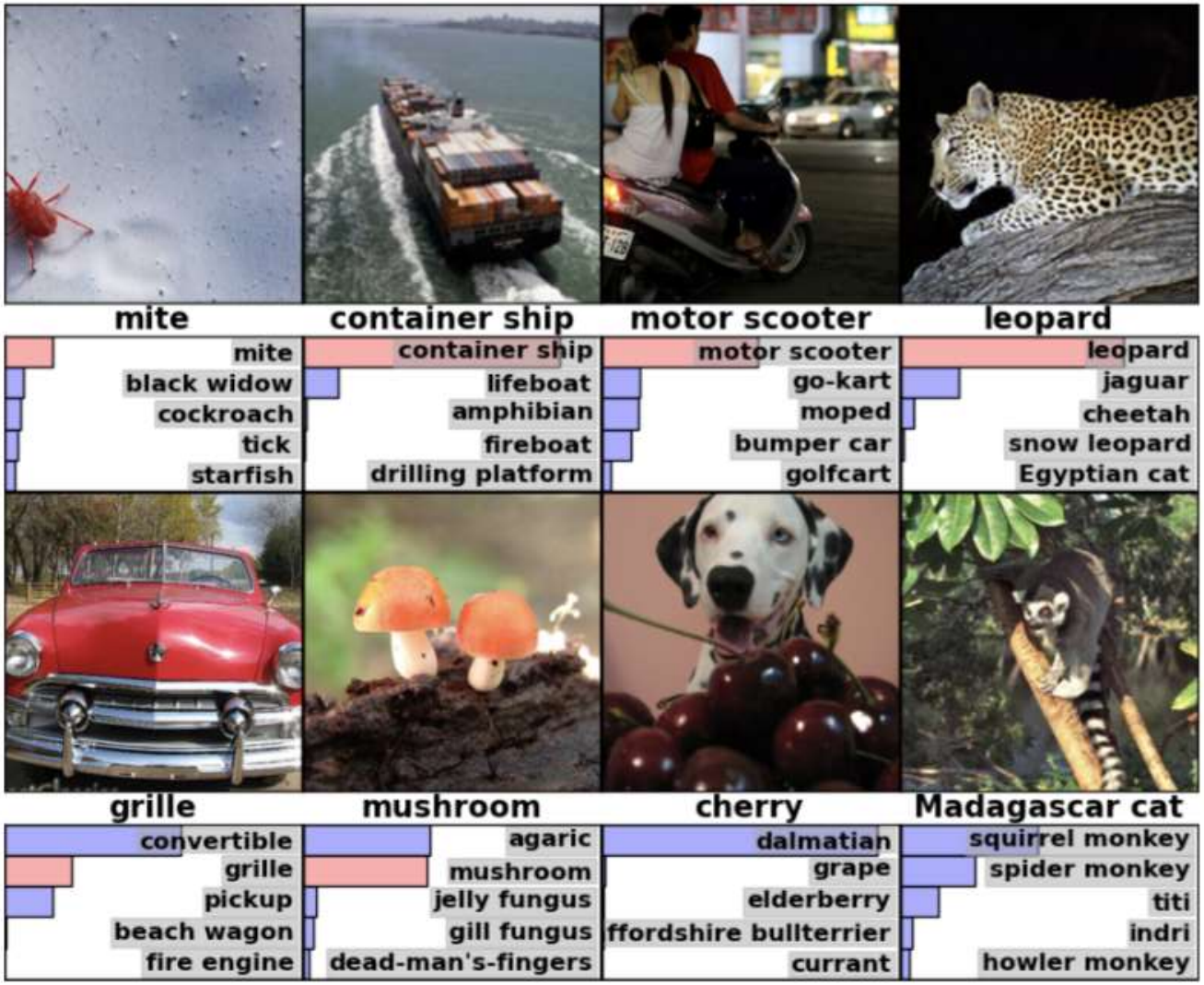
Extract patterns from data using neural networks

Example

https://www.youtube.com/watch?v=l82PxsKHxYc&t=47s

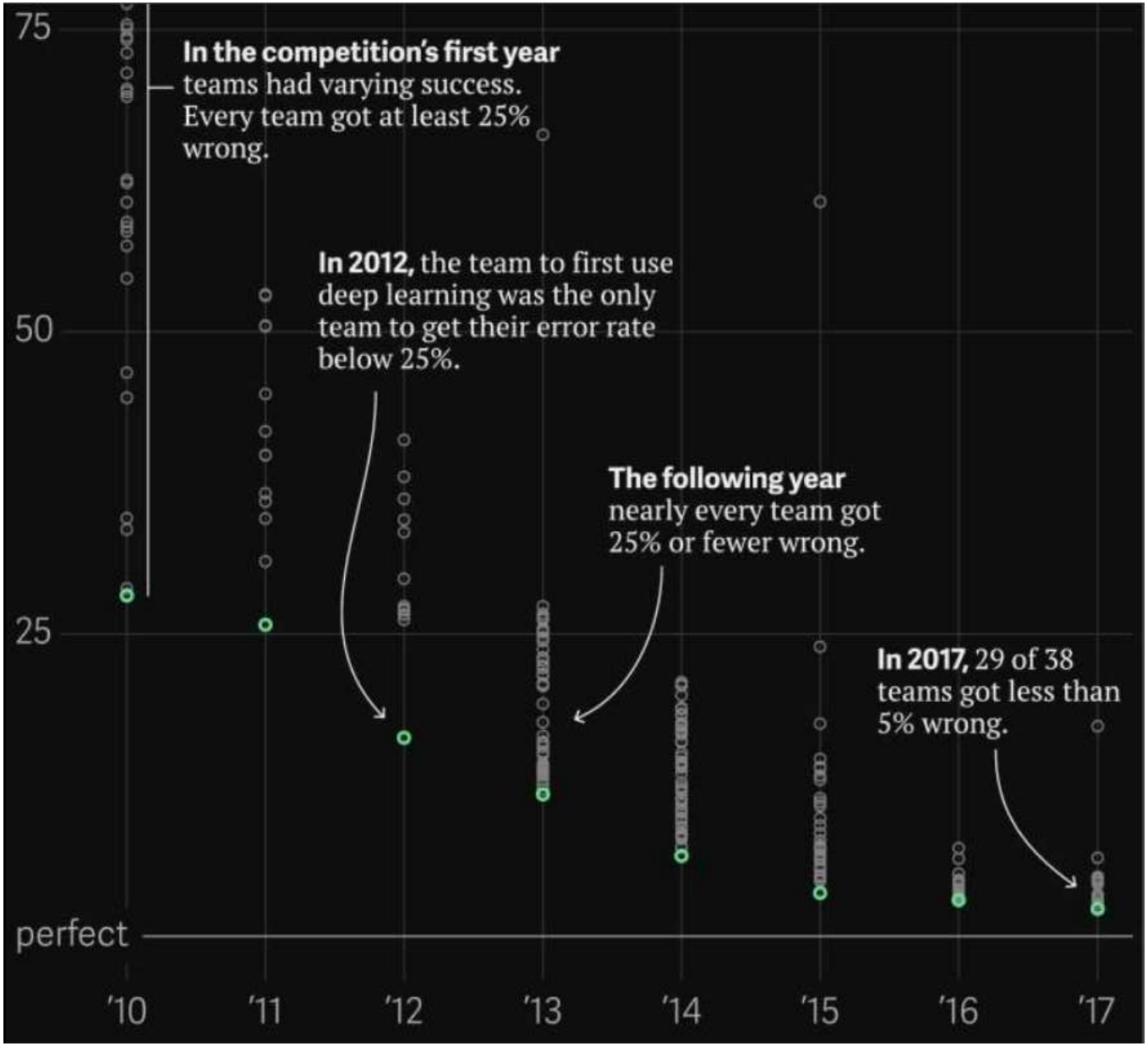
2009: ImageNet Competition

- Launched in 2009
- 15 million high-resolution images
- 22,000 categories

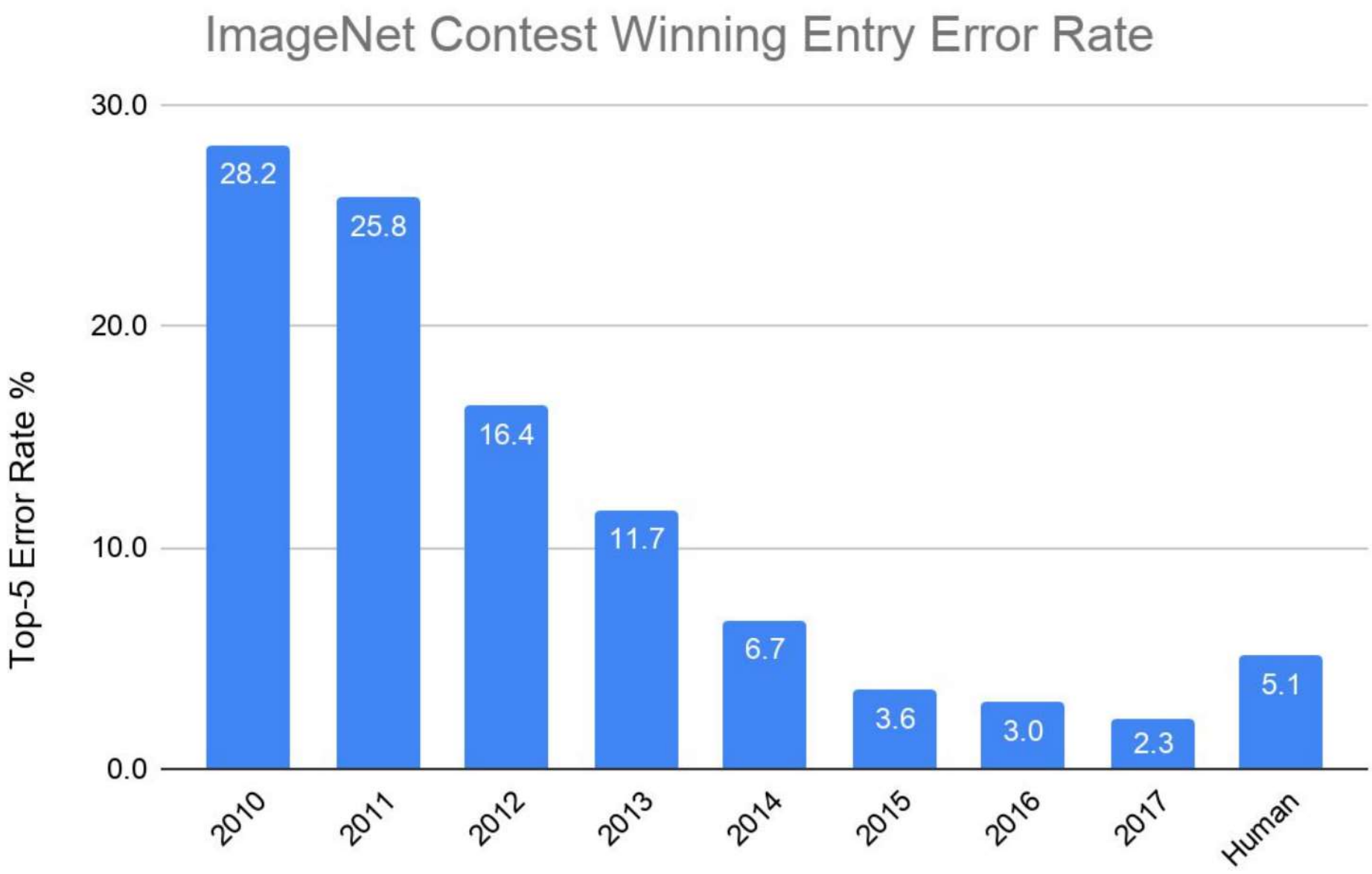


AlexNet

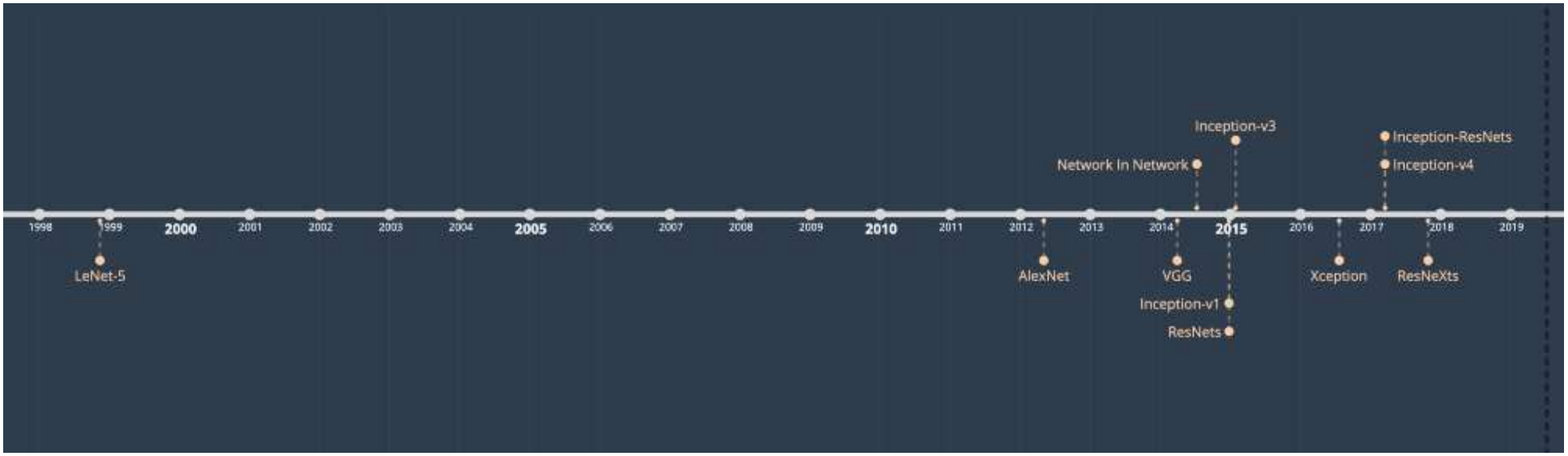
- Dramatic performance gain
- No Teams get better than 25% accuracy by 2012
- AlexNet was imtroduce in 2012 with 15.3% accuracy
- No team did worst than 25% since



AlexNet


ImageNet Contest Winning Entry Error Rate
Top-5 Error Rate %
30.0
20.0
10.0
0.0
28.2
25.8
16.4
11.7
6.7
3.6
3.0
2.3
5.1
2010
2011
2012
2013
2014
2015
2016
2017
Human

CNN


1998
1999
2000
2001
2002
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2004
2005
2006
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2008
2009
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2011
2012
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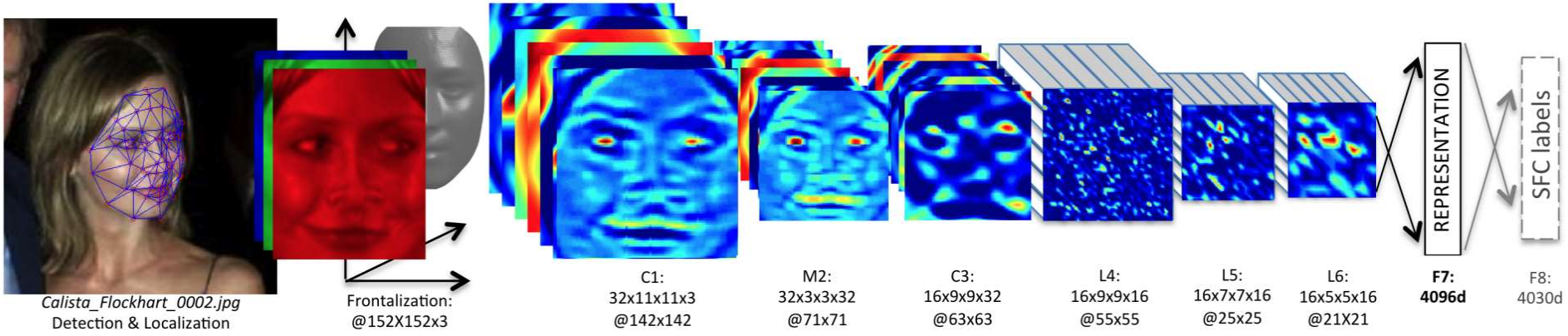
2014
2015
2016
2017
2018
2019
LeNet-5
AlexNet
VGG
Inception-v1
ResNets
Network In Network
Inception-v3
Xception
Inception-ResNets
Inception-v4
ResNeXts

2014: DeepFace - Facebook

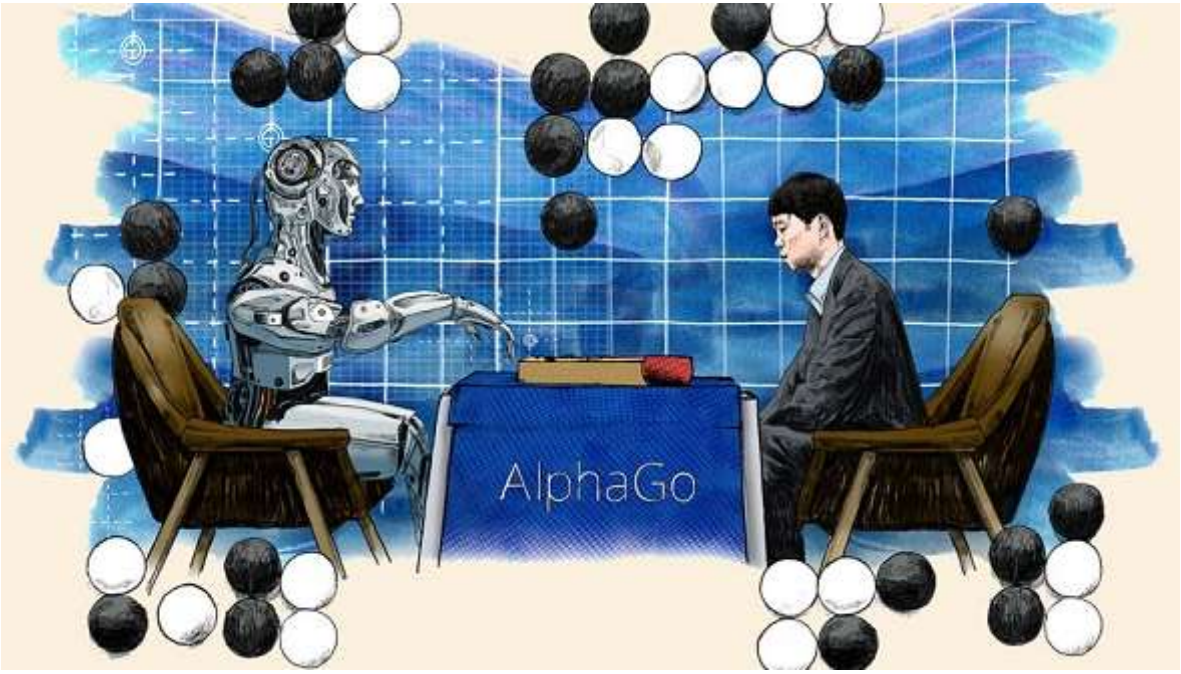
- In 2014, Facebook - DeepFace can identify faces with 97.35% accuracy, beating rivals human performance



Outline of the *DeepFace* architecture.

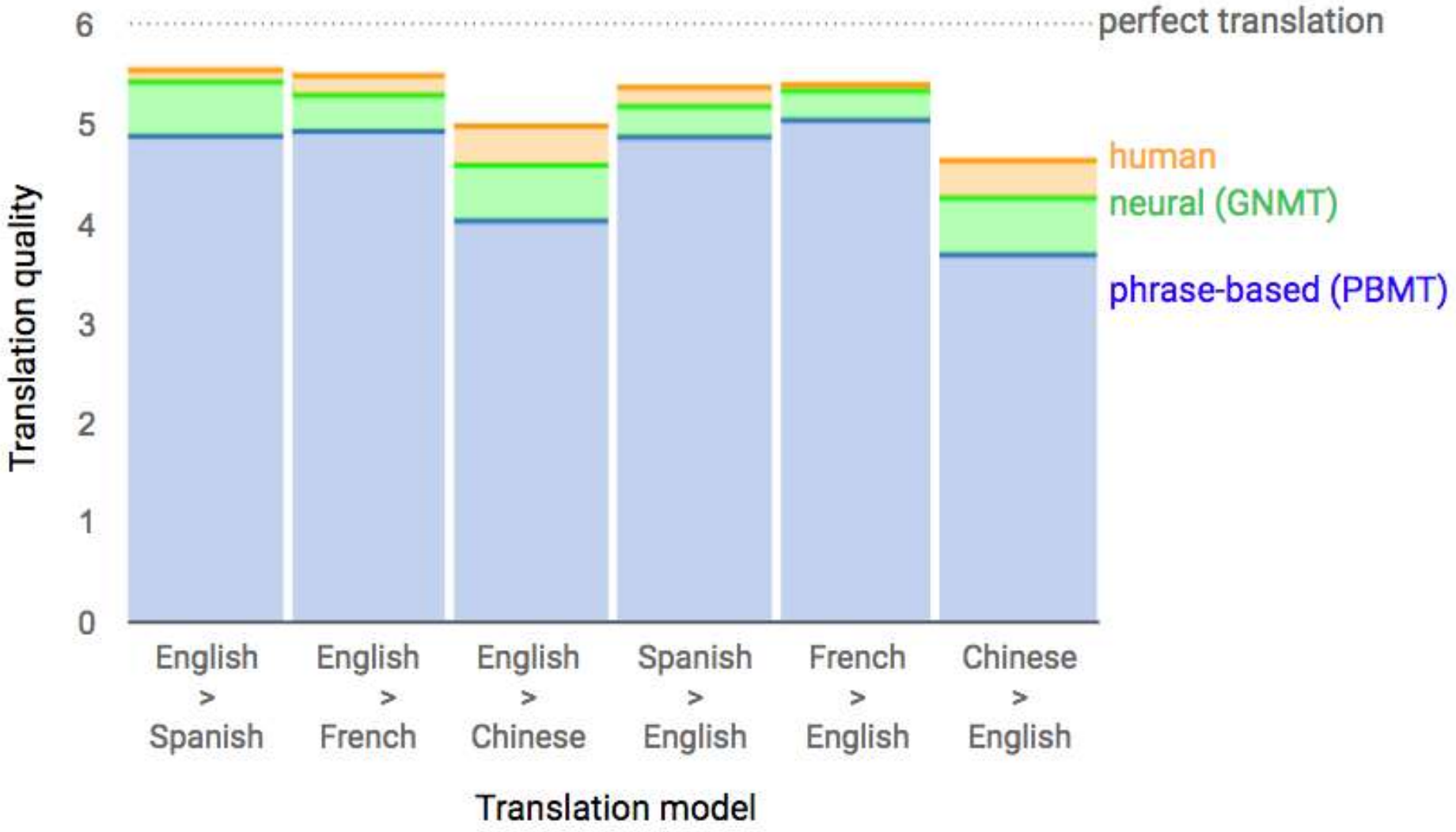
2016: AlphaGo - Google

- In 2016, AlphaGo became the first computer program to defeat a professional human Go player
- the first to defeat a Go world champion,
- arguably the strongest Go player in history.
- AlphaGo was one of the Breakthrough of the Year by Science.



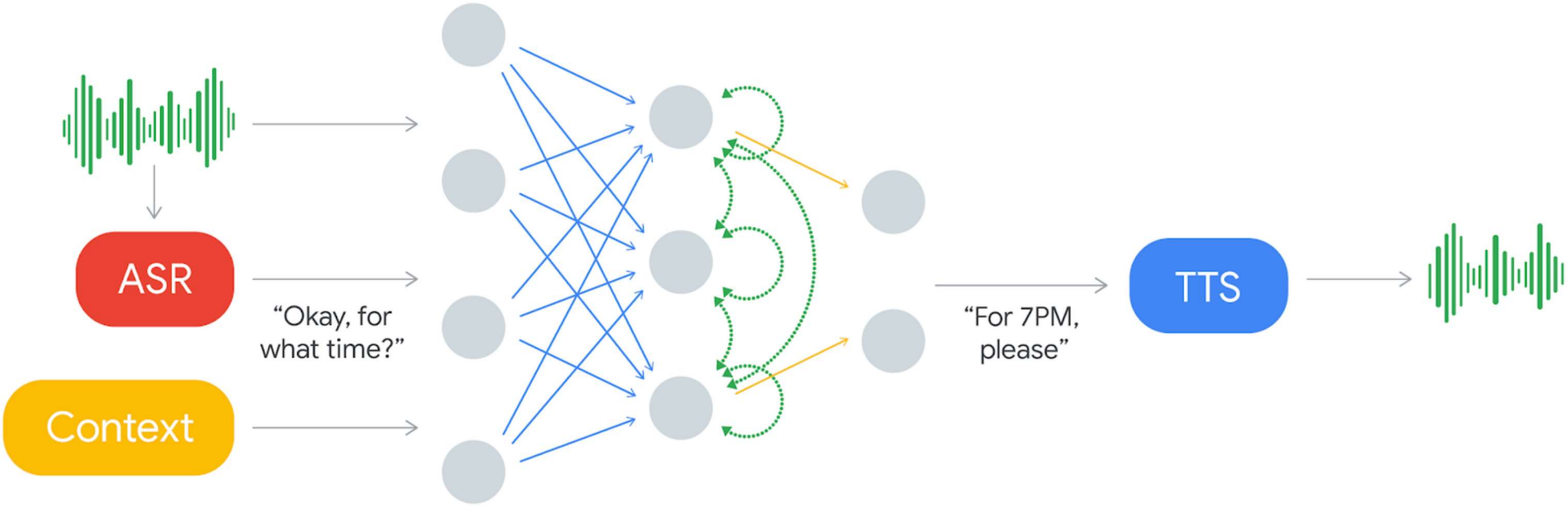
2016: Google Translate

- In 2016, Google Translate Deep Learning blew other language translation techniques out of the water



Google Assistant

https://ai.googleblog.com/2018/05/duplex-ai-system-for-natural-conversation.html



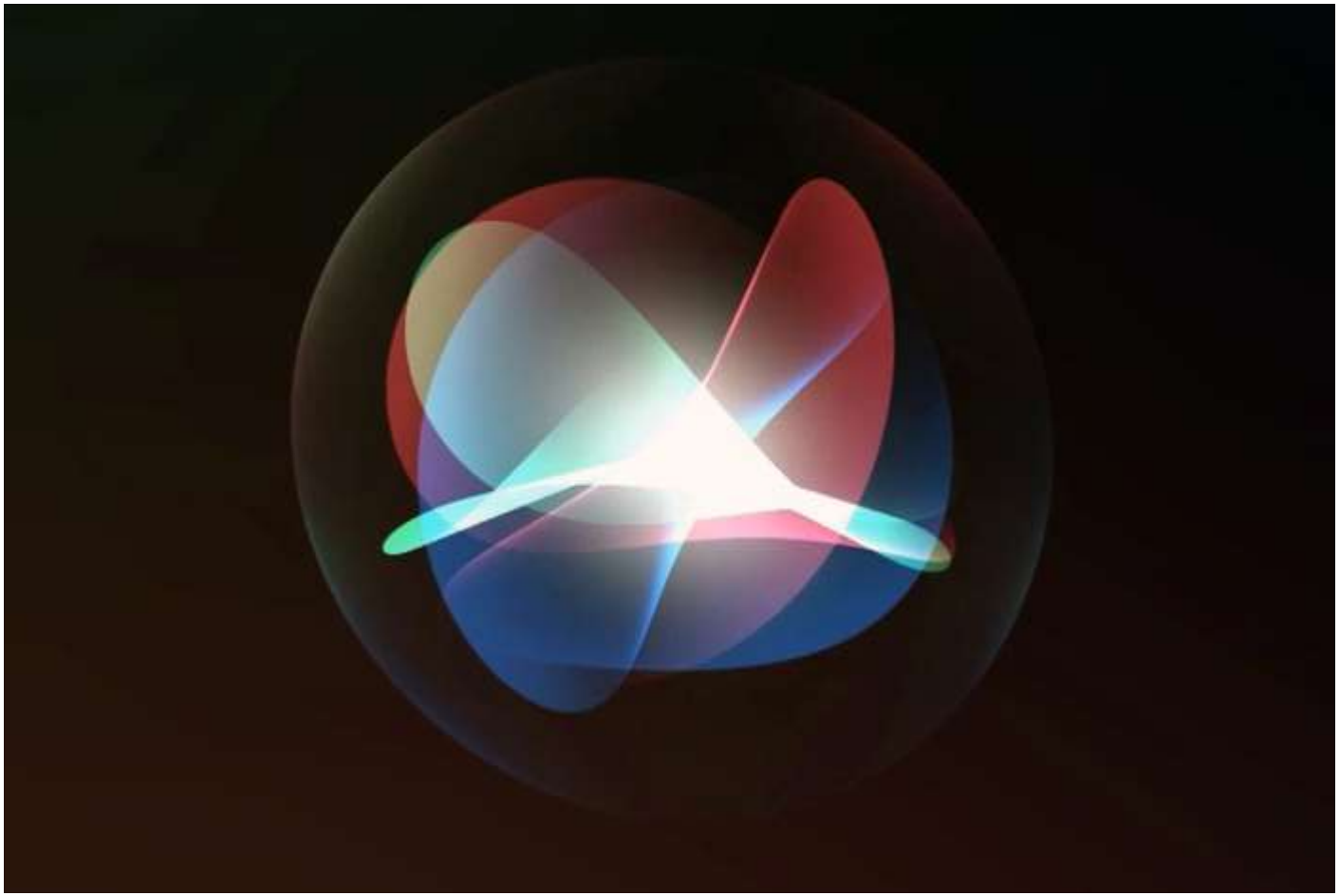
2017: Face ID - Apple

- In 2017, Apple switched to use Deep Learning for face recognition

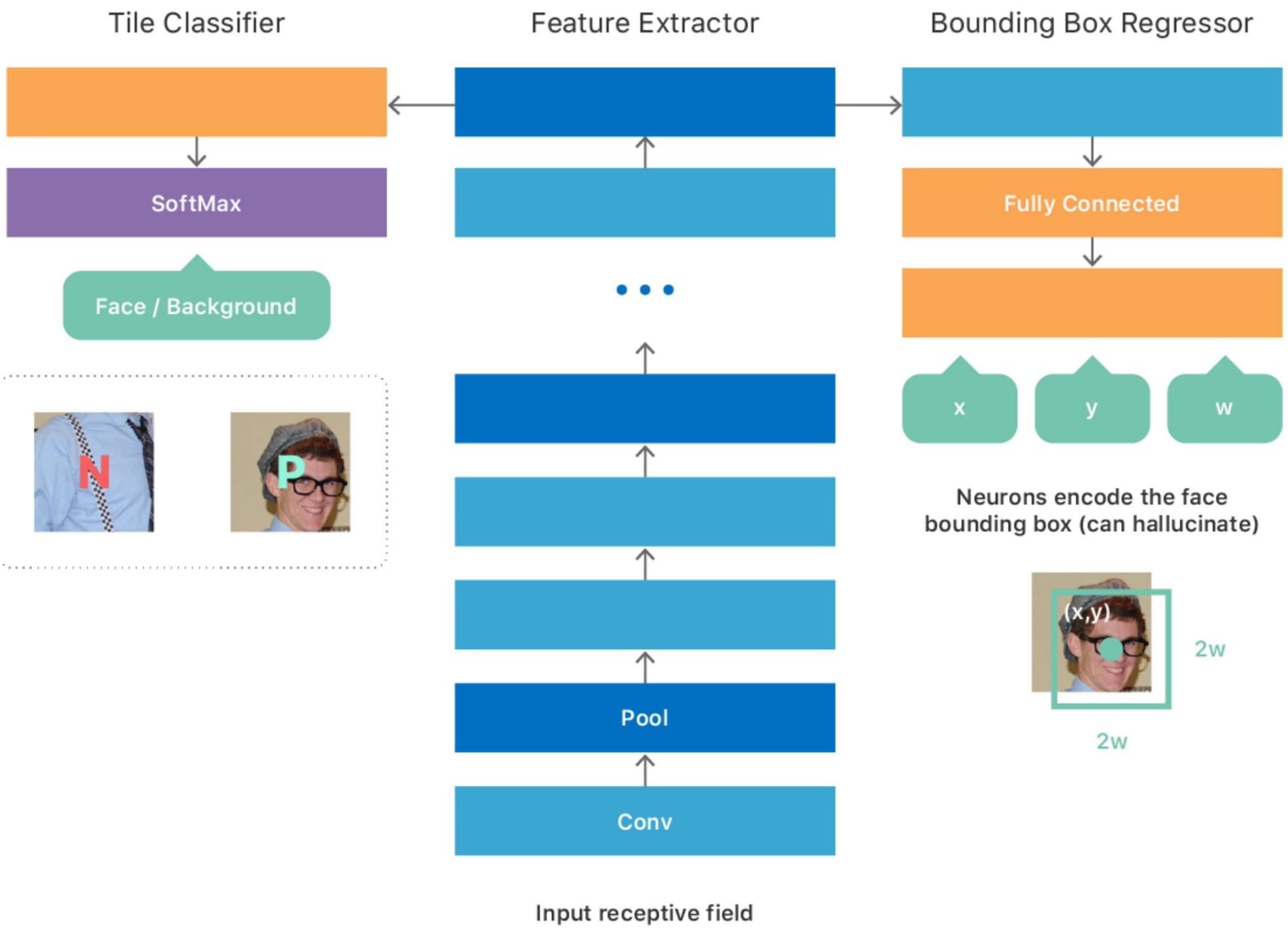
> We had to completely rethink our approach so that we could take advantage of this paradigm shift. https://machinelearning.apple.com/research/face-detection

Apple Siri

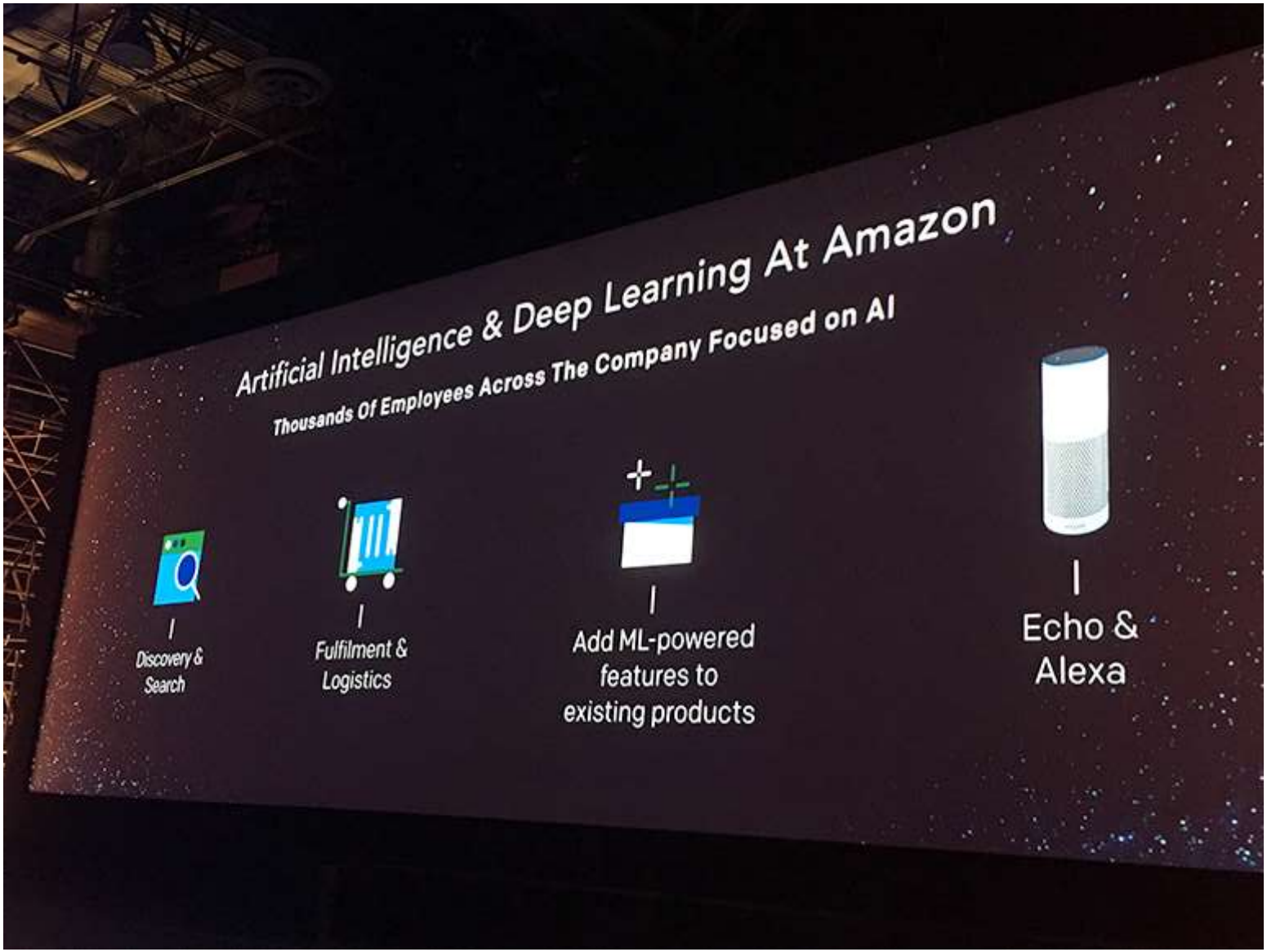
https://machinelearning.apple.com/research/siri-voices



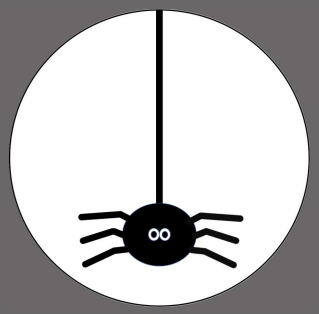
Apple - Deep Learning



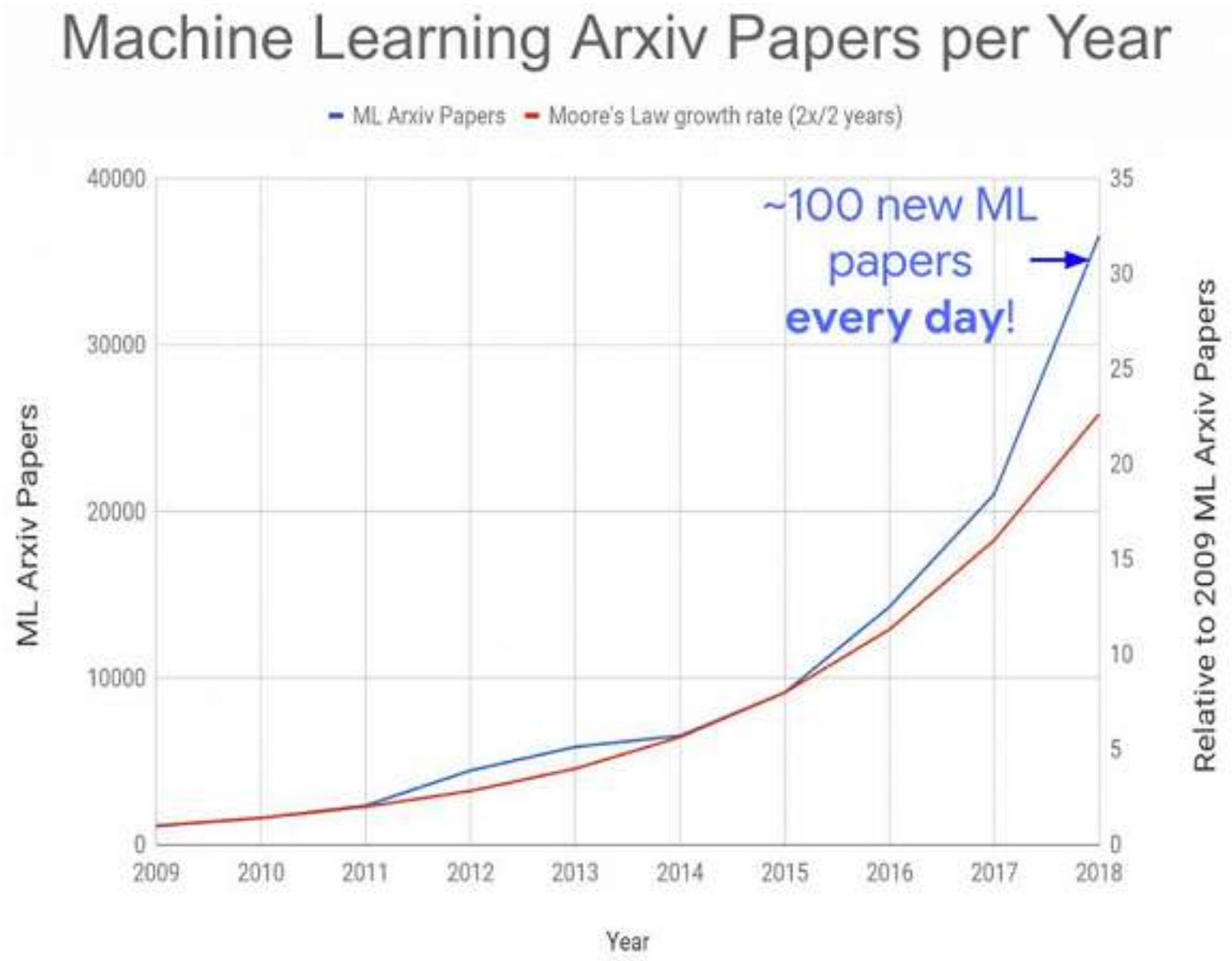
Amazon


Artificial Intelligence & Deep Learning At Amazon
Thousands Of Employees Across The Company Focused on AI
Discovery & Search
Fulfilment & Logistics
Add ML-powered features to existing products
Echo & Alexa

Academia

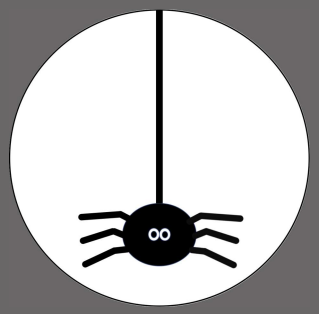


Academia


Machine Learning Arxiv Papers per Year
ML Arxiv Papers
Moore's Law growth rate (2x/2 years)
~100 new ML papers every day!
ML Arxiv Papers
Relative to 2009 ML Arxiv Papers
Year
0
10000
20000
30000
40000
0
5
10
15
20
25
30
35
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

2018: Alan Turing Award

Big Tech Companies Interested



Google

- In 2014, Google acquired DeepMind.
- https://deepmind.com/research/case-studies/alphago-the-story-so-far
- https://en.wikipedia.org/wiki/DeepMind
- https://www.tensorflow.org/about

Tensorflow

- Google developed TensorFlow in 2015
- particularly focuses on training and inference of deep neural networks.
- Company uses Tensorflow

- https://www.tensorflow.org/about

Google Brain

- Google Brain is a deep learning artificial intelligence research team at Google.
- Formed in the early 2010s
- https://research.google/teams/brain/

Apple

- Deep Learning Team:

https://www.apple.com/jobs/us/teams/machine-learning-and-ai.html

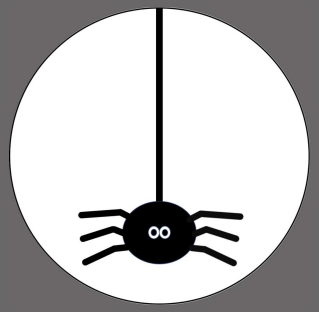
Facebook: Pytoch

- In 2016, Facebook developed PyTorch, an open source deep learning framework

Microsoft

Deep Learning Group: https://www.microsoft.com/en-us/research/group/deep-learning-group/

But…



But...

- Neural Network was invented a long time ago
- Why now?

Why Now?

Neural Networks date back decades, so why the resurgence?

1952 Stochastic Gradient Descent

1958 Perceptron
- Learnable Weights

1986 Backpropagation
- Multi-Layer Perceptron

1995 Deep Convolutional NN
- Digit Recognition

1. Big Data

- Larger Datasets
- Easier Collection & Storage

IMAGENET

WIKIPEDIA
The Free Encyclopedia

2. Hardware

- Graphics Processing Units (GPUs)
- Massively Parallelizable

3. Software

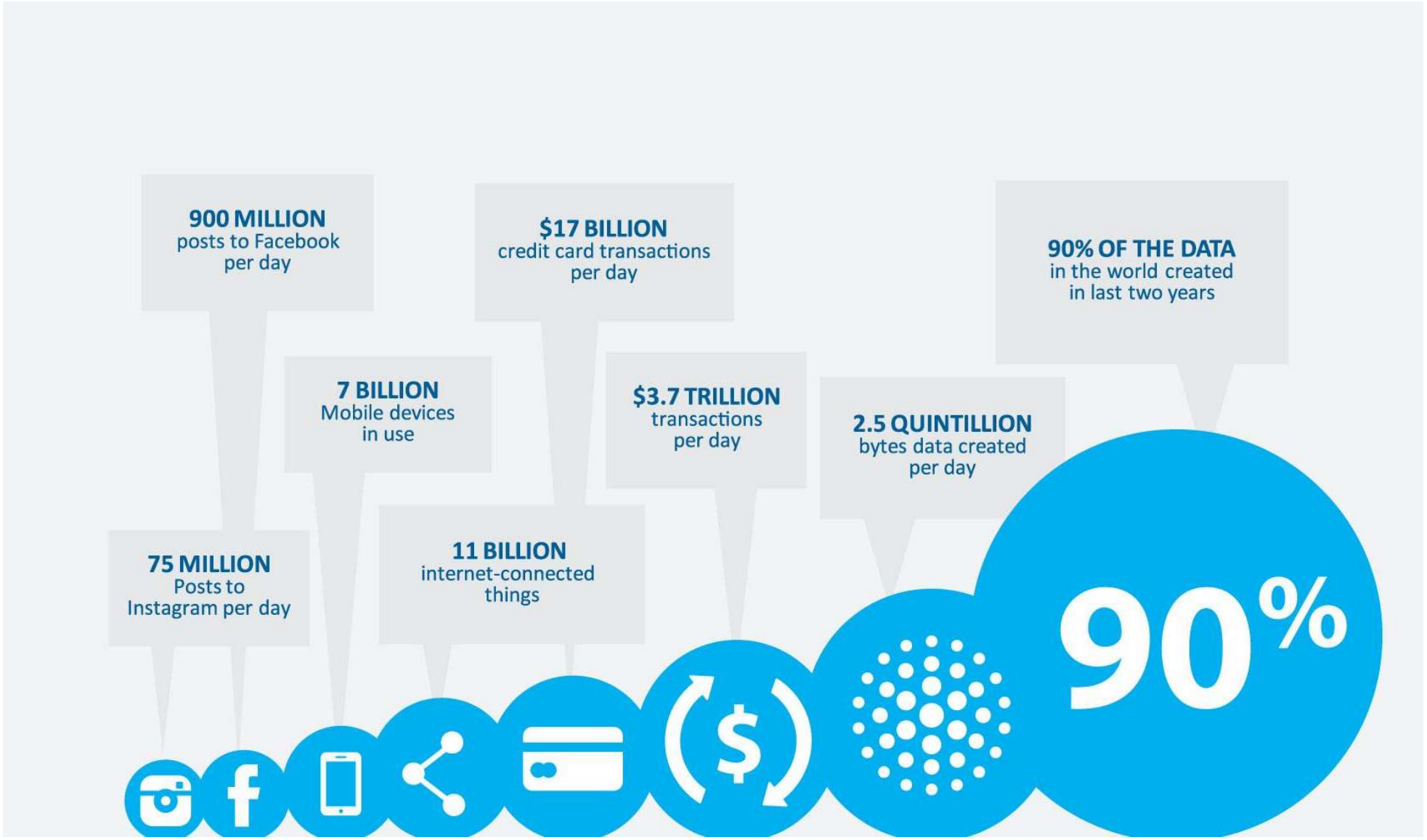
- Improved Techniques
- New Models
- Toolboxes

TensorFlow

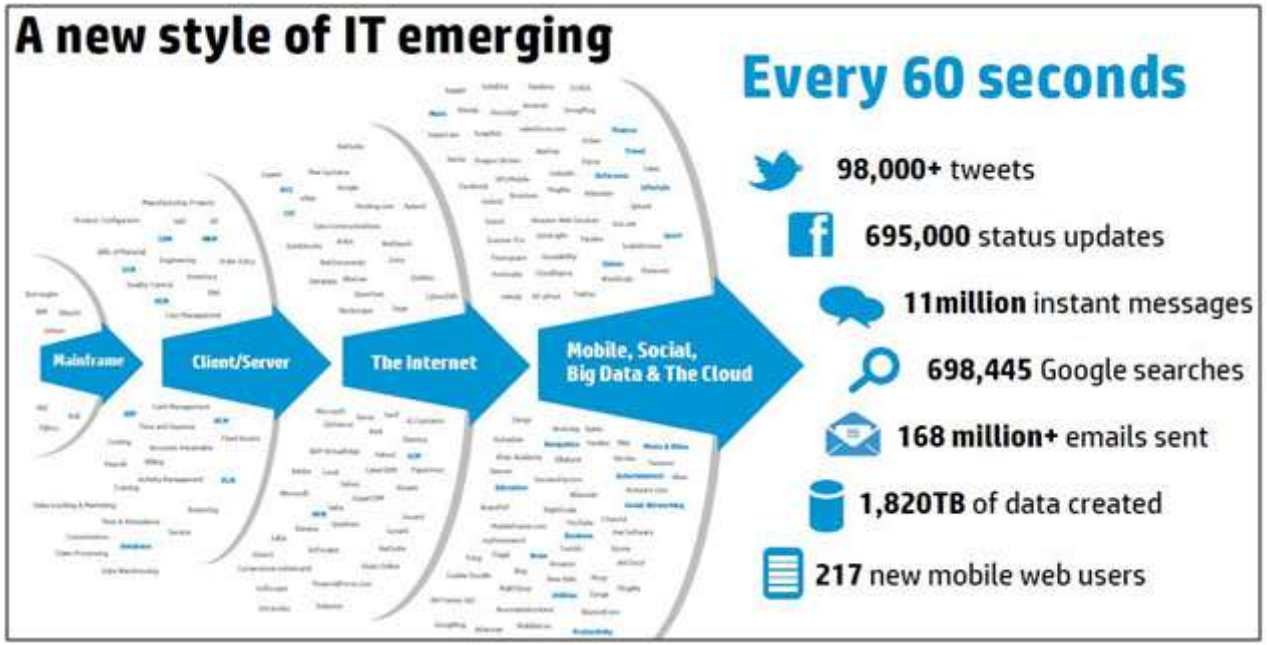
Big Data


BIG DATA
INTERNET
BUSINESS
SOCIAL
TARGET
PLAN
ADVERTISING
PROMOTION
SOCIAL MEDIA
SERVICES
PROJECTS
WEB MARKETING
BRANDING
COMPUTER
CONSUMER DEMAND
MARKETS
ORGANIZATION
PLANNING
EVENTS
PROGRAMMING
STATISTICS
APPS
BRANDS
SOLUTIONS
VISION
ENGINEERING
RESEARCH
BRAND
WEB DEV
WEB SERVICES
BIG DATA
STRATEGY
WORLDWIDE
BUZZ
ORGANIZATION
BEHAVIOUR
PRICING
B2B TARGET
PLANNING
MEDIA
MOBILE
SEGMENTATION
INFORMATION
SOCIAL NETWORKS
DIGITAL
MULTIMEDIA
NETWORK
WWW
INFORMATION TECHNOLOGY
BIG DATA
CONTENT
CODING
SOFTWARE
E-MARKETING
COMMUNICATION
CONSUMER
SOCAIL NETWORKS
SOLUTIONS
PROJECTS
SERVICE
PRO
COM

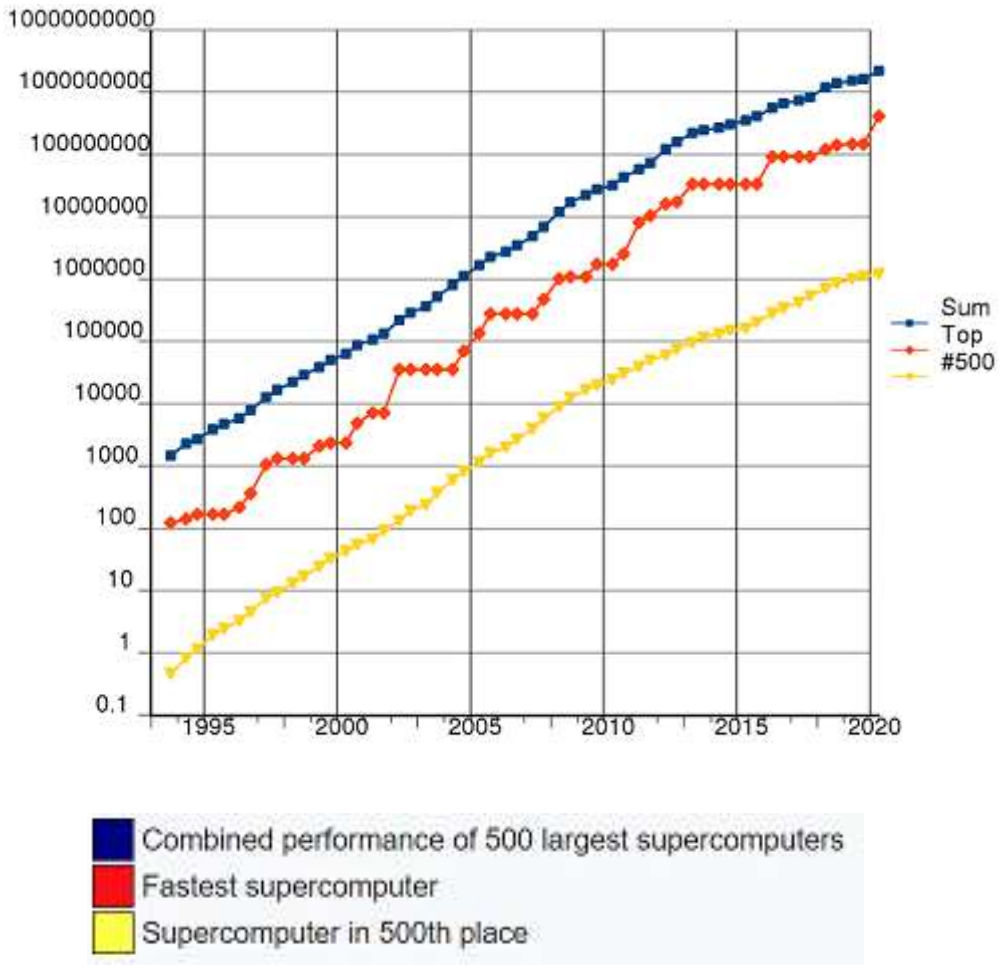
Big Data


900 MILLION
posts to Facebook
per day
$17 BILLION
credit card transactions
per day
90% OF THE DATA
in the world created
in last two years
7 BILLION
Mobile devices
in use
$3.7 TRILLION
transactions
per day
2.5 QUINTILLION
bytes data created
per day
75 MILLION
Posts to
Instagram per day
11 BILLION
internet-connected
things
90%

Big Data

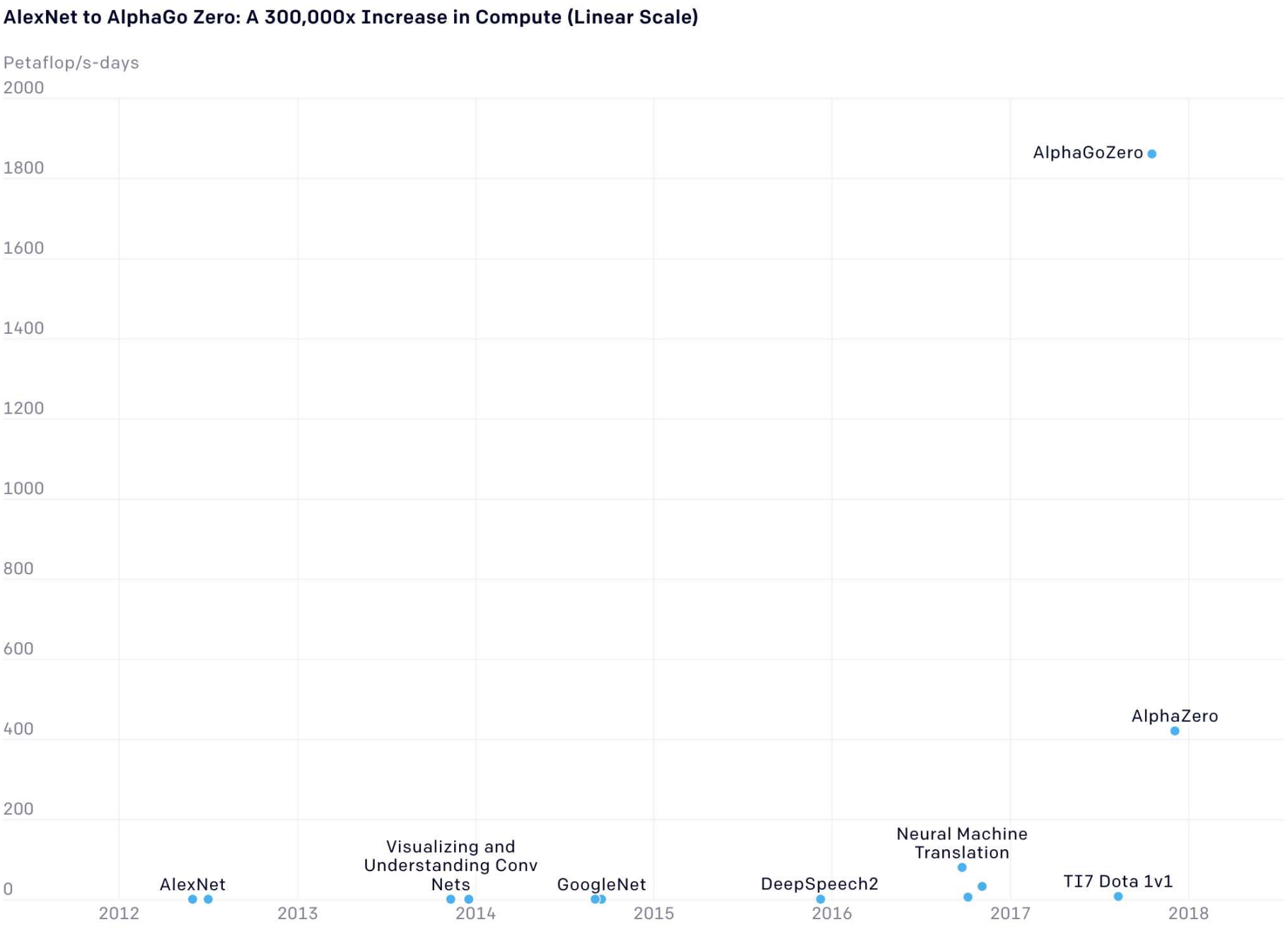

A new style of IT emerging
Mainframe
Client/Server
The Internet
Mobile, Social, Big Data & The Cloud
Every 60 seconds
98,000+ tweets
695,000 status updates
11million instant messages
698,445 Google searches
168 million+ emails sent
1,820TB of data created
217 new mobile web users

Powerful Computing



- https://en.wikipedia.org/wiki/History_of_supercomputing

Powerful Computing

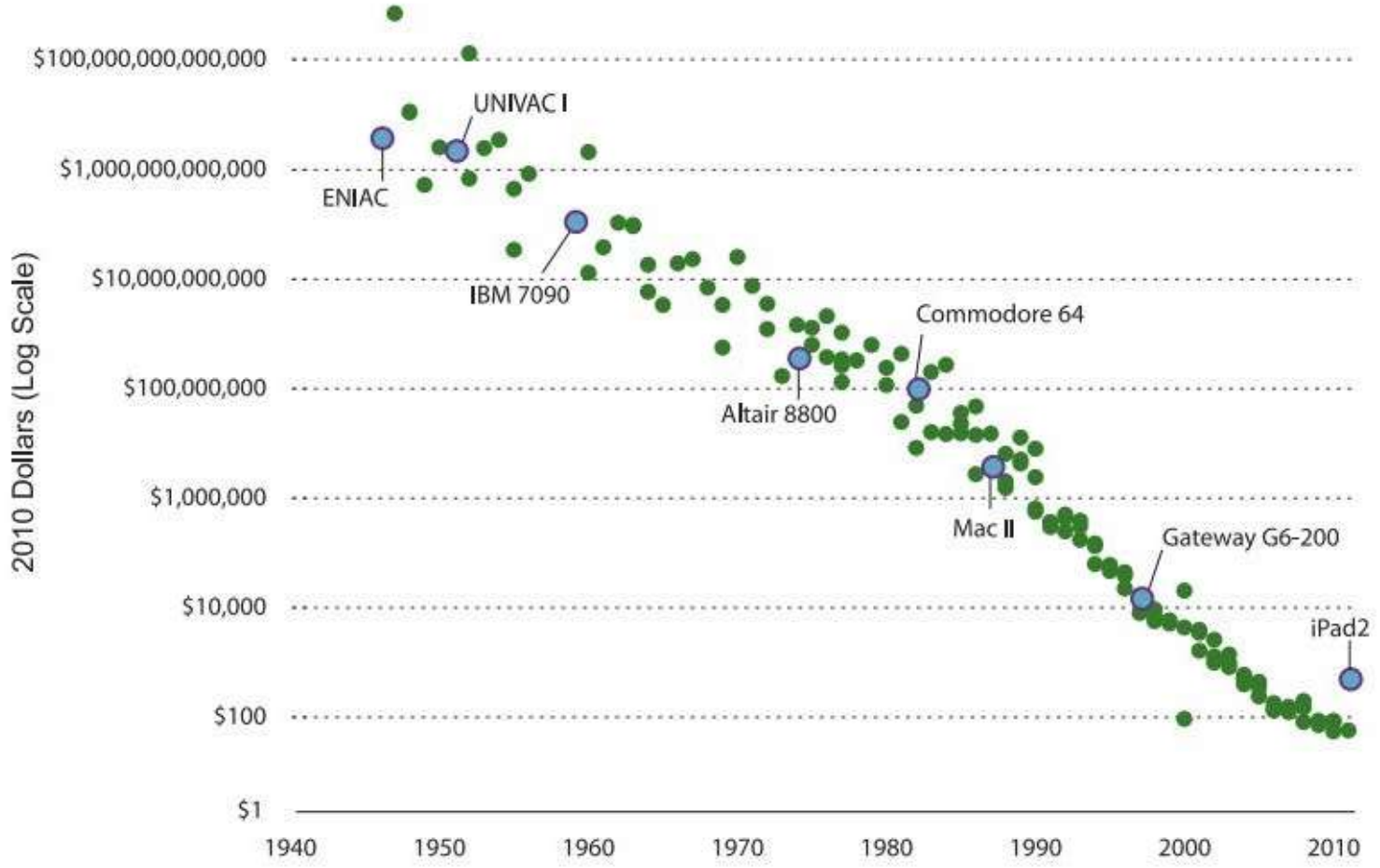


Powerful Computing

- If AlphaGoZero was trained in 1 day in 2020, how long would it take to train AlphaGoZero in 2012?
- More than 821 years!

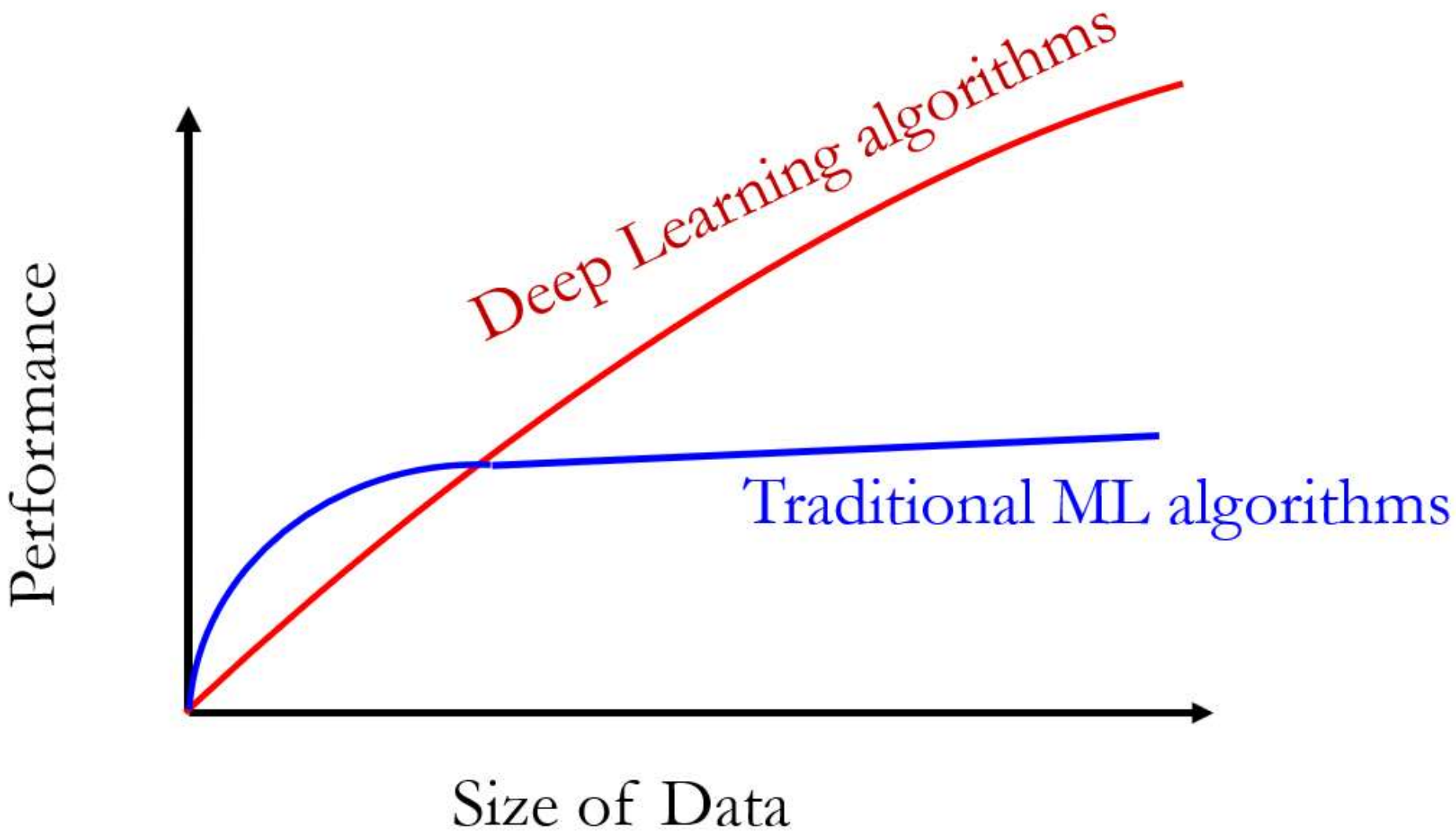
Cheaper Computing

Cost of Computing Power Equal to an iPad 2

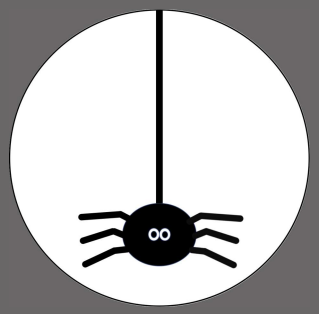


Note: The iPad2 has computing power equal to 1600 million instructions per second (MIPS). Each data point represents the cost of 1600 MIPS of computing power based on the power and price of a specific computing device released that year.

Source: Moravec n.d..


Deep Learning algorithms
Traditional ML algorithms
Performance
Size of Data

Neural Network



A linear Model is a Neural Network