

Learning

Son Nguyen

Deep



# 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

3 1 3 4 7 2  
1 7 4 2 3 5

# Example

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

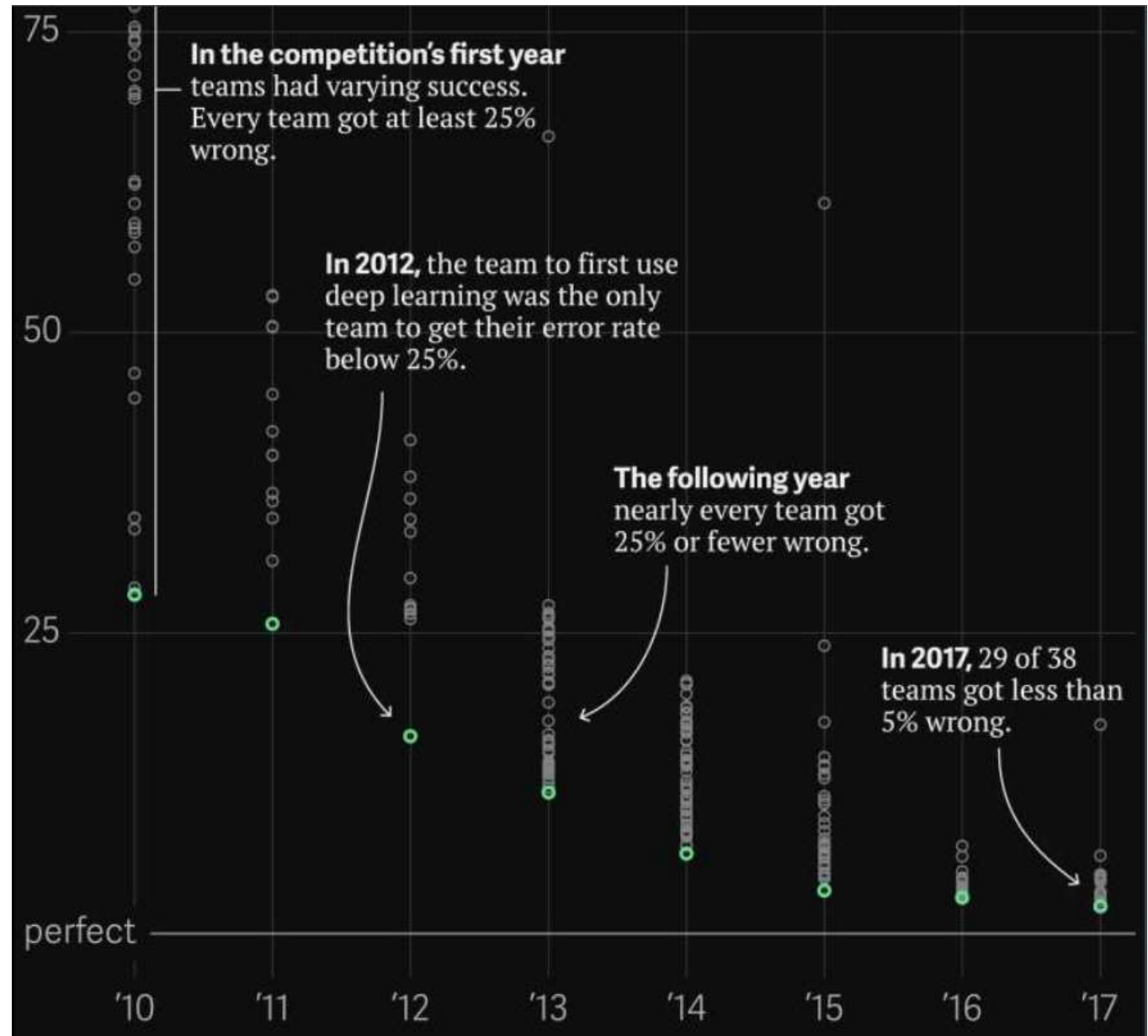
# 2009: ImageNet Competition

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

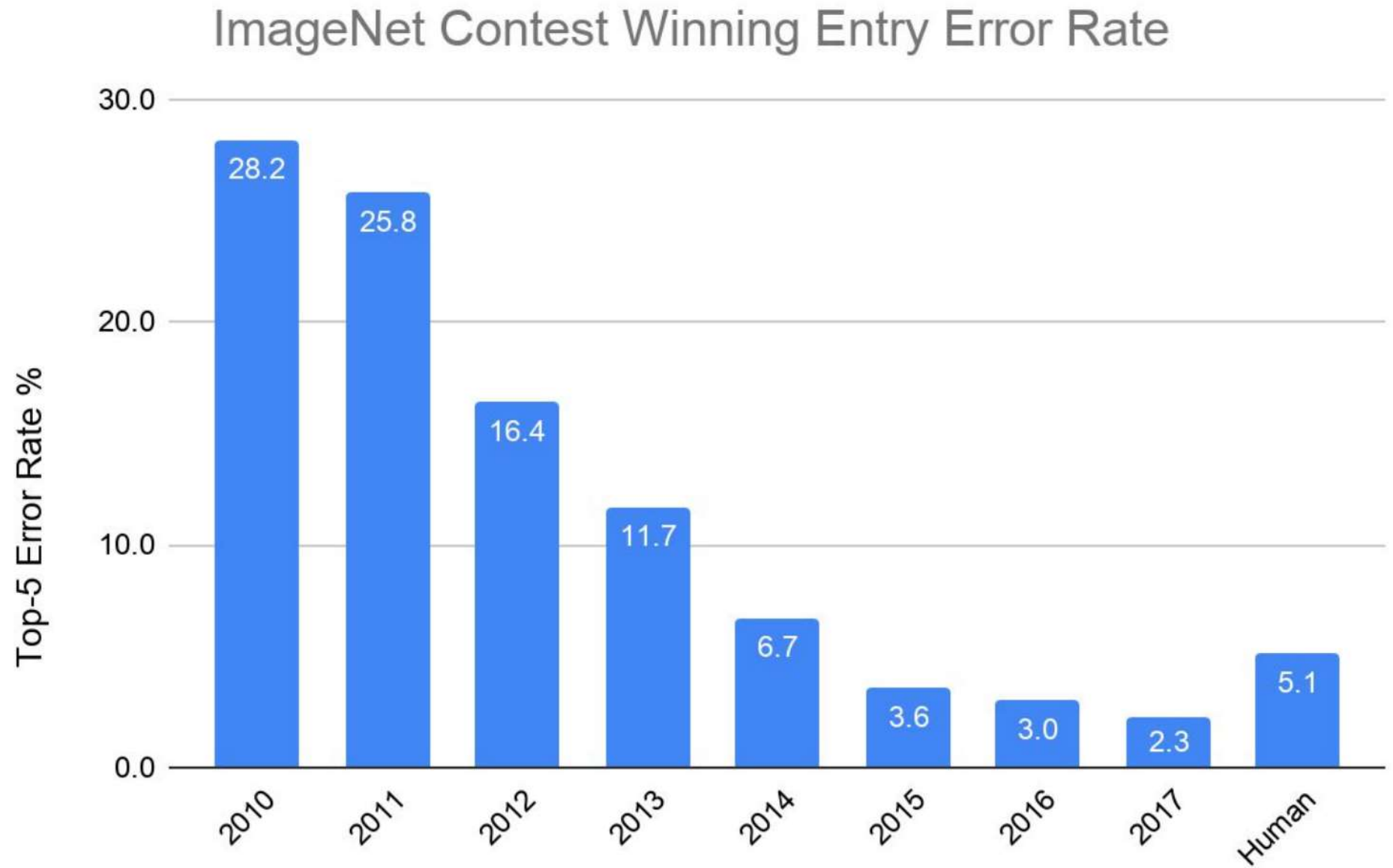


# AlexNet

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

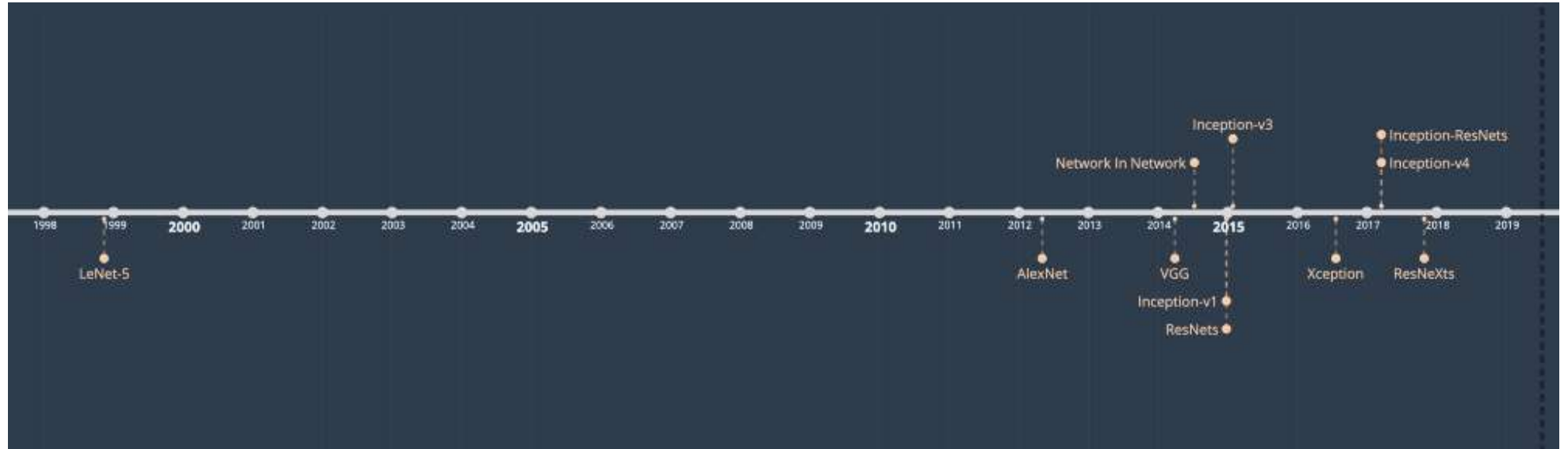


# AlexNet



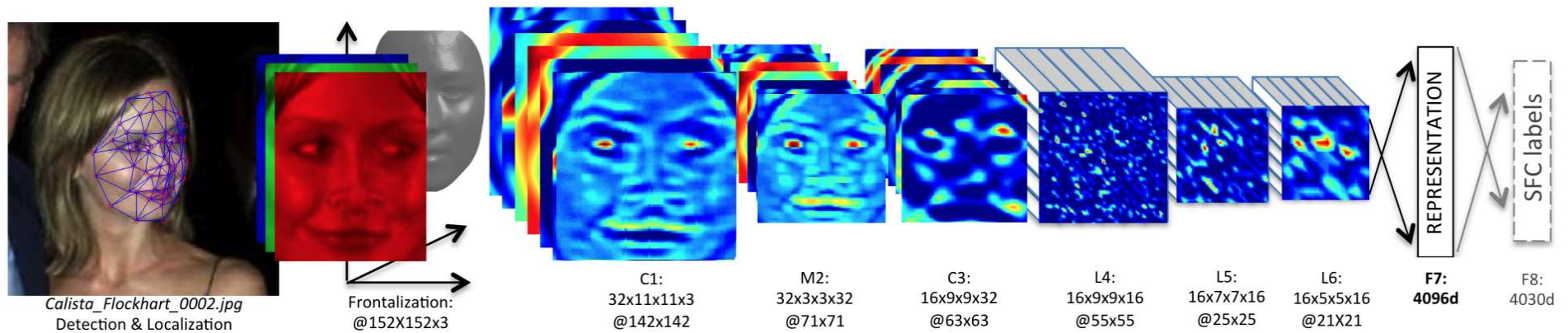


# CNN



# 2014: DeepFace - Facebook

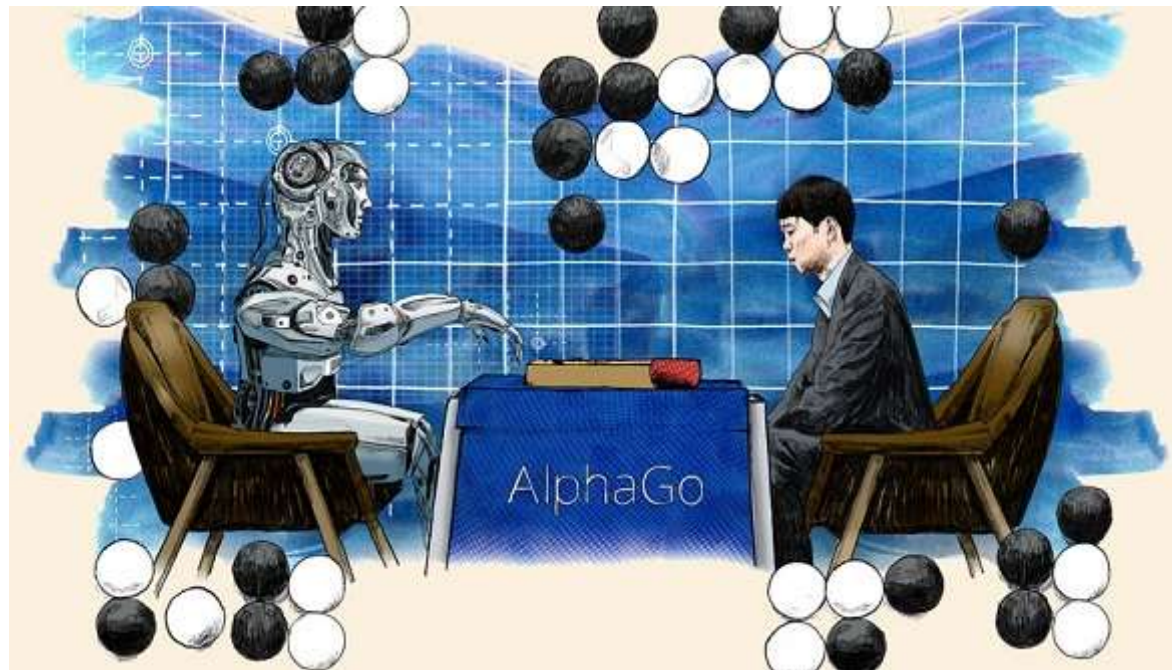
- In 2014, Facebook - DeepFace can identify faces with 97.35% accuracy, beating rivals human performance



Outline of the *DeepFace* architecture.

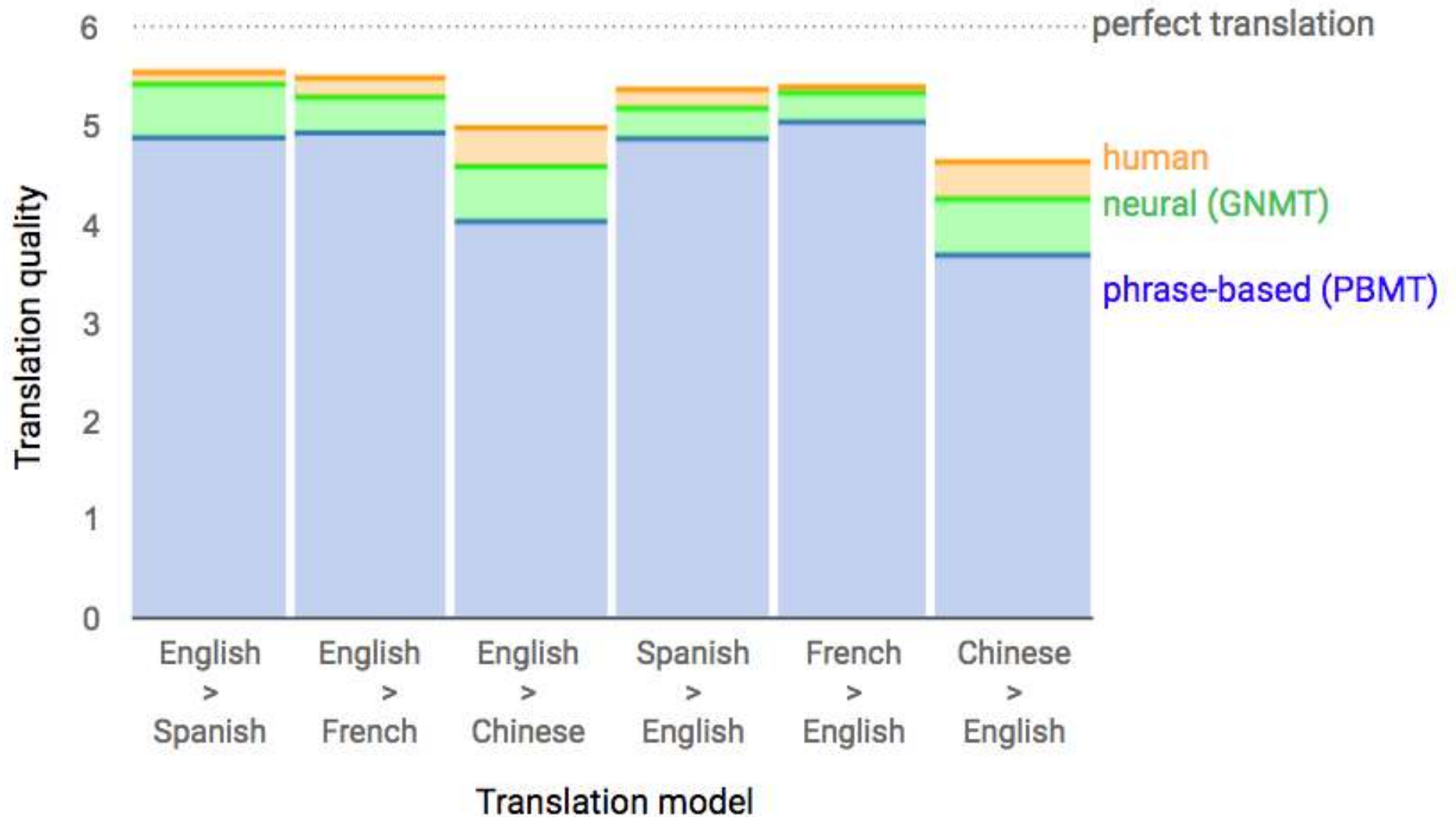
# 2016: AlphaGo - Google

- 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.



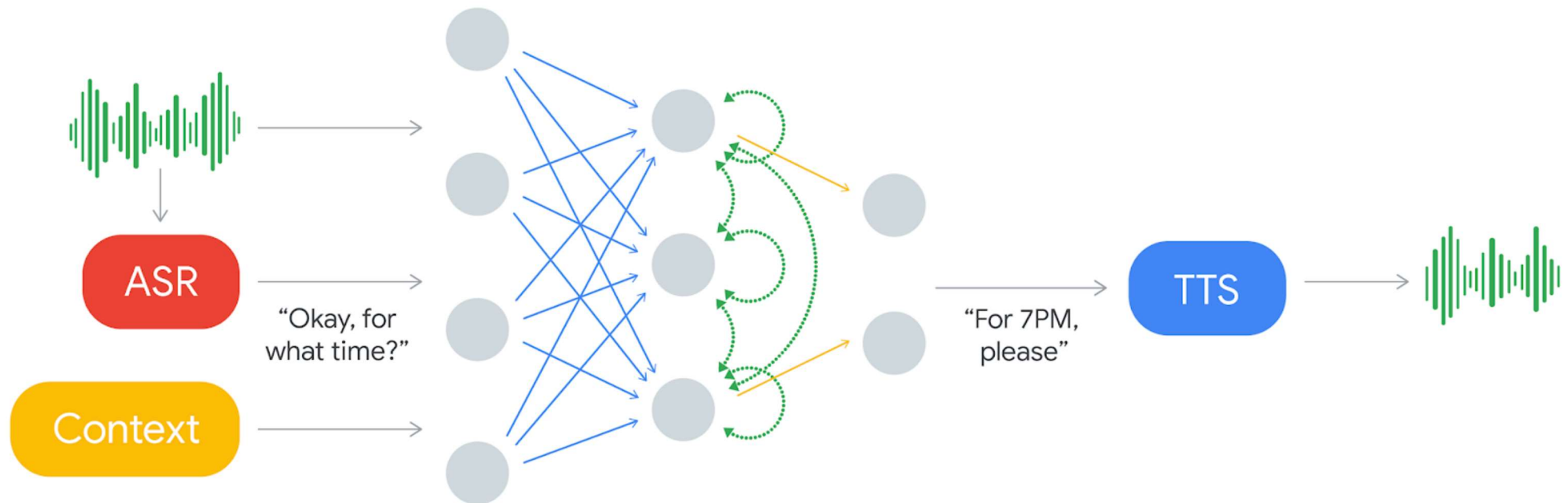
# 2016: Google Translate

- 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

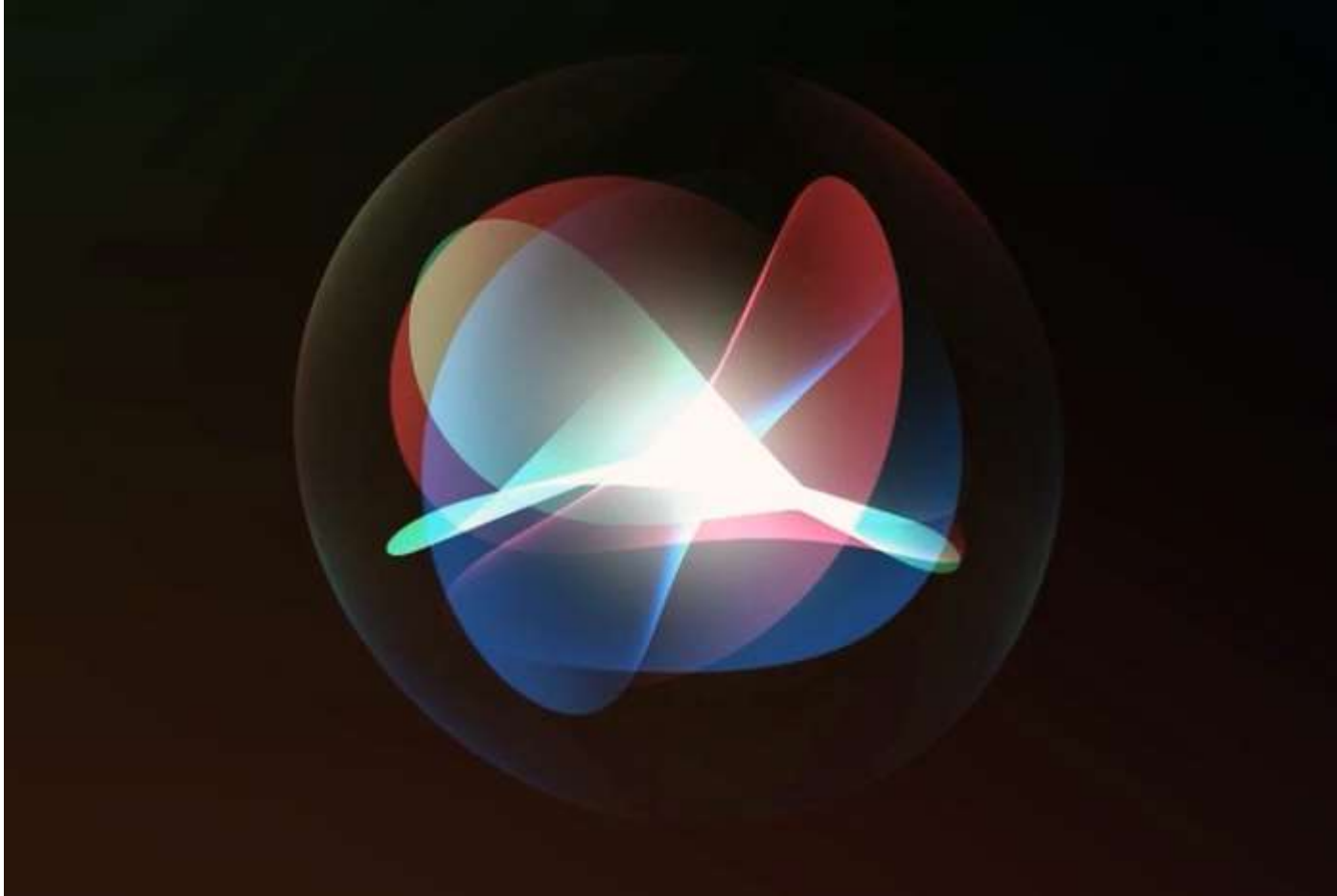
- In 2017, Apple switched to use Deep Learning for face recognition

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

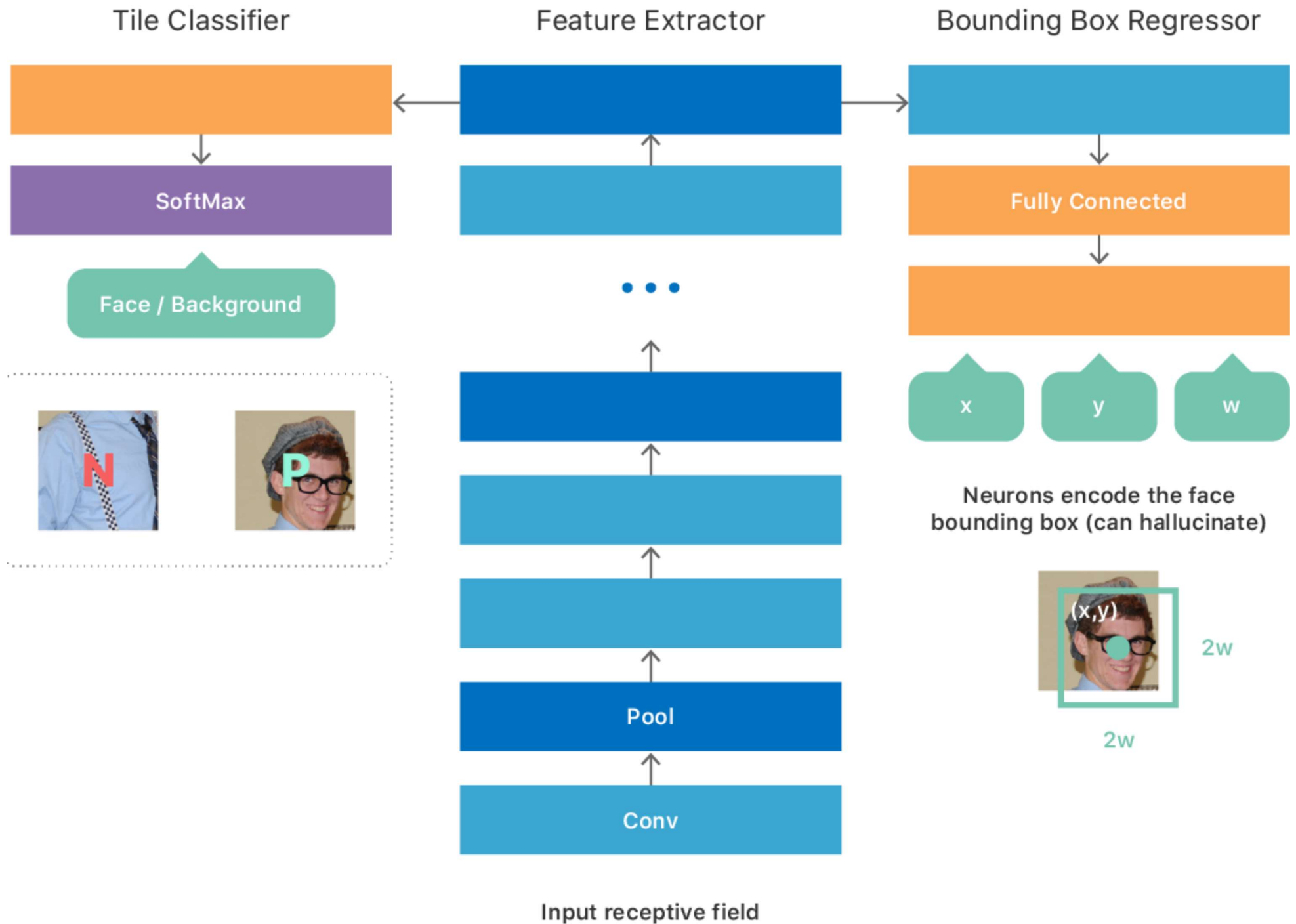


# Apple Siri

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

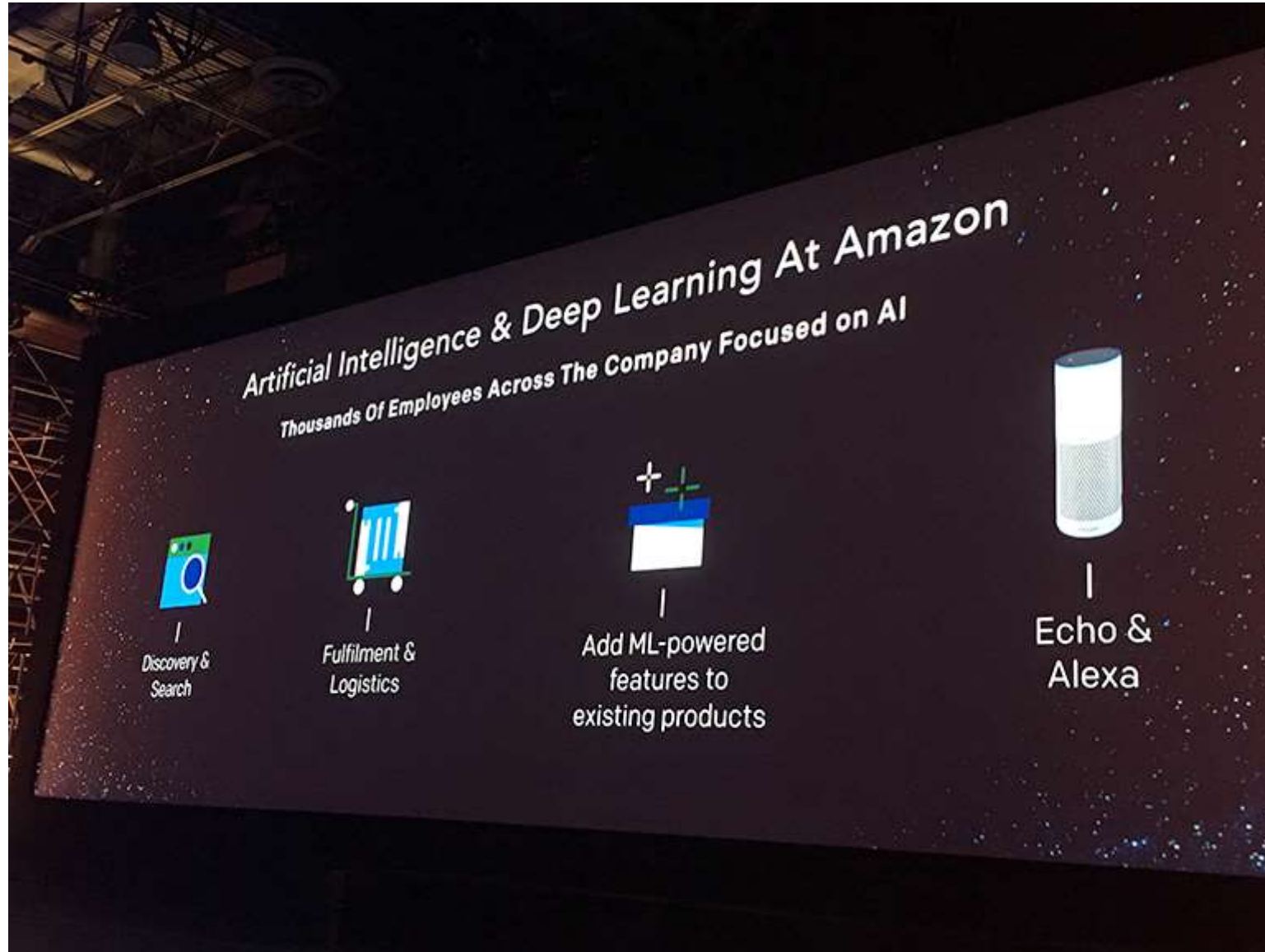


# Apple - Deep Learning

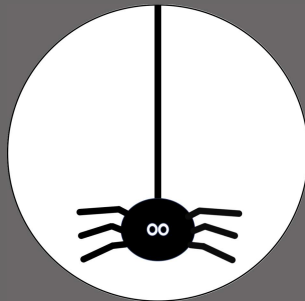




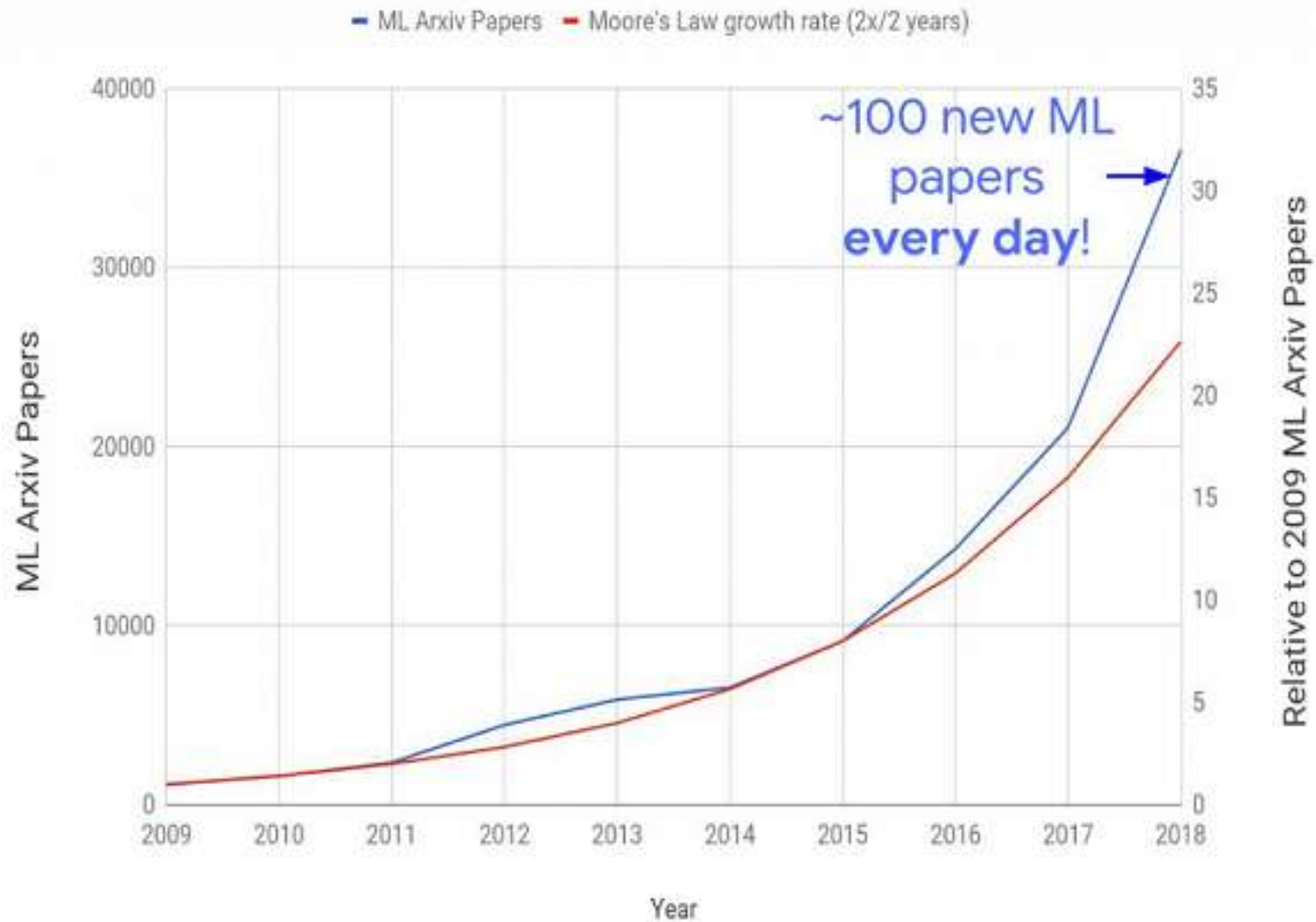
# Amazon



# Academia



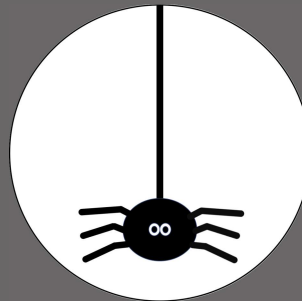
## Machine Learning Arxiv Papers per Year



# 2018: Alan Turing Award



# Big Tech Companies Interested



- 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:

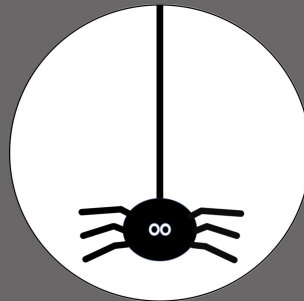
<https://www.apple.com/jobs/us/teams/machine-learning-and-ai.html>

# Facebook: Pytorch

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

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

But...

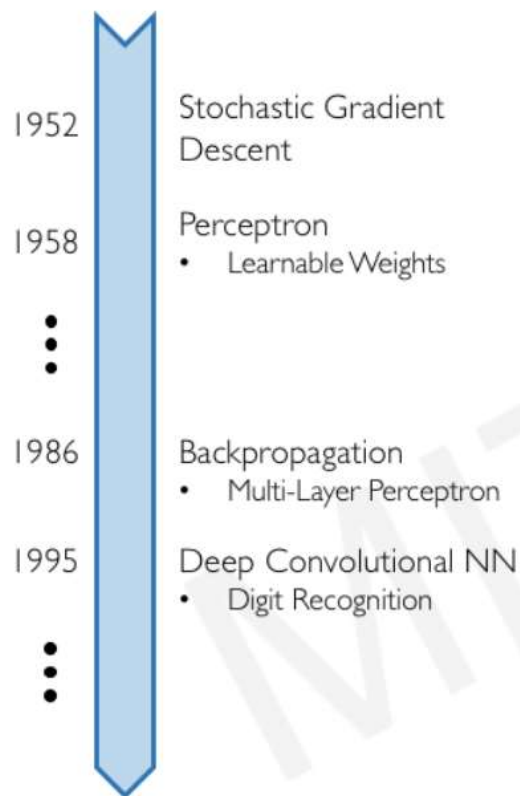


# But...

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

# Why Now?

Neural Networks date back decades, so why the resurgence?



## 1. Big Data

- Larger Datasets
- Easier Collection & Storage

IMAGENET



WIKIPEDIA  
The Free Encyclopedia



## 2. Hardware

- Graphics Processing Units (GPUs)
- Massively Parallelizable



## 3. Software

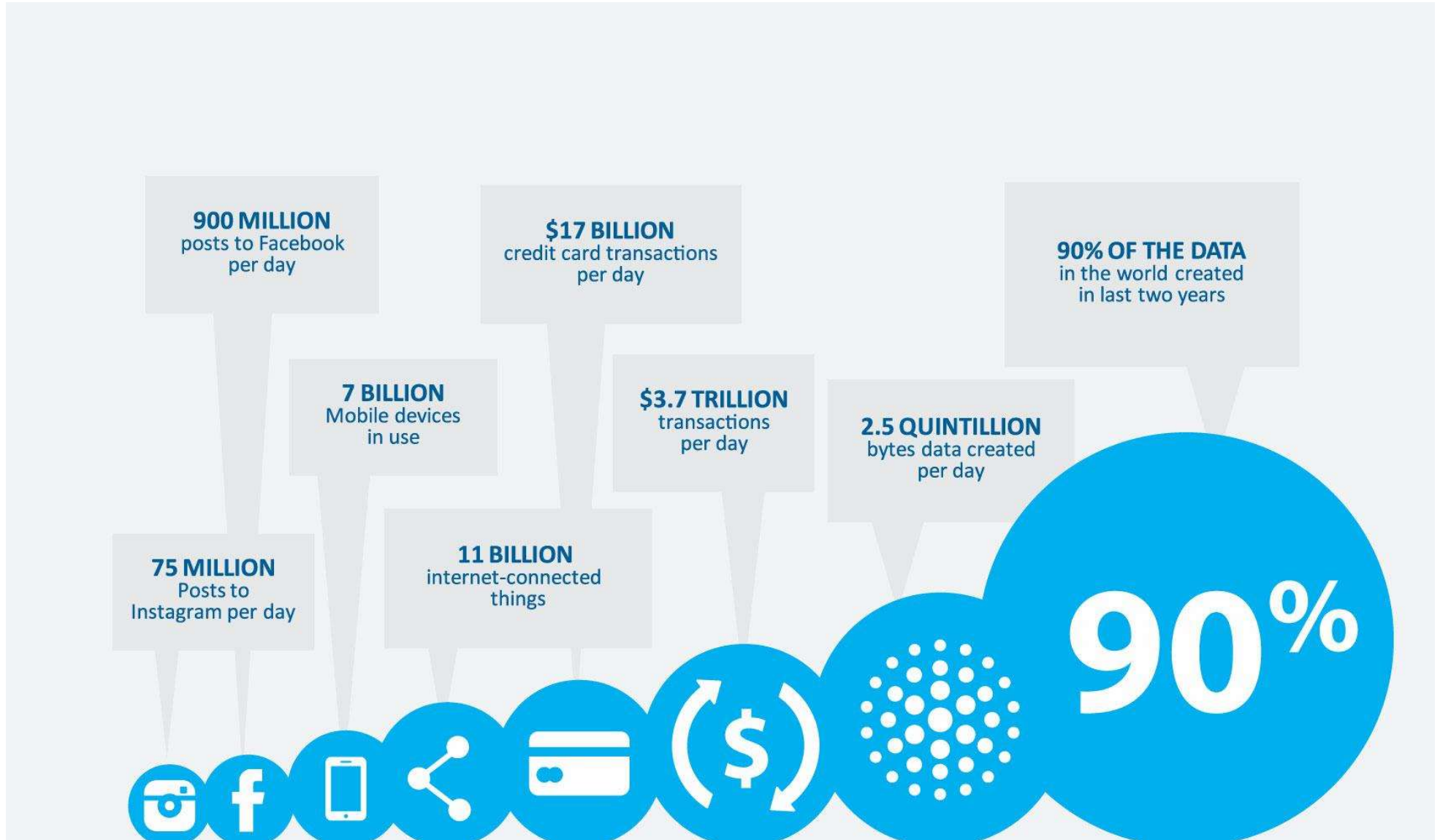
- Improved Techniques
- New Models
- Toolboxes



# Big Data

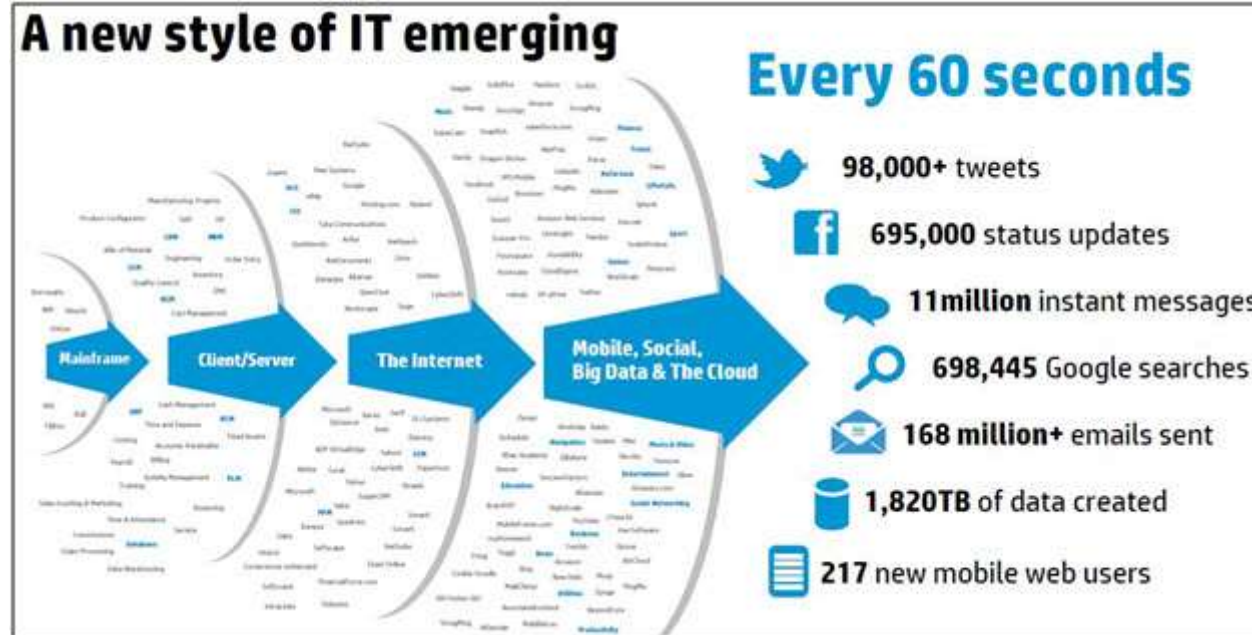


# Big Data

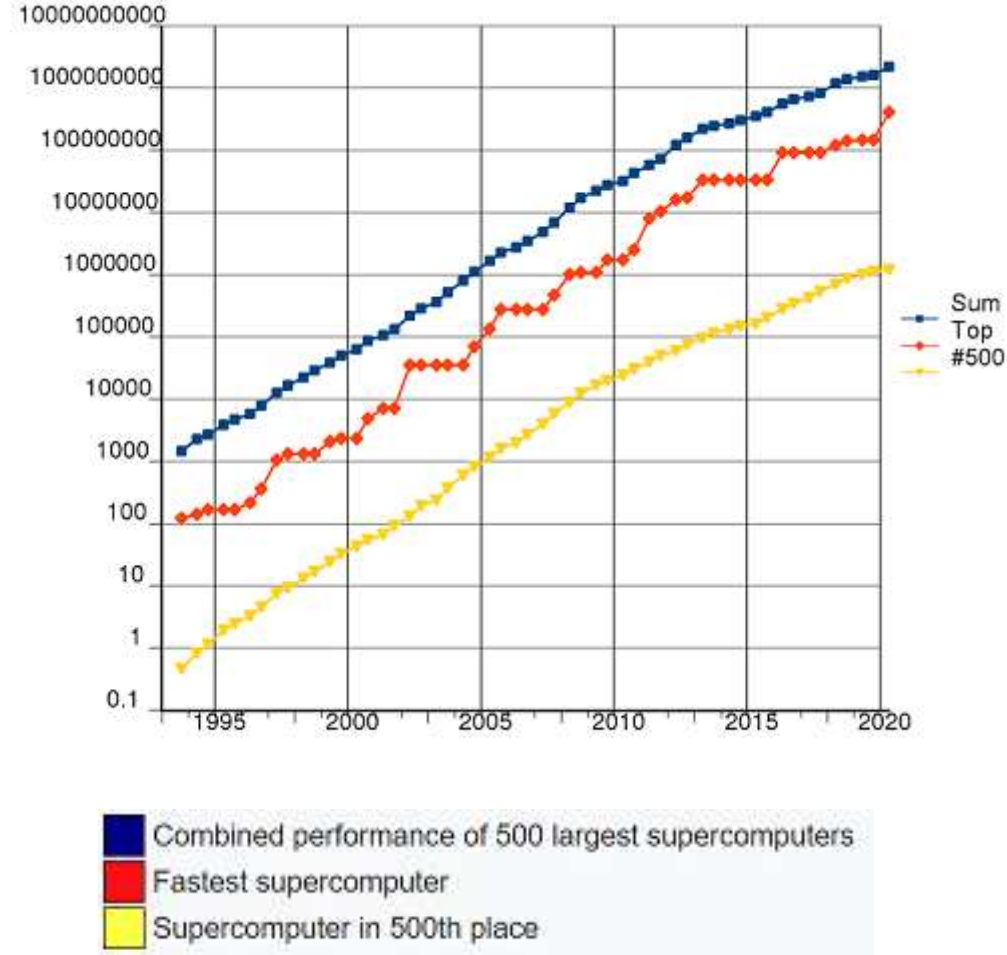




# Big Data



# Powerful Computing

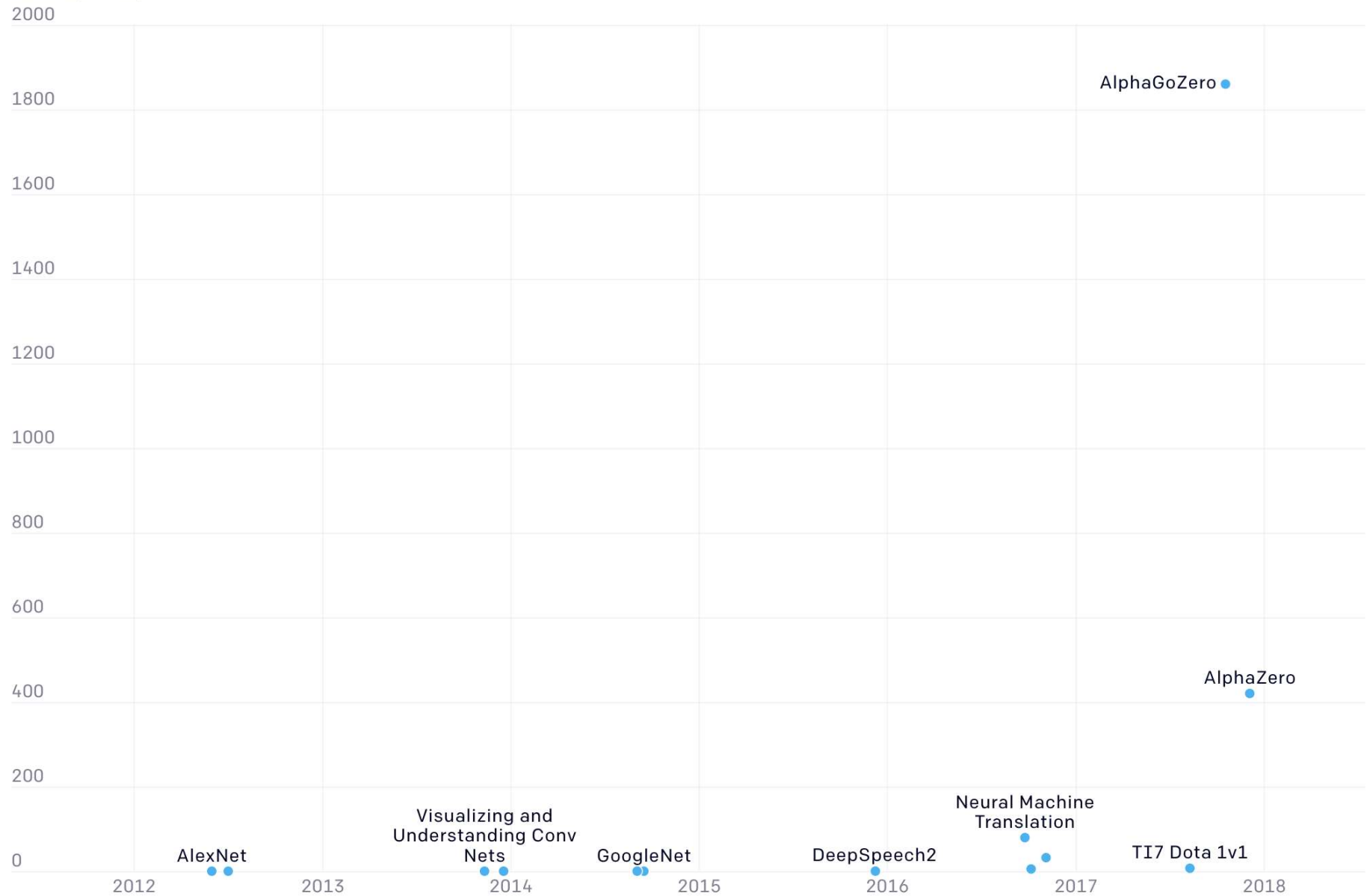


- [https://en.wikipedia.org/wiki/History\\_of\\_supercomputing](https://en.wikipedia.org/wiki/History_of_supercomputing)

# Powerful Computing

## AlexNet to AlphaGo Zero: A 300,000x Increase in Compute (Linear Scale)

Petaflop/s-days

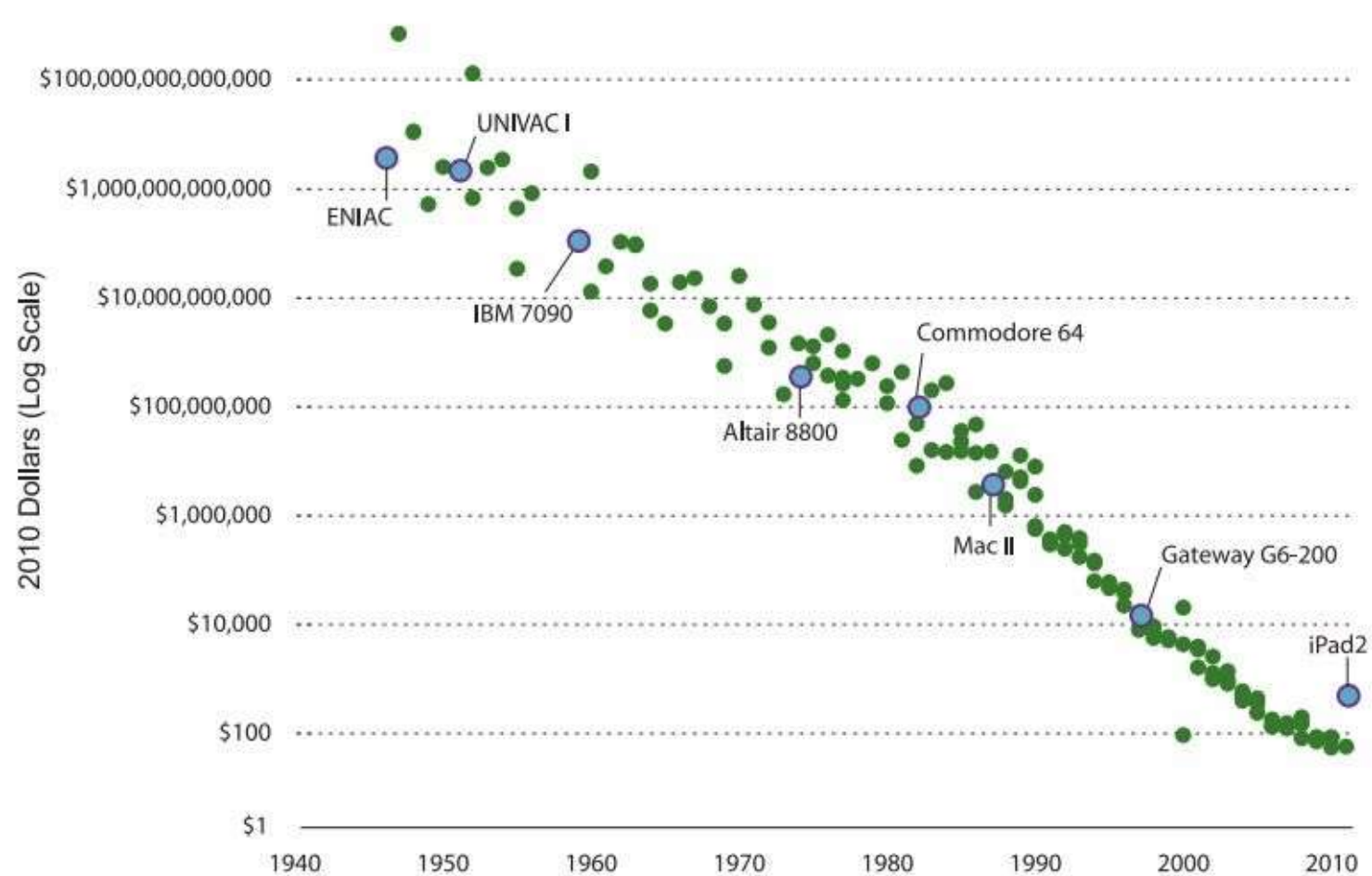


# Powerful Computing

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

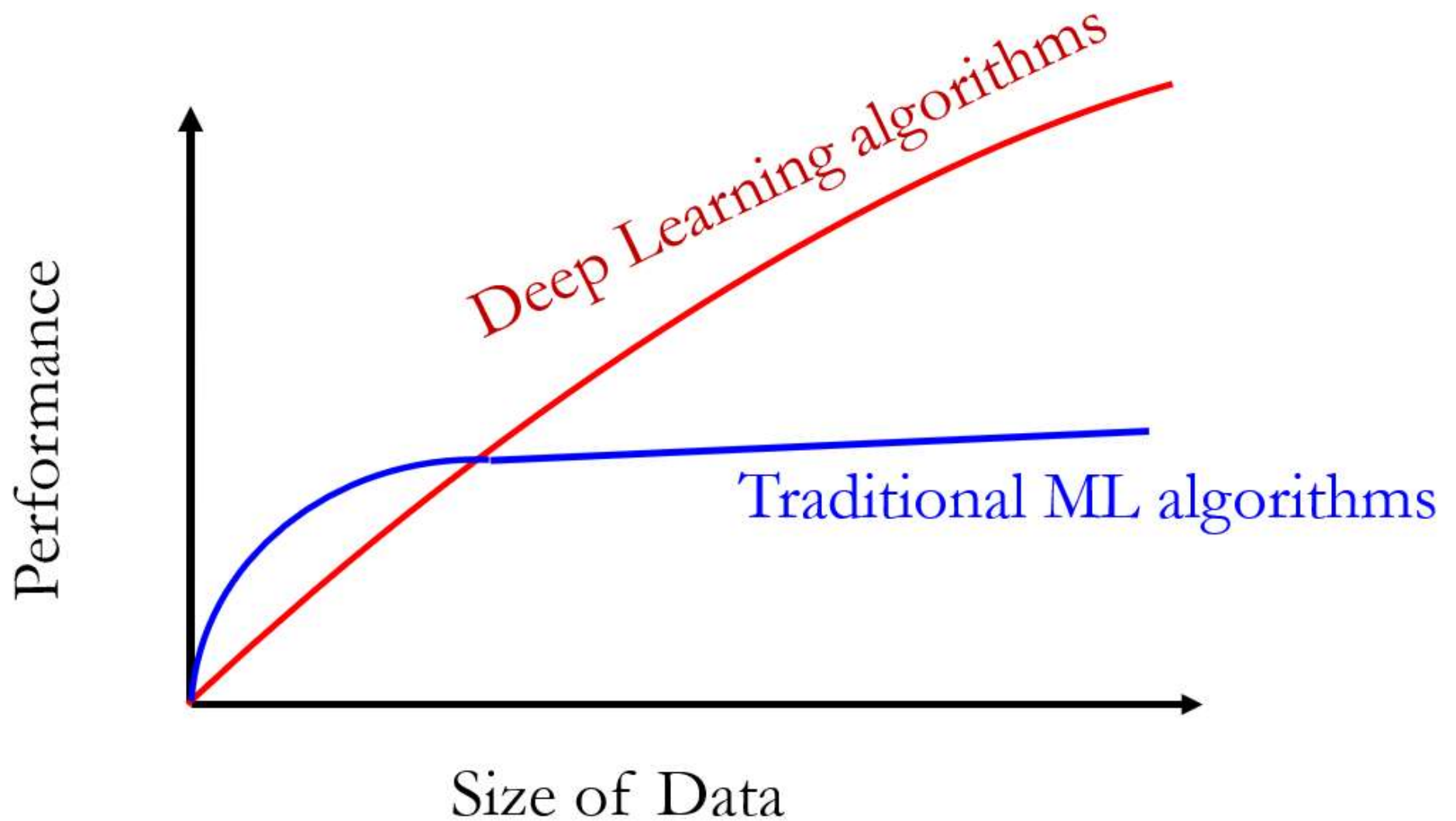
# Cheaper Computing

## 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..



# Neural Network

