

MACHINE LEARNING

DEEP LEARNING

DATE : 04.01.2024

DT/NT : DATA SCIENCE

LESSON : DEEP LEARNING

SUBJECT: ANN

BATCH : BATCH 168

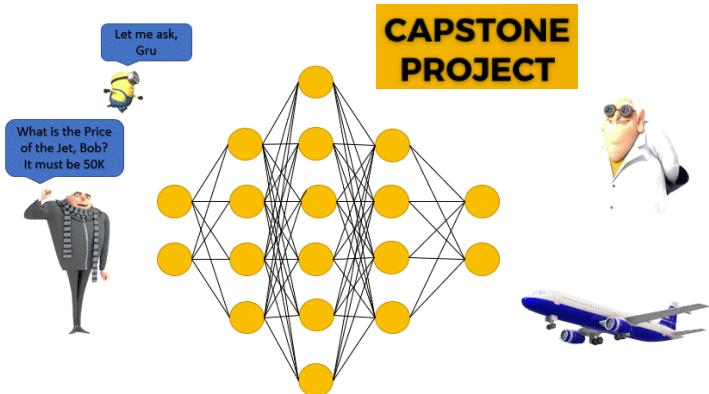


DEEP LEARNING

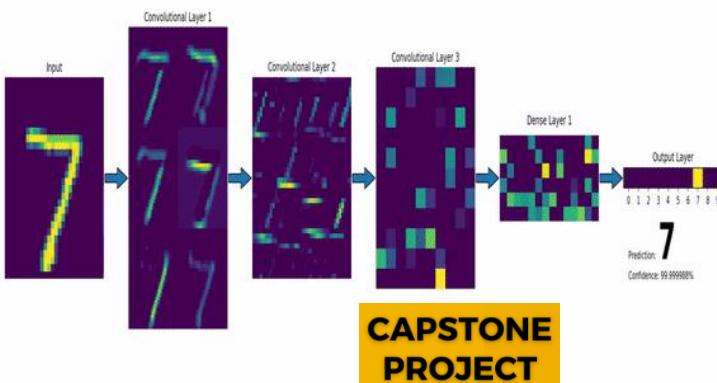
TECHPRO
EDUCATION

Kahoot!

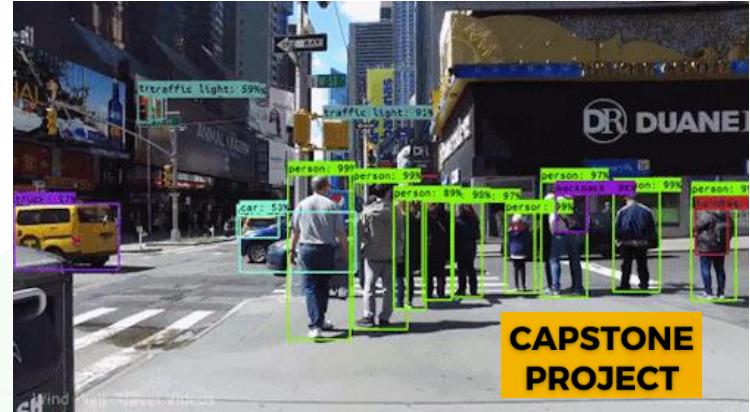
ANN = 18 saat



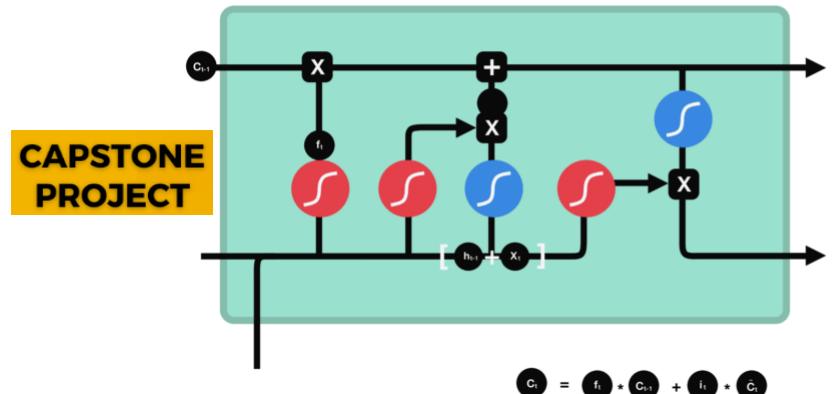
CNN = 21 saat



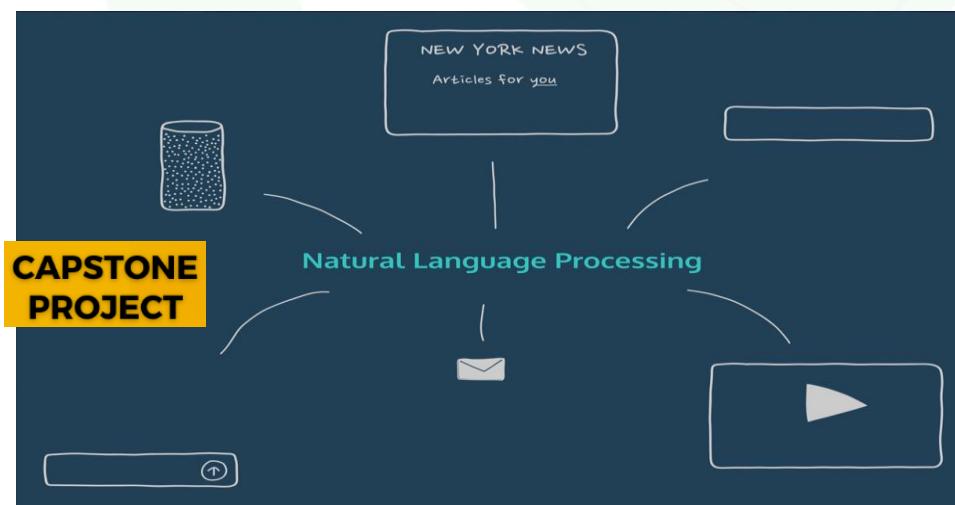
COMPUTER VISION = 24 saat



RNN+LSTM+GRU = 12 saat



NLP = 18 saat



**TOPLAM
93 saat**



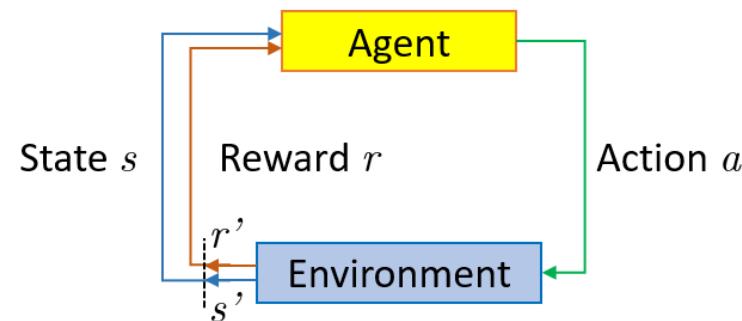
DEEP LEARNING

Generative AI = 9 saat



**TOPLAM
121 saat**

Reinforcement Learning= 9 saat



**TOPLAM
18 saat**

DEEP LEARNING

ANN

CNN

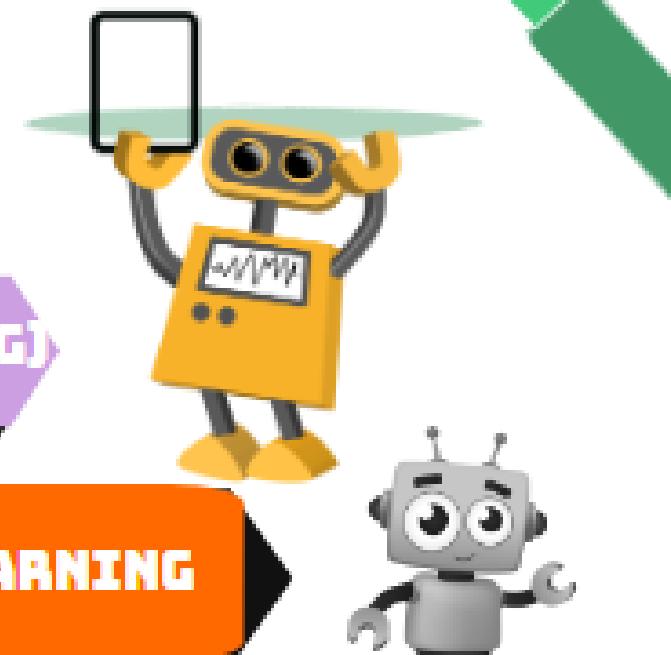
COMPUTER VISION

RNN-LSTM-GRU

NLP (NATURAL LANGUAGE PROCESSING)

GENERATIVE AI & REINFORCEMENT LEARNING

2024
SKILLS





DEEP LEARNING



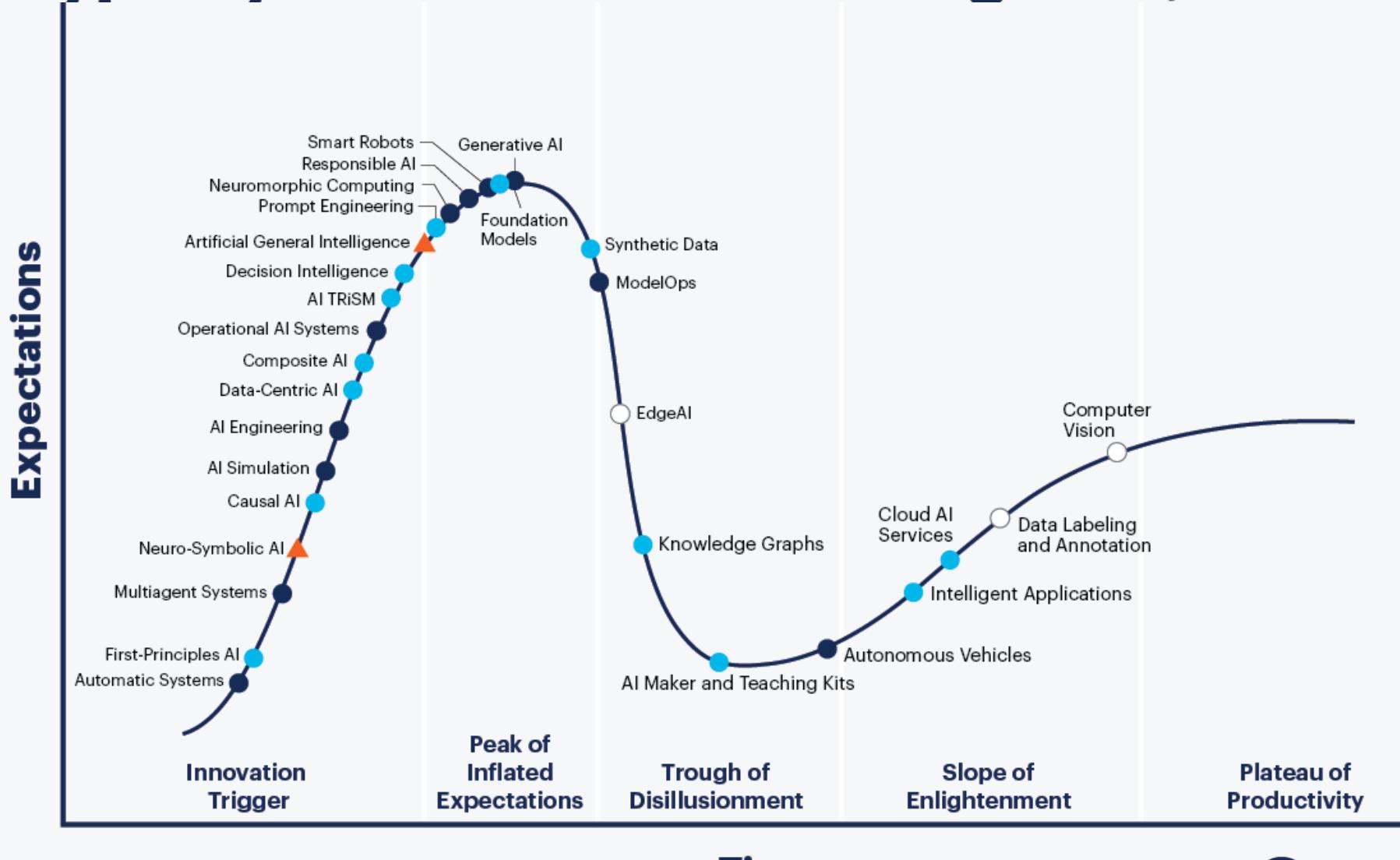
LESSON CONTENTS

- 🕒 Why Deep Learning?
- 🕒 AI and Deep Learning Milestones
- 🕒 Artificial Neural Network (ANN)
- 🕒 Deep Neural Network
- 🕒 Activation Functions
- 🕒 Gradient Descent
- 🕒 Backpropagation
- 🕒 Regularization
- 🕒 Most Popular Deep Learning Libraries



WHY DEEP LEARNING?

Hype Cycle for Artificial Intelligence, 2023



Plateau will be reached:

○ less than 2 years

● 2 to 5 years

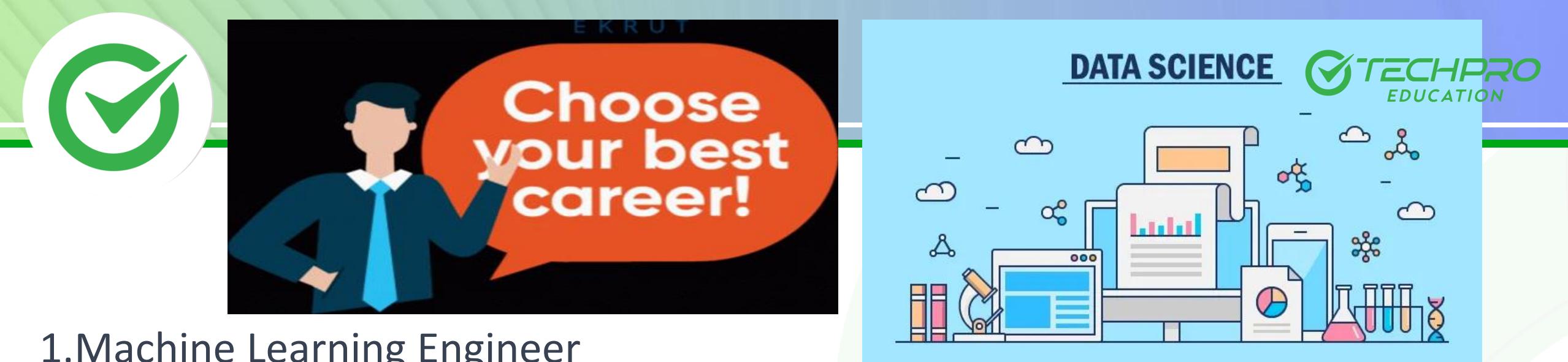
● 5 to 10 years

▲ more than 10 years

✖ obsolete before plateau

As of July 2023

Gartner®



1. Machine Learning Engineer
2. Deep Learning Engineer
3. Computer Vision Engineer
4. Natural Language Processing Engineer
5. AI Research Scientist
6. AI Software Developer
7. AI Consultant
8. Data Scientist - AI/ML



DATA SCIENCE

TECHPRO
EDUCATION

**Jobs with a
Data Science
Background**

How much does a Computer Vision Engineer make in USA?

\$165,000 / Annual

Based on 968 salaries

The average computer vision engineer salary in the USA is \$165,000 per year or \$84.62 per hour. Entry level positions start at \$137,500 per year while most experienced workers make up to \$205,000 per year.



Data Scientist Average Salary

ComputerCareers.org



How much does a Natural Language Processing Engineer make?

Experience

All years of Experience

\$88,551 / yr

Total Pay

\$75,072 / yr

Base Pay

\$13,479 / yr

Additional Pay

\$88,551 / yr

\$49K

\$162K

\$28K

\$279K

Most Likely Range Possible Range



AI job titles with the highest salaries



| Rank | Job title | Average salary |
|------|---------------------------|----------------|
| 1. | Machine learning engineer | \$142,858.57 |
| 2. | Data scientist | \$126,927.41 |
| 3. | Computer vision engineer | \$126,399.81 |

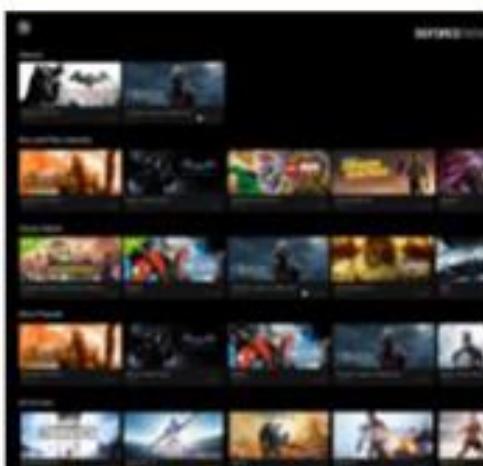
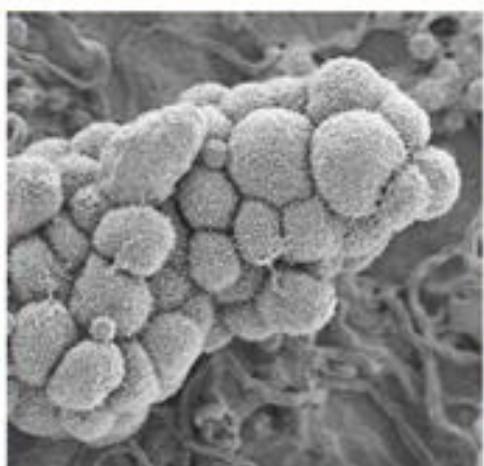
Prestige®



DEEP LEARNING



DEEP LEARNING EVERYWHERE



INTERNET & CLOUD

Image Classification
Speech Recognition
Language Translation
Language Processing
Sentiment Analysis
Recommendation

MEDICINE & BIOLOGY

Cancer Cell Detection
Diabetic Grading
Drug Discovery

MEDIA & ENTERTAINMENT

Video Captioning
Video Search
Real Time Translation

SECURITY & DEFENSE

Face Detection
Video Surveillance
Satellite Imagery

AUTONOMOUS MACHINES

Pedestrian Detection
Lane Tracking
Recognize Traffic Sign



DEEP LEARNING

10 FASCINATING APPLICATIONS OF DEEP LEARNING



SELF-DRIVEN
CARS



AUTOMATIC
HANDWRITING
GENERATION



PIXEL
RESTORATION



COLOURISATION OF
BLACK & WHITE
IMAGES



DEEP
DREAMING



DETECTION OF
GROWTH DELAYS
IN CHILDREN



DEMOGRAPHIC
PREDICTION



SOUND
ADDITION TO
SILENT FILMS



NEWS
GENERATION



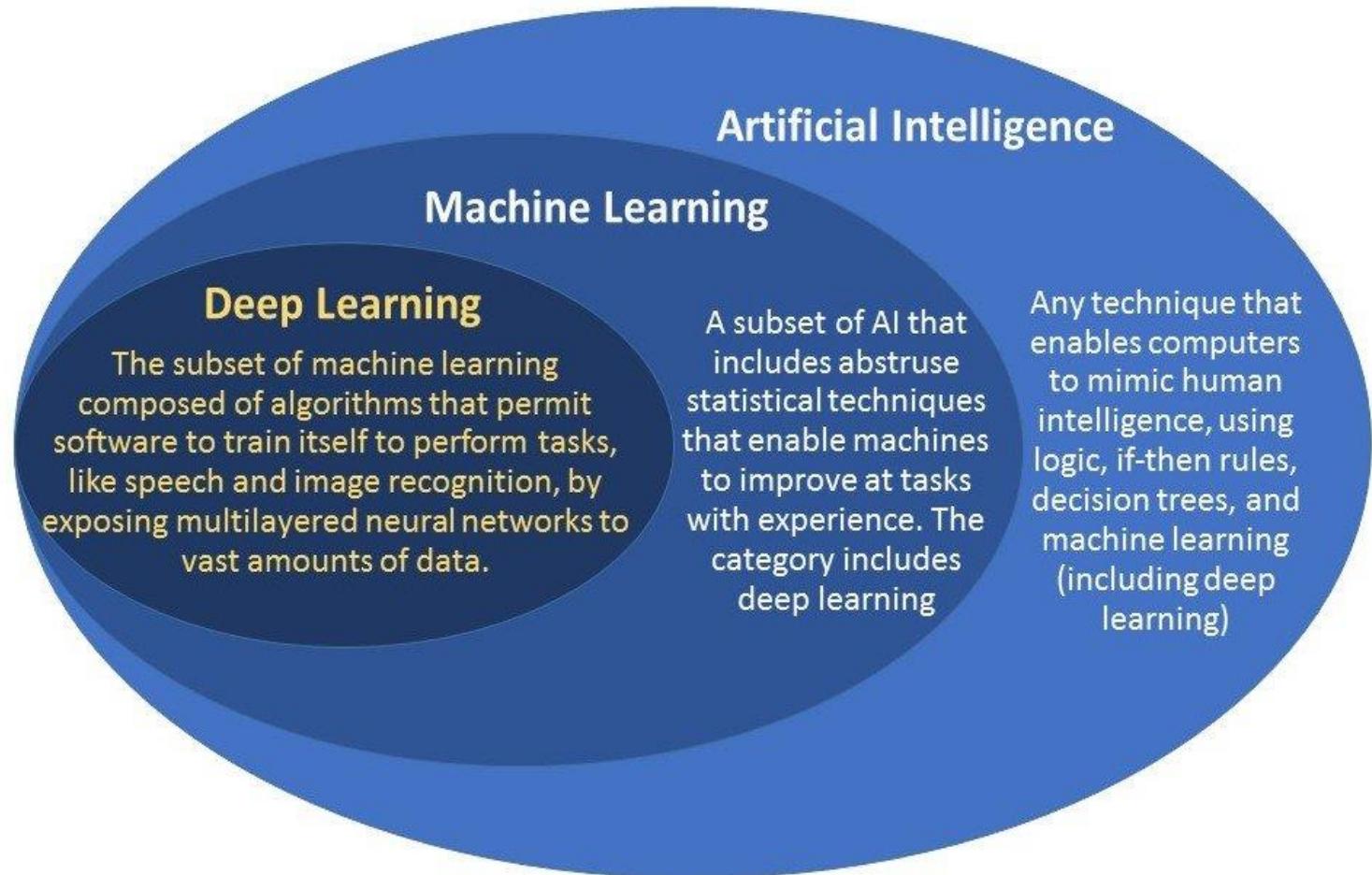
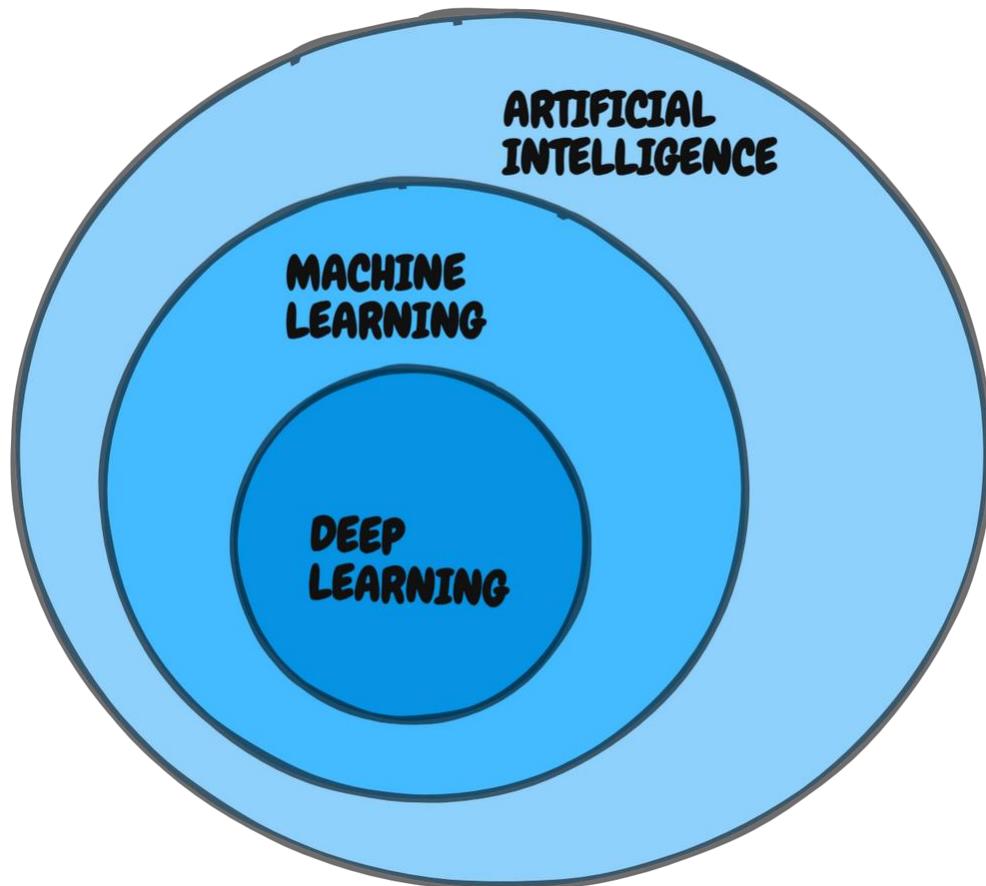
AUTOMATIC
MACHINE
TRANSLATION

20 DEEP LEARNING Applications

-
- 1 Self Driving Cars
 - 2 Entertainment
 - 3 Visual Recognition
 - 4 Virtual Assistants
 - 5 Fraud Detection
 - 6 Natural Language Processing
 - 7 News Aggregation and Fraud News Detection
 - 8 Detecting Developmental Delay in Children
 - 9 Colourisation of Black and White images
 - 10 Adding sounds to silent movies
 - Healthcare 11
 - Personalisations 12
 - Automatic Machine Translation 13
 - Automatic Handwriting Generation 14
 - Demographic & Election Predictions 15
 - Automatic Game Playing 16
 - Language Translations 17
 - Pixel Restoration 18
 - Photo Descriptions 19
 - Deep Dreaming 20



AI/MACHINE LEARNING/DEEP LEARNING





WHAT IS DEEP LEARNING?



ARTIFICIAL INTELLIGENCE

Any technique that enables computers to mimic human behavior



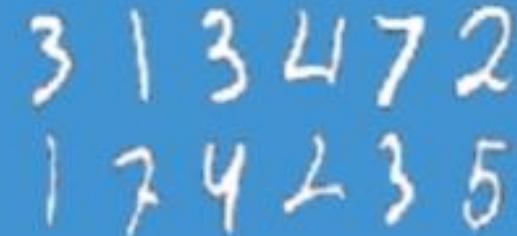
MACHINE LEARNING

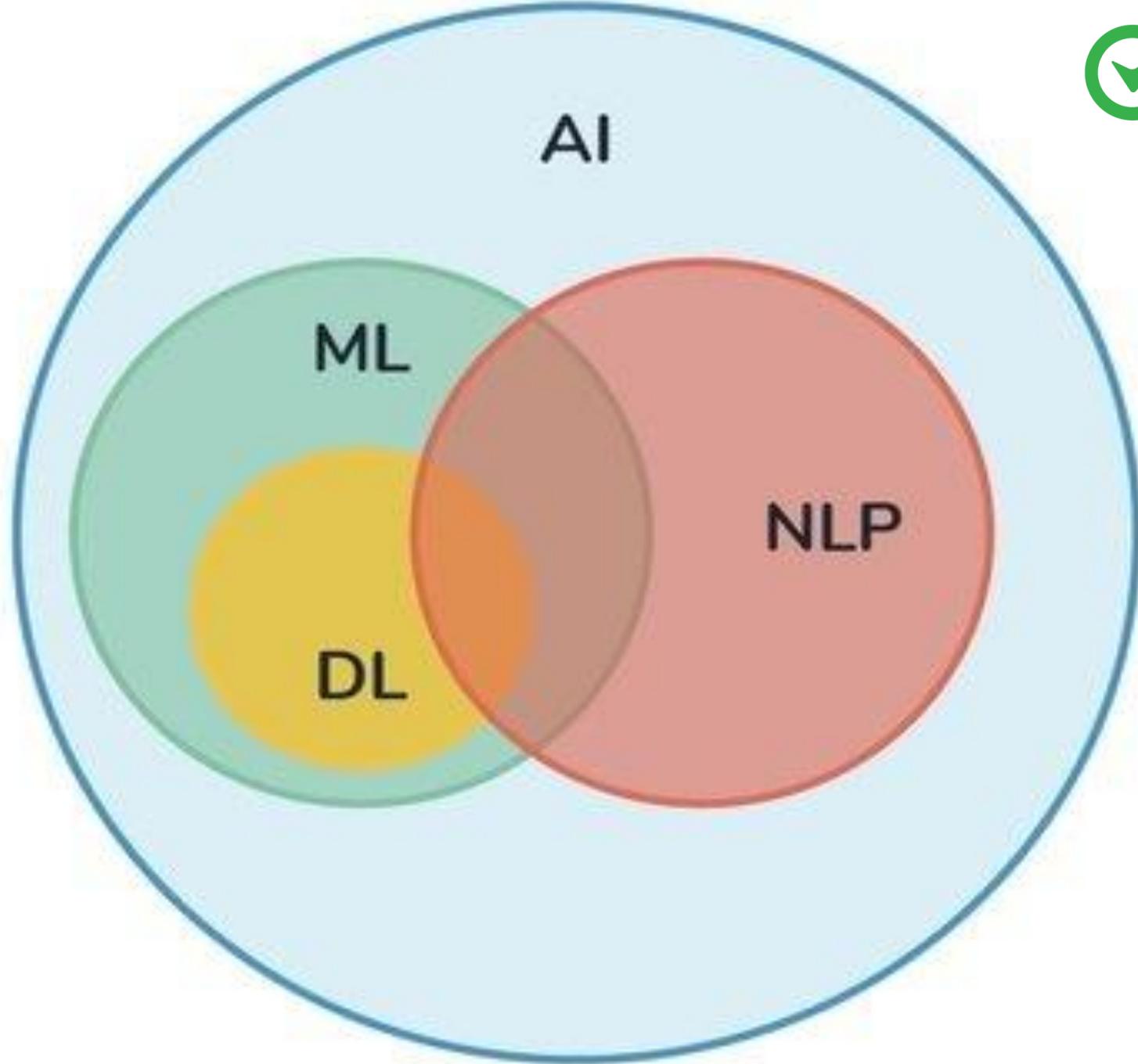
Ability to learn without explicitly being programmed



DEEP LEARNING

Extract patterns from data using neural networks

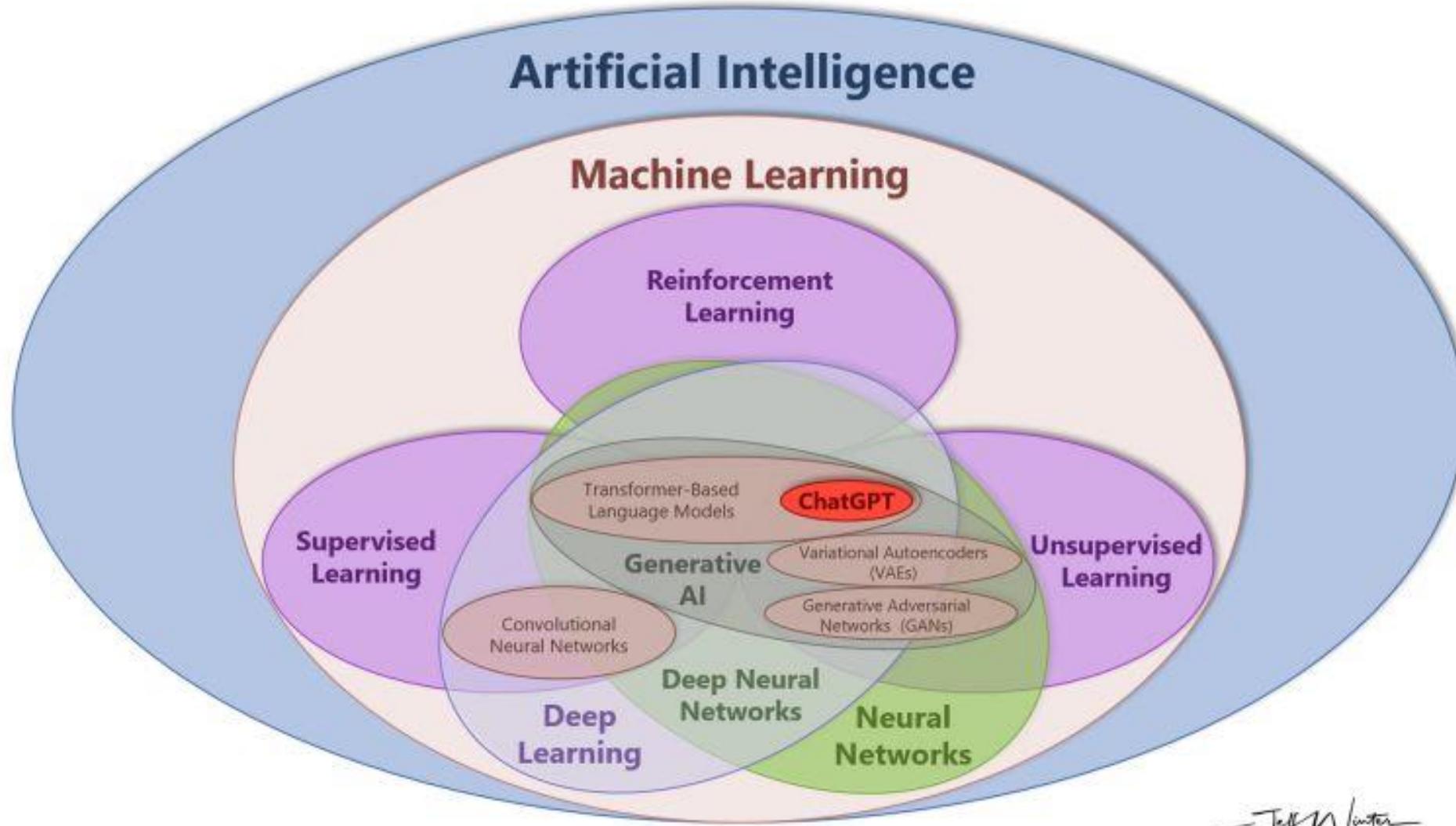




- Artificial intelligence
- Machine learning
- Language Processing
- Deep learning



AI/MACHINE LEARNING/DEEP LEARNING



Jeff Winter



WHY DEEP LEARNING IS SO POPULAR

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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

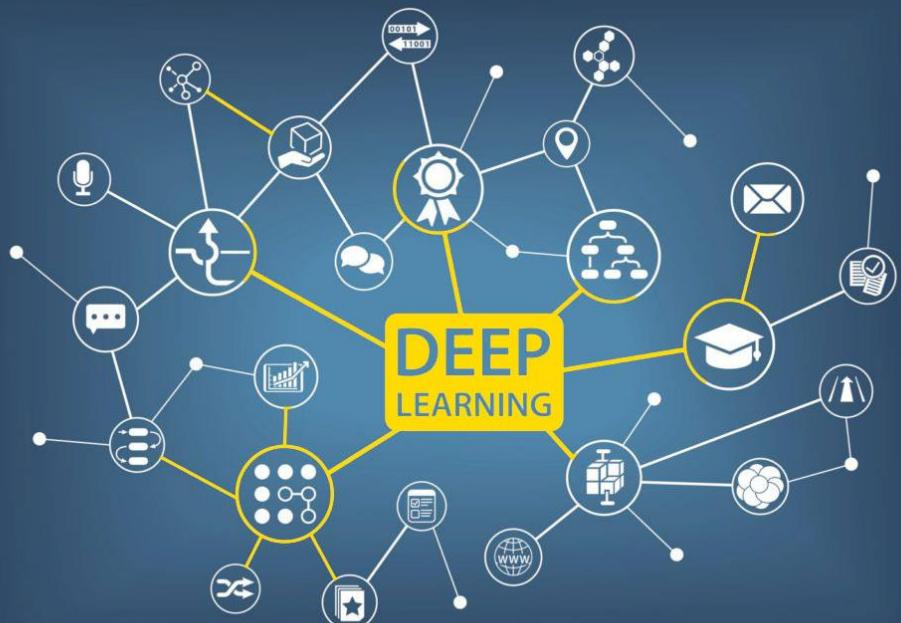
TensorFlow



DEEP LEARNING



İnsan beyninin çalışmalarını taklit eden yapay zeka işlevidir.



Derin öğrenme bir makine öğrenimi yöntemidir!

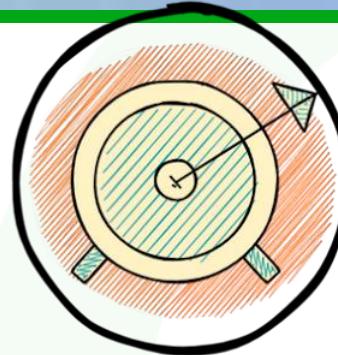
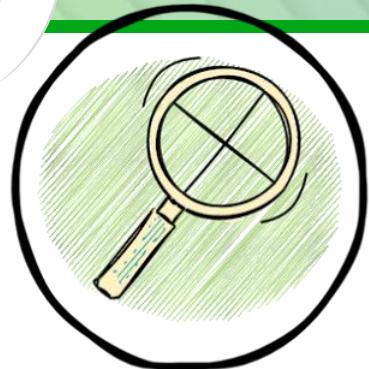


Büyük miktarda veri gerektirir.



5

WHY DEEP LEARNING IS SO POPULAR



01

02

03

04

05

RAPIDLY INCREASING DATA

BIG DATA
TRANSFER LEARNING
PRE-TRAINED MODELS
LARGE DATASETS

TECHNOLOGICAL ADVANCEMENTS IN HARDWARE

INCREASED COMPUTING POWER (GPU, TPU)

TECHNOLOGICAL ADVANCEMENTS IN SOFTWARE

OPEN SOURCE FRAMEWORKS
(TENSORFLOW
KERAS, CAFFE
PYTORCH)

HIGH ACCURACY

REMARKABLE ACCURACY
IN TASKS SUCH AS
IMAGE RECOGNITION,
SPEECH RECOGNITION,
NATURAL LANGUAGE
PROCESSING

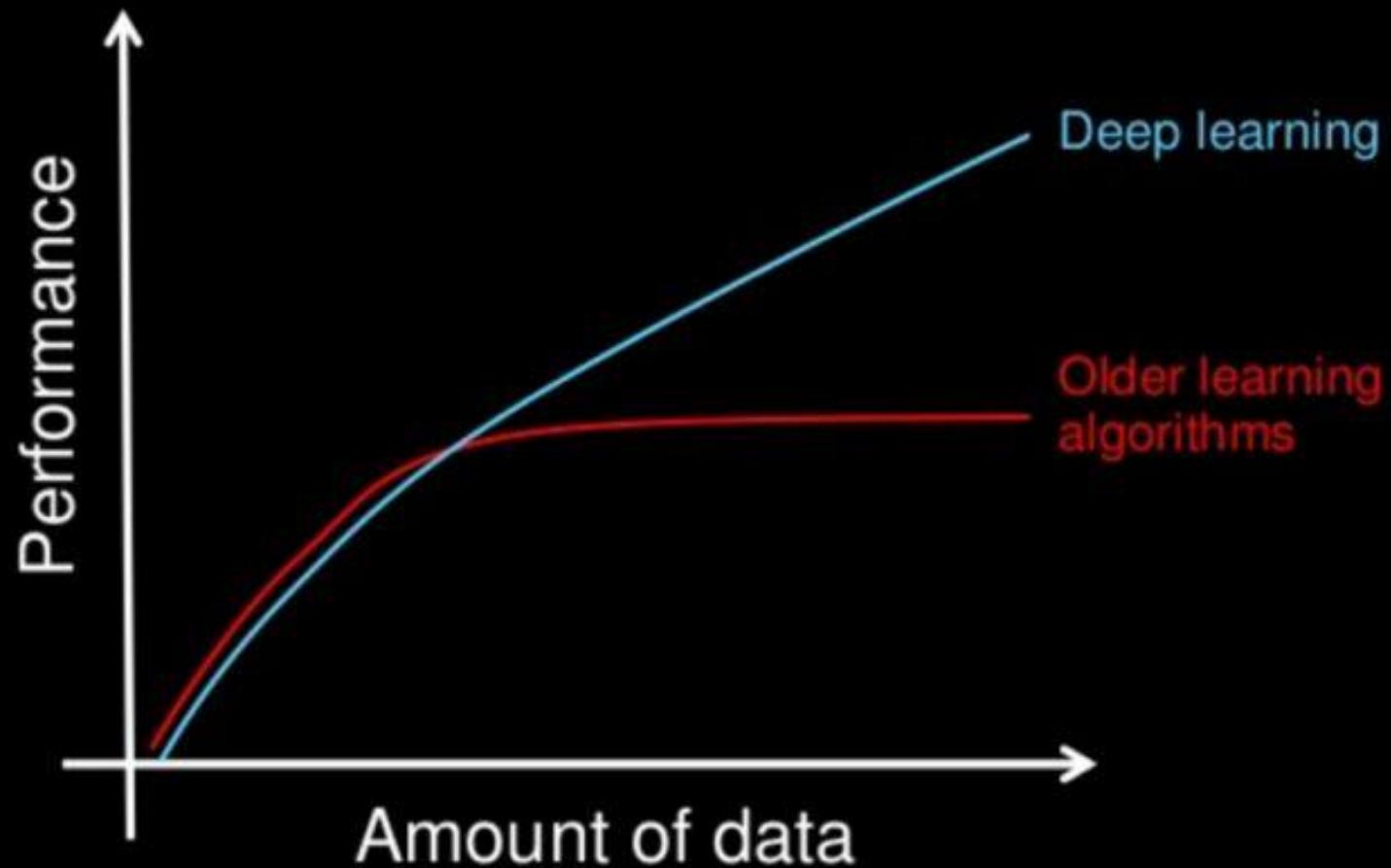
REAL-WORLD APPLICATIONS

SELF-DRIVING CARS
VIRTUAL ASSISTANTS
MEDICAL DIAGNOSIS



RAPIDLY INCREASING DATA

Why deep learning



How do data science techniques scale with amount of data?

WHY DEEP LEARNING IS SO POPULAR



AT'S A ZETTABYTE?

| | |
|-------------|---------------------------|
| 1 kilobyte | 1,000,000,000,000,000,000 |
| 1 megabyte | 1,000,000,000,000,000,000 |
| 1 gigabyte | 1,000,000,000,000,000,000 |
| 1 terabyte | 1,000,000,000,000,000,000 |
| 1 petabyte | 1,000,000,000,000,000,000 |
| 1 exabyte | 1,000,000,000,000,000,000 |
| 1 zettabyte | 1,000,000,000,000,000,000 |

Data volume in zettabytes

150

100

50

0



Data Never Sleeps 10.0

PEOPLE SEND 16M
TEXTS



ONLINE
EVENT
GOERS PURCHASE
\$12.9K



EMAIL
USERS SEND



231.4M messages

CRYPTO
BUYERS PURCHASE



\$90.2M in cryptocurrency

VENMO
USERS SEND
\$437.6K



AMAZON
SHOPPERS SPEND
\$443K



GOOGLE
USERS CONDUCT



5.9M searches

EVERY
MINUTE
OF THE DAY

DOMO

FACEBOOK

USERS SHARE

1.7M pieces of content



INSTAGRAM
USERS SHARE



66K photos

TWITTER
USERS SHARE



347.2K tweets

SNAPCHAT
USERS SEND



2.43M snaps

TINDER
USERS SWIPE



1.1M times

YOUTUBE
USERS UPLOAD



500 hours of video

VIEWERS SPEND
1M hours
STREAMING



DOORDASH
DINERS PLACE



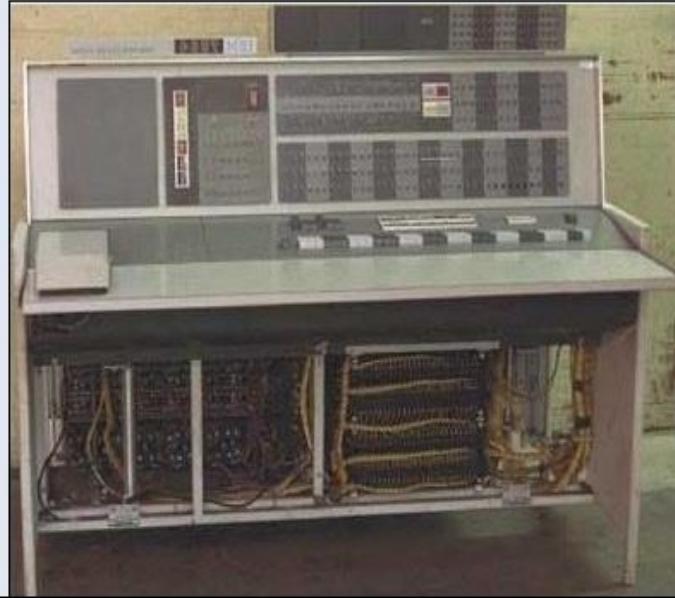
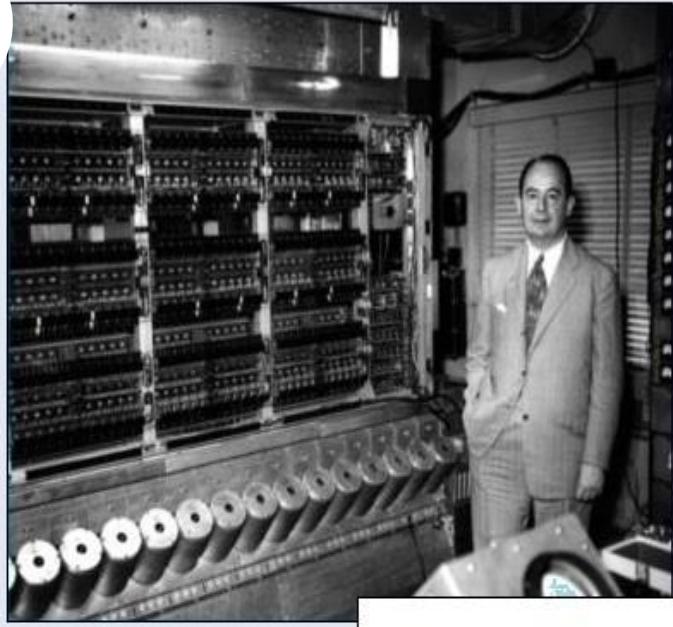
\$76.4K in orders

104.6 hours
SPENT IN
ZOOM
MEETINGS





TECHNOLOGICAL ADVANCEMENTS IN HARDWARE



Generations and Future Computers





WHY DEEP LEARNING IS SO POPULAR

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THE BIG BANG IN DEEP LEARNING



DNN



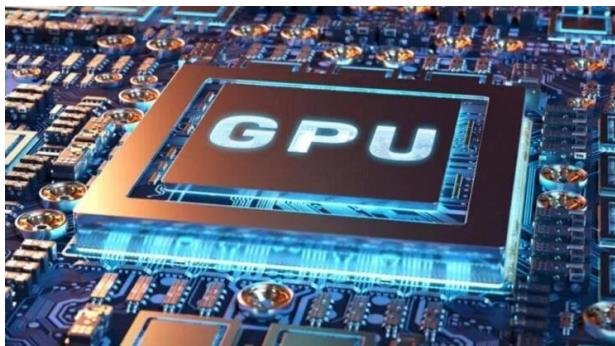
BIG DATA



GPU

“The GPU is the workhorse of modern A.I.”

POPULAR
SCIENCE



GPU AND Deep Learning

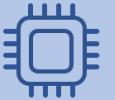


GPU and Deep Learning:
A Combination That Works Miracles



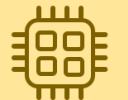
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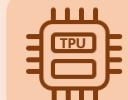
CPU

- Small models
- Small datasets
- Useful for design space exploration



GPU

- Medium-to-large models, datasets
- Image, video processing
- Application on CUDA or OpenCL



TPU

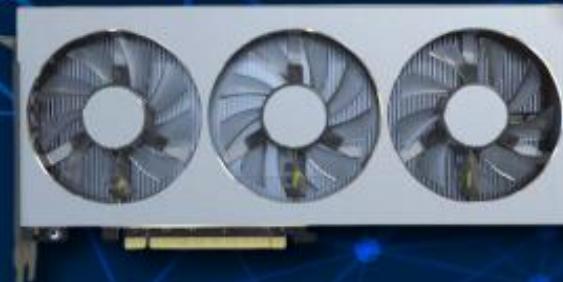
- Matrix computations
- Dense vector processing
- No custom TensorFlow operations

Central processing unit



CPU

Graphics processing unit



GPU

Tensor Processing Unit



TPU





WHY DEEP LEARNING IS SO POPULAR

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CPU



GPU



Tensor Processing Unit

TPU



WHY DEEP LEARNING IS SO POPULAR

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Why GPU Matters in Deep Learning?

```
X_train shape: (50000, 3, 32, 32)
50000 train samples
10000 test samples
Using real-time data augmentation.
Epoch 1/200
50000/50000 [=====] 734s
```

Epoch 2/200
50000/50000 [=====] 733s
Epoch 3/200
50000/50000 [=====] 733s
Epoch 4/200
50000/50000 [=====] 733s

VS

```
X_train shape: (50000, 3, 32, 32)
50000 train samples
10000 test samples
Using real-time data augmentation.
Epoch 1/200
50000/50000 [=====] 27s
```

Epoch 2/200
50000/50000 [=====] 27s
Epoch 3/200
50000/50000 [=====] 27s
Epoch 4/200
50000/50000 [=====] 27s

Running time **without GPU**

Running time **with GPU**

With GPU, the running time is $733/27=27.1$ times faster than the running time without GPU!!!



TECHNOLOGICAL ADVANCEMENTS IN SOFTWARE



WHY DEEP LEARNING IS SO POPULAR

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Keras



TensorFlow

Caffe

PyTorch



PROMINENT FIGURES OR GURUS IN THE FIELD OF DEEP LEARNING



THE 100 MOST INFLUENTIAL PEOPLE IN ARTIFICIAL INTELLIGENCE

TIME 100/AI



+
ELON
MUSK'S
FIGHT
FOR THE
FUTURE
OF AI
By WALTER
ISAACSON



Geoffrey Hinton

“The Godfather of deep learning”





deeplearning.ai presents
Heroes of Deep Learning

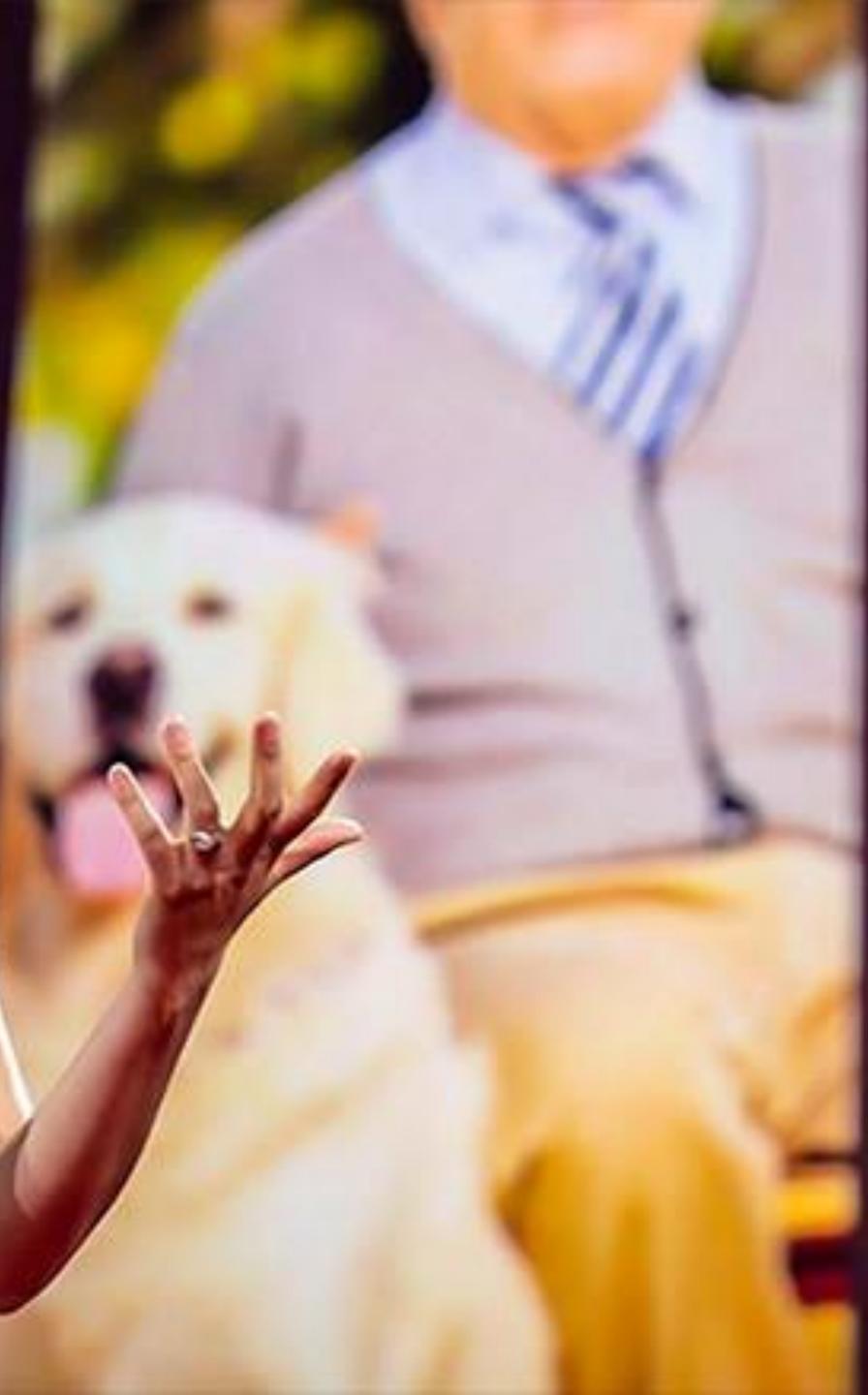
Ian Goodfellow

Research Scientist at Google Brain



Fei-Fei Li

Sequoia Professor of Computer
Science at Stanford University





DEEP LEARNING



deeplearning.ai



Carnegie Mellon University
Machine Learning

“

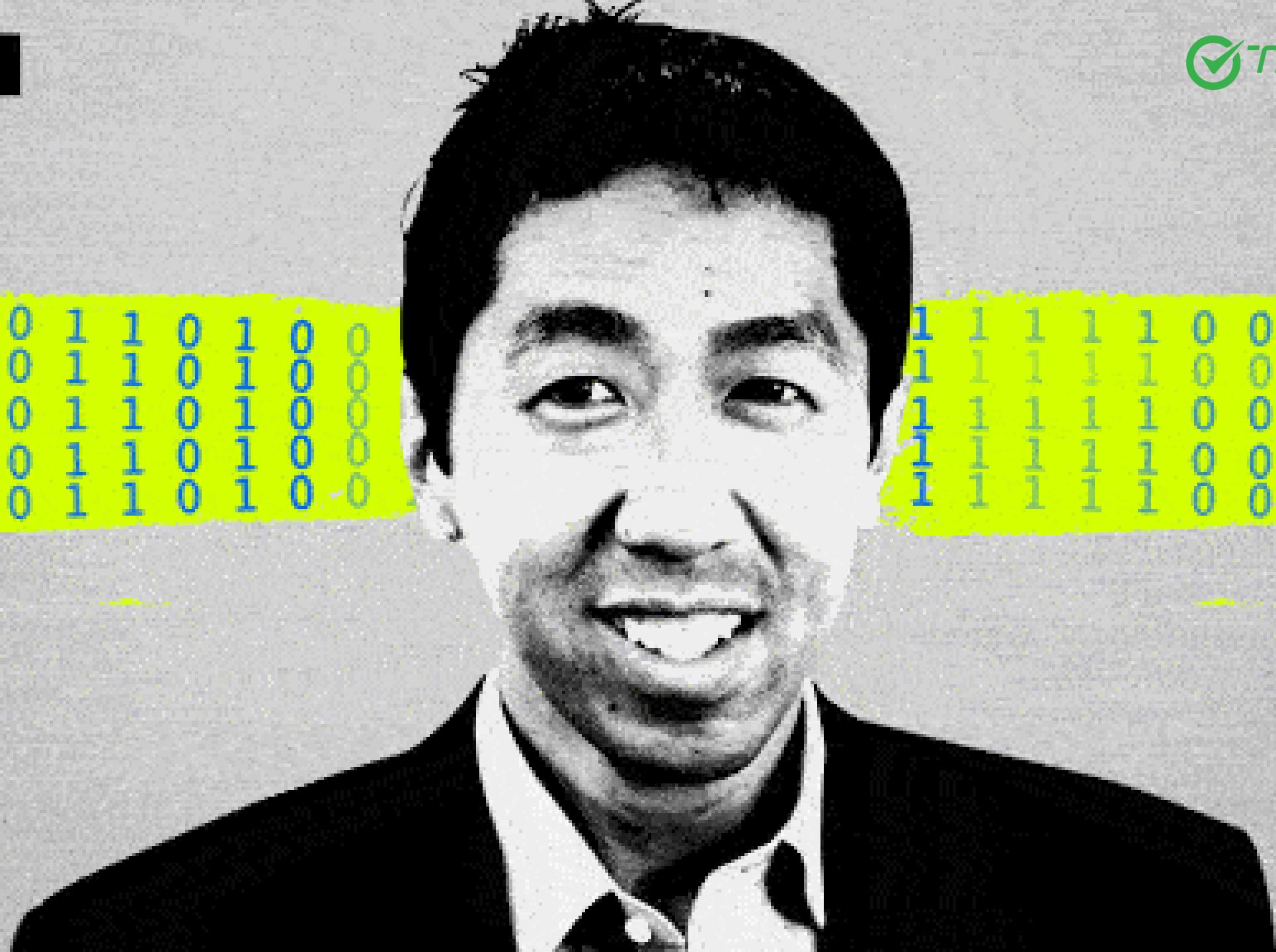
Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years.

~ Andrew Ng



1 0 0 0 1 1 0 1 0 0
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1 0 0 0 1 1 0 1 0 0
1 0 0 0 1 1 0 1 0 0
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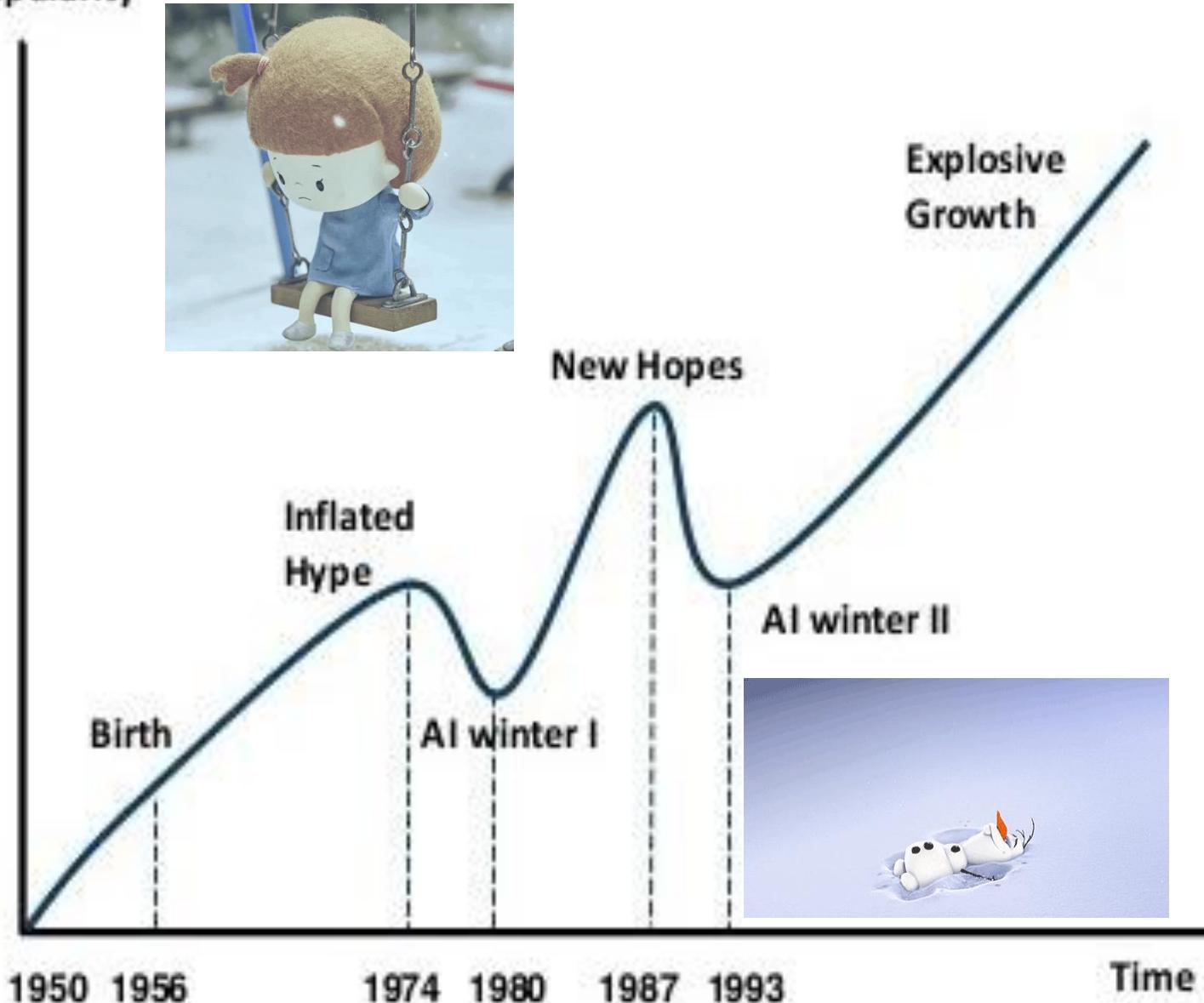
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DEEP LEARNING HISTORY

Popularity

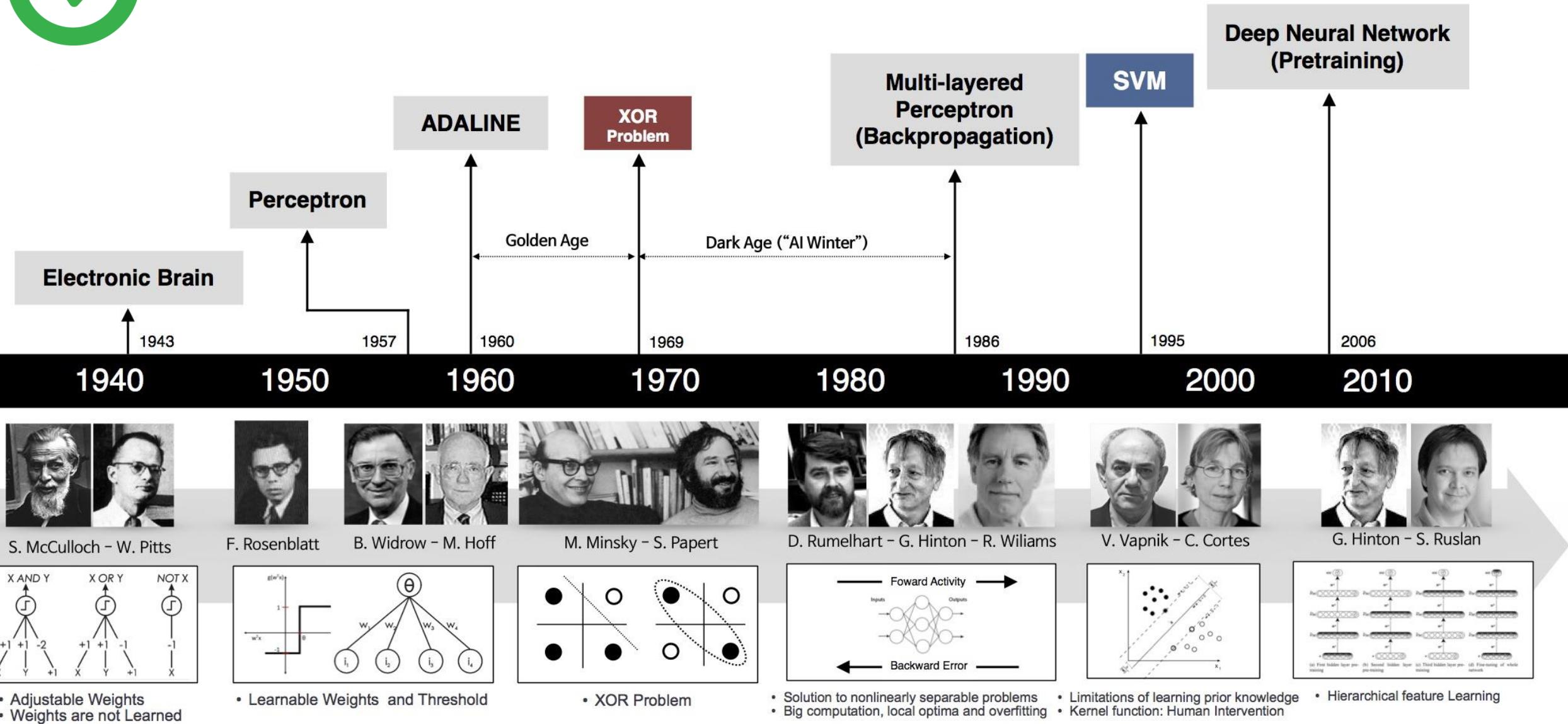


Timeline of AI Development

- **1950s-1960s:** First AI boom - the age of reasoning, prototype AI developed
- **1970s:** AI winter I
- **1980s-1990s:** Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s:** AI winter II
- **1997:** Deep Blue beats Gary Kasparov
- **2006:** University of Toronto develops Deep Learning
- **2011:** IBM's Watson won Jeopardy
- **2016:** Go software based on Deep Learning beats world's champions



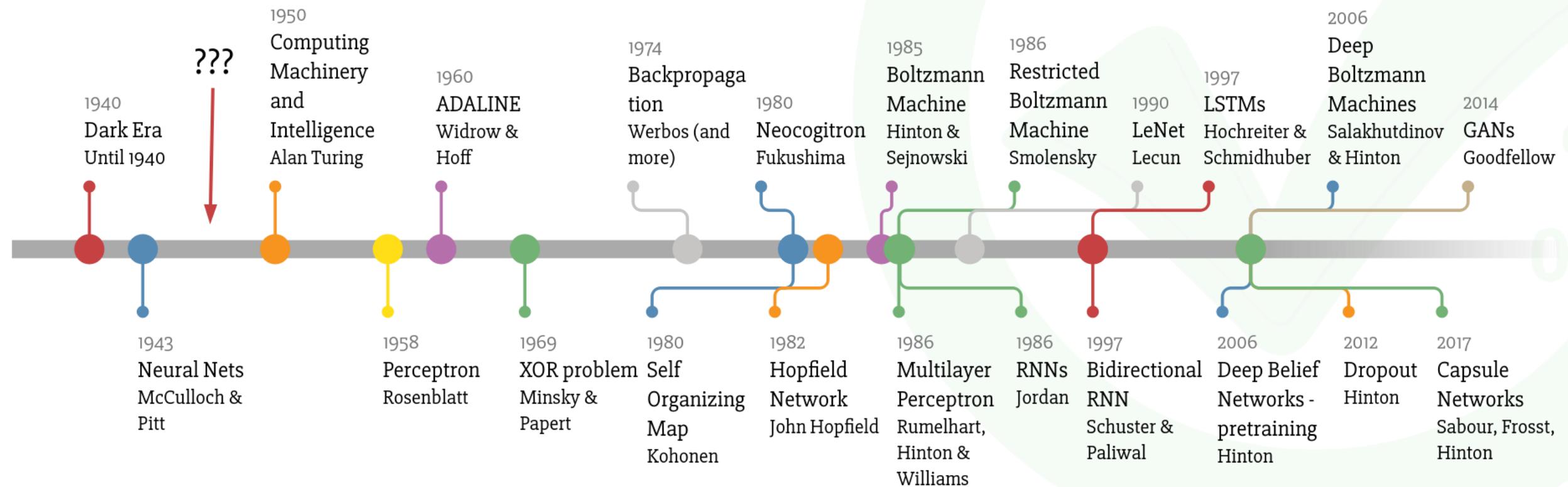
DEEP LEARNING HISTORY



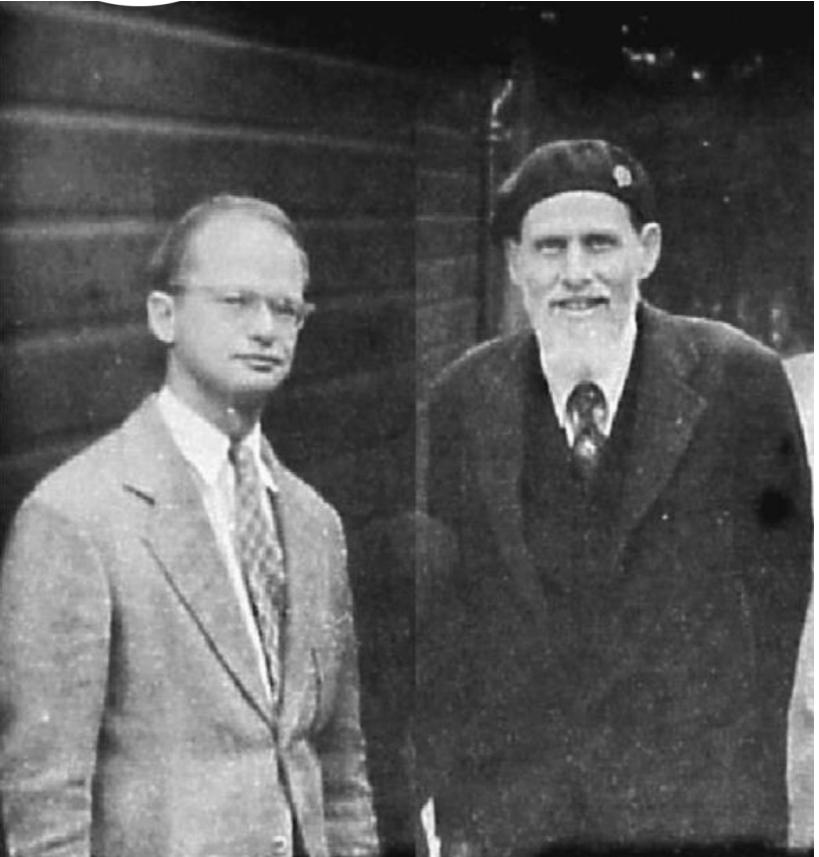


DEEP LEARNING HISTORY

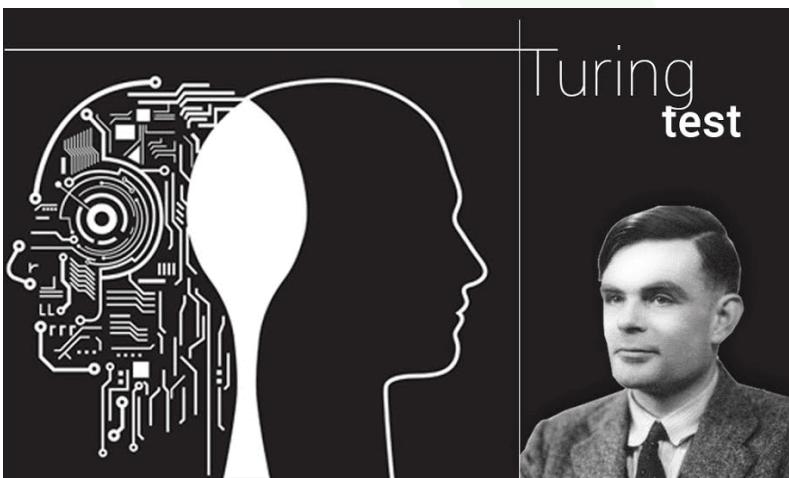
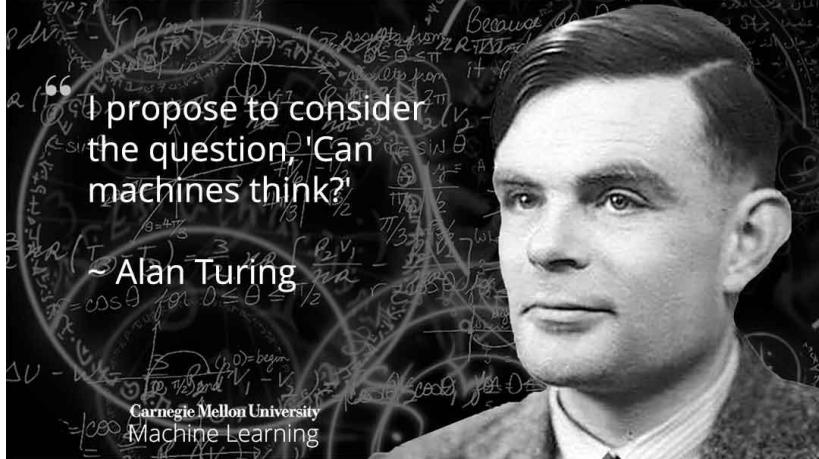
Deep Learning Timeline



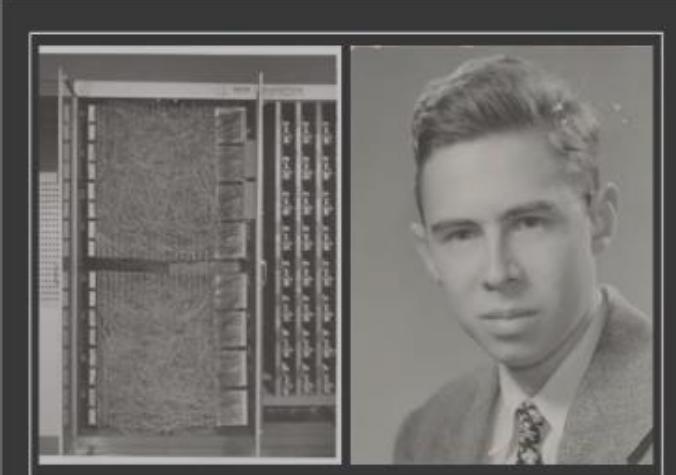
DEEP LEARNING HISTORY



McCulloch (right) and Pitts (left)



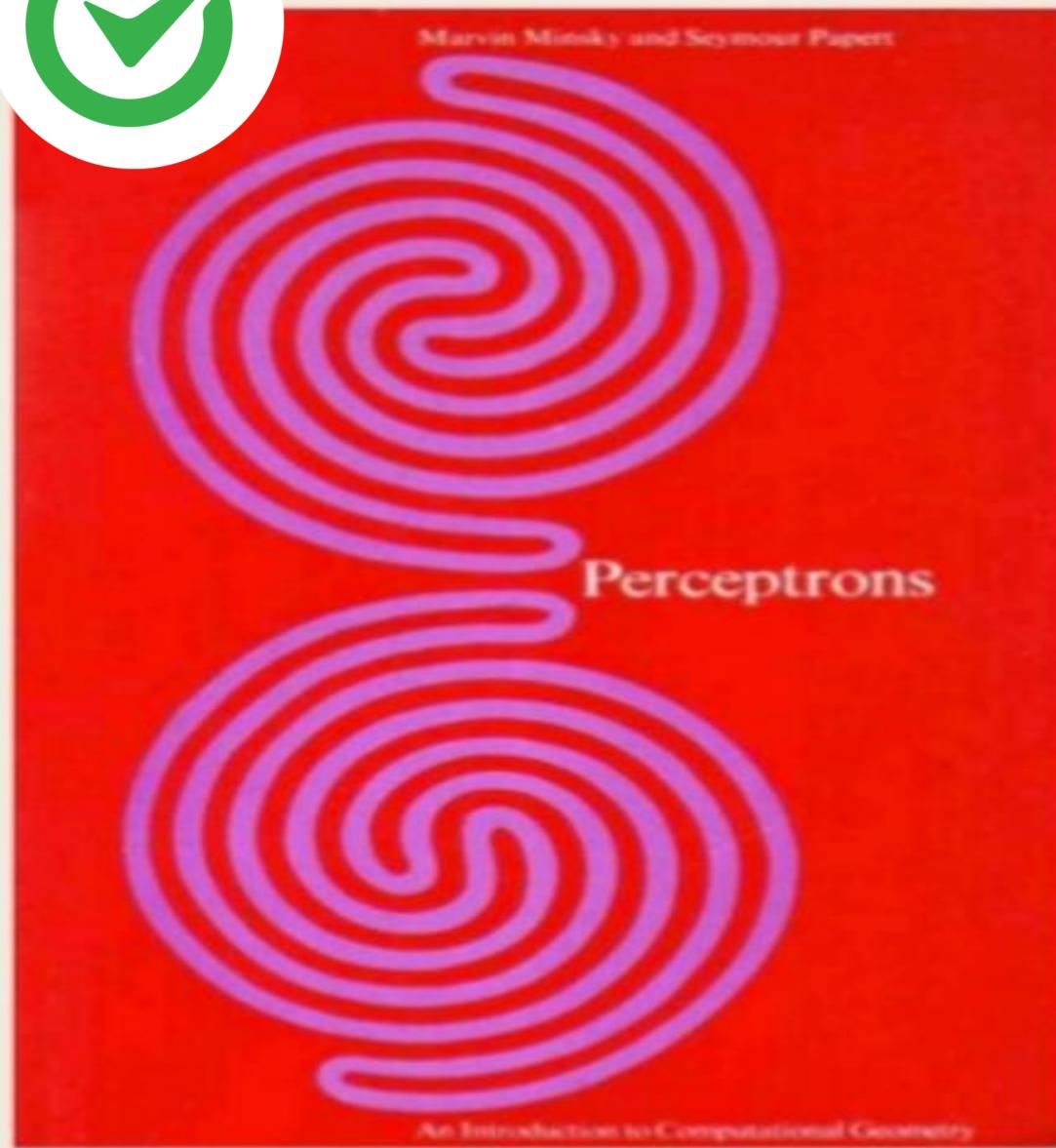
Frank Rosenblatt Creates Perceptron



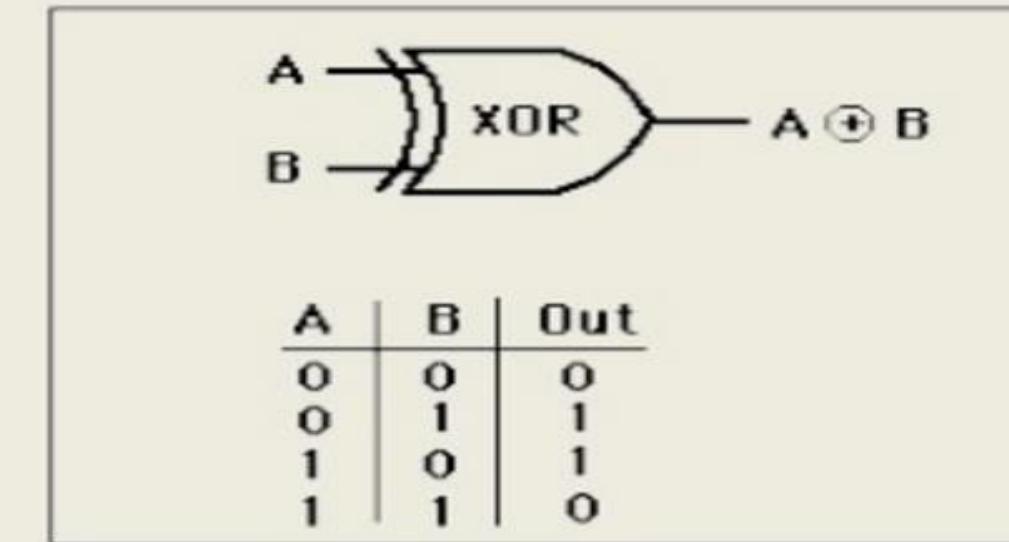
In his paper "The Perceptron: A Perceiving and Recognizing Automaton", Rosenblatt shows the new avatar of McCulloch-Pitts neuron – 'Perceptron' that had true learning capabilities to do binary classification on its own. This inspires the revolution in research of shallow neural network for years to come, till first AI winter.



1969: Perceptrons can't do XOR!



<http://www.i-programmer.info/images/stories/BabBag/AI/book.jpg>



1969: Minsky and Papert proved that perceptrons cannot represent non-linearly separable target functions.



Minsky & Papert

<https://constructingkids.files.wordpress.com/2013/05/minsky-papert-71-csolomon-x640.jpg>



DEEP LEARNING HISTORY

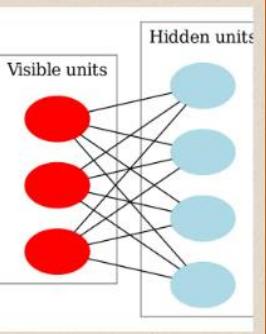
1986

1995

1997

2019

Restricted Boltzmann Machine



Paul Smolensky comes up with a variation of Boltzmann Machine where there is not intra layer connection in input and hidden layer. It is known as Restricted Boltzmann Machine (RBM). It would become popular in years to come especially for building recommender systems.

Boltzmann Machine



David H. Ackley, Geoffrey Hinton and Terrence Sejnowski create Boltzmann Machine that is a stochastic recurrent neural network. This neural network has only input layer and hidden layer but no output layer.

The Milestone Of LSTM



Sepp Hochreiter and Jürgen Schmidhuber publishes a milestone paper on "Long Short-Term Memory" (LSTM). It is a type of recurrent neural network architecture which will go on to revolutionize deep learning in decades to come.

Trio Win Turing Award

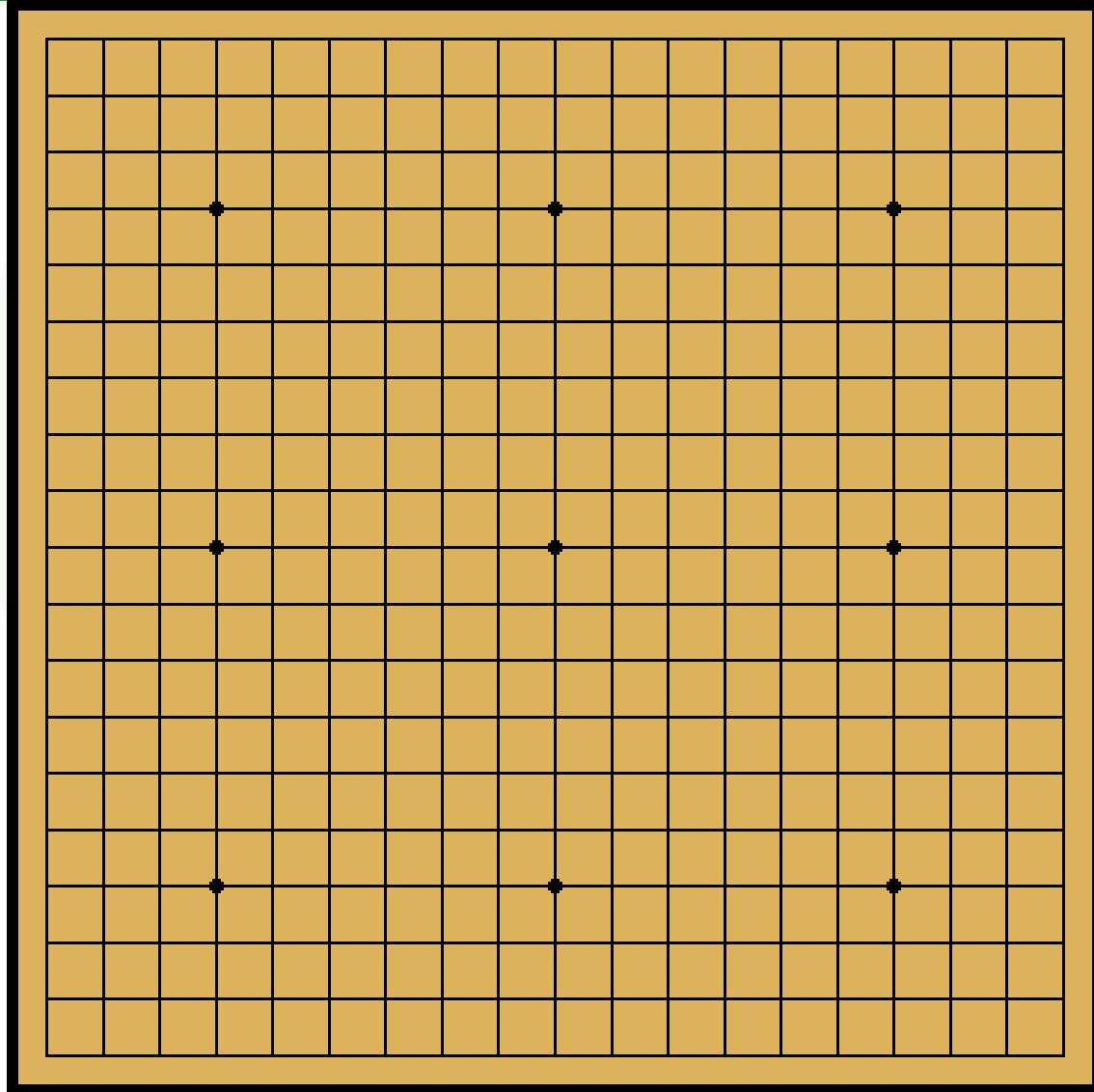


Yoshua Bengio, Geoffrey Hinton, and Yann LeCun wins Turing Award 2018 for their immense contribution in advancements in area of deep learning and artificial intelligence. This is a defining moment for those who had worked relentlessly on neural networks when entire machine learning community had moved away from it in 1970s.



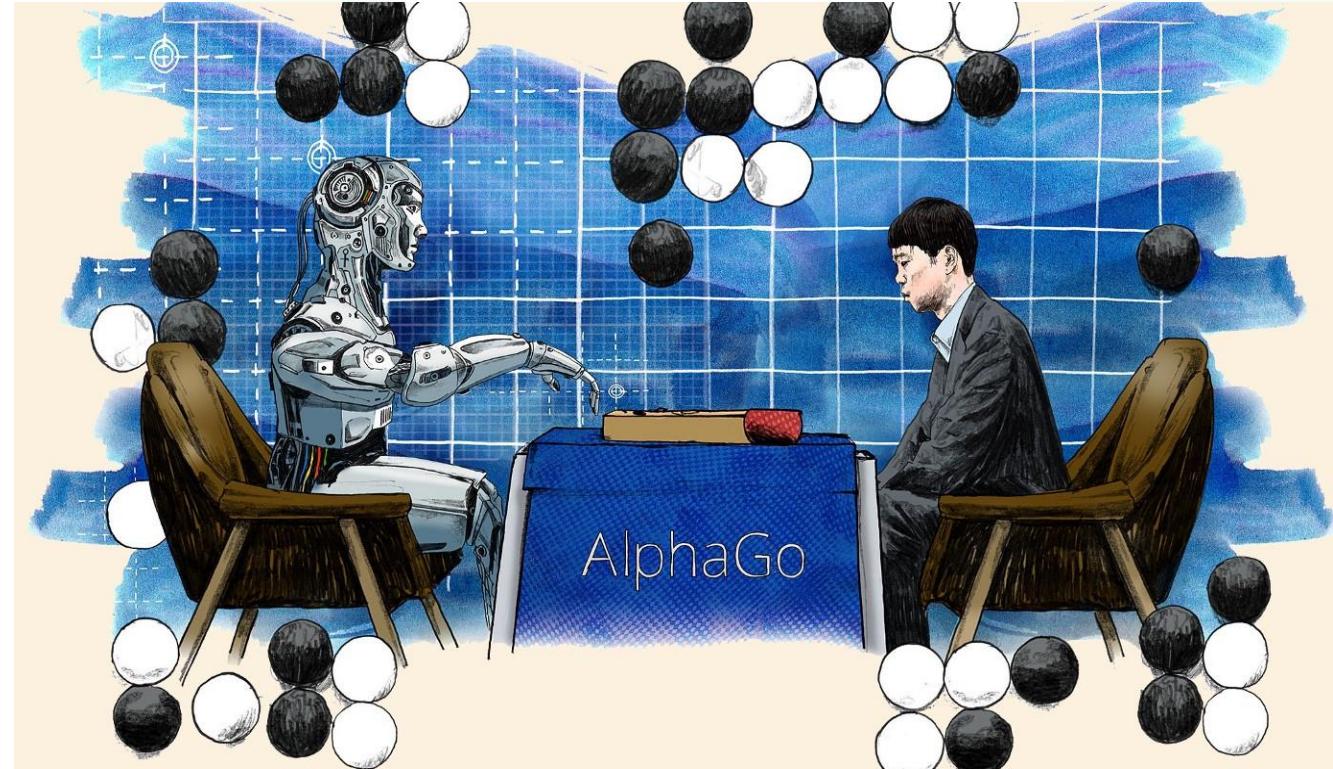
DEEP LEARNING MILESTONES

DEEP LEARNING MILESTONES





DEEP LEARNING MILESTONES





DEEP LEARNING MILESTONES

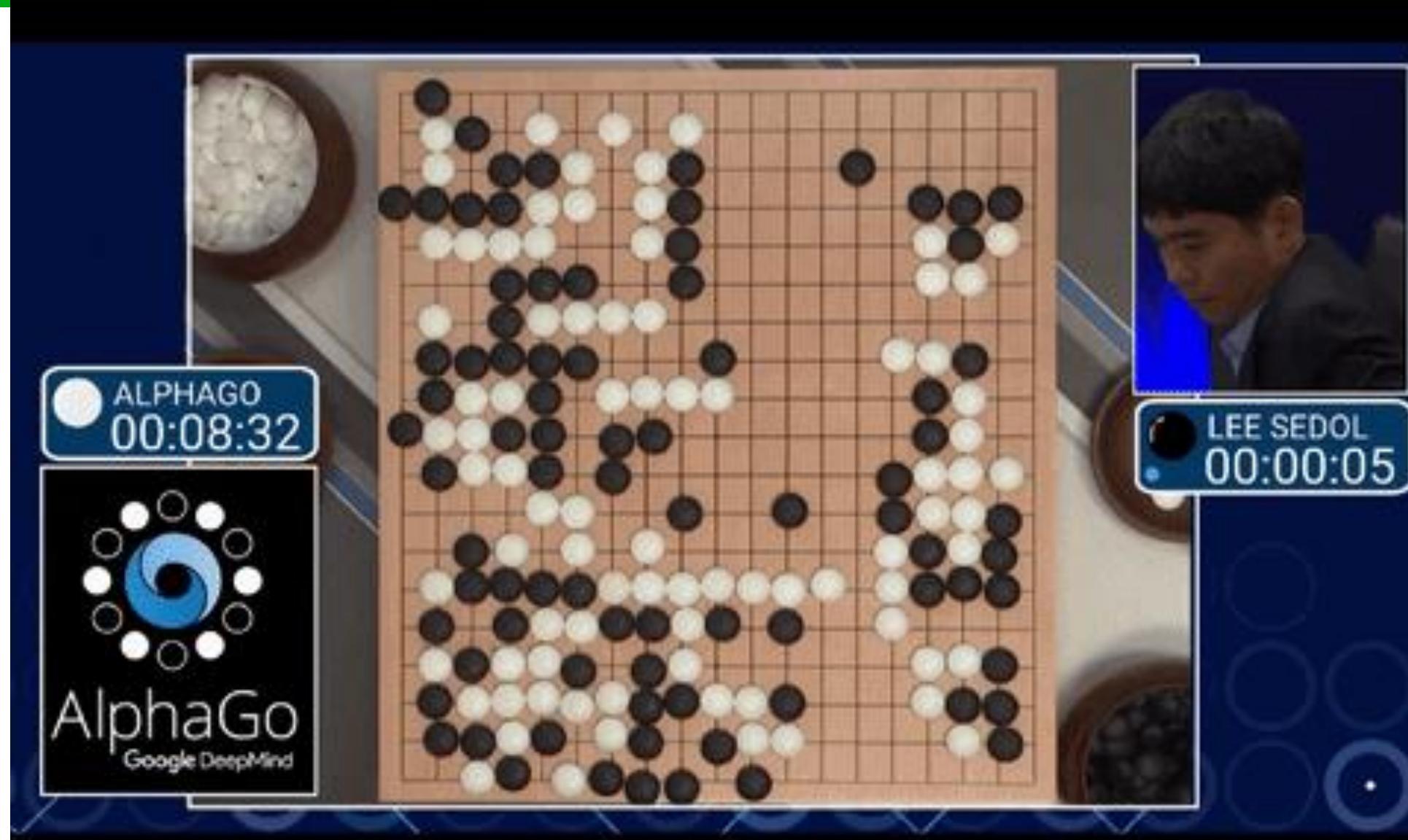
1997





DEEP LEARNING MILESTONES

2016





DEEP LEARNING MILESTONES

2017

