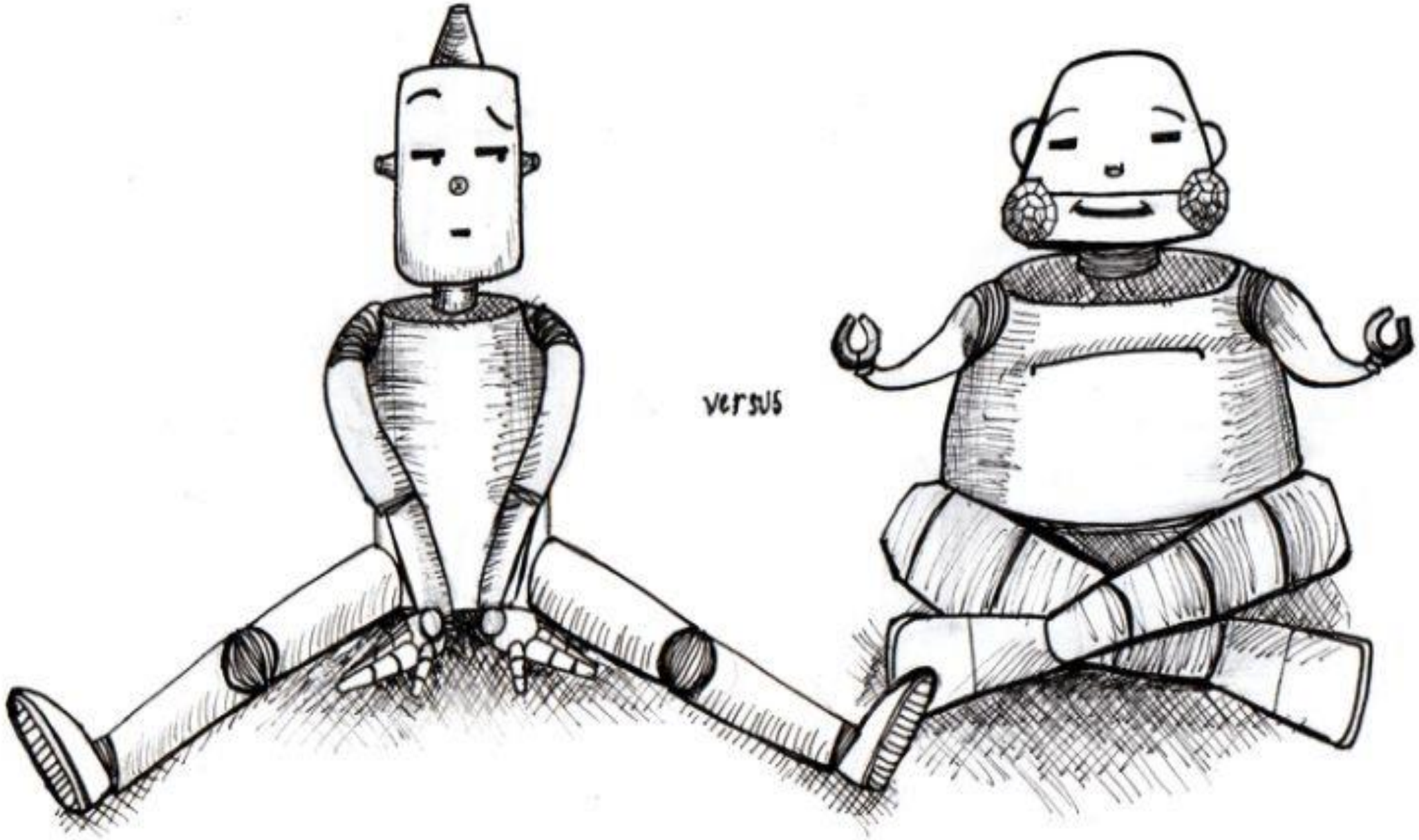

versus
MACHINE LEARNING
DEEP LEARNING

DATE : 08.01.2024

DT/NT : DATA SCIENCE

LESSON : DEEP LEARNING

SUBJECT: BACKPROPOGATION

BATCH : BATCH 168

TECHPRO EDUCATION

techproeducation.com

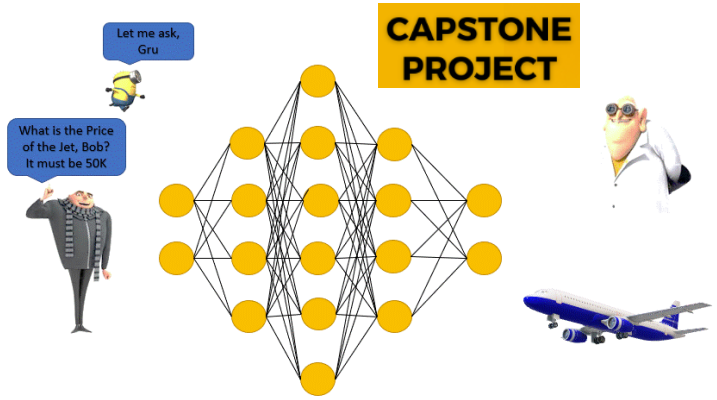
+1 (585) 304 29 59

DEEP LEARNING

Kahoot!

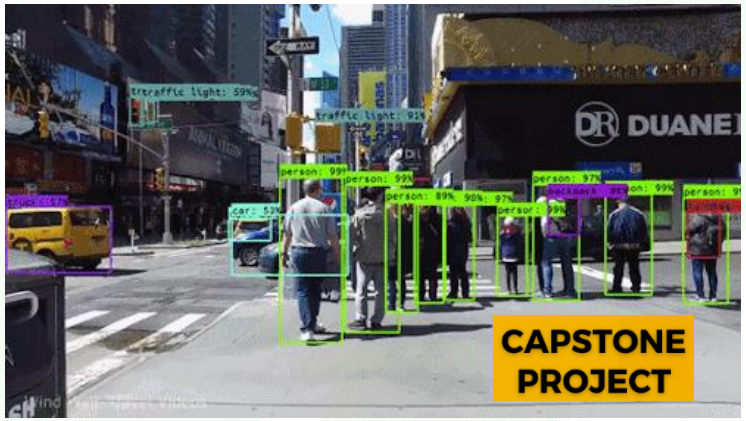
TECHPRO EDUCATION

ANN = 18 saat

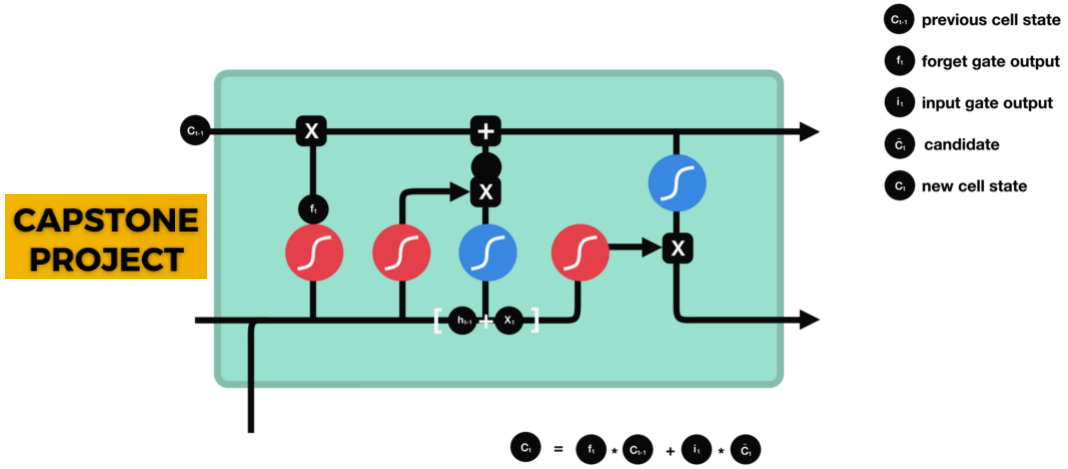


CNN = 21 saat

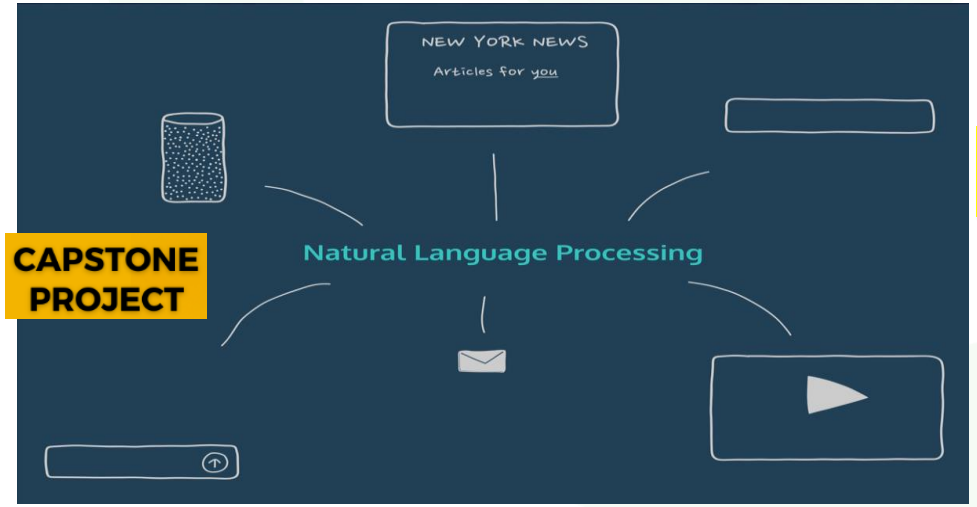
COMPUTER VISION = 24 saat



RNN+LSTM+GRU = 12 saat



NLP = 18 saat

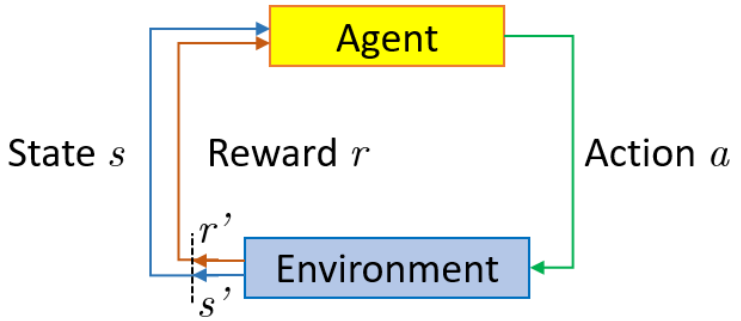


TOPLAM 93 saat

DEEP LEARNING

Generative AI = 9 saat

Reinforcement Learning= 9 saat



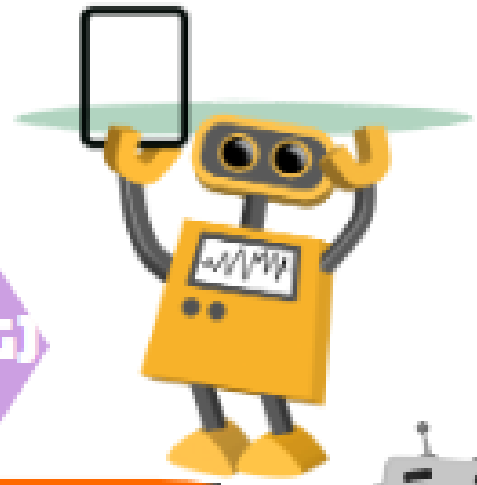
TOPLAM 121 saat

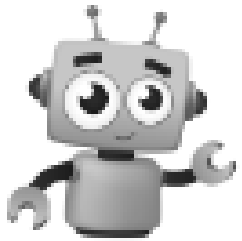
TOPLAM 18 saat

DEEP LEARNING

2024 SKILLS

- ANN
- CNN
- COMPUTER VISION
- RNN-LSTM-GRU
- NLP (NATURAL LANGUAGE PROCESSING)
- GENERATIVE AI & REINFORCEMENT LEARNING





DEEP LEARNING

LESSON CONTENTS

TECHPRO EDUCATION

- 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:

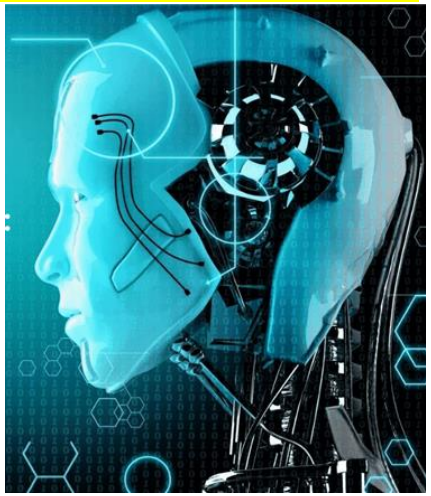
○ less than 2 years ● 2 to 5 years ● 5 to 10 years ▲ more than 10 years ⊗ obsolete before plateau

Gartner

As of July 2023

TECHPRO EDUCATION

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



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.

How much does a Natural Language Processing Engineer make?

Experience

All years of Experience

TECHPRO EDUCATION

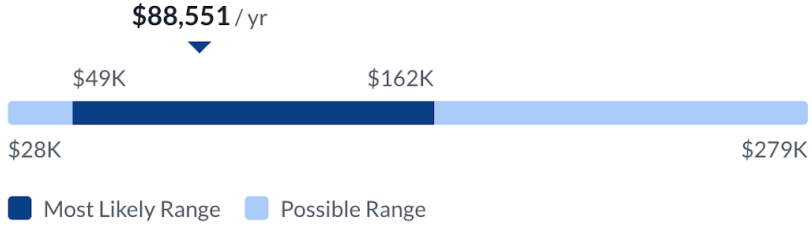
Confident

$88,551 / yr

Total Pay

$75,072 / yr
Base Pay

$13,479 / yr
Additional Pay



Data Scientist Average Salary

ComputerCareers.org

Prestige®

AI job titles with the highest salaries

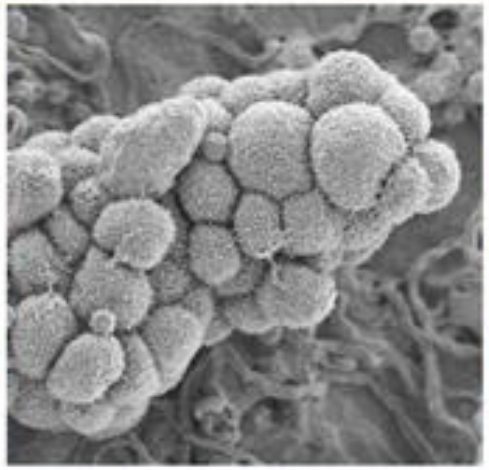
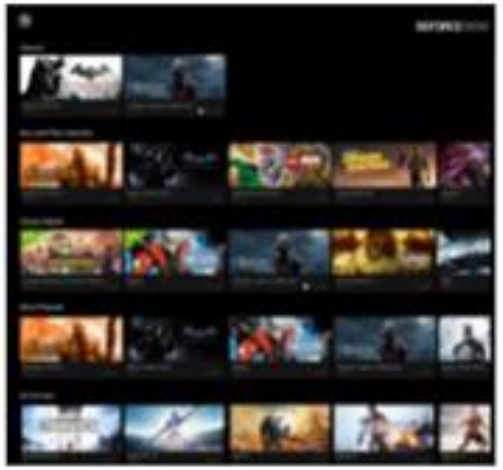
ARTIFICIAL INTELLIGENCE

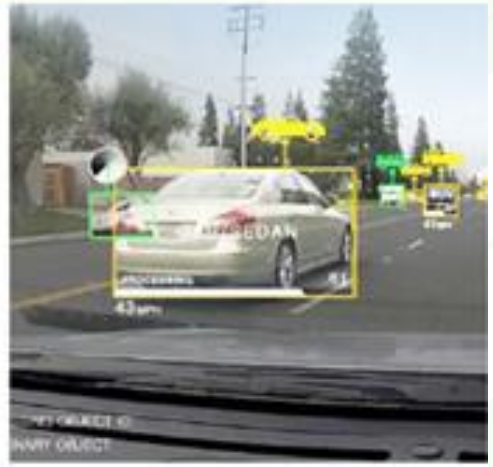
Rank	Job title	Average salary
1.	Machine learning engineer	$142,858.57
2.	Data scientist	$126,927.41
3.	Computer vision engineer	$126,399.81

DEEP LEARNING

TECHPRO EDUCATION

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

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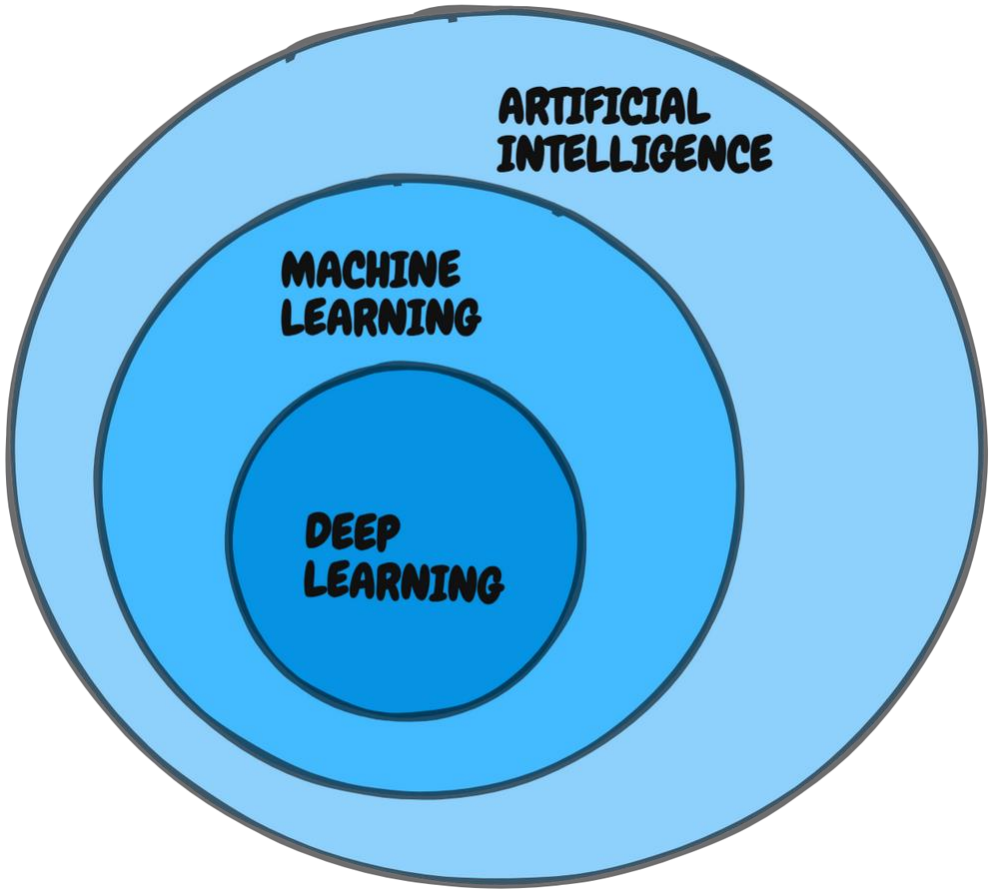
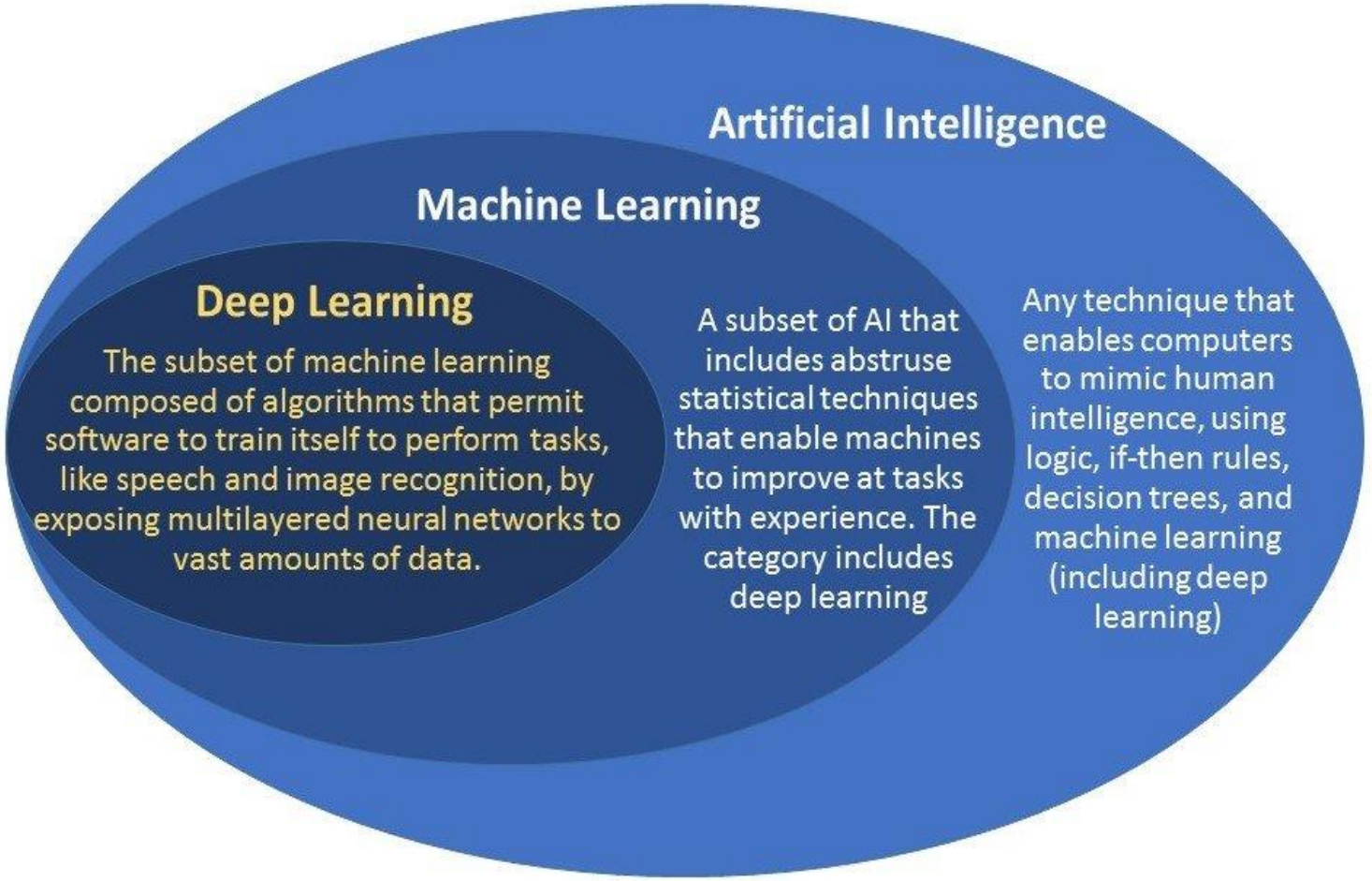
20 DEEP LEARNING Applications

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
11. Healthcare
12. Personalisations
13. Automatic Machine Translation
14. Automatic Handwriting Generation
15. Demographic & Election Predictions
16. Automatic Game Playing
17. Language Translations
18. Pixel Restoration
19. Photo Descriptions
20. Deep Dreaming

AI/MACHINE LEARNING/DEEP LEARNING





WHAT IS DEEP LEARNING?

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ARTIFICIAL INTELLIGENCE

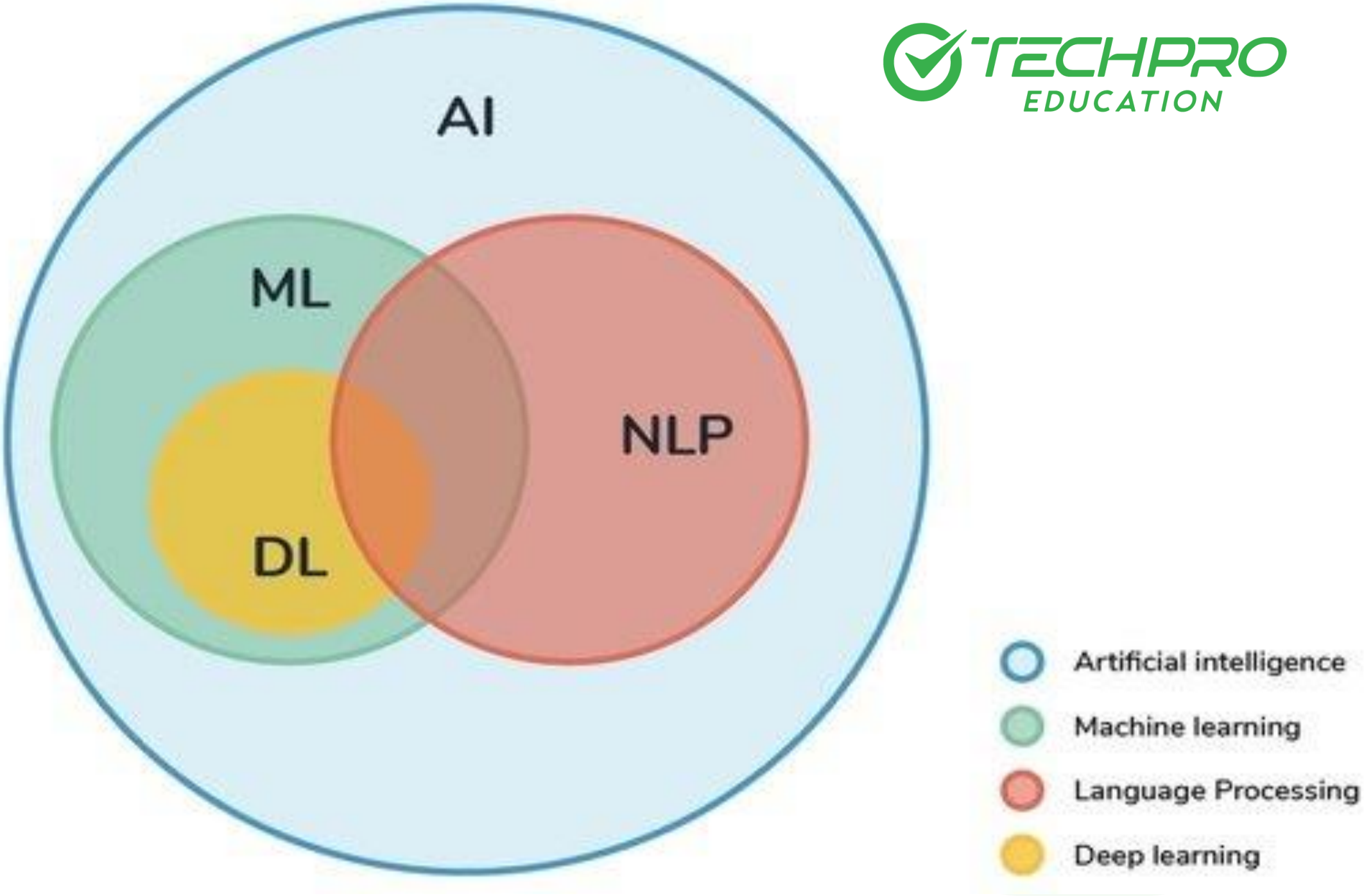
Any technique that enables computers to mimic human behavior

MACHINE LEARNING

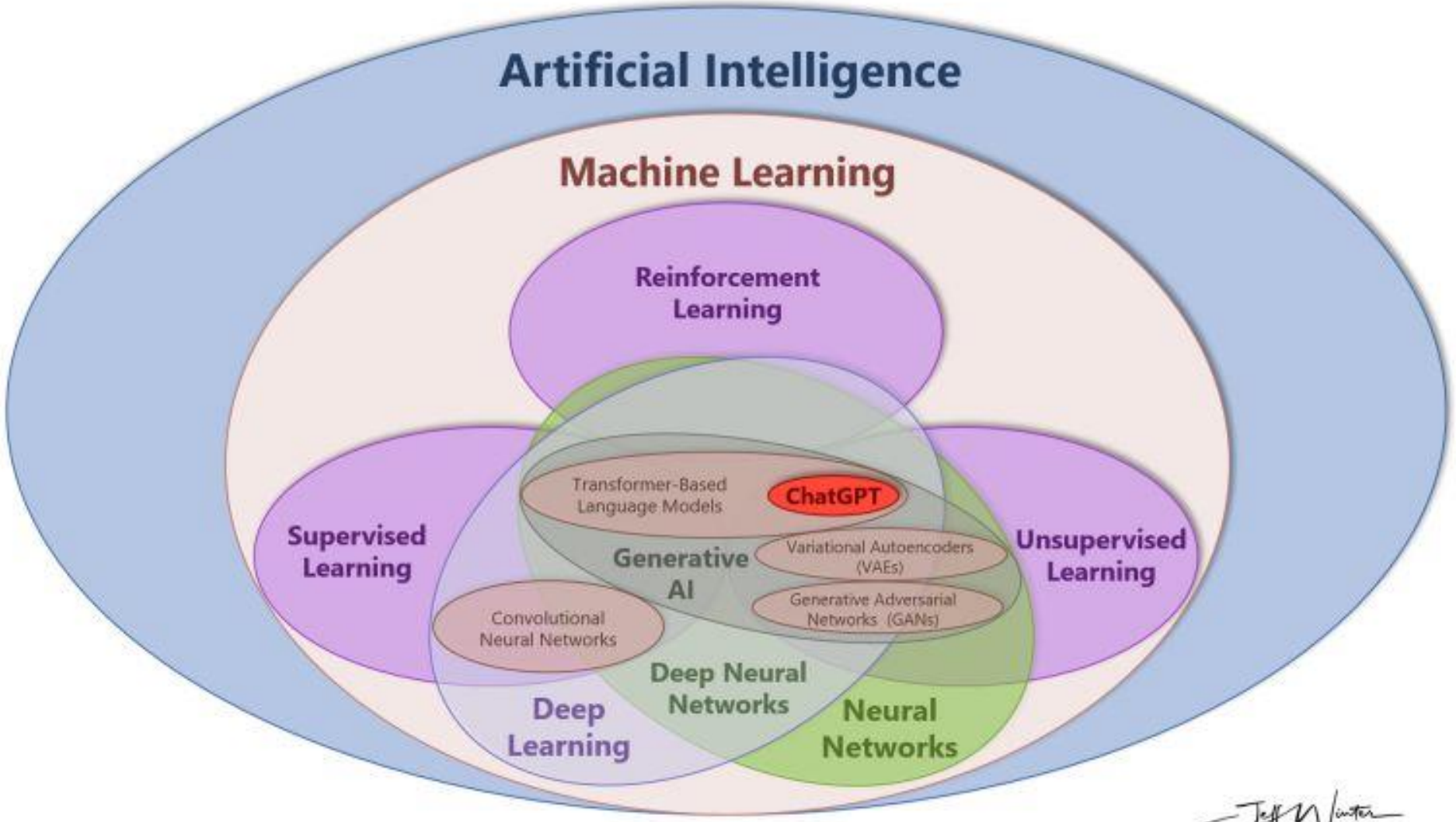
Ability to learn without explicitly being programmed

DEEP LEARNING

Extract patterns from data using neural networks


AI
ML
NLP
DL
Artificial intelligence
Machine learning
Language Processing
Deep learning

AI/MACHINE LEARNING/DEEP LEARNING



WHY DEEP LEARNING IS SO POPULAR

TECHPRO EDUCATION

Why Now?

Neural Networks date back decades, so why the resurgence?

1. Big Data

- Larger Datasets
- Easier Collection & Storage

IMAGENET

WIKIPEDIA

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

TECHPRO EDUCATION

01

RAPIDLY INCREASING DATA

BIG DATA
TRANSFER LEARNING
PRE-TRAINED MODELS
LARGE DATASETS

02

TECHNOLOGICAL ADVANCEMENTS IN HARDWARE

INCREASED COMPUTING POWER (GPU, TPU)

03

TECHNOLOGICAL ADVANCEMENTS IN SOFTWARE

OPEN SOURCE FRAMEWORKS (TENSORFLOW KERAS, CAFFE PYTORCH)

04

HIGH ACCURACY

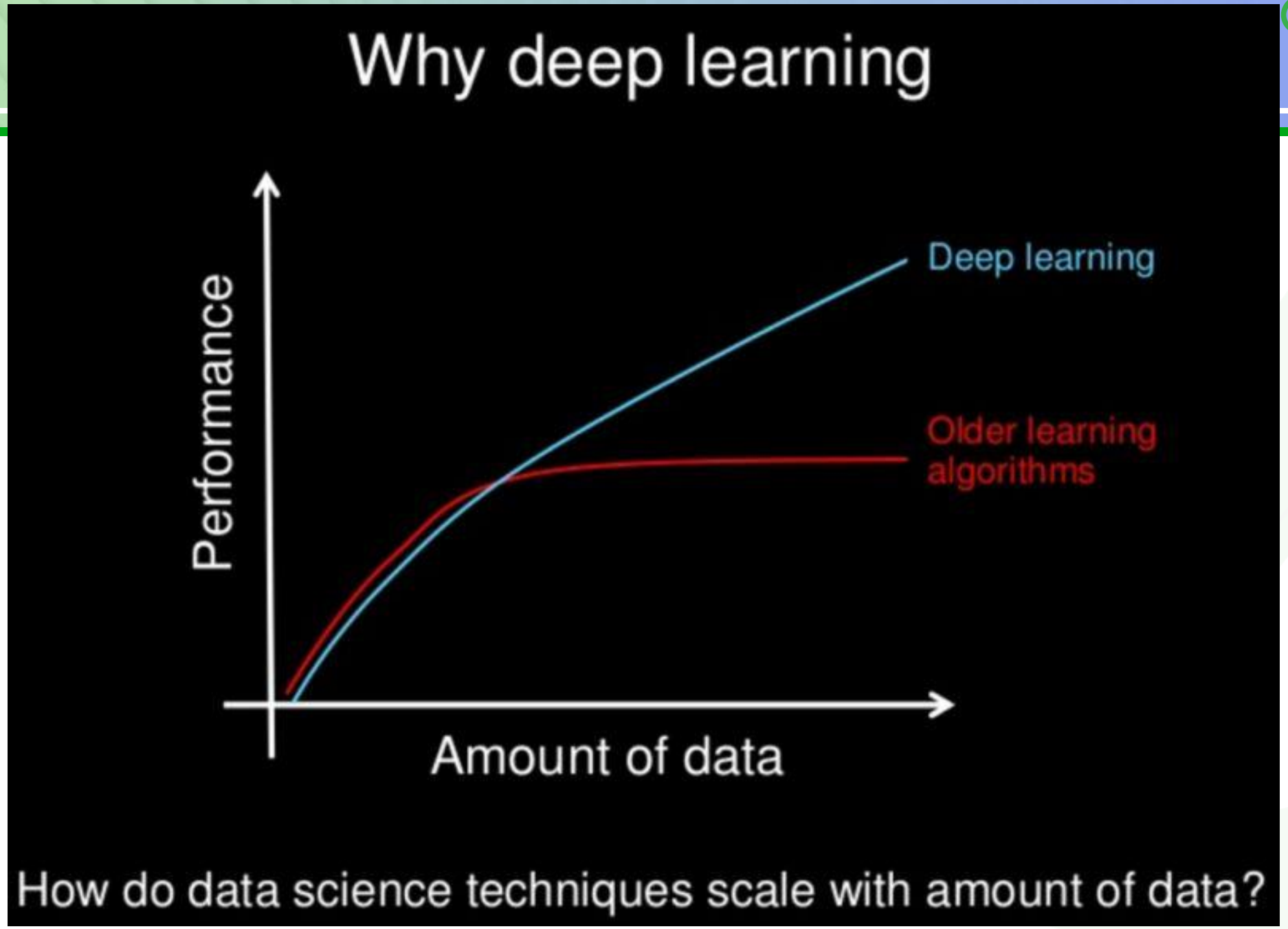
REMARKABLE ACCURACY IN TASKS SUCH AS IMAGE RECOGNITION, SPEECH ROCOGNITION, NATURAL LANGUAGE PROCESSING

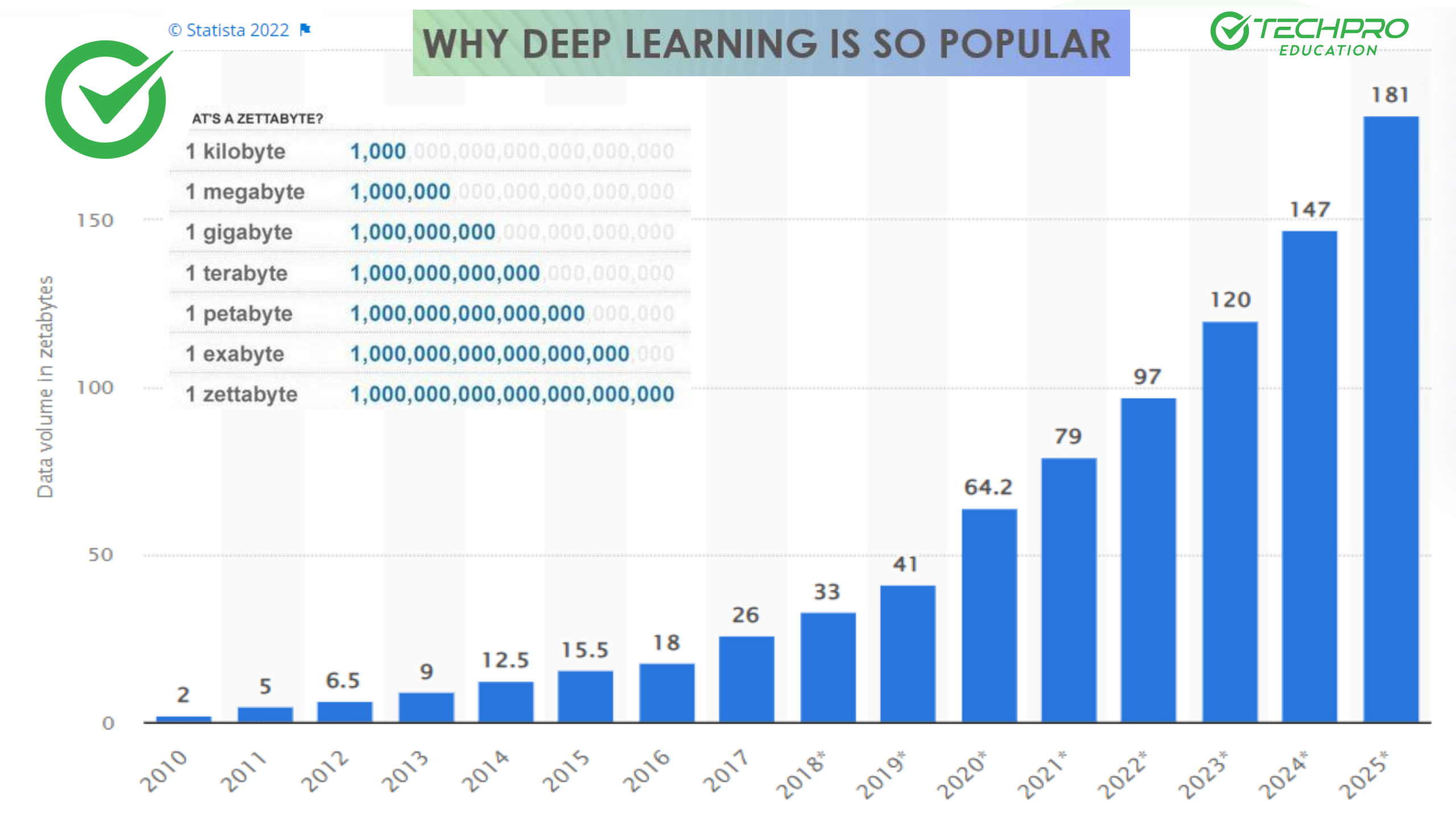
05

REAL-WORLD APPLICATIONS

SELF-DRIVING CARS
VIRTUAL ASSISTANS
MEDICAL DIAGNOSIS

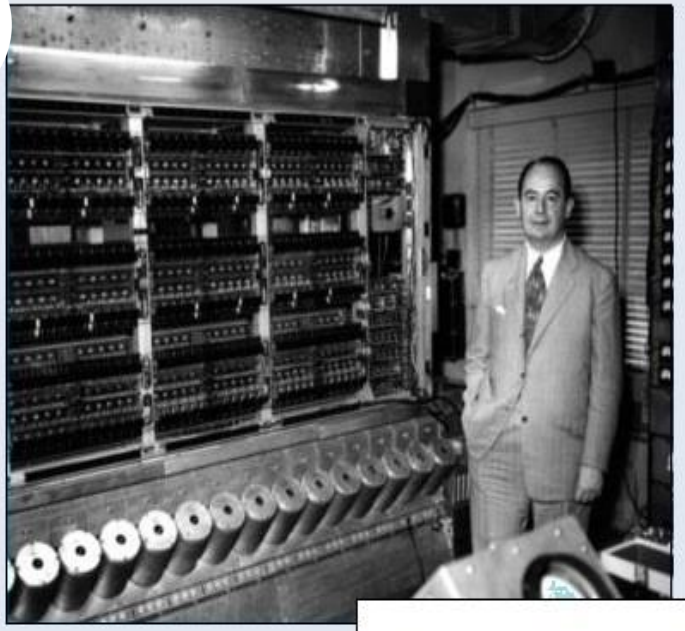
RAPIDLY INCREASING DATA

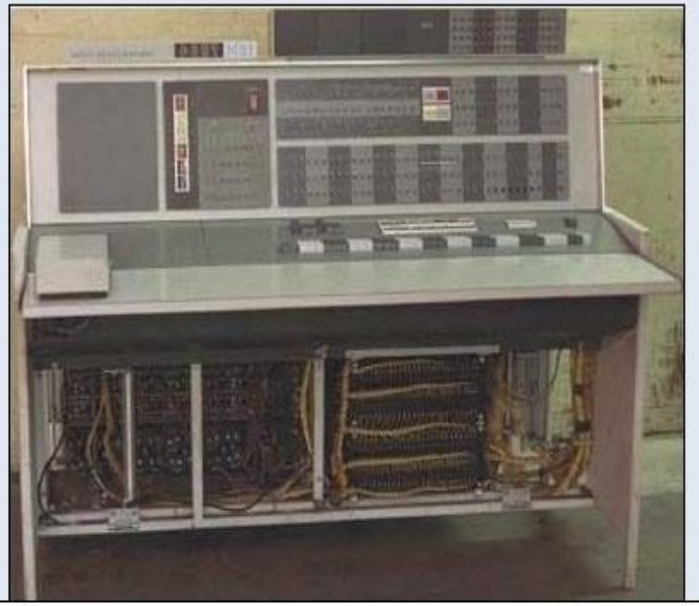

Why deep learning
Performance
Deep learning
Older learning algorithms
Amount of data
How do data science techniques scale with amount of data?


© Statista 2022
WHY DEEP LEARNING IS SO POPULAR
TECHPRO EDUCATION
AT'S A ZETTABYTE?
1 kilobyte 1,000,000,000,000,000,000,000
1 megabyte 1,000,000,000,000,000,000,000
1 gigabyte 1,000,000,000,000,000,000,000
1 terabyte 1,000,000,000,000,000,000,000
1 petabyte 1,000,000,000,000,000,000,000
1 exabyte 1,000,000,000,000,000,000,000
1 zettabyte 1,000,000,000,000,000,000,000
Data volume in zetabytes
0
50
100
150
2
5
6.5
9
12.5
15.5
18
26
33
41
64.2
79
97
120
147
181
2010
2011
2012
2013
2014
2015
2016
2017
2018*
2019*
2020*
2021*
2022*
2023*
2024*
2025*

Data Never Sleeps 10.0

TECHNOLOGICAL ADVANCEMENTS IN HARDWARE



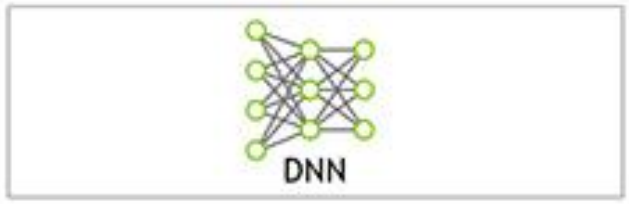


Generations and Future Computers

WHY DEEP LEARNING IS SO POPULAR

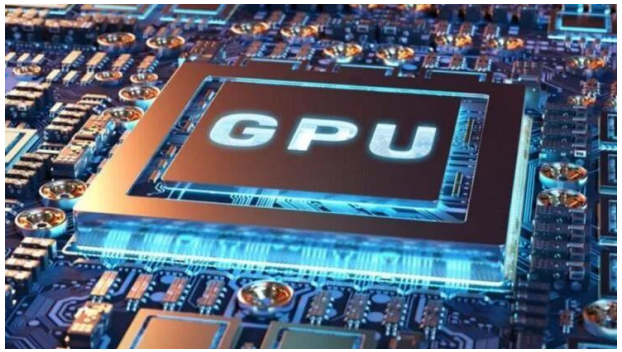
TECHPRO EDUCATION

THE BIG BANG IN DEEP LEARNING



"The GPU is the workhorse of modern A.I."

POPULAR SCIENCE



GPU AND Deep Learning

GPU and Deep Learning:

A Combination That Works Miracles

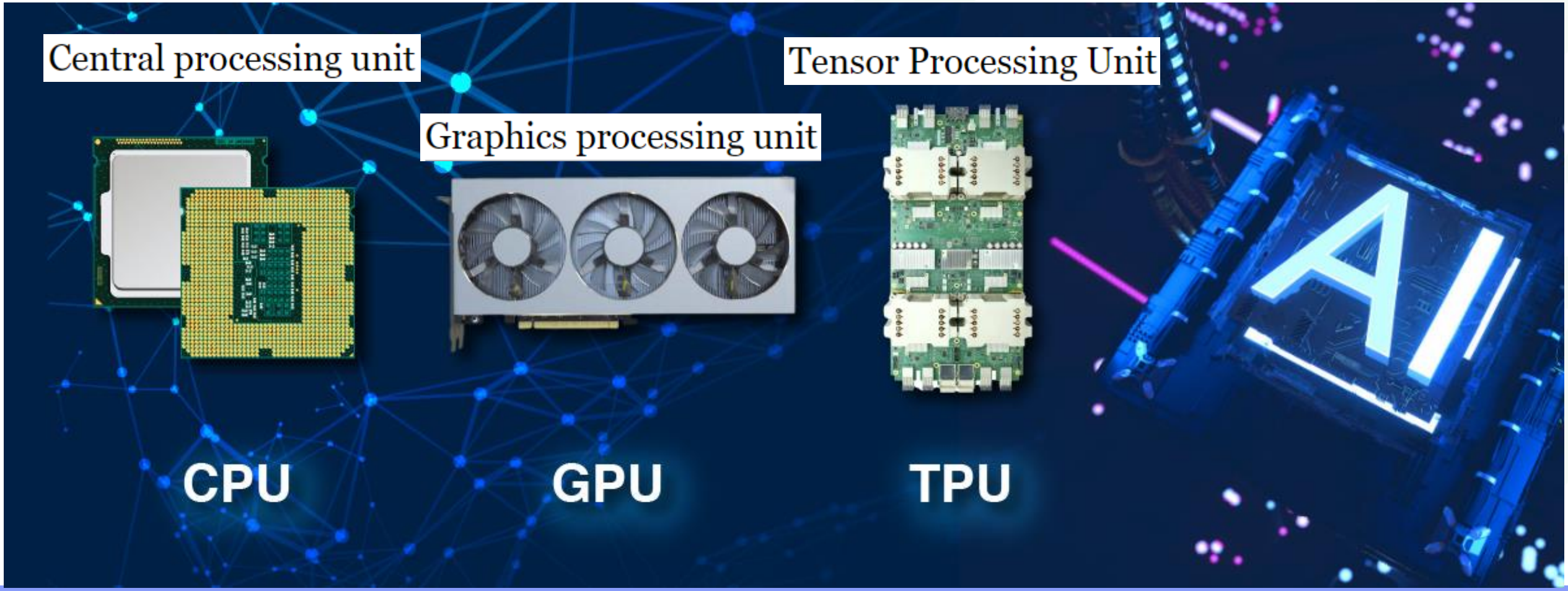
WHY DEEP LEARNING IS SO POPULAR

TECHPRO EDUCATION

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



WHY DEEP LEARNING IS SO POPULAR

Tensor Processing Unit

CPU GPU TPU

WHY DEEP LEARNING IS SO POPULAR

TECHPRO EDUCATION

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
```

Running time **without** GPU

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 **with** GPU

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

TECHNOLOGICAL ADVANCEMENTS IN SOFTWARE

WHY DEEP LEARNING IS SO POPULAR

TECHPRO EDUCATION

Keras

Caffe

TensorFlow

PyTorch

PROMINENT FIGURES OR GURUS IN THE FIELD OF DEEP LEARNING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EDUCATION


OCT. 9, 2023
THE 100 MOST INFLUENTIAL PEOPLE IN ARTIFICIAL INTELLIGENCE
TIME100/AI
ELON MUSK'S FIGHT FOR THE FUTURE OF AI
By WALTER ISAACSON
time.com


Geoffrey Hinton
Emeritus Professor, University of Toronto
Yoshua Bengio
Scientific Director, Montreal Institute for Learning Algorithms
Yann LeCun
Chief AI Scientist, Meta
Stuart Russell
Professor, University of California, Berkeley
Demis Hassabis
CEO and Co-Founder, Google DeepMind
Fei-Fei Li
Professor, Stanford University
Andrew Ng
Founder, DeepLearning.AI
Mustafa Suleyman
CEO and Co-Founder, Inflection AI
Sam Altman
CEO, OpenAI

Geoffrey Hinton

"The Godfather of deep learning"

deeplearning.ai presents

Heroes of Deep Learning

Ian Goodfellow

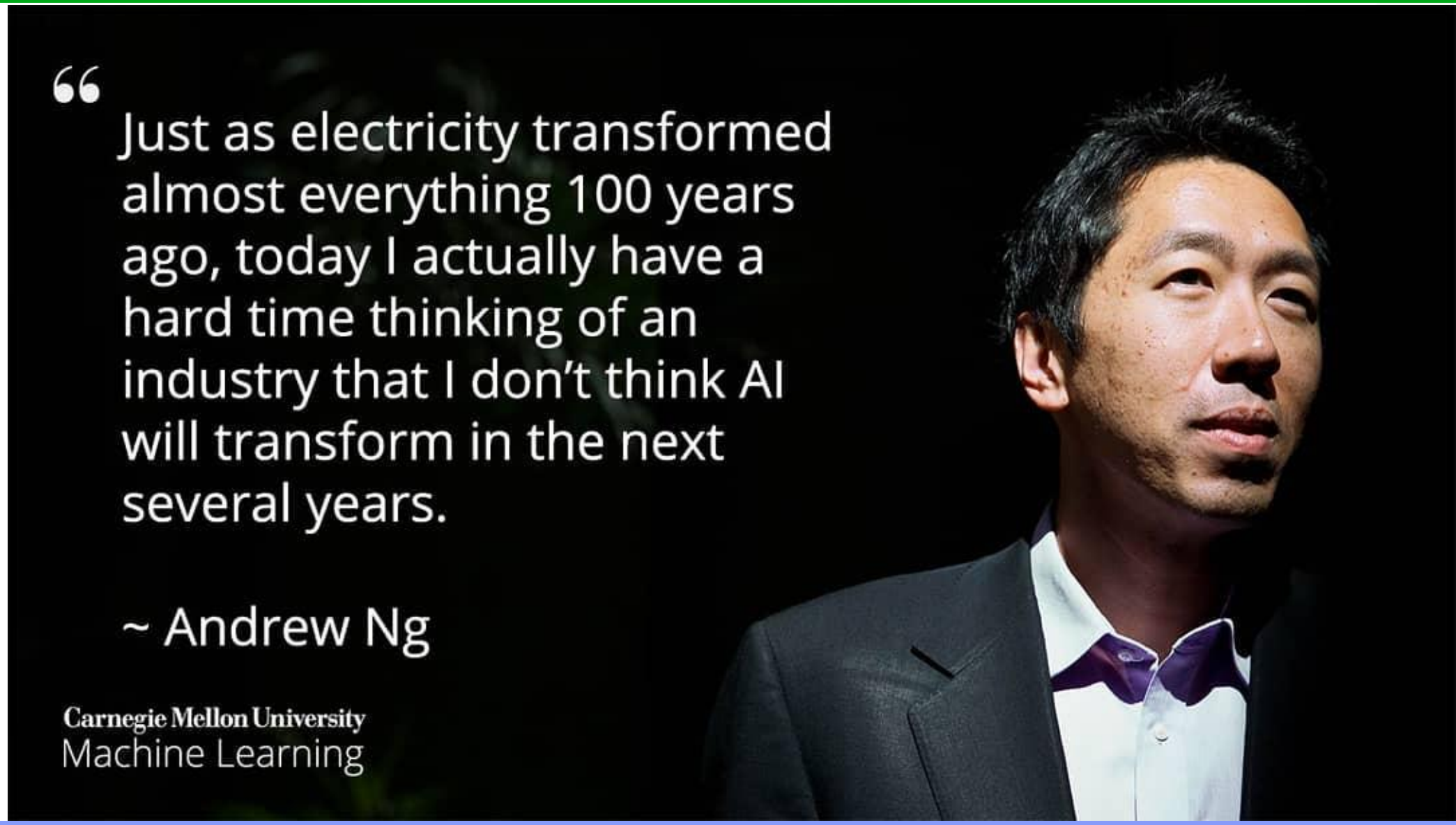
Research Scientist at Google Brain


Fei-Fei Li
Sequoia Professor of Computer Science at Stanford University
TECHPRO EDUCATION
FEI FEI LI

DEEP LEARNING

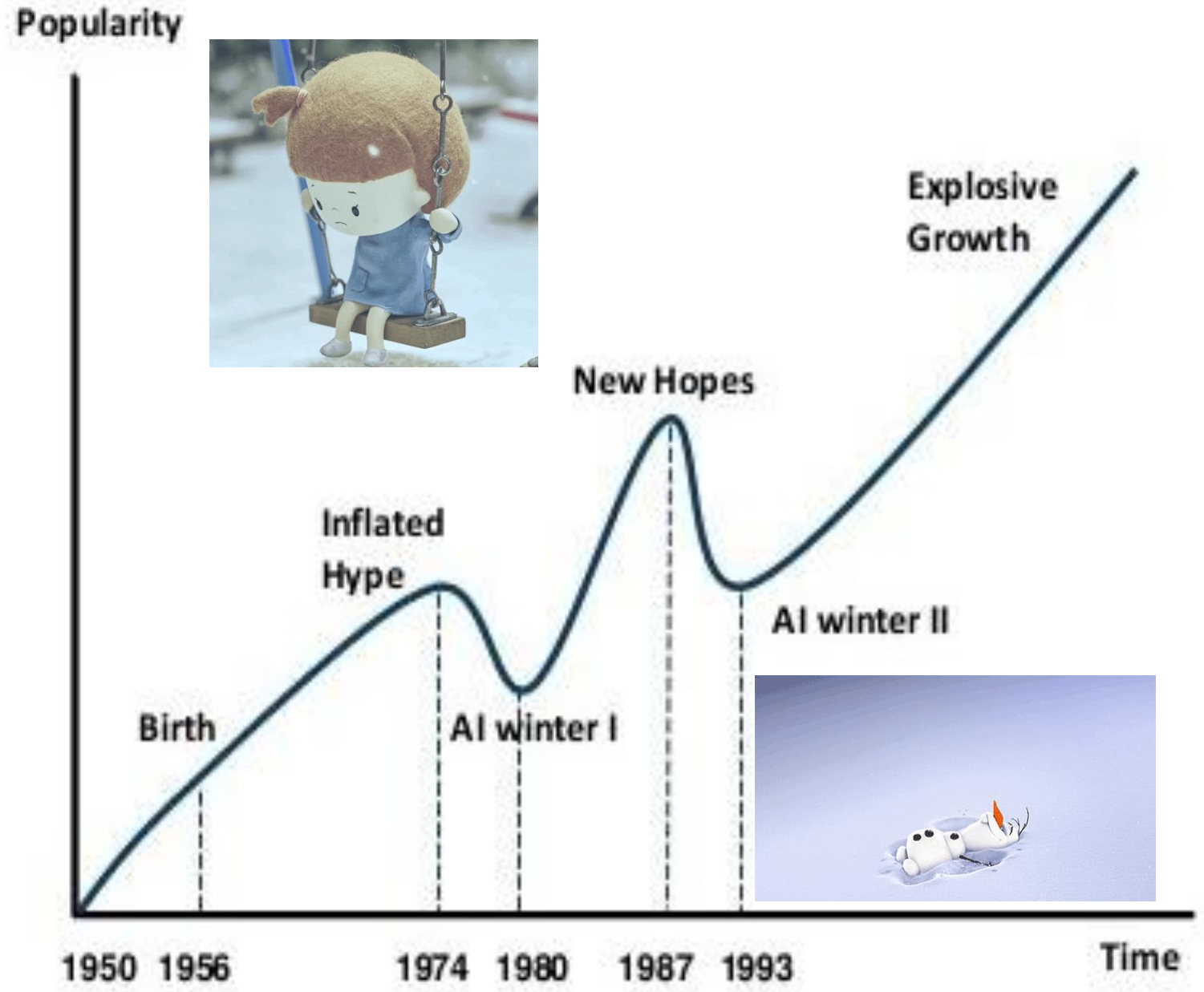
deeplearning.ai

Baidu 百度




CIM
TECHPRO
EDUCATION

DEEP LEARNING HISTORY



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

TECHPRO EDUCATION

Electronic Brain — 1943

Perceptron — 1957

ADALINE — 1960

XOR Problem — 1969

Golden Age

Dark Age ("AI Winter")

Multi-layered Perceptron (Backpropagation) — 1986

SVM — 1995

Deep Neural Network (Pretraining) — 2006

1940 1950 1960 1970 1980 1990 2000 2010

S. McCulloch – W. Pitts

F. Rosenblatt

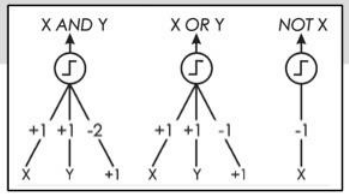
B. Widrow – M. Hoff

M. Minsky – S. Papert

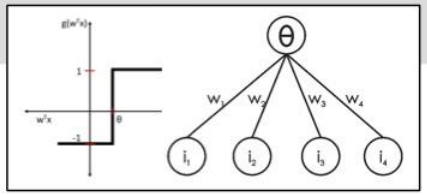
D. Rumelhart – G. Hinton – R. Wiliams

V. Vapnik – C. Cortes

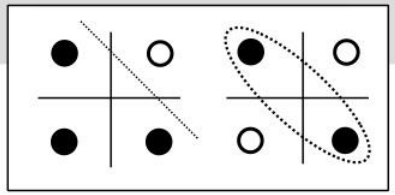
G. Hinton – S. Ruslan



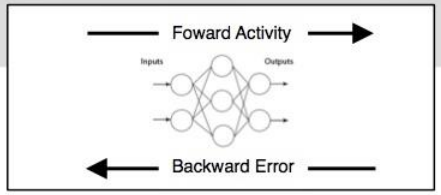
- Adjustable Weights
- Weights are not Learned



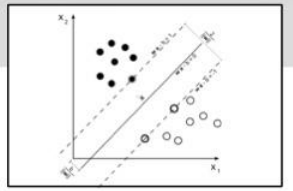
- Learnable Weights and Threshold



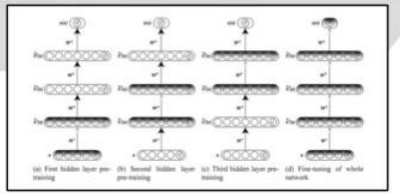
- XOR Problem



- Solution to nonlinearly separable problems
- Big computation, local optima and overfitting



- Limitations of learning prior knowledge
- Kernel function: Human Intervention

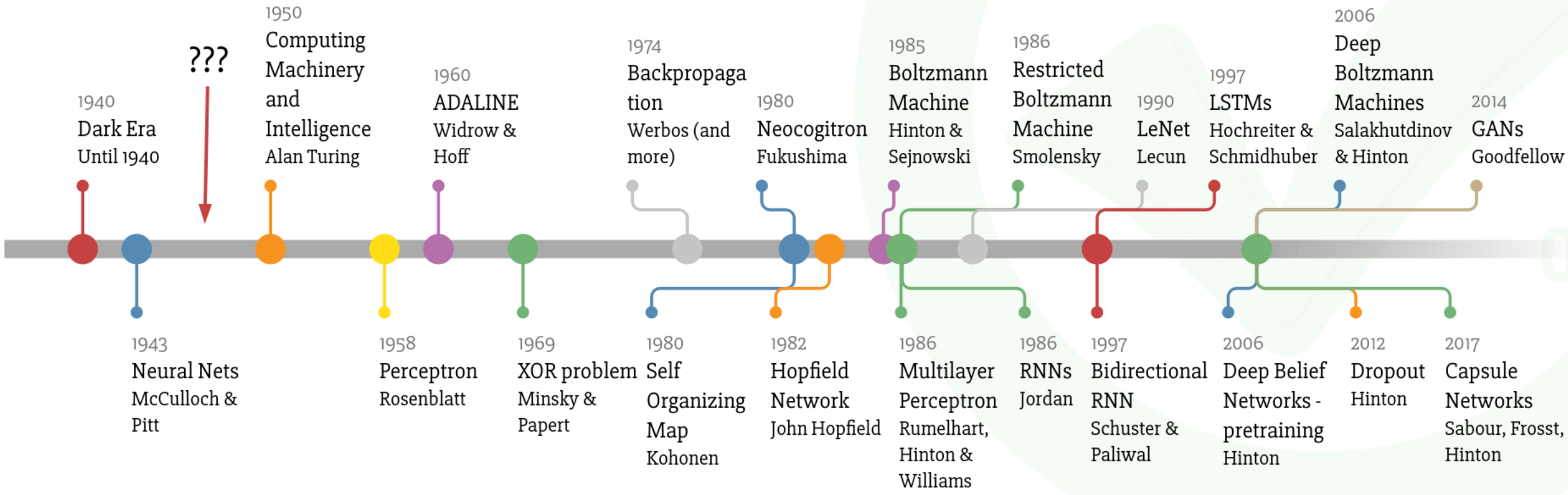


- Hierarchical feature Learning

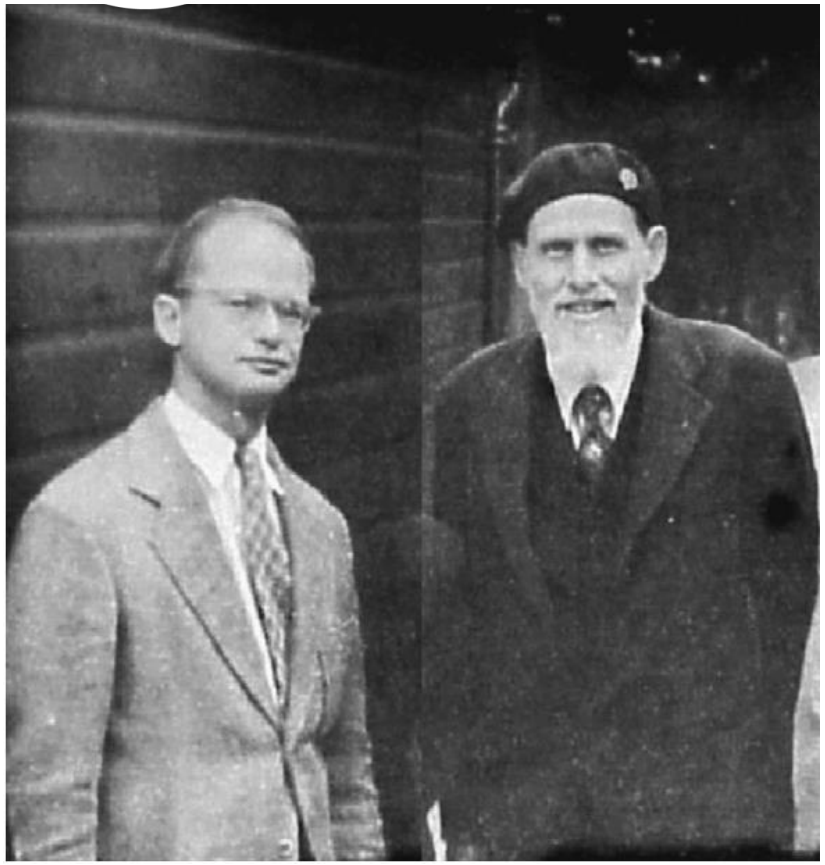
DEEP LEARNING HISTORY

TECHPRO EDUCATION

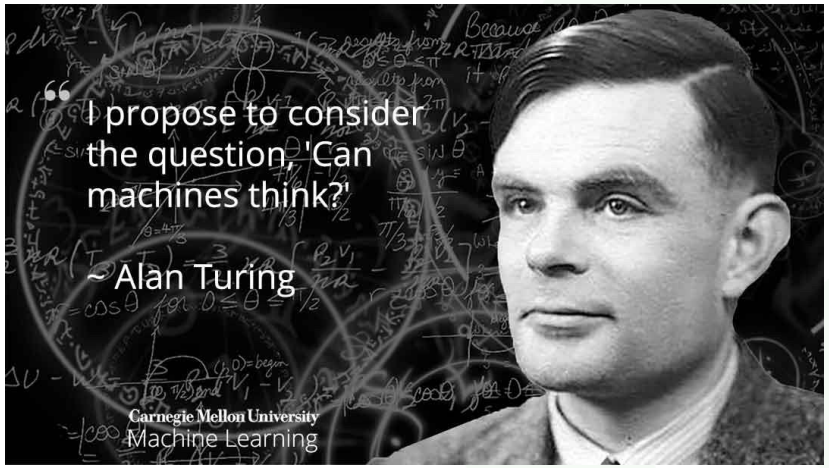
Deep Learning Timeline

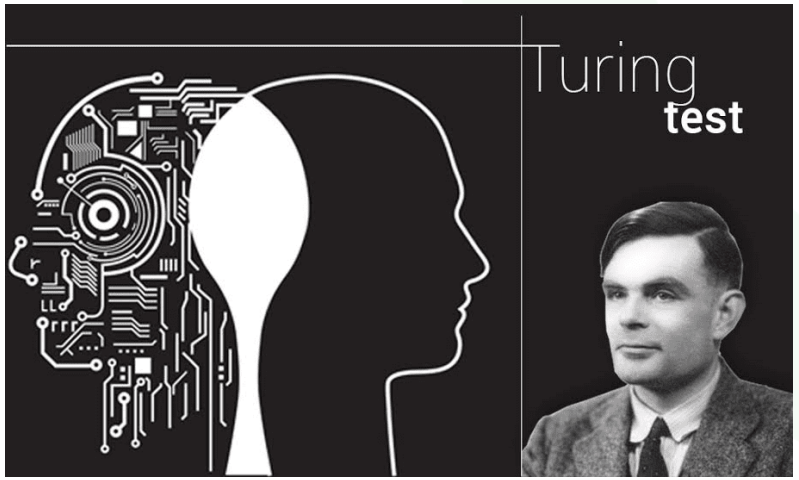


DEEP LEARNING HISTORY



McCulloch (right) and Pitts (left)

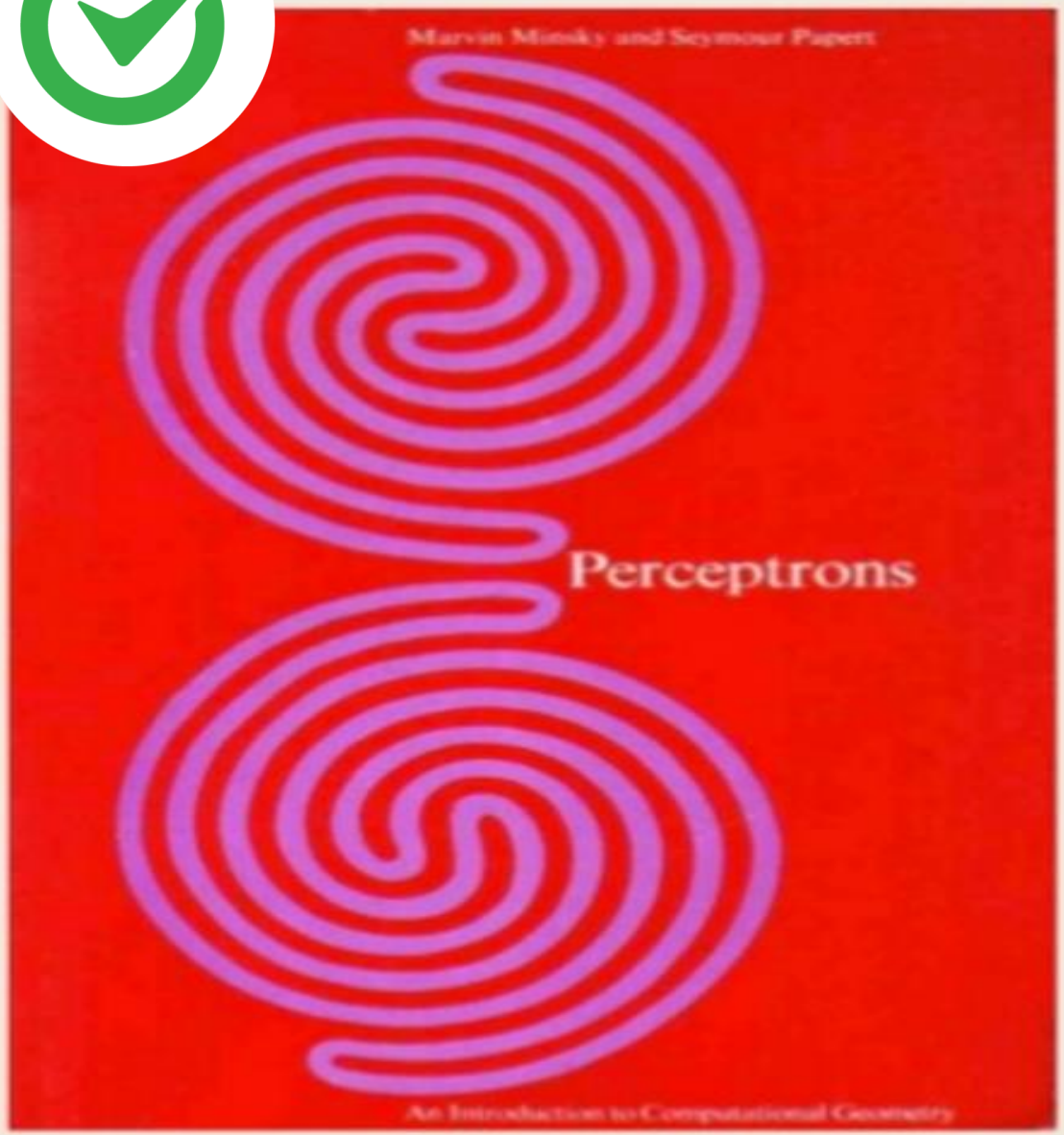




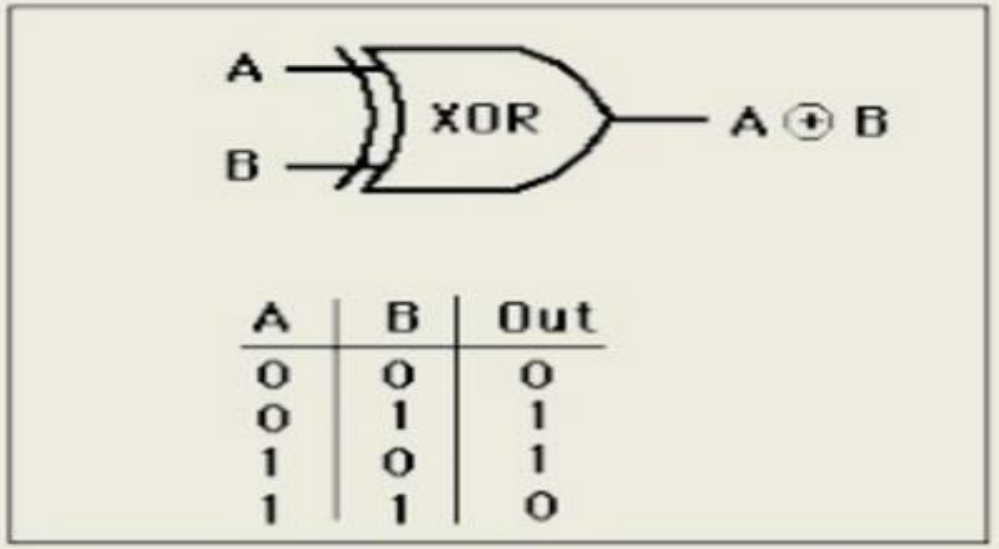
Frank Rosenblatt Creates Perceptron

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 it’s 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



A	B	Out
0	0	0
0	1	1
1	0	1
1	1	0

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

Minsky & Papert

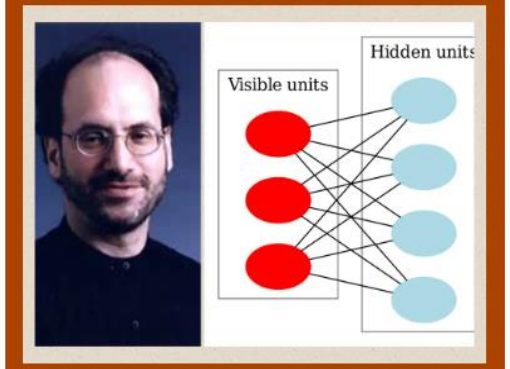
https://constructingkids.files.wordpress.com/2013/05/minsky-papert-71-csolomon-x640.jpg

DEEP LEARNING HISTORY

TECHPRO EDUCATION

1986

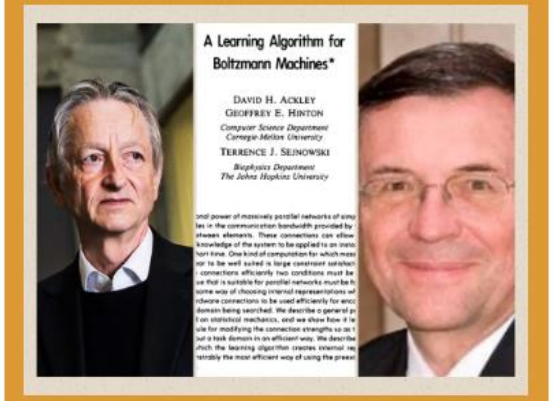
Restricted Boltzmann Machine



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.

1995

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.

1997

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.

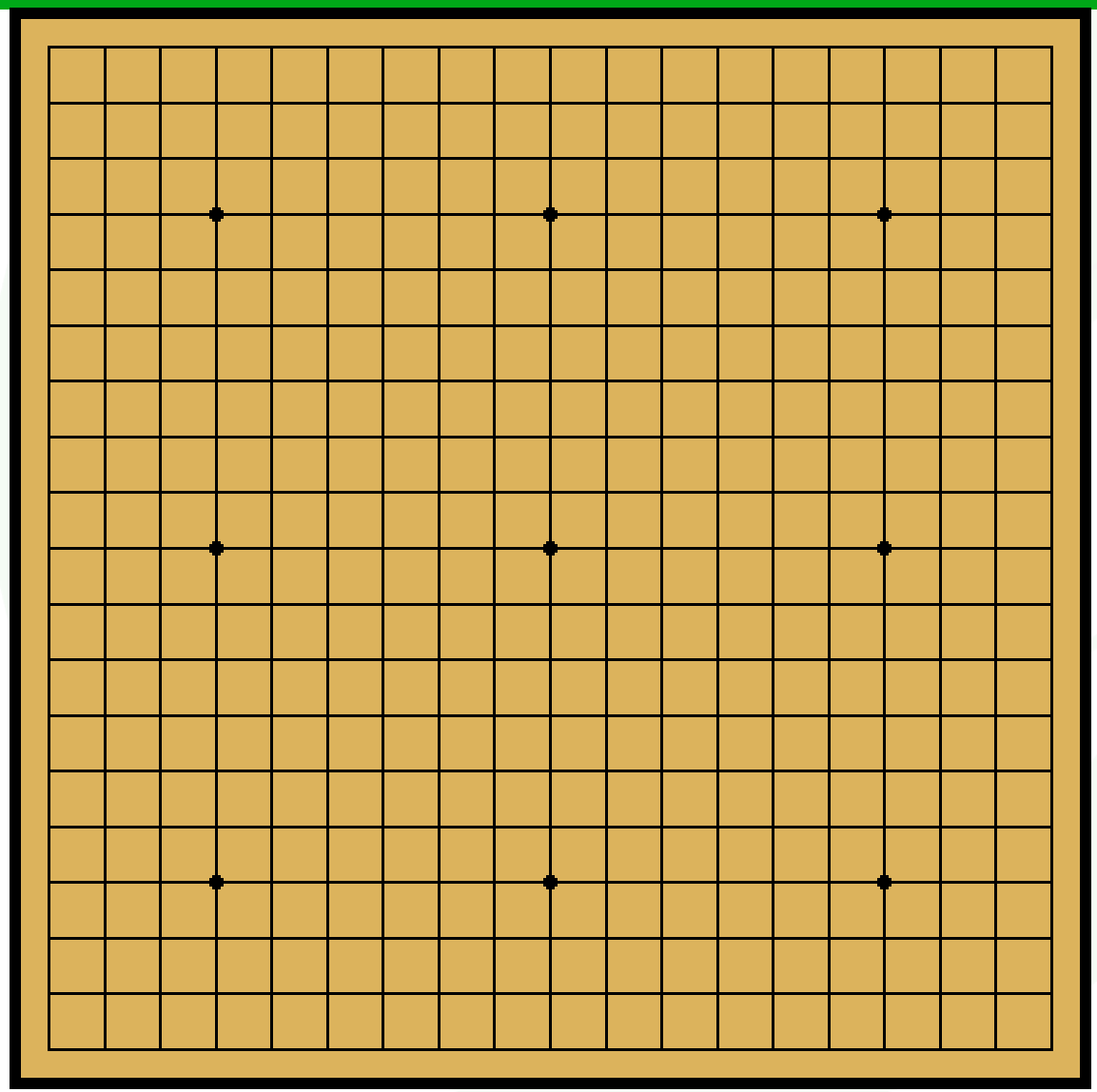
2019

Trio Win Turing Award

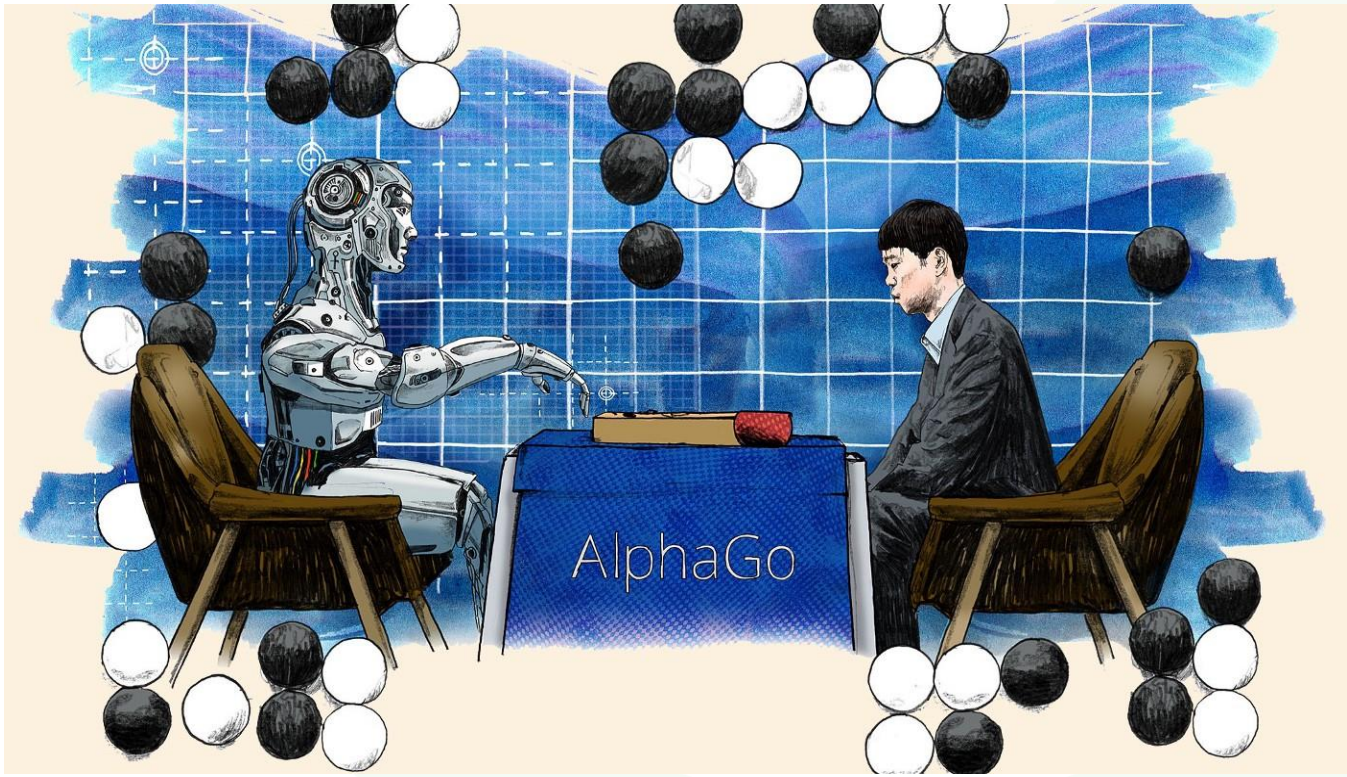
Yoshua Bengio, Geoffrey Hinton, and Yann LeCun wins Turing Award 2018 for their immense contribution in advancements in area of deep learning and artificial intelligence. This is a defining moment for those who had worked relentlessly on neural networks when entire machine learning community had moved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

DEEP LEARNING MILESTONES

DEEP LEARNING MILESTONES



DEEP LEARNING MILESTONES



DEEP LEARNING MILESTONES

1997

DEEP LEARNING MILESTONES

DEEP LEARNING MILESTONES

TECHPRO EDUCATION

2017