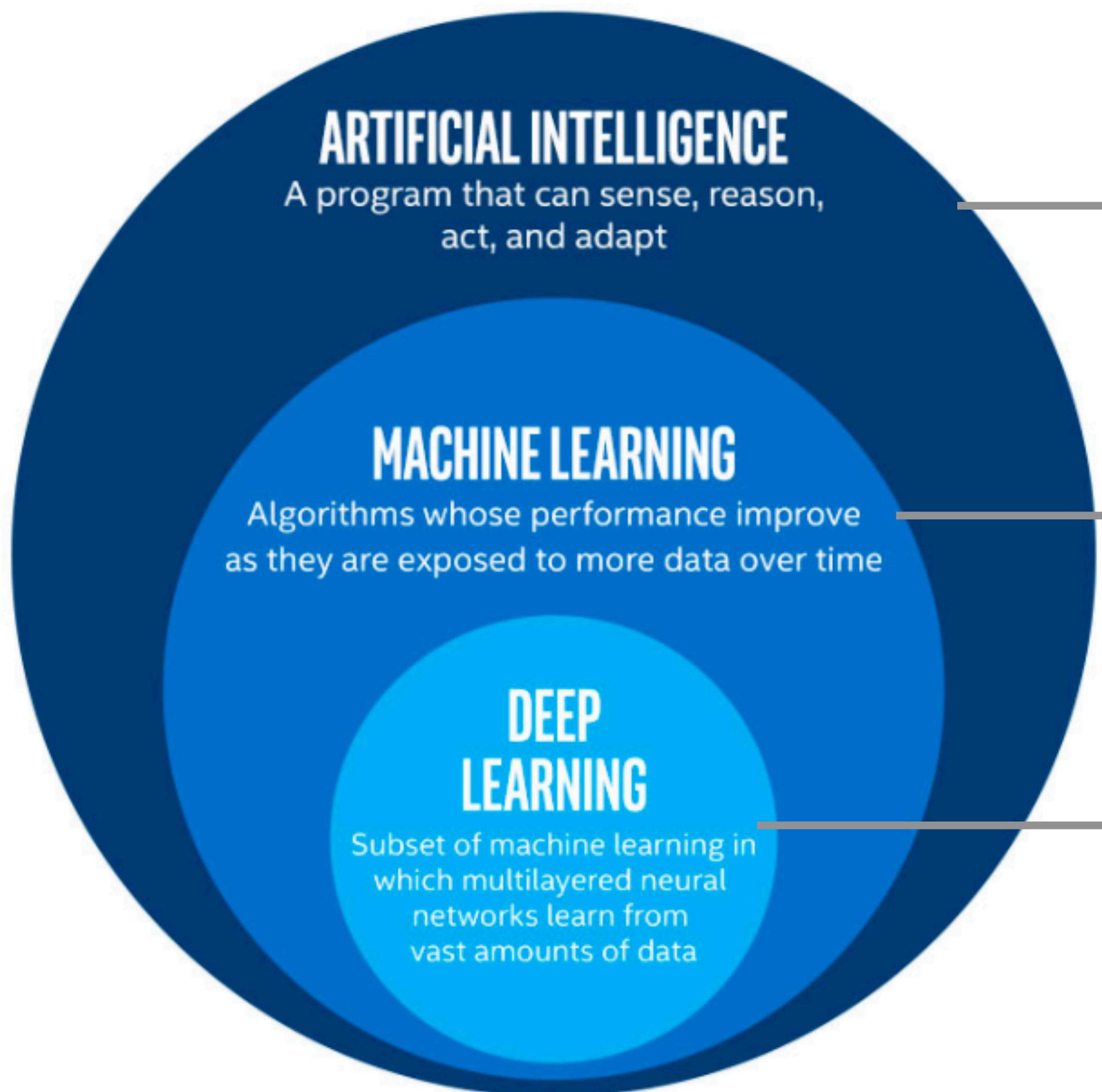


# What is machine learning really?

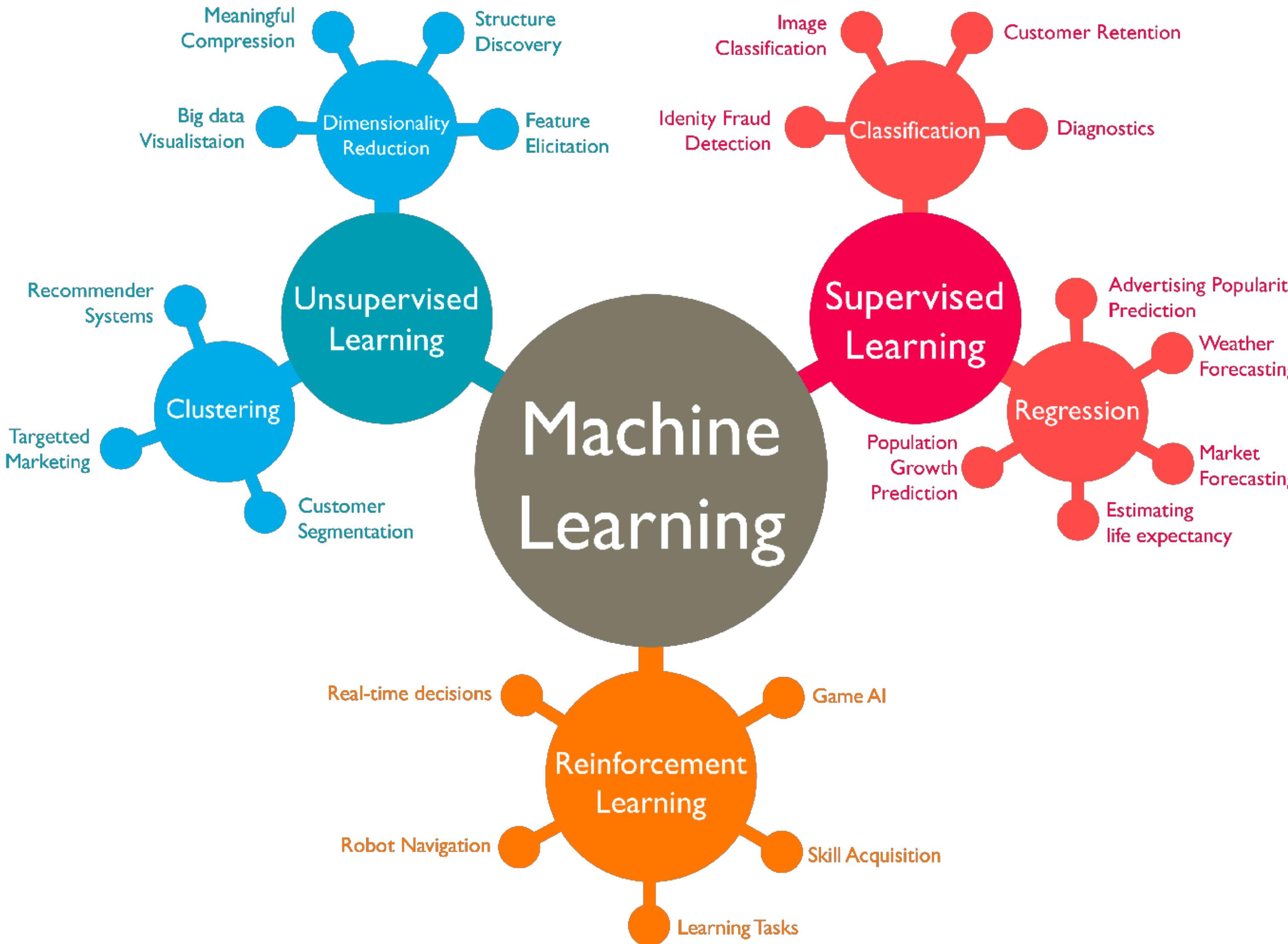


1950's: creation of first “intelligent” algorithms and programs

1980's: statistical models and algorithms that can learn from data

2010's: statistical models and algorithms inspired by neurones that can learn from data

# Machine Learning Branches



## 3 Main Branches:

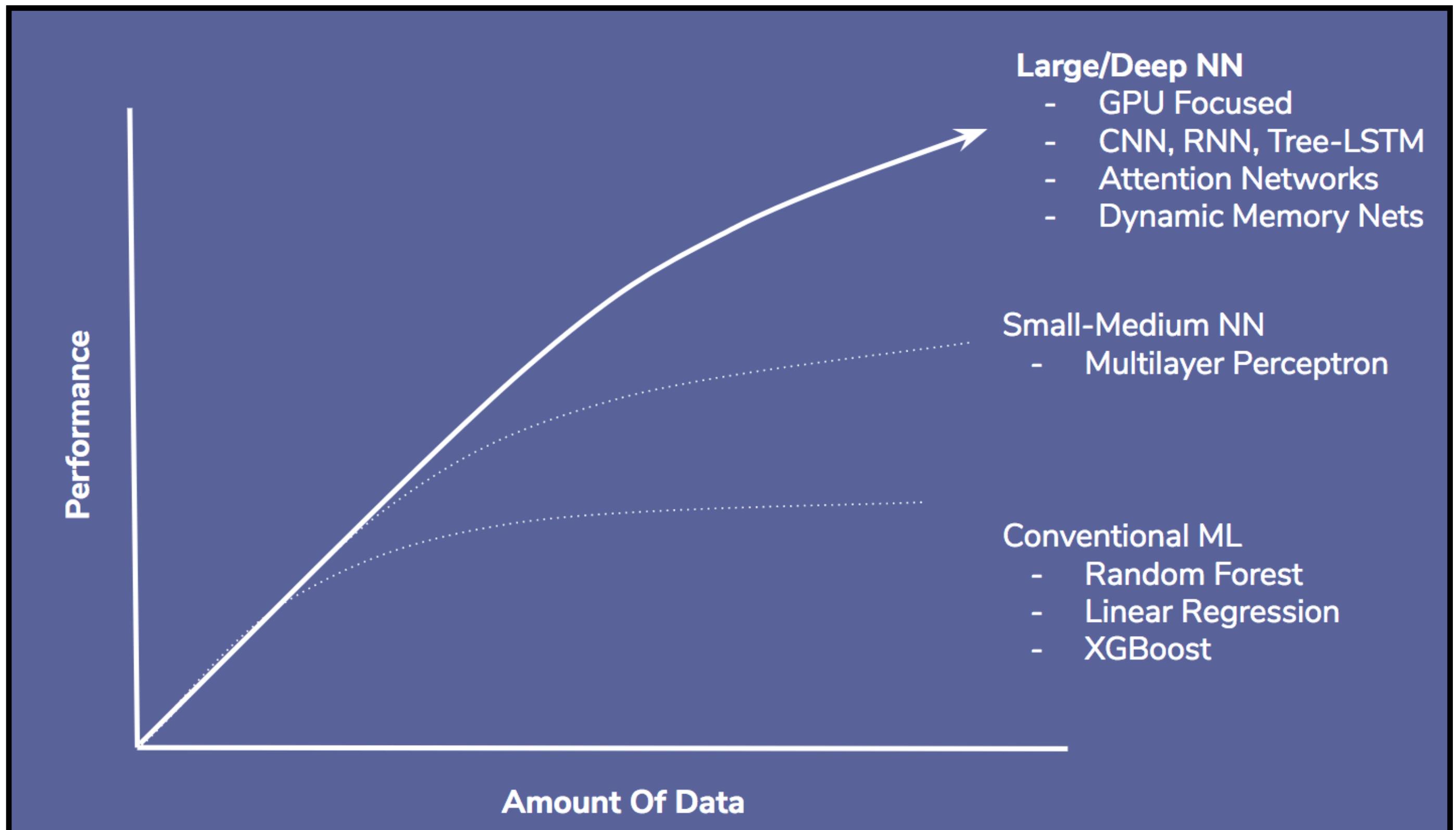
- **Supervised Learning**
- **Unsupervised Learning**
- **Reinforcement Learning**

# Part II: Deep Learning

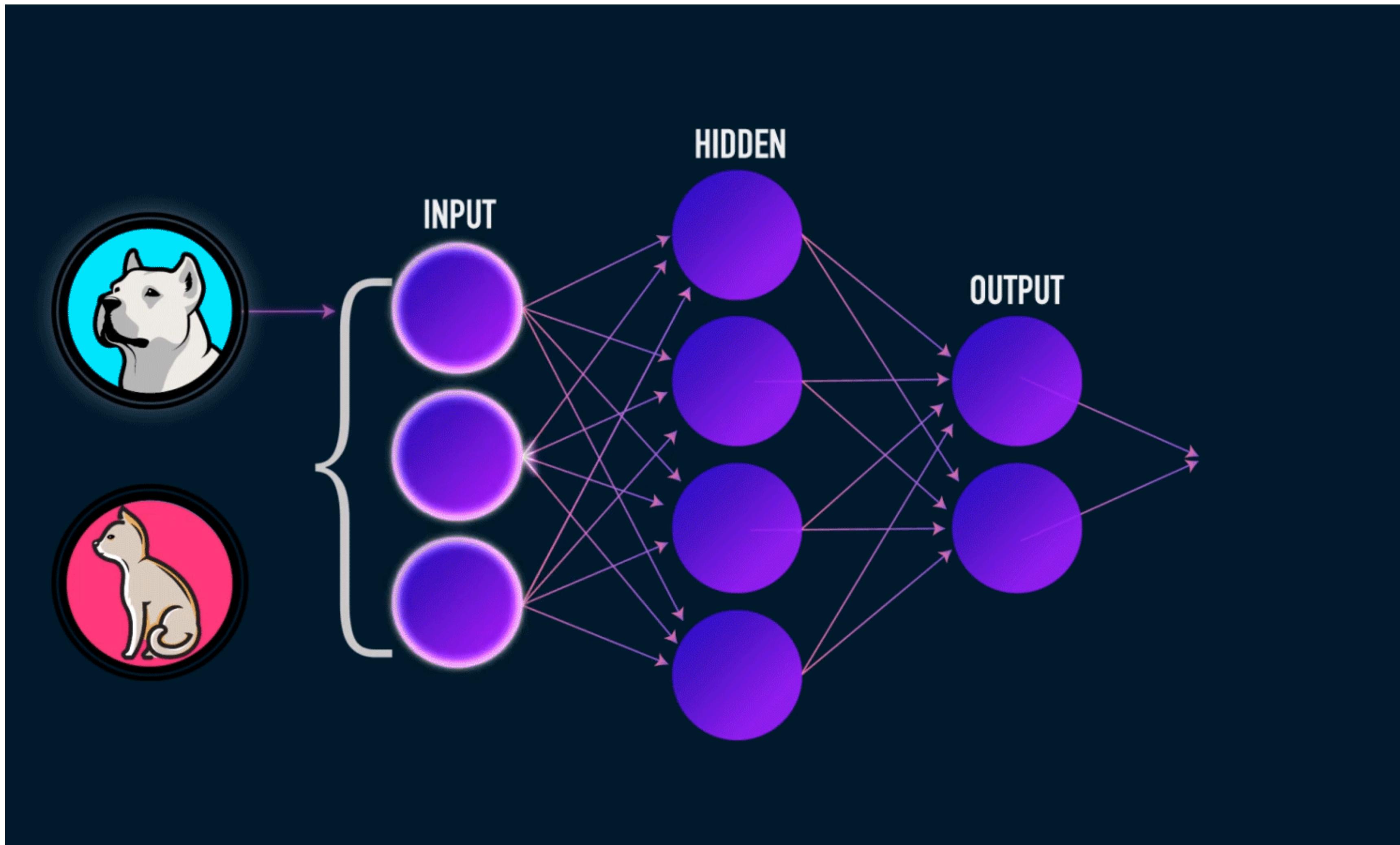
## Why now?

In recent years two things became available:

1. A lot of data
2. Necessary compute



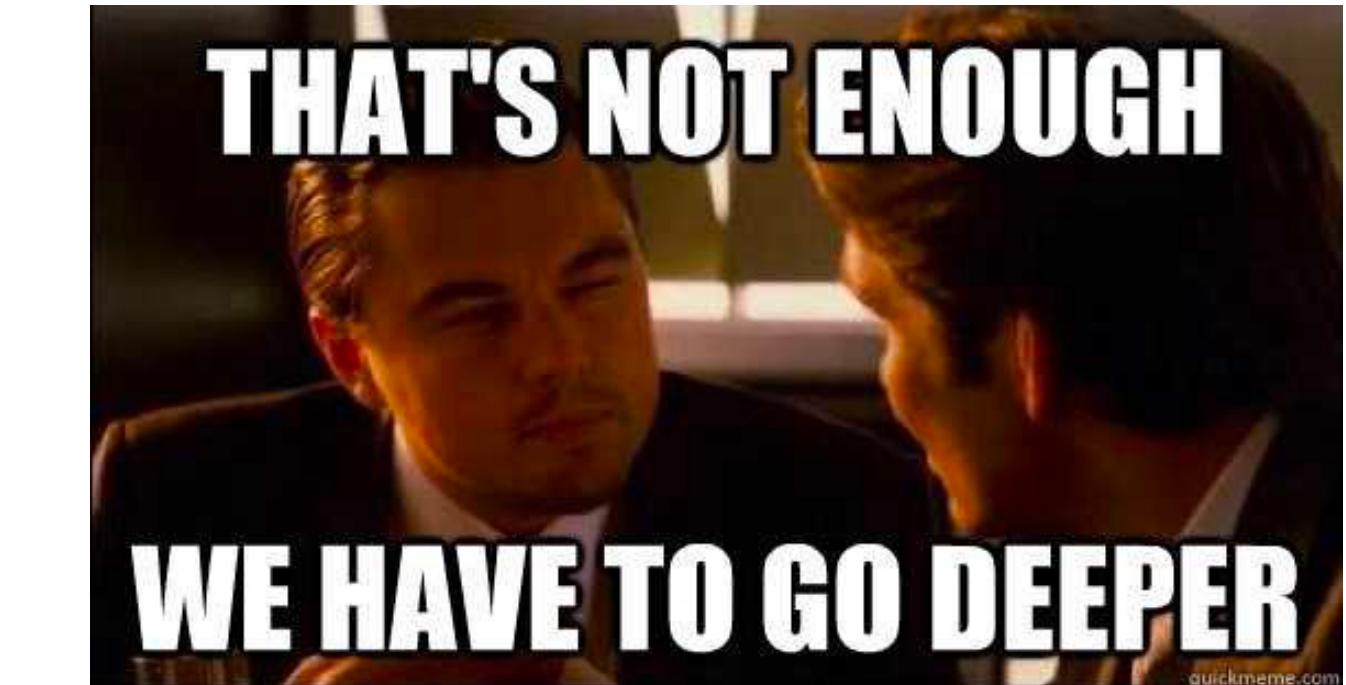
# What is deep learning?



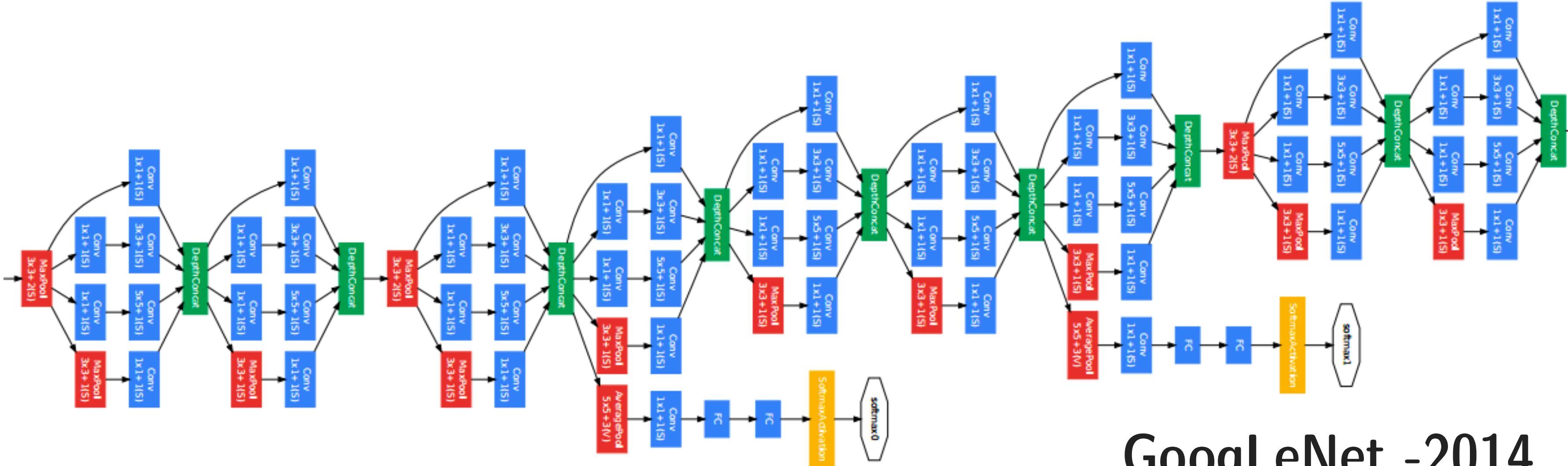
Rosenblatt - 1961

# What is new in deep learning?

What is new (among other things) is a learning algorithm called **backpropagation** which allows to train **deep neural nets**.



State of the art networks can have **over 200 layers!**



GoogLeNet -2014

# Difference classical ML vs. Deep Learning

Classical ML methods don't handle high dimensionality well.

⇒ **dimensionality reduction & feature selection**

Deep neural nets learn compact representations of data even in a high dimensionality/sparse setting - **no feature engineering** required!



# Unsupervised Learning: Generative Adversarial Nets (GAN)



2014



2015



2016



2017



2018  
NVIDIA

None of these images was taken in the real world!

# Unsupervised Learning: Generative Adversarial Nets (GAN)



DeepMind - 2018

Which of these images was generated?

# Unsupervised Learning: Language Generation

## OpenAI, February 14 2019: Better Language Models and Their Implications

**SYSTEM PROMPT  
(HUMAN-WRITTEN)**

*In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.*

**MODEL COMPLETION  
(MACHINE-WRITTEN,  
10 TRIES)**

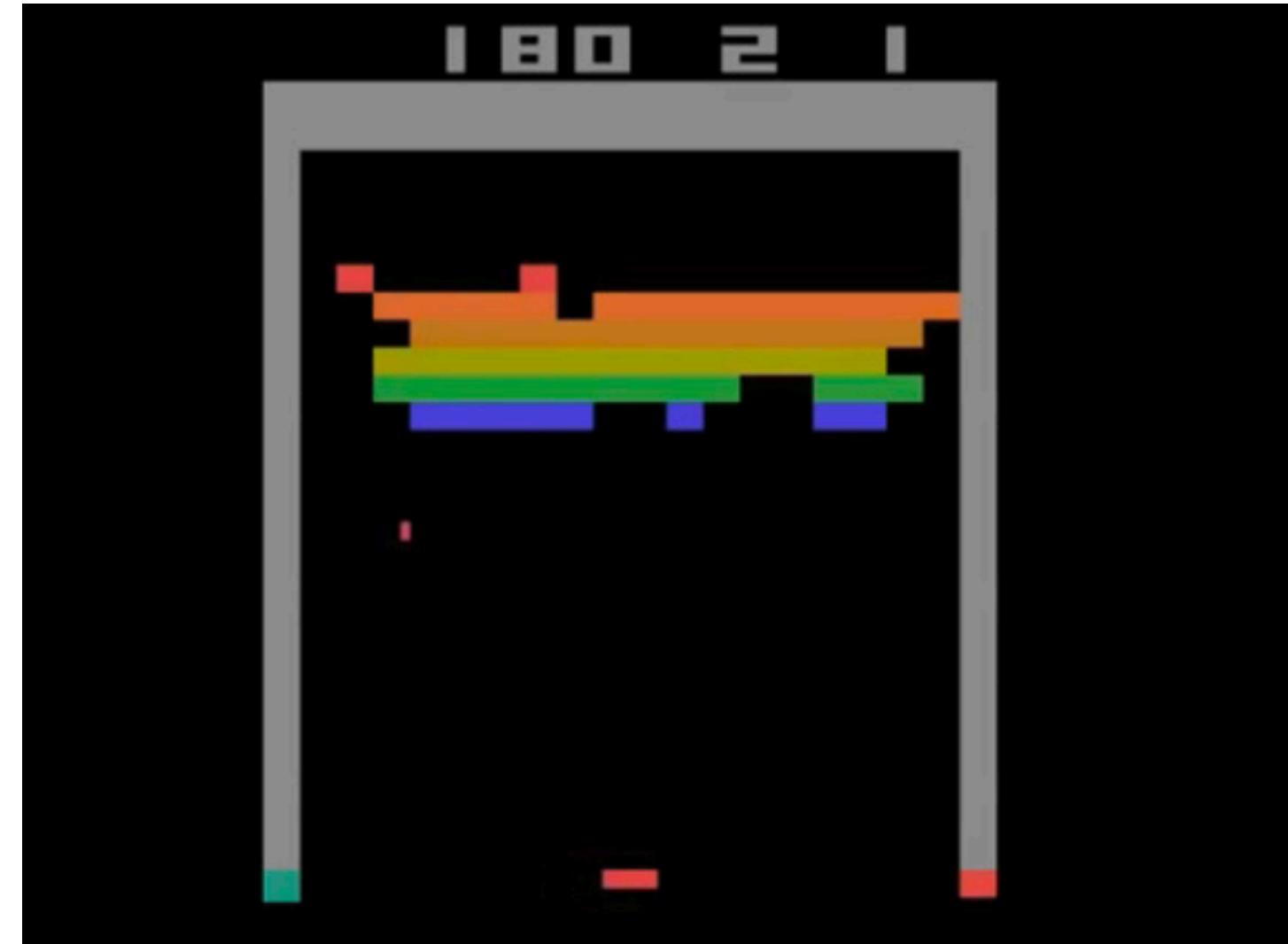
The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science.

Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.

Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

Pérez and the others then ventured further into the valley. "By

# Reinforcement Learning: DeepMind



19. December 2013:  
DQN Algorithm beats 7  
Atari Games exposing  
super-human level in  
some instances.

15. March 2016:  
AlphaGo beats south-  
korean Go grandmaster  
Lee Sedol 4:1.

24. January 2019:  
AlphaStar beats two  
professional StarCraft II  
players 10:1.

# So why not use Deep Learning for everything?



- There are reasons why we don't only use DL:
- Necessary data not available
  - Computational power not available
  - Harder to interpret results
  - Deep networks can be fooled:

