

# AI FOR EVERYONE

An Introductory Overview

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HANDS ON:  
CODING  
ENVIRONMENT



# Alyona

Computational Astrophysicist

Research Software Engineer

Artificial Intelligence Graduate Student



## What do I enjoy?

- Making Science Videos
- Art, Photography, Film
- Working with Astronomical Data

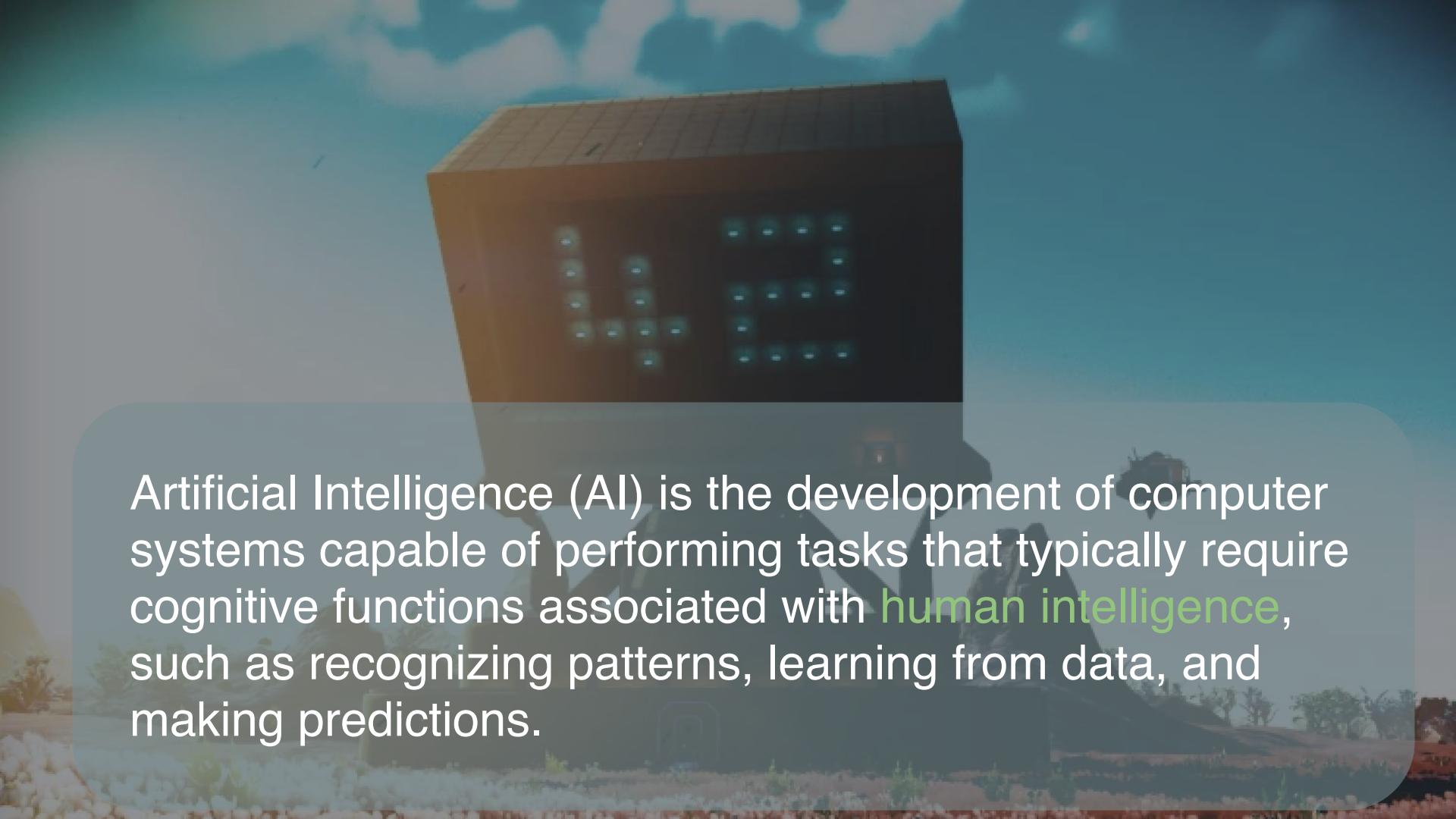
**DORK  
MATTER GIRL**



- What is your research focus?
- Have you used any ML or AI tools in your work?
- If not, have you considered using them?
- What types of data do you typically work with?
- What do you hope to gain from the Cyber2A program?

# WHAT IS AI?

YOUR DEFINITION



Artificial Intelligence (AI) is the development of computer systems capable of performing tasks that typically require cognitive functions associated with **human intelligence**, such as recognizing patterns, learning from data, and making predictions.

But... there is a problem

WHAT IS HUMAN INTELLIGENCE?

But... there is a problem

## WHAT IS HUMAN INTELLIGENCE?



# HOW DO HUMANS THINK?

# HOW DO HUMANS THINK?

Geoffrey Hinton

Computer scientist and  
cognitive psychologist



# HOW DO HUMANS THINK?

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WE THINK EXPERIENTIALLY!



# HOW DO HUMANS THINK?

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## WE THINK EXPERIENTIALLY!

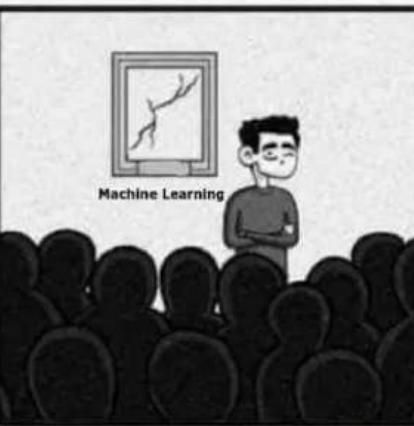
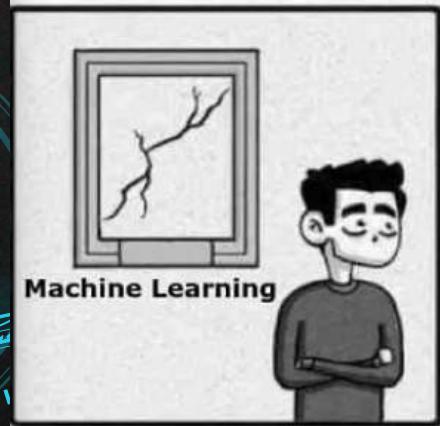
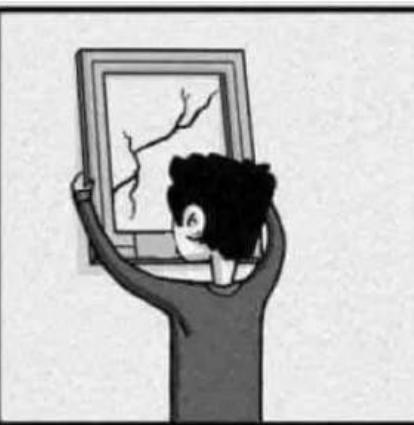
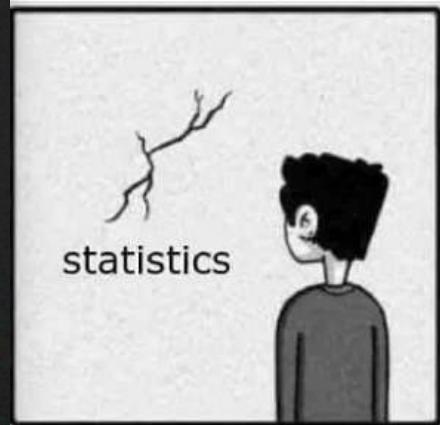
Nobel Prize,  
2024



**Artificial  
Intelligence**

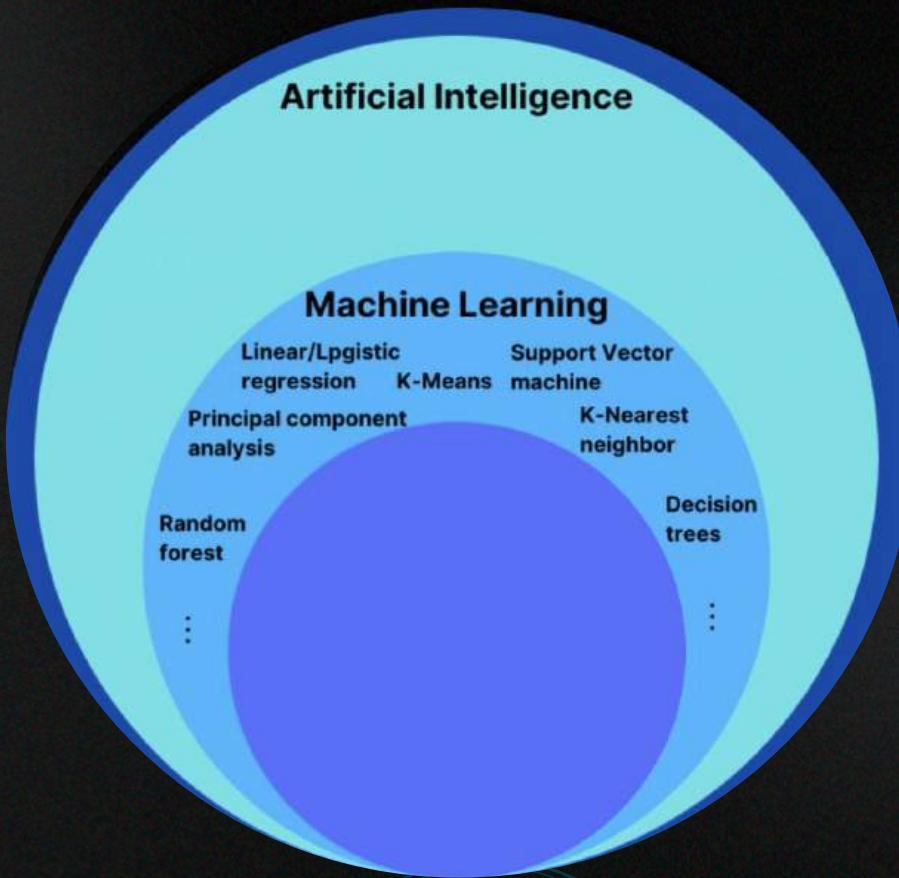
Machine  
Learning

# MACHINE LEARNING

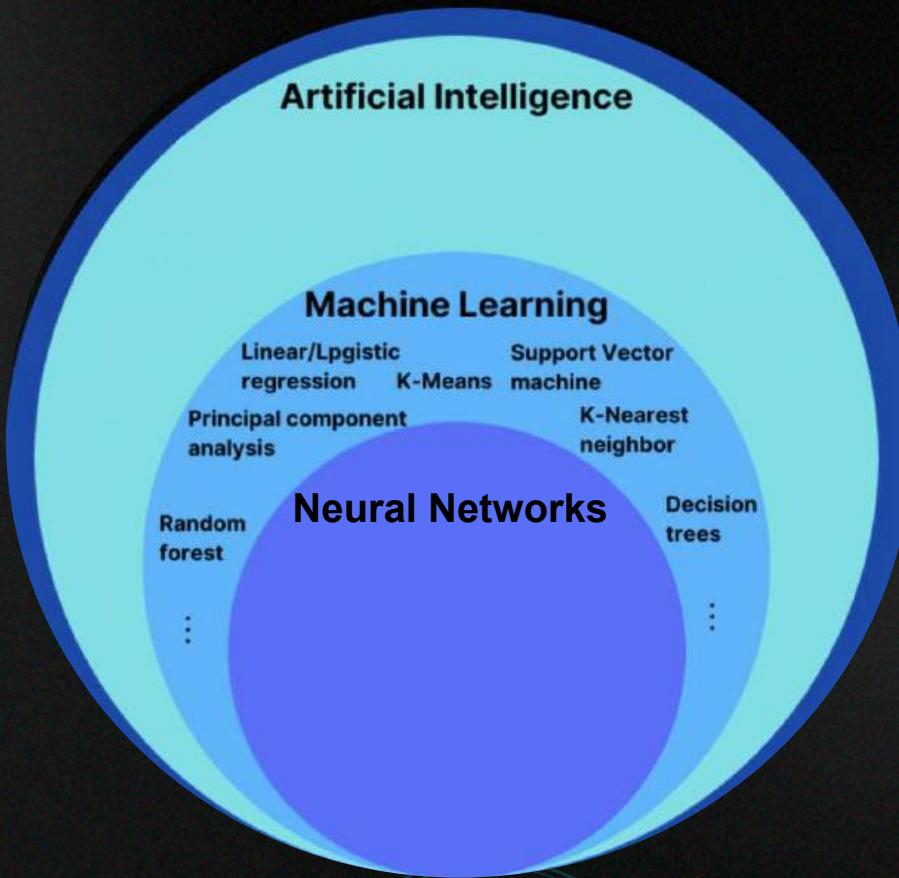


**Machine Learning** is a subset of AI that specifically focuses on algorithms that allow computers to learn from data and create probabilistic models.

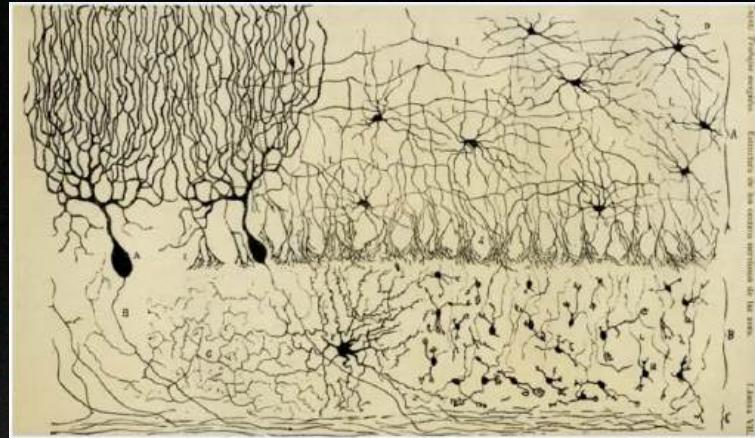
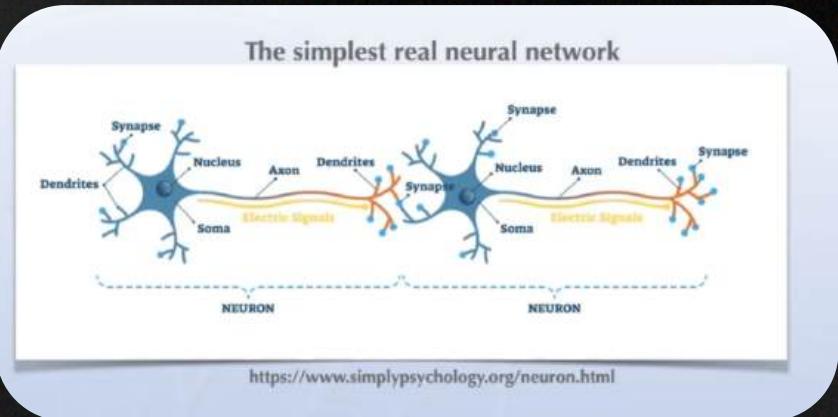
# Machine Learning



# Machine Learning



# Neural Networks



De Felipe, Brain Research, 2013

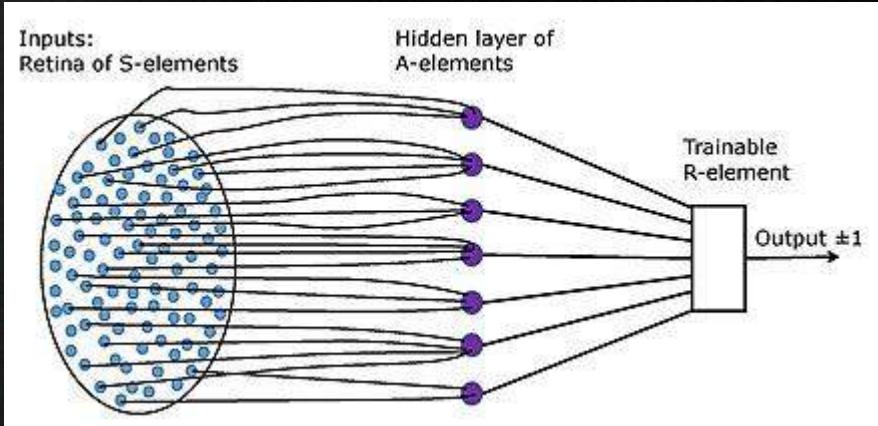
# Frank Rosenblatt

Psychologist,  
“Father of deep learning”

Inventor of the first ANN (Perceptron)



# Frank Rosenblatt



# Neural Networks

Try the Playground! [playground.tensorflow.org](https://playground.tensorflow.org)

Tinker With a Neural Network Right Here in Your Browser.  
Don't Worry, You Can't Break It. We Promise.

Epoch 000,111 Learning rate 0.03 Activation Tanh Regularization None Regularization rate 0 Problem type Classification

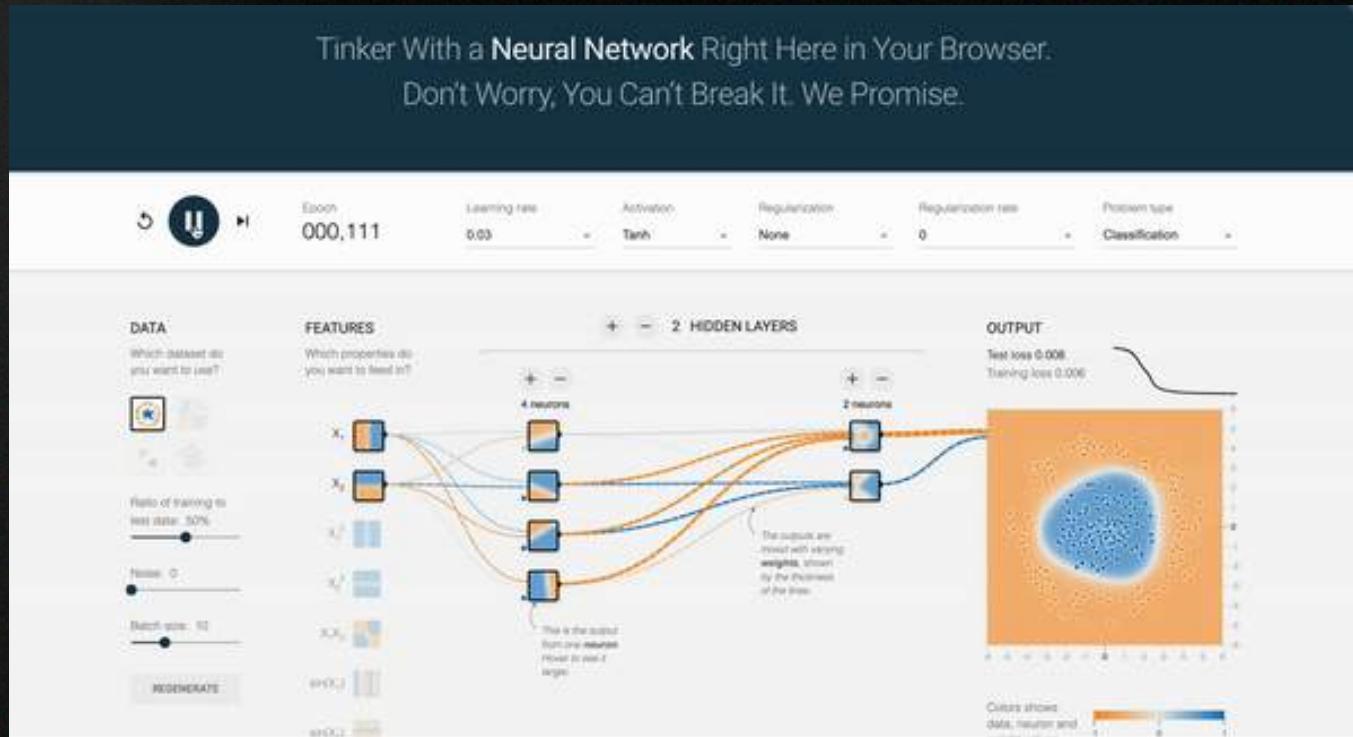
**DATA**  
Which dataset do you want to use?  
 MNIST  
Ratio of training to test data: 50%  
Noise: 0%  
Batch-size: 10  
GENERATE

**FEATURES**  
Which properties do you want to feed in?  
+ - 2 HIDDEN LAYERS  
4 neurons  
2 neurons

**OUTPUT**  
Test loss 0.008  
Training loss 0.006

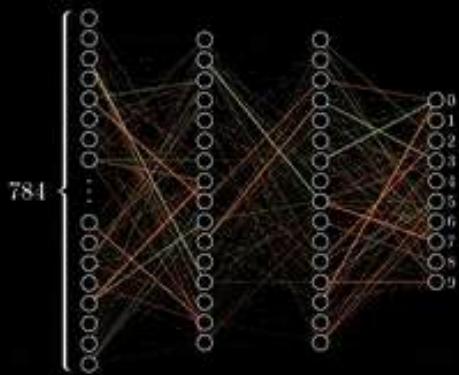
The outputs are mixed with strong weights, shown by the thickness of the lines.  
This is the output from one neuron. Mixed to predict targets.

Colors show data, neuron and



# Backpropagation

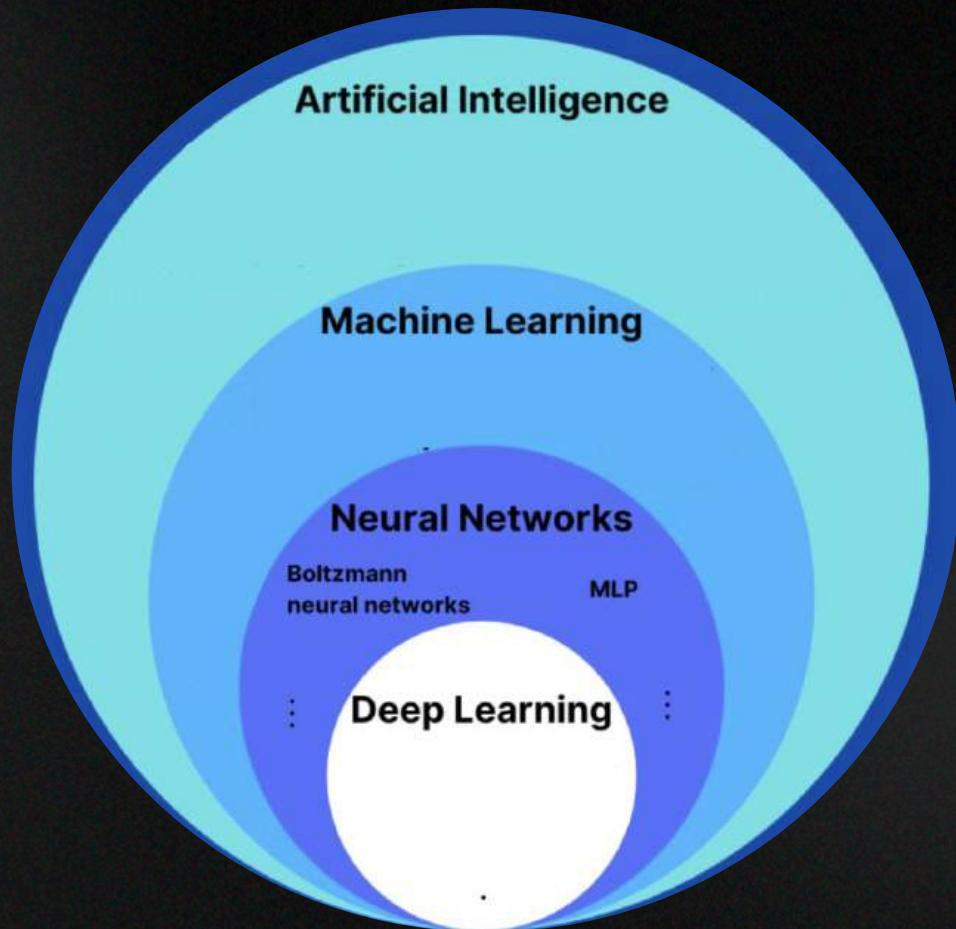
Training in progress...



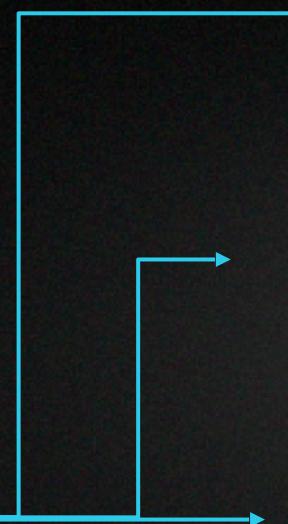
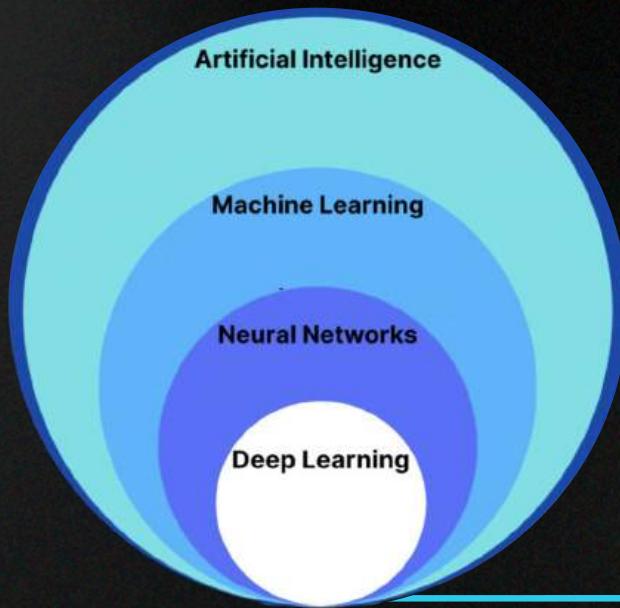
credit: 3Blue1Brown

**Backpropagation** is an algorithm that calculates the error at the output layer of a neural network and then "back propagates" this error through the network, layer by layer. It updates the connections (weights) between neurons to reduce the error, allowing the model to improve its accuracy during training.

(Invented in 1970s)



**Deep Learning (DL)** is a subset of ML, using neural networks with many layers.

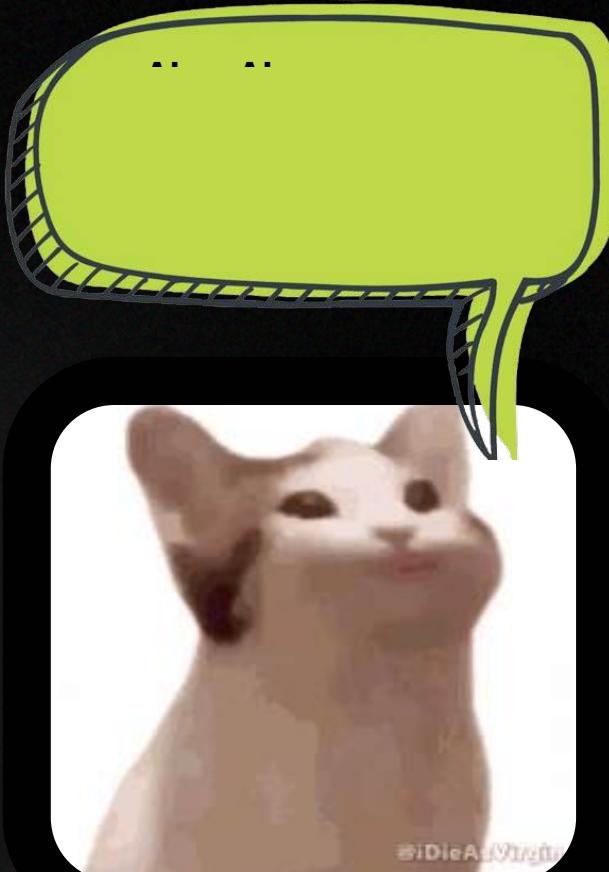
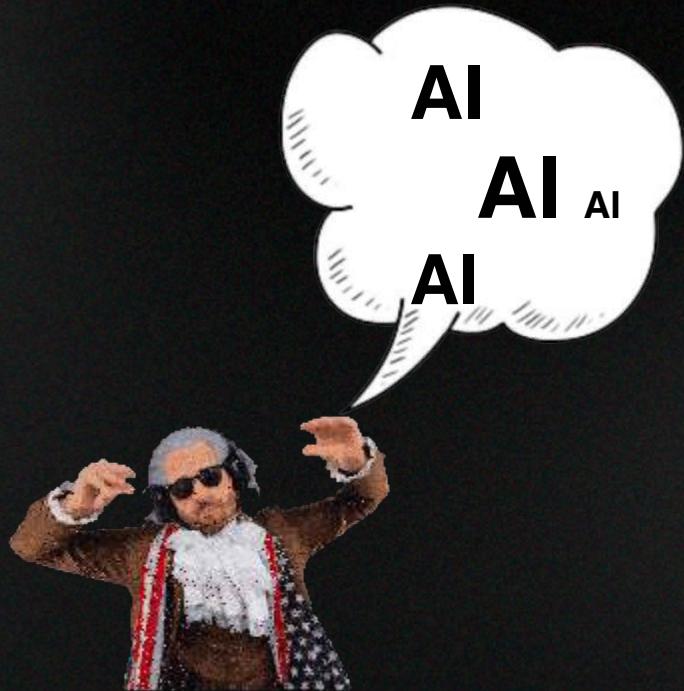


**Convolutional NN**  
(image recognition and processing)

**Large Language Models**  
(language understanding (e.g., GPT))

**Recurrent NN**  
(sequential data)

TOO MUCH! Why now?



# HISTORY OF LARGE LANGUAGE MODELS



# HISTORY OF LARGE LANGUAGE MODELS



**"Attention Is All You Need."**

# HISTORY OF LARGE LANGUAGE MODELS

## Attention Is All You Need

**Ashish Vaswani\***  
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### Abstract

The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles, by over 2 BLEU. On the WMT 2014 English-to-French translation task, our model establishes a new single-model state-of-the-art BLEU score of 41.8 after training for 3.5 days on eight GPUs, a small fraction of the training costs of the best models from the literature. We show that the Transformer generalizes well to other tasks by applying it successfully to English constituency parsing both with large and limited training data.

2020

# GPT-3

175 bil parameters or 175 billion 'neural connections'

96 layers

1,000 tokens

# Types and Techniques

## MACHINE LEARNING



### Supervised Learning

Training on labeled (by humans) data

### Unsupervised Learning

Discovering patterns within unlabeled data

### Reinforcement Learning

Interacting with an environment

### Semi-Supervised

Training on auto generated labels

# "Garbage in, Garbage out"



## Structured data

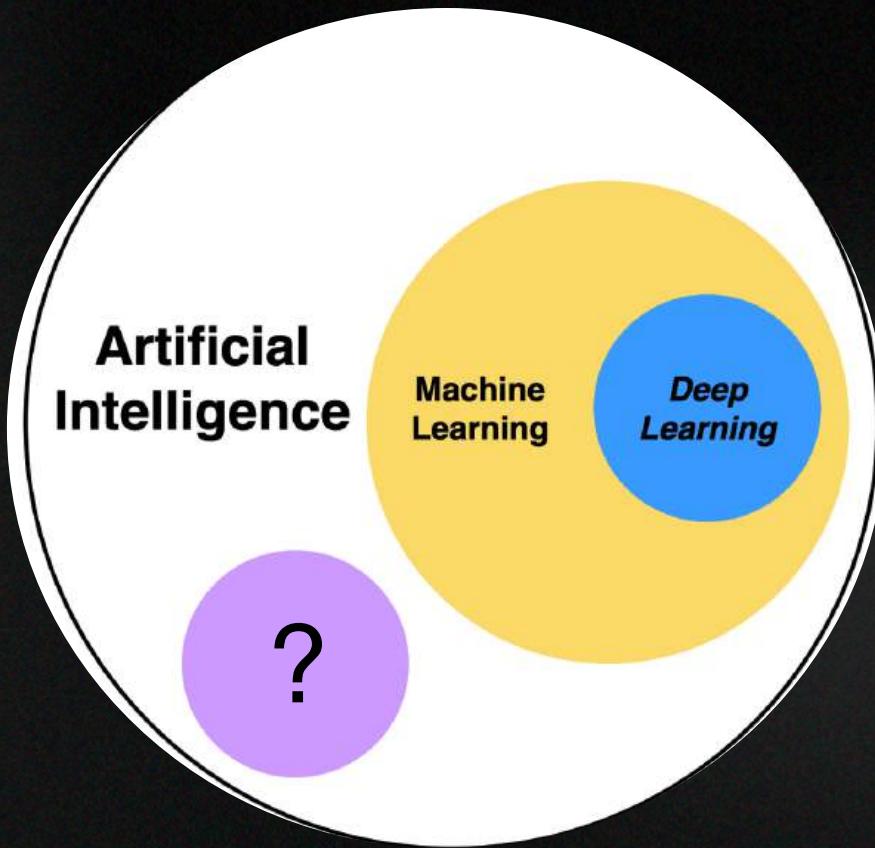
Quick insights with simpler models



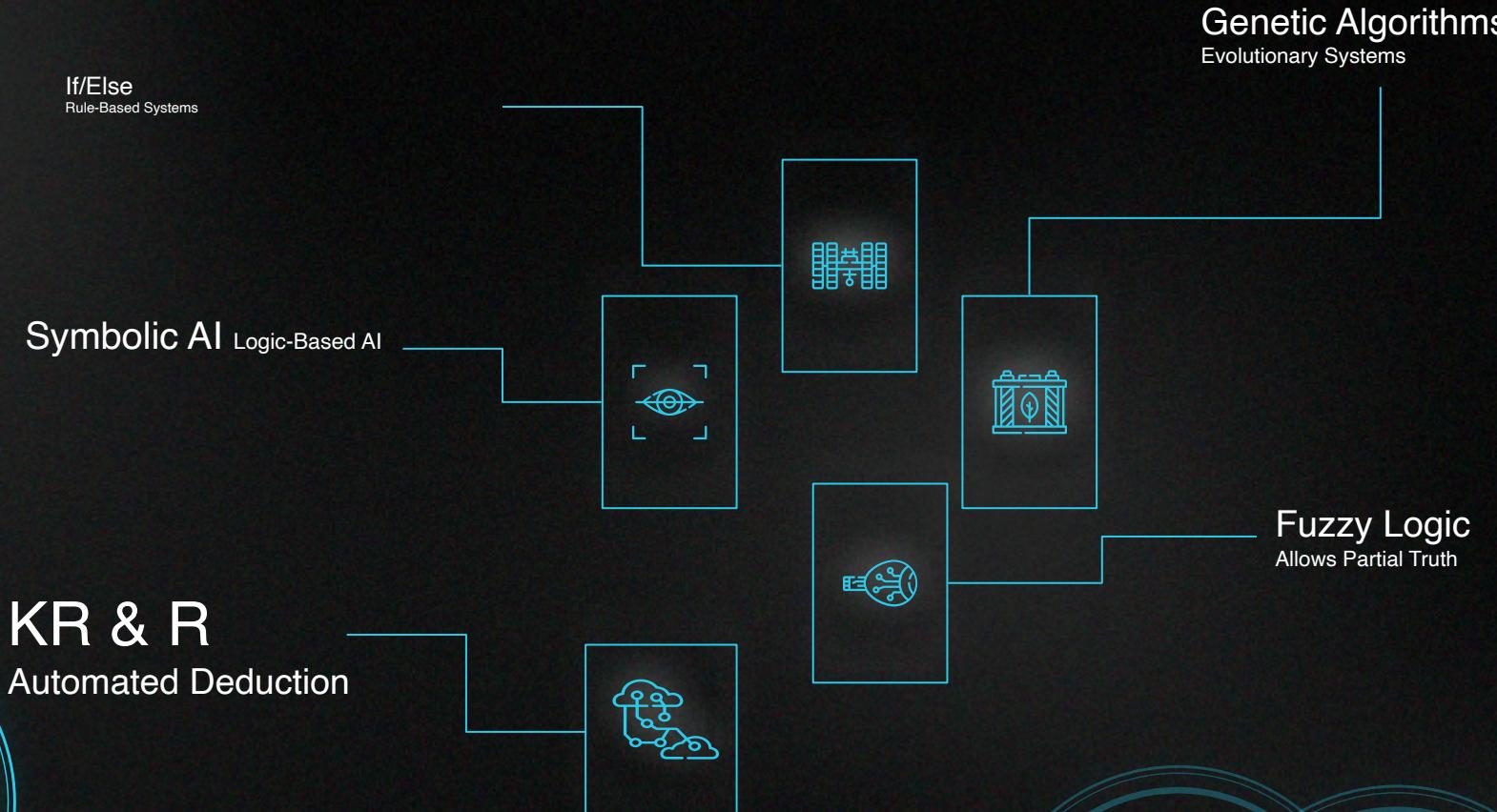
## Unstructured data

More effort but can lead to more nuanced and complex findings

# Beyond Machine Learning

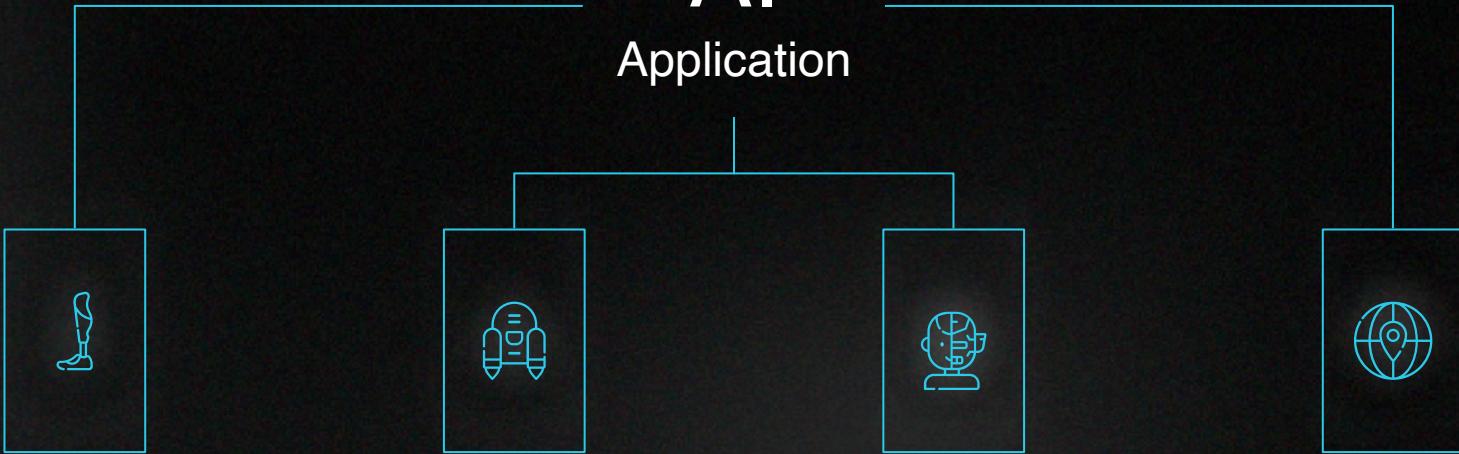


# WHAT IS AI BUT NOT ML?



# AI

## Application



Genomics

Astrophysics

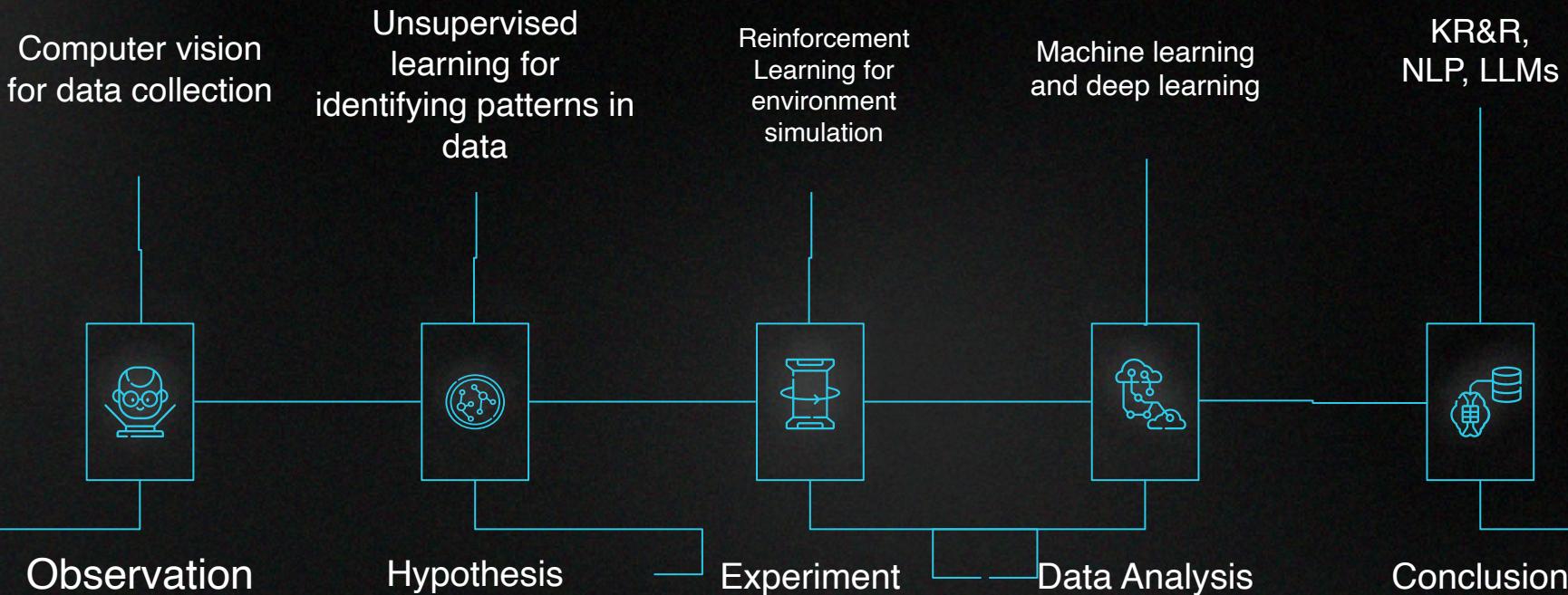
Robotics

Arctic Research

and more...



# Artificial Intelligence + Science



# RECOMMENDATIONS

- Ray Kurzweil, “How to Create a Mind”, 2012
- Max Bennett, “A Brief History of Intelligence” , 2023
-  3Blue1Brown Neural Networks Playlist

## Deep Dive

- Understanding LSTM Networks, 2015, [Link](#)
- Jakob Uszkoreit, “Transformer: A Novel Neural Network Architecture for Language Understanding”, 2017, [Link](#)



# Farewell

Do you have any questions?

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[alonakosobokova.com](http://alonakosobokova.com)

<https://youtube.com/@dorkmattergirl>



**P.S.** One more thing...

<http://35.197.83.168>