



# DEEP LEARNING FOUNDATION & APPLICATION

WITH A FOCUS ON MEDICAL INFORMATICS

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# **AI and Deep Learning; What and Why?**

# OUTLINES

- What is AI?
- Sub-systems of AI?
- Rule-based versus Learning-based AI
- Deep learning; what and why?

# LEARNING OBJECTIVES

- To get a big picture of AI and deep learning
- To learn the workflows of traditional machine learning methods versus deep learning algorithms

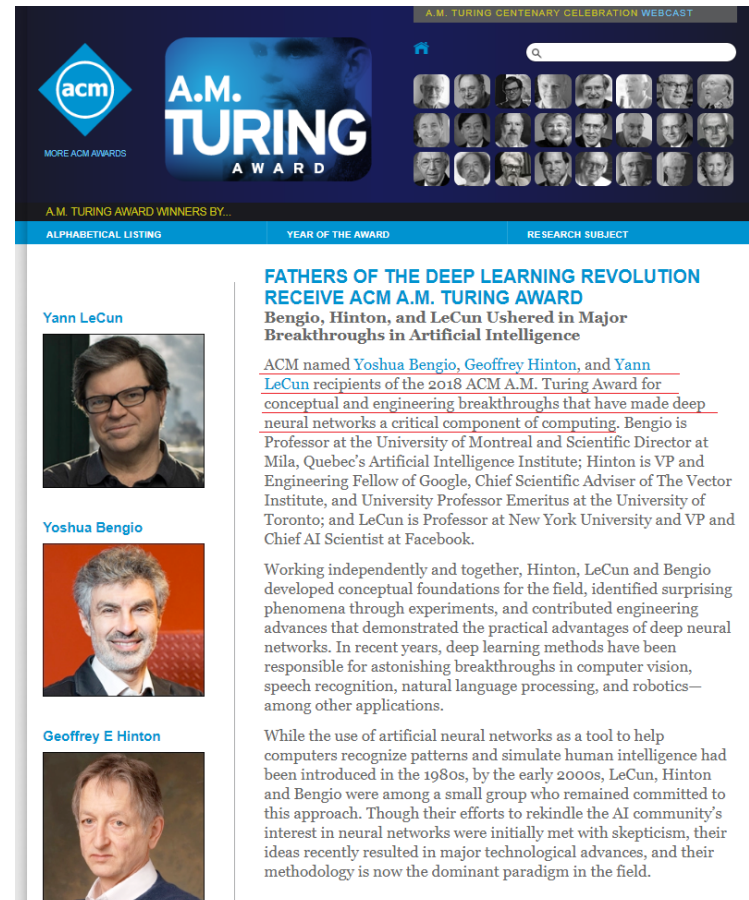
# AI AND DEEP LEARNING; WHAT AND WHY?



US \$1 million

Photos and Content are from:

<https://amturing.acm.org/>

A screenshot of the ACM A.M. Turing Award website. The header features the ACM logo, the text 'A.M. TURING AWARD', and a grid of past winners' portraits. Below the header, there are navigation links: 'ALPHABETICAL LISTING', 'YEAR OF THE AWARD', and 'RESEARCH SUBJECT'. The main content area is titled 'FATHERS OF THE DEEP LEARNING REVOLUTION RECEIVE ACM A.M. TURING AWARD' and lists the 2018 winners: Bengio, Hinton, and LeCun. It includes a paragraph about their contributions to deep learning and a section titled 'ACM named Yoshua Bengio, Geoffrey Hinton, and Yann LeCun recipients of the 2018 ACM A.M. Turing Award for conceptual and engineering breakthroughs that have made deep neural networks a critical component of computing.' The page also features individual portraits and names of the winners: Yann LeCun, Yoshua Bengio, and Geoffrey E Hinton.

**FATHERS OF THE DEEP LEARNING REVOLUTION RECEIVE ACM A.M. TURING AWARD**  
Bengio, Hinton, and LeCun Ushered in Major Breakthroughs in Artificial Intelligence

ACM named Yoshua Bengio, Geoffrey Hinton, and Yann LeCun recipients of the 2018 ACM A.M. Turing Award for conceptual and engineering breakthroughs that have made deep neural networks a critical component of computing. Bengio is Professor at the University of Montreal and Scientific Director at Mila, Quebec's Artificial Intelligence Institute; Hinton is VP and Engineering Fellow of Google, Chief Scientific Adviser of The Vector Institute, and University Professor Emeritus at the University of Toronto; and LeCun is Professor at New York University and VP and Chief AI Scientist at Facebook.

Working independently and together, Hinton, LeCun and Bengio developed conceptual foundations for the field, identified surprising phenomena through experiments, and contributed engineering advances that demonstrated the practical advantages of deep neural networks. In recent years, deep learning methods have been responsible for astonishing breakthroughs in computer vision, speech recognition, natural language processing, and robotics—among other applications.

While the use of artificial neural networks as a tool to help computers recognize patterns and simulate human intelligence had been introduced in the 1980s, by the early 2000s, LeCun, Hinton and Bengio were among a small group who remained committed to this approach. Though their efforts to rekindle the AI community's interest in neural networks were initially met with skepticism, their ideas recently resulted in major technological advances, and their methodology is now the dominant paradigm in the field.

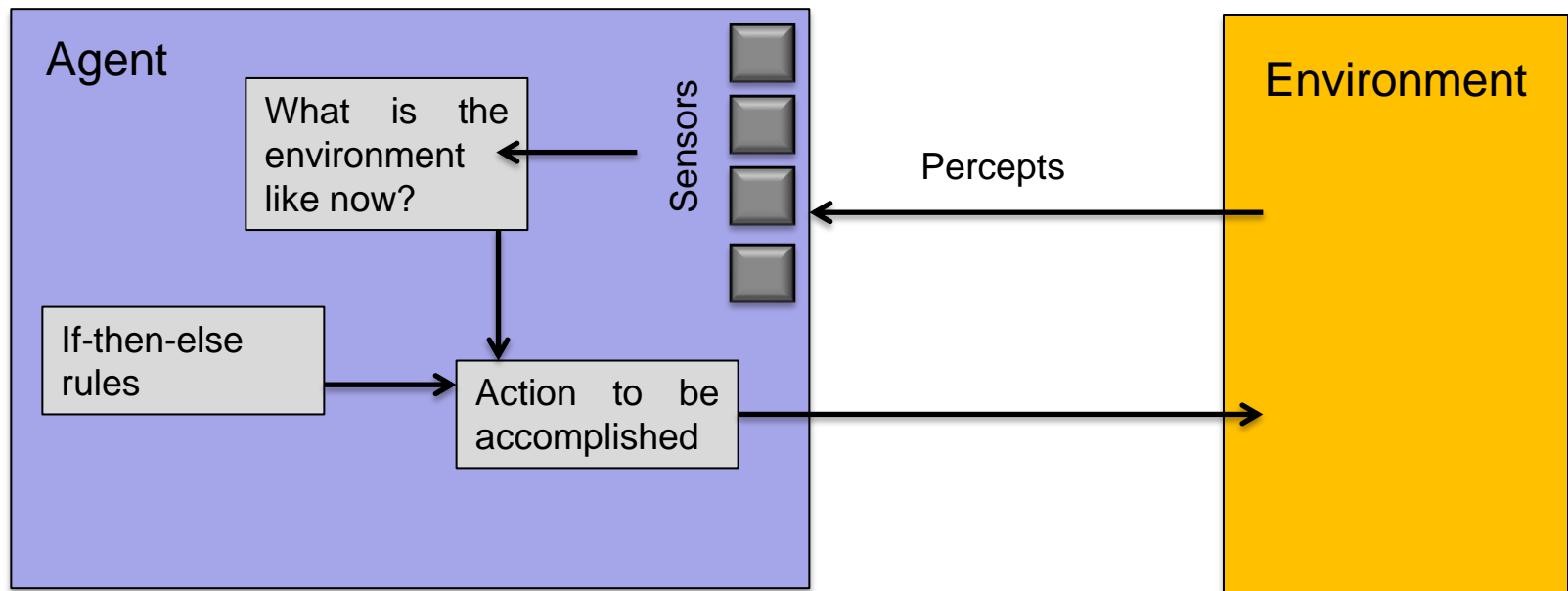
**Yann LeCun**

**Yoshua Bengio**

**Geoffrey E Hinton**

# AI AND DEEP LEARNING; WHAT AND WHY?

- **What is AI?** AI is all about computerized models targeting at **Perception**, and **Action**.
- It **solves a problem, optimally**.
- It **figures out (alone)** what is the **best action to take**.



# AI SUB-SYSTEMS

- Speech Recognition
- Natural Language Processing
- Computer Vision
- Robotics

# RULE-BASED VERSUS LEARNING-BASED AI

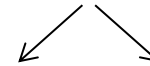


Step



Door

How to implement **singularities**???

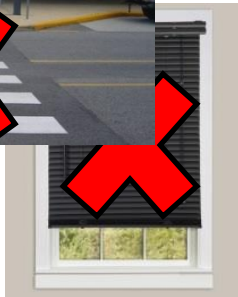
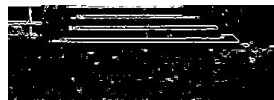
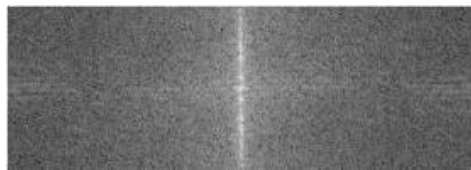


Rule-based algorithms

Learning-based algorithms

**Deep and machine learning** strategies vs. **Traditional** (rule-based) methods

Traditional (there is no any learning technique)



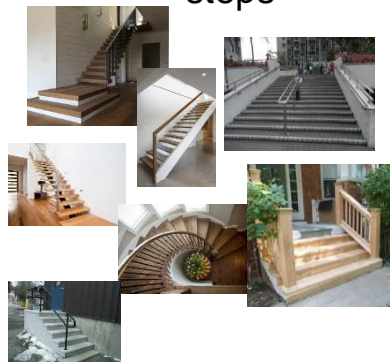
Deep and machine learning techniques

We train computers at recognizing doors from steps by showing them a **large amount** of:

(**object\_type**, **picture**) pairs.



steps

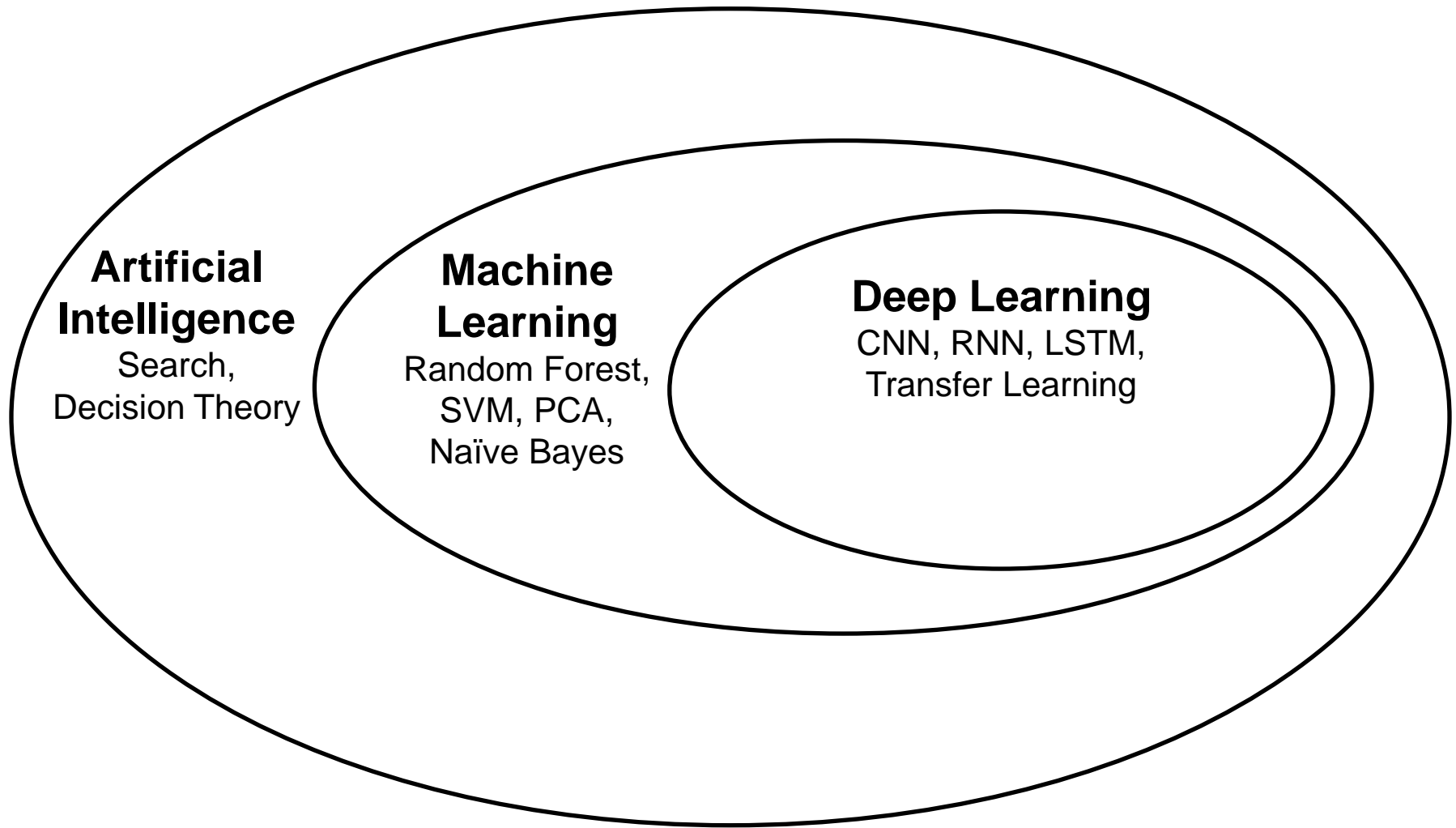


doors

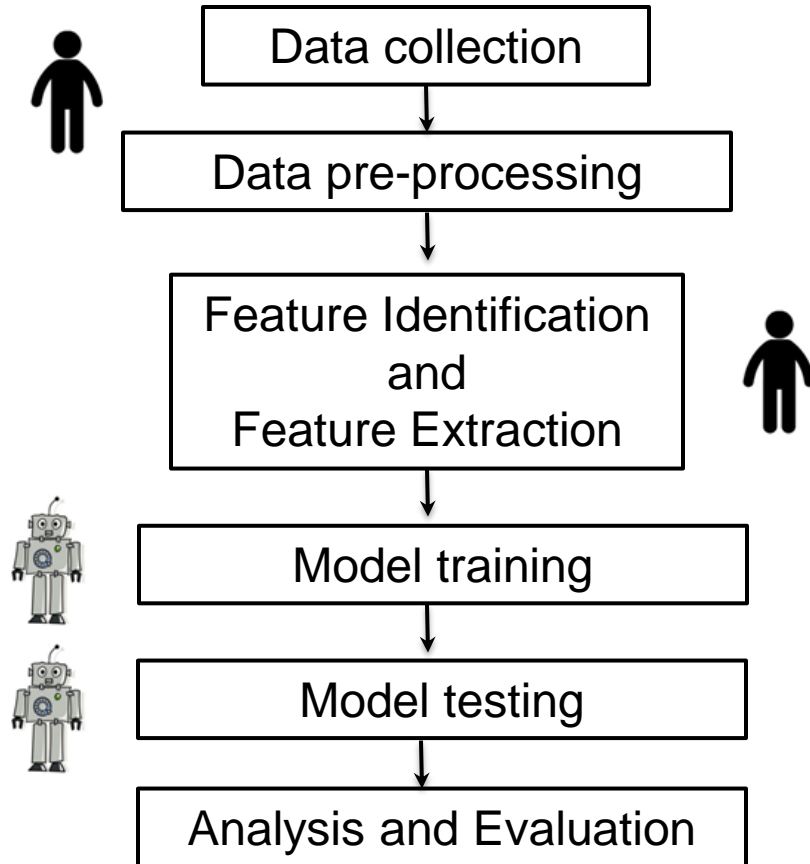




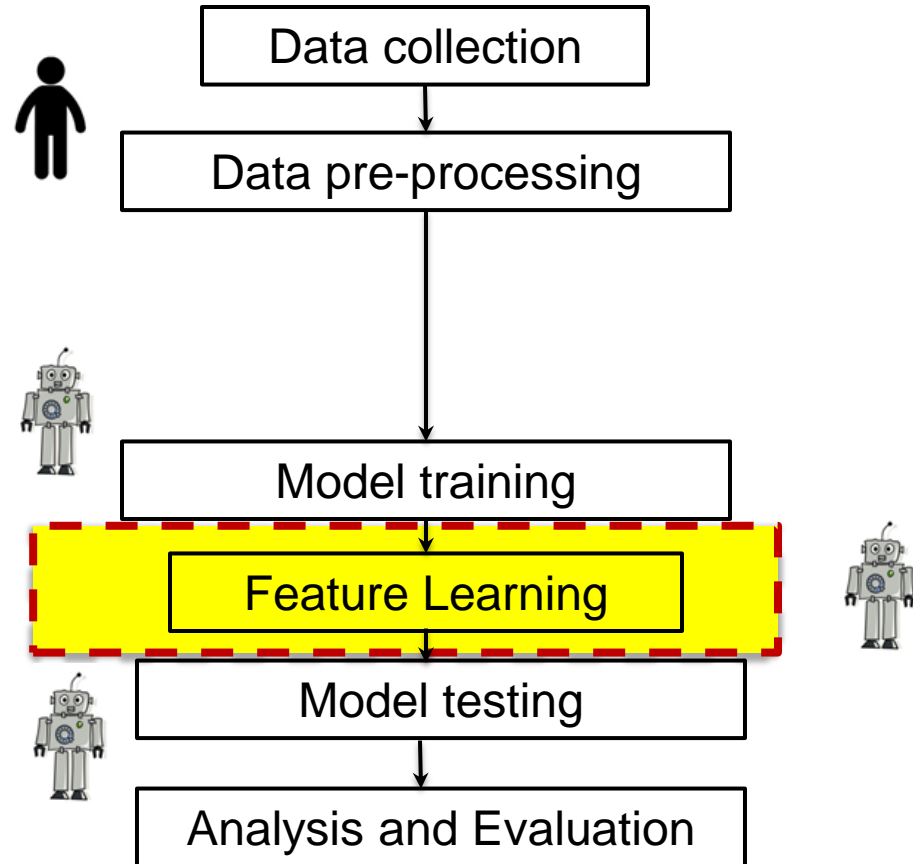
# DEEP LEARNING; WHAT AND WHY?



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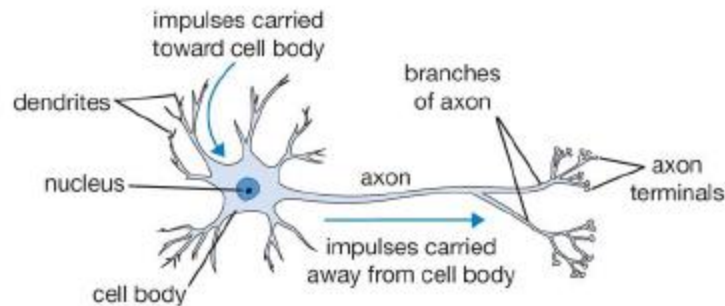


**Machine Learning**

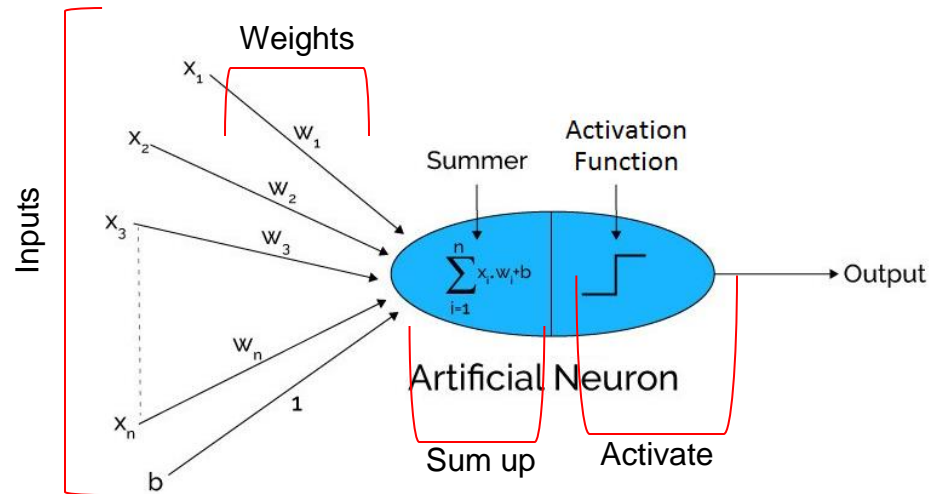


**Deep Learning**

# DEEP LEARNING; WHAT AND WHY?



**Neuron:** Computational building block for the “Brain”

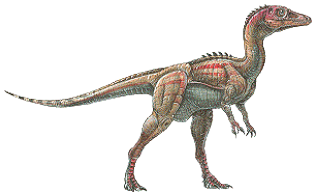


**Artificial Neuron:** Computational building block for the “Artificial Neural Networks”

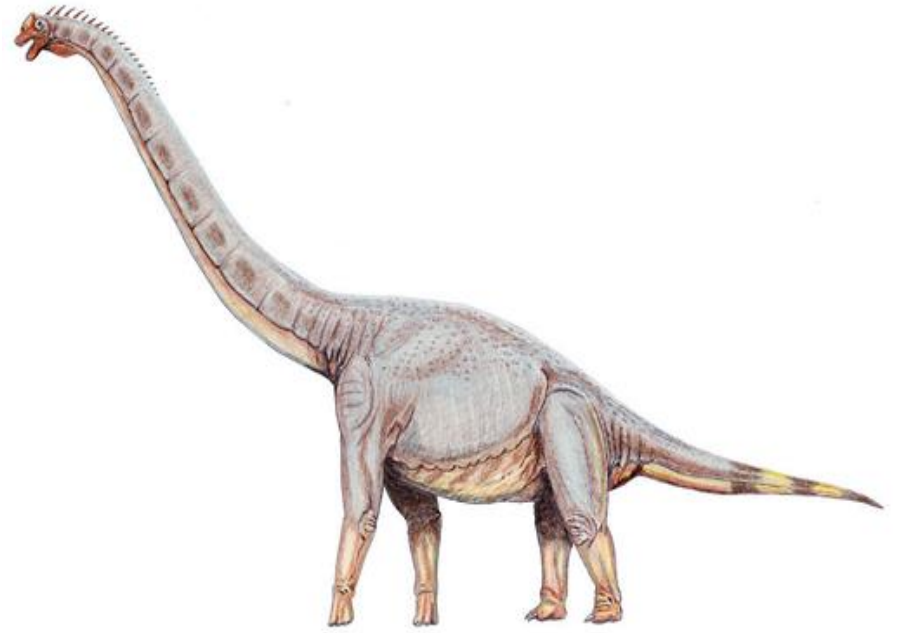
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**Universality:** for any arbitrary function  $f(x)$ , there exists an artificial neural network that closely approximates the function for any input  $x$ .

# DEEP LEARNING; WHAT AND WHY?



**Machine Learning**



**Deep Learning**

## REFERENCES

