AI and education

A brief history of AI

700 BC

The myth describes Talos as a giant bronze man built by Hephaestus, the Greek god of invention and blacksmithing. Talos was commissioned by Zeus, the king of Greek gods, to protect the island of Crete from invaders.

1789

During medieval and early modern times, it was thought that homunculus, an artificial humanlike being, could be created through alchemy. The homunculus first appears in alchemical writings attributed to Paracelsus (1493–1541)

History of AI

Artificial intelligence is based on the assumption that the process of human thought can be mechanized.

1000 BC

Philosophers developed structured methods of formal deduction.

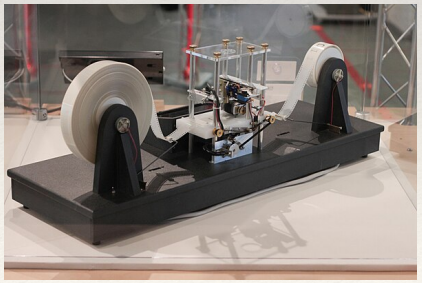
Deductive reasoning: Aristotle (syllogisms), Euclid…

1700…

Leibniz, Thomas Hobbes and René Descartes explored the possibility that all rational thought could be made as systematic as algebra or geometry.

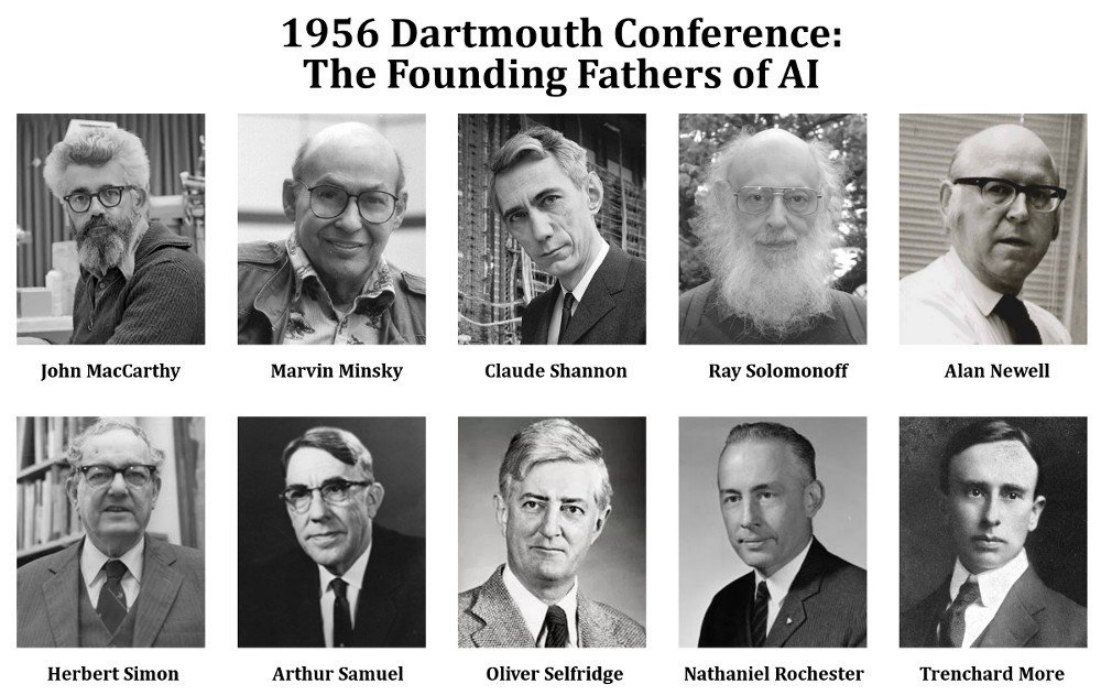
1850-1950

Mathematical logic:
- Boole, Russell, Hilbert, Goedel, Turing…



Turing machine

Dartmouth workshop: 1956



G(ood) O(old) F(ashioned) A(rtificial) I(ntelligence)

Symbolic AI: GOFAI uses symbols and explicit rules to represent knowledge. AI in this form operates by manipulating these symbols to perform logical operations and reasoning.

Logic-Based Systems: It relies on predefined rules, often in the form of "if-then" statements, and works well with structured, rule-based problems.

Human-Readable Rules: The rules and knowledge in GOFAI systems are transparent and interpretable by humans, making it easier to understand how the system reaches conclusions.

Examples: Early AI systems like **expert systems** in medical diagnostics and **rule-based chatbots** used GOFAI principles. These systems excelled at tasks like theorem proving, chess, and knowledge representation but struggled with real-world variability.

Deep Learning
(Learning-based Artificial Intelligence)

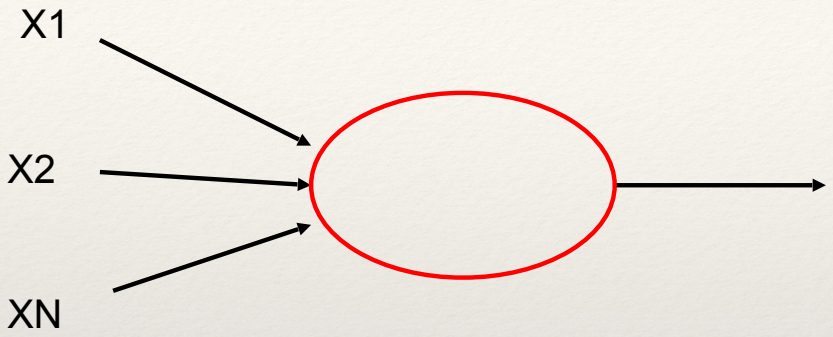
Neural Network-Based: Deep learning uses multi-layered neural networks that mimic aspects of the human brain to process data. These networks have layers of interconnected nodes (neurons) that transform and analyze data in complex ways.

Data-Driven Learning: Deep learning models learn from large datasets through pattern recognition rather than predefined rules. They adjust based on patterns in data rather than explicit programming.

Lack of Explicit Reasoning: Unlike GAFAI, deep learning models are often seen as "black boxes" because the decision-making process isn't always interpretable.

Examples: Deep learning powers **image recognition systems**, **language translation**, and **speech recognition**. It is also foundational in technologies like **CLAUDE** or **ChatGPT**, autonomous driving systems, and facial recognition.

The perceptron



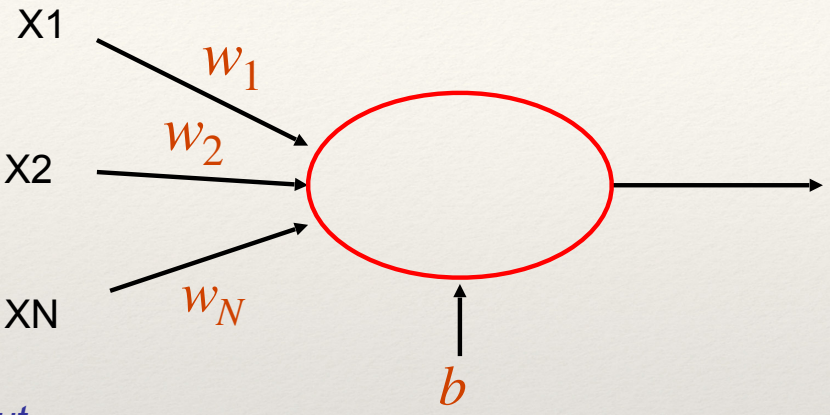
$$f(X) = \begin{cases} 1 \\ 0 \end{cases}$$

Input
(Predictor)

Output
(Response: here, classification)

The perceptron classifies the input vector X into two categories.

The perceptron



$$f(X) = \begin{cases} 1 \\ 0 \end{cases}$$

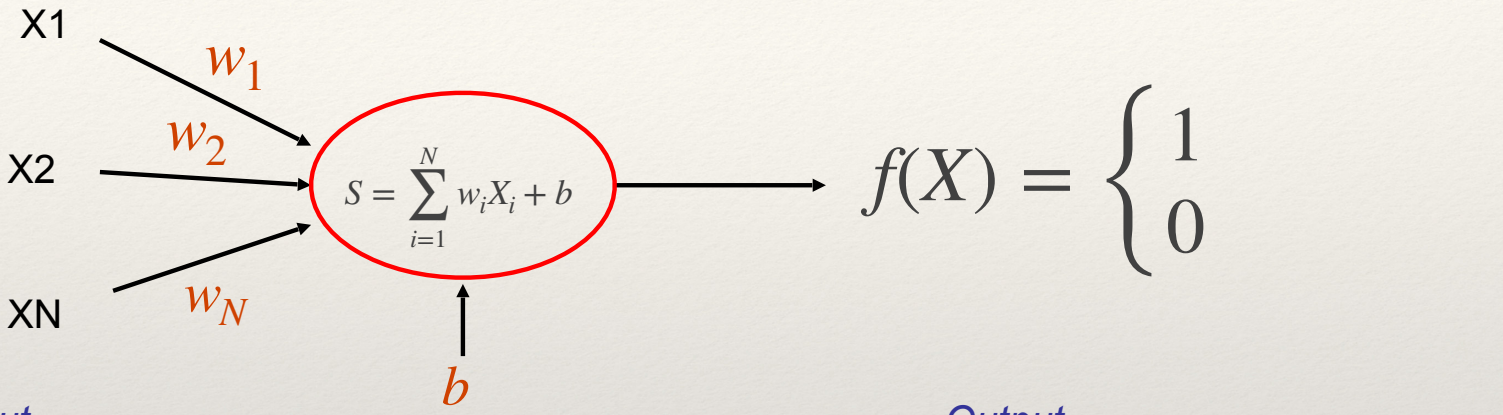
Input
(Predictor)

Output
(Response: here, classification)

The perceptron classifies the input vector X into two categories.

Add weights ***w*** to all predictors, and a bias ***b***

The perceptron



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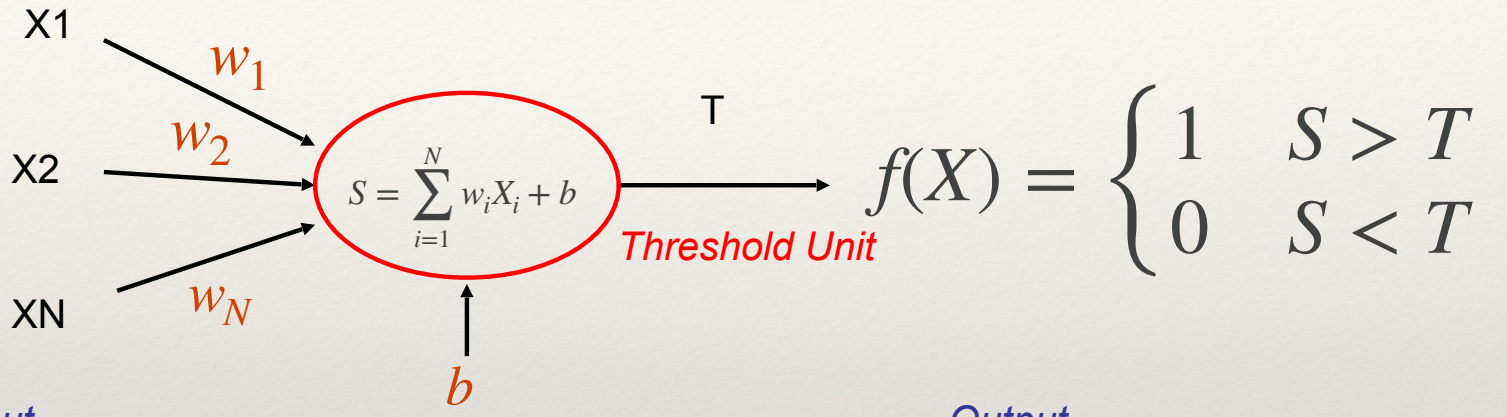
The perceptron classifies the input vector X into two categories.

Add weights ***w*** to all predictors, and a bias ***b***

Define simple "function" *S* as weighted sum of the predictors plus a bias

The perceptron



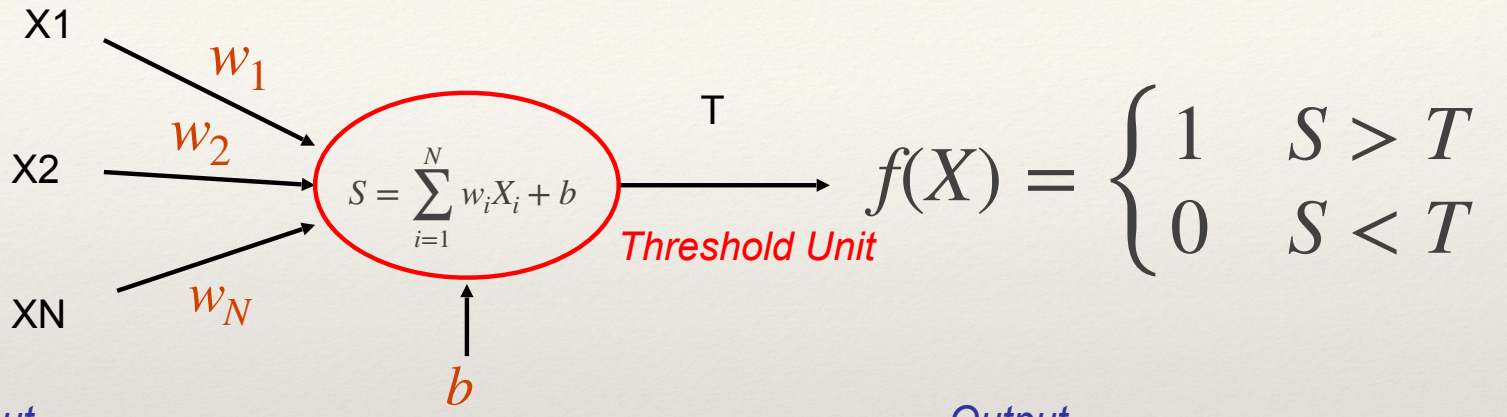
The perceptron classifies the input vector X into two categories.

Add weights ***w*** to all predictors, and a bias ***b***

Define simple "function" *S* as weighted sum of the predictors plus a bias

Add threshold to the function S

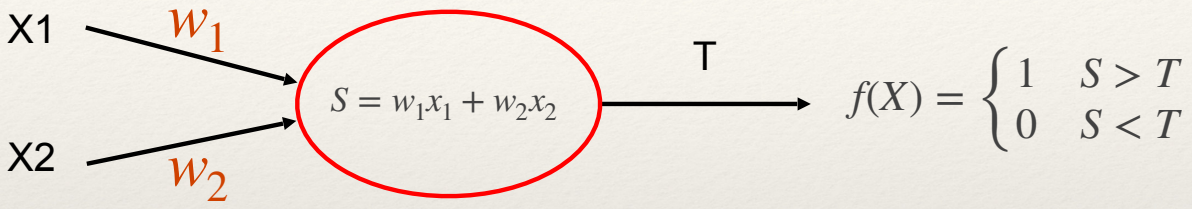
The perceptron



If the weights, bias, and threshold T are not known in advance, the perceptron must be trained. Ideally, the perceptron must be trained to return the correct answer on all training examples, and perform well on examples it has never seen.

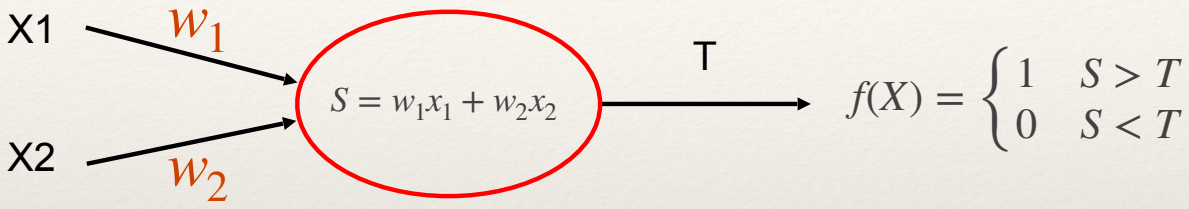
The training set must contain both type of data (i.e. with "1" and "0" output).

Example: the OR gate



X1	X2	Output	S
1	1	1	$w_1 + w_2$
1	0	1	w_1
0	1	1	w_2
0	0	0	0

Example: the OR gate



X1	X2	Output	S
1	1	1	$w_1 + w_2$
1	0	1	w_1
0	1	1	w_2
0	0	0	0

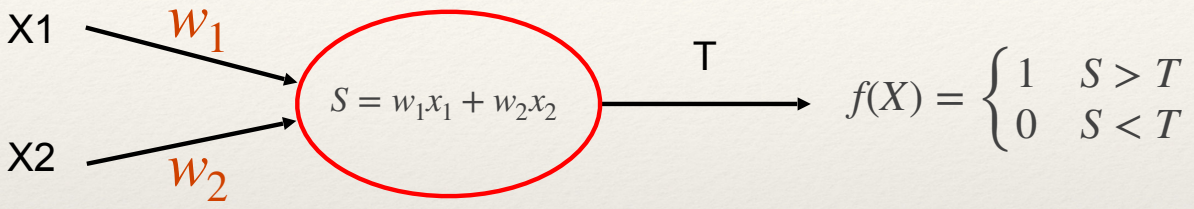
Possible solution:

$w_1 = 1$

$w_2 = 1$

$T = 0.5$

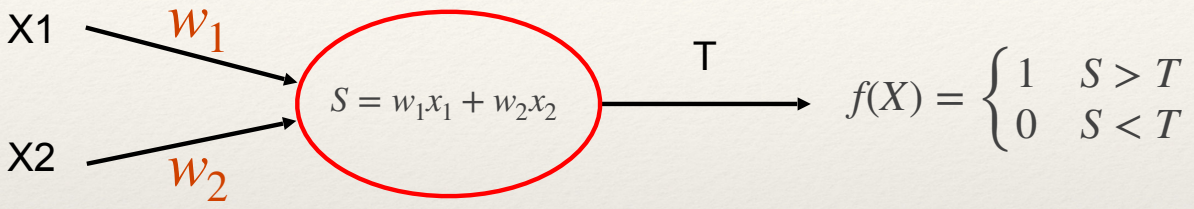
(Counter) Example: the XOR gate



X1	X2	Output	S
1	1	0	$w_1 + w_2$
1	0	1	w_1
0	1	1	w_2
0	0	0	0

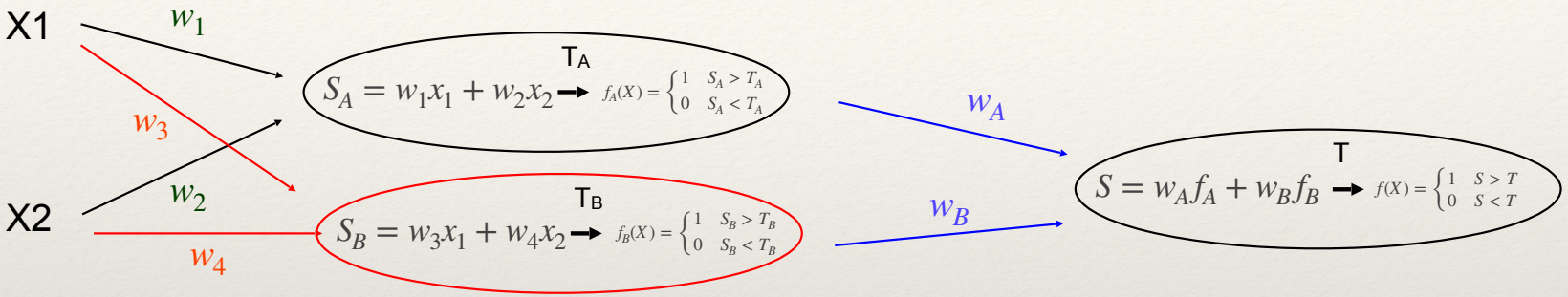
Cannot find a solution with a "simple" perceptron

(Counter) Example: the XOR gate



X1	X2	Output	S
1	1	0	$w_1 + w_2$
1	0	1	w_1
0	1	1	w_2
0	0	0	0

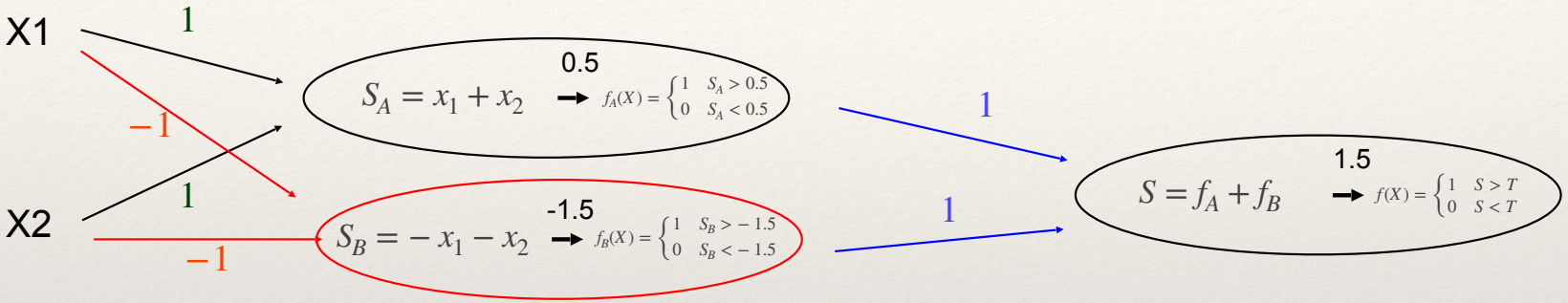
A more complex network for the XOR gate



"Hidden layer" *"Output layer"*

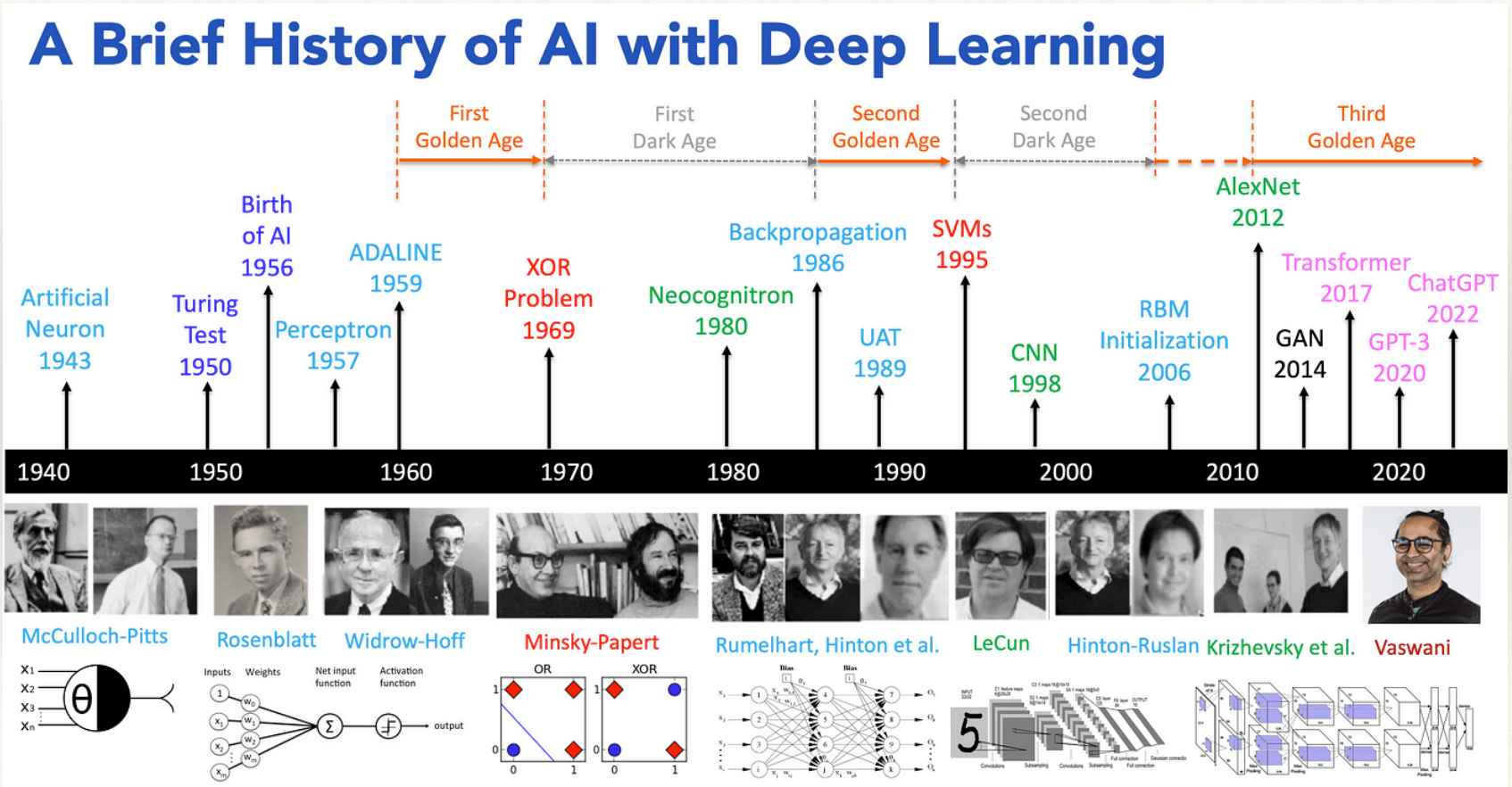
X1	X2	Output	S_A	S_B	S
1	1	0	$w_1 + w_2$	$w_1 + w_2$	$w_Af_A + w_Bf_B$
1	0	1	w_1	w_1	$w_Af_A + w_Bf_B$
0	1	1	w_2	w_2	$w_Af_A + w_Bf_B$
0	0	0	0	0	$w_Af_A + w_Bf_B$

A more complex network for the XOR gate

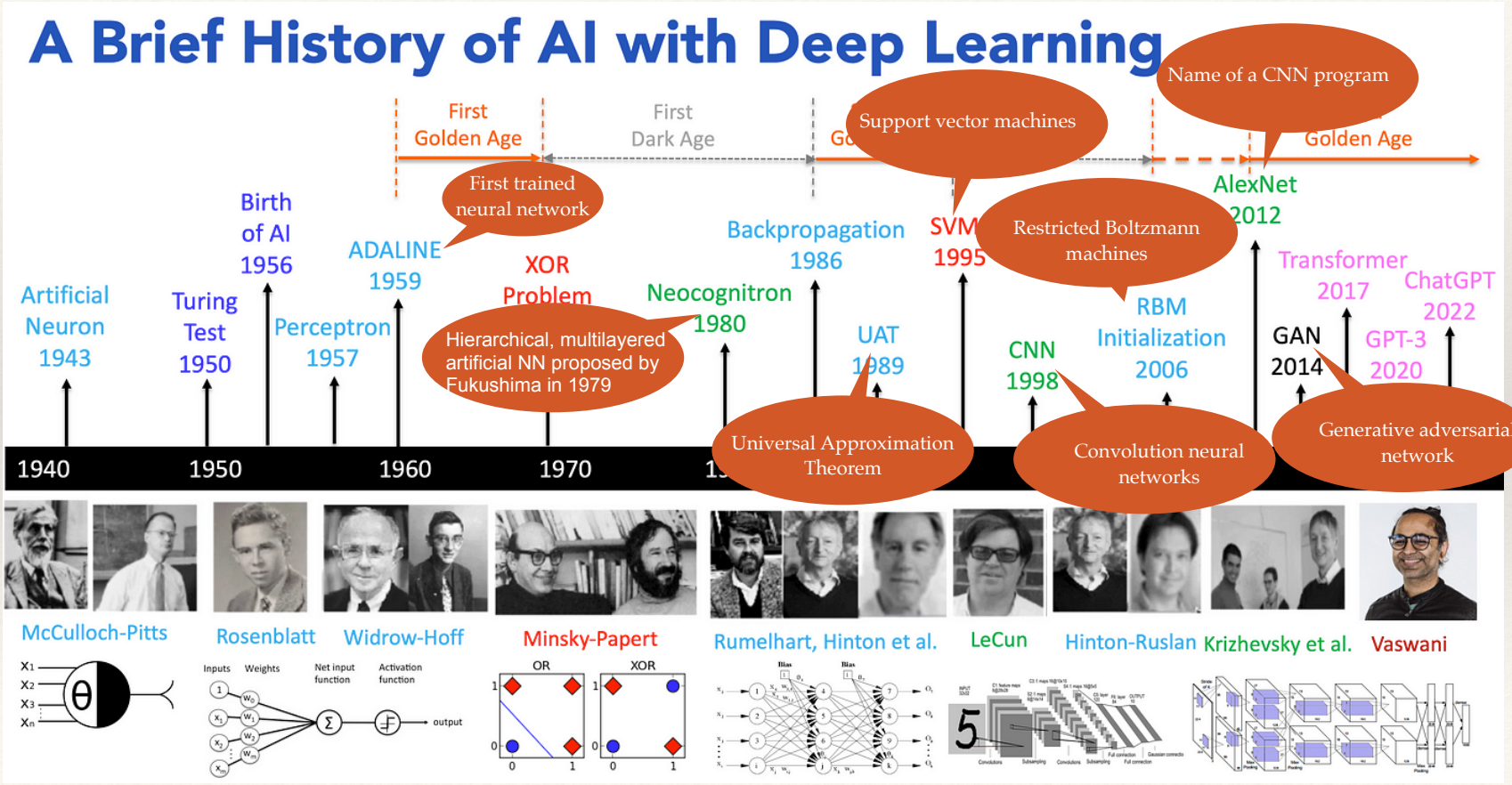


X1	X2	Output
1	1	0
1	0	1
0	1	1
0	0	0

A brief history of AI



A brief history of AI



AI

AI can be broadly categorized into three main types based on capabilities and complexity:

1. **Narrow AI (Weak AI)**: This is AI designed to perform a specific task or a set of tasks, often excelling in one domain but unable to operate outside of it. Examples include facial recognition, recommendation systems, and language translation.

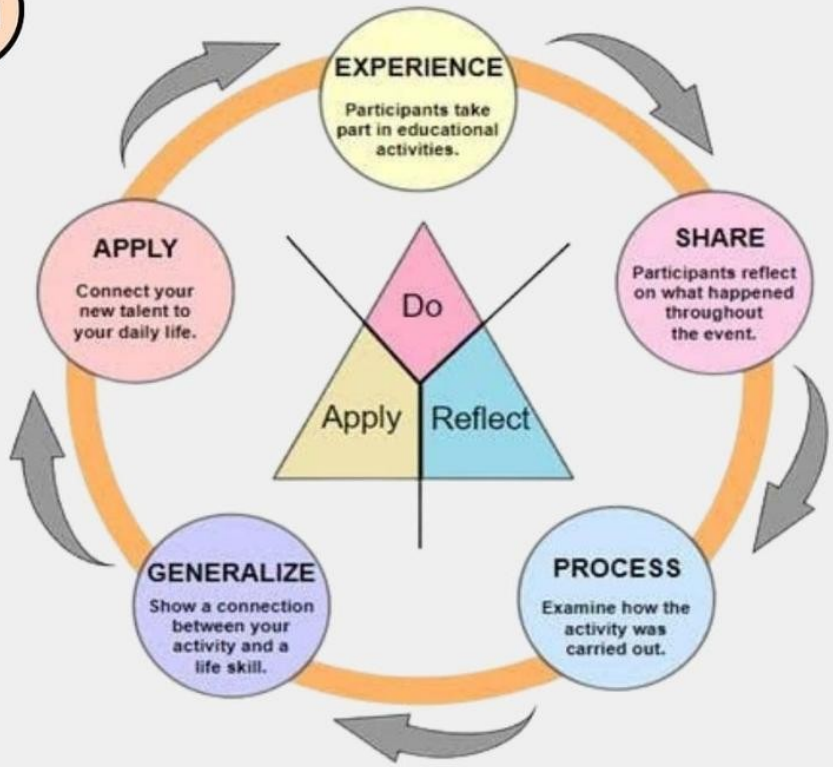
2. **General AI (Strong AI)**: General AI refers to an AI system with the ability to understand, learn, and apply knowledge across various tasks at the level of human intelligence. It would be capable of reasoning, problem-solving, and adapting to new situations. General AI remains theoretical and doesn't yet exist

3. **Superintelligent AI**: This hypothetical type of AI would surpass human intelligence in all aspects, including creativity, problem-solving, and emotional intelligence. It could perform any intellectual task better than humans.

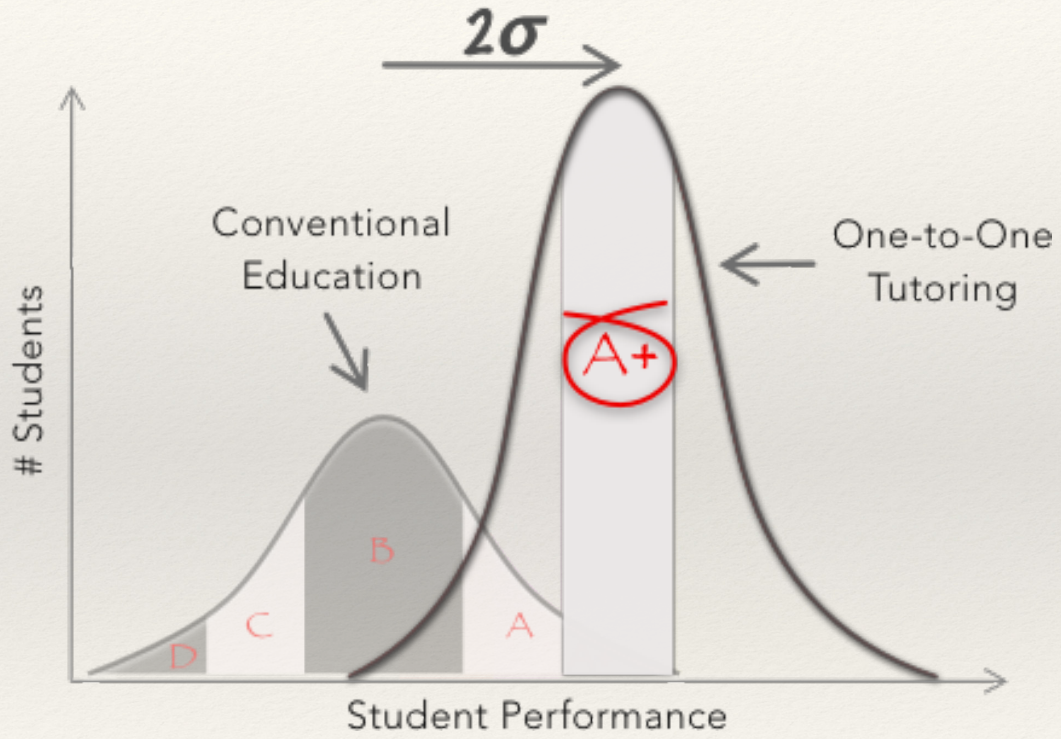
Education models

Pragmatism

- 1870s
- Charles Sanders Peirce,
- William James, and
- John Dewey

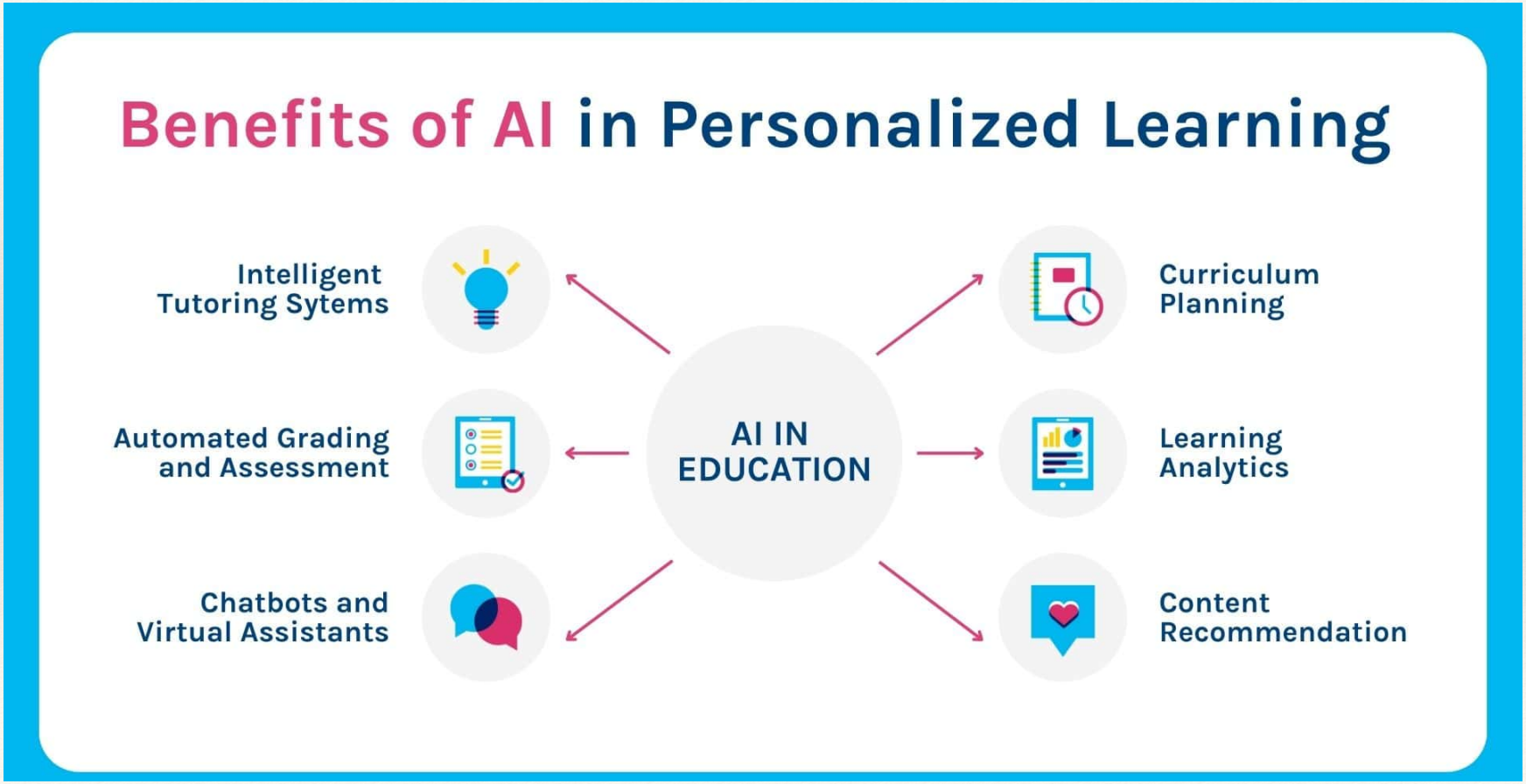


Education models



Bloom, the 2 sigma problem (1984)

Benefits of AI



Cartoon of the day

By the way, ChatGPT misspelled your name.

AI and education

- Who benefits from AI in education? Who might be left behind?
- What happens to student data when using AI tools?
- How does AI reshape the teacher-student relationship?
- What constitutes academic integrity in an AI-enhanced classroom?

AI and education

1. **Privacy and Data Security**: AI systems in education often rely on student data for personalization and analysis. This raises concerns about how data is collected, stored, and used.

2. **Fairness and Bias**: AI systems trained on certain data can unintentionally reinforce biases. For instance, if an AI grading system is trained on past grades, it might carry forward biases in grading patterns that historically disadvantage certain groups.

3. **Student Autonomy**: While AI can support personalized learning and real-time feedback, it can also risk over-reliance on technology, possibly diminishing students' critical thinking and decision-making.

4. **Teacher Roles and Accountability**: AI might be viewed as a replacement for certain teaching tasks, such as grading or tutoring.

5. **Accessibility and Equity**: While AI has potential to democratize access to resources, it also risks increasing inequality. Not all students have equal access to technology, so a focus on AI could widen the digital divide.