

Artificial Intelligence and Machine Learning

Subject Code : 21CS54

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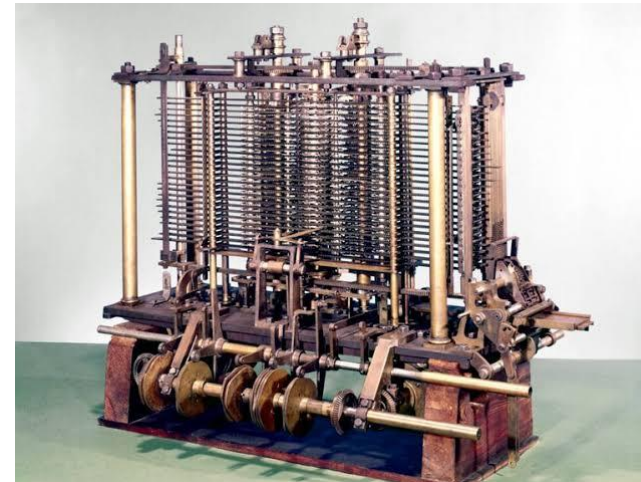
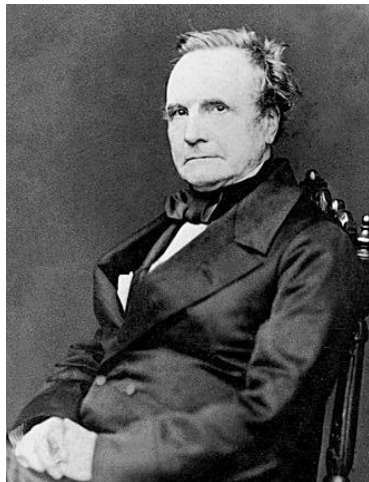


Module 1

A Brief History of AI

Charles Babbage an English mathematician and inventor, designed a difference machine in 1820s that computes **polynomial co-efficients**.

That it operates on **discrete digits** rather than **smooth quantities**, and the digits were decimal(0-9), represented by position of **toothed wheels**.



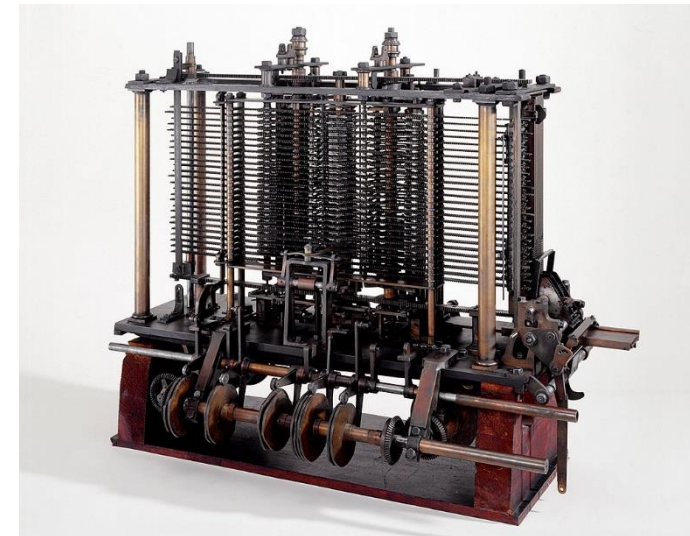
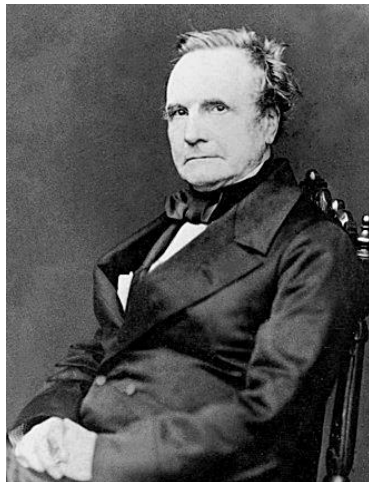
A Brief History of AI



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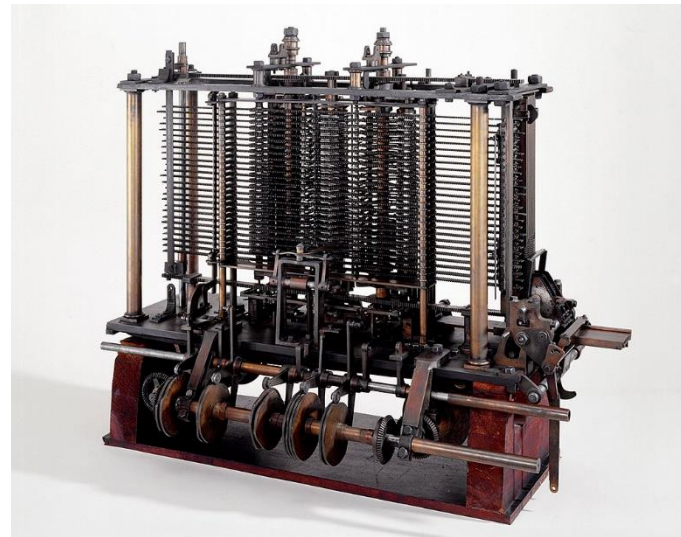
Charles Babbage an English mathematician and inventor, designed a difference machine in 1820s that computes **polynomial co-efficients**.

Analytical Engine (AE, 1837): Proposed general-purpose computer; integrating loops, memory, logic unit (Turing-complete machine).



A Brief History of AI

The analytical engine incorporated an arithmetic logic unit, control flow in the form of conditional branching and loops, and integrated memory, making it the first design for a general-purpose computer that could be described in modern terms as Turing-complete



A Brief History of AI



The History of Artificial Intelligence

The gestation of artificial intelligence(1943-1955)

The first work was done by **Warren McCulloch** and **Walter Pitts(1943)**

They proposed a model of artificial neurons in which each neuron is characterized as being “on” or “off”

Boolean circuit of neuron.

The History of Artificial Intelligence

The gestation of artificial intelligence(1943-1955)

Donald Hebb(1949) demonstrated a simple updating rule for modifying the connection strengths between neurons.

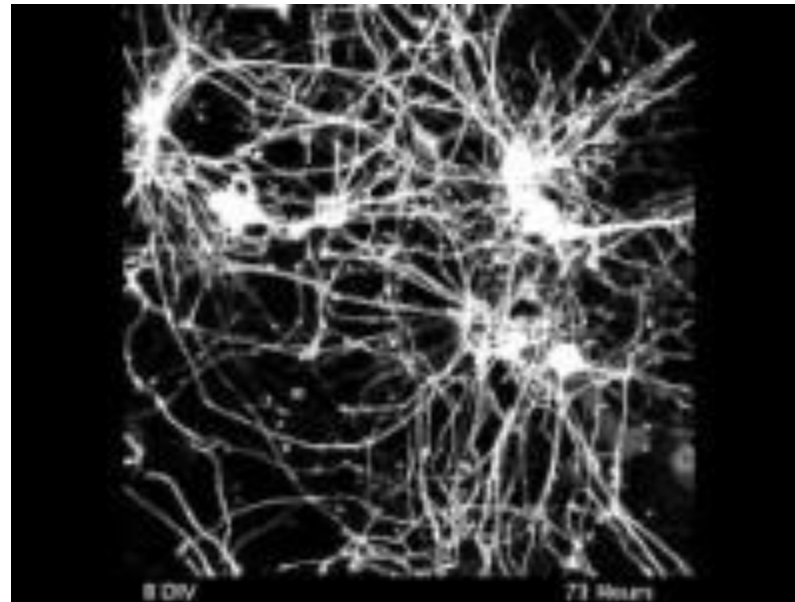
This is the **Hebbian Rule**

If two interconnected neurons on either side of a synapses are both on or fired at the same time(synchronously). The synaptic weight between them should be increased.

The History of Artificial Intelligence

The gestation of artificial intelligence(1943-1955)

The neurons that fire together, wire together.



The History of Artificial Intelligence

The gestation of artificial intelligence(1943-1955)

The neurons that fire together, wire together.



The History of Artificial Intelligence

The gestation of artificial intelligence(1943-1955)

Marvin Minsky and **Dean Edmonds**, built the first **neural network computer** in **1950**.

They used 3000 vacuum tubes, and a surplus automatic pilot mechanism from a B-24 bomber to simulate a network of 40 neurons.

In 1950, **Alan Turing** introduced “**Computing Machinery and Intelligence**”. Designed the Turing Test, machine learning, genetic algorithms, and reinforcement learning.

The History of Artificial Intelligence

The birth of artificial intelligence(1956)

John McCarthy proposed the study that every aspect of learning or any other **feature of intelligence** can in principle be so precisely described that a **machine can be made to simulate** it.

Newell and Simon already had a reasoning program, the **Logic Theorist (LT)**, about which Simon claimed, “We have invented a computer program capable of thinking non-numerically, and thereby solved the venerable mind–body problem”.

The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)

Newell and Simon's early success was followed up with the **General Problem Solver or GPS**. This program was designed from the start to **imitate human problem-solving protocols**. Thus, GPS was probably the first program to embody the “thinking humanly” approach.

At IBM, Nathaniel Rochester and his colleagues produced some of the first AI programs. Herbert Gelernter (1959) constructed the **Geometry Theorem Prover**, which was able to prove theorems that **many students of mathematics** would find quite tricky.

The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)

In 1952, Arthur Samuel wrote a series of programs for **checkers (draughts)** that eventually learned to play at a strong amateur level.

In 1958, MIT AI Lab Memo No. 1, **McCarthy defined the high-level language Lisp**, which was to become the dominant AI programming language for the next 30 years.

The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)

Minsky supervised a series of students who chose limited problems that appeared to require intelligence to solve. These limited domains became known as **microworlds**.

James Slagle's SAINT program (1963) was able to solve closed-form calculus integration problems typical of first-year college courses.

Tom Evans's ANALOGY program (1968) solved geometric analogy problems that appear in IQ tests.

Daniel Bobrow's STUDENT program (1967) solved algebra story problems.

The History of Artificial Intelligence

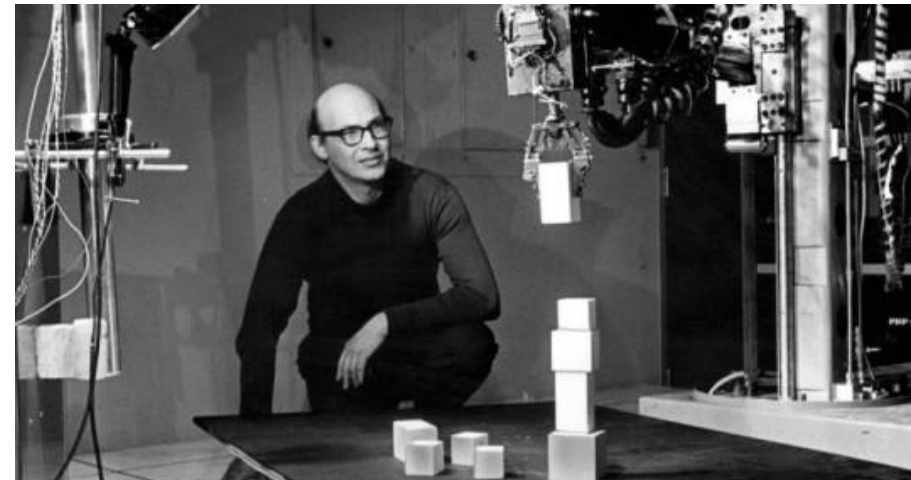
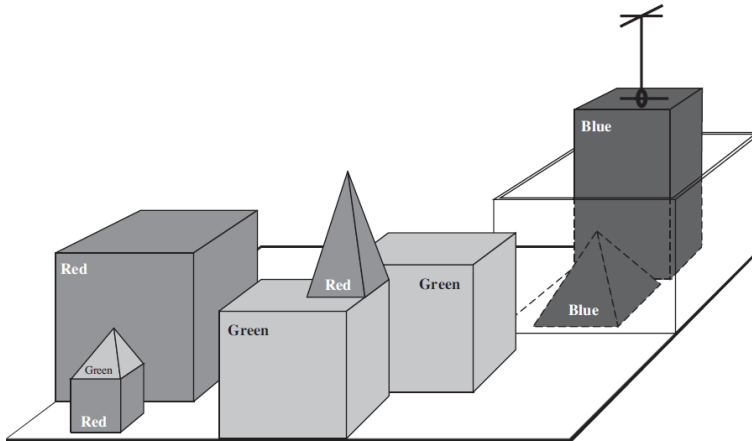
Early enthusiasm, great expectations (1952–1969)

The most famous microworld was the blocks world, which consists of a set of solid blocks placed on a tabletop (or more often, a simulation of a tabletop).

A typical task in this world is to rearrange the blocks in a certain way, using a robot hand that can pick up one block at a time.

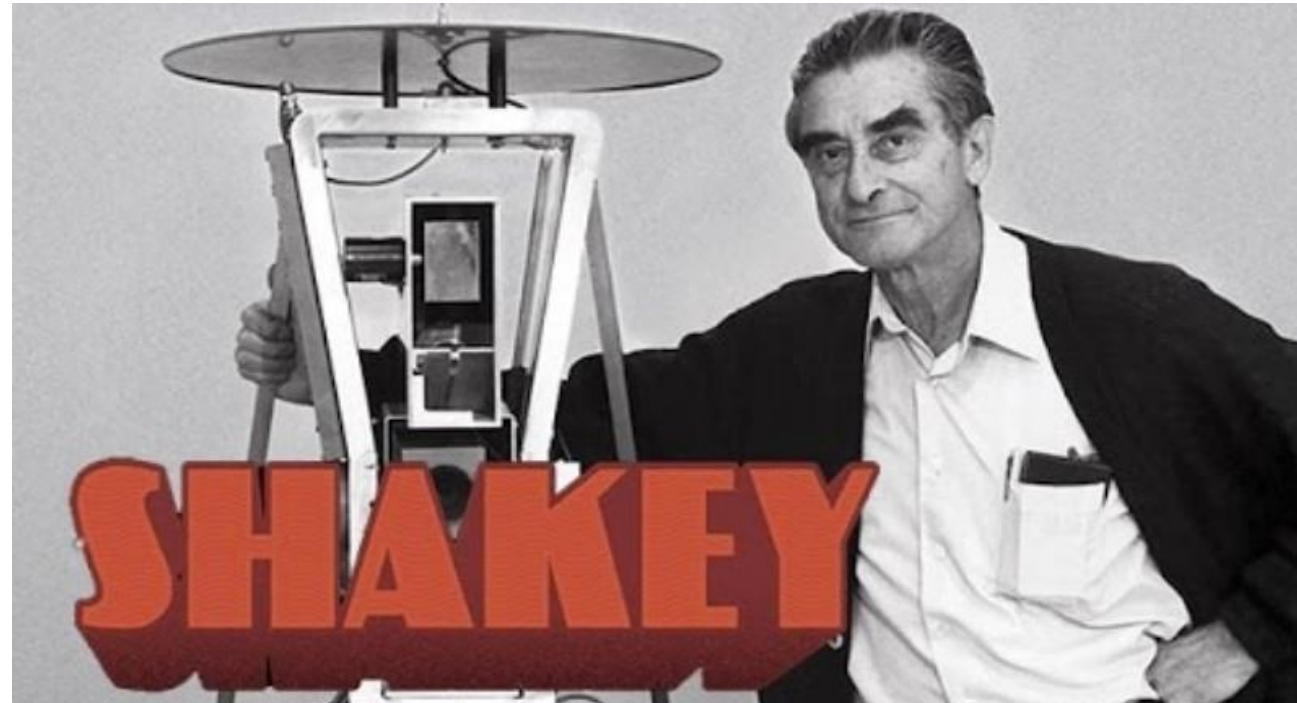
The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)



The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)



The History of Artificial Intelligence

Early enthusiasm, great expectations (1952–1969)

Hebb's learning methods were enhanced by Bernie Widrow (Widrow and Hoff, 1960; Widrow, 1962), who called his networks **adalines**, and by **Frank Rosenblatt (1962)** with his **perceptrons**.

The **perceptron convergence theorem** (Block *et al.*, 1962) says that the learning algorithm can adjust the connection strengths of a perceptron to match any input data, provided such a match exists.

The History of Artificial Intelligence

A dose of reality (1966–1973)

- Early **machine translation** efforts to speed up the translation of **Russian scientific papers** in the wake of the Sputnik launch in 1957.
- The fact is that accurate translation requires background knowledge in order to resolve ambiguity and establish the content of the sentence.

The History of Artificial Intelligence

AI Winter (1966-1973)

Rosenblatt (1962) proved that the **perceptron learning rule** converges to correct **weights** in a **finite number of steps**, provided the training examples are linearly separable.

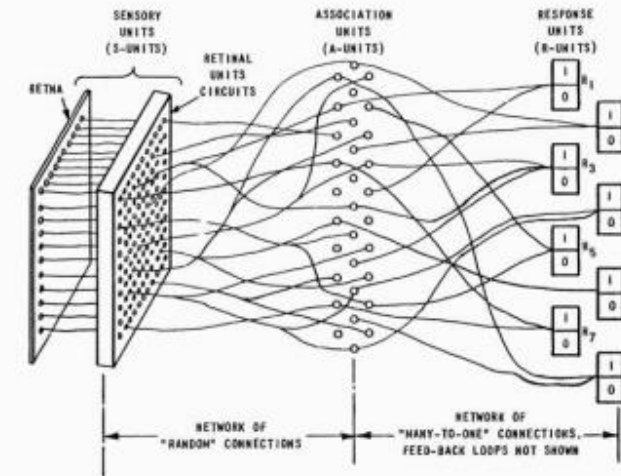


Figure 1 ORGANIZATION OF THE MARK I PERCEPTRON

The History of Artificial Intelligence

AI Winter (1966-1973)

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

Later it was shown that by using continuous activation functions (rather than thresholds), a fully connected network with a single hidden layer can in principle represent any function (UAT (1989): universal approximation theorem). The well-known backpropagation algorithm (essential to deep learning) algorithm was later “rediscovered” by Hinton et al.

The History of Artificial Intelligence

AI adopts the scientific method (1987–present)

In recent years, approaches based on **Hidden Markov models** (HMMs) have come to dominate the area. Two models aspects of HMMs are relevant.

A Hidden Markov Model (HMM) is a probabilistic model that consists of a sequence of hidden states, each of which generates an observation