Unit I

Introduction to Artificial Intelligence

(6 Hours)

1.1 Introduction to AI, AI Perspectives: Acting and thinking humanly, Acting and thinking rationally

1.2 Scope of AI

> *1.2.1. Game Playing*

> *1.2.2. Problem Solving:*

> *1.2.3. Natural Language Processing*

> *1.2.4. Robotics*

> *1.2.5. Computer Vision*

> *1.2.6. Expert Systems*

1.3 Turing Machine and Turing Test

1.4. Intelligent Agents, Structure of Intelligent agent, Properties of Intelligent Agents
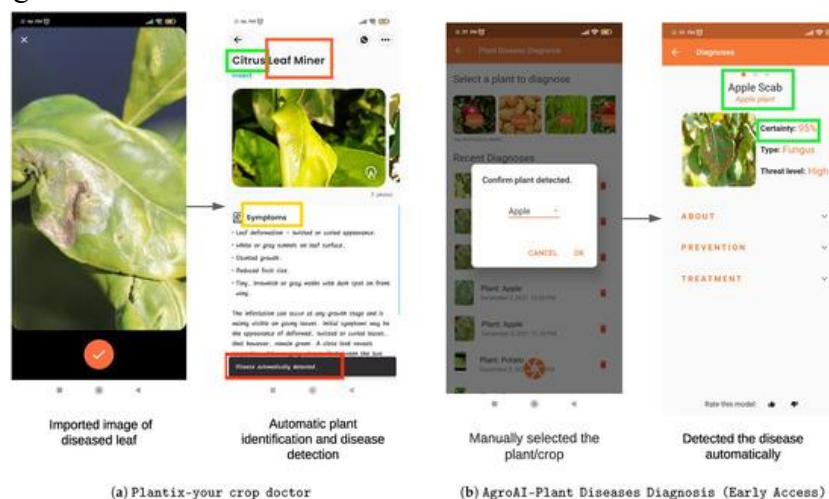
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Case Example: "SmartFarm AI – Helping a Farmer with Artificial Intelligence"

1. Ramesh is a farmer in Nepal.
2. He grows tomatoes, potatoes, and rice on his small farm.
3. Every year, he faces problems with plant diseases.
4. Sometimes his crops get damaged before he even notices it.
5. He loses a lot of money due to late detection of crop disease.
6. He wishes he could get early warnings before his plants die.
7. One day, his friend tells him about **SmartFarm AI**, a mobile app that uses Artificial Intelligence.
8. The app can identify plant diseases from photos taken by the farmer.
9. Ramesh decides to try it out.
10. He opens the app and takes a photo of an infected tomato leaf.
11. The app immediately analyzes the photo.
12. It detects brown spots and discolored edges on the leaf.
13. Within a few seconds, it says:
14. "Your plant may have *Early Blight* disease."
15. It also shows what medicine to use and how to prevent it next time.
16. Ramesh is surprised and happy.
17. He realizes this is **Artificial Intelligence** at work.
18. But what exactly is happening inside the app?
19. Let's break it down to understand how AI helps Ramesh.

Part 1: How the AI Works

20. The app uses a **camera** (sensor) to capture the image.
21. The photo is sent to a computer model trained on thousands of leaf images(ML).
22. The model has learned from **past data** to recognize patterns of healthy and infected leaves.
23. The computer compares Ramesh's leaf with known examples in its database.
24. It uses a **machine learning algorithm** to predict the disease.
25. The algorithm gives a result: "Early Blight, 95% confidence."
26. It then generates suggestions and sends them back to Ramesh's phone.
27. The app acts as an **intelligent agent** — it perceives, thinks, and acts.
28. The AI doesn't just see colors; it interprets meaning — like a human would.
29. It has learned from experience, not by being told every rule manually.
30. That's what makes it "intelligent."

(a) Plantix-your crop doctor

(b) AgroAI-Plant Diseases Diagnosis (Early Access)

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31. If a human expert saw the leaf, he would:
32. Observe the color and texture.
33. Recall past experiences of plant diseases.
34. Think logically and emotionally ("I've seen this disease before").
35. Then decide which treatment to apply.
36. The AI system, on the other hand:
37. Doesn't have feelings or experience pain or stress.
38. It just processes the image mathematically.
39. It calculates similarity scores and probabilities.
40. It uses stored data and algorithms instead of emotions.
41. It works faster but only in the field it was trained for.
42. If the app is shown a banana leaf (not in its training data), it may fail.
43. So, humans are flexible and adaptive — AI is powerful but limited.

Part 3: Understanding AI Perspectives through this Case

1. Acting Humanly

44. The app acts like a human plant expert.
45. It observes the leaf, identifies the problem, and gives a solution.
46. Ramesh talks to it like a person — "What's wrong with my plant?"
47. The app responds naturally, like a conversation.
48. It passes the "acting humanly" test because Ramesh feels like he's talking to an expert.

2. Thinking Humanly

49. The AI "thinks" by simulating how a human reasons.
50. It doesn't just store pictures — it looks for patterns and causes.
51. For example, it identifies that brown spots usually mean fungus.
52. It has learned cause-and-effect relationships like humans do.
53. It "thinks" but without emotions or fatigue.

3. Acting Rationally

54. The AI tries to choose the best action for the situation.
55. It doesn't panic or guess randomly.
56. It analyzes data and selects the most effective disease treatment.
57. That's rational action — doing what maximizes success.
58. Humans might hesitate or delay, but AI acts immediately.

4. Thinking Rationally

59. The app uses logic and rules behind the scenes.
60. For example:

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61. IF leaf has dark circular spots AND yellow edges, THEN disease = Early Blight.
62. These are logical rules that follow the "laws of thought."
63. It reasons step by step to reach a conclusion.

Part 4: Inside the Intelligent Agent

64. The app behaves as an **Intelligent Agent**.
65. It perceives the environment using its camera.
66. It reasons using algorithms and learned knowledge.
67. It acts by giving the user advice and actions.
68. It can even improve with feedback — a key property of learning agents.
69. Over time, as more farmers use the app, the model becomes smarter.

Agent Components:
70. **Sensor** → Camera (captures leaf image)
71. **Processor** → AI model (analyzes the data)
72. **Actuator** → App interface (shows diagnosis and advice)

Properties:
73. Autonomy — works on its own.
74. Reactivity — responds to user input quickly.
75. Proactiveness — gives preventive advice before diseases occur.
76. Rationality — chooses best solution with available information.
77. Learning — improves through continuous data updates.

Part 5: How AI Learns Like a Student

78. AI learning is similar to how a student studies for exams.
79. Suppose you show a student 100 pictures of diseased leaves.
80. The student learns to recognize patterns — shapes, colors, textures.
81. Then you test them with a new image.
82. If they recognize it correctly, they've learned.
83. Similarly, AI uses "training data" and "testing data."
84. The more examples it sees, the better it gets.
85. But unlike humans, AI can learn from **millions of examples** in minutes.

Part 6: Expanding AI in the Farm

86. SmartFarm AI doesn't stop at disease detection.
87. It also uses AI to predict **weather conditions**.
88. It combines data from satellites and local sensors.
89. The AI forecasts rainfall, temperature, and humidity.

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90. It alerts Ramesh: "Heavy rain tomorrow, avoid spraying chemicals."

91. It helps him plan his work smarter.

92. The AI is like a "digital assistant farmer."

Part 7: How Humans and AI Work Together

93. Humans have **intuition** and **creativity**.

94. AI has **data and computation power**.

95. Together, they form a strong partnership.

96. Ramesh still decides what to do, but the AI helps him make better choices.

97. The AI learns patterns faster, but Ramesh knows his farm better.

98. So both intelligence types complement each other.

Part 8: Advantages of AI in this Case

99. Early detection of diseases.

100. Saves time and effort.

101. Reduces crop loss and increases productivity.

102. Provides consistent advice without fatigue.

103. Works 24/7 and improves continuously.

Part 9: Limitations of AI

104. Depends on quality of data and internet connection.

105. May fail if shown something completely new.

106. Cannot replace human judgment or creativity.

107. Needs updates and maintenance regularly.

108. May be costly for small farmers initially.

Part 10: Learning from the SmartFarm Example

109. Through this example, we can understand AI concepts easily.

110. It shows **AI is not magic**, it's logic and learning combined.

111. Machines are powerful because they follow rules without getting tired.

112. But they lack feelings and social understanding.

113. Humans, on the other hand, can feel empathy and make moral decisions.

114. The goal of AI is not to replace humans but to assist them.

115. AI augments human intelligence — not competes with it.

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116.   SmartFarm AI acts humanly — like an agricultural expert.
117.   It thinks humanly — by recognizing disease patterns.
118.   It acts rationally — choosing the best solution.
119.   It thinks rationally — using logical rules.
120.   It behaves like an intelligent agent with perception, reasoning, and action.
121.   The Turing Test concept can be applied — if Ramesh can't tell if advice came from a person or AI, it's intelligent.
122.   This is how AI makes real-world impact.
123.   Farmers, doctors, teachers, and engineers can all use AI tools similarly.

In Summary

124.   Humans and AI are both intelligent in their own ways.
125.   Humans are creative, emotional, and adaptive.
126.   AI is logical, fast, and precise.
127.   Together, they can solve big problems — like hunger, disease, and education.
128.   Ramesh's SmartFarm AI shows how intelligence can be shared between man and machine.
129.   Artificial Intelligence is not just technology — it's the next step in human innovation.
130.   Understanding how AI works in simple examples helps us use it responsibly.

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OR

Evolution of Artificial Intelligence: From Alan Turing to Modern AI

Chief Events of World War II, 1939–45

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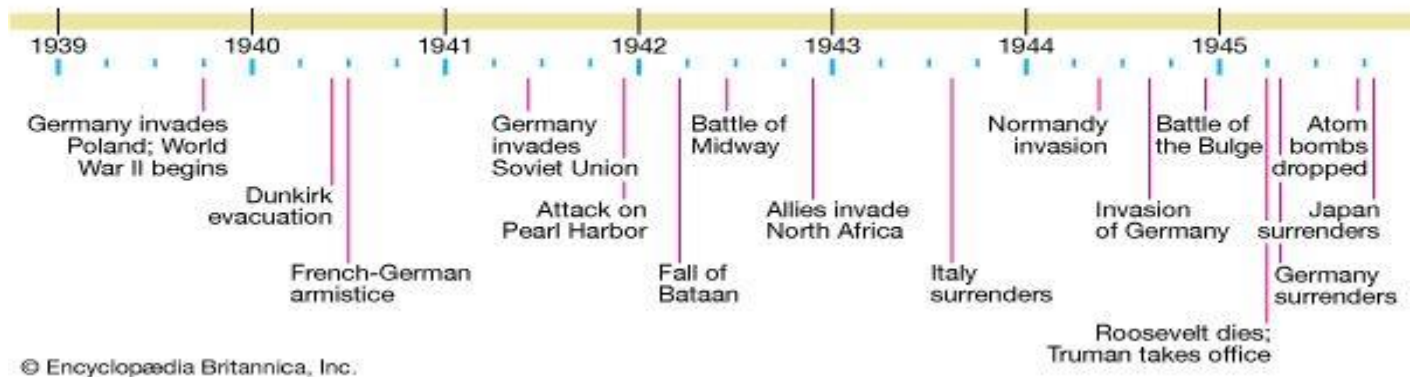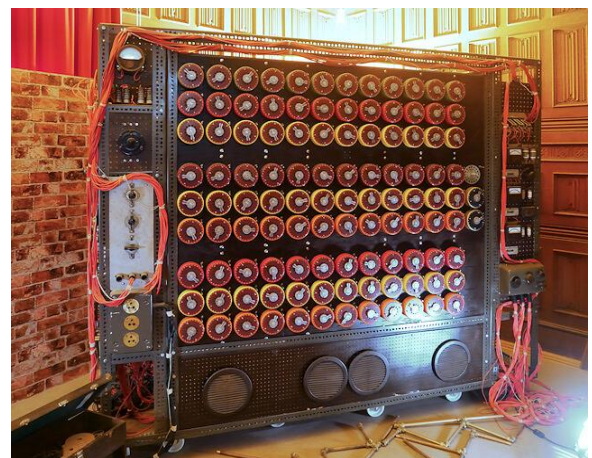
1. Early Foundations (1940s–1950s)

Alan Turing and the Birth of AI Thought

- **Alan Turing (1912–1954)** – British mathematician, considered the *Father of Theoretical Computer Science and AI*.

- During **World War II**, he worked at **Bletchley Park** to decrypt German codes.

- Built the **Bombe Machine**, which cracked the **Enigma cipher**, helping the Allies win the war.

- Proposed the concept of a **"Universal Machine" (Turing Machine)** in 1936 — a model for any computation.

- In 1950, introduced the **Turing Test** – a benchmark for whether a machine can *think like a human*.
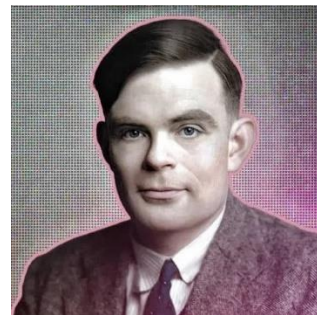
💡 *Turing's vision connected logic, computation, and cognition — laying the foundation of AI.*
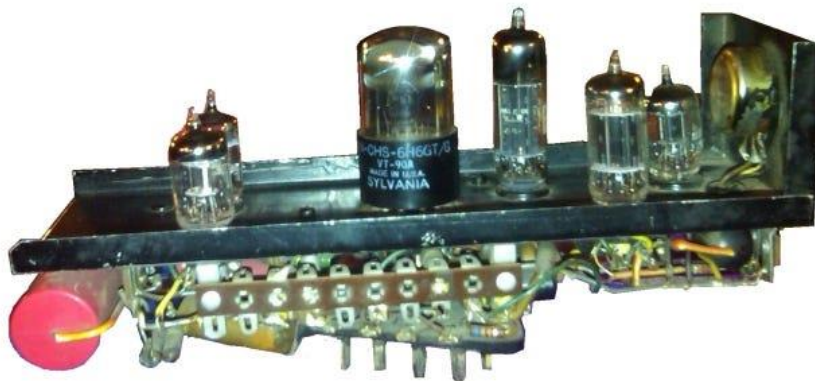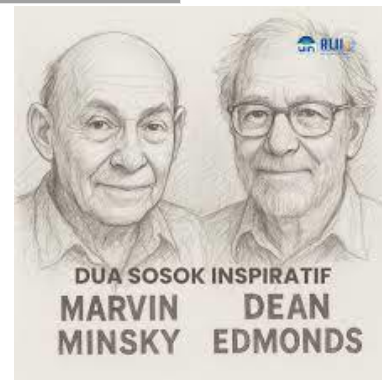

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✤ McCulloch and Pitts (1943)

- **Warren McCulloch** and **Walter Pitts** published *"A Logical Calculus of the Ideas Immanent in Nervous Activity."*

- First mathematical model of **artificial neurons** — described how simple binary neurons could perform logical reasoning.

- Drew from **neurobiology**, **mathematical logic**, and **philosophy of mind**.

- Marked the beginning of the **neural-network concept** in AI.
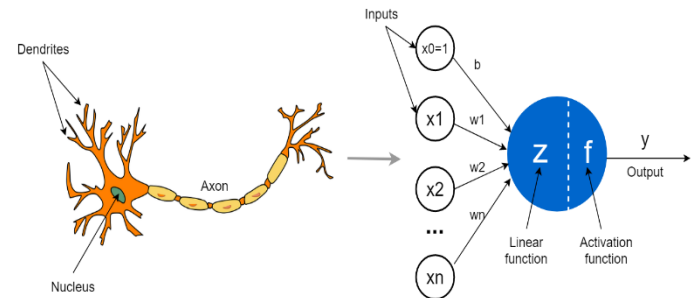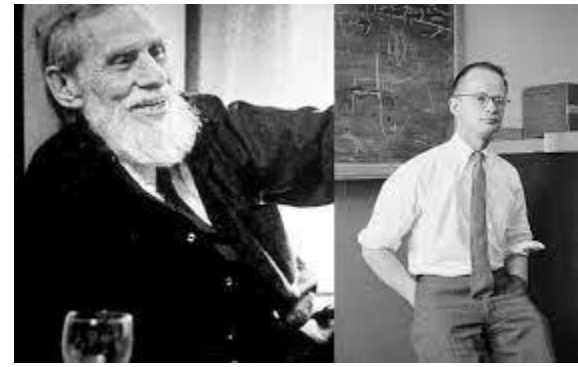
⚙ Marvin Minsky and Dean Edmonds – The SNARC (1951)

- Built **SNARC (Stochastic Neural Analog Reinforcement Calculator)** — the **first physical neural-network computer**.

- Simulated how a rat learns a maze using **reinforcement learning** and 3,000 vacuum tubes.

- Showed that machines could **learn from experience** — the first step toward **machine learning**.

DUA SOSOK INSPIRATIF
MARVIN MINSKY   DEAN EDMONDS

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- **Year:** 1956 — considered the official **birth of Artificial Intelligence**.

- **Organizer: John McCarthy**, who coined the term **"Artificial Intelligence."**

- **Event:** *Dartmouth Summer Research Project on AI* at Dartmouth College, New Hampshire.

- **Key Participants:** John McCarthy, Marvin Minsky, Claude Shannon, Nathaniel Rochester.

- **Goal:** To explore how machines could **simulate learning, reasoning, and understanding.**
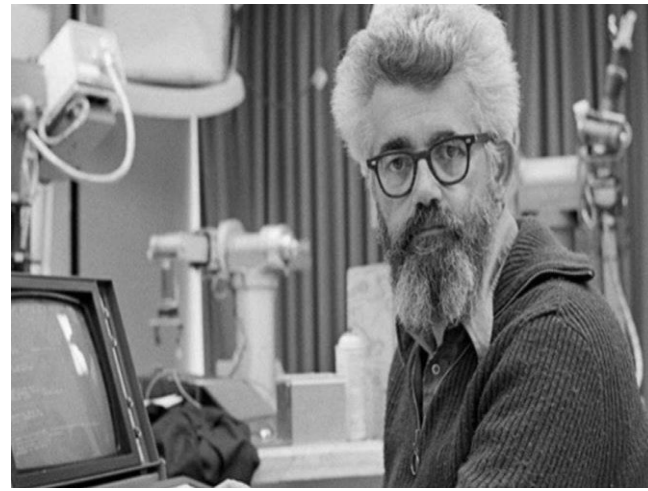
💬 *This conference made AI an academic discipline and inspired the creation of the first AI labs (MIT & Stanford).*
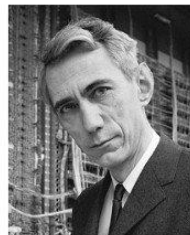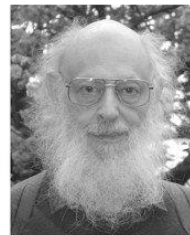

**1956 Dartmouth Conference:
The Founding Fathers of AI**

John MacCarthy — Marvin Minsky — Claude Shannon — Ray Solomonoff — Alan Newell

Herbert Simon — Arthur Samuel — Oliver Selfridge — Nathaniel Rochester — Trenchard More
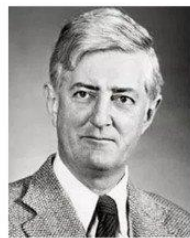
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◆ **3. Early Growth and the First AI Winter (1960s–1970s)**

- Early programs like **ELIZA** (chatbot), **SHRDLU** (language understanding), and **General Problem Solver** showed initial promise.

- However, **limited computing power** and **overhyped expectations** led to the **First AI Winter (1974–1980)**.

- **Lighthill Report (1973, UK)** criticized AI for lack of progress → funding cuts.

🧊 *AI enthusiasm cooled as projects failed to meet human-level expectations.*

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```
Welcome to
         EEEEEE  LL       IIII   ZZZZZZ   AAAAA
         EE      LL        II        ZZ  AA   AA
         EEEEE   LL        II       ZZZ  AAAAAAA
         EE      LL        II      ZZ    AA   AA
         EEEEEE  LLLLLL   IIII  ZZZZZZ   AA   AA

 Eliza is a mock Rogerian psychotherapist.
 The original program was described by Joseph Weizenbaum in 1966.
 This implementation by Norbert Landsteiner 2005.


ELIZA: Is something troubling you ?
YOU:   Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU:   They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU:   Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU:   He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU:   It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU:
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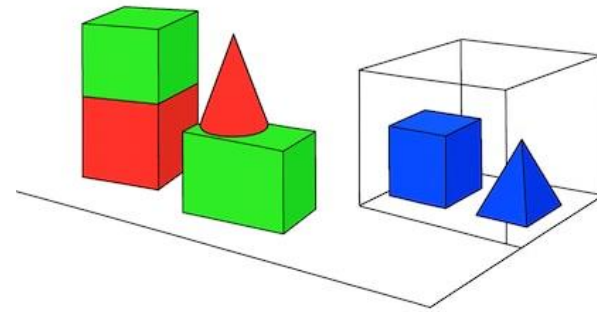
◆ 4. AI Revival: Expert Systems Boom (1980s)

- AI regained popularity with **Expert Systems** — programs that simulated **human expert reasoning**.

- **Examples:**

  o **MYCIN** (medical diagnosis)

  o **DENDRAL** (chemical analysis)

  o **XCON** (Digital Equipment Corp., computer configuration)

- These systems used **if-then rules** and **knowledge bases** to make domain-specific decisions.

- Became profitable in business → major commercial adoption.
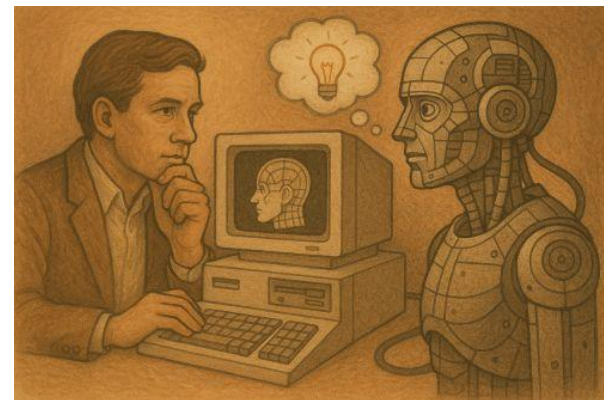
💡 *Expert systems marked the first industrial success of AI.*

◆ 5. The Second AI Winter (Late 1980s–1990s)

- **Causes:**

  o High maintenance cost of rule-based systems.

  o Lack of learning or adaptability.

  o Overhyped expectations and market collapse.

- Resulted in **loss of funding** and a second slowdown in AI research.

📦 *AI progress slowed again — but new foundations in statistics, data, and algorithms were forming.*

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◆ 6. Modern AI Milestones (1997–2018)

♟ 1997 – IBM Deep Blue Defeats Garry Kasparov

- IBM's **Deep Blue** beats world chess champion **Garry Kasparov**.

- Used massive parallel processing and search algorithms.

- First time a machine outperformed a human in strategic reasoning.

🚗 2005 – Stanford's "Stanley" Wins DARPA Grand Challenge

- **Stanford University** team built **"Stanley,"** an autonomous vehicle that completed a 132-mile desert course.

- Combined LIDAR, GPS, radar, and machine learning.

- Proved that **AI can navigate the real world** safely.

💬 **2011 – IBM Watson Wins *Jeopardy!* **

- IBM's **Watson** AI beat human quiz champions Ken Jennings and Brad Rutter.

- Used **Natural Language Processing** and **Machine Learning**.

- Demonstrated AI's ability to understand and answer human language.

🧠 2015 – Deep Learning Breakthrough

- AI systems like **Google Inception v3** and **Microsoft ResNet** achieved **human-level accuracy** in image recognition.

- Error rate on ImageNet fell below 5%.

- Fueled by **neural networks, GPUs, and big data**.

- Sparked the **Deep Learning Revolution.**

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🎯 2016 – AlphaGo Defeats Lee Sedol

- **Google DeepMind's AlphaGo** beat the 18-time world Go champion Lee Sedol.

- Used **Deep Reinforcement Learning and Monte Carlo Tree Search**.

- Showed AI could exceed human intuition and strategic creativity.

💬 2018 – OpenAI and Large Language Models

- **OpenAI** introduced **GPT (Generative Pre-trained Transformer)**, based on Google's 2017 Transformer architecture.

- Model could **generate human-like text, summaries, translations, and conversations.**

- Marked the rise of **Large Language Models (LLMs)** and modern AI assistants like ChatGPT.
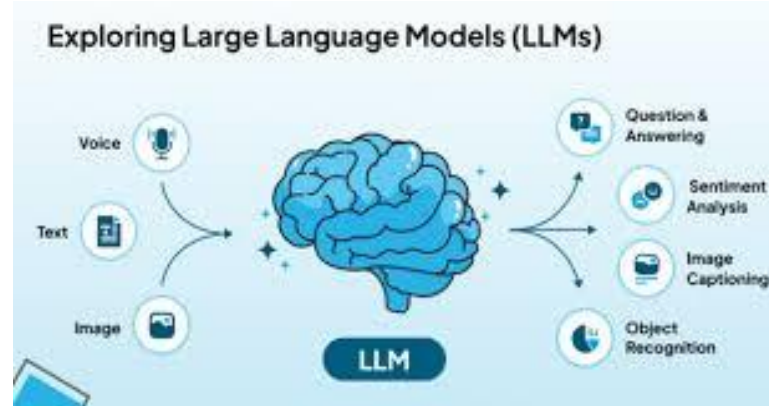
Era / Year	Milestone	Key Contribution
1943	McCulloch & Pitts Neural Model	First mathematical model of neurons
1951	SNARC – Minsky & Edmonds	First neural-network computer
1956	Dartmouth Conference – John McCarthy	Birth of AI as a field; term coined
1974–1980	First AI Winter	Funding cuts, limited progress
1980s	Expert Systems	First commercial AI boom
Late 1980s–1990s	Second AI Winter	Decline due to brittle systems
1997	IBM Deep Blue	Machine defeats human in chess
2005	Stanford DARPA Challenge	Autonomous vehicle success
2011	IBM Watson	Natural language AI victory
2015	Deep Learning Breakthrough	Image recognition at human level
2016	AlphaGo (DeepMind)	Strategic self-learning AI

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| 2018	OpenAI GPT	Rise of language intelligence

The Turing Test

The **Turing Test** is one of the earliest and most influential ideas in Artificial Intelligence (AI). It was proposed by **Alan Turing (1950)** in his paper *"Computing Machinery and Intelligence"*.

Turing introduced a practical question:

<div align="center">

"Can machines think?"

</div>

To answer it scientifically, he reframed it as an **"imitation game"** — a way to test whether a machine can **imitate human intelligence** convincingly enough to be indistinguishable from a human.
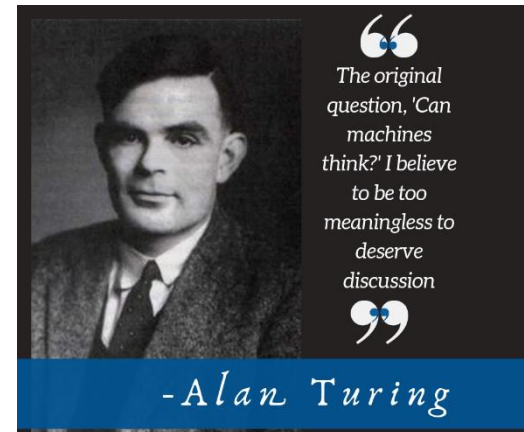
Concept of the Turing Test (The Imitation Game)

🎮 **The Setup**

- The test involves **three participants**:
    1. **A Human Interrogator (Judge)**
    2. **A Human Respondent**
    3. **A Machine (AI Program)**

- All participants communicate **through text only** (e.g., a chat terminal) — so that **appearance or voice** does not influence judgment.

- The **interrogator's task**: to ask any question and determine **which one is human** and **which is the machine**.
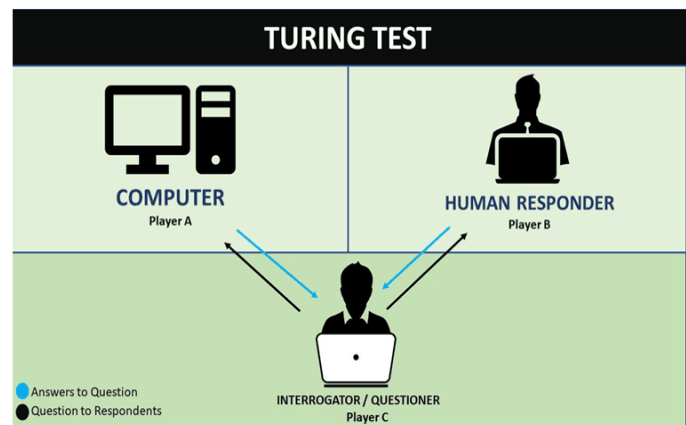
✳️ **The Rule**

If the **machine's answers** are so convincing that the human judge **cannot reliably distinguish** it from the human respondent,
then the machine is said to **have passed the Turing Test**.

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Objective of the Test
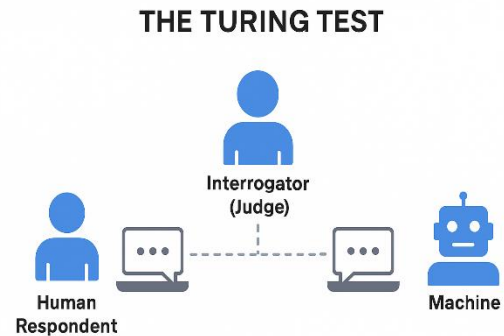
- To measure a machine's **ability to exhibit intelligent, human-like behavior**.

- Focuses on **behavioral intelligence** rather than the internal process.

- The test does **not require consciousness or emotion** — only the *appearance* of understanding.

THE TURING TEST

◆ **Example Scenario**

Imagine a judge chatting with two unseen entities (A and B):

Judge: What do you like to do in your free time?

> *A: I enjoy reading books and sometimes coding small games.*
>
> *B: I like watching cricket and chatting with friends.*
>
> *If **A** is a computer program and the judge **cannot tell**, then A has **passed the Turing Test**.*

Example	Description
ELIZA (1966)	A chatbot by *Joseph Weizenbaum* that simulated a psychotherapist. Many users thought it was human.
PARRY (1972)	Simulated a person with paranoid schizophrenia; passed limited Turing-style tests.
Eugene Goostman (2014)	A chatbot that simulated a 13-year-old boy; claimed to have fooled 33% of judges.
ChatGPT (2022– Present)	Modern large language model that produces highly human-like conversations — a near Turing-level AI.

💬 *While no system has perfectly passed the Turing Test under rigorous conditions, modern LLMs (like ChatGPT and GPT-4) come closest.*

Modern Relevance (Extra)

- The **Turing Test** remains a **symbolic milestone**, though AI today is measured differently — by performance in **tasks**, **learning ability**, and **generalization**.

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- **ChatGPT**, **Google Bard**, and **Anthropic Claude** have reached conversation quality where many users cannot distinguish them from humans.

- AI now extends beyond imitation to **reasoning, self-learning, and creativity**, going beyond Turing's original vision.

AI Perspectives (Approaches to Building Intelligent Systems)

According to **Russell and Norvig (2021)**, AI perspectives can be categorized into **four main approaches**, depending on whether the system aims to **think** or **act**, and whether it models **human** or **rational** behavior.

1) **Acting Humanly (The Turing Test Approach)**
2) **Thinking Humanly (Cognitive Modeling Approach)**
3) **Acting Rationally (Rational Agent Approach)**
4) **Thinking Rationally (Laws of Thought Approach)**

✴️ A. Acting Humanly (The Turing Test Approach)

- Focus: Systems that **behave like humans**.

- A machine is intelligent if it can **imitate human behavior** indistinguishably.

- AI behaves like a human — if people can't tell whether it's a human or a machine, it passes the Turing Test.

- Proposed by **Alan Turing (1950)** in his famous **Turing Test**.

  Example:

  - Chatbots like **ChatGPT**, **ELIZA**, or **Siri**, which can hold human-like conversations.

  Goal:

  - To replicate observable human behavior (speech, perception, reasoning).

🧠 B. Thinking Humanly (Cognitive Modeling Approach)

- Focus: Systems that **think like humans**.

- Attempts to **model human thought processes** and cognitive functions.

- AI tries to think the way humans think — by simulating how the human brain learns and solves problems.

- Based on psychology and neuroscience.

  Example:

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- *Neural networks* modeled after brain neurons, such as image recognition systems that "learn" patterns like humans.

- Cognitive AI systems that simulate human memory and learning — e.g., **ACT-R cognitive model**, **neural networks** modeled after the brain.

Goal:

- Understand how humans think and replicate that process in machines.

⚙ C. Acting Rationally (Rational Agent Approach)

- Focus: Systems that **act to achieve the best outcome** based on logic and data.

- AI acts to achieve the best possible result or goal logically — not necessarily like a human, but optimally.

- Rational agents perceive their environment and act to maximize performance.

- Emphasizes **decision-making and goal achievement** rather than mimicry.

  Example:

  - **Autonomous drones** and **self-driving cars** making optimal navigation decisions.

  - **AI trading bots** that act to maximize profit.

  Goal:

  - Choose the best possible action for a given objective.

📊 D. Thinking Rationally (Laws of Thought Approach)

- Focus: Systems that **reason logically** like mathematicians or philosophers.

- AI makes decisions based on logical reasoning — using facts and rules to reach conclusions.

- Uses formal logic to derive conclusions from facts and rules.

- Foundation of **expert systems** and **rule-based AI**.

  Example:

  - *Medical expert systems* that use "if–then" logic to suggest correct diagnoses or treatments.

  - **MYCIN (1970s)** – Used logical rules to diagnose bacterial infections.

  - **Modern knowledge-based reasoning systems** in medical and legal domains.

  Goal:

  - Develop machines that can reason correctly using formal rules of inference.

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Introduction to Artificial Intelligence (AI)

Artificial Intelligence (AI) is a field of computer science that focuses on building systems capable of performing tasks that normally require **human intelligence** — such as **understanding language, recognizing patterns, learning from experience, reasoning, and making decisions.**

AI combines techniques from **mathematics, computer programming, data science, psychology, and neuroscience** to create machines that can think and act intelligently.
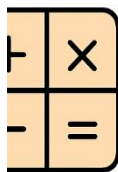
Mathematics   Computer Programming   Data Science   Psychology   Neuroscience

💡 **Examples**

- **Voice Assistants:** Siri, Alexa, and Google Assistant understand and respond to human speech.

- **Autonomous Vehicles:** Self-driving cars detect obstacles and make safe driving decisions.

- **Recommendation Systems:** Netflix and YouTube recommend content based on user behavior.

- **Chatbots:** AI systems like ChatGPT interact naturally with users.

Top 5 classic definitions of Artificial Intelligence (AI)

🧠 1 John McCarthy (1956) — *Father of Artificial Intelligence*

Definition: "Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs."

Meaning: AI combines science (understanding intelligence) and engineering (building systems that behave intelligently).
Focus: Building *intelligent behavior*, not just simulating it.

🧩 2 Marvin Minsky (1968)

Definition: "Artificial Intelligence is the science of making machines do things that would require intelligence if done by humans."

Meaning: AI is measured by what humans consider "intelligent tasks" — reasoning, learning, problem-solving.
Focus: Human-like task performance.

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⚙ 3 Elaine Rich (1983)

Definition: "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better."

Meaning: AI's goal is to close the gap between human and machine capabilities.
Focus: Progressive improvement — machines learning from humans.

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4 Stuart Russell & Peter Norvig (1995, 2021)

Definition: "AI is the study of agents that receive percepts from the environment and perform actions to achieve their goals."

Meaning: AI systems act rationally — sensing, thinking, and acting to maximize success.
Focus: *Rational agent* behavior — the foundation of modern AI.

✖ 5 Winston Patrick Henry (1992)

Definition: "Artificial Intelligence is concerned with computational understanding of intelligent behavior and the creation of machines that exhibit such behavior."

Meaning: AI aims to both understand *how intelligence works* and build *systems that display it.*
Focus: Understanding and replication of intelligence.

Scope of Artificial Intelligence

The **scope of AI** is vast and continuously expanding as technology evolves. It covers all areas where machines can assist, augment, or automate human tasks.

◆ **Major Areas of AI Scope**

Area	Description	Example Application
Machine Learning (ML)	Systems that learn automatically from data.	Predictive analytics, spam filters
Natural Language Processing (NLP)	Understanding and generating human language.	ChatGPT, Google Translate
Computer Vision	Interpreting images and videos.	Face recognition, medical imaging

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Area	Description	Example Application
Robotics	Designing intelligent robots for tasks.	Industrial robots, drones
Expert Systems	Rule-based systems that mimic expert decisions.	Medical diagnosis tools
Speech Recognition	Converting speech to text and responding.	Alexa, Siri
Planning and Reasoning	Making logical decisions for specific goals.	AI route planners, logistics
AI in Healthcare	Diagnosing diseases, analyzing medical data.	IBM Watson Health
AI in Agriculture	Predicting weather and crop yield.	Smart irrigation systems
AI in Education	Personalized learning and virtual tutoring.	Adaptive e-learning platforms

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Artificial Intelligence (AI) is a branch of computer science that focuses on creating machines capable of performing tasks that require human-like intelligence such as reasoning, learning, decision-making, perception, and understanding natural language.

Origin:

The term *Artificial Intelligence* was first introduced by **John McCarthy in 1956** during the Dartmouth Conference.
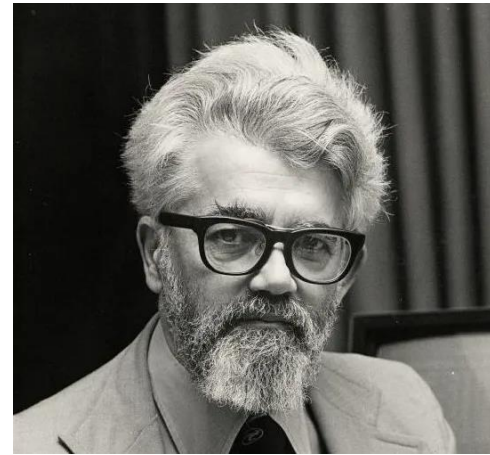
Objectives of AI:

- To build systems that can simulate human thinking and behavior.
- To design machines that can solve complex problems intelligently.
- To enable computers to learn from experience and adapt to new situations.
- To automate reasoning and improve human decision-making.

Examples of AI Applications:

- Virtual assistants (Siri, Alexa, Google Assistant)
- Self-driving cars
- Recommendation systems (Netflix, YouTube)
- Fraud detection in banking
- Smart home automation

AI Perspectives

Artificial Intelligence can be viewed from four main perspectives that describe how a system can behave or think intelligently.

1. Acting Humanly (The Turing Test Approach)

- Proposed by **Alan Turing (1950)**.
- Focuses on building systems that behave like humans.
- The **Turing Test** evaluates whether a machine can exhibit human-like behavior that is indistinguishable from a person.
- If a human evaluator cannot differentiate the machine's responses from a human's, the machine is said to possess intelligence.

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- Example: Chatbots or virtual assistants that communicate naturally with humans.

Key Idea:

If a machine can *act* humanly, it can be considered intelligent.

2. Thinking Humanly (The Cognitive Modeling Approach)

- Tries to model how humans think and reason.
- Involves understanding the human brain and replicating its functions using computational models.
- Often data from cognitive psychology and neuroscience is used.
- Example: Neural networks and cognitive architectures that mimic brain processing.

Key Idea:

AI should *think* the same way humans do — by replicating mental processes like learning and memory.

3. Acting Rationally (The Rational Agent Approach)

- Focuses on designing intelligent agents that act to achieve the best possible outcome in any given situation.
- A **rational agent** perceives its environment and takes actions to maximize performance or success.
- Example: Self-driving cars choosing the safest and most efficient path.

Key Idea:

Intelligence means choosing and executing the *best possible action* based on goals and knowledge.

4. Thinking Rationally (The Laws of Thought Approach)

- Based on the use of logic and reasoning to make decisions.
- Derived from the principles of philosophy and mathematics (e.g., Aristotle's logic).
- AI systems are designed to *reason correctly* using logical rules and formal proofs.
- Example: Expert systems that use rule-based reasoning to diagnose diseases.

Key Idea:

AI should *think logically and rationally* — following correct principles of reasoning to reach conclusions.

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