Unit 1: Introduction

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* Intelligence: Intelligence is the capacity to learn and solve problems, and act rationally like humans. It is the part of computer science concerned with designing intelligence computer systems.

* Artificial Intelligence:

→ Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

→ It is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence (thinking rationally & acting rationally)

→ Ex: Voice assistants like Siri, Alexa, & self-driving cars, conversational bots, recommendations in media streaming platforms and so on.

Some Perspectives of AI

1. Thinking Humanly & Acting Humanly.
2. Thinking Rationally and Acting rationally.

* Thinking Humanly (Cognitive modeling approach)

→ This requires "getting inside" of the human mind to see how it works and then compairing our computer programs to do this. This is what ~~cog~~ cognitive science attempts to do. Another way to do this is to observe a human problem solving & argue that one's Programs go about solving problem in a similar way.

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Ex: GPS (General Problem solver) was an early computer program that attempted to model human thinking. The developers were not so much interested in whether or not GPS solved problems correctly. They were more interested in showing that it solved problems like people, going through the same steps & taking around the same amount of time to perform those steps.

* Acting Humanly. (The turing test approach)

→ A computer could be called intelligent if it passes a test where the interrogator cannot tell whether the answers asked by the interrogator came from a person or a computer.

→ An example of it is the turing test. It was developed by Alan turing in 1950. It is a simple method of determining whether a machine can demonstrate human intelligence. He proposed a twist on what is called "The imitation Game" where he asked some questions to humans as well as computers in separate rooms. And compare the answers to determine whether it was given by computer or human. And computer passed that test, as he couldn't recognize whether the answers were given by human or computer.

→ For that a computer should possess following capabilities

i) Natural language processing → to communicate

ii) Knowledge of representation → to store what it knows or hears

iii) Automated reasoning → to use the stored information to answer questions & draw new conclusions

iv) Machine learning → to adopt new circumstances & to detect & extrapolate patterns.

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* Thinking Rationally (The laws of thought approach)

→ Thinking rationally means ability to draw justifiable conclusions from data, rules and logic.

→ This requires 100% knowledge about something and too many computations are required.

→ Aristotle was one of the first to attempt to codify "right thinking", that is irrefutable reasoning process. He gave syllogisms that always yielded correct conclusion when correct premises are given.

Ex: Ankit is a boy.
All boys got their future plans to fulfil.
Then → Ankit got his future plans to fulfil.

These law of thought were supposed to govern the operation of mind; this study initiated the field of logic. The logicist tradition of AI hopes to create intelligent systems using logic programming. However there are two obstacles to this approach.

i) First is, it is not easy to take informal knowledge & state in the formal terms required by logical notation, particularly when knowledge is not 100% certain.

ii) Second is solving problem "in principle" is different from doing it in practice.

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NOTE: rational behaviour: doing the right thing

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* Acting rationally (The rational agent approach)
→ It is more general than laws of thought approach.
→ Acting rationally means doing/behaving rightly.
→ It means acting to achieve one's goals, given one's beliefs or understanding about the word.
→ An agent is a system that perceives an environment and acts within that environment. An intelligent agent is one that acts rationally with respect to its goal.
→ Ex: An agent that is designed to play game should make moves that increase its chances of winning the game.
→ An agent is just something that acts, but a rational agent is one that acts so as to achieve the best outcome.
⇒ In the "laws of thought" approach to AI, the emphasis was given to correct inferences. Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion and act on that conclusion.
→ Computer agent is expected to have following attributes

- Autonomous control
- Perceiving their environment
- Persisting over a prolonged period of time.
- Adapting to change
- And capable of taking on another's goal.

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History of AI (Note: Arrowed date are important)

~~1943 ⇒~~

Artificial Intelligence (AI) Maturation (1943-1952)

- In 1943: Warren McCulloch and Walter pits suggested an artificial neuron model.
- In 1949: Hebbian learning algorithm for altering the strength of connection between neurons was introduced
- → In 1950: Alan Turing, an English Mathematician, pioneered machine learning. He developed a turing test that could test the intelligence of a machine.

The Birth of Artificial Intelligence (1952-1956)

- In 1955: The first artificial intelligence program was introduced. It verified 38 out of 52 mathematical theorems.
- → In 1958: The name "Artificial Intelligence" was introduced by computer scientist John McCarthy

The golden years early enthusiasm (1956-1974)

- → In 1966: The first chatbot, ELIZA was invented.
- → In 1972: Japan produced WABOT-1, the world's 1st intelligent humanoid robot

The first AI winter (1974-1980)

→ Computer scientists faced a severe lack of government funding for AI research

→ There was drop in public interest in AI.

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A boom of AI (1980-1987)

→ o 1980: Expert systems were introduced that could mimic the abilities of a human expert to make decisions

The second AI Winter (1987-1993)

→ o Investors & the government have once again failed for funding AI research due to excessive costs and ineffective results.

The emergence of intelligent agent (1993-2011)

→ o In 1997: IBM Deep Blue defeats Gary Kasparov, the world chess champion, and becomes the first computer to defeat a world chess champion.

→ o In 2006: AI was introduced into the business world by companies like Facebook, twitter, Netflix.

Deep learning, big data & artificial general intelligence (2011- present)

→ o In 2012: Google released an Android software called "Google Now", which could present users with information in the form of a prediction.

o In 2014: Chat bot "Eugene Goostman" won a competition in the famed "Turing Test" in 2014

o In 2018: Amazon Echo, a voice assistant was introduced

→ o In 2016: A social AI robot was created by Hanson robotics

o In 2018: IBM's "project Debater" debated tough topics with two master debators & did exceptionally well

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* Foundations of AI

The foundations of AI are designed with an aim to enable students and engineers to build a strong AI base. Some of the foundations of AI are:

i) Philosophy

→ Philosophy is the study of the fundamental nature of knowledge, reality, and existence, especially when considered as an academic discipline.

→ AI has close connections with philosophy because both share several concepts & these include intelligence, consciousness and even free will.

→ The philosophy of AI attempts to answer such questions:
- Can a machine act intelligently? Can it solve any problem that a person would solve by thinking?
- Are human intelligence & machine intelligence same?
- Can a machine have a mind, mental states, & consciousness in the same way as a human being can? Can it feel how things are?

ii) Economics

→ Economics is the branch of knowledge concerned with the production, consumption, & transfer of wealth.

→ The Economics in AI attempts to answer questions such as:
- How should we make decisions to maximize profit / or payoff?
- How should we do this when others may not go along?
- How should we do this when the payoff may be far in the future?

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iii) Psychology

→ Psychology is the scientific study of the human mind and its functions, especially those affecting behaviour in a given context.
→ Psychology in AI attempts to answer such questions as follows:
  o How humans & animals think & act?

iv) Sociology

→ Sociology is the study of the development, structure, and functioning of human society.
→ Sociology in AI attempts to answer such questions as follows:
  o How social life, social change and social causes & consequences of behaviour affect something?

v) Linguistics.

→ The science of the study of language, its structure including the grammar, syntax & phonetics is called ...
→ Speech demonstrates human intelligence
→ Modern linguistics & AI intersect in a hybrid field called computational linguistics or natural language processing.
→ It attempts to answer questions such as
  o How does language relate to thought?

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vi) Neuroscience

→ It is the study of nervous system, particularly the brain.
→ The exact way in which the brain enables thought is unknown. However, it does enable thought has the evidence.
→ "A strong blow to the head can lead to the mental incapacitation"
→ It attempts to answer questions such as
  ○ How brain process information?

vii) Mathematics.

→ It is the science that deals with the logic of shape, quantity and arrangement.
→ From math to meaning: AI blends algorithms & applications
→ Mathematics in AI attempts to answer questions such as
  ○ What are the formal rules to draw conclusions?
  ○ What can be computed?
  ○ How do we reason with uncertain information?

viii) Computer science & Engineering

→ How can we build an efficient computer?
→ For artificial intelligence to succeed, we need two things: intelligence & an artifact
→ Each generation of computer hardware has brought an increase in speed & capacity and decrease in price.
→ computer science & engineering in AI involves in designing systems for AI

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ix) Control theory.

→ It is a subfield of mathematics that deals with the control of continuously operating dynamical systems in engineered process & machine

→ Previous assumption: only living things could modify their behaviour in responses to the change in environment.

→ Machines can modify their behaviour in response to the environment (sense/action loop)

→ Ex: water-flow regulator, thermostat etc.

→ It attempts to answer questions such as:
  - How can artifacts operate under their own control?

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* Applications of AI

AI is making our daily life more comfortable and fast because it can solve complex problems with an efficient way in multiple industries. Such as healthcare, entertainment, finance, education etc. Following are some sectors which have the applications of AI:

i) AI in healthcare
ii) AI in finance
iii) AI in Gaming
iv) AI in Social media
v) AI in data security
vi) AI in education
vii) AI in entertainment
viii) AI in military
ix) AI in e-commerce.

(You can describe them easily).

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Questions asked from this chapter:

Q. How philosophy, sociology and economics influence the study of Artificial Intelligence? (2078 - 5 marks)

Q. What is Turing Test? How can it be used to measure the intelligence of machine? (2078 - 5 marks) (2076 - 10 marks)

Q. What is AI? How can you define AI from the perspective of thought process? (2076 - 5 marks)

Q. How can you define AI from the dimension of rationality? (2076 - 5 marks) (2072 - 10 marks)

Q. "System that think like humans" and "System that act like humans" are the part of AI. Justify with practical examples. (2069 - 10 marks)

Q. How the dimensions like thinking humanly & thinking rationally used to evaluate intelligence behaviour of a machine. (2074 - 10 marks)