UNIT-1: Introduction

What is AI?

1) **A**rtificial Intelligence (AI) is a branch of *science* which deals with helping machines to find the solutions of complex problems in a more human-like fashion.

2) This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way.

3) A more or less flexible or efficient approach can be taken depending on the requirements established, which influences how artificial the intelligent behaviour appears

4) Artificial intelligence can be viewed from a variety of perspectives.

- **From the perspective of intelligence**
  Artificial intelligence is making machines "intelligent" -- acting as we would expect people to act.
- **From a business perspective**
  AI is a set of very powerful tools, and methodologies for using those tools to solve business problems.
- **From a programming perspective,**
  AI includes the study of symbolic programming, problem solving, and search. AI programming languages include: LISP, PROLOG, Object-oriented languages etc.

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Some definitions of artificial intelligence organize the AI into four categories which is shown in Figure below….

| Thinking Humanly	Thinking Rationally
"The exciting new effort to make computers think … *machines with minds*, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …" (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Chamiak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	Acting Rationally
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI …is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Figure above shows the definition of the AI which laid out along two dimensions. The definitions on top are concerned with **thought processes and reasoning**, whereas the ones on the bottom address **behaviour**.

The definitions on the left, measures success in terms of **fidelity to human performance**, whereas the ones on the right measures against an ideal performance measure, called **rationality**.

Acting humanly: The Turing Test approach (Chinese room argument)

The **Turing Test** (Alan Turing (1950)) says that a computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer or it is designed to convince the people that whether a particular machine can think or not.
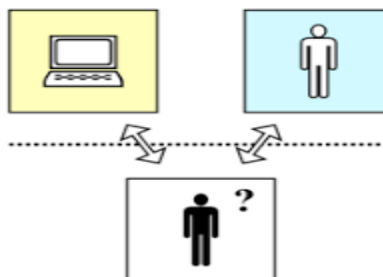
Alan Turing, in his famous paper "Computing Machinery and Intelligence" (1950), suggested that instead of asking whether machines can think, we should ask whether machines can pass a behavioural intelligence test or not, which has is called the **Turing Test**.

The test is for a program to have a conversation with an interrogator for five minutes. The interrogator then has to guess if the conversation is with a program or a person; the program passes the test if it fools the interrogator 30% of the time.

Turing gussed that, by the year 2000, a computer with a storage of 10^9 units could be programmed well enough to pass the test but He was wrong. Some people *have* been fooled for 5 minutes; for example, The ELIZA program and Internet chatbots called MGONZ have fooled humans who didn't realized that they might be talking to a program, and the program ALICE fooled one judge in the 2001 loebner prise competition. But no program has come close to the 30% criterion against trained judges, and the field of AI as a whole has paid little attention to Turing Test.

To pass the Turing test a computer have following capabilities…
• **Natural language processing:** to enable it to communicate successfully in English.
• **Knowledge representation:** to store what it knows or hears.
• **Automated reasoning:** to use the stored information to answer questions and to draw new conclusions;
• **Machine learning:** to adapt to new circumstances and to detect and extrapolate patterns.

Turing's test avoids the physical interaction with the interrogator and the computer, because physical simulation of a person is unnecessary for intelligence. However, the **total Turing Test** includes a video signal so that the interrogator can test the subject's perceptual abilities, as well as the opportunity for the interrogator to pass physical objects. To pass the total Turing Test, the computer must have following additional capabilities
      • **computer vision** to perceive objects, and
      • **robotics** to manipulate objects and move about.

Thinking humanly: The cognitive modelling approach

If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get *inside* the actual workings of human minds. There are three ways to do this:

Through introspection: - trying to catch our own thoughts as they go by;
Through psychological experiments: - observing a person in action; and
Through brain imaging: - observing the brain in action.

Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program. If the program's input–output behaviour matches corresponding human behaviour, then it is the evidence that some of the program's mechanisms could also be operating like human mind.

Thinking rationally: The "laws of thought" approach

The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking," that is, irrefutable reasoning processes. His **syllogisms** provide patterns for argument structures that always yielded correct conclusions when given correct premises.

For example, "Ram is man; all men are mortal; therefore, Ram is mortal." These laws of thought were supposed to govern the operation of mind, and initiated the field of logic. He gave syllogism that always yielded correct conclusion when correct premises are given.

There are two main obstacles to this approach.

1) First, it **is not easy to take informal knowledge and state** it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain.
2) Second, there is a big difference between solving a **problem "in principle" and solving it in practice**. Even problems with just a few hundred facts can exhaust the computational resources of any computer unless it has some guidance as to which reasoning steps to try first.

Although both of these obstacles apply to *any* attempt to build computational reasoning systems, they appeared first in the logicist tradition.

<u>Acting rationally: The rational agent approach</u>

An **agent** is just something that acts. A **rational agent** is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome.

In the "laws of thought" approach to AI, the emphasis was on 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 that a given action will achieve one's goals and then to act on that conclusion. On the other hand, correct inference is not *all* of rationality; in some situations, there is no probably correct thing to do, but something must still be done.

There are also ways of acting rationally that cannot be said to involve inference. For example, recoiling from a hot stove is a reflex action that is usually more successful than a slower action taken after careful deliberation. All the skills needed for the Turing Test also allow an agent to act rationally. Knowledge representation and reasoning enable agents to reach good decisions. We need to be able to generate comprehensible sentences in natural language to get by in a complex society.

The rational-agent approach has two advantages over the other approaches.

First, it is more general than the "laws of thought" approach because correct inference is just one of several possible mechanisms for achieving rationality.

Second, it is more amenable to scientific development that are approached based on human behaviour or human thought.

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Brief History of Al

- 1943: Warren Mc Culloch and Walter Pitts:
  A model of artificial boolean neurons to perform computations.
  - ✓ First steps toward connectionist computation and learning (Hebbian learning)
  - ✓ Marvin Minsky and Dann Edmonds (1951) constructed the first neural network computer

- 1950: Alan Turing's "Computing Machinery and Intelligence"
  - ✓ First complete vision of AI

The Birth of AI (1956)

- Dartmouth Workshop bringing together top minds on automata theory, neural nets and the study of intelligence.
  - ✓ Allen Newell and Herbert Simon: The logic theorist (first nonnumeric thinking program used for theorem proving)
  - ✓ For the next 20 years the field was dominated by these participants.

Great Expectations (1952-1969)

- Newell and Simon introduced the General Problem Solver.

  - ✓ Imitation of human problem-solving

- Arthur Samuel (1952-) investigated game playing (checkers) with great success.
- John McCarthy(1958-).
  - ✓ Inventor of Lisp (second-oldest high-level language)
  - ✓ Logic oriented, Advice Taker (separation between knowledge and reasoning)

- Marvin Minsky (1958-)
- ✓ Introduction of microworlds that appear to require intelligence to solve: e.g. blocks-world.
- ✓ Anti-logic orientation, society of the mind.

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Collapse in AI Research (1966 1973)

- Progress was slower than expected.
    1) Unrealistic predictions.
- Some systems lacked scalability.
    1) Combinatorial explosion in search.
- Fundamental limitations on techniques and representations.
    1) Minsky and Papert (1969) Perceptrons

AI Revival Through Knowledge-based Systems (1969-1970)

- General-purpose vs. domain specific
    - ✓ Eg. the DENDRAL project (Buchanan et al. 1969)
    - ✓ First successful knowledge intensive system.
- Expert systems
    - ✓ MYCIN to diagnose blood infections (Feigenbaum et al)
        Introduction of uncertainty in reasoning
- Increase in knowledge representation research.
        Logic, frames, semantic nets…

AI becomes an Industry (1980 present)

- Rl at DEC (McDermott, 1982)
- Fifth generation project in Japan (1981)
- American response
    Puts an end to the Al winter

Connectionist revival (1986- present): (Return of Neural Network)

Parallel distributed processing (RumelHart and MeClelland, 1986). backprop

AI Becomes a Science (1987 - present)

- In speech recognition: hidden markov models
- In neural networks
- In uncertain reasoning and expert systems Bayesian network formalism

The emergence of intelligent agents (1995- present)

- The whole agent problem:
    "How does an agent act/behave embedded in real environments with continuous sensory inputs".

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Application of AI

1.In E-Commerce

Personalized Shopping
Artificial Intelligence technology is used to create recommendation engines through which you can engage better with your customers. These recommendations are made in accordance with their browsing history, preference, and interests. It helps in improving your relationship with your customers and their loyalty towards your brand.

AI-powered Assistants
Virtual shopping assistants and chatbots help improve the user experience while shopping online. Natural Language Processing is used to make the conversation sound as human and personal as possible. Moreover, these assistants can have real-time engagement with your customers. Did you know that on amazon.com, soon, customer service could be handled by chatbots?

Fraud Prevention
Credit card frauds and fake reviews are two of the most significant issues that E-Commerce companies deal with. By considering the usage patterns, AI can help reduce the possibility of credit card frauds taking place. Many customers prefer to buy a product or service based on customer reviews. AI can help identify and handle fake reviews.

2. In Education

Administrative Tasks Automated to Aid Educators
Artificial Intelligence can help educators with non-educational tasks like task-related duties like facilitating and automating personalized messages to students, back-office tasks like grading paperwork, arranging and facilitating parent and guardian interactions, routine issue feedback facilitating, managing enrollment, courses, and HR-related topics.

Creating Smart Content
Digitization of content like video lectures, conferences, and text book guides can be made using Artificial Intelligence. We can apply different interfaces like animations and learning content through customization for students from different grades.

Artificial Intelligence helps create a rich learning experience by generating and providing audio and video summaries and integral lesson plans.

Voice Assistants
Without even the direct involvement of the lecturer or the teacher, a student can access extra learning material or assistance through Voice Assistants. Through this, printing costs of temporary handbooks and also provide answers to very common questions easily.

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Personalized Learning

Using AI technology, hyper-personalization techniques can be used to monitor students' data thoroughly, and habits, lesson plans, reminders, study guides, flash notes, frequency or revision, etc., can be easily generated.

3. In Lifestyle

Autonomous Vehicles

Automobile manufacturing companies like Toyota, Audi, Volvo, and Tesla use machine learning to train computers to think and evolve like humans when it comes to driving in any environment and object detection to avoid accidents.

Spam Filters

The email that we use in our day-to-day lives has AI that filters out spam emails sending them to spam or trash folders, letting us see the filtered content only. The popular email provider, Gmail, has managed to reach a filtration capacity of approximately 99.9%.

Facial Recognition

Our favorite devices like our phones, laptops, and PCs use facial recognition techniques by using face filters to detect and identify in order to provide secure access. Apart from personal usage, facial recognition is a widely used Artificial Intelligence application even in high security-related areas in several industries.

Recommendation System

Various platforms that we use in our daily lives like e-commerce, entertainment websites, social media, video sharing platforms, like youtube, etc., all use the recommendation system to get user data and provide customized recommendations to users to increase engagement. This is a very widely used Artificial Intelligence application in almost all industries.

4. In Navigation

GPS technology can provide users with accurate, timely, and detailed information to improve safety. The technology uses a combination of Convolutional Neural Network and Graph Neural Network, which makes lives easier for users by automatically detecting the number of lanes and road types behind obstructions on the roads. AI is heavily used by Uber and many logistics companies to improve operational efficiency, analyze road traffic, and optimize routes.

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5. In Robotics

Robotics is another field where artificial intelligence applications are commonly used. Robots powered by AI use real-time updates to sense obstacles in its path and pre-plan its journey instantly.

It can be used for -

- Carrying goods in hospitals, factories, and warehouses
- Cleaning offices and large equipment
- Inventory management

6. In Human Resource

Did you know that companies use intelligent software to ease the hiring process? Artificial Intelligence helps with blind hiring. Using machine learning software, you can examine applications based on specific parameters. AI drive systems can scan job candidates' profiles, and resumes to provide recruiters an understanding of the talent pool they must choose from.

7. In Healthcare

Artificial Intelligence finds diverse applications in the healthcare sector. AI applications are used in healthcare to build sophisticated machines that can detect diseases and identify cancer cells. Artificial Intelligence can help analyze chronic conditions with lab and other medical data to ensure early diagnosis. AI uses the combination of historical data and medical intelligence for the discovery of new drugs.

8. In Agriculture

Artificial Intelligence is used to identify defects and nutrient deficiencies in the soil. This is done using computer vision, robotics, and machine learning applications, AI can analyze where weeds are growing. AI bots can help to harvest crops at a higher volume and faster pace than human laborers.

9. In Gaming

Another sector where Artificial Intelligence applications have found prominence is the gaming sector. AI can be used to create smart, human-like NPCs (non-player characters) to interact with the players.

10. In Automobiles

Artificial Intelligence is used to build self-driving vehicles. AI can be used along with the vehicle's camera, radar, cloud services, GPS, and control signals to operate the vehicle. AI can improve the in-vehicle experience and provide additional systems like emergency braking, blind-spot monitoring, and driver-assist steering.

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11. In social media

Instagram
On Instagram, AI considers your likes and the accounts you follow to determine what posts you are shown on your explore tab.

Facebook
Artificial Intelligence is also used along with a tool called DeepText. With this tool, Facebook can understand conversations better. It can be used to translate posts from different languages automatically.

Twitter
AI is used by Twitter for fraud detection, removing propaganda, and hateful content. Twitter also uses AI to recommend tweets that user might enjoy, based on what type of tweets they engage with.

12. In Marketing

Artificial intelligence (AI) applications are popular in the marketing domain as well.

Using AI, marketers can deliver highly targeted and personalized ads with the help of behavioural analysis, pattern recognition, etc. It also helps with retargeting audiences at the right time to ensure better results and reduced feelings of distrust and annoyance.

13. In Chatbots
AI chatbots can comprehend natural language and respond to people online who use the "live chat" feature that many organizations provide for customer service. AI chatbots are effective with the use of machine learning, and can be integrated in an array of websites and applications. AI chatbots can eventually build a database of answers, in addition to pulling information from an established selection of integrated answers. As AI continues to improve, these chatbots can effectively resolve customer issues, respond to simple inquiries, improve customer service, and provide 24/7 support. All in all, these AI chatbots can help to improve customer satisfaction.

=========================== End Unit 1 ==============================

Unit I: Introduction (3 Hrs.)
1.1. Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally
1.2. History of AI
1.3. Foundations of AI
1.4. Applications of AI

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