COIT20277 Introduction to Artificial Intelligence

Week 1 - Lecture

- Introduction to Artificial Intelligence
- Fundamental Use Cases for AI

Acknowledgement of Country

I respectfully acknowledge the Traditional Custodians of the land on which we live, work and learn. I pay my respects to the First Nations people and their Elders, past, present and future

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Acknowledgment

The content of this lecture has been adopted from the following book:

- Artificial Intelligence with Python (2nd edition), Artasanchez and Joshi, *Packt Publishing Ltd*,ISBN 978-1-83921-953-5.

- Chapters 1 and 2

Assessments and Pass Criteria

- *Assignment 1 - Written assessment (Individual work)* (30% weighting) **- Due week 5**, Friday, 11:55 AEST
- *Assignment 2 - Written assessment (Individual work)* (25% weighting) **- Due week 8**, Friday, 11:55 AEST
- *Assignment 3 - Written assessment (Group work)* (45% weighting) **- Due week 12**, Friday, 11:55 AEST

- Pass Criteria: 50% overall

Topics Covered

- What is AI and why do we need to study it?
- What are some applications of AI?
- A classification of AI branches
- What is the Turing test?
- What are rational agents?
- How to build an intelligent agent?
- What are General Problem Solvers?
- Use Cases for AI

What is Artificial Intelligence (AI)?

- A *skeptical* definition might be: "the area of computer science that studies how machines can closely imitate human intelligence."

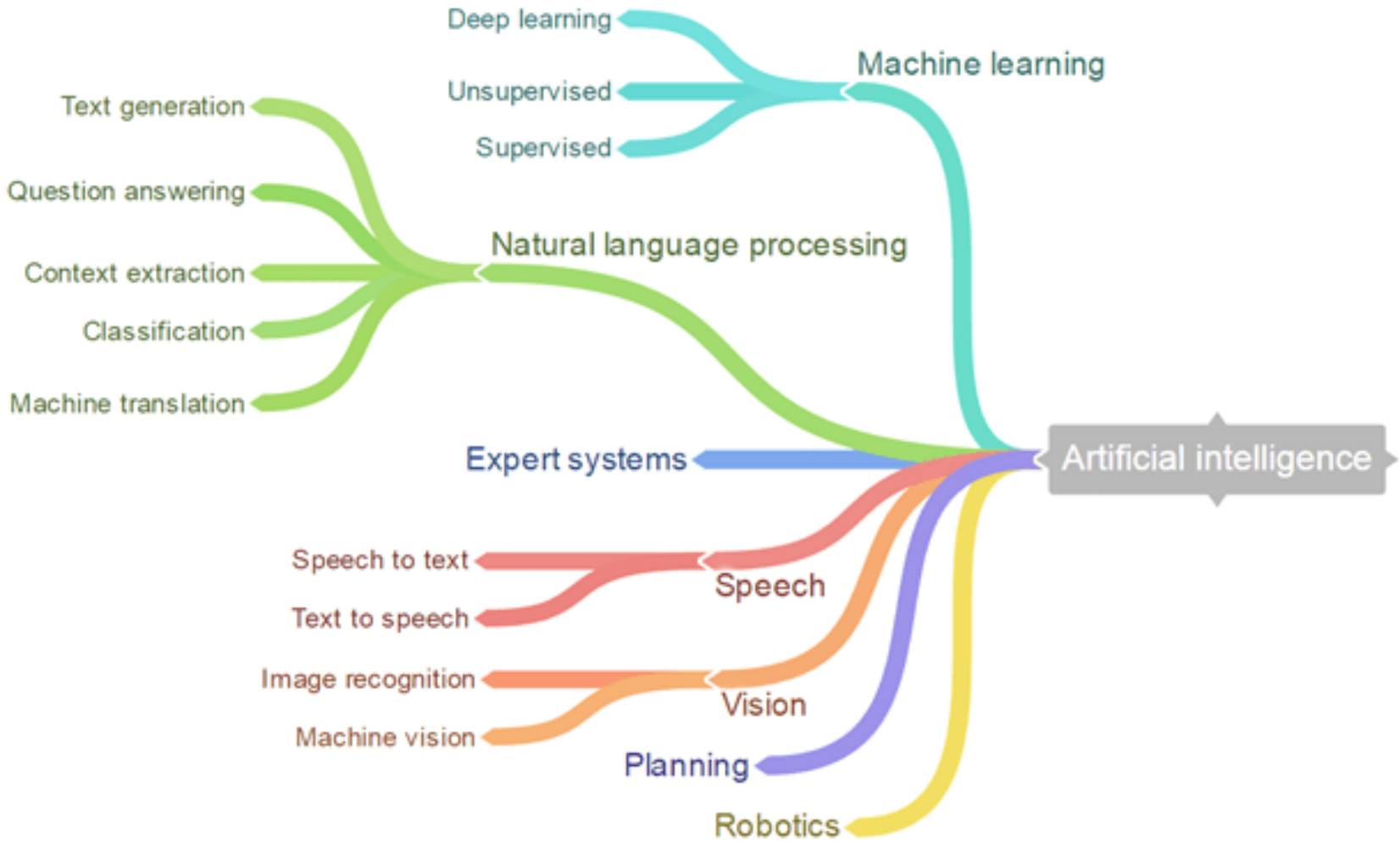
Why do we need to study AI?

- AI is a foundational technology crucial for various industries, including healthcare, finance, and transportation.
- It enables solving complex problems that are challenging for traditional methods or human cognition.
- AI systems improve efficiency by automating tasks and optimizing processes across different sectors.
- Studying AI fosters innovation, leading to the development of new products and services.
- AI contributes to economic growth through increased productivity and job opportunities.

We need AI systems that can:

- Handle large amounts of data in an efficient way. With the advent of Cloud Computing, we are now able to store huge amounts of data.
- Ingest data simultaneously from multiple sources without any lag. Index and organize data in a way that allows us to derive insights.
- Learn from new data and update constantly using the right learning algorithms. Think and respond to situations based on the conditions in real time.
- Continue with tasks without getting tired or needing breaks.

Branches of AI

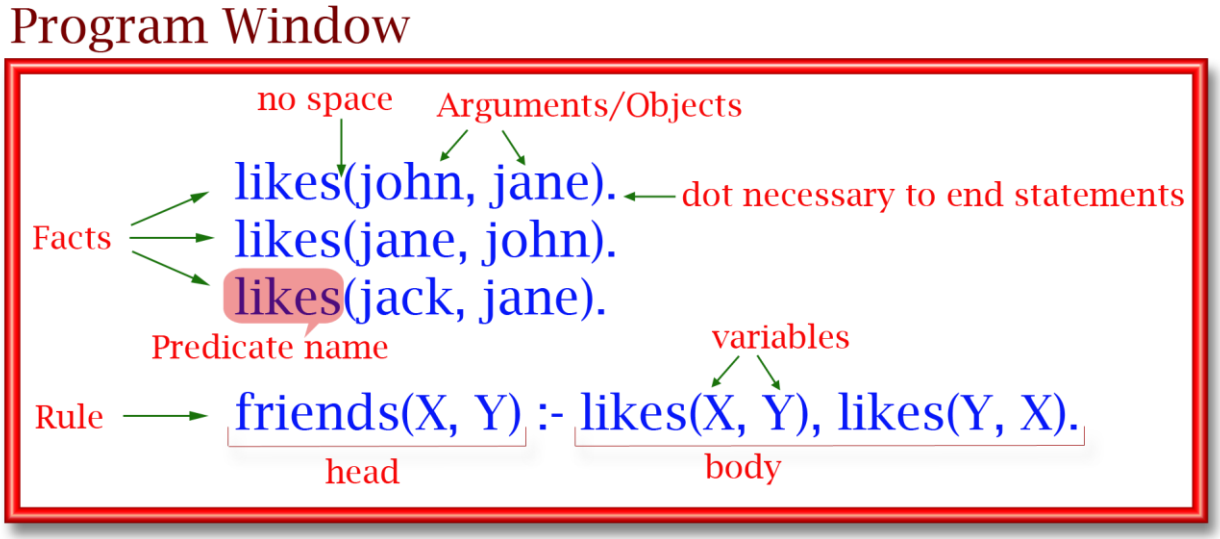


A common classification of AI

- **Machine learning and pattern recognition**:
  - This is perhaps the most popular form of AI out there.
  - We design and develop software that can learn from data. Based on these learning models, we perform predictions on unknown data.
  - One of the main constraints here is that these programs are limited to the power of the data.

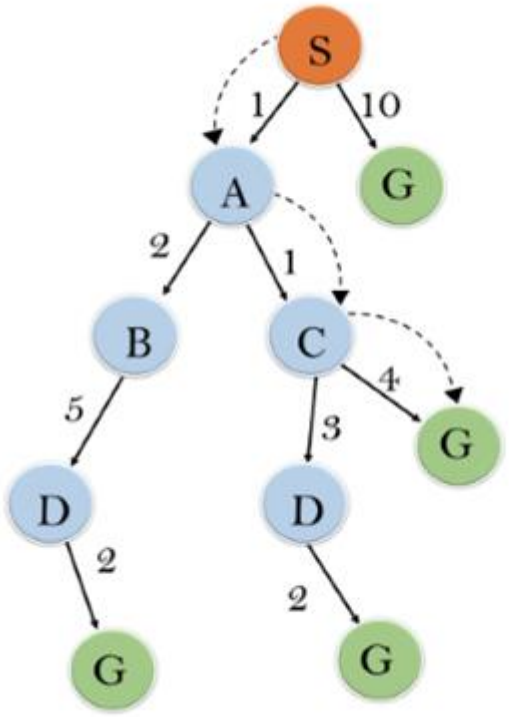
A common classification of AI (cont…)

- **Logic-based AI**:
  - Mathematical logic is used to execute computer programs in logic-based AI.
  - A program written in logic-based AI is basically a set of statements in logical form that expresses facts and rules about a problem domain. This is used extensively in pattern matching, language parsing, semantic analysis, and so on.



A common classification of AI (cont…)

- **Search**:
  - Search techniques are used extensively in AI programs.
  - These programs examine many possibilities and then pick the most optimal path.
  - For example, this is used a lot in strategy games such as chess, networking, resource allocation, scheduling, and so on.



A common classification of AI (cont…)

- **Knowledge representation**:
  - The facts about the world around us need to be represented in some way for a system to make sense of them.
  - Ontology is a formal definition of the properties and relationships of the entities that exist in a domain.
  - The difference between information and knowledge.

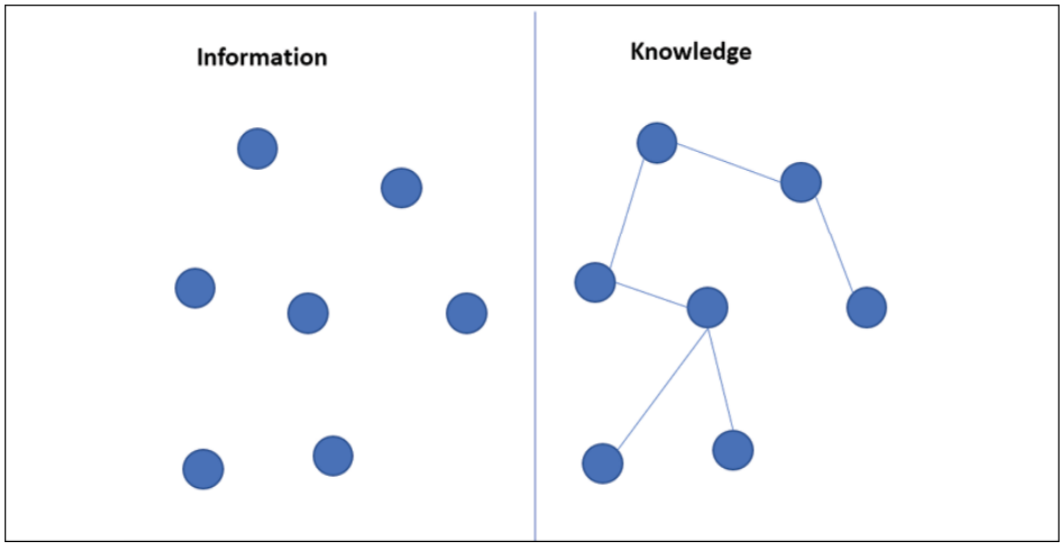


Figure 4: Information vs. Knowledge

A common classification of AI (cont…)

- **Heuristics**:
  - An educated guess on what approach one should take to solve a problem.
  - In AI, we frequently encounter situations where we cannot check every single possibility to pick the best option. Thus, we need to use heuristics to achieve the goal.
  - They are used extensively in AI in fields such as robotics, search engines, and so on.
- **Genetic programming** :
  - Genetic programming is a way to get programs to solve a task by mating programs and selecting the fittest.
  - The programs are encoded as a set of genes, using an algorithm to get a program that can perform the given task well.

Defining intelligence using the Turing test

- The legendary computer scientist and mathematician, *Alan Turing*, proposed the Turing test to provide a definition of intelligence.
- It is a test to see if a computer can learn to mimic human behavior. He defined intelligent behavior as the ability to achieve human-level intelligence during a conversation.
- This performance should be enough to trick an interrogator into thinking that the answers are coming from a human.

Setup of a Turing test

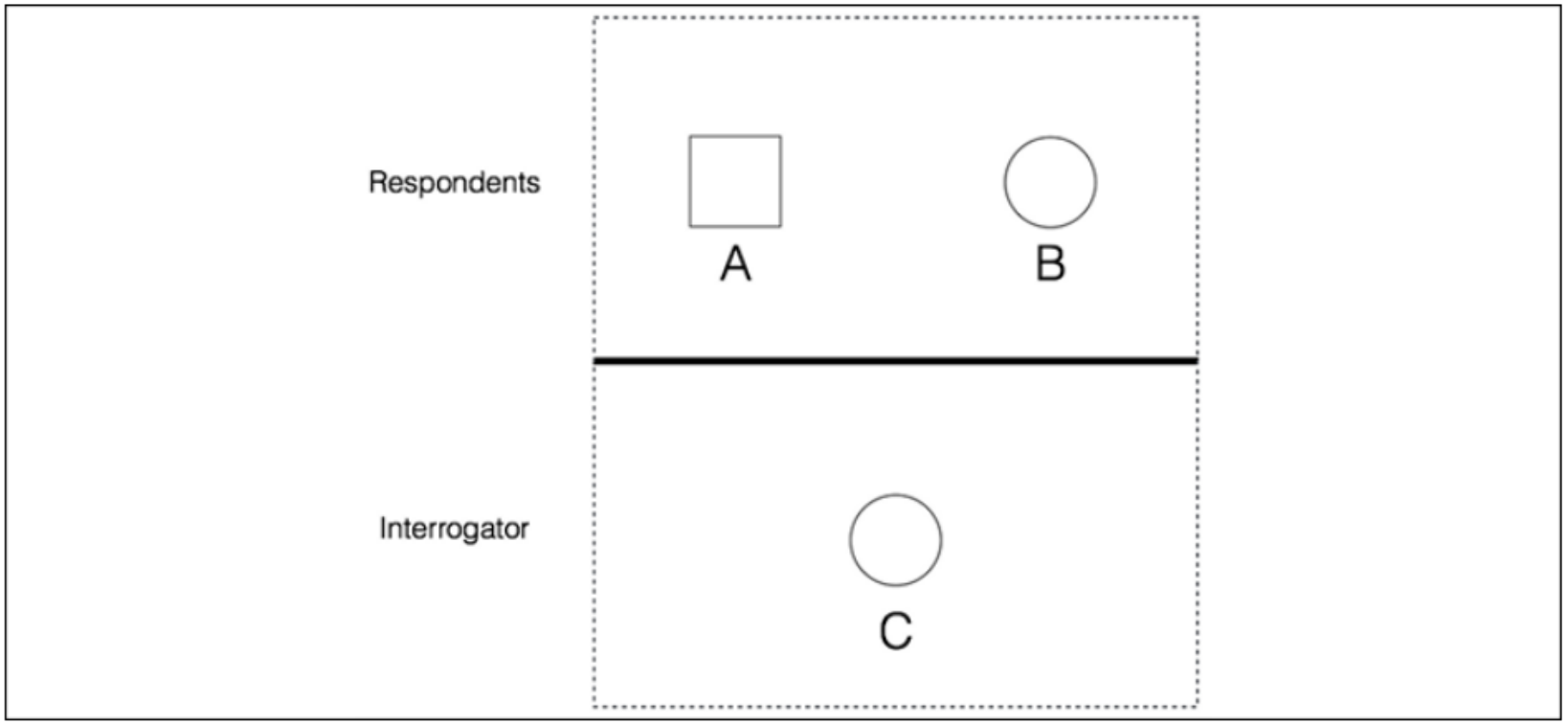


Figure 5: The Turing Test

The Turing Test

The machine needs to be well versed with the following things:

- **Natural language processing**: The machine needs this to communicate with the interrogator. The machine needs to parse the sentence, extract the context, and give an appropriate answer.

- **Knowledge representation**: The machine needs to store the information provided before the interrogation. It also needs to keep track of the information being provided during the conversation so that it can respond appropriately if it comes up again.

- **Reasoning**: It's important for the machine to understand how to interpret the information that gets stored. Humans tend to do this automatically in order to draw conclusions in real time.

- **Machine learning**: This is needed so that the machine can adapt to new conditions in real time. The machine needs to analyze and detect patterns so that it can draw inferences.

Making machines think like humans

The following diagram shows different levels of thinking and how our brain prioritizes things:

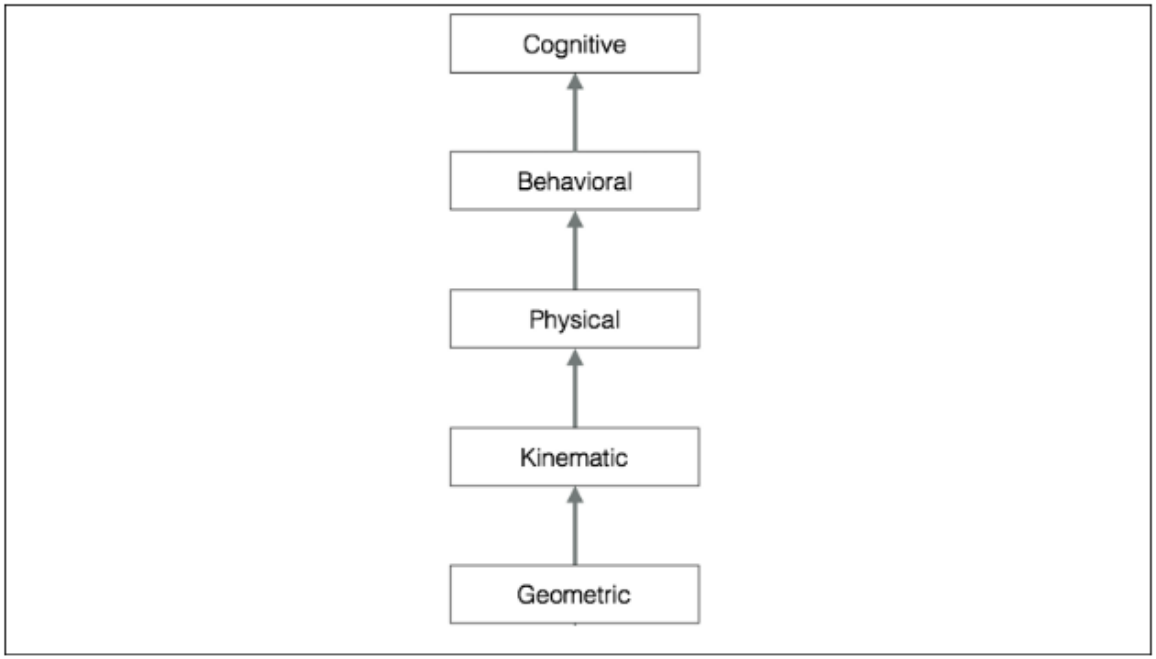


Figure 6: The levels of thought

Making machines think like humans (cont…)

- Within computer science, there is a field of study called **Cognitive Modeling** that deals with simulating the human thinking process. It tries to understand how humans solve problems.
- It takes the mental processes that go into this problem-solving process and turns it into a software model. This model can then be used to simulate human behavior.
- Cognitive modeling is used in a variety of AI applications such as deep learning, expert systems, natural language processing, robotics, and so on.

Building rational agents

- **Rationality** refers to observing a set of rules and following their logical implications in order to achieve a desirable outcome. This needs to be performed in such a way that there is maximum benefit to the entity performing the action.

- An **agent**, therefore, is said to act rationally if, given a set of rules, it takes actions to achieve its goals. It just perceives and acts according to the information that's available. This system is used a lot in AI to design robots when they are sent to navigate unknown terrains.

Building rational agents (cont…)

- The agent is supposed to be intelligent and independent.
- We want to impart the ability to adapt to new situations.
- It should understand its environment and then act accordingly to achieve an outcome that is in its best interests.
- The best interests are dictated by the overall goal it wants to achieve.

Building rational agents (cont…)

- Let's see how an input gets converted to action:

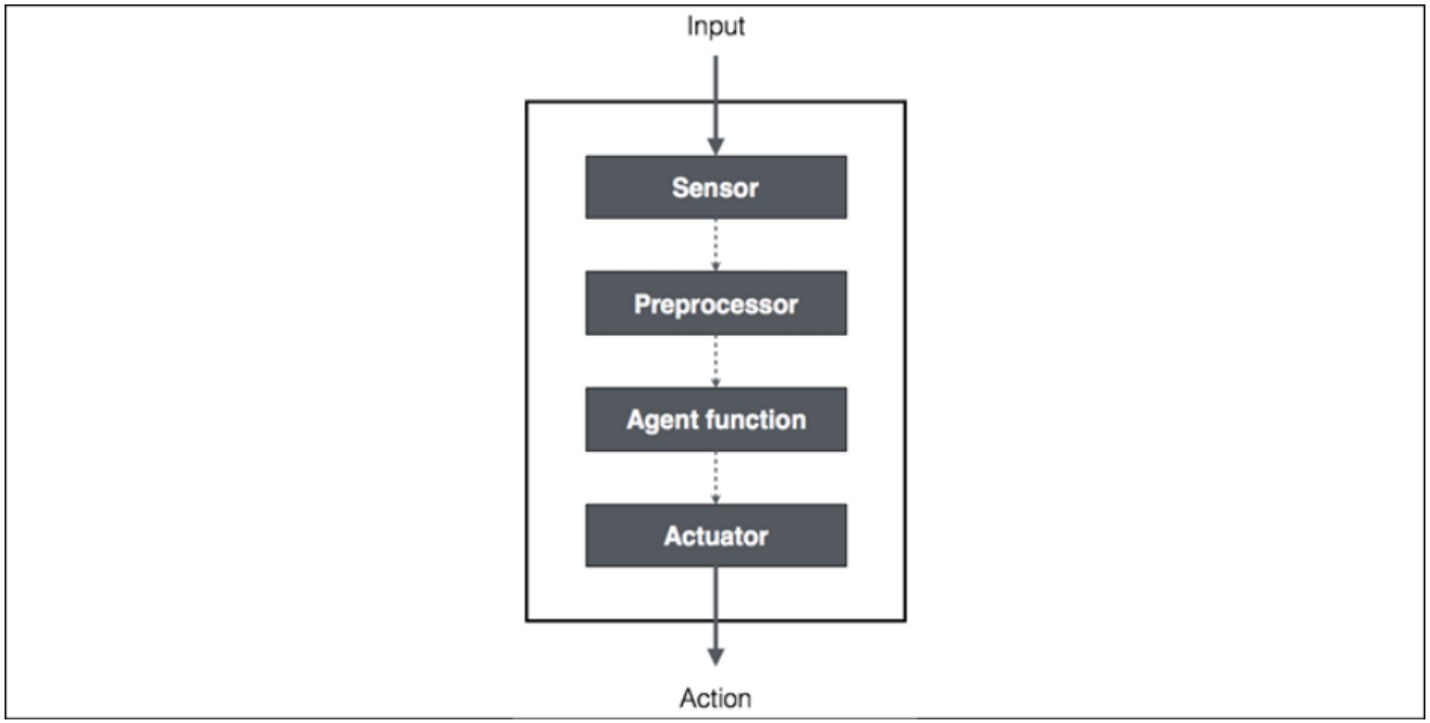


Figure 7: Converting input into action

How does one define the performance measure for a rational agent?

- One might say that it is directly proportional to the degree of success. The agent is set up to achieve a task, so the performance measure depends on what percentage of that task is complete.
- But we must think as to what constitutes rationality in its entirety. If it's just about results, we don't consider the actions leading up to the result.
- Making the right inferences is a part of being rational, because the agent must act rationally to achieve its goals. This will help it draw conclusions that can be used successively.
- But, what about situations where there are no provably right things to do? There are situations where the agent doesn't know what to do, but it still must do something.

How does one define the performance measure for a rational agent? (cont…)

- Let's set up a scenario to make this last point clearer.
- Imagine a self-driving car that's going at 60 miles an hour and suddenly someone crosses its path. For the sake of the example, assume that given the speed the car is going, it only has two choices.
- Either the car crashes against a guard rail knowing that it will kill the car occupant, or it runs over the pedestrian and kills them.
- What's the right decision? How does the algorithm know what to do? If you were driving, would you know what to do?

Building an intelligent agent

- Let's see how an intelligent agent interacts with the environment.

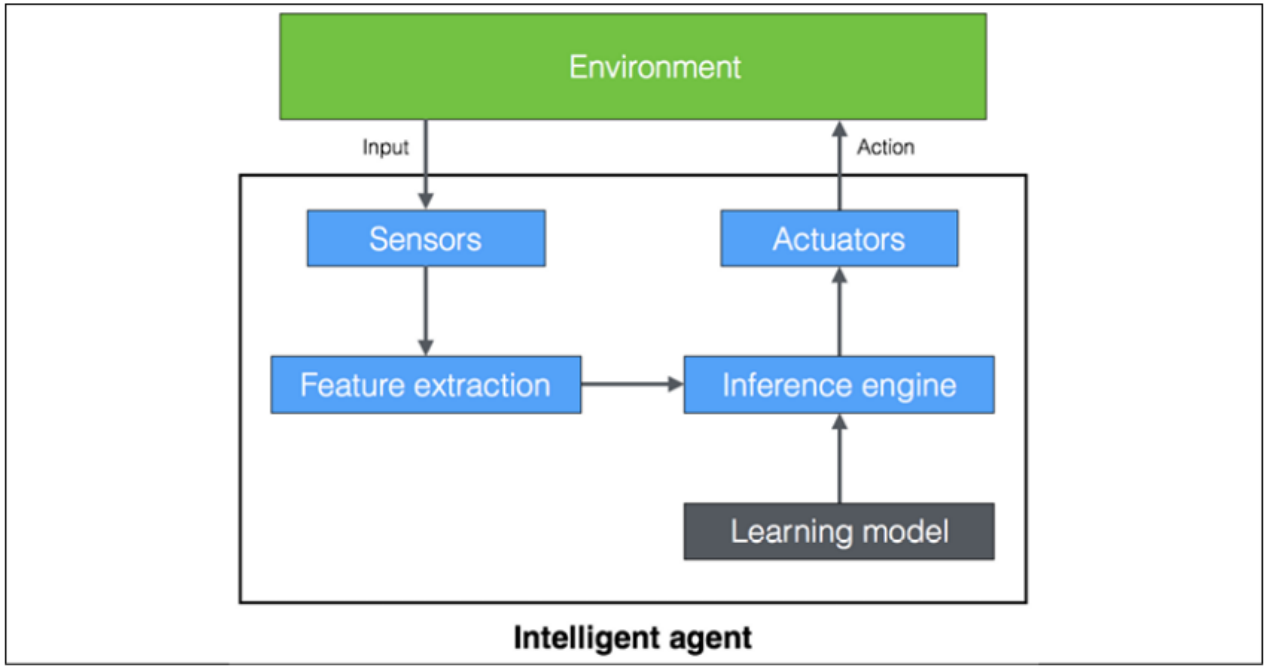


Figure 8: An intelligent agent interaction with its environment

General Problem Solver (GPS)

- A Generalized Problem Solver (GPS) is an adaptable AI system designed to solve a wide range of problems using a general problem-solving approach.
- Proposed by the computer scientists Herbert Simon and Allen Newell in 1959.
- Use algorithmic methods and heuristic strategies to explore problem spaces and generate potential solutions.
- Domain-independent, meaning it can be applied to different problem domains without significant modification.
- Problem-solving process involves iterative refinement, guided by goals or objectives.
- Some GPS systems incorporate learning mechanisms to improve problem-solving performance over time.
- Applications span across various domains, including artificial intelligence research, robotics, planning, and optimization.

Is ChatGPT a GPS?

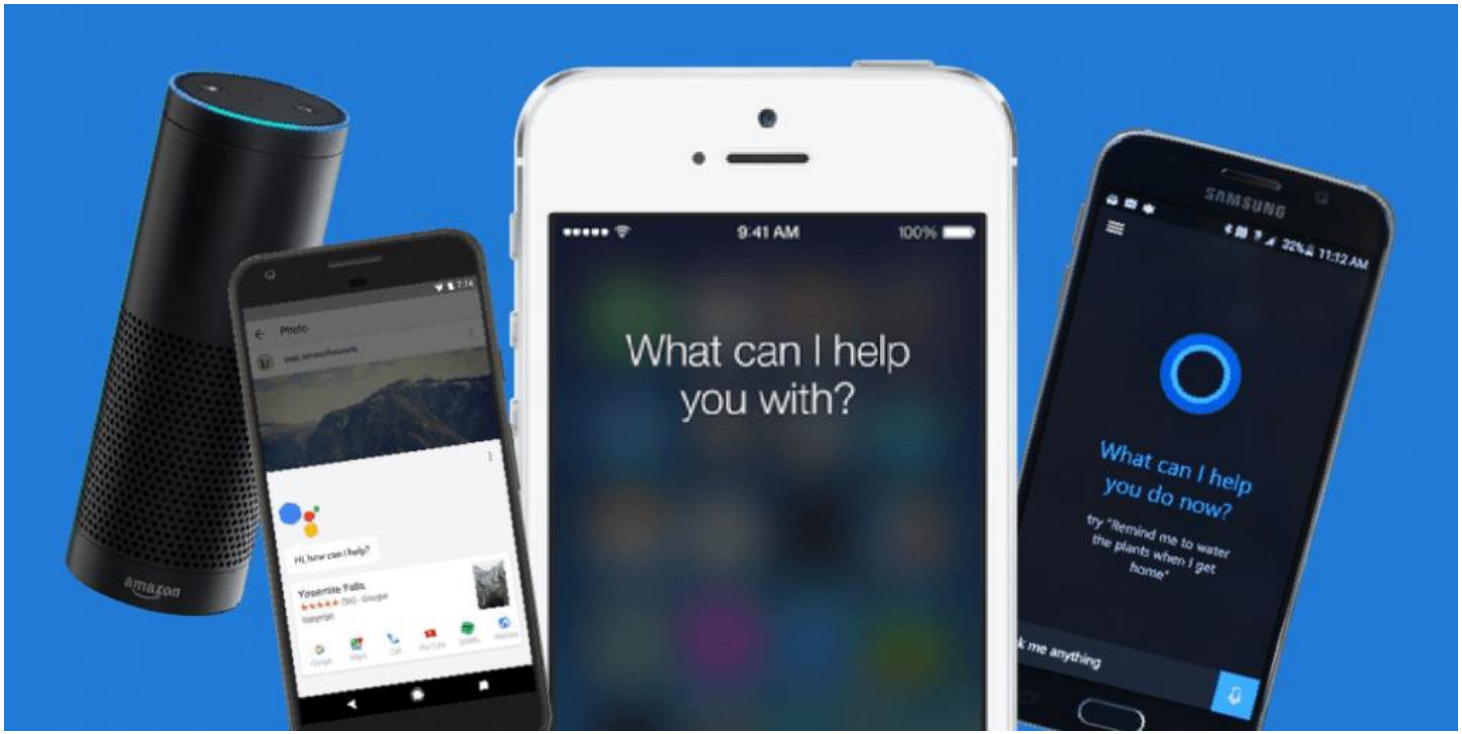
- Unlike a generalized problem solver, ChatGPT is not explicitly designed to solve a wide range of problems across various domains using a general problem-solving approach.

- Instead, it excels at tasks related to understanding and generating human-like text based on patterns learned from large amounts of data.

- However, it's important to note that ChatGPT's underlying technology, such as natural language processing algorithms and machine learning techniques, can be applied to various problem-solving tasks when appropriately adapted and integrated into specific applications.

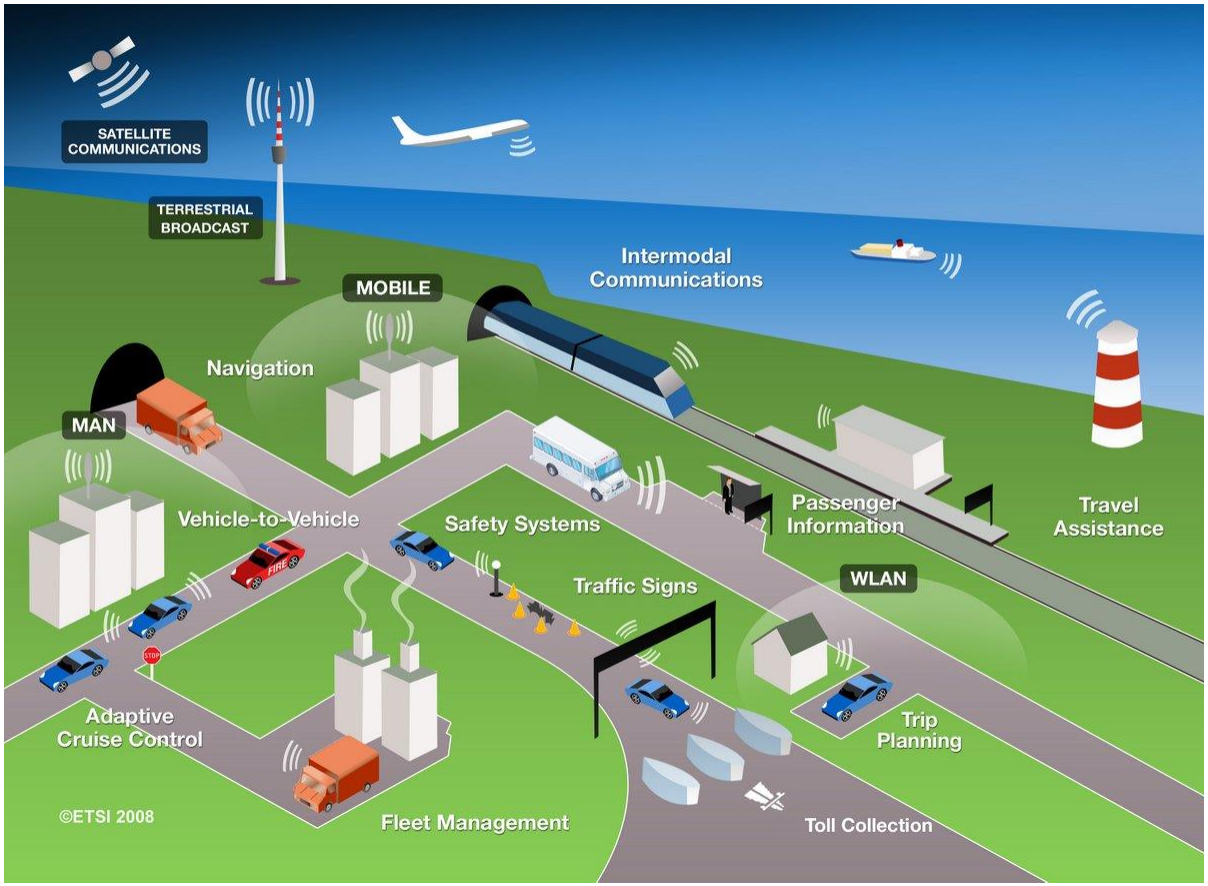
Use Cases for Artificial Intelligence

- Digital personal assistants and chatbots



Use Cases for Artificial Intelligence

- Shipping and warehouse management



Use Cases for Artificial Intelligence

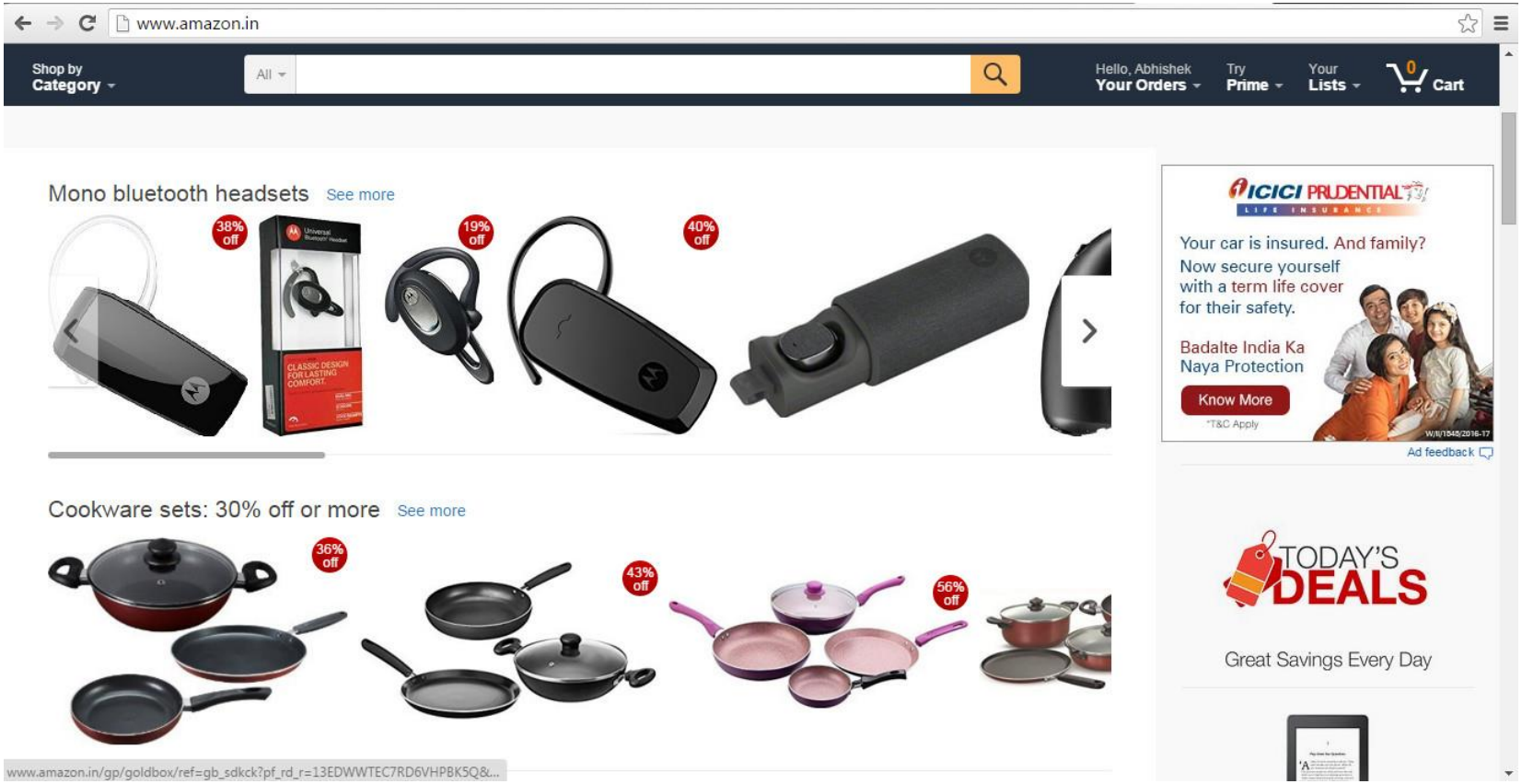
- Human health

Use Cases for Artificial Intelligence

- Knowledge search

Use Cases for Artificial Intelligence

- Recommendation systems



Use Cases for Artificial Intelligence

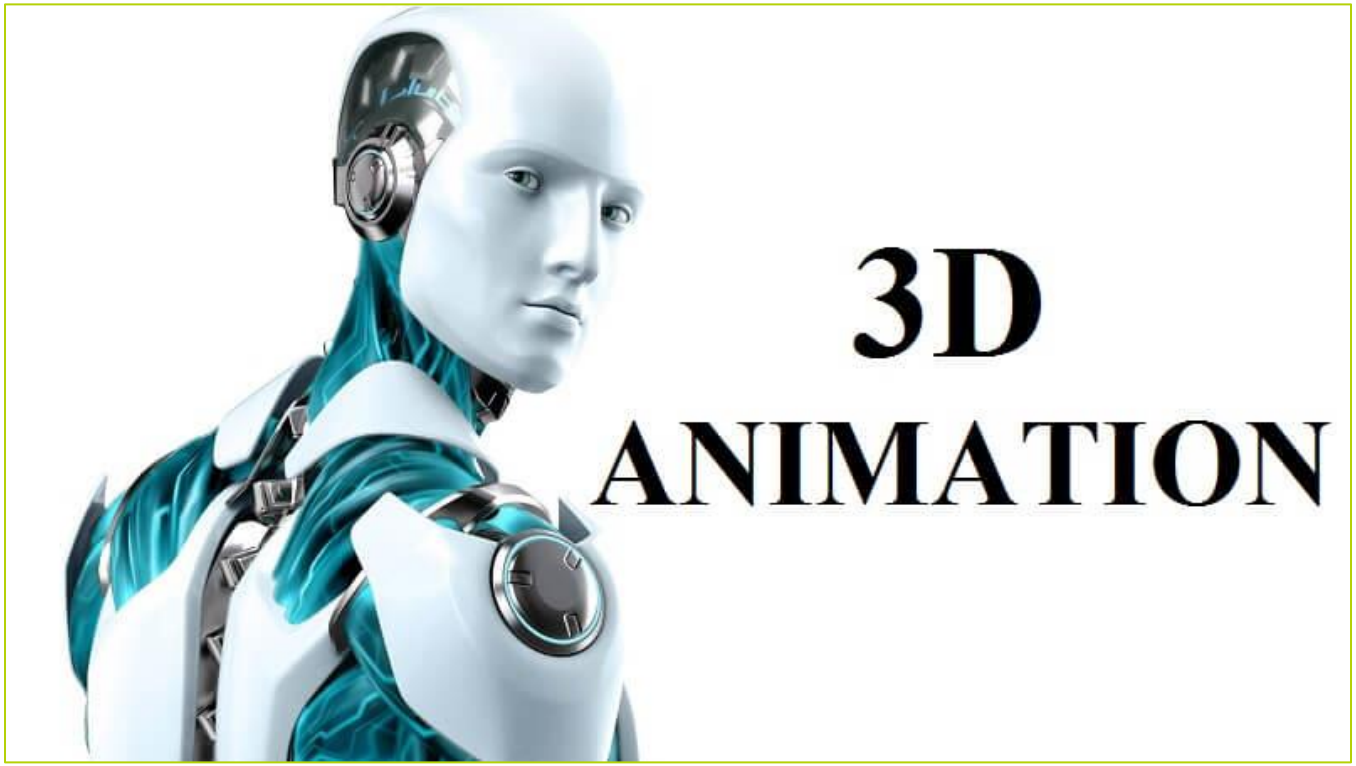
- The Smart Home

Use Cases for Artificial Intelligence

- Gaming

Use Cases for Artificial Intelligence

- Movie Making



Use Cases for Artificial Intelligence

- Underwriting and deal analysis

THANK YOU

TIME FOR DISCUSSION & QUESTIONS