

# Introduction

- *Artificial intelligence* (AI) is one of the newest fields in science and engineering.
- It attempts to understand how we think, perceive, understand, predict, and manipulate a world far larger and more complicated than itself.
- AI tries also to build intelligent agents.

## AI Definitions

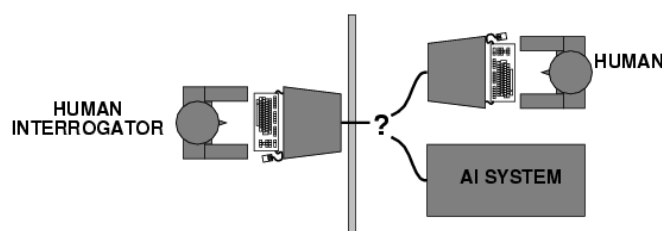
The following table illustrates the four definitions to AI.

- The first row is concerned on *reasoning*
- The second row concerned on *behaviour*.
- The first column measures the success based on *human* performance.
- The second column measures the success based on *ideal* performance (*rationality*).
- A *rational system* does the right thing given what it knows.

<b>Thinking Humanly</b> “AI is to make computers think ”	<b>Thinking Rationally</b> “the study of the computational that make it possible to perceive, reason, ...”
<b>Acting Humanly</b> “The art of creating machines that perform functions that require intelligence when performed by people”	<b>Acting Rationally</b> “AI is concerned with intelligent behaviour in artefacts”

## Acting humanly: the Turing test Approach

A computer passes **Turing test** (by Alan Turing, 1950) if a human interrogator, after posing some written questions, cannot tell whether the response come from a person or from a computer.



The computer would need to possess the following capabilities:

- 1- **Natural language processing:** to communicate in English languages.
  - 2- **Knowledge representation:** to store what it knows.
  - 3- **Automated reasoning:** to draw new conclusions.
  - 4- **Machine learning:** to detect new circumstances.
  - 5- **Computer vision:** to perceive objects.
  - 6- **Robotics:** to manipulate objects.
- However, we can create intelligent agents without trying to imitate humans.

## Thinking humanly: the cognitive modelling approach

There are three ways to determine how human think:

- 1- Thought introspection.
  - 2- 2- observe human action.
  - 3- 3- observing the brain in action.
- The *cognitive science* brings together computer models from AI and experimental techniques from psychology to construct precise and testable theories of the human mind.

## Thinking rationally: The "laws of thought" approach

The Greek philosopher Aristotle was one of the first to attempt to formalize the rules of "right thinking". His syllogisms provided patterns for argument structures that always yielded correct conclusions when given correct premises.

"Socrates is a man; all men are mortal; therefore, Socrates is mortal."

- **Logicist approach to AI:** describe problem in formal logical notation and apply general deduction procedures to solve it

Problems with this approach:

- 1- It is not easy to take informal knowledge and state it in the formal terms required by logical notation.

2- There is a big difference between solving a problem "in principle" and solving it in practice.

## **Acting rationally: The rational agent approach**

- An agent is just something that acts.
- A rational agent is one that acts so as to achieve the best expected outcome.

### Advantages of this approach:

- 1- It is more general than the "laws of thought" approach because correct inference is just one of several possible mechanisms for achieving rationality.
- 2- It is more amenable to scientific development than other approaches.
- 3- Practicality: can be adapted to many real-world problems

## **Foundations of AI**

### **1- Philosophy**

Philosophers made AI conceivable by considering the ideas that the mind is in some ways like a machine, that it operates on knowledge encoded in some internal language, and that thought can be used to choose what actions to take.

### **2- Mathematics**

Mathematicians provided the tools to manipulate statements of logical certainty as well as uncertain, probabilistic statements. They also set the groundwork for understanding computation and reasoning about algorithms.

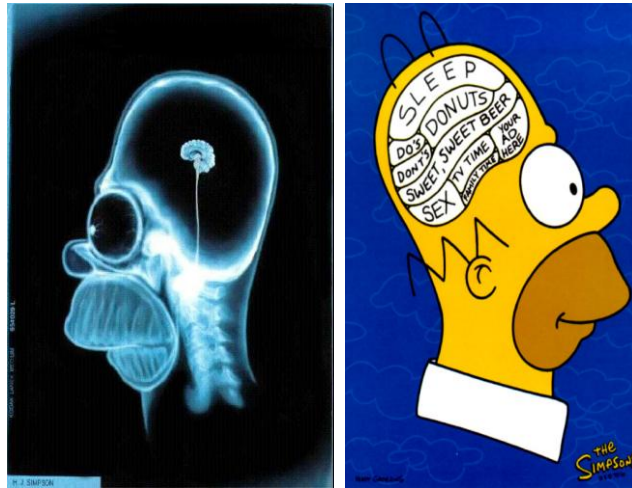
### **3- Economics**

Economists formalized the problem of making decisions that maximize the expected outcome to the decision maker.

### **4- Neuroscience**

Neuroscience is the study of the nervous system, particularly the brain. The exact way in which the brain enables thought is one of the great mysteries of science. Neuroscientists discovered some facts about how the brain works and the ways in which it is similar to and different from computers.

Functional magnetic resonance imaging or functional MRI (fMRI) is a functional neuroimaging procedure using MRI technology that measures brain activity by detecting associated changes in blood flow. MRI focuses on brain anatomy. It provides the anatomical structure on neuronal system. fMRI focuses on the brain activity. It provides neuronal activity.



Comparison between human brain and super computer (IBM BLUE GENE)

	Supercomputer	Human brain
Computational units	$10^4$ CPUs, $10^{12}$ transistors	$10^{11}$ neurons
Storage units	$10^{14}$ bits RAM	$10^{11}$ neurons
Cycle time	$10^{-9}$ sec	$10^{-3}$ sec
Operations/sec	$10^{15}$	$10^{17}$
Memory update/sec	$10^{14}$	$10^{14}$

## 5- Psychology

Psychologists adopted the idea that humans and animals can be considered information-processing machines.

## 6- Computer engineering

Computer engineering provided the ever-more-powerful machines that make AI applications possible. Software developments such as (the operating systems, programming languages, and tools needed to write modem programs) are also affected on AI.

## 7- Linguistics

Modern linguistics and AI were born at about the same time, intersecting in a hybrid field called *natural language processing*.

## 8- Control theory

Design of dynamical systems that use a controller to achieve desired behavior. Control theory deals with designing devices that act optimally on the basis of feedback from the environment.

## AI Applications

Here we sample a few applications:

1. **Robotic vehicles:** A driverless robotic car named **STANLEY** sped through the rough terrain of the Mojave desert at 22 mph, finishing the 132-mile course first to win the 2005 Defense Advanced Research Project Agency DARPA Grand Challenge STANLEY is a Volkswagen Touareg outfitted with cameras, radar, and laser rangefinders to sense the environment and onboard software to command the steering, braking, and acceleration.



2. **Logistics, scheduling, planning**

- a. During the 1991 Gulf War, US forces deployed an AI logistics planning and scheduling program that involved up to 50,000 vehicles, cargo, and people. The AI planning techniques generated in hours a plan that would have taken weeks with older methods.
  - a. NASA's **Remote Agent** software operated the Deep Space 1 spacecraft during two experiments in May 1999.
  - b. In 2004, NASA introduced the **MAPGEN** system to plan the daily operations for the Mars Exploration Rovers.
3. **Game playing:** **IBM's DEEP BLUE** became the first computer program to defeat the world champion in a chess match when it bested Garry Kasparov by a score of 3.5 to 2.5 in an exhibition match. Kasparov said that he felt a "new kind of intelligence" across the board from him.



4. **Robotics:** The *iRobot* Corporation has sold over two million Roomba robotic vacuum cleaners for home use. The company also deploys the more rugged **PackBot** to Iraq and Afghanistan, where it is used to handle hazardous materials, clear explosives, and identify the location of snipers.



5. **Natural language:**

- Automatic speech recognition: *Google voice search*
- Machine translation: *Google translation.*

6. **IBM Watson:**

Watson is a computer system like no other ever built. It analyzes natural language questions and content well enough and fast enough to compete and win against champion players. In February 2011, Watson defeated Brand Rutter and Ken Jennings in Jeopardy! Challenge. The quiz show complex and tricky questions, and very smart champions. Watson had to answer in natural language and not connected to Internet. It uses machine learning, statistical analysis, and language processing to find and understand the clue in the questions. Watson compare possible answers and respond in about three seconds.

