1: Introduction to Artificial Intelligence

Objectives

- Understand the definition of Artificial Intelligence
- Discuss the different faculties involved with intelligent behavior
- Examine the different ways of approaching
- Look at some example systems that uses AI
- Trace briefly the History of AI

OUTCOMES

- Define AI in different ways
- Identify the components of Intelligent behaviour
- Develop an appreciation of the vast scope of AI and intellectual challenges in AI
- Identify what will be the AI problems that could be solved by computers and what are the limitations (beyond the ability of the computers)

Topics of coverage

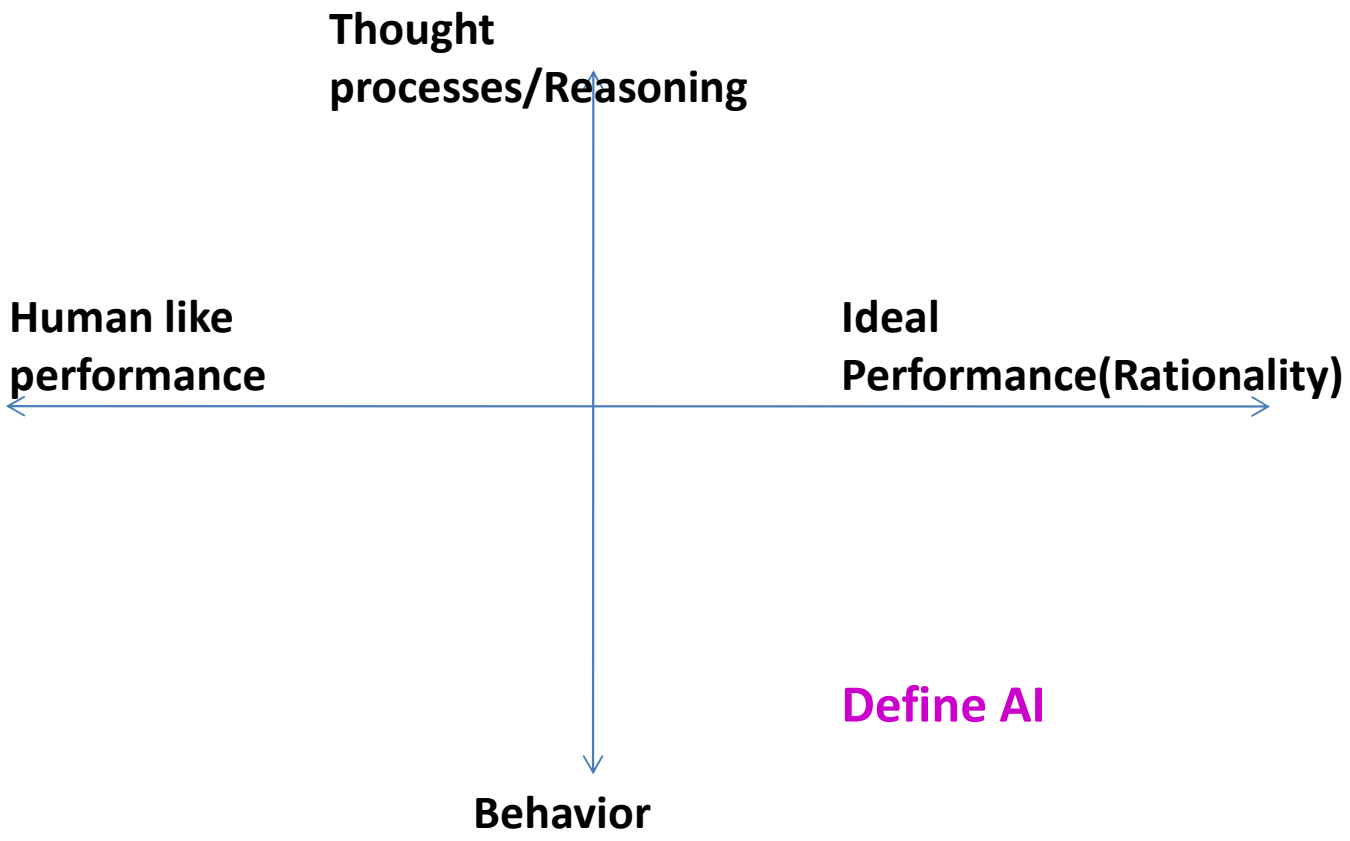
- **Definition of AI**
- **Example Systems**
- **Approaches to AI**
- **Brief History**

What is AI

- **AI - Artificial Intelligence**
- **AI is concerned with the design of intelligence in artificial artifacts and artificial devices**
- **This term was coined by McCarthy in 1956 in a famous conference the Dartmouth conference**
- **What is an Intelligence?**
  - **Human ?**
    - **Behaves as intelligently as human**
    - **Behaves in a best possible manner**
    - **Thinking?**
    - **Acting?**

Definitions of AI

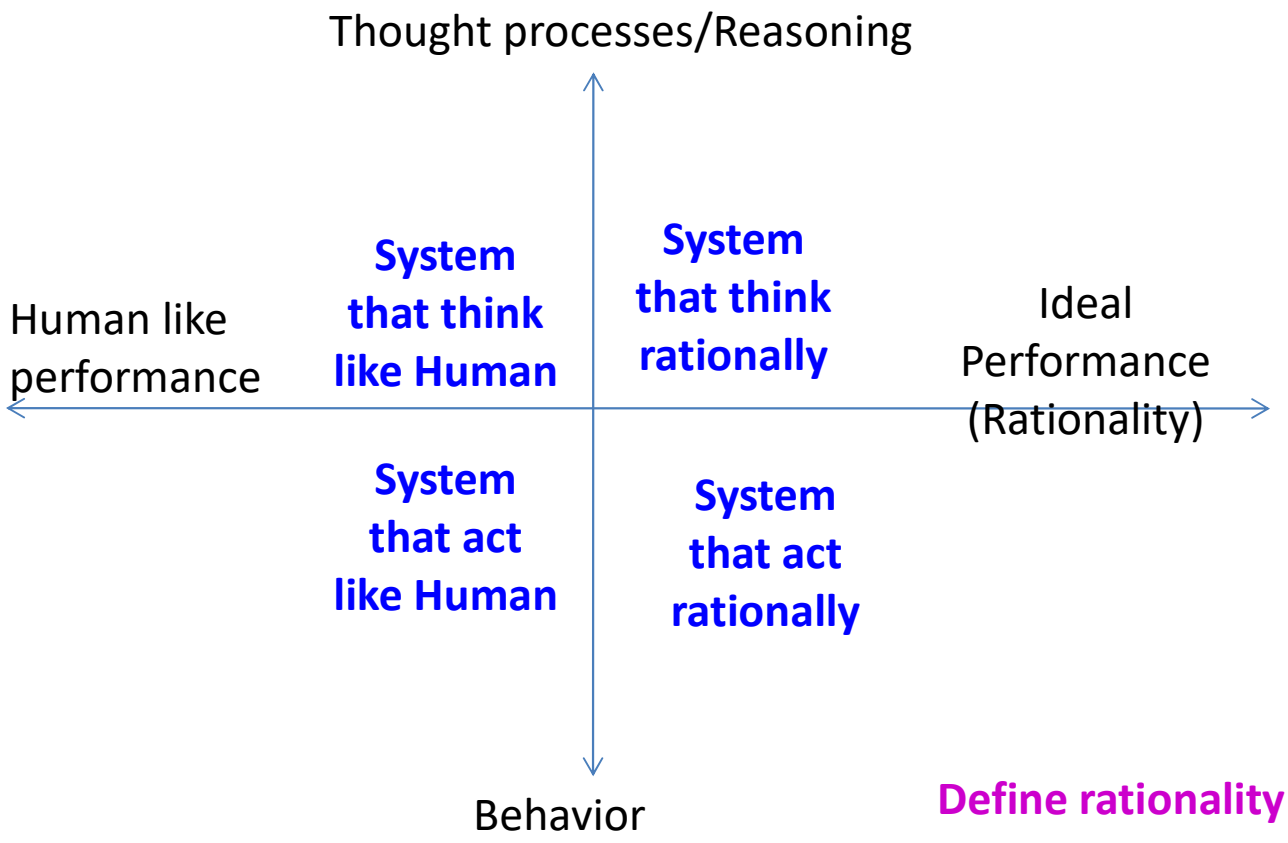
Thought processes/Reasoning Vs Behavior
Human like performance Vs Ideal Performance



Define AI

Approaches to AI

Thought processes/Reasoning Vs Behaviour
Human like performance Vs Ideal Performance

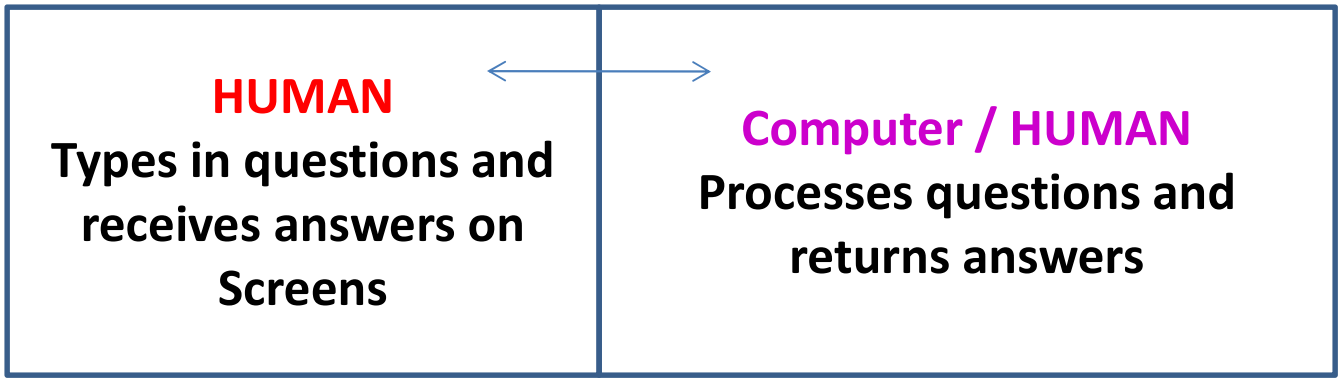


Define Rational

Rational thinking is the ability to consider the relevant variables of a situation and to

- access
- organize
- and analyze relevant information (e.g., facts, opinions, judgments, and data) to arrive at a sound conclusion.

TURING TEST



- If the interrogator is not able to distinguish between the human from computer from the response, then computer is said to possess the Intelligence (artificial)

Typical AI problems

- Intelligent entities or agents need to be able to do both mundane expert tasks:
- Examples for mundane tasks are:
  - Planning route
  - Recognition of objects or recognize faces of people
  - Communication through natural languages
  - Navigation through objects on the street
- Expert Task
  - Medical diagnosis
  - Mathematical problem solving

What is easy and what is hard?

It has very hard to mechanize tasks that lot of animals do easily by

- **Walking around without running into things**
- **Catching prey and avoiding predators**
- **Interpreting common sensory information**
- **Modeling internal states of other animals from their behavior**

Intelligent Behavior

- **Perception**
- **Reasoning**
- **Learning**
- **Understanding Language**
- **Solving Problems**

Practical Impact of AI

AI components are embedded into numerous devices (Eg. Copy machine)

AI systems are in everyday use. For eg:

- Detecting the credit card fraud
- Configuring products
- Aiding complex Planning Task
- Advising physicians

Intelligent tutorial system provides students with personalized attention

Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology
- Requires scientific theories of internal activities of the brain
- How to validate? Requires
  - Predicting and testing behavior of human subjects (top-down)
  - Or Direct identification from neurological data (bottom-up)
- Both approaches (Cognitive Science and Cognitive Neuroscience) are now distinct from AI

Thinking rationally: "laws of thought"

- Aristotle: what are correct arguments/thought processes?
- Several Greek schools developed various forms of *logic*: *notation* and *rules of derivation* for thoughts; may or may not have proceeded to the idea of mechanization
- Direct line through mathematics and philosophy to modern AI Problems:
  1. Not all intelligent behavior is mediated by logical deliberation
  2. What is the purpose of thinking? What thoughts should I have

Acting rationally: Rational agent

- **Rational behavior: doing the right thing**
- **The right thing: that which is expected to maximize goal achievement, given the available information**
- **Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action**

Define agent

Rational agents

- An agent is an entity that perceives and acts
- Abstractly, an agent is a function from percept histories to actions:

$$[f: \mathcal{P}^{\star} \rightarrow \mathcal{A}]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
- Caveat: computational limitations make perfect rationality unachievable

  → design best program for given machine resources

Question ??

Examine the AI literature to discover whether the following tasks can currently be solved by computers

- **Buying a week's worth of groceries at the market**
- **Discovering and providing new mathematical theorems**
- **Performing a complex surgical operations**

Question

“Surely animals, humans and computers cannot be intelligent , they can do only what their constituent atoms are told to do by the laws of physics”. Is the latter statement true, and does it imply the former?

AI prehistory

• Philosophy	Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality
• Mathematics	Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
• Economics	utility, decision theory
• Psychology	phenomena of perception and motor control, experimental techniques
• Computer engineering	building fast computers
• Control theory	design systems that maximize an objective function over time
• Linguistics	knowledge representation, grammar

Abridged history of AI

- 1943 — McCulloch & Pitts: Boolean circuit model of brain
- 1950 — Turing's "Computing Machinery and Intelligence"
- 1956 — Dartmouth meeting: "Artificial Intelligence" adopted
- 1952—69 — Look, Ma, no hands!
- 1950s — Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1965 — Robinson's complete algorithm for logical reasoning
- 1966—73 — AI discovers computational complexity
Neural network research almost disappears
- 1969—79 — Early development of knowledge-based systems
- 1980-- — AI becomes an industry
- 1986-- — Neural networks return to popularity
- 1987-- — AI becomes a science
- 1995-- — The emergence of intelligent agents

State of the art

- Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
- Proved a mathematical conjecture (Robbins conjecture) unsolved for decades
- Translator (Doctor - Patient)
- No hands across America (driving autonomously 98% of the time from Pittsburgh to San Diego)
- 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
- NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft
- `Proverb` solves crossword puzzles better than most humans

State of the art …contd

- **Internet Agents**
  - Monitoring of user tasks
  - Seek for the needed information
  - Learn which information is most useful

APPROACHES TO AI

- Strong AI
- Weak AI
- Applications AI
- Cognitive AI

Name the approaches of AI

AI related topics

Core Areas:

- **Knowledge Representation**
- **Reasoning**
- **Machine Learning**

Perception

- **Vision**
- **NLP**
- **Robotics**

AI related topics …contd

- Uncertain ability
  - Probabilistic approaches
- General Algorithms
  - Search
  - Planning
  - Constraint satisfaction
- Applications
  - Game playing
  - AI and education
  - Distributed Agents
- Decision Theory
- Reasoning with symbolic data