
Introduction to Artificial Intelligence

Artificial Intelligence

- ❑ Modeling human cognition or mental ability using computers
- ❑ Study of making computers do things which at the moment people better
- ❑ Making computers do things which require intelligence

More Formal Definition of AI

- AI is a branch of computer science which is concerned with the study and creation of computer systems that exhibit
 - ❑ some form of intelligence
 - OR
 - ❑ those characteristics which we associate with intelligence in human behavior

- AI is a broad area consisting of different fields, from machine vision, expert systems to the creation of machines that can "think".
- In order to classify machines as "thinking", it is necessary to define intelligence.

What is Intelligence?

- Intelligence is a property of mind that encompasses many related mental abilities, such as the capabilities to
 - reason
 - plan
 - solve problems
 - think abstractly
 - comprehend ideas and language and
 - learn

Characteristics of AI systems

- learn new concepts and tasks
- reason and draw useful conclusions about the world around us
 - remember complicated interrelated facts and draw conclusions from them (inference)
- understand a natural language or perceive and comprehend a visual scene
 - look through cameras and see what's there (vision), to move themselves and objects around in the real world (robotics)

Contd..

- plan sequences of actions to complete a goal
- offer advice based on rules and situations
- may not necessarily imitate human senses and thought processes
 - but indeed, in performing some tasks differently, they may actually exceed human abilities
- capable of performing intelligent tasks effectively and efficiently
- perform tasks that require high levels of intelligence

Understanding of AI

- AI techniques and ideas seem to be harder to understand than most things in computer science
- AI shows best on complex problems for which general principles don't help much, though there are a few useful general principles

- Artificial intelligence is also difficult to understand by its content.
- Boundaries of AI are not well defined.
- Often it means the advanced software engineering, sophisticated software techniques for hard problems that can't be solved in any easy way.
- AI programs - like people - are usually not perfect, and even make mistakes.

- It often means, nonnumeric ways of solving problems, since people can't handle numbers well.
- Nonnumeric ways are generally "common sense" ways, not necessarily the best ones.
- Understanding of AI also requires an understanding of related terms such as intelligence, knowledge, reasoning, thought, cognition, learning, and a number of other computer related terms.

Categories of AI System

- Systems that think like humans
- Systems that act like humans

- Systems that think rationally
- Systems that act rationally

Systems that think like humans

- Most of the time it is a black box where we are not clear about our thought process.
- One has to know functioning of brain and its mechanism for possessing information.
- It is an area of cognitive science.
 - The stimuli are converted into mental representation.
 - Cognitive processes manipulate representation to build new representations that are used to generate actions.
- Neural network is a computing model for processing information similar to brain.

Systems that act like humans

- The overall behaviour of the system should be human like.
- It could be achieved by observation.

Systems that think rationally

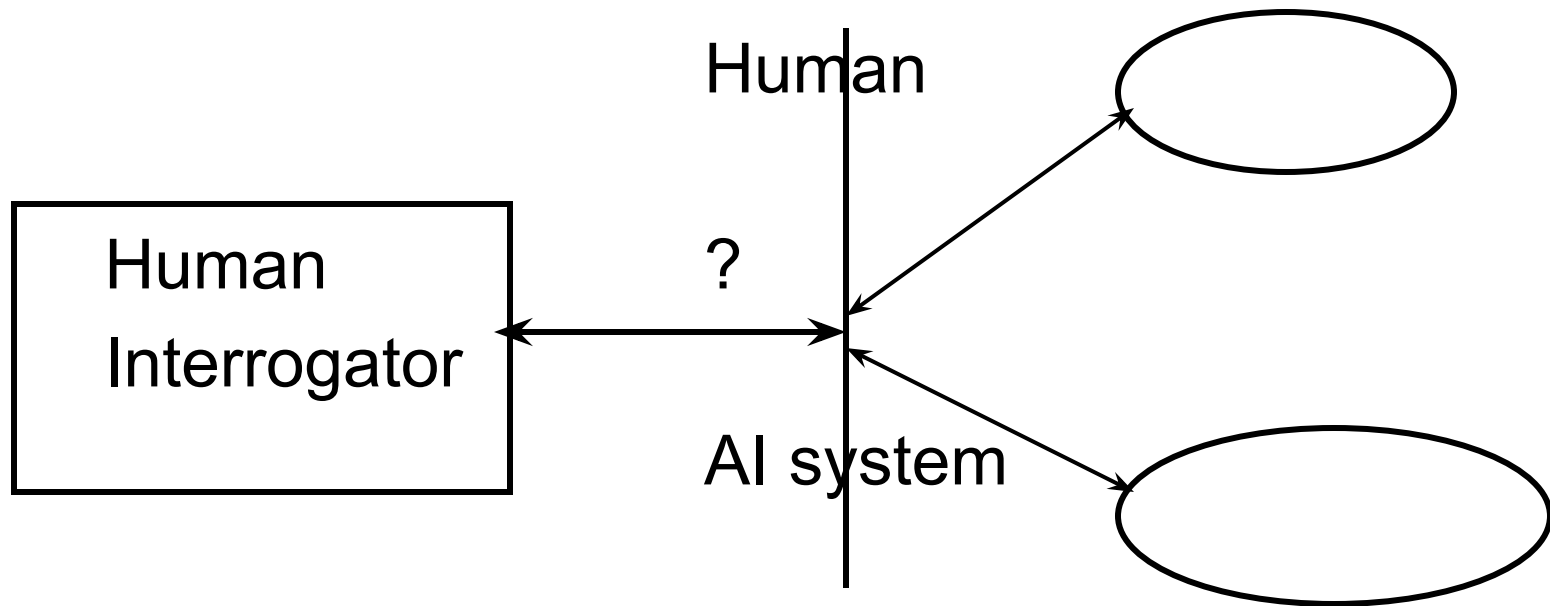
- Such systems rely on logic rather than human to measure correctness.
- For thinking rationally or logically, logic formulas and theories are used for synthesizing outcomes.
- For example,
 - given John is a human and all humans are mortal then one can conclude logically that John is mortal
- Not all intelligent behavior are mediated by logical deliberation.

Systems that act rationally

- Rational behavior means doing right thing.
- Even if method is illogical, the observed behavior must be rational.

The Turing Test

Turing proposed operational test for intelligent behavior in 1950.



ELIZA

- Eliza was first program developed by Joseph Wiezbaum to converse in English in mid 1960's
 - It passed turing test.
- The following passage shows Eliza's talking to a teenage girl. Blue text Eliza's response

Men are all alike.

IN WHAT WAY

They're always bugging us about something or other.

CAN YOU THINK OF A SPECIFIC EXAMPLE

Well, my boyfriend made me come here.

YOUR BOYFRIEND MADE YOU COME HERE

He says that I am depressed all the time.

I AM SORRY TO HEAR THAT YOU ARE DEPRESSED

It's true that I am unhappy

*DO YOU THINK COMING HERE WILL HELP YOU NOT
TO BE UNHAPPY*

I need help, that seems certain.

WHAT WOULD IT MEAN IF YOU GOT SOME HELP

Perhaps I could learn to get along with my mother.

TELL ME MORE ABOUT YOUR FAMILY

My mother takes care of me.

WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU

My father.

YOUR FATHER

You are like my father in some ways.

WHAT RESEMBLANCE DO YOU SEE

You are not very aggressive but I think you don't want me to notice that.

WHAT MAKES YOU THINK THAT I AM NOT VERY AGGRESSIVE

You don't argue with me.

WHY DO YOU THINK I DON'T ARGUE WITH YOU

You are afraid of me.

DOES IT PLEASE YOU TO BELIEVE, I AM AFRAID OF YOU

My father is afraid of everybody.

WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER

Bullies.

DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT YOUR BOYFRIEND MADE YOU COME HERE

Foundations of AI

- Foundation of AI is based on
 - ❑ Mathematics
 - ❑ Neuroscience
 - ❑ Control Theory
 - ❑ Linguistics

Foundations - Mathematics

- More formal logical methods
 - Boolean logic
 - Fuzzy logic
- Uncertainty
 - The basis for most modern approaches to handle uncertainty in AI applications can be handled by
 - ✓ Probability theory
 - ✓ Modal and Temporal logics

Foundations - Neuroscience

- How do the brain works?
 - Early studies (1824) relied on injured and abnormal people to understand what parts of brain work
 - More recent studies use accurate sensors to correlate brain activity to human thought
 - By monitoring individual neurons, monkeys can now control a computer mouse using thought alone
 - Moore's law states that computers will have as many gates as humans have neurons in 2020
 - How close are we to have a mechanical brain?
 - Parallel computation, remapping, interconnections,....

Foundations – Control Theory

- ❑ Machines can modify their behavior in response to the environment (sense/action loop)
 - Water-flow regulator, steam engine governor, thermostat
- ❑ The theory of stable feedback systems (1894)
 - Build systems that transition from initial state to goal state with minimum energy
 - In 1950, control theory could only describe linear systems and AI largely rose as a response to this shortcoming

Foundations - Linguistics

- Speech demonstrates so much of human intelligence
 - Analysis of human language reveals thought taking place in ways not understood in other settings
 - Children can create sentences they have never heard before
 - Language and thought are believed to be tightly intertwined

Two Views of AI Goals

- AI is about duplicating what the (human) brain DOES
 - Cognitive Science
- AI is about duplicating what the (human) brain SHOULD do
 - Rationality (doing things logically)

Task Domains of AI

- Mundane Tasks:
 - Perception
 - Vision
 - Speech
 - Natural Languages
 - Understanding
 - Generation
 - Translation
 - Common sense reasoning
 - Robot Control

- Formal Tasks
 - ❑ Games : chess, checkers etc
 - ❑ Mathematics: Geometry, logic, Proving properties of programs
- Expert Tasks:
 - ❑ Engineering (Design, Fault finding, Manufacturing planning)
 - ❑ Scientific Analysis
 - ❑ Medical Diagnosis
 - ❑ Financial Analysis

AI Techniques

- Rule-based
- Fuzzy Logic
- Neural Networks
- Genetic Algorithms

Components of AI Program

- AI techniques must be independent of the problem domain as far as possible.
- AI program should have
 - ❑ knowledge base
 - ❑ navigational capability
 - ❑ inferencing

Knowledge Base

- AI programs should be learning in nature and update its knowledge accordingly.
- Knowledge base consists of facts and rules.
- Characteristics of Knowledge:
 - It is voluminous in nature and requires proper structuring
 - It may be incomplete and imprecise
 - It may keep on changing (dynamic)

Navigational Capability

- Navigational capability contains various control strategies
- Control Strategy
 - determines the rule to be applied
 - some heuristics (thumb rule) may be applied

Inferencing

- Inferencing requires
 - search through knowledge base
and
 - derive new knowledge

Sub-areas of AI

- Sub areas of AI are:
 - ❑ Knowledge representation
 - ❑ Theorem proving
 - ❑ Game playing
 - ❑ Common sense reasoning dealing with uncertainty and decision making
 - ❑ Learning models, inference techniques, pattern recognition, search and matching etc.
 - ❑ Logic (fuzzy, temporal, modal) in AI
 - ❑ Planning and scheduling

Sub-areas of AI – Contd..

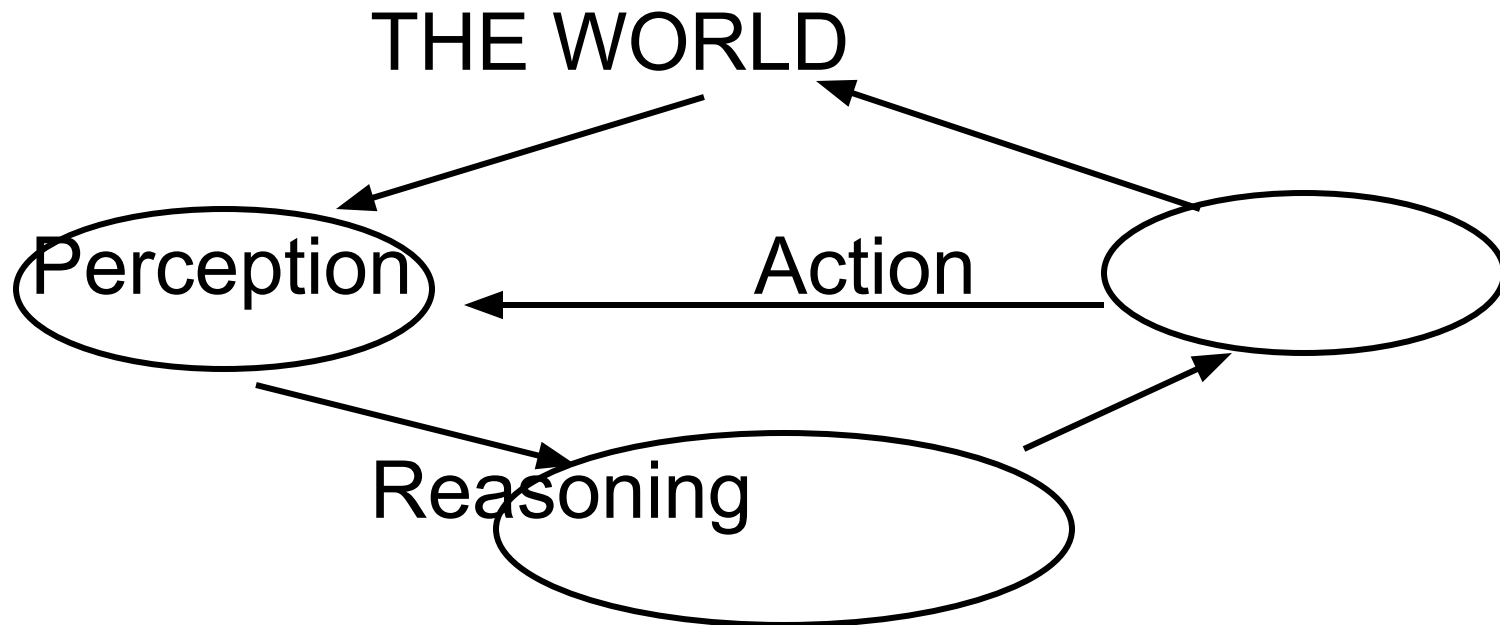
- Natural language understanding
- Computer vision
- Understanding spoken utterances
- Intelligent tutoring systems
- Robotics
- Machine translation systems
- Expert problem solving
- Neural Networks, AI tools etc

Applications

- Some of the applications are given below:
 - ❑ **Business** : Financial strategies, give advice
 - ❑ **Engineering**: check design, offer suggestions to create new product
 - ❑ **Manufacturing**: Assembly, inspection & maintenance
 - ❑ **Mining**: used when conditions are dangerous
 - ❑ **Hospital** : monitoring, diagnosing & prescribing
 - ❑ **Education** : In teaching
 - ❑ **household** : Advice on cooking, shopping etc.
 - ❑ **farming** : prune trees & selectively harvest mixed crops.

Latest Perception of AI

- Three typical components of AI Systems



Recent AI

- Heavy use of
 - ❑ probability theory
 - ❑ decision theory
 - ❑ statistics
 - ❑ logic (fuzzy, modal, temporal)