Artificial Intelligence and Expert System

MCA II Semester

Outline

- Why AI
- Course objective and outcome
- Turing test
- Eliza and its characteristics
- Types of AI Problem
- Foundation Of AI
- History of AI
- Definitions

Why Artificial Intelligence?

- World of automation
- Want computer to do task way humans perform
- Humans are Intelligent
- Want to make system intelligent
- How?
- Make them

Learn *Understand* *Decide* *Think*

Solve problems the way human do it

Objectives of the course

- To make students understand the **techniques** of problem solving
- How the **knowledge** is used, stored and processed for solving problems.
- How system can understand a **natural language**
- How system can use **planning** to solve problem
- How system work under **uncertain** situations
- How can we make system **learn** concepts
- How can we design a **expert system**

Outcome

- You will be familiar with problem solving techniques and will have an idea to implement the technique for solving the problem
- You will be able to create knowledge structure and deduce answers
- You will be create syntactic and semantic structures for natural language
- You will have idea how planning methods are used to solve more complex problems
- You will have understanding of techniques implemented in uncertain situation
- Basic concept of expert system

What is AI?

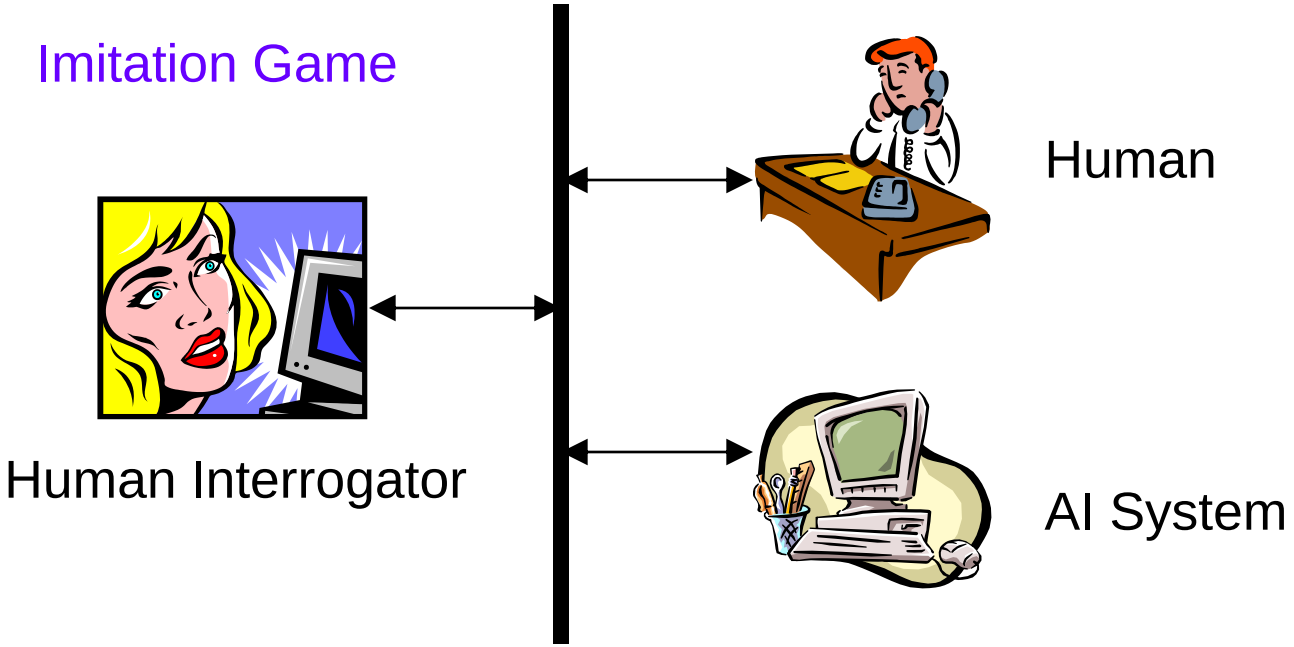
- Intelligence: “ability to learn, understand and think” (Oxford dictionary)

- AI is the study of how to make computers make things which at the moment people do better.

- Examples:
  - Smell, feel identification of Face, Object
  - Language and Speech recognition
  - Inferencing, Intuition Learning new skills
  - Decision making, Abstract thinking

Acting Humanly: The Turing Test

- Alan Turing (1912-1954)
- “Computing Machinery and Intelligence” (1950)



Turing test

- AI is a branch of computer science that is concerned with the automation of intelligent behavior (Lugger and Stubblefield 1993)
- The first view
  - is that AI is about duplicating what human brain DOES (Cognitive Science)
- Second view
  - is that AI is about duplicating what (humans) brain should do, that is doing logically or rationally.
- A system is said to have passed turing test if human interrogator is unable to determine whether he/she is talking to a computer or a human

Turing Test

- The very first system to pass this test was ELIZA
- Eliza was first program that conversed with user in English- (Joseph Wiezbaum 1960's)
- It stored subject information in data bank.
- Picked up speech pattern from user's question and provide responses using those patterns
- The following passage shows Eliza's talking to a teenage girl. Blue text Eliza's response

ELIZA [Weizenbaum 1966]

Hello , I am Eliza

Can you help me?

Don’t you believe that I can help you

Yes

I see

I feel depressed

How long have you been feeling depressed

Since last month

That is quite interesting

What is interesting in this

Have you asked anyone else?

No

Are you saying no just to be negative

ELIZA…

HOW DO YOU DO. PLEASE STATE YOUR PROBLEM

I'm wondering whether computers can think.

WHY DO YOU MENTION COMPUTERS

Since you are one I thought I would ask you - can you think?

DID YOU THINK THEY MIGHT NOT BE ONE YOU THOUGHT YOU WOULD ASK I -CAN I THINK

Let's talk just about you - not me. Can you think?

YOU LIKE TO THINK I - NOT YOU - DON'T YOU

Pardon?

WHAT DOES THAT SUGGEST TO YOU?

What does it suggest to you?

TELL ME ABOUT WHAT DOES IT SUGGEST TO I

That's nonsense - which of us do you mean by I?

WHY DO YOU THINK I MEAN BY YOU

The question meant to which of us is the word referring.

SUPPOSE THE QUESTION MEANT TO WHICH OF US WERE NOT THE WORD REFERRING

I think you are an extremely stupid program.

PERHAPS YOU WOULD LIKE TO BE AN EXTREMELY STUPID PROGRAM

Main Characteristics of ELIZA

- Simulation of intelligence:
  - Eliza program were not intelligent in real sense.
  - They simulate intelligent behavior
  - By recognizing keyword and phrases
- Quality of response
  - Limited syntactic structure
  - Number of template available are less
- Coherence
  - Each response was based on the current input
  - No context information was used
  - Intelligent system take into consideration coherence of conversation
- Semantics
  - No semantic representation of the content of either user input or reply
  - Imitates user conversation style

AI Problems

- Game playing
  - Display intelligence
  - Faster solutions
  - Exponential growth

  Samuel- Checkers problem
  Chess
- Theorem proving
  - Gelenter's theorem proving
- Commonsense reasoning
  - Reasoning about physical objects and relation with each other
  - Newell Shaw and Simon built General problem solver(GPS)
  - It was applied to several common sense task
  - Simple task were selected
  - No attempt to solve problem with large amount of knowledge
- Perception , Natural Language processing. Special domain problems

AI Problems

- Large amount of knowledge was considered in
  - Perception: *vision and speech*
    - More difficult to achieve
    - Requires processing analog rather than digital signal
  - Natural language understanding
  - Problem solving in specialized domain Medical diagnosis and chemical analysis
    - MYCIN and DENDRYL
  - Others : Scientific task, designing task, financial planning

Task Domains of AI

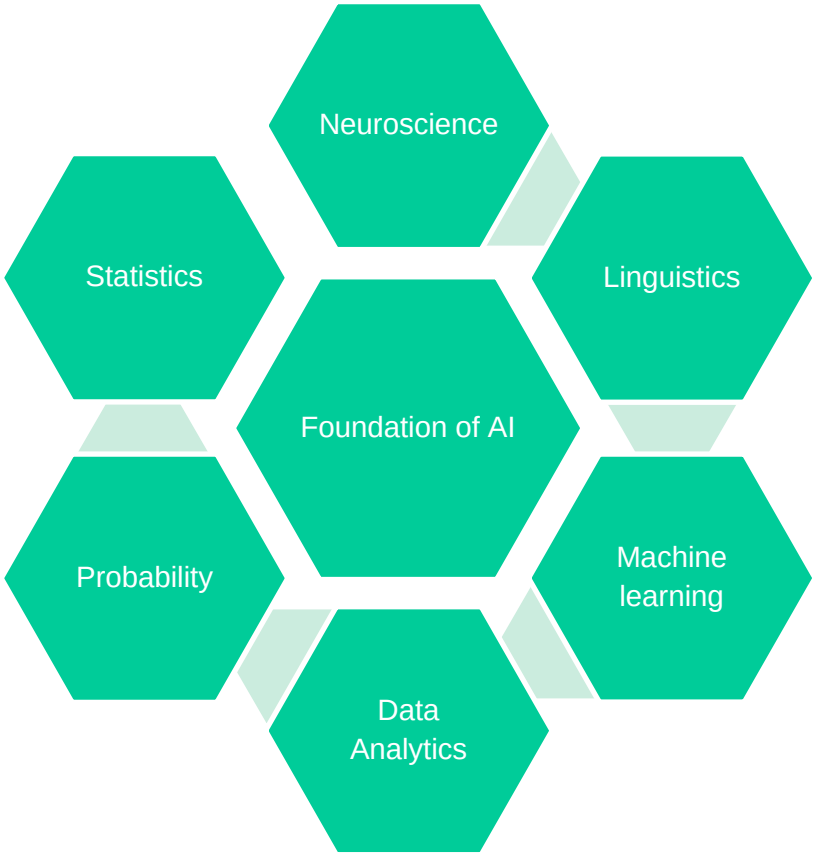
- Mundane Tasks:
  - Perception
    - Vision
    - Speech
  - Natural Languages
    - Understanding
    - Generation
    - Translation
  - Common sense reasoning
  - Robot Control
- Formal Tasks
  - Games : chess, checkers etc
  - Mathematics: Geometry, logic,Proving properties of programs
- Expert Tasks:
  - Engineering (Design, Fault finding, Manufacturing planning)
  - Scientific Analysis
  - Medical Diagnosis
  - Financial Analysis

The Foundations of AI

- Commonly used AI techniques and theories are
  - rule based ,
  - fuzzy logic,
  - neural networks,
  - decision theory,
  - statistics,
  - probability ,
  - genetic algorithm.etc

- Since AI is interdisciplinary in nature. foundations of AI are in various fields such as:

Foundations Of AI



Foundations

- Mathematics
  - AI systems uses formal logic and Boolean logic
  - Formal representation and proof.
  - Algorithms, computation, decidability, tractability.
  - Probability, statistical methods ,fuzzy inferencing
- Neuroscience
  - Science that helps in studying working of brain
  - Sensors are used to correlate brain activity to human thought process
  - Monitoring how neurons behave inside brain
  - Simulation –neural network theory,

The Foundations of AI

- Control Theory
  - Machine can modify their behaviour in response to environment
  - Stem engines are governed by thermostat, water-flow regulator
  - Such theory help in building system in which transition occurs from initial state to goal state with minimum energy

- Linguistics
  - Analysis of natural language
  - Allows thought to be transmitted in best form
    - Knowledge representation.
    - Grammar.

A Brief History of AI

- The gestation of AI (1943 – 1956):
  - 1943: McCulloch & Pitts: Boolean circuit model of brain.
  - 1950: Turing's "Computing Machinery and Intelligence".
  - 1956: McCarthy's name "Artificial Intelligence" adopted.
- After1950
  - Chess playing programs were developed by Shannon at MIT and RAND corporation
  - Other game playing and simulation programs were developed
  - Language translation programs were developed by Weaver in 1955
  - Early researchers were John macrthy, Marvin Minsky, Trenchard More, Allen Newell. Herbert Simon

A Brief History of AI

- **IBM's Deep Blue** that Kasparov lost his first game to a computer at tournament time
- In 1998, **Rebel 10** defeated Vishwanathan Ananad who at the time was ranked second in the world, by a score of 5–3. However most of those games were not played at normal time controls
- In the early 2000s, commercially available programs such as ***junior*** and ***Fritz*** were able to draw matches against former world champion Garry Kasparov and classical world champion Vladimir Kramnik

A Brief History of AI

- Early enthusiasm, great expectations (1952 – 1969):
  -Early successful AI programs: Samuel's checkers,

  -Newell & Simon's Logic Theorist, Gelernter's Geometry theorem proving written in FORTRAN at IBM

  -automatic Theorem Proving by Simon,Newell ,Shaw

  -General Problem Solver(GPS) developed by Newell and Simon in IPL solved variety of problems ranging from symbolic integration to word puzzle and missionary cannibles problem

A Brief History of AI

- Robinson's complete algorithm for logical reasoning.
- First list processing language---IPL(information processing language) was also completed
- Elementary Perceiver and memorizer (EPAM) was written in IPL
  - is a psychological theory of learning and memory implemented as a computer program. Originally designed by Herbert Simon and Edward to simulate phenomena in verbal learning
- Pattern recognition using perceptrons were receiving attention
- In 1958 first AI language LISP was developed by

John MaCarthy at MIT

A Brief History of AI

- A dose of reality (1966 – 1974):
  - AI discovered computational complexity.
  - Neural network research almost disappeared after Minsky & Papert's book in 1969.

- Knowledge-based systems (1969 – 1979):
  - 1969: DENDRAL program that analyzes organic compound to determine their structure by Buchanan et al..
  - 1976: MYCIN a medical diagnostic program by Shortliffle.
  - 1979: PROSPECTOR program to locate the deposits of mineral like copper and uranium by Duda et al..

A Brief History of AI

- Natural language understanding
  - LUNAR system
    - Designed as language interface
    - For geologists
    - To access database containing information on lunar rock and soil composition obtained during NASA Apollo-II moon landing mission
    - Three major components were
      - General purpose grammar and ATN parser
      - Rule driven semantic interpreter
      - Database retrieval and inference component

A Brief History of AI

- AI becomes an industry (1980 – 1988):
  - Expert systems industry booms.
  - 1981: Japan's 10-year Fifth Generation project.

- The return of NNs and novel AI (1986 – present):
  - Mid 80's: Back-propagation learning algorithm reinvented.
  - Expert systems industry busts.
  - 1988: Resurgence of probability.
  - 1988: Novel AI (ALife, GAs, Soft Computing, …).
  - 1995: Agents everywhere.
  - 2003: Human-level AI back on the agenda.

Definition of AI

- AI is field of computer science which is concerned with
  - Study and creation of computer system that exhibit some intelligence
  - System that learn new concept
  - System that can reason and draw conclusions
  - System that understand a natural language, perceive and comprehend a visual space
  - system that perform other type of features that require human type of intelligence

Definition of AI

"The study of how to make computers do things at which, at the moment, people are better"
(Rich and Knight, 1991)

"A field of study that seeks to explain and emulate intelligent behavior in terms of computationl processes"
(Schalkoff, 1990)

"The branch of computer science that is concerned with the automation of intelligent behaviour"
(Luger and Stubblefield, 1993)

Definition of AI

"A collection of algorithms that are computationally tractable, adequate approximations of intractabiliy specified problems"
(Partridge, 1991)

"The enterprise of constructing a physical symbol system that can reliably pass the Turing test"
(Ginsberge, 1993)

"The f ield of computer science that studies how machines can be made to act intelligently"
(Jackson, 1986)