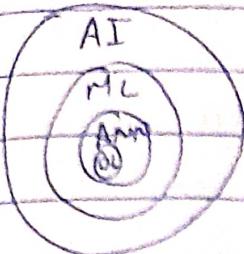


## Module - 3

### JOT



AI → any techniques that enable machine to solve a task in a way like human do.

ML → algorithms that allow computers to learn from examples without being explicitly programmed

ANN → Brain inspired machine learning models

Deep learning → a subset of ML uses deep artificial neural networks as models and automatically builds a hierarchy of data representation.

What is AI?

- It is a branch of Computer science that pursues creating the computers or machines as intelligent as human beings
- making intelligent computer program
- study to make computers do things, which at the moment, people do better
- AI is the ability for a computer to think, learn & simulate human mental process, such as perceiving, reasoning & learning
- it can also independently perform complex tasks that once required human input

- AI is to write Computer programs which can mimic human brain problem solving capabilities

### USES OF AI

① Image & Facial recognition → It can help make data safer and more secure for eg. face authentication can ensure that

only the appropriate person has access to sensitive information that is intended specifically for them.

② Medical diagnosis → provides more exact diagnoses, detects hidden patterns in imaging investigations, and predicts how patient will respond to specific medications. leads to better treatment strategies.

③ Customer service → can get feedback from AI

④ Recommendation system -

### Disadvantages of AI

- lack of transparency, Bias & discrimination

- privacy concerns

- ethical dilemmas

- security risks

- concentration of power

- dependence on AI

- job displacement

AI vocabulary -

Intelligence → relates to tasks involving higher mental process. Intelligence is the computational part of the ability to achieve goals.

Intelligent behavior - is depicted by perceiving one's environment, acting in complex environment, learning & understanding from experience, reasoning to solve problems & discover hidden knowledge, applying knowledge successfully in new situations, thinking abstractly, using analogies, communicating with others & more.

Science based goals of AI → pertain to developing concepts, mechanism & understanding biological intelligent behavior

Engineering based goals of AI → relate to developing concepts, theory & practice of building intelligent machine, the emphasis is on System building.

AI techniques - depict how we represent, manipulate and reason with knowledge in order to solve problems. Knowledge is a collection of 'facts'. To manipulate these facts by program a suitable representation is required. A good representation facilitates problem solving.

learning - program learns from what facts or behavior can represent. learning denotes changes in the systems that are adaptive in other words. it enables the system to do same tasks efficiently.

### # Responsible AI USE

- AI can help do repetitive work for humans but human should prioritize there work.
- Business should adopt security measures, limit access to sensitive data, and anonymize data whenever possible to secure data privacy with AI & ML Technologies.
- data used to train AI should be unbiased if it so the AI <sup>will</sup> always favour over another
- AI systems should be understandable and transparent. mean decision made by AI should be clear to everyone

# problems of AI

# branches of AI

① Logical AI → In general the facts of the specific situation in which it must act and its goals are represented by sentence of some mathematical logical language. The program decides what to do by inferring that certain actions are appropriate for achieving its goals.

Search - AI programs examine large no. of possibilities

② pattern Recognition → when a program makes observations of some kind. It is often planned to compare what it sees with a pattern e.g. a vision program may try to match a pattern of eyes & a nose in a sense in order to find a face.

Representation - usually languages of mathematical logic are used to represent the facts about the world.

③ Inference - drawing conclusions based on certain facts or information. Sometimes we make conclusions automatically based on what we usually know but these conclusions can change if new information comes in. This is called default reasoning.

④ Common Sense Knowledge & Reasoning -  
developing systems of non-monotonic reasoning  
and theories of action.

⑤ learning from experience - there are some rules  
expressed in logic for learning  
programs can only learn what facts or behavior and  
unfortunately learning systems are almost based  
on very limited abilities to represent information

⑥ planning : planning starts with general facts about the  
world (especially facts about the effects of  
actions), facts about the particular situation, and a  
statement of a goal . from these , planning programs  
generate a strategy , sequence of actions for achieving  
the goal .

⑦ epistemology → study of the kinds of knowledge that  
are required for solving problems in the  
world .

⑧ ontology → Study of kinds of things that exists -  
in AI programs and sentences deal with various  
kinds of objects and we study what these kinds  
are and what their basic properties are .

⑨ Heuristics - a heuristic is a way of trying to discover  
something or an idea embedded in a  
program . Heuristic functions are used in some  
approaches to search or to measure how far a node  
in a search tree seems to be from goal .

(10) Genetic Programming - Genetic programming is an automated method for creating a working computer program from a high-level problem statement of a problem. Genetic programming starts from a high-level statement of what needs to be done.

AI techniques is a method that exploits knowledge that is presented

knowledge in AI systems is often generalized and grouped to simple representation, making it easier for humans to provide & understand

even if the much of the data is automatically stored human ilp is crucial. this knowledge should be easily modifiable to correct errors and adapt to changes.

Despite potential incompleteness or inaccuracies it remains useful

e.g. Tic-Tac-Toe

Text based

Method-1

set of templates that match common questions & produce patterns used to match again inputs.

Templates & patterns are used so that a template that matches a given question is associated with the corresponding patterns to find the answer in ilp text.

answering questions include

① Compare the template against the questions and store all successful matches to produce a set of text patterns

② pass these text patterns through a substitution process to change the person or voice and produce an expanded set of text patterns

③ apply each of these patterns to the text, collect all the answers and then print the answers

# if  $\alpha$  then  $\gamma$ , slot & filler systems & statements in mathematical logic. System used here will be the slot & filler systems.

### Algorithm:-

Convert the question to a structured form

using English know how, then use a marker to indicate the substring (like "Who" or "What") of the structure that should be returned as an answer. Answer appears by matching this structured form against the structure text.

The structure form is matched against the text and requested segments of the question are returned.

## # TWO CLASS problem

- ① First class of AI techniques: these involves searching for solution when no straightforward method exists. they use a knowledge about the problems and abstraction to narrow down options, making it possible to find a solution quickly preventing data from becoming overwhelming.
- ② Second class of AI problems: focus on solving complex problems that are challenging for computers using AI to mimic how humans would approach & solve them.

## # to solve the problem of building system following steps should be taken

- ① define the problem accurately including detailed specification and what constitutes a suitable solution.
- ② Scrutinize the problem carefully, for some method may have a central effect on the chosen method of solution.
- ③ Segregate and represent the background knowledge needed in the solution of the Problem.
- ④ Choose the best solving techniques for the problems to solve a solution.

problem solving is a process of generating solutions from observed data. a problem is characterized by a set of goals, set of objects & a set of operations

a problem space is an abstract space, a problem space encompasses all valid states that can be generated by application of any combination of objects. problem space contains one or more solutions. a solution is a combination of operations and objects that achieve the goal.

Search refers to the search for a solution in a problem space

search proceeds with different types of search control strategies

DFS & BFS are two common strategies

## # AI - General problem solving

problem solving is a process of generating solutions from observed or given data. it is not always possible to use direct methods. often needs to use indirect or model based methods

GPS (General Problem Solver) can solve any formalized symbolic problem, such as theorems proof & geometric problems & chess playing. it solved many simple problems

To build a system to solve a particular problem:

- Define the problem precisely - find initial situations as well as final situations for an acceptable solution to the problem
- analyze the problem - find few imp features that may have impact on the appropriateness of various possible techniques for solving the problem
- Isolate and represent task knowledge necessary to solve the problem
- Choose the best problem solving techniques and apply to the particular problem.

## # Problem definitions

a problem is defined by its elements and their relations

state space that contains all the possible configurations of the relevant objects, including some impossible ones.

one or more states that describe possible situations, from which the problem solving process may start. these states are called initial states.

Specify one or more states that would be acceptable solution to the problem. these states are called goal state.

Specify a set of rules that describes the actions available

The problem can then be solved by using the rules, in combination with an appropriate control strategy, to move through the problem space until a path from an initial state to a goal state is found. This process is known as Search.

Search provides the framework into which more direct methods for solving subparts of a problem can be embedded. A very large no. of AI problems are formulated as search problems.

A problem space is represented by a direct graph, where nodes represent search state and paths represent the operators applied to change the state.

### Tree

To simplify search algorithms, it is often convenient to logically & programmatically represent a problem space as a tree.

A tree usually decreases the complexity of a search at a cost. A tree is a graph in which any two vertices are connected by exactly one path.

Connected graph with no cycles is a tree.

## # Types of searches in AI

informed (Heuristic) & uninformed (Blind)

### ① Uninformed Search

apart from the problem definition, these algorithms don't know anything else about the states

- BFS  $\Rightarrow$  levelwise search
- DFS  $\Rightarrow$  Depthwise search
- cost search  $\Rightarrow$  to find the lowest-cost solution,  
uniform cost search expands the least cost node

### ② Informed search

make use of heuristics or extra information to direct the search more effectively in the direction of the desired state.

Greedy Best First search - choosing the node that seems to be closest to the objective using a heuristic.

A\*  $\rightarrow$  sums the projected cost from a node with the cost to get there.

## # Problem Solving

problem solving is a systematic search through a range of possible actions to reach some predefined goal or solution.

problem solving methods are categorized as special purpose & general purpose

Special Purpose methods - These are designed for specific problems & take advantage of the unique characteristics of that particular solution.

General purpose methods - These can be applied to many different problems. one

Common general-purpose technique in AI is called mean-end-analysis. this involves gradually reducing the gap between where you are now and where you want to be.

### # to solve the problem of playing a game

- ① the rules of the game are required
- ② Targets for winning, as well as representing positions in the game.
- ③ opening position, initial state & a winning position goal state.
- ④ moves from initial state to other states leading to the goal state follow legally
- ⑤ The rules are far too abundant in most games - especially in chess

### # a state space

a state space represents a problem in terms of states and operators that change states.

- a representation of the states the system can be
- a set of operators that can change one state into another state.

- an initial state.
- a set of final states

## # Production System

Production systems provide appropriate structures for performing and describing search processes

- a set of rules each consisting of a left side that determines the applicability of the rule and right side that describes the operations to be performed if the rule is applied
- a database of current facts established during the process of inference.
- a control strategy that specifies the order in which the rules will be compared with facts in the database and also specifies how to resolve conflicts in selection of several rules or selection of more facts
- a rule firing module

## Issues in searching

Tree can be searched fwd from the initial node to the goal state or backward from the goal state to the initial state.

To select applicable rules, it is critical to have an efficient procedure for matching rules against states.

## # Search algorithms

### properties of search algorithms

(i) Completeness - a search algorithm is said to be complete if it guarantees to return a solution if at least any solution exists for any random ilp

(2) optimality - if a solution found for an algorithm is guaranteed to be the best

Solution (lowest path cost) among all other solutions then such a solution for is said to be an optimal solution

(3) Time Complexity - Time complexity is a measure of time for an algorithm to complete its task.

① space Complexity - It is a maximum storage space required at any point during the search as the complexity of problem.

### Heuristic Search

Heuristic Search methods use knowledge about the problem domain & choose promising operator first. These heuristic search methods use heuristic functions to evaluate the next state towards the goal state.

Add domain-specific information to select what is the best path to continue searching along.

Define a heuristic function  $h(n)$  that estimates the 'goodness' of a node  $n$ .

Specifically,  $h(n)$  = estimated cost (or distance) of minimal lost path from  $n$  to a goal state.

Heuristic means 'serving to aid discovery' and is an estimate, based on domain specific information that is computable.

## Characteristics of heuristic search

Heuristic are knowledge about domain, which help search & reasoning in its domain

Heuristic Search incorporates domain knowledge to improve efficiency over blind search.

Heuristic is a function that when applied to a state, return values as estimated merit of state with respect to goal

- Heuristic might (for reasons) underestimate or overestimate the merit of a state with respect to goal
- Heuristics that underestimate are desirable are called admissible

Heuristic evaluation function estimates likelihood of a given state leading to goal state.

Heuristic search function estimates cost from current state to goal, presuming function is efficient