UNIT II

Introduction

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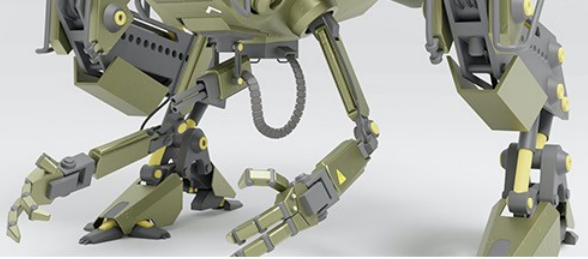
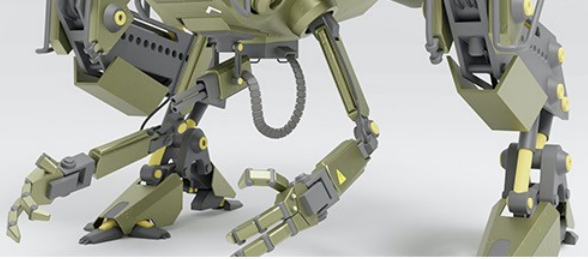
Unit II	Problem-solving	07 Hours
Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.		
#Exemplar/Case Studies	4th Industrial Revolution Using AI, Big Data And Robotics	
***Mapping of Course Outcomes for Unit II**	CO2, CO4	

Problem Solving



- The process of problem-solving is frequently used to achieve objectives or resolve particular situations.
- In computer science, the term "problem-solving" refers to artificial intelligence methods, which may include formulating ensuring appropriate, using algorithms, and conducting root-cause analyses that identify reasonable solutions.
- Artificial intelligence (AI) problem-solving often involves investigating potential solutions to problems through reasoning techniques, making use of polynomial and differential equations, and carrying them out and use modelling frameworks.
- A same issue has a number of solutions, that are all accomplished using an unique algorithm. Additionally, certain issues have original remedies. Everything depends on how the particular situation is framed.

Problem Solving



- Artificial intelligence is being used by programmers all around the world to automate systems for effective both resource and time management.
- Games and puzzles can pose some of the most frequent issues in daily life. The use of AI algorithms may effectively tackle this.
- Various problem-solving methods are implemented to create solutions for a variety complex puzzles, includes mathematics challenges such crypto-arithmetic and magic squares, logical puzzles including Boolean formulae as well as N-Queens, and quite well games like Sudoku and Chess.
- Therefore, these below represent some of the most common issues that artificial intelligence has remedied:
  Chess, N-Queen problem, Tower of Hanoi Problem, Travelling Salesman Problem, Water-Jug Problem

Problem Solving

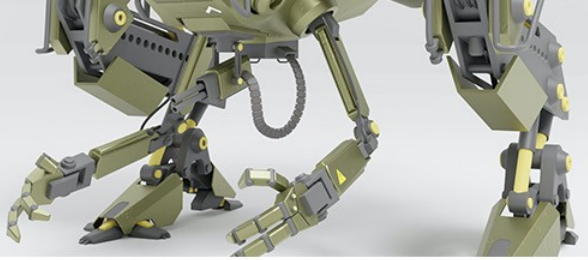
- So we can say that problem solving is a part of artificial intelligence that encompasses a number of techniques such as a tree, B-tree, heuristic algorithms to solve a problem.
- We can also say that a problem-solving agent is a result-driven agent and always focuses on satisfying the goals.
- There are basically three types of problem in artificial intelligence:

1. Ignorable: In which solution steps can be ignored.
2. Recoverable: In which solution steps can be undone.
3. Irrecoverable: Solution steps cannot be undo.

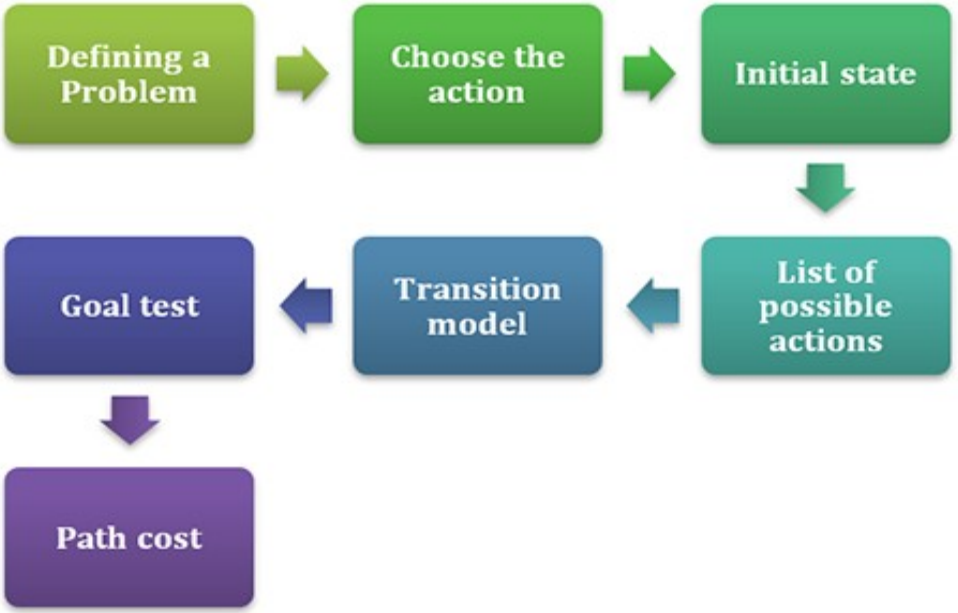
Problem Solving

- Steps problem-solving in AI: The problem of AI is directly associated with the nature of humans and their activities. So we need a number of finite steps to solve a problem which makes human easy works.
- These are the following steps which require to solve a problem :
- **Problem definition:** Detailed specification of inputs and acceptable system solutions.
- **Problem analysis:** Analyse the problem thoroughly.
- **Knowledge Representation:** collect detailed information about the problem and define all possible techniques.
- **Problem-solving:** Selection of best techniques.

Problem Solving



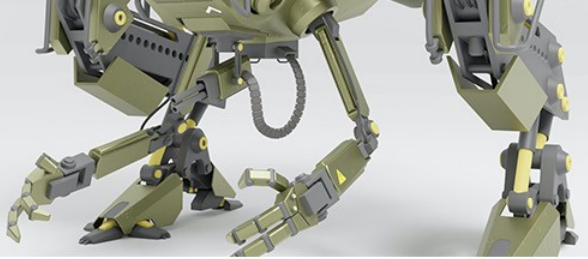
Steps performed in problem-solving



Problem Solving

- **Steps performed in problem-solving**
- **Initial State:** This state requires an initial state for the problem which starts the AI agent towards a specified goal. In this state new methods also initialize problem domain solving by a specific class.
- **Action:** This stage of problem formulation works with function with a specific class taken from the initial state and all possible actions done in this stage.
- **Transition:** This stage of problem formulation integrates the actual action done by the previous action stage and collects the final stage to forward it to their next stage.
- **Goal test:** This stage determines that the specified goal achieved by the integrated transition model or not, whenever the goal achieves stop the action and forward into the next stage to determines the cost to achieve the goal.
- **Path costing:** This component of problem-solving numerical assigned what will be the cost to achieve the goal. It requires all hardware software and human working cost.

Problem-solving agent



- The problem-solving agent perfoms precisely by defining problems and its several solutions.

1. According to psychology, “a problem-solving refers to a state where we wish to reach to a definite goal from a present state or condition.”
2. According to computer science, a problem-solving is a part of artificial intelligence which encompasses a number of techniques such as algorithms, heuristics to solve a problem.

- Therefore, a problem-solving agent is a goal-driven agent and focuses on satisfying the goal.

Example Problems

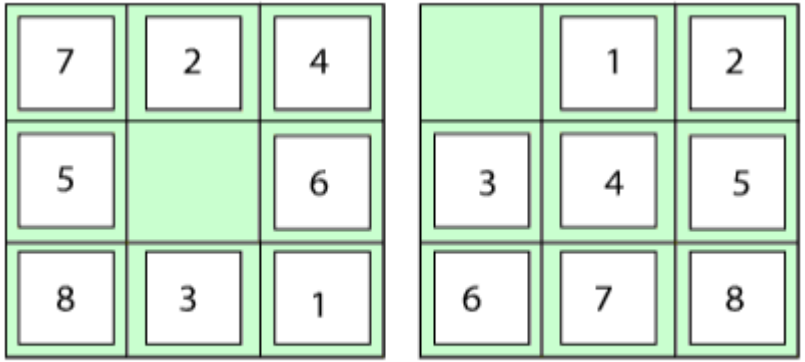
- Basically, there are two types of problem approaches:

- **Toy Problem:** It is a concise and exact description of the problem which is used by the researchers to compare the performance of algorithms.

- **Real-world Problem:** It is real-world based problems which require solutions. Unlike a toy problem, it does not depend on descriptions, but we can have a general formulation of the problem.

Toy Problem Example

- **8 Puzzle Problem:**
- Here, we have a 3×3 matrix with movable tiles numbered from 1 to 8 with a blank space. The tile adjacent to the blank space can slide into that space. The objective is to reach a specified goal state similar to the goal state, as shown in the below figure. In the figure, our task is to convert the current state into goal state by sliding digits into the blank space.



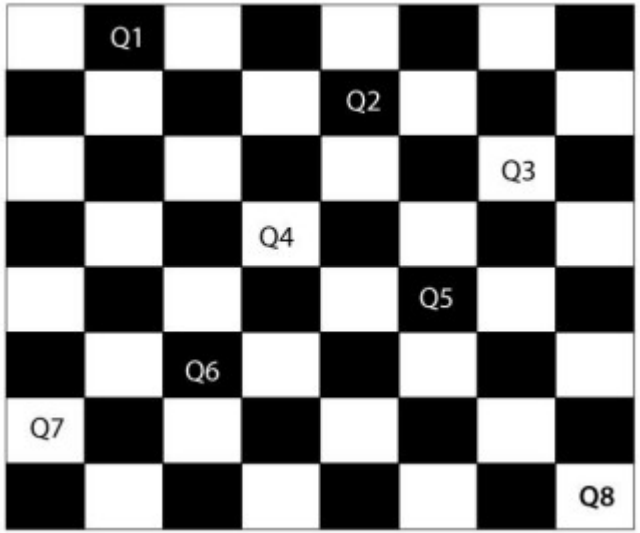
Example Problems

The problem formulation is as follows:

States: It describes the location of each numbered tiles and the blank tile.
Initial State: We can start from any state as the initial state.
Actions: Here, actions of the blank space is defined, i.e., either left, right, up or down
Transition Model: It returns the resulting state as per the given state and actions.
Goal test: It identifies whether we have reached the correct goal-state.
Path cost: The path cost is the number of steps in the path where the cost of each step is 1.

Toy Problem Example

- **8-queens problem:** The aim of this problem is to place eight queens on a chessboard in an order where no queen may attack another. A queen can attack other queens either diagonally or in same row and column.
- From the following figure, we can understand the problem as well as its correct solution.



Toy Problem Example

- There are two main kinds of formulation:

  1. Incremental formulation: It starts from an empty state where the operator augments a queen at each step.

Following steps are involved in this formulation:

States: Arrangement of any 0 to 8 queens on the chessboard.

Initial State: An empty chessboard

Actions: Add a queen to any empty box.

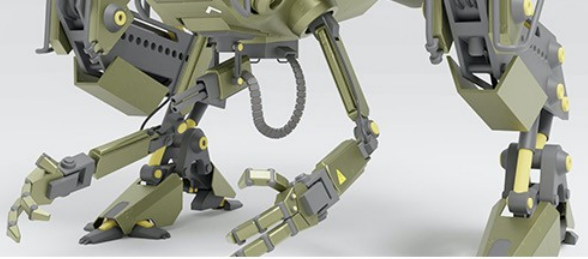
Transition model: Returns the chessboard with the queen added in a box.

Goal test: Checks whether 8-queens are placed on the chessboard without any attack.

Path cost: There is no need for path cost because only final states are counted.

- In this formulation, there is approximately 1.8 x 10^14 possible sequence to investigate.

Toy Problem Example



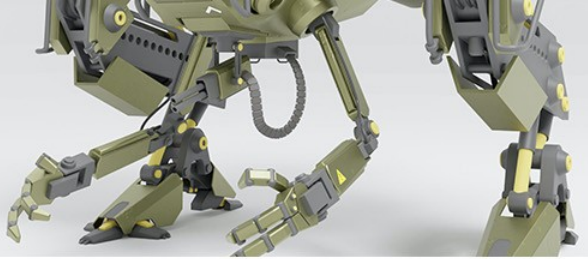
2. Complete-state formulation: It starts with all the 8-queens on the chessboard and moves them around, saving from the attacks.

- Following steps are involved in this formulation
- **States:** Arrangement of all the 8 queens one per column with no queen attacking the other queen.
- **Actions:** Move the queen at the location where it is safe from the attacks.
  This formulation is better than the incremental formulation as it reduces the state space from 1.8 x10^14 to 2057, and it is easy to find the solutions.

Real-world Problem

- **Traveling salesperson problem(TSP):**
- It is a touring problem where the salesman can visit each city only once.
- The objective is to find the shortest tour and sell-out the stuff in each city.

Search Algorithm



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