

Problem formulation

- ▶ One of the core steps of problem-solving which decides **what action should be taken to achieve the formulated goal.**
- ▶ In AI this core part is dependent upon **software agent** which consisted of the following **5 components** to formulate the associated problem.
- ▶ Problem Statement
 - Definition
 - Limitation or Constraints or Restrictions
- ▶ Problem Solution
- ▶ Solution Space
- ▶ Operators

Cont...

▶ Definition of Problem

Why it is important to build AI system? What will be the advantages of proposed system? For example “**I want to predict the price of house using AI system**”.

▶ Problem Limitation

There always some limitations while solving problems. All these limitations or constraints must be fulfilled while creating system.

Goal or Solution

What is expected from system? The **Goal state or final state** or the solution of problem is defined here. This will help us to propose appropriate solution for problem. For example “we can use some machine learning technique to solve this problem”.

Cont...

▶ Solution Space

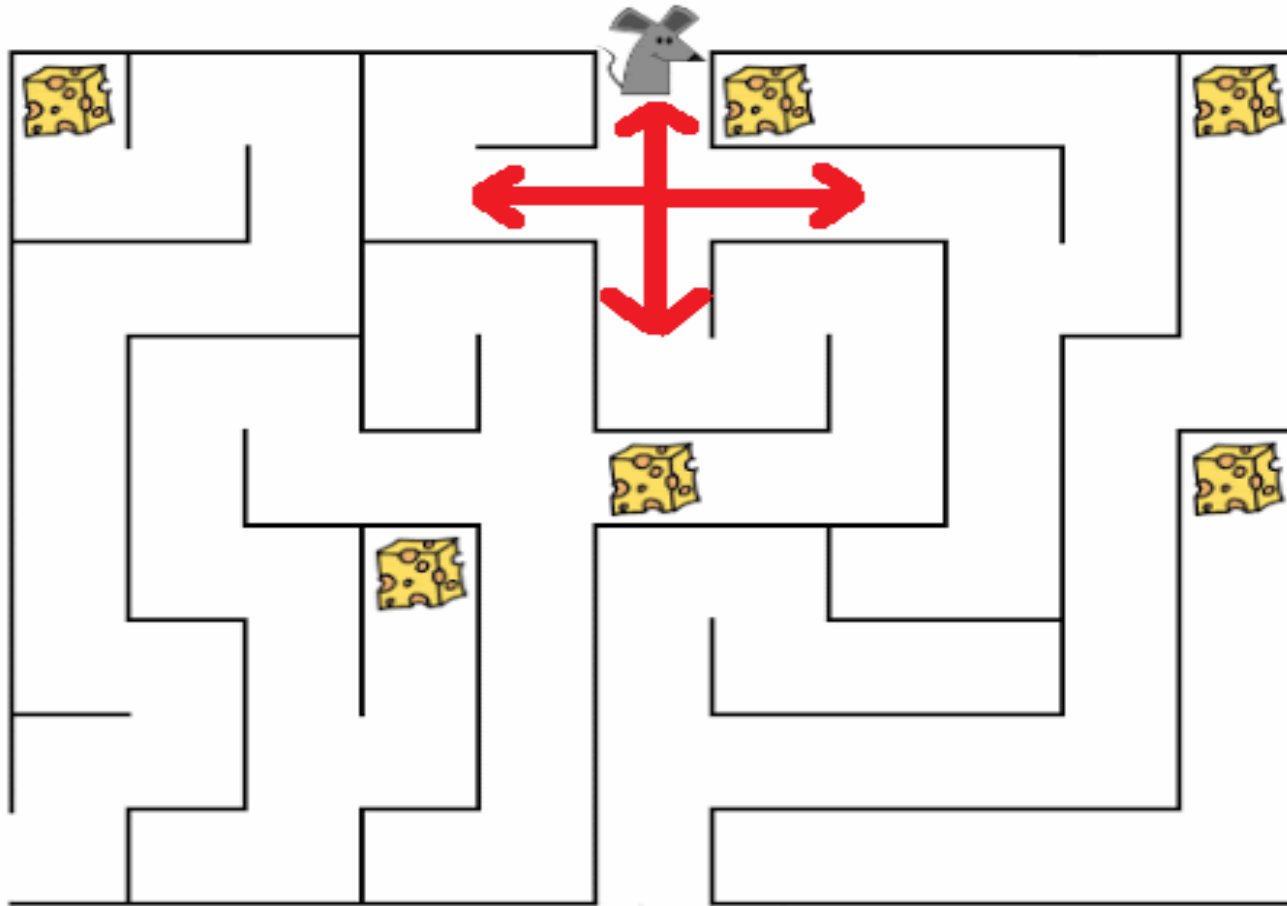
Problem can be solve in many ways. Many possible ways with which we can solve problem is known as **Solution Space**. For example “price of house can be predict using many machine learning algorithms” .

▶ Operators

Operators are the actions taken during solving problem. Complete problem is solved using tiny steps or actions and all these consecutive actions leads to solution of problem.

▶ Examples of Problem Formulation

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▶ Mouse Path Problem

▶ Problem Statement

- ▶ **Problem Definition:** Mouse is hungry, mouse is in a puzzle where there are some cheese. Mouse will only be satisfied if mouse eat cheese
- ▶ **Problem Limitation:** Some paths are close i-e dead end, mouse can only travel through open paths
- ▶ **Problem Solution:** Reach location where is cheese and eat minimum one cheese. There are possible solutions (cheese pieces)
- ▶ **Solution Space:** To reach cheese there are multiple paths possible
- ▶ **Operators:** Mouse can move in four possible directions, these directions are operators or actions which are UP, DOWN, LEFT and RIGHT

Well-defined Problems and Solution

- ▶ Problem solving components discussed above are applicable to any problem. For AI system implementation, problem must be well defined. A well-defined problem must **have five components:-**
- ▶ **Initial State:** Start point of problem
- ▶ **Final State:** The finish point of problem. Goal or solution state
- ▶ **States:** Total states in problem
- ▶ **Transition Model:** How one can shift from one state to another
- ▶ **Actions:** Actions set, used to move from one state to another
- ▶ **Path Cost:** What is total effort (cost) from initial state to final state

8 Puzzle or Slide Puzzle

- ▶ **States:** A state description specifies the location of each of the eight tiles and the blank in one of the nine squares.
- ▶ **Initial state:** Any random shuffled state can be designated as initial state
- ▶ **Actions:**
 - ▶ Slide Left
 - ▶ or Slide Right
 - ▶ or Slide Up
 - ▶ And Slide Down
- ▶ **Transition model:** Given a state and action, this returns the resulting state
- ▶ **Goal test:** This checks whether the state matches the goal
- ▶ **Path cost:** Each step costs 1

Cont...

7	2	4
5		6
8	3	1

Start State

	1	2
3	4	5
6	7	8

Goal State