

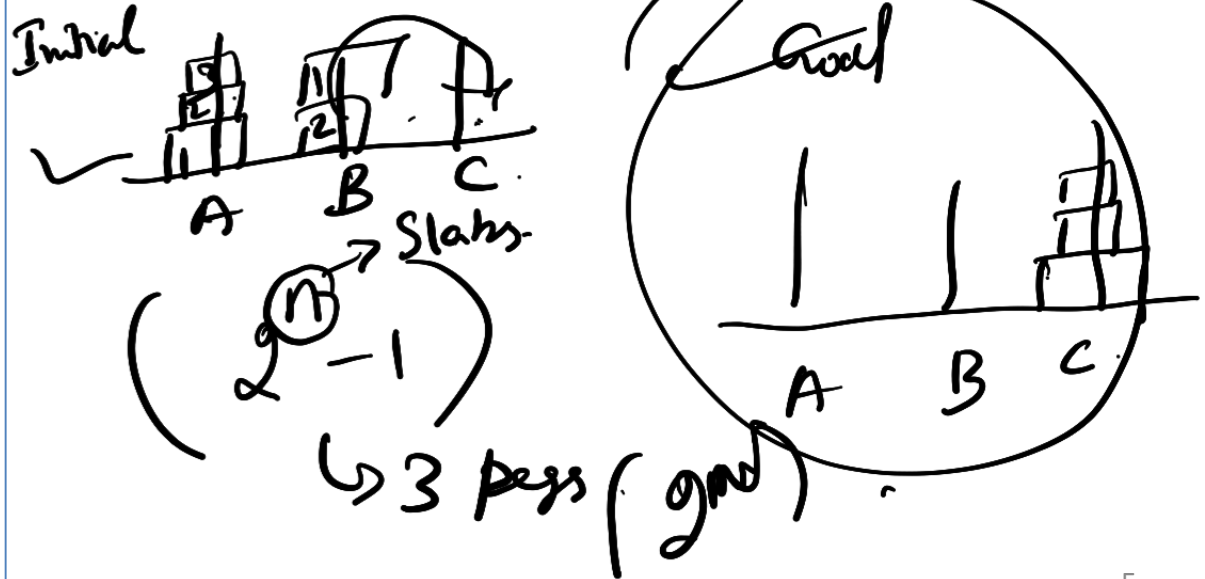
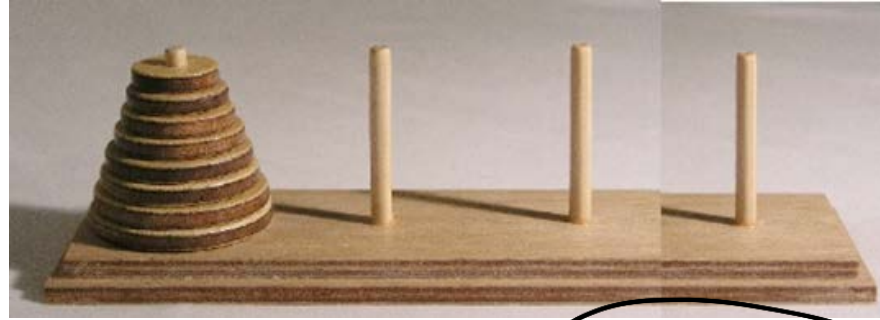
# AUTOMATED PROBLEM SOLVING BY SEARCH

- Generalized Techniques for Solving Large Classes of Complex Problems
- Problem Statement is the Input and solution is the Output, sometimes even the problem specific algorithm or method could be the Output
- Problem Formulation by AI Search Methods consists of the following key concepts
  - Configuration or State
  - Constraints or Definitions of Valid Configurations
  - Rules for Change of State and their Outcomes
  - Initial or Start Configurations
  - Goal Satisfying Configurations
  - An Implicit State or Configuration Space
  - Valid Solutions from Start to Goal in the State Space
  - General Algorithms which SEARCH for Solutions in this State Space
- **ISSUES** (AI)
  - Size of the Implicit Space, Capturing Domain Knowledge, Intelligent Algorithms that work in reasonable time and Memory, Handling Incompleteness and Uncertainty

Rules  
State changes / Algorithm.  
State Space

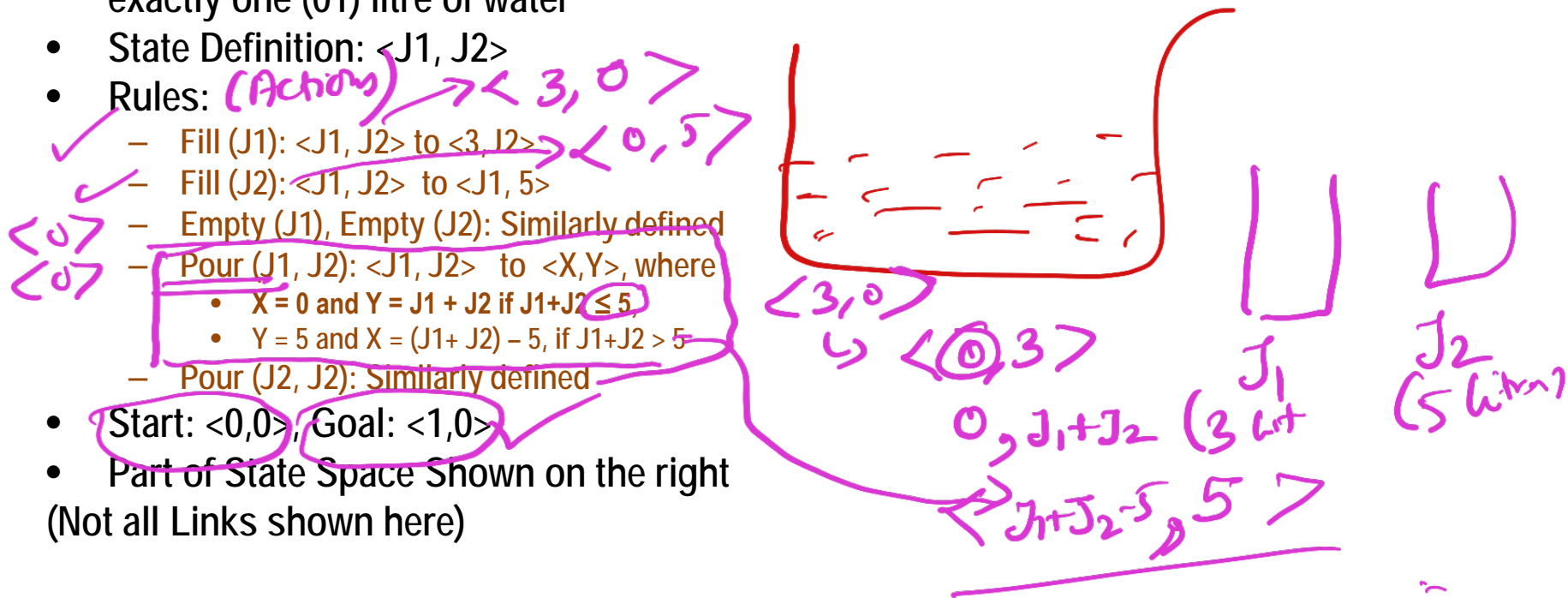
# TOWER OF HANOI

- Configuration or State
- Constraints or Definitions of Valid Configurations
- Rules for Change of State and their Outcomes
- Initial or Start Configurations
- Goal Satisfying Configurations
- An Implicit State or Configuration Space
- Valid Solutions from Start to Goal in the State Space
- General Algorithms which SEARCH for Solutions in this State Space



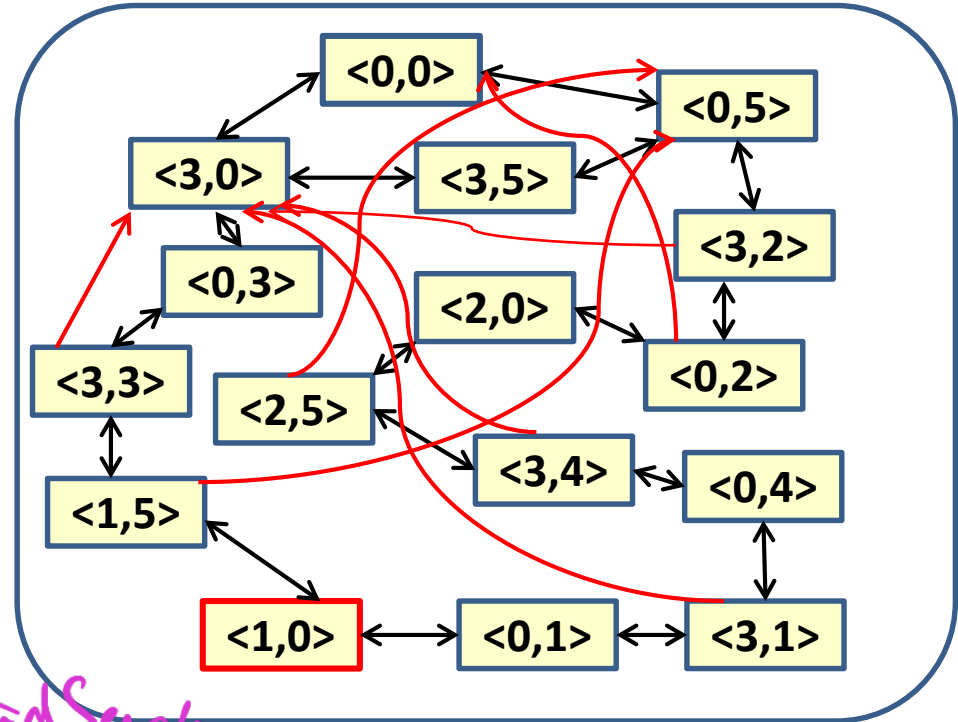
# TWO JUG PROBLEM

- There is a large bucket B full of water and Two (02) jugs, J1 of volume 3 litre and J2 of volume 5 litre. You are allowed to fill up any empty jug from the bucket, pour all water back to the bucket from a jug or pour from one jug to another. The goal is to have jug J1 with exactly one (01) litre of water
- State Definition:  $\langle J1, J2 \rangle$
- Rules: (Action)
  - Fill (J1):  $\langle J1, J2 \rangle$  to  $\langle 3, J2 \rangle$
  - Fill (J2):  $\langle J1, J2 \rangle$  to  $\langle J1, 5 \rangle$
  - Empty (J1), Empty (J2): Similarly defined
  - Pour (J1, J2):  $\langle J1, J2 \rangle$  to  $\langle X, Y \rangle$ , where
    - $X = 0$  and  $Y = J1 + J2$  if  $J1 + J2 \leq 5$
    - $Y = 5$  and  $X = (J1 + J2) - 5$ , if  $J1 + J2 > 5$
  - Pour (J2, J2): Similarly defined
- Start:  $\langle 0, 0 \rangle$ , Goal:  $\langle 1, 0 \rangle$
- Part of State Space Shown on the right  
(Not all Links shown here)



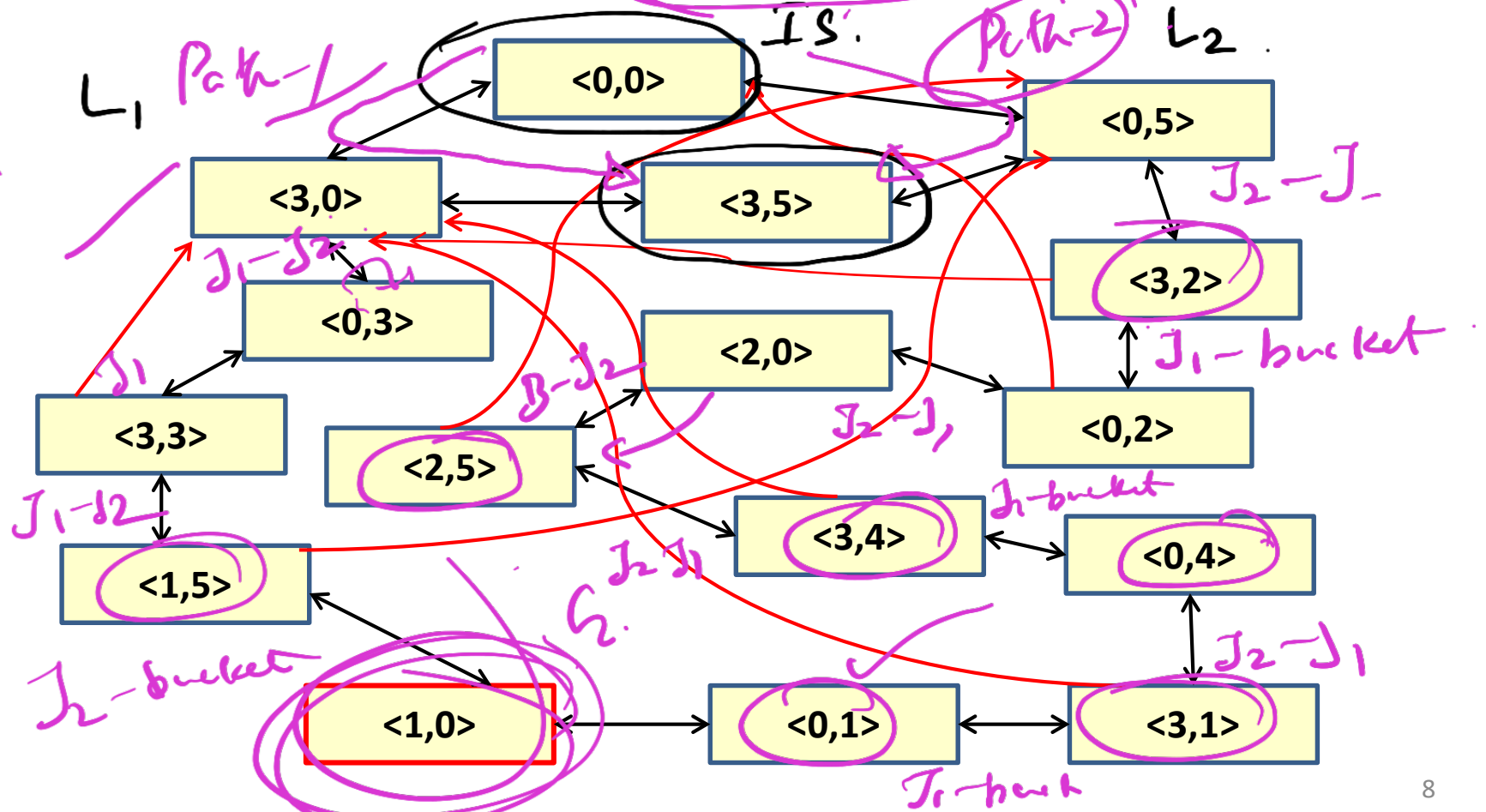
# TWO JUG PROBLEM

- There is a large bucket B full of water and Two (02) jugs, J1 of volume 3 litre and J2 of volume 5 litre. You are allowed to fill up any empty jug from the bucket, pour all water back to the bucket from a jug or pour from one jug to another. The goal is to have jug J1 with exactly one (01) litre of water
- State Definition:  $\langle J1, J2 \rangle$
- Rules:
  - Fill (J1):  $\langle J1, J2 \rangle$  to  $\langle 3, J2 \rangle$
  - Fill (J2):  $\langle J1, J2 \rangle$  to  $\langle J1, 5 \rangle$
  - Empty (J1), Empty (J2): Similarly defined
  - Pour (J1, J2):  $\langle J1, J2 \rangle$  to  $\langle X, Y \rangle$ , where
    - $X = 0$  and  $Y = J1 + J2$  if  $J1 + J2 \leq 5$ ,
    - $Y = 5$  and  $X = (J1 + J2) - 5$ , if  $J1 + J2 > 5$
  - Pour (J2, J2): Similarly defined
- Start:  $\langle 0, 0 \rangle$ , Goal:  $\langle 1, 0 \rangle$
- Part of State Space Shown on the right  
(Not all Links shown here)

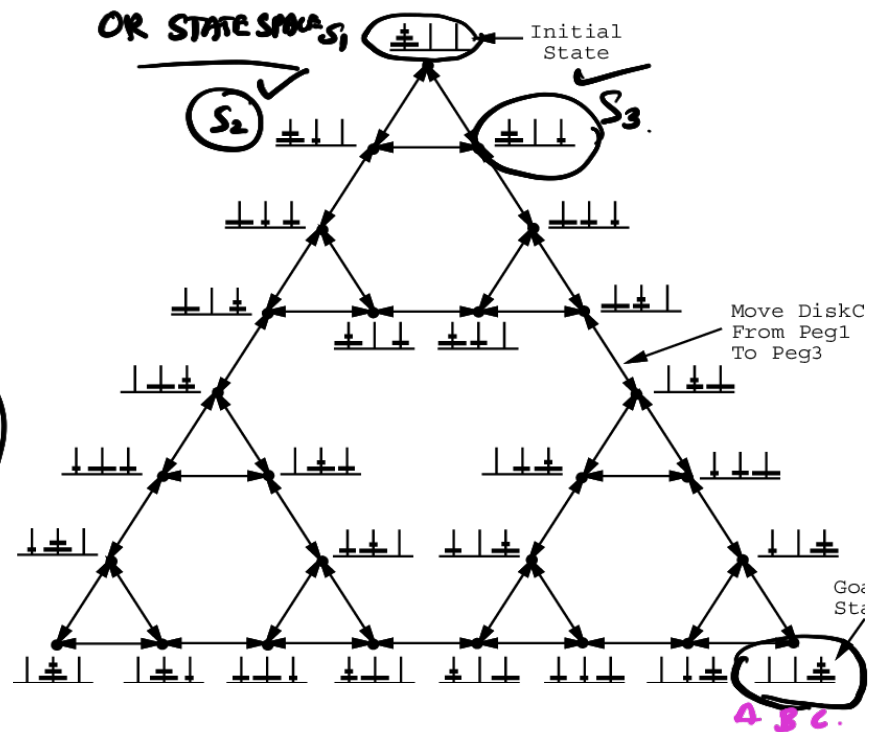
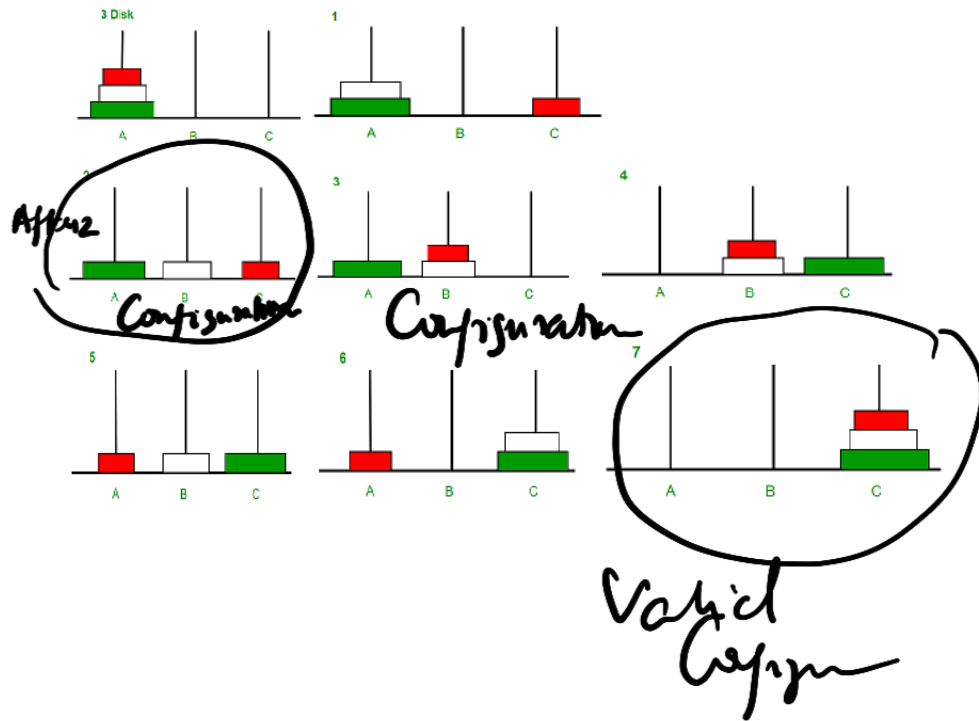


Uniformed Search / Blind Search

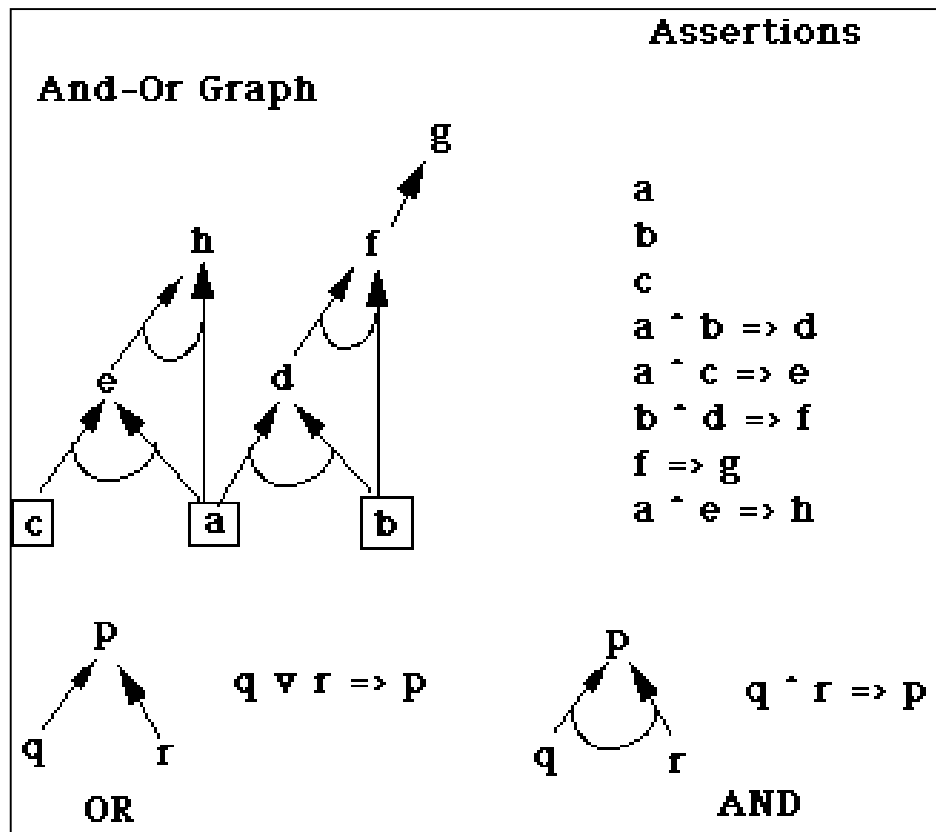
# PART OF STATE SPACE



# 3 DISK, 3 PEG TOWER of HANOI STATE SPACE



# AND / OR STATE SPACES



## Search:-

process of looking for a sequence of actions to reach a goal state.

## Search Algorithm:-

- ↳ Given an input ← Problem
- ↳ Expected to find a o/p ← Solution
- ↳ To identify the sequence of actions to reach the goal State.
- ↳ If a solution is met that corresponds to the goal state, then it's task is executed.
  - ↳ Execution State.



# Well-defined Problem:-

## 5 Components

### ① Initial State :-

An empty board that can hold 0 to 5 Queens.

### ② Actions :-

Add the queen one by one in the boards.

### ③ Goal test :-

All the 5 Queens must be placed in the board.

④ Transition model:- Valid Configuration of states must be ensured at each sequence of placing the queen

### ⑤ Path Cost, States

## 5-Queens

	Q			
			Q	
Q				
		Q		
				Q