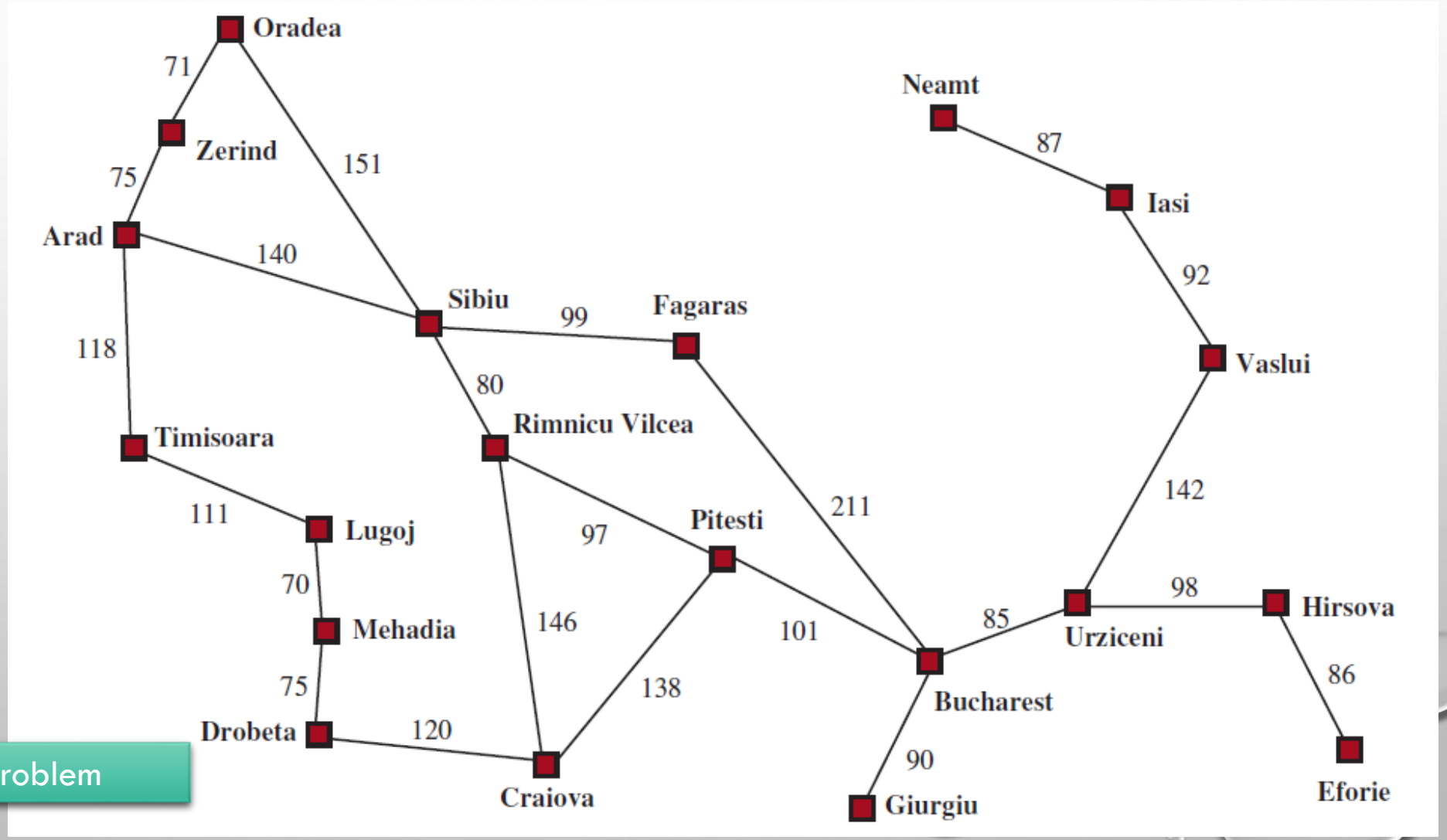
SOLVING PROBLEMS BY SEARCHING

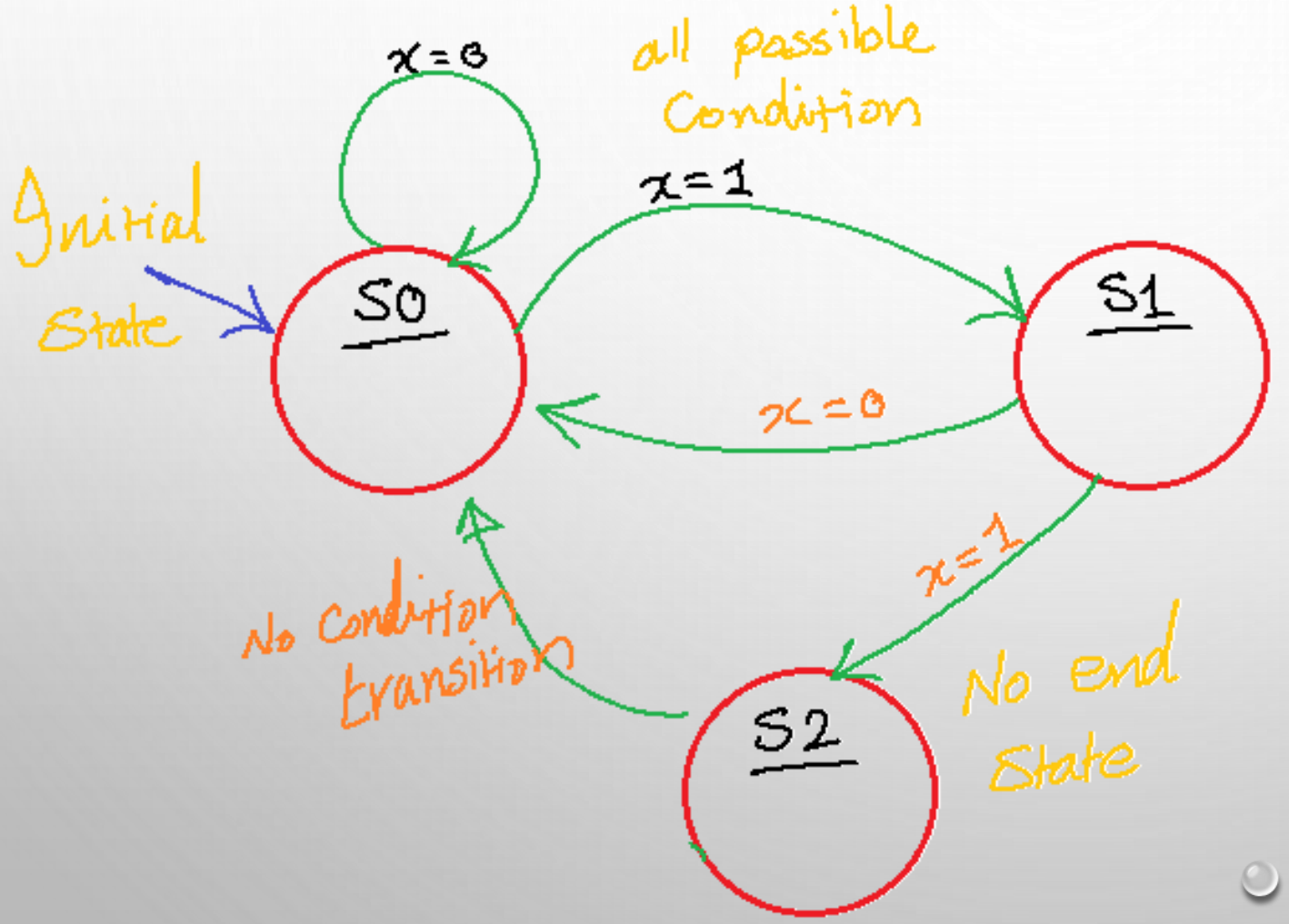
Environment properties

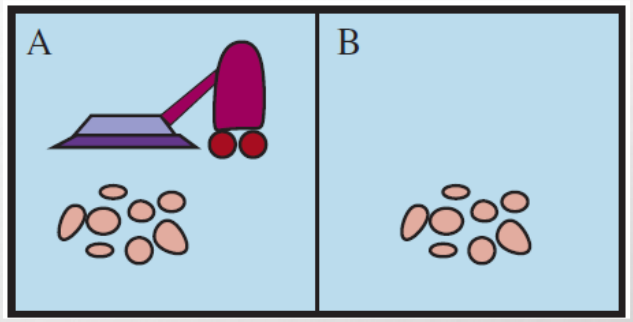
- Deterministic
- *Episodic (sequential)*
- *Static*
- *Discrete*



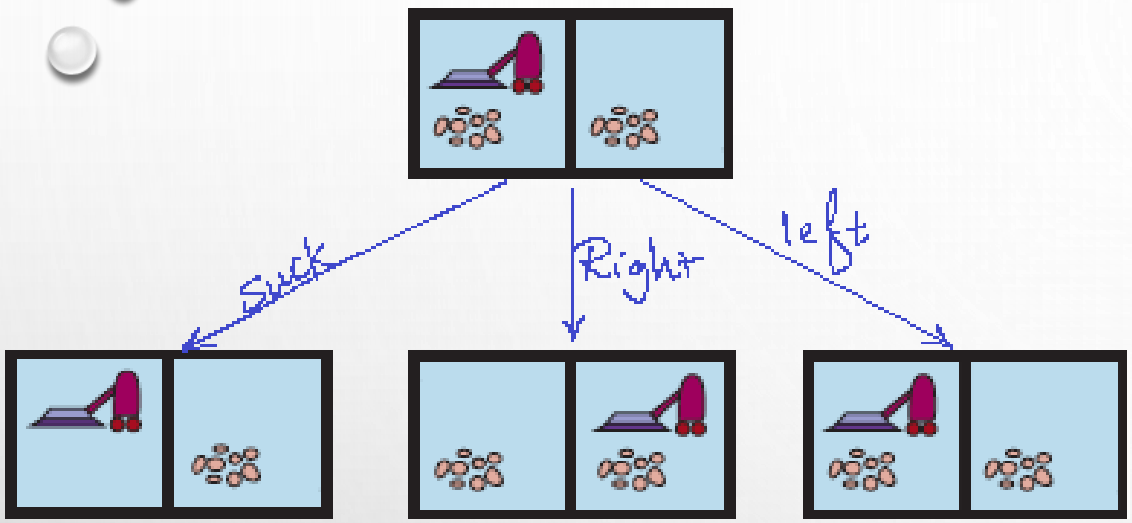
Romania problem

Formulating Problems (Grid World Problem)



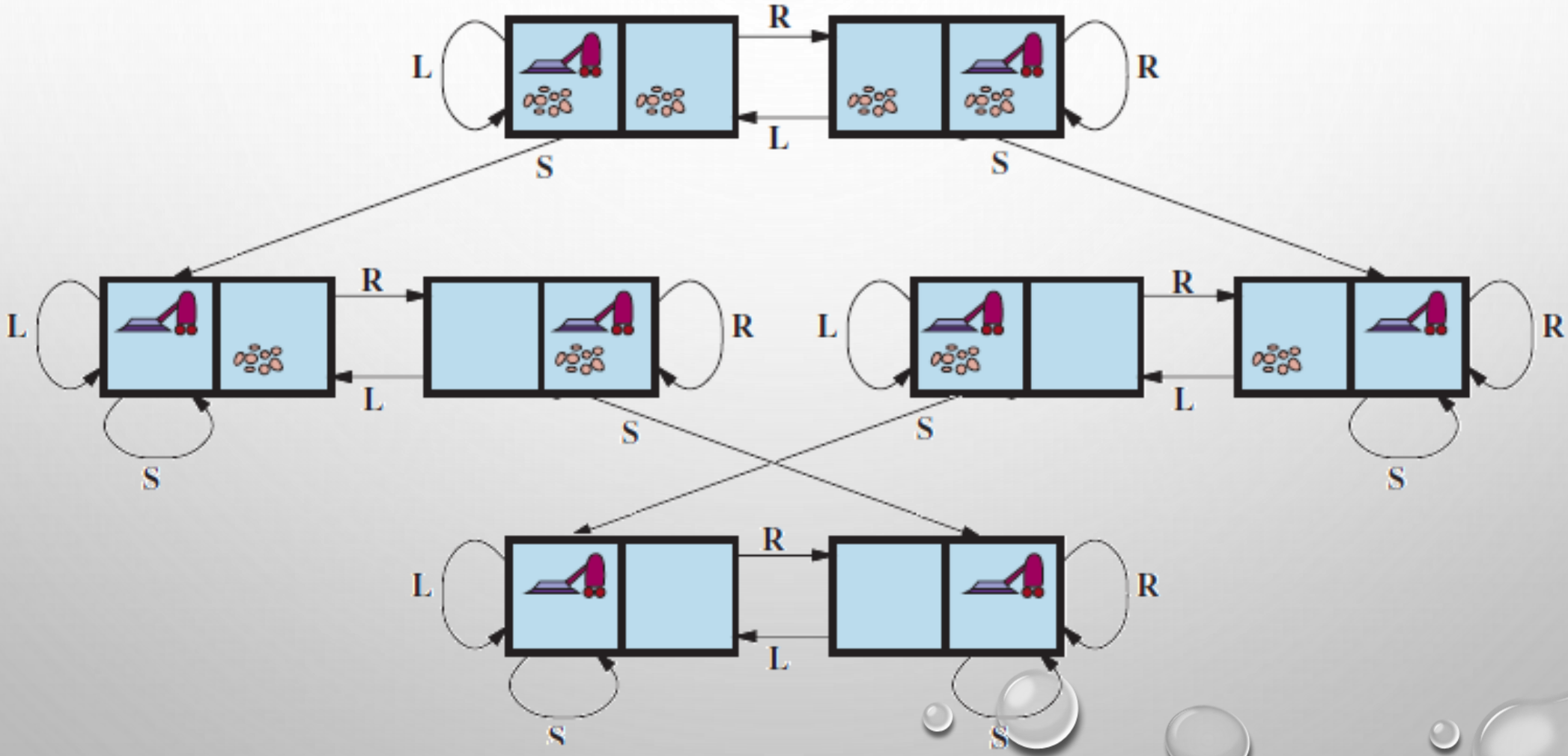


GRAPH SEARCH



- INITIAL STATE
- STATES
- ACTIONS :
  - MOVE RIGHT
  - MOVE LEFT
  - SUCK DIRT
- TRANSITION MODEL (EFFECT OF ACTION; NEXT STATE)
- GOAL STATES
- ACTION COST (DISTANCE, POWER CONSUMPTION, TOLLS, SURFACE CONDITION, TRAFFIC CONDITION …ETC)

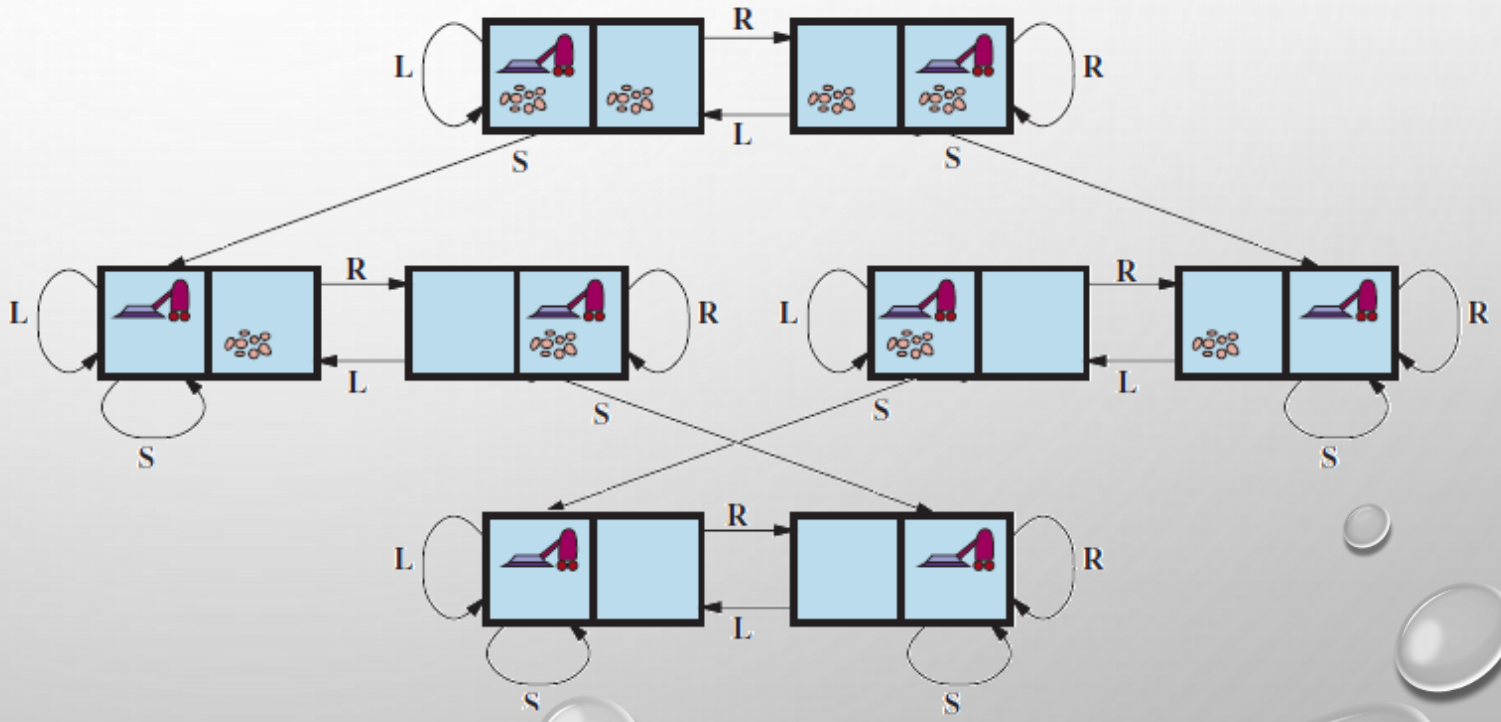
State-space Graph For The Two-cell Vacuum World



Definitions :

State Space: A set of possible states that the environment can be in.

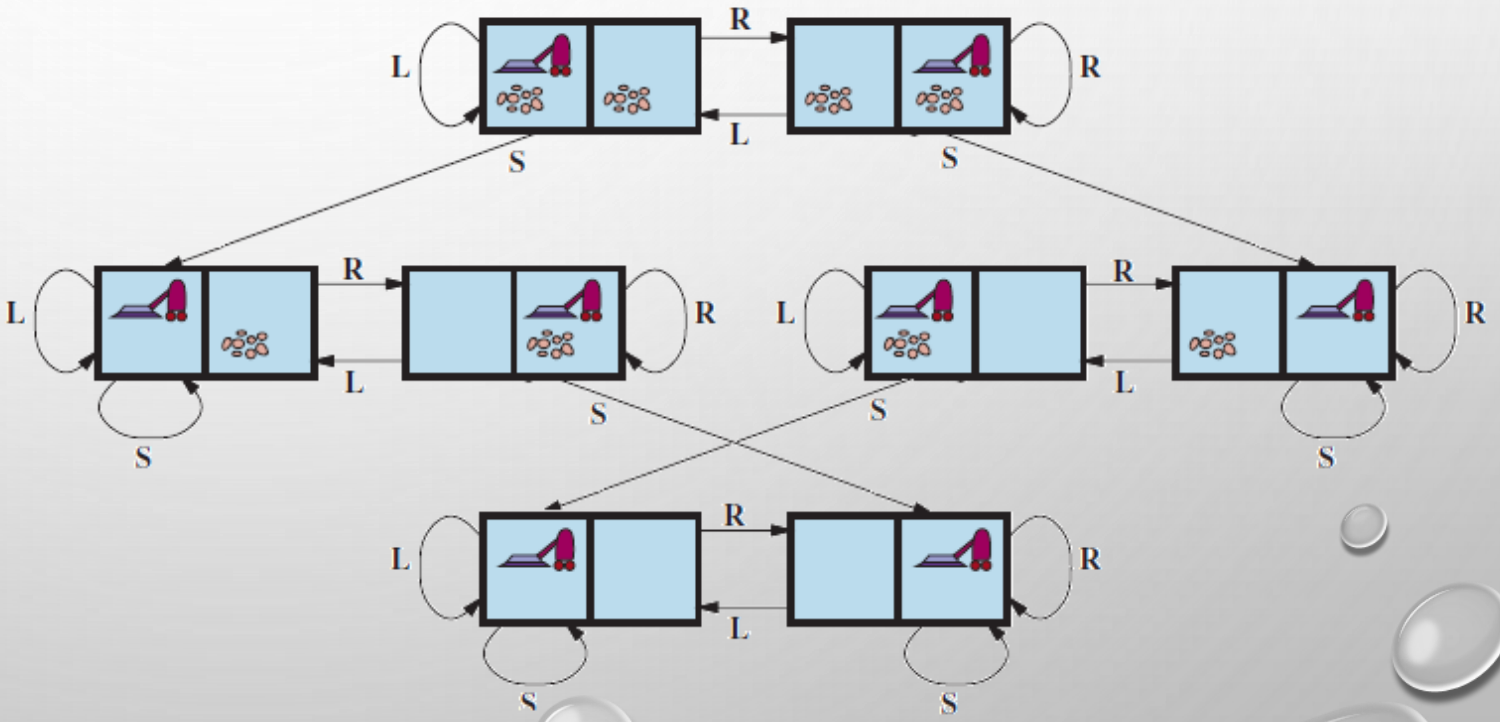
Dirt	
Left R.	Right R.
0	0
0	1
1	0
1	1



Definitions :

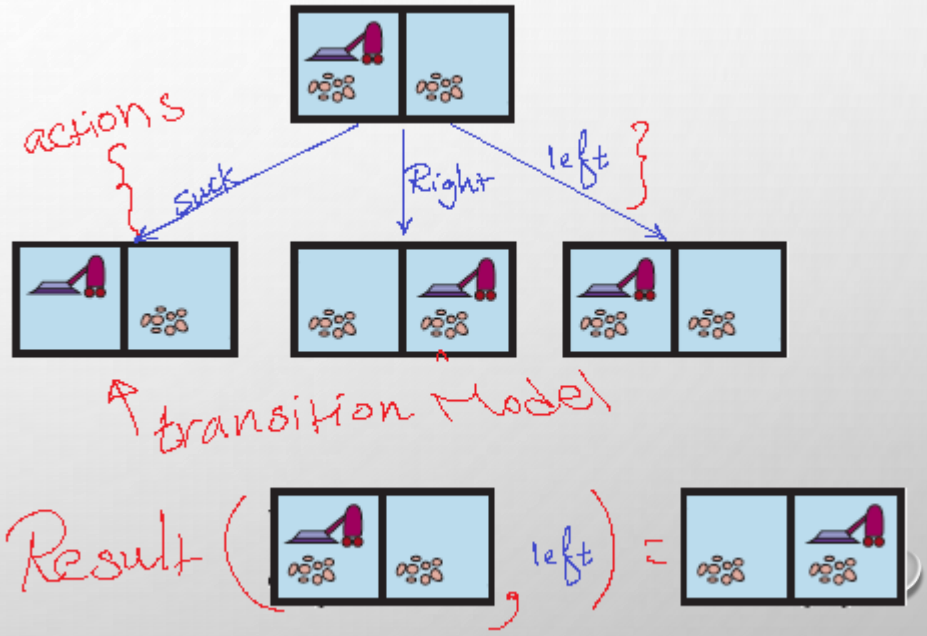
State Space: A set of possible states that the environment can be in. $=2^n=2^3=8$

Robot	Dirt	
L=0,R=1	Left R.	Right R.
0	0	0
0	0	1
0	1	0
0	1	1
1	**0**	**0**
1	0	1
1	1	0
1	1	1



Definitions :

Initial State that the agent starts in.
Action space available to the agent (Right, Left, Suck)
Transition Model, which describes what each action does. RESULT(s, a) returns the Transition model state that results from doing action a in state s.

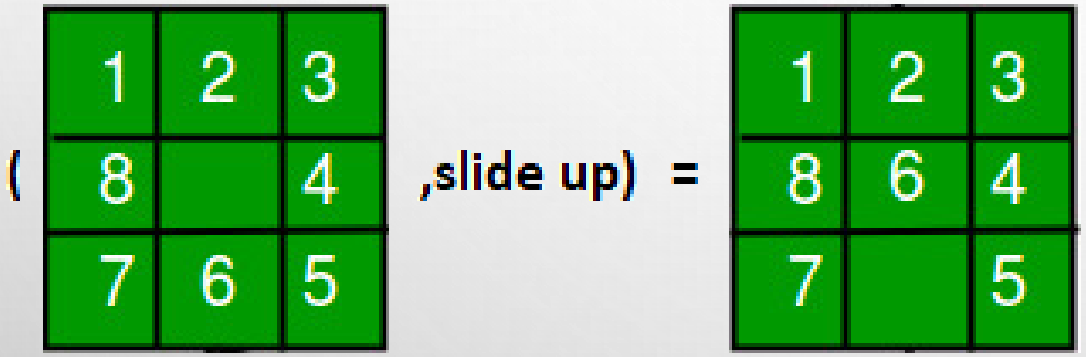


Imagine 2D vacuum problem

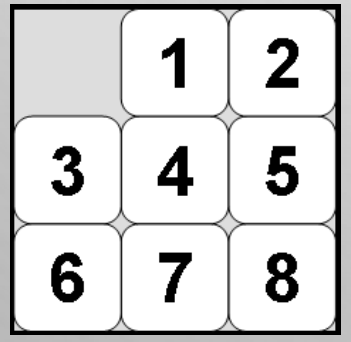
State Space: $=2^5=32$ state

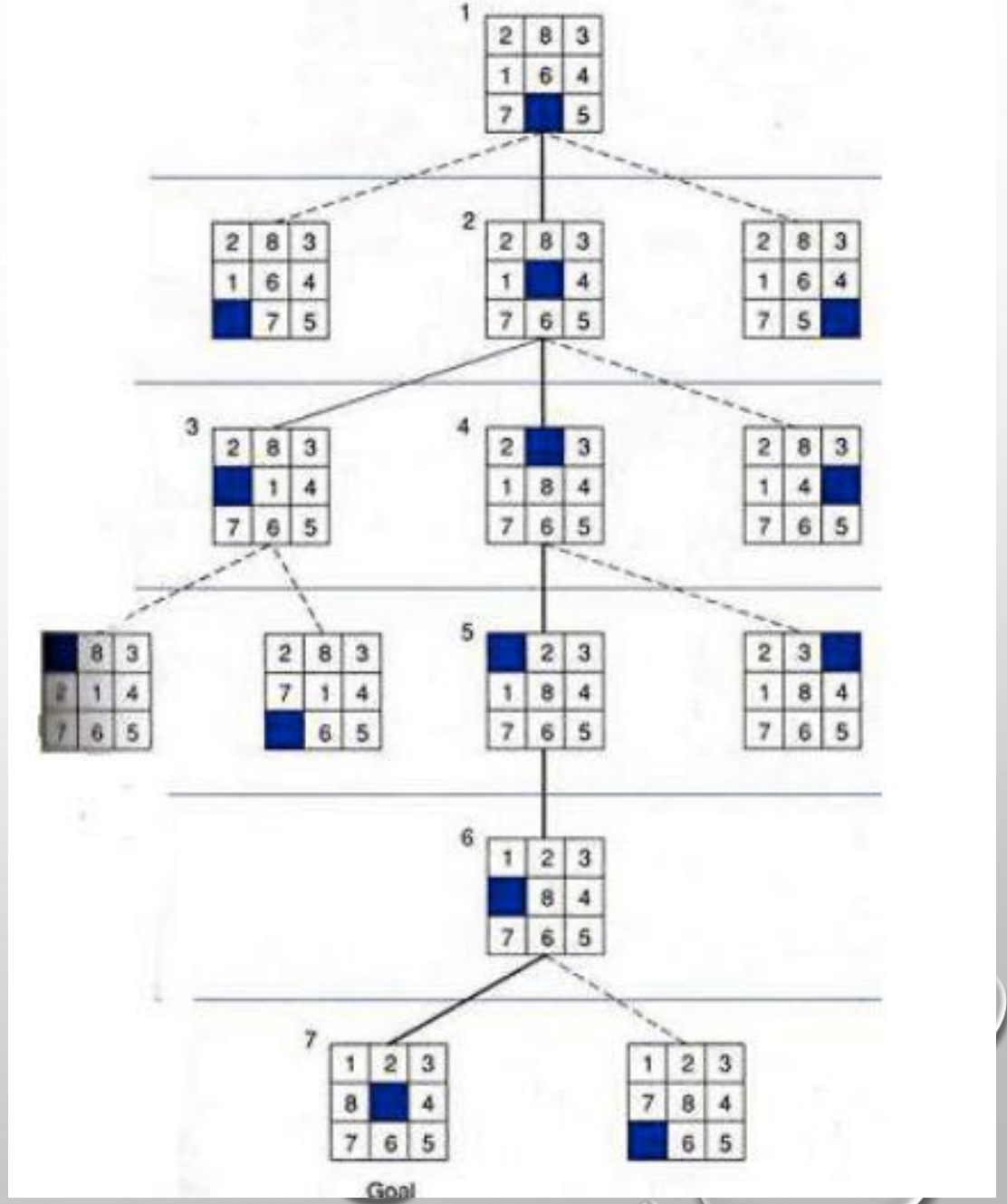
3X3 8-PUZZLE.

State Space : 9!=362 880
Actions = slide left, slide right, slide up, slide down
Transition model:



Goal state





Measuring Problem-solving Performance

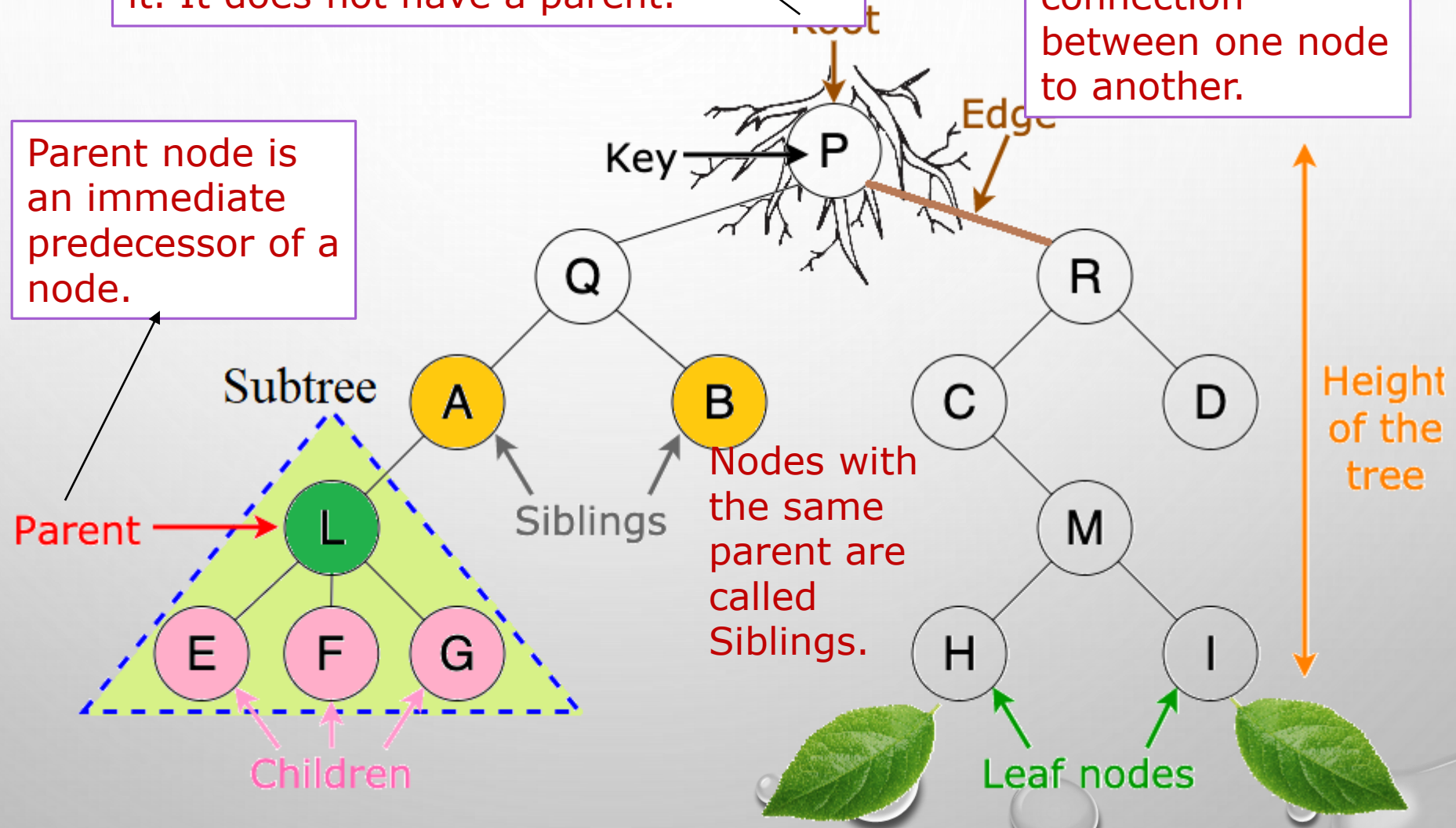
- **COMPLETENESS:** is the algorithm guaranteed to find a solution when there is one, and to correctly report failure when there is not?
- **COST OPTIMALITY:** does it find a solution with the lowest path cost of all solutions.
- **TIME COMPLEXITY:** how long does it take to find a solution? this can be measured in seconds, or more abstractly by the number of states and actions considered.
- **SPACE COMPLEXITY:** how much memory is needed to perform the

DEFINITIONS (SEARCH TREE)

The entire tree is referenced through it. It does not have a parent.

Edge is a connection between one node to another.

Parent node is an immediate predecessor of a node.



Nodes with the same parent are called Siblings.

GRAPH VS. TREE

- a tree is an undirected graph in which any two vertices are connected by exactly one path, or equivalently a connected acyclic undirected graph.
- Any tree is a graph, but not vice versa.