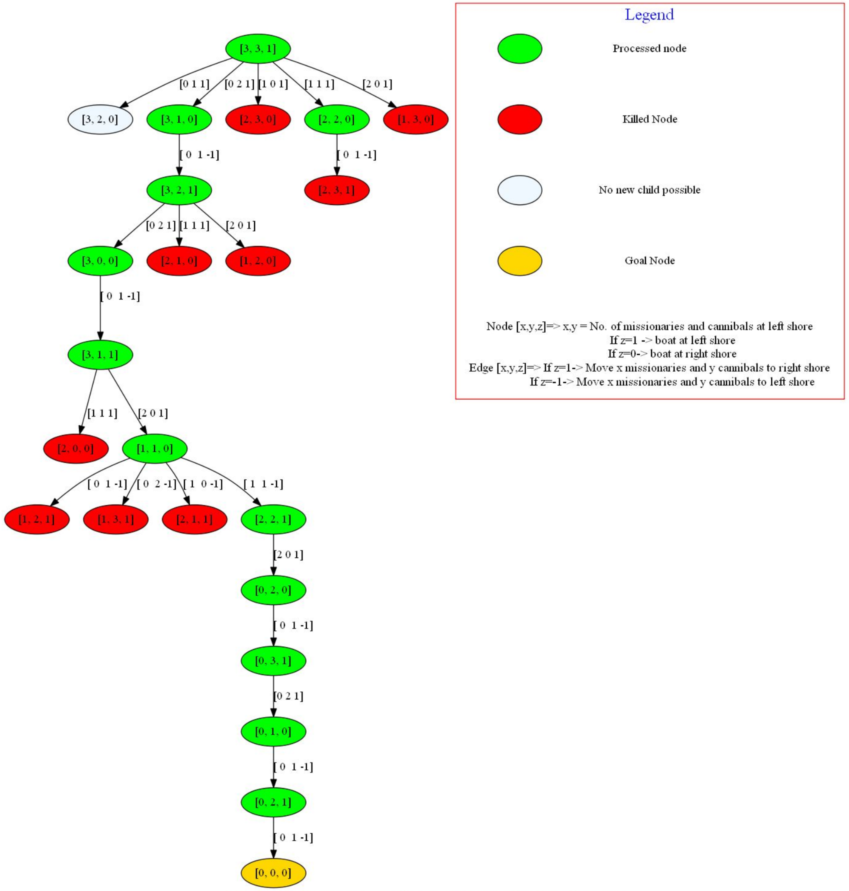
Search Strategies (Module 3)

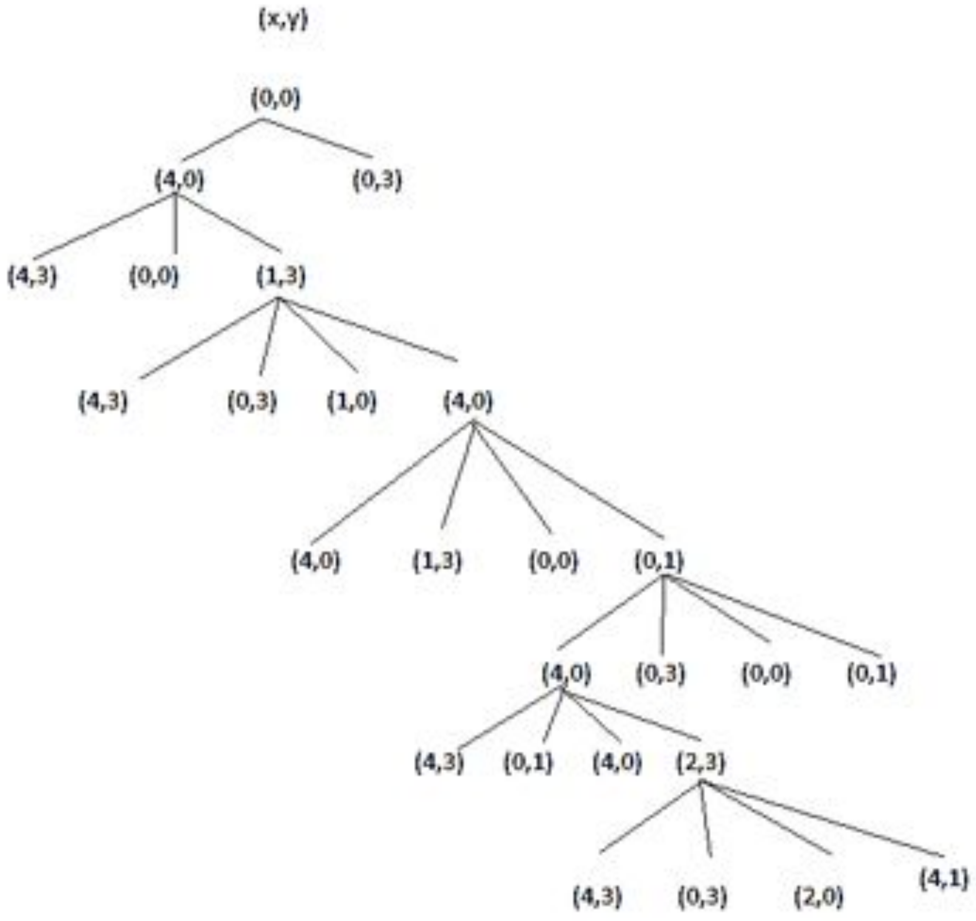
Some Practise Examples…..

State space diagram for Missionary Cannibal Problem



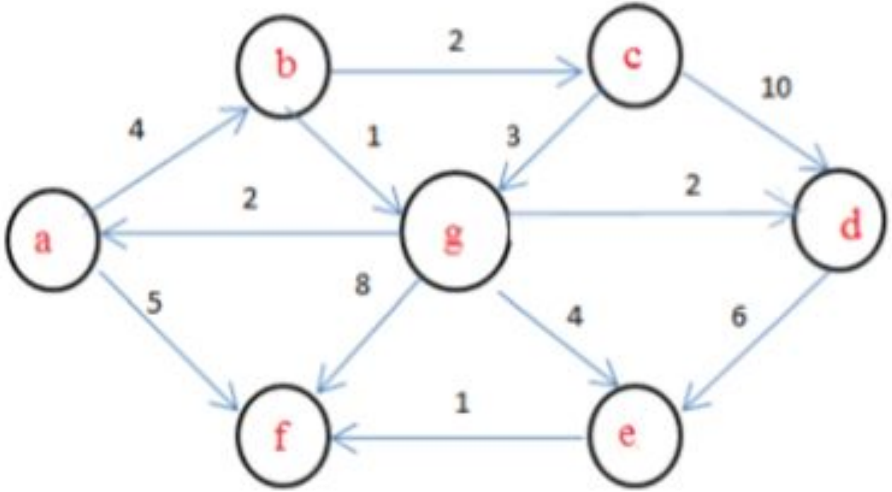
Missionaries and Cannibals State Space

State space diagram for Water Jug Problem



Q. Consider the following graph:

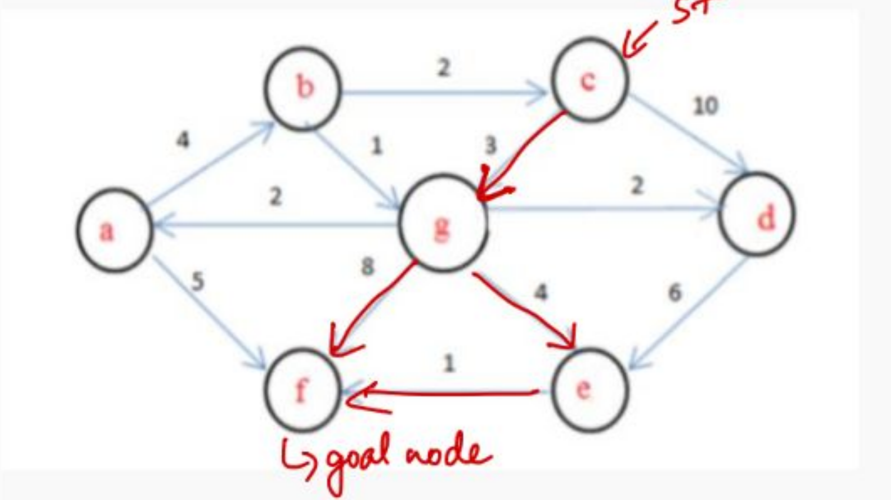
What is the minimum cost to reach vertex f starting from vertex c?



a. 11.0
b. 12.0
c. 6.0
d. 8.0

SOLUTION

10) Consider the following graph:



What is the minimum cost to reach vertex f starting from vertex c?

- ○ 11.0
- ○ 12.0
- ○ 6.0
- ✓ 8.0

greedy.

$c \to g, d$

(3) ✓ (10)

$g \to f, e.$

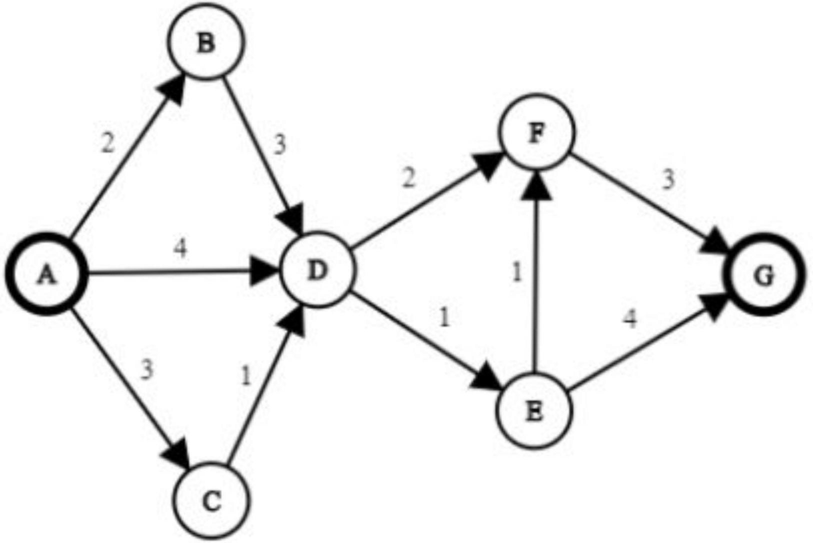
(3) (8), (4)

$c \to g \to f = 11$ ✓

$c \to g \to e = 7 + 1 = 8.$

$\hookrightarrow f(1)$

Q. Consider the following directed graph, having A as the starting node and G as the goal node, with edge costs as mentioned, and the heuristic values for the nodes are given as {h(A)=7, h(B)=6, h(C)=5, h(D)=4, h(E)=3, h(F)=3, h(G)=0}



What is the order of exploration of nodes using A* algorithm in the above question?

Solved in class

Q. In figure 1, illustrate uninformed algorithms BFS, DFS, DLS (L=1). Assume Initial node as **S** and goal node as **G**. Show the path traversed and cost.

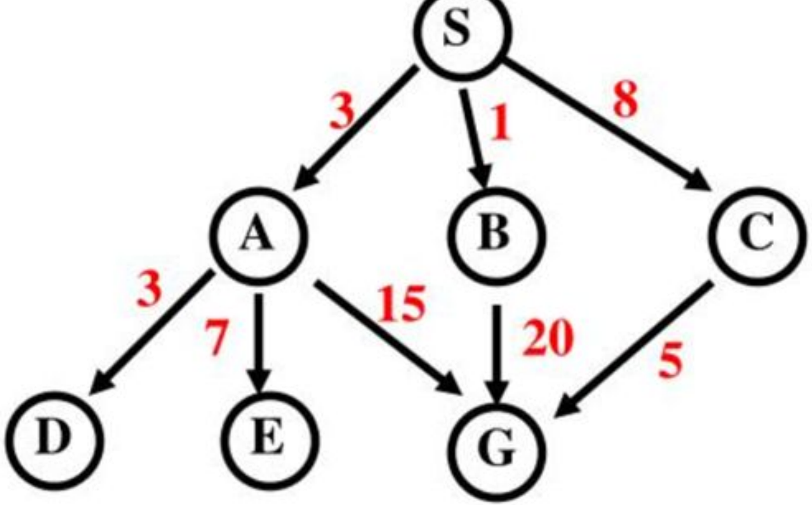
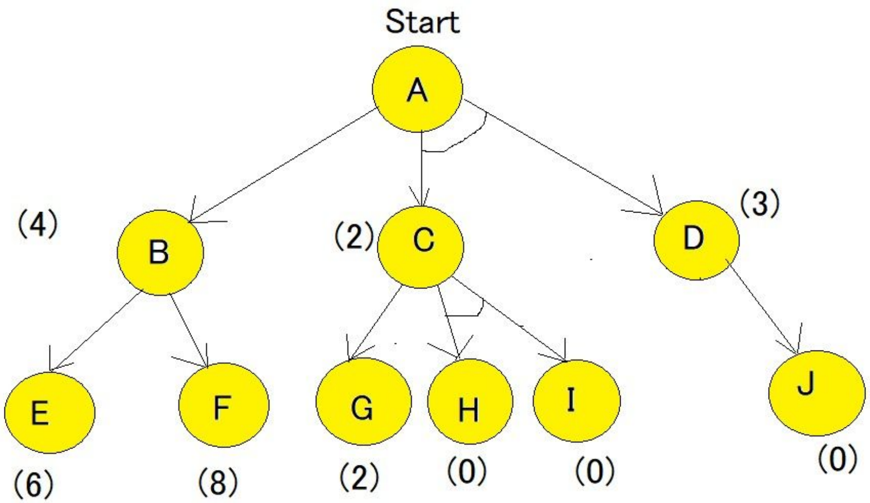
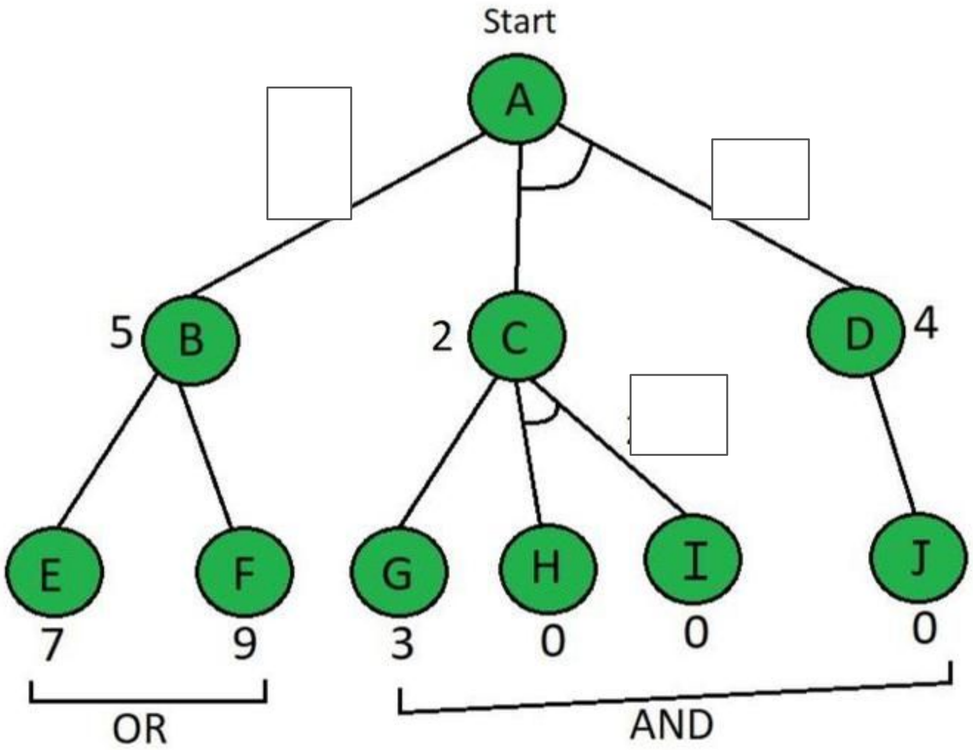


Figure 1

Q. Explain AO* step by step (**exploration**) to find the lowest cost path and the corresponding **lowest cost** from the starting node A to the goal node. All numbers in brackets are the heuristic values i.e., h(n). Consider each edge to have a value of 1.



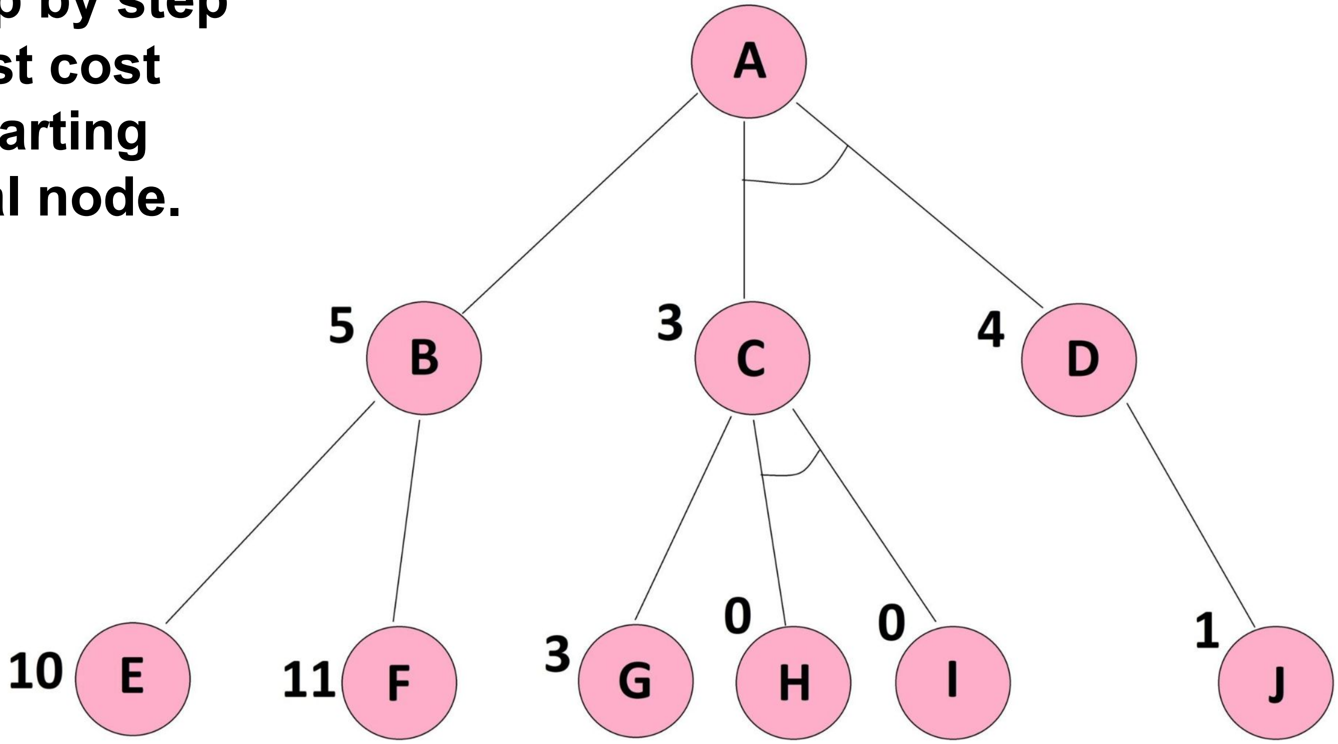
For solution check:
https://iq.opengenus.org/ao-algorithm/#:~:text=The%20AO*%20algorithm%20is%20a,to%20the%20informed%20search%20technique



Q. Below the Node, heuristic values i.e h(n) are given.
Edge length is considered as 1.
Get solved path using AO* search strategy.

Solution: https://www.geeksforgeeks.org/ao-algorithm-artificial-intelligence/

Explain AO* step by step to find the lowest cost path from the starting node to the goal node.



Step by step solution: https://www.baeldung.com/cs/ao-star-algorithm

Q. Given an initial state of a 8-puzzle problem and final state is to be reached. Find the most cost-effective path to reach the final state from initial state using A* Algorithm. Consider g(n) = Depth of node and h(n) = Number of misplaced tiles.

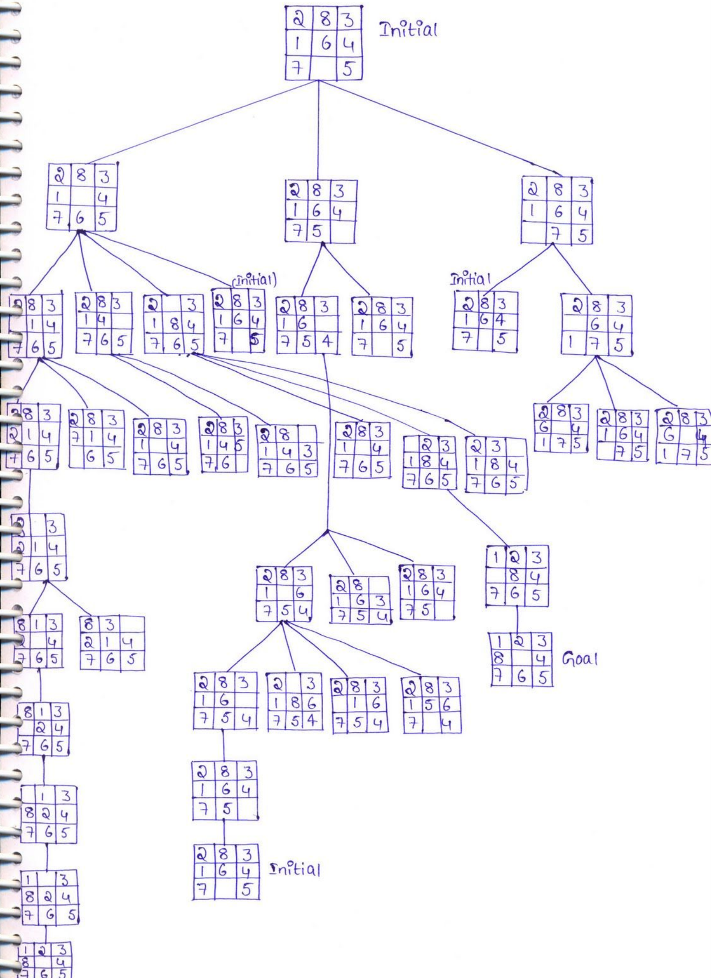
2	8	3
1	6	4
7		5

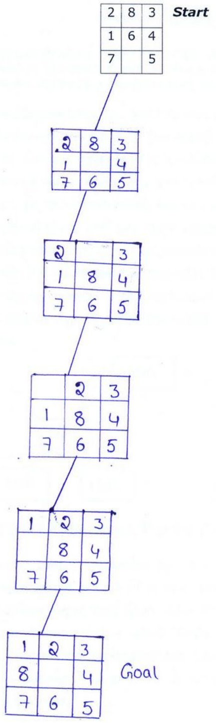
Initial State

1	2	3
8		4
7	6	5

Final State

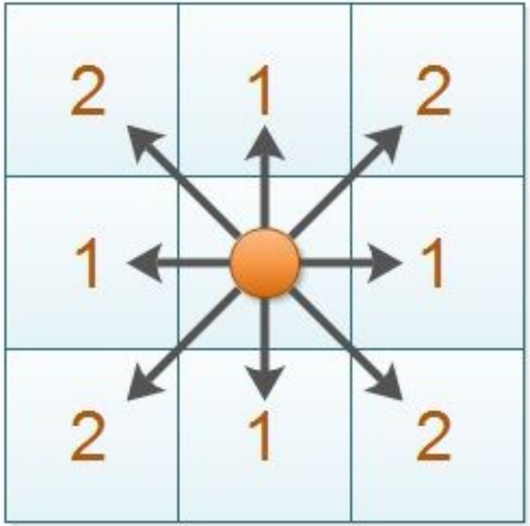
For solution check: https://www.gatevidyalay.com/a-algorithm-a-algorithm-example-in-ai/





Searrh tree for 8-puzzle

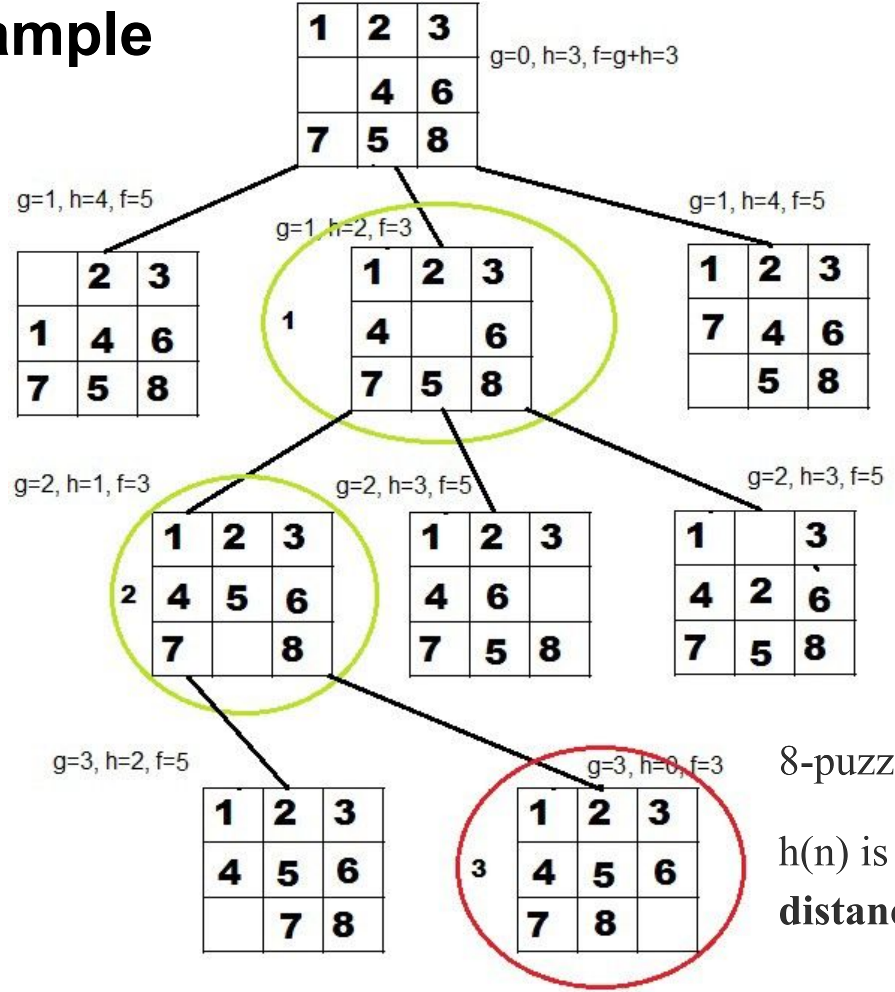
Manhattan Distance



$$|x_1 - x_2| + |y_1 - y_2|$$

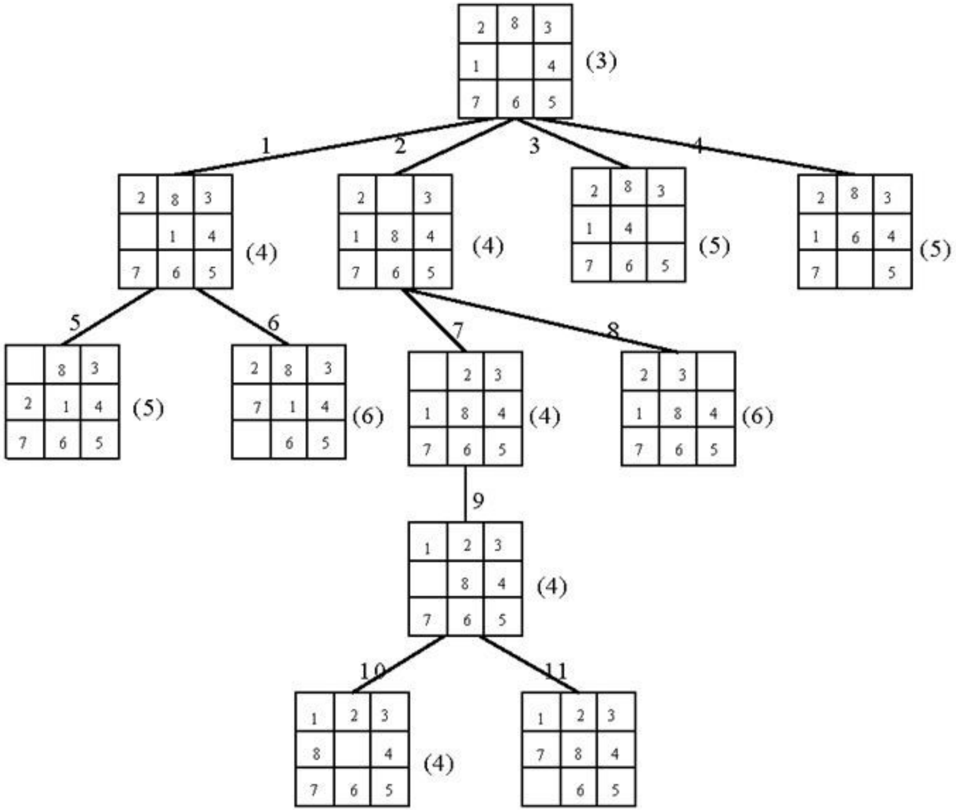
Required to calculate heuristics for the 8 puzzle problem**

Another Example



8-puzzle problem using A* algorithm

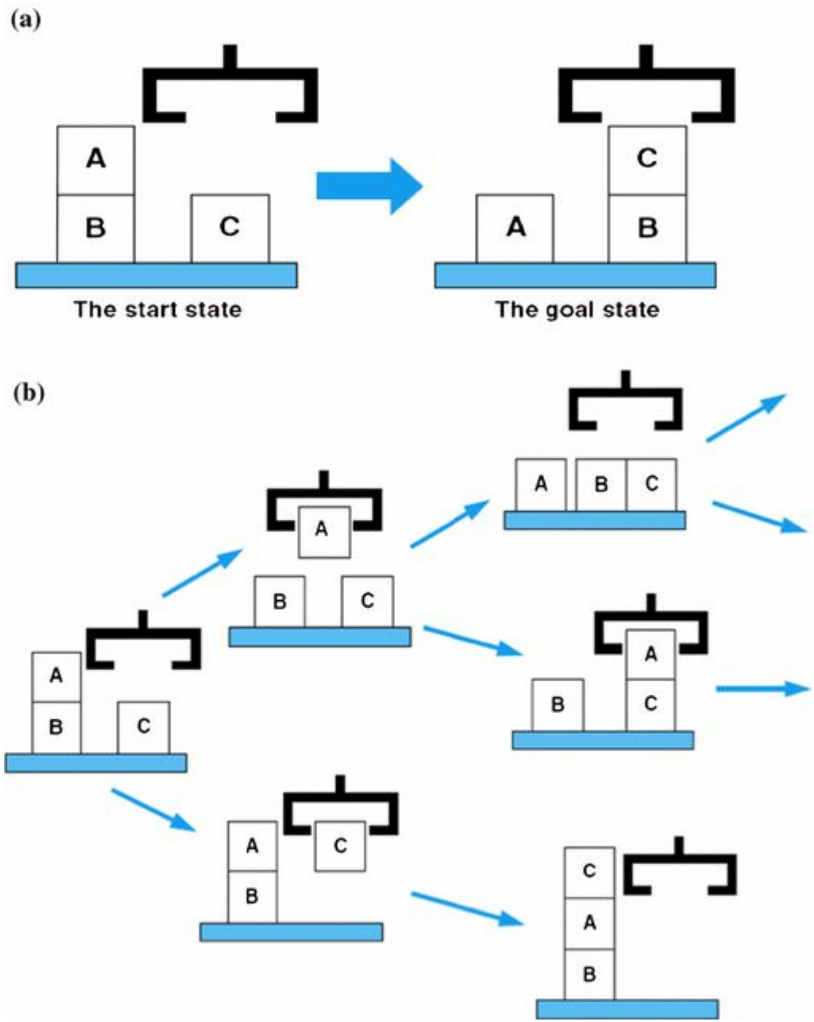
h(n) is calculated using **Manhattan distance**



An 8-puzzle problem solved by a best-first search scheme.

Robot block world

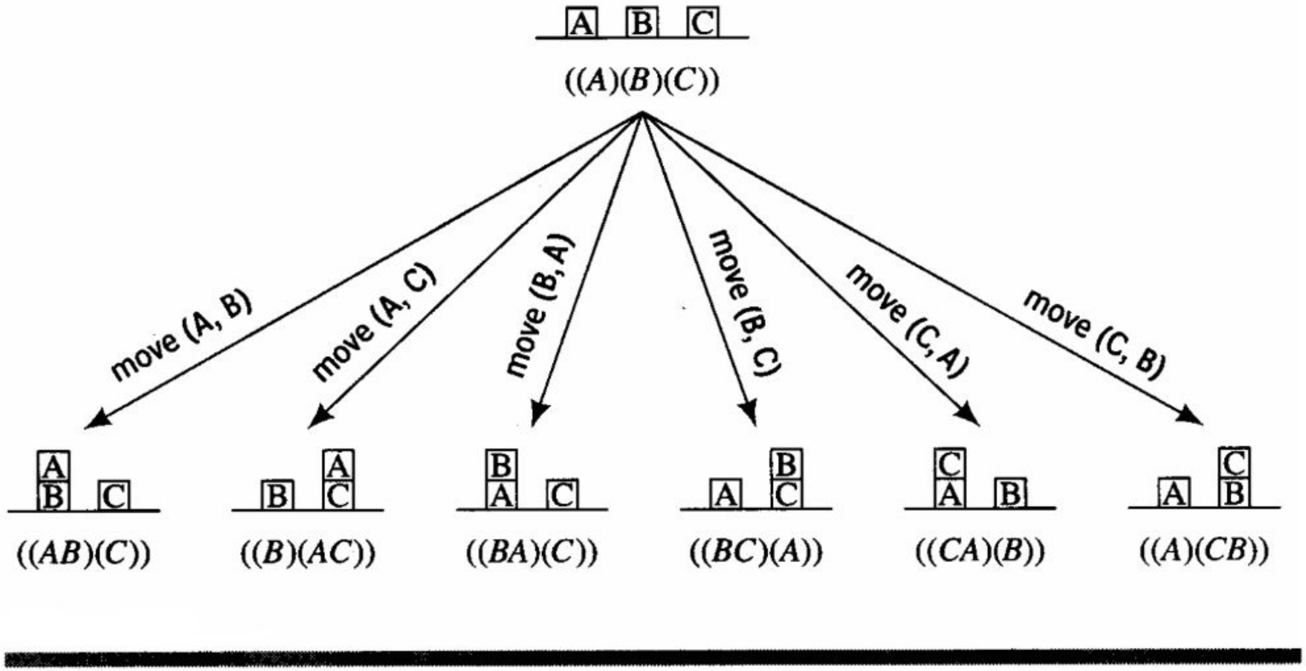
- Given a set of blocks in a certain configuration,
- Move the blocks into a goal configuration.
- Example :
  – (c,b,a) → (b,c,a)



In its basic form, the blocks world problem consists of **cubes in the same size which have all the color black**. A mechanical robot arm has to pick and place the cubes.

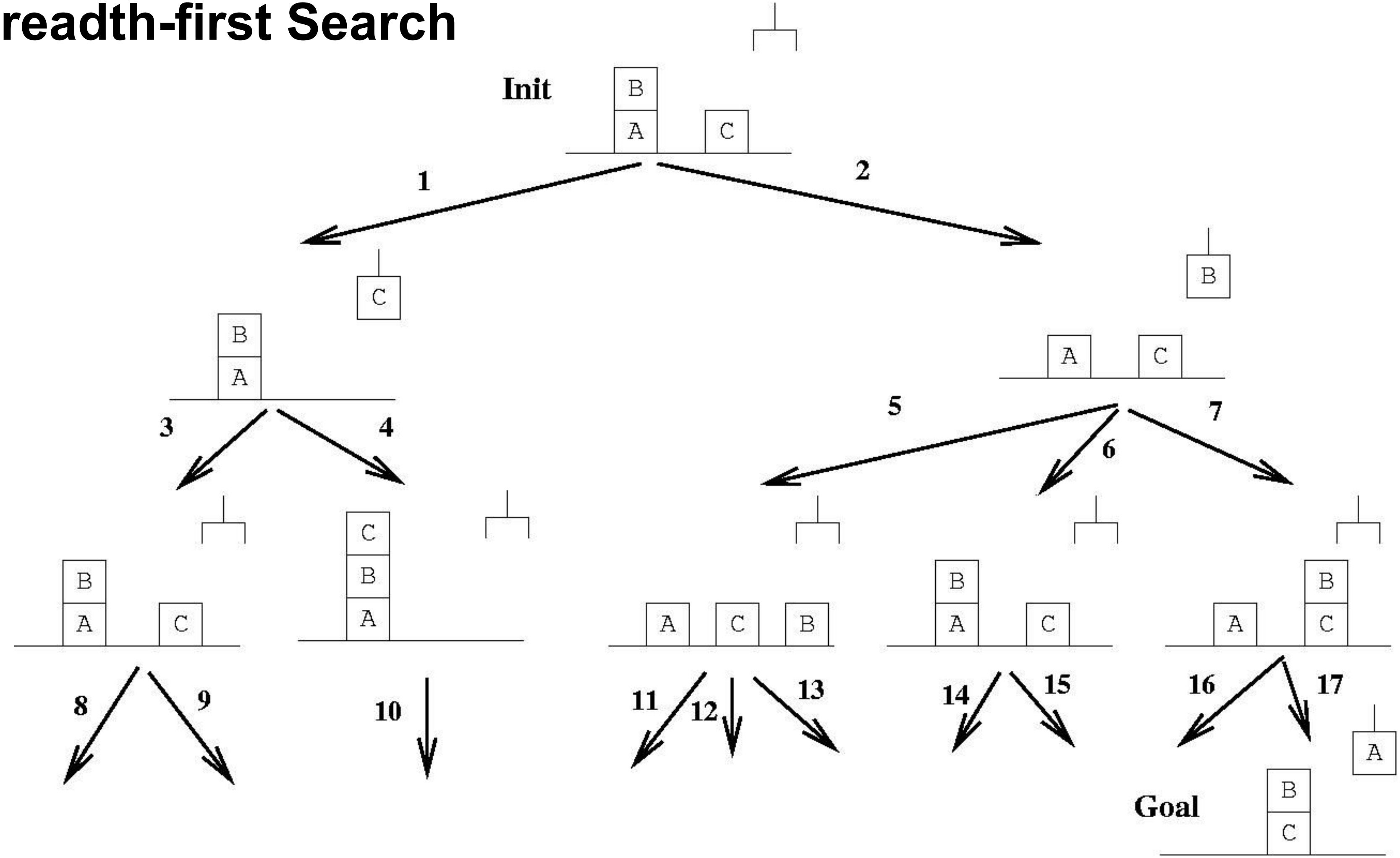
The goal is to build one or more vertical stacks of blocks, turn the initial state into the goal state. Only one block may be moved at a time, it may be placed either on the table or on top of another block.

Operator Description

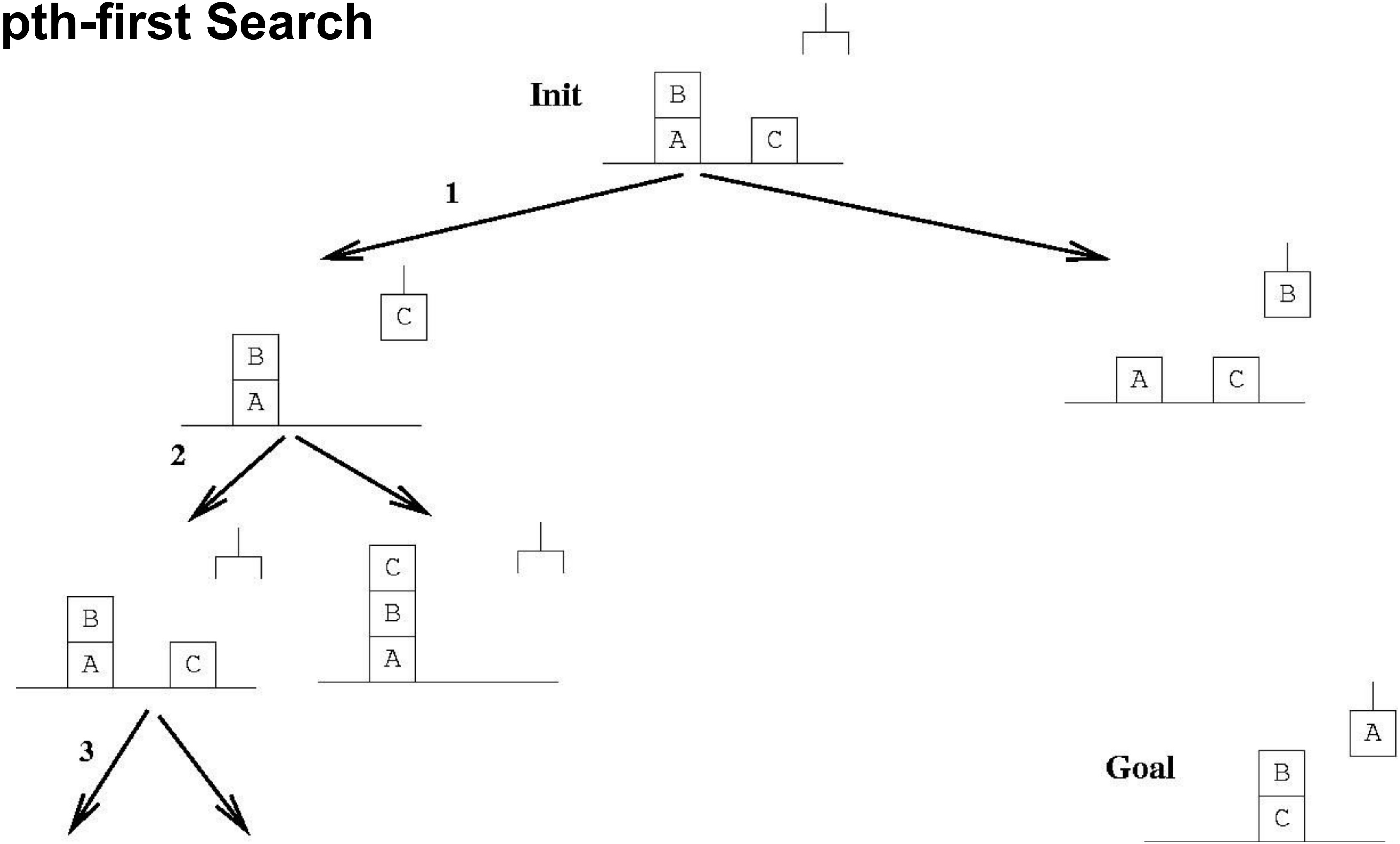


Effects of Moving a Block

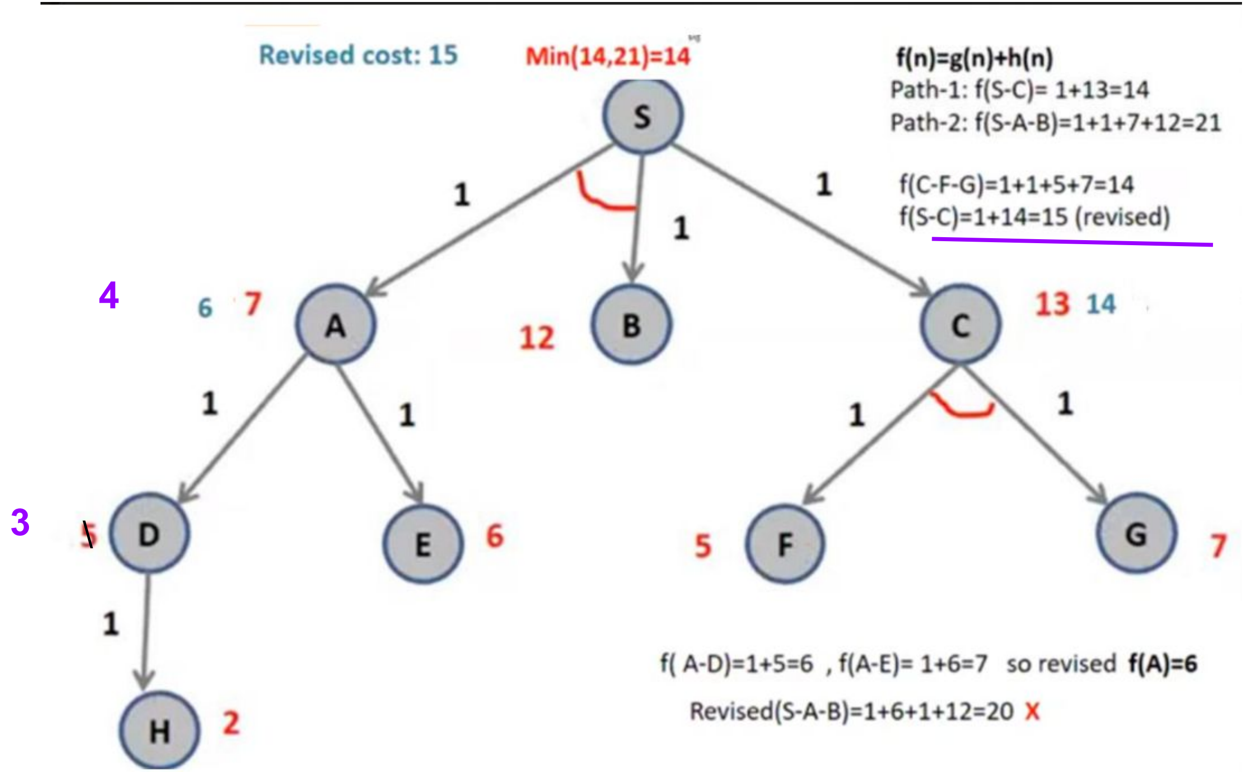
Breadth-first Search



Depth-first Search



Slide 127 correction*



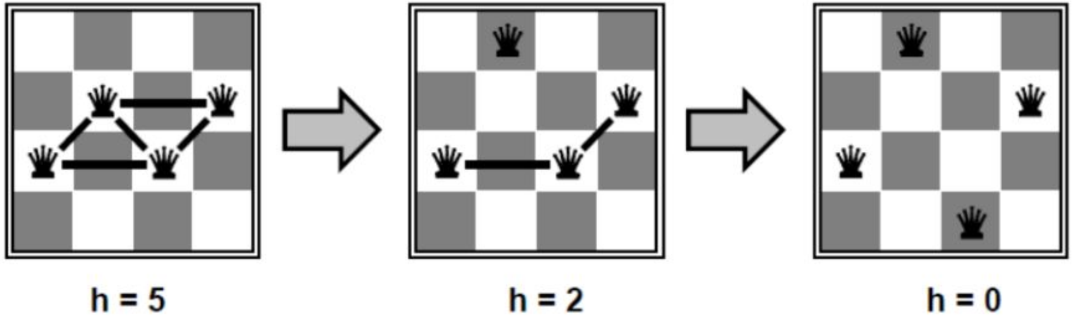
Corrections: f(A-D) revised = 3 +1 = 4
Revised h(A) = min(7,4) = 4
Revised(S-A-B) = 4 + 12 + 1 + 1 = 18

Final revised cost at S = min(15,18) = **15**

Hill Climbing Example
n-queens

- Put n queens on an n × n board with no two queens on the same row, column, or diagonal
- Move a queen to reduce number of conflicts.

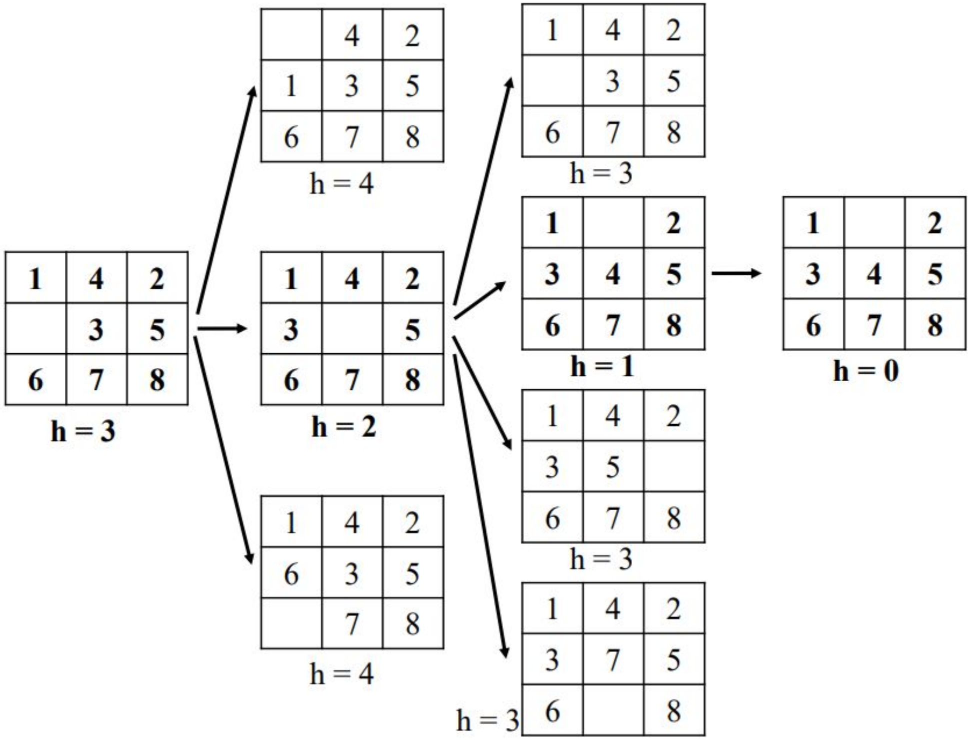
  ➔ **Objective function: number of conflicts (no conflicts is global minimum)**



- The successors of a state are all possible states generated by moving a single queen to another square in the same column (so each state has n*(n-1) successors).
- The heuristic cost function h is the number of pairs of queens that are attacking each other, either directly or indirectly.
- The global minimum of this function is zero, which occurs only at perfect solutions.

Hill Climbing Example

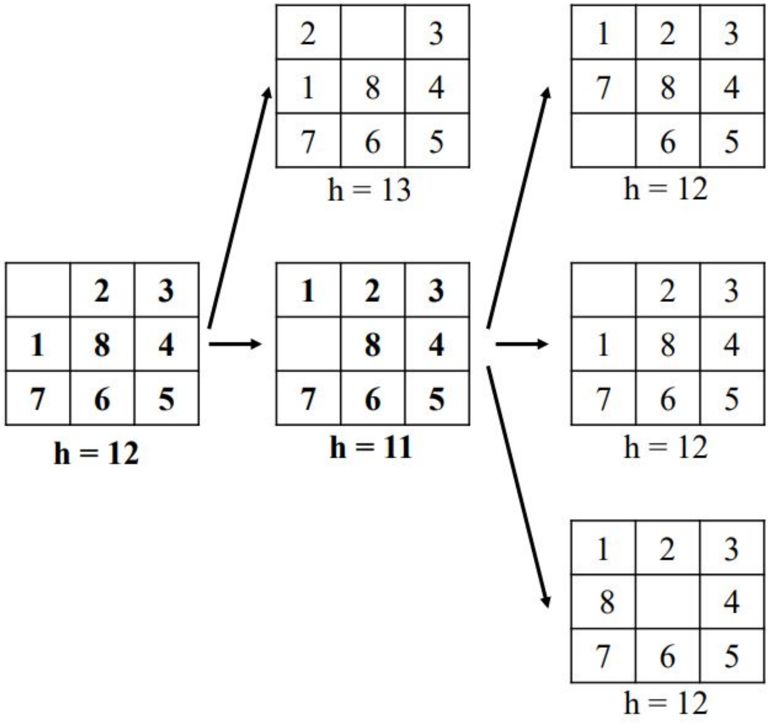
8-puzzle: a solution case



Heuristic function is Manhattan Distance

Hill Climbing Example

8-puzzle: stuck at local maximum



Heuristic function is Manhattan Distance

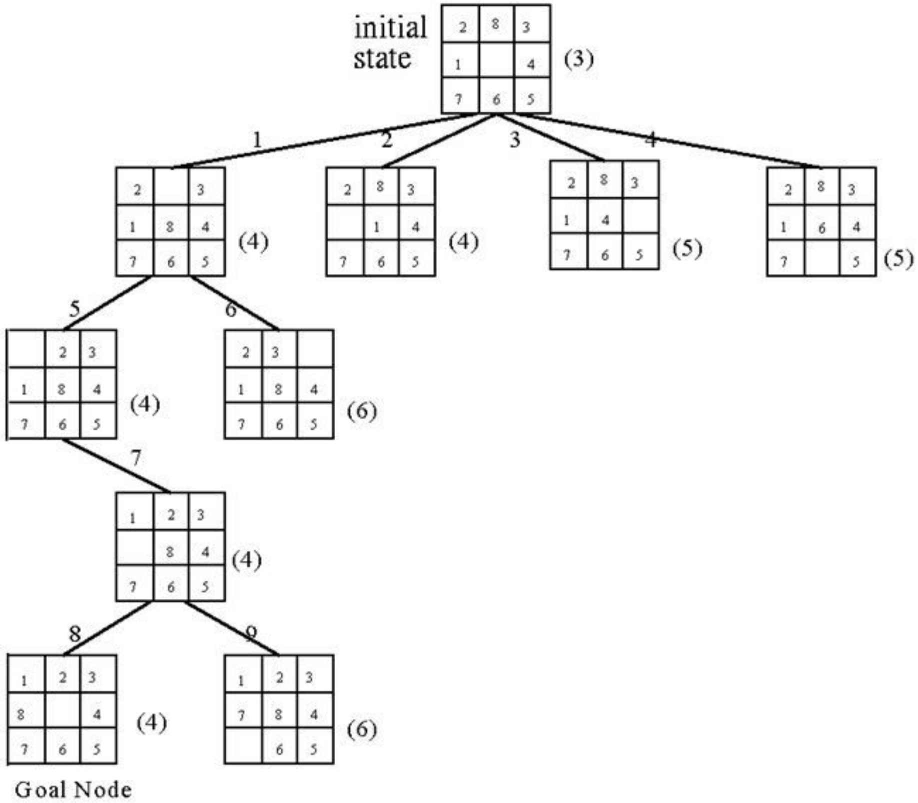
We are stuck with a local maximum.

Hill Climbing

- Hill Climbing is **NOT complete**.
- Hill Climbing is **NOT optimal**.

- **Why use local search?**
  - Low memory requirements – usually constant
  - Effective – Can often find good solutions in extremely large state spaces
  - Randomized variants of hill climbing can solve many of the drawbacks in practice.

- Many variants of hill climbing have been invented.



An 8-puzzle problem solved by a hill climbing method.