

Uniform Informed Search

Heuristic funcⁿ $h(n)$:

$$h(n) \leq h^*(n)$$

This function can be anything depending on the nature of the problem.

Three types of Informed Search

Best First Search

A* Search

Best First Search

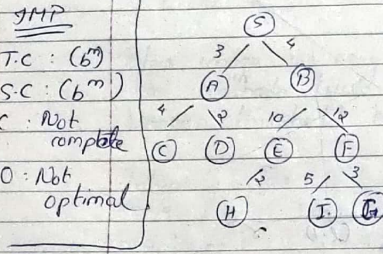
JMP

T.C: (b^m)

S.C: (b^m)

C: Not complete

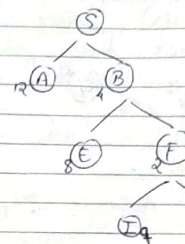
O: Not optimal



Node	$h(n)$
S	13
A	12
B	4
C	7
D	3
E	8
F	2
H	4
I	7
G	0

If no cost given, consider ∞

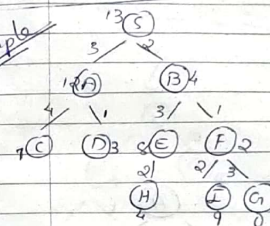
Goal: $S \rightarrow G$



Open	Close
[S]	[]
[B, A]	[S]
[F, E, A]	[S, B]
[G, I, E, A]	[S, B, F]

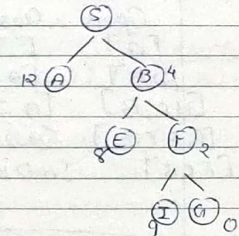
Path: $S \rightarrow B \rightarrow F \rightarrow G$

Example

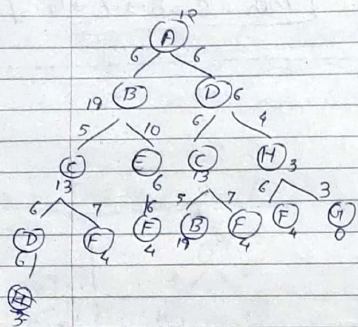
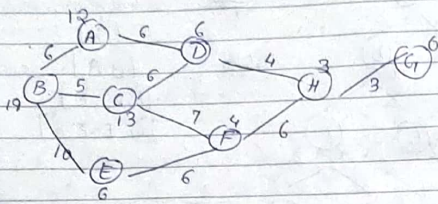


Open	Close
S	13
A	12
B	4
C	7
D	3
E	8
F	2
H	4
I	7
G	0

Path: $S \rightarrow B \rightarrow F \rightarrow G$

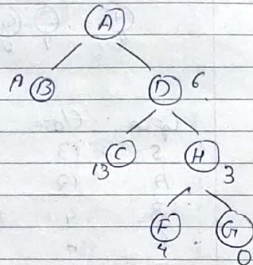


Example



Open	Close
[A]	[]
[DB]	[A]
[HC, B]	[AD]
[GFCB]	[ADH]
[FCB]	[ADHG]

Path: A → D → H → G



A* Search (Advance of Best First)

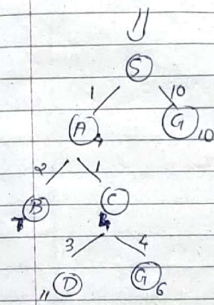
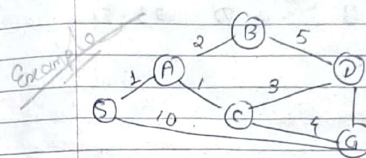
Along with heuristic value, also consider the cost from source to node.

$$f(n) = h(n) + g(n)$$

cost from source to node

Heuristic

Node	$h(n)$
S	5
A	3
B	4
C	2
D	6
G	0



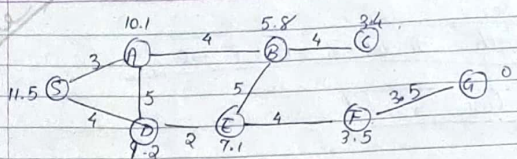
- Iterations
- 1 {S, 5}
 - 2 {S → A, 4} (S → G, 10)
 - 3 {S → A → B, 7} (S → A → C, 4) (S → G, 10)
 - 4 {S → A → C → D, 11} (S → A → C → G, 6) (S → A → B, 7) (S → G, 10)

Hence, the cost to the goal node is min.

Path: S → A → C → G

Cost: 6

Example



Iterations

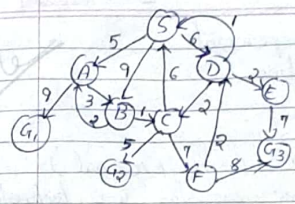
- $\{S, 11.5\}$
- $\{S \rightarrow A, 13.1\}$
 $\{S \rightarrow D, 13.2\}$
- $\{S \rightarrow A \rightarrow B, 13.8\}$
 $\{S \rightarrow A \rightarrow D, 17.2\}$
 $\{S \rightarrow D, 13.2\}$
- $\{S \rightarrow A \rightarrow B \rightarrow C, 14.4\}$
 $\{S \rightarrow A \rightarrow B \rightarrow E, 19.1\}$
 $\{S \rightarrow A \rightarrow D, 17.2\}$
 $\{S \rightarrow D, 13.2\}$
- $\{S \rightarrow A \rightarrow B \rightarrow C, 14.4\}$ $\{S \rightarrow A \rightarrow B \rightarrow E, 19.1\}$ $\{S \rightarrow A \rightarrow D, 17.2\}$
 $\{S \rightarrow D \rightarrow A, 19.1\}$ $\{S \rightarrow D \rightarrow E, 13.1\}$
- $\{S \rightarrow D \rightarrow E \rightarrow B, 16.8\}$ $\{S \rightarrow D \rightarrow E \rightarrow F, 13.5\}$
- $\{S \rightarrow D \rightarrow E \rightarrow F \rightarrow G, 13.5\}$ $\{S \rightarrow D \rightarrow E \rightarrow B, 16.8\}$ $\{S \rightarrow D \rightarrow A, 19.1\}$
 $\{S \rightarrow A \rightarrow B \rightarrow C, 14.4\}$ $\{S \rightarrow A \rightarrow B \rightarrow E, 19.1\}$ $\{S \rightarrow A \rightarrow D, 17.2\}$

Visited

- (S, 11.5)
- (A, 13.1)
- (B, 12.8)
- (D, 13.2)
- (E, 13.1)
- (F, 13.5)
- (G, 13.5)

Path: $S \rightarrow D \rightarrow E \rightarrow F \rightarrow G$
Cost: 13.5

Example



Iterations

- $\{S, 5\}$
- $\{S \rightarrow A, 12\}$
 $\{S \rightarrow B, 12\}$
 $\{S \rightarrow D, 12\}$
- $\{S \rightarrow A \rightarrow G_1, 14\}$
 $\{S \rightarrow A \rightarrow B, 11\}$
 $\{S \rightarrow B, 12\}$
 $\{S \rightarrow D, 12\}$
- $\{S \rightarrow A \rightarrow B \rightarrow C, 13\}$ $\{S \rightarrow A \rightarrow G_1, 14\}$ $\{S \rightarrow B, 12\}$ $\{S \rightarrow D, 12\}$
- $\{S \rightarrow D \rightarrow C, 12\}$ $\{S \rightarrow D \rightarrow E, 13\}$ $\{S \rightarrow A \rightarrow B \rightarrow C, 13\}$ $\{S \rightarrow A \rightarrow G_1, 14\}$
- $\{S \rightarrow D \rightarrow C \rightarrow F, 15\}$ $\{S \rightarrow D \rightarrow C \rightarrow G_2, 13\}$ $\{S \rightarrow D \rightarrow E, 13\}$ $\{S \rightarrow A \rightarrow G_1, 14\}$
- $\{S \rightarrow D \rightarrow C \rightarrow F, 15\}$ $\{S \rightarrow D \rightarrow G_1 \rightarrow G_2, 13\}$ $\{S \rightarrow A \rightarrow G_1, 14\}$
 $\{S \rightarrow D \rightarrow E \rightarrow G_3, 15\}$

Path: $S \rightarrow D \rightarrow C \rightarrow G_2$
Cost: 13

Node	$h(n)$
S	5
A	7
B	3
C	4
D	6
E	5
F	6

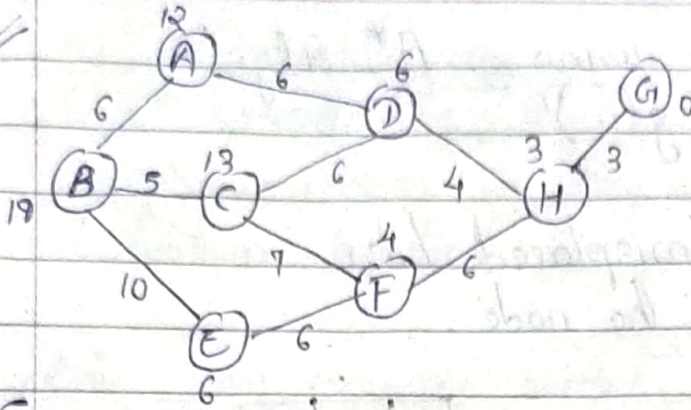
Visited

- (S, 5)
- (A, 12)
- (B, 11)
- (D, 12)
- (C, 12)
- (G₂, 13)

31/1

A1

Example

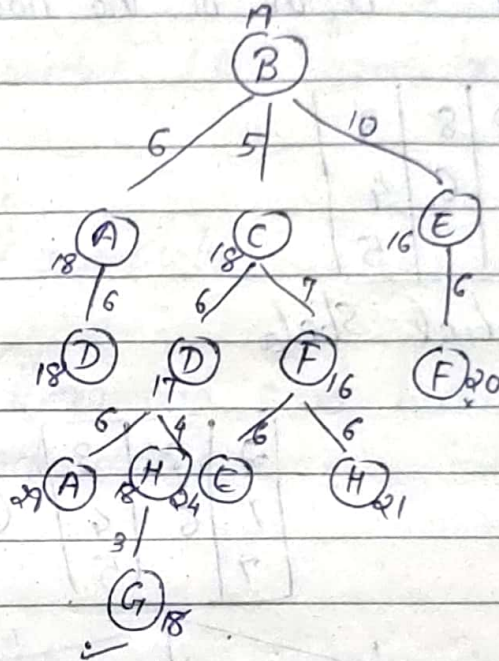


Path:

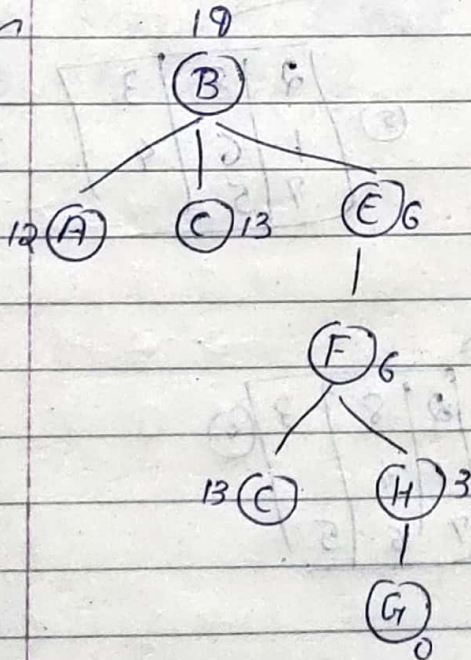
$B \rightarrow C \rightarrow D \rightarrow H \rightarrow G$

Cost: 18

A* Search
Algo



Greedy
approach



Path:

$B \rightarrow E \rightarrow F \rightarrow H \rightarrow G$

Cost: 15

8-puzzles problem using A^* Algo
 $F(n) = h(n) + g(n)$

$h(n)$ = No. of misplaced tiles

$g(n)$ = Depth of the node

2	8	3
1	6	4
7		5

Initial State

1	2	3
8		4
7	6	5

Final State

2	8	3
1	6	4
7		5

(4)

Check
PPT

