

Iterative Deepening Search

#Example input

Input: < - - 0 0 0 - -, - - 0 X 0 - -, 0 0 X X X 0 0, 0 0 0 X 0
0 0, 0 0 0 X 0 0 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION:

< (9 , 7), (23 , 9), (10 , 8), (7 , 9), (9 , 1) >

Time to Complete: 8.11924123764038 seconds

Number of Nodes Expanded: 30

Memory in bytes: 19238912

#more x values, spaced apart

Input: < - - 0 X 0 - -, - - 0 X 0 - -, X X X X X X 0, 0 X 0 X 0
0 0, 0 0 0 X 0 0 0, - - X 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION:

< >

No solution was found.

Time to Complete: 3.2873430252075195 seconds

Number of Nodes Expanded: 4948

Memory in bytes: 20631552

#more x values, spaced together

Input: < - - 0 0 0 - -, - - 0 X 0 - -, 0 X X X X X 0, 0 0 X X X
0 0, 0 0 X X X 0 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION:

< (8 , 6), (10 , 8), (16 , 14), (23 , 21), (24 , 10),
(11 , 9), (9 , 7), (6 , 8), (21 , 7), (7 , 9), (9 , 1
) >

Time to Complete: 93.39516115188599 seconds

Number of Nodes Expanded: 1191585

Memory in bytes: 377602048

#one input

Input: < - - 0 0 0 - -, - - 0 0 0 - -, 0 0 0 0 0 0 0, 0 0 0 0 0
0 0, 0 0 0 0 0 X 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION:

< >

The input was a solution.

Time to Complete: 4.450760841369629 seconds

Number of Nodes Expanded: 1

Memory in bytes: 19283968

#no input

Input: < - - 0 0 0 - -, - - 0 0 0 - -, 0 0 0 0 0 0 0, 0 0 0 0 0
0 0, 0 0 0 0 0 0 0, - - 0 0 0 - -, - - 0 0 0 - - >**Output:**

SOLUTION:

< >

No solution was found.

Time to Complete: 7.172853946685791 seconds

Number of Nodes Expanded: 1

Memory in bytes: 20094976

A* Search (All Heuristics)

#Example input

Input: < - - 0 0 0 - -, - - 0 X 0 - -, 0 0 X X X 0 0, 0 0 0 X 0
0 0, 0 0 0 X 0 0 0, - - 0 0 0 - -, - - 0 0 0 - - >**Output:**

SOLUTION WITH MANHATTAN DISTANCE HEURISTIC:

< (9 , 7), (23 , 9), (10 , 8), (7 , 9), (9 , 1) >

Time to Complete: 3.7410171031951904 seconds

Number of Nodes Expanded: 18

Memory in bytes: 19255296

SOLUTION WITH NUMBER OF MOVEABLE PEGS HEURISTIC:

< (9 , 7), (23 , 9), (10 , 8), (7 , 9), (9 , 1) >

Time to Complete: 3.7428672313690186 seconds
Number of Nodes Expanded: 24
Memory in bytes: 19267584

SOLUTION WITH DISTANCE FROM CENTER (CENTER BIAS) HEURISTIC:
< (9 , 7) , (23 , 9) , (10 , 8) , (7 , 9) , (4 , 16) >

Time to Complete: 3.744084358215332 seconds
Number of Nodes Expanded: 23
Memory in bytes: 19267584

#more x values, spaced apart

Input: < - - 0 X 0 - - , - - 0 X 0 - - , X X X X X X 0 , 0 X 0 X 0
0 0 , 0 0 0 X 0 0 0 , - - X 0 0 - - , - - 0 0 0 - - >

Output:

SOLUTION WITH MANHATTAN DISTANCE HEURISTIC:

< >

No solution was found.

Time to Complete: 5.00240683555603 seconds
Number of Nodes Expanded: 555
Memory in bytes: 19369984

SOLUTION WITH NUMBER OF MOVEABLE PEGS HEURISTIC:

< >

No solution was found.

Time to Complete: 5.062994956970215 seconds
Number of Nodes Expanded: 1223
Memory in bytes: 19406848

SOLUTION WITH DISTANCE FROM CENTER (CENTER BIAS) HEURISTIC:

< >

No solution was found.

Time to Complete: 5.118281841278076 seconds
Number of Nodes Expanded: 611
Memory in bytes: 19406848

#more x values, spaced together

Input: < - - 0 0 0 - -, - - 0 X 0 - -, 0 X X X X X 0, 0 0 X X X
0 0, 0 0 X X X 0 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION WITH MANHATTAN DISTANCE HEURISTIC:

< (23 , 21), (8 , 22), (21 , 23), (24 , 22), (17 , 15
) , (22 , 8), (4 , 16), (7 , 9), (16 , 4), (11 , 9), (9 , 1) >

Time to Complete: 3.034899950027466 seconds

Number of Nodes Expanded: 73

Memory in bytes: 19308544

SOLUTION WITH NUMBER OF MOVEABLE PEGS HEURISTIC:

< (16 , 14), (8 , 6), (10 , 8), (24 , 10), (11 , 9), (9 , 7), (23 , 21), (6 , 8), (21 , 7), (7 , 9), (9 , 1
) >

Time to Complete: 14.774887800216675 seconds

Number of Nodes Expanded: 13322

Memory in bytes: 22593536

SOLUTION WITH DISTANCE FROM CENTER (CENTER BIAS) HEURISTIC:

< (8 , 6), (10 , 8), (24 , 10), (11 , 9), (9 , 7), (6 , 8), (23 , 21), (8 , 22), (21 , 23), (23 , 9), (4 , 16) >

Time to Complete: 14.78713083267212 seconds

Number of Nodes Expanded: 147

Memory in bytes: 22597632

#one input

Input: < - - 0 0 0 - -, - - 0 0 0 - -, 0 0 0 0 0 0 0, 0 0 0 0 0
0 0, 0 0 0 0 0 X 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION FOR ALL FOUR:

< >

The input was a solution.

Time to Complete: 5.355191946029663 seconds

Number of Nodes Expanded: 1

Memory in bytes: 19251200

#no input

Input: < - - 0 0 0 - -, - - 0 0 0 - -, 0 0 0 0 0 0 0, 0 0 0 0 0
0 0, 0 0 0 0 0 0 0, - - 0 0 0 - -, - - 0 0 0 - - >

Output:

SOLUTION FOR ALL FOUR:

< >

No solution was found.

Time to Complete: 3.8442819118499756 seconds

Number of Nodes Expanded: 1

Memory in bytes: 19308544