

Apply A* Algorithm

Misplaced Tiles

Manhattan Distance

2	8	3
1	6	4
7		5

I

1	2	3
8		4
7	6	5

F

$$f(n) = g(n) + h(n) = \text{Misplaced Tiles}$$

Solution

2	8	3
1	6	4
7		5

$g=0$

L

2	8	3
1	6	4
	7	5

$H.V = 6+1 = 7$

Up

2	8	3
1		4
7	6	5

$H.V = 3+1 = 4$

R

2	8	3
1	6	4
7	5	

$H.V = 6+1 = 7$

$g=1$

up

2		3
1	8	4
7	6	5

$H.V = 4+2 = 6$

down

2	8	3
1	6	4
7		5

$H.V = 5+2 = 7$

left

2	8	3
	1	4
7	6	5

$H.V = 4+2 = 6$

right

2	8	3
1	4	
7	6	5

$H.V = 5+2 = 7$

$g=2$

down

2	8	3
1		4
7	6	5

$H.V = 3+3 = 6$

	2	3
1	8	4
7	6	5

$H.V = 3+3 = 6$

2	3	
1	8	4
7	6	5

$H.V = 5+3 = 8$

up

	8	3
2	1	4
7	6	5

$H.V = 1+3 = 4$

right

2	8	3
1		4
7	6	5

$H.V = 3+3 = 6$

down

2	8	3
7	1	4
	6	5

$H.V = 5+3 = 8$

$g=3$

down

2	8	3
1	6	4
7		5

$H.V = 5+4 = 9$

left

2	8	3
	1	4
7	6	5

$H.V = 4+4 = 8$

right

2	8	3
1	4	
7	6	5

$H.V = 5+4 = 9$

down

1	2	3
	8	4
7	6	5

$H.V = 2+4 = 6$

left

		3
1	8	4
7	6	5

$H.V = 4+4 = 8$

up

2		3
1	8	4
7	6	5

$H.V = 4+4 = 8$

left

2	8	3
	1	4
7	6	5

$H.V = 4+4 = 8$

right

2	8	3
1	4	
7	6	5

$H.V = 5+4 = 9$

1	2	3
8		4
7	6	5

$H-V = 2+4 = 6$

up

	2	8
1	8	4
7	6	5

$H-V = 2+5 = 7$
 $t+5 = 9$

down

1	2	3
7	8	4
	6	5

$3+5 = 7$

right

1	2	3
8		4
7	6	5

$= 0+5 = 5$

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

$= 5 + 0$

$f(n) = 5$

Manhattan distance

1	5	8
3	2	
4	6	7

Initial

1	2	3
4	5	6
7	8	

goal

5	8	
8	2	
4	6	7

left

1	5	8
3		2
4	6	7

up

1	5	
3	2	8
4	6	7

down

1	5	8
3	2	7
4	6	

1 2 3 4 5 6 7 8
 0 2 3 1 1 2 2 3 = 14

1 2 3 4 5 6 7 8
 0 1 3 1 1 2 3 3 = 14

1 2 3 4 5 6 7 8
 0 1 3 1 1 2 2 2 = 12

left

1		5
3	2	8
4	6	7

down

1	5	8
3	2	
4	6	7

$= 2$

1 2 3 4 5 6 7 8
 0 1 2 1 2 2 2 2 = 13

1 2 3 4 5 6 7 8
 0 1 3 1 1 2 3 3 = 14

Algorithm for (15-puzzle)

1. Start \rightarrow put initial state in OPEN ($f = g+h$)
2. pick state with smallest f
3. if goal \rightarrow stop
4. Expand neighbours (move blank)
5. For each neighbour

$g := \text{parent} \cdot g + 1$

$h := \text{misplaced files}$

$f = g + h$

6. Repeat until goal found (if open empty add/update in open)

output:

2	8	3
1	6	4
7	0	5

\Rightarrow initial

2	8	3
1	0	4
7	6	5

2	0	3
1	8	4
7	6	5

0	2	3
1	8	4
7	6	5

1	2	3
0	8	4
7	6	5

1	2	3
8	0	4
7	6	5

= goal

Manhattan distance

2	8	3
1	6	4
7		5

I

1	2	3
8		4
7	6	5

F

2	8	3
1	6	4
7		5

left

up

right

2	8	3
1	6	4
7	5	

2	8	3
1		4
7	6	5

2	8	3
1	6	4
7	5	

1	2	3	4	5	6	7	8
1	1	0	0	0	1	1	2

= 6

1	2	3	4	5	6	7	8
1	1	0	0	0	0	0	2

= 4

1	2	3	4	5	6	7	8
1	1	0	0	1	1	0	2

= 6

up

down

right

left

2		3
1	8	4
7	6	5

2	8	3
1	6	4
7		5

2	8	3
1	4	
7	6	5

2	8	3
	1	4
7	6	5

1	2	3	4	5	6	7	8
1	1	0	0	0	0	0	1

= 3

1	2	3	4	5	6	7	8
1	1	0	0	0	1	0	2

= 5

1	2	3	4	5	6	7	8
1	1	0	1	0	0	0	2

= 5

1	2	3	4	5	6	7
2	1	0	0	0	0	0

= 5

left

right

down

	2	3
1	8	4
7	6	5

2	3	
1	8	4
7	6	5

2	8	3
1		4
7	6	5

= 3

1	2	3	4	5	6	7	8
1	1	1	0	0	0	0	1

= 4

1	2	3	4	5	6	7	8
1	1	0	0	0	0	0	2

= 4

right

down

= 4

2		3
1	8	4
7	6	5

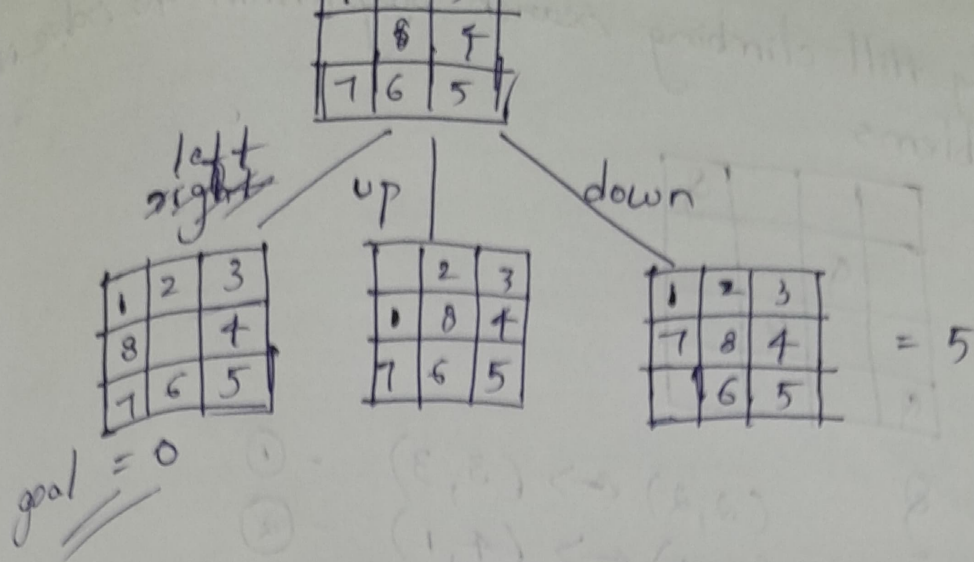
1	2	3
	8	4
7	6	5

1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	1

= 1

1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	1

= 3



Algorithm

1. Start with the current puzzle state
2. Create an empty list to keep track of tile matches
3. For each tile from 1 to 8:
 - if the tile is in correct position, add 0 to the list
 - otherwise, add 1 to the list
4. Check the list:
 - if the list contains all 0's the puzzle is solved - stop
 - otherwise, make a move to get closer to the goal
5. Repeat steps 2 to 4 until the puzzle is solved

Output

2	8	3
1	6	4
7	0	5

= initial

2 8 3

1 0 4

7 6 5

2 0 3

1 8 4

7 6 5

0 2 3

1 8 4

7 6 5

1 2 3

0 8 4

7 6 5

1	2	3
8	0	4
7	6	5

= goal