

PROBLEM SOLVING USING INFORMED SEARCH ALGORITHMS

Assignment 1: Check if given configuration of 8-puzzle is solvable or not

Hint:

- If initial number of inversions are odd \Rightarrow Not solvable
- If initial number of inversions are even \Rightarrow Solvable

How to find inversion:

5	2	8
4	1	7
	3	6

For tile positions m and n , if $m < n$ but $f(m) > f(n)$, it is called inversion.

For above configuration:

5 precedes 1, 2, 3, 4 \Rightarrow 4 inversion

2 precedes 1 \Rightarrow 1 inversion

8 precedes 1, 3, 4, 6, 7 \Rightarrow 5 inversion

4 precedes 1, 3 \Rightarrow 2 inversion

1 precedes none \Rightarrow 0 inversion

7 precedes 3, 6 \Rightarrow 2 inversion

3 precedes none \Rightarrow 0 inversion

6 precedes none \Rightarrow 0 inversion

Total Inversion = 14 \rightarrow Even \Rightarrow Given configuration is solvable

3 ₂	2 ₁	1 ₀
	5 ₁	8 ₃
7 ₂	6 ₁	4 ₀

Start

1	2	3
4	5	6
7	8	

Goal

$$\begin{aligned} \#Inversion &: 2(3) + 1(2) + 0(1) + 1(5) + 3(8) + 2(7) + 1(6) + 0(4) \\ &= 10 \text{ (Even No. of Inversion)} \Rightarrow \text{Solvable} \end{aligned}$$

3 ₂	2 ₁	1 ₀
	5 ₁	8 ₃
7 ₂	4 ₀	6 ₀

Start

1	2	3
4	5	6
7	8	

Goal

$$\begin{aligned} \#Inversion &: 2(3) + 1(2) + 0(1) + 1(5) + 3(8) + 2(7) + 0(4) + 0(6) \\ &= 9 \text{ (Even No. of Inversion)} \Rightarrow \text{Unsolvable} \end{aligned}$$

Assignment 2: Find the heuristic of 8-puzzle problem for given board configuration using following method:

1. Manhattan distance
2. Number of tiles out of place
3. Sum of number of tiles in incorrect row and column.

Hint:

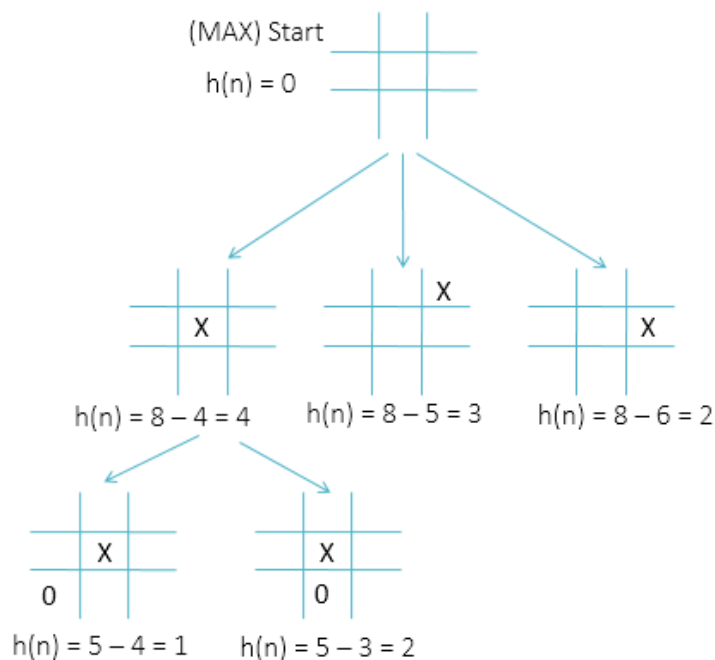
Following diagram explains computation of all three types of heuristic methods for 8-puzzle problem.

Number of Misplaced Tiles	Manhattan Distance	Sum of tiles in incorrect row and column																											
<table style="display: inline-table; margin-right: 20px;"> <tr><td>7</td><td>2</td><td>4</td></tr> <tr><td>5</td><td></td><td>6</td></tr> <tr><td>8</td><td>3</td><td>1</td></tr> </table> Start	7	2	4	5		6	8	3	1	<table style="display: inline-table; margin-right: 20px;"> <tr><td>7</td><td>2</td><td>4</td></tr> <tr><td>5</td><td></td><td>6</td></tr> <tr><td>8</td><td>3</td><td>1</td></tr> </table> Start	7	2	4	5		6	8	3	1	<table style="display: inline-table; margin-right: 20px;"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>8</td><td></td><td>4</td></tr> <tr><td>7</td><td>6</td><td>5</td></tr> </table> Goal	1	2	3	8		4	7	6	5
7	2	4																											
5		6																											
8	3	1																											
7	2	4																											
5		6																											
8	3	1																											
1	2	3																											
8		4																											
7	6	5																											
<table style="display: inline-table; margin-right: 20px;"> <tr><td>7</td><td>2</td><td>4</td></tr> <tr><td>5</td><td></td><td>6</td></tr> <tr><td>8</td><td>3</td><td>1</td></tr> </table> Start	7	2	4	5		6	8	3	1	<table style="display: inline-table; margin-right: 20px;"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>8</td><td></td><td>4</td></tr> <tr><td>7</td><td>6</td><td>5</td></tr> </table> Goal	1	2	3	8		4	7	6	5	<table style="display: inline-table; margin-right: 20px;"> <tr><td>7</td><td>2</td><td>4</td></tr> <tr><td>5</td><td></td><td>6</td></tr> <tr><td>8</td><td>3</td><td>1</td></tr> </table> Start	7	2	4	5		6	8	3	1
7	2	4																											
5		6																											
8	3	1																											
1	2	3																											
8		4																											
7	6	5																											
7	2	4																											
5		6																											
8	3	1																											
<table style="display: inline-table; margin-right: 20px;"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>8</td><td></td><td>4</td></tr> <tr><td>7</td><td>6</td><td>5</td></tr> </table> Goal	1	2	3	8		4	7	6	5	<table style="display: inline-table; margin-right: 20px;"> <tr><td>7</td><td>2</td><td>4</td></tr> <tr><td>5</td><td></td><td>6</td></tr> <tr><td>8</td><td>3</td><td>1</td></tr> </table> Start	7	2	4	5		6	8	3	1	<table style="display: inline-table;"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>8</td><td></td><td>4</td></tr> <tr><td>7</td><td>6</td><td>5</td></tr> </table> Goal	1	2	3	8		4	7	6	5
1	2	3																											
8		4																											
7	6	5																											
7	2	4																											
5		6																											
8	3	1																											
1	2	3																											
8		4																											
7	6	5																											
$h(n) = \text{\#misplaced tiles}$ $h(n) = 7$ $h(n) = \text{\#correctly placed tiles}$ $h(n) = 8$	$h(n) = \text{Manhattan distances}$ $h(n) = 4+0+3+1+3+2+2+1 = 16$	$h(n) = \text{\#tiles out of row} + \text{\#tiles out of column}$ $h(n) = 7 (\text{row}) + 4(\text{column}) = 11$																											

Assignment 3: Find the heuristic of Tic-Tac Toe problem for given board configuration

Hint:

$$h(n) = (\text{\#rows} + \text{\#cols} + \text{\#diagonals open to 'X'}) - (\text{Same to 'O'})$$



Assignment 4: Solve 8-PUZZLE problem using following uninformed search techniques:

1. Generate and Test
2. Depth First Search
3. Breadth First Search
4. Iterative Deepening

Assignment 5: Solve 8-PUZZLE problem using following informed search techniques:

1. Simple Hill Climbing
2. Steepest Ascent Hill Climbing
3. Local Beam Search
4. Best First Search
5. A* Search

Assignment 6: Solve TIC-TAC TOE problem using following uninformed search techniques:

1. Generate and Test
2. Depth First Search
3. Breadth First Search
4. Iterative Deepening

Assignment 7: Solve TIC-TAC-TOE problem using following informed search techniques:

1. Simple Hill Climbing
2. Steepest Ascent Hill Climbing
3. Local Beam Search
4. Best First Search
5. A* Search