CSC425 Assignment 3

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In this problem you are to output the solution to the 8-puzzle problem, i.e., to find the sequence of moves from some initial configuration/state of the puzzle to a final state. As for the moves consider moving the blank tile moving UP, DOWN, LEFT, RIGHT in that order. Each move has cost = 1.

Figure 1 below shows example initial and final states.

Initial State:

1	4	2
	5	3
6	7	8

Final State:

1	2	
5	4	3
6	7	8

Figure 1: an example initial and final state

Figure 1: Question Premise

Question 1

1. [10 points] Show by hand the execution of A* search algorithm. Initially the frontier will have the initial state (name it state 0) with its f-value. Number the subsequent states and compute their f-values. In each step show: a. which path is selected, b. whether it is the optimal path, and c. the contents of the frontier at the completion of the step.

The heuristic function to be used: **h(n) = number of misplaced tiles**, where n is a state. For example, for the initial state, h(initial) = 3 (as tiles 2, 4 and 5 are not in the correct positions)

Figure 2: Question 1

Order : L -> U -> R -> D

Goal		
1	2	_
5	4	3
6	7	8

S0	f=0+3	Initial
1	4	2
_	5	3
6	7	8

Frontier:

S0 : 0+3 = 3

S1	f=1+4	U	S2	f=1+2	R	S3	f=1+4	D
_	4	2	1	4	2	1	4	2
1	5	3	5	_	3	6	5	3
6	7	8	6	7	8	_	7	8

Frontier:

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S0 -> S2 : 1+2 = 3
S0 -> S1 : 1+3 = 4
S0 -> S3 : 1+3 = 4
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S1	f=1+4	U	S21	f=2+1	U	S22	f=2+3	R	S23	f=2+3	D	S3	f=1+4	D
_	4	2	1	_	2	1	4	2	1	4	2	1	4	2
1	5	3	5	4	3	5	3	_	5	7	3	6	5	3
6	7	8	6	7	8	6	7	8	6	_	8	_	7	8

Frontier:

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S0 -> S2 -> S21 : 2+1 = 3
S0 -> S1 : 1+3 = 4
S0 -> S3 : 1+3 = 4
S0 -> S2 -> S22 : 2+3 = 5
S0 -> S2 -> S23 : 2+3 = 5
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S1	f=1+4	U	S22	f=2+3	R	S23	f=2+3	D	S3	f=1+4	D
_	4	2	1	4	2	1	4	2	1	4	2
1	5	3	5	3	_	5	7	3	6	5	3
6	7	8	6	7	8	6	_	8	_	7	8

S211	f=3+2	L	S212	f=3+0	R
_	1	2	1	2	_
5	4	3	5	4	3
6	7	8	6	7	8

Frontier:

```
S0 -> S2 -> S21 -> S212 : 3+0 = 3 #Goal found. Therefore Search Stopped.
S0 -> S1 : 1+3 = 4
S0 -> S3 : 1+3 = 4
S0 -> S2 -> S21 -> S211 : 3+2 = 5
S0 -> S2 -> S22 : 2+3 = 5
S0 -> S2 -> S23 : 2+3 = 5
```

Question 2

2. [30 points] In this problem you will implement the Depth first Branch and Bound algorithm.

a. [5 points] Write a pseudo-code of the "generic" Depth First Branch and Bound algorithm. Update the generic search algorithm presented in class for this.

b. [25 points] Write a code to implement the algorithm to solve the 8-puzzle problem.

Input format: To input the instance of the problem, assume the cell numbers are as shown in figure 2. Then the initial state in figure 1 can be input by the following sequence: 1 4 2 -1 5 3 6 7 8, where the i-th cell of the puzzle contains the i-th number in the sequence and -1 represents the blank tile. The final state of the example above can be input as: 1 2 -1 5 4 3 6 7 8.

cell#1	cell#2	cell#3
cell#4	cell#5	cell#6
cell#7	cell#8	cell#9

Figure2: Cell numbering

Figure 3: Question 2