Introduction to Intelligent System

Assignment 1

Instructor: Le Nguyen

Date: Friday, January 29, 2019

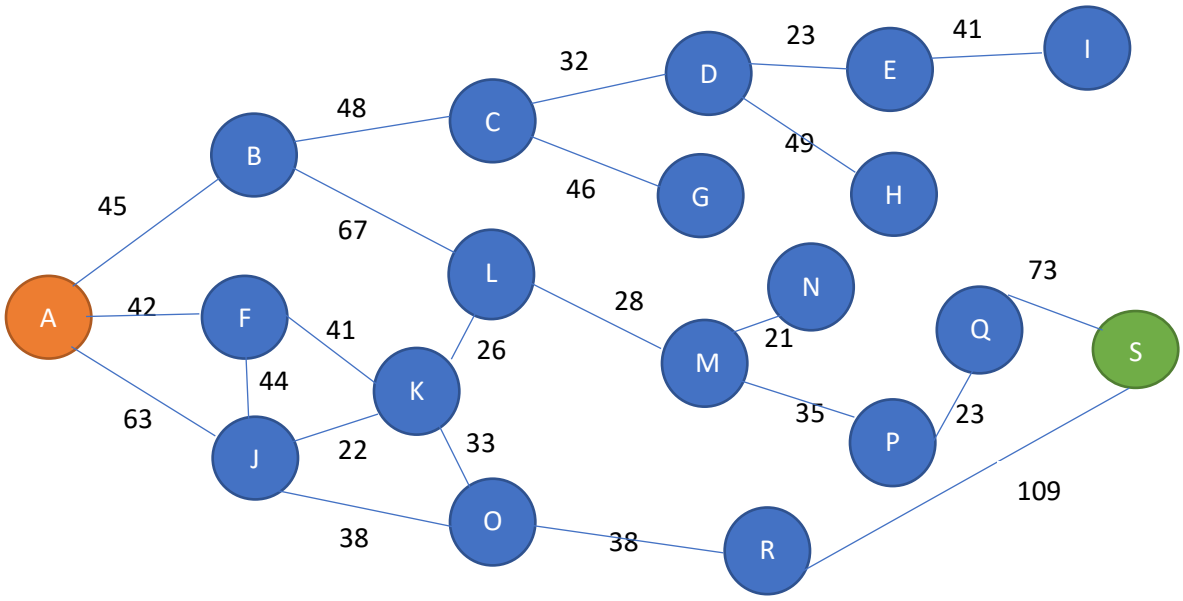
Due Date: February 13, 2019

Total marks: 40.

This is an individual assignment.

1. AI approaches. **(2 marks)**
    a. Briefly summarize the four major approaches in AI. You have to provide a discussion on the main focus of each approach.
    b. What is the difference between weak AI and Strong AI?
2. Task environment **(2 marks)**
    a. For each of the following activities, give a PEAS description of the task environment and characterize it in term of the properties.
        i. Playing soccer
        ii. Playing tennis match

3. Informed and Uninformed Search. **Draw a search tree and list the order of nodes visited** and show to queue information at each depth **(12 marks)**



In this question, A to S are cities. The numbers are the distances for one city to another.

Start from A to S.

a. Breath First search. The expansion of the nodes is from left to right. **(6 marks)**
    i. Write down the solution.
    ii. Can it find optimal solution? Explain your answer.
b. A* search. **(6 marks)**

    Straight line distance is used for heuristic function.

City	SLD to S	City	SLD to S	City	SLD to S
A	184.39	**G**	107.70	**M**	100.00
B	161.25	**H**	101.98	**N**	89.44
C	145.60	**I**	100.00	**O**	111.80
D	141.42	**J**	144.22	**P**	78.10
E	140.00	**K**	128.06	**Q**	67.08
F	148.66	**L**	113.14	**R**	101.98
				S	0.00

    i. Write down the solution.
    ii. Can it find optimal solution? Explain your answer.

4. Implement 8 Puzzle problem in Java for Search Tree using the following search strategies: (24 marks)
    a. Breadth first search.
        i. Node expansion should be in order **LEFT, RIGHT, UP, DOWN.**
    b. A* search with the following **heuristic functions h1 and h2** that discussed in the class.
        i. Number of misplaced tiles. (h1)
        ii. Manhattan distance (h2)

There are **several java interfaces and classes** provided to help you with the implementation. Note: Please do not alter **these classes**.

i. **GenericAction**: This interface provides a template to define action associated with 8-puzzle problem.
ii. **GenericProblem**: This interface provides a template to define the problem.
iii. **GenericState**: This interface provides a template to construct a state of a problem.
iv. **Node**: It is a basic from which the search tree is constructed.

You are **to implement and submit** the following classes: (DO NOT USE ANY PACKAGE)

i. EightPuzzleAction.java
    a. This class should implement **GenericAction**. It must define the actions: LEFT,RIGHT,UP,DOWN. These can be used to move or change the board state.
ii. EightPuzzleProblem.java
    a. This class should implement **GenericProblem**. It must provide the implementation that define in the interface.
    b. Node expands in order of action (LEFT,RIGHT, UP, DOWN).
iii. EightPuzzleBoard.java
    a. This class should implement the **GenericState**. It should provide the implementation that defined in the interface. It should also provide the heuristic functions calculation needed for the A* search.
iv. EightPuzzleSearchAgent.java
    a. This class should implement the treeSearch.
        i. Breadth First Search.
        ii. A* Search with the above heuristic functions
            1. **Note**: When the nodes have the same value for evaluation function, they are visited in FIFO order.

It is used to **launch the search agent** that load the initial state and goal state from a file.

A file has a format. Each digit is separated by a space or new line.

Initial State:
1 2 3
4 5 6
7 8 0
Goal State:
0 8 7
6 5 4
3 2 1

b. Your program should **display** the following information.
   - **i.** The nodes that are **generated and its state, g (path cost), h (heuristic value), f (value).**
   - ii. The number of nodes on the tree.
   - iii. The solution. (Path to the solution)
   - iv. Display the summary of the search strategies.

c. Discuss the reason why one search strategy is better than another.
   - i. Case 1: Breath First Search vs. A* Search
   - ii. Case 2: A* Search with h1 vs. A* Search with h2.
   - iii. Is h1 is admissible? What happen when it is not admissible? Give an example.

C:\> java **EightPuzzleSearchAgent** StateFile

Initial State
0 1 2
3 4 5
6 7 8
Goal State
1 0 2
3 4 5
6 7 8

Breadth First Search:

0 1 2
3 4 5
6 7 8
Action = RIGHT, DOWN //This is the possible actions
g = 0.0
---
1 0 2
3 4 5
6 7 8
Action = LEFT, RIGHT, DOWN //This is the possible actions
g = 1.0

……. //other nodes

Number of nodes on the tree = 3.

Solution:

Initial State
0 1 2
3 4 5
6 7 8
Action = RIGHT //An action leads to next node
g = 0.0
---
1 0 2
3 4 5
6 7 8
g = 1.0

Number of nodes on the tree = 3.

A* Search with h1:

0 1 2
3 4 5
6 7 8
Action = RIGHT, DOWN //This is the possible actions
g = 0.0, h = 1, f = 1
---
1 0 2
3 4 5
6 7 8
Action = LEFT, RIGHT, DOWN //This is the possible actions
g = 1.0, h= 0, f = 1

……. //other nodes

Number of nodes on the tree = 3.

Solution:

Initial State
0 1 2
3 4 5
6 7 8
Action = RIGHT //An action leads to next node
g = 0.0, h = 1, f = 1
---
1 0 2
3 4 5
6 7 8
g = 1.0, h = 0, f = 1
Number of nodes on the tree = 3.

A* Search with h2:
…..

After the search is done it should display.

Depth	Search Cost (Number of nodes generated)		
	A*(h1)	A*(h2)	Breadth First Search
1	2	2	2
……	…	…	…

Bonus: 3 marks

Show the branch factor of the search tree and add to the above table

Depth	Search Cost (Number of nodes generated)			Effective branching factor		
	A*(h1)	A*(h2)	Breadth FS	A*(h1)	A*(h2)	Breadth FS
…	…	…	…	…	…	…
……	…	…	…	…	…	…

Submission:

Codes that **cannot compile** will receive a zero mark. Please make sure it can compile and it should work on Windows 10 and Linux. Java 8 is used to mark the assignment.

- Please comment your code properly.
- Please don't have any **package statement in the Java classes**.

Please submit the following files:

1. A1.pdf.
2. README File
3. The Code:
    a. EightPuzzleAction.java
    b. EightPuzzleSearchAgent.java
    c. EightPuzzleProblem.java
    d. EightPuzzleBoard.java