**Project #2**

**CS 4346: Advanced Artificial Intelligence**

Due Date: April 20, 2020

1. Form a team of a maximum of three students.
2. Implement A\* algorithm (Power point slides 20-22, Rich Chapter #3 Heuristic Search) in C or C++.
3. Run your program for the two heuristic function discussed in the class (h1 and h2) and at least one additional heuristic functions per team member. Run the program for the two different initial states (given below) of the eight puzzle problem.
4. Analyze the performance of the algorithm by tabulating the data and analyzing it. Each row of the table should include the execution time (ET), the number of nodes generated (NG), the number of nodes expanded (NE), depth of the tree (d), effective branching factor b\* (NG/d), and the memory used (MO). A table will be generated for each initial state. Each table will have four rows for four heuristic functions. A sample of such a tables is given below:

**Table 1**

Initial State #1:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Heuristic Function | ET | NG | NE | d | b\* | MO |
| 4 rows |  |  |  |  |  |  |

**Table 2**

Initial State #2:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Heuristic Function | ET | NG | NE | d | b\* | MO |
| 4 rows |  |  |  |  |  |  |

The two initial states are given below:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Initial State #1 | | |  |  |  | Initial State #2 | | |
| 2 | 8 | 3 |  |  |  | 2 | 1 | 6 |
| 1 | 6 | 4 |  |  |  | 4 | ■ | 8 |
| ■ | 7 | 5 |  |  |  | 7 | 5 | 3 |

You are expected to develop the program as a team of a maximum of three students. After the program is developed and tested, each member of the team will work separately to do the following.

1. Run the program for the four heuristic functions and two initial states.

# Best-First Search Algorithm

# Heuristic Functions

* h(n)…Straight-line
* h1(n)…Number of Misplaced tile
* h2(n)…Manhattan distance

1. Tabulate the data generating two table as described above
2. Analyze the results. That is which evaluation function performed better and why. Write the conclusions you draw from these analyses.
3. Write his/her report explaining the problem, methodology, source code implementation, description of heuristic functions, any special approaches used in developing the source code, analysis of results and conclusions.
4. Demonstrate the execution of the program, if asked by the instructor.

Note that writing an efficient and working program is only one-half of the project. The other half of the project is to present it in the best possible understandable form.

In order to conveniently understand your program, print initial state, some intermediate states as they are generated, the final state when it is reached, and finally, the path generated by your program. Note that writing an efficient and working program is only one-half of the project. The other half of the project is to present it in the best possible understandable form.

**Warning: EACH STUDENT MUST PERFORM STEPS 1 TO 5 INDIVIDUALLY. DO NOT COPY PROGRAMS FROM ANY SOURCE. ALSO, DO NOT COPY REPORT FROM YOUR PARTNER OR ANY OTHER PERSON.**

**Project Submission Instructions**

**Report Submission:**

Prepare and upload to TRACS your well documented project report explaining the problem, methodology, source code implementation, description of heuristic functions, any special approaches used in developing the source code, analysis of results and conclusions.

**Source Code SUBMISSION:**

Upload to TRACS source code file as well as other files needed to run the program and verify your results. Source code file naming convention must be: Project1-student ID.cpp; Naming convention of other files will be similar except the file extensions.

**Instructions for Uploading to TRACS [Report as well as Source Code]**

Access CS 4346 sec. #251 Spring 20, then follow the following steps:

* In the left Tool list of the site, click [Assignments].
* Click the assignment's title.
* Add an attachment(s) to the assignment.
* To add an attachment, click [Browse]. Locate your attachment and click [Open].  If you would like to add multiple attachments, click [Browse] and browse for your file.
* If you need to remove an attachment, click [Remove].
* The attachment(s) will be listed in the order they were entered.