CSCE 523

Assignment 1 Rush Hour

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1. **Solution**

To implement the Rush hour puzzle, I utilized a Breadth-First Search (BFS) with a visited list. My implementation of the search interface followed the outline of the generic search function from the chapter 3 slides. BFS was chosen as the search algorithm for its property of completeness. The open list is implemented as a Queue Abstract Data Type and is concretely implemented as a LinkedList of Board objects since each state is a different configuration of the board. The following table shows the file and methods that I added to the skeleton of the Rush Hour program.

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| --- |
| **File Name** |
| NewlinSearch.java |
| equals() method in Board.java |
| goalCheck() in Board.java |

Within the search function itself, the possible moves in that configuration are generated via the genMoves() method inside of Board.java. From there, each configuration of the board generated by the Move list returned is checked against the open and visited lists and added to the open list for exploration only if the board generated by the move is not contained in either list already.

1. **Compilation & Execution**

To compile the program inside of IntelliJ IDEA, right click the Rush Hour program file inside the src/rush hour/afit/edu folder and select “Compile RushHour.main().”

To execute, follow the above instructions and instead of compile, select “Run RushHour.main().”

The console will then output the results of the program running.

1. **Results**

The results of running the easy problems from the “Data.txt” file are located in the table below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data.txt** | | | | |
| **Board 1** | **Board 2** | **Board 3** | **Board 4** | **Board 5** |
| Started board 1  Board: 1 0.001 seconds  Nodes Visited: 1  Move  X0 East 5 spaces | Started board 2  Board: 2 0.004 seconds  Nodes Visited: 32  Move  B1 West 2 spaces  A1 South 3 spaces  X0 East 5 spaces | Started board 3 Board: 3 0.005 seconds  Nodes Visited: 121  Move  D1 East 1 spaces O1 South 3 spaces  Q1 West 2 spaces  C1 North 1 spaces  X0 East 4 spaces | Started board 4 Board: 4 0.487 second  Nodes Visited: 1620  Move  C1 South 1 spaces  B1 East 3 spaces D1 North 2 spaces  E1 North 2 spaces  Q1 West 3 spaces  F1 West 3 spaces E1 South 1 spaces  P1 South 1 spaces  C1 South 2 spaces  X0 East 5 spaces | Started board 5 Board: 5 0.99 seconds  Nodes Visited: 2717  Move  P1 North 2 spaces  E1 East 1 spaces  O1 South 2 spaces  C1 East 2 spaces  B1 East 2 spaces  D1 North 2 spaces  X0 East 1 spaces  A1 South 4 spaces  X0 West 1 spaces  D1 South 2 spaces  C1 West 3 spaces  D1 North 1 spaces  B1 West 3 spaces  O1 North 2 spaces  E1 West 4 spaces  D1 South 1 spaces  O1 South 2 spaces  C1 East 3 spaces  D1 North 2 spaces  E1 East 1 spaces  X0 East 1 spaces  A1 North 3 spaces  E1 West 1 spaces  F1 North 1  Spaces  R1 West 3 spaces  P1 South 3 spaces  O1 South 1 spaces  X0 East 4 spaces |

The results of the problems from the “killer.txt” file are listed in the table below. As we see, these problems are much harder but are handled relatively well by the machine. The only one that took a while was board 5 as it took nearly a minute to complete but at upwards of 15,000 nodes that makes sense that it would take a minute to work. With an enhanced or informed search algorithm such as A\* using a heuristic like the blocking heuristic, this program would most likely run much faster than it does now with BFS and a visited list.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Killers.txt** | | | | |
| **Board 1** | **Board 2** | **Board 3** | **Board 4** | **Board 5** |
| Started board 1  Board: 1 1.735 seconds  Nodes Visited: 3577  Move  I1 East 2 spaces H1 East 1 spaces C1 South 2 spaces A1 South 2 spaces O1 West 3 spaces R1 North 2 spaces H1 East 1 spaces E1 East 1 spaces B1 South 3 spaces E1 West 1 spaces R1 South 1 spaces O1 East 3 spaces A1 North 2 spaces X0 East 3 spaces A1 South 1 spaces O1 West 1 spaces R1 North 1 spaces E1 East 1 spaces D1 East 2 spaces G1 North 4 spaces F1 North 4 spaces D1 West 2 spaces E1 West 2 spaces R1 South 1 spaces O1 East 1 spaces A1 North 1 spaces X0 West 3 spaces A1 South 1 spaces O1 West 1 spaces R1 North 1 spaces E1 East 2 spaces B1 North 3 spaces E1 West 1 spaces R1 South 1 spaces O1 East 1 spaces A1 North 1 spaces C1 North 2 spaces I1 West 4 spaces H1 West 4 spaces C1 South 2 spaces A1 South 2 spaces O1 West 1 spaces R1 North 1 spaces E1 East 1 spaces B1 South 3 spaces E1 West 1 spaces R1 South 3 spaces O1 East 1 spaces A1 North 2 spaces X0 East 5 spaces | Started board 2 Board: 2 1.486 seconds Nodes Visited: 3048 Move  I1 East 1 spaces E1 South 1 spaces P1 North 1 spaces Q1 East 3 spaces F1 North 1 spaces H1 East 1 spaces C1 South 2 spaces O1 South 3 spaces A1 West 1 spaces D1 North 1 spaces X0 West 3 spaces D1 South 1 spaces B1 South 1 spaces A1 East 3 spaces D1 North 1 spaces X0 East 2 spaces C1 North 3 spaces X0 West 1 spaces O1 North 3 spaces H1 West 1 spaces F1 South 1 spaces Q1 West 3 spaces P1 South 1 spaces A1 East 1 spaces E1 North 4 spaces I1 West 1 spaces G1 West 1 spaces Q1 East 2 spaces X0 East 1 spaces C1 South 3 spaces X0 West 1 spaces E1 South 1 spaces A1 West 1 spaces P1 North 1 spaces Q1 East 1 spaces F1 North 1 spaces H1 East 1 spaces O1 South 3 spaces X0 West 1 spaces D1 South 1 spaces A1 West 3 spaces E1 North 1 spaces D1 North 1 spaces X0 East 2 spaces B1 North 1 spaces O1 North 2 spaces H1 West 1 spaces F1 South 1 spaces Q1 West 1 spaces P1 South 3 spaces X0 East 3 spaces | Started board 3 Board: 3 2.733 seconds Nodes Visited: 4063 Move  B1 West 1 spaces Q1 North 3 spaces F1 East 1 spaces G1 North 3 spaces P1 East 1 spaces C1 South 1 spaces E1 West 1 spaces F1 West 2 spaces H1 North 3 spaces P1 East 2 spaces D1 East 3 spaces F1 East 2 spaces G1 South 2 spaces O1 South 3 spaces X0 East 2 spaces A1 South 1 spaces B1 West 3 spaces H1 North 1 spaces X0 East 1 spaces O1 North 3 spaces E1 East 1 spaces C1 North 3 spaces E1 West 1 spaces O1 South 3 spaces B1 East 2 spaces C1 North 1 spaces A1 North 1 spaces X0 West 3 spaces G1 North 2 spaces O1 North 2 spaces D1 West 4 spaces G1 South 2 spaces O1 South 2 spaces X0 East 3 spaces O1 North 2 spaces P1 West 3 spaces G1 South 1 spaces F1 West 1 spaces Q1 South 3 spaces X0 East 2 spaces | Started board 4 Board: 4 10.892 seconds Nodes Visited: 7755 Move  X0 West 1 spaces P1 South 1 spaces A1 South 2 spaces O1 East 3 spaces B1 North 1 spaces X0 West 1 spaces E1 North 1 spaces I1 West 2 spaces P1 South 1 spaces C1 East 3 spaces E1 North 2 spaces D1 East 1 spaces X0 East 1 spaces B1 South 4 spaces D1 West 1 spaces X0 West 1 spaces E1 South 2 spaces C1 West 4 spaces E1 North 1 spaces A1 North 1 spaces O1 West 3 spaces P1 North 2 spaces I1 East 2 spaces D1 East 4 spaces F1 North 1 spaces B1 North 1 spaces G1 West 2 spaces E1 South 3 spaces A1 South 3 spaces D1 West 2 spaces X0 East 2 spaces C1 East 2 spaces P1 South 1 spaces O1 East 3 spaces F1 North 3 spaces B1 North 3 spaces D1 West 2 spaces X0 West 2 spaces E1 North 2 spaces A1 North 2 spaces H1 West 2 spaces I1 West 4 spaces E1 South 1 spaces P1 South 2 spaces A1 South 1 spaces X0 East 5 spaces | Started board 5 Board: 5 56.45 seconds Nodes Visited: 14605 Move  X0 West 1 spaces Q1 South 1 spaces P1 South 1 spaces A1 South 2 spaces O1 East 3 spaces B1 North 1 spaces X0 West 1 spaces E1 North 1 spaces K1 West 2 spaces P1 South 1 spaces C1 East 2 spaces E1 North 2 spaces D1 East 1 spaces X0 East 1 spaces B1 South 4 spaces D1 West 1 spaces X0 West 1 spaces E1 South 2 spaces C1 West 3 spaces E1 North 1 spaces A1 North 1 spaces O1 West 3 spaces Q1 North 1 spaces P1 North 2 spaces K1 East 2 spaces D1 East 4 spaces F1 North 1 spaces B1 North 1 spaces J1 West 2 spaces E1 South 3 spaces A1 South 3 spaces D1 West 2 spaces X0 East 2 spaces C1 East 2 spaces P1 South 1 spaces O1 East 2 spaces F1 North 3 spaces B1 North 3 spaces D1 West 2 spaces X0 West 2 spaces E1 North 2 spaces A1 North 2 spaces L1 West 2 spaces K1 West 4 spaces E1 South 1 spaces Q1 South 3 spaces P1 South 2 spaces A1 South 1 spaces X0 East 5 spaces |