METU Department of Computer Engineering Spring 2011

CENG 462—Artificial Intelligence

HOMEWORK–I Due March 25, 2011 23:59

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In this homework you are going to solve the rotation puzzle found in early Nokia phones using the minimum number of moves possible. The rules of the puzzle are as follows.

The puzzle consists of a square grid (of size $N \times N, N < 100$), where each cell contains a number from 1 to N^2. Initially the numbers in cells are shuffled. Your task is to arrange the numbers into natural order such that the top-left cell contains 1 and the bottom-right cell contains N^2. At each step, you can either rotate the eight cells around the cursor to the left or right or move the cursor to four adjacent cells (up, down, left, right). The cost of rotation and cursor movement actions are uniform and each action constitutes to 1 move. You are not allowed to move the cursor to top/bottom-most rows or left/right-most columns, as doing so would make a 3×3 rotation impossible.

Consider the following 4×4 grid configuration where cursor is located at the cell with 4 in it:

1	5	3	2
8	6	11	10
9	4	13	15
7	16	12	14

A rotate-left action would transform this grid into the following configuration:

1	5	3	2
6	11	13	10
8	4	12	15
9	7	16	14

Implement the A^* search technique to find a solution from an initial configuration to the final configuration. Note that you need to specify an admissible heuristic function.

Specifications:

You are going to use Common Lisp for the implementation. GNU CLISP is readily available at department machines. You can run it by issuing `clisp` command from your shell.

You are going to write a function called `solve`, which takes one argument that contains the initial configuration of the grid. The configuration is given as a list of lists, where the first item contains the list of numbers in the first row. Initially the cursor will be located at the second row and second column.

Your function must return the list of actions required to solve the puzzle. The names of actions that you must put in your list are `rotate-left`, `rotate-right`, `move-up`, `move-down`, `move-left` and `move-right`.

Sample Input:

To test your homework with the following configuration:

1	2	3	4
5	8	12	16
9	7	11	15
13	6	10	14

The following will be entered to clisp:

```
[1]> (load "hw1.cl")
;; Loading file hw1.cl ...
;; Loaded file hw1.cl
T
[2]> (solve '((1 2 3 4) (5 8 12 16) (9 7 11 15) (13 6 10 14)))
(MOVE-RIGHT MOVE-DOWN ROTATE-RIGHT ROTATE-RIGHT)
```

Submission Policy

- You are going to submit a single file called `hw1.cl` through COW System.
- Your `hw1.cl` should contain at least one function, i.e. `solve`.
- Your codes will be graded on inek machines. Make sure they run on these correctly.
- Late submissions will not be accepted.
- All work must be done individually and in compliance with course policy.