CENG213 Data Structures

Spring 2010
Homework 2
Due: 27/04/2011 23:55

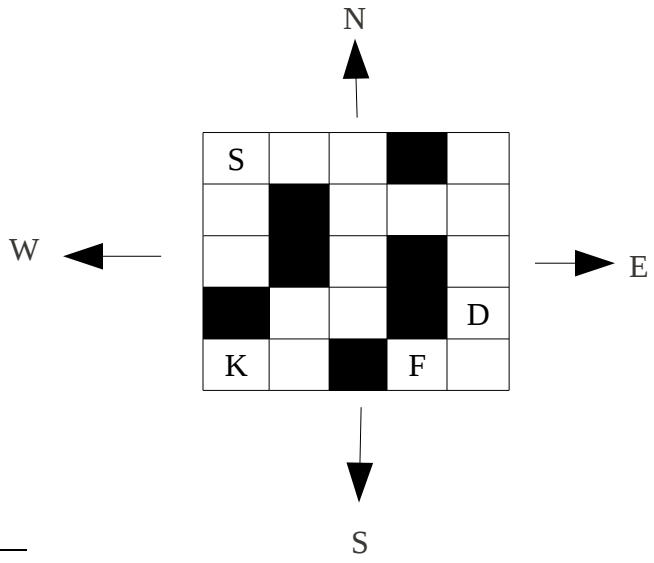
General Rules:

- DO NOT CHEAT.
- In case of cheating, all involved parts will get zero. If you are involved in cheating, all your homeworks will be marked as zero automatically.
- Your source codes must be in C++, and submissions will be compiled with g++ on "inek" machines. Be sure that your homework runs on "inek" machines.
- Coding style is important. Proper use of indentation and coding convention must exist in your code.
- Be careful about input/output specifications (do not print any unnecessary characters, white spaces.)
- You have a total of 7 days for late submissions of your programming assignments for the whole semester. You can spend this credit for any of the assignments or distribute it among your. If you exceed this 7 days late submission credit, penalty for each additional day is calculated by day*day*10.
- There is NO teaming up. The homework has to be done/turned in **individually**.
- Submit your homework electronically through https://cow.ceng.metu.edu.tr

ESCAPE FROM SHAWSHANK

"Remember Red, hope is a good thing, maybe the best of things, and no good thing ever dies."[1]

In this homework, you are going to solve a puzzle. The puzzle is a maze in which you will try to find your way from the "Start" location to the "Finish" location. The arrows show the directions when you look at the map from top. W for West, S for South, E for East and N for North.



1 From the movie "Shawshank Redemption" - http://www.imdb.com/title/tt0111161/quotes

"salvation lies within..."[1]

Salvation lies within the cell which is labeled with 'F' character. Initially, you are at the cell which is labeled with 'S' character. You will try to find a path to the 'F' cell. At a time, you can move to a single cell by a single action. There are walls and locked doors around you which makes it hard to find your way. You can only step into the cell which has no wall or locked door on it.

"Lock them up!"[1]

If you need to open a door to reach to the finish location, you have to have a key to open it. Once a door is opened, it stays open forever. Therefore, initially, you cannot step into a cell which has 'D' label on it. If you have a key, you can apply the convenient action (Unlock action) to open it and then that cell is free for your movements.

The characters in the maze has the following meanings:

- S → Start
- F → Finish
- K → Key
- D → Door

Input file

The puzzle will be passed by a text file to your program. It has the following format:

```
S..X.
.X...
.X.X.
X..XD
K.XF.
```

- '.' character means that the corresponding cell is empty
- 'S' character means that the corresponding cell is the start location
- 'X' character means that the corresponding cell is a wall
- 'D' character means that the corresponding cell is a door
- 'K' character means that the corresponding cell has a key on it.
- 'F' character means that the corresponding cell is the finish location

Solution

The solution to the puzzle will be a single string in which each character corresponds to an action. The actions are as follows:

- W → Move to the cell in West
- S → Move to the cell in South
- E → Move to the cell in East
- N → Move to the cell in North
- P → Pick the key on which you are standing
- U → Unlock the door next to you

1 From the movie "Shawshank Redemption" - http://www.imdb.com/title/tt0111161/quotes

It is not expected to implement a path planning to find best/optimal ways to the finish location. If you can reach the finish location with a valid set of actions, then the solution is correct. Two correct solutions for the given puzzle are as follows:

1. SSNNEESSSWSWPENENNEESUSSW
2. EESEENSSNWWSSWSWPENENNEESUSSW

You will write your solution string to the file whose path is given as the second argument to your program. If there is no solution, which means there is no possible ways to reach 'F' cell, you will print “no solution” to the output file.

Directives

- You are not allowed to use recursion. Any recursive function definition will be detected.
- You are not allowed to use STL. We recommend you to use the Stack implementation which is persented to you in the lectures. If you find any other implementation, you have to state (i.e. link to the website on which you find the Stack implementation) your reference to the code that you use.
- Input maze can be of any size, but it will be a square matrix → (NxN).
- You will start in the 'S' location, finish in the 'F' location.
- You cannot move to a cell on which there is a wall or an unlocked door. If you do so, the solution will be wrong immediately.
- You cannot pick a key if there is no key on the cell you are currently standing. The solution will be wrong immediately.
- Any key unlocks any door. So, if you have a key, you can open any locked door.
- When you unlock a door, the key remains on the door. So, one key unlocks only one door. You need a second key to unlock a second door.
- You cannot unlock a door if you are not standing next to an unlocked door. U action is valid only if you have a door on your immediate West, South, East or North. After you unlock the door, the cell on which the door stands, is now available for movements until the end of the program.
- There may be no solution for a given puzzle.
- There may be more than one solutions for a given puzzle.

Submission

You will submit a single zip file (hw2.zip) including your source files and a Makefile **only**. You should not put any binary or executable files inside your submission bundle (the zip file). The zip should include *.h *.cpp and a Makefile. Existence of any other file will lead to a decrease in your grade. The following command sequence is expected to compile and run on a Linux system:

```
$ unzip hw2.zip
$ make
$ ./hw2 inputfilepath outputfilepath
```

Please note that this is not possible if the zip file extracts into a directory ;)

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