Problem 272: Word Search

Difficulty: Hard

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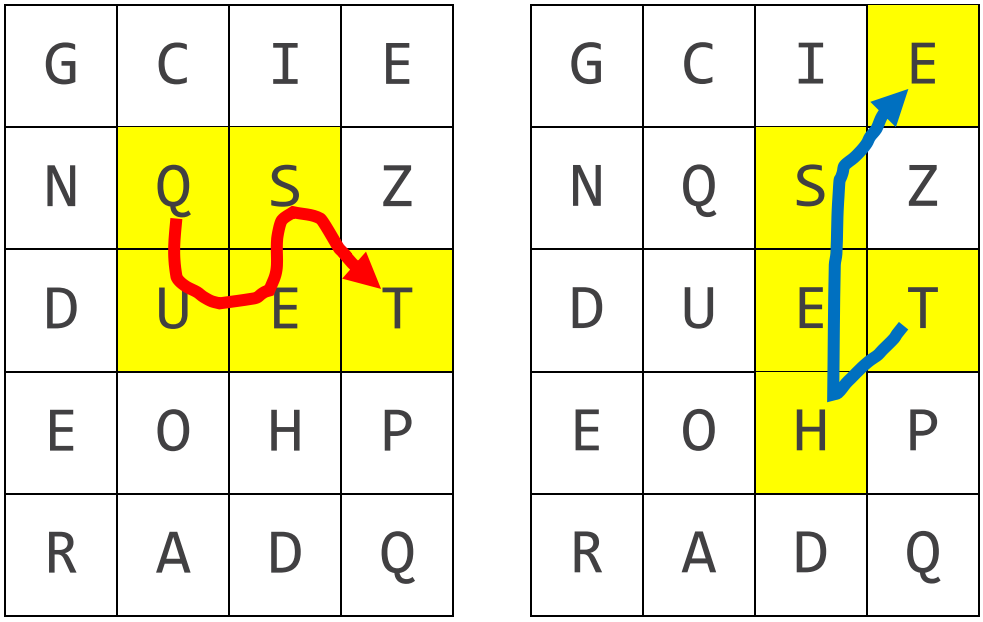
Problem Background

Word search puzzles are a common form of puzzle, found in newspapers and restaurant kid's menus worldwide. Given a grid of seemingly random letters, you're expected to find a series of words hidden within the grid, written in any direction (forward, backward, up, down, or along any diagonal). Computers can solve such a puzzle easily, however; let's try making this a little more difficult.

Problem Description

In this version of a word search, words can change directions. As in a normal word search, each letter in a word will be adjacent to the one before it (in any of the eight surrounding positions), but that direction may not be consistent. For example, in the grid below, you can find the words "QUEST" and "THESE" by following the indicated paths (the same grid is shown on both sides):



If a word contains duplicate letters (for example, THESE contains two E's), each letter in the puzzle may only be used once within that word. As shown above, the final E must be pulled from the top row; it's not legal to double back and use the E in the third row twice. However, letters may be shared between words, as is done here with the shared E, S, and T between QUEST and THESE.

Design a program which can identify the path followed by each word given in such a puzzle by listing the coordinates of each letter within the word. The first (top-most) row is row 0, and the first (left-

most) column is column 0, with numbers increasing as you move to the bottom or right of the grid, respectively. Each test case is guaranteed to contain each target word only once; put another way, only one valid path exists for each word.

Sample Input

The first line of your program's input, **received from the standard input channel**, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing three positive integers, separated by spaces, representing:
  - N, the number of words to locate within the puzzle grid
  - W, the width of the puzzle grid
  - H, the height of the puzzle grid
- H lines, each containing W uppercase letters, representing the puzzle grid
- N lines, each containing a word in uppercase letters at least five letters long.

```
1
5 4 5
GCIE
NQSZ
DUET
EOHP
RADQ
QUEST
ADORE
THESE
DUETS
THUNDER
```

Sample Output

For each test case, your program must print N lines indicating the paths taken through the puzzle grid by each target word. For each word provided (and in the order provided), your program should print the coordinates of each letter within the word, separated by spaces. Each coordinate should include the integer row number of the letter, a comma, and the integer column number of the letter. Row and column numbers range from 0 (the top- or left-most, respectively) to H-1 or W-1, respectively.

```
1,1 2,1 2,2 1,2 2,3
4,1 4,2 3,1 4,0 3,0
2,3 3,2 2,2 1,2 0,3
2,0 2,1 2,2 2,3 1,2
2,3 3,2 2,1 1,0 2,0 3,0 4,0
```