FIT1045 Algorithmic Problem Solving – Assignment 2 (10%).

Due: 23:55:00, Sunday 13th May, 2018.

Submission Procedure

1. In the file that you submit, **DO NOT** put your name, student ID or any other information that can reveal your identity. Peer marking will be done following a *double-blind* policy where your identity and markers' identities are not disclosed to anyone else except the teaching team.

2. Place your files named `scrabble2.py`, `bruteforce.pdf` and `efficient.pdf` in a zipped file named ass2.zip and submit this on Moodle. Make sure that your assignment is not in "Draft" mode. You need to click "Submit" to successfully submit the assignment.

Important Notes:

1. Please ensure that you have read and understood the university's policies on plagiarism and collusion available at `http://www.monash.edu.au/students/policies/academic-integrity.html`. You will be required to agree to these policies when you submit your assignment. The assignments will be checked for plagiarism using an advanced plagiarism detector and the students will be interviewed by tutors to demonstrate the understanding of their code. Last year, many students were detected by the plagiarism detector and almost all got zero mark for the assignment and, as a result, failed the unit. "Helping" others is **NOT** okay. Please do not share your solutions with others. If someone asks you for help, ask them to visit us during consultation hours for help.

2. Your program will be checked against a number of test cases. Do not forget to include comments in your code explaining your algorithm. If your implementations have bugs, you may still get some marks based on how close your algorithm is to the correct algorithm.

3. Your submission will be assessed by your lab demonstrator as well as two randomly chosen peers. The peers' assessment will be checked for consistency by your demonstrator.

Marks: This assignment has a total of 100 marks and contributes to 10% of your final mark. Late submission will have 10% off the total assignment marks per day (including weekends) deducted from your assignment mark, i.e., 10 marks per day. So, if you are 2 day late, you will lose 20 marks. Assignments submitted 7 days after the due date will normally not be accepted.

Marking Guide:

Task 1: 50 marks

(a) Code readability (Non-trivial comments where necessary and meaningful variable names) – 5 marks

(b) Code decomposition – 5 marks

(c) Correctly checking whether the move is valid or not – 30 marks

(d) Correctly placing the word on the board – 5 marks

(e) Correctly computing score of the move and total score – 5 marks

Task 2: 50 marks

(a) Code readability (Non-trivial comments where necessary and meaningful variable names) – 5 marks

(b) Code decomposition – 5 marks

(c) Correctly computing the best possible move (in a reasonable time) – 25 marks

(d) *Description* of your solution to Task 2 – 5 marks

(e) *Description* of a more efficient algorithm – 10 marks

Background

Download the file `scrabble2.py` from Moodle which is a modified version of `scrabble1.py` provided to you for assignment 1. Make sure that all the files (`dictionary.txt`, `scores.txt`, `tiles.txt` and `scrabble2.py`) are in the same folder. The provided code in `scrabble2.py` asks user to enter the scrabble board size which must be a number between 5 to 15. It then calls the function `initializeBoard` to initialize an empty scrabble board of the given size (e.g., a 7×7 board if the board size entered by the user is 7). `printBoard` function prints the empty board. Below is a sample output from the code when the user enters 7.

```
Do you want to use random tiles (enter Y or N): N
Enter board size (a number between 5 to 15): 7

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|

Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2
```

You are required to complete the following tasks in this assignment.

Task 1: Placing a word on Scrabble board 50 Marks

After the program prints the board (which is initially empty) and the 7 tiles along with their scores, you will need to ask the user to enter a word and its location on the board. Once the user enters a valid word and location, you will need to place the word on the scrabble board at the entered location.

The location is to be entered in `r:c:d` format where r and c are two digits denoting row number and column number referring to the starting location of the word. The value of d must be either `H` or `V` and denotes the direction of the word which is either horizontal (`H`) or vertical (`V`). If the direction is `H` then the word must be placed on the board horizontally starting at the cell at row r and column c. If the direction is `V` then the word must be placed on the board vertically starting at the cell at row r and column c. Below are two examples.

```
Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2


Enter your word: TONE
Enter the location in row:col:direction format: 3:3:H

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 |   |   |   | T | O | N | E |
--|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
```

Note that in the above example, the word starts at row numbered 3 and column numbered 3 and is placed horizontally.

The Scrabble board is represented by a list of lists called `Board`. `Board[r][c]` corresponds to the cell at row r and column c. Initially, `Board` is a list of lists where each letter is an empty string (i.e., board is empty).

```
[['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''],
['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''],
['', '', '', '', '', '', '']]
```

After the word `TONE` is inserted at location `3:3:H`, the list of lists `Board` is updated to represent this.

```
[['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''],
 ['', '', '', 'T', 'O', 'N', 'E'], ['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''],
 ['', '', '', '', '', '', '']]
```

Once you have updated `Board` appropriately, you can call the function `printBoard(Board)` provided in `scrabble2.py` which displays the board as shown in the sample output earlier.

Below is another example where the word `TONE` is placed vertically.

```
Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2


Enter your word: TONE
Enter the location in row:col:direction format: 3:3:V

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
```

```
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 |   |   |   | T |   |   |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|
```

The list of lists in this case is updated as follows.

```
[['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''], ['', '', '', '', '', '', ''],
 ['', '', '', 'T', '', '', ''], ['', '', '', 'O', '', '', ''], ['', '', '', 'N', '', '', ''],
 ['', '', '', 'E', '', '', '']]
```

In the Scrabble game you are developing, the player will always have 7 tiles presented to them. In `scrabble2.py`, these tiles are stored in a list called `myTiles` and the function `printTiles` prints these tiles and their scores as in the sample output above. After a word has been placed on the board, you need to update `myTiles` by removing the tiles used in this move. For example, after the word `TONE` has been placed on the board (as in above example), the remaining tiles are `B`, `S` and `U`, i.e., after inserting `TONE`, you need to ensure `myTiles = ['B','S','U']`.

A function `getTiles(myTiles)` has been provided to you in `scrabble2.py`. This function takes the list `myTiles` and adds new tiles to the list to ensure that `myTiles` contains exactly 7 tiles. After you have updated `myTiles` to `['B','S','U']`, if you call `getTiles(myTiles)` and then `printTiles(myTiles)`, four new tiles are appended to `myTiles` as illustrated below.

```
Tiles remaining after the move:  ['B', 'S', 'U']
Calling getTiles(myTiles) function...

Printing the tiles.

Tiles : B  S  U  E  I  N  A
Scores: 3  3  1  1  1  3  1
```

After each move by the user, you need to update `myTiles` by removing the tiles used in the move and then call `getTiles(myTiles)` to get new tiles.

Your program must ensure that the location entered by the user is a valid location. A location is valid if it satisfies all of the following.

- The location must be in the format `r:c:d` where r and c must be two integers and d must be either `H` or `V`.
- The values of r and c must be valid, i.e., r and c both must be greater than or equal to zero and less than the board size.
- In the **first move**, the word **must** start at the center of the board. In other words, the values of r and c must be equal to `len(Board)//2`. The direction can be either `H` or `V`. For example, in the above example where board size is 7×7, `3:3:H` and `3:3:V` are the valid locations for the first move whereas `1:3:H` is an invalid location. Note that this rule only applies in the first move.
- If the word cannot fit on the board starting at this location, the location is considered invalid. In the above example, `BONES` cannot fit on the board if inserted at `3:3:H` or `3:3:V` because the last letter of the word will be outside the dimensions of the board.

Your program must continue asking the user to enter a location until the user enters a valid location. When the user enters a valid location, the word must be placed at the location. You need to ensure that the word and location entered by the user are valid, i.e., they satisfy the following rules.

1. The word is a valid English word, i.e., it must exist in the dictionary.
2. The word can be made using the tiles in `myTiles` **and** the tiles currently on the board. Note that there are no tiles on the board at the first move.
3. In every move (except the first move), the word must use **at least one** tile from the board.
4. The move must not change or relocate any existing tile on the board.

Below are the details for the rule 3 and 4. Assume that the word `TONE` was inserted at `3:3:H` in the first move. If the user enters the word `BASE` at `0:0:H` in the second move, this is an invalid move because no tile from the board is used. Similarly, the move `BASE` at `2:3:V` is also invalid because placing `BASE` here requires replacing `T` with `A` on the scrabble board at row 3, column 3. The move `BASE` at `0:6:V` is valid. Similarly, the move `SOB` at `2:4:V` or `SEEN` at `2:6:V` would also be valid. A sample execution is shown below.

```
Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2

Enter your word: TONE
Enter the location in row:col:direction format: 3:3:H

Your score in this move: 8
Your total score is: 8

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 |   |   |   | T | O | N | E |
--|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : B  S  U  E  I  N  A
Scores: 3  3  1  1  1  3  1

Enter your word: BASE
Enter the location in row:col:direction format: 0:0:H
Invalid Move!

Enter your word: BIN
Enter the location in row:col:direction format: 2:2:H
Invalid Move!

Enter your word: BASE
Enter the location in row:col:direction format: 2:3:H
Invalid Move!

Enter your word: BASE
Enter the location in row:col:direction format: 0:6:V

Your score in this move: 7
Your total score is: 15

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   | B |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   | A |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   | S |
--|---|---|---|---|---|---|---|
3 |   |   |   | T | O | N | E |
--|---|---|---|---|---|---|---|
```

```
4 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : U  E  I  N  O  N  R
Scores: 1  1  1  3  2  3  3
```

Note that the rules of this game are not exactly the same as the traditional scrabble game. In the above example, the move `BIN` at `2:2:H` is considered invalid because it does not use any existing tile on the scrabble board. This move would be valid in traditional scrabble game. For this assignment, a move is considered valid **if and only if** it satisfies all of the rules mentioned above (i.e., `BIN` at `2:2:H` is an invalid move for this assignment).

Score at each move is the total score of the tiles placed on the board in **this** move. In the first move, the score for the word `TONE` is 8 which is the total score for these four tiles. In the second move, for the word `BASE`, three new tiles are placed on the board (the tiles `B`, `A` and `S`). Therefore, the score of the user in this move is the sum of the scores of these three tiles (3+1+3=7). The total score is also updated accordingly ($8 + 7 = 15$: 8 in first move and 7 in the second move). Note that, after the second move, you will need to remove the three tiles `B`, `A` and `S` from `myTiles`. If you call `getTiles(myTiles)`, three new tiles `O`, `N` and `R` will appended to `myTiles` to ensure the user has 7 tiles (as in the above example).

You must quit the game if the entered word is `***`. Below are two more examples with different moves by the user (the samples also show the maximum possible score for each move which you can ignore for now – you will need to implement this in the next task).

```
Do you want to use random tiles (enter Y or N): N
Enter board size (a number between 5 to 15): 7

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2

Enter your word: TONE
Enter the location in row:col:direction format: 3:1:H
The location in the first move must be 3:3:H or 3:3:V
Invalid Move!!!

Enter your word: TON3
Enter the location in row:col:direction format: 3:3:H
Invalid Move!

Enter your word: tone
Enter the location in row:col:direction format: 3:3:V
Maximum possible score in this move was 11 with word SNOB at 3:3:H
Your score in this move: 8
Your total score is: 8
```

```
Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 |   |   |   | T |   |   |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : B  S  U  E  I  N  A
Scores: 3  3  1  1  1  3  1

Enter your word: bEsT
Enter the location in row:col:direction format: 3:0:H
Maximum possible score in this move was 12 with word BESTAIN at 3:0:H
Your score in this move: 7
Your total score is: 15

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 | B | E | S | T |   |   |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 |   |   |   | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : U  I  N  A  O  N  R
Scores: 1  1  3  1  2  3  3

Enter your word: Rain
Enter the location in row:col:direction format: 5:0:H
Maximum possible score in this move was 13 with word RUNNION at 5:0:H
Your score in this move: 5
Your total score is: 20

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
```

```
3 | B | E | S | T |   |   |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 | R | A | I | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : U  N  O  N  N  R  R
Scores: 1  3  2  3  3  3  3

Enter your word: ton
Enter the location in row:col:direction format: 3:3:H
Maximum possible score in this move was 10 with word RUNER at 0:1:V
Your score in this move: 5
Your total score is: 25

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
3 | B | E | S | T | O | N |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 | R | A | I | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|


Tiles : U  N  N  R  R  T  C
Scores: 1  3  3  3  3  2  5

Enter your word: NUT
Enter the location in row:col:direction format: 1:3:V
Maximum possible score in this move was 13 with word CRETAN at 1:1:V
Your score in this move: 4
Your total score is: 29

Board:
  | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
--|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|
1 |   |   |   | N |   |   |   |
--|---|---|---|---|---|---|---|
2 |   |   |   | U |   |   |   |
--|---|---|---|---|---|---|---|
3 | B | E | S | T | O | N |   |
--|---|---|---|---|---|---|---|
4 |   |   |   | O |   |   |   |
--|---|---|---|---|---|---|---|
5 | R | A | I | N |   |   |   |
--|---|---|---|---|---|---|---|
6 |   |   |   | E |   |   |   |
--|---|---|---|---|---|---|---|
```

```
Tiles : N  R  R  T  C  A  D
Scores: 3  3  3  2  5  1  3

Enter your word: CATERAN
Enter the location in row:col:direction format: 0:1:V
Your move was the best move. Well done!
Maximum possible score in this move was 14 with word CATERAN at 0:1:V
Your score in this move: 14
Your total score is: 43

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
---|---|---|---|---|---|---|---|
0  |   | C |   |   |   |   |   |
---|---|---|---|---|---|---|---|
1  |   | A |   | N |   |   |   |
---|---|---|---|---|---|---|---|
2  |   | T |   | U |   |   |   |
---|---|---|---|---|---|---|---|
3  | B | E | S | T | O | N |   |
---|---|---|---|---|---|---|---|
4  |   | R |   | O |   |   |   |
---|---|---|---|---|---|---|---|
5  | R | A | I | N |   |   |   |
---|---|---|---|---|---|---|---|
6  |   | N |   | E |   |   |   |
---|---|---|---|---|---|---|---|


Tiles : R  D  I  D  P  N  L
Scores: 3  3  1  3  5  3  3

Enter your word: ***
```

As stated earlier, the rules of this game are not exactly the same as the traditional scrabble game. For example, the move `TON` at `3:3:H` is considered valid (although it is an invalid move in traditional scrabble because there is no such word as `BESTON`). Similarly, the move `NUT` at `1:3:V` is also considered valid although the word `NUTONE` does not exist in the dictionary. These moves are considered valid because these satisfy all the rules defined above.

Below is another sample execution.

```
Do you want to use random tiles (enter Y or N): N
Enter board size (a number between 5 to 15): 9

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
```

```
Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2

Enter your word: BONUS
Enter the location in row:col:direction format: 3:3:H
The location in the first move must be 4:4:H or 4:4:V
Invalid Move!!!

Enter your word: Bonus
Enter the location in row:col:direction format: 4:4:H
Your move was the best move. Well done!
Maximum possible score in this move was 12 with word BONUS at 4:4:H
Your score in this move: 12
Your total score is: 12

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   | B | O | N | U | S |
---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|


Tiles : E  T  E  I  N  A  O
Scores: 1  2  1  1  3  1  2

Enter your word: BEAT
Enter the location in row:col:direction format: 4:10:V
Invalid Move!!!

Enter your word: BEAT
Enter the location in row:col:direction format: 10:10:H
Invalid Move!!!

Enter your word: BEAT
Enter the location in row:col:direction format: -1:4:H
Invalid Move!!!

Enter your word: BEAT
Enter the location in row:col:direction format: 4:4:V:1
Invalid Move!!!

Enter your word: BEAT
Enter the location in row:col:direction format: 4:4:V
Maximum possible score in this move was 10 with word NIOBATE at 1:4:V
Your score in this move: 4
Your total score is: 16

Board:
```

```
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
--|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   | B | O | N | U | S |
--|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   | E |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   | A |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   | T |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|


Tiles : E  I  N  O  N  R  N
Scores: 1  1  3  2  3  3  3

Enter your word: ROB
Enter the location in row:col:direction format: 4:2:H
Maximum possible score in this move was 12 with word NONONE at 1:5:V
Your score in this move: 5
Your total score is: 21

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
--|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
4 |   |   | R | O | B | O | N | U | S |
--|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   | E |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   | A |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   | T |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|


Tiles : E  I  N  N  N  R  R
Scores: 1  1  3  3  3  3  3

Enter your word: None
Enter the location in row:col:direction format: 3:5:H
Invalid Move!

Enter your word: nOnE
Enter the location in row:col:direction format: 3:5:V
Maximum possible score in this move was 13 with word RUNNER at 3:7:V
Your score in this move: 7
```

```
Your total score is: 28

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   | N |   |   |   |
---|---|---|---|---|---|---|---|---|---|
4 |   |   | R | O | B | O | N | U | S |
---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   | E | N |   |   |   |
---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   | A | E |   |   |   |
---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   | T |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|


Tiles : I  N  R  R  T  C  A
Scores: 1  3  3  3  2  5  1

Enter your word: RENT
Enter the location in row:col:direction format: 5:2:H
Invalid Move!

Enter your word: RENT
Enter the location in row:col:direction format: 5:3:H
Maximum possible score in this move was 15 with word RANCOR at 0:3:V
Your score in this move: 5
Your total score is: 33

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   | N |   |   |   |
---|---|---|---|---|---|---|---|---|---|
4 |   |   | R | O | B | O | N | U | S |
---|---|---|---|---|---|---|---|---|---|
5 |   |   |   | R | E | N | T |   |   |
---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   | A | E |   |   |   |
---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   | T |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|


Tiles : I  N  R  C  A  D  I
Scores: 1  3  3  5  1  3  1

Enter your word: CARE
```

```
Enter the location in row:col:direction format: 5:1:H
Maximum possible score in this move was 16 with word IRACUND at 0:7:V
Your score in this move: 6
Your total score is: 39

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   | N |   |   |   |
---|---|---|---|---|---|---|---|---|---|
4 |   |   | R | O | B | O | N | U | S |
---|---|---|---|---|---|---|---|---|---|
5 |   | C | A | R | E | N | T |   |   |
---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   | A | E |   |   |   |
---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   | T |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|


Tiles : I  N  R  D  I  D  P
Scores: 1  3  3  3  1  3  5

Enter your word: ***
```

Task 2: Finding the move with maximum score 50 Marks

In this task, after the player has made a move, you need to find the best possible move (i.e., the move with maximum possible score) and display it to the user. The move (i.e., a word and location) must satisfy all the rules discussed above. It is possible that there are multiple moves that achieve maximum possible score. In this case, you can print any of the moves with the maximum score.

In the sample execution shown at the end of the previous task, after each move, the best possible move along with the score is displayed to the user. Below is another sample execution for a 12×12 board.

```
Do you want to use random tiles (enter Y or N): N
Enter board size (a number between 5 to 15): 12

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : B  S  N  O  E  U  T
Scores: 3  3  3  2  1  1  2

Enter your word: TONES
Enter the location in row:col:direction format: 3:3:H
The location in the first move must be 6:6:H or 6:6:V
Invalid Move!!!

Enter your word: BONUS
Enter the location in row:col:direction format: 6:6:H
Your move was the best move. Well done!
Maximum possible score in this move was 12 with word BONUS at 6:6:H
Your score in this move: 12
Your total score is: 12

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   |   |   |   |   |
```

```
--|---|---|---|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   | B | O | N | U | S |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : E  T  E  I  N  A  O
Scores: 1  2  1  1  3  1  2

Enter your word: USE
Enter the location in row:col:direction format: 6:9:H
Maximum possible score in this move was 10 with word ENATION at 0:8:V
Your score in this move: 1
Your total score is: 13

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   | B | O | N | U | S | E |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : T  E  I  N  A  O  N
Scores: 2  1  1  3  1  2  3

Enter your word: NINE
Enter the location in row:col:direction format: 1:1:H
Invalid Move!

Enter your word: NINE
```

```
Enter the location in row:col:direction format: 3:11:V
Maximum possible score in this move was 13 with word ANNOTINE at 0:8:V
Your score in this move: 7
Your total score is: 20

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
---|---|---|---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   |   |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |   |   |   |   | I |
---|---|---|---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   |   |   |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   | B | O | N | U | S | E |
---|---|---|---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
9  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
10 |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
11 |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : T  E  A  O  R  N  R
Scores: 2  1  1  2  3  3  3

Enter your word: BARTER
Enter the location in row:col:direction format: 6:6:V
Maximum possible score in this move was 15 with word ANTRORSE at 0:10:V
Your score in this move: 10
Your total score is: 30

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
---|---|---|---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   |   |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |   |   |   |   | I |
---|---|---|---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   |   |   |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   | B | O | N | U | S | E |
---|---|---|---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   | A |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   | R |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
9  |   |   |   |   |   |   | T |   |   |   |   |   |
```

```
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   |   |   |   |   | E |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : O  N  R  T  C  A  D
Scores: 2  3  3  2  5  1  3

Enter your word: CARTOON
Enter the location in row:col:direction format: 0:8:V
Invalid Move!

Enter your word: CARTON
Enter the location in row:col:direction format: 0:8:V
Invalid Move!

Enter your word: CARTON
Enter the location in row:col:direction format: 1:8:V
Maximum possible score in this move was 19 with word ACRODONT at 1:7:V
Your score in this move: 13
Your total score is: 43

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   | C |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   | A |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   | R |   |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |   | T |   |   | I |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   |   | O |   |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   | B | O | N | U | S | E |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   | A |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   | T |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   |   |   |   |   | E |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : N  D  I  D  P  N  L
Scores: 3  3  1  3  5  3  3

Enter your word: POLIN
Enter the location in row:col:direction format: 5:7:H
This word doesn't exist in the dictionary!

Enter your word: POD
Enter the location in row:col:direction format: 5:7:H
Maximum possible score in this move was 13 with word INLAND at 2:5:H
Your score in this move: 8
Your total score is: 51
```

```
Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
---|---|---|---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   | C |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   | A |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   | R |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |   | T |   |   | I |
---|---|---|---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   | P | O | D |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   | B | O | N | U | S | E |
---|---|---|---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   | A |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   | R |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
9  |   |   |   |   |   |   | T |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
10 |   |   |   |   |   |   | E |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
11 |   |   |   |   |   |   | R |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : N  I  D  N  L  G  V
Scores: 3  1  3  3  3  4  10

Enter your word: LID
Enter the location in row:col:direction format: 3:9:V
This word doesn't exist in the dictionary!

Enter your word: GLIDE
Enter the location in row:col:direction format: 10:2:H
Maximum possible score in this move was 18 with word GIVEN at 10:3:H
Your score in this move: 11
Your total score is: 62

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
---|---|---|---|---|---|---|---|---|---|---|---|---|
0  |   |   |   |   |   |   |   |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
1  |   |   |   |   |   |   |   |   | C |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
2  |   |   |   |   |   |   |   |   | A |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
3  |   |   |   |   |   |   |   |   | R |   |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
4  |   |   |   |   |   |   |   |   | T |   |   | I |
---|---|---|---|---|---|---|---|---|---|---|---|---|
5  |   |   |   |   |   |   |   | P | O | D |   | N |
---|---|---|---|---|---|---|---|---|---|---|---|---|
6  |   |   |   |   |   |   | B | O | N | U | S | E |
---|---|---|---|---|---|---|---|---|---|---|---|---|
7  |   |   |   |   |   |   | A |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
8  |   |   |   |   |   |   | R |   |   |   |   |   |
---|---|---|---|---|---|---|---|---|---|---|---|---|
9  |   |   |   |   |   |   | T |   |   |   |   |   |
```

```
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   | G | L | I | D | E |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   | R |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : N  N  V  E  I  A  E
Scores: 3  3  10 1  1  1  1

Enter your word: TONE
Enter the location in row:col:direction format: 4:8:V
Maximum possible score in this move was 20 with word AVENTINE at 9:2:H
Your score in this move: 1
Your total score is: 63

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   | C |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   | A |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   | R |   |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
4 |   |   |   |   |   |   |   |   | T |   |   | I |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   | P | O | D |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   | B | O | N | U | S | E |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   | A |   | E |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   | T |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   | G | L | I | D | E |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : N  N  V  I  A  E  A
Scores: 3  3  10 1  1  1  1

Enter your word: RAVEN
Enter the location in row:col:direction format: 8:6:H
Maximum possible score in this move was 19 with word NIRVANA at 8:4:H
Your score in this move: 15
Your total score is: 78

Board:
   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |10 |11 |
--|---|---|---|---|---|---|---|---|---|---|---|---|
0 |   |   |   |   |   |   |   |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
1 |   |   |   |   |   |   |   |   | C |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
2 |   |   |   |   |   |   |   |   | A |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
3 |   |   |   |   |   |   |   |   | R |   |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
```

```
4 |   |   |   |   |   |   |   |   | T |   |   | I |
--|---|---|---|---|---|---|---|---|---|---|---|---|
5 |   |   |   |   |   |   |   | P | O | D |   | N |
--|---|---|---|---|---|---|---|---|---|---|---|---|
6 |   |   |   |   |   |   | B | O | N | U | S | E |
--|---|---|---|---|---|---|---|---|---|---|---|---|
7 |   |   |   |   |   |   | A |   | E |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
8 |   |   |   |   |   |   | R | A | V | E | N |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
9 |   |   |   |   |   |   | T |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
10|   |   | G | L | I | D | E |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|
11|   |   |   |   |   |   | R |   |   |   |   |   |
--|---|---|---|---|---|---|---|---|---|---|---|---|


Tiles : N  I  A  U  J  E  O
Scores: 3  1  1  1  10 1  2

Enter your word: ***
```

Description of your bruteforce algorithm

A bruteforce algorithm can be used to complete this task. Your algorithm must be able to find the move with maximum possible score in a reasonable time (e.g., around one minute for a 12×12 board). You must also provide a PDF file named `bruteforce.pdf` that describes your bruteforce algorithm to find the move with the maximum possible score. Your description must consist of: 1) a high level strategy written in plain English in enough detail that another student in the unit would be able to understand; and 2) a justification for why your strategy correctly finds the valid move with maximum score.

Description of a more efficient algorithm

You need to brainstorm a more efficient approach to solve this task and describe in a PDF file named `efficient.pdf` your approach to improve the efficiency of the bruteforce algorithm. You are encouraged to consider the approaches shown in lectures (backtracking, greedy, divide and conquer, transform and conquer and potentially use of stack/queues) to guide your brainstorming. Note that you do **NOT** need to implement the more efficient version of the algorithm – a description of your approach is sufficient. Your description must consist of:

- a high level strategy written in plain English in enough detail that another student in the unit would be able to understand
- a justification of why your algorithm is more efficient than the bruteforce algorithm
- if your efficient algorithm does not produce correct results (e.g., you are using a greedy approach), you need to provide a justification that although it may not always report the best move, it usually does report a reasonably good valid move. On the other hand, if your efficient algorithm always produces the best move, you need to justify its correctness, i.e., why it always finds the best possible move.