The game you are making is Scrabble. Scrabble is a word game where you can score points creating words by placing letters on the board. There are a lot of analog and digital versions of scrabble available. (There is even an official scrabble competition).

To learn the game you can play it online, for example at:
- https://www.scrabblegames.info/play/scrabble-online
- https://scrabble.hasbro.com/en-us (official)

More information about the game can be found at:
Online scrabble dictionary: https://scrabble.hasbro.com/en-us/tools#dictionary
Resources: https://scrabble.hasbro.com/en-us/tools#dictionary

The rules and gameplay we use for this project, can be found in Appendix A.

Functionality

For the game there are some mandatory requirements, But there is also a list of additional functionalities.

Required functionality

The application should at least do the following:

1. You should be able to play scrabble with at least 2 people over a network with a client & server application.

2. The client should be able to connect to a server, play a game and announce the winner in the end.
3. The server should be able to host at least one game with 2 players, following the rules of scrabble, and determine the winner in the end.
4. It is required to have a UI in the client in order to play the game. This may be a TUI, and it doesn't matter what it looks like.
5. Your application / codebase should be structured as an MVC application.
6. Your application should handle common exceptions and errors correctly during running (connection loss, invalid input)
7. preconditions, postconditions and invariants should only be added for one class (the most significant one)
8. the most complex class should be unit-tested,

The protocol

For the client and server to communicate, a protocol is needed. If the server and client have the same protocol, they should be able to play with each other. Protocol is defined in protocol.pdf

Appendix A: Scrabble Rules

Setup

You should have a game board (15x15), 100 letter tiles, a letter bag, and **two** racks.

For the game during this module we will follow the official Collins Scrabble dictionary. This means all words in this dictionary are valid. A word validation service will be provided for everyone.

The server should assign random 7 tiles to each player, and only inform the player itself about the tiles. Afterwards the server decides which player should start.

The board

A scrabble board consists of a matrix containing 15x15 squares, on which you can place a single tile with a letter. There are some premium squares that multiply the number of points you get for that title.
- 8x dark red "triple-word"
- 16x pale red "double-word"
- 1x start "center square", which also counts double word
- 12x dark blue "triple-letter"
- 24x pale blue "double-letter"
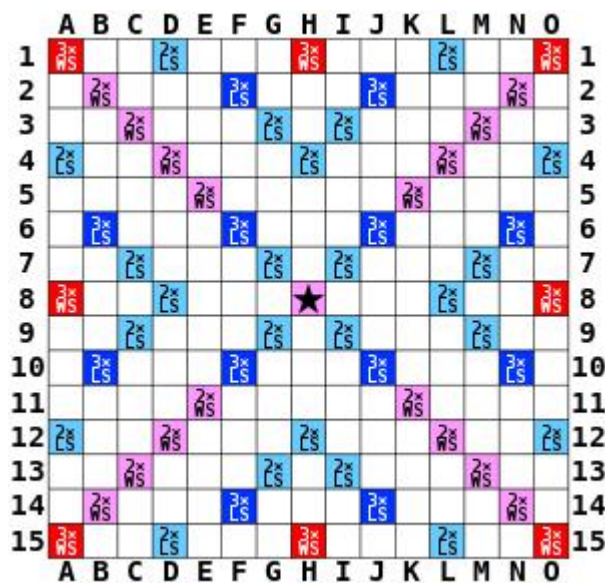
The tiles

The following tiles are in the game:
9xA, 2xB, 2xC, 4xD, 12xE, 2xF, 2xG, 2xH, 8xI, 2xJ, 2xK, 4xL, 2xM, 6xN, 8xO, 2xP, 1xQ, 6xR, 4xS, 6xT, 4xU, 2xV, 2xW, 1xX, 2xY, 1xZ and 2xBlank.

Each tile can have a different value for the scoring:
A=1, B=3, C=3, D=2, E-1, F=4, G=2, H=4, I=1, J=8, K=5, L=1, M=3, N=1, O=1, P=3, Q=10, R=1, S=1, T=1, U=1. V=4, W=4, X=8, Y=4, Z=10, Blank = 0

A 1 qt: 9	K 5 qt: 1	U 1 qt: 4
B 3 qt: 2	L 1 qt: 4	V 4 qt: 2
C 3 qt: 2	M 3 qt: 2	W 4 qt: 2
D 2 qt: 4	N 1 qt: 6	X 8 qt: 1
E 1 qt: 12	O 1 qt: 8	Y 4 qt: 2
F 4 qt: 2	P 3 qt: 2	Z 10 qt: 1
G 2 qt: 2	Q 10 qt: 1	! 0 qt: 2
H 4 qt: 2	R 1 qt: 6	
I 1 qt: 8	S 1 qt: 4	
J 8 qt: 1	T 1 qt: 6	

Gameplay

1. The first player combines two or more of his or her letters to form a word and places it on the board to read either horizontally or vertically as long as one letter is placed on the center square. **Diagonal words are not allowed**.
2. Complete your turn by counting and announcing your score for that turn. Then pick from the bag as many new letters as you played; always keep seven letters on your rack, as long as there are enough tiles left in the bag.
3. The second player, and then each in turn, adds one or more letters to those already played to form new words. All letters played on a turn must be placed in one row across

or down the board, to form at least one complete word. If, at the same time, they touch others letters in adjacent rows, those must also form complete words, crossword fashion, with all such letters. The player gets full credit for all words formed or modified on his or her turn (i.e. when his/her letter combines with the letters on the board and forms a new word, all the points of that word goes for this player too).

4. New words may be formed by:
    a. Adding one or more letters to a word or letters already on the board.
    b. Placing a word at right angles to a word already on the board. The new word must use one of the letters already on the board or must add a letter to it. (See Turns 2, 3 and 4 below.)
    c. Placing a complete word parallel to a word already played so that adjacent letters also form complete words. (See Turn 5 in the Scoring Examples section below.)
5. No tile may be shifted or replaced after it has been played and scored.
6. Blanks: The two blank tiles may be used as any letters. When playing a blank, you must state which letter it represents. It remains that letter for the rest of the game.
7. You may use a turn to exchange all, some, or none of the letters. To do this, place your discarded letter(s) facedown. Draw the same number of letters from the pool, then mix your discarded letter(s) into the pool. This ends your turn.
8. If a user plays an invalid word the player gets back his tiles and loses his turn
9. The game ends when all letters have been drawn and one player uses his or her last letter; or when all possible plays have been made.

Scoring

1. The score for each turn is the sum of the letter values in each word(s) formed or modified on that turn, plus the additional points obtained from placing letters on Premium Squares.
2. Premium Letter Squares: A light blue square doubles the score of a letter placed on it; a dark blue square triples the letter score.
3. Premium Word Squares: The score for an entire word is doubled when one of its letters is placed on a pink square: it is tripled when one of its letters is placed on a red square. Include premiums for double or triple letter values, if any, before doubling or tripling the word score. If a word is formed that covers two premium word squares, the score is doubled and then re-doubled (4 times the letter count), or tripled and then re-tripled (9 times the letter count). NOTE: the center square is a pink square, which doubles the score for the first word.
4. Letter and word premiums count only on the turn in which they are played. On later turns, letters already played on premium squares count at face value.
5. When a blank tile is played on a pink or red square, the value of the word is doubled or tripled, even though the blank itself has no score value.
6. When two or more words are formed in the same play, each is scored. The common letter is counted (with full premium value, if any) for each word. (See Turns 3, 4 and 5 in the Scoring Examples section.)

7. BINGO! If you play seven tiles in a turn, it's a Bingo!. You score a premium of 50 points after totaling your score for the turn.
8. Unplayed Letters: When the game ends, each player's score is reduced by the sum of his or her unplayed letters. In addition, if a player has used all of his or her letters, the sum of the other players' unplayed letters is added to that player's score.
9. The player with the highest final score wins the game. In case of a tie, the player with the highest score before adding or deducting unplayed letters wins.

Example

In the following, the words added on five successive turns are shown in bold type. The scores shown are the correct scores if the letter R is placed on the center square. In Turn 1, count HORN: in Turn 2, FARM; in Turn 3, PASTE and FARMS; in Turn 4, MOB, NOT and BE; in Turn 5, BIT, PI and AT.

Turn 1: Score = 14   Turn 2: Score = 9   Turn 3: Score = 25   Turn 4: Score = 16   Turn 5: Score = 16