

Scrabble Algorithm - Jure Jurcevic 2212275

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Scrabble Algorithm
Analysing and Solving Problems
ACCA4019

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Task 1. Requirements

Describe the rules of Scrabble.

1. *Setting Up the Game:* The game is designed for 2-4 players. Each player draws a letter. The player that has the letter closest to "A" starts the game. A blank tile beats any letter. [11]

2. *Game Play:* Players take turns creating words on the game board. Words can be placed either left to right (horizontally) or top to bottom (vertically). The first word must be placed so that one of the letters is on the star in the center of the board. [8]

3. *Drawing Tiles:* Each player begins the game with seven tiles. After playing a word, the player draws the same number of tiles they played, thus always holding seven tiles in their hand unless the draw pile is exhausted. [1]

4. *Valid Words:* Any words found in a standard English dictionary are allowed, except for abbreviations, prefixes and suffixes standing alone, words requiring a hyphen or an apostrophe, and words requiring the use of a capital letter (like proper nouns or acronyms). [3]

5. *Scoring:* Each letter has a point value which is used to calculate the score for each word. Some squares on the board give bonus points. If a player uses all seven tiles in one turn, they receive a 50-point bonus in addition to the word score. [3]

- Double Letter (DL): This square doubles the score of the letter placed on it. [2]
- Triple Letter (TL): This square triples the score of the letter placed on it. [2]
- Double Word (DW): This square doubles the score of the entire word.
- Triple Word (TW): This square triples the score of the entire word. [3]

6. *End of the Game:* 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. The player with the highest score at the end of the game wins. [2]

7. *Penalties:* If a word is challenged and found to be incorrect, the player must remove the word from the board and forfeit their turn. [1]

These are the basic rules of Scrabble. [4]

Create a requirement features list for a possible computer-based solution for the game using the requirements prioritisation technique.

Prioritization is categorized as "Must Have", "Should Have", "Could Have", and "Would Like to Have". Here's a breakdown for a digital Scrabble game:

Must Have (High Priority):

1. *Board and Tile Representation*: An interactive game board that accurately represents the traditional Scrabble board with the correct distribution and arrangement of premium squares.
2. *Word Validation*: A feature that verifies whether a word is valid or not, using the Official Scrabble Players Dictionary or equivalent.
3. *Scoring System*: Automated calculation and display of scores based on the placement of tiles on the board.
4. *Tile Bag and Drawing Mechanism*: A system to represent the tile bag, from which players draw their tiles randomly.
5. *Turn-Based System*: An implementation that allows for a smooth turn-based game flow.
6. *Game Ending Conditions*: The system must correctly identify when the game has ended (either when all tiles have been drawn and one player has used all their tiles, or all players have passed twice consecutively). [5]

Should Have (Medium Priority):

1. *Multiplayer Option*: The ability for multiple users to join a game, potentially with both local and online multiplayer options.
2. *Player Profiles*: Functionality to create, save, and load player profiles, tracking statistics like games won, words played, highest scoring word, etc.
3. *Bingo Bonus*: A system to automatically recognize and award the bonus points when a player uses all seven tiles in a single turn. [4]

Could Have (Low Priority):

1. *Tile Exchange Mechanism*: A feature that allows players to exchange their tiles, which counts as their turn.
2. *Undo Option*: An option to undo a move, perhaps limited to the current turn.
3. *AI Opponent*: A single-player mode where users can play against a computer opponent. [6]

Would Like to Have (Wishlist):

1. *Chat Feature*: For online multiplayer games, a feature that allows players to chat with each other during the game.

2. *Achievement System*: A system to award players with achievements or trophies based on in-game accomplishments.
3. *Tutorial or Guide*: An interactive tutorial or guide to help new players understand the rules and strategies of Scrabble.
4. *Difficulty Levels*: For the AI opponent, different difficulty levels ranging from easy to hard.

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Select three of the options to implement under Must and explain their priorities.

Word Validation: As the top priority, this is crucial because Scrabble is a word game and being able to validate whether the words players place on the board are actual, playable words according to the Scrabble dictionary is fundamental. This feature will ensure fair play, preventing players from placing non-existent or invalid words and keeping the gameplay smooth and enjoyable.

Scoring System: Taking the second spot, this is another essential component of the game. Scrabble is a competitive game and the main point of competition is the score. Implementing an automated scoring system not only makes the game more user-friendly (as players won't have to calculate scores manually), but it also ensures accurate, objective scorekeeping. This feature should take into account the point value of letters, the impact of premium squares, and additional scoring mechanics such as the 50-point "bingo" bonus for using all seven tiles in a turn.

Turn-Based System: The third priority would be to implement a smooth turn-based game flow. This is a critical feature as it would determine the sequence of the gameplay. It should ensure that each player can only make a move during their turn and that the turns rotate correctly among the players. Proper implementation of this feature will ensure fair play and orderly progression of the game.

Task 2: Implementation

Identify the variables you need to use in your solution.

Brief descriptions of the variables. If any are constants, indicate.

Variables:

playerList: An array or list that contains all the players participating in the game. Each player can be represented as an object or structure containing relevant information like name, current score, and tile rack.

currentPlayerIndex: An integer to track which player's turn it is currently. This variable can be updated after each turn to cycle through the "playerList".

gameBoard: A 2D array or matrix to represent the game board. Each cell in the array can hold a structure or object that represents a tile (with letter and score) and the type of square (regular, double letter, triple letter, double word, triple word).

tileBag: An array or list to hold the remaining tiles. Each tile can be an object or structure containing information like letter and score.

currentWord: A string to hold the word currently being placed by a player. This will change with each turn.

gameOver: Variable that indicates whether the game has ended or not. It can be set to true when all tiles have been drawn and one player has used all their tiles, or all players have passed twice consecutively. [7]

Constants:

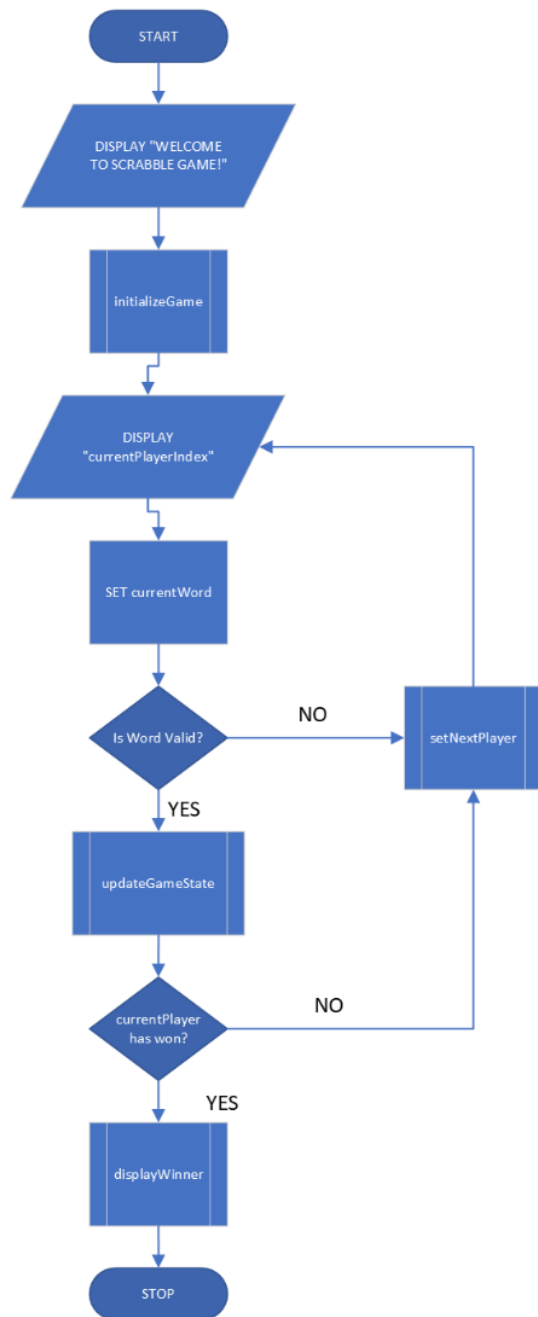
letterValues: A dictionary or map that stores the point value of each letter. For example, 'A' might map to 1, 'B' to 3, etc. These are constants as the values of the letters do not change throughout the game.

totalTiles: An integer constant that represents the total number of tiles at the start of the game.

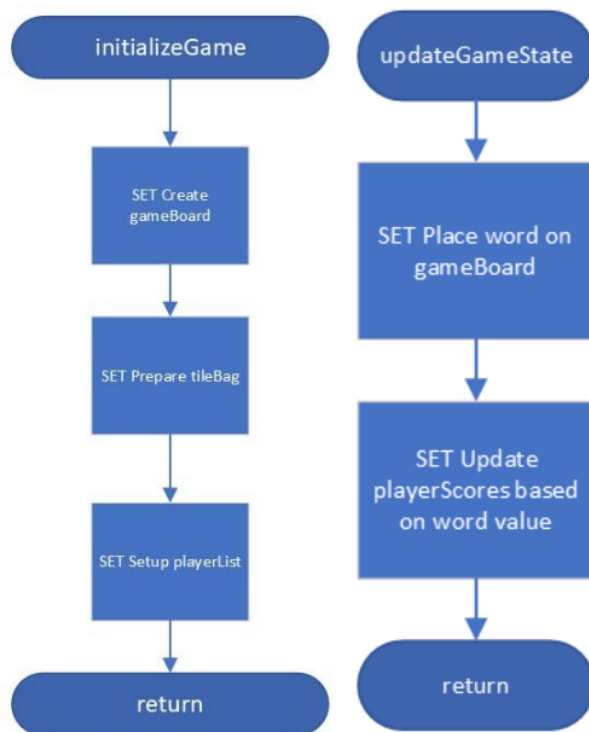
boardSize: An integer constant that represents the dimensions of the game board. For a standard Scrabble board, this would be 15 (as the board is a 15x15 grid).

bonusForAllTileUse: An integer constant that represents the bonus points awarded when a player uses all seven tiles in a single turn (50 points, often referred to as a "bingo").

Use Microsoft Visio to create flowcharts to represent an algorithm for your solution.
Copy the flowchart from Visio to your Word report.



MainProgram



InitializeGame

UpdateGameState

Using pseudo code, detail two of the sub processes of your solution

PSEUDOCODE	EXPLANATION
initializeGame	Function
SET Create gameBoard	Creates an empty game board
SET Prepare tileBag	Fills the bag with set of Scrabble tiles
SET Setup playerList	Creates players with names and empty tile racks

PSEUDOCODE	EXPLANATION
updateGameState	Function
SET Place word on gameBoard	Places the word on the game board
SET Update playerScores based on word value	Ads the score for the word to the players total score

[8]

References:

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- [4] Triple S Games, *How to Play Scrabble*, (Dec. 16, 2015). Accessed: Jul. 18, 2023. [Online Video]. Available: <https://www.youtube.com/watch?v=K1KgvZwwJqo>
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- [6] M. Vestola, "A comparison of nine basic techniques for requirements prioritization," 2010. [Online]. Available: http://www.mvnet.fi/publications/software_development_seminar.pdf
- [7] Rahman, K. A., Ahmad, S., & Nordin, M. J., *The Design of an Automated C Programming Assessment Using Pseudocode Comparison Technique*, 2007.
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