SE 3XA3: Module Interface Specification Scrabble Project

Team #214, The Trifecta
Kanakabha Choudhri, Choudhrk
Lucia Cristiano, Cristial
Raymond Tu, Tur1

April 6, 2020

This document is the Module Interface Specification of the Scrabble Project being done by Team Trifecta.

Table 1: **Revision History**

Date	Version	Notes
13/3/20	~~1.0~~ 0.0	Had revision 0 finished.
6/4/20	1.0	Revision 1 complete.

Tile Module

Module

Tile Type

Uses

N/A

Syntax

Exported Constants

N/A

Exported Types

Tile = tuple of (letter: String, score: $\mathbb{N}$)

Exported Access Programs

Routine name	In	Out	Exceptions
init	String	Tile	invalid_size
getLetter		String	
getScore		$\mathbb{N}$	

Semantics

State Variables

letter
score

Environment Variables

None

State Invariant

$0 < score \leq 10$

Assumptions

N/A

Access Routine Semantics

init($letter$):

- transition: $score := LETTER\_VALUES[letter]$
- output: None
- exception: ~~None~~ invalid_size

getLetter():

- transition: None
- output: letter
- exception: None

getScore():

- transition: None
- output: score
- exception: None

Local Constants

$LETTER\_VALUES$ = tuple of ("A" : 1, "B" : 3, "C" : 3, "D" : 2, "E" : 1, "F" : 4, "G" : 2, "H" : 4, "I" : 1, "J" : 1, "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)

Bag Module

Module

Bag Type

Uses

Tile

Syntax

Exported Constants

N/A

Exported Types

Bag = list of Tiles

Exported Access Programs

Routine name	In	Out	Exceptions
init		Bag	
addToBag	Tile, N	Bag	
initBag			
takeFromBag		Tile	
getRemainingTiles		N	

Semantics

State Variables

Bag

Environment Variables

None

State Invariant

$0 \leq |Bag| \leq 100$

Assumptions

N/A

Access Routine Semantics

init():

- transition: $Bag \rightarrow Bag$
- output: None
- exception: None

addToBag(Tile, n):

- transition: $Bag \rightarrow Bag + n * Tiles$
- output: None
- exception: None

initBag():

- transition: $Bag \rightarrow Bag + 10 * Tiles(A) + 2 * Tiles(B) + 2 * Tiles(C) + 4 * Tiles(D) + 12 * Tiles(E) + 2 * Tiles(F) + 3 * Tiles(G) + 2 * Tiles(H) + 9 * Tiles(I) + 1 * Tiles(J) + 1 * Tiles(K) + 4 * Tiles(L) + 2 * Tiles(M) + 6 * Tiles(N) + 8 * Tiles(O) + 2 * Tiles(P) + 1 * Tiles(Q) + 6 * Tiles(R) + 5 * Tiles(S) + 6 * Tiles(T) + 4 * Tiles(U) + 2 * Tiles(V) + 2 * Tiles(W) + 1 * Tiles(X) + 2 * Tiles(Y) + 1 * Tiles(Z)$
  Additionally shuffles the order of the letters.
- output: None
- exception: None

takeFromBag():

- transition: $|Bag| \rightarrow |Bag| - 1$
- output: $Bag(|Bag| - 1)$

- exception: None

getRemainingTiles():

- transition: None
- output: $|Bag|$
- exception: None

Rack Module

Module

Rack Type

Uses

Bag

Syntax

Exported Constants

N/A

Exported Types

Rack = set of Tiles where $t : Tile \in Bag$

Exported Access Programs

Routine name	In	Out	Exceptions
init	Bag	Rack	
addToRack			
initialize			
getRackStr		String	
getRackArr		Rack	
removeFromRack	Tile		
getRackLength		N	
replenishRack			

Semantics

State Variables

rack
bag

Environment Variables

None

State Invariant

$0 < |rack| \leq 7$

Assumptions

N/A

Access Routine Semantics

init(Bag):

- transition: $rack := \emptyset$
  $bag = Bag$
- output: None
- exception: None

addToRack():

- transition: $rack \rightarrow rack + t$
  where $t : Tile \in bag$
- output: None
- exception: None

initialize():

- transition: $rack \rightarrow rack + 7 * t$
  where $t : Tile \in bag$
- output: None
- exception: None

getRackStr():

- transition: None
- output: $r : Rack \rightarrow s : String$
  where r and s represent same set of characters.
- exception: None

getRackArr():

- transition: None
- output: rack
- exception: None

removeFromRack(tile):

- transition: $rack \rightarrow rack \setminus tile$
  where tile : Tile
- output: None
- exception: None

getRackLength():

- transition: None
- output: —rack—
- exception: None

replenishRack():

- transition: $rack \rightarrow rack + n * t$
  where $n : 7 - |rack|$
- output: None
- exception: None

Player Module

Module

Player Type

Uses

Bag, Rack

Syntax

Exported Constants

N/A

Exported Types

Player = tuple of $(rack : Rack, score : \mathbb{N})$

Exported Access Programs

Routine name	In	Out	Exceptions
init	Bag	Player	
getRackStr		String	
getRackArr		Rack	
increaseScore	$\mathbb{N}$		
getScore		$\mathbb{N}$	

Semantics

State Variables

Score
Rack

Environment Variables

None

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

init(Bag):

- transition: $Rack = t : Tile \in Bag$
  $score = 0$
- output: None
- exception: None

getRackStr():

- transition: None
- output: $r : Rack \rightarrow s : String$
  where r and s represent same set of characters.
- exception: None

getRackArr():

- transition: None
- output: Rack
- exception: None

increaseScore($increase$):

- transition: $score \rightarrow score + increase$
- output: None
- exception: None

getScore():

- transition: None
- output: score
- exception: None

Board Module

Module

Board Type

Uses

N/A

Syntax

Exported Constants

N/A

Exported Types

Board = 16×16 matrix of Tiles

Exported Access Programs

Routine name	In	Out	Exceptions
init		Board	
getBoard		Board	
updateBackBoard	N, N, String, String		ValueError

Semantics

State Variables

backBoard

Environment Variables

None

State Invariant

$|Board| = 256$

Assumptions

N/A

Access Routine Semantics

init():

- transition: $Board \rightarrow Board$
- output: None
- exception: None

getLetter():

- transition: None
- output: backBoard
- exception: None

updateBackBoard($row, column, direction, word$):

- transition: $Board \rightarrow Board + word$
  where first letter of word is added from Board[row][column] and the rest are added to row(right) or column(down) depending on direction.
- output: None
- exception: ~~None~~ ValueError

EndTurn Module

Module

Uses

Tiles, Bag, Rack

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
updateFrontBoard	$\mathbb{N}, \mathbb{N}$, String, String	List	ValueError
removeTile	String, Rack		
exchangeTile	String, Rack		
calculateScore	$\mathbb{N}, \mathbb{N}$, String, String	N	ValueError
checkWinState	Rack, Rack, Bag	$\mathbb{B}$	

Semantics

State Variables

word_score

Environment Variables

None

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

updateFrontBoard($row, column, direction, word$):

- transition: Empty $List \rightarrow List$ of Tuples
- output: List of Tuples
- exception: ~~None~~ ValueError

removeTile($word, rack$):

- transition: $Rack \rightarrow Rack \setminus lettersinword$
  $Rack \setminus lettersinword \rightarrow (Rack \setminus lettersinword) + n$
  where n = letters in word.
- output: None
- exception: None

exchangeTile($word, rack$):

- transition: $Rack \rightarrow Rack$
- output: None
- exception: None

calculateScore($row, column, direction, word$):

- transition: $word\_score \rightarrow +(\forall letters \in word \cdot score)$
- output: word_score
- exception: ~~None~~ ValueError

checkWinState($rack1, rack2, bag$):

- transition: None
- output: $\mathbb{B}$
- exception: None

WordChecks Module

Module

Correct scrabble word check.

Uses

N/A

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
checkRack	String, Rack	$\mathbb{B}$	ValueError
checkInDict	String	$\mathbb{B}$	IOError

Semantics

State Variables

N/A

Environment Variables

~~N/A~~ Dictionary = dic.txt

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

checkRack($word, rack$):

- transition: None
- output: ~~$\mathbb{B}$~~ $(\exists\ word \in rack \cdot true)$
- exception: ~~None~~ ValueError for empty word.

checkInDict($word$):

- transition: None
- output: ~~$\mathbb{B}$~~ $(\exists\ word \in Dictionary \cdot true)$
- exception: ~~None~~ IOError for incorrect file.

BoardChecks Module

Uses

WordChecks, Board, copy

Right Module

Module

Right Direction Board Checks.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
occupiedTiles	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
adjWordCheck	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
outOfBounds	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
placementCheck	$\mathbb{N}, \mathbb{B}$, String, Board, $\mathbb{N}$	$\mathbb{B}$	
rightCheck	$\mathbb{N}, \mathbb{B}$, String, Board, $\mathbb{N}$	$\mathbb{B}$	

Semantics

State Variables

matches

Environment Variables

N/A

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

occupiedTile($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ for whether a Tile is occupied or not.
- exception: None

adjWordCheck($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ if there are adjacent words that can be made with user's word placement.
- exception: None

outOfBounds($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ if word placement is out of the bounds of the board.
- exception: None

placementCheck($row, column, word, board, count$):

- transition: None
- output: $\mathbb{B}$ for the first word starting at tile 7×7.
- exception: None

rightCheck($row, column, word, board, count$):

- transition: None
- output: $\mathbb{B}$ for correct placement of word in the right direction using free tiles.
- exception: None

Down Module

Module

Down Direction Board Checks.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
occupiedTiles	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
adjWordCheck	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
outOfBounds	$\mathbb{N}, \mathbb{B}$, String, Board	$\mathbb{B}$	
placementCheck	$\mathbb{N}, \mathbb{B}$, String, Board, $\mathbb{N}$	$\mathbb{B}$	
downCheck	$\mathbb{N}, \mathbb{B}$, String, Board, $\mathbb{N}$	$\mathbb{B}$	

Semantics

State Variables

N/A

Environment Variables

N/A

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

occupiedTile($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ for whether a Tile is occupied or not.
- exception: None

adjWordCheck($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ if there are adjacent words that can be made with user's word placement.
- exception: None

outOfBounds($row, column, word, board$):

- transition: None
- output: $\mathbb{B}$ if word placement is out of the bounds of the board.
- exception: None

placementCheck($row, column, word, board, count$):

- transition: None
- output: $\mathbb{B}$ for the first word starting at tile 7×7.
- exception: None

downCheck($row, column, word, board, count$):

- transition: None
- output: $\mathbb{B}$ for correct placement of word in the down direction using free tiles.
- exception: None

MainGame Module

Uses

~~sys~~, tkinter, ~~Board, Bag, Player, Rack, Tile, BoardChecks, WordChecks, EndTurn~~, WidgetCreation, GameController

FrontEndMain Module

Module

Game introduction screens which take players information.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
init		tkinter Grid	
instructions		tkinter Grid	
getPlayerName		tkinter Grid	

Semantics

State Variables

turn, player_1rack, player2_rack, roundCount

Environment Variables

~~N/A~~ *GameWindow · Tkinter grid*

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

init():

- transition: None
- output: ~~A tkinter grid~~ GameWindow displaying the introduction screen with options to start the game or read the instructions.
- exception: None

instructions():

- transition: None
- output: ~~A tkinter screen~~ GameWindow which lays out the rules of Scrabble.
- exception: None

getPlayerName():

- transition: None
- output: ~~A tkinter screen~~ GameWindow that asks for the two player names.
- exception: None

BoardFrame Module

Module

Creates the GUI of the playable scrabble board.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
scrabbleBoard	tkinter root, tkinter frame, String, String	tkinter Grid	

Semantics

State Variables

root, frame, player1name, player2name

Environment Variables

GameWindow · Tkinter grid

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

scrabbleBoard(root, frame, player1Name, player2Name):

- transition: None
- output: GameWindow displaying a functional scrabble board, input boxes for word, direction, starting row and column values, shared letters and letters to exchange, and current players turn and their score.
- exception: None

~~BoardFrame~~ GameController

Module

~~Window with scrabble board that controls game play~~ Contains control for the back end logic of the Scrabble game based on user inputs.

Uses

~~sys~~, tkinter, Board, Bag, Player, Rack, Tile, BoardChecks, WordChecks, EndTurn

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
updateGUI	List of Tile location		
clearEntry	6 Strings		
skipTurn	2 Strings		
exchangeTiles	3 Strings		
scoreBoard	3 Strings		
completeTurn	15 Strings		
endChecks	18 Strings		
endMove	17 Strings		
updateLabelText	String		
scrabbleBoard	4 Strings		

Semantics

State Variables

turn, player_1rack, player2_rack, roundCount

Environment Variables

N/A

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

updateGUI($updateList$):

- transition: Updates board with a tuple of row and column per letter of inputted word.
- output: None
- exception: None

clearEntry($inputWordE, inputRowE, inputColE, inputDirE, inputWordSharedE, inputWordExchange$

- transition: Clears text boxes for game inputs.
- output: None
- exception: None

skipTurn($turnLabel, rackLabel$):

- transition: Skips players turn if the enter button is hit.
- output: None
- exception: None

exchangeTiles($exchangeTiles, label, turnLabel$):

- transition: Exchanges current rack tiles with tiles in the bag.
- output: None
- exception: None

scoreBoard($frame, score1Label, score2Label$):

- transition: Declares winner of game and their score.
- output: None
- exception: None

completeTurn($frame, word, row, col, dir, player, rackLabel, score1Label, score2Label, turnLabel, inputWordE, inputRowE, inputColE, inputDirE, validMoveL$):

- transition: Signifies the completion of a turn.
- output: None
- exception: None

endChecks($frame, word, row, col, dir, player, rackLabel, score1Label, score2Label, turnLabel, inputWordE, inputRowE, inputColE, inputDirE, inputWordSharedE, inputWordExchangeE, validMoveL, sharedLetters$):

- transition: Performs checks on input data from players turn.
- output: None
- exception: None

endMove($frame, word, row, col, dir, rackLabel, score1Label, score2Label, turnLabel, inputWordE, inputRowE, inputColE, inputDirE, inputWordSharedE, inputWordExchangeE, validMoveL, sharedLetters$):

- transition: Takes in user data from window text boxes.
- output: None
- exception: None

updateLabelText($label$):

- transition: Updates window components labels with string input label.
- output: None
- exception: None

scrabbleBoard($root, frame, player1Name, player2Name$):

- transition: Creates initial scrabble board after taking player's names.
- output: None
- exception: None

WidgetCreation

~~BoardLabel~~ MakeLabel Module

Module

Creates labels for various tkinter window components.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
init		tkinter Label	

Semantics

State Variables

N/A

Environment Variables

N/A

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

init():

- transition: None
- output: A tkinter label to be attached to the various tkinter window components.
- exception: None

~~ColorButton~~ MakeButtons Module

Module

~~Creates labels~~ Creates button objects for the various tkinter window components.

Syntax

Exported Constants

N/A

Exported Types

N/A

Exported Access Programs

Routine name	In	Out	Exceptions
init	String, String, String, String, String	tkinter button	
configure	String, String		

Semantics

State Variables

N/A

Environment Variables

N/A

State Invariant

N/A

Assumptions

N/A

Access Routine Semantics

init($frame, colour, row, column, text$):

- transition: None
- output: A tkinter button representing each tile on the board.
- exception: None

configure($attribute, text$):

- transition: Changes the tile button attributes label.
- output: None
- exception: None