Analysis and Design for Word Ladder Assignment

Team # 33:
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ANALYSIS

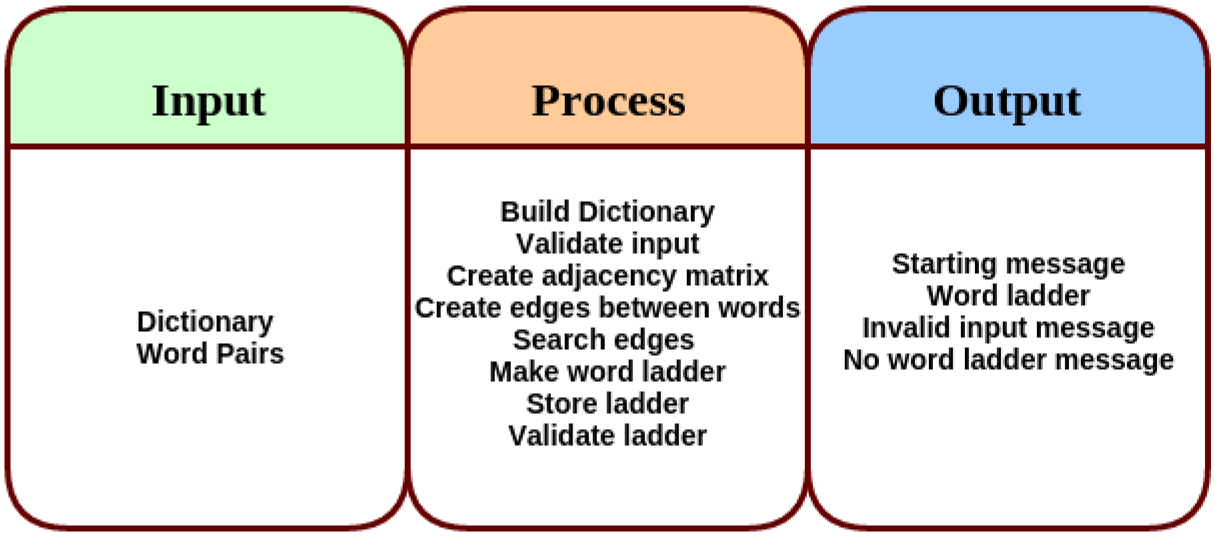
The Assignment asks us to create a "word ladder" between two given words. From the start word, one letter is altered at a time to create another word that exists within the dictionary until the end word is reached. These two words are input as strings with some sort of white space separating the two. (Note that on Piazza Post @193 states that the input will actually be the same format as the code stub).

Some given rules:

- The input should be five letters long
- The input should be a real word which exists within the dictionary of five letter words
- The word ladder can be as long as necessary
- Throw a NoSuchLadder Exception if the ladder does not exist
- Handle invalid input

DESIGN

System IPO diagram



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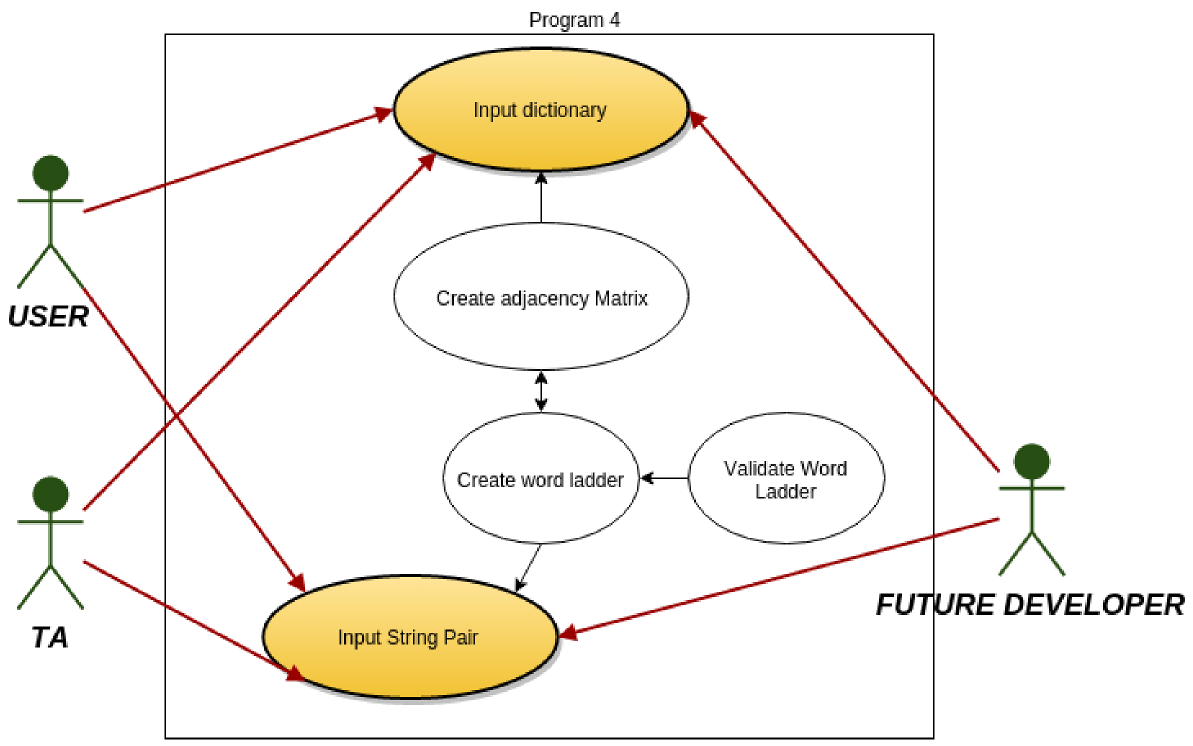
Use-case diagram



UML model of the needed classes and their relationships

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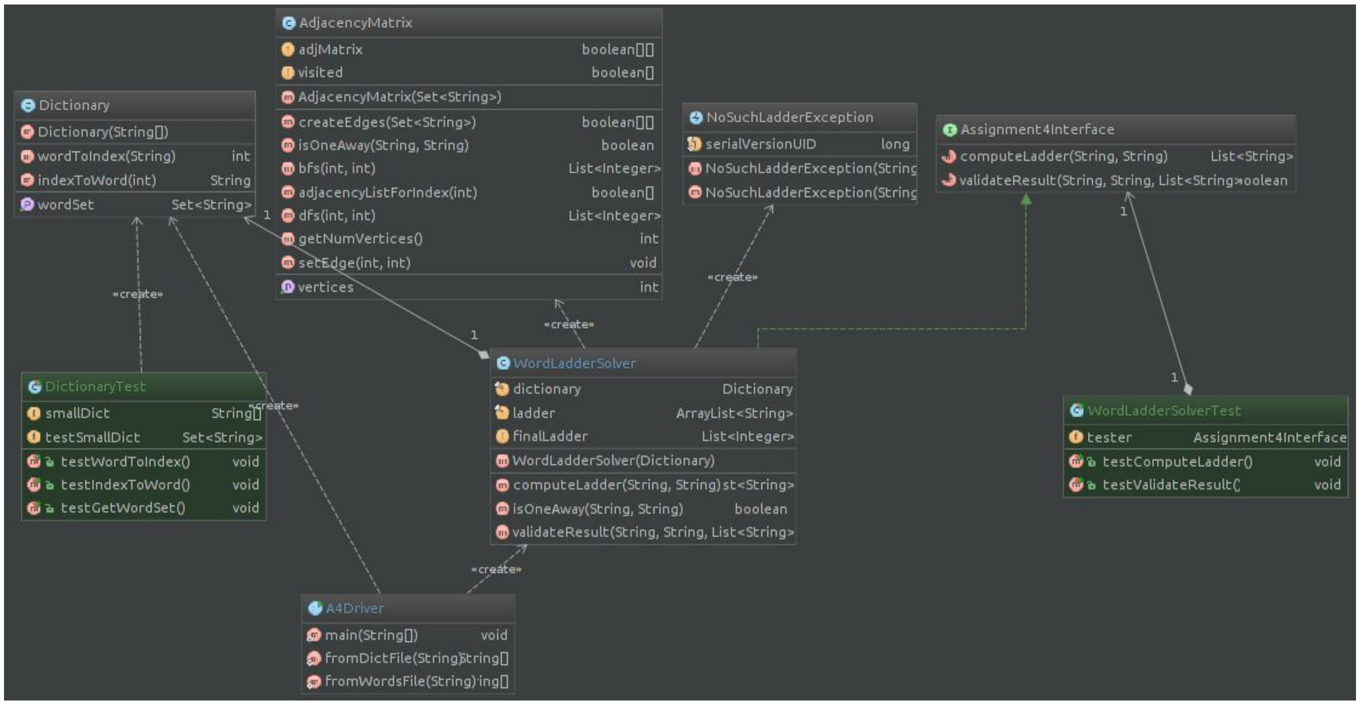
AdjacencyMatrix
adjMatrix boolean[][]
visited boolean[]
AdjacencyMatrix(Set<String>)
createEdges(Set<String>) boolean[][]
isOneAway(String, String) boolean
bfs(int, int) List<Integer>
adjacencyListForIndex(int) boolean[]
dfs(int, int) List<Integer>
getNumVertices() int
setEdge(int, int) void
vertices int
Dictionary
Dictionary(String[])
wordToIndex(String) int
indexToWord(int) String
wordSet Set<String>
NoSuchLadderException
serialVersionUID long
NoSuchLadderException(String
NoSuchLadderException(String
Assignment4Interface
computeLadder(String, String) List<String>
validateResult(String, String, List<String>oolean
«create»
1
WordLadderSolver
dictionary Dictionary
ladder ArrayList<String>
finalLadder List<Integer>
WordLadderSolver(Dictionary)
computeLadder(String, String) st<String>
isOneAway(String, String) boolean
validateResult(String, String, List<String>
DictionaryTest
smallDict String[]
testSmallDict Set<String>
testWordToIndex() void
testIndexToWord() void
testGetWordSet() void
WordLadderSolverTest
tester Assignment4Interface
testComputeLadder() void
testValidateResult(void
A4Driver
main(String[]) void
fromDictFile(String) String[]
fromWordsFile(String) ing[]

Functional block diagram showing the calling relationships between methods (library methods are not included)

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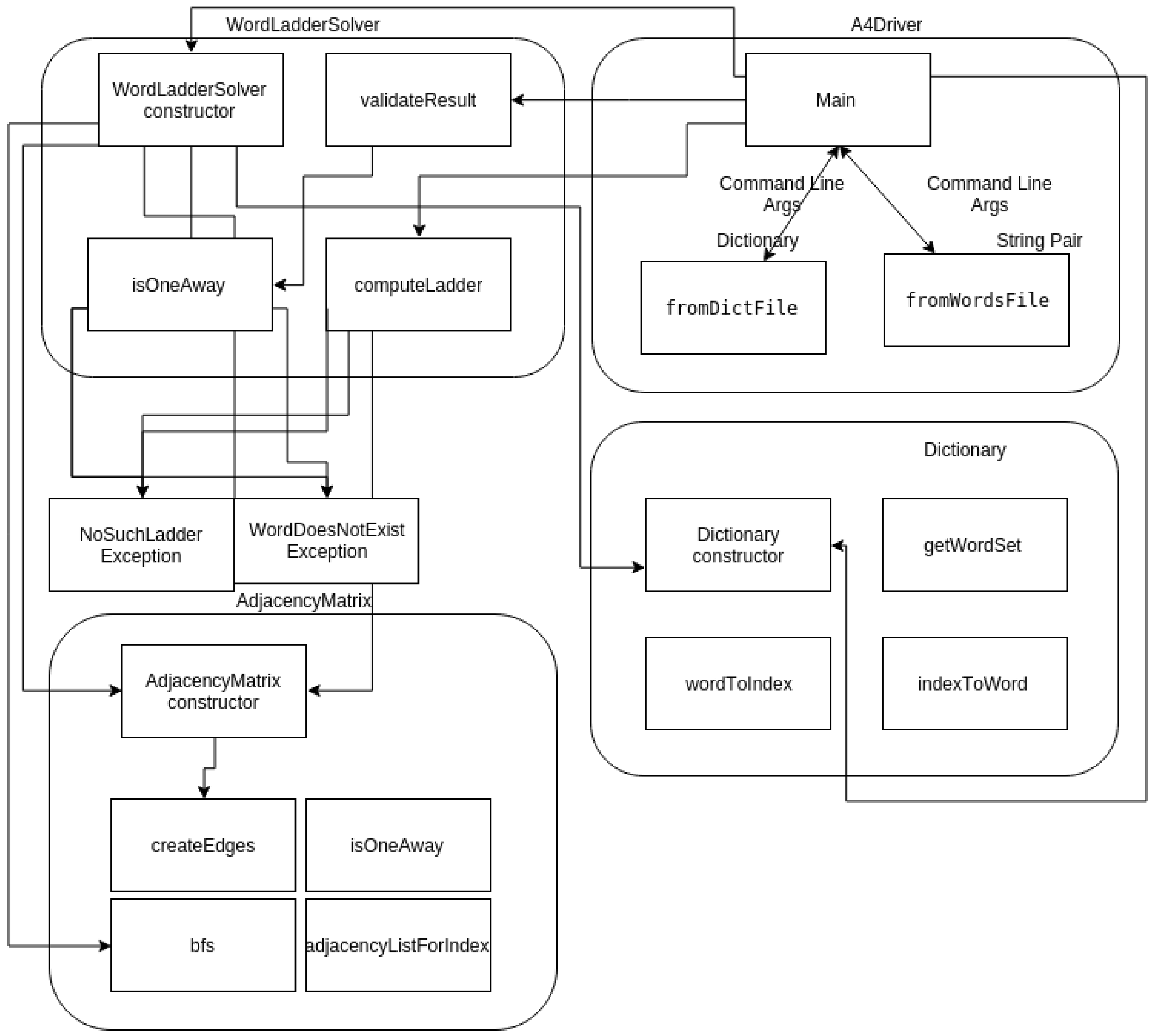

Algorithm for the driver (main method)

1) make sure the command line input is valid
2) create a dictionary by reading from the dictionary
3) create a wordLadderSolver and interface
4) check that word pairs are valid
5) create a ladder
6) if invalid throw exception, catch and output message
7) clear and continue

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Rationale Behind Design.

a) How does your OOD reflect the interaction and behavior of the real-world objects that it models

The Dictionary methods are useful the same way a real dictionary would be, and the adjacency matrix and the word checking mimic real-world checks.

b) What alternatives did you consider? & What were the advantages/disadvantages of each alternative both from a programming perspective and a user perspective?

We initially decided to create a depth-first-search on our adjacency matrix but realized the ladders were very long and time consuming and thus switched to a breadth-first-search.

c) What are some expansions or possible flexibilities that your design offers for future enhancements?

The design could be expanded by using a full dictionary or adding functionality to create ladders between differently sized words.

d) How does your design adhere to principles of good design: OOD, cohesion, coupling, info hiding, etc?

The correct methods are made private, public, static, and all information is shared properly. We break the several methods related to the Dictionary and the methods related to the Adjacency Matrix into their own classes to allow for modularity and cohesion.

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Test Requirements

Black Box Testing

We tested three main cases, string pairs that work, string pairs in which there existed no ladder, and string pairs which were invalid. This was done simply by running the program with a test file and documenting what we expected the output to be and what it was after running.

an example valid string pair: “honey”, “stone”

an example string with no ladder: “atlas”, “zebra”

an example string with invalid input: “joe”, “garbl”

White Box Testing

The majority of our testing was white box testing. During the testing phase breadcrumbs were placed to make sure that each function was behaving as expected “System.Out.println(“Entering the constructor for Dictionary”)” is one example. We also set strategic breakpoints to test the values at certain points (for example that the length of the dictionary was 5757 as it should be).

JUnit tests

We write a test for the AdjacencyMatrix, the WordLadderSolver, and the Dictionary.
Each of these tests checks that the end conditions of each method is correct in the following way:
WORDLADDERSOLVER:
testComputeLadder - tested that the ladders we expected to break did in fact break
testValidateResult - made sure that the ladders were not incorrect

DICTIONARY:
testWordToIndex - tests on a smaller dictionary to make sure that the method is properly getting indexes from strings
testIndexToWord - tests on a smaller dictionary to make sure that the method is properly getting strings from indexes
testGetWordSet - tests to make sure that the set returned differs in no way from the one input

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ADJACENCY MATRIX

testBfs - makes sure that the adjacency list creates the correct list

testGetNumVertices - makes sure that the adjacency list has the proper number of vertices