Word Ladders Extension: Any-Length Ladders

Eckel, TJHSST AI1, Fall 2022

Background & Explanation

This assignment is exactly like the Word Ladders BLUE assignment, except for three changes:

- You have a dictionary that includes words of any length
- In addition to one letter *changing* from one word to the next, it is also legal for one letter to be added somewhere or removed somewhere
- Your submitted code also needs to answer all four of the brainteasers after generating the requested word ladders, in real time, and this is included in the runtime requirements.

Files Provided

You are provided equivalents to the files from word ladders:

- `words_all.txt` is your dictionary
- `puzzles_all.txt` is your puzzle file
- `word_ladder_all_sr.txt` is your sample run (reminder: you may not get the same exact word ladders, but they should be the same length)

Brainteasers

As a reminder, here are the four brainteasers that your code will need to answer based on the dictionary it reads in:

1) Several words in `words_06_letters.txt` actually don't connect to any other words at all (ie, have no valid children). How many words are singletons like this?
2) On the other hand, a whole lot of the dictionary lives in one big clump. What is the number of words in the largest connected subcomponent of this graph? In other words, what is the size of the largest group of words that can all be reached from each other by a word ladder of some length?
3) How many clumps (or connected subcomponents) are there, total? Excluding the singletons in #1 but including the huge clump in #2, how many different, separate clumps are there with at least two words in them? (To clarify: two words are part of the same clump if and only if a word ladder can be constructed between them.)
4) BFS always finds **ideal paths**, ie the shortest path between two nodes. What is the **longest ideal path** between two words in this dictionary? Give at least one pair of words that produce an ideal word ladder of the longest possible length, as well as the complete solution from one to the other and the length of that solution.

Specification

Submit a single Python file to the link on the course website.

This assignment is **complete** if:

- You follow the instructions on the submission form to format your submission properly.
- Your code outputs everything specified in the BLUE specification (using, of course, the new modifications).
- **Your code also generates and prints answers to questions 1, 2, 3, and 4 from earlier in this assignment, and prints their answers below all of the puzzle solutions it has generated.**
    - Note that I'll be using a different dictionary from the one provided to you, so hardcoding any part of this is a bad idea!
    - Generating these answers is included in the runtime total below.
- **Total** runtime is less than one minute. (For what it's worth, as you can see on the sample run provided, mine runs in a little over 10 seconds on the given files.)