EE2703 - Applied Programming Lab
Assignment-5: Keyboard Layout Optimization

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1 Introduction

In this assignment our goal was to optimize a keyboard layout using the process of **simulated annealing**, this is a np-hard level optimization problem, this means that finding the most optimal solution is not really the best thing to do, rather we must come up with heuristics to approximate the optimal solution. The famous **Travelling Salesman Problem (TSP)** is another example of np-hard problems.

2 Problem Description

The input contains a text string to analyze and a keyboard layout. In my code I have defined some predefined layouts like **Qwerty**, **Dvorak**, **Colemak** and also provide an option to provide a custom layout as per the user's wish. The layout must follow the key configuration of our Programming Quiz - 4, Question - 3. The size of all keyboards is assumed to be 5x15.
Given all this info, our tasks are as follows:

- Generate a heat map visualization of key usage (by counting the frequency of each key)
- Calculate the distance travelled by the fingers for typing the given sentence. (Must include distance to and from shift keys etc.)
- Find a layout that is optimized for the given input text, this is done using simulated annealing
- Create an animation of this optimization process.

3 Assumptions I have used in my code

In order to solve this problem there were a number of assumptions that I had to use in my code.

- Any input layout will follow the same convention as given in the APL programming quiz Q3
(`https://eex.dev.iitm.ac.in/pluginfile.php/1/question/questiontext/9442/3/473/qwerty_layout.py`).
Also this input is from the terminal, not any file.
- The size of all keyboard layouts has been assumed to be 5x15.
- There are no other characters in the input text apart from the ones mentioned in the characters dictionary, part of the APL Programming Quiz 4 Q3.
- Bottom left corner is assigned the value of (-0.5, -0.5).
- All keys will have the same size, so please excuse any sort of overlapping problem
- The Heat map generated is not exactly like how it was shown in the demo, but it does highlight the fact that some keys are used more than others.
- The animation generated cannot be downloaded, it can be viewed in the output of the online JupyterLab notebook itself.
- The color map I have used is not the one mentioned in the demo, this one is called **"cividis"**
- The maximum size of the generated animation is 75 MB, anything beyond that is going to be omitted.

4 Results

When using the input text:

> Hi my name is Prajwal Vijay. I am 19 years old. I am a sophomore student studying in the Department of Electrical Engineering at IIT Madras. The following is a demo of my Applied programming lab (EE2703) assignment 4, where I have created and analysed various layouts of keyboards in python using matplotlib.

The following output was generated:

5 Steps to reproduce results

- There exists only one cell in the notebook.
- Running this cell will generate an animation. This process may take a few minutes

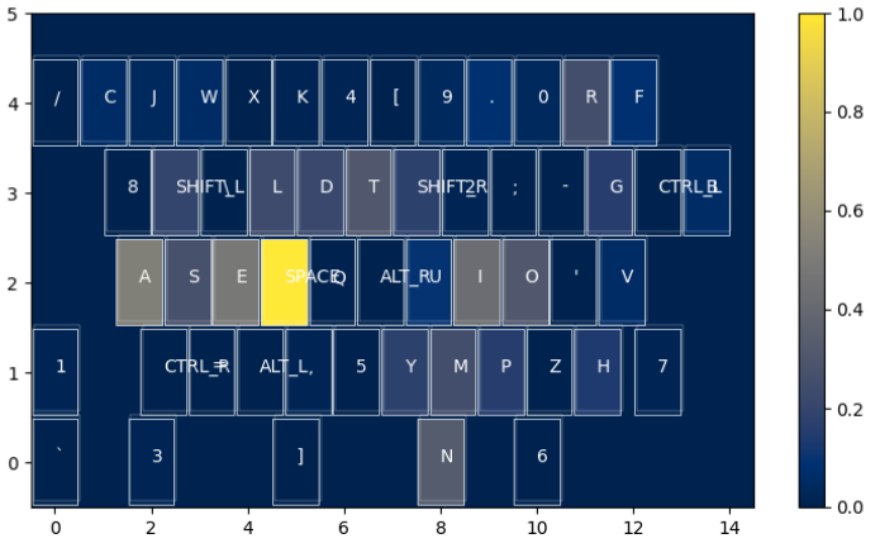

Figure 1: Output

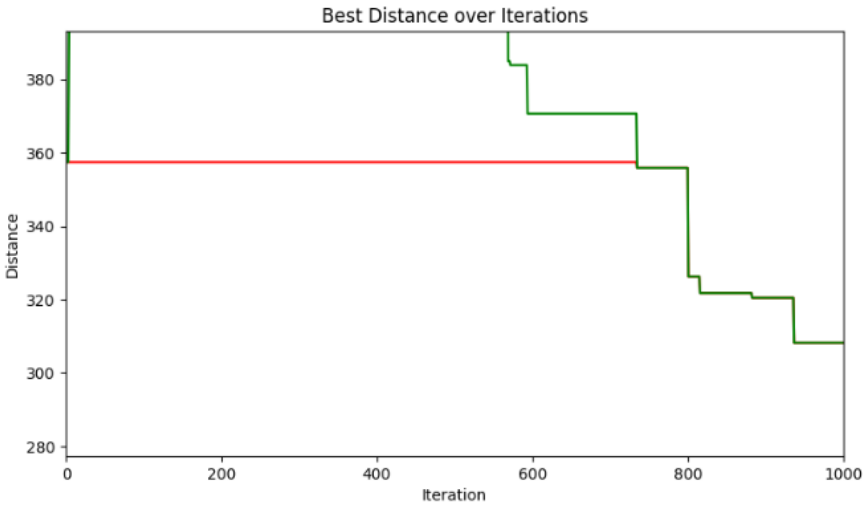

Figure 2: Output-graph

6 References

1. `https://www.overleaf.com/` was used to create the LATEX document
2. `https://docs.python.org/3/` the Python3 Documentation
3. `https://matplotlib.org/stable/api/index` the Matplotlib documentation
4. `https://eex.dev.iitm.ac.in/pluginfile.php/1/question/questiontext/9442/3/473/qwerty_layout.py` The fomat used is according to this document part of Question 3 in programming Quiz 4
5. `https://www.geeksforgeeks.org/` Here I found the details on np hard problems