

# Assignment 5 - Keyboard Optimization

October 13, 2024

## 1 How to Run the Notebook

To run this notebook and get the results you need, follow these steps:

1. **Download the Notebook:** Get the Jupyter notebook file (`ee23b110.ipynb`).
2. **Enter Your Layout in Section I:** Open the notebook, go to Section I, and fill in your layout information as asked.
3. **Run the Notebook:** Run the cells in the notebook one by one.
4. **Input Text When Prompted:** At the end of the notebook, after running the last cell, you will be asked to enter some text.
5. **Generate Plots and Distance Calculations:** The notebook will then create plots and calculate distances based on the input.

Make sure your notebook environment has all the required dependencies installed for everything to work smoothly.

## 2 Notebook Overview and Section Descriptions

### 2.1 Section I: Layout Configuration

In this section, you need to input the layout configuration, which is important for setting up the structure and data that will be used in the notebook. This layout is the base for all the analysis that follows. Make sure you define your layout properly to match what you need.

### 2.2 Section II: Data Preprocessing

This section gets the data ready for the main calculations. The input layout is checked and organized. Here, the data is cleaned, adjusted, and transformed so that it works well with the algorithms used later. Any missing or incorrect values are fixed to make sure the data is good quality.

### 2.3 Section III: Algorithm Implementation

This section contains the main algorithm: **Simulated Annealing**. Simulated annealing is a method used to find the best solution by trying different possibilities. The goal is to keep exploring different options, accepting better ones and sometimes even worse ones, to avoid getting stuck at a bad solution.

The steps include: - Starting from an initial point (based on the user input from Section I). - Changing the solution little by little to explore different options. - Using a schedule to make it less likely to accept worse solutions as time goes on, which helps the search focus on better solutions.

We made sure the algorithm doesn't get stuck on a bad solution too soon.

## 2.4 Section IV: Result Computation and Plotting

After running the simulated annealing algorithm, the results are calculated and shown in this section. The notebook measures how close the output is to what we want and shows this with graphs. This helps you see how well the algorithm worked.

The notebook creates graphs and metrics that show how the optimization process is going and how well the layout is performing.

## 2.5 Section V: User Interaction

After running the notebook, users are asked to enter some text that will be used for more analysis. Based on this input, the notebook updates the plots and distance measures, showing how the current layout and optimization respond to the new data.

# 3 Methodology: Simulated Annealing

The optimization method used in this notebook is **Simulated Annealing**. This method is inspired by how metals cool down and solidify, and it helps find a good solution for complex problems.

## 3.1 Key Features of Our Approach

- **Temperature Schedule:** The temperature controls how often we accept worse solutions. As the temperature gets lower, the algorithm is less likely to accept bad options, focusing more on finding the best solution.
- **No Special Characters in Switching:** We did not use special characters when switching between different states. This was done to keep things simple and make it easier for anyone to understand and follow the main idea of simulated annealing.

Overall, simulated annealing was chosen because it is simple and good at avoiding getting stuck at bad solutions, striking a balance between exploring new possibilities and focusing on the best ones.