**Task:**

The London Underground tube system is a complex interconnection of stations across the London area. You are provided with a standard map in pdf format that depicts the network. This map was downloaded from the Transport For London (TFL) site at <https://tfl.gov.uk/maps/track/tube> . You may assume that the trains operate from 05:00 until midnight each day. You may assume that there is no difference between peak times and off-peak times and that the trains run every 5 minutes with a 1 minute stop at each station to allow passengers to (dis)embark. The travel times taken between any two successive stations is determined already based on previously collected data and is provided in the accompanying excel spreadsheet called **“London Underground Data.xlsx”**. This data :

* 1. has not been quality checked and may contain errors or omissions. You are to decide how you will report and act on these as part of your study.
  2. does not include the waiting time at a station or the (dis)embarking of passengers.

Your team have been asked to provide a model software solution for a route planner of the London Underground tube system for use by the general public. For a ***Basic Solution*** you should provide a model that will determine the solution for the quickest journey time and you should carefully consider the design, implementation and testing of the software using appropriate or stated technology. **The stated technology is to use Dijkstra’s algorithm, the python programming language and a double linked list data structure to store information about each station and its connections. The additional technology to be considered should include that for the GUI with clear rationale for any choices made.**

For a user of the underground system, your **basic solution (mark >= 40%)** needs to provide

1. the functionality to quickly and efficiently elicit the information from the customer for a planned route
2. provide a list of stations showing how the customer will travel from one starting station (x) to the destination station (y) on the underground system
3. how long the journey will take in total

To enhance your grade further you should provide an **extended solution (mark >70%)** to include two additional features to your application

i. a table or graphic showing the list of stations from start to destination with corresponding times of how long it will take

e.g. Journey from **Maida Vale** to **Westbourne Park** **travel time to total travel**

**station line next station time**

**Maida Vale Bakerloo** 1 min 0 min

**Warwick Avenue Bakerloo** 2 min 2 min

**Paddington Bakerloo** 2 min 5 min

**Royal Oak Hammersmith & City** 2 min 8 min

**Westbourne Park Hammersmith & City** 11 min

**Journey summary**

**Bakerloo: Maida Vale to Paddington**

change

**Hammersmith & City: Paddington to Westbourne Park**

Total journey time: 11 minutes

ii. The London Underground tube system is a very reliable service that offers a safe form of public transportation around the city at high speeds. TFL would like to experiment with a new operation for The Bakerloo line (Brown) to a more frequent one where a different signal sequencing of lights are used at certain times during the day and therefore each journey between stations can be travelled at twice the original speed. This happens only between 9am-4pm and from 7pm-midnight. This will also mean that the customer needs to specify their time of travel in order to obtain the correct information for (i) above.