Indian Institute of Science

Bengaluru, Karnataka

CiSTUP

Internship Report

Test 1

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Figure 1: Example image

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Question 1 Part 1

Step1: Data Analysis

As a preliminary step,*Bicycle-sharing system dataset* consisting of 6,867 bicycle trips over one day was thoroughly analyzed. I leverage the tools from *panadas* library for the same. Following observation were made:

- Dataset was read as a Dataframe cossisting of 6867 rows and 7 columns. Each row denotes a unique datapoint/trip. Every datapoint/trip has following charateristics:

  `trip_id`: Unique trip identifier.

  `started_at`: Start time of the trip.

  `ended_at`: End time of the trip.

  `start_lat`: Latitude of the starting depot.

  `start_lng`: Longitude of the starting depot.

  `end_lat`: Latitude of the end depot.

  `end_lng`: Longitude of the end depot.

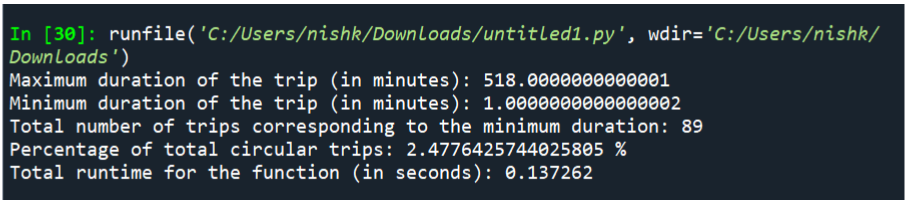
Program Logic

- The bicycle trip dataset is loaded into a *pandas DataFrame*.
- The *start* and *end* time columns in the DataFrame are converted to *datetime objects*.
- Trip duration in minutes is calculated by subtracting the start time from the end time and dividing the result by 60.
- Trips with a duration of 0 minutes are filtered out.
- The maximum and minimum trip durations are calculated and printed.
- The total number of trips corresponding to the minimum duration is calculated and printed.
- Circular trips are identified based on the start and end latitude and longitude being equal.
- The percentage of total circular trips is calculated and printed.
- The total runtime of the function is calculated by subtracting the start time from the end time. [*df.datetime.now()* was used to record the runtime]

Output

- The maximum and minimum trip durations are printed.
- The total number of trips corresponding to the minimum duration is printed.
- The percentage of total circular trips is printed.

- The total runtime of the function is printed.

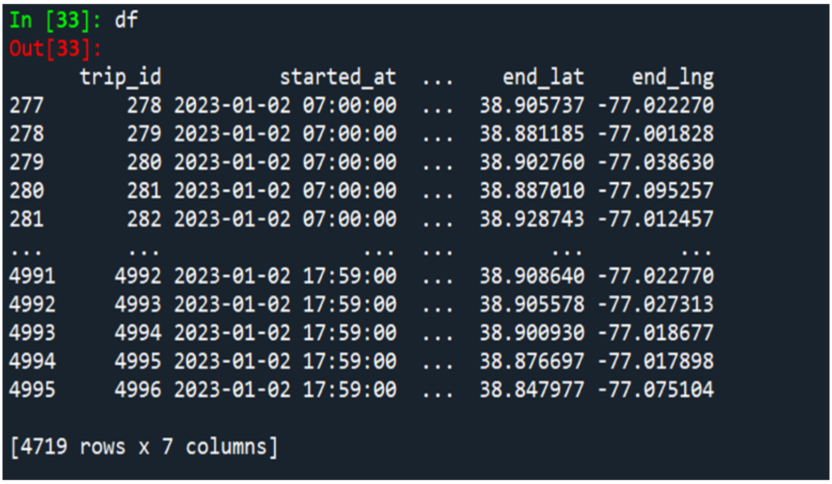


```
In [30]: runfile('C:/Users/nishk/Downloads/untitled1.py', wdir='C:/Users/nishk/
Downloads')
Maximum duration of the trip (in minutes): 518.0000000000001
Minimum duration of the trip (in minutes): 1.0000000000000002
Total number of trips corresponding to the minimum duration: 89
Percentage of total circular trips: 2.4776425744025805 %
Total runtime for the function (in seconds): 0.137262
```

Question 1 Part 2

Analyzing the Data

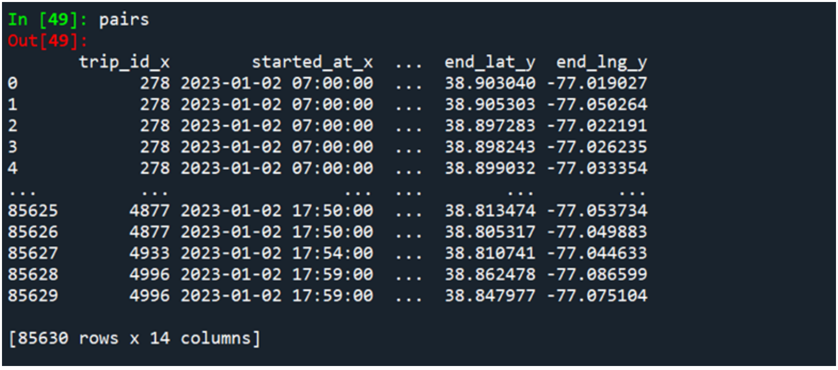
- The data is loaded from the *"bike_data_new.csv"* file using Pandas library.
- The *"started_at"* column is converted to datetime format using the *"pd.to_datetime()"* function.
- Trips starting between 6:00 AM and 6:00 PM are filtered using datetime filtering methods.



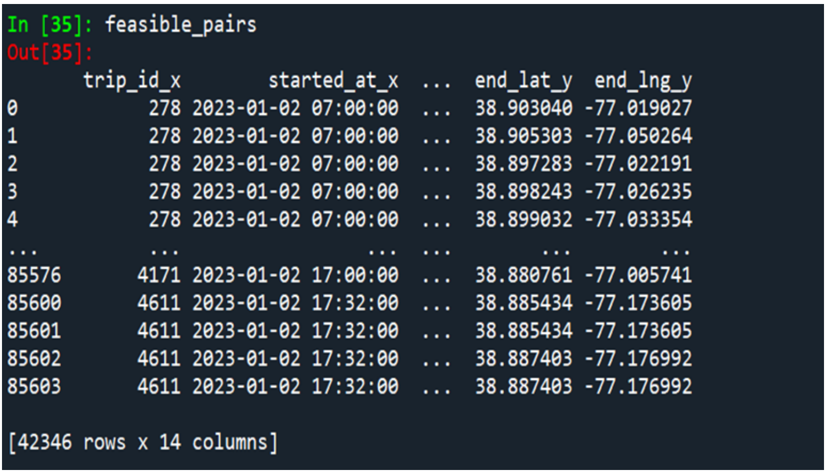
```
In [33]: df
Out[33]:
      trip_id          started_at  ...    end_lat    end_lng
277       278 2023-01-02 07:00:00  ...  38.905737 -77.022270
278       279 2023-01-02 07:00:00  ...  38.881185 -77.001828
279       280 2023-01-02 07:00:00  ...  38.902760 -77.038630
280       281 2023-01-02 07:00:00  ...  38.887010 -77.095257
281       282 2023-01-02 07:00:00  ...  38.928743 -77.012457
...       ...                 ...  ...        ...        ...
4991     4992 2023-01-02 17:59:00  ...  38.908640 -77.022770
4992     4993 2023-01-02 17:59:00  ...  38.905578 -77.027313
4993     4994 2023-01-02 17:59:00  ...  38.900930 -77.018677
4994     4995 2023-01-02 17:59:00  ...  38.876697 -77.017898
4995     4996 2023-01-02 17:59:00  ...  38.847977 -77.075104

[4719 rows x 7 columns]
```

Program Logic

- The dataset is joined to itself using the *"pd.merge()"* function.
- The program filters feasible pairs of trips based on their start and end locations and start and end times.
- The total number of feasible pairs of trips is counted and printed.
- Feasible pairs of trips for a specific trip ID (4611) are filtered and a new DataFrame is created from the results.



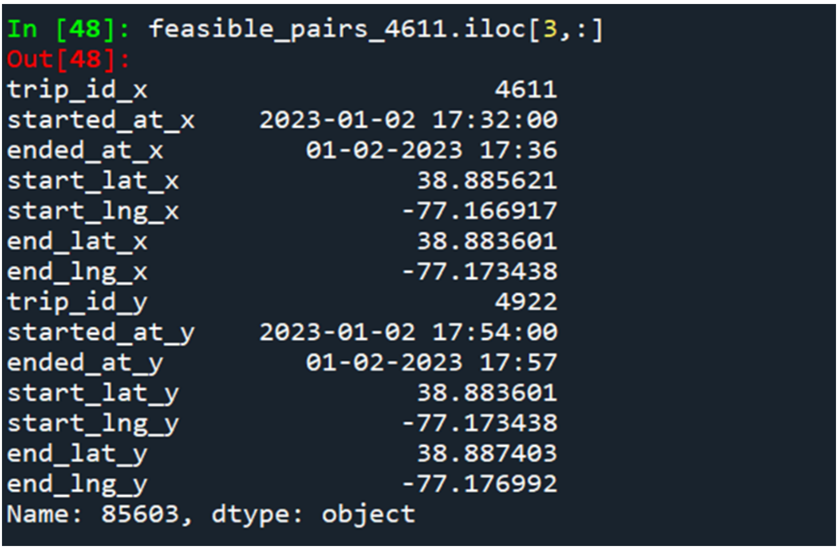
```
In [49]: pairs
Out[49]:
       trip_id_x          started_at_x  ...  end_lat_y  end_lng_y
0            278 2023-01-02 07:00:00  ...  38.903040 -77.019027
1            278 2023-01-02 07:00:00  ...  38.905303 -77.050264
2            278 2023-01-02 07:00:00  ...  38.897283 -77.022191
3            278 2023-01-02 07:00:00  ...  38.898243 -77.026235
4            278 2023-01-02 07:00:00  ...  38.899032 -77.033354
...          ...                 ...  ...        ...        ...
85625       4877 2023-01-02 17:50:00  ...  38.813474 -77.053734
85626       4877 2023-01-02 17:50:00  ...  38.805317 -77.049883
85627       4933 2023-01-02 17:54:00  ...  38.810741 -77.044633
85628       4996 2023-01-02 17:59:00  ...  38.862478 -77.086599
85629       4996 2023-01-02 17:59:00  ...  38.847977 -77.075104

[85630 rows x 14 columns]
```



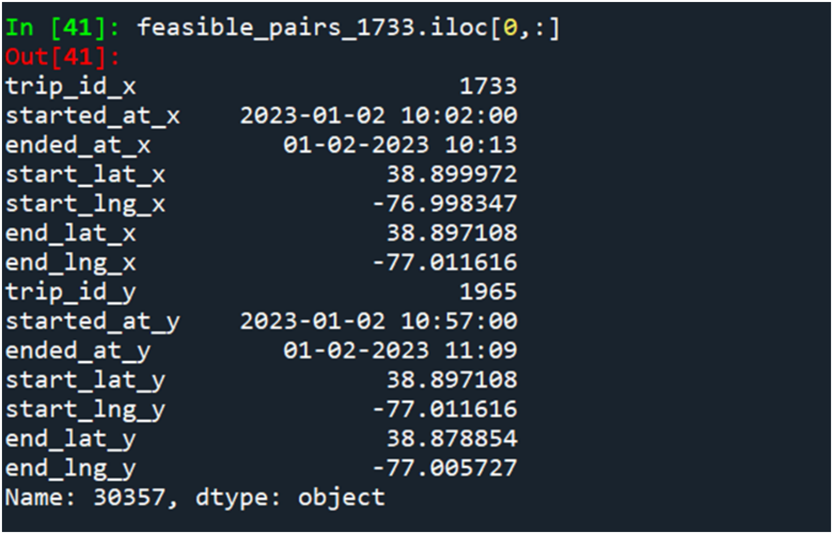
```
In [35]: feasible_pairs
Out[35]:
       trip_id_x          started_at_x  ...  end_lat_y  end_lng_y
0            278 2023-01-02 07:00:00  ...  38.903040 -77.019027
1            278 2023-01-02 07:00:00  ...  38.905303 -77.050264
2            278 2023-01-02 07:00:00  ...  38.897283 -77.022191
3            278 2023-01-02 07:00:00  ...  38.898243 -77.026235
4            278 2023-01-02 07:00:00  ...  38.899032 -77.033354
...          ...                 ...  ...        ...        ...
85576       4171 2023-01-02 17:00:00  ...  38.880761 -77.005741
85600       4611 2023-01-02 17:32:00  ...  38.885434 -77.173605
85601       4611 2023-01-02 17:32:00  ...  38.885434 -77.173605
85602       4611 2023-01-02 17:32:00  ...  38.887403 -77.176992
85603       4611 2023-01-02 17:32:00  ...  38.887403 -77.176992

[42346 rows x 14 columns]
```

Output

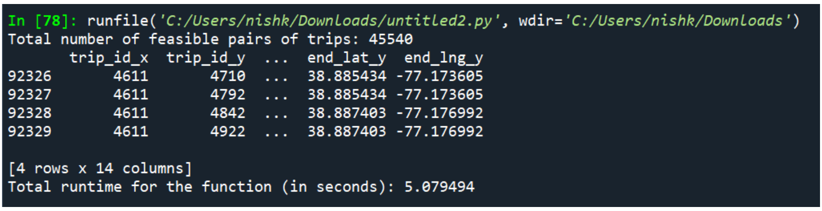
- The total number of feasible pairs of trips is printed.
- A new DataFrame containing feasible pairs of trips for trip ID 4611 is printed.
- The total runtime for the function is calculated and printed.



```
In [48]: feasible_pairs_4611.iloc[3,:]
Out[48]:
trip_id_x                        4611
started_at_x      2023-01-02 17:32:00
ended_at_x           01-02-2023 17:36
start_lat_x                 38.885621
start_lng_x                -77.166917
end_lat_x                   38.883601
end_lng_x                  -77.173438
trip_id_y                        4922
started_at_y      2023-01-02 17:54:00
ended_at_y           01-02-2023 17:57
start_lat_y                 38.883601
start_lng_y                -77.173438
end_lat_y                   38.887403
end_lng_y                  -77.176992
Name: 85603, dtype: object
```



```
In [41]: feasible_pairs_1733.iloc[0,:]
Out[41]:
trip_id_x                         1733
started_at_x       2023-01-02 10:02:00
ended_at_x            01-02-2023 10:13
start_lat_x                  38.899972
start_lng_x                 -76.998347
end_lat_x                    38.897108
end_lng_x                   -77.011616
trip_id_y                         1965
started_at_y       2023-01-02 10:57:00
ended_at_y            01-02-2023 11:09
start_lat_y                  38.897108
start_lng_y                 -77.011616
end_lat_y                    38.878854
end_lng_y                   -77.005727
Name: 30357, dtype: object
```



```
In [78]: runfile('C:/Users/nishk/Downloads/untitled2.py', wdir='C:/Users/nishk/Downloads')
Total number of feasible pairs of trips: 45540
       trip_id_x  trip_id_y  ...  end_lat_y  end_lng_y
92326       4611       4710  ...  38.885434 -77.173605
92327       4611       4792  ...  38.885434 -77.173605
92328       4611       4842  ...  38.887403 -77.176992
92329       4611       4922  ...  38.887403 -77.176992

[4 rows x 14 columns]
Total runtime for the function (in seconds): 5.079494
```

Question 1 Part 3

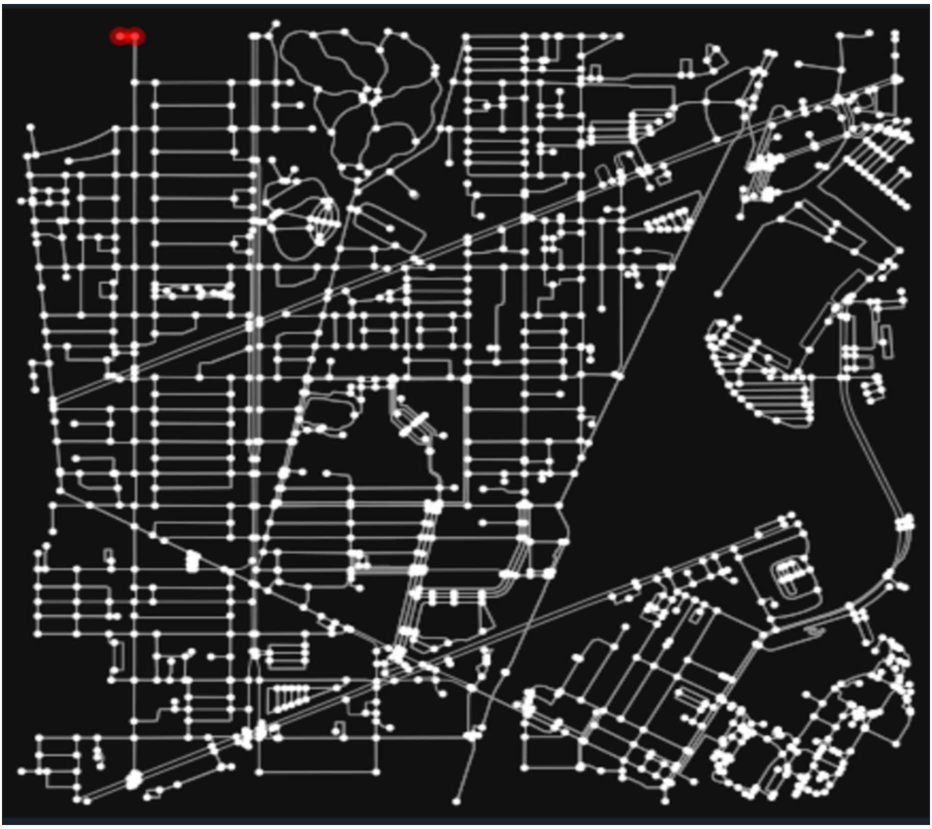
Analyzing the Data

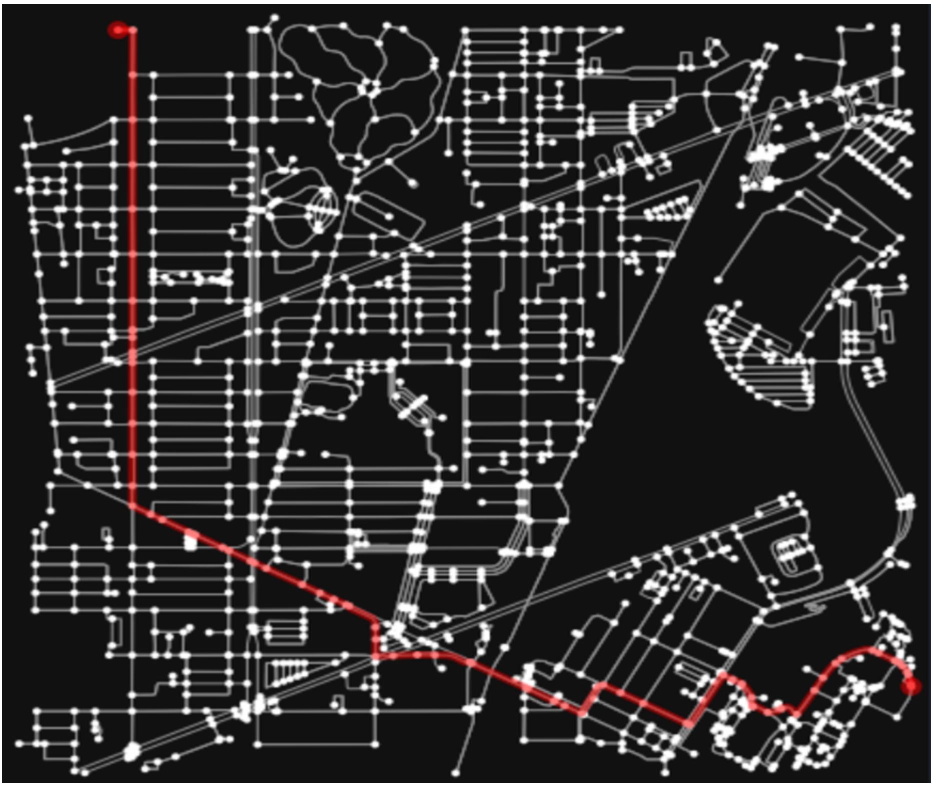
- The code reads a CSV file named *"bike_data_new.csv"* containing information about bicycle rides.
- The data has columns including start and end coordinates, start and end times, and trip IDs.
- The first 100 rows of the dataset are loaded and used for analysis.
- The unique depots are extracted from the start and end coordinates of the bike rides.
- The *OSMnx* package is used to create a street network graph for the first depot.

Program Logic

- The program reads in a CSV file and extracts the unique depots used by bike riders.
- For each depot, it finds the nearest node on the street network graph using the *OSMnx* package.
- The program then computes the shortest path between each pair of depots using the *bidirectional Dijkstra algorithm* from the *NetworkX* package.
- If there is no path between two depots, the distance is set to -1.

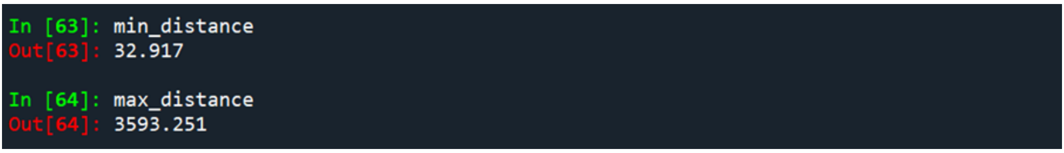
- The program then finds the pair of depots with the minimum and maximum distance between them and plots the shortest routes on the street network graph.



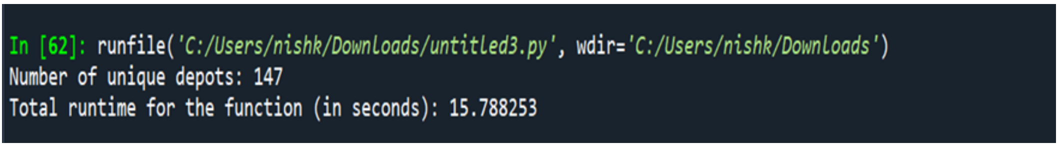


Output

- The program generates two plots showing the shortest routes between the pair of depots with the minimum and maximum distance between them.
- Total runtime for the function (in seconds) is also outputted.



```
In [63]: min_distance
Out[63]: 32.917

In [64]: max_distance
Out[64]: 3593.251
```



```
In [62]: runfile('C:/Users/nishk/Downloads/untitled3.py', wdir='C:/Users/nishk/Downloads')
Number of unique depots: 147
Total runtime for the function (in seconds): 15.788253
```