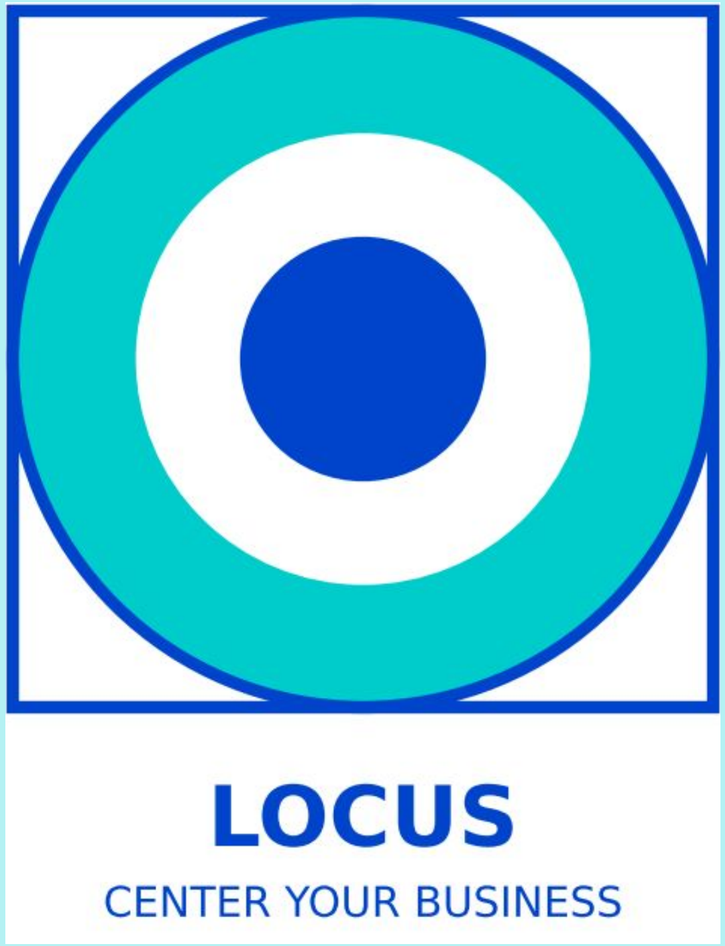
Project LOCUS

Locating Optimal Centerings by Understanding Stakeholders

By John Emmett Souder

- Operations Research and Financial Engineering (ORFE)
at Princeton, class of 2027

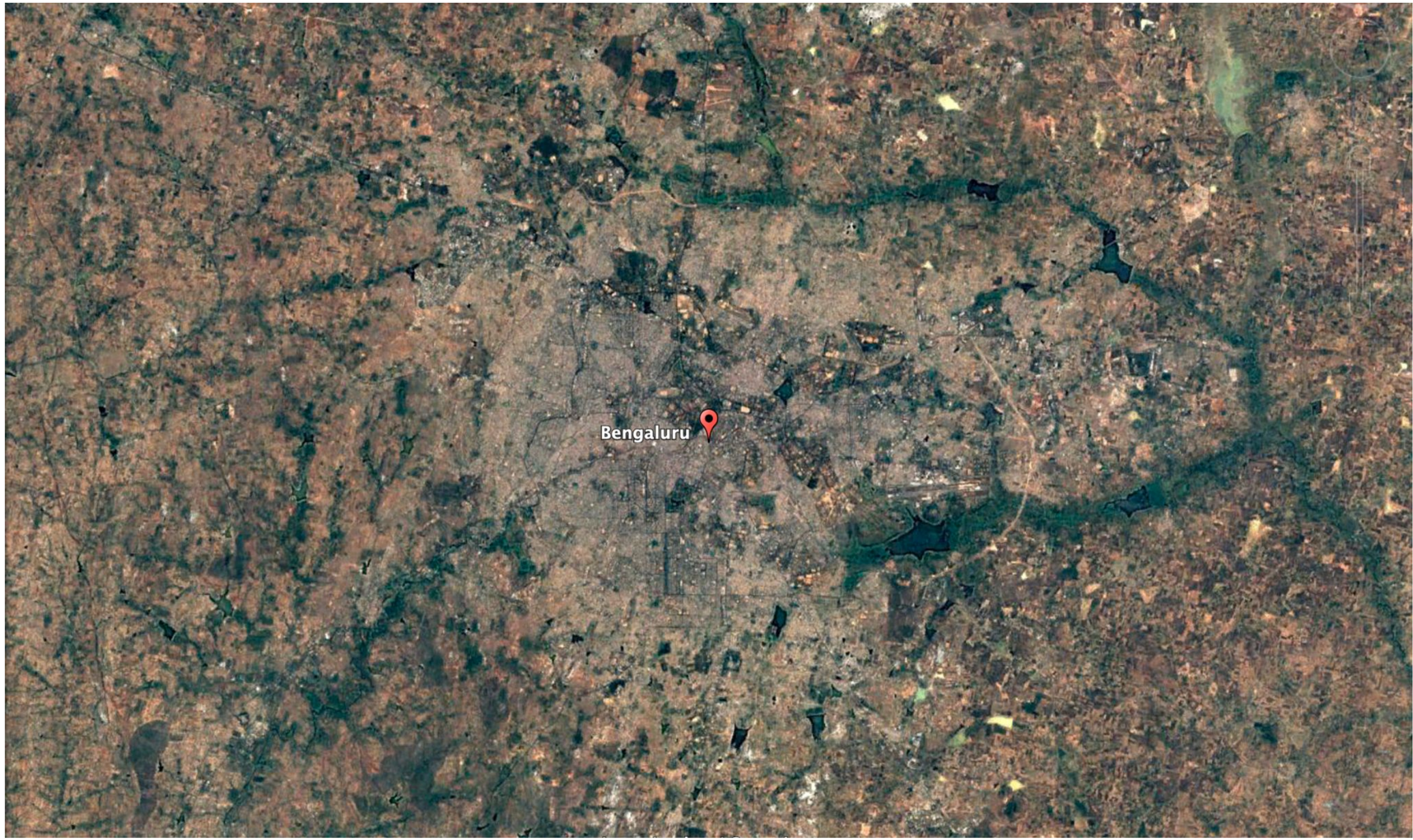
Jun'24-Aug'24



All employee data is made up as a proof of concept demonstration

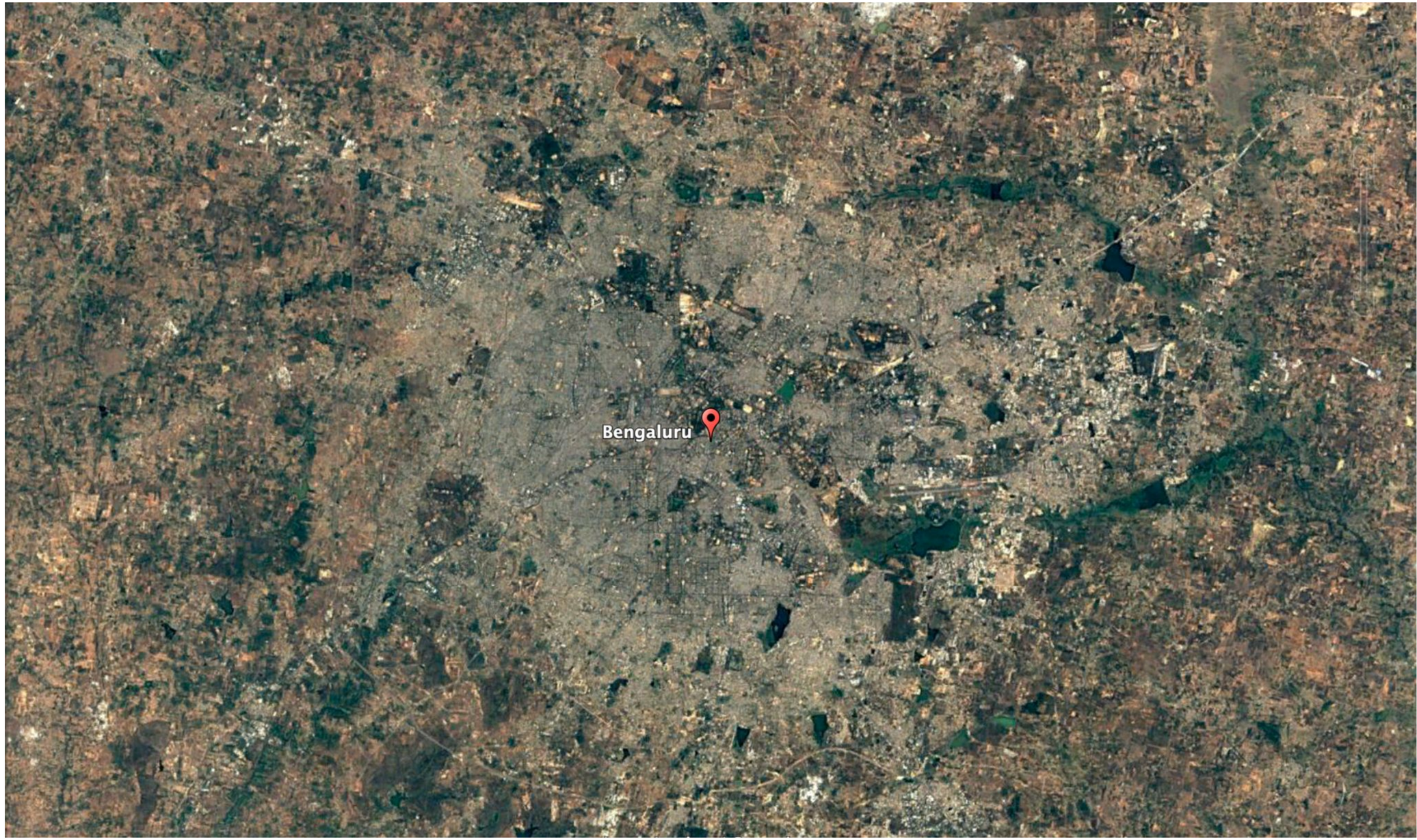
Week 3

2000



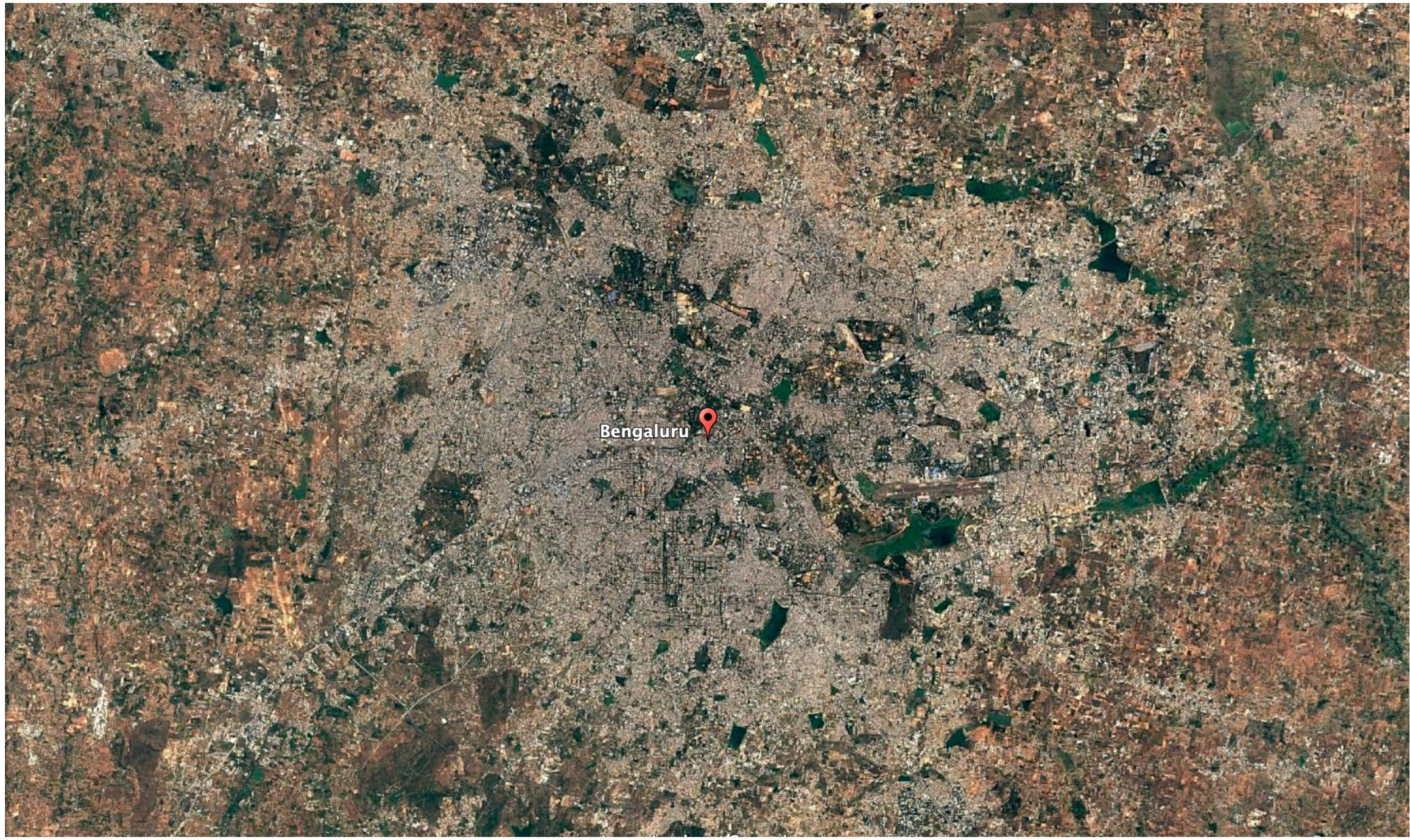
Week 3

2010



Week 3

2020



Section 1 of 7

Locus Survey

Thank you for your participation in a Locus Survey © !

This survey should take 5 minutes.

The goal of the Locus Tool is to understand all stakeholders and improve the employee experience, with a focus on commuting.

Index	Feature Name	Survey Question
0	don't need	Timestamp
1	Level	Level
2	Department	What department are you in?
3	Years w/ Company	How many years have you been with the company? For more detail, please use decimals. For example 3.5 (no need to write years).
4	Lat and Long	Latitude and Longitude
5	Pincode	What is you pincode? (optional)
6	Commute Time	How long, in minutes, is your current commute on average? Please enter only numbers
7	Commute Method	How do you commute?
8	Age	What is your age?
9	Gender	What is your gender?
10	Marraige	Are you married?
11	Children	How many children do you have?
12	Residence	Which do you live in?
13	Daycare Preference	Is having daycares / schools near your office important to you?
14	Shifting Preference	If your office considered shifting, would you like to stay living where you are?
15	Pincode Preference	Please enter the pincode of where you would like to live (optional)
16	Salary / WFO Preference	Would you prefer salary raises or more work from home option?
17	Managed by Indiqube?	Is your current office space managed by Indiqube?
18	Indiqube Rating	In your opinion, does your current Indiqube workplace provide an overall better employee
19	Frequency of app	How often do you use the MiQube app?
20	Usefulness of app	How useful do you find the MiQube app?
21	Sentiment	Write down any words you associate with Indiqube. (optional)
22	Suggestions	Do you have an feedback or suggestions for Indiqube? (optional)

Week 3

Today

If you can, avoid this road

Dug up pavements, Metro work, unrelenting traffic make Mysore Road a nightmare

Muthi-ur-Rahman Siddiqui

BANGALORE: Fifty-year-old Naga Gowda selling cigarettes near the Gopalan Mall on Mysore Road is on the edge whenever the volume of traffic increases near his petty shop.

The one-time mason started the shop after he could no longer toil to make a living. At times, however, he regrets the decision.

For, due to the heavy traffic, a daily phenomenon, several vehicles climb over the footpath endangering the lives of Gowda and many others.

"For me, it's become a daily nightmare. Irritated motorists often tower over the pavement risking our lives," Gowda said.

Gowda's case is just the tip of the iceberg of the widespread disgruntlement among the residents, shop owners, and motorists of Mysore Road.

No wonder, when *Deccan Herald* took stock of the traffic debacle on the stretch with the help of the citizens, everyone seemed to be agitated.

Nemathullah Haneedi, a resident, is very clear about what ails Mysore Road.

"First, the metro work was started around 10 months ago. Second, the roadside and footpaths have been dug up, chopped tree trunks have been plonked. Third, the BWSSB is [illegible] pipelines, make the stretch a living hell for the commuters," he said.

Problem accentuated

According to Haneedi, several heavy vehicles passing through the stretch also aggravate the problem. According to him, frustrated drivers of autorickshaws and lorries caught in traffic jams often quarrel with each other.

Reaching the City Market from Nayandahalli should not take more than 15 minutes. But, during the peak hours from 9 am to noon and 5 pm to 8 pm, motorists' patience is stretched to the breaking point when they cover the distance in an hour, A Chandrasekharan, a resident of Rajarajeshwarinagar, said.

Ramanna, an auto driver from Kumaraswamy Layout, says, "Coming to the City is a nightmare during the morning peak hours whereas heading out of it is a challenge in the evening." According to Ramanna, even the flyover often gets congested.

Standstill

Surendra, a shop owner near Kavika, gropes another reason for the congestion. "Last Monday, traffic was nearly blocked for four hours when a lorry turned turtle near BHEL Circle. Actually, even if a car gets stuck due to any technical reason, traffic comes to a standstill," he said.

The stretch has many problem to grapple with. Only hapless motorists know what it takes to tolerate the regular influx of lorries into a raw mill in Hosa Guddadahalli. Moreover, these heavy vehicles occupy half of the space on one side of the road.

For Mohan B N, a traffic constable attached with Byatarayanapura police station, regulating the traffic on the road is a "hell of an affair."

Mohan reports for duty at 7 am daily. The first two hours pass off smoothly. But come 9 am, his anguish begins and lasts till noon. Later, at 5 pm, another round of frustration awaits him.

Disgusted with the traffic woes, Chandrasekharan has a solution in mind. He says traffic mismanagement is the root cause.

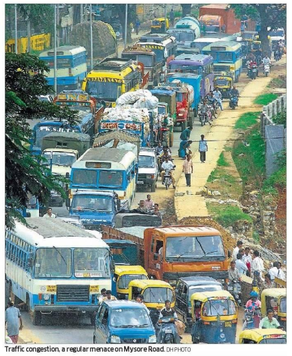
"Our tattoo buses should not be allowed to enter the City. They should depart from and arrive at the satellite bus stations only," he says.

DCP Traffic (West) Pandurang H Rane admits managing the situation is difficult.

"We are helpless. On one hand, the metro work is going on and on the other, the BWSSB is laying pipelines," he told *Deccan Herald*.

Rane, however, hopes the problem will be solved once the metro work is over. Till then, avoid Mysore Road, is his advice.

DH News Service



Traffic congestion, a regular menace on Mysore Road. DH PHOTO

Bengaluru: Metro work delayed at KR Puram due to this reason

By Yamini C S

May 04, 2022 01:46 PM IST

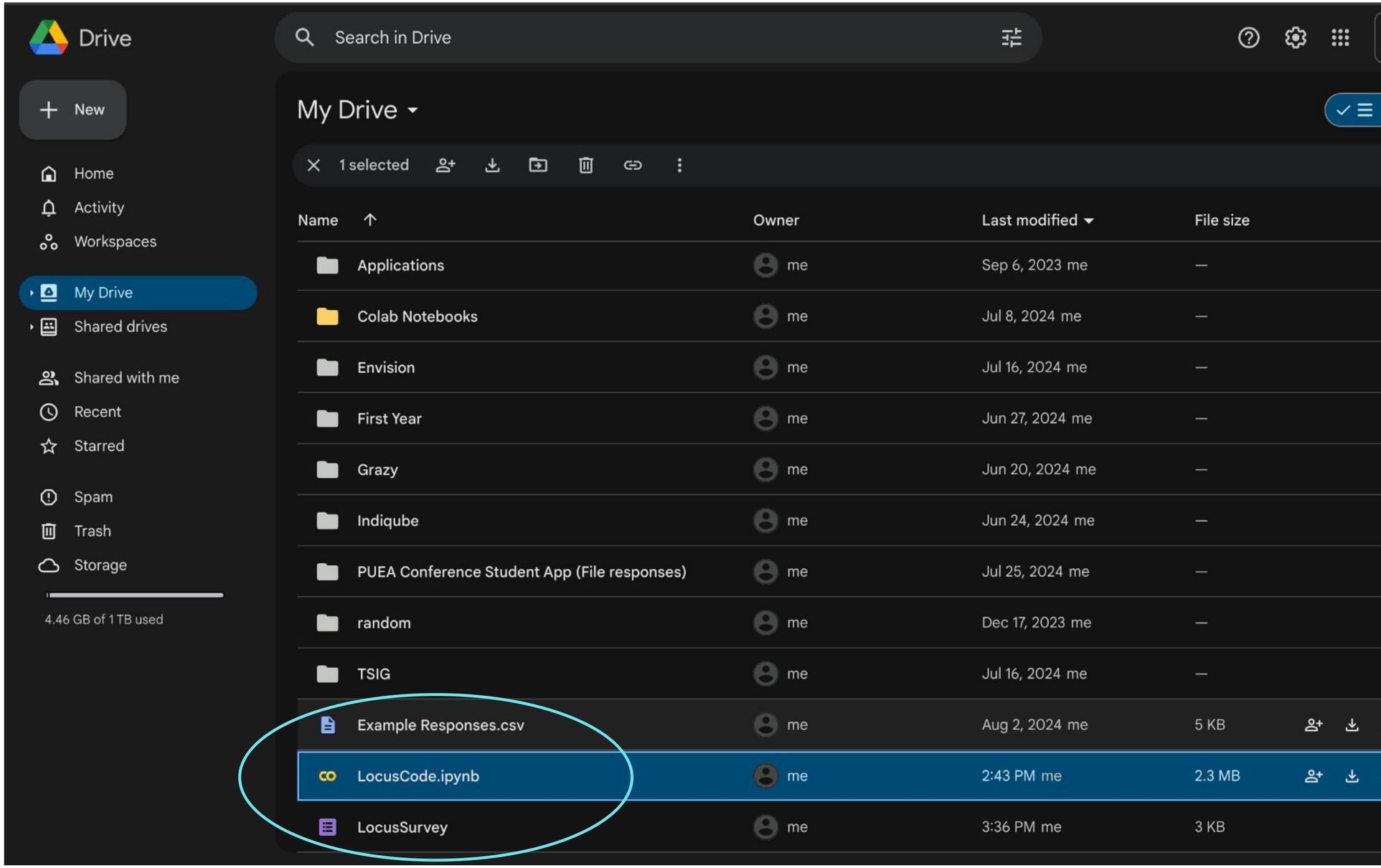
Play & Win

The Phase 2 project of Bengaluru's Namma Metro will likely be delayed further due to civil work undertaken at the area like shifting of gas pipelines, which will affect the highly-anticipated Silk Board to K R Puram line.

BMRCL labourers at work for the second construction phase on Namma Metro Rail network in Bengaluru. (File photo)

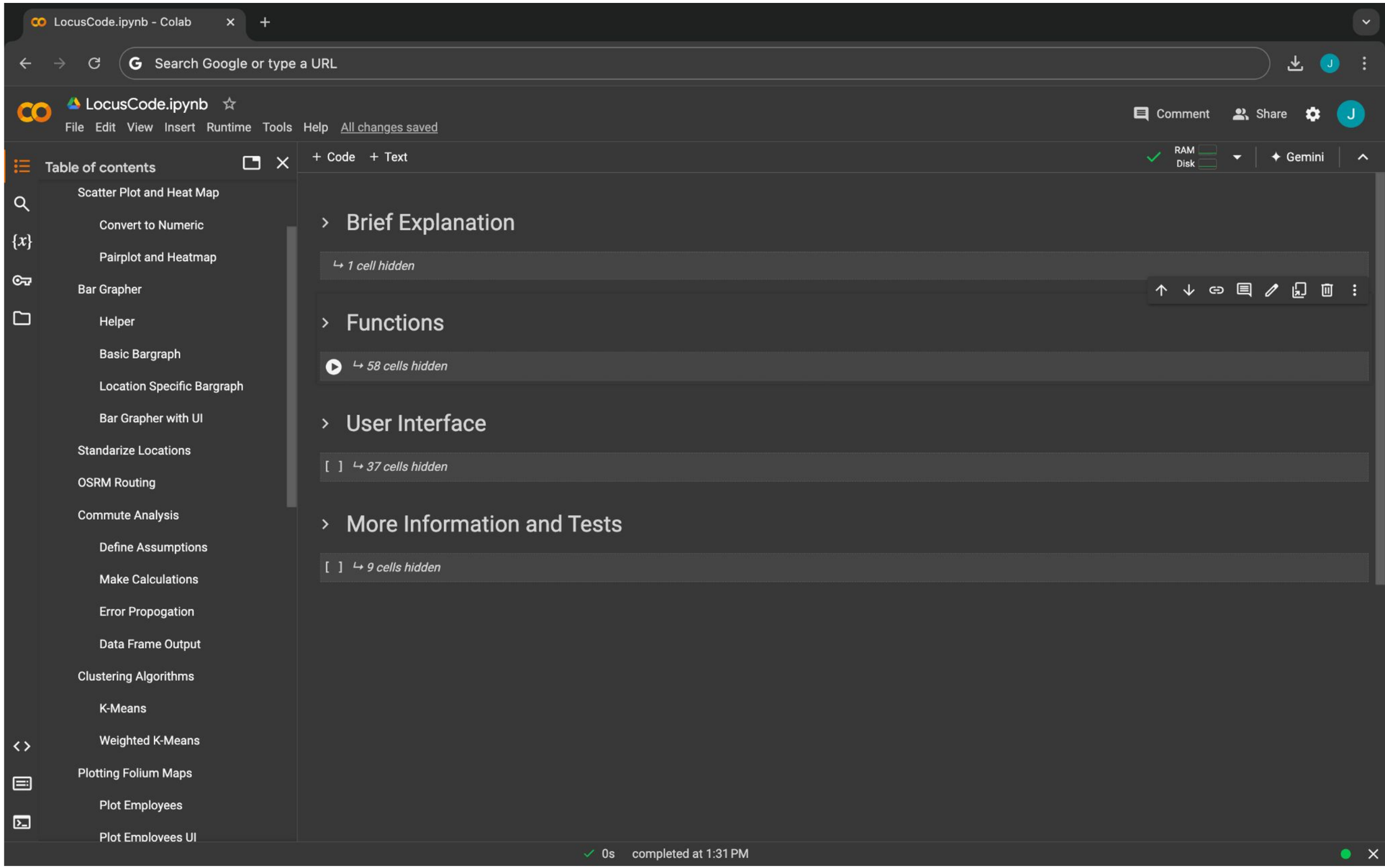
Week 9

Python Notebook in Google Colab



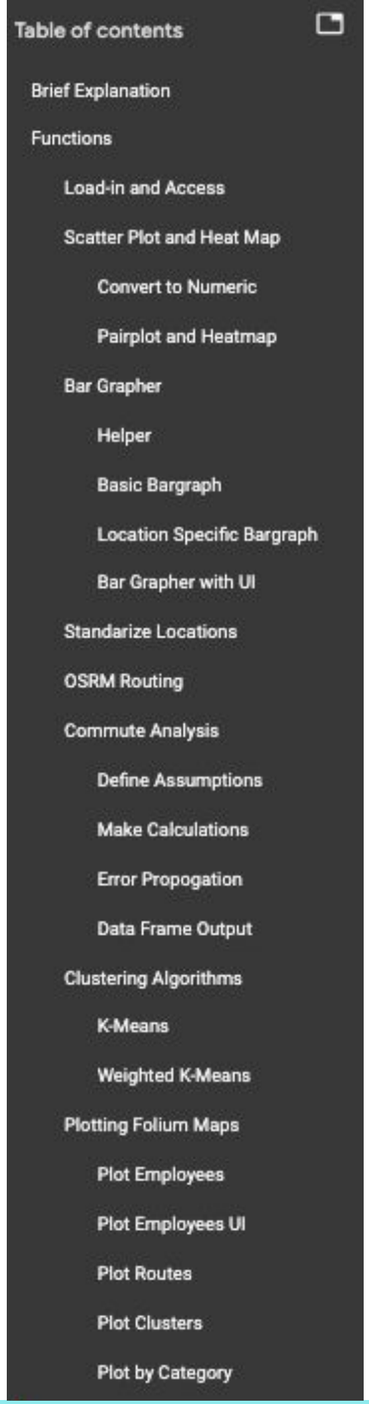
Week 9

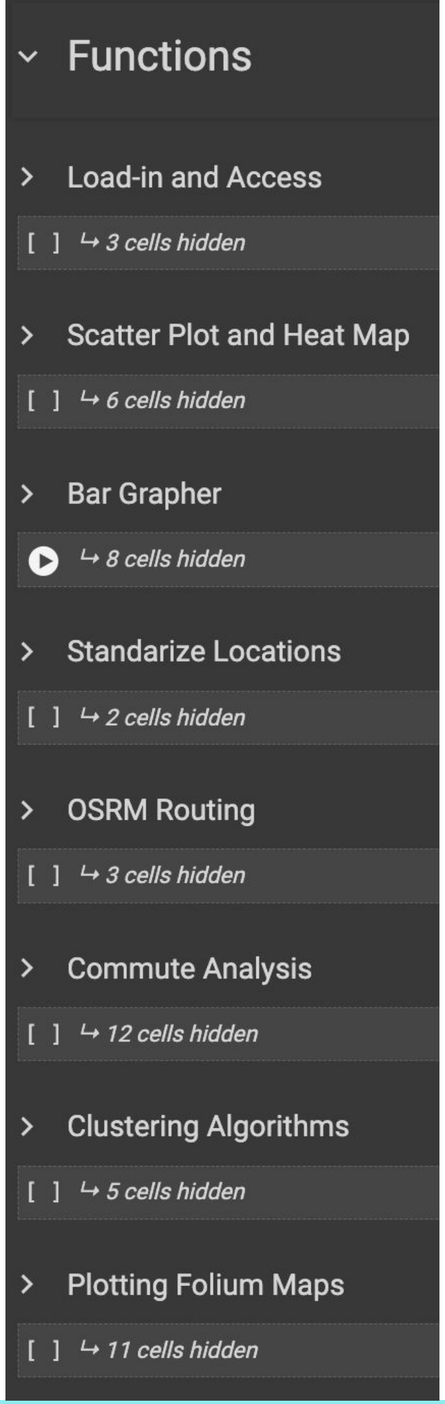
Open the File

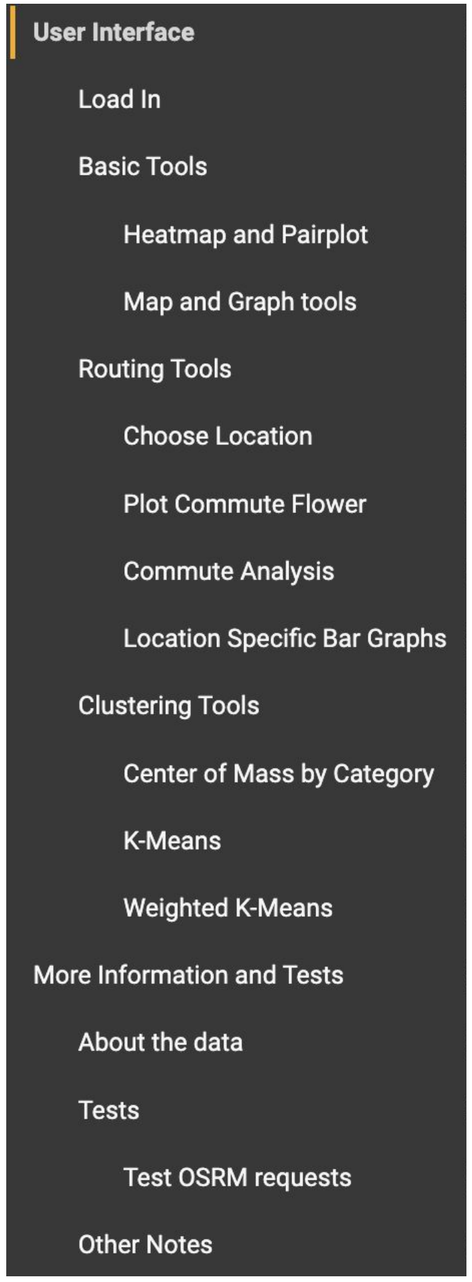


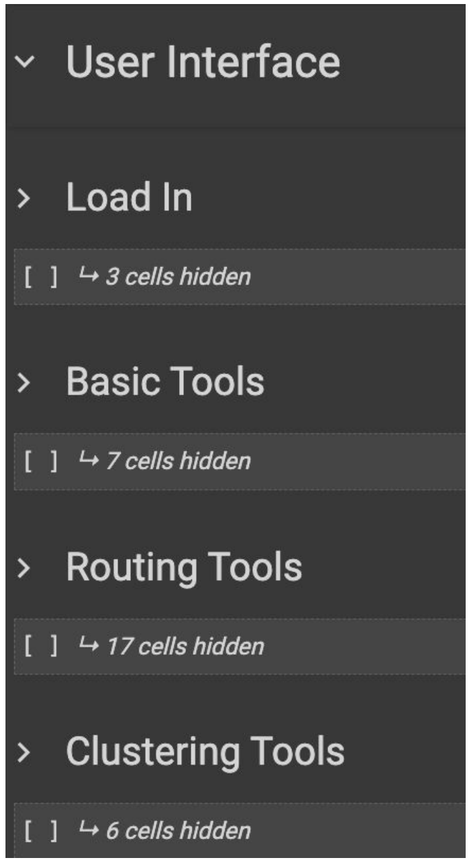
Week 9

Format









Week 9

Getting Started

User Interface

Load In

```
[312] surveyfilename = "Example Responses.csv"
```

```
[315] df = load_in(surveyfilename)
```

```
Mounted at /content/drive
```

```
[326] df.head(2)
```

	Time	Level	Department	Years w/ Company	Lat and Long	Pincode	Commute Time	Commute Method	Age	Gender	...
0	7/23/2024 12:30:11	Non executive	Marketing	0.25	12.929219184155466, 77.62771079999999	NaN	30	Two wheeler EV	20	Man	...
1	NaN	Non executive	IT	1.50	12.950795517102389, 77.61704047253774	NaN	40	Two Wheeler EV	24	Man	...

2 rows × 23 columns

Basic Tools

Week 9

Getting Started

User Interface

Load In

```
[312] surveyfilename = "Example Responses.csv"
```

```
[315] df = load_in(surveyfilename)
      # df.head()
```

```
Mounted at /content/drive
```

```
[317] df['Level'].unique()
```

Show hidden output

Basic Tools

Heatmap and Pairplot

```
[52] num_df = numeric(df)
     # num_df.head()
```

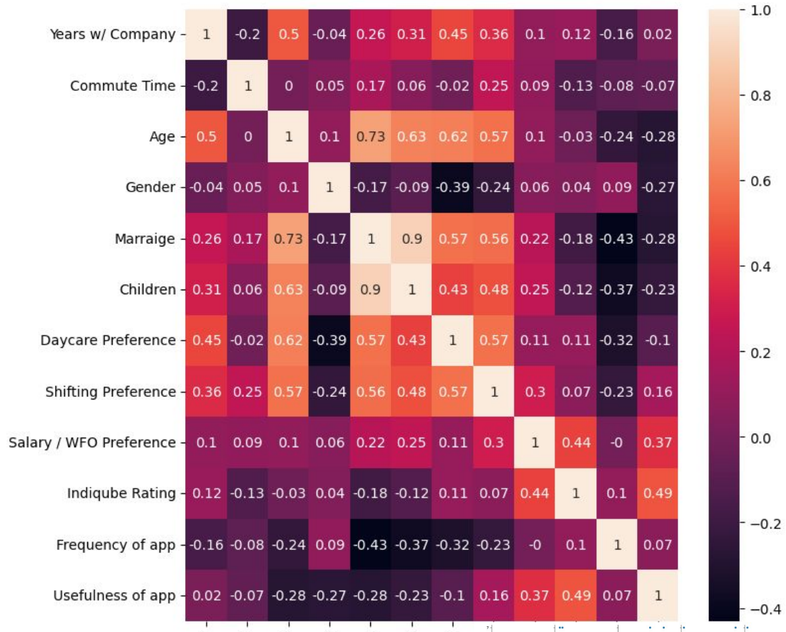
```
[53] heatmap(num_df)
```

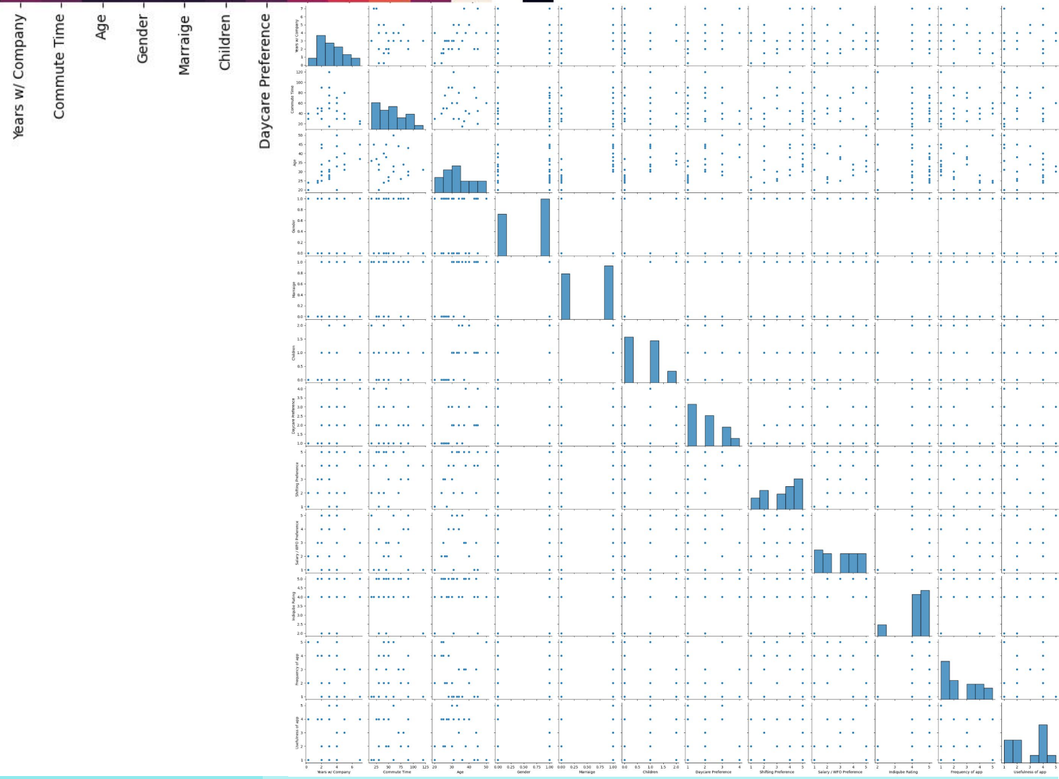
Show hidden output

```
[54] pairplot(num_df)
```

Show hidden output

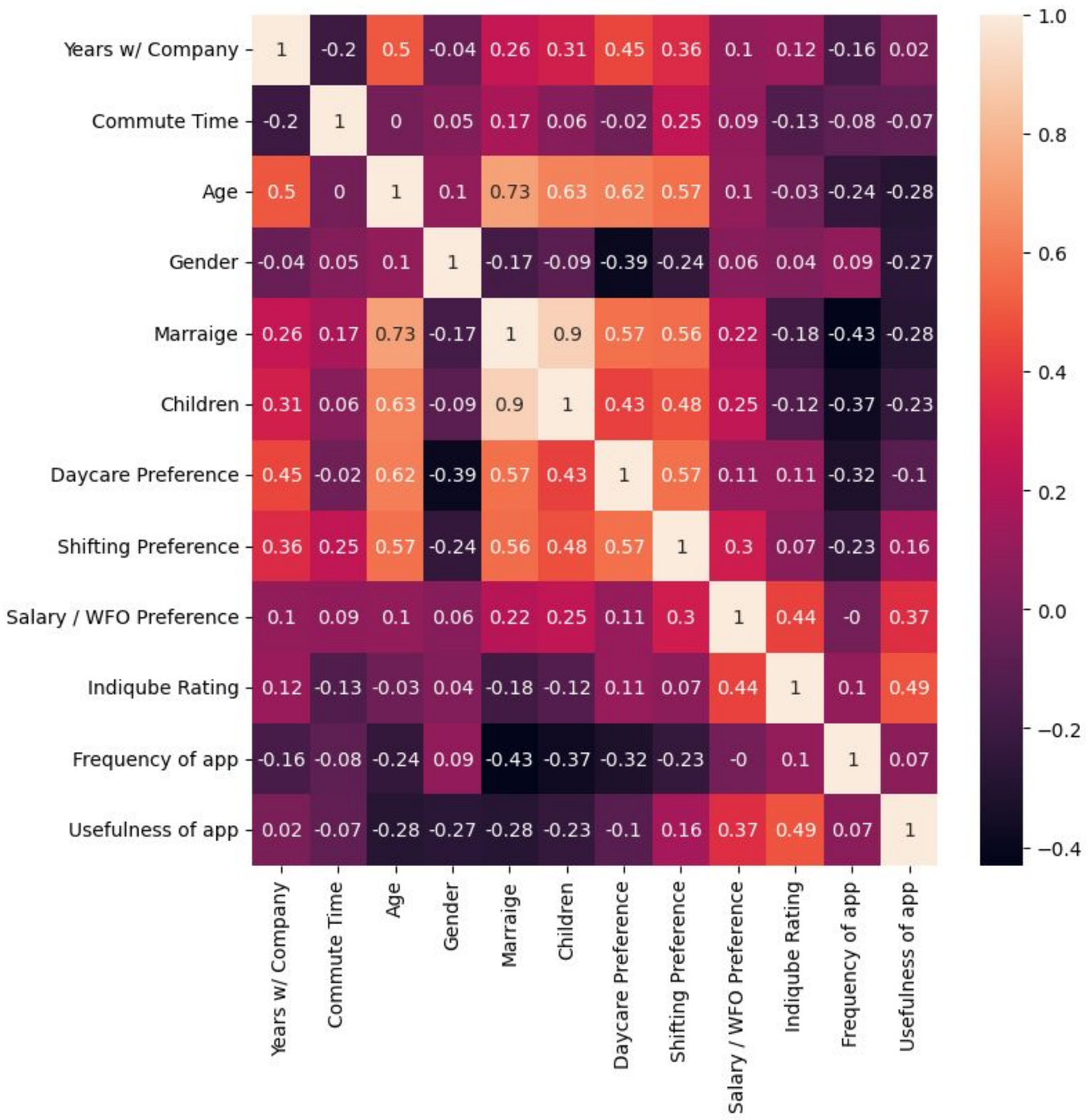
Map and Graph tools





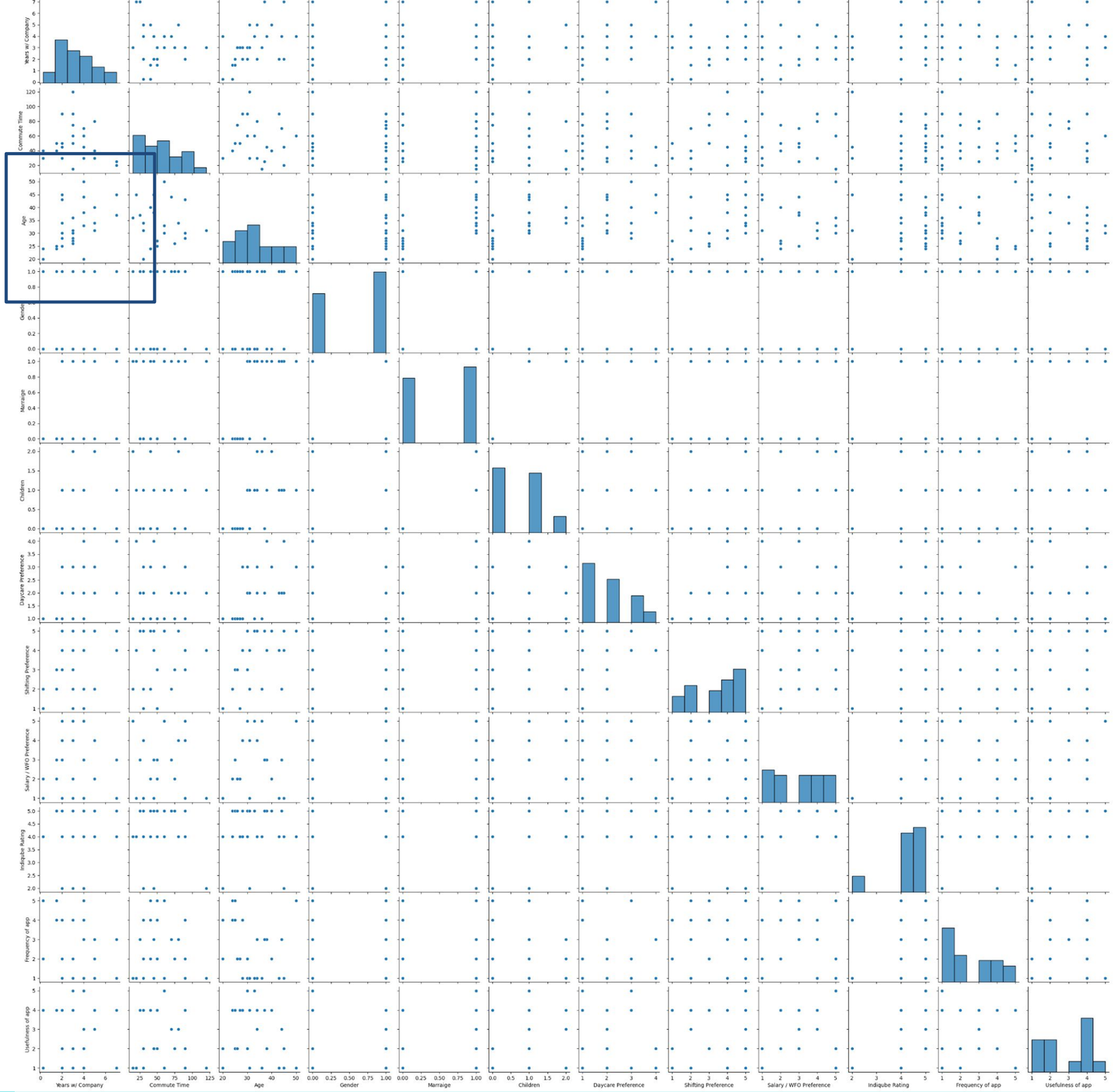
Week 9

Heat Map



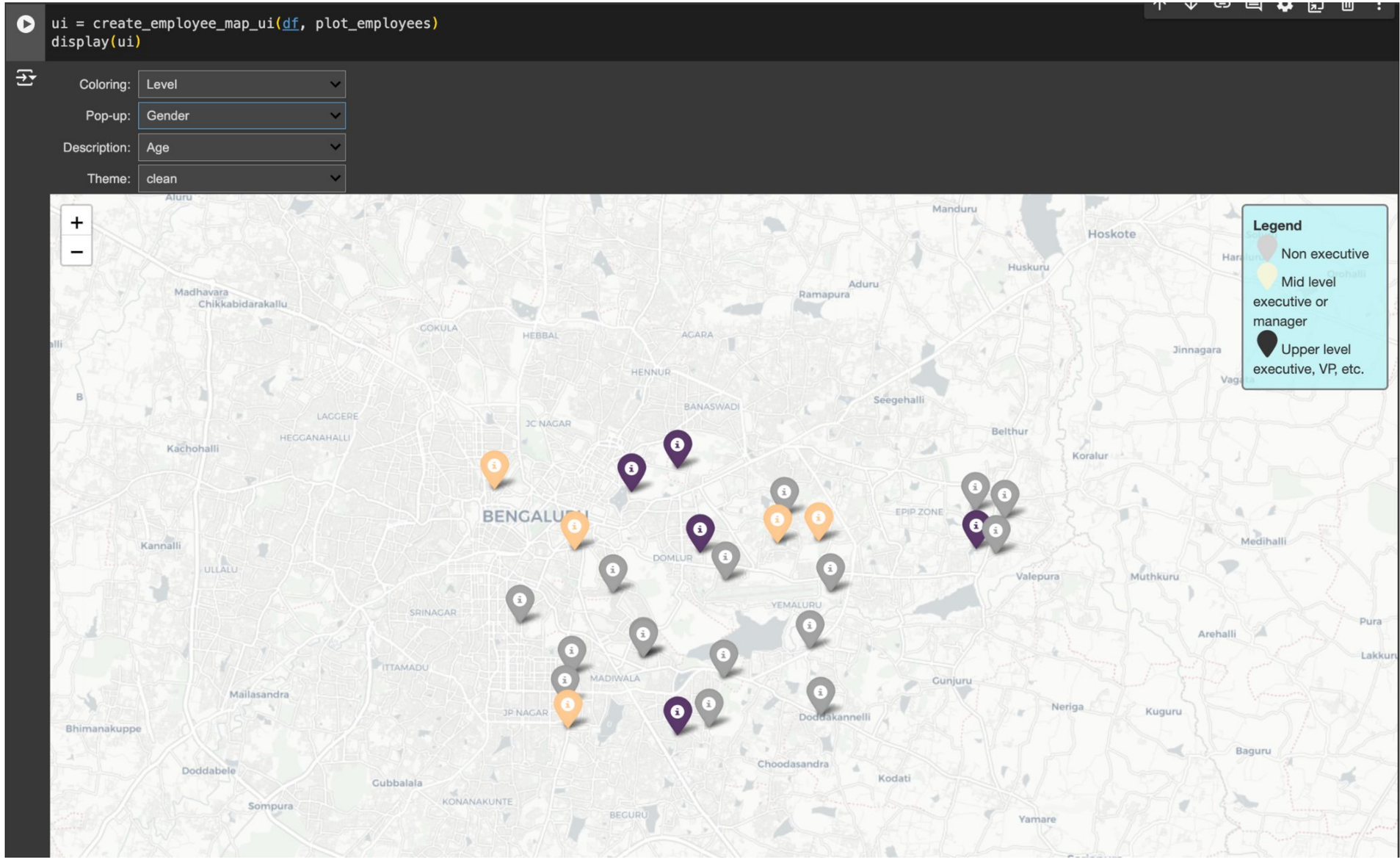
Week 9

Pairplot



Week 9

Employee Mapping Interface



Week 9

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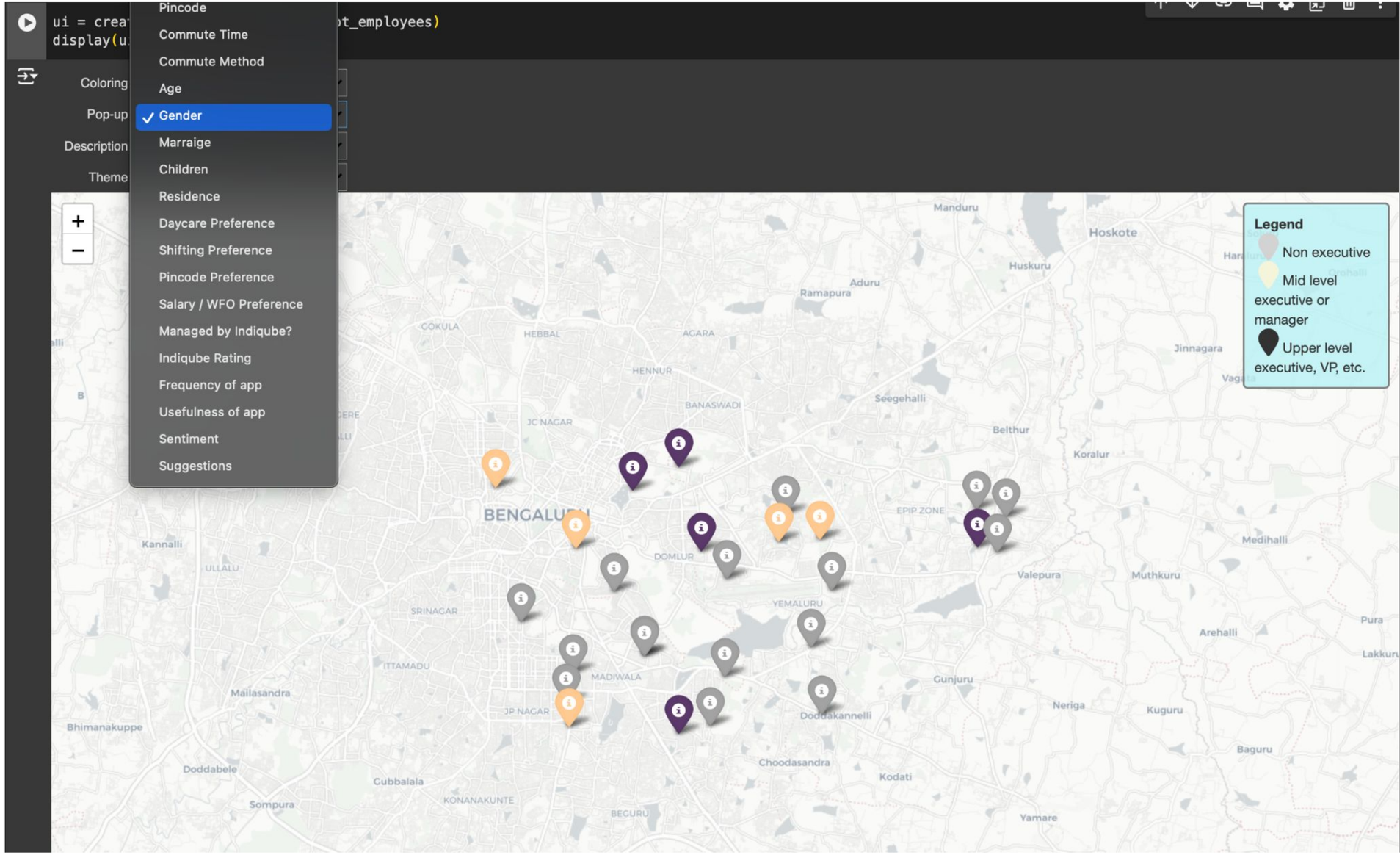

Week 9

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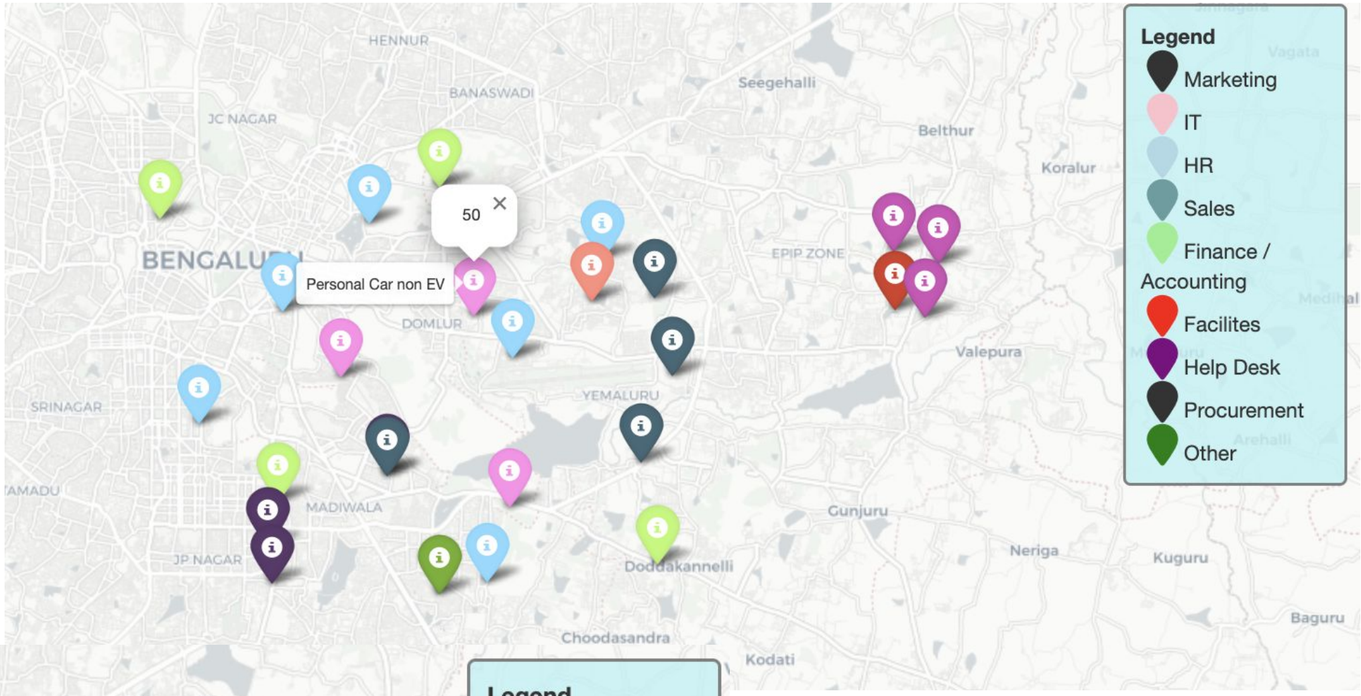
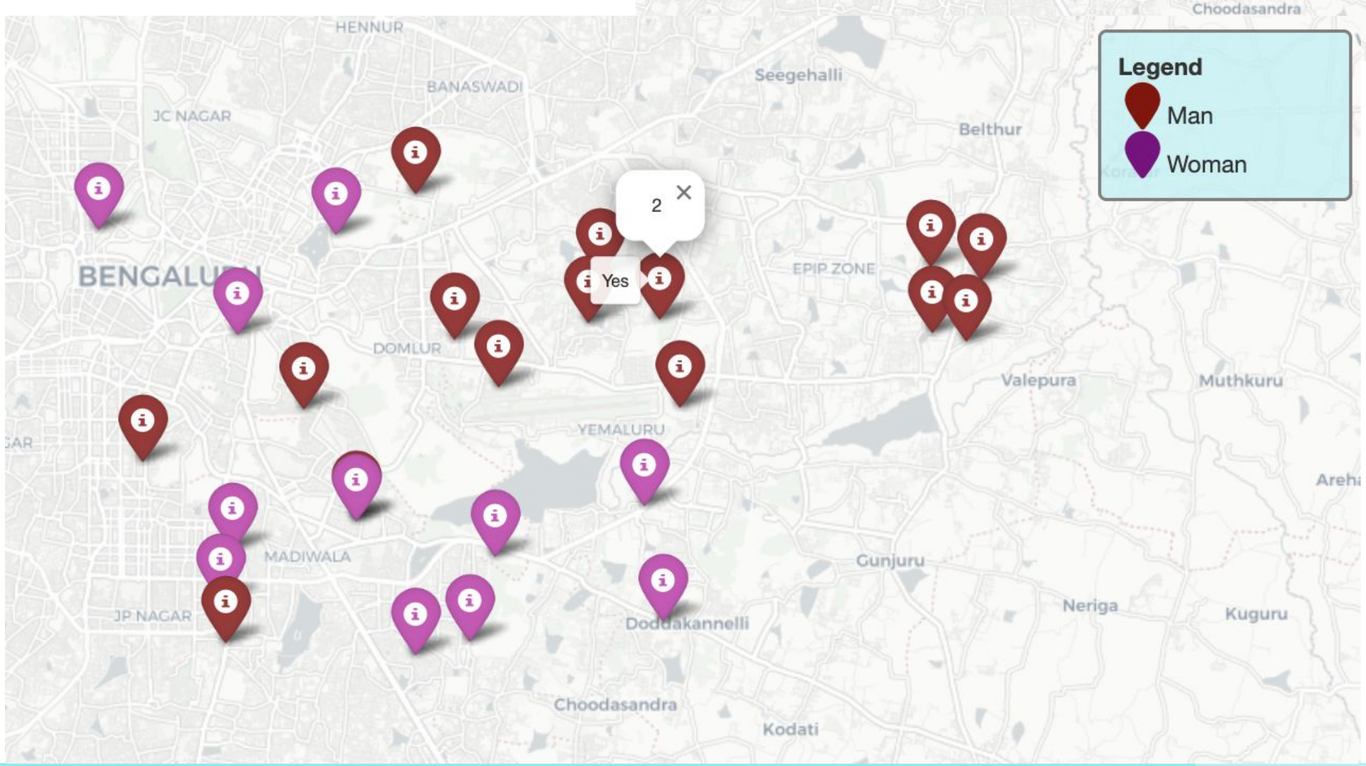
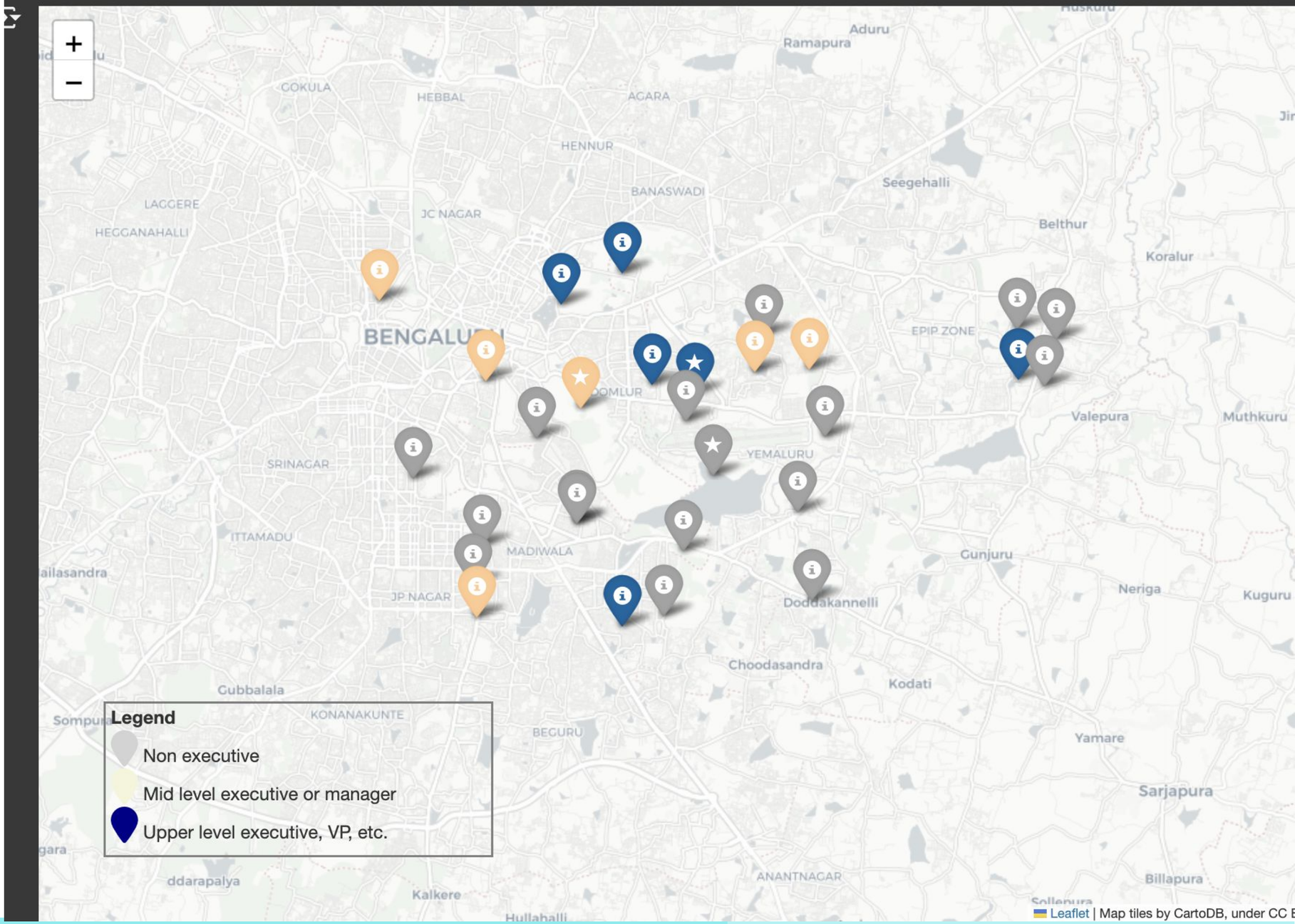




Week 9

Center of Mass by Category

```
coms_map = plot_by_category(df, "Level", geocenter, 12, 'clean')
coms_map
```



Week 9

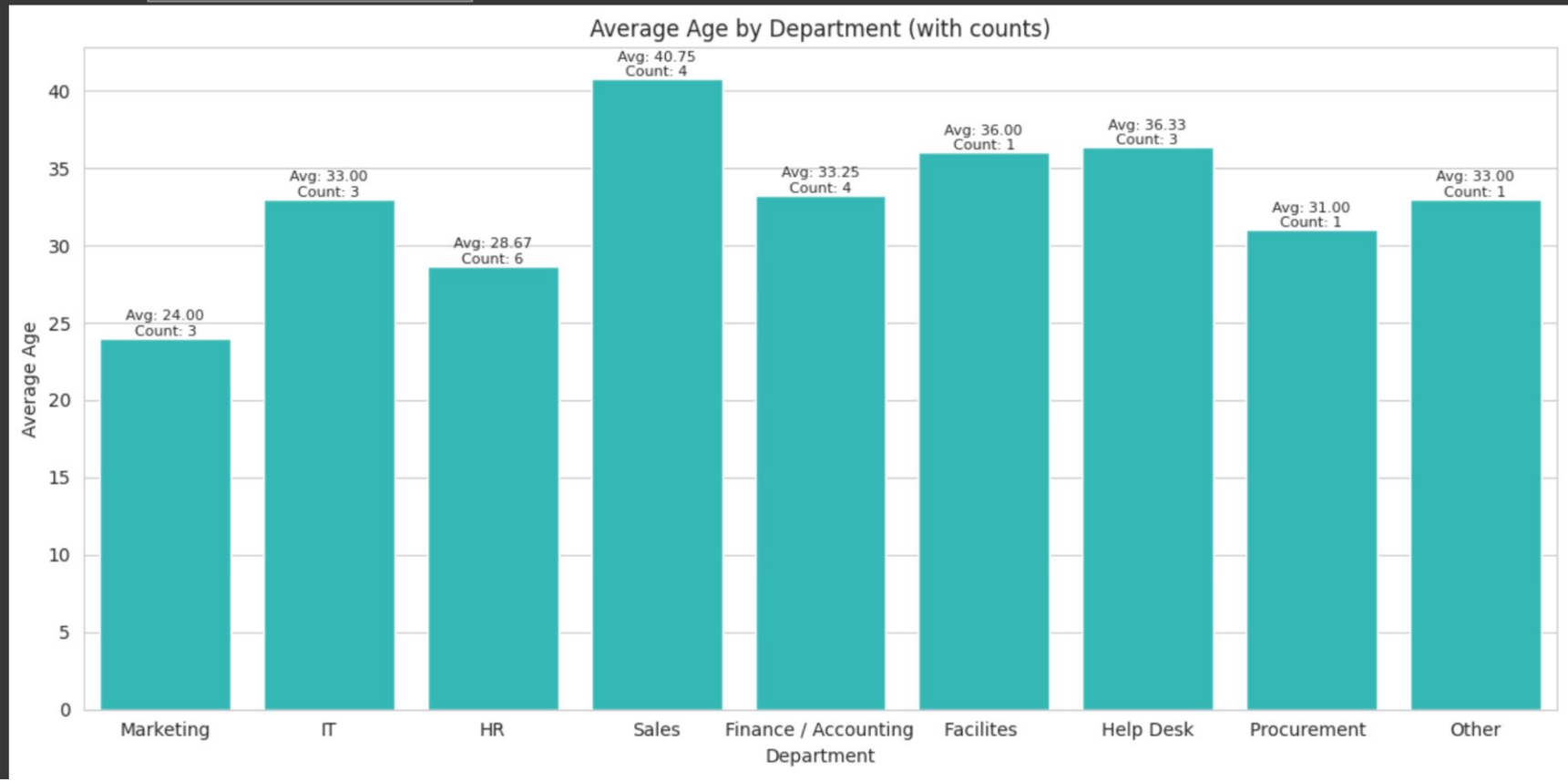
Interactive Bar graph

```
interactive_bargraph(df_to_show)
```

Categories: Department

Value: Age

Title:



Week 9

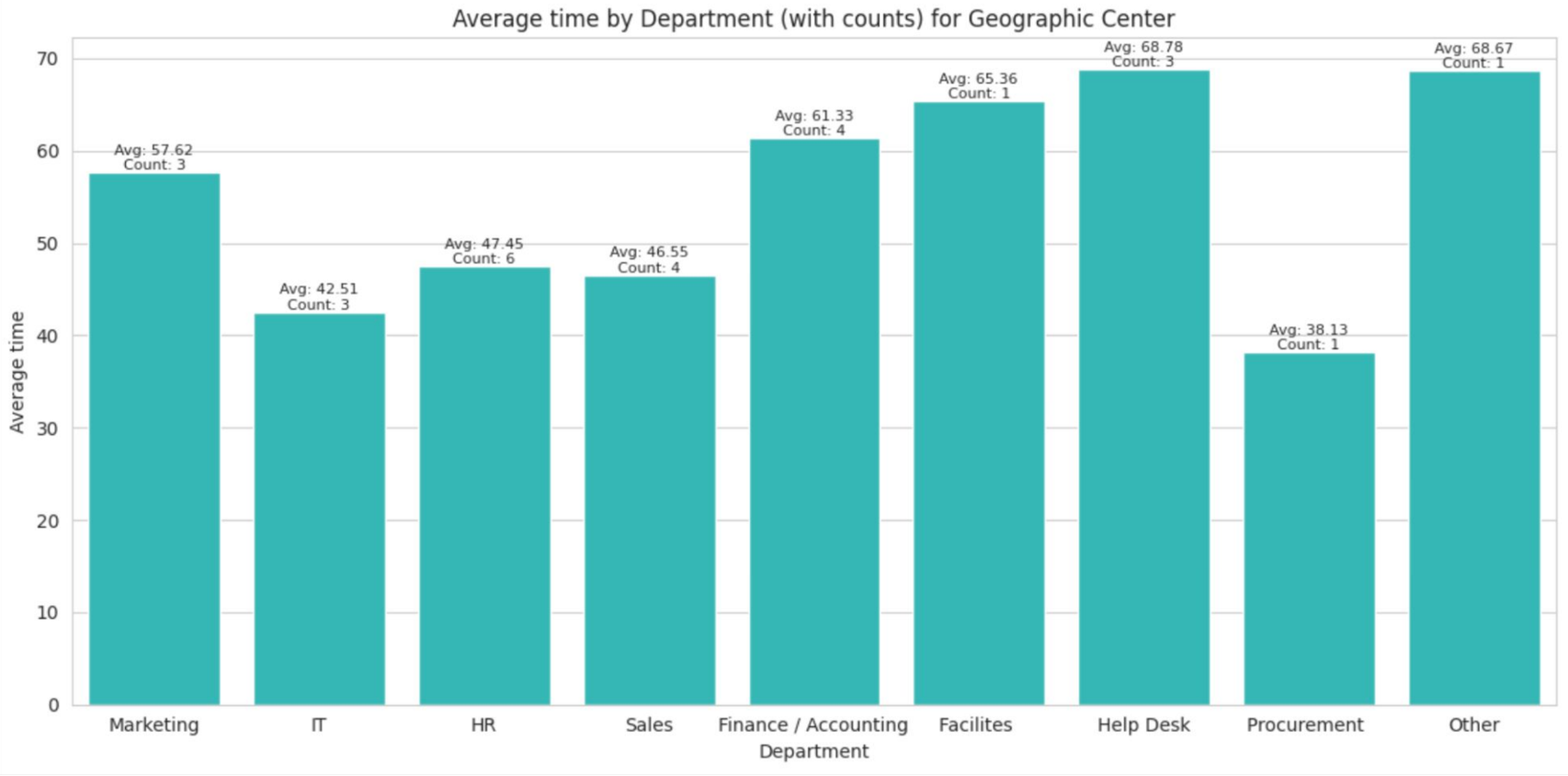
Interactive Bar graph - With Test Centering Specific Variables

```
interactive_bargraph(df_to_show)
```

Categories: Department

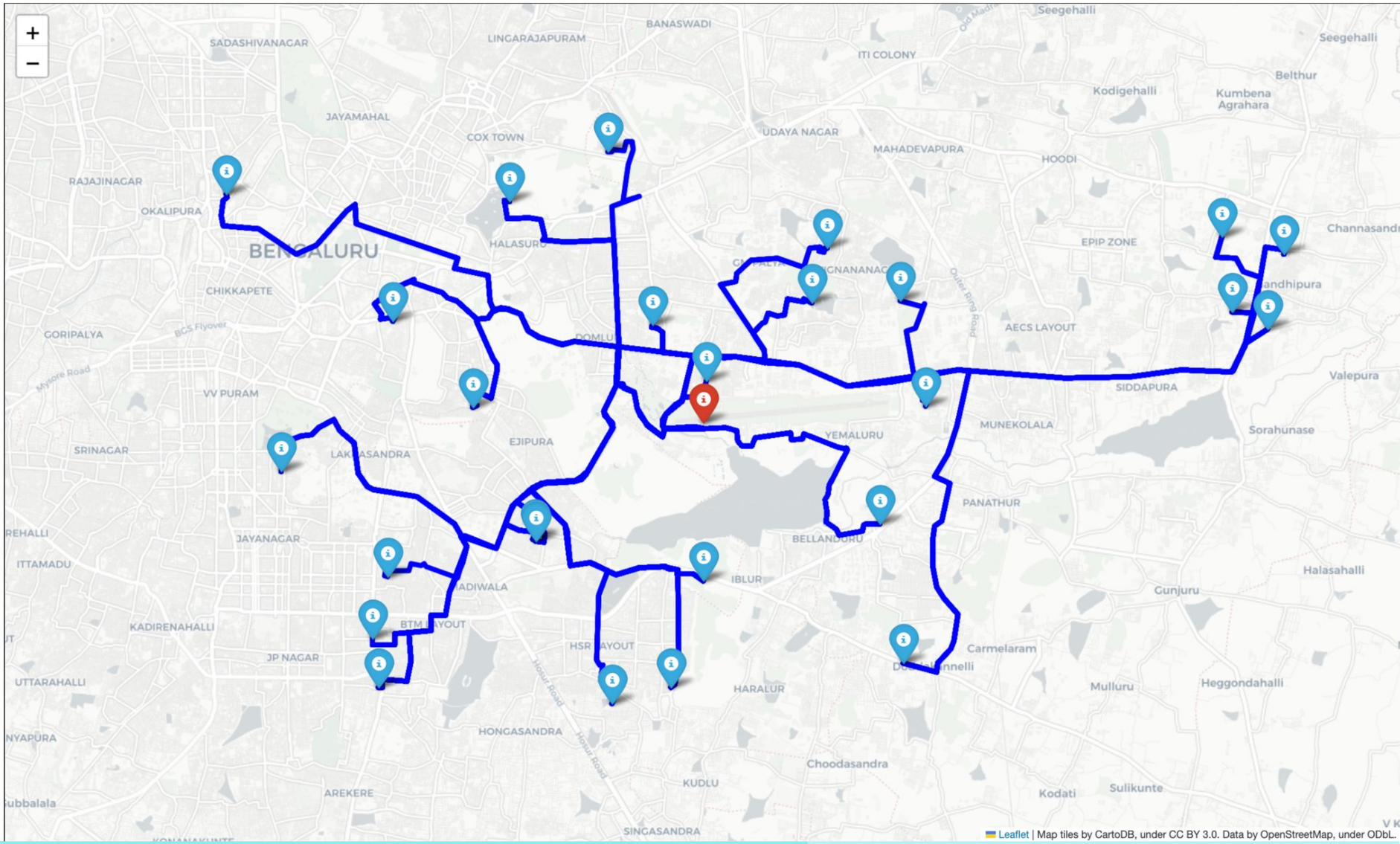
Value: time

Title: for Geographic Center



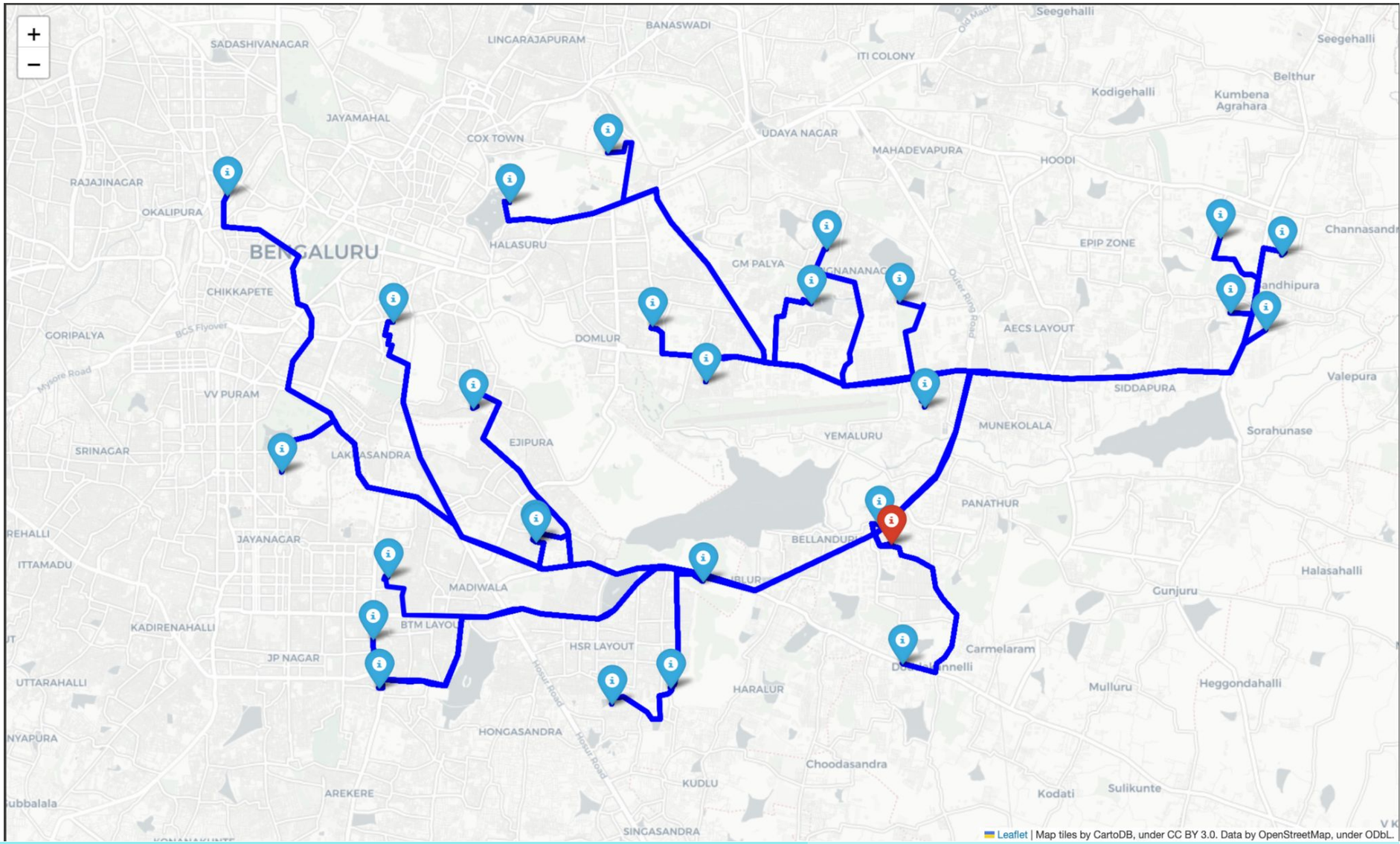
Week 9

Route to Geographic Center



Week 9

Route to Corporate Office



Week 9

Analyze Commute Differences

	Measure	For Geographic Center	For Corporate Office	Difference
0	total time spend commuting (hours e/ day)	46.50	48.74	2.240
1	mean commute time (minutes)	53.66	56.24	2.580
2	median commute time (minutes)	56.45	60.47	4.020
3	total distance (km a/ day)	523.25	525.29	2.040
4	mean commute distance (km)	10.06	10.10	0.040
5	median commute distance (km)	10.22	10.64	0.420
6	total emissions (kgs e/ year)	51783.44	57446.74	5663.300
7	emissions error margin (kgs e/ year)	5980.32	6535.61	6257.965

$$\frac{\frac{57}{10}(.4)(28)(2)(6)(50)}{60} = 638.4$$

$$2.2(6)(50) = 660$$

Week 9

Analyze Commute Differences

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Week 9

K means

1. Initialize **cluster centroids** $\mu_1, \mu_2, \ldots, \mu_k \in \mathbb{R}^n$ randomly.
2. Repeat until convergence: {

   For every i, set

   $$c^{(i)} := \arg\min_j ||x^{(i)} - \mu_j||^2.$$

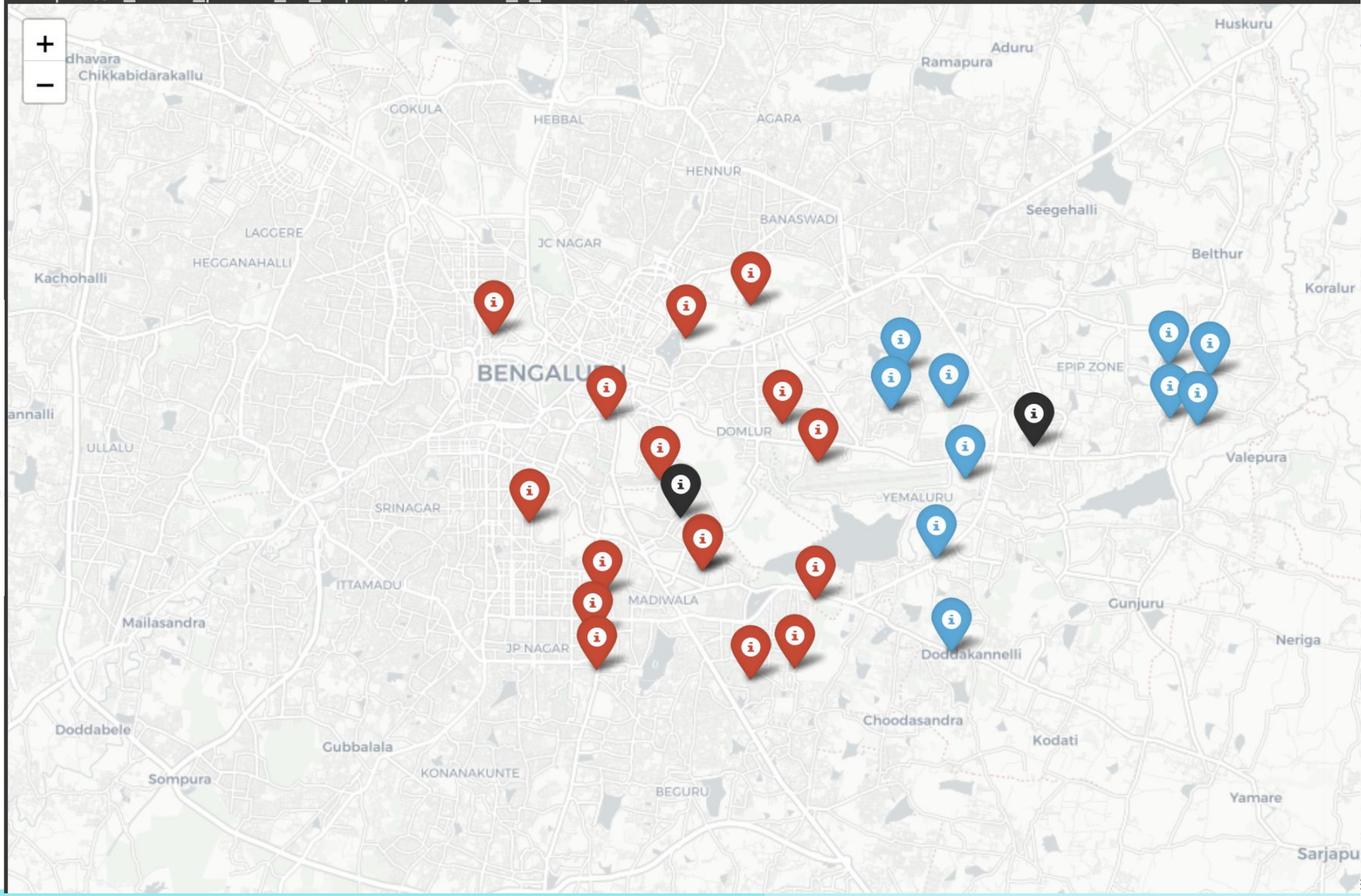
   For each j, set

   $$\mu_j := \frac{\sum_{i=1}^{m} 1\{c^{(i)} = j\} x^{(i)}}{\sum_{i=1}^{m} 1\{c^{(i)} = j\}}.$$

   }

```
labels, centroids = Kmeans(points)
cluster_map = plot_clusters(points, geocenter, labels, centroids,'clean')
cluster_map
```

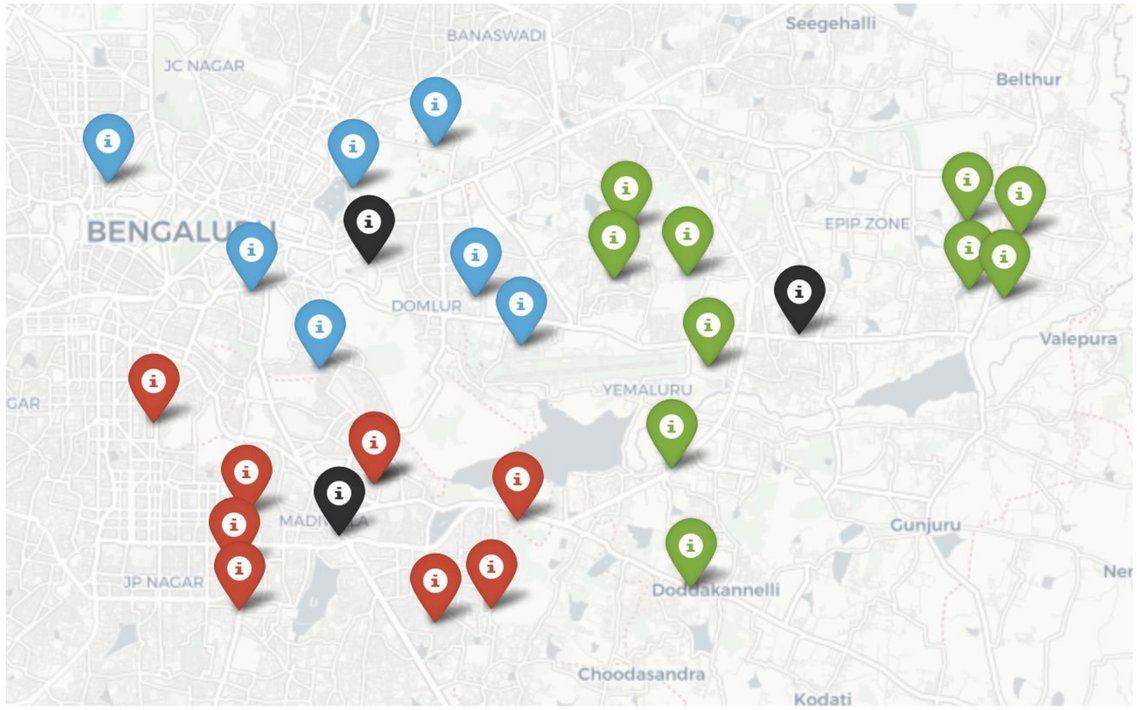
```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:1416: FutureWarning: The default value of `n_init`
  super()._check_params_vs_input(X, default_n_init=10)
```

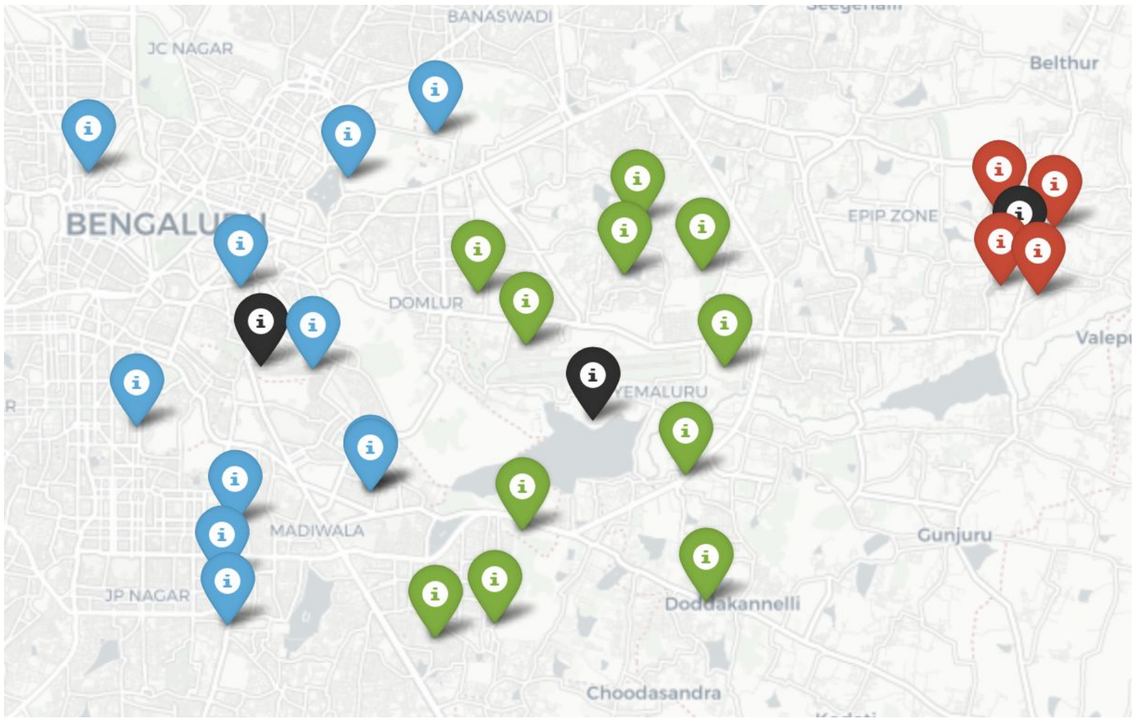


Week 9

Weighted K means

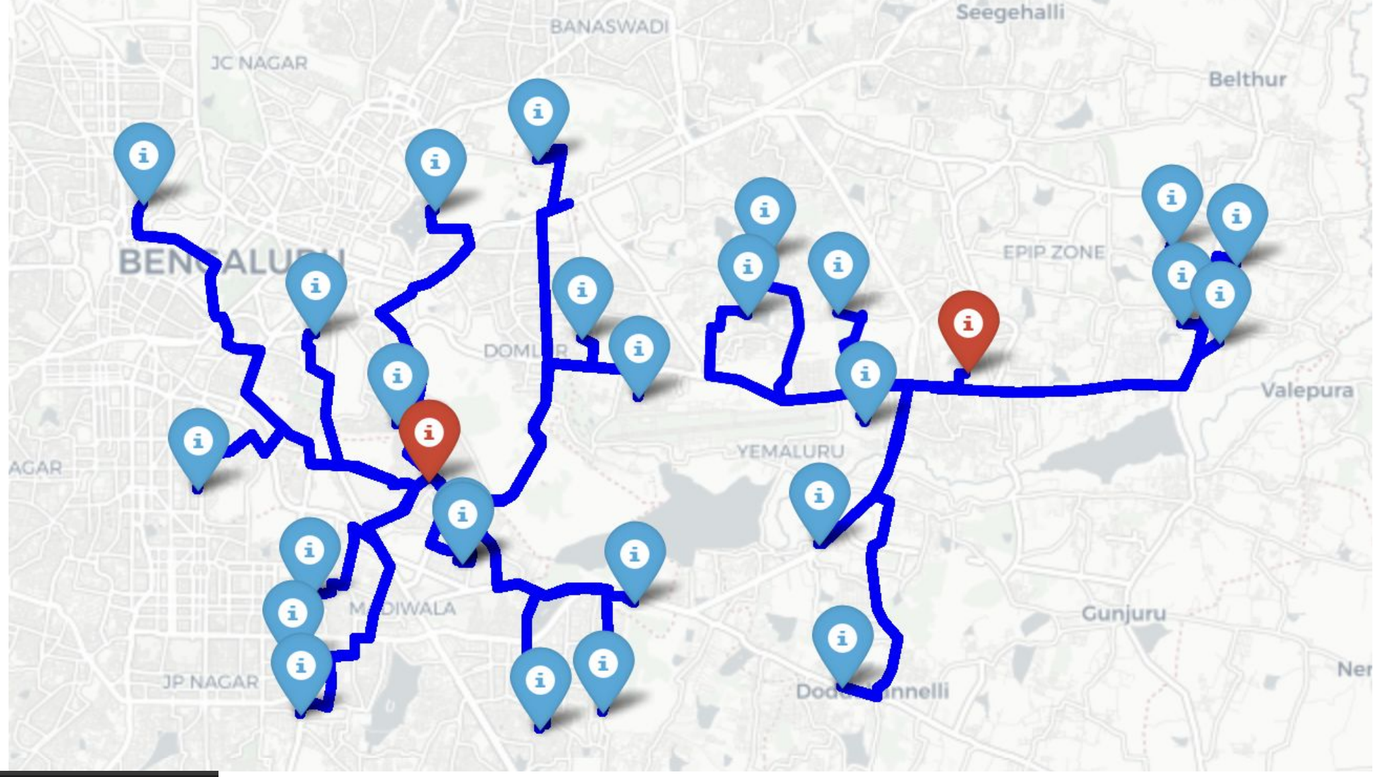
```
weights = list(df['Shifting Preference'])

n_clusters = 2
max_iterations = 5
n_repetitions = 5

labels, centroids = claudes_weighted_kmeans(points,weights,n_clusters, max_iterations, n_repetitions, standard_distan
cluster_map = plot_clusters(points, geocenter, labels, centroids,'clean')
cluster_map
```





Week 9

How much would clustering help?




```
[115] compare_cluster_df = create_the_comparison_df(results2, results3)
      compare_cluster_df
```

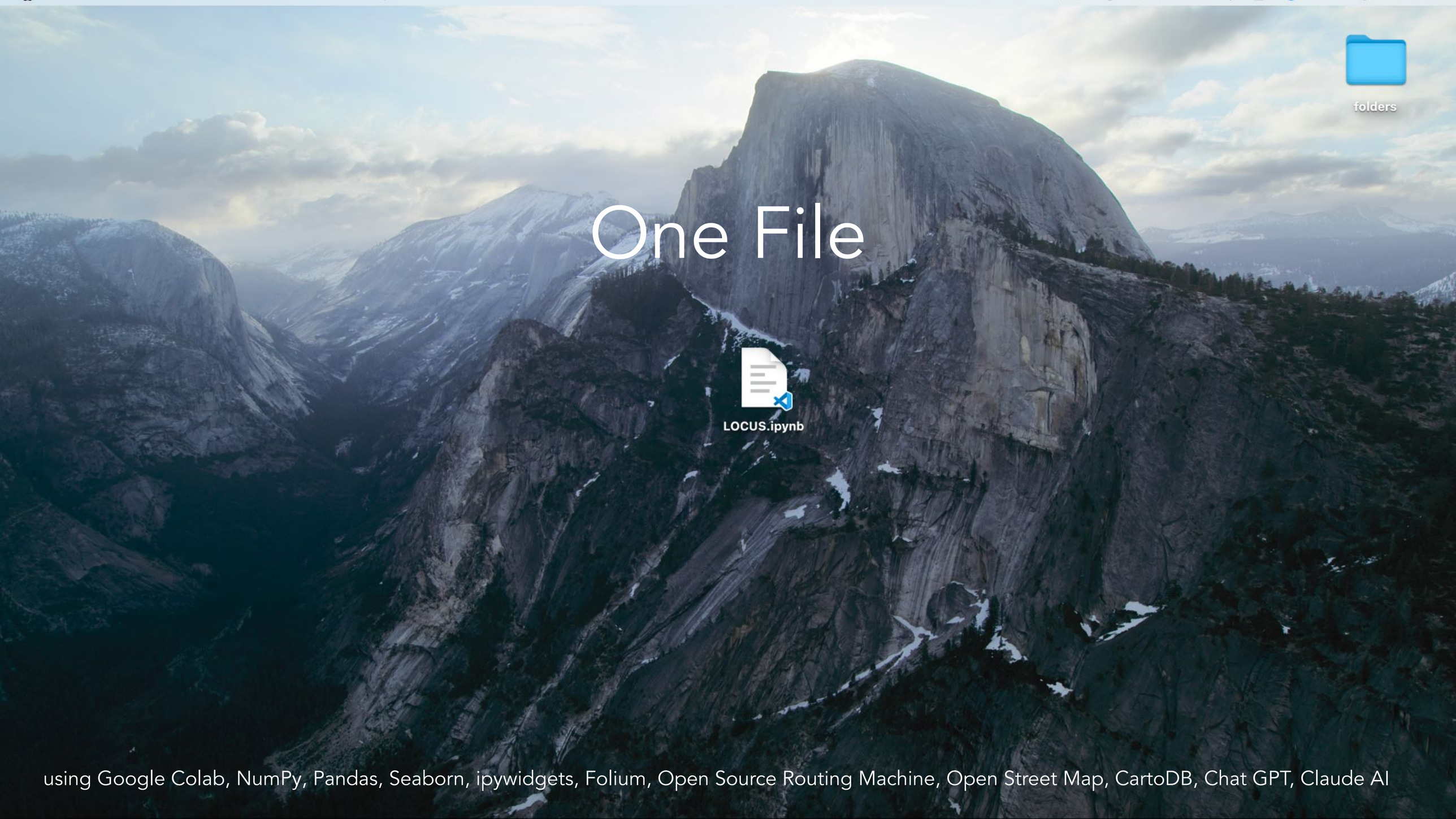
0s

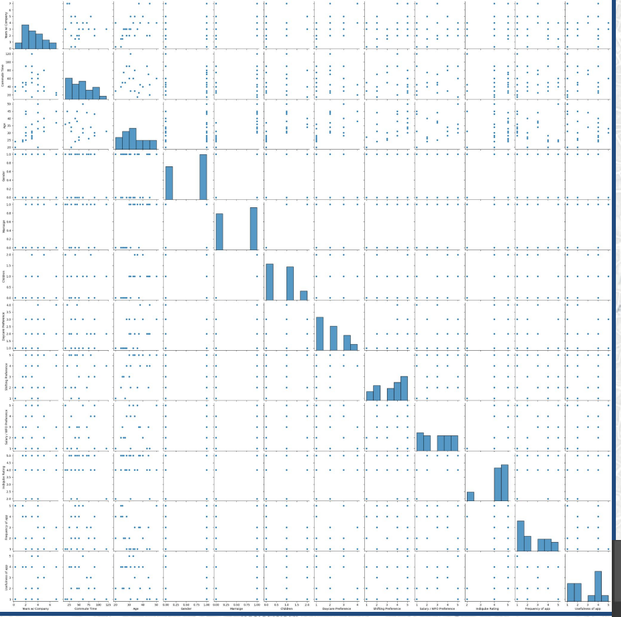
	Measure	For Corporate Office	For Clustered	Difference
0	total time spend commuting (hours e/ day)	48.74	29.00	-19.740
1	mean commute time (minutes)	56.24	33.46	-22.780
2	median commute time (minutes)	60.47	34.09	-26.380
3	total distance (km a/ day)	525.29	315.41	-209.880
4	mean commute distance (km)	10.10	6.07	-4.030
5	median commute distance (km)	10.64	6.20	-4.440
6	total emissions (kgs e/ year)	57446.74	32432.94	-25013.800
7	emissions error margin (kgs e/ year)	6535.61	3715.84	5125.725

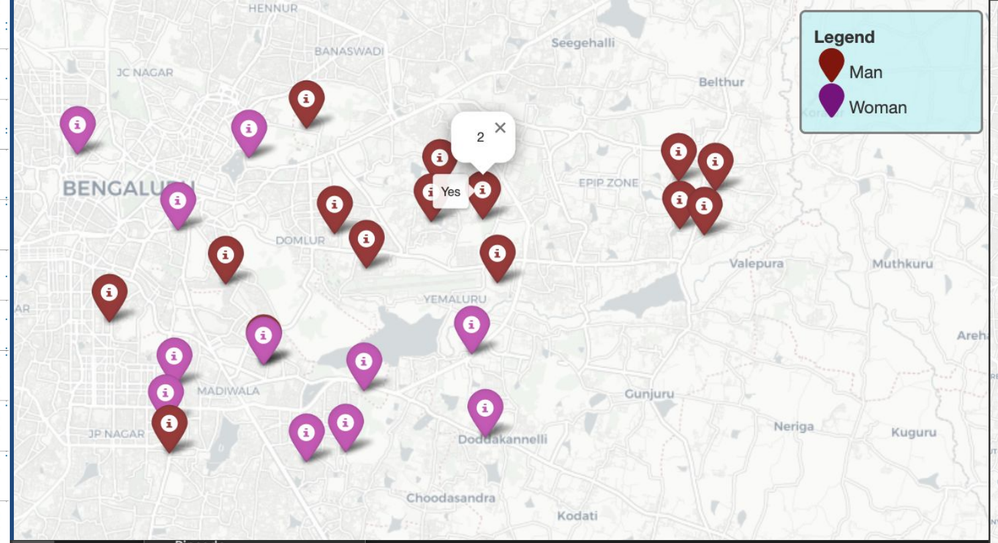
for 26 employees:

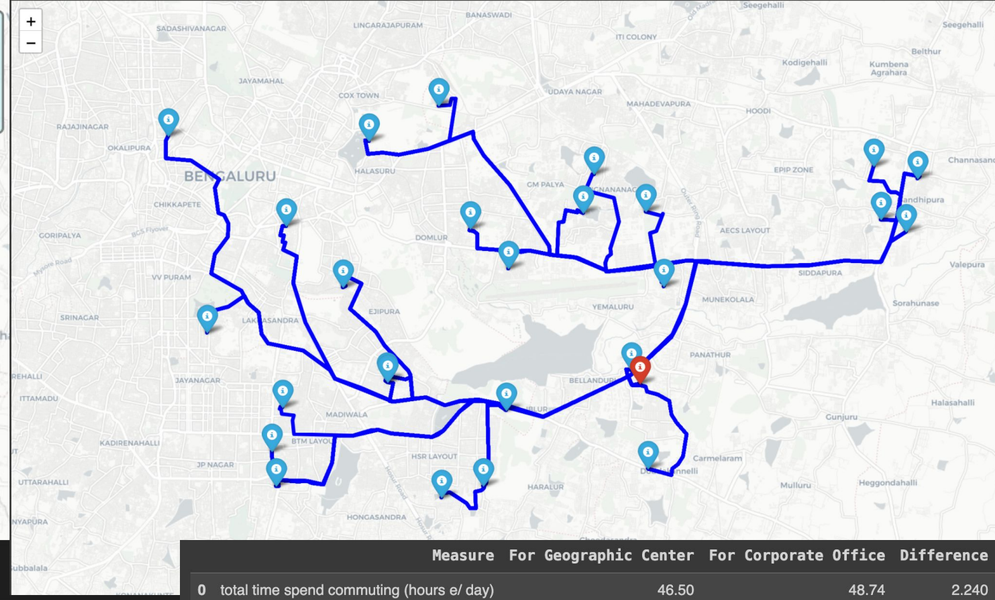
5,910 hours saved yearly

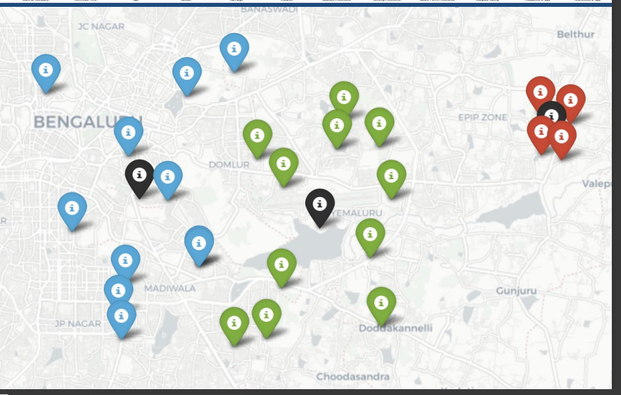
25,000 kgs of CO_2 reduced


folders
One File
LOCUS.ipynb
using Google Colab, NumPy, Pandas, Seaborn, ipywidgets, Folium, Open Source Routing Machine, Open Street Map, CartoDB, Chat GPT, Claude AI










```
ui = crea                                    t_employees)
display(u
```

Coloring
Pop-up
Description
Theme

- Pincode
- Commute Time
- Commute Method
- Age
- ✓ Gender
- Marraige
- Children
- Residence
- Daycare Preference
- Shifting Preference
- Pincode Preference
- Salary / WFO Preference
- Managed by Indiqube?
- Indiqube Rating
- Frequency of app
- Usefulness of app
- Sentiment
- Suggestions

A Collage of Functionality

	Measure	For Geographic Center	For Corporate Office	Difference
0	total time spend commuting (hours e/ day)	46.50	48.74	2.240
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