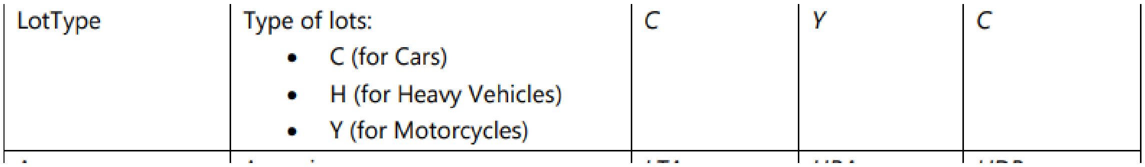
Hello, this is Group 37. Out solution for Question 1 is here :D

Question 1.1:

Look at the features in the dataset. What does lot type mean? Hint: Note that data.gov.sg gets its data from the Land Transport Authority (LTA). Try searching for the LTA Datamall API documentation.

Answer:

From the LTA_DataMall_API documentation, we can see that lot_type shows the type of lots inside the carpark i.e. for Cars (C), Heavy Vehicles (H) & Motorcycles (Y) as shown below



LotType	Type of lots: • C (for Cars) • H (for Heavy Vehicles) • Y (for Motorcycles)	*C*	*Y*	*C*

Question 1.2:

Try making an API call for the data from a single specified date & time. Then, do the same thing for the next second of the initially chosen date & time. Notice that “update time” is unchanged. Carry out and document a systematic approach to approximate the frequency at which the data values are updated.

Manual Approach:

From the LTA_DataMall_API documentation, we can see that lot_type shows the type of lots inside the carpark i.e. for Cars (C), Heavy Vehicles (H) & Motorcycles (Y) as shown below

Notes

There are 2 get_data function below to query data from the LTA API. The first `get_data` function is mainly used for fast one-time access as we do not ignore the missing values. The second `get_data_except` is similar to the first function but with a handles exception for the missing values. This is mainly used when querrying a range of continuous data where missing values is close to unavoidable.

In [27]:

```
import requests
import json
import pandas as pd
```

```
def get_data(year, month, day, hour, minute, second):
    site = f'https://api.data.gov.sg/v1/transport/carpark-availability?date_time={year}
    response_API = requests.get(site)
    data = response_API.text
    data = json.loads(data)
    df = pd.DataFrame()
    data = data["items"][0]["carpark_data"]
    with open("EE4211data.json", 'w') as fp:
        json.dump(data, fp)
    df = pd.read_json("EE4211data.json")
    for heading in ("total_lots","lot_type","lots_available"):
        df[heading] = df["carpark_info"].apply(lambda x: x[0][heading])
    df = df.drop(["carpark_info"], axis=1)

    return df

def get_data_clean(year, month, day, hour, minute, second):
    site = f'https://api.data.gov.sg/v1/transport/carpark-availability?date_time={year}
    response_API = requests.get(site)
    data = response_API.text
    data = json.loads(data)
    df = pd.DataFrame()
    try:
        data = data["items"][0]["carpark_data"]
        with open("EE4211data.json", 'w') as fp:
            json.dump(data, fp)
        df = pd.read_json("EE4211data.json")
        for heading in ("total_lots","lot_type","lots_available"):
            df[heading] = df["carpark_info"].apply(lambda x: x[0][heading])
        df = df.drop(["carpark_info"], axis=1)
    except KeyError:
        pass

    return df
```

In [18]:

```
get_data("2022", "4", "12", "12", "30", "0")
```

Out[18]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T12:12:32	105	C	0
1	HLM	2022-04-12T12:12:42	583	C	0
2	RHM	2022-04-12T12:12:32	329	C	106
3	BM29	2022-04-12T12:12:32	97	C	1
4	Q81	2022-04-12T12:12:32	96	C	0
...	...	...	...	...	...
1961	B65M	2022-04-12T12:11:58	679	C	499
1962	B65L	2022-04-12T12:11:58	5	C	0
1963	BE3	2022-04-12T11:30:52	306	C	148
1964	BE3R	2022-04-12T11:30:52	195	C	150
1965	B8B	2022-04-12T12:11:45	249	C	172

1966 rows × 5 columns

In [12]:

```
get_data("2022", "4", "12", "12", "30", "1")
```

Out[12]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T12:12:32	105	C	0
1	HLM	2022-04-12T12:12:42	583	C	0
2	RHM	2022-04-12T12:12:32	329	C	106
3	BM29	2022-04-12T12:12:32	97	C	1
4	Q81	2022-04-12T12:12:32	96	C	0
...	...	...	...	...	...
1961	B65M	2022-04-12T12:11:58	679	C	499
1962	B65L	2022-04-12T12:11:58	5	C	0
1963	BE3	2022-04-12T11:30:52	306	C	148
1964	BE3R	2022-04-12T11:30:52	195	C	150
1965	B8B	2022-04-12T12:11:45	249	C	172

1966 rows × 5 columns

In [10]:

```
get_data("2022", "4", "12", "13", "30", "0")
```

Out[10]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T13:13:32	105	C	0
1	HLM	2022-04-12T13:13:13	583	C	0
2	RHM	2022-04-12T13:13:32	329	C	121
3	BM29	2022-04-12T13:13:32	97	C	5
4	Q81	2022-04-12T13:13:33	96	C	0
...	...	...	...	...	...
1959	B65M	2022-04-12T13:13:28	679	C	503
1960	B65L	2022-04-12T13:13:28	5	C	0
1961	BE3	2022-04-12T12:14:59	306	C	159
1962	BE3R	2022-04-12T12:14:59	195	C	147
1963	B8B	2022-04-12T13:12:16	249	C	177

1964 rows × 5 columns

In [6]:

```
get_data("2022", "4", "12", "11", "30", "0")
```

Out[6]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T11:11:32	105	C	0
1	HLM	2022-04-12T11:11:40	583	C	52
2	RHM	2022-04-12T11:11:32	329	C	125
3	BM29	2022-04-12T11:11:32	97	C	5
4	Q81	2022-04-12T11:11:30	96	C	0
...	...	...	...	...	...
1960	B65M	2022-04-12T11:10:59	679	C	486
1961	B65L	2022-04-12T11:10:59	5	C	1
1962	BE3	2022-04-12T10:45:49	306	C	142
1963	BE3R	2022-04-12T10:45:49	195	C	146
1964	B8B	2022-04-12T11:10:16	249	C	174

1965 rows × 5 columns

In [9]:

```
get_data("2022", "4", "12", "12", "29", "0")
```

Out[9]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T12:12:32	105	C	0
1	HLM	2022-04-12T12:12:42	583	C	0
2	RHM	2022-04-12T12:12:32	329	C	106
3	BM29	2022-04-12T12:12:32	97	C	1
4	Q81	2022-04-12T12:12:32	96	C	0
...	...	...	...	...	...
1961	B65M	2022-04-12T12:11:58	679	C	499
1962	B65L	2022-04-12T12:11:58	5	C	0
1963	BE3	2022-04-12T11:30:52	306	C	148
1964	BE3R	2022-04-12T11:30:52	195	C	150
1965	B8B	2022-04-12T12:11:45	249	C	172

1966 rows × 5 columns

In [8]:

```
get_data("2022", "4", "12", "12", "31", "0")
```

Out[8]:

	carpark_number	update_datetime	total_lots	lot_type	lots_available
0	HE12	2022-04-12T12:12:32	105	C	0
1	HLM	2022-04-12T12:12:42	583	C	0

	carpark_number	update_datetime	total_lots	lot_type	lots_available
2	RHM	2022-04-12T12:12:32	329	C	106
3	BM29	2022-04-12T12:12:32	97	C	1
4	Q81	2022-04-12T12:12:32	96	C	0
...	...	...	...	...	...
1961	B65M	2022-04-12T12:11:58	679	C	499
1962	B65L	2022-04-12T12:11:58	5	C	0
1963	BE3	2022-04-12T11:30:52	306	C	148
1964	BE3R	2022-04-12T11:30:52	195	C	150
1965	B8B	2022-04-12T12:11:45	249	C	172

1966 rows × 5 columns

Analysis of Question 1.2 (Manual):

There is no difference in the data between one second difference of get_data("2022", "4", "12", "12", "30", "0") & get_data("2022", "4", "12", "12", "30", "1") based on the outputs above

There is a slight difference in the data between one hour difference of get_data("2022", "4", "12", "12", "30", "0") & get_data("2022", "4", "12", "13", "30", "0") & get_data("2022", "4", "12", "11", "30", "0") based on the outputs above

There is no difference in the data between one minute difference of get_data("2022", "4", "12", "12", "30", "0"), get_data("2022", "4", "12", "12", "29", "0") & get_data("2022", "4", "12", "12", "31", "0") based on the outputs above

Systematic Approach:

Automate the process and scan through consecutive time period and compare their output

In [13]:

```
df_list = []

for x in range(60):
    year = "2022"
    month = "4"
    day = "12"
    hour = "12"
    minute = str(x)
    second = "30"
    df_list.append(get_data(year, month, day, hour, minute, second))

for x in range(59):
    json_dict1 = json.loads(df_list[x].to_json(orient = 'split'))
    json_dict2 = json.loads(df_list[x+1].to_json(orient = 'split'))
    print(str(x), end =" ")
    print(sorted(json_dict1.items()) == sorted(json_dict2.items()))
```

```
0 True
1 True
2 True
3 True
4 True
5 True
6 True
7 True
8 True
9 True
10 True
11 True
12 False
13 True
14 True
15 True
16 True
17 True
18 True
19 True
20 True
21 True
22 True
23 True
24 True
25 True
26 True
27 True
28 True
29 True
30 True
31 True
32 True
33 True
34 True
35 True
36 True
37 True
38 True
39 True
40 True
41 True
42 True
43 False
44 True
45 True
46 True
47 True
48 True
49 True
50 True
51 True
52 True
53 True
54 True
55 True
56 True
57 True
58 True
```

Analysis of Question 1.2 (Systematic):

The frequency at which the data values are updated is approximately every 30 minutes or (1/1800) Hz. JSON files are read then compared every minute. At the 12th and 43rd comparison, the data values changes which is indicated by a False output. Therefore, every 42-12 = 30 minutes, the data value are updated in their system.

Question 1.3(i):

How many carparks are included in the data.gov.sg car park database?

In [4]:

```
import requests
import json
import pandas as pd

def get_data(year, month, day, hour, minute, second):
  site = f'https://api.data.gov.sg/v1/transport/carpark-availability?date_time={year}-{
  # print(site)
  response_API = requests.get(site)
  data = response_API.text
  data = json.loads(data)
  df = pd.DataFrame()

  # Skip malfunctioning data
  if "items" in data:
    timestamp = data["items"][0]["timestamp"]

    data = data["items"][0]["carpark_data"]
    with open("EE4211data.json", 'w') as fp:
        json.dump(data, fp)
    df = pd.read_json("EE4211data.json")
    for heading in ("total_lots","lot_type","lots_available"):
        df[heading] = df["carpark_info"].apply(lambda x: x[0][heading])
    df = df.drop(["carpark_info"], axis=1)

  return df
```

In [5]:

```
#continue Question 1.3: (i) How many carparks are included in the data.gov.sg car park
def total_carparks_included_in_database(year, month, day):
  for x in range(1,24): #24 hours in a day so this checks no of carparks in a day
    hour = str(x)
    minute = "00"
    second = "00"
    carpark_checker=get_data(year, month, day, hour, minute, second) #Calling the dataf

    if carpark_checker.empty: #Check if carpark has malfunctioning and anomalous sensor
      return "This is a malfunctioning and anomalous sensors as it does not report it's

    else:
      return carpark_checker["carpark_number"].drop_duplicates().count() #Removing dupl

print(total_carparks_included_in_database("2022", "4", "12"))

#Answer 1.3 (i): There are 1960 carparks in the data.gov.sg car park database
```

```
# Alternative method:
def total_carparks_included_in_database2(year, month, day, hour, minute, second):
  df = get_data(year, month, day, hour, minute, second)
  if df.empty:
    return -1 # this signifies that carpark sensor is mulfunctioning or faulty
  return df["carpark_number"].drop_duplicates().count() #Removing duplicate carpark nam

total_carparks_included_in_database2("2022", "4", "12", "01", "00", "00")
```

```
1960
1960
```

Out[5]:

Answer:

There are 1960 carparks in the data.gov.sg car park database at 2022-04-12 11:59:45

Question 1.3(ii):

Does this number vary based on the time? You should notice that it does vary with time.

In [24]:

```
import requests
import json
import pandas as pd

year = "2018"
month = "4"
day = "12"
hour = "12"
minute = "00"
second = "00"
i = 0 #Setting iterator as 0 to start off with the year 2018

while i <= 4: #Printing out the number of carparks from 2018-2022
    try:
        site = f'https://api.data.gov.sg/v1/transport/carpark-availability?date_time={i
        # print(site)
        response_API = requests.get(site)
        data = response_API.text
        data = json.loads(data)
        timestamp = data["items"][0]["timestamp"]
        print(timestamp)
        data = data["items"][0]["carpark_data"]
        with open("EE4211data.json", 'w') as fp:
            json.dump(data, fp)
        df = pd.read_json("EE4211data.json")
        carparks_number = df["carpark_number"].drop_duplicates()
        i+=1
        print("Number of carparks:", len(carparks_number)) #Print out the total number
    except:
        i+=1
        print("Missing entry")
        pass
```

```
2018-04-12T11:59:45+08:00
```

```
Number of carparks: 1700
Missing entry
2020-04-12T11:59:27+08:00
Number of carparks: 1904
2021-04-12T11:59:27+08:00
Number of carparks: 1936
2022-04-12T11:59:27+08:00
Number of carparks: 1960
```

Answer:

Yes, the number of carpark numbers does indeed vary with time on a 5 year interval from 1700 in 2018 to 1960 in 2022

Question 1.3(iii):

A carpark may have malfunctioning sensors and nor report its data. Identify one of these carparks with anomalous sensors and a time period where that carpark's sensors were malfunctioning.

In [2]:

```python
import requests
import json
import pandas as pd

year = "2018"
month = "7"
day = "12"
hour = "12"
minute = "00"
second = "00"
i = 0 #Setting iterator as 0 to start off with the year 2018

while i <= 4: #Printing out the number of carparks from 2018-2022
    try:
        site = f'https://api.data.gov.sg/v1/transport/carpark-availability?date_time={i
        # print(site)
        response_API = requests.get(site)
        data = response_API.text
        data = json.loads(data)
        timestamp = data["items"][0]["timestamp"]
        print(timestamp)
        data = data["items"][0]["carpark_data"]

        with open("EE4211data.json", 'w') as fp:
            json.dump(data, fp)
        df = pd.read_json("EE4211data.json")

        carparks_number = df["carpark_number"].drop_duplicates()
        i+=1
        print(df[(df['lots_available'] < 0) | (df['lots_available']> df['total_lots'])]
    except KeyError:
        pass
```

```
2018-07-12T11:59:29+08:00
2019-07-12T11:59:27+08:00
2020-07-12T11:59:27+08:00
```

```
2021-07-12T11:59:27+08:00
2022-07-12T11:59:27+08:00
```

Explanation:

If sensor is malfunctioning, it will return a negative number (not >=0) and lots_available is more than the total no of carpark lots which is odd as well and `print(df[(df["lots_available"] <'0') | (df["lots_available"]> df["total_lots"])])` does that

Question 1.4:

Generate hourly readings from the raw data. Select a one month interval and plot the hourly data (time-series) for that interval (aggregate results instead of plotting for each location individually). Identify any patterns in the visualization. Note: You will have to decide what to do if there are no carpark readings for a certain hour, for example, should you impute the missing data or ignore it.

Explanation:

Here, we are generating the cumulative data per month for each lot types in each hourly time period. The aggregated hourly data will alll then be passed to the array of All_LotC, All_LotH and All_LotH for each types respectively.

NB: for the get_data function call, we used the get_data_except function defined above to ignore missing values.

In [28]:

```
# Question 1.4
All_LotC=[0]*23
ALL_LotH=[0]*23
All_LotY=[0]*23
for y in range (1,31):
    Lot_C=[]
    Lot_H=[]
    Lot_Y=[]
    for x in range(1,24):
        year = "2022"
        month = "4"
        day = str(y)
        hour = str(x)
        minute = "00"
        second = "00"
        chart = get_data_except(year, month, day, hour, minute, second)
        C = 0
        H = 0
        Y = 0
        for i in range(len(chart)):
            if chart.lot_type[i]=="C":
                C=C+int(chart.lots_available[i])

            if chart.lot_type[i]=="H":
                H=H+int(chart.lots_available[i])
            if chart.lot_type[i]=="Y":
                Y=Y+int(chart.lots_available[i])

        Lot_C.append(C)
        Lot_H.append(H)
        Lot_Y.append(Y)

    for o in range(0,len(All_LotC)):
        All_LotC[o]=All_LotC[o]+Lot_C[o]
        ALL_LotH[o]=ALL_LotH[o]+Lot_H[o]
        All_LotY[o]=All_LotY[o]+Lot_Y[o]

All_LotC
```

Out[28]:

```
[9708301,
 9873381,
 8488511,
 9424225,
 9079450,
 9515406,
 9544617,
 11884862,
 12500664,
 11612877,
 13264272,
 12920607,
 12932395,
 13529192,
 13050259,
 12070938,
 13805272,
 12623600,
 12434607,
 11595828,
 10076054,
 10471177,
 9644549]
```

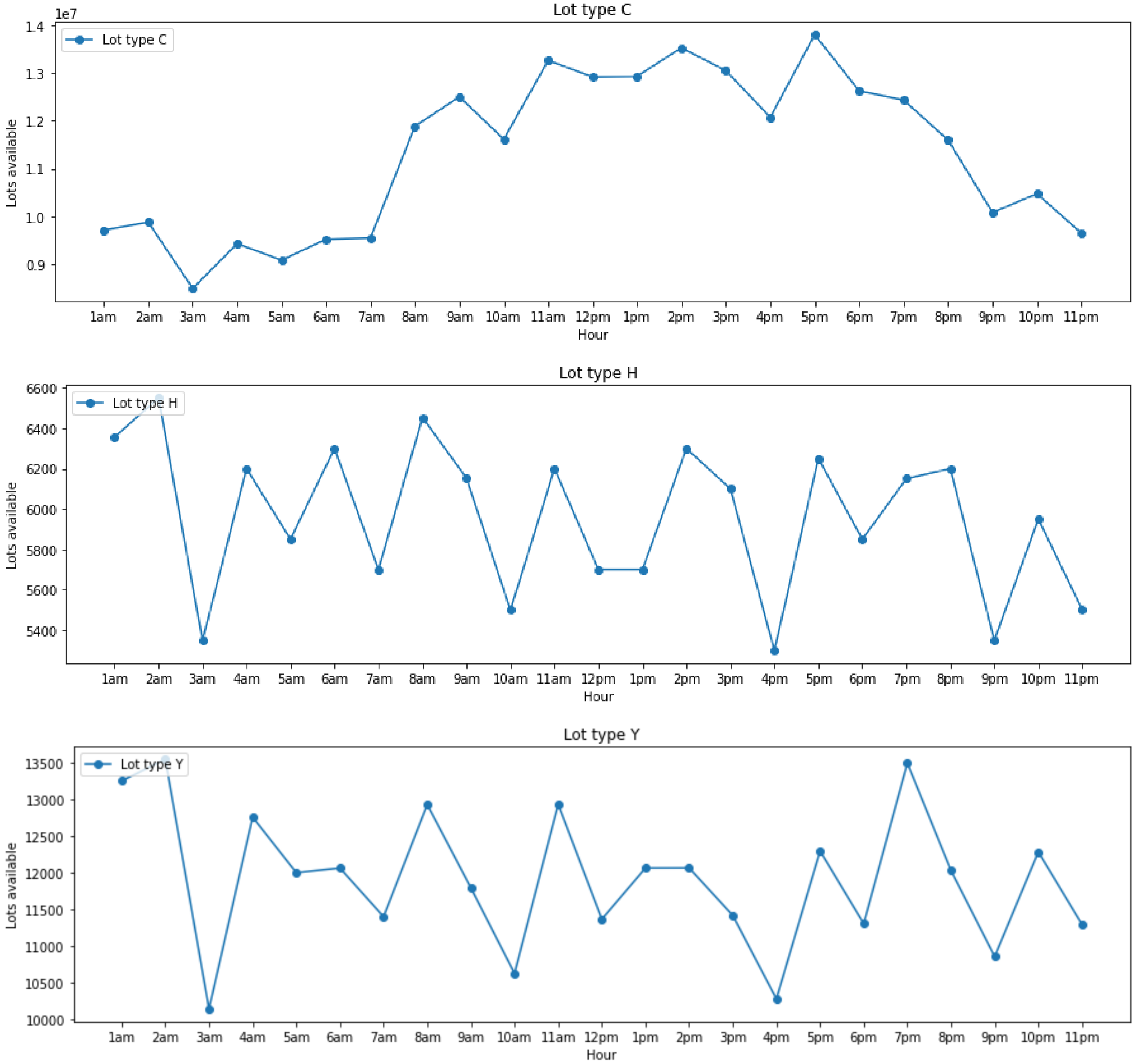
In [30]:

```
#continue Question 1.4
import matplotlib.pyplot as plt
def plot_graph(x_values, y_values, graph_name):
  f = plt.figure()
  f.set_figwidth(15)

  plt.plot(x_values, y_values,'-o')

  plt.title(graph_name)
  plt.xlabel("Hour")
  plt.ylabel("Lots available")
  plt.legend([graph_name], loc ="upper left") # can comment this if want
  plt.show()

x_values = ["1am","2am", "3am", "4am","5am" ,"6am","7am" ,"8am","9am","10am","11am","12
plot_graph(x_values, All_LotC, "Lot type C")
plot_graph(x_values, ALL_LotH, "Lot type H")
plot_graph(x_values, All_LotY, "Lot type Y")
```



Explanation:

From the data received, the plot of the hourly data of each Lot is shown above. From the graph, it can be observed that Lot Type C (Car) has the most available space on the working hours which make sense considering people driving in the midday. For Lot Type H (Heavy Vehicle) and X (Motorcycle), however, not much variation is observed as these 2 are mainly used for item transportation (compared to Cars for personal use). Motorcycle mainly used for small items delivery (i.e, food) and heavy vehicles for large item transportation.

Question 5:

Intuitively, we expect that carpark availability across certain carparks to be correlated. For example, many housing carparks would experience higher carpark availability during working hours. Using the same interval chosen in 1.4, write a function to find the top five carparks with which it shows the highest correlation. Demonstrate an example of this function call using a randomly selected carpark.

Explanation:

The main approach of the question is to first identify all the carpark types. Once, we have the carparaks names, we can create a dataframe to store all the occupancy rate of the carparks. Next, we will iterate through all the hours and dates in the months to count the available lot. From the gathered data, we can then find the correlation between the carparks using the `corr` function

In [31]:

```
# Question 1.5
def get_carpark_names(year, month, day):
    df = get_data(year, month, day, "12", "00", "00")
    return df.carpark_number.drop_duplicates()

carpark_names = get_carpark_names("2022", "4", "15")
carpark_names
```

Out[31]:

```
0       HE12
1        HLM
2        RHM
3       BM29
4        Q81
        ... 
1959    B65M
1960    B65L
1961     BE3
1962    BE3R
1963     B8B
Name: carpark_number, Length: 1961, dtype: object
```

In [33]:

```
overall_df = pd.DataFrame(0, columns=[hour for hour in range(0,24)], index= [carpark fo

# Fixed period on Q1.4
year = "2022"
month = "4"

print("Gathering data for a month...")
# 30 days in a month
for day in range(1,31):
    print("Processing day ", str(day))
    # each hour
    for hour in range(1,24):
        # print("Processing hour ", str(hour))
        hourly_df = get_data_except(year, month, str(day), str(hour), "00", "00")
        for _,row in hourly_df.iterrows():
            curr_carpark = row["carpark_number"]
            if curr_carpark in overall_df.index:
                overall_df.at[curr_carpark, hour] += int(row['lots_available'])

overall_df
```

```
Gathering data for a month...
Processing day  1
Processing day  2
Processing day  3
Processing day  4
Processing day  5
Processing day  6
Processing day  7
Processing day  8
Processing day  9
Processing day  10
Processing day  11
Processing day  12
Processing day  13
Processing day  14
Processing day  15
Processing day  16
Processing day  17
Processing day  18
Processing day  19
Processing day  20
Processing day  21
Processing day  22
Processing day  23
Processing day  24
Processing day  25
Processing day  26
Processing day  27
Processing day  28
Processing day  29
Processing day  30
```

Out[33]:

	0	1	2	3	4	5	6	7	8	9	...	14	15	16
HE12	0	1495	1509	1450	1397	1039	717	273	53	65	...	171	435	503
HLM	0	13157	13347	13593	13746	13057	12625	13430	12059	9114	...	1749	2872	4595
RHM	0	3155	3214	3157	3460	3113	3103	3480	3626	3564	...	4027	4527	5267
BM29	0	2058	2180	2193	2266	2135	2113	2225	1530	944	...	250	177	194
Q81	0	2029	2107	2105	2195	2030	2024	1844	410	229	...	197	500	838
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
B65M	0	9172	9483	9422	9836	9149	9121	10329	11397	11428	...	12816	12621	12505
B65L	0	0	0	0	0	0	0	0	0	11	...	0	1	0
BE3	0	1321	1251	1163	1193	1097	1259	1861	2639	2865	...	4245	4162	4051
BE3R	0	3037	3110	3058	3135	2889	2887	3198	3518	3260	...	3769	3921	4000
B8B	0	3765	3844	3812	3954	3724	3657	4075	4460	4305	...	4601	4432	4483

1961 rows × 24 columns

Explanation:

Last, we can randomly pick 5 carparks and find their correlation to the other carparks. Then sort the output and return the top 5.

In [34]:

```
import heapq

# Find top 5 correlation
```

```
def gen_correlation(chosen_carpark, occupancy_df):
    corr_data = {}
    chosen_df = occupancy_df.loc[chosen_carpark]
    for carpark, data in occupancy_df.iterrows():
        if chosen_carpark == carpark:
            continue
        corr_val = chosen_df.corr(data)
#         print(carpark)
#         print(corr_val)
        corr_data[carpark] = corr_val
    return corr_data

corr_data = gen_correlation("HE12", overall_df)
# print(corr_data)
heapq.nlargest(5, corr_data, key=corr_data.get)
```

Out[34]:

```
['Q80', 'GM3', 'B45', 'A37', 'J24']
```

In [36]:

```
import random

# pick 5 random carparks
random_carpark = random.choices(carpark_names, k=5)

for i in range(0,5):
    corr_data = gen_correlation(random_carpark[i], overall_df)
    top_5 = heapq.nlargest(5, corr_data, key=corr_data.get)
    print("Carpark", random_carpark[i], "has 5 top correlation with", top_5)
```

```
Carpark HG41 has 5 top correlation with ['CK13', 'HG33', 'J81M', 'U13', 'BJ8']
Carpark A53 has 5 top correlation with ['TAM1', 'U39', 'PDC4', 'BJ69', 'TM43']
Carpark JM31 has 5 top correlation with ['CC5', 'PP2', 'TGM2', 'PDC5', 'SB45']
Carpark J23 has 5 top correlation with ['W105', 'T51', 'W25', 'Y16', 'PM40']
Carpark TM43 has 5 top correlation with ['U39', 'BJ69', 'PD8W', 'BJ72', 'B80']
```

Question 1.6 is the EE4211_Group_37_Project_Proposal for Question 3

For Question 3, what we intend to do is to create a certain number of classes or labels to group clusters of unaggregated data. There are 4 features that we will look at in the dataset in order to classify the data. The 4 features are the “update_datetime”, ”total_lots”, “lot_type” and “lots_available”. The feature in the dataset that we intend to leave out is the “carpark_number”. We believe that “carpark_number” which mentions the number of car parks containing the cars is unnecessary for grouping data. Looking at the 4 features mentioned earlier ,we can group each carpark to a specific category based on the qualities of its 4 features. The feature “lot_type” with it being a discrete feature, will make grouping each carpark easier since it has distinct values. However for other features such as “update_datetime”, “total_lots”, and “lots_available” the values are continuous. For features with continuous values thresholding will have to be set since each Carpark has its own unique set of values for “Update_datetime”, ”total_lots” and “lots_available”.

Based on the features, we notice that some of the carparks actually have malfunctioning sensors as it does not report any data during a period of time (as described in Question 1.3). From this information, we plan to further expand to investigate the areas where this malfunctioning sensors actually occurs as we believe this leads to further reflection of the social and security aspect of the area. Based on our hypothesis, we believe that this data can reflect areas in Singapore that might be neglected (especially for sensors that consistently fail) and which needs government investment for it (maybe the not so popular and tourist areas).

For this analysis, we will require several data mainly, data of the malfunctioning carpark sensors, general income distribution for regions in Singapore and general crime rate distribution in Singapore. For carpark data given, we can easily find out the location and time period when the malfunctioning occurs. For the income distribution data, we plan to figure out areas in Singapore that are not that well-off and see whether there is a correlation between this and the malfunctioning sensor. Lastly, with the data on crime rate, we plan to analyse the relationship between the regions with malfunctioning data and general crime rate in the area.

Overall, we plan to find the relationship between the malfunctioning sensor to the economic(income) and social(crime rate) aspect of the region. From our analysis, it will be useful for both the government and general public. For the government, it can shed light to which region in Singapore that required more attention to. For the general public, this analysis can raise the public awareness of the importance of maintaining their general infrastructure well and what a “broken” infrastructure on their area might correlates to.