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```
In [1]: import matplotlib.pyplot as plt
        import numpy as np
        import os
        import pandas as pd

        from insight_datachallenges.week2 import DATADIR
```

0.1 Overall approach

I was provided with a chart showing user engagement over calendar time, as well as server log data on each user. I noticed right away that user engagement dropped at the end of July. Is this drop significant? And, what could be the reason for it?

0.2 Conclusion

Vacation time in Europe is the likely cause of the decrease in user engagement.

```
In [2]: events_csv_filename = os.path.join(DATADIR, 'yammer_events.csv')
        events = pd.read_csv(events_csv_filename)
```

I wasn't sure whether user engagement events were logged by user's local time or a time of day at the server's location. To infer this, I plotted the number of users signing up for Yammer as a function of time of day. If events were logged user-local time, I'd expect them to be distributed during typical waking hours. (This assumes a uniform distribution of users across the world).

```
In [3]: events['occurred_at'] = pd.to_datetime(events['occurred_at'])
        events['occurred_at_date'] = events['occurred_at'].apply(lambda x: x.date())
        events['time_of_day'] = events['occurred_at'].apply(lambda x: x.hour)
```

```
In [4]: engagement_mask = events['event_type'] == 'signup_flow'
```

```
In [5]: event_time_groupby = events.loc[engagement_mask, :].groupby(['time_of_day'])
```

```
In [6]: # a peek a the data (sanity check)
        events.head()
```

```
Out[6]:    user_id         occurred_at  event_type    event_name location  \
        0  10522.0 2014-05-02 11:02:39  engagement         login    Japan
```

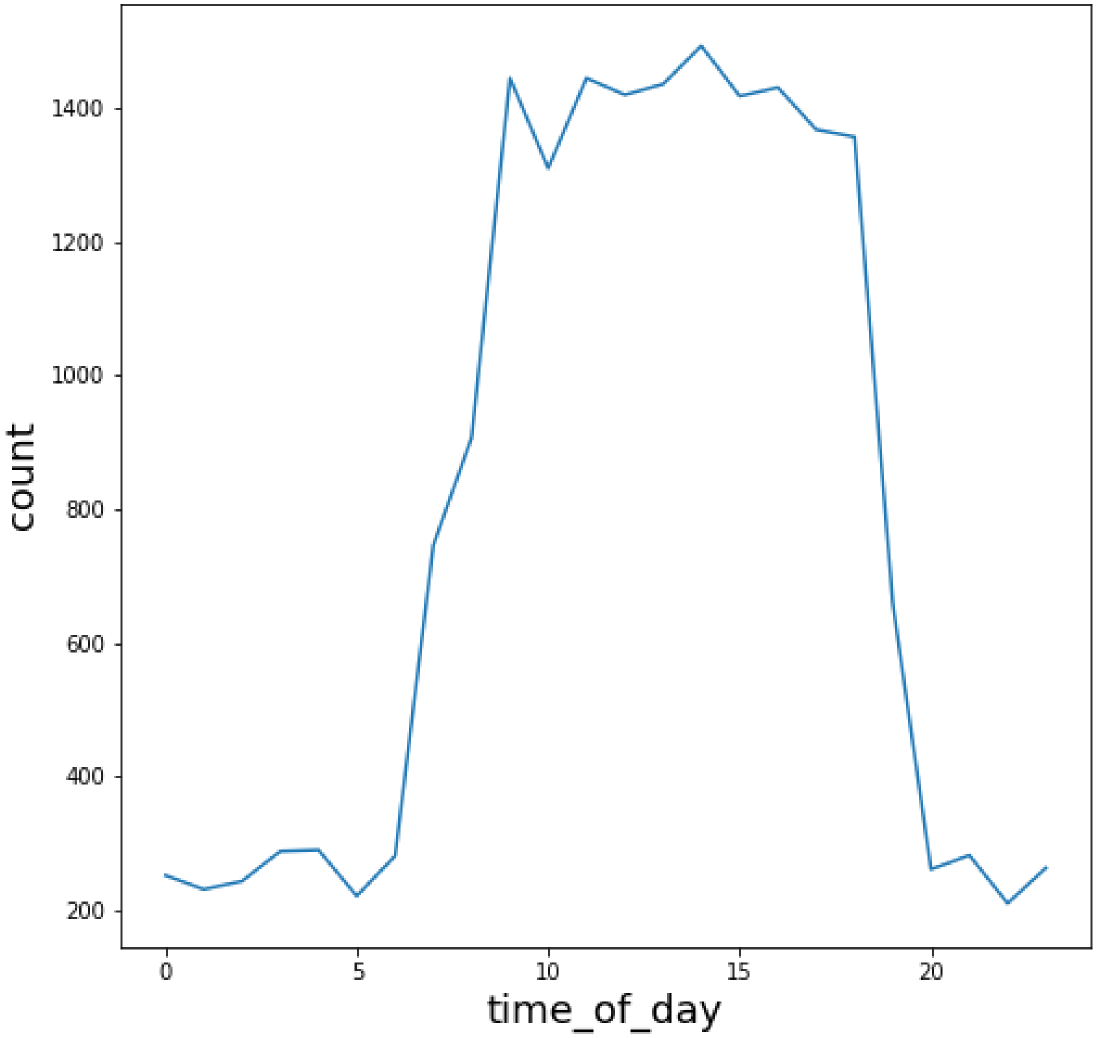
```
1  10522.0 2014-05-02 11:02:53  engagement    home_page    Japan
2  10522.0 2014-05-02 11:03:28  engagement  like_message    Japan
3  10522.0 2014-05-02 11:04:09  engagement    view_inbox    Japan
4  10522.0 2014-05-02 11:03:16  engagement    search_run    Japan

                  device  user_type occurred_at_date  time_of_day
0  dell inspiron notebook        3.0       2014-05-02           11
1  dell inspiron notebook        3.0       2014-05-02           11
2  dell inspiron notebook        3.0       2014-05-02           11
3  dell inspiron notebook        3.0       2014-05-02           11
4  dell inspiron notebook        3.0       2014-05-02           11
```

From the plot below, it's clear sign ups occur during normal waking hours, so the `occurred_at` column is indeed user local time.

```
In [7]: counts_time_of_day = event_time_groupby.agg('count')
        # df = counts_time_of_day.unstack(level=0)
        fig, ax = plt.subplots(1, 1, figsize=(8, 8))
        ax.set_ylabel('count', fontsize=18)
        ax.set_xlabel('time of day (24 hour scale)', fontsize=18)
        counts_time_of_day.loc[:, 'user_id'].plot(ax=ax)

Out[7]: <matplotlib.axes._subplots.AxesSubplot at 0x7f87aed75470>
```



Let’s just confirm the assumption that users are evenly distributed around the world. Below I’ve printed out the number of user events for each country.

```
In [8]: location_groupby = events.groupby('location')
        location_groupby.agg('count')['user_id']
```

```
Out[8]: location
        Argentina                1717
        Australia                7494
        Austria                  2494
        Belgium                  2822
        Brazil                  11240
        Canada                   9126
        Chile                    1092
        Colombia                 1945
        Denmark                  2191
```

```
Egypt                     2258
Finland                   1926
France                   17364
Germany                  23524
Greece                     989
Hong Kong                 1525
India                     9620
Indonesia                 6224
Iran                      3122
Iraq                      1400
Ireland                   1073
Israel                    2130
Italy                    11790
Japan                    26046
Korea                     7180
Malaysia                  2529
Mexico                    9106
Netherlands               4494
Nigeria                   1642
Norway                    2020
Pakistan                  1035
Philippines               1373
Poland                    3803
Portugal                  1336
Russia                   12226
Saudi Arabia              4104
Singapore                 1497
South Africa              2324
Spain                     5874
Sweden                    3901
Switzerland               3760
Taiwan                    3600
Thailand                  2008
Turkey                    2432
United Arab Emirates      2343
United Kingdom           16475
United States            94728
Venezuela                 1930
Name: user_id, dtype: int64
```

It looks like most users are from Europe, which suggests the end-of-July drop in engagement is due to Europeans going on holiday the month of August.

```
In [ ]:
```