Team Mango Component One

Created on Sun Apr 9 13:25:13 2017

Yikai Deng

Those datasets are based on the CUMTD data. They give information about bus routes in Champaign Urbana. Firstly, Yikai did a scatterplot about the distribution of bus stations by using their longitude and latitude data. Secondly, he used colored density map to show density of bus stations. Thirdly, Hanlin cleaned original data by classifying buses based on their routes and labeled with colors, then Yikai did a scatterplot about routes of buses on the map of Champaign-Urbana. It clearly showed bus system of this area. However, because lots of different buses are included, multiple colors make it difficult to distinguish specific one route. To improve this visualization, Hanlin applied Ipywidgets. Therefore, users are able to select one bus route to view.

Hanlin Zhang

Approach :

OSM adapted from Group member Yikai and online resources Applied Pandas structural adaptations Applied Ipywidgets dropbox to select category Developed methods to clean the data Developed methods to calculate the time bus traveling Adapted On Street Map(OSM) to project scatter points on map Applied Ipywidgets interactive plot to plot based on selected bus route and time. Added one dimension to reflect the traffic condition depending on the time bus

Strengths :

Finding out the time interval bus traveling reference to stop.txt file. Coloring out the traffic condition based on the selected bus route and time.

Weaknesses:

Scatter plot takes time to draw, limited real-time streaming possibility

Further ideas:

Improve the methodology for plotting the bus routes. Instead of plotting all the bus stops, bus routes can be identified by the starting point, stopping point, and every stops when the bus change driving directions. Thus a route can be drawn by connecting points, which provides a faster way of drawing. Require real-time streaming data from CUMTD. Plotting with historical data cannot reflect the real-time traffic situation, it can be improved by collecting streaming data from bus on the street.

In [2]:

```
%matplotlib inline
```

In [3]:

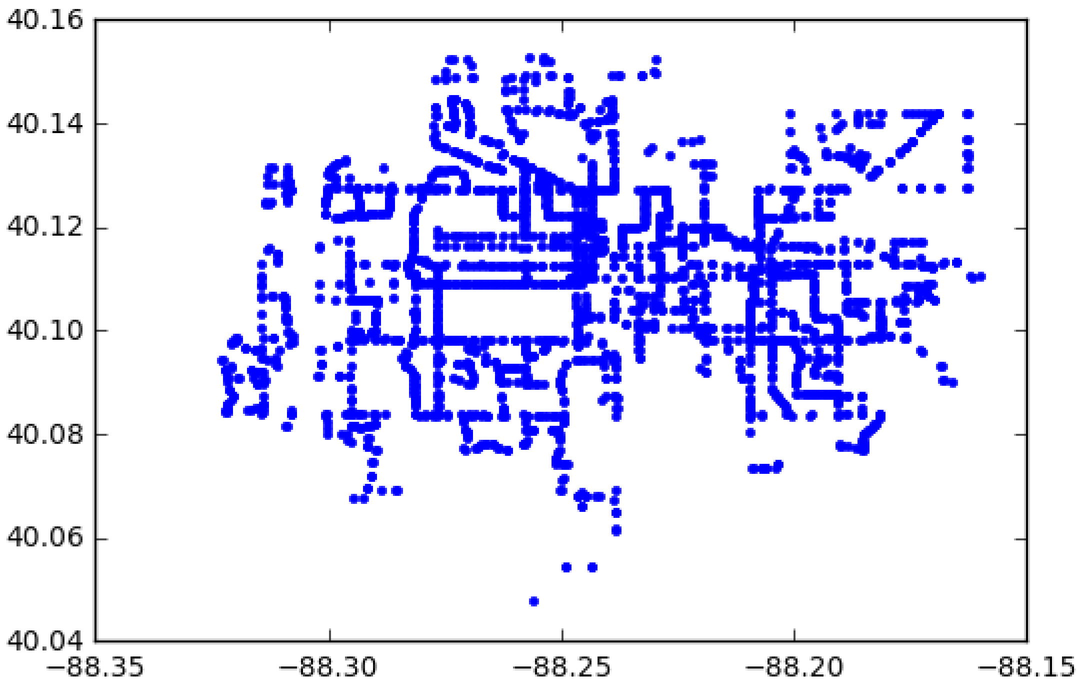
```
import numpy as np
import pandas as pd
import matplotlib as plt
from collections import Counter
import matplotlib.patches as mpatches
```

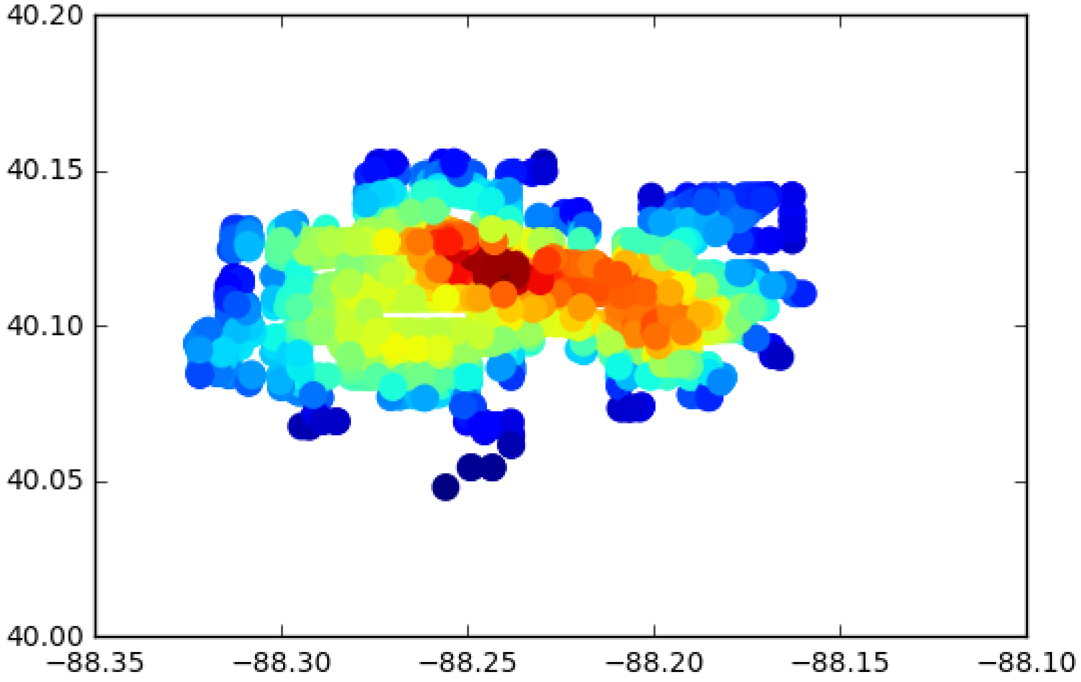
In [18]:

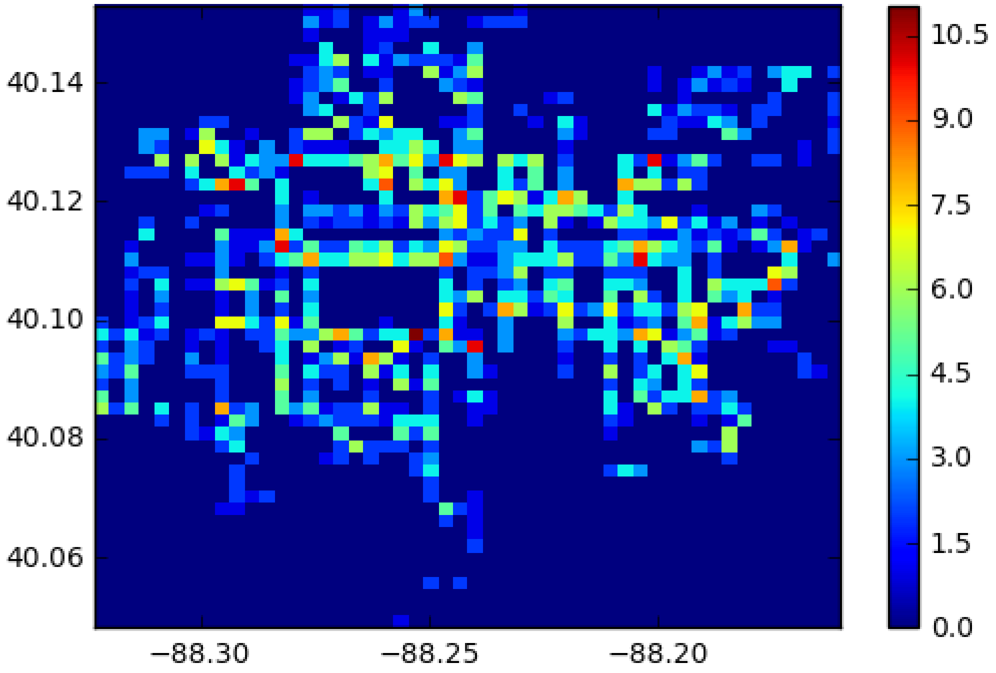
```
# Here and below is Yikai's contribution
# %load viz_yikai.py
import csv
import numpy as np
import pandas as pd
import cartopy.crs as ccrs
import matplotlib.pyplot as plt
from collections import Counter
from cartopy.io.img_tiles import OSM
from scipy.stats import gaussian_kde

dataset_stop = open("/home/hanlinz3/work/data-readonly/CUMTD/stops.txt")
data_csv1= csv.reader(dataset_stop)
header1 = next(data_csv1)

data_stop = {}
for name in header1:
    data_stop[name] = []
data_stop

for row in data_csv1:
    for name, value in zip(header1, row):
        data_stop[name].append(value)

plt.plot(data_stop['stop_lon'],data_stop['stop_lat'],'.')

sum(Counter(data_stop['stop_id']).values())

x = np.array(data_stop['stop_lat']).astype(np.float)
y = np.array(data_stop['stop_lon']).astype(np.float)

# Calculate the point density
xy = np.vstack([x,y])
z = gaussian_kde(xy)(xy)

fig, ax = plt.subplots()
ax.scatter(y, x, c=z, s=100, edgecolor='')
plt.show()
plt.hist2d(y, x, (50, 50), cmap=plt.cm.jet)
plt.colorbar()

dataset_stoptime = open("/home/hanlinz3/work/data-readonly/CUMTD/stop_times.
data_csv2= csv.reader(dataset_stoptime)
header2 = next(data_csv2)

data_stoptimes = {}
for name in header2:
    data_stoptimes[name] = []

for row in data_csv2:
    for name, value in zip(header2, row):
        data_stoptimes[name].append(value)


Counter(data_stoptimes['stop_id'])
```

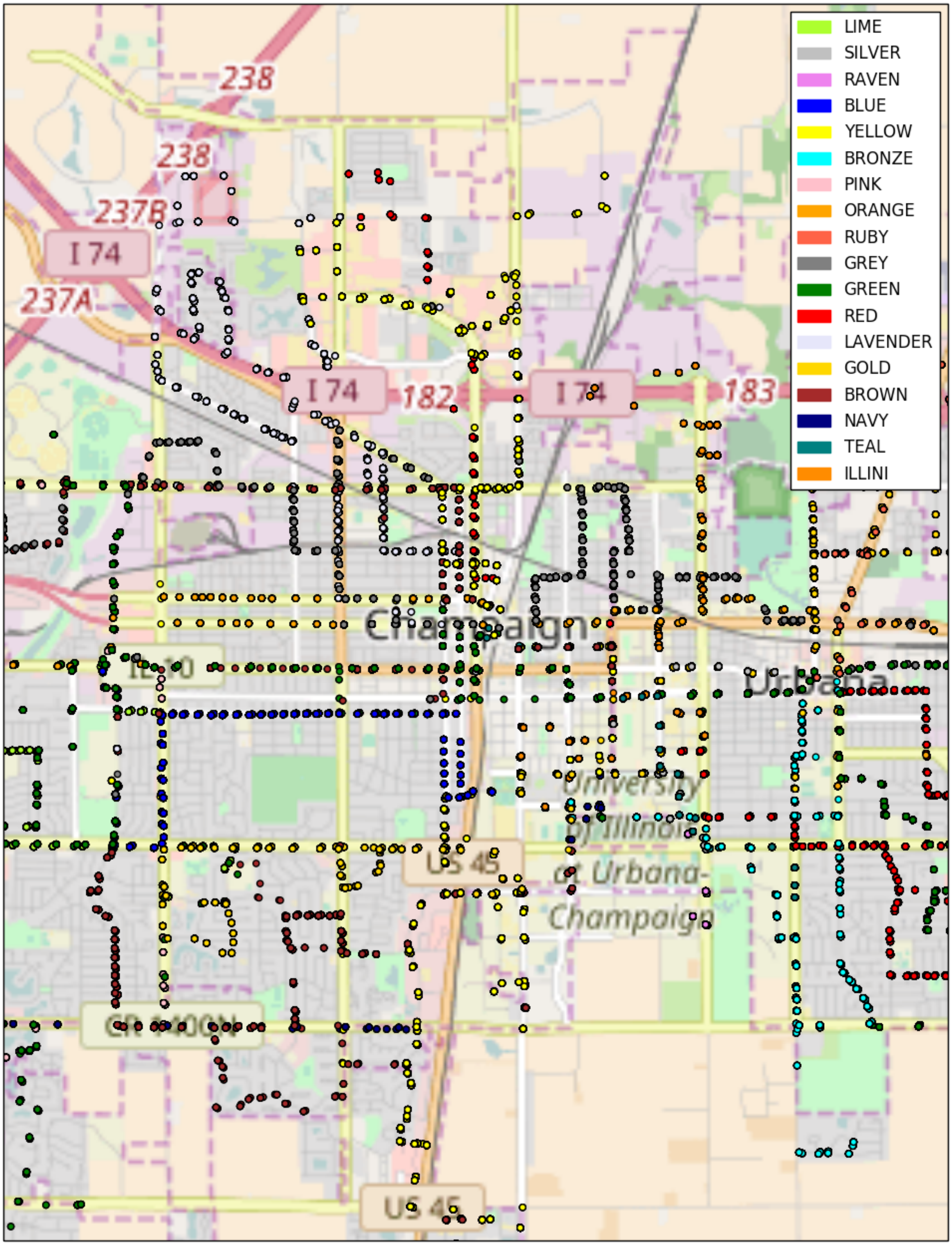
```
dataset_routes = open("/home/hanlinz3/work/data-readonly/CUMTD/routes.txt")
data_csv3= csv.reader(dataset_routes)
header3 = next(data_csv3)

data_routes = {}
for name in header3:
    data_routes[name] = []

for row in data_csv3:
    for name, value in zip(header3, row):
        data_routes[name].append(value)
dataset_trips = open("/home/hanlinz3/work/dv_fnl_pj/CUMTD/trips_re.csv")
data_csv4= csv.reader(dataset_trips)
header4 = next(data_csv4)

data_trips = {}
for name in header4:
    data_trips[name] = []

for row in data_csv4:
    for name, value in zip(header4, row):
        data_trips[name].append(value)

c_routes = Counter(data_trips['route_id'])
c_routes
#numbers of trips on each routes

dataset_shapes = open("/home/hanlinz3/work/data-readonly/CUMTD/shapes.txt")
data_csv5 = csv.reader(dataset_shapes)
header5 = next(data_csv5)

data_shapes = {}
for name in header5:
    data_shapes[name] = []

for row in data_csv5:
    for name, value in zip(header5, row):
        data_shapes[name].append(value)

left = pd.DataFrame({'stop_id': data_stop['stop_id'], 'stop_lon': data_stop[
middle = pd.DataFrame({'stop_id': data_stoptimes['stop_id'], 'trip_id': data
result1 = pd.merge(left, middle, on='stop_id')
right = pd.DataFrame({'route_id': data_trips['route_id'], 'trip_id': data_tr
result2 = pd.merge(result1, right, on='trip_id')

result2

Counter(data_trips['route_id'])

import matplotlib.patches as mpatches
use_colours = {'GREEN': '#008000', 'BRONZE': '#00FFFF', 'TEAL': '#008080','
               ,'ILLINI':'#FF8C00','LAVENDER':'#E6E6FA','NAVY':'#000080','OR
               ,'YELLOW':'#FFFF00', 'LIME':'#ADFF2F','RED':'#FF0000','BLUE':
              }

lat, lon=40.1164, -88.2434
```

```
dlat, dlon=0.05, 0.05
osm_tiles=OSM()

plt.figure(figsize=(16,16))
ax = plt.axes(projection=osm_tiles.crs)
ax.set_extent([lon-dlon,lon+dlon,lat - dlat, lat + dlat])
ax.add_image(osm_tiles,12)
ax.stock_img()

ax.scatter(list(result2['stop_lon']),list(result2['stop_lat']),
             c=[use_colours[x] for x in result2['route_id']],transform=ccrs.

c_patch=[]
for item, value in zip(use_colours.keys(),use_colours.values()):
    patch=mpatches.Patch(color=value, label=item)
    c_patch.append(patch)

ax.legend(handles=[c_patch[0],c_patch[1],c_patch[2],c_patch[3],c_patch[4],c_
                    c_patch[10],c_patch[11],c_patch[12],c_patch[13],c_patch[

plt.show()
```




40.20
40.15
40.10
40.05
40.00
−88.35
−88.30
−88.25
−88.20
−88.15
−88.10


40.14
40.12
40.10
40.08
40.06
−88.30
−88.25
−88.20
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0


LIME
SILVER
RAVEN
BLUE
YELLOW
BRONZE
PINK
ORANGE
RUBY
GREY
GREEN
RED
LAVENDER
GOLD
BROWN
NAVY
TEAL
ILLINI
238
238
237B
I 74
237A
I 74
182
I 74
183
Champaign
IL 10
Urbana
University of Illinois at Urbana-Champaign
US 45
CR 1400N
US 45

In [5]:

```
# Here and below is Hanlin's contribution
# %load load_data.py
"""
Created on Sun Apr  9 13:25:13 2017

@author: hanlinz
"""
#load data from file
agency = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/agency.txt")
calendar = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/calendar.txt
calendar_dates = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/calenc
fare_attributes = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/fare_
fare_rules = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/fare_rules
routes = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/routes.txt")
shapes = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/shapes.txt")
stop_times = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/stop_times
stops = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/stops.txt")
trips = pd.read_csv("/home/hanlinz3/work/data-readonly/CUMTD/trips.txt")

#load data into df
stp_time = pd.DataFrame({'trip_id': stop_times['trip_id'], 'stop_times': stc
                         "stop_sequence": stop_times['stop_sequence'].astype

#dic for data cleanning
diff = {}
diff['trip_id']=[]
diff['start_min']=[]
diff['stop_min']=[]
diff['start_time']=[]
diff['stop_time']=[]
diff['result']=[]
diff['stops']=[]

#get start and stop time
for i in range(0, len(stp_time)):
    if stp_time['stop_sequence'][i]==0 and i > 0:
        trip_id = stp_time['trip_id'][i]
        start_time = stp_time['stop_times'][i]
        stop_time = stp_time['stop_times'][i-1]
        start_min = start_time.split(":")[1]
        stop_min = stop_time.split(":")[1]
        diff['trip_id'].append(trip_id)
        diff['start_min'].append(start_min)
        diff['stop_min'].append(stop_min)
        diff['start_time'].append(start_time)
        diff['stop_time'].append(stop_time)
        diff['stops'].append(stp_time['stop_sequence'][i-1])

#add components missing, beginning and ending
diff['trip_id'].insert(0,"[@14.0.51708725@][4][1277756770140]/0__T4_UIMF")
diff['start_min'].insert(0,"25")
diff['stop_min'].insert(len(diff['stop_min'])+1,"09")
diff['start_time'].insert(0,"07:25:00")
diff['stop_time'].insert(len(diff['stop_min'])+1,"16:09:37")
diff['stops'].insert(len(diff['stops'])+1,"30")
```

```
#calculate travel time interval
start = np.array(diff['start_min'], dtype='int')
stop = np.array(diff['stop_min'], dtype='int')
for i in range (0, len(diff['stop_min'])):
    if stop[i] - start[i] < 0:
        diff['result'].append(stop[i] - start[i] +60)
    else:
        diff['result'].append(stop[i] - start[i])

#load into datafram
df = pd.DataFrame({'trip_id': diff['trip_id'],'time intervals': diff['result
                   'start_times':diff['start_time'],'stop_times':diff['stop_
                  'stops': diff['stops']})

#translate trip_id into route_name
merge = pd.DataFrame({'route_id': trips['route_id'], 'trip_id': trips['trip_

#get rid of descriptions
for i in range(0, len(merge['route_id'])):
    temp = merge['route_id'][i].split(" ")[0]
    merge['route_id'][i] = temp

#get rid of hopper
for i in range(0, len(merge['route_id'])):
    if len(merge['route_id'][i])>9:
        temp = merge['route_id'][i][:-6]
        merge['route_id'][i] = temp

#get rid of numbers
for i in range(0, len(merge['route_id'])):
    if merge['route_id'][i][0] == '1':
        merge['route_id'][i] = "YELLOW"
    elif merge['route_id'][i][0] == '3':
        merge['route_id'][i] = "LAVENDER"
    elif merge['route_id'][i][0] == '5':
        merge['route_id'][i] = "GREEN"
    elif merge['route_id'][i][0] == '7':
        merge['route_id'][i] = "GREY"
    elif merge['route_id'][i] == '10W':
        merge['route_id'][i] = "GOLD"

temp_df1 = pd.merge(df, merge, on='trip_id')
```

In [6]:
```
temp_df1
```

Out[6]:

	start_times	stop_times	stops	time intervals	trip_id	route_id
0	07:25:00	07:35:00	2	10	[@14.0.51708725@][4][1277756770140]/0__T4_UIMF	TEAL
1	07:35:00	07:50:00	15	15	[@14.0.51708725@][4][1275505811421]/0__T4_UIMF	TEAL
2	07:55:00	08:15:00	26	20	[@7.0.41893871@][3][1243541396687]/72__T4_UIMF	TEAL
3	08:16:00	08:35:00	22	19	[@7.0.41893871@][4][1243540851671]/4__T4_UIMF	TEAL
4	08:35:00	08:55:00	26	20	[@7.0.41893871@][3][1243541396687]/74__T4_UIMF	TEAL
5	08:56:00	09:15:00	22	19	[@7.0.41893871@][4][1243540851671]/6__T4_UIMF	TEAL
6	09:25:00	09:40:00	17	15	[@7.0.41893871@][3][1243541488843]/110__T4_UIMF	TEAL
7	09:51:00	10:05:00	15	14	[@14.0.51708725@][4][1275506079140]/6__T4_UIMF	TEAL
8	10:15:00	10:35:00	26	20	[@7.0.41893871@][3][1243541396687]/79__T4_UIMF	TEAL
9	10:36:00	10:55:00	22	19	[@7.0.41893871@][4][1243540851671]/11__T4_UIMF	TEAL
10	10:55:00	11:15:00	26	20	[@7.0.41893871@][3][1243541396687]/81__T4_UIMF	TEAL
11	11:16:00	11:35:00	22	19	[@7.0.41893871@][4][1243540851671]/13__T4_UIMF	TEAL
12	11:35:00	11:55:00	26	20	[@7.0.41893871@][3][1243541396687]/83__T4_UIMF	TEAL
13	11:56:00	12:15:00	22	19	[@7.0.41893871@][4][1243540851671]/15__T4_UIMF	TEAL
14	12:25:00	12:40:00	17	15	[@7.0.41893871@][3][1243541488843]/119__T4_UIMF	TEAL
15	12:51:00	13:05:00	15	14	[@14.0.51708725@][4][1275506079140]/12__T4_UIMF	TEAL
16	13:15:00	13:35:00	26	20	[@7.0.41893871@][3][1243541396687]/88__T4_UIMF	TEAL
17	13:36:00	13:55:00	22	19	[@7.0.41893871@][4][1243540851671]/20__T4_UIMF	TEAL

	start_times	stop_times	stops	time intervals	trip_id	route_id
18	13:55:00	14:15:00	26	20	[@7.0.41893871@][3] [1243541396687]/90__T4_UIMF	TEAL
19	14:16:00	14:35:00	22	19	[@7.0.41893871@][4] [1243540851671]/22__T4_UIMF	TEAL
20	14:35:00	14:55:00	26	20	[@7.0.41893871@][3] [1243541396687]/92__T4_UIMF	TEAL
21	14:56:00	15:15:00	22	19	[@7.0.41893871@][4] [1243540851671]/24__T4_UIMF	TEAL
22	15:25:00	15:40:00	17	15	[@7.0.41893871@][3] [1243541488843]/128__T4_UIMF	TEAL
23	15:51:00	16:05:00	15	14	[@14.0.51708725@][4] [1275506123875]/18__T4_UIMF	TEAL
24	16:15:00	16:35:00	26	20	[@7.0.41893871@][3] [1243541396687]/97__T4_UIMF	TEAL
25	16:36:00	16:55:00	22	19	[@7.0.41893871@][4] [1243540851671]/29__T4_UIMF	TEAL
26	16:55:00	17:15:00	26	20	[@7.0.41893871@][3] [1243541396687]/99__T4_UIMF	TEAL
27	17:16:00	17:35:00	22	19	[@7.0.41893871@][4] [1243540851671]/31__T4_UIMF	TEAL
28	17:35:00	17:55:00	26	20	[@7.0.41893871@][3] [1243541396687]/101__T4_UIMF	TEAL
29	17:56:00	18:15:00	22	19	[@7.0.41893871@][4] [1243540851671]/33__T4_UIMF	TEAL
...	...	...	...	...	...	...
5468	13:20:00	14:02:00	103	42	[@15.0.73009433@][12] [1402682836659]/37__LM1SA...	LIME
5469	14:06:00	14:33:00	54	27	[@15.0.73009433@][11] [1402676676689]/9__LM1SA_EVE	LIME
5470	14:40:00	15:22:00	103	42	[@15.0.73009433@][12] [1402682836659]/39__LM1SA...	LIME
5471	15:26:00	15:53:00	54	27	[@15.0.73009433@][11] [1402676676689]/11__LM1SA...	LIME
5472	15:55:00	16:42:00	105	47	[@15.0.73009433@][12] [1402678897199]/28__LM1SA...	LIME
5473	16:46:00	17:13:00	54	27	[@15.0.73009433@][11] [1402676676689]/13__LM1SA...	LIME

	start_times	stop_times	stops	time intervals	trip_id	route_id
5474	17:15:00	18:02:00	105	47	[@15.0.73009433@][12][1402679001843]/29__LM1SA...	LIME
5475	18:06:00	18:33:00	54	27	[@15.0.73009433@][11][1402676676689]/15__LM1SA...	LIME
5476	18:38:00	19:22:00	104	44	[@15.0.73009433@][12][1402683433784]/47__LM1SA...	LIME
5477	07:00:00	07:20:00	2	20	[@15.0.73009433@][12][1402685655732]/0__LM2SA_EVE	LIME
5478	07:20:00	08:02:00	103	42	[@15.0.73009433@][12][1402682631373]/31__LM2SA...	LIME
5479	08:06:00	08:33:00	54	27	[@15.0.73009433@][11][1402676435949]/0__LM2SA_EVE	LIME
5480	08:33:00	09:22:00	105	49	[@15.0.73009433@][12][1402678344466]/24__LM2SA...	LIME
5481	09:26:00	09:53:00	54	27	[@15.0.73009433@][11][1402676676689]/2__LM2SA_EVE	LIME
5482	10:00:00	10:42:00	103	42	[@15.0.73009433@][12][1402682836659]/32__LM2SA...	LIME
5483	10:46:00	11:13:00	54	27	[@15.0.73009433@][11][1402676676689]/4__LM2SA_EVE	LIME
5484	11:20:00	12:02:00	103	42	[@15.0.73009433@][12][1402682836659]/34__LM2SA...	LIME
5485	12:06:00	12:33:00	54	27	[@15.0.73009433@][11][1402676676689]/6__LM2SA_EVE	LIME
5486	12:40:00	13:22:00	103	42	[@15.0.73009433@][12][1402682836659]/36__LM2SA...	LIME
5487	13:26:00	13:53:00	54	27	[@15.0.73009433@][11][1402676676689]/8__LM2SA_EVE	LIME
5488	14:00:00	14:42:00	103	42	[@15.0.73009433@][12][1402682836659]/38__LM2SA...	LIME
5489	14:46:00	15:13:00	54	27	[@15.0.73009433@][11][1402676676689]/10__LM2SA...	LIME
5490	15:20:00	16:02:00	103	42	[@15.0.73009433@][12][1402682836659]/40__LM2SA...	LIME
5491	16:06:00	16:33:00	54	27	[@15.0.73009433@][11][1402676676689]/12__LM2SA...	LIME
5492	16:40:00	17:22:00	103	42	[@15.0.73009433@][12][1402682859723]/41__LM2SA...	LIME

	start_times	stop_times	stops	time intervals	trip_id	route_id
5493	17:26:00	17:53:00	54	27	[@15.0.73009433@][11] [1402676676689]/14__LM2SA...	LIME
5494	17:55:00	18:42:00	105	47	[@15.0.73009433@][12] [1402679035062]/30__LM2SA...	LIME
5495	18:46:00	19:13:00	54	27	[@15.0.73009433@][11] [1402676676689]/16__LM2SA...	LIME
5496	15:05:00	15:29:00	24	24	[@15.0.69155236@][3] [1368635976437]/6__6E_SCH_...	ORANGE
5497	15:43:00	16:09:37	30	26	[@15.0.69155236@][3] [1368635065623]/5__6E_SCH_...	ORANGE

5498 rows × 6 columns

In [7]:
```
def bugsinyourhair(value):
    lat, lon=40.1164, -88.2434
    use_colours = {'GREEN': '#008000', 'BRONZE': '#00FFFF', 'TEAL': '#00808
                   ,'ILLINI':'#FF8C00','LAVENDER':'#E6E6FA','NAVY':'#000080
                   ,'YELLOW':'#FFFF00', 'LIME':'#ADFF2F','RED':'#FF0000','B
                  }
    #devide into grade
    dlat, dlon=0.05, 0.05
    osm_tiles=OSM()
    plt.figure(figsize=(25,25))
    #collasp maps
    ax = plt.axes(projection=osm_tiles.crs)
    ax.set_extent([lon-dlon,lon+dlon,lat - dlat, lat + dlat])
    ax.add_image(osm_tiles,12)
    ax.stock_img()
    select = result2['route_id'] == value
    #project plot
    ax.scatter(list(result2['stop_lon'][select]),list(result2['stop_lat'][se
               c = use_colours[value], transform=ccrs.PlateCarree())

    plt.show()
```

In [8]:
```
from ipywidgets import widgets
from ipywidgets import interact, interactive, fixed
from IPython.display import display
from IPython.display import clear_output
```

In [9]:
```
busline = list(result2['route_id'].drop_duplicates().values)
```

In [10]:
```
busline_display = widgets.Dropdown(
    options=busline,
    description=u'Bus Line',
    disabled=False,
    continuous_update=True
)
```

In [11]:
```
display(busline_display)
```

Bus Line GREEN ▾

In [12]:
```
select_busline = temp_df1['route_id'] == busline_display.value
timeline = list(temp_df1['start_times'][select_busline].drop_duplicates().va
```

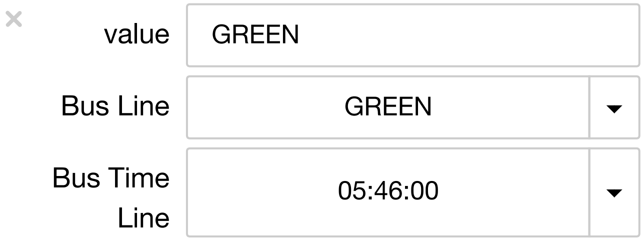
In [13]:
```
timeline_display = widgets.Dropdown(
    options=timeline,
    description=u'Bus Time Line',
    disabled=False,
    continuous_update=True
)
```

In [14]:
```
display(timeline_display)
```

Bus Time Line 05:46:00 ▾

In [15]:
```
def bugsinyourhair2(value):

    display(busline_display)
    display(timeline_display)

    select_time = temp_df1['start_times'] == timeline_display.value
    mean_time = temp_df1['time intervals'][select_busline][select_time].mean
    lat, lon=40.1164, -88.2434
    if temp_df1['time intervals'][select_time].mean() > mean_time:
        use_colours = 'RED'
    else:
        use_colours = 'GREEN'
    use_colours
    #devide into grade
    dlat, dlon=0.1, 0.1
    osm_tiles=OSM()
    plt.figure(figsize=(16,16))
    #collasp maps
    ax = plt.axes(projection=osm_tiles.crs)
    ax.set_extent([lon-dlon,lon+dlon,lat - dlat, lat + dlat], ccrs.PlateCarr
    ax.add_image(osm_tiles,12)
    ax.stock_img()
    select = result2['route_id'] == value
    #project plot
    ax.scatter(list(result2['stop_lon'][select]),list(result2['stop_lat'][se
               c = use_colours, transform=ccrs.PlateCarree())
```

```
In [16]: widgets.interact(bugsinyourhair2, value = busline_display.value)
```

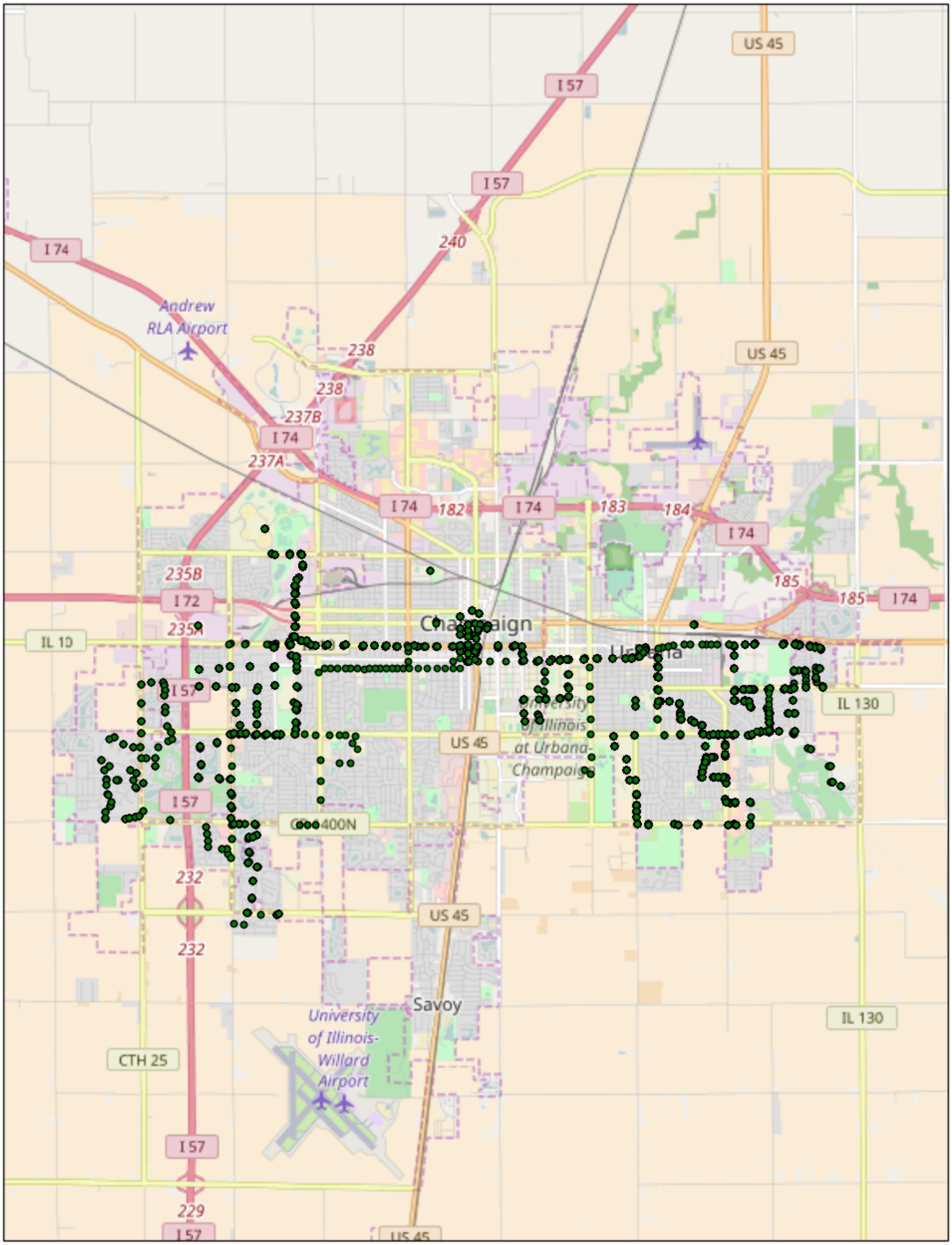


value: GREEN

Bus Line: GREEN ▾

Bus Time Line: 05:46:00 ▾

```
Out[16]: <function __main__.bugsinyourhair2>
```


I 57
US 45
I 57
240
I 74
Andrew
RLA Airport
238
US 45
238
237B
I 74
237A
I 74
182
I 74
183
184
I 74
185
235B
I 72
185
I 74
235A
Champaign
IL 10
Urbana
I 57
IL 130
University
of Illinois
at Urbana-
Champaign
US 45
I 57
CR 1400N
232
US 45
232
Savoy
University
of Illinois-
Willard
Airport
IL 130
CTH 25
I 57
229
I 57
US 45