In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import csv
import folium
from folium import plugins
%matplotlib inline
```

Importing Data

TTC Schedule:

- routes: Data of TTC routes (vehicle - associated lines)
- trips: Data of from where to where the transit is heading
- stops: Which stops associated with the transit
- stop_times: When the vehicle is arriving at particular stop as well as the frequency of the transit
- shapes: shapes of the route

Passenger Analysis Data:

- ridership_analysis: Complete data of who, which transit, and when the passengers taking the transit from 1985 to 2017
- ranking_2016: Transit stops ranking based on ridership in 2016
- non_peak_passengers: Summary of ridership during non-peak time from 2004 to 2017
- peak_passengers: Summary of ridership during peak hours from 2004 to 2017
- average_weekday_ridership : Summary of ridership during weekdays from 2016 to parts of 2018
- average_monthly_ridership : Summary of monthly ridership from 2016 to parts of 2018

Delay Data:

- subway_delay_14_to_17: Logs for all reported delay for TTC from 2014 to 2017, complete with cause of incident, when the delay is, how long the delay is, and which stop
- subway_delay: Summary of subway delay from January to November 2018
- streetcar_delay: Summary of streetcar delay from January to November 2018
- bus_delay: Summary of bus delay from January to November 2018

In [74]:
```
routes = pd.read_csv('./OpenData_TTC_Schedules/routes.txt', low_memory=False)
trips = pd.read_csv('./OpenData_TTC_Schedules/trips.txt', low_memory=False)
stops = pd.read_csv('./OpenData_TTC_Schedules/stops.txt', low_memory=False)
stop_times = pd.read_csv('./OpenData_TTC_Schedules/stop_times.txt', low_memory=False)
shapes = pd.read_csv('./OpenData_TTC_Schedules/shapes.txt', low_memory=False)

ridership_analysis = pd.read_excel('./data/1985-2017 Analysis of ridership.xlsx')
ranking_2016 = pd.read_excel('./data/Ranking surface routes 2016 Open Data Toronto.xlsx')
non_peak_passengers = pd.read_csv('./data/TTC Annual Passenger Rides Non-Peak (000s).csv', low_memory=False)
peak_passengers = pd.read_csv('./data/TTC Annual Passenger Rides Peak (000s).csv', low_memory=False)
average_weekday_ridership = pd.read_csv('./data/TTC Average Weekday Ridership.csv', low_memory=False)
monthly_ridership = pd.read_csv('./data/TTC Monthly Ridership.csv', low_memory=False)

subway_delay_14_to_17 = pd.read_csv('./data/Subway & SRT Logs (Jan01_14 to April30_17).csv', low_memory=False)
subway_delay = pd.read_csv('./data/2018_delay_subway.csv', low_memory=False)
streetcar_delay = pd.read_csv('./data/2018_delay_streetcar.csv', low_memory=False)
bus_delay = pd.read_csv('./data/2018_delay_bus.csv', low_memory=False)
```

Shapes

Below is the list of how many `(rows, columns)` each dataset is

In [3]:
```
print("This shape of routes:", routes.shape)
print("This shape of trips:", trips.shape)
print("This shape of stops:", stops.shape)
print("This shape of stop_times:", stop_times.shape)
print("This shape of shapes:", shapes.shape)

print("This shape of ridership_analysis:", ridership_analysis.shape)
print("This shape of ranking_2016:", ranking_2016.shape)
print("This shape of non_peak_passengers:", non_peak_passengers.shape)
print("This shape of peak_passengers:", peak_passengers.shape)
print("This shape of average_weekday_ridership:", average_weekday_ridership.shape)
print("This shape of monthly_ridership:", monthly_ridership.shape)

print("This shape of subway_delay_14_to_17:", subway_delay_14_to_17.shape)
print("This shape of subway_delay:", subway_delay.shape)
print("This shape of streetcar_delay:", streetcar_delay.shape)
print("This shape of bus_delay:", bus_delay.shape)
```

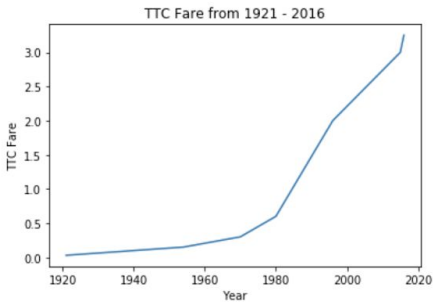
```
This shape of routes: (209, 9)
This shape of trips: (104633, 9)
This shape of stops: (10649, 11)
This shape of stop_times: (4329783, 9)
This shape of shapes: (373464, 5)
This shape of ridership_analysis: (54, 34)
This shape of ranking_2016: (217, 5)
This shape of non_peak_passengers: (1, 14)
This shape of peak_passengers: (1, 14)
This shape of average_weekday_ridership: (3, 13)
This shape of monthly_ridership: (4, 13)
This shape of subway_delay_14_to_17: (69016, 10)
This shape of subway_delay: (11, 2)
This shape of streetcar_delay: (11, 2)
This shape of bus_delay: (11, 2)
```

FACTS: Here is data of TTC Fare over the years

What a big jump, eh?

In [97]:
```
year = [1921, 1954, 1970, 1980, 1996, 2015, 2016]
fare = [0.03, 0.15, 0.30, 0.60, 2, 3, 3.25]
plt.plot(year, fare)
plt.xlabel("Year")
plt.ylabel("TTC Fare")
plt.title("TTC Fare from 1921 - 2016")
```

Out[97]:
```
Text(0.5,1,'TTC Fare from 1921 - 2016')
```



Data Cleanup

Routes

Dropping unecessary columns: *'agency_id'*, *'route_desc'*, *'route_url'*, *'route_color'*, *'route_text_color'*

In [4]:
```
# drop columns from dataset
routes = routes.drop(['agency_id', 'route_desc', 'route_url', 'route_color', 'route_text_color'], axis = 1)

# preview the cleanup dataset
routes.head()
```

Out[4]:

	route_id	route_short_name	route_long_name	route_type
0	55518	1	LINE 1 (YONGE-UNIVERSITY)	1
1	55309	10	VAN HORNE	3
2	55310	100	FLEMINGDON PARK	3
3	55311	101	DOWNSVIEW PARK	3
4	55312	102	MARKHAM RD.	3

Trips

Dropping unecessary columns: *'service_id'*, *'trip_short_name'*, *'direction_id'*, *'block_id'*, *'shape_id'*

In [5]:
```
# drop columns from dataset
trips = trips.drop(['service_id', 'trip_short_name', 'direction_id', 'block_id', 'shape_id'], axis = 1)

# preview the cleanup dataset
trips.head()
```

Out[5]:

	route_id	trip_id	trip_headsign	wheelchair_accessible
0	55309	37075813	EAST - 10 VAN HORNE TOWARDS VICTORIA PARK	1
1	55309	37075794	EAST - 10 VAN HORNE TOWARDS VICTORIA PARK	1
2	55309	37075821	EAST - 10 VAN HORNE TOWARDS VICTORIA PARK	1
3	55309	37075797	EAST - 10 VAN HORNE TOWARDS VICTORIA PARK	1
4	55309	37075791	EAST - 10 VAN HORNE TOWARDS VICTORIA PARK	1

Stops

Dropping Unecessary columns: *'zone_id'*, *'stop_url'*, *'location_type'*, *'parent_station'*, *'wheelchair_boarding'*, *'stop_desc'*

In [6]:
```
# drop columns from dataset
stops = stops.drop(['zone_id', 'stop_url', 'location_type', 'parent_station', 'wheelchair_boarding', 'stop_desc'], axis

# preview the cleanup dataset
stops.head()
```

Out[6]:

	stop_id	stop_code	stop_name	stop_lat	stop_lon
0	262	662	DANFORTH RD AT KENNEDY RD	43.714395	-79.260962
1	263	929	DAVENPORT RD AT BEDFORD RD	43.674448	-79.399696
2	264	940	DAVENPORT RD AT DUPONT ST	43.675540	-79.401960
3	265	1871	DAVISVILLE AVE AT CLEVELAND ST	43.702096	-79.378146
4	266	11700	DISCO RD AT ATTWELL DR	43.701331	-79.594777

Stop Times

Dropping unecessary columns: *'stop_headsign'*, *'pickup_type'*, *'drop_off_type'*, *'shape_dist_traveled'*

In [7]:
```
# drop columns from dataset
stop_times = stop_times.drop(['stop_headsign', 'pickup_type', 'drop_off_type', 'shape_dist_traveled'], axis = 1)

# preview the cleanup dataset
stop_times.head()
```

Out[7]:

	trip_id	arrival_time	departure_time	stop_id	stop_sequence
0	37075791	6:15:00	6:15:00	13173	1
1	37075791	6:15:22	6:15:22	14155	2
2	37075791	6:16:11	6:16:11	3807	3
3	37075791	6:17:33	6:17:33	6904	4
4	37075791	6:18:48	6:18:48	1163	5

Merge Data

Merging following dataset into one dataset: `routes` , `trips` , `stop_times` , and `stops`

In [9]:
```
# Merge routes with trips on route_id
route_trip = pd.merge(routes, trips, on='route_id')
```

In [10]:
```
# Merge routes + trips with stop_times on trip_id
route_trip_stop_times = pd.merge(route_trip, stop_times, on = 'trip_id')
```

In [11]:
```
# Merge routes + trips + stop_times on stop_id
route_trip_stop = pd.merge(route_trip_stop_times, stops, on = 'stop_id')
```

In [12]:
```
# Preview the first 5 data
route_trip_stop.head()
```

Out[12]:

	route_id	route_short_name	route_long_name	route_type	trip_id	trip_headsign	wheelchair_accessible	arrival_time	departure_time	stop_id	stop_sequenc
0	55518	1	LINE 1 (YONGE-UNIVERSITY)	1	37181522	LINE 1 (YONGE-UNIVERSITY) TOWARDS VAUGHAN METR...	1	5:31:21	5:31:21	14404	
1	55518	1	LINE 1 (YONGE-UNIVERSITY)	1	37181510	LINE 1 (YONGE-UNIVERSITY) TOWARDS VAUGHAN METR...	1	5:36:03	5:36:03	14404	
2	55518	1	LINE 1 (YONGE-UNIVERSITY)	1	37181426	LINE 1 (YONGE-UNIVERSITY) TOWARDS VAUGHAN METR...	1	5:40:45	5:40:45	14404	
3	55518	1	LINE 1 (YONGE-UNIVERSITY)	1	37181427	LINE 1 (YONGE-UNIVERSITY) TOWARDS VAUGHAN METR...	1	5:45:27	5:45:27	14404	
4	55518	1	LINE 1 (YONGE-UNIVERSITY)	1	37181428	LINE 1 (YONGE-UNIVERSITY) TOWARDS VAUGHAN METR...	1	5:50:09	5:50:09	14404	

In [13]:
```
# Final shape of the merged data
route_trip_stop.shape
```

Out[13]:
```
(4329783, 15)
```

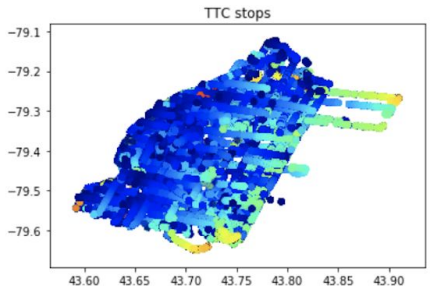
TTC Stop and Routes

Plot scatter plot of all listed stops and routes

`Note` : *Does the shape look familiar?*

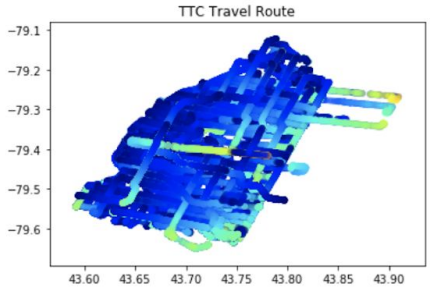
In [15]:
```
xs = route_trip_stop["stop_lat"]
ys = route_trip_stop["stop_lon"]
sz = route_trip_stop["stop_sequence"]
cm = plt.get_cmap('jet')
plt.title("TTC stops")
plt.scatter(xs, ys, c = sz, cmap = cm, alpha=0.3, edgecolors='None')
```

Out[15]:
```
<matplotlib.collections.PathCollection at 0x1a4fe90cf8>
```



In [16]:
```
xs = shapes["shape_pt_lat"]
ys = shapes["shape_pt_lon"]
sz = shapes["shape_dist_traveled"]
cm = plt.get_cmap('jet')
plt.title("TTC Travel Route")
plt.scatter(xs, ys, c = sz, cmap = cm, alpha=0.3, edgecolors='None')
```

Out[16]:
```
<matplotlib.collections.PathCollection at 0x1a5002f828>
```



TTC Routes Analysis

Analyze the merged data and finding TTC transit that operating the most

Top 20 TTC Routes

- Group by dataset by the route name
- Sort by the one that has the most count
- Take top 20 of the grouped by + sorted data

In [19]:
```
# Group by the dataset by the route name
top20 = route_trip_stop.groupby(['route_long_name']).count()

# Sort Values count (also, reset index!)
top20 = pd.DataFrame(top20).sort_values(by = "trip_id", ascending = False)
top20 = pd.DataFrame(top20).reset_index()

# Let's take the top 20 routes
top20 = top20.head(20)
```

In [20]:
```
# Preview the data
top20
```

Out[20]:

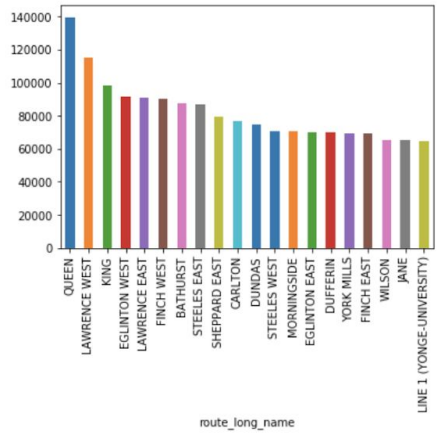
	route_long_name	route_id	route_short_name	route_type	trip_id	trip_headsign	wheelchair_accessible	arrival_time	departure_time	stop_id	stop_sequenc
0	QUEEN	139890	139890	139890	139890	139890	139890	139890	139890	139890	13989
1	LAWRENCE WEST	115070	115070	115070	115070	115070	115070	115070	115070	115070	11507
2	KING	98588	98588	98588	98588	98588	98588	98588	98588	98588	9858
3	EGLINTON WEST	91762	91762	91762	91762	91762	91762	91762	91762	91762	9176
4	LAWRENCE EAST	90834	90834	90834	90834	90834	90834	90834	90834	90834	9083
5	FINCH WEST	90133	90133	90133	90133	90133	90133	90133	90133	90133	9013
6	BATHURST	87326	87326	87326	87326	87326	87326	87326	87326	87326	8732
7	STEELES EAST	86618	86618	86618	86618	86618	86618	86618	86618	86618	8661
8	SHEPPARD EAST	79718	79718	79718	79718	79718	79718	79718	79718	79718	7971
9	CARLTON	77025	77025	77025	77025	77025	77025	77025	77025	77025	7702
10	DUNDAS	75046	75046	75046	75046	75046	75046	75046	75046	75046	7504
11	STEELES WEST	70627	70627	70627	70627	70627	70627	70627	70627	70627	7062
12	MORNINGSIDE	70386	70386	70386	70386	70386	70386	70386	70386	70386	7038
13	EGLINTON EAST	70205	70205	70205	70205	70205	70205	70205	70205	70205	7020
14	DUFFERIN	69864	69864	69864	69864	69864	69864	69864	69864	69864	6986
15	YORK MILLS	69525	69525	69525	69525	69525	69525	69525	69525	69525	6952
16	FINCH EAST	69074	69074	69074	69074	69074	69074	69074	69074	69074	6907
17	WILSON	65501	65501	65501	65501	65501	65501	65501	65501	65501	6550
18	JANE	65044	65044	65044	65044	65044	65044	65044	65044	65044	6504
19	LINE 1 (YONGE-UNIVERSITY)	64435	64435	64435	64435	64435	64435	64435	64435	64435	6443

Bar Plot Top 20 Routes

Breaking down and compare how much different each route

In [22]:
```
top20.plot.bar(x = 'route_long_name', y = 'route_id', legend = False)
```

Out[22]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a50062b38>
```



Scatter Plot Top 20 Routes Location

Since our modified dataset has only count, we have to remodify the data

- Group by the original merged dataset by its `stop latitude` and `stop longitude`
- Sort Values
- Take top 20 data
- Plot data (the bigger the size the more TTC running in that particular route)

`Note` : *Again, do you see any similar shape on the plotted dots*

In [23]:
```
# Group by the original merged dataset by its stop_lat and stop_lon
location = route_trip_stop.groupby(['stop_lat', 'stop_lon']).count()

# Sort value descending
location = location.sort_values(by = "trip_id", ascending = False)

# Take top 20
location = location.head(20)
```

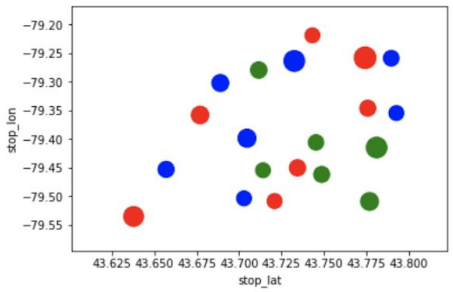
In [24]:
```
# Preview data
location
```

Out[24]:

stop_lat	stop_lon	route_id	route_short_name	route_long_name	route_type	trip_id	trip_headsign	wheelchair_accessible	arrival_time	departure_time	stop
43.774232	**-79.258146**	7484	7484	7484	7484	7484	7484	7484	7484	7484	7
43.732489	**-79.263685**	6918	6918	6918	6918	6918	6918	6918	6918	6918	6
43.781006	**-79.415011**	6839	6839	6839	6839	6839	6839	6839	6839	6839	6
43.637835	**-79.535423**	6223	6223	6223	6223	6223	6223	6223	6223	6223	6
43.704614	**-79.398706**	5218	5218	5218	5218	5218	5218	5218	5218	5218	5
43.776858	**-79.509285**	5102	5102	5102	5102	5102	5102	5102	5102	5102	5
43.677011	**-79.358222**	4897	4897	4897	4897	4897	4897	4897	4897	4897	4
43.688918	**-79.302183**	4581	4581	4581	4581	4581	4581	4581	4581	4581	4
43.711551	**-79.279570**	4313	4313	4313	4313	4313	4313	4313	4313	4313	4
43.734382	**-79.450533**	4221	4221	4221	4221	4221	4221	4221	4221	4221	4
43.656986	**-79.453233**	4138	4138	4138	4138	4138	4138	4138	4138	4138	4
43.748653	**-79.462031**	4101	4101	4101	4101	4101	4101	4101	4101	4101	4
43.775778	**-79.346305**	4082	4082	4082	4082	4082	4082	4082	4082	4082	4
43.789613	**-79.258828**	3909	3909	3909	3909	3909	3909	3909	3909	3909	3
43.745297	**-79.406064**	3817	3817	3817	3817	3817	3817	3817	3817	3817	3
43.720909	**-79.508618**	3558	3558	3558	3558	3558	3558	3558	3558	3558	3
43.702872	**-79.503822**	3553	3553	3553	3553	3553	3553	3553	3553	3553	3
43.714080	**-79.454736**	3552	3552	3552	3552	3552	3552	3552	3552	3552	3
43.743174	**-79.218906**	3550	3550	3550	3550	3550	3550	3550	3550	3550	3
43.792654	**-79.354723**	3528	3528	3528	3528	3528	3528	3528	3528	3528	3

In [43]:
```
# Plot data using matplotlib
# Note the bigger the size, the more TTC running in that route
cm = plt.get_cmap('jet')
size = np.array(location["route_id"])
location.reset_index().plot.scatter(x = "stop_lat", y = "stop_lon", s= size/20, c=['red', 'blue', 'green'])
```

Out[43]: <matplotlib.axes._subplots.AxesSubplot at 0x1a0a21d588>



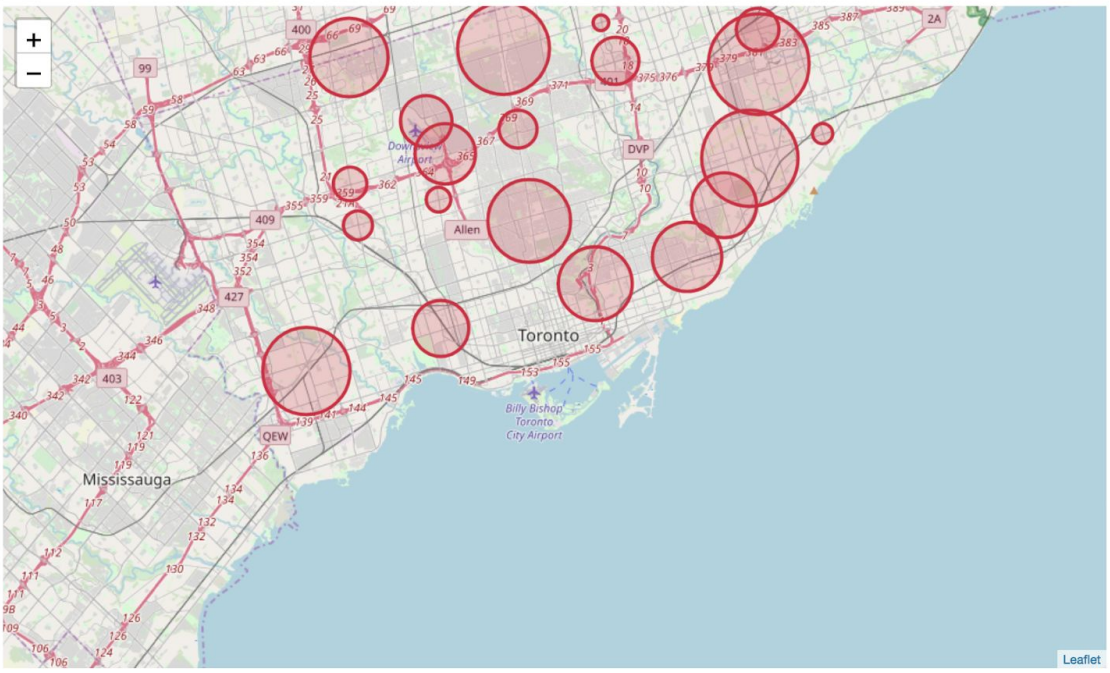
Map the Routes

Using `folium` let's take closer look where are these stops located

`Answer` : *It is all located in Toronto!*

In [28]:
```
top20_map = folium.Map(location=[43.6532,-79.3832], zoom_start = 11)
for i in range(0,len(location)):
    folium.CircleMarker(
          location=[location.index[i][0], location.index[i][1]],
          radius = int(45 - (2*i)),
          color='crimson',
          fill=True,
    ).add_to(top20_map)
top20_map
```

Out[28]:



TTC Ridership Analysis

Let's take a closer look on how many people are using the transit system and find out:

- Who they are and which transit people take the most?
- When people are using the service the most?

Who takes the transit? Which transit do people take the most?

Analysis of passengers and transit from 2008 to 2017

Note that ridership results for 2015 exclude the Free Rides allowance for Pan Am & Parapan Am games.

In [39]:
```
# Let's make sure we got all the sub-total for each category from the dataset
passenger = ridership_analysis[ridership_analysis['  FARE MEDIA'] == '  SUB-TOTAL']
```

In [40]:
```
# Drop 'FARE MEDIA' from the column then reset index
passenger = passenger.drop(columns=['  FARE MEDIA'], axis = 1)
passenger = passenger.reset_index()

# Drop 'Index' column since it produces NaN
passenger = passenger.drop(columns=['index'], axis = 1)
```

In [41]:
```
# Narrow down data from 1985-2017 to 2008-2017 by slicing the data using iloc
passenger = passenger.iloc[: , :10]
```

In [42]:
```
# Preview the modified dataset
passenger
```

Out[42]:

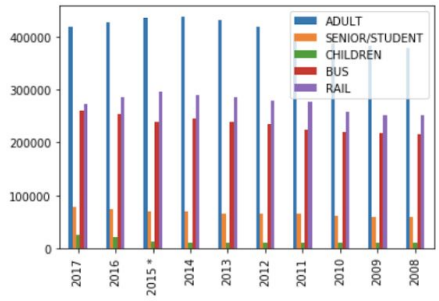
	2017	2016	2015 *	2014	2013	2012	2011	2010	2009	2008
0	417608.0	426973.0	434889.0	437287.0	431142.0	419118.0	406594.0	386351.0	381848.0	378893.0
1	78044.0	73648.0	70967.0	69036.0	65059.0	65596.0	65200.0	62513.0	60346.0	59994.0
2	25019.0	21911.0	12541.0	10802.0	10271.0	10518.0	10737.0	10826.0	10972.0	11035.0
3	261113.0	252899.0	238943.0	245292.0	239968.0	234582.0	223269.0	219855.0	218545.0	215997.0
4	272103.0	285180.0	295062.0	289523.0	285226.0	279425.0	276950.0	257502.0	252688.0	250703.0

Bar Plot the Results!

- Transpose data for plot clarity
- Set the new category for column name: "*ADULT*", "*SENIOR/STUDENT*", "*CHILDREN*", "*BUS*", "*RAIL*"
- Using matplotlib bar plot to plot the result

In [44]:
```
# Transpose Dataset
passenger = passenger.T

# Set column name (for categories letter in the plot)
passenger.columns = ["ADULT", "SENIOR/STUDENT", "CHILDREN", "BUS", "RAIL"]

# Bar plot the data using matplotlib
passenger.plot.bar()
```

Out[44]: <matplotlib.axes._subplots.AxesSubplot at 0x1a0c0467f0>



When do people use the transit the most?

Do those people take the transit during the `weekdays` for work? During Peak time? Non peak time?

Or maybe on the `weekend` just to visit various events happening in Toronto?

Weekdays Dataset Modification

- Filter ridership_analysis data that match week days
- Clean up dataset
- Transpose dataset, reset index, set new index
- Take data from 2008 to 2017

In [45]:
```
# Get the total number of people who take transit on weekdays
weekdays = ridership_analysis[ridership_analysis['  FARE MEDIA'] == 'WEEKDAY']
```

In [46]:
```
# Drop 'FARE MEDIA' column (clean up)
weekdays = weekdays.drop(columns=['  FARE MEDIA'], axis = 1)

# Transpose Data that later going to be useful for easiness in plotting
weekdays = weekdays.T

# Reset index and set 'index' as the new index
weekdays = weekdays.reset_index().set_index('index')
```

In [47]:
```
# Take data from 2008 to 2017
weekdays = weekdays.head(10)

# Preview data
weekdays
```

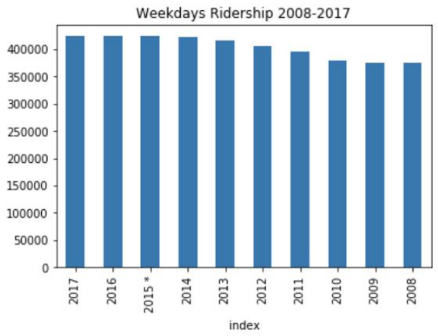
Out[47]:

index	WHEN
2017	424155.0
2016	424117.0
2015 *	423808.0
2014	423269.0
2013	416297.0
2012	406913.0
2011	395578.0
2010	379810.0
2009	374908.0
2008	374765.0

Plot TTC Ridership on Weekdays 2008 -2017

In [51]:
```
weekdays.plot.bar(legend=False, title="Weekdays Ridership 2008-2017")
```

Out[51]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a0ca18b00>
```



Weekend Dataset Modification

- Filter ridership_analysis data that match weekend
- Clean up dataset
- Transpose dataset, reset index, set new index
- Take data from 2008 to 2017

In [48]:
```
# Get total number of people who take transit on weekends
weekend = ridership_analysis[ridership_analysis['  FARE MEDIA'] == 'WEEKEND/HOLIDAY']
```

In [49]:
```
# Drop 'FARE MEDIA' column (clean up)
weekend = weekend.drop(columns=['  FARE MEDIA'], axis = 1)

# Transpose Data that later going to be useful for easiness in plotting
weekend = weekend.T

# Reset index and set 'index' as the new index
weekend = weekend.reset_index().set_index('index')
```

In [50]:
```
# Take data from 2008 to 2017
weekend = weekend.head(10)

# Preview data
weekend
```

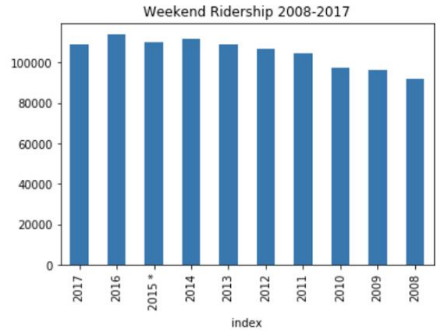
Out[50]:

index	nan
2017	109061.0
2016	113962.0
2015 *	110197.0
2014	111546.0
2013	108897.0
2012	107094.0
2011	104641.0
2010	97547.0
2009	96325.0
2008	91935.0

Plot TTC Ridership on Weekend 2008 -2017

In [52]:
```
weekend.plot.bar(legend=False, title="Weekend Ridership 2008-2017")
```

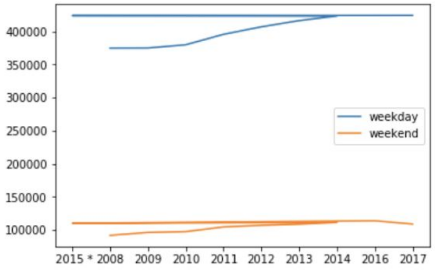
Out[52]: <matplotlib.axes._subplots.AxesSubplot at 0x1a0f114ba8>



Overall weekdays vs weekend comparison

In [55]:
```
# Plot weekdays
plt.plot(weekdays, label = "weekday")

# Plot weekend
plt.plot(weekend, label = "weekend")

 # show plot legend
plt.legend()
```

Out[55]: <matplotlib.legend.Legend at 0x1a0f2aab70>



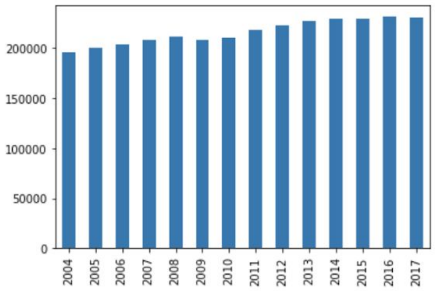
Analysis: Peak Time & Non-Peak Time Riders

Peak Time

Is it increasing or decreasing?

In [101]:
```
# Transpose Data
peak_passengers = peak_passengers.T

# Plot data using pandas
peak_passengers.plot.bar(legend = False)
```

Out[101]: <matplotlib.axes._subplots.AxesSubplot at 0x1a1f13d0f0>

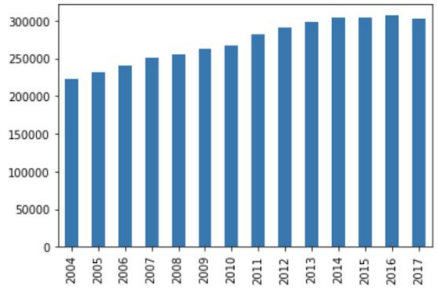


Non-Peak Time

Is it increasing or decreasing?

In [103]:
```
# Transpose data
non_peak_passengers = non_peak_passengers.T

# Plot data using pandas
non_peak_passengers.plot.bar(legend = False)
```

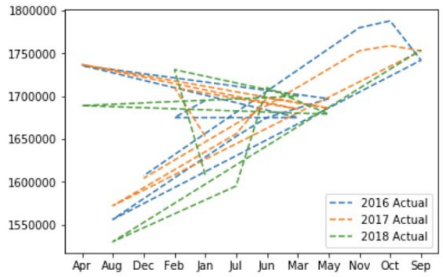
Out[103]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a1f37b7b8>
```



Analysis: Average Weekday Ridership

How is it correlating over the months and years?

In [104]:
```
# Set 'Year' as index
average_weekday_ridership = average_weekday_ridership.set_index('Year')

# Plot how is it fluctuating depending on the months in the year
for i in range(len(average_weekday_ridership)):
    plt.plot(average_weekday_ridership.iloc[i], '--', label = average_weekday_ridership.index[i])
    plt.legend()
```

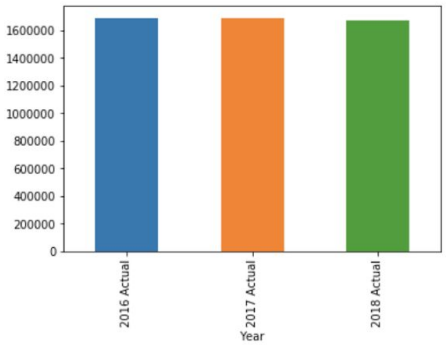


Average Weekdays Ridership

Let's do quick analysis over the yearly average

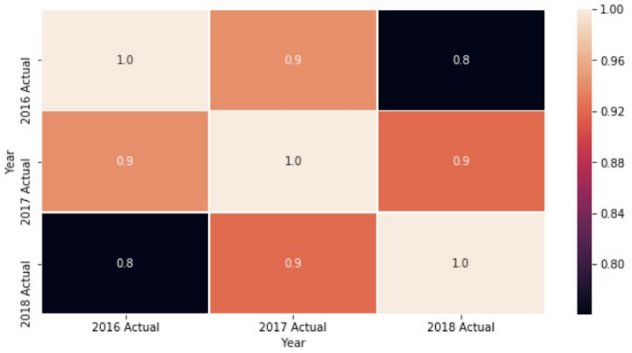
In [107]:
```
# Transpose Data
yearly_average = average_weekday_ridership.T

# Aggregate mean of the data
yearly_average = yearly_average.agg(np.mean)

# Plot the data
yearly_average.plot.bar(legend=False)
```

Out[107]: <matplotlib.axes._subplots.AxesSubplot at 0x1a297d9b00>



How is the correlation of the mean over the years?

In [109]:
```
yearly_average = average_weekday_ridership.T
f,ax = plt.subplots(figsize=(10,5))
sns.heatmap(yearly_average.corr(), annot=True, linewidths=.5, fmt= '.1f',ax=ax)
plt.show()
```



Which Route do People Take the Most?

Based on 2016 ranking data

Clean up the dataset

Read in spreadsheet format, need some cleanup

In [75]:
```
# Raw data preview
ranking_2016.head()
```

Out[75]:

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	Rank	Route #	Route Name	Ridership	NaN
1	1	504	King	64579	NaN
2	2	32	Eglinton West	48684	NaN
3	3	36	Finch West	43952	NaN
4	4	52	Lawrence West	43882	NaN

In [76]:
```
# Take the first row of the dataset
new_header = ranking_2016.iloc[0]

# Reset data starting from second row onwards
ranking_2016 = ranking_2016[1:]

# Set the first row as the column header
ranking_2016.columns = new_header

# Slice the last column out since it only contain NaN and has no useful data for this analysis
ranking_2016 = ranking_2016.iloc[:, :5]
```

In [77]:
```
# Convert 'Ridership' Column from string to int
ranking_2016.Ridership = pd.to_numeric(ranking_2016.Ridership, errors='coerce').fillna(0).astype(np.int64)

# Sort dataset based on 'Ridership' values descending then reset index
ranking_2016 = pd.DataFrame(ranking_2016).sort_values(by = "Ridership", ascending = False).reset_index()
```

In [78]:
```
# Make sure it's not taking 'NaN' since it's not specifying which routes
ranking_2016 = ranking_2016.iloc[1:, :]

# Take top 20 routes
ranking_2016 = ranking_2016.head(20)

# Preview data
ranking_2016
```

Out[78]:

Out[78]:

	index	Rank	Route #	Route Name	Ridership	nan
1	1	1	504	King	64579	NaN
2	2	2	32	Eglinton West	48684	NaN
3	3	3	36	Finch West	43952	NaN
4	4	4	52	Lawrence West	43882	NaN
5	5	5	510	Spadina	43804	NaN
6	6	6	501	Queen	43464	NaN
7	7	7	29	Dufferin	39721	NaN
8	8	8	506	Carlton	39601	NaN
9	21	21	25	Don Mills	39066	NaN
10	9	9	512	St. Clair	38113	NaN
11	10	10	54	Lawrence East	36277	NaN
12	11	11	35	Jane	32479	NaN
13	12	12	505	Dundas	32410	NaN
14	13	13	60	Steeles West	29819	NaN
15	14	14	34	Eglinton East	29501	NaN
16	15	15	53	Steeles East	28278	NaN
17	16	16	95	York Mills	27485	NaN
18	17	17	85	Sheppard East	27146	NaN
19	18	18	24	Victoria Park	26869	NaN
20	19	19	7	Bathurst	26251	NaN

Map the Routes

Using `folium` let's take closer look where are these routes in Toronto

Find what is latitude and longitude for each of this route

In [86]:
```
# Find full dataset from original merged data where route number match all top 20 route in 2016
route_rank = route_trip_stop[route_trip_stop.route_short_name.isin([ranking_2016['Route #'][i] for i in range (1,len(ra
```

In [89]:
```
# Group by the longitude and latitude
route_rank = route_rank.groupby(['stop_lat', 'stop_lon']).count()

# For map plotting purposes
temp = route_rank.index

# Preview data
route_rank.head()
```

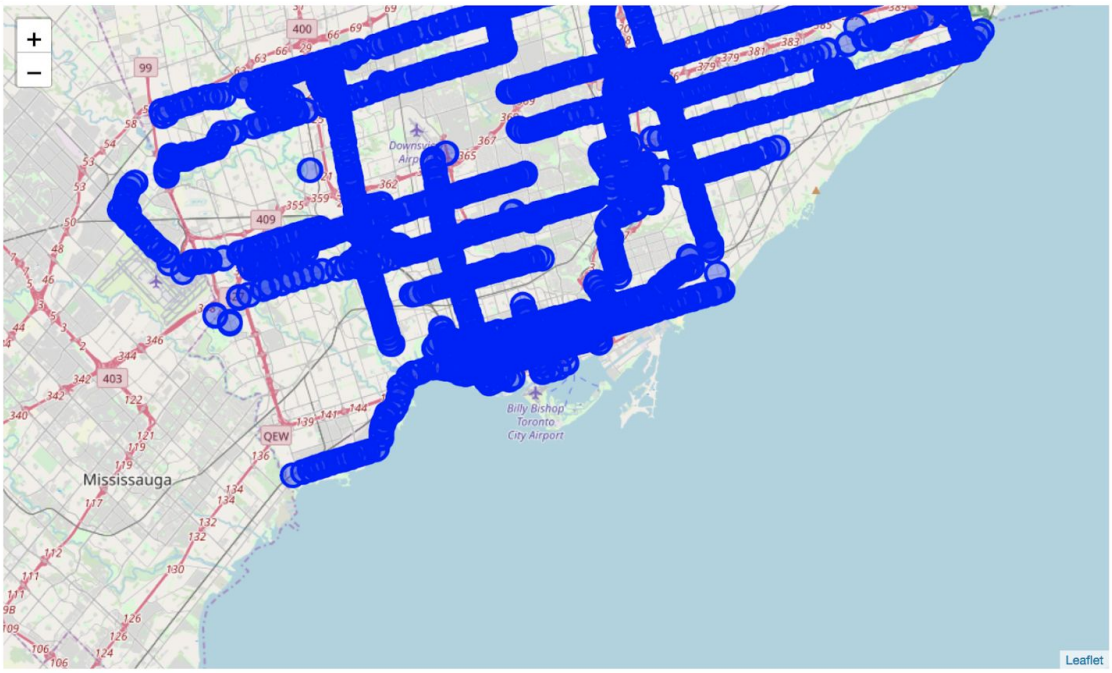
Out[89]:

stop_lat	stop_lon	route_id	route_short_name	route_long_name	route_type	trip_id	trip_headsign	wheelchair_accessible	arrival_time	departure_time	stop
43.591664	-79.544173	1	1	1	1	1	1	1	1	1	
43.591810	-79.544124	1	1	1	1	1	1	1	1	1	
43.593354	-79.538224	1	1	1	1	1	1	1	1	1	
43.593490	-79.537983	1	1	1	1	1	1	1	1	1	
43.594317	-79.534096	1	1	1	1	1	1	1	1	1	

In [91]:
```
# Plot route stops using Folium
m2 = folium.Map(location=[43.6532,-79.3832], zoom_start = 11)
for i in range(0,len(temp)):
    folium.CircleMarker(
          location=[route_rank.index[i][0], route_rank.index[i][1]],
          radius=10,
          color='blue',
          fill=True,
    ).add_to(m2)
```

In [117]:
```
# Preview the map
m2
```

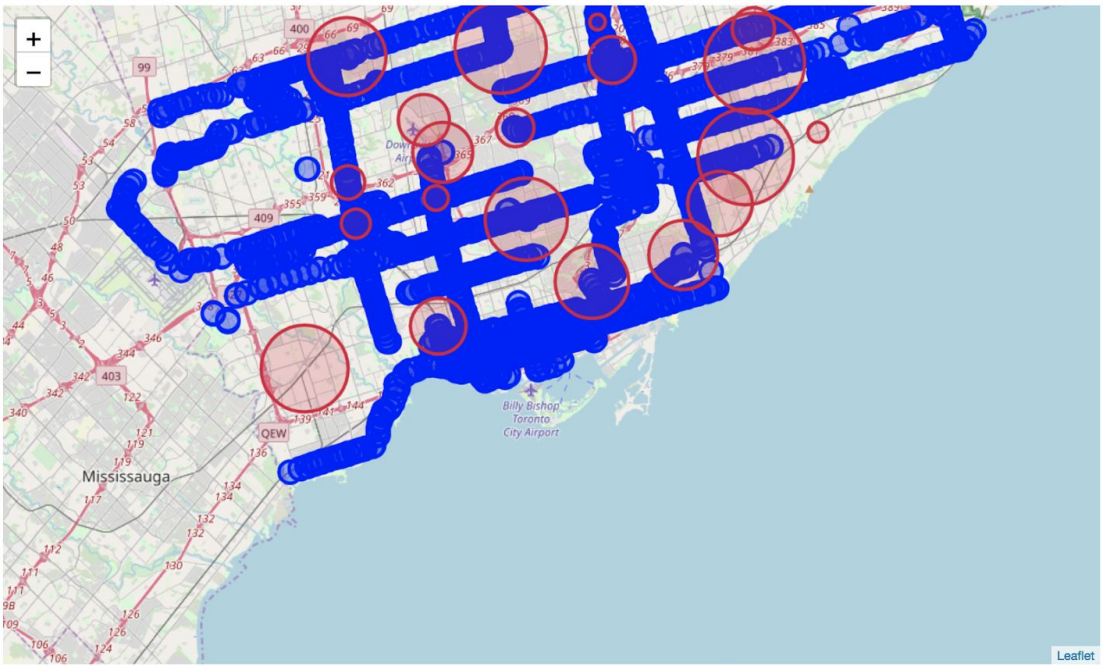
Out[117]:



Analysis: Are the frequent transits covering the popular routes taken by people?

In [95]:
```
m3 = folium.Map(location=[43.6532,-79.3832], zoom_start = 10.5)

# Add all the popular route stop from 2016
for i in range(0,len(temp)):
    folium.CircleMarker(
          location=[route_rank.index[i][0], route_rank.index[i][1]],
          radius=10,
          color='blue',
          fill=True,
    ).add_to(m3)

# Add all top 20 TTC routes
for i in range(0,len(location)):
    folium.CircleMarker(
          location=[location.index[i][0], location.index[i][1]],
          radius = int(45 - (2*i)),
          color='crimson',
          fill=True,
    ).add_to(m3)


# Preview the map
m3
```

Out[95]:



TTC Delay

Analysis of TTC delay over the years and in the most recent year of 2018

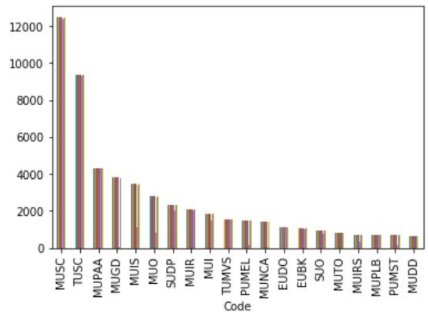
Analysis TTC Subway delay 2014 to 2017

How long is the total delay and what cause the delay the most?

`Note: The code will be explained in the analysis document`

In [112]:
```
# Group by incident code
incident = subway_delay_14_to_17.groupby(['Code']).count()

# Sort by the the longest delay
incident = pd.DataFrame(incident).sort_values(by = "Min Delay", ascending = False)

# Take top 20 incidents
incident = incident.head(20)

# Plot top 20 incidents
incident.plot.bar(legend=False)
```

Out[112]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a29b999e8>
```



Overview: TTC Delay in 2018

In [113]:
```
# Merge summary of subway and streetcar delay
delay = subway_delay.merge(streetcar_delay, on = "Time")
```

In [114]:
```
# Merge summary of subway + streetcar delay and bus delay
delay = delay.merge(bus_delay, on = "Time")
```

In [115]:
```
# Set Time as index
delay = delay.set_index("Time")

# Set column names
delay.columns = ["subway", "streetcar", "bus"]
```

In [116]:
```
# Plot to compare which TTC service experience the most in 2018
delay.plot.bar()
```

Out[116]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a36c04f98>
```