# Working_File

December 2, 2022

[1]:
```
import pandas as pd
from pyspark import SparkContext, SparkConf
from pyspark.sql import SparkSession
appName = "PySparkFlight_tbl"
master = "local"


# Create Spark session
spark = SparkSession.builder \
    .appName(appName) \
    .master(master) \
    .enableHiveSupport() \
    .getOrCreate()

#spark.sparkContext.setLogLevel("WARN")


# Create DF by reading from Hive
df = spark.sql("select * from f_db.flight_analysis2;")
```

```
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use
setLogLevel(newLevel).
22/12/01 12:23:53 INFO org.apache.spark.SparkEnv: Registering MapOutputTracker
22/12/01 12:23:53 INFO org.apache.spark.SparkEnv: Registering BlockManagerMaster
22/12/01 12:23:53 INFO org.apache.spark.SparkEnv: Registering
BlockManagerMasterHeartbeat
22/12/01 12:23:53 INFO org.apache.spark.SparkEnv: Registering
OutputCommitCoordinator
ivysettings.xml file not found in HIVE_HOME or
HIVE_CONF_DIR,/etc/hive/conf.dist/ivysettings.xml will be used
```

[2]:
```
df=df.toPandas()
#print("PySpark Dataframe converted to Pandas Dataframe")
```

[3]:
```
df_lad= spark.sql("select late_aircraft_delay from f_db.ontimerep")
```

[4]:
```
df_lad=df_lad.toPandas()
```

```
22/12/01 12:25:02 WARN org.apache.spark.sql.catalyst.util.package: Truncated the
string representation of a plan since it was too large. This behavior can be
adjusted by setting 'spark.sql.debug.maxToStringFields'.
```

[5]:
```
df_dest= spark.sql("select dest_city_name from f_db.ontimerep;")

df_dest=df_dest.toPandas()
```

[6]:
```
df['late_aircraft_delay']=df_lad['late_aircraft_delay']
df['dest_city_name']=df_dest['dest_city_name']
```

[7]:
```
df.reset_index(inplace = True, drop = True)
df['dte'] = pd.to_datetime(df['dte']) # date to datetime datatype
df[['op_carrier_fl_num',␣
 ↪'origin_airport_id','dep_time','dep_delay_new','dep_del15','distance','carrier_delay','weat
 ↪= df[['op_carrier_fl_num',␣
 ↪'origin_airport_id','dep_time','dep_delay_new','dep_del15','distance','carrier_delay','weat
 ↪apply(pd.to_numeric)
```

[14]:
```
#pd.DataFrame.hist(df.op_carrier_fl_num)
```

[8]:
```
#Exploratory Questions
#Q1: Which carriers are most and least reliable for on-time departure?
#Q2: Which airports are best and worst for on-time departures?

df_dep_delay=df[df.dep_delay_new>0.0]
df_dep_delay=df_dep_delay[["dep_delay_new","carrier_name",'display_airport_name']]
```

[112]:
```
#df_dep_delay.info()
```

[9]:
```
#Answer of Q1

len(pd.unique(df_dep_delay.carrier_name))
len(pd.unique(df.carrier_name))
#if the above two results match then execute next line of code

carriers=round(((df_dep_delay.groupby(by='carrier_name').size()/df.
 ↪groupby(by='carrier_name').size())*100),2).sort_values()

carriers=carriers.reset_index()
#carriers.info()

carriers=carriers.rename(columns={0:"% of flights delayed"})
```

[60]:
```
#import html library for display
from IPython.core.display import display, HTML
```

```
/tmp/ipykernel_3115/2058709175.py:1: DeprecationWarning: Importing display from
IPython.core.display is deprecated since IPython 7.14, please import from
IPython display
  from IPython.core.display import display, HTML
```

[10]:
```
#Answer to Q2 :Begin
len(pd.unique(df_dep_delay.display_airport_name)) #result 350
len(pd.unique(df.display_airport_name)) #result 351

#find missing row
for i in pd.unique(df.display_airport_name) :
  if i not in pd.unique(df_dep_delay.display_airport_name):
       print(i)
```

[11]:
```
#Need to remove 'Yellowstone Regional' from df dataframe

df=df.drop(df[df.display_airport_name=='Yellowstone Regional'].index)

#len(pd.unique(df.display_airport_name))

#((df_dep_delay.groupby(by='display_airport_name').size()/df.
 ↪groupby(by='display_airport_name').size())*100).sort_values()
```

[12]:
```
#Create new dataframe from above results. We'll plot this data in our map
df_q2=df[['display_airport_name', 'latitude', 'longitude']]
df_q2.drop_duplicates(subset=['display_airport_name'],inplace=True)

temp=df.groupby(by='display_airport_name').size()
df_q2['Total Flights']=temp[df_q2.display_airport_name].values

temp=df_dep_delay.groupby(by='display_airport_name').size()
df_q2['No of flights delayed']=temp[df_q2.display_airport_name].values

temp=(df_dep_delay.groupby(by='display_airport_name').size()/df.
 ↪groupby(by='display_airport_name').size())*100
df_q2['% of flights delayed']=temp[df_q2.display_airport_name].values

#df_q2.iloc[349]
```

```
/tmp/ipykernel_3115/2011631351.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame
```

```
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_q2.drop_duplicates(subset=['display_airport_name'],inplace=True)
/tmp/ipykernel_3115/2011631351.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_q2['Total Flights']=temp[df_q2.display_airport_name].values
/tmp/ipykernel_3115/2011631351.py:9: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_q2['No of flights delayed']=temp[df_q2.display_airport_name].values
/tmp/ipykernel_3115/2011631351.py:12: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_q2['% of flights delayed']=temp[df_q2.display_airport_name].values
```

[13]:
```
df_q2['display_airport_name']=df_q2.display_airport_name+" Airport"
```

```
/tmp/ipykernel_3115/2672709948.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_q2['display_airport_name']=df_q2.display_airport_name+" Airport"
```

[24]:
```
df_q2.columns
```

[24]:
```
Index(['display_airport_name', 'latitude', 'longitude', 'Total Flights',
       'No of flights delayed', '% of flights delayed'],
      dtype='object')
```

[16]:
```
correlations=df.corr().round(2)
#correlations.dep_delay_new

dep_corr=correlations.dep_delay_new
```

```
dep_corr=dep_corr.reset_index()
dep_corr["index"].iloc[[6,7,8,16]]=['carrier','weather','nas','late aircraft']
```

[18]:
```
df_carrier=df.groupby(by=['carrier_name','origin_city_name','dest_city_name']).
 ↪size()
df_carrier=df_carrier.reset_index()
df_carrier.rename(columns={0:"No of Flights"},inplace=True)
```

[19]:
```
df_dep_delay_carrier=df[df.dep_delay_new>0.0].
 ↪groupby(by=['carrier_name','origin_city_name','dest_city_name']).size()
df_dep_delay_carrier=df_dep_delay_carrier.reset_index()
df_dep_delay_carrier.rename(columns={0:"No of Flights"},inplace=True)
```

[35]:
```
#output=pd.
 ↪DataFrame(columns=['carrier_name','origin_city_name','dest_city_name','flight_delay'])
#output=output.append(df_carrier[df_carrier.carrier_name=="United Air Lines Inc.
 ↪"].sort_values(by='No of Flights',ascending=False).
 ↪head(5)[['carrier_name','origin_city_name','dest_city_name','No of␣
 ↪Flights']])
#output[(output.carrier_name.str.contains('United Air Lines Inc.') & output.
 ↪origin_city_name.str.contains('Newark, NJ'))]['No of Flights'].iloc[0]
```

[143]:
```
def Carrier_Delay_Freq_Cal(df_carrier,df_dep_delay_carrier):
    output=pd.
 ↪DataFrame(columns=['carrier_name','origin_city_name','dest_city_name','flight_delay'])
    output_delay=pd.
 ↪DataFrame(columns=['carrier_name','origin_city_name','dest_city_name'])
    carriers=pd.unique(df_carrier['carrier_name'])
    carriers_delay=pd.unique(df_dep_delay_carrier['carrier_name'])

    for carrier in carriers:
        output=output.append(df_carrier[df_carrier.carrier_name==carrier].
 ↪sort_values(by='No of Flights',ascending=False).
 ↪head(10)[['carrier_name','origin_city_name','dest_city_name','No of␣
 ↪Flights']])
        #df_carrier[df_carrier.carrier_name==carrier].sort_values(by='No of␣
 ↪Flights',ascending=False).head(5))
        output_delay=output_delay.
 ↪append(df_dep_delay_carrier[df_dep_delay_carrier.carrier_name==carrier].
 ↪sort_values(by='No of Flights',ascending=False).head(10))

    for index in range(len(output)):
```

```
        output.flight_delay.iloc[index]=output_delay[(output_delay.carrier_name.
 ↪str.contains(output.carrier_name.iloc[index]) & output_delay.
 ↪origin_city_name.str.contains(output.origin_city_name.iloc[index]) &␣
 ↪output_delay.dest_city_name.str.contains(output.dest_city_name.
 ↪iloc[index]))]['No of Flights']

    #print(output_delay['No of Flights'].tail())

    return output,output_delay
save_1,save_2=Carrier_Delay_Freq_Cal(df_carrier,df_dep_delay_carrier)
```

[144]:
```
#Check if the index match
#save_1.index.equals(save_2.index)

#Reassign the index using RangeIndex method
save_1.index=pd.RangeIndex(len(save_1))

#save_1.index
save_2.index=save_1.index
save_1['flight_delay']=save_2['No of Flights']
save_1['Delay Percentage']=round((save_1['flight_delay']/save_1['No of␣
 ↪Flights'])*100,2)
```

[145]:
```
#Flight Navigation system --Start
#Data Preparation

#Origin City longitude, latitude, and airport name
save_1['origin_lat']="XYZ"
save_1['origin_lon']="XYZ"
save_1['origin_airport_name']="XYZ"
origin_city=pd.unique(save_1.origin_city_name)

for value in origin_city:
    save_1.loc[save_1.origin_city_name==value,'origin_lat']=pd.unique(df[df.
 ↪origin_city_name.str.contains(value)].latitude)[0]
    save_1.loc[save_1.origin_city_name==value,'origin_lon']=pd.unique(df[df.
 ↪origin_city_name.str.contains(value)].longitude)[0]
    save_1.loc[save_1.origin_city_name==value,'origin_airport_name']=pd.
 ↪unique(df[df.origin_city_name.str.contains(value)].display_airport_name)[0]

#Destination City longitude, latitude, and airport name
save_1['dest_lat']='XYZ'
save_1['dest_lon']='XYZ'
save_1['dest_airport_name']='XYZ'
dest_city=pd.unique(save_1.dest_city_name)

for value in dest_city:
```

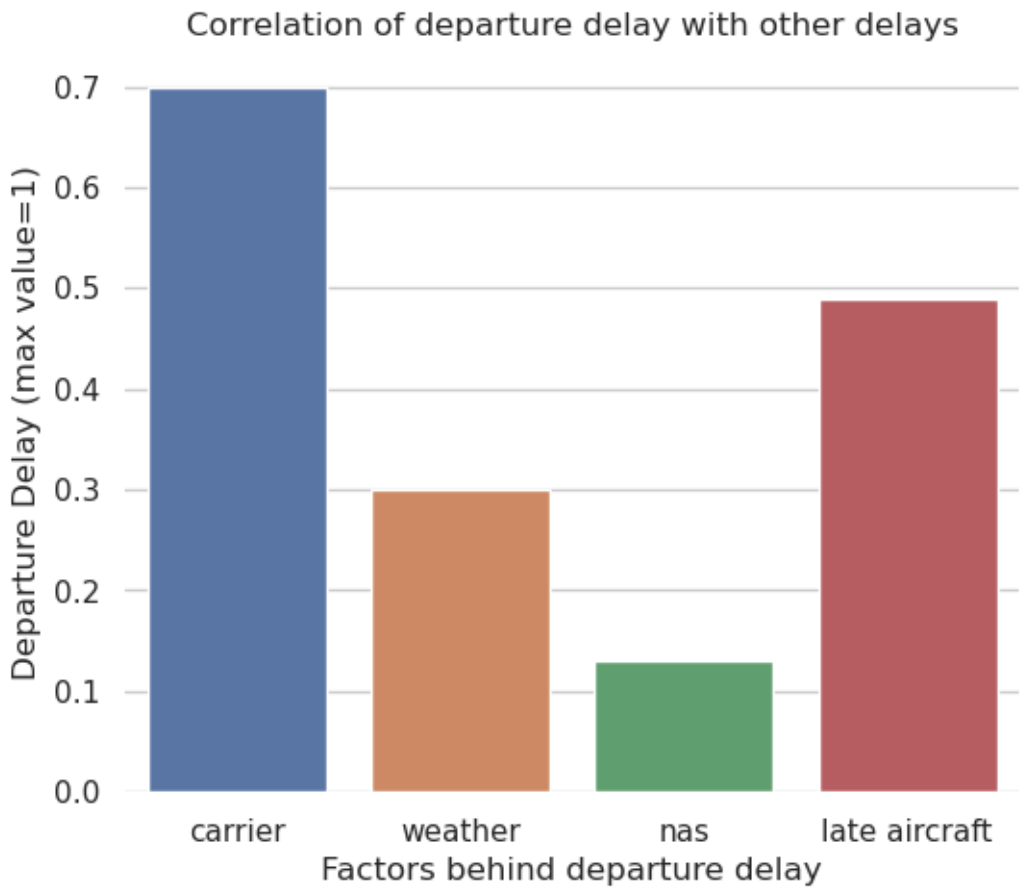
```
    save_1.loc[save_1.dest_city_name==value,'dest_lat']=pd.unique(df[df.
 ↪origin_city_name.str.contains(value)].latitude)[0]
    save_1.loc[save_1.dest_city_name==value,'dest_lon']=pd.unique(df[df.
 ↪origin_city_name.str.contains(value)].longitude)[0]
    save_1.loc[save_1.dest_city_name==value,'dest_airport_name']=pd.
 ↪unique(df[df.origin_city_name.str.contains(value)].display_airport_name)[0]
```

[146]:
```
#distance between two locations
save_1['distance']="XYZ"
for index in range(len(save_1)):
    save_1['distance'].iloc[index]=df.loc[df.origin_city_name.str.
 ↪contains(save_1.origin_city_name.iloc[index]) & df.dest_city_name.str.
 ↪contains(save_1.dest_city_name.iloc[index])].distance.iloc[0]
```

[151]:
```
#len(save_1[save_1.dest_city_name.str.contains(Dest.value) & save_1.
 ↪origin_city_name.str.contains(Origin.value)])
```

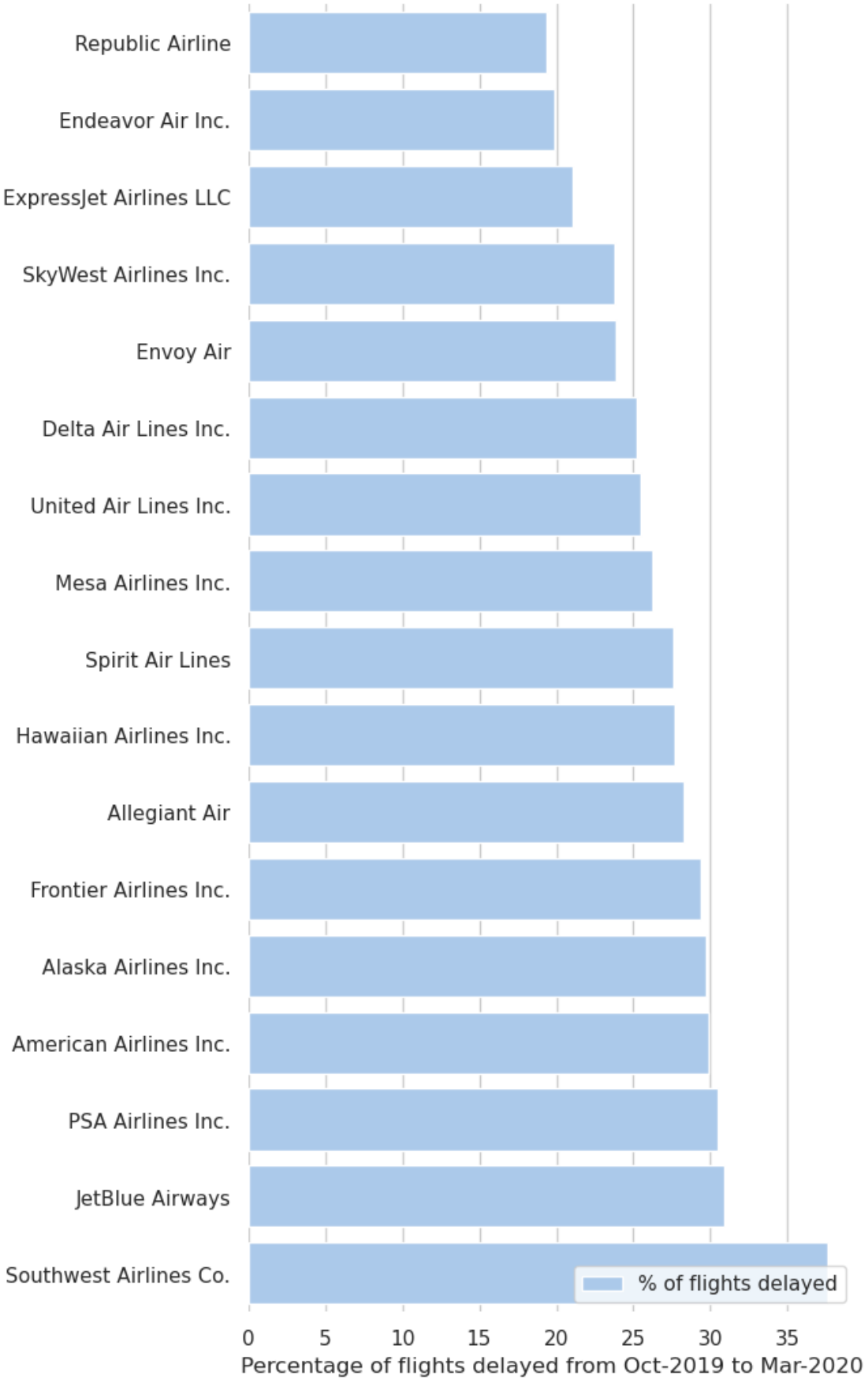
[151]:
```
0
```

[203]:
```
import seaborn as sns
import matplotlib.pyplot as plt

sns.set_theme(style="whitegrid")
f,ax = plt.subplots(figsize=(6,5))

#bar_p=sns.barplot(data=dep_corr.iloc[[6,7,8,16]], x="index", y="dep_delay_new")

sns.set_color_codes("pastel")
sns.barplot(data=dep_corr.iloc[[6,7,8,16]], x="index", y="dep_delay_new")
ax.set(ylabel='Departure Delay (max value=1)', xlabel="Factors behind departure␣
 ↪delay",title='Correlation of departure delay with other delays')
sns.despine(left=True, bottom=True)

plt.savefig('save_as_png.png')
```




[61]:
```
display(HTML('<h1 style="background-color:powderblue;">Aircraft carriers with␣
 ↪ratio of flights delayed!</h1>'))

import seaborn as sns
import matplotlib.pyplot as plt
import voila
#!voila --show_tracebacks=True
sns.set_theme(style="whitegrid")
f,ax = plt.subplots(figsize=(6,13))

sns.set_color_codes("pastel")

sns.barplot(x="% of flights delayed", y="carrier_name", data=carriers,
            label="% of flights delayed", color="b")

ax.legend(ncol=2, loc="lower right", frameon=True)
ax.set(ylabel="",
       xlabel="Percentage of flights delayed from Oct-2019 to Mar-2020")
sns.despine(left=True, bottom=True)
```

```
<IPython.core.display.HTML object>
```


Republic Airline
Endeavor Air Inc.
ExpressJet Airlines LLC
SkyWest Airlines Inc.
Envoy Air
Delta Air Lines Inc.
United Air Lines Inc.
Mesa Airlines Inc.
Spirit Air Lines
Hawaiian Airlines Inc.
Allegiant Air
Frontier Airlines Inc.
Alaska Airlines Inc.
American Airlines Inc.
PSA Airlines Inc.
JetBlue Airways
Southwest Airlines Co.
% of flights delayed
0
5
10
15
20
25
30
35
Percentage of flights delayed from Oct-2019 to Mar-2020

[161]:
```
display(HTML('<h1 style="background-color:powderblue;">Top 50 airports with␣
 ↪maximum percentage of flights delayed!</h1>'))

import folium

m = folium.Map(location=[47.116386,-101.299591],zoom_start=4)
df_q2_len=df_q2.head(50)
for index in range(len(df_q2_len)):

    iframe = folium.IFrame('<b>Total number of flights operated in  2019:␣
 ↪<b>'+str(df_q2.iloc[index][3])+"<br><br><b>No of fligths delayed in 2019:<b>␣
 ↪"+str(df_q2.iloc[index][4])+"<br><br><b>Percentage of flights delayed in␣
 ↪2019:<b> "+str(round(df_q2.iloc[index][5],2)))

    popup=folium.Popup(iframe,min_width=300,max_width=300)

    folium.Marker([df_q2.iloc[index][1], df_q2.iloc[index][2]], popup=popup,␣
 ↪tooltip=df_q2.iloc[index][0]
                ).add_to(m)

m
```

```
<IPython.core.display.HTML object>
```

[161]:
```
<folium.folium.Map at 0x7f8fa6184f10>
```

[200]:
```
#Navigation system
import ipywidgets as widgets
from IPython.display import display
import folium

display(HTML('<h1 style="background-color:powderblue;">Flight Navigation System␣
 ↪(most delayed routes)</h1>'))

origin_unq=pd.unique(save_1.origin_city_name.sort_values())
dest_unq=pd.unique(save_1.dest_city_name.sort_values())
Origin=widgets.Dropdown(
    options=origin_unq,
    value="Los Angeles, CA",
    description='<b>Origin:<b>',
)
Dest=widgets.Dropdown(
    options=dest_unq,
    value="San Francisco, CA",
    description='<b>Destination:<b>',
```

```
)
button = widgets.Button(
    description='Search',
    disabled=False,
    button_style='', # 'success', 'info', 'warning', 'danger' or ''
    tooltip='Search Flights',
    icon='check' # (FontAwesome names without the `fa-` prefix)
)

output=widgets.Output()

def on_button_clicked(b):
    output.clear_output()
    with output:
        org_lat,org_lon=pd.unique(save_1[save_1.origin_city_name==Origin.value].
 ↪origin_lat)[0],pd.unique(save_1[save_1.origin_city_name==Origin.value].
 ↪origin_lon)[0]
        des_lat,des_lon=pd.unique(save_1[save_1.dest_city_name==Dest.value].
 ↪dest_lat)[0],pd.unique(save_1[save_1.dest_city_name==Dest.value].dest_lon)[0]

        if (len(save_1[save_1.dest_city_name.str.contains(Dest.value) & save_1.
 ↪origin_city_name.str.contains(Origin.value)])==0):
            display("No Results Found!")
            return
        m_1 = folium.Map(location=[47.116386,-101.299591],zoom_start=4)

        #Origin Marker
        iframe = folium.IFrame('<b>Carrier: <b>'+save_1[save_1.dest_city_name.
 ↪str.contains(Dest.value) & save_1.origin_city_name.str.contains(Origin.
 ↪value)].carrier_name.iloc[0]+"<br><br>They delayed "+str(save_1[save_1.
 ↪dest_city_name.str.contains(Dest.value) & save_1.origin_city_name.str.
 ↪contains(Origin.value)]["Delay Percentage"].iloc[0])+"% of their flights on␣
 ↪this route.")

        org_popup=folium.Popup(iframe,min_width=200,max_width=200)

        folium.Marker([org_lat,org_lon],popup=org_popup, tooltip=save_1[save_1.
 ↪origin_city_name==Origin.value].origin_airport_name.iloc[0]).add_to(m_1)

        #Destination Marker
        #iframe = folium.IFrame('<b>Total number of flights in  2019:␣
 ↪<b>'+str(df_q2.iloc[0][3])+"<br><br><b>No of fligths delayed in 2019:<b>␣
 ↪"+str(df_q2.iloc[0][4])+"<br><br><b>Percentage of flights delayed in 2019:
 ↪<b> "+str(round(df_q2.iloc[0][5],2)))

        #dest_popup=folium.Popup(iframe,min_width=300,max_width=300)
```

```
        #popup=dest_popup
        folium.Marker([des_lat,des_lon],tooltip=save_1[save_1.
 ↪dest_city_name==Dest.value].dest_airport_name.iloc[0]).add_to(m_1)

        #Line Connection

        lat_lng_points=[[org_lat,org_lon],[des_lat,des_lon]]
        folium.PolyLine(locations=lat_lng_points,tooltip=str(save_1[save_1.
 ↪dest_city_name.str.contains(Dest.value) & save_1.origin_city_name.str.
 ↪contains(Origin.value)].distance.iloc[0])+" miles",weight=3,opacity=0.8).
 ↪add_to(m_1)
        folium.Circle(radius=100,location=[org_lat,␣
 ↪org_lon],color='green',fill=False,).add_to(m_1)
        folium.Circle(radius=100,location=[des_lat,␣
 ↪des_lon],color='red',fill=False,).add_to(m_1)
        display(m_1)
        m_1.save('Navigation.html')

button.on_click(on_button_clicked)
box= widgets.HBox([Origin,Dest,button])
display(box,output)
```

```
<IPython.core.display.HTML object>
```

```
HBox(children=(Dropdown(description='<b>Origin:<b>', index=35,␣
 ↪options=('Amarillo, TX', 'Anchorage, AK', 'Ashe…
```

```
Output()
```

[ ]: