In [1]:
```
!pip3 install folium
!pip3 install wget
```

```
Collecting folium
  Downloading folium-0.12.1.post1-py2.py3-none-any.whl (95 kB)
Requirement already satisfied: numpy in c:\users\hp\anaconda3\lib\site-packages
(from folium) (1.20.3)
Collecting branca>=0.3.0
  Downloading branca-0.4.2-py3-none-any.whl (24 kB)
Requirement already satisfied: requests in c:\users\hp\anaconda3\lib\site-packa
ges (from folium) (2.26.0)
Requirement already satisfied: jinja2>=2.9 in c:\users\hp\anaconda3\lib\site-pa
ckages (from folium) (2.11.3)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\hp\anaconda3\lib\si
te-packages (from jinja2>=2.9->folium) (1.1.1)
Requirement already satisfied: charset-normalizer~=2.0.0 in c:\users\hp\anacond
a3\lib\site-packages (from requests->folium) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\hp\anaconda3\lib\site-p
ackages (from requests->folium) (3.2)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\hp\anaconda3\lib
\site-packages (from requests->folium) (2021.10.8)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\hp\anaconda3\l
ib\site-packages (from requests->folium) (1.26.7)
Installing collected packages: branca, folium
Successfully installed branca-0.4.2 folium-0.12.1.post1
Collecting wget
  Downloading wget-3.2.zip (10 kB)
Building wheels for collected packages: wget
  Building wheel for wget (setup.py): started
  Building wheel for wget (setup.py): finished with status 'done'
  Created wheel for wget: filename=wget-3.2-py3-none-any.whl size=9672 sha256=8
92a38569ecbc43771ded65c30d803ee92ecb9a33b5cfbde39965fefa584f856
  Stored in directory: c:\users\hp\appdata\local\pip\cache\wheels\04\5f\3e\46cc
37c5d698415694d83f607f833f83f0149e49b3af9d0f38
Successfully built wget
Installing collected packages: wget
Successfully installed wget-3.2
```

In [2]:
```
import folium
import wget
import pandas as pd
```

In [3]:
```
# Import folium MarkerCluster plugin
from folium.plugins import MarkerCluster
# Import folium MousePosition plugin
from folium.plugins import MousePosition
# Import folium DivIcon plugin
from folium.features import DivIcon
```

In [4]:
```
# Download and read the `spacex_launch_geo.csv`
spacex_csv_file = wget.download('https://cf-courses-data.s3.us.cloud-object-stora
spacex_df=pd.read_csv(spacex_csv_file)
```

```
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[..........................................................................
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```

In [5]:
```
# Select relevant sub-columns: `Launch Site`, `Lat(Latitude)`, `Long(Longitude)`,
spacex_df = spacex_df[['Launch Site', 'Lat', 'Long', 'class']]
launch_sites_df = spacex_df.groupby(['Launch Site'], as_index=False).first()
launch_sites_df = launch_sites_df[['Launch Site', 'Lat', 'Long']]
launch_sites_df
```

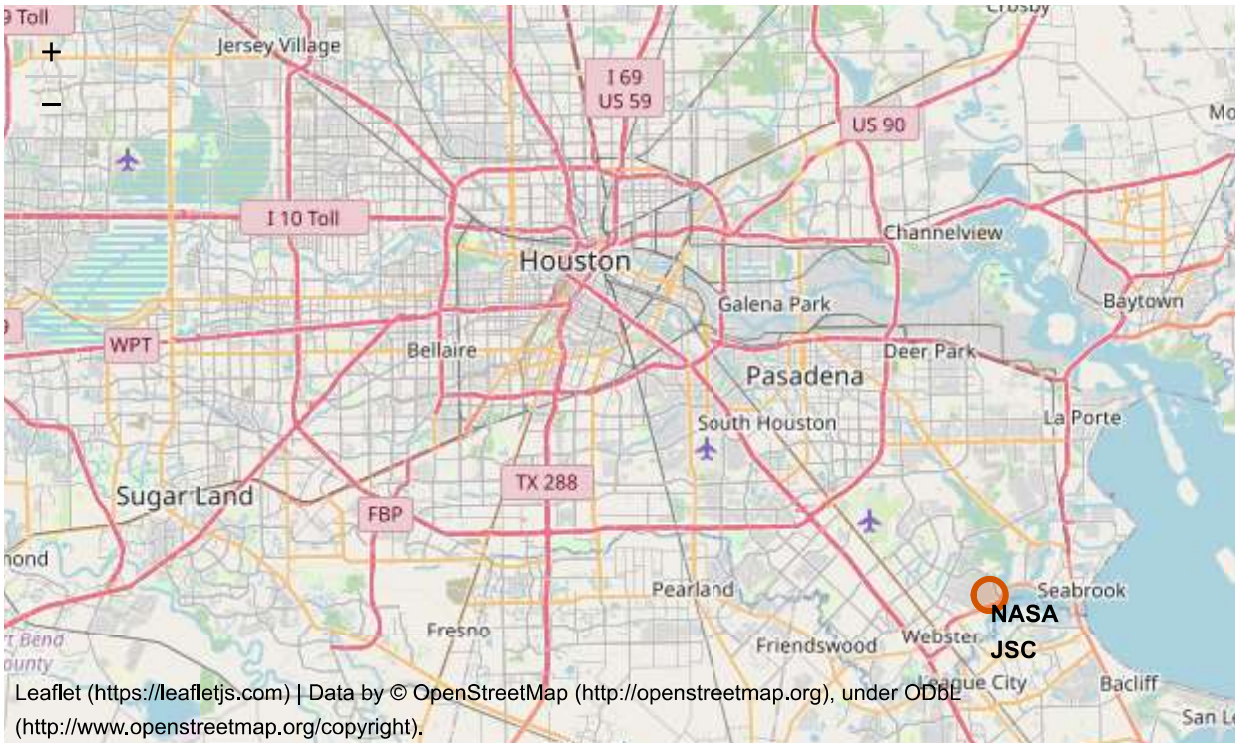
Out[5]:

	Launch Site	Lat	Long
0	CCAFS LC-40	28.562302	-80.577356
1	CCAFS SLC-40	28.563197	-80.576820
2	KSC LC-39A	28.573255	-80.646895
3	VAFB SLC-4E	34.632834	-120.610746

In [6]:
```
# Start location is NASA Johnson Space Center
nasa_coordinate = [29.559684888503615, -95.0830971930759]
site_map = folium.Map(location=nasa_coordinate, zoom_start=10)
```

In [7]:
```
# Create a blue circle at NASA Johnson Space Center's coordinate with a popup lab
circle = folium.Circle(nasa_coordinate, radius=1000, color='#d35400', fill=True).
# Create a blue circle at NASA Johnson Space Center's coordinate with a icon show
marker = folium.map.Marker(
    nasa_coordinate,
    # Create an icon as a text label
    icon=DivIcon(
        icon_size=(20,20),
        icon_anchor=(0,0),
        html='<div style="font-size: 12; color:#d35400;"><b>%s</b></div>' % 'NASA
        )
    )
site_map.add_child(circle)
site_map.add_child(marker)
```

Out[7]:



In [10]:
```
zoom_start=5)
d on its coordinate (Lat, Long) values. In addition, add Launch site name as a pop


radius=1000, color='#d35400', fill=True).add_child(folium.Popup(row[0])))
icon=DivIcon(icon_size=(20,20),icon_anchor=(0,0), html='<div style="font-size: 12
```

```
  File "C:\Users\HP\AppData\Local\Temp/ipykernel_12088/532505504.py", line 7
    site_map.add_child(folium.Marker(coordinate, icon=DivIcon(icon_size=(20,2
0),icon_anchor=(0,0), html='<div style="font-size: 12; color:#d35400;"><b>%s</b
></div>' % 'label', ))

^
SyntaxError: unexpected EOF while parsing
```

In [11]:
```
spacex_df.tail(10)
```

Out[11]:

	Launch Site	Lat	Long	class
46	KSC LC-39A	28.573255	-80.646895	1
47	KSC LC-39A	28.573255	-80.646895	1
48	KSC LC-39A	28.573255	-80.646895	1
49	CCAFS SLC-40	28.563197	-80.576820	1
50	CCAFS SLC-40	28.563197	-80.576820	1
51	CCAFS SLC-40	28.563197	-80.576820	0
52	CCAFS SLC-40	28.563197	-80.576820	0
53	CCAFS SLC-40	28.563197	-80.576820	0
54	CCAFS SLC-40	28.563197	-80.576820	1
55	CCAFS SLC-40	28.563197	-80.576820	0

In [12]:
```
marker_cluster = MarkerCluster()
```

In [13]:
```
# Apply a function to check the value of `class` column
# If class=1, marker_color value will be green
# If class=0, marker_color value will be red
# Function to assign color to launch outcome
def assign_marker_color(launch_outcome):
    if launch_outcome == 1:
        return 'green'
    else:
        return 'red'

spacex_df['marker_color'] = spacex_df['class'].apply(assign_marker_color)
spacex_df.tail(10)
```

Out[13]:

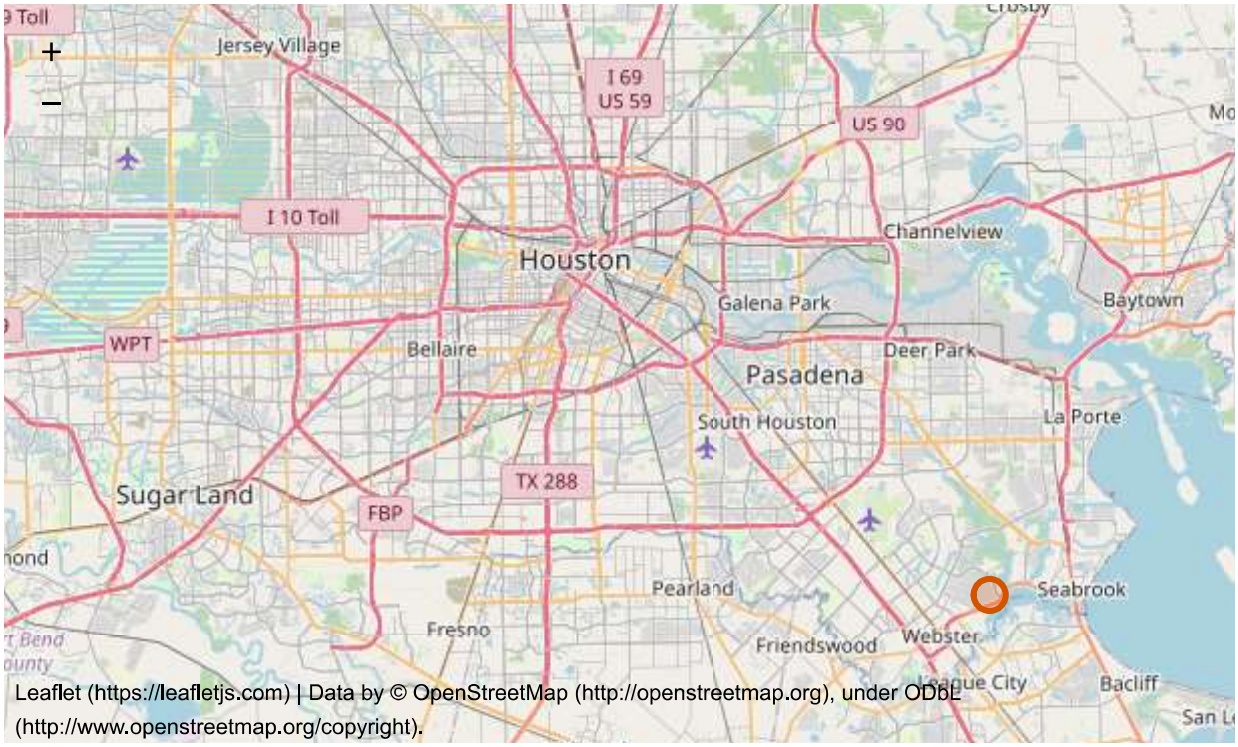
	Launch Site	Lat	Long	class	marker_color
46	KSC LC-39A	28.573255	-80.646895	1	green
47	KSC LC-39A	28.573255	-80.646895	1	green
48	KSC LC-39A	28.573255	-80.646895	1	green
49	CCAFS SLC-40	28.563197	-80.576820	1	green
50	CCAFS SLC-40	28.563197	-80.576820	1	green
51	CCAFS SLC-40	28.563197	-80.576820	0	red
52	CCAFS SLC-40	28.563197	-80.576820	0	red
53	CCAFS SLC-40	28.563197	-80.576820	0	red
54	CCAFS SLC-40	28.563197	-80.576820	1	green
55	CCAFS SLC-40	28.563197	-80.576820	0	red

In [14]:
```
# Add marker_cluster to current site_map
site_map.add_child(marker_cluster)

# for each row in spacex_df data frame
# create a Marker object with its coordinate
# and customize the Marker's icon property to indicate if this launch was success
# e.g., icon=folium.Icon(color='white', icon_color=row['marker_color']
for index, record in spacex_df.iterrows():
    # TODO: Create and add a Marker cluster to the site map
    # marker = folium.Marker(...)
    marker_cluster.add_child(marker)

site_map
```

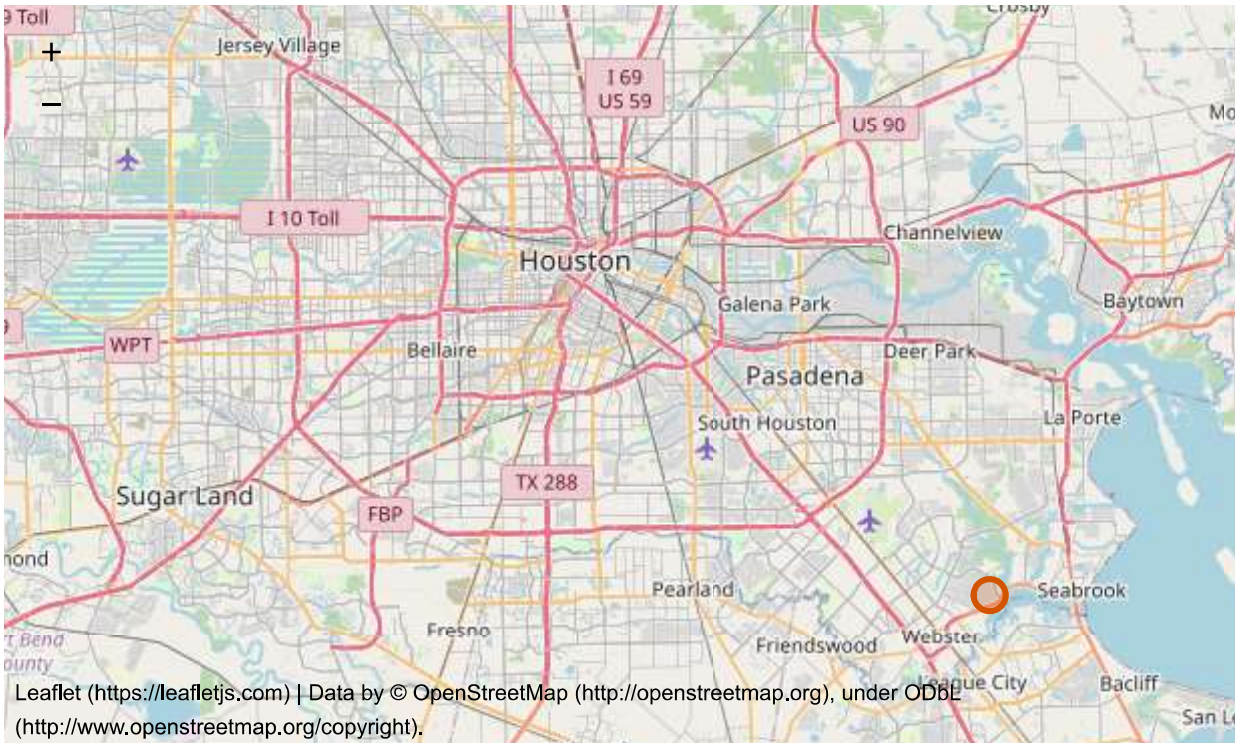
Out[14]:



In [15]:
```
# Add Mouse Position to get the coordinate (Lat, Long) for a mouse over on the mo
formatter = "function(num) {return L.Util.formatNum(num, 5);};"
mouse_position = MousePosition(
    position='topright',
    separator=' Long: ',
    empty_string='NaN',
    lng_first=False,
    num_digits=20,
    prefix='Lat:',
    lat_formatter=formatter,
    lng_formatter=formatter,
)

site_map.add_child(mouse_position)
site_map
```

Out[15]:



In [16]:
```
from math import sin, cos, sqrt, atan2, radians

def calculate_distance(lat1, lon1, lat2, lon2):
    # approximate radius of earth in km
    R = 6373.0

    lat1 = radians(lat1)
    lon1 = radians(lon1)
    lat2 = radians(lat2)
    lon2 = radians(lon2)

    dlon = lon2 - lon1
    dlat = lat2 - lat1

    a = sin(dlat / 2)**2 + cos(lat1) * cos(lat2) * sin(dlon / 2)**2
    c = 2 * atan2(sqrt(a), sqrt(1 - a))

    distance = R * c
    return distance
```

In [17]:
```
# find coordinate of the closet coastline
# e.g.,: Lat: 28.56367  Lon: -80.57163
coastline_lat = 28.56321
coastline_lon = -80.56792

launch_site_lat = 28.56326
launch_site_lon = -80.57679
distance_coastline = calculate_distance(launch_site_lat, launch_site_lon, coastli
```

In [18]:
```
# Create and add a folium.Marker on your selected closest coastline point on the
# Display the distance between coastline point and launch site using the icon pro
# for example
distance_marker = folium.Marker(
   coordinate = [coastline_lat, coastline_lon],
   icon=DivIcon(
       icon_size=(20,20),
       icon_anchor=(0,0),
       html='<div style="font-size: 12; color:#000000;"><b>%s</b></div>' % "{:10.
       )
   )
```

In [19]:
```
# Create a `folium.PolyLine` object using the coastline coordinates and launch si
lines=folium.PolyLine(locations=[(launch_site_lat, launch_site_lon), (coastline_l
site_map.add_child(lines)
```

Out[19]: