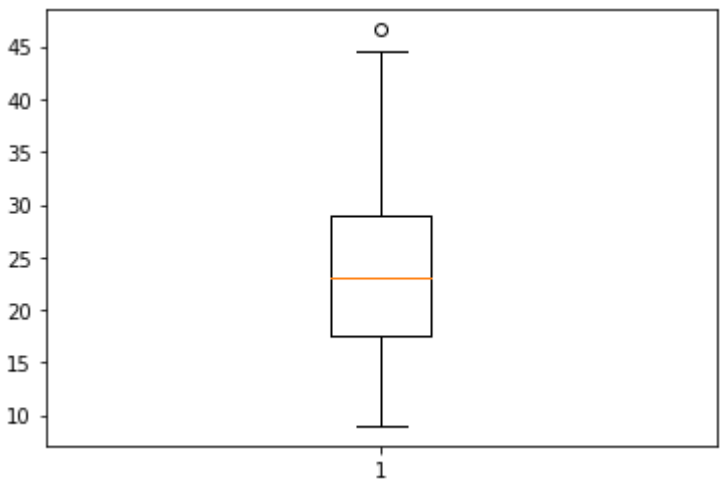
Chap.-2 Advance Visualization

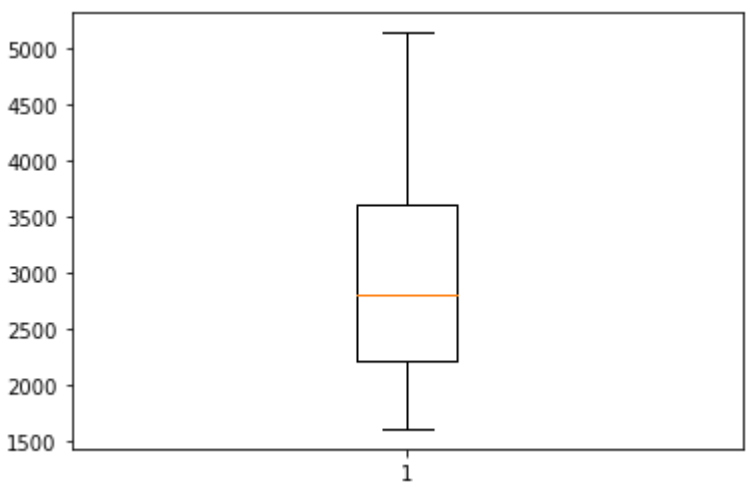
1. Box Plot (boxplot) - to identify outlier (a value that doesn't given)
    notch
    vert
    widths
    patch_artist
2. Scatter (scatter) - relation between 2 var or 2 attribute
    c='r'
    marker='D'
    edgecolor='g'
    linewidths=2
    alpha=0.8
3. Heatmap -
4. Wafflechart - alternate of piechat
5. Regression plot.
6. Wordcloud
7. Area Plot (Area Charts)
8. Geospatial data : latitude and longitudinal

Boxplot - to identify outlier (a value that doesn't given)

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['mpg'])
plt.show()
```

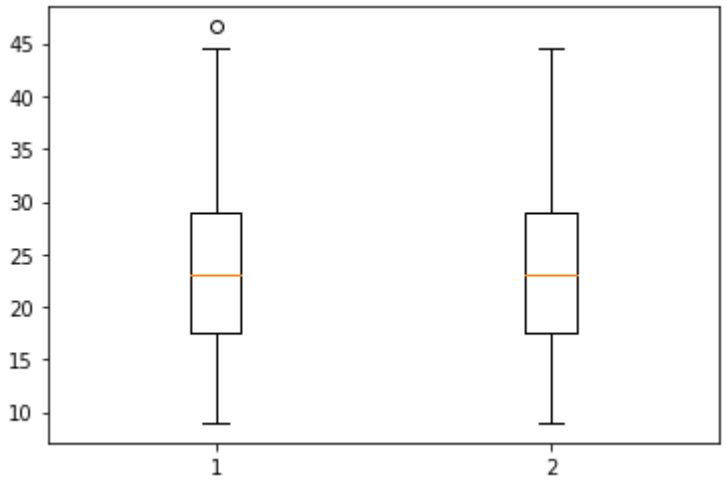


In [2]:
```
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['weight'])
plt.show()
```

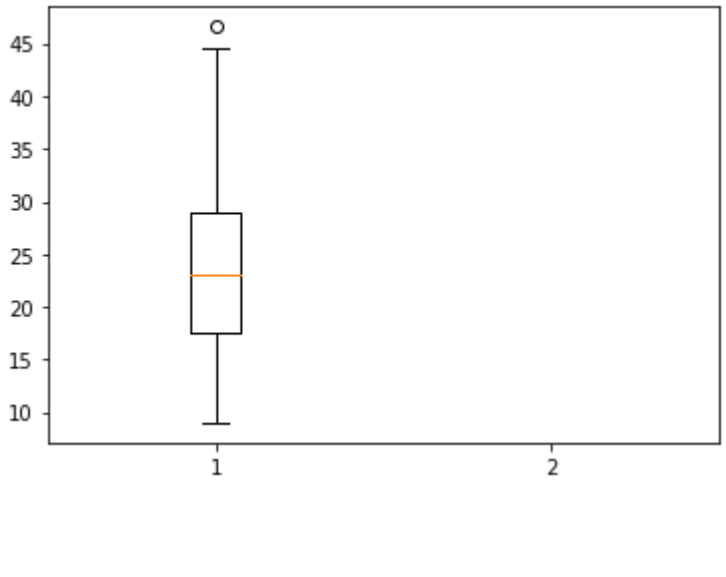


In [3]:
```
df = pd.read_csv('auto-mpg.csv')

def remove_outliers(df,col):
    q1 = df[col].quantile(0.25)
    q3 = df[col].quantile(0.75)
    iqr = q3-q1
    lower = q1-1.5*iqr
    upper  = q3+1.5*iqr
    return (df[(df[col]>=lower)&(df[col]<=upper)])
ndf = remove_outliers(df, 'mpg')
plt.boxplot([df['mpg'],ndf['mpg']])
```

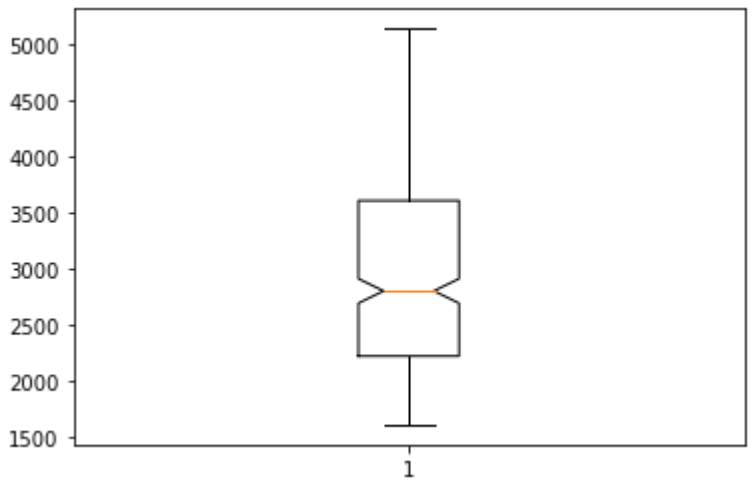
Out[3]:
```
{'whiskers': [<matplotlib.lines.Line2D at 0x1e4cef4ccd0>,
  <matplotlib.lines.Line2D at 0x1e4cef59070>,
  <matplotlib.lines.Line2D at 0x1e4cef654f0>,
  <matplotlib.lines.Line2D at 0x1e4cef65850>],
 'caps': [<matplotlib.lines.Line2D at 0x1e4cef593d0>,
  <matplotlib.lines.Line2D at 0x1e4cef59730>,
  <matplotlib.lines.Line2D at 0x1e4cef65bb0>,
  <matplotlib.lines.Line2D at 0x1e4cef65f10>],
 'boxes': [<matplotlib.lines.Line2D at 0x1e4cef4c970>,
  <matplotlib.lines.Line2D at 0x1e4cef65190>],
 'medians': [<matplotlib.lines.Line2D at 0x1e4cef59a90>,
  <matplotlib.lines.Line2D at 0x1e4cef712b0>],
 'fliers': [<matplotlib.lines.Line2D at 0x1e4cef59df0>,
  <matplotlib.lines.Line2D at 0x1e4cef71610>],
 'means': []}
```



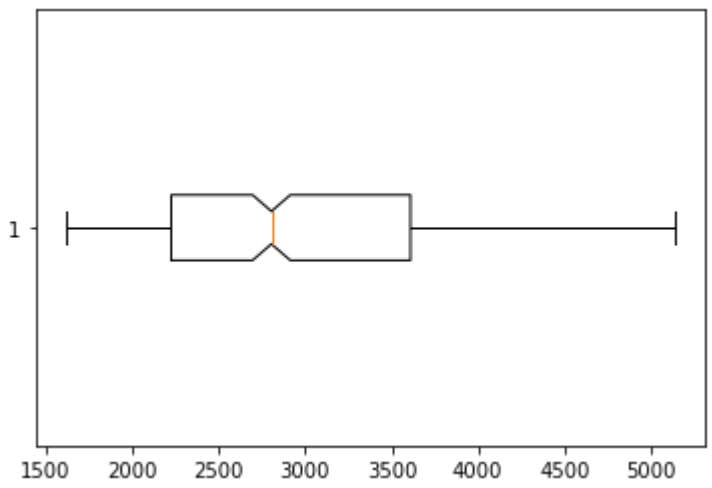
In [4]:
```
df = pd.read_csv('auto-mpg.csv')

def remove_outliers(df,col):
    q1 = df[col].quantile(0.25)
    q3 = df[col].quantile(0.75)
    iqr = q3-q1
    lower = q1-1.5*iqr
    upper  = q3+1.5*iqr
    return (df[(df[col]<lower)&(df[col]>upper)])
ndf = remove_outliers(df, 'mpg')
plt.boxplot([df['mpg'],ndf['mpg']])
plt.show()
```



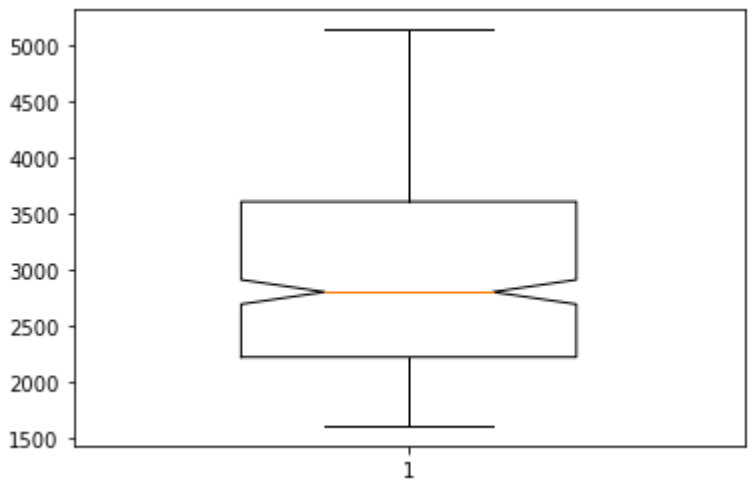
In [5]:
```
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['weight'], notch=True)
plt.show()
```



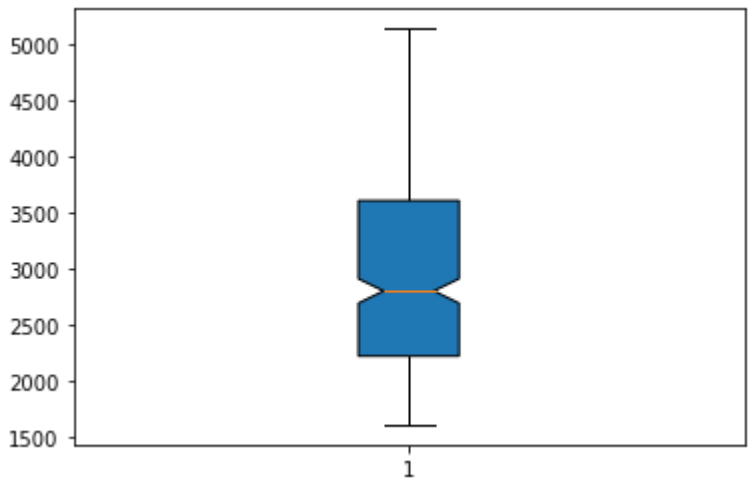
In [6]:
```
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['weight'], notch=True, vert=False)
plt.show()
```



In [7]:
```
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['weight'], notch=True, widths=0.5)
plt.show()
```



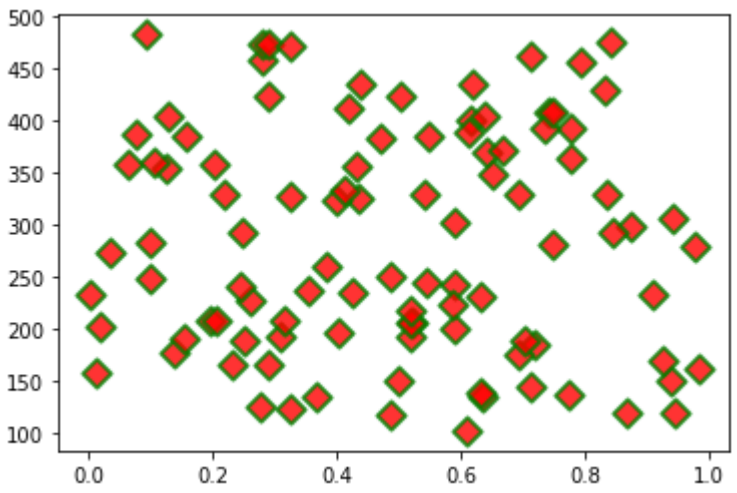
In [8]:
```
df = pd.read_csv('auto-mpg.csv')
plt.boxplot(df['weight'], notch=True, patch_artist=True)
plt.show()
```



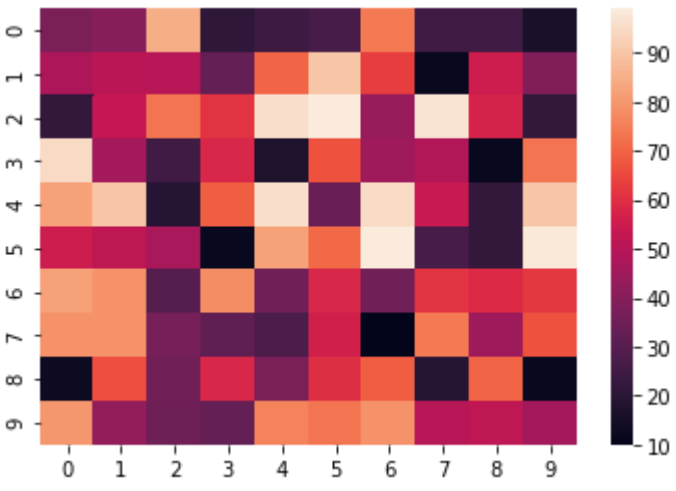
Scatter - relation between 2 var or 2 attribute

In [9]:
```
import numpy as np
x = np.random.rand(100)
y = np.random.randint(low=100,high=500,size=100)
plt.scatter(x,y,s=100,c='r',marker='D',edgecolor='g',linewidths=2,alpha=0.8)
```

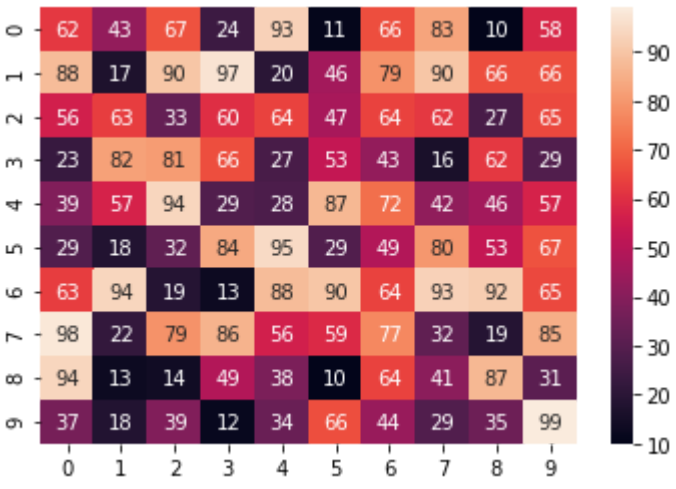
Out[9]: <matplotlib.collections.PathCollection at 0x1e4ceb14be0>



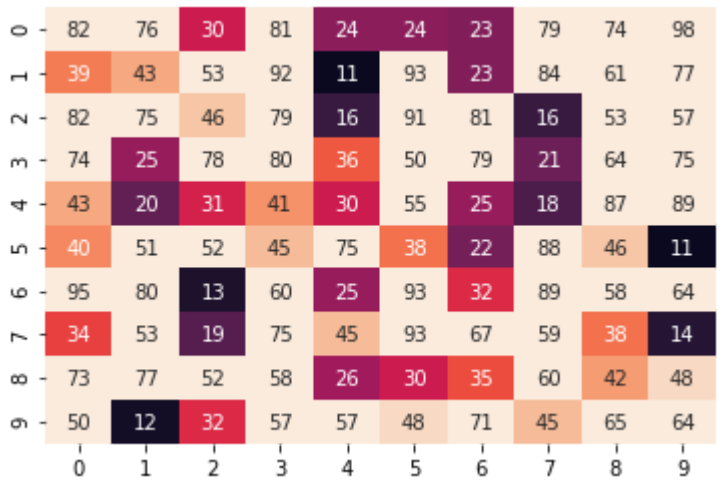
In [10]:
```
import seaborn as sn
import numpy as np
import matplotlib.pyplot as plt
data = np.random.randint(low=10,high=100,size=(10,10))
sn.heatmap(data)
plt.show()
```



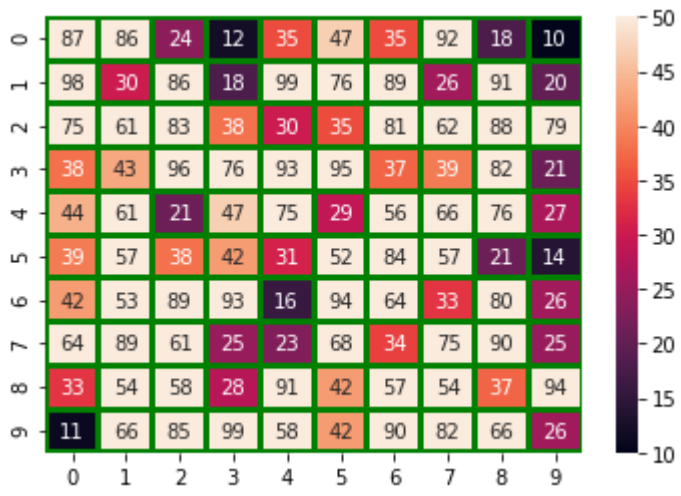
In [11]:
```
import seaborn as sn
import numpy as np
import matplotlib.pyplot as plt
data=np.random.randint(low=10,high=100,size=(10,10))
sn.heatmap(data,annot=True)#annot=Display number
plt.show()
```



In [12]:
```
import seaborn as sn
import numpy as np
import matplotlib.pyplot as plt
data=np.random.randint(low=10,high=100,size=(10,10))
sn.heatmap(data,annot=True,vmin=10,vmax=50,cbar=False)#cbar =False remove cbar
plt.show()
```

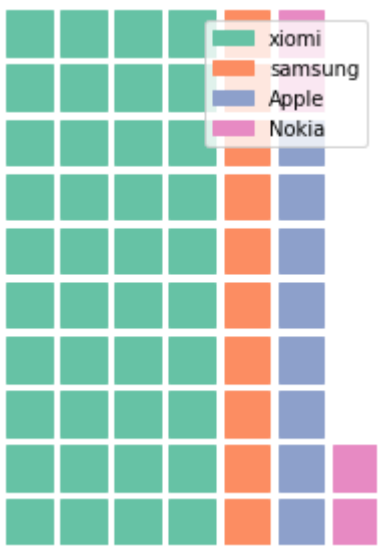


In [13]:
```
import seaborn as sn
import numpy as np
import matplotlib.pyplot as plt
data=np.random.randint(low=10,high=100,size=(10,10))
sn.heatmap(data,annot=True,vmin=10,vmax=50,linecolor='g',linewidth=2)
plt.show()
```



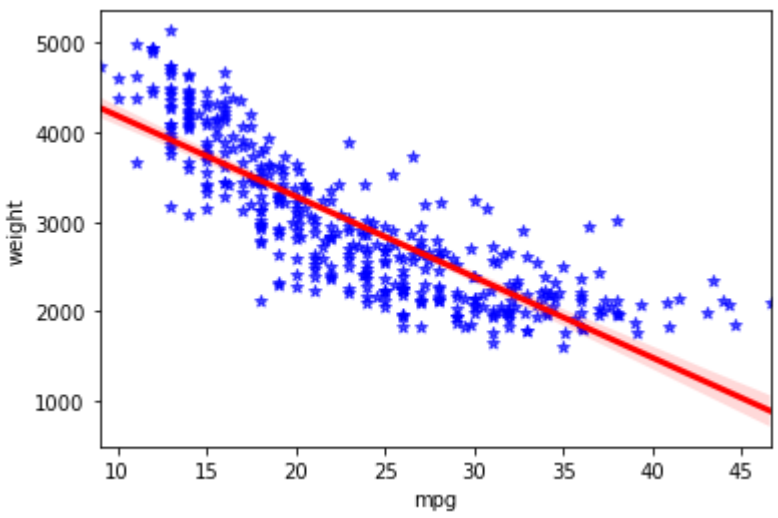
Wafflechart - alternate of piechat

In [18]:
```
import pandas as pd
from pywaffle import Waffle
import matplotlib.pyplot as plt

df=pd.read_csv('auto-mpg.csv')
df=pd.DataFrame(data)
data={'phone':['xiomi','samsung','Apple','Nokia'],'stock':[40,10,8,4]}
new_fig=plt.figure(FigureClass=Waffle,rows=10,values=df.stock,labels=list(df.phone))
```

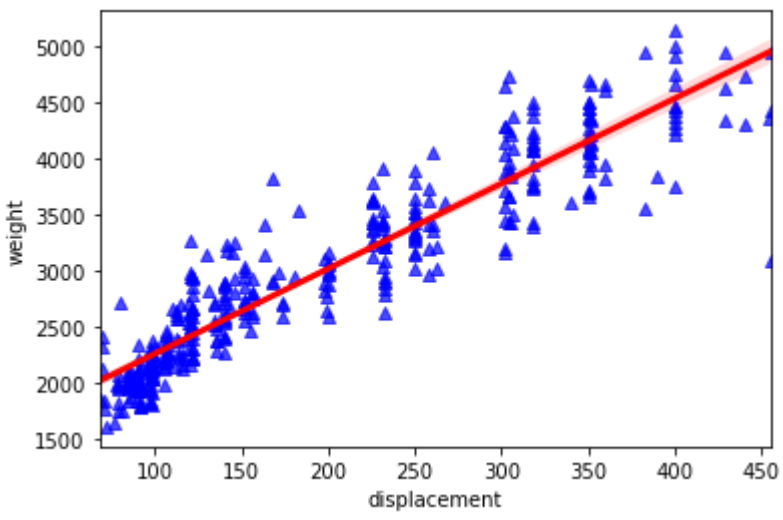


In [15]:
```
import pandas as pd
import matplotlib.pyplot as plt
from pywaffle import Waffle
data={'phone':['samsung','iphone','nokia','redmi','vivo','oppo','google','microsoft'],
'stock':[44,35,67,89,10,69,45,34]}
df=pd.DataFrame(data)
df.head() #It prints first five rows
fig=plt.figure(FigureClass=Waffle,rows=10,values=df.stock,labels=list(df.phone))
```

In [19]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
df=pd.read_csv('auto-mpg.csv')
sns.regplot(y=df['weight'],x=df['mpg'],marker='*',
            scatter_kws={'color':'blue','alpha':0.7},
            line_kws={'color':'red','linewidth':3})
plt.show()
```



In [20]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
df=pd.read_csv('auto-mpg.csv')
sns.regplot(y=df['weight'],x=df['displacement'],marker='^',
            scatter_kws={'color':'blue','alpha':0.7},
            line_kws={'color':'red','linewidth':3})
plt.show()
```



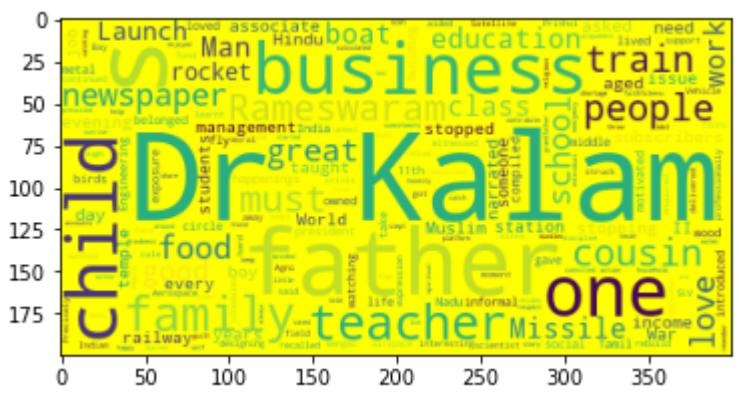
In [ ]:
```
pip install wordcloud
```

In [21]:
```
from wordcloud import WordCloud, STOPWORDS
stopwords = set(STOPWORDS)
print(stopwords)
# stopwords will not give any meaning it is only used for joining as suppose "the" we are using much so it
# it should be stopped and removed from respective textfile
```

```
{"how's", 'a', 'are', 'because', "wouldn't", 'over', 'yourselves', 'otherwise', 'himself', 'an', "they're", 'where',
"mustn't", 'am', 'is', 'themselves', "when's", 'between', 'each', "that's", 'further', "you'll", 'also', "we'll", "th
ey'll", 'who', 'some', "he'd", 'what', 'to', 'nor', 'all', "he'll", 'do', 'would', 'the', 'whom', 'than', "she'll",
'into', 'hers', 'had', 'ours', "hadn't", 'these', 'its', 'few', "we'd", 'again', 'but', 'theirs', 'this', 'herself',
'why', 'my', "haven't", 'on', "what's", "we've", 'only', 'out', "we're", "here's", 'has', "you're", 'there', "can't",
'doing', 'can', 'other', 'she', 'before', 'being', 'it', 'such', 'most', "she's", 'you', 'during', 'i', 'below', 'fo
r', "weren't", 'their', 'own', "there's", 'them', "i'm", "they'd", 'which', 'same', "i'll", 'above', 'however', 'tha
t', 'http', "shouldn't", 'with', 'him', 'those', 'yourself', 'hence', 'until', 'as', 'did', 'ever', 'from', 'while',
"shan't", "aren't", 'any', 'so', "doesn't", 'under', "don't", 'were', 'up', 'should', 'cannot', 'if', 'once', 'com',
'have', "where's", 'he', 'www', "you'd", 'therefore', "wasn't", 'after', 'too', 'ought', "isn't", 'k', 'how', 'agains
t', 'here', 'get', "hasn't", 'not', 'else', "it's", 'at', 'of', 'itself', 'me', 'was', 'having', 'your', "why's", 'th
ey', 'r', 'both', 'be', 'her', "couldn't", 'our', 'by', 'or', 'very', 'his', 'shall', 'just', "who's", 'and', 'off',
'yours', 'been', 'does', 'could', 'myself', 'then', 'when', 'we', "she'd", 'in', 'about', 'ourselves', 'since', "h
e's", "let's", "you've", 'more', 'no', "won't", 'down', "didn't", 'like', "i've", 'through', "i'd", "they've"}
```

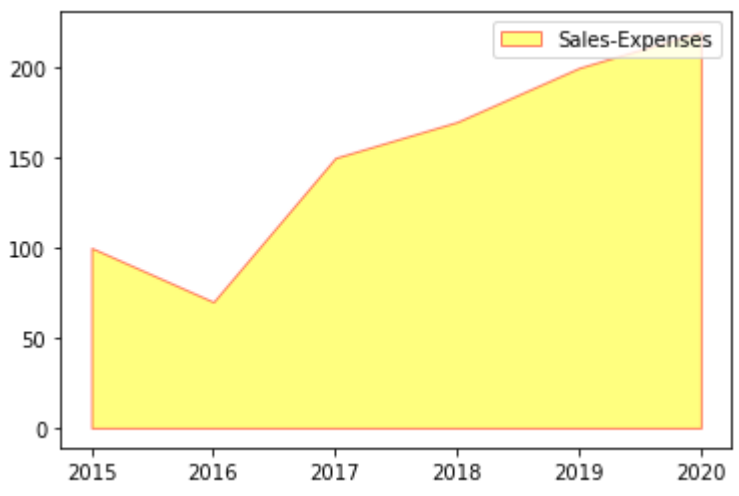
In [22]:
```
f = open('demo.txt','r', encoding='utf-8')
apj = f.read()
wc = WordCloud(background_color='yellow',max_words=200,stopwords=set(STOPWORDS))
#max_words to limit the words
wc.generate(apj)
plt.imshow(wc)
```

Out[22]: <matplotlib.image.AxesImage at 0x1e4d15cd340>

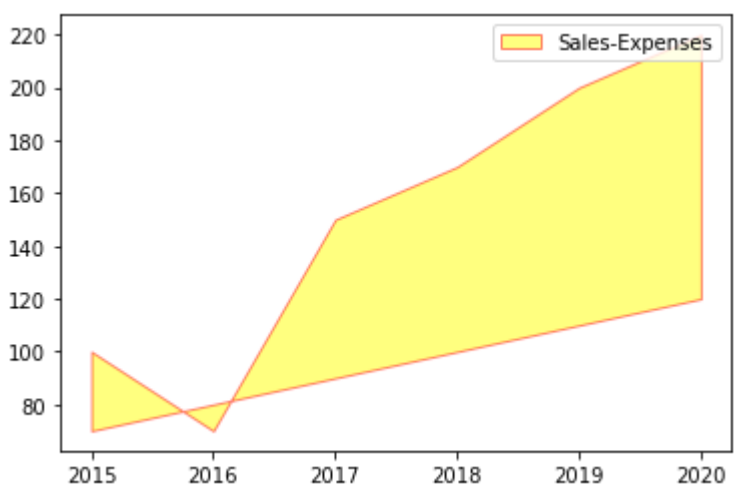


Area Plot (Area Charts)

In [23]:
```
import pandas as pd
import matplotlib.pyplot as plt

data = {'Year':[2015,2016,2017,2018,2019,2020],
        'Sales':[100,70,150,170,200,220],
        'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.fill_between(df['Year'],df['Sales'],
                 facecolor='yellow',
                 edgecolor='red',
                 alpha=0.5,
                 label='Sales-Expenses')

plt.legend()
plt.show()
```

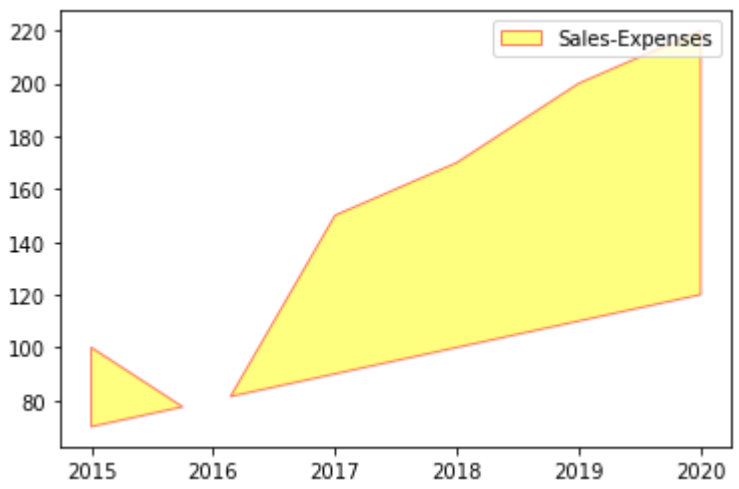


In [25]:
```
import pandas as pd
import matplotlib.pyplot as plt

data = {'Year':[2015,2016,2017,2018,2019,2020],
       'Sales':[100,70,150,170,200,220],
       'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.fill_between(df['Year'],df['Sales'],df['Expenses'],
                 facecolor='yellow',
                 edgecolor='red',
                 alpha=0.5,
                 label='Sales-Expenses')

plt.legend()
plt.show()
```

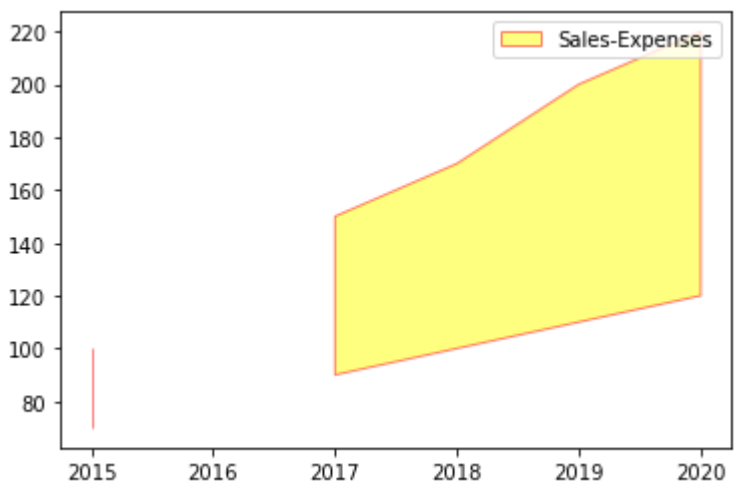


- **interpolate - to indentify intersection**

In [26]:
```
import pandas as pd
import matplotlib.pyplot as plt

data = {'Year':[2015,2016,2017,2018,2019,2020],
       'Sales':[100,70,150,170,200,220],
       'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.fill_between(df['Year'],df['Sales'],df['Expenses'],
                  where=df['Sales']>df['Expenses'],interpolate=True,
                 facecolor='yellow',
                 edgecolor='red',
                 alpha=0.5,
                 label='Sales-Expenses')

plt.legend()
plt.show()
```

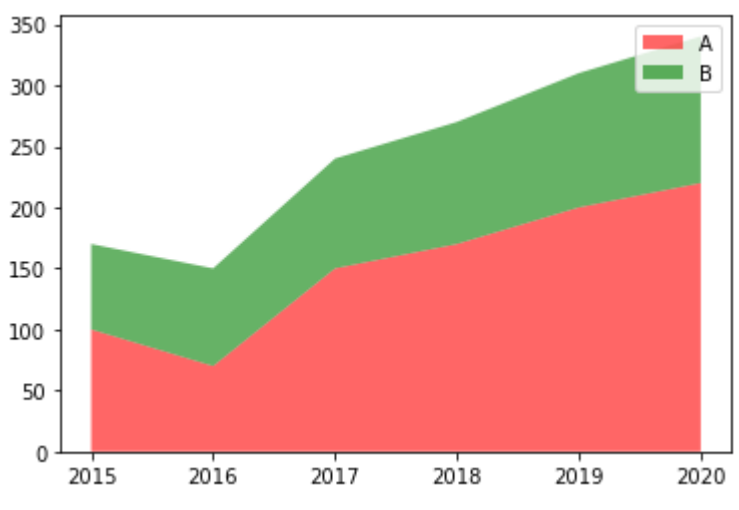


In [27]:
```
import pandas as pd
import matplotlib.pyplot as plt

data = {'Year':[2015,2016,2017,2018,2019,2020],
       'Sales':[100,70,150,170,200,220],
       'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.fill_between(df['Year'],df['Sales'],df['Expenses'],
                 where=df['Sales']>df['Expenses'],
                facecolor='yellow',
                edgecolor='red',
                alpha=0.5,
                label='Sales-Expenses')

plt.legend()
plt.show()
```

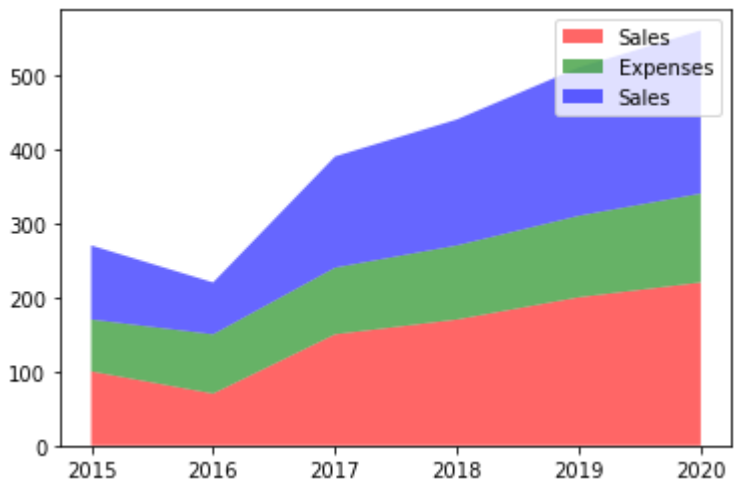


Stackplot - A variation of Area Plot

In [28]:
```
data = {'Year':[2015,2016,2017,2018,2019,2020],
       'Sales':[100,70,150,170,200,220],
       'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.stackplot(df['Year'],df['Sales'],df['Expenses'],
                labels=['A','B'],
                colors=['r','g'],
                alpha=0.6)

plt.legend()
plt.show()
```



In [29]:
```
data = {'Year':[2015,2016,2017,2018,2019,2020],
        'Sales':[100,70,150,170,200,220],
        'Expenses':[70,80,90,100,110,120]}
df = pd.DataFrame(data)
plt.stackplot(df['Year'],df['Sales'],df['Expenses'],df['Sales'],
                labels=['Sales','Expenses','Sales'],
                colors=['r','g','b'],
                alpha=0.6)

plt.legend()
plt.show()
```

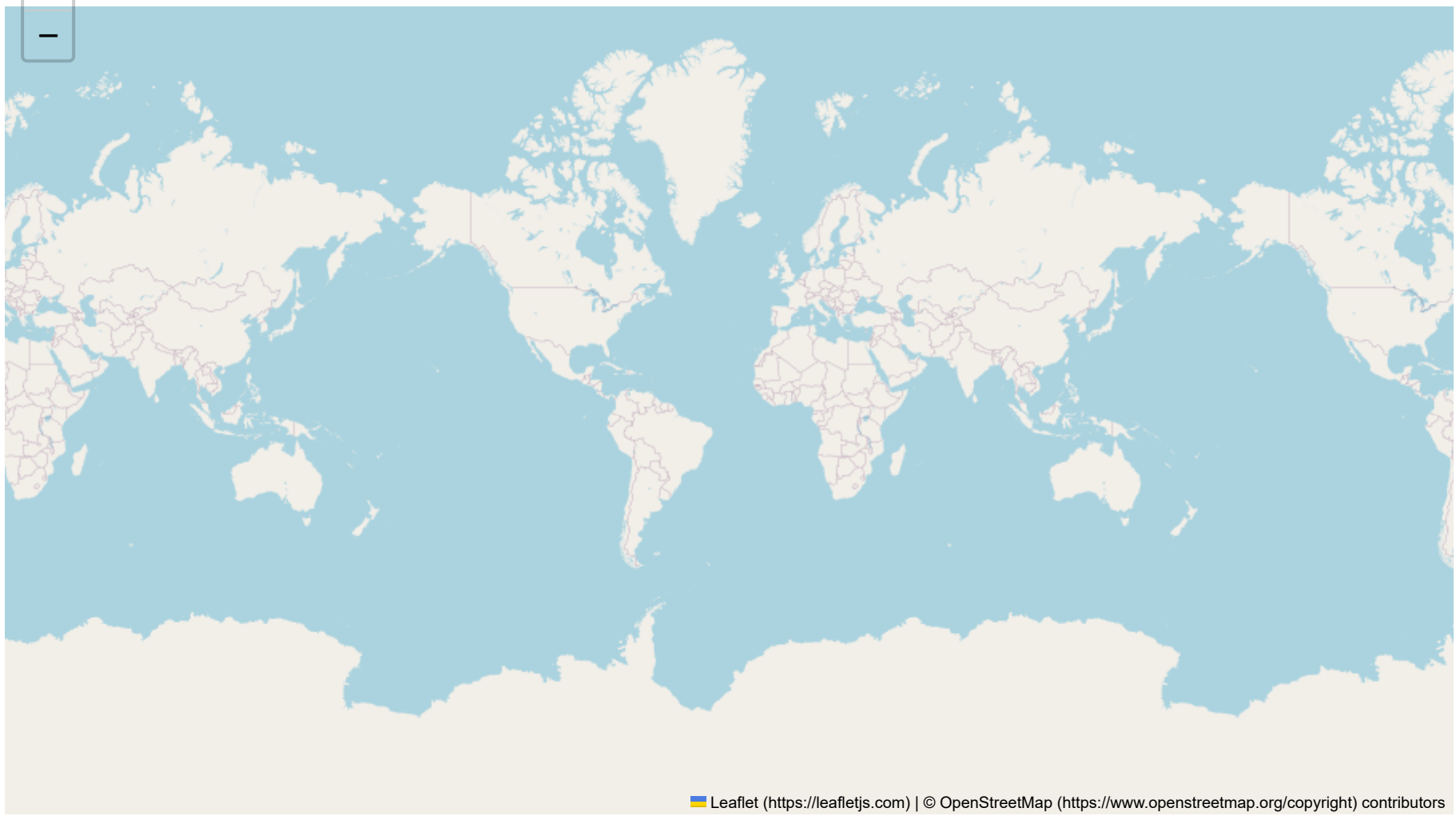


In [ ]:
```
pip install folium
```

Geospatial data : latitude and longitudinal

In [30]:
```
import folium
world_map = folium.Map()
world_map
```

Out[30]:
Make this Notebook Trusted to load map: File -> Trust Notebook



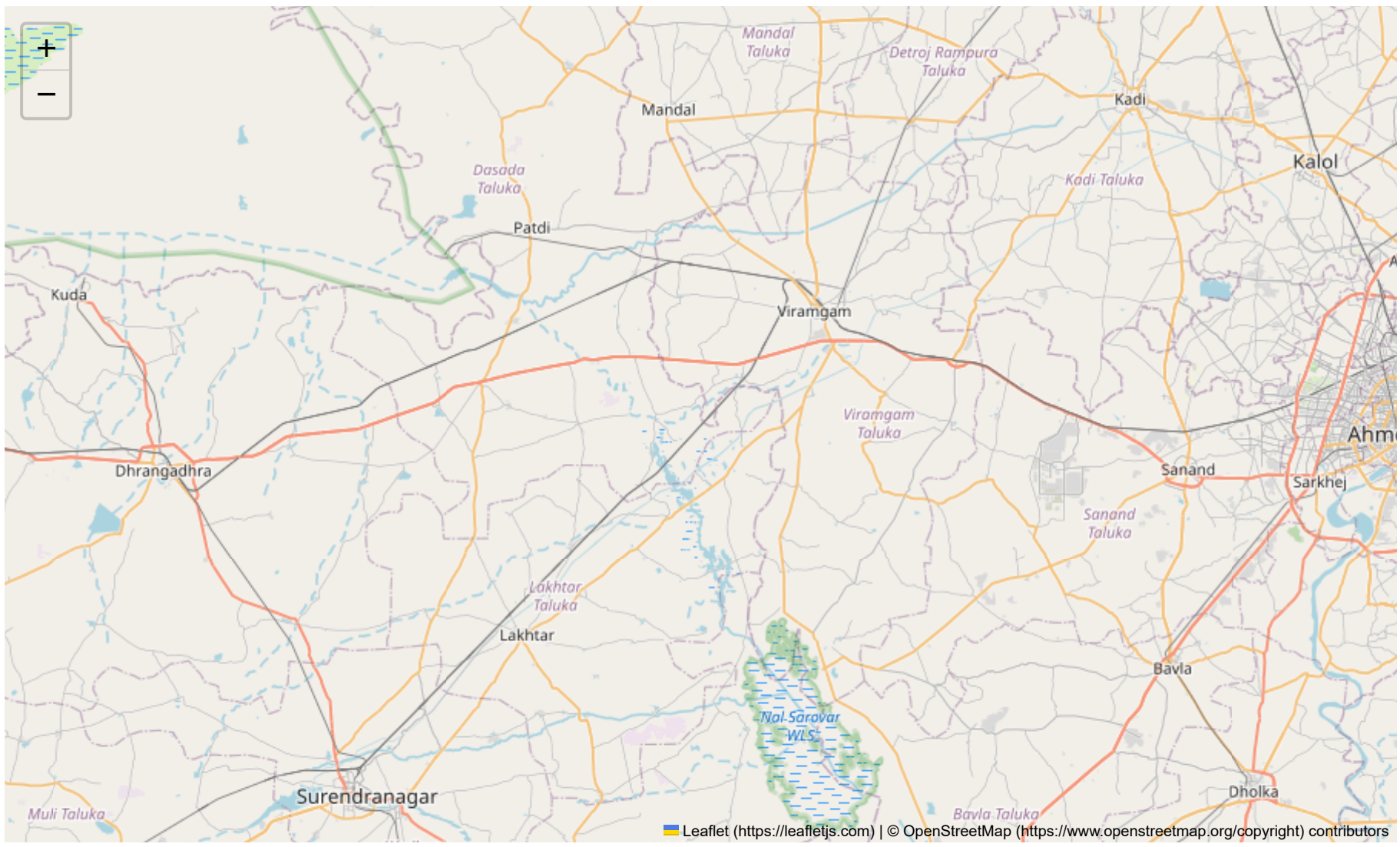
In [31]:
```
import folium
world_map=folium.Map(location=[20.5937,78.9629],zoom_start=10)
#North positive value, South positive value, east positive value, west negative value
world_map
```

Out[31]:

In [36]:
```
import folium
mapObj=folium.Map(location=[23,72],zoom_start=10)
folium.Circle(location=[23,72],radius=50000).add_to(mapObj)
mapObj.save('Output.html')
```

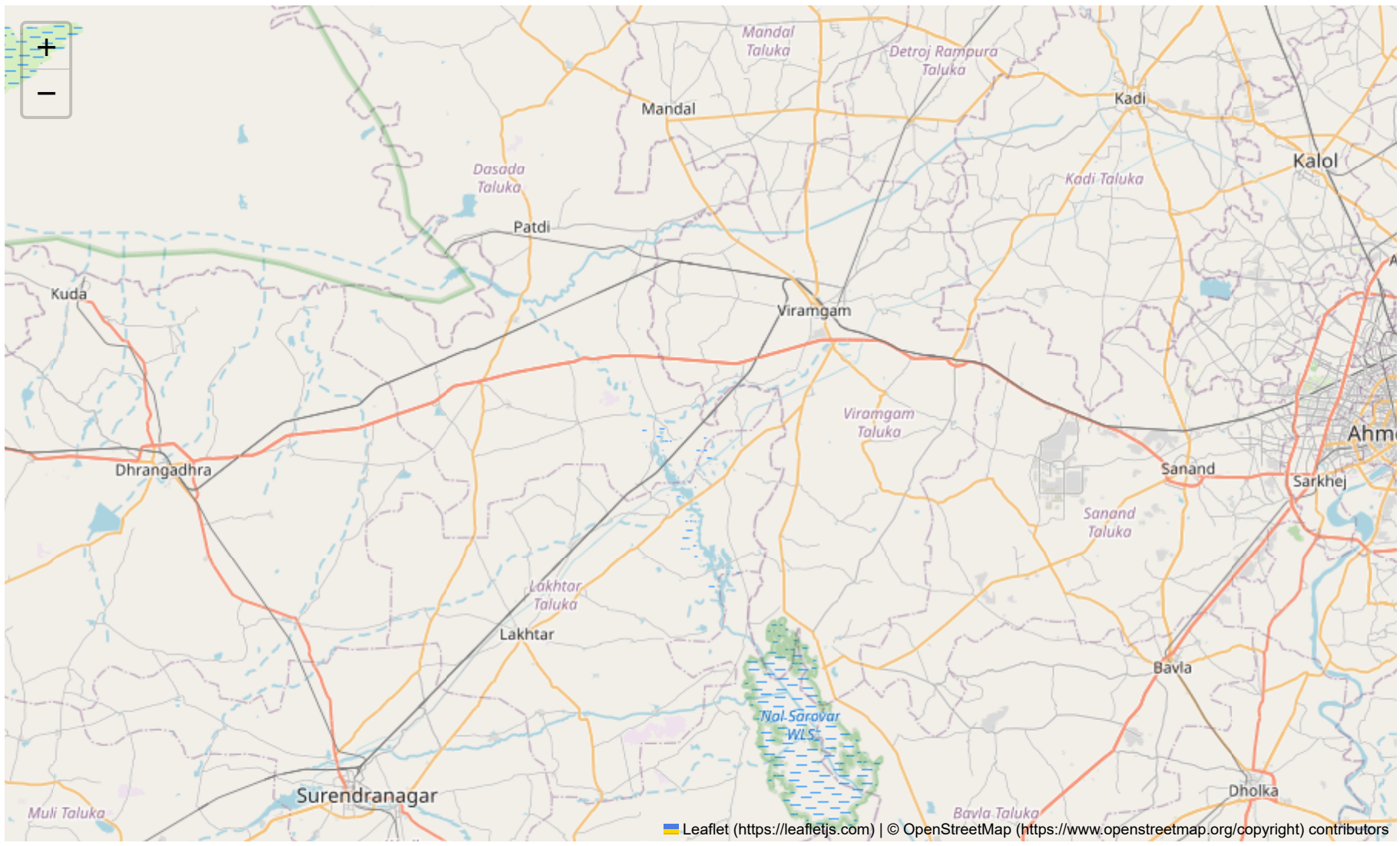
In [40]:
```
import folium
mapObj=folium.Map(location=[23,72],zoom_start=10)
folium.Circle(location=[23,72],radius=50000,color='green',weight=6,fill_color='red',
              opacity=0.1)
mapObj
```

Out[40]:



In [41]:
```
import folium
mapObj=folium.Map(location=[23,72],zoom_start=10)
folium.Circle(location=[23,72],radius=50000,tooltip="This is tooltip text",
              popup=folium.Popup("""<h1>Hiie</h1>"""))
mapObj
```

Out[41]:

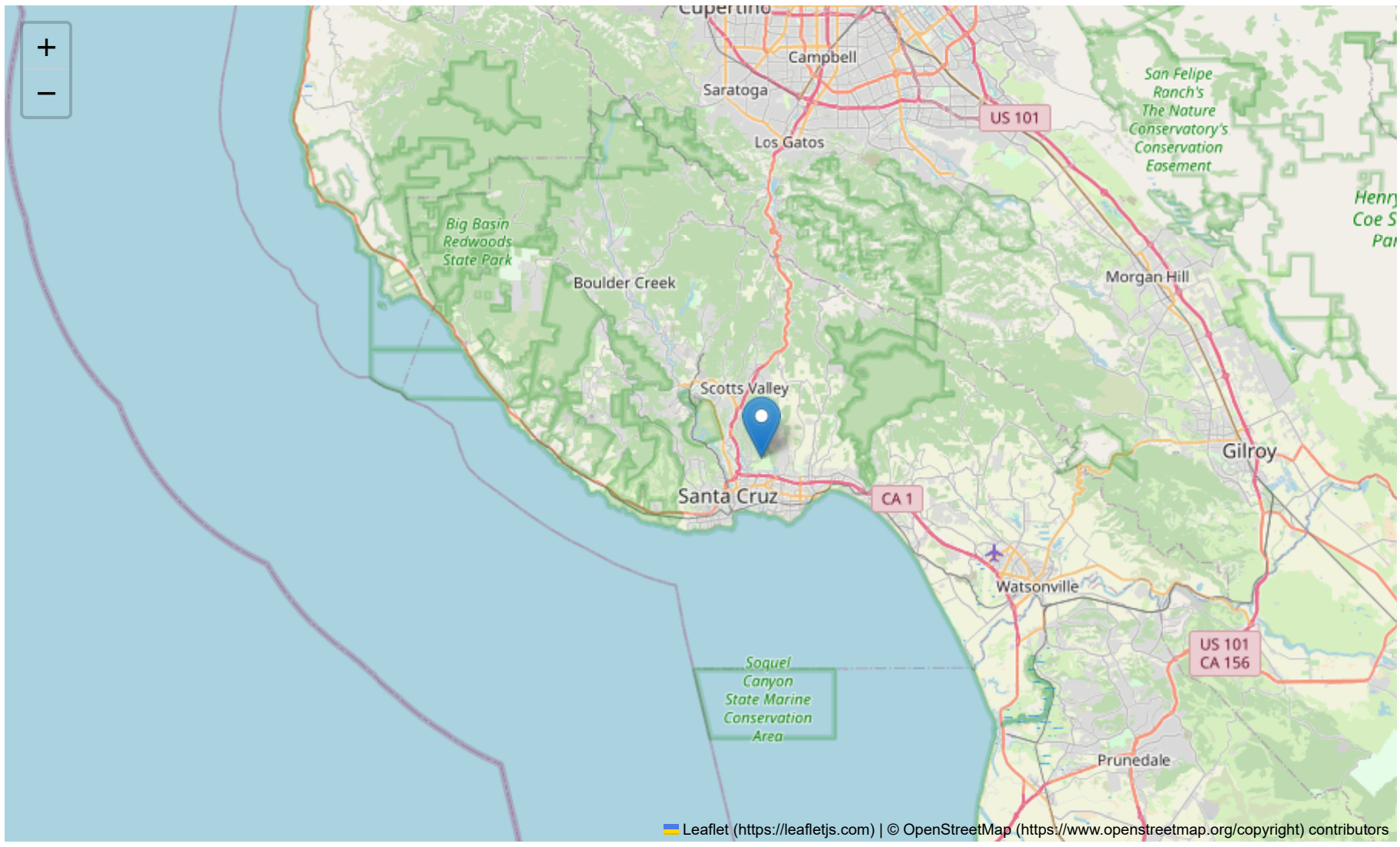


In [43]:
```
import folium
mapObj=folium.Map(location=[23,72],zoom_start=10)
folium.Circle(location=[23,72],radius=50000,tooltip="This is tooltip text",
              popup=folium.Popup("""<h1>Hiie</h1>"""))
folium.LayerControl().add_to(mapObj)
mapObj.save('output.html')
```

In [44]:
```
import folium
mapObj=folium.Map(location=[23,72],zoom_start=10)
folium.CircleMarker(location=[23,72],radius=50).add_to(mapObj)
mapObj.save('Output4.html')
```

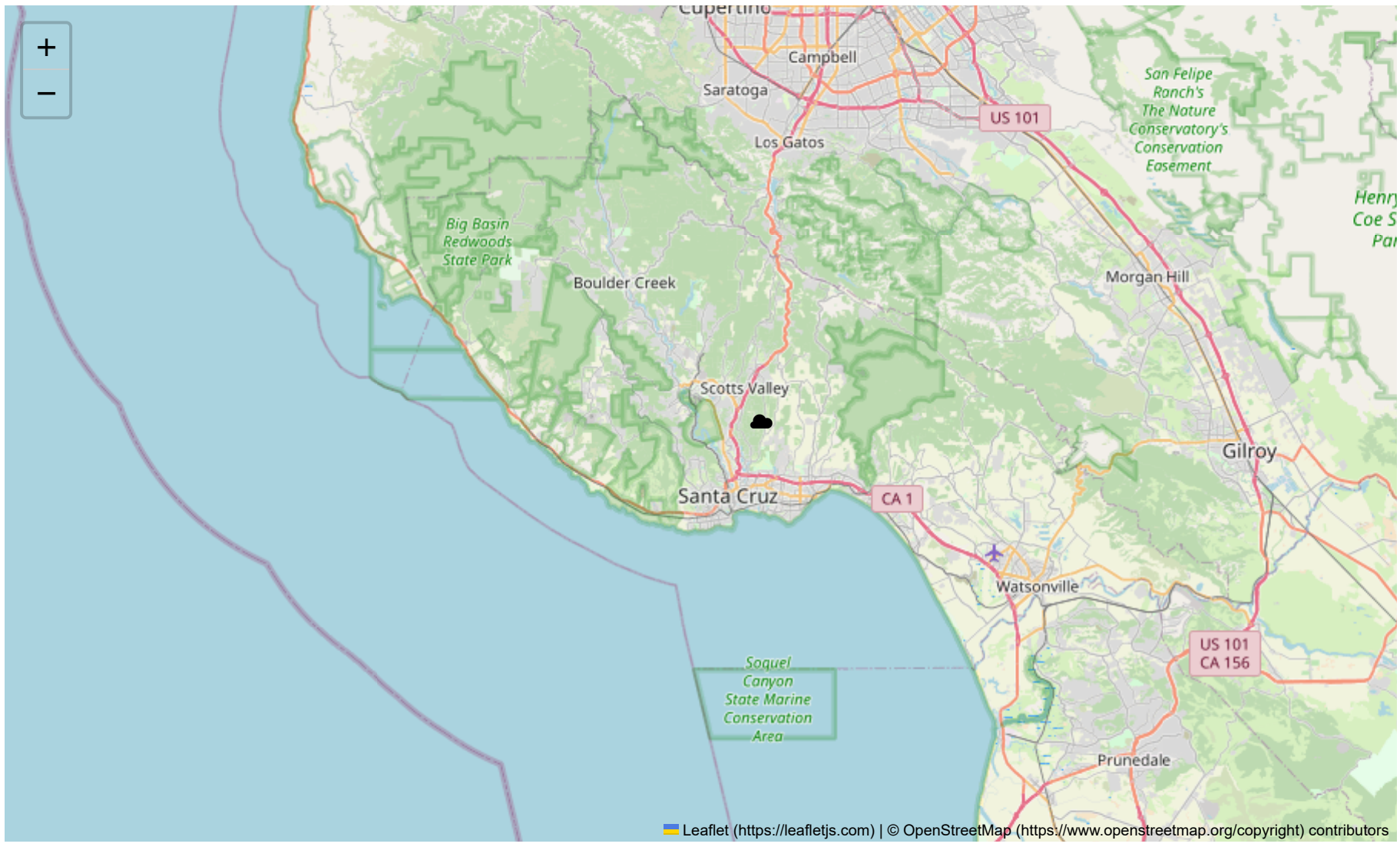
In [45]:
```
import folium
mapObj = folium.Map(location=[37,-122])
icon=folium.features.Icon(icon='cloud')
marker=folium.Marker(location=[37,-122])
marker.add_to(mapObj)
mapObj
```

Out[45]:



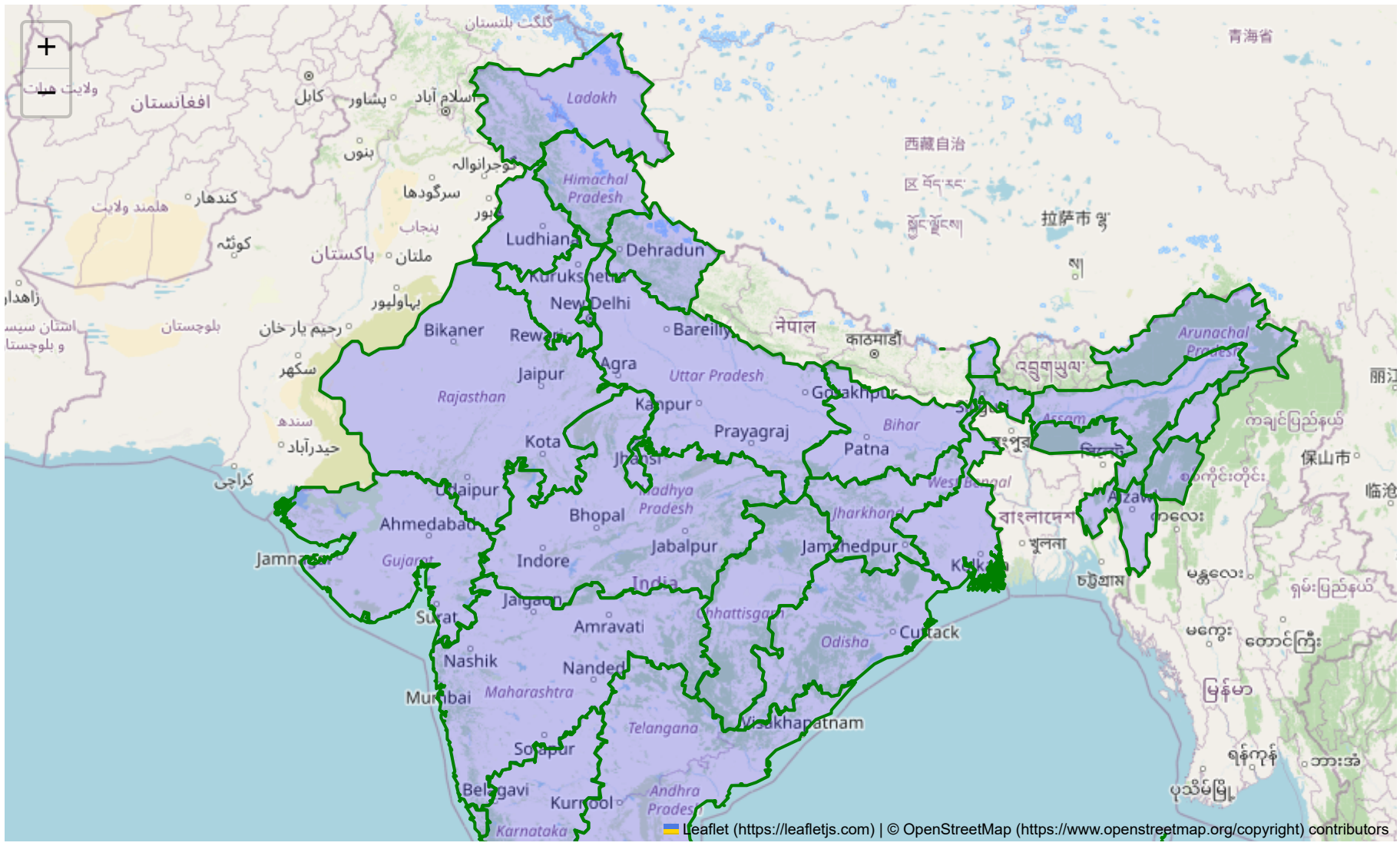
In [46]:
```
import folium
mapObj = folium.Map(location=[37,-122])
icon=folium.features.Icon(icon='cloud')
marker=folium.Marker(location=[37,-122],icon=icon)
marker.add_to(mapObj)
mapObj
```

Out[46]:



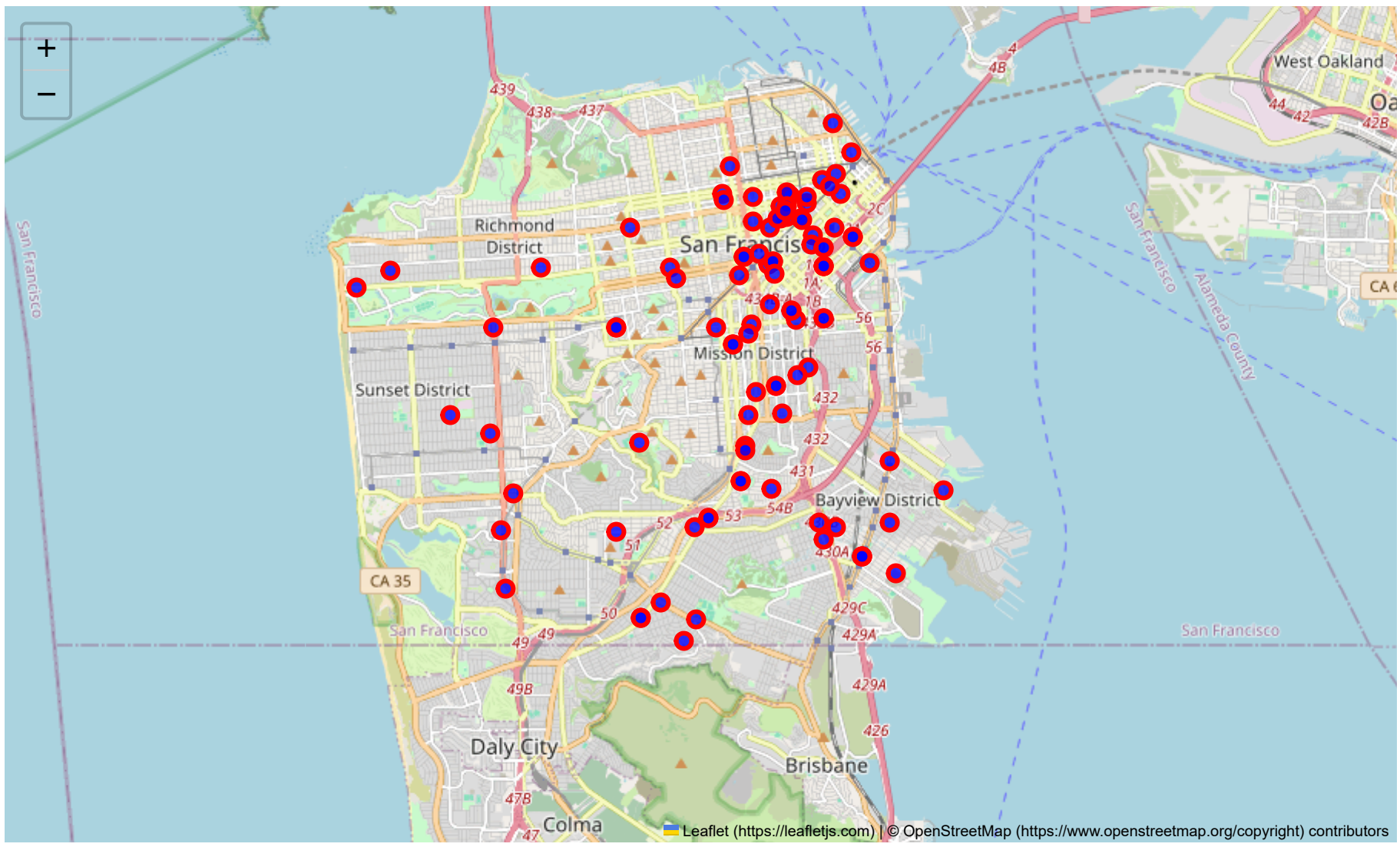
In [50]:
```
import folium
mob = folium.Map(location=[23,72])
folium.GeoJson(data=(open("Indian_States",'r').read()),
               name="India", color='green', weight=2,
               fillColor='blue', fillOpacity=0.2).add_to(mob)
mob
```

Out[50]:



In [53]:
```
df = pd.read_csv('Datasets/Police_Department_Incidents_-_Previous_Year__2016_.csv')
df = df.iloc[0:100,:]
mob = folium.Map(location=[37,-122])
incidents = folium.map.FeatureGroup()
for lat,lon in zip(df.Y,df.X):
    incidents.add_child(folium.features.CircleMarker([lat,lon],
        radius=5,color='red',
        fill=True,fill_color='blue',
        fill_opacity=0.8,))
mob.add_child(incidents)

#zip can be done using df.X and df.Y if both have some number of datas to create a child node
```

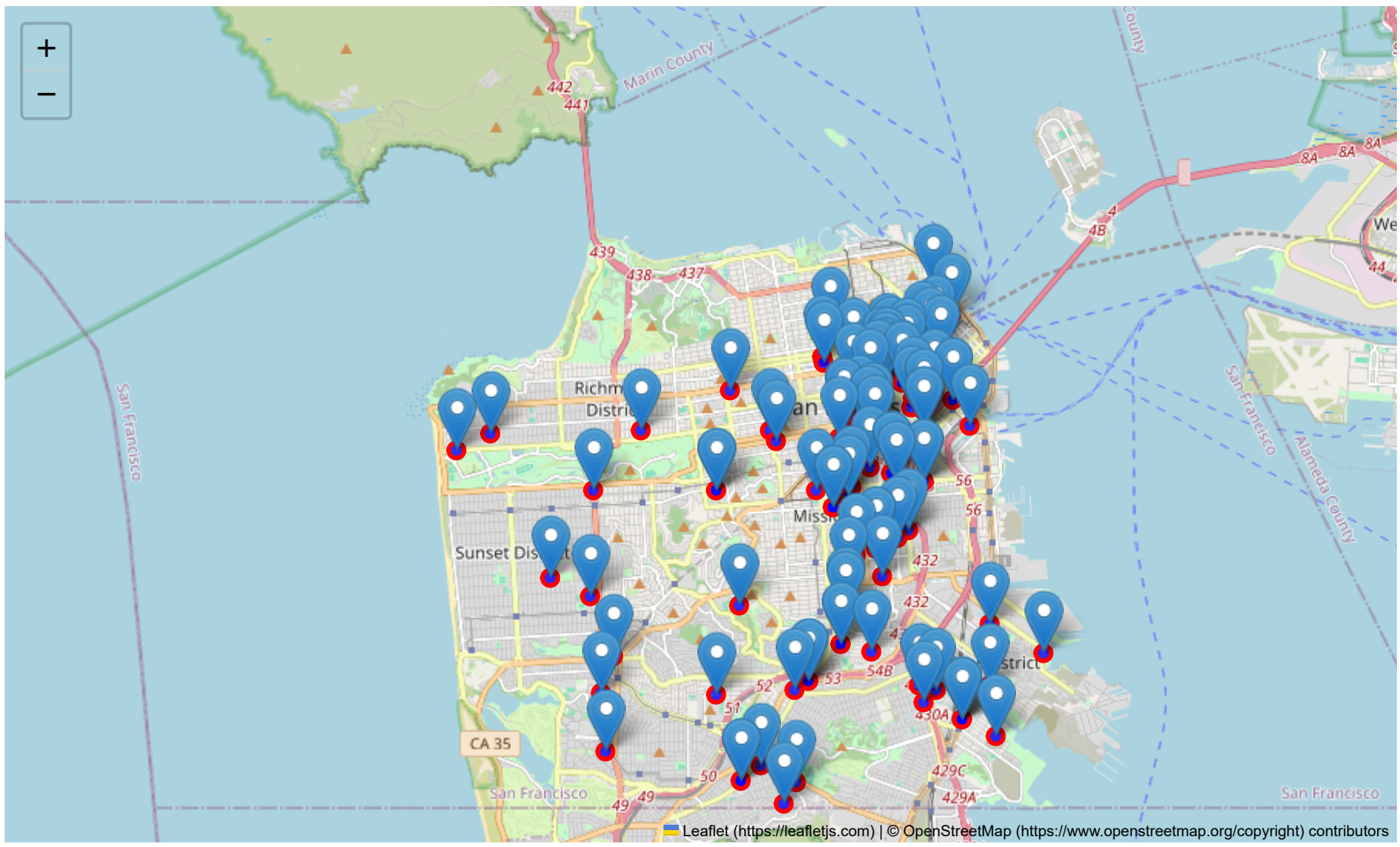
Out[53]:



In [57]:
```
#police file for san fransico
import folium
import pandas as pd
df_incidents=pd.read_csv('Datasets/Police_Department_Incidents_-_Previous_Year__2016_.csv')
print(df_incidents.head())
df_incidents.shape
df=df_incidents.iloc[0:100,:] #passed rows (0 to 100) and columns (all 13)
df.shape
sanfran_map=folium.Map(location=[37.77,-122.44],zoom_start=12)
incidents=folium.map.FeatureGroup()
for lat,lon in zip(df.Y,df.X):
    incidents.add_child(folium.features.CircleMarker([lat,lon],
    radius=5,color='red',
    fill=True,fill_color='blue',
    fill_opacity=0.8,))
for lat,lon,label in zip(df.Y,df.X,df.Category):
    folium.Marker([lat,lon],popup=label).add_to(sanfran_map)
#to show circle with filled color
#iloc in folium for limiting data
sanfran_map.add_child(incidents)
```

```
   IncidntNum     Category                                       Descript  \
0   120058272   WEAPON LAWS                             POSS OF PROHIBITED WEAPON
1   120058272   WEAPON LAWS  FIREARM, LOADED, IN VEHICLE, POSSESSION OR USE
2   141059263      WARRANTS                                WARRANT ARREST
3   160013662  NON-CRIMINAL                                 LOST PROPERTY
4   160002740  NON-CRIMINAL                                 LOST PROPERTY

  DayOfWeek                 Date   Time  PdDistrict      Resolution  \
0    Friday  01/29/2016 12:00:00 AM  11:00    SOUTHERN  ARREST, BOOKED
1    Friday  01/29/2016 12:00:00 AM  11:00    SOUTHERN  ARREST, BOOKED
2    Monday  04/25/2016 12:00:00 AM  14:59     BAYVIEW  ARREST, BOOKED
3   Tuesday  01/05/2016 12:00:00 AM  23:50  TENDERLOIN            NONE
4    Friday  01/01/2016 12:00:00 AM  00:30     MISSION            NONE

                  Address           X          Y  \
0  800 Block of BRYANT ST -122.403405  37.775421
1  800 Block of BRYANT ST -122.403405  37.775421
2   KEITH ST / SHAFTER AV -122.388856  37.729981
3  JONES ST / OFARRELL ST -122.412971  37.785788
4    16TH ST / MISSION ST -122.419672  37.765050

                            Location           PdId
0   (37.775420706711, -122.403404791479)  12005827212120
1   (37.775420706711, -122.403404791479)  12005827212168
2  (37.7299809672996, -122.388856204292)  14105926363010
3  (37.7857883766888, -122.412970537591)  16001366271000
4  (37.7650501214668, -122.419671780296)  16000274071000
```

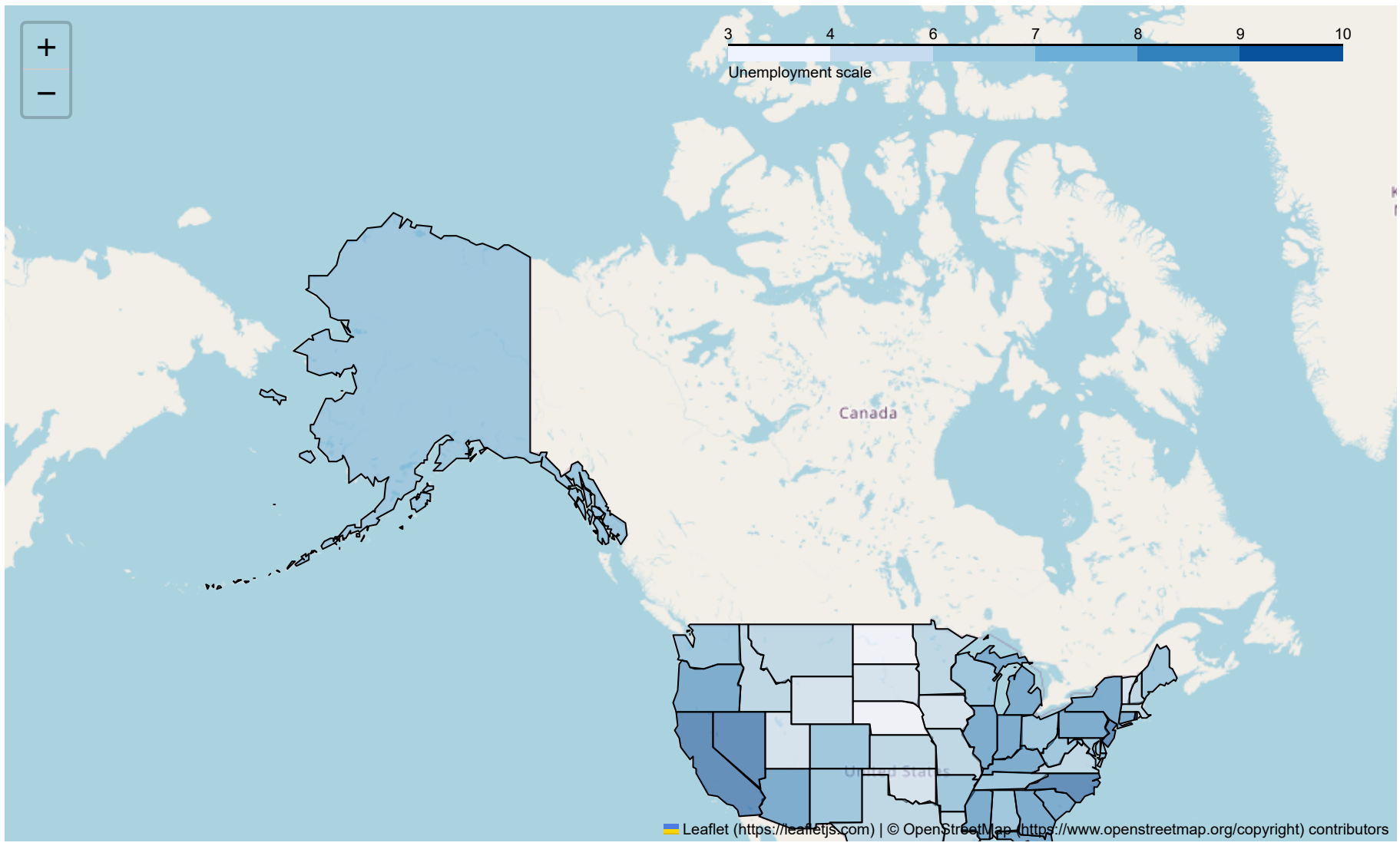
Out[57]:



Choropleth Maps : to make such type of heat maps in folium (world map)

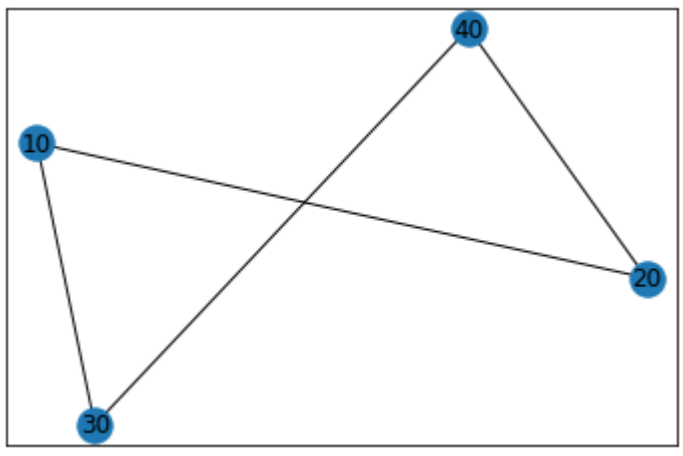
In [65]:
```
import folium
import pandas as pd
state_unemp=pd.read_csv('Datasets/US_Unemployment_Oct2012.csv')
state_geo='us-states.json'
m=folium.Map(location=[48,-102])
folium.Choropleth(geo_data=state_geo,name='choropleth',data=state_unemp,
columns=['State','Unemployment'],key_on='feature.id',
legend_name='Unemployment scale').add_to(m)
m
```

Out[65]:

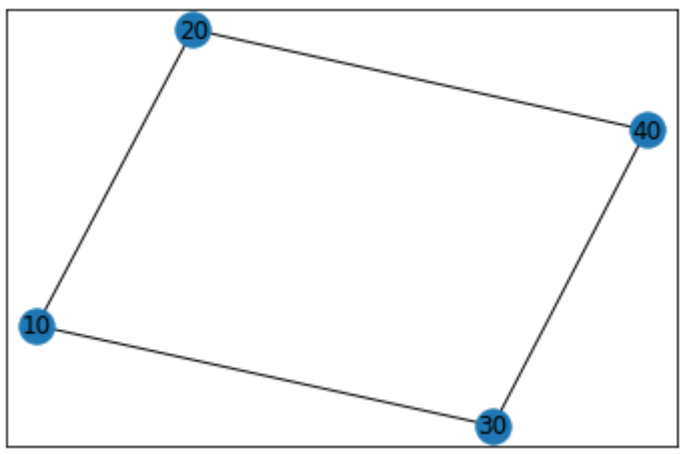


NetworkX

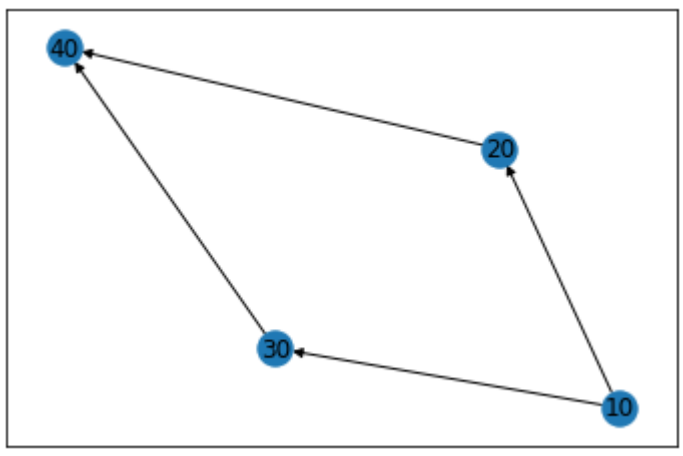
In [5]:
```
import networkx as nx
G=nx.Graph()
G.add_node(10)
G.add_nodes_from([20,30,40])
G.add_edge(10,20)
G.add_edges_from([(10,30),(20,40),(30,40)])
nx.draw_networkx(G)
```



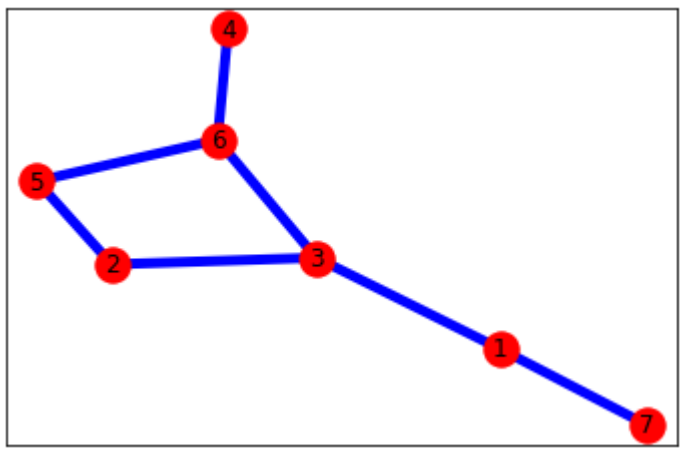
In [6]:
```
import networkx as nx
G=nx.Graph()
G.add_node(10)
G.add_nodes_from([20,30,40])
G.add_edge(10,20)
G.add_edges_from([(10,30),(20,40),(30,40)])
nx.draw_networkx(G)
```



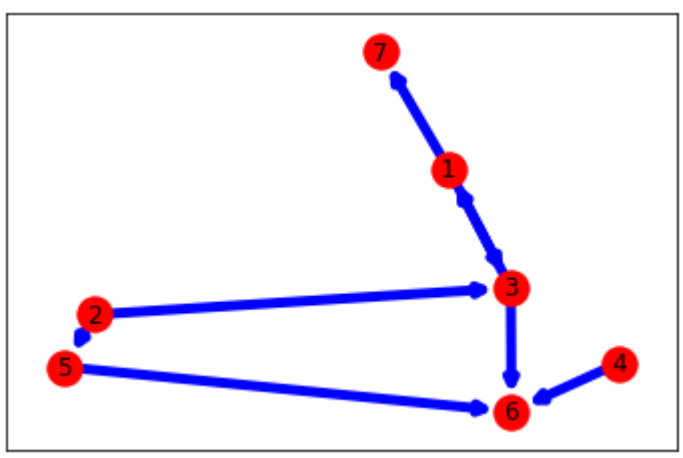
In [7]:
```
import networkx as nx
G=nx.DiGraph()
G.add_node(10)
G.add_nodes_from([20,30,40])
G.add_edge(10,20)
G.add_edges_from([(10,30),(20,40),(30,40)])
nx.draw_networkx(G)
```



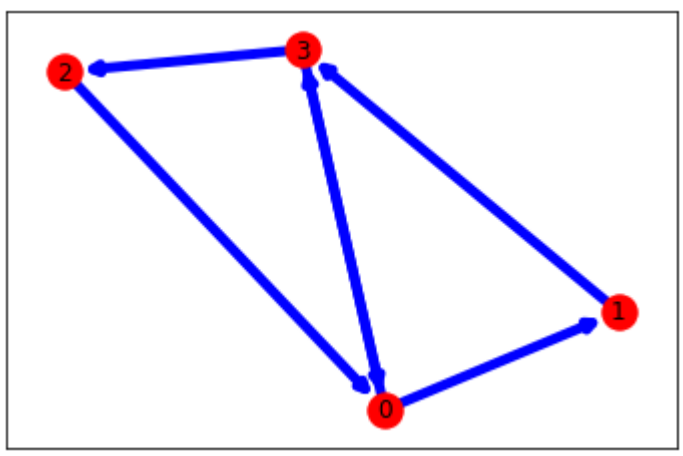
In [16]:
```
#undirected graphs
import networkx as nx
import matplotlib.pyplot as plt
G=nx.Graph()
G.add_node(1)
G.add_nodes_from([2,3]) #to take nodes from list
G.add_nodes_from(range(4,7)) #to take nodes in range 7 not included
G.add_edge(1,3)
G.add_edge(2,5)
G.add_edge(1,7)
G.add_edge(3,3)
G.add_edges_from([(2,3),(3,6),(4,6),(5,6)]) #to draw edges in list
nx.draw_networkx(G,node_size=300,node_color='red',edge_color='blue',width=5)
plt.figsize=[150,150]
plt.show()
```



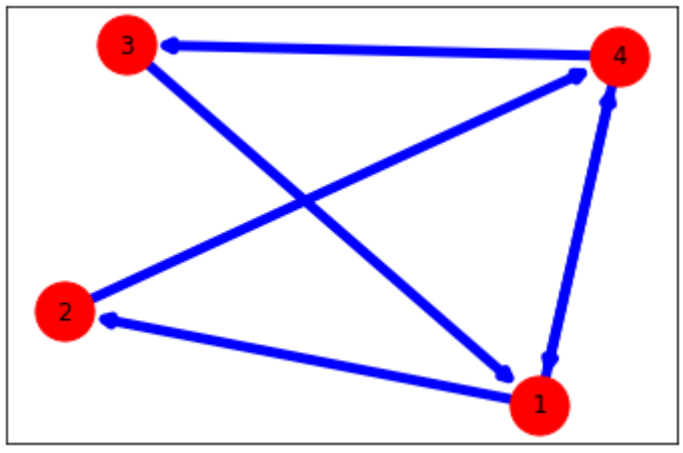
In [20]:
```
#Directed edges graph
import networkx as nx
import matplotlib.pyplot as plt
G=nx.DiGraph()
G.add_node(1)
G.add_nodes_from([2,3]) #to take nodes from list
G.add_nodes_from(range(4,7)) #to take nodes in range 7 not included
G.add_edge(1,3)
G.add_edge(3,1)
G.add_edge(2,5)
G.add_edge(1,7)
G.add_edge(3,3)
G.add_edges_from([(2,3),(3,6),(4,6),(5,6)]) #to draw edges in list
nx.draw_networkx(G,node_size=300,node_color='red',edge_color='blue',width=5)
plt.figsize=[150,150]
plt.show()

```



In [22]:
```
#Creating graph from adjacency matrix
#Directed edges graph
import networkx as nx
import matplotlib.pyplot as plt
G=nx.DiGraph()
G.add_nodes_from(range(4))
L=[[0,1,0,1],[0,0,0,1],[1,0,0,0],[1,0,1,0]]
for i in range(4):
    for j in range(4):
        if L[i][j]==1:
            G.add_edge(i,j)
nx.draw_networkx(G,node_size=300,node_color='red',edge_color='blue',width=5)
plt.figsize=[150,150]
plt.show()

```



In [23]:
```
#Creating graph from adjacency matrix
#Directed edges graph
import networkx as nx
import matplotlib.pyplot as plt
G=nx.DiGraph()
G.add_nodes_from(range(1,5))
L=[[0,1,0,1],[0,0,0,1],[1,0,0,0],[1,0,1,0]]
for i in range(1,5):
    for j in range(1,5):
        if L[i-1][j-1]==1:
            G.add_edge(i,j)
nx.draw_networkx(G,node_size=850,node_color='red',edge_color='blue',width=5)
plt.show()
```



P.b. 88

In [ ]:
```

```

In [13]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from pandas.plotting import parallel_coordinates

# Load dataset
df = pd.read_csv("Datasets\supermarket_sales.csv")  # Replace with correct path if needed

# 1. First 8 rows
print("1. First 8 rows:")
print(df.head(8))
```

```
1. First 8 rows:
    Invoice ID Branch       City Customer type  Gender  \
0  750-67-8428      A     Yangon        Member  Female
1  226-31-3081      C  Naypyitaw        Normal  Female
2  631-41-3108      A     Yangon        Normal    Male
3  123-19-1176      A     Yangon        Member    Male
4  373-73-7910      A     Yangon        Normal    Male
5  699-14-3026      C  Naypyitaw        Normal    Male
6  355-53-5943      A     Yangon        Member  Female
7  315-22-5665      C  Naypyitaw        Normal  Female

             Product line  Unit price  Quantity   Tax 5%     Total  \
0       Health and beauty       74.69         7  26.1415  548.9715
1  Electronic accessories       15.28         5   3.8200   80.2200
2      Home and lifestyle       46.33         7  16.2155  340.5255
3       Health and beauty       58.22         8  23.2880  489.0480
4       Sports and travel       86.31         7  30.2085  634.3785
5  Electronic accessories       85.39         7  29.8865  627.6165
6  Electronic accessories       68.84         6  20.6520  433.6920
7      Home and lifestyle       73.56        10  36.7800  772.3800

         Date   Time      Payment    cogs  gross margin percentage  \
0  01-05-2019  13:08      Ewallet  522.83                 4.761905
1  03-08-2019  10:29         Cash   76.40                 4.761905
2  03-03-2019  13:23  Credit card  324.31                 4.761905
3   1/27/2019  20:33      Ewallet  465.76                 4.761905
4  02-08-2019  10:37      Ewallet  604.17                 4.761905
5   3/25/2019  18:30      Ewallet  597.73                 4.761905
6   2/25/2019  14:36      Ewallet  413.04                 4.761905
7   2/24/2019  11:38      Ewallet  735.60                 4.761905

   gross income  Rating
0       26.1415     9.1
1        3.8200     9.6
2       16.2155     7.4
3       23.2880     8.4
4       30.2085     5.3
5       29.8865     4.1
6       20.6520     5.8
7       36.7800     8.0
```

In [14]:
```
# 2. Check and fill missing values with mean
print("\n2. Missing values before filling:")
print(df.isnull().sum())
df.fillna(df.mean(numeric_only=True), inplace=True)
print("Missing values after filling:\n", df.isnull().sum())
```

```
2. Missing values before filling:
Invoice ID                 0
Branch                     0
City                       0
Customer type              0
Gender                     0
Product line               0
Unit price                 0
Quantity                   0
Tax 5%                     0
Total                      0
Date                       0
Time                       0
Payment                    0
cogs                       4
gross margin percentage    0
gross income               0
Rating                     5
dtype: int64
Missing values after filling:
 Invoice ID                 0
Branch                     0
City                       0
Customer type              0
Gender                     0
Product line               0
Unit price                 0
Quantity                   0
Tax 5%                     0
Total                      0
Date                       0
Time                       0
Payment                    0
cogs                       0
gross margin percentage    0
gross income               0
Rating                     0
dtype: int64
```

In [15]:
```
# 3. Orders with Quantity < 3 and (Rating > 8.5 or Total > 600)
condition = (df['Quantity'] < 3) & ((df['Rating'] > 8.5) | (df['Total'] > 600))
num_orders = df[condition].shape[0]
print(f"\n3. Number of matching orders: {num_orders}")
```

```
3. Number of matching orders: 45
```

In [16]:
```
# 4. Total purchase sum by Customer type
total_by_customer_type = df.groupby('Customer type')['Total'].sum()
print("\n4. Total purchase by Customer Type:")
print(total_by_customer_type)
```

```
4. Total purchase by Customer Type:
Customer type
Member    164223.444
Normal    158743.305
Name: Total, dtype: float64
```

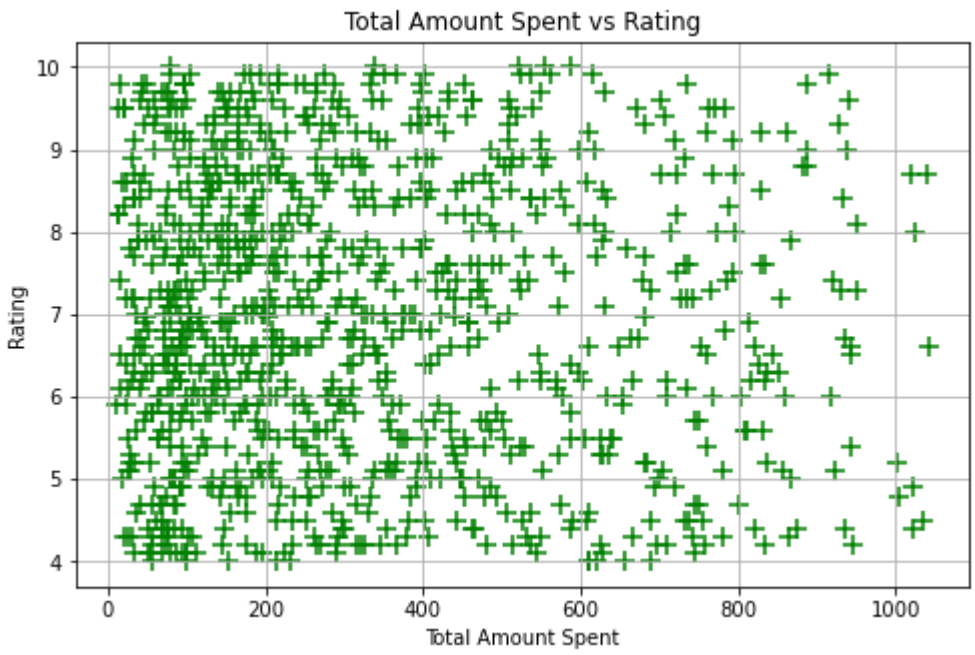
In [17]:
```
# 5. % of gross income by Payment method
gross_income_by_payment = df.groupby('Payment')['gross income'].sum()
gross_income_percent = (gross_income_by_payment / gross_income_by_payment.sum()) * 100
print("\n5. Gross income percentage by Payment method:")
print(gross_income_percent)
```

```
5. Gross income percentage by Payment method:
Payment
Cash           34.742453
Credit card    31.200448
Ewallet        34.057099
Name: gross income, dtype: float64
```

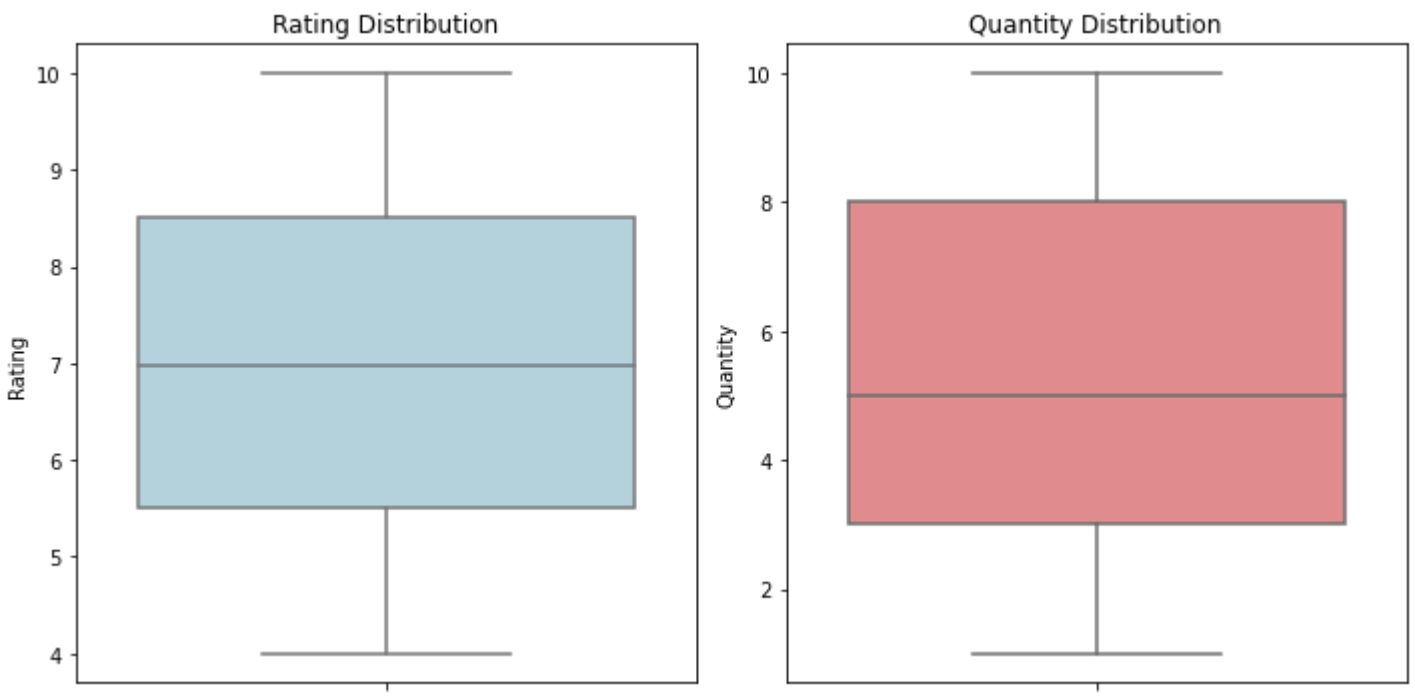
In [18]:
```
# 6. Average purchase price by Gender
avg_total_by_gender = df.groupby('Gender')['Total'].mean()
print("\n6. Average purchase price by Gender:")
print(avg_total_by_gender)
```

```
6. Average purchase price by Gender:
Gender
Female    335.095659
Male      310.789226
Name: Total, dtype: float64
```

In [20]:
```
# 7. Scatter plot: Total vs Rating
plt.figure(figsize=(8, 5))
plt.scatter(df['Total'], df['Rating'], marker='+', color='green', s=100)
plt.title('Total Amount Spent vs Rating')
plt.xlabel('Total Amount Spent')
plt.ylabel('Rating')
plt.grid(True)
plt.show()
```

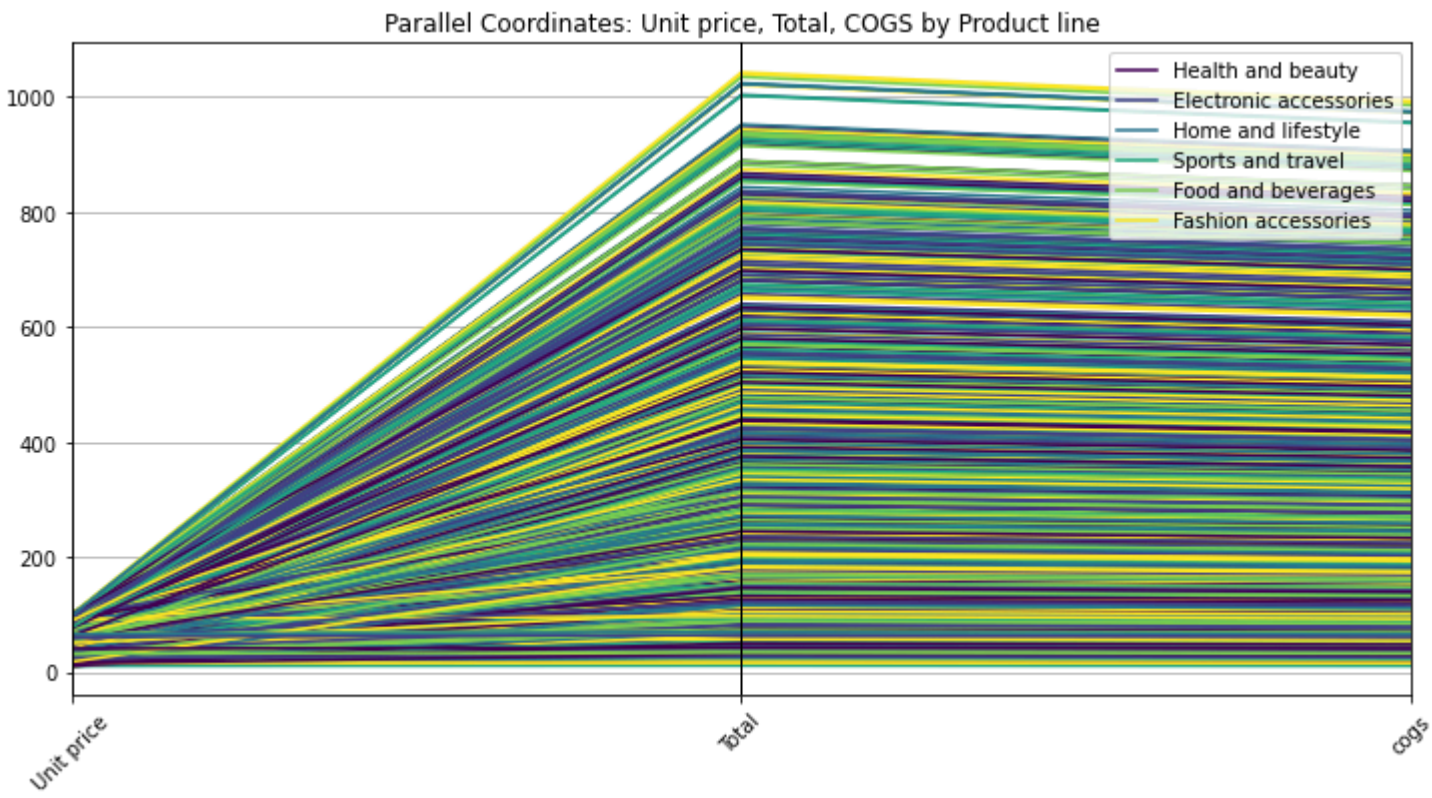


In [21]:
```
# 8. Box plots for Rating and Quantity
plt.figure(figsize=(10, 5))

plt.subplot(1, 2, 1)
sns.boxplot(y=df['Rating'], color='lightblue')
plt.title("Rating Distribution")

plt.subplot(1, 2, 2)
sns.boxplot(y=df['Quantity'], color='lightcoral')
plt.title("Quantity Distribution")

plt.tight_layout()
plt.show()

print("\n8. Outlier analysis:")
print("- Look for dots beyond the whiskers in the box plots.")
print("- 'Rating' is between 4 and 10 mostly, any lower may be outlier.")
print("- 'Quantity' outliers might appear at very high or very low ends.")
```




```
8. Outlier analysis:
- Look for dots beyond the whiskers in the box plots.
- 'Rating' is between 4 and 10 mostly, any lower may be outlier.
- 'Quantity' outliers might appear at very high or very low ends.
```

In [22]:
```
# 9. Parallel Coordinates Plot
subset = df[['Product line', 'Unit price', 'Total', 'cogs']]
plt.figure(figsize=(12, 6))
parallel_coordinates(subset, class_column='Product line', colormap='viridis')
plt.title("Parallel Coordinates: Unit price, Total, COGS by Product line")
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



In [ ]:
```
1
```