San Francisco Housing Rental Analysis

In this assignment, you will perform basic analysis for the San Francisco Housing Market to allow potential real estate investors to choose rental investment properties.

In [133]:
```
# initial imports
import os
import pandas as pd
import matplotlib.pyplot as plt
import hvplot.pandas
import plotly.express as px
from pathlib import Path
from dotenv import load_dotenv
from panel.interact import interact
from panel import widgets
import hvplot.pandas

import panel as pn

%matplotlib inline
```

In [134]:
```
# Read the Mapbox API key
load_dotenv()
mapbox_token = os.getenv("MAPBOX_TOKEN")
```

Load Data

In [135]:
```
# Read the census data into a Pandas DataFrame
file_path = Path("Data/sfo_neighborhoods_census_data.csv")
sfo_data = pd.read_csv(file_path, index_col="year")
sfo_data.head()
```

Out[135]:

year	neighborhood	sale_price_sqr_foot	housing_units	gross_rent
2010	Alamo Square	291.182945	372560	1239
2010	Anza Vista	267.932583	372560	1239
2010	Bayview	170.098665	372560	1239
2010	Buena Vista Park	347.394919	372560	1239
2010	Central Richmond	319.027623	372560	1239

Housing Units Per Year

In this section, you will calculate the number of housing units per year and visualize the results as a bar chart using the Pandas plot function.

Hint: Use the Pandas groupby function

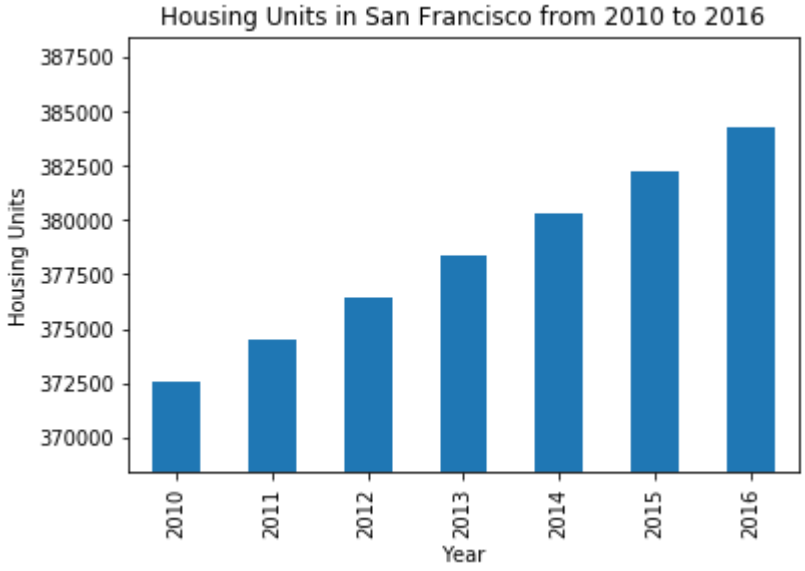
Optional challenge: Use the min, max, and std to scale the y limits of the chart.

In [136]:
```
# Calculate the mean number of housing units per year (hint: use groupby)
# YOUR CODE HERE!
units_per_year= sfo_data.groupby('year').mean()["housing_units"]
units_per_year
```

Out[136]:
```
year
2010    372560
2011    374507
2012    376454
2013    378401
2014    380348
2015    382295
2016    384242
Name: housing_units, dtype: int64
```

In [137]:
```
std_y=units_per_year.std()
min_y=units_per_year.min()-std_y
max_y=units_per_year.max()+std_y
```

In [138]:
```
# Use the Pandas plot function to plot the average housing units per year.
# Note: You will need to manually adjust the y limit of the chart using the mi
n and max values from above.
# YOUR CODE HERE!

# Optional Challenge: Use the min, max, and std to scale the y limits of the c
hart
# YOUR CODE HERE!
ax = units_per_year.plot(kind="bar", title='Housing Units in San Francisco fro
m 2010 to 2016')
ax.set_xlabel("Year")
ax.set_ylabel("Housing Units")
plt.ylim(min_y,max_y)
plt.show()
```



Average Prices per Square Foot

In this section, you will calculate the average gross rent and average sales price for each year. Plot the results as a line chart.

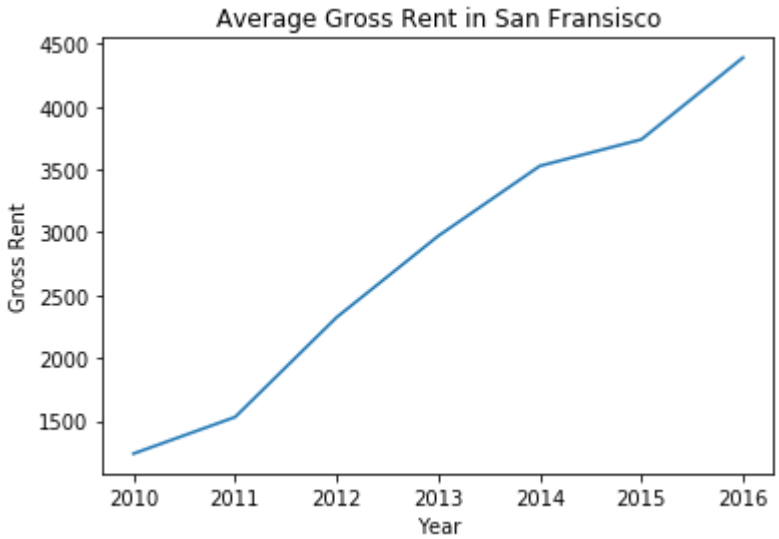
Average Gross Rent in San Francisco Per Year

In [139]:
```
# Calculate the average gross rent and average sale price per square foot
# YOUR CODE HERE!
average_per_year= sfo_data.groupby('year').mean()
average_per_year
```

Out[139]:

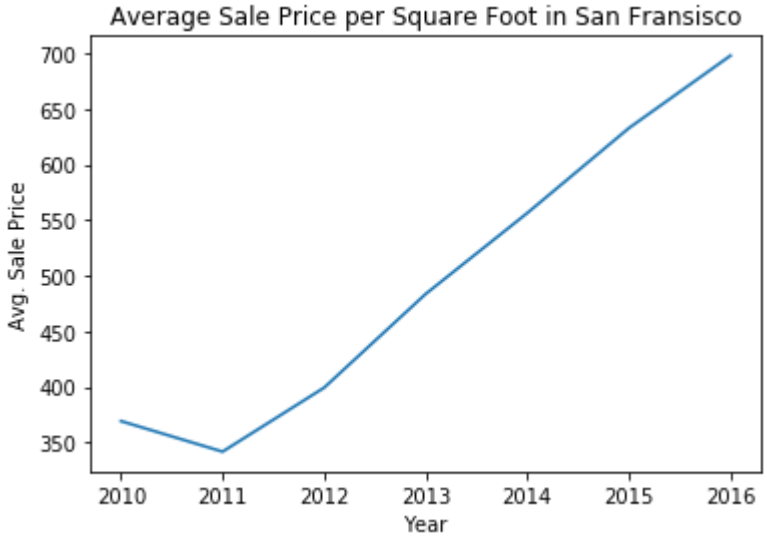
year	sale_price_sqr_foot	housing_units	gross_rent
2010	369.344353	372560	1239
2011	341.903429	374507	1530
2012	399.389968	376454	2324
2013	483.600304	378401	2971
2014	556.277273	380348	3528
2015	632.540352	382295	3739
2016	697.643709	384242	4390

In [140]:
```
# Plot the Average Gross Rent per Year as a Line Chart
# YOUR CODE HERE!
#average_per_year['gross_rent'].plot(title="Average Gross Rent in San Fransisco")

ax = average_per_year['gross_rent'].plot(kind="line",title="Average Gross Rent in San Fransisco")
ax.set_xlabel("Year")
ax.set_ylabel("Gross Rent")
plt.show()
```



Average Sales Price per Year

In [141]:
```
# Plot the Average Sales Price per Year as a line chart
# YOUR CODE HERE!
#average_per_year['sale_price_sqr_foot'].plot(y='Avg. Sale Price',title="Avera
ge Sale Price per Square Foot in San Fransisco")
ax = average_per_year['sale_price_sqr_foot'].plot(kind="line",title="Average S
ale Price per Square Foot in San Fransisco")
ax.set_xlabel("Year")
ax.set_ylabel("Avg. Sale Price")
plt.show()
```



Average Prices by Neighborhood

In this section, you will use hvplot to create an interactive visulization of the Average Prices with a dropdown selector for the neighborhood.

Hint: It will be easier to create a new DataFrame from grouping the data and calculating the mean prices for each year and neighborhood

In [142]:
```
# Group by year and neighborhood and then create a new dataframe of the mean values
# YOUR CODE HERE!
neighborhood_data_per_year= sfo_data.groupby(['year','neighborhood']).mean()
neighborhood_data_per_year.reset_index(inplace=True)
neighborhood_data_per_year
```

Out[142]:

	year	neighborhood	sale_price_sqr_foot	housing_units	gross_rent
0	2010	Alamo Square	291.182945	372560	1239
1	2010	Anza Vista	267.932583	372560	1239
2	2010	Bayview	170.098665	372560	1239
3	2010	Buena Vista Park	347.394919	372560	1239
4	2010	Central Richmond	319.027623	372560	1239
...	...	...	...	...	...
392	2016	Telegraph Hill	903.049771	384242	4390
393	2016	Twin Peaks	970.085470	384242	4390
394	2016	Van Ness/ Civic Center	552.602567	384242	4390
395	2016	Visitacion Valley	328.319007	384242	4390
396	2016	Westwood Park	631.195426	384242	4390

397 rows × 5 columns

In [143]:
```
df_sliced=neighborhood_data_per_year[['year','neighborhood','sale_price_sqr_foot']]
df_sliced
```

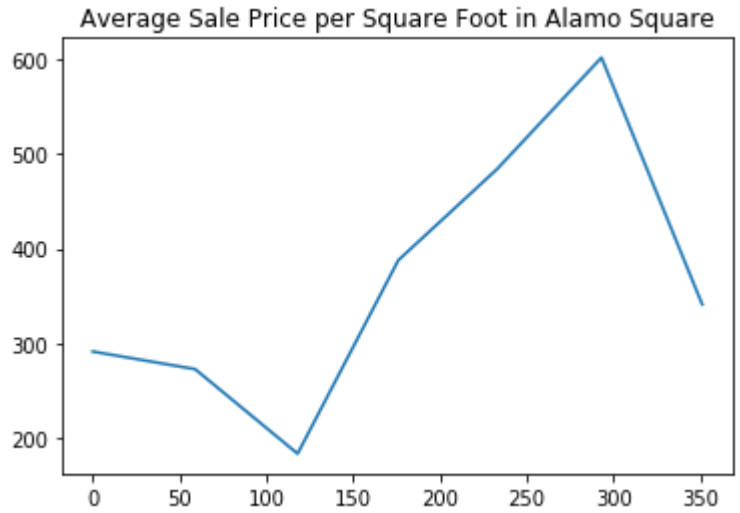
Out[143]:

	year	neighborhood	sale_price_sqr_foot
0	2010	Alamo Square	291.182945
1	2010	Anza Vista	267.932583
2	2010	Bayview	170.098665
3	2010	Buena Vista Park	347.394919
4	2010	Central Richmond	319.027623
...	...	...	...
392	2016	Telegraph Hill	903.049771
393	2016	Twin Peaks	970.085470
394	2016	Van Ness/ Civic Center	552.602567
395	2016	Visitacion Valley	328.319007
396	2016	Westwood Park	631.195426

397 rows × 3 columns

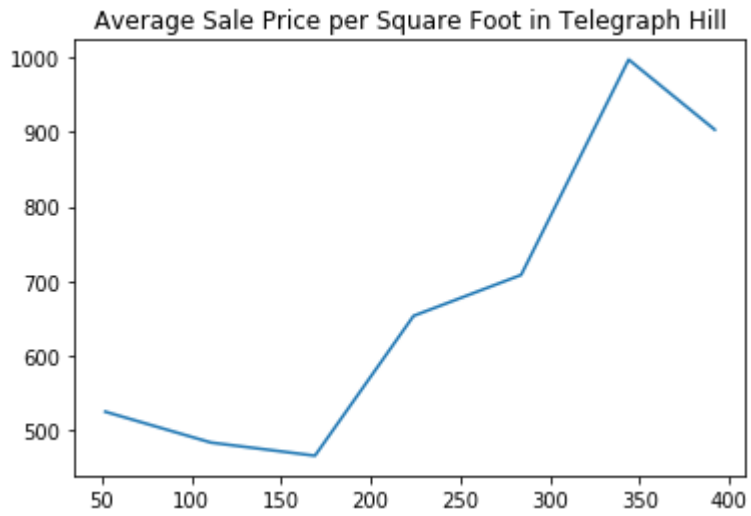
In [144]:
```
# Use hvplot to create an interactive line chart of the average price per sq f
t.
# The plot should have a dropdown selector for the neighborhood
# YOUR CODE HERE!
from panel.interact import interact
from panel import widgets
import hvplot.pandas
def plot_neighborhood_data(neighborhood):
        neighborhood_df=df_sliced.loc[df_sliced["neighborhood"] == neighborhoo
d]
        return neighborhood_df['sale_price_sqr_foot'].plot(kind="line",title=
"Average Sale Price per Square Foot in " + neighborhood)

interact(plot_neighborhood_data, neighborhood=df_sliced['neighborhood'])
```

Out[144]:



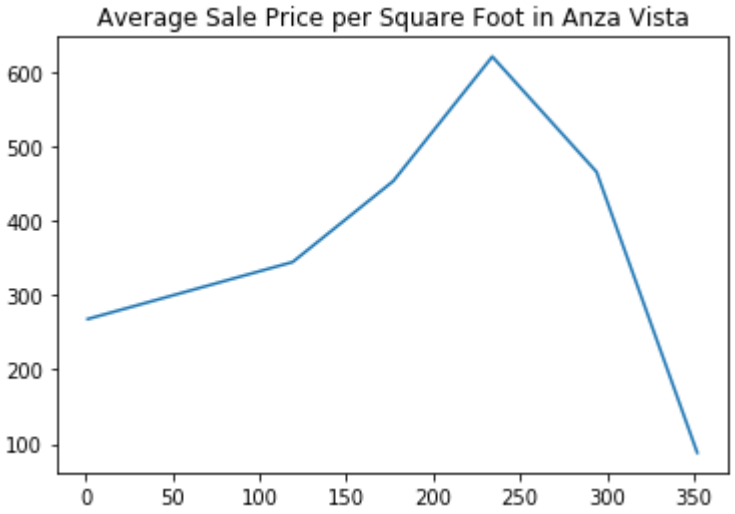
In [145]:
```
plot_neighborhood_data('Telegraph Hill')
```

Out[145]: <matplotlib.axes._subplots.AxesSubplot at 0x26951c83588>



In [146]:
```
interact(plot_neighborhood_data, neighborhood=['Anza Vista','Parkside'])
```

Out[146]:



For some reason, my graph was not refreshing after chaging the value in combo. I tried the following, still not refreshing.

Is there a way to enforce the refresh using some command ? Not sure if I am missing something or my Pyviz/jupyter lab has an issue.

In [15]:
```
def plot_neighborhood_data(neighborhood):
        return (" You selected: " + neighborhood)

interact(plot_neighborhood_data, neighborhood=neighborhood_data_per_year['neighborhood'])
```

Out[15]:

The Top 10 Most Expensive Neighborhoods

In this section, you will need to calculate the mean sale price for each neighborhood and then sort the values to obtain the top 10 most expensive neighborhoods on average. Plot the results as a bar chart.

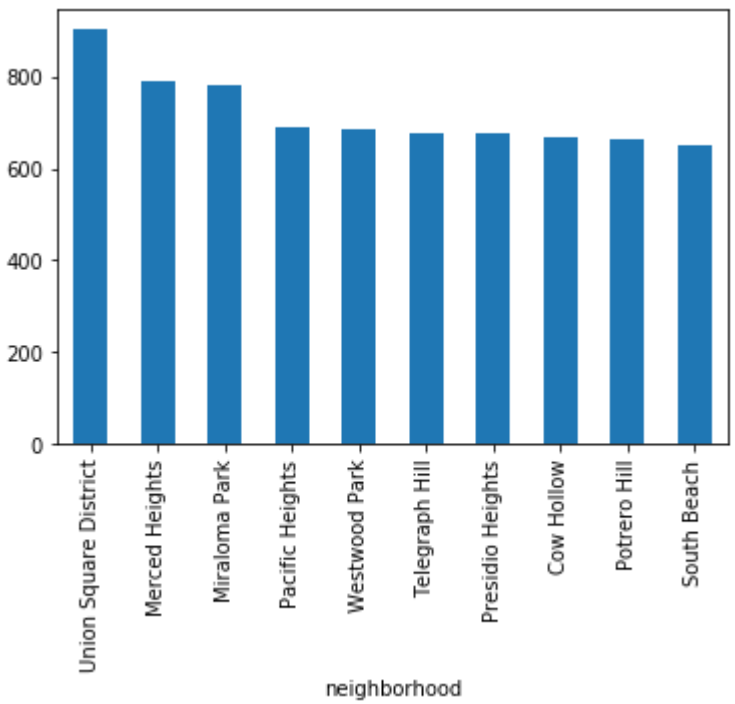
In [147]:
```
# Getting the data from the top 10 expensive neighborhoods
# YOUR CODE HERE!
averages_by_neighborhood=sfo_data.groupby('neighborhood').mean().sort_values(by=['sale_price_sqr_foot'], ascending=False).head(10)
averages_by_neighborhood
```

Out[147]:

neighborhood	sale_price_sqr_foot	housing_units	gross_rent
Union Square District	903.993258	377427.50	2555.166667
Merced Heights	788.844818	380348.00	3414.000000
Miraloma Park	779.810842	375967.25	2155.250000
Pacific Heights	689.555817	378401.00	2817.285714
Westwood Park	687.087575	382295.00	3959.000000
Telegraph Hill	676.506578	378401.00	2817.285714
Presidio Heights	675.350212	378401.00	2817.285714
Cow Hollow	665.964042	378401.00	2817.285714
Potrero Hill	662.013613	378401.00	2817.285714
South Beach	650.124479	375805.00	2099.000000

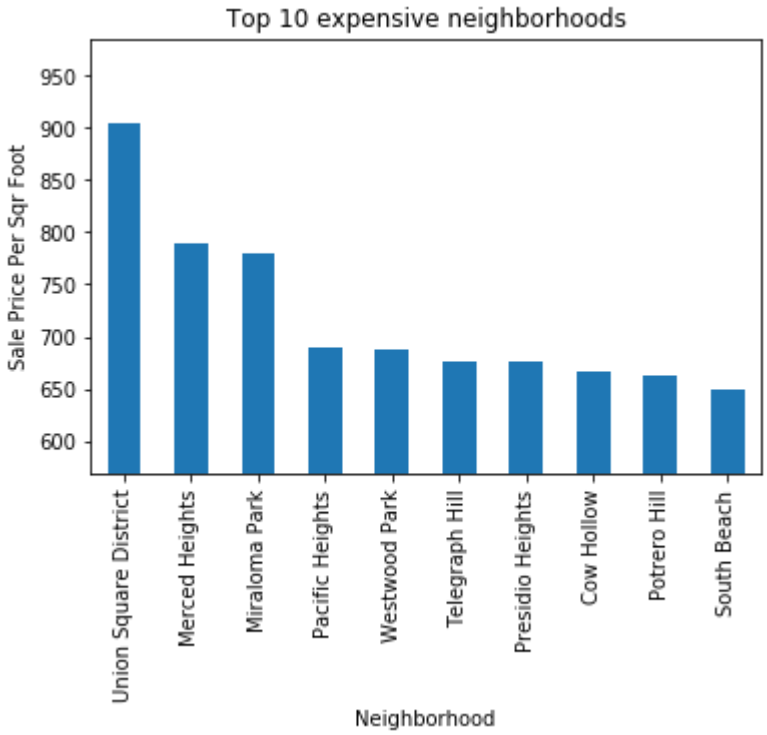
In [148]:
```
# Plotting the data from the top 10 expensive neighborhoods
# YOUR CODE HERE!
averages_by_neighborhood["sale_price_sqr_foot"].plot(kind="bar")
```

Out[148]: <matplotlib.axes._subplots.AxesSubplot at 0x26952381c88>



Leveraging the same code I used above to modify the graph and set min, max values...

In [149]:
```
std_y=averages_by_neighborhood["sale_price_sqr_foot"].std()
min_y=averages_by_neighborhood["sale_price_sqr_foot"].min()-std_y
max_y=averages_by_neighborhood["sale_price_sqr_foot"].max()+std_y

ax = averages_by_neighborhood["sale_price_sqr_foot"].plot(kind="bar", title='T
op 10 expensive neighborhoods')
ax.set_xlabel("Neighborhood")
ax.set_ylabel("Sale Price Per Sqr Foot")
plt.ylim(min_y,max_y)
plt.show()
```



Parallel Coordinates and Parallel Categories Analysis

In this section, you will use plotly express to create parallel coordinates and parallel categories visualizations so that investors can interactively filter and explore various factors related to the sales price of the neighborhoods.

Using the DataFrame of Average values per neighborhood (calculated above), create the following visualizations:

1. Create a Parallel Coordinates Plot
2. Create a Parallel Categories Plot

I figured out my jupyter lab worked only when I used panel.column.. otherwise it wasn't showing the graph. So using the workaround to show the graphs

In [150]:
```
# Parallel Coordinates Plot
# YOUR CODE HERE!
averages_by_neighborhood.reset_index(inplace=True)
ax=px.parallel_coordinates(averages_by_neighborhood, color='sale_price_sqr_foo
t', width=1000)

column = pn.Column(
    "## Parallel Coordinates Plot", ax
)
column
```

Out[150]:

In [ ]:
```

```

In [170]:
```
# Parallel Categories Plot
# YOUR CODE HERE!
ax=px.parallel_categories(
    averages_by_neighborhood,
    dimensions=["neighborhood", "housing_units", "gross_rent"],
    color="sale_price_sqr_foot",
    color_continuous_scale=px.colors.sequential.Inferno,
    labels={
        "neighborhood": "Neighborhood",
        "housing_units": "Uousing Units",
        "gross_rent": "Gross Rent",
    },
    width=1000
)
column = pn.Column(
    "## Parallel Categories Plot", ax
)
column
```

Out[170]:

In [171]:
```
averages_by_neighborhood
```

Out[171]:

	neighborhood	sale_price_sqr_foot	housing_units	gross_rent
0	Union Square District	903.993258	377427.50	2555.166667
1	Merced Heights	788.844818	380348.00	3414.000000
2	Miraloma Park	779.810842	375967.25	2155.250000
3	Pacific Heights	689.555817	378401.00	2817.285714
4	Westwood Park	687.087575	382295.00	3959.000000
5	Telegraph Hill	676.506578	378401.00	2817.285714
6	Presidio Heights	675.350212	378401.00	2817.285714
7	Cow Hollow	665.964042	378401.00	2817.285714
8	Potrero Hill	662.013613	378401.00	2817.285714
9	South Beach	650.124479	375805.00	2099.000000

Neighborhood Map

In this section, you will read in neighboor location data and build an interactive map with the average prices per neighborhood. Use a scatter_mapbox from plotly express to create the visualization. Remember, you will need your mapbox api key for this.

Load Location Data

In [172]:
```
# Load neighborhoods coordinates data
file_path = Path("Data/neighborhoods_coordinates.csv")
df_neighborhood_locations = pd.read_csv(file_path)
df_neighborhood_locations
```

Out[172]:

	Neighborhood	Lat	Lon
0	Alamo Square	37.791012	-122.402100
1	Anza Vista	37.779598	-122.443451
2	Bayview	37.734670	-122.401060
3	Bayview Heights	37.728740	-122.410980
4	Bernal Heights	37.728630	-122.443050
...	...	...	...
68	West Portal	37.740260	-122.463880
69	Western Addition	37.792980	-122.435790
70	Westwood Highlands	37.734700	-122.456854
71	Westwood Park	37.734150	-122.457000
72	Yerba Buena	37.792980	-122.396360

73 rows × 3 columns

Data Preparation

You will need to join the location data with the mean prices per neighborhood

1. Calculate the mean values for each neighborhood
2. Join the average values with the neighborhood locations

In [185]:
```
# Calculate the mean values for each neighborhood
# YOUR CODE HERE!

df_neighborhood=sfo_data.groupby('neighborhood').mean()

df_neighborhood.reset_index(inplace=True)
df_neighborhood.head()
```

Out[185]:

	neighborhood	sale_price_sqr_foot	housing_units	gross_rent
0	Alamo Square	366.020712	378401.0	2817.285714
1	Anza Vista	373.382198	379050.0	3031.833333
2	Bayview	204.588623	376454.0	2318.400000
3	Bayview Heights	590.792839	382295.0	3739.000000
4	Bernal Heights	576.746488	379374.5	3080.333333

In [182]:
```
df_neighborhood_locations.columns=["neighborhood","lat","lon"]

#df_neighborhood_locations.set_index("neighborhood",inplace=True)


df_neighborhood_locations.head()
```

Out[182]:

	neighborhood	lat	lon
0	Alamo Square	37.791012	-122.402100
1	Anza Vista	37.779598	-122.443451
2	Bayview	37.734670	-122.401060
3	Bayview Heights	37.728740	-122.410980
4	Bernal Heights	37.728630	-122.443050

In [186]:
```
#df_neighborhood_locations.set_index("neighborhood",inplace=True)
df_neighborhood_locations
df_neighborhood_locations.set_index("neighborhood",inplace=True)
```

In [190]:
```
df_neighborhood
df_neighborhood.set_index("neighborhood",inplace=True)
```

In [191]:
```
# Join the average values with the neighborhood locations
# YOUR CODE HERE!

df_joined=pd.concat([df_neighborhood,df_neighborhood_locations], axis='column
s', join='inner')
df_joined
```

Out[191]:

neighborhood	sale_price_sqr_foot	housing_units	gross_rent	lat	lon
Alamo Square	366.020712	378401.00	2817.285714	37.791012	-122.402100
Anza Vista	373.382198	379050.00	3031.833333	37.779598	-122.443451
Bayview	204.588623	376454.00	2318.400000	37.734670	-122.401060
Bayview Heights	590.792839	382295.00	3739.000000	37.728740	-122.410980
Buena Vista Park	452.680591	378076.50	2698.833333	37.768160	-122.439330
...	...	...	...	...	...
West Portal	498.488485	376940.75	2515.500000	37.740260	-122.463880
Western Addition	307.562201	377427.50	2555.166667	37.792980	-122.435790
Westwood Highlands	533.703935	376454.00	2250.500000	37.734700	-122.456854
Westwood Park	687.087575	382295.00	3959.000000	37.734150	-122.457000
Yerba Buena	576.709848	377427.50	2555.166667	37.792980	-122.396360

69 rows × 5 columns

Mapbox Visualization

Plot the aveage values per neighborhood with a plotly express scatter_mapbox visualization.

In [197]:
```
df_joined.reset_index(inplace=True)
```

In [200]:
```
# Set token using Plotly Express set function
px.set_mapbox_access_token(mapbox_token)
# YOUR CODE HERE!


myplot= px.scatter_mapbox(
        df_joined,
        lat="lat",
        lon="lon",
        size="sale_price_sqr_foot",
        color="neighborhood",
        color_continuous_scale=px.colors.cyclical.IceFire,
        title="Neighborhood Info",
        zoom=3,
        width=1200,
        height=700
    )

geo_column = pn.Column(
    "## Neighborhood Info", myplot
)
geo_column
```

Out[200]:

In [201]:
```
# Set token using Plotly Express set function
px.set_mapbox_access_token(mapbox_token)
# YOUR CODE HERE!

# chaging the color to be sale price
myplot= px.scatter_mapbox(
        df_joined,
        lat="lat",
        lon="lon",
        size="sale_price_sqr_foot",
        color="sale_price_sqr_foot",
        color_continuous_scale=px.colors.cyclical.IceFire,
        title="Neighborhood Info",
        zoom=3,
        width=1200,
        height=700
    )

geo_column = pn.Column(
    "## Neighborhood Info", myplot
)
geo_column
```

Out[201]:

In [ ]: