ML LAB 1 Exp 22102B2001 Chinmay Rajan Mhatre

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error as mse, r2_score
from sklearn.metrics import accuracy_score
import plotly.express as px
```

```
df = pd.read_csv("/content/housing.csv")
df
```

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_income	median_house_val
0	-122.23	37.88	41.0	880.0	129.0	322.0	126.0	8.3252	45260
1	-122.22	37.86	21.0	7099.0	1106.0	2401.0	1138.0	8.3014	35850
2	-122.24	37.85	52.0	1467.0	190.0	496.0	177.0	7.2574	35210
3	-122.25	37.85	52.0	1274.0	235.0	558.0	219.0	5.6431	34130
4	-122.25	37.85	52.0	1627.0	280.0	565.0	259.0	3.8462	34220
...	...	...	...	...	...	...	...	...	
20635	-121.09	39.48	25.0	1665.0	374.0	845.0	330.0	1.5603	7810
20636	-121.21	39.49	18.0	697.0	150.0	356.0	114.0	2.5568	7710
20637	-121.22	39.43	17.0	2254.0	485.0	1007.0	433.0	1.7000	9230
20638	-121.32	39.43	18.0	1860.0	409.0	741.0	349.0	1.8672	8470
20639	-121.24	39.37	16.0	2785.0	616.0	1387.0	530.0	2.3886	8940

20640 rows × 10 columns

Next steps: Generate code with df   View recommended plots

```
df.isnull().sum()
```

```
longitude               0
latitude                0
housing_median_age      0
total_rooms             0
total_bedrooms        207
population              0
households              0
median_income           0
median_house_value      0
ocean_proximity         0
dtype: int64
```

```
val = df['total_bedrooms'].median()
val
```

```
435.0
```

```
df['total_bedrooms'].dropna()
```

```
0         129.0
1        1106.0
2         190.0
3         235.0
4         280.0
          ...
20635     374.0
20636     150.0
20637     485.0
20638     409.0
20639     616.0
Name: total_bedrooms, Length: 20433, dtype: float64
```

```
df.isnull().sum()
```

```
longitude               0
latitude                0
```

```
housing_median_age      0
total_rooms             0
total_bedrooms        207
population              0
households              0
median_income           0
median_house_value      0
ocean_proximity         0
dtype: int64
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   longitude           20640 non-null  float64
 1   latitude            20640 non-null  float64
 2   housing_median_age  20640 non-null  float64
 3   total_rooms         20640 non-null  float64
 4   total_bedrooms      20433 non-null  float64
 5   population          20640 non-null  float64
 6   households          20640 non-null  float64
 7   median_income       20640 non-null  float64
 8   median_house_value  20640 non-null  float64
 9   ocean_proximity     20640 non-null  object 
dtypes: float64(9), object(1)
memory usage: 1.6+ MB
```

```
df['ocean_proximity'].unique()
```

```
array(['NEAR BAY', '<1H OCEAN', 'INLAND', 'NEAR OCEAN', 'ISLAND'],
      dtype=object)
```

```
df['ocean_proximity'] = df['ocean_proximity'].map({'NEAR BAY': 0, '<1H OCEAN': 1, 'INLAND': 2,  'NEAR OCEAN': 3, 'ISLAND': 4})
df['ocean_proximity']
```

```
0        0
1        0
2        0
3        0
4        0
        ..
20635    2
20636    2
20637    2
20638    2
20639    2
Name: ocean_proximity, Length: 20640, dtype: int64
```

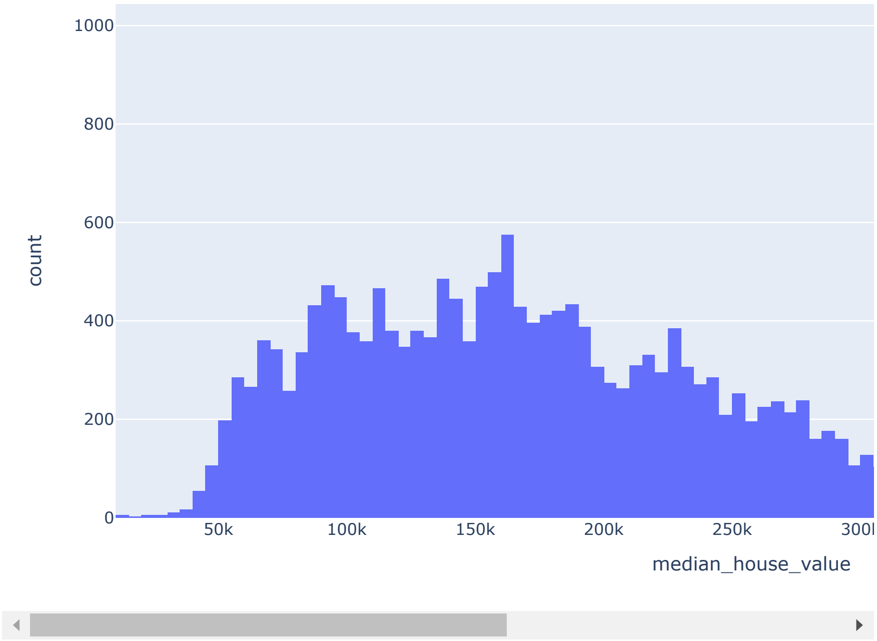
EDA

```
df.head()
```

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population
0	-122.23	37.88	41.0	880.0	129.0	322.0
1	-122.22	37.86	21.0	7099.0	1106.0	2401.0
2	-122.24	37.85	52.0	1467.0	190.0	496.0
3	-122.25	37.85	52.0	1274.0	235.0	558.0
4	-122.25	37.85	52.0	1627.0	280.0	565.0

Next steps: Generate code with df   View recommended plots

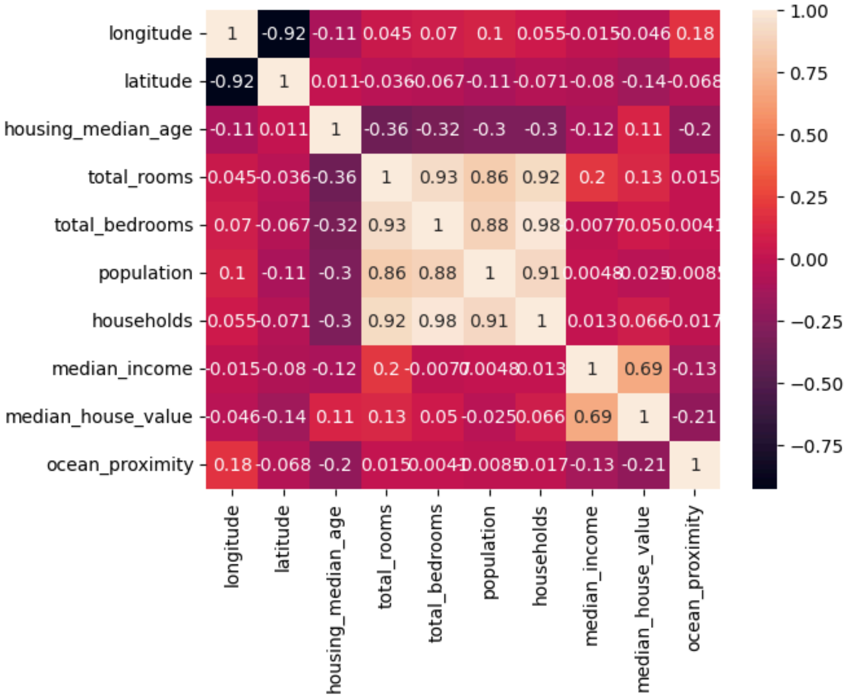
```
fig = px.histogram(df, x="median_house_value")
fig.show()
```



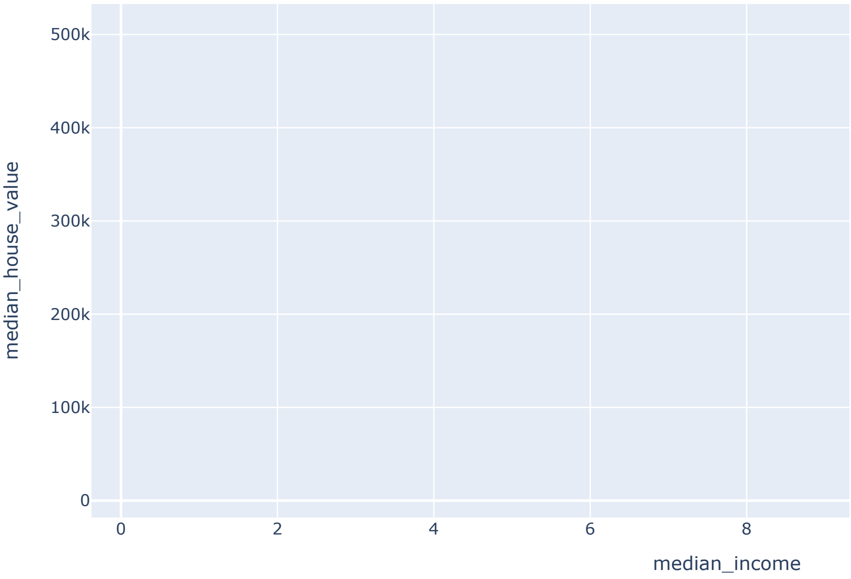
```
corr = df.corr(method = 'pearson')['median_house_value']
corr
```

```
longitude            -0.045967
latitude             -0.144160
housing_median_age    0.105623
total_rooms           0.134153
total_bedrooms        0.049686
population           -0.024650
households            0.065843
median_income         0.688075
median_house_value    1.000000
ocean_proximity      -0.210600
Name: median_house_value, dtype: float64
```

```
heatmap = sns.heatmap(df.corr(),annot=True)
```



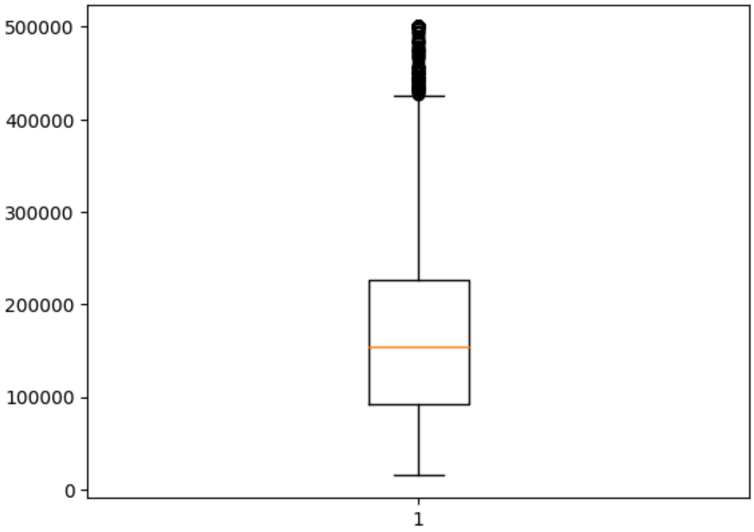
```
data = df.head(5000)
x = data['median_income']
y = data['median_house_value']
px.scatter(data,x,y)
```



```
np.linspace(y.min(), y.max(), 11)
```

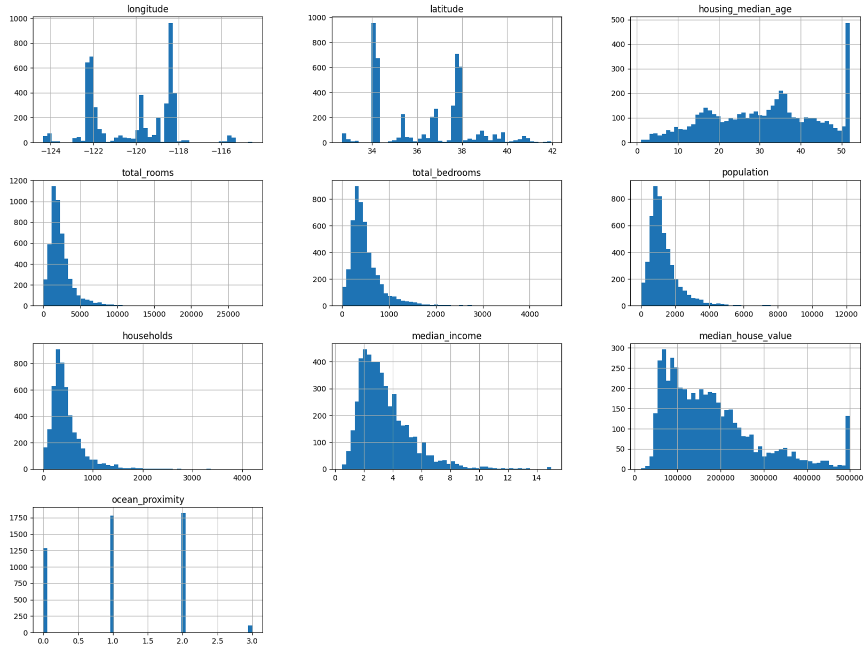
```
array([ 14999. ,  63499.2, 111999.4, 160499.6, 208999.8, 257500. ,
        306000.2, 354500.4, 403000.6, 451500.8, 500001. ])
```

```
plt.boxplot(data['median_house_value'])
plt.show()
```



```
data.hist(bins=50,figsize=(20,15))
```

```
array([[<Axes: title={'center': 'longitude'}>,
        <Axes: title={'center': 'latitude'}>,
        <Axes: title={'center': 'housing_median_age'}>],
       [<Axes: title={'center': 'total_rooms'}>,
        <Axes: title={'center': 'total_bedrooms'}>,
        <Axes: title={'center': 'population'}>],
       [<Axes: title={'center': 'households'}>,
        <Axes: title={'center': 'median_income'}>,
        <Axes: title={'center': 'median_house_value'}>],
       [<Axes: title={'center': 'ocean_proximity'}>, <Axes: >, <Axes: >]],
      dtype=object)
```



```
(df['median_house_value'] > 420000)
```

```
0         True
1        False
2        False
3        False
4        False
         ...  
20635    False
20636    False
20637    False
20638    False
20639    False
Name: median_house_value, Length: 20640, dtype: bool
```

```
(df['median_house_value'] > 420000).sum()
```

```
1540
```

```
df.columns
housing_Df = df[['longitude', 'latitude', 'housing_median_age', 'total_rooms',
       'total_bedrooms', 'population', 'households', 'median_income',
       'median_house_value', 'ocean_proximity']]
housing_Df.head()
housing_Df.dropna(inplace=True)
housing_Df.isnull().sum()
```

```
longitude             0
latitude              0
housing_median_age    0
total_rooms           0
total_bedrooms        0
population            0
households            0
median_income         0
median_house_value    0
ocean_proximity       0
dtype: int64
```

```
train_pd, test_pd, val_pd = housing_Df[:18000], housing_Df[18000:19217], housing_Df[19215:]
len(train_pd), len(test_pd), len(val_pd)
```

```
(18000, 1217, 1218)
```

```
X_train, y_train = train_pd.drop('median_house_value', axis=1), train_pd.to_numpy()[:,-1]
X_train.head(10)
```

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population
0	-122.23	37.88	41.0	880.0	129.0	322.0
1	-122.22	37.86	21.0	7099.0	1106.0	2401.0
2	-122.24	37.85	52.0	1467.0	190.0	496.0
3	-122.25	37.85	52.0	1274.0	235.0	558.0
4	-122.25	37.85	52.0	1627.0	280.0	565.0
5	-122.25	37.85	52.0	919.0	213.0	413.0
6	-122.25	37.84	52.0	2535.0	489.0	1094.0
7	-122.25	37.84	52.0	3104.0	687.0	1157.0
8	-122.26	37.84	42.0	2555.0	665.0	1206.0
9	-122.25	37.84	52.0	3549.0	707.0	1551.0

Next steps: Generate code with X_train View recommended plots

```
X_val, y_val = val_pd.to_numpy()[:,:-1], val_pd.to_numpy()[:,-1]
X_test, y_test = test_pd.to_numpy()[:,:-1],test_pd.to_numpy()[:,-1]
```

```
X_train.shape, y_train.shape, X_test.shape, y_test.shape, X_val.shape, y_val.shape
```

```
((18000, 9), (18000,), (1217, 9), (1217,), (1218, 9), (1218,))
```

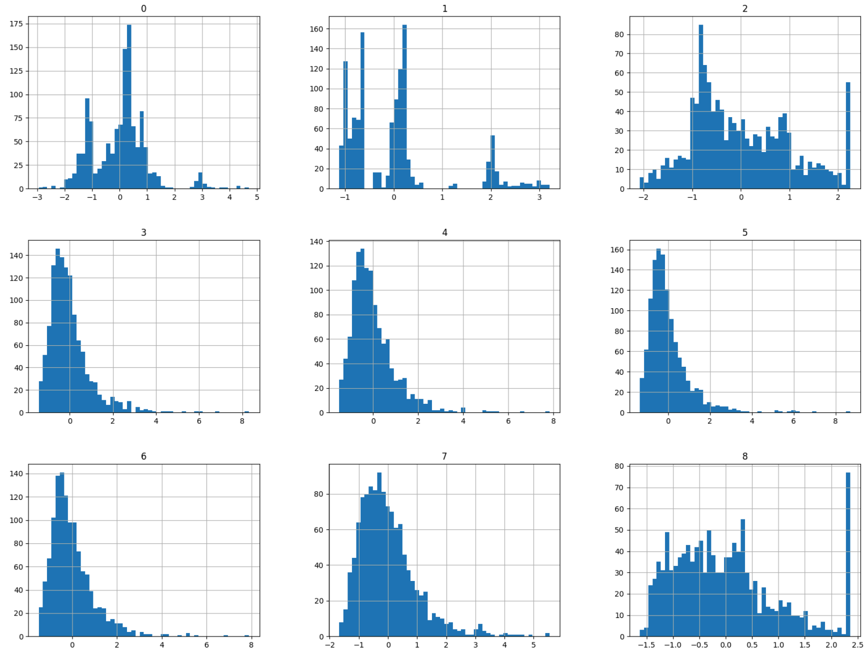
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.fit_transform(X_test)
X_val = scaler.fit_transform(X_val)
```

```
pd.DataFrame(X_train)
```

	0	1	2	3	4	5	6	
0	-1.453822	1.204250	0.935040	-0.795703	-0.964371	-0.970876	-0.972988	2.32936
1	-1.448767	1.194570	-0.642170	2.018961	1.315597	0.843015	1.637958	2.31688
2	-1.458876	1.189729	1.802506	-0.530032	-0.822019	-0.819064	-0.841409	1.76947
3	-1.463931	1.189729	1.802506	-0.617382	-0.717005	-0.764970	-0.733049	0.92303
4	-1.463931	1.189729	1.802506	-0.457617	-0.611991	-0.758863	-0.629850	-0.01915
...	...	...	...	...	...	...	...	.
17995	-1.352724	0.947718	-0.799891	0.530841	1.597968	0.432076	1.676658	-0.19260
17996	-1.352724	0.957398	-1.036472	0.345732	1.518624	0.038586	1.392859	-0.15553
17997	-1.347669	0.952558	-0.642170	-0.075631	0.314465	0.044694	0.479544	0.01104
17998	-1.347669	0.952558	-0.326728	-0.255309	-0.362291	-0.141145	-0.309932	0.46045
17999	-1.342614	0.952558	-1.036472	-0.693870	-0.439302	-0.816447	-0.462151	0.16955

18000 rows × 9 columns

```
pd.DataFrame(X_test).hist(bins=50, figsize=(20,15))
plt.show()
```



```
X_train.shape, X_test.shape, X_val.shape
```

```
((18000, 9), (1217, 9), (1218, 9))
```

Linear Regression

```
#  Preprocessing - scaling the data
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_val_scaled = scaler.transform(X_val)
# Train the model
lm = LinearRegression().fit(X_train_scaled, y_train)

y_train_pred = lm.predict(X_train_scaled)
y_val_pred = lm.predict(X_val_scaled)
```

```
mse_train = mse(y_train, y_train_pred)
rmse_train = mse(y_train, y_train_pred, squared=False)
# Calculate MSE and RMSE for validation set
mse_val = mse(y_val, y_val_pred)
rmse_val = mse(y_val, y_val_pred, squared=False)
# Calculate R² score for training set
r2_train = r2_score(y_train, y_train_pred)
# Calculate R² score for validation set
r2_val = r2_score(y_val, y_val_pred)
```

```
print(f'Training MSE: {mse_train}')
print(f'Training RMSE: {rmse_train}')
print(f'Training R²: {r2_train}')
```

```
Training MSE: 3.543895986947175e-31
Training RMSE: 5.953063066142652e-16
Training R²: 1.0
```

```
print(f'Validation MSE: {mse_val}')
print(f'Validation RMSE: {rmse_val}')
print(f'Validation R²: {r2_val}')
```

```
Validation MSE: 1.4624634571995185
Validation RMSE: 1.2093235535618738
Validation R²: -3.725684670880182
```

```
print('Some predictions on the validation set:', y_val_pred[:5])
```

```
Some predictions on the validation set: [2.50073119 1.5260041  1.6479579  1.66873522 1.61001672]
```

```
plt.figure(figsize=(10, 5))
# Plot actual values
plt.scatter(range(len(y_val)), y_val, color='blue', alpha=0.5, label='Actual')
# Plot predicted values
plt.scatter(range(len(y_val)), y_val_pred, color='red', alpha=0.5, label='Predicted')
plt.xlabel('House Price')
plt.ylabel('Value')
plt.title('Actual vs Predicted Values')
```