```
## Importing Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.metrics import r2_score, mean_squared_error
from math import sqrt

##1. Load the data

df = pd.read_excel("housing.xlsx")

df.head()
```

```
   longitude  latitude  housing_median_age  total_rooms
total_bedrooms  \
0    -122.23     37.88                  41          880
129.0
1    -122.22     37.86                  21         7099
1106.0
2    -122.24     37.85                  52         1467
190.0
3    -122.25     37.85                  52         1274
235.0
4    -122.25     37.85                  52         1627
280.0

   population  households  median_income ocean_proximity
median_house_value
0         322         126         8.3252        NEAR BAY
452600
1        2401        1138         8.3014        NEAR BAY
358500
2         496         177         7.2574        NEAR BAY
352100
3         558         219         5.6431        NEAR BAY
341300
4         565         259         3.8462        NEAR BAY
342200
```

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

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

```
df
```

```
       longitude  latitude  housing_median_age  total_rooms
total_bedrooms  \
0        -122.23     37.88                  41          880
129.0
1        -122.22     37.86                  21         7099
```

```
1106.0
2        -122.24     37.85                52         1467
190.0
3        -122.25     37.85                52         1274
235.0
4        -122.25     37.85                52         1627
280.0
...          ...       ...               ...          ...
...
20635    -121.09     39.48                25         1665
374.0
20636    -121.21     39.49                18          697
150.0
20637    -121.22     39.43                17         2254
485.0
20638    -121.32     39.43                18         1860
409.0
20639    -121.24     39.37                16         2785
616.0

       population  households  median_income ocean_proximity  \
0             322         126         8.3252        NEAR BAY
1            2401        1138         8.3014        NEAR BAY
2             496         177         7.2574        NEAR BAY
3             558         219         5.6431        NEAR BAY
4             565         259         3.8462        NEAR BAY
...           ...         ...            ...             ...
20635         845         330         1.5603          INLAND
20636         356         114         2.5568          INLAND
20637        1007         433         1.7000          INLAND
20638         741         349         1.8672          INLAND
20639        1387         530         2.3886          INLAND

       median_house_value
0                  452600
1                  358500
2                  352100
3                  341300
4                  342200
...                   ...
20635               78100
20636               77100
20637               92300
20638               84700
20639               89400

[20640 rows x 10 columns]
```

```
X = df.drop("median_house_value", axis = 1)
Y = df["median_house_value"]

## 2. Handle missing values
X.isnull().any()
```

```
longitude             False
latitude              False
housing_median_age    False
total_rooms           False
total_bedrooms         True
population            False
households            False
median_income         False
ocean_proximity       False
dtype: bool
```

```
X['total_bedrooms'] =
X['total_bedrooms'].fillna(X['total_bedrooms'].mean())

X.isnull().any()
```

```
longitude             False
latitude              False
housing_median_age    False
total_rooms           False
total_bedrooms        False
population            False
households            False
median_income         False
ocean_proximity       False
dtype: bool
```

```
X.head()
```

```
   longitude  latitude  housing_median_age  total_rooms
total_bedrooms  \
0    -122.23     37.88                  41          880
129.0
1    -122.22     37.86                  21         7099
1106.0
2    -122.24     37.85                  52         1467
190.0
3    -122.25     37.85                  52         1274
235.0
4    -122.25     37.85                  52         1627
280.0

   population  households  median_income ocean_proximity
0         322         126         8.3252        NEAR BAY
```

```
1        2401        1138         8.3014        NEAR BAY
2         496         177         7.2574        NEAR BAY
3         558         219         5.6431        NEAR BAY
4         565         259         3.8462        NEAR BAY
```

```
##Encode categorical data
```

```
df1 = pd.get_dummies(X['ocean_proximity'])
```

```
df1
```

```
       <1H OCEAN  INLAND  ISLAND  NEAR BAY  NEAR OCEAN
0              0       0       0         1           0
1              0       0       0         1           0
2              0       0       0         1           0
3              0       0       0         1           0
4              0       0       0         1           0
...          ...     ...     ...       ...         ...
20635          0       1       0         0           0
20636          0       1       0         0           0
20637          0       1       0         0           0
20638          0       1       0         0           0
20639          0       1       0         0           0

[20640 rows x 5 columns]
```

```
X = pd.concat([X, df1], axis=1).reindex(df.index)
```

```
X.drop('ocean_proximity', axis=1, inplace=True)
```

```
X
```

```
       longitude  latitude  housing_median_age  total_rooms
total_bedrooms  \
0        -122.23     37.88                  41          880
129.0
1        -122.22     37.86                  21         7099
1106.0
2        -122.24     37.85                  52         1467
190.0
3        -122.25     37.85                  52         1274
235.0
4        -122.25     37.85                  52         1627
280.0
...          ...       ...                 ...          ...
...
20635    -121.09     39.48                  25         1665
374.0
20636    -121.21     39.49                  18          697
150.0
20637    -121.22     39.43                  17         2254
```

```
485.0
20638    -121.32     39.43                  18         1860
409.0
20639    -121.24     39.37                  16         2785
616.0

       population  households  median_income  <1H OCEAN  INLAND
ISLAND  \
0             322         126         8.3252          0       0
0
1            2401        1138         8.3014          0       0
0
2             496         177         7.2574          0       0
0
3             558         219         5.6431          0       0
0
4             565         259         3.8462          0       0
0
...           ...         ...            ...        ...     ...     ..
.
20635         845         330         1.5603          0       1
0
20636         356         114         2.5568          0       1
0
20637        1007         433         1.7000          0       1
0
20638         741         349         1.8672          0       1
0
20639        1387         530         2.3886          0       1
0

       NEAR BAY  NEAR OCEAN
0             1           0
1             1           0
2             1           0
3             1           0
4             1           0
...         ...         ...
20635         0           0
20636         0           0
20637         0           0
20638         0           0
20639         0           0

[20640 rows x 13 columns]
```

```
## 4. Split the dataset
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
random_state=0, train_size = .75)
```

```
X_train = X_train.to_numpy()
X_test = X_test.to_numpy()
Y_train = Y_train.to_numpy()
Y_test = Y_test.to_numpy()

type(X_train)

numpy.ndarray

## 5. Standardize data
from sklearn.preprocessing import StandardScaler
object= StandardScaler()

X_train = object.fit_transform(X_train)
X_test = object.fit_transform(X_test)
Y_train = Y_train.reshape(-1,1)
Y_test = Y_test.reshape(-1,1)
Y_train = object.fit_transform(Y_train)
Y_test = object.fit_transform(Y_test)

##X_train = X_train.reshape(-1,1)

##X_test = X_test.reshape(-1,1)

## 6. Perform Linear Regression
from sklearn.linear_model import LinearRegression

lm = LinearRegression()
lm.fit(X_train,Y_train)

LinearRegression()

lm.coef_

array([[-0.46959202, -0.47524462,  0.12000773, -0.09168507,  0.2619366
,
        -0.37357447,  0.24309035,  0.64330638,  0.05030324, -
0.10440986,
         0.02086915,  0.02022685,  0.05022507]])
```

lm.intecet

```
lm.intercept_

array([5.02596391e-16])

preds = lm.predict(X_test)
preds

array([[ 0.08509055],
       [ 0.69571552],
       [-0.23304258],
       ...,
```

```
       [ 0.15593717],
       [ 0.77111862],
       [ 0.70433327]])
```

```
print(sqrt(mean_squared_error(Y_test,preds)))
```

```
0.6009916525619308
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
random_state=0, train_size = .75)
```

lm.rsquared

lm.conf_int()

```
from sklearn.tree import DecisionTreeClassifier
from sklearn import metrics
```

```
## 7. Perform Decision Tree Regression
```

```
Classifier = DecisionTreeClassifier()
```

```
Classifier.fit(X_train, Y_train)
```

```
predict = Classifier.predict(X_test)
```

```
print(sqrt(mean_squared_error(Y_test,predict)))
```

```
79523.2537453181
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
random_state=0, train_size = .75)
```

```
## 8. Perform Random Forest Regression
from sklearn.ensemble import RandomForestClassifier
classifier = RandomForestClassifier()
```

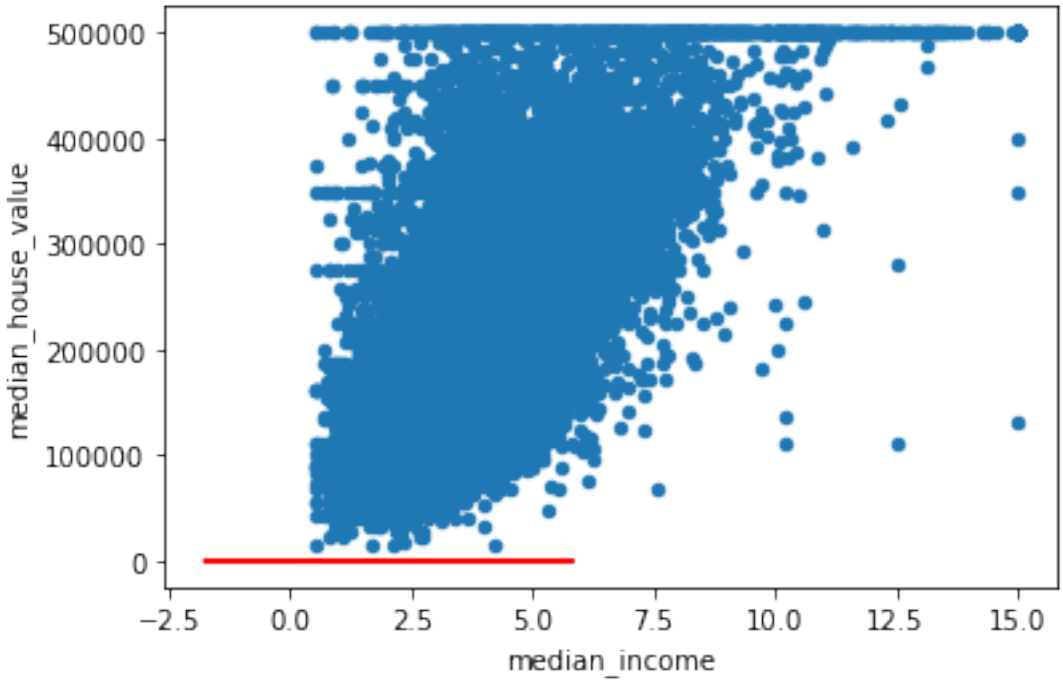
```
classifier.fit(X_train,Y_train)
Y_predict = classifier.predict(X_test)
```

```
print(sqrt(mean_squared_error(Y_test,Y_predict)))
```

```
69827.99715587698
```

```
## 9. Bonus exercise: Perform Linear Regression with one independent
variable
X = df['median_income']
Y = df["median_house_value"]
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
random_state=0, train_size = .75)

X_train = X_train.to_numpy()
X_test = X_test.to_numpy()
Y_train = Y_train.to_numpy()
Y_test = Y_test.to_numpy()

X_train = X_train.reshape(-1,1)
X_test = X_test.reshape(-1,1)
Y_train = Y_train.reshape(-1,1)
Y_test = Y_test.reshape(-1,1)

from sklearn.preprocessing import StandardScaler
object= StandardScaler()

X_train = object.fit_transform(X_train)
X_test = object.fit_transform(X_test)

Y_train = object.fit_transform(Y_train)
Y_test = object.fit_transform(Y_test)

from sklearn.linear_model import LinearRegression

lm = LinearRegression()
lm.fit(X_train,Y_train)

LinearRegression()

preds_1 = lm.predict(X_test)
preds_1

array([[ 0.10607599],
       [ 0.69531393],
       [ 0.17735068],
       ...,
       [-0.08295218],
       [ 0.59891752],
       [ 0.32764654]])

import matplotlib.pyplot as plt

df.plot(kind = 'scatter', x = "median_income", y =
'median_house_value')
plt.plot(X_test,preds_1, c = 'red', linewidth=2)

[<matplotlib.lines.Line2D at 0x7faac8d6ea00>]
```




```
print(sqrt(mean_squared_error(Y_test,Y_predict)))
```

```
242240.9643463396
```