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2020CSB039

ML Assignment 1

```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
from sklearn.preprocessing import OneHotEncoder
```

```
df = pd.read_csv('/content/train.csv')
df.head(10)
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour
0	1	60	RL	65.0	8450	Pave	NaN	Reg	
1	2	20	RL	80.0	9600	Pave	NaN	Reg	
2	3	60	RL	68.0	11250	Pave	NaN	IR1	
3	4	70	RL	60.0	9550	Pave	NaN	IR1	
4	5	60	RL	84.0	14260	Pave	NaN	IR1	
5	6	50	RL	85.0	14115	Pave	NaN	IR1	Lvl
6	7	20	RL	75.0	10084	Pave	NaN	Reg	Lvl
7	8	60	RL	NaN	10382	Pave	NaN	IR1	Lvl
8	9	50	RM	51.0	6120	Pave	NaN	Reg	Lvl
9	10	190	RL	50.0	7420	Pave	NaN	Reg	Lvl

10 rows × 81 columns

```
df1 = df[['LotArea','SalePrice']]
df1.head()
```

	LotArea	SalePrice
0	8450	208500

Checking Any Missing Value is Present or not

```
df1.isnull().any()
```

```
LotArea      False
SalePrice    False
dtype: bool
```

```
df1['LotArea'].isnull().sum()
```

```
0
```

```
df1['SalePrice'].isnull().sum()
```

```
0
```

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(df['LotArea'],df['SalePrice'],train_s
x_train.shape
```

```
(1168,)
```

```
x_train = np.array(x_train).reshape(-1,1)
x_test = np.array(x_test).reshape(-1,1)
y_train = np.array(y_train).reshape(-1,1)
y_test = np.array(y_test).reshape(-1,1)
y_test.shape
```

```
(292, 1)
```

```
from sklearn.linear_model import LinearRegression
model1 = LinearRegression()
model1.fit(x_train,y_train)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred = model1.predict(x_test)
y_pred.shape
```

```
(292, 1)
```

```
from sklearn.metrics import r2_score
r2 = r2_score(y_test, y_pred)
print(r2)
```

```
0.07134689169937702
```

Let's Plot The sample train data set and the Best Fit Line

Calculate Slope and Intercept

```
slope = model1.coef_[0]
intercept = model1.intercept_

print("Slope:", slope)
print("Intercept:", intercept)
```

```
Slope: [1.93934378]
Intercept: [160835.29204219]
```

```
df = pd.read_csv('/content/train.csv')
df.head()
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandCont
0	1	60	RL	65.0	8450	Pave	NaN	Reg	
1	2	20	RL	80.0	9600	Pave	NaN	Reg	
2	3	60	RL	68.0	11250	Pave	NaN	IR1	
3	4	70	RL	60.0	9550	Pave	NaN	IR1	Lvl
4	5	60	RL	84.0	14260	Pave	NaN	IR1	Lvl

5 rows × 81 columns

```
df.dropna(subset=['LotArea', 'SalePrice'], inplace=True)

Q1 = df['LotArea'].quantile(0.25)
Q3 = df['LotArea'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
df = df[(df['LotArea'] >= lower_bound) & (df['LotArea'] <= upper_bound)]


X_train = df[['LotArea']].values
y_train = df['SalePrice'].values

scaler = StandardScaler()
X_train_normalized = scaler.fit_transform(X_train)

huber = LinearRegression()
```

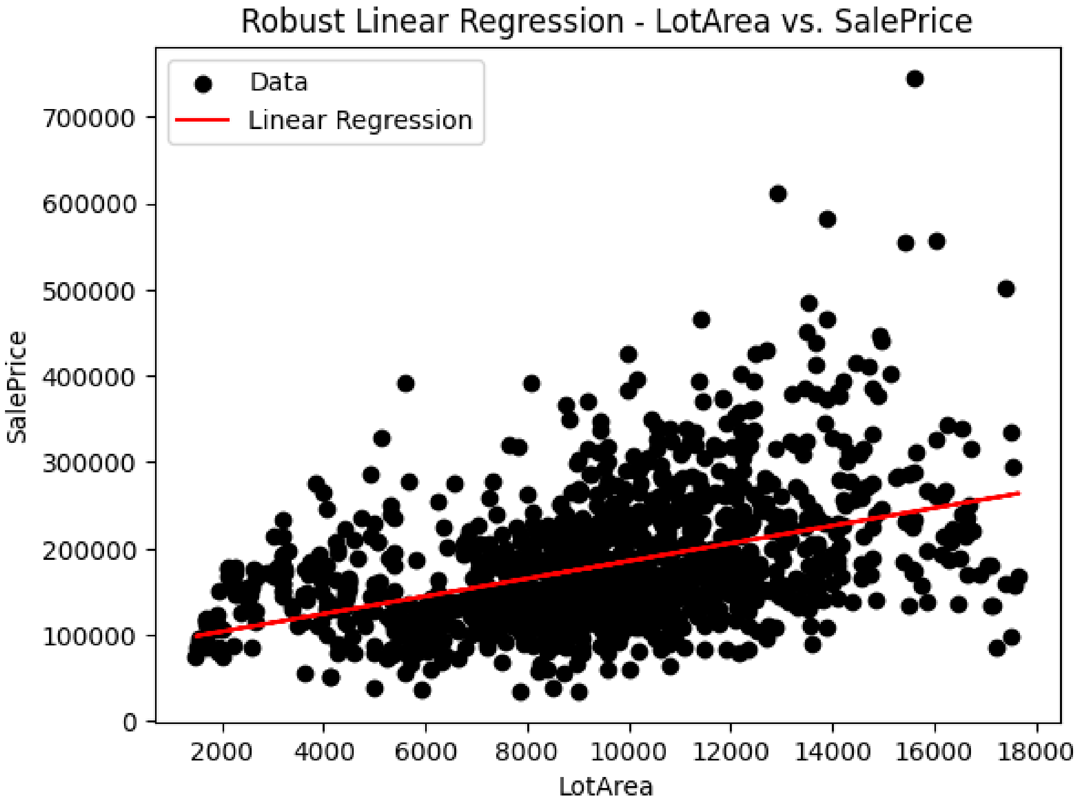
```
huber.fit(X_train_normalized, y_train)

# Get the slope and intercept
slope = huber.coef_[0]
intercept = huber.intercept_

print("Slope:", slope)
print("Intercept:", intercept)

# Plot the data points and the regression line
plt.scatter(X_train, y_train, color='black', label='Data')
plt.plot(X_train, huber.predict(X_train_normalized), color='red', label='Linear Regression'
plt.xlabel('LotArea')
plt.ylabel('SalePrice')
plt.title('Robust Linear Regression - LotArea vs. SalePrice')
plt.legend()
plt.show()
```

```
Slope: 32612.843599611195
Intercept: 178136.29259525522
```




```
def mean_squared_error(y_true, y_pred):
    # Calculate the squared differences between true and predicted values
    squared_errors = (y_true - y_pred) ** 2

    # Calculate the mean of the squared differences
    mse = np.mean(squared_errors)

    return mse
```

Model 1: LotFrontage, LotArea

```
df1 = df[['LotFrontage','LotArea','SalePrice']]
df1.head()
```

	LotFrontage	LotArea	SalePrice
0	65.0	8450	208500
1	80.0	9600	181500
2	68.0	11250	223500
3	60.0	9550	140000
4	84.0	14260	250000

```
df1.shape
```

```
(1391, 3)
```

```
df1.isnull().sum()
```

```
LotFrontage    233
LotArea          0
SalePrice        0
dtype: int64
```

```
df1.dropna(axis=0,inplace=True)
df1.shape
```

```
<ipython-input-483-acde98d29509>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stabl
  df1.dropna(axis=0,inplace=True)
(1158, 3)
```

```
x_train1,x_test1,y_train1,y_test1 = train_test_split(df1[['LotFrontage','LotArea']],df1['Sa
model1 = LinearRegression()
model1.fit(x_train1,y_train1)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred1 = model1.predict(x_test1)
r2_1= r2_score(y_test1,y_pred1)
print("R2 Score : ",r2_1)
# print("Mean Squared Error : ",mean_squared_error(y_test1,y_pred1))
```

```
R2 Score :  0.1963377483220171
```

```
slope1 = model1.coef_[0]
intercept1 = model1.intercept_

print("Slope:", slope1)
print("Intercept:", intercept1)
```

```
Slope: 706.0535213900636
Intercept: 52901.633693265176
```

Model 2: LotFrontage, LotArea, OverallQual, OverallCond

```
df2 = df[['LotFrontage','LotArea','OverallQual','OverallCond','SalePrice']]
df2.head()
```

	LotFrontage	LotArea	OverallQual	OverallCond	SalePrice
0	65.0	8450	7	5	208500
1	80.0	9600	6	8	181500
2	68.0	11250	7	5	223500
3	60.0	9550	7	5	140000
4	84.0	14260	8	5	250000

```
df2.shape
```

```
(1391, 5)
```

```
df2.isnull().sum()
```

```
LotFrontage    233
LotArea          0
OverallQual      0
OverallCond      0
SalePrice        0
dtype: int64
```

```
df2.dropna(axis=0,inplace=True)
```

```
<ipython-input-490-7cc6f020b4a6>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/use
  df2.dropna(axis=0,inplace=True)
```

```
x_train2,x_test2,y_train2,y_test2 = train_test_split(df2[['LotFrontage','LotArea','OverallQ
model2 = LinearRegression()
model2.fit(x_train2,y_train2)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred2 = model2.predict(x_test2)
r2_2= r2_score(y_test2,y_pred2)
print("R2 Score : ",r2_2)
print("Mean Squared Error : ",mean_squared_error(y_test2,y_pred2))
```

```
R2 Score :  0.7785592633959165
Mean Squared Error :  1356327682.1040606
```

```
slope2 = model2.coef_[0]
intercept2 = model2.intercept_

print("Slope:", slope2)
print("Intercept:", intercept2)
```

```
Slope: 415.2138254840703
Intercept: -147018.14476752628
```

Model 3: LotFrontage, LotArea, OverallQual, OverallCond, 1stFlrSF, GrLivArea

```
df3 = df[['LotFrontage','LotArea','OverallQual','OverallCond','1stFlrSF', 'GrLivArea','Sale
df3.head()
```

	LotFrontage	LotArea	OverallQual	OverallCond	1stFlrSF	GrLivArea	SalePrice
0	65.0	8450	7	5	856	1710	208500
1	80.0	9600	6	8	1262	1262	181500
2	68.0	11250	7	5	920	1786	223500
3	60.0	9550	7	5	961	1717	140000
4	84.0	14260	8	5	1145	2198	250000

```
df3.shape
```

```
(1391, 7)
```

```
df3.isnull().sum()
```

```
LotFrontage    233
LotArea          0
OverallQual      0
OverallCond      0
1stFlrSF         0
GrLivArea        0
SalePrice        0
dtype: int64
```

```
df3 = df3.dropna(axis=0)
df3.shape
```

```
(1158, 7)
```

```
x_train3,x_test3,y_train3,y_test3 = train_test_split(df3[['LotFrontage','LotArea','OverallQ
model3 = LinearRegression()
model3.fit(x_train3,y_train3)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred3 = model3.predict(x_test3)
r2_3 = r2_score(y_test3, y_pred3)
print("R2 Score : ",r2_3)
print("Mean Squared Error : ",mean_squared_error(y_test3,y_pred3))
```

```
R2 Score :  0.8049612868883286
Mean Squared Error :  1122762624.377745
```

```
slope3 = model3.coef_[0]
intercept3 = model3.intercept_

print("Slope:", slope3)
print("Intercept:", intercept3)
```

```
Slope: 186.13906389347122
Intercept: -150799.11579627203
```

Model 4: LotArea, Street

```
df4 = df[['LotArea','Street','SalePrice']]
df4.head()
```

	LotArea	Street	SalePrice
0	8450	Pave	208500
1	9600	Pave	181500
2	11250	Pave	223500
3	9550	Pave	140000
4	14260	Pave	250000

```
df4.isnull().any()
```

```
LotArea      False
Street       False
SalePrice    False
dtype: bool
```

```
df4['Street'].nunique()
```

```
2
```

```
df4.shape
```

```
(1391, 3)
```

```
df4['Street'].unique()
```

```
array(['Pave', 'Grvl'], dtype=object)
```

```
# Select the column you want to one-hot encode
column_to_encode = 'Street'
column_data = df4[[column_to_encode]]
```

```
# Create an instance of the OneHotEncoder
encoder = OneHotEncoder()

# Fit and transform the selected column to perform one-hot encoding
one_hot_encoded = encoder.fit_transform(column_data)
# The result of one-hot encoding is a sparse matrix. You can convert it to a dense array or
# For example, to convert to a dense array:
one_hot_encoded_array = one_hot_encoded.toarray()
# Or, to convert to a DataFrame with appropriate column names:
one_hot_encoded_df = pd.DataFrame(one_hot_encoded_array, columns=encoder.get_feature_names_

# Concatenate the one-hot encoded DataFrame with the original DataFrame, dropping the origi
df4 = pd.concat([df4.drop(columns=[column_to_encode]), one_hot_encoded_df], axis=1)

df4.head()
```

	LotArea	SalePrice	Street_Grvl	Street_Pave
0	8450.0	208500.0	0.0	1.0
1	9600.0	181500.0	0.0	1.0
2	11250.0	223500.0	0.0	1.0
3	9550.0	140000.0	0.0	1.0
4	14260.0	250000.0	0.0	1.0

```
df4.shape
```

```
(1455, 4)
```

```
df4.isnull().sum()
```

```
LotArea        64
SalePrice      64
Street_Grvl    64
Street_Pave    64
dtype: int64
```

```
df4.head()
```

	LotArea	SalePrice	Street_Grvl	Street_Pave
0	8450.0	208500.0	0.0	1.0
1	9600.0	181500.0	0.0	1.0
2	11250.0	223500.0	0.0	1.0
3	9550.0	140000.0	0.0	1.0
4	14260.0	250000.0	0.0	1.0

```
df4.isnull().any()
```

```
LotArea        True
SalePrice      True
Street_Grvl    True
Street_Pave    True
dtype: bool
```

```
# df4 = df4.dropna(axis=0)
df4.dropna(axis=0,inplace=True)


x_train4,x_test4,y_train4,y_test4 = train_test_split(df4[['LotArea','Street_Grvl','Street_P
model4 = LinearRegression()
# x_train4 = np.array(x_train4).reshape(-1,1)
# x_test4 = np.array(x_test4).reshape(-1,1)
# y_train4 = np.array(y_train4).reshape(-1,1)
# y_test4 = np.array(x_test4).reshape(-1,1)

model4.fit(x_train4,y_train4)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred4 = model4.predict(x_test4)
r2_4 = r2_score(y_test4,y_pred4)
print("R2 Score : ",r2_4)
print("Mean Squared Error : ",mean_squared_error(y_test4,y_pred4))
```

```
R2 Score :  0.15876855386780908
Mean Squared Error :  4104867355.4336057
```

```
slope4 = model4.coef_[0]
intercept4 = model4.intercept_

print("Slope:", slope4)
print("Intercept:", intercept4)
```

```
Slope: 10.614153697434354
Intercept: 97124.79506253726
```

Model 5: LotArea, OverallCond, Street, Neighborhood

```
df5 = df[['LotArea','Street','OverallCond','Neighborhood','SalePrice']]
df5.head()
```

	LotArea	Street	OverallCond	Neighborhood	SalePrice
0	8450	Pave	5	CollgCr	208500
1	9600	Pave	8	Veenker	181500
2	11250	Pave	5	CollgCr	223500
3	9550	Pave	5	Crawfor	140000
4	14260	Pave	5	NoRidge	250000

```
df5['Neighborhood'].nunique()
```

```
25
```

```
df5.shape
```

```
(1391, 5)
```

```
# Select the column you want to one-hot encode
column_to_encode = 'Neighborhood'
column_data = df5[[column_to_encode]]
# Create an instance of the OneHotEncoder
encoder = OneHotEncoder()

# Fit and transform the selected column to perform one-hot encoding
one_hot_encoded = encoder.fit_transform(column_data)
# The result of one-hot encoding is a sparse matrix. You can convert it to a dense array or
# For example, to convert to a dense array:
one_hot_encoded_array = one_hot_encoded.toarray()
# Or, to convert to a DataFrame with appropriate column names:
one_hot_encoded_df = pd.DataFrame(one_hot_encoded_array, columns=encoder.get_feature_names_

# Concatenate the one-hot encoded DataFrame with the original DataFrame, dropping the origi
df5 = pd.concat([df5.drop(columns=[column_to_encode]), one_hot_encoded_df], axis=1)

df5.head()
```

	LotArea	Street	OverallCond	SalePrice	Neighborhood_Blmngtn	Neighborhood_Blueste
0	8450.0	Pave	5.0	208500.0	0.0	
1	9600.0	Pave	8.0	181500.0	0.0	
2	11250.0	Pave	5.0	223500.0	0.0	
3	9550.0	Pave	5.0	140000.0	0.0	
4	14260.0	Pave	5.0	250000.0	0.0	

5 rows × 29 columns

```
column_to_encode = 'Street'
column_data = df5[[column_to_encode]]
one_hot_encoded = encoder.fit_transform(column_data)
one_hot_encoded_array = one_hot_encoded.toarray()
one_hot_encoded_df = pd.DataFrame(one_hot_encoded_array, columns=encoder.get_feature_names_
df5 = pd.concat([df5.drop(columns=[column_to_encode]), one_hot_encoded_df], axis=1)
df5.head()
```

	LotArea	OverallCond	SalePrice	Neighborhood_Blmngtn	Neighborhood_Blueste	Neighbc
0	8450.0	5.0	208500.0	0.0	0.0	
1	9600.0	8.0	181500.0	0.0	0.0	
2	11250.0	5.0	223500.0	0.0	0.0	
3	9550.0	5.0	140000.0	0.0	0.0	

```
df5.dropna(axis=0,inplace=True)
```

```
target = df5['SalePrice']
df5 = df5.drop(['SalePrice'],axis=1)
```

```
df5.head()
```

	LotArea	OverallCond	Neighborhood_Blmngtn	Neighborhood_Blueste	Neighborhood_BrDa:
0	8450.0	5.0	0.0	0.0	C
1	9600.0	8.0	0.0	0.0	C
2	11250.0	5.0	0.0	0.0	C
3	9550.0	5.0	0.0	0.0	(
4	14260.0	5.0	0.0	0.0	

5 rows × 30 columns

```
target
```

```
0       208500.0
1       181500.0
2       223500.0
3       140000.0
4       250000.0
          ...
1386    250000.0
1387    136000.0
1388    377500.0
1389    131000.0
1390    235000.0
Name: SalePrice, Length: 1327, dtype: float64
```

```
x_train5,x_test5,y_train5,y_test5 = train_test_split(df5,target,train_size=0.8)
model5 = LinearRegression()
model5.fit(x_train5,y_train5)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred5 = model5.predict(x_test5)
r2_5 = r2_score(y_test5, y_pred5)
print("R2 Score : ",r2_5)
print("Mean Squared Error : ",mean_squared_error(y_test5,y_pred5))
```

```
R2 Score :  0.1300129527177708
Mean Squared Error :  4700536656.808294
```

```
slope5 = model5.coef_[0]
intercept5 = model5.intercept_

print("Slope:", slope5)
print("Intercept:", intercept5)
```

```
Slope: 10.38775370020335
Intercept: 105051.8995223769
```

Model 6: LotArea, OverallCond, Street, 1stFlrSF, Neighborhood, Year

```
df6 = df[['LotArea','OverallCond', 'Street', '1stFlrSF', 'Neighborhood','SalePrice']]
df6.head()
```

	LotArea	OverallCond	Street	1stFlrSF	Neighborhood	SalePrice
0	8450	5	Pave	856	CollgCr	208500
1	9600	8	Pave	1262	Veenker	181500
2	11250	5	Pave	920	CollgCr	223500
3	9550	5	Pave	961	Crawfor	140000
4	14260	5	Pave	1145	NoRidge	250000

```
df.columns
```

```
Index(['Id', 'MSSubClass', 'MSZoning', 'LotFrontage', 'LotArea', 'Street',
       'Alley', 'LotShape', 'LandContour', 'Utilities', 'LotConfig',
       'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType',
       'HouseStyle', 'OverallQual', 'OverallCond', 'YearBuilt', 'YearRemodAdd',
       'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType',
       'MasVnrArea', 'ExterQual', 'ExterCond', 'Foundation', 'BsmtQual',
       'BsmtCond', 'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1',
       'BsmtFinType2', 'BsmtFinSF2', 'BsmtUnfSF', 'TotalBsmtSF', 'Heating',
       'HeatingQC', 'CentralAir', 'Electrical', '1stFlrSF', '2ndFlrSF',
       'LowQualFinSF', 'GrLivArea', 'BsmtFullBath', 'BsmtHalfBath', 'FullBath',
       'HalfBath', 'BedroomAbvGr', 'KitchenAbvGr', 'KitchenQual',
       'TotRmsAbvGrd', 'Functional', 'Fireplaces', 'FireplaceQu', 'GarageType',
       'GarageYrBlt', 'GarageFinish', 'GarageCars', 'GarageArea', 'GarageQual',
       'GarageCond', 'PavedDrive', 'WoodDeckSF', 'OpenPorchSF',
       'EnclosedPorch', '3SsnPorch', 'ScreenPorch', 'PoolArea', 'PoolQC',
       'Fence', 'MiscFeature', 'MiscVal', 'MoSold', 'YrSold', 'SaleType',
       'SaleCondition', 'SalePrice'],
      dtype='object')
```

```
# Select the column you want to one-hot encode
column_to_encode = 'Neighborhood'
column_data = df6[[column_to_encode]]
# Create an instance of the OneHotEncoder
```

```
encoder = OneHotEncoder()

# Fit and transform the selected column to perform one-hot encoding
one_hot_encoded = encoder.fit_transform(column_data)
# The result of one-hot encoding is a sparse matrix. You can convert it to a dense array or
# For example, to convert to a dense array:
one_hot_encoded_array = one_hot_encoded.toarray()
# Or, to convert to a DataFrame with appropriate column names:
one_hot_encoded_df = pd.DataFrame(one_hot_encoded_array, columns=encoder.get_feature_names_

# Concatenate the one-hot encoded DataFrame with the original DataFrame, dropping the origi
df6 = pd.concat([df6.drop(columns=[column_to_encode]), one_hot_encoded_df], axis=1)

df6.head()
```

	LotArea	OverallCond	Street	1stFlrSF	SalePrice	Neighborhood_Blmngtn	Neighborhoo
0	8450.0	5.0	Pave	856.0	208500.0	0.0	
1	9600.0	8.0	Pave	1262.0	181500.0	0.0	
2	11250.0	5.0	Pave	920.0	223500.0	0.0	
3	9550.0	5.0	Pave	961.0	140000.0	0.0	
4	14260.0	5.0	Pave	1145.0	250000.0	0.0	

5 rows × 30 columns

```
column_to_encode = 'Street'
column_data = df6[[column_to_encode]]
one_hot_encoded = encoder.fit_transform(column_data)
one_hot_encoded_array = one_hot_encoded.toarray()
one_hot_encoded_df = pd.DataFrame(one_hot_encoded_array, columns=encoder.get_feature_names_
df6 = pd.concat([df6.drop(columns=[column_to_encode]), one_hot_encoded_df], axis=1)
df6.head()
```

	LotArea	OverallCond	1stFlrSF	SalePrice	Neighborhood_Blmngtn	Neighborhood_Bluest
0	8450.0	5.0	856.0	208500.0	0.0	0
1	9600.0	8.0	1262.0	181500.0	0.0	0
2	11250.0	5.0	920.0	223500.0	0.0	0
3	9550.0	5.0	961.0	140000.0	0.0	0
4	14260.0	5.0	1145.0	250000.0	0.0	0

5 rows × 32 columns

```
df6.dropna(axis=0,inplace=True)
```

```
target6 = df6['SalePrice']
df6 = df6.drop(['SalePrice'],axis=1)
x_train6,x_test6,y_train6,y_test6 = train_test_split(df6,target6,train_size=0.8)
model6 = LinearRegression()
model6.fit(x_train6,y_train6)
```

```
▾ LinearRegression
LinearRegression()
```

```
y_pred6 = model6.predict(x_test6)
r2_6 = r2_score(y_test6,y_pred6)
print("R2 Score: ",r2_6)
print("Mean Squared Error : ",mean_squared_error(y_test6,y_pred6))
```

```
R2 Score:  0.4618803629270799
Mean Squared Error :  3667616125.459418
```

```
slope6 = model6.coef_[0]
intercept6 = model6.intercept_

print("Slope:", slope6)
print("Intercept:", intercept6)
```

```
Slope: 3.9658896309960925
Intercept: 2389.5485131267924
```

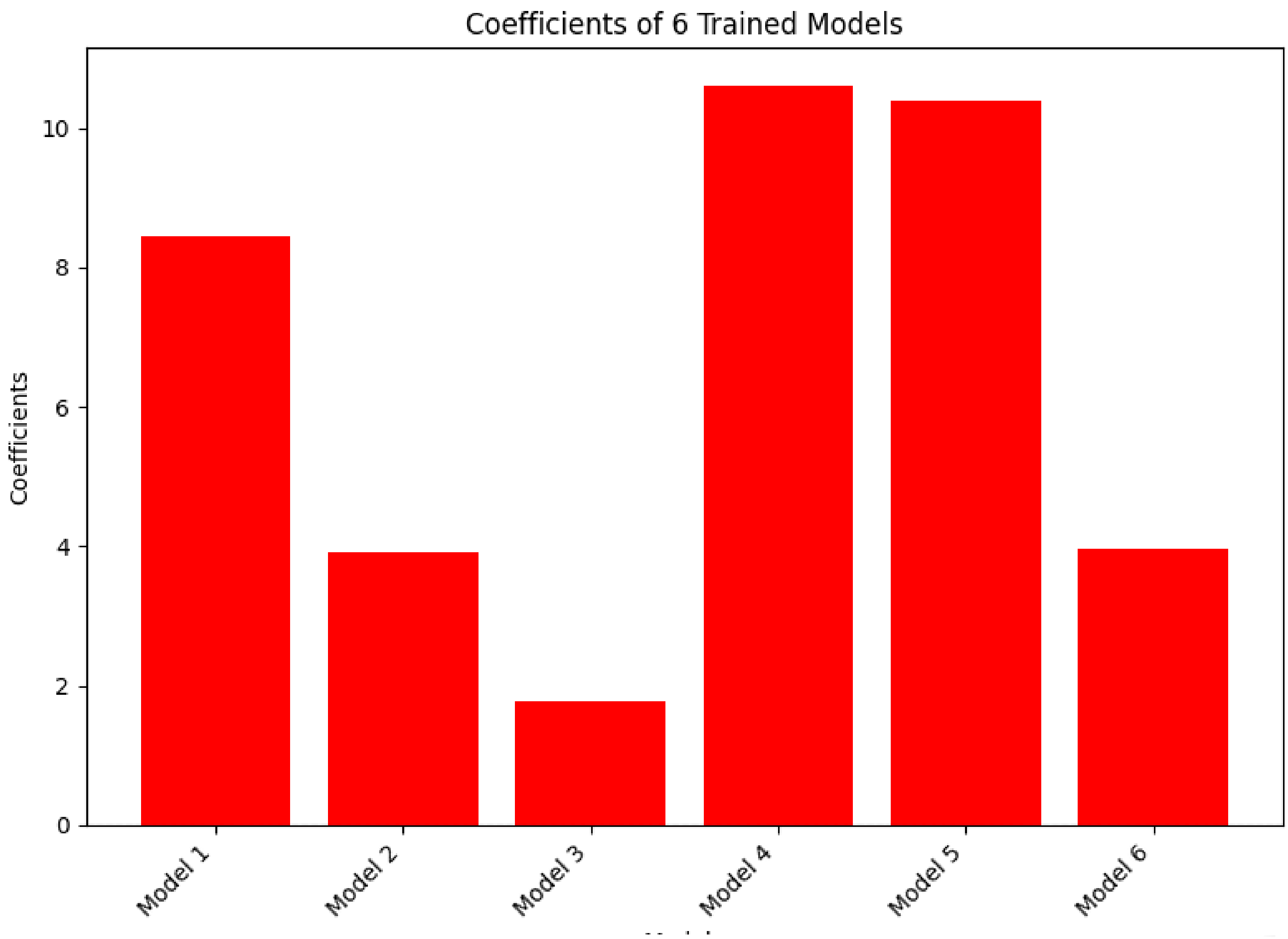
```
c1 = model1.coef_[1]
c2 = model2.coef_[1]
c3 = model3.coef_[1]
c4 = model4.coef_[0]
c5 = model5.coef_[0]
c6 = model6.coef_[0]
```

```
import matplotlib.pyplot as plt

# Assuming you have 6 coefficients stored in a list or array called 'coefficients'
coefficients = [c1,c2,c3,c4,c5,c6]

# Names of the features (optional, just for labeling the bars)
feature_names = ['Model 1', 'Model 2', 'Model 3', 'Model 4', 'Model 5', 'Model 6']

# Plot the coefficients using a bar plot
plt.figure(figsize=(8, 6))
plt.bar(range(len(coefficients)), coefficients, tick_label=feature_names, color='red')
plt.axhline(y=0, color='gray', linestyle='--', linewidth=0.8)  # Add a horizontal line at y
plt.xlabel('Models')
plt.ylabel('Coefficients')
plt.title('Coefficients of 6 Trained Models')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for better visibility
plt.tight_layout()
plt.show()
```



Polynomial Regression (Degree 2)

```
from sklearn.preprocessing import PolynomialFeatures
df7 = df[['LotArea','SalePrice']]
df7.head()
```

	LotArea	SalePrice
0	8450	208500
1	9600	181500
2	11250	223500
3	9550	140000
4	14260	250000

```
x = df7['LotArea']
y = df7['SalePrice']
x = np.array(x).reshape(-1,1)
# Polynomial regression with degree 2
poly_features = PolynomialFeatures(degree=2)
x_poly2 = poly_features.fit_transform(x)
x_train7,x_test7,y_train7,y_test7 = train_test_split(x_poly2,y,train_size=0.8)
```

```
model7 = LinearRegression()
model7.fit(x_train7, y_train7)
```

```
▾ LinearRegression
LinearRegression()
```

```
# Predict the values using the model
y_pred7 = model7.predict(x_test7)
```

```
x_train7
y_pred7 = model7.predict(x_test7)
r2_7 = r2_score(y_test7,y_pred7)
print("R2 Score: ",r2_7)
print("Mean Squared Error : ",mean_squared_error(y_test7,y_pred7))
```

```
R2 Score:  0.1739963817404826
Mean Squared Error :  4920928947.986283
```

```
df8 = df[['LotArea','SalePrice']]
df8.head()
```

	LotArea	SalePrice
0	8450	208500
1	9600	181500
2	11250	223500
3	9550	140000
4	14260	250000

```
x = df8['LotArea']
y = df8['SalePrice']
x = np.array(x).reshape(-1,1)
# Polynomial regression with degree 3
poly_features = PolynomialFeatures(degree=3)
x_poly3 = poly_features.fit_transform(x)
x_train8,x_test8,y_train8,y_test8= train_test_split(x_poly3,y,train_size=0.8)
```

```
model8 = LinearRegression()
model8.fit(x_train8, y_train8)
```

```
▾ LinearRegression
LinearRegression()
```

```
# Predict the values using the model
y_pred8 = model8.predict(x_test8)
r2_8 = r2_score(y_test8,y_pred8)
print("R2 Score: ",r2_8)
print("Mean Squared Error : ",mean_squared_error(y_test8,y_pred8))
```

```
R2 Score:  0.1283236140539712
Mean Squared Error :  3793389619.5334477
```

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