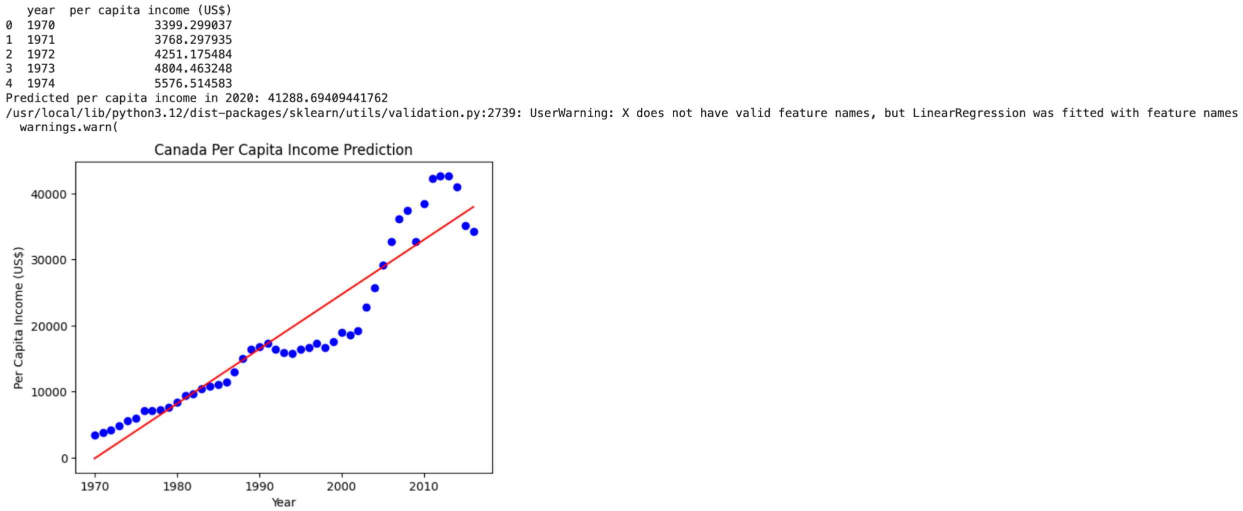
Lab 3-Linear Regression

Write Python code to implement the following:
1. Predict canada's per capita income in year 2020. Use the data file canada_per_capita_income.csv file. If required, apply the necessary data processing steps. Using this build a regression model and predict the per capita income for canadian citizens in year 2020

Code:

```python
# Import required libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression

# Load the dataset
df = pd.read_csv("canada_per_capita_income.csv")

# Display first few rows
print(df.head())

# Define independent (X) and dependent (y) variables
X = df[['year']]
y = df['per capita income (US$)']

# Create and train the model
model = LinearRegression()
model.fit(X, y)

# Predict income for year 2020
predicted_income_2020 = model.predict([[2020]])

print("Predicted per capita income in 2020:", predicted_income_2020[0])

# Optional: Plot regression line
plt.scatter(X, y, color='blue')
plt.plot(X, model.predict(X), color='red')
plt.xlabel("Year")
plt.ylabel("Per Capita Income (US$)")
plt.title("Canada Per Capita Income Prediction")
plt.show()
```

Output:



```
   year  per capita income (US$)
0  1970              3399.299037
1  1971              3768.297935
2  1972              4251.175484
3  1973              4804.463248
4  1974              5576.514583
Predicted per capita income in 2020: 41288.69409441762
/usr/local/lib/python3.12/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

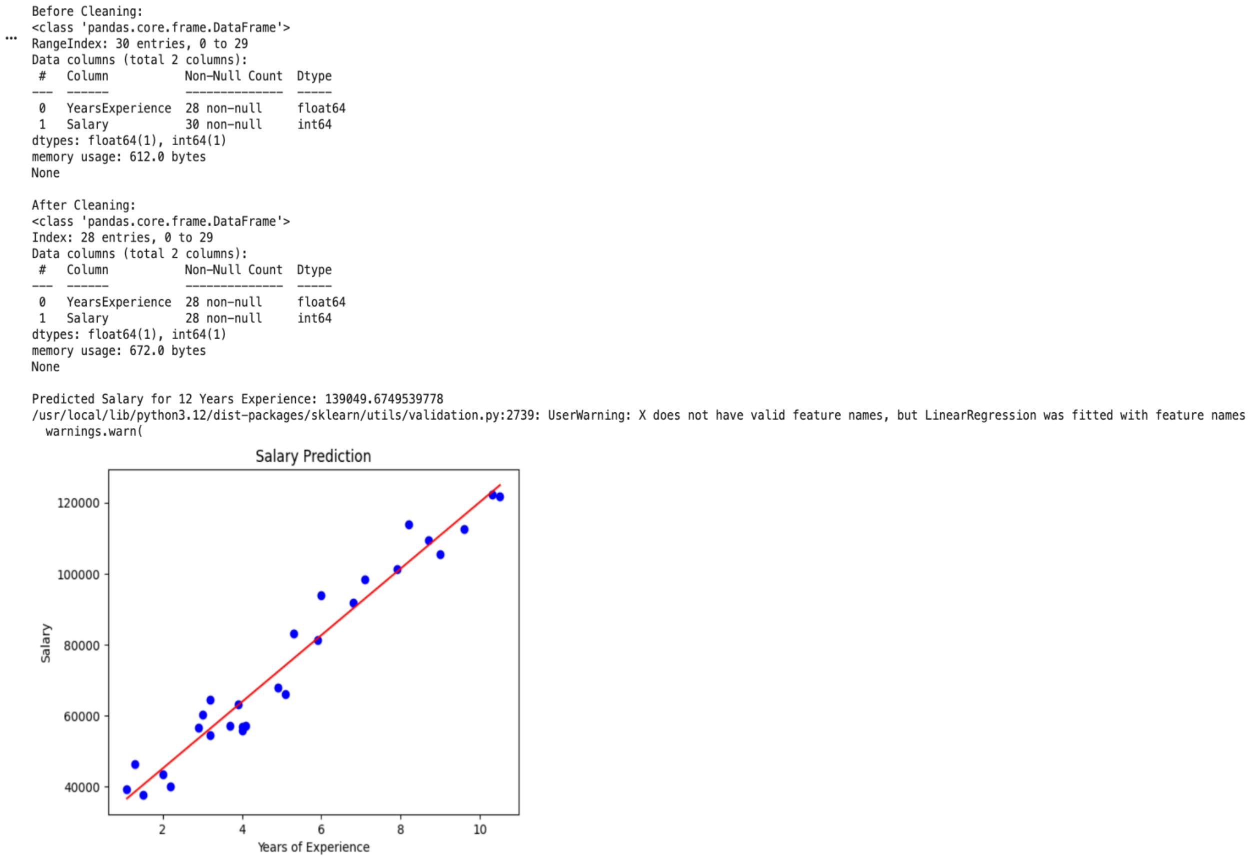
2. Predict Salary of the employee. Use the data file salary.csv file. If required, apply the necessary data processing steps. Using this build a regression model and predict the salary of the employee with 12 years of experience.

Code:

```
# Import libraries
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression

# Load dataset
df = pd.read_csv('salary.csv')

print("Before Cleaning:")
print(df.info())

#Remove missing values
df = df.dropna()

print("\nAfter Cleaning:")
print(df.info())

# Define X and y
X = df[['YearsExperience']]
y = df['Salary']
```

```python
# Train model
model = LinearRegression()
model.fit(X, y)

#  Predict salary for 12 years
salary_12 = model.predict([[12]])

print("\nPredicted Salary for 12 Years Experience:", salary_12[0])

# Plot graph
plt.scatter(X, y, color='blue')
plt.plot(X, model.predict(X), color='red')
plt.xlabel("Years of Experience")
plt.ylabel("Salary")
plt.title("Salary Prediction")
plt.show()
```

Output



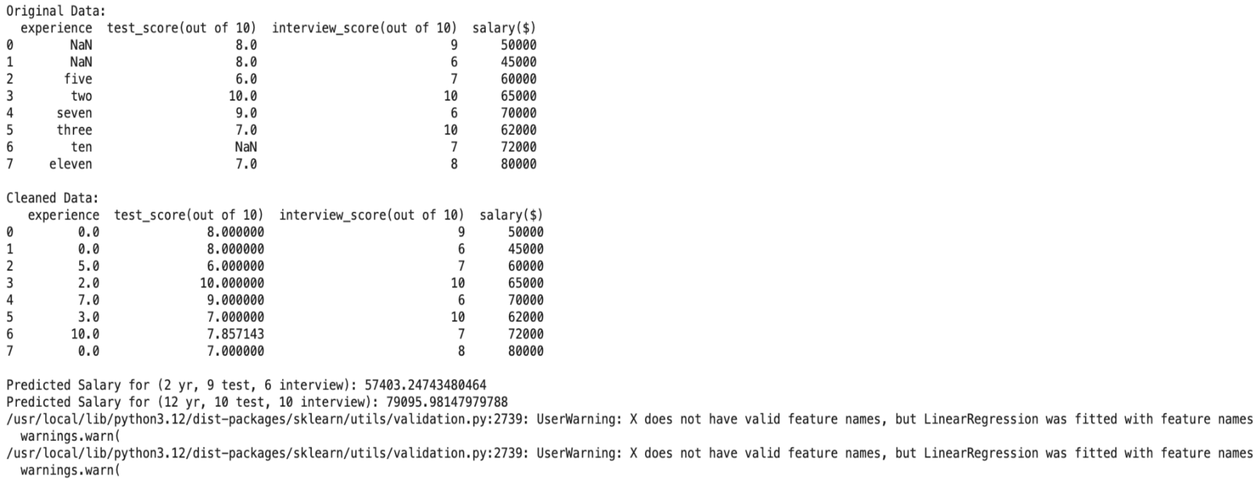
```
Before Cleaning:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30 entries, 0 to 29
Data columns (total 2 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   YearsExperience  28 non-null     float64
 1   Salary           30 non-null     int64  
dtypes: float64(1), int64(1)
memory usage: 612.0 bytes
None

After Cleaning:
<class 'pandas.core.frame.DataFrame'>
Index: 28 entries, 0 to 29
Data columns (total 2 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   YearsExperience  28 non-null     float64
 1   Salary           28 non-null     int64  
dtypes: float64(1), int64(1)
memory usage: 672.0 bytes
None

Predicted Salary for 12 Years Experience: 139049.6749539778
/usr/local/lib/python3.12/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

3. Write Python code to implement the following:
Considering the data file hiring.csv. The file contains hiring statics for a firm such as experience of candidate, his written test score and personal interview score. Based on these 3 factors, HR will decide the salary. Given this data, you need to build a Multiple Linear Regression model for HR department that can help them decide salaries for future candidates. Using this predict salaries for following candidates,
2 yr experience, 9 test score, 6 interview score
12 yr experience, 10 test score, 10 interview score

Code:

```
1. # Upload hiring.csv
from google.colab import files
uploaded = files.upload()

# Import libraries
import pandas as pd
from sklearn.linear_model import LinearRegression

# Load dataset
df = pd.read_csv('hiring.csv')

print("Original Data:")
print(df)

# ----------------------------
# Data Preprocessing
# ----------------------------

# Convert word numbers to digits
word_to_num = {
    'zero': 0,
    'one': 1,
    'two': 2,
    'three': 3,
    'four': 4,
    'five': 5,
    'six': 6,
    'seven': 7,
    'eight': 8,
    'nine': 9,
    'ten': 10
}

df['experience'] = df['experience'].replace(word_to_num)

# Convert to numeric
df['experience'] = pd.to_numeric(df['experience'], errors='coerce')

# Fill missing values
df['experience'] = df['experience'].fillna(0)
df['test_score(out of 10)'] = df['test_score(out of
10)'].fillna(df['test_score(out of 10)'].mean())

print("\nCleaned Data:")
print(df)

# ----------------------------
# Model Training
# ----------------------------

X = df[['experience', 'test_score(out of 10)', 'interview_score(out of
10)']]
y = df['salary($)']

model = LinearRegression()
model.fit(X, y)

# ----------------------------
# Predictions
# ----------------------------

salary1 = model.predict([[2, 9, 6]])
salary2 = model.predict([[12, 10, 10]])

print("\nPredicted Salary for (2 yr, 9 test, 6 interview):", salary1[0])
print("Predicted Salary for (12 yr, 10 test, 10 interview):", salary2[0])
```

Output:



```
Original Data:
  experience  test_score(out of 10)  interview_score(out of 10)  salary($)
0        NaN                    8.0                           9      50000
1        NaN                    8.0                           6      45000
2       five                    6.0                           7      60000
3        two                   10.0                          10      65000
4      seven                    9.0                           6      70000
5      three                    7.0                          10      62000
6        ten                    NaN                           7      72000
7     eleven                    7.0                           8      80000

Cleaned Data:
   experience  test_score(out of 10)  interview_score(out of 10)  salary($)
0         0.0               8.000000                           9      50000
1         0.0               8.000000                           6      45000
2         5.0               6.000000                           7      60000
3         2.0              10.000000                          10      65000
4         7.0               9.000000                           6      70000
5         3.0               7.000000                          10      62000
6        10.0               7.857143                           7      72000
7         0.0               7.000000                           8      80000

Predicted Salary for (2 yr, 9 test, 6 interview): 57403.24743480464
Predicted Salary for (12 yr, 10 test, 10 interview): 79095.98147979788
/usr/local/lib/python3.12/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
/usr/local/lib/python3.12/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

4. Considering the data file 1000_companies.csv. The file contains profit statics for a firm such as R&D Spend, Administration, Marketing Spend and State. Based on these four factors build a Multiple Linear Regression model to predict the profit. Using this predict profit for following,

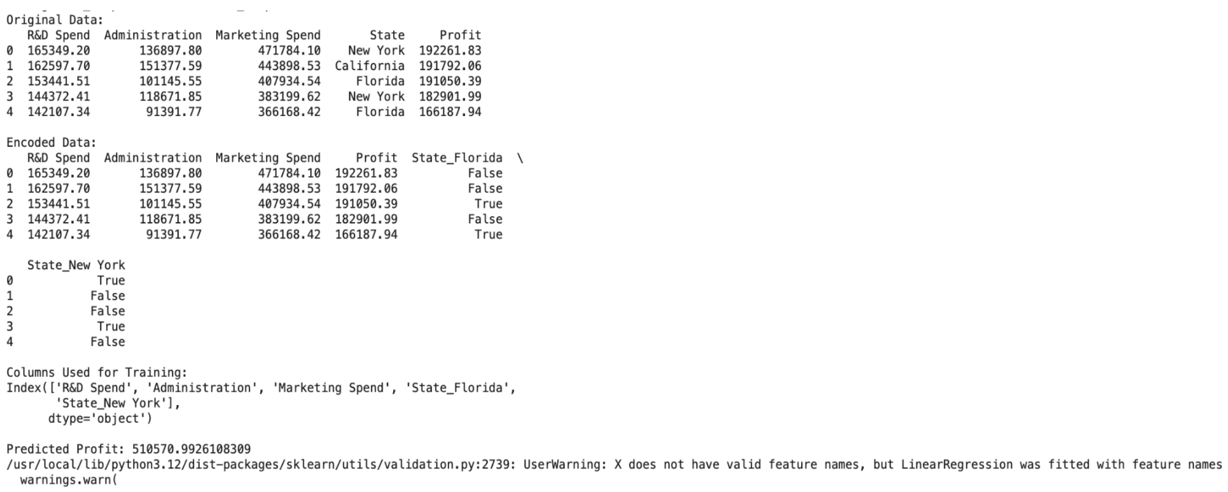
- 91694.48 R&D Spend, 515841.3 Administration, 11931.24 Marketing Spend, Florida State

Note: If required, apply the necessary data processing steps to data files.

Code:

```
# Upload file
from google.colab import files
uploaded = files.upload()

# Import libraries
import pandas as pd
from sklearn.linear_model import LinearRegression

# Load dataset (Correct File Name)
df = pd.read_csv('1000_Companies.csv')

print("Original Data:")
print(df.head())

# -----------------------------
# Data Preprocessing
# -----------------------------
# Remove missing values
df = df.dropna()

# One Hot Encoding for State column
df = pd.get_dummies(df, columns=['State'], drop_first=True)

print("\nEncoded Data:")
print(df.head())

# ----------------------------
# Model Training
# ----------------------------

X = df.drop('Profit', axis=1)
y = df['Profit']

model = LinearRegression()
model.fit(X, y)

# ----------------------------
# Prediction
# ----------------------------

# Check column order
print("\nColumns Used for Training:")
print(X.columns)

# Florida prediction
profit = model.predict([[91694.48, 515841.3, 11931.24, 1, 0]])

print("\nPredicted Profit:", profit[0])
```

Output:



```
Original Data:
   R&D Spend  Administration  Marketing Spend       State     Profit
0  165349.20       136897.80        471784.10    New York  192261.83
1  162597.70       151377.59        443898.53  California  191792.06
2  153441.51       101145.55        407934.54     Florida  191050.39
3  144372.41       118671.85        383199.62    New York  182901.99
4  142107.34        91391.77        366168.42     Florida  166187.94

Encoded Data:
   R&D Spend  Administration  Marketing Spend     Profit  State_Florida  \
0  165349.20       136897.80        471784.10  192261.83          False
1  162597.70       151377.59        443898.53  191792.06          False
2  153441.51       101145.55        407934.54  191050.39           True
3  144372.41       118671.85        383199.62  182901.99          False
4  142107.34        91391.77        366168.42  166187.94           True

   State_New York
0            True
1           False
2           False
3            True
4           False

Columns Used for Training:
Index(['R&D Spend', 'Administration', 'Marketing Spend', 'State_Florida',
       'State_New York'],
      dtype='object')

Predicted Profit: 510570.9926108309
/usr/local/lib/python3.12/dist-packages/sklearn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```