CSc 177- Project 2 - Linear Regression and Classification Tree

By Alec Resha

Due: April 12, 2022

In [ ]:
```
# Dataset of "bottle" is from https://www.kaggle.com/datasets/sohier/calcofi?select=bot
```

In [ ]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
```

Chosen Dataset

Loading in Data

In [ ]:
```
df = pd.read_csv("./data/bottle.csv")
```

```
C:\Users\Alecr\AppData\Local\Programs\Python\Python39\lib\site-packages\IPython\core\int
eractiveshell.py:3071: DtypeWarning: Columns (47,73) have mixed types.Specify dtype opti
on on import or set low_memory=False.
  has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
```

In [ ]:
```
# T_degC is temp in Celcius, Salnty is the Salinity in g per kg, Depthm is the depth in
df = df[["T_degC", "Salnty", "Depthm", "O2ml_L"]]
df.dropna(inplace=True)
df.reset_index(drop=True, inplace=True)
```

Simple Linear Regression

Data Splitting and Linear Regression

In [ ]:
```
x_train, x_test = train_test_split(df["T_degC"].values.reshape(-1, 1), test_size=0.2)
```

In [ ]:
```
y_train, y_test = train_test_split(df["Salnty"].values.reshape(-1, 1), test_size=0.2)
```

In [ ]:
```
linear_regressor = LinearRegression(fit_intercept=True, normalize=True)
linear_regressor.fit(x_train, y_train)
```

Out[ ]:
```
LinearRegression(normalize=True)
```

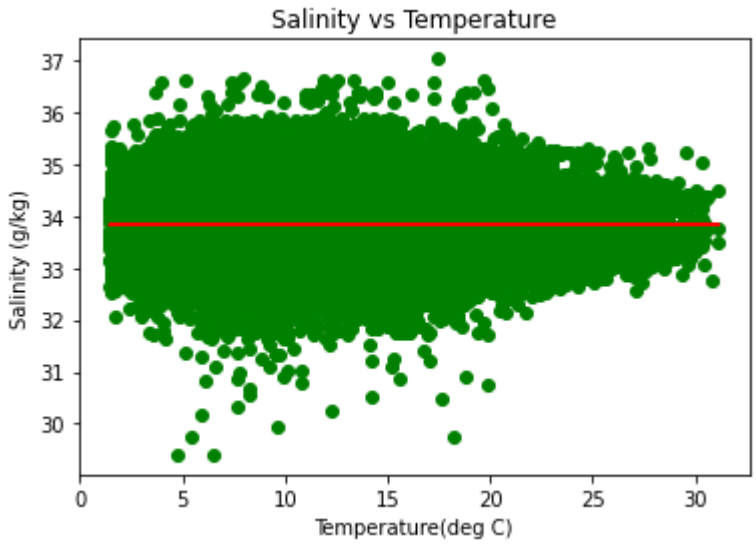
Data evaluation and visualization

In [ ]:
```
# Train mean squared error
# Temp and salinity are being compared for simple linear regression
print("Mean Squared Error for Training Set:", mean_squared_error(y_train, linear_regres
```

```
Mean Squared Error for Training Set: 0.21175824134684196
```

In [ ]:
```
plt.scatter(x_train, y_train, color="green")
plt.plot(x_train, linear_regressor.predict(x_train), color="red")
plt.title("Salinity vs Temperature")
plt.xlabel("Temperature(deg C)")
plt.ylabel("Salinity (g/kg)")
plt.show
```

Out[ ]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```

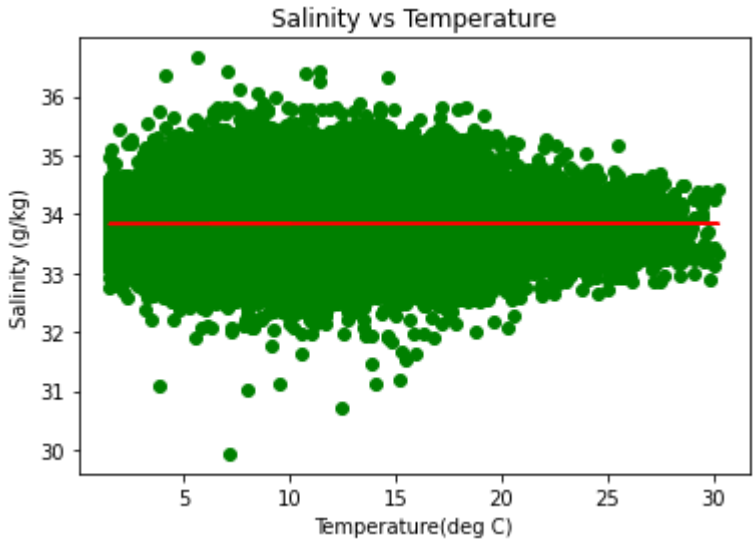


In [ ]:
```
# MSE for test set
print("Mean Squared Error for Testing Set:", mean_squared_error(y_test, linear_regresso
```

```
Mean Squared Error for Testing Set: 0.21254452952316563
```

In [ ]:
```
plt.scatter(x_test, y_test, color="green")
plt.plot(x_test, linear_regressor.predict(x_test), color="red")
plt.title("Salinity vs Temperature")
plt.xlabel("Temperature(deg C)")
plt.ylabel("Salinity (g/kg)")
plt.show
```

Out[ ]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Multiple Linear Regression

Data Splitting and Linear Regression

In [ ]:
```
x_train, x_test = train_test_split(df[["T_degC", "Depthm", "O2ml_L"]], test_size=0.2)
y_train, y_test = train_test_split(df["Salnty"], test_size=0.2)
```

In [ ]:
```
linear_regressor = LinearRegression().fit(x_train, y_train)
```

Linear Regression Evaluation

In [ ]:
```
# Train mean squared error
print("Mean Squared Error for Training Set:", mean_squared_error(y_train, linear_regres
```

```
Mean Squared Error for Training Set: 0.21206880519545226
```

In [ ]:
```
# Test mean squared error
print("Mean Squared Error for Testing Set:", mean_squared_error(y_test, linear_regresso
```

```
Mean Squared Error for Testing Set: 0.21130126365382598
```

Provided Dataset

Loading in Data

In [ ]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn import metrics
from sklearn.tree import export_graphviz
from six import StringIO
from IPython.display import Image
import pydotplus
```

In [ ]:
```
df = pd.read_csv("./data/Admission_Predict_Ver1.1_small_data_set_for_Linear_Regression.
```

Linear Regression

Simple Line Regression

In [ ]:
```
x, y = df["GRE Score"].values.reshape(-1, 1), df["Chance of Admit "].values.reshape(-1,
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2)
```

In [ ]:
```
linear_regressor = LinearRegression(fit_intercept=True, normalize=True)
linear_regressor.fit(x_train, y_train)
```

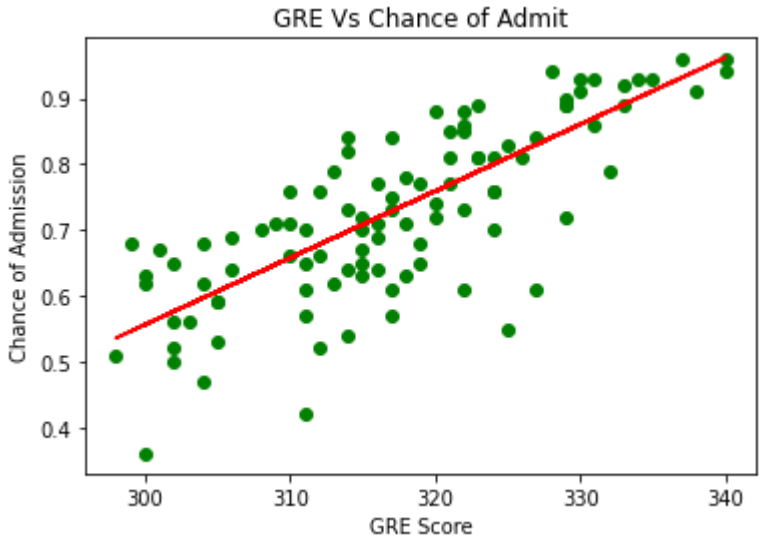
Out[ ]:
```
LinearRegression(normalize=True)
```

In [ ]:
```
# MSE for test set
print("Mean Squared Error for Testing Set:", mean_squared_error(y_test, linear_regresso
```

```
Mean Squared Error for Testing Set: 0.0071318033076448115
```

In [ ]:
```
plt.scatter(x_test, y_test, color="green")
plt.plot(x_test, linear_regressor.predict(x_test), color="red")
plt.title("GRE Vs Chance of Admit")
plt.xlabel("GRE Score")
plt.ylabel("Chance of Admission")
plt.show
```

Out[ ]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Multiple Linear Regression

In [ ]:
```
x, y = df[["GRE Score", "TOEFL Score", "University Rating", "SOP", "LOR ", "CGPA", "Res
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2)
```

In [ ]:
```
linear_regressor = LinearRegression().fit(x_train, y_train)
```

In [ ]:

```
# Test mean squared error
print("Mean Squared Error for Testing Set:", mean_squared_error(y_test, linear_regresso
```

```
Mean Squared Error for Testing Set: 0.0028376825494695946
```

Classification

In [ ]:
```
df = pd.read_csv("./data/Admission_Predict_Ver1.1_small_data_set_for_Linear_Regression.
```

In [ ]:
```
# Classes:
# 0-0.4: Low
# 0.4-0.7: Medium
# 0.7-1.0: High
def classifier(row):
    if row['Chance of Admit '] <= 0.4:
        return -1
    elif row['Chance of Admit '] <= 0.7:
        return 0
    elif row['Chance of Admit '] <= 1.0:
        return 1
    else:
        return 2 # This should never happen
df['chance'] = df.apply(classifier, axis=1)
```

Splitting

In [ ]:
```
feature_cols = ['GRE Score', 'TOEFL Score', 'University Rating', 'SOP', 'LOR ', 'CGPA',
x = df[feature_cols]
y = df['chance']
```

In [ ]:
```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2)
```

Model

In [ ]:
```
classifier = DecisionTreeClassifier(criterion="entropy", min_samples_leaf=0.01, max_lea
y_pred = classifier.predict(x_test)
```

Evaluation

In [ ]:
```
print("Accuracy:", metrics.accuracy_score(y_test, y_pred))
```

```
Accuracy: 0.85
```

Visualization

In [ ]:
```
dot_data = StringIO()
export_graphviz(classifier,
                filled=True,
                out_file=dot_data,
                rounded=True,
                special_characters=True,
```

```
                feature_names=feature_cols,
                class_names=['Low', 'Medium', 'High'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png("decision_tree.png")
Image(graph.create_png())
```

Out[ ]: