Assignment 3 Part 1

CS4172 Machine Learning Lab

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Task 1

Download Titanic Dataset (https://www.kaggle.com/heptapod/titanic/version/1#) and do initial pre-processing and train a Logistic Regression for the classifier.

In [ ]:

```
import pandas as pd

FILE_PATH = "./../ML_DRIVE/Assign_3/titanic/train_and_test2.csv"

titanic_df = pd.read_csv(FILE_PATH).dropna()

titanic_df
```

Out[ ]:

	Passengerid	Age	Fare	Sex	sibsp	zero	zero.1	zero.2	zero.3	zero.4	...	zero.12	zero.13	zero.14	Pclass	zero.15	zero.16	Embarked	zero.17	zer
0	1	22.0	7.2500	0	1	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
1	2	38.0	71.2833	1	1	0	0	0	0	0	...	0	0	0	1	0	0	0.0	0	
2	3	26.0	7.9250	1	0	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
3	4	35.0	53.1000	1	1	0	0	0	0	0	...	0	0	0	1	0	0	2.0	0	
4	5	35.0	8.0500	0	0	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1304	1305	28.0	8.0500	0	0	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
1305	1306	39.0	108.9000	1	0	0	0	0	0	0	...	0	0	0	1	0	0	0.0	0	
1306	1307	38.5	7.2500	0	0	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
1307	1308	28.0	8.0500	0	0	0	0	0	0	0	...	0	0	0	3	0	0	2.0	0	
1308	1309	28.0	22.3583	0	1	0	0	0	0	0	...	0	0	0	3	0	0	0.0	0	

1307 rows × 28 columns

In [ ]:

```
titanic_df.columns
```

Out[ ]:

```
Index(['Passengerid', 'Age', 'Fare', 'Sex', 'sibsp', 'zero', 'zero.1',
       'zero.2', 'zero.3', 'zero.4', 'zero.5', 'zero.6', 'Parch', 'zero.7',
       'zero.8', 'zero.9', 'zero.10', 'zero.11', 'zero.12', 'zero.13',
       'zero.14', 'Pclass', 'zero.15', 'zero.16', 'Embarked', 'zero.17',
       'zero.18', '2urvived'],
      dtype='object')
```

In [ ]:

```
# all the zero column are not useful (kaggle saying all zero)
# so ignoring them

# also dropping "Passengerid" cause using pandas internal
# 0-index id

titanic_df = titanic_df[
    filter(
        lambda colName: "zero" not in colName,
        titanic_df.columns
    )
]
titanic_df = titanic_df.drop("Passengerid", axis=1)
titanic_df
```

Out[ ]:

	Age	Fare	Sex	sibsp	Parch	Pclass	Embarked	2urvived
0	22.0	7.2500	0	1	0	3	2.0	0
1	38.0	71.2833	1	1	0	1	0.0	1
2	26.0	7.9250	1	0	0	3	2.0	1
3	35.0	53.1000	1	1	0	1	2.0	1
4	35.0	8.0500	0	0	0	3	2.0	0
...	...	...	...	...	...	...	...	...
1304	28.0	8.0500	0	0	0	3	2.0	0
1305	39.0	108.9000	1	0	0	1	0.0	0
1306	38.5	7.2500	0	0	0	3	2.0	0
1307	28.0	8.0500	0	0	0	3	2.0	0
1308	28.0	22.3583	0	1	1	3	0.0	0

1307 rows × 8 columns

In [ ]:

```python
from sklearn.preprocessing import OneHotEncoder

def one_hot_encode(X: "pd.DataFrame", col_name: "str") -> "pd.DataFrame":
    encoder = OneHotEncoder()

    encoded_df = pd.DataFrame(
        encoder.fit_transform(X[[col_name]]).toarray(),
        index=X.index,
        columns=encoder.get_feature_names_out()
    )

    X = X.join(encoded_df)
    X = X.drop(col_name, axis=1)

    return X
```

In [ ]:

```python
# sibsp has value ranging from 0 to 8 (doing OneHotEncoding)
# Parch has value ranging from 0 to 9 (doing OneHotEncoding)
# Pclass has value ranging from 0 to 3 (doing OneHotEncoding)
# Embarked has value ranging from 0 to 3 (doing OneHotEncoding)

columns_to_encode = ["Pclass", "Embarked", "Sex"]
```

```
for column in columns_to_encode:
    titanic_df = one_hot_encode(titanic_df, column)

titanic_df
```

Out[ ]:

	Age	Fare	sibsp	Parch	2urvived	Pclass_1	Pclass_2	Pclass_3	Embarked_0.0	Embarked_1.0	Embarked_2.0	Sex_0	Sex_1
0	22.0	7.2500	1	0	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1	38.0	71.2833	1	0	1	1.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
2	26.0	7.9250	0	0	1	0.0	0.0	1.0	0.0	0.0	1.0	0.0	1.0
3	35.0	53.1000	1	0	1	1.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
4	35.0	8.0500	0	0	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
1304	28.0	8.0500	0	0	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1305	39.0	108.9000	0	0	0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
1306	38.5	7.2500	0	0	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1307	28.0	8.0500	0	0	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1308	28.0	22.3583	1	1	0	0.0	0.0	1.0	1.0	0.0	0.0	1.0	0.0

1307 rows × 13 columns

In [ ]:

```
# Age and Fare needs to be standardized
from sklearn.preprocessing import StandardScaler

def standardize(df: "pd.DataFrame", col_name: "str") -> "pd.DataFrame":
    scaler = StandardScaler()

    df[[col_name]] = pd.DataFrame(
        data=scaler.fit_transform(df[[col_name]]),
        index=df.index,
        columns=[col_name]
    )
    return df
```

In [ ]:

```
columns_to_standardize = ['Age', "Fare", 'sibsp', "Parch"]

for column in columns_to_standardize:
    titanic_df = standardize(titanic_df, column)

titanic_df
```

Out[ ]:

	Age	Fare	sibsp	Parch	2urvived	Pclass_1	Pclass_2	Pclass_3	Embarked_0.0	Embarked_1.0	Embarked_2.0	Sex_0	Sex_1
0	-0.580261	-0.501839	0.480272	-0.445407	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1	0.662297	0.736023	0.480272	-0.445407	1	1.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
2	-0.269621	-0.488790	-0.479537	-0.445407	1	0.0	0.0	1.0	0.0	0.0	1.0	0.0	1.0
3	0.429318	0.384512	0.480272	-0.445407	1	1.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
4	0.429318	-0.486373	-0.479537	-0.445407	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
1304	-0.114301	-0.486373	-0.479537	-0.445407	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1305	0.739957	1.463211	-0.479537	-0.445407	0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
1306	0.701127	-0.501839	-0.479537	-0.445407	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1307	-0.114301	-0.486373	-0.479537	-0.445407	0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0
1308	-0.114301	-0.209772	0.480272	0.709647	0	0.0	0.0	1.0	1.0	0.0	0.0	1.0	0.0

1307 rows × 13 columns

In [ ]:

```
# Preprocessing Done, lets move to model
X = titanic_df.drop('2urvived', axis=1)
y = titanic_df[['2urvived']]
```

In [ ]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y)
```

In [ ]:

```
# make, train, and score the model
from sklearn.linear_model import LogisticRegression

model = LogisticRegression().fit(X_train, y_train.iloc[:,0])
accuracy = model.score(X_test, y_test)
print(f"accuracy = {accuracy}")
```

```
accuracy = 0.764525993883792
```

Task 2

Analyze and control the overfitting by varying the inverse of regularization strength parameter (0.1, 0.25,0.5, 0.75, 0.9) and plot the accuracy graph for the test set.

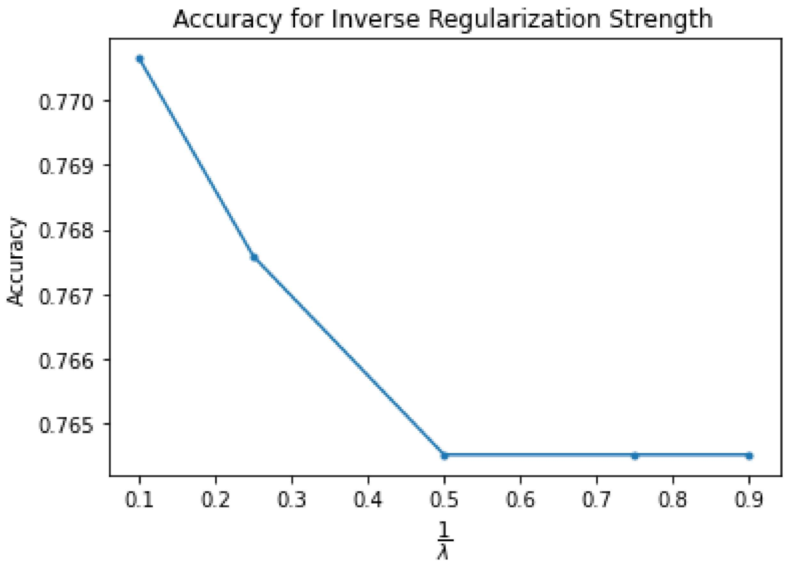
In [ ]:

```
import matplotlib.pyplot as plt


def get_acc_log_reg(
    X_train: "pd.DataFrame",
    X_test: "pd.DataFrame",
    y_train: "pd.DataFrame",
    y_test: "pd.DataFrame",
    c=1.0
) -> "float":
    return LogisticRegression(C=c)\
        .fit(X_train, y_train.iloc[:, 0])\
        .score(X_test, y_test)


inv_reg_strs = (0.1, 0.25, 0.5, 0.75, 0.9)
accuracies = [get_acc_log_reg(X_train, X_test, y_train, y_test, c) for c in inv_reg_strs]


plt.plot(inv_reg_strs, accuracies, '.-')
plt.title("Accuracy for Inverse Regularization Strength")
plt.xlabel(r"$\dfrac{1}{\lambda}$")
plt.ylabel("Accuracy")
plt.show()
```



In [ ]:

```
pd.DataFrame(
    data = zip(inv_reg_strs, accuracies),
    columns=['inv_reg_str', 'accuracy']
)
```

Out[ ]:

	inv_reg_str	accuracy
0	0.10	0.773700
1	0.25	0.785933
2	0.50	0.788991
3	0.75	0.788991
4	0.90	0.788991

Task 3

Using the same dataset train a Decision Tree classifier and vary the maximum depth of the tree to train at least 5 classifiers to analyze the effectiveness.

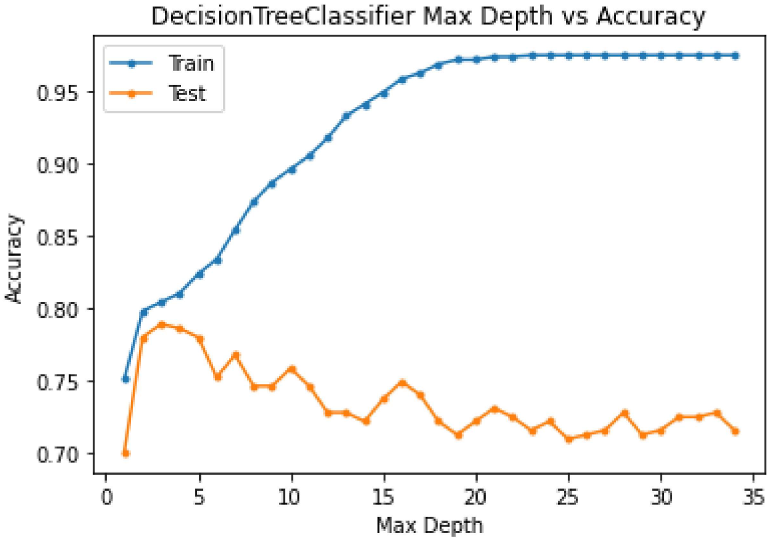
In [ ]:

```
from sklearn.tree import DecisionTreeClassifier


def get_acc_dec_tree(
    X_train: "pd.DataFrame",
    X_test: "pd.DataFrame",
    y_train: "pd.DataFrame",
    y_test: "pd.DataFrame",
    max_depth=1
) -> "float":
    return DecisionTreeClassifier(max_depth=max_depth)\
        .fit(X_train, y_train)\
        .score(X_test, y_test)


max_depths = range(1, 35)
train_accuracies = [get_acc_dec_tree(X_train, X_train, y_train, y_train, max_d) for max_d in max_depths]
test_accuracies = [get_acc_dec_tree(X_train, X_test, y_train, y_test, max_d) for max_d in max_depths]

plt.plot(max_depths, train_accuracies, ".-", label='Train')
plt.plot(max_depths, test_accuracies, ".-", label='Test')
plt.title("DecisionTreeClassifier Max Depth vs Accuracy")
plt.xlabel("Max Depth")
plt.ylabel("Accuracy")
plt.legend()
plt.show()
```


DecisionTreeClassifier Max Depth vs Accuracy
Train
Test
Accuracy
Max Depth