```
#import libraries
from sklearn.metrics import accuracy_score
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
from sklearn.linear_model import RANSACRegressor, LogisticRegression
from sklearn.tree import DecisionTreeClassifier
```

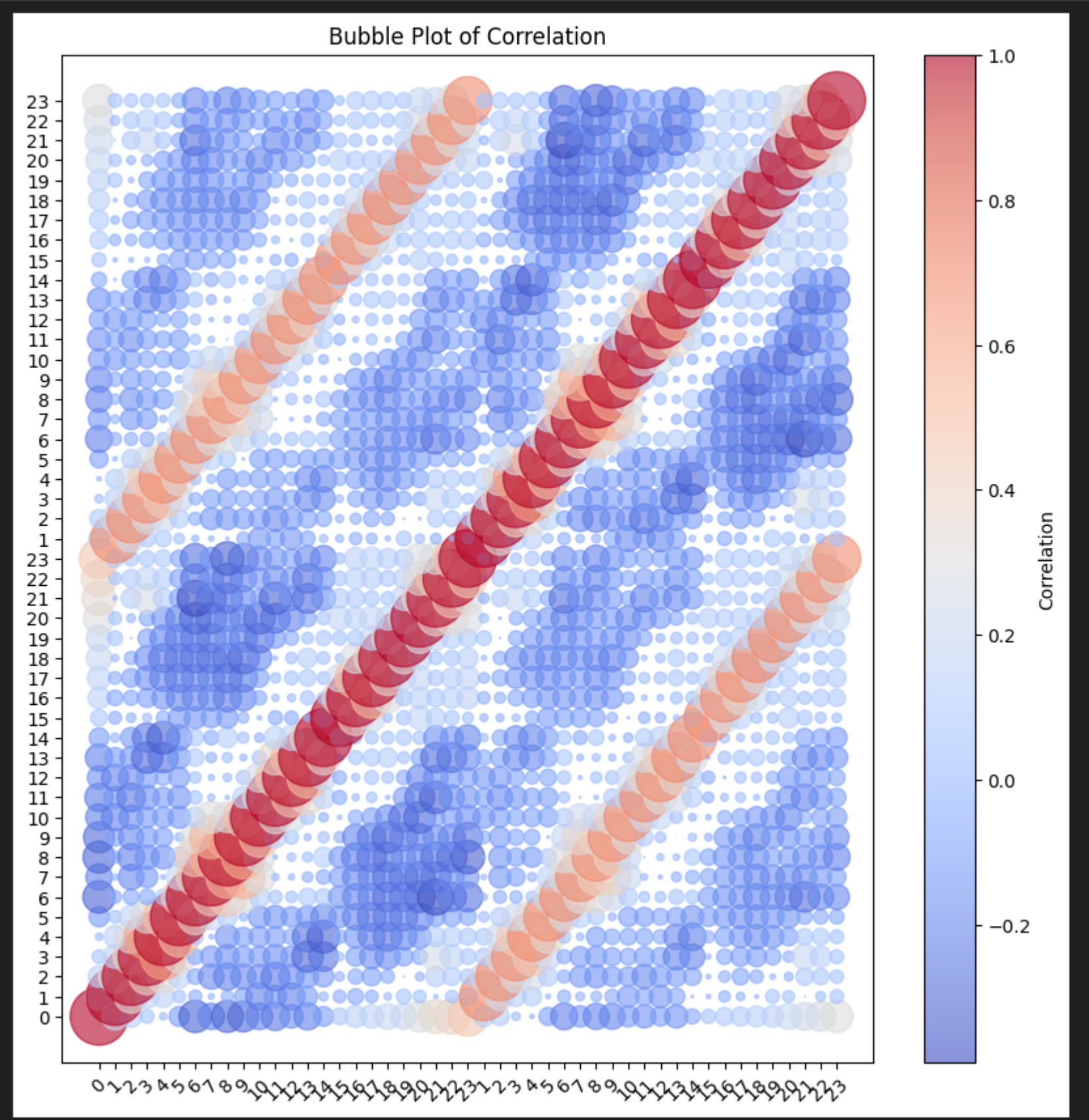
```
np.random.seed(1)

df2 = pd.read_csv("C:\ML1 CA\wall+following+robot+navigation+data\sensor_readings_2.data", header = None)
df4 = pd.read_csv("C:\ML1 CA\wall+following+robot+navigation+data\sensor_readings_4.data", header = None)
df24 = pd.read_csv("C:\ML1 CA\wall+following+robot+navigation+data\sensor_readings_24.data", header = None)


classes = ("Move-Forward", "Slight-Right-Turn", "Sharp-Right-Turn", "Slight-Left-Turn")
n_classes = len(classes)
#data preprocessing
for i, item in enumerate(classes):
    df2 = df2.replace(to_replace = item, value = i)
    df4 = df4.replace(to_replace = item, value = i)
    df24 = df24.replace(to_replace = item, value = i)

df = df24
from sklearn.model_selection import train_test_split
X = df.drop(24,axis=1).fillna(0)
y = df[24]
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)
df_diff=X_train[[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23]].diff(periods=1, axis=0)
df=pd.concat([X_train,df_diff],axis=1)
df.head()
```

```
C:\Users\vigne\AppData\Local\Temp\ipykernel_20936\3591477363.py:12: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a fut
  df2 = df2.replace(to_replace = item, value = i)
C:\Users\vigne\AppData\Local\Temp\ipykernel_20936\3591477363.py:13: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a fut
  df4 = df4.replace(to_replace = item, value = i)
C:\Users\vigne\AppData\Local\Temp\ipykernel_20936\3591477363.py:14: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a fut
  df24 = df24.replace(to_replace = item, value = i)
```

	0	1	2	3	4	5	6	7	8	9	...	14	15	16	17	18	19	20	21	22	23
5365	1.805	1.785	1.553	1.256	1.246	1.258	1.568	1.302	1.581	0.845	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2584	1.707	2.669	2.648	1.925	1.913	1.955	5.000	1.950	2.306	2.012	...	0.000	-2.644	0.611	0.000	0.597	-3.039	-1.785	-0.893	-0.897	-0.904
2201	1.191	1.300	5.000	2.828	2.791	2.797	5.000	3.009	2.993	2.996	...	-1.439	3.389	-0.856	-4.379	-4.369	0.053	-0.272	-1.152	-0.592	-0.538
618	1.392	1.416	1.439	2.621	2.641	3.255	5.000	5.000	5.000	5.000	...	1.439	-4.429	-0.174	-0.174	-0.175	2.596	0.236	0.919	0.294	0.216
4680	0.822	0.848	1.442	1.451	1.473	5.000	5.000	4.107	5.000	5.000	...	-4.147	0.083	0.189	0.204	0.213	-2.384	0.035	-0.663	-0.599	-0.561

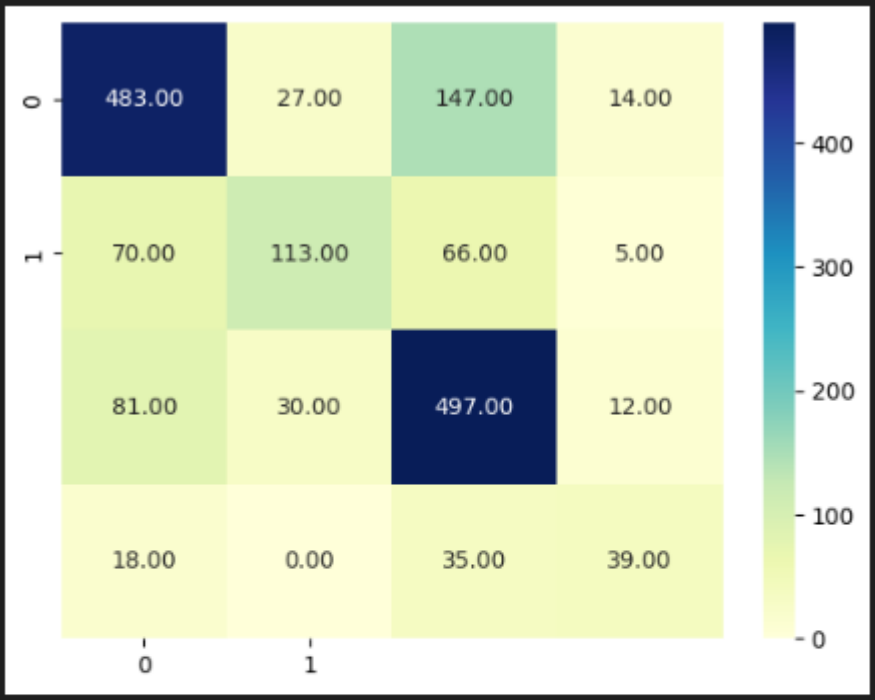
5 rows × 47 columns

```python
def plot_corr_bubble(df, size=10):
    corr = df.corr()
    fig, ax = plt.subplots(figsize=(size, size))
    ax.set_title("Bubble Plot of Correlation")
    column_names = corr.columns
    X, Y = np.meshgrid(np.arange(corr.shape[0]), np.arange(corr.shape[1]))
    bubble_size = np.abs(corr.values) * 1000
    scatter = ax.scatter(X.flatten(), Y.flatten(), s=bubble_size.flatten(), cmap='coolwarm', c=corr.values.flatten(), alpha=0.6)
    ax.set_xticks(np.arange(len(column_names)))
    ax.set_yticks(np.arange(len(column_names)))
    ax.set_xticklabels(column_names, rotation=45)
    ax.set_yticklabels(column_names)
    cbar = fig.colorbar(scatter, ax=ax)
    cbar.set_label('Correlation')
    plt.show()
plot_corr_bubble(df)
```


Bubble Plot of Correlation
Correlation
1.0
0.8
0.6
0.4
0.2
0.0
−0.2

```python
def rmsle(y_predicted, y_real):
    return np.sqrt(np.mean(np.power(np.log1p(y_predicted) - np.log1p(y_real), 2)))

def procenterror(y_predicted, y_real):
    return np.round(np.mean(np.abs(y_predicted - y_real)) / np.mean(y_real) * 100, 1)

n_col = 22

names = ['LogisticRegression', 'DecisionTreeClassifier', 'RANSACRegressor']
classifiers = [LogisticRegression(), DecisionTreeClassifier(), RANSACRegressor()]

# Hyperparameter tuning
param_grids = [
    {'C': [0.1, 1, 10, 100, 1000], 'solver': ['liblinear'], 'penalty': ['l1', 'l2']},
    {'max_depth': [None, 10, 20, 30, 40], 'min_samples_split': [2, 5, 10], 'min_samples_leaf': [1, 2, 4]},
    {'min_samples': [1, 5, 10, 20], 'residual_threshold': [1, 2, 3]}
]

for name, clf, param_grid in zip(names, classifiers, param_grids):
    grid_search = GridSearchCV(clf, param_grid, cv=5, scoring='accuracy' if name != 'RANSACRegressor' else 'neg_mean_squared_error')
    grid_search.fit(X_train, y_train)

    best_estimator = grid_search.best_estimator_
    best_params = grid_search.best_params_
    regr = best_estimator.fit(X_train, y_train)

    try:
        # Calculate metrics on the testing set
        y_pred = regr.predict(X_test)
        print(name, '%error:', procenterror(y_pred, y_test), 'RMSLE:', rmsle(y_pred, y_test))

        # Confusion Matrix
        print(name, 'Confusion Matrix')
        conf = confusion_matrix(y_test, np.round(y_pred))
        label = ["0", "1"]
        sns.heatmap(conf, annot=True, xticklabels=label, yticklabels=label, cmap="YlGnBu",fmt=".2f")
        plt.show()
        # Accuracy
        accuracy = round(accuracy_score(y_test, np.round(y_pred)) * 100, 2)
        print('Accuracy', accuracy, '%')
        # Classification Report
        print(name, 'Classification Report')
        classif = classification_report(y_test, np.round(y_pred))
        print(classif)
        print('--' * 40)
    except ValueError as e:
        print(f"Error occurred for {name}: {e}")
```

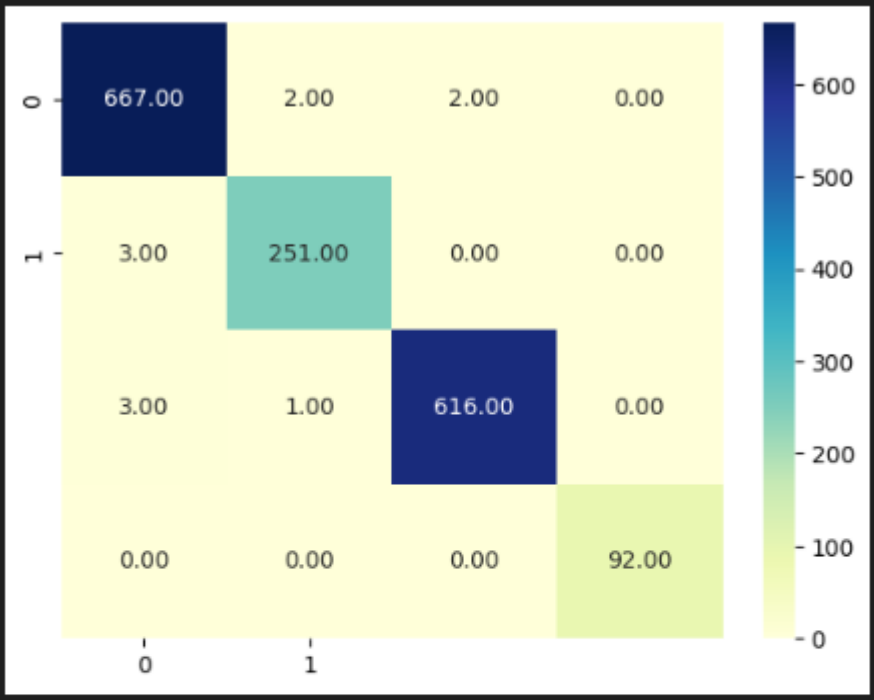
LogisticRegression %error: 45.3 RMSLE: 0.49761858644816104
LogisticRegression Confusion Matrix



Accuracy 69.15 %
LogisticRegression Classification Report

	precision	recall	f1-score	support
0	0.74	0.72	0.73	671
1	0.66	0.44	0.53	254
2	0.67	0.80	0.73	620
3	0.56	0.42	0.48	92
accuracy			0.69	1637
macro avg	0.66	0.60	0.62	1637
weighted avg	0.69	0.69	0.68	1637

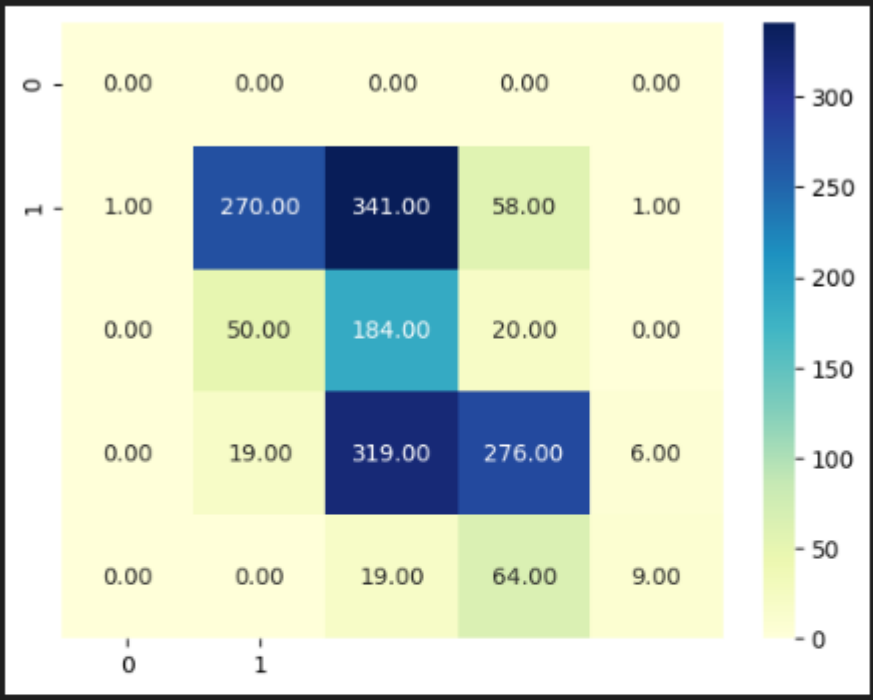
DecisionTreeClassifier %error: 0.9 RMSLE: 0.07248706761217664
DecisionTreeClassifier Confusion Matrix



Accuracy 99.33 %
DecisionTreeClassifier Classification Report

	precision	recall	f1-score	support
0	0.99	0.99	0.99	671
1	0.99	0.99	0.99	254
2	1.00	0.99	1.00	620
3	1.00	1.00	1.00	92
accuracy			0.99	1637
macro avg	0.99	0.99	0.99	1637
weighted avg	0.99	0.99	0.99	1637

RANSACRegressor %error: 59.5 RMSLE: 0.4413350249743825
RANSACRegressor Confusion Matrix



Accuracy 45.14 %
RANSACRegressor Classification Report

	precision	recall	f1-score	support
-1.0	0.00	0.00	0.00	0
0.0	0.80	0.40	0.53	671
1.0	0.21	0.72	0.33	254
2.0	0.66	0.45	0.53	620
3.0	0.56	0.10	0.17	92
accuracy			0.45	1637
macro avg	0.45	0.33	0.31	1637
weighted avg	0.64	0.45	0.48	1637