```python
from classifiers import NaiveBayes, LDA, QDA
from generate_data import generate_data_scheme_1,
generate_data_scheme_2
from sklearn.model_selection import train_test_split
import numpy as np
import pandas as pd

rho = 0.5
a_list = [0.1, 0.5, 1, 2, 3, 5]

models = [NaiveBayes(), LDA(), QDA()]

test_sizes = [0.05, 0.1, 0.2, 0.3, 0.4]

for model in models:
    print(model.name)
```

```
Naive Bayes
LDA
QDA
```

```python
def accuracy(y_true, y_pred):
    accuracy = np.sum(y_true == y_pred) / len(y_true)
    return accuracy
```

Single experiment

```python
for a in a_list:
    print(f"\tCurrent value of a = {a}")

    X, y = generate_data_scheme_1(1000, a)

    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=test_size, random_state=123
    )


    for model in models:
        model.fit(X_train, y_train)
        y_pred = model.predict(X_test)
        acc = accuracy(y_test, y_pred)

        res.append([model.name, a, acc, scheme+1])
        print(f"\t\tModel {model.name} accuracy: {round(acc*100, 2)}
%")
```

```
        Current value of a = 0.1
                Model Naive Bayes accuracy: 53.0%
                Model LDA accuracy: 53.5%
                Model QDA accuracy: 55.5%
```

```
	Current value of a = 0.5
		Model Naive Bayes accuracy: 60.0%
		Model LDA accuracy: 61.25%
		Model QDA accuracy: 60.25%
	Current value of a = 1
		Model Naive Bayes accuracy: 80.25%
		Model LDA accuracy: 80.25%
		Model QDA accuracy: 80.5%
	Current value of a = 2
		Model Naive Bayes accuracy: 91.25%
		Model LDA accuracy: 92.0%
		Model QDA accuracy: 91.25%
	Current value of a = 3
		Model Naive Bayes accuracy: 98.75%
		Model LDA accuracy: 98.0%
		Model QDA accuracy: 98.75%
	Current value of a = 5
		Model Naive Bayes accuracy: 100.0%
		Model LDA accuracy: 100.0%
		Model QDA accuracy: 100.0%
```

```python
for a in a_list:
    print(f"\tCurrent value of a = {a}")

    X, y = generate_data_scheme_2(1000, a, rho)

    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=test_size, random_state=123
    )


    for model in models:
        model.fit(X_train, y_train)
        y_pred = model.predict(X_test)
        acc = accuracy(y_test, y_pred)

        res.append([model.name, a, acc, scheme+1])
        print(f"\t\tModel {model.name} accuracy: {round(acc*100, 2)}
%")
```

```
	Current value of a = 0.1
		Model Naive Bayes accuracy: 50.0%
		Model LDA accuracy: 44.75%
		Model QDA accuracy: 51.5%
	Current value of a = 0.5
		Model Naive Bayes accuracy: 60.0%
		Model LDA accuracy: 61.0%
		Model QDA accuracy: 59.5%
	Current value of a = 1
		Model Naive Bayes accuracy: 69.0%
```

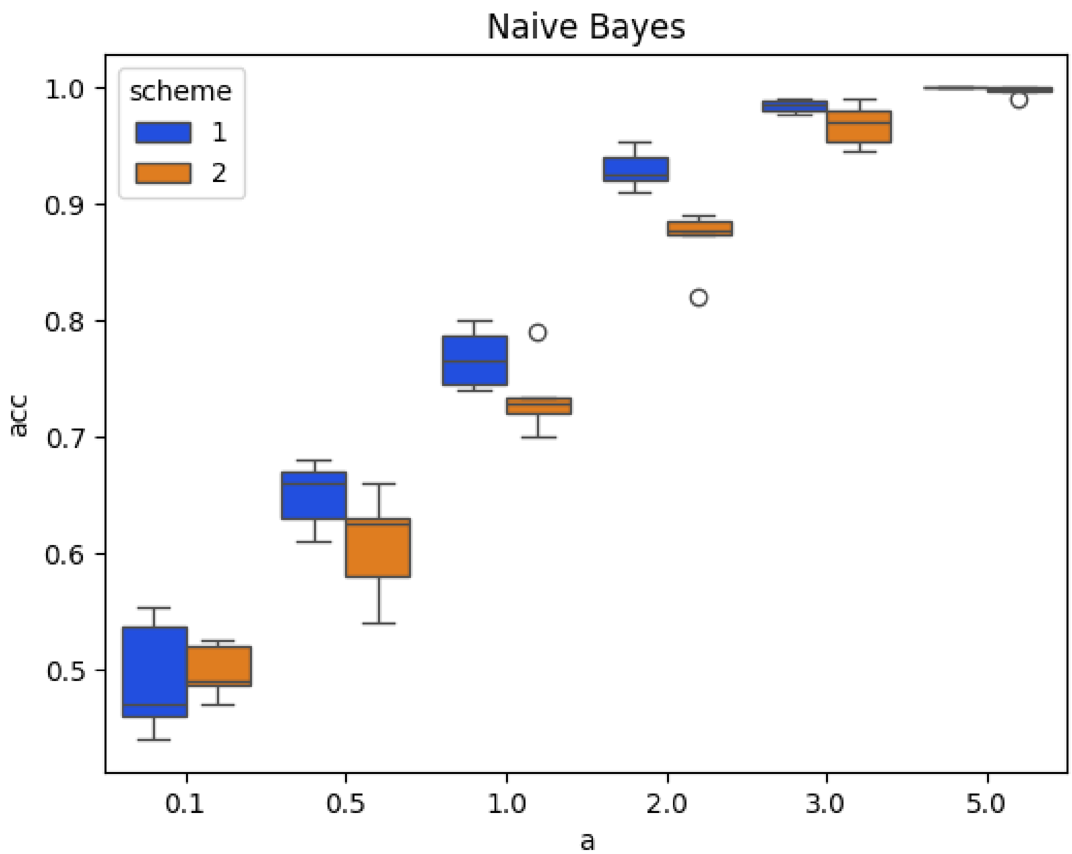
```
            Model LDA accuracy: 68.0%
            Model QDA accuracy: 67.75%
      Current value of a = 2
            Model Naive Bayes accuracy: 87.5%
            Model LDA accuracy: 88.0%
            Model QDA accuracy: 87.75%
      Current value of a = 3
            Model Naive Bayes accuracy: 97.0%
            Model LDA accuracy: 96.25%
            Model QDA accuracy: 97.0%
      Current value of a = 5
            Model Naive Bayes accuracy: 100.0%
            Model LDA accuracy: 100.0%
            Model QDA accuracy: 100.0%
```

Experiments on multiple test-train splits

```
columns = ['model', 'a', 'acc', 'scheme']
res = []

for scheme in range(2):

    for test_size in test_sizes:

        for a in a_list:
            # print(f"Current value of a = {a}")

            if scheme == 0:
                X, y = generate_data_scheme_1(1000, a)
            else:
                X, y = generate_data_scheme_2(1000, a, rho)

            X_train, X_test, y_train, y_test = train_test_split(
                X, y, test_size=test_size, random_state=123
            )


            for model in models:
                model.fit(X_train, y_train)
                y_pred = model.predict(X_test)
                acc = accuracy(y_test, y_pred)

                res.append([model.name, a, acc, scheme+1])
                # print(f"\tModel {model.name} accuracy:
{round(acc*100, 2)}%")

import seaborn as sns

df = pd.DataFrame(res, columns=columns)
```

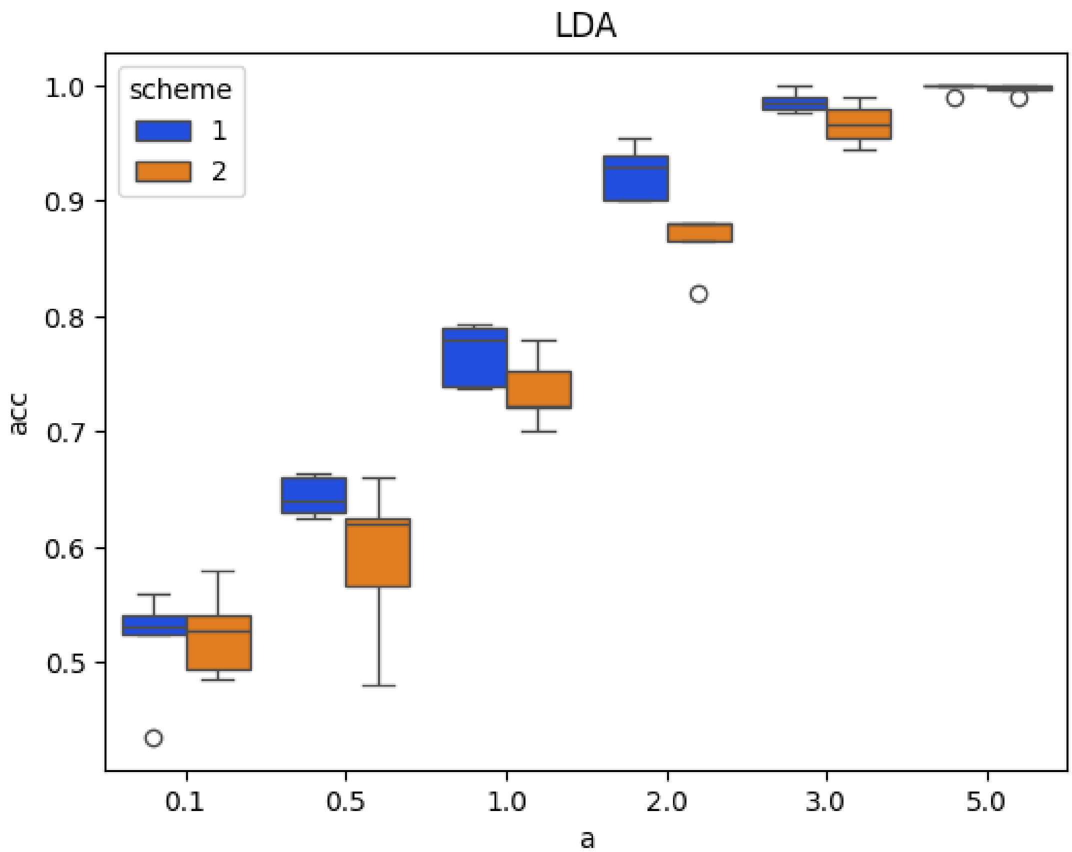
```
nb_df = df[df['model'] == 'Naive Bayes']
lda_df = df[df['model'] == 'LDA']
qda_df = df[df['model'] == 'QDA']

sns.boxplot(x="a", y="acc", hue="scheme", data=nb_df,
palette="bright").set_title("Naive Bayes")
```

```
Text(0.5, 1.0, 'Naive Bayes')
```



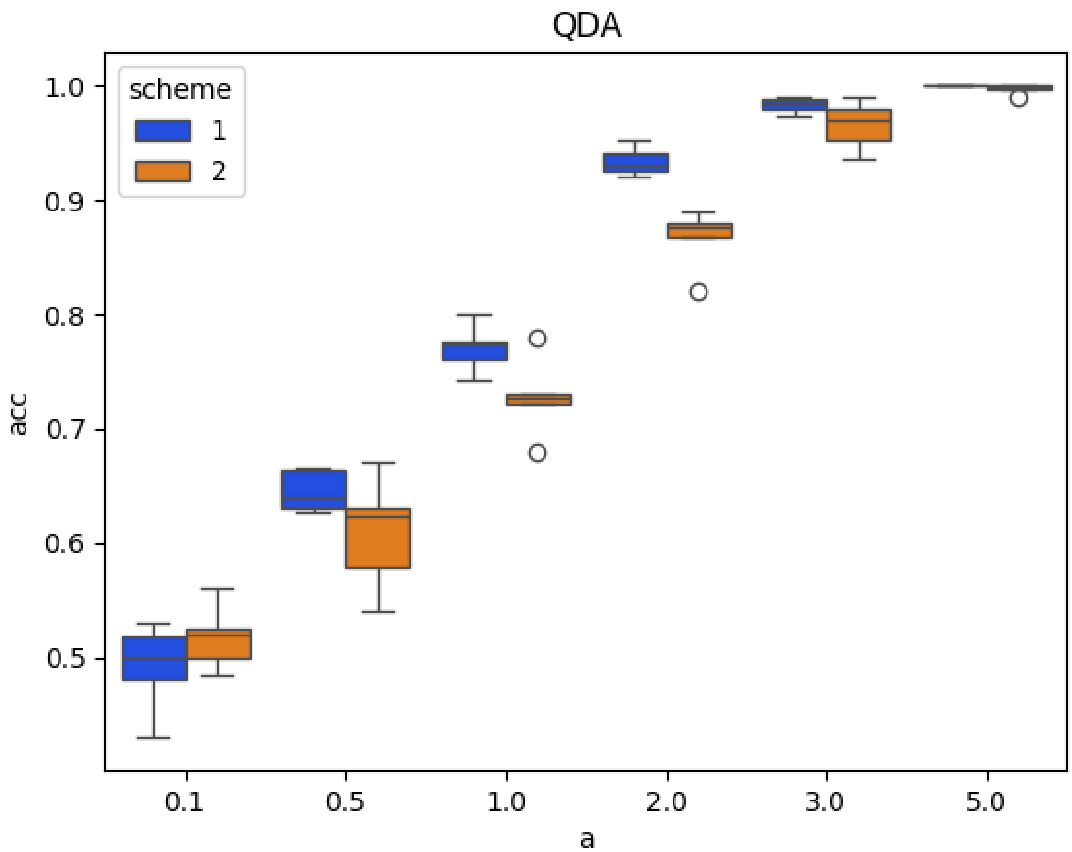

```
sns.boxplot(x="a", y="acc", hue="scheme", data=lda_df,
palette="bright").set_title("LDA")
```

```
Text(0.5, 1.0, 'LDA')
```




```
sns.boxplot(x="a", y="acc", hue="scheme", data=qda_df,
palette="bright").set_title("QDA")
```

```
Text(0.5, 1.0, 'QDA')
```



In all cases we can see, that the higher a is, the better performances are done by all the models.
In all the cases accuracy is much higher when the dataset was generated with scheme no.1.