ANALYTICS III Iris Dataset - Naive Bayes Theorem

In [3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.datasets import load_iris
```

Load dataset

In [9]:
```
iris_data = load_iris(as_frame = True)
```

In [13]:
```
x = pd.DataFrame(iris['data'], columns=iris['feature_names'])
y = pd.DataFrame(iris['target'], columns=['target'])
```

In [14]:
```
x.head()
```

Out[14]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)
0	5.1	3.5	1.4	0.2
1	4.9	3.0	1.4	0.2
2	4.7	3.2	1.3	0.2
3	4.6	3.1	1.5	0.2
4	5.0	3.6	1.4	0.2

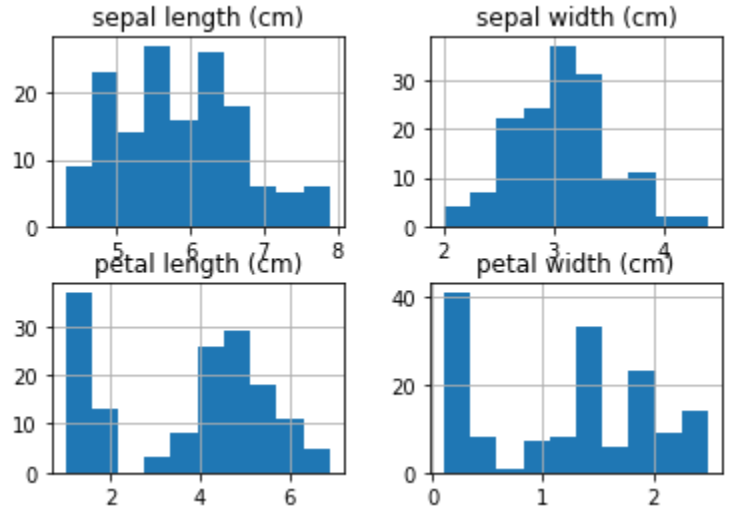
In [15]:
```
y.head()
```

Out[15]:

	target
0	0
1	0
2	0
3	0
4	0

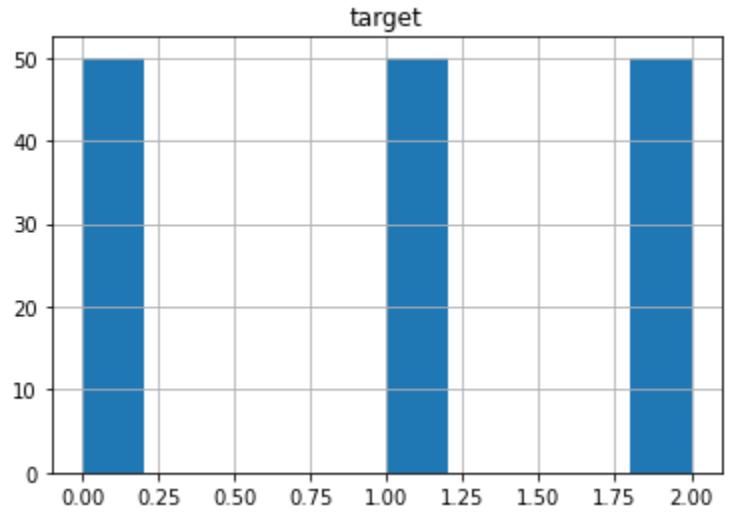
In [17]:
```
x.hist()
```

Out[17]:
```
array([[<AxesSubplot:title={'center':'sepal length (cm)'}>,
        <AxesSubplot:title={'center':'sepal width (cm)'}>],
       [<AxesSubplot:title={'center':'petal length (cm)'}>,
        <AxesSubplot:title={'center':'petal width (cm)'}>]], dtype=object)
```



In [18]:
```
y.hist()
```

Out[18]:
```
array([[<AxesSubplot:title={'center':'target'}>]], dtype=object)
```



Train Test Split

In [56]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.25, random_state=1
```

In [57]:
```
## Feature Scaling
```

In [58]:
```
from sklearn.preprocessing import StandardScaler
std_scaler = StandardScaler()
```

In [59]:
```
std_scaler.fit_transform(x_train,x_test)
```

Out[59]:
```
array([[-0.99152669,  1.96872963, -1.22808711, -1.22657149],
       [-1.11223429,  0.96303878, -1.40503277, -1.22657149],
       [ 1.18121006,  0.20877065,  0.65933322,  1.36285721],
       [-1.23294189, -1.55118834, -0.40234072, -0.40885716],
       [ 0.09484168, -0.79692021,  0.65933322,  0.40885716],
       [-1.59506468,  1.46588421, -1.75892408, -1.49914293],
       [ 2.14687084, -1.04834292,  1.72100716,  1.36285721],
       [ 0.21554928, -0.04265207,  0.36442379,  0.13628572],
       [-1.11223429, -1.80261106, -0.40234072, -0.40885716],
       [ 0.33625688, -2.05403377,  0.30544191,  0.27257144],
       [-0.02586591, -0.04265207,  0.12849625,  0.27257144],
       [-0.38798871, -0.54549749,  0.54136945,  0.95400005],
```

```
[ 0.93979487,  0.20877065,  0.42340568,  0.27257144],
[ 0.93979487, -0.04265207,  0.7183151 ,  1.36285721],
[ 0.93979487,  0.71161607,  1.01322453,  1.63542865],
[-0.8708191 ,  1.2144615 , -1.46401465, -1.49914293],
[ 1.18121006,  0.20877065,  0.83627887,  1.09028577],
[-0.5086963 ,  1.2144615 , -1.58197843, -1.49914293],
[-0.14657351, -1.04834292,  0.01053248, -0.13628572],
[ 2.14687084, -0.54549749,  1.60304338,  0.95400005],
[ 2.38828604,  1.96872963,  1.42609773,  0.95400005],
[ 0.57767207,  0.46019336,  0.77729699,  1.36285721],
[-0.38798871, -0.79692021,  0.12849625,  0.        ],
[-0.26728111, -1.04834292, -0.28437695, -0.40885716],
[-0.5086963 , -1.29976563,  0.01053248,  0.        ],
[-1.47435708,  0.46019336, -1.58197843, -1.49914293],
[-1.35364949, -0.04265207, -1.52299654, -1.36285721],
[-0.6294039 ,  1.71730692, -1.46401465, -1.49914293],
[-0.6294039 , -0.04265207,  0.30544191,  0.27257144],
[ 0.45696448, -0.79692021,  0.54136945,  0.6814286 ],
[ 0.57767207, -0.54549749,  0.95424265,  1.09028577],
[-0.99152669,  0.96303878, -1.46401465, -1.49914293],
[ 1.06050246,  0.46019336,  1.1311883 ,  1.36285721],
[-0.5086963 , -1.55118834, -0.10743129, -0.27257144],
[-0.99152669,  1.71730692, -1.46401465, -1.22657149],
[ 0.21554928, -0.54549749,  0.42340568, -0.13628572],
[-0.26728111, -0.54549749,  0.06951436,  0.        ],
[-1.59506468,  0.46019336, -1.52299654, -1.49914293],
[ 0.09484168, -0.04265207,  0.48238756,  0.6814286 ],
[ 0.33625688,  0.96303878,  0.83627887,  1.36285721],
[-1.35364949, -0.04265207, -1.52299654, -1.63542865],
[ 0.69837967, -0.04265207,  1.07220642,  1.22657149],
[ 0.81908727, -0.29407478,  0.36442379,  0.        ],
[ 2.14687084, -0.04265207,  1.24915207,  1.36285721],
[-1.11223429,  0.71161607, -1.52299654, -1.49914293],
[-0.14657351, -0.54549749,  0.65933322,  1.49914293],
[ 0.33625688, -0.54549749,  0.48238756,  0.6814286 ],
[-0.26728111, -0.29407478,  0.12849625,  0.        ],
[ 2.02616325, -0.04265207,  1.5440615 ,  1.09028577],
[-1.83647988,  0.46019336, -1.58197843, -1.49914293],
[-0.14657351, -0.79692021,  0.06951436, -0.40885716],
[-0.5086963 , -1.55118834, -0.16641318, -0.40885716],
[ 0.57767207,  0.46019336,  0.30544191,  0.27257144],
[-0.26728111, -0.04265207,  0.12849625, -0.13628572],
[-1.11223429,  1.2144615 , -1.58197843, -1.36285721],
[ 1.54333285, -0.04265207,  1.07220642,  0.40885716],
[-0.6294039 ,  2.22015235, -1.58197843, -1.22657149],
[-1.71577228, -1.80261106, -1.58197843, -1.36285721],
[ 0.21554928, -0.29407478,  0.42340568,  0.13628572],
[-0.8708191 , -0.79692021, -0.04844941,  0.13628572],
[-1.35364949,  0.20877065, -1.40503277, -1.49914293],
[ 1.18121006,  0.46019336,  1.01322453,  1.36285721],
[-0.8708191 ,  2.72299777, -1.46401465, -1.63542865],
[-0.26728111, -0.54549749,  0.30544191,  0.        ],
[-0.6294039 ,  0.96303878, -1.46401465, -1.22657149],
[-0.02586591, -0.04265207,  0.65933322,  0.6814286 ],
[ 0.21554928, -0.54549749,  0.01053248,  0.        ],
[ 1.06050246, -0.04265207,  0.89526076,  1.09028577],
[ 0.57767207, -0.29407478,  0.18747814,  0.        ],
[ 0.69837967, -0.04265207,  0.89526076,  0.6814286 ],
[ 0.57767207, -0.54549749,  0.95424265,  1.22657149],
[ 0.21554928, -0.04265207,  0.54136945,  0.6814286 ],
[-0.38798871, -0.04265207,  0.06951436,  0.        ],
[-0.26728111, -1.29976563,  0.60035133,  0.95400005],
[ 0.45696448, -0.54549749,  0.65933322,  0.27257144],
[-0.38798871, -0.04265207,  0.30544191,  0.27257144],
[-0.14657351,  2.47157506, -1.64096031, -1.49914293],
[-1.35364949,  0.96303878, -1.22808711, -1.49914293],
```

```
       [ 0.93979487,  0.71161607,  1.01322453,  1.09028577],
       [-0.8708191 ,  0.96303878, -1.52299654, -1.49914293],
       [-1.11223429, -2.55687919, -0.28437695, -0.40885716],
       [ 1.30191766,  0.46019336,  0.42340568,  0.13628572],
       [-0.14657351, -0.79692021, -0.04844941, -0.13628572],
       [-1.59506468,  0.96303878, -1.52299654, -1.36285721],
       [ 0.57767207,  0.20877065,  0.89526076,  0.6814286 ],
       [ 0.45696448, -1.29976563,  0.54136945,  0.27257144],
       [-0.99152669, -1.29976563, -0.57928637, -0.27257144],
       [-1.83647988, -0.29407478, -1.52299654, -1.49914293],
       [ 1.42262526, -0.04265207,  1.1311883 ,  1.09028577],
       [-0.6294039 ,  2.22015235, -1.34605088, -1.22657149],
       [ 0.57767207, -0.79692021,  0.77729699,  0.81771432],
       [-1.23294189, -1.29976563,  0.30544191,  0.54514288],
       [ 0.93979487,  0.20877065,  0.95424265,  1.49914293],
       [-1.11223429,  0.46019336, -1.64096031, -1.49914293],
       [ 0.81908727, -0.04265207,  0.24646002,  0.13628572],
       [ 0.45696448, -1.80261106,  0.24646002,  0.        ],
       [-0.14657351, -0.79692021,  0.65933322,  0.81771432],
       [ 0.21554928, -1.04834292,  0.95424265,  0.13628572],
       [ 1.06050246, -0.54549749,  0.48238756,  0.13628572],
       [ 0.69837967,  0.46019336,  0.65933322,  0.95400005],
       [ 2.14687084,  1.96872963,  1.60304338,  1.22657149],
       [ 1.66404045, -0.29407478,  1.36711584,  0.6814286 ],
       [-1.11223429, -0.04265207, -1.40503277, -1.49914293],
       [ 0.93979487, -0.04265207,  0.60035133,  0.54514288],
       [-0.02586591,  0.46019336,  0.48238756,  0.6814286 ],
       [-1.23294189,  0.20877065, -1.46401465, -1.49914293],
       [ 0.09484168,  0.96303878,  0.30544191,  0.40885716],
       [ 1.18121006,  0.20877065,  0.54136945,  0.27257144],
       [ 0.93979487, -1.29976563,  1.07220642,  0.6814286 ],
       [-1.23294189, -0.04265207, -1.52299654, -1.49914293],
       [ 0.45696448,  0.71161607,  0.42340568,  0.40885716],
       [ 0.45696448,  0.96303878,  0.95424265,  1.49914293]])
```

In [60]:
```
## Data is distributed normally hence Gaussian Dataset
from sklearn.naive_bayes import GaussianNB
model = GaussianNB()
model.fit(x_train,y_train)
```

```
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/utils/validation.py:993: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

Out[60]:
```
GaussianNB()
```

In [61]:
```
y_predict = model.predict(x_test)
```

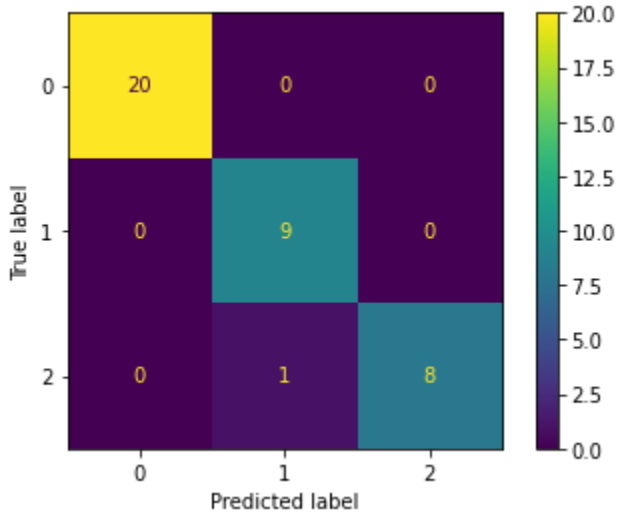
In [62]:
```
y_predict
```

Out[62]:
```
array([0, 0, 2, 2, 0, 0, 0, 0, 1, 0, 0, 1, 2, 2, 0, 0, 0, 0, 0, 1, 0, 0,
       1, 1, 0, 0, 2, 0, 1, 1, 1, 0, 0, 2, 2, 1, 1, 2])
```

In [126…
```
#y_test
# for i in range(len(y_predict)):
#       print(y_test[i],y_predict[i])
```

Confusion Matrix

In [125…
```
from sklearn.metrics import confusion_matrix,ConfusionMatrixDisplay
cm = confusion_matrix(y_test,y_predict)
cm_d = ConfusionMatrixDisplay(cm).plot()
```



Accuracy, Precision

In [124…
```
from sklearn.metrics import accuracy_score,precision_score,recall_score
```

In [65]:
```
acc_score = accuracy_score(y_test,y_predict)
acc_score
```

Out[65]:
```
0.9736842105263158
```

In [66]:
```
prec_score = precision_score(y_test,y_predict,average='macro')
prec_score
```

Out[66]:
```
0.9666666666666667
```

User Input

In [74]:
```
X_new = np.array([[3, 2, 1, 0.2], [  4.9, 2.2, 3.8, 1.1 ], [  5.3, 2.5, 4.6, 1.9 ]])
```

In [75]:
```
prediction = model.predict(X_new)
print("Prediction of Species: {}".format(prediction))
```

```
Prediction of Species: [0 1 1]
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but GaussianNB was fitted with feature names
  warnings.warn(
```

In [82]:
```
new_data = np.array([[2.5,3.6,4.2,1.2]])
new_data = std_scaler.fit_transform(new_data)
print(model.predict(new_data))
```

```
[1]
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but GaussianNB was fitted with feature names
  warnings.warn(
```

In [89]:
```
new_data = np.array([[2.5,3.6,4.2,1.2]])
s_ff = std_scaler.fit(x_train)
new_data = s_ff.transform(new_data)
print(model.predict(new_data))
```

```
[2]
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
```

```
does not have valid feature names, but StandardScaler was fitted with feature names
  warnings.warn(
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but GaussianNB was fitted with feature names
  warnings.warn(
```

In [92]:
```
new_data = np.array([[5.1,3.5,1.4,0.2]])
s_ff = std_scaler.fit(x_train)
new_data = s_ff.transform(new_data)
print(model.predict(new_data))
```

```
[2]
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but StandardScaler was fitted with feature names
  warnings.warn(
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but GaussianNB was fitted with feature names
  warnings.warn(
```

In [109…
```
new_d = np.array([[2,3,6,1.2]])
new_d = std_scaler.fit_transform(new_d)
print(model.predict(new_d))
```

```
[1]
/home/student/anaconda3/lib/python3.9/site-packages/sklearn/base.py:450: UserWarning: X
does not have valid feature names, but GaussianNB was fitted with feature names
  warnings.warn(
```

In [ ]:
```
```