1.Importing Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.axes as ax

from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import confusion_matrix,accuracy_score

import seaborn as sns
```

2.Loading Data

In [2]:
```
data = pd.read_csv(r'C:\Users\G.SAI KRISHNA\Desktop\ML_Projects\ML_GFG\9.Naive Bayes Classi
data.head()
```

Out[2]:

	repetition_time	study_time	knowledge_level
0	0.00	0.00	Low
1	0.24	0.90	High
2	0.25	0.33	Low
3	0.65	0.30	High
4	0.98	0.24	Low

In [3]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 258 entries, 0 to 257
Data columns (total 3 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   repetition_time  258 non-null    float64
 1   study_time       258 non-null    float64
 2   knowledge_level  258 non-null    object 
dtypes: float64(2), object(1)
memory usage: 6.2+ KB
```

In [4]:
```
data.describe()
```

Out[4]:

	repetition_time	study_time
count	258.000000	258.000000
mean	0.432713	0.458539
std	0.248108	0.255211
min	0.000000	0.000000
25%	0.250000	0.250000
50%	0.330000	0.500000
75%	0.647500	0.660000
max	0.990000	0.930000

In [5]:
```
#Counting unique values
data['knowledge_level'].unique()
```

Out[5]:
```
array(['Low', 'High'], dtype=object)
```

In [6]:
```
data['knowledge_level'].value_counts()
```

Out[6]:
```
High    151
Low     107
Name: knowledge_level, dtype: int64
```

3.Data Splitting

In [7]:
```
x=data.drop(['knowledge_level'],axis=1)
y=data['knowledge_level']
```

In [8]:
```
x.head()
```

Out[8]:

	repetition_time	study_time
0	0.00	0.00
1	0.24	0.90
2	0.25	0.33
3	0.65	0.30
4	0.98	0.24

In [9]:
```
y.head()
```

Out[9]:
```
0     Low
1    High
2     Low
3    High
4     Low
Name: knowledge_level, dtype: object
```

In [10]:
```
y=pd.get_dummies(data,columns=['knowledge_level'])
```

In [11]:
```
y.head()
```

Out[11]:

	repetition_time	study_time	knowledge_level_High	knowledge_level_Low
0	0.00	0.00	0	1
1	0.24	0.90	1	0
2	0.25	0.33	0	1
3	0.65	0.30	1	0
4	0.98	0.24	0	1

4.Data Scaling

In [12]:
```
scaler_x = StandardScaler()
x = scaler_x.fit_transform(x)
x
```

```
       [ 0.67556045, -0.93648978],
       [-0.13210682,  1.45833598],
       [-1.22245762,  0.71240664],
       [-0.53594045,  0.24129338],
       [ 0.75632717, -1.01500866],
       [ 1.40246099,  1.57611429],
       [-1.02054081,  0.6731472 ],
       [-0.65709054, -0.81871146],
       [ 0.87747726, -0.81871146],
       [ 1.84667798,  1.65463317],
       [-1.34360771,  0.79092552],
       [-0.57632381, -0.66167371],
       [ 0.87747726,  1.73315205],
       [ 1.44284435, -0.03352269],
       [-1.38399108,  0.79092552],
       [-0.49555708,  0.1627745 ],
       [ 0.8370939 , -1.05426809],
       [ 1.96782807,  0.47685001],
       [-0.98015744,  0.55536889],
       [-0.57632381,  1.22277934]
```

5.Training & Testing Data

In [13]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y['knowledge_level_High'],test_size=0.3
```

In [14]:
```
x_train.shape
```

Out[14]:
```
(180, 2)
```

In [15]:
```
x_test.shape
```

Out[15]:
```
(78, 2)
```

In [16]:
```
y_train.shape
```

Out[16]:
```
(180,)
```

In [17]:
```
y_test.shape
```

Out[17]:
```
(78,)
```

6.Naive Bayes Classification

Training the Model

In [18]:
```
nvb = GaussianNB()
nvb.fit(x_train,y_train)
```

Out[18]:
```
GaussianNB()
```

Predicting Test Values

In [19]:
```
y_pred = nvb.predict(x_test)

y_pred
```

Out[19]:
```
array([1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0,
       1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0,
       1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0], dtype=uint8)
```

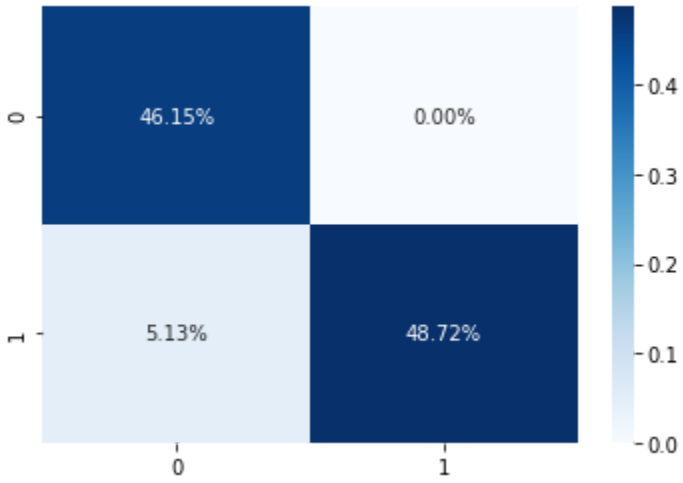
Visualizing Model Performance

In [20]:
```
cm = confusion_matrix(y_test,y_pred)
cm
```

Out[20]:
```
array([[36,  0],
       [ 4, 38]], dtype=int64)
```

In [21]:
```
sns.heatmap(cm/np.sum(cm), annot=True,fmt='.2%', cmap='Blues')
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2037de37400>
```



In [22]:
```
print("Accuracy : "+str(accuracy_score(y_test,y_pred)*100)+"%")
```

```
Accuracy : 94.87179487179486%
```

###

In [23]:
```
from matplotlib.colors import ListedColormap
x_set,y_set = x_test,y_test
x1,x2 = np.meshgrid(np.arange(start=x_set[:,0].min()-1,stop=x_set[:,0].max()+1,step=0.01),
                    np.arange(start=x_set[:,1].min()-1,stop=x_set[:,1].max()+1,step=0.01))
x1
```

Out[23]:
```
array([[-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202],
       [-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202],
       [-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202],
       ...,
       [-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202],
       [-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202],
       [-2.70705798, -2.69705798, -2.68705798, ...,  3.22294202,
         3.23294202,  3.24294202]])
```

In [24]:
```
x2
```

Out[24]:
```
array([[-2.76093799, -2.76093799, -2.76093799, ..., -2.76093799,
        -2.76093799, -2.76093799],
       [-2.75093799, -2.75093799, -2.75093799, ..., -2.75093799,
        -2.75093799, -2.75093799],
       [-2.74093799, -2.74093799, -2.74093799, ..., -2.74093799,
        -2.74093799, -2.74093799],
       ...,
       [ 2.58906201,  2.58906201,  2.58906201, ...,  2.58906201,
         2.58906201,  2.58906201],
       [ 2.59906201,  2.59906201,  2.59906201, ...,  2.59906201,
         2.59906201,  2.59906201],
       [ 2.60906201,  2.60906201,  2.60906201, ...,  2.60906201,
         2.60906201,  2.60906201]])
```

In [25]:
```
plt.contourf(x1,x2,nvb.predict(np.array([x1.ravel(),x2.ravel()]).T).reshape(x1.shape),alpha
plt.xlim(x1.min(),x1.max())
plt.ylim(x2.min(),x2.max())

for i,j in enumerate(np.unique(y_set)):
    plt.scatter(x_set[y_set == j,0],x_set[y_set == j,1],c=ListedColormap(('red','green'))(

plt.xlabel('r time')
plt.ylabel('s time')
plt.legend()
plt.show()
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as
value-mapping will have precedence in case its length matches with *x* & *y*.  Please use
the *color* keyword-argument or provide a 2-D array with a single row if you intend to sp
ecify the same RGB or RGBA value for all points.
*c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as
value-mapping will have precedence in case its length matches with *x* & *y*.  Please use
the *color* keyword-argument or provide a 2-D array with a single row if you intend to sp
ecify the same RGB or RGBA value for all points.
```