# Code & Expected Output

## (a) Rule Based Smart Home Automation Using Random Sensor Data

**[input:]**

```
#importing modules
import numpy as np
import pandas as pd
#defining perception input
def perception():
    temp=(np.random.rand()-0.5)*100 #temprature between -50 and 50
    hum=np.random.rand()*10 #humidity between 0 and 10
    opt=np.random.rand()*100 #light brightness 0 and 100
    return (temp,hum,opt)
def motion():
    return np.random.choice([0,1])
#logic for automation
def decision():
    t,h,l=perception()
    m=motion()
    if m==1:
        fan="on" if t>28.0 else "off"
        ac="on" if h>3.0 else "off"
        light="on" if l<50 else "off"
    else:
        ac,fan,light="off","off","off"
    print(f"Perception := Temprature : {t} , Humidity : {h} , Light : {l} , Motion : {m}")
    print(f"Action := fan : {fan} , ac : {ac} , light : {light}\n")
#simulation loop
for _ in range(2):
    decision()
```

**[output:]**

```
Perception := Temprature : -20.159077373637512 , Humidity : 3.590772314334979 , Light :
14.389360692155428 , Motion : 1
Action := fan : off , ac : on , light : on

Perception := Temprature : 9.587410809251484 , Humidity : 0.8042216512432565 , Light :
98.15730398862574 , Motion : 0
Action := fan : off , ac : off , light : off
```

## (b) Rule Based Smart Home Automation Using Sensor Data From CSV File

**[input:]**

```
#reading CSV File
d1=pd.read_csv("/content/drive/MyDrive/AIOT_3rd_sem/LABS_PRACTICALS/datatest.txt")

d2=pd.read_csv("/content/drive/MyDrive/AIOT_3rd_sem/LABS_PRACTICALS/datatest2.txt")

d3=pd.read_csv("/content/drive/MyDrive/AIOT_3rd_sem/LABS_PRACTICALS/datatraining.txt")

#concating data
df=pd.DataFrame(pd.concat([d1,d2,d3], ignore_index=True))

#first three data rows
df.head(3)
```

**[output:]**

| | date | Temperature | Humidity | Light | CO2 | HumidityRatio | Occupancy |
|---|---|---|---|---|---|---|---|
| **0** | 2015-02-02 14:19:00 | 23.700 | 26.272 | 585.200000 | 749.200000 | 0.004764 | 1 |
| **1** | 2015-02-02 14:19:59 | 23.718 | 26.290 | 578.400000 | 760.400000 | 0.004773 | 1 |
| **2** | 2015-02-02 14:21:00 | 23.730 | 26.230 | 572.666667 | 769.666667 | 0.004765 | 1 |

**[input:]**

```
#defining perception input
def csv_percept(i):
  temp=df.iloc[i,1]
  hum=df.iloc[i,2]
  opt=df.iloc[i,3]
  return (temp,hum,opt)
def csv_motion(i):
  return df.iloc[i,6]
```

**[input:]**

```
def csv_decision(i):
    t,h,l=csv_percept(i)
    m=csv_motion(i)
    if m==1:
        fan="on" if t>23.0 else "off"
        ac="on" if h>30.0 else "off"
        light="on" if l<400.0 else "off"
    else:
        ac,fan,light="off","off","off"
    print(f"Perception := Temprature : {t} , Humidity : {h} , Light : {l} , Motion : {m}")
    print(f"Action := fan : {fan} , ac : {ac} , light : {light}\n")
#simulation loop
for i in range(10):
    csv_decision(i)
```

**[output:]**

```
Perception := Temprature : 23.7 , Humidity : 26.272 , Light : 585.2 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.718 , Humidity : 26.29 , Light : 578.4 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.73 , Humidity : 26.23 , Light : 572.666666666667 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.7225 , Humidity : 26.125 , Light : 493.75 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.754 , Humidity : 26.2 , Light : 488.6 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.76 , Humidity : 26.26 , Light : 568.666666666667 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.73 , Humidity : 26.29 , Light : 536.333333333333 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.754 , Humidity : 26.29 , Light : 509.0 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.754 , Humidity : 26.35 , Light : 476.0 , Motion : 1
Action := fan : on , ac : off , light : off

Perception := Temprature : 23.736 , Humidity : 26.39 , Light : 510.0 , Motion : 1
Action := fan : on , ac : off , light : off
```

## (c) Learning Occupancy From Sensor's Data And Applying Rule Based Smart Home Automation

**[input:]**

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn import svm
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
```

**[input:]**

```
#splitting features and target
x=np.array(df.iloc[:,1:6]).reshape(len(df),5)
y=np.array(df.iloc[:,6]).reshape(len(df),)
#splitting test-train split
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.2,random_state=42)
#for comparison
model_auc_comp, cm_comp ={},[]
```

**[input:]**

```
#trainging logistic regression model
logR=LogisticRegression(random_state=72)
logR.fit(np.array(xtrain),np.array(ytrain))
```

**[output:]**

```
LogisticRegression
LogisticRegression(random_state=72)
```

**[input:]**

```
model_auc_comp["LogisticRegression"]=accuracy_score(logR.predict(np.array(xtest)),ytest)
*100
cm_comp.append(confusion_matrix(ytest,logR.predict(np.array(xtest))))
#printing accuracy score
print("Training Accuracy (Logistic Regression):
",accuracy_score(logR.predict(np.array(xtrain)),ytrain)*100)
#printing accuracy score
print("Testing Accuracy (Logistic Regression) :
",accuracy_score(logR.predict(np.array(xtest)),ytest)*100)
```

**[output:]**

```
Training Accuracy (Logistic Regression):  98.93604085603113
Testing Accuracy (Logistic Regression) :  98.75972762645915
```

**[input:]**

```
decT=DecisionTreeClassifier(random_state=72)
decT.fit(np.array(xtrain),np.array(ytrain))
```

**[output:]**

```
DecisionTreeClassifier
DecisionTreeClassifier(random_state=72)
```

**[input:]**

```
model_auc_comp["DecisionTree"]=accuracy_score(decT.predict(np.array(xtest)),ytest)*100
cm_comp.append(confusion_matrix(ytest,decT.predict(np.array(xtest))))
print("Training Accuracy (Decision Tree):
",accuracy_score(decT.predict(np.array(xtrain)),ytrain)*100)
print("Testing Accuracy (Decision Tree) :
",accuracy_score(decT.predict(np.array(xtest)),ytest)*100)
```

**[output:]**

```
Training Accuracy (Decision Tree):  100.0
Testing Accuracy (Decision Tree) :  98.9056420233463
```

**[input:]**

```
ranF=RandomForestClassifier(n_estimators=100,random_state=72)
ranF.fit(np.array(xtrain),np.array(ytrain))
```

**[output:]**

```
RandomForestClassifier
RandomForestClassifier(random_state=72)
```

**[input:]**

```
model_auc_comp["RandomForest"]=accuracy_score(ranF.predict(np.array(xtest)),ytest)*100
cm_comp.append(confusion_matrix(ytest,ranF.predict(np.array(xtest))))
#printing accuracy score
print("Training Accuracy (Random Forest):
",accuracy_score(ranF.predict(np.array(xtrain)),ytrain)*100)
#printing accuracy score
print("Testing Accuracy (Random Forest) :
",accuracy_score(ranF.predict(np.array(xtest)),ytest)*100)
```

**[input:]**

```
#creating a token generator using custom dictionary
chinese_tokens_generator= jieba.cut(ctext)
chinese_tokens_generator
```

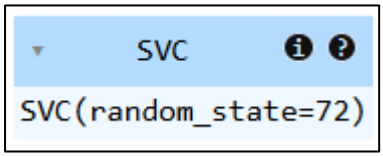
**[output:]**

```
Training Accuracy (Random Forest):  100.0
Testing Accuracy (Random Forest) :  99.19747081712063
```

**[input:]**

```
svmC=svm.SVC(random_state=72)
svmC.fit(np.array(xtrain),np.array(ytrain))
```

**[output:]**




**[input:]**

```
model_auc_comp["SuppourtVector"]=accuracy_score(svmC.predict(np.array(xtest)),ytest)*1
00
cm_comp.append(confusion_matrix(ytest,svmC.predict(np.array(xtest))))
#printing accuracy score
print("Training Accuracy (Suppourt Vector):
",accuracy_score(svmC.predict(np.array(xtrain)),ytrain)*100)
#printing accuracy score
print("Testing Accuracy (Suppourt Vector) :
",accuracy_score(svmC.predict(np.array(xtest)),ytest)*100)
```

**[output:]**

```
Training Accuracy (Suppourt Vector):  98.9238813229572
Testing Accuracy (Suppourt Vector) :  98.784046692607
```

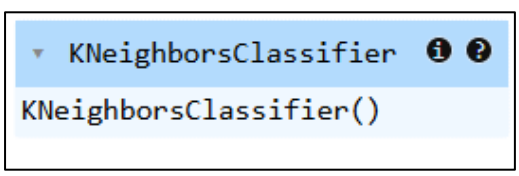
**[input:]**

```
scaler=StandardScaler()
xtrains=scaler.fit_transform(xtrain)
xtests=scaler.transform(xtest)
```

**[input:]**

```
knnC=KNeighborsClassifier(n_neighbors=5)
knnC.fit(np.array(xtrains),np.array(ytrain))
```

**[output:]**



**[input:]**

```
model_auc_comp["KNN"]=accuracy_score(knnC.predict(np.array(xtests)),ytest)*100
cm_comp.append(confusion_matrix(ytest,logR.predict(np.array(xtests))))
#printing accuracy score
print("Training Accuracy (KNN):
",accuracy_score(knnC.predict(np.array(xtrains)),ytrain)*100)
#printing accuracy score
print("Testing Accuracy (KNN) :
",accuracy_score(knnC.predict(np.array(xtests)),ytest)*100)
```

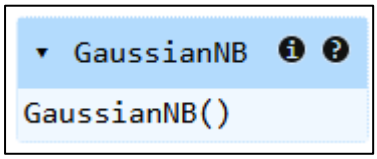
**[output:]**

```
Training Accuracy (KNN):  99.51969844357976
Testing Accuracy (KNN) :  99.00291828793775
```

**[input:]**

```
naiB=GaussianNB()
naiB.fit(np.array(xtrain),np.array(ytrain))
```

**[output:]**




**[input:]**

```
model_auc_comp["NaiveBayes"]=accuracy_score(naiB.predict(np.array(xtest)),ytest)*100
cm_comp.append(confusion_matrix(ytest,naiB.predict(np.array(xtest))))
#printing accuracy score
print("Training Accuracy (Naive Bayes):
",accuracy_score(naiB.predict(np.array(xtrain)),ytrain)*100)
#printing accuracy score
print("Testing Accuracy (Naive Bayes) :
",accuracy_score(naiB.predict(np.array(xtest)),ytest)*100)
```

**[output:]**

```
Training Accuracy (Naive Bayes):  96.78988326848248
Testing Accuracy (Naive Bayes) :  96.03599221789884
```

**[input:]**

```
#finding best classifier
clf=""
max_auc=0.0
for k in model_auc_comp.keys():
    if model_auc_comp[k]>max_auc:
        max_auc=model_auc_comp[k]
        clf=k
print("Best classifier = ",clf)
```

**[output:]**

```
Best classifier =  RandomForest
```

**[input:]**

```
#predicting on test data
ypred=ranF.predict(np.array(xtest))
ypred.shape
```

**[output:]**

```
(4112,)
```

**[input:]**

```
#defining perception input
def csv_predict_percept(i):
    temp=xtest[i,1]
    hum=xtest[i,2]
    opt=xtest[i,3]
    return (temp,hum,opt)
def csv_predict_motion(i):
    return ranF.predict(xtest[i].reshape(1, -1))[0]
```

**[input:]**

```
#logic for automation
def csv_predict_decision(i):
    t,h,l=csv_predict_percept(i)
    m=csv_predict_motion(i)
    if m==1:
        fan="on" if t>23.0 else "off"
        ac="on" if h>30.0 else "off"
        light="on" if l<400.0 else "off"
    else:
        ac,fan,light="off","off","off"
    print(f"Perception := Temprature : {t} , Humidity : {h} , Light : {l} , Motion : {m}")
    print(f"Action := fan : {fan} , ac : {ac} , light : {light}\n")
for i in range(10): #simulation loop
    csv_predict_decision(i)
```

**[output:]**

```
Perception := Temprature : 30.6333333333333 , Humidity : 6.0 , Light : 430.0 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 31.29 , Humidity : 0.0 , Light : 511.0 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 30.745 , Humidity : 0.0 , Light : 1119.5 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 27.0 , Humidity : 24.0 , Light : 423.333333333333 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 24.1 , Humidity : 0.0 , Light : 617.0 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 28.2 , Humidity : 0.0 , Light : 852.25 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 33.0 , Humidity : 0.0 , Light : 446.333333333333 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 19.5333333333333 , Humidity : 0.0 , Light : 479.333333333333 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 28.7 , Humidity : 326.5 , Light : 635.25 , Motion : 0
Action := fan : off , ac : off , light : off

Perception := Temprature : 31.39 , Humidity : 0.0 , Light : 507.0 , Motion : 0
Action := fan : off , ac : off , light : off
```

## Models Comparison

```
import matplotlib.pyplot as plt
models = list(model_auc_comp.keys())
auc_scores = list(model_auc_comp.values())
max_score, colors = max(auc_scores), plt.cm.viridis(np.linspace(0, 1, len(models)))
plt.figure(figsize=(9, 6))
bars = plt.bar(models, auc_scores, color=colors, edgecolor='black', linewidth=0.1,
alpha=0.85)
for bar, score in zip(bars, auc_scores):
    plt.text(bar.get_x() + bar.get_width()/2., bar.get_height() + 0.05, f'{score:.2f}%',
            ha='center', va='bottom', fontsize=10, fontweight='bold')
plt.title('Model Comparison - Accuracy Scores', fontsize=16, fontweight='bold', pad=20)
plt.ylabel('Accuracy (%)', fontsize=13, fontweight='semibold', labelpad=10)
plt.grid(True, axis='y', alpha=0.3, linestyle='--')
plt.ylim(min(auc_scores)-1, 100)
plt.axhline(y=max_score, color='red', linestyle='--', alpha=0.5, linewidth=1,  label=f'Max
Accuracy: {max_score:.2f}%')
plt.legend(loc='upper right', fontsize=10)
plt.text(0.02, 0.98, f'Mean: {np.mean(auc_scores):.2f}%\nStd Dev:
{np.std(auc_scores):.2f}%', transform=plt.gca().transAxes, fontsize=10,
verticalalignment='top',  bbox=dict(boxstyle='round', facecolor='wheat', alpha=0.8))
plt.tight_layout()
plt.show()
```