PRACTICAL NUMBER: 1

Aim: Design an Expert system using AIML

E.g: An expert system for responding the patient query for identifying the flu.

Code:

```
import aiml


kernel=aiml.Kernel()
kernel.learn("std-startup.xml")
kernel.respond("load aiml b")


while True:
   input_text=input(">Human:")
   response=kernel.respond(input_text)
   print(">Bot: "+response)
```

std-startup.xml

```
<aiml version="2.0" encoding="UTF-8">
        <!-- std-startup.xml -->
        <category>
                <!-- Pattern to match in user imput -->
                <!-- If user enters "Load AIML B" -->
                <pattern>LOAD AIML B</pattern>


                <!-- Template is the response to the pattern -->
                <!-- This learns an aiml file -->
                <template>
                        <learn>basic_chat.aiml</learn>
                        <!-- You can add more aiml files here -->
                        <!--<learn>more_aiml.aiml</learn>-->
```

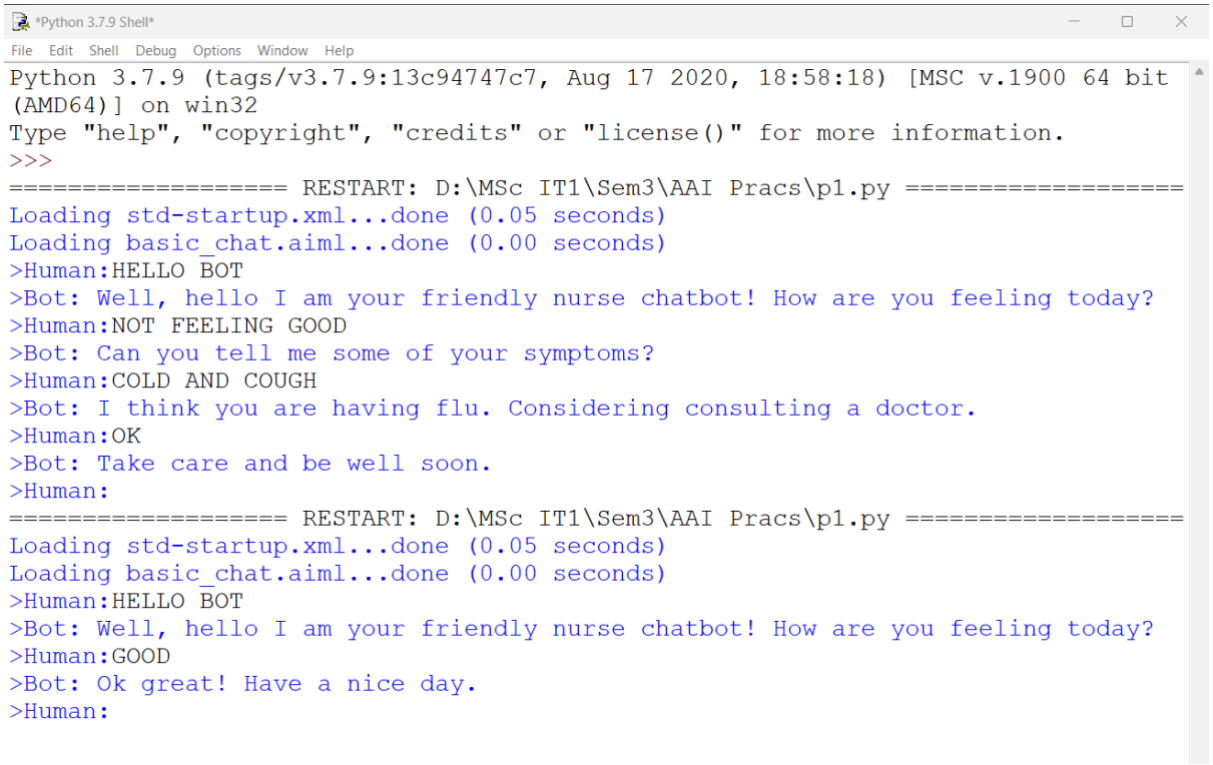
```
        </template>
    </category>
</aiml>
```

basic_chat.aiml

```
<aiml version="1.0.1" encoding="UTF-8">
<!-- basic_chat.aiml -->

    <category>
        <pattern>HELLO *</pattern>
        <template>
            Well, hello I am your friendly nurse chatbot!
            How are you feeling today?
        </template>
    </category>

    <category>
        <pattern>GOOD</pattern>
        <template>
            Ok great! Have a nice day.
        </template>
    </category>

    <category>
        <pattern>NOT FEELING GOOD</pattern>
        <template>
            Can you tell me some of your symptoms?
        </template>
    </category>
```

```
        <category>
            <pattern>COLD AND COUGH</pattern>
            <template>
                I think you are having flu. Considering consulting a doctor.
            </template>
        </category>
        <category>
            <pattern>OK</pattern>
            <template>
                Take care and be well soon.
            </template>
        </category>
</aiml>
```

Output:



PRACTICAL NUMBER: 2

Aim: Design a bot using AIML.

Code:

```
import aiml
kernel = aiml.Kernel()
kernel.learn("std2-startup.xml")
kernel.respond ("load prac 2")

while True:
    input_text = input("> Human: ")
    response = kernel.respond(input_text)
    print("> Bot: "+response)
```

std2-startup.xml

```
<aiml version="1.0.1" encoding="UTF-8">
 <!--std-startup.xml -->
 <category>
   <!-- Pattern to match in user input -->
   <!-- If user enters "LOAD AIML B" -->
   <pattern>LOAD PRAC 2</pattern>
   <!-- Template is the response to the pattern -->
   <!-- This learn an aiml file -->
   <template>
     <learn>prac2_chat.aiml</learn>
     <!-- You can add more aiml files here --> <!--<learn>more_aiml.aiml</learn>-->
   </template>
 </category>
```

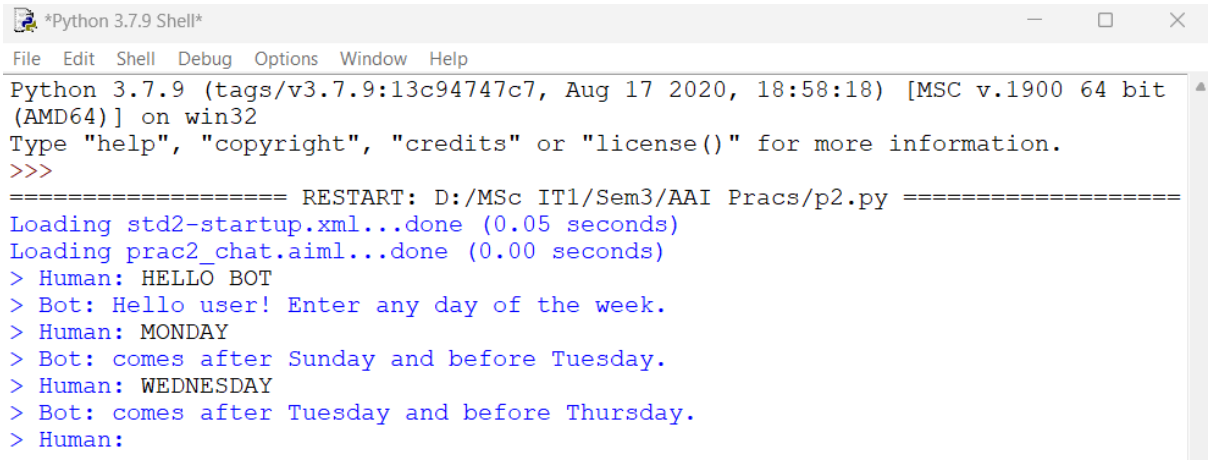
```
</aiml>
```

prac2_chat.aiml

```
<aiml version="1.0.1" encoding="UTF-8">
<!-- prac2_chat.aiml -->
<category>
                <pattern> HELLO * </pattern>
                <template>
                    Hello user! Enter any day of the week.
                </template>
</category>
<category>
                <pattern>SUNDAY</pattern>
                <template>comes after Saturday and before Monday.</template>
</category>
<category>
                <pattern>MONDAY</pattern>
                <template>comes after Sunday and before Tuesday.</template>
</category>
<category>
                <pattern>TUESDAY</pattern>
                <template>comes after Monday and before Wednesday.</template>
</category>
<category>
                <pattern>WEDNESDAY</pattern>
                <template>comes after Tuesday and before Thursday.</template>
</category>
<category>
                <pattern>THURSDAY</pattern>
```

```
        <template>comes after Wednesday and before Friday.</template>
</category>
<category>
        <pattern>FRIDAY</pattern>
        <template>comes after Thursday and before Saturday.</template>
</category>
<category>
        <pattern>SATURDAY</pattern>
        <template>comes after Friday and before Sunday.</template>
</category>
</aiml>
```

Output:



PRACTICAL NUMBER: 3

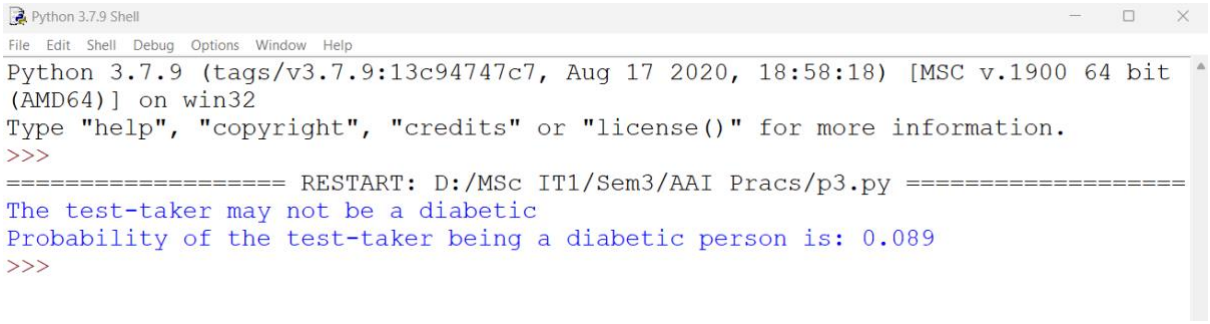
Aim: Implement Bayes Theorem using Python.

Code:

```
def diabetes_prob(
    prob_th=0.8,
    sensitivity=0.79,
    specificity=0.79,
    prevelance=0.02,
    verbose=True):

    #Computes the posterior using Bayes rule
    p_user=prevelance
    p_non_user=1-prevelance
    p_pos_user=sensitivity
    p_neg_user=specificity
    p_pos_non_user=1-specificity

    num=p_pos_user*p_user
    den=p_pos_user*p_user+p_pos_non_user*p_non_user

    prob=num/den
    if verbose:
        if prob>prob_th:
            print("The test-taker could be diabetic")
        else:
            print("The test-taker may not be a diabetic")
    return prob
p=diabetes_prob(prob_th=0.5,sensitivity=0.97,specificity=0.95,prevelance=0.005)
```

print("Probability of the test-taker being a diabetic person is:",round(p,3))

Output:



PRACTICAL NUMBER: 4

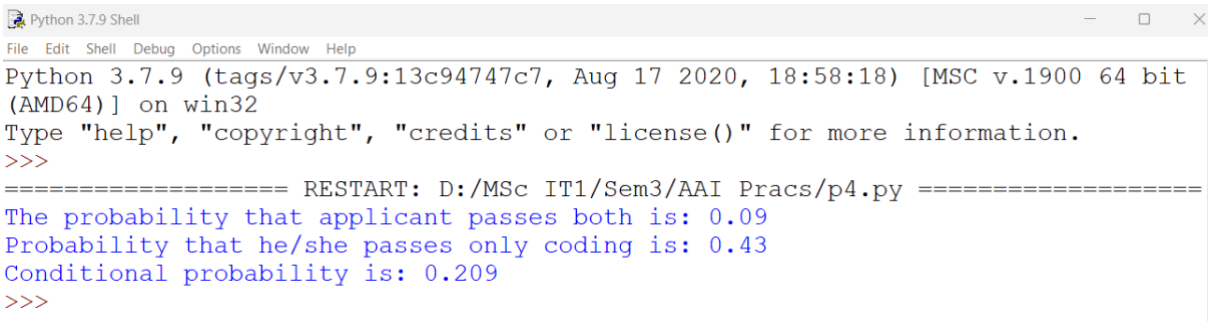
Aim: Implement Conditional Probability and joint probability using Python.

Code:

Conditional probability:

```
def conditional():
    pass_stats=0.15
    pass_codingWStats=0.60
    pass_codingWOStats=0.40
    prob_both=pass_stats*pass_codingWStats
    print("The probability that applicant passes both is:",round(prob_both,3))
    prob_coding=(prob_both)+((1-pass_stats)*pass_codingWOStats)
    print("Probability that he/she passes only coding is:",round(prob_coding,3))
    stats_given_coding=prob_both/prob_coding
    print("Conditional probability is:",round(stats_given_coding,3))


conditional()
```

Output:

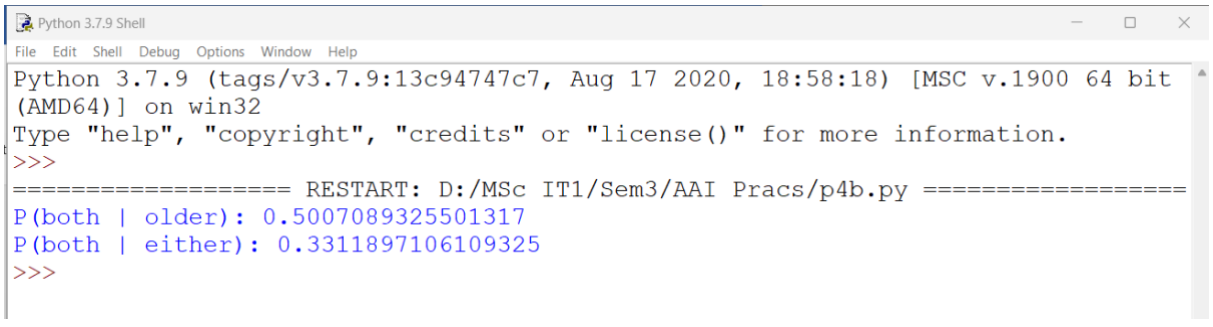


Joint probability:

```
import enum, random

class Kid(enum.Enum):
    BOY = 0
    GIRL = 1

def random_kid() -> Kid:
```

```
    return random.choice([Kid.BOY, Kid.GIRL])

# We create variables representing joint distributions; one variable for both children being girls (both_girls), one variable for only the older child being a girl (older_girl), and one for at least one child being a girl (either_girl).

both_girls = 0

older_girl = 0

either_girl = 0

random.seed(0)

for _ in range(10000):

    younger = random_kid()

    older = random_kid()

    if older == Kid.GIRL:

        older_girl += 1

    if older == Kid.GIRL and younger == Kid.GIRL:

        both_girls += 1

    if older == Kid.GIRL or younger == Kid.GIRL:

        either_girl += 1

print("P(both | older):", both_girls / older_girl)

print("P(both | either):", both_girls / either_girl)
```

Output:



PRACTICAL NUMBER: 5

Aim: Write a program for to implement Rule based system.

Code:

```
import contextlib

import sys

from pyke import knowledge_engine

from pyke import krb_traceback


engine = knowledge_engine.engine(__file__)

def test():

   engine.reset()      # Allows us to run tests multiple times.

   engine.activate('simple_rules') #STUDENTS: you will need to edit the name of your rule file here

   print("doing proof")

   try:

      with engine.prove_goal('simple_rules.what_to_bring($bring)') as gen: #STUDENTS: you will need to edit this line

         for vars, plan in gen:

            print("You should bring: %s" % (vars['bring'])) #STUDENTS: you will need to edit this line

   except Exception:

      # This converts stack frames of generated python functions back to the

      # .krb file.

      krb_traceback.print_exc()

      sys.exit(1)

   print()

   print("done")

   #engine.print_stats()
```

```
def test_questions():
    engine.reset()      # Allows us to run tests multiple times.
    engine.activate('simple_rule_questions') #STUDENTS: you will need to edit the name of your rule file here
    print("doing proof")
    try:
        with engine.prove_goal('simple_rule_questions.what_to_bring($bring)') as gen: #STUDENTS: you will need to edit this line
            for vars, plan in gen:
                print("You should bring: %s" % (vars['bring'])) #STUDENTS: you will need to edit this line
    except Exception:
        # This converts stack frames of generated python functions back to the
        # .krb file.
        krb_traceback.print_exc()
        sys.exit(1)
    print()
    print("done")
test()
test_questions()
```

Files:

facts.kfb:

```
#Weather facts
raining(True)
windy(True)
```

simple_rules.krb

```
# simple_rules.krb
wear_rain_protection
```

```
   use rain_protection(True)
   when
         facts.raining(True)

what_to_bring_raincoat
   use what_to_bring(raincoat)
   when
         rain_protection($protection)
         facts.windy(True)

what_to_bring_umbrella
   use what_to_bring(umbrella)
   when
         rain_protection($protection)
         facts.windy(False)

what_to_bring_nothing
   use what_to_bring(nothing)
   when
         facts.raining(False)
         facts.windy(False)
```

questions.kqb

```
# questions.kqb
any_disasters($ans)
         Are any of the following disasters currently occurring?
         ---
         $ans = select_1
                  1: Forest Fire
                  2: Tornado
```

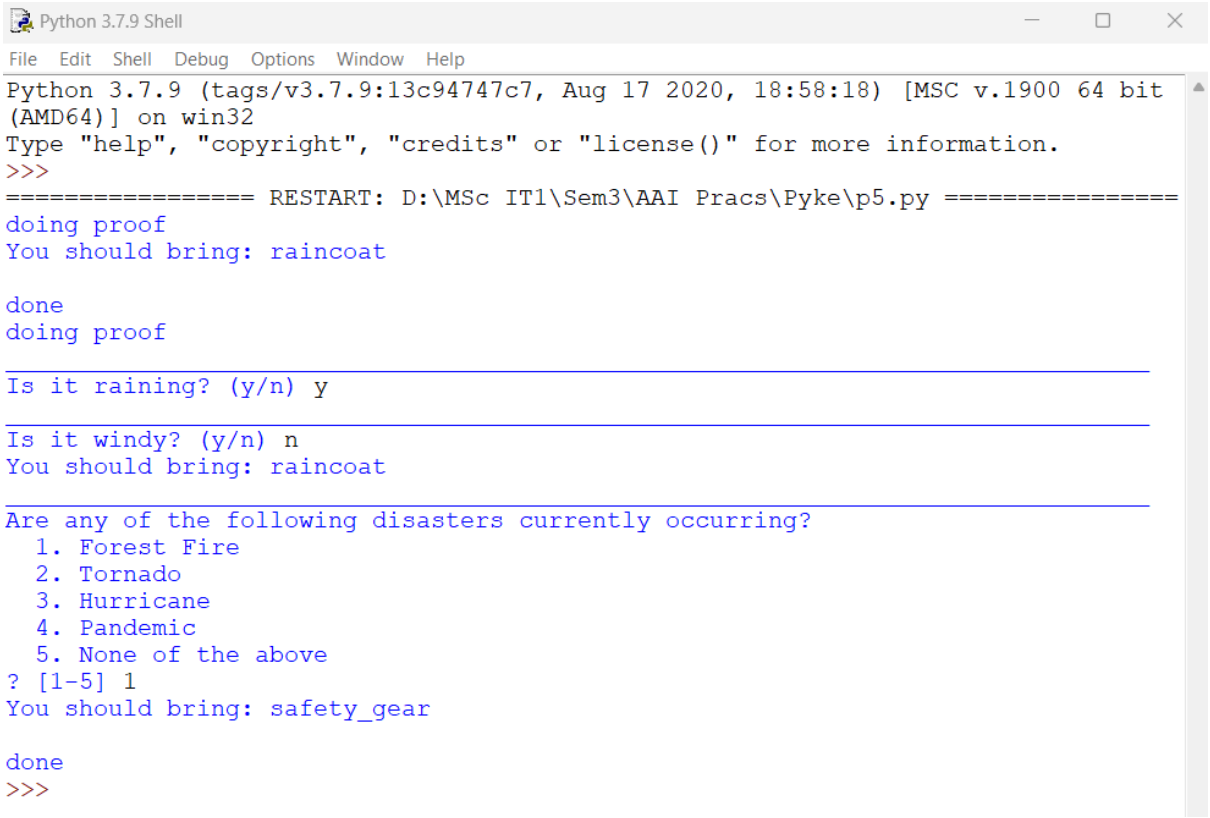
```
            3: Hurricane
            4: Pandemic
            5: None of the above
                ! Thank goodness
is_raining($ans)
    Is it raining?
    ---
    $ans = yn

is_windy($ans)
    Is it windy?
    ---
    $ans = yn
```

simple_rule_questions.krb

```
# simple_rule_questions.krb

no_rain
  use what_to_bring(no_rain_gear)
  when
    questions.is_raining(False)

what_to_bring_raincoat
  use what_to_bring(raincoat)
  when
    questions.is_raining(True)
    questions.is_windy(False)

what_to_bring_umbrella
  use what_to_bring(umbrella)
```

```
  when
    questions.is_raining(True)
    questions.is_windy(True)

what_to_bring_safety_gear
  use what_to_bring(safety_gear)
  when
    questions.any_disasters($ans)
    check $ans in (1,2,3)

what_to_bring_tissues
  use what_to_bring(tissues)
  when
    questions.any_disasters($ans)
    check $ans in (4,)
```

Output:



PRACTICAL NUMBER: 6

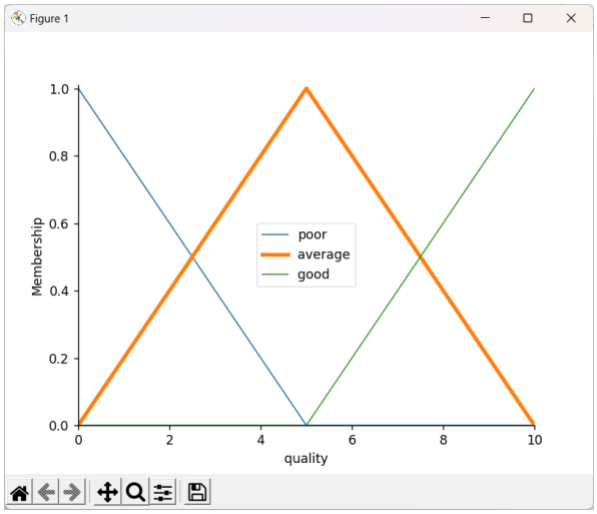
Aim: Design a Fuzzy based application using Python / R.

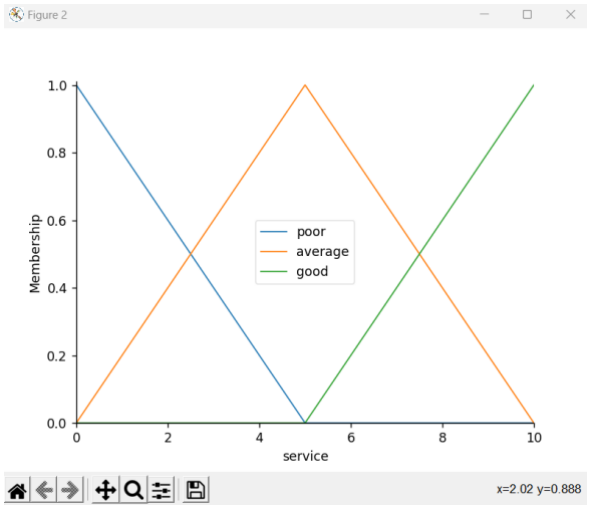
Code:

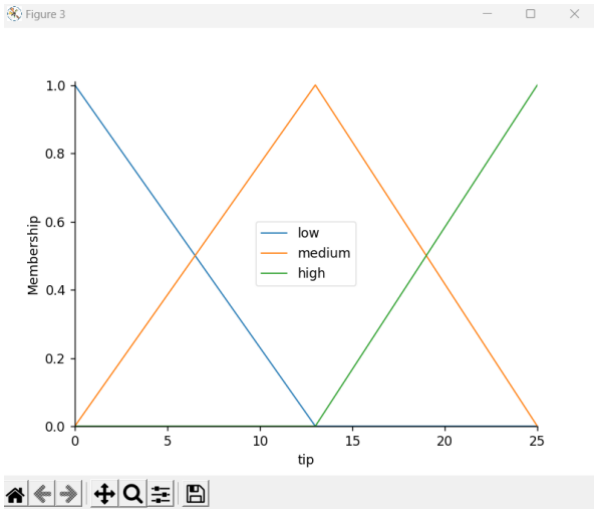
```
import numpy as np
import skfuzzy as fuzz
from skfuzzy import control as ctrl

quality=ctrl.Antecedent(np.arange(0,11,1),'quality')
service=ctrl.Antecedent(np.arange(0,11,1),'service')
tip=ctrl.Consequent(np.arange(0,26,1),'tip')
quality.automf(3)
service.automf(3)

tip['low']=fuzz.trimf(tip.universe,[0,0,13])
tip['medium']=fuzz.trimf(tip.universe,[0,13,25])
tip['high']=fuzz.trimf(tip.universe,[13,25,25])

quality['average'].view()
service.view()
tip.view()

rule1=ctrl.Rule(quality['poor']|service['poor'],tip['low'])
rule2=ctrl.Rule(service['average'],tip['medium'])
rule3=ctrl.Rule(service['good']|quality['good'],tip['high'])
rule1.view()
tipping_ctrl=ctrl.ControlSystem([rule1,rule2,rule3])
tipping=ctrl.ControlSystemSimulation(tipping_ctrl)
```

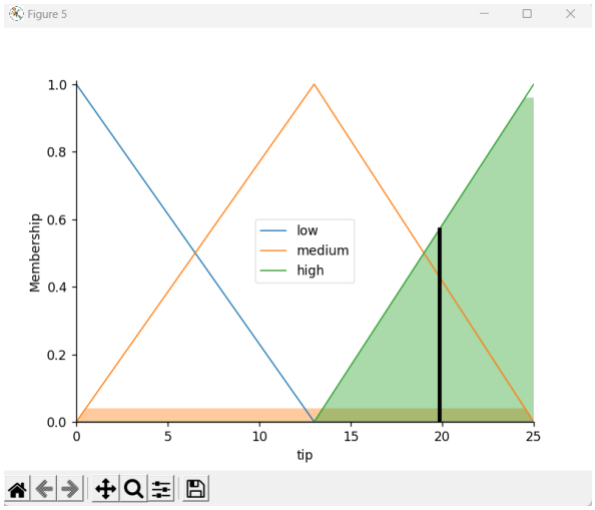
```
tipping.input['quality']=6.5
tipping.input['service']=9.8
tipping.compute()
print(tipping.output['tip'])
tip.view(sim=tipping)
```

Output:










```
Python 3.7.9 Shell
File  Edit  Shell  Debug  Options  Window  Help
Python 3.7.9 (tags/v3.7.9:13c94747c7, Aug 17 2020, 18:58:18) [MSC v.1900 64 bit
(AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: D:\MSc IT1\Sem3\AAI Pracs\p6.py ==========
19.847607361963192
>>>
```

PRACTICAL NUMBER: 7

Aim: Write an application to simulate supervised and un-supervised learning model.

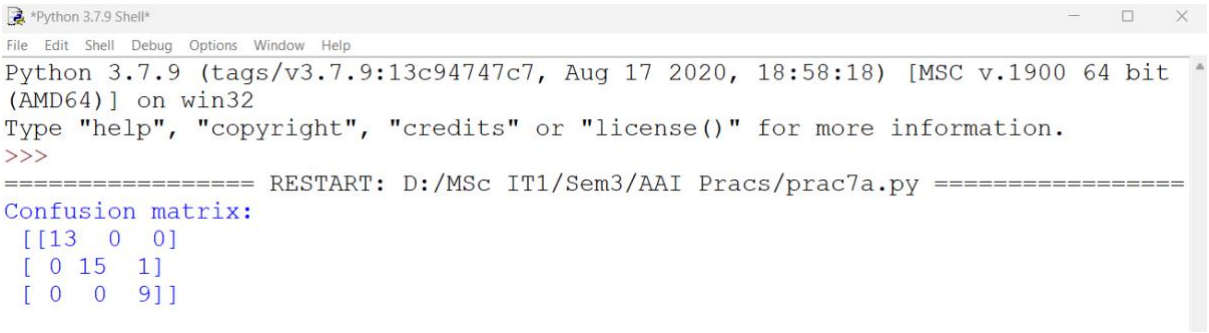
Supervised learning:

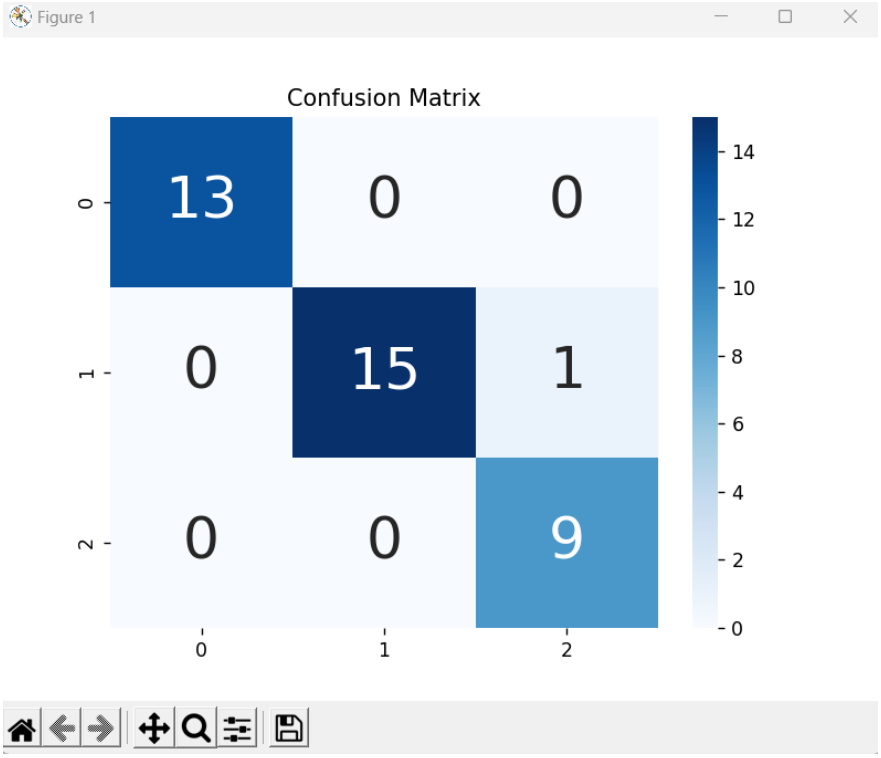
Code:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.linear_model import LogisticRegression
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import confusion_matrix
import seaborn as sns

#Importing the dataset
dataset=pd.read_csv("iris.csv")
dataset.describe()

X=dataset.iloc[:,[0,1,2,3]].values
y=dataset.iloc[:,4].values
```

```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.25,random_state=0)
sc=StandardScaler()
X_train=sc.fit_transform(X_train)
X_test=sc.transform(X_test)

#Fitting Logistic Regression to the training set
classifier=LogisticRegression(random_state=0,solver='lbfgs',multi_class='auto')
classifier.fit(X_train,y_train)

#Predicting the test set results
y_pred=classifier.predict(X_test)
#Predict probabilities
probs_y=classifier.predict_proba(X_test)
cm=confusion_matrix(y_test,y_pred)
print('Confusion matrix:\n',cm)

ax=plt.subplot()
df_cm=cm
sns.heatmap(df_cm,annot=True,annot_kws={"size":30},fmt="d",cmap="Blues",ax=ax)
ax.set_title('Confusion Matrix')
plt.show()
```

Output:





Unsupervised learning:

Code:

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import scipy.cluster.hierarchy as shc
from sklearn.cluster import AgglomerativeClustering


customer_data = pd.read_csv('shopping_data.csv')
#shape: Returns tuple of shape (Rows, columns) of dataframe/series
print("Rows,colums in data:",customer_data.shape)
#head: Displays the first five rows of the dataframe by default.
print("First five rows:",customer_data.head())
#iloc: helps us to select a specific row or column from the data set.
data = customer_data.iloc[:,3:5].values
plt.figure(figsize=(10,7))
```

```
plt.title("Customer Dendograms")

# create a dendrogram variable linkage is actually the algorithm itself of hierarchical clustering and then

# in linkage we have to specify on which data we apply and engage.

# Ward method is actually a method that tries to minimize the variance within each cluster.

# We choose Euclidean distance and ward method for our algorithm class.

dend = shc.dendrogram(shc.linkage(data,method = 'ward'))

cluster = AgglomerativeClustering(n_clusters=5, affinity='euclidean', linkage='ward')

cluster.fit_predict(data)

plt.figure(figsize=(10, 7))

plt.scatter(data[:,0], data[:,1], c=cluster.labels_,cmap='rainbow')

plt.show()
```

Output:

```
*Python 3.7.9 Shell*
File  Edit  Shell  Debug  Options  Window  Help
Python 3.7.9 (tags/v3.7.9:13c94747c7, Aug 17 2020, 18:58:18) [MSC v.1900 64 bit
(AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: D:/MSc IT1/Sem3/AAI Pracs/p7b.py ==========
Rows,colums in data: (200, 5)
First five rows:    CustomerID   Genre  Age  Annual Income (k$)  Spending Score
(1-100)
0             1    Male   19                  15                      39
1             2    Male   21                  15                      81
2             3  Female   20                  16                       6
3             4  Female   23                  16                      77
4             5  Female   31                  17                      40
```

Figure 1

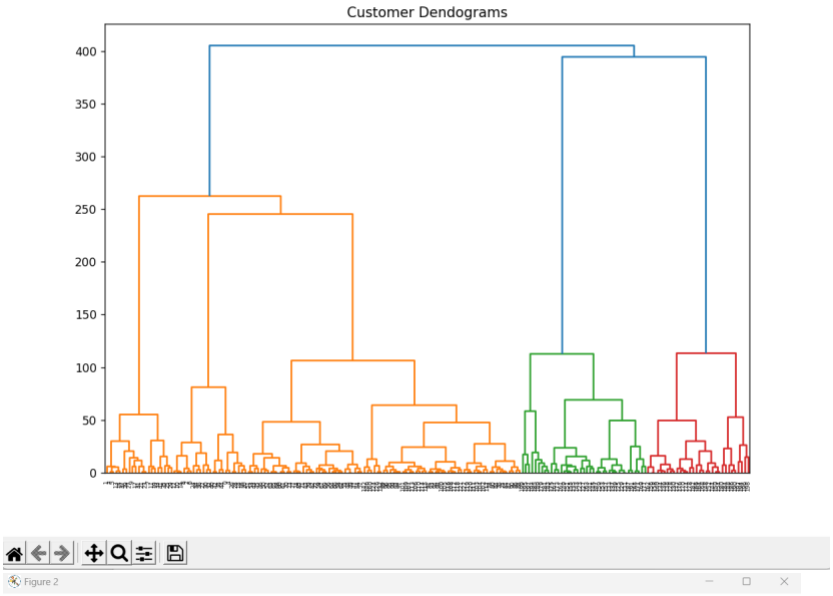
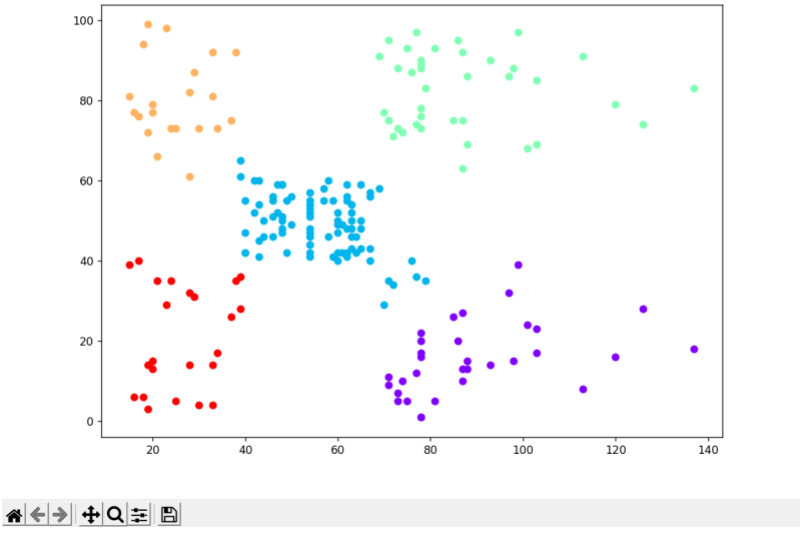


Figure 2



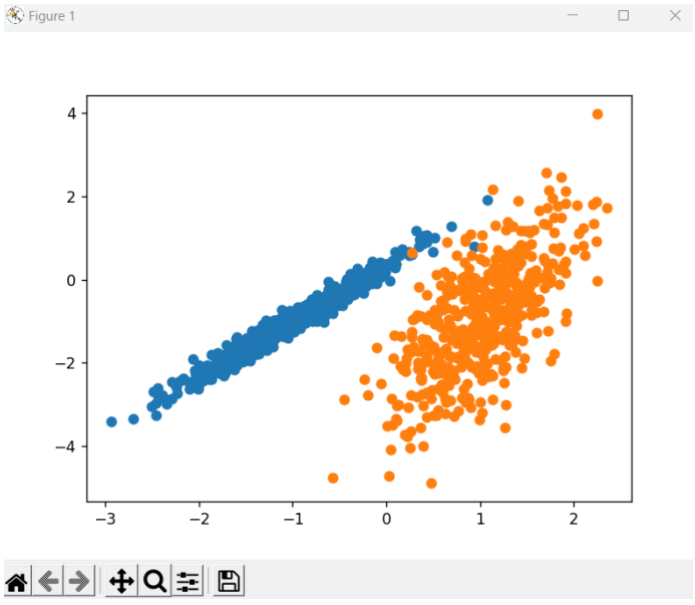
PRACTICAL NUMBER: 8

Aim: Write an application to implement clustering algorithm.

Code:

```
from numpy import where
from sklearn.datasets import make_classification
from matplotlib import pyplot

#Define dataset
X,y=make_classification(n_samples=1000,n_features=2,n_informative=2,n_redundant=0,n_clusters_per_class=1,random_state=4)
#Create scatter plot for samples from each class
for class_value in range(2):
    #Get row indexes for samples with this class
    row_ix=where(y==class_value)
    #Create scatter of these samples
    pyplot.scatter(X[row_ix,0],X[row_ix,1])
#Show the plot
pyplot.show()
```

Output:



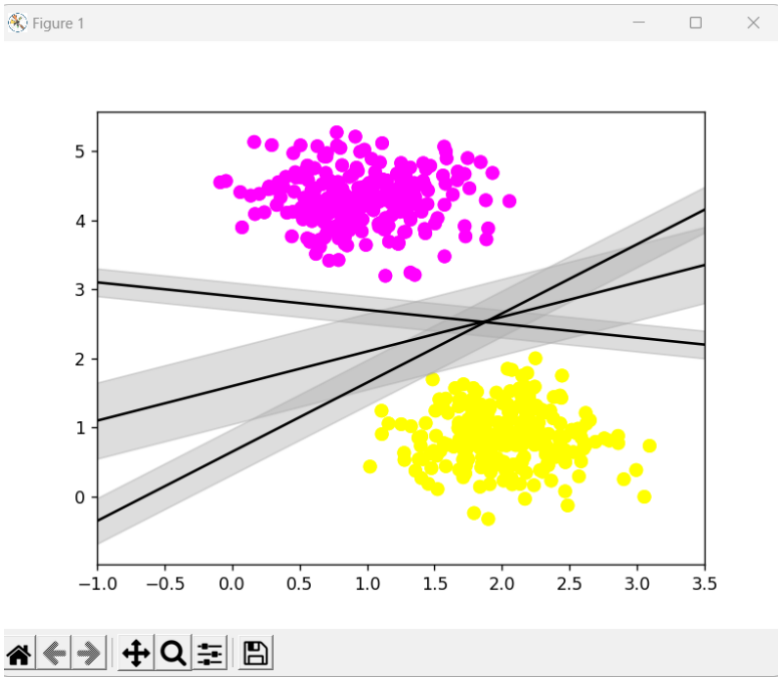
PRACTICAL NUMBER: 9

Aim: Write an application to implement support vector machine algorithm.

Code:

```
# importing scikit learn with make_blobs
from sklearn.datasets.samples_generator import make_blobs
import numpy as np
import matplotlib.pyplot as plt
# creating datasets X containing n_samples
# Y containing two classes
X, Y = make_blobs(n_samples=500, centers=2,random_state=0, cluster_std=0.40)
# plotting scatters
plt.scatter(X[:, 0], X[:, 1], c=Y, s=50, cmap='spring');
# creating linspace between -1 to 3.5
xfit = np.linspace(-1, 3.5)
# plotting scatter
plt.scatter(X[:, 0], X[:, 1], c=Y, s=50, cmap='spring')
# plot a line between the different sets of data
for m, b, d in [(1, 0.65, 0.33), (0.5, 1.6, 0.55), (-0.2, 2.9, 0.2)]:
        yfit = m * xfit + b
        plt.plot(xfit, yfit, '-k')
        plt.fill_between(xfit, yfit - d, yfit + d, edgecolor='none',
        color='#AAAAAA', alpha=0.4)
plt.xlim(-1, 3.5);
plt.show()
```

Output:



PRACTICAL NUMBER:10

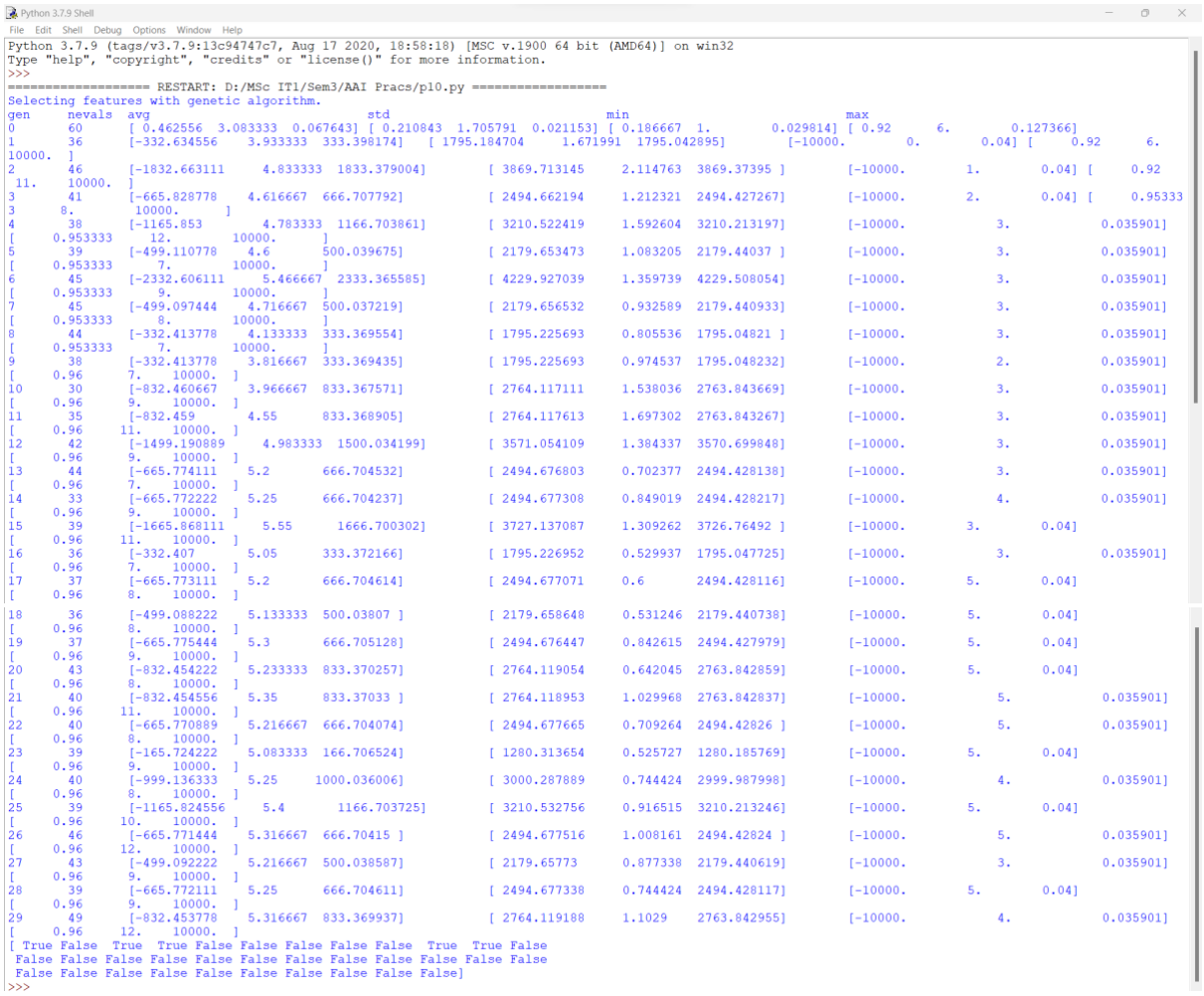
Aim: Simulate genetic algorithm with suitable example using Python / R or any other platform.

Code:

```
from __future__ import print_function
import numpy as num
from sklearn import datasets, linear_model
from genetic_selection import GeneticSelectionCV

def main():
    iris = datasets.load_iris()

    # Some noisy data not correlated
    e = num.random.uniform(0, 0.2, size=(len(iris.data), 30))
    x = num.hstack((iris.data, e))
    Y = iris.target
    estimators = linear_model.LogisticRegression(solver="liblinear", multi_class="ovr")
    selectors = GeneticSelectionCV(estimators,
                                   cv=6,
                                   verbose=2,
                                   scoring="accuracy",
                                   max_features=6,
                                   n_population=60,
                                   crossover_proba=0.6,
                                   mutation_proba=0.2,
                                   n_generations=50,
                                   crossover_independent_proba=0.6,
                                   mutation_independent_proba=0.06,
                                   tournament_size=4,
```

```
                    n_gen_no_change=20,
                    caching=True,
                    n_jobs=-2)
    selectors = selectors.fit(x, Y)
    print(selectors.support_)
if __name__ == "__main__":
    main()
```

Output:



```
Python 3.7.9 Shell
File  Edit  Shell  Debug  Options  Window  Help
Python 3.7.9 (tags/v3.7.9:13c94747c7, Aug 17 2020, 18:58:18) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: D:/MSc IT1/Sem3/AAI Pracs/p10.py ==========
Selecting features with genetic algorithm.
gen     nevals  avg                             std                             min                             max
0       60      [ 0.462556  3.083333  0.067643] [ 0.210843  1.705791  0.021153] [ 0.186667  1.        0.029814] [ 0.92      6.        0.127366]
1       36      [-332.634556    3.933333  333.398174]   [ 1795.184704     1.671991  1795.042895]        [-10000.        0.        0.04] [     0.92      6.
10000.  ]
2       46      [-1832.663111     4.833333  1833.379004]        [ 3869.713145     2.114763  3869.37395 ]        [-10000.        1.        0.04] [     0.92
 11.    10000.  ]
3       41      [-665.828778    4.616667  666.707792]           [ 2494.662194     1.212321  2494.427267]        [-10000.        2.        0.04] [     0.95333
3       8.      10000.      ]
4       38      [-1165.853        4.783333  1166.703861]        [ 3210.522419     1.592604  3210.213197]        [-10000.            3.            0.035901]
[       0.953333        12.         10000.      ]
5       39      [-499.110778    4.6       500.039675]           [ 2179.653473     1.083205  2179.44037 ]        [-10000.            3.            0.035901]
[       0.953333        7.          10000.      ]
6       45      [-2332.606111     5.466667  2333.365585]        [ 4229.927039     1.359739  4229.508054]        [-10000.            3.            0.035901]
[       0.953333        9.          10000.      ]
7       45      [-499.097444    4.716667  500.037219]           [ 2179.656532     0.932589  2179.440933]        [-10000.            3.            0.035901]
[       0.953333        8.          10000.      ]
8       44      [-332.413778    4.133333  333.369554]           [ 1795.225693     0.805536  1795.04821 ]        [-10000.            3.            0.035901]
[       0.953333        7.          10000.      ]
9       38      [-332.413778    3.816667  333.369435]           [ 1795.225693     0.974537  1795.048232]        [-10000.            2.            0.035901]
[       0.96    7.      10000.  ]
10      30      [-832.460667    3.966667  833.367571]           [ 2764.117111     1.538036  2763.843669]        [-10000.            3.            0.035901]
[       0.96    9.      10000.  ]
11      35      [-832.459       4.55      833.368905]           [ 2764.117613     1.697302  2763.843267]        [-10000.            3.            0.035901]
[       0.96    11.     10000.  ]
12      42      [-1499.190889     4.983333  1500.034199]        [ 3571.054109     1.384337  3570.699848]        [-10000.            3.            0.035901]
[       0.96    9.      10000.  ]
13      44      [-665.774111    5.2       666.704532]           [ 2494.676803     0.702377  2494.428138]        [-10000.            3.            0.035901]
[       0.96    7.      10000.  ]
14      33      [-665.772222    5.25      666.704237]           [ 2494.677308     0.849019  2494.428217]        [-10000.            4.            0.035901]
[       0.96    9.      10000.  ]
15      39      [-1665.868111     5.55        1666.700302]        [ 3727.137087     1.309262  3726.76492 ]        [-10000.        3.        0.04]
[       0.96    11.     10000.  ]
16      36      [-332.407       5.05      333.372166]           [ 1795.226952     0.529937  1795.047725]        [-10000.            3.            0.035901]
[       0.96    7.      10000.  ]
17      37      [-665.773111    5.2       666.704614]           [ 2494.677071     0.6       2494.428116]        [-10000.        5.        0.04]
[       0.96    8.      10000.  ]
18      36      [-499.088222    5.133333  500.03807 ]           [ 2179.658648     0.531246  2179.440738]        [-10000.        5.        0.04]
[       0.96    8.      10000.  ]
19      37      [-665.775444    5.3       666.705128]           [ 2494.676447     0.842615  2494.427979]        [-10000.        5.        0.04]
[       0.96    9.      10000.  ]
20      43      [-832.454222    5.233333  833.370257]           [ 2764.119054     0.642045  2763.842859]        [-10000.        5.        0.04]
[       0.96    8.      10000.  ]
21      40      [-832.454556    5.35      833.37033 ]           [ 2764.118953     1.029968  2763.842837]        [-10000.            5.            0.035901]
[       0.96    11.     10000.  ]
22      40      [-665.770889    5.216667  666.704074]           [ 2494.677665     0.709264  2494.42826 ]        [-10000.            5.            0.035901]
[       0.96    8.      10000.  ]
23      39      [-165.724222    5.083333  166.706524]           [ 1280.313654     0.525727  1280.185769]        [-10000.        5.        0.04]
[       0.96    9.      10000.  ]
24      40      [-999.136333    5.25      1000.036006]          [ 3000.287889     0.744424  2999.987998]        [-10000.            4.            0.035901]
[       0.96    8.      10000.  ]
25      39      [-1165.824556     5.4         1166.703725]        [ 3210.532756     0.916515  3210.213246]        [-10000.        5.        0.04]
[       0.96    10.     10000.  ]
26      46      [-665.771444    5.316667  666.70415 ]           [ 2494.677516     1.008161  2494.42824 ]        [-10000.            5.            0.035901]
[       0.96    12.     10000.  ]
27      43      [-499.092222    5.216667  500.038587]           [ 2179.65773      0.877338  2179.440619]        [-10000.            3.            0.035901]
[       0.96    9.      10000.  ]
28      39      [-665.772111    5.25      666.704611]           [ 2494.677338     0.744424  2494.428117]        [-10000.        5.        0.04]
[       0.96    9.      10000.  ]
29      49      [-832.453778    5.316667  833.369937]           [ 2764.119188     1.1029    2763.842955]        [-10000.            4.            0.035901]
[       0.96    12.     10000.  ]
[ True False  True  True False False False False False  True  True False
 False False False False False False False False False False False False
 False False False False False False False False False False False False]
>>>
```