AI Lab Test

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Question 1

```
#a)
An algorithm to solve limited and unconstrained optimised problems based on nature is called an evolutionary algorithm process. The initialization of the population at random is the first step of the evolutionary algorithm process. Next comes evaluation, which involves computing population fitness. Create crossover and mutation operators after choosing the parents using a selection technique. Then, using the selection technique, choose the population members who will die. Return to the phase of evaluation if the conditions have been met.
```

In [1]:

```
#b)
import random

from deap import base, creator, tools

# Evaluation function
def eval_func(individual):
    target_sum = 25
    return len(individual) - abs(sum(individual) - target_sum),

# Create the toolbox with the right parameters
def create_toolbox(num_bits):
    creator.create("FitnessMax", base.Fitness, weights=(1.0,))
    creator.create("Individual", list, fitness=creator.FitnessMax)

    # Initialize the toolbox
    toolbox = base.Toolbox()

    # Generate attributes
    toolbox.register("attr_bool", random.randint, 0, 1)

    # Initialize structures
    toolbox.register("individual", tools.initRepeat, creator.Individual,
        toolbox.attr_bool, num_bits)

    # Define the population to be a list of individuals
    toolbox.register("population", tools.initRepeat, list, toolbox.individual)

    # Register the evaluation operator
    toolbox.register("evaluate", eval_func)

    # Register the crossover operator
    toolbox.register("mate", tools.cxTwoPoint)

    # Register a mutation operator
    toolbox.register("mutate", tools.mutFlipBit, indpb=0.05)

    # Operator for selecting individuals for breeding
    toolbox.register("select", tools.selTournament, tournsize=3)

    return toolbox

if __name__ == "__main__":
    # Define the number of bits
    num_bits = 50

    # Create a toolbox using the above parameter
    toolbox = create_toolbox(num_bits)

    # Seed the random number generator
    random.seed(7)

    # Create an initial population of 200 individuals
    population = toolbox.population(n=200)

    # Define probabilities of crossing and mutating
    probab_crossing, probab_mutating  = 0.6, 0.3

    # Define the number of generations
```

```python
    num_generations = 40

    print('\nStarting the evolution process')

    # Evaluate the entire population
    fitnesses = list(map(toolbox.evaluate, population))
    for ind, fit in zip(population, fitnesses):
        ind.fitness.values = fit

    print('\nEvaluated', len(population), 'individuals')

    # Iterate through generations
    for g in range(num_generations):
        print("\n===== Generation", g)

        # Select the next generation individuals
        offspring = toolbox.select(population, len(population))

        # Clone the selected individuals
        offspring = list(map(toolbox.clone, offspring))

        # Apply crossover and mutation on the offspring
        for child1, child2 in zip(offspring[::2], offspring[1::2]):
            # Cross two individuals
            if random.random() < probab_crossing:
                toolbox.mate(child1, child2)

                # "Forget" the fitness values of the children
                del child1.fitness.values
                del child2.fitness.values

        # Apply mutation
        for mutant in offspring:
            # Mutate an individual
            if random.random() < probab_mutating:
                toolbox.mutate(mutant)
                del mutant.fitness.values

        # Evaluate the individuals with an invalid fitness
        invalid_ind = [ind for ind in offspring if not ind.fitness.valid]
        fitnesses = map(toolbox.evaluate, invalid_ind)
        for ind, fit in zip(invalid_ind, fitnesses):
            ind.fitness.values = fit

        print('Evaluated', len(invalid_ind), 'individuals')

        # The population is entirely replaced by the offspring
        population[:] = offspring

        # Gather all the fitnesses in one list and print the stats
        fits = [ind.fitness.values[0] for ind in population]

        length = len(population)
        mean = sum(fits) / length
        sum2 = sum(x*x for x in fits)
        std = abs(sum2 / length - mean**2)**0.5

        print('Min =', min(fits), ', Max =', max(fits))
        print('Average =', round(mean, 2), ', Standard deviation =',
                round(std, 2))

```

```python
    print("\n==== End of evolution")

    best_ind = tools.selBest(population, 1)[0]
    print('\nBest individual:\n', best_ind)
    print('\nNumber of ones:', sum(best_ind))
```

```
Starting the evolution process

Evaluated 200 individuals

===== Generation 0
Evaluated 141 individuals
Min = 44.0 , Max = 50.0
Average = 48.37 , Standard deviation = 1.23

===== Generation 1
Evaluated 151 individuals
Min = 45.0 , Max = 50.0
Average = 48.46 , Standard deviation = 1.28

===== Generation 2
Evaluated 150 individuals
Min = 43.0 , Max = 50.0
Average = 48.55 , Standard deviation = 1.35
```

Question 2

In [2]:

```
# import SentimentIntensityAnalyzer class
# from vaderSentiment.vaderSentiment module.
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer

# import all methods and classes from the tkinter
from tkinter import *

# Function for clearing the
# contents of all entry boxes
# And text area.
def clearAll() :

    # deleting the content from the entry box
    negativeField.delete(0, END)
    neutralField.delete(0, END)
    positiveField.delete(0, END)
    overallField.delete(0, END)

    # whole content of text area is deleted
    textArea.delete(1.0, END)

# function to print sentiments
# of the sentence.
def detect_sentiment():

    # get a whole input content from text box
    sentence = textArea.get("1.0", "end")

    # Create a SentimentIntensityAnalyzer object.
    sid_obj = SentimentIntensityAnalyzer()

    # polarity_scores method of SentimentIntensityAnalyzer
    # object gives a sentiment dictionary.
    # which contains pos, neg, neu, and compound scores.
    sentiment_dict = sid_obj.polarity_scores(sentence)

    string = str(sentiment_dict['neg']*100) + "% Negative"
    negativeField.insert(10, string)


    string = str(sentiment_dict['neu']*100) + "% Neutral"
    neutralField.insert(10, string)

    string = str(sentiment_dict['pos']*100) +"% Positive"
    positiveField.insert(10, string)

    # decide sentiment as positive, negative and neutral
    if sentiment_dict['compound'] >= 0.05 :
        string = "Positive"

    elif sentiment_dict['compound'] <= - 0.05 :
        string = "Negative"


    else :
        string = "Neutral"

    overallField.insert(10, string)

```

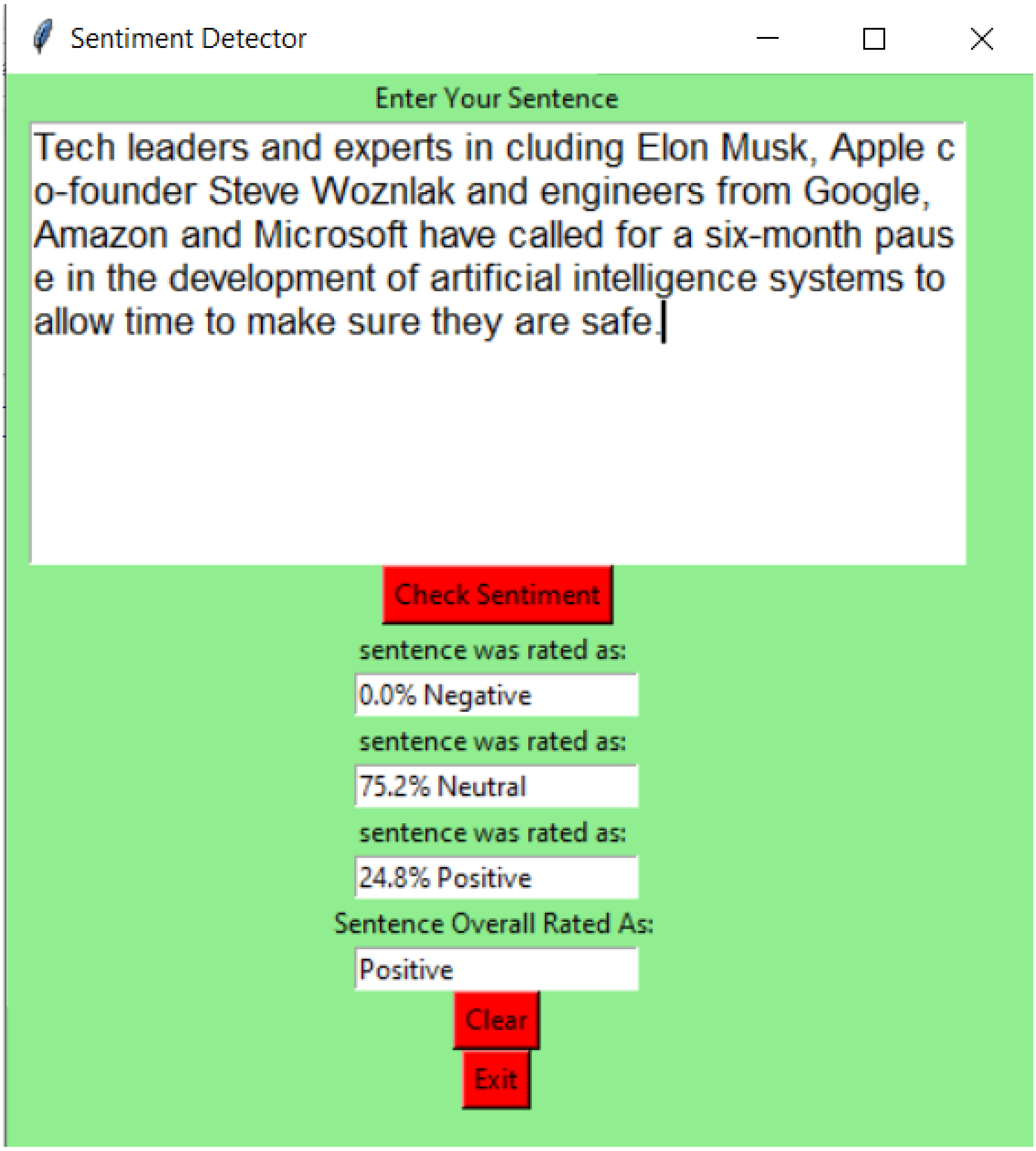
```


# Driver Code
if __name__ == "__main__" :


    # Create a GUI window
    gui = Tk()

    # Set the background colour of GUI window
    gui.config(background = "light green")

    # set the name of tkinter GUI window
    gui.title("Sentiment Detector")

    # Set the configuration of GUI window
    gui.geometry("250x400")

    # create a label : Enter Your Task
    enterText = Label(gui, text = "Enter Your Sentence",
                                    bg = "light green")

    # create a text area for the root
    # with lunida 13 font
    # text area is for writing the content
    textArea = Text(gui, height = 10, width = 45, font = "lucida 13")

    # create a Submit Button and place into the root window
    # when user press the button, the command or
    # function affiliated to that button is executed
    check = Button(gui, text = "Check Sentiment", fg = "Black",
                        bg = "Red", command = detect_sentiment)

    # Create a negative : label
    negative = Label(gui, text = "sentence was rated as: ",
                                        bg = "light green")

    # Create a neutral : label
    neutral = Label(gui, text = "sentence was rated as: ",
                                    bg = "light green")

    # Create a positive : label
    positive = Label(gui, text = "sentence was rated as: ",
                                        bg = "light green")

    # Create a overall : label
    overall = Label(gui, text = "Sentence Overall Rated As: ",
                                        bg = "light green")

    # create a text entry box
    negativeField = Entry(gui)

    # create a text entry box
    neutralField = Entry(gui)

    # create a text entry box
    positiveField = Entry(gui)

    # create a text entry box
    overallField = Entry(gui)

```

```
    # create a Clear Button and place into the root window
    # when user press the button, the command or
    # function affiliated to that button is executed .
    clear = Button(gui, text = "Clear", fg = "Black",
                    bg = "Red", command = clearAll)

    # create a Exit Button and place into the root window
    # when user press the button, the command or
    # function affiliated to that button is executed .
    Exit = Button(gui, text = "Exit", fg = "Black",
                        bg = "Red", command = exit)

    # grid method is used for placing
    # the widgets at respective positions
    # in table like structure.
    enterText.grid(row = 0, column = 2)

    textArea.grid(row = 1, column = 2, padx = 10, sticky = W)

    check.grid(row = 2, column = 2)

    negative.grid(row = 3, column = 2)

    neutral.grid(row = 5, column = 2)

    positive.grid(row = 7, column = 2)

    overall.grid(row = 9, column = 2)

    negativeField.grid(row = 4, column = 2)

    neutralField.grid(row = 6, column = 2)

    positiveField.grid(row = 8, column = 2)

    overallField.grid(row = 10, column = 2)

    clear.grid(row = 11, column = 2)

    Exit.grid(row = 12, column = 2)

    # start the GUI
    gui.mainloop()
```

In [3]:

```python
from IPython.display import Image
Image("results question 2.png")
```

Out[3]:



Question 3

In [4]:

```
import cv2
import numpy as np

# Define a class to handle object tracking related functionality
class ObjectTracker(object):
    def __init__(self, scaling_factor=0.5):
        # Initialize the video capture object
        self.cap = cv2.VideoCapture(0)

        # Capture the frame from the webcam
        _, self.frame = self.cap.read()

        # Scaling factor for the captured frame
        self.scaling_factor = scaling_factor

        # Resize the frame
        self.frame = cv2.resize(self.frame, None,
                fx=self.scaling_factor, fy=self.scaling_factor,
                interpolation=cv2.INTER_AREA)

        # Create a window to display the frame
        cv2.namedWindow('Object Tracker')

        # Set the mouse callback function to track the mouse
        cv2.setMouseCallback('Object Tracker', self.mouse_event)

        # Initialize variable related to rectangular region selection
        self.selection = None

        # Initialize variable related to starting position
        self.drag_start = None

        # Initialize variable related to the state of tracking
        self.tracking_state = 0

    # Define a method to track the mouse events
    def mouse_event(self, event, x, y, flags, param):
        # Convert x and y coordinates into 16-bit numpy integers
        x, y = np.int16([x, y])

        # Check if a mouse button down event has occurred
        if event == cv2.EVENT_LBUTTONDOWN:
            self.drag_start = (x, y)
            self.tracking_state = 0

        # Check if the user has started selecting the region
        if self.drag_start:
            if flags & cv2.EVENT_FLAG_LBUTTON:
                # Extract the dimensions of the frame
                h, w = self.frame.shape[:2]

                # Get the initial position
                xi, yi = self.drag_start

                # Get the max and min values
                x0, y0 = np.maximum(0, np.minimum([xi, yi], [x, y]))
                x1, y1 = np.minimum([w, h], np.maximum([xi, yi], [x, y]))

                # Reset the selection variable
```

```
                self.selection = None

                # Finalize the rectangular selection
                if x1-x0 > 0 and y1-y0 > 0:
                    self.selection = (x0, y0, x1, y1)

            else:
                # If the selection is done, start tracking
                self.drag_start = None
                if self.selection is not None:
                    self.tracking_state = 1

    # Method to start tracking the object
    def start_tracking(self):
        # Iterate until the user presses the Esc key
        while True:
            # Capture the frame from webcam
            _, self.frame = self.cap.read()

            # Resize the input frame
            self.frame = cv2.resize(self.frame, None,
                    fx=self.scaling_factor, fy=self.scaling_factor,
                    interpolation=cv2.INTER_AREA)

            # Create a copy of the frame
            vis = self.frame.copy()

            # Convert the frame to HSV colorspace
            hsv = cv2.cvtColor(self.frame, cv2.COLOR_BGR2HSV)

            # Create the mask based on predefined thresholds
            mask = cv2.inRange(hsv, np.array((0., 60., 32.)),
                        np.array((180., 255., 255.)))

            # Check if the user has selected the region
            if self.selection:
                # Extract the coordinates of the selected rectangle
                x0, y0, x1, y1 = self.selection

                # Extract the tracking window
                self.track_window = (x0, y0, x1-x0, y1-y0)

                # Extract the regions of interest
                hsv_roi = hsv[y0:y1, x0:x1]
                mask_roi = mask[y0:y1, x0:x1]

                # Compute the histogram of the region of
                # interest in the HSV image using the mask
                hist = cv2.calcHist( [hsv_roi], [0], mask_roi,
                        [16], [0, 180] )

                # Normalize and reshape the histogram
                cv2.normalize(hist, hist, 0, 255, cv2.NORM_MINMAX);
                self.hist = hist.reshape(-1)

                # Extract the region of interest from the frame
                vis_roi = vis[y0:y1, x0:x1]

                # Compute the image negative (for display only)
                cv2.bitwise_not(vis_roi, vis_roi)
                vis[mask == 0] = 0
```

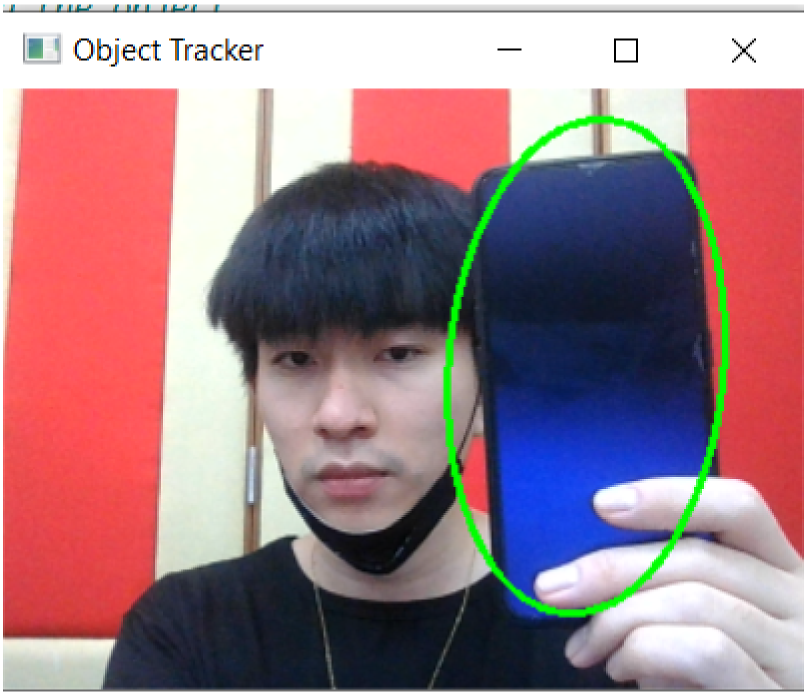
```python

            # Check if the system in the "tracking" mode
            if self.tracking_state == 1:
                # Reset the selection variable
                self.selection = None

                # Compute the histogram back projection
                hsv_backproj = cv2.calcBackProject([hsv], [0],
                        self.hist, [0, 180], 1)

                # Compute bitwise AND between histogram
                # backprojection and the mask
                hsv_backproj &= mask

                # Define termination criteria for the tracker
                term_crit = (cv2.TERM_CRITERIA_EPS | cv2.TERM_CRITERIA_COUNT,
                        10, 1)

                # Apply CAMShift on 'hsv_backproj'
                track_box, self.track_window = cv2.CamShift(hsv_backproj,
                        self.track_window, term_crit)

                # Draw an ellipse around the object
                cv2.ellipse(vis, track_box, (0, 255, 0), 2)

            # Show the output live video
            cv2.imshow('Object Tracker', vis)

            # Stop if the user hits the 'Esc' key
            c = cv2.waitKey(5)
            if c == 27:
                break

        # Close all the windows
        cv2.destroyAllWindows()

if __name__ == '__main__':
    # Start the tracker
    ObjectTracker().start_tracking()
```

```
---------------------------------------------------------------------------
-
error                                     Traceback (most recent call las
t)
~\AppData\Local\Temp\ipykernel_4464\679748809.py in <module>
    157 if __name__ == '__main__':
    158         # Start the tracker
--> 159     ObjectTracker().start_tracking()

~\AppData\Local\Temp\ipykernel_4464\679748809.py in __init__(self, scaling
_factor)
     15
     16         # Resize the frame
---> 17         self.frame = cv2.resize(self.frame, None,
     18                 fx=self.scaling_factor, fy=self.scaling_factor,
     19                 interpolation=cv2.INTER_AREA)

error: OpenCV(4.7.0) D:\a\opencv-python\opencv-python\opencv\modules\imgpr
oc\src\resize.cpp:4062: error: (-215:Assertion failed) !ssize.empty() in f
unction 'cv::resize'
```

In [5]:

```python
from IPython.display import Image
Image("results question 3.png")
```

Out[5]:



Question 4

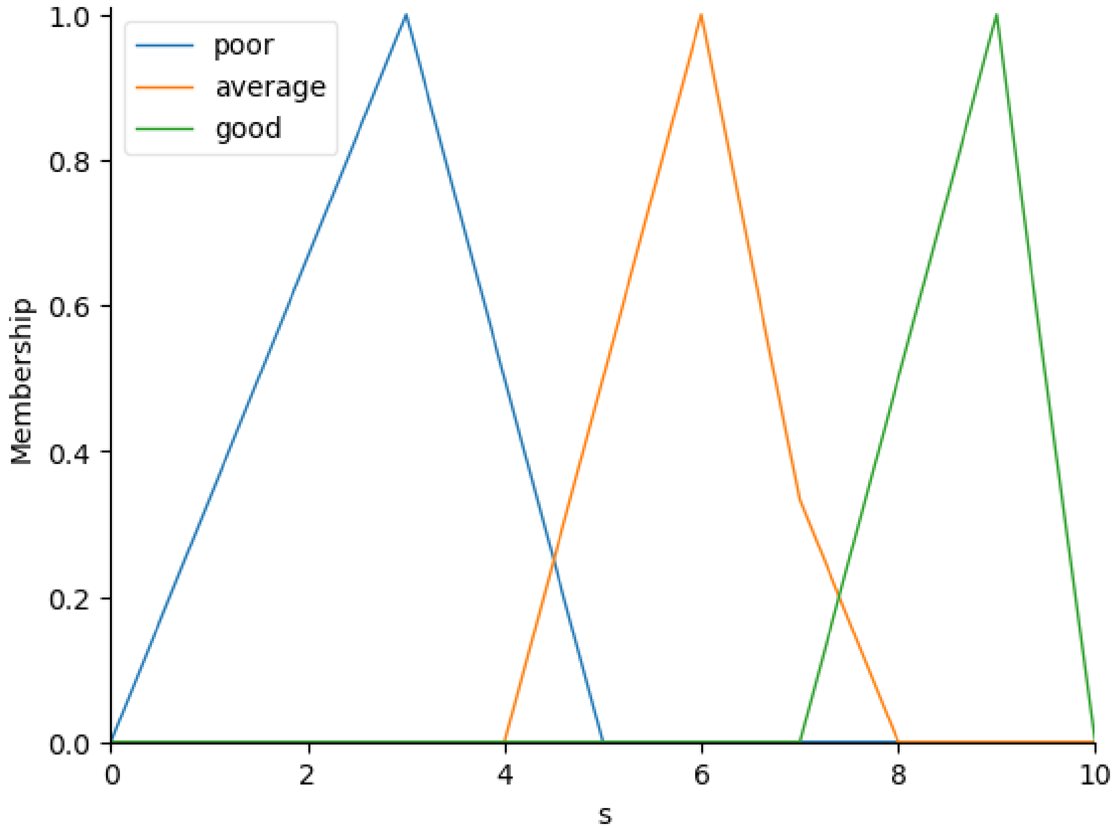
In [6]:

```
import numpy as np
import skfuzzy.control as ctrl
import skfuzzy as fuzzy

#Antecedent is used for input parameters and Consequent is used for output. Here s,o
s=ctrl.Antecedent(np.arange(0,11,1),'s') #S marks range 0-10
o=ctrl.Antecedent(np.arange(0,11,1),'o') #O marks range 0-10
d=ctrl.Antecedent(np.arange(0,11,1),'d') #D marks range 0-10
r=ctrl.Consequent(np.arange(0,11,1),'r') #cgpa between 0-10

#now we consider poor Severity(S) when marks are between 0-5, average when marks bet

s['poor']=fuzzy.trimf(s.universe,[0,3,5])
s['average']=fuzzy.trimf(s.universe,[4,6,7.5])
s['good']=fuzzy.trimf(s.universe,[7,9,10])

#now we consider bad Occurrence(O) when marks are between 0-5, decent when marks bet

o['bad']=fuzzy.trimf(o.universe,[0,3,5])
o['decent']=fuzzy.trimf(o.universe,[4,6,7.5])
o['great']=fuzzy.trimf(o.universe,[7,9,10])

#now we consider bad Detection(D) when marks are between 0-5, decent when marks betw

d['bad']=fuzzy.trimf(d.universe,[0,3,5])
d['decent']=fuzzy.trimf(d.universe,[4,6,7.5])
d['great']=fuzzy.trimf(d.universe,[7,9,10])

#now we consider Low Risk(R) when marks are between 0-5, medium when marks between 4

r['low']=fuzzy.trimf(r.universe,[0,3,5])
r['medium']=fuzzy.trimf(r.universe,[4,6,7.5])
r['high']=fuzzy.trimf(r.universe,[7,9,10])
```

In [7]:

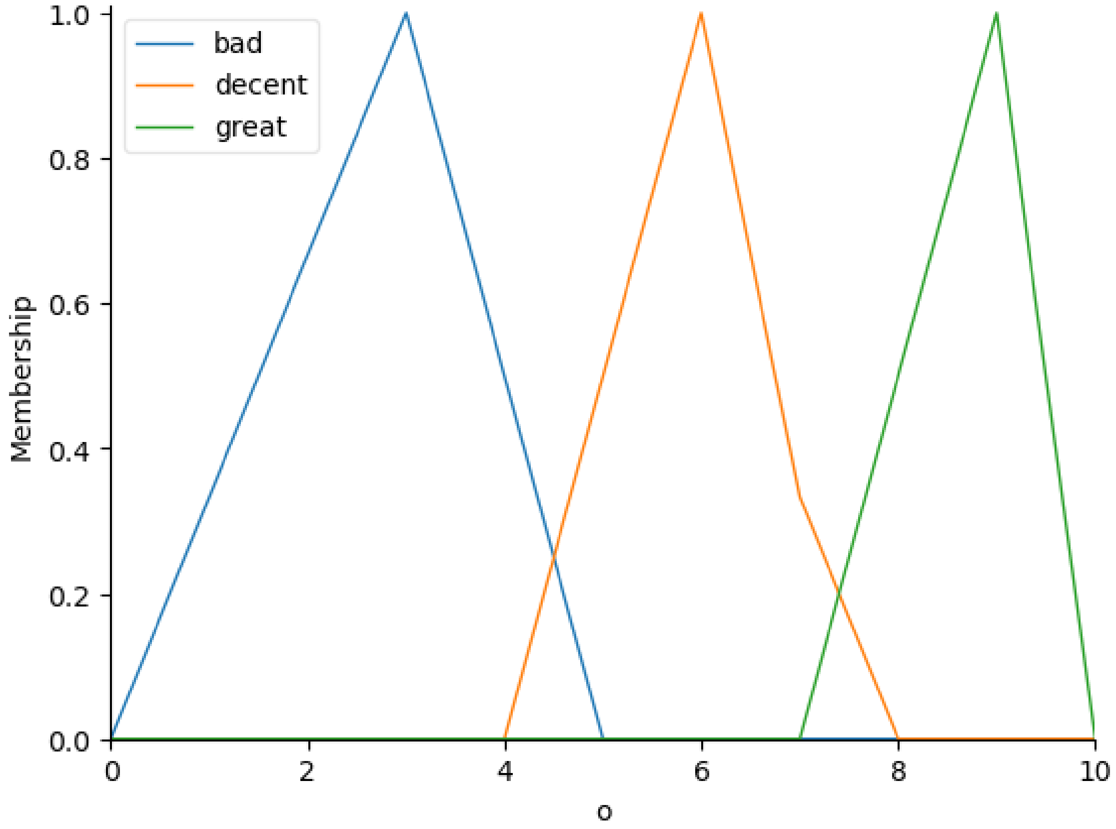
```
1  s.view()
```

```
D:\Anaconda\lib\site-packages\skfuzzy\control\fuzzyvariable.py:122: UserWa
rning: Matplotlib is currently using module://matplotlib_inline.backend_in
line, which is a non-GUI backend, so cannot show the figure.
  fig.show()
```



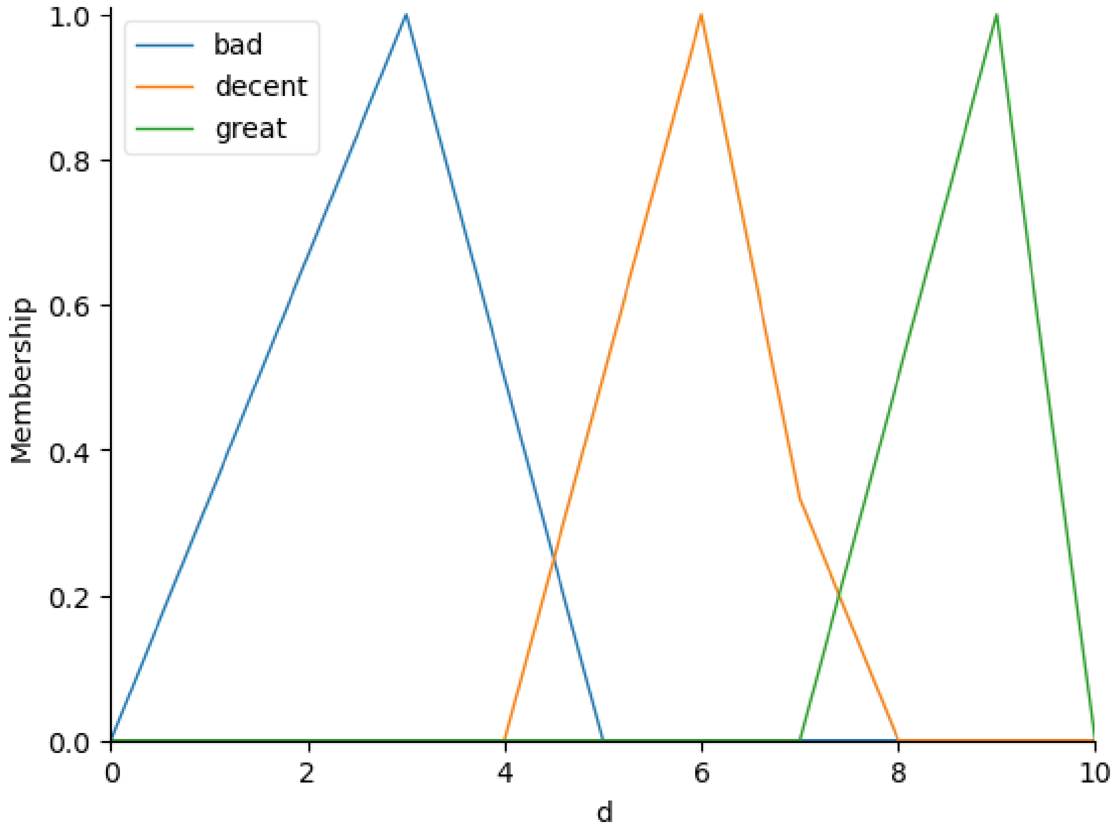
In [8]:

```
1 o.view()
```



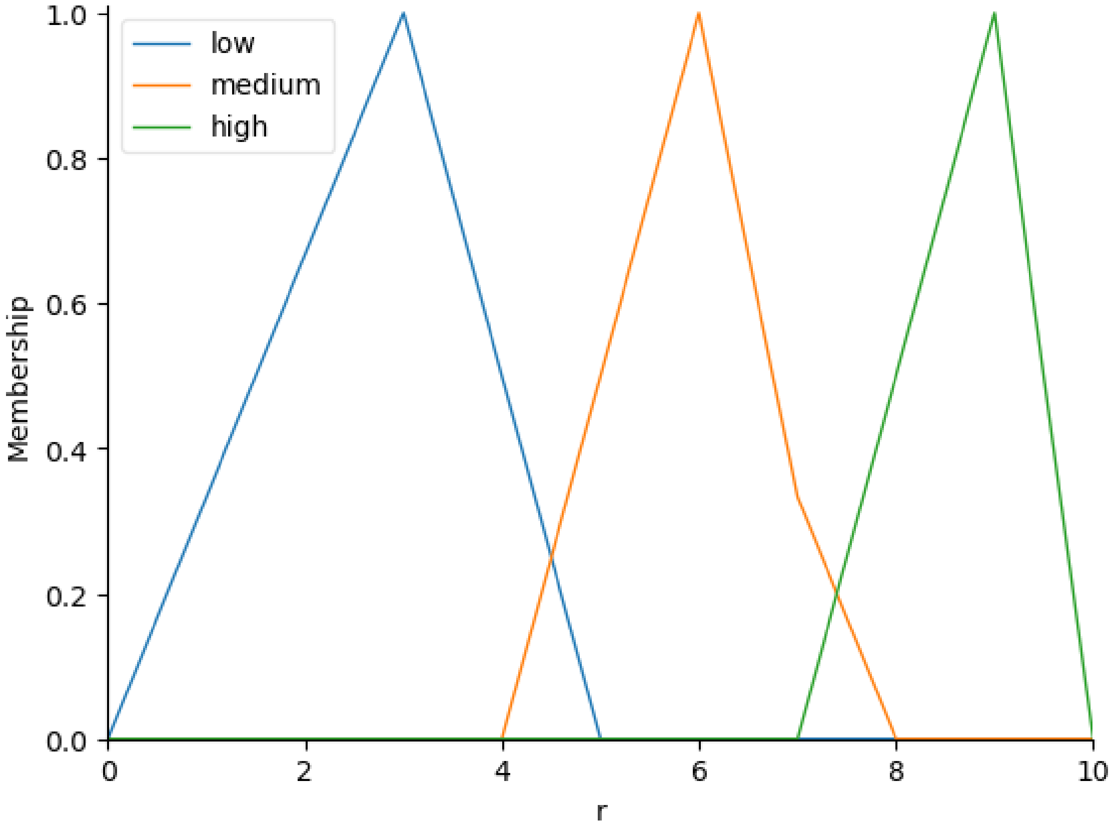
In [9]:

```
1 d.view()
```



In [10]:

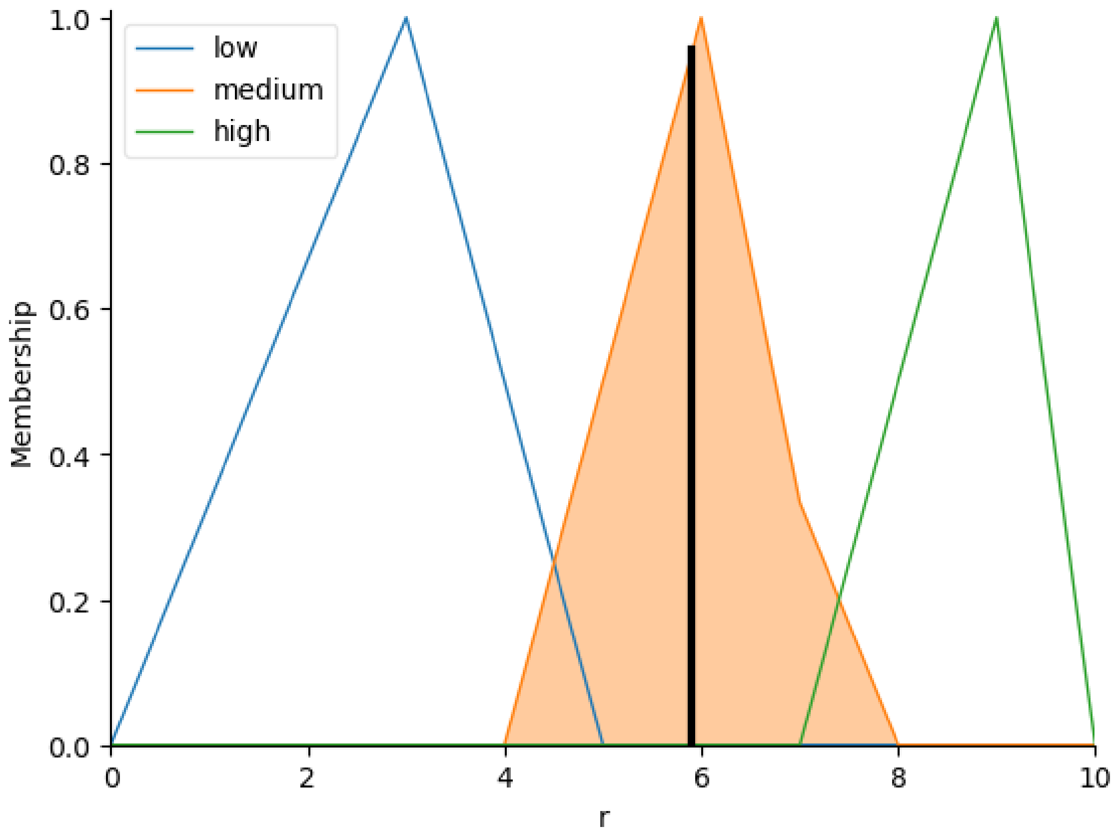
```
r.view()
```



In [11]:

```
#now we will decide rules based on creteria of Severity(S), Occurrence(O) and Detect

rule1 = ctrl.Rule(s['poor'] | o['bad'] | d['bad'], r['low'])
rule2 = ctrl.Rule(s['average'], r['medium'])
rule3 = ctrl.Rule(s['good'] | o['great'] | d['great'], r['high'])
rule4 = ctrl.Rule(o['decent'], r['medium'])
rule5 = ctrl.Rule(d['decent'], r['medium'])
#pass the value to ControlSystem and Simulate before calculating actual output.

risk_calc = ctrl.ControlSystem([rule1, rule2, rule3, rule4, rule5])
risk_sim = ctrl.ControlSystemSimulation(risk_calc)

#Now pass input as
risk_sim.input['s'] = 7
risk_sim.input['o'] = 7
risk_sim.input['d'] = 6

risk_sim.compute() #calculate the risk level

print("Risk level: ", risk_sim.output['r']) #print result
r.view(sim=risk_sim) #visualize output risk
```

```
Risk level:  5.909090909090908
```



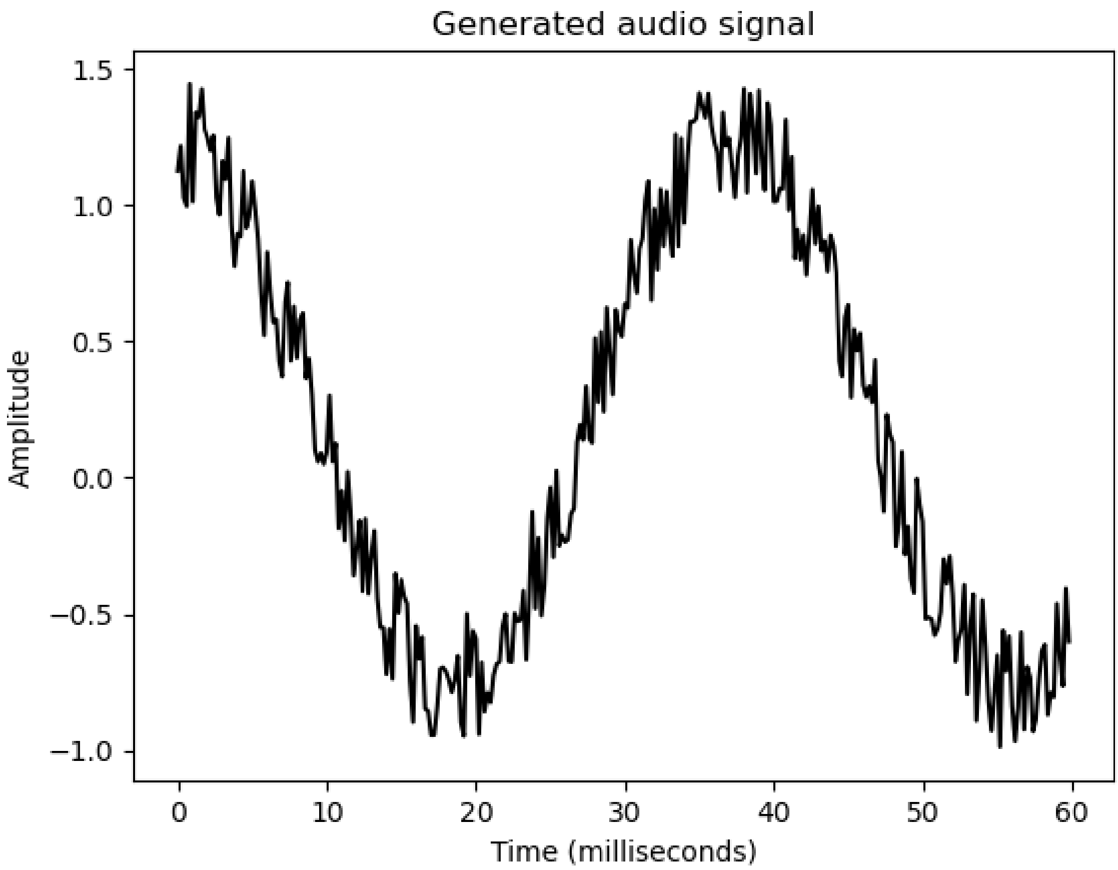

```
From this visualization, we can see that the risk level is 5.9091 since it falls
within the range of 4-7.99, which corresponds to the "Medium risk" category.
Therefore, the interpretation of the risk level based on membership is that it is
classified as medium risk.
```

```
The assessed risk has a moderate potential impact or possibility, according to the risk level's interpretation in this situation. To effectively handle and manage the associated risks, it might need some attention, monitoring, and suitable risk mitigation measures.

It's critical to remember that these membership categories and ranges are arbitrary and can have different definitions depending on the particular risk assessment methodology, business norms, or organisational policies. The interpretation offered here serves as an example illustration and is based on the membership categories and ranges provided.

Establishing distinct and well-defined membership groups based on the unique situation, information at hand, and pertinent risk variables is crucial in practise when determining risk levels. This guarantees consistency and permits efficient risk management decision-making.
```

Question 5

In [12]:

```
import numpy as np
import matplotlib.pyplot as plt
from scipy.io.wavfile import write

# Output file where the audio will be saved
output_file = 'generated_audio.wav'

# Specify audio parameters
duration = 10  # in seconds
sampling_freq = 5000  # in Hz
tone_freq = 800 #in Hz
min_val = -10 * np.pi
max_val = 10 * np.pi

# Generate the audio signal
t = np.linspace(min_val, max_val, duration * sampling_freq)
signal = np.sin(2 * np.pi * tone_freq * t)

# Add some noise to the signal
noise = 0.5 * np.random.rand(duration * sampling_freq)
signal += noise

# Scale it to 16-bit integer values
scaling_factor = np.power(2, 15) - 1
signal_normalized = signal / np.max(np.abs(signal))
signal_scaled = np.int16(signal_normalized * scaling_factor)

# Save the audio signal in the output file
write(output_file, sampling_freq, signal_scaled)

# Extract the first 300 values from the audio signal
signal = signal[:300]

# Construct the time axis in milliseconds
time_axis = 1000 * np.arange(0, len(signal), 1) / float(sampling_freq)

# Plot the audio signal
plt.plot(time_axis, signal, color='black')
plt.xlabel('Time (milliseconds)')
plt.ylabel('Amplitude')
plt.title('Generated audio signal')
plt.show()
```


Generated audio signal
Amplitude
Time (milliseconds)
1.5
1.0
0.5
0.0
−0.5
−1.0
0
10
20
30
40
50
60

In [ ]:

```
1
```