Submission of 2nd Assignment

"Defuzzification Methods"

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Soft Computing

1) Max membership principle

```python
n = int(input("Enter the number of fuzzy sets:\n"))
mp = {}
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    for i in range(0, len(v)):
        if v[i] in mp.keys():
            mp[v[i]] = max(mp[v[i]], d[i])
        else:
            mp[v[i]] = d[i]

values = list(mp.keys())
degrees = list(mp.values())

res = []
for i in range(0, len(values)):
    if degrees[i] == max(degrees):
        res.append(values[i])

print("The defuzzified value(s) are", res)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
```

```
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# The defuzzified value(s) are [6.0, 7.0]
```

2) Centroid Method

```
n = int(input("Enter the number of fuzzy sets:\n"))
mp = {}
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    for i in range(0, len(v)):
        if v[i] in mp.keys():
            mp[v[i]] = max(mp[v[i]], d[i])
        else:
            mp[v[i]] = d[i]

values = list(mp.keys())
degrees = list(mp.values())

INTERVAL = 0.08


def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)


areaXxbar = 0.0
area = 0.0
for i in range(0, len(values)-1):
    x1 = values[i]
    while x1 < values[i+1]:
        x2 = x1 + INTERVAL
        curr_area = (
            INTERVAL*(y_value(x1, values[i+1], degrees[i+1], values[i],
degrees[i]) + y_value(x2, values[i+1], degrees[i+1], values[i],
degrees[i]))/2)
        area += curr_area
        areaXxbar += (curr_area * ((x1+x2)/2))
        x1 += INTERVAL
```

```
print("The defuzzified value is ", areaXxbar/area)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# The defuzzified value is  4.948717948717948
```

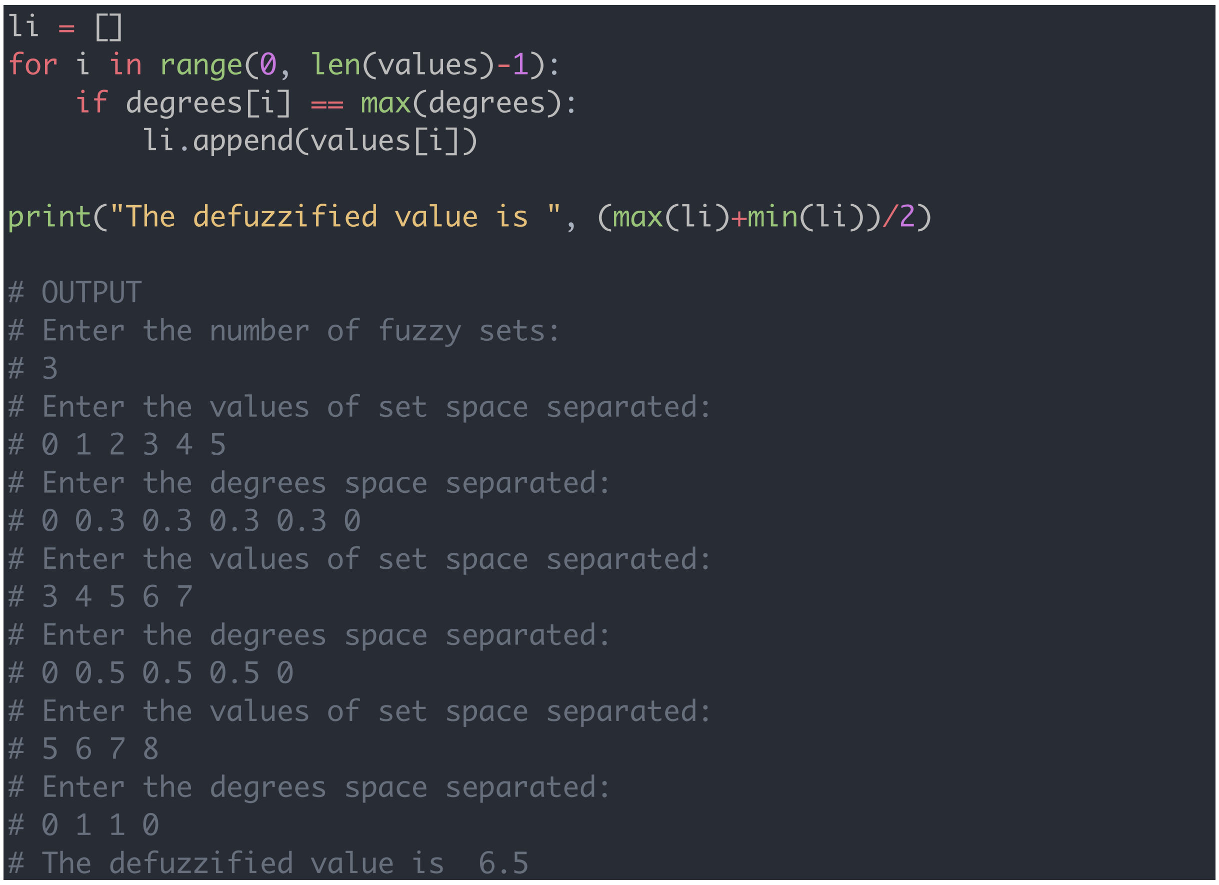
3) Mean max membership

```
n = int(input("Enter the number of fuzzy sets:\n"))
mp = {}
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    for i in range(0, len(v)):
        if v[i] in mp.keys():
            mp[v[i]] = max(mp[v[i]], d[i])
        else:
            mp[v[i]] = d[i]

values = list(mp.keys())
degrees = list(mp.values())

INTERVAL = 0.08


def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)
```

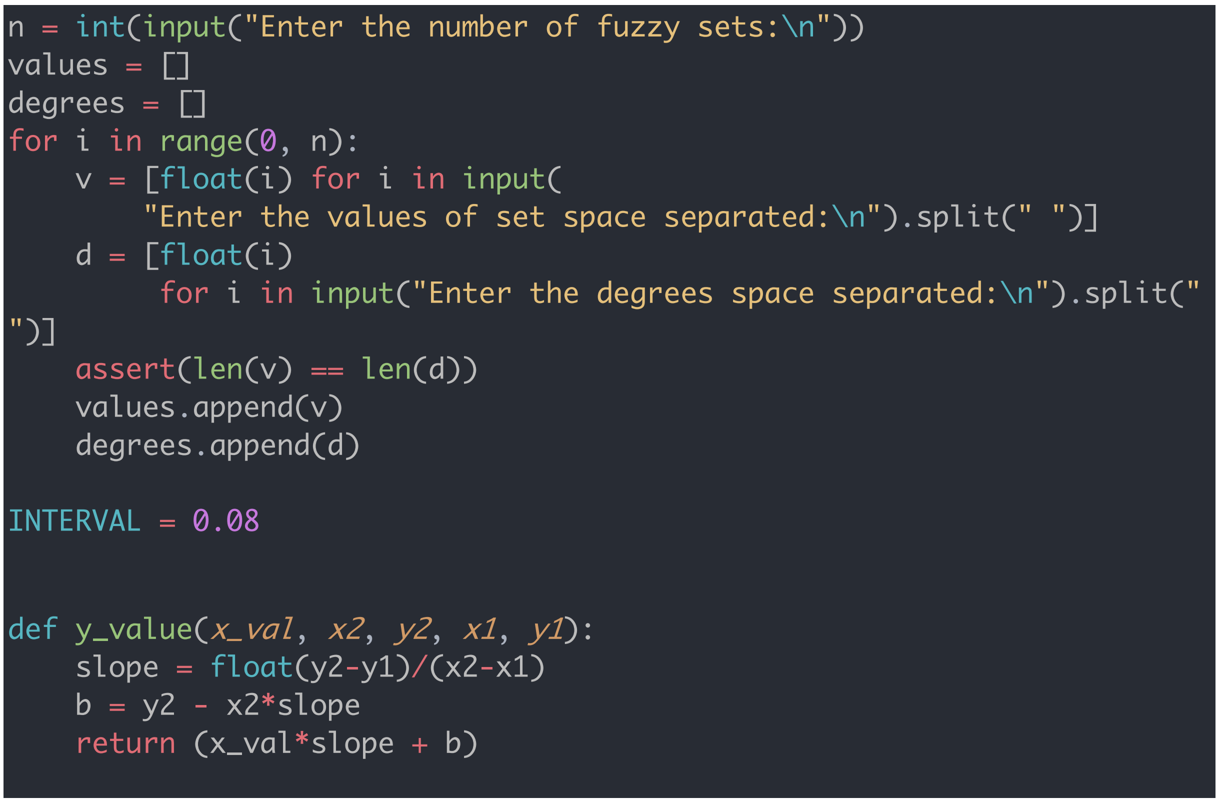


```
li = []
for i in range(0, len(values)-1):
    if degrees[i] == max(degrees):
        li.append(values[i])

print("The defuzzified value is ", (max(li)+min(li))/2)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# The defuzzified value is  6.5
```

4) Center of sums



```
n = int(input("Enter the number of fuzzy sets:\n"))
values = []
degrees = []
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    values.append(v)
    degrees.append(d)

INTERVAL = 0.08


def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)
```

```
def find_area(value1, degree1, value2, degree2):
    area = 0.0
    x1 = value1
    while x1 < value2:
        x2 = x1 + INTERVAL
        curr_area = (
            INTERVAL*(y_value(x1, value2, degree2, value1, degree1) +
y_value(x2, value2, degree2, value1, degree1))/2)
        area += curr_area
        x1 += INTERVAL
    return area


ans = 0.0
denom = 0.0
for i in range(0, n):
    v_list = values[i]
    d_list = degrees[i]
    area = 0.0
    for j in range(0, len(v_list)-1):
        area += find_area(v_list[j], d_list[j], v_list[j+1],
d_list[j+1])
    ans += (area * (sum(v_list)/len(v_list)))
    denom += (area)

ans /= denom
print("The defuzzified value is ", ans)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# The defuzzified value is  5.0
```

5) First (or Last) Of Maxima Method

```python
n = int(input("Enter the number of fuzzy sets:\n"))
mp = {}
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    for i in range(0, len(v)):
        if v[i] in mp.keys():
            mp[v[i]] = max(mp[v[i]], d[i])
        else:
            mp[v[i]] = d[i]

values = list(mp.keys())
degrees = list(mp.values())


def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)


li = []
for i in range(0, len(values)-1):
    if degrees[i] == max(degrees):
        li.append(values[i])

print(f"First of maxima {min(li)} and last of maxima {max(li)}")

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# First of maxima 6.0 and last of maxima 7.0
```

6) Weighted Average Method

```
def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)


n = int(input("Enter the number of fuzzy sets:\n"))

mul = 0.0
degrees = 0.0

for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    avg = sum(v)/len(v)
    for i in range(0, len(v)-1):
        if v[i] <= avg <= v[i+1]:
            y_val = y_value(avg, v[i+1], d[i+1], v[i], d[i])
    mul += (avg * y_val)
    degrees += y_val

print("The defuzzified value is ", mul/degrees)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
```

```
# 0 1 1 0
# The defuzzified value is  5.416666666666667
```

7) Center of Largest Area

```
n = int(input("Enter the number of fuzzy sets:\n"))
values = []
degrees = []
for i in range(0, n):
    v = [float(i) for i in input(
        "Enter the values of set space separated:\n").split(" ")]
    d = [float(i)
         for i in input("Enter the degrees space separated:\n").split("
")]
    assert(len(v) == len(d))
    values.append(v)
    degrees.append(d)

INTERVAL = 0.08


def y_value(x_val, x2, y2, x1, y1):
    slope = float(y2-y1)/(x2-x1)
    b = y2 - x2*slope
    return (x_val*slope + b)


def find_area(value1, degree1, value2, degree2):
    area = 0.0
    x1 = value1
    while x1 < value2:
        x2 = x1 + INTERVAL
        curr_area = (
            INTERVAL*(y_value(x1, value2, degree2, value1, degree1) +
y_value(x2, value2, degree2, value1, degree1))/2)
        area += curr_area
        x1 += INTERVAL
    return area


index = 0
store = -1
for i in range(0, n):
    v_list = values[i]
    d_list = degrees[i]
```

```python
    area = 0.0
    for j in range(0, len(v_list)-1):
        area += find_area(v_list[j], d_list[j], v_list[j+1], 
d_list[j+1])
    if store < area:
        store = area
        index = i

val = sum((values[index])) / len(values[index])
print("The defuzzified value is ", val)

# OUTPUT
# Enter the number of fuzzy sets:
# 3
# Enter the values of set space separated:
# 0 1 2 3 4 5
# Enter the degrees space separated:
# 0 0.3 0.3 0.3 0.3 0
# Enter the values of set space separated:
# 3 4 5 6 7
# Enter the degrees space separated:
# 0 0.5 0.5 0.5 0
# Enter the values of set space separated:
# 5 6 7 8
# Enter the degrees space separated:
# 0 1 1 0
# The defuzzified value is  6.5
```