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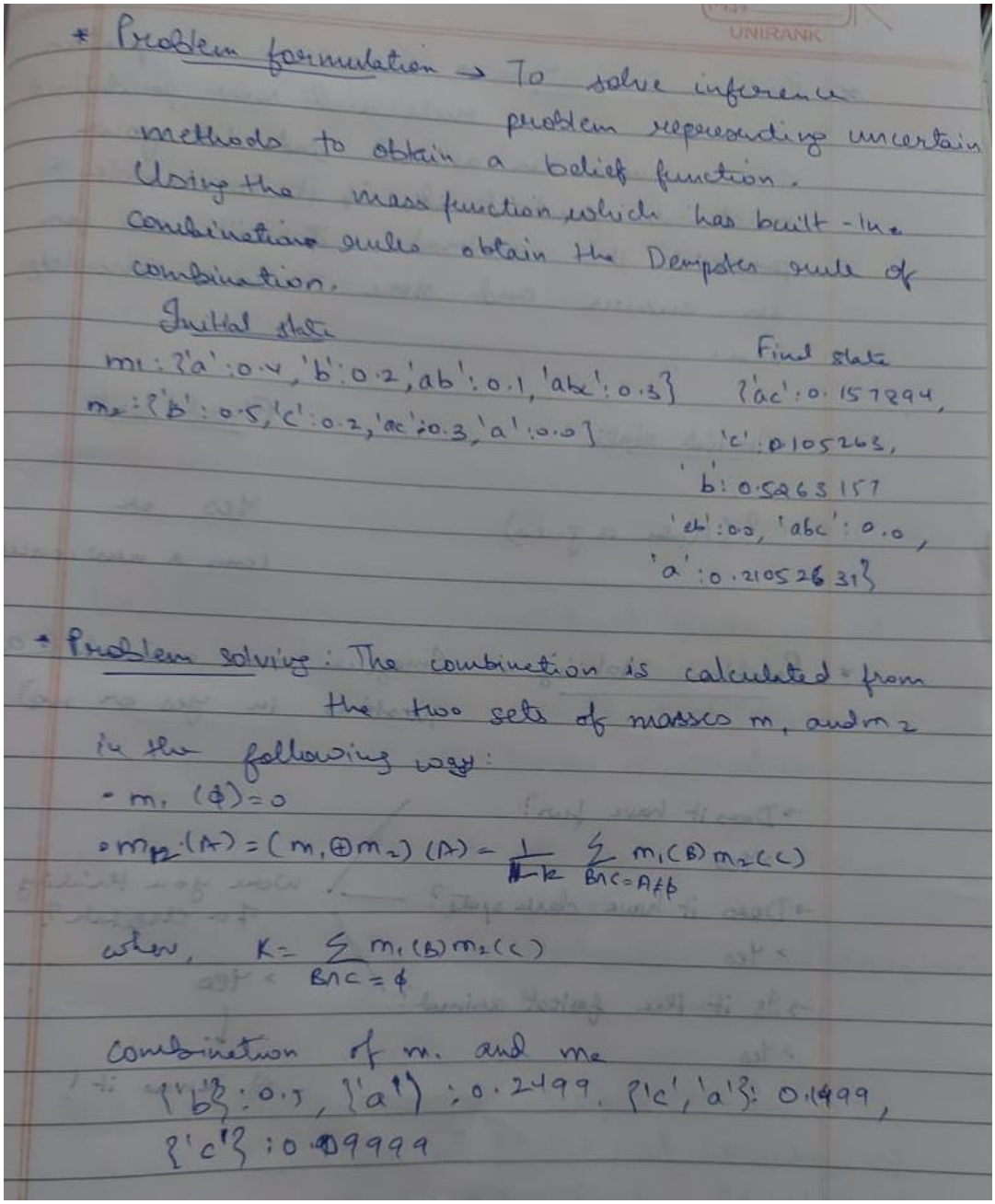
AI LAB-9

Aim- Implementation of UNCERTAIN METHODS – DEMPSTER SHAFER THEORY



* Problem formulation → To solve inference problem representing uncertain methods to obtain a belief function. Using the mass function which has built-in combination rules obtain the Dempster rule of combination.

Initial state

m_1: {'a': 0.4, 'b': 0.2, 'ab': 0.1, 'abc': 0.3}

m_2: {'b': 0.5, 'c': 0.2, 'ac': 0.3, 'a': 0.0}

Final state

{'ac': 0.157894, 'c': 0.105263, 'b': 0.5263157, 'ab': 0.0, 'abc': 0.0, 'a': 0.21052631}

* Problem solving: The combination is calculated from the two sets of masses m_1 and m_2 in the following way:

- $m_1(\phi) = 0$
- $m_{12}(A) = (m_1 \oplus m_2)(A) = \frac{1}{1-k} \sum_{B \cap C = A \neq \phi} m_1(B)\, m_2(C)$

where, $K = \sum_{B \cap C = \phi} m_1(B)\, m_2(C)$

Combination of m_1 and m_2

{'b'}: 0.3, {'a'}: 0.2499, {'c', 'a'}: 0.1499, {'c'}: 0.09999

Algorithm-

Step 1: Start

Step 2: Each piece of evidence is represented by a separate belief function

Step 3: Combination rules are then used to successively fuse all these belief functions in order to obtain a belief function representing all available evidence.

Step 4: Specifically, the combination (called the joint mass) is calculated from the two sets of masses m1 and m2 in the following manner:

- $m_{1,2}(\emptyset) = 0$
- $m_{1,2}(A) = (m_1 \oplus m_2)(A) = (1/1-K) \sum_{B \cap C = A \neq \emptyset} m_1(B)\, m_2(C)$

where,

- $K = \sum_{B \cap C = \emptyset} m_1(B)\, m_2(C)\, K$

K is a measure of the amount of conflict between the two mass sets.

Step 5: In python Mass-Function has the built-in combination rules.

Step 6: Stop

Code-

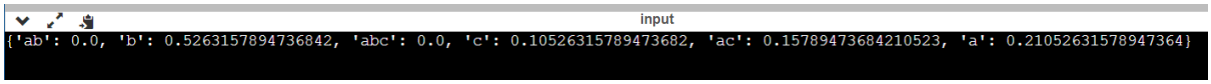
```
from numpy import *


# Do NOT use, just for illustration of the D-S combination rules implementation
def DempsterRule(m1, m2):
   ## extract the frame of discernment
   sets=set(m1.keys()).union(set(m2.keys()))
   result=dict.fromkeys(sets,0)
   ## Combination process
   for i in m1.keys():
      for j in m2.keys():
         if set(str(i)).intersection(set(str(j))) == set(str(i)):
            result[i]+=m1[i]*m2[j]
         elif set(str(i)).intersection(set(str(j))) == set(str(j)):
            result[j]+=m1[i]*m2[j]
```

```
    ## normalize the results
    f= sum(list(result.values()))
    for i in result.keys():
        result[i] /=f
    return result

m1 = {'a':0.4, 'b':0.2, 'ab':0.1, 'abc':0.3}
m2 = {'b':0.5, 'c':0.2, 'ac':0.3, 'a':0.0}
print(DempsterRule(m1, m2))
```

Output-



Result-

Hence, the Implementation of Dempster Shafer Theory is done successfully.