

Course: CS631 Data Mining

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Subject: Mid-Term Project Report

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Midterm Project – Part 1

Programming Language Used: Python3

Source Code for Apriori Alogoritm

```
import numpy as np
import time

start_time=time.time()

#load the data
def load_data(path):
    tr=[]
    with open(path,'r') as fid:
        for line in fid:
            sline= list(line.strip().split(','))
            t=list(np.unique(sline))
            tr.append(t)
    return tr

path= input("Enter path to the data")
min_support=float(input("Enter minimum support:"))
min_conf=float(input("Enter minimum confidence:"))
transaction=load_data(path)
print(*transaction, sep = "\n")

num_trans=len(transaction)

flist = []
for sublist in transaction:
    for item in sublist:
        flist.append(item)

i_list=[]
for i in flist:
    if i not in i_list:
        i_list.append(i)

i_list = [i for i in i_list if i] #contains names of all items in items list

#count frequency of items
def count_frequency(itemset, transaction):
    count=0
    for i in range(len(transaction)):
        if set(itemset).issubset(set(transaction[i])):
            count+=1
    return count
```

```

#to get frequent items
def frequent_item(itemsets,transaction,min_support,discarded):
    l=[]
    supp_count=[]
    new_discarded=[]
    k=len(discarded.keys())
    for s in range(len(itemsets)):
        discard_b=False
        if k>0:
            for it in discarded[k]:
                if set(it).issubset(set(itemsets[s])):
                    discard_b=True
                    break
        if not discard_b:
            count=count_frequency(itemsets[s],transaction)
            if count/len(transaction)>= min_support:
                l.append(itemsets[s])
                supp_count.append(count)
            else:
                new_discarded.append(itemsets[s])
    return l, supp_count, new_discarded

def join_items(itemset,i_list):
    join=[]
    for i in range(len(itemset)):
        for j in range(i+1,len(itemset)):
            ij=jointwo(itemset[i],itemset[j],i_list)
            if len(ij)>0:
                join.append(ij)
    return join

def jointwo(i1,i2,i_list):
    i1.sort(key=lambda x: i_list.index(x))
    i2.sort(key=lambda x: i_list.index(x))
    for i in range(len(i1)-1):
        if i1[i]!=i2[i]:
            return []
    if i_list.index(i1[-1])<i_list .index(i2[-1]):
        return i1+[i2[-1]]

    return []

def ch(*it):
    for i in it:
        for element in i:
            yield element

def iter(it):
    for i in it:
        for element in i:
            yield element

def comb(it, r):
    trans = tuple(it)

```

```

n = len(trans)
if r > n:
    return
index = list(range(r))
yield tuple(trans[i] for i in index)
while True:
    for i in reversed(range(r)):
        if index[i] != i + n - r:
            break
    else:
        return
    index[i] += 1
    for j in range(i+1, r):
        index[j] = index[j-1] + 1
    yield tuple(trans[i] for i in index)

def combination_gen(s):
    return list(ch(ite(comb(s,r) for r in range(1,len(s)+1)))))

def rules(S1,S2,S,conf,supp,num_trans):
    w_rule=""
    w_rule+="frequent itemsets:{}\n".format(S1)
    w_rule+="    Rule:{} -> {} \n".format(list(S),list(S2))
    w_rule+="    confidence:{0:2.3f}\n".format(conf)
    w_rule+="    support:{0:2.3f}\n".format(supp/num_trans)

    return w_rule

#initialize

cf={}
lf={}
itemset_size=1

discarded={itemset_size:[]}
cf.update({itemset_size:[f for f in i_list]})

supp_count_lf={}
freq,sup,new_discard=frequent_item(cf[itemset_size],transaction,min_support,discarded)
discarded.update({itemset_size:new_discard})
lf.update({itemset_size:freq})
supp_count_lf.update({itemset_size:sup})

#updating itemsets and frequent itemsets
k=itemset_size+1
con=False
while not con:
    cf.update({k:join_items(lf[k-1],i_list)})

    freq,sup,new_discard=frequent_item(cf[k],transaction,min_support,discarded)
    discarded.update({k:new_discard})
    lf.update({k:freq})
    supp_count_lf.update({k:sup})
    if len(lf[k])==0:
        con=True

```

```
k+=1

#generating association rule
a_rules=""
for i in range(1,len(lf)):
    for j in range(len(lf[i])):
        m=list(combination_gen(set(lf[i][j])))
        m.pop()
        for n in m:
            S=set(n)
            S1=set(lf[i][j])
            S2=set(S1-S)
            sup_x=count_frequency(S1, transaction)
            conf=sup_x/count_frequency(S,transaction)
            if conf>=min_conf and sup_x>=min_support:
                a_rules+=rules(S1,S2,S,conf,sup_x,num_trans)

print(a_rules)
print("Execution time is: %s seconds " % (time.time() - start_time))
```

Outputs for Apriori Algorithm

Outputs for Dataset 1

```
In [1]: runfile('C:/Users/Twinkle/Apriori_final.py', wdir='C:/Users/Twinkle')
<IPython.core.display.HTML object>

Enter path to the dataC:\Users\Twinkle\Desktop\Data Mining\dataset1.csv

Enter minimum support:0.3

Enter minimum confidence:0.6
[', 'apples', 'avocado', 'banana', 'bread', 'chickpeas', 'eggs', 'orangejuice', 'peanutbutter', 'sugar', 'yogurt', 'i»;milk']
[', 'bread', 'broccoli', 'butter', 'chips', 'crackers', 'milk', 'onions', 'popcorn', 'potatoes', 'strawberry', 'sugar', 'tofu']
[', 'avocado', 'banana', 'blackbeans', 'cereal', 'chickpeas', 'eggs', 'grapes', 'lemon', 'milk', 'strawberry', 'tomato', 'yogurt']
[', 'avocado', 'banana', 'bread', 'butter', 'cheese', 'eggs', 'macroni', 'milk', 'sugar', 'tofu', 'yogurt']
[', 'blackbeans', 'butter', 'cauliflower', 'chickpeas', 'chips', 'grapes', 'tomato']
[', 'bread', 'cereal', 'cheese', 'eggs', 'ketchup', 'macroni', 'milk', 'mustard']
[', 'avocado', 'bread', 'butter', 'cheese', 'eggs', 'lemon', 'onions', 'tofu', 'tomato']
[', 'apples', 'eggs', 'grapes', 'lemon', 'milk', 'orange juice', 'yogurt']
[', 'avocado', 'bread', 'butter', 'cheese', 'eggs', 'milk', 'peanutbutter', 'potatoes']
[', 'blackbeans', 'broccoli', 'cauliflower', 'chickpeas', 'lemon', 'onions', 'potatoes', 'tomato']
[', 'chips', 'crackers', 'milk', 'popcorn', 'sugar', 'yogurt']
[', 'avocado', 'bread', 'eggs', 'ketchup', 'lemon', 'mustard', 'tomato']
[', 'apples', 'avocado', 'broccoli', 'cauliflower', 'cheese', 'tomato']
[', 'bread', 'butter', 'cereal', 'chips', 'crackers', 'eggs', 'milk', 'tofu', 'yogurt']
[', 'bread', 'cereal', 'cheese', 'eggs', 'lemon', 'milk', 'onions', 'orangejuice', 'peanutbutter', 'strawberry', 'sugar']
[', 'avocado', 'broccoli', 'cauliflower', 'lemon', 'onions', 'potatoes']
[', 'avocado', 'bread', 'chickpeas', 'chips', 'eggs', 'ketchup', 'mustard', 'onions', 'tomato']
[', 'apples', 'avocado', 'bread', 'butter', 'cereal', 'chickpeas', 'chips', 'crackers', 'eggs', 'macroni', 'milk', 'sugar', 'tofu', 'yogurt']
[', 'apples', 'avocado', 'banana', 'blackbeans', 'broccoli', 'cauliflower', 'chickpeas', 'lemon', 'macroni', 'strawberry']
[', 'blackbeans', 'bread', 'broccoli', 'butter', 'cereal', 'chickpeas', 'chips', 'crackers', 'lemon', 'milk', 'onions', 'peanutbutter', 'sugar']

Associations rules:
frequent itemsets:{'bread', 'avocado'}
    Rule:[ 'avocado'] -> [ 'bread']
    confidence:0.636
    support:0.350
frequent itemsets:{'eggs', 'avocado'}
    Rule:[ 'eggs'] -> [ 'avocado']
    confidence:0.667
    support:0.400
frequent itemsets:{'eggs', 'avocado'}
    Rule:[ 'avocado'] -> [ 'eggs']
    confidence:0.727
    support:0.400
frequent itemsets:{'bread', 'eggs'}
    Rule:[ 'bread'] -> [ 'eggs']
    confidence:0.833
    support:0.500
```

Output1 with Data set 1

Dataset 1 is displayed below input values and above rules

Minimum Support:0.3

Minimum Confidence: 0.6

```

frequent itemsets:{'bread', 'eggs'}
  Rule:[ 'eggs' ] -> [ 'bread' ]
  confidence:0.833
  support:0.500
frequent itemsets:{'bread', 'sugar'}
  Rule:[ 'sugar' ] -> [ 'bread' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'bread', 'butter'}
  Rule:[ 'butter' ] -> [ 'bread' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'bread', 'milk'}
  Rule:[ 'bread' ] -> [ 'milk' ]
  confidence:0.667
  support:0.400
frequent itemsets:{'bread', 'milk'}
  Rule:[ 'milk' ] -> [ 'bread' ]
  confidence:0.727
  support:0.400
frequent itemsets:{'yogurt', 'eggs'}
  Rule:[ 'yogurt' ] -> [ 'eggs' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'milk', 'eggs'}
  Rule:[ 'milk' ] -> [ 'eggs' ]
  confidence:0.727
  support:0.400
frequent itemsets:{'milk', 'eggs'}
  Rule:[ 'eggs' ] -> [ 'milk' ]
  confidence:0.667
  support:0.400
frequent itemsets:{'sugar', 'milk'}
  Rule:[ 'sugar' ] -> [ 'milk' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'yogurt', 'milk'}
  Rule:[ 'yogurt' ] -> [ 'milk' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'milk', 'butter'}
  Rule:[ 'butter' ] -> [ 'milk' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'bread', 'eggs', 'avocado'}
  Rule:[ 'avocado' ] -> [ 'bread', 'eggs' ]
  confidence:0.636
  support:0.300

```

Output 2

```

frequent itemsets:{'milk', 'butter'}
  Rule:[ 'butter' ] -> [ 'milk' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'bread', 'eggs', 'avocado'}
  Rule:[ 'avocado' ] -> [ 'bread', 'eggs' ]
  confidence:0.636
  support:0.350
frequent itemsets:{'bread', 'eggs', 'avocado'}
  Rule:[ 'bread', 'eggs' ] -> [ 'avocado' ]
  confidence:0.700
  support:0.350
frequent itemsets:{'bread', 'eggs', 'avocado'}
  Rule:[ 'bread', 'avocado' ] -> [ 'eggs' ]
  confidence:1.000
  support:0.350
frequent itemsets:{'bread', 'eggs', 'avocado'}
  Rule:[ 'eggs', 'avocado' ] -> [ 'bread' ]
  confidence:0.875
  support:0.350
frequent itemsets:{'bread', 'milk', 'eggs'}
  Rule:[ 'bread', 'milk' ] -> [ 'eggs' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'bread', 'milk', 'eggs'}
  Rule:[ 'bread', 'eggs' ] -> [ 'milk' ]
  confidence:0.600
  support:0.300
frequent itemsets:{'bread', 'milk', 'eggs'}
  Rule:[ 'milk', 'eggs' ] -> [ 'bread' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'butter' ] -> [ 'bread', 'milk' ]
  confidence:0.857
  support:0.300
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'bread', 'milk' ] -> [ 'butter' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'bread', 'butter' ] -> [ 'milk' ]
  confidence:1.000
  support:0.300
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'milk', 'butter' ] -> [ 'bread' ]
  confidence:1.000

```

Output 3

```

support:0.500
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'bread', 'butter' ] -> [ 'milk' ]
  confidence:1.000
  support:0.300
frequent itemsets:{'bread', 'milk', 'butter'}
  Rule:[ 'milk', 'butter' ] -> [ 'bread' ]
  confidence:1.000
  support:0.300

```

Execution time is: 6.635251045227051 seconds

Output 4 with execution time

Outputs for Dataset 2

```
Enter path to the dataC:\Users\Twinkle\Desktop\Data Mining\dataset2.csv
Enter minimum support:0.4
Enter minimum confidence:0.8
[', 'broccoli', 'cauliflower', 'cheese', 'crackers', 'eggs', 'ketchup', 'lemon', 'onions', 'peanutbutter', 'popcorn', 'strawberry', 'tofu', 'tomato', 'yogurt', 'ix{potatoes']
[', 'apples', 'avocado', 'banana', 'blackbeans', 'bread', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'grapes', 'macroni', 'mustard', 'orangejuice', 'potatoes', 'sugar', 'tomato']
[', 'apples', 'avocado', 'blackbeans', 'butter', 'cereal', 'chips', 'crackers', 'eggs', 'ketchup', 'lemon', 'macroni', 'milk', 'onions', 'popcorn', 'potatoes', 'sugar', 'tofu', 'tomato', 'yogurt']
[', 'apples', 'avocado', 'bread', 'broccoli', 'cauliflower', 'cereal', 'chips', 'crackers', 'eggs', 'ketchup', 'macroni', 'milk', 'popcorn', 'potatoes', 'strawberry', 'tofu', 'tomato', 'yogurt']
[', 'banana', 'blackbeans', 'bread', 'cauliflower', 'chickpeas', 'eggs', 'grapes', 'lemon', 'macroni', 'milk', 'mustard', 'orangejuice', 'sugar', 'tofu', 'tomato']
[', 'apples', 'avocado', 'blackbeans', 'chickpeas', 'crackers', 'eggs', 'grapes', 'lemon', 'macroni', 'milk', 'mustard', 'orangejuice', 'peanutbutter', 'popcorn', 'potatoes', 'sugar', 'tomato']
[', 'apples', 'avocado', 'banana', 'butter', 'cauliflower', 'cereal', 'chickpeas', 'crackers', 'eggs', 'grapes', 'ketchup', 'macroni', 'milk', 'peanutbutter', 'potatoes', 'sugar', 'tofu', 'tomato', 'yogurt']
[', 'banana', 'blackbeans', 'bread', 'broccoli', 'butter', 'cereal', 'crackers', 'eggs', 'grapes', 'lemon', 'macroni', 'mustard', 'orangejuice', 'peanutbutter', 'popcorn', 'sugar', 'yogurt']
[', 'apples', 'avocado', 'bread', 'broccoli', 'cereal', 'cheese', 'chickpeas', 'crackers', 'eggs', 'grapes', 'ketchup', 'lemon', 'macroni', 'milk', 'onions', 'peanutbutter', 'popcorn', 'potatoes', 'sugar', 'tomato']
[', 'apples', 'avocado', 'banana', 'blackbeans', 'bread', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'grapes', 'lemon', 'macroni', 'milk', 'mustard', 'orangejuice', 'sugar', 'tomato', 'yogurt']
[', 'apples', 'avocado', 'banana', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'grapes', 'ketchup', 'lemon', 'macroni', 'milk', 'onions', 'peanutbutter', 'popcorn', 'potatoes', 'sugar', 'tomato', 'yogurt']
[', 'blackbeans', 'bread', 'cheese', 'chickpeas', 'chips', 'crackers', 'grapes', 'ketchup', 'macroni', 'milk', 'onions', 'orangejuice', 'potatoes', 'strawberry', 'sugar', 'tofu']
[', 'banana', 'broccoli', 'butter', 'cauliflower', 'cereal', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'potatoes', 'sugar', 'tomato', 'yogurt']
[', 'apples', 'avocado', 'blackbeans', 'bread', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'grapes', 'lemon', 'macroni', 'milk', 'peanutbutter', 'popcorn', 'potatoes', 'sugar', 'tomato', 'yogurt']
[', 'blackbeans', 'broccoli', 'cauliflower', 'cereal', 'cheese', 'chickpeas', 'chips', 'grapes', 'lemon', 'macroni', 'milk', 'mustard', 'orangejuice', 'popcorn', 'strawberry', 'sugar', 'yogurt']
['avocado', 'banana', 'broccoli', 'butter', 'cauliflower', 'cereal', 'chickpeas', 'chips', 'crackers', 'eggs', 'grapes', 'ketchup', 'macroni', 'milk', 'mustard', 'peanutbutter', 'popcorn', 'strawberry', 'sugar', 'tofu']
[', 'apples', 'bread', 'broccoli', 'butter', 'cauliflower', 'chickpeas', 'chips', 'crackers', 'lemon', 'macroni', 'orangejuice', 'potatoes', 'strawberry', 'sugar', 'tofu', 'tomato', 'yogurt']
[', 'apples', 'avocado', 'bread', 'butter', 'cereal', 'cheese', 'chips', 'eggs', 'grapes', 'ketchup', 'lemon', 'macroni', 'milk', 'onions', 'popcorn', 'potatoes', 'sugar', 'tomato', 'yogurt']
[', 'banana', 'blackbeans', 'broccoli', 'cauliflower', 'cereal', 'cheese', 'chickpeas', 'crackers', 'eggs', 'grapes', 'ketchup', 'lemon', 'macroni', 'milk', 'orangejuice', 'peanutbutter', 'potatoes', 'sugar', 'tomato', 'yogurt']

Associations rules:
frequent itemsets:{'broccoli', 'cauliflower'}
    Rule:[‘broccoli’] → [‘cauliflower’]
        confidence:0.833
        support:0.500
frequent itemsets:{‘crackers’, ‘broccoli’}
    Rule:[‘broccoli’] → [‘crackers’]
        confidence:0.833
        support:0.500
frequent itemsets:{‘banana’, ‘cauliflower’}
    Rule:[‘banana’] → [‘cauliflower’]
        confidence:0.900
        support:0.450
frequent itemsets:{‘cheese’, ‘lemon’}
    Rule:[‘cheese’] → [‘lemon’]
        confidence:0.818
        support:0.450
```

Output 1 for Dataset 2 with Data set
Dataset 2 is displayed below input values and above rules
Minimum Support:0.4
Minimum Confidence: 0.8

```

frequent itemsets:{'cheese', 'sugar'}
  Rule:['cheese'] -> ['sugar']
  confidence:0.818
  support:0.450
frequent itemsets:{'peanutbutter', 'crackers'}
  Rule:['peanutbutter'] -> ['crackers']
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'lemon'}
  Rule:['eggs'] -> ['lemon']
  confidence:0.857
  support:0.600
frequent itemsets:{'eggs', 'lemon'}
  Rule:['lemon'] -> ['eggs']
  confidence:0.800
  support:0.600
frequent itemsets:{'banana', 'eggs'}
  Rule:['banana'] -> ['eggs']
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'mustard'}
  Rule:['mustard'] -> ['eggs']
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'cereal'}
  Rule:['cereal'] -> ['eggs']
  confidence:0.846
  support:0.550
frequent itemsets:{'ketchup', 'onions'}
  Rule:['onions'] -> ['ketchup']
  confidence:0.889
  support:0.400
frequent itemsets:{'ketchup', 'peanutbutter'}
  Rule:['peanutbutter'] -> ['ketchup']
  confidence:0.800
  support:0.400
frequent itemsets:{'ketchup', 'tofu'}
  Rule:['ketchup'] -> ['tofu']
  confidence:0.833
  support:0.500
frequent itemsets:{'onions', 'lemon'}
  Rule:['onions'] -> ['lemon']
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'lemon'}
  Rule:['yogurt'] -> ['lemon']
  confidence:0.846

```

Output 2 for Dataset 2

```

frequent itemsets:{'blackbeans', 'lemon'}
  Rule:['blackbeans'] -> ['lemon']
  confidence:0.800
  support:0.400
frequent itemsets:{'mustard', 'lemon'}
  Rule:['mustard'] -> ['lemon']
  confidence:0.800
  support:0.400
frequent itemsets:{'orangejuice', 'lemon'}
  Rule:['orangejuice'] -> ['lemon']
  confidence:0.800
  support:0.400
frequent itemsets:{'lemon', 'sugar'}
  Rule:['lemon'] -> ['sugar']
  confidence:0.800
  support:0.600
frequent itemsets:{'popcorn', 'onions'}
  Rule:['onions'] -> ['popcorn']
  confidence:0.889
  support:0.400
frequent itemsets:{'popcorn', 'peanutbutter'}
  Rule:['peanutbutter'] -> ['popcorn']
  confidence:0.800
  support:0.400
frequent itemsets:{'peanutbutter', 'tofu'}
  Rule:['peanutbutter'] -> ['tofu']
  confidence:0.800
  support:0.400
frequent itemsets:{'peanutbutter', 'chickpeas'}
  Rule:['peanutbutter'] -> ['chickpeas']
  confidence:0.800
  support:0.400
frequent itemsets:{'grapes', 'peanutbutter'}
  Rule:['peanutbutter'] -> ['grapes']
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'peanutbutter'}
  Rule:['peanutbutter'] -> ['macroni']
  confidence:0.800
  support:0.400
frequent itemsets:{'tofu', 'chickpeas'}
  Rule:['chickpeas'] -> ['tofu']
  confidence:0.818
  support:0.450
frequent itemsets:{'macroni', 'tofu'}
  Rule:['tofu'] -> ['macroni']
  confidence:0.846

```

Output 3 for Dataset 2

```

support:0.833
frequent itemsets:{'tofu', 'milk'}
  Rule:['milk'] -> ['tofu']
  confidence:0.833
  support:0.500
frequent itemsets:{'apples', 'tomato'}
  Rule:['apples'] -> ['tomato']
  confidence:0.818
  support:0.450
frequent itemsets:{'potatoes', 'tomato'}
  Rule:['potatoes'] -> ['tomato']
  confidence:0.846
  support:0.550
frequent itemsets:{'avocado', 'apples'}
  Rule:['avocado'] -> ['apples']
  confidence:0.833
  support:0.500
frequent itemsets:{'avocado', 'apples'}
  Rule:['apples'] -> ['avocado']
  confidence:0.909
  support:0.500
frequent itemsets:{'macroni', 'apples'}
  Rule:['apples'] -> ['macroni']
  confidence:0.818
  support:0.450
frequent itemsets:{'potatoes', 'apples'}
  Rule:['apples'] -> ['potatoes']
  confidence:0.909
  support:0.500
frequent itemsets:{'apples', 'sugar'}
  Rule:['apples'] -> ['sugar']
  confidence:0.818
  support:0.450
frequent itemsets:{'avocado', 'sugar'}
  Rule:['avocado'] -> ['sugar']
  confidence:0.833
  support:0.500
frequent itemsets:{'banana', 'macroni'}
  Rule:['banana'] -> ['macroni']
  confidence:0.800
  support:0.400
frequent itemsets:{'banana', 'sugar'}
  Rule:['banana'] -> ['sugar']
  confidence:0.900
  support:0.450
frequent itemsets:{'blackbeans', 'grapes'}
  Rule:['blackbeans'] -> ['grapes']
  confidence:0.800

```

Output 4 for Dataset 2

```

frequent itemsets:{'blackbeans', 'macroni'}
  Rule:['blackbeans'] -> ['macroni']
  confidence:0.800
  support:0.400
frequent itemsets:{'blackbeans', 'orangejuice'}
  Rule:['blackbeans'] -> ['orangejuice']
  confidence:0.800
  support:0.400
frequent itemsets:{'blackbeans', 'orangejuice'}
  Rule:['orangejuice'] -> ['blackbeans']
  confidence:0.800
  support:0.400
frequent itemsets:{'blackbeans', 'sugar'}
  Rule:['blackbeans'] -> ['sugar']
  confidence:0.800
  support:0.400
frequent itemsets:{'blackbeans', 'milk'}
  Rule:['blackbeans'] -> ['milk']
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'bread'}
  Rule:['bread'] -> ['macroni']
  confidence:0.889
  support:0.400
frequent itemsets:{'sugar', 'bread'}
  Rule:['bread'] -> ['sugar']
  confidence:0.889
  support:0.400
frequent itemsets:{'grapes', 'chickpeas'}
  Rule:['chickpeas'] -> ['grapes']
  confidence:0.818
  support:0.450
frequent itemsets:{'macroni', 'chickpeas'}
  Rule:['chickpeas'] -> ['macroni']
  confidence:0.909
  support:0.500
frequent itemsets:{'sugar', 'chickpeas'}
  Rule:['chickpeas'] -> ['sugar']
  confidence:0.818
  support:0.450
frequent itemsets:{'sugar', 'chips'}
  Rule:['chips'] -> ['sugar']
  confidence:0.909
  support:0.500
frequent itemsets:{'macroni', 'orangejuice'}
  Rule:['orangejuice'] -> ['macroni']
  confidence:0.800

```

Output 5 for Dataset 2

```

frequent itemsets:{'macroni', 'sugar'}
  Rule:[ 'macroni' ] -> [ 'sugar' ]
  confidence:0.867
  support:0.650
frequent itemsets:{'macroni', 'sugar'}
  Rule:[ 'sugar' ] -> [ 'macroni' ]
  confidence:0.812
  support:0.650
frequent itemsets:{'macroni', 'milk'}
  Rule:[ 'milk' ] -> [ 'macroni' ]
  confidence:0.833
  support:0.500
frequent itemsets:{'mustard', 'sugar'}
  Rule:[ 'mustard' ] -> [ 'sugar' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'orangejuice', 'sugar'}
  Rule:[ 'orangejuice' ] -> [ 'sugar' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'butter', 'sugar'}
  Rule:[ 'butter' ] -> [ 'sugar' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'sugar', 'cereal'}
  Rule:[ 'cereal' ] -> [ 'sugar' ]
  confidence:0.846
  support:0.550
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'broccoli', 'crackers' ] -> [ 'cauliflower' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'crackers', 'cauliflower' ] -> [ 'broccoli' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'broccoli', 'cauliflower' ] -> [ 'crackers' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'broccoli', 'cauliflower'}
  Rule:[ 'yogurt', 'broccoli' ] -> [ 'cauliflower' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'broccoli', 'cauliflower'}
  Rule:[ 'yogurt', 'cauliflower' ] -> [ 'broccoli' ]
  confidence:0.889
  support:0.400

```

Output 6 for Dataset 2

```

frequent itemsets:{'yogurt', 'broccoli', 'cauliflower'}
  Rule:[ 'broccoli', 'cauliflower' ] -> [ 'yogurt' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'eggs', 'broccoli'}
  Rule:[ 'broccoli', 'crackers' ] -> [ 'eggs' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'eggs', 'broccoli'}
  Rule:[ 'eggs', 'broccoli' ] -> [ 'crackers' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'crackers', 'lemon', 'broccoli'}
  Rule:[ 'lemon', 'crackers' ] -> [ 'broccoli' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'lemon', 'broccoli'}
  Rule:[ 'broccoli', 'crackers' ] -> [ 'lemon' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'lemon', 'broccoli'}
  Rule:[ 'lemon', 'broccoli' ] -> [ 'crackers' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'broccoli'}
  Rule:[ 'yogurt', 'crackers' ] -> [ 'broccoli' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'broccoli'}
  Rule:[ 'yogurt', 'broccoli' ] -> [ 'crackers' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'broccoli'}
  Rule:[ 'broccoli', 'crackers' ] -> [ 'yogurt' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cereal'}
  Rule:[ 'broccoli', 'crackers' ] -> [ 'cereal' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cereal'}
  Rule:[ 'crackers', 'cereal' ] -> [ 'broccoli' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cereal'}
  Rule:[ 'broccoli', 'cereal' ] -> [ 'crackers' ]
  confidence:1.000
  support:0.400

```

Output 7 for Dataset 2

```

frequent itemsets:{'yogurt', 'lemon', 'broccoli'}
  Rule:[ 'yogurt', 'broccoli' ] -> [ 'lemon' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'lemon', 'broccoli'}
  Rule:[ 'lemon', 'broccoli' ] -> [ 'yogurt' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cauliflower'}
  Rule:[ 'yogurt', 'crackers' ] -> [ 'cauliflower' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cauliflower'}
  Rule:[ 'yogurt', 'cauliflower' ] -> [ 'crackers' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cauliflower'}
  Rule:[ 'crackers', 'cauliflower' ] -> [ 'yogurt' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'sugar', 'banana', 'cauliflower'}
  Rule:[ 'banana' ] -> [ 'cauliflower', 'sugar' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'sugar', 'banana', 'cauliflower'}
  Rule:[ 'banana', 'sugar' ] -> [ 'cauliflower' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'sugar', 'banana', 'cauliflower'}
  Rule:[ 'cauliflower', 'sugar' ] -> [ 'banana' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'sugar', 'banana', 'cauliflower'}
  Rule:[ 'banana', 'cauliflower' ] -> [ 'sugar' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'sugar', 'macroni', 'cauliflower'}
  Rule:[ 'cauliflower', 'sugar' ] -> [ 'macroni' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'sugar', 'macroni', 'cauliflower'}
  Rule:[ 'macroni', 'cauliflower' ] -> [ 'sugar' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'cheese', 'lemon'}
  Rule:[ 'yogurt', 'cheese' ] -> [ 'lemon' ]
  confidence:1.000

```

Output 8 for Dataset 2

```

frequent itemsets:{'yogurt', 'cheese', 'lemon'}
  Rule:[ 'cheese', 'lemon' ] -> [ 'yogurt' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'eggs', 'lemon', 'crackers'}
  Rule:[ 'eggs', 'crackers' ] -> [ 'lemon' ]
  confidence:0.818
  support:0.450
frequent itemsets:{'eggs', 'lemon', 'crackers'}
  Rule:[ 'lemon', 'crackers' ] -> [ 'eggs' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'eggs', 'crackers', 'tomato'}
  Rule:[ 'eggs', 'tomato' ] -> [ 'crackers' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'crackers', 'tomato'}
  Rule:[ 'crackers', 'tomato' ] -> [ 'eggs' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'eggs', 'crackers'}
  Rule:[ 'yogurt', 'eggs' ] -> [ 'crackers' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'yogurt', 'eggs', 'crackers'}
  Rule:[ 'yogurt', 'crackers' ] -> [ 'eggs' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'crackers', 'sugar'}
  Rule:[ 'crackers', 'sugar' ] -> [ 'eggs' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'crackers', 'cereal'}
  Rule:[ 'eggs', 'crackers' ] -> [ 'cereal' ]
  confidence:0.818
  support:0.450
frequent itemsets:{'eggs', 'crackers', 'cereal'}
  Rule:[ 'eggs', 'cereal' ] -> [ 'crackers' ]
  confidence:0.818
  support:0.450
frequent itemsets:{'eggs', 'crackers', 'cereal'}
  Rule:[ 'crackers', 'cereal' ] -> [ 'eggs' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'ketchup', 'crackers', 'tofu'}
  Rule:[ 'ketchup', 'crackers' ] -> [ 'tofu' ]
  confidence:1.000

```

Output 9 for Dataset 2

```

frequent itemsets:{'ketchup', 'crackers', 'tofu'}
  Rule:[‘ketchup’, ‘tofu’] -> [‘crackers’]
  confidence:0.900
  support:0.450
frequent itemsets:{'ketchup', 'crackers', 'tofu'}
  Rule:[‘crackers’, ‘tofu’] -> [‘ketchup’]
  confidence:0.900
  support:0.450
frequent itemsets:{'lemon', 'crackers', 'tomato'}
  Rule:[‘lemon’, ‘crackers’] -> [‘tomato’]
  confidence:0.800
  support:0.400
frequent itemsets:{'lemon', 'crackers', 'tomato'}
  Rule:[‘crackers’, ‘tomato’] -> [‘lemon’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'lemon', 'crackers'}
  Rule:[‘yogurt’, ‘crackers’] -> [‘lemon’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'lemon', 'crackers'}
  Rule:[‘lemon’, ‘crackers’] -> [‘yogurt’]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'tofu', 'tomato'}
  Rule:[‘crackers’, ‘tofu’] -> [‘tomato’]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'tofu', 'tomato'}
  Rule:[‘crackers’, ‘tomato’] -> [‘tofu’]
  confidence:0.800
  support:0.400
frequent itemsets:{'crackers', 'tofu', 'tomato'}
  Rule:[‘tofu’, ‘tomato’] -> [‘crackers’]
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'crackers', 'tofu'}
  Rule:[‘macroni’, ‘crackers’] -> [‘tofu’]
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'crackers', 'tofu'}
  Rule:[‘crackers’, ‘tofu’] -> [‘macroni’]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'crackers', 'tofu'}
  Rule:[‘potatoes’, ‘crackers’] -> [‘tofu’]
  confidence:0.889

```

Output 10 for Dataset 2

```

frequent itemsets:{'potatoes', 'crackers', 'tofu'}
  Rule:[‘potatoes’, ‘tofu’] -> [‘crackers’]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'crackers', 'tofu'}
  Rule:[‘crackers’, ‘tofu’] -> [‘potatoes’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'tomato'}
  Rule:[‘yogurt’, ‘crackers’] -> [‘tomato’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'tomato'}
  Rule:[‘yogurt’, ‘tomato’] -> [‘crackers’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'tomato'}
  Rule:[‘crackers’, ‘tomato’] -> [‘yogurt’]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'crackers', 'tomato'}
  Rule:[‘potatoes’, ‘crackers’] -> [‘tomato’]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'crackers', 'tomato'}
  Rule:[‘crackers’, ‘tomato’] -> [‘potatoes’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cereal'}
  Rule:[‘yogurt’, ‘crackers’] -> [‘cereal’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cereal'}
  Rule:[‘yogurt’, ‘cereal’] -> [‘crackers’]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'crackers', 'cereal'}
  Rule:[‘crackers’, ‘cereal’] -> [‘yogurt’]
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'crackers', 'sugar'}
  Rule:[‘macroni’, ‘crackers’] -> [‘sugar’]
  confidence:0.800
  support:0.400
frequent itemsets:{'macroni', 'crackers', 'sugar'}
  Rule:[‘crackers’, ‘sugar’] -> [‘macroni’]
  confidence:0.800

```

Output 11 for Dataset 2

```

frequent itemsets:{'macroni', 'crackers', 'cereal'}
    Rule:[‘macroni’, ‘crackers’] -> [‘cereal’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘crackers’, ‘cereal’}
    Rule:[‘macroni’, ‘cereal’] -> [‘crackers’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘crackers’, ‘cereal’}
    Rule:[‘crackers’, ‘cereal’] -> [‘macroni’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘crackers’, ‘sugar’] -> [‘cereal’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘crackers’, ‘cereal’] -> [‘sugar’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘eggs’, ‘tofu’, ‘ketchup’}
    Rule:[‘eggs’, ‘tofu’] -> [‘ketchup’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘eggs’, ‘tofu’, ‘ketchup’}
    Rule:[‘eggs’, ‘ketchup’] -> [‘tofu’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘eggs’, ‘tofu’, ‘ketchup’}
    Rule:[‘ketchup’, ‘tofu’] -> [‘eggs’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘eggs’, ‘lemon’, ‘tomato’}
    Rule:[‘eggs’, ‘tomato’] -> [‘lemon’]
    confidence:0.900
    support:0.450
frequent itemsets:{‘eggs’, ‘lemon’, ‘tomato’}
    Rule:[‘lemon’, ‘tomato’] -> [‘eggs’]
    confidence:0.818
    support:0.450
frequent itemsets:{‘yogurt’, ‘eggs’, ‘lemon’}
    Rule:[‘yogurt’, ‘eggs’] -> [‘lemon’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘eggs’, ‘lemon’, ‘sugar’}
    Rule:[‘eggs’, ‘sugar’] -> [‘lemon’]
    confidence:0.818

```

Output 12 for Dataset 2

```

frequent itemsets:{‘macroni’, ‘sugar’, ‘cereal’}
    Rule:[‘macroni’, ‘cereal’] -> [‘sugar’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘sugar’, ‘milk’}
    Rule:[‘macroni’, ‘milk’] -> [‘sugar’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘sugar’, ‘milk’}
    Rule:[‘sugar’, ‘milk’] -> [‘macroni’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘macroni’, ‘milk’, ‘cereal’}
    Rule:[‘macroni’, ‘milk’] -> [‘cereal’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘milk’, ‘cereal’}
    Rule:[‘macroni’, ‘cereal’] -> [‘milk’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘macroni’, ‘milk’, ‘cereal’}
    Rule:[‘cereal’, ‘milk’] -> [‘macroni’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘crackers’, ‘sugar’] -> [‘eggs’, ‘cereal’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘crackers’, ‘cereal’] -> [‘eggs’, ‘sugar’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘eggs’, ‘crackers’, ‘sugar’] -> [‘cereal’]
    confidence:1.000
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘eggs’, ‘crackers’, ‘cereal’] -> [‘sugar’]
    confidence:0.889
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘eggs’, ‘sugar’, ‘cereal’] -> [‘crackers’]
    confidence:0.800
    support:0.400
frequent itemsets:{‘eggs’, ‘crackers’, ‘sugar’, ‘cereal’}
    Rule:[‘crackers’, ‘sugar’, ‘cereal’] -> [‘eggs’]
    confidence:1.000

```

Output 13 for Dataset 2

```

frequent itemsets:{'eggs', 'lemon', 'sugar', 'cereal'}
  Rule:[ 'lemon', 'cereal' ] -> [ 'eggs', 'sugar' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'lemon', 'sugar', 'cereal'}
  Rule:[ 'eggs', 'lemon', 'sugar' ] -> [ 'cereal' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'eggs', 'lemon', 'sugar', 'cereal'}
  Rule:[ 'eggs', 'lemon', 'cereal' ] -> [ 'sugar' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'eggs', 'lemon', 'sugar', 'cereal'}
  Rule:[ 'eggs', 'sugar', 'cereal' ] -> [ 'lemon' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'eggs', 'lemon', 'sugar', 'cereal'}
  Rule:[ 'lemon', 'sugar', 'cereal' ] -> [ 'eggs' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'avocado' ] -> [ 'apples', 'tomato' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'apples' ] -> [ 'avocado', 'tomato' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'avocado', 'apples' ] -> [ 'potatoes', 'tomato' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'avocado', 'tomato' ] -> [ 'potatoes', 'apples' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'apples', 'tomato' ] -> [ 'potatoes', 'avocado' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'avocado', 'apples' ] -> [ 'tomato' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'avocado', 'tomato' ] -> [ 'apples' ]
  confidence:1.000

```

Output 14 for Dataset 2

```

support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'apples', 'tomato' ] -> [ 'potatoes', 'avocado' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'avocado', 'apples' ] -> [ 'tomato' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'avocado', 'tomato' ] -> [ 'apples' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'potatoes', 'apples', 'tomato' ] -> [ 'avocado' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'avocado', 'apples', 'tomato'}
  Rule:[ 'avocado', 'apples', 'tomato' ] -> [ 'potatoes' ]
  confidence:1.000
  support:0.400

```

Execution time is: 7.85387110710144 seconds

Output 15 for Dataset 2 with execution time

I have not included some intermediate screenshots of this output as it will be too long and will take too much space. I have included some important ones.

Outputs for Dataset 3

```
Enter path to the dataC:\Users\Twinkle\Desktop\Data Mining\dataset3.csv
Enter minimum support:0.3
Enter minimum confidence:0.55
[', 'broccoli', 'butter', 'cheese', 'crackers', 'eggs', 'macroni', 'onion', 'orangejuice', 'tofu', 'tomato', 'milk']
[', 'apple', 'avocado', 'banana', 'bread', 'cereal', 'cheese', 'grapes', 'lemon', 'milk', 'strawberry', 'sugar', 'tofu']
[', 'avocado', 'blackbeans', 'chips', 'grapes', 'ketchup', 'macroni', 'milk', 'tofu', 'yogurt']
[', 'avocado', 'banana', 'bread', 'chickpeas', 'chips', 'macroni', 'popcorn', 'tomato', 'yogurt']
[', 'avocado', 'chips', 'crackers', 'onion', 'peanutbutter', 'popcorn', 'yogurt']
[', 'avocado', 'bread', 'cereal', 'chips', 'lemon', 'macroni', 'popcorn', 'sugar']
[', 'blackbeans', 'chickpeas', 'chips', 'grapes', 'ketchup', 'lemon', 'milk', 'onion', 'popcorn', 'tofu', 'yogurt']
[', 'avocado', 'cereal', 'cheese', 'chickpeas', 'chips', 'ketchup', 'macroni', 'milk', 'mustard', 'orangejuice', 'popcorn', 'strawberry']
[', 'blackbeans', 'broccoli', 'chips', 'grapes', 'ketchup', 'macroni', 'milk', 'mustard', 'onion', 'popcorn', 'yogurt']
[', 'avocado', 'broccoli', 'chickpeas', 'ketchup', 'macroni', 'orangejuice', 'peanutbutter', 'popcorn', 'sugar']
[', 'chickpeas', 'chips', 'macroni', 'milk', 'onion', 'popcorn', 'sugar']
[', 'avocado', 'bread', 'broccoli', 'cheese', 'grapes', 'macroni', 'milk', 'strawberry', 'sugar', 'yogurt']
[', 'crackers', 'grapes', 'ketchup', 'lemon', 'milk', 'mustard', 'onion', 'popcorn', 'tofu']
[', 'avocado', 'banana', 'bread', 'cheese', 'lemon', 'popcorn', 'sugar', 'tofu', 'yogurt']
[', 'blackbeans', 'chips', 'ketchup', 'lemon', 'popcorn', 'tofu', 'yogurt']
[', 'cheese', 'chickpeas', 'ketchup', 'macroni', 'onion', 'popcorn', 'tomato']
[', 'apple', 'blackbeans', 'chips', 'ketchup', 'lemon', 'macroni', 'onion', 'tofu', 'yogurt']
[', 'cereal', 'eggs', 'lemon', 'macroni', 'milk', 'onion', 'popcorn']
[', 'cheese', 'chickpeas', 'chips', 'grapes', 'onion', 'orangejuice', 'popcorn', 'tofu', 'yogurt']
[', 'avocado', 'banana', 'blackbeans', 'butter', 'cereal', 'cheese', 'chickpeas', 'chips', 'crackers', 'grapes', 'macroni', 'sugar']

Associations rules:
frequent itemsets:{'macroni', 'onion'}
    Rule:[['onion']] -> [['macroni']]
    confidence:0.600
    support:0.300
frequent itemsets:{'avocado', 'macroni'}
    Rule:[['avocado']] -> [['macroni']]
    confidence:0.700
    support:0.350
frequent itemsets:{'macroni', 'milk'}
    Rule:[['milk']] -> [['macroni']]
    confidence:0.667
    support:0.300
frequent itemsets:{'macroni', 'chips'}
    Rule:[['macroni']] -> [['chips']]
    confidence:0.615
    support:0.400
frequent itemsets:{'macroni', 'chips'}
    Rule:[['chips']] -> [['macroni']]
    confidence:0.667
```

Output 1 for Dataset 3

Dataset 3 is displayed below input values and above rules

Minimum Support:0.3

Minimum Confidence: 0.55

```

frequent itemsets:{'macroni', 'ketchup'}
  Rule:[ 'ketchup' ] -> [ 'macroni' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'macroni', 'chickpeas'}
  Rule:[ 'chickpeas' ] -> [ 'macroni' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'popcorn', 'macroni'}
  Rule:[ 'popcorn' ] -> [ 'macroni' ]
  confidence:0.571
  support:0.400
frequent itemsets:{'popcorn', 'macroni'}
  Rule:[ 'macroni' ] -> [ 'popcorn' ]
  confidence:0.615
  support:0.400
frequent itemsets:{'onion', 'chips'}
  Rule:[ 'onion' ] -> [ 'chips' ]
  confidence:0.600
  support:0.300
frequent itemsets:{'popcorn', 'onion'}
  Rule:[ 'popcorn' ] -> [ 'onion' ]
  confidence:0.571
  support:0.400
frequent itemsets:{'popcorn', 'onion'}
  Rule:[ 'onion' ] -> [ 'popcorn' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'lemon', 'tofu'}
  Rule:[ 'lemon' ] -> [ 'tofu' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'lemon', 'tofu'}
  Rule:[ 'tofu' ] -> [ 'lemon' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'yogurt', 'tofu'}
  Rule:[ 'yogurt' ] -> [ 'tofu' ]
  confidence:0.600
  support:0.300
frequent itemsets:{'yogurt', 'tofu'}
  Rule:[ 'tofu' ] -> [ 'yogurt' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'avocado', 'sugar'}
  Rule:[ 'avocado' ] -> [ 'sugar' ]
  confidence:0.600

```

Output 2 for Dataset 3

```

frequent itemsets:{'avocado', 'chips'}
  Rule:[ 'avocado' ] -> [ 'chips' ]
  confidence:0.600
  support:0.300
frequent itemsets:{'popcorn', 'avocado'}
  Rule:[ 'avocado' ] -> [ 'popcorn' ]
  confidence:0.600
  support:0.300
frequent itemsets:{'grapes', 'milk'}
  Rule:[ 'grapes' ] -> [ 'milk' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'grapes', 'milk'}
  Rule:[ 'milk' ] -> [ 'grapes' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'popcorn', 'lemon'}
  Rule:[ 'lemon' ] -> [ 'popcorn' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'popcorn', 'milk'}
  Rule:[ 'milk' ] -> [ 'popcorn' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'blackbeans', 'chips'}
  Rule:[ 'blackbeans' ] -> [ 'chips' ]
  confidence:1.000
  support:0.300
frequent itemsets:{'ketchup', 'chips'}
  Rule:[ 'ketchup' ] -> [ 'chips' ]
  confidence:0.667
  support:0.300
frequent itemsets:{'yogurt', 'chips'}
  Rule:[ 'yogurt' ] -> [ 'chips' ]
  confidence:0.800
  support:0.400
frequent itemsets:{'yogurt', 'chips'}
  Rule:[ 'chips' ] -> [ 'yogurt' ]
  confidence:0.667
  support:0.400
frequent itemsets:{'chickpeas', 'chips'}
  Rule:[ 'chickpeas' ] -> [ 'chips' ]
  confidence:0.750
  support:0.300
frequent itemsets:{'popcorn', 'chips'}
  Rule:[ 'popcorn' ] -> [ 'chips' ]
  confidence:0.643

```

Output 3 for Dataset 3

```
frequent itemsets:{'popcorn', 'chips'}
  Rule:['chips'] -> ['popcorn']
  confidence:0.750
  support:0.450
frequent itemsets:{'popcorn', 'ketchup'}
  Rule:['ketchup'] -> ['popcorn']
  confidence:0.778
  support:0.350
frequent itemsets:{'yogurt', 'popcorn'}
  Rule:['yogurt'] -> ['popcorn']
  confidence:0.700
  support:0.350
frequent itemsets:{'popcorn', 'chickpeas'}
  Rule:['chickpeas'] -> ['popcorn']
  confidence:0.875
  support:0.350
frequent itemsets:{'yogurt', 'popcorn', 'chips'}
  Rule:['yogurt'] -> ['popcorn', 'chips']
  confidence:0.600
  support:0.300
frequent itemsets:{'yogurt', 'popcorn', 'chips'}
  Rule:['yogurt', 'popcorn'] -> ['chips']
  confidence:0.857
  support:0.300
frequent itemsets:{'yogurt', 'popcorn', 'chips'}
  Rule:['yogurt', 'chips'] -> ['popcorn']
  confidence:0.750
  support:0.300
frequent itemsets:{'yogurt', 'popcorn', 'chips'}
  Rule:['popcorn', 'chips'] -> ['yogurt']
  confidence:0.667
  support:0.300
```

Execution time is: 7.294085741043091 seconds

Output 4 for Dataset 3 with execution time

Outputs for Dataset 4

```
Enter path to the dataC:\Users\Twinkle\Desktop\Data Mining\dataset4.csv
Enter minimum support:0.35
Enter minimum confidence:0.75
[", 'avocado', 'blackbeans', 'butter', 'cereal', 'cheese', 'eggs', 'ketchup', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'orangejuice', 'peanutbutter', 'potatoes', 'sugar', 'tofu', 'tomato', 'i\x{bread}']
[", 'apples', 'banana', 'blackbeans', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'ketchup', 'lemon', 'milk', 'mustard', 'onions', 'popcorn', 'potatoes', 'strawberry', 'sugar']
[", 'bread', 'butter', 'chips', 'crackers', 'eggs', 'ketchup', 'orangejuice', 'peanutbutter', 'tofu', 'yogurt']
[", 'avocado', 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'onions', 'potatoes', 'tomato']
['apples', 'avocado', 'banana', 'blackbeans', 'bread', 'butter', 'cauliflowers', 'cereal', 'cheese', 'chickpeas', 'eggs', 'grapes', 'milk', 'onions', 'orangejuice', 'potatoes', 'strawberry', 'sugar', 'tofu', 'tomato', 'yogurt']
[", 'apples', 'cereal', 'chips', 'crackers', 'grapes', 'macroni', 'milk', 'popcorn', 'yogurt']
[", 'avocado', 'bread', 'chickpeas', 'chips', 'crackers', 'eggs', 'ketchup', 'lemon', 'milk', 'mustard', 'onions', 'orangejuice', 'yogurt']
[", 'apples', 'avocado', 'banana', 'bread', 'cereal', 'chips', 'eggs', 'milk', 'peanutbutter', 'popcorn', 'sugar', 'tofu', 'yogurt']
[", 'avocado', 'blackbeans', 'bread', 'butter', 'cheese', 'chickpeas', 'eggs', 'lemon', 'macroni', 'milk', 'orangejuice', 'peanutbutter', 'strawberry', 'tomatos']
[", 'banana', 'bread', 'butter', 'cheese', 'chips', 'grapes', 'ketchup', 'macroni', 'milk', 'mustard', 'orangejuice', 'tomato']
[", 'blackbeans', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'ketchup', 'lemon', 'milk', 'onions', 'orangejuice', 'potatoes', 'sugar', 'tomato']
[", 'avocado', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chips', 'crackers', 'eggs', 'ketchup', 'macroni', 'mustard', 'potatoes', 'tomato']
[", 'avocado', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chips', 'crackers', 'eggs', 'lemon', 'onions', 'orangejuice', 'popcorn', 'potatoes', 'sugar']
[", 'avocado', 'bread', 'broccoli', 'butter', 'cheese', 'chips', 'crackers', 'eggs', 'ketchup', 'lemon', 'macroni', 'mustard', 'orangejuice', 'peanutbutter', 'popcorn', 'sugar', 'tomato']
[", 'apples', 'avocado', 'butter', 'cheese', 'chips', 'eggs', 'ketchup', 'lemon', 'macroni', 'milk', 'onions', 'popcorn', 'potatoes', 'tomato', 'yogurt']
[", 'apples', 'blackbeans', 'bread', 'butter', 'cheese', 'eggs', 'ketchup', 'macroni', 'milk', 'mustard', 'sugar']
[", 'blackbeans', 'bread', 'broccoli', 'butter', 'cereal', 'cheese', 'chickpeas', 'chips', 'crackers', 'lemon', 'milk', 'onions', 'peanutbutter', 'sugar']
[", 'avocado', 'banana', 'cereal', 'chips', 'eggs', 'grapes', 'lemon', 'milk', 'strawberry', 'sugar', 'tomato', 'yogurt']
[", 'avocado', 'blackbeans', 'bread', 'cauliflower', 'cheese', 'chickpeas', 'ketchup', 'lemon', 'macroni', 'mustard', 'onions', 'potatoes', 'sugar', 'tomato']
[", 'apples', 'avocado', 'banana', 'butter', 'chips', 'crackers', 'milk', 'popcorn', 'sugar', 'yogurt']

Associations rules:
frequent itemsets:{'avocado', 'eggs'}
    Rule:[ 'eggs' ] -> [ 'avocado' ]
    confidence:0.750
    support:0.450
frequent itemsets:{'avocado', 'lemon'}
    Rule:[ 'lemon' ] -> [ 'avocado' ]
    confidence:0.750
    support:0.450
frequent itemsets:{'potatoes', 'avocado'}
    Rule:[ 'potatoes' ] -> [ 'avocado' ]
    confidence:0.778
    support:0.350
frequent itemsets:{'avocado', 'tomato'}
    Rule:[ 'tomato' ] -> [ 'avocado' ]
    confidence:0.889
    support:0.400
frequent itemsets:{'blackbeans', 'cheese'}
```

Output 1 for Dataset 4

Dataset 4 is displayed below input values and above rules

Minimum Support:0.35

Minimum Confidence: 0.75

```

frequent itemsets:{'blackbeans', 'cheese'}
  Rule:[ 'blackbeans' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.450
frequent itemsets:{'blackbeans', 'lemon'}
  Rule:[ 'blackbeans' ] -> [ 'lemon' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'blackbeans', 'milk'}
  Rule:[ 'blackbeans' ] -> [ 'milk' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'blackbeans', 'onions'}
  Rule:[ 'blackbeans' ] -> [ 'onions' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'blackbeans', 'sugar'}
  Rule:[ 'blackbeans' ] -> [ 'sugar' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'butter', 'cheese'}
  Rule:[ 'butter' ] -> [ 'cheese' ]
  confidence:0.846
  support:0.550
frequent itemsets:{'butter', 'cheese'}
  Rule:[ 'cheese' ] -> [ 'butter' ]
  confidence:0.786
  support:0.550
frequent itemsets:{'butter', 'orangejuice'}
  Rule:[ 'orangejuice' ] -> [ 'butter' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'milk', 'cereal'}
  Rule:[ 'cereal' ] -> [ 'milk' ]
  confidence:1.000
  support:0.350
frequent itemsets:{'cheese', 'ketchup'}
  Rule:[ 'ketchup' ] -> [ 'cheese' ]
  confidence:0.818
  support:0.450
frequent itemsets:{'cheese', 'lemon'}
  Rule:[ 'lemon' ] -> [ 'cheese' ]
  confidence:0.833
  support:0.500
frequent itemsets:{'macroni', 'cheese'}
  Rule:[ 'macroni' ] -> [ 'cheese' ]
  confidence:0.875

```

Output 2 for Dataset 4

```

frequent itemsets:{'cheese', 'mustard'}
  Rule:[ 'mustard' ] -> [ 'cheese' ]
  confidence:0.875
  support:0.350
frequent itemsets:{'cheese', 'onions'}
  Rule:[ 'onions' ] -> [ 'cheese' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'cheese', 'orangejuice'}
  Rule:[ 'orangejuice' ] -> [ 'cheese' ]
  confidence:0.778
  support:0.350
frequent itemsets:{'potatoes', 'cheese'}
  Rule:[ 'potatoes' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.450
frequent itemsets:{'cheese', 'sugar'}
  Rule:[ 'sugar' ] -> [ 'cheese' ]
  confidence:0.750
  support:0.450
frequent itemsets:{'cheese', 'tomato'}
  Rule:[ 'tomato' ] -> [ 'cheese' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'cheese', 'broccoli'}
  Rule:[ 'broccoli' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.350
frequent itemsets:{'cheese', 'bread'}
  Rule:[ 'bread' ] -> [ 'cheese' ]
  confidence:0.889
  support:0.400
frequent itemsets:{'eggs', 'milk'}
  Rule:[ 'eggs' ] -> [ 'milk' ]
  confidence:0.750
  support:0.450
frequent itemsets:{'ketchup', 'mustard'}
  Rule:[ 'mustard' ] -> [ 'ketchup' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'onions', 'lemon'}
  Rule:[ 'onions' ] -> [ 'lemon' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'onions', 'lemon'}
  Rule:[ 'lemon' ] -> [ 'onions' ]
  confidence:0.750

```

Output 3 for Dataset 4

```

frequent itemsets:{'potatoes', 'lemon'}
  Rule:[['potatoes']] -> [['lemon']]
  confidence:0.778
  support:0.350
frequent itemsets:{'lemon', 'tomato'}
  Rule:[['tomato']] -> [['lemon']]
  confidence:0.778
  support:0.350
frequent itemsets:{'lemon', 'chips'}
  Rule:[['lemon']] -> [['chips']]
  confidence:0.750
  support:0.450
frequent itemsets:{'sugar', 'milk'}
  Rule:[['sugar']] -> [['milk']]
  confidence:0.750
  support:0.450
frequent itemsets:{'apples', 'milk'}
  Rule:[['apples']] -> [['milk']]
  confidence:1.000
  support:0.350
frequent itemsets:{'yogurt', 'milk'}
  Rule:[['yogurt']] -> [['milk']]
  confidence:0.875
  support:0.350
frequent itemsets:{'potatoes', 'onions'}
  Rule:[['potatoes']] -> [['onions']]
  confidence:0.889
  support:0.400
frequent itemsets:{'potatoes', 'onions'}
  Rule:[['onions']] -> [['potatoes']]
  confidence:0.800
  support:0.400
frequent itemsets:{'potatoes', 'tomato'}
  Rule:[['potatoes']] -> [['tomato']]
  confidence:0.778
  support:0.350
frequent itemsets:{'potatoes', 'tomato'}
  Rule:[['tomato']] -> [['potatoes']]
  confidence:0.778
  support:0.350
frequent itemsets:{'broccoli', 'chips'}
  Rule:[['broccoli']] -> [['chips']]
  confidence:1.000
  support:0.350
frequent itemsets:{'crackers', 'chips'}
  Rule:[['crackers']] -> [['chips']]
  confidence:1.000

```

Output 4 for Dataset 4

```

support:0.450
frequent itemsets:{'popcorn', 'chips'}
  Rule:[['popcorn']] -> [['chips']]
  confidence:1.000
  support:0.350
frequent itemsets:{'yogurt', 'chips'}
  Rule:[['yogurt']] -> [['chips']]
  confidence:0.875
  support:0.350
frequent itemsets:{'avocado', 'butter', 'cheese'}
  Rule:[['avocado', 'butter']] -> [['cheese']]
  confidence:0.875
  support:0.350
frequent itemsets:{'avocado', 'cheese'}
  Rule:[['avocado', 'cheese']] -> [['butter']]
  confidence:0.778
  support:0.350
frequent itemsets:{'avocado', 'lemon', 'cheese'}
  Rule:[['avocado', 'lemon']] -> [['cheese']]
  confidence:0.778
  support:0.350
frequent itemsets:{'avocado', 'lemon', 'cheese'}
  Rule:[['avocado', 'cheese']] -> [['lemon']]
  confidence:0.778
  support:0.350
frequent itemsets:{'potatoes', 'avocado', 'cheese'}
  Rule:[['potatoes']] -> [['avocado', 'cheese']]
  confidence:0.778
  support:0.350
frequent itemsets:{'potatoes', 'avocado', 'cheese'}
  Rule:[['potatoes', 'avocado']] -> [['cheese']]
  confidence:1.000
  support:0.350
frequent itemsets:{'potatoes', 'avocado', 'cheese'}
  Rule:[['potatoes', 'cheese']] -> [['avocado']]
  confidence:0.778
  support:0.350
frequent itemsets:{'avocado', 'cheese', 'tomato'}
  Rule:[['tomato']] -> [['avocado', 'cheese']]
  confidence:0.778
  support:0.350
frequent itemsets:{'avocado', 'cheese', 'tomato'}
  Rule:[['avocado', 'cheese']] -> [['tomato']]
  confidence:0.778

```

Output 5 for Dataset 4

```

frequent itemsets:{'avocado', 'eggs', 'lemon'}
Rule:[ 'avocado', 'eggs' ] -> [ 'lemon' ]
confidence:0.778
support:0.350
frequent itemsets:{'avocado', 'eggs', 'lemon'}
Rule:[ 'avocado', 'lemon' ] -> [ 'eggs' ]
confidence:0.778
support:0.350
frequent itemsets:{'avocado', 'eggs', 'lemon'}
Rule:[ 'eggs', 'lemon' ] -> [ 'avocado' ]
confidence:0.875
support:0.350
frequent itemsets:{'avocado', 'eggs', 'milk'}
Rule:[ 'avocado', 'eggs' ] -> [ 'milk' ]
confidence:0.778
support:0.350
frequent itemsets:{'avocado', 'eggs', 'milk'}
Rule:[ 'avocado', 'milk' ] -> [ 'eggs' ]
confidence:0.875
support:0.350
frequent itemsets:{'avocado', 'eggs', 'milk'}
Rule:[ 'eggs', 'milk' ] -> [ 'avocado' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'lemon'}
Rule:[ 'blackbeans' ] -> [ 'cheese', 'lemon' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'lemon'}
Rule:[ 'blackbeans', 'cheese' ] -> [ 'lemon' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'lemon'}
Rule:[ 'blackbeans', 'lemon' ] -> [ 'cheese' ]
confidence:1.000
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'milk'}
Rule:[ 'blackbeans' ] -> [ 'cheese', 'milk' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'milk'}
Rule:[ 'blackbeans', 'cheese' ] -> [ 'milk' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'milk'}
Rule:[ 'blackbeans', 'milk' ] -> [ 'cheese' ]
confidence:1.000
support:0.350

```

Output 6 for Dataset 4

```

frequent itemsets:{'blackbeans', 'cheese', 'milk'}
Rule:[ 'cheese', 'milk' ] -> [ 'blackbeans' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'onions'}
Rule:[ 'blackbeans' ] -> [ 'cheese', 'onions' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'onions'}
Rule:[ 'blackbeans', 'cheese' ] -> [ 'onions' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'onions'}
Rule:[ 'blackbeans', 'onions' ] -> [ 'cheese' ]
confidence:1.000
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'onions'}
Rule:[ 'cheese', 'onions' ] -> [ 'blackbeans' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'sugar'}
Rule:[ 'blackbeans' ] -> [ 'cheese', 'sugar' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'sugar'}
Rule:[ 'blackbeans', 'cheese' ] -> [ 'sugar' ]
confidence:0.778
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'sugar'}
Rule:[ 'blackbeans', 'sugar' ] -> [ 'cheese' ]
confidence:1.000
support:0.350
frequent itemsets:{'blackbeans', 'cheese', 'sugar'}
Rule:[ 'cheese', 'sugar' ] -> [ 'blackbeans' ]
confidence:0.778
support:0.350
frequent itemsets:{'butter', 'eggs', 'cheese'}
Rule:[ 'butter', 'eggs' ] -> [ 'cheese' ]
confidence:0.875
support:0.350
frequent itemsets:{'butter', 'eggs', 'cheese'}
Rule:[ 'eggs', 'cheese' ] -> [ 'butter' ]
confidence:0.875
support:0.350
frequent itemsets:{'butter', 'cheese', 'ketchup'}
Rule:[ 'butter', 'ketchup' ] -> [ 'cheese' ]
confidence:0.875

```

Output 7 for Dataset 4

```

frequent itemsets:{'butter', 'cheese', 'ketchup'}
  Rule:[‘cheese’, ‘ketchup’] -> [‘butter’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘butter’, ‘lemon’, ‘cheese’}
  Rule:[‘butter’, ‘lemon’] -> [‘cheese’]
  confidence:1.000
  support:0.350
frequent itemsets:{‘butter’, ‘cheese’, ‘milk’}
  Rule:[‘butter’, ‘milk’] -> [‘cheese’]
  confidence:0.889
  support:0.400
frequent itemsets:{‘butter’, ‘cheese’, ‘milk’}
  Rule:[‘cheese’, ‘milk’] -> [‘butter’]
  confidence:0.889
  support:0.400
frequent itemsets:{‘sugar’, ‘butter’, ‘cheese’}
  Rule:[‘butter’, ‘sugar’] -> [‘cheese’]
  confidence:0.875
  support:0.350
frequent itemsets:{‘sugar’, ‘butter’, ‘cheese’}
  Rule:[‘cheese’, ‘sugar’] -> [‘butter’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘butter’, ‘cheese’, ‘chips’}
  Rule:[‘butter’, ‘chips’] -> [‘cheese’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘butter’, ‘cheese’, ‘chips’}
  Rule:[‘cheese’, ‘chips’] -> [‘butter’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘cheese’, ‘mustard’, ‘ketchup’}
  Rule:[‘mustard’] -> [‘cheese’, ‘ketchup’]
  confidence:0.875
  support:0.350
frequent itemsets:{‘cheese’, ‘mustard’, ‘ketchup’}
  Rule:[‘cheese’, ‘mustard’] -> [‘ketchup’]
  confidence:1.000
  support:0.350
frequent itemsets:{‘cheese’, ‘mustard’, ‘ketchup’}
  Rule:[‘cheese’, ‘ketchup’] -> [‘mustard’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘cheese’, ‘mustard’, ‘ketchup’}
  Rule:[‘ketchup’, ‘mustard’] -> [‘cheese’]
  confidence:0.875

```

Output 8 for Dataset 4

```

frequent itemsets:{‘onions’, ‘cheese’, ‘lemon’}
  Rule:[‘onions’] -> [‘cheese’, ‘lemon’]
  confidence:0.800
  support:0.400
frequent itemsets:{‘onions’, ‘cheese’, ‘lemon’}
  Rule:[‘cheese’, ‘onions’] -> [‘lemon’]
  confidence:0.889
  support:0.400
frequent itemsets:{‘onions’, ‘cheese’, ‘lemon’}
  Rule:[‘onions’, ‘lemon’] -> [‘cheese’]
  confidence:0.889
  support:0.400
frequent itemsets:{‘onions’, ‘cheese’, ‘lemon’}
  Rule:[‘cheese’, ‘lemon’] -> [‘onions’]
  confidence:0.800
  support:0.400
frequent itemsets:{‘potatoes’, ‘cheese’, ‘lemon’}
  Rule:[‘potatoes’] -> [‘cheese’, ‘lemon’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘lemon’}
  Rule:[‘potatoes’, ‘cheese’] -> [‘lemon’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘lemon’}
  Rule:[‘potatoes’, ‘lemon’] -> [‘cheese’]
  confidence:1.000
  support:0.350
frequent itemsets:{‘cheese’, ‘lemon’, ‘sugar’}
  Rule:[‘cheese’, ‘sugar’] -> [‘lemon’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘cheese’, ‘lemon’, ‘sugar’}
  Rule:[‘lemon’, ‘sugar’] -> [‘cheese’]
  confidence:0.875
  support:0.350
frequent itemsets:{‘cheese’, ‘lemon’, ‘chips’}
  Rule:[‘cheese’, ‘chips’] -> [‘lemon’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘cheese’, ‘lemon’, ‘chips’}
  Rule:[‘lemon’, ‘chips’] -> [‘cheese’]
  confidence:0.778
  support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘onions’}
  Rule:[‘potatoes’] -> [‘cheese’, ‘onions’]
  confidence:0.889

```

Output 9 for Dataset 4

```

frequent itemsets:{'potatoes', 'cheese', 'onions'}
Rule:[‘onions’] -> [‘potatoes’, ‘cheese’]
confidence:0.800
support:0.400
frequent itemsets:{‘potatoes’, ‘cheese’, ‘onions’}
Rule:[‘potatoes’, ‘cheese’] -> [‘onions’]
confidence:0.889
support:0.400
frequent itemsets:{‘potatoes’, ‘cheese’, ‘onions’}
Rule:[‘potatoes’, ‘onions’] -> [‘cheese’]
confidence:0.100
support:0.400
frequent itemsets:{‘potatoes’, ‘cheese’, ‘onions’}
Rule:[‘cheese’, ‘onions’] -> [‘potatoes’]
confidence:0.889
support:0.400
frequent itemsets:{‘cheese’, ‘onions’, ‘sugar’}
Rule:[‘cheese’, ‘onions’] -> [‘sugar’]
confidence:0.778
support:0.350
frequent itemsets:{‘cheese’, ‘onions’, ‘sugar’}
Rule:[‘cheese’, ‘sugar’] -> [‘onions’]
confidence:0.778
support:0.350
frequent itemsets:{‘cheese’, ‘onions’, ‘sugar’}
Rule:[‘onions’, ‘sugar’] -> [‘cheese’]
confidence:1.000
support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘tomato’}
Rule:[‘potatoes’] -> [‘cheese’, ‘tomato’]
confidence:0.778
support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘tomato’}
Rule:[‘tomato’] -> [‘potatoes’, ‘cheese’]
confidence:0.778
support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘tomato’}
Rule:[‘potatoes’, ‘cheese’] -> [‘tomato’]
confidence:0.778
support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘tomato’}
Rule:[‘potatoes’, ‘tomato’] -> [‘cheese’]
confidence:1.000
support:0.350
frequent itemsets:{‘potatoes’, ‘cheese’, ‘tomato’}
Rule:[‘cheese’, ‘tomato’] -> [‘potatoes’]
confidence:0.875

```

Output 10 for Dataset 4

```

frequent itemsets:{‘cheese’, ‘broccoli’, ‘chips’}
Rule:[‘broccoli’] -> [‘cheese’, ‘chips’]
confidence:1.000
support:0.350
frequent itemsets:{‘cheese’, ‘broccoli’, ‘chips’}
Rule:[‘cheese’, ‘broccoli’] -> [‘chips’]
confidence:1.000
support:0.350
frequent itemsets:{‘cheese’, ‘broccoli’, ‘chips’}
Rule:[‘cheese’, ‘chips’] -> [‘broccoli’]
confidence:0.778
support:0.350
frequent itemsets:{‘cheese’, ‘broccoli’, ‘chips’}
Rule:[‘broccoli’, ‘chips’] -> [‘cheese’]
confidence:1.000
support:0.350
frequent itemsets:{‘potatoes’, ‘onions’, ‘lemon’}
Rule:[‘potatoes’] -> [‘onions’, ‘lemon’]
confidence:0.778
support:0.350
frequent itemsets:{‘potatoes’, ‘onions’, ‘lemon’}
Rule:[‘potatoes’, ‘onions’] -> [‘lemon’]
confidence:0.875
support:0.350
frequent itemsets:{‘potatoes’, ‘onions’, ‘lemon’}
Rule:[‘potatoes’, ‘lemon’] -> [‘onions’]
confidence:1.000
support:0.350
frequent itemsets:{‘potatoes’, ‘onions’, ‘lemon’}
Rule:[‘onions’, ‘lemon’] -> [‘potatoes’]
confidence:0.778
support:0.350
frequent itemsets:{‘onions’, ‘lemon’, ‘chips’}
Rule:[‘onions’, ‘lemon’] -> [‘chips’]
confidence:0.778
support:0.350
frequent itemsets:{‘onions’, ‘lemon’, ‘chips’}
Rule:[‘onions’, ‘chips’] -> [‘lemon’]
confidence:1.000
support:0.350
frequent itemsets:{‘onions’, ‘lemon’, ‘chips’}
Rule:[‘lemon’, ‘chips’] -> [‘onions’]
confidence:0.778
support:0.350
frequent itemsets:{‘onions’, ‘cheese’, ‘lemon’, ‘potatoes’}
Rule:[‘potatoes’] -> [‘cheese’, ‘onions’, ‘lemon’]
confidence:0.778

```

Output 11 for Dataset 4

```
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['cheese', 'onions'] -> ['potatoes', 'lemon']
confidence:0.778
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['onions', 'lemon'] -> ['potatoes', 'cheese']
confidence:0.778
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'onions'] -> ['cheese', 'lemon']
confidence:0.875
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'cheese'] -> ['onions', 'lemon']
confidence:0.778
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'lemon'] -> ['cheese', 'onions']
confidence:1.000
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['cheese', 'onions', 'lemon'] -> ['potatoes']
confidence:0.875
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'cheese', 'onions'] -> ['lemon']
confidence:0.875
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'onions', 'lemon'] -> ['cheese']
confidence:1.000
support:0.350
frequent itemsets:{'onions', 'cheese', 'lemon', 'potatoes'}
Rule:['potatoes', 'cheese', 'lemon'] -> ['onions']
confidence:1.000
support:0.350
```

Execution time is: 8.128976345062256 seconds

Output 12 for Dataset 4 with execution time

Outputs for Dataset 5

```
Enter path to the data:C:\Users\Twinkle\Desktop\Data Mining\dataset5.csv
Enter minimum support:0.4
Enter minimum confidence:0.9
[[], 'apple', 'banana', 'bread', 'butter', 'cheese', 'eggs', 'peanutbutter', 'strawberry', 'sugar', 'tofu', 'yogurt', 'ix:milk']
[[], 'blackbeans', 'bread', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'crackers', 'eggs', 'milk', 'onions', 'peanutbutter', 'potatoes', 'sugar', 'tomato']
[[], 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chips', 'crackers', 'eggs', 'ketchup', 'milk', 'mustard', 'onions', 'potatoes', 'sugar', 'tomato']
[[], 'blackbeans', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'ketchup', 'lemon', 'milk', 'onions', 'orangejuice', 'potatoes', 'sugar', 'tomato']
[[], 'banana', 'bread', 'butter', 'cheese', 'chips', 'grapes', 'ketchup', 'macroni', 'milk', 'mustard', 'orangejuice', 'tomato']
[[], 'apple', 'avocado', 'banana', 'cereal', 'chips', 'eggs', 'grapes', 'ketchup', 'macroni', 'milk', 'mustard', 'orangejuice', 'sugar', 'tomato', 'yogurt']
[[], 'avocado', 'blackbeans', 'bread', 'butter', 'cheese', 'chickpeas', 'eggs', 'lemon', 'macroni', 'milk', 'orangejuice', 'peanutbutter', 'strawberry', 'tomatos']
[[], 'avocado', 'blackbeans', 'bread', 'cauliflower', 'cheese', 'chickpeas', 'ketchup', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'potatoes', 'sugar', 'tomato']
[[], 'avocado', 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'potatoes', 'sugar', 'tomato']
[[], 'avocado', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chips', 'crackers', 'eggs', 'ketchup', 'macroni', 'milk', 'mustard', 'potatoes', 'tomato']
[[], 'apples', 'avocado', 'banana', 'bread', 'broccoli', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'ketchup', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'peanutbutter', 'popcorn', 'sugar', 'yogurt']
[[], 'apples', 'avocado', 'banana', 'bread', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'ketchup', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'peanutbutter', 'popcorn', 'sugar', 'yogurt', 'tomato']
[[], 'blackbeans', 'bread', 'cheese', 'chickpeas', 'chips', 'crackers', 'grapes', 'ketchup', 'macroni', 'milk', 'onions', 'orangejuice', 'peanutbutter', 'popcorn', 'potatoes', 'strawberry', 'sugar', 'tomato']
[[], 'banana', 'blackbeans', 'bread', 'butter', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'potatoes', 'tomato', 'yogurt']
[[], 'blackbeans', 'bread', 'cheese', 'chickpeas', 'chips', 'crackers', 'grapes', 'ketchup', 'macroni', 'milk', 'onions', 'orangejuice', 'peanutbutter', 'popcorn', 'potatoes', 'strawberry', 'sugar', 'tomato', 'yogurt']
[[], 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'orangejuice', 'popcorn', 'strawberry', 'sugar', 'yogurt']
[[], 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'orangejuice', 'popcorn', 'strawberry', 'sugar', 'yogurt', 'tomato']
[[], 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'orangejuice', 'popcorn', 'strawberry', 'sugar', 'yogurt', 'tomato']
[[], 'blackbeans', 'broccoli', 'cauliflower', 'cheese', 'chickpeas', 'chips', 'crackers', 'eggs', 'lemon', 'macroni', 'milk', 'mustard', 'onions', 'orangejuice', 'popcorn', 'strawberry', 'sugar', 'yogurt', 'tomato', 'yogurt']
Associations rules:
frequent itemsets:{'bread', 'cheese'}
Rule:[['bread']] -> [['cheese']]
confidence:0.909
support:0.500
frequent itemsets:{'blackbeans', 'cheese'}
Rule:[['blackbeans']] -> [['cheese']]
confidence:1.000
support:0.500
frequent itemsets:{'onions', 'cheese'}
Rule:[['onions']] -> [['cheese']]
confidence:0.900
support:0.450
frequent itemsets:{'onions', 'sugar'}
Rule:[['onions']] -> [['sugar']]
confidence:0.900
support:0.450
```

Output 1 for Dataset 5

Dataset 5 is displayed below input values and above rules

Minimum Support:0.4

Minimum Confidence: 0.9

```

frequent itemsets:{'broccoli', 'cauliflower'}
  Rule:[ 'broccoli' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.550
frequent itemsets:{'crackers', 'broccoli'}
  Rule:[ 'crackers' ] -> [ 'broccoli' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'crackers', 'cauliflower'}
  Rule:[ 'crackers' ] -> [ 'cauliflower' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'onions', 'potatoes'}
  Rule:[ 'onions' ] -> [ 'potatoes' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'tomato', 'potatoes'}
  Rule:[ 'tomato' ] -> [ 'potatoes' ]
  confidence:0.917
  support:0.550
frequent itemsets:{'chickpeas', 'blackbeans', 'cheese'}
  Rule:[ 'chickpeas', 'blackbeans' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'milk', 'blackbeans', 'cheese'}
  Rule:[ 'milk', 'blackbeans' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'blackbeans', 'potatoes', 'cheese'}
  Rule:[ 'blackbeans', 'potatoes' ] -> [ 'cheese' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'broccoli', 'cauliflower', 'cheese'}
  Rule:[ 'broccoli', 'cheese' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.450
frequent itemsets:{'broccoli', 'cauliflower', 'cheese'}
  Rule:[ 'cauliflower', 'cheese' ] -> [ 'broccoli' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'tomato', 'potatoes', 'cheese'}
  Rule:[ 'tomato', 'potatoes' ] -> [ 'cheese' ]
  confidence:0.909
  support:0.500
frequent itemsets:{'tomato', 'potatoes', 'cheese'}
  Rule:[ 'tomato', 'cheese' ] -> [ 'potatoes' ]
  confidence:1.000

```

Output 2 for Dataset 5

```

frequent itemsets:{'tomato', 'potatoes', 'cheese'}
  Rule:[ 'potatoes', 'cheese' ] -> [ 'tomato' ]
  confidence:0.909
  support:0.500
frequent itemsets:{'broccoli', 'sugar', 'cauliflower'}
  Rule:[ 'broccoli', 'sugar' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'crackers' ] -> [ 'broccoli', 'cauliflower' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'crackers', 'broccoli' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.450
frequent itemsets:{'crackers', 'broccoli', 'cauliflower'}
  Rule:[ 'crackers', 'cauliflower' ] -> [ 'broccoli' ]
  confidence:1.000
  support:0.450
frequent itemsets:{'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'broccoli', 'potatoes' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'cauliflower'}
  Rule:[ 'tomato', 'broccoli' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'broccoli', 'cauliflower', 'chips'}
  Rule:[ 'broccoli', 'chips' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'broccoli', 'cauliflower', 'chips'}
  Rule:[ 'cauliflower', 'chips' ] -> [ 'broccoli' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes'}
  Rule:[ 'tomato', 'broccoli' ] -> [ 'potatoes' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes'}
  Rule:[ 'broccoli', 'potatoes' ] -> [ 'tomato' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'potatoes', 'cauliflower'}
  Rule:[ 'tomato', 'cauliflower' ] -> [ 'potatoes' ]
  confidence:1.000

```

Output 3 for Dataset 5

```
frequent itemsets:{'tomato', 'potatoes', 'cauliflower'}
  Rule:[ 'potatoes', 'cauliflower' ] -> [ 'tomato' ]
  confidence:0.900
  support:0.450
frequent itemsets:{'tomato', 'potatoes', 'cauliflower', 'cheese'}
  Rule:[ 'tomato', 'cauliflower', 'cheese' ] -> [ 'potatoes' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'potatoes', 'cauliflower', 'cheese'}
  Rule:[ 'potatoes', 'cauliflower', 'cheese' ] -> [ 'tomato' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'tomato', 'broccoli' ] -> [ 'potatoes', 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'broccoli', 'potatoes' ] -> [ 'tomato', 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'tomato', 'broccoli', 'potatoes' ] -> [ 'cauliflower' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'tomato', 'broccoli', 'cauliflower' ] -> [ 'potatoes' ]
  confidence:1.000
  support:0.400
frequent itemsets:{'tomato', 'broccoli', 'potatoes', 'cauliflower'}
  Rule:[ 'broccoli', 'potatoes', 'cauliflower' ] -> [ 'tomato' ]
  confidence:1.000
  support:0.400
Execution time is: 7.39327597618103 seconds
```

Output 4 for Dataset 5

Midterm Project – Part 2

Brute Force Attack for Association Rule Mining

```
import numpy as np
import time
from IPython.core.display import display, HTML
display(HTML("<style>.container { width:100% !important; }</style>")) #to
display the ouput in full screen.
start_time=time.time()
#load the data
def load_data(path):
    tr=[]
    with open(path,'r') as fid:
        for line in fid:
            sline= list(line.strip().split(','))
            t=list(np.unique(sline))
            tr.append(t)
    return tr

path_to_data= input("Enter path to the data")
min_supp=float(input("Enter minimum support:"))
min_conf=float(input("Enter minimum confidence:"))
transaction=load_data(path_to_data)
print(*transaction, sep = "\n")

num_trans=len(transaction)

flist = []
for sublist in transaction:
    for item in sublist:
        flist.append(item)

i_list=[]
for i in flist:
    if i not in i_list:
        i_list.append(i)

i_list = [i for i in i_list if i] #contains names of all items in database

#create subsets of items
def sub_lists(l):
    base = []
    lists = [base]
    for i in range(len(l)):
        orig = lists[:]
        new = l[i]
        for j in range(len(lists)):
            lists[j] = lists[j] + [new]
        lists = orig + lists
```

```

    return lists

subsets=sub_lists(i_list)

#count occurence of itemsets in transaction
def subset(c_list, transactions):
    candidate_counts={}
    for transaction in transactions:
        for candidate in c_list:
            if set(candidate).issubset(set(transaction)):
                candidate_counts[tuple(candidate)] =
candidate_counts.get(tuple(candidate), 0)
                candidate_counts[tuple(candidate)] += 1
    return candidate_counts

c_count=subset(subsets,transaction)
f = {}

supp_count=[]
for k,v in c_count.items():
    if (v/num_trans>=min_supp):
        f[k] = v
        supp_count.append(v)

for k,v in f.items():
    print("Frequent Items:{}\nSupport:{}\n".format(k,v/num_trans))

print("Execution time is: {} seconds " % (time.time() - start_time))

```

I could not run all 5 databases because it was taking too much time to run as Brute force is so much slower than Apriori algorithm.

But I have attached some outputs for small files as it was running fast compared to these big databases.

Also, I could not generate confidence value and association rule for this source code because of time issues.

I have generated code for frequent items having support greater than minimum support.

Outputs of Brute Force Attack for Association Rule Mining

```
Enter path to the dataC:\Users\Twinkle\Desktop\Data Mining\sample_tesco_dataset.csv
Enter minimum support:0.2
Enter minimum confidence:0.3
[['apple', 'beer', 'chicken', 'rice']]
[['apple', 'beer', 'rice']]
[['apple', 'beer']]
[['apple', 'mango']]
[['beer', 'chicken', 'milk', 'rice']]
[['beer', 'milk', 'rice']]
[['beer', 'milk']]
[['mango', 'milk']]
Frequent Items:()
Support:1.0

Frequent Items:('apple',)
Support:0.5

Frequent Items:('beer',)
Support:0.75

Frequent Items:('apple', 'beer')
Support:0.375

Frequent Items:('chicken',)
Support:0.25

Frequent Items:('beer', 'chicken')
Support:0.25

Frequent Items:('rice',)
Support:0.5

Frequent Items:('apple', 'rice')
Support:0.25

Frequent Items:('beer', 'rice')
Support:0.5

Frequent Items:('apple', 'beer', 'rice')
Support:0.25

Frequent Items:('chicken', 'rice')
Support:0.25
```

Output 1

Dataset is displayed below input values

```
Frequent Items:('chicken', 'rice')
Support:0.25

Frequent Items:('beer', 'chicken', 'rice')
Support:0.25

Frequent Items:('mango',)
Support:0.25

Frequent Items:('milk',)
Support:0.5

Frequent Items:('beer', 'milk')
Support:0.375

Frequent Items:('rice', 'milk')
Support:0.25

Frequent Items:('beer', 'rice', 'milk')
Support:0.25

Execution time is: 7.0849878787994385 seconds
```

Output 2 with execution time