题目描述

DBLP数据集 包括超过100万篇发表在计算机科学会议和杂志上的论文项。在这些项中，很多作者都有合著关系。

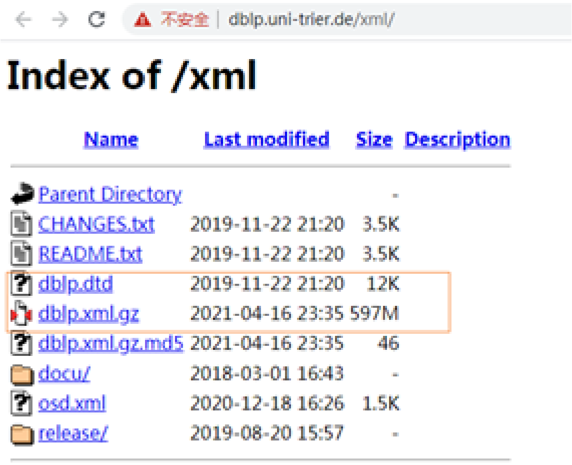
(a)提出一种方法，挖掘密切相关的（即，经常一起合写文章）合著者关系。

(b)根据挖掘结果和本章讨论的模式评估度量，讨论哪种度量可能比其他度量更令人信服地揭示紧密合作模式。

(c)基于以上研究，开发一种方法，它能粗略地预测导师和学生关系，以及这种指导的近似周期。

测试数据

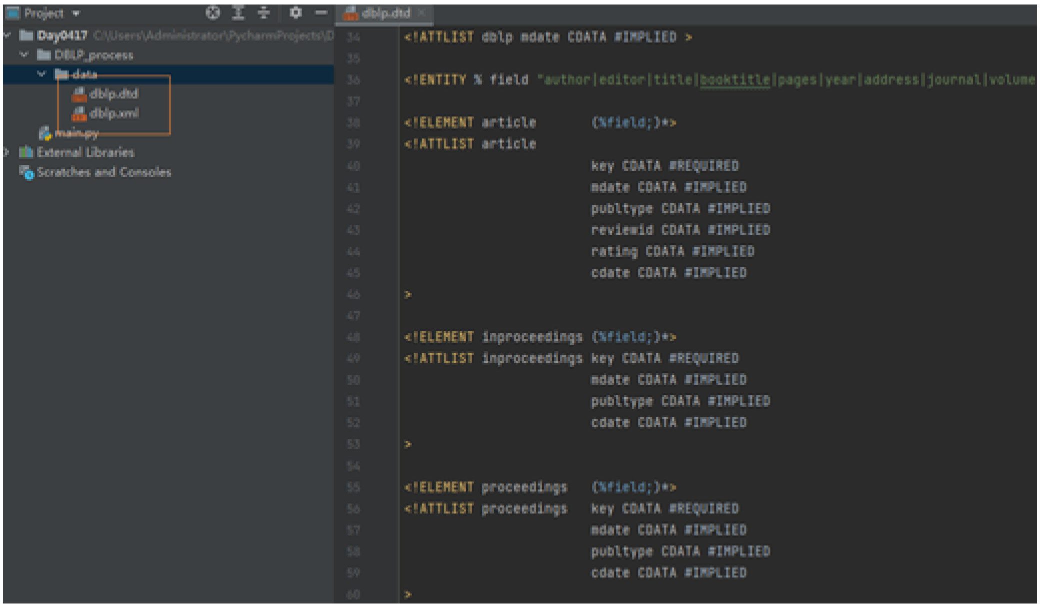
从官网下载DBLP数据集



Index of /xml

Name	Last modified	Size	Description
Parent Directory		-	
CHANGES.txt	2019-11-22 21:20	3.5K	
README.txt	2019-11-22 21:20	3.5K	
dblp.dtd	2019-11-22 21:20	12K	
dblp.xml.gz	2021-04-16 23:35	597M	
dblp.xml.gz.md5	2021-04-16 23:35	46	
docu/	2018-03-01 16:43	-	
osd.xml	2020-12-18 16:26	1.5K	
release/	2019-08-20 15:57	-	

解压缩后得:



```
<!ATTLIST dblp mdate CDATA #IMPLIED >

<!ENTITY % field "author|editor|title|booktitle|pages|year|address|journal|volume

<!ELEMENT article       (%field;)*>
<!ATTLIST article
                        key CDATA #REQUIRED
                        mdate CDATA #IMPLIED
                        publtype CDATA #IMPLIED
                        reviewid CDATA #IMPLIED
                        rating CDATA #IMPLIED
                        cdate CDATA #IMPLIED
>

<!ELEMENT inproceedings (%field;)*>
<!ATTLIST inproceedings key CDATA #REQUIRED
                        mdate CDATA #IMPLIED
                        publtype CDATA #IMPLIED
                        cdate CDATA #IMPLIED
>

<!ELEMENT proceedings   (%field;)*>
<!ATTLIST proceedings   key CDATA #REQUIRED
                        mdate CDATA #IMPLIED
                        publtype CDATA #IMPLIED
                        cdate CDATA #IMPLIED
>
```

''' 文件太大无法上传 '''

结题思路

从DBLP数据库中找到经常一起写作的合作者任务分解：

从DBLP数据集中提取作者信息

建立索引作者ID并对文件编码

分析数据的规模

构建FP-Tree并从FP-Tree得到频繁项集

频繁项集挖掘结果分析

解析文件

所有的作者信息分布在以下这些属性中：

‘article’,‘inproceedings’,‘proceedings’,‘book’,‘incollection’,‘phdthesis’,‘mastersthesis’,‘www’

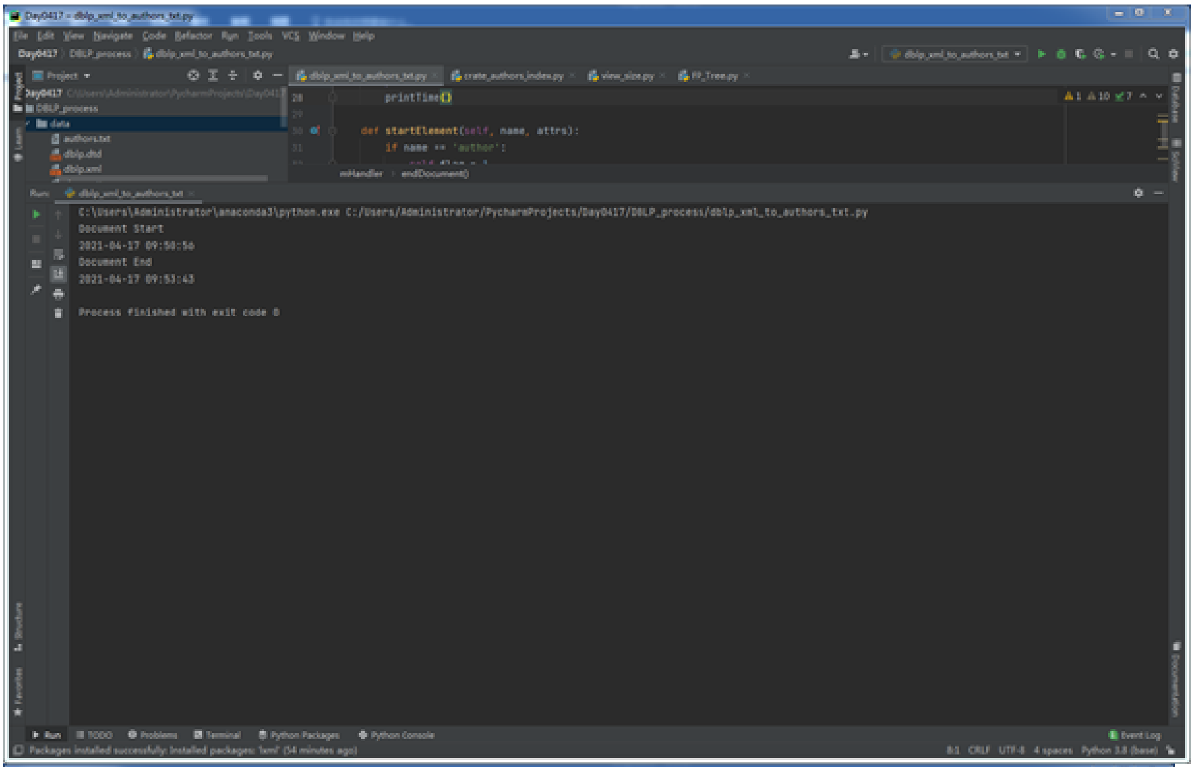
使用python自带的xml分析器解析，分析器在进入上面那些属性中的某一个时，标记flag=1，然后将author属性的内容输出到文件，退出时再标记flag = 0

解析源代码为：

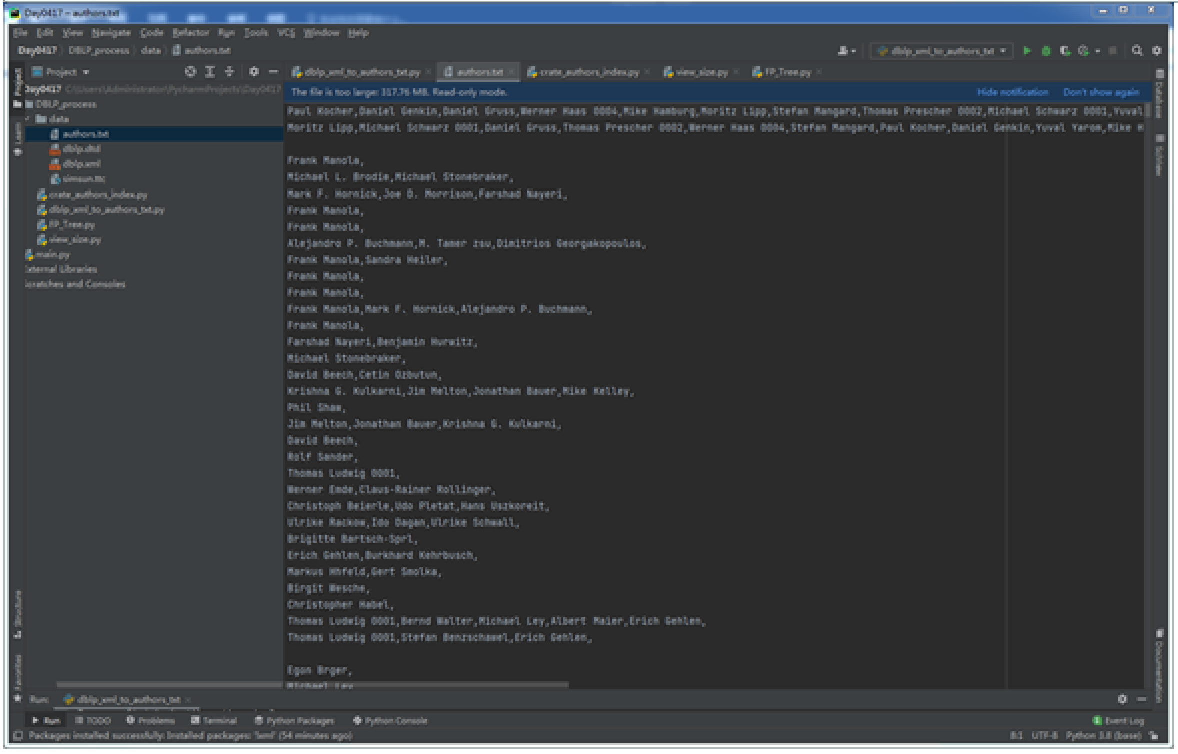
```
import codecs
from xml.sax import handler, make_parser
from time import strftime, localtime

paper_tag = ('article', 'inproceedings', 'proceedings', 'book',
             'incollection', 'phdthesis', 'mastersthesis', 'www')

# 打印当前时间
def printTime():
    print(strftime("%Y-%m-%d %H:%M:%S", localtime()))
    return

class mHandler(handler.ContentHandler):
    def __init__(self, result):
        self.result = result
        self.flag = 0

    def startDocument(self):
        print('Document Start')
        printTime()

    def endDocument(self):
        print('Document End')
        printTime()

    def startElement(self, name, attrs):
        if name == 'author':
            self.flag = 1

    def endElement(self, name):
        if name == 'author':
```

```python
            self.result.write(',')
            self.flag = 0
        if (name in paper_tag):
            self.result.write('\r\n')

    def characters(self, chrs):  # [8]
        if self.flag:
            self.result.write(chrs)

def parserDblpXml(source, result):
    handler = mHandler(result)
    parser = make_parser()
    parser.setContentHandler(handler)

    parser.parse(source)

if __name__ == '__main__':
    source = codecs.open('data/dblp.xml', 'r', 'utf-8')
    result = codecs.open('data/authors.txt', 'w', 'utf-8')
    parserDblpXml(source, result)
    result.close()
    source.close()
```

结果保存到authors.txt文件：



```
C:\Users\Administrator\anaconda3\python.exe C:/Users/Administrator/PycharmProjects/Day0417/DBLP_process/dblp_xml_to_authors_txt.py
Document Start
2021-04-17 09:50:56
Document End
2021-04-17 09:53:43

Process finished with exit code 0
```



The file is too large: 317.76 MB. Read-only mode.

```
Paul Kocher,Daniel Genkin,Daniel Gruss,Werner Haas 0004,Mike Hamburg,Moritz Lipp,Stefan Mangard,Thomas Prescher 0002,Michael Schwarz 0001,Yuval
Moritz Lipp,Michael Schwarz 0001,Daniel Gruss,Thomas Prescher 0002,Werner Haas 0004,Stefan Mangard,Paul Kocher,Daniel Genkin,Yuval Yarom,Mike H

Frank Manola,
Michael L. Brodie,Michael Stonebraker,
Mark F. Hornick,Joe D. Morrison,Farshad Nayeri,
Frank Manola,
Frank Manola,
Alejandro P. Buchmann,M. Tamer zsu,Dimitrios Georgakopoulos,
Frank Manola,Sandra Heiler,
Frank Manola,
Frank Manola,
Frank Manola,Mark F. Hornick,Alejandro P. Buchmann,
Frank Manola,
Farshad Nayeri,Benjamin Hurwitz,
Michael Stonebraker,
David Beech,Cetin Ozbutun,
Krishna G. Kulkarni,Jim Melton,Jonathan Bauer,Mike Kelley,
Phil Shaw,
Jim Melton,Jonathan Bauer,Krishna G. Kulkarni,
David Beech,
Rolf Sander,
Thomas Ludwig 0001,
Werner Emde,Claus-Rainer Rollinger,
Christoph Beierle,Udo Pletat,Hans Uszkoreit,
Ulrike Rackow,Ido Dagan,Ulrike Schwall,
Brigitte Bartsch-Sprl,
Erich Gehlen,Burkhard Kehrbusch,
Markus Hhfeld,Gert Smolka,
Birgit Wesche,
Christopher Habel,
Thomas Ludwig 0001,Bernd Walter,Michael Ley,Albert Maier,Erich Gehlen,
Thomas Ludwig 0001,Stefan Benzschawel,Erich Gehlen,

Egon Brger,
Michael Ley
```

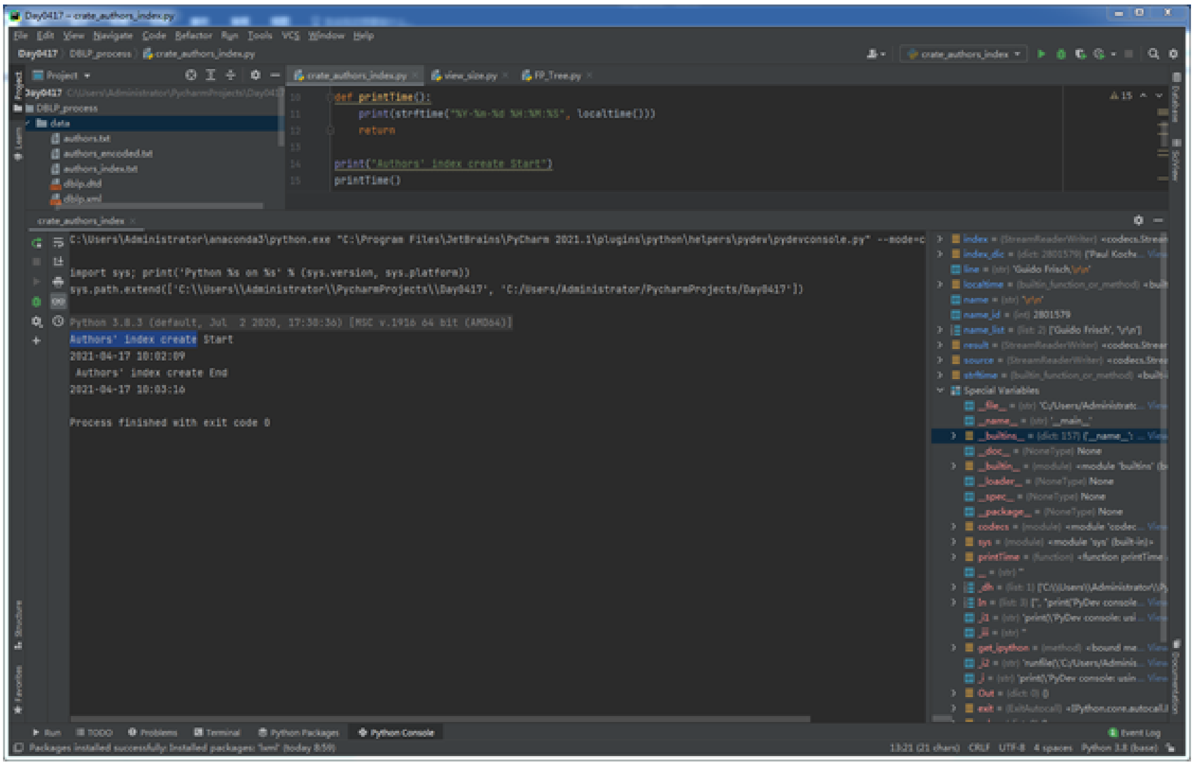
建立索引作者ID

读取得到的authors.txt文件，将其中不同的人名按照人名出现的次序编码，
存储到文件authors_index.txt中，同时将编码后的合作者列表写入authors_encoded.txt文件。
源代码为：

```
import codecs
from time import strftime, localtime
source = codecs.open('data/authors.txt','r','utf-8')
result = codecs.open('data/authors_encoded.txt','w','utf-8')
index = codecs.open('data/authors_index.txt','w','utf-8')
index_dic = {}
name_id = 0
```

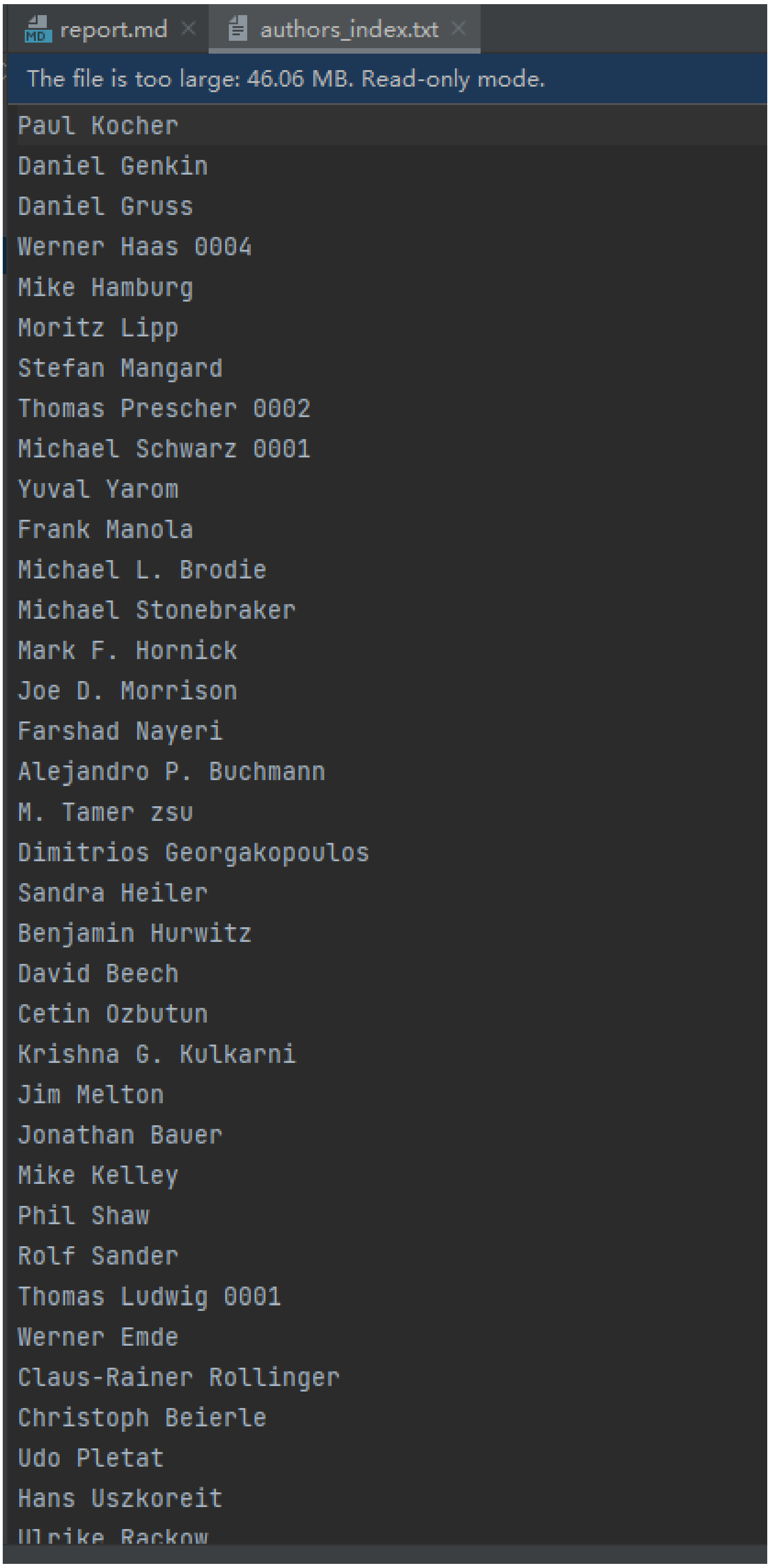
```python
# 打印当前时间
def printTime():
    print(strftime("%Y-%m-%d %H:%M:%S", localtime()))
    return

print("Authors' index create Start")
printTime()

for line in source:
    name_list = line.split(',')
    for name in name_list:
        if not (name == '\r\n'):
            if name in index_dic:
                index_dic[name][1] +=1
            else:
                index_dic[name] = [name_id,1]
                index.write(name + u'\r\n')
                name_id += 1
            result.write(str(index_dic[name][0]) + u',')
    result.write('\r\n')

source.close()
result.close()
index.close()
print(" Authors' index create End")
printTime()
```

运行结果：



```
def printTime():
    print(strftime("%Y-%m-%d %H:%M:%S", localtime()))
    return

print("Authors' index create Start")
printTime()
```

```
C:\Users\Administrator\anaconda3\python.exe "C:\Program Files\JetBrains\PyCharm 2021.1\plugins\python\helpers\pydev\pydevconsole.py" --mode=c

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['C:\\Users\\Administrator\\PycharmProjects\\Day0417', 'C:/Users/Administrator/PycharmProjects/Day0417'])

Python 3.8.3 (default, Jul  2 2020, 17:30:36) [MSC v.1916 64 bit (AMD64)]
Authors' index create Start
2021-04-17 10:02:09
 Authors' index create End
2021-04-17 10:03:16

Process finished with exit code 0
```



The file is too large: 46.06 MB. Read-only mode.

```
Paul Kocher
Daniel Genkin
Daniel Gruss
Werner Haas 0004
Mike Hamburg
Moritz Lipp
Stefan Mangard
Thomas Prescher 0002
Michael Schwarz 0001
Yuval Yarom
Frank Manola
Michael L. Brodie
Michael Stonebraker
Mark F. Hornick
Joe D. Morrison
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Alejandro P. Buchmann
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Dimitrios Georgakopoulos
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Benjamin Hurwitz
David Beech
Cetin Ozbutun
Krishna G. Kulkarni
Jim Melton
Jonathan Bauer
Mike Kelley
Phil Shaw
Rolf Sander
Thomas Ludwig 0001
Werner Emde
Claus-Rainer Rollinger
Christoph Beierle
Udo Pletat
Hans Uszkoreit
Ulrike Rackow
```
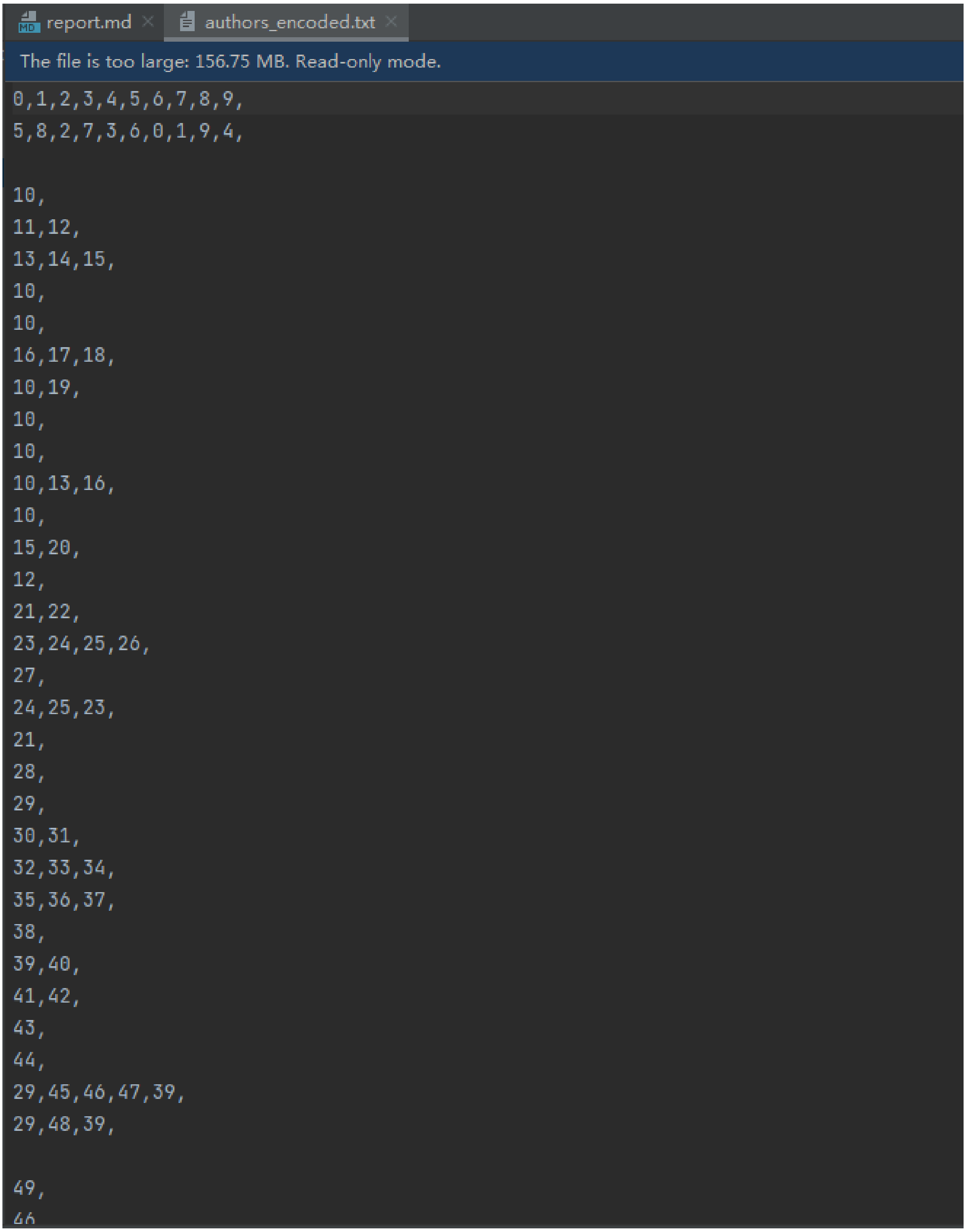



The file is too large: 156.75 MB. Read-only mode.

```
0,1,2,3,4,5,6,7,8,9,
5,8,2,7,3,6,0,1,9,4,

10,
11,12,
13,14,15,
10,
10,
16,17,18,
10,19,
10,
10,
10,13,16,
10,
15,20,
12,
21,22,
23,24,25,26,
27,
24,25,23,
21,
28,
29,
30,31,
32,33,34,
35,36,37,
38,
39,40,
41,42,
43,
44,
29,45,46,47,39,
29,48,39,

49,
46,
```

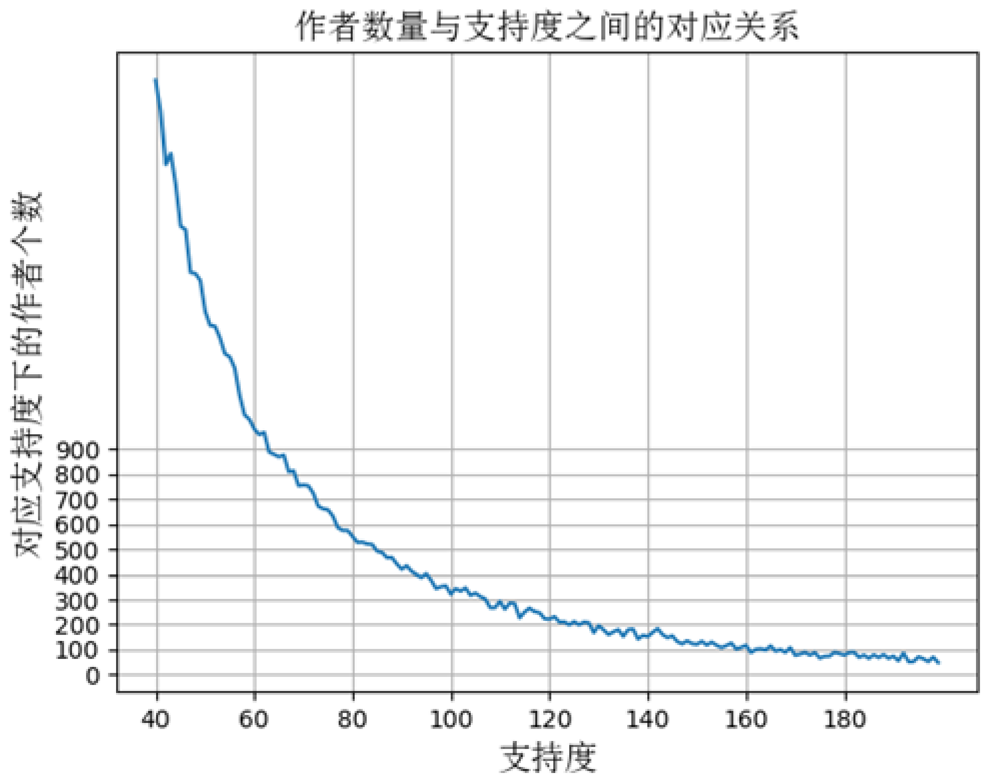
分析数据的规模

查看在DBLP数据集中作者发表文章的数量。即统计只发表过1次文章的人数有多少，
发表过2篇文章的人数有多少...发表过n篇文章的有多少人,分析可知，当支持度为40的作者数量接近1000，
随后支持度每增加20，对应的作者数量减半，为了降低计算量，第一次实验时支持度阈值不宜选得太小，
同时为了避免结果数量太少，初次实验时阈值可选在40~60之间,这里不妨选40。

源代码为：

```
# -*- coding: utf-8 -*-
from matplotlib.font_manager import FontProperties
import codecs
import matplotlib.pyplot as plt
import numpy as np

font = FontProperties(fname=r"data/simsun.ttc", size=14)
data = codecs.open('data/authors_encoded.txt','r','utf-8')
word_counts = {}
maxCounts = 0
for line in data:
    line = line.split(',')
    for word in line[0:-1]:
        word_counts[word] = word_counts.get(word,0) + 1
        if word_counts[word] > maxCounts:
            maxCounts = word_counts[word]
            maxKey = word

xMax = maxCounts
data.close()
bins = {}
for k,v in word_counts.items():
    bins[v] = bins.get(v,0) + 1

y = []
for i in range(40, 200):
    y.append(bins.get(i,0))
plt.plot(y,'-');
plt.grid()
plt.yticks(range(0,1000,100))
plt.xticks(range(0,160,20),range(40,200,20))
plt.xlabel(u'支持度',fontproperties=font)
plt.ylabel(u'对应支持度下的作者个数',fontproperties=font)
plt.title(u'作者数量与支持度之间的对应关系',fontproperties=font)
plt.show()
```

运行结果：



构建FP-Tree得到频繁项集

FP-Tree算法其核心思想分为2步，首先扫描数据库得到FP-Tree,然后再从树上递归生成条件模式树并上溯找到频繁项集。

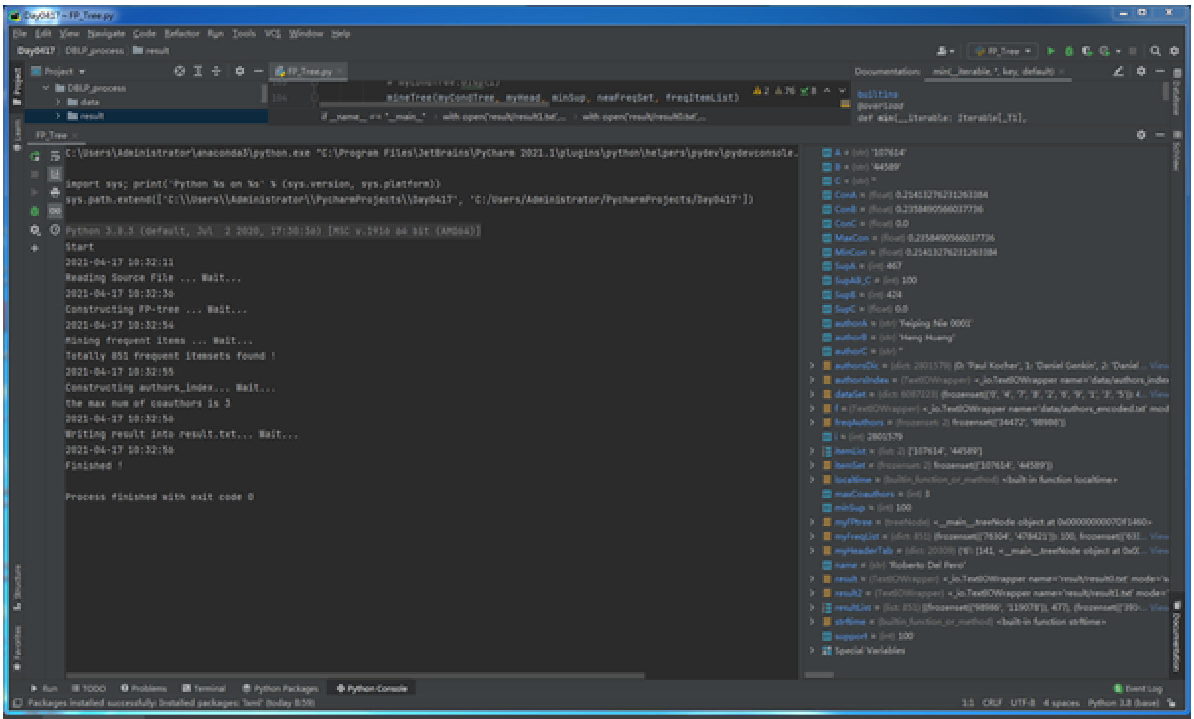
源代码为：

```
from time import strftime, localtime

# 打印当前时间
def printTime():
    print(strftime("%Y-%m-%d %H:%M:%S", localtime()))
    return

class treeNode:
    def __init__(self, nameValue, numOccur, parentNode):
        self.name = nameValue
        self.count = numOccur
        self.nodeLink = None
        self.parent = parentNode  # needs to be updated
        self.children = {}

    def inc(self, numOccur):
        self.count += numOccur

    def disp(self, ind=1):
        print('  ' * ind, self.name, ' ', self.count)
        for child in self.children.values():
            child.disp(ind + 1)
```

```
def createTree(dataSet, minSup=1):  # create FP-tree from dataset but don't mine
    freqDic = {}
    # go over dataSet twice
    for trans in dataSet:  # first pass counts frequency of occurance
        for item in trans:
            freqDic[item] = freqDic.get(item, 0) + dataSet[trans]

    headerTable = {k: v for (k, v) in freqDic.items() if v >= minSup}

    # print 'freqItemSet: ',freqItemSet
    if len(headerTable) == 0: return None, None  # if no items meet min support
-->get out
    for k in headerTable:
        headerTable[k] = [headerTable[k], None]  # reformat headerTable to use
Node link
    # print 'headerTable: ',headerTable
    retTree = treeNode('Null Set', 1, None)  # create tree
    for tranSet, count in dataSet.items():  # go through dataset 2nd time
        localD = {}
        for item in tranSet:  # put transaction items in order
            if headerTable.get(item, 0):
                localD[item] = headerTable[item][0]
        if len(localD) > 0:
            orderedItems = [v[0] for v in sorted(localD.items(), key=lambda p:
p[1], reverse=True)]
            updateTree(orderedItems, retTree, headerTable, count)  # populate
tree with ordered freq itemset
    return retTree, headerTable  # return tree and header table


def updateTree(items, inTree, headerTable, count):
    if items[0] in inTree.children:  # check if orderedItems[0] in
retTree.children
        inTree.children[items[0]].inc(count)  # incrament count
    else:  # add items[0] to inTree.children
        inTree.children[items[0]] = treeNode(items[0], count, inTree)
        if headerTable[items[0]][1] == None:  # update header table
            headerTable[items[0]][1] = inTree.children[items[0]]
        else:
            updateHeader(headerTable[items[0]][1], inTree.children[items[0]])
    if len(items) > 1:  # call updateTree() with remaining ordered items
        updateTree(items[1::], inTree.children[items[0]], headerTable, count)


def updateHeader(nodeToTest, targetNode):  # this version does not use recursion
    while (nodeToTest.nodeLink != None):  # Do not use recursion to traverse a
linked list!
        nodeToTest = nodeToTest.nodeLink
    nodeToTest.nodeLink = targetNode


def ascendTree(leafNode, prefixPath):  # ascends from leaf node to root
    if leafNode.parent != None:
        prefixPath.append(leafNode.name)
        ascendTree(leafNode.parent, prefixPath)


def findPrefixPath(basePat, treeNode):  # treeNode comes from header table
```

```python
    condPats = {}
    while treeNode != None:
        prefixPath = []
        ascendTree(treeNode, prefixPath)
        if len(prefixPath) > 1:
            condPats[frozenset(prefixPath[1:])] = treeNode.count
        treeNode = treeNode.nodeLink
    return condPats


def mineTree(inTree, headerTable, minSup, preFix, freqItemList):
    bigL = [v[0] for v in sorted(headerTable.items(), key=lambda p: p[1][0])]  # (sort header table)
    for basePat in bigL:  # start from bottom of header table
        newFreqSet = preFix.copy()
        newFreqSet.add(basePat)
        # print 'finalFrequent Item: ',newFreqSet    #append to set
        if len(newFreqSet) > 1:
            freqItemList[frozenset(newFreqSet)] = headerTable[basePat][0]
        condPattBases = findPrefixPath(basePat, headerTable[basePat][1])
        # print 'condPattBases :',basePat, condPattBases
        # 2. construct cond FP-tree from cond. pattern base

        myCondTree, myHead = createTree(condPattBases, minSup)
        # print 'head from conditional tree: ', myHead
        if myHead != None:  # 3. mine cond. FP-tree
            # print 'conditional tree for: ',newFreqSet
            # myCondTree.disp(1)
            mineTree(myCondTree, myHead, minSup, newFreqSet, freqItemList)


def loadSimpDat(inFile):
    dataSet = {}
    for line in inFile:
        line = line.strip().split(',')
        dataLine = [word for word in line if word.isdigit()]
        dataSet[frozenset(dataLine)] = dataSet.get(frozenset(dataLine), 0) + 1

    return dataSet


if __name__ == "__main__":
    minSup = 100
    print("Start")
    printTime()
    print("Reading Source File ... Wait...")
    with open('data/authors_encoded.txt', 'r') as f:
        dataSet = loadSimpDat(f)

    printTime()
    print("Constructing FP-tree ... Wait...")
    myFPtree, myHeaderTab = createTree(dataSet, minSup)

    printTime()
    print("Mining frequent items ... Wait...")
    myFreqList = {}
    mineTree(myFPtree, myHeaderTab, minSup, set([]), myFreqList)
    print("Totally %d frequent itemsets found ! " % len(myFreqList))
    printTime()
    print("Constructing authors_index... Wait...")

    maxCoauthors = 0
    for freqAuthors in myFreqList.keys():
        if len(freqAuthors) > maxCoauthors:
            maxCoauthors = len(freqAuthors)
    print("the max num of coauthors is %d " % (maxCoauthors))

    with open('data/authors_index.txt', 'r') as authorsIndex:
        i = 0
        authorsDic = {}
        for name in authorsIndex:
            name = name.strip()
            authorsDic[i] = name
            i = i + 1

    printTime()
    print("Writing result into result.txt... Wait...")

    with open('result/result1.txt', 'w') as result2:
        with open('result/result0.txt', 'w') as result:

 result.write("%25s\t%25s\t%15s\t%10s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\n"
\
                         % ('authorA', 'authorB', 'authorC', 'Sup(A,B,C)',
'Sup(A)', 'Sup(B)', 'Sup(C)', \
                            'Con(A)', 'Con(B)', 'Con(C)', 'MinCon', 'MaxCon'))

 result2.write("%25s\t%25s\t%15s\t%10s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\t%6s\n
" \
                          % ('authorA', 'authorB', 'authorC', 'Sup(A,B,C)',
'Sup(A)', 'Sup(B)', 'Sup(C)', \
                             'Con(A)', 'Con(B)', 'Con(C)', 'MinCon', 'MaxCon'))
            resultList = sorted(myFreqList.items(), key=lambda p: p[1],
reverse=True)
            for itemSet, support in resultList:
                itemList = list(itemSet)
                A = itemList[0]
                authorA = authorsDic.get(int(A), '0')
                B = itemList[1]
                authorB = authorsDic.get(int(B), '0')
                SupAB_C = int(support)
                SupA = int(myHeaderTab.get(A, [0])[0])
                SupB = int(myHeaderTab.get(B, [0])[0])
                ConA = float(SupAB_C) / float(SupA)
                ConB = float(SupAB_C) / float(SupB)
                (C, authorC, SupC, ConC) = ('', '', 0.0, 0.0)

                if len(itemList) == 3:
                    C = itemList[2]
                    authorC = authorsDic.get(int(C), '0')
                    SupC = int(myHeaderTab.get(C, [0])[0])
                    ConC = float(SupAB_C) / float(SupC)
                    MinCon = min([ConA, ConB, ConC])
                    MaxCon = max([ConA, ConB, ConC])
                elif len(itemList) == 2:
                    MinCon = min([ConA, ConB])
                    MaxCon = max([ConA, ConB])

                if MinCon < 0.4 or MaxCon < 0.5 or (MinCon + MaxCon) / 2 < 0.5:
                    continue

 result.write("%25s\t%25s\t%15s\t%10.0f\t%6.0f\t%6.0f\t%6.0f\t%6.4f\t%6.4f\t%6.4f\t%6.4f\t%6.4f\n" % (authorA, authorB, authorC, SupAB_C, SupA, SupB, SupC, ConA, ConB, ConC, MinCon, MaxCon))

 result2.write("%25s\t%25s\t%15s\t%10.0f\t%6.0f\t%6.0f\t%6.0f\t\%6.4f\t%6.4f\t%6.4f\t%6.4f\t%6.4f\n" % (A, B, C, SupAB_C, SupA, SupB, SupC, ConA, ConB, ConC, MinCon, MaxCon))

    result.close()
    result2.close()
    authorsIndex.close()
    f.close()
    printTime()
    print("Finished !")
```

运行结果：



Day0417 – FP_Tree.py
File Edit View Navigate Code Refactor Run Tools VCS Window Help
Day0417 DBLP_process result
Project
DBLP_process
data
result
FP_Tree.py
FP_Tree
Documentation: min(__iterable, *, key, default)
Run TODO Problems Terminal Python Packages Python Console
Event Log
1:1 CRLF UTF-8 4 spaces Python 3.8 (base)

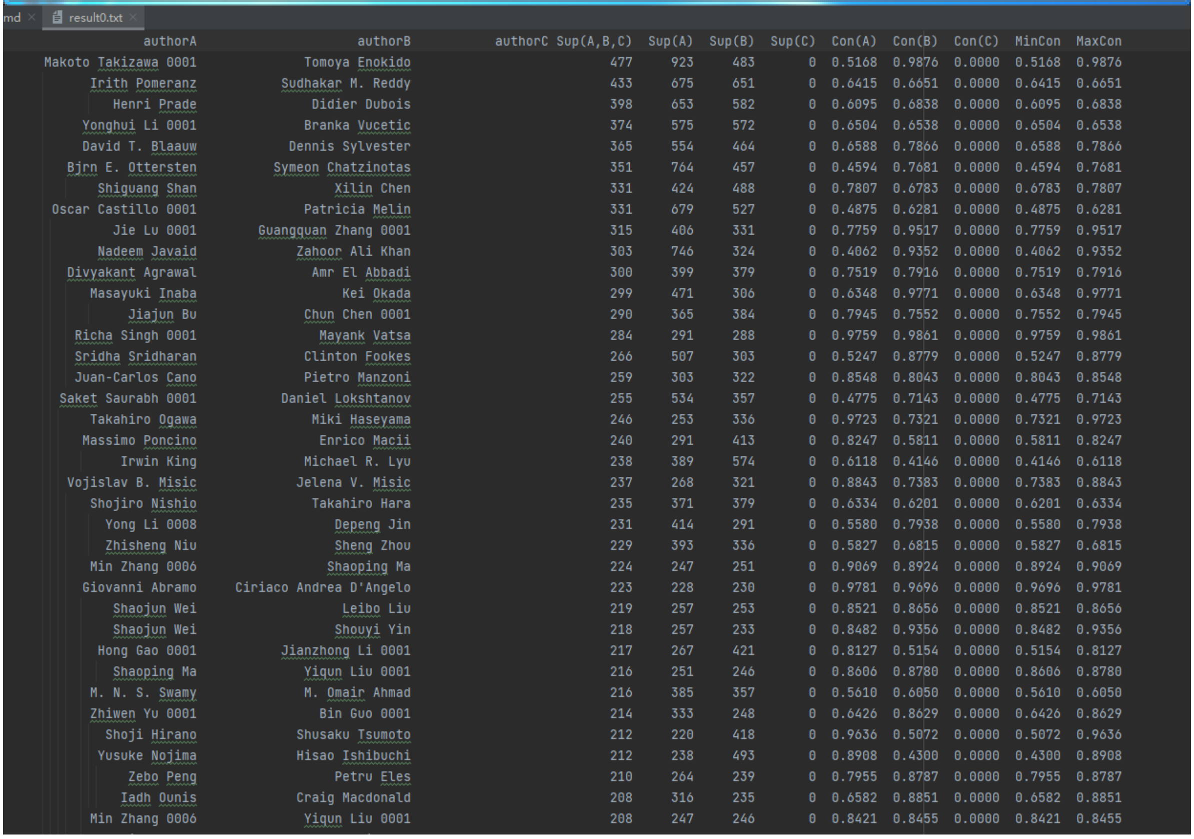
```
mineTree(myCondTree, myHead, minSup, newFreqSet, freqItemList)
if __name__ == '__main__'  with open('result/result1.txt'...  with open('result/result0.txt'...
```

```
builtins
@overload
def min(__iterable: Iterable[_T1],
```

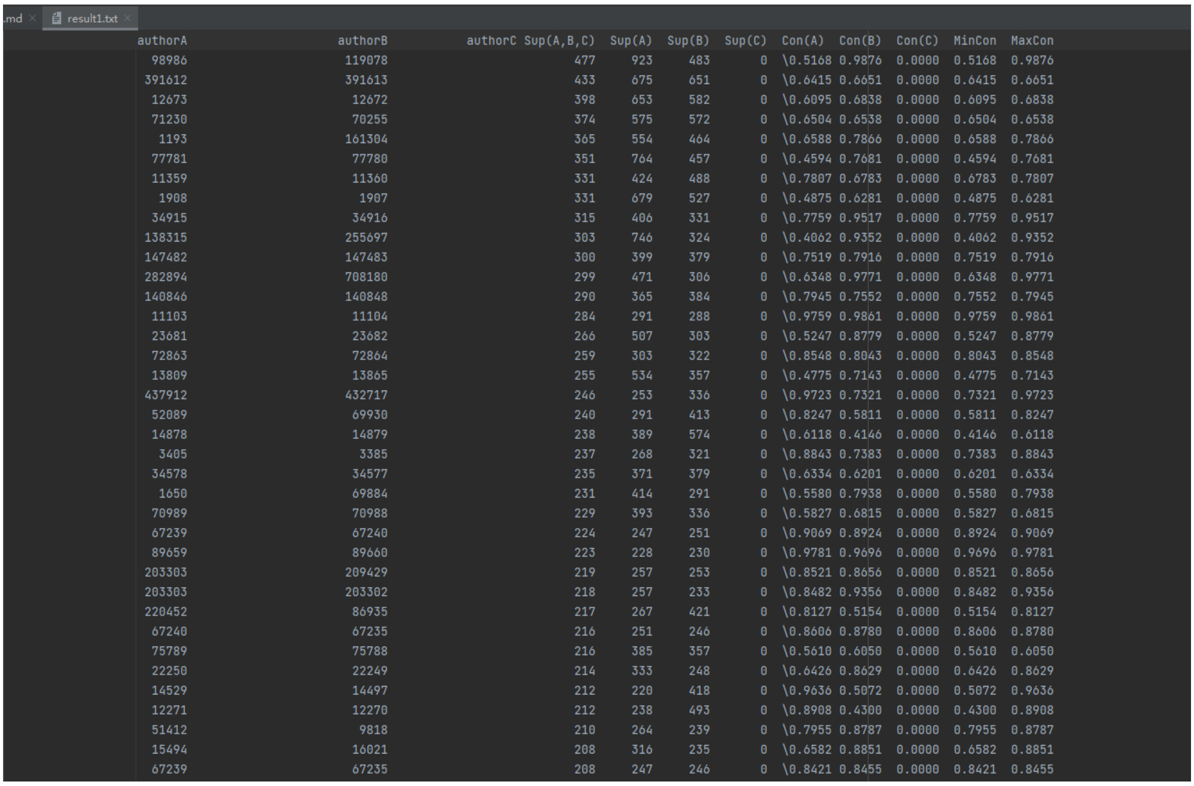
```
C:\Users\Administrator\anaconda3\python.exe "C:\Program Files\JetBrains\PyCharm 2021.1\plugins\python\helpers\pydev\pydevconsole...

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['C:\\Users\\Administrator\\PycharmProjects\\Day0417', 'C:/Users/Administrator/PycharmProjects/Day0417'])

Python 3.8.3 (default, Jul  2 2020, 17:30:36) [MSC v.1916 64 bit (AMD64)]
Start
2021-04-17 10:32:11
Reading Source File ... Wait...
2021-04-17 10:32:36
Constructing FP-tree ... Wait...
2021-04-17 10:32:54
Mining frequent items ... Wait...
Totally 851 frequent itemsets found !
2021-04-17 10:32:55
Constructing authors_index... Wait...
the max num of coauthors is 3
2021-04-17 10:32:56
Writing result into result.txt... Wait...
2021-04-17 10:32:56
Finished !

Process finished with exit code 0
```

```
A = {str} '107614'
B = {str} '44589'
C = {str} ''
ConA = {float} 0.25413276231263384
ConB = {float} 0.2358490566037736
ConC = {float} 0.0
MaxCon = {float} 0.2358490566037736
MinCon = {float} 0.25413276231263384
SupA = {int} 467
SupAB_C = {int} 100
SupB = {int} 424
SupC = {float} 0.0
authorA = {str} 'Feiping Nie 0001'
authorB = {str} 'Heng Huang'
authorC = {str} ''
authorsDic = {dict: 2801579} {0: 'Paul Kocher', 1: 'Daniel Genkin', 2: 'Daniel... View
authorsIndex = {TextIOWrapper} <_io.TextIOWrapper name='data/authors_index...
dataSet = {dict: 6087223} {frozenset({'0', '4', '7', '8', '2', '6', '9', '3', '1', '5'}): 4... View
f = {TextIOWrapper} <_io.TextIOWrapper name='data/authors_encoded.txt' mod
freqAuthors = {frozenset: 2} frozenset({'34472', '98986'})
i = {int} 2801579
itemList = {list: 2} ['107614', '44589']
itemSet = {frozenset: 2} frozenset({'107614', '44589'})
localtime = {builtin_function_or_method} <built-in function localtime>
maxCoauthors = {int} 3
minSup = {int} 100
myFPtree = {treeNode} <__main__.treeNode object at 0x00000000007DF1460>
myFreqList = {dict: 851} {frozenset({'76304', '478421'}): 100, frozenset({'631... View
myHeaderTab = {dict: 20309} {'6': [141, <__main__.treeNode object at 0x0... View
name = {str} 'Roberto Del Pero'
result = {TextIOWrapper} <_io.TextIOWrapper name='result/result0.txt' mode='w
result2 = {TextIOWrapper} <_io.TextIOWrapper name='result/result1.txt' mode='
resultList = {list: 851} [(frozenset({'98986', '119078'}), 477), (frozenset({'391... View
strftime = {builtin_function_or_method} <built-in function strftime>
support = {int} 100
Special Variables
```

Packages installed successfully: Installed packages: 'xml' (today 8:59)



```
                authorA                      authorB           authorC Sup(A,B,C) Sup(A) Sup(B) Sup(C) Con(A) Con(B) Con(C) MinCon MaxCon
   Makoto Takizawa 0001              Tomoya Enokido                         477    923    483      0 0.5168 0.9876 0.0000 0.5168 0.9876
         Irith Pomeranz             Sudhakar M. Reddy                        433    675    651      0 0.6415 0.6651 0.0000 0.6415 0.6651
            Henri Prade                Didier Dubois                         398    653    582      0 0.6095 0.6838 0.0000 0.6095 0.6838
           Yonghui Li 0001             Branka Vucetic                        374    575    572      0 0.6504 0.6538 0.0000 0.6504 0.6538
         David T. Blaauw             Dennis Sylvester                        365    554    464      0 0.6588 0.7866 0.0000 0.6588 0.7866
         Bjrn E. Ottersten         Symeon Chatzinotas                        351    764    457      0 0.4594 0.7681 0.0000 0.4594 0.7681
          Shiguang Shan                   Xilin Chen                         331    424    488      0 0.7807 0.6783 0.0000 0.6783 0.7807
   Oscar Castillo 0001               Patricia Melin                          331    679    527      0 0.4875 0.6281 0.0000 0.4875 0.6281
            Jie Lu 0001         Guangquan Zhang 0001                         315    406    331      0 0.7759 0.9517 0.0000 0.7759 0.9517
          Nadeem Javaid           Zahoor Ali Khan                            303    746    324      0 0.4062 0.9352 0.0000 0.4062 0.9352
      Divyakant Agrawal              Amr El Abbadi                           300    399    379      0 0.7519 0.7916 0.0000 0.7519 0.7916
       Masayuki Inaba                   Kei Okada                            299    471    306      0 0.6348 0.9771 0.0000 0.6348 0.9771
             Jiajun Bu               Chun Chen 0001                          290    365    384      0 0.7945 0.7552 0.0000 0.7552 0.7945
      Richa Singh 0001                Mayank Vatsa                           284    291    288      0 0.9759 0.9861 0.0000 0.9759 0.9861
      Sridha Sridharan             Clinton Fookes                            266    507    303      0 0.5247 0.8779 0.0000 0.5247 0.8779
       Juan-Carlos Cano             Pietro Manzoni                           259    303    322      0 0.8548 0.8043 0.0000 0.8043 0.8548
     Saket Saurabh 0001         Daniel Lokshtanov                            255    534    357      0 0.4775 0.7143 0.0000 0.4775 0.7143
        Takahiro Ogawa               Miki Haseyama                           246    253    336      0 0.9723 0.7321 0.0000 0.7321 0.9723
       Massimo Poncino                Enrico Macii                           240    291    413      0 0.8247 0.5811 0.0000 0.5811 0.8247
            Irwin King              Michael R. Lyu                           238    389    574      0 0.6118 0.4146 0.0000 0.4146 0.6118
      Vojislav B. Misic            Jelena V. Misic                           237    268    321      0 0.8843 0.7383 0.0000 0.7383 0.8843
        Shojiro Nishio               Takahiro Hara                           235    371    379      0 0.6334 0.6201 0.0000 0.6201 0.6334
          Yong Li 0008                 Depeng Jin                            231    414    291      0 0.5580 0.7938 0.0000 0.5580 0.7938
          Zhisheng Niu                Sheng Zhou                             229    393    336      0 0.5827 0.6815 0.0000 0.5827 0.6815
        Min Zhang 0006                Shaoping Ma                            224    247    251      0 0.9069 0.8924 0.0000 0.8924 0.9069
       Giovanni Abramo     Ciriaco Andrea D'Angelo                           223    228    230      0 0.9781 0.9696 0.0000 0.9696 0.9781
            Shaojun Wei                  Leibo Liu                           219    257    253      0 0.8521 0.8656 0.0000 0.8521 0.8656
            Shaojun Wei                Shouyi Yin                            218    257    233      0 0.8482 0.9356 0.0000 0.8482 0.9356
         Hong Gao 0001          Jianzhong Li 0001                            217    267    421      0 0.8127 0.5154 0.0000 0.5154 0.8127
            Shaoping Ma             Yiqun Liu 0001                           216    251    246      0 0.8606 0.8780 0.0000 0.8606 0.8780
        M. N. S. Swamy             M. Omair Ahmad                            216    385    357      0 0.5610 0.6050 0.0000 0.5610 0.6050
        Zhiwen Yu 0001              Bin Guo 0001                             214    333    248      0 0.6426 0.8629 0.0000 0.6426 0.8629
           Shoji Hirano            Shusaku Tsumoto                           212    220    418      0 0.9636 0.5072 0.0000 0.5072 0.9636
         Yusuke Nojima             Hisao Ishibuchi                           212    238    493      0 0.8908 0.4300 0.0000 0.4300 0.8908
             Zebo Peng                 Petru Eles                            210    264    239      0 0.7955 0.8787 0.0000 0.7955 0.8787
            Iadh Ounis            Craig Macdonald                            208    316    235      0 0.6582 0.8851 0.0000 0.6582 0.8851
        Min Zhang 0006             Yiqun Liu 0001                            208    247    246      0 0.8421 0.8455 0.0000 0.8421 0.8455
```



```
authorA    authorB    authorC Sup(A,B,C)  Sup(A)  Sup(B)  Sup(C)  Con(A) Con(B) Con(C) MinCon MaxCon
  98986     119078                 477     923     483       0 \0.5168 0.9876 0.0000 0.5168 0.9876
 391612     391613                 433     675     651       0 \0.6415 0.6651 0.0000 0.6415 0.6651
  12673      12672                 398     653     582       0 \0.6095 0.6838 0.0000 0.6095 0.6838
  71230      70255                 374     575     572       0 \0.6504 0.6538 0.0000 0.6504 0.6538
   1193     161304                 365     554     464       0 \0.6588 0.7866 0.0000 0.6588 0.7866
  77781      77780                 351     764     457       0 \0.4594 0.7681 0.0000 0.4594 0.7681
  11359      11360                 331     424     488       0 \0.7807 0.6783 0.0000 0.6783 0.7807
   1908       1907                 331     679     527       0 \0.4875 0.6281 0.0000 0.4875 0.6281
  34915      34916                 315     406     331       0 \0.7759 0.9517 0.0000 0.7759 0.9517
 138315     255697                 303     746     324       0 \0.4062 0.9352 0.0000 0.4062 0.9352
 147482     147483                 300     399     379       0 \0.7519 0.7916 0.0000 0.7519 0.7916
 282894     708180                 299     471     306       0 \0.6348 0.9771 0.0000 0.6348 0.9771
 140846     140848                 290     365     384       0 \0.7945 0.7552 0.0000 0.7552 0.7945
  11103      11104                 284     291     288       0 \0.9759 0.9861 0.0000 0.9759 0.9861
  23681      23682                 266     507     303       0 \0.5247 0.8779 0.0000 0.5247 0.8779
  72863      72864                 259     303     322       0 \0.8548 0.8043 0.0000 0.8043 0.8548
  13809      13865                 255     534     357       0 \0.4775 0.7143 0.0000 0.4775 0.7143
 437912     432717                 246     253     336       0 \0.9723 0.7321 0.0000 0.7321 0.9723
  52089      69930                 240     291     413       0 \0.8247 0.5811 0.0000 0.5811 0.8247
  14878      14879                 238     389     574       0 \0.6118 0.4146 0.0000 0.4146 0.6118
   3405       3385                 237     268     321       0 \0.8843 0.7383 0.0000 0.7383 0.8843
  34578      34577                 235     371     379       0 \0.6334 0.6201 0.0000 0.6201 0.6334
   1650      69884                 231     414     291       0 \0.5580 0.7938 0.0000 0.5580 0.7938
  70989      70988                 229     393     336       0 \0.5827 0.6815 0.0000 0.5827 0.6815
  67239      67240                 224     247     251       0 \0.9069 0.8924 0.0000 0.8924 0.9069
  89659      89660                 223     228     230       0 \0.9781 0.9696 0.0000 0.9696 0.9781
 203303     209429                 219     257     253       0 \0.8521 0.8656 0.0000 0.8521 0.8656
 203303     203302                 218     257     233       0 \0.8482 0.9356 0.0000 0.8482 0.9356
 220452      86935                 217     267     421       0 \0.8127 0.5154 0.0000 0.5154 0.8127
  67240      67235                 216     251     246       0 \0.8606 0.8780 0.0000 0.8606 0.8780
  75789      75788                 216     385     357       0 \0.5610 0.6050 0.0000 0.5610 0.6050
  22250      22249                 214     333     248       0 \0.6426 0.8629 0.0000 0.6426 0.8629
  14529      14497                 212     220     418       0 \0.9636 0.5072 0.0000 0.5072 0.9636
  12271      12270                 212     238     493       0 \0.8908 0.4300 0.0000 0.4300 0.8908
  51412       9818                 210     264     239       0 \0.7955 0.8787 0.0000 0.7955 0.8787
  15494      16021                 208     316     235       0 \0.6582 0.8851 0.0000 0.6582 0.8851
  67239      67235                 208     247     246       0 \0.8421 0.8455 0.0000 0.8421 0.8455
```

输出结果说明

统计满足支持度条件的合作者个数可以发现，经常一起合作的作者数目最多为3，故在输出文件中输出authorA，authorB，authorC（当合作者数目为2时，authorC为空，其对应支持度和置信度为0），Sup（A,B,C）为A,B,C共同合作的次数，Sup（A）Sup（B）Sup（C）分别为A,B,C各自的写作次数，Con（A）、Con（B）、Con（C）分别表示A,B,C的置信度（即合作次数除以写作总次数）MinCon和MaxCon分别统计Con（A）、Con（B）、Con（C）的最小值和最大值（注意，当authorC为空时，其对应的置信度不加入最大最小值的统计）

输出结果分析

初步分析可以发现以下特性：

1.在满足支持度条件的合作者中，大多数是两个人，但是也有少数3个人一起经常合作的情况；

2.由于在这里我们关注的是作者之间的合作程度，故可以不关注提升度对于结果的影响；

3.合作者之间的关系是双向性的，也就是说，A与B的合作程度与B与A合作的程度是一致的，因此可以直接考虑置信度；

4.在按支持度排序后，某些作者的置信度较低，需要引入置信度阈值，为了避免置信度不平衡的情况（比如A经常和B合作，但该合作次数占B写作次数很少一部分），
需要加入阈值条件MinCon>=阈值,同时置信度中的较大值应该满足MaxCon>=1/2，另外加入平衡条件后过滤结果。

(b)根据挖掘结果和本章讨论的模式评估度量，讨论哪种度量可能比其他度量更令人信服地揭示紧密合作模式。

关于作者A(Noboru Niki)和作者B(Kenji Eguchi)的2×2的相依表(显示期望值)

	Kenji Eguchi	**^(Kenji Eguchi)**	**sum**
Noboru Niki	100(0.119)	6(105.9)	106
^(Noboru Niki)	66(165.9)	14653(147,481)	147647
sum	166	147587	147753

1.使用提升度的相关分析

P({A})=106/147753

P({B})=166/147753

P({A,B})=100/147753

提升度为P({A,B})/(P({A})*P({B}))=(100/147753)/(106/147753)*(166/147753)=839.67

2．使用χ2进行相关分析

(100-0.119)^2÷0.119 + (6-105.9)^2÷105.9 + (66-165.9)^2÷165.9 + (14653-147481)^2÷147481 =
83,833.73 + 94.23 + 60.15 + 119,630.85 =203,619

3.全置信度

P({A|B})=100/106=0.943

P({B|A})=100/166=0.602

all_conf(A,B)=min{P({A|B}),P({B|A})}=0.602

4.最大置信度

max{P({A|B}),P({B|A})}=0.943

5. Kulczynski置信度

Kulc(A,B)= 1/2*(P(A|B)+P(B|A))=0.773

6.余弦置信度

Cosine(A,B)= sqrt(P(A|B)P(B|A))= 0.754

比较6种模式评估度量:

上述6种模式评估中，提升度和χ2的计算受零事务的影响很大，在上面的例子中，^AB表示零事务的个数。一般,
零事务的个数可能大大超过个体购买的个数，因为，A和B发表过的论文相对于整个数据库中的论文总数,
是很小的一部分。其他四个度量很好地消除了^AB的影响。由于上述例子中P(A|B）和P(B|A)差别较大,
导致四种评估度量(全置信度，最大置信度，Kulczynski，余弦)结果也差别较大,

(c)基于以上研究，开发一种方法，它能粗略地预估导师和学生的关系，以及这种指导的周期

1.根据经验，我们知道，学生发表的论文上往往会署导师的名字，而导师的论文上却不一定有学生的署名,或者说导师发表过的论文要远比学生多，
而且老师往往同时指导多个学生，设置两个参数15和5，作者A和B、C、D、E满足频繁项集的要求，并且A发表过的论文不小于15篇，B、C、D、E发表过的论文不超过5篇，
则我们可以认定A为导师，B、C、D、E为A指导的学生。

2.若要求得指导的近似周期，我们需要在求频繁项集时，将发表的日期作为属性假如到事务中，如果我们已确定A为导师，B为学生，
并且他们的合著次数满足频繁项集的支持度，我们需要计算A和B合著论文中的最近日期和最早日期，最近日期-最早日期+ 1~2年=近似的指导周期。

参考博客

my blog