COSI 126A Homework 0

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Abstract

This is Homework 0 of Intro to Data Mining class

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Problem 1 (9 points)

Discuss whether or not each of the following activities is a data mining task.

(A) Dividing the customers of a company according to their gender.
No. A simple SQL query can implement this work. It classifies the customers by gender. Thus it's not data mining.

(B) Dividing the customers of a company according to their profitability.
No. A simple SQL query can implement this work. It classifies the customers by their profitability. Thus it's not data mining.

(C) Computing the total sales of company.
No. This is just a computation and didn't mine anything.

(D) Sorting a student database based on student identification numbers.
No. A simple SQL query can implement this work as well. This just needs students' information from database using their identification numbers. Thus it's not data mining.

(E) Predicting the outcomes of tossing a fair pair of dice.
No. It's just a prediction, not data mining.

(F) Predicting the future stock price of a company using historical records.
No. It's also a prediction, not data mining.

(G) Monitoring the heart rate of a patient for abnormalities.
Yes. It is detecting abnormalities, which is a part of data mining.

(H) Monitoring seismic waves for earthquake activities.
Yes. It needs to detect when the earthquake is coming and needs data and standard to do this kind of work.

(I) Extracting the frequencies of a sound wave.
No. This action is more about physics.

Problem 2 (10 points)

Suppose that you are employed as a data mining consultant for an Internet search engine company. Describe how data mining can help the company by giving specific examples of how techniques, such as clustering, classification, association rule mining, and anomaly detection can be applied.

Answer:

The Internet search engine company can benefit a lot from data mining. For example, the clustering can help them group different types of news or information. This can improve their effeciency. Moreover, classification and association rule mining can help them classify customers from which they can wisely recommend staffs for their customers. For example, if a person ususally search some snacks on the engine, then we can recommend some delicious snacks to them, and they will tend to buy those snacks.

Problem 3 (10 points)

For each of the following data sets, explain whether or not data privacy is an important issue.

(A) Census data collected from 1900-1950.

Answer: In this case, data privacy is an important issue. Because there's so much private information for citizens. Data reveal can cause serious problems.

(B) IP addresses and visit times of Web users who visit your Website.

Answer: Uasually, data privacy is not a big issue in this case. Because IP addresses and visit times do not reveal too much personal information. Also, many websites will inform people that they use cookies, if a person doesn't want to be recorded, he can just leave that website.

(C) Images from Earth-orbiting satellites.

Answer: In this case, it might depend. The images from Earth-orbiting satellites might not reveal much information of a person. While it is important for a country because the it can contain some important information such as the location of military troops.

(D) Names and addresses of people from the telephone book.

Answer: In this case, definitely yes! Because it contians personal information which is so private.

(E) Names and email addresses collected from the Web.

Answer: Yes, the data privacy is also important in this case. Data revealing can be harmful to owners of those email addresses. For example, they might receive spam emails too often.

Problem 4 (15 points)

Matrix A = $\begin{matrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{matrix}$ calculate A^{-1} , A^{+}, A^{100}

Answer:

$$A = \begin{matrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{matrix} \sim \begin{matrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix}$$

A^{-1} and A^{+} don't exist, because A is a singular matirx.

$$A^{100} = \begin{matrix} 1*14^{99} & 2*14^{99} & 3*14^{99} \\ 2*14^{99} & 4*14^{99} & 6*14^{99} \\ 3*14^{99} & 6*14^{99} & 9*14^{99} \end{matrix}$$

Problem 5 (14 points)

Assume there three students, X, Y , Z. Only one of them gets a score A+. X asks Teacher if he gets A+. Teacher refuses to tell X his score. Instead, Teacher says that Y does not get A+. Calculate P(Z gets A+)

Answer:

Even though the professor tell X that Y doesn't get A. But what the question is asking is that the probability of Z gets A+ without given any condition. As a result:

P(Z gets A+) = 1/3

Problem 6 (14 points)

There are two kinds of products in a warehouse, A and B. The percentage of A is 70%, B is 30%. The probability of substandard products in A is P(A = sub) = 2.5%, for B, it's P(B = sub) = 5%. Warehouse tests 4 products and one of them is substandard. What is the probability that this product is from A, P(this sub from A)

Answer:

In this case, we only care about the substandard items, also taking products from the warehouse has no effect on P(A = sub), P(B = sub), the percentage of A, and the percentage of B. They are independent. As a result:

P(this sub from A) = 2.5%/(2.5%+5%) = 1/3.

Problem 7 (14 points)

Calculate the similarity matrix between 9 planets. The data of planets is in Table 1.

You can use s(p1, p2) = $\sqrt{a0(d1-d2)^2 + a1(r1-r2)^2 + a2(m1-m2)^2}$, a0 = 3.5 $*$ 10^−7, a1 = 1.6 $*$ 10^−5, a2 = 1.1 $*$ 10^−27.

Set a threshold to separate 9 planets into different groups. What is the relationship between threshold and groups.

Answer:

```
from scipy.spatial.distance import euclidean, pdist, squareform
import math
var =  pd.DataFrame([['Jupiter', 778000, 71492, 1.90e27],
                     ['Saturn',1429000, 60268, 5.69e26],
                     ['Uranus',2870990, 25559, 8.69e25],
                     ['Neptune', 4504300, 24764, 1.02e26],
                     ['Earth', 149600, 6378, 5.98e24],
                     ['Venus', 108200, 6052, 4.87e24],
                     ['Mars', 227940, 3398, 6.42e23],
                     ['Mercury', 57910, 2439, 3.30e23],
                     ['Pluto', 5913520, 1160, 1.32e22]],
                     columns=['p', 'd','r','m']).set_index('p')
var
```

p	d	r	m
Jupiter	778000	71492	1.900000e+27
Saturn	1429000	60268	5.690000e+26
Uranus	2870990	25559	8.690000e+25
Neptune	4504300	24764	1.020000e+26
Earth	149600	6378	5.980000e+24
Venus	108200	6052	4.870000e+24
Mars	227940	3398	6.420000e+23
Mercury	57910	2439	3.300000e+23
Pluto	5913520	1160	1.320000e+22

```
a0 = 3.5e-7
a1 = 1.6e-5
a2 = 1.1e-22
coef = np.array([a0,a1,a2])
dists  = pdist(var, lambda u, v: math.sqrt((((u-v)**2)*coef).sum()))
square_dists = pd.DataFrame(squareform(dists),columns=var.index, index = var.index)
square_dists
```

p	Jupiter	Saturn	Uranus	Neptune	Earth	Venus	Mars	Mercury	Pluto
Jupiter	0.000000e+00	1.395965e+16	1.901595e+16	1.885758e+16	1.986465e+16	1.987629e+16	1.992063e+16	1.992391e+16	1.992723e+16
Saturn	1.395965e+16	0.000000e+00	5.056307e+15	4.897937e+15	5.905004e+15	5.916645e+15	5.960989e+15	5.964261e+15	5.967584e+15
Uranus	1.901595e+16	5.056307e+15	0.000000e+00	1.583701e+14	8.486961e+14	8.603379e+14	9.046815e+14	9.079538e+14	9.112764e+14
Neptune	1.885758e+16	4.897937e+15	1.583701e+14	0.000000e+00	1.007066e+15	1.018708e+15	1.063052e+15	1.066324e+15	1.069647e+15
Earth	1.986465e+16	5.905004e+15	8.486961e+14	1.007066e+15	0.000000e+00	1.164178e+13	5.598542e+13	5.925770e+13	6.258033e+13
Venus	1.987629e+16	5.916645e+15	8.603379e+14	1.018708e+15	1.164178e+13	0.000000e+00	4.434364e+13	4.761592e+13	5.093855e+13
Mars	1.992063e+16	5.960989e+15	9.046815e+14	1.063052e+15	5.598542e+13	4.434364e+13	0.000000e+00	3.272284e+12	6.594910e+12
Mercury	1.992391e+16	5.964261e+15	9.079538e+14	1.066324e+15	5.925770e+13	4.761592e+13	3.272284e+12	0.000000e+00	3.322626e+12
Pluto	1.992723e+16	5.967584e+15	9.112764e+14	1.069647e+15	6.258033e+13	5.093855e+13	6.594910e+12	3.322626e+12	0.000000e+00

```
square_dists > dists.mean()
```

p	Jupiter	Saturn	Uranus	Neptune	Earth	Venus	Mars	Mercury	Pluto
Jupiter	False	True	True	True	True	True	True	True	True
Saturn	True	False	False	False	True	True	True	True	True
Uranus	True	False	False	False	False	False	False	False	False
Neptune	True	False	False	False	False	False	False	False	False
Earth	True	True	False	False	False	False	False	False	False
Venus	True	True	False	False	False	False	False	False	False
Mars	True	True	False	False	False	False	False	False	False
Mercury	True	True	False	False	False	False	False	False	False
Pluto	True	True	False	False	False	False	False	False	False

From the result above, I set the mean of total distance as a threshold. If most of a planet's distances to other planets are larger than mean distance, then we divide those into a group, otherwise, another group. Thus, Group1: Jupiter, Saturn. Group2: Uranus, Neptune, Earth, Venus, Mar, Mercury, Pluto.

Problem 8 (14 points)

Given N documents. Write a Python program to find the most frequent

1. < word >
2. < word1, word2 >
3. < word1, word2, word3 >

e.g. D1 = {aa aa a aaa}, D2 = {aa aa aaa}, D3 = {aaa}, most frequent < word > is < aaa > whose frequency is 3, < word1, word2 > is < aa, aaa > whose frequency is 2, < word1, word2, word3 > is < a, aa, aaa > whose frequency is 1.

Answer:

```
## loading packages
import os
import numpy as np
import pandas as pd
import re
from string import digits
from nltk.tokenize import word_tokenize
from collections import Counter

## loading all the file names into a list
path = '/Users/tjmask/Desktop/Semester 2/Course/Data Mining/HW0/docs/'
fileList = os.listdir(path)
print("There are %d documents in total" %len(fileList))
print(path+fileList[1])

## reading all the files in the 'fileList[i]' fromat
for i in range(93):
    fileList[i] = open(path+fileList[i],"r")


## put all the files into a list
doc = []
for i in range(93):
    d = []
    for j in fileList[i]:
        d.append(j.lower())
    doc.append(d)


## deleting all specail characters
for i in range(93):
    doc[i] = re.sub('[\s+\.\!|/_,$%^&*(+\"\')]+|[+--()?[]“”！？。、]+', ' ', doc[i][0])
    remove_digits = str.maketrans('','',digits)
    doc[i] = doc[i].translate(remove_digits).lower()
    doc[i] = doc[i].split()
```

```
## getting the unique word in a set
word_set = set()
for i in range(93):
    word_set =  word_set.union(doc[i])

## getting the word dictionary in a set
word_dict ={}
for index, word in enumerate(list(word_set)):
    word_dict[word] = index


## getting every document and transform it into 0 & 1 based on word_dict
doc_vector =[]
for j in range(93):
    X = {}
    for i in word_dict.keys():
        if i in doc[j]:
            X[i] = 1
        else:
            X[i] = 0
    word_vector.append(X)
```

```
## have a grasp of the data frame
df_vector = pd.DataFrame(word_vector)
df_vector.head()
```

	#	-	-acre	;	a	aau	abbreviated	abel	able	abolitionist	...	year	year-round	years	yerkes	yeshiva	york	youngest	zanvyl	–	—of
0	0	0	0	0	1	0	0	0	0	0	...	1	0	0	0	0	0	0	0	1	0
1	0	0	0	0	1	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	1	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	1	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	0

5 rows × 2376 columns

```
## The most frequent words
df_vector.sum().sort_values(ascending=False).head()
```

```
is            93
university    93
in            92
a             92
research      91
dtype: int64
```

From the result, we can see that, the word 'is', 'university' are the most frequent words. While obviously, the combination of 'is university' is the most frequent two-combined word, and 'is a univeristy' and 'in a university' are the most frequent three-combined word! This is because there are only 93 documents in total! That's all of it!

From the result, we can see that, the word < is > and < university > are the most frequent words whose frequency is 93. While obviously, the combination of < is, university > is the most frequent two-combined word whose frequency is 93 as well. And < is a university > and < in, a, university > are the most frequent three-combined word whose frequency is 92! This is because there are only 93 documents in total! That's all of it!