Mining High-Utility Frequent Spatial Patterns in Spatiotemporal Utility Databases

What is High-Utility Frequent Spatial pattern mining?

High utility frequent spatial pattern mining aims to discover all the patterns with ***utility*** of pattern is no less than user-specified ***minimum utility*** (***minutil***), ***support*** of pattern is no less than ***minimum support*** (***minSup***) and the distance between any of its two items should not be more than user-specified ***maximum distace***.

What is the utility database?

A utility database is a collection of transaction, where each transaction contains a set of items and a positive integer called ***internal utility*** respectively. And each unique item in database is also associated with another positive number called ***external utility*** for each transaction.

Transactions	external utilities
(a,2) (b,3) (c,1) (g,1)	5 4 3 2
(b,3) (c,2) (d,3) (e,2)	5 2 9 3
(a,2) (b,1) (c,3) (d,4)	2 3 5 6
(a,3) (c,2) (d,1) (f,2)	1 3 4 6
(a,3) (b,1) (c,2) (d,1) (g,2)	2 5 3 6 1
(c,2) (d,2) (e,3) (f,1)	2 3 4 5
(a,2) (b,1) (c,1) (d,2)	5 4 3 2
(a,1) (e,2) (f,2)	4 8 3
(a,2) (b,2) (c,4) (d,2)	7 4 9 8
(b,3) (c,2) (d,2) (e,2)	5 9 10 24

Note: Duplicate items must not exist in a transaction.

Acceptable format of utility databases in PAMI

Each row in a utility database must contain only items, total sum of utilties and external utility values.

a b c g:7:2 3 1 1:5 4 3 2
b c d e:10:3 2 3 2:5 2 9 3
a b c d:10:2 1 3 4:2 3 5 6
a c d f:7:3 2 1 2:1 3 4 6
a b c d g:9:3 1 2 1 2:2 5 3 6 1
c d e f:8:2 2 3 1:2 3 4 5
a b c d:6:2 1 1 2:5 4 3 2
a e f:5:1 2 2:4 8 3
a b c d:10:2 2 4 2:7 4 9 8
b c d e:9:3 2 2 2:5 9 10 24

What is neighbour file?

A neighbour files consists item and set of its neighbours. A hypothetical neighbour database is defined below

Item	Neighbours
a	b c d
b	a e g
c	a d
d	a c
e	b f
f	e g
g	b f

Accepted format of neighbour database in PAMI

a b c d
b a e g
c a d
d a c
e b f
f e g
g b f

Understanding the statisctics of database

To understand about the database. The below code will give the detail about the transactional database.

- Total number of transactions (Database size)
- Total number of unique items in database
- Minimum lenth of transaction that existed in database
- Average length of all transactions that exists in database
- Maximum length of transaction that existed in database
- Minimum utility value exists in database
- Average utility exists in database
- Maximum utility exists in database
- Standard deviation of transaction length
- Variance in transaction length
- Sparsity of database

The sample code

```
import PAMI.extras.dbStats.utilityDatabaseStats as stats

obj = stats.utilityDatabaseStats('sampleInputFile.txt', ' ')
obj.run()
obj.printStats()
```

What is the input to high-utility frequent sptial pattern mining algorithms

Algorithms to mine the high-utility frequent spatial patterns requires ***utility database***, ***neighbours database***, ***minUtil***, ***minSup*** (specified by user).

- Input utility database is accepted in `path` format
- Neighbour input file is accepted in `path` format
- minUtil should be mentioned in **count**.
- minSup should be mentioned in either **count**(in numbers) or **percentage**(in float, multiplied with length of database)
- seperator (delimiter used in input file) default delimiter is `\t`

What is the output of high-utility frequent spatial pattern mining algorithms

The output of these algorithms is in two ways:

> - Saves the patterns in user specified output file.
> - Returns the patterns in dataframe variable.

How to run the high-utility frequent spatial pattern algorithm in terminal

- Download the code from github.
- Navigate to PAMI folder where you downloaded the file.
- Go to highUtilityFrequentSpatialPattern/basic folder

And execute the following command on terminal.

python3 algorithmName.py `path of Sample input file` `path of neighbour file` $minUtil$ $minSup$ `seperator`

Sample command to execute the SHUFIM algorithm in highUtilityFrequentSpatialPattern/basic folder

python3 `SHUFIM.py` `/Users/Donwloads/inputFile.txt` `/Users/Downloads/neighbourFile.txt` `$20$ $5$ ' '`

How to implement the SHUFIM algorithm by importing PAMI package

Import the PAMI package executing: **pip3 install PAMI**

Run the below sample code by making simple changes

- Replace sampleInputFile name or path in place of iFile and sampleNeighbourFile name or path in place of nFile and sampleOutputFile name or path in place of oFile.
- Specify the minUtil (like 10) in place of minUtil
- Specify the minSup (like 5) in place of minSup
- Specify the seperator of input file after minSup. (If no seperator is specified the default tab seperator is considered for input file)

import PAMI.highUtilityFrequentSpatialPattern.basic.SHUFIM as alg
obj = alg.SHUFIM(iFile, nFile, minUtil, minSup, sep)
obj.startMine()
obj.savePatterns(oFile) (to store the patterns in file)
Df = obj.getPatternsAsDataFrame() (to store the patterns in dataframe)
obj.printStats() (to print the no of patterns, runtime and memory consumption details)

What is the output of high utility frequent pattern mining algorithms

Returns the pattern, utility and support respectively with $minUtil=15$ and $minSup=5$

The output in file format:

The format followed to save in file is: `pattern : utility : support`

c : 19:9
c d : 35:8
c d a : 34:5
c a : 27:6
d : 17:8
d a : 22:5
a : 15:7
a b : 19:5

The output in DataFrame format:

	Patterns	Utility	Support
0	c	19	9
1	c d	35	8
2	c d a	34	5
3	c a	27	6
4	d	17	8
5	d a	22	5
6	a	15	7
7	a b	19	5