Association Rule Mining by Weka Explorer

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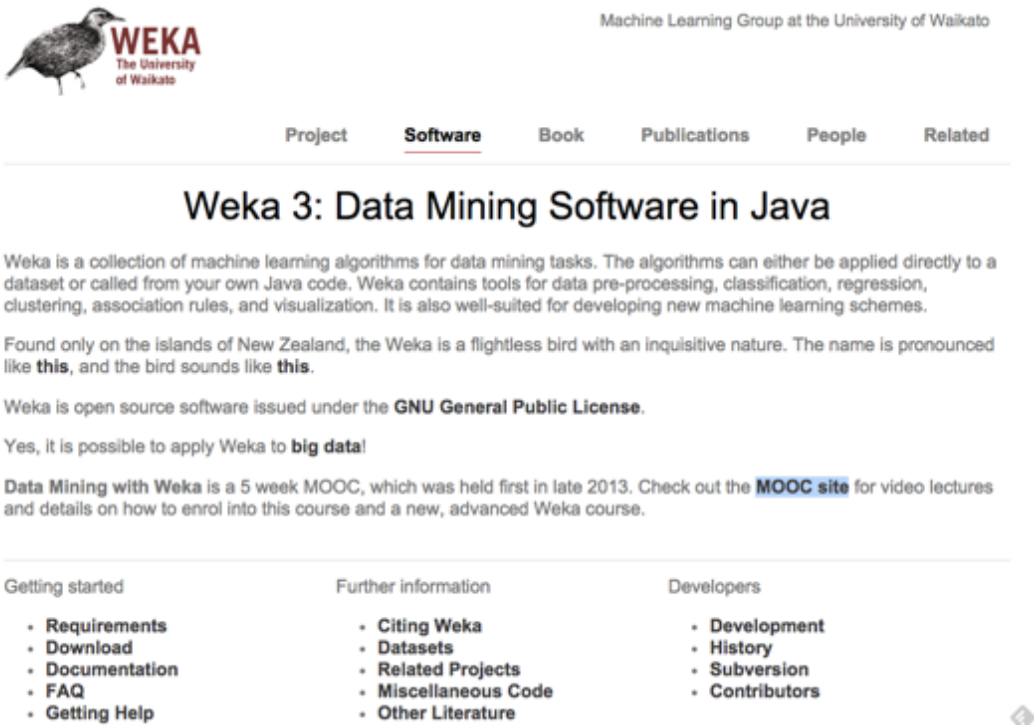
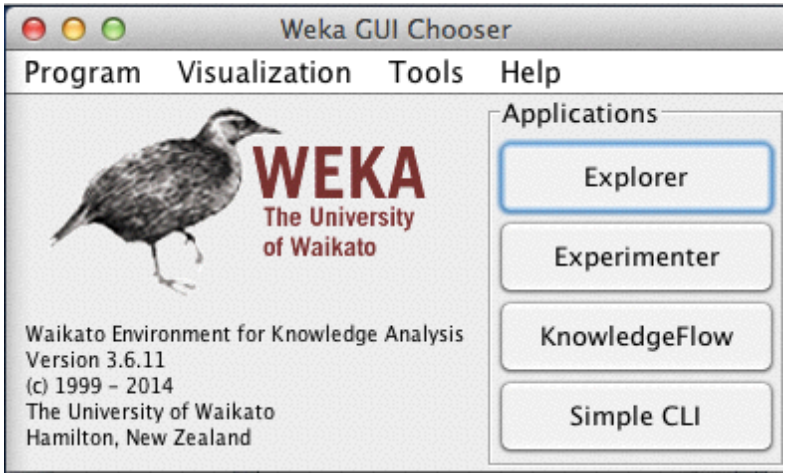
Weka

- A collection of machine learning algorithms for data mining tasks.
- Contains tools for data pre-processing, classification, regression, clustering, **association rules**, and visualization.
- http://www.cs.waikato.ac.nz/ml/weka/



Weka

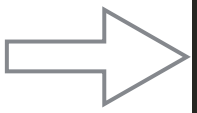
- Install GUI: http://www.cs.waikato.ac.nz/ml/weka/downloading.html (Stable book 3rd ed. version)
- We will use Explorer.



Weka

- Load data: import weka-3-6-11/data/supermarket.arff
- ARFF: Attribute domain + Data domain. Represent a transaction database.
- Attribute domain: Attribute name ‘department1’ followed by value range { t}
- Data domain: A vector that represent presence of one item (t) or absence(?)
- More information: http://www.cs.waikato.ac.nz/ml/weka/arff.html.

Trans	Itemsets
T1	Department1, grocery misc,…
T2	baby needs, baking needs,…
…	…..



supermarket.arff

```
@relation supermarket
@attribute 'department1' { t}
@attribute 'department2' { t}
@attribute 'department3' { t}
@attribute 'department4' { t}
@attribute 'department5' { t}
@attribute 'department6' { t}
@attribute 'department7' { t}
@attribute 'department8' { t}
@attribute 'department9' { t}
@attribute 'grocery misc' { t}
@attribute 'department11' { t}
@attribute 'baby needs' { t}
@attribute 'bread and cake' { t}
@attribute 'baking needs' { t}
@attribute 'coupons' { t}
@attribute 'juice-sat-cord-ms' { t}
@attribute 'tea' { t}
@attribute 'biscuits' { t}
@attribute 'canned fish-meat' { t}
@attribute 'canned fruit' { t}
@attribute 'department215' { t}
@attribute 'department216' { t}
@attribute 'total' { low, high} % low < 100
@data
?,?,?,?,?,?,?,?,?,?,?,t,t,t,?,t,?,t,?,?,t,?,?,?,
t,t,t,t,?,t,?,t,t,?,?,?,?,?,?,t,t,t,?,?,?,?,?,?,
?,t,?,?,?,?,?,?,?,?,?,t,?,t,?,?,t,?,t,?,?,?,?,?,
?,?,?,?,?,?,?,?,?,?,?,t,?,?,t,?,?,?,?,?,?,?,?,?,
?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,
?,t,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,
?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,
?,?,?,?,?,?,?,?,?,?,?,?,t,?,?,?,?,?,?,?,?,?,?,?,
?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,
high
t,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,t,t,t,?,?,?,
?,?,t,?,?,?,t,t,?,?,?,?,?,t,t,?,t,?,?,?,?,?,?,?,
t,?,?,t,?,?,?,?,?,?,?,?,t,?,?,?,?,?,?,?,?,?,?,?,
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?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,
```
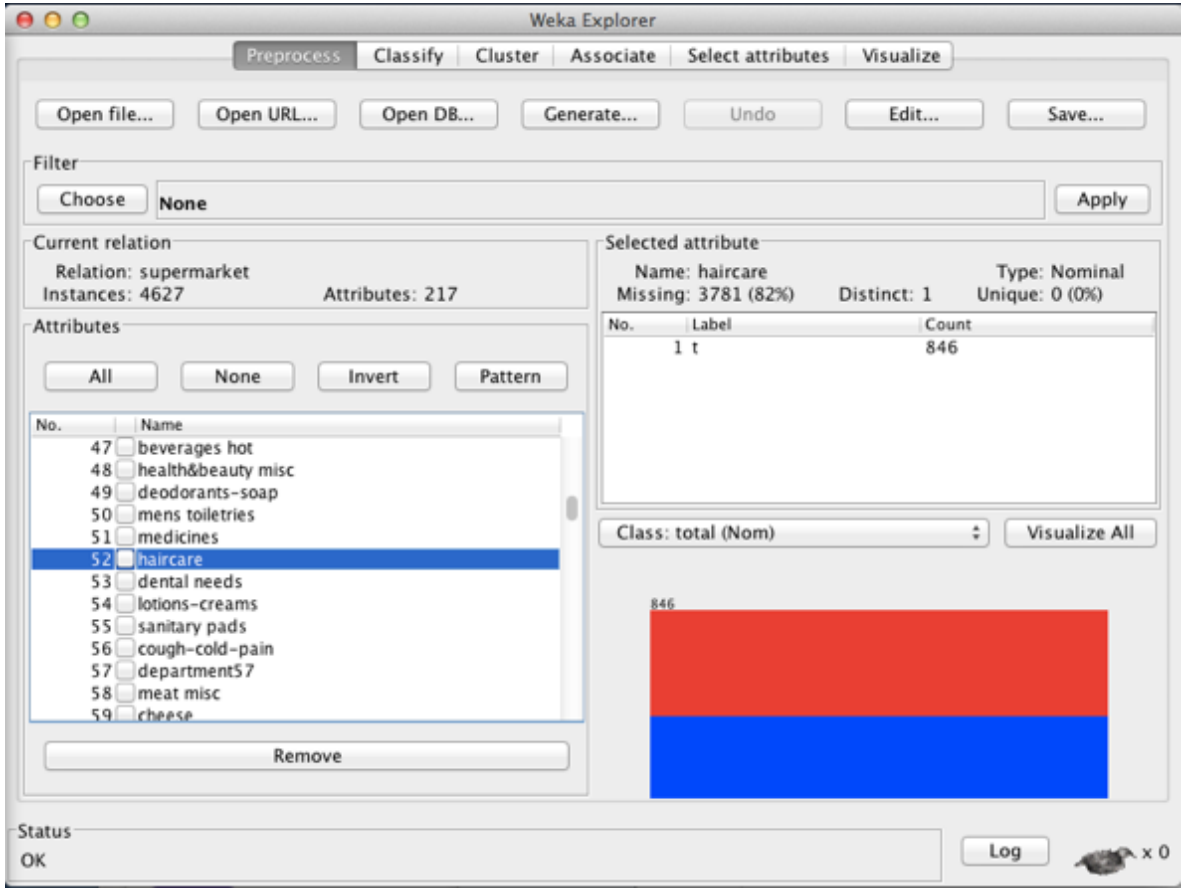
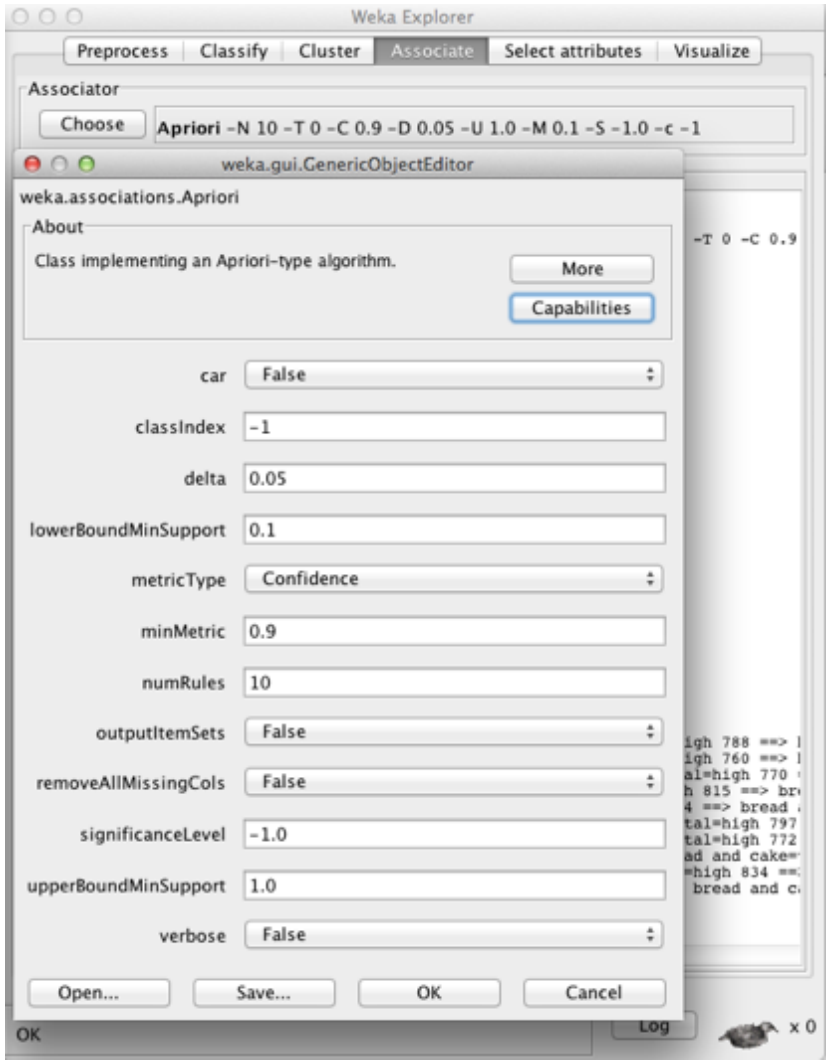

Weka

- Load data



Apriori

- Choose association rule mining: 'Associate'
- Set up parameters for Apriori
  - metricType: confidence
  - minMetric: 0.9 -> min_conf = 0.9
  - numRules: 10

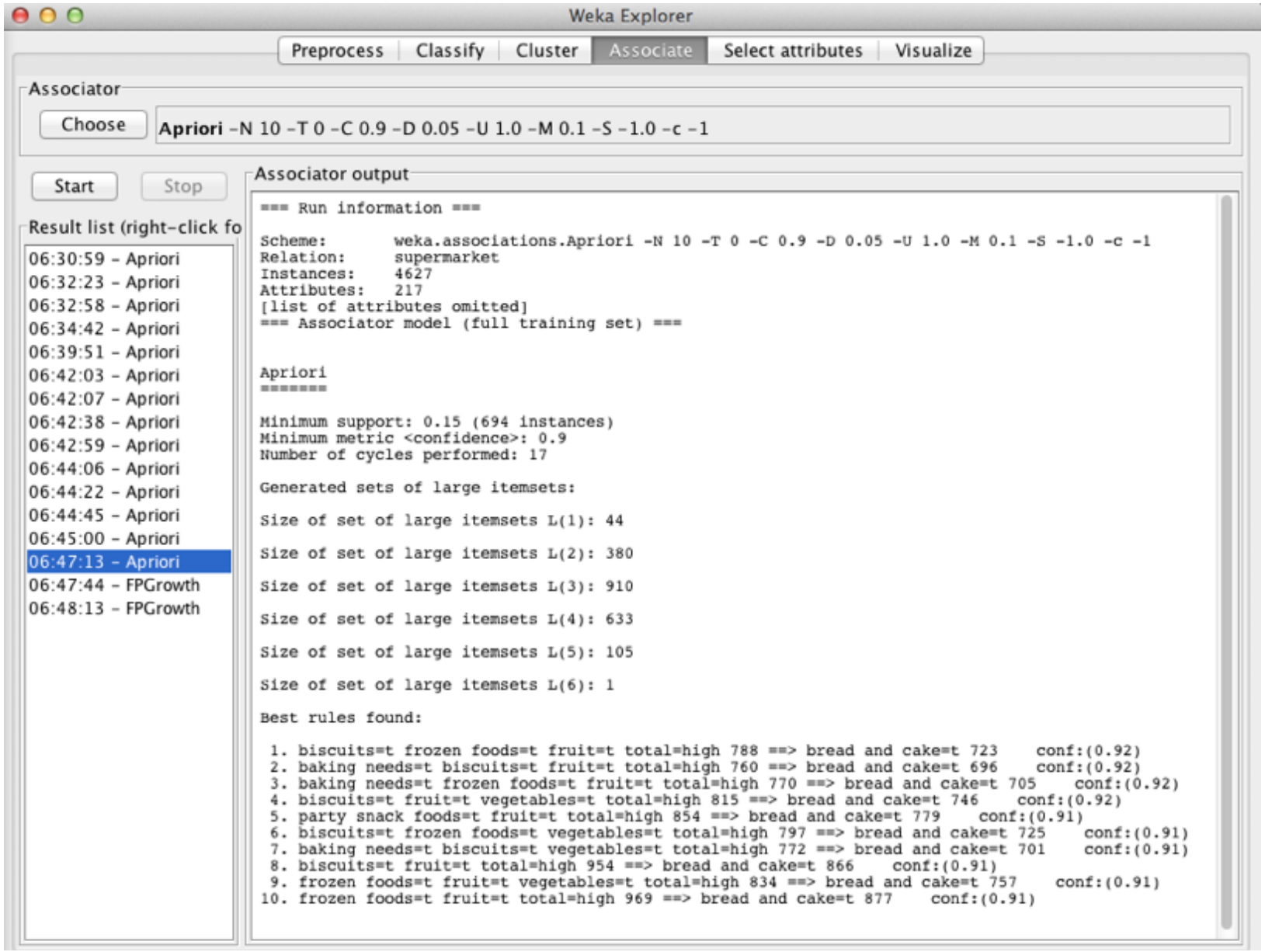


Recap

Tid	Items bought
10	Beer, Nuts, Diaper
20	Beer, Coffee, Diaper
30	Beer, Diaper, Eggs
40	Nuts, Eggs, Milk
50	Nuts, Coffee, Diaper, Eggs, Milk

- **Support(count)**: Occurrence of an itemset X (#X)
  - Support count(Beer) = 3
  - Support count(Diaper) = 4
  - Support count(Beer, Diaper) =3
- **Support of X** : Fraction of all transactions that contains X (#X/#Transactions)
  - Support(Beer) = 3/5 = 0.6
  - Support(Diaper) = 4/5 = 0.8
  - Support(Beer, Diaper) = 3/5 = 0.6
- **Confidence of X, Y**: Conditional probability that a transaction having X also contains Y(#XY/#X)
  - Confidence(Beer, Diaper) = 3/3 = 1
  - Confidence(Diaper, Beer) = 3/4 = 0.75
- **Association Rule**: When buy X, how likely will also buy Y?
  - Represented as X->Y, support(XY), Confidence(X, Y)
  - Beer -> Diaper (0.6, 1)
  - Diaper -> Beer (0.6, 0.75)

Result


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Associator
Choose
Apriori -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1
Start
Stop
Result list (right-click fo
06:30:59 - Apriori
06:32:23 - Apriori
06:32:58 - Apriori
06:34:42 - Apriori
06:39:51 - Apriori
06:42:03 - Apriori
06:42:07 - Apriori
06:42:38 - Apriori
06:42:59 - Apriori
06:44:06 - Apriori
06:44:22 - Apriori
06:44:45 - Apriori
06:45:00 - Apriori
06:47:13 - Apriori
06:47:44 - FPGrowth
06:48:13 - FPGrowth
Associator output
=== Run information ===
Scheme: weka.associations.Apriori -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1
Relation: supermarket
Instances: 4627
Attributes: 217
[list of attributes omitted]
=== Associator model (full training set) ===
Apriori
=======
Minimum support: 0.15 (694 instances)
Minimum metric <confidence>: 0.9
Number of cycles performed: 17
Generated sets of large itemsets:
Size of set of large itemsets L(1): 44
Size of set of large itemsets L(2): 380
Size of set of large itemsets L(3): 910
Size of set of large itemsets L(4): 633
Size of set of large itemsets L(5): 105
Size of set of large itemsets L(6): 1
Best rules found:
1. biscuits=t frozen foods=t fruit=t total=high 788 ==> bread and cake=t 723 conf:(0.92)
2. baking needs=t biscuits=t fruit=t total=high 760 ==> bread and cake=t 696 conf:(0.92)
3. baking needs=t frozen foods=t fruit=t total=high 770 ==> bread and cake=t 705 conf:(0.92)
4. biscuits=t fruit=t vegetables=t total=high 815 ==> bread and cake=t 746 conf:(0.92)
5. party snack foods=t fruit=t total=high 854 ==> bread and cake=t 779 conf:(0.91)
6. biscuits=t frozen foods=t vegetables=t total=high 797 ==> bread and cake=t 725 conf:(0.91)
7. baking needs=t biscuits=t vegetables=t total=high 772 ==> bread and cake=t 701 conf:(0.91)
8. biscuits=t fruit=t total=high 954 ==> bread and cake=t 866 conf:(0.91)
9. frozen foods=t fruit=t vegetables=t total=high 834 ==> bread and cake=t 757 conf:(0.91)
10. frozen foods=t fruit=t total=high 969 ==> bread and cake=t 877 conf:(0.91)

Result

- === Run information ===

- Scheme: weka.associations.Apriori -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1
- Relation: supermarket
- Instances: 4627
- Attributes: 217
- [list of attributes omitted]
- === Associator model (full training set) ===

parameter setting

- Apriori
- =======

- Minimum support: 0.15 (694 instances)
- Minimum metric <confidence>: 0.9

metric

support count of (biscuits, frozen food, fruit, total=high)

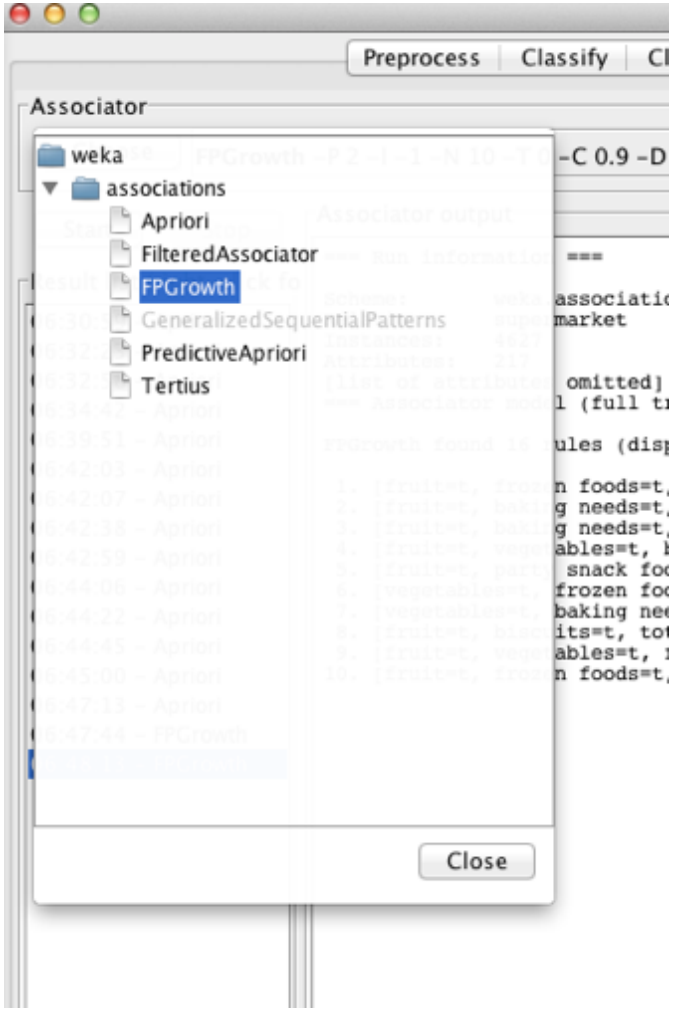
support count of (biscuits, frozen food, fruit, total=high, bread and cake)

- Best rules found:

- 1. biscuits=t frozen foods=t fruit=t total=high 788 ==> bread and cake=t 723 conf:(0.92)
- 2. baking needs=t biscuits=t fruit=t total=high 760 ==> bread and cake=t 696 conf:(0.92)
- 3. baking needs=t frozen foods=t fruit=t total=high 770 ==> bread and cake=t 705 conf:(0.92)
- 4. biscuits=t fruit=t vegetables=t total=high 815 ==> bread and cake=t 746 conf:(0.92)
- 5. party snack foods=t fruit=t total=high 854 ==> bread and cake=t 779 conf:(0.91)
- 6. biscuits=t frozen foods=t vegetables=t total=high 797 ==> bread and cake=t 725 conf:(0.91)
- 7. baking needs=t biscuits=t vegetables=t total=high 772 ==> bread and cake=t 701 conf:(0.91)
- 8. biscuits=t fruit=t total=high 954 ==> bread and cake=t 866 conf:(0.91)
- 9. frozen foods=t fruit=t vegetables=t total=high 834 ==> bread and cake=t 757 conf:(0.91)
- 10. frozen foods=t fruit=t total=high 969 ==> bread and cake=t 877 conf:(0.91)

FP-growth

- Choose ‘FPGrowth’
- Set parameters for FP-growth
  - metricType: confidence
  - minMetric: 0.9 -> min_conf = 0.9
  - numRules: 10



Result

- === Run information ===

- Scheme: weka.associations.FPGrowth -P 2 -I -1 -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1
- Relation: supermarket
- Instances: 4627
- Attributes: 217
- [list of attributes omitted]
- === Associator model (full training set) ===

- FPGrowth found 16 rules (displaying top 10)

- 1. [fruit=t, frozen foods=t, biscuits=t, total=high]: 788 ==> [bread and cake=t]: 723 <conf:(0.92)> lift:(1.27) lev:(0.03) conv:(3.35)
- 2. [fruit=t, baking needs=t, biscuits=t, total=high]: 760 ==> [bread and cake=t]: 696 <conf:(0.92)> lift:(1.27) lev:(0.03) conv:(3.28)
- 3. [fruit=t, baking needs=t, frozen foods=t, total=high]: 770 ==> [bread and cake=t]: 705 <conf:(0.92)> lift:(1.27) lev:(0.03) conv:(3.27)
- 4. [fruit=t, vegetables=t, biscuits=t, total=high]: 815 ==> [bread and cake=t]: 746 <conf:(0.92)> lift:(1.27) lev:(0.03) conv:(3.26)
- 5. [fruit=t, party snack foods=t, total=high]: 854 ==> [bread and cake=t]: 779 <conf:(0.91)> lift:(1.27) lev:(0.04) conv:(3.15)
- 6. [vegetables=t, frozen foods=t, biscuits=t, total=high]: 797 ==> [bread and cake=t]: 725 <conf:(0.91)> lift:(1.26) lev:(0.03) conv:(3.06)
- 7. [vegetables=t, baking needs=t, biscuits=t, total=high]: 772 ==> [bread and cake=t]: 701 <conf:(0.91)> lift:(1.26) lev:(0.03) conv:(3.01)
- 8. [fruit=t, biscuits=t, total=high]: 954 ==> [bread and cake=t]: 866 <conf:(0.91)> lift:(1.26) lev:(0.04) conv:(3)
- 9. [fruit=t, vegetables=t, frozen foods=t, total=high]: 834 ==> [bread and cake=t]: 757 <conf:(0.91)> lift:(1.26) lev:(0.03) conv:(3)
- 10. [fruit=t, frozen foods=t, total=high]: 969 ==> [bread and cake=t]: 877 <conf:(0.91)> lift:(1.26) lev:(0.04) conv:(2.92)

Assignment 3

- Give a set of paper titles under 5 topics(Data Mining, Machine Learning, Information Retrieval, Database, Theory), mine “meaningful” frequent words/ phrases.
- “data mining” is meaningful. But “based algorithm” is not. But they are all frequent patterns. Frequent phrases does not necessarily mean “meaningful”.
- You need to write Apriori or FPGrowth to mine frequent words/phrases
- Also, it is interesting to see closed & max patterns, association rules.
- Is there any methods that could get better phrases?

PaperID	Title
7600	The Automatic Acquisition of Proof Methods
85825	Frequent pattern discovery with memory

Assignment 3

- Input file: topic0.txt~topic4.txt, vocab.txt
- Each line is the words that most likely belongs to this topic.

```
45 40 41
71 74 73
115 98 117 118 114 116
126 124
134 25 130 132 136 133
161
185
```

Name topic-0.txt

```
0 3 1 2
7 5
25 26 28 23 27 24
30 29 34 31 32
38
43 44 42
47 48 46 49
51 53 52
58 57 26 59
64
```

Name topic-3.txt

```
0       automatic
1       acquisition
2       proof
3       method
4       philosophical
5       formal
6       learning
7       theory
8       low
9       cost
```

Name vocab.txt

Assignment 3

- In the introduction part, we first describe how we generate the input files. You don't need to write code for these steps. But it helps you understand the background.
- Step 1: Implement frequent pattern mining algorithm and find frequent patterns in 5 files

```
#SUP: 1226 web
#SUP: 1211 information
#SUP: 1114 retrieval
#SUP: 863 based
#SUP: 757 system
#SUP: 707 search
#SUP: 564 document
#SUP: 490 language
```

- Step 2: Find max/closed patterns
- Step 3: Find association rules by Weka

```
FPGrowth found 8 rules (displaying top 8)

1. [structure=1]: 209 ==> [decomposition=1]: 194   <
2. [method=1, matrix=1]: 159 ==> [path=1]: 123   <c
3. [method=1, path=1]: 159 ==> [matrix=1]: 123   <c
4. [path=1]: 336 ==> [matrix=1]: 233   <conf:(0.69)
5. [massive=1]: 211 ==> [discovery=1]: 141   <conf:
6. [matrix=1]: 416 ==> [path=1]: 233   <conf:(0.56)
7. [improved=1]: 227 ==> [method=1]: 127   <conf:(0
8. [matrix=1, path=1]: 233 ==> [method=1]: 123   <c
```

Thanks!