

Association Rule Exercises

Exercise 1

- Run the APRIORI algorithm, with the weather.nominal dataset with default parameters
- Repeat the previous experiment, setting the number of rules equal to 1000. Discuss the results.
- Repeat the previous experiment, setting confidence value equal to 0.75. Discuss the results.
- Repeat the previous experiment, setting the lower bound min sup to 0.2. Discuss the results.

Associator output

```
== Run information ==
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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: weather.symbolic
 Instances: 14
 Attributes: 5
 outlook
 temperature
 humidity
 windy
 play
 == Associator model (full training set) ==

Apriori
=====

Minimum support: 0.15 (2 instances)
 Minimum metric <confidence>: 0.9
 Number of cycles performed: 17

Generated sets of large itemsets:

Size of set of large itemsets L(1): 12
 Size of set of large itemsets L(2): 47
 Size of set of large itemsets L(3): 39
 Size of set of large itemsets L(4): 6

Best rules found:

1. outlook=overcast 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
2. temperature=cool 4 => humidity=normal 4 <conf:(1)> lift:(2) lev:(0.14) [2] conv:(2)
3. humidity=normal windy=FALSE 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
4. outlook=sunny play=no 3 => humidity=high 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
5. outlook=sunny humidity=high 3 => play=no 3 <conf:(1)> lift:(2.8) lev:(0.14) [1] conv:(1.93)
6. outlook=rainy play=yes 3 => windy=FALSE 3 <conf:(1)> lift:(1.75) lev:(0.09) [1] conv:(1.29)
7. outlook=rainy windy=FALSE 3 => play=yes 3 <conf:(1)> lift:(1.56) lev:(0.08) [1] conv:(1.07)
8. temperature=cool play=yes 3 => humidity=normal 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
9. outlook=sunny temperature=hot 2 => humidity=high 2 <conf:(1)> lift:(2) lev:(0.07) [1] conv:(1)
10. temperature=hot play=no 2 => outlook=sunny 2 <conf:(1)> lift:(2.8) lev:(0.09) [1] conv:(1.29)

Associator output

```
== Run information ==
```

Scheme: weka.associations.Apriori -N 1000 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1
 Relation: weather.symbolic
 Instances: 14
 Attributes: 5
 outlook
 temperature
 humidity
 windy
 play
 == Associator model (full training set) ==

Apriori
=====

Minimum support: 0.1 (1 instances)
 Minimum metric <confidence>: 0.9
 Number of cycles performed: 18

Generated sets of large itemsets:

Size of set of large itemsets L(1): 12
 Size of set of large itemsets L(2): 54
 Size of set of large itemsets L(3): 96
 Size of set of large itemsets L(4): 64
 Size of set of large itemsets L(5): 14

Best rules found:

1. outlook=overcast 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
2. temperature=cool 4 => humidity=normal 4 <conf:(1)> lift:(2) lev:(0.14) [2] conv:(2)
3. humidity=normal windy=FALSE 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
4. outlook=sunny play=no 3 => humidity=high 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
5. outlook=sunny humidity=high 3 => play=no 3 <conf:(1)> lift:(2.8) lev:(0.14) [1] conv:(1.93)
6. outlook=rainy play=yes 3 => windy=FALSE 3 <conf:(1)> lift:(1.75) lev:(0.09) [1] conv:(1.29)
7. outlook=rainy windy=FALSE 3 => play=yes 3 <conf:(1)> lift:(1.56) lev:(0.08) [1] conv:(1.07)
8. temperature=cool play=yes 3 => humidity=normal 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
9. outlook=sunny temperature=hot 2 => humidity=high 2 <conf:(1)> lift:(2) lev:(0.07) [1] conv:(1)
10. temperature=hot play=no 2 => outlook=sunny 2 <conf:(1)> lift:(2.8) lev:(0.09) [1] conv:(1.29)
11. outlook=sunny temperature=hot 2 => nplay=no 2 <conf:(1)> lift:(2.8) lev:(0.09) [1] conv:(1.29)

On the left the default application of APRIORI algorithm on the right we changed the number of desired association rules to 1000. We can see the total associations rules that we could find in this data set with this parameters are 336. Association rules are sorted in descending order by metric, which in this case is the confidence, in same confidence groups they are ordered by the support.

Associator output

== Run information ==

Scheme: weka.associations.Apriori -N 1000 -T 0 **-C 0.75** -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1

Relation: weather.symbolic

Instances: 14

Attributes: 5

outlook
temperature
humidity
windy
play

== Associator model (full training set) ==

Apriori

=====

Minimum support: 0.1 (1 instances)

Minimum metric <confidence>: 0.75

Number of cycles performed: 18

Generated sets of large itemsets:

Size of set of large itemsets L(1): 12

Size of set of large itemsets L(2): 54

Size of set of large itemsets L(3): 96

Size of set of large itemsets L(4): 64

Size of set of large itemsets L(5): 14

Best rules found:

1. outlook=overcast 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
2. temperature=cool 4 => humidity=normal 4 <conf:(1)> lift:(2) lev:(0.14) [2] conv:(2)
3. humidity=normal windy=FALSE 4 => play=yes 4 <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
4. outlook=sunny play=no 3 => humidity=high 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
5. outlook=sunny humidity=high 3 => play=no 3 <conf:(1)> lift:(2.8) lev:(0.14) [1] conv:(1.93)
6. outlook=rainy play=yes 3 => windy=FALSE 3 <conf:(1)> lift:(1.75) lev:(0.09) [1] conv:(1.29)
7. outlook=rainy windy=FALSE 3 => play=yes 3 <conf:(1)> lift:(1.56) lev:(0.08) [1] conv:(1.07)
8. temperature=cool play=yes 3 => humidity=normal 3 <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
9. outlook=sunny temperature=hot 2 => humidity=high 2 <conf:(1)> lift:(2) lev:(0.07) [1] conv:(1)
10. temperature=hot play=no 2 => outlook=sunny 2 <conf:(1)> lift:(2.8) lev:(0.09) [1] conv:(1.29)
11. outlook=sunny tempperature=hot 2 => play=no 2 <conf:(1)> lift:(2.8) lev:(0.09) [1] conv:(1.29)

Associator output

302. temperature=mild windy=TRUE play=no 1 => outlook=rainy humidity=nigh 1 <conf:(1)> lift:(7) lev:(0.06) [0] conv:(0.86)
303. outlook=rainy humidity=high play=no 1 => temperature=mild windy=TRUE 1 <conf:(1)> lift:(4.67) lev:(0.06) [0] conv:(0.79)
304. outlook=rainy humidity=high windy=TRUE 1 => temperature=mild play=no 1 <conf:(1)> lift:(7) lev:(0.06) [0] conv:(0.86)
305. outlook=rainy temperature=mild play=no 1 => humidity=high windy=TRUE 1 <conf:(1)> lift:(4.67) lev:(0.06) [0] conv:(0.79)
306. outlook=rainy temperature=mild windy=TRUE 1 => humidity=high play=no 1 <conf:(1)> lift:(3.5) lev:(0.05) [0] conv:(0.71)
307. temperature=mild humidity=high windy=FALSE play=yes 1 => outlook=rainy 1 <conf:(1)> lift:(2.8) lev:(0.05) [0] conv:(0.64)
308. outlook=rainy humidity=high windy=FALSE play=yes 1 => temperature=mild 1 <conf:(1)> lift:(2.33) lev:(0.04) [0] conv:(0.57)
309. outlook=rainy temperature=mild humidity=high play=yes 1 => windy=FALSE 1 <conf:(1)> lift:(1.75) lev:(0.03) [0] conv:(0.43)
310. outlook=rainy temperature=mild humidity=high windy=FALSE 1 => play=yes 1 <conf:(1)> lift:(1.56) lev:(0.03) [0] conv:(0.36)
311. outlook=rainy humidity=high play=yes 1 => temperature=mild windy=FALSE 1 <conf:(1)> lift:(4.67) lev:(0.06) [0] conv:(0.79)
312. outlook=rainy humidity=high windy=FALSE 1 => temperature=mild play=yes 1 <conf:(1)> lift:(3.5) lev:(0.05) [0] conv:(0.71)
313. temperature=mild humidity=normal windy=FALSE play=yes 1 => outlook=rainy 1 <conf:(1)> lift:(2.8) lev:(0.05) [0] conv:(0.64)
314. outlook=rainy temperature=mild humidity=normal play=yes 1 => windy=FALSE 1 <conf:(1)> lift:(1.75) lev:(0.03) [0] conv:(0.43)
315. outlook=rainy temperature=mild humidity=normal windy=FALSE 1 => play=yes 1 <conf:(1)> lift:(1.56) lev:(0.03) [0] conv:(0.36)
316. temperature=mild humidity=normal windy=FALSE 1 => outlook=rainy play=yes 1 <conf:(1)> lift:(4.67) lev:(0.06) [0] conv:(0.79)
317. outlook=rainy temperature=mild humidity=normal 1 => windy=FALSE play=yes 1 <conf:(1)> lift:(2.33) lev:(0.04) [0] conv:(0.57)
318. temperature=cool humidity=normal windy=TRUE play=no 1 => outlook=rainy 1 <conf:(1)> lift:(2.8) lev:(0.05) [0] conv:(0.64)
319. outlook=rainy humidity=normal windy=TRUE play=no 1 => temperature=cool 1 <conf:(1)> lift:(3.5) lev:(0.05) [0] conv:(0.71)
320. outlook=rainy temperature=cool windy=TRUE play=no 1 => humidity=normal 1 <conf:(1)> lift:(2) lev:(0.04) [0] conv:(0.5)
321. outlook=rainy temperature=cool humidity=normal play=no 1 => windy=TRUE 1 <conf:(1)> lift:(2.33) lev:(0.04) [0] conv:(0.57)
322. outlook=rainy temperature=cool humidity=normal windy=TRUE 1 => play=no 1 <conf:(1)> lift:(2.8) lev:(0.05) [0] conv:(0.64)
323. humidity=normal windy=TRUE play=no 1 => outlook=rainy temperature=cool 1 <conf:(1)> lift:(7) lev:(0.06) [0] conv:(0.86)
324. temperature=cool windy=TRUE play=no 1 => outlook=rainy humidity=normal 1 <conf:(1)> lift:(4.67) lev:(0.06) [0] conv:(0.79)
325. temperature=cool humidity=normal play=no 1 => outlook=rainy windy=TRUE 1 <conf:(1)> lift:(7) lev:(0.06) [0] conv:(0.86)
326. outlook=rainy humidity=normal play=no 1 => temperature=cool windy=TRUE 1 <conf:(1)> lift:(7) lev:(0.06) [0] conv:(0.86)
327. outlook=rainy humidity=normal windy=TRUE 1 => temperature=cool play=no 1 <conf:(1)> lift:(14) lev:(0.07) [0] conv:(0.93)
328. outlook=rainy temperature=cool play=no 1 => humidity=normal windy=TRUE 1 <conf:(1)> lift:(14) lev:(0.07) [0] conv:(0.93)
329. outlook=rainy temperature=cool windy=TRUE 1 => humidity=normal play=no 1 <conf:(1)> lift:(14) lev:(0.07) [0] conv:(0.93)
330. humidity=normal play=no 1 => outlook=rainy temperature=cool windy=TRUE 1 <conf:(1)> lift:(14) lev:(0.07) [0] conv:(0.93)
331. temperature=cool play=no 1 => outlook=rainy humidity=normal windy=TRUE 1 <conf:(1)> lift:(14) lev:(0.07) [0] conv:(0.93)
332. outlook=rainy temperature=cool windy=FALSE play=yes 1 => humidity=normal 1 <conf:(1)> lift:(2) lev:(0.04) [0] conv:(0.5)
333. outlook=rainy temperature=cool humidity=normal play=yes 1 => windy=FALSE 1 <conf:(1)> lift:(1.75) lev:(0.03) [0] conv:(0.43)
334. outlook=rainy temperature=cool humidity=normal windy=FALSE 1 => play=yes 1 <conf:(1)> lift:(1.56) lev:(0.03) [0] conv:(0.36)
335. outlook=rainy temperature=cool play=yes 1 => humidity=normal windy=FALSE 1 <conf:(1)> lift:(3.5) lev:(0.05) [0] conv:(0.71)
336. outlook=rainy temperature=cool windy=FALSE 1 => humidity=normal play=yes 1 <conf:(1)> lift:(2.33) lev:(0.04) [0] conv:(0.57)
337. humidity=normal 7 => play=yes 6 <conf:(0.86)> lift:(1.33) lev:(0.11) [1] conv:(1.25)
338. play=no 5 => humidity=high 4 <conf:(0.8)> lift:(1.6) lev:(0.11) [1] conv:(1.25)
339. windy=FALSE 8 => play=yes 6 <conf:(0.75)> lift:(1.17) lev:(0.06) [0] conv:(0.95)
340. temperature=hot 4 => humidity=high 3 <conf:(0.75)> lift:(1.5) lev:(0.07) [1] conv:(1)
341. temperature=hot 4 => windy=FALSE 3 <conf:(0.75)> lift:(1.31) lev:(0.05) [0] conv:(0.86)
342. temperature=cool 4 => play=yes 3 <conf:(0.75)> lift:(1.17) lev:(0.03) [0] conv:(0.71)
343. humidity=high play=no 4 => outlook=sunny 3 <conf:(0.75)> lift:(2.1) lev:(0.11) [1] conv:(1.29)
344. temperature=cool humidity=normal 4 => play=yes 3 <conf:(0.75)> lift:(1.17) lev:(0.03) [0] conv:(0.71)
345. temperature=cool 4 => humidity=normal play=yes 3 <conf:(0.75)> lift:(1.75) lev:(0.09) [1] conv:(1.14)

The decreasing of confidence value lead us to find more association rules in particular them with confidence < 1 and >= 0.75 (337-345).

Associator output

```
== Run information ==
Scheme: weka.associations.Apriori -N 1000 -T 0 -C 0.75 -D 0.05 -U 1.0 -M 0.2 -S -1.0 -c -1
Relation: weather.symbolic
Instances: 14
Attributes: 5
outlook
temperature
humidity
windy
play
== Associator model (full training set) ==

Apriori
=====
Minimum support: 0.2 (3 instances)
Minimum metric <confidence>: 0.75
Number of cycles performed: 16

Generated sets of large itemsets:
Size of set of large itemsets L(1): 12
Size of set of large itemsets L(2): 26
Size of set of large itemsets L(3): 4

Best rules found:
1. outlook=overcast 4 ==> play=yes 4   <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
2. temperature=cool 4 ==> humidity=normal 4   <conf:(1)> lift:(2) lev:(0.14) [2] conv:(2)
3. humidity=normal windy=FALSE 4 ==> play=yes 4   <conf:(1)> lift:(1.56) lev:(0.1) [1] conv:(1.43)
4. outlook=sunny play=no 3 ==> humidity=high 3   <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
5. outlook=sunny humidity=high 3 ==> play=no 3   <conf:(1)> lift:(2.8) lev:(0.14) [1] conv:(1.93)
6. outlook=rainy play=yes 3 ==> windy=FALSE 3   <conf:(1)> lift:(1.75) lev:(0.09) [1] conv:(1.29)
7. outlook=rainy windy=FALSE 3 ==> play=yes 3   <conf:(1)> lift:(1.56) lev:(0.08) [1] conv:(1.07)
8. temperature=cool play=yes 3 ==> humidity=normal 3   <conf:(1)> lift:(2) lev:(0.11) [1] conv:(1.5)
9. humidity=normal 7 ==> play=yes 6   <conf:(0.86)> lift:(1.33) lev:(0.11) [1] conv:(1.25)
10. play=no 5 ==> humidity=high 4   <conf:(0.8)> lift:(1.6) lev:(0.11) [1] conv:(1.25)
11. windy=FALSE 8 ==> play=yes 6   <conf:(0.75)> lift:(1.17) lev:(0.06) [0] conv:(0.95)
12. temperature=hot 4 ==> humidity=high 3   <conf:(0.75)> lift:(1.5) lev:(0.07) [1] conv:(1)
13. temperature=hot 4 ==> windy=FALSE 3   <conf:(0.75)> lift:(1.31) lev:(0.05) [0] conv:(0.86)
14. temperature=cool 4 ==> play=yes 3   <conf:(0.75)> lift:(1.17) lev:(0.03) [0] conv:(0.71)
15. humidity=high play=no 4 ==> outlook=sunny 3   <conf:(0.75)> lift:(2.1) lev:(0.11) [1] conv:(1.29)
```

By incrementing the number of the lowerBoundMinSupport we reduce the number of iteration to decrease the upperBoundMinSupport but also decrease drastically the total number of association rule, which now are only 17. All the association rule with support under or equal to 2 (in the antecedent or in the consequence) were not found.

Exercise 2

- Load the weather.nominal dataset
- Apply the FP-growth algorithm with default parameters.

No.	Name
1	<input type="checkbox"/> outlook
2	<input type="checkbox"/> temperature
3	<input type="checkbox"/> humidity
4	<input type="checkbox"/> windy
5	<input type="checkbox"/> play

NominalToBinary
filter

No.	Name
1	<input type="checkbox"/> outlook=sunny
2	<input type="checkbox"/> outlook=overcast
3	<input type="checkbox"/> outlook=rainy
4	<input type="checkbox"/> temperature=hot
5	<input type="checkbox"/> temperature=mild
6	<input type="checkbox"/> temperature=cool
7	<input type="checkbox"/> humidity
8	<input type="checkbox"/> windy
9	<input type="checkbox"/> play

Associator output

== 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: weather.symbolic-weka.filters.unsupervised.attribute.NominalToBinary-N-Rfirst-last
 Instances: 14
 Attributes: 9

outlook=sunny
 outlook=overcast
 outlook=rainy
 temperature=hot
 temperature=mild
 temperature=cool
 humidity
 windy
 play

== Associator model (full training set) ==

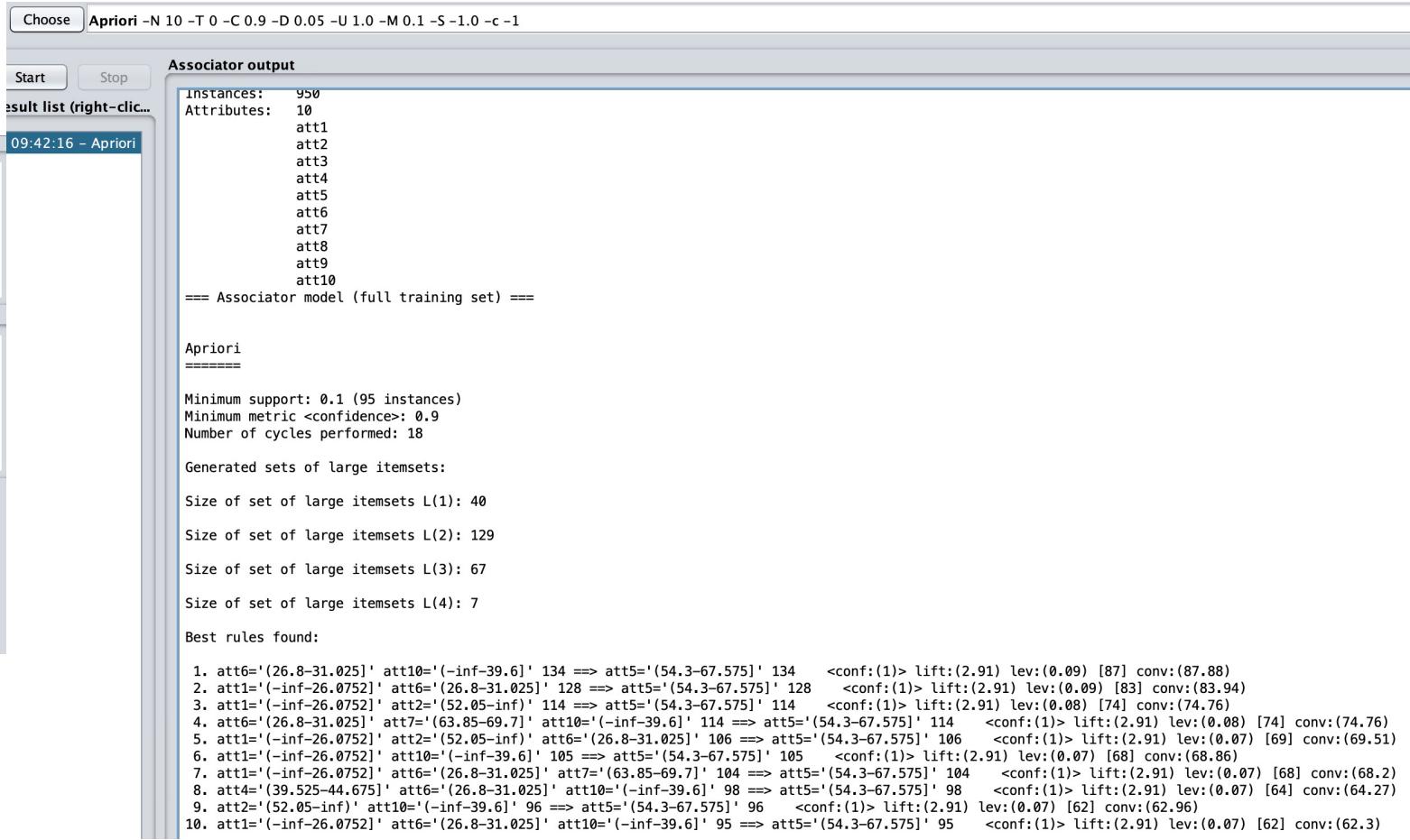
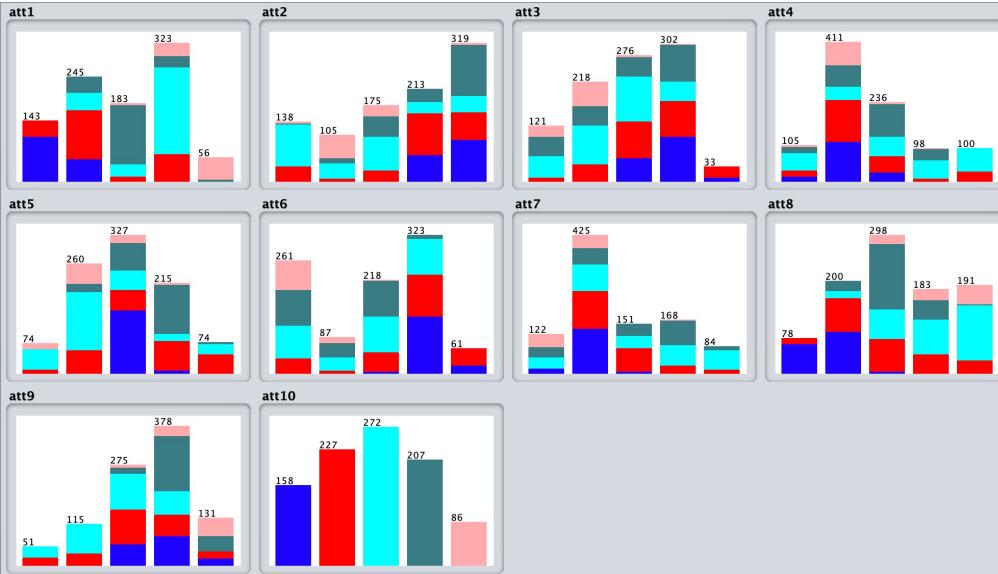
FPGrowth found 8 rules (displaying top 8)

- [temperature=cool=t]: 4 ==> [humidity=normal]: 4 <conf:(1)> lift:(2) lev:(0.14) conv:(2)
- [windy=FALSE, temperature=cool=t]: 2 ==> [humidity=normal]: 2 <conf:(1)> lift:(2) lev:(0.07) conv:(1)
- [windy=FALSE, play=no]: 2 ==> [outlook=sunny=t]: 2 <conf:(1)> lift:(2.8) lev:(0.09) conv:(1.29)
- [windy=FALSE, outlook=overcast=t]: 2 ==> [temperature=hot=t]: 2 <conf:(1)> lift:(3.5) lev:(0.1) conv:(1.43)
- [temperature=hot=t, outlook=overcast=t]: 2 ==> [windy=FALSE]: 2 <conf:(1)> lift:(1.75) lev:(0.06) conv:(0.86)
- [outlook=rainy=t, temperature=cool=t]: 2 ==> [humidity=normal]: 2 <conf:(1)> lift:(2) lev:(0.07) conv:(1)
- [play=no, temperature=hot=t]: 2 ==> [outlook=sunny=t]: 2 <conf:(1)> lift:(2.8) lev:(0.09) conv:(1.29)
- [outlook=sunny=t, temperature=hot=t]: 2 ==> [play=no]: 2 <conf:(1)> lift:(2.8) lev:(0.09) conv:(1.29)

Before apply the FP-growth we need to transform the nominal attributes to binary ones. In order to achieve this result we use the filter NominalToBinary and set binaryAttributesNominal to true.

Exercise 3

- Transform the stock.csv dataset into the .arff format and save the dataset
- Discretize the dataset by using 5 bins and save the dataset
- Generate the set of association rules by using the APRIORI algorithm with default parameters
- Calculate the average confidence and support



After the discretization we should obtain the situation in the left figure, the run of the Apriori algorithm with the default value obtains 10 association rules with an average of confidence of 1 and an average support of 109.4

Exercise 4

Repeat the previous exercise changing the APRIORI parameters as follows:

- Set the maximum number of rules to 1000
- Set the minimum confidence to 0.75
- Set the minimum support to 0.2
- Set the minimum confidence to 0.50

Associator

Choose **Apriori -N 1000 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1**

Associator output

Best rules found:

```

1. att6='(26.8-31.025]' att10='(-inf-39.6]' 134 ==> att5='(54.3-67.575]' 134 <conf:(1)> lift:(2.91) lev:(0.09) [87] conv:(87.88)
2. att1='(-inf-26.0752]' att6='(26.8-31.025]' 128 ==> att5='(54.3-67.575]' 128 <conf:(1)> lift:(2.91) lev:(0.09) [83] conv:(83.94)
3. att1='(-inf-26.0752]' att2='(52.05-inf)' 114 ==> att5='(54.3-67.575]' 114 <conf:(1)> lift:(2.91) lev:(0.08) [74] conv:(74.76)
4. att6='(26.8-31.025]' att7='(63.85-69.7]' att10='(-inf-39.6]' 114 ==> att5='(54.3-67.575]' 114 <conf:(1)> lift:(2.91) lev:(0.08) [74] conv:(74.76)
5. att1='(-inf-26.0752]' att2='(52.05-inf)' att6='(26.8-31.025]' 106 ==> att5='(54.3-67.575]' 106 <conf:(1)> lift:(2.91) lev:(0.07) [69] conv:(69.51)
6. att1='(-inf-26.0752]' att10='(-inf-39.6]' 105 ==> att5='(54.3-67.575]' 105 <conf:(1)> lift:(2.91) lev:(0.07) [68] conv:(68.86)
7. att1='(-inf-26.0752]' att6='(26.8-31.025]' att7='(63.85-69.7]' 104 ==> att5='(54.3-67.575]' 104 <conf:(1)> lift:(2.91) lev:(0.07) [68] conv:(68.2)
8. att4='(39.525-44.675]' att6='(26.8-31.025]' att10='(-inf-39.6]' 98 ==> att5='(54.3-67.575]' 98 <conf:(1)> lift:(2.91) lev:(0.07) [64] conv:(64.27)
9. att2='(52.05-inf)' att10='(-inf-39.6]' 96 ==> att5='(54.3-67.575]' 96 <conf:(1)> lift:(2.91) lev:(0.07) [62] conv:(62.96)
10. att1='(-inf-26.0752]' att6='(26.8-31.025]' att10='(-inf-39.6]' 95 ==> att5='(54.3-67.575]' 95 <conf:(1)> lift:(2.91) lev:(0.07) [62] conv:(62.3)
11. att1='(-inf-26.0752]' att7='(63.85-69.7]' 117 ==> att5='(54.3-67.575]' 116 <conf:(0.99)> lift:(2.88) lev:(0.08) [75] conv:(38.36)
12. att1='(-inf-26.0752]' 143 ==> att5='(54.3-67.575]' 141 <conf:(0.99)> lift:(2.86) lev:(0.1) [91] conv:(31.26)
13. att8='(26.675-inf)' att10='(45.2-50.8]' 118 ==> att1='(43.7876-52.6438]' 115 <conf:(0.97)> lift:(2.87) lev:(0.08) [74] conv:(19.47)
14. att3='(20.175-22.65]' att4='(44.675-49.825]' 115 ==> att2='(52.05-inf)' 112 <conf:(0.97)> lift:(2.9) lev:(0.08) [73] conv:(19.1)
15. att4='(44.675-49.825]' att9='(44.4-48.7]' 137 ==> att2='(52.05-inf)' 132 <conf:(0.96)> lift:(2.87) lev:(0.09) [85] conv:(15.17)
16. att4='(54.975-inf)' 100 ==> att1='(43.7876-52.6438]' 96 <conf:(0.96)> lift:(2.82) lev:(0.07) [62] conv:(13.2)
17. att3='(-inf-15.225]' 121 ==> att6='(-inf-18.351]' 115 <conf:(0.95)> lift:(3.46) lev:(0.09) [81] conv:(12.54)
18. att10='(-inf-39.6]' 158 ==> att5='(54.3-67.575]' 150 <conf:(0.95)> lift:(2.76) lev:(0.1) [95] conv:(11.51)
19. att4='(39.525-44.675]' att5='(54.3-67.575]' att6='(26.8-31.025]' 104 ==> att10='(-inf-39.6]' 98 <conf:(0.94)> lift:(5.67) lev:(0.08) [80] conv:(12.39)
20. att7='(63.85-69.7]' att10='(-inf-39.6]' 137 ==> att5='(54.3-67.575]' 129 <conf:(0.94)> lift:(2.74) lev:(0.09) [81] conv:(9.98)
21. att2='(52.05-inf)' att9='(44.4-48.7]' att10='(50.8-56.4]' 106 ==> att5='(67.575-80.85]' 99 <conf:(0.93)> lift:(4.13) lev:(0.08) [75] conv:(10.25)
22. att2='(52.05-inf)' att6='(22.575-26.8]' 105 ==> att5='(67.575-80.85]' 98 <conf:(0.93)> lift:(4.12) lev:(0.08) [74] conv:(10.15)
23. att4='(39.525-44.675]' att10='(-inf-39.6]' 117 ==> att5='(54.3-67.575]' 109 <conf:(0.93)> lift:(2.71) lev:(0.07) [68] conv:(8.53)
24. att3='(20.175-22.65]' att5='(54.3-67.575]' 102 ==> att6='(26.8-31.025]' 95 <conf:(0.93)> lift:(2.74) lev:(0.06) [60] conv:(8.41)
25. att3='(20.175-22.65]' att5='(54.3-67.575]' 102 ==> att7='(63.85-69.7]' 95 <conf:(0.93)> lift:(2.08) lev:(0.05) [49] conv:(7.05)
26. att5='(67.575-80.85)' att10='(50.8-56.4]' 116 ==> att2='(52.05-inf)' 108 <conf:(0.93)> lift:(2.77) lev:(0.07) [69] conv:(8.56)
27. att1='(-inf-26.0752]' att2='(52.05-inf)' 114 ==> att6='(26.8-31.025]' 106 <conf:(0.93)> lift:(2.73) lev:(0.07) [67] conv:(8.36)
28. att1='(-inf-26.0752]' att2='(52.05-inf)' att5='(54.3-67.575]' 114 ==> att6='(26.8-31.025]' 106 <conf:(0.93)> lift:(2.73) lev:(0.07) [67] conv:(8.36)
29. att1='(-inf-26.0752]' att2='(52.05-inf)' 114 ==> att5='(54.3-67.575]' att6='(26.8-31.025]' 106 <conf:(0.93)> lift:(4.7) lev:(0.09) [83] conv:(10.16)
30. att1='(26.0752-34.9314]' att2='(43.85-52.05]' 123 ==> att4='(39.525-44.675]' 114 <conf:(0.93)> lift:(2.14) lev:(0.06) [60] conv:(6.98)
31. att5='(67.575-80.85)' att9='(44.4-48.7]' att10='(50.8-56.4]' 107 ==> att2='(52.05-inf)' 99 <conf:(0.93)> lift:(2.76) lev:(0.07) [63] conv:(7.9)
32. att5='(67.575-80.85)' att6='(22.575-26.8]' 106 ==> att2='(52.05-inf)' 98 <conf:(0.92)> lift:(2.75) lev:(0.07) [62] conv:(7.82)
33. att2='(52.05-inf)' att10='(50.8-56.4]' 117 ==> att5='(67.575-80.85]' 108 <conf:(0.92)> lift:(4.08) lev:(0.09) [81] conv:(9.05)
34. att5='(67.575-80.85)' att10='(50.8-56.4]' 116 ==> att9='(44.4-48.7]' 107 <conf:(0.92)> lift:(2.32) lev:(0.06) [60] conv:(6.98)
35. att1='(26.0752-34.9314]' att2='(52.05-inf)' 122 ==> att3='(20.175-22.65]' 112 <conf:(0.92)> lift:(2.89) lev:(0.08) [73] conv:(7.57)
36. att2='(52.05-inf)' att5='(67.575-80.85)' att10='(50.8-56.4]' 108 ==> att9='(44.4-48.7]' 99 <conf:(0.92)> lift:(2.3) lev:(0.06) [56] conv:(6.5)
37. att1='(-inf-26.0752]' att5='(54.3-67.575]' 141 ==> att6='(26.8-31.025]' 128 <conf:(0.91)> lift:(2.67) lev:(0.08) [80] conv:(6.65)
38. att4='(44.675-49.825)' att8='(21.525-24.1]' 118 ==> att2='(52.05-inf)' 107 <conf:(0.91)> lift:(2.7) lev:(0.07) [67] conv:(6.53)
39. att2='(52.05-inf)' att10='(50.8-56.4]' 117 ==> att9='(44.4-48.7]' 106 <conf:(0.91)> lift:(2.28) lev:(0.06) [59] conv:(5.87)
40. att1='(-inf-26.0752]' att10='(-inf-39.6]' 105 ==> att6='(26.8-31.025]' 95 <conf:(0.9)> lift:(2.66) lev:(0.06) [59] conv:(6.3)
41. att1='(-inf-26.0752]' att5='(54.3-67.575)' att10='(-inf-39.6]' 105 ==> att6='(26.8-31.025]' 95 <conf:(0.9)> lift:(2.66) lev:(0.06) [59] conv:(6.3)
42. att1='(-inf-26.0752]' att10='(-inf-39.6]' 105 ==> att5='(54.3-67.575)' att6='(26.8-31.025]' 95 <conf:(0.9)> lift:(4.57) lev:(0.08) [74] conv:(7.66)

```

Increasing the number of desired rules we found other 32 rules with a confidence less than 1

Associator

Choose Apriori -N 1000 -T 0 -C 0.75 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -c -1

Associator output

Start Stop

Result list (right-click)

09:42:16 - Apriori
10:22:16 - Apriori
10:23:08 - Apriori

```

92. att2='(52.05-inf)' att6='(26.8-31.025)' 15 ==> att7='(63.85-69.7]' 128 <conf:(0.82)> lift:(1.82) lev:(0.06) [57] conv:(2.89)
93. att1='(26.0752-34.9314]' att9='(44.4-48.7]' 124 ==> att3='(20.175-22.65]' 101 <conf:(0.81)> lift:(2.56) lev:(0.06) [61] conv:(3.52)
94. att2='(52.05-inf)' att5='(54.3-67.575]' att6='(26.8-31.025)' 118 ==> att7='(63.85-69.7]' 96 <conf:(0.81)> lift:(1.82) lev:(0.05) [43] conv:(2.84)
95. att1='(-inf-26.0752]' att6='(26.8-31.025)' 128 ==> att7='(63.85-69.7]' 104 <conf:(0.81)> lift:(1.82) lev:(0.05) [46] conv:(2.83)
96. att1='(-inf-26.0752]' att5='(54.3-67.575]' att6='(26.8-31.025)' 128 ==> att7='(63.85-69.7]' 104 <conf:(0.81)> lift:(1.82) lev:(0.05) [46] conv:(2.83)
97. att1='(-inf-26.0752]' att6='(26.8-31.025)' 128 ==> att5='(54.3-67.575]' att7='(63.85-69.7]' 104 <conf:(0.81)> lift:(3.56) lev:(0.08) [74] conv:(3.95)
98. att4='(39.525-44.675]' att5='(54.3-67.575]' 186 ==> att7='(63.85-69.7]' 151 <conf:(0.81)> lift:(1.81) lev:(0.07) [67] conv:(2.86)
99. att1='(-inf-26.0752]' 143 ==> att5='(54.3-67.575]' att7='(63.85-69.7]' 116 <conf:(0.81)> lift:(3.55) lev:(0.09) [83] conv:(3.94)
100. att2='(52.05-inf)' att5='(54.3-67.575]' 136 ==> att7='(63.85-69.7]' 110 <conf:(0.81)> lift:(1.81) lev:(0.05) [49] conv:(2.78)
101. att1='(-inf-26.0752]' att5='(54.3-67.575]' 141 ==> att2='(52.05-inf)' 114 <conf:(0.81)> lift:(2.41) lev:(0.07) [66] conv:(3.34)
102. att5='(54.3-67.575]' att6='(26.8-31.025)' att7='(63.85-69.7]' 141 ==> att10='(-inf-39.6]' 114 <conf:(0.81)> lift:(4.86) lev:(0.1) [90] conv:(4.2)
103. att1='(34.9314-43.7876]' att9='(44.4-48.7]' 130 ==> att10='(50.8-56.4]' 105 <conf:(0.81)> lift:(3.71) lev:(0.08) [76] conv:(3.91)
104. att4='(44.675-49.825]' att8='(21.525-24.1]' 118 ==> att9='(44.4-48.7]' 95 <conf:(0.81)> lift:(2.02) lev:(0.05) [48] conv:(2.96)
105. att4='(39.525-44.675]' att10='(39.6-45.2]' 123 ==> att1='(26.0752-34.9314]' 99 <conf:(0.8)> lift:(3.12) lev:(0.07) [67] conv:(3.65)
106. att1='(43.7876-52.6438]' att8='(26.675-inf)' 144 ==> att10='(45.2-50.8]' 115 <conf:(0.8)> lift:(2.79) lev:(0.08) [73] conv:(3.43)
107. att1='(-inf-26.0752]' 143 ==> att2='(52.05-inf)' 114 <conf:(0.8)> lift:(2.37) lev:(0.07) [65] conv:(3.17)
108. att1='(-inf-26.0752]' 143 ==> att2='(52.05-inf)' att5='(54.3-67.575]' 114 <conf:(0.8)> lift:(5.57) lev:(0.1) [93] conv:(4.08)
109. att2='(52.05-inf)' att8='(21.525-24.1]' 143 ==> att3='(20.175-22.65]' 114 <conf:(0.8)> lift:(2.51) lev:(0.07) [68] conv:(3.25)
110. att3='(20.175-22.65]' att8='(21.525-24.1]' 137 ==> att9='(44.4-48.7]' 109 <conf:(0.8)> lift:(2) lev:(0.06) [54] conv:(2.84)
111. att3='(20.175-22.65]' att7='(63.85-69.7]' 161 ==> att6='(26.8-31.025)' 127 <conf:(0.79)> lift:(2.32) lev:(0.08) [72] conv:(3.04)
112. att5='(67.575-80.85]' att8='(21.525-24.1]' 141 ==> att2='(52.05-inf)' 110 <conf:(0.78)> lift:(2.32) lev:(0.07) [62] conv:(2.93)
113. att2='(52.05-inf)' att5='(54.3-67.575]' 136 ==> att1='(-inf-26.0752]' att6='(26.8-31.025)' 106 <conf:(0.78)> lift:(5.78) lev:(0.09) [87] conv:(3.8)
114. att4='(39.525-44.675]' att6='(26.8-31.025)' 154 ==> att7='(63.85-69.7]' 120 <conf:(0.78)> lift:(1.74) lev:(0.05) [51] conv:(2.43)
115. att1='(26.0752-34.9314]' att6='(26.8-31.025)' 125 ==> att7='(63.85-69.7]' 97 <conf:(0.78)> lift:(1.73) lev:(0.04) [41] conv:(2.38)
116. att4='(44.675-49.825]' 236 ==> att2='(52.05-inf)' 183 <conf:(0.78)> lift:(2.31) lev:(0.11) [103] conv:(2.9)
117. att5='(67.575-80.85]' att8='(21.525-24.1]' 141 ==> att9='(44.4-48.7]' 109 <conf:(0.77)> lift:(1.94) lev:(0.06) [52] conv:(2.57)
118. att2='(52.05-inf)' att8='(21.525-24.1]' 143 ==> att5='(67.575-80.85]' 110 <conf:(0.77)> lift:(3.4) lev:(0.08) [77] conv:(3.25)
119. att2='(52.05-inf)' att5='(67.575-80.85]' 143 ==> att8='(21.525-24.1]' 110 <conf:(0.77)> lift:(2.45) lev:(0.07) [65] conv:(2.89)
120. att2='(-inf-27.45]' 138 ==> att5='(41.025-54.3]' 106 <conf:(0.77)> lift:(2.81) lev:(0.07) [68] conv:(3.04)
121. att1='(26.0752-34.9314]' att6='(26.8-31.025)' 125 ==> att3='(20.175-22.65]' 96 <conf:(0.77)> lift:(2.42) lev:(0.06) [56] conv:(2.84)
122. att5='(67.575-80.85]' att9='(44.4-48.7]' 142 ==> att8='(21.525-24.1]' 109 <conf:(0.77)> lift:(2.45) lev:(0.07) [64] conv:(2.87)
123. att1='(26.0752-34.9314]' 245 ==> att3='(20.175-22.65]' 187 <conf:(0.76)> lift:(2.4) lev:(0.11) [109] conv:(2.83)
124. att1='(34.9314-43.7876]' att10='(50.8-56.4]' 138 ==> att9='(44.4-48.7]' 105 <conf:(0.76)> lift:(1.91) lev:(0.05) [50] conv:(2.44)
125. att5='(54.3-67.575]' att10='(-inf-39.6]' 150 ==> att6='(26.8-31.025)' att7='(63.85-69.7]' 114 <conf:(0.76)> lift:(3.59) lev:(0.09) [82] conv:(3.2)
126. att3='(20.175-22.65]' att8='(21.525-24.1]' 137 ==> att1='(26.0752-34.9314)' 104 <conf:(0.76)> lift:(2.94) lev:(0.07) [68] conv:(2.99)
127. att2='(52.05-inf)' att5='(67.575-80.85]' 143 ==> att10='(50.8-56.4]' 108 <conf:(0.76)> lift:(3.47) lev:(0.08) [76] conv:(3.11)
128. att2='(43.85-52.05]' att4='(39.525-44.675]' 151 ==> att1='(26.0752-34.9314)' 114 <conf:(0.75)> lift:(2.93) lev:(0.08) [75] conv:(2.95)
129. att1='(34.9314-43.7876]' 183 ==> att10='(50.8-56.4]' 138 <conf:(0.75)> lift:(3.46) lev:(0.1) [98] conv:(3.11)
130. att8='(26.675-inf)' 191 ==> att1='(43.7876-52.6438)' 144 <conf:(0.75)> lift:(2.22) lev:(0.08) [79] conv:(2.63)
131. att5='(67.575-80.85]' att9='(44.4-48.7]' 142 ==> att10='(50.8-56.4)' 107 <conf:(0.75)> lift:(3.46) lev:(0.08) [76] conv:(3.08)
132. att1='(-inf-26.0752]' att5='(54.3-67.575]' 141 ==> att2='(52.05-inf)' att6='(26.8-31.025)' 106 <conf:(0.75)> lift:(4.55) lev:(0.09) [82] conv:(3.27)
133. att2='(52.05-inf)' att6='(26.8-31.025)' 157 ==> att5='(54.3-67.575]' 118 <conf:(0.75)> lift:(2.18) lev:(0.07) [63] conv:(2.57)
134. att5='(54.3-67.575]' att6='(26.8-31.025)' 188 ==> att7='(63.85-69.7]' 141 <conf:(0.75)> lift:(1.68) lev:(0.06) [56] conv:(2.16)
135. att2='(52.05-inf)' att6='(26.8-31.025)' att7='(63.85-69.7]' 128 ==> att5='(54.3-67.575)' 96 <conf:(0.75)> lift:(2.18) lev:(0.05) [51] conv:(2.54)

```

If we decide to reduce the confidence value to 0.75 we discover 135 rules, but...

Associator

Choose Apriori -N 1000 -T 0 -C 0.75 -D 0.05 -U 1.0 **-M 0.2 -S -1.0 -c -1**

Associator output

Start **Stop**

Result list (right-click to copy)

- 09:42:16 - Apriori
- 10:22:16 - Apriori
- 10:23:08 - Apriori
- 10:23:34 - Apriori**

== Run information ==

Scheme: weka.associations.Apriori -N 1000 -T 0 -C 0.75 -D 0.05 -U 1.0 -M 0.2 -S -1.0 -c -1
Relation: stock-weka.filters.unsupervised.attribute.Discretize-B5-M-1.0-Rfirst-last-precision6
Instances: 950
Attributes: 10
att1
att2
att3
att4
att5
att6
att7
att8
att9
att10

== Associator model (full training set) ==

Apriori

=====

Minimum support: 0.2 (190 instances)
Minimum metric <confidence>: 0.75
Number of cycles performed: 16

Generated sets of large itemsets:

Size of set of large itemsets L(1): 24

Size of set of large itemsets L(2): 6

Best rules found:

If we decide to increase the lowBoundMinSupport to 0.2 we can't find any rules, in this way we are searching for rules with an higher or equal support of 20%.

Associator

Choose Apriori -N 1000 -T 0 -C 0.5 -D 0.05 -U 1.0 -M 0.2 -S -1.0 -c -1

Associator output

Start Stop

Result list (right-click to select)

- 09:42:16 - Apriori
- 10:22:16 - Apriori
- 10:23:08 - Apriori
- 10:23:34 - Apriori
- 10:24:01 - Apriori**

```

Scheme: weka.associations.Apriori -N 1000 -T 0 -C 0.5 -D 0.05 -U 1.0 -M 0.2 -S -1.0 -c -1
Relation: stock-weka.filters.unsupervised.attribute.Discretize-B5-M-1.0-Rfirst-last-precision6
Instances: 950
Attributes: 10
att1
att2
att3
att4
att5
att6
att7
att8
att9
att10
==== Associator model (full training set) ====
Apriori
=====
Minimum support: 0.2 (190 instances)
Minimum metric <confidence>: 0.5
Number of cycles performed: 16

Generated sets of large itemsets:
Size of set of large itemsets L(1): 24
Size of set of large itemsets L(2): 6

Best rules found:

1. att10='(45.2-50.8]' 272 ==> att1='(43.7876-52.6438]' 203 <conf:(0.75)> lift:(2.2) lev:(0.12) [110] conv:(2.56)
2. att2='(52.05-inf)' 319 ==> att9='(44.4-48.7]' 228 <conf:(0.71)> lift:(1.8) lev:(0.11) [101] conv:(2.09)
3. att3='(20.175-22.65]' 302 ==> att2='(52.05-inf)' 211 <conf:(0.7)> lift:(2.08) lev:(0.12) [109] conv:(2.18)
4. att5='(54.3-67.575]' 327 ==> att7='(63.85-69.7]' 217 <conf:(0.66)> lift:(1.48) lev:(0.07) [70] conv:(1.63)
5. att2='(52.05-inf)' 319 ==> att3='(20.175-22.65]' 211 <conf:(0.66)> lift:(2.08) lev:(0.12) [109] conv:(2)
6. att4='(39.525-44.675]' 411 ==> att7='(63.85-69.7]' 267 <conf:(0.65)> lift:(1.45) lev:(0.09) [83] conv:(1.57)
7. att1='(43.7876-52.6438]' 323 ==> att10='(45.2-50.8]' 203 <conf:(0.63)> lift:(2.2) lev:(0.12) [110] conv:(1.91)
8. att7='(63.85-69.7]' 425 ==> att4='(39.525-44.675]' 267 <conf:(0.63)> lift:(1.45) lev:(0.09) [83] conv:(1.52)
9. att6='(26.8-31.025]' 323 ==> att7='(63.85-69.7]' 201 <conf:(0.62)> lift:(1.39) lev:(0.06) [56] conv:(1.45)
10. att9='(44.4-48.7]' 378 ==> att2='(52.05-inf)' 228 <conf:(0.6)> lift:(1.8) lev:(0.11) [101] conv:(1.66)
11. att7='(63.85-69.7]' 425 ==> att5='(54.3-67.575]' 217 <conf:(0.51)> lift:(1.48) lev:(0.07) [70] conv:(1.33)

```

From that situation, if we decrease again the confidence value to 0.5 we can now find 11 rules

Exercise 5

- Load the supermarket.arff dataset
- Apply the both APRIORI and FP-growth algorithm with default parameters.
- Compare the achieved results, also in terms of execution time.

Associator

Choose

Apriori -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1 -S -1.0 -V -c -1

Start

Stop

Associator output

Result list (right-click to copy)

10:58:13 - Apriori

```
==== 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 -V -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)> lift:(1.27) lev:(0.03) [155] conv:(3.35)
2. baking needs=t biscuits=t fruit=t total=high 760 ==> bread and cake=t 696    <conf:(0.92)> lift:(1.27) lev:(0.03) [149] conv:(3.28)
3. baking needs=t frozen foods=t fruit=t total=high 770 ==> bread and cake=t 705    <conf:(0.92)> lift:(1.27) lev:(0.03) [150] conv:(3.27)
4. biscuits=t fruit=t vegetables=t total=high 815 ==> bread and cake=t 746    <conf:(0.92)> lift:(1.27) lev:(0.03) [159] conv:(3.26)
5. party snack foods=t fruit=t total=high 854 ==> bread and cake=t 779    <conf:(0.91)> lift:(1.27) lev:(0.04) [164] conv:(3.15)
6. biscuits=t frozen foods=t vegetables=t total=high 797 ==> bread and cake=t 725    <conf:(0.91)> lift:(1.26) lev:(0.03) [151] conv:(3.06)
7. baking needs=t biscuits=t vegetables=t total=high 772 ==> bread and cake=t 701    <conf:(0.91)> lift:(1.26) lev:(0.03) [145] conv:(3.01)
8. biscuits=t fruit=t total=high 954 ==> bread and cake=t 866    <conf:(0.91)> lift:(1.26) lev:(0.04) [179] conv:(3)
9. frozen foods=t fruit=t vegetables=t total=high 834 ==> bread and cake=t 757    <conf:(0.91)> lift:(1.26) lev:(0.03) [156] conv:(3)
10. frozen foods=t fruit=t total=high 969 ==> bread and cake=t 877    <conf:(0.91)> lift:(1.26) lev:(0.04) [179] conv:(2.92)
```

Choose FP-Growth -P 2 -I -1 -N 10 -T 0 -C 0.9 -D 0.05 -U 1.0 -M 0.1

Start

Stop

Associator output

Result list (right-click f...)

10:58:13 - Apriori

10:59:08 - FP-Growth

==== 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)

The results are the same as the number of desired rules are 10. The time taken by the Apriori algorithm (3 sec) is 3 times the time taken by the FP algorithm (1 sec)