Homework 1

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# Apriori Algorithm

The Apriori algorithm works on the Apriori principle which states that if an itemset is frequent, all of its subsets must also be frequent. To generate frequent itemsets, the Apriori algorithm uses support-based pruning to control the exponential growth of candidate itemsets.

Initially, every item is considered as a candidate-1 itemset. After counting their supports, the candidate itemsets who have support value below the minimum support threshold are discarded and the resultant is called the frequent 1-itemsets. In the subsequent iterations, the candidate 2-itemsets are generated from the previous frequent-1 itemsets and the process goes on until there are no frequent itemsets of a particular length. This describes the overall flow of the Apriori algorithm for frequent itemsets generation.

# Rule Generation

It uses a level-wise approach for generating association rules where each level corresponds to the number of items that belong to the rule consequent. Initially, all the high confidence rules that have only 1 item in the rule are generated. Then these rules are used to generate new candidate rules. If any node in the lattice of association rules has low confidence, the according to the Apriori principle, the entire subgraph spanned by the node can be pruned immediately. Another form of the Apriori principle is that if a rule X -> Y does not satisfy the confidence threshold, then any rule X’ -> Y – X’, where X’ is a subset of X must not satisfy the confidence threshold as well. This is how rules are generated from the frequent itemsets.

# Task 1:

## Support 30%

﻿Support is set to be 30 percentage

Number of length-1 frequent itemsets:196

Number of length-2 frequent itemsets:5340

Number of length-3 frequent itemsets:5287

Number of length-4 frequent itemsets:1518

Number of length-5 frequent itemsets:438

Number of length-6 frequent itemsets:88

Number of length-7 frequent itemsets:11

Number of length-8 frequent itemsets:1

## Support 40%

﻿Support is set to be 40 percentage

Number of length-1 frequent itemsets:167

Number of length-2 frequent itemsets:753

Number of length-3 frequent itemsets:149

Number of length-4 frequent itemsets:7

Number of length-5 frequent itemsets:1

## Support 50%

﻿Support is set to be 50 percentage

Number of length-1 frequent itemsets:109

Number of length-2 frequent itemsets:63

Number of length-3 frequent itemsets:2

## Support 60%

﻿Support is set to be 60 percentage

Number of length-1 frequent itemsets:34

Number of length-2 frequent itemsets:2

## Support 70%

﻿Support is set to be 70 percentage

Number of length-1 frequent itemsets:7

# Task 2:

## Template 1:

### 11:

cnt= 26

result11: (Mapped as L[0] -> L[1]

﻿[[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene6\_up'], ['gene59\_up']],

[['gene59\_up'], ['gene88\_down']],

[['gene59\_up'], ['gene72\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up']],

[['gene59\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene96\_down']],

[['gene38\_down'], ['gene59\_up']],

[['gene59\_up'], ['gene82\_down']],

[['gene96\_down'], ['gene59\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene13\_down'], ['gene59\_up']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene10\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene28\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene59\_up']]]

### 12:

cnt= 91

result12: (Mapped as L[0] -> L[1]

﻿[[['gene67\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene32\_down']],

[['gene10\_down'], ['gene70\_down']],

[['gene88\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene72\_up']],

[['gene38\_down'], ['gene52\_down']],

[['gene28\_down'], ['gene52\_down']],

[['gene72\_up'], ['gene1\_up']],

[['gene87\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene28\_down']],

[['gene65\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene1\_up']],

[['gene24\_down'], ['gene54\_up']],

[['gene97\_down'], ['gene72\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene88\_down'], ['gene54\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene41\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene6\_up'], ['gene28\_down']],

[['gene72\_up'], ['gene82\_down']],

[['gene72\_up'], ['gene96\_down']],

[['gene67\_up'], ['gene1\_up']],

[['gene8\_up'], ['gene88\_down']],

[['gene87\_up'], ['gene28\_down']],

[['gene1\_up'], ['gene38\_down']],

[['gene96\_down'], ['gene72\_up']],

[['gene70\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene47\_up']],

[['gene82\_down'], ['gene13\_down']],

[['gene2\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene41\_down']],

[['gene82\_down'], ['gene72\_up']],

[['gene13\_down'], ['gene82\_down']],

[['gene38\_down'], ['gene1\_up']],

[['gene96\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene54\_up'], ['gene1\_up']],

[['gene24\_down'], ['gene88\_down']],

[['gene28\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene38\_down']],

[['gene94\_up'], ['gene38\_down']],

[['gene88\_down'], ['gene87\_up']],

[['gene72\_up'], ['gene13\_down']],

[['gene82\_down'], ['gene97\_down']],

[['gene88\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene24\_down']],

[['gene1\_up'], ['gene67\_up']],

[['gene41\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene8\_up']],

[['gene38\_down'], ['gene70\_down']],

[['gene10\_down'], ['gene28\_down']],

[['gene10\_down'], ['gene88\_down']],

[['gene97\_down'], ['gene82\_down']],

[['gene1\_up'], ['gene70\_down']],

[['gene54\_up'], ['gene88\_down']],

[['gene82\_down'], ['gene96\_down']],

[['gene28\_down'], ['gene32\_down']],

[['gene13\_down'], ['gene72\_up']],

[['gene54\_up'], ['gene24\_down']],

[['gene13\_down'], ['gene6\_up']],

[['gene32\_down'], ['gene6\_up']],

[['gene28\_down'], ['gene88\_down']],

[['gene6\_up'], ['gene13\_down']],

[['gene13\_down'], ['gene28\_down']],

[['gene6\_up'], ['gene32\_down']],

[['gene28\_down'], ['gene2\_down']],

[['gene91\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene10\_down']],

[['gene52\_down'], ['gene38\_down']],

[['gene41\_down'], ['gene28\_down']],

[['gene28\_down'], ['gene6\_up']],

[['gene1\_up'], ['gene72\_up']],

[['gene6\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene13\_down']],

[['gene38\_down'], ['gene91\_up']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene54\_up']],

[['gene52\_down'], ['gene28\_down']],

[['gene32\_down'], ['gene28\_down']],

[['gene47\_up'], ['gene28\_down']],

[['gene47\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene47\_up']],

[['gene2\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene87\_up']],

[['gene1\_up'], ['gene10\_down']],

[['gene41\_down'], ['gene88\_down']]]

### 13:

cnt= 39

result13: (Mapped as L[0] -> L[1]

﻿[[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene10\_down'], ['gene70\_down']],

[['gene6\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene10\_down']],

[['gene59\_up'], ['gene88\_down']],

[['gene59\_up'], ['gene72\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up']],

[['gene59\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene96\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene38\_down'], ['gene59\_up']],

[['gene70\_down'], ['gene10\_down']],

[['gene59\_up'], ['gene82\_down']],

[['gene96\_down'], ['gene59\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene10\_down'], ['gene28\_down']],

[['gene13\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene88\_down']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene28\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene59\_up']],

[['gene38\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene10\_down']]]

### 14:

cnt= 9

result14: (Mapped as L[0] -> L[1]

﻿[[['gene59\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene88\_down']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene59\_up'], ['gene96\_down']],

[['gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene59\_up'], ['gene82\_down']]]

### 15:

cnt= 108

result15: (Mapped as L[0] -> L[1]

﻿[[['gene67\_up'], ['gene38\_down']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene38\_down'], ['gene32\_down']],

[['gene10\_down'], ['gene70\_down']],

[['gene6\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene72\_up']],

[['gene38\_down'], ['gene52\_down']],

[['gene28\_down'], ['gene52\_down']],

[['gene72\_up'], ['gene1\_up']],

[['gene87\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene59\_up']],

[['gene65\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene1\_up']],

[['gene24\_down'], ['gene54\_up']],

[['gene97\_down'], ['gene72\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene88\_down'], ['gene54\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene41\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene6\_up'], ['gene28\_down']],

[['gene72\_up'], ['gene82\_down']],

[['gene72\_up'], ['gene96\_down']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene67\_up'], ['gene1\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene8\_up'], ['gene88\_down']],

[['gene87\_up'], ['gene28\_down']],

[['gene1\_up'], ['gene38\_down']],

[['gene72\_up'], ['gene59\_up']],

[['gene96\_down'], ['gene72\_up']],

[['gene70\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene47\_up']],

[['gene82\_down'], ['gene13\_down']],

[['gene2\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene41\_down']],

[['gene82\_down'], ['gene72\_up']],

[['gene13\_down'], ['gene82\_down']],

[['gene38\_down'], ['gene1\_up']],

[['gene96\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene54\_up'], ['gene1\_up']],

[['gene24\_down'], ['gene88\_down']],

[['gene28\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene59\_up']],

[['gene70\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene38\_down']],

[['gene94\_up'], ['gene38\_down']],

[['gene88\_down'], ['gene87\_up']],

[['gene72\_up'], ['gene13\_down']],

[['gene82\_down'], ['gene97\_down']],

[['gene88\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene24\_down']],

[['gene96\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene67\_up']],

[['gene41\_down'], ['gene38\_down']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene8\_up']],

[['gene38\_down'], ['gene70\_down']],

[['gene10\_down'], ['gene28\_down']],

[['gene13\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene88\_down']],

[['gene97\_down'], ['gene82\_down']],

[['gene1\_up'], ['gene70\_down']],

[['gene10\_down'], ['gene59\_up']],

[['gene54\_up'], ['gene88\_down']],

[['gene82\_down'], ['gene96\_down']],

[['gene28\_down'], ['gene32\_down']],

[['gene13\_down'], ['gene72\_up']],

[['gene54\_up'], ['gene24\_down']],

[['gene13\_down'], ['gene6\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene32\_down'], ['gene6\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene28\_down'], ['gene88\_down']],

[['gene6\_up'], ['gene13\_down']],

[['gene13\_down'], ['gene28\_down']],

[['gene6\_up'], ['gene32\_down']],

[['gene28\_down'], ['gene59\_up']],

[['gene28\_down'], ['gene2\_down']],

[['gene1\_up'], ['gene59\_up']],

[['gene91\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene10\_down']],

[['gene52\_down'], ['gene38\_down']],

[['gene41\_down'], ['gene28\_down']],

[['gene28\_down'], ['gene6\_up']],

[['gene1\_up'], ['gene72\_up']],

[['gene6\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene13\_down']],

[['gene38\_down'], ['gene91\_up']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene54\_up']],

[['gene52\_down'], ['gene28\_down']],

[['gene32\_down'], ['gene28\_down']],

[['gene47\_up'], ['gene28\_down']],

[['gene47\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene47\_up']],

[['gene2\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene87\_up']],

[['gene1\_up'], ['gene10\_down']],

[['gene41\_down'], ['gene88\_down']]]

### 16:

cnt= 17

result16: (Mapped as L[0] -> L[1]

﻿[[['gene10\_down'], ['gene70\_down']],

[['gene59\_up'], ['gene88\_down']],

[['gene10\_down'], ['gene28\_down']],

[['gene10\_down'], ['gene88\_down']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene59\_up'], ['gene72\_up']],

[['gene10\_down'], ['gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene59\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene96\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene59\_up'], ['gene82\_down']]]

### 17:

cnt= 17

result17: (Mapped as L[0] -> L[1]

﻿[[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up']],

[['gene6\_up'], ['gene59\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up']],

[['gene13\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene59\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene38\_down'], ['gene59\_up']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene28\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene59\_up']]]

### 18:

cnt= 100

result18: (Mapped as L[0] -> L[1]

﻿[[['gene67\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene32\_down']],

[['gene10\_down'], ['gene70\_down']],

[['gene88\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene72\_up']],

[['gene59\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene52\_down']],

[['gene28\_down'], ['gene52\_down']],

[['gene72\_up'], ['gene1\_up']],

[['gene87\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene28\_down']],

[['gene59\_up'], ['gene72\_up']],

[['gene65\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene1\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene24\_down'], ['gene54\_up']],

[['gene97\_down'], ['gene72\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene88\_down'], ['gene54\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene41\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene6\_up'], ['gene28\_down']],

[['gene72\_up'], ['gene82\_down']],

[['gene72\_up'], ['gene96\_down']],

[['gene67\_up'], ['gene1\_up']],

[['gene8\_up'], ['gene88\_down']],

[['gene87\_up'], ['gene28\_down']],

[['gene1\_up'], ['gene38\_down']],

[['gene59\_up'], ['gene13\_down']],

[['gene96\_down'], ['gene72\_up']],

[['gene70\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene47\_up']],

[['gene82\_down'], ['gene13\_down']],

[['gene2\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene41\_down']],

[['gene59\_up'], ['gene96\_down']],

[['gene82\_down'], ['gene72\_up']],

[['gene13\_down'], ['gene82\_down']],

[['gene38\_down'], ['gene1\_up']],

[['gene96\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene54\_up'], ['gene1\_up']],

[['gene24\_down'], ['gene88\_down']],

[['gene28\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene38\_down']],

[['gene94\_up'], ['gene38\_down']],

[['gene88\_down'], ['gene87\_up']],

[['gene72\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene82\_down']],

[['gene82\_down'], ['gene97\_down']],

[['gene88\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene24\_down']],

[['gene1\_up'], ['gene67\_up']],

[['gene41\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene8\_up']],

[['gene38\_down'], ['gene70\_down']],

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[['gene1\_up'], ['gene70\_down']],

[['gene54\_up'], ['gene88\_down']],

[['gene82\_down'], ['gene96\_down']],

[['gene28\_down'], ['gene32\_down']],

[['gene13\_down'], ['gene72\_up']],

[['gene54\_up'], ['gene24\_down']],

[['gene13\_down'], ['gene6\_up']],

[['gene32\_down'], ['gene6\_up']],

[['gene28\_down'], ['gene88\_down']],

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[['gene6\_up'], ['gene13\_down']],

[['gene13\_down'], ['gene28\_down']],

[['gene6\_up'], ['gene32\_down']],

[['gene28\_down'], ['gene2\_down']],

[['gene91\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene10\_down']],

[['gene52\_down'], ['gene38\_down']],

[['gene41\_down'], ['gene28\_down']],

[['gene28\_down'], ['gene6\_up']],

[['gene1\_up'], ['gene72\_up']],

[['gene6\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene13\_down']],

[['gene38\_down'], ['gene91\_up']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene54\_up']],

[['gene52\_down'], ['gene28\_down']],

[['gene32\_down'], ['gene28\_down']],

[['gene47\_up'], ['gene28\_down']],

[['gene47\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene47\_up']],

[['gene2\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene87\_up']],

[['gene1\_up'], ['gene10\_down']],

[['gene41\_down'], ['gene88\_down']]]

### 19:

cnt=24

result19: (Mapped as L[0] -> L[1]

﻿[[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene96\_down'], ['gene59\_up']],

[['gene6\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene10\_down']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene13\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene59\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene94\_up'], ['gene10\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene28\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene59\_up']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene38\_down'], ['gene10\_down']],

[['gene82\_down'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up']],

[['gene28\_down'], ['gene10\_down']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene10\_down']],

[['gene38\_down'], ['gene59\_up']],

[['gene70\_down'], ['gene10\_down']]]

## Template 2:

### 21:

cnt= 9

result21: (Mapped as L[0] -> L[1]

﻿[[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']]]

### 22:

cnt= 6

result22: (Mapped as L[0] -> L[1]

﻿[[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']]]

### 23:

cnt= 117

result23: (Mapped as L[0] -> L[1]

﻿[[['gene67\_up'], ['gene38\_down']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene38\_down'], ['gene32\_down']],

[['gene10\_down'], ['gene70\_down']],

[['gene6\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene72\_up']],

[['gene59\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene52\_down']],

[['gene28\_down'], ['gene52\_down']],

[['gene72\_up'], ['gene1\_up']],

[['gene87\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene28\_down']],

[['gene59\_up'], ['gene72\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene65\_down'], ['gene38\_down']],

[['gene70\_down'], ['gene1\_up']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene24\_down'], ['gene54\_up']],

[['gene97\_down'], ['gene72\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene88\_down'], ['gene54\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene41\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene6\_up'], ['gene28\_down']],

[['gene72\_up'], ['gene82\_down']],

[['gene72\_up'], ['gene96\_down']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene67\_up'], ['gene1\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene8\_up'], ['gene88\_down']],

[['gene87\_up'], ['gene28\_down']],

[['gene1\_up'], ['gene38\_down']],

[['gene72\_up'], ['gene59\_up']],

[['gene59\_up'], ['gene13\_down']],

[['gene96\_down'], ['gene72\_up']],

[['gene70\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene47\_up']],

[['gene82\_down'], ['gene13\_down']],

[['gene2\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene41\_down']],

[['gene59\_up'], ['gene96\_down']],

[['gene82\_down'], ['gene72\_up']],

[['gene13\_down'], ['gene82\_down']],

[['gene38\_down'], ['gene1\_up']],

[['gene96\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene54\_up'], ['gene1\_up']],

[['gene24\_down'], ['gene88\_down']],

[['gene28\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene59\_up']],

[['gene70\_down'], ['gene10\_down']],

[['gene32\_down'], ['gene38\_down']],

[['gene94\_up'], ['gene38\_down']],

[['gene88\_down'], ['gene87\_up']],

[['gene72\_up'], ['gene13\_down']],

[['gene59\_up'], ['gene82\_down']],

[['gene82\_down'], ['gene97\_down']],

[['gene88\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene24\_down']],

[['gene96\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene67\_up']],

[['gene41\_down'], ['gene38\_down']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene8\_up']],

[['gene38\_down'], ['gene70\_down']],

[['gene10\_down'], ['gene28\_down']],

[['gene13\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene88\_down']],

[['gene97\_down'], ['gene82\_down']],

[['gene82\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up', 'gene96\_down'], ['gene72\_up']],

[['gene1\_up'], ['gene70\_down']],

[['gene10\_down'], ['gene59\_up']],

[['gene54\_up'], ['gene88\_down']],

[['gene82\_down'], ['gene96\_down']],

[['gene28\_down'], ['gene32\_down']],

[['gene13\_down'], ['gene72\_up']],

[['gene54\_up'], ['gene24\_down']],

[['gene13\_down'], ['gene6\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene32\_down'], ['gene6\_up']],

[['gene72\_up'], ['gene82\_down', 'gene59\_up']],

[['gene28\_down'], ['gene88\_down']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene6\_up'], ['gene13\_down']],

[['gene13\_down'], ['gene28\_down']],

[['gene6\_up'], ['gene32\_down']],

[['gene28\_down'], ['gene59\_up']],

[['gene28\_down'], ['gene2\_down']],

[['gene1\_up'], ['gene59\_up']],

[['gene91\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene10\_down']],

[['gene52\_down'], ['gene38\_down']],

[['gene41\_down'], ['gene28\_down']],

[['gene28\_down'], ['gene6\_up']],

[['gene1\_up'], ['gene72\_up']],

[['gene6\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene13\_down']],

[['gene38\_down'], ['gene91\_up']],

[['gene47\_up'], ['gene10\_down']],

[['gene1\_up'], ['gene54\_up']],

[['gene52\_down'], ['gene28\_down']],

[['gene32\_down'], ['gene28\_down']],

[['gene47\_up'], ['gene28\_down']],

[['gene47\_up'], ['gene38\_down']],

[['gene28\_down'], ['gene47\_up']],

[['gene2\_down'], ['gene38\_down']],

[['gene28\_down'], ['gene87\_up']],

[['gene1\_up'], ['gene10\_down']],

[['gene41\_down'], ['gene88\_down']]]

## Template 3:

### 31:

cnt= 24

result31: (Mapped as L[0] -> L[1]

[[['gene10\_down'], ['gene70\_down']],

[['gene10\_down'], ['gene88\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene10\_down'], ['gene28\_down']],

[['gene10\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene1\_up'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene32\_down'], ['gene59\_up']],

[['gene87\_up'], ['gene59\_up']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene59\_up']],

[['gene6\_up'], ['gene59\_up']],

[['gene38\_down'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up']],

[['gene13\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene28\_down'], ['gene59\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene72\_up'], ['gene59\_up', 'gene82\_down']]]

### 32:

cnt=1

result32: (Mapped as L[0] -> L[1]

[[['gene10\_down'], ['gene59\_up']]]

### 33:

cnt=11

result33: (Mapped as L[0] -> L[1]

[[['gene10\_down'], ['gene70\_down']],

[['gene10\_down'], ['gene88\_down']],

[['gene10\_down'], ['gene94\_up']],

[['gene10\_down'], ['gene28\_down']],

[['gene10\_down'], ['gene59\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene10\_down'], ['gene47\_up']],

[['gene10\_down'], ['gene38\_down']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene59\_up', 'gene82\_down']]]

### 34:

cnt=0

result34: (Mapped as L[0] -> L[1]

[]

### 35:

cnt= 117

result35: (Mapped as L[0] -> L[1]

[[['gene82\_down'], ['gene96\_down']],

[['gene2\_down'], ['gene38\_down']],

[['gene88\_down'], ['gene54\_up']],

[['gene88\_down'], ['gene24\_down']],

[['gene54\_up'], ['gene1\_up']],

[['gene32\_down'], ['gene6\_up']],

[['gene28\_down'], ['gene88\_down']],

[['gene38\_down'], ['gene52\_down']],

[['gene88\_down'], ['gene10\_down']],

[['gene8\_up'], ['gene88\_down']],

[['gene82\_down', 'gene72\_up'], ['gene59\_up']],

[['gene47\_up'], ['gene10\_down']],

[['gene32\_down'], ['gene59\_up']],

[['gene65\_down'], ['gene38\_down']],

[['gene6\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene70\_down']],

[['gene6\_up'], ['gene13\_down']],

[['gene70\_down'], ['gene10\_down']],

[['gene6\_up'], ['gene28\_down']],

[['gene47\_up'], ['gene38\_down']],

[['gene1\_up'], ['gene10\_down']],

[['gene59\_up'], ['gene13\_down']],

[['gene28\_down'], ['gene2\_down']],

[['gene41\_down'], ['gene28\_down']],

[['gene10\_down'], ['gene59\_up']],

[['gene38\_down'], ['gene47\_up']],

[['gene59\_up'], ['gene72\_up']],

[['gene88\_down'], ['gene87\_up']],

[['gene28\_down'], ['gene13\_down']],

[['gene97\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene38\_down']],

[['gene6\_up'], ['gene32\_down']],

[['gene28\_down'], ['gene41\_down']],

[['gene38\_down'], ['gene59\_up']],

[['gene82\_down'], ['gene97\_down']],

[['gene38\_down'], ['gene1\_up']],

[['gene97\_down'], ['gene72\_up']],

[['gene2\_down'], ['gene28\_down']],

[['gene59\_up', 'gene72\_up'], ['gene82\_down']],

[['gene59\_up'], ['gene88\_down']],

[['gene10\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene28\_down']],

[['gene1\_up'], ['gene70\_down']],

[['gene72\_up'], ['gene13\_down']],

[['gene13\_down'], ['gene59\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene32\_down'], ['gene72\_up']],

[['gene28\_down'], ['gene87\_up']],

[['gene59\_up', 'gene82\_down'], ['gene72\_up']],

[['gene47\_up'], ['gene28\_down']],

[['gene28\_down'], ['gene10\_down']],

[['gene96\_down', 'gene59\_up'], ['gene72\_up']],

[['gene59\_up'], ['gene82\_down']],

[['gene28\_down'], ['gene47\_up']],

[['gene82\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene54\_up']],

[['gene13\_down'], ['gene82\_down']],

[['gene70\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene10\_down']],

[['gene28\_down'], ['gene6\_up']],

[['gene70\_down'], ['gene1\_up']],

[['gene28\_down'], ['gene52\_down']],

[['gene72\_up'], ['gene59\_up', 'gene82\_down']],

[['gene24\_down'], ['gene54\_up']],

[['gene1\_up'], ['gene59\_up']],

[['gene10\_down'], ['gene70\_down']],

[['gene94\_up'], ['gene10\_down']],

[['gene52\_down'], ['gene38\_down']],

[['gene72\_up'], ['gene1\_up']],

[['gene54\_up'], ['gene88\_down']],

[['gene38\_down'], ['gene91\_up']],

[['gene10\_down'], ['gene94\_up']],

[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene1\_up'], ['gene38\_down']],

[['gene59\_up', 'gene72\_up'], ['gene96\_down']],

[['gene72\_up'], ['gene96\_down']],

[['gene87\_up'], ['gene59\_up']],

[['gene88\_down'], ['gene38\_down']],

[['gene38\_down'], ['gene28\_down']],

[['gene87\_up'], ['gene28\_down']],

[['gene28\_down'], ['gene32\_down']],

[['gene94\_up'], ['gene38\_down']],

[['gene96\_down', 'gene72\_up'], ['gene59\_up']],

[['gene59\_up'], ['gene96\_down']],

[['gene13\_down'], ['gene28\_down']],

[['gene88\_down'], ['gene8\_up']],

[['gene82\_down'], ['gene13\_down']],

[['gene91\_up'], ['gene38\_down']],

[['gene88\_down'], ['gene59\_up']],

[['gene1\_up'], ['gene72\_up']],

[['gene10\_down'], ['gene1\_up']],

[['gene72\_up'], ['gene82\_down']],

[['gene41\_down'], ['gene38\_down']],

[['gene10\_down'], ['gene47\_up']],

[['gene67\_up'], ['gene1\_up']],

[['gene32\_down'], ['gene28\_down']],

[['gene6\_up'], ['gene59\_up']],

[['gene67\_up'], ['gene38\_down']],

[['gene38\_down'], ['gene32\_down']],

[['gene72\_up'], ['gene59\_up']],

[['gene96\_down'], ['gene82\_down']],

[['gene10\_down'], ['gene88\_down']],

[['gene1\_up'], ['gene67\_up']],

[['gene41\_down'], ['gene88\_down']],

[['gene96\_down'], ['gene59\_up']],

[['gene54\_up'], ['gene24\_down']],

[['gene32\_down'], ['gene38\_down']],

[['gene52\_down'], ['gene28\_down']],

[['gene82\_down'], ['gene72\_up']],

[['gene88\_down'], ['gene41\_down']],

[['gene28\_down'], ['gene38\_down']],

[['gene96\_down'], ['gene72\_up']],

[['gene24\_down'], ['gene88\_down']],

[['gene28\_down'], ['gene59\_up']],

[['gene13\_down'], ['gene72\_up']],

[['gene87\_up'], ['gene88\_down']],

[['gene13\_down'], ['gene6\_up']]]

### 36:

cnt= 3

result36: (Mapped as L[0] -> L[1]

[[['gene82\_down'], ['gene59\_up', 'gene72\_up']],

[['gene96\_down'], ['gene59\_up', 'gene72\_up']],

[['gene72\_up'], ['gene59\_up', 'gene82\_down']]]