

Midterm exam

Question 1 (10 points):

Calculate city block, Euclidean and supremum distances for the below data.

(a). $x = (1, -1, 10, 3, 4)$, $y = (10, -1, 4, 5, 2)$

(b). $x_1 = (5, 4)$, $x_2 = (-2, 3)$

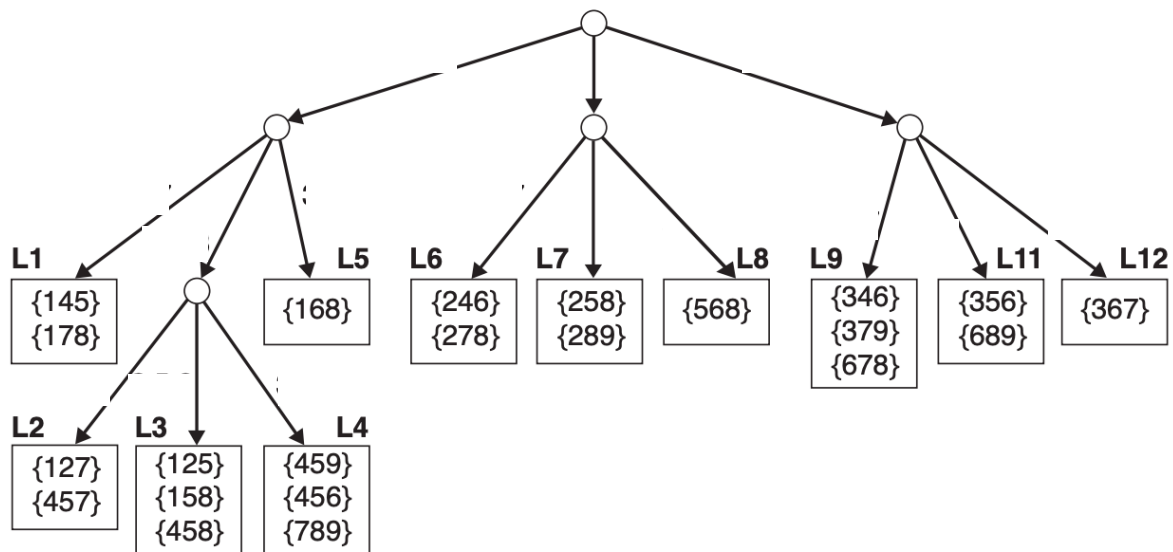
Question 2 (15 points):

Discuss the advantages and disadvantages of using sampling to reduce the number of data objects. Would simple random sampling (without replacement) be a good approach to sampling? Why or why not? What kind of sampling method that you would like to use?

Question 3 (10 points):

The Apriori algorithm uses a hash tree data structure to efficiently count the support of candidate itemsets. Consider the hash tree for candidate 3-itemsets as show in the below figure.

Given a transaction that contains items $\{1,3,4,5,8\}$, which of the hash tree leaf nodes will be visited when finding the candidates of the transaction?



Question 4 (15 points):

Consider the following set of candidate 3-itemsets:

$\{1,2,3\}$, $\{1,2,6\}$, $\{1,3,4\}$, $\{2,3,4\}$, $\{2,4,5\}$, $\{3,4,5\}$, $\{4,5,6\}$

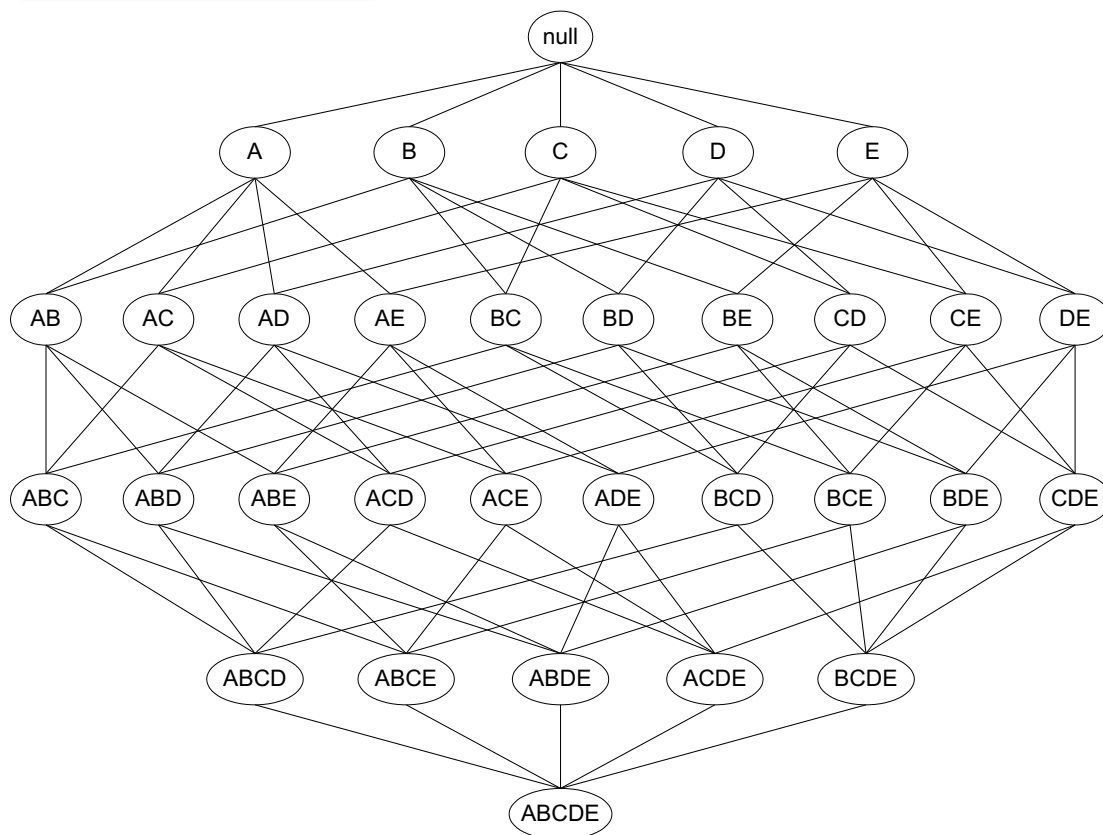
Construct a hash tree for the above candidate 3-itemsets. Assume the tree uses a hash function where:

1. all odd-numbered items are hashed to the left child of a node
2. the even-numbered items are hashed to the right child.

Question 5 (30 points)

Given the lattice structure in the below picture and the transactions given in the below table, label each node with the following letter(s): I if it is infrequent; F if it is frequent; M if the node is a maximal frequent itemset. Assume that the support threshold (minimum support) is 20%.

Transaction ID	Items Bought
1	{a, b, d, e}
2	{b, c, d}
3	{a, b, d, e}
4	{a, c, d, e}
5	{b, c, d, e}
6	{b, d, e}
7	{c, d}
8	{a, b, c}
9	{a, d, e}
10	{b, d}



Question 6 (20 points)

Consider the dataset in the below table. A rule is considered to be strong if its support exceeds 10%. The dataset in the Table supports the following two strong rules:

(a). $\{(1 \leq A \leq 2), B = 1\} \rightarrow \{C = 1\}$

(b). $\{(5 \leq A \leq 8), B = 1\} \rightarrow \{C = 1\}$

Compute the support and confidence for both rules.

A	B	C
1	1	1
2	1	1
3	1	0
4	1	0
5	1	1
6	0	1
7	0	0
8	1	1
9	0	0
10	0	0
11	0	0
12	0	1

Extra points (10 points)

Consider the following set of frequent 3-itemsets:

Assume that there are only 5 items in the dataset.

- (a). List all candidate 4-itemsets obtained by the candidate generation procedure in Apriori.
- (b). List all the candidate 4-itemsets that survive the candidate pruning step of the Apriori algorithm.

$\{1, 2, 3\}, \{1, 2, 4\}, \{1, 2, 5\}, \{1, 3, 4\}, \{1, 3, 5\}, \{2, 3, 4\}, \{2, 3, 5\}, \{3, 4, 5\}.$