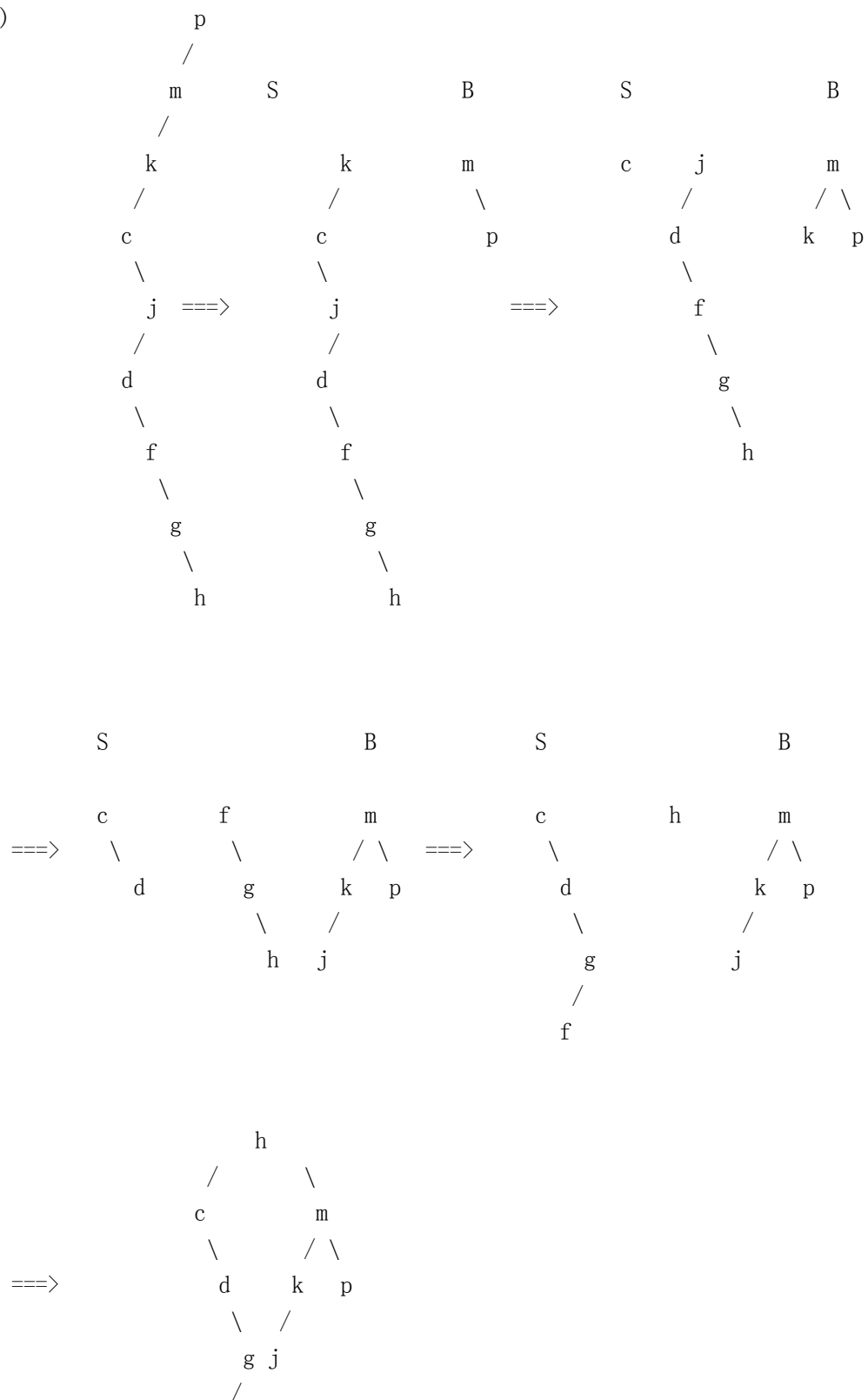


<<< Exam\_3 Solution >>>

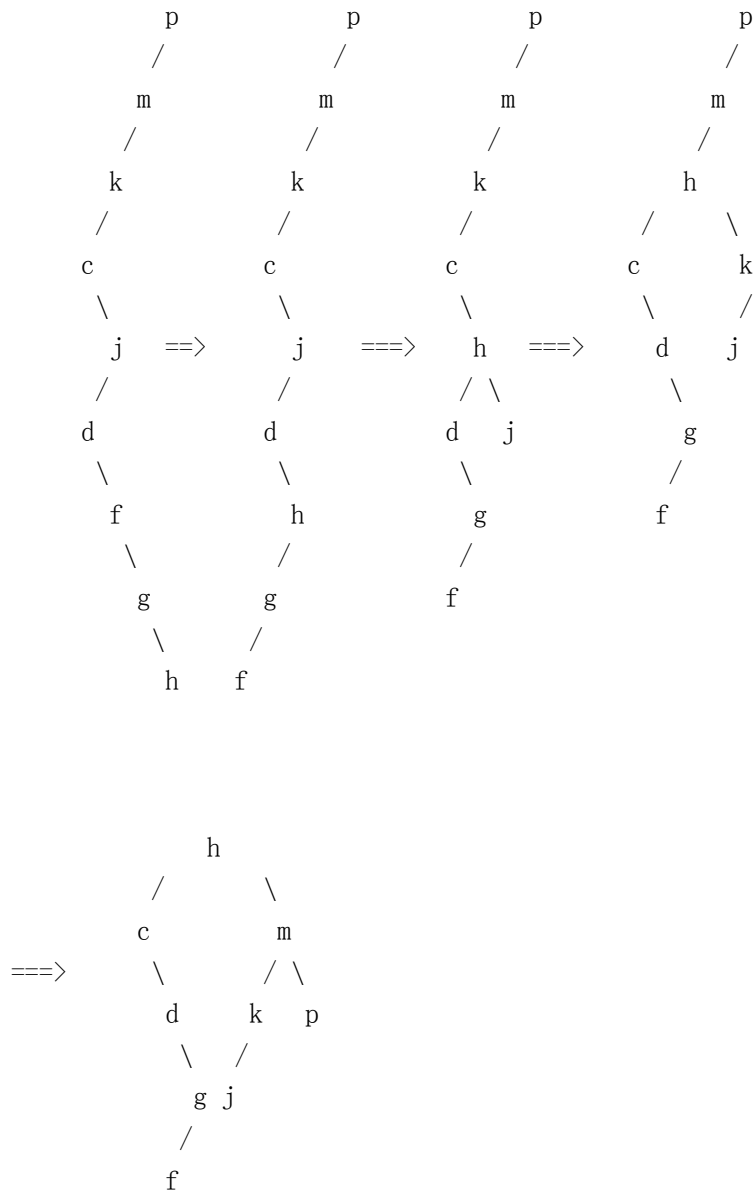
1.

(a)

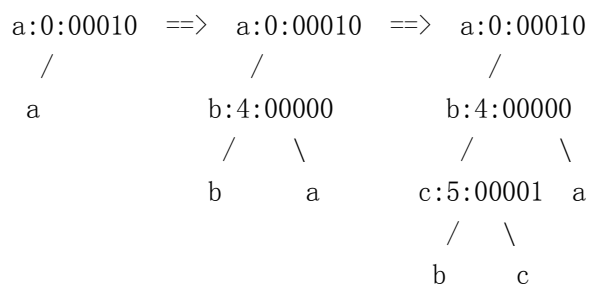


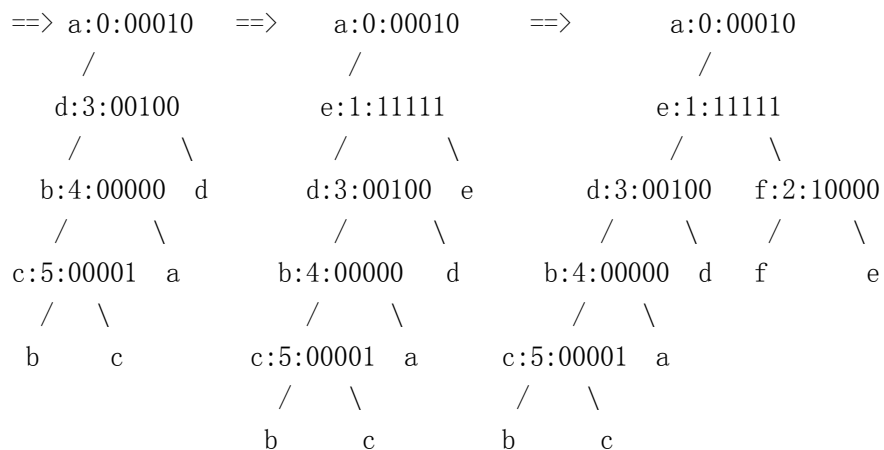
f

(b)



2. Patricia





o Node : (NodeLabel:BitNumber:Data)

- NodeLabel is used to show the link of pointer to node.

3. This problem can be solved using suffix tree.

Let S and T be given two strings.

First, combine the two strings into one as follows:

ST=S#T\$, where special characters # and \$ are appended to each string.

Second, construct suffix tree of concatenated string ST.

This takes linear time,  $O(m+n)$

While constructing suffix tree, we add information, length, substring to each internal node. The LCS is a substring with maximum length.

Example) S = "abc", T = "bcd"

ST=abc#bcd\$

S1=abc#bcd\$

S2=bc#bcd\$

S3=c#bcd\$

S4=#bcd\$

S5=bcd\$

S6=cd\$

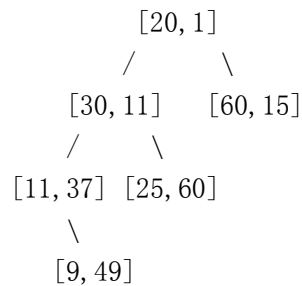
S7=d\$

S8=\$

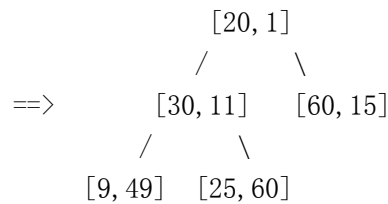
LCS: "bc"

4.

(a)



(b)



5. 2D range tree

Assume we have  $N$  records with 2 keys,  $x$  and  $y$ .

A 2-D range tree is a binary tree using the range of  $x$ , while in each node we keep a sorted list based on  $y$ . The tree always splits the records in half, using a median  $x$  key value as the discriminator.

Preprocessing time  $P$ :

we need to build a sorted list on  $y$ , and another on  $x$ . Since we have the sorted list on  $x$ , we can find the discriminator easily. And since we have the sorted list on  $y$ , we can split the list in linear time on each level ( there are  $\log N$  levels overall ). So the preprocessing time is:

$$P = N \log N + N \log N + N \log N = O(N \log N)$$

Space required  $S$ :

In each node we store an array of the records. At each level the number of records is  $N$ . So the space required is:

$$S = N \log N = O(N \log N)$$

Query time  $Q$ :

Upon each query, we start at the root, decide which branch to take by comparing the boundaries of  $x$  with the discriminator. Once we arrive a node, we use binary search on  $y$  in the array. Then

we report those records that fit the query. So the query time is:

$$Q = \log N * \log N + F = O((\log N)^2 + F)$$

where F is the number of records reported.