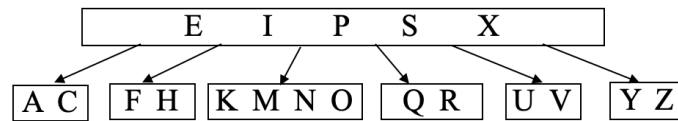


1. Given the following B-tree with degree  $t = 3$ .



- (a) Show the steps and results of adding L and J in order. (20 marks)  
 (b) Show the steps and results of deleting H, L, J, and S. (40 marks)
2. A sorted list  $A$  contains 1 and some **prime** numbers. Then, for every item  $p < q$  in the list, what is the  $k$ th smallest fraction  $p/q$ ? Return your answer as an array of ints, where  $\text{answer}[0] = p$  and  $\text{answer}[1] = q$ .

Examples:

Input:  $A = [1, 2, 3, 5]$ ,  $k = 3$

Output:  $[2, 5]$

Explanation:

The fractions to be considered in sorted order are:

$1/5, 1/3, 2/5, 1/2, 3/5, 2/3$ .

The third fraction is  $2/5$ .

- (a) Design an algorithm with time-complexity better than  $O(n^2)$ , where  $n$  is the size of array  $A$ . It means that don't list all of the fractions, which costs  $O(n^2)$ . Analyze your algorithm and show the results using order notation. (20 marks)  
 (b) Implement your algorithm in Python as a function:

```
def kth_smallest_fraction (A, k):
```

The fastest three implementations in the class will get a bonus 10 marks for this assignment. (20 marks)