Birla Institute of Technology and Science, Pilani

Second Semester 2017-2018, DSA (CS F211)

Lab Assignment #9

1. Write a menu driven C program to implement a hash table of size 10. Consider input keys {71, 23, 73, 99, 44, 19, 49, 93, 81, 39} using the hash function h (k) = k mod 10. Upon collisions use quadratic probing (h (k) = $(k+i^2)$ mod 10). Your program must support the following operations.

   a. Insert an element

   b. Print the hash table

   c. Searching an element (i.e., search (key))

   d. Delete an element

   e. Exit

2. Rahul loves strings and his friends wants to gift him a machine which works as follows: Given a string S it prints all distinct permutations of that string but since none of his friends know how to code they have asked you for help. So, write a C code which takes a string as input and prints all distinct permutations of that string.
   Note: The string may contain duplicate characters
   Input: String S
   Output: Distinct permutations of S each on a new line
   Sample Input: ABCA
   Sample Output:
   AABC
   AACB
   ABAC
   ABCA
   ACBA
   ACAB
   BAAC
   BACA
   BCAA
   CABA
   CAAB
   CBAA

3. A) Given a linked list, find its middle element. If the list has odd number of elements then the middle element is its median. Ex: - In 1->2->3 middle element is 2. If the list has even number of elements then the middle element is the element at position N/2(0-indexing and N is size of list)
   Ex: - 1->2->3->4, its middle element is 3

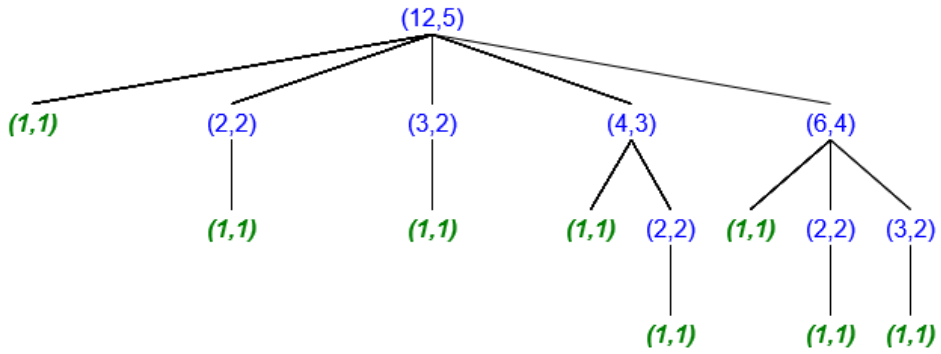
Note: You have to write functions for inserting and deleting elements from linked list and implement in a menu-based way. Also, you have to traverse the list only once.

B) Given a singly Linked List sort the list using Quick Sort.
Note: You have to write functions for inserting and deleting elements from linked list and implement in a menu-based way.

4. Bharat was very intrigued after sir did the derivation for average case complexity of search in a hash table and wanted to try it out on his own. As we all know, the complexity is $O(1 + \frac{m}{n})$, where m is the table size and n is the number of elements inserted into the table. Write a program, which inputs m and n, creates a table of size m and insert in n randomly generated numbers. Use chaining and an appropriate hash function. Now, perform x number of random queries and compute the average number of elements accessed per query. The number of elements accessed for a query is the number of traversals done in the chained list. Choose x as you want. Higher the value, better the approximation you'll get.

5. Vallabha came up with a new kind of rooted tree called Lite tree which follows certain rules:
   A. Each node has a positive integer written on it
   B. Suppose a node has the integer X written on it, and suppose X has k proper divisors. Then this node will have exactly k child nodes, and each of X's proper divisors will be written on exactly one of the child nodes. Ex; - A node with number 15 written on it would have children with the numbers 1, 3 and 5 written on them.

   You can observe that the nodes have 1 written on them, if and only if, they are leaves.
   The lite level of a path in this tree is defined as the sum of degrees of all of the nodes in the path. The lite level of the tree is defined as the maximum lite level of a path from the root to one of the leaves.
   You are given two integers U, V. You want to find the sum of lite levels of all the divisor trees which have n written on their root, where $U \leq n \leq V$.
   Input:
   U V
   Output:
   Find the sum of lite level of all the divisor trees which have n written on their root, where $U \leq n \leq V$.
   Constraints:
   $1 \leq A \leq B \leq 10^{12}$
   $B - A < 10^5$
   Sample Input:
   11 12
   Sample Output:
   14
   Sample Input-2:
   932451 935212
   Sample Output-2:
   101245
   Explanation-1:



Clearly, for 11 its 2 and for 12 its 5 + 4 + 2 + 1 = 12 if you consider the path 12 -> 6 -> 3 -> 1. This is the maximum lite level of a path among all paths from root to the leaves. Hence, the lite level of this tree is 12.