Assignment: Unit 3 & 4—Data Structures 2019.

Q1: Given a List of 10 numbers. Write the algorithm for creating another list of the same set of 10 numbers but rearranged such that all the numbers which are multiples of 2 are to the left of all the numbers which are not multiples of 2.

Write a program for solving the above problem assuming

   a. The lists are implemented using an Array data structure.
   b. The lists are implemented using the Doubly Linked list data structure.

Q2: Given a list of 10 numbers. Write an algorithm for creating another list of the same set of 10 numbers such that the numbers which occupy the "odd" positions in the first list are put in the first half of the new list and those which occupy the "even" positions in the first list are put in the second half of the new list without altering their relative order.

Write a program for solving the above problem assuming

   a. The lists are implemented using an Array data structure.
   b. The lists are implemented using the Doubly Linked list data structure.

Q3: Let the word "Gandhi" be represented using a list data structure with one character occupying one position in the list. Traverse the whole list from left to right and while traversing associate the "ascii code" of the particular character as a value to that character. Once all the characters of the word have been assigned the respective values rearrange the list so that it forms a priority queue (assuming the character with the smallest Ascii value will have the highest priority). Display the contents of the priority queue as tuples: "character, priority".

Write a program for solving the above problem assuming

   a. The "character string" and the associated "ascii values" are represented using an Array data structure, and the priority queue is also implemented using an array data structure.
   b. The lists are implemented using the Linked list data structure.

Q4: On the occasion of the "Karnataka Rajyotsava", a school is preparing a dance recital with a team comprising of primary school and High school students. One of the patterns in this dance recital requires this team of students to form a circular pattern with each child holding the hand of the child on its either side. The dance teacher formed the circular pattern with all the primary school students being next to each other followed by the high school students with the last high school student holding the hand of the first primary school student. However, on seeing the rehearsal the principal felt that it would be better if the primary school students and the High school students are interleaved i.e neither two primary school students nor two high school students will be next to each other in this formation. Develop a program which will convert the first pattern to the second pattern assuming that there are 5 primary school students and 5 high school students. Assume the names of the primary school students are (a,b,c,d,e) and those of the High school students are (A,B,C,D,E) respectively.

Q5:

A bakery has got a carousel (circular belt) of containers designed into which they put the buns as they are taken out of the oven. The belt has a special feature that indicates the temperature of the hottest bun on the carousel by lighting up that container. The circular belt is constantly revolving. The baker's assistant has a habit of putting the new bun into the container right after the currently hottest bun on the belt. Initially the customers used to pick up the buns at random and after sometime they also realized that the hottest bun would be the one in the illuminated container. Then the customers would pick up buns from the illuminated container only. Design a data structure to support this and its associated operations for adding buns by the assistant and removal of buns by the customers using the logic stated earlier.

Q6:

The baker observed the system built according to the scheme stated above for a few days and realized that the hotter buns were always getting picked up first by the customers while the colder buns would be left out. Therefore, he got an attachment made such that the customer would have to press a button to get a bun and the machine would push out the coldest bun on the carousel.

Reworded for clarity:

A baker had a vending machine into which he would fill the new buns as and when they are taken out of the oven one at a time. He would always arrange it such that the buns on the carousel of the machine are always in descending order of their time of putting them on the carousel and there are no empty slots between the youngest and the oldest bun on the carousel. His assistant has been instructed to pick up the buns strictly in the descending order of age to fulfil any customer's order. Design an appropriate data structure and its associated operations so as to support the above scheme of the baker.

Q6:

In a fair there is a "merry-go-round" (Carousel). This carousel has 12 positions each sporting a different animal. The positions are numbered from 1 to 12. The owner operates using the following policy:

1. The seats are filled in the ascending order i.e. the first customer is seated in position 1, the second in 2 and so on.
2. In order to keep the customers happy, the owner operates the carousel even if only one seat is occupied.
3. He guarantees that each customer will get to go around at least 10 times.
4. When a new customer arrives, the operator stops the ride and seats the new customer following the rule 1.
   Note: However, if all seats are occupied and nobody has completed 10 rounds then the new customer is made to wait until at least one customer on the ride completes the ten rounds. The ride is then stopped and the customer who was seated earlier than all others is asked to get off the ride and the waiting customer is seated in this place.

Design a data structure to mimic the merry-go-round and implement the appropriate operations of seating and unseating the customers by the operator following the policy stated above.

Q7.

Assume there is a set of three large numbers (A, B, C), each of which is 12 digits long and is stored in 3 words of four digits each. The range of numbers which can be stored in a word is 0…9999. Store each number using the Doubly linked List data structure. Develop a program that can compute the result "R" for the following expression: ABC-+10*; assuming A > B > C. The result should also be stored in the same large number format.

Q8:

There is an orchard which is full of apple trees. The trees have been genetically modified and these trees are such that no fork has more than two branches. At the forking point instead of a branch there can be a fruit. Valid possibilities at each fork are two fruits, one fruit and one branch or two branches. A robot is designed which will start from the main trunk and move along each branch to determine the health of the tree and also count the total number of ripened fruits in the tree. The orchard owner then decides the number of fruits that should be harvested from the tree and commands the Robot. The robot then plucks the fruits in a depth first manner. Design the appropriate algorithms and develop the program which should be loaded into the Robot for performing the above operations.

Q9:

Design a program which given a mathematical expression (with only binary operators) in "infix" form will develop the corresponding expression tree. Assuming, values for each of the variables in the expression evaluate the result by traversing the tree and performing the required operations.