Data Structure Lab

Lab Assignment - 1

Name - Radhika Garg
Roll No. - 18114060
Batch - O3

Problem Statement 1:

Write a C program to create a student management system, where the students' information are stored in a doubly circular linked list, as shown in Figure 1. The structure of each node from the list is shown in Figure 2. Initially, the circular doubly linked list is empty and the student personal data is entered from the filename "***StudentData.xlsx***" that contains the data of 13 students)name, D.O.B., address and phone no(in tabular form. The program should have the following operations: **insert**, **delete**, **search**, **modify**, **sort** and **print**. While inserting, a unique roll number in the linked list is assigned to each student, where the starting roll number should be 101 and the list should always be in sorted according to their roll number)ascending order(. However, when a deletion operation is performed, the roll number of the deleted student node is stored in a queue named ***unusedRollNo.*** These deleted roll numbers from the ***unusedRollNo*** queue will be allotted to the new students on next insertion operations.

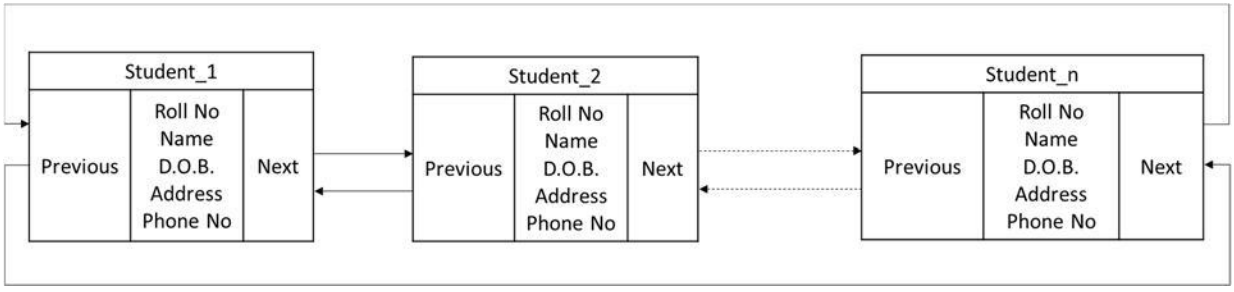


Figure 1: Doubly linked list for student data.

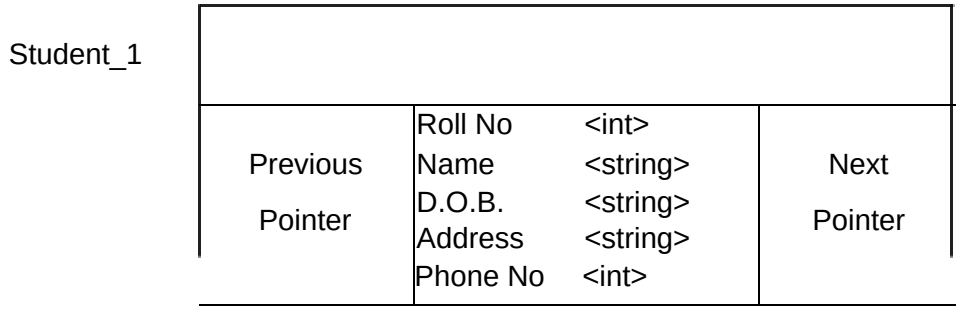


Figure 2: Student Node

Perform the testing of your code with the following TestCases:

)Initially the list is empty(

delete)roll number 108(- delete the student node with roll number 108

insert - insert first student data from the "***StudentData.xlsx***" file)Row2(

insert - insert second student data from the "***StudentData.xlsx***" file)Row3(

insert - insert 3rd student data from the "***StudentData.xlsx***" file)Row4(

insert - insert 4th student data from the “***StudentData.xlsx***” file)Row5(

delete)roll number 102(- delete the student node with roll number 102

delete)roll number 101(- delete the student node with roll number 101

insert - insert 5th student data from the “***StudentData.xlsx***” file)Row6(

insert - insert 6th student data from the “***StudentData.xlsx***” file)Row7(

insert - insert 7th student data from the “***StudentData.xlsx***” file)Row8(

print - print the linked list with the roll number, name and D.O.B

sort)name(- sort the name according to student names

print - print the linked list with the roll number, name and D.O.B

modify)roll number 103(- modify the student node having roll number 103

print - print the linked list with the roll number, name and D.O.B

Note: In ‘modify’ function, the programmer can update the other fields except the roll number of a student.

Data Structure:

1. Struct use for store student data
2. Queue use for store deleted roll no.
3. Double linked list use for store struct node.
4. Array used to store CSV file Data.

Algorithm:

1. Read CSV file and store whole Data in Arrays
2. For insertion there are 2 modes, first is the custom mode -> user has to write all the details, second from csv mode -> user have to write only index from 0 to 12 only, then that node inserted in doubly linked list according to roll number. Also if queue have elements then roll number is picked from queue, else new roll number is assigned O(n).
3. For Delete find the node respective to roll number, then remove from the list and add push number in queue in O(n).
4. Similarly, for modify and search, find node respective to roll number and modify and print respectively in O(n).
5. For sort, we sort by name with bubble sort and print list. After that we again sort by roll number in O(n^2).

ScreenShots:

Activities Terminal

ra

```
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
1
Select Mode:
1. Custom
2. From CSV File
2
Enter the index of student data in excel sheet.
3
Time: 113.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
1
Select Mode:
1. Custom
2. From CSV File
2
Enter the index of student data in excel sheet.
4
Time: 148.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
2

Roll No.: 101
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890


Roll No.: 102
Name: Virat Kohli
Address: DLF City, Phase-1 (C-Block), Gurgaon
DOB: 11/05/1997
Phone Number: 3214569087


Roll No.: 103
Name: Rakesh Kumar Bhadauria
Address: Vice Chief of the Air Staff, Air Headquarters, New Delhi
DOB: 06/15/1993
Phone Number: 7896325014
```

```
Activities  Terminal

rad

Roll No.: 104
Name: Narendra Modi
Address: Parliament House, Room No.1, South Block, Raisina Hills, New Delhi
DOB: 09/17/1995
Phone Number: 9630258741


Roll No.: 105
Name: Arijit Singh
Address: 181, 1st Floor, Aram Nagar Part 2, Andheri, Mumbai
DOB: 04/25/1994
Phone Number: 9874102563

Time: 254.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
3
102
Time: 47.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
4
102
Not exist
Time: 60.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
4
101

Roll No.: 101
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890

Time: 124.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
```

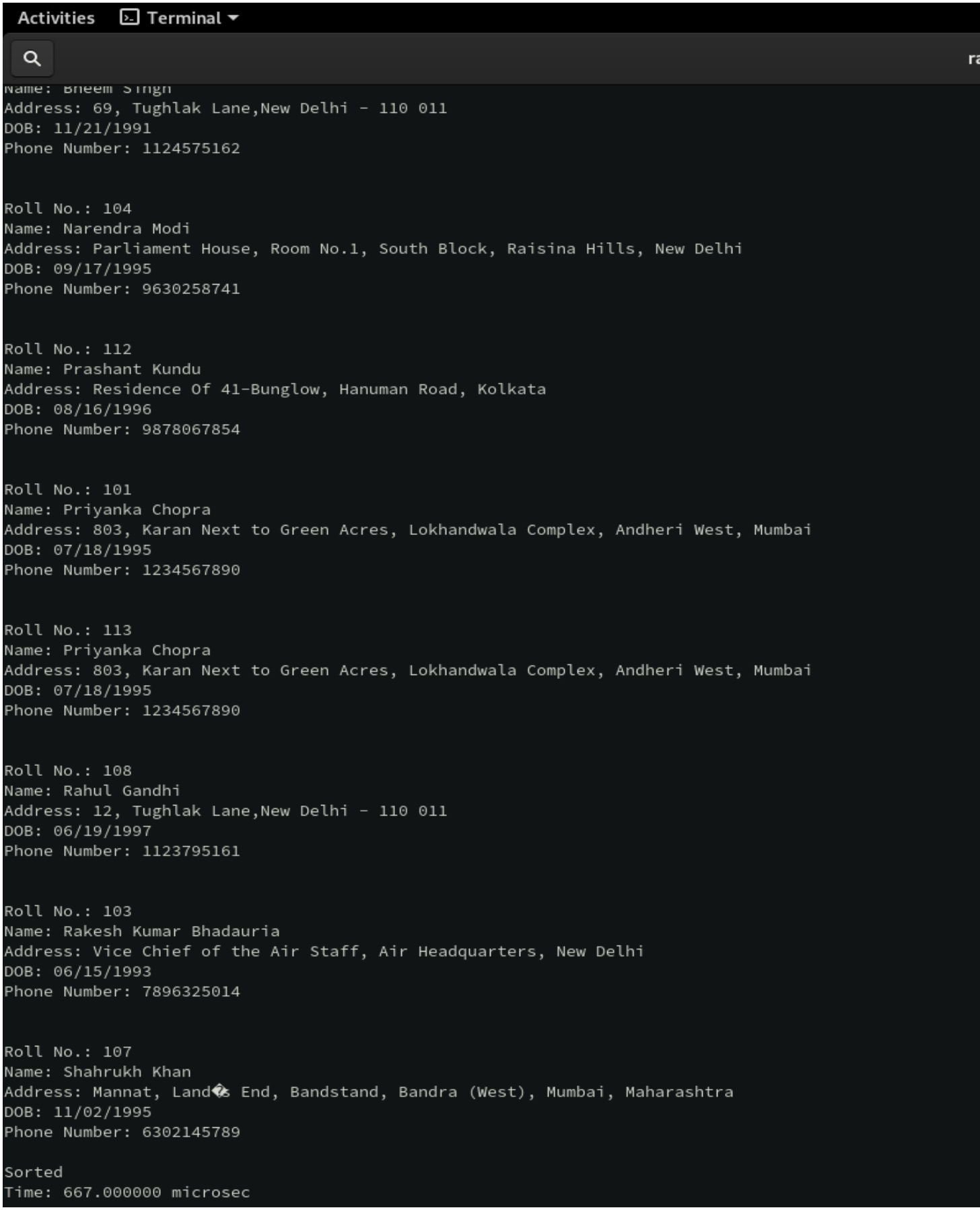
Activities Terminal

rad

```
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
1
Select Mode:
1. Custom
2. From CSV File
2
Enter the index of student data in excel sheet.
5
Time: 126.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
2

Roll No.: 101
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890


Roll No.: 102
Name: Amit
Address: G-21, Sector 9, Opposite of Community House, Chandigarh
DOB: 09/19/1988
Phone Number: 9644258744


Roll No.: 103
Name: Rakesh Kumar Bhadauria
Address: Vice Chief of the Air Staff, Air Headquarters, New Delhi
DOB: 06/15/1993
Phone Number: 7896325014


Roll No.: 104
Name: Narendra Modi
Address: Parliament House, Room No.1, South Block, Raisina Hills, New Delhi
DOB: 09/17/1995
Phone Number: 9630258741


Roll No.: 105
Name: Arijit Singh
Address: 181, 1st Floor, Aram Nagar Part 2, Andheri, Mumbai
DOB: 04/25/1994
Phone Number: 9874102563
```

Activities Terminal

```
Roll No.: 112
Name: Prashant Kundu
Address: Residence Of 41-Bunglow, Hanuman Road, Kolkata
DOB: 08/16/1996
Phone Number: 9878067854


Roll No.: 113
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890

Time: 625.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
6
Sorted

Roll No.: 102
Name: Amit
Address: G-21, Sector 9, Opposite of Community House, Chandigarh
DOB: 09/19/1988
Phone Number: 9644258744


Roll No.: 106
Name: Amit
Address: 391, 3rd Floor, Aram Nagar Part 2, Andheri, Mumbai
DOB: 04/21/1994
Phone Number: 7874102563


Roll No.: 105
Name: Arijit Singh
Address: 181, 1st Floor, Aram Nagar Part 2, Andheri, Mumbai
DOB: 04/25/1994
Phone Number: 9874102563


Roll No.: 110
Name: Arjun
Address: S-03,  Land's End, Bandra (West), Mumbai, Maharashtra
DOB: 01/02/1995
Phone Number: 6302145789


Roll No.: 109
Name: Arvind Kejriwal
Address: Residence Of 41-Bunglow, Hanuman Road, New Delhi
DOB: 11/02/1995
Phone Number: 9868456953
```


Activities
Terminal
Name: Bheem Singh
Address: 69, Tughlak Lane,New Delhi - 110 011
DOB: 11/21/1991
Phone Number: 1124575162
Roll No.: 104
Name: Narendra Modi
Address: Parliament House, Room No.1, South Block, Raisina Hills, New Delhi
DOB: 09/17/1995
Phone Number: 9630258741
Roll No.: 112
Name: Prashant Kundu
Address: Residence Of 41-Bunglow, Hanuman Road, Kolkata
DOB: 08/16/1996
Phone Number: 9878067854
Roll No.: 101
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890
Roll No.: 113
Name: Priyanka Chopra
Address: 803, Karan Next to Green Acres, Lokhandwala Complex, Andheri West, Mumbai
DOB: 07/18/1995
Phone Number: 1234567890
Roll No.: 108
Name: Rahul Gandhi
Address: 12, Tughlak Lane,New Delhi - 110 011
DOB: 06/19/1997
Phone Number: 1123795161
Roll No.: 103
Name: Rakesh Kumar Bhadauria
Address: Vice Chief of the Air Staff, Air Headquarters, New Delhi
DOB: 06/15/1993
Phone Number: 7896325014
Roll No.: 107
Name: Shahrukh Khan
Address: Mannat, Land's End, Bandstand, Bandra (West), Mumbai, Maharashtra
DOB: 11/02/1995
Phone Number: 6302145789
Sorted
Time: 667.000000 microsec

```
Activities  Terminal
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
5
101
Enter Name, address ,dob, phoneno
Rajesh Koothrapali
Harvard Institute
16/8/1990
9876543210
Modified
Time: 339.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
4
101

Roll No.: 101
Name: Rajesh Koothrapali
Address: Harvard Institute
DOB: 16/8/1990
Phone Number: 9876543210

Time: 76.000000 microsec
1. To insert.
2. To display the List
3. To delete a roll number.
4. To search a roll number.
5. to modify a student data at particular roll number
6. to view list of sorted names of students.
2

Roll No.: 101
Name: Rajesh Koothrapali
Address: Harvard Institute
DOB: 16/8/1990
Phone Number: 9876543210


Roll No.: 102
Name: Amit
Address: G-21, Sector 9, Opposite of Community House, Chandigarh
DOB: 09/19/1988
Phone Number: 9644258744


Roll No.: 103
Name: Rakesh Kumar Bhadauria
Address: Vice Chief of the Air Staff, Air Headquarters, New Delhi
```


Problem Statement 2:

Write a C Program for resizeable deque using dynamic memory allocation, where a deque can perform the insertion and deletion operations at its both ends. The capacity of the deque depends on the number of elements currently stored in it, according to the following two rules:

- If an element is being inserted into a deque, when it is already full, then its capacity is doubled of its current size.
- After removing an element from a deque, if the number of elements are equal to the half of the capacity of the deque, then its capacity is made half of its current size.

Data Structure:

1. Dynamic array used to create a deque.

Algorithm:

1. Whenever insert in deque and deque is empty then assign size of deque is 1.
2. During insertion if deque is filled completely, then reallocate memory to deque of twice its size in O(n).
3. During Deletion if deque is filled half of its size, then reduce deque size by 2.
4. When element delete from front then all element shift left by 1 in O(n).
5. When we insert an element in front then first we shift all element right by one.

ScreenShot

Activities Terminal

```
[radhika@localhost Radhika 18114060 assignment1]$ ./a.out
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 0
Filled entires are 0
The entries filled in deque are :

Time: 59.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

1
Enter the number to insert
1
Time: 17.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 1
Filled entires are 1
The entries filled in deque are : 1

Time: 43.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

3
Time: 5.000000 microsec
Please select from the following choices.
```


Activities
Terminal
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
4
Deque is empty
Time: 26.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
5
Deque is empty
Time: 15.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
6
Deque is empty
Time: 18.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
1
Enter the number to insert
3
Time: 2.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element

Activities Terminal

```
2
22
Enter the number to insert
Time: 3.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 8
Filled entires are 5
The entries filled in deque are : 10 3 1 18 22

Time: 21.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

3
Time: 5.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 4
Filled entires are 4
The entries filled in deque are : 3 1 18 22

Time: 44.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
```

Activities Terminal

```
3
Time: 5.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 4
Filled entires are 4
The entries filled in deque are : 3 1 18 22

Time: 44.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

1
Enter the number to insert
100
Time: 6.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque

7
The size of deque is 8
Filled entires are 5
The entries filled in deque are : 100 3 1 18 22

Time: 54.000000 microsec
Please select from the following choices.
1. To add element in front.
2. To add element from back
3. To remove element from front
4. To remove element from back
5. To get the front element
6. To get the last element
7. To print the deque
```


Problem Statement 3:

Given a digital image in a 3D array format. For a particular image pixel, the color shade of that pixel is Red if the pixel value at that position of the matrix corresponding to RED is greater than that of GREEN and BLUE. Same goes for GREEN and BLUE shades also. Write a C program that can perform following operations on the given image file:

- Remove all Red shades.
- Remove all Green shades.
- Remove all Blue shades.
- RedOnly: Preserve any red shades in the image, but remove all green and blue.
- GreenOnly: Preserve any green shades in the image, but remove all red and blue.
- BlueOnly: Preserve any blue shades in the image, but remove all red and green.

Further, write a function to check the output files with the given output sample files.

Perform the testing of your code with the following TestCases:

Input: Q3_ip_Red.dat, Q3_ip_Green.dat and Q3_ip_Blue.dat are the three files with red, green and blue pixel values for the image file Q3_ip.jpg

Output after removing only green: Q3_op_Red.dat, Q3_op_Green.dat and Q3_op_Blue.dat are the output files w.r.t. red, green and blue pixel values after removing green from the input file Q3_ip.jpg, respectively.

Data Structure:

1. 3 Arrays used to store pixel value of red, green, blue.

Algorithm:

1. We scan all three files and store values in respective 2D-array.
2. A pixel value can be directly accessed by index.
3. The functions for removing or preserving are of O(n^2) as we have to travel the whole 2D array
4. After all operations, save all arrays data in respective files.

Screenshots:

Activities Terminal

```
[radhika@localhost Radhika 18114060 assignment1]$ ./a.out
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
3 3
Red: 0
Green: 2
Blue 1
Time: 238927.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
8 2
Red: 0
Green: 1
Blue 0
Time: 209.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
129 1240
Red: 189
Green: 86
Blue 67
Time: 239046.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
5
Time: 17933.000000 microsec
```

Activities Terminal

```
129 1240
Red: 189
Green: 86
Blue 67
Time: 239046.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
5
Time: 17933.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
3
3
Red: 0
Green: 2
Blue 1
Time: 239259.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
129 1240
Red: 0
Green: 86
Blue 67
Time: 18095.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
```

Activities Terminal

```
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
129 1240
Red: 189
Green: 86
Blue 67
Time: 181396.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
130 140
Red: 254
Green: 0
Blue 0
Time: 176.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
1
Time: 191705.000000 microsec
Enter the index to choose from following
1.      Remove all Red shades
2.      Remove all Green shades
3.      Remove all Blue shades
4.      Red Only: Preserve any red shades in the image, but remove all green and blue
5.      Green Only: Preserve any green shades in the image, but remove all red and blue
6.      Blue Only: Preserve any blue shades in the image, but remove all green and red
7.      Print the pixel values at a point
7
Enter x and y coordinates.
129 1240
Red: 0
Green: 86
Blue 67
Time: 361.000000 microsec
Enter the index to choose from following
```