Date: 05.09.2023 Name: Niranjan.B
Ex. No: 1 Reg. No.: 3122225001082

UCS 2312 Data Structures Lab
Exercise 1: Array ADT and its applications

Date of Exercise: 05.09.2023

Create an ADT for the array data structure with the following functions. *arrADT* will have the integer array and size. [CO1, K3]

a. create(arrADT,size, array) – Create the array with the required number of elements
b. deleteAt(arrADT, pos) – Delete the specified element
c. insertAtEvery(arrADT,data) – Insert data before every element
d. search(arrADT, key) – return the position of the second occurrence of the element. If found return the position, otherwise return 1
e. printArray(arrADT) – prints the elements of the array
f. findPeek(arrADT, int *) – return a set of peek elements
   Given an array **arr[]** of integers. Find a peak element i.e. an element that is **not smaller** than its neighbors.
   Note: For corner elements, we need to consider only one neighbor.
   Example:
   Input: array[] = {10, 20, 15, 2, 23, 90, 67}
   Output: 20, 90
   Explanation: The element 20 has neighbors 10 and 15, both of them are less than 20, similarly 90 has neighbors 23 and 67.

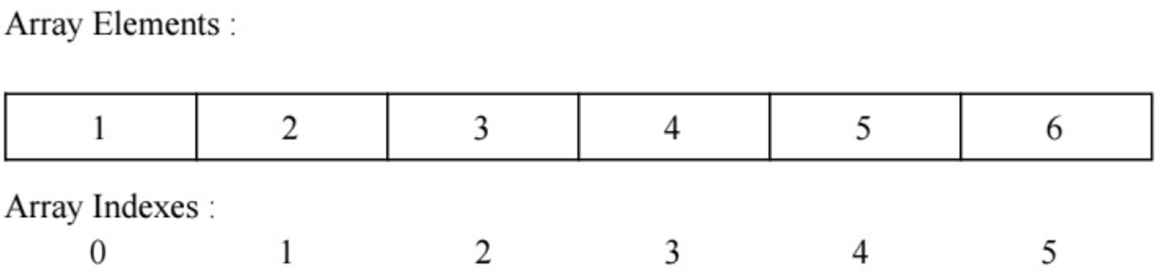
Write a program in C to test the operations of arrADT with the following test cases:

Operation	**Expected Output**
create(arrADT,20,[2,4,6,8,10])	2,4,6,8,10
deleteAt(arrADT, 3)	2,4,6,10
insertAtEvery(arrADT,1)	1,2,1,4,1,6,1,10
search(arrADT,1)	2
search(arrADT,2)	-1
printArray(arrADT)	1,2,1,4,1,6,1,10
create(arrADT,20,[10,20,15,2,23,90,67])	20,90
create(arrADT,20,[1,2,3,4,4])	-1

Best practices to be followed:

- Design before coding
- Usage of algorithm notation
- Use of multi-file C program
- Versioning of code

Data Structure – Array:



Array Elements :

1	2	3	4	5	6

Array Indexes :

0	1	2	3	4	5

Algorithm –

Algorithm: Deleting an element from specified position

Input – Pointer to array, position of element to be deleted

Output – void

```
1.  for (i=pos-1; i<size-1; i++)
        A->a[i] = A->a[i+1]
2.  A->size-=1
```

Algorithm: Insert data before every element

Input – Pointer to array, data to be inserted

Output – void

```
1.  for (i=A->size-1; i>=0; i--)
        A->a[(i*2) +1] = A->a[i]
        A->a[i*2] = data
2.  A->size*=2
```

Algorithm: Return the position of the second occurrence of the element. If found return the position, otherwise return 1

Input – Pointer to array, data to be found

Output – int

```
1.  C=0 and pos=-1
2.  for (i=0; i<A->size; i++)
        if c==2
            break
        if A->a[i]==key
            pos=i+1
            c+=1
3.  return pos
```

Algorithm: Return a set of peek elements

Input – Pointer to array, array to store peak elements

Output – int

```
1.  c=0 and l=A->size
2.  if A->a[0] > A->a[1]
        p[c++]=A->a[0]
3.  for (i=1; i<l-1; i++)
        if A->a[i] > A->a[i-1] && A->a[i] > A->a[i+1]
            p[c++]=A->a[i]
4.  if A->a[l-1] > A->a[l-2]
        p[c++]=A->a[l-1]
5.  return c
```

main.c code:

```
#include<stdio.h>
#include<stdlib.h>
#include"arrADT.h"
void main()
{
	struct arrADT *A;
	A=(struct arrADT *)malloc(sizeof(struct arrADT));
	int size;
	printf("Enter the size of the array : ");
	scanf("%d",&size);
	int a[size],p[size];
	printf("Enter %d array elements : \n",size);
	for(int i=0;i<size;i++)
	{
		scanf("%d",&a[i]);
	}
	printf("\n");
	create(A,size,a);
	printArray(A);
	printf("Enter the position of element to be deleted : ");
	int pos;
	scanf("%d",&pos);
	deleteAt(A,pos);
	printArray(A);
	printf("Enter the data to be inserted : ");
	int data;
	scanf("%d",&data);
	printf("Inserting At Front :\n");
	insertAtFront(A,data);
	printArray(A);
	printf("Inserting At Middle :\n");
	insertAtMiddle(A,data);
	printArray(A);
	printf("Inserting At End :\n");
	insertAtEnd(A,data);
	printArray(A);
	printf("Deleting At Front :\n");
	deleteAtFront(A);
```

```
    printArray(A);
    printf("Deleting At Middle :\n");
    deleteAtMiddle(A);
    printArray(A);
    printf("Deleting At End :\n");
    deleteAtEnd(A);
    printArray(A);
    printf("Inserting at every position :\n");
    insertAtEvery(A,data);
    printArray(A);
    printf("Enter the key to search : ");
    int key;
    scanf("%d",&key);
    printf("The position of %d is %d\n",key,search(A,key));
    printf("Peek Values are : ");
    int c=findPeek(A,p);
    for(int i=0;i<c;i++)
    {
        printf("%d ",p[i]);
    }
}
```

arrADT.h code:

```
struct arrADT
{
int size;
int a[100];
};

void create(struct arrADT *A,int size,int array[])
{
    A->size=size;
    for(int i=0;i<size;i++)
    {
        A->a[i]=array[i];
    }
}

void printArray(struct arrADT *A)
{
    for(int i=0;i<(A->size);i++)
    {
        printf("%d ",A->a[i]);
    }
    printf("\n");
}

void deleteAt(struct arrADT *A,int pos)
{
    for(int i=pos-1;i<((A->size)-1);i++)
    {
        A->a[i]=A->a[i+1];
    }
    A->size=(A->size)-1;
}

void deleteAtFront(struct arrADT *A)
{
	int pos=1;
	for(int i=pos-1;i<((A->size)-1);i++)
	{
		A->a[i]=A->a[i+1];
	}
	A->size=(A->size)-1;
}

void deleteAtMiddle(struct arrADT *A)
{
	int pos=(A->size)/2;
	pos+=1;
	for(int i=pos-1;i<((A->size)-1);i++)
	{
		A->a[i]=A->a[i+1];
	}
	A->size=(A->size)-1;
}

void deleteAtEnd(struct arrADT *A)
{
	int pos=(A->size);
	for(int i=pos-1;i<((A->size)-1);i++)
	{
		A->a[i]=A->a[i+1];
	}
	A->size=(A->size)-1;
}

void insertAtEvery(struct arrADT *A,int data)
{
	for(int i=(A->size)-1;i>=0;i--)
	{
		A->a[(i*2)+1]=A->a[i];
		A->a[i*2]=data;
	}
	A->size=(A->size)*2;
}

void insertAtFront(struct arrADT *A,int data)
{
	for(int i=(A->size)-1;i>=0;i--)
	{
		A->a[i+1]=A->a[i];
	}
	A->a[0]=data;
	A->size=(A->size)+1;
}

void insertAtMiddle(struct arrADT *A,int data)
```

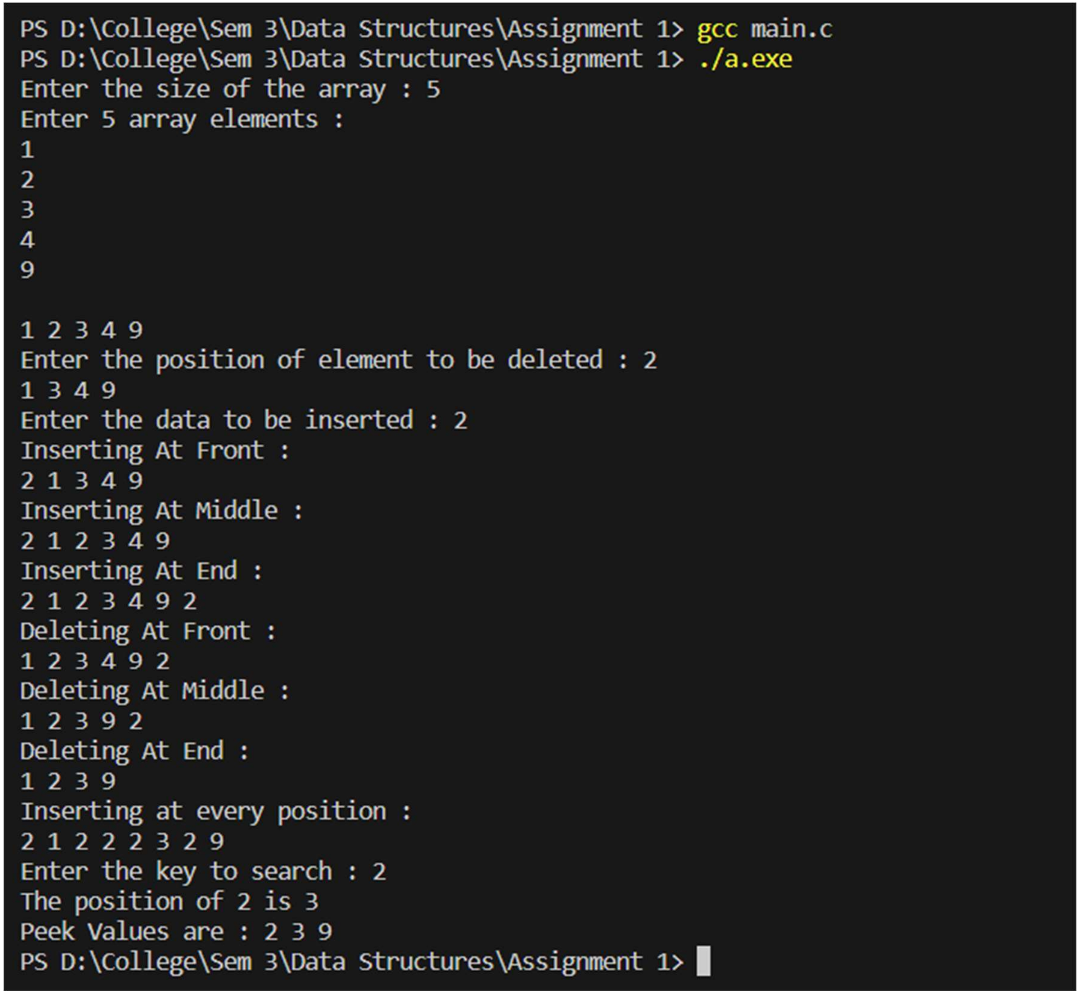
```
{
      for(int i=(A->size)-1;i>=((A->size)/2);i--)
      {
            A->a[i+1]=A->a[i];
      }
      A->a[((A->size)/2)]=data;
      A->size=(A->size)+1;
}

void insertAtEnd(struct arrADT *A,int data)
{
      A->a[(A->size)]=data;
      A->size=(A->size)+1;
}

int search(struct arrADT *A,int key)
{
      int c=0,pos=-1;
      for(int i=0;i<(A->size);i++)
      {
            if(c==2)
            break;
            if(A->a[i]==key)
            {
                  pos=i+1;
                  ++c;
            }
      }
      return pos;
}

int findPeek(struct arrADT *A,int p[])
{
      int c=0,l=A->size;
      if(A->a[0]>A->a[1])
      {
            p[c++]=A->a[0];
      }
      for(int i=1;i<l-1;i++)
      {
            if(A->a[i]>A->a[i-1] && A->a[i]>A->a[i+1])
            {
                  p[c++]=A->a[i];
            }
      }
      if(A->a[l-1]>A->a[l-2])
      {
            p[c++]=A->a[l-1];
      }
      return c;
}
```

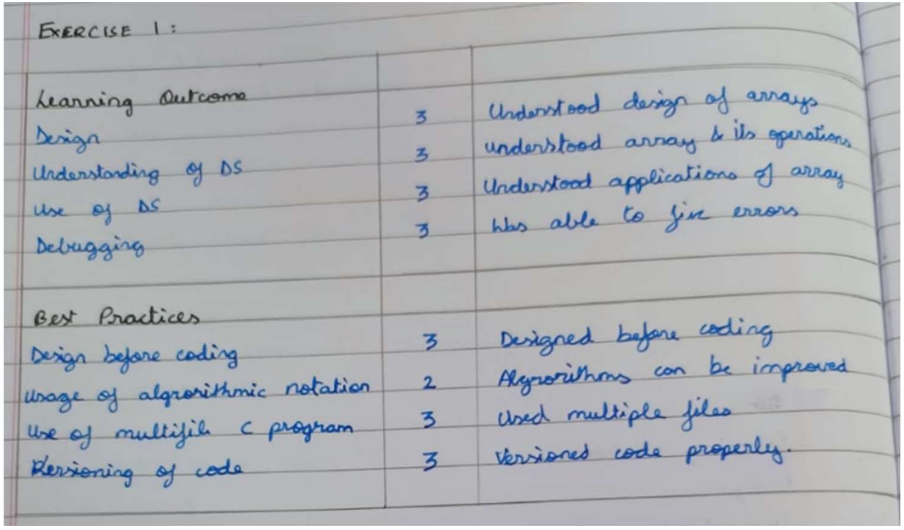
Output:



```
PS D:\College\Sem 3\Data Structures\Assignment 1> gcc main.c
PS D:\College\Sem 3\Data Structures\Assignment 1> ./a.exe
Enter the size of the array : 5
Enter 5 array elements :
1
2
3
4
9

1 2 3 4 9
Enter the position of element to be deleted : 2
1 3 4 9
Enter the data to be inserted : 2
Inserting At Front :
2 1 3 4 9
Inserting At Middle :
2 1 2 3 4 9
Inserting At End :
2 1 2 3 4 9 2
Deleting At Front :
1 2 3 4 9 2
Deleting At Middle :
1 2 3 9 2
Deleting At End :
1 2 3 9
Inserting at every position :
2 1 2 2 2 3 2 9
Enter the key to search : 2
The position of 2 is 3
Peek Values are : 2 3 9
PS D:\College\Sem 3\Data Structures\Assignment 1> █
```

Learning Outcome:



EXERCISE 1:

Learning Outcome		
Design	3	Understood design of arrays
Understanding of DS	3	understood array & its operations
Use of DS	3	Understood applications of array
Debugging	3	Was able to fix errors
Best Practices		
Design before coding	3	Designed before coding
Usage of algrorithmic notation	2	Algrorithms can be improved
Use of multifile C program	3	Used multiple files
Versioning of code	3	Versioned code properly.