ARCHANA KUMARI **CS DSA ASSIGNMENT**
DEPT. - ECE **2021 😊**

ROLL NO. - 408 **MID - TERM**

Q1: Write a C program to convert an infix expression to a postfix expression.

-> A:) Algorithm:

I. Create a stack using structure and make an character array to store the answer ie.,postfix expression.

II. Implement basic functions like pop(), push(), isEmpty() to perform basic operations on stack.

III.Traverse the given string from left to right and follow the below steps:

1. If operand is found -> store it in the answer array.
2. else if '(' -> push it to the stack.
3. else if ')' -> pop from the stack and add the popped elements to the answer array until '(' is found.
4. else if operator -> if stack top precedence is greater than the operator, pop elements from the stack and add it to the answer arrayuntil an operator with less precedence is found.
5. else -> print invalid infix expression and exit.

IV. Return the answer array and print its values in the main function.

BELOW IS THE IMPLEMENTATION OF THE RULE(DRY RUN):

Implementation of infix expression : (a – b / c) * (a / k – l)

S.No.	Current symbol	stack	Postfix Exp.	Reason(see above pts.)
1.	(	(		2.
2.	a	(	a	1.
3.	-	(-	a	4.
4.	b	(-	ab	1.
5.	/	(-/	ab	4.
6.	c	(-/	abc	1.
7.	)		abc/-	3.
8.	*	*	abc/-	4.
9.	(	*(	abc/-	2.
10.	a	*(	abc/-a	1.
11.	/	*(/	abc/-a	4.
12.	k	*(/	abc/-ak	1.
13.	-	*(-	abc/-ak/	4.
14.	l	*(-	abc/-ak/l	1.
15.	)		abc/-ak/l-*	3.

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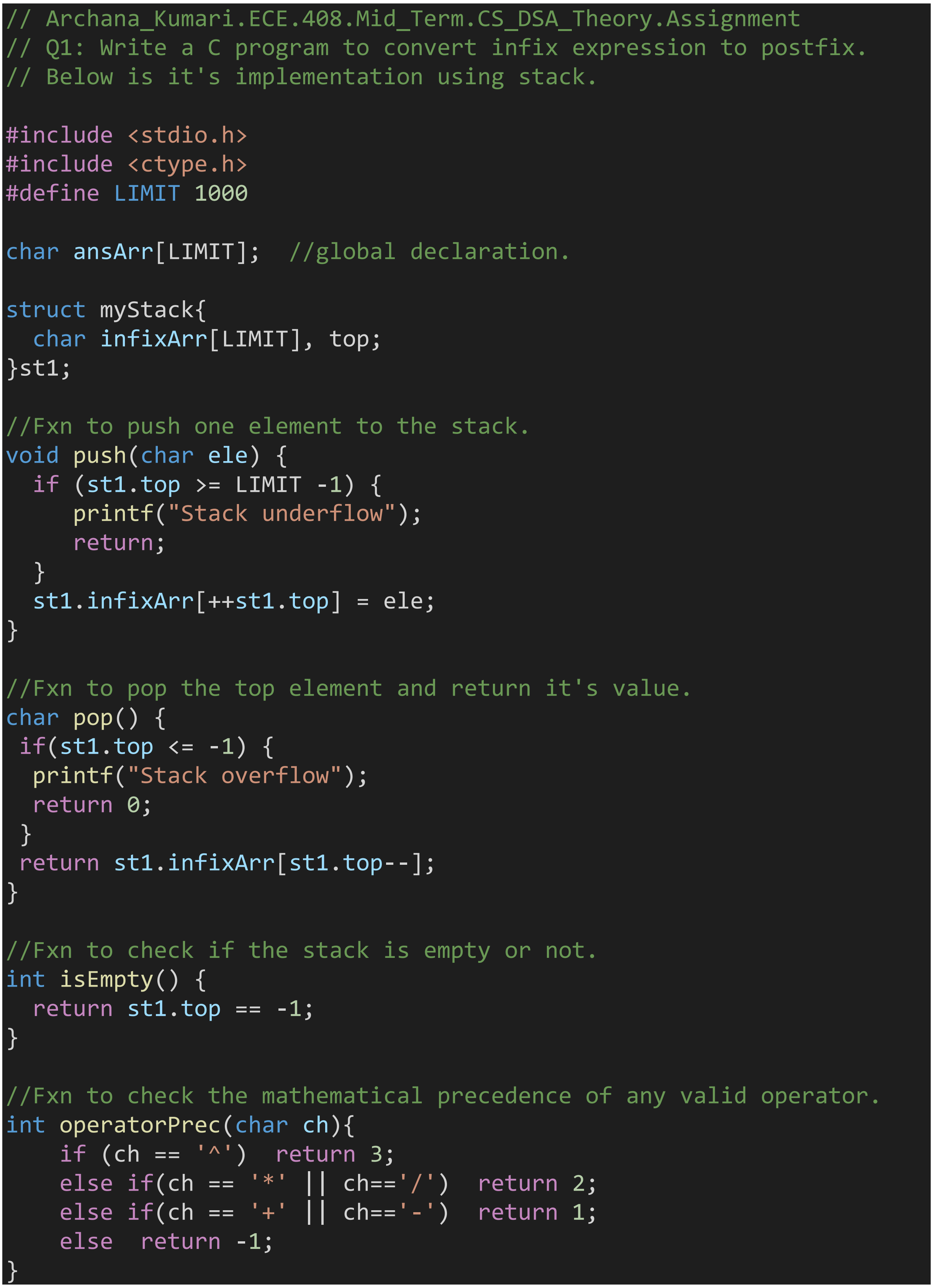

```c
// Archana_Kumari.ECE.408.Mid_Term.CS_DSA_Theory.Assignment
// Q1: Write a C program to convert infix expression to postfix.
// Below is it's implementation using stack.

#include <stdio.h>
#include <ctype.h>
#define LIMIT 1000

char ansArr[LIMIT];  //global declaration.

struct myStack{
  char infixArr[LIMIT], top;
}st1;

//Fxn to push one element to the stack.
void push(char ele) {
  if (st1.top >= LIMIT -1) {
     printf("Stack underflow");
     return;
  }
  st1.infixArr[++st1.top] = ele;
}

//Fxn to pop the top element and return it's value.
char pop() {
 if(st1.top <= -1) {
  printf("Stack overflow");
  return 0;
 }
 return st1.infixArr[st1.top--];
}

//Fxn to check if the stack is empty or not.
int isEmpty() {
  return st1.top == -1;
}

//Fxn to check the mathematical precedence of any valid operator.
int operatorPrec(char ch){
    if (ch == '^')  return 3;
    else if(ch == '*' || ch=='/')  return 2;
    else if(ch == '+' || ch=='-')  return 1;
    else  return -1;
}
```

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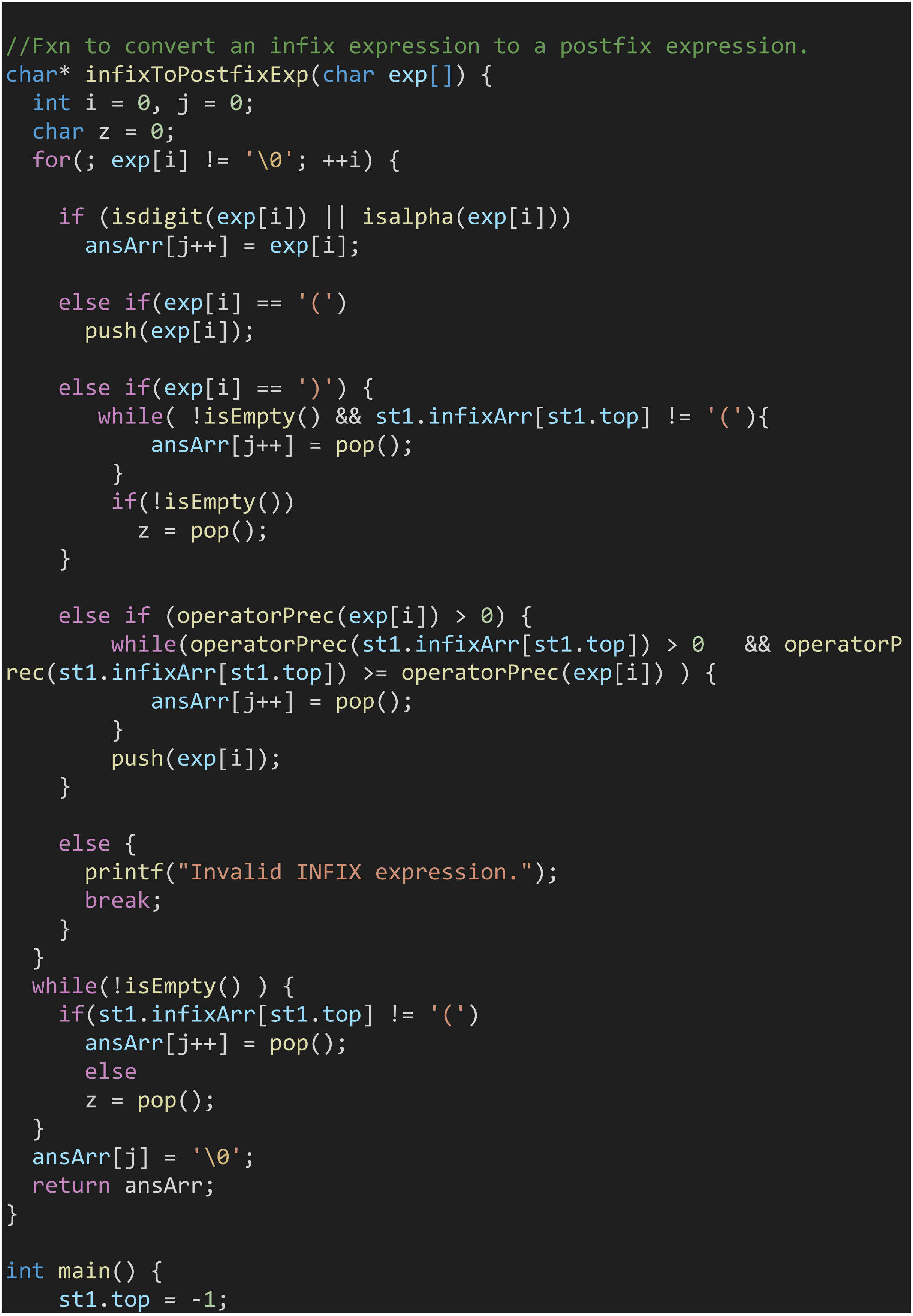
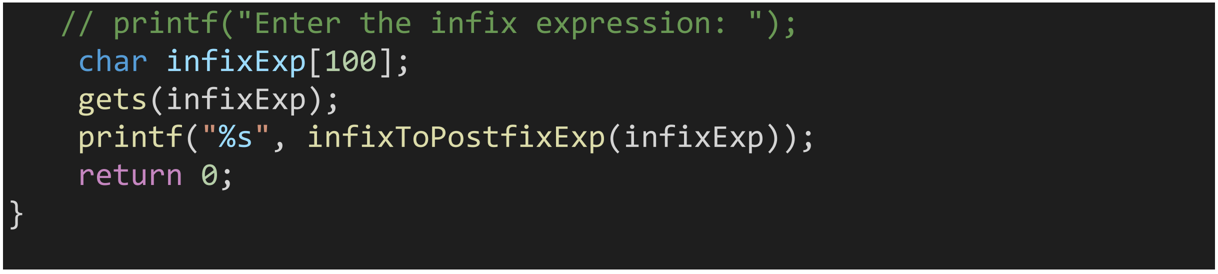


```
//Fxn to convert an infix expression to a postfix expression.
char* infixToPostfixExp(char exp[]) {
  int i = 0, j = 0;
  char z = 0;
  for(; exp[i] != '\0'; ++i) {

    if (isdigit(exp[i]) || isalpha(exp[i]))
      ansArr[j++] = exp[i];

    else if(exp[i] == '(')
      push(exp[i]);

    else if(exp[i] == ')') {
       while( !isEmpty() && st1.infixArr[st1.top] != '('){
           ansArr[j++] = pop();
        }
        if(!isEmpty())
          z = pop();
    }

    else if (operatorPrec(exp[i]) > 0) {
        while(operatorPrec(st1.infixArr[st1.top]) > 0   && operatorPrec(st1.infixArr[st1.top]) >= operatorPrec(exp[i]) ) {
           ansArr[j++] = pop();
        }
        push(exp[i]);
    }

    else {
      printf("Invalid INFIX expression.");
      break;
    }
  }
  while(!isEmpty() ) {
    if(st1.infixArr[st1.top] != '(')
      ansArr[j++] = pop();
      else
      z = pop();
  }
  ansArr[j] = '\0';
  return ansArr;
}

int main() {
    st1.top = -1;
```



```
    // printf("Enter the infix expression: ");
     char infixExp[100];
     gets(infixExp);
     printf("%s", infixToPostfixExp(infixExp));
     return 0;
}
```

C:) Input-Output:

Input_1 : (a-b/c)*(a/k-l)

Output_1 : abc/-ak/l-*

Input_2 : a+b

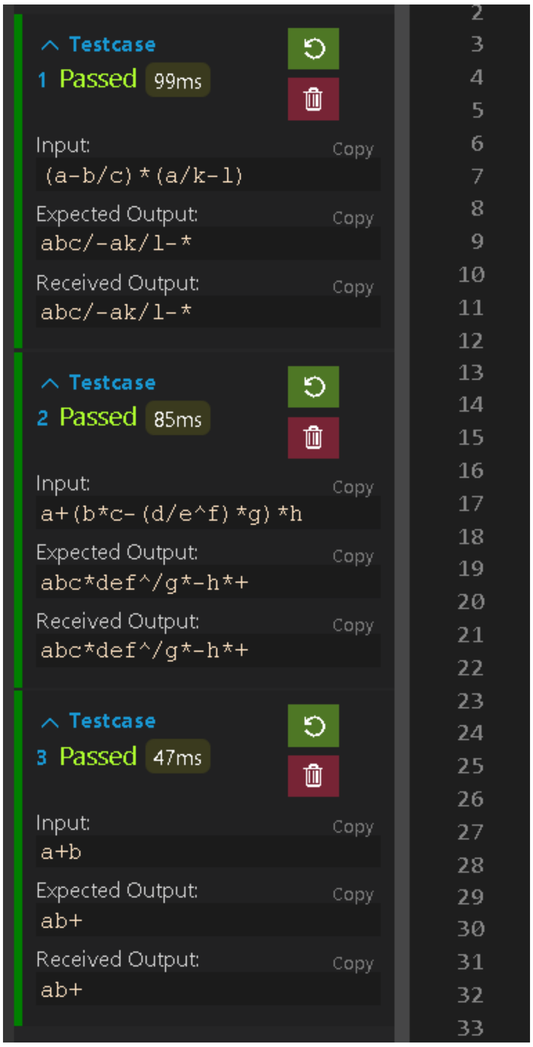
Output_2 : ab+

Input_3 : (a+b)*(c+d)

Output_3 : ab+cd+*

Input-4 : a+(b*c-(d/e^f)*g)*h

Output_4 : abc*def^/g*-h*+



1 Passed 99ms

```
Input:
(a-b/c)*(a/k-l)
Expected Output:
abc/-ak/l-*
Received Output:
abc/-ak/l-*
```

2 Passed 85ms

```
Input:
a+(b*c-(d/e^f)*g)*h
Expected Output:
abc*def^/g*-h*+
Received Output:
abc*def^/g*-h*+
```

3 Passed 47ms

```
Input:
a+b
Expected Output:
ab+
Received Output:
ab+
```

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Q2:) Write a C program to evaluate the value of a given postfix expression.

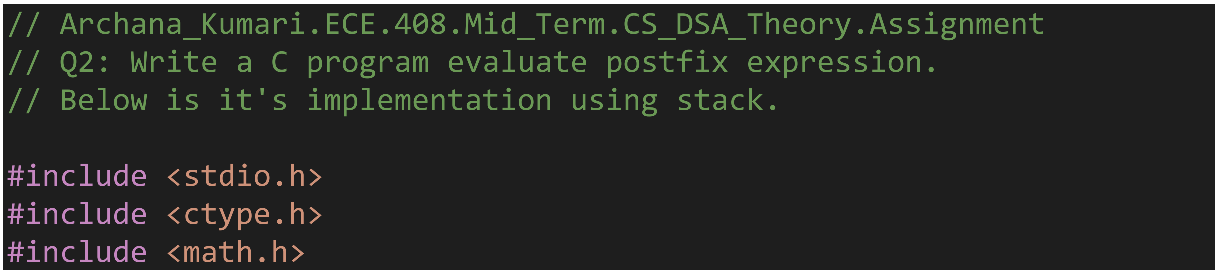
A:) Algorithm:

```
I.  Create a stack to store operands value.
II.  Make 2 variables(say, op1, op2) of int datatype to store the evaluate the expression.
III.  Traverse the given string from left to right and follow the below steps:
    1. if the character is an operand, push it to the stack.
    2.else if the character is an operator,
       i)  pop the elements twice from the stack.
       ii) Store the first popped value to op2 and the next to op1.
       iii) perform the operation on them and evaluate the result.
       iv) push the obtained result to the stack.
IV. Perform the step III. until we traverse the entire string.
V. The element left at the end in the stack is the answer.
```

DRY RUN:

Implementation of postfix expression : 4 6 + 2 / 5 * 7 +

S. No.	Op_1	Op_2	Result
1.	4	6	4+6 = 10
2.	10	2	10/2 = 5
3.	5	5	5*5 = 25
4.	25	7	25+7=32



```
// Archana_Kumari.ECE.408.Mid_Term.CS_DSA_Theory.Assignment
// Q2: Write a C program evaluate postfix expression.
// Below is it's implementation using stack.

#include <stdio.h>
#include <ctype.h>
#include <math.h>
```

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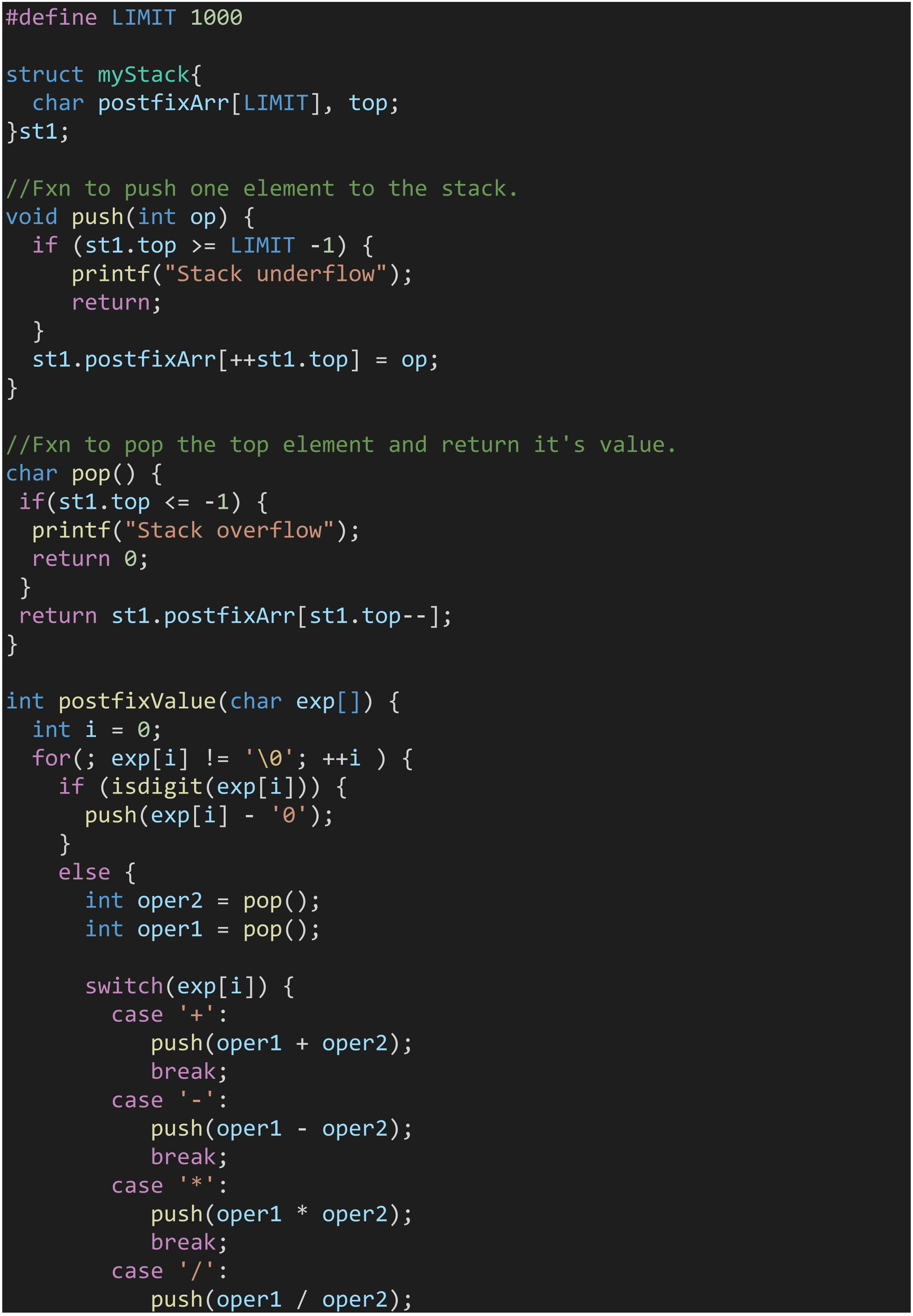
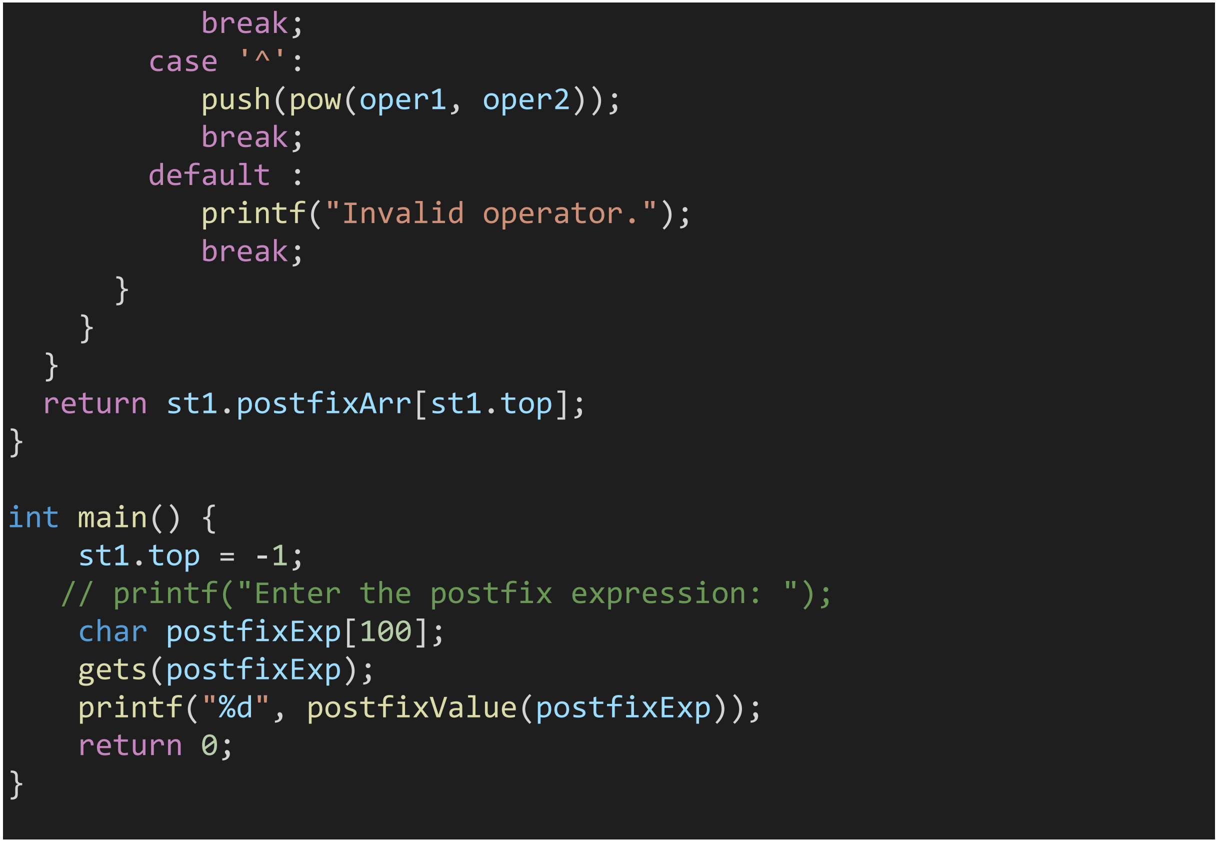


```
#define LIMIT 1000

struct myStack{
  char postfixArr[LIMIT], top;
}st1;

//Fxn to push one element to the stack.
void push(int op) {
  if (st1.top >= LIMIT -1) {
     printf("Stack underflow");
     return;
  }
  st1.postfixArr[++st1.top] = op;
}

//Fxn to pop the top element and return it's value.
char pop() {
 if(st1.top <= -1) {
  printf("Stack overflow");
  return 0;
 }
 return st1.postfixArr[st1.top--];
}

int postfixValue(char exp[]) {
  int i = 0;
  for(; exp[i] != '\0'; ++i ) {
    if (isdigit(exp[i])) {
      push(exp[i] - '0');
    }
    else {
      int oper2 = pop();
      int oper1 = pop();

      switch(exp[i]) {
        case '+':
           push(oper1 + oper2);
           break;
        case '-':
           push(oper1 - oper2);
           break;
        case '*':
           push(oper1 * oper2);
           break;
        case '/':
           push(oper1 / oper2);
```

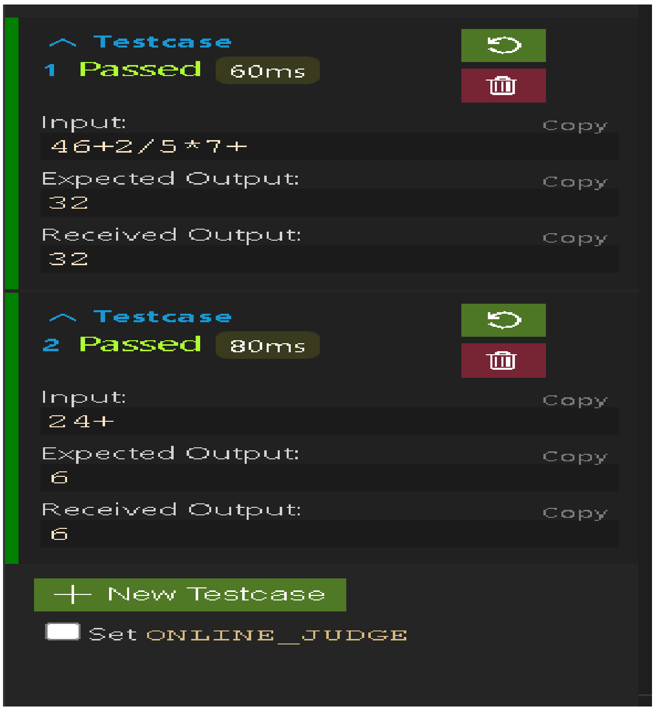


```
           break;
        case '^':
           push(pow(oper1, oper2));
           break;
        default :
           printf("Invalid operator.");
           break;
      }
    }
  }
  return st1.postfixArr[st1.top];
}

int main() {
    st1.top = -1;
   // printf("Enter the postfix expression: ");
    char postfixExp[100];
    gets(postfixExp);
    printf("%d", postfixValue(postfixExp));
    return 0;
}
```

C:) Input-Output:

Input_1 : 24+ **Input-2 : 46+2/5*7+**

Output_1 : 6 **Output_2 : 32**



```
Testcase
1 Passed 60ms
Input:
46+2/5*7+
Expected Output:
32
Received Output:
32

Testcase
2 Passed 80ms
Input:
24+
Expected Output:
6
Received Output:
6
```

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Q3:) Give a real-life example using queue.

A:) Problem statement: Patient Queue (using Priority Queue) :

- ➔ **This problem deals with the real-life implementation of Priority Queue in hospitals for managing the waiting list of patients.**
- ➔ **To assist patients in a hospitals,because some pateints may have more urgent and serious injuries than others, use priority queue to manage the waiting list of patients in a hospital.**
- ➔ **The patient with more urgent priority is seen first, regardless of the appointment no.**
- ➔ **The patient with highest priority is removed first as well.**

B:) Algorithm: Make a structure with integer element & integer priority as structural variables.

I) Enqueue (Insert) -> 1. Take the data and it's priority as input.

2. If front == 0 & rear == size -1, then queue is full.

3. Else we initialise front and rear with 0.

4. Insert the data in Priority Queue using rear pointer.

II) Delete highest priority (dequeue) -> 1. Removes the element with the highest priority from the queue.

2. Searches the element with highest priority and stores it in a variable.

3. Shifts the elements to delete it and decrements the rear pointer.

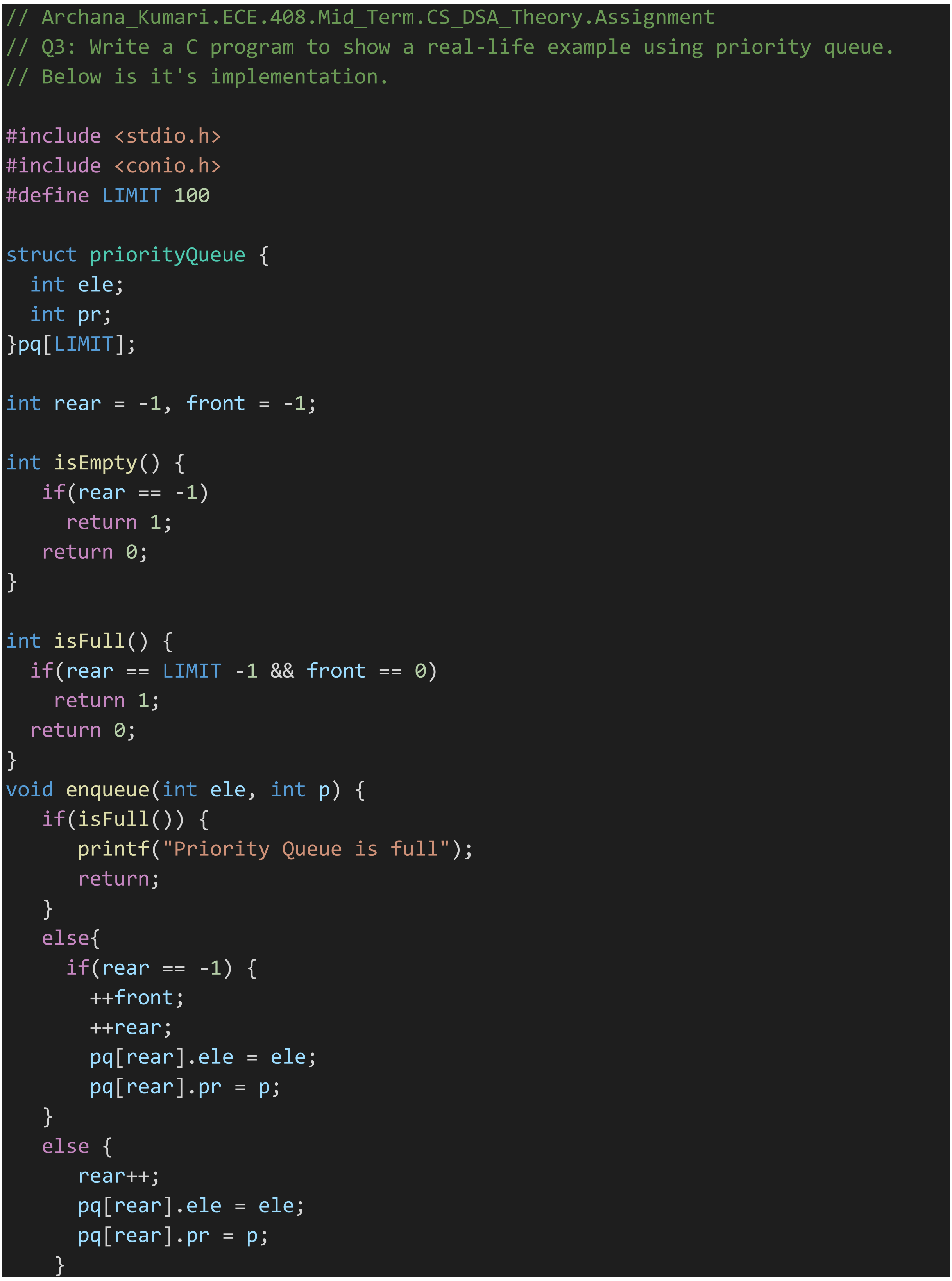
4. Returns the deleted element.

III) Display -> Loop through the priority queue from front to the rear pointer and print it's data and priority. Returns the list of the patients a/c their priority.

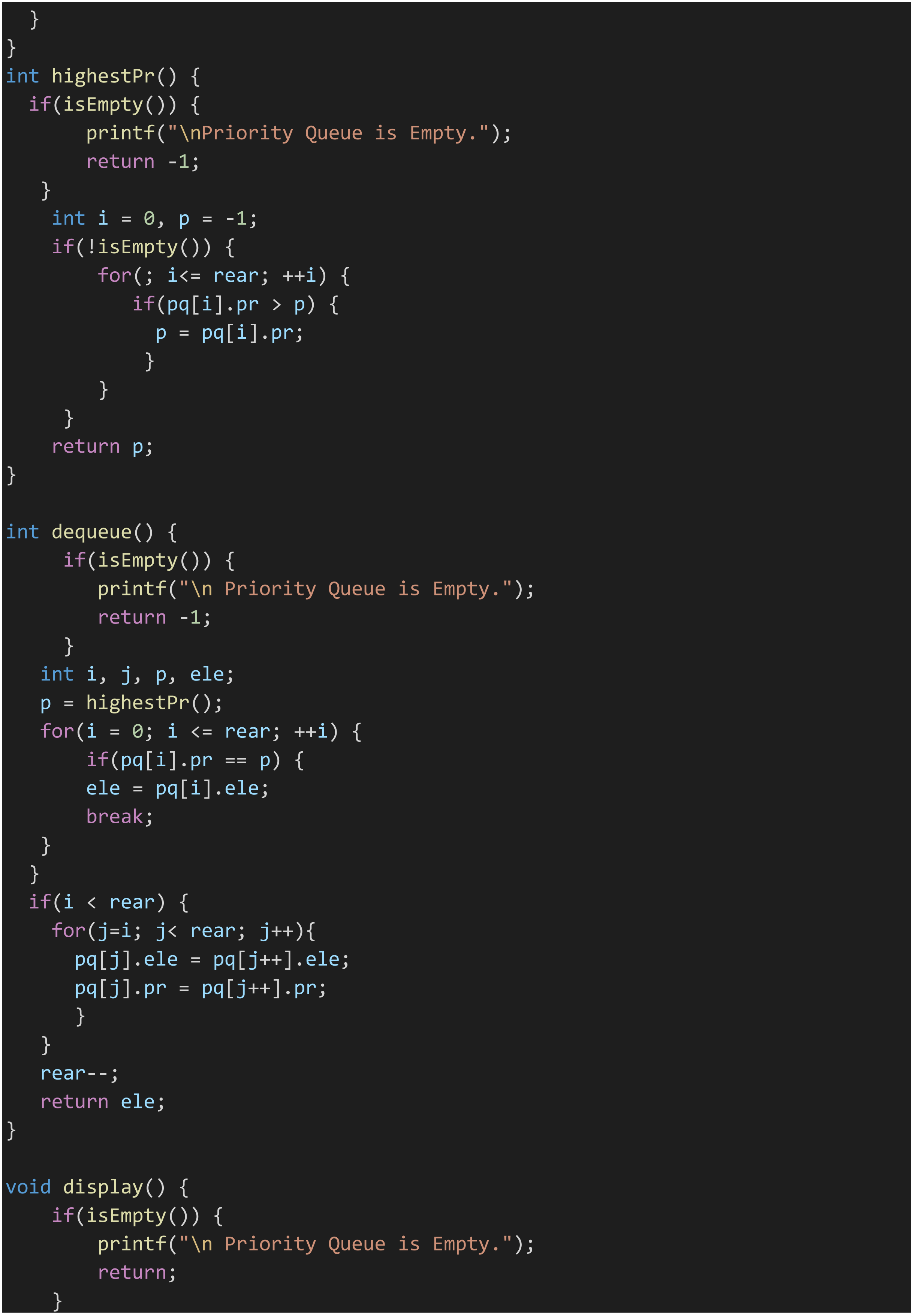
IV) highestPr -> Returns the highest priority input by the user.

V) isFull -> Return true if the the Priority Queue is full.

VI) isEmpty -> Returns true if the Priority Queue is empty ie., front == -1, else false.



```c
// Archana_Kumari.ECE.408.Mid_Term.CS_DSA_Theory.Assignment
// Q3: Write a C program to show a real-life example using priority queue.
// Below is it's implementation.

#include <stdio.h>
#include <conio.h>
#define LIMIT 100

struct priorityQueue {
  int ele;
  int pr;
}pq[LIMIT];

int rear = -1, front = -1;

int isEmpty() {
   if(rear == -1)
     return 1;
   return 0;
}

int isFull() {
  if(rear == LIMIT -1 && front == 0)
    return 1;
  return 0;
}
void enqueue(int ele, int p) {
   if(isFull()) {
      printf("Priority Queue is full");
      return;
   }
   else{
     if(rear == -1) {
       ++front;
       ++rear;
       pq[rear].ele = ele;
       pq[rear].pr = p;
   }
   else {
      rear++;
      pq[rear].ele = ele;
      pq[rear].pr = p;
    }
```



```
 }
}
int highestPr() {
 if(isEmpty()) {
    printf("\nPriority Queue is Empty.");
    return -1;
  }
  int i = 0, p = -1;
  if(!isEmpty()) {
    for(; i<= rear; ++i) {
       if(pq[i].pr > p) {
         p = pq[i].pr;
        }
    }
   }
  return p;
}

int dequeue() {
   if(isEmpty()) {
     printf("\n Priority Queue is Empty.");
     return -1;
   }
  int i, j, p, ele;
  p = highestPr();
  for(i = 0; i <= rear; ++i) {
     if(pq[i].pr == p) {
     ele = pq[i].ele;
     break;
  }
 }
 if(i < rear) {
  for(j=i; j< rear; j++){
   pq[j].ele = pq[j++].ele;
   pq[j].pr = pq[j++].pr;
   }
  }
  rear--;
  return ele;
}

void display() {
  if(isEmpty()) {
    printf("\n Priority Queue is Empty.");
    return;
  }
```

```
   int i = front;
   printf("Priority Queue is: ");
   for( ; i<= rear; ++i) {
      printf("\nPatient's appointment no. = %d , Priority = %d", pq[i].ele, pq
[i].pr);
   }
}

int main() {
   int c = 0, p = 0, ele = 0;
   do{
   printf("\n 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit")
;
   printf("\nEnter choice: ");
   scanf("%d", &c);
   switch(c) {
     case 1:
           printf("Enter Patient's appointment no.: ");
           scanf("%d", &ele);
           printf("Enter the priority: ");
           scanf("%d", &p);
           enqueue(ele, p);
        break;
    case 2:
           p = highestPr();
           printf("\nHighest Priority is: %d", p);
        break;
    case 3:
           ele = dequeue();
           printf("\nPateint with appointment no. %d is deleted.", ele);
       break;
    case 4:
             display();
        break;
        case 5: break;
    default: printf("\nWrong input");

           }
   }while(c != 5);
   return 0;
}
```

D:) Input-Output:

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```
1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 3
 Priority Queue is Empty.
Pateint with appointment no. -1 is deleted.
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 2

Priority Queue is Empty.
Highest Priority is: -1
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 3
Enter the priority: 2

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 2
Enter the priority: 1

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 1
Enter the priority: 3

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 4
Priority Queue is:
Patient's appointment no. = 3 , Priority = 2
```

```
Patient's appointment no. = 2 , Priority = 1
Patient's appointment no. = 1 , Priority = 3
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 2

Highest Priority is: 3
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 3

Pateint with appointment no. 1 is deleted.
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 4

Priority Queue is:
Patient's appointment no. = 3 , Priority = 2
Patient's appointment no. = 2 , Priority = 1
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 5

--------------------------------
Process exited after 32.12 seconds with return value 0
Press any key to continue . . .
```

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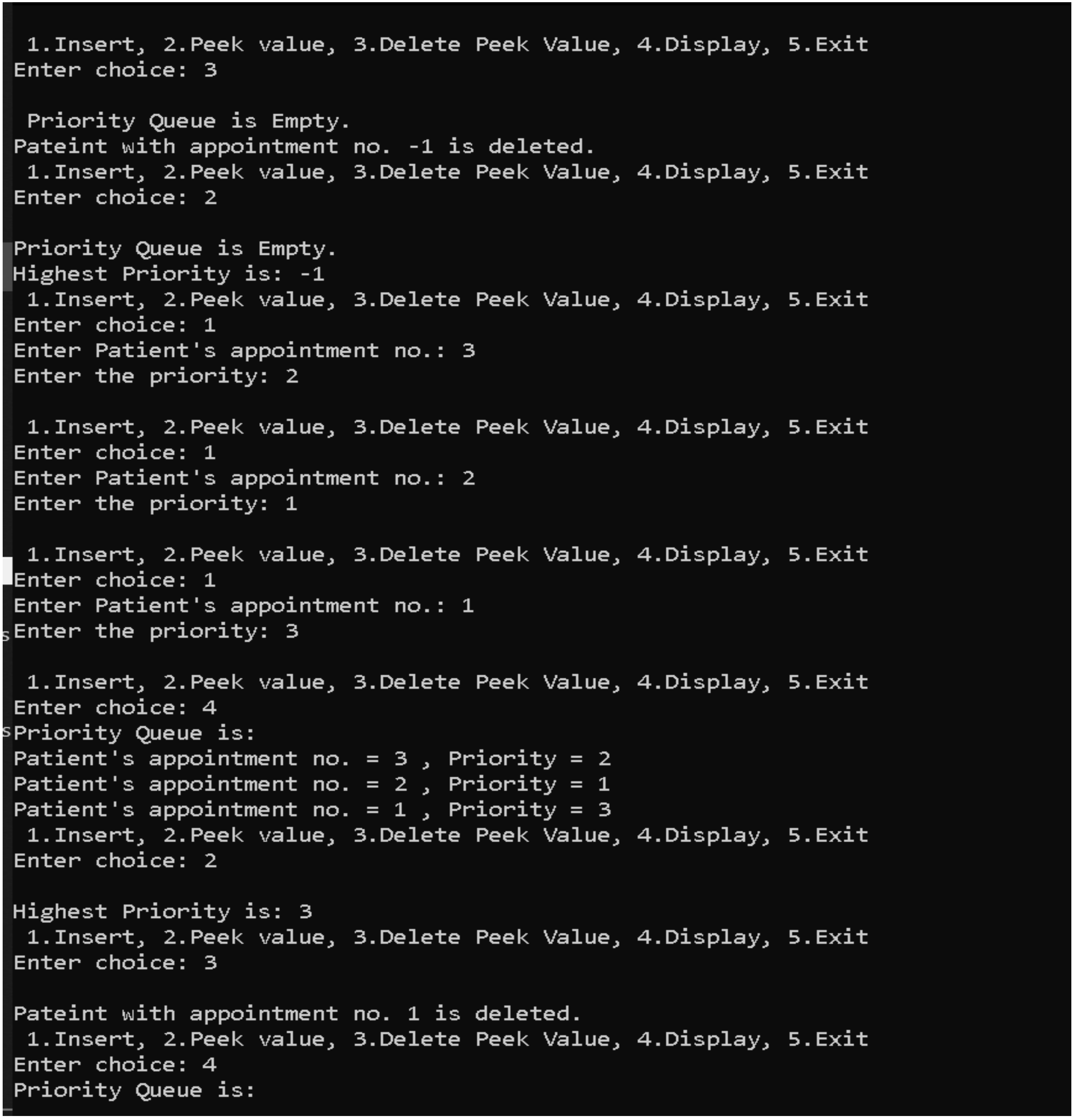
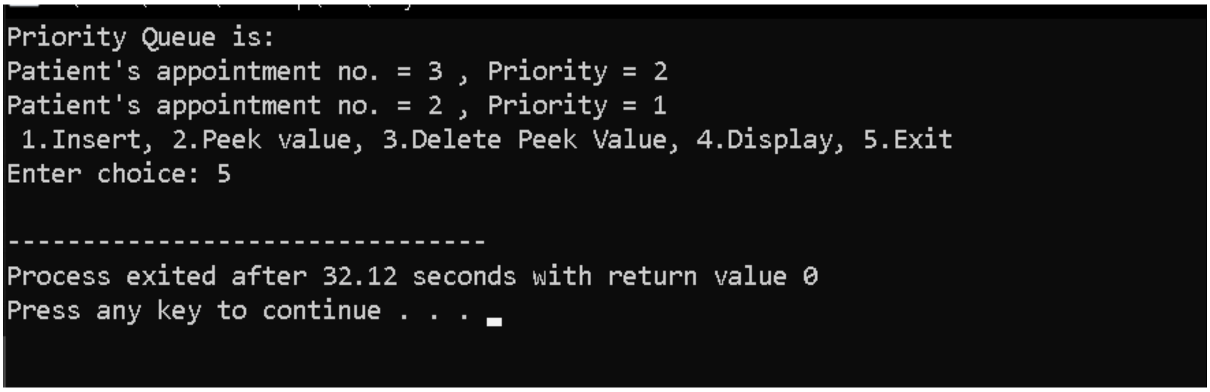


```
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 3

 Priority Queue is Empty.
Pateint with appointment no. -1 is deleted.
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 2

Priority Queue is Empty.
Highest Priority is: -1
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 3
Enter the priority: 2

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 2
Enter the priority: 1

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 1
Enter Patient's appointment no.: 1
Enter the priority: 3

 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 4
Priority Queue is:
Patient's appointment no. = 3 , Priority = 2
Patient's appointment no. = 2 , Priority = 1
Patient's appointment no. = 1 , Priority = 3
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 2

Highest Priority is: 3
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 3

Pateint with appointment no. 1 is deleted.
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 4
Priority Queue is:
```



```
Priority Queue is:
Patient's appointment no. = 3 , Priority = 2
Patient's appointment no. = 2 , Priority = 1
 1.Insert, 2.Peek value, 3.Delete Peek Value, 4.Display, 5.Exit
Enter choice: 5

--------------------------------
Process exited after 32.12 seconds with return value 0
Press any key to continue . . .
```