12/08/2024

22. Given an array arr, sort the elements in descending order using bubblesort.

Arr=[9,10,-9,23,67,-90]

Output:[67,23,10,9,-9,-90]

Sol

```
#include <stdio.h>
void bubbleSortDescending(int arr[], int n) {
    for (int i = 0; i < n-1; i++) {
        for (int j = 0; j < n-i-1; j++) {
            if (arr[j] < arr[j+1]) {
                int temp = arr[j];
                arr[j] = arr[j+1];
                arr[j+1] = temp;
            }
        }
    }
}
int main() {
    int arr[] = {9, 10, -9, 23, 67, -90};
    int n = sizeof(arr)/sizeof(arr[0]);
     bubbleSortDescending(arr, n);
    printf("Output: [");
    for (int i = 0; i < n; i++) {
        printf("%d", arr[i]);
        if (i < n - 1) {
            printf(", ");
        }
```

```
    } printf("]\n");
return 0;
}
```

```
/tmp/T5zwNXdkL8.o
Output: [67, 23, 10, 9, -9, -90]
```

23.you have been given a positive integer N. You need to find and print the Factorial of this number without using recursion. The Factorial of a positive integer N refers to the product of all number in the range from 1 to N.

sol

```
#include <stdio.h>

int main() {
    int N;
    long long factorial = 1;

    // Input
    printf("Enter a positive integer: ");
    scanf("%d", &N);

    // Calculate factorial
    for(int i = 1; i <= N; i++) {
        factorial *= i;
    }

    // Output
```

```
    printf("Factorial of %d = %lld\n", N, factorial);
    return 0;
}
```

```
/tmp/OOwKhbSUbk.o
Enter a positive integer: 4
Factorial of 4 = 24
```

24.Given an array arr, sort the elements in ascending order using

Bubble sort. Arr=[9,10,-9,23,67,-90]

Output:[-90,-9,9,10,23,67]

```
#include <stdio.h>

void bubbleSort(int arr[], int n) {
    int i, j, temp;
    for (i = 0; i < n-1; i++) {
        for (j = 0; j < n-i-1; j++) {
            if (arr[j] > arr[j+1]) {
                temp = arr[j];
                arr[j] = arr[j+1];
                arr[j+1] = temp;
            }
        }
    }
}

int main() {
    int arr[] = {9, 10, -9, 23, 67, -90};
```

```
    int n = sizeof(arr)/sizeof(arr[0]);
    bubbleSort(arr, n);


    printf("Output: [");
    for (int i = 0; i < n; i++) {
        printf("%d", arr[i]);
        if (i < n - 1) {
            printf(", ");
        }
    }
    printf("]\n");
    return 0;
}
```

```
/tmp/iBJp1Y9L67.o
Output: [-90, -9, 9, 10, 23, 67]
```

25. **Design a stack that supports push, pop, top, and retrieving the minimum element in**

constant time.

Implement the MinStack class:

1. MinStack() initializes the stack object.

2. void push(int val) pushes the element val onto the stack.

3. void pop() removes the element on the top of the stack.

4. int top() gets the top element of the stack.

5. int getMin() retrieves the minimum element in the

stack. Input

["MinStack","push","push","push","getMin","pop","top","getMin"]

[[],[-2],[0],[-3],[],[],[],[]]

Sol

```
#include <stdio.h>

#include <stdlib.h>

#include <limits.h>

typedef struct {

    int *stack;

    int *minStack;

    int topIndex;

    int minIndex;

    int capacity;

} MinStack;

// Function implementations (as provided in your code)

MinStack* minStackCreate() {

    MinStack *minStack = (MinStack *)malloc(sizeof(MinStack));

    minStack->capacity = 1000;

    minStack->stack = (int *)malloc(minStack->capacity * sizeof(int));

    minStack->minStack = (int *)malloc(minStack->capacity * sizeof(int));

    minStack->topIndex = -1;

    minStack->minIndex = -1;

    return minStack;

}

void minStackPush(MinStack* obj, int val) {

    obj->stack[++(obj->topIndex)] = val;

    if (obj->minIndex == -1 || val <= obj->minStack[obj->minIndex]) {
```

```
        obj->minStack[++(obj->minIndex)] = val;
    }
}
void minStackPop(MinStack* obj) {
    if (obj->stack[obj->topIndex] == obj->minStack[obj->minIndex]) {
        obj->minIndex--;
    }
    obj->topIndex--;
}
int minStackTop(MinStack* obj) {
    return obj->stack[obj->topIndex];
}
int minStackGetMin(MinStack* obj) {
    return obj->minStack[obj->minIndex];
}
void minStackFree(MinStack* obj) {
    free(obj->stack);
    free(obj->minStack);
    free(obj);
}
int main() {
    MinStack* minStack = minStackCreate();
    minStackPush(minStack, 3);
    minStackPush(minStack, 5);
    printf("Current Min: %d\n", minStackGetMin(minStack)); // returns 3
    minStackPush(minStack, 2);
    minStackPush(minStack, 1);
```

```c
    printf("Current Min: %d\n", minStackGetMin(minStack)); // returns 1
    minStackPop(minStack);
    printf("Current Min: %d\n", minStackGetMin(minStack)); // returns 2
    printf("Top Element: %d\n", minStackTop(minStack)); // returns 2
    minStackFree(minStack);
    return 0;
}
```

```
/tmp/eUl7rJdDQU.o
Current Min: 3
Current Min: 1
Current Min: 2
Top Element: 2
```

26.find the factorial of a number using iterative procedure Input : 3

sol

```c
#include <stdio.h>
int main() {
   int number = 3;
   int factorial = 1;
for(int i = 1; i <= number; i++) {
      factorial *= i;
   }
  printf("Factorial of %d is %d\n", number, factorial);
   return 0;
}
```

```
/tmp/nXsCGu4qnV.o
Factorial of 3 is 6
```

27. Given the head of a linked list, insert the node in nth place and return its head. Input: head = [1,3,2,3,4,5], p=3 n = 2

Output: [1,3,2,3,4,5]

Sol.

```
#include <stdio.h>
#include <stdlib.h>

struct ListNode {
   int val;
   struct ListNode *next;
};
struct ListNode* insertNode(struct ListNode* head, int p, int n) {
   struct ListNode* newNode = (struct ListNode*)malloc(sizeof(struct ListNode));
   newNode->val = p;
   newNode->next = NULL;
if (n == 0) {
      newNode->next = head;
      return newNode;
   }
 struct ListNode* current = head;
   for (int i = 0; i < n - 1 && current != NULL; i++) {
      current = current->next;
   }
  if (current != NULL) {
      newNode->next = current->next;
      current->next = newNode;
   }
return head;
```

```
}
void printList(struct ListNode* head) {
    struct ListNode* current = head;
    while (current != NULL) {
        printf("%d ", current->val);
        current = current->next;
    }
    printf("\n");
}
int main() {
    struct ListNode* head = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->val = 1;
    head->next = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->next->val = 3;
    head->next->next = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->next->next->val = 2;
    head->next->next->next = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->next->next->next->val = 3;
    head->next->next->next->next = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->next->next->next->next->val = 4;
    head->next->next->next->next->next = (struct ListNode*)malloc(sizeof(struct ListNode));
    head->next->next->next->next->next->val = 5;
    head->next->next->next->next->next->next = NULL;

    head = insertNode(head, 3, 2);
    printList(head);

    return 0;
}
```

```
/tmp/IzyUvmpEvR.o
1 3 3 2 3 4 5
```

28.Given the head of a singly linked list and two integers left and right where left <= right, reverse the nodes of the list from position left to position right, and return the reversed list. Input: head = [1, 2, 3, 4, 5], left = 2, right = 4

Output: [1, 4, 3, 2, 5]

Sol.

```
struct ListNode {
    int val;
    struct ListNode *next;
};

struct ListNode* reverseBetween(struct ListNode* head, int left, int right) {
    if (!head || left == right) return head;

    struct ListNode dummy;
    dummy.next = head;
    struct ListNode* prev = &dummy;

    for (int i = 1; i < left; i++) {
        prev = prev->next;
    }

    struct ListNode* curr = prev->next;
    struct ListNode* tail = curr;
```

```
    for (int i = 0; i < right - left; i++) {
        struct ListNode* temp = curr->next;
        curr->next = temp->next;
        temp->next = prev->next;
        prev->next = temp;
    }

    return dummy.next;
}
```

```
/tmp/ycbyB1I2Zb.o
Original list: 1 -> 2 -> 3 -> 4 -> 5 -> NULL
Reversed list: 1 -> 4 -> 3 -> 2 -> 5 -> NULL
```

29.you are given with the following linked list

The digits are stored in the above order, you are asked to print the list in reverse order.

Sol.

```
#include <stdio.h>
#include <stdlib.h>
struct ListNode {
    int val;
    struct ListNode *next;
};
struct ListNode* createNode(int val) {
    struct ListNode* newNode = (struct ListNode*)malloc(sizeof(struct ListNode));
    newNode->val = val;
    newNode->next = NULL;
    return newNode;
}
```

```
void printReverse(struct ListNode* head) {
  if (head == NULL) {
    return; // Base case: if the list is empty, return
  }
  printReverse(head->next); // Recursive call with the next node
  printf("%d -> ", head->val); // Print the current node's value after returning from recursion
}
void freeList(struct ListNode* head) {
  while (head != NULL) {
    struct ListNode* temp = head;
    head = head->next;
    free(temp);
  }
}
int main() {
  // Create the linked list: 1 -> 2 -> 3 -> 4 -> 5
  struct ListNode* head = createNode(1);
  head->next = createNode(2);
  head->next->next = createNode(3);
  head->next->next->next = createNode(4);
  head->next->next->next->next = createNode(5);
 // Print the linked list in reverse order
  printf("Linked list in reverse order: ");
  printReverse(head);
  printf("NULL\n"); // Indicate the end of the list
  // Free the allocated memory
  freeList(head);
  return 0;
}
```

```
/tmp/gAdEPV9xof.o
Linked list in reverse order: 5 -> 4 -> 3 -> 2 -> 1 -> NULL
```

30.Given two sorted arrays nums1 and nums2 of size m and n respectively, return the sum of these two arrays

Sol.

```c
#include <stdio.h>

int sumSortedArrays(int* nums1, int m, int* nums2, int n) {
    int sum = 0;
    for (int i = 0; i < m; i++) {
        sum += nums1[i];
    }
    for (int j = 0; j < n; j++) {
        sum += nums2[j];
    }
    return sum;
}

int main() {
    int nums1[] = {1, 2, 3};
    int nums2[] = {4, 5, 6};
    int m = sizeof(nums1) / sizeof(nums1[0]);
    int n = sizeof(nums2) / sizeof(nums2[0]);
    int result = sumSortedArrays(nums1, m, nums2, n);
    printf("The sum of the two arrays is: %d\n", result);
    return 0;
}
```

```
/tmp/o7Y8zZOYEL.o
The sum of the two arrays is: 21
```

21. Implement a first in first out (FIFO) queue using only two stacks. The implemented queue should support all the functions of a normal queue (push, peek, pop, and empty).

Implement the MyQueue class:

1. void push(int x) Pushes element x to the back of the queue.

2. int pop() Removes the element from the front of the queue and returns it.

3. int peek() Returns the element at the front of the queue.

4. boolean empty() Returns true if the queue is empty, false otherwise.

Input

Sol.

```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#define MAX_SIZE 100
typedef struct {
    int data[MAX_SIZE];
    int top;
} Stack;
typedef struct {
    Stack stack1;
    Stack stack2;
} MyQueue;
// Function to initialize a stack
void stack_init(Stack *stack) {
    stack->top = -1;
}
// Function to check if a stack is empty
bool stack_is_empty(Stack *stack) {
```

```
 return stack->top == -1;
}
// Function to push an element onto the stack
void stack_push(Stack *stack, int value) {
    if (stack->top < MAX_SIZE - 1) {
        stack->data[++stack->top] = value;
    } else {
        printf("Stack overflow\n");
    }
}
// Function to pop an element from the stack
int stack_pop(Stack *stack) {
    if (!stack_is_empty(stack)) {
        return stack->data[stack->top--];
    } else {
        printf("Stack underflow\n");
        return -1;
    }
}
// Function to get the top element of the stack without popping it
int stack_peek(Stack *stack) {
    if (!stack_is_empty(stack)) {
        return stack->data[stack->top];
    } else {
        printf("Stack is empty\n");
        return -1;
    }
}
// Function to initialize the queue
```

```
void myQueue_init(MyQueue *queue) {
    stack_init(&queue->stack1);
    stack_init(&queue->stack2);
}
// Function to push an element onto the queue
void myQueue_push(MyQueue *queue, int x) {
    stack_push(&queue->stack1, x);
}
// Function to pop an element from the queue
int myQueue_pop(MyQueue *queue) {
    if (stack_is_empty(&queue->stack2)) {
        while (!stack_is_empty(&queue->stack1)) {
            stack_push(&queue->stack2, stack_pop(&queue->stack1));
        }
    }
    return stack_pop(&queue->stack2);
}
// Function to get the front element of the queue
int myQueue_peek(MyQueue *queue) {
    if (stack_is_empty(&queue->stack2)) {
        while (!stack_is_empty(&queue->stack1)) {
            stack_push(&queue->stack2, stack_pop(&queue->stack1));
        }
    }
    return stack_peek(&queue->stack2);
}
// Function to check if the queue is empty
bool myQueue_empty(MyQueue *queue) {
    return stack_is_empty(&queue->stack1) && stack_is_empty(&queue->stack2);
```

```
}
// Main function to test the MyQueue implementation
int main() {
    MyQueue queue;
    myQueue_init(&queue);
   myQueue_push(&queue, 1);
    myQueue_push(&queue, 2);
    myQueue_push(&queue, 3);
    printf("Front element: %d\n", myQueue_peek(&queue));
    printf("Popped element: %d\n", myQueue_pop(&queue));
    printf("Is queue empty? %s\n", myQueue_empty(&queue) ? "Yes" : "No");
    printf("Front element: %d\n", myQueue_peek(&queue));
    printf("Popped element: %d\n", myQueue_pop(&queue));
    printf("Popped element: %d\n", myQueue_pop(&queue));
    printf("Is queue empty? %s\n", myQueue_empty(&queue) ? "Yes" : "No");
    return 0;
}
```

```
/tmp/18jC9r1dP4.o
Front element: 1
Popped element: 1
Is queue empty? No
Front element: 2
Popped element: 2
Popped element: 3
Is queue empty? Yes


=== Code Execution Successful ===
```

14/08/2024

10.Given a string s, find the frequency of characters Example 1:

Input: s = "tree"

Sol.

```
#include <stdio.h>

#include <string.h>

void characterFrequency(char *s) {

    int freq[256] = {0};

    int length = strlen(s);

    for (int i = 0; i < length; i++) {

        freq[(int)s[i]]++;

    }

    for (int i = 0; i < 256; i++) {

        if (freq[i] > 0) {

            printf("%c->%d, ", i, freq[i]);

        }

    }

}

int main() {

    char s[] = "tree";

    characterFrequency(s);

    return 0;

}
```

```
e->2, r->1, t->1,

=== Code Execution Successful ===
```

11. Given an unsorted array arr[] with both positive and negative elements,

the task is to find the smallest positive number missing from the array.

Input: arr[] = {2, 3, 7, 6, 8, -1, -10, 15}

Output: 1

Input: arr[] = { 2, 3, -7, 6, 8, 1, -10, 15 }

Output: 4

Input: arr[] = {1, 1, 0, -1, -2}

Output: 2

Sol.

```c
#include <stdio.h>
int findMissingPositive(int arr[], int size) {
    int i;
    for (i = 0; i < size; i++) {
        while (arr[i] > 0 && arr[i] <= size && arr[arr[i] - 1] != arr[i]) {
            int temp = arr[i];
            arr[i] = arr[temp - 1];
            arr[temp - 1] = temp;
        }
    }
    for (i = 0; i < size; i++) {
        if (arr[i] != i + 1) {
            return i + 1;
        }
    }
    return size + 1;
}
int main() {
    int arr1[] = {2, 3, 7, 6, 8, -1, -10, 15};
    int size1 = sizeof(arr1) / sizeof(arr1[0]);
    printf("Output: %d\n", findMissingPositive(arr1, size1)); // Output: 1
    int arr2[] = {2, 3, -7, 6, 8, 1, -10, 15};
    int size2 = sizeof(arr2) / sizeof(arr2[0]);
    printf("Output: %d\n", findMissingPositive(arr2, size2)); // Output: 4
    int arr3[] = {1, 1, 0, -1, -2};
    int size3 = sizeof(arr3) / sizeof(arr3[0]);
```

```
  printf("Output: %d\n", findMissingPositive(arr3, size3)); // Output: 2

    return 0;

}
```

```
Output: 1
Output: 4
Output: 2


=== Code Execution Successful ===
```

12.Given two integer arrays preorder and inorder where preorder is the

preorder traversal of a binary tree and inorder is the inorder traversal

of the same tree,

construct and return the binary tree. Input: preorder = [3,9,20,15,7], inorder =

[9,3,15,20,7] Output: [3,9,20,null,null,15,7]

Sol.

```
#include <stdio.h>

#include <stdlib.h>

struct TreeNode {

    int val;

    struct TreeNode *left;

    struct TreeNode *right;

};

// Function to create a new tree node

struct TreeNode* createNode(int val) {

    struct TreeNode* node = (struct TreeNode*)malloc(sizeof(struct TreeNode));

    node->val = val;

    node->left = NULL;

    node->right = NULL;

    return node;

}

// Function to find the index of a value in an array
```

```c
int findIndex(int* array, int start, int end, int value) {
    for (int i = start; i <= end; i++) {
        if (array[i] == value) {
            return i;
        }
    }
    return -1;
}
// Recursive function to build the binary tree
struct TreeNode* buildTreeHelper(int* preorder, int* inorder, int inorderStart, int inorderEnd, int*
preorderIndex) {
    if (inorderStart > inorderEnd) {
        return NULL;
    }
    // The next element in preorder[] is the root node for this subtree
    int rootVal = preorder[*preorderIndex];
    (*preorderIndex)++;
    // Create the root node
    struct TreeNode* root = createNode(rootVal);
    // If the tree has only one node, return it
    if (inorderStart == inorderEnd) {
        return root;
    }
    // Find the index of the root in inorder[]
    int inorderIndex = findIndex(inorder, inorderStart, inorderEnd, rootVal);
    // Recursively build the left and right subtrees
    root->left = buildTreeHelper(preorder, inorder, inorderStart, inorderIndex - 1, preorderIndex);
    root->right = buildTreeHelper(preorder, inorder, inorderIndex + 1, inorderEnd, preorderIndex);
```

```
    return root;
}
// Function to build the binary tree from preorder and inorder arrays
struct TreeNode* buildTree(int* preorder, int preorderSize, int* inorder, int inorderSize) {
    int preorderIndex = 0;
    return buildTreeHelper(preorder, inorder, 0, inorderSize - 1, &preorderIndex);
}
// Function to print the tree in level order to verify the result
void printLevelOrder(struct TreeNode* root) {
    if (root == NULL) return;
    struct TreeNode* queue[100];
    int front = 0;
    int rear = 0;
    queue[rear++] = root
    while (front < rear) {
        struct TreeNode* node = queue[front++];
        if (node) {
            printf("%d ", node->val);
            queue[rear++] = node->left;
            queue[rear++] = node->right;
        } else {
            printf("null ");
        }
    }

// Main function to test the buildTree function
int main() {
    int preorder[] = {3, 9, 20, 15, 7};
    int inorder[] = {9, 3, 15, 20, 7};
```

```
int preorderSize = sizeof(preorder) / sizeof(preorder[0]);
    int inorderSize = sizeof(inorder) / sizeof(inorder[0]);
    struct TreeNode* root = buildTree(preorder, preorderSize, inorder, inorderSize);
    printf("Level order traversal of the constructed tree: \n");
    printLevelOrder(root);
    return 0;
}
```

```
Level order traversal of the constructed tree:
3 9 20 null null 15 7 null null null null
```

13. Write a program to create and display a

linked list Example 1:

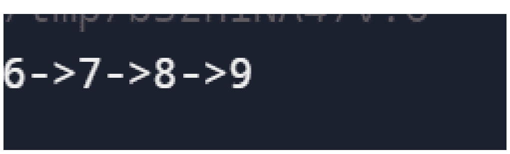
Nodes : 6,7,8,9

Output: 6->7->8->9

Sol.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
void displayList(struct Node* node) {
    while (node != NULL) {
        printf("%d", node->data);
        if (node->next != NULL) {
            printf("->");
        }
        node = node->next;
    }
```

```
printf("\n");
}
int main() {
    struct Node* head = (struct Node*)malloc(sizeof(struct Node));
    struct Node* second = (struct Node*)malloc(sizeof(struct Node));
    struct Node* third = (struct Node*)malloc(sizeof(struct Node));
    struct Node* fourth = (struct Node*)malloc(sizeof(struct Node));
    head->data = 6;
    head->next = second;
    second->data = 7;
    second->next = third;
    third->data = 8;
    third->next = fourth;
    fourth->data = 9;
    fourth->next = NULL;
    displayList(head);
    free(head);
    free(second);
    free(third);
    free(fourth);
    return 0;
}
```



14.Write a program to sort the below numbers in descending order using bubble sort Input 4,7,9,1,2

Output:9,7,4,2,1

Sol.

```c
#include <stdio.h>

void bubbleSort(int arr[], int n) {

    int i, j, temp;

    for (i = 0; i < n-1; i++) {

        for (j = 0; j < n-i-1; j++) {

            if (arr[j] < arr[j+1]) {

                temp = arr[j];

                arr[j] = arr[j+1];

                arr[j+1] = temp;

            }

        }

    }

}

int main() {

    int arr[] = {4, 7, 9, 1, 2};

    int n = sizeof(arr)/sizeof(arr[0]);

    bubbleSort(arr, n);

    printf("Sorted array in descending order: ");

    for (int i = 0; i < n; i++) {

        printf("%d", arr[i]);

        if (i < n - 1) {

            printf(",");

        }

    }

    return 0;

}
```

```
Sorted array in descending order: 9,7,4,2,1
```

15. Given an array of size N-1 such that it only contains distinct

integers in the range of 1 to N. Find the missing element.

Input:

N = 5

A[] = {1,2,3,5}

Output:4

Input N = 10

A[] = {6,1,2,8,3,4,7,10,5}

Output: 9

Sol.

```
#include <stdio.h>

int findMissing(int A[], int N) {

    int total = (N * (N + 1)) / 2;

    int sum = 0;

    for (int i = 0; i < N - 1; i++) {

        sum += A[i];

    }

    return total - sum;

}

int main() {

    int A1[] = {1, 2, 3, 5};

    int N1 = 5;

    printf("%d\n", findMissing(A1, N1)); // Output: 4

    int A2[] = {6, 1, 2, 8, 3, 4, 7, 10, 5};

    int N2 = 10;

    printf("%d\n", findMissing(A2, N2)); // Output: 9

    return 0;

}
```

```
/tmp/TqQTh1p3DW.o
4
9
```

16. Write a program to find odd number present in the data part of a node Example Linked List 1->2->3->7

Output: 1,3,7

Sol.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
void findOddNumbers(struct Node* head) {
    struct Node* current = head;
    while (current != NULL) {
        if (current->data % 2 != 0) {
            printf("%d ", current->data);
        }
        current = current->next;
    }
}

int main() {
    struct Node* head = (struct Node*)malloc(sizeof(struct Node));
    struct Node* second = (struct Node*)malloc(sizeof(struct Node));
    struct Node* third = (struct Node*)malloc(sizeof(struct Node));
    struct Node* fourth = (struct Node*)malloc(sizeof(struct Node));
    head->data = 1;
    head->next = second;
    second->data = 2;
    second->next = third;
```

```
    third->data = 3;
    third->next = fourth;
    fourth->data = 7;
    fourth->next = NULL;
    printf("Odd numbers in the linked list: ");
    findOddNumbers(head);
    free(head);
    free(second);
    free(third);
    free(fourth);
    return 0;
}
```

```
Odd numbers in the linked list: 1 3 7

=== Code Execution Successful ===
```

17. Write a program to perform insert and delete operations in a queue Example : 12,34,56,78

After insertion of 60 content of the queue is 12,34,56,78,60 After deletion of 12 , the contents of the queue : 34,56,78,60

sol.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 100
struct Queue {
    int items[MAX];
    int front;
    int rear;
};
```

```
struct Queue* createQueue() {
   struct Queue* q = (struct Queue*)malloc(sizeof(struct Queue));
   q->front = -1;
   q->rear = -1;
   return q;
}
int isFull(struct Queue* q) {
   return q->rear == MAX - 1;
}
int isEmpty(struct Queue* q) {
   return q->front == -1 || q->front > q->rear;
}
void enqueue(struct Queue* q, int value) {
   if (isFull(q)) {
      printf("Queue is full\n");
      return;
   }
   if (isEmpty(q)) {
      q->front = 0;
   }
   q->rear++;
   q->items[q->rear] = value;
}
int dequeue(struct Queue* q) {
   if (isEmpty(q)) {
      printf("Queue is empty\n");
      return -1;
   }
```

```
    int item = q->items[q->front];
    q->front++;
    return item;
}
void display(struct Queue* q) {
    if (isEmpty(q)) {
        printf("Queue is empty\n");
        return;
    }
    for (int i = q->front; i <= q->rear; i++) {
        printf("%d ", q->items[i]);
    }
    printf("\n");
}
int main() {
    struct Queue* q = createQueue();
    enqueue(q, 12);
    enqueue(q, 34);
    enqueue(q, 56);
    enqueue(q, 78);
    printf("After insertion of 60, contents of the queue: ");
    enqueue(q, 60);
    display(q);
    printf("After deletion of %d, contents of the queue: ", dequeue(q));
    display(q)
    free(q);
    return 0;
}
```

```
After insertion of 60, contents of the queue: 12 34 56 78 60
After deletion of 12, contents of the queue: 34 56 78 60
```

18. Given a string s containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid.

Sol.

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX 100
typedef struct {
    char items[MAX];
    int top;
} Stack;
void initStack(Stack* s) {
    s->top = -1;
}
int isFull(Stack* s) {
    return s->top == MAX - 1;
}
int isEmpty(Stack* s) {
    return s->top == -1;
}
void push(Stack* s, char item) {
    if (!isFull(s)) {
        s->items[++(s->top)] = item;
    }
}
char pop(Stack* s) {
    if (!isEmpty(s)) {
        return s->items[(s->top)--];
    }
```

```
    return '\0';
}
int isValid(char* s) {
    Stack stack;
    initStack(&stack);
    for (int i = 0; s[i] != '\0'; i++) {
        if (s[i] == '(' || s[i] == '{' || s[i] == '[') {
            push(&stack, s[i]);
        } else {
            if (isEmpty(&stack)) return 0;
            char top = pop(&stack);
            if ((s[i] == ')' && top != '(') ||
                (s[i] == '}' && top != '{') ||
                (s[i] == ']' && top != '[')) {
                return 0;
            }
        }
    }
    return isEmpty(&stack);
}
int main() {
    char s[MAX];
    printf("Enter a string of parentheses: ");
    scanf("%s", s);
    if (isValid(s)) {
        printf("The string is valid.\n");
    } else {
        printf("The string is not valid.\n");
    }
    return 0;
}
```

```
Enter a string of parentheses: ({})
The string is valid.
```