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Queue | Set 2 (Linked List Implementation)

February 7, 2014

In the previous post, we introduced Queue and discussed array implementation. In this post, linked list implementation is discussed. The following two main operations must be implemented efficiently.

In a Queue data structure, we maintain two pointers, *front* and *rear*. The *front* points the first item of queue and *rear* points to last item.

enQueue() This operation adds a new node after *rear* and moves *rear* to the next node.

deQueue() This operation removes the front node and moves *front* to the next node.

```
// A C program to demonstrate linked list based implementation of queue
#include <stdlib.h>
#include <stdio.h>

// A linked list (LL) node to store a queue entry
struct QNode
{
    int key;
    struct QNode *next;
};

// The queue, front stores the front node of LL and rear stores ths
// last node of LL
struct Queue
{
    struct QNode *front, *rear;
};
```

```c
// A utility function to create a new linked list node.
struct QNode* newNode(int k)
{
    struct QNode *temp = (struct QNode*)malloc(sizeof(struct QNode));
    temp->key = k;
    temp->next = NULL;
    return temp;
}

// A utility function to create an empty queue
struct Queue *createQueue()
{
    struct Queue *q = (struct Queue*)malloc(sizeof(struct Queue));
    q->front = q->rear = NULL;
    return q;
}

// The function to add a key k to q
void enQueue(struct Queue *q, int k)
{
    // Create a new LL node
    struct QNode *temp = newNode(k);

    // If queue is empty, then new node is front and rear both
    if (q->rear == NULL)
    {
        q->front = q->rear = temp;
        return;
    }

    // Add the new node at the end of queue and change rear
    q->rear->next = temp;
    q->rear = temp;
}

// Function to remove a key from given queue q
struct QNode *deQueue(struct Queue *q)
{
    // If queue is empty, return NULL.
    if (q->front == NULL)
        return NULL;

    // Store previous front and move front one node ahead
    struct QNode *temp = q->front;
    q->front = q->front->next;

    // If front becomes NULL, then change rear also as NULL
    if (q->front == NULL)
        q->rear = NULL;
    return temp;
}

// Driver Program to test anove functions
```

```c
int main()
{
    struct Queue *q = createQueue();
    enQueue(q, 10);
    enQueue(q, 20);
    deQueue(q);
    deQueue(q);
    enQueue(q, 30);
    enQueue(q, 40);
    enQueue(q, 50);
    struct QNode *n = deQueue(q);
    if (n != NULL)
      printf("Dequeued item is %d", n->key);
    return 0;
}
```

Output:

```
Dequeued item is 30
```

Time Complexity: Time complexity of both operations enqueue() and dequeue() is O(1) as we only change few pointers in both operations. There is no loop in any of the operations.

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above

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Vikas Bansal · 8 months ago

free(frontnode) in dequeue operation......deallocate the memory

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Siva Krishna • a year ago

According to standard notation enQueue() means moving moving rear pointer to right and deQueue() means moving front pointer to right...but here it was given reverse..please check it

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Sriram Ganesh → Siva Krishna • 9 months ago

Exactly.. i was confused after reading that. But its not updated yet.!

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GeeksforGeeks Mod → Sriram Ganesh • 9 months ago

Thanks for reminding about this. We have updated the post.

1 ∧ | ∨ • Reply • Share ›

GeeksforGeeks Mod → Siva Krishna • a year ago

Thanks for pointing this out. We will update this post soon.

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Harshit Rai • 8 months ago

There is a chance although very rare, that we might run out of space during enqueue... The malloc function in new node wolud return null in that case.... It should be checked too

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Aditya Goel • 4 days ago

Please include Heap overflow condition as well.

```
void enQueue(struct Queue *q, int k)
{
    struct QNode *temp = newNode(k);
    if(temp==NULL)
        return;
    ...
}
```

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anirudh • 6 days ago

isn't its better to return an integer value and free the memory in dequeue function?

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maddy • 10 days ago

I am not so familiar with pointers but if we do so (as we are not passing the address of the

queue) would the change be reflected???

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Ashish Jaiswal · 2 months ago

```
#include<stdio.h>
#include<stdlib.h>
typedef struct queue
{
int data;
struct queue*next;
}Queue;
Queue*front=NULL;
Queue*rear=NULL;

void enqueue(int d)
{
Queue*newnode=(Queue*)malloc(sizeof(Queue));
newnode->data=d;
printf("\nEnqueued element is =%d\n",d);
newnode->next=NULL;
if(front==NULL &&rear==NULL)
{
```

see more

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disqus_8vHOSNH3Ot · 2 months ago

How do I implement the same thing for Trees? when I don't have next instead I have *left and *right.

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Anonymous · 6 months ago

@GeeksforGeeks

What if the queue is full? We have no condition to check that

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Dhruba jyoti Das · 7 months ago

There is no return statement in newNode() function

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GeeksforGeeks Mod ➔ Dhruba jyoti Das · 7 months ago

Thanks for pointing this out. We have added the return statement.

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ryan · 7 months ago

@GeeksforGeeks

in newNode() function it should return node* "temp",

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GeeksforGeeks Mod → ryan · 7 months ago

Thanks for pointing this out. We have added the return statement

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Vibhor Garg · 7 months ago

Should'nt the function newNode be returning the pointer temp?

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Tushar Dwivedi · 9 months ago

In below code (from this article), don't we need to free the allocated memory...??
If yes, then how to achieve it ?

```
struct QNode *deQueue(struct Queue *q)
{
// If queue is empty, return NULL.
if (q->front == NULL)
return NULL;

// Store previous front and move front one node ahead
struct QNode *temp = q->front;
q->front = q->front->next;

// If front becomes NULL, then change rear also as NULL
if (q->front == NULL)
q->rear = NULL;
return temp;
}
```

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ryan → Tushar Dwivedi · 7 months ago

no ,since deQueue is returning node so we cant free node here

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- pavithra

can anyone help me by answering this question...

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