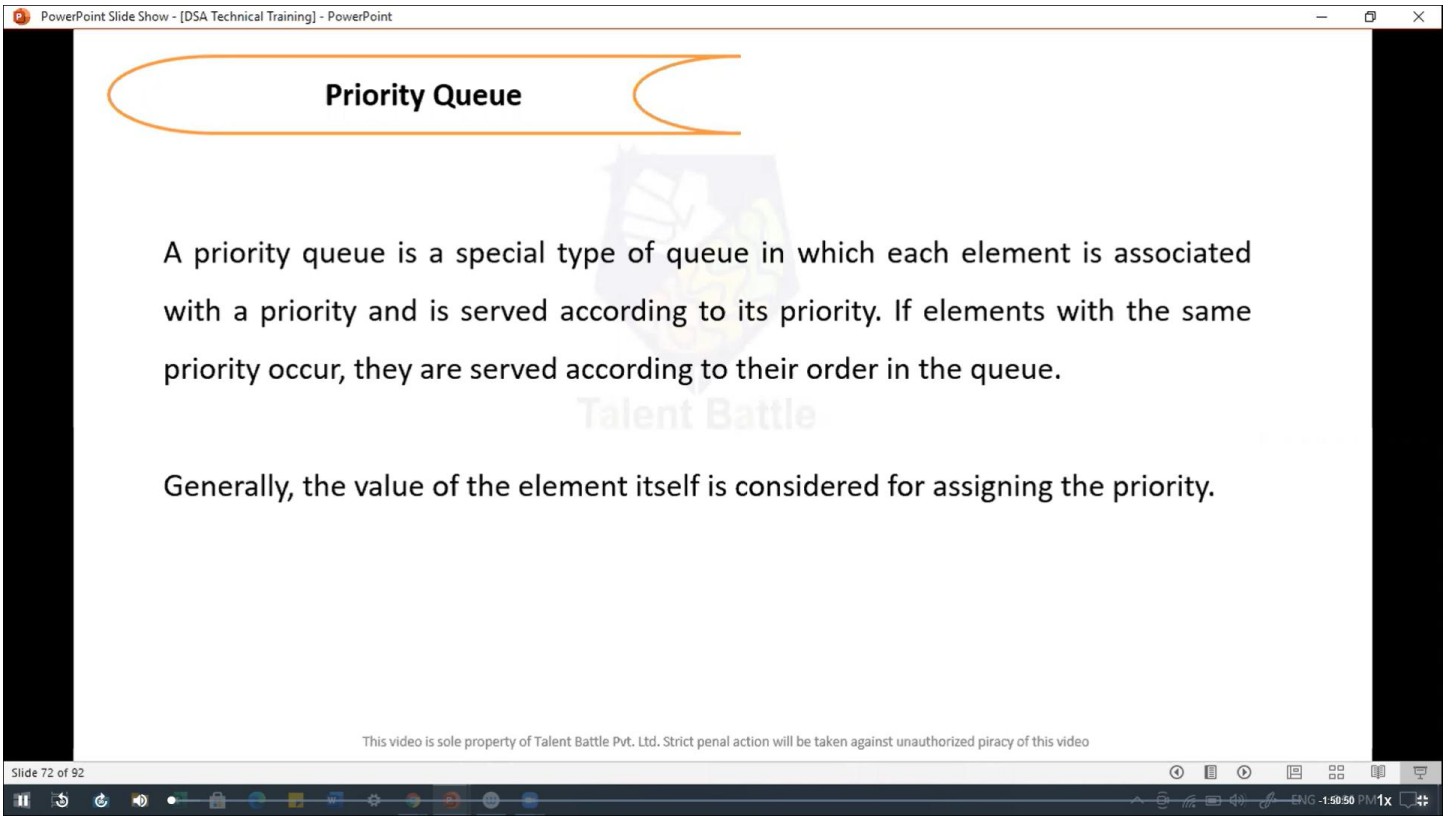
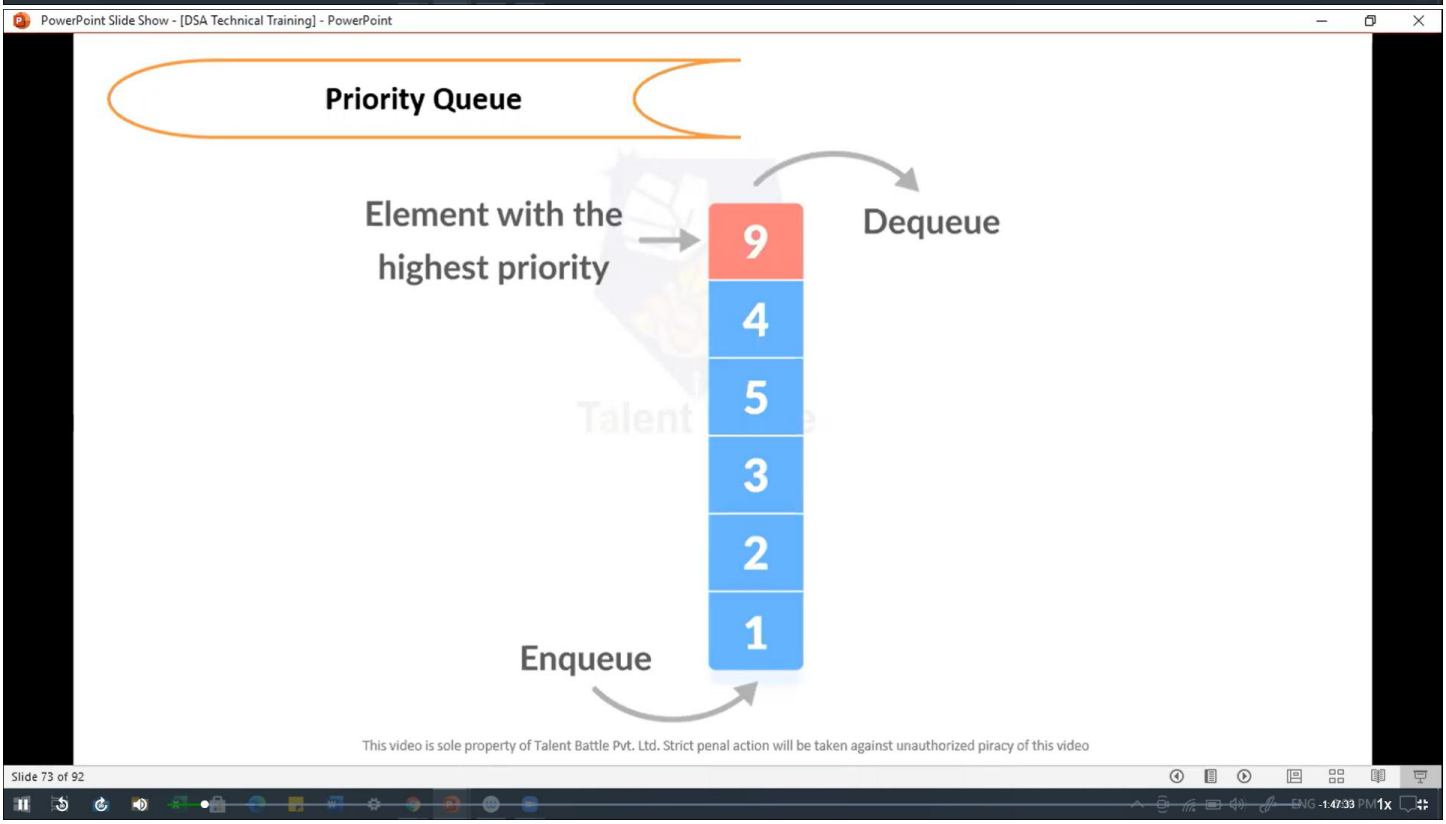
Session5

Linked list Part 1





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Priority Queue

Priority Queue Applications

Some of the applications of a priority queue are:

- Dijkstra's algorithm
- for implementing stack
- for load balancing and interrupt handling in an operating system
- for data compression in Huffman code

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Double Ended Queue (Deque)

Deque or Double Ended Queue is a type of queue in which insertion and removal of elements can be performed from either from the front or rear. Thus, it does not follow FIFO rule (First In First Out).

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Double Ended Queue (Deque)

Types of Deque

•Input Restricted Deque
In this deque, input is restricted at a single end but allows deletion at both the ends.

•Output Restricted Deque
In this deque, output is restricted at a single end but allows insertion at both the ends.

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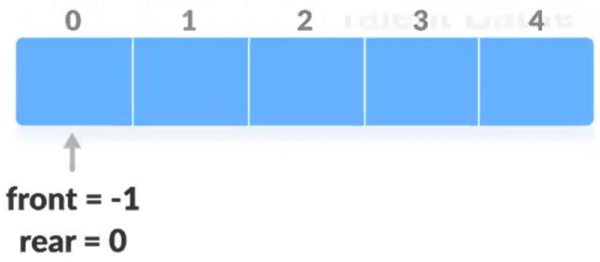
Double Ended Queue (Deque)

Operations on a Deque

Before performing the following operations, these steps are followed.
1. Take an array (deque) of size n.
2. Set two pointers at the first position and set front = -1 and rear = 0.



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Double Ended Queue (Deque)

1. Insert at the Front

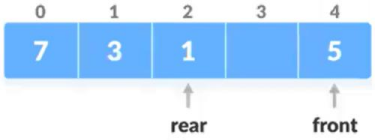
This operation adds an element at the front.

1.Check the position of front.

2. If front < 1, reinitialize front = n-1 (last index).

3. Else, decrease front by 1.

4. Add the new key 5 into array[front]



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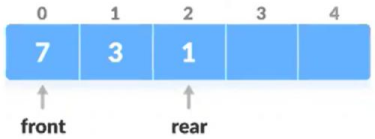
Double Ended Queue (Deque)

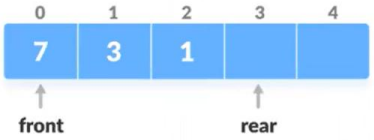
2. Insert at the Rear

This operation adds an element at the rear.

1.Check if the array is full.

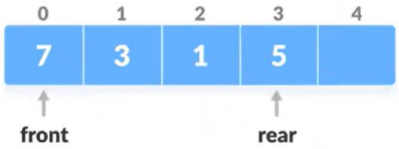


2. If the deque is full, reinitialize rear = 0 .



3. Else, increase rear by 1.

4. Add the new key 5 into array[rear]



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Double Ended Queue (Deque)

3. Delete from the Front

This operation deletes an element from the front.

1.Check if the deque is empty.

2. If the deque is empty (i.e. front = -1), deletion cannot be performed (**underflow condition**).
3. If the deque has only one element (i.e. front = rear), set front = -1 and rear = -1.
4. Else if front is at the end (i.e. front = n - 1), set go to the front front = 0.
5. Else, front = front + 1.

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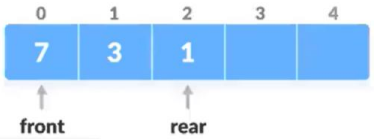
Double Ended Queue (Deque)

4. Delete from the Rear

This operation deletes an element from the rear.

1.Check if the deque is empty.



2. If the deque is empty (i.e. front = -1), deletion cannot be performed (**underflow condition**).
3. If the deque has only one element (i.e. front = rear), set front = -1 and rear = -1.
4. Else if rear is at the front (i.e. rear = 0), set go to the front rear=n-1.
5. Else, rear = rear - 1.

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Double Ended Queue (Deque)

5. Check Empty

This operation checks if the deque is empty .

Close

If front = -1, deque is empty.

6. Check Full

This operation checks if the deque is full.

If front = 0 and rear = n-1 OR front = rear+1, the deque is full.

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Deque Implementation.

Time Complexity

The time complexity of all the above operations is constant i.e. O(1).

Applications of Deque Data Structure

1.In undo operations on software.

2.To store history in browsers.

3.For implementing both stacks and queues.

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Linked List

A linked list data structure includes a series of connected nodes. Here, each node store the data and the address of the next node. For example,

You might have played the game Treasure Hunt, where each clue includes the information about the next clue. That is how the linked list operates.

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Linked List

Representation of Linked List

Let's see how each node of the linked list is represented. Each node consists:
- A data item
- An address of another node

We wrap both the data item and the next node reference in a struct as:

```
struct node
{
int data;
struct node *next;
};
```

Understanding the structure of a linked list node is the key to having a grasp on it. Each struct node has a data item and a pointer to another struct node.

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Linked List

```
/* Initialize nodes */
struct node *head;
struct node *one = NULL;
struct node *two = NULL;
struct node *three = NULL;

/* Allocate memory */
one = malloc(sizeof(struct node));
two = malloc(sizeof(struct node));
three = malloc(sizeof(struct node));
```

```
/* Assign data values */
one->data = 1;
two->data = 2;
three->data=3;

/* Connect nodes */
one->next = two;
two->next = three;
three->next = NULL;

/* Save address of first node in head */
head = one;
```

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Linked List

The power of a linked list comes from the ability to break the chain and rejoin it.
E.g. if you wanted to put an element 4 between 1 and 2, the steps would be:

- Create a new struct node and allocate memory to it.
- Add its data value as 4
- Point its next pointer to the struct node containing 2 as the data value
- Change the next pointer of "1" to the node we just created.

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Linked List

Linked List Complexity

Time Complexity

	Worst case	Average Case
Search	O(n)	O(n)
Insert	O(1)	O(1)
Deletion	O(1)	O(1)

Space Complexity: O(n)

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Linked List

Linked List Applications

- Dynamic memory allocation
- Implemented in stack and queue
- In **undo** functionality of software's
- Hash tables, Graphs

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Linked List

Linked List Operations: Traverse, Insert and Delete

```
struct node
{
int data;
struct node *next;
};
```

Two important points to remember:

- head points to the first node of the linked list
- next pointer of the last node is NULL, so if the next current node is NULL, we have reached the end of the linked list.

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