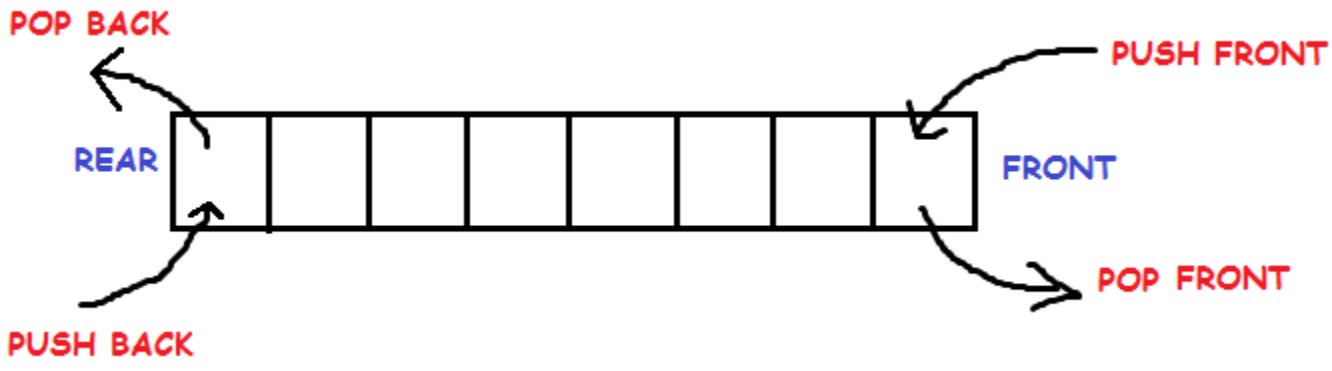
Double Ended Queue

Double ended queue is a more generalized form of queue data structure which allows insertion and removal of elements from both the ends, i.e , front and back.



Implementation of Double ended Queue

Here we will implement a double ended queue using a circular array. It will have the following methods:

- **push_back :** inserts element at back
- **push_front :** inserts element at front
- **pop_back :** removes last element
- **pop_front :** removes first element
- **get_back :** returns last element
- **get_front :** returns first element
- **empty :** returns true if queue is empty
- **full :** returns true if queue is full

```
// Maximum size of array or Dequeue



#define SIZE 5



class Dequeue

{

    //front and rear to store the head and tail pointers

    int  *arr;

    int front, rear;



    public :
```

```
    Dequeue()

    {

     //Create the array

        arr = new int[SIZE];



        //Initialize front and rear with -1

        front = -1;

        rear = -1;

    }



    // Operations on Deque

    void  push_front(int );

    void  push_back(int );

    void  pop_front();

    void  pop_back();

    int  get_front();

    int  get_back();

    bool  full();

    bool  empty();

};
```

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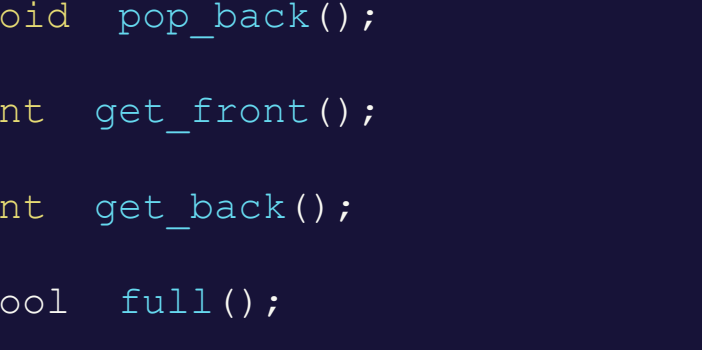
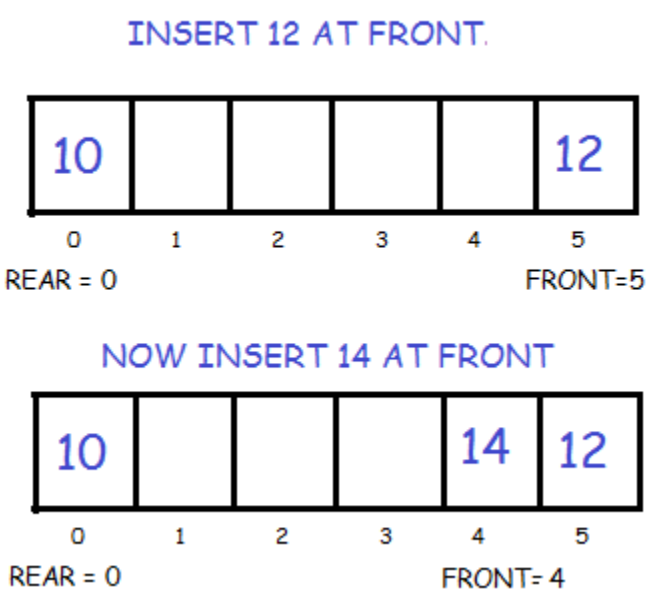
Insert Elements at Front

First we check if the queue is full. If its not full we insert an element at front end by following the given conditions :

- If the queue is empty then intialize front and rear to 0. Both will point to the first element.



- Else we decrement front and insert the element. Since we are using circular array, we have to keep in mind that if front is equal to 0 then instead of decreasing it by 1 we make it equal to SIZE-1.




```
void Dequeue :: push_front(int key)

{

    if(full())

    {

        cout << "OVERFLOW\n";

    }

    else

    {

     //If queue is empty

     if(front == -1)

          front = rear = 0;


   //If front points to the first position element

      else if(front == 0)

          front = SIZE-1;


      else

        --front;


      arr[front] = key;

  }
```

```
}
```

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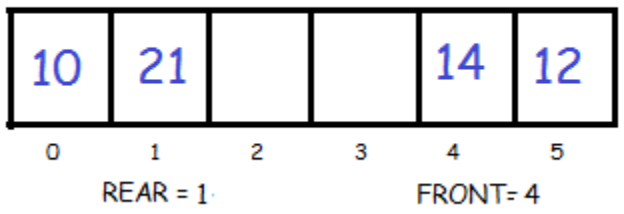
Insert Elements at back

Again we check if the queue is full. If its not full we insert an element at back by following the given conditions:

- If the queue is empty then intialize front and rear to 0. Both will point to the first element.
- Else we increment rear and insert the element. Since we are using circular array, we have to keep in mind that if rear is equal to SIZE-1 then instead of increasing it by 1 we make it equal to 0.




```
void Dequeue :: push_back(int key)

{

    if(full())

    {

        cout << "OVERFLOW\n";

    }

    else

    {

        //If queue is empty

    if(front == -1)

        front = rear = 0;


    //If rear points to the last element

    else if(rear == SIZE-1)

        rear = 0;


    else

      ++rear;
```

```
        arr[rear] = key;

    }

}
```

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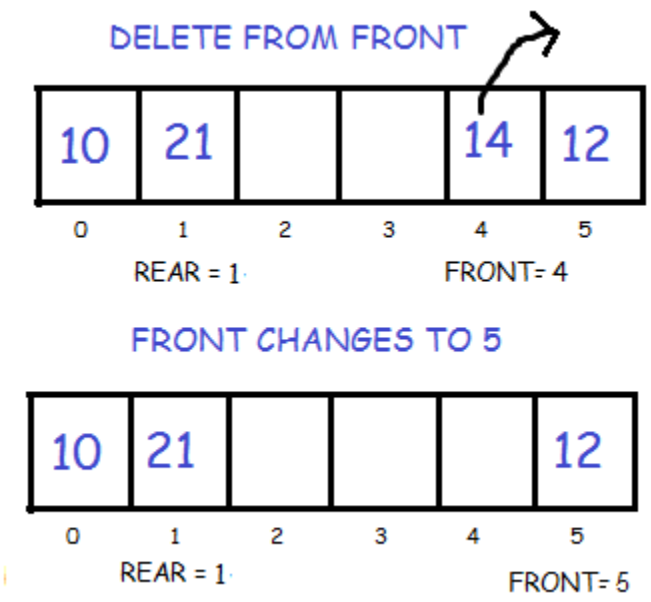
Delete First Element

In order to do this, we first check if the queue is empty. If its not then delete the front element by following the given conditions :

- If only one element is present we once again make front and rear equal to -1.
- Else we increment front. But we have to keep in mind that if front is equal to SIZE-1 then instead of increasing it by 1 we make it equal to 0.




```
void Dequeue :: pop_front()

{

    if(empty())

    {

        cout << "UNDERFLOW\n";

    }

    else

    {

     //If only one element is present

        if(front == rear)

          front = rear = -1;
```

```
        //If front points to the last element
        else if(front == SIZE-1)
          front = 0;


        else
          ++front;
    }
}
```

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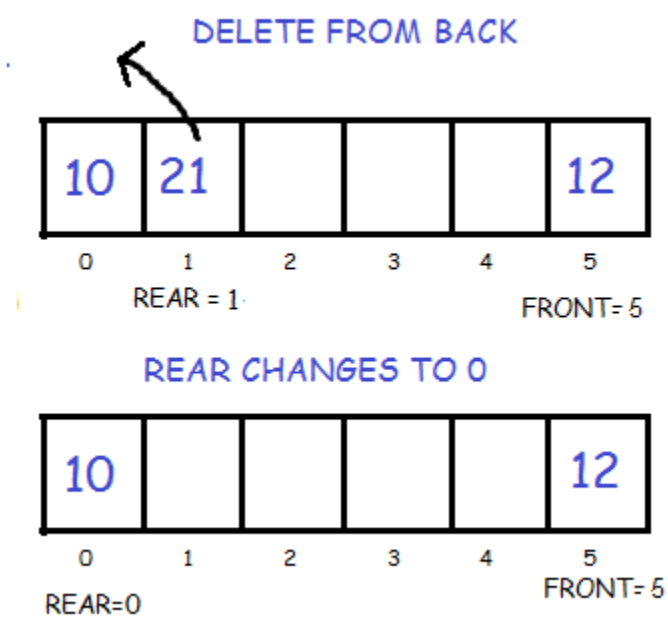
Delete Last Element

Inorder to do this, we again first check if the queue is empty. If its not then we delete the last element by following the given conditions :

- If only one element is present we make front and rear equal to -1.
- Else we decrement rear. But we have to keep in mind that if rear is equal to 0 then instead of decreasing it by 1 we make it equal to SIZE-1.




```
void Dequeue :: pop_back()
{
    if(empty())
    {
        cout << "UNDERFLOW\n";
    }
    else
```

```
    {
     //If only one element is present
        if(front == rear)
          front = rear = -1;

        //If rear points to the first position element
        else if(rear == 0)
          rear = SIZE-1;

        else
            --rear;
    }
}
```

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Check if Queue is empty

It can be simply checked by looking where front points to. If front is still intialized with -1, the queue is empty.

```
bool Dequeue :: empty()
{
    if(front == -1)
     return true;
    else
     return false;
}
```

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Check if Queue is full

Since we are using circular array, we check for following conditions as shown in code to check if queue is full.

```
bool Dequeue :: full()
```

```
{

    if((front == 0 && rear == SIZE-1)   ||

     (front == rear + 1))

        return true;

    else

        return false;

}
```

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Return First Element

If the queue is not empty then we simply return the value stored in the position which front points.

```
int Dequeue :: get_front()

{

    if(empty())

    {cout << "f=" <<front << endl;

        cout << "UNDERFLOW\n";

        return -1;

    }

    else

    {

        return arr[front];

    }

}
```

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Return Last Element

If the queue is not empty then we simply return the value stored in the position which rear points.

```
int Dequeue :: get_back()

{
```

```
    if(empty())
    {
        cout << "UNDERFLOW\n";
        return -1;
    }
    else
    {
        return arr[rear];
    }
}
```

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