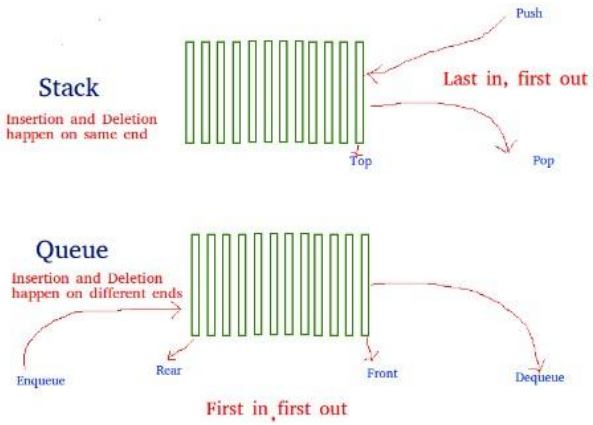
Implementing Stack using Queue

Problem: Given a Queue data structure that supports standard operations like enqueue() and dequeue(). We need to implement a Stack data structure using only instances of Queue and queue operations allowed on the instances.



This problem is just the opposite of the problem described in the previous post of implementing a queue using stacks. Similar to the previous problem, a **stack** can also be implemented using two queues. Let stack to be implemented be **'s'** and queues used to implement be **'q1'** and **'q2'**.

Stack 's' can be implemented in two ways:

- **Method 1 (By making push operation costly)**: This method makes sure that newly entered element is always at the front of 'q1', so that pop operation just dequeues from 'q1'. The queue, 'q2' is used to put every new element at front of 'q1'.

```
push(s, x) // x is the element to be pushed and s is stack
  1) Enqueue x to q2
  2) One by one dequeue everything from q1 and enqueue to q2.
  3) Swap the names of q1 and q2
// Swapping of names is done to avoid one more
// movement of all elements from q2 to q1.

pop(s)
  1) Dequeue an item from q1 and return it.
```

Implementation:

C++ Java

```
// C++ pogram to implement a stack using two queues
#include<bits/stdc++.h>
using namespace std;
// Stack class
class Stack
{
    // Two inbuilt queues
    queue<int> q1, q2;
    // To maintain current number of elements
    int curr_size;
    public:
    Stack()
    {
        curr_size = 0;
    }
    // Function to implement push() operation
    void push(int x)
    {
        curr_size++;
        // Push x first in empty q2
        q2.push(x);
        // Push all the remaining elements in q1 to q2.
        while (!q1.empty())
        {
            q2.push(q1.front());
            q1.pop();
        }
        // swap the names of two queues
        queue<int> q = q1;
```

```
        q1 = q2;
        q2 = q;
    }
    // Function to implement pop() operation
    void pop(){
        // if no elements are there in q1
        if (q1.empty())
            return ;
        q1.pop();
        curr_size--;
    }
    // Function to return top element of implemented Stack
    int top()
    {
        if (q1.empty())
            return -1;
        return q1.front();
    }
    // Function to return size of stack
    int size()
    {
        return curr_size;
    }
};
// Driver code
int main()
{
    Stack s;
    s.push(1);
    s.push(2);
    s.push(3);
    cout << "current size: " << s.size() << endl;
    cout << s.top() << endl;
    s.pop();
    cout << s.top() << endl;
    s.pop();
    cout << s.top() << endl;
    cout << "current size: " << s.size()  << endl;
    return 0;
}
```

Output :

```
current size: 3
3
2
1
current size: 1
```

Method 2 (By making pop operation costly): In push operation, the new element is always enqueued to q1. In pop() operation, if q2 is empty then all the elements except the last, are moved to q2. Finally the last element is dequeued from q1 and returned.

```
push(s,  x)
  1) Enqueue x to q1 (assuming size of q1 is unlimited).

pop(s)
  1) One by one dequeue everything except the last element
     from q1 and enqueue to q2.
  2) Dequeue the last item of q1, the dequeued item
     is the result, store it.
  3) Swap the names of q1 and q2
  4) Return the item stored in step 2.
// Swapping of names is done to avoid one more
// movement of all elements from q2 to q1.
```

Implementation:

```cpp
// Program to implement a stack using two queues
#include<bits/stdc++.h>
using namespace std;
// Stack class
class Stack
{
    queue<int> q1, q2;
    int curr_size;
    public:
    Stack()
    {
        curr_size = 0;
    }
    void pop()
    {
        if (q1.empty())
            return;
        // Leave one element in q1 and push others in q2.
        while (q1.size() != 1)
        {
            q2.push(q1.front());
            q1.pop();
        }
        // Pop the only left element from q1
        q1.pop();
        curr_size--;
        // swap the names of two queues
        queue<int> q = q1;
        q1 = q2;
        q2 = q;
```

```
    }
    void push(int x)
    {
        q1.push(x);
        curr_size++;
    }
    int top()
    {
        if (q1.empty())
            return -1;
        while( q1.size() != 1 )
        {
           q2.push(q1.front());
           q1.pop();
        }
        // last pushed element
        int temp = q1.front();
        // to empty the auxiliary queue after last operation
        q1.pop();
        // push last element to q2
        q2.push(temp);
        // swap the two queues names
        queue<int> q = q1;
        q1 = q2;
        q2 = q;
        return temp;
    }
    int size()
    {
        return curr size;
    }
};
// Driver code
int main()
{
    Stack s;
    s.push(1);
    s.push(2);
    s.push(3);
    s.push(4);
    cout << "current size: " << s.size() << endl;
    cout << s.top() << endl;
    s.pop();
    cout << s.top() << endl;
    s.pop();
    cout << s.top() << endl;
    cout << "current size: " << s.size()  << endl;
    return 0;
}
```

Output :

```
current size: 4
4
3
2
current size: 2
```