Stack Problems - I

Infix, Postfix and Prefix Expressions

Infix to Postfix Conversion (Logic)

Infix to Postfix Conversion

1. If we have an opening parenthesis "(", we push it into the stack.
2. If we have an operand, we append it to our postfix expression.
3. If we have a closing parenthesis ")" we keep popping out elements from the top of the stack and append them to our postfix expression until we encounter an opening parenthesis. We pop out the left parenthesis without appending it.
4. If we encounter an operator:-

   4.1. If the operator has higher precedence than the one on top of the stack (We can compare), we push it in the stack.

   4.2. If the operator has lower or equal precedence than the one on top of the stack, we keep popping out and appending it to the postfix expression.
5. When the last token of infix expression has been scanned, we pop the remaining elements from stack and append them to our postfix expression.*

Evaluation of Postfix Expression (Logic)

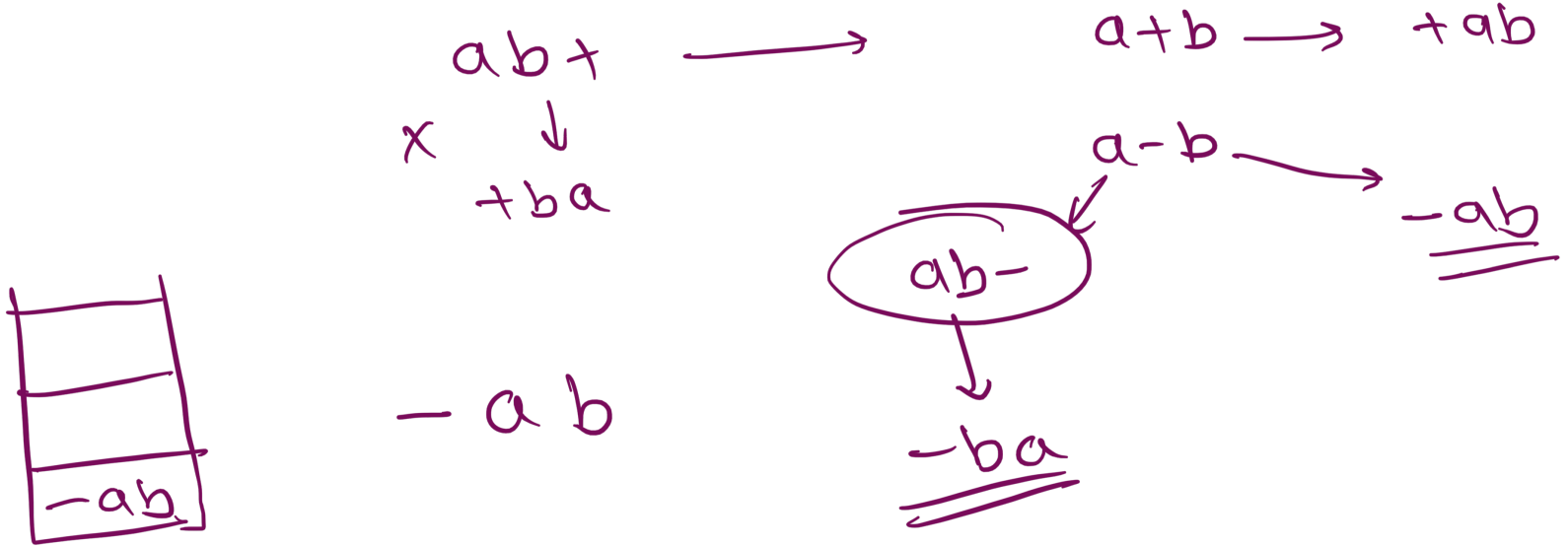
Infix to Prefix Conversion (Logic)

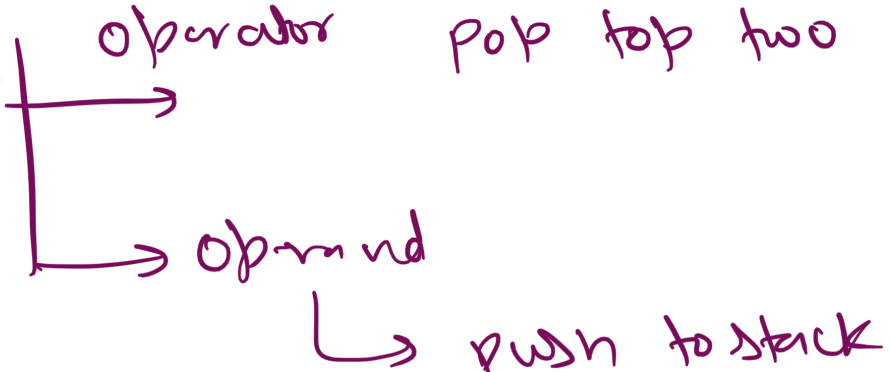
Infix to Prefix Conversion

1. First, reverse the infix expression given in the problem.
2. Scan the expression from left to right.
3. Whenever the operands arrive, print them.
4. If the operator arrives and the stack is found to be empty, then simply push the operator into the stack.
5. If the incoming operator has higher precedence than the TOP of the stack, push the incoming operator into the stack.
6. If the incoming operator has the same precedence with a TOP of the stack, push the incoming operator into the stack.
7. If the incoming operator has lower precedence than the TOP of the stack, pop, and print the top of the stack. Test the incoming operator against the top of the stack again and pop the operator from the stack till it finds the operator of a lower precedence or same precedence.
8. If the incoming operator has the same precedence with the top of the stack and the incoming operator is ^, then pop the top of the stack till the condition is true. If the condition is not true, push the ^ operator.
9. When we reach the end of the expression, pop, and print all the operators from the top of the stack.
10. If the operator is ')', then push it into the stack.
11. If the operator is '(', then pop all the operators from the stack till it finds) opening bracket in the stack.
12. If the top of the stack is ')', push the operator on the stack.
13. At the end, reverse the output.

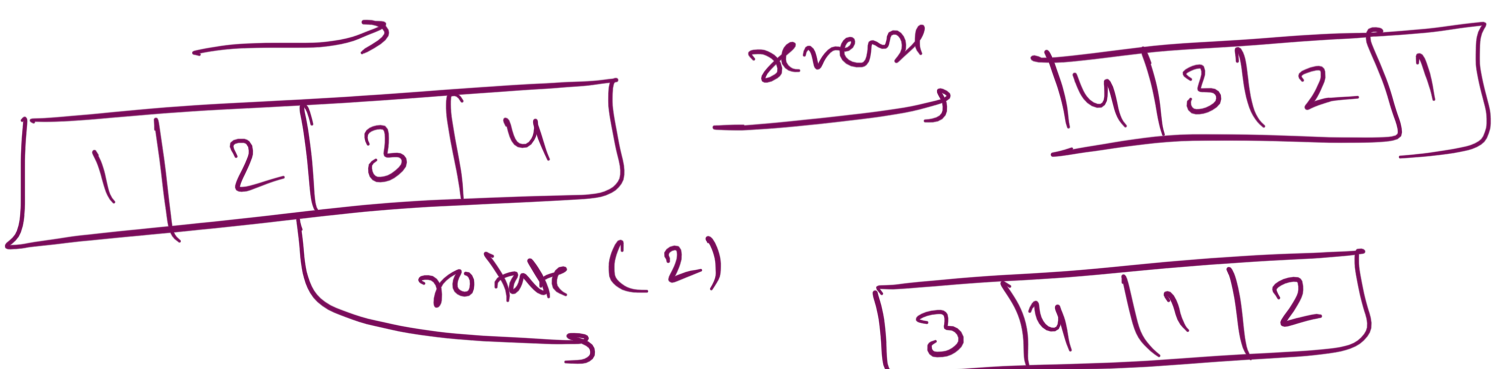
Evaluation of Prefix Expression (Logic)

Convert a Postfix expression to a Prefix Expression





op1 = stack.pop()
op2 = stack.pop()
"operator op2 op1"
↓
push to stack.



Stack Problems - II

Implement Two stacks using one Array

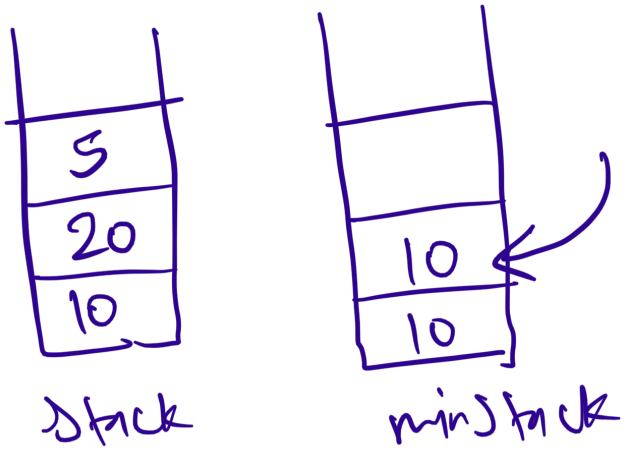
Find Maximum Area in a Histogram

Find Maximum Area Submatrix in a Matrix

Implement minStack using O(n) extra space

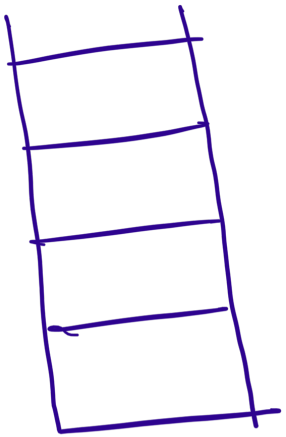
Practice Problems

1. Implement k Stacks using Array
2. Implement minStack using O(1) space
3. Simplify Directory Path
4. https://www.interviewbit.com/courses/programming/stacks-and-queues/



Stack minStack

O(N) space



Node {
data ←
min ←
}

var minElement →
↳ min

Push
↳

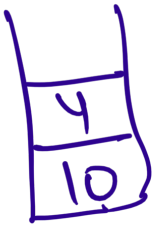
if (t >= min)
stack.push(t)

else
stack.push(2*t - min)
min = t;

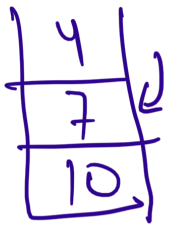
2*5 - 10
= 0

Pob

```
t = stack.pop();
if (t >= min)
    return t;
else
    ans = min
    min = 2*min - t
    return ans;
```



min = 7



Virtual

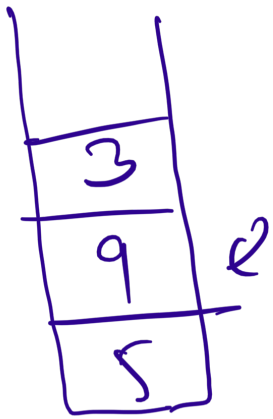
$t < min$

$t - min < 0$

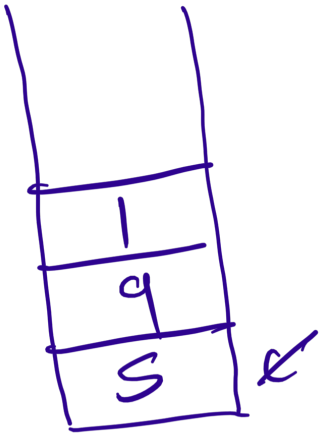
$2t - min < t$

$t - min < 0$

$\boxed{2*t - min < t}$



fictional



actual

min = 3

$2*2-5 = -1$

$t = -1$ ans = 2

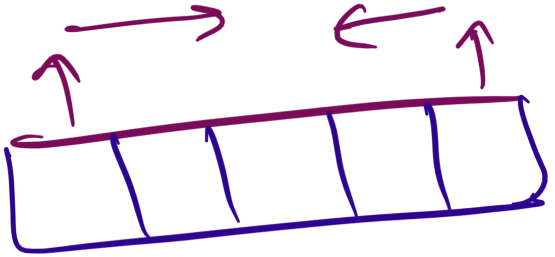
$2*2-(-1) = 5$

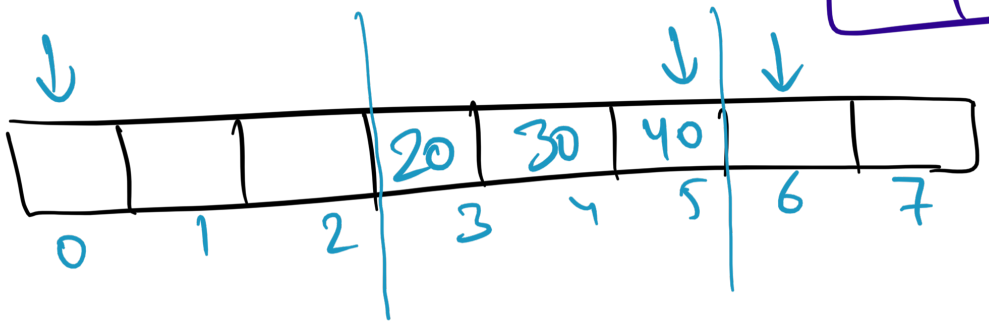
$2*1-5 = -3$

$t = -3$ ans = 1

min = $2*1-(-3) = 5$

Implement k - Stacks

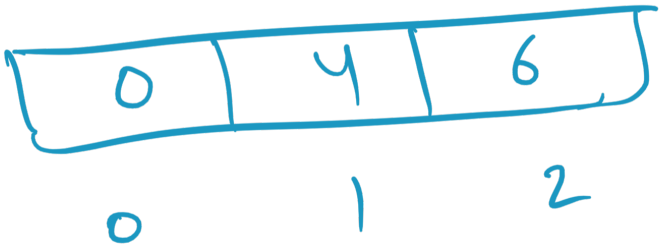




3

$\frac{8}{3} + 1 \rightarrow 3$

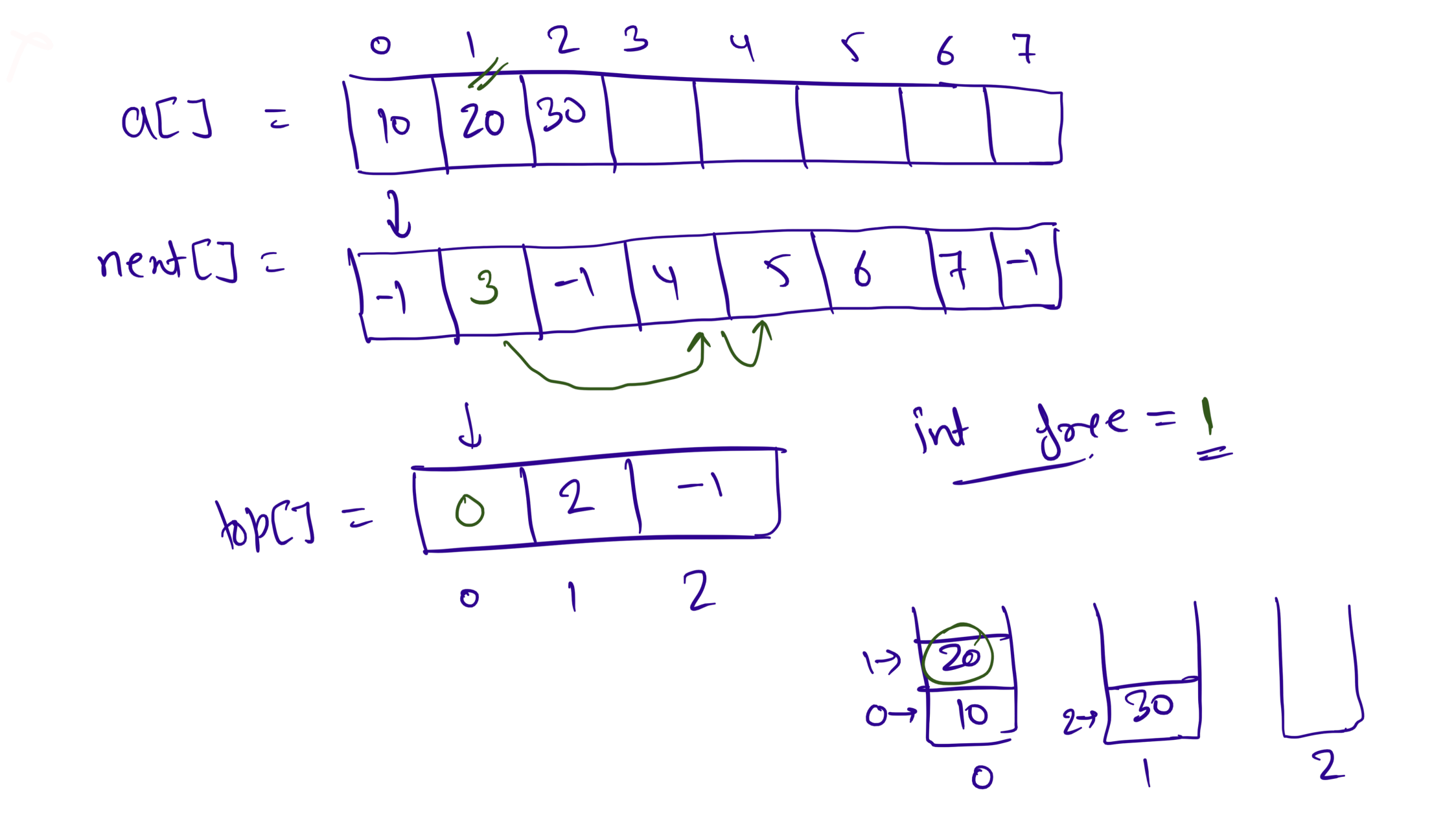
// top[] =



push(20, 1)

// isFull(i)

isEmpty(i)


0 1 2 3 4 5 6 7
a[] =
10 20 30
next[] =
-1 3 -1 4 5 6 7 -1
top[] =
0 2 -1
0 1 2
int free = 1
1→ 20
0→ 10
2→ 30
0
1
2

data sn

push(10, 0)

j = free

free = next[i]

next[i] = top[sn]

top[sn] = i

a[i] = data

push(20, 0)

sn

pop(0)

i = top[sn]

top[sn] = next[i]

next[i] = free

free = i

return a[i];

isfull() {

return free == -1;

}

a[] = {2, 3, 4 | 1, 5 | 3, 1}

b = 3

$$S(a) = \min\left(\sum_{0}^{b} (sub)^2 \right)$$

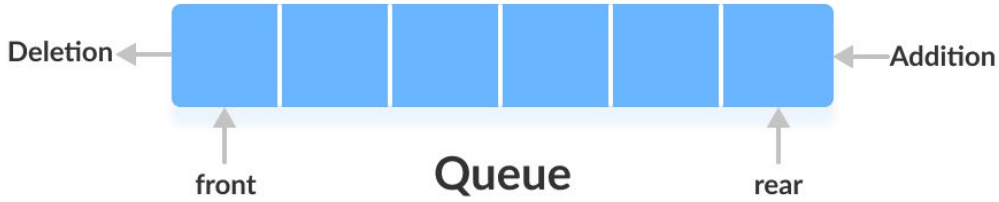
min = 0
max = sum²

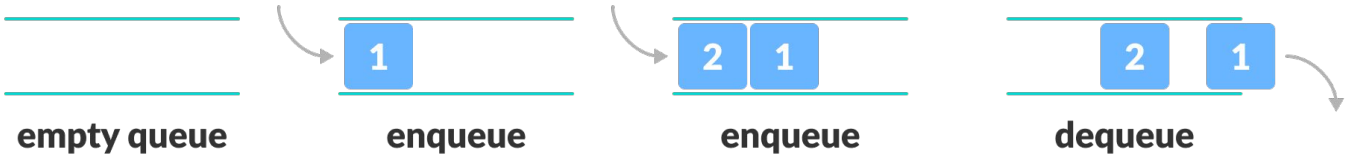
mid = x, l = mid+1, r = mid-1

$(2)^2$	$(3\ 4)^2$	$(5)^2$

Queue Basics

Queue Data Structure



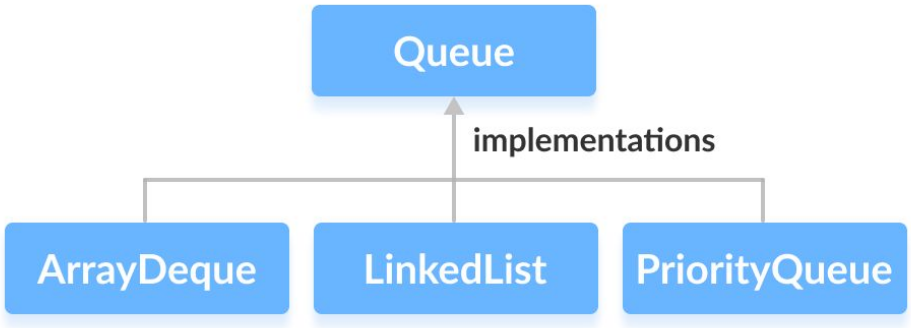


Implement Queue Using Linked List

Implement Queue Using Array

Implement Queue Using Circular Array

Queue Interface in Collection Framework



Methods of Queue

- **add()** - Inserts the specified element into the queue. If the task is successful, `add()` returns `true`, if not it throws an exception.
- **offer()** - Inserts the specified element into the queue. If the task is successful, `offer()` returns `true`, if not it returns `false`.
- **element()** - Returns the head of the queue. Throws an exception if the queue is empty.
- **peek()** - Returns the head of the queue. Returns `null` if the queue is empty.
- **remove()** - Returns and removes the head of the queue. Throws an exception if the queue is empty.
- **poll()** - Returns and removes the head of the queue. Returns `null` if the queue is empty.

Implement Queue using Two Stacks

Practice Problems

1. Implement Stack using Two Queues
2. Implement Stack using One Queue
3. Reverse a Queue
4. Reverse the first k elements of the Queue