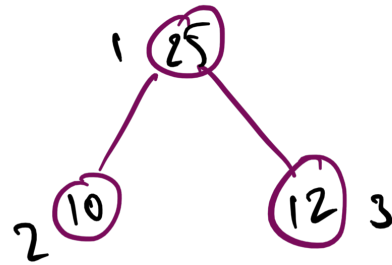
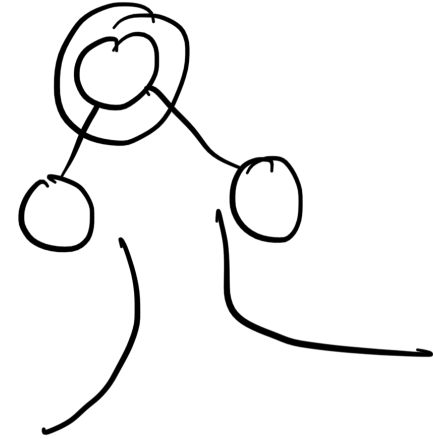


Heaps - I

Maxheap



isBST(Node root) {



isHeap(int i) {

if (a[i] > a[left]) {

a[i] > a[right] {

isHeap(left) {

isHeap(right)

return true;

return false;

i

left → $2 \times i$

right → $2 \times i + 1$

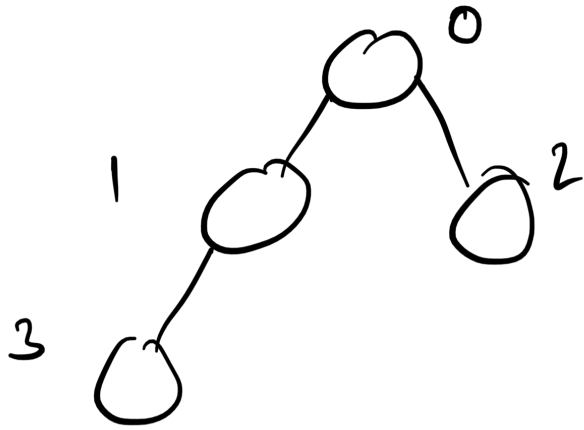
•

i

left → $2 \times i + 1$

right → $2 \times i + 2$

}



$n = 4$
 $[\frac{n}{2} = 2 \dots n-1]$
 $[0, \frac{n}{2})$
left right



Basics of Heaps



Insertion in Heaps



Deletion in Heaps & Heapify



Practice Problems

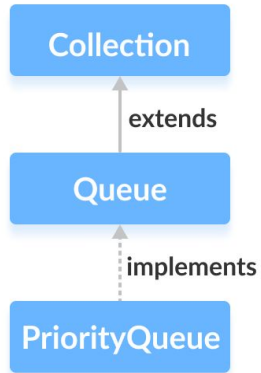
1. Read about the Heap Sort Algorithm
2. Read about the PriorityQueue Class in Java

Priority Queue - I



HeapSort Algorithm

PriorityQueue in Java



The `PriorityQueue` class provides the implementation of all the methods present in the `Queue` interface.



Find the kth Largest Element in an Array.



Practice Problems

1. Maximum sum of at most two non-overlapping intervals in a list of Intervals | Interval Scheduling Problem
- ✓ 2. Split Array into K non-overlapping subset such that maximum among all subset sum is minimum
3. Maximize profit possible by selling M products such that profit of a product is the number of products left of that supplier

Priority Queue - II



Connect n ropes with minimum cost



Split Array in k subarrays where the maximum sum is minimum

4, 1, 5, 3, 7, 2 | 1, 2, 3, 4, 5, 7

Sort

K=3

right to left

=

4, 7
=

1, 3, 2
=

5
=

7, 1

5, 2

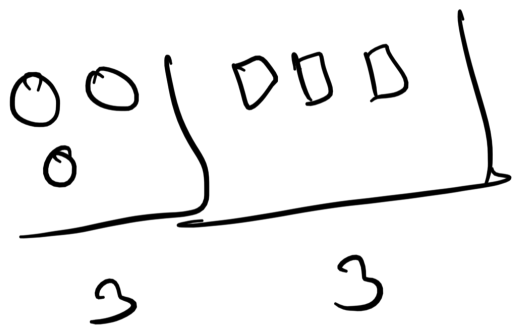
4, 3

M products

$$a[] = \{4, 6\}$$

$$= m = 4$$

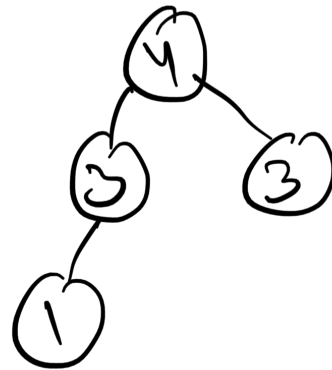
minimize profit \rightarrow Number of products left



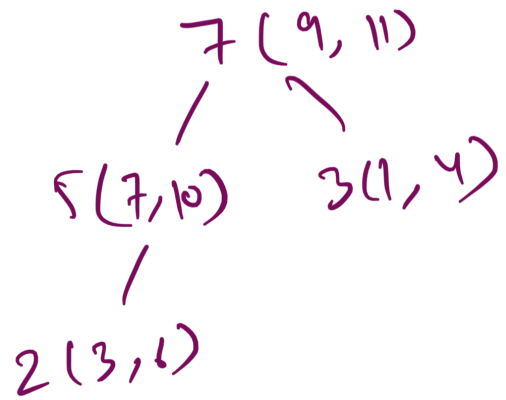
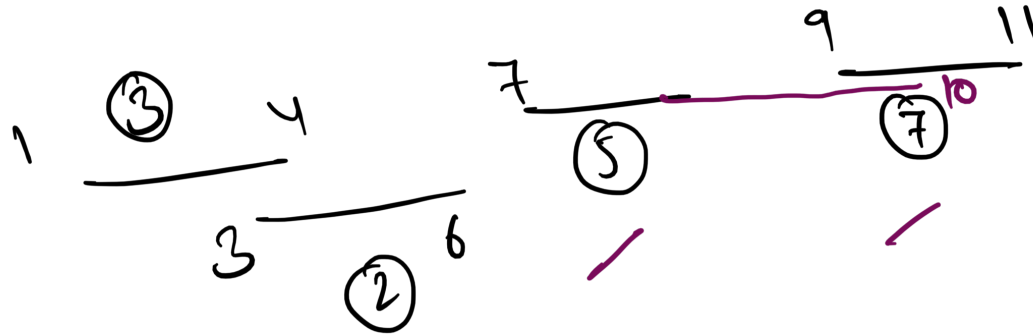
$$\text{profit} = 6 + 5 + 4 + 4$$
$$= \underline{\underline{19}}$$

$$a[] = \{4, 3, 1, 6\} \rightarrow$$

$$= \text{profit} = 6 + 5 + 4$$

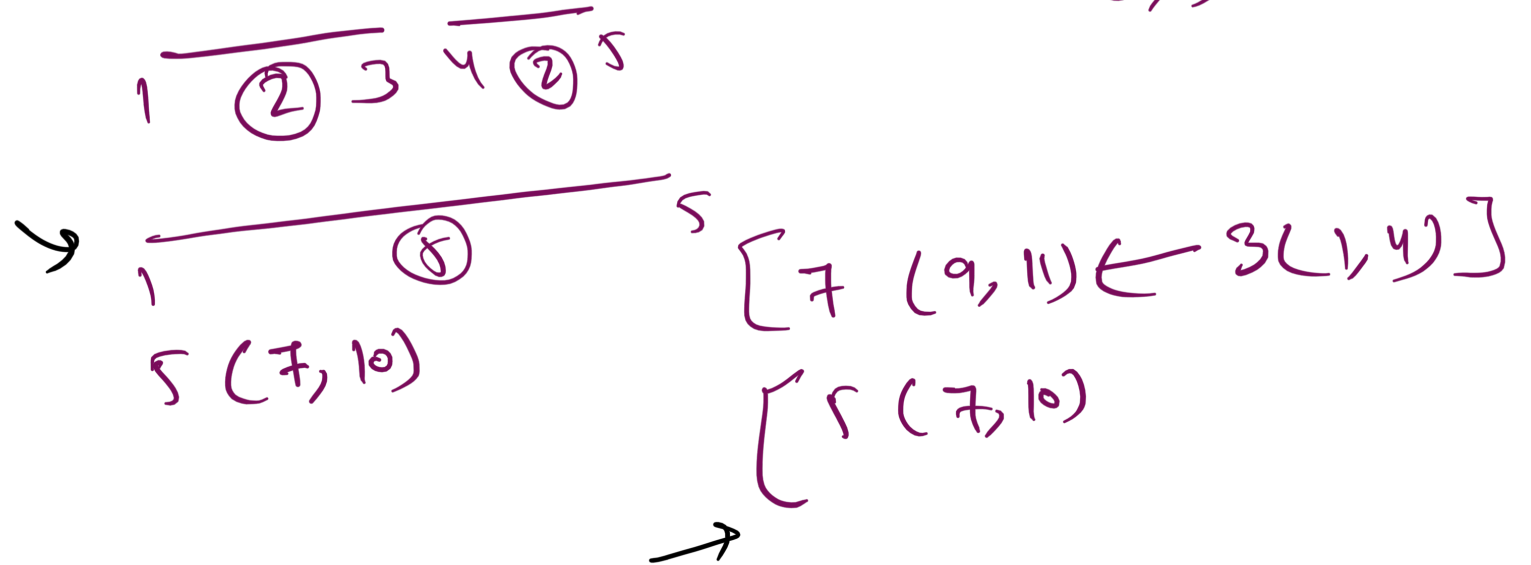


Interval scheduling.



$7(9, 11)$

$5(1, 5)$
 $2(1, 3)$ $2(4, 5)$

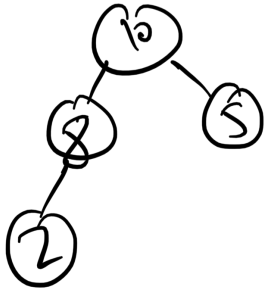




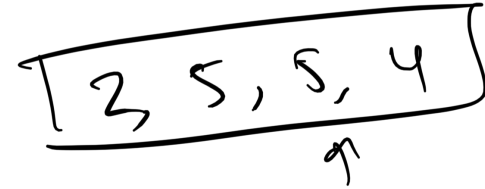
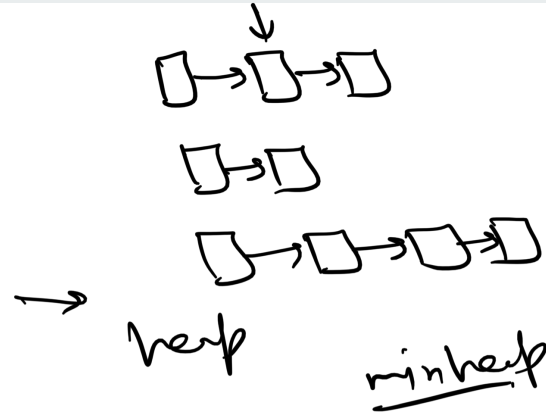
Find the median in a running stream of numbers.

Practice Problems

- 1. Merge k sorted lists → LL
- ✓ 2. Check if a given array represents a binary heap
3. [Magician and chocolates](#)
4. [N max pair combinations](#)
5. <https://www.interviewbit.com/courses/programming/heaps-and-maps>



ans = 10 + 8



$a = [1, 4, 2, 3] \leftarrow i$ $\rightarrow [1, 2, 3, 4] \leftarrow i$
 $b = [2, 5, 3, 6] \leftarrow j$ $\rightarrow [2, 3, 5, 6] \leftarrow j$

\downarrow
 N

$$\text{sum} = a[i] + b[j]$$

$q(2, 3)$

$$\text{ans} = 10 + 9 + 9$$

$q(3, 2) \rightarrow$
 $\swarrow \quad \searrow$
 $8(1, 3) \quad 8(2, 2)$

$8(1, 3)$
 \downarrow
 $8(2, 2)$

class Pair {
 int sum;
 int i, j;
 }

Disjoint Sets



Introduction to Disjoint Sets



Implementation of Union - Find



Union - Find with Rank



Union - Find with Path Compression