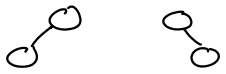
Last time on Priority Queues

PQ is an ADT w/

- ✓ peek()
- P peekPrio()
- void enqueue(P, V) — insert
- V dequeue() — remove



What is a binary tree?

A tree where all nodes have at most one left child and at most one right child

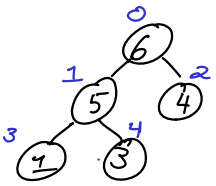
complete binary tree?

A binary tree where all levels of the tree are completely packed except the last, which is packed to the left.

max-heap?

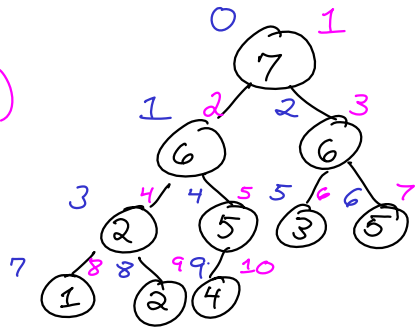
A complete binary tree where all nodes contain priorities which is ≥ that of their children.

Method enqueue(prio, value)
add prio, value to "end" of tree
bubble up "end"
End Method



6	5	4	1	3

getParentIndex(idx)
return $\left\lfloor \frac{idx}{2} \right\rfloor$
end



7 6 6 2 5 3 5 1 2 4

getParentIndex(idx)
return $\left\lfloor \frac{idx+1}{2} \right\rfloor - 1$
end

idx*2
getLeftChildIndex
(idx+1)*2-1
return idx*2+1
end

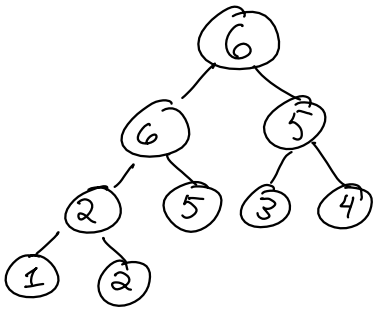
idx*2+1
getRightChildIndex
return idx*2+2
end

Method bubbleUp(idx)
IF idx==0: Return
pidx ← getParentIndex(idx)
If contents.get(idx) > contents.get(pidx):
tmp ← contents.get(idx)
contents.set(idx, contents.get(pidx))
contents.set(pidx, tmp)
bubbleUp(pidx)
EndIf
EndMethod

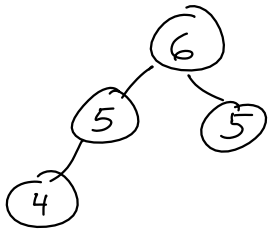
worst case O(n)
amortized case O(log n)

Method enqueue(prio, value)
contents.insertLast((prio, value))
bubbleUp(contents.getSize()-1)
End Method

amortized O(1)
O(log n)




```
Method dequeue()
    Swap index contents.getSize()-1 w/ index 0
    answer ← contents.removeLast()
    bubbleDown(0)
    Return answer.second
End Method
```




```
Method bubbleDown(idx)
    lidx ← getLeftChildIndex(idx)
    ridx ← getRightChildIndex(idx)
    If lidx ≥ contents.getSize(): Return
    If ridx ≥ contents.getSize() and contents.get(idx) < contents.get(lidx):
        swap index idx w/ index lidx
        Return
    EndIf
    If contents.get(idx) < contents.get(lidx) or contents.get(idx) < contents.get(ridx):
        If contents.get(lidx) > contents.get(ridx):
            swap index idx w/ index lidx
            bubbleDown(lidx)
        Else:
            swap index idx w/ index ridx
            bubbleDown(ridx)
        EndIf
    EndIf
End Method
```

assumes left & right children