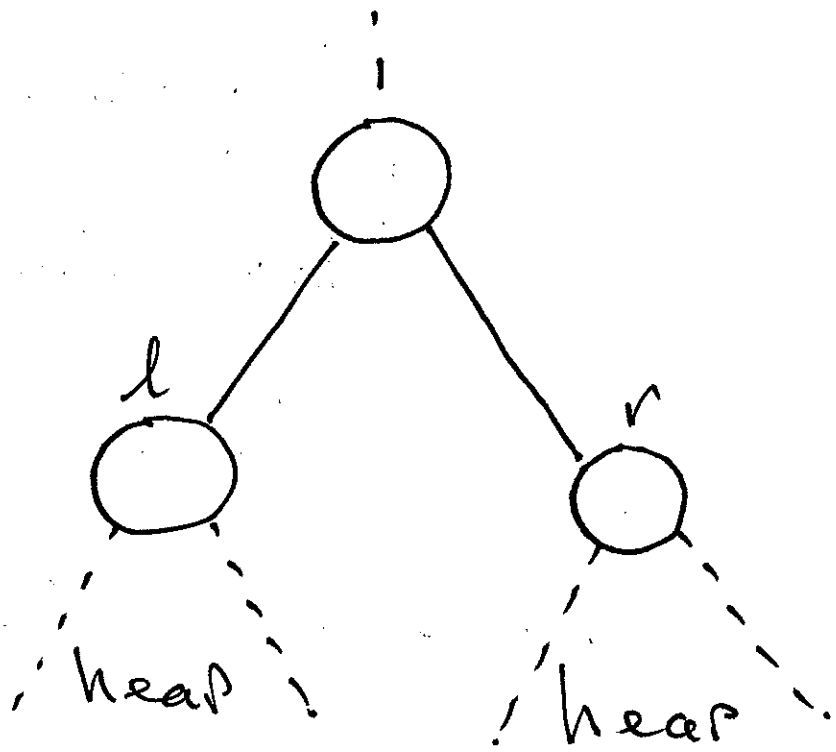
CSE 101 3-12-25

- Final: Tue 3/18, 12-2 PM
- SETs: Due SUN. 3/16 11:59 PM.
  If response rate is ≥ 80%, will add 0.5% to all overall scores.
- Pas: ext. 1 last day

Algorithms for a (max) heap.

- Heapify() ✓
- BuildHeap() ✓
- HeapSort()
- P.Q. operations
  - HeapMaximum
  - HeapDeleteMax
  - HeapExtractMax
  - HeapIncreaseKey
  - HeapInsert

6.2 Heapify



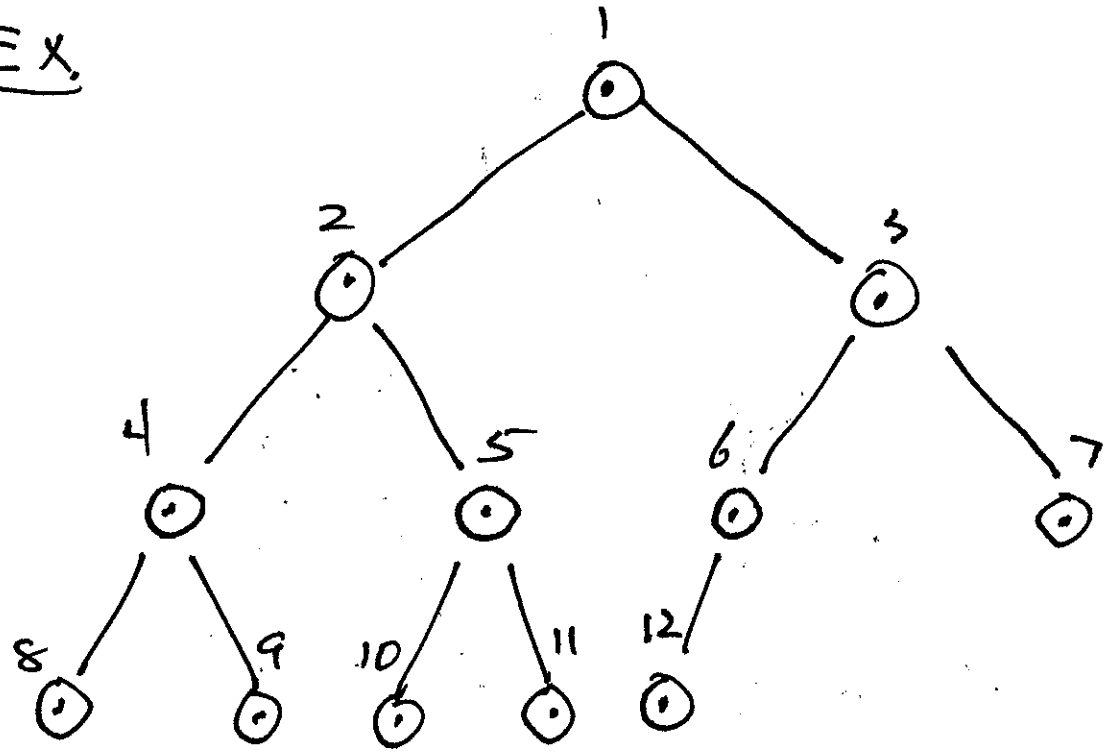
Pre: l, r are valid heaps

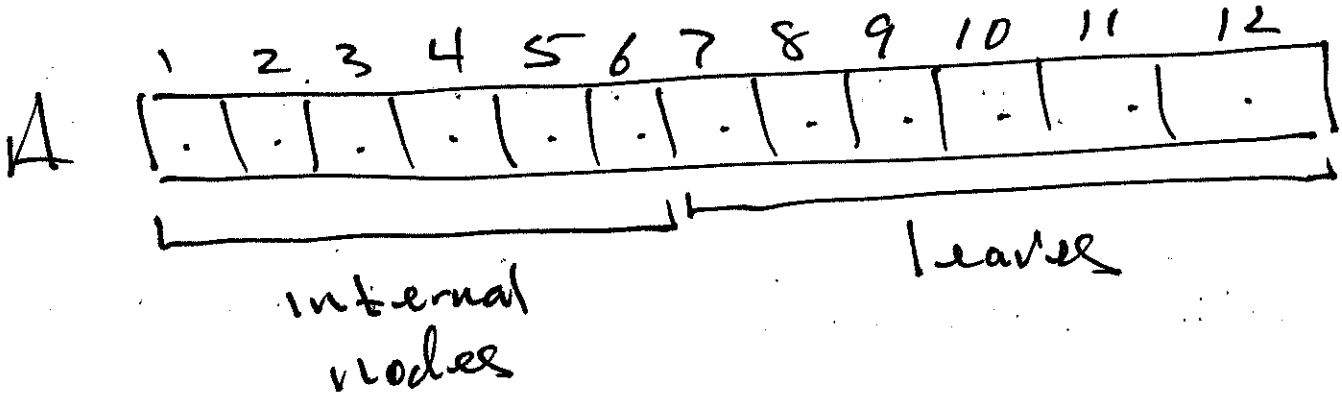
Heapify(A, i) establishes (max) heap property at i

Worst case runtime: $\lfloor \lg n \rfloor = \Theta(\log n)$.

6.3 BuildHeap

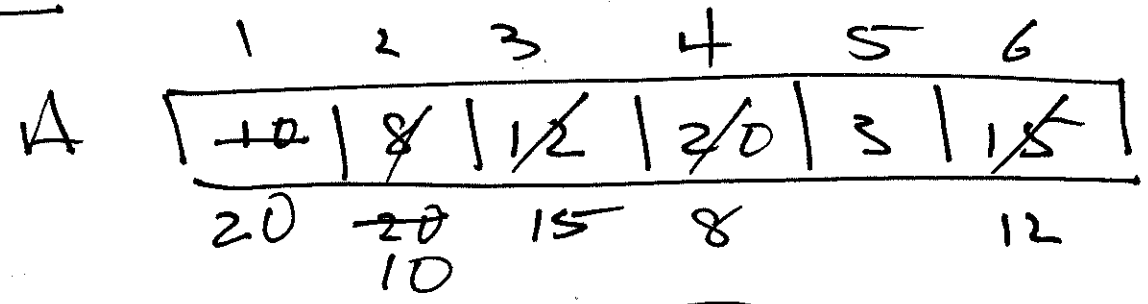
Ex.

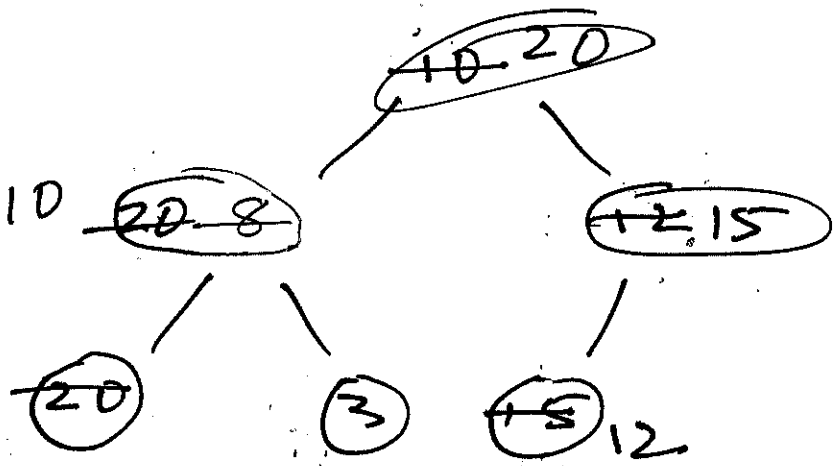


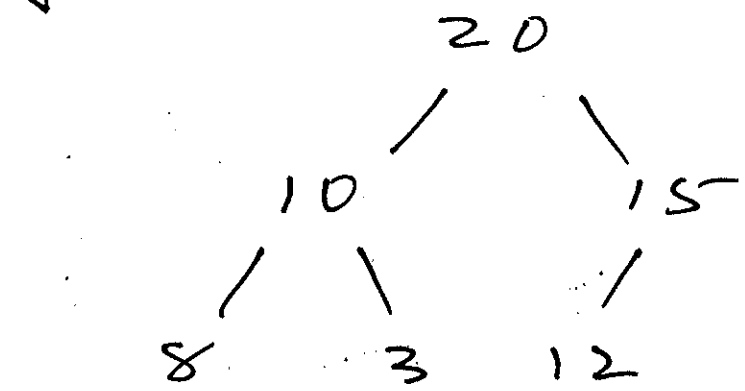


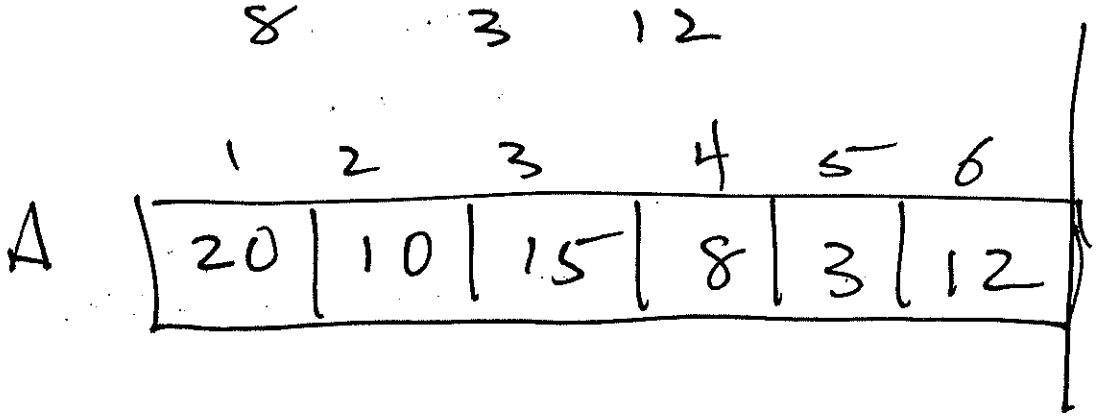
Runtime: $\Theta(n)$

Ex.


1 2 3 4 5 6
A
10 8 12 20 3 15
20 20 15 8 12
10


10 20
10 20 8
12 15
8 20 3 15 12

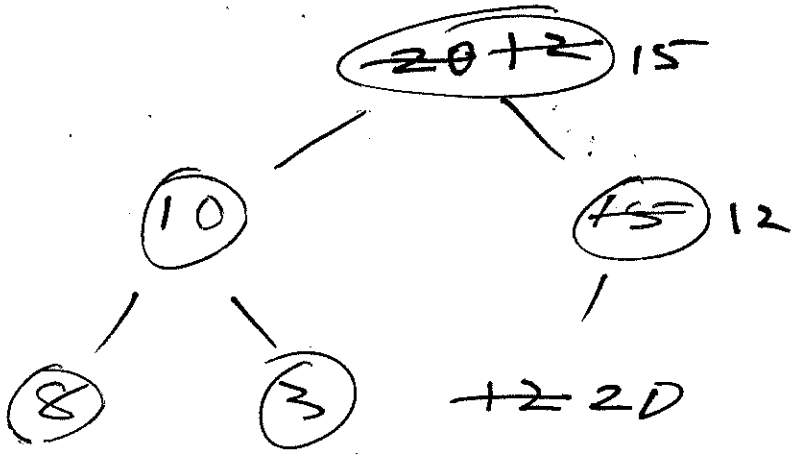

20
10 15
8 3 12


1 2 3 4 5 6
A
20 10 15 8 3 12

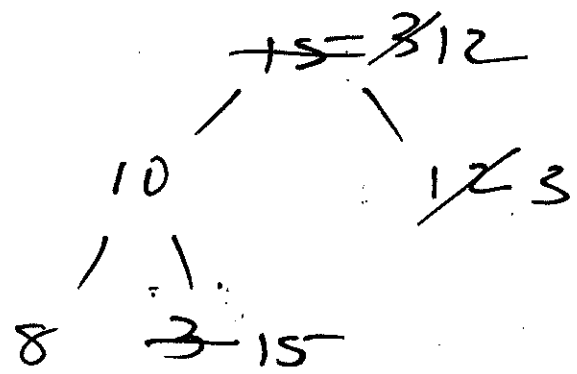
6.4 Heapsort

start: $A = (10, 8, 12, 20, 3, 15)$

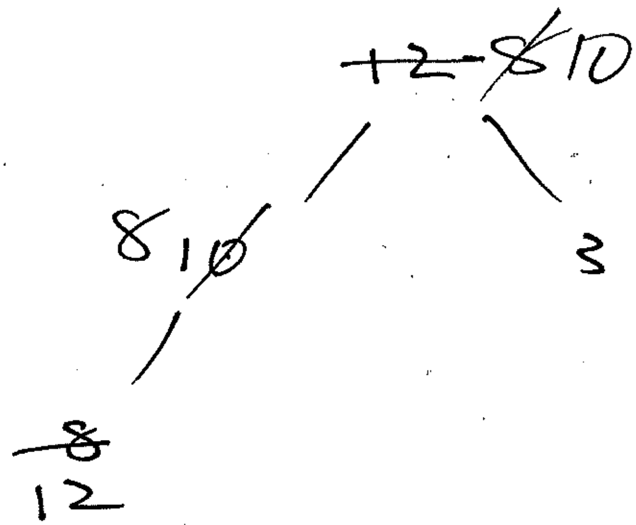
BuildHeap: $A = (\overset{15}{\cancel{20}}, 10, \overset{12}{\cancel{15}}, 8, 3 \mid \overset{20}{\cancel{12}})$



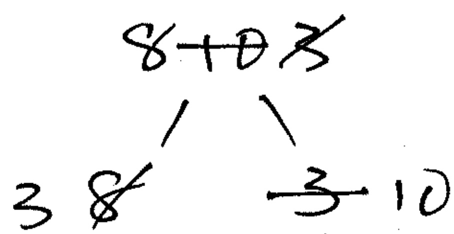
A: $\overset{12}{\cancel{15}}$ 10 $\overset{3}{\cancel{12}}$ 8 $\mid \overset{15}{\cancel{3}} \mid$ 20



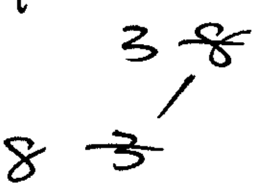
A = ~~15~~ ~~8~~ 10 ~~10~~ 8 3 | ~~8~~ 12 | 15 20



A = ~~10~~ ~~3~~ 8 ~~8~~ 3 | ~~3~~ 10 | 12 15 20



A = ~~8~~ 3 | ~~3~~ 8 | 10 12 15 20



Result

$A = 3 \quad 8 \quad 10 \quad 12 \quad 15 \quad 20$

Runtime: $\Theta(n \log n)$

P.Q. OPS

- HeapMaximum(A) : $\Theta(1)$
- HeapDeleteMax(A) : $\Theta(\log n)$
- HeapExtractMax(A) : $\Theta(\log n)$
- HeapIncreaseKey(A, i, k) : $\Theta(\log n)$