# CSE12 - Lecture 21

Monday, May 22, 2023 8:00 AM

PA7

PA4 Late / Resubmit > due tomorrow

Exam 2 → Friday

**Heap Applications**

Median

heap

high to low → max heap

low to high → min heap

```
class Tracker {
  PriorityQueue<Integer> pq1 = new PriorityQueue<>(Collections.reverseOrder(Integer::compare));
  PriorityQueue<Integer> pq2 = new PriorityQueue<>(Integer::compare);
  void add(int n) {
    if(pq2.size() == 0 && pq1.size() == 0) {
      pq2.add(n);
      return;
    }
    int current = get();
    if(n >= current) {
      pq2.add(n);
    }
    else {
      pq1.add(n);
    }
    int sizeDifference = pq2.size() - pq1.size();
    if(sizeDifference > 1) { pq1.add(pq2.poll()); }
    else if(sizeDifference < -1) { pq2.add(pq1.poll()); }
  }

  int get() {
    if(pq2.size() == pq1.size()) { return (pq2.peek() + pq1.peek()) / 2; }
    if(pq2.size() > pq1.size()) { return pq2.peek(); }
    else { return pq1.peek(); }
  }

  public String toString() {
    return "" + pq1 + " " + this.get() + " " + pq2;
  }
}
```

M → # elements

add()

height ↳ $\log_2(N)$

BC: sorted input

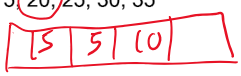
poll()

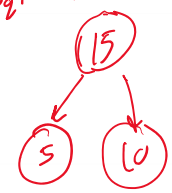
$\Theta(\log_2 N)$

Draw the picture and the arrays for the following:

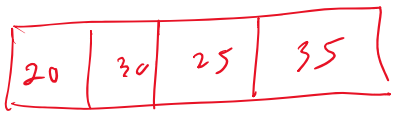
Add the following elements to the Tracker (in this order):
5, 10, 15, 20, 25, 30, 35

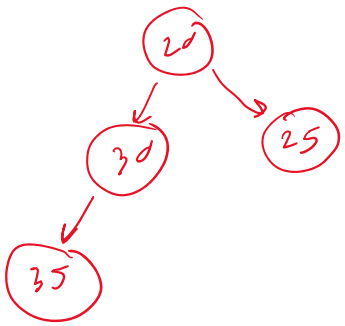
max heap pq1




min heap pq2




get() → 20

Name: _____ PID: _____ Code: 3072

What is the result of the call to get() after adding all the elements?

20

What is the run-time for the tracker?

Worst Case

Best Case:

Write a method to use the tracker:

iterate array ] N &
add to tracker ] log N

final set ()

What is the total run-time using the tracker:

O ( N + log N )

Using a PriorityQueue, write a Heap Sort method to perform an in-place sort of an array: