CSE12 - Lecture 21

Wednesday, November 22, 2023 8:00 AM

PA7 and PA5 Late/Resubmit - slip day - due Thursday @ 8am
No class on Friday - holiday
PA8 released today
Discussion - tonight is on Zoom only - see Piazza post for link

Lecture 21

Heap Applications

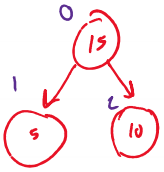
```
class Tracker {
  PriorityQueue<Integer> pq1 = new PriorityQueue<>(Collections.reverseOrder(Integer::compare));
  PriorityQueue<Integer> pq2 = new PriorityQueue<>(Integer::compare);
  void add(int n) {
    if(pq2.size() == 0 && pq1.size() == 0) {
      pq2.add(n);
      return;
    }
    int current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

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

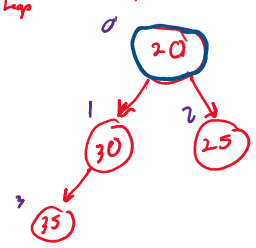
pq1 (max heap)

0	1	2	3
15	5	10	



pq2 (min heap)

0	1	2	3
20	30	25	35



value of final get()? 20

Name: _____ PID: _____ Code: 8634

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

20

What is the run-time for the tracker?

add() get()

Worst Case $\Theta(\log_2(n))$ $\Theta(1)$

Best Case: $\Theta(1)$

↳ add evenly to both sides

Write a method to use the tracker:

```
int findNumber ( Integer [] arr ) {
    MedianTracker tracker = new ______
    for ( int i=0; i< arr.length; i++) {
        tracker.add( arr[i] );       ] log2(N)   ] N * log2(n)
    }
    return tracker.get();             1
}
```

What is the total run-time using the tracker:

$N + \log_2(n)$

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