Order Statistics
&
Heap Sort

335 Fall 2022 – Recitation 6

Order Statistics

- RANDOMIZED-SELECT(*A, p, r, i)*
- 1 **if *p = r***
- 2 **then return *A[p]***
- 3 *q* ← *RANDOMIZED-PARTITION(A, p, r)*
- 4 *k* ← *q - p + 1*
- 5 **if *i = k* ▷ *the pivot value is the answer***
- 6 **then return *A[q]***
- 7 **elseif *i < k***
- 8 **then return RANDOMIZED-SELECT(*A, p, q - 1, i)***
- 9 **else return RANDOMIZED-SELECT(*A, q + 1, r, i - k)***

A = [3, 2, 9, 0, 7, 5, 4, 8, 6, 1] is our array.

- Find 5^{th}-order statistic.
- Describe a sequence of partitions that results in a worst-case performance for n^{th}-order statistic.

- https://www.youtube.com/watch?v=AHaaFVmAsvA

Heap Sort

Use Heapsort to sort the given array
A = [4, 1, 3, 2, 16, 9, 10, 14, 8, 7].

```
BUILD-MAX-HEAP(A)
1  A.heap-size = A.length
2  for i = ⌊A.length/2⌋ downto 1
3      MAX-HEAPIFY(A, i)
```

```
MAX-HEAPIFY(A, i)
 1  l = LEFT(i)
 2  r = RIGHT(i)
 3  if l ≤ A.heap-size and A[l] > A[i]
 4      largest = l
 5  else largest = i
 6  if r ≤ A.heap-size and A[r] > A[largest]
 7      largest = r
 8  if largest ≠ i
 9      exchange A[i] with A[largest]
10      MAX-HEAPIFY(A, largest)
```

A 3-ary heap is like a binary heap, but with the exception of the root, non-leaf nodes have 3 children instead of 2 children.

- Find the parent-child index relation/formula.
- Try it with the previous example.

A = [4, 1, 3, 2, 16, 9, 10, 14, 8, 7]