

## CS3130 Homework 3

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### Question 1.

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6.1-1

What are the minimum and maximum numbers of elements in a heap of height  $h$

Minimum will be a heap with only one node in its bottom level

$$2^0 + 2^1 + 2^2 + \dots + 2^{h-1} + 1$$
$$\frac{2^h - 1}{2 - 1} + 1 = 2^h$$

Maximum is a heap with the bottom node full

$$2^0 + 2^1 + 2^2 + \dots + 2^h$$
$$\frac{2^{h+1} - 1}{2 - 1} = 2^{h+1} - 1$$

### Question 2.

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6.2-2

What is the effect of calling Max-Heapify( $A, i$ ) when the element  $A[i]$  is larger than its children?

No effect. The three if conditions,

$$\begin{aligned} &\text{if } l \leq A.\text{heap-size} \text{ and } A[l] > A[i], \\ &\text{if } r \leq A.\text{heap-size} \text{ and } A[r] > A[largest] \\ &\quad \text{if } largest \neq i \end{aligned}$$

all fail and nothing changes.

**Question 3.**

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6.2-4

What is the effect of calling  $\text{Max-Heapify}(A, i)$  for  $i > A.\text{heap} - \text{size}/2$ ?

If  $i > A.\text{heap} - \text{size}/2$ , then node  $i$  is either in the lowest or second lowest level of the tree and does not have any children. When  $\text{LEFT}(i)$  and  $\text{RIGHT}(i)$  are called the array index that gets called will be out of bounds.

**Question 4.**

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6.4-1