Midterm Review Questions

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1 Introduction

These are midterm review questions I made up to prep for exam 1.

Notes on exam logistics:
- There's not enough seats to have one empty space between each pair of students. So you'll be allowed to sit next to someone, but please leave space if you can. TAs will also be in the room to help proctor.

- The very front row will be reserved for students who come in late. Don't sit in the front row if you're early/on time.

2 Asymptotics

1. Select always, sometimes or never: $f(n)+g(n)$ is ______ $\mathcal{O}(\min\{f(n), g(n)\})$.
2. Select always, sometimes or never: $f(n)+g(n)$ is ______ $\Omega(\min\{f(n), g(n)\})$.

3 Code Analysis

Describe the worst-case runtime of the code below, using a simplified big-oh bound:

```
void f(int n) {
    for (int i = 1; i <= n; i++) {
        int copy = i;
        while (copy > 0) {
            copy /= 2;
        }
    }
}
```

$\mathcal{O}(\_\_\_\_\_\_)$

```
int g(int n) {
    int count = 0;
    if (n * n < 20 * n) {
        for (int i = 0; i < n; i++) {
            for (int j = 0; j < n; j++) {
                for (int k = 0; k < n; k++) {
                    count++;
                }
            }
        }
    } else {
        count--;
    }
    return count;
}
```

$\mathcal{O}(\_\_\_\_\_\_)$

4 Solving a recurrence

Solve this recurrence:

$$T(n) = 3T(n-2) + 3^n$$

5 Heaps

Here's a 0-indexed binary min heap, named `heap`:

$$[23, 25, 55, 81, 49, 64, 79, 98, 95, 70, 68]$$

1. Draw the visual representation of `heap`.

2. Suppose we execute the code: `heap.insert(x)`, where `x` is some integer (`x` is both the value and the priority, just like in lecture). For each assertion below, give a value of `x` such that the assertion is true after the code is executed, or explain why no such `x` exists (1-2 sentences max). Consider each assertion independently; use the same initial heap for each one.

   (a) No leaf node has a value of "68"

   (b) Some node with value "64" has a child with value "71".

   (c) No node with value "79" has a parent with value "55".

   (d) Every node with value "49" has exactly one child

6 AVL

Insert these elements into an AVL tree: 4, 7, 2, 1, 6, 3, 5

7 Hashing

1. If you have a separate chaining hash table with n elements and table size p, what is the minimum possible length of the longest chain? You may assume n is a multiple of p.