15.6 Exercises

Doing more practices is the best way to gain intuition when it comes to asymptotics!

Factual

1. Prove that $\Theta(\log_2 n) = \Theta(\log_3 n)$.
2. What is the runtime of the following function?

```
public static int f(int n) {
    if (n <= 1) {
        return 0;
    }
    return f(n - 1) + f(n - 1) + f(n - 1);
}
```

> Problem 1

> Problem 2

Procedural

1. Find the runtime of running `print_fib` with for arbitrarily large n.

```java
public void print_fib(int n) {
   for (int i = 0; i < n; i++) {
       System.out.println(fib(i));
   }
}

public int fib(int n){
   if (n <= 0) {
     return 0;
   } else if (n == 1) {
     return 1;
   } else {
     return fib(n-1) + fib(n-2);
   }
}
```

2. Do the above problem again, but change the body of the for loop in `print_fib` to be:

```java
System.out.println(fib(n));
```

3. Find the runtime of the function `f` on an input of size `n`, given the `createArray` function as described below:

```java
public static void f(int n) {
    if (n == 1) {
        return;
    }
    f(n / 2);
    f(n / 2);
    createArray(n);
}

public int[] createArray(int Q) {
    int[] x = new int[Q];
    for (int i = 0; i < x.length; i++) {
        x[i] = i;
    }
    return x;
}
```

4. Problem 8 from the Spring 2018 Midterm 2
5. Problem 4 from the Spring 2017 Midterm 2

- Problem 1
- Problem 2
- Problem 3
- Problem 4
- Problem 5

Metacognitive

1. What would the runtime of `modified_fib` be? Assume that values is an array of size n. If a value in an int array is not initialized to a number, it is automatically set to 0.

```
public void modified_fib(int n, int[] values) {
   if (n <= 1) {
     values[n] = n;
     return n;
   } else {
     int val = values[n];
     if (val == 0) {
       val = modified_fib(n-1, values) + modified_fib(n-2, values);
       values[n] = val;
     }
     return val;
   }
}
```

- Problem 1

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