

1 Re-cursed with Asymptotics

- (a) What is the runtime of the code below in terms of n ?

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

- (b) Can you find a runtime bound for the code below? We can assume the `System.arraycopy` method takes $\Theta(N)$ time, where N is the number of elements copied. The official signature is `System.arraycopy(Object sourceArr, int srcPos, Object dest, int destPos, int length)`. Here, `srcPos` and `destPos` are the starting points in the source and destination arrays to start copying and pasting in, respectively, and `length` is the number of elements copied.

```
public static void silly(int[] arr) {  
    if (arr.length <= 1) {  
        System.out.println("You won!");  
        return;  
    }  
  
    int newLen = arr.length / 2;  
    int[] firstHalf = new int[newLen];  
    int[] secondHalf = new int[newLen];  
  
    System.arraycopy(arr, 0, firstHalf, 0, newLen);  
    System.arraycopy(arr, newLen, secondHalf, 0, newLen);  
  
    silly(firstHalf);  
    silly(secondHalf);  
}
```

- (c) Given that `exponentialWork` runs in $\Theta(3^N)$ time with respect to input N , what is the runtime of `amy`?

```
public void ronnie(int N) {  
    if (N <= 1) {  
        return;  
    }  
    amy(N - 2);  
    amy(N - 2);  
    amy(N - 2);  
    exponentialWork(N); // Runs in  $\Theta(3^N)$  time  
}
```


3 ADT Matchmaking!

Match each task to the best Abstract Data Type for the job and justify your answer (ie. explain why other options would be less ideal). The options are **List**, **Map**, **Queue**, **Set**, and **Stack**. Each ADT will be used once.

1. You want to keep track of all the unique users who have logged on to your system.
2. You are creating a version control system and want to associate each file name with a Blob.
3. We are grading a pile of exams and want to grade starting from the top of the pile (*Hint*: what order do we pile papers in?).
4. We are running a server and want to service clients in the order they arrive.
5. We have a lot of books at our library and we want our website to display them in some sorted order. We have multiple copies of some books and we want each listing to be separate.