## 1 Old Town Code

Next to each line, write out in words what you think the code will do when it is run. Assume the Singer class exists and that the code below compiles.

```
int x = 7;
String chorus = "Thank u, next";
Singer queen = new Singer("Ariana");
while (x > 0) {
    x -= 1;
    queen.sing(chorus);
}
String[] phrases = {"love", "patience", "pain", "what does the fox say?"};
for (int i = 0; i < 3; i += 1) {
    System.out.println("One taught me " + phrases[i]);
}
System.out.println(phrases[phrases.length - 1]);
```

Hint: For reference, here is an equivalent Python program.

```
x = 7
chorus = "Thank u, next"
queen = Singer("Ariana")
while (x > 0):
    x -= 1
    queen.sing(chorus)
phrases = ["love", "patience", "pain", "what does the fox say?"]
for i in range(3):
    print("One taught me " + phrases[i])
print(phrases[len(phrases) - 1])
```


## 2 Reading Code: A Mystery

Below is a function (or method) called mystery1. It takes in two arguments and returns an integer, answer. The first argument it takes in is an array of integers called inputArray, and the second argument it takes in is an integer, k .

```
public static int mysteryl(int[] inputArray, int k) {
    int x = inputArray[k];
    int answer = k;
    int index = k + 1;
    while (index < inputArray.length) {
        if (inputArray[index] < x) {
            x = inputArray[index];
            answer = index;
        }
        index = index + 1;
    }
    return answer;
}
```

Write the return value of mystery 1 if inputArray is the array $\{3,0,4,6,3\}$ and $k$ is 2 . What is the significance of the value returned by mystery1 (what is the significance of answer)?

Extra: Below is another function called mystery2. It takes a single array of integers called inputArray as an argument and returns nothing.

```
public static void mystery2(int[] inputArray) {
    int index = 0;
    while (index < inputArray.length) {
        int targetIndex = mysteryl(inputArray, index);
        int temp = inputArray[targetIndex];
        inputArray[targetIndex] = inputArray[index];
        inputArray[index] = temp;
        index = index + 1;
    }
}
```

Describe what mystery 2 will do and return if inputArray is the array $\{3,0,4,6,3\}$. Then, explain in English what the method mystery 2 does.

## 3 Recursion Practice: Fibonacci

Implement fib1 recursively. fib1 takes in an integer $N$ and returns an integer representing the $N$ th Fibonacci number. The Fibonacci sequence is $0,1,1,2,3,5,8,13,21, \ldots$, where 0 is the 0 th Fibonacci number. As a reminder, the $N$ th Fibonacci number is calculated as follows:

```
fib(N) = fib(N - 1) + fib(N - 2)
public static int fibl(int N) {
```

\}

Extra: Implement fib2 in 5 lines or fewer that avoids redundant computation. fib2 takes in an integer N and helper arguments $\mathrm{k}, \mathrm{f} 0$, and $f 1$ and returns an integer representing the $N$ th Fibonacci number. If you're stuck, try implementing fib1 iteratively and then see how you can transform your iterative approach to implement fib2.

```
public static int fib2(int N, int k, int f0, int f1) {
```

\}

Hint: To compute the $N$ th fibonacci number, call fib2 ( $\mathrm{N}, 0,0,1$ ).

