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.

```java
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.

```python
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.

```java
public static int mystery1(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 mystery1 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.

```java
public static void mystery2(int[] inputArray) {
    int index = 0;
    while (index < inputArray.length) {
        int targetIndex = mystery1(inputArray, index);
        int temp = inputArray[targetIndex];
        inputArray[targetIndex] = inputArray[index];
        inputArray[index] = temp;
        index = index + 1;
    }
}
```

Describe what mystery2 will do and return if inputArray is the array {3, 0, 4, 6, 3}. Then, explain in English what the method mystery2 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, 2, 3, 5, 8, 13, 21, ..., where 0 is the 0th Fibonacci number. As a reminder, the `N`th Fibonacci number is calculated as follows:

\[
\text{fib}(N) = \text{fib}(N-1) + \text{fib}(N-2)
\]

```java
public static int fib1(int N) {
}
```

*Extra:* Implement `fib2` in 5 lines or fewer that avoids redundant computation. `fib2` takes in an integer `N` and helper arguments `k`, `f0`, and `f1` 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`.

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

*Hint:* To compute the `N`th fibonacci number, call `fib2(N, 0, 0, 1)`. 