# 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`)?

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

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

\begin{verbatim}
public static int fib1(int N) {
    // implementation goes here
}
\end{verbatim}

\textit{Extra:} Implement \texttt{fib2} in 5 lines or fewer that avoids redundant computation. \texttt{fib2} takes in an integer \texttt{N} and helper arguments \texttt{k, f0}, and \texttt{f1} and returns an integer representing the \texttt{N}th Fibonacci number. If you’re stuck, try implementing \texttt{fib1} iteratively and then see how you can transform your iterative approach to implement \texttt{fib2}.

\begin{verbatim}
public static int fib2(int N, int k, int f0, int f1) {
    // implementation goes here
}
\end{verbatim}

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