Can we improve Fibonacci?

Let's recall the Fibonacci sequence

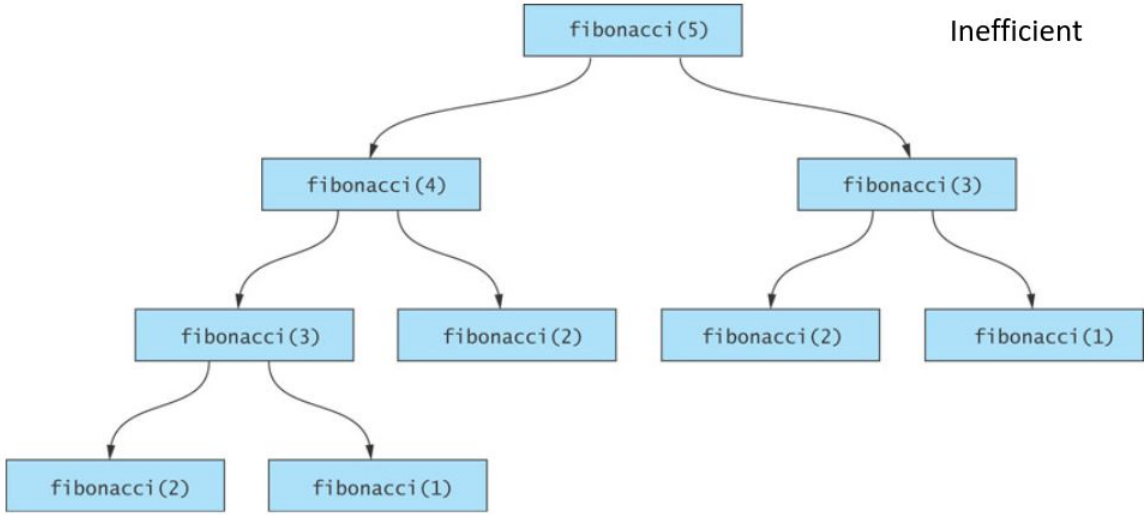
The first Fibonacci numbers are:

0, 1, 1, 2, 3, 5, 8, 13, 21, …

Bases cases:
When **n** is 0 or 1
fib(0) = 0 and fib(1) = 1

Recursive case:
fib(n-1) + fib(n-2)

Time complexity:
O(2^n)



Is there a way to improve the recursive Fibonacci?

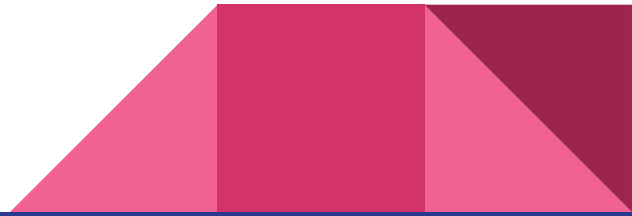
Yes, we can implement an iterative Fibonacci using tail recursion.

Recall:
In tail recursion, **no other operation is needed** after the successful execution of a recursive function call.

Tail recursion requires to **pass additional parameter to maintain the state of the recursive call.**

What would be the time complexity?

O(n)



Iterative Fibonacci Algorithm

Maintain two variables **(f1 and f2)** to store the last two Fibonacci numbers. This will allow you to calculate the next value in constant time.

Update these variables in each iteration to compute the next Fibonacci number.

Initial values for these variables f1=1 and f2=0

The method signature should be:

public static int fibIter(int n, int f1, int f2) {}

Test cases:

fibIter(0, 1, 0) returns 0
fibIter(1, 1, 0) returns 1
fibIter(2, 1, 0) returns 1
fibIter(3, 1, 0) returns 2
...

Sequence:
0, 1, 1, 2, 3, 5, 8, 13, 21, ...

Classwork

1. Draw the call stack for fibIter(10, 1, 0)

2. Let's implement the iterative Fibonacci algorithm:

```
/*
 * Preconditions:
 * n is a non-negative integer
 * n refers to the nth element in the fib sequequence
 * initial f1 value is 1
 * initial f2 value is 0
 */

 public static int fibIter(int n, int f1, int f2){
   // remember the recursive case calls  fibIter once
 }
```