## N<sup>th</sup> Fibonacci Number

## **Problem**

Find the n<sup>th</sup> fibonacci number.

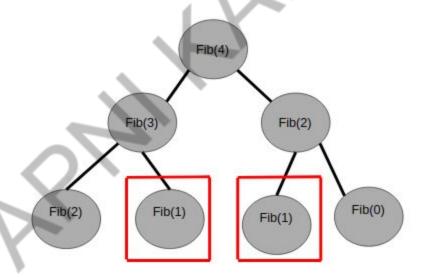
Fibonacci Numbers

Let f(n) be the n<sup>th</sup> fibonacci number, then it follows

$$f(n) = f(n-1) + f(n-2)$$

Since we can write its recurrence relation, hence it follows <u>optimal substructure</u> property.

Its recursion tree looks like



In the above figure, we can see that Fib(1) repeats, hence it follows the <u>overlapping subproblem</u> property also.

Since it follows both optimal substructure and overlapping subproblem property hence we can apply <u>dynamic programming</u> here.

## Memoization

```
int fib[200] = {-1};
int computeFib(int n)
{
    if(n == 0 || n == 1)
        return n;

    if(fib[n] != -1)
        return fib[n];

    int res = fib[n-1] + fib[n-2];

    fib[n] = res; // memoization part

    return res;
}
```

## **Tabulation**

```
int n;
cin >> n;

vi fib(n+1);
fib[1] = 0, fib[2] = 1;

for(int i=2; i<=n; i++)
{
    fib[i] = fib[i-1] + fib[i-2];
}

cout << fib[n] << endl;</pre>
```

Time complexity: O(n)