INTRO TO COMPETITIVE PROGRAMMING

WORKSHOP #3

WEDNESDAY, MAY 15TH • 5:00 - 6:00 PM

Lower Napier - LG21

WHO'S HERE?

Everyone is going to have slightly different experience

- Who came last time?
- No programming experience?
- Currently doing IP/Matlab?
- Current doing OOP?
- Finished OOP?

WORKSHOP STRUCTURE

Intro to Competitive Programming Talk

~45 Minutes

- *Summary of last time*
- *Functions in C++*
- *Recursion*
- *Example Problems*

QUESTIONS?

C++ BASIC DATA TYPES

Data Type	What it stores
int	An integer between $-2 * 10^9$ and $2 * 10^9$
long long	An integer between $-9 * 10^{18}$ and $9 * 10^{18}$
float	A decimal number usually with about 7 decimal digits
double	A decimal number usually with about 15 decimal digits
string	Any text, e.g. the work "monkey"
Arrays (e.g. int[100])	Fixed size list used to store a bunch of the same data type together

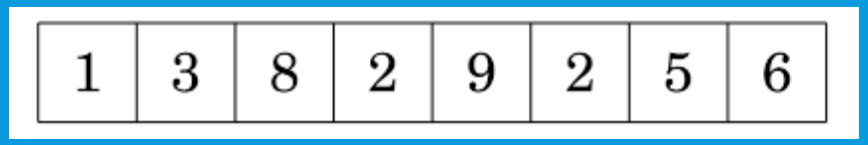
VECTORS IN C++

```
vector<int> v;
v.push_back(3); // [3]
v.push_back(2); // [3,2]
v.push_back(5); // [3,2,5]
```

```
cout << v[0] << "\n"; // 3
cout << v[1] << "\n"; // 2
cout << v[2] << "\n"; // 5
```

```
for (int i = 0; i < v.size(); i++) {
    cout << v[i] << "\n";
}
```

SORTING ARRAYS AND VECTORS




```
vector<int> v = {4,2,5,3,5,8,3};
sort(v.begin(),v.end());
```

```
int n = 7; // array size
int a[] = {4,2,5,3,5,8,3};
sort(a,a+n);
```

MAPS

A **map** is a generalized array that consists of key-value-pairs. While the keys in an ordinary array are always the consecutive integers $0, 1, \ldots, n-1$, where n is the size of the array, the keys in a map can be of any data type and they do not have to be consecutive values.

```
map<string,int> m;
m["monkey"] = 4;
m["banana"] = 3;
m["harpsichord"] = 9;
cout << m["banana"] << "\n"; // 3
```

FUNCTIONS IN C++

```
int factorial(int a) {

    int result = 1;
    for (int i = 1; i <= a; i++) {
        result *= i;
    }
    return result;

}
```

RECURSION IN C++

```
int factorial(int a) {

    if (a == 1) {
        return 1;
    }

    return a * factorial(a-1);

}
```

SOLVING A PROBLEM WITH RECURSION

Practice Problem on HackerRank:

Recursion: Fibonacci Numbers

https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem

FIBONACCI SEQUENCE

The Fibonacci Sequence is

0, 1, 1, 2, 3, 5, 8, 13, 21, 34…

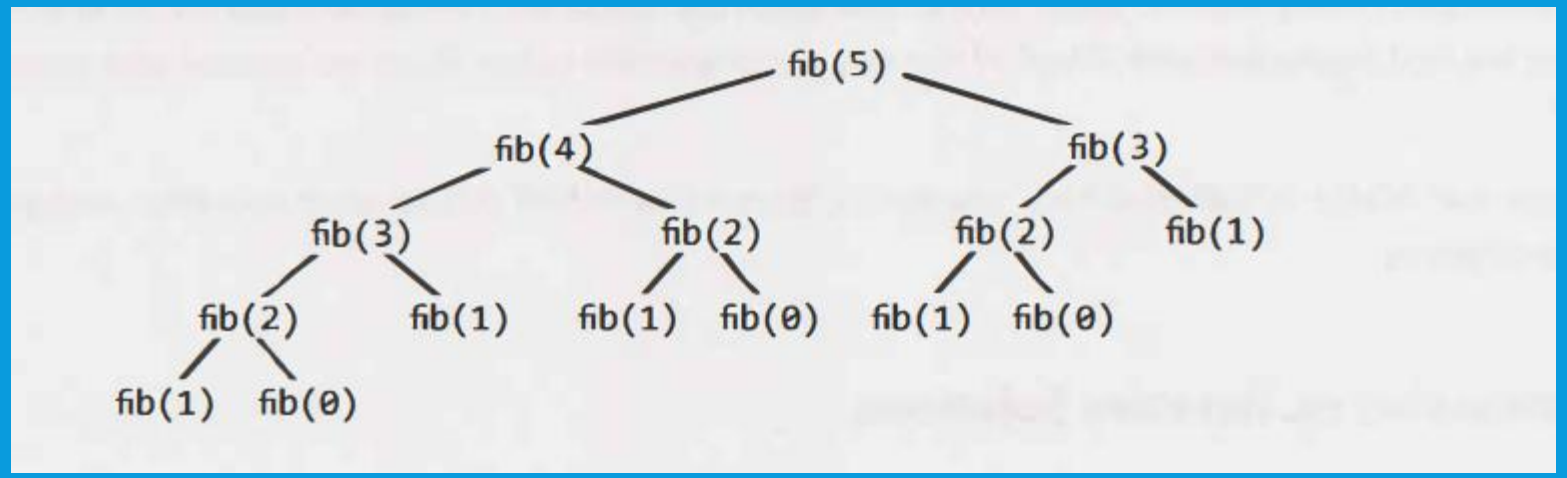
Therefore…

$$f(0) = 0$$
$$f(1) = 1$$
$$f(n) = f(n-1) + f(n-2)$$

FIBONACCI RECURSION

```
1   int fibonacci(int i) {
2     if (i == 0) return 0;
3     if (i == 1) return 1;
4     return fibonacci(i - 1) + fibonacci(i - 2);
5   }
```

FIBONACCI RECURSIVE CALL TREE



SOLVING A PROBLEM WITH RECURSION

Practice Problem on HackerRank:

Recursion: Davis' Staircase

https://www.hackerrank.com/challenges/ctci-recursive-staircase/problem

CACHING RESULTS

Instead of calculating the result every time we call the function, we can just generate the result whenever we call the function with new parameters.

We can store the results in a map, which starts empty.

$1 \longrightarrow 1$

$2 \longrightarrow 2$

$3 \longrightarrow 4$

$4 \longrightarrow 7$

$5 \longrightarrow 13$

$6 \longrightarrow 24$

…

QUESTIONS?

RESOURCES

Competitive Programmer's Handbook

by Antti Laaksonen

https://cses.fi/book/book.pdf

Cracking the Coding Interview

by Gary Laakmann McDowell

WEBSITES

HackerRank

https://www.hackerrank.com

As well as…

TopCoder

LeetCode

Codeforces

CodeChef

AtCoder

Coderbyte

Codewars

UWA: pcs.org.au

GeeksForGeeks

Project Euler

NEXT COMPETITION