

Data Structures & Algorithms - Week 1

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- Variables and Basic Types
- Functions and Selection
- Loops
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- Scope - Block
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- All announcement through the course webpage <https://subodhvsharma.github.io/course/col106>. **So regularly visit and check for updates!**
- All **content-specific discussions on Piazza**. You will be added to COL106's Piazza shortly.
- Course email: **2301-col106@courses.iitd.ac.in**
- Subject header **must** include: **[COL106]**. **Most individual emails will not be entertained**
- **Lab Venue:** LHC 503, LHC 504

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- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)
- Minimum of 30% in Mid-sem+Final+Quizzes
- Minimum of 30% in Lab-exams+Lab-assignments

Book References

- Kernighan, Brian W., and Dennis M. Ritchie. "The C programming language." (2002)
- Stroustrup, Bjarne. "The C++ Programming Language Fourth Edition." (2013)
- Goodrich, Michael T., Roberto Tamassia, and David M. Mount. Data structures and algorithms in C++. John Wiley & Sons, 2011
- Mark Allen Weiss. Data Structures and Algorithm Analysis in C++. Fourth edition, Pearson.

History

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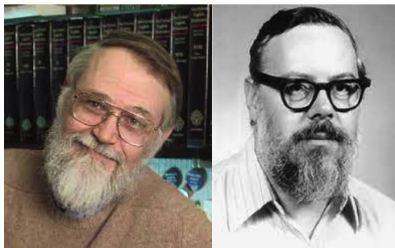
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- **1978:** Kernighan and Ritchie from Bell Labs published “The C Programming Language”
- **1983:** Barne Stroustrup at Bell Labs introduce C with Classes as C++.
- **2011:** C/C++11 standard introduced with a native support for **Concurrency**, range-based loops, lambda functions, unique/weak/shared pointers, etc.



Variables and Basic Types

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- Variables are symbolic names given to expressions or identifiers
- Variables store data
- Each variable has a **type**

```
int inch; // declaration
/*
definition
requires declaration first!
*/
inch = 2;
```

- Types determine the operations that can be performed on variables
- Basic types: **bool, char, int, float, double**

Functions and Selection

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```
// Func declaration
int someFunc(char i);
// Func definition
int someFunc(char input){
    if (input == 'y') return 1;
    else return 0;
}
```

- Function name: `someFunc`
- Function return type: `int`
- Formal parameters: `char input`
- Function declaration: `int someFunc(char input);`

Loops

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```
bool accept() {  
    int tries = 1;  
    while (tries < 4) {  
        std::cout << "Proceed (y/n)?\n";  
        char answer=0;  
        std::cin >> answer;  
        switch(answer){  
            case 'y':  
                return true;  
            case 'n':  
                return false;  
            default:  
                std::cout >> "Unknown option\n";  
                tries++; //tries = tries +1  
        }  
    }  
}
```


LoopsContinued

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```
#include <iostream>

int main() {
    int sum = 0;
    for (int i = 1; i <= 10; i++) {
        sum += i;
    }
    std::cout << sum << std::endl;
    return 0;
}
```

Scope - Global and Local

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```
int globalVar;    // global variable

void someFunction() {
    globalVar = 10; // accessible here
    int localVar = 5; // not accessible outside
}
```

Scope - Block

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```
int main() {  
    {    // new block scope starts  
        int blockVar = 5;  
        // blockVar is accessible here  
        {  
            // blockVar is accessible here  
        }  
    }    // block scope ends  
    // blockVar is not accessible  
    return 0;  
}
```

Scope - Static Local Variable

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```
void someFnc() {  
    static int x = 30; // Static local variable  
    x++;  
    // ...  
}  
  
// x is not accesssible here  
// but when someFnc is called again, x = 31
```

Other keywords relating to scope and visibility: **extern, const, public, private, protected, namespace, volatile, mutable**
Home Reading, Try it out in lab sessions!

C++ Pointers

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Pointers

In C++, a pointer is a variable that stores the memory address of another variable.

- Declaration:

```
int *p; // p points to an int val
```

- Definition:

```
int x = 5;  
p = &x; // p points to x
```

- Dereference:

```
int y = *p;  
// y has the same value as x
```

- Value modification through pointers:

```
*p = 20;  
// y has the same value as x
```

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- Homogeneous container; Contiguous

```
char v[10]; // array of 10 chars
int num[] = {1, 2, 3, 4};
char *p;
p = &v[3];
```

- Arrays are passed to functions as pointers

```
void someFnc(int *num, int size){
    for (int i = 0; i < size; i++){
        std::cout << num[i];
    }
}
```

Reading Assignment:

- Pass by value vs Pass by reference
- Pointers vs Reference
- Use of `const` with pointers
- Unique and Shared pointers

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Classes are user defined datatypes which encapsulated data and functions into a single unit.

```
class Node{
    private:
        int val;
        Node * next;
    public:
        Node(int value, Node *n=nullptr) {
            val = value;
            next = n;
        }
};

Node *n1 = new Node(1);
Node *n2 = new Node(2, n1);
```

Classes:Visibility

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- **Public, Private, Protected:** Access specifiers that specify the visibility of variables and functions.
- **Public:** The entity is accessible from anywhere outside the class definition
- **Private:** These members are only accessible from within the class itself through member functions or the **friend** functions.
- **Protected:** These members are accessible from within the class and its derived classes.

Classes:Example

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```
#include <iostream>
#include <string>
```

```
class Person {
private:
    std::string aadhaar;
```

```
public:
    std::string name;
```

```
void setAadhaar(std::string s) {
    aadhaar = s;
}
```

```
std::string getAadhaar() const {
    return aadhaar;
}

};
```

Classes: Inheritance

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```
class Base {
public:
    virtual void foo() {
        std::cout << "Base::foo()\n";
    };
};

class Derived : public Base {
public:
    void foo() {
        std::cout << "Derived::foo()\n";
    }
    void bar() { Base::foo(); }
};
```

Keyword **virtual** is *necessary* for method overriding.

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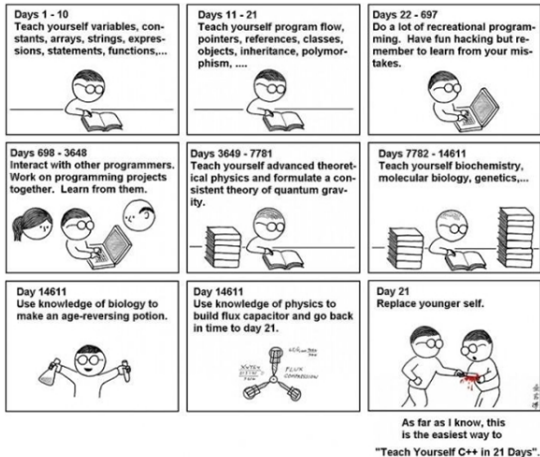


Figure: Learning C++ in 21 days!