Module M02
Partha Pratim Das
Objectives & Outline
Hello World
Add Two Numbers
Square Root
Standard Library
Header Conventions
Sum of n Numbers
Using bool
Module Summary

Programming in Modern C++

Module M02: IO & Loop

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All url's in this module have been accessed in September, 2021 and found to be functional

Module Recap

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- Understood the importance and ease of C++ in programming
- Learnt about the course - objective, prerequisites, outline, evaluation, books, and tools

Module Objectives

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- Understand differences between C and C++ programs
- Appreciate the ease of programming in C++

Note that here we are trying to understand the difference between the C-style of programming with the C++-style of programming, and how the C++ features make programming easier and less error-prone compared to its C equivalent. This is different from the compatibility issues between the two languages which will be discussed in Tutorial on **Compatibility of C and C++** *along with cross-functionality issues.*

Module Outline

Module M02

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Objectives & Outline

Hello World

Add Two Numbers

Square Root

Standard Library Header Conventions

Sum of n Numbers

Using bool

Module Summary

1. Hello World: Handling IO
2. Add Two Numbers and Handling IO
3. Square Root: `math` Library
4. C and C++ Standard Library Headers & `std`
   - Header Conventions
5. Sum of `n` Numbers: Variable Declaration
6. Using Boolean in C and C++
7. Module Summary

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Hello World: Handling IO

Program 02.01: Hello World

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C Program

```c
// HelloWorld.c
#include <stdio.h>

int main() {
    printf("Hello World in C");
    printf("\n");

    return 0;
}
```

Hello World in C

- IO Header is `stdio.h`
- `printf` to *print* to console
- Console is `stdout` file
- `printf` is a variadic function
- `\n` to go to the new line
- `\n` is escaped newline character

C++ Program

```cpp
// HelloWorld.cpp
#include <iostream>

int main() {
    std::cout << "Hello World in C++";
    std::cout << std::endl;

    return 0;
}
```

Hello World in C++

- IO Header is `iostream`
- `operator<<` to *stream* to console
- Console is `std::cout` `ostream` (in `std` namespace)
- `operator<<` is a binary operator
- `std::endl` (in `std` namespace) to go to the new line
- `std::endl` is stream manipulator (newline) functor

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Add Two Numbers and Handling IO

Program 02.02: Add two numbers

C Program

```
// Add_Num.c
#include <stdio.h>
int main() { int a, b; int sum;

    printf("Input two numbers:\n");
    scanf("%d%d", &a, &b);

    sum = a + b;

    printf("Sum of %d and %d", a, b);
    printf(" is: %d\n", sum);
}
```

Input two numbers:
3 4
Sum of 3 and 4 is: 7

- scanf to *scan* (*read*) from console
- Console is stdin file
- scanf is a variadic function
- Addresses of a and b needed in scanf
- All variables a, b & sum declared first (K&R)
- Formatting (%d) needed for variables

C++ Program

```
// Add_Num_c++.cpp
#include <iostream>
int main() { int a, b;

    std::cout << "Input two numbers:\n";
    std::cin >> a >> b;

    int sum = a + b; // Declaration of sum

    std::cout << "Sum of " << a << " and " << b <<
        " is: " << sum << std::endl;
}
```

Input two numbers:
3 4
Sum of 3 and 4 is: 7

- operator>> to *stream* from console
- Console is std::cin istream (in std namespace)
- operator>> is a binary operator
- a and b can be directly used in operator>> operator
- sum may be declared when needed. Allowed from C89 too
- Formatting is derived from type (int) of variables

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Square Root: math Library

Program 02.03: Square Root of a number

C Program

```
// Sqrt.c
#include <stdio.h>
#include <math.h>


int main() { double x, sqrt_x;
    printf("Input number:\n");
    scanf("%lf", &x);

    sqrt_x = sqrt(x);

    printf("Sq. Root of %lf is:", x);
    printf(" %lf\n", sqrt_x);
}
```

```
Input number:
2
Square Root of 2.000000 is: 1.414214
```

- Math Header is `math.h` (C Standard Library)
- Formatting (`%lf`) needed for variables
- `sqrt` function from C Standard Library
- Default precision in print is 6

C++ Program

```
// Sqrt_c++.cpp
#include <iostream>
#include <cmath>
using namespace std;

int main() { double x;
    cout << "Input number:" << endl;
    cin >> x;

    double sqrt_x = sqrt(x);

    cout << "Sq. Root of " << x;
    cout << " is: " << sqrt_x << endl;
}
```

```
Input number:
2
Square Root of 2 is: 1.41421
```

- Math Header is `cmath` (C Standard Library in C++)
- Formatting is derived from type (`double`) of variables
- `sqrt` function from C Standard Library
- Default precision in print is 5 (*different*)

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C and C++ Standard Library Headers & `std`

namespace std for C++ Standard Library

C Standard Library	C++ Standard Library
• All names are global • stdout, stdin, printf, scanf	• All names are within std namespace • std::cout, std::cin • Use using namespace std; to get rid of writing std:: for every standard library name

W/o using

```
#include <iostream>


int main() {

    std::cout << "Hello World in C++"
              << std::endl;

    return 0;
}
```

W/ using

```
#include <iostream>
using namespace std;

int main() {

    cout << "Hello World in C++"
         << endl;

    return 0;
}
```

Standard Library: C/C++ Header Conventions

	C Header	C++ Header
C Program	Use `.h`. Example: `#include <stdio.h>` *Names in global namespace*	Not applicable
C++ Program	Prefix `c`, no `.h`. Example: `#include <cstdio>` *Names in `std` namespace*	No `.h`. Example: `#include <iostream>`

- A C std. library header is used in C++ with prefix '`c`' and without the `.h`. These are in `std` namespace:

```
#include <cmath>  // In C it is <math.h>
...
std::sqrt(5.0);   // Use with std::
```

It is possible that a C++ program include a C header as in C. Like:

```
#include <math.h> // Not in std namespace
...
sqrt(5.0);        // Use without std::
```

This, however, is not preferred

- **Using `.h` with C++ header files, like `iostream.h`, is disastrous. These are deprecated. It is dangerous, yet true, that some compilers do not error out on such use. Exercise caution.**

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Sum of n Numbers: Variable Declaration

Program 02.04: Sum of n natural numbers

C Program

```c
// Sum_n.c
#include <stdio.h>

int main() {
    int n;
    int i;
    int sum = 0;

    printf("Input limit:\n");
    scanf("%d", &n);

    for (i = 0; i <= n; ++i)
        sum = sum + i;

    printf("Sum of %d", n);
    printf(" numbers is: %d\n", sum);
}
```

```
Input limit:
10
Sum of 10 numbers is: 55
```

- `i` must be declared at the beginning (`C89`)

C++ Program

```cpp
// Sum_n_c++.cpp
#include <iostream>
using namespace std;
int main() {
    int n;

    int sum = 0;

    cout << "Input limit:" << endl;
    cin >> n;

    for (int i = 0; i <= n; ++i) // Local Decl.
        sum = sum + i;

    cout << "Sum of " << n ;
    cout << " numbers is: " << sum << endl;
}
```

```
Input limit:
10
Sum of 10 numbers is: 55
```

- `i` declared locally in `for` loop. Allowed from `C99` too

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Using Boolean in C and C++

Program 02.05: Using bool

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C Program

```c
// bool.c
#include <stdio.h>
#define TRUE 1
#define FALSE 0

int main() {
    int x = TRUE;

    printf
        ("bool is %d\n", x);
}
```

bool is 1

- Using `int` and `#define` for `bool`
- Only way to have `bool` in K&R

C Program

```c
// bool.c
#include <stdio.h>
#include <stdbool.h>


int main() {
    bool x = true;

    printf
        ("bool is %d\n", x);
}
```

bool is 1

- `stdbool.h` included for `bool`
- `_Bool` type & macros in C89 expanding:
  `bool` to `_Bool`
  `true` to `1`
  `false` to `0`
  `__bool_true_false_are_defined` to `1`

C++ Program

```cpp
// bool_c++.cpp
#include <iostream>

using namespace std;

int main() {
    bool x = true;

    cout <<
        "bool is " << x;
}
```

bool is 1

- No additional headers required

  `bool` is a built-in type
  `true` is a literal
  `false` is a literal

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- Understanding differences between C and C++ for:
  - IO
  - Variable declaration
  - Standard Library
- C++ gives us more flexibility in terms of basic declaration and input / output
- Many C constructs and functions are simplified in C++ which helps to increase the ease of programming