

# C++: Everything You Need to Know

Supta Richard Philip  
Lecturer

Department of CS  
American International University(AIUB).

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- 1 History of C/C++
- 2 C++ is Powerful Language
- 3 Why is C++ so Powerful?
- 4 If you want to learn C++
- 5 Research with me
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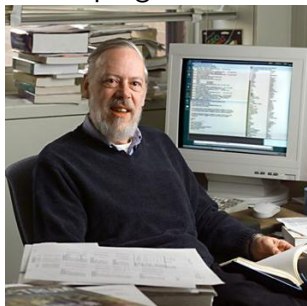
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# History of C++

- During 1970 Dennis Ritchie created C Programming language.
- C++ was developed by Bjarne Stroustrup at AT & T Bell Laboratories in 1979 and new language was based upon the C language and called C with Classes. Later in 1983 the language was called C++.
- C++ is an OOP i.e. Object Oriented Programming, which allows programmers to develop large and complex applications.



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# Numerical Computation

- C++ is power full tools for Numerical Computation.
- Arithmetic Function: “math.h” header file supports all the mathematical related functions in C/C++ language.
- User define function. More likely mathematical functions.
- For example  $f(x)=x^2 + 2x + 5$ . *Derivative?*

[https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/User\\_Define\\_Function.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/User_Define_Function.cpp)



# Number Generation

- Number Generation is important for simulation.
- Create vector  $v = \text{linspace}(0, 1, 5)$   $v = [0 \ 0.2 \ 0.4 \ 0.6 \ 0.8 \ 1.0]$
- Example sigmoid and tanh function.
- Random Number Generation: `stdlib.h` and `time.h` helps to generate random numbers.

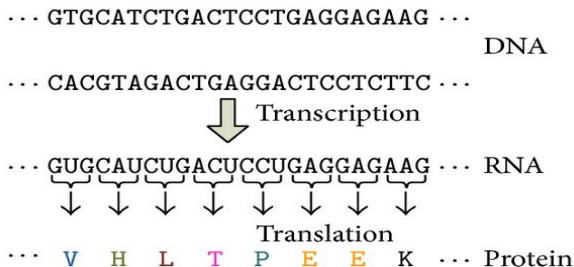
[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/  
linspace.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/linspace.cpp)

[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/  
Random\\_number.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Random_number.cpp)



# Computational Biology

- String and DNA sequence.
- ACGT is an acronym for the four types of bases found in a DNA molecule: adenine (A), cytosine (C), guanine (G), and thymine (T).



[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/DNA.  
cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/DNA.cpp)





# Numerical Analysis

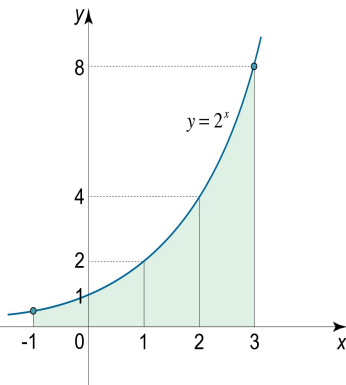
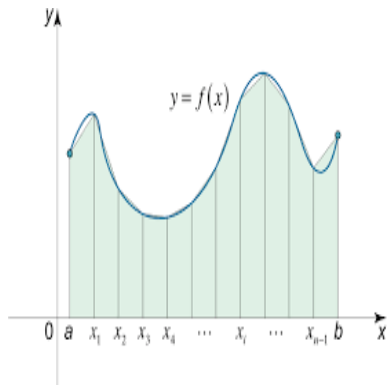
- Root findings and Numerical Integration.
- Let  $f(x)$  be continuous on  $[a,b]$ . We partition the interval  $[a,b]$  into  $n$  equal sub intervals, each of width 
$$\Delta x = \frac{b-a}{n}, a = x_0 < x_1 < x_2 < \cdots < x_n = b.$$

The Trapezoidal Rule for approximating  $\int_a^b f(x) dx$   
$$\approx \frac{\Delta x}{2} [f(x_0) + 2f(x_1) + 2f(x_2) + \cdots + 2f(x_{n-1}) + f(x_n)]$$
 where  $x_i = a + i\Delta x$ .

[https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Numerical\\_Integration.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Numerical_Integration.cpp)



# Numerical Integration using Trapezoidal Rule



# Numerical Analysis

- Root findings using Newton Raphson method.
- Newton's method (or Newton Raphson method) is an iterative procedure used to find the roots of a function.
- Start with an initial approximation  $x_0 = c$ .

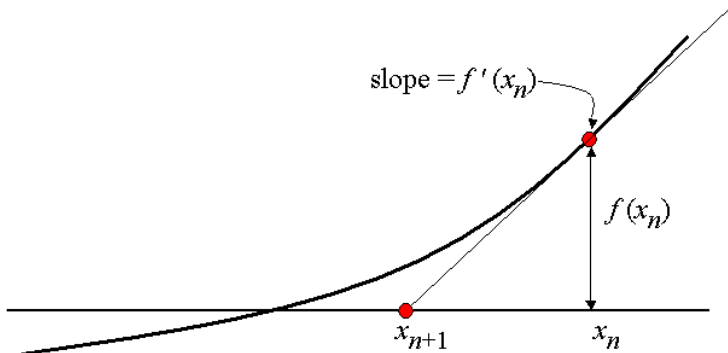
$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}.$$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

[https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Newtons\\_Rapson.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Newtons_Rapson.cpp)

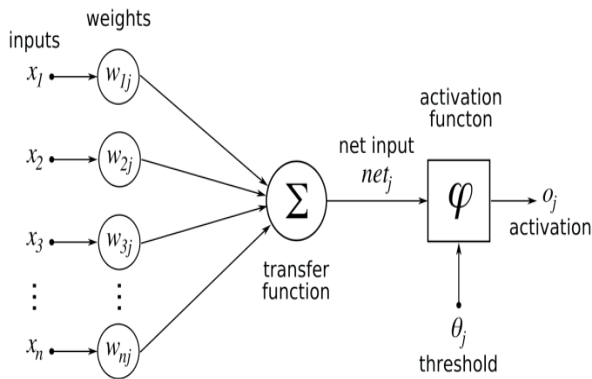


# Root findings using Newton Raphson method



# Research area using C++ Language

- Mathematical modeling
- ML/Computer vision/ Robotics/ Image processing
- Network Theory/ Graph Theory
- Artificial Neural networks/ Deep Learning



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# Class and Object

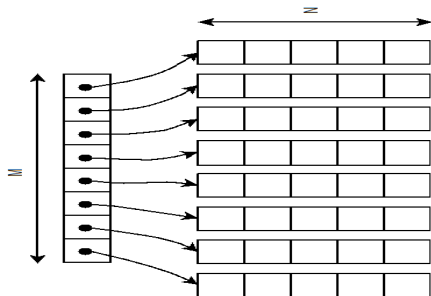
- Representing complex data, for example image data as matrix.
- User define data type as List of Object.
- Example: Weather data.

[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/  
RainFull.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/RainFull.cpp)



# Dynamic Memory Allocation/Pointer

- Very Useful in Linear Algebra. Used for Matrix operation; Matrix Transpose, Matrix Multiplication.



[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/  
Dynamic\\_2D\\_Array.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Dynamic_2D_Array.cpp)





# Standard Template Library (STL).

- Standard Template Library (STL) is a set of C++ template classes to provide common programming data structures and functions.
- Class Templates Like function templates, class templates are useful when a class defines something that is independent of the data type.

[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/STL\\_  
Vector.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/STL_Vector.cpp)

[https://github.com/suptaphilip/  
C-Plus-Plus-Everything-You-Should-Know/blob/main/  
Matrix.cpp](https://github.com/suptaphilip/C-Plus-Plus-Everything-You-Should-Know/blob/main/Matrix.cpp)



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# The steps you can follow to learn C++

- Data Types and Variables
- Operator and Expression
- Decision(if else/switch)
- Iteration(Loops)
- Array/List
- Function
- String
- Pointer and Dynamic memory allocation
- Class and Object(OOP)
- Standard Template Library (STL)
- Templates Class and function templates,



# Data Types and Variables

- Integer: (signed) int, 32 bits, Range:  $-2^{31} - 1$  to  $2^{31} - 1$
- Integer: unsigned int, 32 bits, Range: 0 to  $2^{32} - 1$
- Integer: (signed) long long int, 64 bits, Range:  $-2^{63} - 1$  to  $2^{63} - 1$
- Integer: unsigned long long int, 64 bits, Range: 0 to  $2^{64} - 1$
- float: 32 bits, single precision,  $\pm 1.18 \times 10^{-38}$  to  $\pm 3.4 \times 10^{38}$
- double: 64 bits, double precision,  $\pm 2.23 \times 10^{-308}$  to  $\pm 1.80 \times 10^{308}$
- Boolean (T/F)
- char: 8 bits
- String



# Operator and Expression

- Arithmetic Operator (+, -, \*, /, %, ++, --)
- Conditional Operator
- Logical Operator
- Ternary Operator



# References

## C++ Reference

- <https://www.cplusplus.com/reference/>
- <https://www.cplusplus.com/doc/tutorial/>

## Reference Books

- C++ The Complete Reference, 4th Edition by Herbert Schildt
- Teach Yourself C, 3/e by Herbert Schildt.
- C++ How To Program, 8/e by Paul Deitel, Harvey Deitel.



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# Research Interest

- Machine Learning/Deep Learning/Computer Vision
- Computational Geometry/ Optimization Algorithm

## About Me

Supta Richard Philip

Lecturer, CS, AIUB.

Office: Room D0726

Email: richard@aiub.edu

<https://suptaphilip.github.io/>

<https://cs.aiub.edu/profile/richard>





# Questions

Any Questions



Thank You.



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# References

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-  <https://en.wikipedia.org/wiki/Dennis-Ritchie>
-  <https://math24.net/trapezoidal-rule.html#example5>
-  <https://math24.net/newtons-method.html#example2>
-  <https://www.techiedelight.com/pass-2d-array-function-parameter/>

