Introduction to Computer Programming with C++

Getting started with the world of C++

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Professional Journey

My professional voyage has been an exciting one, with roles spanning various domains. I've delved into the world of data science, machine learning, and software engineering. My journey includes:

- Data Science Specialist
- Senior Software Engineer and AI Developer with expertise in:
- Fraud detection using AI models
- Deepstream applications for analytics
- Facial expression and landmark detection for young learners
- IoT device setup and management
- Voice technology integration using NVIDIA NeMo and Riva\
- Traffic violation detection with C/C++

Achievements

In each role, I've achieved milestones that reflect my commitment to innovation and excellence. Some of my accomplishments include:

- Developing LSTM models to predict cryptocurrency prices
- Crafting machine learning models for healthcare and medical data
- Creating robust machine learning pipelines and AutoML solutions
- Architecting facial authentication applications and speech-to-text systems
- Designing traffic violation detection systems for enhanced safety

Teaching Approach

- My teaching approach draws from my real-world experiences. I believe in a hands-on and practical learning journey. Through my roles, I've gained insights into various industries, enabling me to provide you with context-rich examples and applications of C++ concepts.

Agenda

Computer Programming

Overview of C++

Evolution and History

Basic Syntax and Structure

Key Features

Getting Started: Setting Up

Summary & Next Steps

Understanding Computer Programming: A Simple Analogy

What is a Recipe in Cooking?

- **Definition**: A set of instructions to create a dish.
- **Ingredients**: Specific items needed to make the dish.
- **Steps**: Detailed procedures on how to combine and cook the ingredients.
- **Outcome**: Following the recipe gives you a predictable dish.

Understanding Computer Programming: A Simple Analogy

What is Computer Programming?

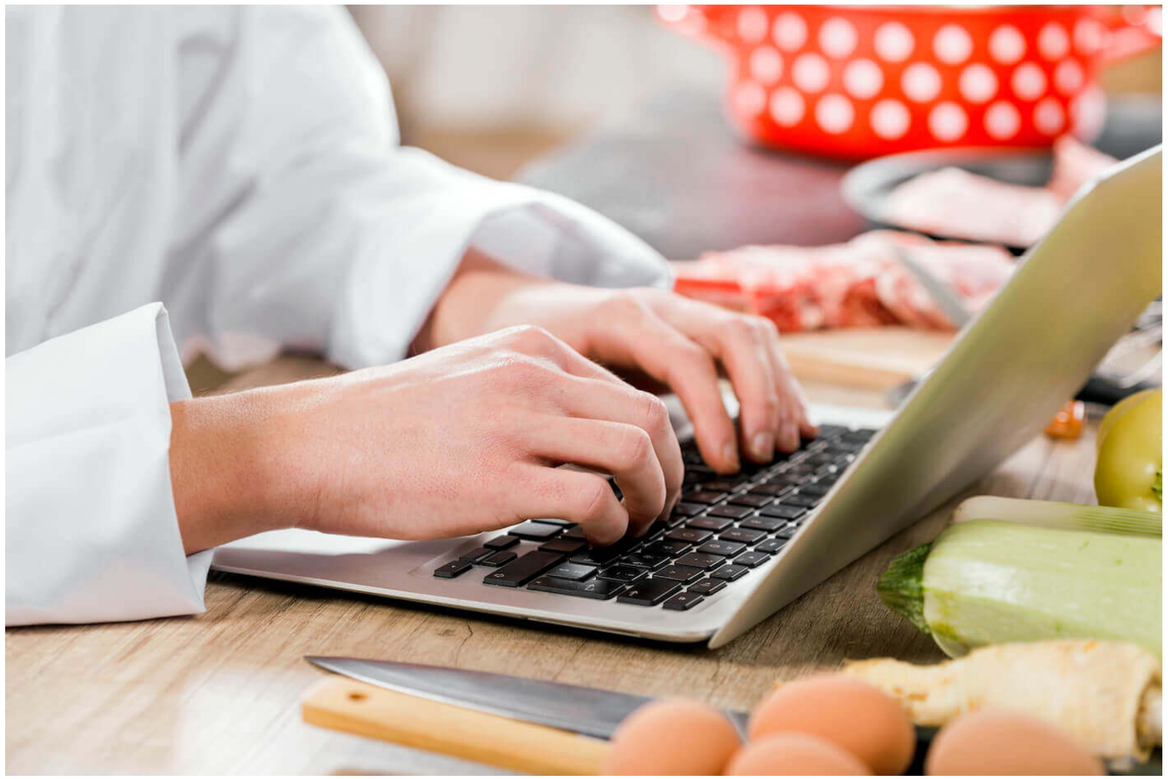
- **Definition**: A set of instructions given to a computer.
- **Variables**: Specific data the computer uses (like the ingredients in cooking).
- **Commands/Functions**: Detailed procedures that tell the computer what to do with the data (like the cooking steps).
- **Outcome**: Executing the program leads to predictable results or actions.

```cpp
// main.cpp
#include <iostream>
#include <limits>

int main() {
    // Integer Types
    int myInt = 2147483647;
    short myShort = 32767;
    long myLong = 2147483647L;
    long long myLongLong = 9223372036854775807LL;
    unsigned int myUnsignedInt = 4294967295;

    std::cout << "Integer Types:" << std::endl;
    std::cout << "int: " << myInt << std::endl;
    std::cout << "short: " << myShort << std::endl;
    std::cout << "long: " << myLong << std::endl;
    std::cout << "long long: " << myLongLong << std::endl;
    std::cout << "unsigned int: " << myUnsignedInt << std::endl;

    // Floating-Point Types
    float myFloat = 3.14159f;
    double myDouble = 3.141592653589793;
    long double myLongDouble = 3.14159265358979323L;

    std::cout << "\nFloating-Point Types:" << std::endl;
    std::cout << "float: " << myFloat << std::endl;
    std::cout << "double: " << myDouble << std::endl;
    std::cout << "long double: " << myLongDouble << std::endl;

    // Character Types
    char myChar = 'A';
    unsigned char myUnsignedChar = 255;
    wchar_t myWideChar = L'Z';

    std::cout << "\nCharacter Types:" << std::endl;
    std::cout << "char: " << myChar << std::endl;
    std::cout << "unsigned char: " << static_cast<int>(myUnsignedChar) << std::endl;  // Casting to int for display
    std::wcout << L"wchar_t: " << myWideChar << std::endl;

    // Boolean Type
    bool myBool = true;

    std::cout << "\nBoolean Type:" << std::endl;
    std::cout << "bool: " << std::boolalpha << myBool << std::endl;  // boolalpha to print true/false instead of 1/0

    return 0;
}
```

The Similarities

Programming = Cooking for Computers!

- Both recipes and programs need **specificity** (exact ingredients or exact commands).
- **Order** matters: Just as steps must be followed in order for a dish, commands must be in order for a program.
- **Outcome**: If you miss an ingredient or a step, you might not get the dish or result you expected!
- With **practice**, both cooking and programming become more intuitive and versatile.



- **Chef**: A satisfied customer with a full belly.

- **Programmer**: A satisfied user with a functional app.

What is C++?

- High-level language with low-level capabilities.
- Superset of C.
- Object-Oriented, Procedural, and Generic programming capabilities.s

Evolution and History

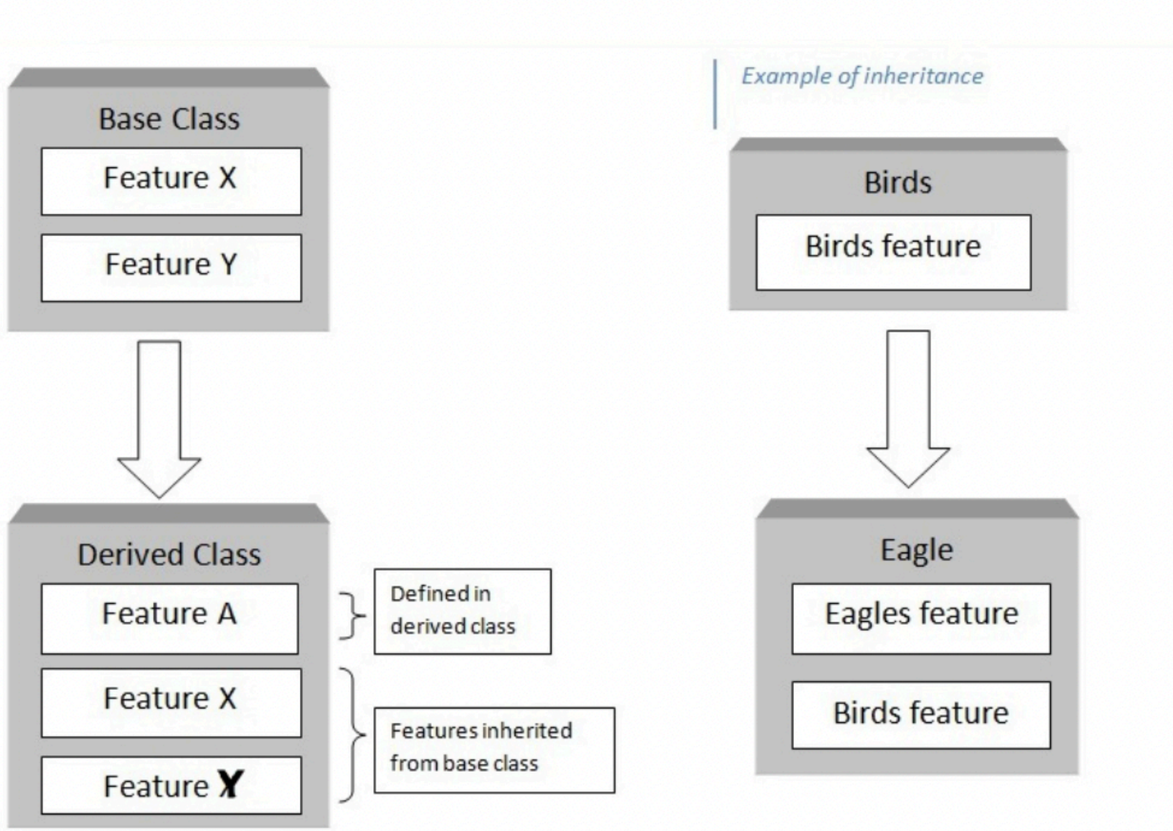
- Developed by Bjarne Stroustrup in 1979.
- Originally called "C with Classes”.
- Adopted the name C++ in 1983.
- C++98, C++03, C++11, C++14, C++17... and more.

Basic Syntax & Structure

- Basic Structure: #include, main().
- Basic Data Types: int, float, char, bool, etc.
- Control Structures: if, for, while, etc.
- Functions and Recursion.

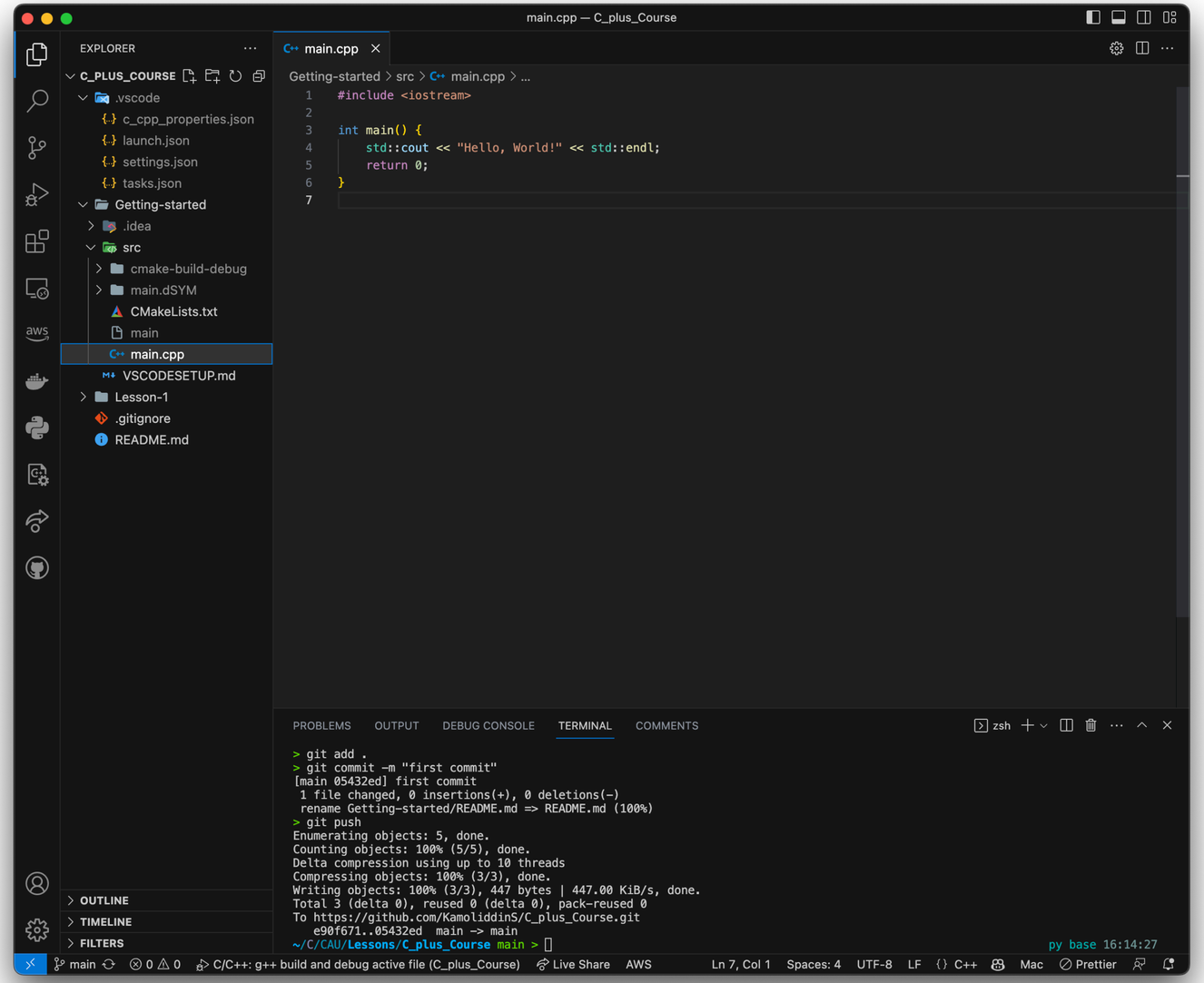
Key Features

- Object-Oriented: Classes and objects, inheritance, polymorphism, etc.
- Memory Management: Pointers, references.
- STL (Standard Template Library): Containers, algorithms, iterators.
- Exception Handling.



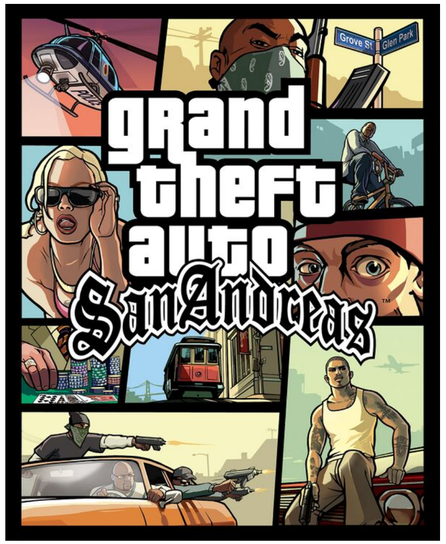
Getting Started: Setting Up

- Installing a compiler: g++, clang.
- IDEs: Visual Studio Code, CLion, Eclipse.
- Hello World in C++.



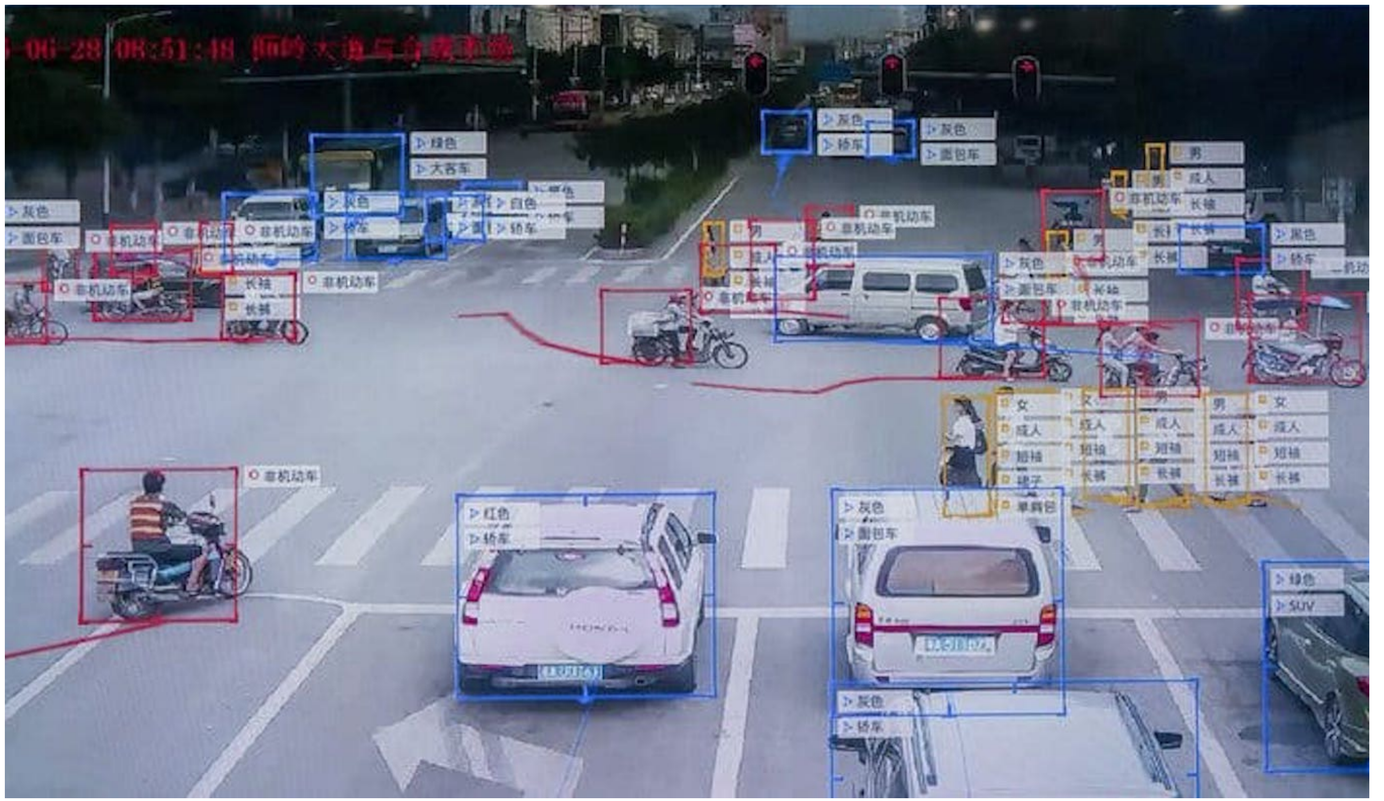
The Importance of C++

- Widely used in system/software development.
- OS: Windows, Linux, MacOSX,
- DB: MongoDB, MySQL
- VR, Unreal Engine
- Game development.
- High-performance applications.
- Embedded and real-time systems.



C++ in AI Video Analytics & Surveillance

- **Performance-Intensive Applications:** C++ offers close-to-the-metal performance, making it ideal for real-time video processing.
- **Robust Libraries:** Libraries like OpenCV, with its C++ APIs, aid in complex image and video analysis tasks.
- **Memory Management:** Precise control over memory aids in handling large video data streams efficiently.
- **Integration with Deep Learning:** Seamless integration with frameworks like TensorFlow and Caffe, which offer C++ interfaces, allows for advanced AI model deployments.
- **Scalability:** C++ can handle large-scale surveillance systems, processing multiple video feeds simultaneously without lag.



C++ Programming Timeline (Part 1)

- Introduction - Getting Started
  - Introduction to programming with C++
  - Handling various errors: compile, runtime, logic, etc.
- C++ Program Structure
  - Preprocessor directives (#include)
  - The main() function and namespaces
- Variables and Constants
  - Variable definitions and scope
  - C++ primitive types and global variables
- Arrays and Vectors
  - Data storage with arrays
  - Multidimensional arrays and vectors
- Statements and Operators
  - Various operators: assignment, arithmetic, etc.
  - Operator precedence and conditional statements
- Controlling Program Flow
  - If and if-else statements
  - Loop structures: for, while, and range-based for loops
- Characters and Strings
  - C-style strings and C++ string class

C++ Programming Timeline (Part 2)

- Functions
  - Function definitions, prototypes, and overloading
  - Pass by reference and value
- Pointers and References
  - Understanding pointers and references
- OOP: Classes and Objects
  - Object-oriented programming principles
  - Class definitions, constructors, and methods
- Operator Overloading and Inheritance
  - Extending classes and understanding inheritance
- Polymorphism and Smart Pointers
  - Virtual functions and smart pointers
- Exception Handling and I/O Streams
  - Handling exceptions and data streams
- STL and Lambda Expressions
  - Exploring the Standard Template Library
  - Function templates and lambda expressions

Tips for Beginners

- Practice regularly.
- Start with simple projects.
- Join communities: Stack Overflow, Reddit, C++ forums.
- Seek feedback and review your code.

Summary & Next Steps

- C++ is a powerful and versatile language.
- Has a rich history and is constantly evolving.
- Great for a wide range of applications.
- Start coding, experimenting, and building.

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