UNIVERSITY OF RICHMOND

Welcome to CMSC 240!

CMSC 240 Software Systems Development

Fall 2024

Today

- Introductions
- Course logistics
- Motivation
- Hello C++
- Environment setup
- In-class coding exercise

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I have some questions for you!

- If you are building large software (e.g., an operating system, a video game, a passenger reservation system), what problems might you have that you would not necessarily have with, say, a CMSC 150 or CMSC 221 project? Can you think of tools it might be nice to have to solve some of these problems? (By tools, I don’t mean specific software applications, but rather “a program that does x…”)

Introductions

Dr. Doug Szajda

When I started here. And had no gray hair

- Prof. Doug Szajda

  “Shade-uh” or “Prof S”
- He/Him

- BS in Math from Lafayette College
- MS, PhD in Math from UVA
- MCS from UVA, Postdoc at UMIACS (U Maryland)
- UR CS faculty since 2001
- CS Department Chair
- Research: Computer S&P, ML

Dr. Doug Szajda

Monaco

- Things I like (in no particular order)
  - Travel
  - Learning Italian
  - Cooking
  - Godzilla movies
  - Lego video games
  - Programming
  - Dogs (and cats)

Dr. Doug Szajda

La Fontana di Trevi

- Things I like (in no particular order)
  - Travel
  - Learning Italian
  - Cooking
  - Godzilla movies
  - Lego video games
  - Programming
  - Dogs (and cats)

The Pets: Frosty, Ethan, and Indy

Ask me anything

Classroom Meet and Greet

1. Introduce yourself to a person near you

2. Introduce yourself to a different person near you

- Potential conversation topics:
  - What are some of the things that you like?
  - Who are your favorite pets?
  - Why do you want to take this class?

Student Introductions

- Name
- Pronouns
- Major
- Class year
- Food you cannot live without

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Course Logistics

Classroom Norms

- Questions are always welcome!!
  - Ask them at any time
- “I don’t know” is okay
- Be curious
- Treat peers and instructors with kindness and respect
- Communication is key!
- Seek support when needed

Where All Class Information Can Be Found

https://cmsc240-f24-dcs.github.io/cmsc240-f24-s2.github.io/

(Don’t ask. Github classroom just seemed to want to make this URL like this, regardless of what Dr. Balash and I tried.)

How to Communicate With Me

- Public or private post on Ed
  - https://edstem.org

- After class or in office hours - 219 Jepson Hall
  - Tue 1:30 – 2:30
  - Fri 1:00 – 2:00
  - and by appointment

- Email
  - dszajda@richmond.edu

Course Outline

- **Weeks 1-5** Introduction to C++ programming
  - Syntax, memory management, libraries, file IO
- **Weeks 6-10** Object-oriented programming
  - Abstraction, polymorphism, inheritance, encapsulation
- **Weeks 11-15** Software systems development
  - UML, design patterns, testing, debugging

Learning Outcomes

- Experience modern* C++ programming
- Gain familiarity with Unix/Linux environments
- Understand the software development life cycle
- Practice object-oriented programming and design
- Understand design patterns, reuse, and usability
- Exposure to version control systems
- Demonstrate skill in software testing and debugging

Lecture

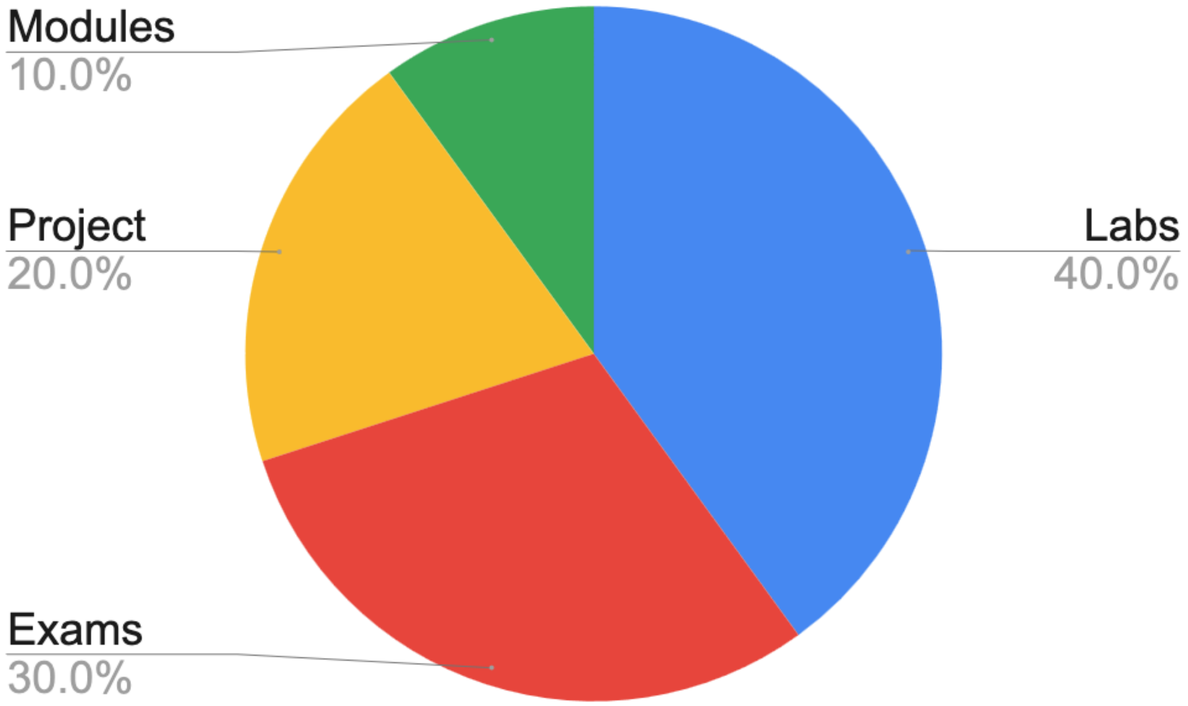
- Tuesdays and Thursdays Jepson 103A
- Will usually include in-class exercises
- In-class exercises will be due one week from when they are assigned (except during break)
- Regular attendance is expected
- Students who are sick should not attend class
- Notify me in advance of the absence, if possible

Labs

- Fridays in Jepson 103A
- Lab assignments done individually and in groups
  - but will always be turned in individually
- Lab assignments are typically due at 5:00 pm on the night prior to the next lab (except during break)
- Please ask for help from me or the lab assistant (if we get one).

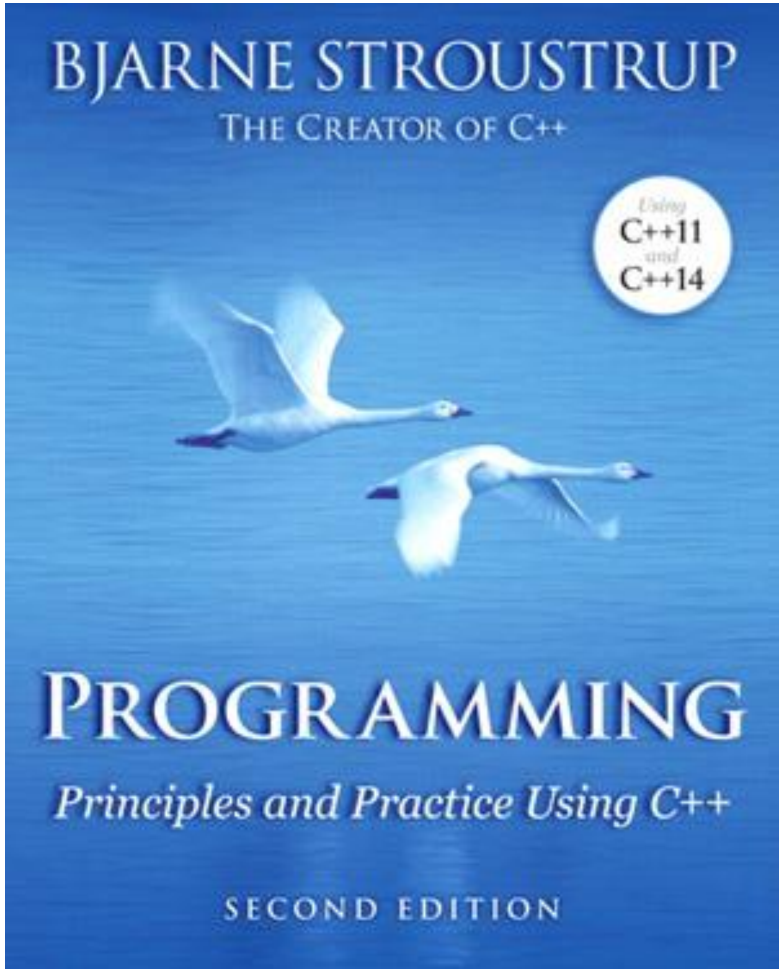
Coursework and Grading

- Modules (In-class coding exercises)
- Lab assignments
- Programming project
- Midterm exam
- Final exam



Textbook

- Free electronically from the UR library
- Reading assignments



Ask me questions

Motivation

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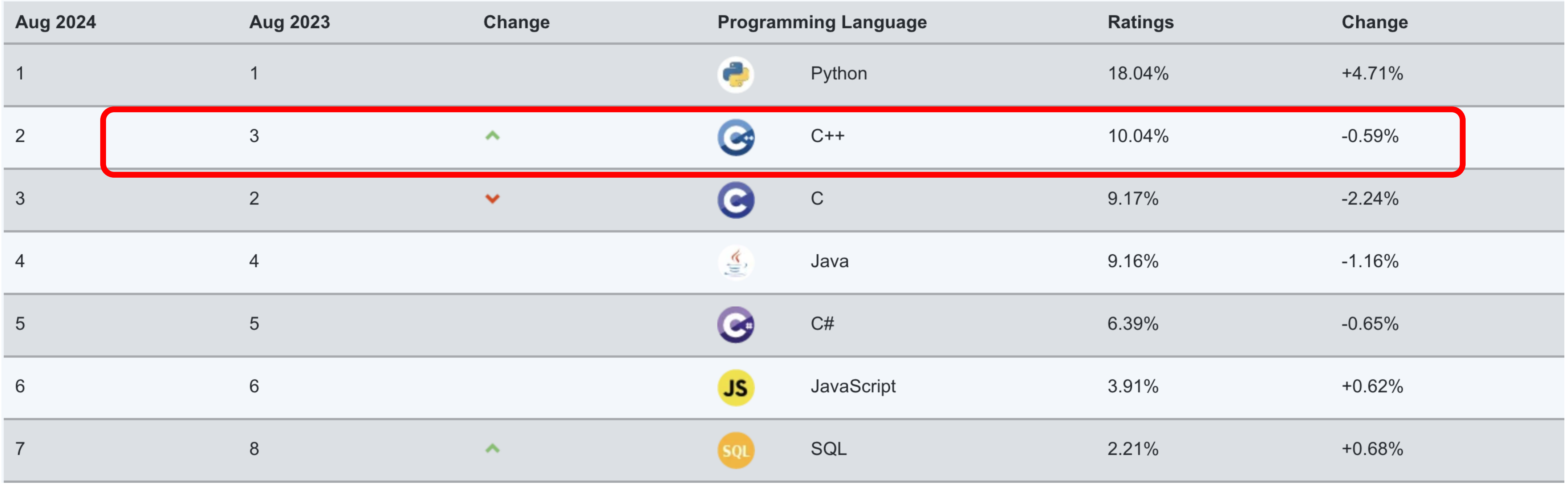
I have some questions for you!

- Why C++?

- Why so many programming languages?
  - Today, between 250 and 2500: https://en.wikipedia.org/wiki/List_of_programming_languages
  - Historically, almost 9000

C++ is a Very Popular Language

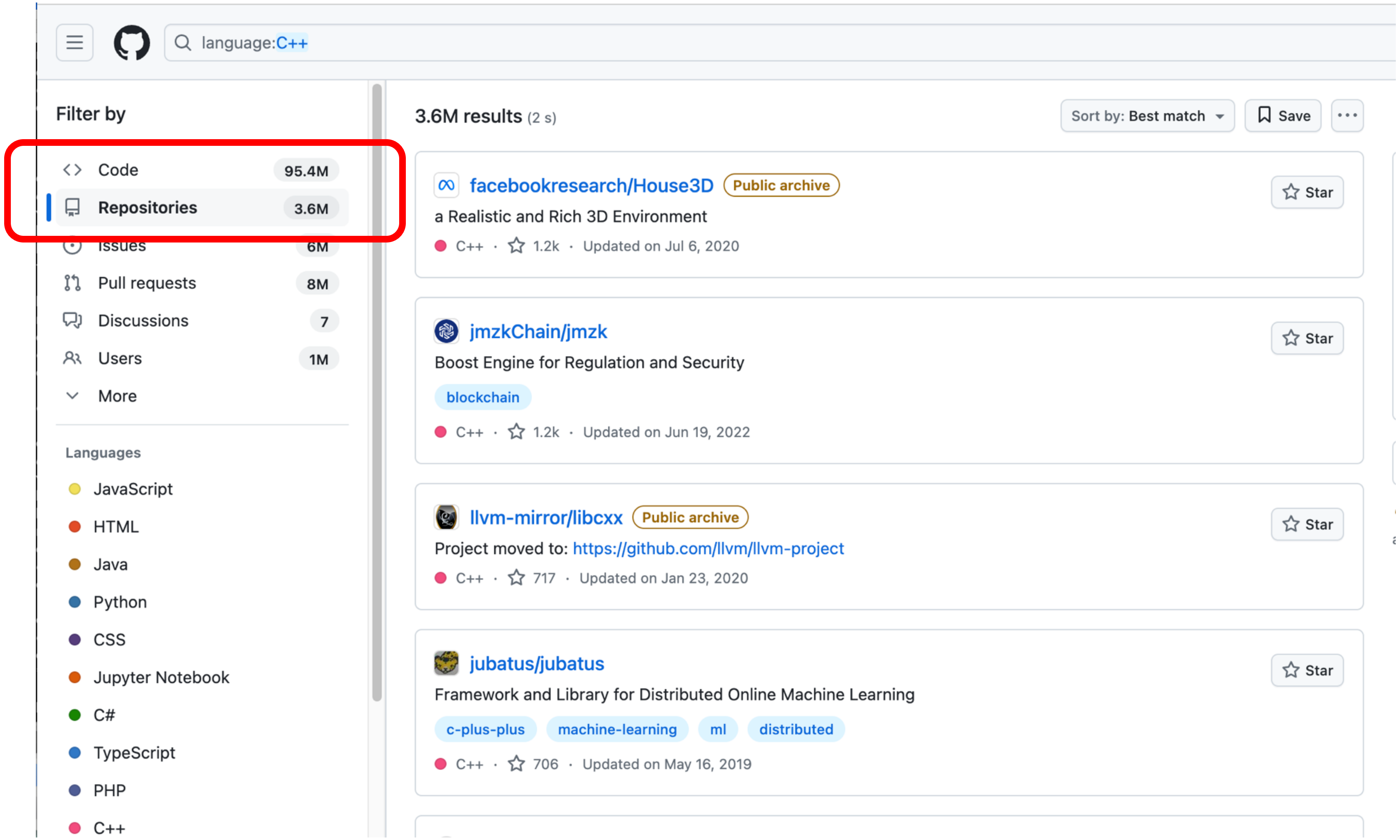


Aug 2024	Aug 2023	Change	Programming Language	Ratings	Change
1	1		Python	18.04%	+4.71%
2	3	▲	C++	10.04%	-0.59%
3	2	▼	C	9.17%	-2.24%
4	4		Java	9.16%	-1.16%
5	5		C#	6.39%	-0.65%
6	6		JavaScript	3.91%	+0.62%
7	8	▲	SQL	2.21%	+0.68%

TIOBE Index for August 2024

Source: https://www.tiobe.com

Many Open-Source Projects



language:C++

Filter by

Code	95.4M
Repositories	3.6M
Issues	6M
Pull requests	8M
Discussions	7
Users	1M
More	

Languages

- JavaScript
- HTML
- Java
- Python
- CSS
- Jupyter Notebook
- C#
- TypeScript
- PHP
- C++

3.6M results (2 s)

Sort by: Best match · Save

facebookresearch/House3D Public archive
a Realistic and Rich 3D Environment
C++ · 1.2k · Updated on Jul 6, 2020

jmzkChain/jmzk
Boost Engine for Regulation and Security
blockchain
C++ · 1.2k · Updated on Jun 19, 2022

llvm-mirror/libcxx Public archive
Project moved to: https://github.com/llvm/llvm-project
C++ · 717 · Updated on Jan 23, 2020

jubatus/jubatus
Framework and Library for Distributed Online Machine Learning
c-plus-plus · machine-learning · ml · distributed
C++ · 706 · Updated on May 16, 2019

https://github.com

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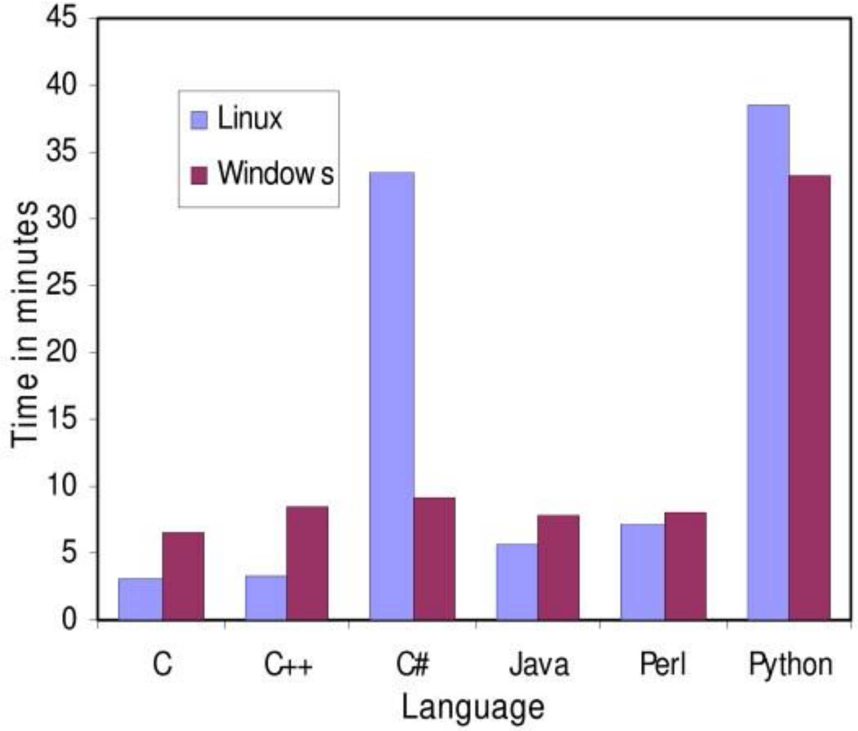
Cool Things Were Built With C++

amazon.com
Google
Windows

Images source: https://commons.wikimedia.org

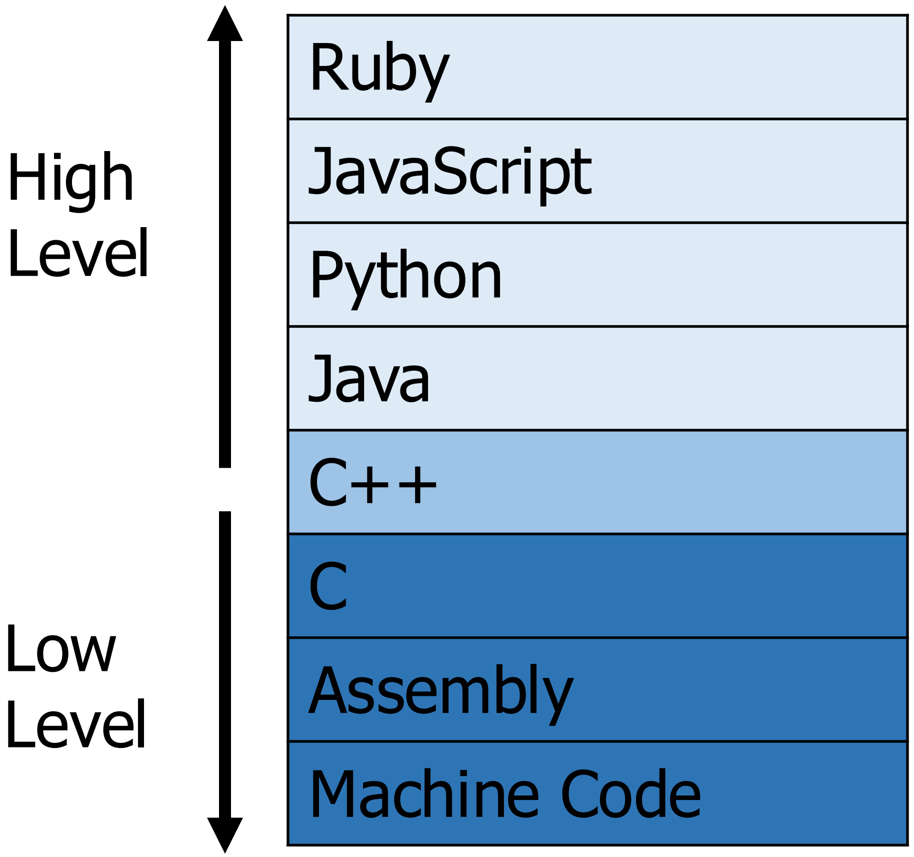
What Makes C++ Great?

Speed: It's Fast!



Source: https://www.researchgate.net

Low-level control



High Level

Low Level

Ruby

JavaScript

Python

Java

C++

C

Assembly

Machine Code

Foundational Software Development Skills

- Object-oriented design
- Software development life cycle
- Design patterns and code reuse
- Version control systems
- Testing and debugging

What motivates you?

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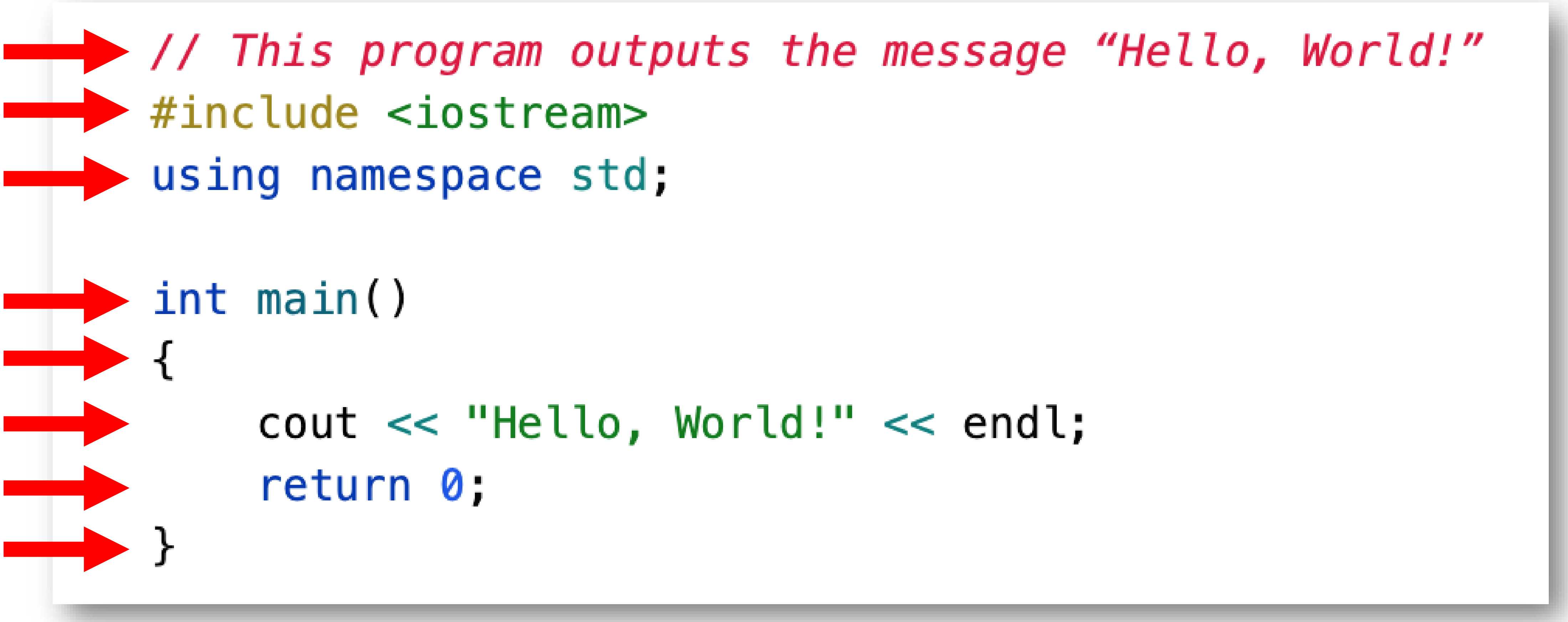
Hello C++

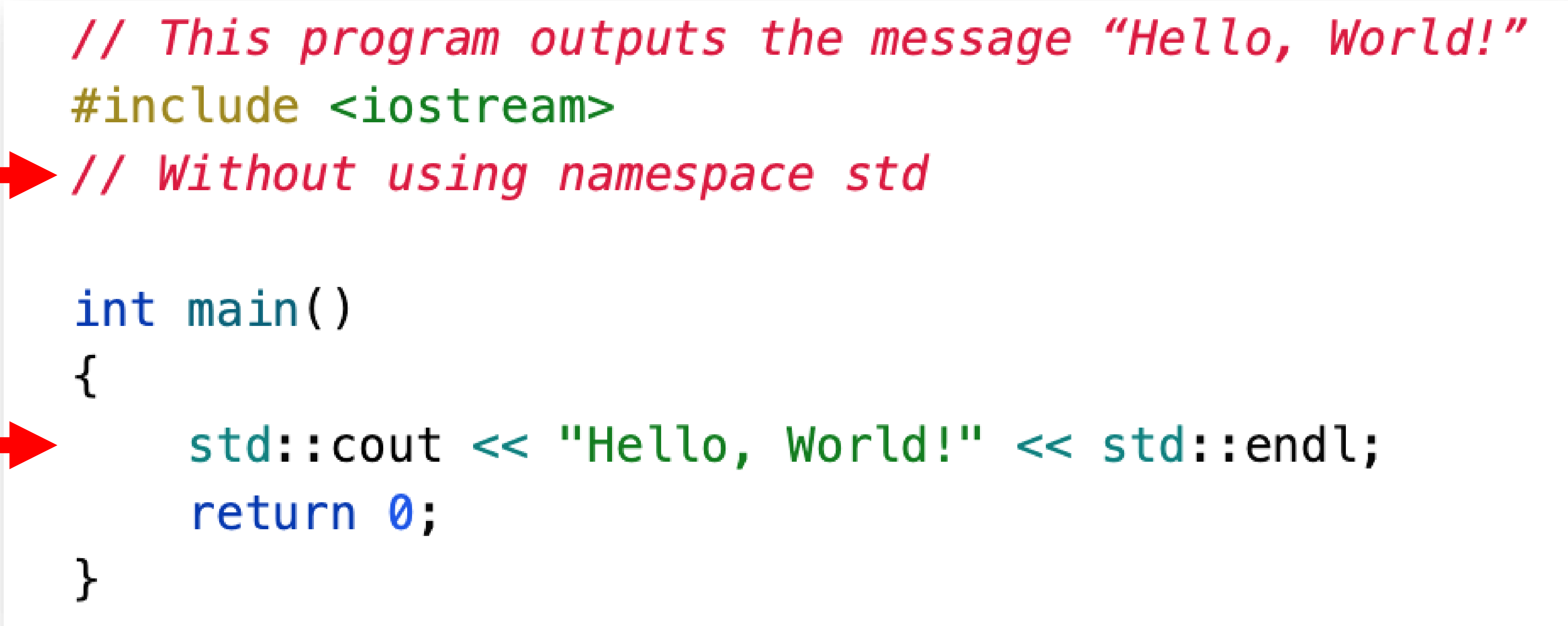
Writing Your First C++ Program



```cpp
// This program outputs the message “Hello, World!”
#include <iostream>
using namespace std;

int main()
{
    cout << "Hello, World!" << endl;
    return 0;
}
```

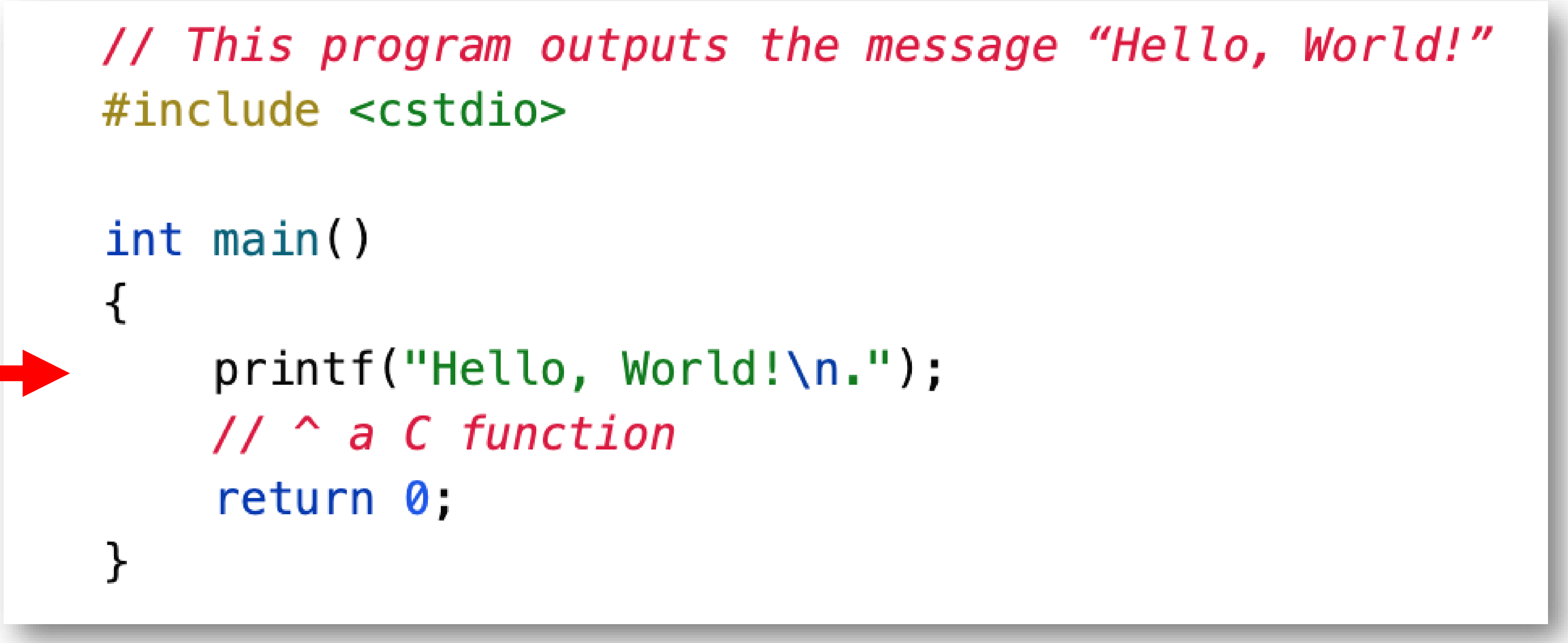
Writing Your First C++ Program



```
// This program outputs the message “Hello, World!”
#include <iostream>
// Without using namespace std

int main()
{
    std::cout << "Hello, World!" << std::endl;
    return 0;
}
```

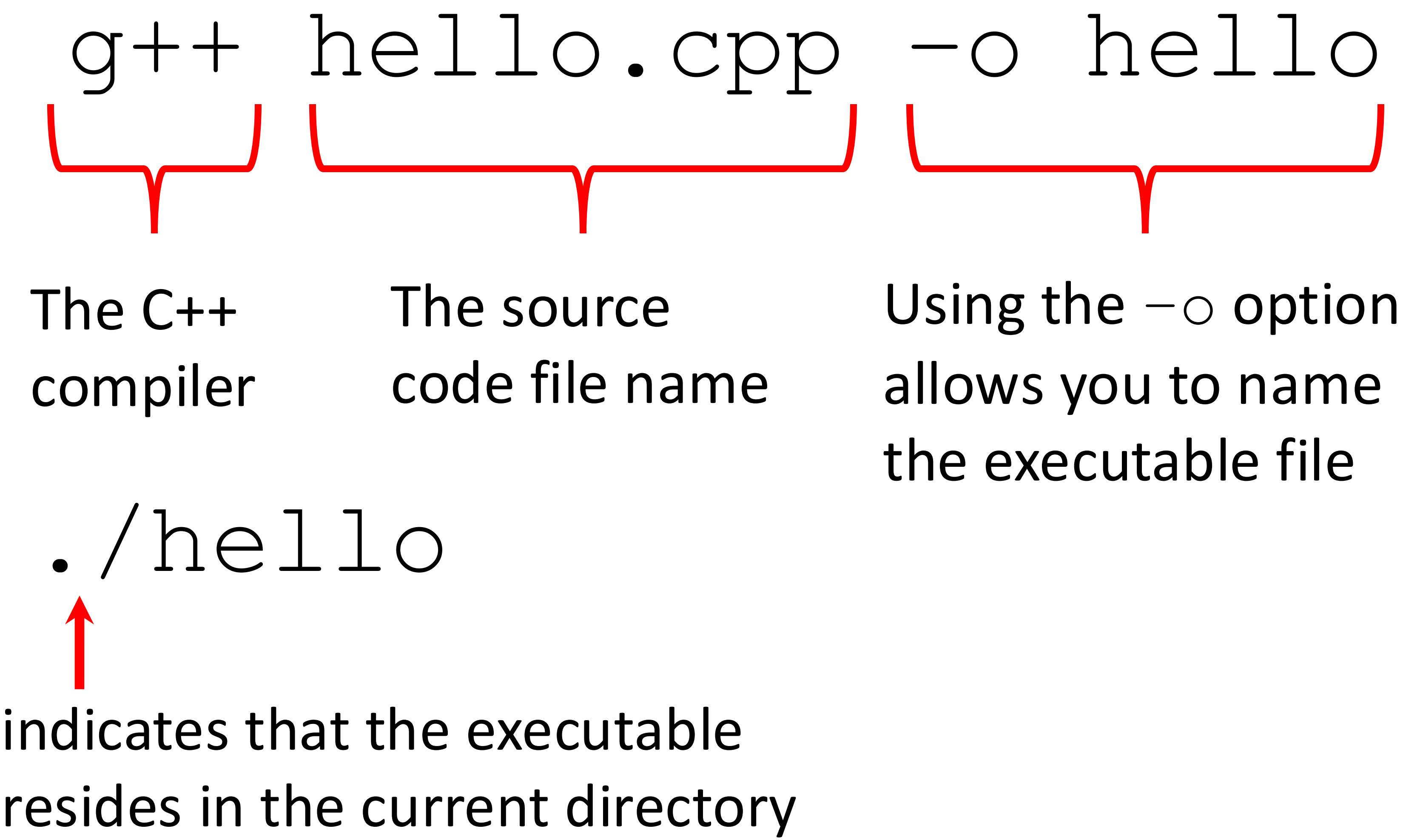
Writing Your First C++ Program



```
// This program outputs the message “Hello, World!”
#include <cstdio>

int main()
{
    printf("Hello, World!\n.");
    // ^ a C function
    return 0;
}
```

Compile & Execute Your Program



```
g++ hello.cpp -o hello
```

The C++ compiler

The source code file name

Using the `-o` option allows you to name the executable file

```
./hello
```

indicates that the executable resides in the current directory

Environment Setup

Development Environment

- All work will be compiled, run, tested and graded on the computer science Linux machines:
  - cs01 – cs06.richmond.edu

Ubuntu

- GitHub classroom for all assignments
  1. Accept the assignment
  2. Clone repository using VSCode with remote-ssh
  3. Make updates to the code and README.md file
  4. Add (Stage), Commit, and Sync changes

Development Environment

1. Open a terminal
2. ssh your_UR_netid@cs01.richmond.edu
   For example: for me, ssh dszajda@cs01.richmond.edu

3. Follow instructions:
   - https://cmsc240-f24-dcs.github.io/cmsc240-f24-s2.github.io/guides/vscode-ssh

In-Class Coding Exercise