

Introduction to C++

Dr. Robert Lowe

Division of Mathematics and Computer Science
Maryville College

Outline

- 1 Working with Git
- 2 Introduction to Programming
- 3 Our First C++ Program

Outline

- 1 Working with Git
- 2 Introduction to Programming
- 3 Our First C++ Program

Your Repository

- 1 Check your email. Look for an invite to a repository named:
`cs1-fall2019-username`

Your Repository

- 1 Check your email. Look for an invite to a repository named:
`cs1-fall12019-username`
- 2 Accept the invitation.

Your Repository

- 1 Check your email. Look for an invite to a repository named:
`cs1-fall12019-username`
- 2 Accept the invitation.
- 3 Look at the repository on GitHub.



Your Repository

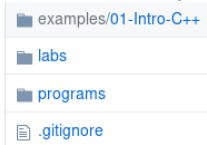
- 1 Check your email. Look for an invite to a repository named:
`cs1-fall12019-username`
- 2 Accept the invitation.
- 3 Look at the repository on GitHub.



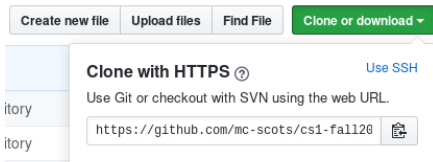
- 4 Log in to `cs.maryvillecollege.edu` via ssh.

Your Repository

- 1 Check your email. Look for an invite to a repository named:
`cs1-fall12019-username`
- 2 Accept the invitation.
- 3 Look at the repository on GitHub.



- 4 Log in to `cs.maryvillecollege.edu` via ssh.
- 5 On GitHub, click “Clone or download” and select “https”.



Your Repository (ctd.)

- 6 Copy the https URL to your clipboard.

Your Repository (ctd.)

- 6 Copy the https URL to your clipboard.
- 7 Type the following command in your ssh shell (pasting the URL where specified)

```
git clone «Paste URL Here»
```

Your Repository (ctd.)

- 6 Copy the https URL to your clipboard.
- 7 Type the following command in your ssh shell (pasting the URL where specified)

```
git clone «Paste URL Here»
```
- 8 Change into your `cs1-fall2019-username` directory.
HINT: Use tab completion! Type `cd cs1` and then press the tab key. It saves time!

Your Repository (ctd.)

- 6 Copy the https URL to your clipboard.
- 7 Type the following command in your ssh shell (pasting the URL where specified)

```
git clone «Paste URL Here»
```
- 8 Change into your `cs1-fall2019-username` directory.
HINT: Use tab completion! Type `cd cs1` and then press the tab key. It saves time!
- 9 Look around in your newly cloned repository. This is where you will do all of your work!

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

`git pull` Pull changes from GitHub. (Do this at the beginning of each class meeting!)

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

`git pull` Pull changes from GitHub. (Do this at the beginning of each class meeting!)

`git add filename` Add a file to the list of files tracked by git.

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

`git pull` Pull changes from GitHub. (Do this at the beginning of each class meeting!)

`git add filename` Add a file to the list of files tracked by git.

`git add -A` Add all untracked files to the git repository.

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

`git pull` Pull changes from GitHub. (Do this at the beginning of each class meeting!)

`git add filename` Add a file to the list of files tracked by git.

`git add -A` Add all untracked files to the git repository.

`git commit -a` Commit all changes to the local repository.
(Do this at the end of every major change.)

Basic `git` Commands

Basic Pattern: `git command args`

`git clone url` Clone a repository to your current directory.

`git pull` Pull changes from GitHub. (Do this at the beginning of each class meeting!)

`git add filename` Add a file to the list of files tracked by git.

`git add -A` Add all untracked files to the git repository.

`git commit -a` Commit all changes to the local repository.
(Do this at the end of every major change.)

`git push` Push all changes to GitHub. (Do this at the end of every work session.)

Your Workflow

Each time you sit down to work:

- 1 Login on MCCA via ssh.

Your Workflow

Each time you sit down to work:

- 1 Login on M CCS via ssh.
- 2 Change into your `cs1-fall2019-username` directory.

Your Workflow

Each time you sit down to work:

- 1 Login on M CCS via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`

Your Workflow

Each time you sit down to work:

- 1 Login on MCCA via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`
- 4 Do some rather taxing and stressful programming.

Your Workflow

Each time you sit down to work:

- 1 Login on MCCC via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`
- 4 Do some rather taxing and stressful programming.
- 5 Periodically (and at the end): `git add -A`

Your Workflow

Each time you sit down to work:

- 1 Login on MCCS via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`
- 4 Do some rather taxing and stressful programming.
- 5 Periodically (and at the end): `git add -A`
- 6 Periodically (and at the end): `git commit -a`

Your Workflow

Each time you sit down to work:

- 1 Login on MCCS via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`
- 4 Do some rather taxing and stressful programming.
- 5 Periodically (and at the end): `git add -A`
- 6 Periodically (and at the end): `git commit -a`
- 7 At the end of your work session: `git push`

Your Workflow

Each time you sit down to work:

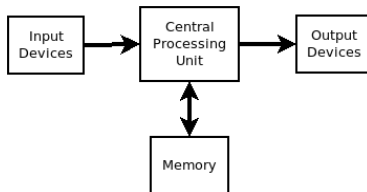
- 1 Login on MCCC via ssh.
- 2 Change into your `cs1-fall2019-username` directory.
- 3 `git pull`
- 4 Do some rather taxing and stressful programming.
- 5 Periodically (and at the end): `git add -A`
- 6 Periodically (and at the end): `git commit -a`
- 7 At the end of your work session: `git push`
- 8 Contemplate coding until the blessed hour arrives when you can resume your work.

Outline

- 1 Working with Git
- 2 Introduction to Programming
- 3 Our First C++ Program

Anatomy of a Computer

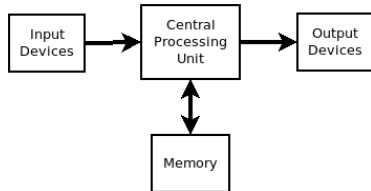
- A **computer** is a device which executes programs.



Von-Neumann Architecture

Anatomy of a Computer

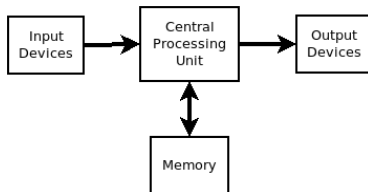
- A **computer** is a device which executes programs.
- The most common computer architecture is the Von-Neumann Architecture.



Von-Neumann Architecture

Anatomy of a Computer

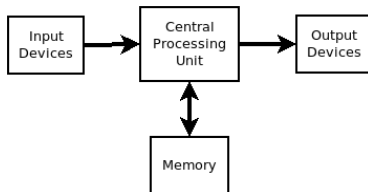
- A **computer** is a device which executes programs.
- The most common computer architecture is the Von-Neumann Architecture.
- Program code and data are stored in the same memory.



Von-Neumann Architecture

Anatomy of a Computer

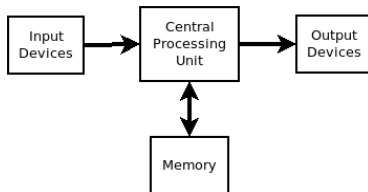
- A **computer** is a device which executes programs.
- The most common computer architecture is the Von-Neumann Architecture.
- Program code and data are stored in the same memory.
- **CPU** Executes very simple instructions.



Von-Neumann Architecture

Anatomy of a Computer

- A **computer** is a device which executes programs.
- The most common computer architecture is the Von-Neumann Architecture.
- Program code and data are stored in the same memory.
- **CPU** Executes very simple instructions.
- Collectively, the components of a computer are called its **hardware**.



Von-Neumann Architecture

Program Representation & Translation

- The text typed by a programmer is called **source code**.

Program Representation & Translation

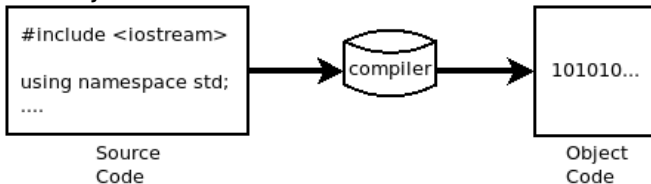
- The text typed by a programmer is called **source code**.
- The binary code executed by a computer is called **object code** or **machine code**.

Program Representation & Translation

- The text typed by a programmer is called **source code**.
- The binary code executed by a computer is called **object code** or **machine code**.
- In **interpreted** languages an **interpreter** directly executes source code.

Program Representation & Translation

- The text typed by a programmer is called **source code**.
- The binary code executed by a computer is called **object code** or **machine code**.
- In **interpreted** languages an **interpreter** directly executes source code.
- In **compiled** languages a **compiler** translates source code into object code.



A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba  
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00  
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c  
64 0a 00 00
```

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.
- Change into your `examples/01-Intro-C++` directory.

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.
- Change into your `examples/01-Intro-C++` directory.
- `cat prognum.S`

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.
- Change into your `examples/01-Intro-C++` directory.
- `cat prognum.S`
- `as prognum.S -o prognum.o`

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.
- Change into your `examples/01-Intro-C++` directory.
- `cat prognum.S`
- `as prognum.S -o prognum.o`
- `ld prognum.o -o prognum`

A Program - In Machine Code

```
b8 04 00 00 00 bb 01 00 00 00 b9 25 10 40 00 ba
33 10 40 00 81 ea 25 10 40 00 cd 80 b8 01 00 00
00 31 db cd 80 68 65 6c 6c 6f 2c 20 77 6f 72 6c
64 0a 00 00
```

- What does this do?
- Really, even this needs to have a bit of a wrapper to turn it into binary.
- Change into your `examples/01-Intro-C++` directory.
- `cat prognum.S`
- `as prognum.S -o prognum.o`
- `ld prognum.o -o prognum`
- `./prognum`

A Program - In Assembly

```
.text
.globl _start

_start:

    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:    .string "hello, world\n"
msgend: .byte 0
```

A Program - In Assembly

```
.text
.globl _start

_start:

    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:    .string "hello, world\n"
msgend: .byte 0
```

- Make sure you are in `examples/01-Intro-C++`.

A Program - In Assembly

```
.text
.globl _start

_start:
    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:     .string "hello, world\n"
msgend:  .byte 0
```

- Make sure you are in `examples/01-Intro-C++`.
- `cat hello.S`

A Program - In Assembly

```
.text
.globl _start

_start:
    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:     .string "hello, world\n"
msgend:  .byte 0
```

- Make sure you are in `examples/01-Intro-C++`.
- `cat hello.S`
- `as hello.S -o hello.o`

A Program - In Assembly

```
.text
.globl _start

_start:
    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:     .string "hello, world\n"
msgend:  .byte 0
```

- Make sure you are in
examples/01-Intro-C++.
- `cat hello.S`
- `as hello.S -o
hello.o`
- `ld hello.o -o hello`

A Program - In Assembly

```
.text
.globl _start

_start:
    movl    $4, %eax
    movl    $1, %ebx
    movl    $msg, %ecx
    movl    $msgend, %edx
    sub     $msg, %edx
    int     $0x80

    movl    $1, %eax
    xorl    %ebx, %ebx
    int     $0x80

msg:     .string "hello, world\n"
msgend:  .byte 0
```

- Make sure you are in `examples/01-Intro-C++`.
- `cat hello.S`
- `as hello.S -o hello.o`
- `ld hello.o -o hello`
- `./hello`

A Program - In Python

```
print "hello, world"
```

A Program - In Python

```
print "hello, world"
```

- Make sure you are in `examples/01-Intro-C++`.

A Program - In Python

```
print "hello, world"
```

- Make sure you are in `examples/01-Intro-C++`.
- `cat hello.py`

A Program - In Python

```
print "hello, world"
```

- Make sure you are in `examples/01-Intro-C++`.
- `cat hello.py`
- `python hello.py`

Levels of Abstraction

- (Too) Many programming languages exist.

High(Human)



Low (Machine)

Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.

High(Human)



Low (Machine)

Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.

High(Human)



Low (Machine)

Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.
- A programming language's level of abstraction is the degree to which it hides details from the programmer.

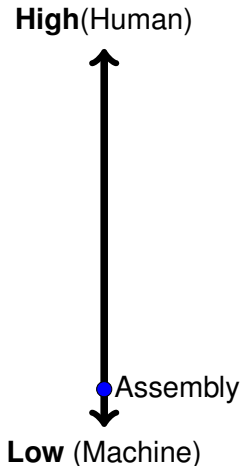
High(Human)



Low (Machine)

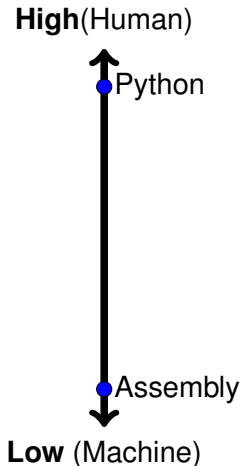
Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.
- A programming language's level of abstraction is the degree to which it hides details from the programmer.



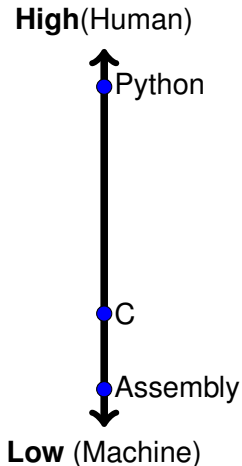
Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.
- A programming language's level of abstraction is the degree to which it hides details from the programmer.



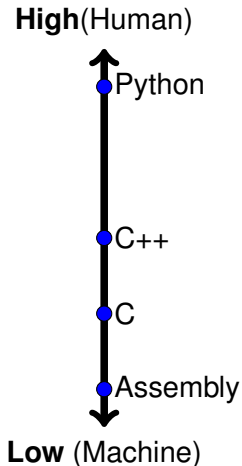
Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.
- A programming language's level of abstraction is the degree to which it hides details from the programmer.



Levels of Abstraction

- (Too) Many programming languages exist.
- Each language is designed for some set of purposes.
- Usually, humans desire a fair degree of **abstraction**.
- A programming language's level of abstraction is the degree to which it hides details from the programmer.



The C++ Programming Language



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.
- Adds Object Oriented Programming to C.



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.
- Adds Object Oriented Programming to C.
- Compiled, Mid-Level language.



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.
- Adds Object Oriented Programming to C.
- Compiled, Mid-Level language.
- Ported to virtually all modern platforms.



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.
- Adds Object Oriented Programming to C.
- Compiled, Mid-Level language.
- Ported to virtually all modern platforms.
- Low level access with high level facilities.



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

The C++ Programming Language

- Created at Bell Labs by Bjarne Stroustrup as a successor to the C programming language.
- Adds Object Oriented Programming to C.
- Compiled, Mid-Level language.
- Ported to virtually all modern platforms.
- Low level access with high level facilities.
- You get to explore a bit of all worlds when learning C++!



Source: https://en.wikipedia.org/wiki/Bjarne_Stroustrup

Outline

- 1 Working with Git
- 2 Introduction to Programming
- 3 Our First C++ Program

Creating The `week2` Directory

- 1 Change to your `~/cs1-fall2019-username` directory.

Creating The `week2` Directory

- 1 Change to your `~/cs1-fall2019-username` directory.
- 2 `cd labs`

Creating The `week2` Directory

- 1 Change to your `~/cs1-fall2019-username` directory.
- 2 `cd labs`
- 3 `mkdir week2`

Creating The `week2` Directory

- 1 Change to your `~/cs1-fall2019-username` directory.
- 2 `cd labs`
- 3 `mkdir week2`
- 4 `cd week2`

Create `hello.cpp`

Using the text editor of your choice, enter the following into a file titled `hello.cpp`.

```
#include <iostream>

using namespace std;

int main()
{
    cout << "hello, world" << endl;
}
```

Compile `hello.cpp`

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

Compile `hello.cpp`

- 1 `g++ hello.cpp -o hello`
- 2 Correct any errors you may have encountered.

Compile `hello.cpp`

- 1 `g++ hello.cpp -o hello`
- 2 Correct any errors you may have encountered.
- 3 Once it compiles error free, proceed.

Compile `hello.cpp`

- 1 `g++ hello.cpp -o hello`
- 2 Correct any errors you may have encountered.
- 3 Once it compiles error free, proceed.
- 4 `./hello`

Push Your Work to GitHub

```
1 git add hello.cpp
```


Push Your Work to GitHub

- 1 `git add hello.cpp`
- 2 `git commit hello.cpp -m 'Added hello.cpp'`

Push Your Work to GitHub

- 1 `git add hello.cpp`
- 2 `git commit hello.cpp -m 'Added hello.cpp'`
- 3 `git push`

Push Your Work to GitHub

- 1 `git add hello.cpp`
- 2 `git commit hello.cpp -m 'Added hello.cpp'`
- 3 `git push`
- 4 Go to your GitHub repository and verify that your file is in your `labs/week2` folder.