

## 03 - Program Structure and Variables

Dr. Robert Lowe

Division of Mathematics and Computer Science  
Maryville College

# Outline

- 1 Program Structure
- 2 Variables
- 3 Stock Portfolio Program

# Outline

- 1 Program Structure
- 2 Variables
- 3 Stock Portfolio Program

# Startup

- 1 Log in to your shell account
- 2 `cd cs1-fall2019-username`
- 3 `git pull`

# hello.cpp

```
#include <iostream>

using namespace std;

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

# hello.cpp

```
Preprocessor → #include <iostream>

using namespace std;

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

# hello.cpp

Preprocessor → `#include <iostream>`

`using namespace std;`

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

# hello.cpp

Preprocessor → `#include <iostream>`

`using namespace std;`

Main Header → `int main()`  
`{` ← Begin Block  
 `cout << "hello, world" << endl;`  
`}` ← End Block



# hello.cpp

Preprocessor → `#include <iostream>`

`using namespace std;`

Main Header → `int main()`

`{` ← Begin Block

Main Body → `cout << "hello, world" << endl;`

`}` ← End Block

# Preprocessor Directives

- The preprocessor runs before the main compilation takes place.

# Preprocessor Directives

- The preprocessor runs before the main compilation takes place.
- Preprocessor directives begin with #.

# Preprocessor Directives

- The preprocessor runs before the main compilation takes place.
- Preprocessor directives begin with #.
- The include directive copies the contents of a file to its location.

# Preprocessor Directives

- The preprocessor runs before the main compilation takes place.
- Preprocessor directives begin with #.
- The include directive copies the contents of a file to its location.
- `iostream` is a C++ library file which contains definitions for input and output.

# Preprocessor Directives

- The preprocessor runs before the main compilation takes place.
- Preprocessor directives begin with #.
- The include directive copies the contents of a file to its location.
- `iostream` is a C++ library file which contains definitions for input and output.
- For any program that does input and output in C++, you must therefore have the directive:

```
#include<iostream>
```

# using

- In order to avoid name collisions, C++ has namespaces.

# using

- In order to avoid name collisions, C++ has namespaces.
- All of the C++ library is in the `std` namespace.



# using

- In order to avoid name collisions, C++ has namespaces.
- All of the C++ library is in the `std` namespace.
- To access these elements, we would normally have to use the `::` operator.

# using

- In order to avoid name collisions, C++ has namespaces.
- All of the C++ library is in the `std` namespace.
- To access these elements, we would normally have to use the `::` operator.
- for example, the `cout` line in `hello.cpp` would read:  

```
std::cout << "hello, world" << std::endl;
```

# using

- In order to avoid name collisions, C++ has namespaces.
- All of the C++ library is in the `std` namespace.
- To access these elements, we would normally have to use the `::` operator.
- for example, the `cout` line in `hello.cpp` would read:  
`std::cout << "hello, world" << std::endl;`
- Needless to say, this gets tedious!

# using

- In order to avoid name collisions, C++ has namespaces.
- All of the C++ library is in the `std` namespace.
- To access these elements, we would normally have to use the `::` operator.
- for example, the `cout` line in `hello.cpp` would read:  

```
std::cout << "hello, world" << std::endl;
```
- Needless to say, this gets tedious!
- The `using` line tells c++ to import all the objects from a namespace so we don't have to use `::` to access them.  

```
using namespace std;
```

# The `main` Function

- Every C++ program begins its execution in the `main` function.

# The `main` Function

- Every C++ program begins its execution in the `main` function.
- This is formally called **the program entry point**.

# The `main` Function

- Every C++ program begins its execution in the main function.
- This is formally called **the program entry point**.
- The main function returns an integer to the operating system. A 0 means success, all other numbers are errors.

# The `main` Function

- Every C++ program begins its execution in the main function.
- This is formally called **the program entry point**.
- The main function returns an integer to the operating system. A 0 means success, all other numbers are errors.
- If you do not specify a return value, the compiler will default to 0.



# The `main` Function

- Every C++ program begins its execution in the main function.
- This is formally called **the program entry point**.
- The main function returns an integer to the operating system. A 0 means success, all other numbers are errors.
- If you do not specify a return value, the compiler will default to 0.
- All of your code, for now, will go in between the curly braces that mark the start and end of the main function.

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ; .

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ;.
- For example, this line is the only statement in `hello.cpp`:  

```
cout << "hello, world" << endl;
```

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ;.
- For example, this line is the only statement in `hello.cpp`:  
`cout << "hello, world" << endl;`
- C++ does not care about white space, so a statement can span multiple lines.

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ;.
- For example, this line is the only statement in `hello.cpp`:  
`cout << "hello, world" << endl;`
- C++ does not care about white space, so a statement can span multiple lines.
- Groups of statements are called blocks, and they are wrapped in curly braces: { and }.

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ;.
- For example, this line is the only statement in `hello.cpp`:  
`cout << "hello, world" << endl;`
- C++ does not care about white space, so a statement can span multiple lines.
- Groups of statements are called blocks, and they are wrapped in curly braces: { and }.
- The `main` function's body is a block of code.

# Blocks and Statements

- A statement is a group of operations terminated by a semicolon ; .
- For example, this line is the only statement in `hello.cpp`:  
`cout << "hello, world" << endl;`
- C++ does not care about white space, so a statement can span multiple lines.
- Groups of statements are called blocks, and they are wrapped in curly braces: { and }.
- The `main` function's body is a block of code.
- Blocks can be nested inside each other (more on this later).

# Comments

- Comments are notes which explain the code.



# Comments

- Comments are notes which explain the code.
- The text of comments are ignored by the compiler.

# Comments

- Comments are notes which explain the code.
- The text of comments are ignored by the compiler.
- C++ has two types of comments:

```
// Everything to the end is a comment
```

```
/* Everything within is a comment */
```

# Comments

- Comments are notes which explain the code.
- The text of comments are ignored by the compiler.
- C++ has two types of comments:
  - `// Everything to the end is a comment`
  - `/* Everything within is a comment */`
- The `//` comment is new to C++, and is the preferred method.

# Comments

- Comments are notes which explain the code.
- The text of comments are ignored by the compiler.
- C++ has two types of comments:
  - // Everything to the end is a comment
  - /\* Everything within is a comment \*/
- The // comment is new to C++, and is the preferred method.
- /\* \*/ are c-style comments and can be used to make multi-line comments, but be careful!

# Comments

- Comments are notes which explain the code.
- The text of comments are ignored by the compiler.
- C++ has two types of comments:  

```
// Everything to the end is a comment
```

```
/* Everything within is a comment */
```
- The `//` comment is new to C++, and is the preferred method.
- `/* */` are c-style comments and can be used to make multi-line comments, but be careful!
- Every program should have comments (lest they lose points when being graded).

# boilerplate.cpp

- 1 `cd ~/cs1-fall2019-username`
- 2 **Create the file `boilerplate.cpp` and enter the following:**

```
// File:
// Purpose:
// Author:
#include <iostream>

using namespace std;

int main()
{

}
```

# The Stream Insertion Operator

- `cout` is the character output stream.

# The Stream Insertion Operator

- `cout` is the character output stream.
- Inserting data into `cout` will display it on the screen.



# The Stream Insertion Operator

- `cout` is the character output stream.
- Inserting data into `cout` will display it on the screen.
- The operator `<<` is the **insertion operator**.

# The Stream Insertion Operator

- `cout` is the character output stream.
- Inserting data into `cout` will display it on the screen.
- The operator `<<` is the **insertion operator**.
- `endl` is a constant which means “end of line”.

# The Stream Insertion Operator

- `cout` is the character output stream.
- Inserting data into `cout` will display it on the screen.
- The operator `<<` is the **insertion operator**.
- `endl` is a constant which means “end of line”.
- So the line of C++:  

```
cout << "hello, world" << endl;
```

means “Display the words ‘hello, world’ and then end the line”

# The Stream Insertion Operator

- `cout` is the character output stream.
- Inserting data into `cout` will display it on the screen.
- The operator `<<` is the **insertion operator**.
- `endl` is a constant which means “end of line”.
- So the line of C++:  

```
cout << "hello, world" << endl;
```

means “Display the words ‘hello, world’ and then end the line”
- **Something to Try:** Remove the `<< endl` portion of this line in `hello.cpp`. Recompile and run it. What changed?

# Multiple Lines of Output

Often, we want to have multiple lines of text. This can be done in one statement!

```
cout << "Tell me, where is fancy bred?" << endl  
    << "  Or in the heart, or in the head?" << endl  
    << "                --William Shakespeare" << endl  
    << "                (Merchant of Venice)" << endl;
```

## Challenge: Draw a Diamond!

**Challenge:** Write a program `diamond.cpp` in your `labs/week2` folder which uses a single statement to print the following figure (begin by copying your `boilerplate.cpp` file!:

#

# # #

# # # # #

# # # # # # #

# # # # # # # # #

# # # # # # # # # # #

# # # # # # # # # # #

# # # # # # #

# # #

#

# Outline

- 1 Program Structure
- 2 Variables
- 3 Stock Portfolio Program

# The Basic Idea of Variables

- Variables are where programs store data.



# The Basic Idea of Variables

- Variables are where programs store data.
- Variables can be assigned values, be used in operations, and can be changed.

# The Basic Idea of Variables

- Variables are where programs store data.
- Variables can be assigned values, be used in operations, and can be changed.
- In C++, variables are strongly typed. That is, each variable can only store one type of information!

# Types and Declarations

- C++ has the following variable types:

# Types and Declarations

- C++ has the following variable types:
  - `bool` Stores a value that is either true or false

# Types and Declarations

- C++ has the following variable types:
  - bool** Stores a value that is either true or false
  - char** Stores a single character (a letter, digit, or any other symbol)

# Types and Declarations

- C++ has the following variable types:
  - bool** Stores a value that is either true or false
  - char** Stores a single character (a letter, digit, or any other symbol)
  - int** Stores an integer

# Types and Declarations

- C++ has the following variable types:
  - bool** Stores a value that is either true or false
  - char** Stores a single character (a letter, digit, or any other symbol)
  - int** Stores an integer
  - float** Stores a single precision floating point number (don't use these!)

# Types and Declarations

- C++ has the following variable types:

**bool** Stores a value that is either true or false

**char** Stores a single character (a letter, digit, or any other symbol)

**int** Stores an integer

**float** Stores a single precision floating point number (don't use these!)

**double** Stores a double precision floating point number.



# Types and Declarations

- C++ has the following variable types:

**bool** Stores a value that is either true or false

**char** Stores a single character (a letter, digit, or any other symbol)

**int** Stores an integer

**float** Stores a single precision floating point number (don't use these!)

**double** Stores a double precision floating point number.

- Variables must be declared before they are used:

```
int x;
```

```
char letter;
```

```
double num;
```

# Variable Names

Variables names:

- must begin with a letter or \_.

# Variable Names

Variables names:

- must begin with a letter or \_.
- can contain letters, numbers, or \_.

# Variable Names

Variables names:

- must begin with a letter or \_.
- can contain letters, numbers, or \_.
- are case sensitive.

# Variable Names

Variables names:

- must begin with a letter or \_.
- can contain letters, numbers, or \_.
- are case sensitive.
- must be unique.

# The `cin` Stream

- `cin` is the character input stream object.

# The `cin` Stream

- `cin` is the character input stream object.
- User input can be read into a variable using the **extraction operator** `>>`.

# The `cin` Stream

- `cin` is the character input stream object.
- User input can be read into a variable using the **extraction operator** `»`.
- For example:

```
cin » x;
```

would allow the user to enter an integer which is then stored in `x`.



# Example: multiple\_choice.cpp

Compile and run this program (found in your examples folder)

```
#include <iostream>

using namespace std;

int main()
{
    char choice; //The choice made by the user

    //Get the user's choice
    cout << "In my opinion, computer programming is _____.\" << endl
         << "\tA) the best part of my day\" << endl
         << "\tB) what gives me a sense of purpose\" << endl
         << "\tC) how I scream into the void\" << endl
         << endl
         << "Your Choice? ";
    cin >> choice;

    //report the user's choice
    cout << "You chose \" << choice << "."\" << endl;
}
```

# Outline

- 1 Program Structure
- 2 Variables
- 3 Stock Portfolio Program

# Overview

Over the course of this class, we will develop an application which manages a stock portfolio. It will allow us to:

- Buy Stocks

This program was inspired by a project found in *Complete C Language Programming for the IBM PC* by Douglas A. Troy (1986)

# Overview

Over the course of this class, we will develop an application which manages a stock portfolio. It will allow us to:

- Buy Stocks
- Sell Stocks

This program was inspired by a project found in *Complete C Language Programming for the IBM PC* by Douglas A. Troy (1986)

# Overview

Over the course of this class, we will develop an application which manages a stock portfolio. It will allow us to:

- Buy Stocks
- Sell Stocks
- Run Reports

This program was inspired by a project found in *Complete C Language Programming for the IBM PC* by Douglas A. Troy (1986)

# Overview

Over the course of this class, we will develop an application which manages a stock portfolio. It will allow us to:

- Buy Stocks
- Sell Stocks
- Run Reports
- Store Stock Data in a File

This program was inspired by a project found in *Complete C Language Programming for the IBM PC* by Douglas A. Troy (1986)

# Main Menu

Write a program `stock.cpp` which displays the main menu of the stock portfolio system and reads a user's choice.

```
$ ./stock
```

```
    Stock Portfolio Management System
```

```
        Please Make a Selection
```

```
1 -- Buy a Stock
```

```
2 -- Sell a Stock
```

```
3 -- Report Current Holdings
```

```
4 -- Report Gains and Losses
```

```
5 -- Remove a Current Holding
```

```
6 -- Done!  (quit)
```

```
Choice? 6
```

# Finishing Up

- Make sure you have the following files in `cs1-fall2019-username/labs/week2`
  - `hello.cpp`
  - `diamond.cpp`
  - `stock.cpp`
- Make sure you have `boilerplate.cpp` in your `cs1-fall2019-username` directory.
- These programs must all be in working order to receive full credit for the week!
- `git add -A`
- `git commit -a -m 'Finished Week2!'`
- `git push`