Week 1: Introduction to C++

Gaddis: Chapter 2
(excluding 2.1, 2.11, 2.14)

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Literals

- A literal represents a constant value used in a program statement.
- Numbers: `0, 34, 3.14159, -1.8e12,` etc.
- Characters: `'A', 'z', '!', '5',` etc.
- Strings (sequence of characters):
  - `"Hello", "This is a string"`
  - `"100 years", "100", "Y",` etc.
- NOTE: These are all different: `5, '5', "5"`

Special characters

- Newline: `'\n'`
- Double quote: `'\"'`.
- These can occur in strings:
  - `"Hello\nthere"`
  - `"she said \"boo\" very quietly"`
- See textbook for more
- It's a backslash (\), not a slash (/)

2.2 The `cout` Object

- `cout`: short for "console output"
  - a stream object: represents the contents of the screen
- <<: the stream insertion operator
  - use it to send data to `cout` (to be output to the screen)

```
cout << "This is an example."
```

- when this instruction is executed, the console (screen) looks like this:

```
This is an example.
```

The `endl` manipulator

- `endl`: short for “end line”
  - send it to cout when you want to start a new line of output.

```
cout << “Hello ” << endl << “there!”;
```

- or you can use the newline character: `\n`

```
cout << “Hello \nthere!”;
```

- Either way the output to the screen is:

```
Hello
there!
```


more examples

```
cout << “Hello ” << “there!”;
```

```
Hello there!
```

```
cout << “Hello ”;
cout << “there!”;
```

```
Hello there!
```

```
cout << “The best selling book on Amazon\n is \”The Help\””;
```

```
The best selling book on Amazon
 is ”The Help”
```


2.5 Identifiers

- An identifier is a name for some program element (like a variable).
- Rules:
  - May not be a keyword (see Table 2.4 in the book)
  - First character must be a letter or underscore
  - Following characters must be letters, numbers or underscores.
- Identifiers are case-sensitive:
  - `myVariable` is not the same as `MyVariable`

2.4 Variables (and Literals)

- Variable: named location in main memory
- Has a name and a datatype
  - <datatype> <identifier>
  - The data type indicates the kind of data it can contain.
- A variable must be defined before it can be used!!
- Examples:
  - `int someNumber;`
  - `char firstLetter;`

2.12 Variable Assignments and Initialization

- An **assignment statement** uses the = operator to store a value in an already defined variable.
  - `someNumber = 12;`
- When this statement is executed, the computer stores the value 12 in memory, in the location named “someNumber”.
- The variable receiving the value must be on the left side of the = (the following does NOT work):
  - `12 = someNumber;  //This is an ERROR`

Example program using a variable

```
#include <iostream>
using namespace std;

int main()  {
   int number;

   number = 100;
   cout << “The value of the number is “
        << number  << endl;
   return 0;
}
```

output screen:

```
The value of the number is 100
```


Variable Initialization

- To initialize a variable means to assign it a value when it is defined:
  - `int length = 12;`
- You can define and initialize multiple variables at once (and change them later) :

```
int length = 12, width = 5, area;
area = 35;
length = 10;
area =40;
```


Data Types

- Variables are classified according to their data type.
- The data type determines the kind of information that may be stored in the variable.
- A data type is a set of values.
- Generally two main (types of) data types:
  - Numeric
  - Character-based

C++ Data Types

- `int, short, long`
  - whole numbers (integers)
- `float, double`
  - real numbers (with fractional amounts, decimal points)
- `bool`
  - logical values: true and false
- `char`
  - a single character
- `string`
  - any text, a sequence of characters

2.6 Integer Data Types

- Whole numbers such as 12, 7, and -99
- Typical ranges (may vary on different systems):

Data Type:	Range of values:
short	-32,768 to 32,767
unsigned short	0 to 65,535
int	-2,147,483,648 to 2,147,483,647
unsigned int	0 to 4,294,967,295
long	-2,147,483,648 to 2,147,483,647
unsigned long	0 to 4,294,967,295

- Example variable definitions:

```
short dayOfWeek;
unsigned long distance;
int xCoordinate;
```


2.9 Floating-Point Data Types

- Real numbers such as 12.45, and -3.8
- Typical ranges (may vary on different systems):

Data Type:	Range of values:
float	+/- 3.4e +/- 38 (~7 digits of precision)
double	+/- 1.7e +/- 308 (~15 digits of precision)
long double	+/- 1.7e +/- 308 (~15 digits of precision)

- Floating-point literals can be represented in
  - Fixed point (decimal) notation:

    `31.4159` `0.0000625`
  - E (scientific) notation:

    `3.14159E1` `6.25e-5`

Example program using floating-point data types

```
// This program uses floating point data types.
#include <iostream>
using namespace std;

int main() {
   float distance;
   double mass;

   distance = 1.495979E11;
   mass = 1.989E30;
   cout << "The Sun is " << distance << " meters away.\n";
   cout << "The Sun\'s mass is " << mass << " kilograms.\n";
   return 0;
}
```

output screen:

```
The Sun is 1.49598e+11 meters away.
The Sun's mass is 1.989e+30 kilograms.
```

2.10 The `bool` Data Type

- The values true and false.
- Literal values: `true, false`
- (false is equivalent to 0, true is equivalent to 1)

```
int main() {
   bool boolValue;
   boolValue = true;
   cout << boolValue << endl;
   boolValue = false;
   cout << boolValue << endl;
   return 0;
}
```

output screen:

```
1
0
```


2.7 The `char` Data Type

- All the keyboard and printable symbols.
- Literal values: `'A' '5' '?' 'b'`
  - see also: slides 2 and 3.
- Numeric value of character from the ASCII character set is stored in memory:

CODE:

```
char letter;
letter = 'C';
cout << letter << endl;
```

MEMORY:

letter

67

OUTPUT:

```
C
```

Appendix B shows the ASCII code values

2.8 The C++ `string` class

- Sequences of characters
- Requires the string header file: `#include <string>`
- To define `string` variables in programs:

```
string firstName, lastName;
```

- To assign literals to variables:

```
firstName = "George";
lastName = "Washington";
```

See slides 2 and 3 for more examples of string literals.

- To display via `cout`

```
cout << firstName << " " << lastName;
```

OUTPUT:

```
George Washington
```


2.13 Scope

- The scope of a variable is the part of the program in which the variable can be accessed.
- A variable cannot be used before it is defined.

```
// This program can't find its variable.
#include <iostream>
using namespace std;

int main() {
   cout << value; // ERROR! value not defined yet!

   int value = 100;
   return 0;
}
```

2.15 Comments

- Used to document parts of the program
- Intended for humans reading the source code of the program:
  - Indicate the purpose of the program
  - Describe the use of variables
  - Explain complex sections of code
- Are ignored by the compiler

Single and Mult-Line Comments

- Single-Line comments begin with // through to the end of line:

```
int length = 12; // length in inches
int width = 15;  // width in inches
int area;        // calculated area
// calculate rectangle area
area = length * width;
```

- Multi-Line comments begin with /*, end with */

```
/* this is a multi-line
   comment
*/

int area;   /* calculated area */
```


2.16 Named Constants

- Named constant : variable whose value cannot be changed during program execution
- Used for representing constant values with descriptive names:

```
const double TAX_RATE = 0.0675;
const int NUM_STATES = 50;
```

Note: initialization required.

- Often named in uppercase letters (see style guidelines)

2.17 Programming Style

- The visual organization of the source code
- Includes the use of spaces, tabs, and blank lines
- Includes naming of variables, constants.
- Includes where to use comments.
- Purpose: improve the readability of the source code

Programming Style

Common elements to improve readability:

- Braces { } aligned vertically
- Indentation of statements within a set of braces
- Blank lines between declaration and other statements
- Long statements wrapped over multiple lines with aligned operators

See the Style Guidelines on the class website.
You must follow these in your programming assignments.