Chapter 2: Introduction to C++

Starting Out with C++
Early Objects

Eighth Edition

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Topics

Topics (continued)

2.1 The Parts of a C++ Program

`// sample C++ program`	**comment**
`#include <iostream>`	**preprocessor directive**
`using namespace std;`	**which namespace to use**
`int main()`	**beginning of function named `main`**
`{`	**beginning of block for `main`**
`    cout << "Hello, there!";`	**output statement**
`    return 0;`	**send `0` back to operating system**
`}`	**end of block for `main`**

Special Characters

Character	Name	Description
`//`	Double Slash	Begins a comment
`#`	Pound Sign	Begins preprocessor directive
`< >`	Open, Close Brackets	Encloses filename used in `#include` directive
`( )`	Open, Close Parentheses	Used when naming function
`{ }`	Open, Close Braces	Encloses a group of statements
`" "`	Open, Close Quote Marks	Encloses string of characters
`;`	Semicolon	Ends a programming statement

Important Details

- C++ is case-sensitive. Uppercase and lowercase characters are different characters. ‘`Main`’ is not the same as ‘`main`’.
- Every `{` must have a corresponding `}`, and vice-versa.

2.2 The `cout` Object

- Displays information on computer screen
- Use **<<** to send information to cout

```
cout << "Hello, there!";
```

- Can use **<<** to send multiple items to cout

```
cout << "Hello, " << "there!";
```

Or

```
cout << "Hello, ";
cout << "there!";
```

Starting a New Line

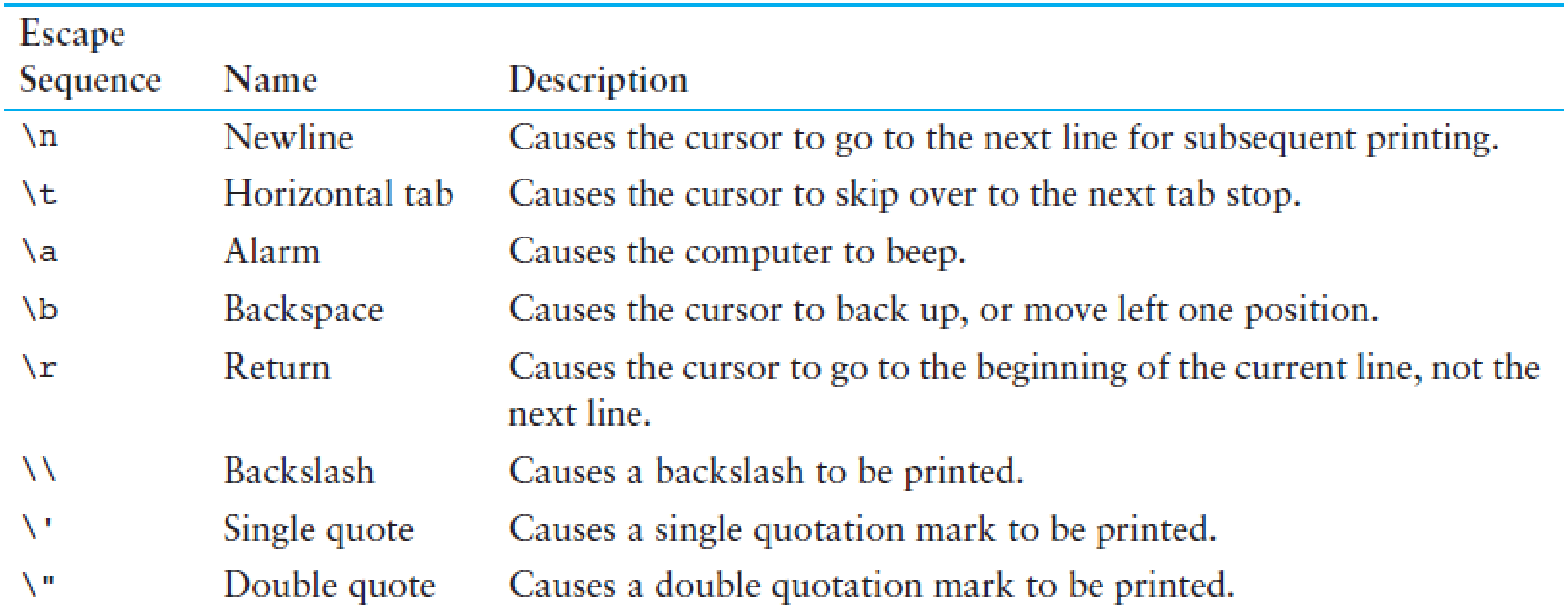
- To get multiple lines of output on screen
  - Use **`endl`**

    ```
    cout << "Hello, there!" << endl;
    ```

  - Use **`\n`** in an output string

    ```
    cout << "Hello, there!\n";
    ```

Escape Sequences – More Control Over Output



Escape Sequence	Name	Description
`\n`	Newline	Causes the cursor to go to the next line for subsequent printing.
`\t`	Horizontal tab	Causes the cursor to skip over to the next tab stop.
`\a`	Alarm	Causes the computer to beep.
`\b`	Backspace	Causes the cursor to back up, or move left one position.
`\r`	Return	Causes the cursor to go to the beginning of the current line, not the next line.
`\\`	Backslash	Causes a backslash to be printed.
`\'`	Single quote	Causes a single quotation mark to be printed.
`\"`	Double quote	Causes a double quotation mark to be printed.

2.3 The **`#include`** Directive

- Inserts the contents of another file into the program
- Is a preprocessor directive
  - Not part of the C++ language
  - Not seen by compiler
- Example:

```
#include <iostream>
```

No ; goes here

2.4 Standard and Prestandard C++

Prestandard (Older-style) C++ programs

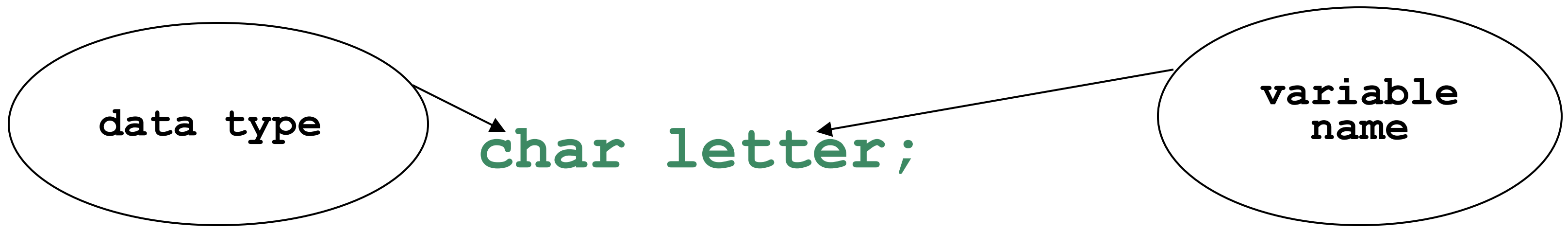
- Use **`.h`** at end of header files

  ```
  #include <iostream.h>
  ```

- Do not use **`using namespace`** convention
- May not use **`return 0;`** at the end of function **`main`**
- May not compile with a standard C++ compiler

2.5 Variables, Literals, and the Assignment Statement

- Variable
  - Has a name and a type of data it can hold



```
char letter;
```

  - Is used to reference a location in memory where a value can be stored
  - Must be defined before it can be used
  - The value that is stored can be changed, *i.e.*, it can “vary”

Variables

– If a new value is stored in the variable, it replaces the previous value

– The previous value is overwritten and can no longer be retrieved

```
int age;
age = 17;       // age is 17
cout << age;    // Displays 17
age = 18;       // Now age is 18
cout << age;    // Displays 18
```

Assignment Statement

- Uses the **=** operator
- Has a single variable on the left side and a value on the right side
- Copies the value on the right into the variable on the left

```
    item = 12;
```

Constants

Literal

- Data item whose value does not change during program execution
- Is also called a constant

```
'A'       // character constant
"Hello"   // string literal
12        // integer constant
3.14      // floating-point constant
```

2.6 Identifiers

- Programmer-chosen names to represent parts of the program, such as variables
- Name should indicate the use of the identifier
- Cannot use C++ key words as identifiers
- Must begin with alphabetic character or _, followed by alphabetic, numeric, or _ . Alphabetic characters may be upper- or lowercase

Multi-word Variable Names

- Descriptive variable names may include multiple words
- Two conventions to use in naming variables:
  - Capitalize all but first letter of first word. Run words together:

    ```
    quantityOnOrder
    totalSales
    ```

  - Use the underscore _ character as a space:

    ```
    quantity_on_order
    total_sales
    ```

- Use one convention consistently throughout program

Valid and Invalid Identifiers

IDENTIFIER	VALID?	REASON IF INVALID
`totalSales`	Yes	
`total_Sales`	Yes	
`total.Sales`	No	Cannot contain period
`4thQtrSales`	No	Cannot begin with digit
`totalSale$`	No	Cannot contain $

2.7 Integer Data Types

- Designed to hold whole (non-decimal) numbers
- Can be **`signed`** or **`unsigned`**

  `12        -6        +3`

- Available in different sizes (*i.e.*, number of bytes): **`short`**, **`int`**, and **`long`**
- Size of **`short`** ≤ size of **`int`** ≤ size of **`long`**

Signed vs. Unsigned Integers

- C++ allocates one bit for the sign of the number. The rest of the bits are for data.
- If your program will never need negative numbers, you can declare variables to be **`unsigned`**. All bits in unsigned numbers are used for data.
- A variable is signed unless the **`unsigned`** keyword is used.

Defining Variables

- Variables of the same type can be defined
  - In separate statements

```
int length;
int width;
```

  - In the same statement

```
int length,
    width;
```

- Variables of different types must be defined in separate statements

Integral Constants

- To store an integer constant in a long memory location, put '**`L`**' at the end of the number: `1234L`
- Constants that begin with '**`0`**' (zero) are octal, or base 8: `075`
- Constants that begin with '**`0x`**' are hexadecimal, or base 16: `0x75A`

2.8 Floating-Point Data Types

- Designed to hold real numbers

  `12.45          -3.8`

- Stored in a form similar to scientific notation
- Numbers are all signed
- Available in different sizes (number of bytes): **`float`**, **`double`**, and **`long double`**
- Size of **`float`** $\leq$ size of **`double`**

  $\leq$ size of **`long double`**

Floating-point Constants

- Can be represented in
  - Fixed point (decimal) notation:

    `31.4159          0.0000625`
  - E notation:

    `3.14159E1        6.25e-5`
- Are **`double`** by default
- Can be forced to be float **`3.14159F`** or long double **`0.0000625L`**

Assigning Floating-point Values to Integer Variables

If a floating-point value is assigned to an integer variable

- The fractional part will be truncated (*i.e.*, “chopped off” and discarded)
- The value is not rounded

```
int rainfall = 3.88;
cout << rainfall;  // Displays 3
```

2.9 The **`char`** Data Type

- Used to hold single characters or very small integer values
- Usually occupies 1 byte of memory
- A numeric code representing the character is stored in memory

SOURCE CODE **MEMORY**

```
char letter = 'C';    letter
```

Character Literal

- A character literal is a single character
- When referenced in a program, it is enclosed in single quotation marks:

```
cout << 'Y' << endl;
```

- The quotation marks are not part of the literal, and are not displayed

String Literals

- Can be stored as a series of characters in consecutive memory locations

  `"Hello"`

- Stored with the null terminator, **`\0`**, automatically placed at the end

`H`	`e`	`l`	`l`	`o`	`\0`

- Is comprised of characters between the **`"  "`**

A character or a string literal?

- A character literal is a single character, enclosed in single quotes:

```
'C'
```

- A string literal is a sequence of characters enclosed in double quotes:

```
"Hello, there!"
```

- A single character in double quotes is a string literal, not a character literal:

```
"C"
```

2.10 The C++ **`string`** Class

- Must **`#include <string>`** to create and use string objects
- Can define **`string`** variables in programs

```
string name;
```

- Can assign values to string variables with the assignment operator

```
name = "George";
```

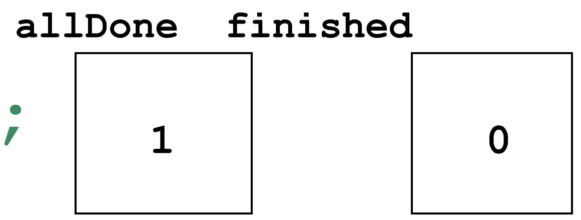
- Can display them with **`cout`**

```
cout << "My name is " << name;
```

2.11 The **`bool`** Data Type

- Represents values that are **`true`** or **`false`**
- **`bool`** values are stored as integers
- **`false`** is represented by 0, **`true`** by 1

```
bool allDone = true;
bool finished = false;
```



2.12 Determining the Size of a Data Type

The **`sizeof`** operator gives the size in number of bytes of any data type or variable

```
double amount;
cout << "A float is stored in "
     << sizeof(float) << " bytes\n";
cout << "Variable amount is stored in "
     << sizeof(amount) << " bytes\n";
```

2.13 More on Variable Assignments and Initialization

Assigning a value to a variable

- Assigns a value to a previously created variable
- A single variable name must appear on left side of the **=** symbol

```
int size;
size = 5;     // legal
5 = size;     // not legal
```

Variable Assignment vs. Initialization

Initializing a variable

- Gives an initial value to a variable at the time it is created
- Can initialize some or all of the variables being defined

```
int length = 12;
int width = 7, height = 5, area;
```

2.14 Scope

- The scope of a variable is that part of the program where the variable may be used
- A variable cannot be used before it is defined

```
int num1 = 5;
cout >> num1;    // legal
cout >> num2;    // illegal
int num2 = 12;
```

2.15 Arithmetic Operators

- Used for performing numeric calculations
- C++ has unary, binary, and ternary operators
  - unary (1 operand) **`-5`**
  - binary (2 operands) **`13 - 7`**
  - ternary (3 operands) **`exp1 ? exp2 : exp3`**

Binary Arithmetic Operators

SYMBOL	OPERATION	EXAMPLE	`ans`
`+`	**addition**	`ans = 7 + 3;`	`10`
`-`	**subtraction**	`ans = 7 - 3;`	`4`
`*`	**multiplication**	`ans = 7 * 3;`	`21`
`/`	**division**	`ans = 7 / 3;`	`2`
`%`	**modulus**	`ans = 7 % 3;`	`1`

`/` Operator

- C++ division operator (`/`) performs integer division if both operands are integers

```
cout << 13 / 5;     // displays 2
cout <<  2 / 4;     // displays 0
```

- If either operand is floating-point, the result is floating-point

```
cout << 13 / 5.0;   // displays 2.6
cout << 2.0 / 4;    // displays 0.5
```

`%` Operator

- C++ modulus operator (`%`) computes the remainder resulting from integer division

```
cout << 9 % 2;   // displays 1
```

- `%` requires integers for both operands

```
cout << 9 % 2.0; // error
```

2.16 Comments

- Are used to document parts of a program
- Are written for persons 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-Line Comments

- Begin with `//` and continue 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;
```

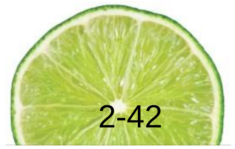
Multi-Line Comments

- Begin with `/*` and end with `*/`
- Can span multiple lines

```
/*----------------------------
   Here's a multi-line comment
  ----------------------------*/
```

- Can also be used as single-line comments

```
int area;   /* Calculated area */
```



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The End!!