Chapter 2: Introduction to C++

Starting Out with C++
Early Objects
Seventh Edition

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Topics

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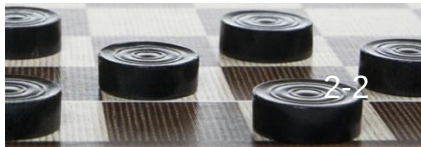
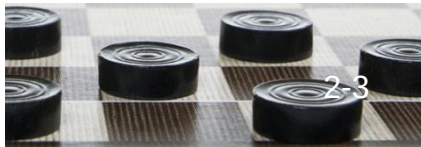


Topics (continued)



2.1 The Parts of a C++ Program

```
// sample C++ program
#include <iostream>
using namespace std;
int main()
{
   cout << "Hello, there!";
   return 0;
}
```

comment

preprocessor directive

which namespace to use

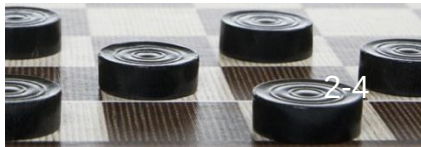
beginning of function named `main`

beginning of block for `main`

output statement

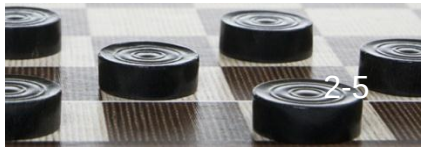
send `0` back to operating system

end of block for `main`



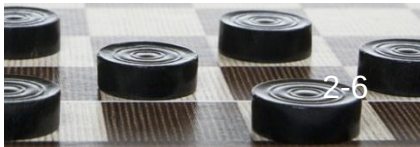
2.1 The Parts of a C++ Program

Statement	Purpose
`// 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 the operating system
`}`	end of block for `main`



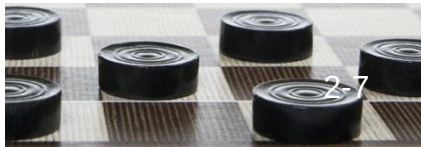
Special Characters

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

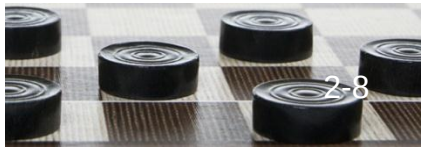
```
cout << "Hello, there!";
```

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

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

Or

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

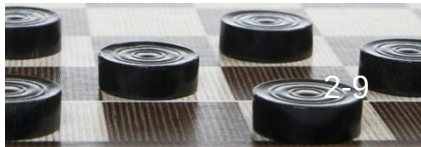
Starting a New Line

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

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

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

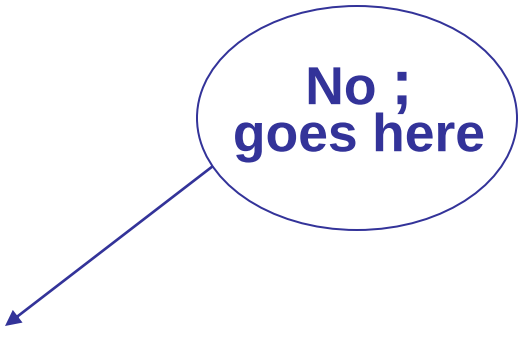
```
cout << "Hello, there!\n";
```

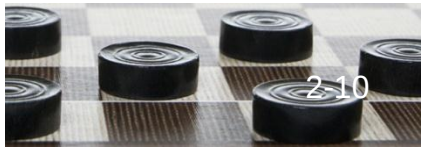



2.3 The `#include` Directive

- 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>
```





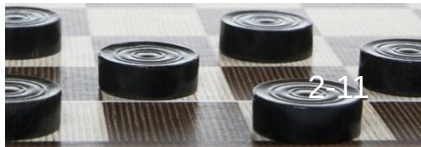
2.4 Standard and Prestandard C++

Older-style C++ programs

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

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

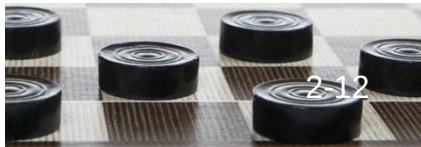
- Do not use **`using namespace`** convention
- May not compile with a standard C++ compiler



2.5 Variables, Constants, and the Assignment Statement

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

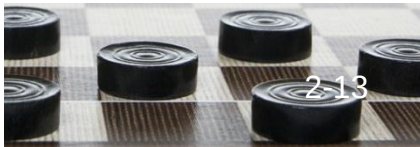
  - Is used to reference a location in memory where a value can be stored
  - Must be defined before it can be used
  - The value that is stored can be changed, *i.e.*, it can "vary"



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

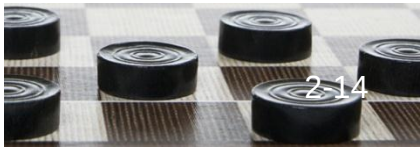
```
int age;
age = 17;       // age is 17
cout << age;    // Displays 17
age = 18;       // Now age is 18
cout << age;    // Displays 18
```



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

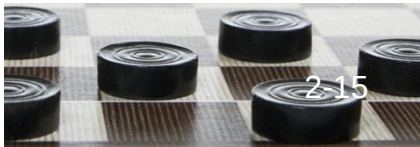
```
item = 12;
```

Constants

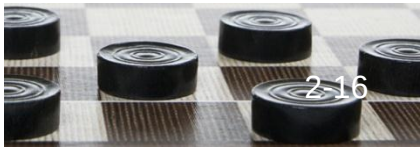
- Constant
  - Data item whose value does not change during program execution
  - Is also called a literal

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

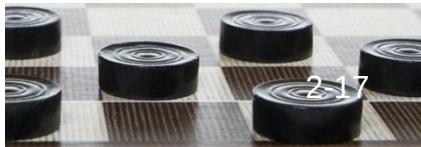
2.6 Identifiers

- 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 _ . Alpha may be upper- or lowercase



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 $

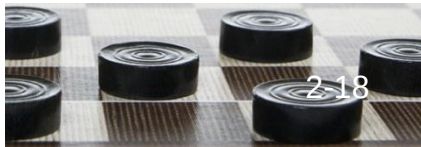


2.7 Integer Data Types

- Designed to hold whole 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`**



Defining Variables

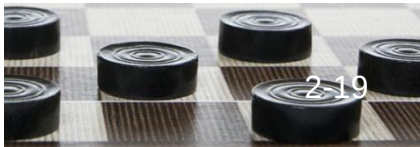
- Variables of the same type can be defined
  - In separate statements

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

  - In the same statement

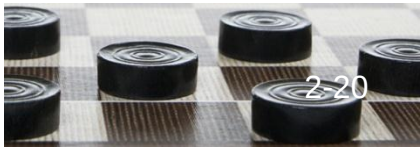
```
int length,
    width;
```

- 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 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

67

String Constant

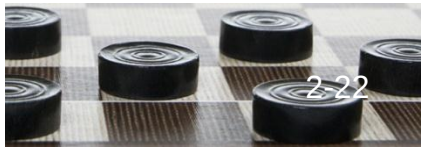
- Can be stored a series of characters in consecutive memory locations

```
"Hello"
```

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

H	e	l	l	o	\0

- Is comprised of characters between the `"  "`



A character or a string constant?

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

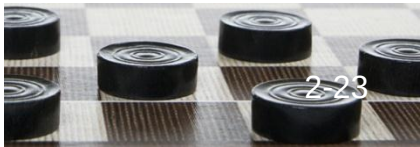
```
'C'
```

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

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

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

```
"C"
```

2.9 The C++ `string` Class

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

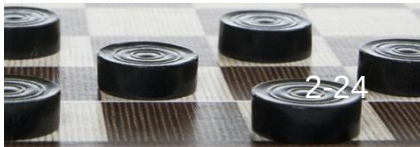
```
string name;
```

- Can assign values to string variables with the assignment operator

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

- Can display them with `cout`

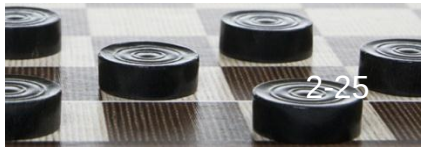
```
cout << name;
```

2.10 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`** ≤ size of **`double`**
  ≤ size of **`long double`**

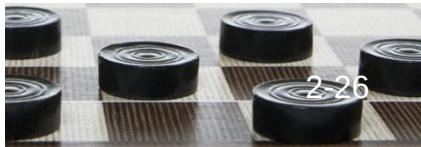


Floating-point Constants

- 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`**

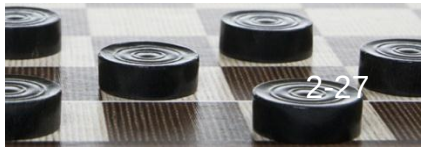


Assigning Floating-point Values to Integer Variables

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

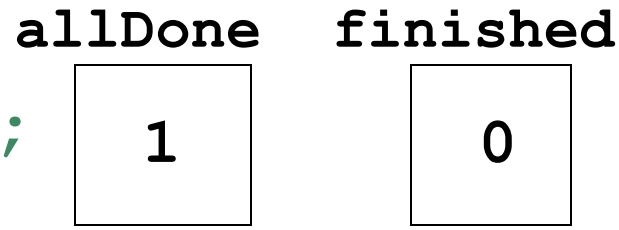
```
int rainfall = 3.88;
cout << rainfall;  // Displays 3
```

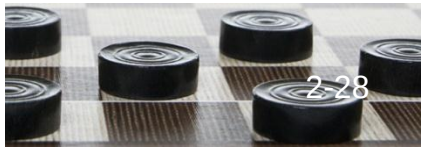



2.11 The `bool` Data Type

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

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

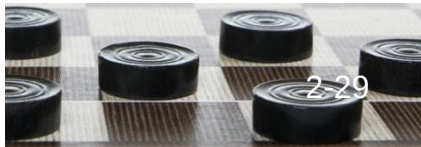




2.12 Determining the Size of a Data Type

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

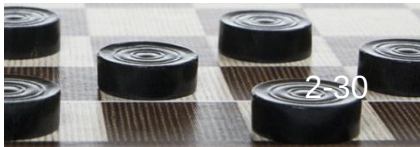
```
double amount;
cout << "A float is stored in "
     << sizeof(float) << " bytes\n";
cout << "Variable amount is stored in "
     << sizeof(amount) << " bytes\n";
```

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

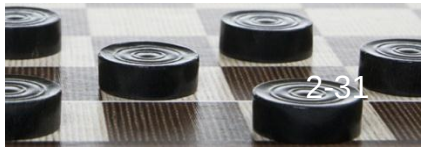
```
int size;
size = 5;     // legal
5 = size;     // not legal
```

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 variables of definition

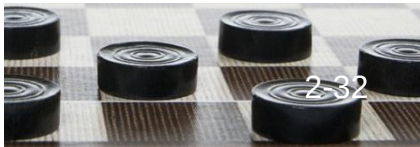
```
int length = 12;
int width = 7, height = 5, area;
```

2.14 Scope

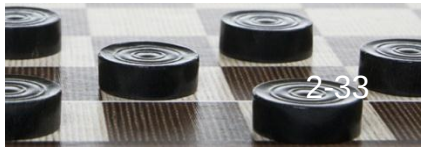
- The scope of a variable is that part of the program where the variable may be used
- A variable cannot be used before it is defined

```
int a;
cin >> a;    // legal
cin >> b;    // illegal
int b;
```

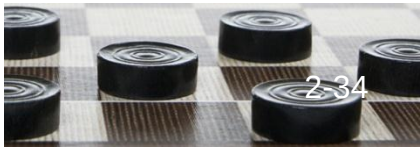
2.15 Arithmetic Operators

- 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



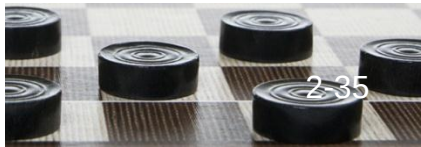
/ Operator

- 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
```

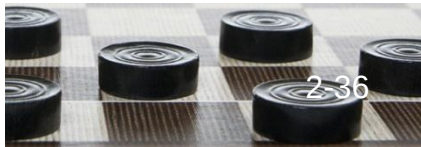
% Operator

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

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

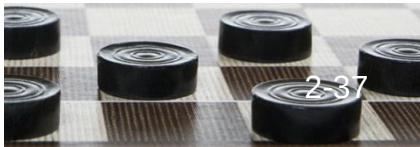
- % requires integers for both operands

```
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

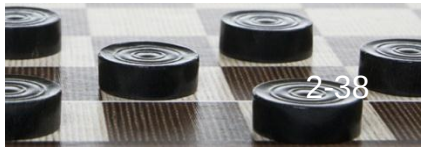


Single-Line Comments

- Begin with `//` 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;
```

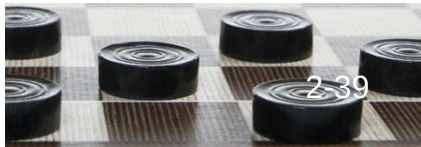
Multi-Line Comments

- Begin with `/*` 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 */
```

Chapter 2: Introduction to C++

Starting Out with C++
Early Objects
Seventh Edition

by Tony Gaddis, Judy Walters,
and Godfrey Muganda

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