

Chapter Two: **Fundamental** Data Types

Chapter Goals

- To understand the properties and limitations of integer and floating-point numbers
- To write arithmetic expressions and assignment statements in C++
- To appreciate the importance of comments and good code layout
- To be able to define and initialize variables and constants
- To learn how to read user input and display program output
- To use the standard C++ string type to define and manipulate character strings
- To be able to write simple programs that read numbers and text, process the input, and display the results

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Defining Variables (2.1)

- A variable
- A variable (سلمانه)

 is used to store information: the contents of the variable
 - · A variable can contain one piece of of information at a time.
- has an identifier: the name of the variable

The programmer picks a good name

· A good name describes the contents of the variable or what the variable will be used for

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Defining Variables

Parking garages store cars.



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Defining Variables

Each parking space is identified - like a variable's identifier



A each parking space in a garage "contains" a car — like a variable's current contents.

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Defining Variables

and each space can contain only One car



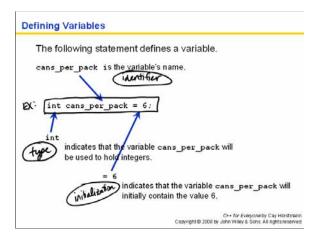
and only cars, not buses or trucks

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Defining Variables - Type and Initialization

- When creating variables, the programmer specifies the type of information to be stored.
 - (more on types later) e.g. integer or real or string
- Unlike a parking space, a variable is often given an initial value.
 - Initialization is putting a value into a variable when the variable is created.
 - Initialization is not required.

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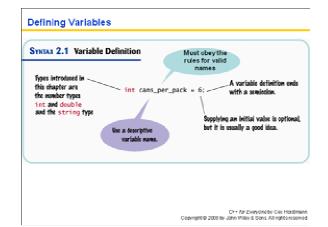


Table 1 Variable Definitions in C++			
Variable Name	Comment		
int cans = 6;	Defines an integer variable and initializes it with 6.		
int total - cans - bottles;	The initial value need not be a constant. (Of course, cans and bottles must have been previously defined.)		
O bottles = 1;	Error: The type is missing. This statement is not a definition but an assignment of a new value to an existing variable—see Section 2.2.		
Int bottles - "10";	Error: You cannot initialize a number with a string.		
int bottles;	Defines an integer variable without initializing it. This can be a cause for errors—see Common Error 2.2 on page 40.		
int cans, hotzles;	Defines two integer variables in a single statement. In this book, we will define each variable in a separate statement.		

Choosing Variable Names

- When you define a variable, you should pick a name that explains its purpose.
- For example, it is better to use a descriptive name, such as can_volume, than a terse name, such as cv.

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Choosing Variable Names

In C++, there are a few simple rules for creating variable names:

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	Variable names must start with a letter or the underscore (_) character, and the remaining characters must be letter numbers, or underscores.
	You cannot use other symbols such as \$ or %. Spaces are not permitted inside names; you can use an underscore instead of a space, as in can_volume. Variable names are case-sensitive, that is, CanVolume and canvolume are different names.
1	For that reason, it is a good idea to use only lowercase letters in variable names. You cannot use reserved words such as double or
-	return as names; these words are reserved exclusively for their special C++ meanings.
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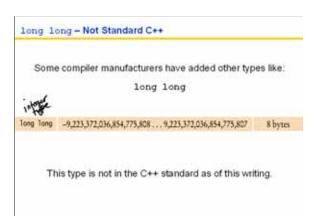
Variable Name	Comment
can_volume1	Variable names consist of letters, numbers, and the underscore character.
*	In mathematics, you use short variable names such as x or y. This is legal in C++, but not very common, because it can make programs harder to understand.
▲ CanVolume	Caution: Variable names are case-sensitive. This variable name is different from carvolume.
⊘ fpack	Error: Variable names cannot start with a number.
O can volume	Error: Variable names cannot contain spaces.
⊘ double	Error: You cannot use a reserved word as a variable name.
O ltr/fl.sz	Error: You cannot use symbols such as / or.

Numb	erLiterals
An	umber written by a programmer is called a <u>number literal</u> .
	There are rules for writing literal values:
1.	integers do not have decimal points
a.	real #5 (aouble) have deciral points OR are uniter in exponential notation
3.	
4.	no fractions w/integers Copyright® 2008 by John Willey & Sons. All rights reserved

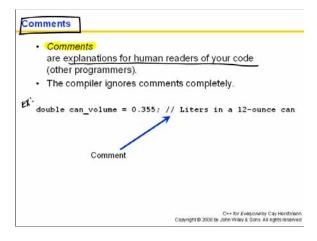
Number	Type	Comment
4	tes	An integer has no fractional part.
-6	tet:	Integers can be negative.
0	ter:	Zero is an inneger.
0.5	double	A number with a fractional part has type double.
1.0	double	An integer with a fractional part 3 has type double.
1×10 6	doub1e	A number in exponential notation: 3 × 10 or 1000000. Numbers in exponential notation always have type double.
2.96E-2	double	Negative exponent: 2.96 × 10 ⁻² = 2.96 / 100 = 0.0296
0 100,000		Error: Do not use a comma as a decimal separator.
O 31/2		Error. Do not use fractions; use decimal

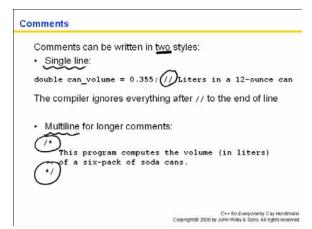
Number	Ranges – Not Standardized
	The C++ Standard does not completely specify the number of bytes or ranges for numeric types.
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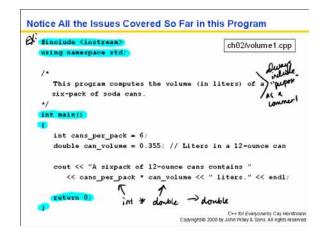
bit =	ow 1 Table 4 Number Types 9 bits :	I byte
Туре	Typical Range	Typical Size
# int	-2,147,483,648 2,147,483,647 (about 2 billion)	4 bytes
unsigned	04,294,967,295	4 bytes
short	-32,76832,767	2 bytes
unsigned short	065,535	2 bytes
double	The double-precision floating-point type, with a range of about ±10 x08 and about 15 significant decimal digits	8 bytes
float	The single-precision floating-point type, with a range of about ±10 ³⁰ and about 7 significant decimal digits	4 bytes



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You must define a variable before you use it for the first time.
For example, the following sequence of statements would not be legal:

double can_volume = 12 * liter_per_ounce;
double liter_per_ounce = 0.0296;

Statements are compiled in top to bottom order.
When the compiler reaches the first statement, it does not know that liter_per_ounce will be defined in the next line, and it reports an error.
```

```
Initializing a variable is not required, but there is always a value in every variable, even uninitialized ones.

Some value will be there, the flotsam left over from some previous calculation or simply the random value there when the transistors in RAM were first turned on.

int bottles; // Forgot to initialize int bottle_volume = bottles * 2; // Result is unpredictable

What value would be output from the following statement?

cout << bottle_volume << endl; // Unpredictable
```