

Learning Objectives: Variables

- Understand the rules of naming a variable
- Assign/overwrite a value to a variable
- Understand four basic data types: integers (ints), floats, boolean (bool), and strings

Variables

What Is a Variable?

In computer science, we often need to use data. **Variables** are used to store a value for a particular type of data.

Each variable in C++ has:

1. a data type
2. a name
3. a value

We will discuss each of these parts over the rest of this reading assignment.

Three Actions for Variables

There are a few different actions taken involving variables:

1. **Declaring** - when you set or declare the *data type* and *name* of the variable. These two properties of a variable do *not* change.

1. **Assigning** - when you set the *value* of the variable. The value of a variable *can* change.

1. **Accessing** - when you retrieve the *value* of the variable by calling its *name*.

You *must* declare and assign a variable before you can access it.

Take a look at the visualizer on the left to see an example of how this works. Click on the Forward > button at the bottom of the page to repeatedly move through each stage of the process. *The visualizer may take a few seconds to load. Click on the Refresh code button in the upper left corner if you encounter an error message.*

Data Types: Integers

Integers

Integers (often called `ints`) are whole numbers. They can be positive or negative. Do not use a comma when typing large numbers.

Copy the code below into the text editor. Then click the TRY IT button.

```
int number;  
number = 50;  
cout << number << endl;
```

Next, let's modify the code to look like what's below and then click the TRY IT button again.

```
int number = 50;  
cout << number << endl;
```

important

You may have noticed that we can declare a variable name and assign it a value all in one step by using `int number = 50;` instead of `int number;` followed by `number = 50;`. Both ways will produce the same result.

▼ 5 vs. "5"

5 is not the same thing as "5". The first one is an integer, the second is a string. You will see in a later lesson the different operations you can perform on strings and numbers. Treating a string as a number can cause errors.

challenge

What happens if you:

- Change the variable to 5000?
- Change the variable to 5,000?
- Change the variable to 050?
- Change the variable to "5000" (with double quotes)?

Data Types: Floating Point Numbers

Floating Point Numbers

Floating point numbers (often called floats) are numbers with a decimal. They can be positive or negative. Copy the code below and TRY IT.

```
double decimal = 0.5;
cout << decimal << endl;
```

Why Use Double Instead of Float?

In C++, there is a data type called **float**, but as it only uses 4 bytes, it is insufficient for most math. Instead, we use **double** which uses 8 bytes or double the space of a float.

challenge

What happens if you:

- Change the variable to 50.?
- Change the variable to .001?

Data Types: Boolean

Boolean

A boolean variable (declared as a `bool`) can only take on the value of `true` or `false`. You will see how boolean values are used when we talk about conditionals and while loops. Copy the code below and TRY IT.

```
bool thisIsFun = true;
cout << boolalpha << thisIsFun << endl;
```

challenge

What happens if you:

- Change the variable to `false`?
- Remove the `boolalpha <<` command?
- Change the variable to `True`?
- Change the variable to `False`?
- Change the variable to `TRUE`?

important

You may have noticed that printing a boolean of `true` resulted in a `1` and a boolean of `false` resulted in a `0` when you remove the `boolalpha <<` command. In C++, the boolean value of `true` is associated with the integer `1` while the boolean value of `false` is associated with the integer `0`. Assigning the value of uppercase `True` or `False` to a boolean variable will cause an error message to appear.

Data Types: Strings

Strings

A string is a collection of text, numbers, or symbols. Strings are always surrounded by quotation marks. Copy the code below and TRY IT.

```
string words = "This is a string.";
cout << words << endl;
```

challenge

What happens if you:

- Forget one of the " quotation marks?
- Forget both " " quotation marks?
- Use single (') quotation marks?
- Use uppercase String instead of lowercase string?

Notice that when you print a string, the quotation marks are not printed.

Declaring Variables

Declaring a Variable

Declaring a variable has two parts - setting or declaring the **data type** and the **name** of the variable. These two properties of a variable do **not** change.

To declare a variable, type the data type and name of the variable you want to create, and a ; (semi-colon). Copy the code below and TRY IT.

```
string my_var;
```

You will notice we are not printing anything - that is because no value has been assigned yet. Thus, the message Command was successfully executed. appears when you click on the TRY IT button. The declaration step only sets aside empty memory.

challenge

What happens if you:

- Create two variables with the same type and name?
- Create two variables with the same name but different capitalization (i.e. my_var and My_var)?
- Create two variables of different types with the same name?

Variable Naming Rules

Here are the rules for naming a variable.

| Rule | Correct | Incorrect |
|--|----------------------|----------------------|
| Start with a letter or underscore | variable, _variable | 1variable |
| Remainder of variable name is letters, | var_i_able, variable | var-i-able, var!able |

numbers, or
underscores

Cannot use a
C++ keyword

my_class

class

Variables
are case
sensitive

variable, Variable, and
VARIABLE are all
different variables

What Are C++ Key Words?

C++ keys words are words that are reserved for specific functions or tasks within C++ programs. These words **cannot** be used to name variables and will result in errors if they are not handled correctly. Click below to see a list of C++ key words.

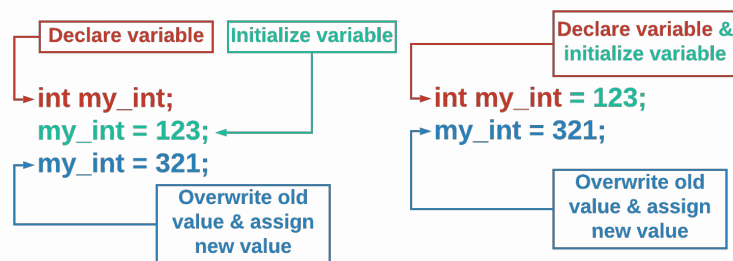
▼ List of C++ key words

| | | | | |
|--------------|------------------|-------------|-----------|------------|
| and | and_eq | asm | auto | bitand |
| bitor | bool | break | case | catch |
| char | class | compl | const | const_cast |
| continue | default | delete | do | double |
| dynamic_cast | else | enum | explicit | extern |
| false | float | for | friend | goto |
| if | inline | int | long | mutable |
| namespace | new | not | not_eq | operator |
| or | or_eq | private | protected | public |
| register | reinterpret_cast | return | short | signed |
| sizeof | static | static_cast | struct | switch |
| template | this | throw | true | try |
| typedef | typeid | typename | union | unsigned |
| using | virtual | void | volatile | wchar_t |
| while | xor | xor_eq | | |

Initializing, Assigning, and Assessing

Initializing & Assigning Values

We call the process of setting the **initial** value of a variable **initialization**. Recall that you can do this separately after the declaration or combine it into the same statement as the declaration.



[.guides/img/VariableAssignmentInt](#)

Since the value stored in a variable can change, we call changing the value **assigning** or **re-assigning**. Use the assignment operator, `=`, to give a variable a new value.

Accessing Variables

Copy the code below and TRY IT to see the results of the `cout` commands. Click on the [++Code Visualizer++](#) link to see how the value of `my_int` changes.

```
int my_int = 123;
cout << my_int << endl;
my_int = 321;
cout << my_int << endl;
```

When we use a variable's name to get the value like in the `cout` statements above, we say we are **accessing** the variable.

[Code Visualizer](#)