

# Laboratory 02B

CS-102

Spring 2022

# Laboratory 02B

- Your assignment is to determine how many bytes of memory space is taken up for each of the following data types on your computer:
  - char
  - bool
  - short int
  - int
  - long int
  - long long int
  - unsigned long long int
  - float
  - double
  - long double

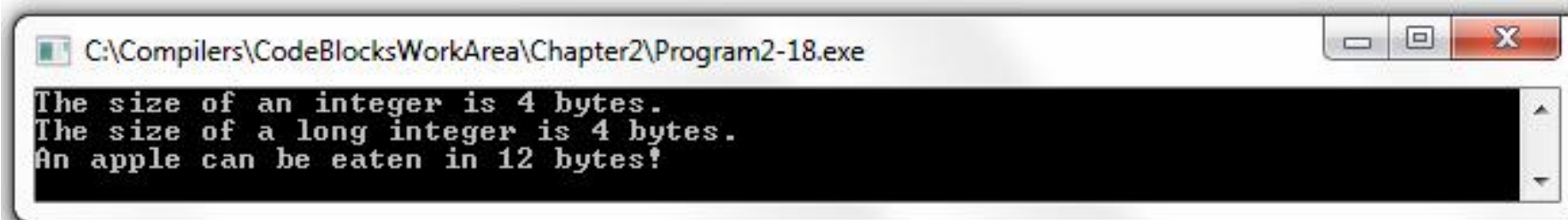
# Laboratory 02B Part 1

- Write a C++ program that will determine the amount of memory used by each of these types, in the order shown, and display this information on the screen. Call your program: *YourName\_Lab02B-1.cpp*
- Hint: You may find Program 2-18 helpful.
- Don't forget to put your name on your program.
- When you have completed Laboratory 2B:
  - If you are doing the Lab synchronously, please ask your instructor to credit you for your work.
  - If you are doing the Lab asynchronously, please submit your Lab to Canvas.

# Program 2-18

// This program determines the size of integers, long integers, and long doubles.  
// **sizeof()** is a special operator which reports the number of bytes of memory  
// used by any data type or variable.

```
#include <iostream>
using namespace std;
int main()
{
    long double apple;
    cout << "The size of a short integer is " << sizeof(short) << " bytes.\n";
    cout << "The size of a long integer is " << sizeof(long) << " bytes.\n";
    cout << "An apple can be eaten in " << sizeof(apple) << " bytes!\n";
    return 0;
}
```



The screenshot shows a Windows command prompt window titled "C:\Compilers\CodeBlocksWorkArea\Chapter2\Program2-18.exe". The window has standard Windows window controls (minimize, maximize, close) in the top right corner. The command prompt displays the output of the program, which is: "The size of an integer is 4 bytes.", "The size of a long integer is 4 bytes.", and "An apple can be eaten in 12 bytes!". The text is displayed in a monospaced font on a black background.

# Laboratory 02B Part 2

Below is the format that we will be using for C++ programs.

```
// Your Name Goes Here.
```

```
// Here's where you will put comments about what this program does
```

```
#include <iostream>
```

```
using namespace std;
```

```
int main()
```

```
{
```

```
    // Here is where you will write the program.
```

```
    // In the first 5 chapters of this book, your entire program should fit in this space.
```

```
    // Note that in this format everything between the two braces is indented.
```

```
    // Also note the generous use of comments (see: CPP_Program_Requirements)
```

```
    return 0;    // Finally, notice that all programs must end with a "return 0;"
```

```
}
```

Please follow the Instructions shown in:  
CPP\_Program\_Requirements.pdf

The 1<sup>st</sup> draft of your Program will start out as shown below:

```
//your name
//CS-102 Laboratory 2 Program B
//This program does ...
#include <iostream>          //required for cin, cout
using namespace std;
int main()
{
    // declare variables
    cout << "Coded by your name";
    return 0;
}    //end main
```

## Laboratory 02B Part 2

The following is a program that violates all the formatting rules followed in this course.

```
#include <iostream>
using namespace std;int main(){int shares=220;
double avgPrice=14.67;cout<<"There were "<<shares
<<" shares sold at $"<<avgPrice<<" per share.\n";
return 0;}
```

- Your job is to rewrite this program so that it conforms to the CPP\_Program\_Requirements.pdf. Call your program: *YourName\_Lab02B-2.cpp*
- When you have it properly formatted in your IDE:
  - If you are doing this lab synchronously, call the instructor so that you might get proper credit for your work.
  - If you are doing this lab asynchronously, submit your program to Canvas.

# Laboratory 02B Part 3

## Mixing Integer Arithmetic with Floating Point

- Write a program to input a temperature in fahrenheit and convert it to Celsius. The formula is:

$$\text{Cel} = 5/9(\text{far} - 32)$$

INPUT fTemp	PROCESING Read fahrenheit temp Calculate Celsius temp Display output	OUTPUT cTemp
----------------	---	-----------------

- PSEUDOCODE
  - READ fTemp
  - $\text{cTemp} = 5/9 * (\text{fTemp} - 32)$
  - DISPLAY cTemp



## Laboratory 02B Part 3

# Mixing Integer Arithmetic with Floating Point

```
//declare variables
double fTemp, cTemp;

//get inputs
cout << "Enter temp in fahrenheit: ";
cin >> fTemp ;
//convert to celsius
cTemp = 5/9*(fTemp-32);      // Careful with this line
//display output
cout <<fTemp<< "fahrenheit = " <<cTemp<< " celsius" << endl;
```

# Laboratory 02B Part 3

## Mixing Integer Arithmetic with Floating Point

- This program has a problem with it, as written on the previous page.
- See if you can find the problem, and then fix it so it works.
- The Temperature, this morning at 8:00 am was 70 degrees F.
- Use your program to find the temperature in Celsius.
- Call your program: *YourName\_Lab02B-3.cpp*
  - If you are doing this lab synchronously, call the instructor so that you might get proper credit for your work.
  - If you are doing this lab asynchronously, submit your program to Canvas.

# Laboratory 02B Part 4

## Raising a number to a power

- C++ has some “built in” math functions
- `pow(base, exp)`
- This calculates base raised to the exp power
- $\text{Num}^3$  would be `pow(num, 3)`
- You will need to use the `#include <cmath>` library at the top of your program, in addition to use this function.
- The following, from the textbook, shows how to use this function.

# Laboratory 02B Part 4

## Raising a number to a power

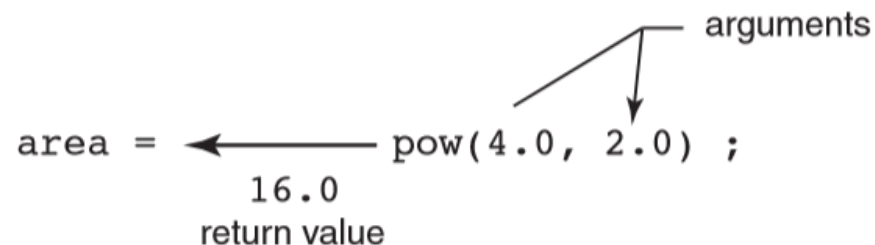
### No Exponents Please!

Unlike many programming languages, C++ does not have an exponent operator. Raising a number to a power requires the use of a *library function*. The C++ library isn't a place where you check out books, but a collection of specialized functions. Think of a library function as a "routine" that performs a specific operation. One of the library functions is called `pow`, and its purpose is to raise a number to a power. Here is an example of how it's used:

```
area = pow(4.0, 2.0);
```

This statement contains a *call* to the `pow` function. The numbers inside the parentheses are *arguments*. Arguments are data being sent to the function. The `pow` function always raises the first argument to the power of the second argument. In this example, 4 is raised to the power of 2. The result is *returned* from the function and used in the statement where the function call appears. In this case, the value 16 is returned from `pow` and assigned to the variable `area`. This is illustrated in Figure 3-3.

**Figure 3-3**



# Laboratory 2B – Part 4

## Compute the Volume of the Earth

- Assuming that the Earth is a perfect sphere, we can use the formula to compute the volume of a sphere which is:
  - $\text{Volume} = \frac{4}{3}\pi r^3$
- The radius of the Earth is 6,371 Kilometers.
  - Using this for the value of  $r$ , write a program that will compute the volume of the earth in cubic kilometers.
  - You may use: `const double PI = 3.141592653589793` for the value of  $\pi$ .
  - You will need to include the **`cmath`** library in order to use the `pow()` function.
- Call your program: *YourName\_Lab02B-4.cpp*
- If you are doing the Lab synchronously, show your program and your calculated result to the instructor in order to receive full credit for it.
- If you are doing the Lab synchronously, submit the Lab to Canvas.

## Laboratory 2B – Part 5

Write a program that will determine the following

- Using long long integers, write a program that will print out the following:
  1. The value of the largest long long integer possible.
  2. The value of the smallest (most negative) long long integer possible.
  3. The value of the largest unsigned long long integer possible.
  4. The value of the smallest unsigned long long integer possible.
- Note: Do not use the pow() function to do this calculation.
  - Use either hexadecimal or binary values for your input.
- Call your program: *YourName\_Lab02B-5.cpp*
- If you are doing the Lab synchronously, show your program and your calculated result to the instructor in order to receive full credit for it.
- If you are doing the Lab asynchronously, submit the Lab to Canvas.