

# SY DE 121

## Lab Number 3

You are expected to continue using the design methodology used in the previous labs. Although this design will not be submitted nor graded, the onus is on the student to ensure that their designs are prepared prior to trying to code the solution. In general, this will save time and hair pulling in front of the computer. It is highly recommended that you develop the habit of planning your program before you type it into the computer.

Note that there are some marks allocated to the programming exercises with regards to “code conciseness and readability” so consult the Style Guide to start building good habits with regards to this.

### Exercise 1: Weeks, Days, Hours, Minutes, Seconds

**Learning Objectives:** To apply integer division and the % (modulus) operator; to gain more experience with input, computation with assignment statements and arithmetic expressions, and output.

#### Read This First

Converting an integer number of seconds to weeks, days, hours, minutes and seconds is similar to converting an integer number of cents into numbers of bills and coins.

#### What To Do

Write a program (call it "wdhms.cpp") that asks a user for an integer number of seconds. The program should print out the length of the time interval in weeks, days, hours, minutes and seconds, where the number of hours is  $\geq 0$  and  $< 24$ , and the numbers of minutes and seconds are each  $\geq 0$  and  $< 60$ . You must utilize the modulus operator to perform these calculations.

Ensure that the number of seconds entered is greater than zero. You can do this using an `if` operator and simply exiting (by using the `return` command) if the number is not appropriate. A more clever way of dealing with this is to use the `while` loop which, although not yet discussed in class it is presented in Chapter 2 of the text (as is required in Exercise 3). Either method is appropriate for this lab, but in the future you would be expected to use the `while` loop to ensure appropriateness of data entry.

#### What To Hand In

Email your “wdhms.cpp” program to the course account. Submit a hardcopy to the submission box.

### Exercise 2: Run-Time Errors

**Learning Objectives:** To be able to recognize signs that some kind of illegal arithmetic operation has been attempted.

#### Read This First

Certain arithmetic and math operations do not make sense. One example is dividing by zero. Another example — assuming that complex results are not allowed — is taking the square root of a negative number. Errors of this sort fall into the category of *run-time errors*, because they occur while a program is running, not when the program is being compiled.

The response of a C or C++ program to errors such as division by zero and illegal arguments to math functions depends on the computer hardware, operating system, and compiler. It is very helpful to be able to recognize the effects of arithmetic and math run-time errors in C or C++ programs compiled with your particular system.

#### What To Do

Download the file ‘runtime\_errors.cpp’ from the course website. Build the executable and run it. Make sure it produces correct answers when you enter positive numbers to all of the prompts.

Run the program a few more times in order to determine the effect of the following run-time errors:

- division of an int by the int value of 0
- division of a double by the double value of 0.0
- trying to compute the square root of a negative number

For each of the above cases, answer these questions:

1. Does the program keep running after the error occurs?
2. What output appears as the result of the computation, if any?

#### What To Hand In

Submit your responses to the SYDE 121 submission box.

### Exercise 3: Wind-Chill Index

**Learning Objectives:** Practice using **if ... else if ... else** commands. Use of `sqrt` function.

#### Read This First

The temperature reported by TV stations usually refers to the air temperature. However, even light to moderate wind can cause an *effective temperature* much lower than that of the air temperature. It would be useful to be able to determine the wind-chill, based on the air temperature and wind speed.

An empirical (not so effective!) formula for the wind-chill index is:

$$\text{wind-chill index} = \begin{cases} \text{temperature} & \text{wind} \leq 4 \text{ mph} \\ 91.4 - (10.45 + 6.69\sqrt{\text{wind}} - 0.447\text{wind}) \times \frac{91.4 - \text{temperature}}{22.0} & 4 \text{ mph} < \text{wind} \leq 45 \text{ mph} \\ 1.6 \times \text{temperature} - 55.0 & \text{wind} > 45 \text{ mph} \end{cases}$$

where,

*temperature* is the temperature in degrees Fahrenheit, and

*wind* is the wind speed in miles per hour (mph).

Note that the second function is stretched over two lines.

#### What To Do

As usual, you are expected to design your program before you try to enter it into a `cpp` file. Also, create a few hand calculated examples for program testing prior to coding your solution. Use temperatures typical to Canadian winters.

Your main function should ask the user for the air temperature in Celsius, and the wind speed in kilometres per hour (km/h) (ensure that the wind speed is positive), perform the necessary unit conversions, and tell the user the computed wind-chill index (in the appropriate units i.e. convert your calculation back to Celsius).

*Note: do not be concerned about the use of this model in practice – it is not a real conversion, just one that has been made up for this lab.*

#### Some Help

You will need to take the square root of a number. This is a *predefined function* call in C/C++ and it is determined as follows:

```
a = sqrt( b );
```

where **a** will be assigned the square root of **b** and both **a** and **b** are type `double`. This function is included in the math library, so you will have to include `<cmath>` using an 'include' compiler directive. A description of predefined functions is provided in your Savitch text (we will cover this material in detail in Section 5 of the course).

#### Conversions

1 km/h = 0.6215 mph

Fahrenheit = (9/5) \* Celsius + 32;

#### What To Hand In

Email your `wind.cpp` program to the course email account. Submit a hardcopy to the submission box.

#### Due Date

All material for each exercise is due Friday, September 30 by 6:00pm.