Lab 3: Arithmetic Expressions

Date: Tuesday, September 9, 2003
Total points: 20
Summary of assignment: Write a program that uses arithmetic expressions
Due date: Tuesday, September 16, 2003, 8:00 am

The objective of this lab is to write your first program from scratch on your own. It will use simple arithmetic expressions. This lab is also an exercise in following directions. Carefully read each step and do not proceed to the next step unless you have successfully completed your current step.

Lab Instructions

1) We're ready to start programming. First, we need a problem to solve. Here is your mission for today:

   After years of doing laundry at a laundromat, you have finally purchased your own washer and dryer. Congratulations on achieving one of life's sweetest goals! The only unfortunate consequence of this wonderful purchase is that you now have jars and jars of quarters that will take you years to spend. So, you've decided to start selling those quarters to all of your poor friends who are still visiting the laundromat. You want to write a nice program that will calculate how many quarters to give your friends when they start bringing you money to change.

2) The interface for the program should look like this (sample input is given in bold):

```
Please enter your name: Shereen
Welcome, Shereen.
Please enter the amount of money you would like to
change into quarters: 3.40
$3.4 will be changed into 13 quarters with 15 cents
left over.
```

3) First we need a program analysis. Answering the following questions will help step you through the process.

   a) What is the input for your program? What units will it be in?

b) What is the output for your program? What units will it be in?

c) What are the calculations needed for your program? Answering the following questions will help you answer this overall question. Note: The input to the program is an amount of money that is a decimal amount. It has two components: the number of dollars and the number of cents. We will need both of these components for our calculations. So, this means we'll be converting a decimal number into two integer parts.
   i) How do you calculate the number of dollars that you are changing from the total money amount inputted?

   ii) How do you calculate the number of cents?

   iii) How do you determine the number of quarters in the whole dollar amount?

   iv) How do you determine the number of quarters in the cents amount?

   v) How do you calculate the total number of quarters?

   vi) How do you determine if you have any leftover amount that cannot be changed into quarters?

4) Next, you need to do an algorithm design. What are the steps of your algorithm? Remember, these are the steps that you'll need to comment in your program.

5) Now you're ready to start programming. You can write out your code on paper first or start programming. Create a C++ project in CodeWarrior called 'xxxxx-Lab2', replacing the x's with your PU net ID. Remember to save your work on your (Winter) folder. When you are finished and happy with your program, try compiling it. Correct any errors the compiler finds. If it compiles, then run your program. Did it work properly? Test some other values for money. Does it work for every value?

6) It is possible to find input values where it looks like your program made an error. In these cases, the amount of cents left over is one less than it should be. Can you find an input value where this is the case? What is it? In reality, your program did not make a mistake. It's working exactly as it should. The problem is with how the floats are stored in the computer. Because they're not stored in decimal format (it's scientific format), decimal numbers are not represented exactly. So, when you try to make it an integer, it might convert to a number that is one less or one more than the number. This is called roundoff error and it's something you'll have to be very careful about when coding later on. For now, it's enough that we know what it is.

7) It is always a good idea to create backup copies of your work. You should do this whenever you work on your code, not just when you finish. In this case, create a backup copy of your project folder and name it 'xxxxx-Lab2-bak', replacing the x's with your PU net ID.

Finishing the lab. If you've managed to finish the lab during lab time, notify the lab assistant or the professor to show them your work. They will record that you successfully completed the lab. You're done! If you don't finish during lab time, then you have till next Tuesday at 8:00am to place your program in the drop box.