

CSC 160 WINTER 16 LAB 6-1 NUMBER SYSTEMS

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1. THE DECIMAL NUMBER SYSTEM

The system of representing numbers that we use in everyday life is called the *decimal number system*.

The decimal number system represents integers as strings of the 10 *decimal digits* '0', '1', '2',... '9'. The digits that make up a number are actually characters, which means they have type `char`. However, sometimes we will think of them as integers with type `int`. Later, we will look at how to move back and forth between the character and integer representation.

2. EXERCISE 6-1

For your first exercise, you are going to write a program that asks the user to enter a positive integer and prints out the sequence of decimal digits that make up that number. The program should do this 3 times. A sample run of the program might look like this:

```
Enter a positive integer: 5027
The decimal digits of 5027 are 7, 2, 0, 5
Enter a positive integer: 78
The decimal digits of 78 are 8, 7
Enter a positive integer: 1240
The decimal digits of 1240 are 0, 4, 2, 1
```

Notice that the decimal digits are being printed from right to left.

To write this program, begin by writing a program that will print out the decimal digits for *only one* number.

```
Enter a positive integer: 5027
The decimal digits of 5027 are 7, 2, 0, 5
```

To begin with, don't even worry about the commas. Once this is done, you can figure out how to put in the commas, and then you can add a loop to repeat three times.

3. STRATEGY FOR EXERCISE 6-1

Consider how to write out the digits for a number such as 5027.

- (1) Print out the remainder of dividing the number 5027 by 10. This will print:
7.

- (2) Replace the number 5027 by the result of dividing the number by 10. This will set the number to 502.
- (3) Print out the remainder of dividing the number 502 by 10. This will print: 2.
- (4) Replace the number 502 by the result of dividing the number by 10. This will set the number to 50.
- (5) Print out the remainder of dividing the number 50 by 10. This will print: 0.
- (6) Replace the number 50 by the result of dividing the number by 10. This will set the number to 5.
- (7) Print out the remainder of dividing the number 5 by 10. This will print: 5.
- (8) Replace the number 5 by the result of dividing the number by 10. This will set the number to 0. When the number becomes 0, there are no more digits from the original number, so we stop.

Figure out how to write the above strategy in the form of a loop.

4. BINARY NUMBER SYSTEM

The decimal number system weights digits by powers of 10, counting from 0 beginning with the rightmost, or least significant digit. Thus,

$$\begin{aligned}
 5027 &= 5 \cdot 10^3 + 0 \cdot 10^2 + 2 \cdot 10^1 + 7 \cdot 10^0 \\
 &= 5 \cdot 1000 + 0 \cdot 100 + 2 \cdot 10 + 7 \\
 &= 5000 + 20 + 7
 \end{aligned}$$

The *binary number system* is a way of representing a positive integer using only two binary digits 0 and 1. It is based on powers of 2, also counting from the right.

For example 43 in binary is 101011 because

$$\begin{aligned}
 43 &= 1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 \\
 &= 32 + 8 + 2 + 1
 \end{aligned}$$

5. EXERCISE 6-2

You are now going to modify your program so that it asks the user for tree more positive integers and prints out the binary digits that make up the number. When you run your program, you will see something like this

```

Enter a positive integer: 13
The decimal digits of 13 are 3, 1
Enter a positive integer: 456
The decimal digits of 456 are 6, 5, 4
Enter a positive integer: 10245
The decimal digits of 10245 are 5, 4, 2, 0, 1
Enter a positive integer: 13
The binary digits of 13 are 1, 0, 1, 1
Enter a positive integer: 43
The binary digits of 43 are 1, 1, 0, 1, 0, 1
Enter a positive integer: 16
The binary digits of 16 are 0, 0, 0, 0, 1

```

Notice that we are printing the binary (and decimal) digits in the reverse order in which they are used to write the number.

Due Date is Wednesday of Week 6.