Lab 01

Worksheet 01A

Novel Numeral System

In this activity, you will create and experiment with a numeral system using an uncommon base.

The most familiar numeral system is decimal, or base 10. Other frequently used bases include binary (2), octal (8), and hexadecimal (16).

In systems with bases greater than 10, symbols are often used to represent values greater than 9. For instance, hexadecimal uses the following:

Decimal	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hex	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Note that the base of a numeral system is typically chosen for a specific reason or application. For instance, decimal is natural to humans because we have 10 fingers. Binary is useful in computers since it can be represented via the 'on' and 'off' (or 'high' and 'low') states of a circuit. One hexadecimal digit can be represented in four binary digits, and vice versa. Thus, hex is useful for shortening binary data.

Now, take a moment to think of a new a numeral system with a base other than 1, 2, 8, 10, or 16. Try to think of an application corresponding to the base you are considering.

(1) Write your new numeral system's base b here: _________

(2) Next, devise a set of b digits for your new system. You may choose to incorporate the standard decimal digits 0-9, alphabetic letters like A-F in hexadecimal, or you can invent your own symbols (they should be easily distinguishable).

At this point, please check with your instructor or lab TA before proceeding.

Instructor's Initials: _________

(3) Write a 5-digit number in your new base (b): _____________

Base Conversion

A modern way to represent numbers is *positional notation*. You are already used to doing this with decimal numbers, however, you may not be familiar with the expanded form. For instance:

$$3251_{10} = 3 \times 10^3 + 2 \times 10^2 + 5 \times 10^1 + 1 \times 10^0$$

You will notice that each term in the expanded summation takes the following form, where the rightmost position is zero, and positions increase consecutively to the left.

$$\text{value} \times \text{base}^{\text{position}}$$

This becomes useful when converting between bases. For instance:

$$\text{CB3}_{16} = 12 \times 16^2 + 11 \times 16^1 + 3 \times 16^0 = 3251_{10}$$

(4) Convert your 5-digit number from **(3)** into base 10 (decimal). Convert each of the digits in your number to their decimal value, then add them using positional notation as shown above.

(5) List at least one application in which your numeric system might be useful.