Digital System Problem Set Solutions (W.I.P)

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1 Introduction

Hello there, my name is Duy and I'm making a solution set to the problem set given by Dr. Bruce for his Intro to Digital Systems class.If you find a mistake in the solutions or if you don't like that fact that I'm making my worked solutions publicly available for the world to see, feel free to send me a polite email at dtran(fortythree)[at]tntech(dot)edu.

2 Numbers

Problem 1-1 *What is meant by binary?*

A: When something is said to be binary,it means that it can be represented by two quantities or two discrete values (typically 0 or 1).

Problem 1-2 *What is a bit - a portmanteau for "binary digit"? Enumerate all possible single-bit entities.*

A: A bit is a unit of information that can represent two states of a quantity. For example, take the quantity of "voltage" and consider a wall outlet from your home. You could measure the exact voltage it is carrying, may it be 120V, 40V, or 119.3V using a Digital Multi-meter. However, you could just check if there exists a voltage in the wall outlet just by sticking your fingers into the wall socket.

We can symbolically represent the existence of voltage in the wall socket as "1" and the absence of said voltage as "0." We refer to each 0 and 1 as a bit or binary digit.

Problem 1-3 *Can you identify some other commonly-used names for the value it takes on? Can you create some new ones that make sense? Justify your choices.*

A: Some other commonly-used names aside from zeroes and ones (0s and 1s) are:

- "True and False"
- "High and Low"
- "Active and Inactive"
- "3.3 volts and 0 volts"
- "5 volts and 0 volts"
- "On and Off"

Anything with two logical states can considered a bit. Creating something like 5 amps and 0 amps of current for the bit value can satisfy the two logical states. The newly created names for the value that a bit takes on are all interchangeable with the commonly-used names for the bit values (see how 5 amps can "1 or True or High", and 0 amps can be "0 or False or Low?").

Problem 1-4 *Define a "nibble". Enumerate all possible binary nibbles. How many are there? Besides counting them, describe a mathematical way to get your answer*

A: A "nibble" is 4 bits or half of a byte (8-bits). Below are the representations of all the possible binary nibbles:

0000	0001	0010	0011
0100	0101	0110	0111
1000	1001	1010	1011
1100	1101	1110	1111

There are 16 combinations and a mathematical way to get this answer is shown below:

$$n = 2^k$$

where n is the number of combinations and k is the number of bits (for a nibble that is 4).

Problem 1-5 *Define a "byte". Enumerate all possible binary nibbles. How many are there? Besides counting them, describe a mathematical way to get your answer.*

A: