RUTGERS
UNIVERSITY

Course Name: Computer Architecture Lab

Course Number and Section: **14:332:333:01**

Experiment: [Lab # [1] – Introduction, Github Tutorial, Number Representation]

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GRADE: ________________

COMMENTS:

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ECE Lab Report Structure

1. Purpose / Introduction / Overview – describe the problem and provide background information

    a. This purpose of this lab was simply to learn how to use GitHub and do some problems in regard to Number Representation.

2.. Results – present your data and analysis, experimental results, etc.

<u>1.1a Convert the following from their initial radix to the other two common radices: 0b10001110, 0xC3BA, 81, 0b100100100, 0xBCA1, 0, 42, 0xBAC4</u>

- 0b10001110 is **0x8E** in hex and **142** in decimal.
- 0xC3BA is **0b1100001110111010** in binary and **50106** in decimal.
- 81 is **0b1010001** in binary and **0x51** in hex.
- 0b100100100 is **292** in decimal and **0x124** in hex.
- 0xBCA1 is **0b1011110010100001** in binary and **48289** in decimal.
- 0 is **0** in binary and **0** in hex.
- 42 is **0b101010** in binary and **0x2A** in hex.
- 0xBAC4 **is 0b1011101011000100** in binary and **47812** in decimal.

<u>1.1b Write the following using IEC prefixes: 2^14,2^43,2^23,2^58,2^64,2^42</u>

- 2^14 = **16 Ki**
- 2^43 = **8 Ti**
- 2^23 = **8 Mi**
- 2^58 = **256 Pi**
- 2^64 = **16 Ei**
- 2^42 = **4 Ti**

<u>1.1c Write the following as powers of 2: 2 Ki, 512 Pi, 256 Ki, 32 Gi, 64 Mi, 8 Ei</u>

- 2 Ki = **2^11**
- 512 Pi = **2^59**
- 256 Ki **= 2^18**
- 32 Gi = **2^35**
- 64 Mi =**2^26**
- 8 Ei = **2^63**

<u>**2.2 assume an 8-bit integer and answer each one for the case of a two's complement number and unsigned number, indicating if it cannot be answered with a specific representation.**</u>

1. What is the largest integer? The largest integer + 1?

11111111 would be the largest number in a binary, which is the number 255. Adding 00000001 to this would be a problem because there is no 9^{th} bit to carry on the 1 and make the number 256

2. How do you represent the numbers 0, 3, and -3

0=00000000, 3=00000011, and -3=11111101. In order to find -3 one must find the two's compliment of 3 which is flipping the number values from 0 to 1 and 1 to 0 respectively and add 1 to it.

Two's complement of 3 a.k.a -3 **= 11111101**

3. How do you represent 42, -42?

00101010 is the binary representation of 42.

In order to find the -42 one must find the two's complement of 42.

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4. . What is the largest integer that can be represented by any encoding scheme that only uses 8 bits?

The largest integer that can be represented by 8 bits in 255.

5. Prove that the two's complement inversion trick is valid (i.e. that x and x'+ 1 sum to 0)

In order to prove this I will be adding 2 and -2.

2 in binary is 010. The two's compliment of two would be 101+001 which is 110. Now if you add 010+110 you will receive 1000 but since I am adding only from 3 bits, then the leftmost 1 is taken away and only 000 is left.

6. Explain where each of the three radices shines and why it is preferred over other bases in a given context.

Binary is useful in order to understand how a computer reads and translates information. It's simplistic.

Hex is useful in order to convert very large binary numbers into a smaller frame but is also something that has to be deciphered.

Decimal is the easiest way for humans to understand a number.

3.1 Exercises

1. How many bits do we need to represent a variable that can only take on the values 0, π or e?

Theoretically an infinite number of bits could be used to represent both pi and e because they seemingly go on forever. However, if one would like to represent these numbers by approximations, one could use a minimum of 32 bits for pi which can be represented by 64 bits.

2. If we need to address 2TiB of memory and we want to address every byte of memory, how long does an address need to be?

Memory addresses for an address that is 2TiB must be 10^12.

3. If the only value a variable can take on is e, how many bits are needed to represent it.

e only requires 8 bits to be properly approximated.

4. Conclusion / Summary – what was done and how it was done

Using previous knowledge gained in Digital Logic Design, I was tested on some conversions from Binary to hex and decimal. As well as test my knowledge on bit amounts and address sizes.