Course Name: Computer Architecture Lab

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

Experiment: [Experiment # [1] – ***Introduction, GitHub tutorial, Number representation***

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Date Performed: 9/10/18

Date Submitted: 9/24/18

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1.1

a) Convert the following from their initial radix to the other two common radices:

0b10001110
Decimal: 142
Hex: 8E
0xC3BA
Decimal: 50106
Binary: 1100 0011 1011 1010
81
Binary: 01010001
Hex: 51
0b100100100
Hex: 124
Decimal: 292
0xBCA1
Decimal: 48289
Binary: 1011110010100001
0
Binary: 0
Hex: 0
42
Binary: 101010
Hex: 2A
0xBAC4
Binary: 1011101011000100
Decimal: 47812

b) Write the following using IEC prefixes

2^{14} : 16 Ki
2^{43} : 8 Ti
2^{23} : 8 Mi
2^{58} : 256 Pi
2^{64} : 16 Ei
2^{42} : 4 Ti

c) Write the following as powers of 2

2 Ki : 2^{11}
512 Pi : 2^{59}
256 Ki : 2^{18}
32 Gi : 2^{35}
64 Mi : 2^{26}
8 Ei : 2^{63}

2.2

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

Two's Complement: 127, -128
Unsigned: 255, 0

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

Two's Complement: 0b0000 0000, 0b0000 0011, 0b11111101
Unsigned: 0b0000 0000, 0b0000 0011, NA

3) How do you represent 42, -42?

Two's Complement: 0b0010 1010, 0b1101 0110
Unsigned: 0b0010 1010, NA

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

There exists no such integer. You could either choose an arbitrary 8-bit mapping to represent the numbers from 1 to 256 or instead 0 to 255.

5) Prove that the two's complement inversion trick is valid

Adding an unsigned bitstream and its 2's complement does in fact result in 0 which validates this trick.

0b0001+0b1111=0.

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

Decimal is the preferred radix for human hand calculations, likely related to the fact that we humans have 10 fingers.

Binary numerals are particularly useful for computers. Binary signals are less likely to be mixed up than higher radix signals, as there is more distance (voltage or current) between valid signals. Additionally, binary signals are quite convenient to design circuits with.

Hexadecimal numbers are a convenient shorthand for displaying binary numbers, owing to the fact that one hex digit corresponds exactly to four binary digits.

3.1

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

2

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?

$2*2^{40}$ =41 bits

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

1 bit or to be precise ½ a bit because 1 bit can differentiate between 2 values.

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