Course Name: Computer Architecture Lab

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

Experiment: Computer Architecture Lab 1

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Course Name: __________________

Course Number and Section: **14:332:xxx:xx**

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GRADE: ________________

COMMENTS:

1. <u>Conversions</u>

   a. Bolded numbers are the givens and the handwritten work is at the end of the lab report. To convert from binary to decimal, you find its corresponding exponent and add them together. When the binary is 1, it is $2^?$ and when the binary is 0, then it is 0. To convert decimal to binary, you divide the decimal number by 2. We are only look for a whole number so if there is a reminder of 1, then it becomes the binary number 1. If there is no remainder then it would be 0. Then keep dividing until you reach 1 / 2 = 0 with a remainder of 1. Then the binary number of that decimal number is the remainders in the order from the last division that you did to the first division of the original number. For binary numbers to hex numbers, you need split up the binary numbers into 4s starting from the right. If it runs out of numbers at the most left, fill it up with 0s in the front of the numbers until it has 4 binary numbers. Then each individual binary numbers of 4 is correlated to a specific hex number. 0000 = 0, 0001 = 1, and starting from "10" it becomes the letter A. So 1010 = A and all the way down to 1111 = 15(decimal) = F (hex). To convert hex to binary, it is basically the opposite, find what the number of letter stand for in its binary and write it down from left to right. To convert from decimal to hex or hex to decimal, the best way is to convert it to its correlated binary number and work from there. So it becomes binary to hex or binary to decimal and follow the same steps again.

Binary	Decimal	Hex
0b100001110	142	0x8E
0b1100001110111010	50106	**0xC3BA**
0b1010001	**81**	0x51
0b100100100	292	0x124
0b1011110010100001	48289	**0xBCA1**
0b0	**0**	0x0000
0b101010	**42**	0x2A
0b1011101011000100	47812	**0xBAC4**

   b. 2^{14} = 16Ki $\quad$ 2^{10} = Ki $\quad$ 2^4 = 16
   2^{43} = 8Ti $\quad$ 2^{40} = Ti $\quad$ 2^3 = 8
   2^{23} = 8Mi $\quad$ 2^{20} = Mi $\quad$ 2^3 = 8

2^{58} = 256Pi 2^{50} = Pi 2^8 = 256
2^{64} = 16Ei 2^{60} = Ei 2^4 = 16
2^{42} = 4Ti 2^{40} = Ti 2^2 = 4

c. 2Ki = 2^{11} Ki = 2^{10} 2 = 2^1
512Pi = 2^{59} Pi = 2^{50} 512 = 2^9
256Ki = 2^{18} Ki = 2^{10} 256 = 2^8
32Gi = 2^{35} Gi = 2^{30} 32 = 2^5
64Mi = 2^{26} Mi = 2^{20} 64 = 2^6
8Ei = 2^{63} Ei = 2^{60} 8 = 2^3

2. Signed Integers

a. Largest 8 bit unsigned integer is 1111 1111 which is **255**. To get the this you need to do $2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$ and you will get 255 as the result. Largest 8 bit plus 1 will become a 9 bit of 1 0000 0000 (256). Since it is asking for 8 bit only it will be **0**.
The largest 8 bit two's compliment is 0111 1111 which is **127**. Because you need a 0 in the front to use two's complement. Since it is a positive integer, it will keep its binary number as the same for its two's compliment (127 or 0111 1111). The largest 8 bit integer plus 1 will be 0111 1111 plus 1 which will be 1 0000 0000. It is a two's compliment and the sign (1) tells you it is a negative so is **-128**.

b. 0 signed: 0000 0000
0's two's compliment: 0000 0000

3 unsigned: 0000 0011
3's twos compliment: 0000 0011 because the positive integer's two's compliment will be the same as its binary numbers.

-3 unsigned: not possible can't be a negative binary numbers
-3 two's compliment: 1111 1101 To get this number, you must the one's compliment of 3 and add 1. 0000 0011 will become 1111 1100 and plus 1 to the binary number.

c. For 42 the binary numbers are 0010 1010 and two's complement will be the same since it is positive
for -42 it is impossible to get a binary because it is negative, but the twos compliment is 1101 0110 and to get that we need the one's compliment of 42 which is 1101 0101 and you add 1 to the binary number.

d. The largest integer is on a bit encoding scheme is 255 because $2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$ gives you 255.

e. For example, take the binary number of 5 and its two's complement. 0110 = 5 1010 = -5 or twos complement 0110 + 1010 = 10000 which is 16 but ignore the 1 in the front since it is an overflow and it became a 5 bit so in the end, it will give you 0.

f. Decimal is easy humans to count or read since it literally just numbers.

   Binary is preferred for computers to count and read since computers only work with 1s and 0s.

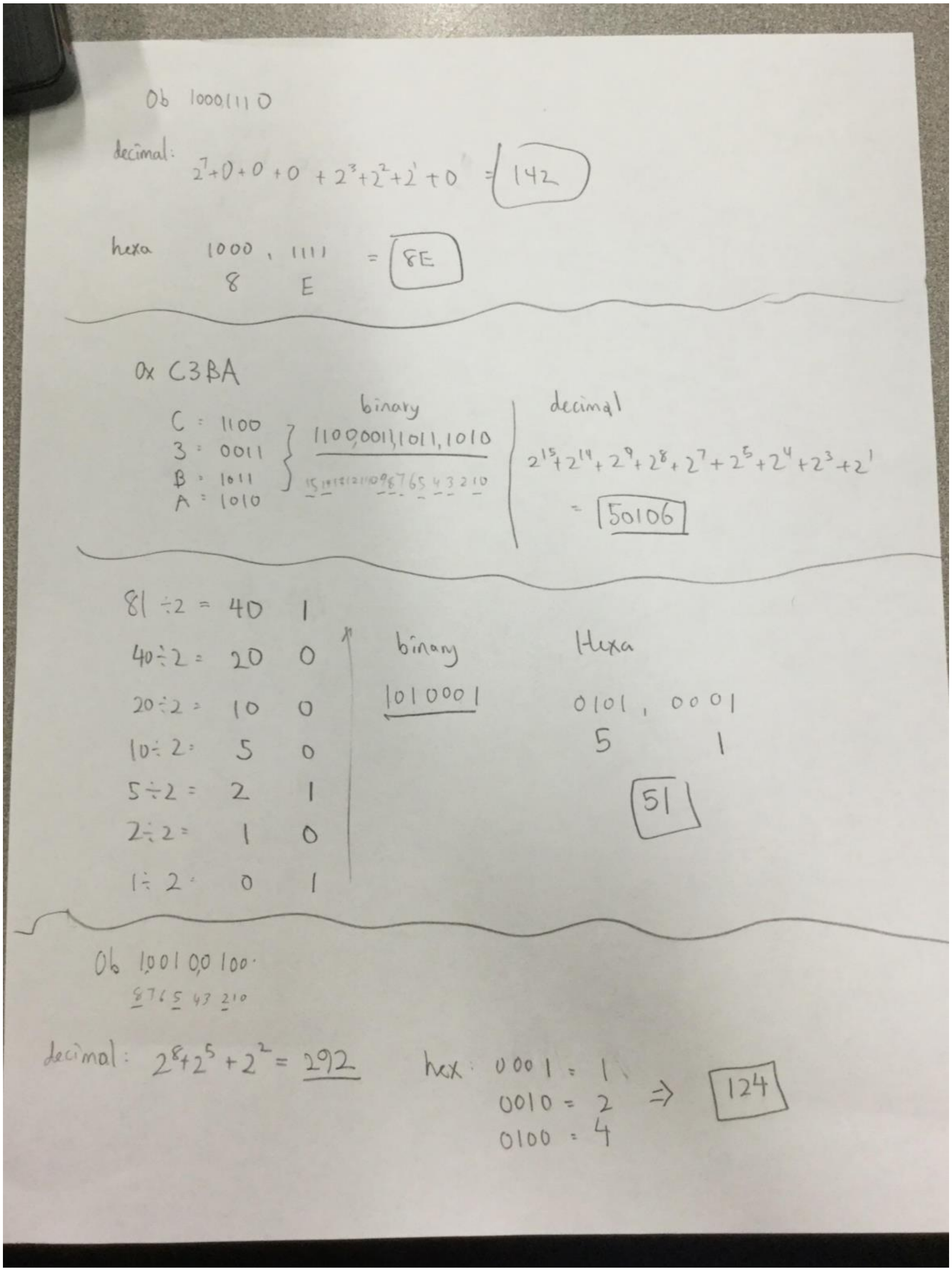
   Hexadecimal is just a shorter version of the binary numbers for the users and computer to count and read.

3. Counting

   a. The minimal number of bits to represent 0, π, or *e* is N = 2 because $2^{2\,=}$ 4 and 4 is greater than 0, π (3.14) , and e (2.71).

   b. 41 bits long to address the 2TiB of memory since Ti is 2^{40} and the 2 in the front is 2^1 so the answer will be 41, similar to problem 1.
   c. It would take 0 bits to represent *e* because *e* is not an integer.

Work for problem 1:



0x BCA1

binary

B : 1011
C : 1100
A : 1010
1 : 0001

$\Big\}$ 1011 1100 1010 0001

decimal 1011 1100 1010 0001

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

$2^{15} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^{7} + 2^{5} + 2^{0} = 48289$

0 hexa = 0000

binary = 0

42 binary:

$42 \div 2 = 21$	0	
$21 \div 2 = 10$	1	101010
$10 \div 2 = 5$	0	
$5 \div 2 = 2$	1	
$2 \div 2 = 1$	0	
$1 \div 2 = 0$	1	

hexa 0010 1010 = $\underline{2A}$

2 A

hex: BAC4

binary

B : 1011
A : 1010
C : 1100
4 : 0100

1011,1010,1100,0100

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

$2^{15} + 2^{13} + 2^{12} + 2^{11} + 2^{9} + 2^{7} + 2^{6} + 2^{2} = \boxed{47812}$