Name: (as it would appear on official course roster)	Grant Clark
UCSB email address:	gclark**@ucsb.edu**
Lab Section Time:	Friday, 11-11:50am
Optional: name you wish to be called if different from above	
Optional: name of "homework buddy" (leaving this blank signifies "I worked alone")	

Lab 01: Data Representation and Binary Arithmetic

Assigned: *Wednesday, October 2nd, 2019*
Due: *Wednesday, October 9th, 2019*
Points: *30 (normalized to 100)*

- You may collaborate on this homework with AT MOST one person, an optional "homework buddy".
- MAY ONLY BE TURNED ON **GRADESCOPE as a PDF file**.
- There is NO MAKEUP for missed assignments.
- We are strict about enforcing the LATE POLICY for all assignments (see syllabus).

Don't use a calculator or online solvers when working these problems. You will not be able to use them in exams either, so it's good practice to know how to do these!

Values of Different Bases

The following questions ask you what value a given number has for a given number in a given base. Write your answers in exponent form (10^3) or a number multiplied by the exponent form (11*10^4). *Keep in mind that we start from position 0*.
For example:
In decimal, how much is a 1 in position 3 worth
10^3

1. In binary, how much is a 1 in position 4 worth? 2^4 (answer)
2. In octal, how much is a 1 in position 4 worth? 8^4 (answer)
3. In hexadecimal, how much is a 1 in position 4 worth? 16^4 (answer)
4. In hexadecimal, how much is a 2 in position 4 worth? 2*16^4 (answer)
5. In hexadecimal, how much is a B in position 4 worth? 11*16^4 (answer)
6. In hexadecimal, how much is a 9 in position 5 worth? 9*16^5 (answer)

Converting Positive Decimal to Binary

Convert the following numbers into 8-bit binary, showing all bits.
For example:
Convert decimal 0 into binary.
00000000

7. Convert decimal 15 into binary.
   00001111

Name: Grant Clark
(as it would appear on official course roster)

8. Convert decimal 2 into binary.
   00000010

9. Convert decimal 8 into binary.
   00001000

10. Convert decimal 65 into binary.
    01000001

Converting Binary to Decimal

Convert the following unsigned binary numbers into decimal.
For example:
Convert binary 0000 into decimal.
0

11. Convert binary 1000 into decimal.
    8

12. Convert binary 1001 into decimal.
    9

13. Convert binary 1111 into decimal.
    15

14. Convert binary 1101 into decimal.
    13

Converting Decimal to Hexadecimal

Convert the following decimal numbers into 2-digit hexadecimal numbers, showing both digits preceded with the standard '0x' to indicate that the number is in hexadecimal.
For example:
Convert decimal 0 into hexadecimal.
0x00

15. Convert decimal 16 into hexadecimal.
    0x10

Name:
(as it would appear on official course roster)

16. Convert decimal 65 into hexadecimal.
    0x41

17. Convert decimal 31 into hexadecimal.
    0x1F

18. Convert decimal 166 into hexadecimal.
    0xA6

Converting Binary to Hexadecimal

Convert the following binary numbers into 2-digit hexadecimal numbers, showing both digits preceded with the standard '0x' to indicate that the number is in hexadecimal.
For example:
Convert binary 0 into hexadecimal.
0x00

19. Convert binary 110 into hexadecimal.
    0x06

20. Convert binary 11110000 into hexadecimal.
    0xF0

21. Convert binary 10110011 into hexadecimal.
    0xB3

Bit Positions
Remember that we number bit positions from right to left, starting with 0.
For example:
The rightmost bit of an 8-bit number is in what position?
Position 0
The leftmost bit of an 8-bit number is in what position?
Position 7

22. The rightmost bit of a 16-bit number is in what position? Position 0 (answer)

23. The leftmost bit of a 16-bit number is in what position? Position 15 (answer)

24. What is the 4-bit binary number that contains a 0 in all positions ***except*** for position 2?
    0100

Name: Grant Clark

(as it would appear on official course roster)

Terminology

25. How many bits are in a byte? 8 bits (answer)

26. How many bits are in a nibble? 4 bits (answer)

Binary Addition

Find the results of the following binary addition operations of numbers. **You must express the answer in 8 bits.** You have to assume that these numbers could be either ***signed*** or ***unsigned***!
Hint: for the function of addition, it does not matter which of these they are – the 8-bit answer will be the same. You must also identify whether the addition created a carry out bit (C = 0 or 1) AND an overflow bit (V = 0 or 1) – use the usual convention of 0 means "no" and 1 means "yes". Place this information after the 8-bit answer, separated by a comma.
For example:
EX1: What is

```
  00101001
+ 11101001
```

00010010, C = 1 and V = 0 **(i.e. there's a carry-out, but no overflow)**

EX2: What is

```
  10001001
+ 10001001
```

00010010, C = 1 and V = 1 **(i.e. there's a carry-out, and there's overflow since 2 neg. numbers add up to a pos. number)**

27. What is

```
  10010001
+ 01100110
```

11110111, C = 0, V = 0 (answer)

28. What is

```
  11011011
+ 01100011
```

00111110, C = 1, V = 0 (answer)

29. What is

```
  00111101
+ 10110001
```

11101110, C = 0, V = 0 (answer)

30. What is

```
  10111101
+ 10000001
```

00111110, C = 1, V = 1 (answer)