Name Answers

CE-1901 – Dr. Durant – Quiz 2
Fall 2015, Week 2

1. (1 point) **List** the powers of 2 from 2^0 to 2^{16} as decimal numbers.

$2^0 = 1$ $2^1 = 2$ $2^2 = 4$ $2^3 = 8$ $2^4 = 16$ $2^5 = 32$ $2^6 = 64$ $2^7 = 128$ $2^8 = 256$ $2^9 = 512$ $2^{10} = 1024$ $2^{11} = 2048$ $2^{12} = 4096$ $2^{13} = 8192$ $2^{14} = 16384$ $2^{15} = 32768$ $2^{16} = 65536$

2. (2 points) **Convert** the base 10 number 389 to binary, octal, and hexadecimal. **Show** your work.

ALT → oct.
8|389
8|48 R5
8|6 R0
0 R6

2|389
2|194 R1 ← LSB
2|97 R0
2|48 R1
2|24 R0
2|12 R0
2|6 R0
2|3 R0
2|1 R1
0 R1 ← MSB

$1\_1000\_0101_2$ = 110_000_101

$1\ 8\ 5_{16}$

$6\ 0\ 5_8$

check
$6 \cdot 8^2 + 5 = 6 \cdot 64 + 5 = 384 + 5 = 389$ ✓

3. (1 point) **Convert** the hexadecimal number CA1F to octal. **Show** your work.

$C\ A\ 1\ F_{16}$
$1100, 1010, 0001, 1111_2$
$1\ 4\ 5\ 0\ 3\ 7_8$

(-1/2) binary but not octal
(-1/4) ~~(-1/2)~~ hex digit ≠ 4 bits

4. (1 point) **Calculate** the minimum number of bits required to encode the decimal number 67 in (unsigned) binary. **Hint:** Although you could convert it to binary, you can determine the answer by finding which powers of 2 it is between. For example, 7 is between 8 and 4, so we don't need an 8's place (2^3) to represent it, but we do need a 4's place (2^2). Don't forget to count the 1's (2^0) bit.

$64 \leq 67 < 128$
$2^6 \leq 67 < 2^7$
∴ 7 bits are needed: 2^0 through 2^6

(-1/4) no work shown
(-1/2) off by 1 w/ work shown
(-1/4 if good idea)

5. (3 points) Using exactly 4 bits, **add** the binary numbers 1010 and 1001.

```
  1
  1010
+ 1001
------
  0011
```

a. Treat the operation as **unsigned** and **convert** the addends and sum to decimal. **Explain** how you determine whether there was **unsigned** overflow.

10
+ 9
3 ← $16 = 2^4$ short of 19 ∴ unsigned overflow

OR

carry out = 1 ∴ unsigned overflow

b. Treat the operation as **signed** and **convert** the addends and sum to decimal. **Explain** how you determine whether there was **signed** overflow.

2's comp (1010 → 0101 → 0110) → −6
(1001 → 0110 → 0111) → −7
3 ← $16 = 2^4$ higher than "correct" answer of −13 ∴ signed overflow

6. (2 points) **Draw** the **gate symbols** and **truth tables** for NOT, AND2, NOR3, and XOR3. The number after the gate name indicates the number of inputs.

NOT

a	y
0	1
1	0

AND2

a	b	y
0	0	0
0	1	0
1	0	0
1	1	1

NOR3

a	b	c	y
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

XOR3

a	b	c	y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1