

CE-1901-12 - Dr. Durant - Quiz 2
Winter 2016-'17, Week 2

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

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

2. (2 points) Convert the base 10 number 181 to binary, octal, and hexadecimal. Show your work.

2 | 181

2 | 90 R 1

2 | 45 R 0

2 | 22 R 1

2 | 11 R 0

2 | 5 R 1

2 | 2 R 1

2 | 1 R 0

0 R 1

MSB

$B5_{16}$

1011-0101

26₈ 5₈

↑ LSB

3. (1 point) Convert the hexadecimal number F01D to octal. Show your work.

F01D = 1111-0000-0001-1101

17
00
03
5

8

4. (1 point) Calculate the minimum number of bits required to encode the decimal number 1500 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.

$1024 \leq 1500 < 2048$

$2^{10} \leq 1500 < 2^{11}$

\therefore need bits 10..0, which is 11 bits

5. (3 points) Using exactly 4 bits, **add** the binary numbers 1010 and 0011.

$$\begin{array}{r} 1010 \\ + 0011 \\ \hline 1101 \end{array}$$

(a)

$$\begin{array}{r} 10 \\ + 3 \\ \hline 13 \end{array}$$

(b)

$$\begin{array}{r} -6 \\ + 3 \\ \hline -3 \end{array}$$

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

*10+3=13 is correct → no unsigned overflow
carryout is 0*

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

The 2nd addend starts w/ 0, so it is not negative & is the same as in unsigned, 3.

*The other 2 start w/ 1 ∴ are negative:
input. Flip + 1 as decimal
1010 0101 0110 6
1101 0010 0011 3*

*no signed overflow
since -6+3=-3 is correct.*

6. (2 points) **Draw** the **gate symbols** and **truth tables** for OR3, and XNOR2. The number after the gate name indicates the number of inputs.



ABC	F
000	0
001	1
010	1
011	1
100	1
101	1
110	1
111	1

DE	G
00	1
01	0
10	0
11	1

is an even # of 1s on?

CE-1901-11 - Dr. Durant - Quiz 2
Winter 2016-'17, Week 2

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

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

2. (2 points) Convert the base 10 number 155 to binary, octal, and hexadecimal. Show your work.

2 | 155

2 | 77 R1

2 | 38 R1

2 | 19 R0

2 | 9 R1

2 | 4 R1

2 | 2 R0

2 | 1 R0

0 | 1 R1

LSB

↑

MSB

9 B₁₆

1001-1011

2 33₈

3. (1 point) Convert the hexadecimal number BA5E to octal. Show your work.

BA5E = 1011-1010-0101-1110

135136₈

4. (1 point) Calculate the minimum number of bits required to encode the decimal number 699 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.

$512 \leq 699 < 1024$

$2^9 \leq 699 < 2^{10}$

∴ need bits 1...0, which is 10 bits.

5. (3 points) Using exactly 4 bits, **add** the binary numbers 1101 and 1111.

$$\begin{array}{r}
 1101 \\
 + 1111 \\
 \hline
 1100
 \end{array}
 \quad
 \begin{array}{r}
 \textcircled{a} \\
 13 \\
 + 15 \\
 \hline
 12
 \end{array}
 \quad
 \begin{array}{r}
 \textcircled{b} \\
 -3 \\
 + -1 \\
 \hline
 -4
 \end{array}$$

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

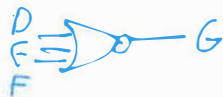
carry out is on \rightarrow unsigned overflow
 result is wrong \rightarrow
 wanted $13+15=28$ error = $12-28 = -16 = -(2^4)$
 # of bits \downarrow
 value of overflow

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

all #s start w/ 1, so all are negative
 use 2's comp. operation to get mag

	Flip	+1	decimal mag
1101	0010	0011	3
1111	0000	0001	1
1100	0011	0100	4

6. (2 points) **Draw** the **gate symbols** and **truth tables** for AND2, and NOR3. The number after the gate name indicates the number of inputs.



AB	H
00	0
01	0
10	0
11	1

DEF	G
000	1
001	0
010	0
011	0
100	0
101	0
110	0
111	0