

CE-1901-11 - Dr. Durant - Quiz 1
Fall 2016, Week 1

1. (1 point) An analog voltage signal is allowed to vary continuously within some range. An ideal digital voltage signal takes on a finite number of levels; when there are only 2 levels, we have a base-2 or binary system. What is a key **advantage** of a digital/binary system over an analog one?

When there is noise (there always is), we have a good chance of interpreting the voltage as the exact intended value.

2. (1 point) What is 2^1 as a decimal number?

2

3. (2 points) Write all the 4-bit unsigned numbers in both binary and decimal.

0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111

4. (2 points) List/calculate the powers of 2 from 2^4 to 2^{10} as decimal numbers.

$$2^4 = 16$$

$$2^5 = 32$$

$$2^6 = 64$$

$$2^7 = 128$$

$$2^8 = 256$$

$$2^9 = 512$$

$$2^{10} = 1024$$

$$2^5 = 32 \quad 2^1 = 2$$

$$\downarrow \quad \downarrow$$

$$2^4 = 16$$

5. (1 point) Convert 110010 from binary to decimal. Show your work.

$$\begin{array}{r} 32 \\ + 16 \\ + 2 \\ \hline 50 \end{array}$$

6. (2 points) Convert 57 from decimal to binary. Show your work.

$$\begin{array}{l} 2 \overline{) 57} \\ 2 \overline{) 28} \text{ R } 1 \leftarrow \text{LSB} = \text{least significant bit} = 1\text{'s place} = 2^0 \text{ position} \\ 2 \overline{) 14} \text{ R } 0 \leftarrow 2^1 = 2 \text{ position} \\ 2 \overline{) 7} \text{ R } 0 \\ 2 \overline{) 3} \text{ R } 1 \\ 1 \overline{) 1} \text{ R } 1 \leftarrow 2^5 = 32\text{'s place} = \text{MSB} = \text{most significant bit} \end{array}$$

$$\begin{array}{c} \text{MSB} \quad \text{LSB} \\ \downarrow \quad \downarrow \\ \boxed{11-1001_2} \\ 54-32=10 \leftarrow \text{position/exponent of 2} \end{array}$$

7. (1 point) What is the largest unsigned number that can be represented with 7 bits?

a. Answer in decimal (base 10):

$$2^7 - 1 = \boxed{127} \quad 128 \text{ values from } 0 \text{ to } 127$$

b. Answer in binary (base 2):

$$\boxed{111-1111}$$

$$\uparrow$$

7 bits, all 1s

CE-1901-12 - Dr. Durant - Quiz 1
Fall 2016, Week 1

1. (1 point) An analog voltage signal is allowed to vary continuously within some range. An ideal digital voltage signal takes on a finite number of levels; when there are only 2 levels, we have a base-2 or binary system. Considering **noise**, **explain** why a binary system is preferable to, say, a base-4 (4 discrete voltage level) system.

In a binary system, the levels are (about) twice as far apart as in a base-4 (4-level) system, thus we can successfully correct for noise of twice the level.

2. (1 point) What is 2^2 as a decimal number?

4

3. (2 points) Write all the 4-bit unsigned numbers in both binary and decimal.

0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111

4. (2 points) List/calculate the powers of 2 from 2^2 to 2^8 as decimal numbers.

$$2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

$$2^6 = 64$$

$$2^7 = 128$$

$$2^8 = 256$$

$$2^4 = 16 \quad 2^0 = 1$$



5. (1 point) Convert 110101 from binary to decimal. Show your work.

$$2^5 = 32 \quad 2^2 = 4$$

$$\begin{array}{r} 32 \\ 16 \\ 4 \\ + 1 \\ \hline 53 \end{array}$$

6. (2 points) Convert 95 from decimal to binary. Show your work.

$$2 \overline{) 95}$$

$$2 \overline{) 47} \text{ R } 1 \leftarrow \text{LSB} = \text{least-significant bit} = 2^0 = 1\text{'s place}$$

$$2 \overline{) 23} \text{ R } 1 \leftarrow 2^1 = 2\text{'s place}$$

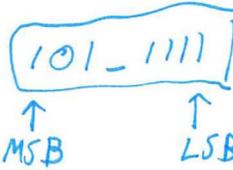
$$2 \overline{) 11} \text{ R } 1 \leftarrow 2^2$$

$$2 \overline{) 5} \text{ R } 1$$

$$2 \overline{) 2} \text{ R } 1$$

$$2 \overline{) 1} \text{ R } 0$$

$$2 \overline{) 0} \text{ R } 1 \leftarrow 2^6 = 64\text{'s place} = \text{MSB} = \text{most-significant bit}$$



7. (1 point) What is the largest unsigned number that can be represented with 8 bits?

a. Answer in **decimal** (base 10):

$$2^8 - 1 = \boxed{255} \quad (\text{256 values from 0 to 255})$$

b. Answer in **binary** (base 2):

