CprE 288 – Homework Question Set 1

Question 1: C Variables and Number Representation

Complete the table below. Assume ASCII encoding of characters, and a 2's complement encoding of negative numbers. When representing a number in hexadecimal or binary, **use the proper number of digits** for the TM4C123 architecture (depends on type of variable). The first row is already completed.

	Value of x		
	x (decimal)	x (hex)	x (binary)
signed char x = 60;	60	0x3c	0b00111100
unsigned char x = 'K';			
unsigned char x = '7';			
short x = 0x0381;			
unsigned short x = 0x4060 + 0x2051;			
signed char x = 0x7 + 6;			
unsigned int x = 0xE9;			
signed short x = -1;			
signed char x = -128;			
signed char x = -1;			
int x = -1;			

Question 2: TM4C123G Microcontroller & Documentation
Throughout this class you will be using the textbook and TM4C123G datasheet as a reference to learn about and design systems using the TM4C123G microcontroller. The TM4C123G datasheet can be found with the lab reference files and on Canvas with this homework assignment.

Bai Book Reading: Read Chapter 1, Section 1.2; Chapter 2, Sections 2.1 and 2.7. Refer to Chapter 4, Sections 4.5.7.1-4.5.7.2.4.

Datasheet Reading: Read Chapter 1 (pages 45-48), and scan Chapter 22 and Chapter 23.

V&Y ES Book Reading: Browse Valvano & Yerraballi, Chapter 2: Fundamental Concepts, Sections 2.1 – 2.4, http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C2_FundamentalConcepts.htm

Answer the following questions using the readings.

   a.   What is the maximum clock speed of the CPU of TM4C123G?

b. How many package pins does the TM4C123G microcontroller have?

c. What are the types and sizes of memory available, and the use for each type of memory?

d. What does it mean for a General Purpose I/O (GPIO) port pin to have an *alternative function*? Give one example of a GPIO port pin and its alternative function.

e. The textbook describes two programing models presented in the textbook: Direct Register Access (DRA) and Software Driver (SD). This course **will only use** the Direct Register Access programming model. Briefly describe each of these models. Note: these are not covered in the assigned readings, so you will need to search a little farther.

Question 3: Endianness

Find an online article on Endianness (i.e., little-endian and big-endian). Briefly summarize the concept of Endianness and the difference between little-endian and big-endian. Properly cite the article you use to obtain your information to receive credit. For proper formatting, see the IEEE citation reference manual: https://ieee-dataport.org/sites/default/files/analysis/27/IEEE%20Citation%20Guidelines.pdf . Note: while Wikipedia is discouraged for citations used within published academic papers, it can be useful for obtaining an overview on a topic. If you use a Wikipedia article, then use this guide for properly citing your "source": http://www.wikihow.com/Cite-a-Wikipedia-Article-in-MLA-Format

Question 4: Basic Review

a. Fill in the units

__ms__ 10^{-3} seconds (answer given)

_____ 10^{-6} seconds   _____ 2^{10} Bytes

_____ 10^{-9} seconds   _____ 2^{20} Bytes

_____ 10^{3} Hz   _____ 2^{30} Bytes

_____ 10^{6} Hz

b. Period or frequency

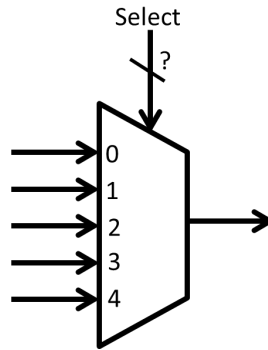i) What is the period of a 2 MHz clock?

ii) What is the frequency of a clock with a 1 ns period?

iii) How many positive edges of a 4 MHz clock will occur in 4 ms?

c. Digital logic

i) Briefly describe how a multiplexer works?

ii) What is the **minimum** number of select bits (wires) need for the multiplexer below? Why?

iii) A clock signal is given as an input to an AND gate, as shown below. What value needs to be placed on the other input to allow the clock signal to propagate through the AND gate?   Why?
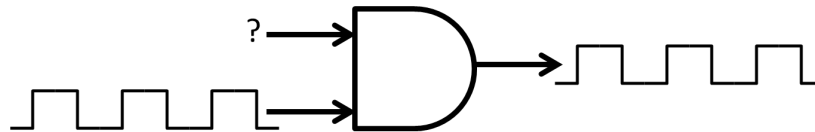
Question 5: C Variables and Memory Use

Reminder: Assume a TM4C123 is being used unless specified otherwise.

a. For each declaration, indicate how many bytes will be allocated in memory

i) _____   `long input_num2;`

ii) _____   `int sensor_readings[10];`

iii) _____   `unsigned short scan_data[20][40];`

b. For each, indicate the value of `my_length` after executing each fragment of C code. Function strlen is a standard C library function. Specify N/A if the value of `my_length` cannot be determined.

i) `my_length` is _____.

```
char msg[] = "CPRE288";
int my_length = 0xFFFFFFFF;

my_length = strlen(msg);
```

ii) `my_length` is _____.

```
char msg[7] = "CPRE288";
int my_length = 0xFFFFFFFF;

my_length = strlen(msg);
```

iii) `my_length` is _____.

```
char msg[100] = {'C','P','R','E','\0','2','8','8','\0'};
int my_length = 0xFFFFFFFF;

my_length = strlen(msg);
```

iv) `my_length` is _____.

```
char msg[] = {5, 7, 10, 0, 9, 2, 0, 3, 5, 77, 23};
int my_length = 0xFFFFFFFF;

my_length = strlen(msg + 4);
```

Question 6: C-string Formatting

Given:

```
char message[100];
char str1[] = "CprE";
char str2[] = "iRobot";
int  num  = 100;
char ch1 = 50;
char ch2 = 56;
```

Predict the C-string contained in `message` after each sprint.

Note 1: Treat each part independently.

Note 2: You may need to look up on your own more details on printf and sprintf.

a) `sprintf(message, "Read %d datasheet pages every week", num);`

b) `sprintf(message, "CprE%c%c%c is %s!", ch1, ch2, ch2, "fun");`

c) `sprintf(message, "Move the %s forward for %d cm", str2+1, num/2);`

d) `sprintf(message, "The ASCII value for %c is decimal %d and hex %X",`
`        ch1, ch1, ch1);`