ECEN 5813 Principles of Embedded Software
Homework 3 (60 Pts) - Due Friday 9/22, 10pm

Instructions

This homework requires you to turn in your answers in a .pdf on D2L dropbox. Your file must be named **HW3-<Name>.pdf**. Additionally, some content will be graded out of the classroom git repository.

[Problem 1 – 16 Pts] Pointer Math

Given the following code and memory table, fill in the table with the new values after the following code executes. Each address holds a byte. (Answer in Hex). Remember, the shift operations are zero-fill logical shifts

```
unsigned char * ptr = (char*)100;
*ptr = 0xF1 & 127;
ptr++;
*ptr += 17;
ptr += 2;
*ptr = 15 % 4;
ptr--;
*ptr >>= 4;
ptr = (char*)105;
*ptr = (1<<5)|(4<<2);
*((char*)107) = 22;
```

Address	Data	Data After
100	0xEE	
101	0x12	
102	0x77	
103	0xBE	
104	0x66	
105	0x54	
106	0x33	
107	0xF0	

[Problem 2 – 16 pts] Emulate Memory Behavior

Given the pointer question from Problem 1, write a small C-program that will emulates the behavior on your host machine. Use an array to emulate memory and check your answer. Have the program print-out the entire table when complete. Include that output when you turn in the assignment.

Example:

```
unsigned char arr [8];
…              // more code here
arr[0] = 0xFE;
…              // more code here
unsigned char * ptr = arr;
…              // more code here
printf(“Addr: %d    %x\n“, (100+index), *ptr++);
```

[Problem 3 - 18 pts] Using the BeagleBoneBlack Board

For this problem you are going to make sure you can run code on your BeagleBoneBlack by both cross compiling and native compiling.

Installing the USB drivers for the BeagleBone allows the BeagleBone to create a network connection to your laptop via the USB cable. However, the BeagleBone boards also have an Ethernet port that you can connect to a switch using a standard Ethernet cable. The board has an IP address, just like any other network connected device. When using the USB connection alone, your BeagleBone can only connect to the internet if you bridge your connection from your computer to the internet connection setup on your computer. By connecting your BeagleBone directly to a switch, the device should be able to get an IP address from your local network that will allow you to connect to websites. Obtain an Ethernet cable and plug your BeagleBone into a local router/switch or your computer.

Connect your BeagleBone via USB and check that you can SSH onto the board. Once on the board make the directory /home/debian/bin.

```
ssh root@192.168.7.2
mkdir /home/debian/bin
```

[Problem 3.1 - 4 pts] Run the steps below with and without the Ethernet cable plugged in. Report any differences you might see.

```
$ ip addr
$ ping github.com
```

[Problem 3.2 - 4 pts] You will need to create your own private git repo to do some of the assignments and project work. Go ahead and do this. Create a subfolder in your repo that is titled hw3 and put a copy of your code there. Start by seeing if you can successfully cross compile a simple print statement main function "<*your-name-here*> hello world!" Copy the executable over to BBB with scp and execute it. Get a screenshot of the output and include it in your report. (There is no need to turn-in the code.)

[Problem 3.3 - 6 pts] Add your reverse function from homework 2 to your git repository. In your simple main function, add three reverse function calls for the strings below. Turn in a screenshot of the output of your reverse string function on the following strings:

a. "This is a string.", **Length = 17**
b. "some NUMmbers12345", **Length = 18**
c. "Does it reverse \n\0\t correctly?" , **Length = 30**

[Problem 3.4 - 4 pts] With either an ethernet cable or you USB connection bridged to the network, clone your repository down to your BBB. Natively compile your hello world and your reverse function. Then run the output to print the results. Include a screenshot of this in your assignment.

[Question 4 – 10 pts] Architecture data sizes

Write a function to report architecture data. Call it **print_arch_data()**. Report what size your host machine and your BBB architecture (BeagleBone ARM Cortex A8) uses for the following data types. Print these nicely using **printf()** and include that output in the assignment. Use the **sizeof()** function.

- char
- int
- float
- double
- short
- long
- long int
- long long
- int8_t
- uint8_t
- uint16_t
- uint32_t
- char *
- int *
- float *
- void *
- void **
- int8_t *
- int16_t *
- int32_t *
- size_t