Assignment 4 – ECE 3056A – Fall 2016 (Due Oct 6, 2016 at 2:00 PM EDT)

The problems in this assignment are more involved that the code discussed in class, and are certainly more involved that those problems that will be asked in Quiz 1. You should refer to the ARM ARM instruction manual to lookup instructions that look unfamiliar to you. This assignment is designed to provide design experience to you so that you can look up resources on the web and in the ARM documentation and use the Keil v4 (or v5 if you wish) simulator to understand more about the ARM. Your TAs are available during their office hours on Mon/Tuesday/Wednesday.

The steps in learning are *analysis, synthesis and optimization*. Analysis is taking existing code apart, synthesis is putting code together correctly, and optimization is making working code more efficient for a purpose.

Problem #1:

Read through the following code and answer the questions.

1. What does this piece of code do?

2. Assume that PC = 0x10000001 initially, what is the value of LR when PC = 0x1000000D

3. What do lines 5-7 do?

4. If you are not allowed to use instruction BL in line 4, how can you change edit the code to achieve the same goal, without changing other parts of the code.

5. Before executing line 13, assume that SP = 0x22220000, what will SP be after executing line 16?

```
1  _start
2
3       mov r0, #10
4       bl _func
5       sub r1, r1
6       sub r2, r2
7       sub r3, r3
8
9       mov r7, #1
10      swi #0
11
12 _func:
13    str lr, [sp], #-4
14    cmp r0, #2
15    movle r0, #1
16    ldrle pc, [sp, #4]!
17
18    mov r3, r0
19    mov r0, #0
20    mov r1, #1
21    mov r2, #1
22
23 __loop__
24
25       cmp r3, #2
26       movle r0, r2
27       ldrle pc, [sp, #4]!
28
29       add r0, r1
30       add r0, r2
31       mov r1, r2
32       mov r2, r0
33       sub r0, r0
34
35       sub r3, #1
36       b __loop__

37       END
```

Problem #2:

1. Declare a memory space of length 9 starting at 0x200000f0
2. Store the following number into memory:

   0x94ff3e02, 0x000c0001, 0x36fbaaaa, 0x21211212, 0x0004bff2

0x00382159, 0x77777777, 0x44444443, 0x00889900

3. Perform a bubble sort with the list of numbers and store them back to memory

4. Perform a binary search of number 0x21211212, store the address in register R10

Homework submission requirements:

1. Please, submit the following screenshots of memory space:

   Before the numbers are sorted
   After the numbers are sorted and stored back to memory
   Numbers stored in R10 when the binary search is done

2. Working source code in .s format. Reasonably amount of comment should be included for readers to understand you code.
3. Refer to the ARM ARM for guidance and cite the ARM ARM if necessary in the comments to clarify your reasons.

* Please don't put your code or screenshot in Microsoft Words. Source code should be in .s format and screen shots can either be png, or put together in a pdf file.