CSE/EE 5/7385 Microcontroller Architecture and Interfacing

HOMEWORK 3

1. Assume the following values are signed ARM halfwords. Calculate their value in decimal (radix-10) and show all your work.

a) **`0xFEED`**

b) **`0xCAFE`**

c) **`0xACE`**

d) **`0xFF`**

2) An embedded system designer must output a one byte (1) signed magnitude value to an interface that drives a seven-segment LCD display with a plus/minus sign. Answer the following questions about signed magnitude values.

a) What is the maximum positive value in both decimal and hexadecimal?

b) What is the minimum negative value in both decimal and hexadecimal?

c) What decimal value does **`0x80`** correspond to?

d) What hexadecimal value should be output to the LCD display if the decimal value 0 (zero) is to be displayed?

3) Using the smallest size among (BYTE, HALFWORD, WORD), give the hexadecimal value for the following decimal values. Assume that 2's complement is used for signed values. For full credit, show your calculations, do not merely use a calculator and give the result.

a) -17,635

b) -47

c) 238

d) -128

4) Translate the following string given between the double quotes into it's 8-bit ASCII equivalent. Give your answer as a set of hexadecimal bytes and include the spaces.

"**HW 3 Question**"

5) What constant would be loaded in register **r0** after the following instructions execute. Give your answer in BOTH hexadecimal and decimal. Assume the constants represent signed 2's complement values

a) `mov r0, #0x9D, 5`

b) `mov r0, #0x53, 30`

c) `mvn r0, #53`

d) `mvn r0, #255, 30`

6) Using any combination of **mov**, **mvn**, with or without rotates, or shifts, give a single instruction that will cause the following constants to be loaded into register **r1**.

a) **0xFF**

b) **0xC400**

c) **0x7D8**

d) **0x17400**

e) **0x1980**

f) **0xA50000**

7) Give the single instruction that will load the following constants into register r0. You may ONLY use a literal pool if that is the only possible way to load the instruction.

a) **`0xFFFFFFFF`**

b) **`0x12340000`**

c) **`0xFFFFFFFE`**

d) **`0x88888888`**

8) Give the total number of **bits** (as a decimal, base-10 number) for the following. Your answer should be in total number of bits in the form $\mathbf{A}\times 2^{\mathbf{B}}$ where **A** is NOT a factor of 2 (two). Do not use Kilo-, Mega-, or Giga-. An example is 6 Kbits = 3×2^{11} so **A**=3 and B=**11**.

ARM word: _____ 32 Mbits: _____ Byte: _____

16 GBytes: _____ ARM halfword: _____ 48 KBytes: _____

9) The diagram below depicts a portion of the ARM memory before the instruction executes. Assume that the processor is operating in ***little endian*** mode, is executing the sequence of instructions below, and that it DOES support unaligned accesses.

ADDRESS	DATA
0x8000	0xA1
0x8001	0x33
0x8002	0x2C
0x8003	0xFF
0x8004	0x00
0x8005	0x7D
0x8006	0x7E
0x8007	0x7F
0x8008	0x37
0x8009	0x5B

```
mov  r0, #0x8004
ldr  r1, [r0, #-1]
ldr  r2, [r0]
ldr  r3, =0xFFFFFFFF
and  r1, r1, #0xff
and  r2, r2, #0xff
cmp  r2, #255      ;Instruction A
cmp  r1, #255      ;Instruction B
cmp  r3, r1        ;Instruction C
cmp  r1, #0        ;Instruction D
```

a) Give the flag contents immediately after `Instruction A` executes:

N = ____ C = ____ Z = ____ V = ____

b) Give the flag contents immediately after `Instruction B` executes:

N = ____ C = ____ Z = ____ V = ____

c) Give the flag contents immediately after `Instruction C` executes:

N = ____ C = ____ Z = ____ V = ____

d) Give the flag contents immediately after `Instruction D` executes:

N = ____ C = ____ Z = ____ V = ____