Homework #2

Course: CSE4010-01 Computer Architecture

Professor Juho Kim

April 7, 2021

1. Submission

- Submission Deadline: **April 14, 2021, 11:59 pm (Submit at Cyber Campus)** (Late submissions not allowed)
- Write solving processes and answers on a blank white paper, scan it and submit it as a **PDF file.**
- The filename should be **HW2_STUDENT-ID_NAME.pdf**

  (ex. HW2_20219999_홍길동.pdf)
- **WARNING**:
  - Students who copy other's homework will get zero point for this assignment.
  - Submission without any solving processes will get zero points.
  - Submission with another form rather than pdf will have a 3 points reduction of the total score.
  - Submission with the wrong file name will have 3 points reduction of total score.
  - Before submission, please check whether your solving processes and answers are clear enough to read. (No credit will be given if your work is illegible)
  - All works must be hand-written.(50% reduction for typed submissions)

2. Reference

- Lecture notes
- Patterson and Hennessy, Computer Organization and Design 4th (ARM Edition), Morgan Kaufmann, 2010

1. The following problem deal with translating from C to ARM. Assume that the variables f, g, and h are assigned to registers R0, R1, and R2 respectively. Assume that the base address of the arrays A and B are in registers R6 and R7, respectively.**(15pts)**

a.	f = -g + h + B[2]
b.	f = A[B[g]+1]

For the C statement above, what is the corresponding ARM assembly code?

2. The following problems deal with sign extension and overflow. Registers R0 and R1 hold the values as shown in the table below. You will be asked to perform a ARM operation on these registers and show the result. **(20pts)**

a.	r0 = $70000000_{sixteen}$, r1 = $0x0FFFFFFF_{sixteen}$
b.	r0 = $0x40000000_{sixteen}$, r1 = $0x40000000_{sixteen}$

2-1 For the contents of registers r0 and r1 as specified above, what is value of r4 for the following assembly code?

SUB r4, r0, r1

Is the result in r4 the desired result, or has there been overflow?

The table below contains various values for register r1. You will be asked to evaluate if there would be overflow for a given operation.

a.	2147483647_{ten}
b.	$0xD0000000_{sixteen}$

2-2 Assume that register r0 = 0x70000000 and r1 has the value as given in the table. If the instruction ADD r0, r0, r1 is executed, what is the value of r0? Will there be overflow?

3. In the following problems, the data table contains bits that represent the opcode of an instruction. You will be asked to translate the entries into assembly code and determine what format of ARM instruction the bit represent. **(20pts)**

a.	0xE0842005
b.	0xE0423001

3-1 What instruction does the above hexadecimal number represent?

3-2 What type (DP,DT) instruction do the hexadecimal entries above represent?

Name	Format	Example							
ADD	DP	14	0	0	4	0	2	1	3
SUB	DP	14	0	0	2	0	2	1	3
LDR	DT	14	1		24		2	1	100
STR	DT	14	1		25		2	1	100
Field Size		4 bits	2 bits	1 bit	4 bits	1 bit	4 bits	4 bits	12 bits
DP	DP	Cond	F	I	Opcode	S	Rn	Rd	Operand2
DT	DP	Cond	F		Opcode		Rn	Rd	Offset12

4. In the following problems, the data table contains the values for registers r3 and r4. You will be asked to perform several ARM logical operations on these registers.(write answers in hexadecimal) **(20pts)**

a.	r3 = 0x12345678, r4 = 9ABCDEF0

4-1 For the lines above, what is the value of r5 for the following sequence of instructions?

```
MVN  r3,  #1
AND  r5,  r3,  r4,  LSL  #4
```

4-2 For the lines above, what is the value of r5 for the following sequence of instructions?

```
MOV r5,  0xABCD
AND r5,  r5,  r3,  LSR  #4
```

5. For these problems, the table hold C code. You will be asked to evaluate these C code statement in ARM assembly code. **(25pts)**

```
While( a < 10){
    D[a] = a - b + i;
    a += 2;
}
```

5-1 For the code above, translate the C code to ARM assembly code. Use a minimum

number of instructions. Assume that the value a, b, i are in registers r0, r1, r2 respectively. Also, assume that register r6 holds the base address of the array D.

5-2 If the variables i, a and b are initialized to 1, 10 and 100, and all elements of D are initially 1, what is the total number of ARM instructions that is executed to complete the loop.