Temple University

College of Engineering

Department of Electrical and Computer Engineering (ECE)

Student Lab Report Cover Page

Course Number : 3613

Course Section : 001 / 002

Experiment # : Lab #2

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Date : 9/12/19

Grade : _____ **/100**

TA Name : Sung Choi

ACTIVITIES:

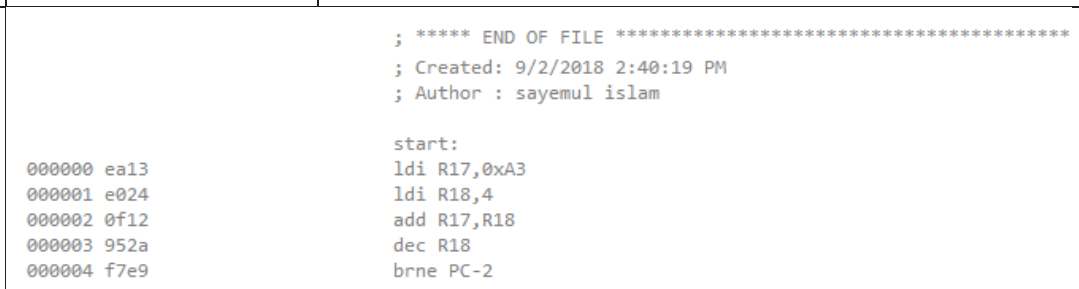
Activity 1

Read each code and write its own mathematical or logical expression (30 pts).

Run the following codes in the Atmel Studio environment. Examine the values of each register. Fill each section (it's operation) with mathematical or logical expression. Also, attach the *lss* file screenshots after you run the code. (See the given example in Figure 1).

Section	Assembly Code	Mathematical and Logical Expression

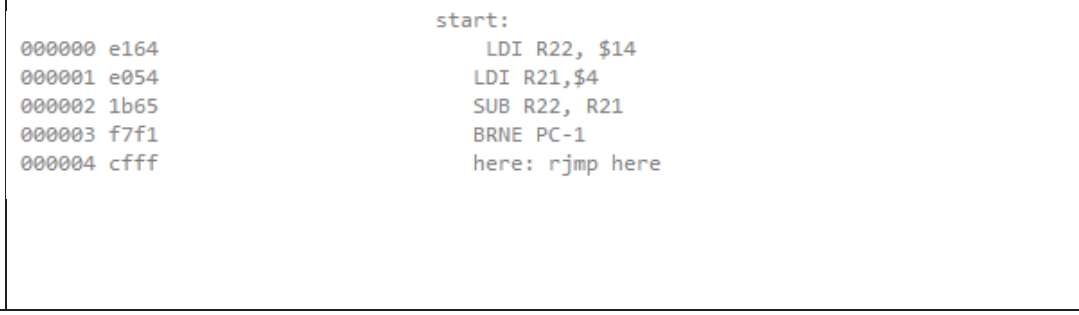
Example	LDI R17, 0xA3
	LDI R18, 4
	ADD R17, R18
	DEC R18
	BRNE PC-2
		R17 = 0xA3
		R18 = 4
		R17 = R17 + R18
		R18 = R18 – 1
		If Z=0, then PC=PC-2, else PC=PC+1 (exit the loop)

lss screenshot		

<Figure 1. Example of *lss* file screenshot>

Section	Assembly Code	Mathematical Expression

1-1.	LDI R22, $14
	LDI R21, $4
	SUB R22, R21
	BRNE PC-1
		R22 = $14
		R21 = $4
		R22 = R22 – R21
		If Z = 0, then PC = PC – 1, else PC = PC + 1. Finish

lss screenshot		

1-2.	LDI R16, $15
	LDI R17, $22
	ADC R16, R17
	BRCC PC-1
		R16 = $15
		R17 = $22
		R16 = R16 + R17 w/ carry
		If C = 1, then PC = PC -1, else PC+ 1. Finish

lss screenshot	000000 e105
	000001 e212
	000002 1f01
	000003 f7f0
	000004 cfff
		start:
		LDI R16, $15
		LDI R17,$22
		ADC R16, R17
		BRCC PC-1
		here: rjmp here

1-3.	LDI R25, $15
	LDI R26, $52
	DEC R26
	CP R25, R26
	BRNE PC-2
		R25 = $15
		R26 = $52
		R26 = R26 – 1
		R25 – R26, If R26 < R25 will create carry.
		If C = 1, then PC = PC -2, else PC+ 1. Finish

lss screenshot	000000 e195
	000001 e5a2
	000002 95aa
	000003 179a
	000004 f7e9
	000005 cfff
		start:
		LDI R25, $15
		LDI R26,$52
		DEC R26
		CP R25, R26
		BRNE PC-2
		here: rjmp here

Activity 2

Read the error message and correct the error parts in the code (30 pts).

2-1. This assembly code loads the hex values to the general purposed registers, R16 and R17. Then, it swaps the contents of the registers. Answer the questions.

```
ldi r16, 560          ; load a value 560 in decimal to R16
ld r17, 0x81          ; load a value 0x81 in hex to R17
; The following section is for swapping the values of the register 16 and 17
mov r22, r16          ; move the value of R16 to R22
mov r16, r17          ; move the value of R17 to R16
mov r17, r22          ; move the value of R22 to R17
```

Questions:

Q. What is the syntax error in this code?

Answer:

LD should be LDI

560 is out of range. Too high for the amount of bytes it holds

Q. How to fix the error?

Answer:

Reduce to less than 255.

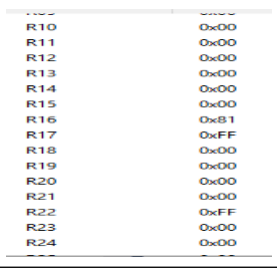
Change LD to LDI.

Code and Result:
Show the modified code and attach the screenshots of the register values.

1) Show your modified code. (Copy and Paste the code)

```
; Created: 9/12/2019 9:35:55 AM
; Author : Von Kaukeano
; Replace with your application code
start:
 LDI R16, 255
 LDI R17, 0x81
 mov R22, R16
 mov R16,R17
 mov R17,R22
here: rjmp here
```

2) Show the final value of the register 16 and 17. (Screenshots)



2-2. This assembly code loads four hex values ($10, $42, $a8, and $11) to the address 0x0100, 0x101, 0x0102 and 0x0103 in the data memory.

```
Ldi $10, r0          ; load a hex value $10 to a GPR
sts 0x100,r0         ; store the value to the memory location 0x0100
ldi r17, $42         ; load a hex value $42 to a GPR
sts 0x101,r17        ; store the value to the memory location 0x0101
ldi r1, $a8          ; load a hex value $a8 to a GPR
sts 0x102,r1         ; store the value to the memory location 0x0102
ldi r18, $11         ; load a hex value $11 to a GPR
sts 0x103,r18        ; store the value to the memory location 0x0103
```

Questions:

Q. What is the syntax error in this code?

Answer:

The register number should be before the hex value.

Cannot load into R0-R15.

Q. How to fix the error?

Answer:

LDI R20,$10

LDI R16 $A8

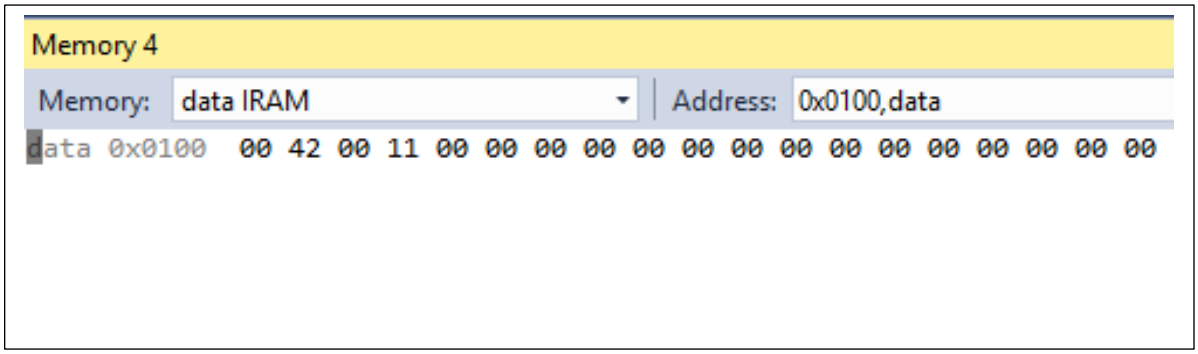
Code and Result:

Show the modified code and attach the screenshots of the values in the memory locations.

1) Show your modified code. (Copy and paste the code)

```
start:
 LDI R20, $10
 STS 0x100, R0
 LDI R17, $42
 STS 0x101, R17
 LDI R16,$A8
 STS 0x102, R1
 LDI R18, $11
 STS 0x103,R18
here: rjmp here
```

2) Show the final values of the memory location 0x100, 0x101, 0x102, and 0x103 (Screenshot)



2-3. This assembly code loads value $7 to the memory address 0x0200. Then, load the contents of 0x0200 to the memory location 0x220. The content of the location 0x220 is decremented continuously until the value hits zero by using the register R1.

```
ld r17, $7          ; load $7 to R17
sts 0x200, r17      ; store R17 value to 0x200
ldi r1, 0x200       ; load the content of ox200 to R1
sts 0x220, r1       ; store the value of R1 to the location 0x220
dec r1              ; decrement by 1
brne PC-3           ; return to the step with the current program counter – 3
```

Questions:

Q. What is the syntax error in this code?

Answer:

LD should be LDI

Cannot load into R1 and 0x200 is out of range

Q. How to fix the error?

Answer:

LDI R17, $7

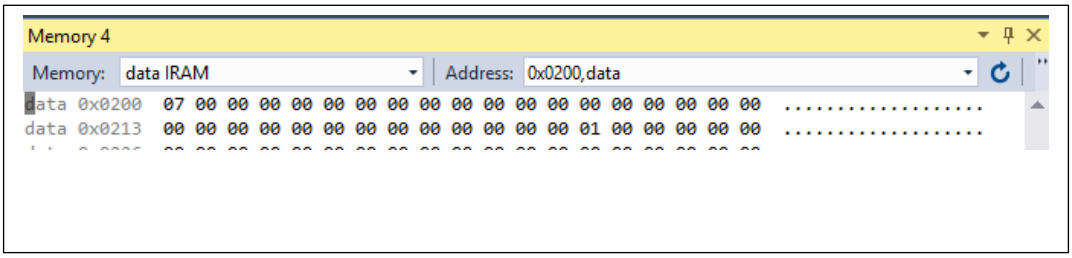
LDI R16 0x20

Code and Result:
Show the modified code and attach the screenshots of the values in the memory locations.

1. Show your modified code. (Copy and paste the code in the box)

```
start:
LDI R17, $7
STS 0x200, R17
LDI R16, 0x20
STS 0x220,R1
DEC R16
BRNE PC-3
here: rjmp here
```

2. Show the final values in the memory location 0x200, 0x0220 (Screenshots)



Activity 3

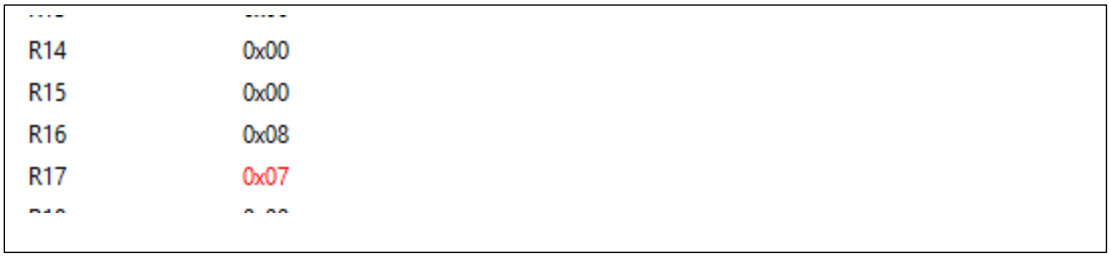
The assembly codes do not correctly perform each task given. Modify the codes based on the task given for each code (40 pts).

3-1. The assembly code is created to increment value of r16 from $8 to $F and to decrement value of r17 to zero (10 pts).

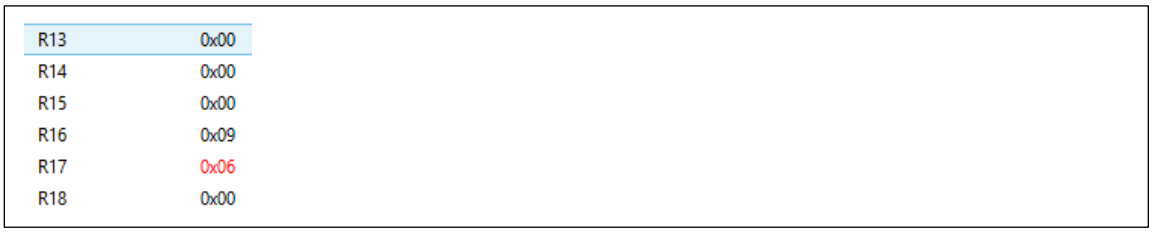
```
start:
        ldi r16, $8
        ldi r17, $7
        inc r16
        dec r17
        brne PC-4
end:    rjmp end
```

Questions:

Q. Show the **initial** value stored at R16 and R17 after you run the first two lines.. (Attach the screenshot)



What are the **final** values of r16 and r17 without correction? (Attach the screenshot)



Q. What are the **expected final values** of R16 and R17 based on the given task?

Answer:

R16 = 0F

R17 = 0

How to modify the code to do correct operation? Show the modified code and the final values of R16 and R17 after the correction. (Copy and paste the code and attach the screenshot of the R16 and R17 values)

Code: modified code (copy and paste)

```
start:
LDI R16, $8
LDI R17, $7
INC R16
DEC R17
BRNE PC-2
end: rjmp end
```

Result: R16 and R17 values (Screenshot)

3-2. The assembly code is programmed to accomplish two tasks based on the arithmetic operation for R16 and R17 (30 pts).

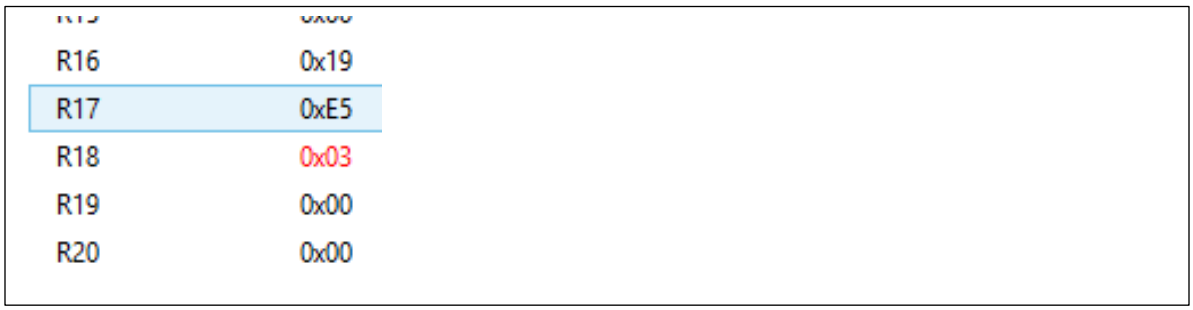
Task 1) R16 = R16 + (R20 – R18)
Task 2) R17 = R17 + R16. (use the R16 value from the Task 1)

```
start:
        ldi r16, $19
        ldi r17, $e5
```

```
        ldi r18, 3
        sub r18, r20
        add r18, r16
        add r16, r17
end:    rjmp end
```

Questions:

Q. Show the initial value stored at R16, R17, R18, and R20 before you run the arithmetic operation. (Attach the screenshot)



What are the mathematical expressions of the R16, R17, R18, and R20 without correction? What are the final values for these registers after you run the code without correction?

Answer:

R18 = R18 – R20

R18 = R18 + R16

R16 = R16 + R17

R16 = 0xFE ; R17 = 0xE5 ; R18 = 0x1C ; R20 = 0x00

Q. What are the expected final values of R16 and R17 based on the given task?

Answer:

R16 = 16

R17 = FB

How to modify the code to do the correct operation? Show the modified code and the corrected values of R16 and R17. (Copy and paste the code and attach the screenshot of the R16 and R17 values)

Code: modified code (copy and pasted)

```
start:
   LDI R16, $19
        LDI R17, $e5
        LDI R18, 3
        SUB R20, R18
        ADD R16, R20
        ADD R17, R16
end: rjmp end
```

Result: R16 and R17 values (Screenshot)

R15	0x00
R16	0x16
R17	0xFB
R18	0x03
R19	0x00
R20	0xFD

ECE3613 Processor System Laboratory Rubric
Lab #: 2
Section: 001 / 002
Name: _____

Activity	Section	Task	Full Points	Earned Points	Comment
1	1.1	Math Exp	5		
		lss file screenshot	5		
	1.2	Math Exp	5		
		lss file screenshot	5		
	1.3	Math Exp	5		
		lss file screenshot	5		

Subtotal			30		
2	2.1	Question	5		
		Code & Result	5		
	2.2	Question	5		
		Code & Result	5		
	2.3	Question	5		
		Code & Result	5		
Subtotal			30		
3	3.1	Question	5		
		Code & Result	5		
	3.2	Question	15		
		Code & Result	15		
Subtotal			40		
Total			100		