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 #9

Student Name (print) : Von Kaukeano

TUid# : 915596703

Date : 10/31/19

Grade : _____ **/100**

TA Name : Sung Choi

ACTIVITY 1

1.

```
LDI R17,12
LDI XL,0X40
LDI XH,0X01
LDI ZL,0X00
LDI ZH,0X04

LOOP:
LPM R16,Z+
ST X+,R16
DEC R17
BRNE LOOP

.ORG $200
MYDATA: .DB "VON KAUKEANO",0
```

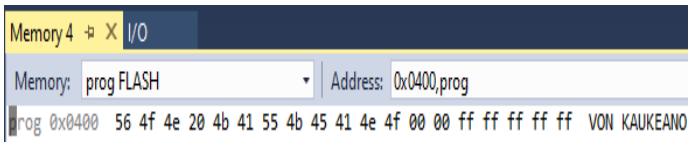
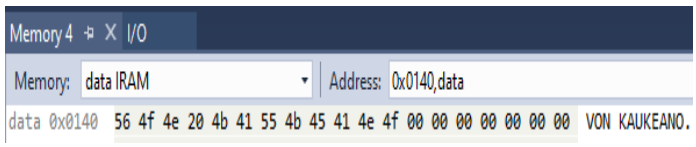
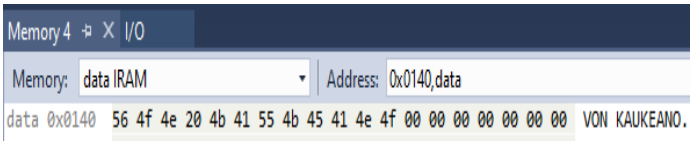
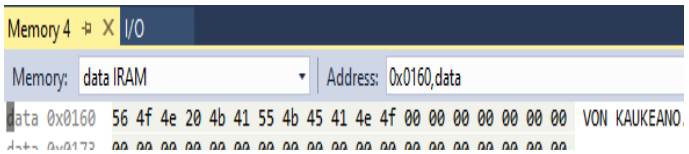
1-B

```
LDI R17,12
LDI XL,0X40
LDI XH,0X01
LDI ZL,0X00
LDI ZH,0X04
LDI YL,0X60
LDI YH,0X01

LOOP:
LPM R16,Z+
ST X+,R16
CALL STORE
DEC R17
BRNE LOOP

HERE: RJMP HERE

STORE:
ST Y+,R16
RET


.ORG $200
MYDATA: .DB "VON KAUKEANO",0
```

Table 1.1. Activity 1 – Part I and Part II Description: Data, Origin and Destined Memory Locations

PART I			
Data	Starting Program Memory Address		Starting SRAM Address
Alex Young	0x0200	➔	0x0140
PART II			
Data	Starting SRAM Address		Starting SRAM Address
Alex Young	0x0140	➔	0x0160

Table 1.2. Activity 1 – Part I and Part II Result Screenshots: Data, Origin and Destined Memory Locations

PART I	
Data in Program Memory (address, hex & string)	Data in SRAM (address, hex & string)
	
PART II	
Data in SRAM (address, hex & string)	Data in SRAM (address, hex & string)
	

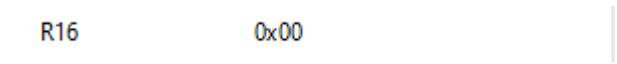
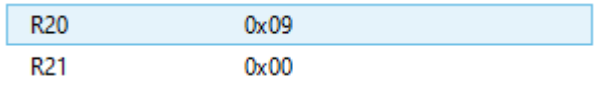
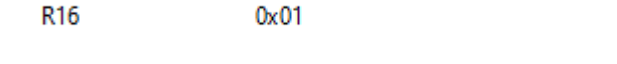
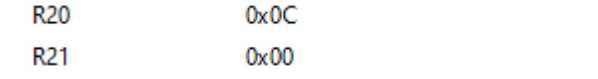
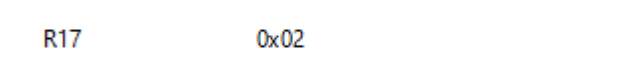
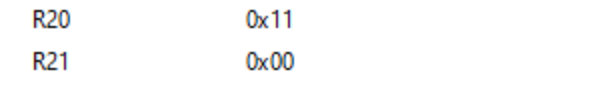
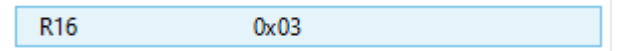
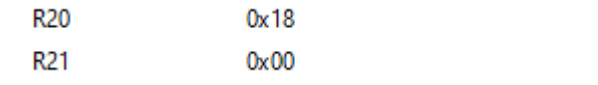
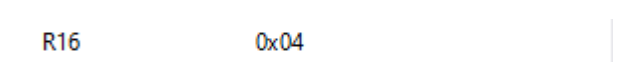
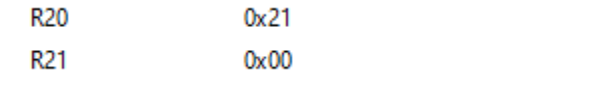
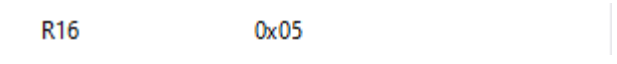
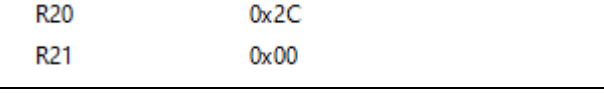
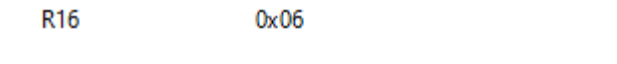
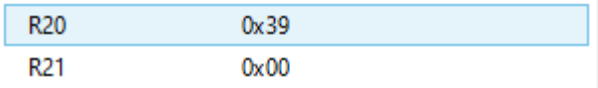
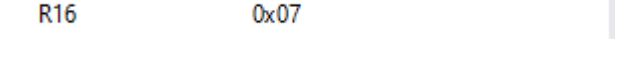
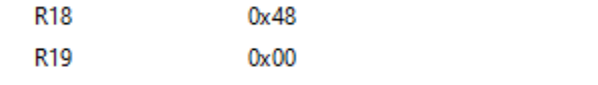
ACTIVITY 2

```
LDI R17,2 ; MULTIPLIER
LDI R25,9 ; ADDER
LDI R24,10 ; COUNTER
LDI ZL,0X00
LDI ZH,0X04
LDI YL,0X00
LDI YH,0X01

LOOP:
LPM R16,Z+

MUL R16,R16
MOVW R18:R19,R1:R0 ; R18,R19 = R16(H) , R16(L)

MUL R16,R17 ; R16 = 2 * R16
MOVW R22:R23,R1:R0

ADC R18,R22
ADD R19,R23

ADC R18,R25

MOV R20,R18
MOV R21,R19

DEC R24
BRNE LOOP

HERE: RJMP HERE

.ORG $50
MYDATA: .DB 9,12,17,24,33,44,57,72,89,108
.ORG $200
X_VAL: .DB 0,1,2,3,4,5,6,7,8,9
```

Table 2.1. Arithmetic Computation Result (Expected result)

Index	R16 *(x)*	x_2	$x_2+2\,x$	R20,R21 *($y= x_2+2\,x+9$)*
1	0	0	0	R20=$09, R21=$00
2	1	1	3	R20=$0C, R21=$00
3	2	4	8	R20 = $11 ,R21 =$00
4	3	9	15	R20 =$18 ,R21 =$00
5	4	16	24	R20 =$21 ,R21 =$00
6	5	25	35	R20 =$2C ,R21 =$00
7	6	36	48	R20 =$39 ,R21 =$00
8	7	49	63	R20 =$48 ,R21 =$00
9	8	64	80	R20 =$59 ,R21 =$00
10	9	81	99	R20 =$6C ,R21 =$00

Table 2.2. Arithmetic Computation Result shown in Simulation, R20 and R21(Screenshots)

Index	R16 *(x)* (hex)	R20,R21 *($y= x_2+2\,x+9$)* (hex)
1		
2		
3		
4		
5		
6		
7		
8		

9	R16	0x08	R20 0x59 R21 0x00
10	R16	0x09	R20 0x6C R21 0x00

ACTIVITY 3

```
LDI R24,10 ; COUNTER
LDI R20,0
LDI ZL,0X00
LDI ZH,0X02
LDI YL,0X00
LDI YH,0X01


LOOP:
LPM R16,Z+
CALL ADD_0
CALL ADD_1
CALL ADD_2
CALL ADD_3
CALL ADD_4
CALL ADD_5
CALL ADD_6
CALL ADD_7
CALL ADD_8
CALL ADD_9

HERE: RJMP HERE

ADD_0:
LDI R19,0
ADD R16,R20
MOV R18,R16
RET

ADD_1:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY1
RET
```

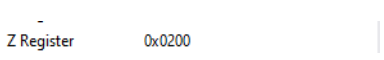
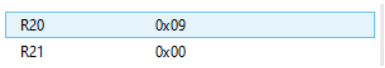
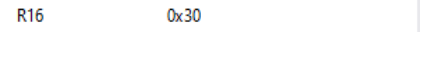
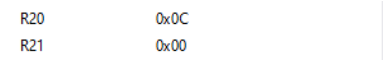
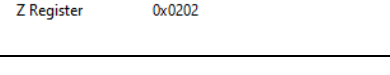
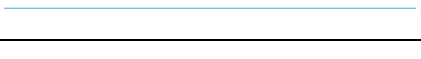
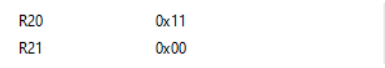
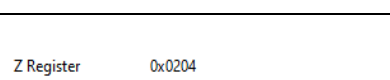
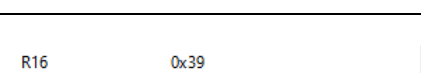
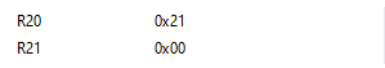
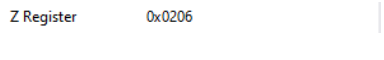
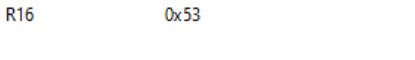
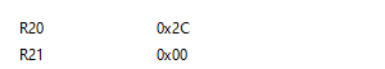
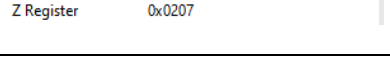
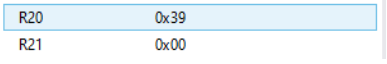
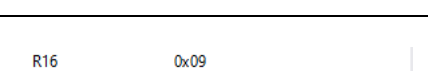
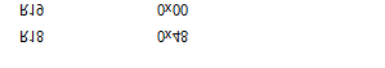
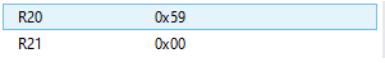
```
CARRY1:
INC R19
RET

ADD_2:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY2
RET
CARRY2:
INC R19
RET

ADD_3:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY3
RET
CARRY3:
INC R19
RET

ADD_4:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY4
RET
CARRY4:
INC R19
RET

ADD_5:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY5
RET
CARRY5:
INC R19
RET

ADD_6:
LDI R19,0
```

```
LPM R17,Z+
ADD R18,R17
BRCS CARRY6
RET
CARRY6:
INC R19
RET

ADD_7:
LDI R19,0
LPM R17,Z+
ADD R18,R17
BRCS CARRY7
RET
CARRY7:
INC R19
RET

ADD_8:
LDI R19,0
LPM R17,Z+
ADD R18,R17
ADD R18,R21
BRCS CARRY8
RET
CARRY8:
INC R19
RET

ADD_9:
LDI R19,0
LPM R17,Z+
ADD R18,R17
ADD R18,R21
BRCS CARRY9
RET
CARRY9:
INC R19
RET

.ORG $100
X_VAL: .DB 32,48,21,60,57,25,83,74,58,9
```

Table 3.1. Arithmetic Computation Result and the Expected Values of R18 and R19

Data Index, n	Data Value, D_n	Data Location	Accumulated Result $D_n = D_n+D_{n-1}$	Accumulated Result of (R18,R19 = D_n) in hex
1	32	0x0200	32+0=32	R19=$00, R18=$20
2	48	0x0201	32+48=80	R19=$00, R18=$50
3	21	0x0202	32+48+21=101	R19=$00, R18=$65
4	60	0x0203	161	R19=$00, R18=$A1
5	57	0x0204	218	R19=$00, R18=$DA
6	25	0x0205	243	R19=$00, R18=$F3
7	83	0x0206	326	R19=$01, R18=$46
8	74	0x0207	400	R19=$00, R18=$90
9	58	0x0208	458	R19=$00, R18=$CA
10	9	0x0209	467	R19=$00, R18=$D3

Table 3.2. Result Table of the Arithmetic operation (screenshots)

Data Index, n	Data Value, D_n	Z pointer value screenshot	Rn, Data holding register value screenshot	R18, R19 Values Screenshot
1	32			
2	48			
3	21			
4	60			
5	57			
6	25			
7	83			
8	74			
9	58			
10	9