Imamshah, Nicholas
3744
HW3

```
6.1)
        a) IF P >= Q
        cp P, Q
        brsh ELSE

        b) IF Q > P
        cp P, Q
        brlo ELSE

        c) iF P = Q
        cp P, Q
        breq ELSE

6.2)
        a) IF P >= Q
        cp P, Q
        brge ELSE

        b) IF Q > P
        cp P, Q
        brlt ELSE

        c) IF P = Q
        cp P, Q
        breq ELSE
```

6.11)

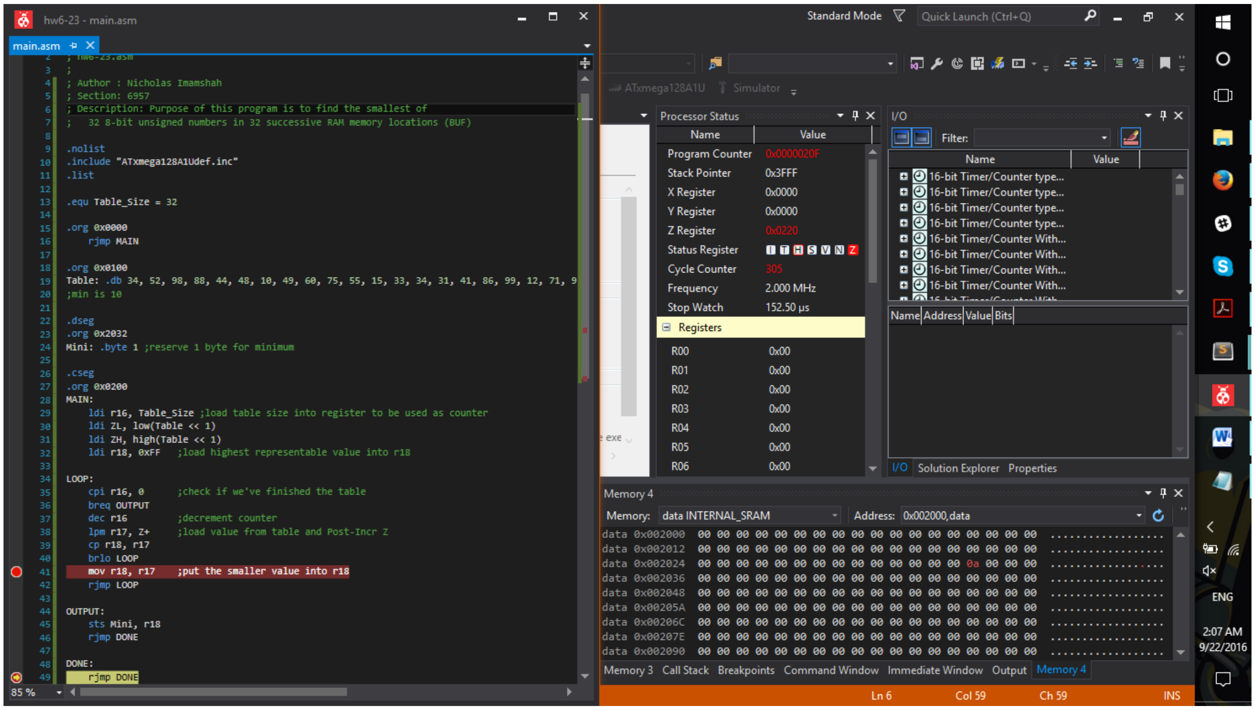
Using a space in memory is a waste since we know the constant before compile time.

```
6.12) FOR Loop
        ldi r16, 0
LOOP:
        cpi r16, 10
        breq DONE
        inc r16
        rjmp LOOP
DONE:
        rjmp DONE

6.15)
        lds r16, K1
        lds r17, K2
        lds r18, K3
WHILE:
        cp r16, r17
        brlt DONE
        cp r17, r18
        brlt THEN
        mov r17, r18
        inc r16
        rjmp WHILE

THEN:
        mov r17, r16
        rjmp WHILE
```

6.16)

```
iter    K1      K2      K3
------------------
0       1       3       -2
1       2       -2      -2
------------------
1 pass  2       -2      -2
```

6.23)


hw6-23 - main.asm
main.asm
Standard Mode
Quick Launch (Ctrl+Q)
ATxmega128A1U
Simulator
I/O
Filter:
16-bit Timer/Counter type...
16-bit Timer/Counter type...
16-bit Timer/Counter type...
16-bit Timer/Counter type...
16-bit Timer/Counter With...
16-bit Timer/Counter With...
16-bit Timer/Counter With...
16-bit Timer/Counter With...
Name Address Value Bits
I/O Solution Explorer Properties
Memory 3 Call Stack Breakpoints Command Window Immediate Window Output Memory 4
85 %
ENG
2:07 AM
9/22/2016

```
; hw6-23.asm
;
; Author : Nicholas Imamshah
; Section: 6957
; Description: Purpose of this program is to find the smallest of
;   32 8-bit unsigned numbers in 32 successive RAM memory locations (BUF)

.nolist
.include "ATxmega128A1Udef.inc"
.list

.equ Table_Size = 32

.org 0x0000
    rjmp MAIN

.org 0x0100
Table: .db 34, 52, 98, 88, 44, 48, 10, 49, 60, 75, 55, 15, 33, 34, 31, 41, 86, 99, 12, 71, 9
;min is 10

.dseg
.org 0x2032
Mini: .byte 1 ;reserve 1 byte for minimum

.cseg
.org 0x0200
MAIN:
    ldi r16, Table_Size ;load table size into register to be used as counter
    ldi ZL, low(Table << 1)
    ldi ZH, high(Table << 1)
    ldi r18, 0xFF   ;load highest representable value into r18

LOOP:
    cpi r16, 0      ;check if we've finished the table
    breq OUTPUT
    dec r16         ;decrement counter
    lpm r17, Z+     ;load value from table and Post-Incr Z
    cp r18, r17
    brlo LOOP
    mov r18, r17    ;put the smaller value into r18
    rjmp LOOP

OUTPUT:
    sts Mini, r18
    rjmp DONE

DONE:
    rjmp DONE
```

Processor Status

Name	Value
Program Counter	0x0000020F
Stack Pointer	0x3FFF
X Register	0x0000
Y Register	0x0000
Z Register	0x0220
Status Register	I T H S V N Z
Cycle Counter	305
Frequency	2.000 MHz
Stop Watch	152.50 µs
Registers	
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00

Memory 4

Memory: data INTERNAL_SRAM Address: 0x002000,data

```
data 0x002000  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x002012  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x002024  00 00 00 00 00 00 00 00 00 00 00 00 00 00 0a 00 00 00  ..................
data 0x002036  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x002048  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x00205A  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x00206C  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x00207E  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x002090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
```

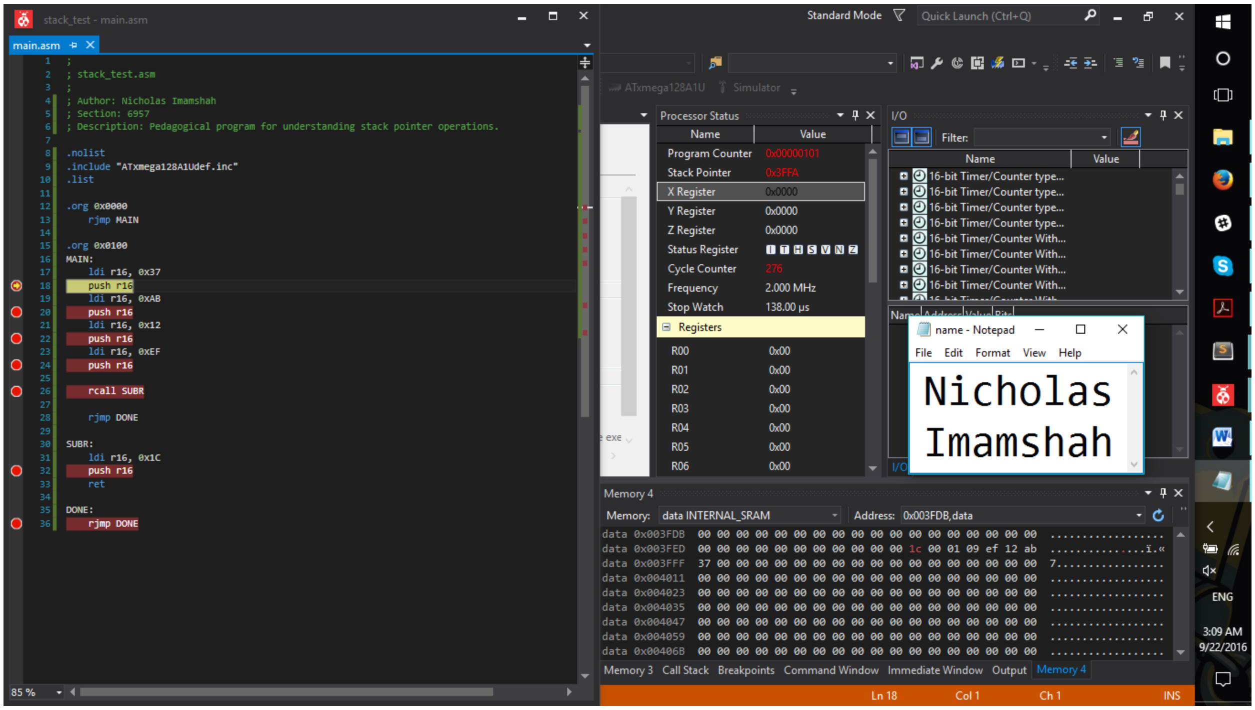
Ln 6 Col 59 Ch 59 INS

```
;
; hw6-23.asm
;
; Author : Nicholas Imamshah
; Section: 6957
; Description: Purpose of this program is to find the smallest of
;       32 8-bit unsigned numbers in 32 successive RAM memory locations (BUF)

.nolist
.include "ATxmega128A1Udef.inc"
.list

.equ Table_Size = 32

.org 0x0000
        rjmp MAIN

.org 0x0100
Table: .db 34, 52, 98, 88, 44, 48, 10, 49, 60, 75, 55, 15, 33, 34, 31, 41, 86, 99, 12, 71, 96,
95, 25, 32, 37, 21, 70, 99, 85, 54, 19, 23
;min is 10
```

Imamshah, Nicholas
3744
HW3

```
.dseg
.org 0x2032
Mini: .byte 1 ;reserve 1 byte for minimum

.cseg
.org 0x0200
MAIN:
       ldi r16, Table_Size   ;load table size into register to be used as counter
       ldi ZL, low(Table << 1)
       ldi ZH, high(Table << 1)
       ldi r18, 0xFF  ;load highest representable value into r18

LOOP:
       cpi r16, 0            ;check if we've finished the table
       breq OUTPUT
       dec r16               ;decrement counter
       lpm r17, Z+           ;load value from table and Post-Incr Z
       cp r18, r17
       brlo LOOP
       mov r18, r17   ;put the smaller value into r18
       rjmp LOOP

OUTPUT:
       sts Mini, r18
       rjmp DONE

DONE:
       rjmp DONE
```

Stack Question:



stack_test - main.asm

```
;
; stack_test.asm
;
; Author: Nicholas Imamshah
; Section: 6957
; Description: Pedagogical program for understanding stack pointer operations.

.nolist
.include "ATxmega128A1Udef.inc"
.list

.org 0x0000
    rjmp MAIN

.org 0x0100
MAIN:
    ldi r16, 0x37
    push r16
    ldi r16, 0xAB
    push r16
    ldi r16, 0x12
    push r16
    ldi r16, 0xEF
    push r16

    rcall SUBR

    rjmp DONE

SUBR:
    ldi r16, 0x1C
    push r16
    ret

DONE:
    rjmp DONE
```

ATxmega128A1U Simulator

Processor Status

Name	Value
Program Counter	0x00000101
Stack Pointer	0x3FFA
X Register	0x0000
Y Register	0x0000
Z Register	0x0000
Status Register	I T H S V N Z
Cycle Counter	276
Frequency	2.000 MHz
Stop Watch	138.00 µs
Registers	
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00

name - Notepad

Nicholas
Imamshah

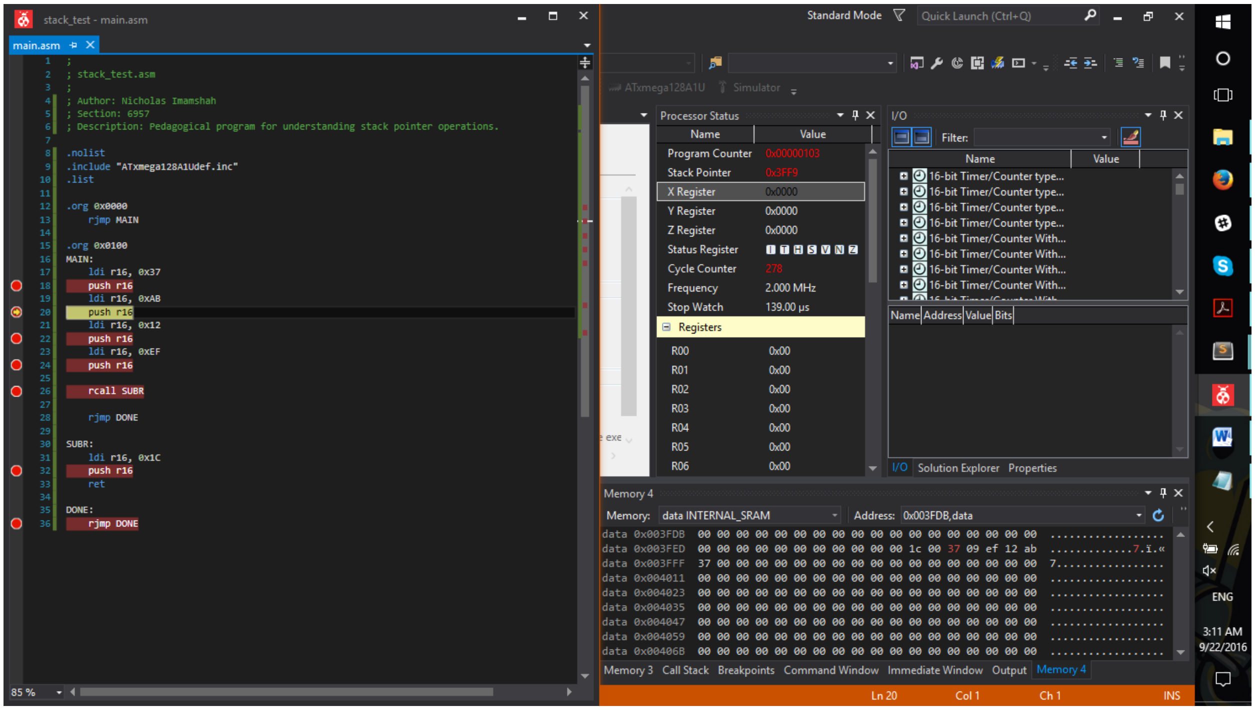
Memory 4

Memory: data INTERNAL_SRAM Address: 0x003FDB,data

```
data 0x003FDB  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x003FED  00 00 00 00 00 00 00 00 00 00 00 1c 00 01 09 ef 12 ab  ...............ï.«
data 0x003FFF  37 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  7.................
data 0x004011  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004023  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004035  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004047  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004059  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x00406B  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
```

main.asm
Standard Mode
Quick Launch (Ctrl+Q)
I/O
Filter:
Name
Value
16-bit Timer/Counter type...
16-bit Timer/Counter With...
File Edit Format View Help
Memory 3 Call Stack Breakpoints Command Window Immediate Window Output Memory 4
Ln 18 Col 1 Ch 1 INS
85 %
ENG
3:09 AM
9/22/2016

Initial return from subroutine



```
;
; stack_test.asm
;
; Author: Nicholas Imamshah
; Section: 6957
; Description: Pedagogical program for understanding stack pointer operations.

.nolist
.include "ATxmega128A1Udef.inc"
.list

.org 0x0000
	rjmp MAIN

.org 0x0100
MAIN:
	ldi r16, 0x37
	push r16
	ldi r16, 0xAB
	push r16
	ldi r16, 0x12
	push r16
	ldi r16, 0xEF
	push r16

	rcall SUBR

	rjmp DONE

SUBR:
	ldi r16, 0x1C
	push r16
	ret

DONE:
	rjmp DONE
```

Processor Status

Name	Value
Program Counter	0x00000103
Stack Pointer	0x3FF9
X Register	0x0000
Y Register	0x0000
Z Register	0x0000
Status Register	I T H S V N Z
Cycle Counter	278
Frequency	2.000 MHz
Stop Watch	139.00 µs
Registers	
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00

Memory 4

Memory: data INTERNAL_SRAM Address: 0x003FDB,data

```
data 0x003FDB  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x003FED  00 00 00 00 00 00 00 00 00 00 00 1c 00 37 09 ef 12 ab  .............7.ï.«
data 0x003FFF  37 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  7.................
data 0x004011  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004023  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004035  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004047  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x004059  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
data 0x00406B  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..................
```

Ln 20 Col 1 Ch 1 INS

First push to stack after return

```
;
; stack_test.asm
;
; Author: Nicholas Imamshah
; Section: 6957
; Description: Pedagogical program for understanding stack pointer operations.

.nolist
.include "ATxmega128A1Udef.inc"
.list

.org 0x0000
        rjmp MAIN

.org 0x0100
MAIN:
        ldi r16, 0x37
        push r16
        ldi r16, 0xAB
        push r16
        ldi r16, 0x12
        push r16
        ldi r16, 0xEF
        push r16

        rcall SUBR

        rjmp DONE

SUBR:
        ldi r16, 0x1C
        push r16
        ret
```

```
DONE:
        rjmp DONE
```

Address	Data
0x3FF8	0x1C
0x3FF9	0x00
0x3FFA	0x01
0x3FFB	0x09
0x3FFC	0xEF
0x3FFD	0x12
0x3FFE	0xAB
0x3FFF	0x37

Before return

Instead of using 0x0109 as return address, it uses 0x0001, but the code segment is .org’d to 0x0100; so it instead returns to 0x0101.