REQUIREMENTS NOT MET

N/A. All requirements are met in this lab.

PROBLEMS ENCOUNTERED

For the homework 1, I did not encounter a problem when installing Atmel Studio but some issues did occur in the "Creating, Simulating, and Emulating in Atmel Studio" guide. One of the problems encountered, was in compiling the assembly code given where errors occurred. This was solved with me manually typing out the code rather than copying and pasting it, causing bits to randomly disappear or get corrupted. There were also issues in finding the buttons and shortcuts mentation in the guide as my toolbar was not initially installed so I had to manually bring up the toolbar and each of its components. This was not difficult but took some time to do. The final problem was that the processor status was not showing which through playing around in Atmel Studio, it was discovered that it appears when debugging is active and vanishes when its not.

HOMEWORK EXERCISES

1.1. Download and install Atmel Studio by following the aforementioned guide.

Seen being used in the screenshots below.

2.1. Obtain a screen shot from your computer of the results of step 12 (the simulation), also including your name in big letters on the same screen.

See appendix screenshot 2.1.

2.2. Obtain a screen shot from your computer of the results of step 14 (the emulation), again including your name in big letters on the same screen.

See appendix screenshot 2.2.

PSEUDOCODE/FLOWCHARTS

SECTION X (1, 2, etc.)

N/A. Code is given and written by Dr. Schwartz.

PROGRAM CODE

SECTION X (1, 2, etc.)

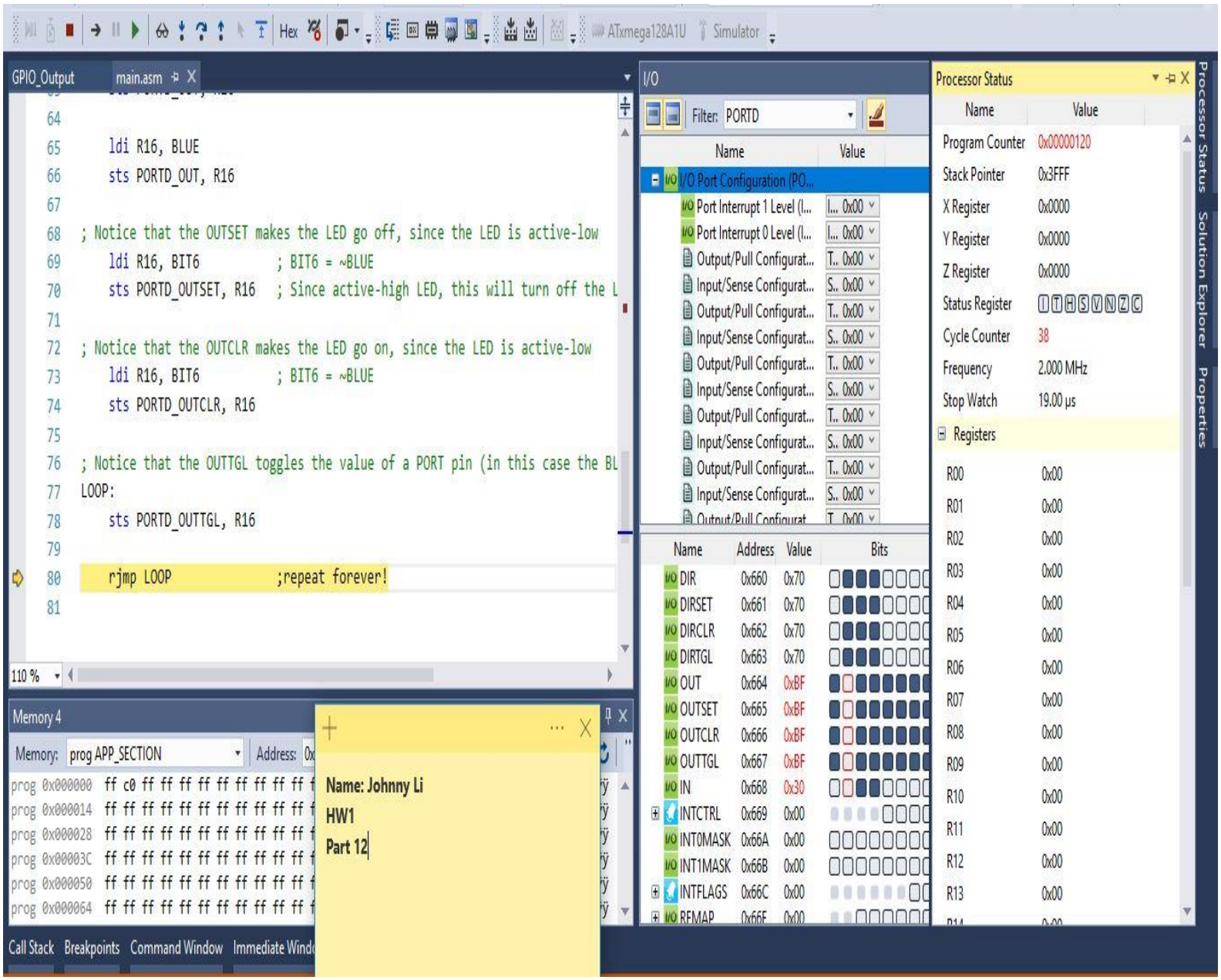
Code is given and written by Dr. Schwartz.

Section 2:

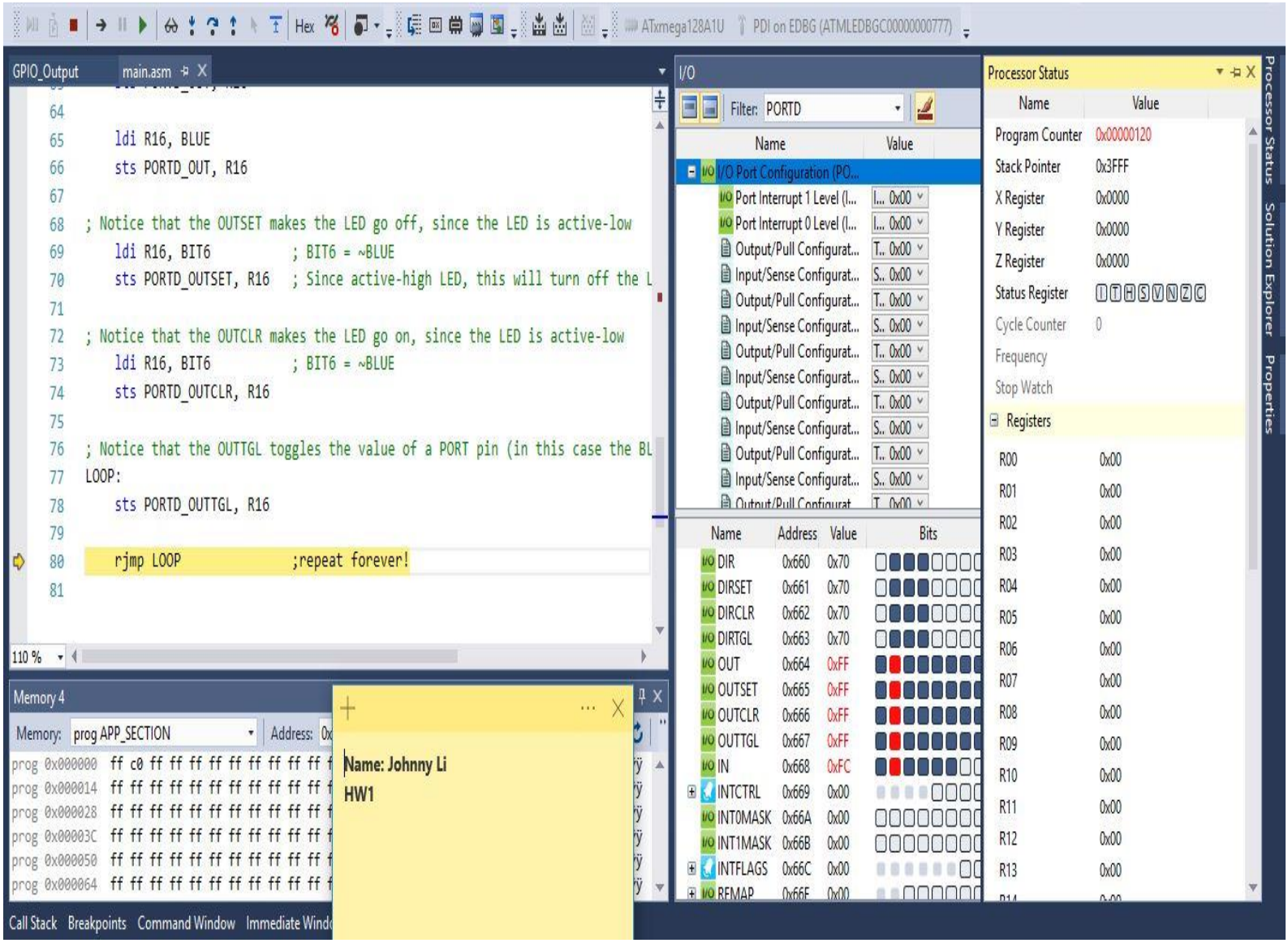
```
/****
 * GPIO_Output.asm
 *
 *  Modified: 22 May 19
 *  Author: Dr. Schwartz

 This program shows how to initialize a GPIO port on the Atmel
 (Port D for this example) and demonstrates various ways to write to
 a GPIO port.  The output will blink LEDs at the bottom left of the
 uPAD, labeled D4. PortD4, PortD5, and PortD6 are the red, green,
 and blue LEDs, respectively.  Note that these LEDs are active-low.
****/

;Definitions for all the registers in the processor. ALWAYS REQUIRED.
;View the contents of this file in the Processor "Solution Explorer"
;   window under "Dependencies"
.include "ATxmega128A1Udef.inc"

.equ    BIT4 = 0b00010000
.equ    INV4 = 0b11101111
.equ    RED = INV4
.equ    BIT5 = 0b00100000
.equ    INV5 = ~BIT5
.equ    GREEN = ~(BIT5)
.equ    BIT6 = 0x40
.equ    BLUE = ~(BIT6)
.equ    BIT456 = 0x70
.equ    WHITE = ~(BIT456)
.equ    BIT64 = 0x50
.equ    PINK = ~(BIT64)
.equ    BLACK = 0xFF

.ORG 0x0000                             ;Code starts running from address 0x0000.
        rjmp MAIN                       ;Relative jump to start of program.

.ORG 0x0100                             ;Start program at 0x0100 so we don't overwrite
                                                ;  vectors that are at 0x0000-0x00FD
MAIN:
; initialize the data direction of the three LEDs as outputs (PD4-6)
        ldi R16, BIT456
        sts PORTD_DIRSET, R16
; Notice that the 3 LEDs (RED, GREEN, and BLUE) are all now on, creating white

; The following code shows different ways to write to the GPIO pins.

; Turn on each of the primary colored LEDs in turn, then use some combinations
        ; These instructions sends the value in R16 to the PORTD pins.
        ; Since the LEDs are wired as active-low, an R16 = RED = 0xFE = 0b1111 1110
        ; will turn the RED LED on.
```

```
        ldi     R16, RED
        sts PORTD_OUT, R16              ;send the value in R16 to the PORTD pins

        ldi     R16, GREEN
        sts PORTD_OUT, R16
        ldi     R16, BLUE
        sts PORTD_OUT, R16
        ldi     R16, WHITE
        sts PORTD_OUT, R16
        ldi     R16, PINK
        sts PORTD_OUT, R16

        ldi     R16, BLACK
        sts PORTD_OUT, R16

        ldi     R16, BLUE
        sts PORTD_OUT, R16

; Notice that the OUTSET makes the LED go off, since the LED is active-low
        ldi     R16, BIT6                       ; BIT6 = ~BLUE
        sts PORTD_OUTSET, R16    ; Since active-high LED, this will turn off the LED

; Notice that the OUTCLR makes the LED go on, since the LED is active-low
        ldi     R16, BIT6                       ; BIT6 = ~BLUE
        sts PORTD_OUTCLR, R16

; Notice that the OUTTGL toggles the value of a PORT pin (in this case the BLUE LED)
LOOP:
        sts PORTD_OUTTGL, R16

        rjmp LOOP                               ;repeat forever!
```

APPENDIX



2.1: Screenshot of part 12.



2.2: Screenshot of part 14