ECE 375 Prelab 5

**Lab Time: Friday 16:00 ~ 17:50**

Hyunjae Kim

# Questions

1. For this lab, you will be asked to perform arithmetic operations on numbers that are larger than 8 bits. To be successful at this, you will need to understand and utilize many of the various arithmetic operations supported by the AVR 8-bit instruction set. List and describe all of the addition, subtraction, and multiplication instructions (i.e. ADC, SUBI, FMUL, etc.) available in AVR’s 8-bit instruction set.

(a) Add

* ADC – Add with Carry
* ADD – Add without Carry
* ADIW – Add immediate to word

(b)Subtraction

* SBC – Subtract with carry
* SBCI – Subtract immediate with carry
* SBIW – Subtract immediate from word
* SUB – Subtract without carry
* SUBI – Subtract immediate

(c)Multiplication

* MUL – Multiply unsigned
* MULS – Multiply signed
* MULSU – Multiply signed with unsigned
* FMUL – Fractional multiply unsigned
* FMULS – Fractional multiply signed
* FMULSU – Fractional multiply signed with unsigned

2. Write pseudocode for an 8-bit AVR function that will take two 16-bit numbers (from data memory addresses $0111:$0110 and $0121:$0120), add them together, and then store the 16-bit result (in data memory addresses $0101:$0100). (Note: The syntax “$0111:$0110” is meant to specify that the function will expect little-endian data, where the highest byte of a multi-byte value is stored in the highest address of its range of addresses.)

LDI XH, $01

LDI XL, $10

LDI YH, $01

LDI YL, $20

LD r15, X+

LD r16, Y+

ADD r15, 16

STS $0100, r15

LDI r15, X

LDI r16, Y

ADC r15, r16

STS $0101, r15

3. Write pseudocode for an 8-bit AVR function that will take the 16-bit number in $0111:$0110, subtract it from the 16-bit number in $0121:$0120, and then store the 16-bit result into $0101:$0100.

LDI XH, $01

LDI XL, $10

LDI YH, $01

LDI YL, $20

LD r15, X+

LD r16, Y+

SUB r16, r15

STS $0100, r16

LDI r15, X

LDI r16, Y

SBC r16, r15

STS $0101, r16

# Reference

[AVR Instruction Set Manual](http://ww1.microchip.com/downloads/en/devicedoc/atmel-0856-avr-instruction-set-manual.pdf)