Homework 9

**1. Decode the following AVR binary code located in the program memory.  What are the registers involved?  What are their values before and after the program finishes? You will need to pay attention to the endianess of the coding. (The dashes are not part of the code but are added to increase readability)**

Starting program memory address is 0x0100

**LOW BYTE** | **HIGH BYTE**

0x0100:           0010-0001-1110-0000

0x0101:           0011-0001-1110-0000

0x0102:           0100-1000-1110-0000

0x0103:           0011-0010-0000-1111

0x0104:           0010-0011-0010-1111

0x0105:           0100-1010-1001-0101

0x0106:           1110-0001-1111-0111

LDI R18, 1

LDI R19, 1

LDI R20, 8

L1: ADD R19, R18

MOV R18, R19

DEC R20

BRNE L1

Registers used are R18, R19, R20

At the beginning of the program R18 = 1, R19 = 1, R20 = 0

By the end of the program all registers = 0.

**2. Indicate the value loaded into R30, R31, and R20 in the following program:**

             .ORG 0x0

                        LDI R30, LO8(OUR\_DATA << 1)

                        LDI R31, HI8(OUR\_DATA << 1)

                        LPM  R20, Z

            .ORG 0x0525

            OUR\_DATA: .DB 20, ‘$’, ‘5’

R31 = 0x0A

R30 = 0x4A

R20 = 0x25

**3. Write a program to read the following message from program ROM and place it in data RAM starting at 0x200:**

.ORG 0 ; put in rom start at 0x0000

LDI ZL, lo8(MYDATA<<1) ; low-byte address of mydata

LDI ZH, hi8(MYDATA<<1) ; high-byte address of mydata

LDI XL, lo8(0x200) ; low-byte ram address

LDI XH, h8(0x200) ; high-byte ram address

AGAIN: LPM R16, Z+ ; read value from rom, then inc

CPI R16, 0 ; compare r16 with 0

BREQ END ; branch if is 0

ST X+, R16 ; store value, then inc

RJMP AGAIN ; keep reading until 0 is reached

END: RJMP END

.ORG 0x0500

MYDATA: .DB “Will artificial intelligence rule human?”,0

**4. Write a program that calculates the checksum of the values at location 0x00D5 to 0x0300 of EEPROM.**

WAIT: SBIC EECR, EEWE

RJMP WAIT

LDI R18, lo8(0x00D5)

LDI R19, hi8(0x00D5

OUT EEARH, R18

OUT EEARL, R19

SBI EECR, EERE

IN R20, EEDR

LDI R18, lo8(0x0300)

LDI R19, hi8(0x0300)

OUT EEARH, R18

OUT EEARL, R19

IN R21, EEDR

ADD R20, R21

NEG R20

**5. In each of the following cases perform checksum calculation to see if data is corrupted or not.**

(a) Data=$62, $F3, and $15; checksum=$72

Corrupted

(b) Data=$50, $88, $3C, and $8E; checksum=$6D

Corrupted

(c) Data=0, 0, 0, 0, 0, 0; checksum=0

No evidence for corruption

(d) Data=1, -1,1, -1,1, -1; checksum=1

Corrupted