Homework 7

1. The CALL and RET instruction.

1. How many bytes do CALL and RET instructions each have?

* CALL is 4 bytes and RET is 2 bytes.

1. With each CALL instruction, is the stack pointer incremented or decremented, and by how much?

* It is incremented by 1.

1. With each RET instruction, is the stack pointer incremented or decremented, and by how much?

- It is decremented by 1.

2. Convert the following assembly code to binary by hand using the instruction table in the end of the 273 booklet. You must use the little endian in representing the low and high bytes at each program memory location.

FUN: LDI R16, 200 ------------------🡪

LDI R19, 15 -------------------🡪

BACK: LDI R18, 25 ------------------🡪

SUB R19, R18 ----------------🡪

HERE: NOP --------------------🡪

DEC R18 ----------------------🡪

INC R19 ----------------------🡪

BRNE HERE --------------------🡪

DEC R16 ----------------------🡪

BRNE BACK --------------------🡪

RET ------------------------------🡪

1110 1100 0000 1000

1110 0000 0011 1111

1110 0001 0010 1001

0001 1011 0011 0010

0000 0000 0000 0000

1001 0101 0010 1010

1001 0101 0011 0011

1111 01

1001 0101 0000 1010

1. 01

1001 0101 0000 1000

3. Find the time delay of the above program if the system has an AVR with a frequency of 16MHz.

* FUN: LDI R16, 200 ; 1

LDI R19, 15 ; 1 \* 200

BACK: LDI R18, 25 ; 1 \* 200 \* 15

SUB R19, R18 ; 1 \* 200 \* 15

HERE: NOP ; 1 \* 200 \* 15

DEC R18 ; 1 \* 200 \* 15

INC R19 ; 1 \* 200 \* 15

BRNE HERE ; ½ 200 \* (1\*1 + 2\*14)

DEC R16 ; 1 \* 200

BRNE BACK ; ½ (1\*1 + 2\*199)

RET ; 4 \* 200

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22,399 \* 1/16,000,000

= 1.4 milliseconds