EE2016 Microprocessors Theory and Lab

Tutorial 3 (Classes on 12 & 13 of Aug. 2019)

July-Nov 2019, EE Dept, IIT Madras.

1 Fill in the blanks

1. What are all the (most common) different addressing schemes used in microprocessors or microcontrollers?
2. What is the advantages and disadvantages of indirect addressing scheme?
3. How is indirect addressing (IA) scheme implemented in Atmel's AVR family of microcontrollers? (Hint: What are X, Y & Z registers in the context of GPRs in AVR?)
4. What is the OP code CMP in QEEE means? The equivalent OP code in AVR is CP. What does the instruction CP Rd, Rs does to registers Rd and Rs? How many cycles, does it take?
5. What kind of the address does the OP code LDI belong to?

2 Problems

1. The assembly program was a slight modification of the first (AVR) assembly program (in slides) you have learnt in this course

   (a) LDI R0, 40;
   (b) LDI R1, 50;
   (c) ADD R0, R1;
   (d) BRCS LDR5W1;
   (e) LDI R5, 0;
   (f) JMP EXIT;
   (g) LDIR5W1: LDI R5, 1;
   (h) EXIT: NOP

   Now, answer the following:

   (a) What if the line (f) is not there?
   (b) What are the values of flag bits immediately after instruction (d)?
   (c) What is the values of function lines during instruction (c)?

2. Consider the following program (corresponding to QEEE) which is an example of IA scheme and illustrates its power.

   (a) LOAD R4, 11;
   (b) LOAD R5, 20;
   (c) LOAD R0, 0;
   (d) MOVI R1, R(R4);

(e) ADD R0, R1;

(f) MOV R0, R2;

(g) INR R4;

(h) CMP R4, R5;

(i) if flag ON stop;

(j) JUMP (d)

The above program could be rewritten for AVR as below:

(a) LDI R16, 11;

(b) LDI R17, 20;

(c) LDI R18, 0;

(d) LDI XL, R16;

(e) LDI XH, 0x00;

(f) LOOP: LD R19, X+;

(g) ADD R18, R19;

(h) CP X, R17;

(i) BRNE LOOP;

(j) NOP

Now answer the following

(a) What is the Indirect Address Register (IAR) implemented in the QEEE processor? Is it a pointer register?

(b) What is the analogous pointer register which is used in above AVR program?

(c) What is the maximum value of X when the execution reaches NOP?

(d) What does the program do?