Problem:

The hypothetical machine of Figure 3.4 also has two I/O instructions:

        0011 = Load AC from I/O

        0111 = Store AC to I/O

In these cases, the 12-bit address identifies a particular I/O device. Show the program execution (using the format of Figure 3.5) for the following program:

1. Load AC from device 5
2. Add contents of memory location 940
3. Store AC to device 6.

0	3	4	15
Opcode		Address	

(a) Instruction format

0	1	15
	Magnitude	

(b) Integer format

Program counter (PC) = Address of instruction
Instruction register (IR) = Instruction being executed
Accumulator (AC) = Temporary storage

(c) Internal CPU registers

0001 = Load AC from memory
0010 = Store AC to memory
0101 = Add to AC from memory

(d) Partial list of opcodes
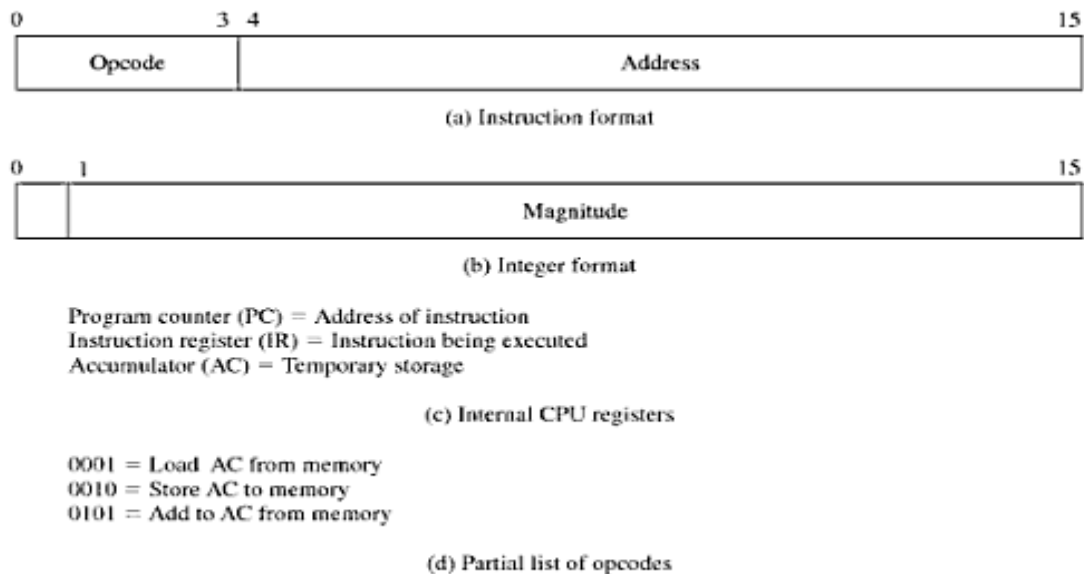
Figure 3.4 Characteristics of a Hypothetical Machine

From Stallings-Computer Organization and Architecture, 8th Edition, Pearson Inc

Solutions:

Assume that the next value retrieved from device 5 is 3 and that location 940 contains a value of 2.

STEP1

Memory		CPU Registers	
300	3 0 0 5	3 0 0	PC
301	5 9 4 0		AC
302	7 0 0 6	3 0 0 5	IR
	:		I/O devices
940	0 0 0 2	0 0 5	0 0 0 3
941		0 0 6	

STEP2   *Memory*   *CPU Registers*

300	3 0 0 5
301	5 9 4 0
302	7 0 0 6

3 0 1	PC
0 0 0 3	AC
3 0 0 5	IR

I/O devices

:

940	0 0 0 2
941	

0 0 5	0 0 0 3
0 0 6	

STEP3   *Memory*   *CPU Registers*

300	3 0 0 5
301	5 9 4 0
302	7 0 0 6

3 0 1	PC
0 0 0 3	AC
5 9 4 0	IR

I/O devices

:

940	0 0 0 2
941	

0 0 5	0 0 0 3
0 0 6	

STEP4   *Memory*   *CPU Registers*

300	3 0 0 5
301	5 9 4 0
302	7 0 0 6

3 0 2	PC
0 0 0 5	AC
5 9 4 0	IR

I/O devices

:

940	0 0 0 2
941	

0 0 5	0 0 0 3
0 0 6	

STEP5   *Memory*   *CPU Registers*

300	3 0 0 5
301	5 9 4 0
302	7 0 0 6

3 0 2	PC
0 0 0 5	AC
7 0 0 6	IR

I/O devices

:

940	0 0 0 2
941	

0 0 5	0 0 0 3
0 0 6	

STEP6   *Memory*   *CPU Registers*

300	3 0 0 5
301	5 9 4 0
302	7 0 0 6

3 0 3	PC
0 0 0 5	AC
7 0 0 6	IR

I/O devices

:

940	0 0 0 2
941	

0 0 5	0 0 0 3
0 0 6	0 0 0 5