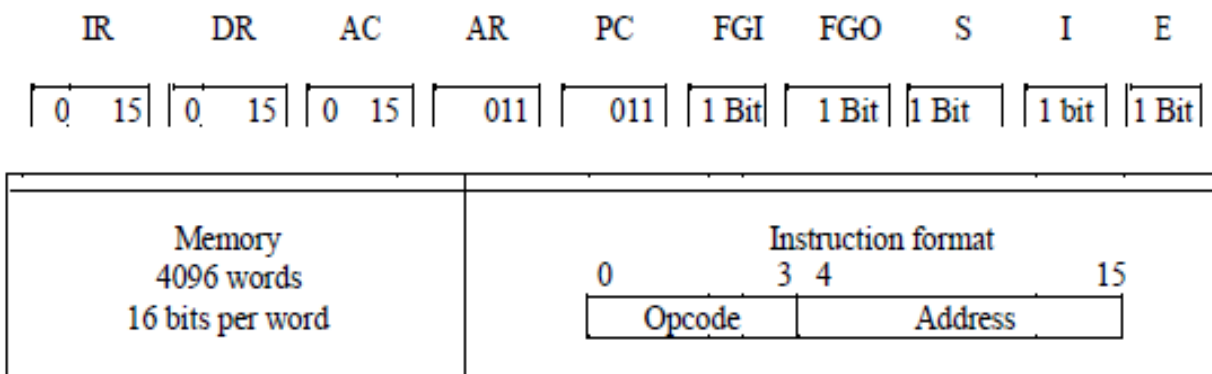


LAB : Computer System Architecture Practical

1. Create a machine based on the following architecture: Register Set



Basic Computer Instructions

Memory Reference		Register Reference		Input-Output	
Symbol	Hex	Symbol	Hex	Symbol	Hex
AND	0xxx	CLA	E800	INP	F80 0
ADD	2xxx	CLE	E400	OUT	F40 0
LDA	4xxx	CMA	E200	SKI	F20 0
STA	6xxx	CME	E100	SKO	F10 0
BUN	8xxx	CIR	E080	ION	F08 0
BSA	Axxx	CIL	E040	IOF	F04 0
ISZ	Cxxx	INC	E020		
AND I	1xxx	SPA	E010		
ADD I	3xxx	SNA	E008		
LDA I	5xxx	SZA	E004		
STA I	7xxx	SZE	E002		
BUN I	9xxx	HLT	E001		
BSA I	Bxxx				
ISZ I	Dxxx				

Optional

Refer to Chapter-5 of Morris Mano for description of instructions.

2. Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.

3. Create a Fetch routine of the instruction cycle.

4. Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

- | | | |
|--------|--------|--------|
| a. CLA | e. CIR | i. SNA |
| b. CLE | f. CIL | j. SZA |
| c. CMA | g. INC | k. SZE |
| d. CME | h. SPA | l. HLT |

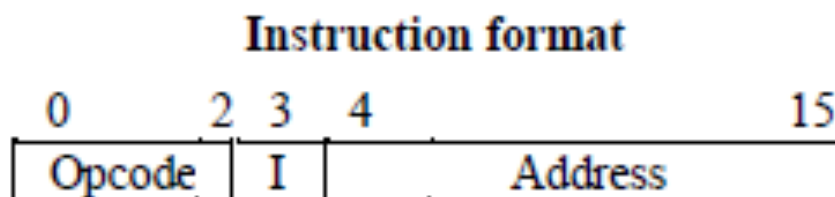
Initialize the contents of AC to $(A937)_{16}$, that of PC to $(022)_{16}$ and E to 1.

5. Simulate the machine for the following memory-reference instructions with $I = 0$ and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

- | | |
|--------|--------|
| a. ADD | f. BSA |
| b. AND | g. ISZ |
| c. LDA | |
| d. STA | |
| e. BUN | |

6. Simulate the machine for the memory-reference instructions referred in above question with $I = 1$ and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

7. Modify the machine created in Practical 1 according to the following instruction format:



- a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12-bit address. There are only two addressing modes, $I = 0$ (direct addressing) and $I = 1$ (indirect addressing).
- b. Create a new register I of 1 bit.
- c. Create two new microinstructions as follows :
 - i. Check the opcode of instruction to determine type of instruction (Memory Reference/ Register Reference/Input-Output) and then jump accordingly.
 - ii. Check the I bit to determine the addressing mode and then jump accordingly.