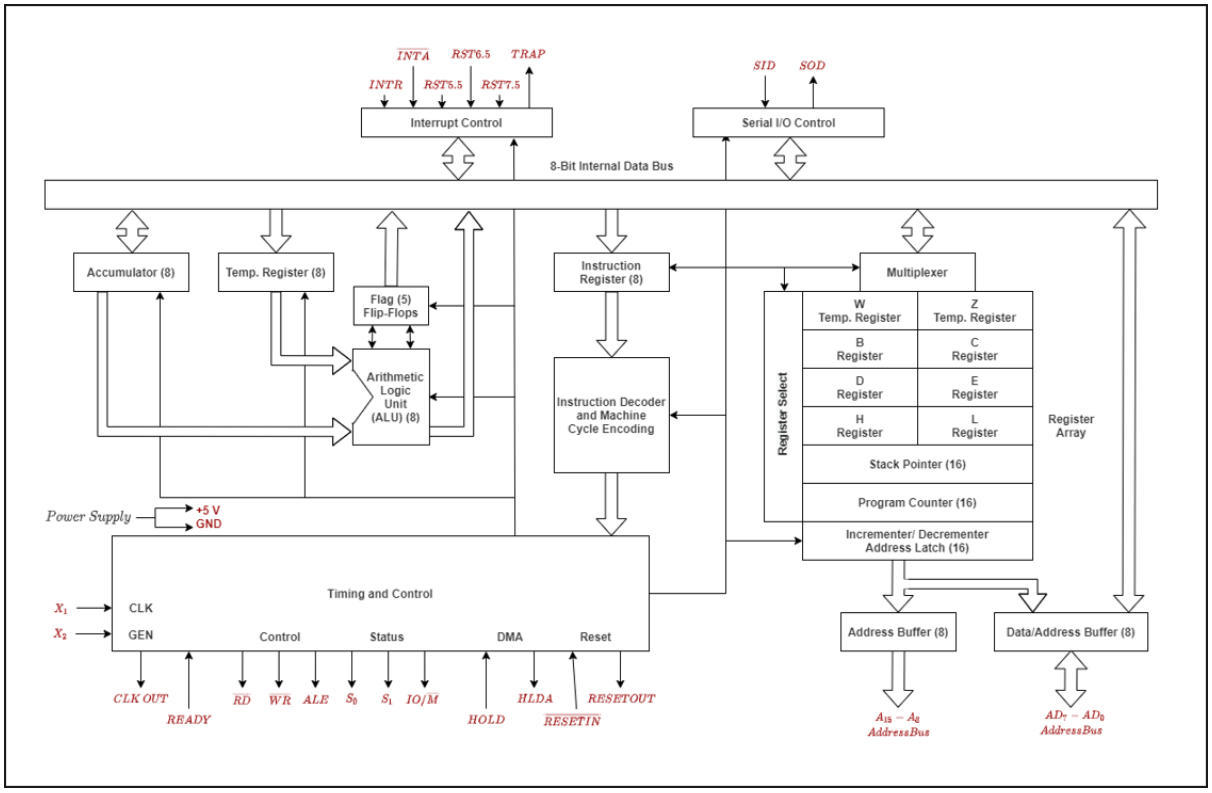
Practical-6

Aim: Study of 8085 Microprocessor Architecture. (Including types of instruction, addressing modes, flag register)

What is the 8085 Microprocessor?

- The 8085 is an 8-bit microprocessor, and it was launched by the Intel team in the year of 1976 with the help of NMOS technology.
- This processor is the updated version of the microprocessor. The configurations of 8085 microprocessor mainly include data bus-8-bit, address bus-16 bit, program counter-16-bit, stack pointer-16 bit, registers 8-bit, +5V voltage supply, and operates at 3.2 MHz single segment CLK.
- The applications of 8085 microprocessor are involved in microwave ovens, washing machines, gadgets, etc.

Architecture:



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Types of instruction:

1. **Control Instructions**: These instructions are mainly used to control the microprocessor operations.

Opcode	Meaning
NOP	No operation
HLT	Halt and enter wait state
DI	Disable interrupts
EI	Enable interrupts
RIM	Read interrupt mask
SIM	Set interrupt mask

2. **Logical Instructions:** Logical instructions are mainly used to perform different operations like logical or Boolean over the data available in either memory or register. These instructions will modify the flag bits based on the operation executed.

Opcode	Meaning
CMP	Compare the register or memory with the accumulator
CPI	Compare immediate with the accumulator
ANA	Logical AND register or memory with the accumulator
ANI	Logical AND immediate with the accumulator
XRA	Exclusive OR register or memory with the accumulator
XRI	Exclusive OR immediate with the accumulator
ORA	Logical OR register or memory with the accumulator
ORI	Logical OR immediate with the accumulator
RLC	Rotate the accumulator left
RRC	Rotate the accumulator right
RAL	Rotate the accumulator left through carry
RAR	Rotate the accumulator right through carry
CMA	Complement accumulator
CMC	Complement carry
STC	Set Carry

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3. **Branching Instructions:** These types of instructions are mainly used to transfer or switch the microprocessor from one location to another. So, it simply changes the general sequential flow.

<table>
<tr><th>Opcode</th><th>Meaning</th></tr>
<tr><td>JMP</td><td>Jump unconditionally</td></tr>
<tr><td>
<table>
<tr><th>Opcode</th><th>Description</th><th>Flag Status</th></tr>
<tr><td>JC</td><td>Jump on Carry</td><td>CY=1</td></tr>
<tr><td>JNC</td><td>Jump on no Carry</td><td>CY=0</td></tr>
<tr><td>JP</td><td>Jump on positive</td><td>S=0</td></tr>
<tr><td>JM</td><td>Jump on minus</td><td>S=1</td></tr>
<tr><td>JZ</td><td>Jump on zero</td><td>Z=1</td></tr>
<tr><td>JNZ</td><td>Jump on no zero</td><td>Z=0</td></tr>
<tr><td>JPE</td><td>Jump on parity even</td><td>P=1</td></tr>
<tr><td>JPO</td><td>Jump on parity odd</td><td>P=0</td></tr>
</table>
</td><td>Jump conditionally</td></tr>
<tr><td>
<table>
<tr><th>Opcode</th><th>Description</th><th>Flag Status</th></tr>
<tr><td>CC</td><td>Call on Carry</td><td>CY=1</td></tr>
<tr><td>CNC</td><td>Call on no Carry</td><td>CY=0</td></tr>
<tr><td>CP</td><td>Call on positive</td><td>S=0</td></tr>
<tr><td>CM</td><td>Call on minus</td><td>S=1</td></tr>
<tr><td>CZ</td><td>Call on zero</td><td>Z=1</td></tr>
<tr><td>CNZ</td><td>Call on no zero</td><td>Z=0</td></tr>
<tr><td>CPE</td><td>Call on parity even</td><td>P=1</td></tr>
<tr><td>CPO</td><td>Call on parity odd</td><td>P=0</td></tr>
</table>
</td><td>Unconditional subroutine call</td></tr>
<tr><td>RET</td><td>Return from subroutine unconditionally</td></tr>
<tr><td>
<table>
<tr><th>Opcode</th><th>Description</th><th>Flag Status</th></tr>
<tr><td>RC</td><td>Return on Carry</td><td>CY=1</td></tr>
</table>
</td><td>Return from subroutine conditionally</td></tr>
</table>

RNC	Return on no Carry	CY=0	
RP	Return on positive	S=0	
RM	Return on minus	S=1	
RZ	Return on zero	Z=1	
RNZ	Return on no zero	Z=0	
RPE	Return on parity even	P=1	
RPO	Return on parity odd	P=0	
PCHL			Load the program counter with HL contents
RST			Restart

4. **Arithmetic Instructions:** The arithmetic instructions perform different operations like addition, subtraction, increment & decrement on the data within memory & register in the 8085 microprocessor.

Opcode	Meaning
ADD	Add register or memory, to the accumulator
ADC	Add register to the accumulator with carry
ADI	Add the immediate to the accumulator
ACI	Add the immediate to the accumulator with carry
LXI	Load the register pair immediate
DAD	Add the register pair to H and L registers
SUB	Subtract the register or the memory from the accumulator
SBB	Subtract the source and borrow from the accumulator
SUI	Subtract the immediate from the accumulator
XCHG	Exchange H and L with D and E
INR	Increment the register or the memory by 1
INX	Increment register pair by 1
DCR	Decrement the register or the memory by 1
DCX	Decrement the register pair by 1
DAA	Decimal adjust accumulator

5. **Data-transfer Instructions**: An instruction that is used to transfer the data from one register to another is known as data transfer instruction. So, the data transfer can be done from source to destination without changing the source contents. Data transfer mainly occurs from one register to another register, from memory location to register, register to memory, and between an I/O device & accumulator.

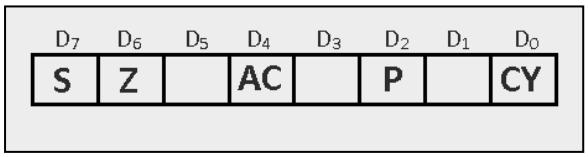
Opcode	Meaning
MOV	Copy from the source (Sc) to the destination(Dt)
MVI	Move immediate 8-bit
LDA	Load the accumulator
LDAX	Load the accumulator indirect
LXI	Load the register pair immediate
LHLD	Load H and L registers direct
STA	16-bit address
STAX	Store the accumulator indirect
SHLD	Store H and L registers direct
XCHG	Exchange H and L with D and E
SPHL	Copy H and L registers to the stack pointer
XTHL	Exchange H and L with top of stack
PUSH	Push the register pair onto the stack
POP	Pop off stack to the register pair
OUT	Output the data from the accumulator to a port with 8bit address
IN	Input data to accumulator from a port with 8-bit address

Addressing Mode

Each instruction requires some data on which it has to operate. There are different techniques to specify data for instructions. These techniques are called addressing modes.

Direct Addressing: In this addressing mode, the address of the operand (data) is given in the instruction itself.
Register Addressing: In register addressing mode, the operand is in one of the general purpose registers. The opcode specifies the address of the register(s) in addition to the operation to be performed.
Register Indirect Addressing: In Register Indirect mode of addressing, the address of the operand is specified by a register pair.
Immediate Addressing: In this addressing mode, the operand is specified within the instruction itself.
Implicit Addressing: There are certain instructions which operate on the content of the accumulator. Such instructions do not require the address of the operand.

Flag Register: The Flag register is a Special Purpose Register. Depending upon the value of the result after any arithmetic and logical operation, the flag bits become set (1) or reset (0). In 8085 microprocessor, the flag register consists of 8 bits and only 5 of them are useful.



Sign flag (S):- The Sign flag is set if D7 bit is negative otherwise 0 reset.
Zero flag (Z):- The Zero flag is set if result of ALU operation is zero. Otherwise reset.
Auxiliary Carry (AC):- This flag is set when a carry is generated from bit D3 and passed to D4.
Parity flag (P):- After an ALU operation is the result has an even number of 1's the Parity flag is set. Otherwise reset.
Carry flag (CY):- Carry flag is set when result generates a carry. Otherwise reset.

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