REGISTERS

What is a register?

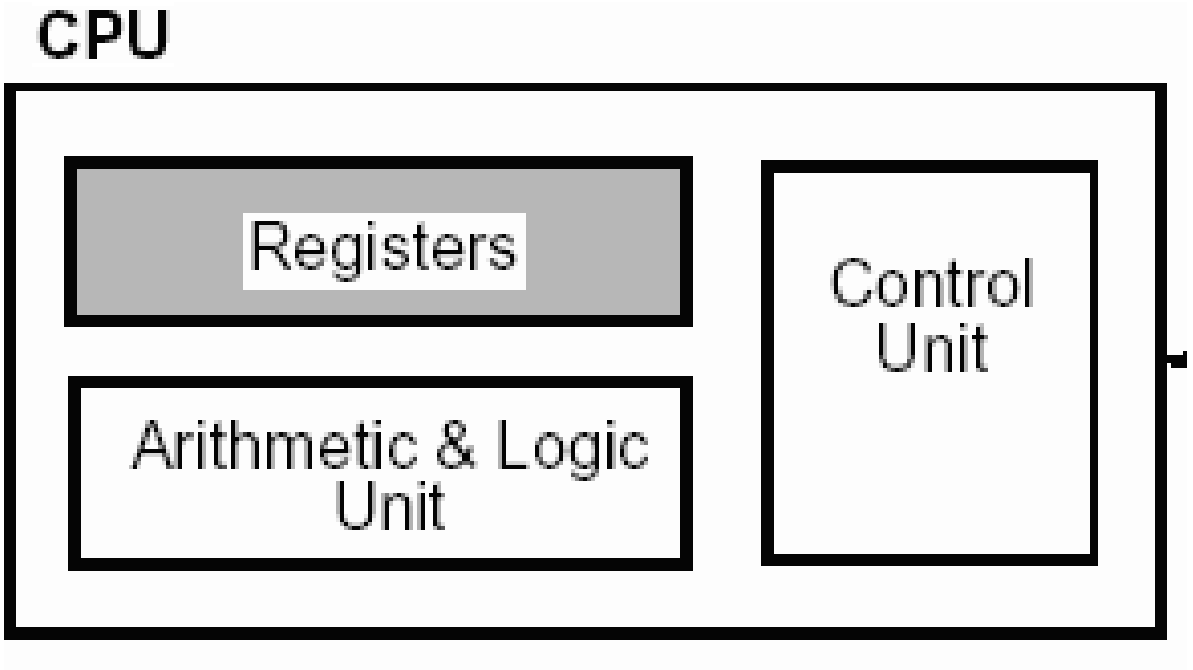
A **register** is one of a small set of data holding places that are part of a computer processor . A **register** may hold :

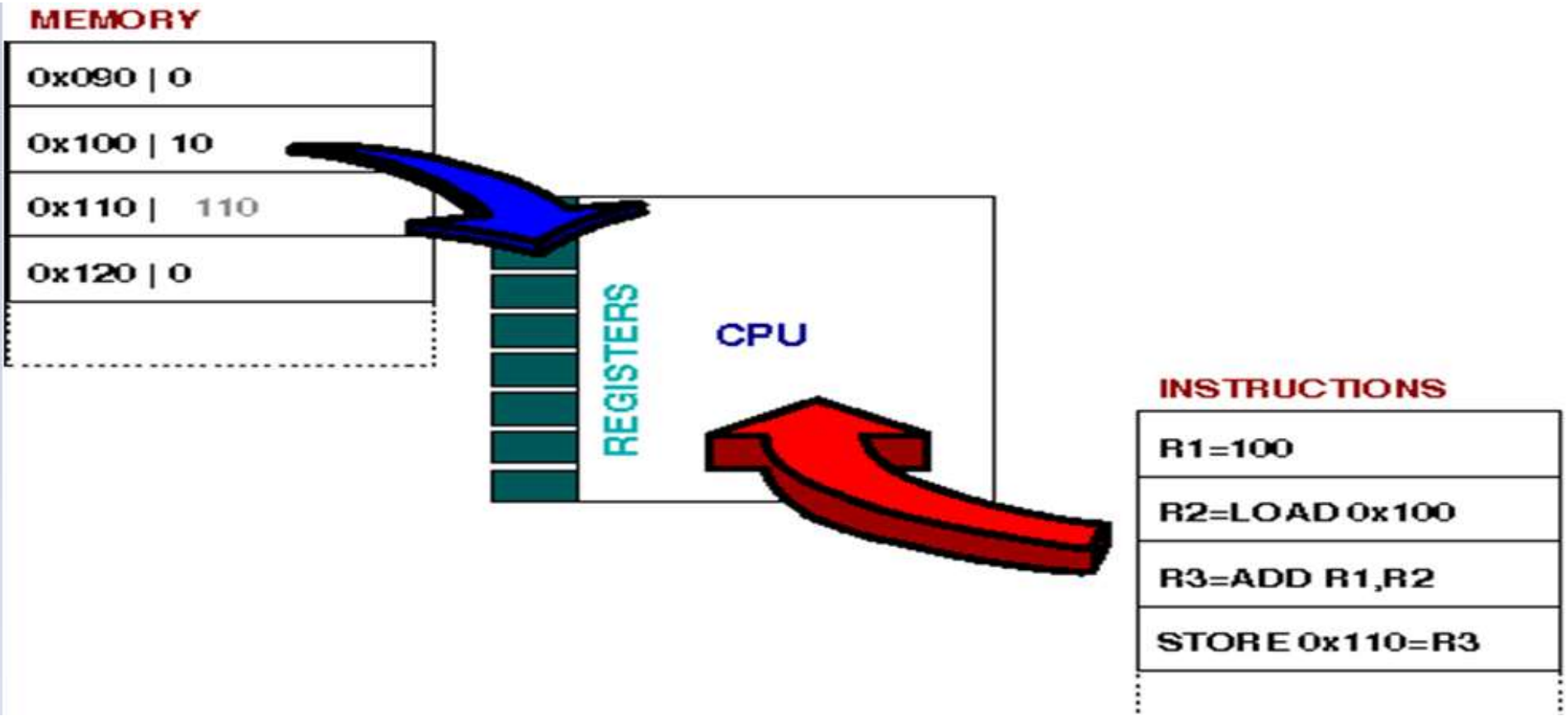
- a computer instruction
- a storage address
- or any kind of data (such as a bit sequence or individual characters)

About Registers

- Rarely more than 64 registers in number
- Small in size
- Typically a register is less than 64 bits in size

Registers Location




MEMORY
0x090 | 0
0x100 | 10
0x110 | 110
0x120 | 0
REGISTERS
CPU
INSTRUCTIONS
R1=100
R2=LOAD 0x100
R3=ADD R1,R2
STORE 0x110=R3

Performance

Registers Perform :

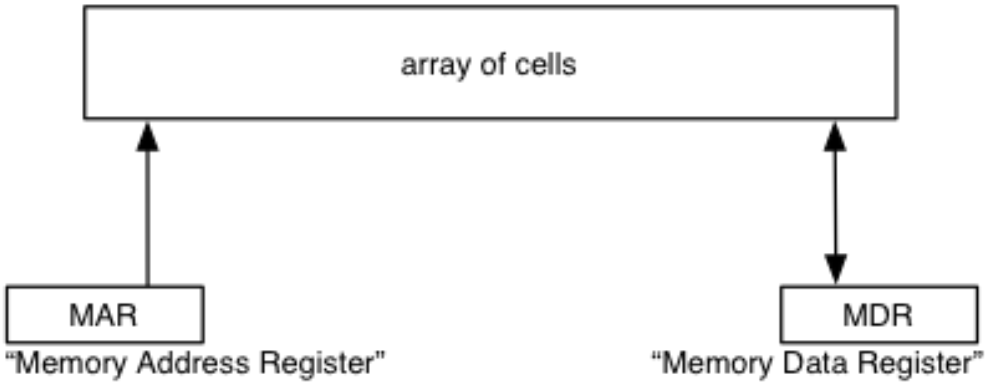
- **Fetch**
- **Decode**
- **Execute**

Types of Registers:
1. Memory Address Register (MAR)

- Holds the memory addresses of data and instructions
- Used to access data and instructions from memory during the execution phase of an instruction
- It contains the copy of designated memory locations specified by the memory address register.

2. Memory Data Register (MDR)

- It contains the **data to be stored in the computer storage** (e.g. RAM).
- It acts **like a buffer** and holds anything that is copied from the memory ready for the processor to use it.
- **MDR hold the information before it goes to the decoder.**



fetch (addr):

1. Put *addr* into MAR
2. Tell memory unit to "load"
3. Memory copies data into MDR

store (addr, new-value):

1. Put *addr* into MAR
2. Put *new-value* into MDR
3. Tell memory unit to "store"
4. Memory stores data from MDR into memory cell.

3.Index Register

- It is used for modifying operand addresses during the run of a program.

Index	Register
000	EAX
001	ECX
010	EDX
011	EBX
100	Illegal
101	EBP
110	ESI

4. General Purpose Registers

Four general-purpose registers:

1. AX
2. BX
3. CX
4. DX

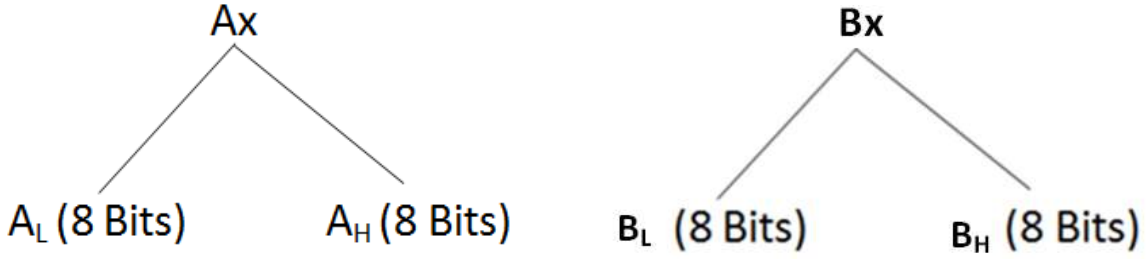
- Combination of two 8-bit registers

which are separately accessible as AL, BL, CL, DL

(the "low" bytes) and AH, BH, CH, and DH (the

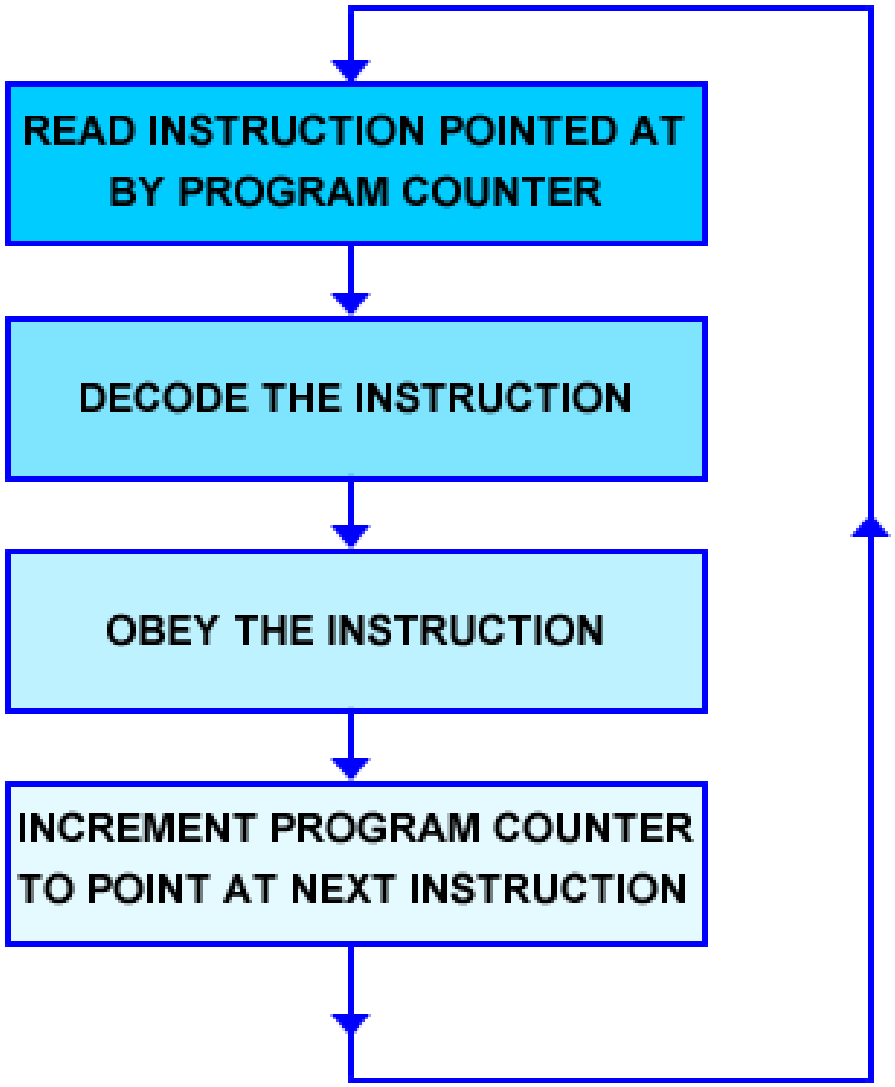
"high" bytes). For example, if AX contains the 16

bit number 1234h, then AL contains 34h and AH contains 12



5. Program Counter

- Part of the instruction sequencer in some computers
- It holds the address of the memory location of the next instruction when the current instruction is executed by the microprocessor.


READ INSTRUCTION POINTED AT BY PROGRAM COUNTER
DECODE THE INSTRUCTION
OBEY THE INSTRUCTION
INCREMENT PROGRAM COUNTER TO POINT AT NEXT INSTRUCTION

Pointer Registers

The pointer registers are 32-bit registers. There are three categories of pointer registers:

- Instruction Pointer (IP)
- Stack Pointer (SP)
- Base Pointer (BP)

Instruction Pointer (IP)

- The 16 bit IP register stores the offset address of the next instruction to be executed.
- It gives the complete address of the current instruction in the code segment.

Stack Pointer (SP)

- The 16-bit SP register provides the offset value within the program stack.
- It refers the current position of data or address within the program stack.

Base Pointer (BP)

- The 16-bit BP register mainly helps in referencing the parameter variables passed to a subroutine (set of sequence).

6. Accumulator Register

- Used for storing the Results those are produced by the System.

- When the CPU will generate Some Results after the Processing then all the Results will be Stored into the **AC Register**

7. Stack Control Register

- A stack represents a set of memory blocks; the data is stored in and retrieved from these blocks in an order, i.e. First In and Last Out (FILO).

- The Stack Control Register is used to manage the stacks in memory. The size of this register is 2 or 4 bytes.

8. Flag Registers

- It is a special purpose register with size one byte or two bytes.
- Each bit of the flag register constitutes a flag (or alarm), such that the bit value indicates if a specified condition was encountered while executing an instruction.

Types of Flag Registers

- **Carry Flag:**
  If 9th bit generated then the carry flag will be 1.

For Example:

```
  10010001
  10010001
 ----------
1 00100010
```

9th bit generated so status of CF is 1.

Types of Flag Registers

- **Auxiliary Carry Flag:**
  If the 4th bit contains carry then AC is 1.

For Example:

```
  0 1 1 0 1 1 1 0
  1 0 0 0 1 1 1 1
-------------------
1 1 1 1 0 1 1 1
```

As 4th bit generated so AC=1.

Types of Flag Registers

- **Parity Flag:**
  If number of ones in the bit are even then PF=1 else if number of ones in the bit are odd then PF=0.

For Example:

```
  01101110
  00001111
----------
  01110111
```

The number of ones are even so PF=1.

Example

```
  10010001
  00010001
----------
  10100010
```

The number of ones are odd so PF=0.

Types of Flag Registers

- **Zero Flag:**
  If the answer is zero then ZF=1 otherwise ZF=0.

Types of Flag Registers

- **Overflow Flag:**
  If the bit are in the range -128 to 127 then OF=0 else OF=1.

$$0110\ 1110 = 6E$$

$$2^7 + 2^6 + 2^5 + 0^4 + 2^3 + 2^2 + 2^1 + 0^0 = 110$$

As 110 is in range. So, OF=0

Types of Flag Registers

- **Sign Flag:**
  If MSB=1 then SF=1 else MSB=0 then SF=0.

0 0 1 1 0 1 0 1

1 = 1's complement

1 1 0 0 1 0 1 0

Here MSB= 1 so SF=1.