MICROPROCESSOR BASED SYSTEMS

CMP 410

LECTURE 11

https://AssemSite8.wix.com/site8
List of Intel Microprocessors

<table>
<thead>
<tr>
<th>Processor part number</th>
<th>Registers size</th>
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<tbody>
<tr>
<td>4004</td>
<td>4</td>
</tr>
<tr>
<td>8008</td>
<td>8</td>
</tr>
<tr>
<td>8080</td>
<td>8</td>
</tr>
<tr>
<td>8085</td>
<td>8</td>
</tr>
<tr>
<td>8086</td>
<td>16</td>
</tr>
<tr>
<td>8089</td>
<td>16</td>
</tr>
<tr>
<td>80286</td>
<td>32</td>
</tr>
<tr>
<td>80386</td>
<td>32</td>
</tr>
<tr>
<td>80486</td>
<td>32</td>
</tr>
<tr>
<td>80586(Pentium)</td>
<td>32</td>
</tr>
<tr>
<td>Pentium Pro</td>
<td>32</td>
</tr>
<tr>
<td>Pentium II</td>
<td>32</td>
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<tr>
<td>Pentium III</td>
<td>32</td>
</tr>
<tr>
<td>Pentium IV</td>
<td>32</td>
</tr>
<tr>
<td>Pentium M</td>
<td>64</td>
</tr>
<tr>
<td>Pentium Xeon</td>
<td>64</td>
</tr>
<tr>
<td>Pentium D 900</td>
<td>64</td>
</tr>
</tbody>
</table>

First member of the X86 family
Pin configuration of Microprocessor 8086
Main characteristics of Microprocessor

8086

• Introduced by Intel Corporation.
• It's the first generation of the X86 family.
• It is a 16-bit microprocessor (what is meaning by 16-bit µP?).
• It has Pipeline technique (what's the benefit?).
• It has fourteen 16-bit internal registers.
Main characteristics of Microprocessor

- It has 16 external multiplexed address data lines \((AD_{0} \rightarrow AD_{15})\) (see pins of µp 8086).
- It has 4 external separated address lines \((A_{16} \rightarrow A_{19})\) (see pins of µp 8086).
- Totally, it has 20 external address lines (what is the maximum capacity of its external memory?).
- Totally, it has 16 external data lines (why 16 data lines?).
Logical addressing-mode in 8086

Segment Register : Offset Register

CS
DS
SS
ES
The internal registers of 8086

- **Code Segment**
- **Data Segment**
- **Stack Segment**
- **Extra Segment**

- **Instruction Pointer**

- **AH**, **AL**, **AX**, **BX**, **CX**, **DX**
  - **(AH:AL): Accumulator**
  - **(BH:BL): Base**

- **Stack Base Pointer**

- **Source Destination**
- **Index**

- **SP**, **BP**, **SI**, **DI**

- **FR**

- **16 bits**
For 8086, any memory location is assigned by **Segment Register**: Offset register

<table>
<thead>
<tr>
<th>Memory Segment</th>
<th>CODE</th>
<th>DATA</th>
<th>EXTRA DATA</th>
<th>STACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment Register</td>
<td>CS</td>
<td>DS</td>
<td>ES</td>
<td>SS</td>
</tr>
<tr>
<td>Relevant Offset register</td>
<td>IP</td>
<td>BX, SI, DI</td>
<td>SP, BP</td>
<td></td>
</tr>
</tbody>
</table>
The segment registers & their memory segments

The main function of the segment registers is defining the start-address of their memory segment
# The Addressing Modes of 8086

<table>
<thead>
<tr>
<th>Addressing mode</th>
<th>Examples</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register addressing</td>
<td>MOV AX, CX</td>
<td>DS are used for all addressing modes except the addressing modes that use BP, they are using register SS and IP using CS.</td>
</tr>
<tr>
<td>Immediate addressing</td>
<td>MOV AX, 1234h</td>
<td></td>
</tr>
<tr>
<td>Direct addressing</td>
<td>MOV AX, [1234h]</td>
<td></td>
</tr>
<tr>
<td>Register indirect addressing</td>
<td>MOV AX, [BX]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOV AX, [DI]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOV AX, [SI]</td>
<td></td>
</tr>
<tr>
<td>Base relative addressing</td>
<td>MOV AX, [BX]+10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOV AX, [BP]+10</td>
<td></td>
</tr>
<tr>
<td>Index relative addressing</td>
<td>MOV AX, [DI]+1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOV AX, [SI]+10</td>
<td></td>
</tr>
<tr>
<td>Base Index relative addressing</td>
<td>MOV AX, [BX][DI]+1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOV AX, [BP][SI]+8</td>
<td></td>
</tr>
</tbody>
</table>
Examples of Register addressing mode

MOV AX, BX
Example of **Direct addressing mode**

```
MOV AL, [0002h]
```

- **Data segment**
- **Offset**
Example of **Direct addressing mode**

MOV BX, [0007h]

Data segment
Offset

8086

Memory
Low address

8 bit
Example of Indirect addressing mode

[BX] or [DI] or [SI]
Example of **Base relative addressing mode**

```
MOV CX, [BX+20h]
```

- **Data segment**
- **Offset**

Diagram: 8086 architecture with `MOV CX, [BX+20h]` instruction and memory segmentation.
Example of **Base relative addressing mode**

MOV [BP+100], CX

Stack segment

- SS: BP+101
- SS: BP+100

8086
Example of **Index relative addressing mode**

**Note**
DI or SI

MOV [DI+10], CX

8086

Ch
Cl

DS: DI +11
DS: DI +10

Memory

Low address

8 bit
Example of **Base Index relative addressing mode**

MOV DX, [BX+SI+33h]
Example of **Base Index relative addressing mode**

MOV AX, [BP+SI+44h]
Example of **Immediate addressing mode**

MOV CX, 8822h