Department of Computer Engineering Techniques (Stage: 4)

Advance Computer Technologies

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INSIDE THE 8088/8086

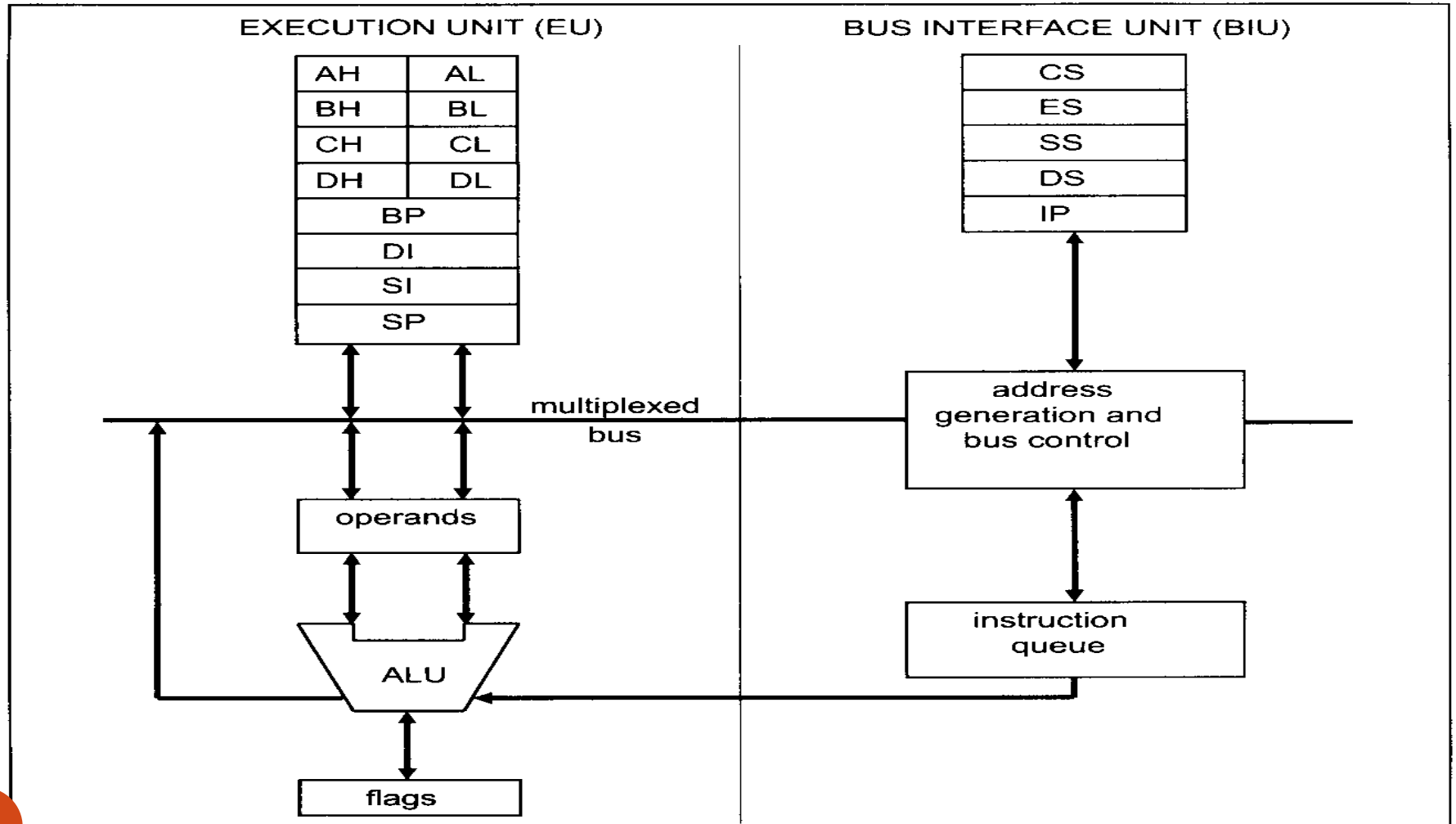

Figure 1-1. Internal Block Diagram of the 8088/86 CPU

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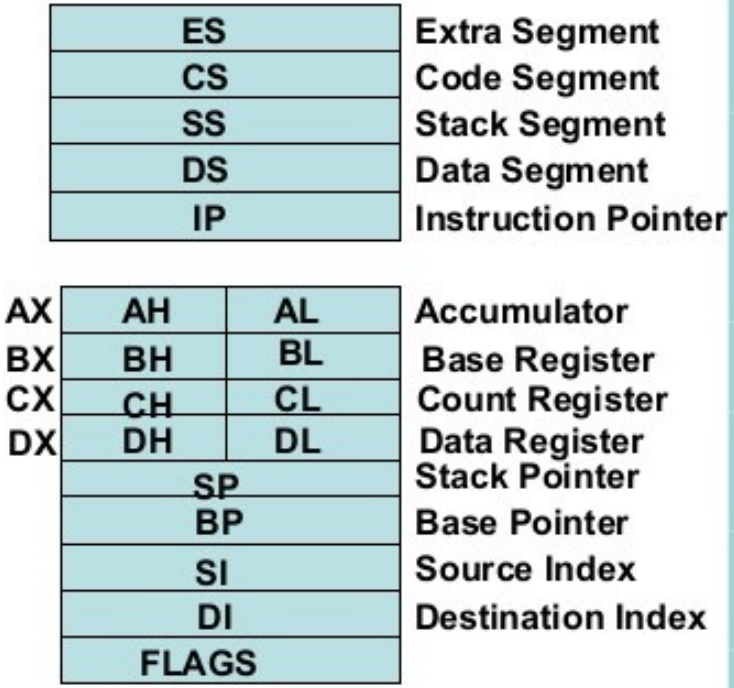
8086 REGISTER ORGANIZATION



Type	Register size	Name of the Register
General purpose registers	16 bit	AX, BX, CX, DX
	8 bit	AL, AH, BL, BH, CL, CH, DL, DH
Pointer registers	16 bit	SP, BP
Indexed registers	16 bit	SI, DI
Instruction Pointer	16 bit	IP
Segment registers	16 bit	CS, DS, SS, ES
Flags	16 bit	Flag register

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EU(Execution Unit)

- EU is responsible for **program execution**
- Contains of an Arithmetic Logic Unit (ALU), a Control Unit (CU) and a number of registers

BIU (Bus Interface Unit)

- **Delivers data and instructions** to the EU.
- manage the bus control unit, segment registers and instruction queue.
- The BIU controls the buses that transfer the data to the EU, to memory and to external input/output devices, whereas the segment registers control memory addressing.

Pipelining

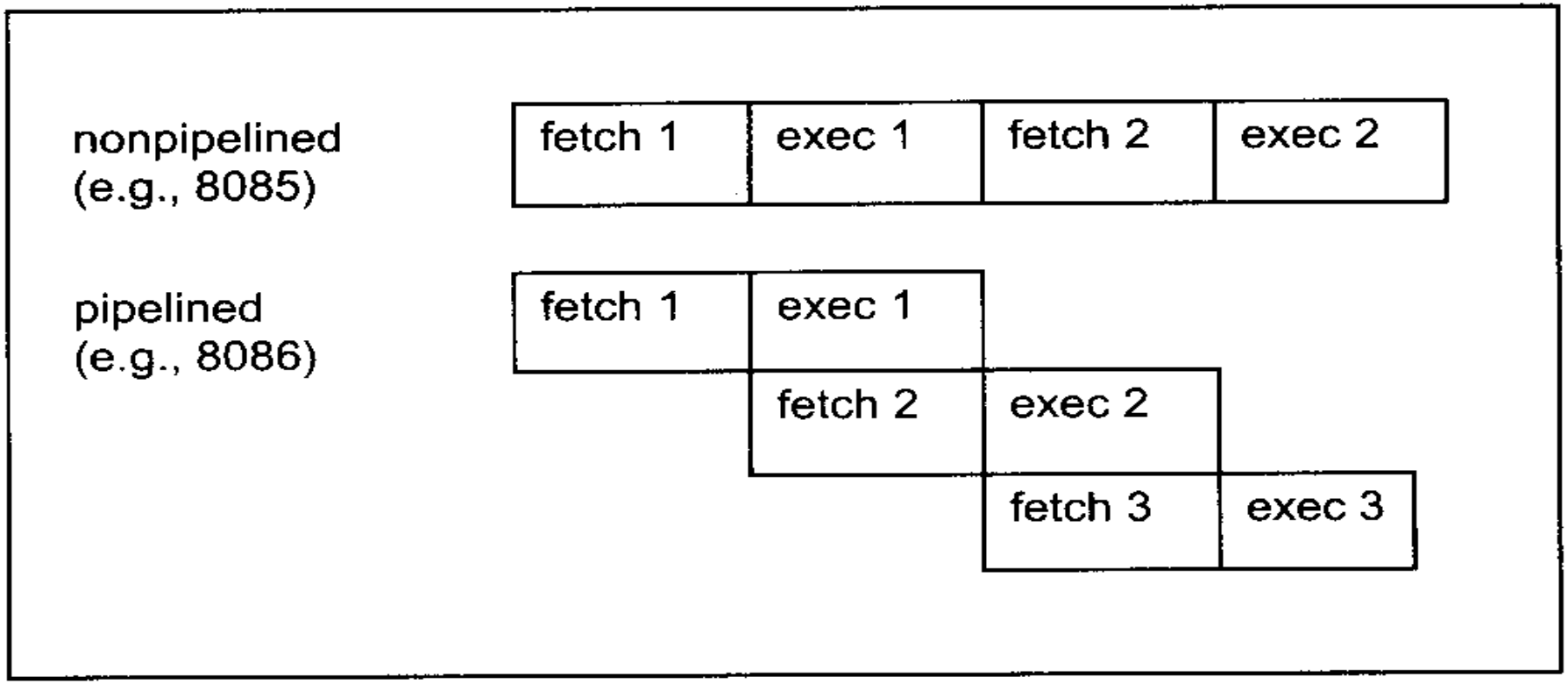

Figure 1-2. Pipelined vs. Nonpipelined Execution

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Pipelining

- 8085 has one unit only which is use in fetch and execute stage when fetch the CPU idle and when execute the bus idle.

- 8086 has two separate unit one for fetch call BIU and one for execute call EU they are connect through 6 byte queue.

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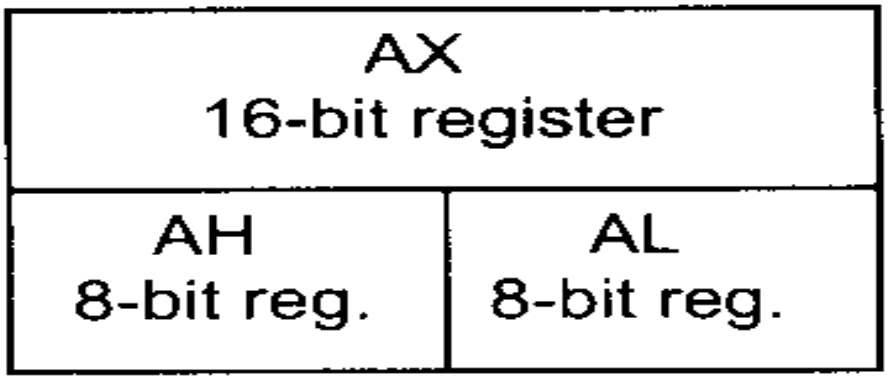
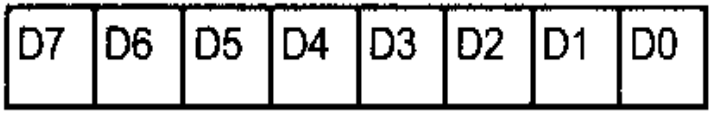
Registers



8-bit register:



16-bit register:

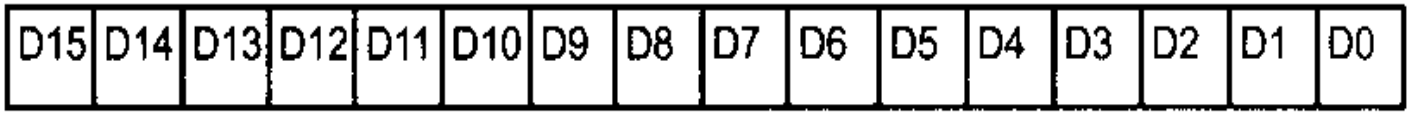


Table 1-2: Registers of the 8086/286 by Category

Category	Bits	Register Names
General	16	AX, BX, CX, DX
	8	AH, AL, BH, BL, CH, CL, DH, DL
Pointer	16	SP (stack pointer), BP (base pointer)
Index	16	SI (source index), DI (destination index)
Segment	16	CS (code segment), DS (data segment), SS (stack segment), ES (extra segment)
Instruction	16	IP (instruction pointer)
Flag	16	FR (flag register)

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Review Questions

1. Explain the functions of the EU and the BIU.
2. What is pipelining, and how does it make the CPU execute faster?
3. Registers of the 8086 are either _____ bits or _____ bits in length.
4. List the 16-bit registers of the 8086.

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INTRODUCTION TO ASSEMBLY PROGRAMMING

MOV instruction

Simply stated, the MOV instruction copies data from one location to another. It has the following format:

```
MOV     destination,source          ;copy source operand to destination
```

```
MOV     CL,55H          ;move 55H into register CL
MOV     DL,CL           ;copy the contents of CL into DL (now DL=CL=55H)
MOV     AH,DL           ;copy the contents of DL into AH (now AH=DL=55H)
MOV     AL,AH           ;copy the contents of AH into AL (now AL=AH=55H)
MOV     BH,CL           ;copy the contents of CL into BH (now BH=CL=55H)
MOV     CH,BH           ;copy the contents of BH into CH (now CH=BH=55H)
```

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The use of 16-bit registers is demonstrated below.

```
MOV   CX,468FH    ;move 468FH into CX (now CH=46,CL=8F)
MOV   AX,CX       ;copy contents of CX to AX (now AX=CX=468FH)
MOV   DX,AX       ;copy contents of AX to DX (now DX=AX=468FH)
MOV   BX,DX       ;copy contents of DX to BX (now BX=DX=468FH)
MOV   DI,BX       ;now DI=BX=468FH
MOV   SI,DI       ;now SI=DI=468FH
MOV   DS,SI       ;now DS=SI=468FH
MOV   BP,DI       ;now BP=DI=468FH
```

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In the 8086 CPU, data can be moved among all the registers shown in Table 1-2 (except the flag register) as long as the source and destination registers match in size. Code such as "MOV AL,DX" will cause an error,

If data can be moved among all registers including the segment registers, can data be moved directly into all registers? The answer is no. Data can be moved directly into nonsegment registers only, using the MOV instruction. For example,

```
MOV   AX,58FCH    ;move 58FCH into AX    (LEGAL)
MOV   DX,6678H    ;move 6678H into DX    (LEGAL)
MOV   SI,924BH    ;move 924B  into SI    (LEGAL)
MOV   BP,2459H    ;move 2459H into BP    (LEGAL)
MOV   DS,2341H    ;move 2341H into DS    (ILLEGAL)
MOV   CX,8876H    ;move 8876H into CX    (LEGAL)
MOV   CS,3F47H    ;move 3F47H into CS    (ILLEGAL)
MOV   BH,99H      ;move 99H into BH      (LEGAL)
```

From the discussion above, note the following three points:

1. Values cannot be loaded directly into any segment register (CS, DS, ES, or SS). To load a value into a segment register, first load it to a nonsegment register and then move it to the segment register, as shown next.

```
MOV   AX,2345H      ;load 2345H into AX
MOV   DS,AX         ;then load the value of AX into DS

MOV   DI,1400H      ;load 1400H into DI
MOV   ES,DI         ;then move it into ES, now ES=DI=1400
```

2. If a value less than FFH is moved into a 16-bit register, the rest of the bits are assumed to be all zeros. For example, in "MOV BX,5" the result will be BX = 0005; that is, BH = 00 and BL = 05.

3. Moving a value that is too large into a register will cause an error.

```
MOV   BL,7F2H       ;ILLEGAL: 7F2H is larger than 8 bits
MOV   AX,2FE456H    ;ILLEGAL: the value is larger than AX
```

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ADD instruction

The ADD instruction has the following format:

```
ADD    destination,source        ;ADD the source operand to the destination
```

```
MOV    AL,25H          ;move 25 into AL
MOV    BL,34H          ;move 34 into BL
ADD    AL,BL           ;AL = AL + BL
```

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```
MOV     DH,25H          ;move 25 into DH
MOV     CL,34H          ;move 34 into CL
ADD     DH,CL           ;add CL to DH: DH = DH + CL

MOV     DH,25H          ;load one operand into DH
ADD     DH,34H          ;add the second operand to DH

MOV     AX,34EH         ;move 34EH into AX
MOV     DX,6A5H         ;move 6A5H into DX
ADD     DX,AX           ;add AX to DX: DX = DX + AX

MOV     CX,34EH         ;load 34EH into CX
ADD     CX,6A5H         ;add 6A5H to CX (now CX=9F3H)
```

The general-purpose registers are typically used in arithmetic operations. Register AX is sometimes referred to as the accumulator.

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Review Questions

1. Write the Assembly language instruction to move value 1234H into register BX.
2. Write the Assembly language instructions to add the values 16H and ABH. Place the result in register AX.
3. No value can be moved directly into which registers?
4. What is the largest hex value that can be moved into a 16-bit register? Into an 8-bit register? What are the decimal equivalents of these hex values?