

Computer Structure and Language

The 8086/8088 Assembly Language

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8086/88 has 7 types of instructions:

1. **Data Transfer Instructions**
2. **Arithmetic Instructions**
3. **Bit Manipulation Instructions**
4. **String Instructions**
5. **Program Execution Transfer Instructions**
6. **Processor Control Instructions**
7. **Interrupt Instructions**

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The 8086's I/O Instructions:

Input Instructions: IN

OFDFIFTFSFZFAPFCF

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-

-

-

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• Input from Fixed Port:

1110010 w

Addr8

$AL \leftarrow (Port_{Addr8})_{byte};$ if $w=0$
 $AX \leftarrow (Port_{Addr8})_{word};$ if $w=1$

Example:

IN AX,33h

\equiv

$AX \leftarrow (Port_{33h})_{word};$

Machine code:

11100101 00110011

\equiv

E533h

• Input from Variable Port:

1110110 w

$AL \leftarrow (Port_{(DX)})_{byte};$ if $w=0$
 $AX \leftarrow (Port_{(DX)})_{word};$ if $w=1$

Example:

IN AX,DX

\equiv

$AX \leftarrow (Port_{(DX)})_{word};$

Machine code:

11101101

\equiv

EDh

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The 8086's I/O Instructions:

Output Instructions: OUT

OFDFIFTFSFZFAPFCF

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-

-

-

-

-

-

-

• Output to Fixed Port:

1110011 w

Addr8

$Port_{Addr8} \leftarrow (AL);$ if $w=0$
 $Port_{Addr8} \leftarrow (AX);$ if $w=1$

Example:

OUT 33h,AL

\equiv

$Port_{33h} \leftarrow (AL);$

Machine code:

11100110 00110011

\equiv

E633h

• Output to Variable Port:

1110111 w

$Port_{(DX)} \leftarrow (AL);$ if $w=0$
 $Port_{(DX)} \leftarrow (AX);$ if $w=1$

Example:

OUT DX,AX

\equiv

$Port_{(DX)} \leftarrow (AX);$

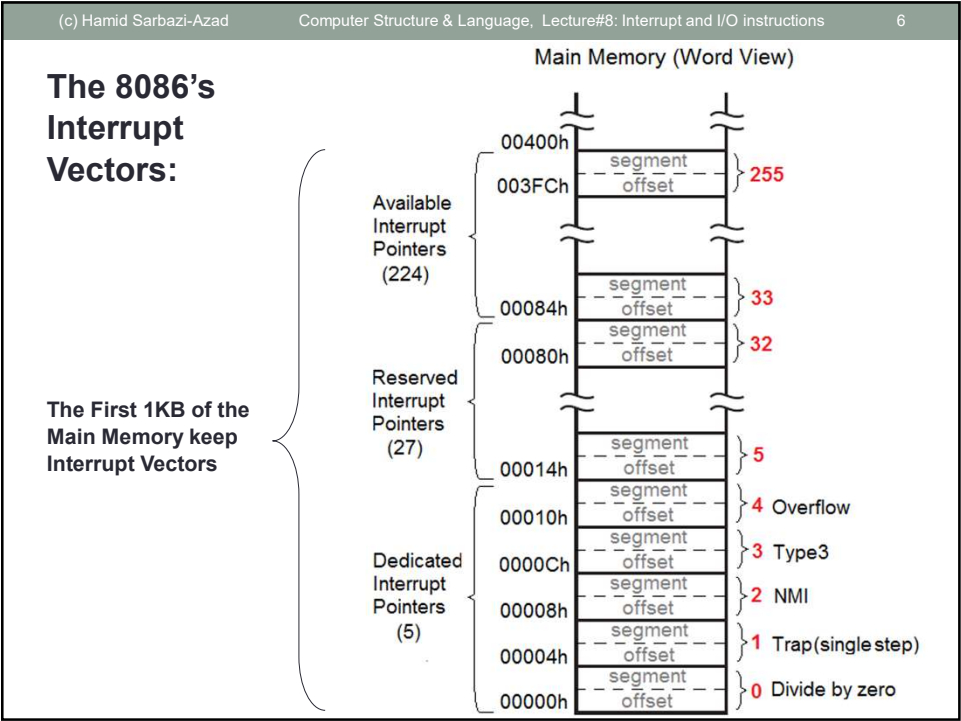
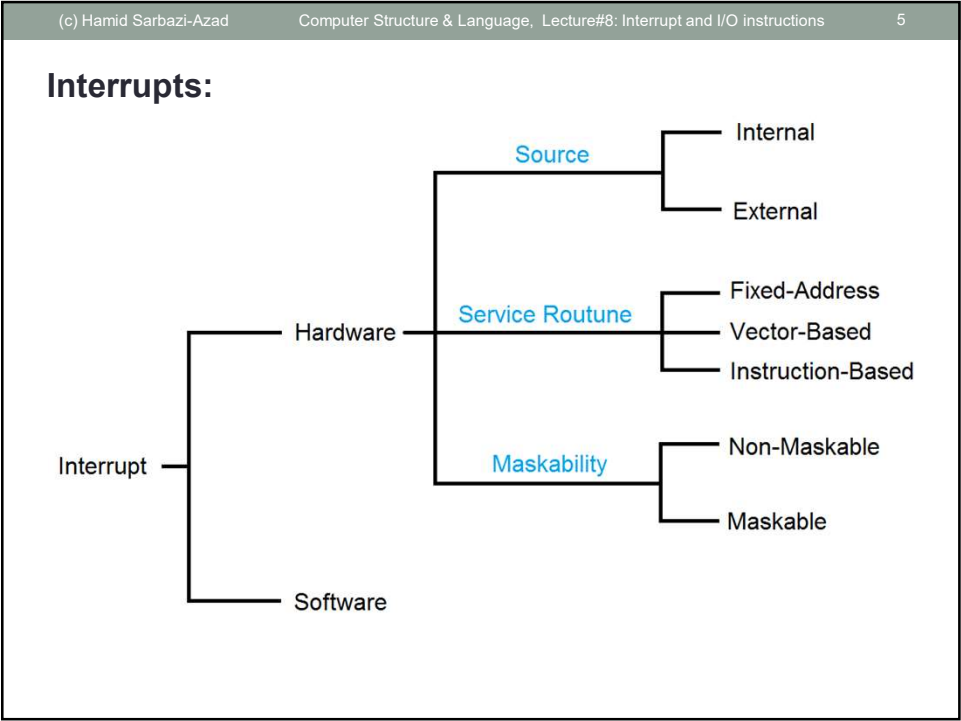
Machine code:

11101111

\equiv

EFh

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The 8086's Interrupt Instructions:

Software Interrupt Generation:

• Type Specified: INT

11001101

Type

OFDFIFTFSFZFAPFCF

- - 0 0 - - - - -

SP ← (SP)-2; M_(SP) ← (F);

SP ← (SP)-2; M_(SP) ← (CS);

SP ← (SP)-2; M_(SP) ← (IP);

IP ← (M_{type*4});

CS ← (M_{type*4 + 2});

Example:

INT33h≡

Push F,CS,IP;

IP←(M_{33h*4});

CS←(M_{33h*4 + 2});

Machine code:

CD33h

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The 8086's Interrupt Instructions:

Software Interrupt Generation:

• Type3 Interrupt: INT3

11001100

OFDFIFTFSFZFAPFCF

- - 0 0 - - - - -

SP ← (SP)-2; M_(SP) ← (F);

SP ← (SP)-2; M_(SP) ← (CS);

SP ← (SP)-2; M_(SP) ← (IP);

IP ← (M₁₂);

CS ← (M₁₄);

• Interrupt On Overflow: INTO

11001110

OFDFIFTFSFZFAPFCF

- - 0 0 - - - - -

if OF=1 then

SP ← (SP)-2; M_(SP) ← (F);

SP ← (SP)-2; M_(SP) ← (CS);

SP ← (SP)-2; M_(SP) ← (IPS);

IP ← (M₁₆);

CS ← (M₁₈);

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The 8086's Interrupt Instructions:

Return from Interrupt: IRET

• Interrupt Return

11001111

OF

DF

IF

TF

SF

ZF

AF

PF

CF

r

r

r

r

r

r

r

r

r

$IP \leftarrow (M_{(SP)});$

$SP \leftarrow (SP)+2;$

$CS \leftarrow (M_{(SP)});$

$SP \leftarrow (SP)+2;$

$F \leftarrow (M_{(SP)});$

$SP \leftarrow (SP)+2;$

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