Computer Structure and Language

The 8086/8088 Assembly Language

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8086/88 has 7 types of instructions:

1. Data Transfer Instructions (I/O instructons)
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

OF	DF	IF	TF	SF	ZF	AF	PF	CF
-	-	-	-	-	-	-	-	-

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

Machine code: 11100101 00110011 ≡ 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 ≡ $AX \leftarrow (Port_{(DX)})_{word}$;

Machine code: 11101101 ≡ EDh

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The 8086's I/O Instructions:

Output Instructions: OUT

OF	DF	IF	TF	SF	ZF	AF	PF	CF
-	-	-	-	-	-	-	-	-

- **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 ≡ $Port_{33h} \leftarrow (AL)$;

Machine code: 11100110 00110011 ≡ 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 ≡ $Port_{(DX)} \leftarrow (AX)$;

Machine code: 11101111 ≡ EFh

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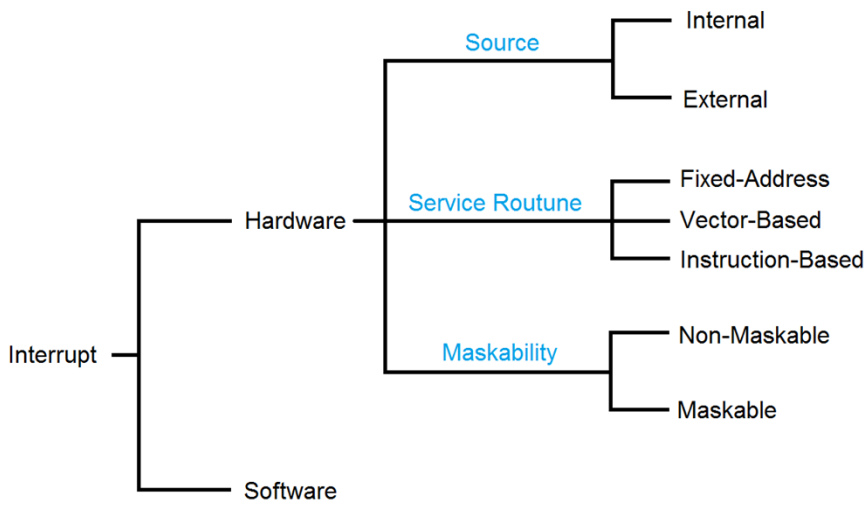
Interrupts:



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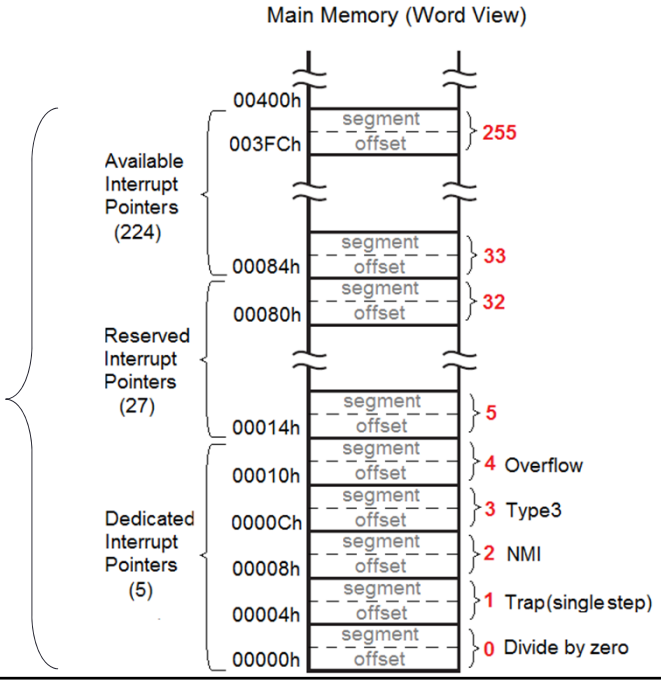
The 8086's Interrupt Vectors:



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The 8086's Interrupt Instructions:

Software Interrupt Generation:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
-	-	0	0	-	-	-	-	-

- **Type Specified: INT**

11001101 **Type**

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:

INT 33h ≡ 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:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
-	-	0	0	-	-	-	-	-

- **Type3 Interrupt: INT3**

11001100

SP ← (SP)-2; $M_{(SP)}$ ← (F);
SP ← (SP)-2; $M_{(SP)}$ ← (CS);
SP ← (SP)-2; $M_{(SP)}$ ← (IP);
IP ← (M_{12});
CS ← (M_{14});

OF	DF	IF	TF	SF	ZF	AF	PF	CF
-	-	0	0	-	-	-	-	-

- **Interrupt On Overflow: INTO**

11001110

if OF=1 then
SP ← (SP)-2; $M_{(SP)}$ ← (F);
SP ← (SP)-2; $M_{(SP)}$ ← (CS);
SP ← (SP)-2; $M_{(SP)}$ ← (IPS);
IP ← (M_{16});
CS ← (M_{18});

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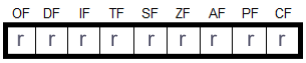
The 8086's Interrupt Instructions:

Return from Interrupt: IRET



- **Interrupt Return**

11001111

IP ← ($M_{(SP)}$); SP ← (SP)+2;
CS ← ($M_{(SP)}$); SP ← (SP)+2;
F ← ($M_{(SP)}$); SP ← (SP)+2;

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End of Slides

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