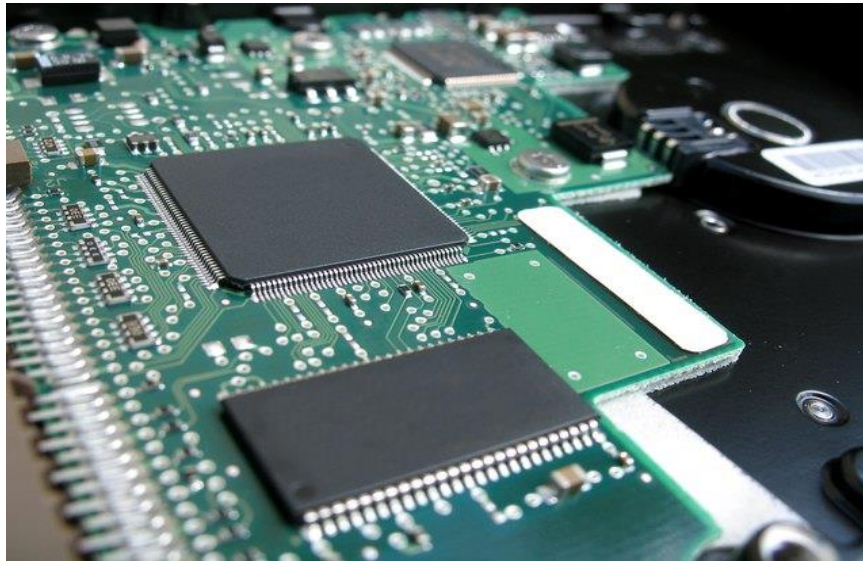Lecture 28

Microprocessors

Prepared by:

Firas Abdulrahman Yosif

Input / output Port

- **IN & OUT instructions**

The IN instruction will copy data from a port to the accumulator. If 8 bit is read the data will go to AL and if 16 bit, then to AX. Similarly, OUT instruction is used to copy data from accumulator to an output port.

Both IN and OUT instructions can be done using direct and indirect

addressing modes.

سوف تقوم تعليمات IN بنسخ البيانات من منفذ إلى المجمع. إذا تمت قراءة 8 بت ، فستنتقل البيانات إلى AL وإذا كانت 16 بت فستنتقل إلى AX وبالمثل ، يتم استخدام تعليمات OUT لنسخ البيانات من المجمع إلى منفذ الإخراج. يمكن إجراء كل من تعليمات IN و OUT باستخدام طرق العنونة مباشرة وغير مباشرة .

IN and OUT: There are two different forms of IN and OUT instructions: the direct I/O instructions and variable I/O instructions. Either of these two types of instructions can be used to transfer a byte or a word of data. All data transfers take place between an I/O device and the MPU's accumulator register. The general form of this instruction is as shown below:

Mnem.	Meaning	Format	operation	Flags
IN	Input direct Input variable	IN Acc, port IN Acc, DX	(Acc) ← (port) (Acc) ← ((DX))	None
OUT	output direct Variable	OUT port, Acc OUT DX, Acc	(Acc) → (port) (Acc) → ((DX))	None

Input port : عن طريق هذا المنفذ يتم نقل word او byte الى السجل ALاو AX من منفذ ادخال ويمكن ان يكون عنوان المنفذ عنوان مياشر او ضمن سجل (عنوان غير مباشر).

The I/O port addressing can be done either directly or indirectly as follows:

• *Direct*

IN AX, PORTA or IN AL, PORTA inputs 16-bit contents of port A into AX or 8-bit contents of port A into AL, respectively.

OUT PORTA, AX or OUT PORTA, AL outputs 16-bit contents of AX into port A or 8-hit contents of AL into port A, respectively.

EX) IN AL, 99H;   ادخال بايت من المنفذ 99 الى السجل AL

EX) IN AX,78H;   AH ادخال بيانات من المنفذ 78 الى AL وادخال بيانات من المنفذ 79 الى السجل

EX) OUT 34H, AX

نقل بايت من AL الى عنوان المنفذ 34H ونقل بايت AH الى المنفذ 35H

• *Indirect*

IN AX, DX or IN AL, DX inputs 16-bit data into a port addressed by DX into AX or 8-bit data into a port addressed by DX into AL, respectively.

OUT DX, AX or OUT DX, AL outputs 16-bit contents of AX into a port addressed by DX or 8-bit contents of AL into a port addressed by DX, respectively.

في العنونة الغير مباشرة يحفظ عنوان المنفذ في DX ثم يدخل الى AL او AX :

EX)   MOV DX, 481H

   IN AL, DX

الايعاز اعلاه يمثل نقل بايت في العنوان 481H الموجود في السجل DX الى السجل AL

EX) MOV DX, 64B1H

OUT DX, AL

في المثال اعلاه يتم نقل بايت من AL الى عنوان المنفذ الموجود في السجل DX .

EX) OUT DX, AX

نقل بايت من AL الى العنوان الموجود في DX وثم نقل بايت من AH الى العنوان الموجود في DX+1

❖ **IN Accumulator, Port**

The IN instruction copies data from a port to the AL or AX register. If an 8-bit port is read, the data will go to AL. If a 16-bit port is read, the data will go to AX.

The IN instruction has two possible formats, fixed port and variable port. For fixed port type, the 8-bit address of a port is specified directly in the instruction. With this form, any one of 256 possible ports can be addressed.

- IN AL, OC8H; Input a byte from port OC8H to AL
- IN AX, 34H; Input a word from port 34H to AX

For the variable-port form of the IN instruction, the port address is loaded into the DX register before the IN instruction. Since DX is a 16-bit register, the port address can be any number between 0000H and FFFFH. Therefore, up to 65,536 ports are addressable in this mode.

- MOV DX, 0FF78H Initialize DX to point to port

IN AL, DX Input a byte from 8-bit port 0FF78H to AL

IN AX, DX Input a word from 16-bit port 0FF78H to AX

The variable-port IN instruction has advantage that the port address can be computed or dynamically determined in the program. Suppose, for example, that an 8086-based computer needs to input data from 10 terminals, each having its own port address. Instead of having a separate procedure to input data from each port, you can write one generalized input procedure and simply pass the address of the desired port to the procedure in DX.

Note: The IN instruction does not change any flag.

❖ **OUT Port, Accumulator**

The OUT instruction copies a byte from AL or a word from AX to the specified port. The OUT instruction has two possible forms, fixed port and variable port.

For the fixed port form, the 8-bit port address is specified directly in the instruction. With this form, anyone of 256 possible ports can be addressed.

- OUT 3BH, AL; Copy the content of AL to port 3BH
- OUT 2CH, AX; Copy the content of AX to port 2CH

For variable port form of the OUT instruction, the content of AL or AX will be copied to the port at an address contained in DX. Therefore, the DX register must be loaded with the desired port address before this form of the OUT instruction is used.

Ex: MOV DX, 0FFF8H; Load desired port address in DX

OUT DX, AX; Copy content of AL to port FFF8H & Copy content of AH to port FFF9H.

Note: The OUT instruction does not affect any flag.

I/O Operations:

IN: Input the port: This instruction is used for reading an input port. The address of the input port may be specified in the instruction directly or indirectly AL and AX are the allowed destinations for 8 and 16-bit input operations. DX is the only register (implicit), which is allowed to carry the port address.

Ex:

1. IN AL, DX

[AL] ⟵ [PORT DX]

 Input AL with the 8-bit contents of the port addressed by DX

2. IN AX, DX

 [AX] ⟵ [PORT DX]

 3. IN AL, PORT

[AL] ⟵ [PORT]

4. IN AX, PORT

[AX] ⟵ [PORT]

5. IN AL, 0300H; This instruction reads data from an 8-bit port whose address is 0300H and stores it in AL.

OUT: Output to the Port: This instruction is used for writing to an output port. The address of the output port may be specified in the instruction directly or implicitly in DX. Contents of AX or AL are transferred to a directly or indirectly addressed port after execution of this instruction. The data to an odd addressed port is transferred on D8 –D15 while that to an even addressed port is transferred on D0-D7. The registers AL and AX are the allowed source operands for 8-bit and 16-bit operations respectively.

Ex:

1. OUT DX, AL

[PORT DX] ⟵ [AL]

2. OUT DX, AX

[PORT DX] ⟵ [AX]

3. OUT 0300H, AL; This sends data available in AL to a port whose address is 0300H.