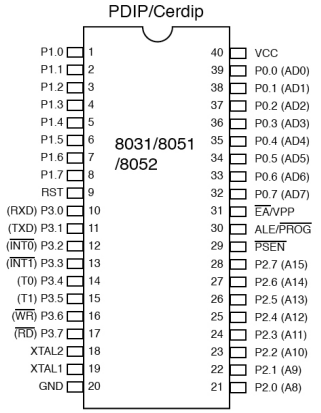
8051 Microcontroller:

Ports



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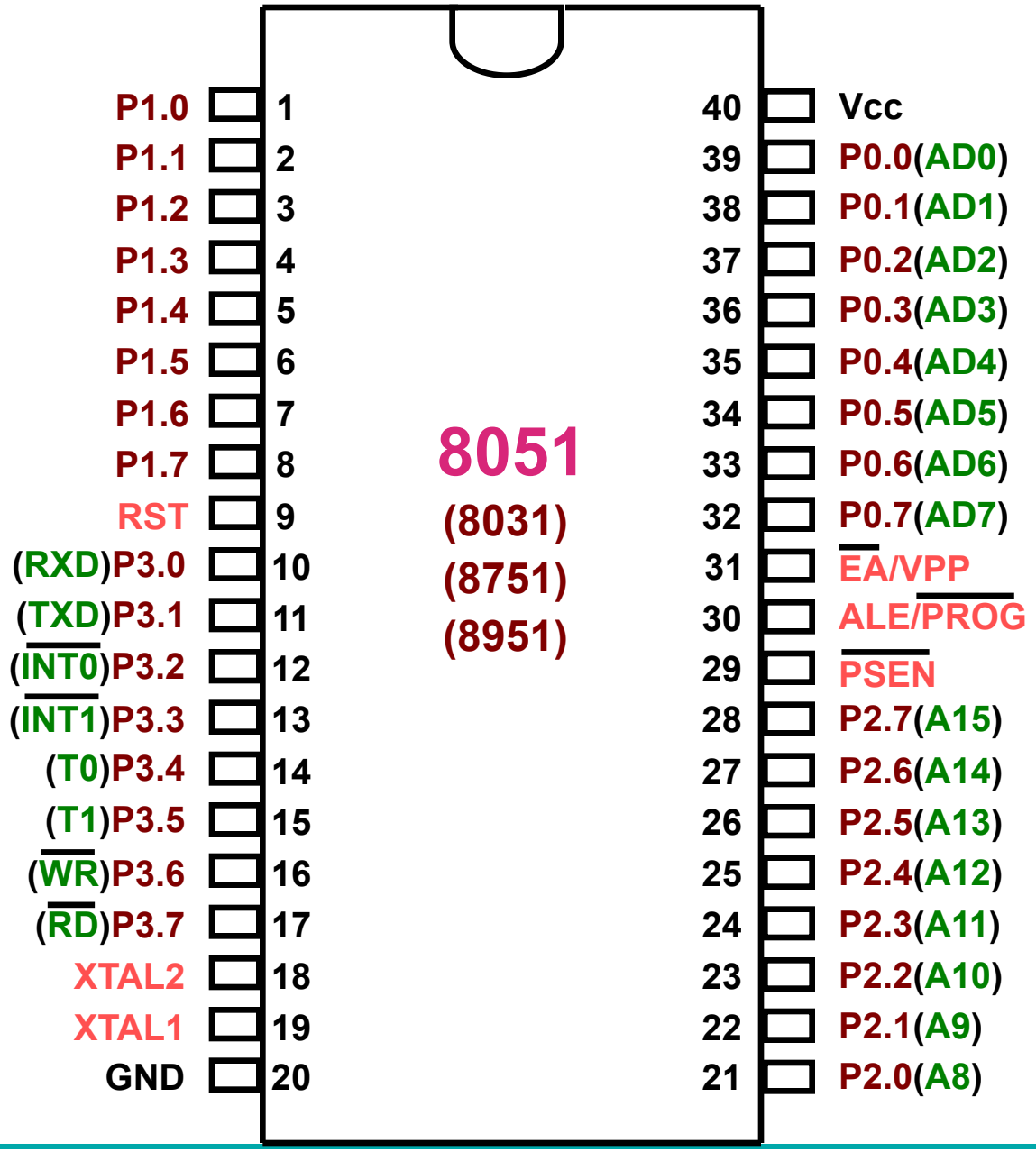
EE-309: Microprocessors

Lecture 9 (06 Aug 2015)

CADSL

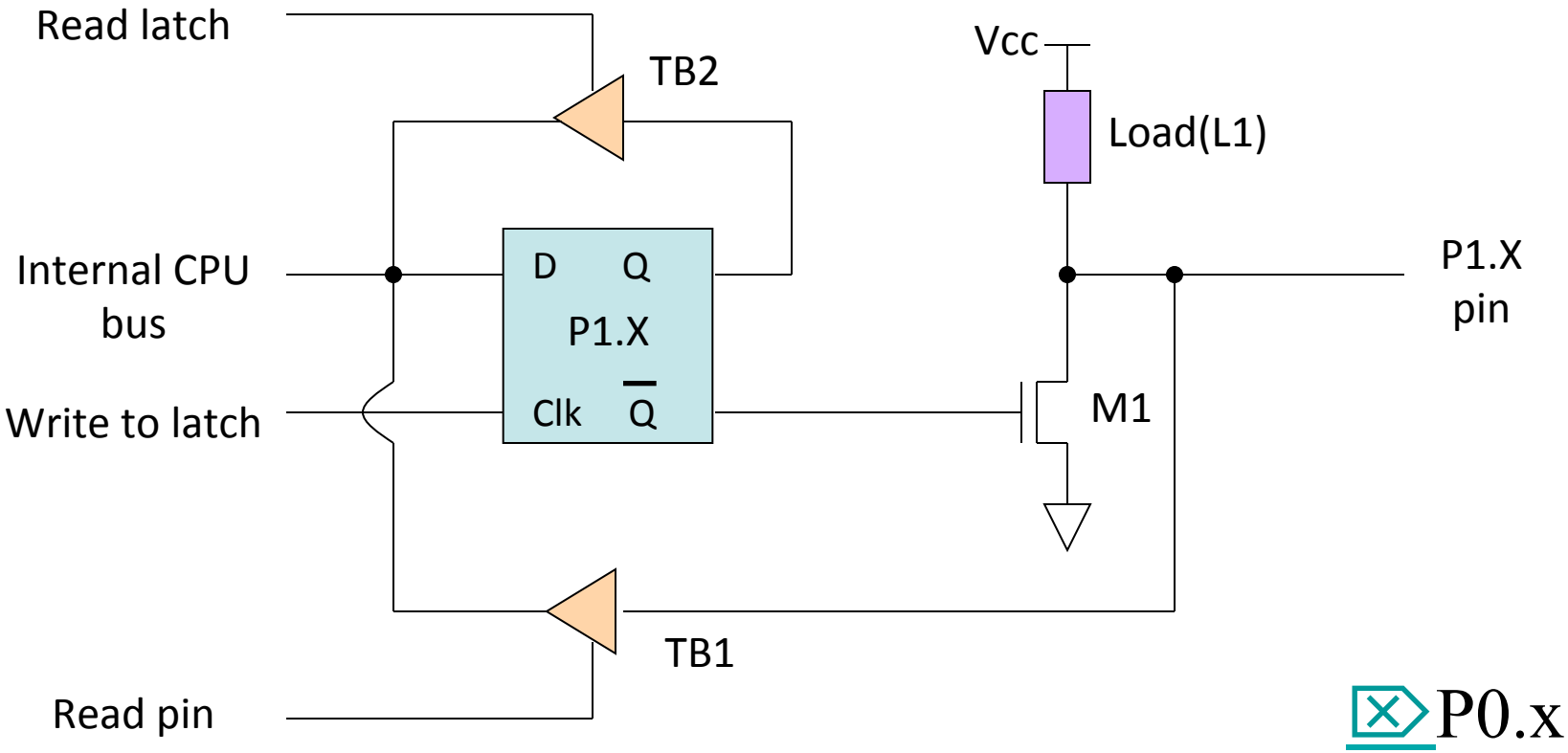
8051 Pin Diagram



8051 Microcontroller

- Limited by the number of pins
- Pins are used for multiple functionality

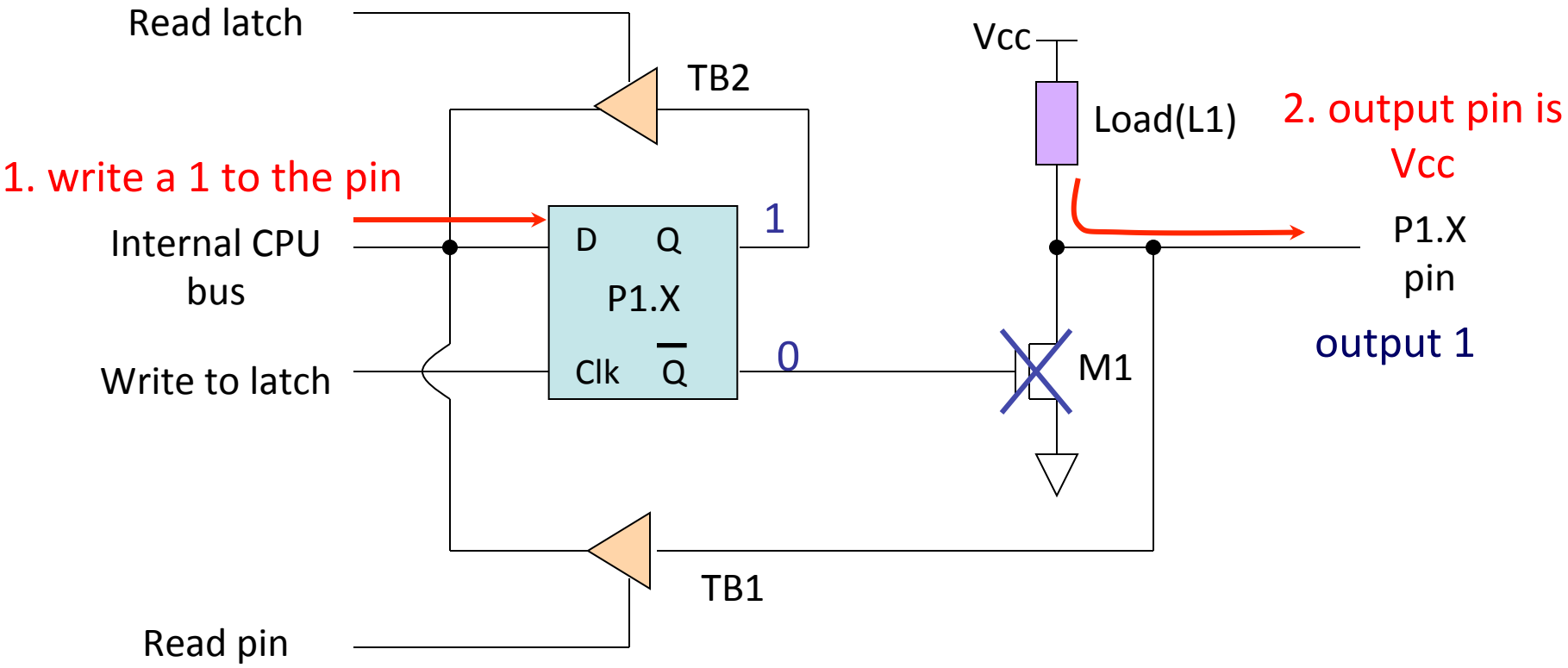
A Pin of Port 1



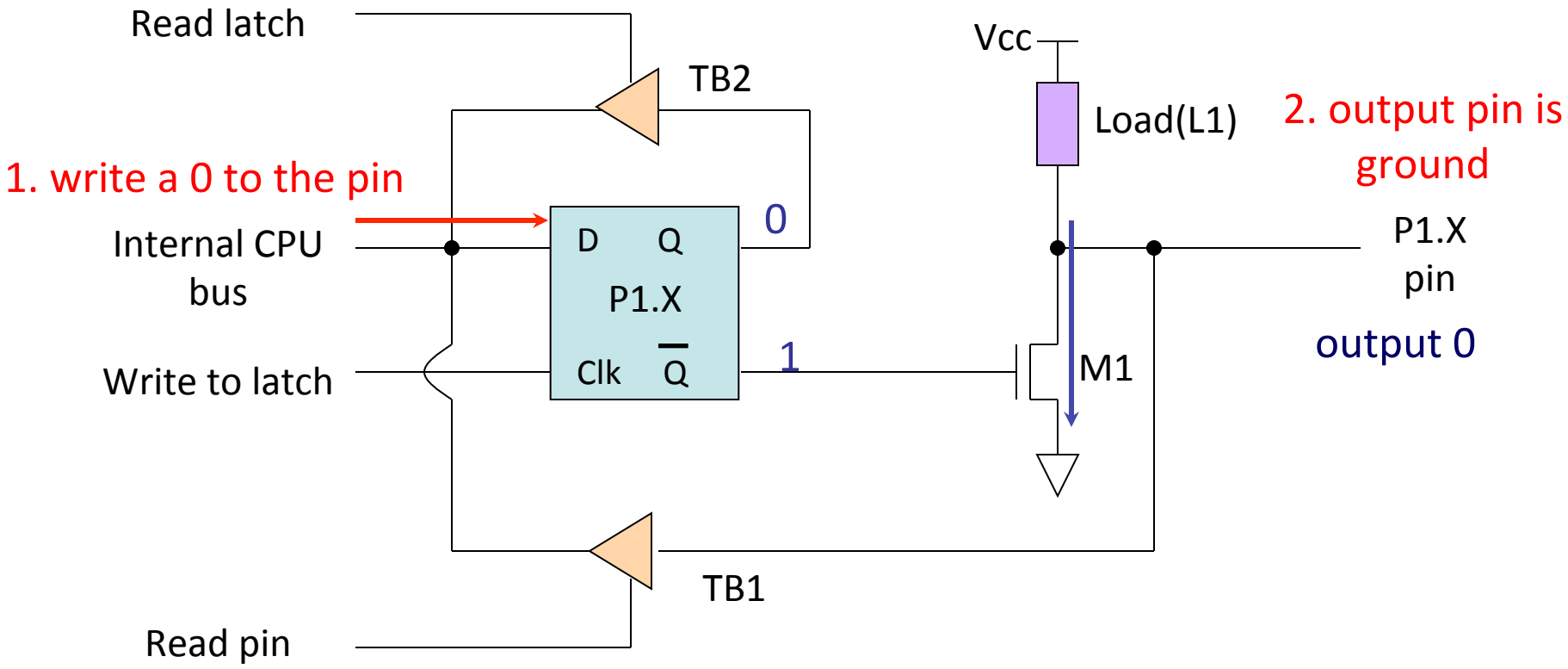
Hardware Structure of I/O Pin

- Each pin of I/O ports
  - Internal CPU bus：communicate with CPU
  - A D latch store the value of this pin
    - D latch is controlled by “Write to latch”
      - Write to latch＝1：write data into the D latch
  - 2 Tri-state buffer： 
    - TB1: controlled by “Read pin”
      - Read pin＝1：really read the data present at the pin
    - TB2: controlled by “Read latch”
      - Read latch＝1：read value from internal latch
  - A transistor M1 gate
    - Gate=0: open
    - Gate=1: close

Writing “1” to Output Pin P1.X



Writing “0” to Output Pin P1.X



Port 1 as Output（Write to a Port）

- Send data to Port 1：

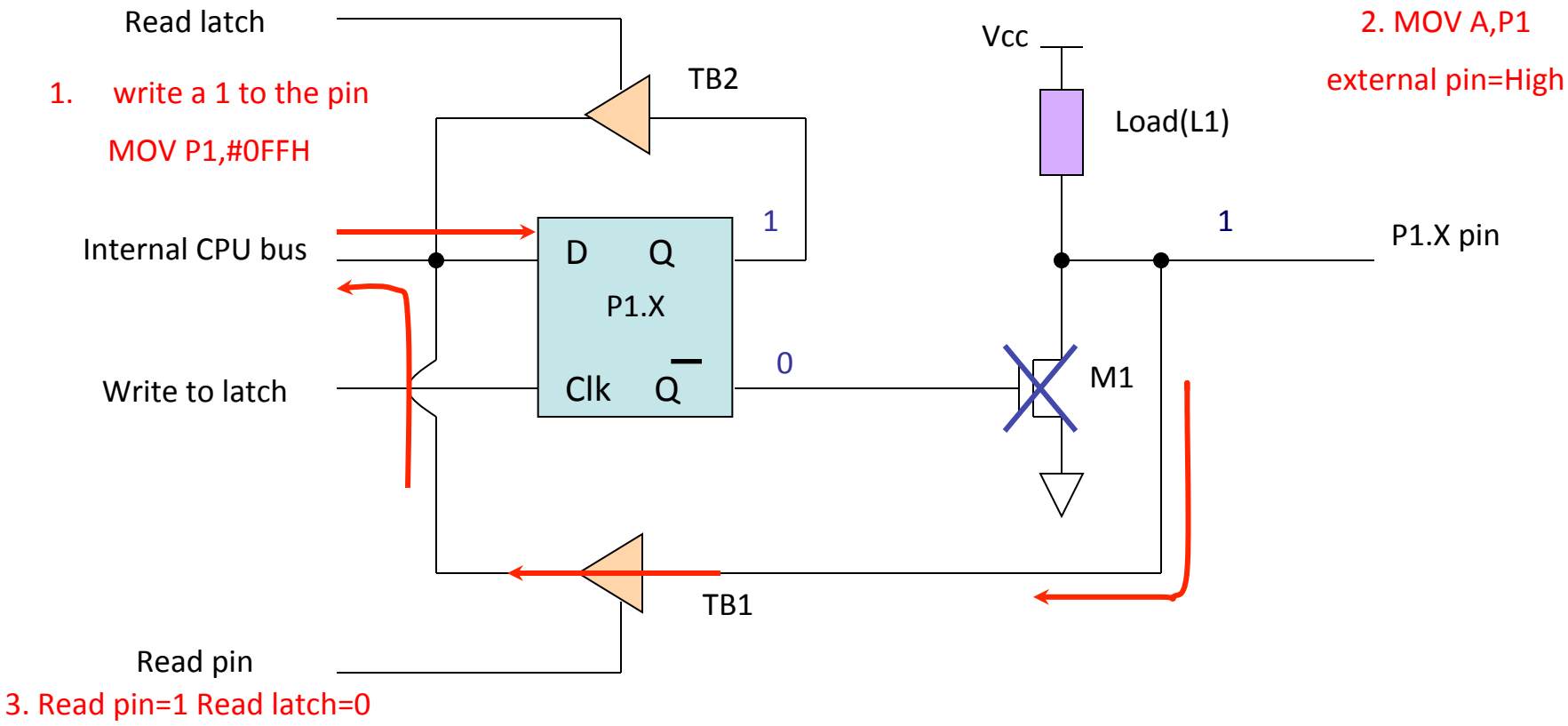
```
        MOV  A,#55H
BACK:   MOV  P1,A
        ACALL DELAY
        CPL  A
        SJMP  BACK
```

  - Let P1 toggle.
  - You can write to P1 directly.

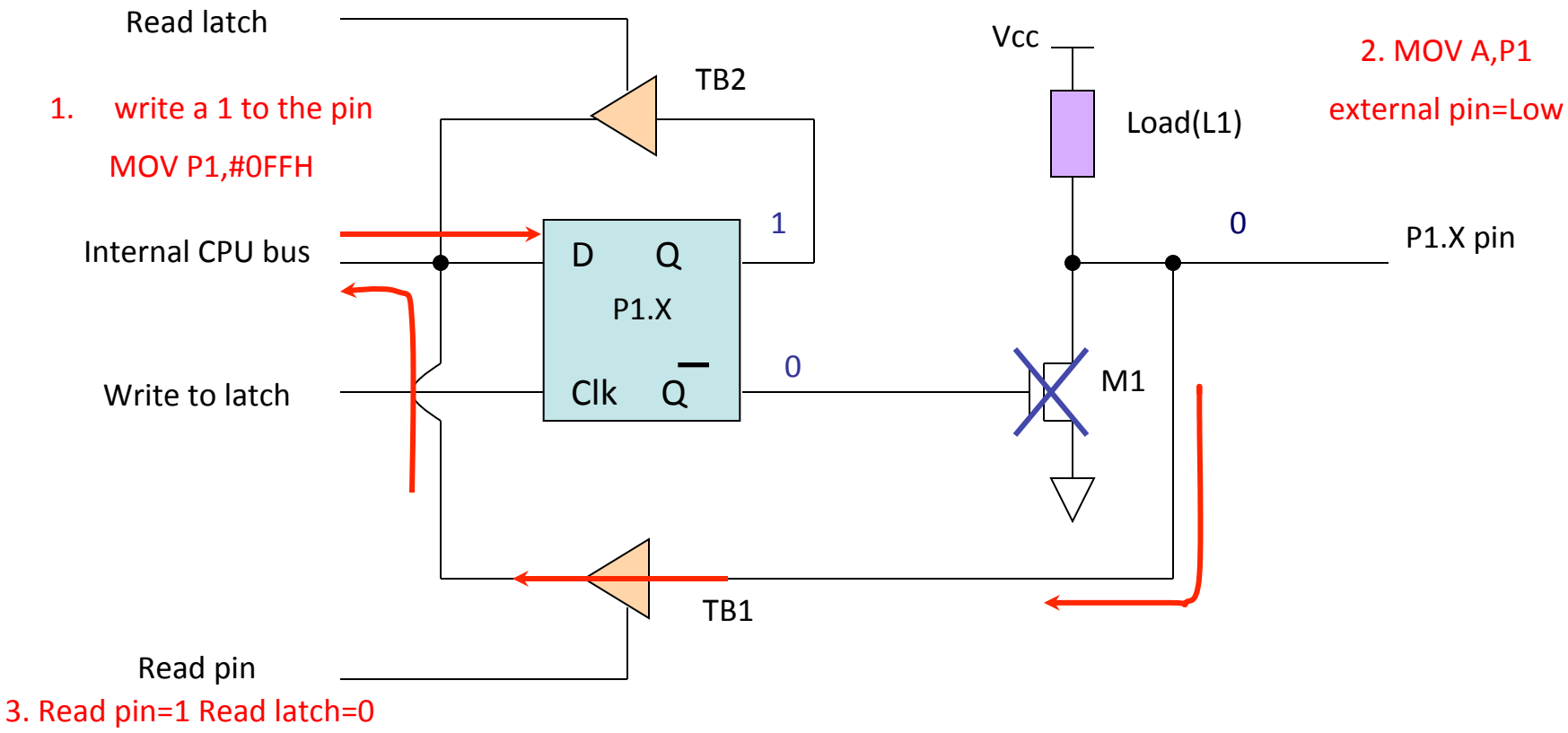
Reading Input vs Port Latch

- When reading ports, there are two possibilities：
  - Read the status of the input pin. （from *external pin value*）
    - MOV A, PX
    - JNB P2.1, TARGET ; jump if P2.1 is not set
    - JB P2.1, TARGET ; jump if P2.1 is set
  - Read the *internal latch* of the output port.
    - ANL P1, A ; P1 ← P1 AND A
    - ORL P1, A ; P1 ← P1 OR A
    - INC P1 ; increase P1

Reading “High” at Input Pin



Reading “Low” at Input Pin



Port 1 as Input（Read from Port）

- In order to make P1 an input, the port must be programmed by writing 1 to all the bit.

```
        MOV   A,#0FFH      ;A=11111111B
        MOV   P1,A         ;make P1 an input port
BACK:   MOV   A,P1         ;get data from P1
        MOV   P2,A         ;send data to P2
        SJMP  BACK
```

  - To be an input port, P0, P1, P2 and P3 have similar methods.

Instructions For Reading an Input Port

Mnemonics	Examples	Description
MOV A,PX	**MOV A,P2**	Bring into A the data at P2 pins
JNB PX.Y,..	**JNB P2.1,TARGET**	Jump if pin P2.1 is low
JB PX.Y,..	**JB P1.3,TARGET**	Jump if pin P1.3 is high
MOV C,PX.Y	**MOV C,P2.4**	Copy status of pin P2.4 to CY

Reading Latch

- Exclusive-or the Port 1：

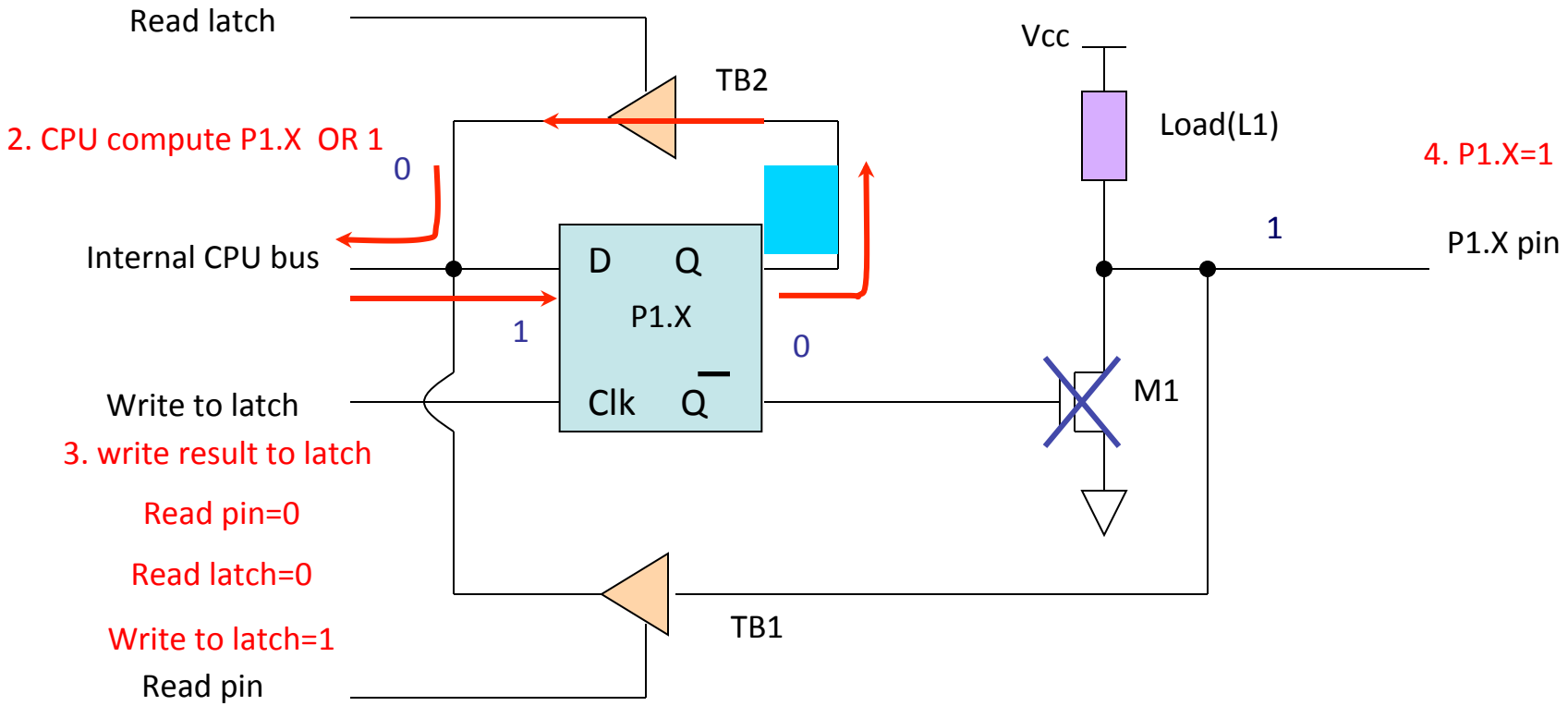
  MOV P1,#55H ;P1=01010101

  ORL P1,#0F0H ;P1=11110101

  1. The read latch activates TB2 and bring the data from the Q latch into CPU.
     - Read P1.0=0
  2. CPU performs an operation.
     - This data is ORed with bit 1 of register A. Get 1.
  3. The latch is modified.
     - D latch of P1.0 has value 1.
  4. The result is written to the external pin.
     - External pin (pin 1: P1.0) has value 1.

Reading the Latch

1. Read pin=0 Read latch=1 Write to latch=0 (Assume P1.X=0 initially)



Read-Modify-Write Instructions

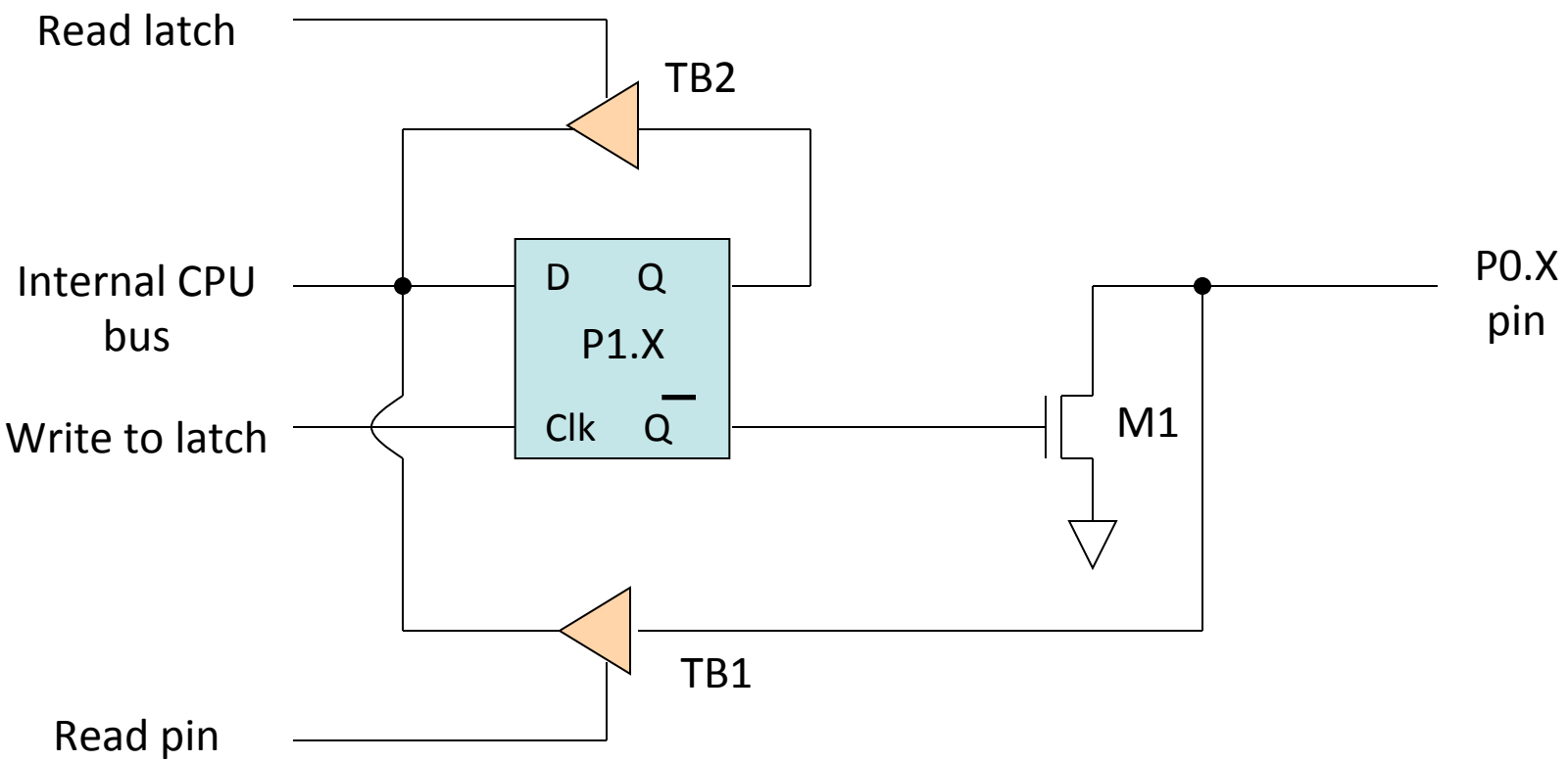
Mnemonics	Example
ANL	ANL P1,A
ORL	ORL P1,A
XRL	XRL P1,A
JBC PX.Y, TARGET	JBC P1.1, TARGET
CPL	CPL P1.2
INC	INC P1
DEC	DEC P1
DJNZ PX, TARGET	DJNZ P1,TARGET
MOV PX.Y,C	MOV P1.2,C
CLR PX.Y	CLR P1.3
SETB PX.Y	SETB P1.4

Other Pins

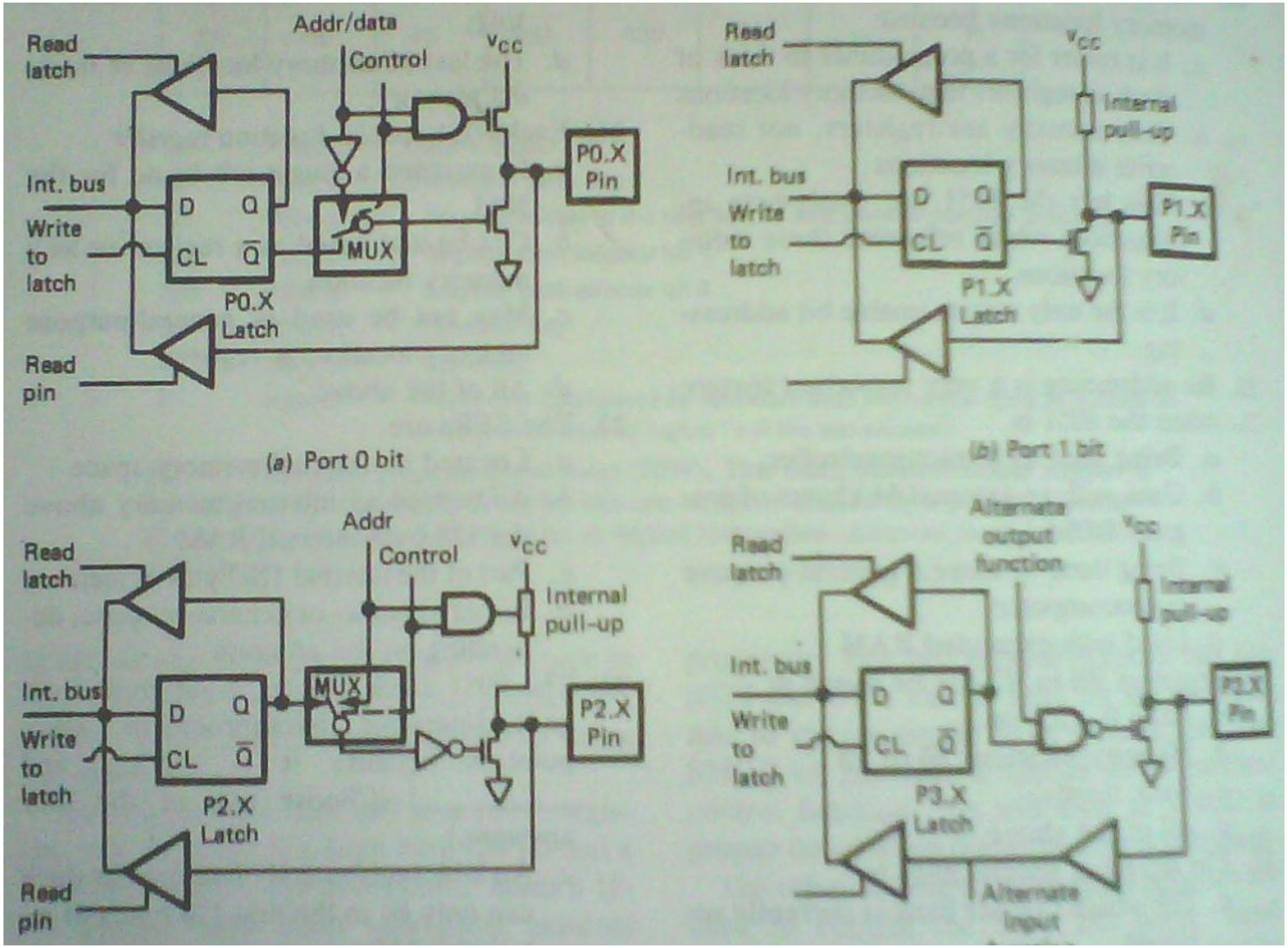
- P1, P2, and P3 have internal pull-up resisters.
  - P1, P2, and P3 are not open drain.
- P0 has no internal pull-up resistors and does not connects to Vcc inside the 8051.
  - P0 is open drain.

- However, for a programmer, it is the same to program P0, P1, P2 and P3.
- All the ports upon RESET are configured as output.

A Pin of Port 0



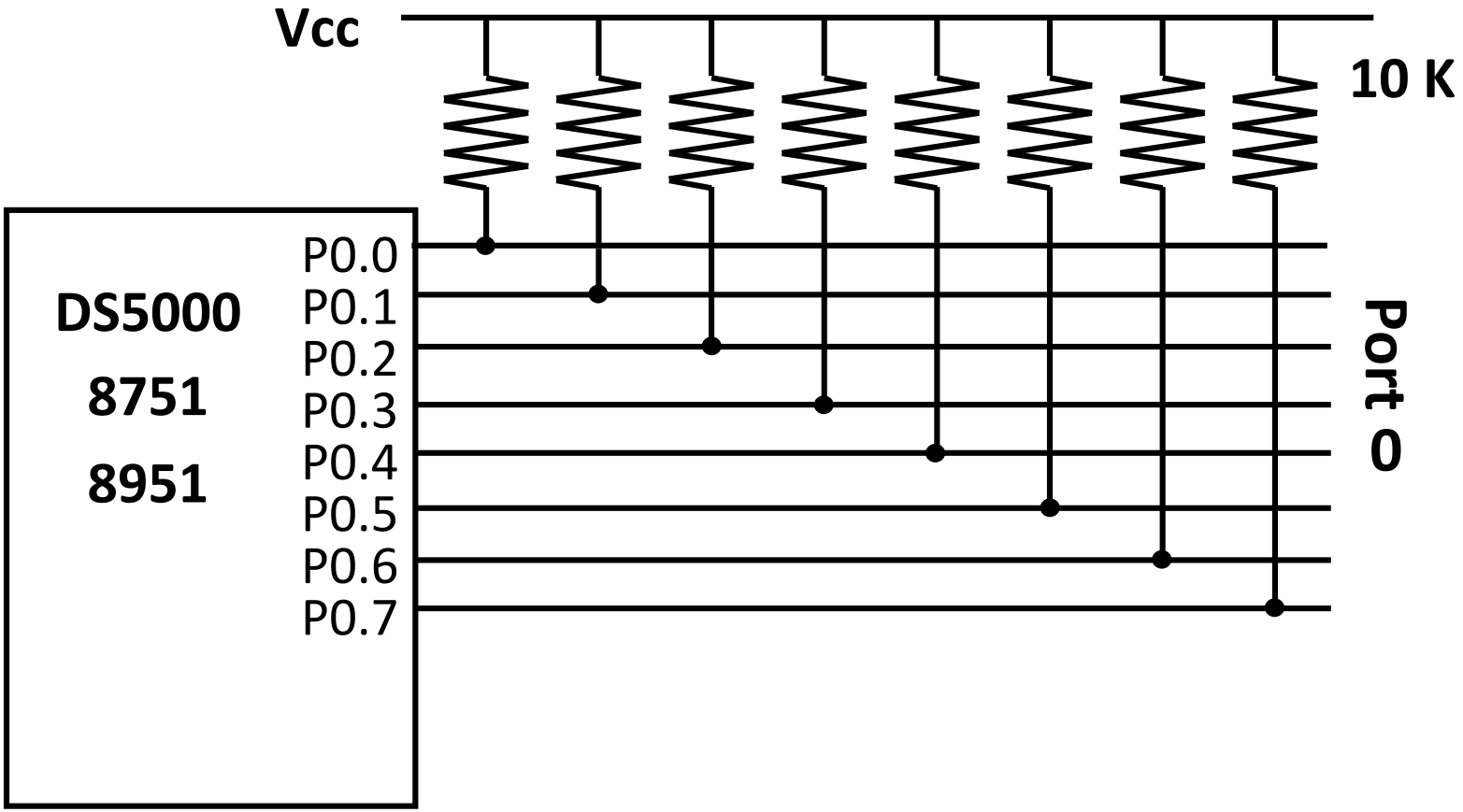
I/O Ports of 8051



Port 0（pins 32-39）

- P0 is an open drain.
  - Open drain is a term used for MOS chips in the same way that open collector is used for TTL chips. 
- When P0 is used for simple data I/O we must connect it to external pull-up resistors.
  - Each pin of P0 must be connected externally to a 10K ohm pull-up resistor.
  - With external pull-up resistors connected upon reset, port 0 is configured as an output port.

Port 0 with Pull-Up Resistors



Thank You