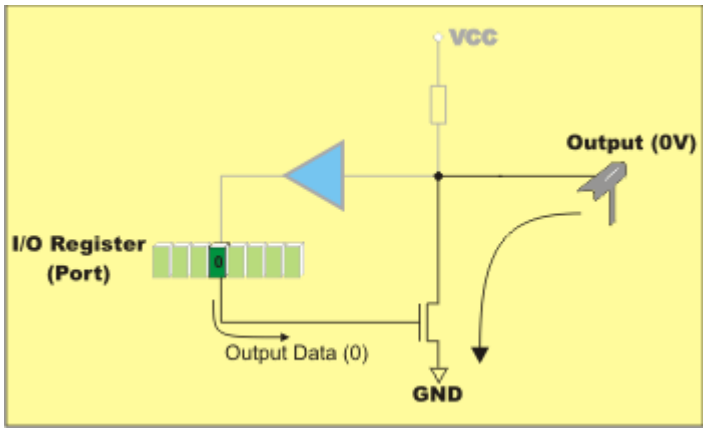
Input / Output Ports (I/O Ports) of 8051

All 8051 microcontrollers have 4 I/O ports each comprising 8 bits which can be configured as inputs or outputs. Accordingly, in total of 32 input/output pins enabling the microcontroller to be connected to peripheral devices are available for use.

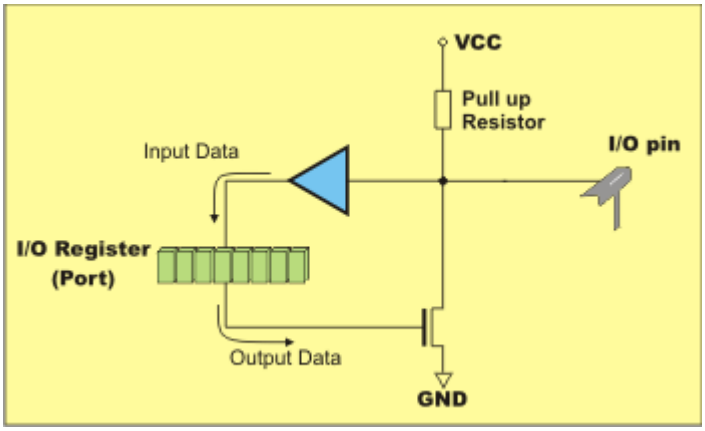
Pin configuration, i.e. whether it is to be configured as an input (1) or an output (0), depends on its logic state. In order to configure a microcontroller pin as an input, it is necessary to apply a logic zero (0) to appropriate I/O port bit. In this case, voltage level on appropriate pin will be 0.

Similarly, in order to configure a microcontroller pin as an input, it is necessary to apply a logic one (1) to appropriate port. In this case, voltage level on appropriate pin will be 5V (as is the case with any TTL input). This may seem confusing but don't loose your patience. It all becomes clear after studying simple electronic circuits connected to an I/O pin.



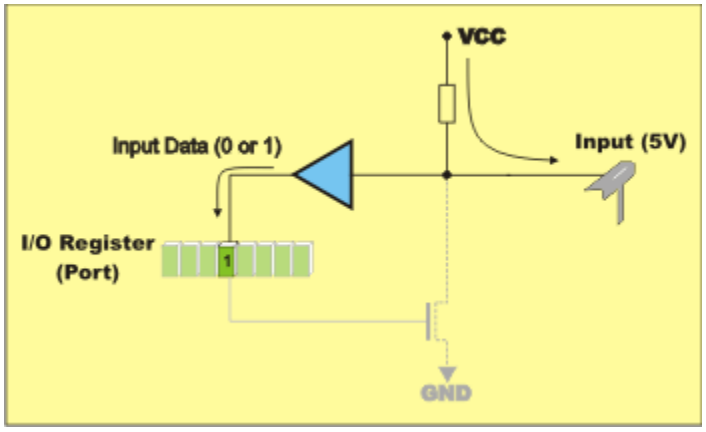
Input/Output (I/O) pin

Figure above illustrates a simplified schematic of all circuits within the microcontroler connected one of its pins. It refers to all the pins except those of the P0 port which do not have pull-up resistors built-in.



Output pin

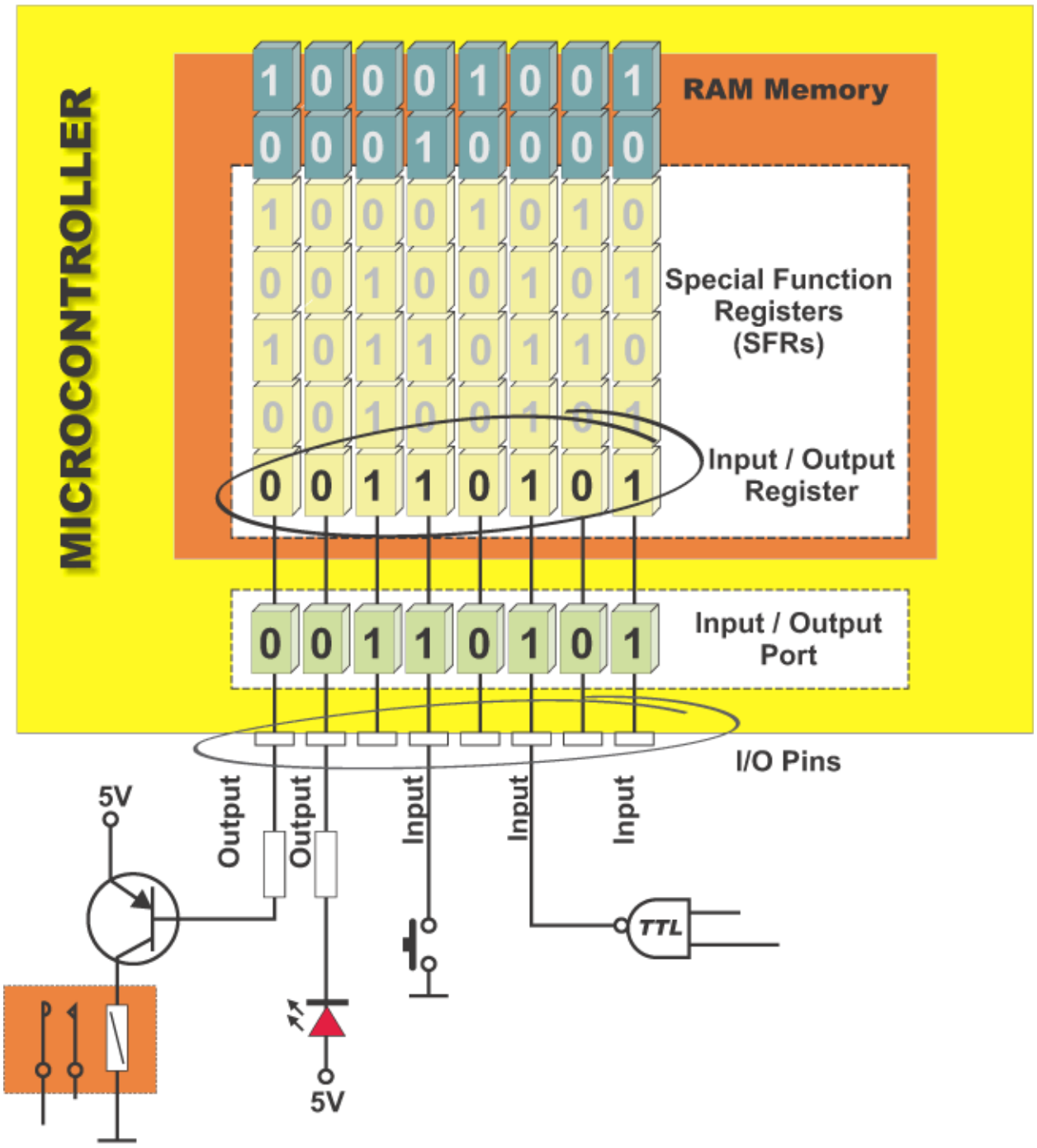
A logic zero (0) is applied to a bit of the P register. The output FE transistor is turned on, thus connecting the appropriate pin to ground.



Input pin
A logic one (1) is applied to a bit of the P register. The output FE transistor is turned off and the appropriate pin remains connected to the power supply voltage over a pull-up resistor of high resistance.

Logic state (voltage) of any pin can be changed or read at any moment. A logic zero (0) and logic one (1) are not equal. A logic one (0) represents a short circuit to ground. Such a pin acts as an output.

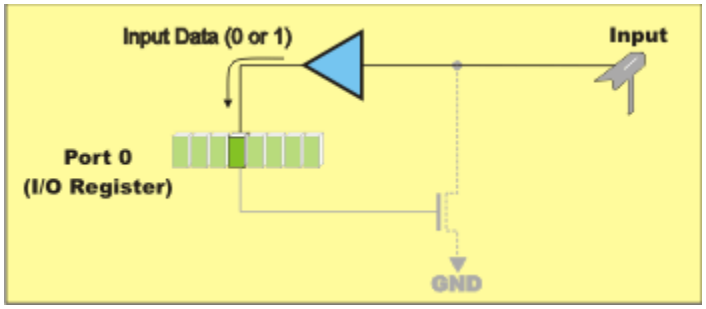
A logic one (1) is “loosely” connected to the power supply voltage over a resistor of high resistance. Since this voltage can be easily “reduced” by an external signal, such a pin acts as an input.



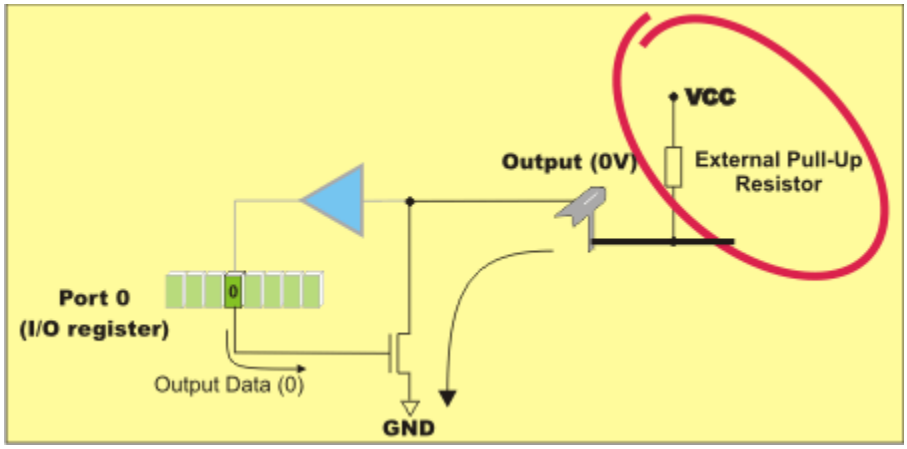
Port 0

The P0 port is characterized by two functions. If external memory is used then the lower address byte (addresses A0-A7) is applied on it. Otherwise, all bits of this port are configured as inputs/outputs.

The other function is expressed when it is configured as an output. Unlike other ports consisting of pins with built-in pull-up resistor connected by its end to 5 V power supply, pins of this port have this resistor left out. This apparently small difference has its consequences:



If any pin of this port is configured as an input then it acts as if it “floats”. Such an input has unlimited input resistance and indetermined potential.



When the pin is configured as an output, it acts as an “open drain”. By applying logic 0 to a port bit, the appropriate pin will be connected to ground (0V). By applying logic 1, the external output will keep on “floating”. In order to apply logic 1 (5V) on this output pin, it is necessary to built in an external pull-up resistor.

Port 1

P1 is a true I/O port, because it doesn't have any alternative functions as is the case with P0, but can be cofigured as general I/O only. It has a pull-up resistor built-in and is completely compatible with TTL circuits.

Port 2

P2 acts similarly to P0 when external memory is used. Pins of this port occupy addresses intended for external memory chip. This time it is about the higher address byte with addresses A8-A15. When no memory is added, this port can be used as a general input/output port showing features similar to P1.

Port 3

All port pins can be used as general I/O, but they also have an alternative function. In order to use these alternative functions, a logic one (1) must be applied to appropriate bit of the P3 register. In terms of hardware, this port is similar to P0, with the difference that its pins have a pull-up resistor built-in.

Source : http://nprcet.org/e%20content/Misc/e-Learning/IT/IV%20Sem/CS%202252-Microprocessors%20and%20Microcontrollers.pdf