What is a Logic Gate?

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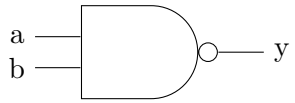
What precisely does one mean by the term "logic gate"? It depends on context. Lets take the example of a two input NAND gate. It can have different meanings depending upon the level of abstraction being considered. Each heading below denotes a context and subsequently the meaning of a two input NAND gate in the context is described.

1. **Abstract mathematical level**: A two input NAND gate can denote a Boolean function which can be specified as the following truth table:

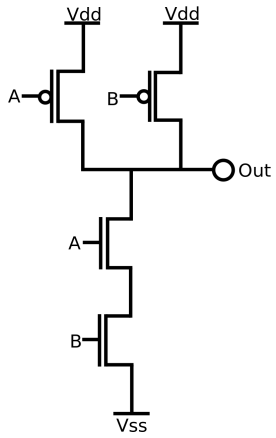
a	b	y
0	0	1
0	1	0
1	0	0
1	1	0

   Logic minimization is a task during which gates are typically thought of as Boolean functions.
2. **Logic design level**: A two input NAND gate can denote a component in a logic circuit. It may be optionally associated with a value that specifies the gate delay.



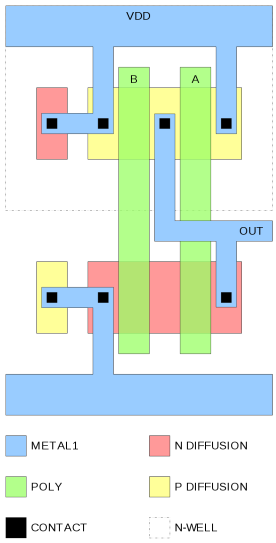
   Such a view of a logic gate is useful during design and analysis of digital circuits.

3. **VLSI design level**: A two input NAND gate is represented by a transistor level circuit diagram. The standard CMOS implementation is:



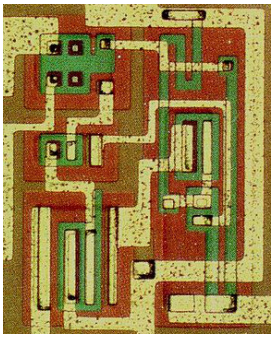
The circuit functions in a digital manner with the transistors acting as switches which are typically in on or off state.

4. **VLSI layout level**: A VLSI designer ("silicon programmer") specifies layout of various layers (silicon, metal etc.) that compose the required logic. Such a layout corresponding to the above transistor circuit is shown below:



5. **VLSI fabrication level**: A "chip" (integrated circuit) such as an Intel microprocessor is fabricated in a VLSI fab and may have more

than a billion gates on it. Following is part of a chip photo showing a two input NAND gate:



To summarize, depending on the context (level of abstraction) the term "logic gate" could refer to any of the above interpretations. Above levels 1 and 2, and aspects of levels 3 and 4, are in the domain of computer science and engineering.