Eleven Ways to Say NAND

NAND is short for Not AND. It acts on two Boolean inputs: call them A and B.
Boolean means logical True vs. False, a.k.a. 1 vs. 0.

George Boole (1815-1864) was arguably the first to formalize the application of symbolic algebra to logic; see Wikipedia's article on Boolean algebra.

Boolean algebra: $\neg(A \wedge B)$

English: the complement of the combination A and B

English-math hybrid: not (A and B)

C: `Y = !(A && B)`

Verilog: `assign Y = ~(A & B)`

VHDL: `Y <= not(A and B)`

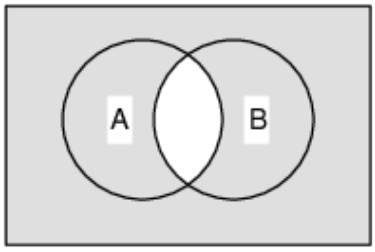
Ladder logic:

```
          A       B         Y
    ----[ ]----[ ]------(\)
```

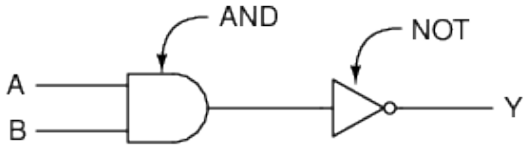
Truth Table

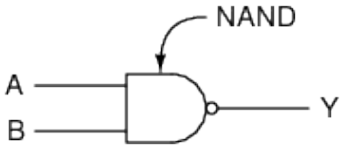
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Venn diagram



Logic circuit diagrams





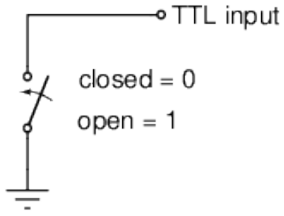
You definitely don't need to know or even understand all these forms!
The Truth Table is crucial, though, and the circuit diagrams should make sense after you start working on the demonstrations.

Arcane TTL knowledge

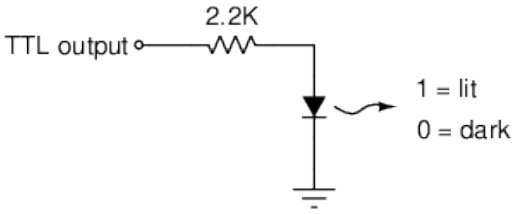
Transistor-Transistor Logic (TTL) was the dominant logic family for commercial, industrial, and hobbyist digital logic, including the construction of computers, starting in the late 1960s. It lost prominence in the 1980s with the advent of CMOS and VLSI chips. It has a niche market even today.

TTL chips are always powered from V_{CC} of 5.0 V. A single chip operating in open air doesn't normally get hot—our 7400 chips are specified to dissipate on the order of 20 mW.

To get to a logic-0 (low, False) state, TTL inputs need to be pulled down to below 0.4 V with at least 1.6 mA. Disconnected inputs float to the logic-1 (high, True) state. For our purposes, a single SPST switch can set the input to a TTL gate.



Correspondingly, TTL outputs can sink more current than they source. A high output can still source about 1 mA, enough to drive a modern LED. We use that configuration, with a 2.2 kΩ series resistor, so that a lit LED represents True.



Here's the schematic of a single two-input NAND gate, as found inside a 7400 chip. Under normal circumstances, the propagation delay from input to output is about 10 ns.