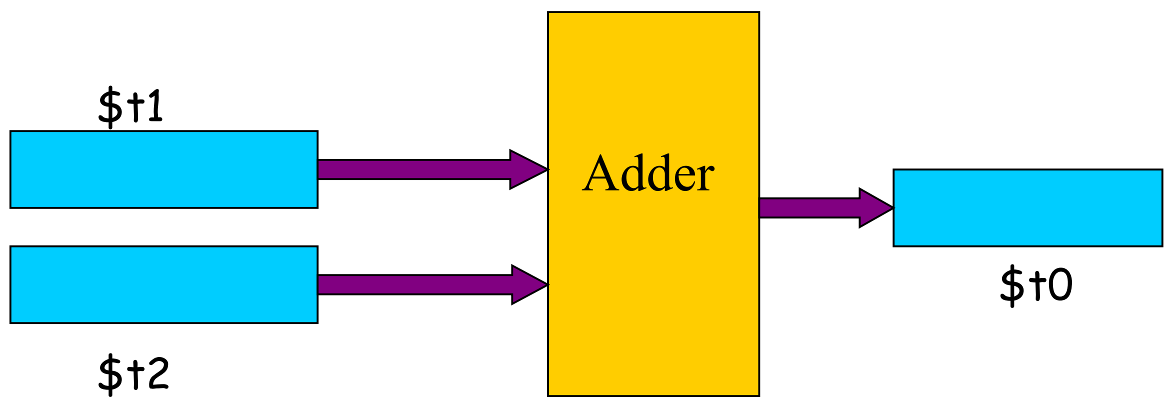
Understanding Logic Design

(Appendix C of your Textbook on the CD)

When you write add $t0, $t1, $t2, you imagine something

like this:



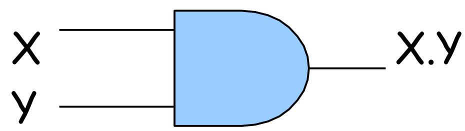
What kind of hardware can ADD two binary integers?

We need to learn about GATES and BOOLEAN ALGEBRA

that are foundations of logic design.

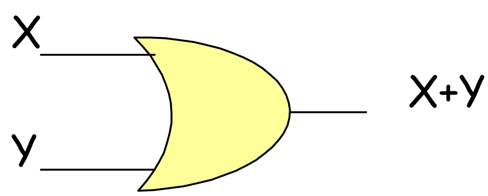
AND gate

X	Y	X.Y
0	0	0
0	1	0
1	0	0
1	1	1



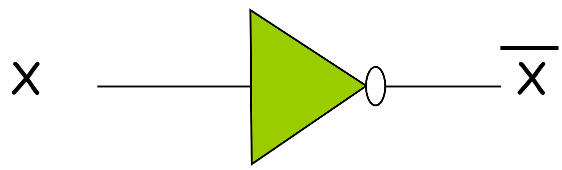
OR gate

X	Y	X+Y
0	0	0
0	1	1
1	0	1
1	1	1



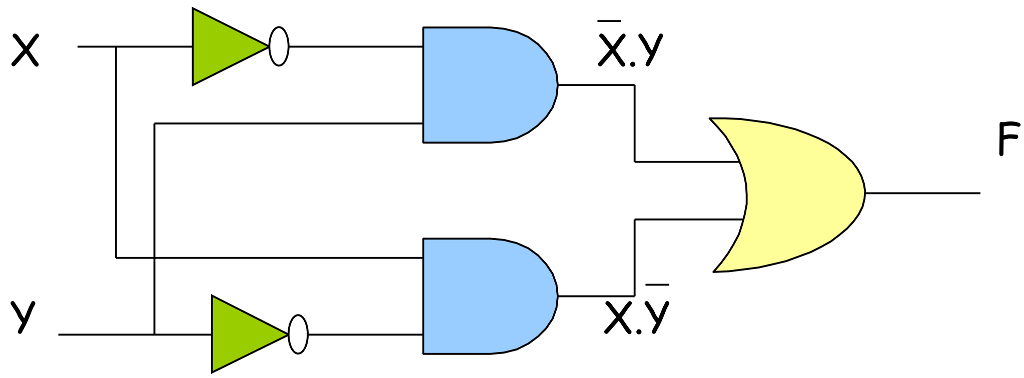
NOT gate

X	$\overline{X}$
0	1
0	0



Typically, logical 1 = +3.5 volt, and logical 0 = 0 volt. Other representations are possible.

Analysis of logical circuits



What is the value of F when X=0 and Y=1?

Draw a truth table.

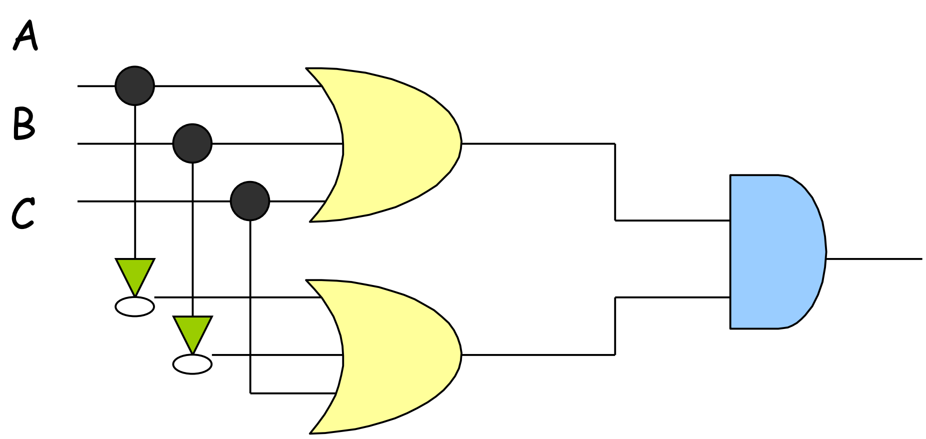
X	Y	F
0	1	0
0	1	1
1	0	1
1	1	0

This is the **exclusive or** (XOR) function. In algebraic form $F = \overline{X}.Y + X.\overline{Y}$

More practice

1. Let $\bar{A}.B + A.C = 0$. What are the values of A, B, C?
1. Let $(A + B + C).(\bar{A} + \bar{B} + C) = 0$. What are the possible values of A, B, C?

- Draw truth tables.
- Draw the logic circuits for the above two functions.



Elementary Boolean Algebra

$$\left.\begin{array}{l} A + 0 = A \\ A \,.\, 1 = A \end{array}\right\}$$

$$A + A' = 1$$

$$A.\ A' = 0$$

$$\left.\begin{array}{l} 1 + A = 1 \\ 0.\ A = 0 \end{array}\right\}$$

$$\left.\begin{array}{l} A + B = B + A \\ A \,.\, B = B \,.\, A \end{array}\right\}$$

$$\left.\begin{array}{l} 0 + A = A \\ 0 + A = A \end{array}\right\}$$

$$\left.\begin{array}{l} A + (B + C) = (A + B) + C \\ A.\ (B.\ C) = (A.\ B).\ C \end{array}\right\}$$

$$\left.\begin{array}{l} A + A = A \\ A \,.\, A = A \end{array}\right\}$$

$$\left.\begin{array}{l} A.\ (B + C) = A.B + A.C \\ A + B.C = (A+B).\ (A+C) \end{array}\right\}$$ Distributive Law

$$\left.\begin{array}{l} \overline{A \,.\, B} = \overline{A} + \overline{B} \\ \overline{A + B} = \overline{A} \,.\, \overline{B} \end{array}\right\}$$ De Morgan's theorem