DeMorgan's Law for **NAND**:

$$\overline{xy} = \bar{x} + \bar{y}$$

Intuition from English:
It's not true that x and y are both true = either x is false or y is false

DeMorgan's Law for **NOR**:

$$\overline{x + y} = \bar{x}\bar{y}$$

Intuition from English:
It's not true that x or y (or both) are true = both x and y are false

"Neither x nor y."

$$\boxed{\overset{\text{not}}{\text{not}}\mathbf{OR}^{\text{not}} = \mathbf{AND}}$$

since $\bar{x} + \bar{y} = \overline{xy}$

by inverting both sides

we have $\overline{\bar{x} + \bar{y}} = xy$

$$\boxed{\overset{\text{not}}{\text{not}}\mathbf{AND}^{\text{not}} = \mathbf{OR}}$$

since $\bar{x}\bar{y} = \overline{x + y}$

by inverting both sides

we have $\overline{\bar{x}\bar{y}} = x + y$

XOR:

$$x \oplus y = x\bar{y} + \bar{x}y$$

This or that but not both (i.e. exactly one is true).

Inverted XOR (aka **NXOR** or **XNOR**):

$$\overline{x \oplus y} = xy + \bar{x}\bar{y}$$

Neither are true, or both are true.