De Morgan's Theorem

De Morgan's theorem provides a valuable tool for simplifying Boolean algebra expressions

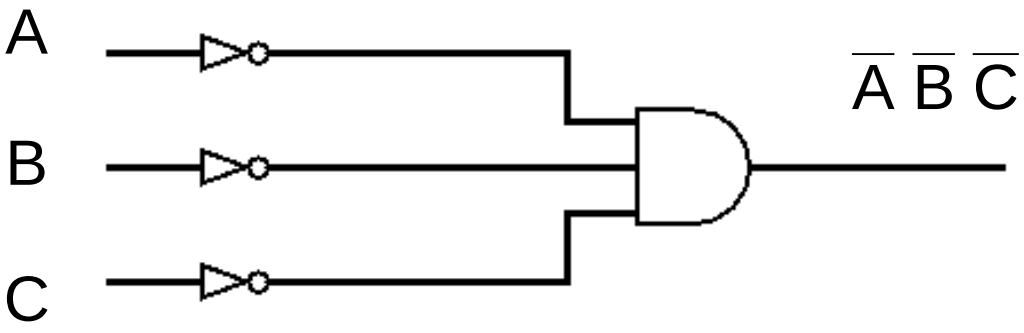
Algorithm – Three steps are required to De Morganize a Boolean algebra expression

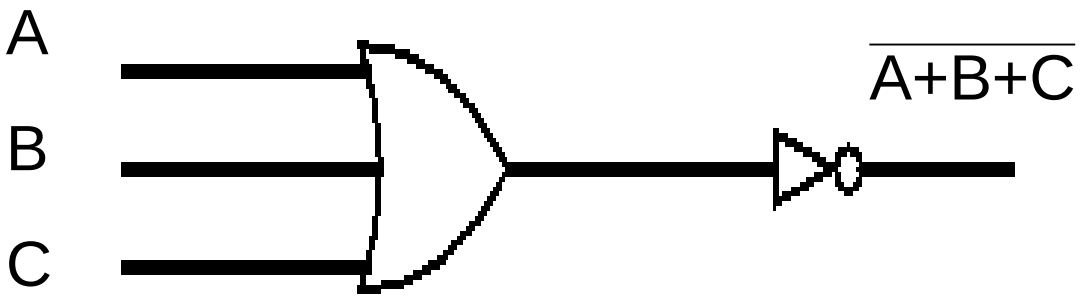
1. Find the biggest single bar and break it
2. Replace OR operator(s) with AND operator, and vice verse
3. Simplify factors or terms using Boolean algebra theorems, postulates, other properties...
4. Repeat steps 1-3 until no further simplification can be made

Augustus De Morgan (1806-1871), English mathematician

De Morgan's Theorem

Logic gate representation of De Morgan's theorem

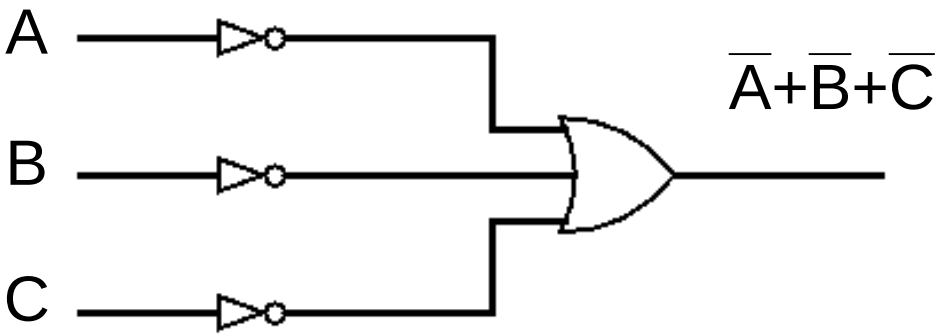


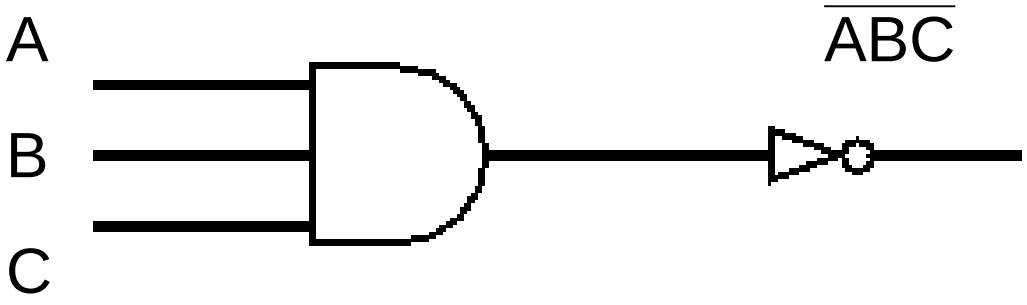


Truth table for this theorem??

De Morgan's Theorem

Logic gate representation of De Morgan's theorem





Truth table for this theorem??

Grouping – NOTs

In certain situations, grouping of variables with AND operation with the use of parenthesis is essential

$\overline{A+BC}$ $\qquad$ $\overline{A+(BC)}$

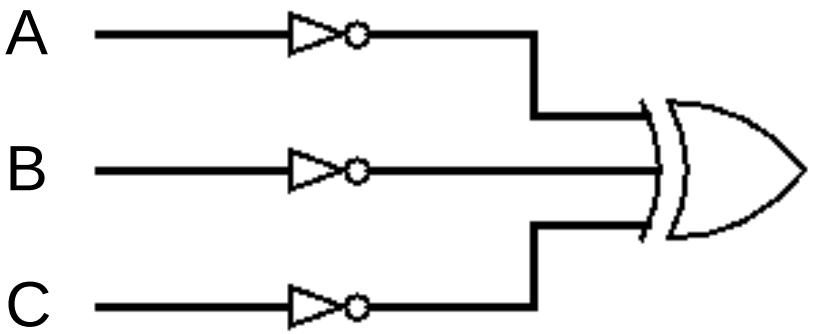
$\overline{A}\,\overline{BC}$ $\qquad$ $\overline{A}(\overline{BC})$

$\overline{A}\,\overline{B}+\overline{C}$ $\qquad$ $\overline{A}(\overline{B}+\overline{C})$

$$\overline{A}\,\overline{B}+\overline{C} \neq \overline{A}(\overline{B}+\overline{C})$$

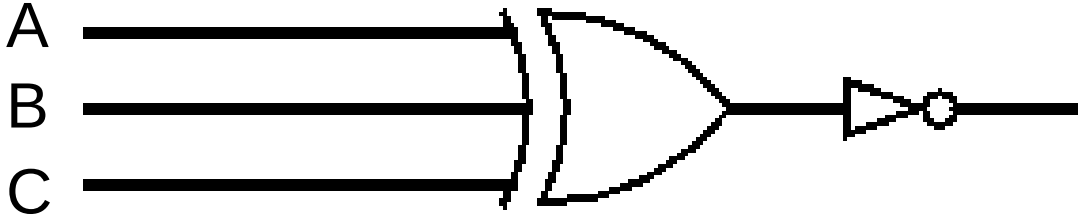
Using the truth table, it can be shown that solution $\overline{A}(\overline{B}+\overline{C})$ is the correct one

XOR – XNOR



$\overline{A} \oplus \overline{B} \oplus \overline{C}$

$\overline{A \oplus B \oplus C}$



Even though this reduction may look like an application of De Morgan's theorem...it cannot be classified as such since it does not follow the algorithm outlined earlier

Truth table for this theorem??

Review Questions

Review question set 10