Section 2.6: More LOL

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De Morgan's:

$$\overline{AB} = \bar{A} + \bar{B}$$

$$\overline{A+B} = \bar{A} \cdot \bar{B}$$

examples: use De Morgan's to rewrite:

① $\overline{B + C} = \bar{B}\,\bar{C}$

② $\overline{\bar{B} + C} = B\,\bar{C}$

③ $\overline{\bar{B} + \bar{C}} = B\,C$

④ 

⑤ $\overline{A\bar{C}} = \bar{A} + C$

⑥ $\bar{A}C = \overline{A + \bar{C}}$

when would you see this in code

if (x = 5 or y = 2) then do Ⓐ
else do Ⓑ

under what conditions does the

"else clause" with action B occur?

=> when (x = 5 or y = 2) is FALSE

in other words, when $x \neq 5$ AND $y \neq 2$

Distributive:

$$A(B+C) = AB + AC$$

$$A + BC = (A+B)(A+C)$$

example: rewrite the following using the distributive law

① $\bar{C}(A+C) = \bar{C}A + \bar{C}C$

② $(A+B)(A+\bar{B}) = A + B\bar{B}$

③ $\bar{B} + \bar{A}\bar{C} = (\bar{B}+\bar{A})(\bar{B}+\bar{C})$

④ $\overline{AB}(B+\bar{C}) = \overline{AB}B + \overline{AB}\bar{C}$

Absorption:

$$A(A+B) = A$$

$$A(\bar{A}+B) = AB$$

$$A + AB = A$$

$$A + \bar{A}B = A + B$$

example: use the absorption laws to rewrite the following:

1. $\bar{C}(\bar{C} + A) = \bar{C}$

2. $\bar{C}(C + A) = \bar{C}A$

3. $AB + ABC = AB$

4. $\bar{B} + BA = \bar{B} + A$

5. $\overline{AB} + ABC = \overline{AB} + C$

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simplify

$(p \vee q) \wedge (p \vee r) \Leftrightarrow p \vee (q \wedge r)$

$(\sim p \vee \sim q) \wedge (p \vee \sim q)$

$\sim q \vee (\sim p \wedge p)$ distributive

$\sim q \vee 0$ complement

$\sim q$ identity

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simplify $AB(\bar{A} + \bar{B})$

method #1: $AB\bar{A} + AB\bar{B}$ distributive

$B \cdot 0 + A \cdot 0$ complement

$0 + 0$ — identity

0 — one of { idempotent, identity, definition of "or" }

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method #2

$AB(\bar{A} + \bar{B})$

$AB\,\overline{AB}$ — De Morgan's

0 — complement

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method #3

$AB(\bar{A} + \bar{B})$

$A\,B\,\bar{A}$ — absorption

$B \cdot 0$ — complement

0 — identity

$A(\bar{A}+B) = AB$

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prove: $\overline{B \cdot 0} = \bar{A} + \overline{\bar{A}\,\bar{B}}$

$\bar{0} = \bar{A} + \overline{\bar{A}\,\bar{B}}$ — identity

$1 = \bar{A} + \overline{\bar{A}\,\bar{B}}$ — definition of "not"

$1 = \bar{A} + A + B$ — DeMorgan's

$1 = 1 + B$ — complement

$1 = 1$ identity

QED

simplify: $\bar{B}(\bar{A}+B) + \bar{A}(\bar{A}+B)$

method #1: $\bar{B}\bar{A} + \bar{A}$ absorption

$\bar{A}$ "

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method #2 $\bar{B}(\bar{A}+B) + \bar{A}(\bar{A}+B)$

$\bar{B}\bar{A} + \bar{B}B + \bar{A}\bar{A} + \bar{A}B$ distributive

$\bar{B}\bar{A} + 0 + \bar{A}\bar{A} + \bar{A}B$ complement

$\bar{B}\bar{A} + \bar{A}\bar{A} + \bar{A}B$ identity

$\bar{B}\bar{A} + \bar{A} + \bar{A}B$ idempotent

$\bar{A} + \bar{A}(\bar{B}+B)$	distrib	$\bar{B}\bar{A} + \bar{A}$	absorption
$\bar{A} + \bar{A}\cdot 1$	complement	$\bar{A}$	absorption
$\bar{A} + \bar{A}$	identity		
$\bar{A}$	idempotent		

method # 3 :

$$\bar{B}(\bar{A} + B) + \bar{A}(\bar{A} + B)$$

$$(\bar{A} + B)(\bar{B} + \bar{A})$$ distributive

$$\bar{A} + B\bar{B}$$ "

$$\bar{A} + 0$$ complement

$$\bar{A}$$ identity