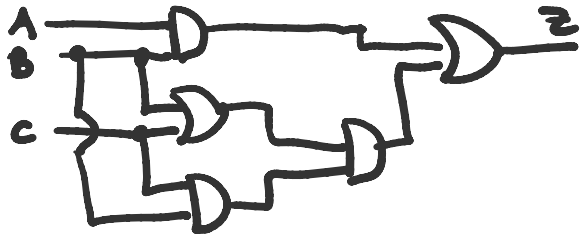
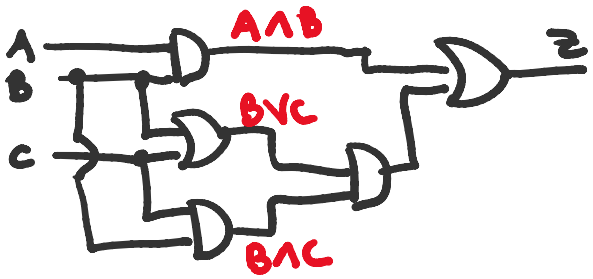
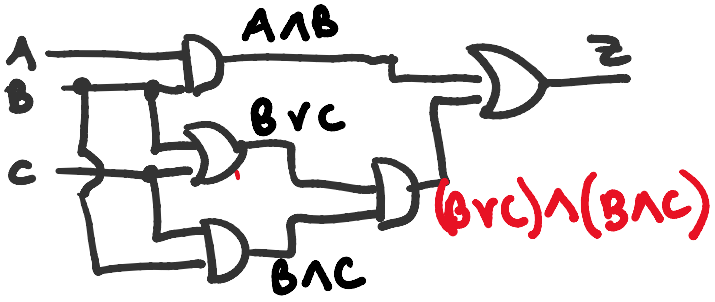
Worked Example - Simplifying Circuits

1. Simplify this circuit:

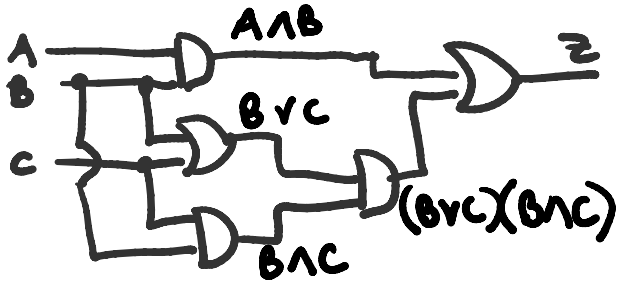


2. Write intermediate expressions for the output of each gate beginning from the left-hand side…





3. Until you finally have an expression for the output (traditionally, the output is Q or Z but could be any letter).



$Z = (A \wedge B) \vee [(B \vee C) \wedge (B \wedge C)]$

4. At this point, you can use the laws of Boolean algebra to simplify:

$(A \wedge B) \vee [(B \vee C) \wedge (B \wedge C)]$

$(A \wedge B) \vee [(B \wedge C) \wedge B) \vee ((B \wedge C) \wedge C)]$ Distributive

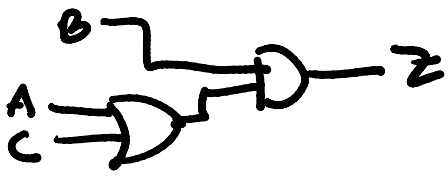
$(A \wedge B) \vee [((B \wedge B) \wedge C) \vee (B \wedge (C \wedge C))]$ Associative (+ Commutative)

$(A \wedge B) \vee [(B \wedge C) \vee (B \wedge C)]$ Idempotent

$(A \wedge B) \vee (B \wedge C)$ Idempotent again

$B \wedge (A \vee C)$ Distributive

5. Redraw the new (simplified) circuit




A
C