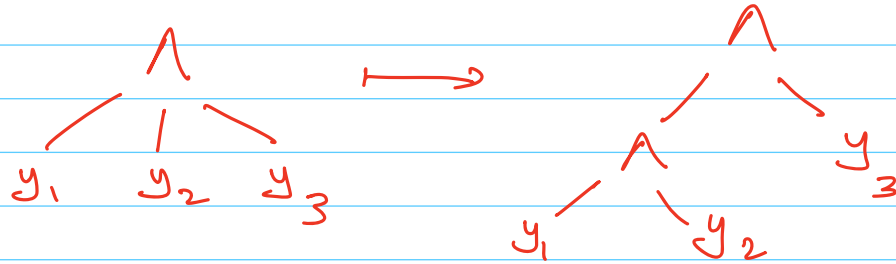
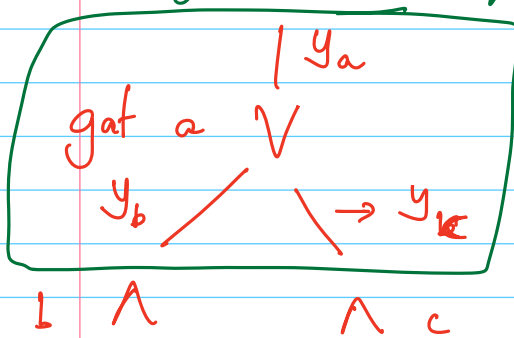


③ $CIRCUITSAT \leq 3SAT = \{ \phi \mid \phi \text{ is a CNF with } \leq 3 \text{ literals per clause} \}$

C: Assume that every gate has fan-in ≤ 2



Every gate can be replaced by a conjunction of clauses with at most 3 literals



y_a	y_b	y_c	
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$(y_a \vee y_b \vee \bar{y}_c) \wedge (y_a \vee \bar{y}_b \vee y_c) \wedge (y_a \vee \bar{y}_b \vee \bar{y}_c) \wedge (\bar{y}_a \vee y_b \vee y_c)$$

↳ Do this conversion for every gate & take conjunction of all formulas to obtain ϕ

* # of variables in φ has increased

* φ is satisfiable iff C is satisfiable.

(\Leftarrow) If C is satisfiable. \exists assignment to the input wires that satisfy C while evaluating the assignment the values of the internal wires are fixed and this gives a satisfying assignment for φ

(\Rightarrow) If φ is satisfiable, consider the assignment that φ gives to the input wires of C .

(4) $3SAT \leq CLIQUE$

$$\varphi = C_1 \wedge C_2 \wedge \dots \wedge C_m \quad C_i = l_{i_1} \vee l_{i_2} \vee l_{i_3}$$

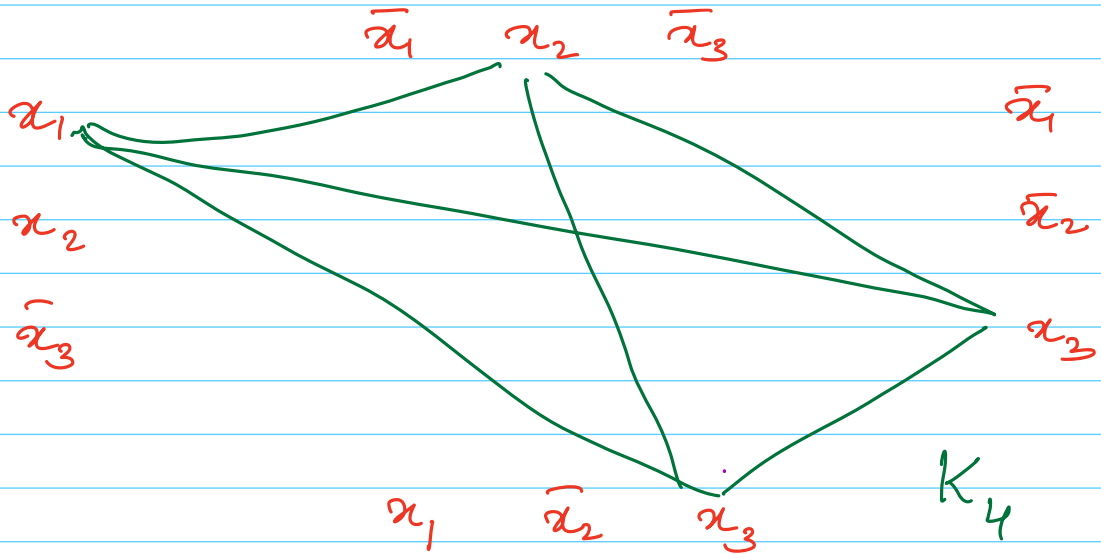
$$G(V, E) \quad V = V_1 \cup V_2 \cup \dots \cup V_m$$

$$\text{where } V_i = \{l_{i_1}, l_{i_2}, l_{i_3}\}$$

No edges between vertices in $V_i \quad \forall i \in [m]$

$$E = \{(l_{i_r}, l_{j_s}) \mid l_{i_r} \neq \bar{l}_{j_s}\}$$

$$\varphi = (x_1 \vee x_2 \vee \bar{x}_3) \wedge (\bar{x}_1 \vee x_2 \vee \bar{x}_3) \\ \wedge (\bar{x}_1 \vee \bar{x}_2 \vee x_3) \wedge (x_1 \vee \bar{x}_2 \vee x_3)$$



φ is satisfiable iff G has a K_m