

Propositional Satisfiability (SAT): Conflict-Driven Clause Learning (CDCL)

Tjark Weber

+ slides by Marijn Heule



The CDCL Algorithm

The main difference between CDCL and DPLL is that CDCL's back jumping is non-chronological.

while not all variables are assigned :

1. select an unassigned variable and assign True or False // *decision*
2. apply unit propagation
3. **if** there is a conflict :
 - 3.1 analyze the conflict to learn a new clause
 - 3.2 non-chronologically backtrack (back jump) to an appropriate decision level depending on the conflict clause
(**return** UNSAT if there is no such level)

return SAT

Mini-tutorial on conflict-driven clause learning solvers

Marijn J. H. Heule

The University of Texas at Austin

20/01/2014 @ BIRS

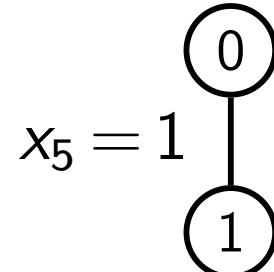
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$

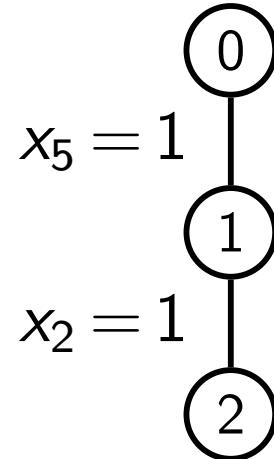
0

Conflict-driven SAT solvers: Search and Analysis

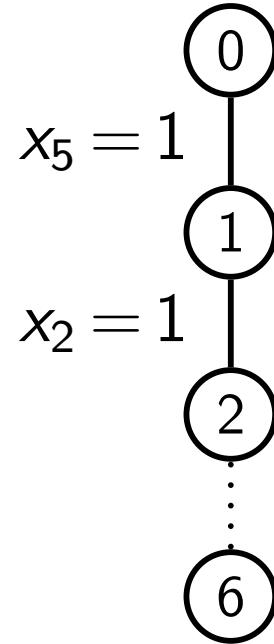
$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



Conflict-driven SAT solvers: Search and Analysis

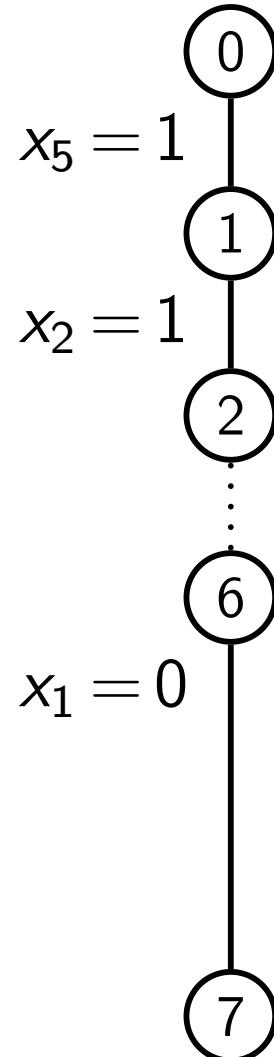
$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$


Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$


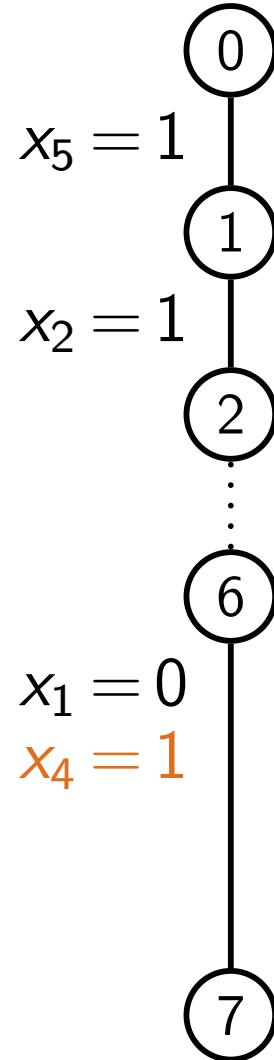
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



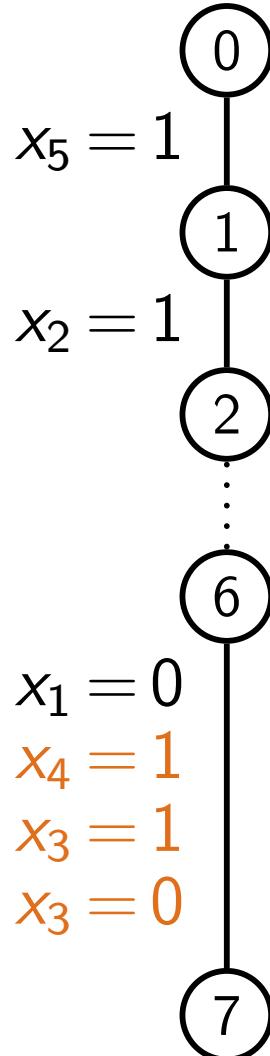
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



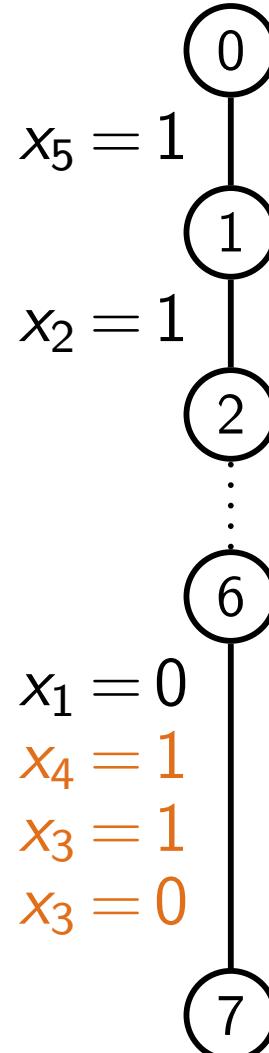
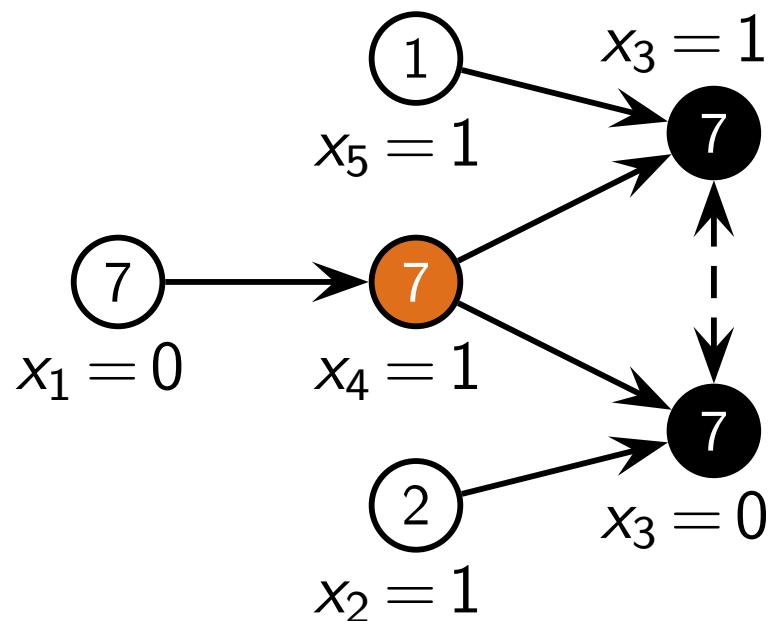
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



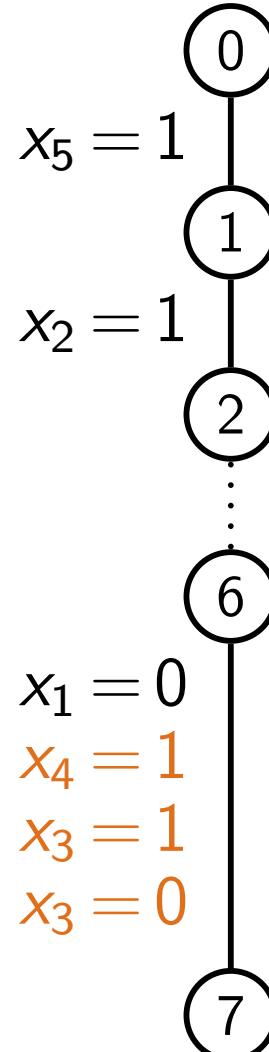
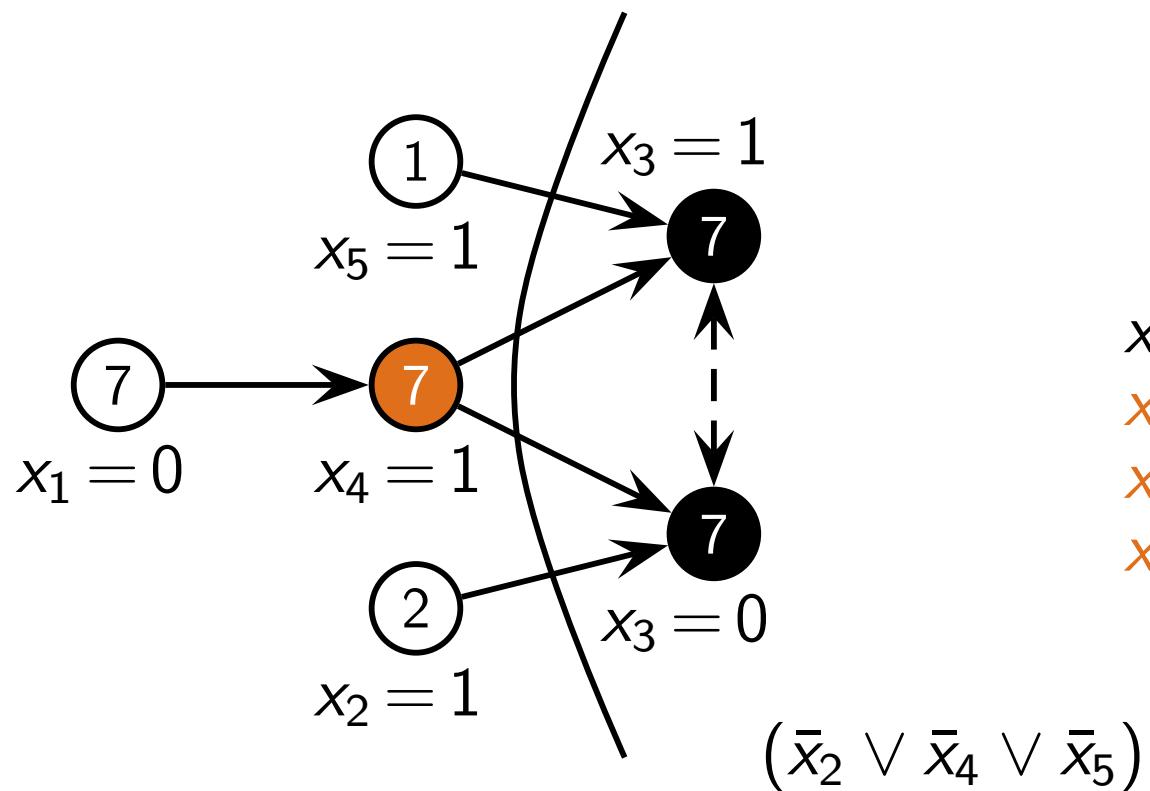
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



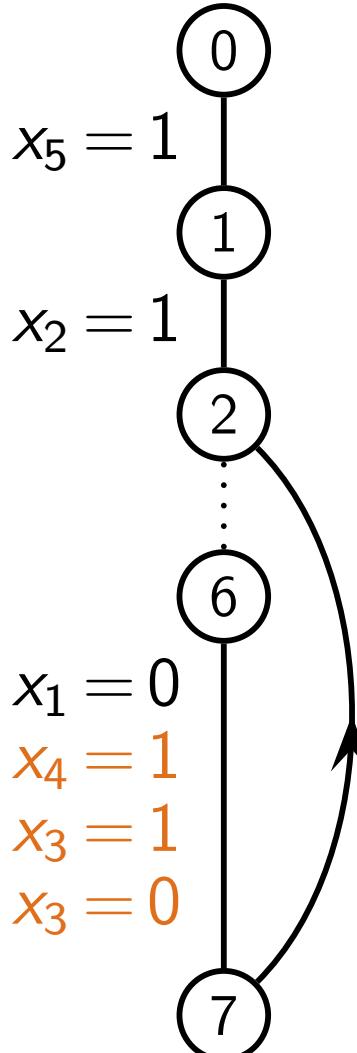
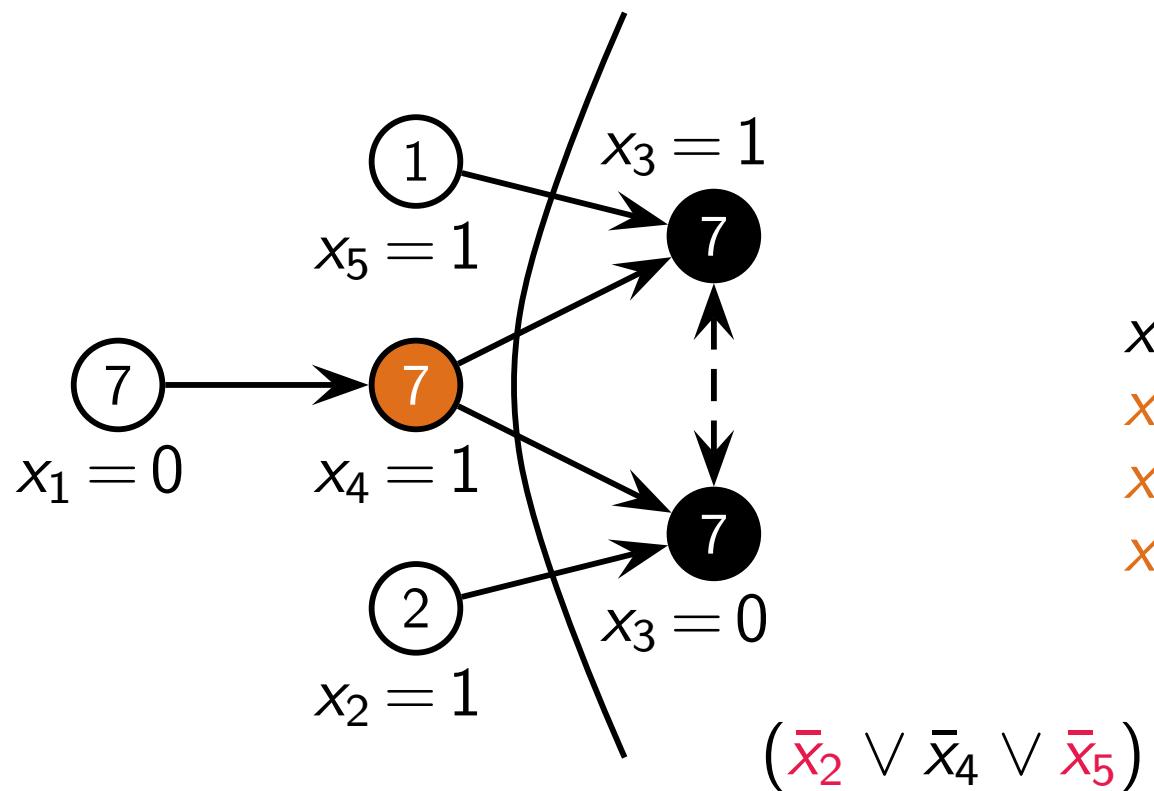
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



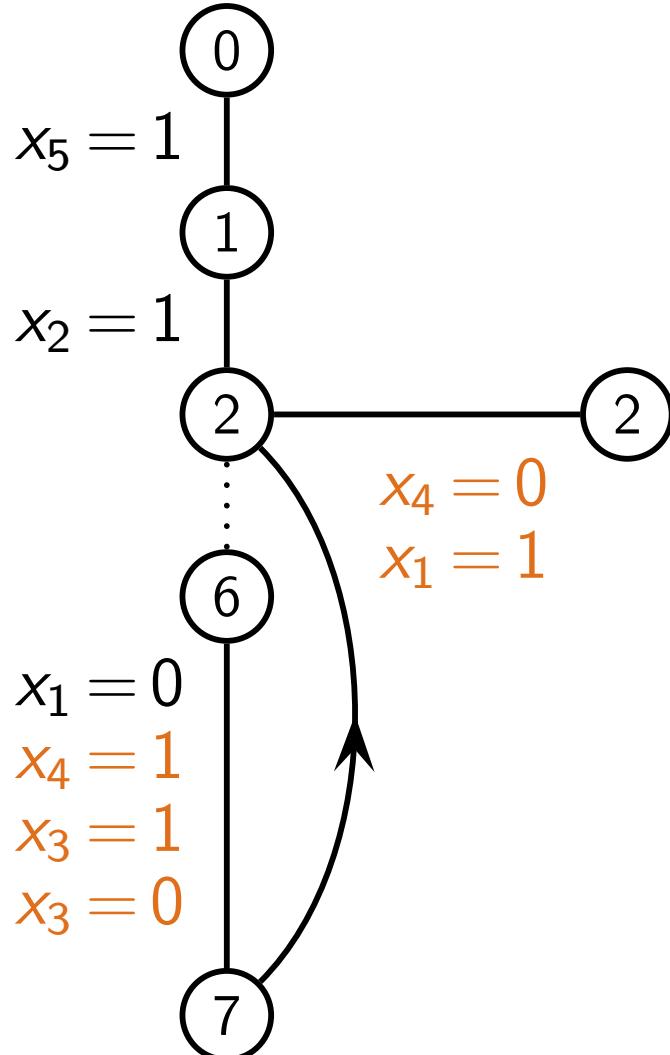
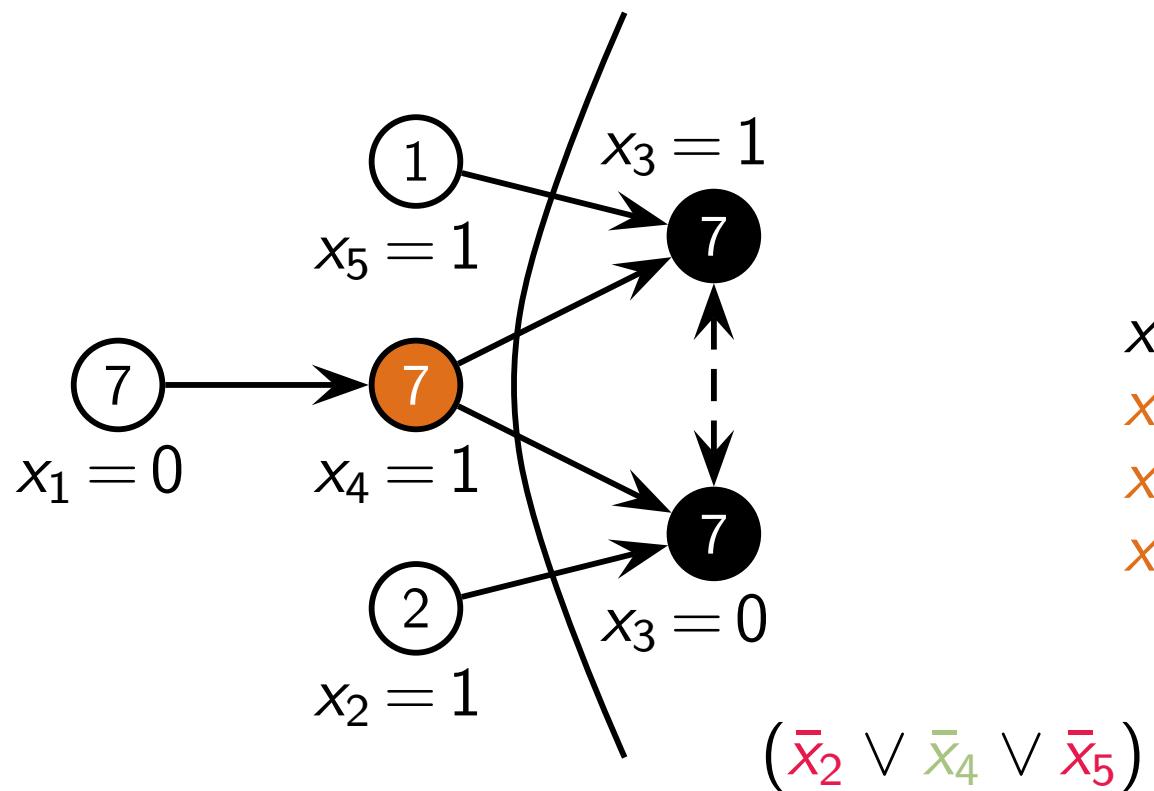
Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$



Conflict-driven SAT solvers: Search and Analysis

$$\begin{aligned} & (x_1 \vee x_4) \wedge \\ & (x_3 \vee \bar{x}_4 \vee \bar{x}_5) \wedge \\ & (\bar{x}_3 \vee \bar{x}_2 \vee \bar{x}_4) \wedge \\ & \mathcal{F}_{\text{extra}} \end{aligned}$$

