

Propositional Satisfiability (SAT)

Solving with

- encode problem in propositional logic
- convert to CNF
- run a SAT solver to find a satisfying assignment (if any)
= solution

SAT solvers are based on the Resolution proof system

SAT is one of the two main methods for formal verification:
Bounded model checking

Resolution Proofs

$$\text{Rule: } \frac{(A \vee l) \quad (\neg l \vee B)}{(A \vee B)}$$

where l is a literal

A, B are ^{disjunctions of} propositional atoms
(or any propositional formulas in general)

In our case, A, B are e.g.

$p \vee q \vee s$ etc.

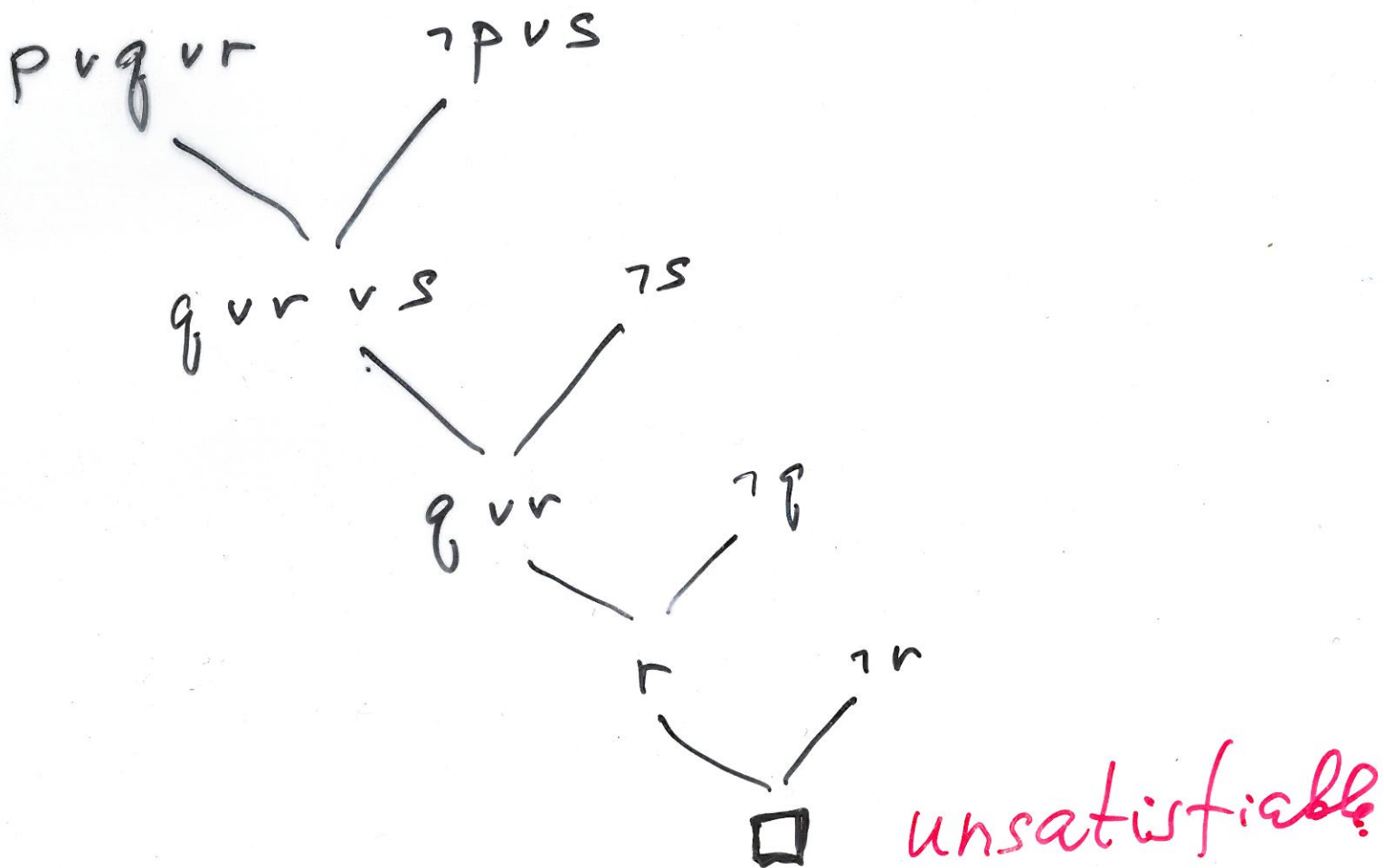
(the rest of the clause)

CNF formula unsatisfiable $\Leftrightarrow$
the empty clause is derived

An example of a resolution refutation:

formula in CNF:

$(p \vee q \vee r) \wedge (\neg p \vee s) \wedge (\neg s) \wedge (\neg q) \wedge (\neg r)$
satisfiable? - construct a resolution refutation.



Ex

$$\frac{(p \vee q) \quad (\neg p \vee q)}{(q)}$$

$$\frac{(p \vee q \vee \neg r \vee \neg s) \quad (\neg p \vee q \vee \neg r \vee \neg u)}{(q \vee \neg r \vee \neg s \vee \neg r \vee \neg u)}$$

$$\frac{(p) \quad (\neg p)}{()}$$

← empty clause,
often written $\square$, is
unsatisfiable.