Learning Better Representations From Less Data For Propositional Satisfiability

Mohamed Ghanem, Frederik Schmitt, Julian Siber, Bernd Finkbeiner

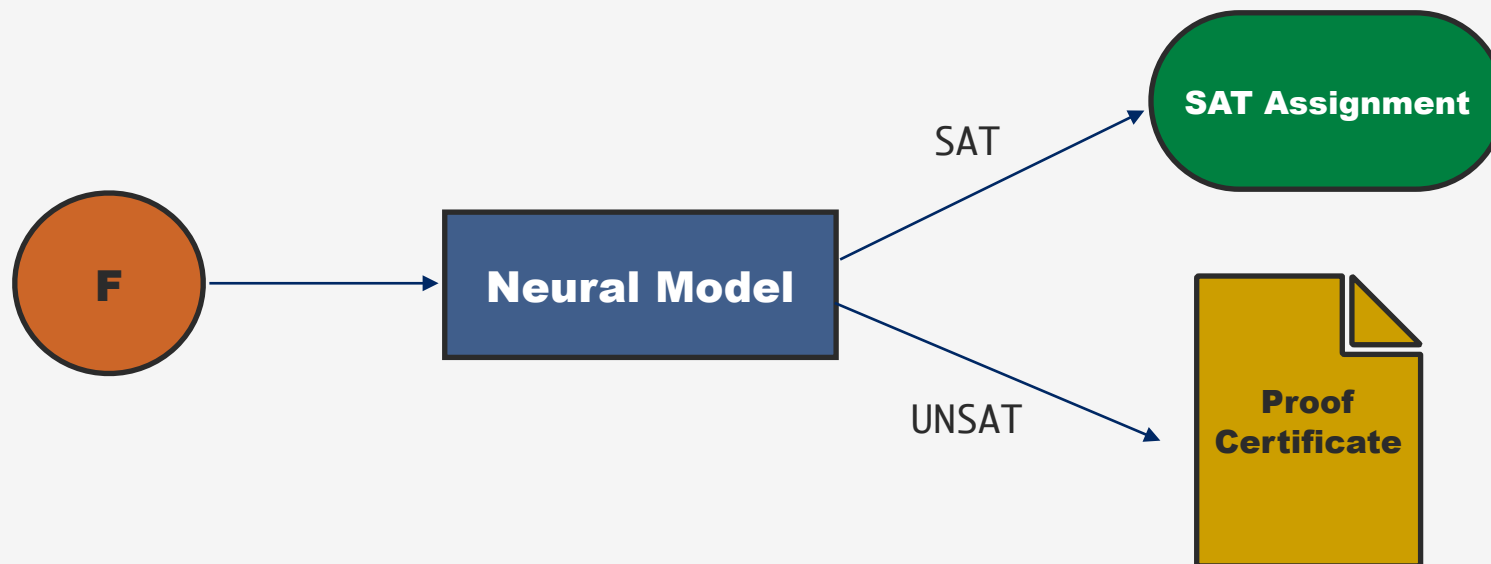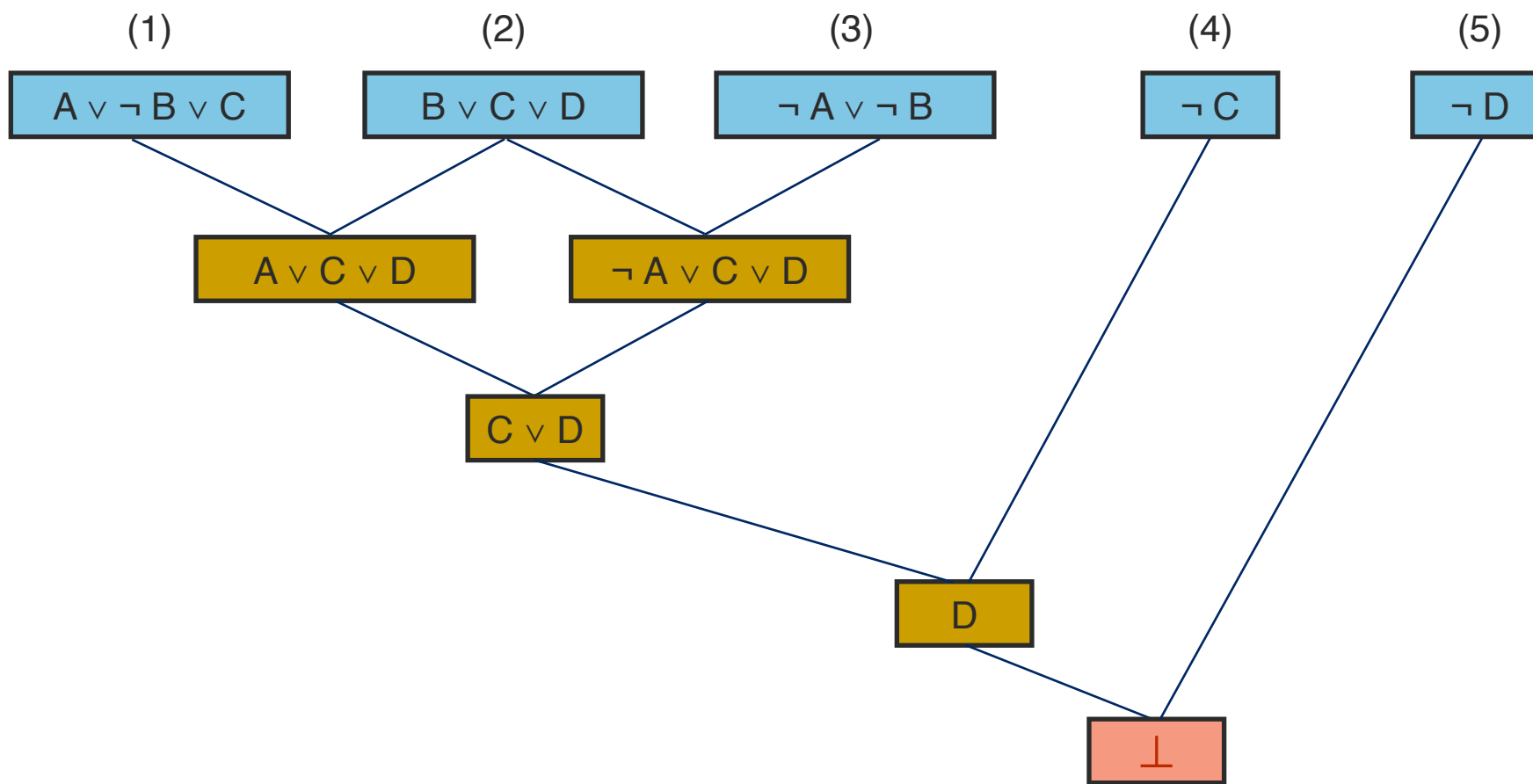## NeurIPS 2024 Spotlight

Motivation

Figure: Ideal Neural SAT Solver
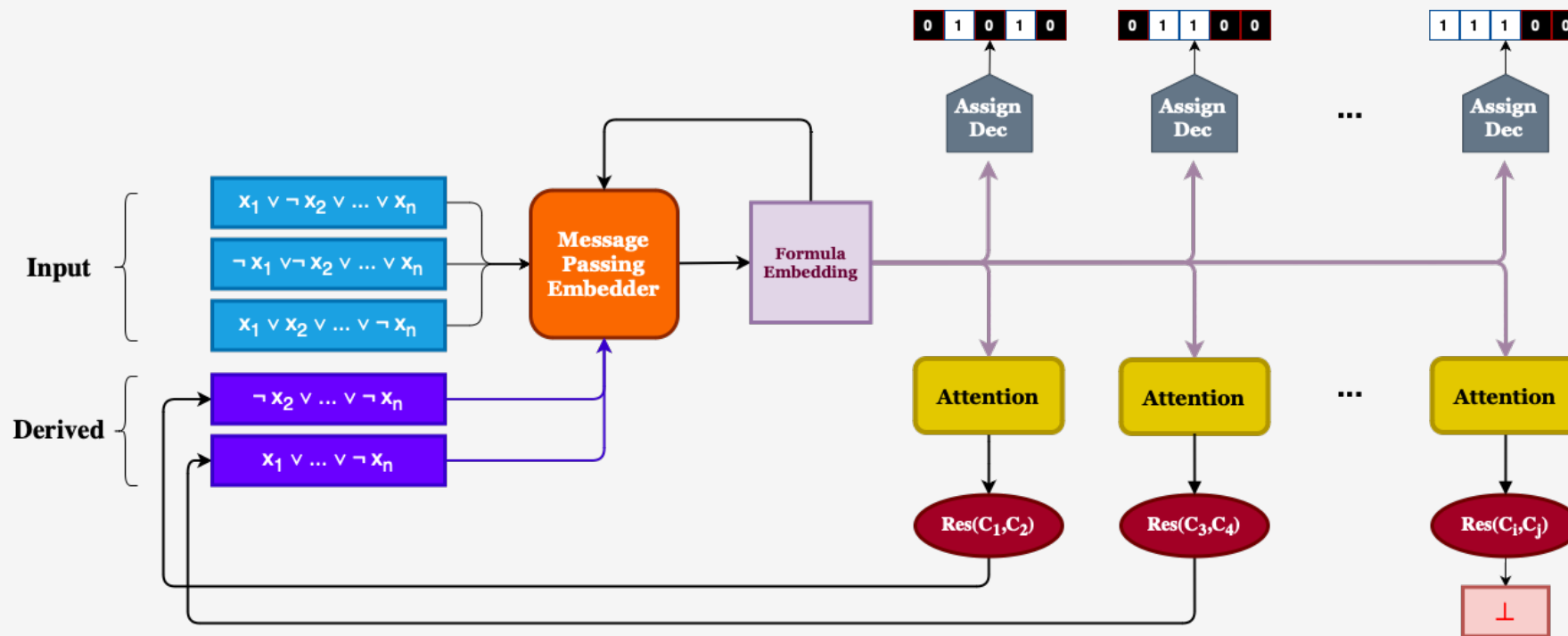
Our solution: **Neu**ral **Res**olution (**NeuRes**)

Resolution Proofs

$$\frac{C_1 \cup \{x\} \qquad C_2 \cup \{\bar{x}\}}{C_1 \cup C_2} \; Res$$

(1)

$A \lor \neg B \lor C$

(2)

$B \lor C \lor D$

(3)

$\neg A \lor \neg B$

(4)

$\neg C$

(5)

$\neg D$

$A \lor C \lor D$

$\neg A \lor C \lor D$

$C \lor D$

D

$\bot$

Overall Network Architecture

Bootstrapping: Proof Reduction

REDUCTION DEPTH	MAX: 23, AVG: 6.6
PROOF REDUCTION (%)	MAX: 86.11, AVG: 33.51
PROOFS REDUCED (%)	90.08
TOTAL REDUCTION (%)	31.85
P-LEN	1.15
SUCCESS RATE (%)	100.0

Full-Solver Performance

Model	Proven (%)			Predicted (%)		
	SAT	UNSAT	Total	SAT	UNSAT	Total
NeuRes	**96.8**	**99.6**	**98.2**	**84.28**	**99.2**	**91.65**
NeuroSAT [1]	70	-	-	73	96	85

[1] Selsam, Daniel, et al. "Learning a SAT solver from single-bit supervision." International Conference on Learning Representations 2019.

Thank You!

I hope you enjoy the paper!

You can find our implementation at https://github.com/Oschart/NeuRes