SAT Solvers in Computational Algorithm Design

- We used SAT and MAX-SAT solvers to design novel distributed algorithms
- **Idea:** Express the existence of an algorithm as a finite combinatorial problem
- **Results:** New optimal algorithms and impossibility results in three domains

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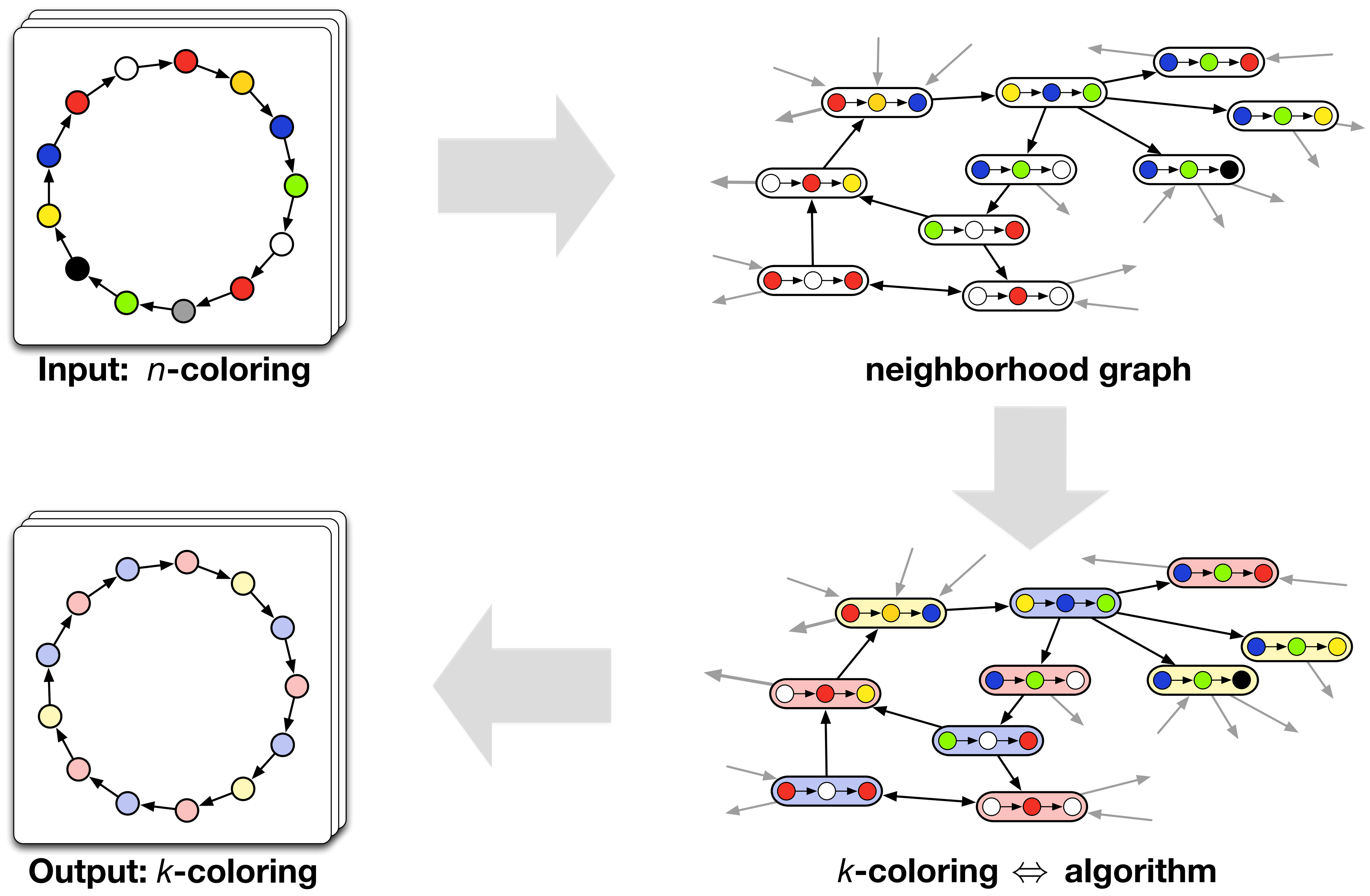
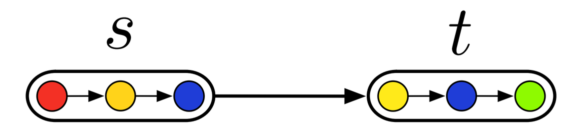
Deterministic graph coloring



k-coloring as SAT instance



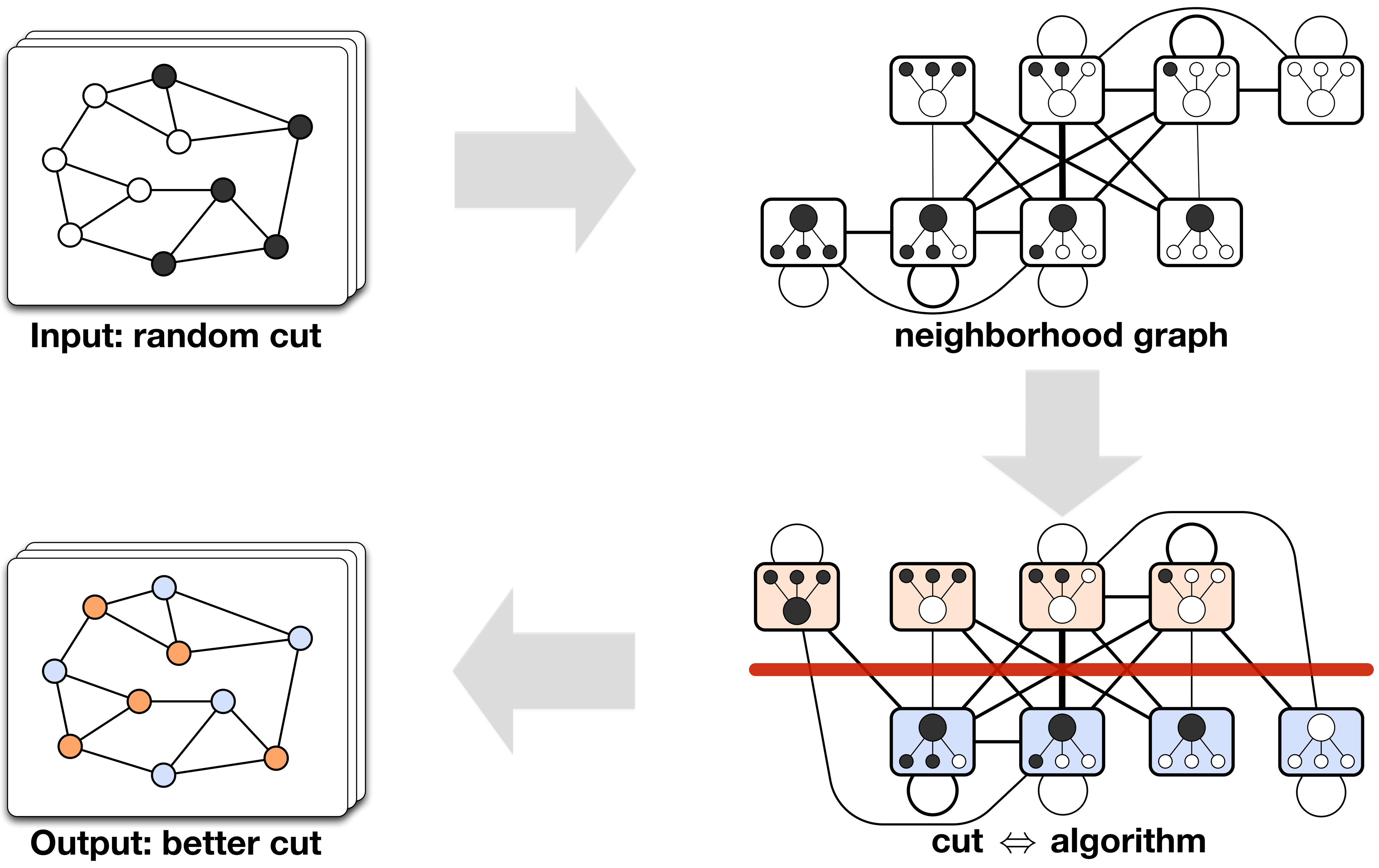
$$\overline{x}_{s,i} \wedge \overline{x}_{t,i} \quad i = 1, \dots, k$$
$$x_{s,1} \vee \cdots \vee x_{s,k}$$

Key results

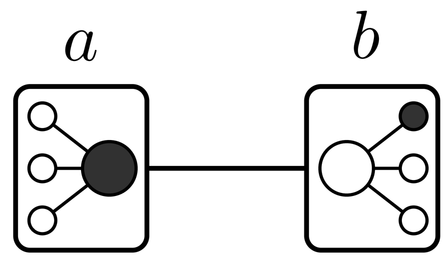
Positive: $\frac{1}{2}(\log^* n + 7) \to \frac{1}{2}(\log^* n + 3)$

Negative: $\frac{1}{2}(\log^* n - 3) \to \frac{1}{2}(\log^* n + 1)$

Randomized max cut



Weighted MAX-SAT instance

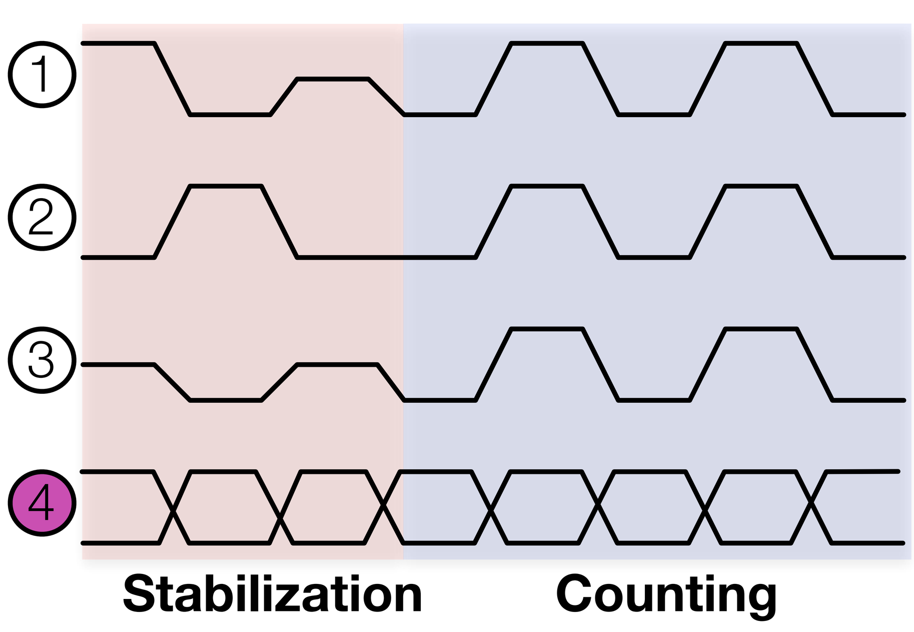


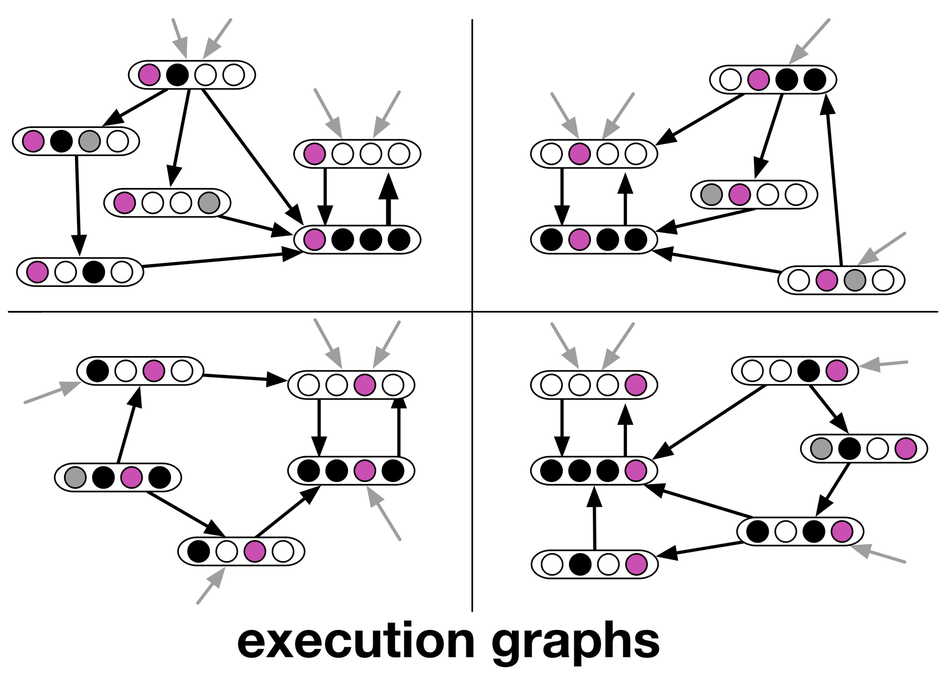
$$(x_a \vee x_b) \colon w(a,b)$$
$$(\overline{x}_a \vee \overline{x}_b) \colon w(a,b)$$

Key results

An optimal cut algorithm: $\frac{1}{2} + \Theta\left(\frac{1}{\sqrt{d}}\right)$

Self-stabilizing counting with Byzantine failures





Key results

	Nodes	Auxilary states
Positive	≥ 4	1
	≥ 6	0
Negative	≤ 5	0