Self-Stab. Clock Sync. with 3-bit Messages

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joint work with

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Weak Communication Model

- Chaotic
- Anonymous
- Passive
- Parsimonious

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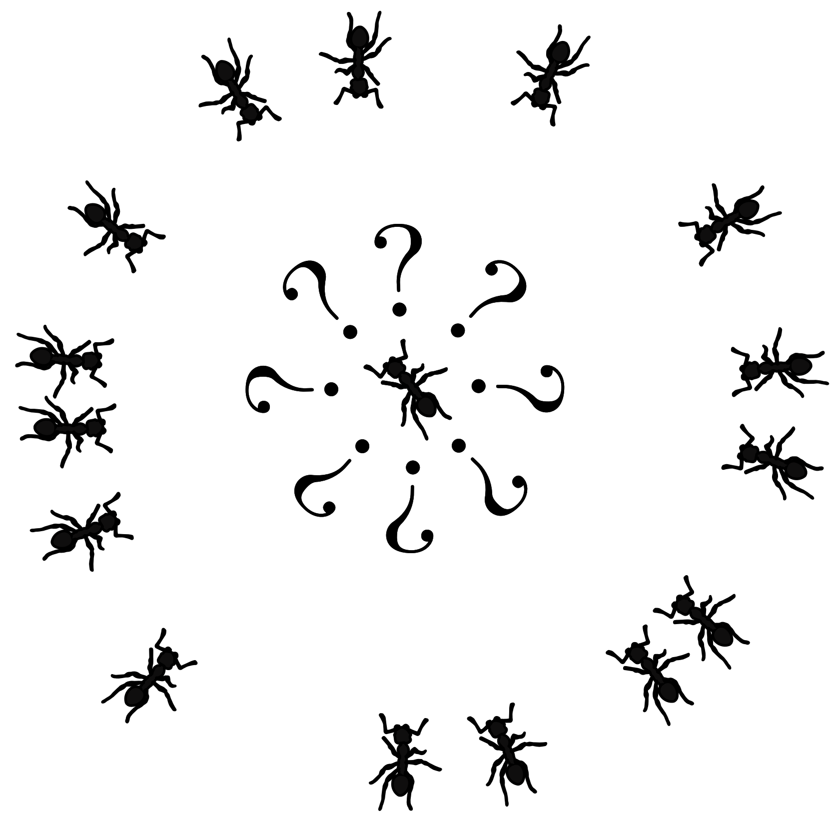
$\mathcal{PULL}(h,\ell)$ **model [Demers '88]**: at each round each agent can *observe* h other agents chosen independently and uniformly at random, and *shows* ℓ *bits* to her observers.



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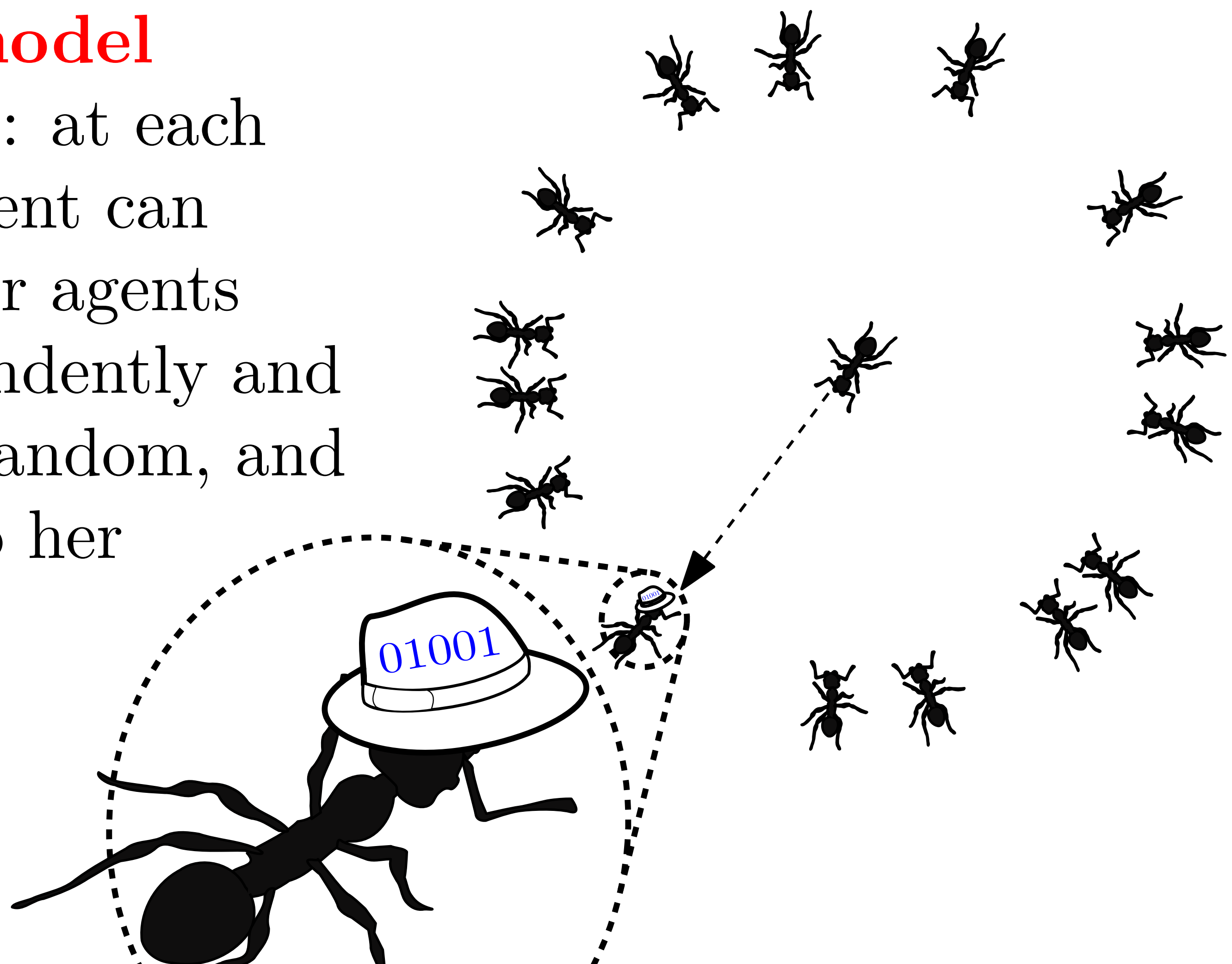
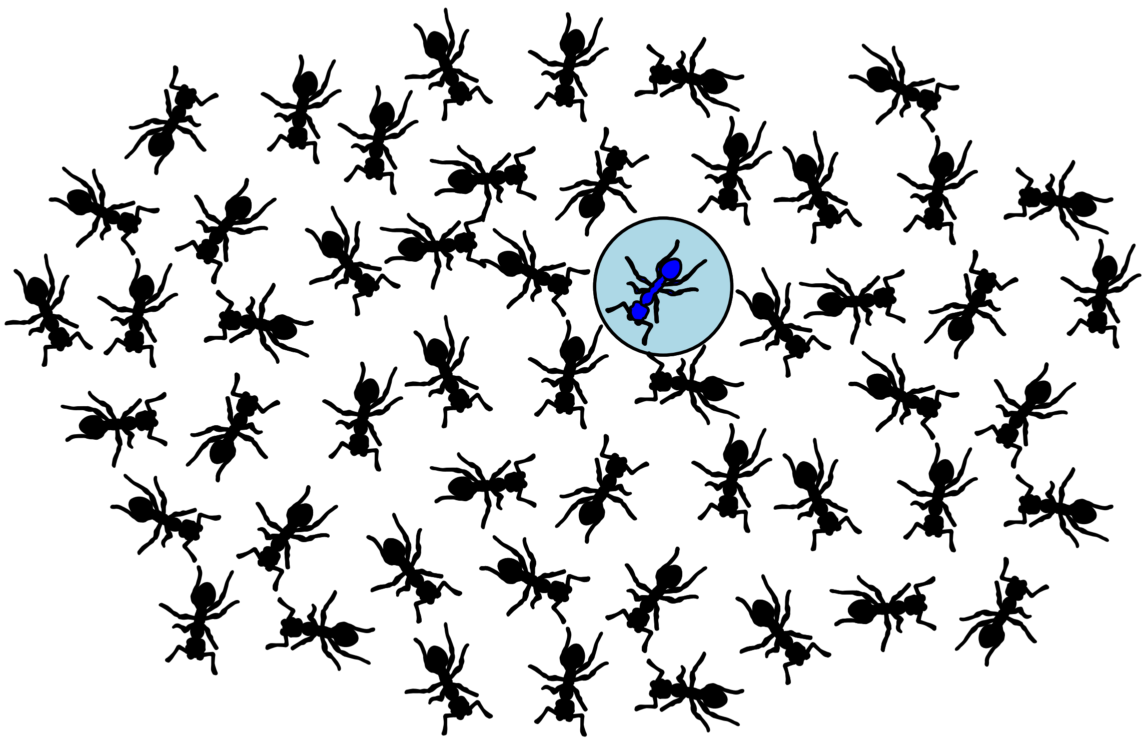


Self-Stabilization Bit Dissemination

Sources' bits may change in response to *external environment*



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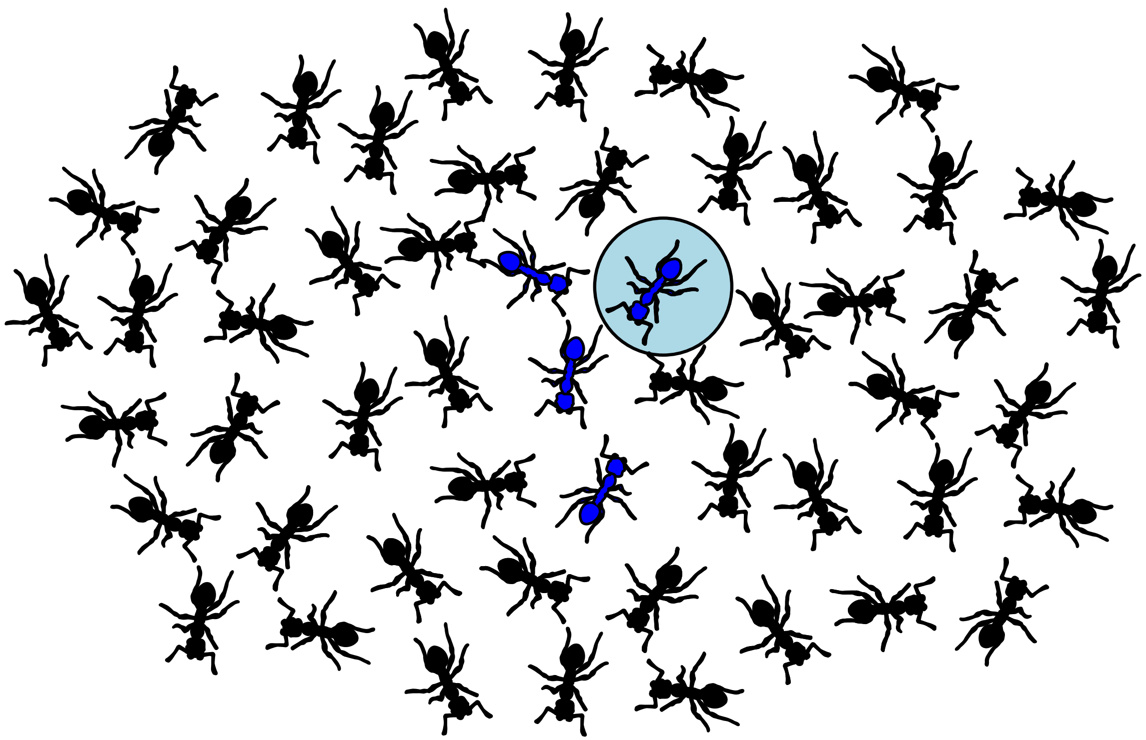

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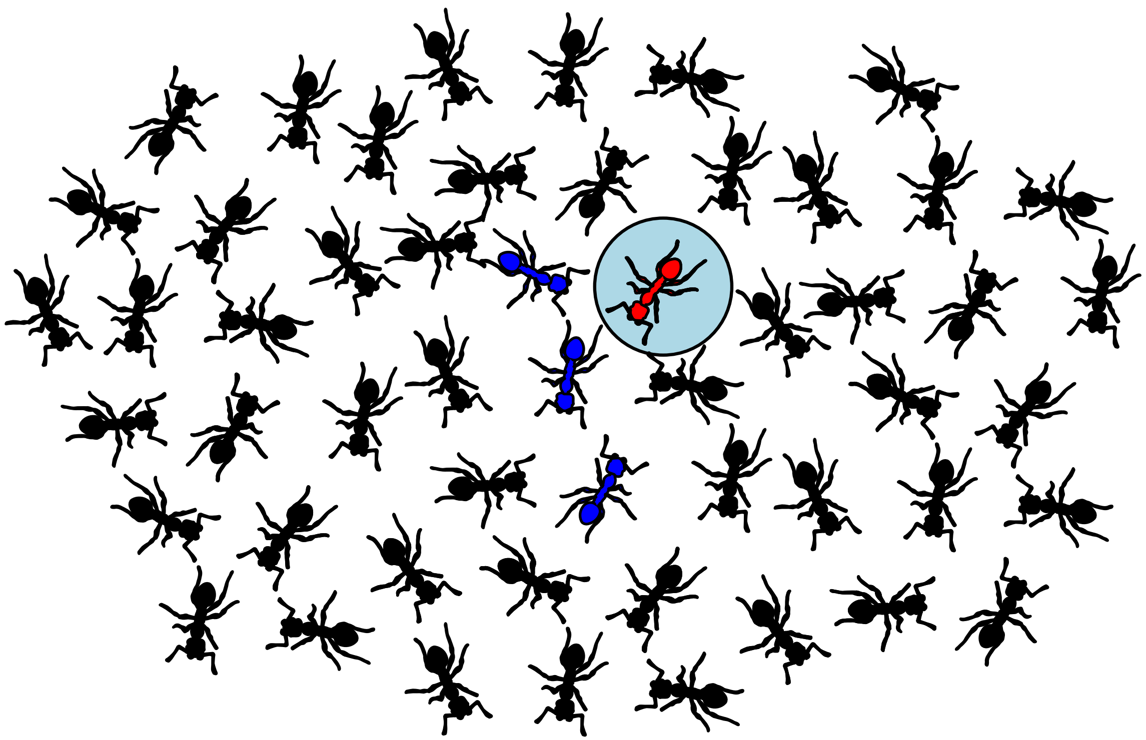

Self-Stabilization Bit Dissemination

(or Broadcast or Rumor Spreading)

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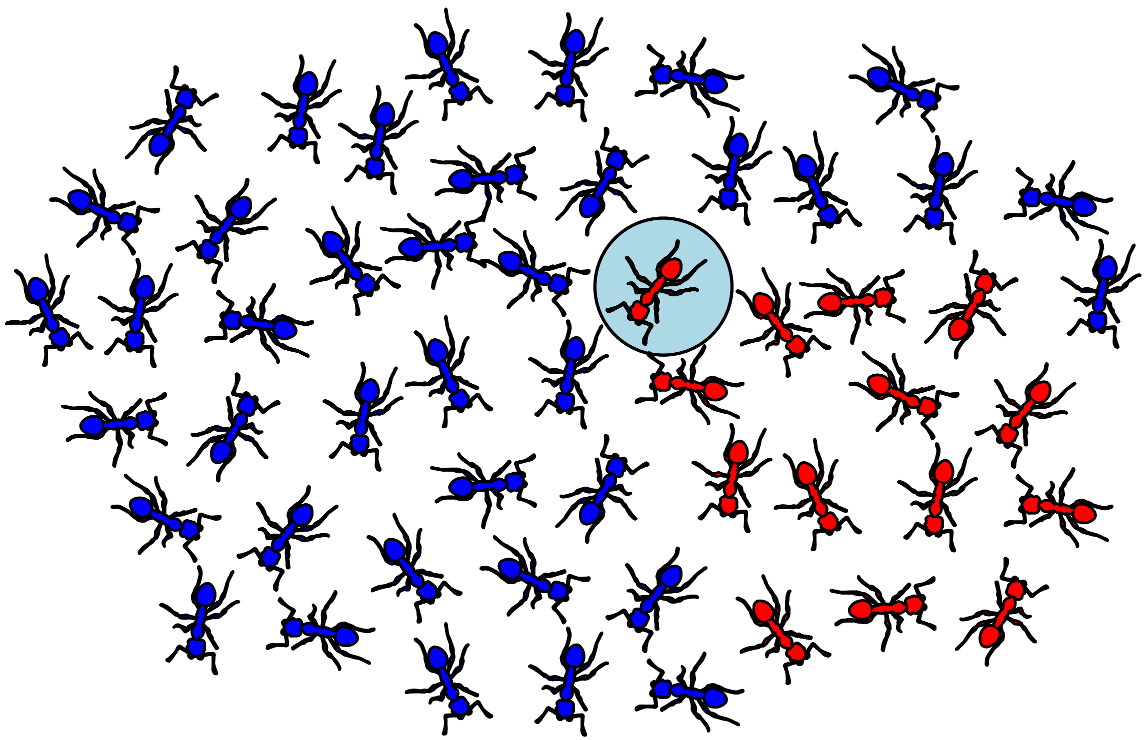


blue vs red:

$39/14 \approx 2.8$

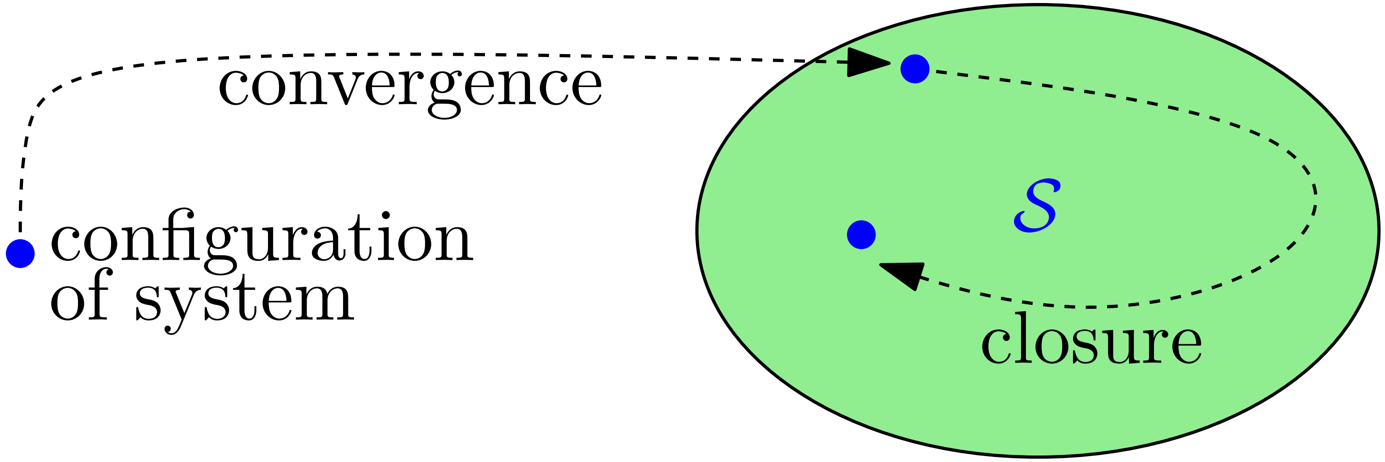
Self-Stabilization Bit Dissemination

(Probabilistic) self-stabilization:

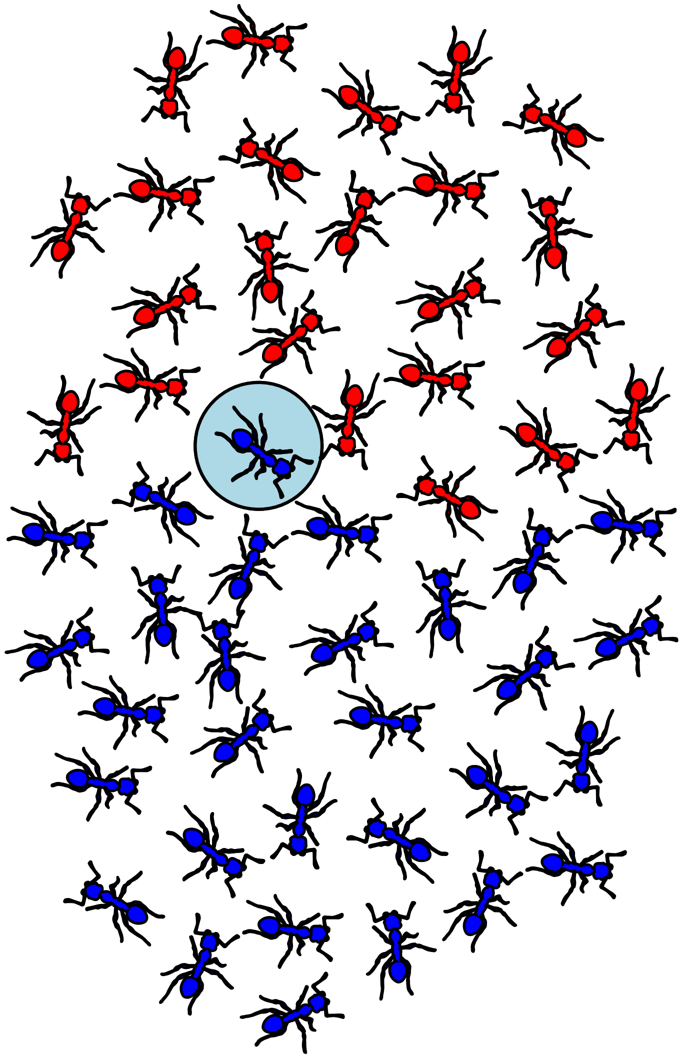
$\mathcal{S}$:= {"correct configurations of the system" }
(= consensus on source's bit)

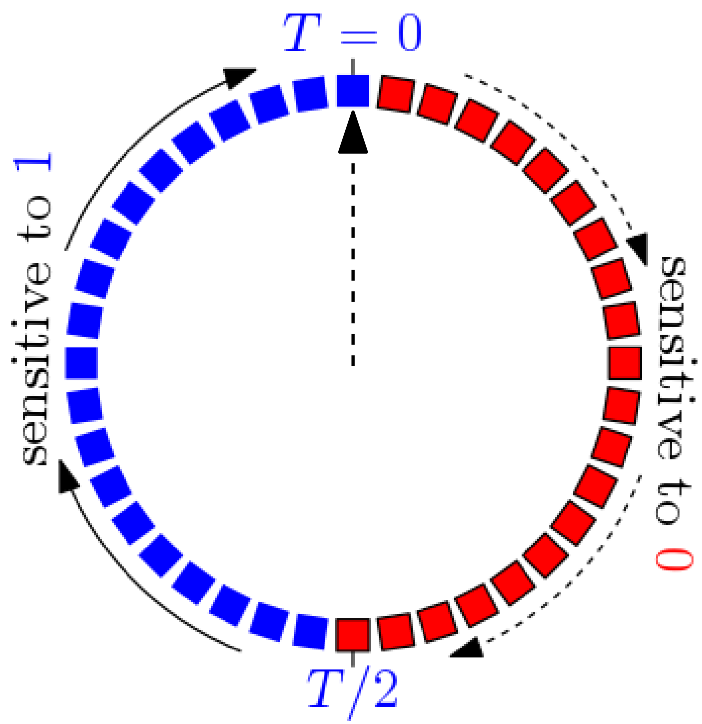
- **Convergence.** From *any* initial configuration, the system reaches $\mathcal{S}$ (w.h.p.)
- **Closure**. If in $\mathcal{S}$, the system stays in $\mathcal{S}$ (w.h.p.)

(Probabilistic) Self-stabilizing algorithm:
guarantees *convergence* and *closure* w.r.t. $\mathcal{S}$ *(w.h.p.)*



(Self-Stab.) Bit Dissemination vs Synchronization





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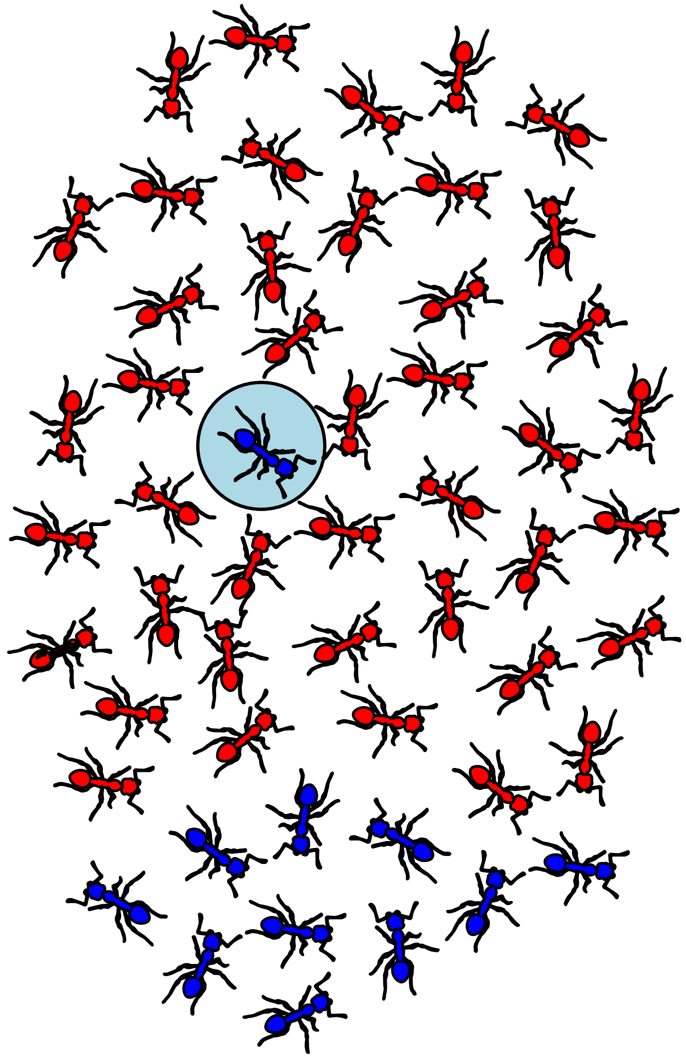

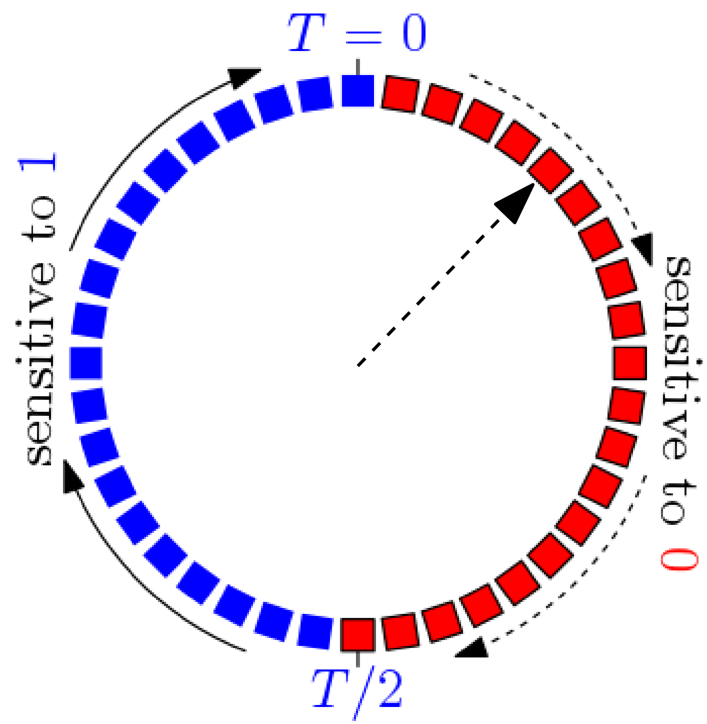

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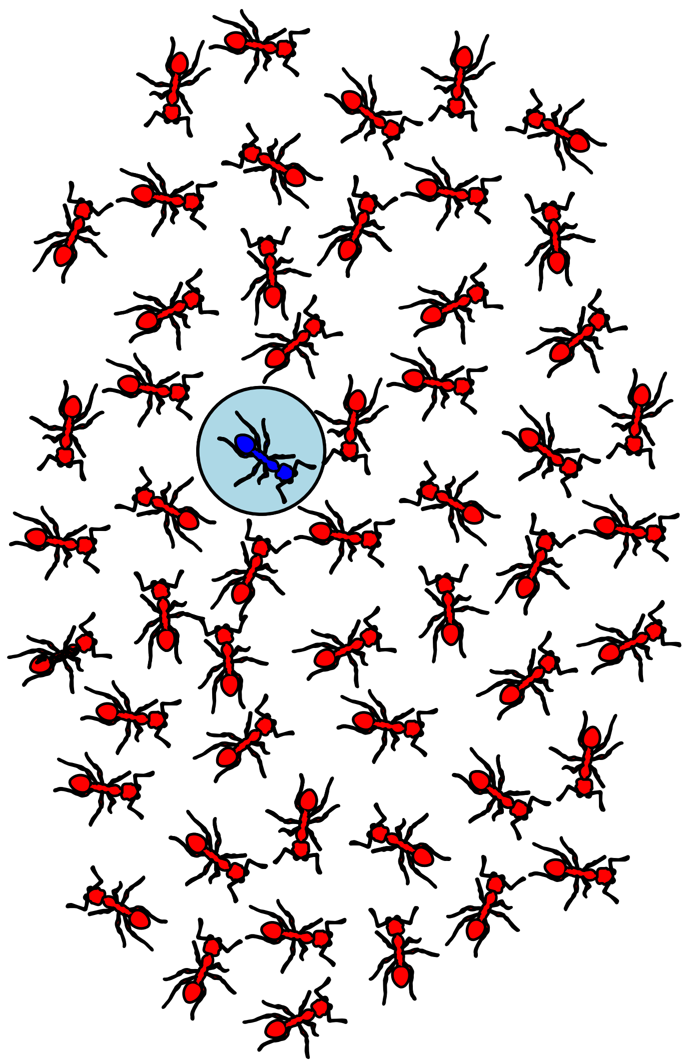

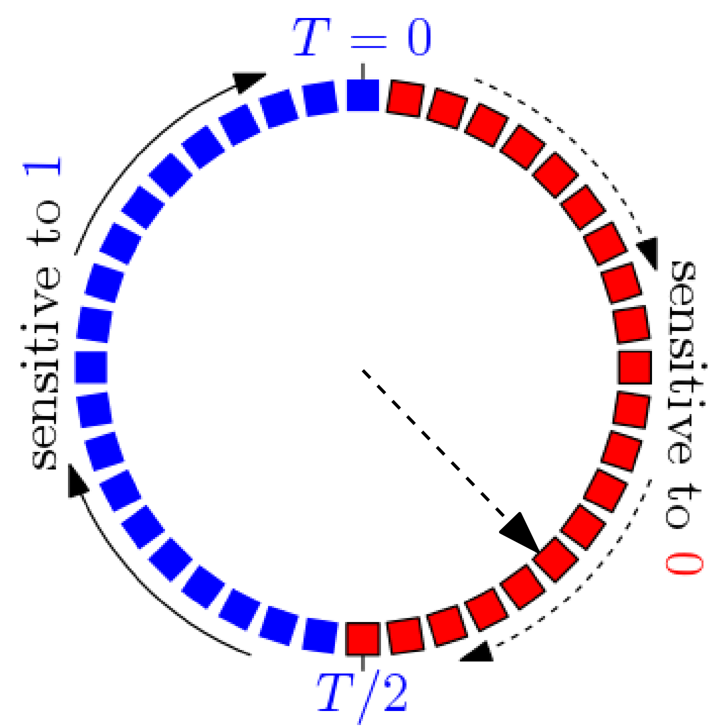

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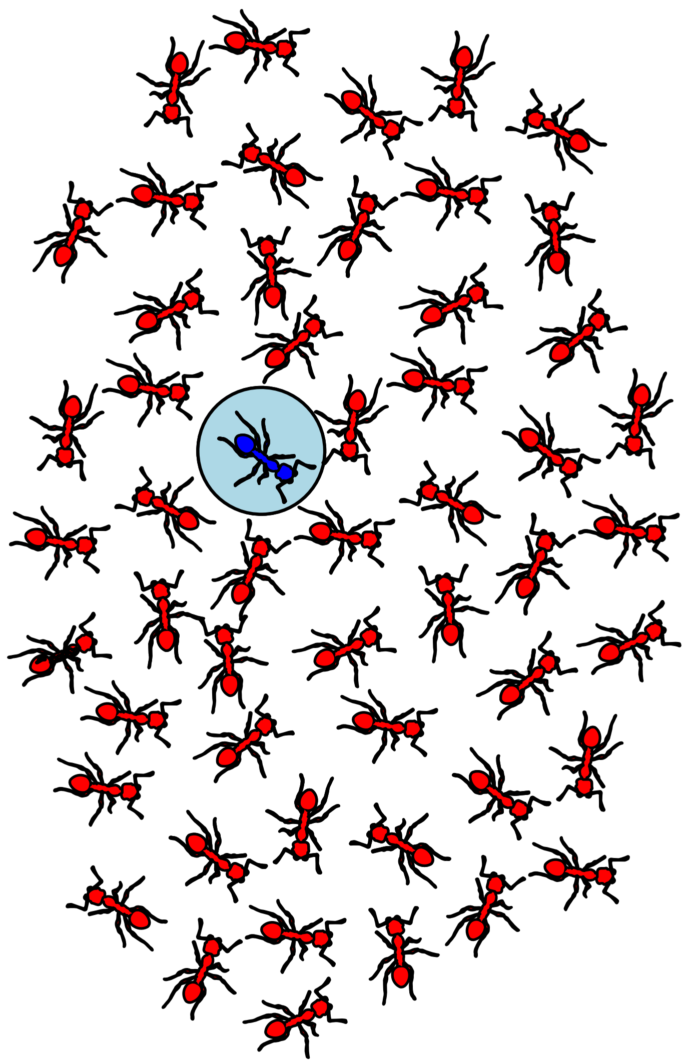

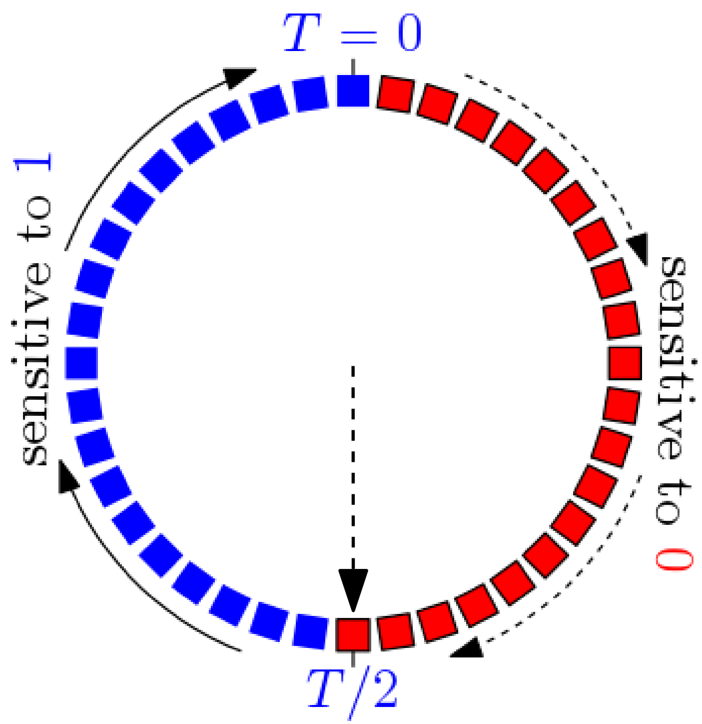

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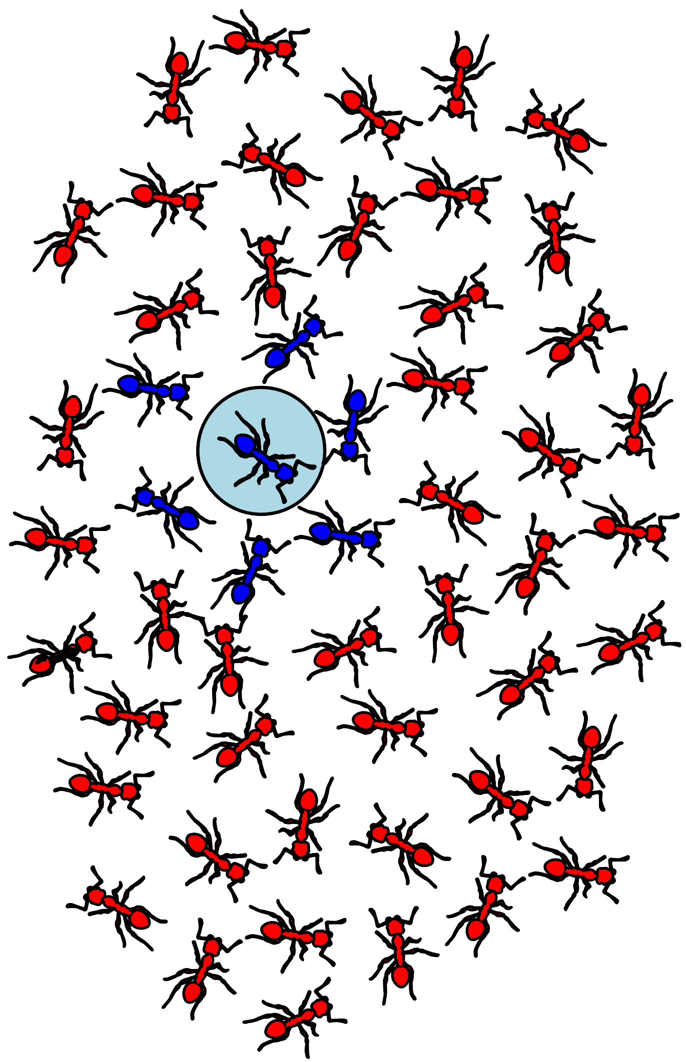

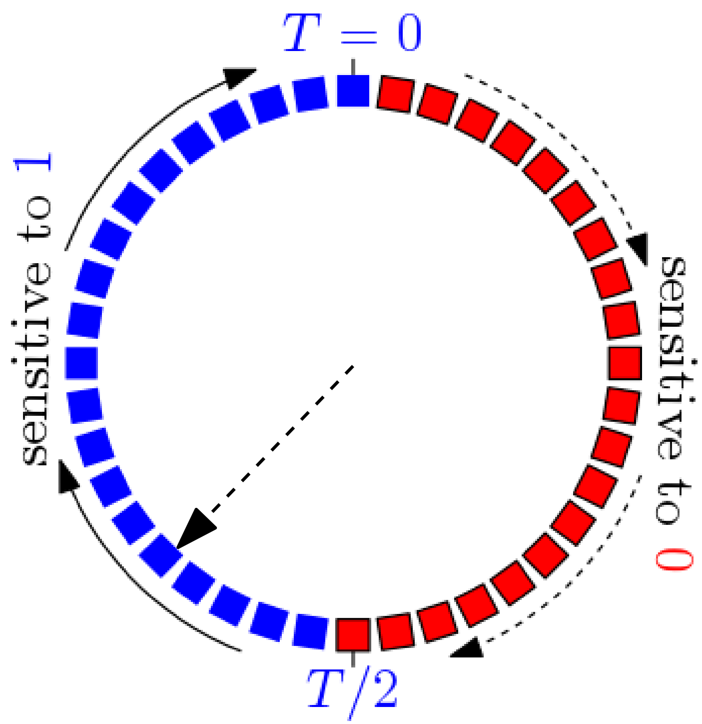

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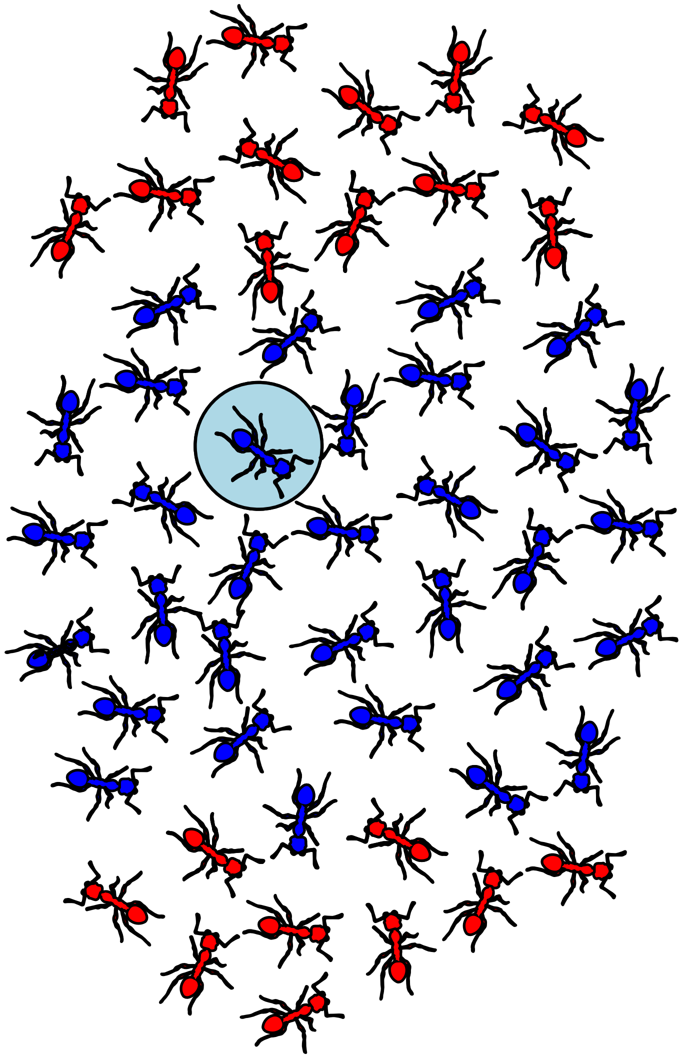

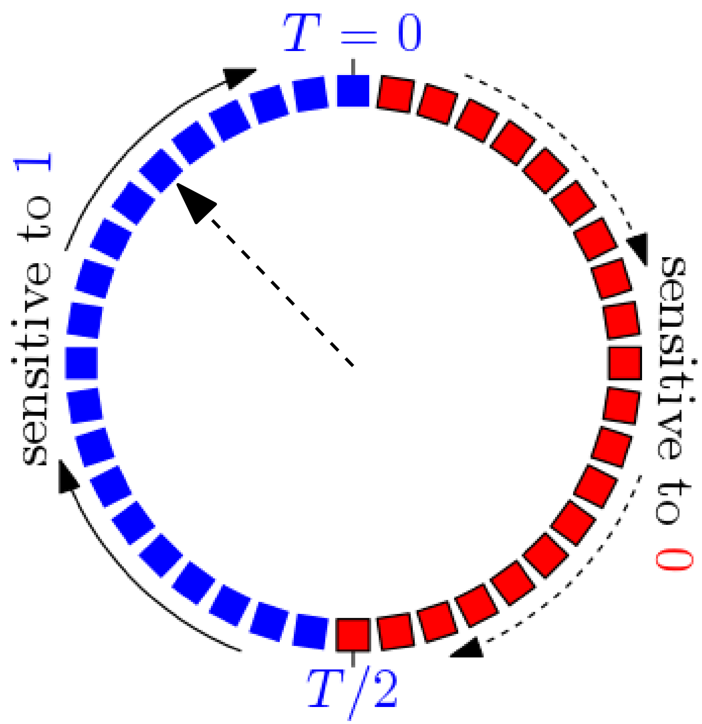

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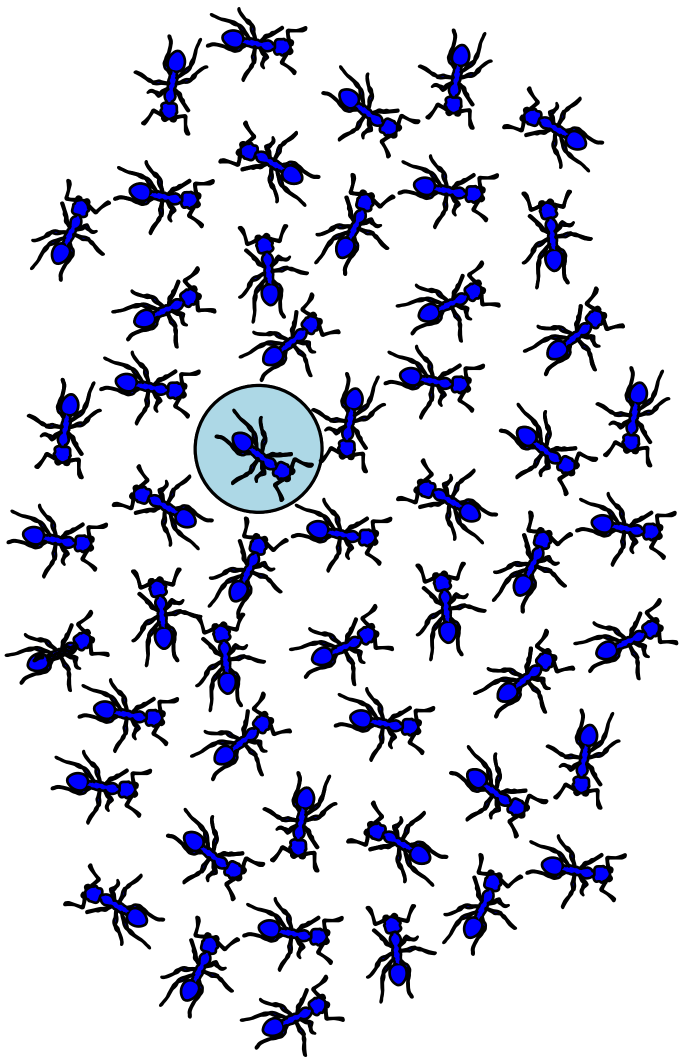
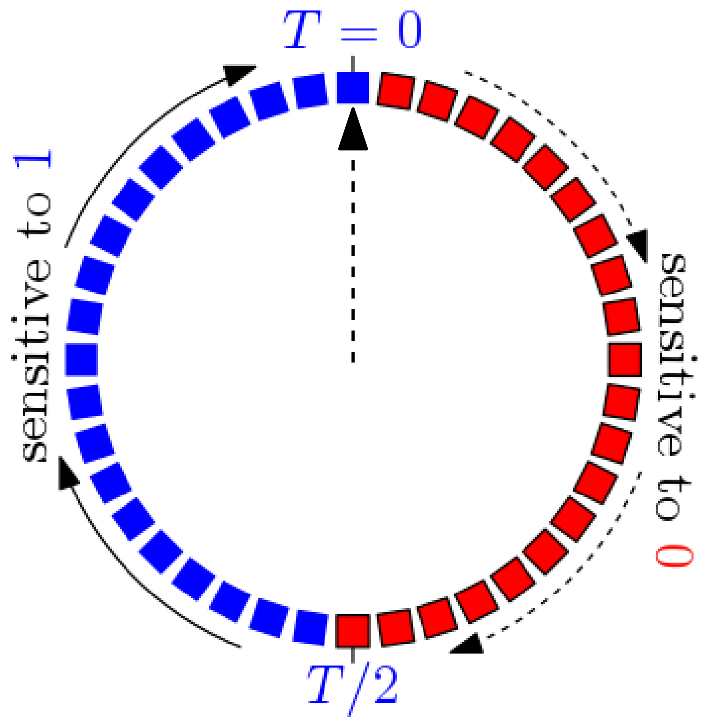
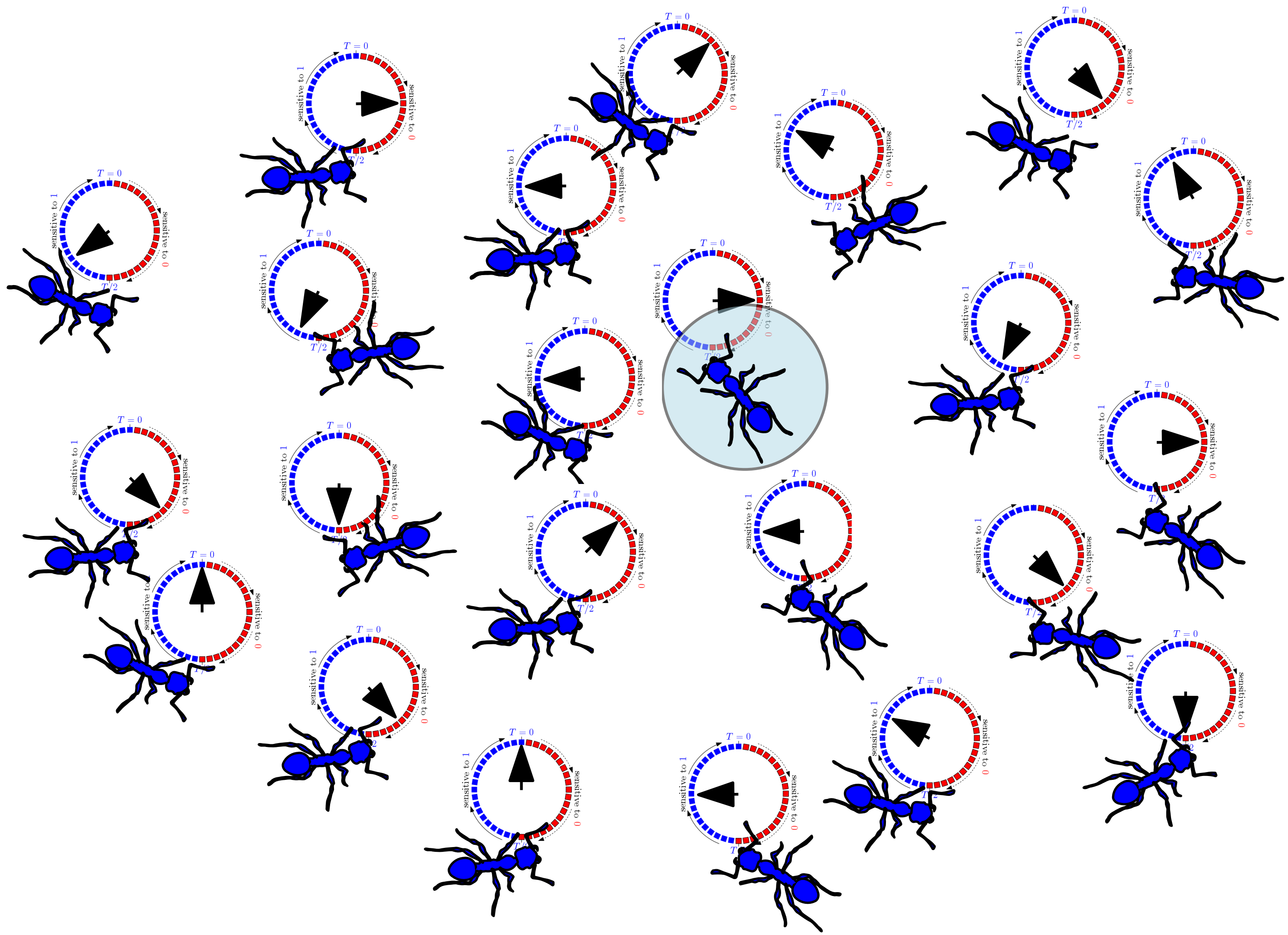


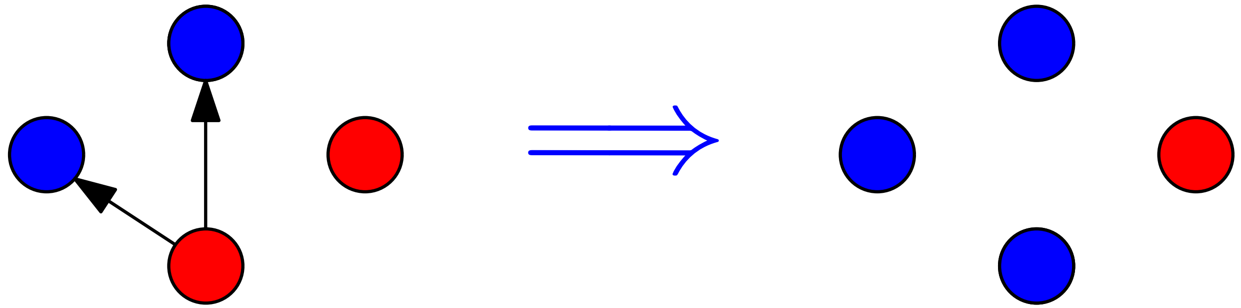


(Self-Stab.) Bit Dissemination vs Synchronization

Self-stablizing algorithms converge from
any initial configuration



Self-Stab. Clock Sync. in $\mathcal{PULL}(2, \log n)$ Model



2-Majority dynamics [Doerr et al. '11]. Converge to consensus in $\mathcal{O}(\log n)$ rounds with high probability.

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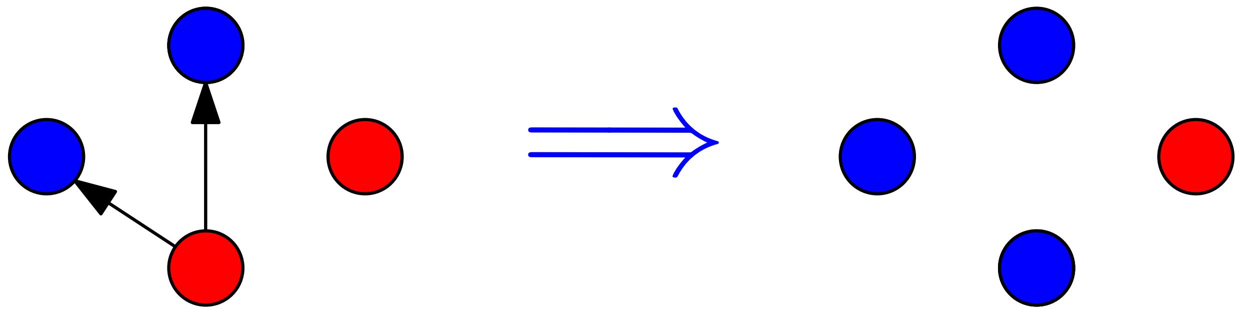

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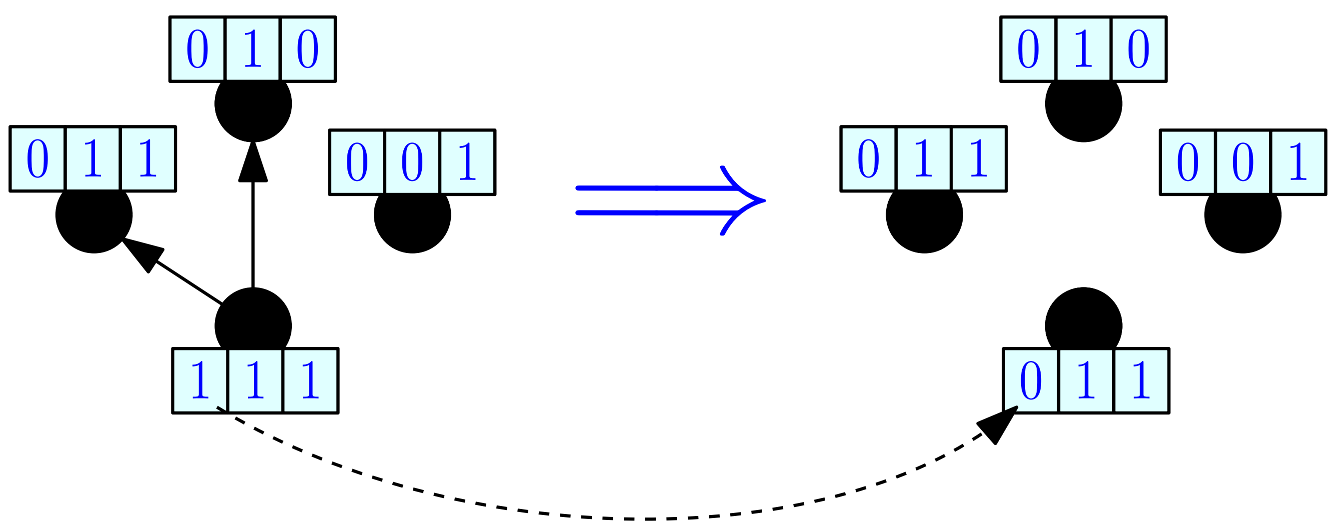
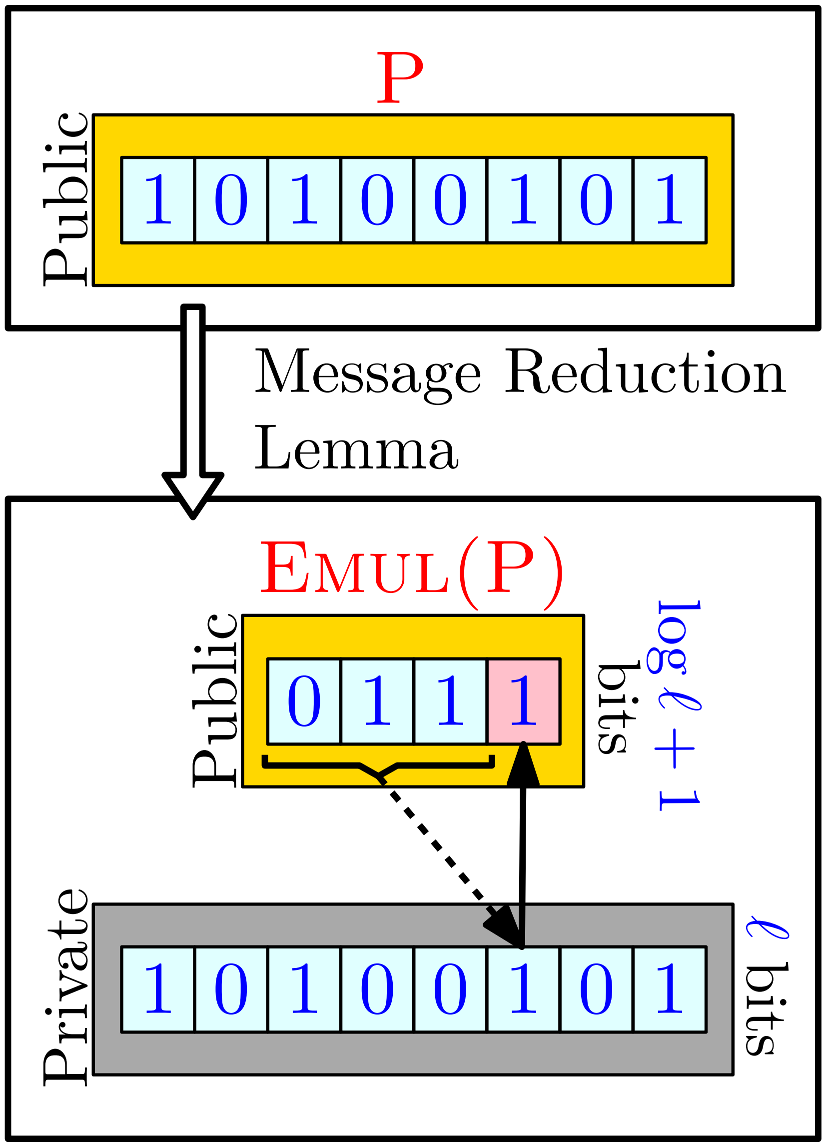


The Message Reduction Lemma



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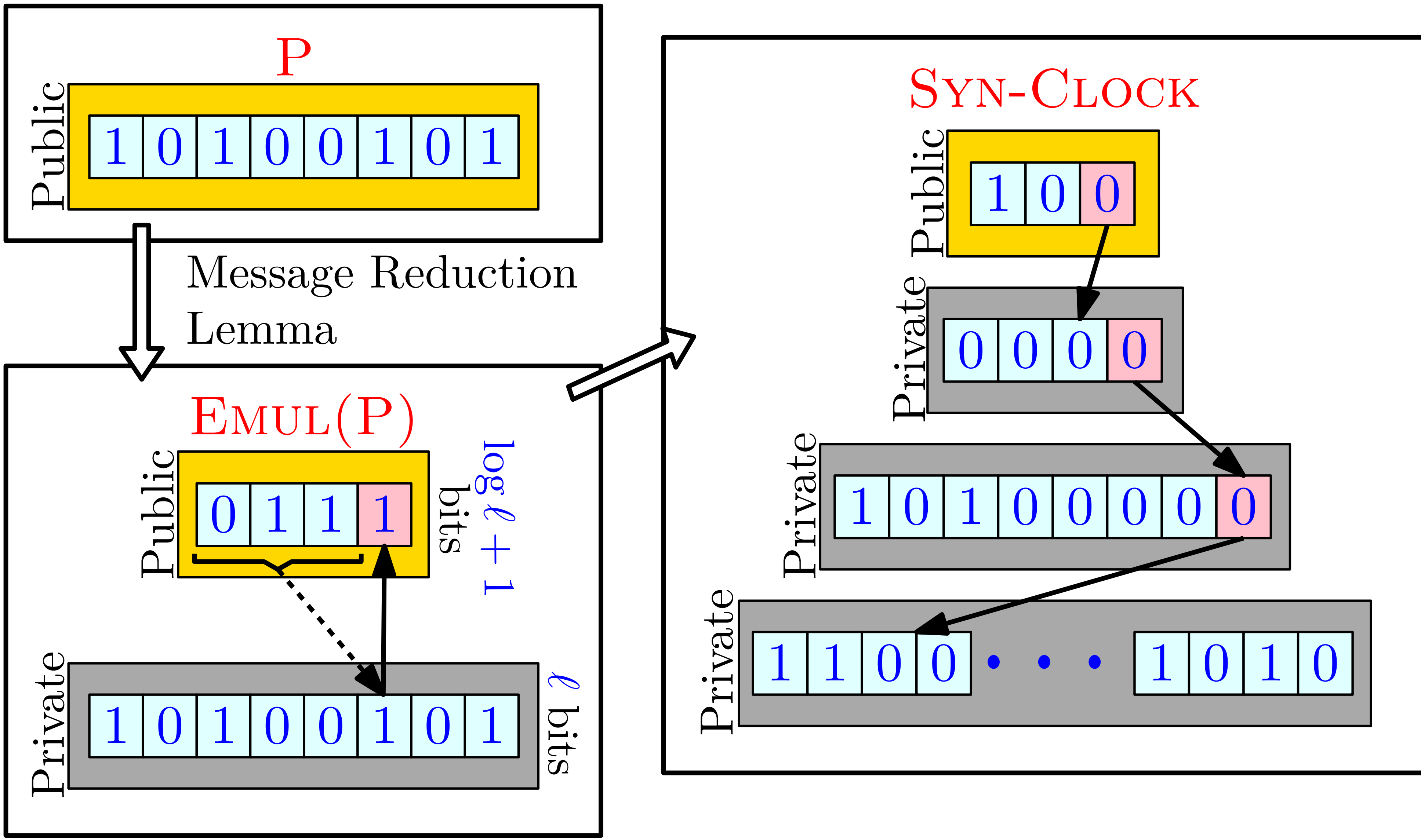

Results

Theorem (Clock Syncronization). SYN-CLOCK is a *self-stabilizing* clock synchronization protocol which synchronizes a clock modulo T in $\tilde{\mathcal{O}}(\log n \log T)$ rounds w.h.p. using 3-bit messages.

Theorem (Bit Dissemination). SYN-PHASE-SPREAD is a *self-stabilizing* Bit Dissemination protocol which converges in $\tilde{\mathcal{O}}(\log n)$ rounds w.h.p using 3-bit messages.

Thank You!