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# On some Opinion Dynamics in Multi-Agent Systems

Emilio Cruciani and Francesco d'Amore\* and Emanuele Natale

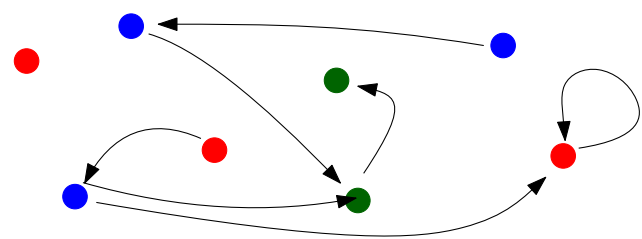
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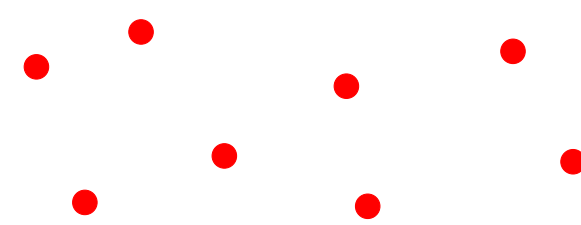
## MULTI-AGENT SYSTEM

MAS = set of  $n$  agents interacting between each others, each supporting some opinion.



## AGREEMENT TASK

The **whole** (or **parts** of the) system must agree on some opinion.



## LABEL PROPAGATION ALGORITHMS

LPAs = class of algorithms for community detection in MAS:

1. an initial label/opinion to each agent;
2. activation rule for each agents;
3. majority-based update rule for labels.

At the end, each community agrees on some different label.

## THE 2-CHOICES DYNAMICS

Opinion Dynamics for majority consensus studied also in non-complete topologies (e.g., expanders) [4,6].

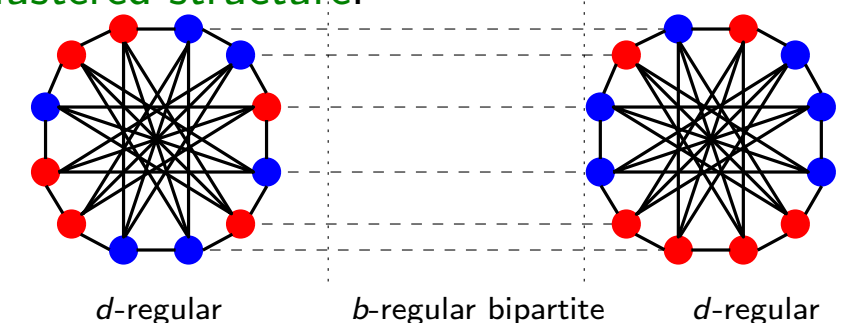
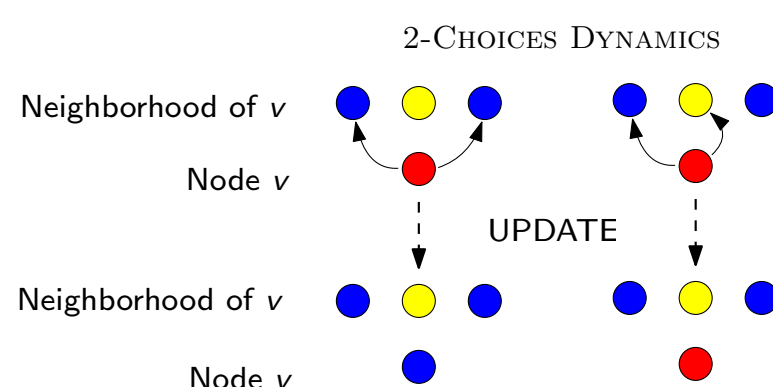
Here, we consider it as a LPA.

Initialization: random binary state, red or blue.

Activation: all nodes active in each round.

Update: each node samples two neighbors and, if they have the same state, updates to that state.

Underlying graph:  $(2n, d, b)$ -clustered regular graph [2] with  $d > 2b$ , which exhibits nice clustered structure.



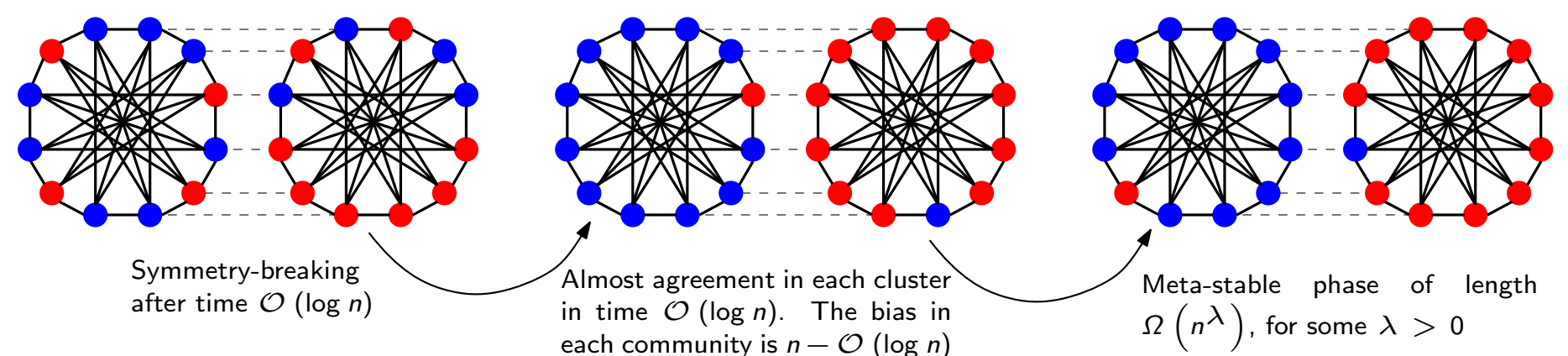
## OPINION DYNAMICS WITH NOISE

Class of simple algorithms for the Majority Consensus Problem with noise perturbing communications. The dynamics must bring the system into a config. satisfying:

1. **Almost-Agreement**: the majority of agents agree on some opinion;
2. **Majority**: this opinion is the initial majority one;
3. **Almost-Stability**: such a configuration lasts for time  $\text{poly}(n)$ .

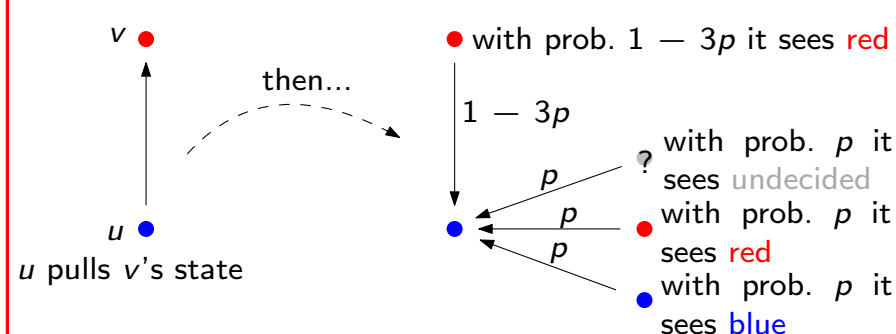
Applications in sensor networks [1], chemical reaction networks [3], biological systems [8], ecc.

**RESULT**: with constant prob. the initialization is asymmetric and, w.h.p., it holds that [5]

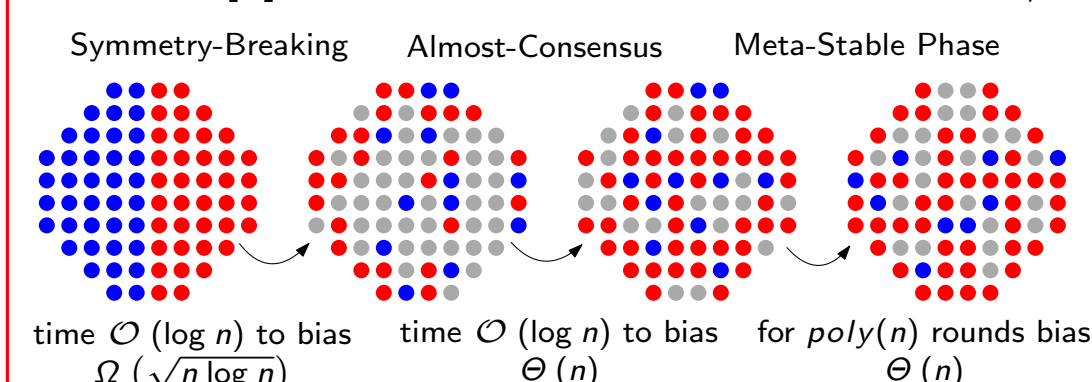


## NOISE MODEL AND RESULTS

We introduce a simple model of uniform noise, bio-inspired [8].



We prove [7] the following holds w.h.p. for  $p < 1/6$ :



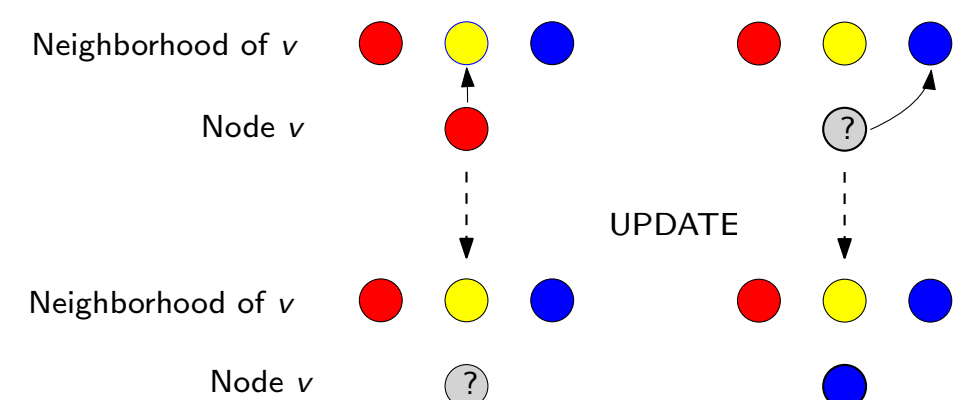
**Note**: if  $p > 1/6$  every information about the majority color is lost in time  $O(\log n)$ , w.h.p.

## THE UNDECIDED-STATE DYNAMICS

Introduced by [1] as a fast, robust and simple dynamics for the majority consensus problem.

Rule:

1. each agent  $u$  samples one neighbor and look at its state  $x$ ;
2. if  $x$  is different from  $\text{state}(u)$ , then  $u$  becomes undecided;
3. if  $u$  is undecided, then it copies what it sees.



[3] has completely characterized the parallel binary case in the complete graph.

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