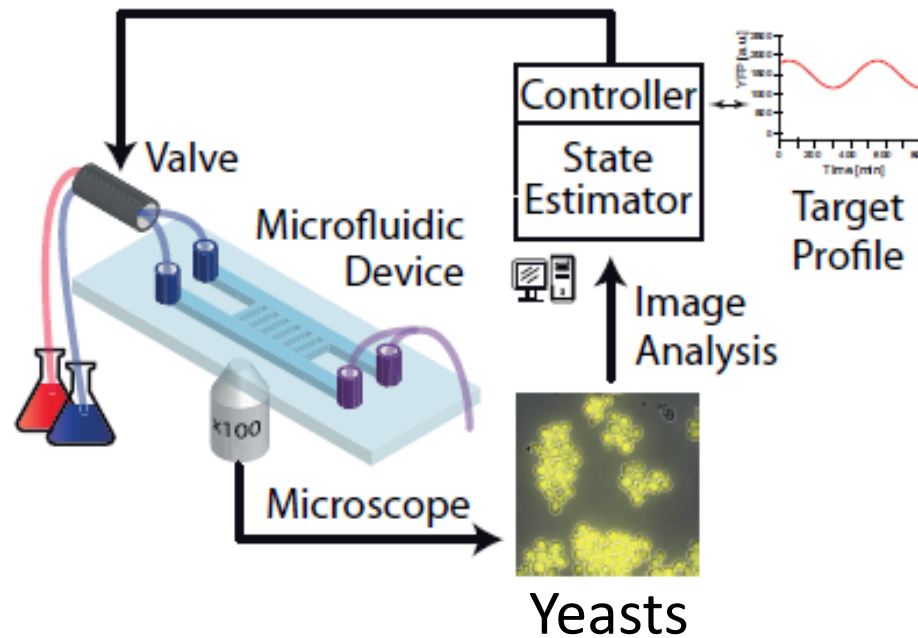


# Controlling a Population ... more realistically

Nathalie Bertrand, Nathanael Fijalkow,  
Blaise Genest, Hugo Gimbert

Work in progress

# Population of cells



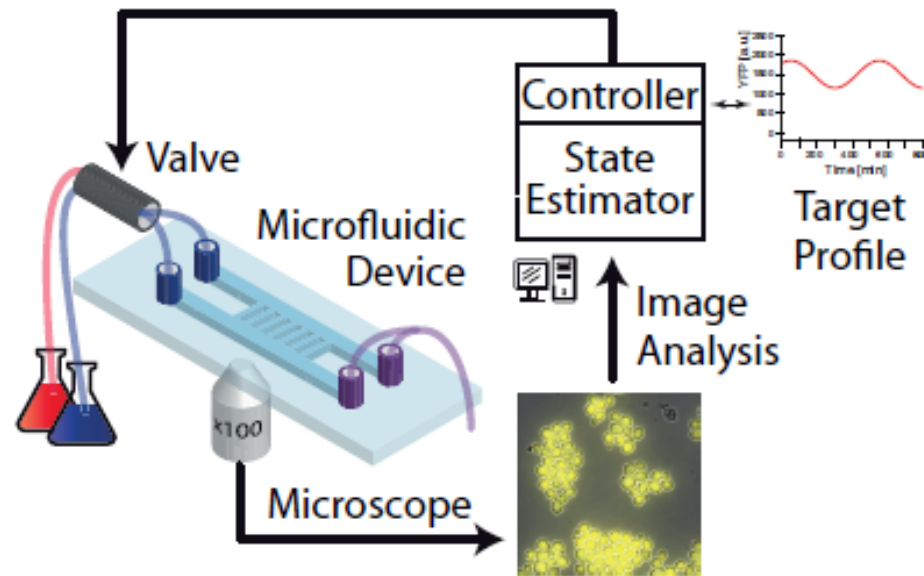
**Setting:** Many yeasts. Simplistic model

Each yeast can be in one of 3 states (1 high, 2 med, 3 low concentr. of X)

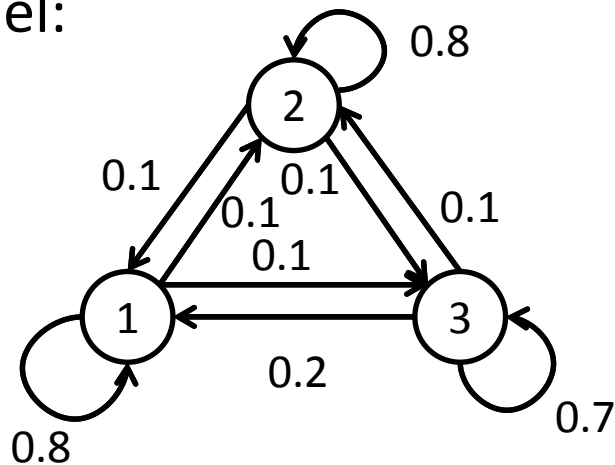
**Image analysis:** proportion in state 1 (high concentration of X => marker).

**Control:** sorbitol solution => osmotic stress influencing X

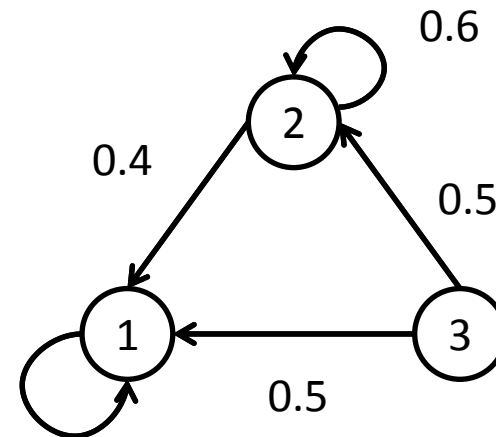
# Population of cells



Stochastic  
Model:

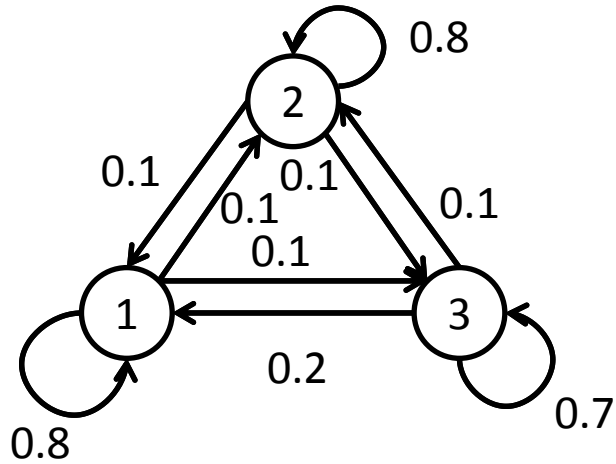


sorbitol **on**

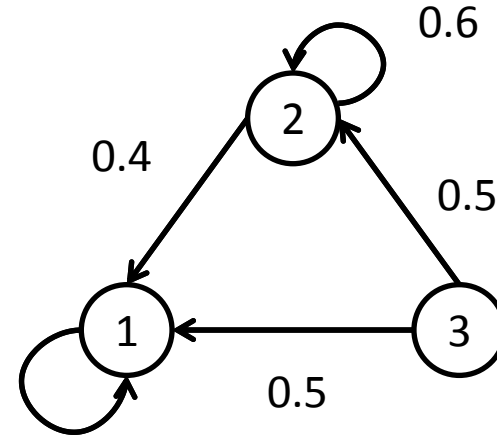


sorbitol **off**

# Sure Reachability:

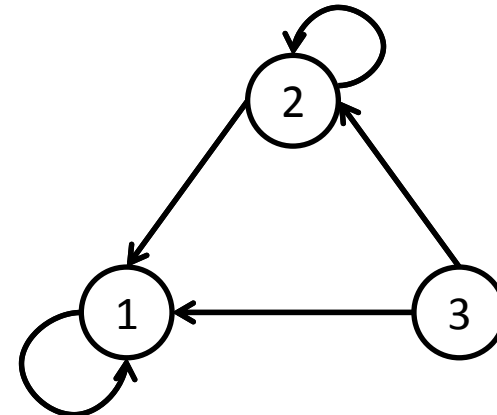
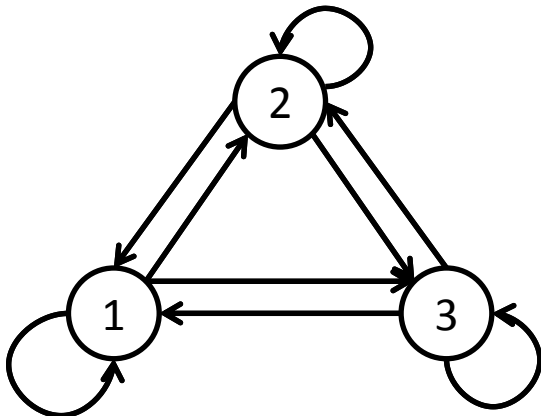


If sorbitol on

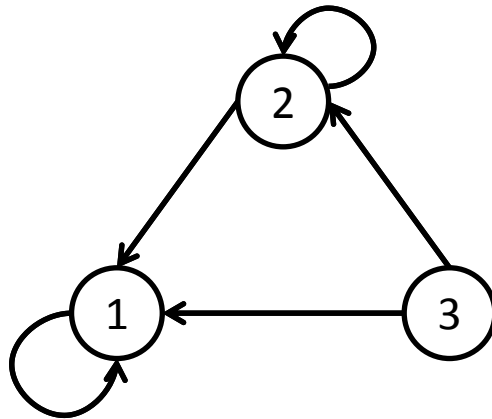


If sorbitol off

## Sure Reachability:



# Problem with **sure** reachability:



If sorbitol off

Possible for Agents to play:  
Always all agents from 2 go to 2.  
Not realistic.

May create cases without a good controller in the population game  
But a real controller.

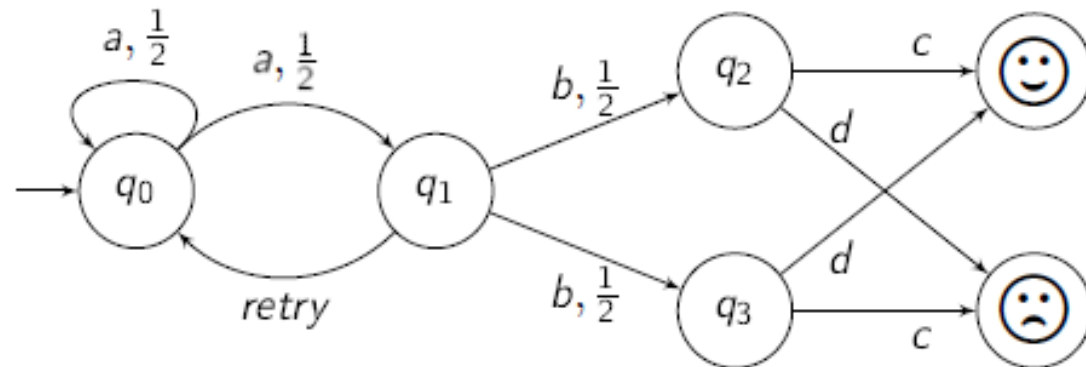
**Idea:** What about **almost sure** reachability?

All cases need to be taken in a fair way.

In particular, cannot always take all agents from 2 go to 2

# Almost-Sure Reachability:

May create cases with a good controller in the population game but no realistic controller.



$$\text{Strategy} = \begin{cases} b & \text{if } \text{count}(q_1) = 1 \\ retry & \text{if } \text{count}(q_1) > 1 \\ \dots & \text{if } \text{count}(q_1) = 0 \wedge \dots \end{cases}$$

# Another notion?

In the NFA case, if winning strategy, then expected time of winning is polynomial in the number of agents.

We could keep this requirement, it would exclude the bad cases of Almost sure reachability waiting for a very unlikely event to happen.

Would correspond to restricted fairness, where the fairness only holds on likely cases, but we would not allow controller to expect an unlikely event with probability one.