Arriving at Consensus on Social Networks

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Big Question/General Goals

OR

Series of Experimental Work

- Latane L'Herrou[96]
  - Try to play majority
- Kearns, Judd, Tan, Wortmann [09]
  - Consensus with different payoffs
- Kearns, Suri, Montefort [06]
  - coloring
  - Enemark, McCubbins, Paturi [09]

Our Model

State

State

State

State

State

$$T = T'(S_{Casey}, S_{Grant}, R, Advice) \; X \; T'(S_{Grant}, S_{Casey}, R, Advice)$$

Problems Studied

- Coordination
- Majority Coordination
- *Optimal Expected* time over class of protocols

Definitions: Broadcast and Collision time

- Broadcast Time: Time for a message to flood network.
  - More like Expansion than Diameter
- Collision Time: Time until for every pair of people, someone has received both of their messages.
  - Provides trivial lower bound

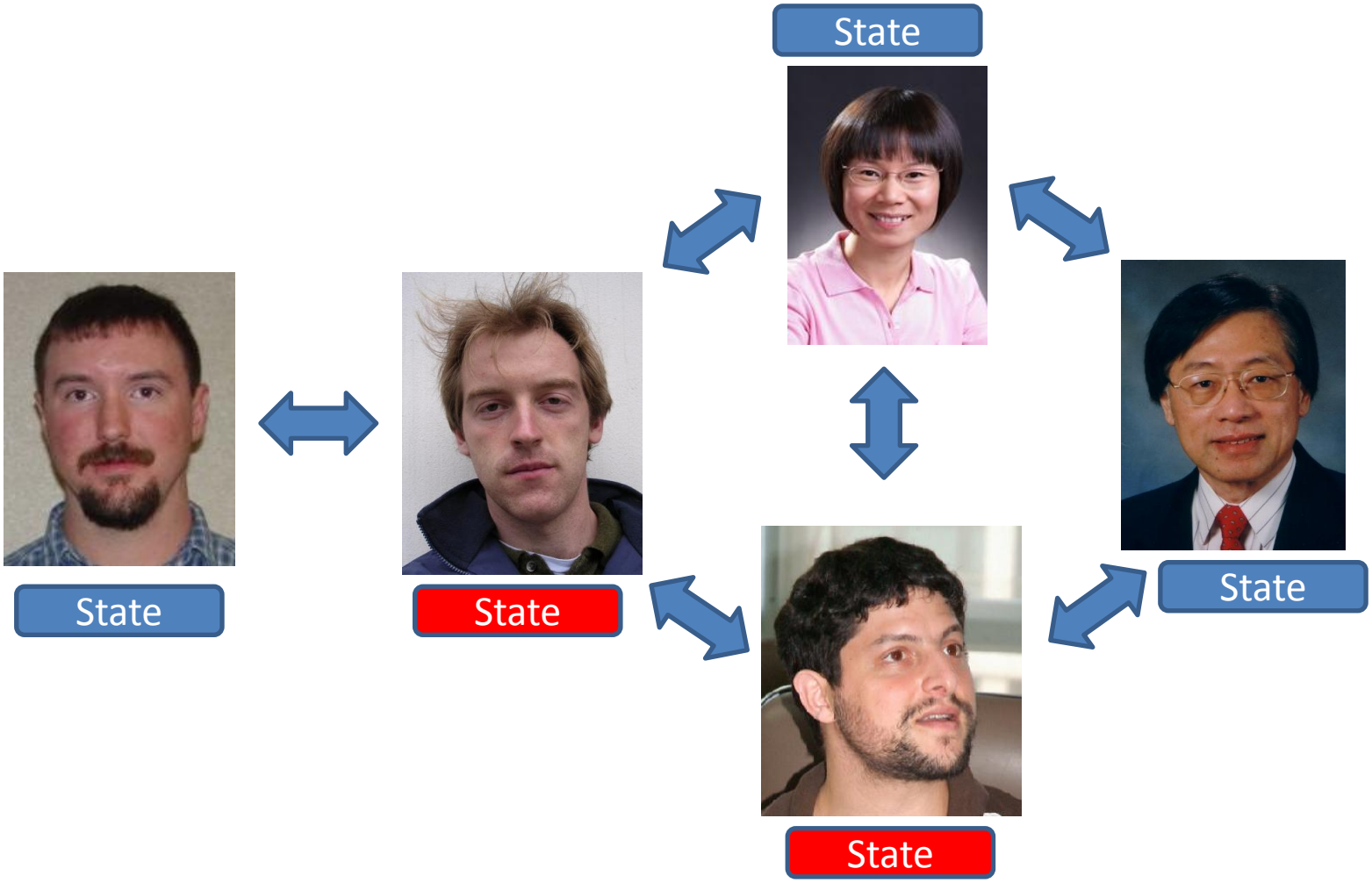
Related Work

- Similar to Distributed Computing
  - Usually a different time metric
    - Synchronous
    - Worst case
  - Usually different symmetry condition
- Coordination Games in Economics
- Similar to Simulations in Social Networking literature.
- More to come in context

Coordination Summary

Problem	Memory	Time	Required Advice
Voter Model	1	n^2	none
Greatest Element	O(log(n))	broadcast	Θ(log(|V|))
Wait-and-See	expected O(1)	O(broadcast)	Θ(broadcast· |E|)

Voter Model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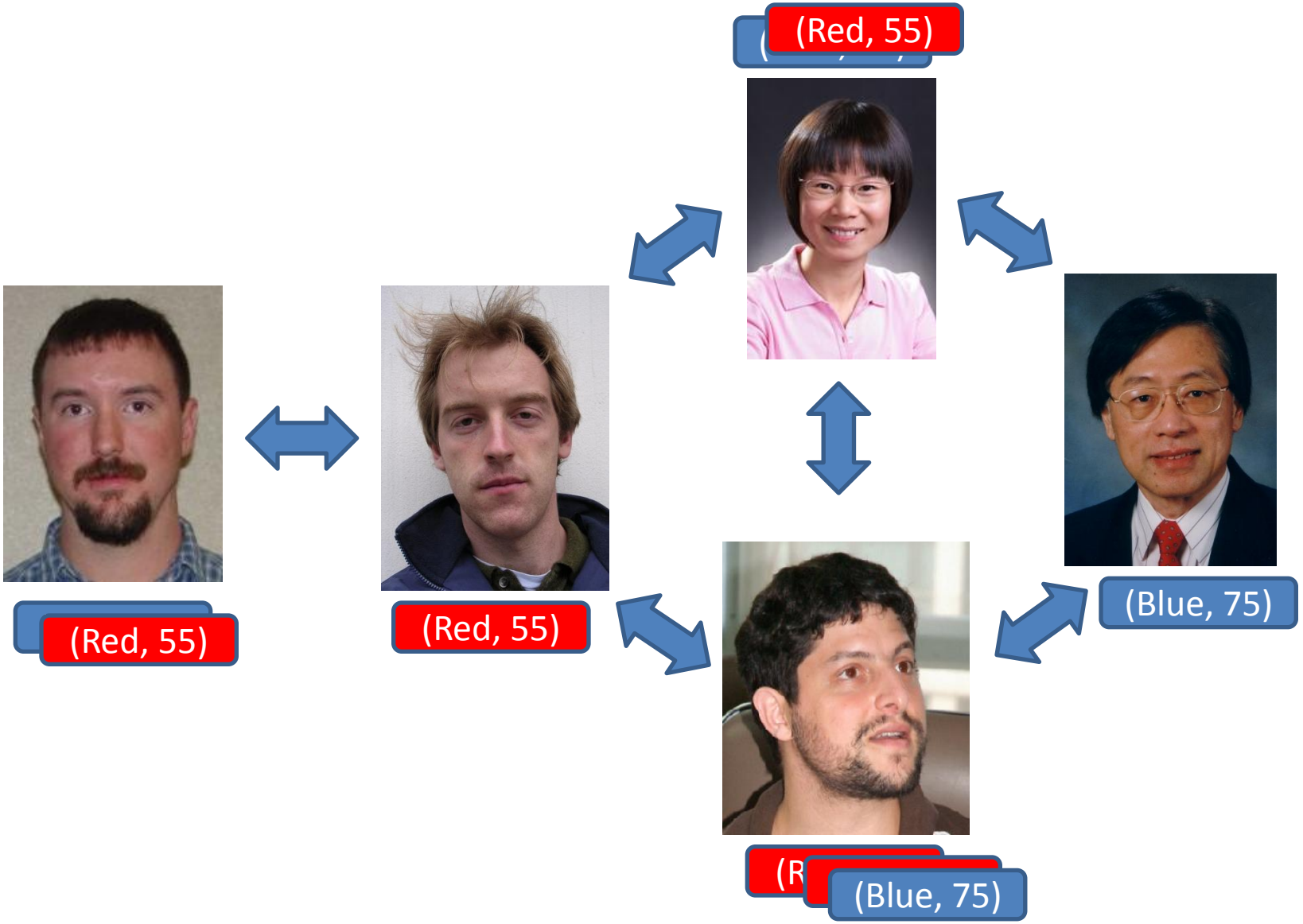
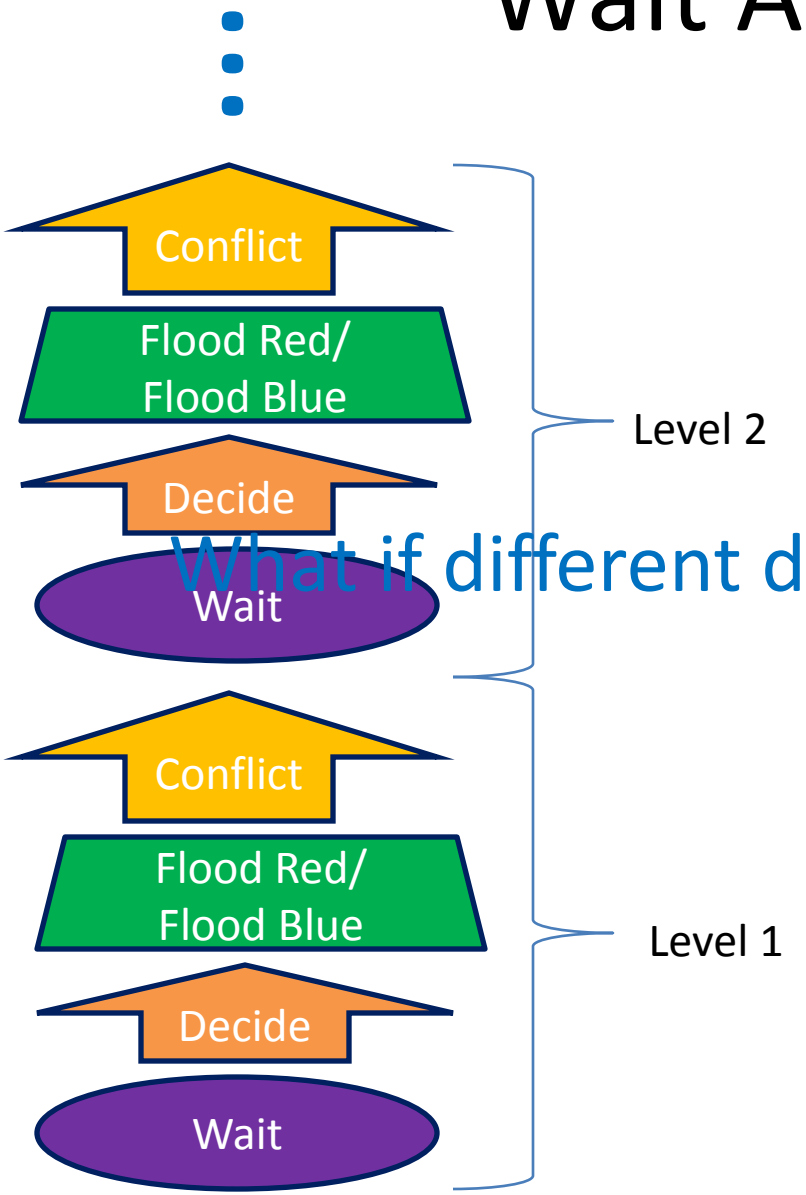
Greatest Element Dynamics



Wait And See



- Wait (large probability)
  Decide with Probability
- Decide (small probability)
  1/c |E| broadcast
- Flood decision
  Decide in expected time
- Within levels:
  c broadcast
  as before
  Success at each level
- If conflict:
  Constant
  increase level
- Different levels:
  copy highest

What if different decisions occur?

Majority Coordination

	Memory	Time	Required Advice
[LB95]	1	impossible	
[BTV09]	2	$< \infty$	none
Strong-Weak	2	$O(n^3)$	none
[KT08]	$O(\log(n))$	$O(n^7)$	$\|V\|$
Wait-and-See	expected $O(\log(\Delta))$	$O(d + \log(n)) \cdot \log(n)$	$\Theta(\text{broadcast} \cdot \|E\|)$

Strong Weak Voter

- Assume Clique (for Now)
- All Voters have **opinion** (red/blue) and **strength** of opinion (STRONG/weak).
- When they meet,
  - Update color:
    - STRONG influence weak
    - Otherwise voter model
  - Update Strengths:
    - Two STRONGS of different colors cancel to weak
    - Otherwise stay the same
    - STRONG/weak swap strengths

Refining the Model

- Experimental Work
- Can be used to make model more realistic?
  - Is convergence time related to mixing or broadcast time?
  - Evolvability (How do agents learn model)
  - Incentives (Game theory)
  - Different Bounded Rationality
    - Bounded Memory
- Perhaps TCS can influence experimental work too

Future Work

- Play with model
- Better lower bounds
- Ask different questions (beyond consensus)
- Ask same questions differently (beyond expectation)

Questions?

- Thank you for your attention!