

Forming Epistemic Networks

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Epistemic networks

From among all networks, what is the best network for a community to adopt?

Given a set of incentives, what network is likely to arise?

Challenger



January 26, 1986

Challenger

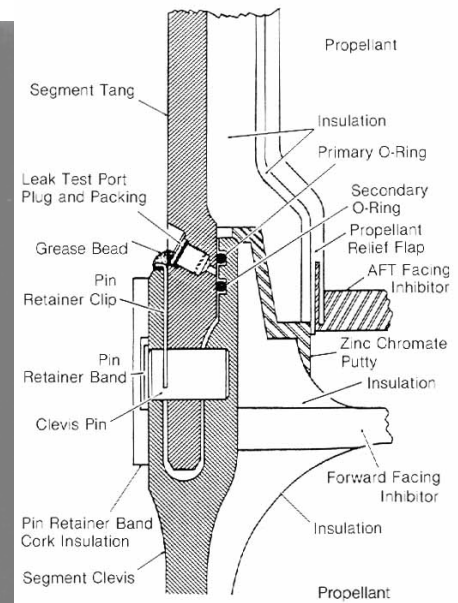
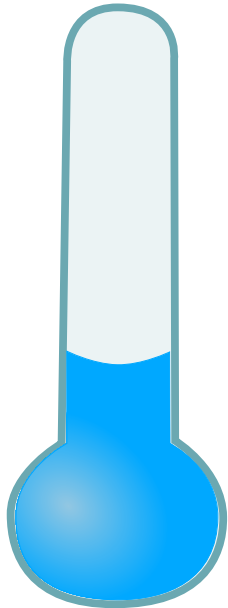
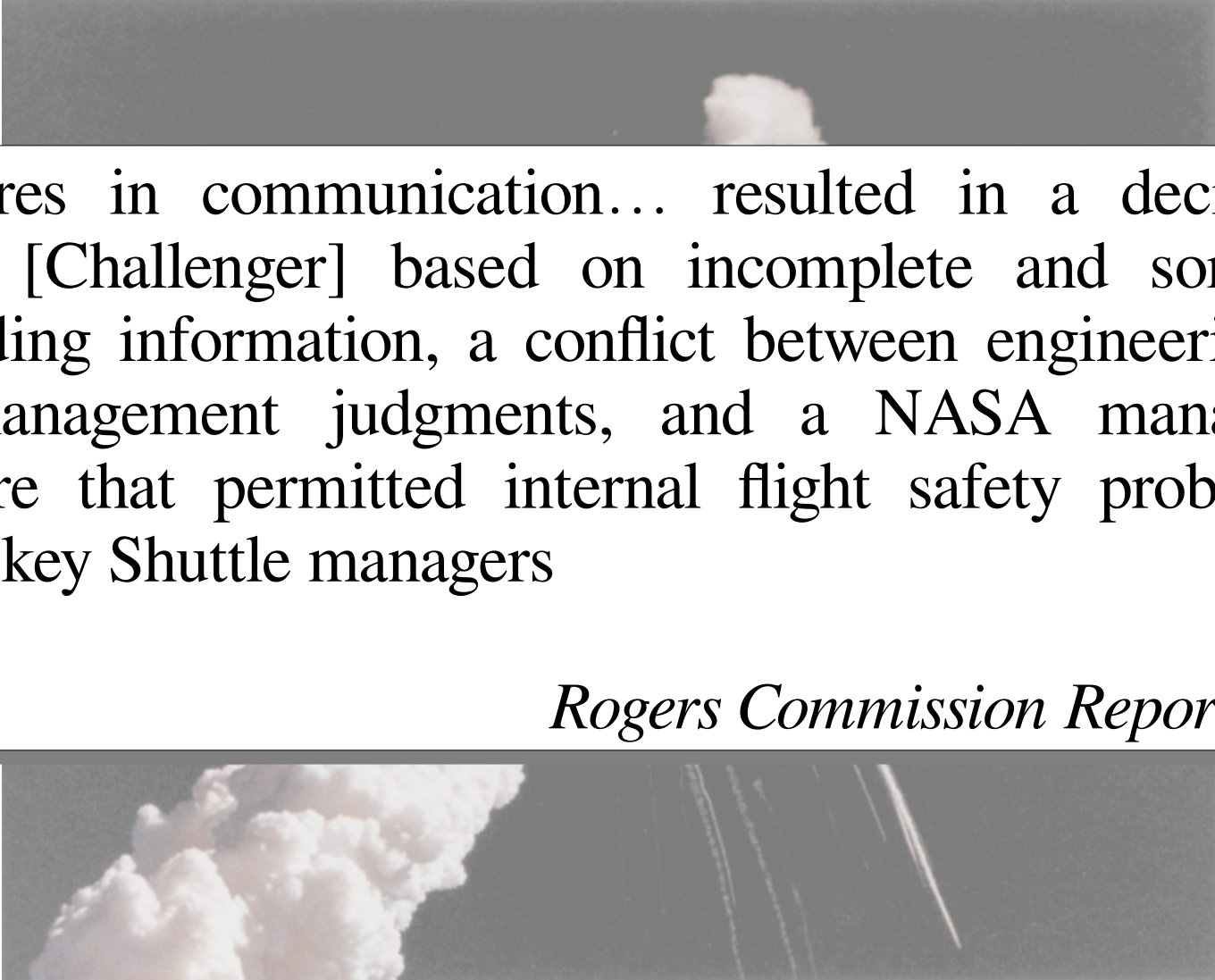


Figure 14
Solid Rocket Motor cross section shows positions of tang, clevis and O-rings. Putty lines the joint on the side toward the propellant.



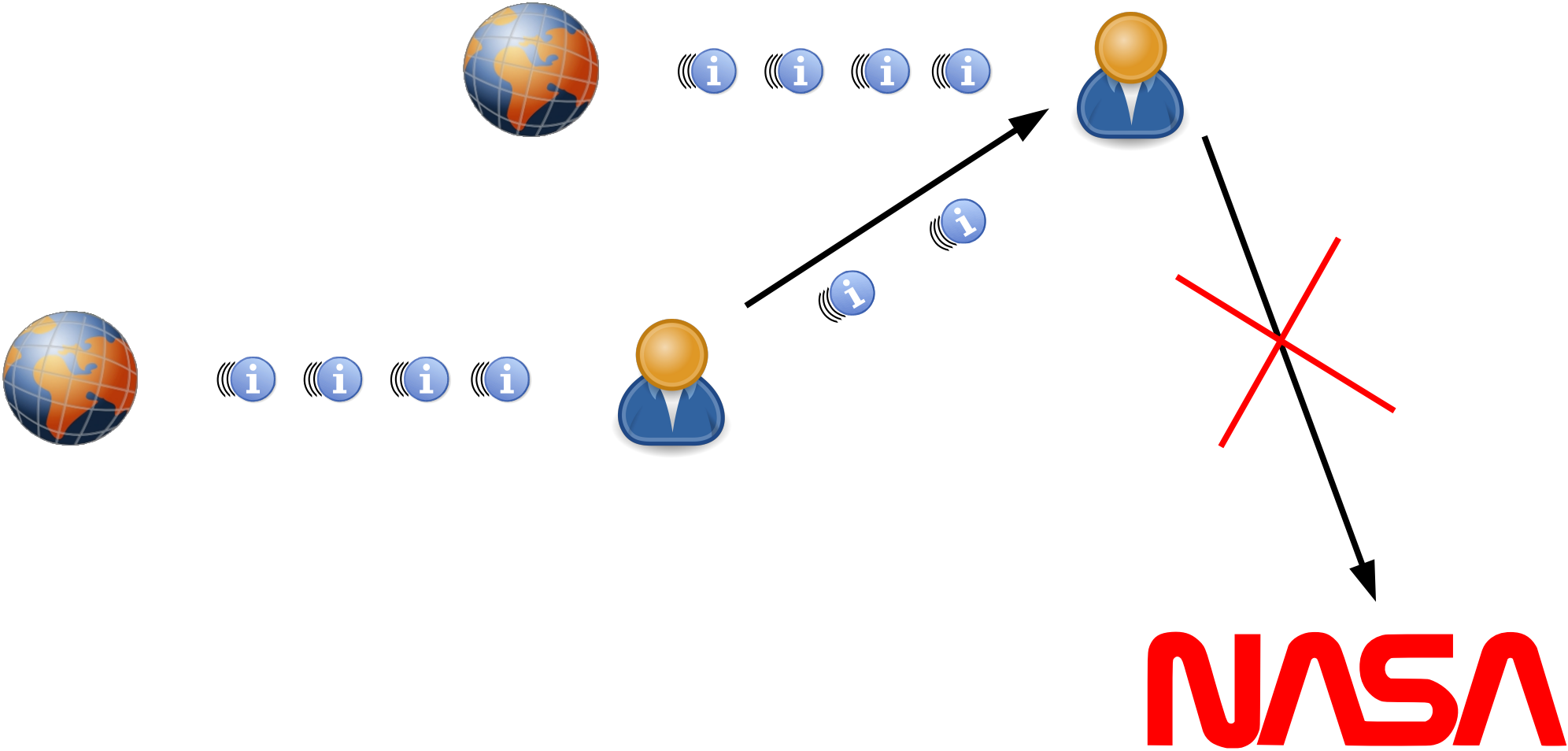
Challenger

A composite image showing the Space Shuttle Challenger during launch. The top portion shows the shuttle ascending with a small plume of white smoke from the right Solid Rocket Booster. The bottom portion shows a larger, more developed plume of white smoke from the same booster, with the shuttle's trajectory visible as a thin line against a dark background.

...failures in communication... resulted in a decision to launch [Challenger] based on incomplete and sometimes misleading information, a conflict between engineering data and management judgments, and a NASA management structure that permitted internal flight safety problems to bypass key Shuttle managers

Rogers Commission Report (1989)

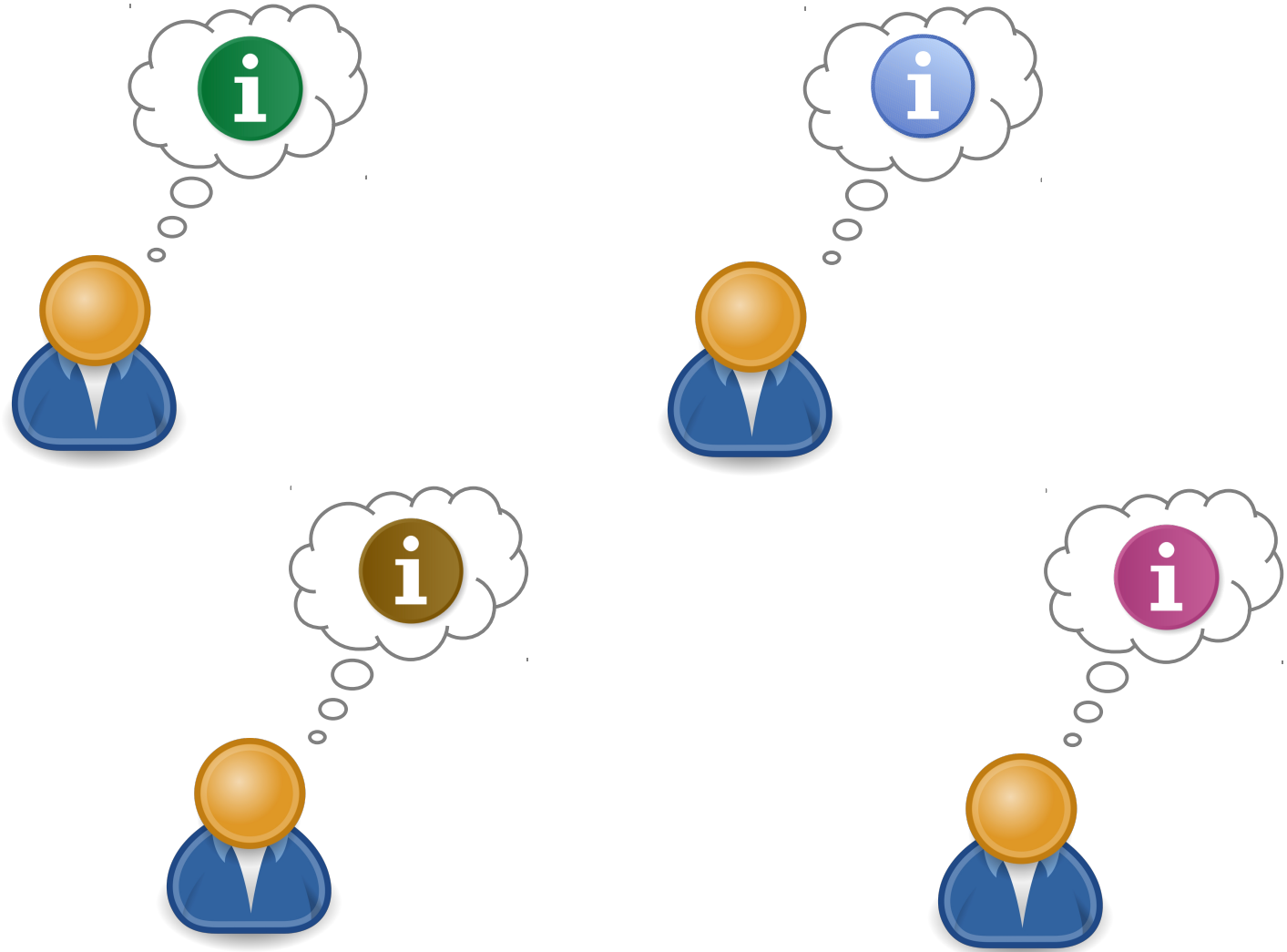
Network failure



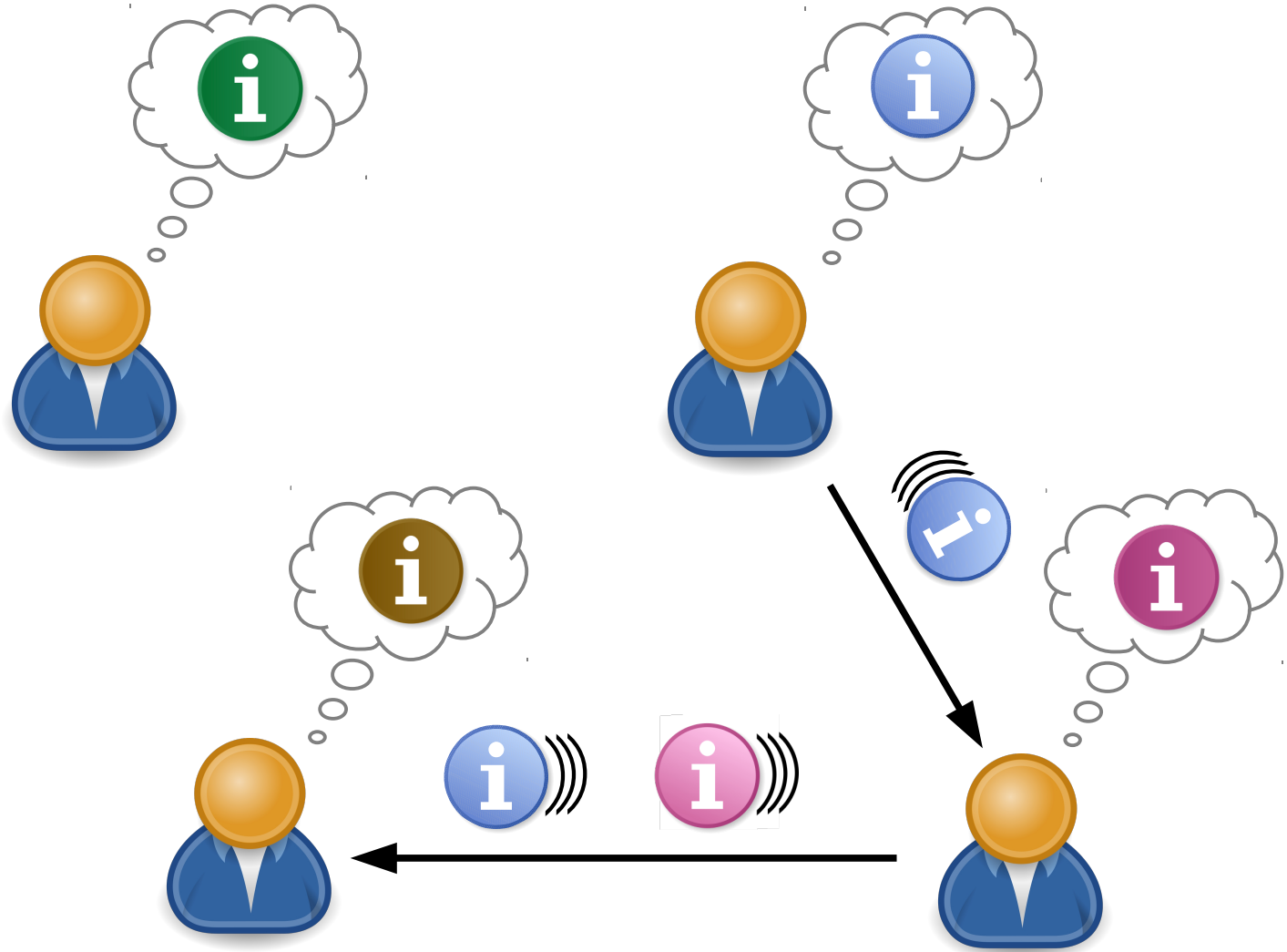
Network structure

Networks should be very dense – contain many connections

Non-overlapping knowledge



Second hand transmission



Four variations

No errors

Some errors

Information
transmission
is free

Information
transmission
is costly

Four variations

No errors

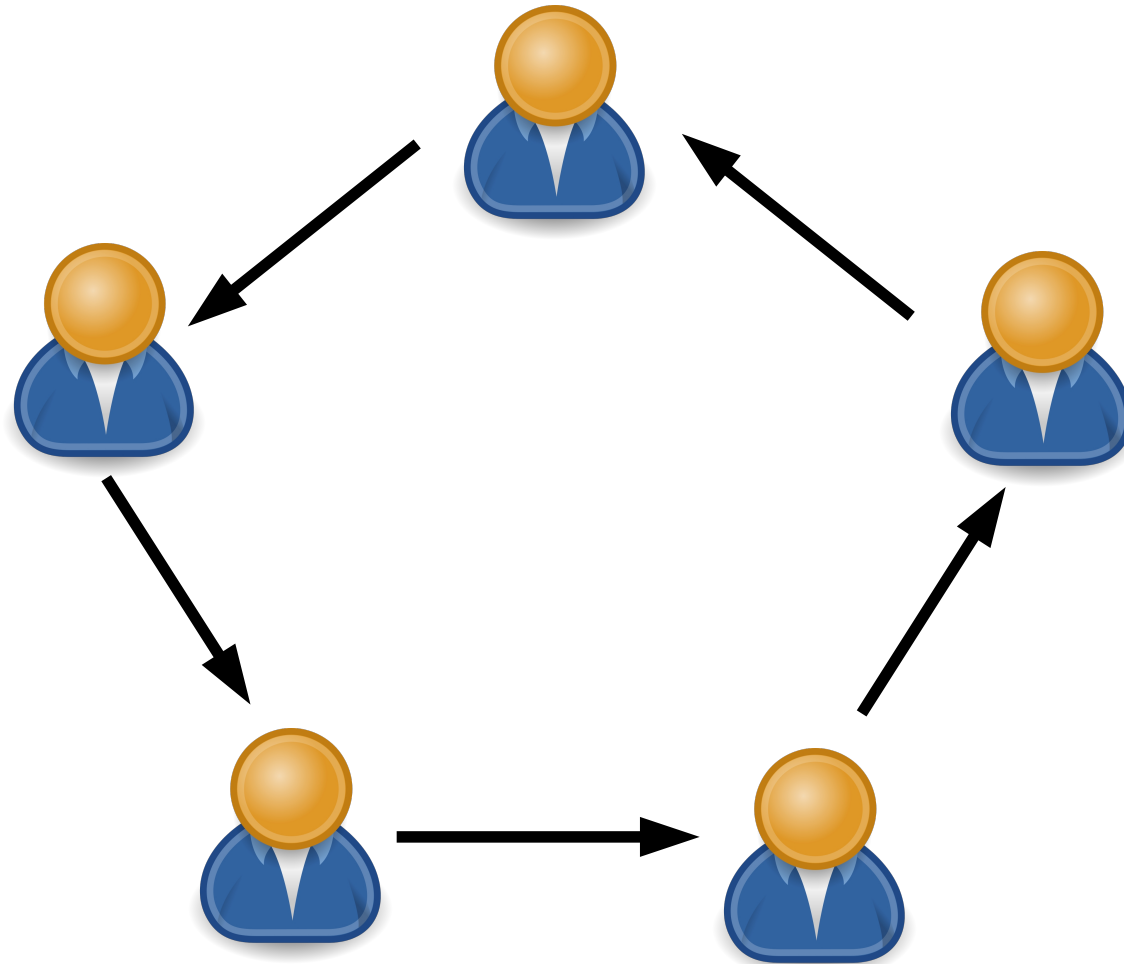
Some errors

Information
transmission
is free

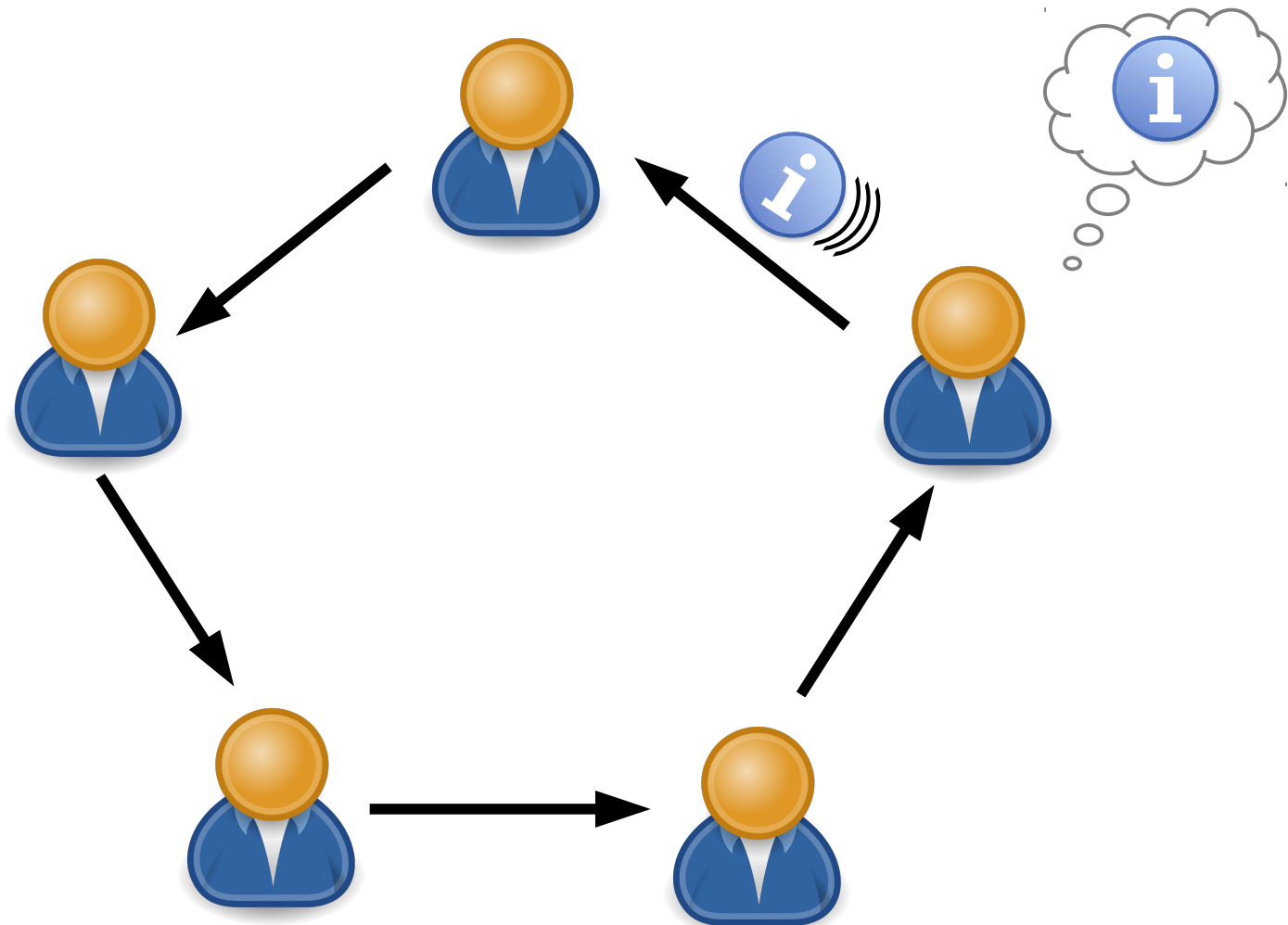
?

Information
transmission
is costly

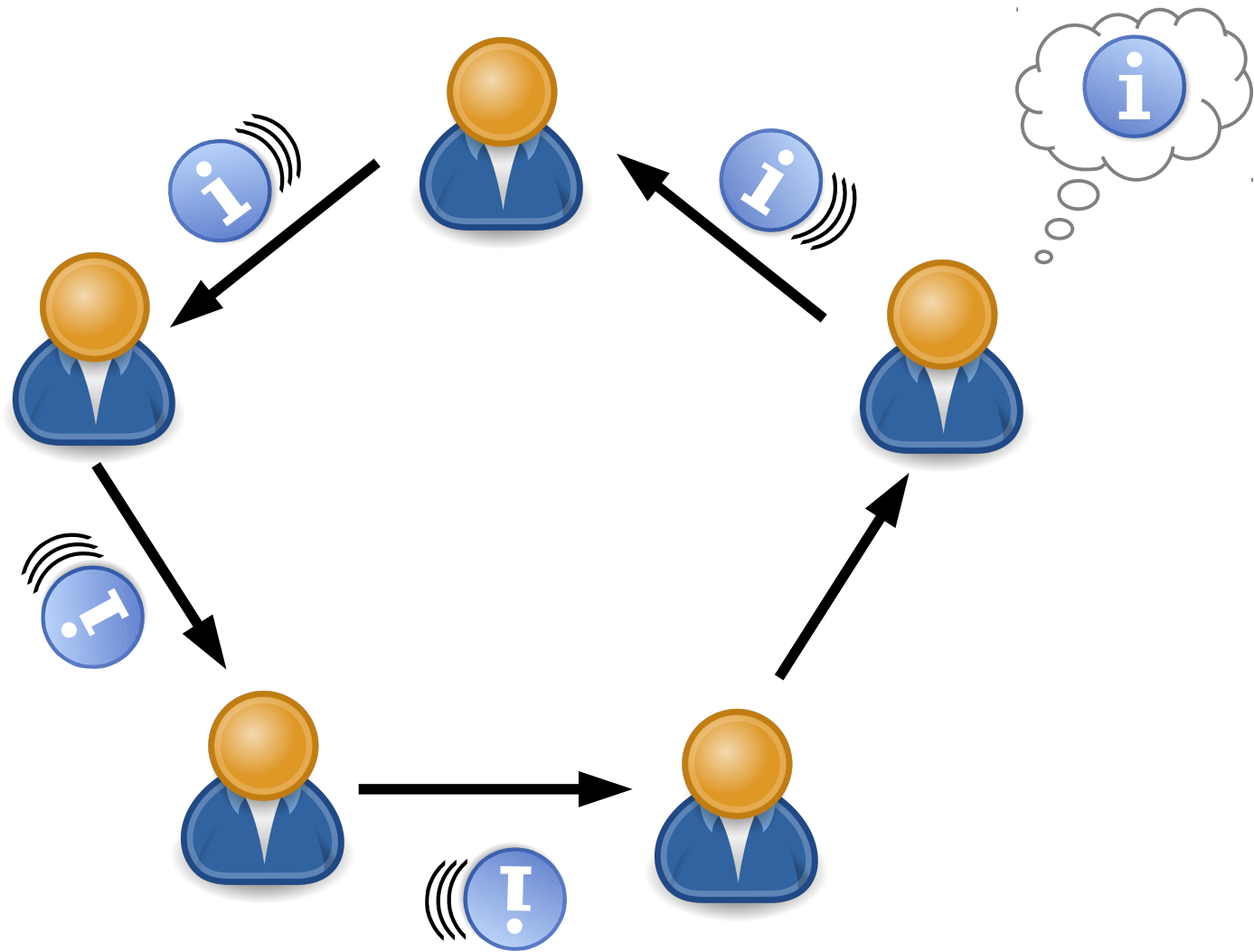
Sparse is fine



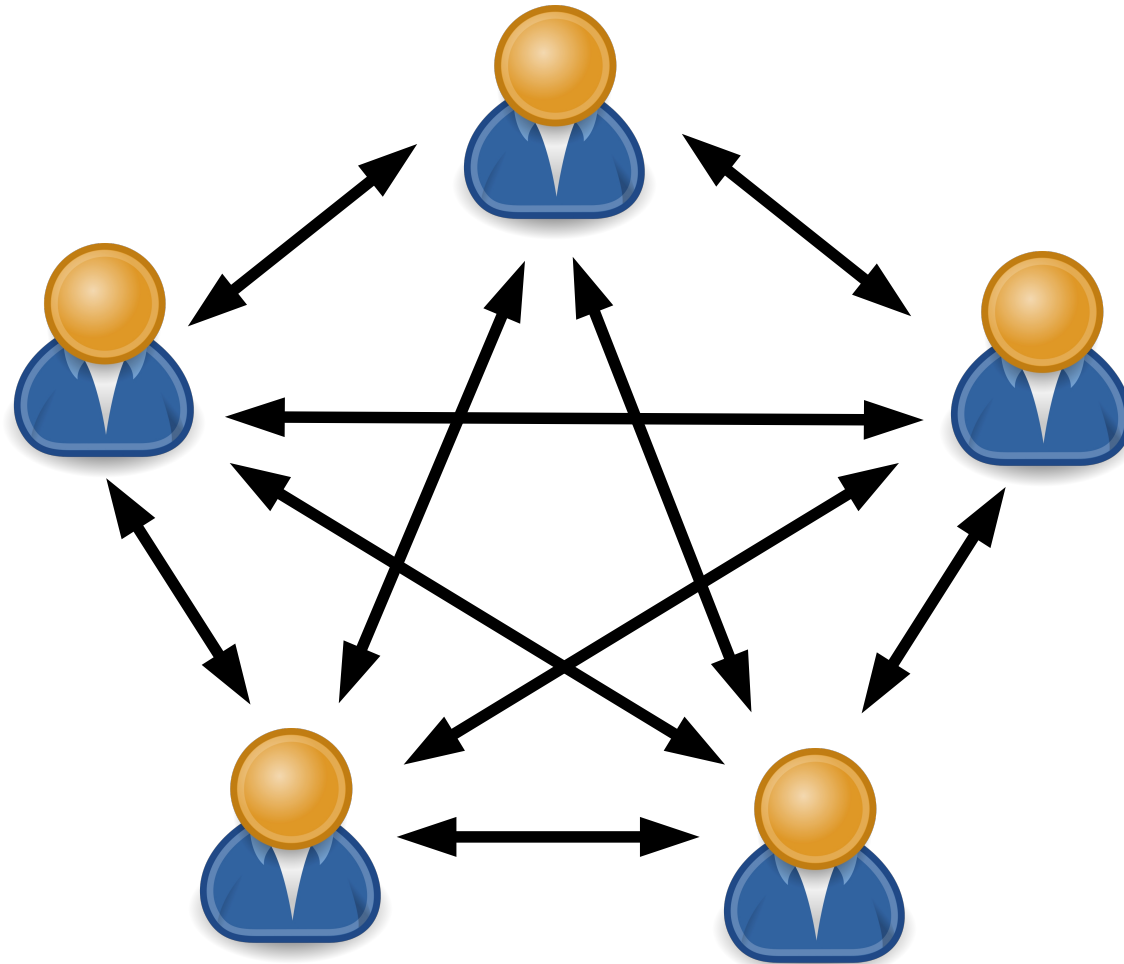
Sparse is fine



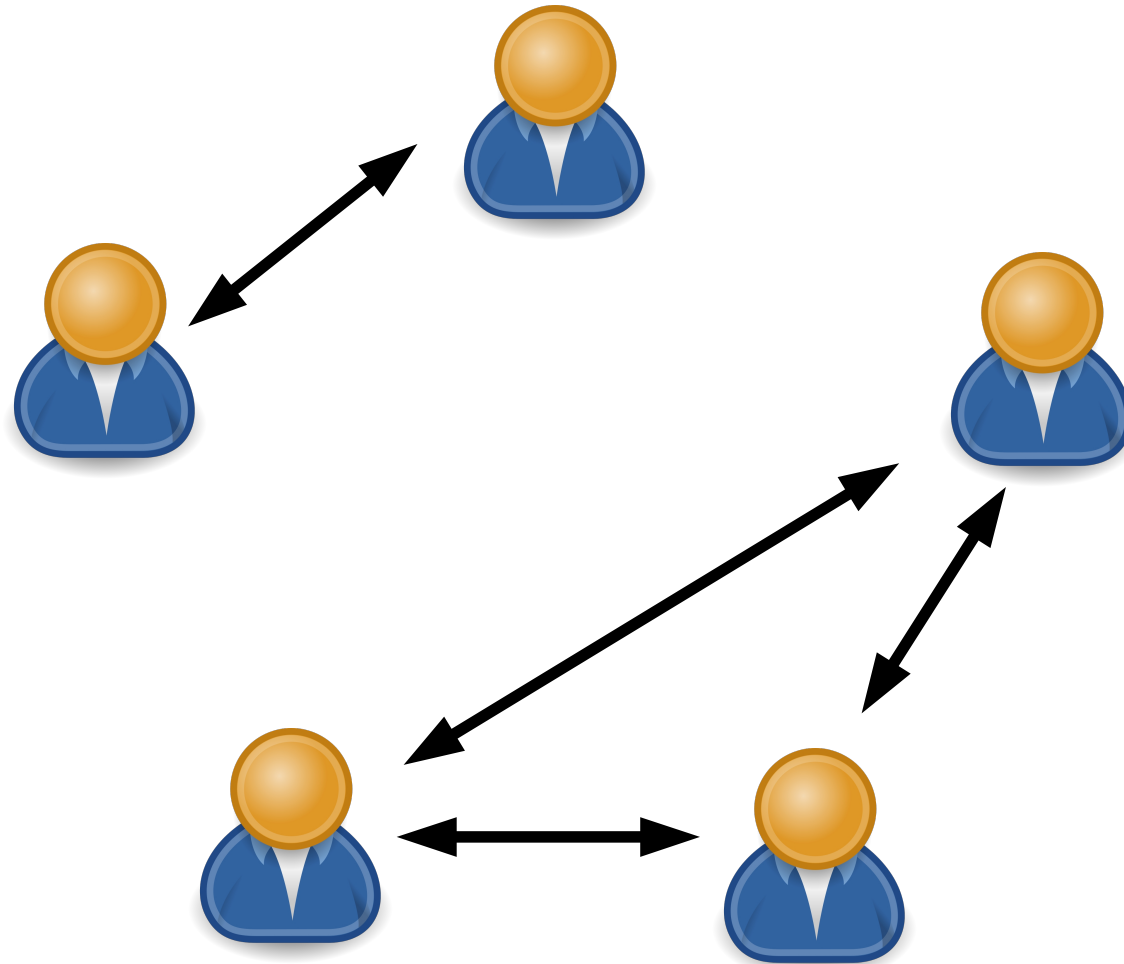
Sparse is fine



Dense is fine, too



Disconnected is bad



Four variations

No errors

Some errors

Information
transmission
is free

Connected

Information
transmission
is costly

Information transmission is free	Connected	
Information transmission is costly		

Four variations

No errors

Some errors

Information
transmission
is free

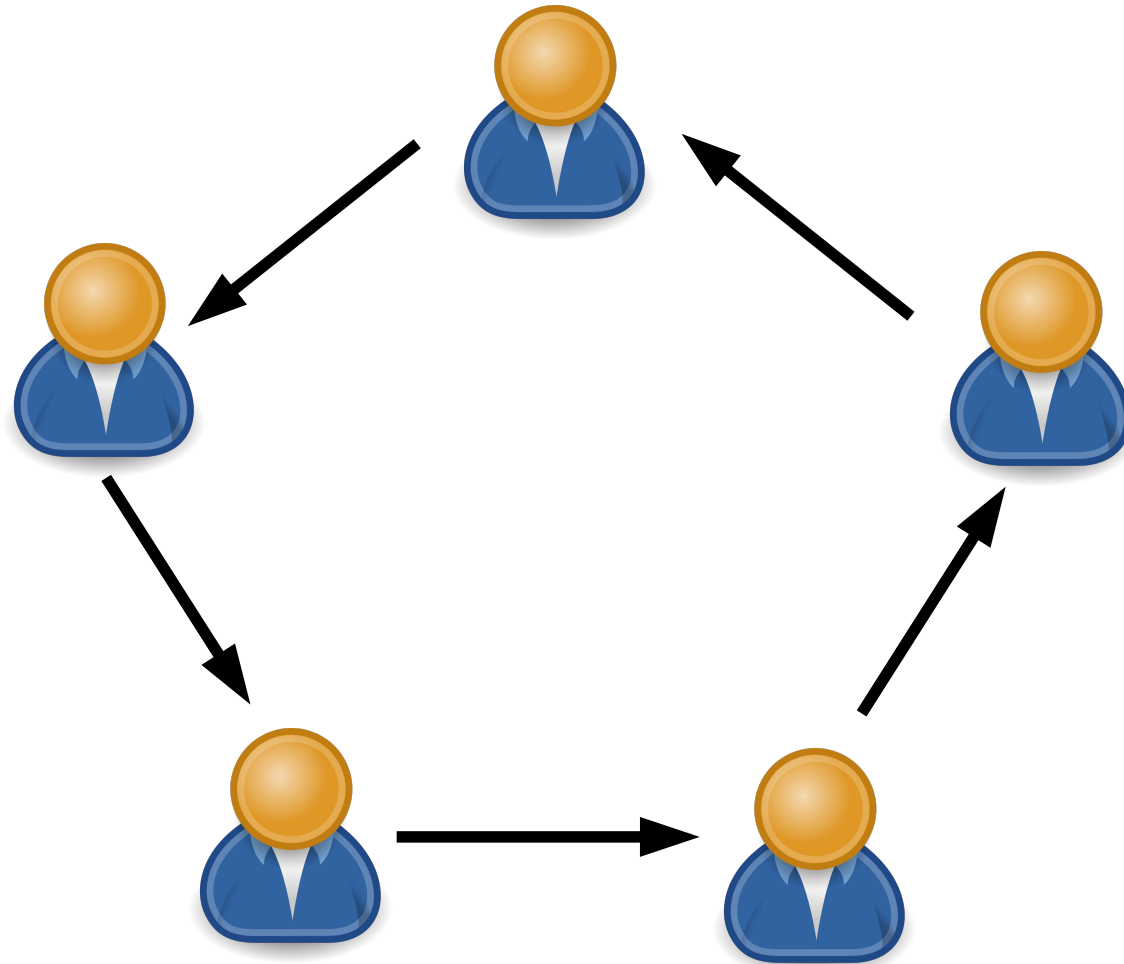
Connected

Information
transmission
is costly

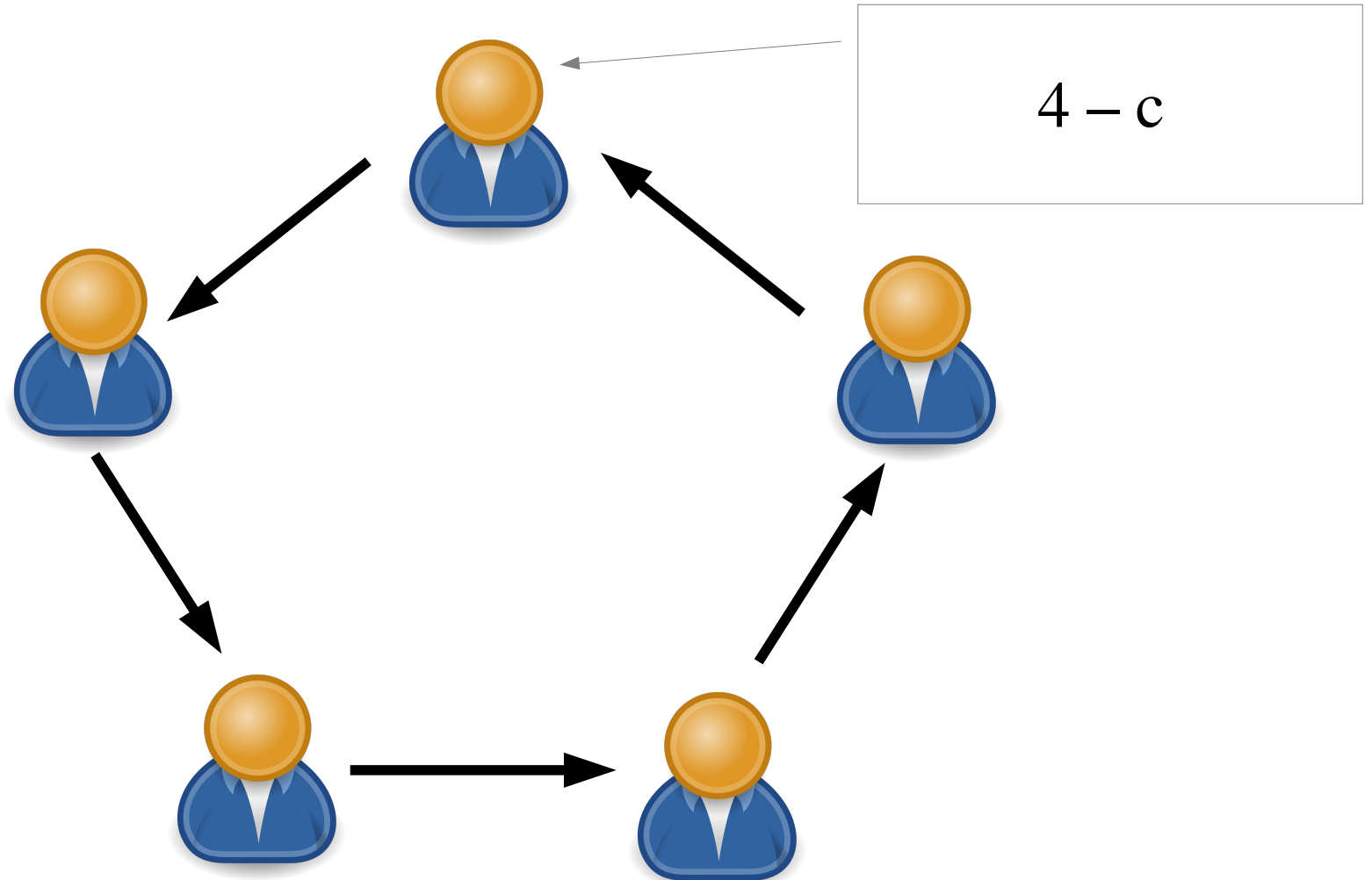
?

Information transmission is free	Connected	
Information transmission is costly	?	

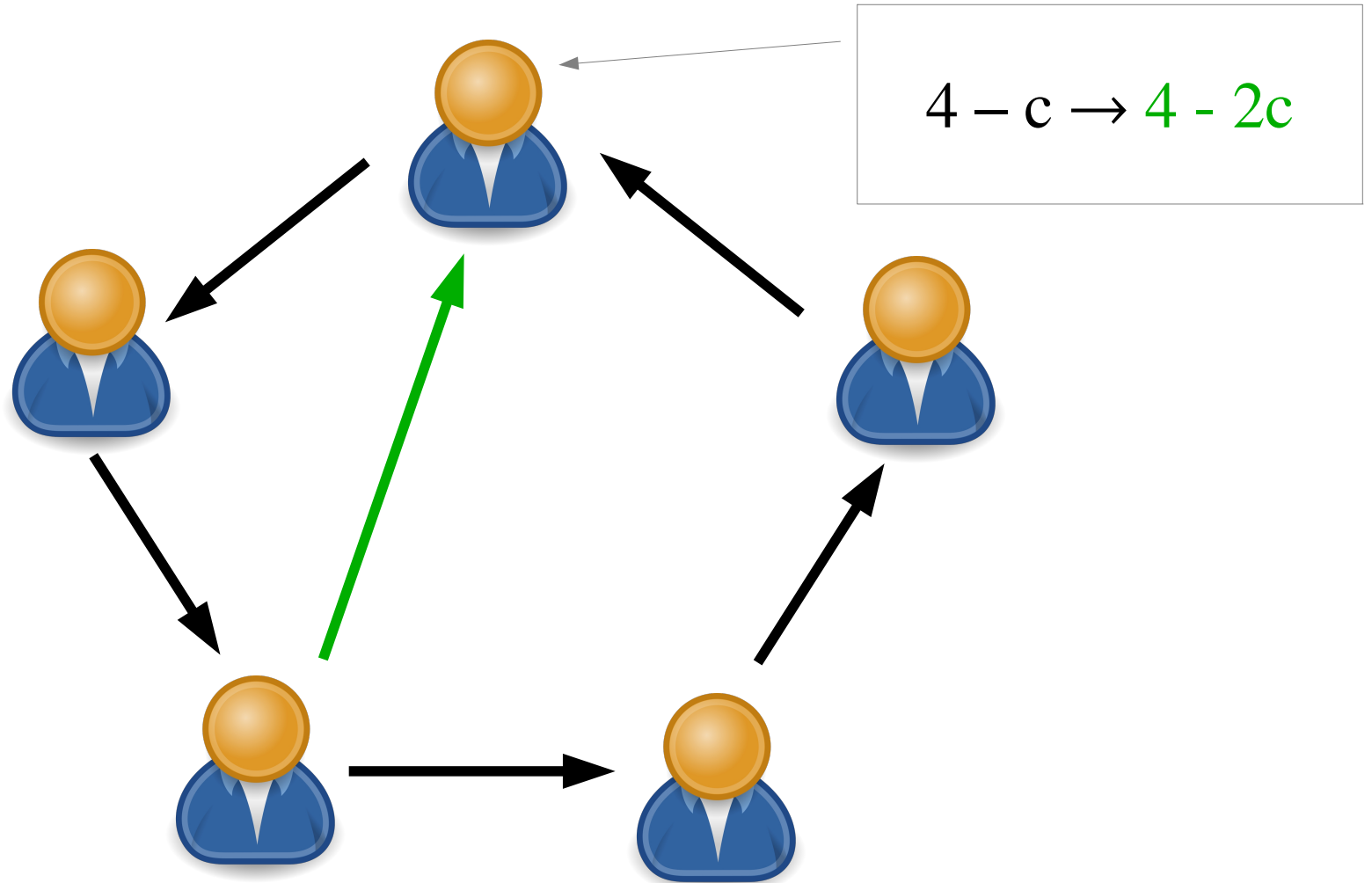
Sparse is good



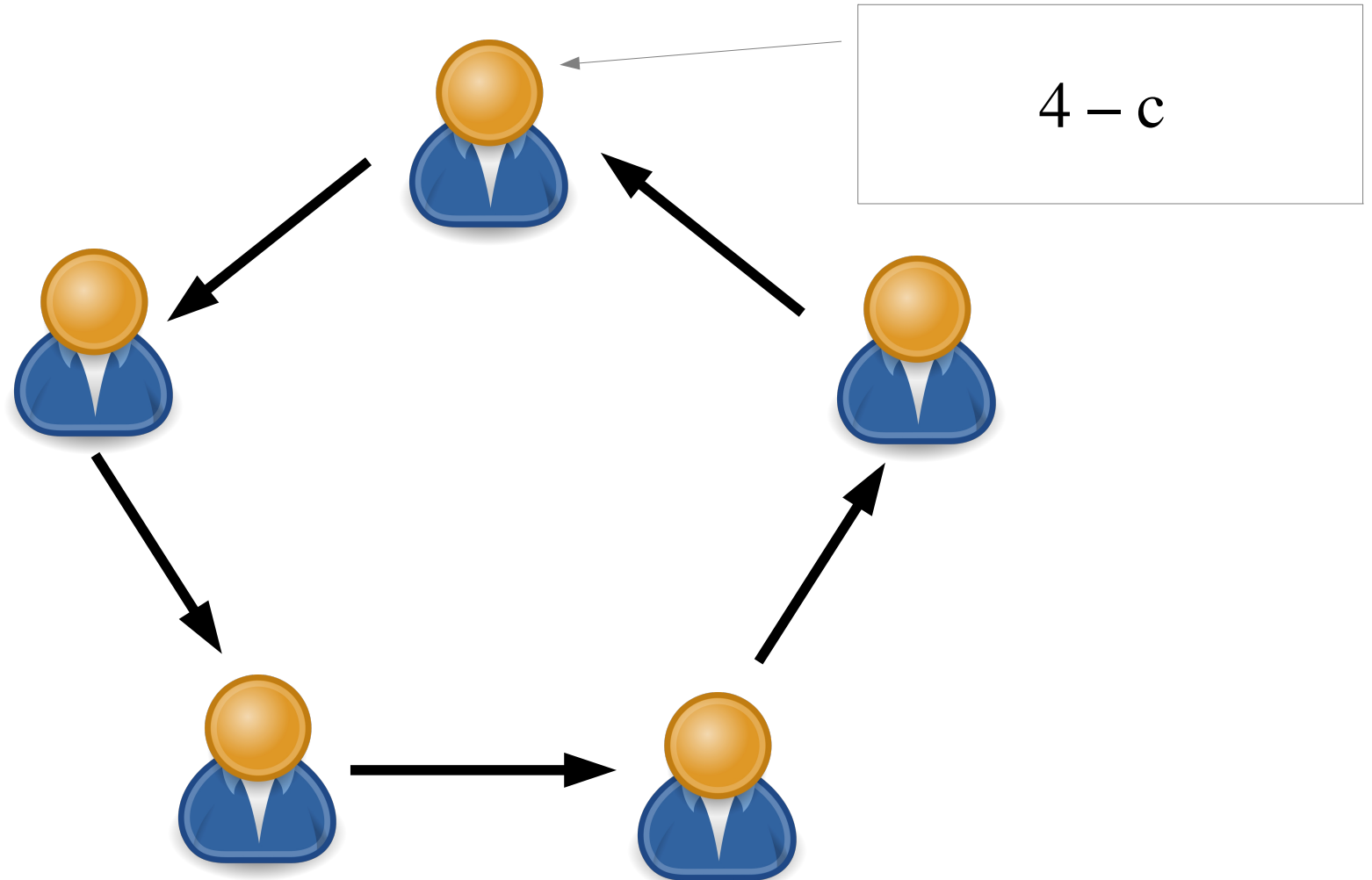
Sparse is good



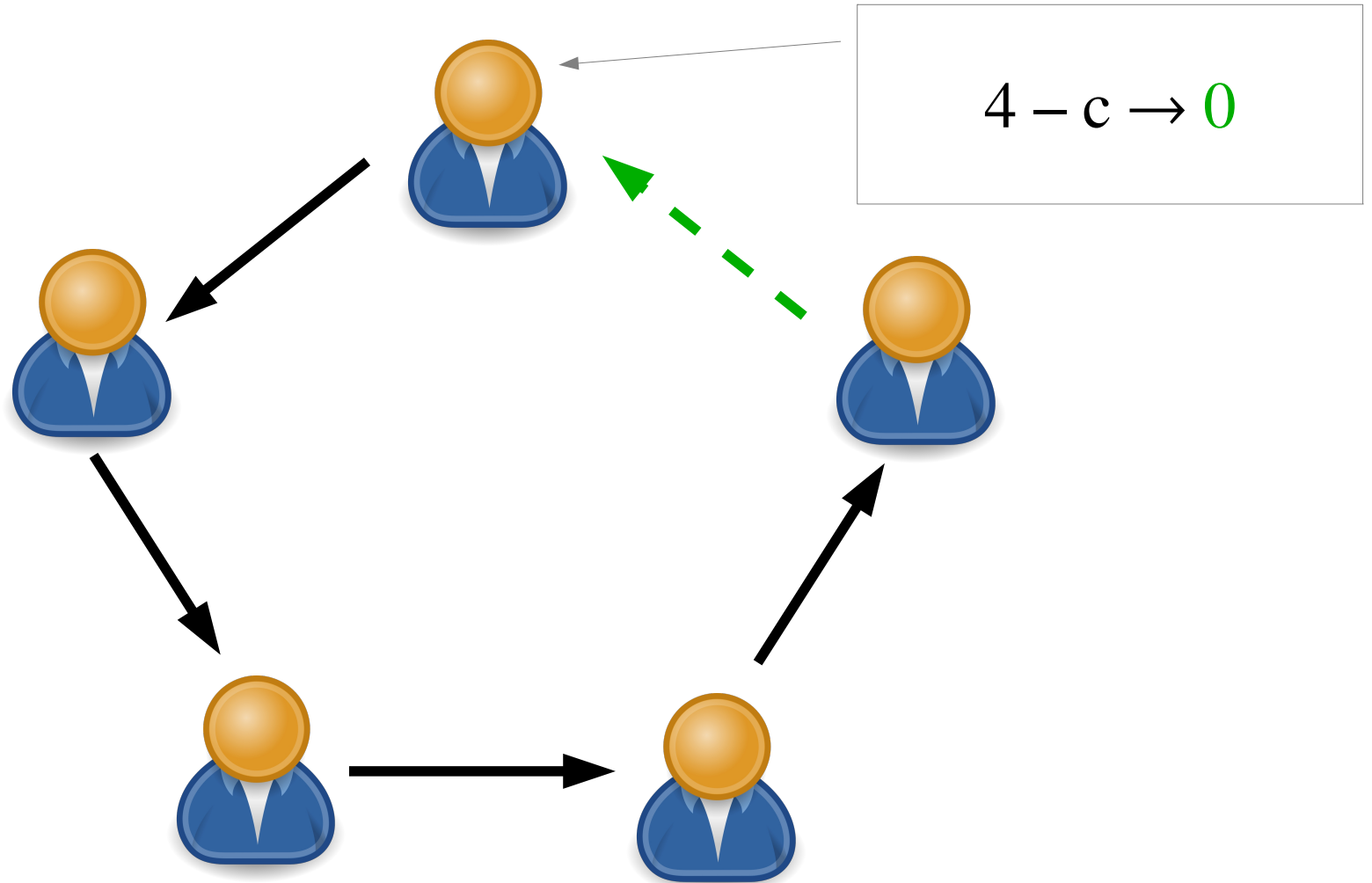
Sparse is good



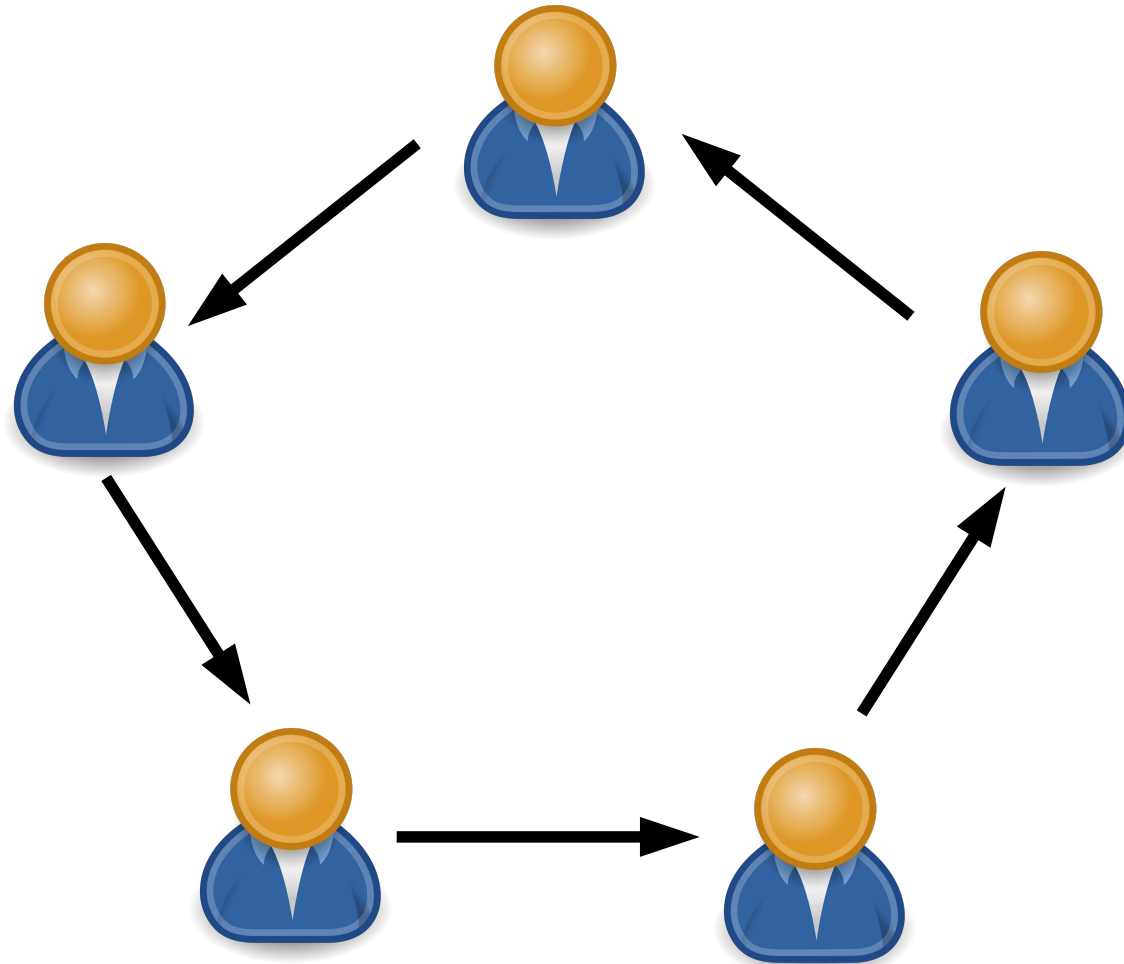
Sparse is good



Sparse is good



Uniquely good



Four variations

No errors

Some errors

Information
transmission
is free

Connected

Information
transmission
is costly

Sparse and
connected

Information transmission is free	Connected	
Information transmission is costly	Sparse and connected	

Four variations

No errors

Some errors

Information
transmission
is free

Connected

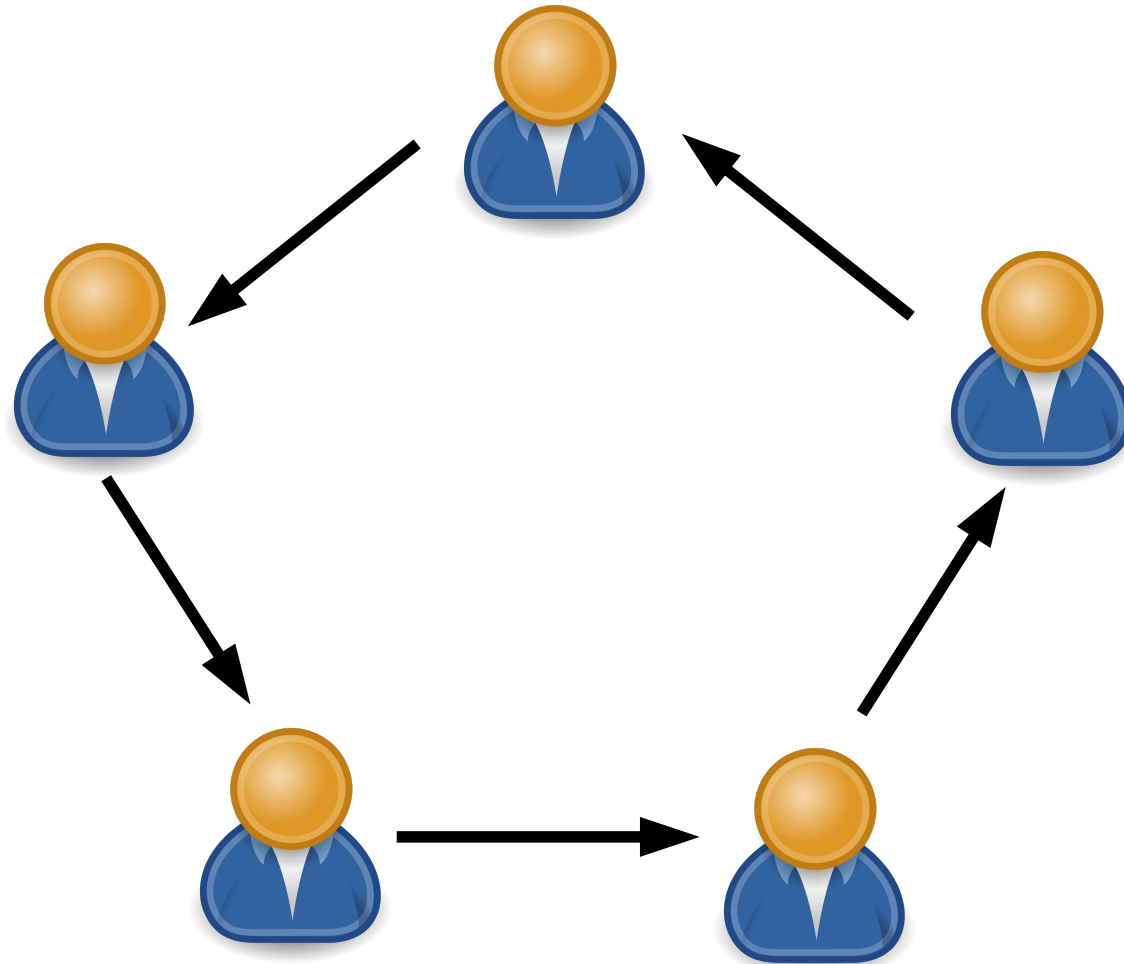
?

Information
transmission
is costly

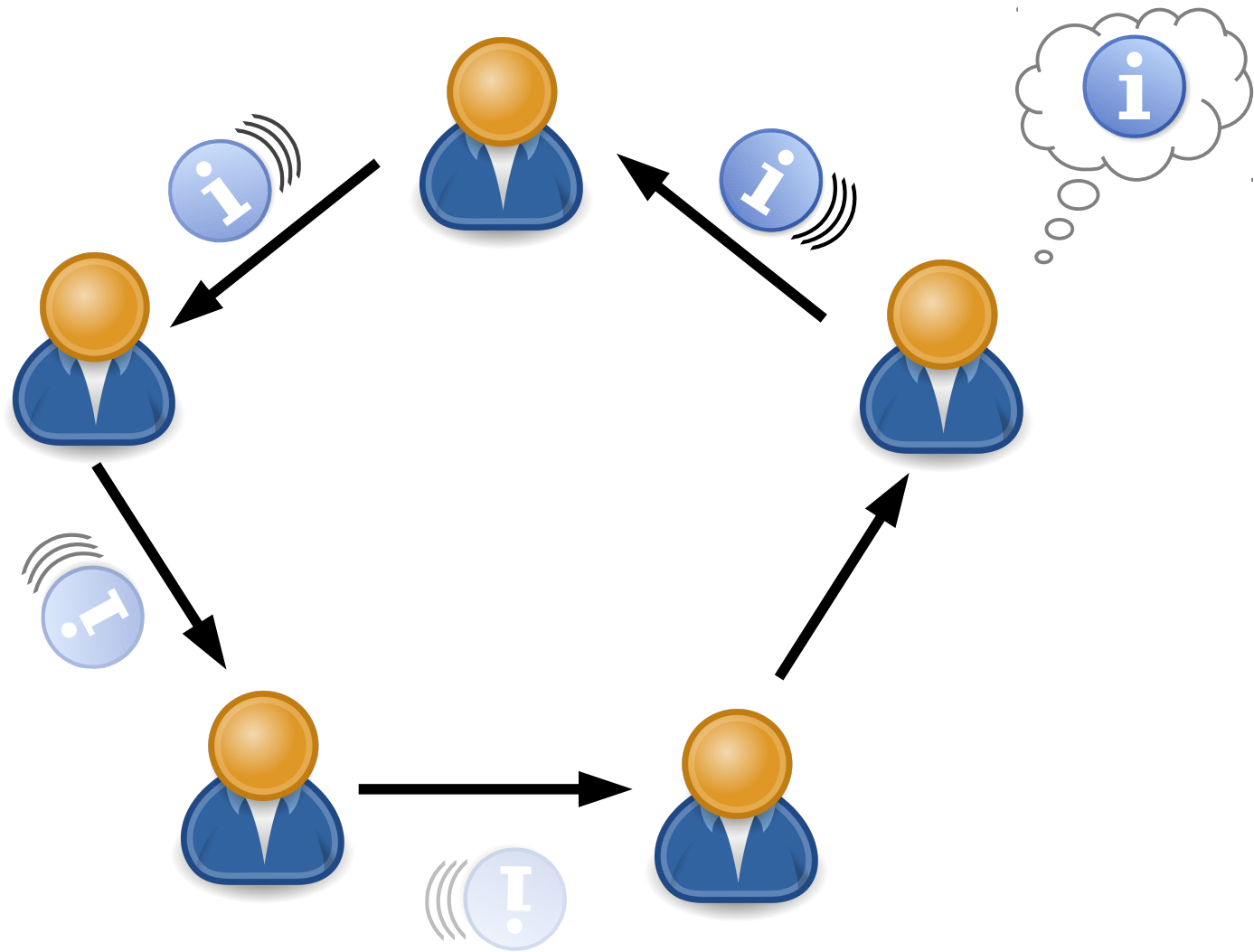
Sparse and
connected

Information transmission is free	Connected	?
Information transmission is costly	Sparse and connected	

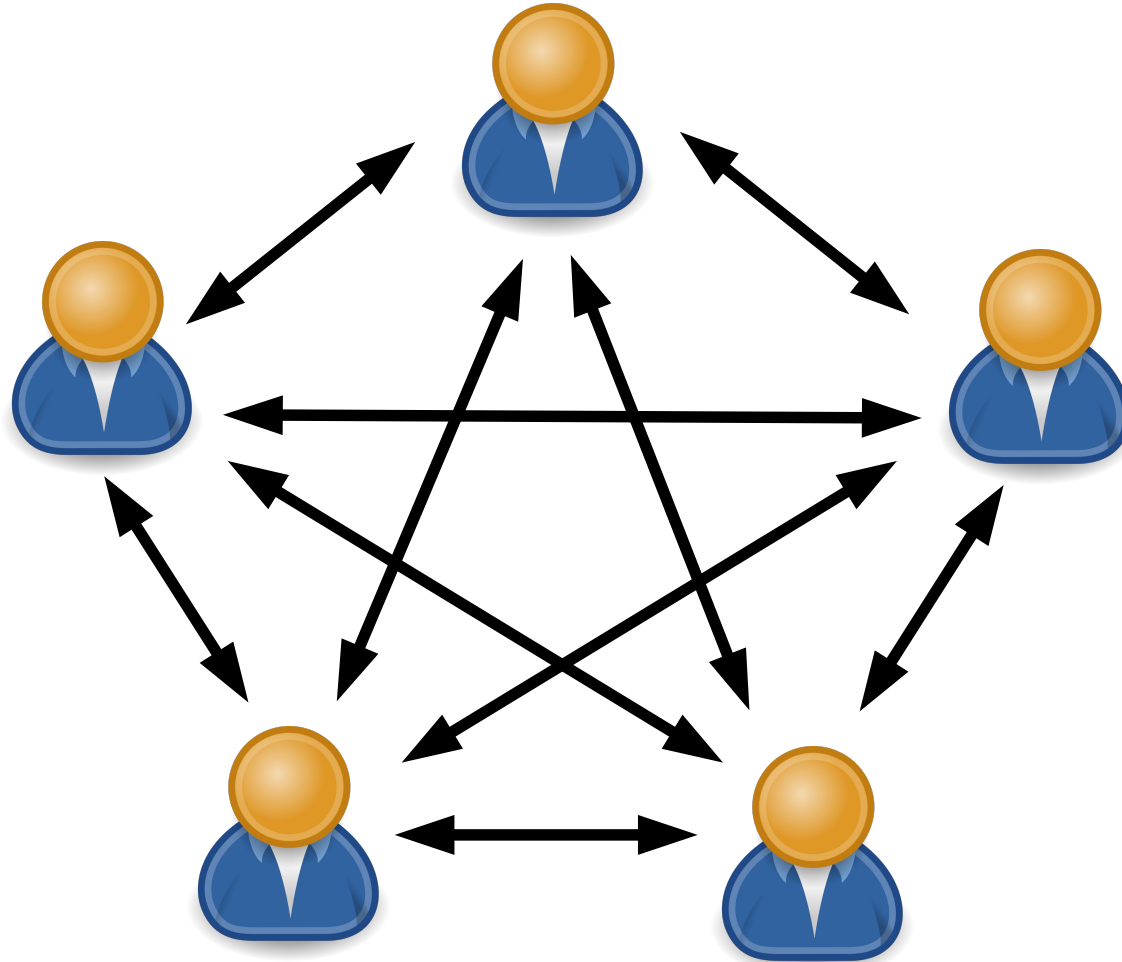
Sparse is bad



Sparse is fine



Dense is good



Four variations

No errors

Some errors

Information
transmission
is free

Connected

Dense and
connected

Information
transmission
is costly

Sparse and
connected

Information transmission is free	Connected	Dense and connected
Information transmission is costly	Sparse and connected	

Four variations

No errors

Some errors

Information
transmission
is free

Connected

Dense and
connected

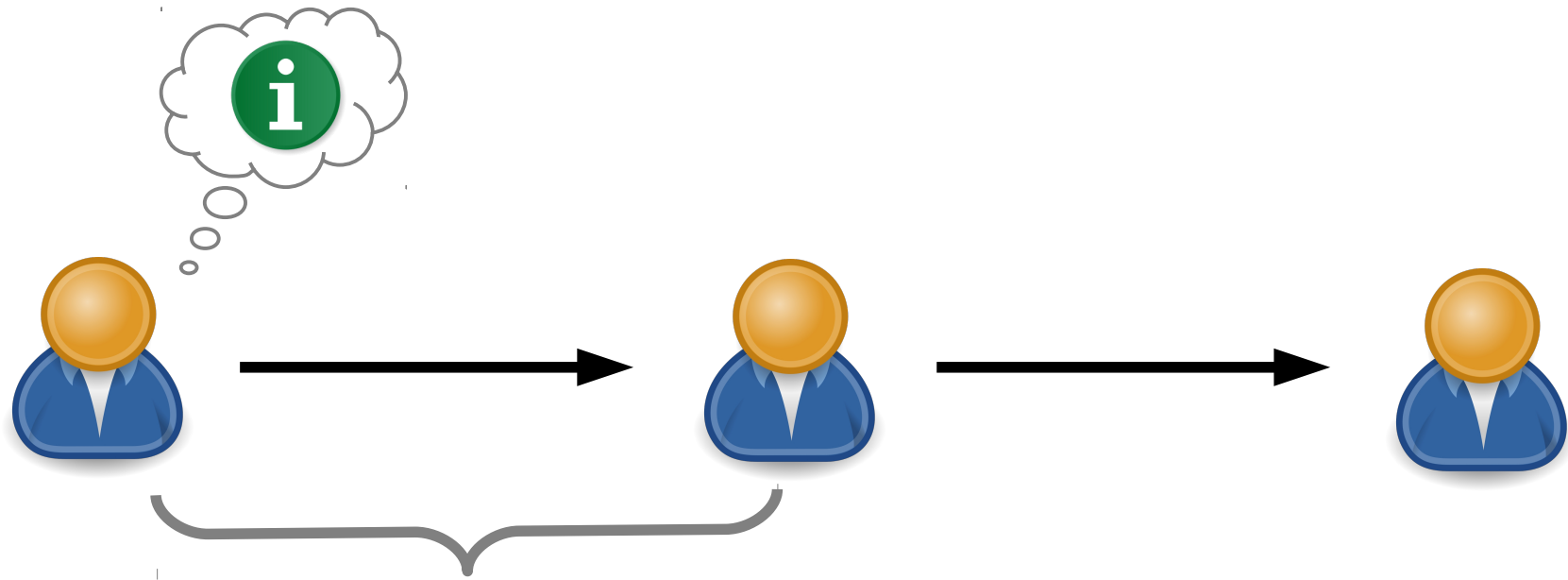
Information
transmission
is costly

Sparse and
connected

?

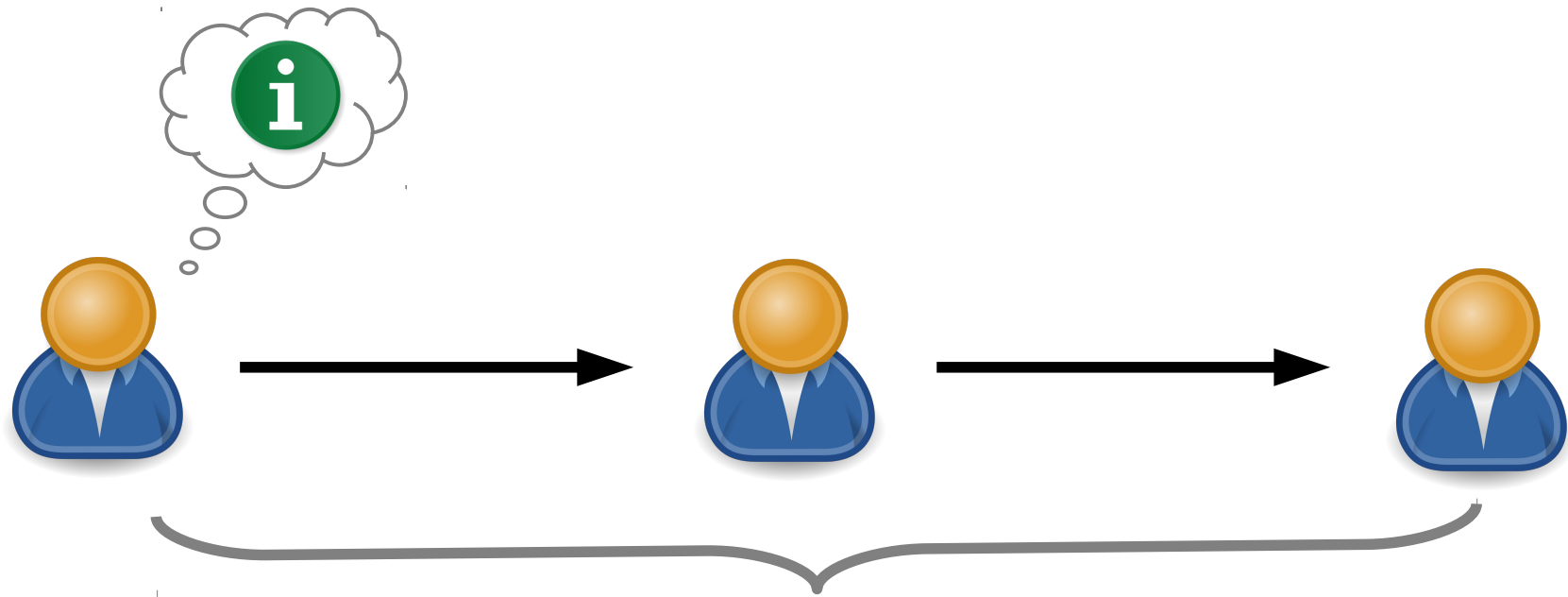
Information transmission is free	Connected	Dense and connected
Information transmission is costly	Sparse and connected	?

Information decay



Probability of successful
transmission: e

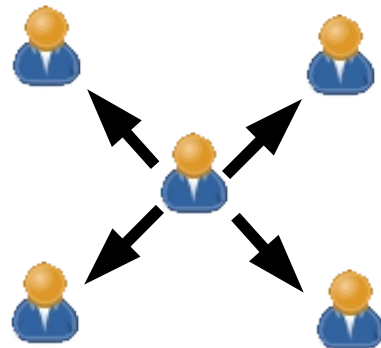
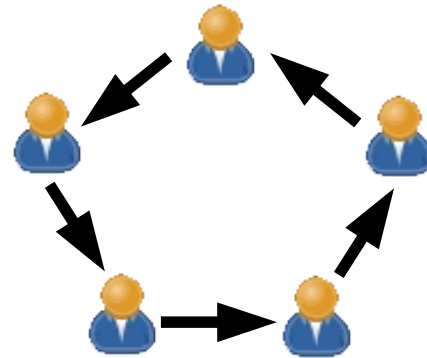
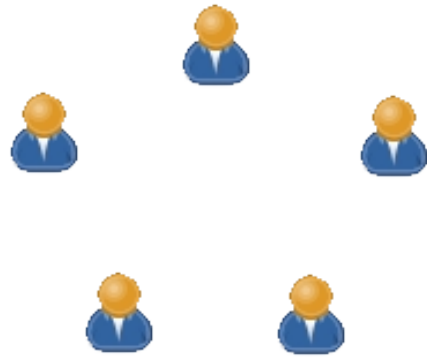
Information decay



Probability of successful
transmission: e^2

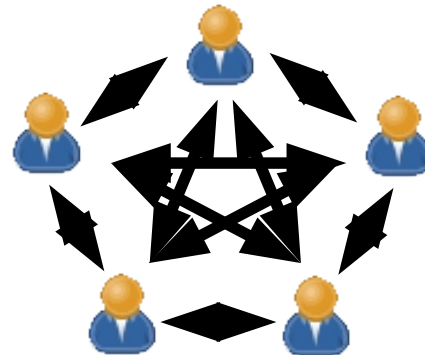
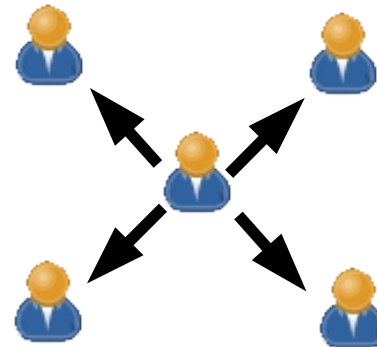
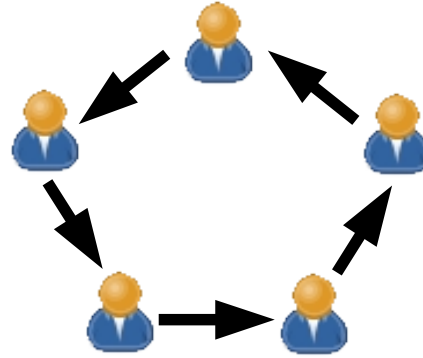
Best network?

Cost of
information



Best network?

Cost of
information



Four variations

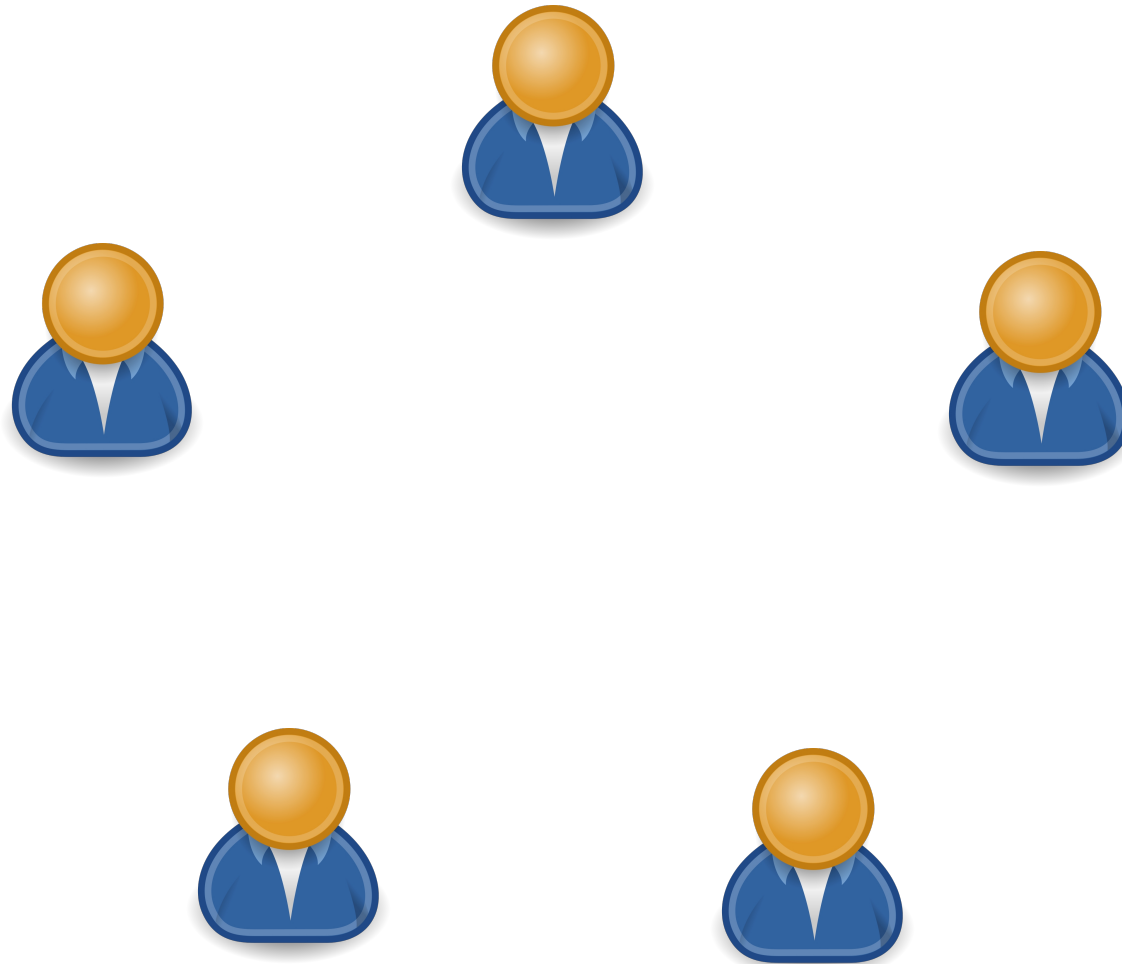
	No errors	Some errors
Information transmission is free	Connected	Dense and connected
Information transmission is costly	Sparse and connected	Depends on the cost of information

Endogenous formation

Q: If left to their own devices will people form the best networks?

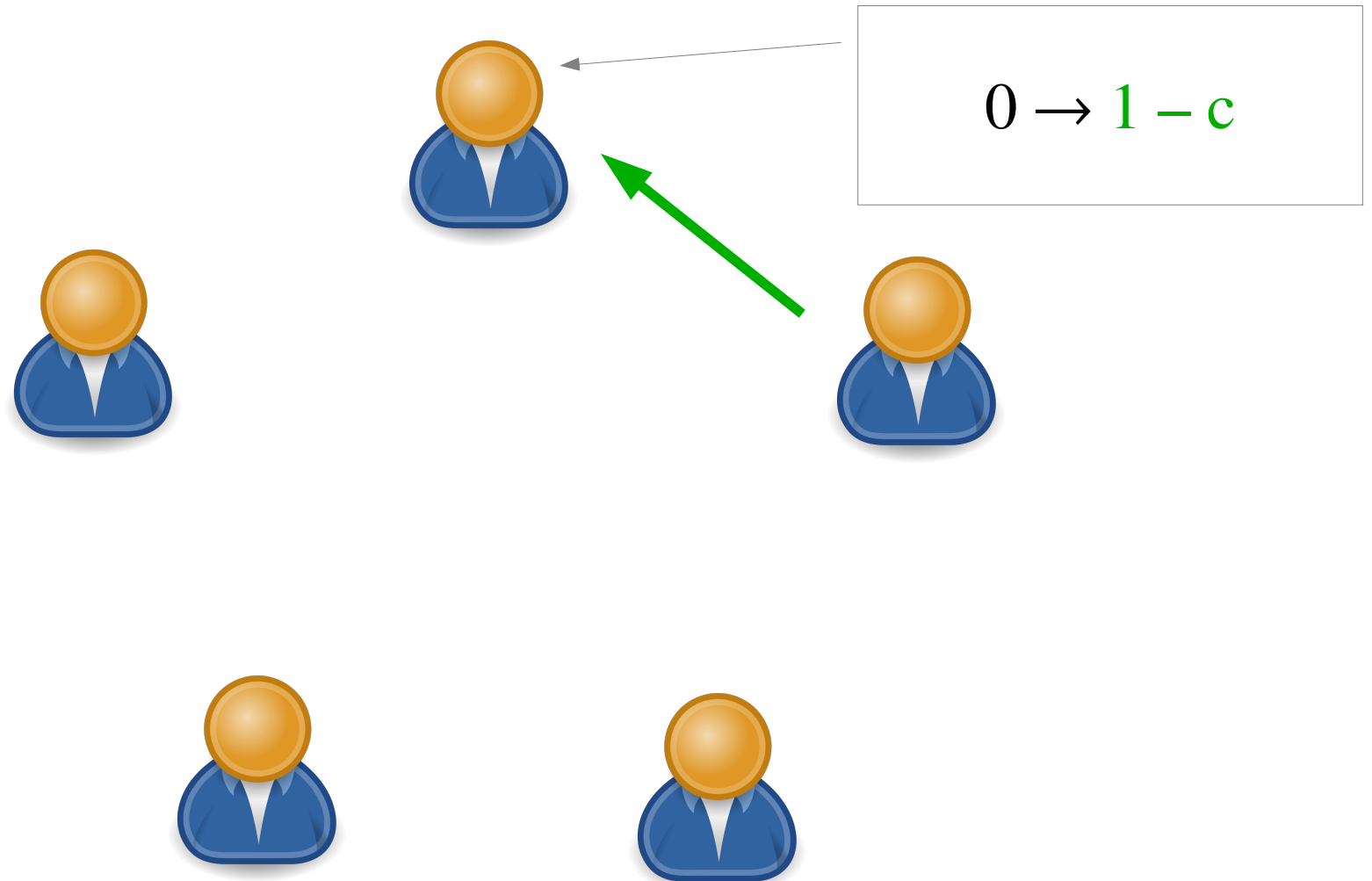
A: Sometimes, but not always

Equilibria



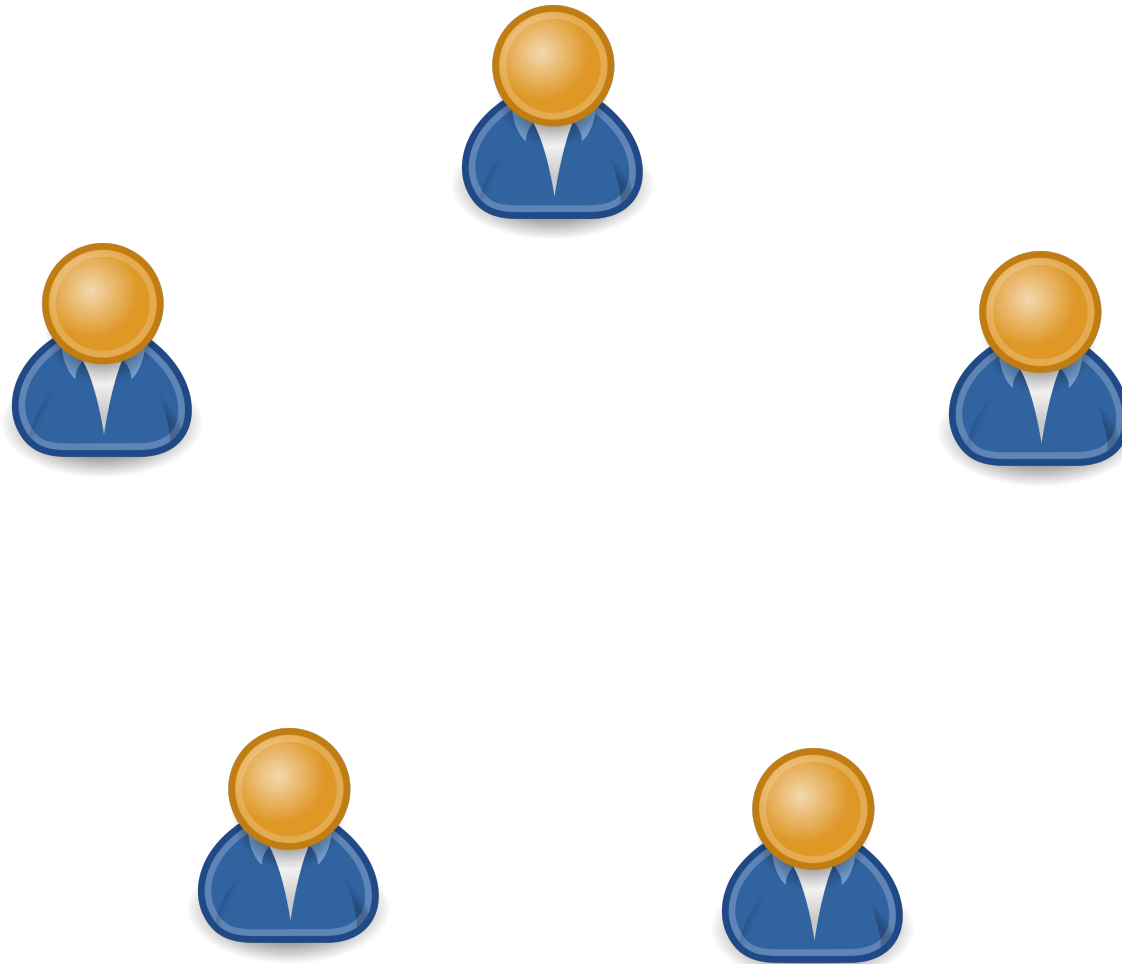
When $c >$ value of one piece of information

Equilibria



When $c >$ value of one piece of information

Equilibria



When $c >$ value of one piece of information

Do people find equilibria?

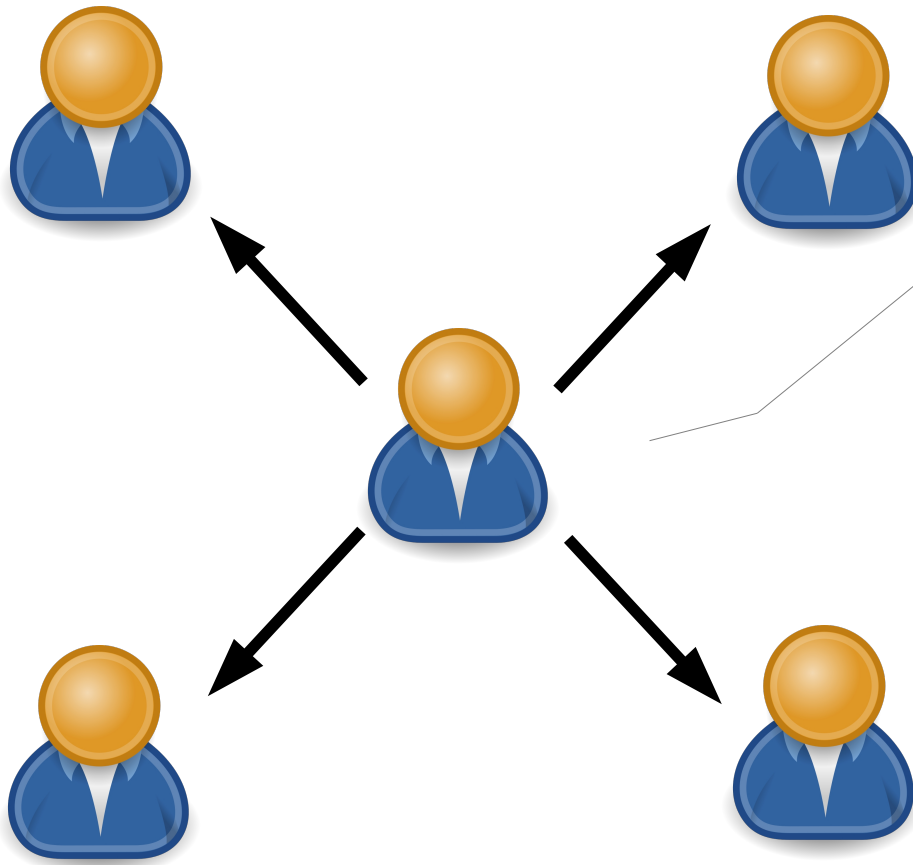
- Yes
 - Bala and Goyal
 - Huttegger, Skyrms, & Zollman
- No
 - Watts
 - Huttegger, Skyrms, & Zollman

One more variant

Until now, information flowed one way and one person paid the cost

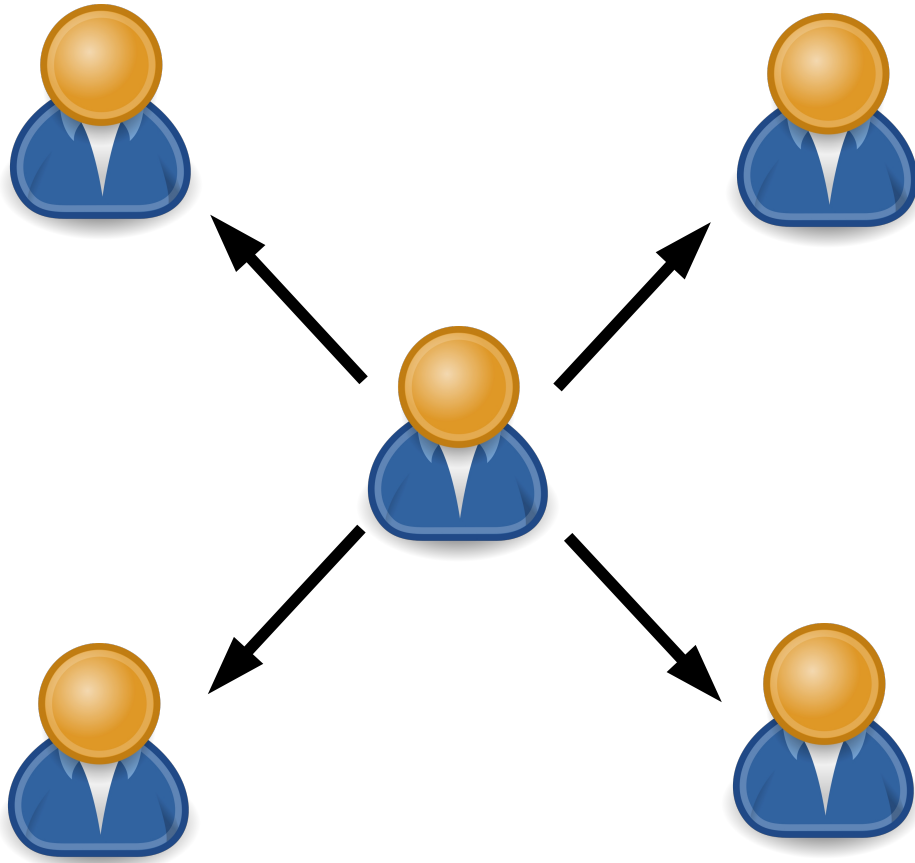
What if information flowed both ways, but only one person paid?

Optimality



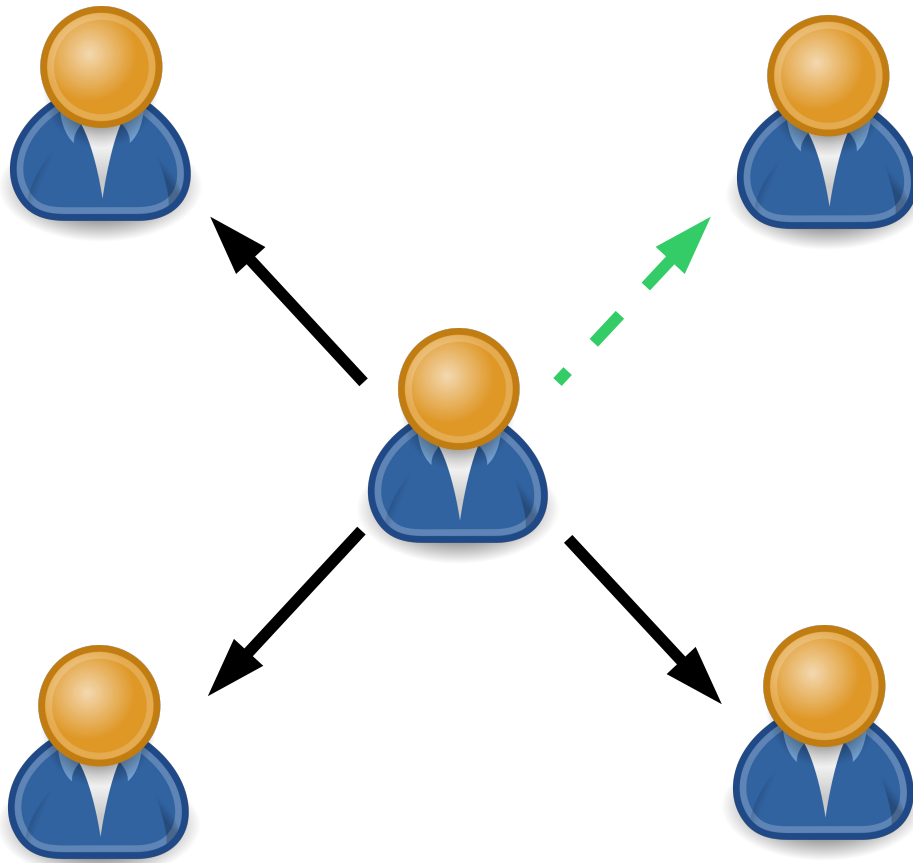
4e

Optimality



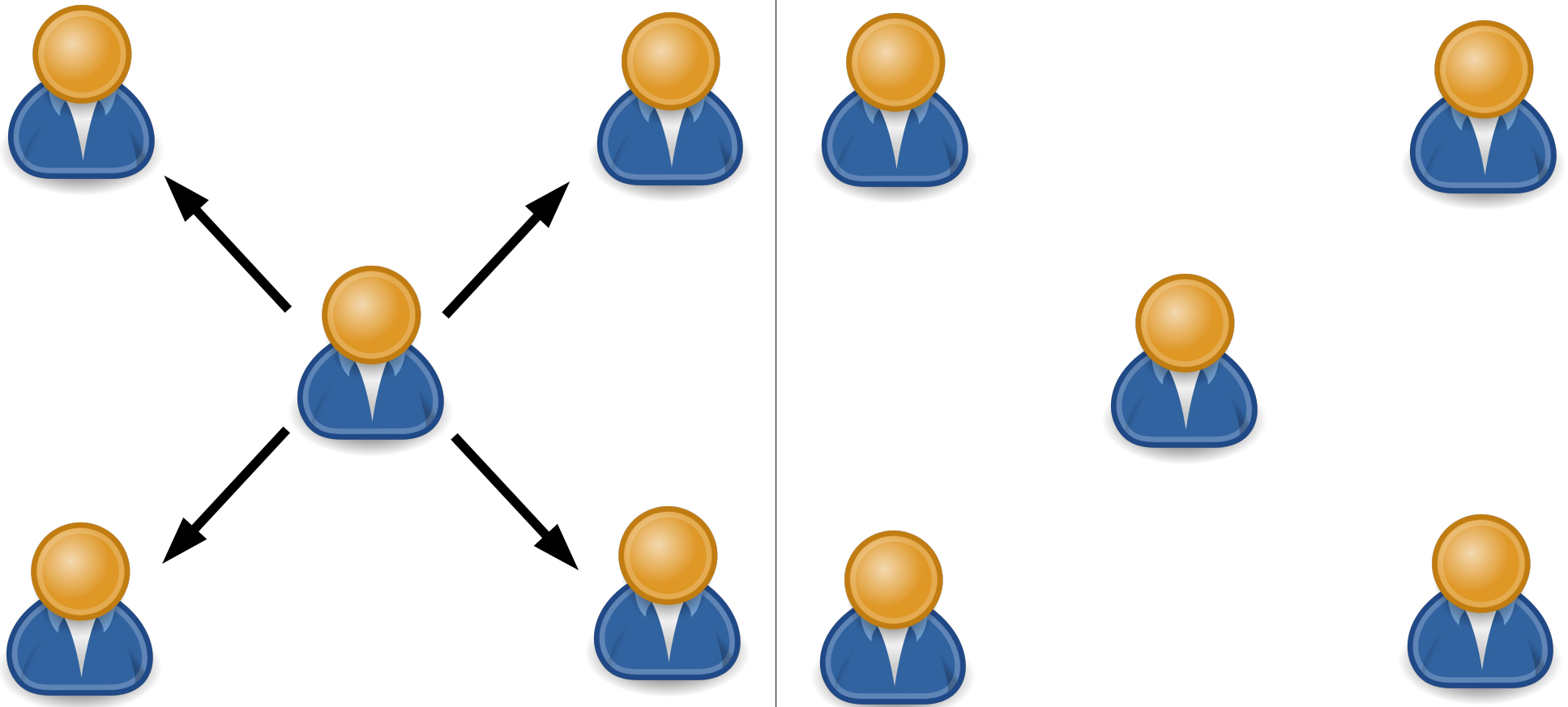
$$e + 3e^2 - c$$

Optimality



$$e + 3e^2 - c \rightarrow 0$$

“Strict” equilibria



$$n-1 > c > e$$

Conclusions

- Low connectivity can be very good
- Unequal connections can be good
- Hard to learn optimal structures