UNIVERSITY OF Southampton

Social Value Propagation for Supply Chain Formation

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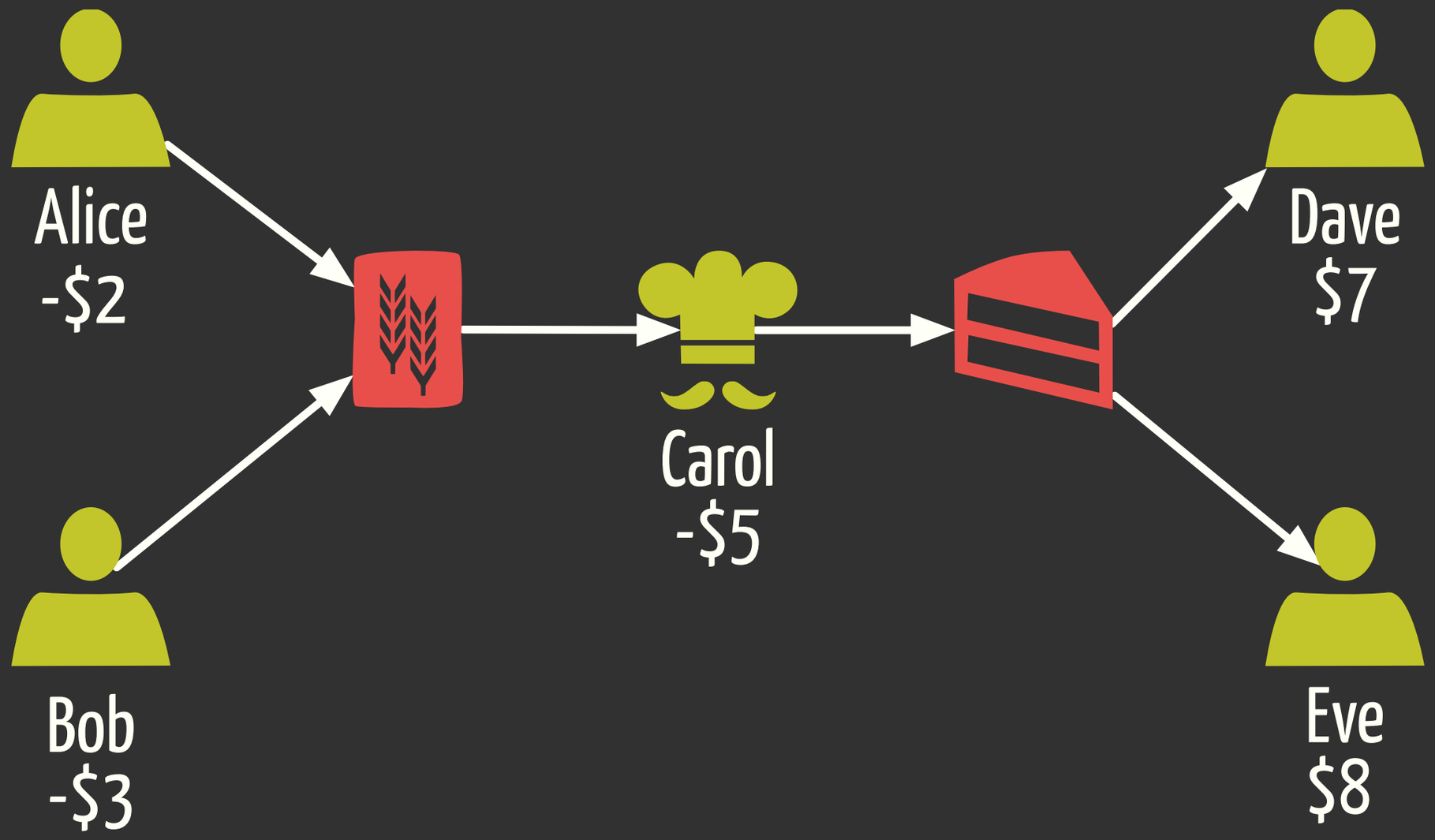
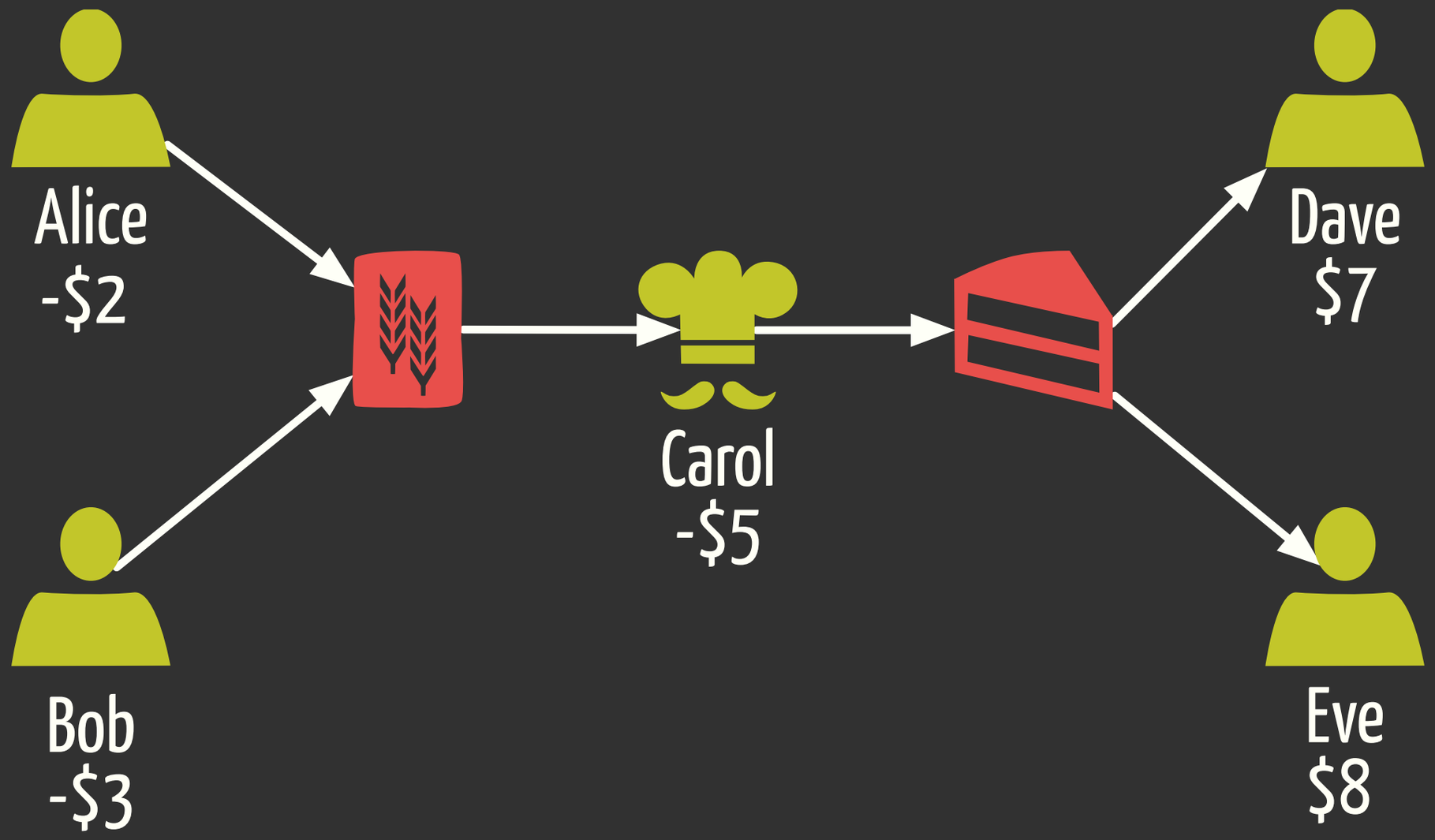
Jesus Cerquides and Juan A. Rodriguez-Aguilar

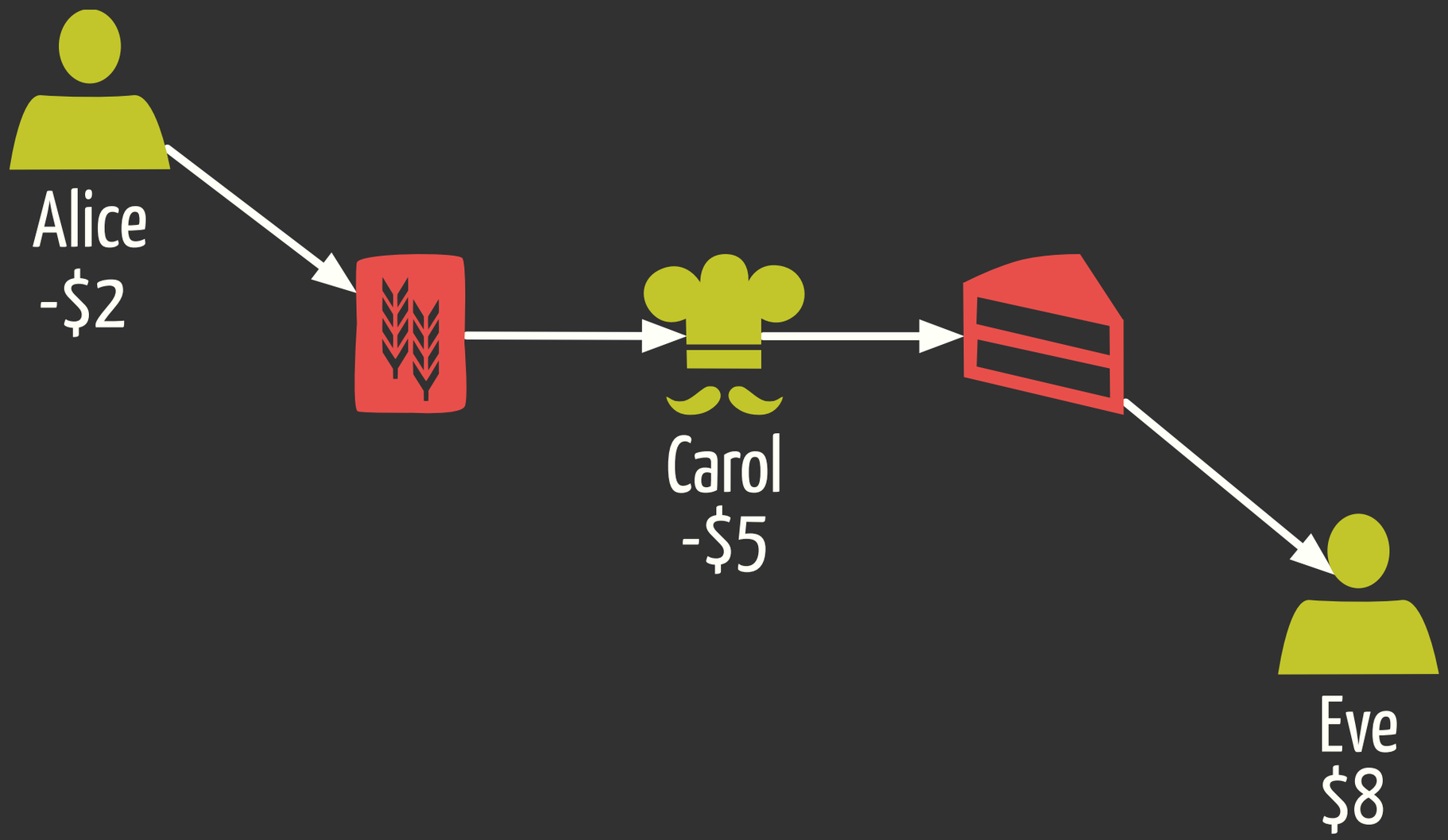
for the 6th International OPTMAS Workshop

The problem


Alice
-$2
Bob
-$3
Carol
-$5
Dave
$7
Eve
$8



The Supply Chain Formation problem is that of finding the feasible configuration with maximum value.



Supply Chain Value = $8 - $5 - $2 = $1

Decentralized algorithm for SCF based on social value propagation.

Reduces computation.
Reduces communication.
Produces (near)optimal solutions.

Related work

Supply Chain Formation Timeline

SAMP-SB

Decentralized
High communication
Low memory & computation
High valued solutions

MMUCA

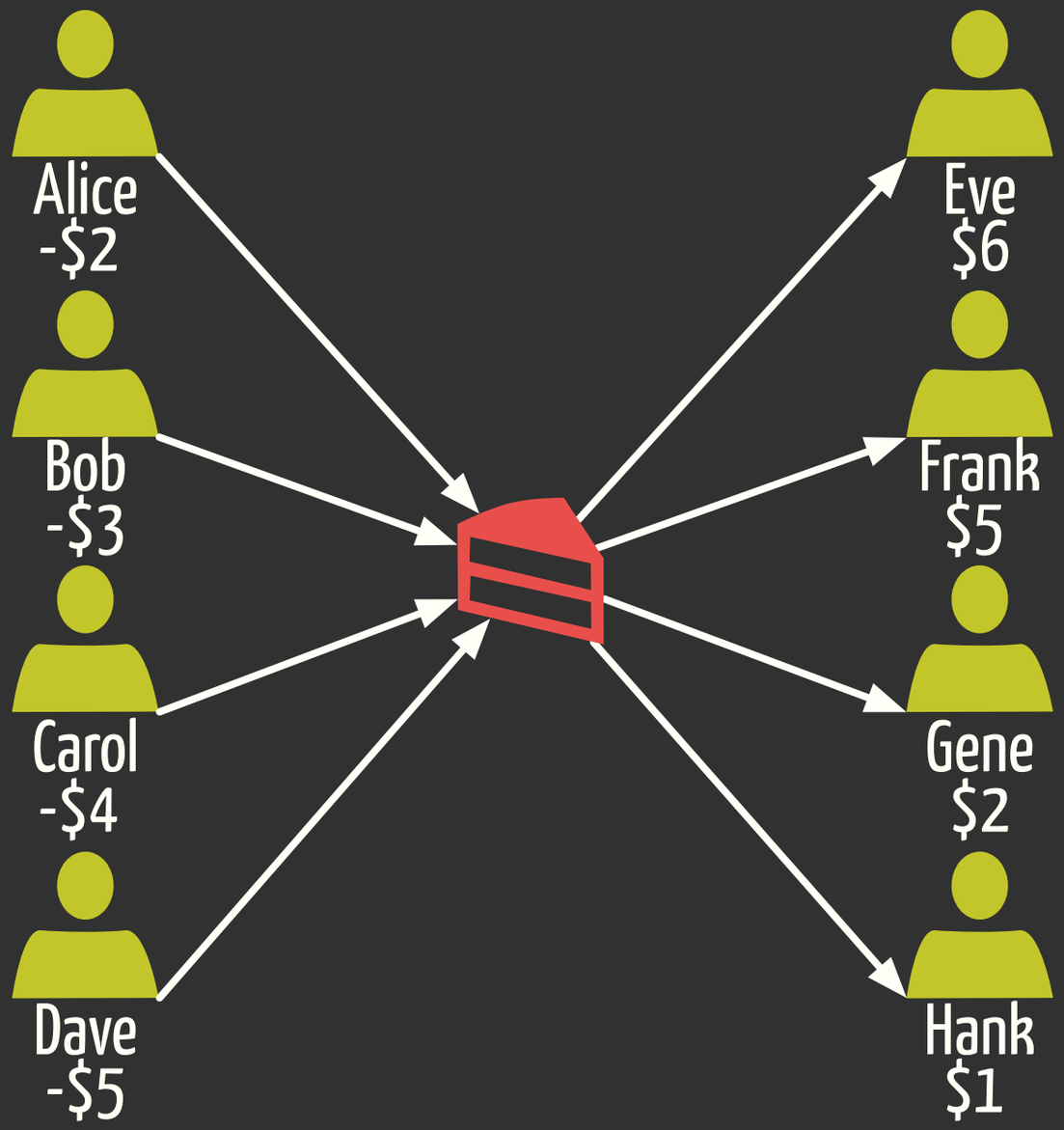
Centralized
Optimal
Multi-unit
Low scalability

RB-LBP

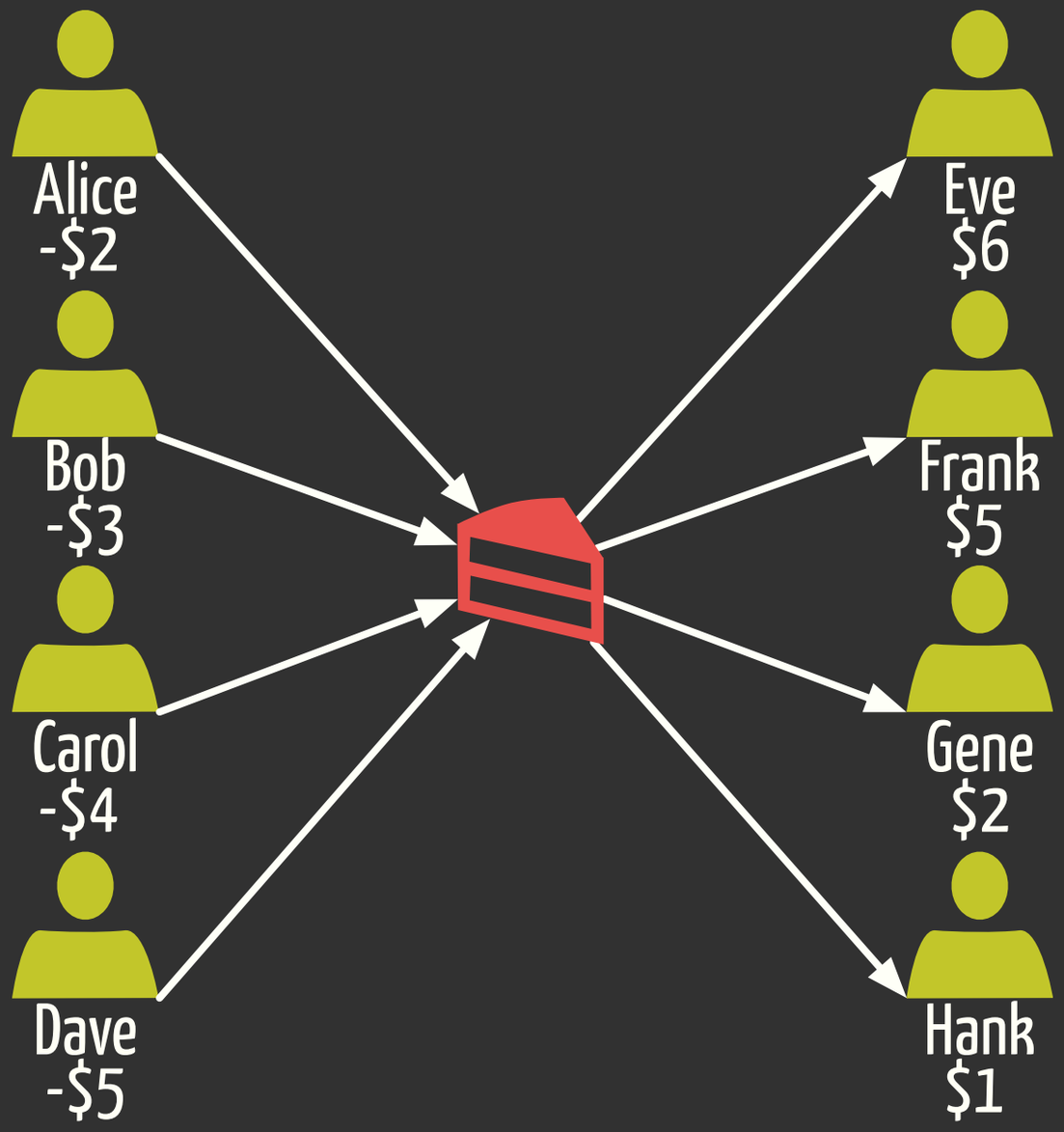
Decentralized
Low communication
Low memory & computation
Low valued solutions

Social Value Propagation

Participant's Social Value

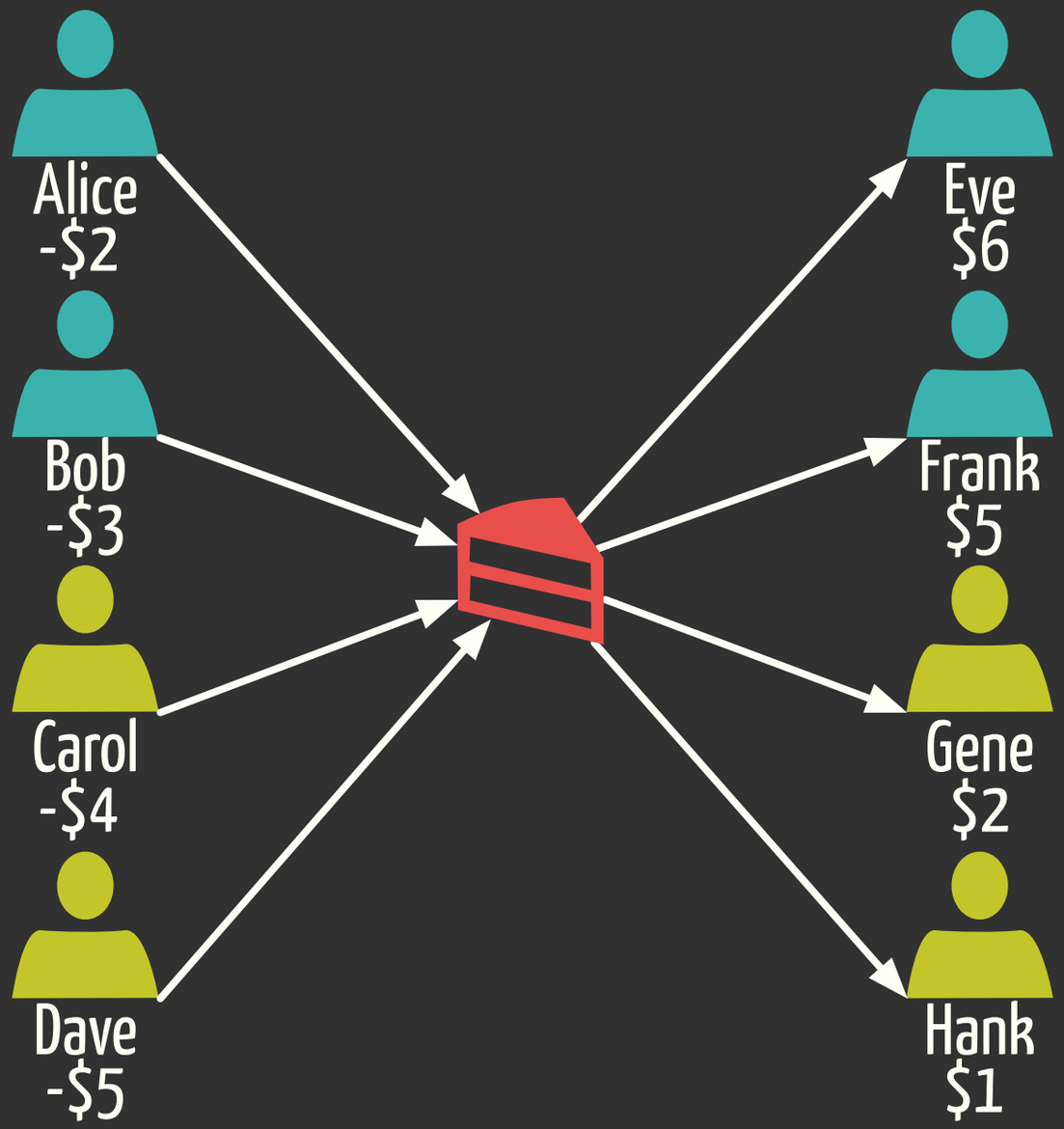


Participant's Social Value



Social value for participant p how much better is for the other agents that p is active over p being inactive.

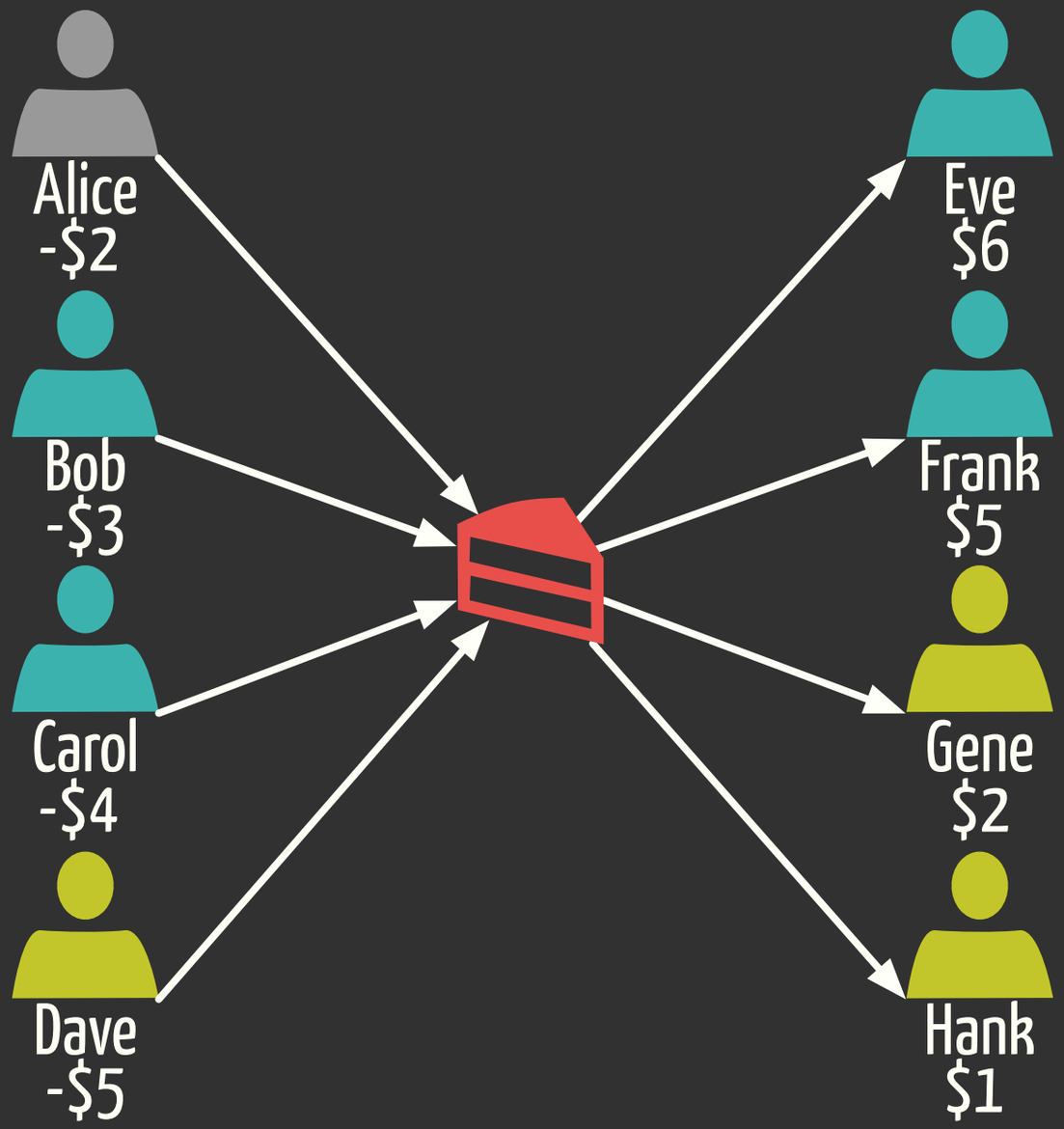
Participant's Social Value



With Alice = 6+5-2-3 = 6

Social value for participant p how much better is for the other agents that p is active over p being inactive.

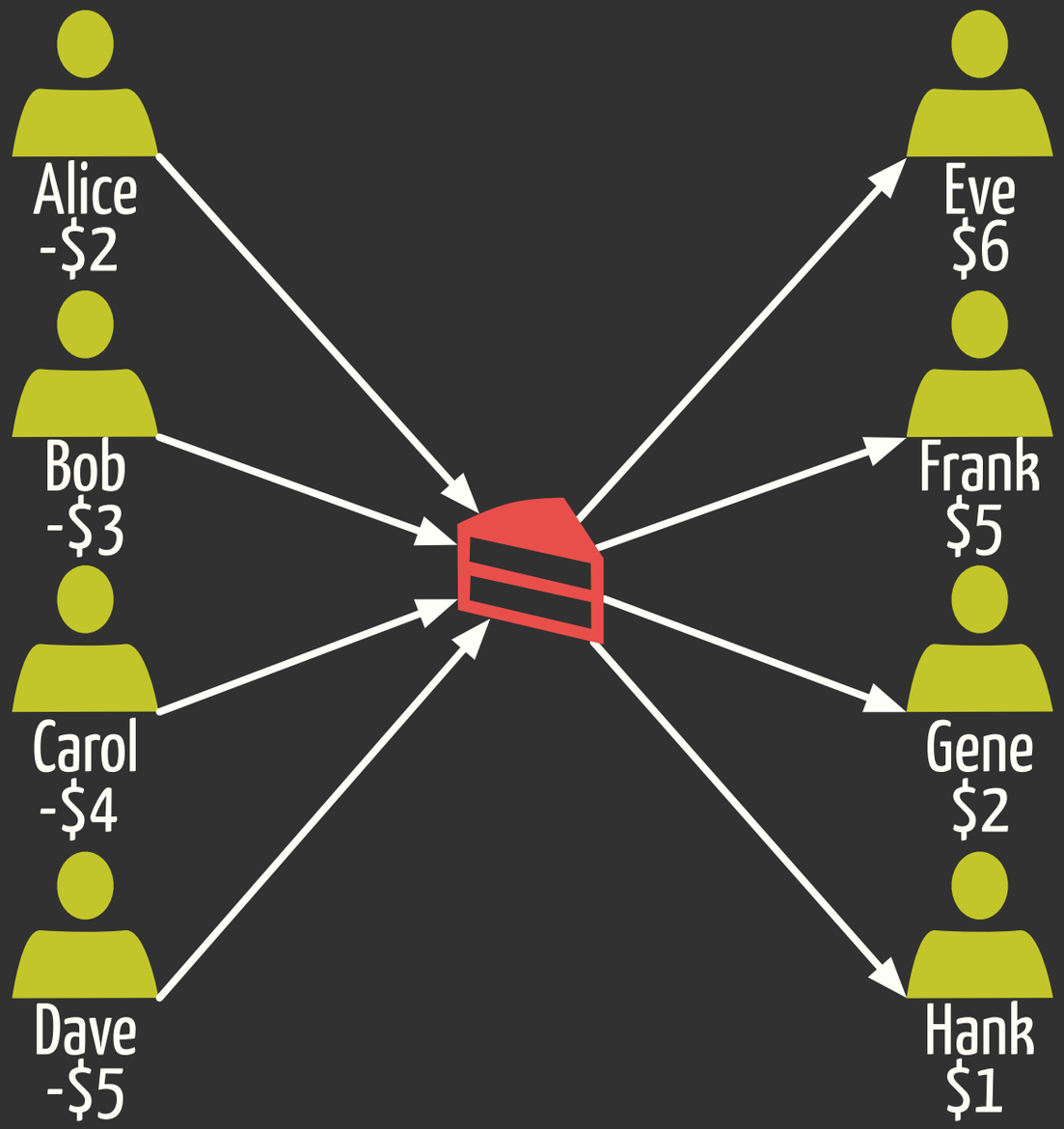
Participant's Social Value



Without Alice = 6+5-3-4 = 4

Social value for participant p how much better is for the other agents that p is active over p being inactive.

Participant's Social Value



Alice's social value = 6 - 4 = 2

Social value for participant p how much better is for the other agents that p is active over p being inactive.

CHAINME

CHaining Agents IN
Mediated Environments

CHAINME is a message passing algorithm

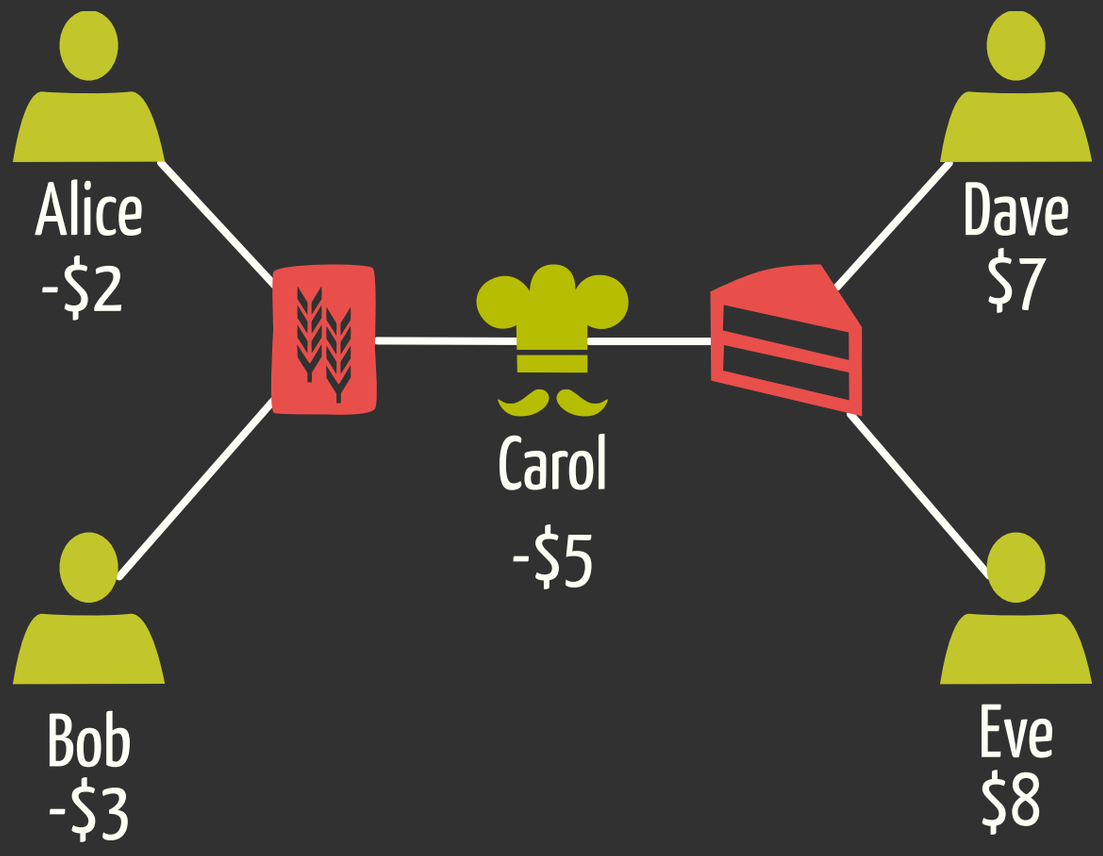
Two phases:

- Assess participants social value.
- Assess the supply chain configuration.

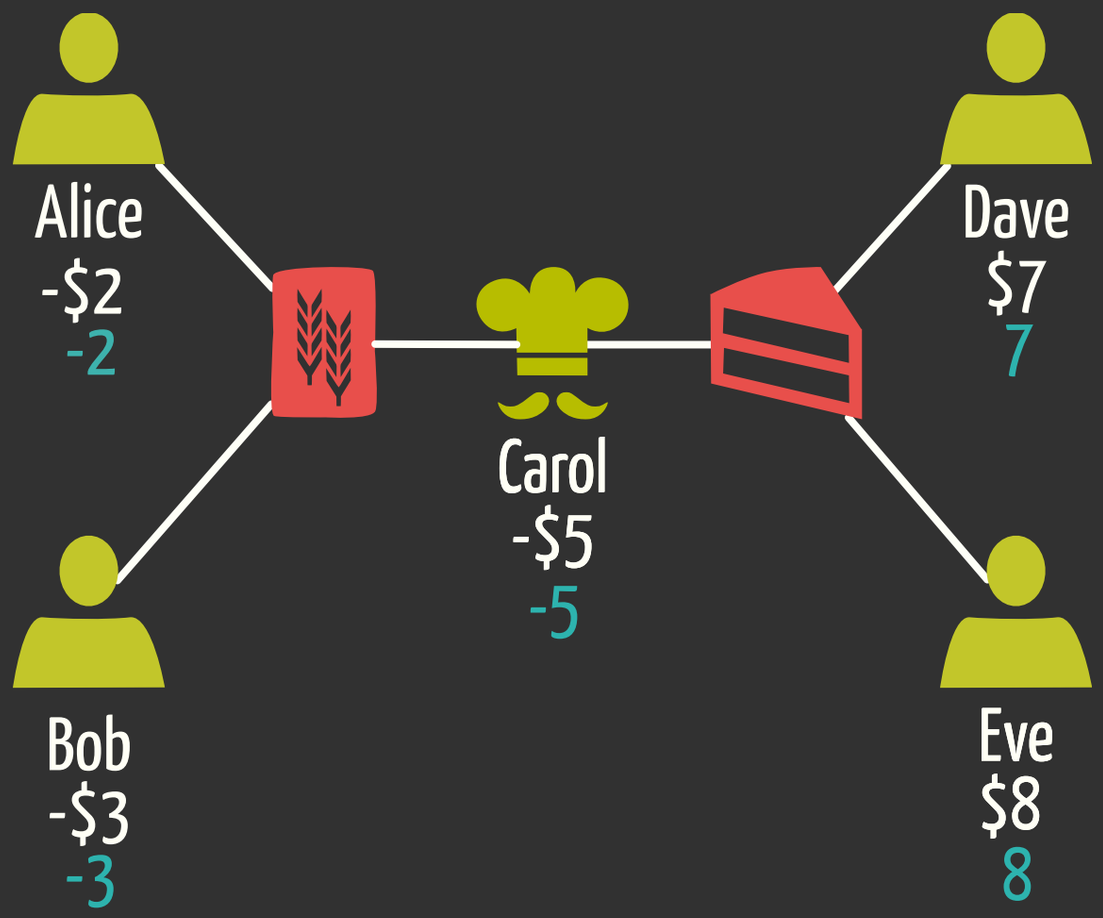
Assessing participants'

Social Value

Assessing Participants' Social Value



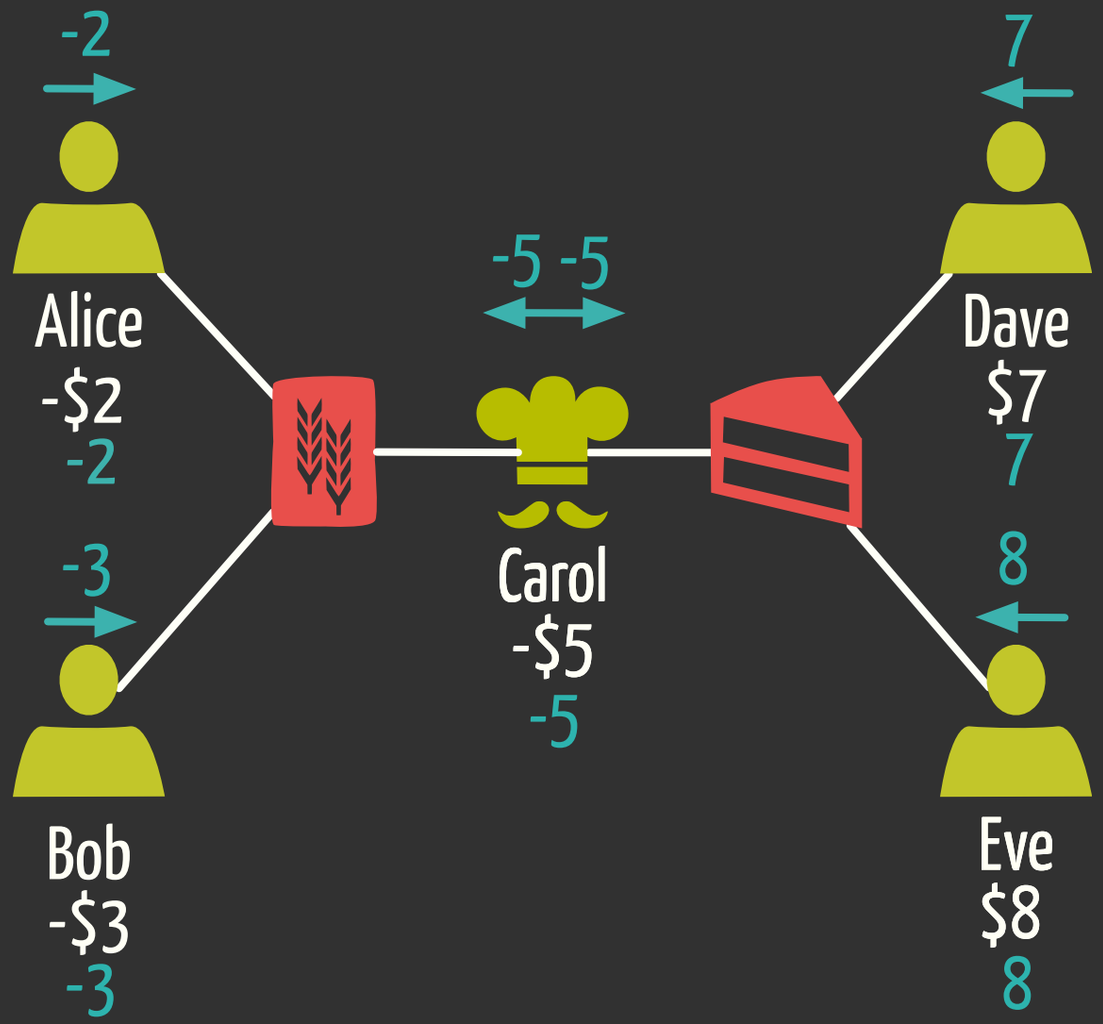
Assessing Participants' Social Value



Determine agent value

$$V_a = C_a + \sum_{g \in G_a} S_a^g$$

Assessing Participants' Social Value



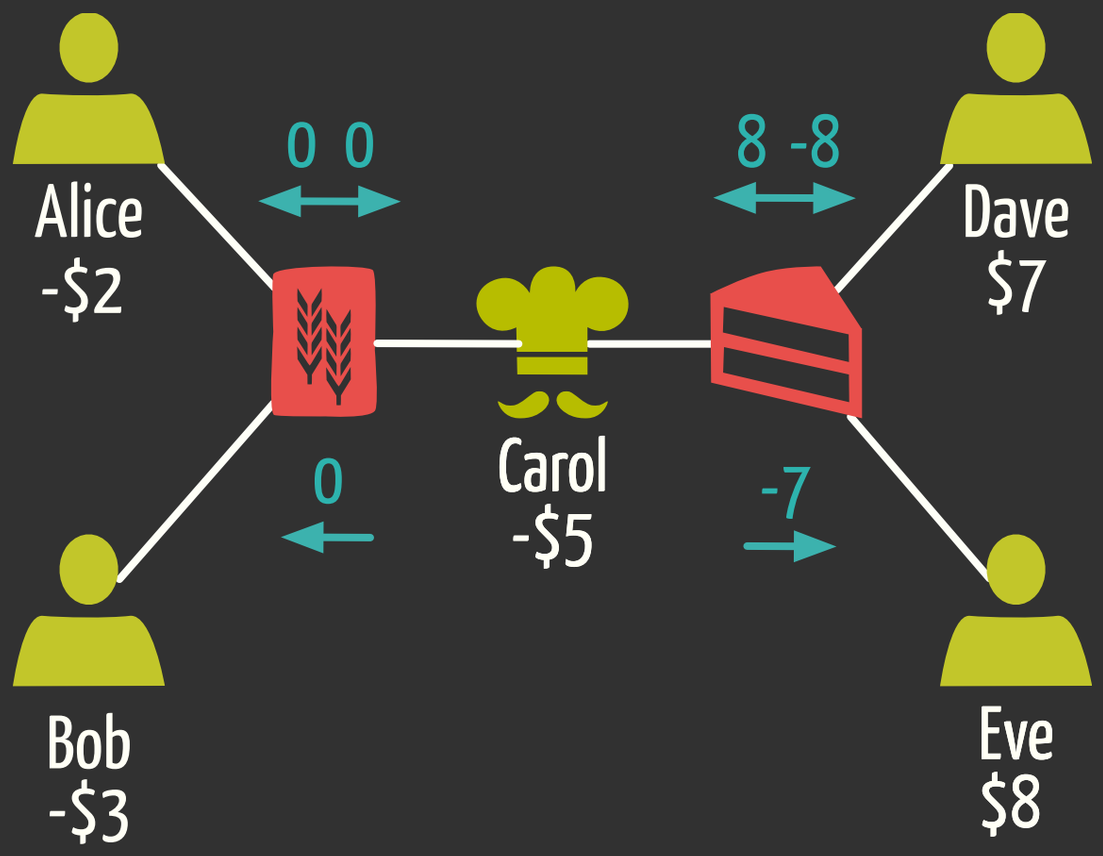
Determine agent value

$$V_a = C_a + \sum_{g \in G_a} S_a^g$$

Send offer to mediators

$$O_a^g \leftarrow V_a - S_a^g$$

Assessing Participants' Social Value



Determine agent value

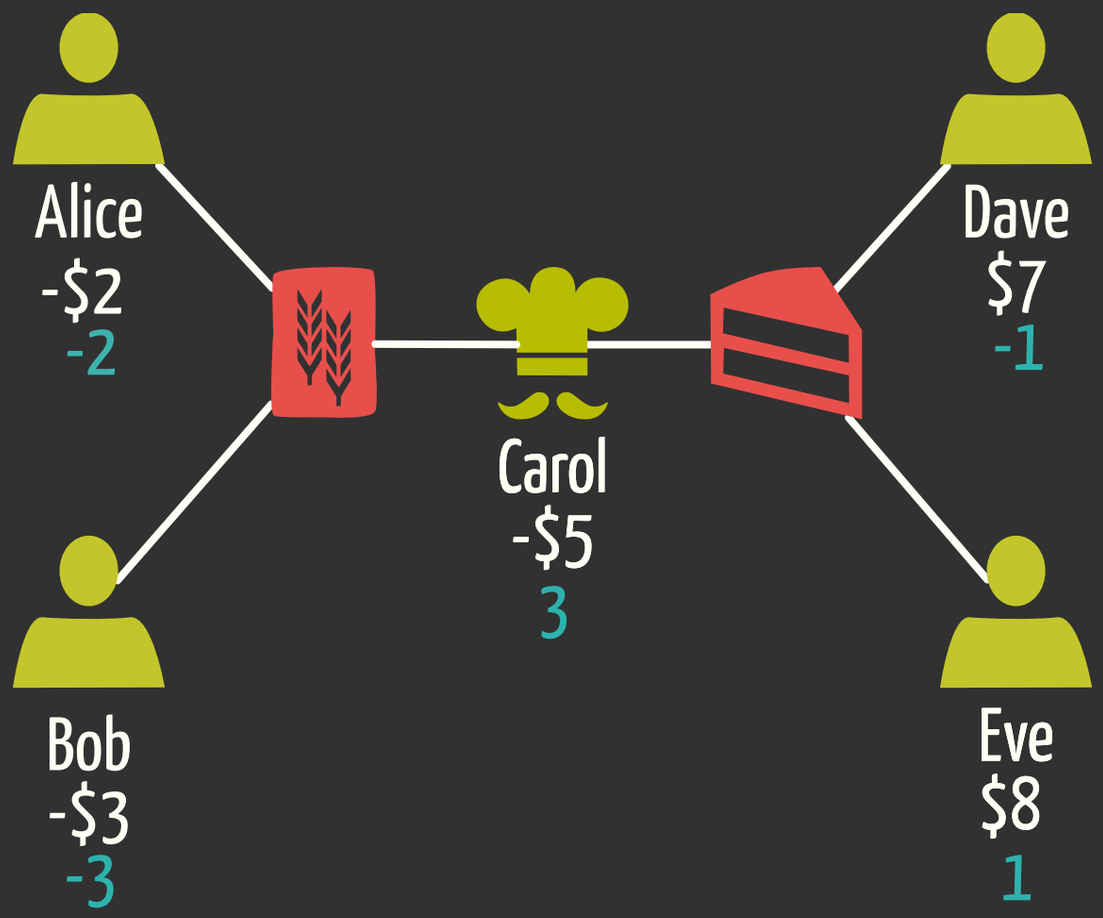
$$V_a = C_a + \sum_{g \in G_a} S_a^g$$

Send offer to mediators

$$O_a^g \leftarrow V_a - S_a^g$$

Send updated social value

Assessing Participants' Social Value



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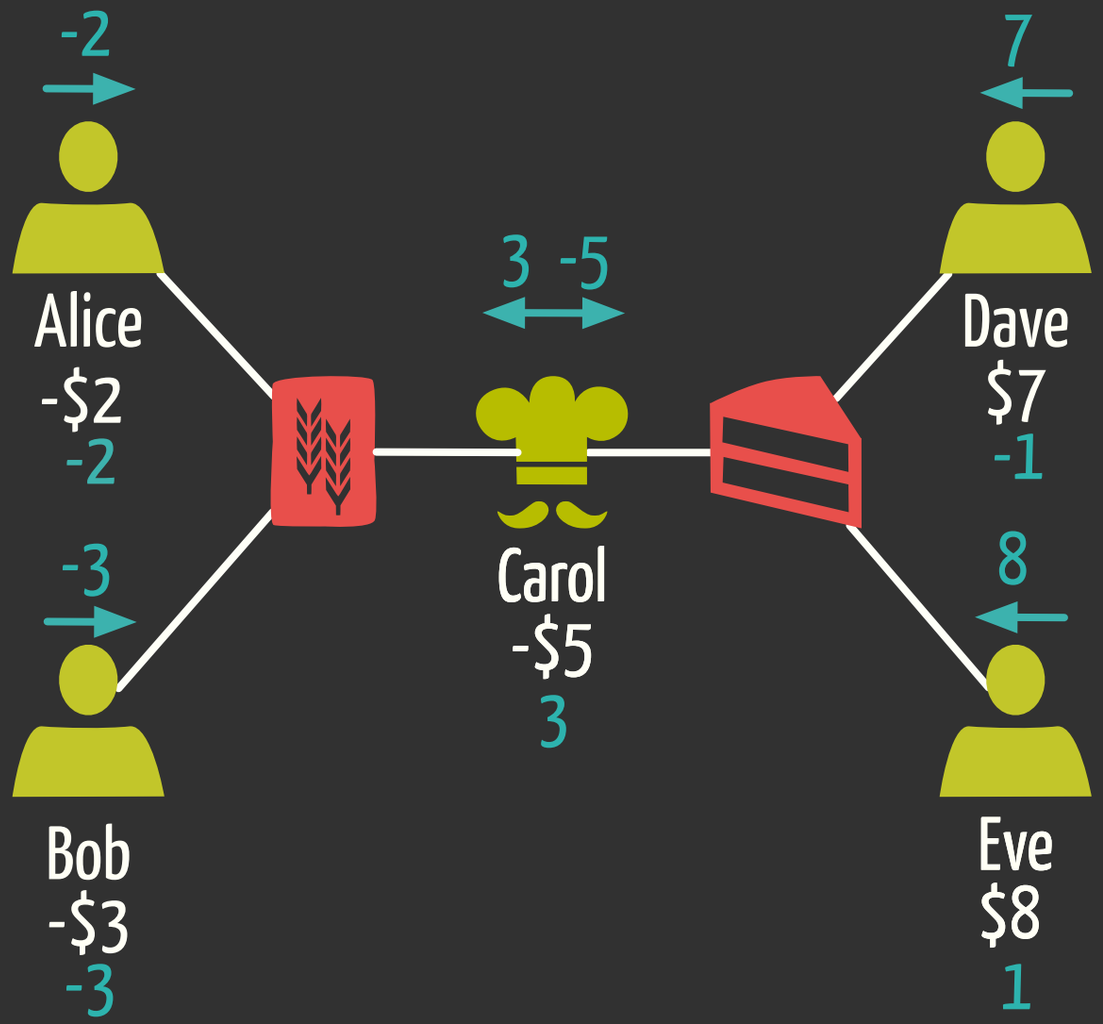

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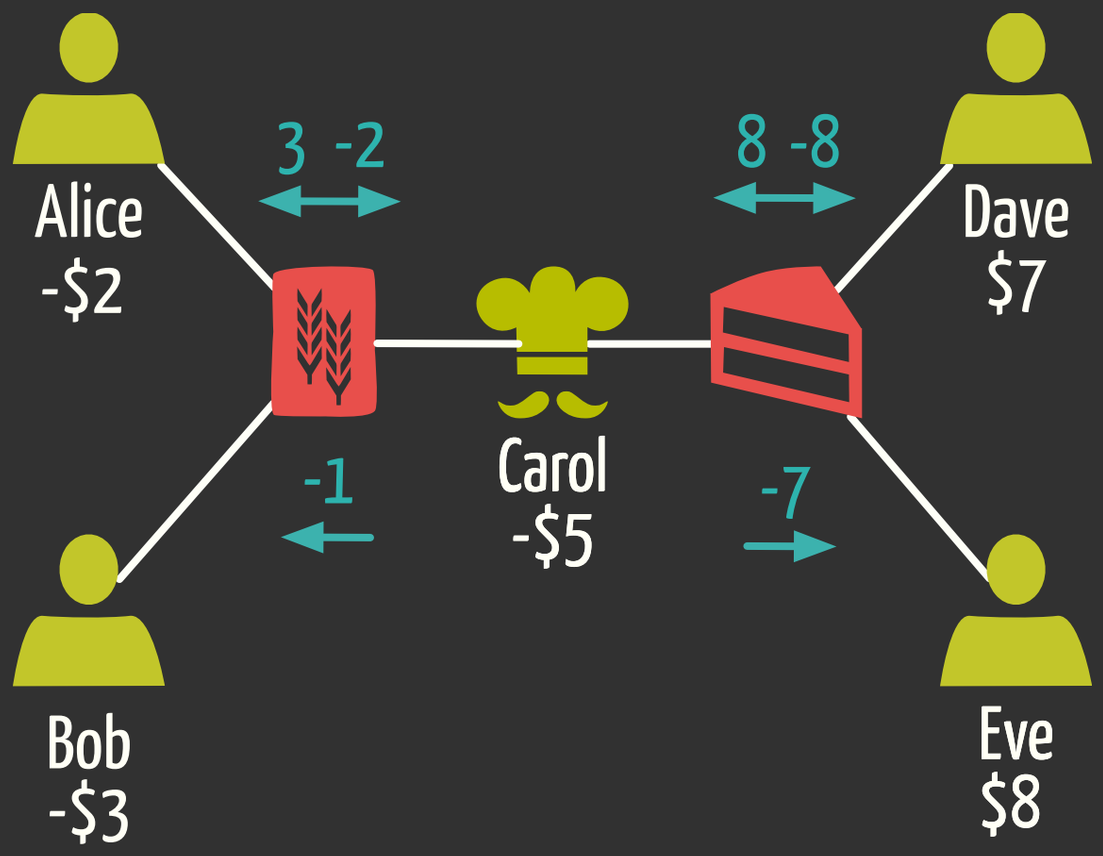

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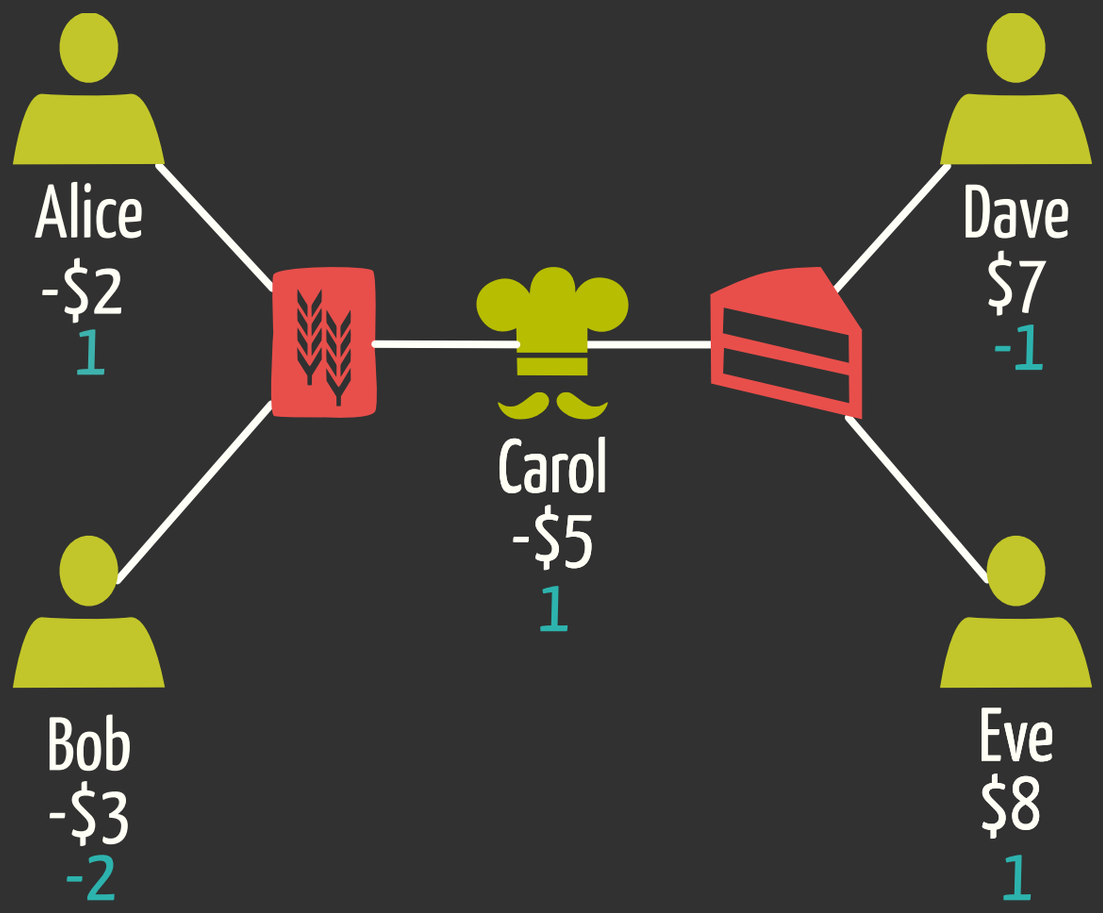

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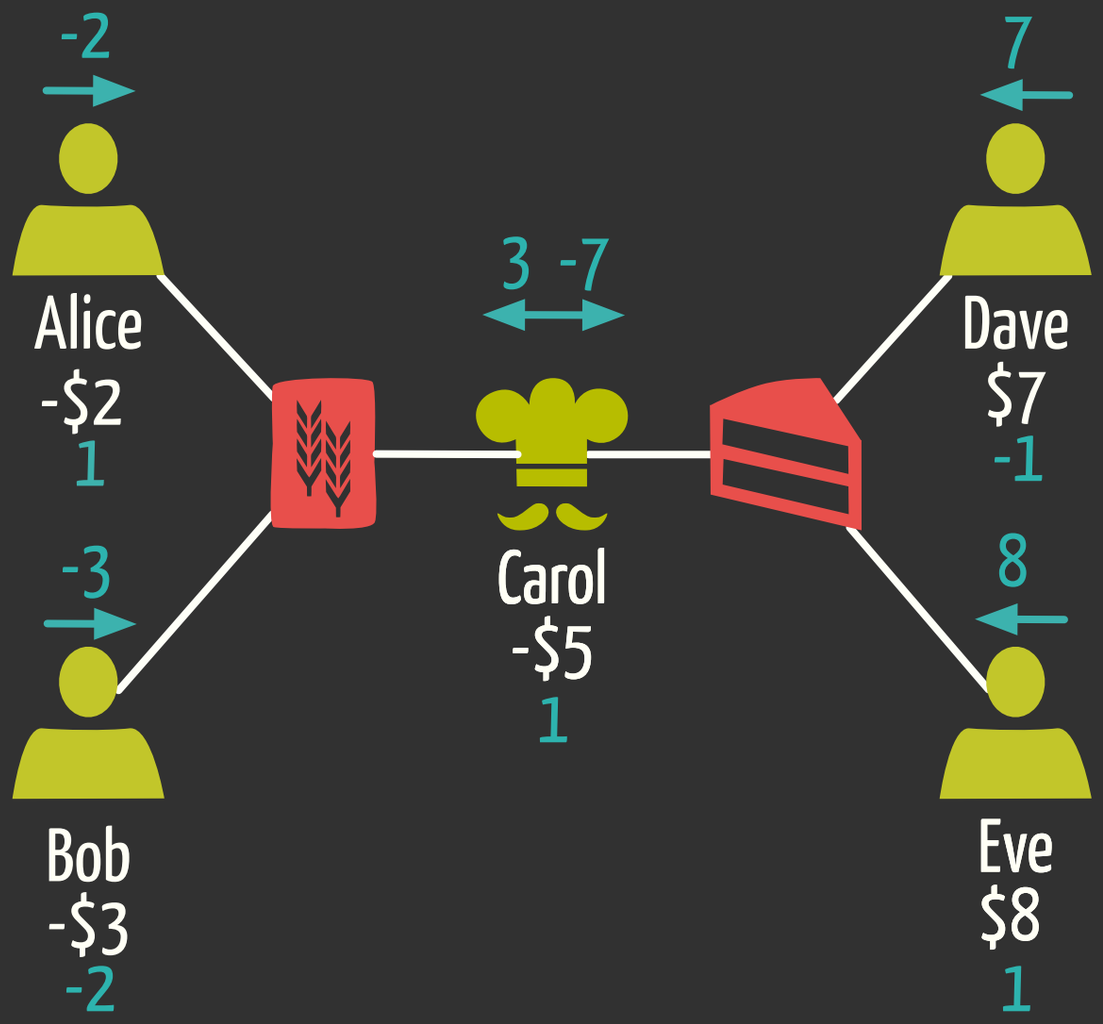

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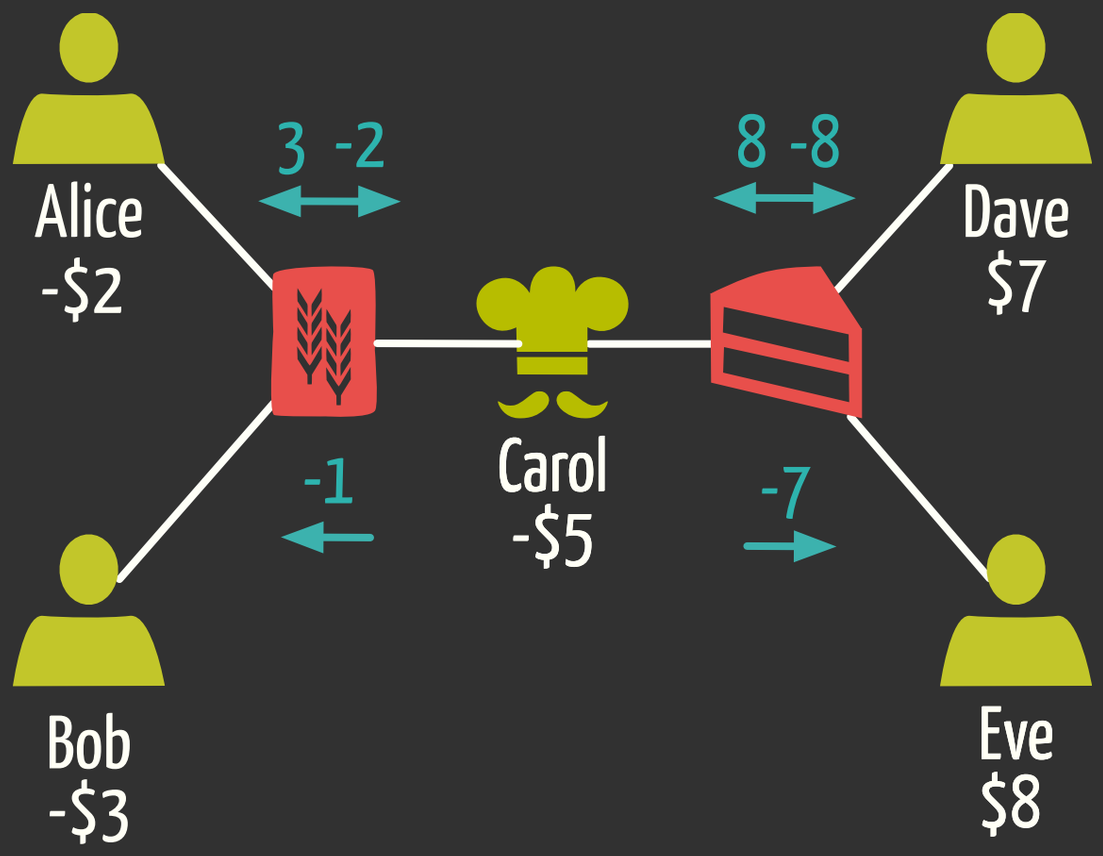

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Send offer to mediators

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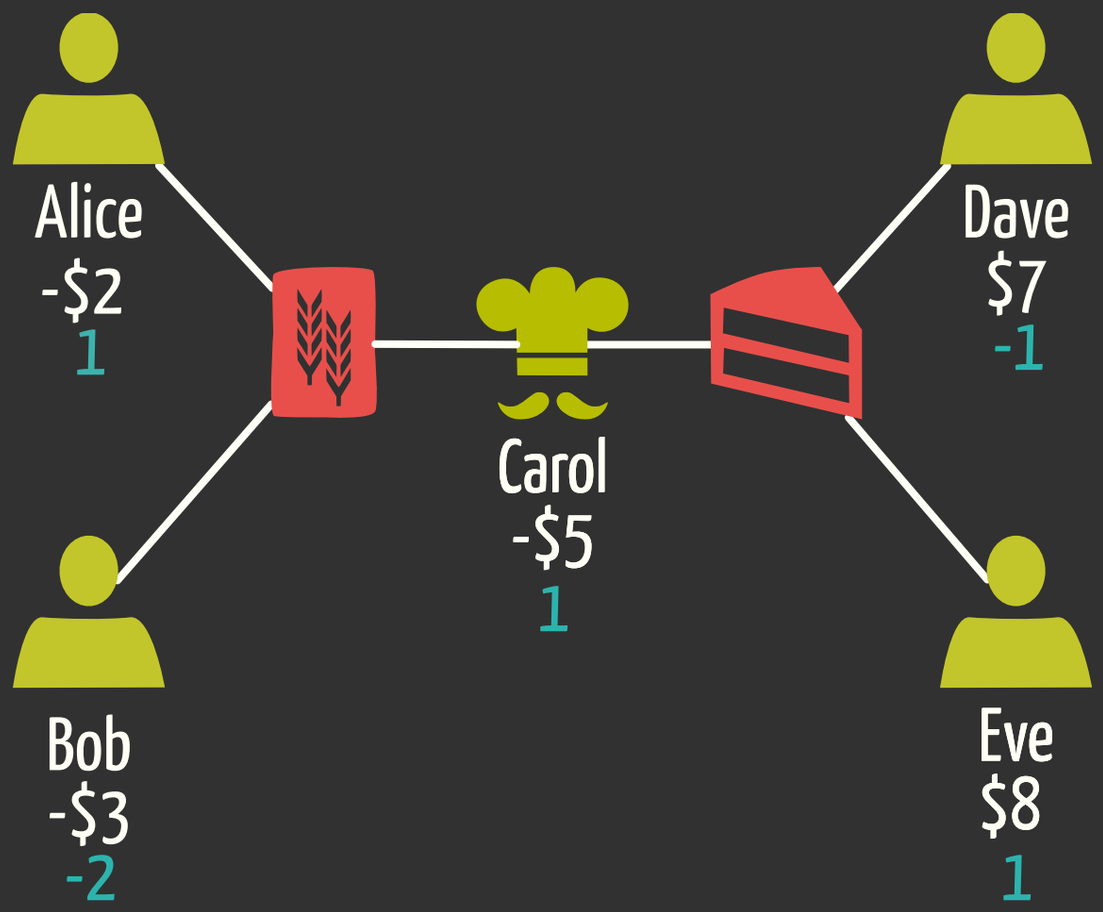
Send updated social value

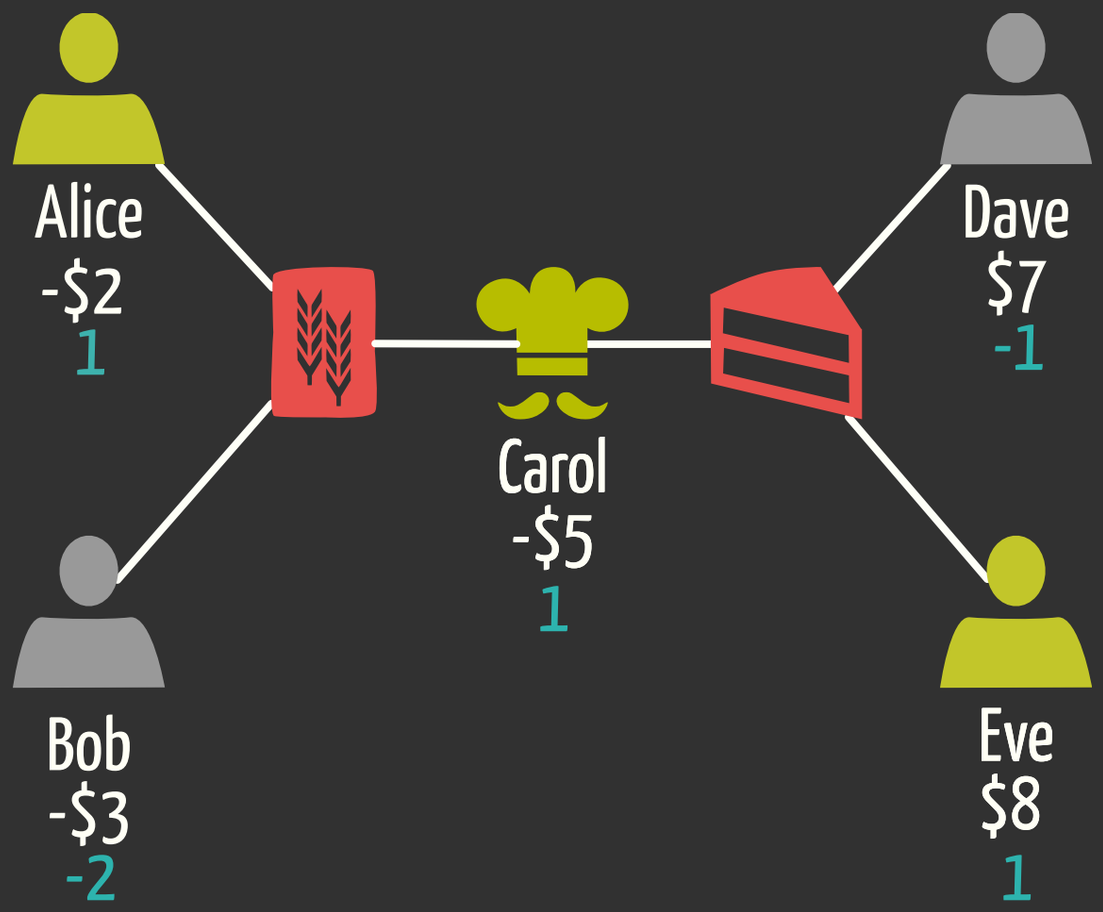
Determining the supply chain configuration

Assessing Participants' Social Value



1. Participants with positive value anounce their availability.
2. Mediators choose active participants out of the available ones.
3. Available participants remain available if all their mediators choose them to be active.
4. Back to 2.

Assessing Participants' Social Value



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Does it work?

	SAMP-SB	RB-LBP	CHAINME
participant memory	O(G)	O(G·A)	O(G)
mediator memory	O(A)		O(A)
participant bandwidth	O(G)	O(G·A)	O(G)
mediator bandwidth	O(A)		O(A)
participant operations	O(G)	$O(G \cdot A^2)$	O(G)
mediator operations	O(logA)		O(A·logA)

large networks

50 goods

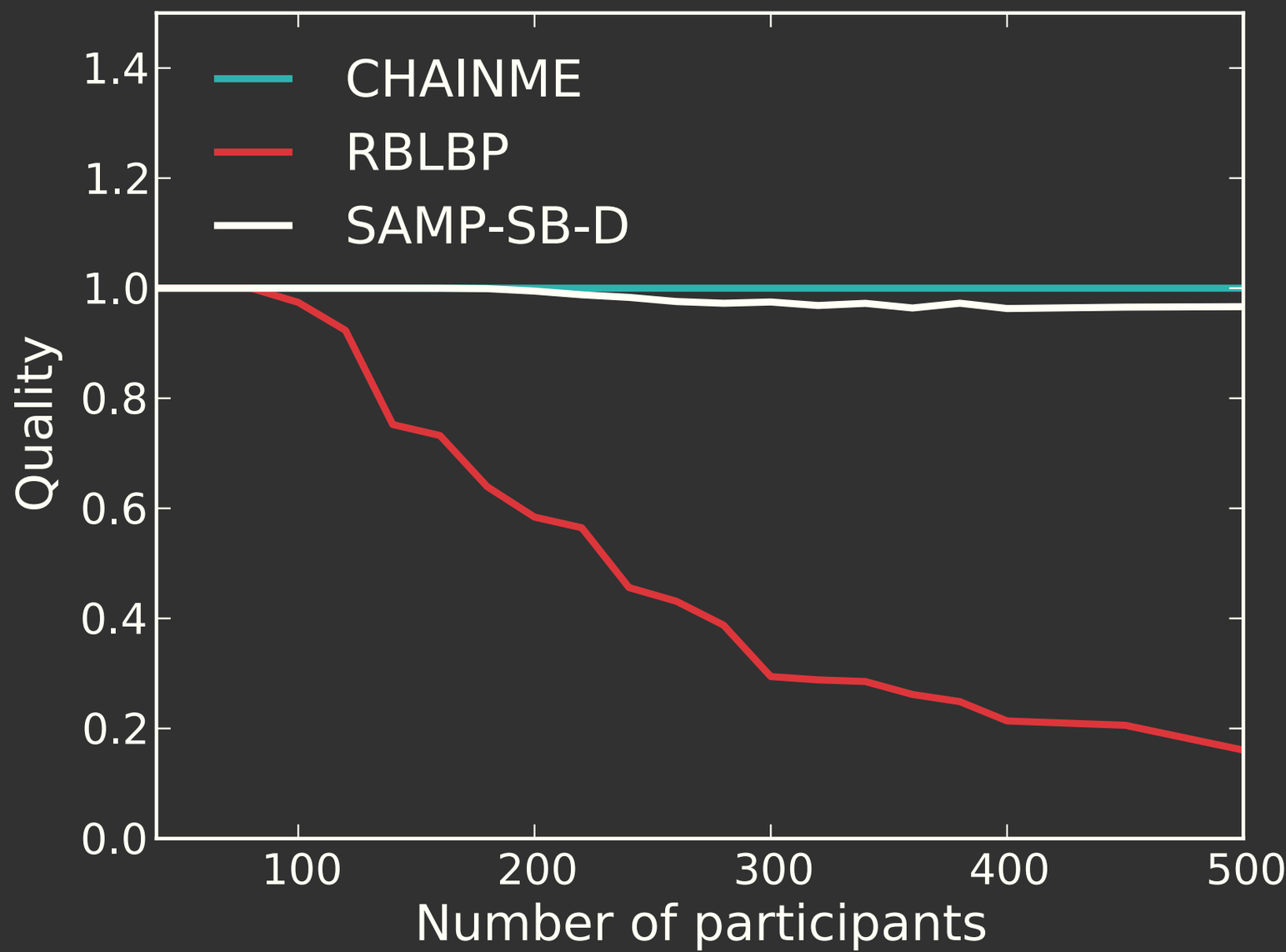
40-500 agents

up to 50 times less bandwidth

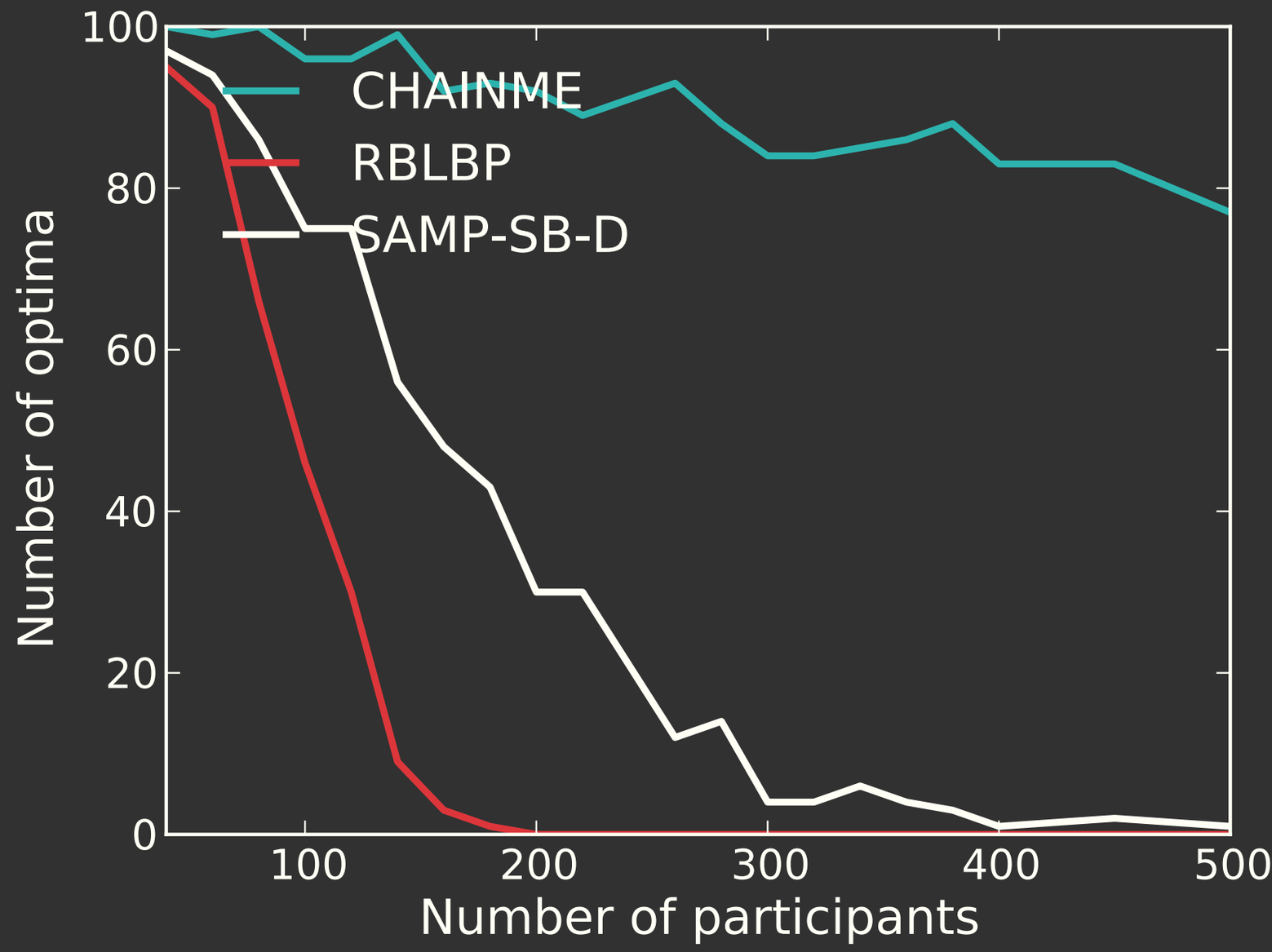
up to 10^2 times faster

consistently better solutions

close to 80% optimal solutions



consistently better solutions



close to 80% optimal solutions

Decentralized algorithm for SCF
based on social value propagation.

Reduces computation.
Reduces communication.
Produces (near)optimal solutions.

What's next?

Payments

Multiple Unit

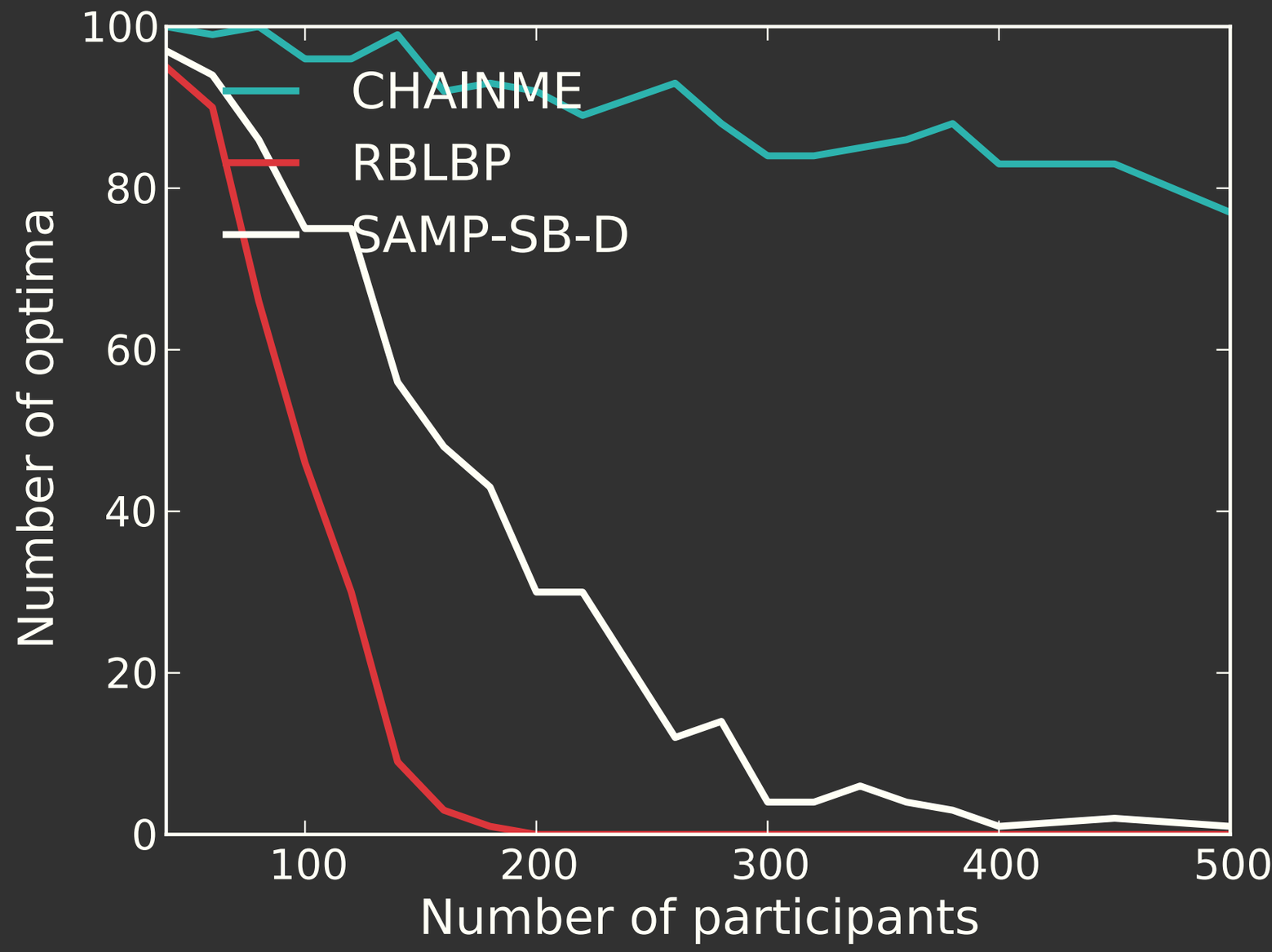
Time constraints

Multiple Attritubes

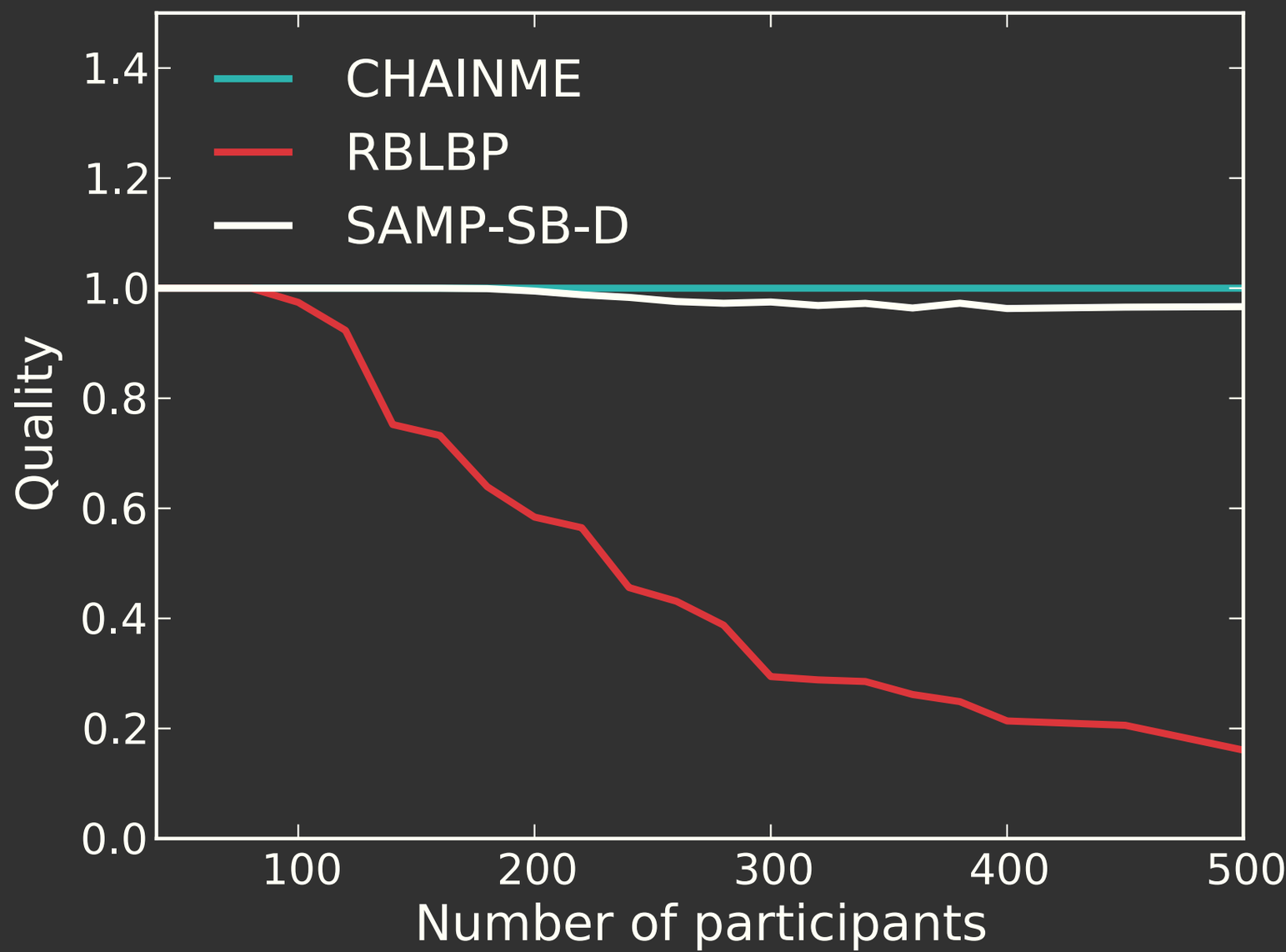
Thank You

Questions?

CHAINME plots



70% optimal solutions



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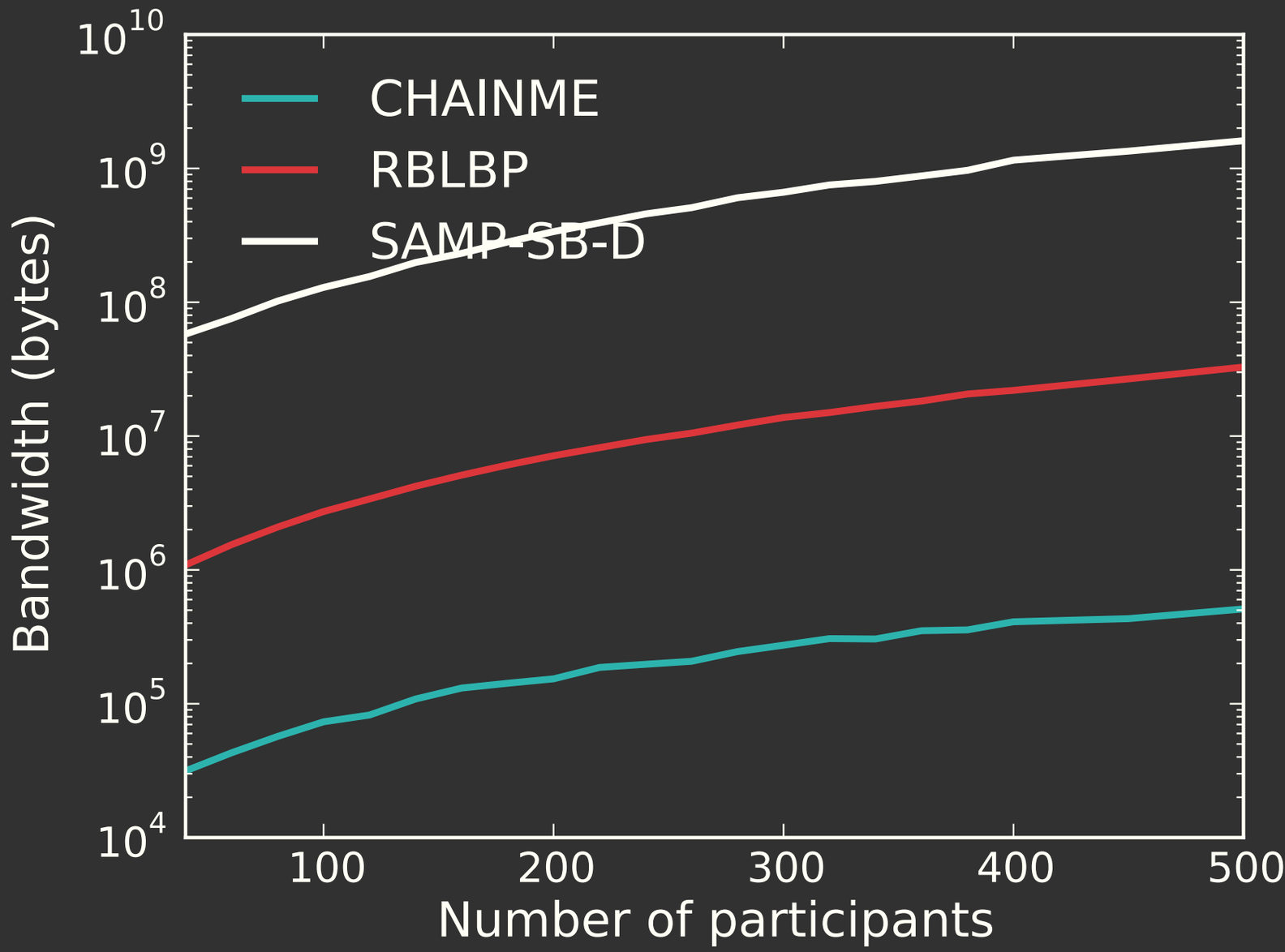
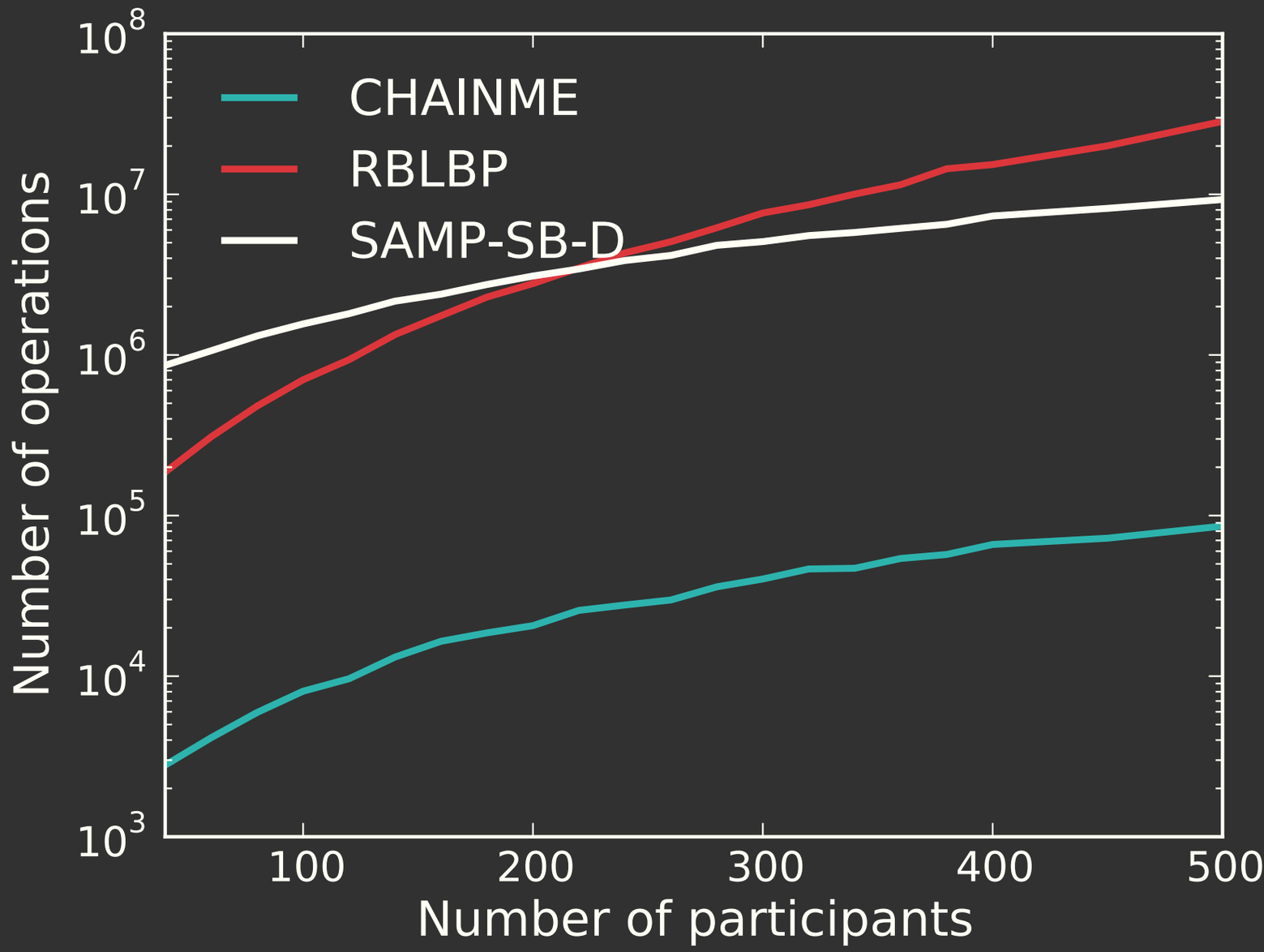
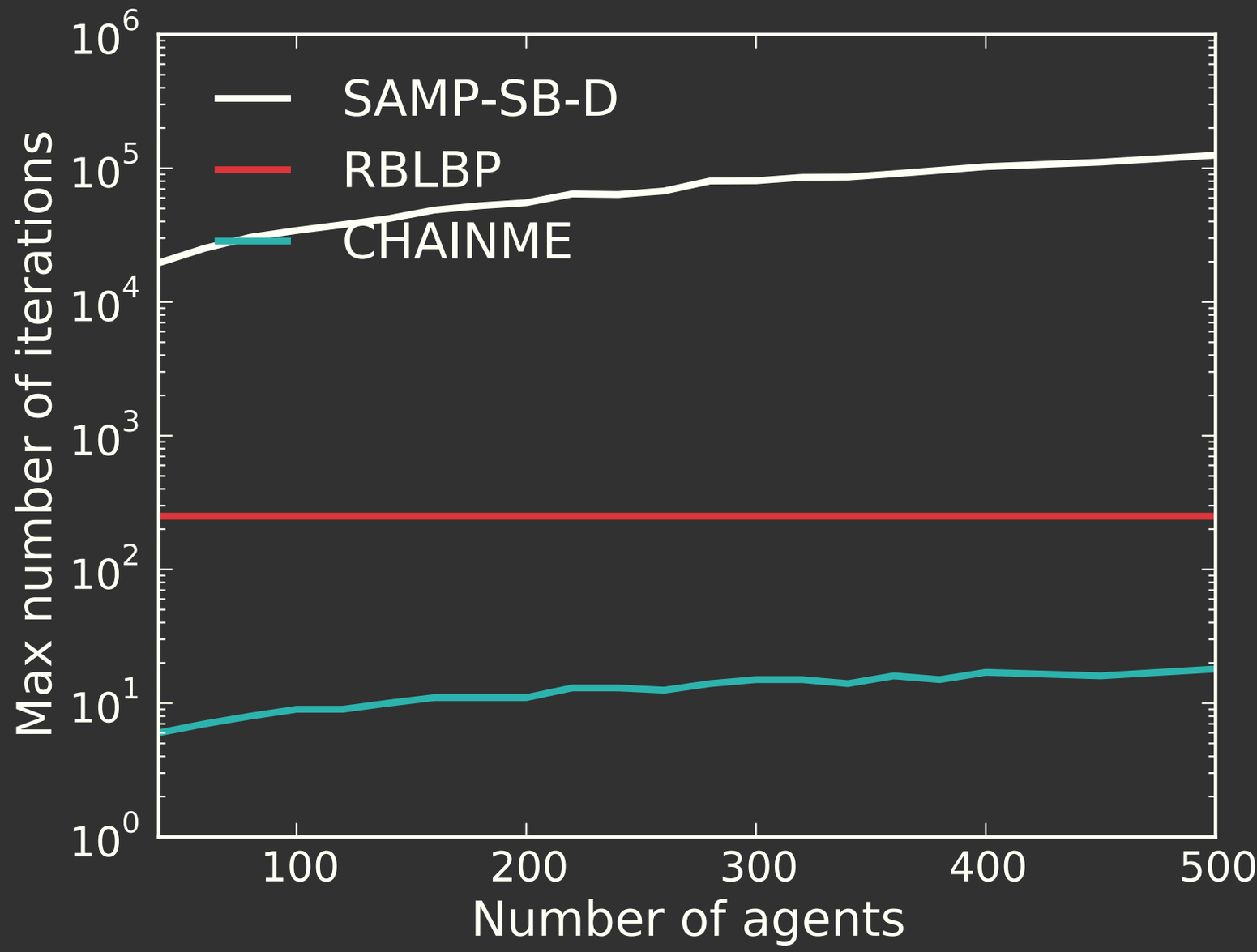


up to 50 times less bandwidth



up to 10^2 times faster



better convergence

CHAINME messages

$$\nu_{M\to s} = \begin{cases} \omega_s, & \text{if } s \in active_s \\ -\omega_b, & \text{otherwise} \end{cases}$$

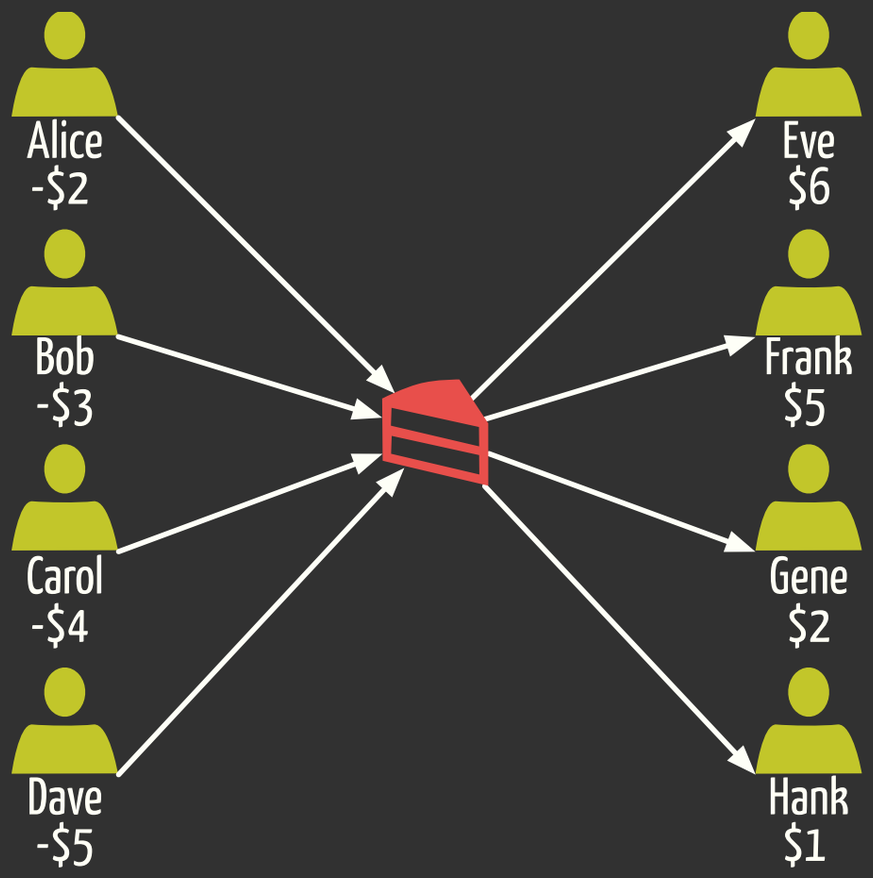
$$\nu_{M\to b} = \begin{cases} \omega_b, & \text{if } b \in active_b \\ -\omega_s, & \text{otherwise} \end{cases}$$

$$\nu_{x\to F} = \sum_{F'\in\mathcal{N}(x)\setminus F} \nu_{F'\to x}$$

Background

Price Rules for Double Auctions

Price Rules for Double Auctions



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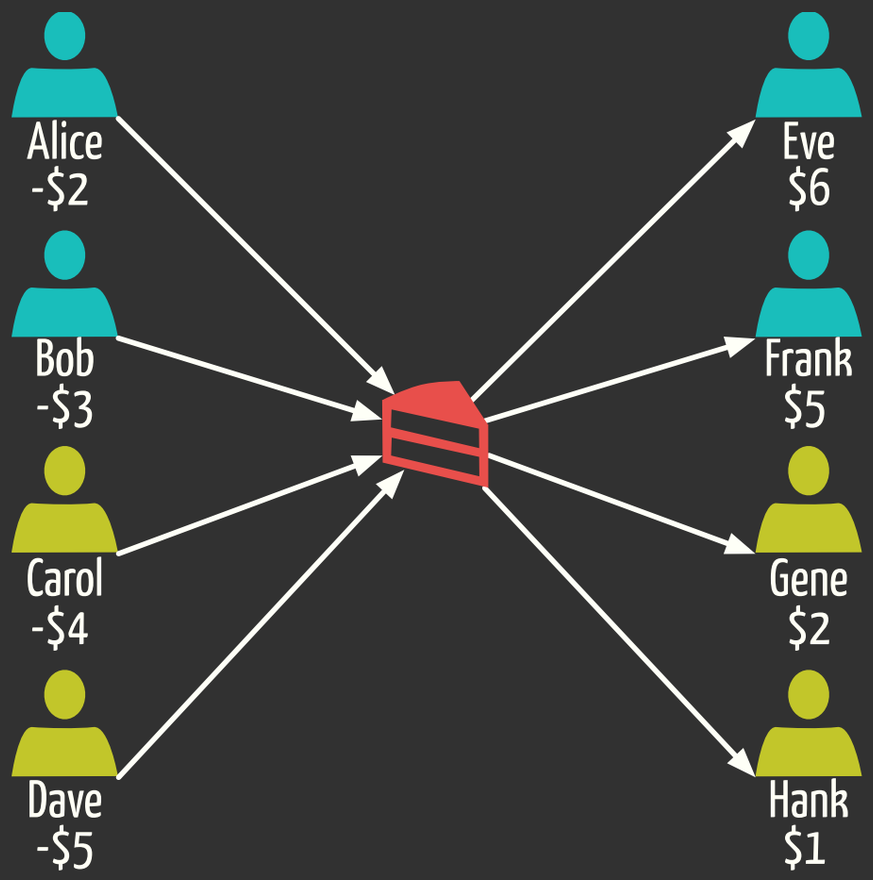

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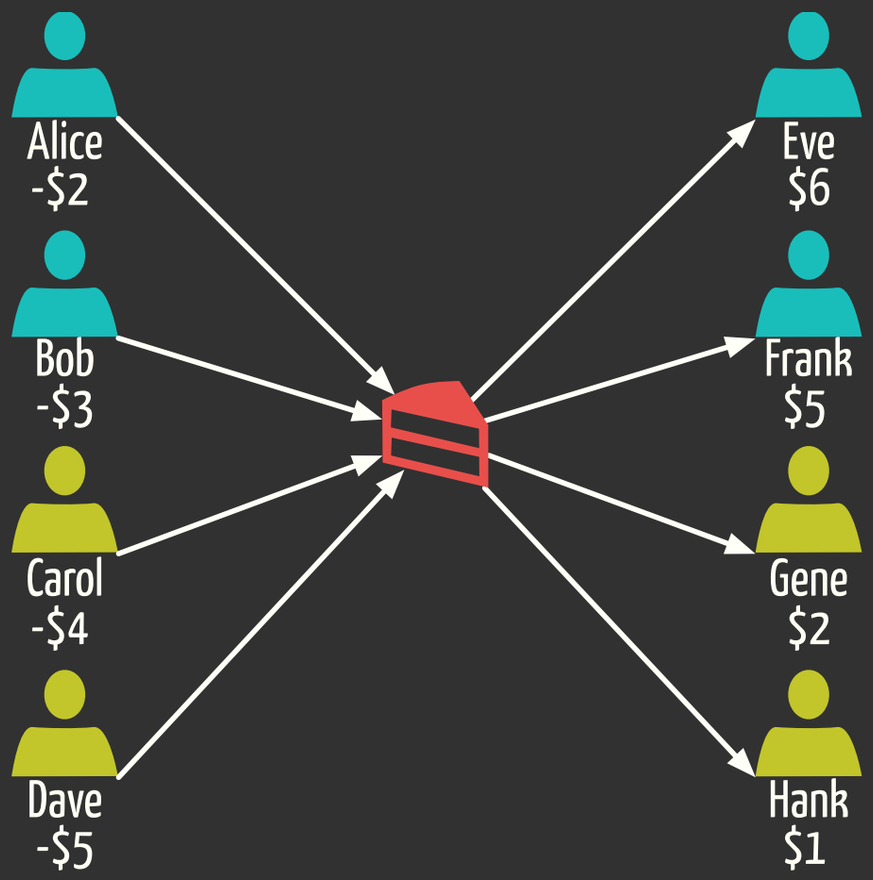

Individual rationality

No seller should be paid less than her bid.

No buyer should pay more than her bid.

Fairness

The price cannot be larger than the bid of any seller out of trade.

The price cannot be smaller than the bid of any buyer out of trade.

Price Rules for Double Auctions

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Fairness

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Price Rules for Double Auctions

Sellers	Buyers	Fact
s^1	b^1	$b^1 + s^1 > 0$
$\vdots$	$\vdots$	
s^η	b^η	$b^\eta + s^\eta \geq 0$
$s^{\eta+1}$	$b^{\eta+1}$	$b^{\eta+1} + s^{\eta+1} < 0$
$\vdots$	$\vdots$	

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Price Rules for Double Auctions

$$\tau^- \leq \tau \leq \tau^+$$

$$\tau^- = \max(-s^\eta, b^{\eta+1})$$

$$\tau^+ = \max(-s^{\eta+1}, b^\eta)$$

Sellers	Buyers	Fact
s^1	b^1	$b^1 + s^1 > 0$
$\vdots$	$\vdots$	
s^η	b^η	$b^\eta + s^\eta \geq 0$
$s^{\eta+1}$	$b^{\eta+1}$	$b^{\eta+1} + s^{\eta+1} < 0$
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CONTRIBUTION


GOAL


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