Voting

Lecture 20

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  - Incoercibility: Even corrupt voters should not be able to convince an adversary about their vote (i.e., no vote-buying)

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  - OK in the back-end, but needs to be very efficient if a large election
- Doesn't account for incoercibility (unless security requirement augmented)

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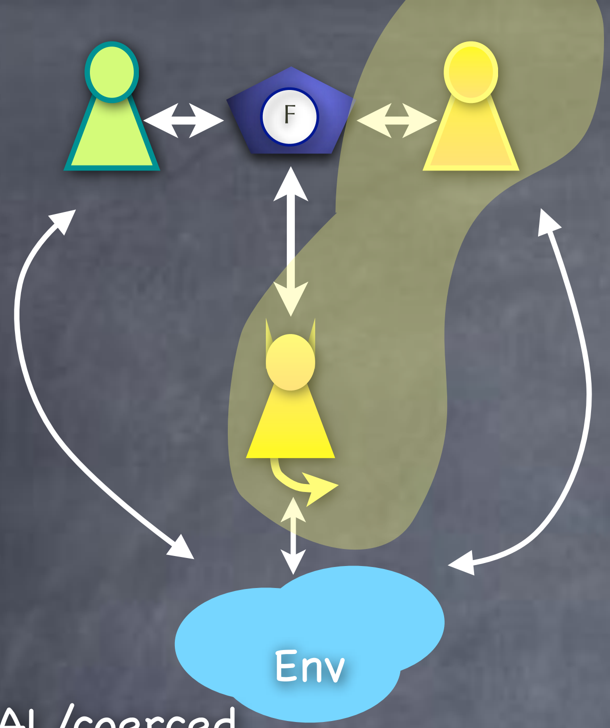
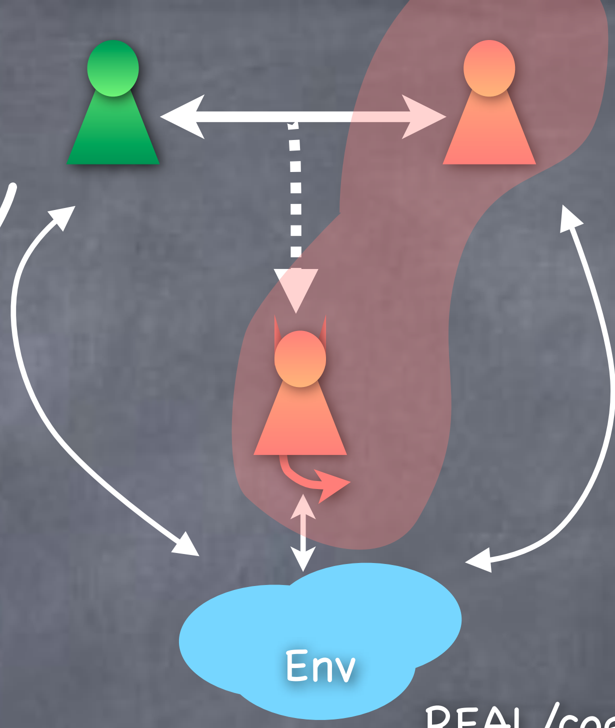
    - Voters cannot follow arbitrary instructions from the environment and still collect the reward
    - Unavoidable coercion (even in the Ideal world)
- We need to protect against <u>further</u> coercion than is possible in the Ideal world

Defining Incoercibility

Real as incoercible (and secure) as Ideal if:



IDEAL/coerced



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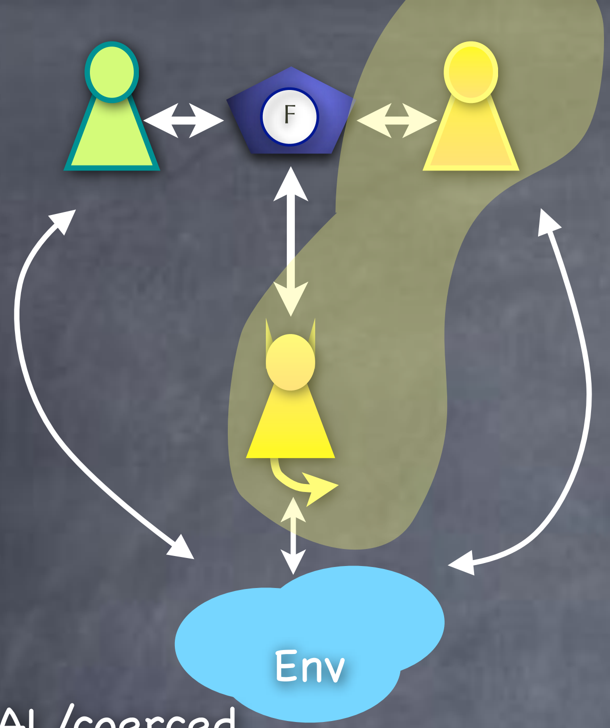

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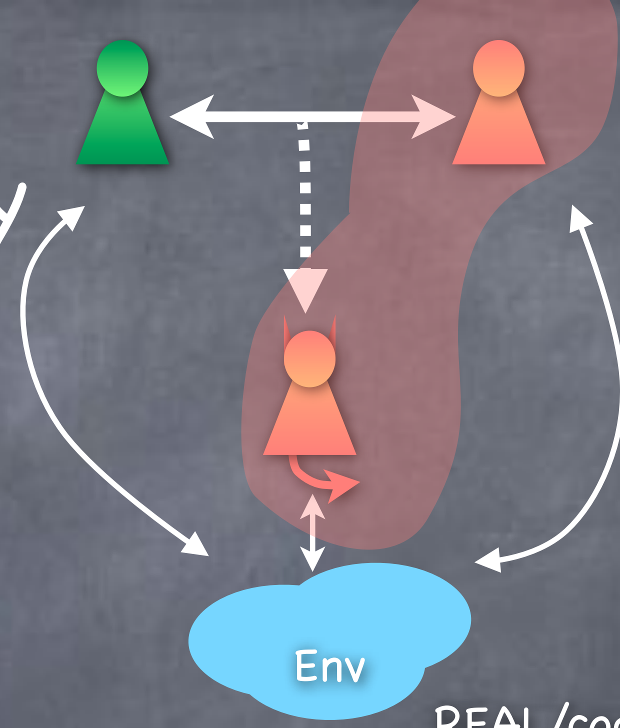

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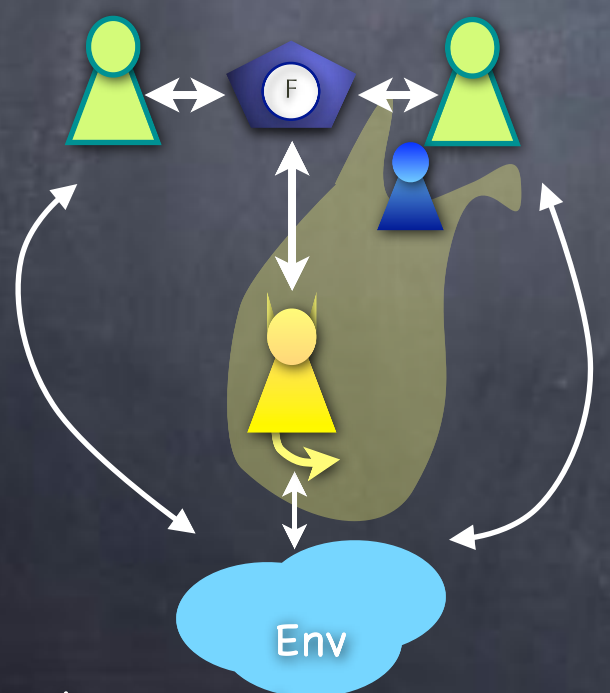

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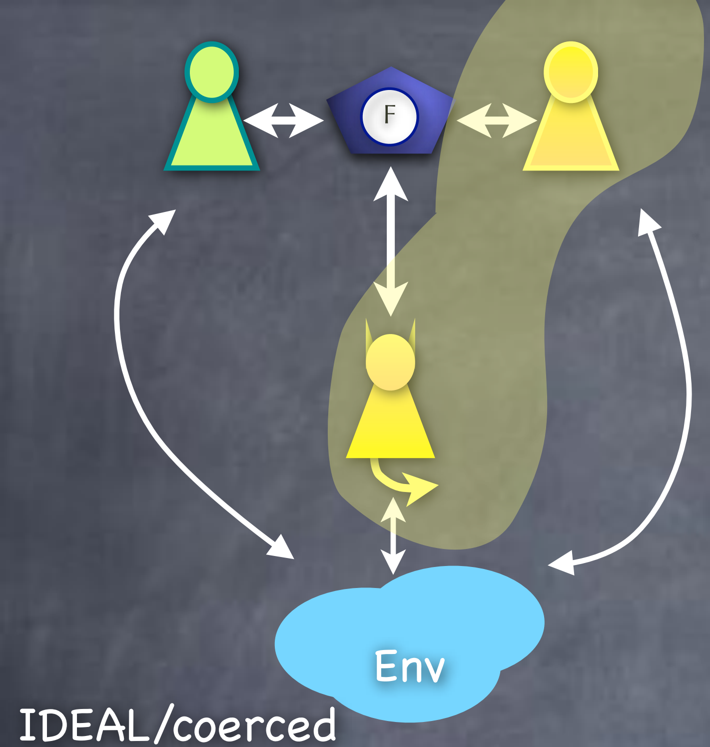

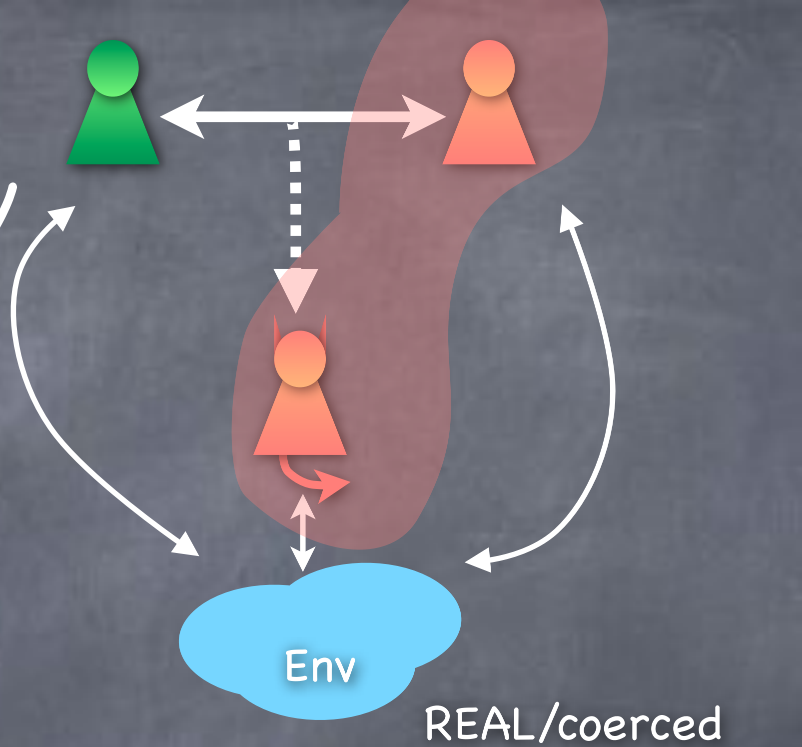

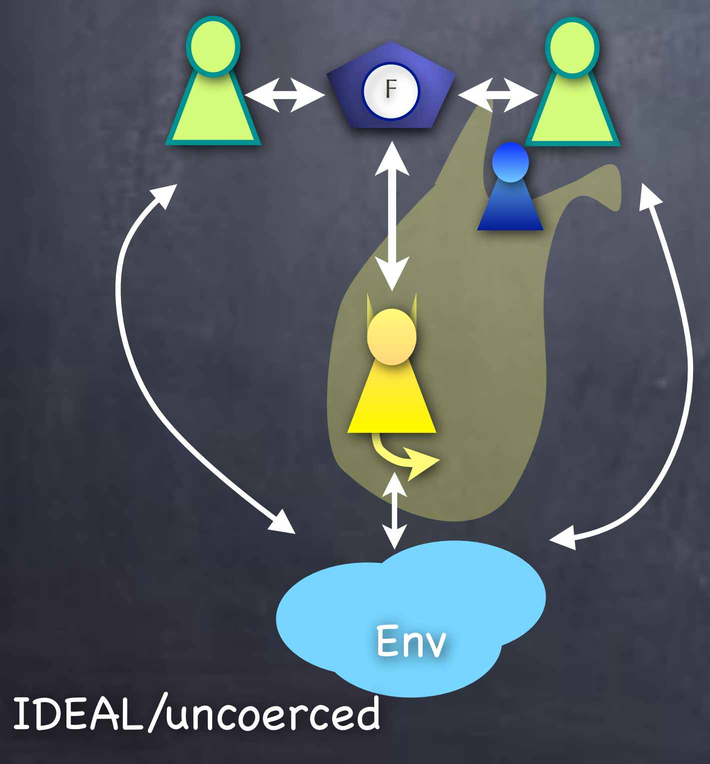

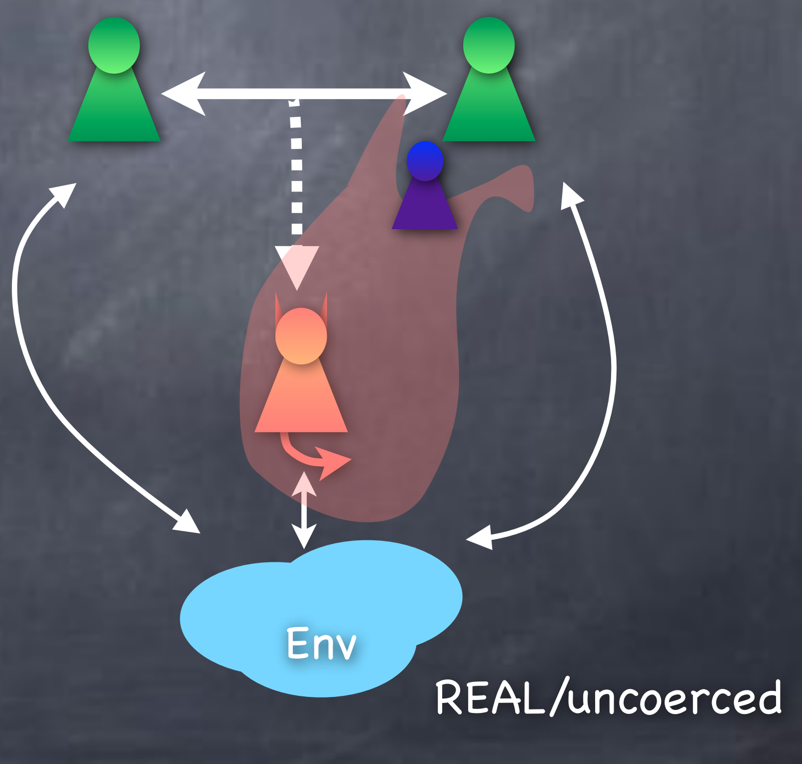

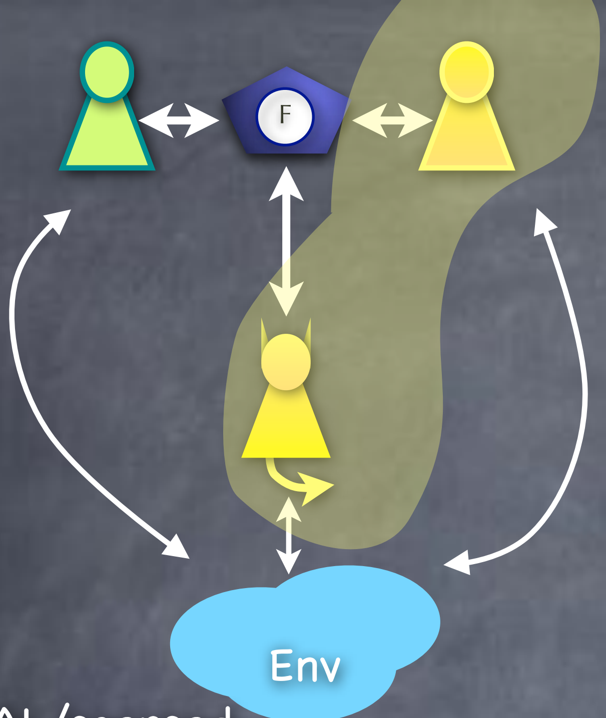

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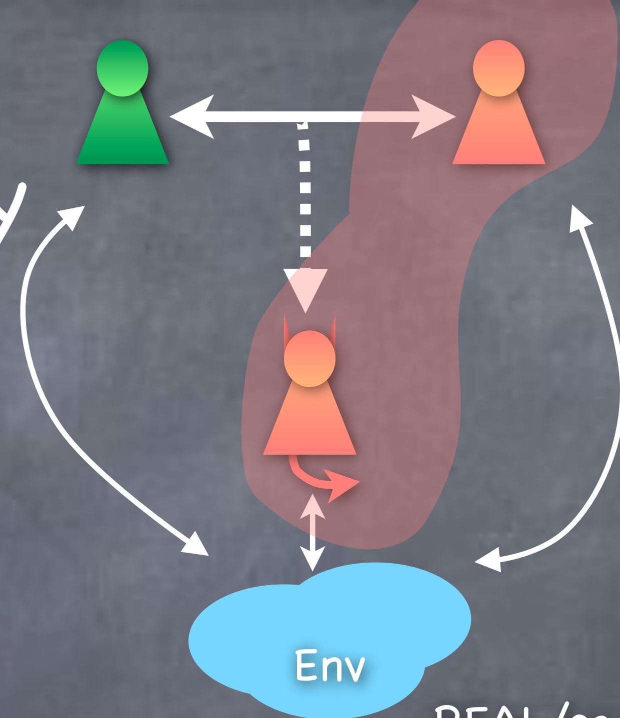

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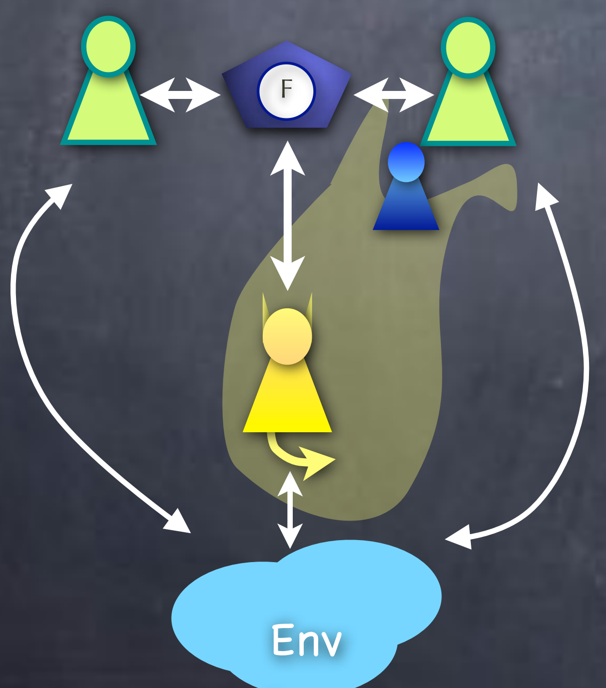

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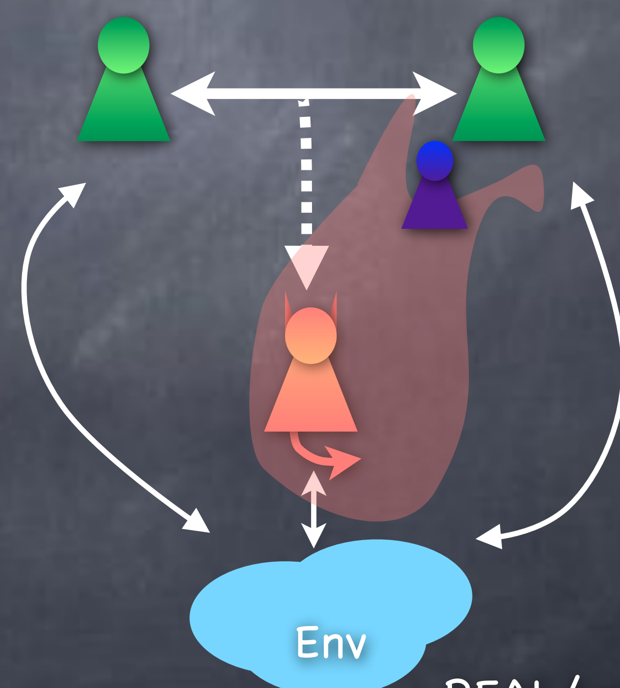

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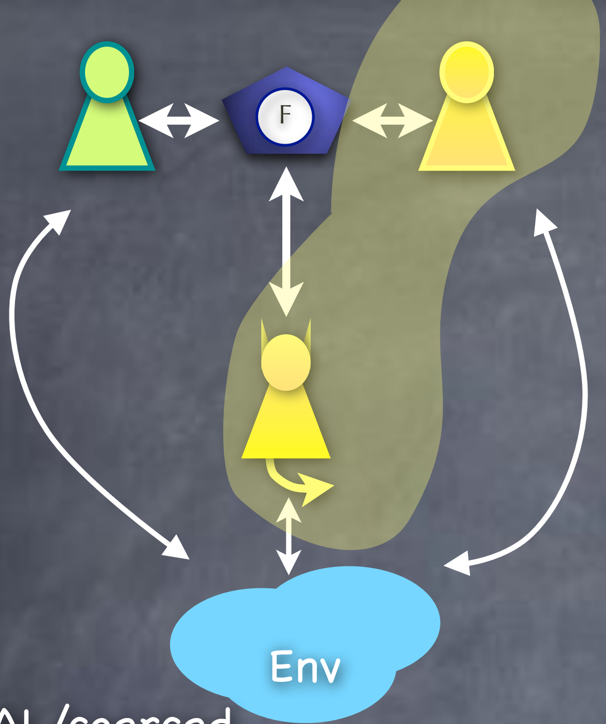

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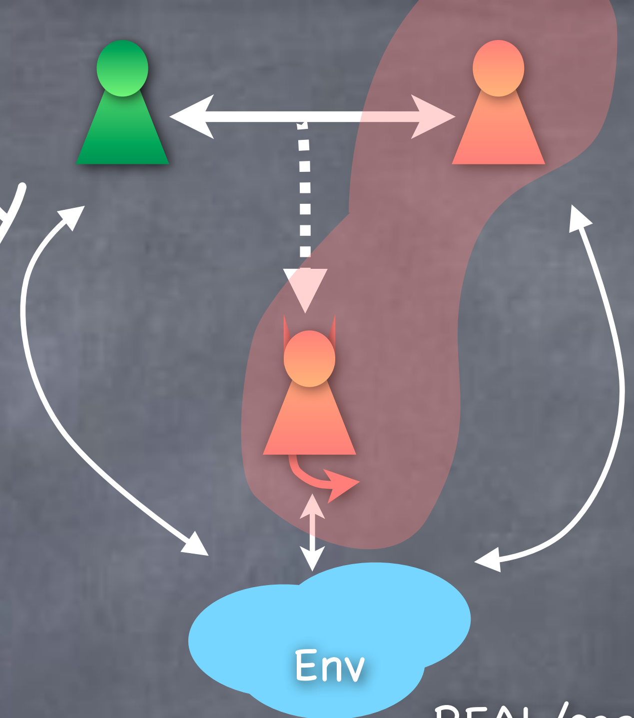

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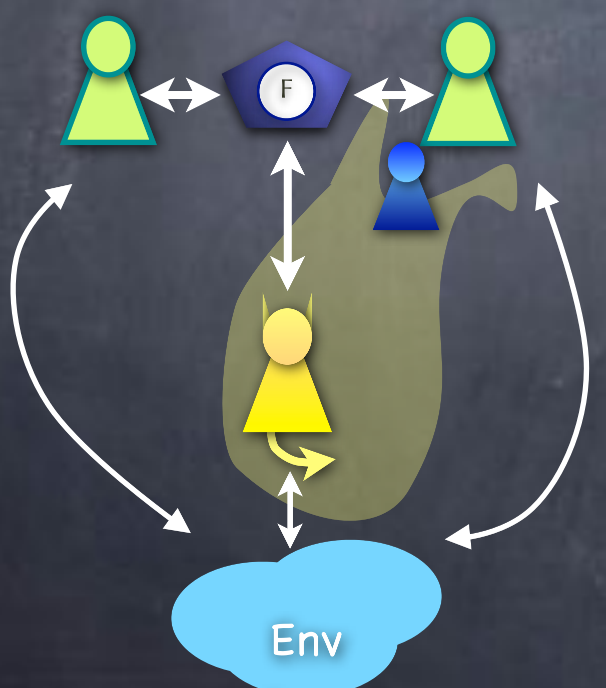

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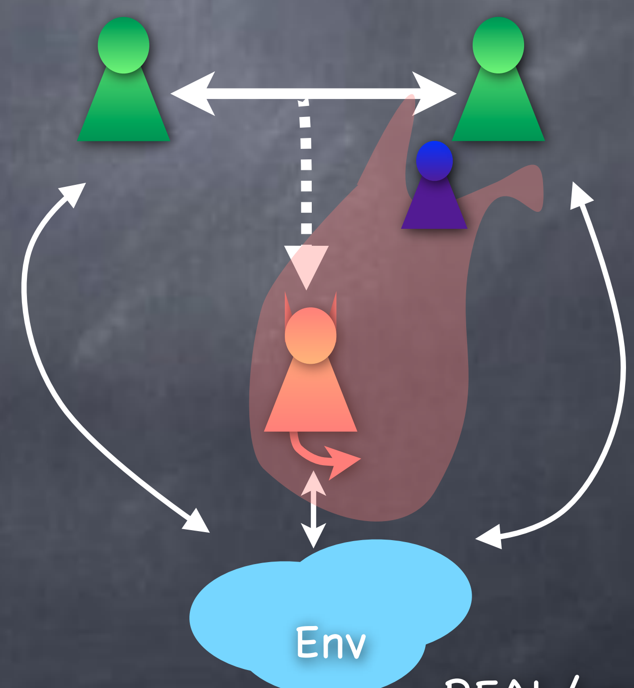
Hence REAL/c and REAL/u only as distinguishable as IDEAL/c and IDEAL/u



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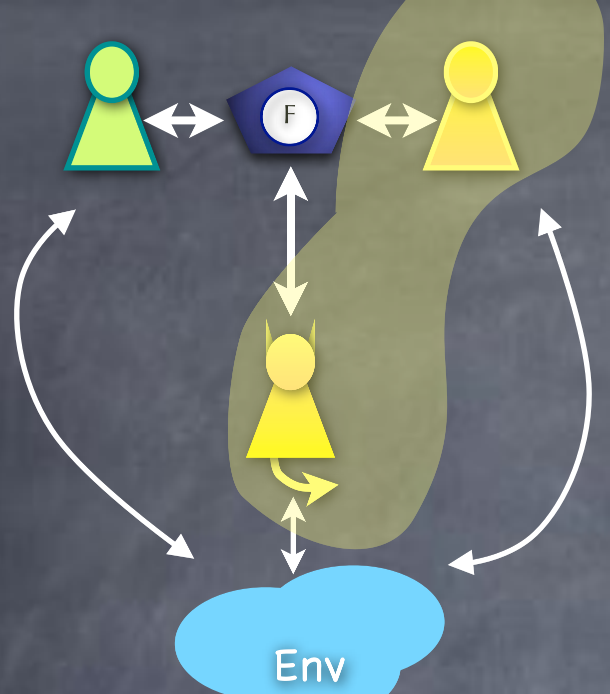

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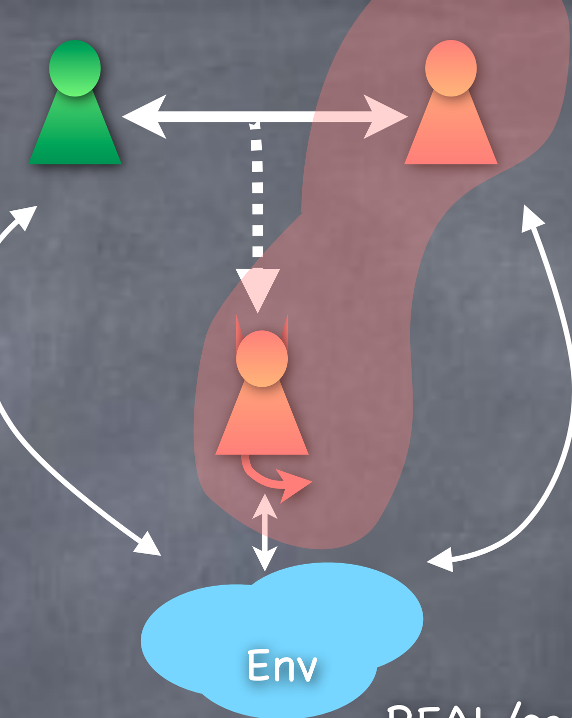

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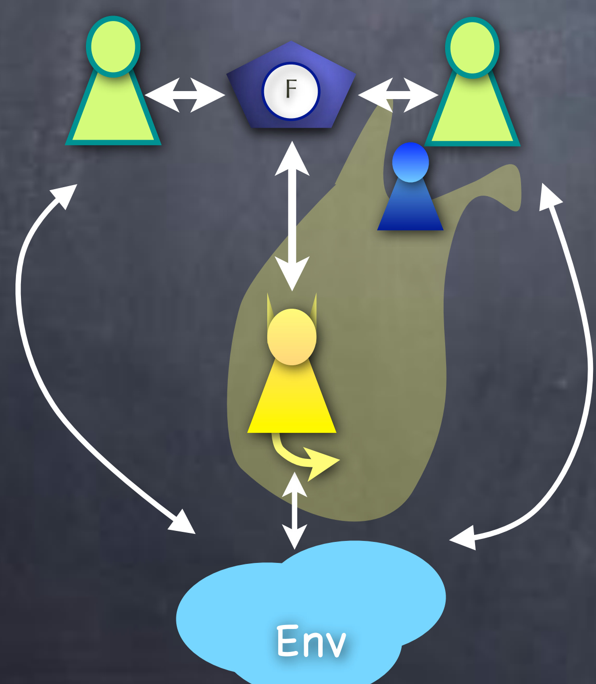

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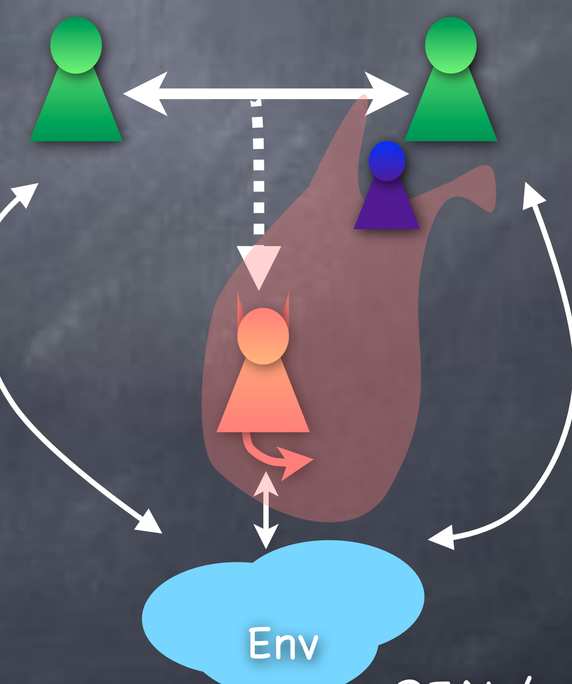

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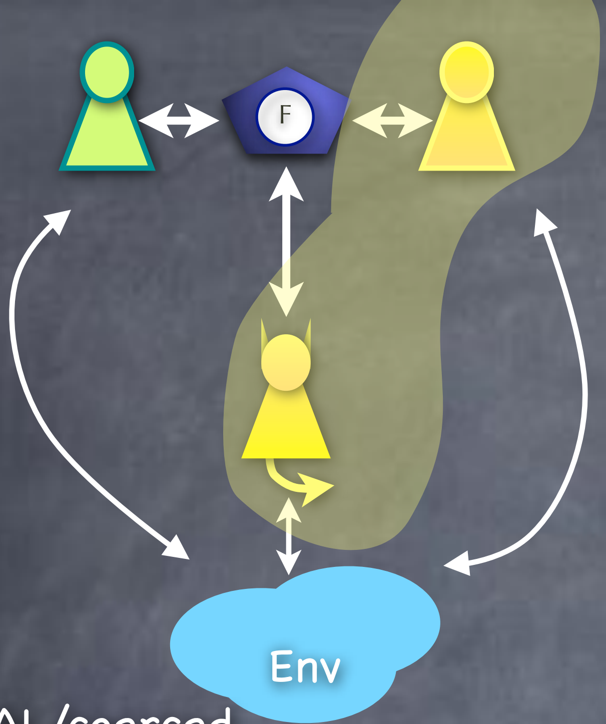

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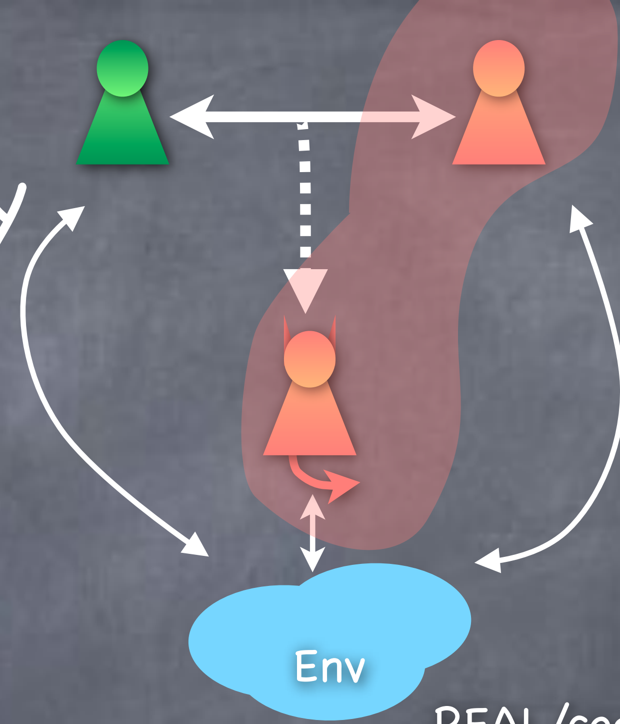

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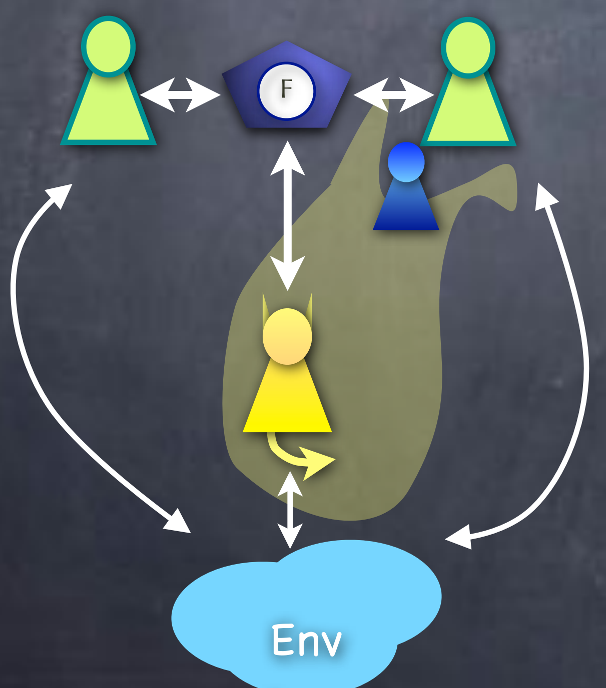

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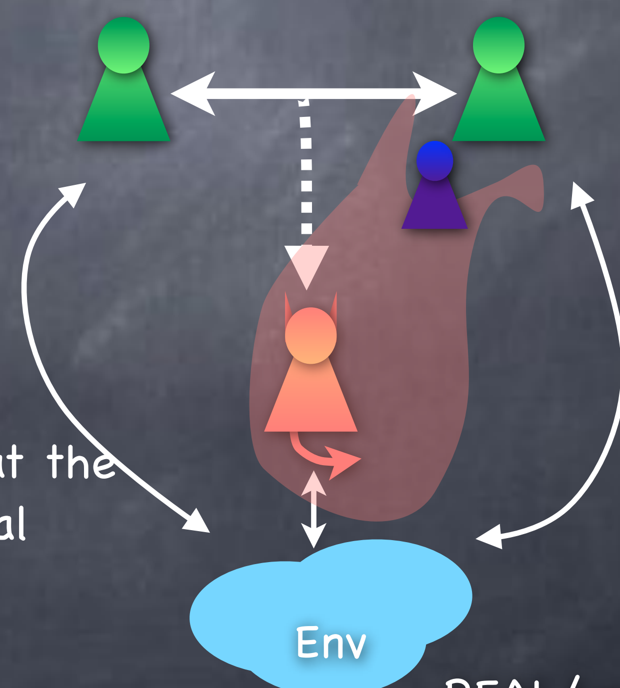

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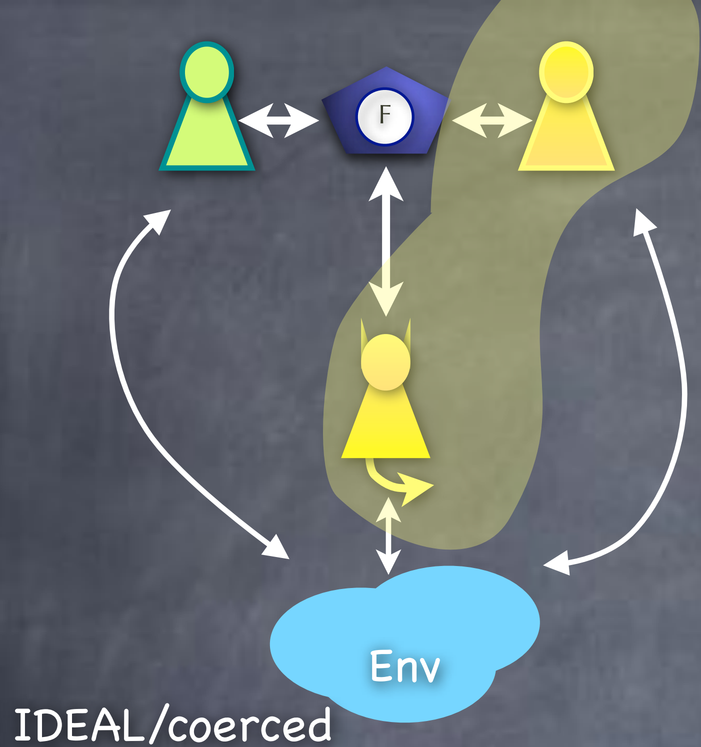

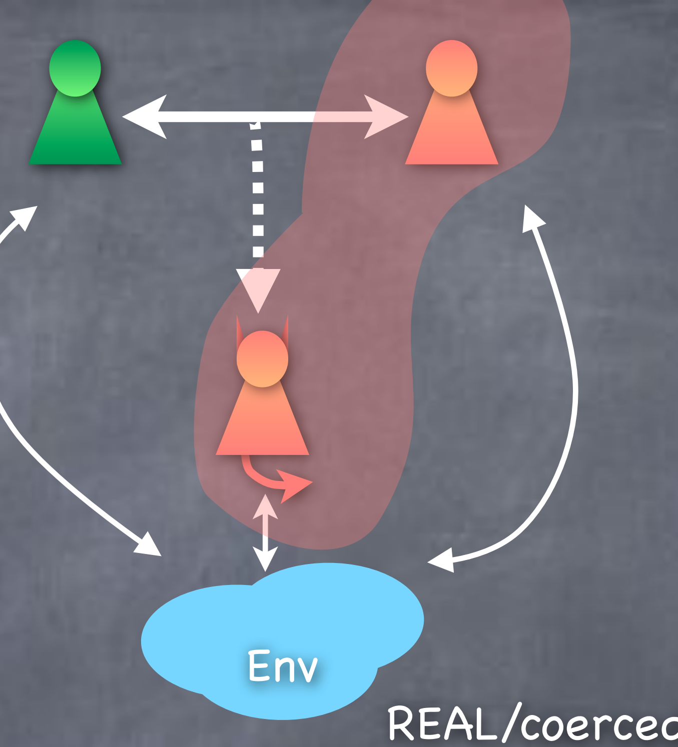

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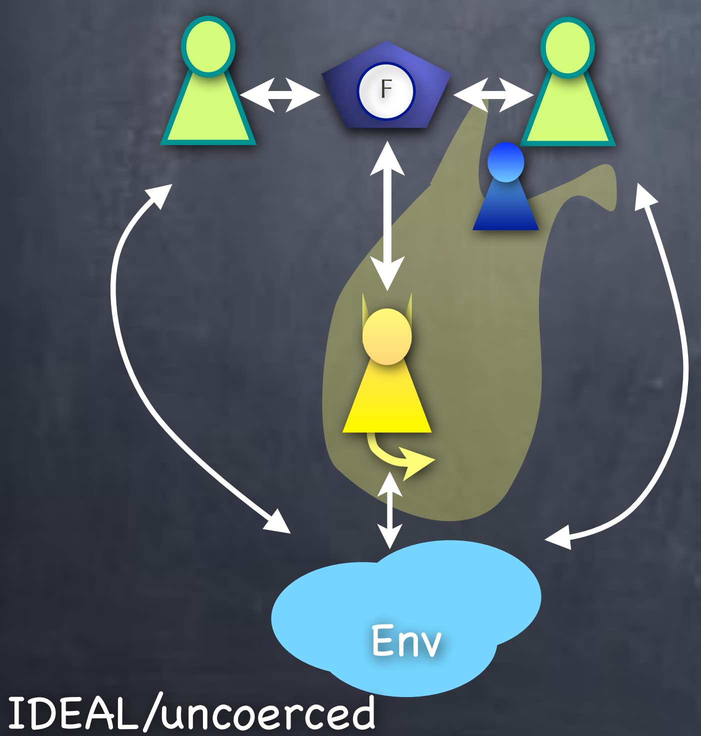

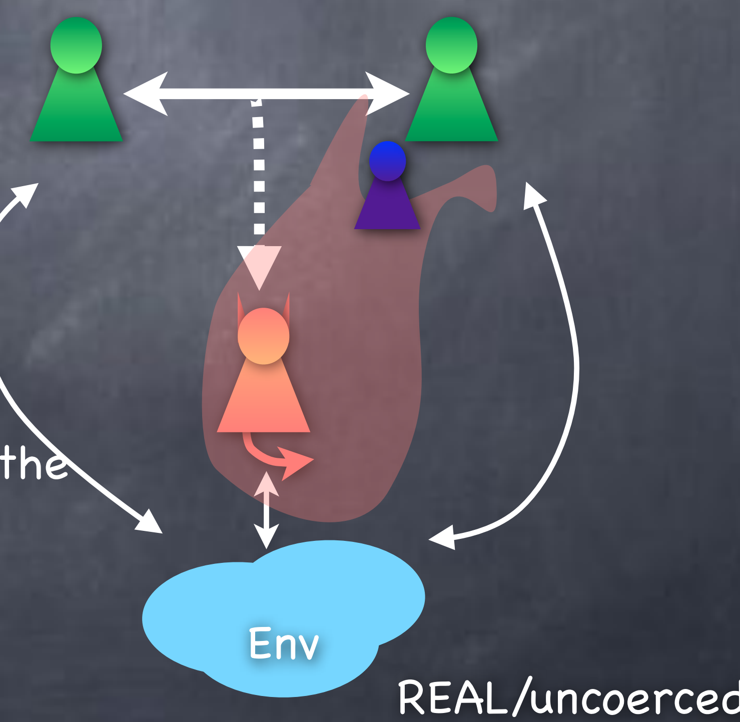

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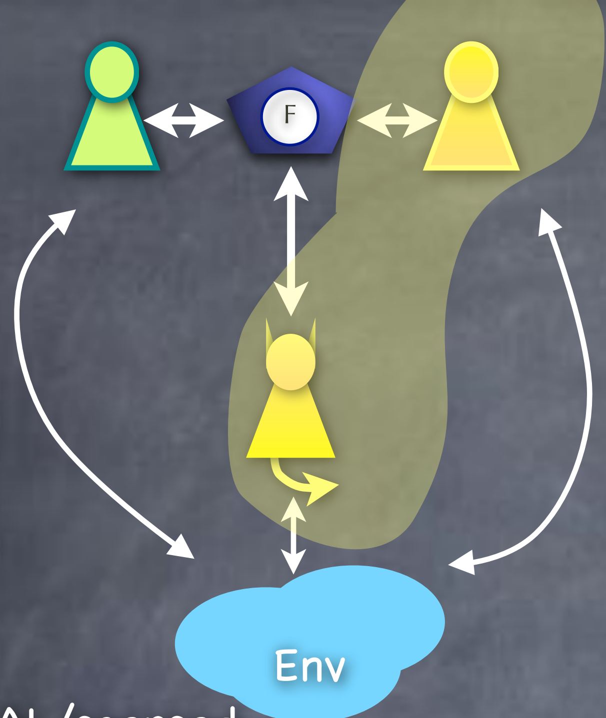

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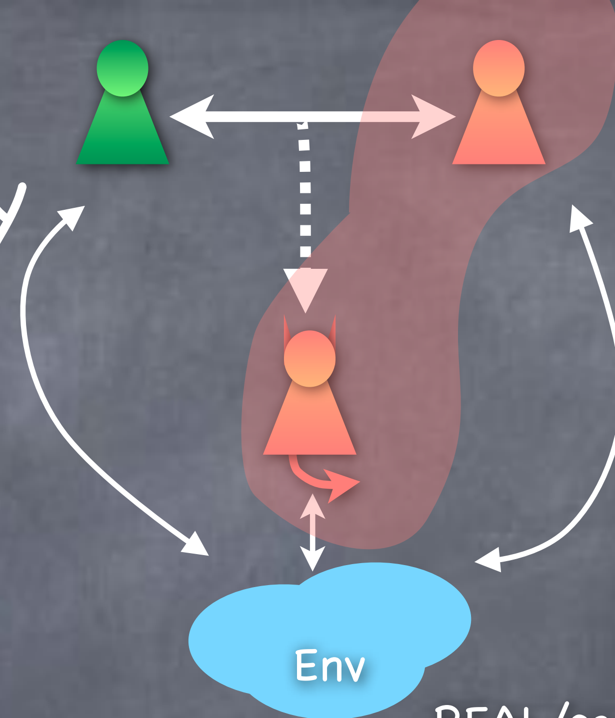

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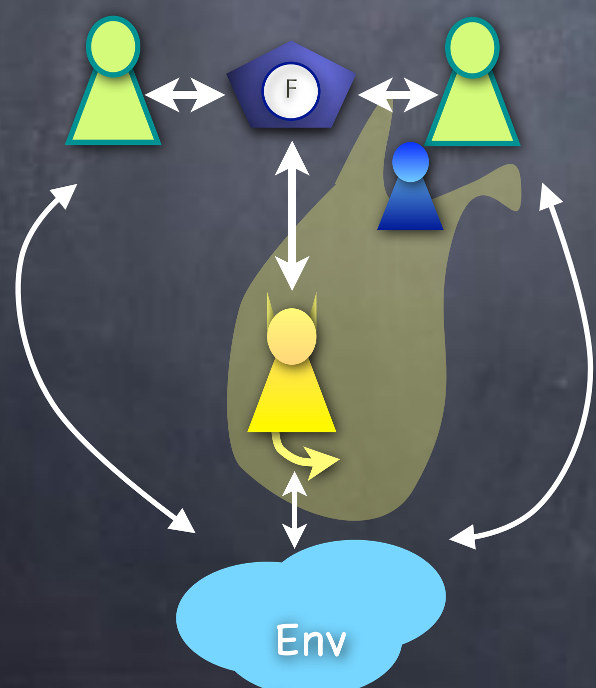

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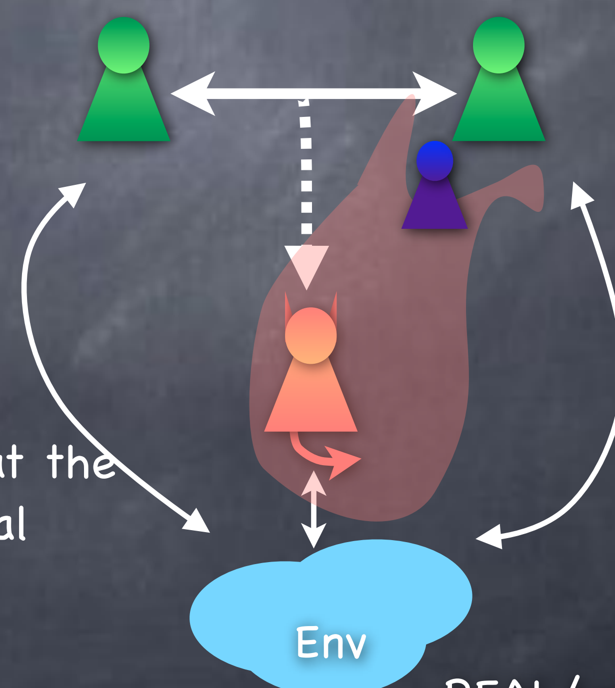

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e-Voting: First Try

Provide encryption devices that have been "verified" by the public? (Perception of) threats: difficulty in verifying devices, substituting devices...

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  - No crypto to ensure vote collected as cast
- Public list will contain information that proves to the voter that the vote collected is as cast
- Should not allow voter to prove to a vote-buyer how the vote was cast

Prêt à Voter

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Carol	
Alice	
Barack	X
	ahdf87

Prêt à Voter

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Prêt à Voter

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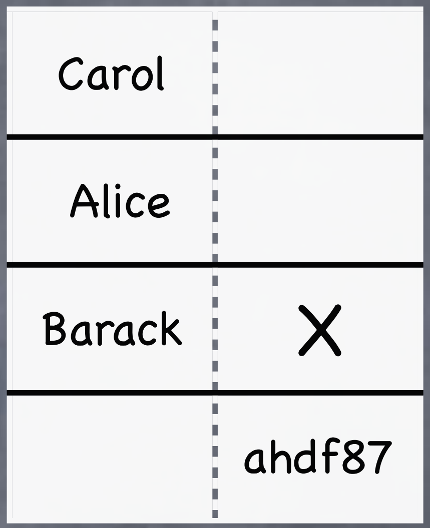

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- Auditing assures that w.h.p the two parts are consistent
- Voter retains a copy of the right-hand part (possibly with a digital signature, verified by helpers outside the booth, to prevent false claims) as a receipt to verify the publicly posted vote. Left-hand part must be destroyed before leaving the polling-booth.

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- Tallying: combine vote-mark and encrypted candidate list into an encrypted vote
  - Candidate list is cyclically permuted by s positions
  - Encryption encodes s
  - Homomorphically add vote-mark position to encryption of s, to get encryption of candidate's index

Prêt à Voter

Carol	
Alice	
Barack	X
	ahdf87

- Tallying: combine vote-mark and encrypted candidate list into an encrypted vote
  - Candidate list is cyclically permuted by s positions
  - Encryption encodes s
  - Homomorphically add vote-mark position to encryption of s, to get encryption of candidate's index
    - Additive homomorphism: Use Paillier, or El Gamal with messages in the exponent (since only a few messages possible)

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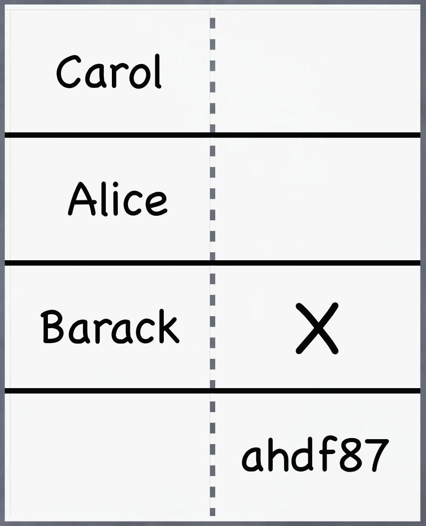

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  - If no errors found in a large random sample (say half the ballots) probability of more than a few bad ballots is very small (say, 2^{-t} probability that more than t bad)

Prêt à Voter

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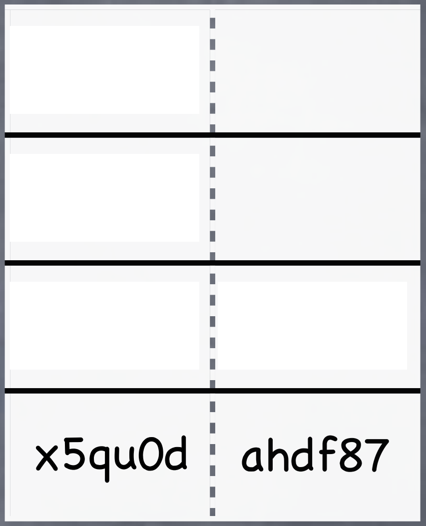

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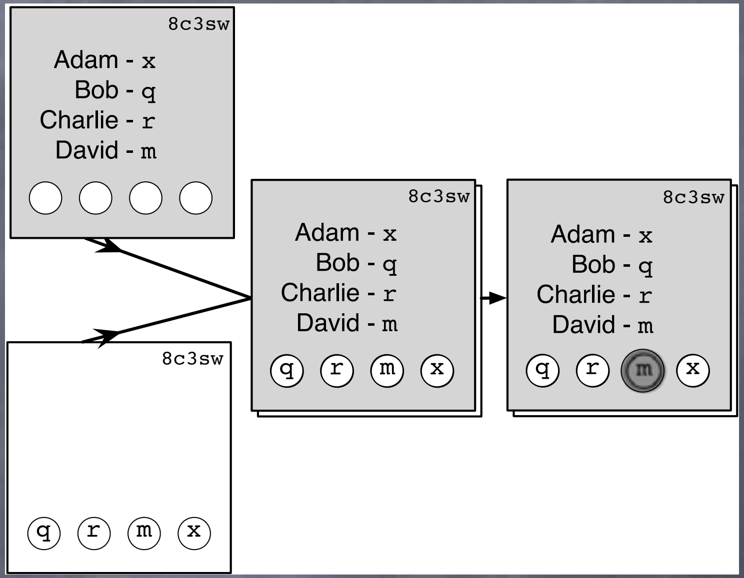

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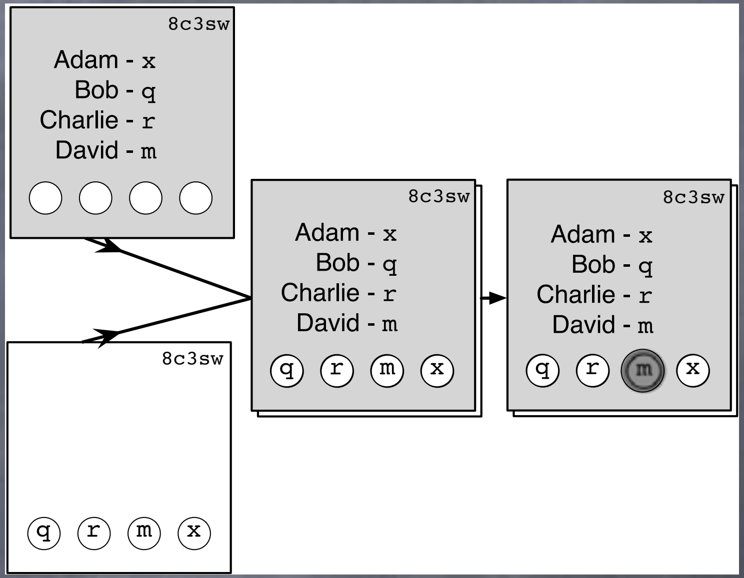

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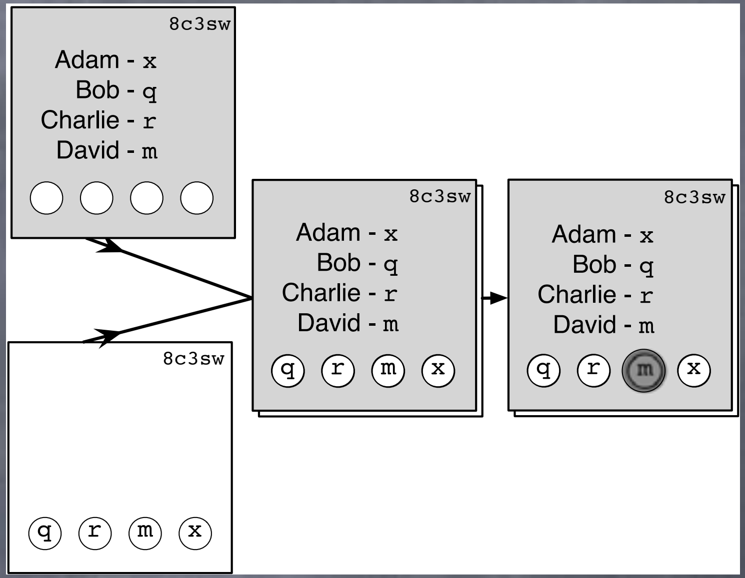

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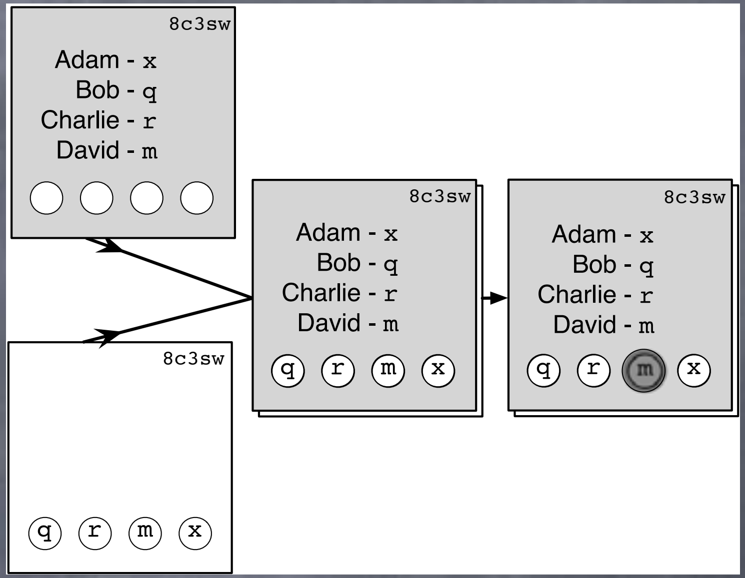

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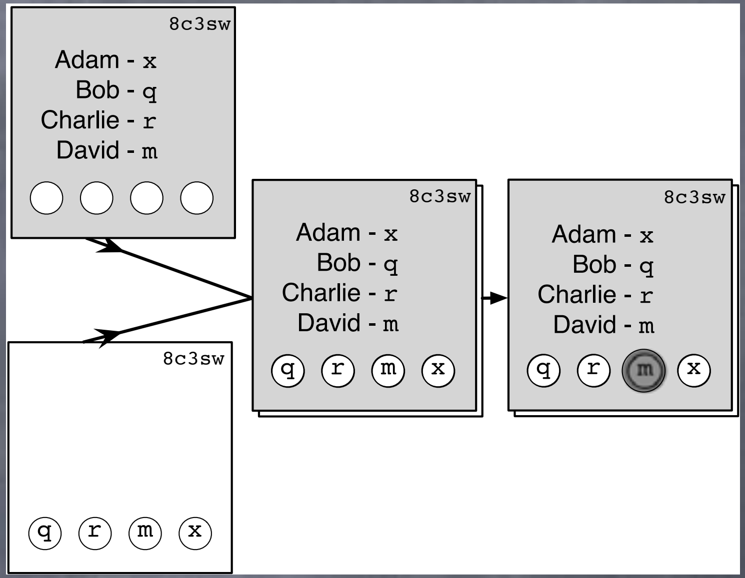

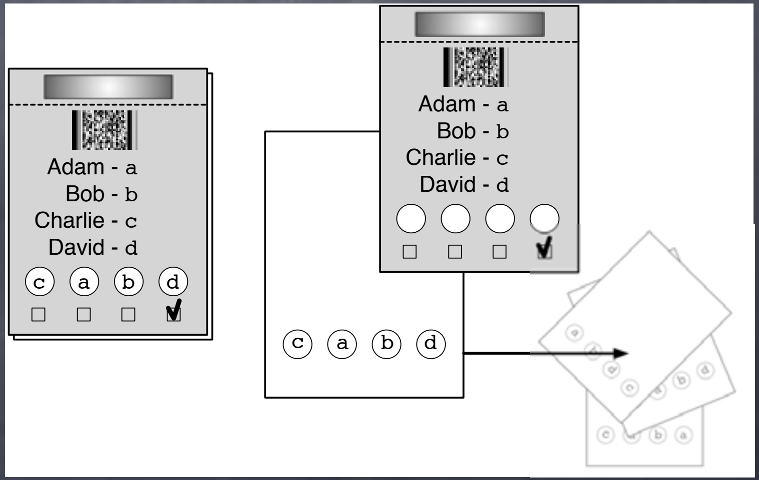

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    - In Prêt à Voter, information on RHS: encryptions of the shifted value to be added for each possible mark

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  - Coercion is hard to prevent, but can be mitigated by allowing voters to change votes any time

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- Front-end and back-end need to be modified

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- Aims to get unprecedented level of confidence from individual voters and public auditors (E2E security)
  - Challenge: Increases risk of coercion
- A cyber-physical system with avenue for new protocol techniques and attacks
- Few satisfactory security definitions yet (let alone proofs)