Sealed-Glass Proofs

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Florian Tramèr, Fan Zhang, Huang Lin,
Jean-Pierre Hubaux, Ari Juels, and Elaine Shi.

Attested Execution

properties, threat model, use-cases

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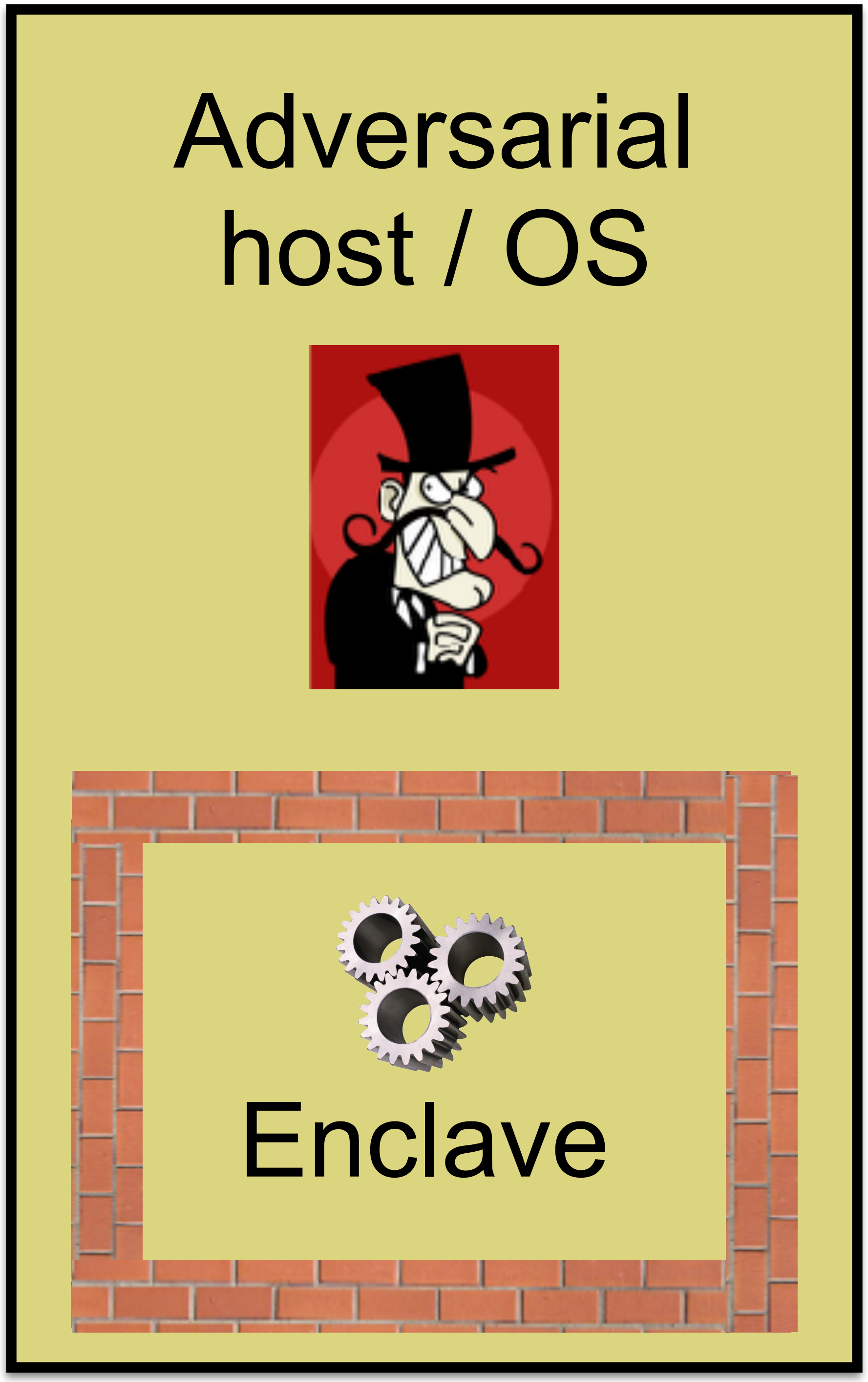

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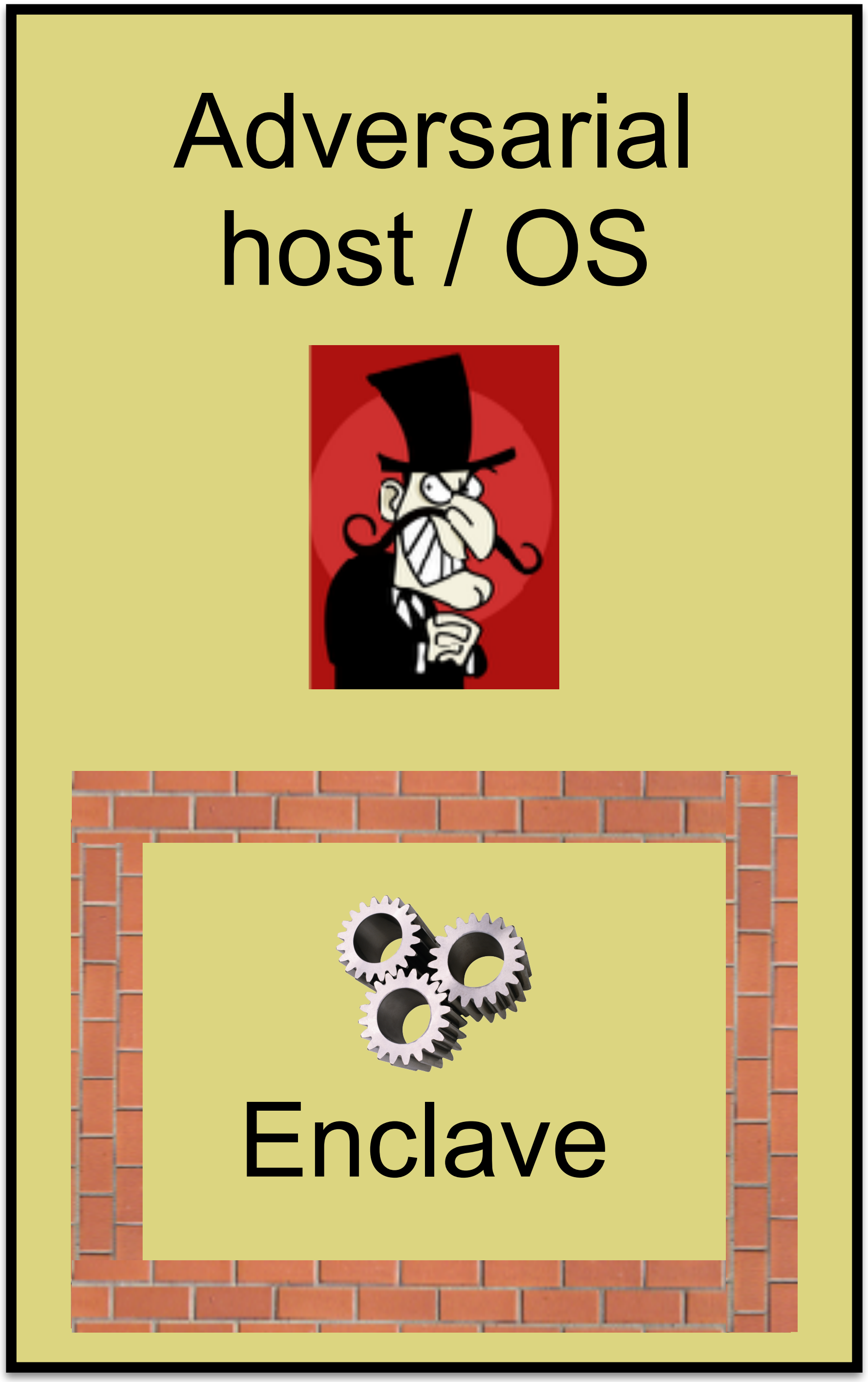

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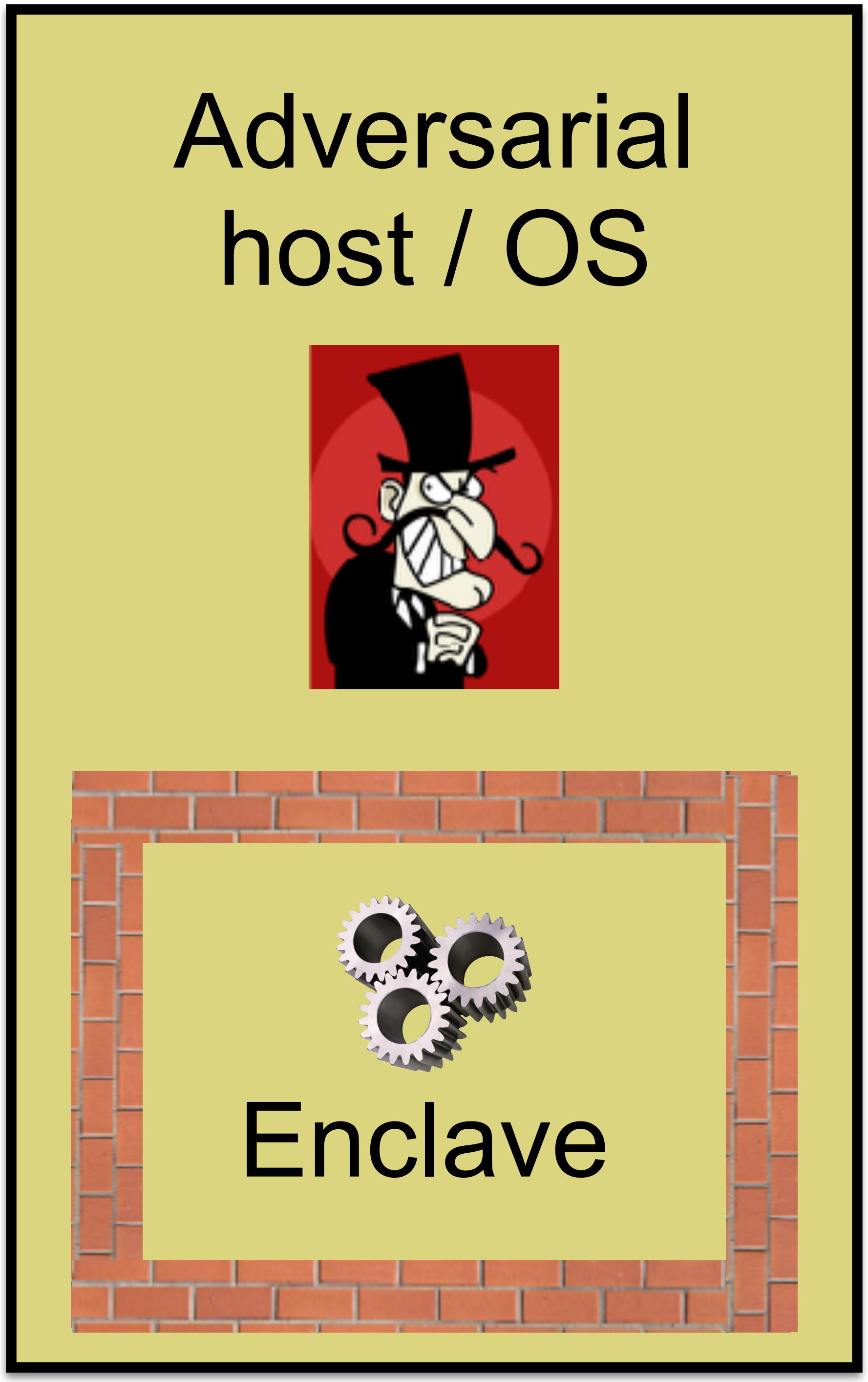

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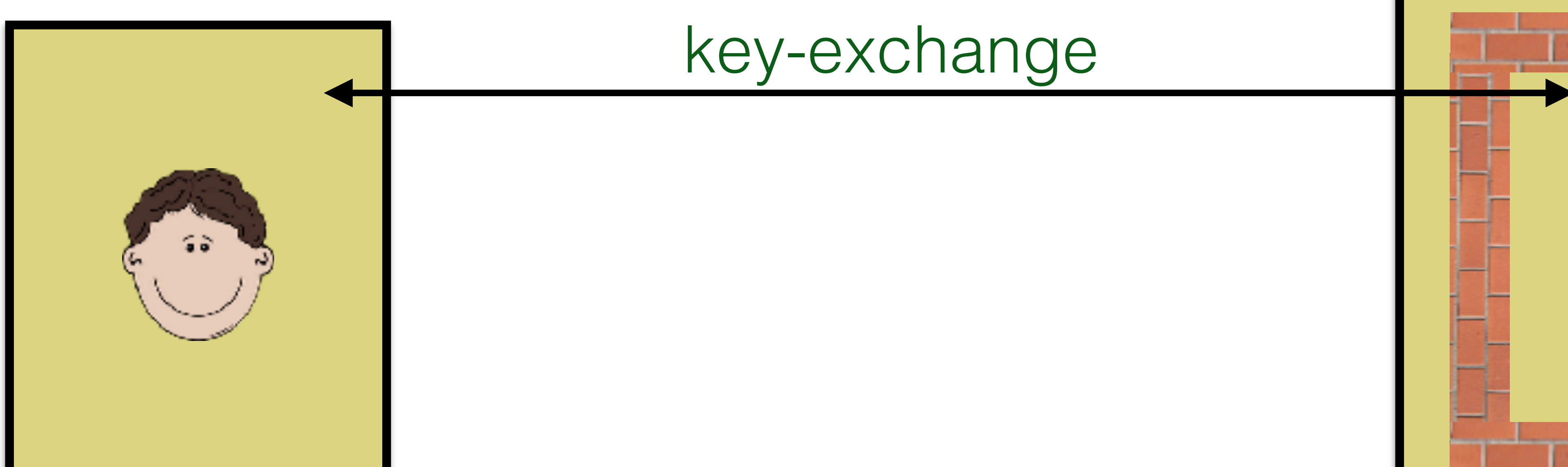

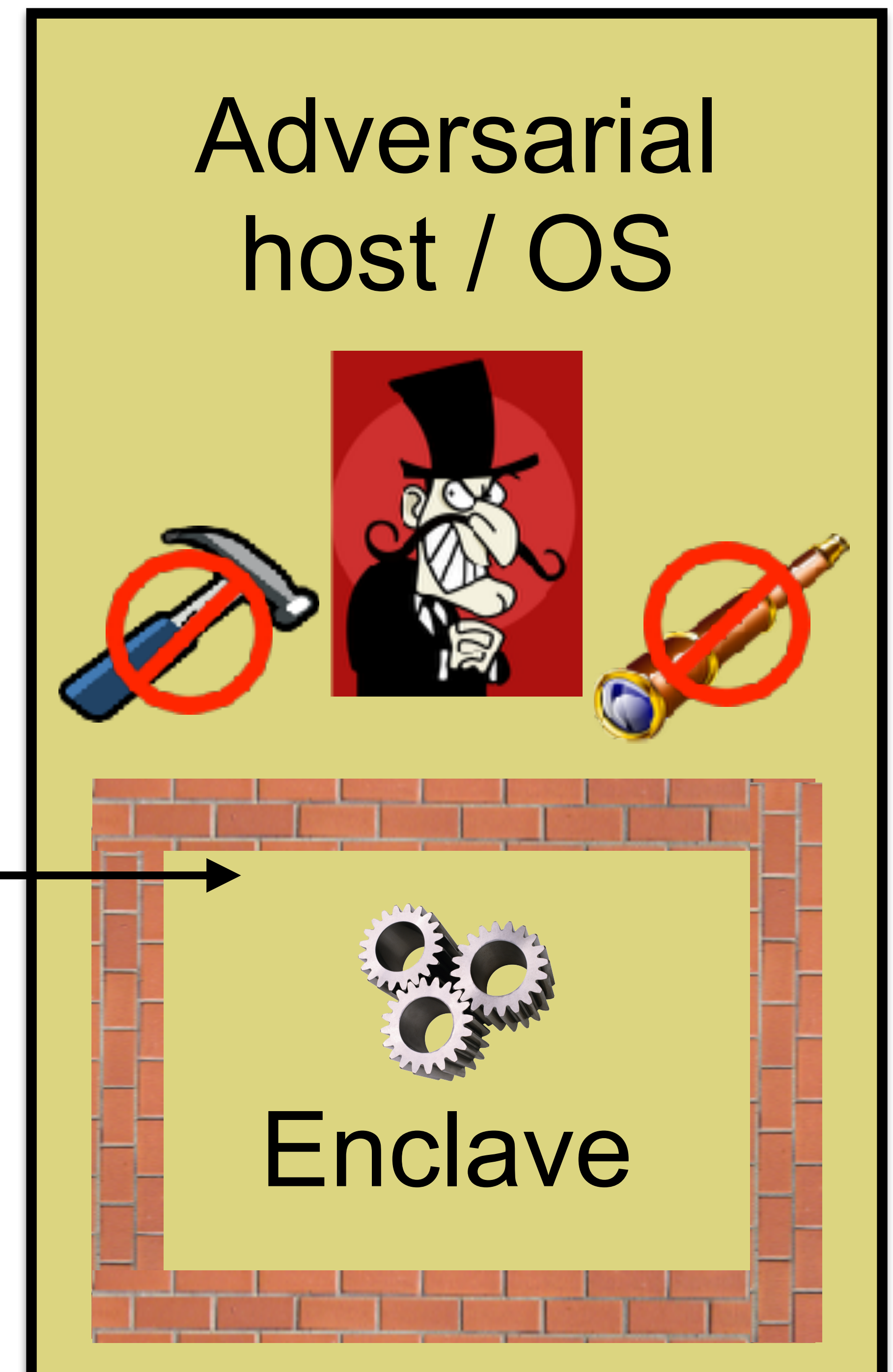

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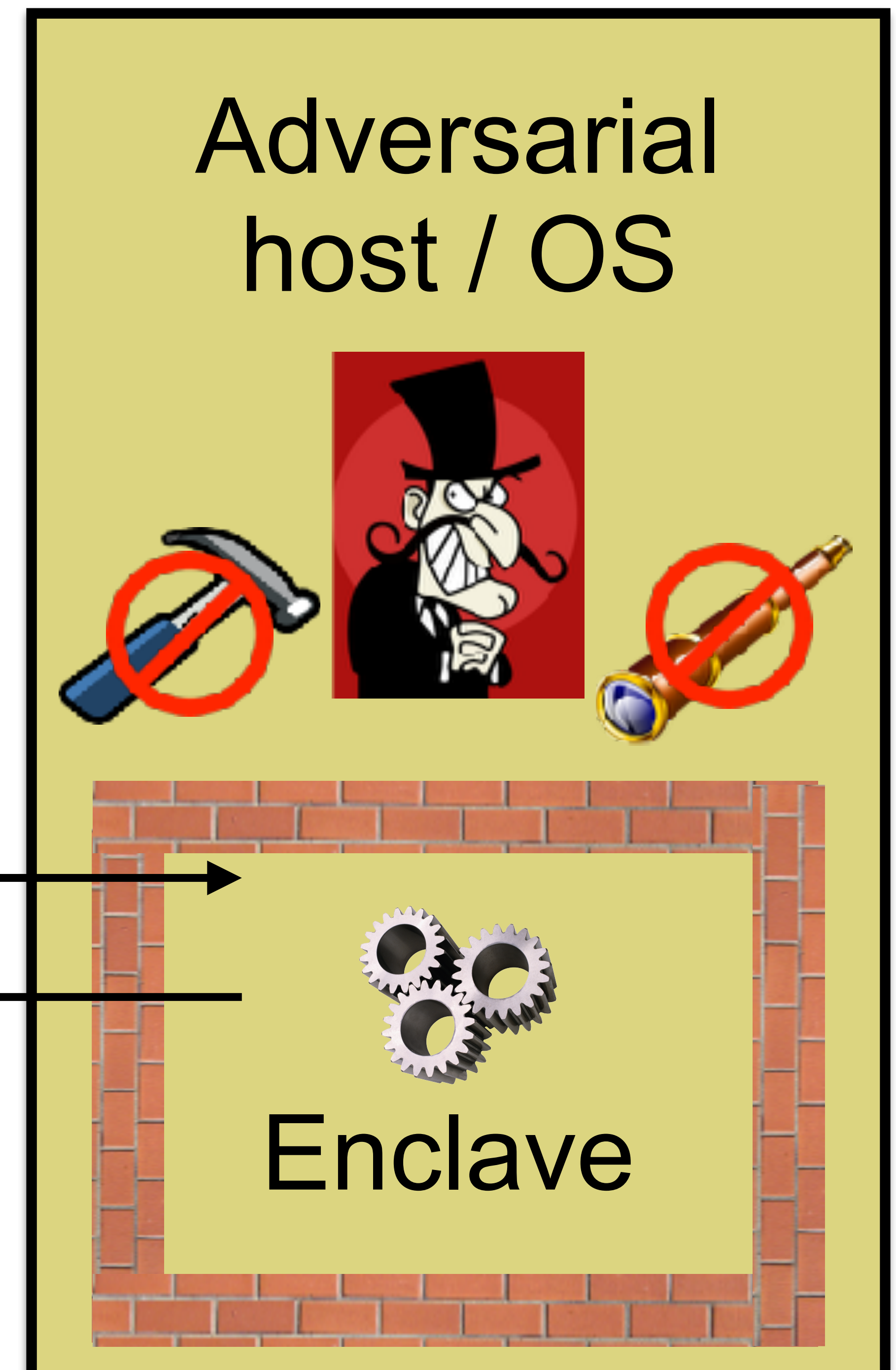

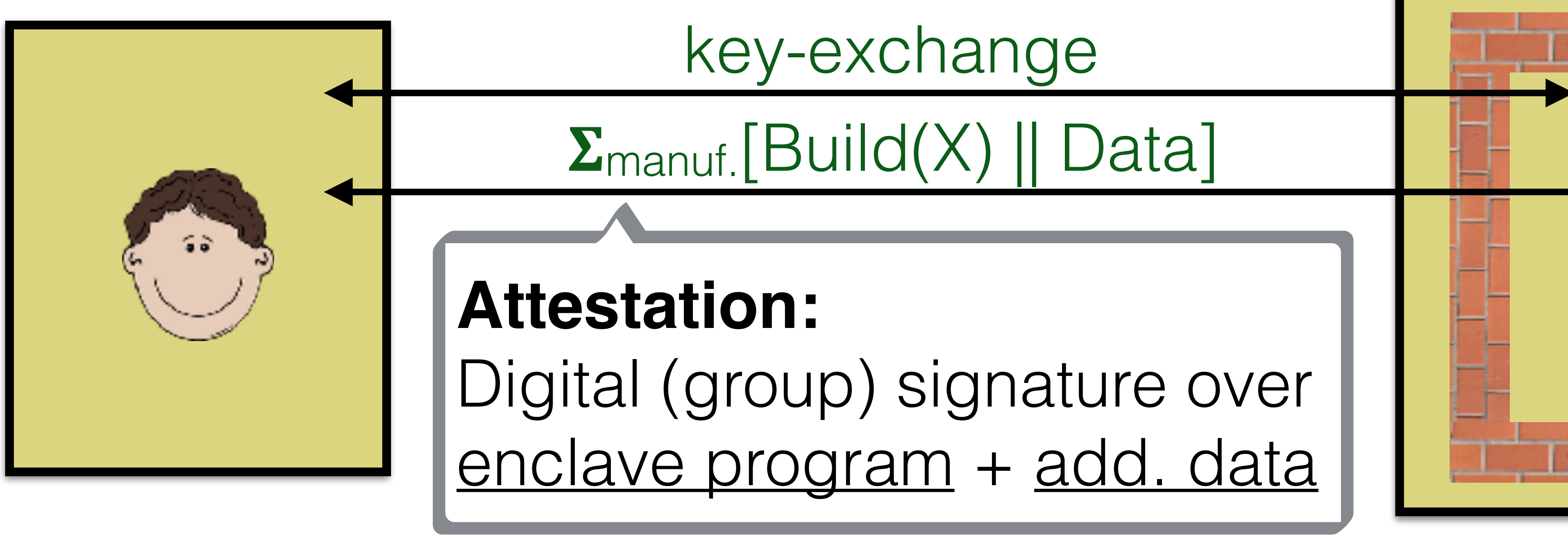

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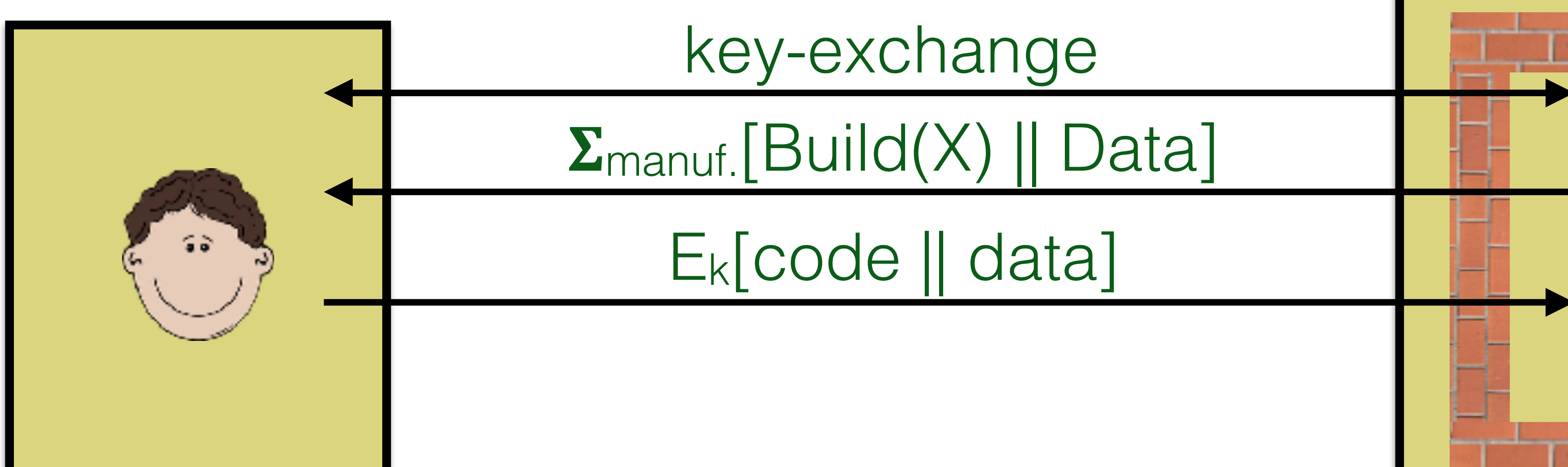

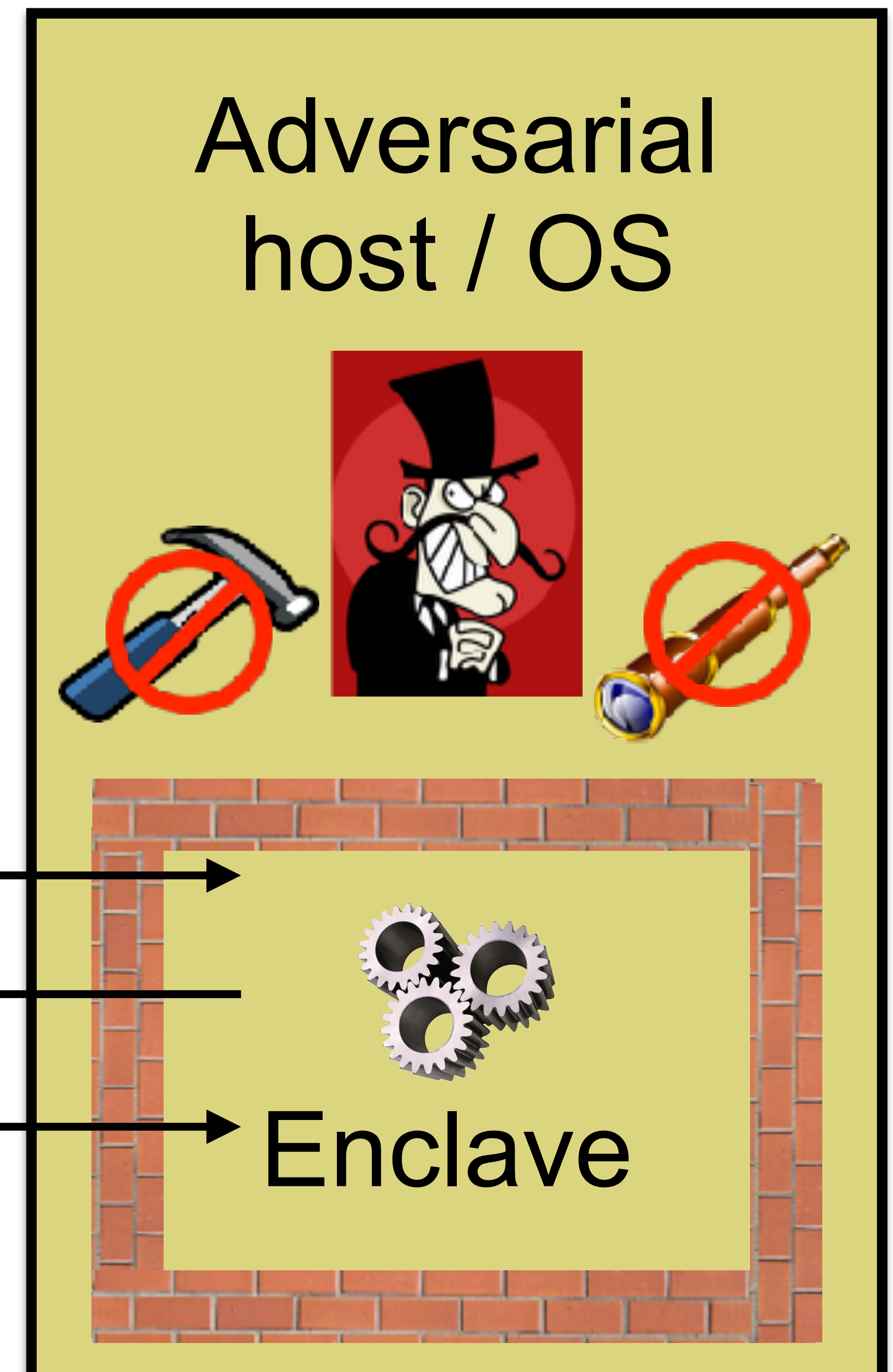

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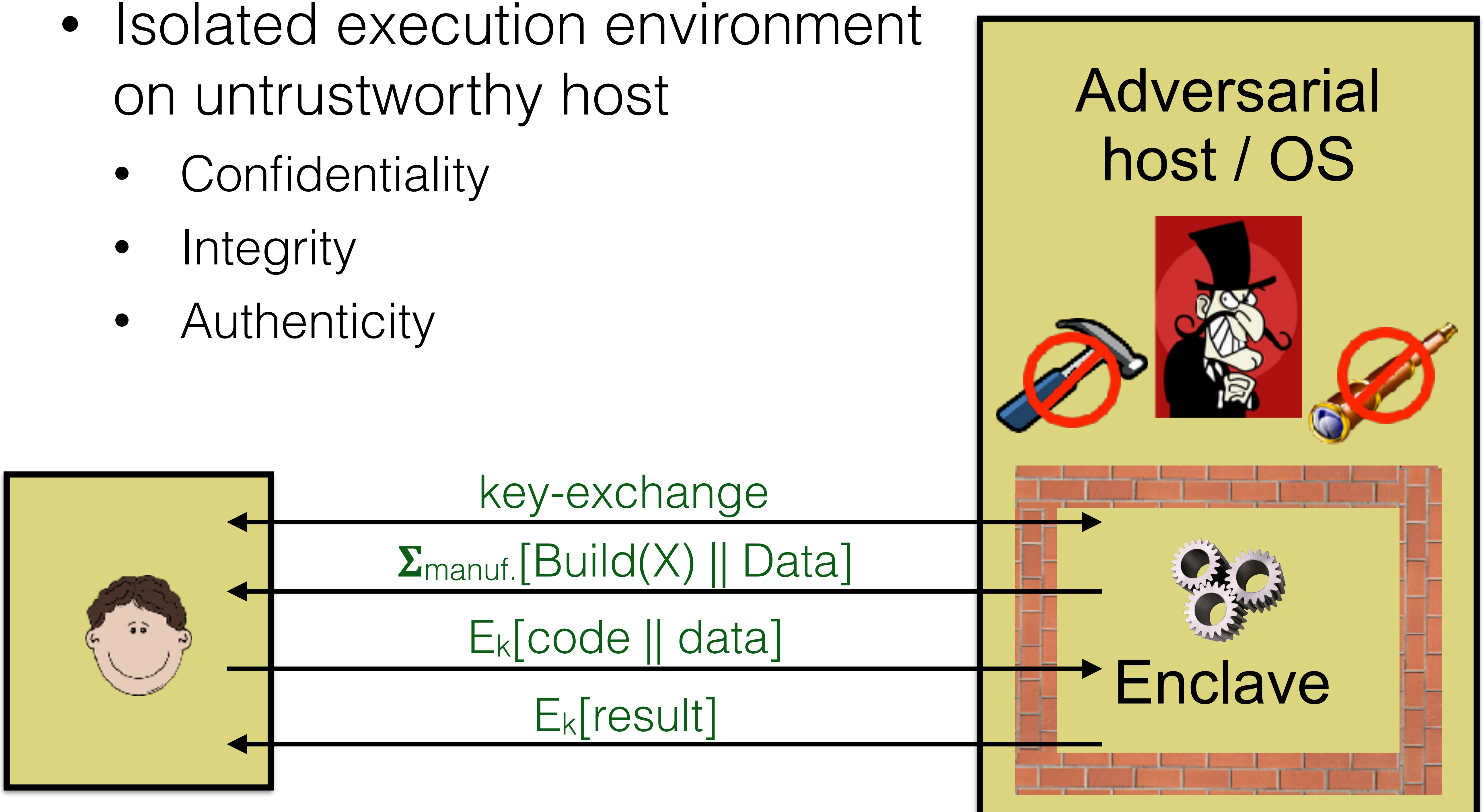

Isolation is imperfect

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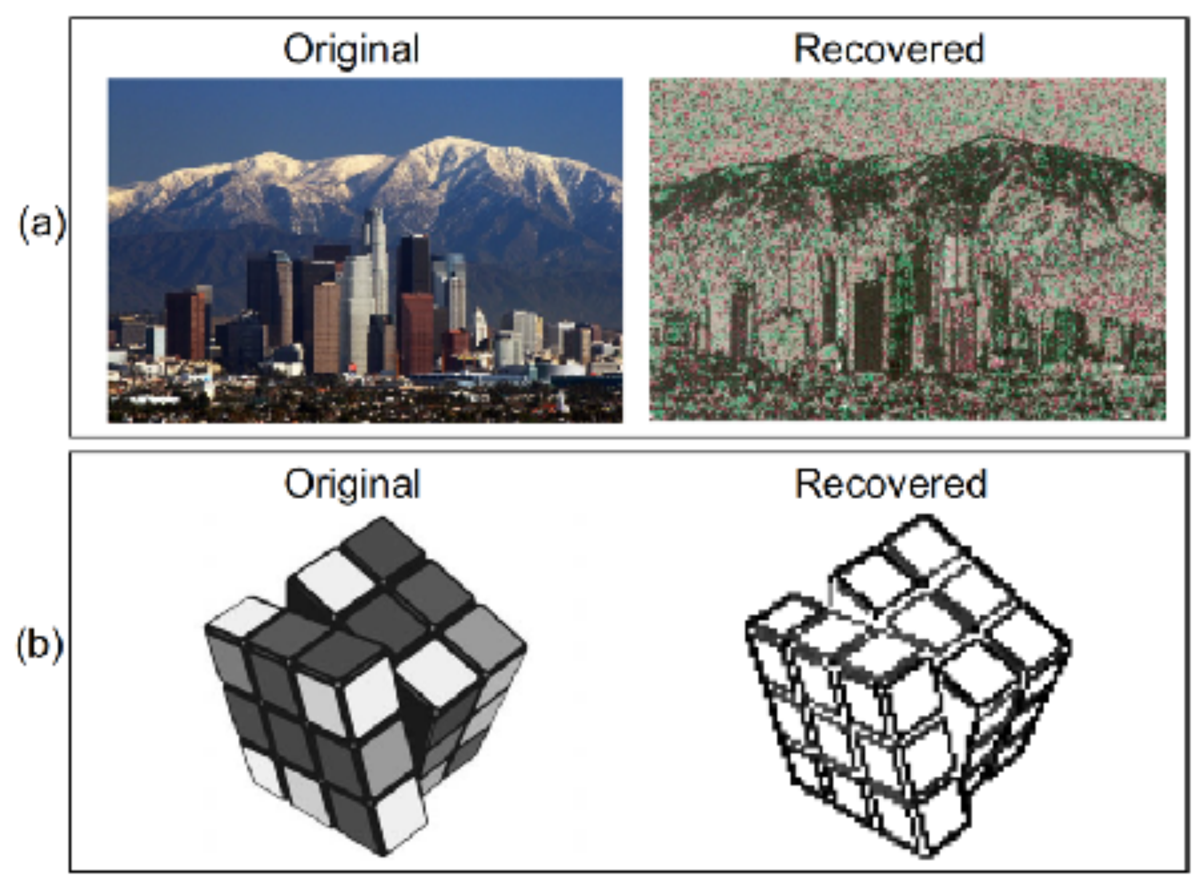
- E.g., SGX page faults can be induced and seen by OS
  - Leaks memory access patterns
- Many recent papers about cache side channels



libjpeg attack from Y. Xu, W. Cui, and M. Peinado, *"Controlled-Channel Attacks: Deterministic Side Channels for Untrusted Operating Systems"*, IEEE S&P, 2015

Solutions?

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- Side channels “out-of-scope”
- Oblivious Data Structures
- ORAM
- What if leakage doesn’t matter?

New adversarial model

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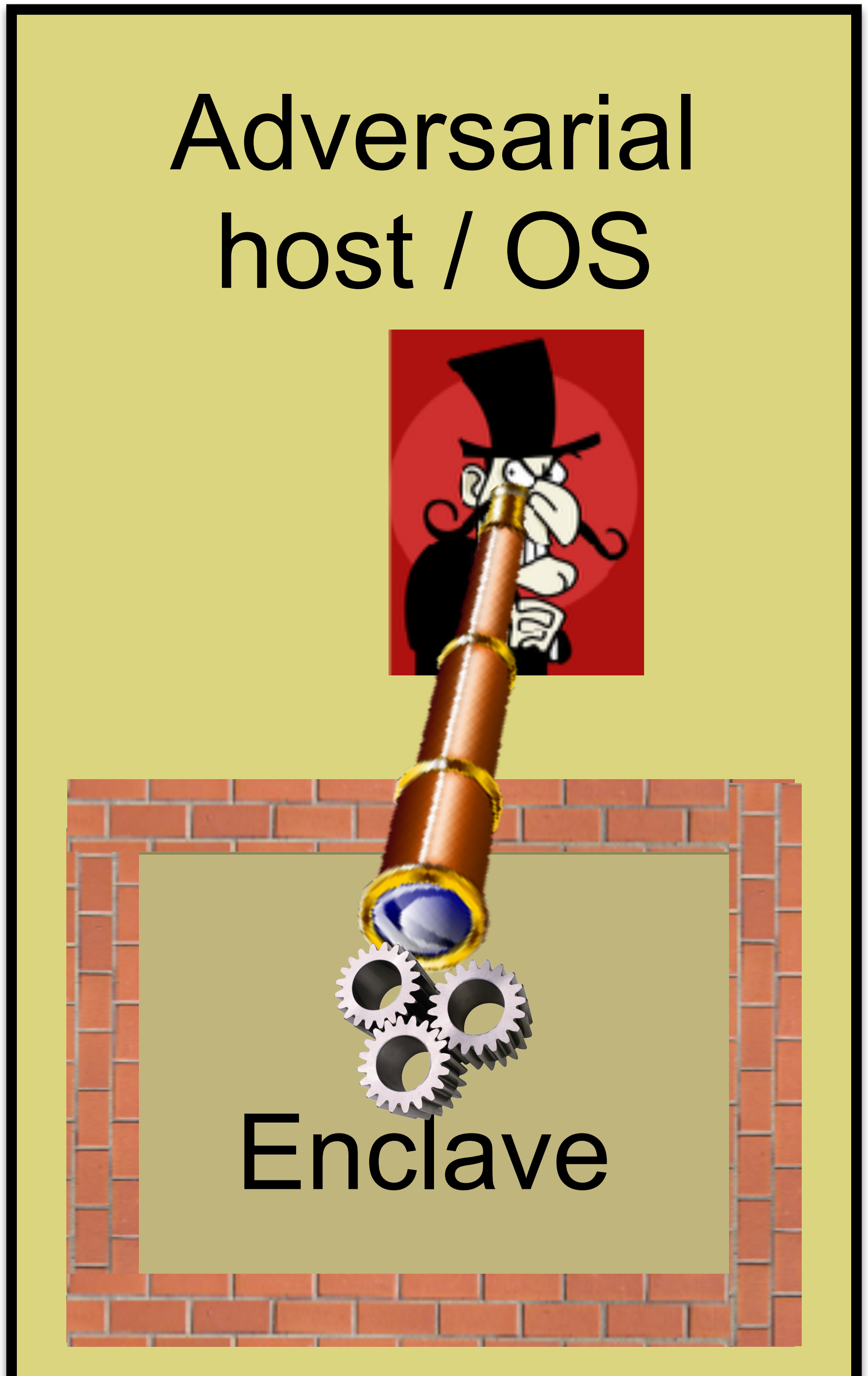

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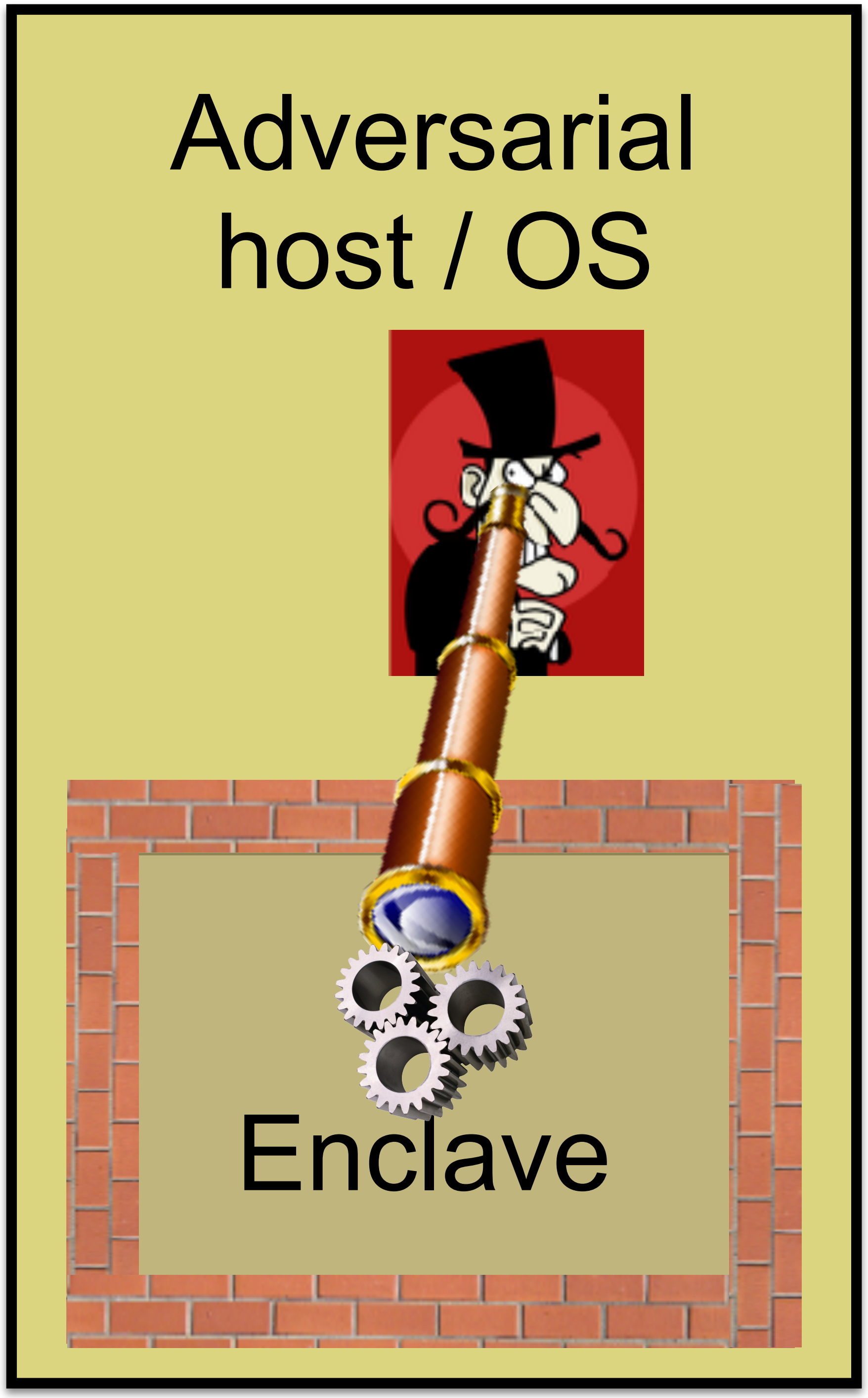

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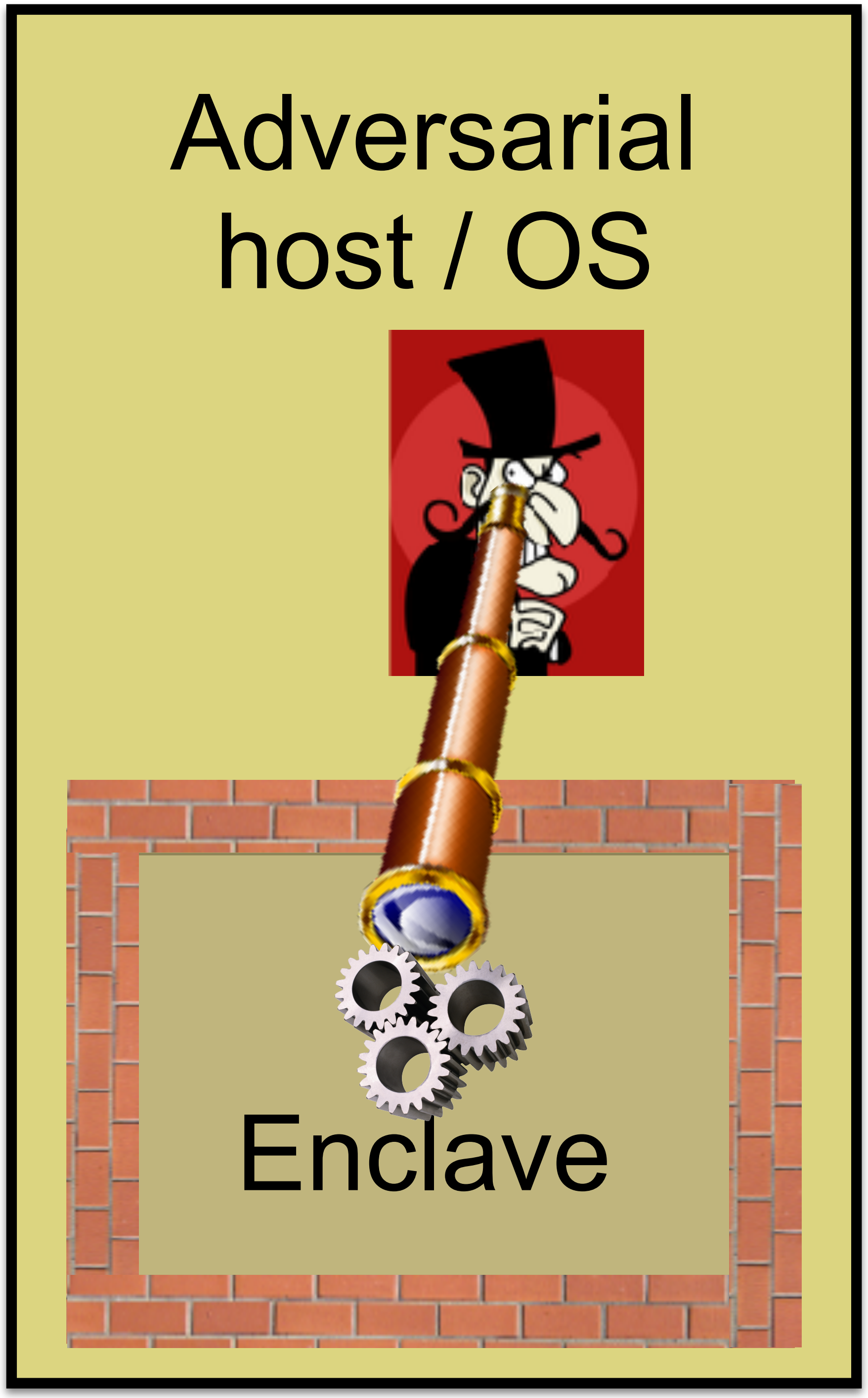

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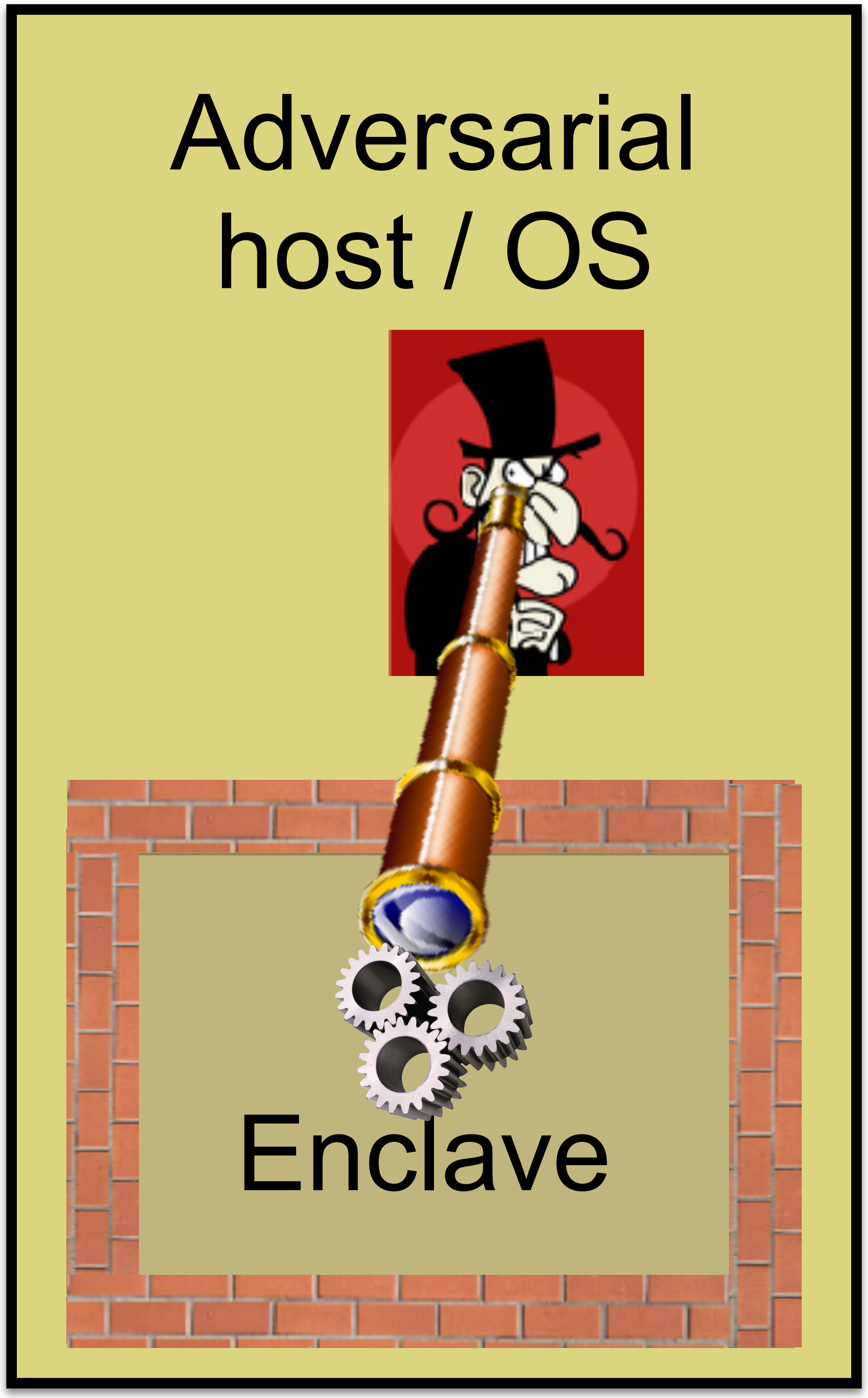

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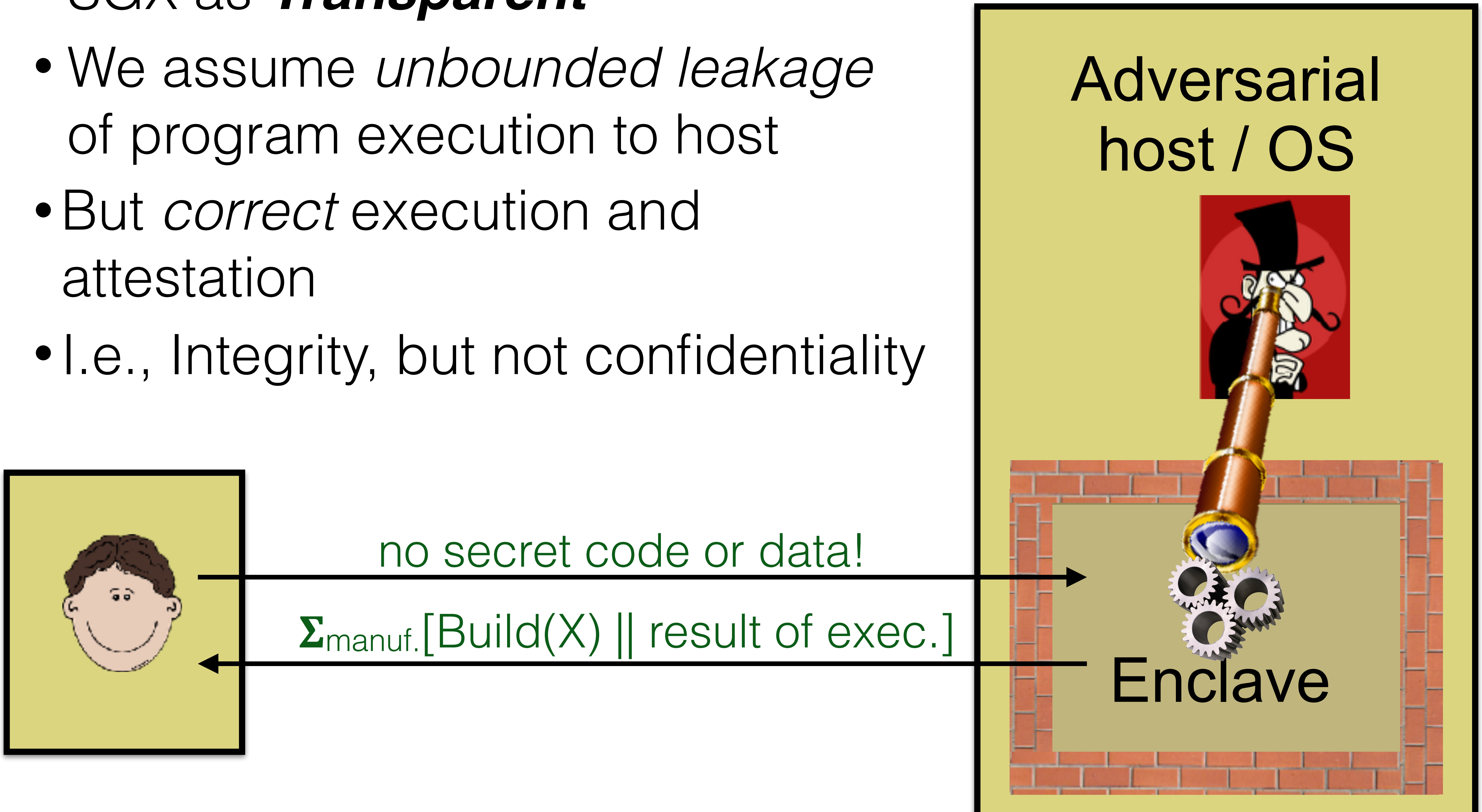

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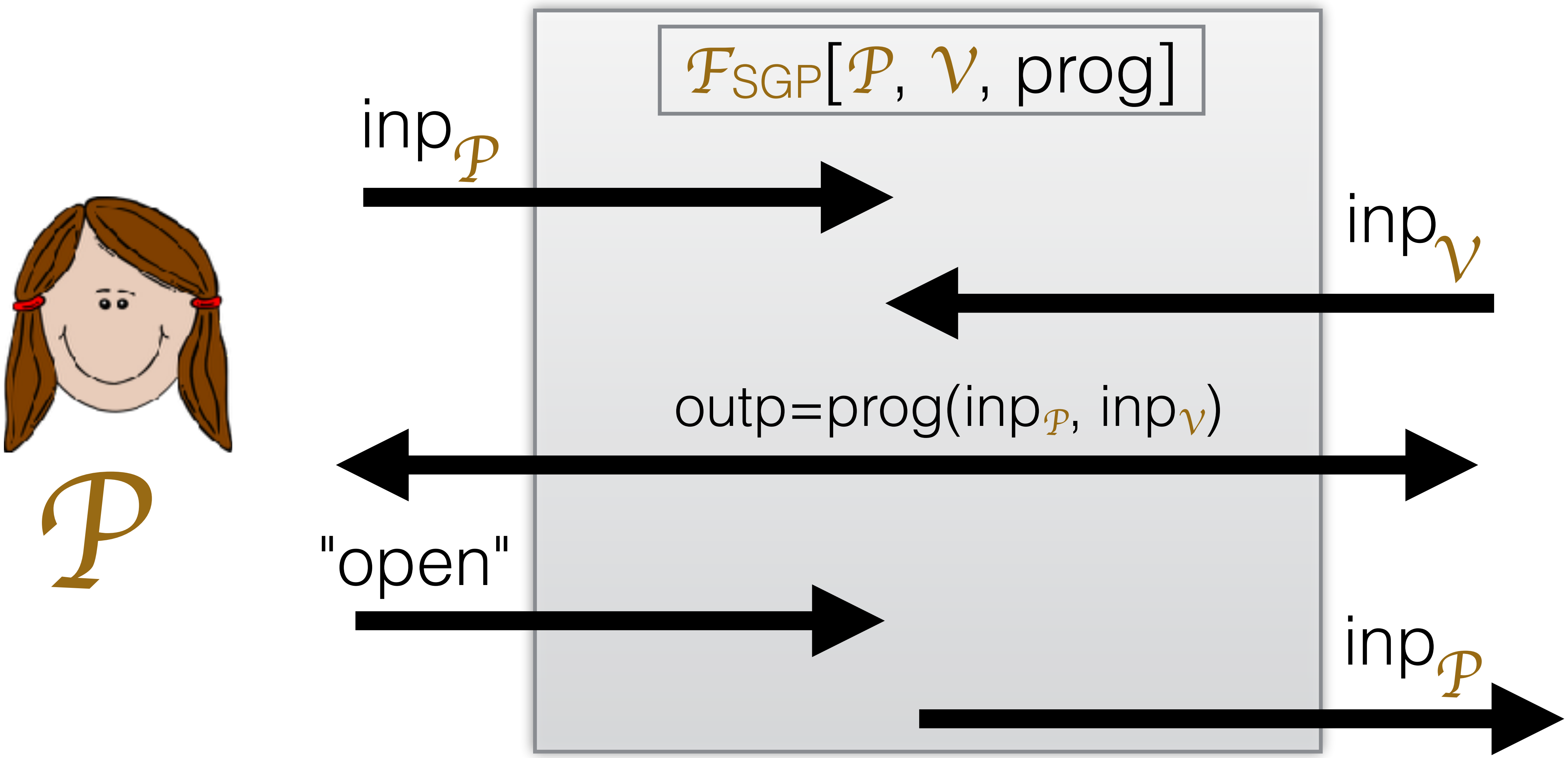
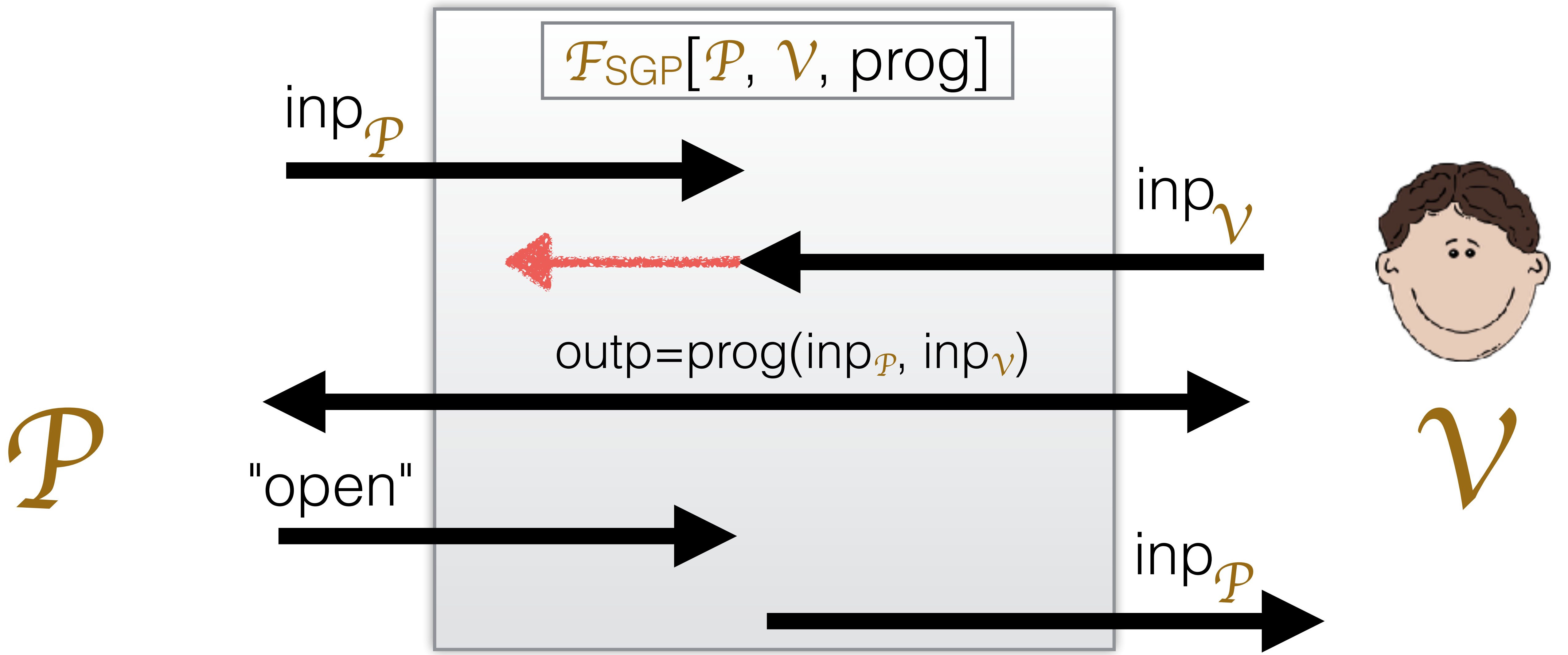


Why "sealed glass" ?

- **Model:** $\mathcal{P}$ can observe but can't modify once $\text{inp}_{\mathcal{P}}$ "committed"



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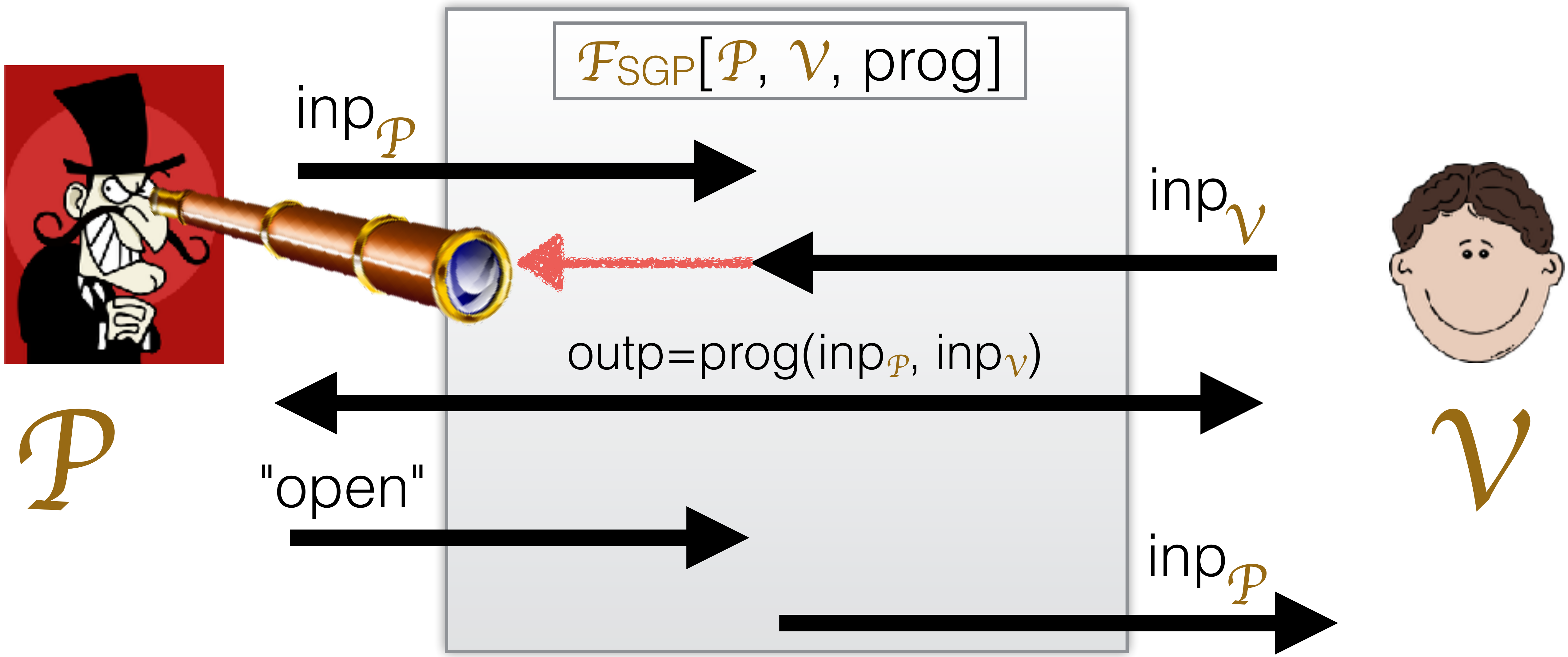

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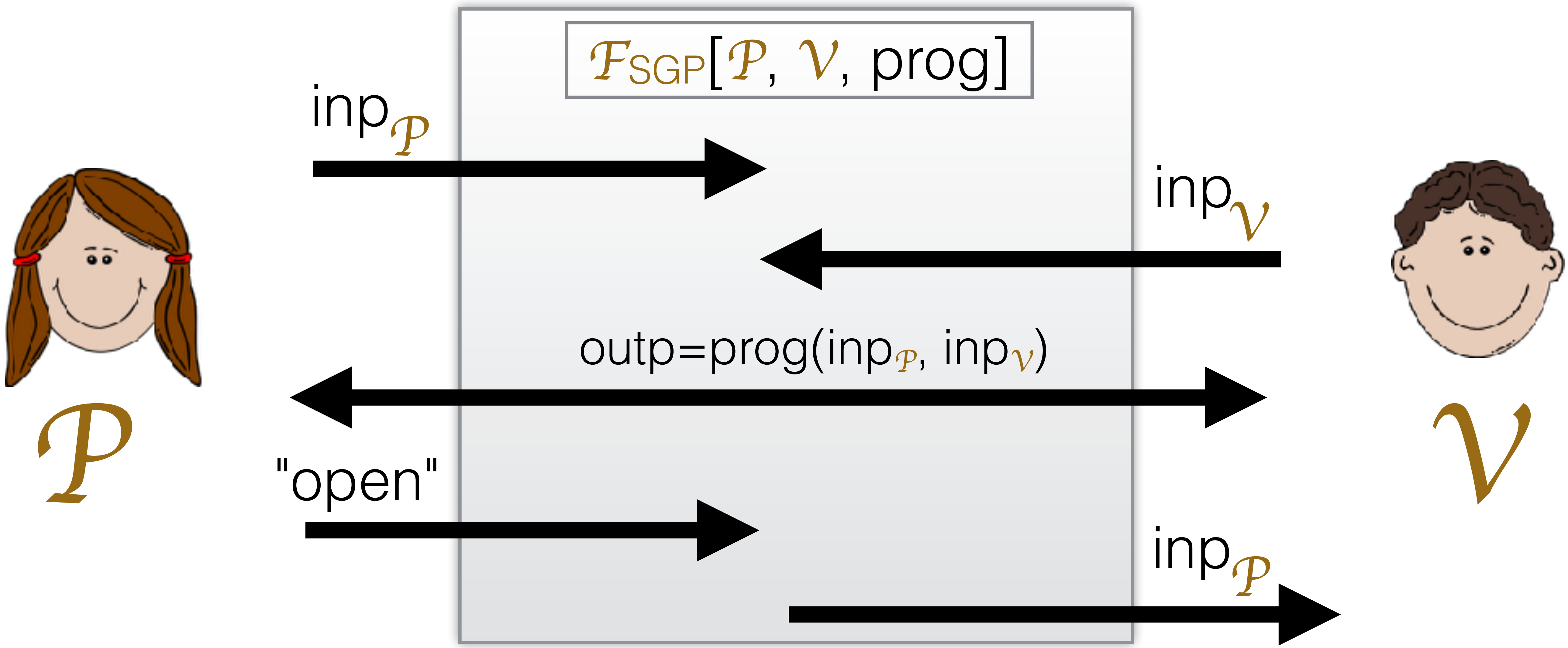

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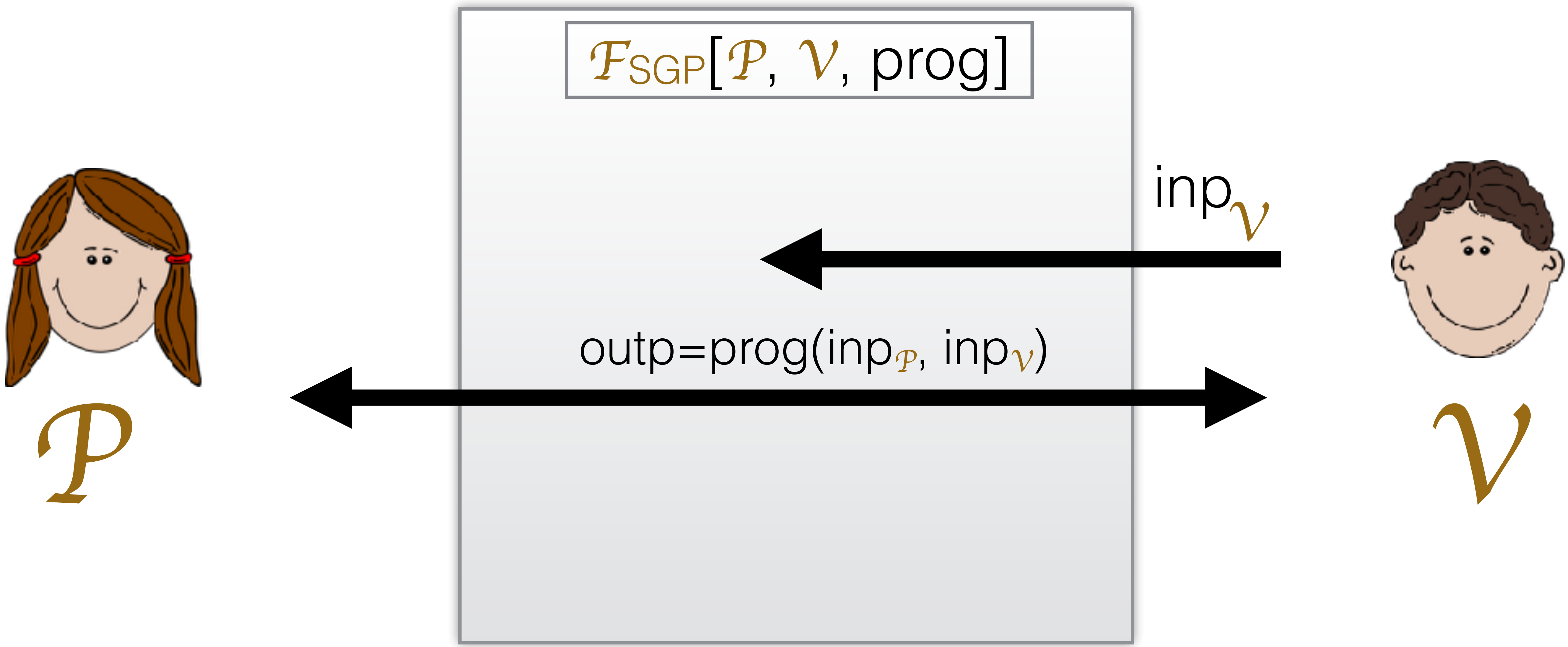

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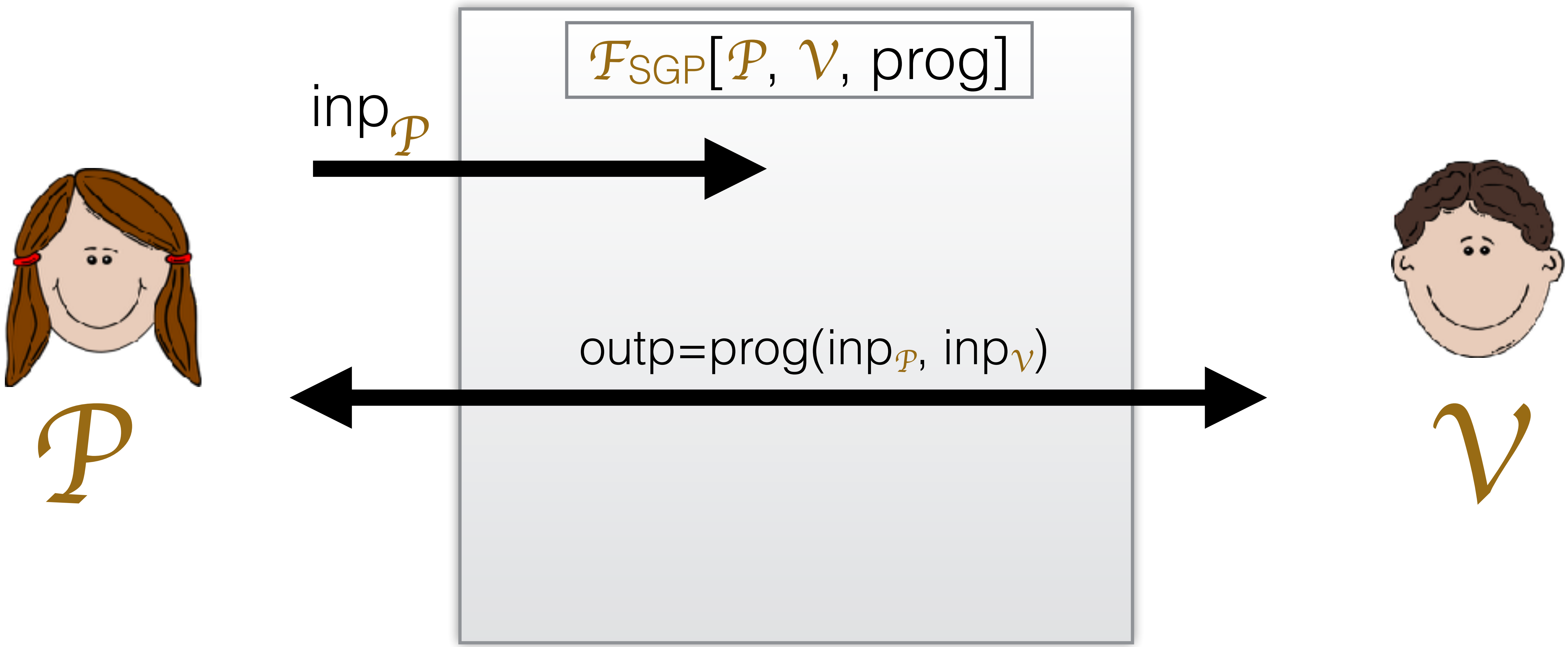
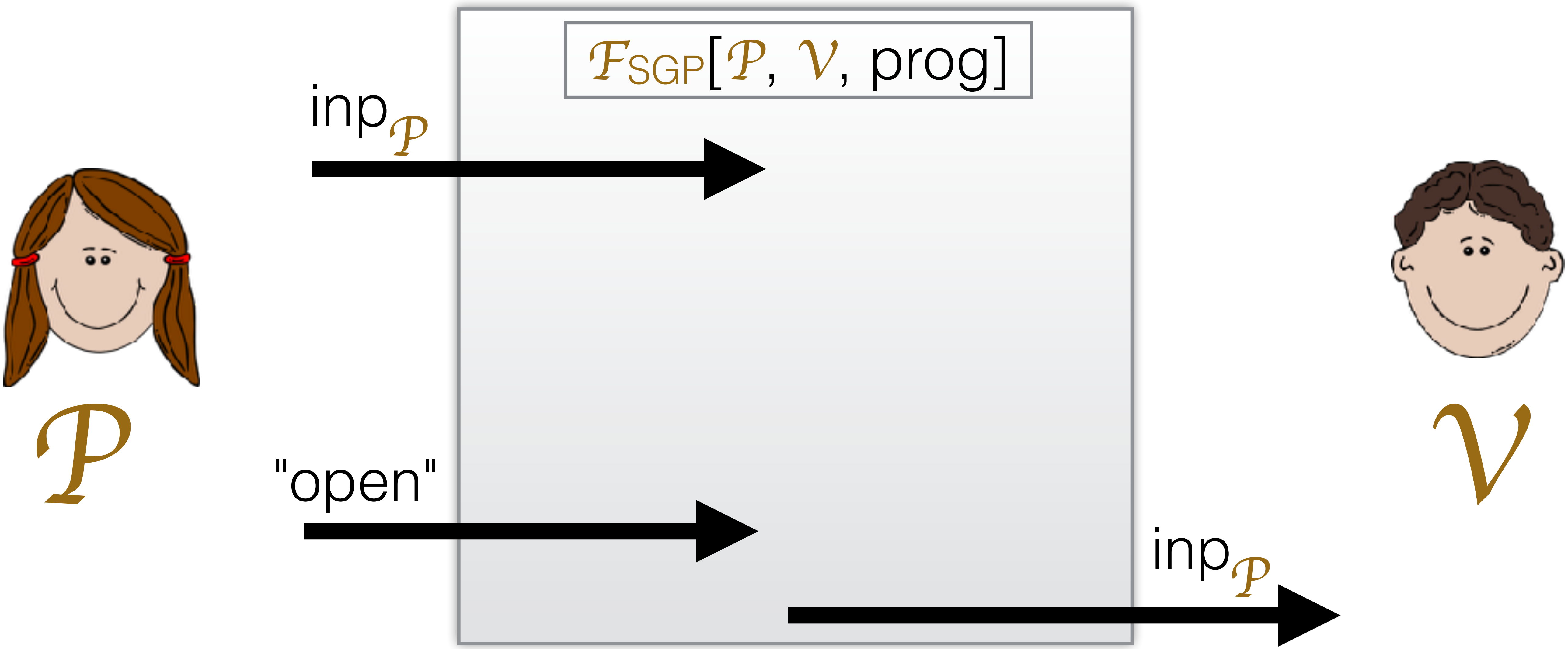


SGP generalizes…

- Verifiable Computing
- ZK proofs
- Commitments, etc.



Application:
Fair bug bounty system

exploit

$Reward
software **S**

seller

buyer

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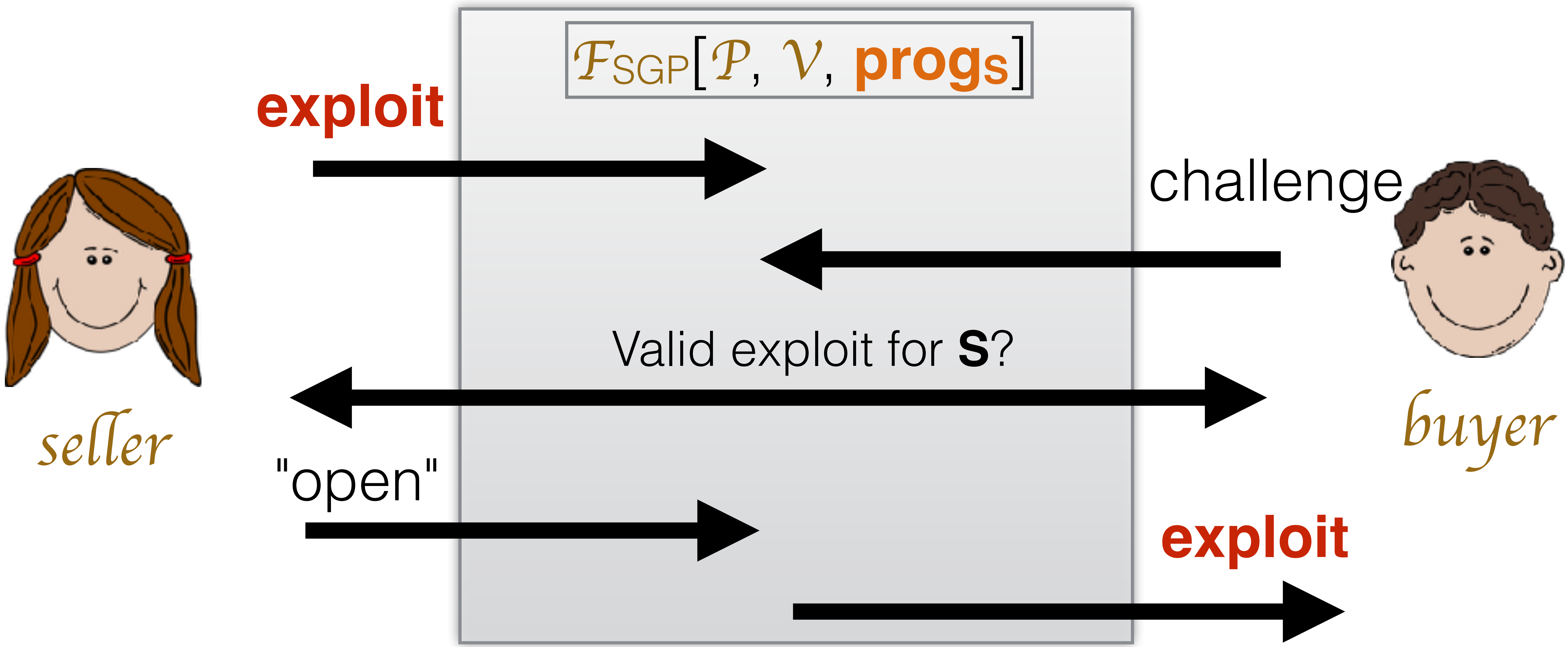

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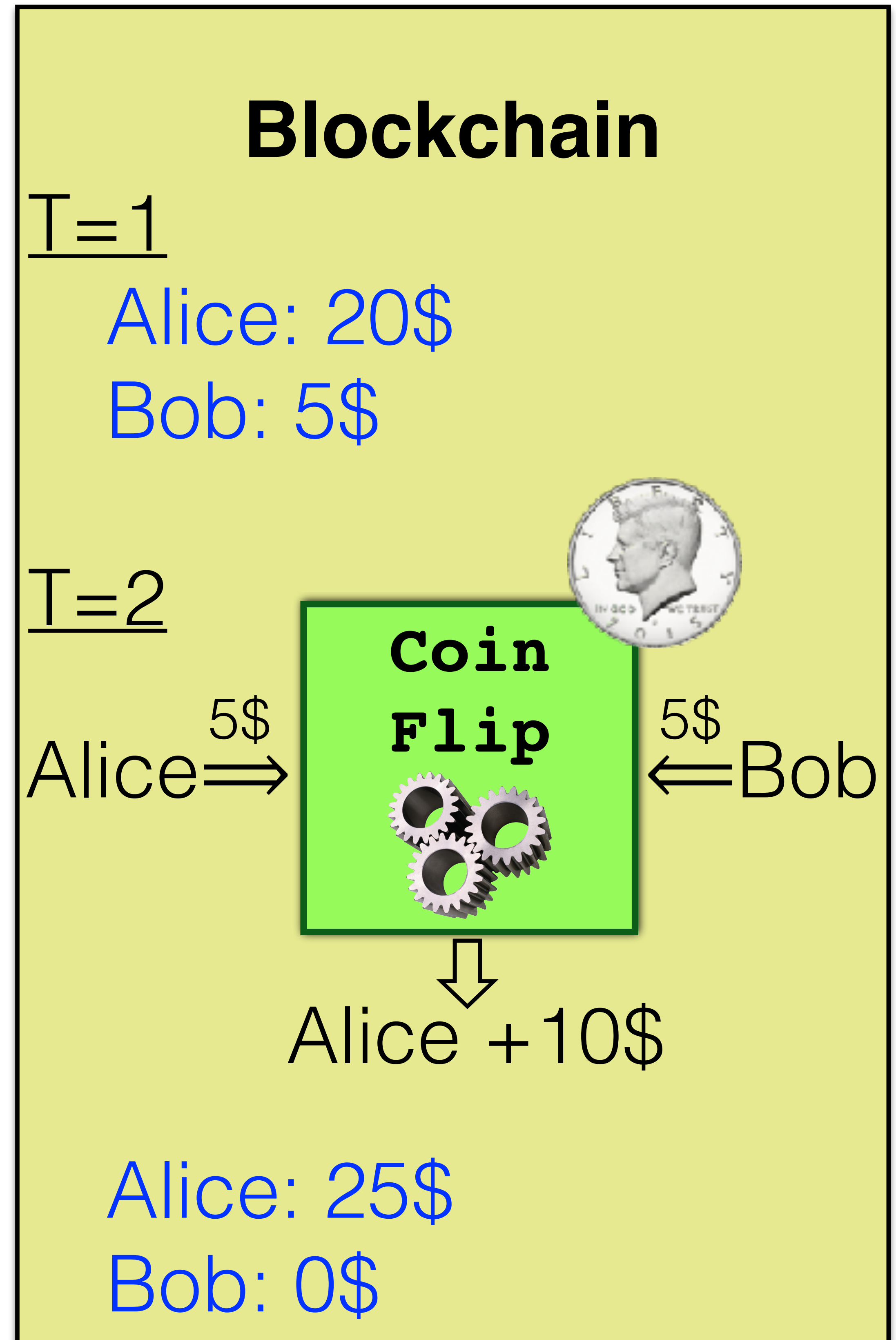

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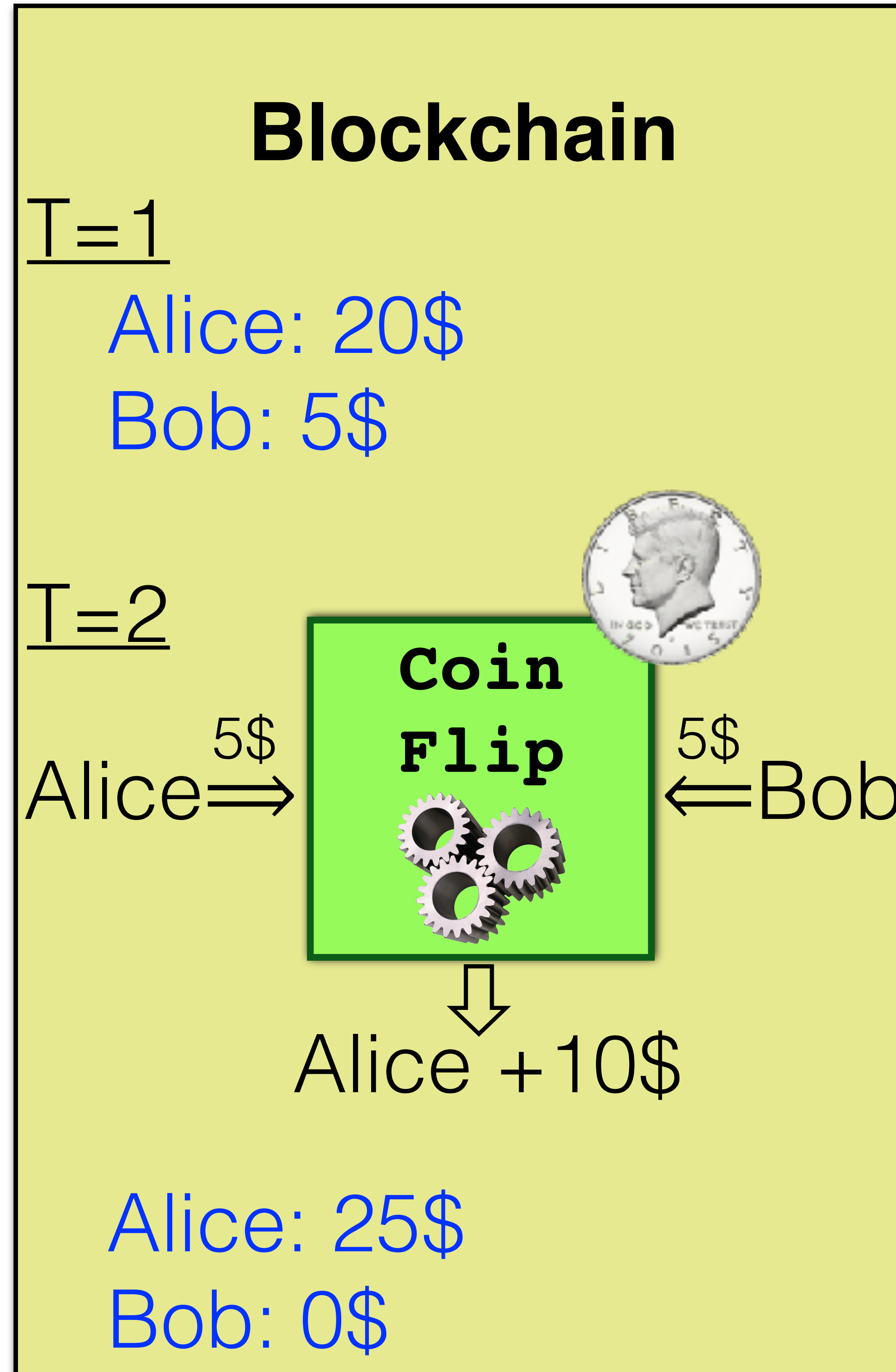

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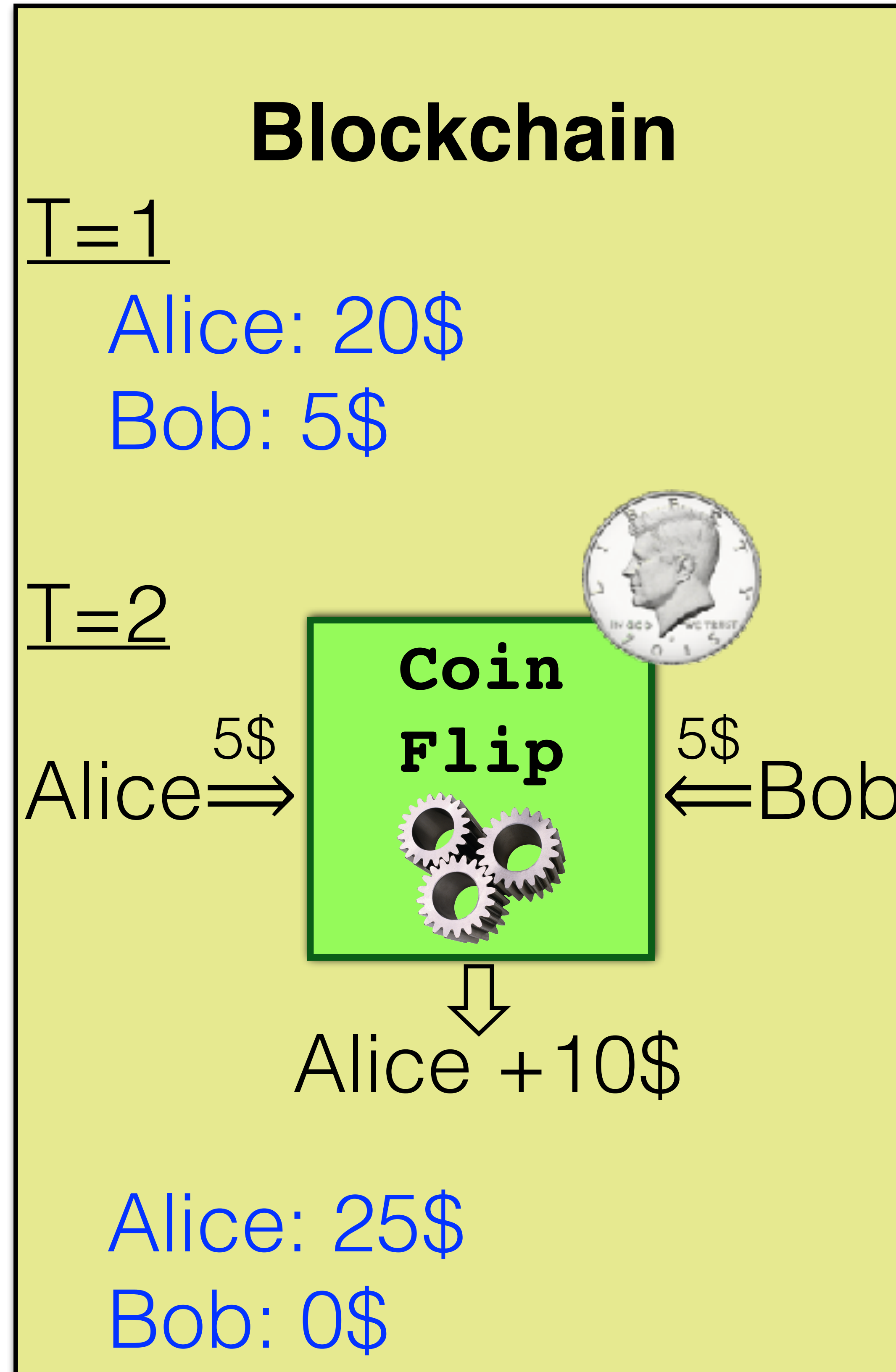

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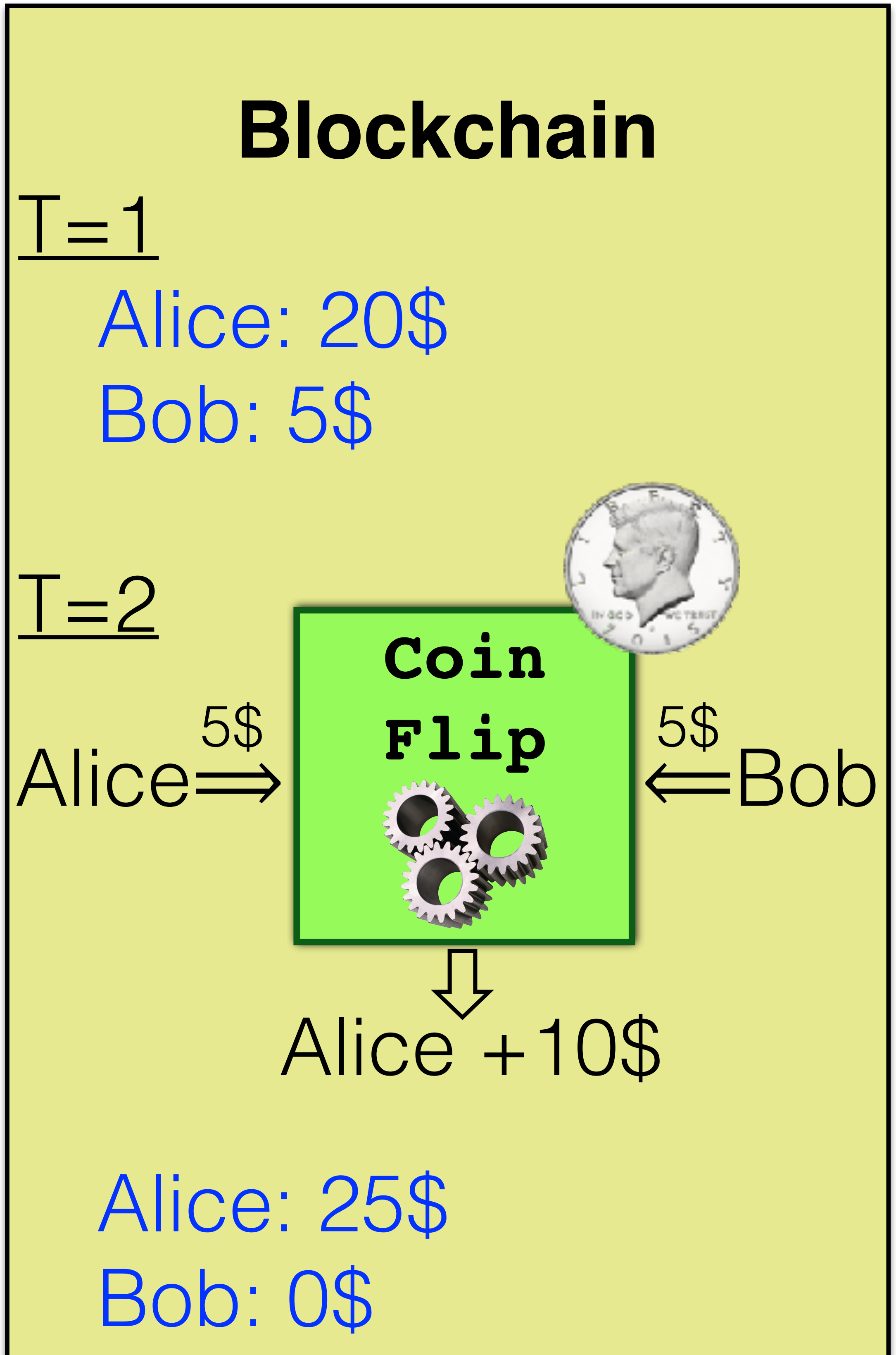

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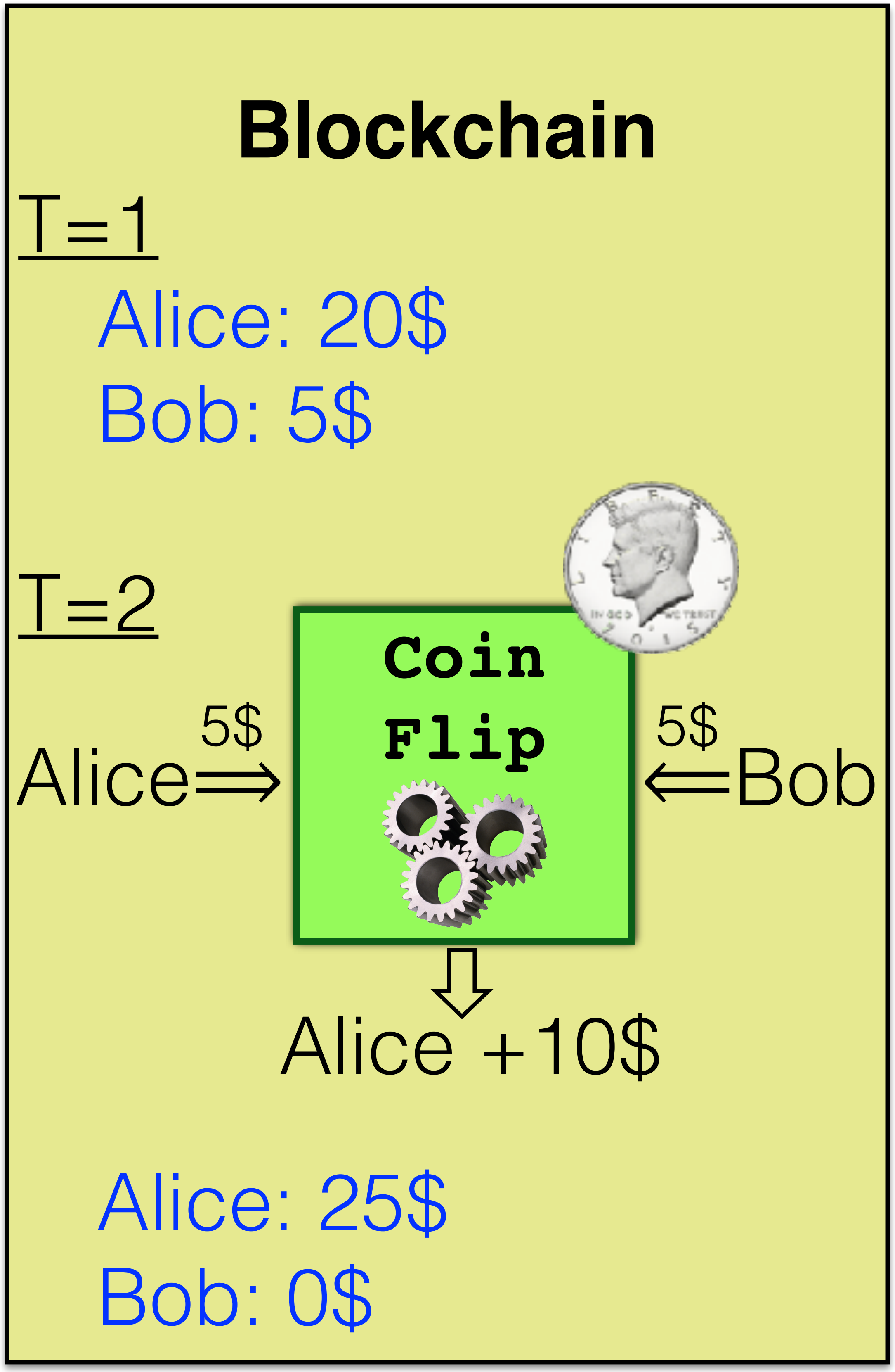

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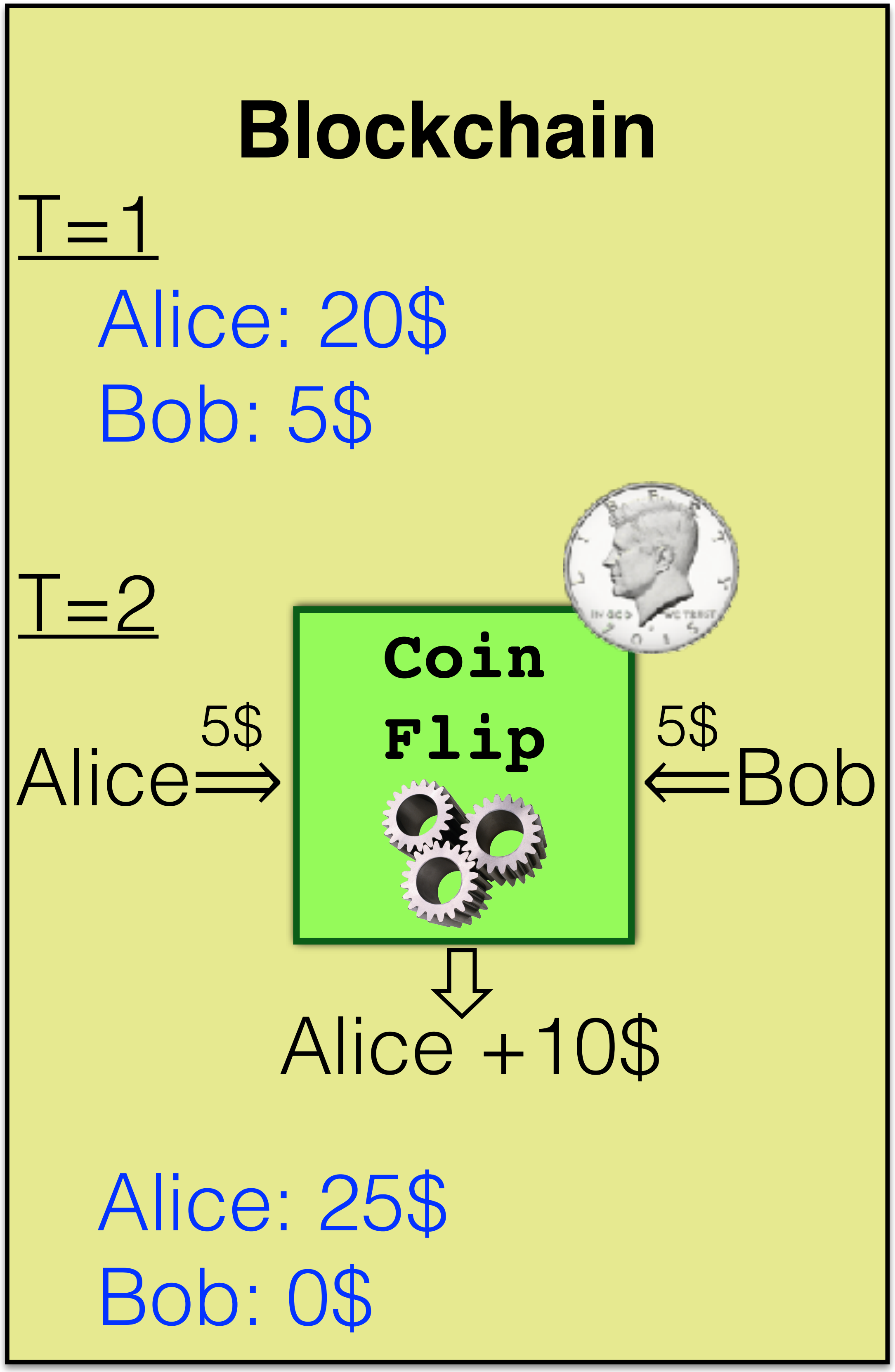

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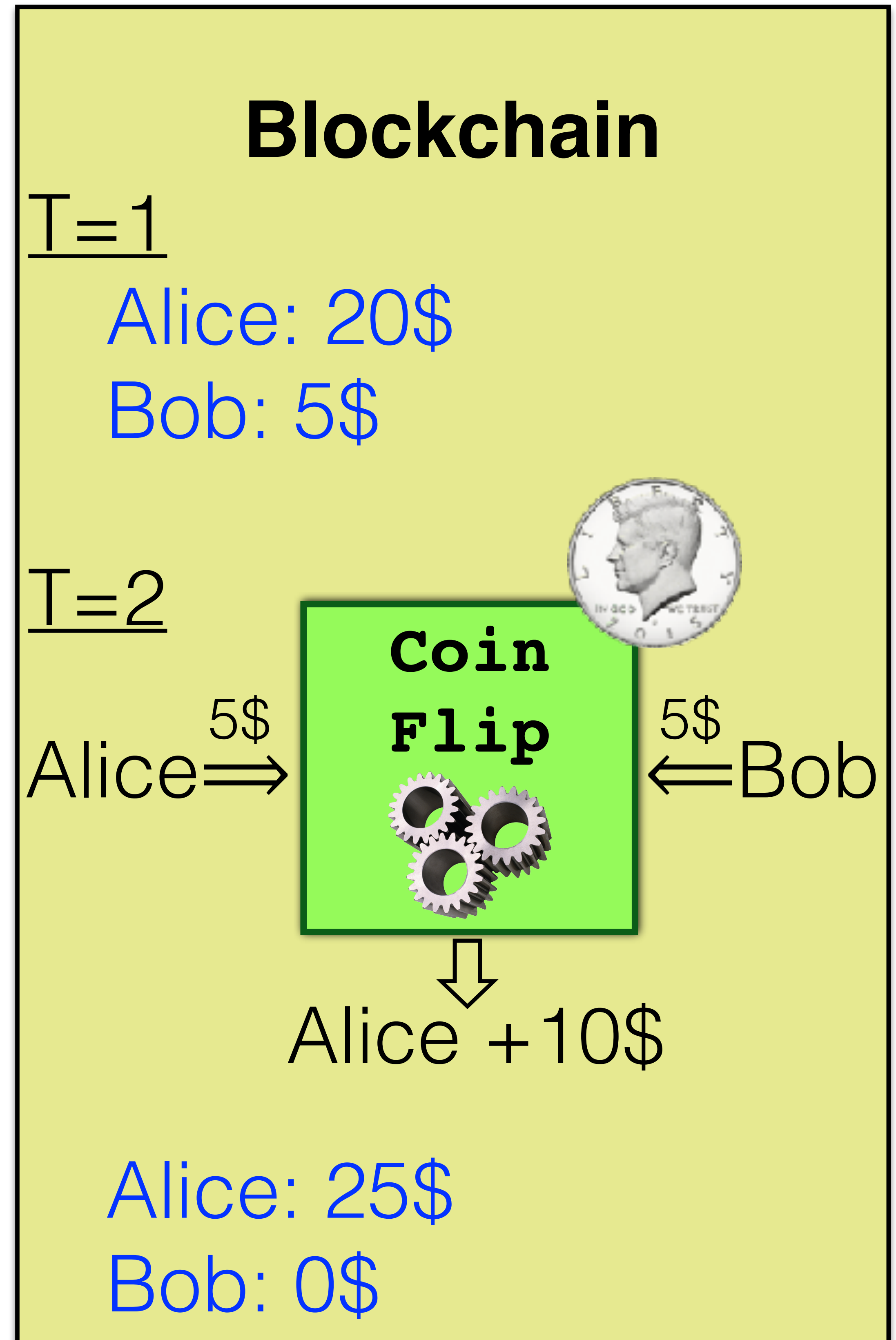
- Contract state is publicly visible



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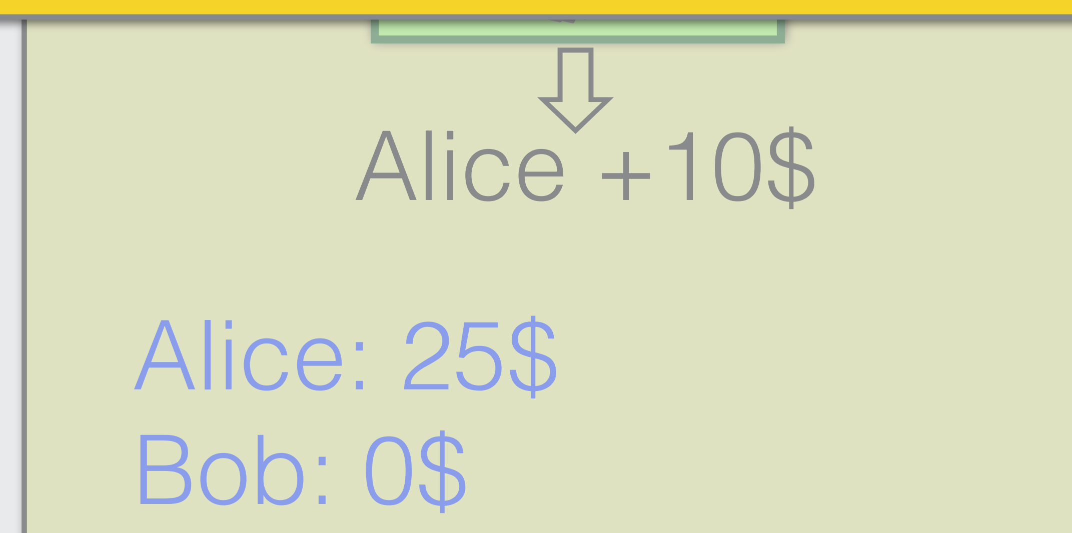
Abstraction: Smart contract simulates ***trusted third party*** *with* ***public state***.

  - Callable by user accounts
  - Callable by other contracts
- State is publicly visible



End-to-end bug-bounty system

$\mathcal{F}_{\mathrm{SGP}}[\mathcal{P}, \mathcal{V}, \quad]$

Blockchain

Bounty contract

buyer

seller

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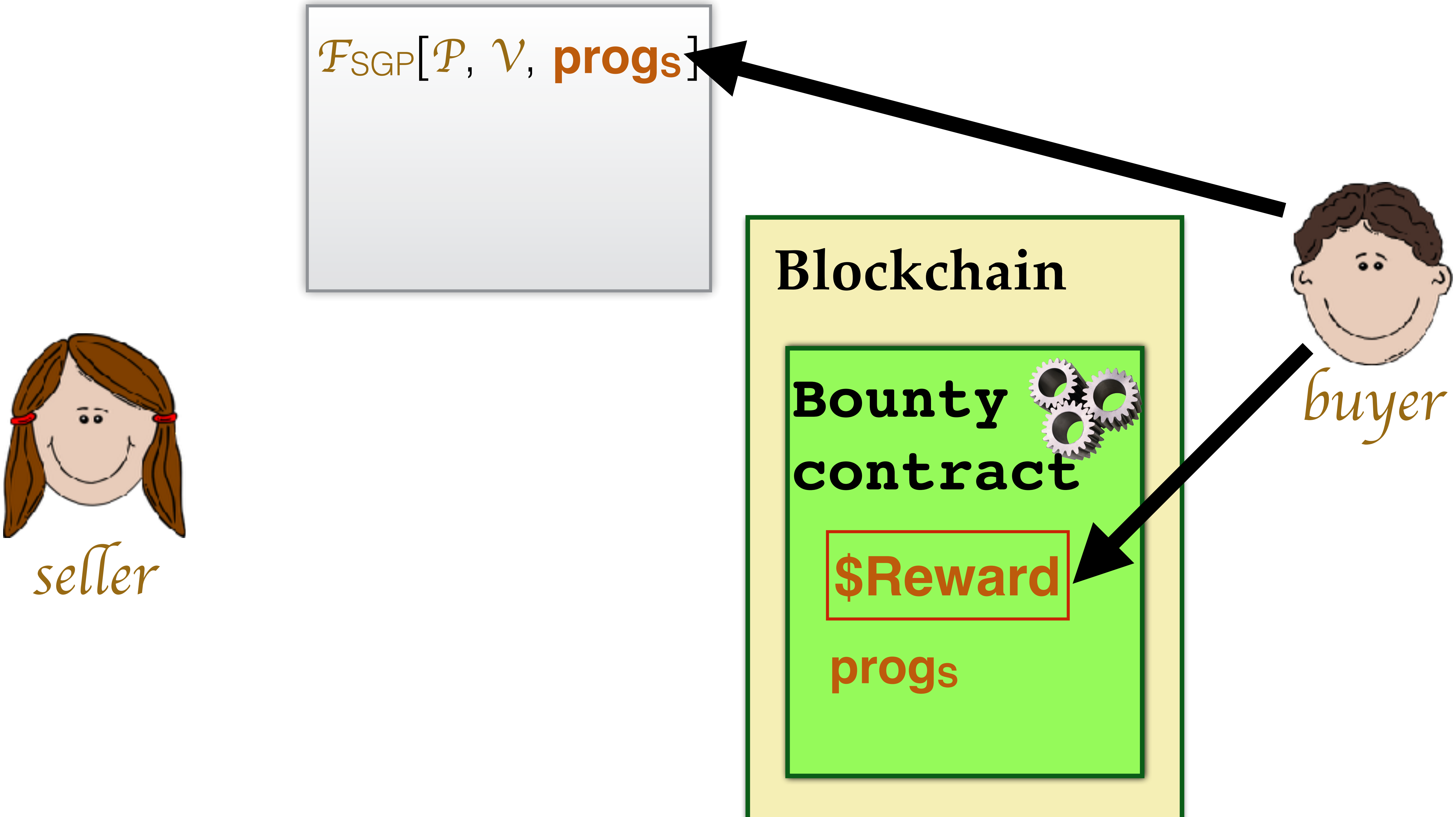

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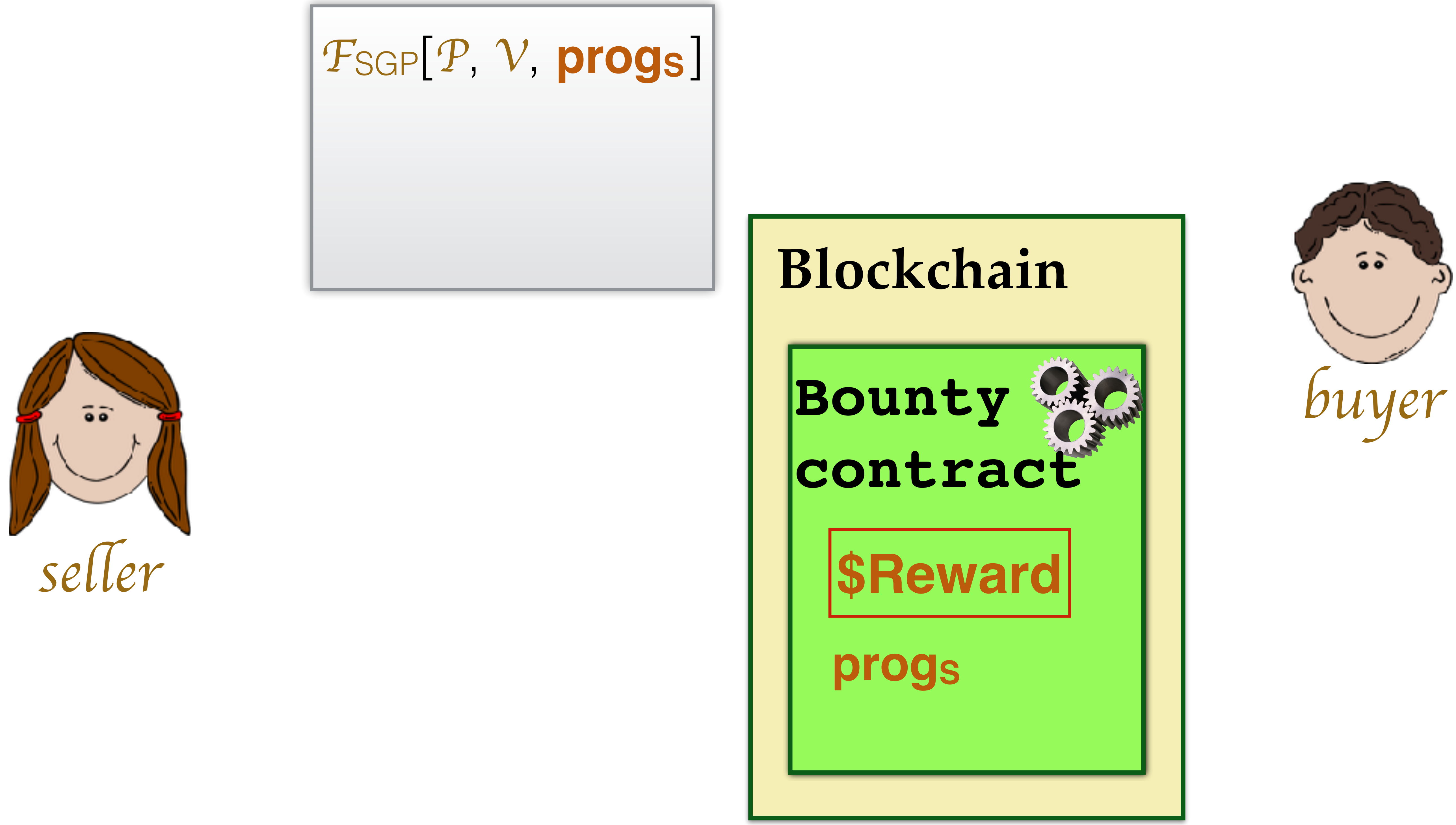

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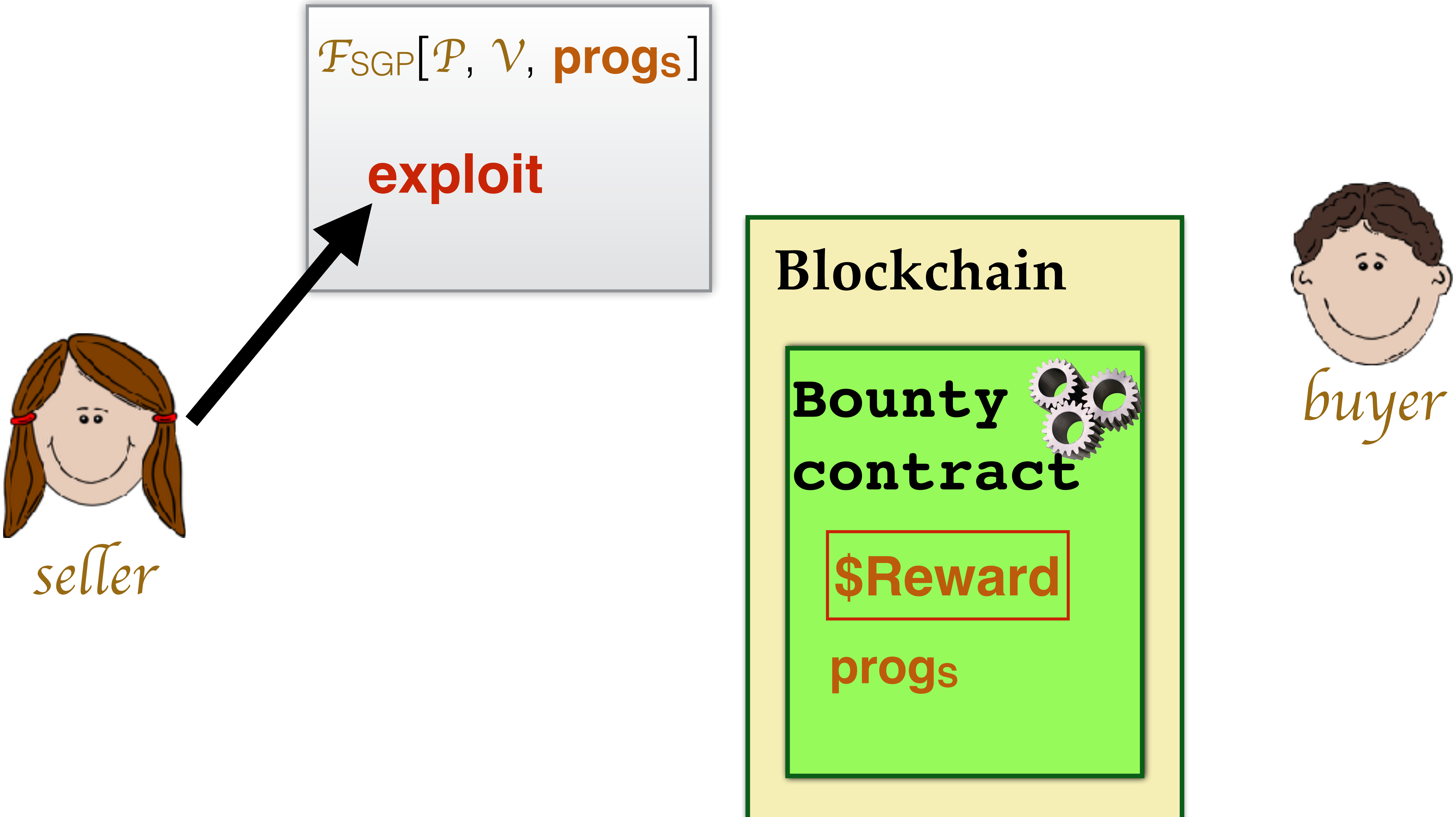

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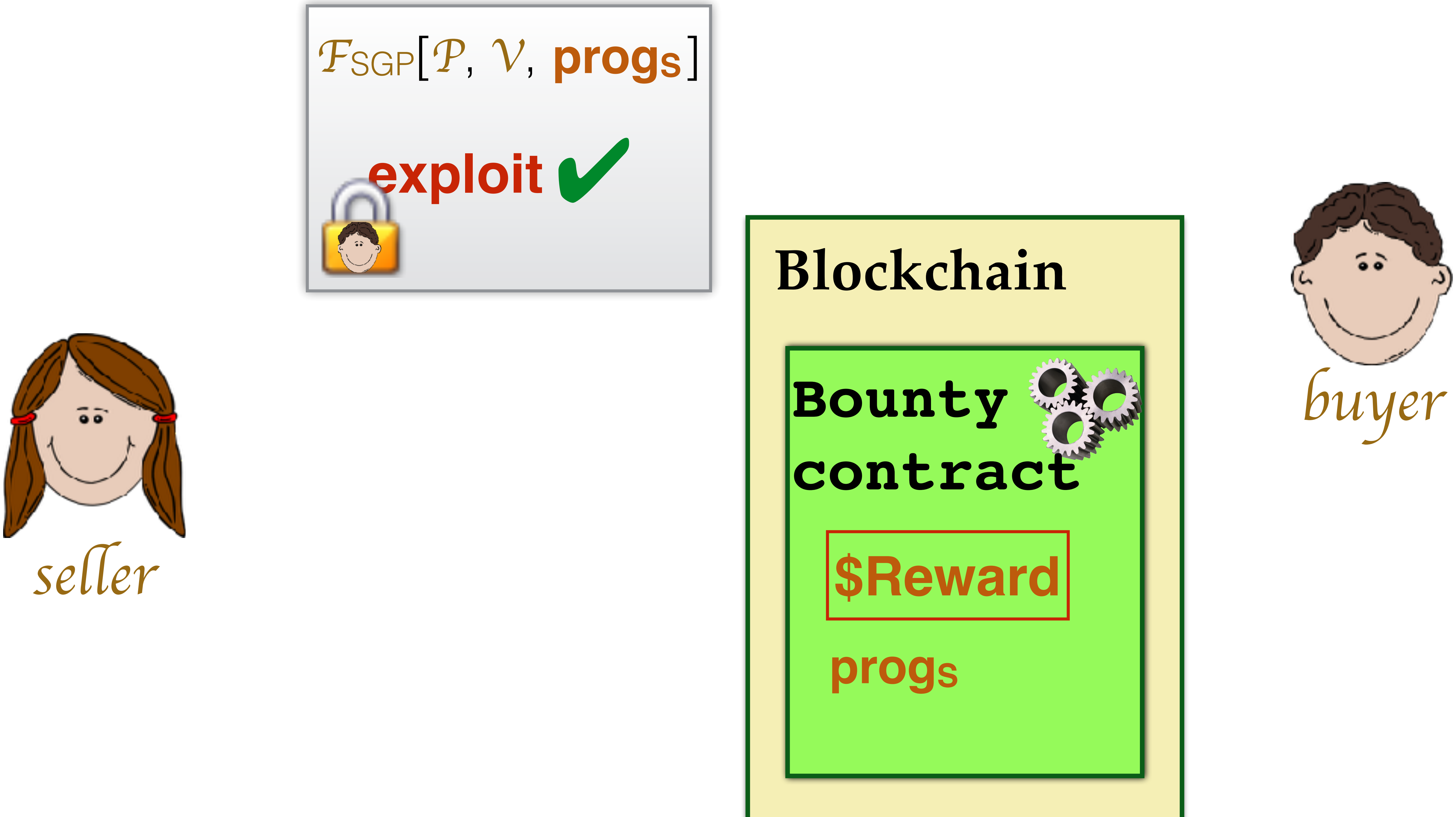

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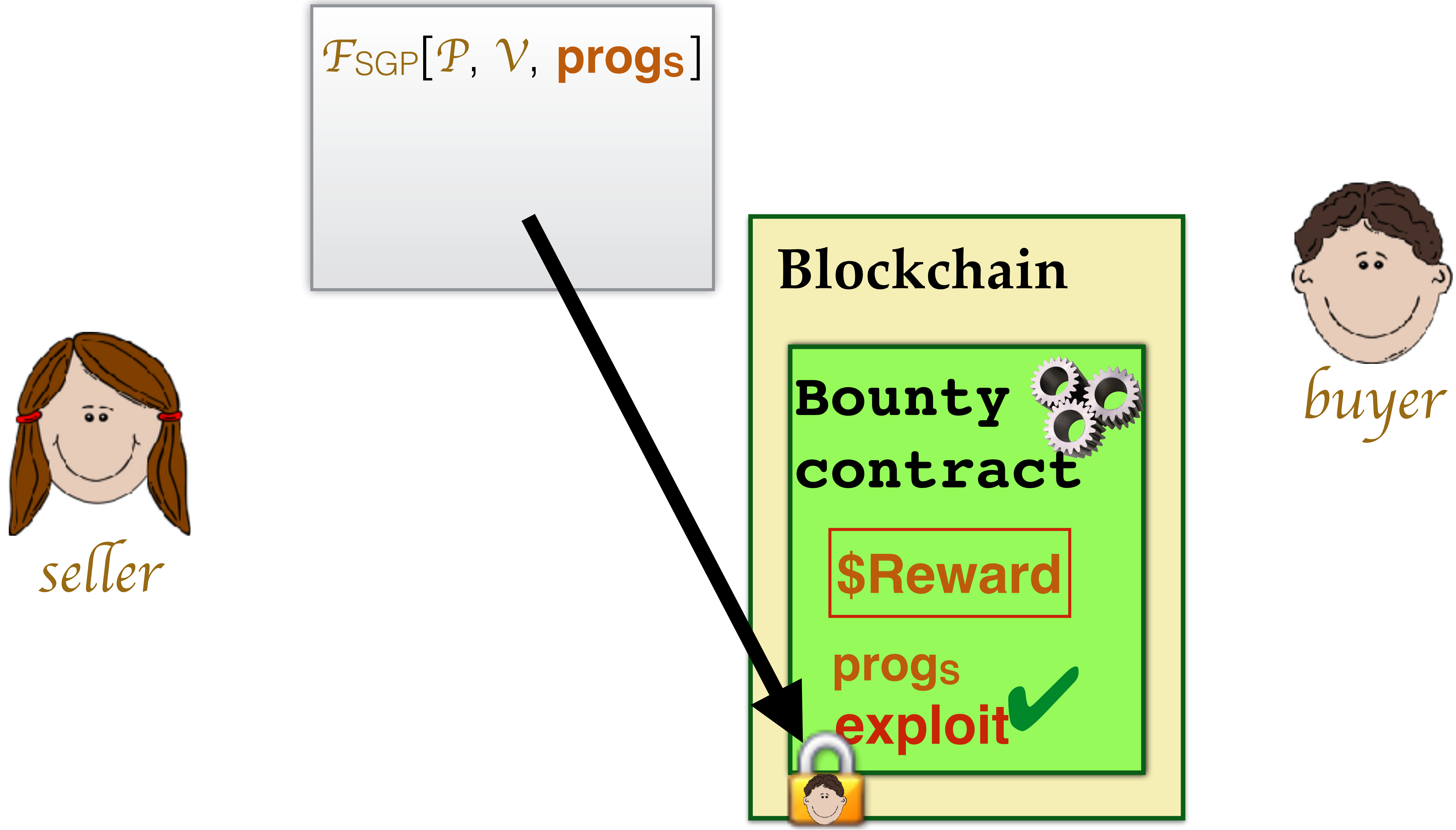

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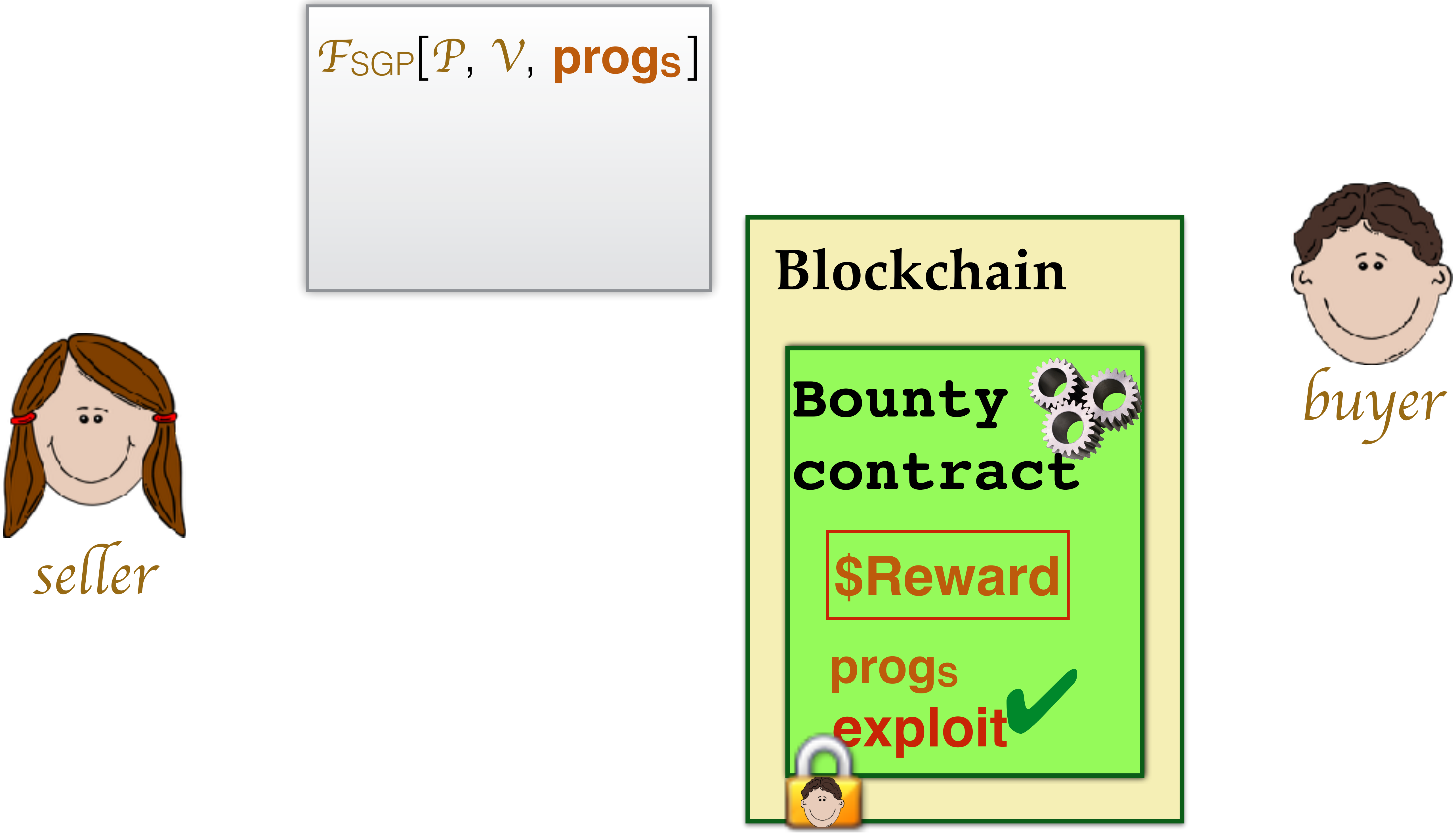

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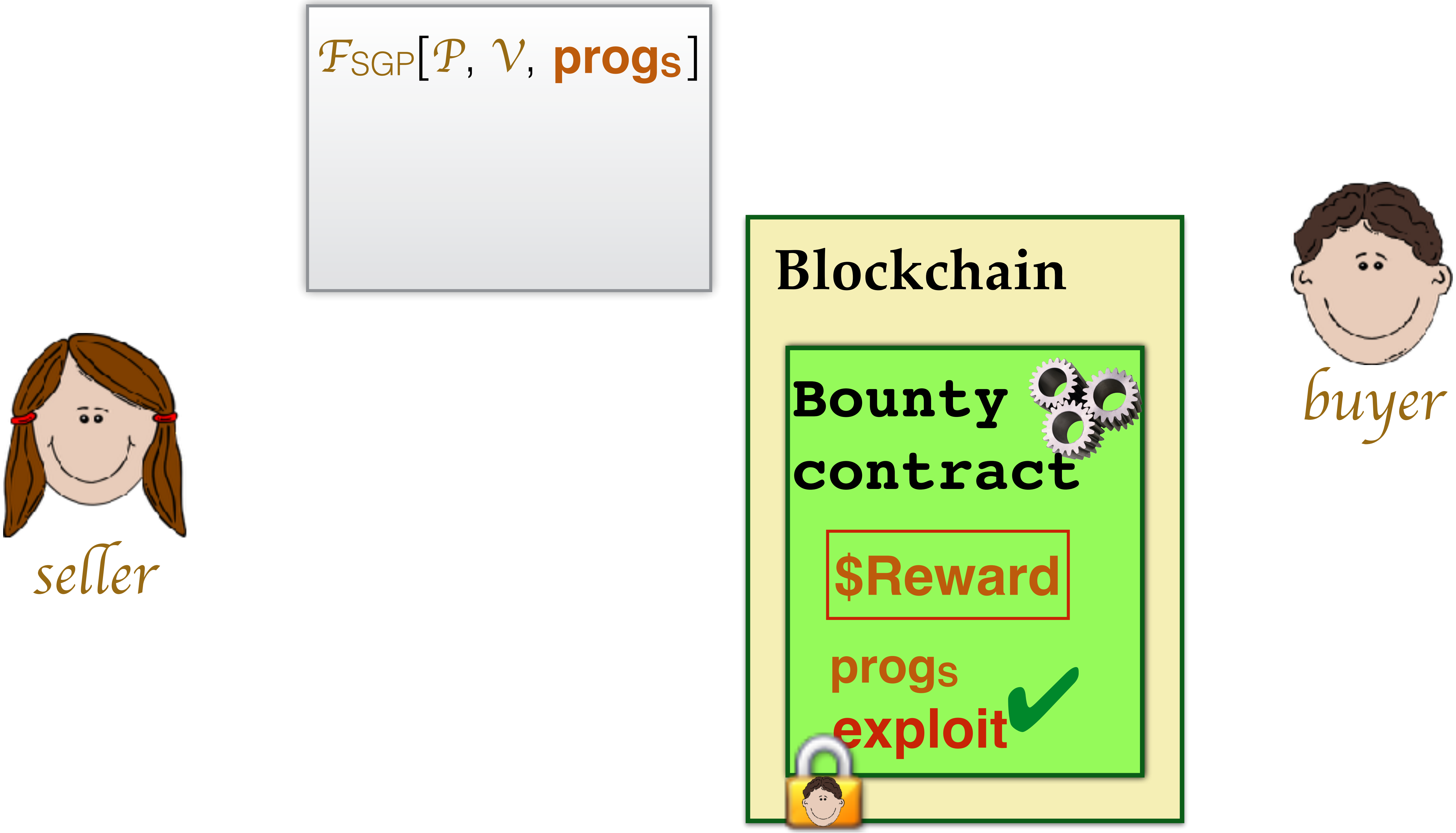

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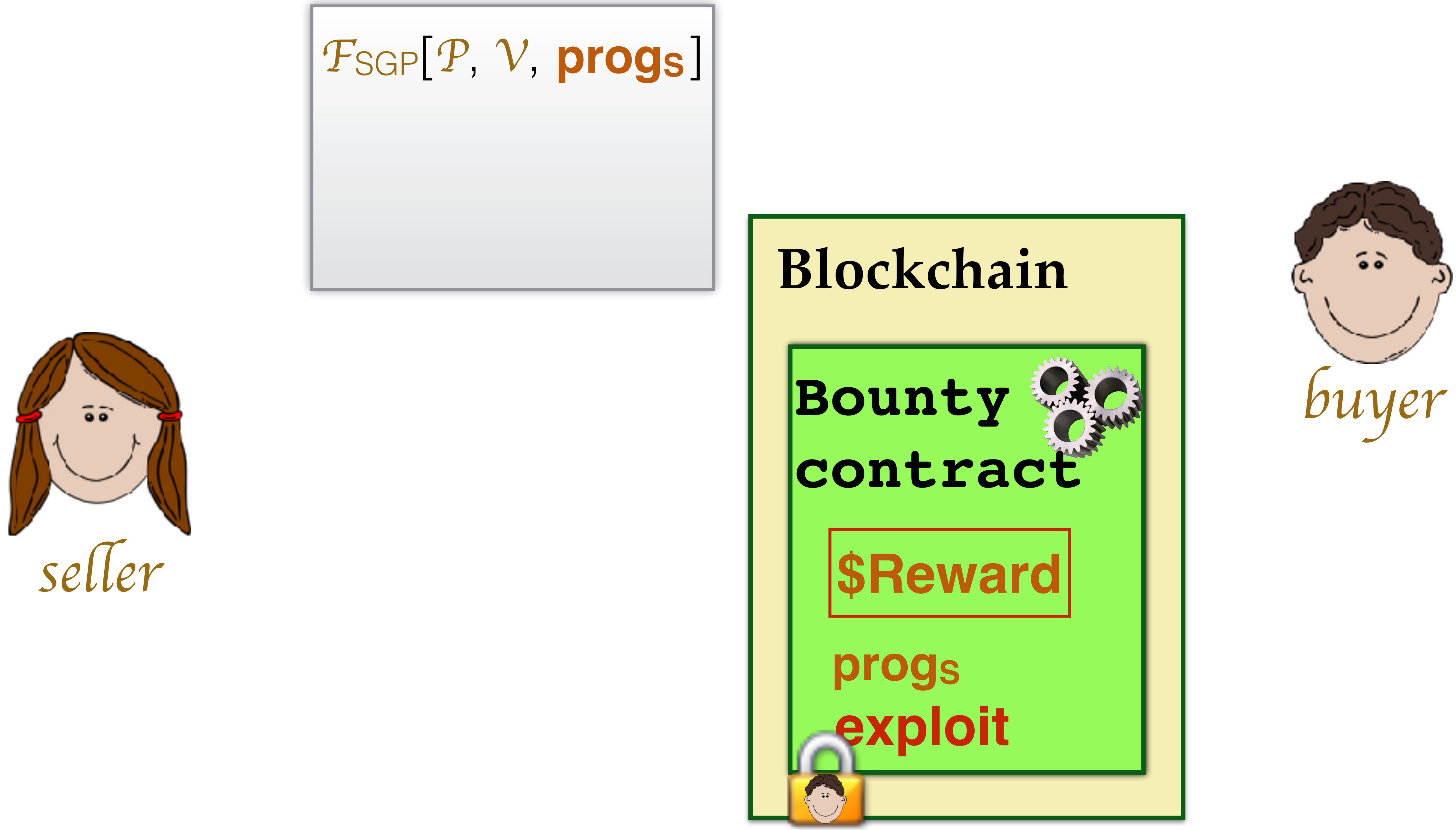

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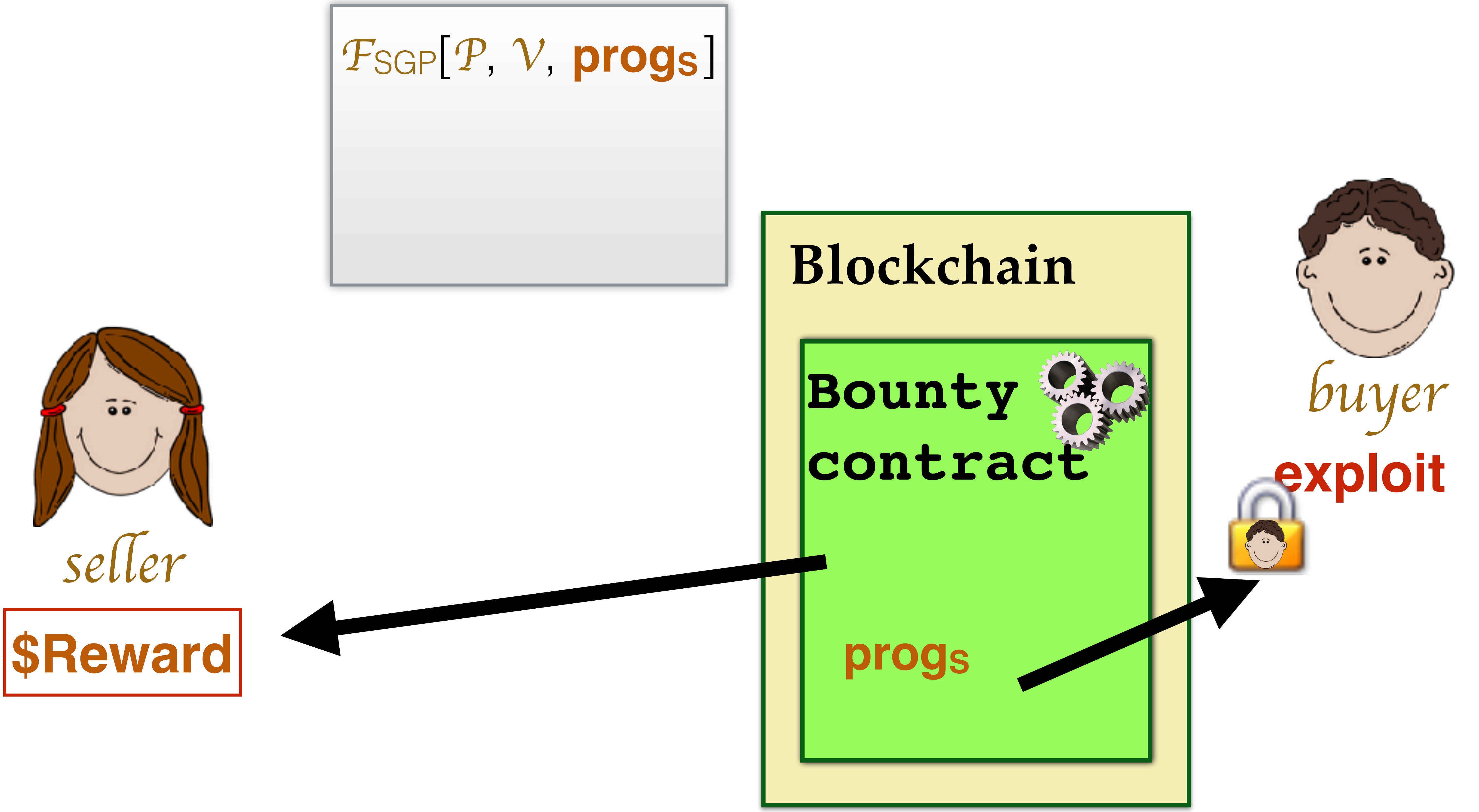

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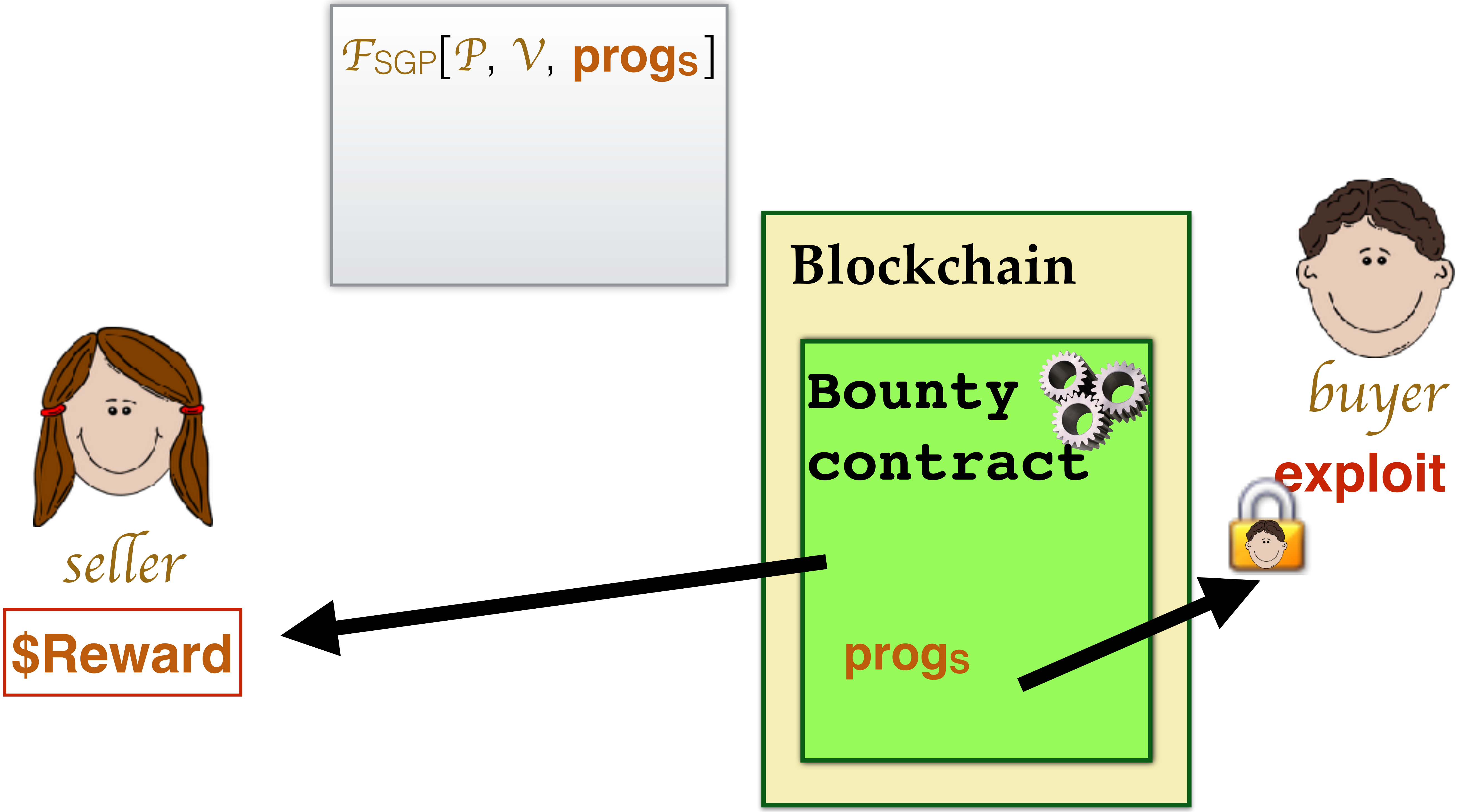

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3. **Guaranteed payment*:** *buyer* will pay at least one valid *seller* before specified deadline
   → Prevents bug-bounty competition from being unfairly terminated

**ZK-snark-based Bitcoin systems can't achieve this one*

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    - Facebook Proxygen library fronting SQLite
  - Certificate Validation Logic conflicts ("Frankencerts")
    - OpenSSL and mbedTLS
  - MITM attacks against TLS handshakes
    - Simulation environment in which exploit attacks simulated handshake between server and honest user
    - (Assuming SGX v2)

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https://eprint.iacr.org/2016/635

Formal Abstractions for Attested Execution Secure Processors

https://eprint.iacr.org/2016/1027