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# A STUDY ON ETHEREUM SECURITY: BRIDGING EDUCATIONAL GAPS THROUGH THE DEVELOPMENT OF FAILLAPOP

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Grado en Ingeniería Telemática

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# Motivation

## Security Problems

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Chainalysis

### $197 Million Stolen: Euler Finance Flash Loan Attack Explained [UPDATED 4/6/23]

Chainalysis new

| Categories | Attacks | | Bug Bounties | |
|---|---|---|---|---|
| | # Bugs | Fund loss | # Bugs | Bounties |
| Lending | 1 | $ 5,000K | 2 | $ 1,630K |
| Dexes | 7 | $ 13,950K | 3 | $ 65K |
| Yield | 6 | $ 20,300K | 1 | $ 10K |
| Services | 3 | $ 5,600K | 2 | $ 610K |
| Derivatives | - | - | 2 | $ 200K |
| Yield Aggregator | 1 | $ 2,100K | 2 | $ 300K |
| Real World Assets | 2 | $ 1,127K | 1 | $ 50K |
| Stablecoins | 5 | $211,360K | - | - |
| Indexes | - | - | 1 | $ 90K |
| NFT Marketplace | 1 | $ 20K | - | - |
| NFT Lending | 2 | $ 5,800K | - | - |
| Cross Chain | - | - | 1 | $10,000K |
| Others | - | - | 1 | $ 1,050K |
| Total | 28 | $265,257K | 16 | $14,005K |

Demystifying Exploitable Bugs in Smart Contracts

# Motivation

## Capture the Flag Deficits

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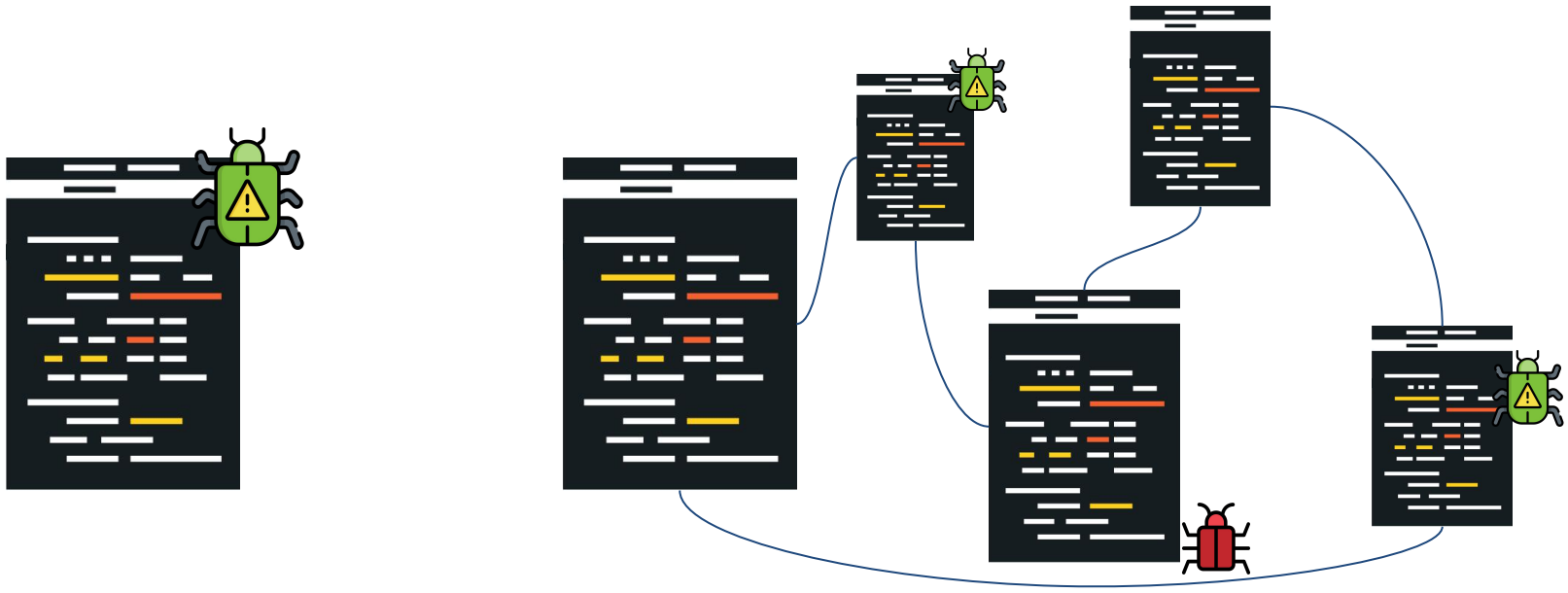

# Methodology

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1. Literature Review and State-of-the-Art Analysis
2. Initial Project Audit and CTF Participation
3. Research on Common Vulnerabilities in Real Applications
4. Design and Implementation of New Features
5. Faillapop's Adherence to Best Practices

# Ethereum

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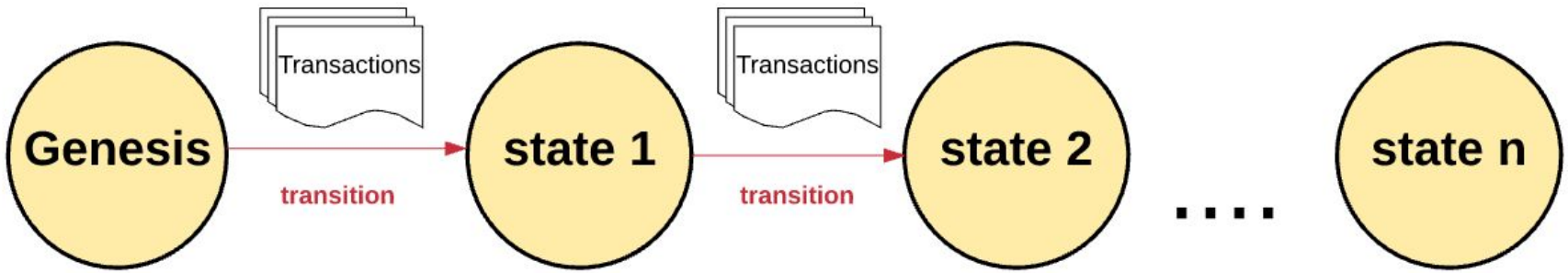
- What is Ethereum?
  - Distributed deterministic state machine
  - Single state - globally accessible
  - Virtual Machine

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# Ethereum

## Smart Contracts

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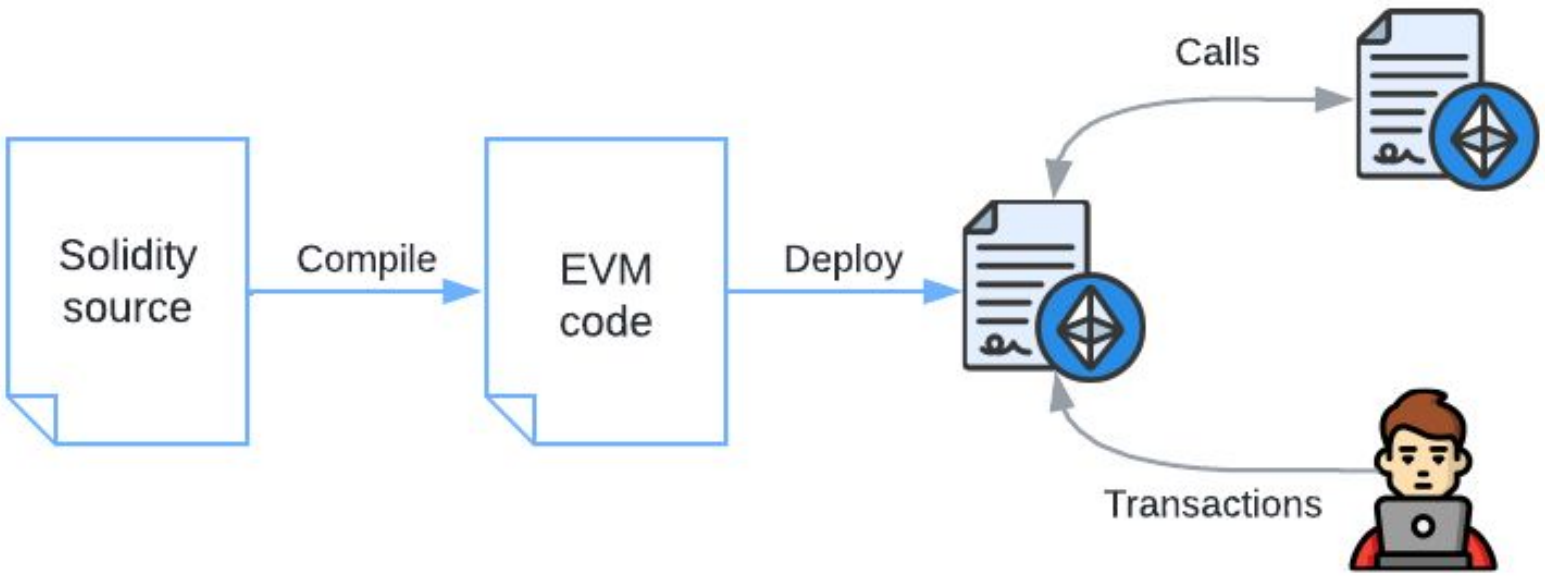
```
pragma solidity ^0.8.0;

contract ContratoSimple {

    uint256 public numeroParticipantes;

    function add() public {
        numeroParticipantes++;
    }

    function set(uint256 _incremento) public{
          numeroParticipantes += _incremento;
    }

    function get() public view returns (uint256) {
        return numeroParticipantes;
    }
}
```

# Ethereum

## Smart Contracts

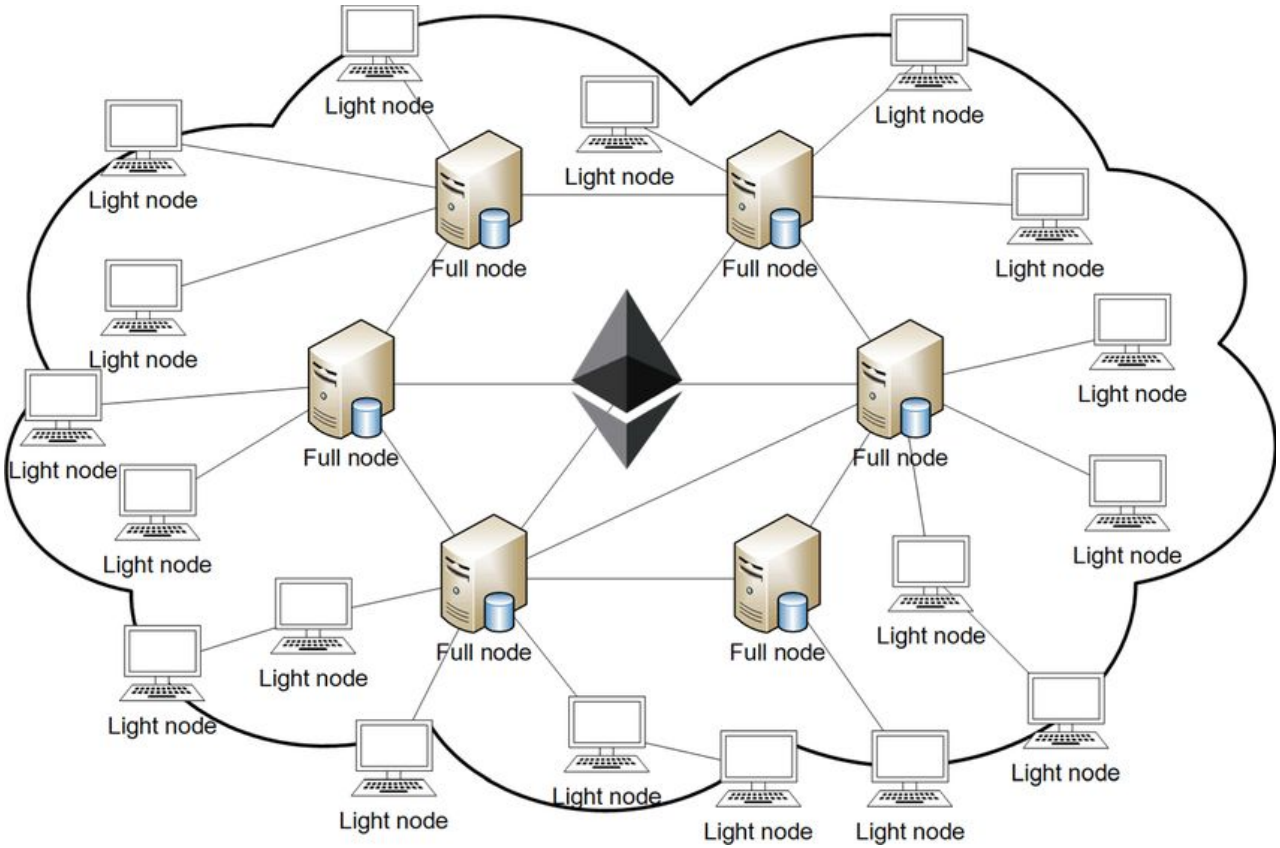




# Ethereum

## Consensus Rules



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# Ethereum Security

## Properties



- Immutability
- Determinism
- Transparency
- Flash Loans
- MEV

# Ethereum Security

## Reentrancy

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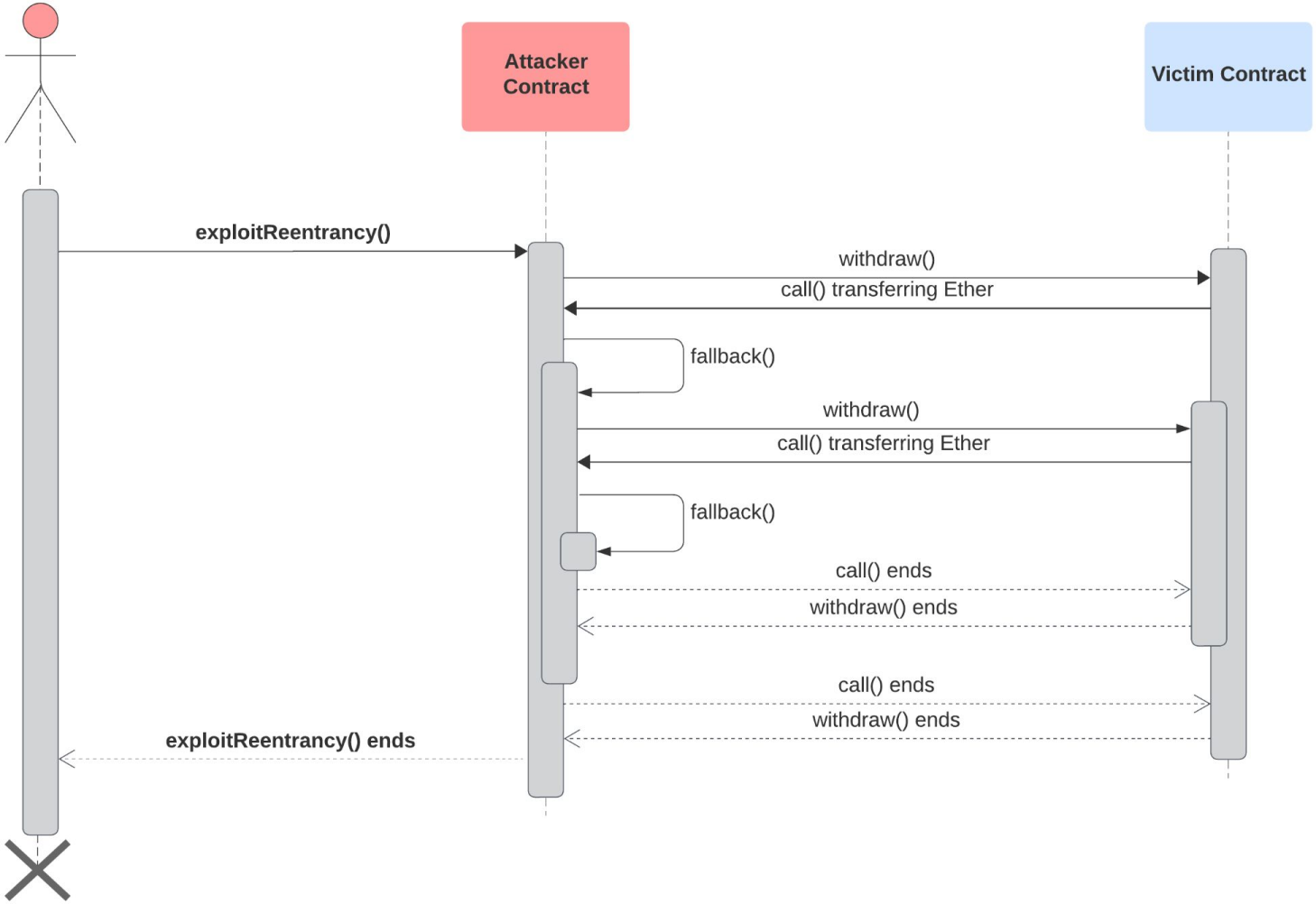

# Faillapop

## Initial Stage

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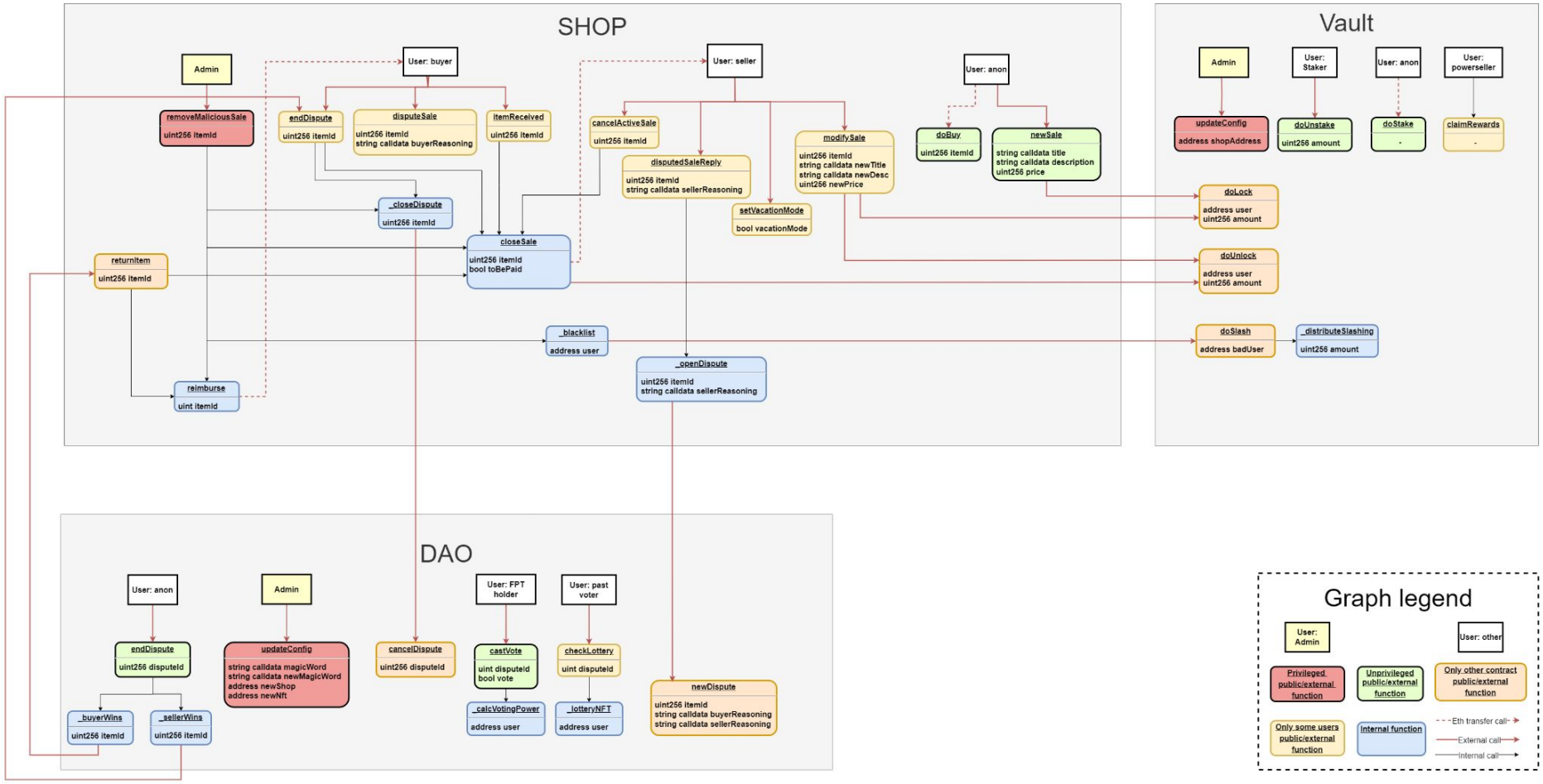

# Faillapop

## Initial Security Evaluation

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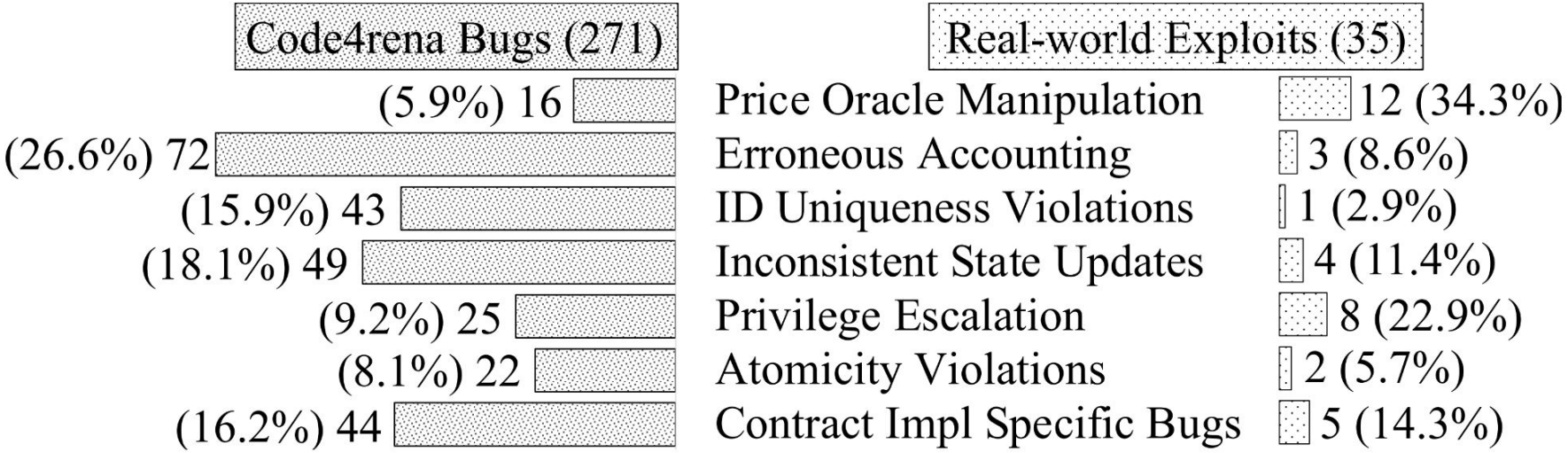
1. Initial Project Audit 
2. Engagement in CTF Exercises 
3. Examination of Common Vulnerabilities in Real Applications




Demystifying Exploitable Bugs in Smart Contracts

# Faillapop

## Initial Project Audit

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1. Code Structure Analysis
2. Threat Modeling
3. Initial Code Reading
4. Detailed Vulnerability Identification
5. Execution Flow Analysis
6. Proof of Concept

# Faillapop

## Engagement in CTF Exercises

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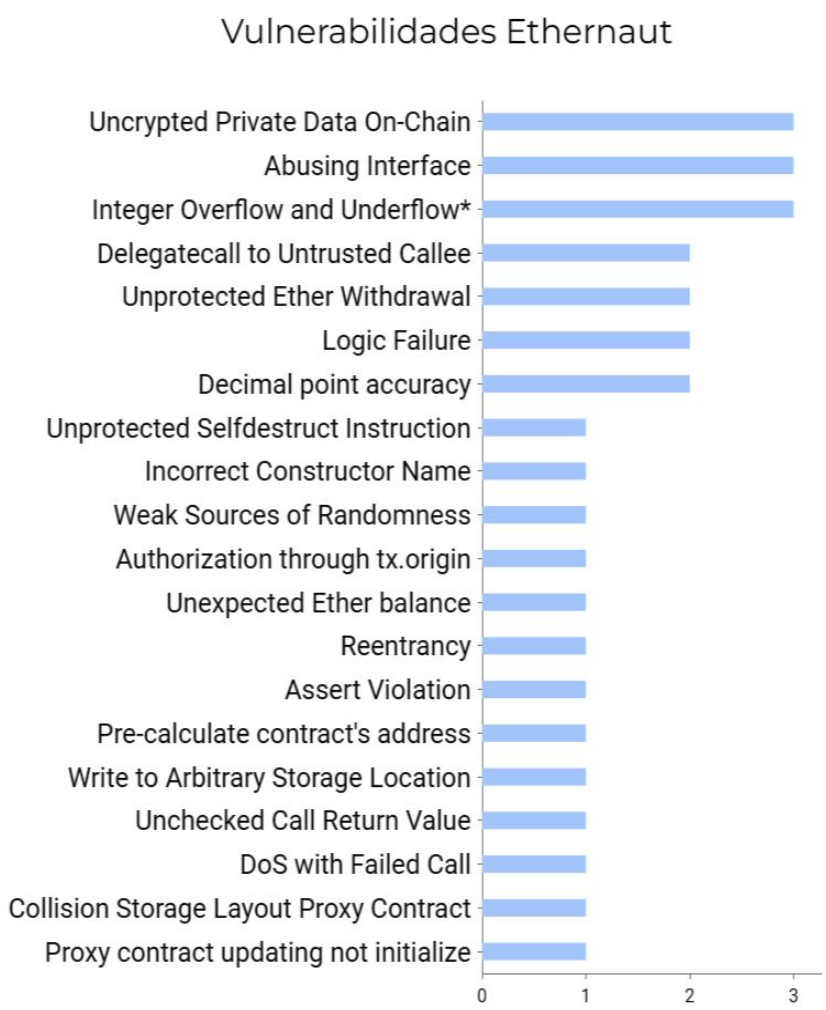


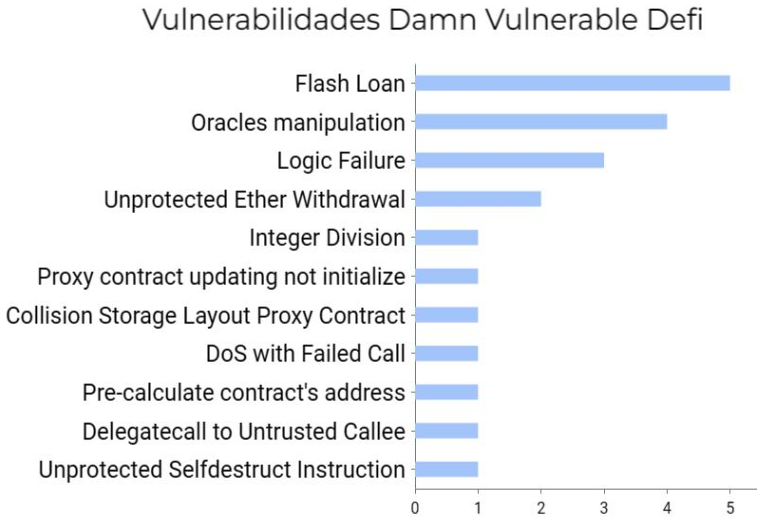


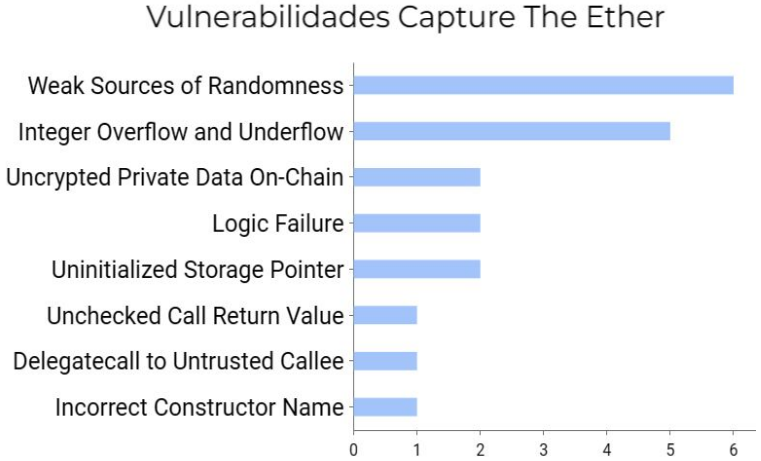

# Faillapop

## Examination of Common Vulnerabilities in Real Applications

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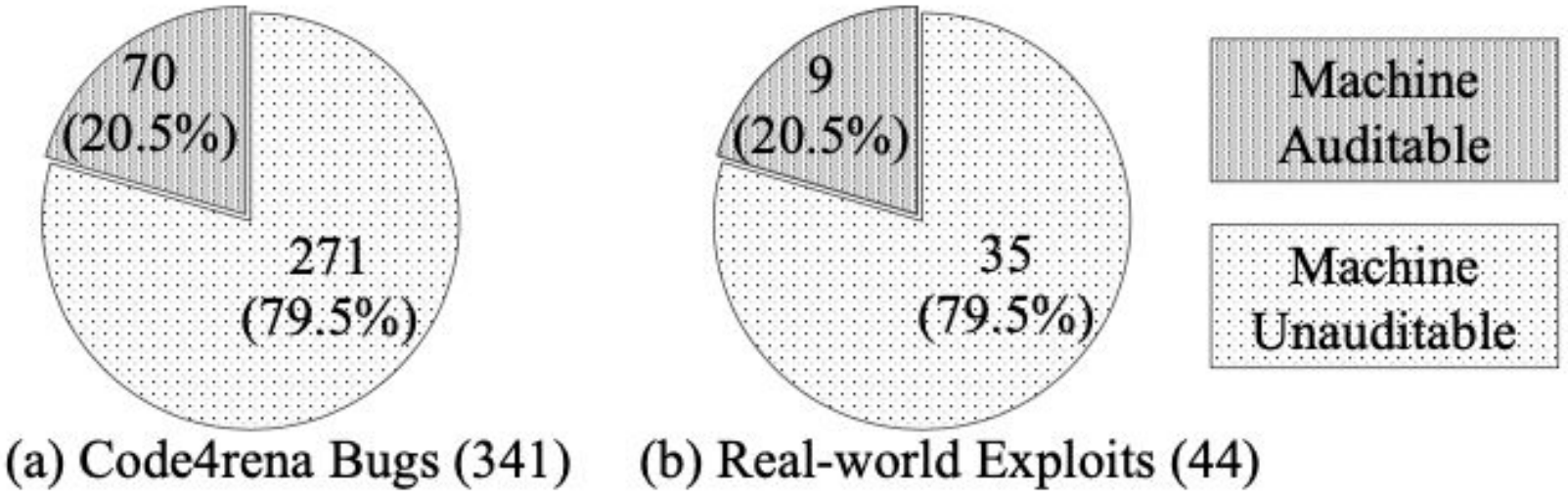
- 385 vulnerabilities
- 167 Smart Contracts




(a) Code4rena Bugs (341) (b) Real-world Exploits (44)

Demystifying Exploitable Bugs in Smart Contracts

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## Current Stage

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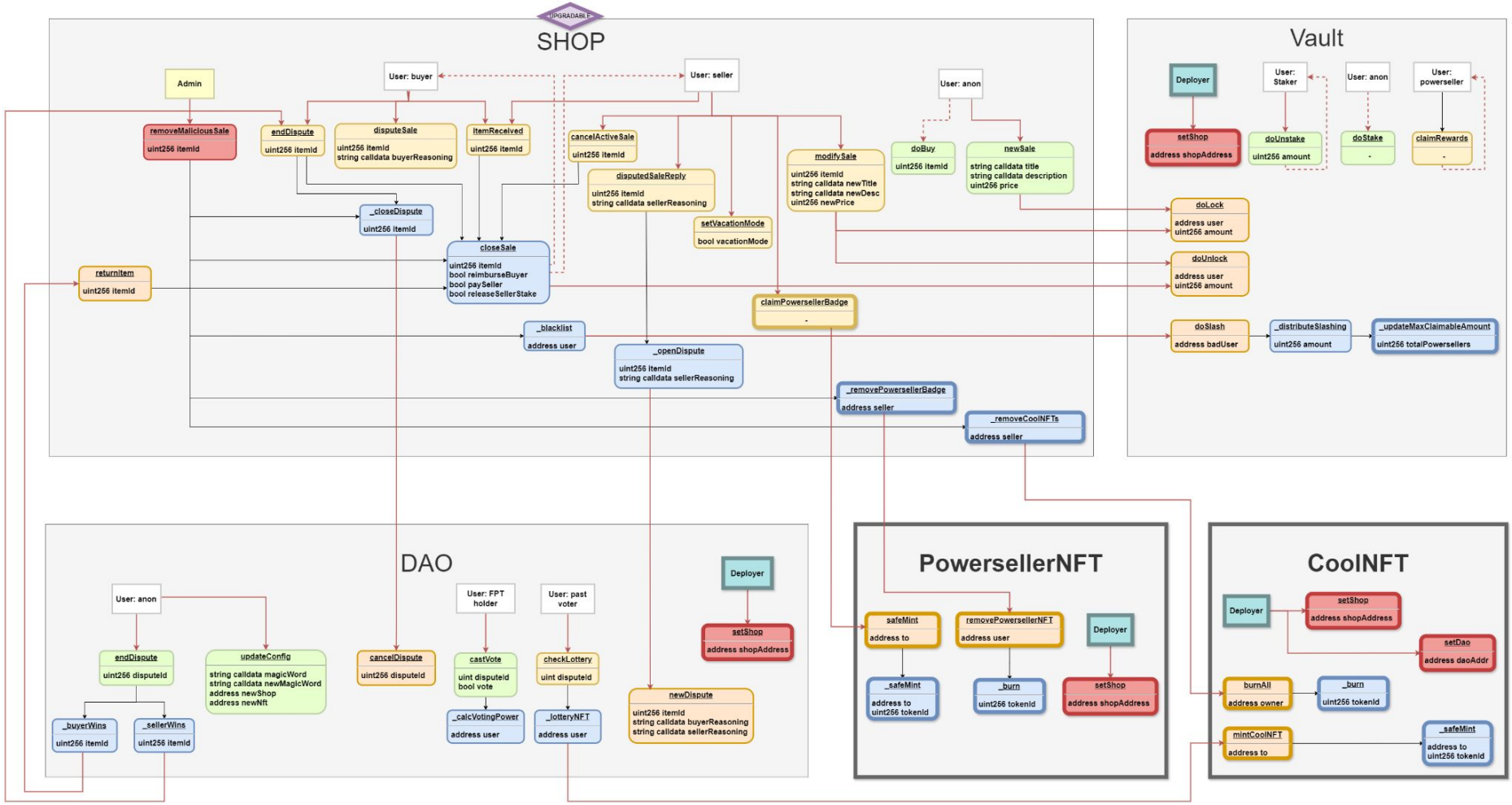
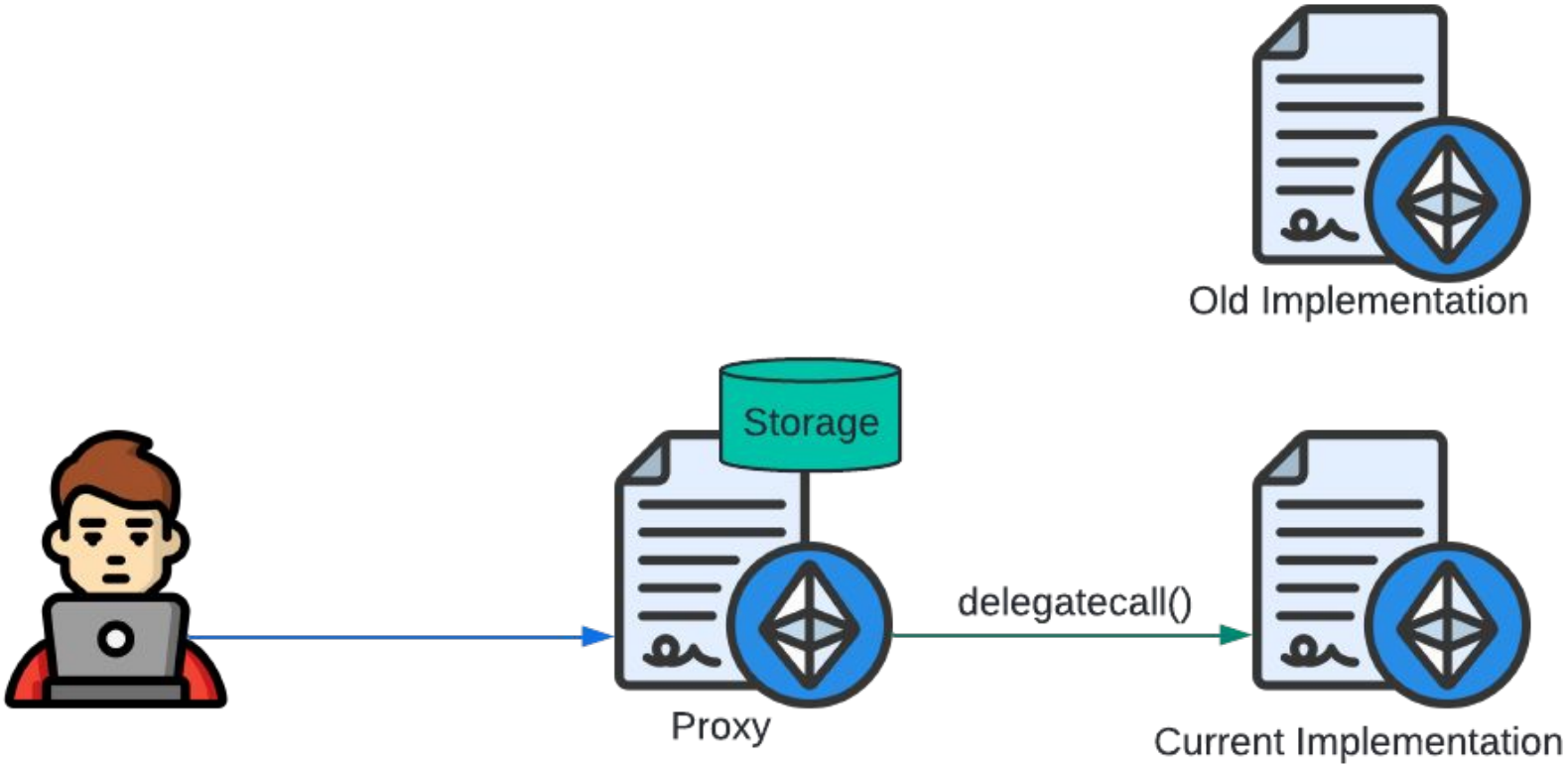


# Faillapop

## Proxy for Upgradeable Shop Contract





# Faillapop

## Features

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- Commit-Reveal Scheme for Dispute Voting
- Comprehensive Documentation
- Deployment Script Implementation
- Optimization Using Inline Assembly
- Comprehensive Unit and Integration Testing

# Faillapop

## Conclusions and Future Work

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- Conclusions
  - Comprehensive and realistic educational resources
  - Faillapop
    - ➢ Simulates complex applications
    - ➢ Develop practical skills
    - ➢ Benefits institutions and companies
- Future Work
  - Continuous updating
  - Promotion and workshops


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