Law, Science and Technology
MSCA ITN EJD n. 814177

RI E
Rights of Internet of Everything

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Argumentation in Trust Services
within a Blockchain Environment

Overview

Introduction

The Problem

General Problem → *Trust in decision-making process*

The Problem

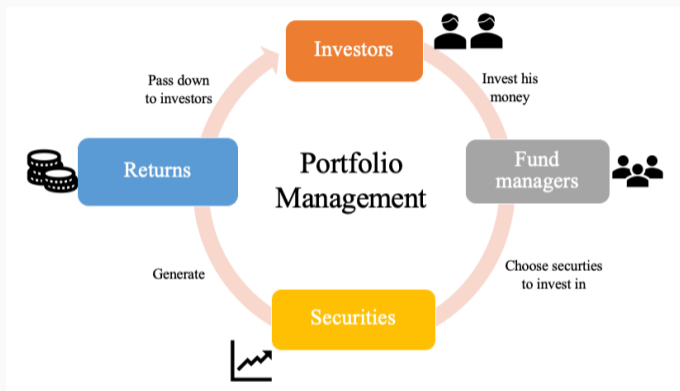General Problem → *Trust in decision-making process*

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The Problem

General Problem → *Trust in decision-making process*

- **Trust service** ← persons or organization *acting on behalf of* another person to deal with the tasks involving finances.
- **Fund management** ← fund managers *manage on behalf of* their investors a portfolio of securities (stock, bonds, etc.) and perform risk management.

Specific: Trust problem that emerges in the fund management

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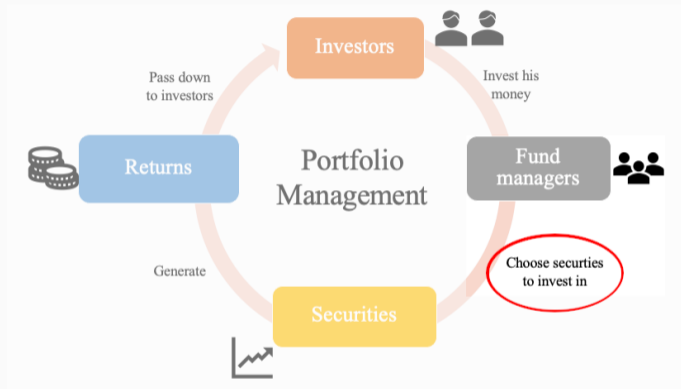
- **reservation** and **lack of documentation** of the decision-making process of investments
- legislators declare <u>investors</u> **right to check the relevant activities** in order to give

Our aim

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- Multi-Agent Negotiation
- Blockchain and Smart Contracts

Motivation: Argumentation + Negotiation + Blockchain

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- *Multi-agent negotiation* is used to **determine the quantities and investment timing**
- *Blockchain* used **not only** to trace the output of a decision-making process
  → **trace argumentation and negotiation and make it auditable**

Conflict Resolution

Portfolio Management Conflict Resolution

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  - **directed graphs**
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- **Agent Argumentation Framework(AAF)** $\leftarrow$ argument belongs to one or more agents
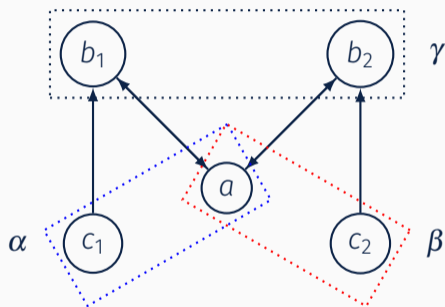
Portfolio Management Example

Figure 1: Agent Argumentation Framework

- $\{\alpha, \beta, \gamma\}$ = fund managers' agents

- *a*: ***Buy*** *the stocks, since the company just donated to charities*

- b_1: ***Sell*** *the stocks, since there is evidence of charity fraud*

- b_2: ***Sell*** *the stocks, since the company has poor sales performance.*

- c_1: *The official has clarified the **accusations collapsed***

- c_2: *The company is going to adopt a **new technology** which will bring huge benefit.*

Preference-based Argumentation Framework (PAF)

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- AAF to PAF reduction is used as an intermediary step for social agent semantics, given an $AAF = \langle \mathscr{A}, \rightarrow, \mathscr{S}, \sqsubset \rangle$, **SAP(AAF)** $= \langle \mathscr{A}, \rightarrow, \succ \rangle$ with $\succ = \{a \succ b || \mathscr{S}_a| > |\mathscr{S}_b|\}$

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- **Social Reductions of AAF to AF (SR)**
  $SR_i(AAF) = PR_i(SAP(AAF))$, PR_i is one of the four reductions of PAF to AF:
  - $PR_1(PAF) = \langle \mathscr{A}, \rightarrow' \rangle$, where $\rightarrow' = \{a \rightarrow' b | a \rightarrow b, b \not\succ a\}$.
  - $PR_2(PAF) = \langle \mathscr{A}, \rightarrow' \rangle$, where $\rightarrow' = \{(a \rightarrow' b | a \rightarrow b, b \not\succ a \text{ or } b \rightarrow a, \text{ not } a \rightarrow b, a \succ b\}$.
  - $PR_3(PAF) = \langle \mathscr{A}, \rightarrow' \rangle$, where $\rightarrow' = \{(a \rightarrow' b | (a \rightarrow b, b \not\succ a \text{ or } a \rightarrow b, \text{ not } b \rightarrow a\}$.
  - $PR_4(PAF) = \langle \mathscr{A}, \rightarrow' \rangle$, where
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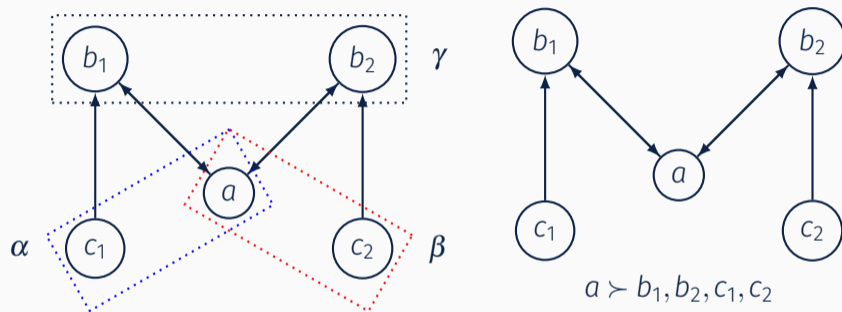
Portfolio Management Example Social Reduction

Figure 2: Social reduction

Then we can calculate the only acceptable set $\{a, c_1, c_2\}$.
The set tells the final decision is to buy the stocks.

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    3. determine what to do next, i.e. *negotiation strategy*

Portfolio Management Example Negotiation
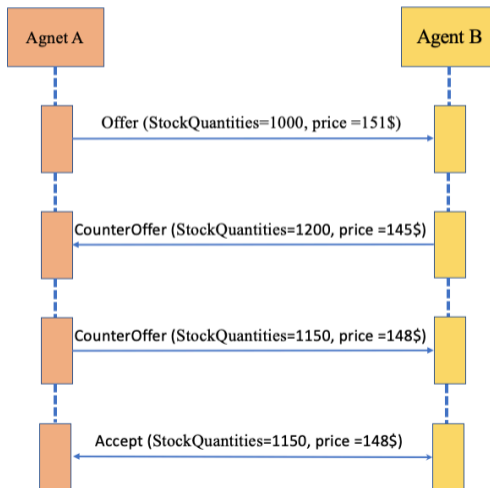
Blockchain

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- **Distributed Ledger Technologies** → potential to revolutionize *financial agreements.*
- fund managers can trade securities on behalf of the investors.

Blockchain Architectures

We consider three kinds of architectures that use the blockchain in conjunction with the conflict resolution multi-agent system
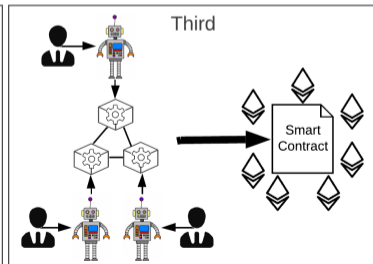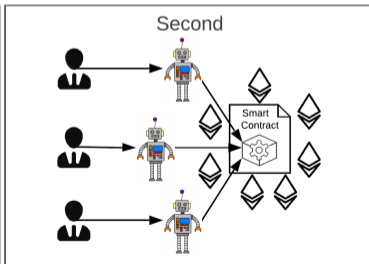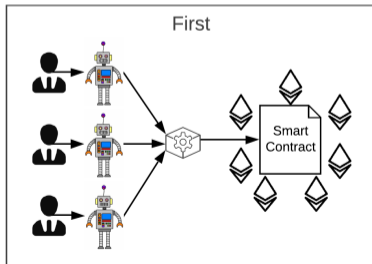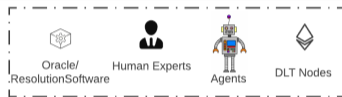
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Oracle/ResolutionSoftware   Human Experts   Agents   DLT Nodes
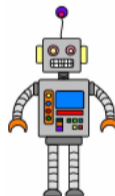
First Architecture: Oracle
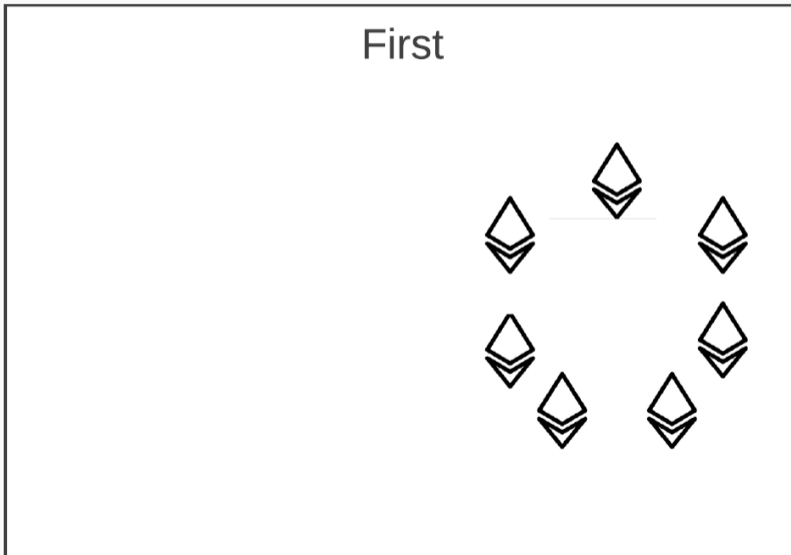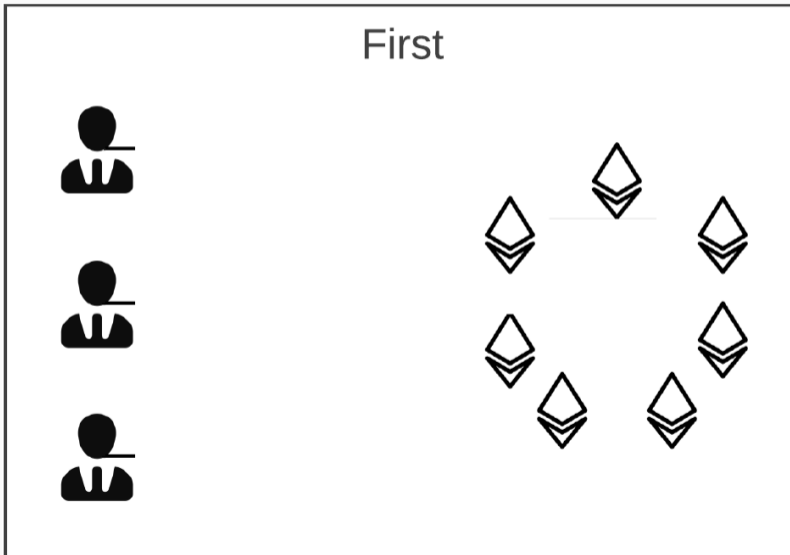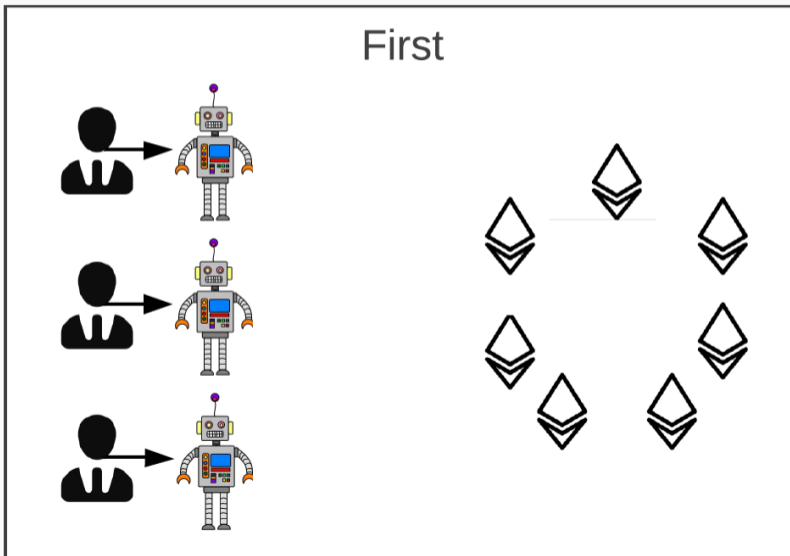
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Introduction   Conflict Resolution   **Blockchain**   IHiBO   Conclusion   Trust   Architectures   **Oracles**   Smart Contracts   Decentralized   Comparison

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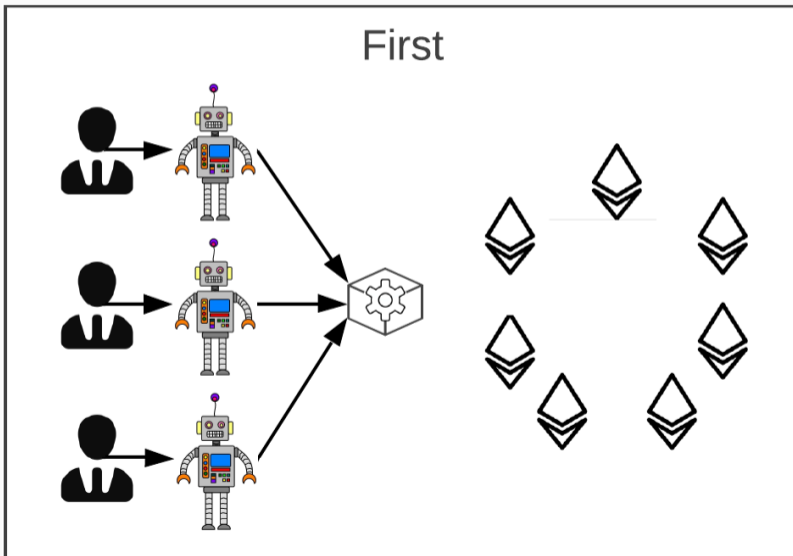
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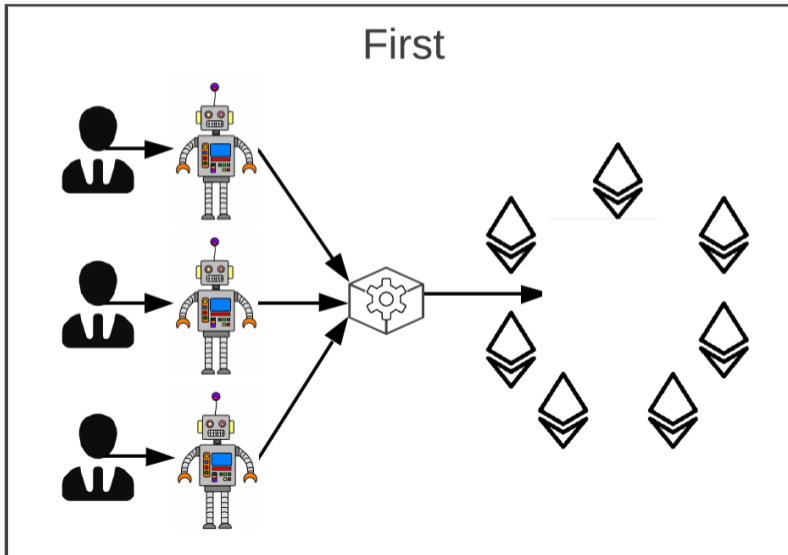
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    3. *human*: individuals manually insert data to DLT, e.g. dispute resolution judge.

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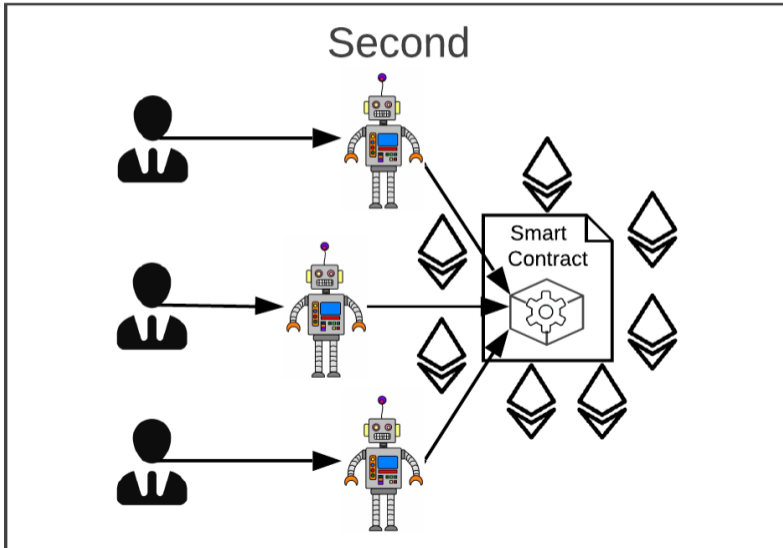
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- store data in the (immutable) ledger

Third Architecture: Decentralized Oracle
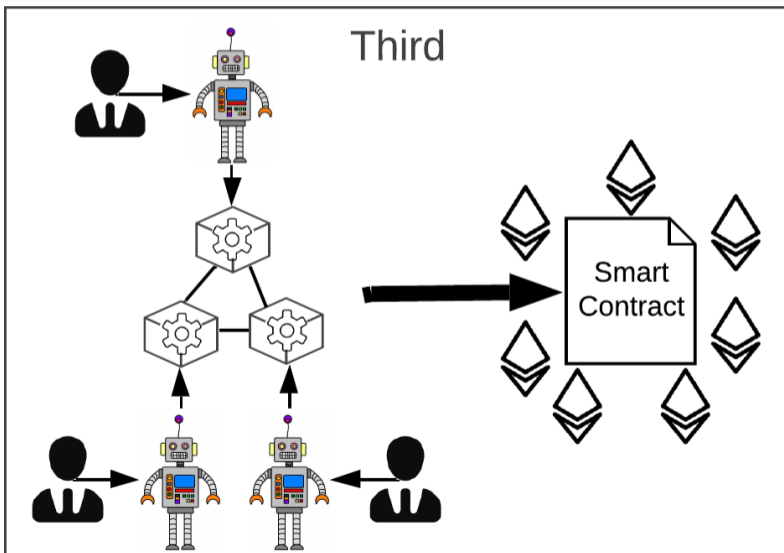
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Third Architecture: Decentralized Oracle

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- **"layer two"** solution
- An instance of such layer two solution → **a second, a "side" blockchain** with different features in respect to the "main" one

Architectures Comparison

Architecture 1
Centralized
Architecture 2
Smart Contract
Architecture 3
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Architectures Comparison

	Argumentation Graph Off-chain
Architecture 1 **Centralized**	✓
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Architectures Comparison

	Argumentation Graph Off-chain	Negotiation Execution Tracing
Architecture 1 **Centralized**	✓	×
Architecture 2 **Smart Contract**	×	✓✓
Architecture 3 **Decentralized**	✓	✓

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	Argumentation Graph Off-chain	Negotiation Execution Tracing	No Single Point of Failure
Architecture 1 **Centralized**	✓	×	×
Architecture 2 **Smart Contract**	×	✓✓	✓
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IHiBO

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    - however → automated disclosure may lead to a too fast information release → limit
      investment speculation
- **IHiBO** ← Third Architecture ← Members of the management body (appointed in
  accordance with national law to oversee management decision-making) shall have
  adequate access to information and documents which are needed to oversee and
  monitor management decision-making (DIRECTIVE 2014/65/EU)

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    - Explainable AI, how we can make the decision-making process explainable for different types of users (experts, non-experts, etc.) and for different purposes (e.g. transparency, debugging, etc.).