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Automated Policy Negotiation: a Four-Course Meal

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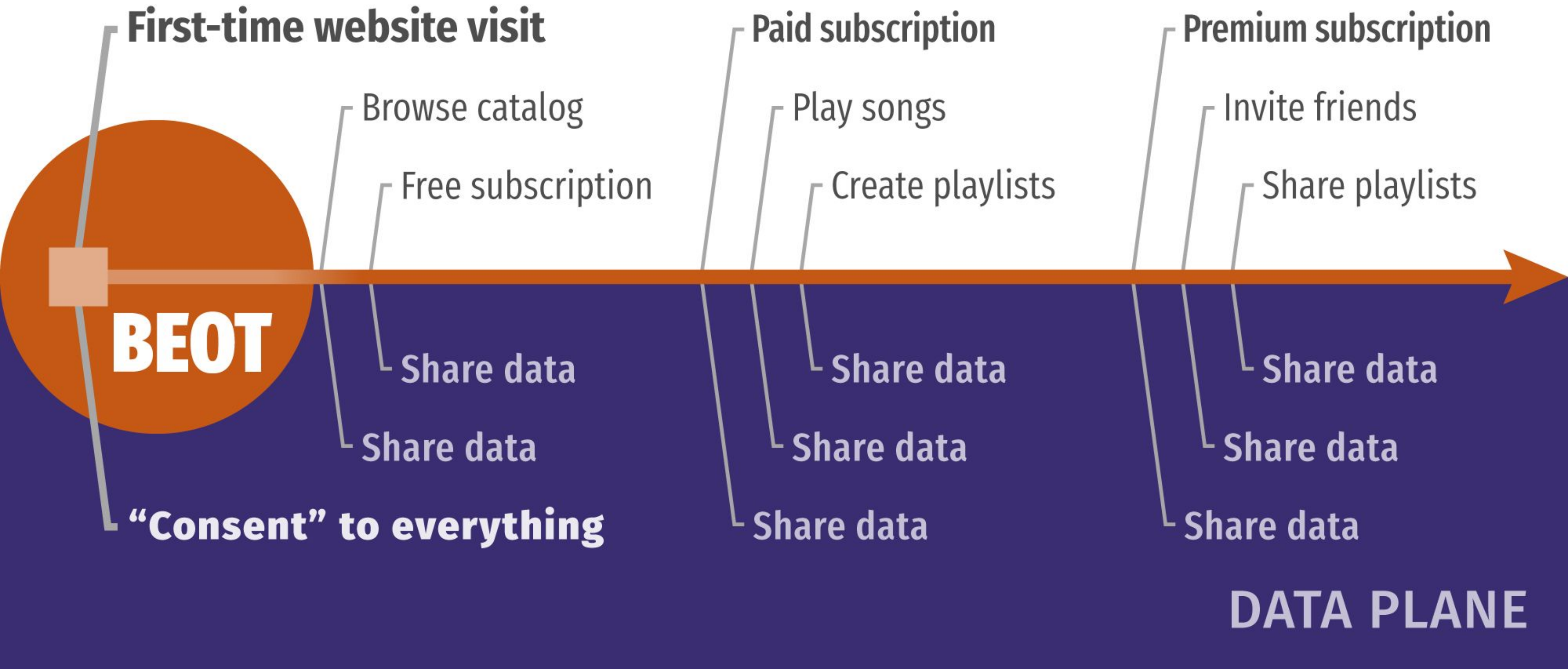
Trustless consent model

INTERACTION PLANE



First-time website visit

Browse catalog

Free subscription

Paid subscription

Play songs

Create playlists

Premium subscription

Invite friends

Share playlists

BEOT

Share data

Share data

“Consent” to everything

Share data

Share data

Share data

Share data

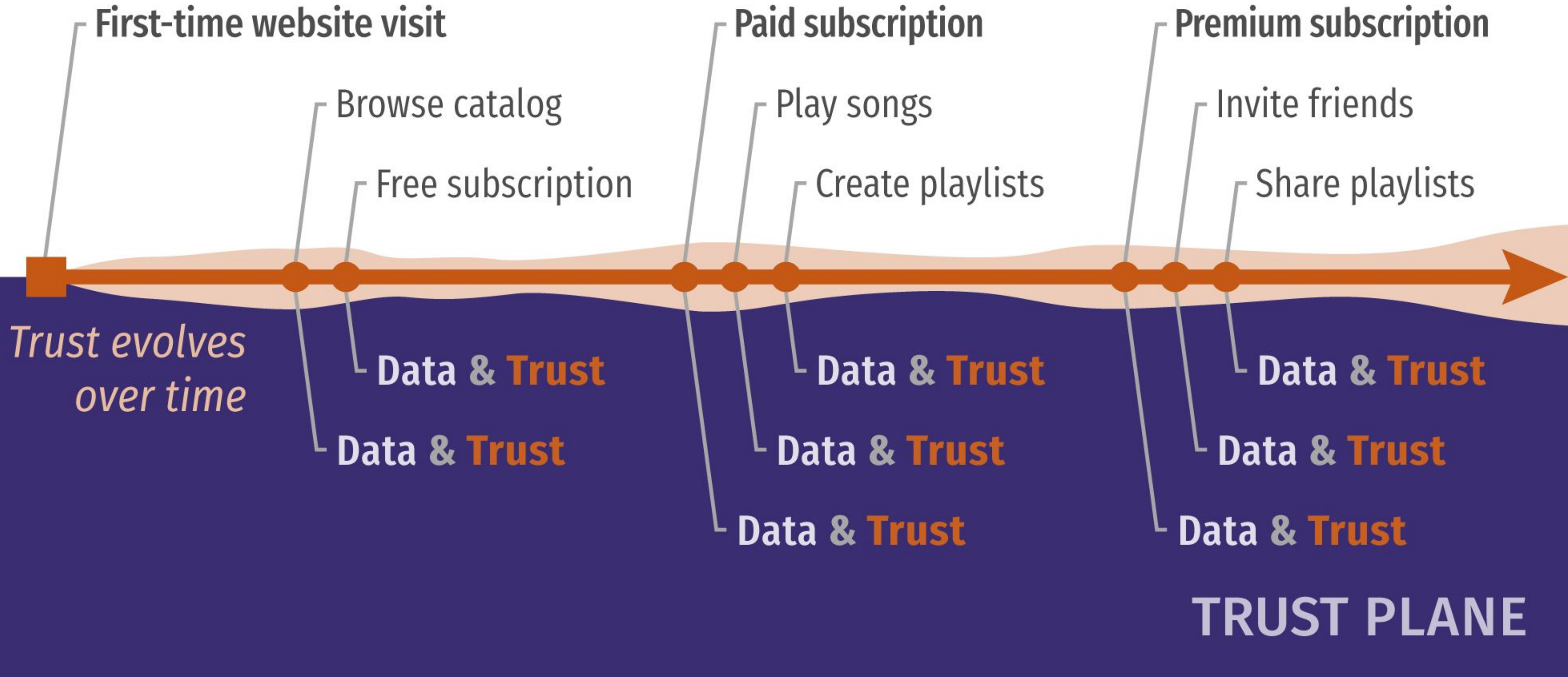
Share data

Share data

DATA PLANE

Evolving trust relationships

INTERACTION PLANE



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Trust evolves over time

Data & Trust

Data & Trust

Data & Trust

Data & Trust

Data & Trust

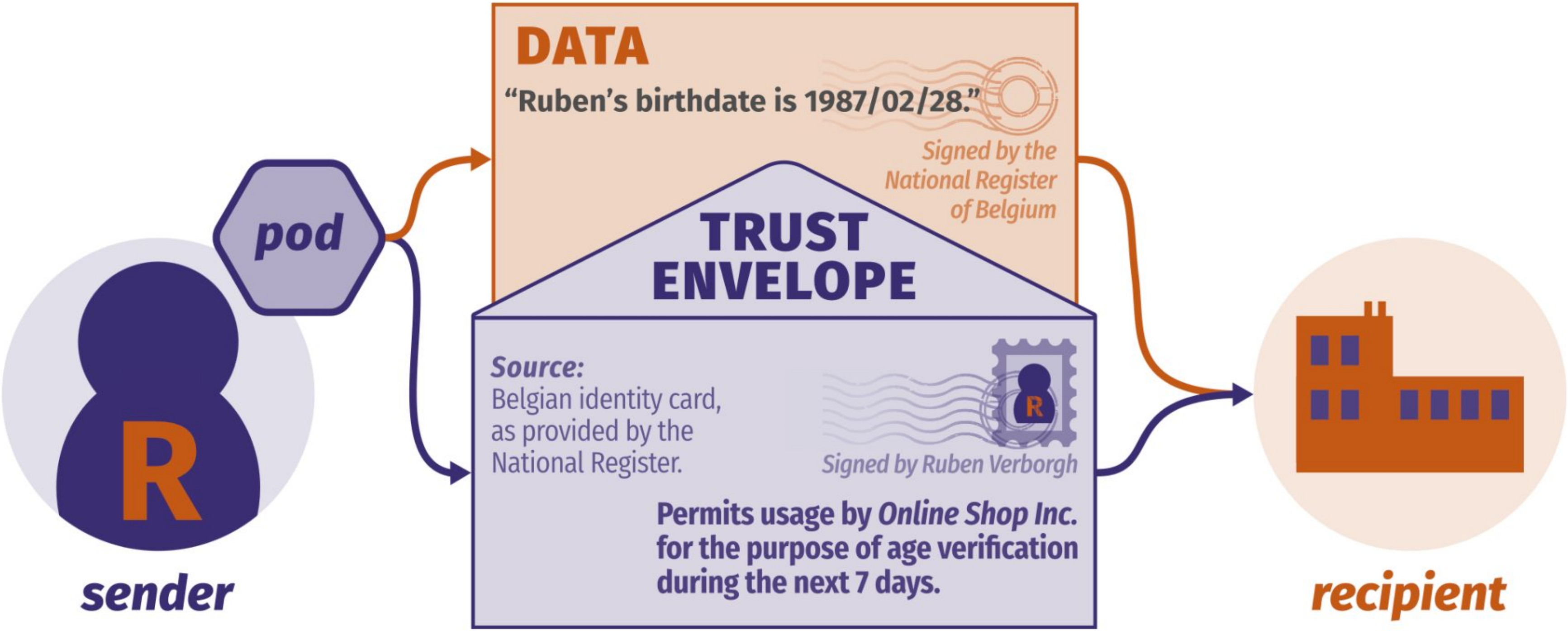
Data & Trust

Data & Trust

Data & Trust

TRUST PLANE

Trust envelopes as vehicles of history & destiny



pod

sender

DATA

"Ruben's birthdate is 1987/02/28."

Signed by the National Register of Belgium

TRUST ENVELOPE

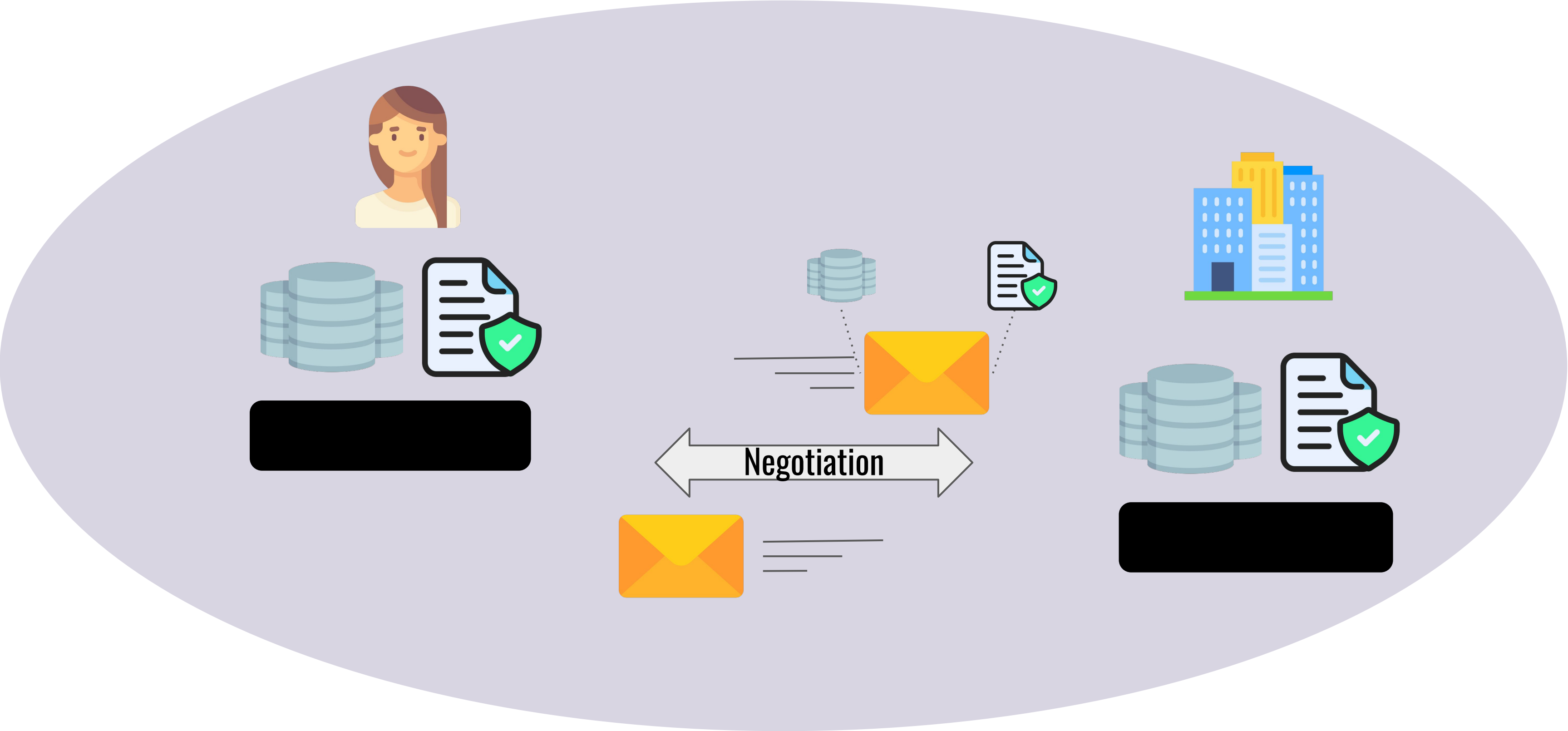
Source:
Belgian identity card, as provided by the National Register.

Signed by Ruben Verborgh

Permits usage by *Online Shop Inc.* for the purpose of age verification during the next 7 days.

recipient

Techno-legal systems? The 10.000 meter view



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Icons from Freepik, Iconiyo, Wahyu.Setyanto, Anggara, Freepik

Automated Policy Negotiation: A Four-Course Meal

1. Challenges
2. Policies as Computer Programs
3. Related Work
4. Conclusions & Future Work

Automated Policy Negotiation: A Four-Course Meal

1. **Challenges**
2. Policies as Computer Programs
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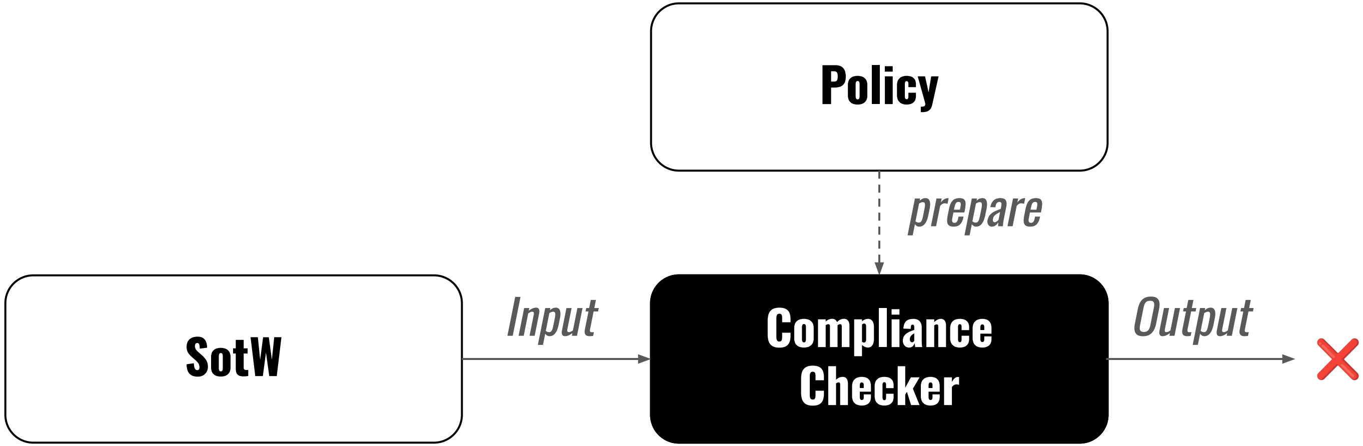
What are typical tasks these machines should be capable to do?

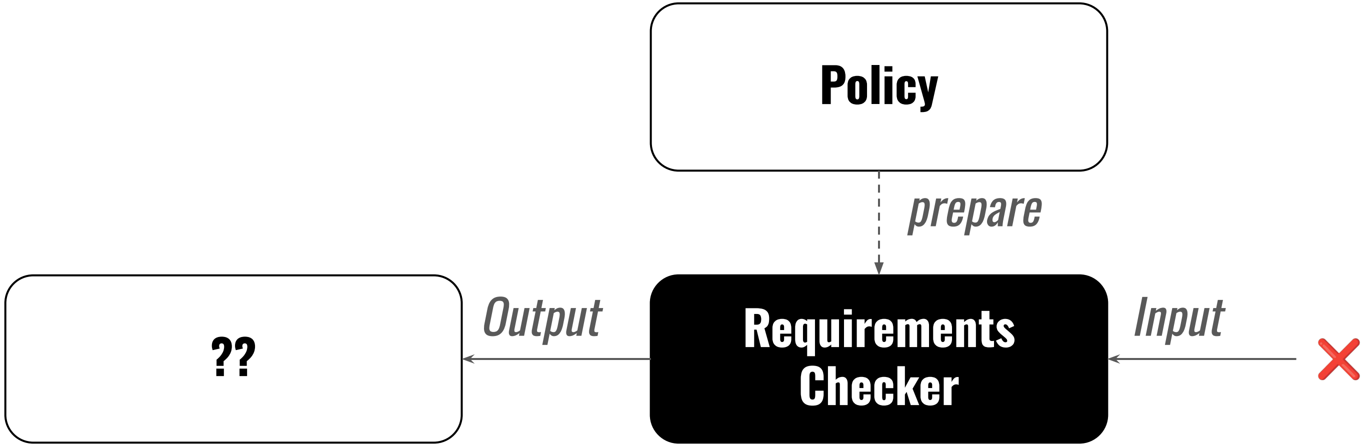
Compliance checking

Given an policy as input, the machine should be able to calculate in a particular state of the world complies with the policy norms.



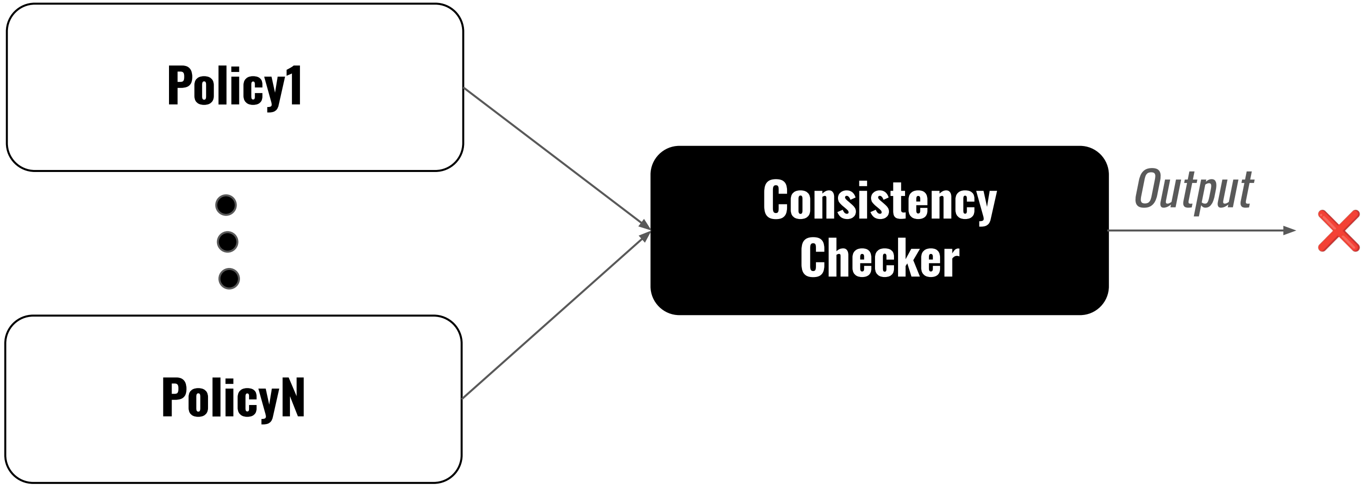
Requirements checking

This is the inverse process of the previous compliance checking. If a "computer says no," we need to understand why and what actions we can take to change the "no" into a "yes."



Consistency checking

This machine get policies as input and it needs to know if there are inconsistencies between these policies. Inconsistent policies are void and useless and potential dangerous if not detected.



Policy1

PolicyN

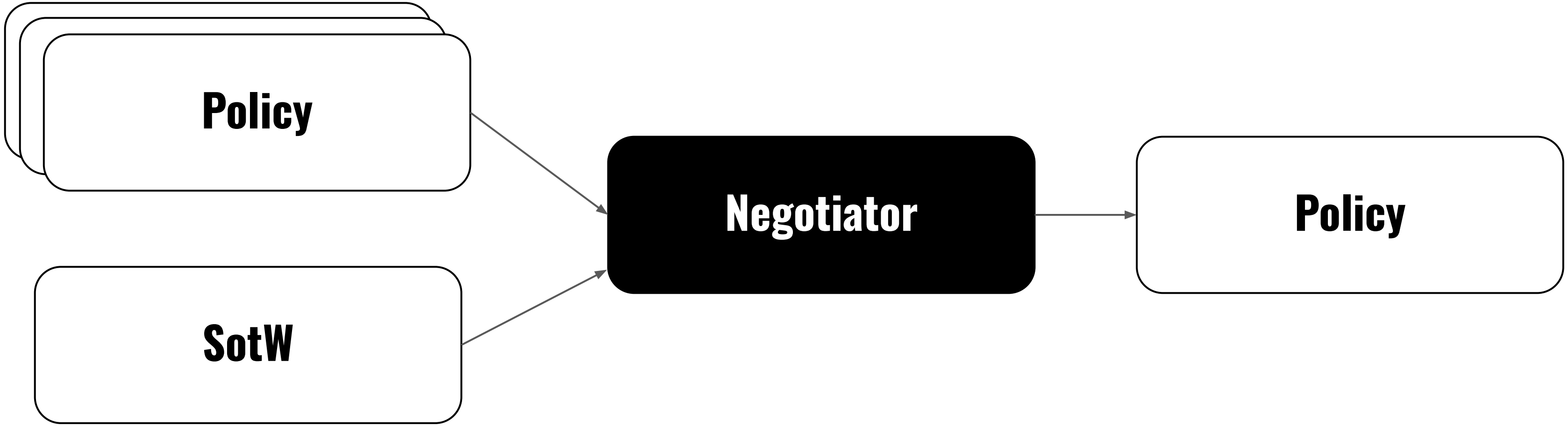
Consistency Checker

Output

❌

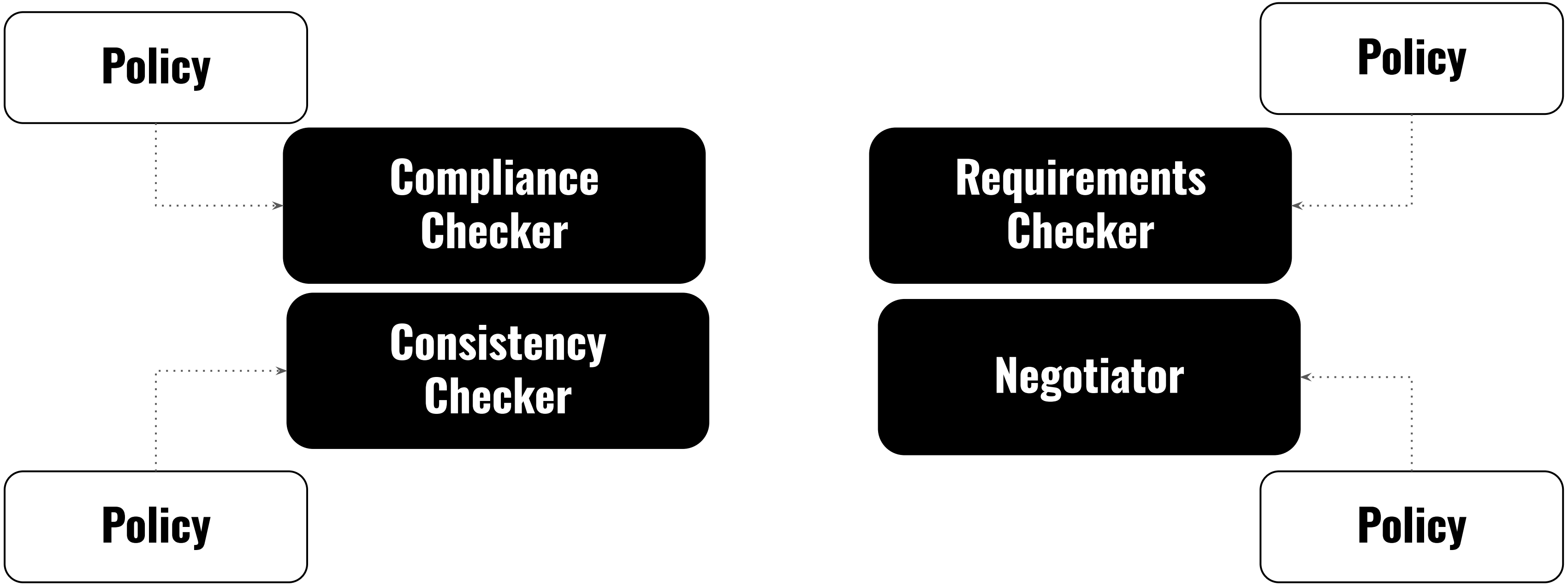
Negotiation

The negotiation process requires a combination of customer policies, company policies, and potentially a state of the world to arrive on a new policy for a particular use-case.



These four challenges are related

The logic as expressed in the policies need to commute between applications.



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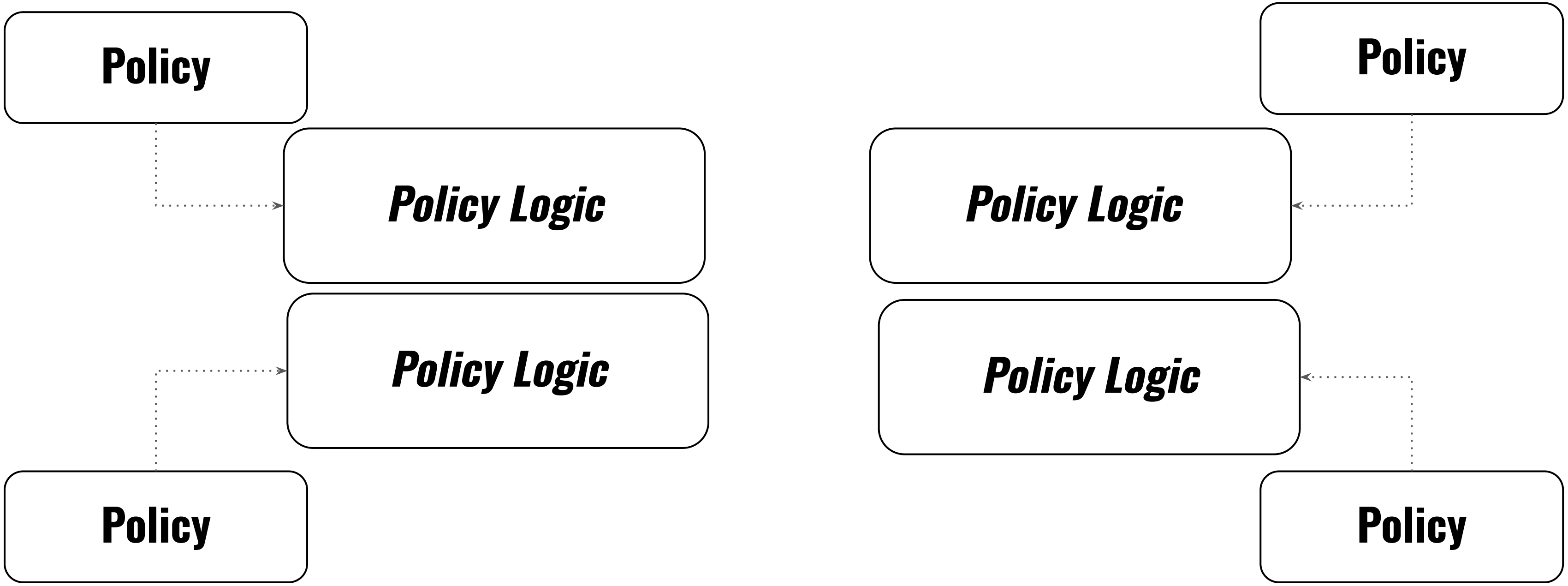

Automated Policy Negotiation: A Four-Course Meal

1. Challenges
2. **<u>Policies as Computer Programs</u>**
3. Related Work
4. Conclusions & Future Work

Policies are, in effect, computer programs

- Policy logic is currently defined by their implementations.

- There were high hopes that Semantic Web logic would automatically provide us common logic suitable for expressing the richness of our policy languages.

- However, in effect, what we see is a balancing act:
  - Implementing the requirements of deontic+defeasilble+(more?) in a particular framework
  - Requiring multiple of these framework, each with their own choice of what logic to implement to be interoperable
  - Making this all scalable

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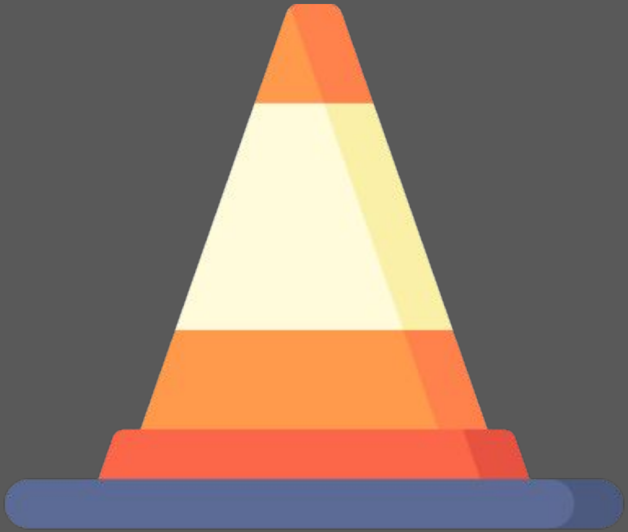

WORK in PROGRESS

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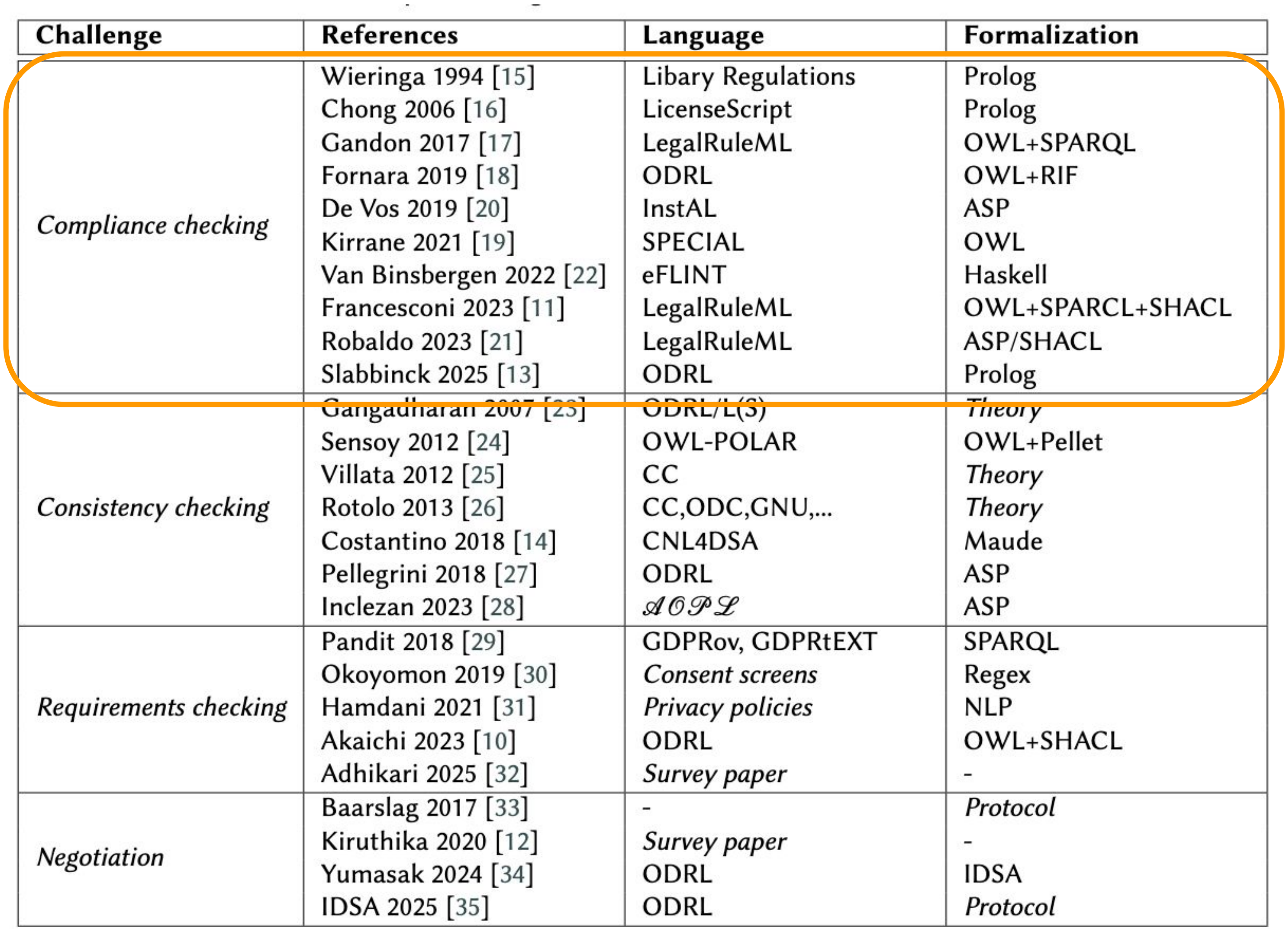

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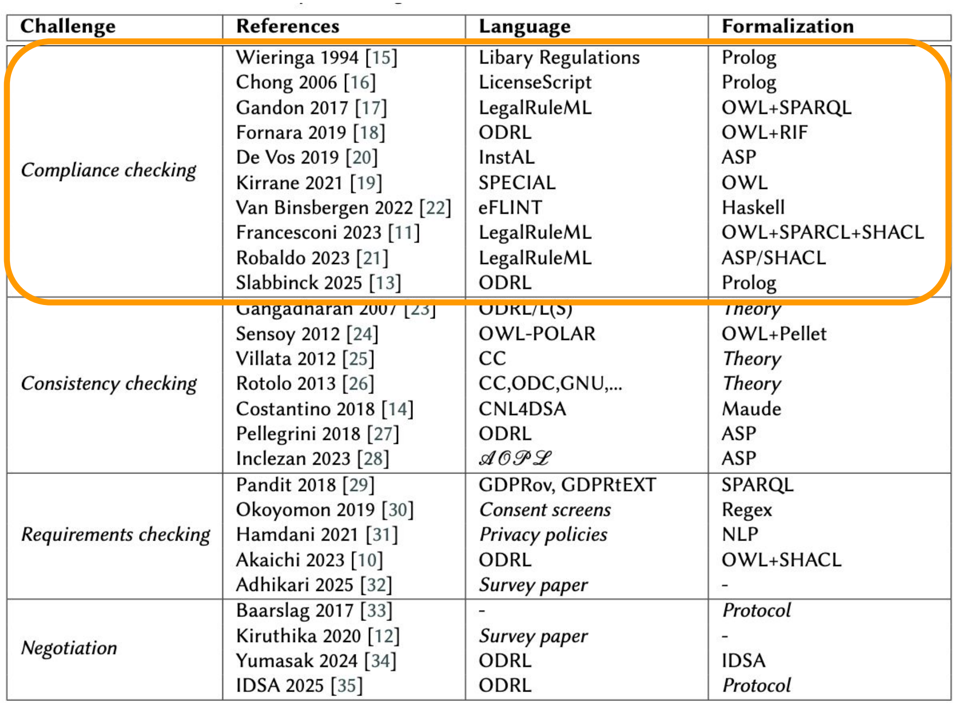

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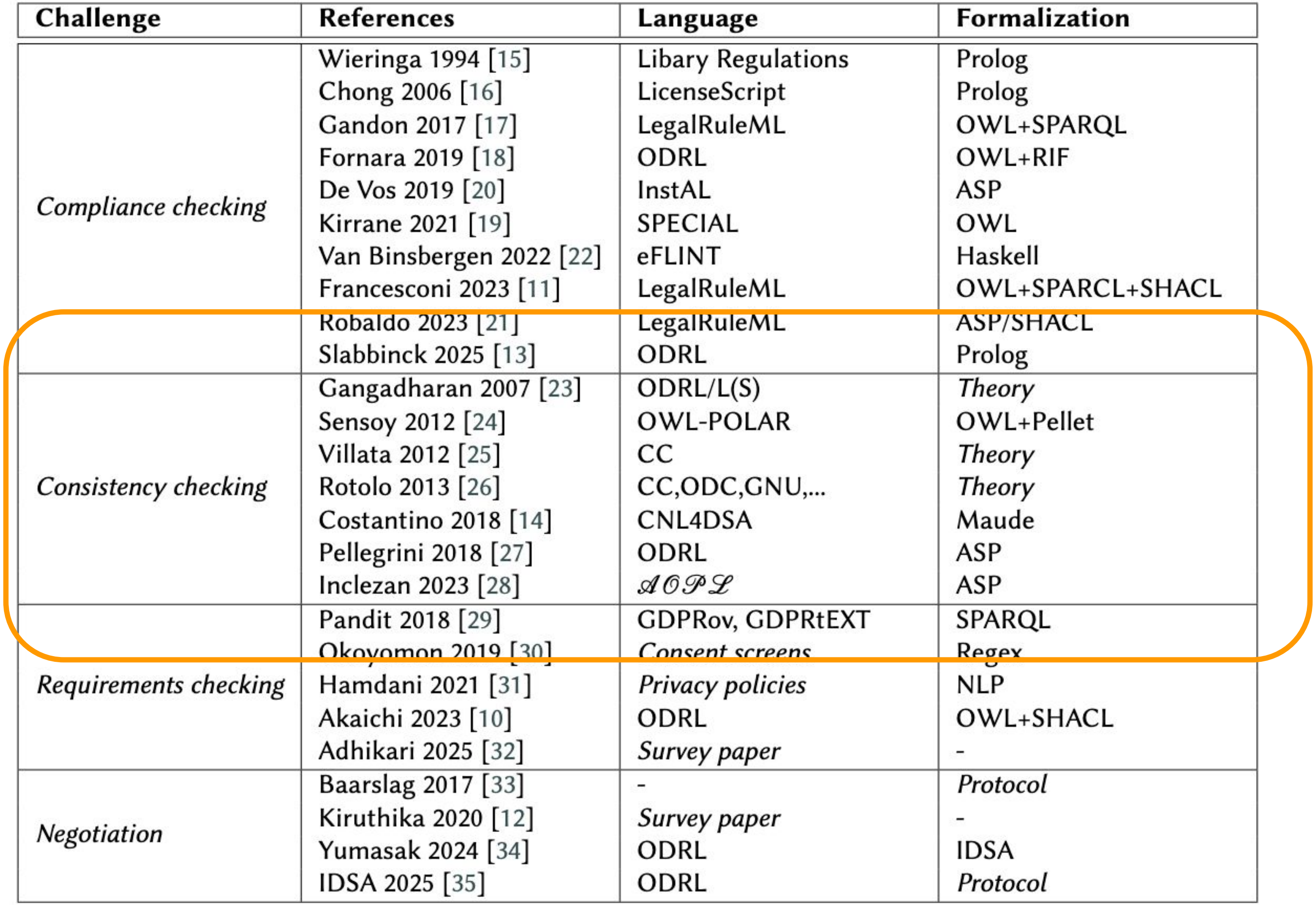
- Early implementations based on **logic programming** languages, e.g., Prolog
- **Rise of the Semantic Web languages**: challenges in covering all the deontic logic requirements, e.g., prohibition requires some form of negation
- **Combination of languages** has the potential to provide the necessary expressivity



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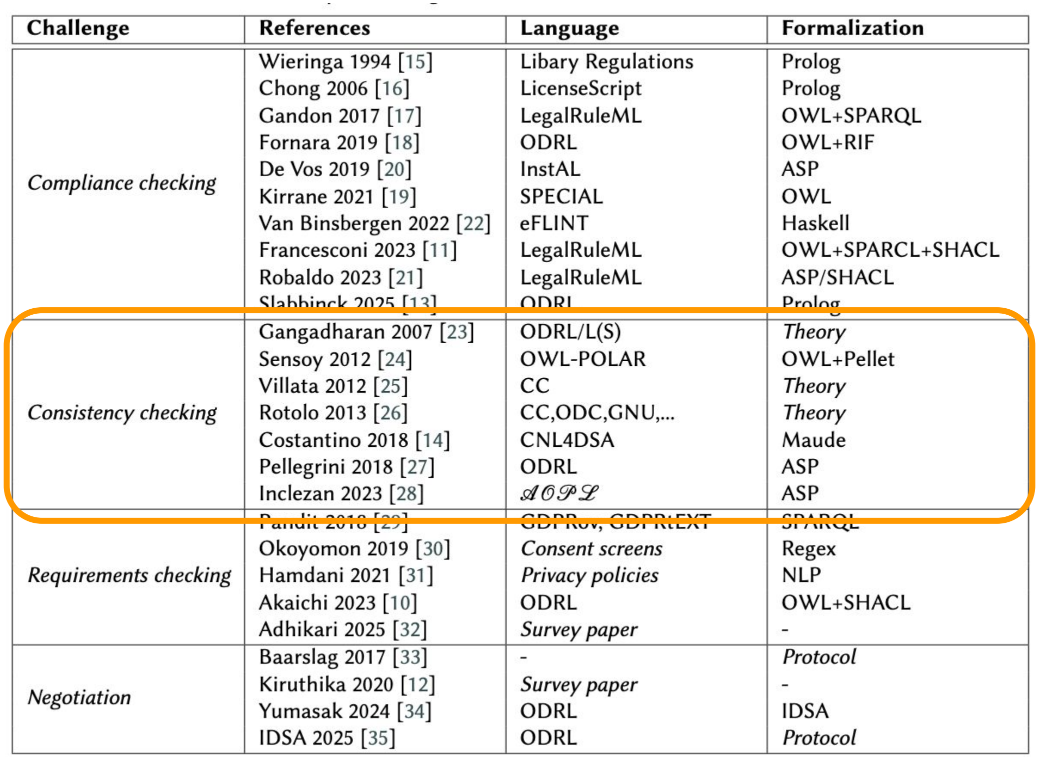

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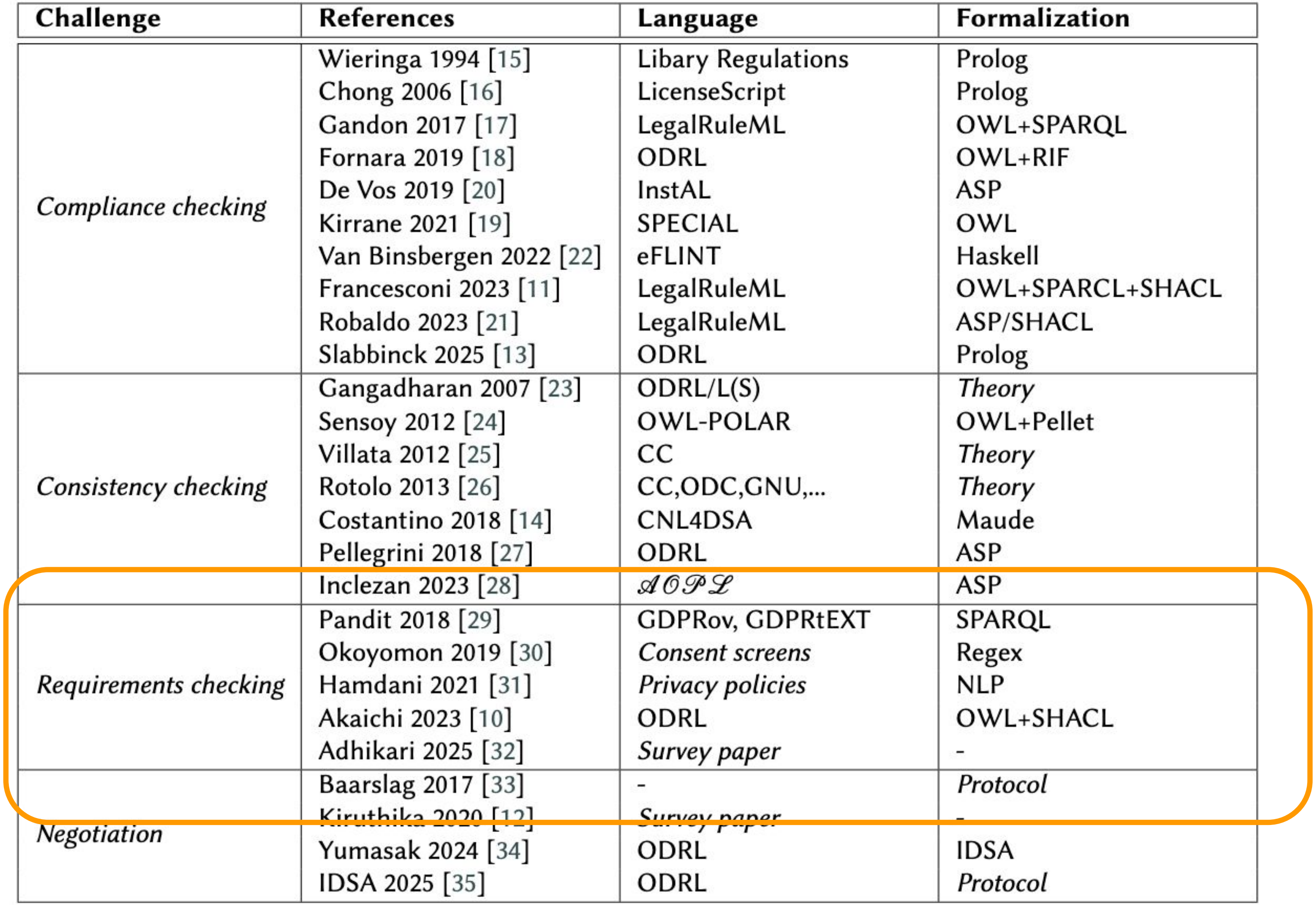
- Focus on software **licenses**
- Maude is a **declarative programming environment** used for specifying and analyzing formal models of systems, including consistency checks
- ASP to find **inconsistencies**, **underspecified**, and **ambiguities**

Inconsistencies – rules that contradict each other

Underspecified – rules that never trigger

Ambiguities – rules that permit an action in one possible state of the world but forbid it in another possible state of the world



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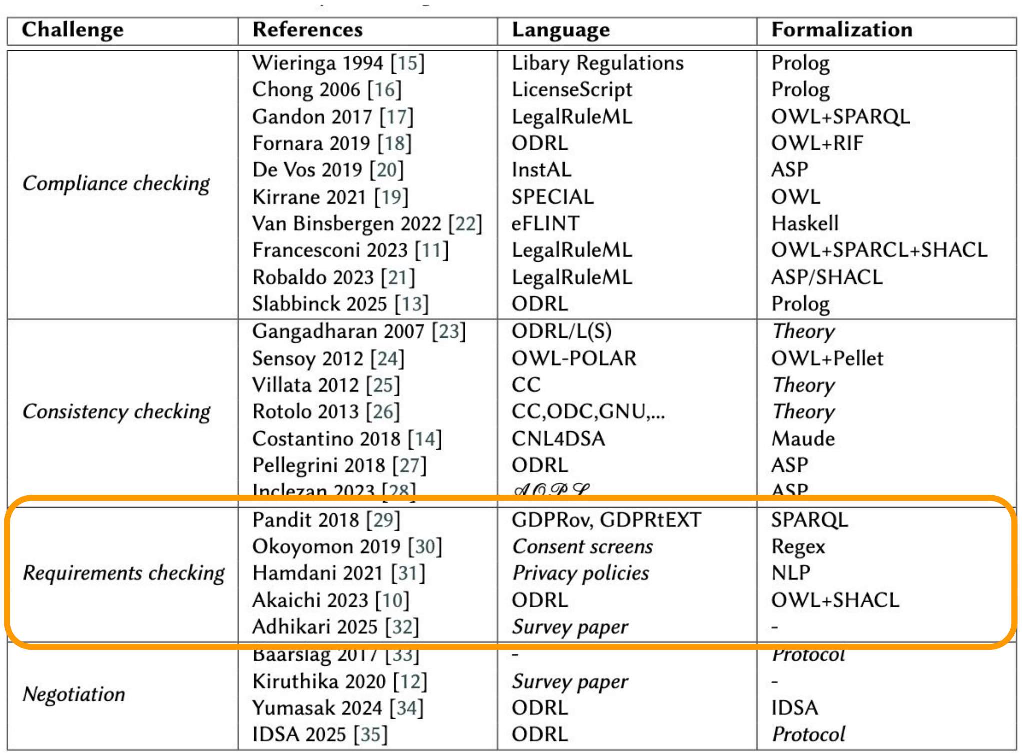

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Three approaches in the literature:

- **Syntactical analysis** of the policy language, e.g., matching of human- and machine-readable representation
- Analysis of the **deeper underlying logic** of the policy language, e.g., using deterministic processes to formalize and analyze the policies
- **Non-deterministic processing**, e.g., machine learning to analyse the policies

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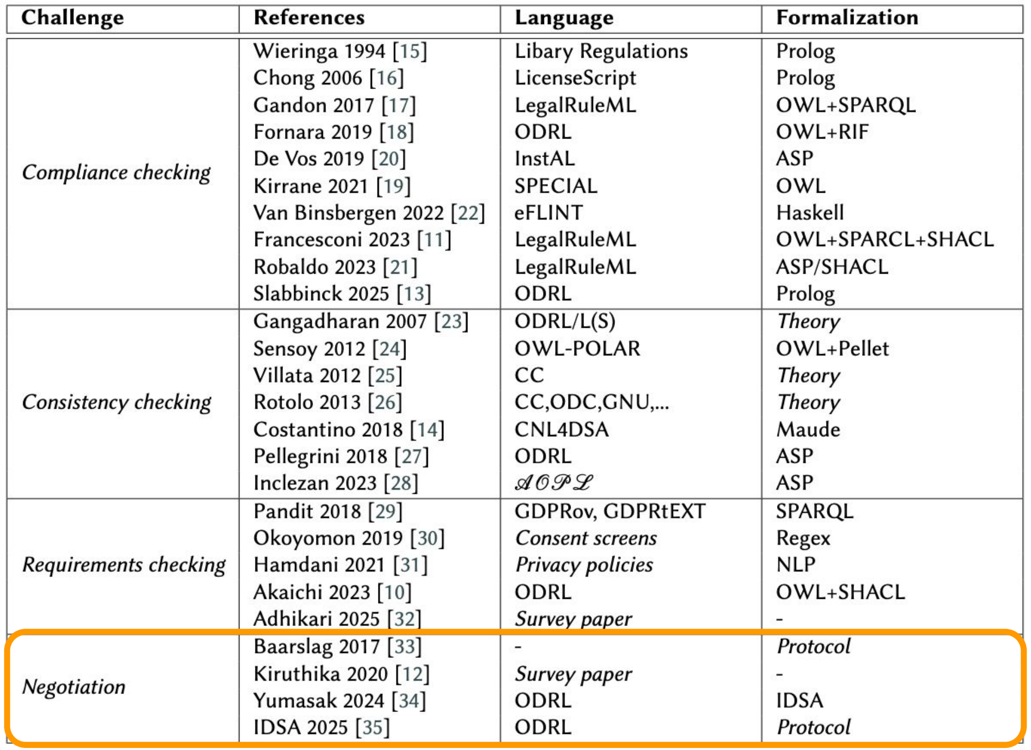

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- **Not many examples of fully automated agents** that can negotiate policies
- **IDSA has semi-automated** for contract negotiation
- Machines could be involved in providing **feedback on the consistency of negotiated policies**, **explaining the consequences of the negotiated policies**, and running some sample scenarios

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Conclusions & Future Work

- A four course meal is required to create a fully automated techno-legal system that does not rely on a "all or nothing" trust.
- What is blocking us is the definition of a formal policy logic.
  - This should not be left to implementers of policy languages.
- High hopes are/were that standard Semantic Web languages would provide the required deontic, defeasible, and other features of such a formal logic.
- There is a renewed interest in symbolic logic that does provide a richer set of logic features.
- Is it possible to have marriage between Semantic Web and a richer set of logic features?
  - In our group, we believe that Notation3 and RDF Surfaces, both based on first-order logic with powerful negation and a rich set of built-ins, could inspire such a recipe.

Automated Policy Negotiation: a Four-Course Meal

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