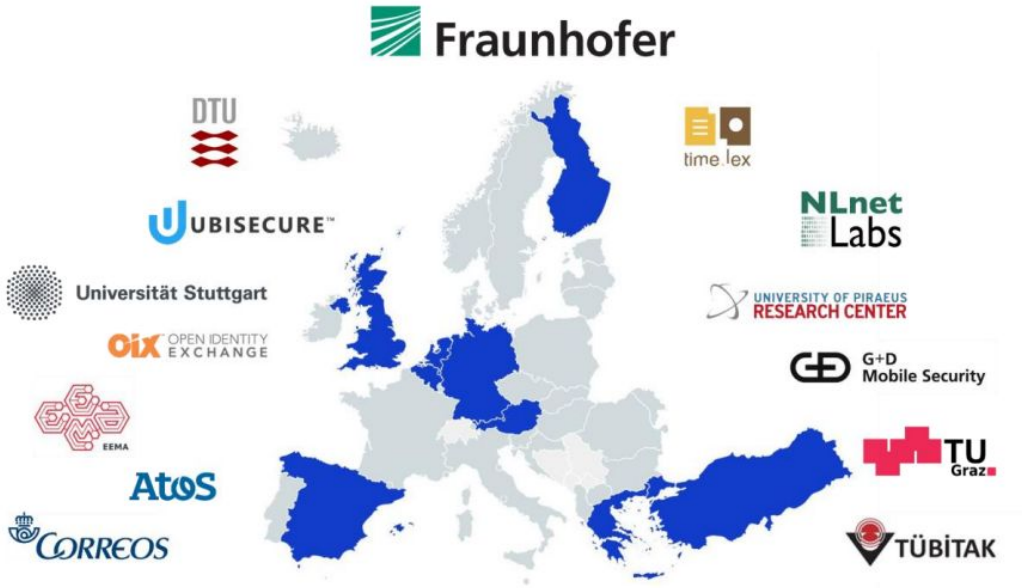
LIGHT*est*

A Lightweight Infrastructure for Global Heterogeneous Trust Management



Trust Verification & Policies in LIGHT*est*

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Outline

- **Formats**
- Policies in Lightest
- An introduction to TPL
- The TPL Interpreter
- Parser
- Natural Language Processing
- GTPL

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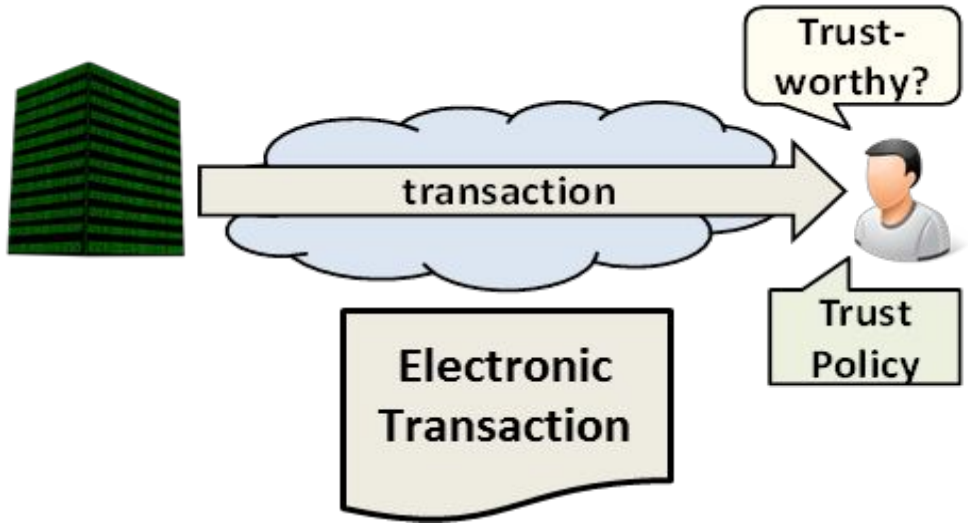
The Electronic Transaction

- An electronic transaction is a container (of a given format)
- Contains several documents or sub-containers
- Documents and containers are associated with an electronic identity, e.g., via electronic signature
- Electronic Signatures: the electronic equivalent of a traditional manual signature, placed on a piece of paper.
  - Qualified ones are even cryptographically secure



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Transaction Format

- In Lightest there are standardized “templates” for Transactions…
- ...so called Formats
- Known by all parties
- Formats may have a specialized parser
- Transactions have to conform to be valid
- Header: same in every Transaction
- Body is domain specific
- That is why we call formats also “domain templates”

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Subformats

- Formats that can be plugged into formats
- Necessary for a building brick approach
- In addition Formats may need a specific parser (e.g. certificate subformat)
- ...TODO.

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Format as blank XML

```
<?xml version="1.0" encoding="UTF-8"?>

<form format="theAuctionHouse2019" specification="theAuctionHouse_v2">

        <person>
                <name type="string" />
                <street type="int" />
                <city type="string" />
                <country type="string" />
        </person>

        <lot_number type="int" />
        <bid type="int" />
        <certificate type="cert" />
</form>

```


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Format as XSD

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" elementFormDefault="qualified"
           attributeFormDefault="unqualified">
    <!-- XML Schema Generated from XML Document with http://xmlgrid.net -->

    <xs:element name="form">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="person">
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element name="name" type="xs:string"></xs:element>
                            <xs:element name="street" type="xs:string"></xs:element>
                            <xs:element name="city" type="xs:string"></xs:element>
                            <xs:element name="country" type="xs:string"></xs:element>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="lot_number" type="xs:int"></xs:element>
                <xs:element name="bid" type="xs:int"></xs:element>
            </xs:sequence>
            <xs:attribute name="format" type="xs:string"></xs:attribute>
        </xs:complexType>
    </xs:element>
</xs:schema>
```


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ASIC

- Associated Signature Container
- Standard for packaging container types
- Standard for associating the data and cryptographic parts
- We use it as standard for Lightest Transactions
- Internal structure of an ASiC container
  - A **root** folder for all the container content, including folders that reflect the structure of the content
  - A "**META-INF**" folder inside the above mentioned root folder that holds files that contain metadata about the content, including the associated signature/and or time assertion files
- This is where Delegation (before lunch session) and transaction comes together again
- Finally qualified signatures is applied

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What are Policies used in general

- A policy is a deliberate system of principles to guide decisions and achieve rational outcomes
- A policy between two parties helps building trust
- Lightest uses policies to automatically decide whether an incoming “request” is to be trusted
- A policy decides what to accept and what to discard

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What are Lightest policies in Lightest? What are they enabling you to do?

- Incoming transaction must be verified and reviewed (e.g. the seller must know if the buyer is authorised to buy in a companies name)
- Lightest enables you to have automated decisions
- To be automated parameters need to be set
- Lightest lets you write multiple policies to every regard
- Feeded to the ATV (or more precisely the Interpreter), policies will take care for you for incoming transaction

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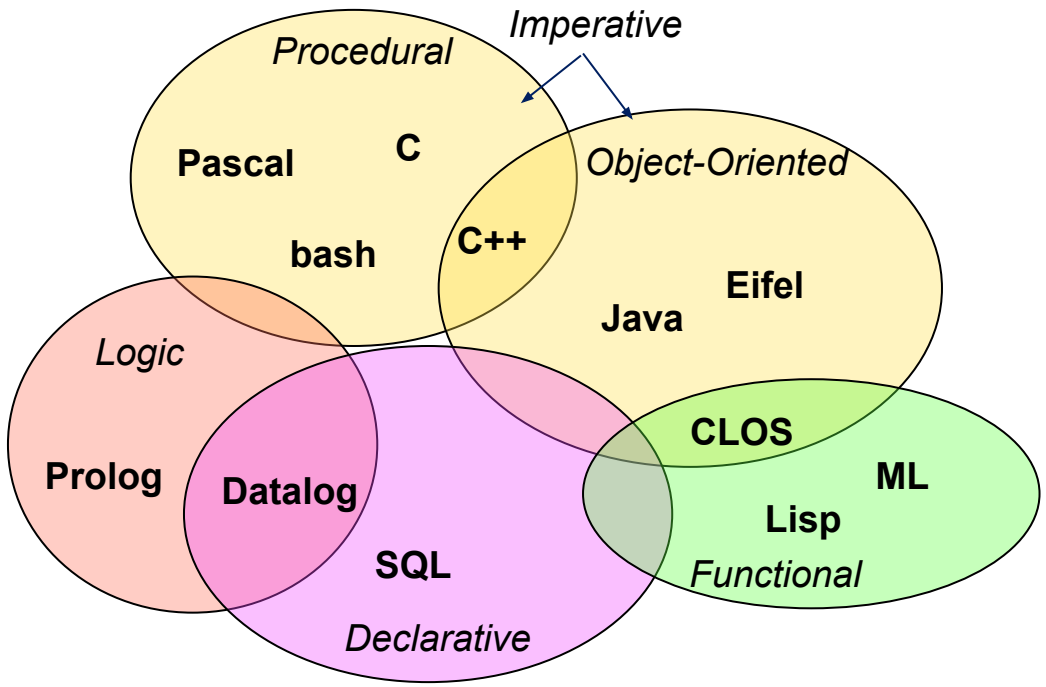
Introduction Logic Programming

- Logic Programming is declarative programming paradigm (in contrast to imperative: Pascal, C, Java,...)
- We use a subset of first-order logic, called Horn clause logic
- Most widely used logic language is Prolog (**Pro**gramming in **log**ic)
- Advantages of logic programming:
  - No need to distinguish programs from database
  - Natural support of pattern-matching and meta-programming
  - Ease of representing knowledge

Programming Language Paradigms



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Introduction to TPL

- made up of facts and rules
- a fact asserts a property or relation:
  - e.g. *parent(alice, bob).*
  - means Alice is a parent of Bob
- a rule infers a property or relation based on preconditions:
  - e.g. *parent(X, Y) :- mother(X, Y).*
  - means that Person X is the parent of Person Y, if X is the mother of Person Y

parent(alice, bob). → Fact

parent(X, Y) :- mother(X, Y) → Rule

Predicate

Head Body

→ Predicate definitions consist of clauses.
→ Facts do not have body because they are always true.

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Introduction to TPL

- A predicate head consists of:
  - predicate name
  - arguments (not necessarily)
- The body basically is made up of:
  - subgoals (calls to a predicate)
  - terms
- These terms can be:
  - Constants e.g. jane, alice,...
  - Variables e.g. X, Person1,...

```
parent(alice, bob).                    → Fact
parent(    X,    Y) :-  mother(X, Y)   → Rule
```

Predicate

Head

Body

→ Predicate definitions consist of clauses.
→ Facts do not have body because they are always true.

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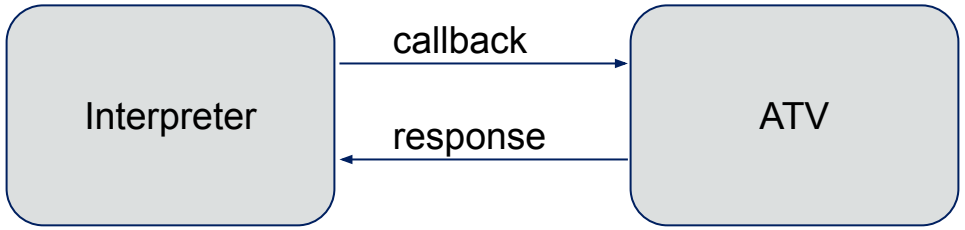
Main Concepts TPL - Build-in Predicates

- Furthermore TPL supports built-in predicates
- ...which trigger events on the ATV

- Custom predicates possible through plug-in system

- Built-in predicates:
  - extract
  - lookup
  - trustlist
  - trustscheme
  - verify_signature
  - verify_hash



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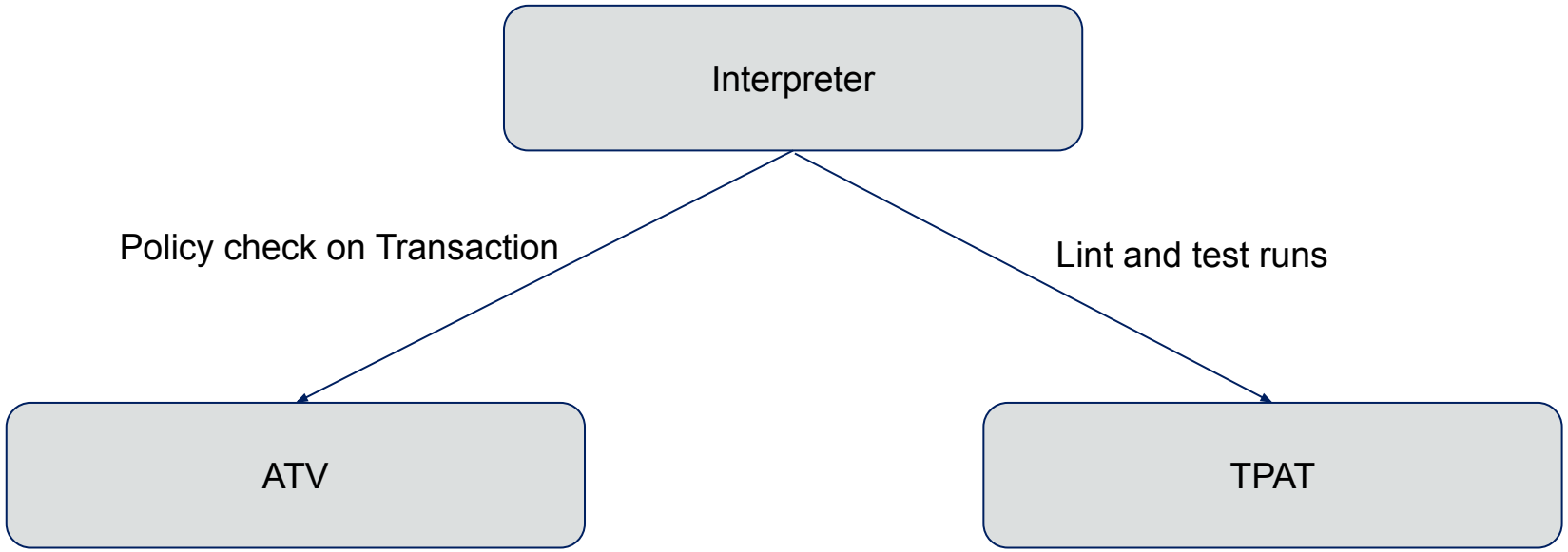
The Interpreter and its interaction with ATV and TPAT



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Policy snippets and what happens in the ATV background Part 01

- How the interpreter and the ATV work together
- Using an example of delegation
- Qualified delegation can be split:
  - checking the mandate
  - checking the mandator's key
  - checking temperedness

```
checkQualifiedDelegation(Document, Mandate) :-
    checkMandate(Document, Mandate),
    checkMandatorKey(Document, Mandate),
    checkValidDelegation(Document, Mandate).
```


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Policy snippets and what happens in the ATV background Part 02

- check mandate is pointing to the correct person
- is the purpose correct?

```
checkMandate(Document, Mandate) :-
    extract(Mandate, format, delegation),
    extract(Mandate, proxyKey, PkSig),
    verify_signature(Document, PkSig),
    extract(Mandate, purpose, place_bid).
```


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Policy snippets and what happens in the ATV background Part 03

- mandator is trustworthy
- is the Delegation's signature correct

```
checkMandatorKey(Document, Mandate) :-
    extract(Mandate, issuer, MandatorCert),
    extract(MandatorCert, trustScheme, TrustSchemeClaim),
    trustscheme(TrustSchemeClaim, eIDAS_qualified),
    trustlist(TrustSchemeClaim, MandatorCert, TrustListEntry),
    extract(TrustListEntry, pubKey, PkIss),
    verify_signature(MandatorCert, PkIss).
```


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Policy snippets and what happens in the ATV background Part 04

- check that the Delegation is untempered

```
checkValidDelegation(Document, Mandate) :-
    extract(Mandate, delegationProvider, DP),
    lookup(DP, DPEntry),
    extract(DPEntry, fingerprint, HMandate),
    verify_hash(Mandate, HMandate).
```


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Parser for ATV & TPAT

- Parsers in ATV and TPAT are used to load transactions respectively their formats
- Two kinds of parsers:
  - Generic
  - Custom
- Subformats need custom parser
- Verifies if the transaction is formally valid
- Independent from the interpreter
- Parser is more an interface to extract information out of transactions

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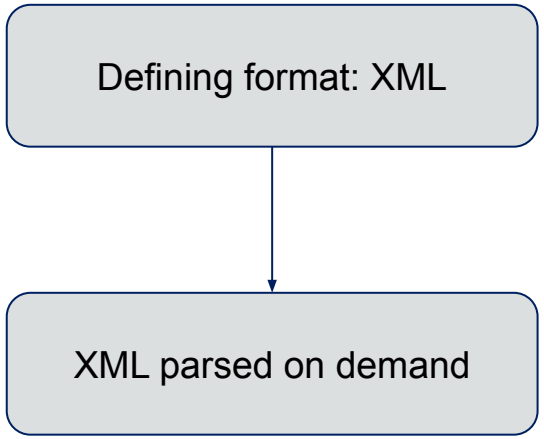
Generic Parser

- Format: blank XML
- Transaction data: filled out XML
- Static
  (e.g. no dynamically sized lists supported)
- Querying simple Fields only



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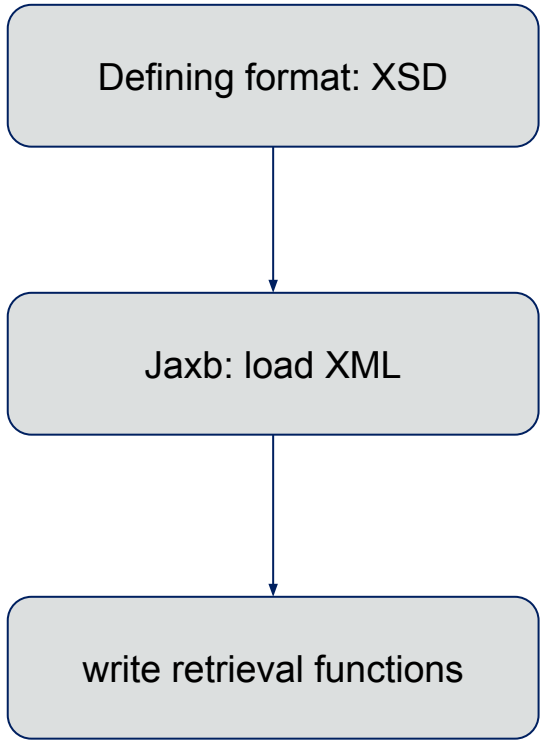
Custom Parser with XSD and Java JBX

- Format: XSD
  - basically cont. from formats with XSD
- Transaction data: filled out XML
- Dynamic
  - Using Jaxb
  - Fields retrieval redirected over Java
- Querying smart fields possible



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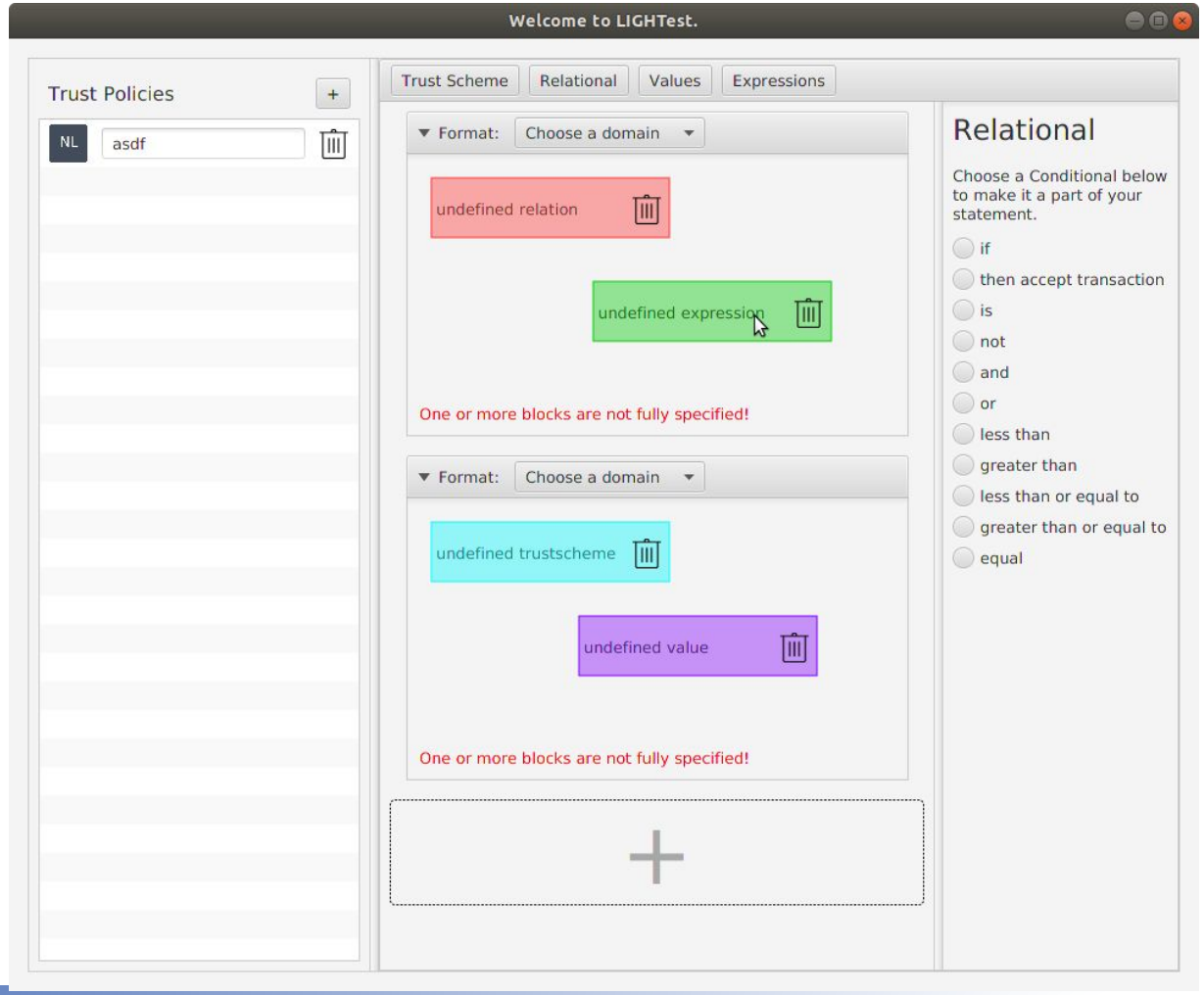
TPAT & NL recap

- **N**atural **L**anguage is the intermediate level in the TPAT (**T**rust **P**olicy **A**uthoring **T**ool)
- A building blocks based approach to create policies in a natural sounding way
- Statements are *OR* connected
- Typical block statement:

  If <condition> and <condition> then accept



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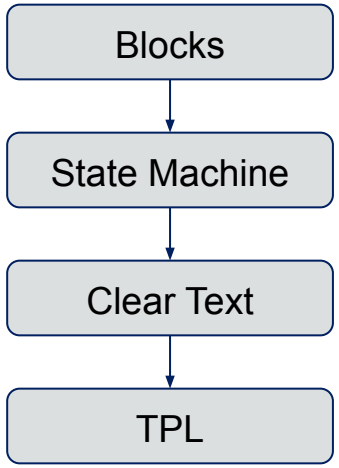
What is Clear Text in Lightest terms? How are NL Blocks translated?

- The User stucks Blocks together
- A State Machine is used
  - user correction support
  - translation to Clear text
- Clear Text is basically Blocks translated to a text string of a certain form
- State Machine offers even more possibilities (e.g. recommender system supported autocompletion)



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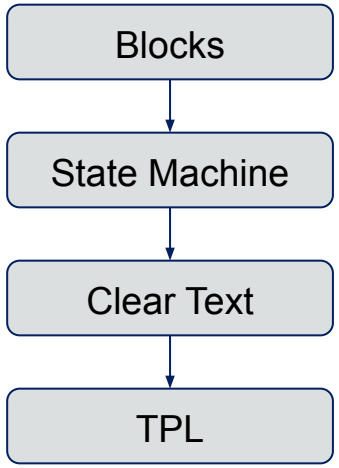
Clear Text to TPL

- Done by the technical university denmark
- Antlr to cross compile
- One Clear Text instruction may extend to multiple TPL instructions (magic words)
- The whole procedure gets triggered on every drop of a block, and saves out TPL-code to a file
- Only one way: TPL to blocks not possible



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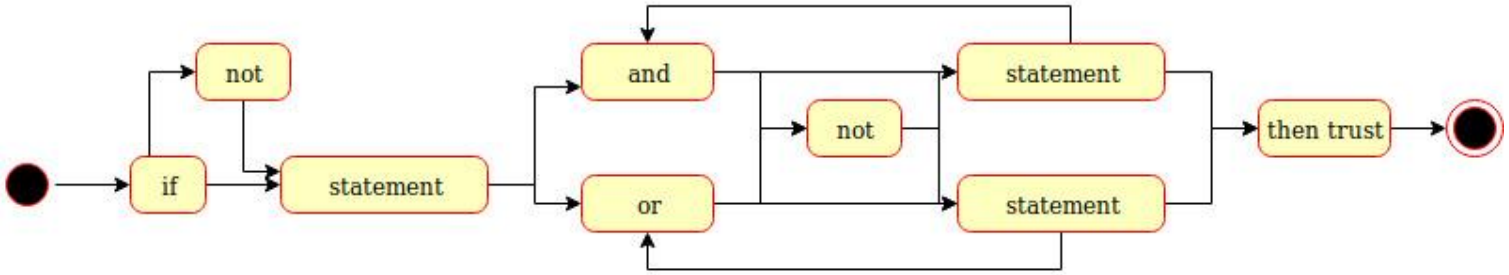
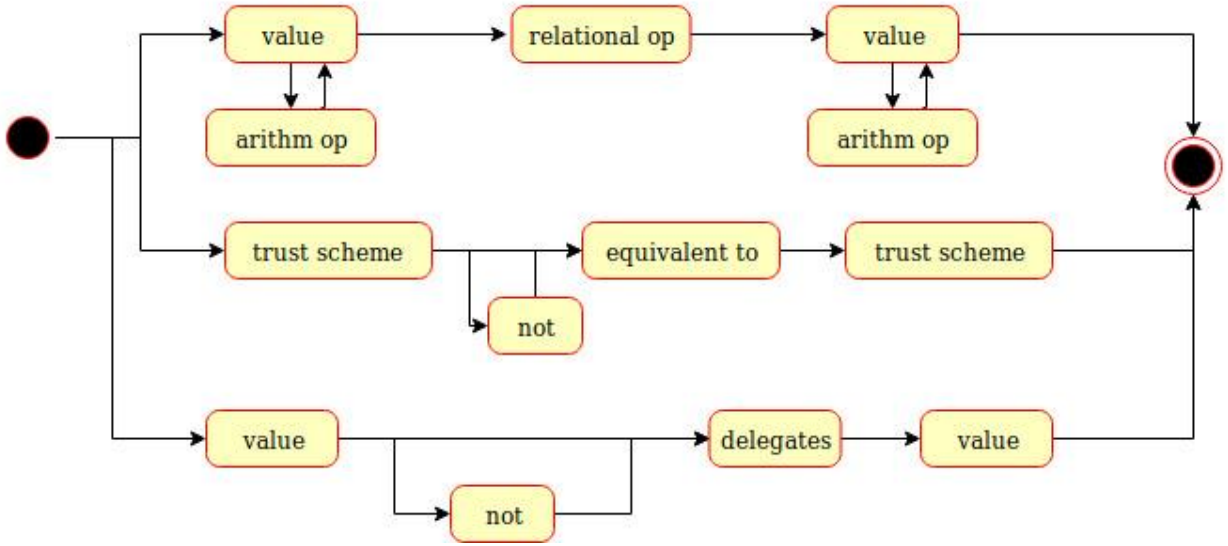
NL State Machine

State Machine:



Statement:



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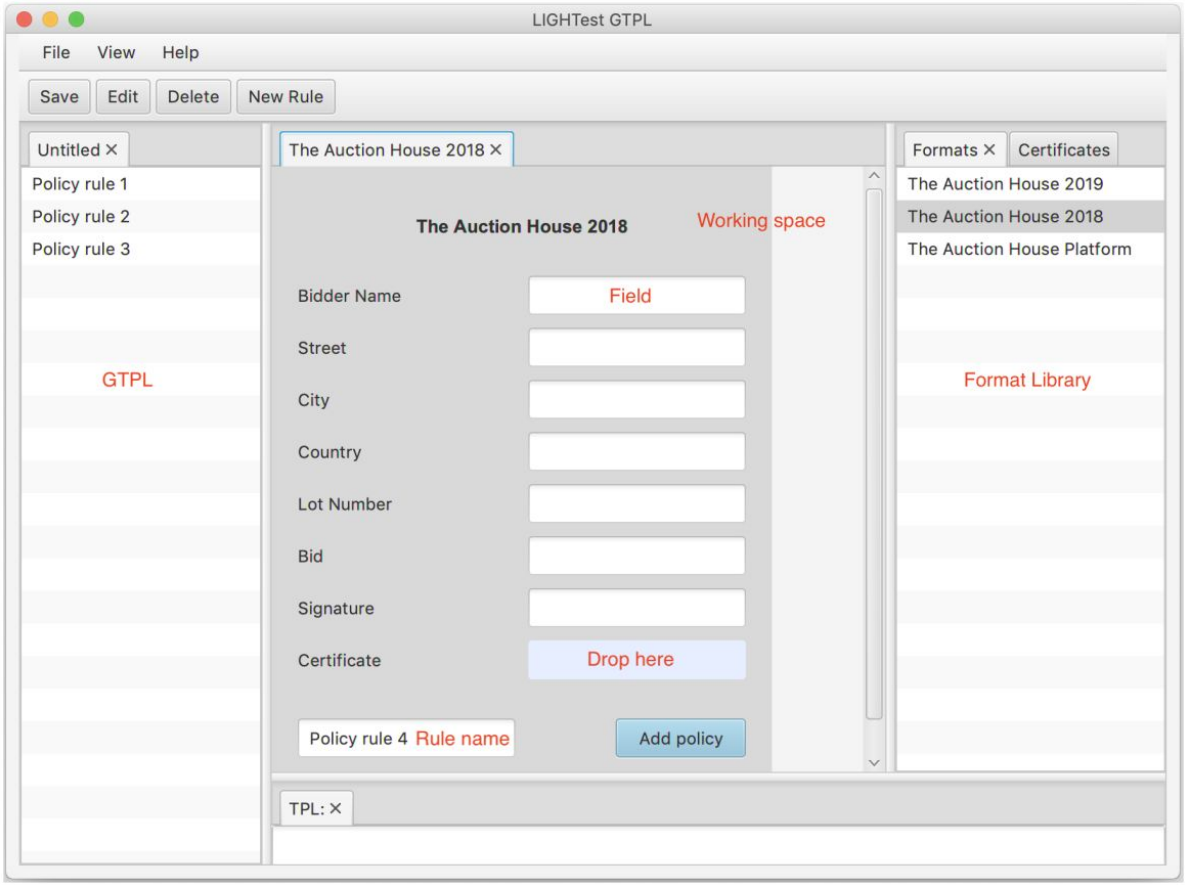
What is GTPL

- Similar to the Delegation Publisher
- For companies:
  - Creating policy formats done by an employee with domain expertise and programming knowledge (e.g. IT finance engineer)
  - Business people then use one of the created formats and fill out the transaction
- Formats can be added using a plugin system



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Q & A

Thank you for your attention

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Q&A Bonus Slides

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