MegaL-Text
A natural language description

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SOFTLANG

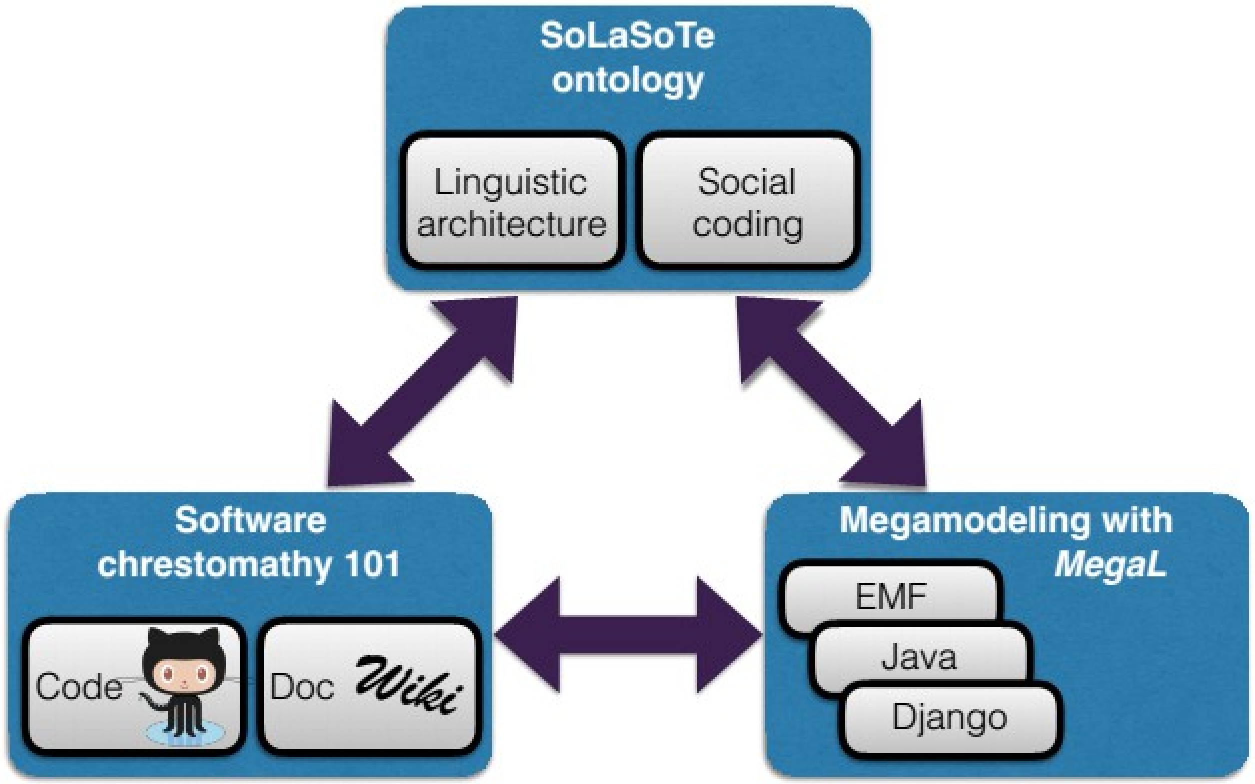
We have a problem!

- Too many technologies, not enough time to master them all…

Consequences

- Vendor lock in (dependency on a software vendor)
- Missing Expertise
- Exhaustion
- Job-Security?
- High costs for introducing a new technology
- ....

SoLaSoTe Process



MegaL

- MegaL is short for for 'Megamodeling Language', where a model describes entities in the context of software development and their relationships from a conceptual perspective.

Megal-Text

- Textual syntax.
- Stable, but minor evolution might happen.
- Newest vocabulary diverges from the vocabulary in papers.

Modularization

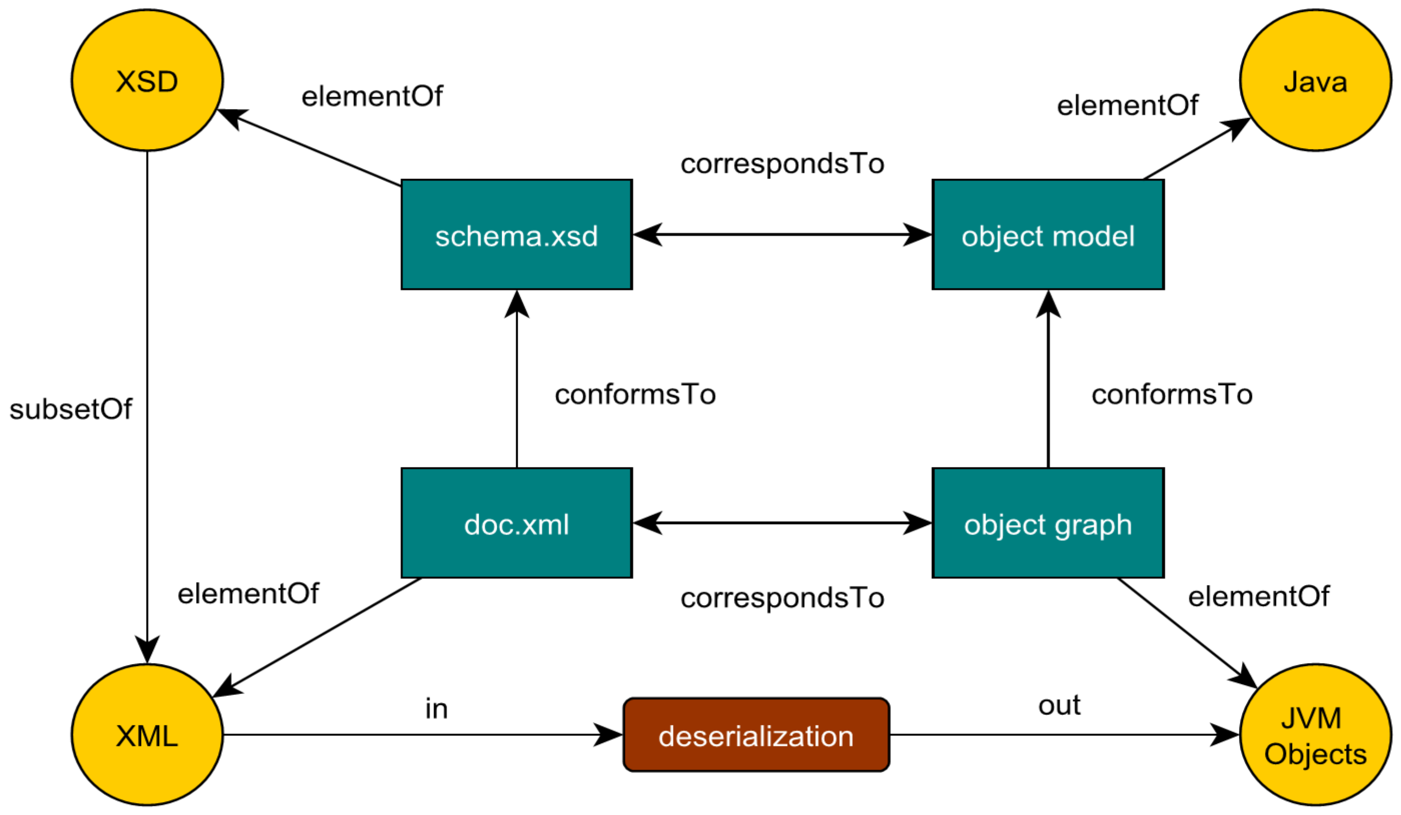
- To enable the reuse of facts every technology model is composed of various modules.
- Every module starts with a module name.
  - e.g., module java.JavaPlatform
- To reuse facts, you can import a module in another module.
  - e.g., import java.JavaPlatform

Path Resolution

- The name of the module can be resolved to a path.
    - E.g., the name java.xml.JAXB can be resolved to the File 'JAXB.megal' in the folder 'xml' in the folder 'java'. Here, the resolution process starts at the parent of 'java'.

An Abstract Technology Model

- Imagine a conceptual model for XML Binding technology in Java.



Prelude

- The Prelude module contains all subtypes and possible relationships.
- It represents the ground truth for the vocabulary.
- It is imported automatically, when processing a new model.
- The following slides shall make you acquainted with the prelude vocabulary.

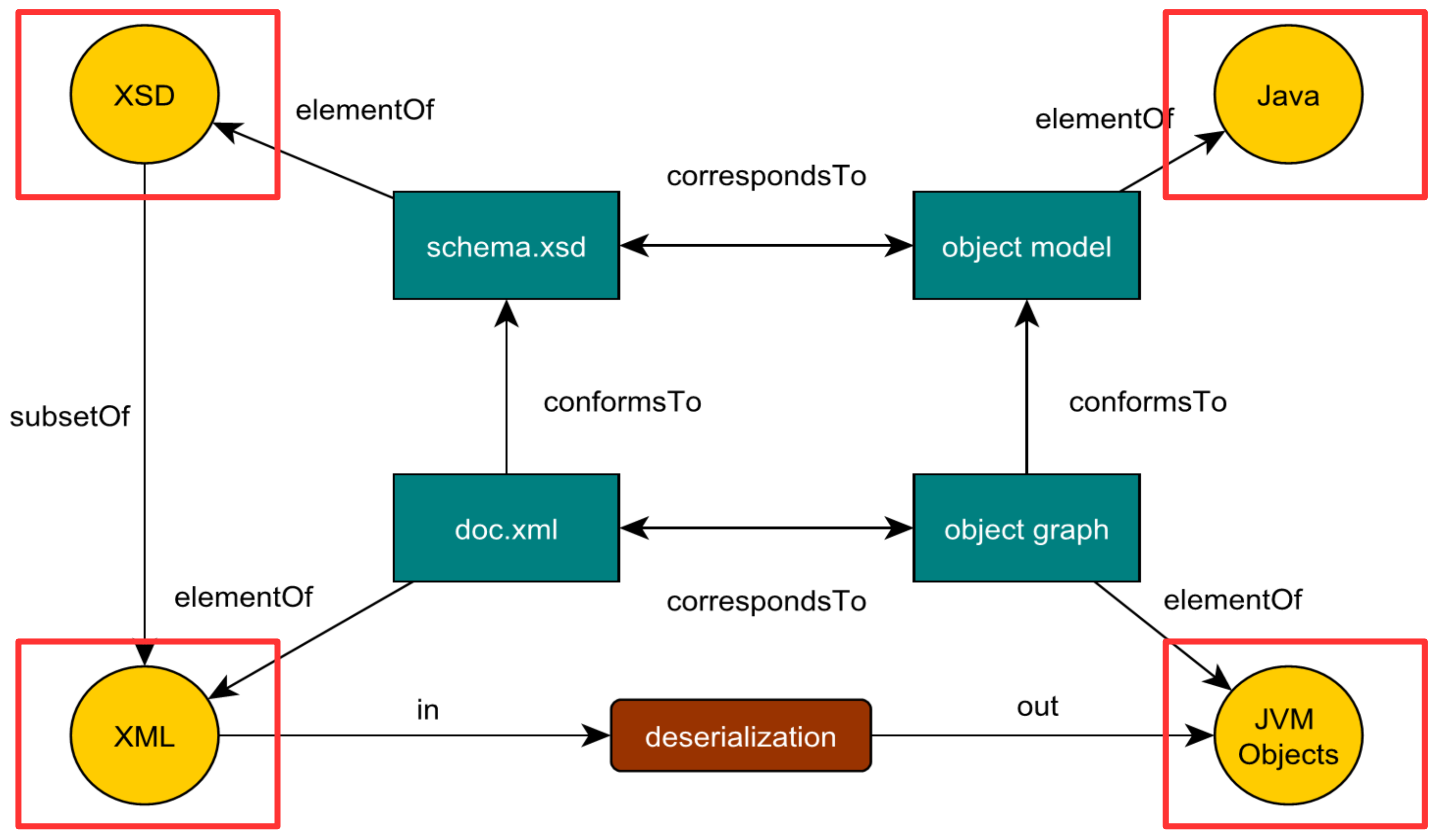
Language

- A language is a set of syntactic entities.
  - Language < Entity
- A language has one specific purpose.
  - Java : ProgrammingLanguage
  - XML : MarkupLanguage
  - XSD : SchemaLanguage
  - JVMObjects : ObjectGraph

Subsets and Embedding

- A language can be a subset of another language.
  - subsetOf < Language # Language
  - XSD subsetOf XML
  - SQLDDL subsetOf SQL
- A language can be embedded into another.
  - embeddedInto < Language # Language
  - EmbeddedSQL embeddedInto Java
  - EmbeddedJavaScript embeddedInto HTML5

An Abstract Technology Model



Artifact

- An artifact is a digital entity.
  - Artifact < Entity
- An artifact is element of a language.
  - elementOf < Artifact # Language
  - schema.xsd elementOf XSD
  - doc.xml elementOf XML
  - objectmodel elementOf Java
  - objectgraph elementOf JVMObjects

Manifestation

- A manifestation describes the shape of an artifact at runtime.
  - Manifestation < Entity
  - File < Manifestation
  - Transient < Manifestation
- An artifact has a manifestation.
  - manifestsAs < Artifact # Manifestation
  - doc.xml manifestsAs File
  - objectgraph manifestsAs Transient

Definition and Conformance

- An artifact can define a language.
  - defines < Artifact # Entity
  - Java8Spec defines Java
  - *FSMLGrammar defines FSML*
- An artifact may be conform to another.
  - conformsTo < Artifact # Artifact
  - doc.xml conformsTo schema.xsd
  - objectgraph conformsTo objectmodel

Pattern

- A design pattern describes a reusable structure that addresses maintainability on the level of code.
  - DesignPattern < Entity
  - Subject-Observer : DesignPattern
- An architectural style describes a reusable structure that addresses maintainability on the level of components.
  - ArchitecturalStyle < Entity
  - Client-Server : ArchitecturalStyle

Role

- Roles relate to terminology from programming domains or technological spaces that describe kinds of artifacts.
  - Role < Entity
  - hasRole < Artifact # Role
- Roles imply a commonly known purpose for the artifact. E.g., a grammar fulfills the purpose of a syntactic definition.
  - Grammar : Role
  - ?grammar.g4 hasRole Grammar

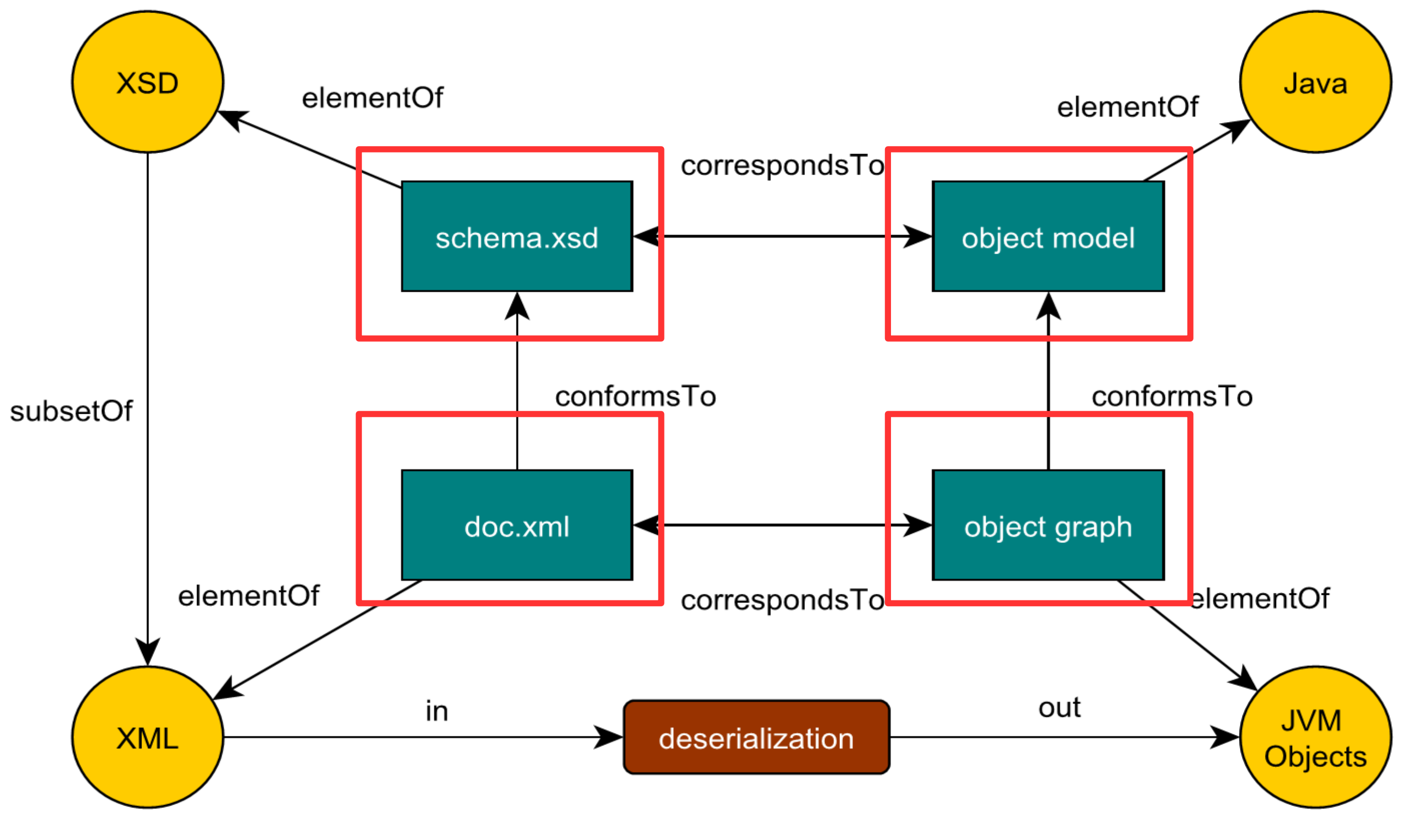
Role

- A design pattern or an architectural style may define a set of roles often referred to as participants.
  - participantOf < Role # DesignPattern
  - participantOf < Role # ArchitecturalStyle
- An artifact has a role.
  - ?models.py hasRole MvcModel

Correspondence

- An artifact can correspond to another in the sense that it is semantically but not syntactically equal.
  - correspondsTo < Artifact # Artifact
  - objectgraph correspondsTo doc.xml
  - objectmodel correspondsTo schema.xsd

An Abstract Technology Model



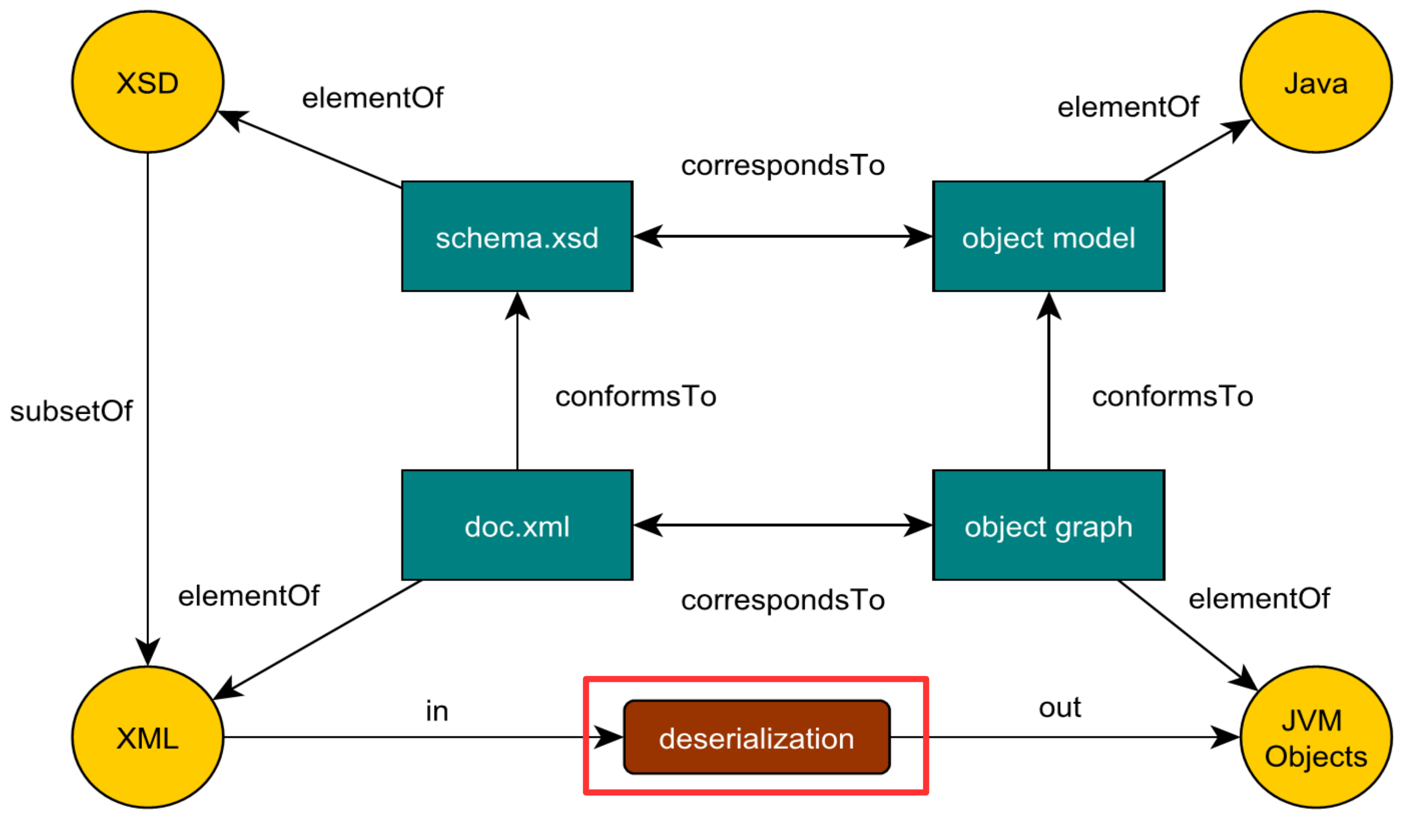
Function

- A function defines a mapping between an input and an output, which are elements of some language.
  - Function < Entity
- A function has a specific syntax.
  - serialize : JavaObject -> XML
  - cutBy : XML # Int -> XML
  - totalAndCount : XML -> Int # Int

Function Application

- A function application maps input to output.
  - deserialization(doc.xml)|-> objectgraph
  - *serialize(?aJavaObject)|->?anXMLFile*
  - *cutBy(?company1, 3)|-> ?company2*
  - *totalAndCountEmpl(?company)|-> (12000, 5)*

An Abstract Technology Model



Technology

- A technology is a reusable piece of software that has various use cases.
  - Technology < Entity

Technology Classification

- Various technology subtypes.
  - FacebookAPI : API
  - Django : Framework
  - JavaSwing : Library
  - Netbeans.RubyPlugin : Plugin
  - EMF.Core : Component
  - MicrosoftOffice2010 : SoftwareSuite
  - Eclipse : IDE
  - GHCI : Platform

Implementation

- A technology implements functions or languages and an artifact can only implement functions.
  - implements < Technology # Language
    - JAXB implements XML
  - implements < Technology # Function
    - JAXB implemets serialize
  - implements < Artifact # Function
    - CutClass implements cut

Usage Scenario

- A system represents a set of artifacts realizing some use cases.
  - System < Entity
- Various kinds of systems.
  - Application < System
  - WebApplication < System
  - FileSystem < System

Let us raise the level of abstraction more!

Paradigm

- A programming paradigm is a way of thinking to have while programming in a language that facilitates it.
  - Paradigm < Entity

Paradigm Facilitation

- A language is classified by the paradigms that it facilitates.
  - facilitates < Language # Paradigm
  - Java facilitates ObjectOrientation
- Besides being a way of thinking it has implications on the kinds of:
  - Semantics
  - Type System
  - Syntax

Domain

- A programming domain is a field of study that may be covered by conferences and communities.
  - ProgrammingDomain < Entity
- A programming domain defines ...
  - ... common requirements and problems.
  - ... terminology.
  - ... ways for technologies and languages to support it.

Domain Support

- A language or a technology may be suited to support a programming domain.
  - supports < Language # ProgrammingDomain
    - Cobol supports DatabaseProgramming
    - Java supports GeneralPurposeProgramming
  - supports < Technology # ProgrammingDomain
    - ANTLR supports MetaProgramming
    - Eclipse supports GeneralPurposeProgramming

Technology Space

- A technological space is a conceptual entity that describes a set of:
    - application scenarios.
    - software languages.
    - programming tools such as IDEs
    - technologies
    - knowledge corpora
    - conferences and communities

Technology Space

- A technological space is a conceptual entity.
  - TechnologySpace < Entity
  - GrammarWare : TechnologySpace
  - JavaWare : TechnologySpace
- A technology can belong to a technological space.
  - belongsTo < Technology # TechnologySpace
  - JAXB belongsTo JavaWare
  - ANTLR belongsTo GrammarWare

Be careful here! It gets difficult to explain such relationships.

Abstract Process

- Commonly known processes where the realization depends on the used technologies and involved languages.
  - AbstractProcess < Entity
  - Serialization : AbstractProcess
  - Compilation : AbstractProcess
  - Transformation : AbstractProcess

Construct

- A construct is an idealized constellation of artifacts where the realization depends on the program's context, and involved languages and technologies.
  - Construct < Entity
  - Semaphore : Construct

Aspects

- Abstract solutions such as constructs may be an aspect of a way of thinking or field of study.
  - aspectOf < Construct # Paradigm
    - Semaphore aspectOf ConcurrentProgramming
  - aspectOf < Construct # ProgrammingDomain
    - QuasiQuotation aspectOf MetaProgramming
  - aspectOf < AbstractProcess # ProgrammingDomain
    - Compilation aspectOf MetaProgramming
  - aspectOf < Role # ProgrammingDomain
    - Grammar aspectOf MetaProgramming

Parthood

- There exist various types of parthood.
    - partOf < Artifact # Artifact
    - partOf < Artifact # Technology
    - partOf < Artifact # System
    - partOf < Technology # Technology
    - partOf < System # System

Software Reuse

- Systems, technologies and artifacts can be reused. The using software depends on the used software.
  - uses < System # System
  - uses < System # Technology
  - uses < Technology # Technology
  - uses < Artifact # System
  - uses < System # Technology

Used Language

- Since only artifacts can be real members of a language, one may still be interested in which languages are used in a composed piece of software.
  - uses < Artifact # Language
    - DatabaseManager uses EmbeddedSQL
  - uses < System # Language
    - MyApp uses ANT
  - uses < Technology # Language
    - JDBC uses Java

Usable Ideal Solutions

- Re-usable forms of solutions can be used in the sense of realization.
  - uses < System # DesignPattern
    - MyWebApp uses MVC
  - uses < System # ArchitecturalPattern
    - MyWebApp uses LayerArchitecture
  - uses < System # AbstractProcess
    - MyWebApp uses Serialization
  - uses < System # Construct
    - MyWebApp uses MessageQueue

Usable Ideal Solutions

- For technologies such facts are of interest to developers who want to improve a technology.
  - uses < Technology # DesignPattern
    - EMF uses FactoryPattern
  - uses < Technology # ArchitecturalPattern
    - Owncloud uses ClientServer
  - uses < Technology # AbstractProcess
    - Owncloud uses Synchronization
  - uses < Technology # Construct
    - Owncloud uses SynchronizationQueue

Facilitation

- A technology facilitates the use of a design pattern or architectural style or abstract process, in the sense of a deferred usage.
  - facilitates < Technology # DesignPattern
    - Django facilitates Model-View-Controller
  - facilitates < Technology # ArchitecturalPattern
    - Chef facilitates ClientServer
  - facilitates < Technology # AbstractProcess
    - ANTLR facilitates Parsing
  - facilitates < Technology # Construct
    - JMS facilitates MessageQueue

Syntactic sugar

- Based on RDF Turtle syntax:

```
models.py : Artifact
    elementOf Python
    hasRole MvcModel
    manifestsAs File
    partOf MyWebApp
```

Abstraction

- Instances concerned with general facts need to be linked to describing resources.
  - Django = „https://www.djangoproject.com/“
- Artifacts that should exist in any usage scenario do not need to be linked.
  - ?models.py : Artifact

Abstraction

- When describing a non-abstract usage scenario, artifacts need to be linked as well.
  - ContributionsController = "https://github.com/101companies/101rails/blob/326a894e38b164c1f1508a73b1954ff807e27cf3/app/controllers/contributions_controller.rb"

Prescriptive vs Descriptive

- One should begin with stating facts in a prescriptive way without relating to a concrete use case.
- Several abstract entities are introduced first.
- A system can then be modeled in a separate module.
- The system module should make use of substitution.

Substitution

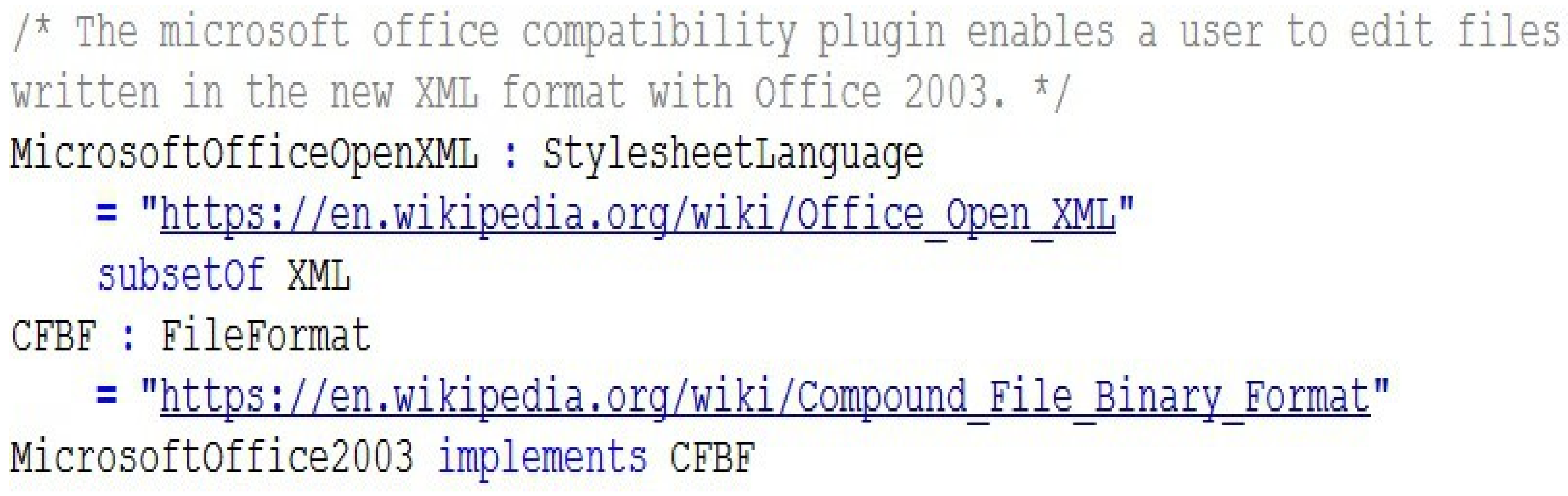
- When importing a module it is possible to substitute abstract entities by concrete ones.

```
import XMLBinding where {
    MyClass substitutes ?objectModel
    MyXML substitutes ?doc.xml
}
   MyClass = "..."
   MyXML = "..."
```

Grouping

- As a modeling rule of thumb a human can perceive 7-11 model elements at once and not lose track.
- All facts in one module are split into groups.
- Every group has to start with a block comment.
- When creating groups, imagine creating a single diagram that only states an aspect.

Grouping Example



```
/* The microsoft office compatibility plugin enables a user to edit files
written in the new XML format with Office 2003. */
MicrosoftOfficeOpenXML : StylesheetLanguage
    = "https://en.wikipedia.org/wiki/Office_Open_XML"
    subsetOf XML
CFBF : FileFormat
    = "https://en.wikipedia.org/wiki/Compound_File_Binary_Format"
MicrosoftOffice2003 implements CFBF
```

Constraints

- Are implemented in the Checker and are stated in natural language in the checker's readme.