

Transformation of Protégé Ontologies into the Eclipse Modeling Framework

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Mayo Clinic

Outline

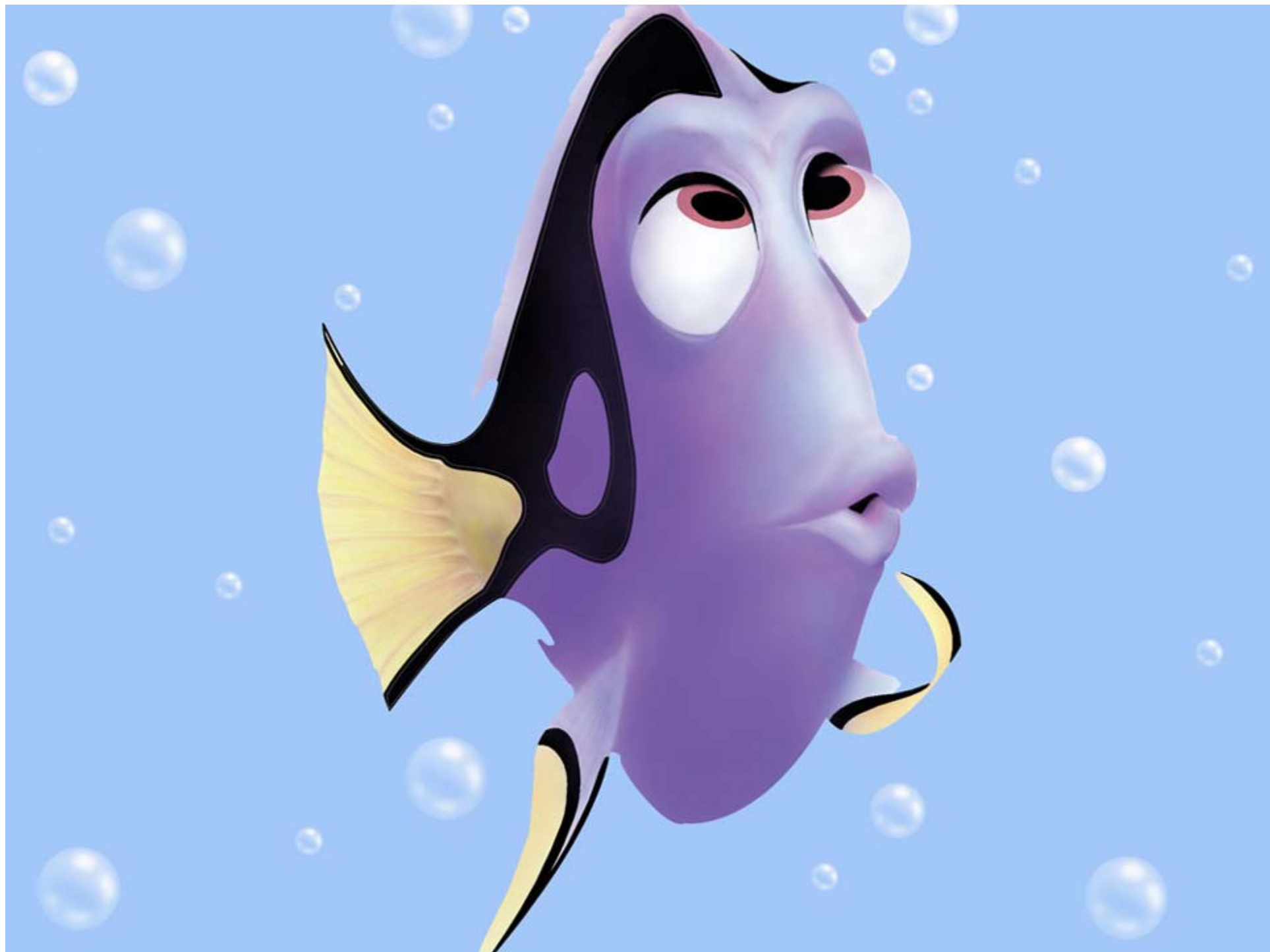
- **Motivation**
- **Eclipse Modeling Framework (EMF)**
- **EMF at work**
- **LexGrid Model & FMA Mapping**
- **FMA Transformation Example**
- **Conclusion**

Outline

- Motivation
- **Eclipse Modeling Framework (EMF)**
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Outline

**Lots of things to
talk about in short
time ☹️**



Motivation

Why do a transformation?

- Native form of FMA cannot be readily integrated into grid, databases and other terminologies
- Need to transform content into a format and structure that is readily accessible via:
 - Standard API's
 - SQL
 - ...
- The Mayo LexGrid model is one such candidate

Motivation

Why EMF ?

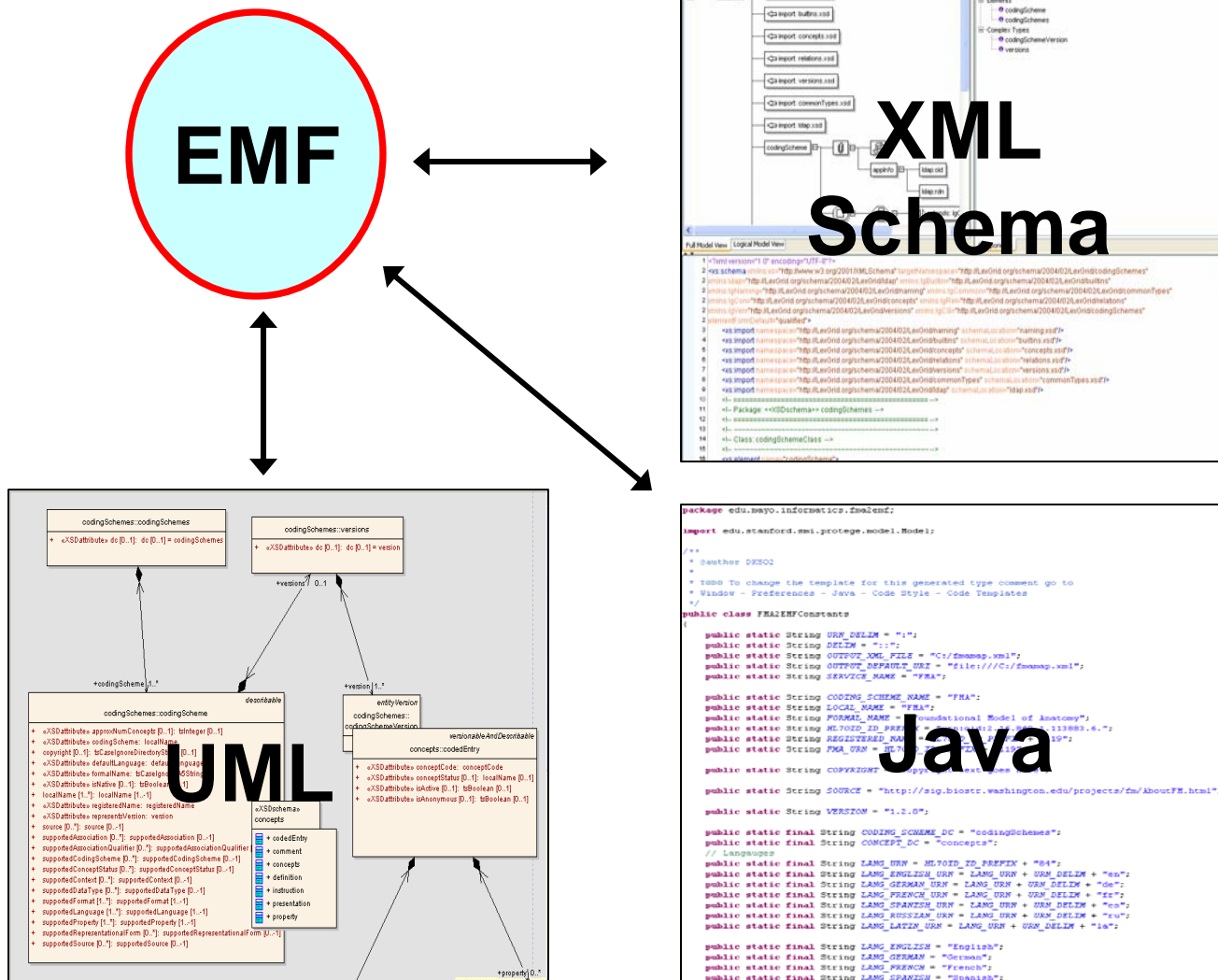
- **Easy & Simple to:**
 - **Use EMF Transformation**
 - **Integrate EMF with Protégé**
 - **Use EMF as a hub**
- **Successful FMA transformation**

What is EMF ?

Eclipse Modeling Framework

- **Framework & Code Generation tool**
- **Available with Eclipse**
- **Modeling \leftarrow EMF \rightarrow Programming**

Eclipse Modeling Framework

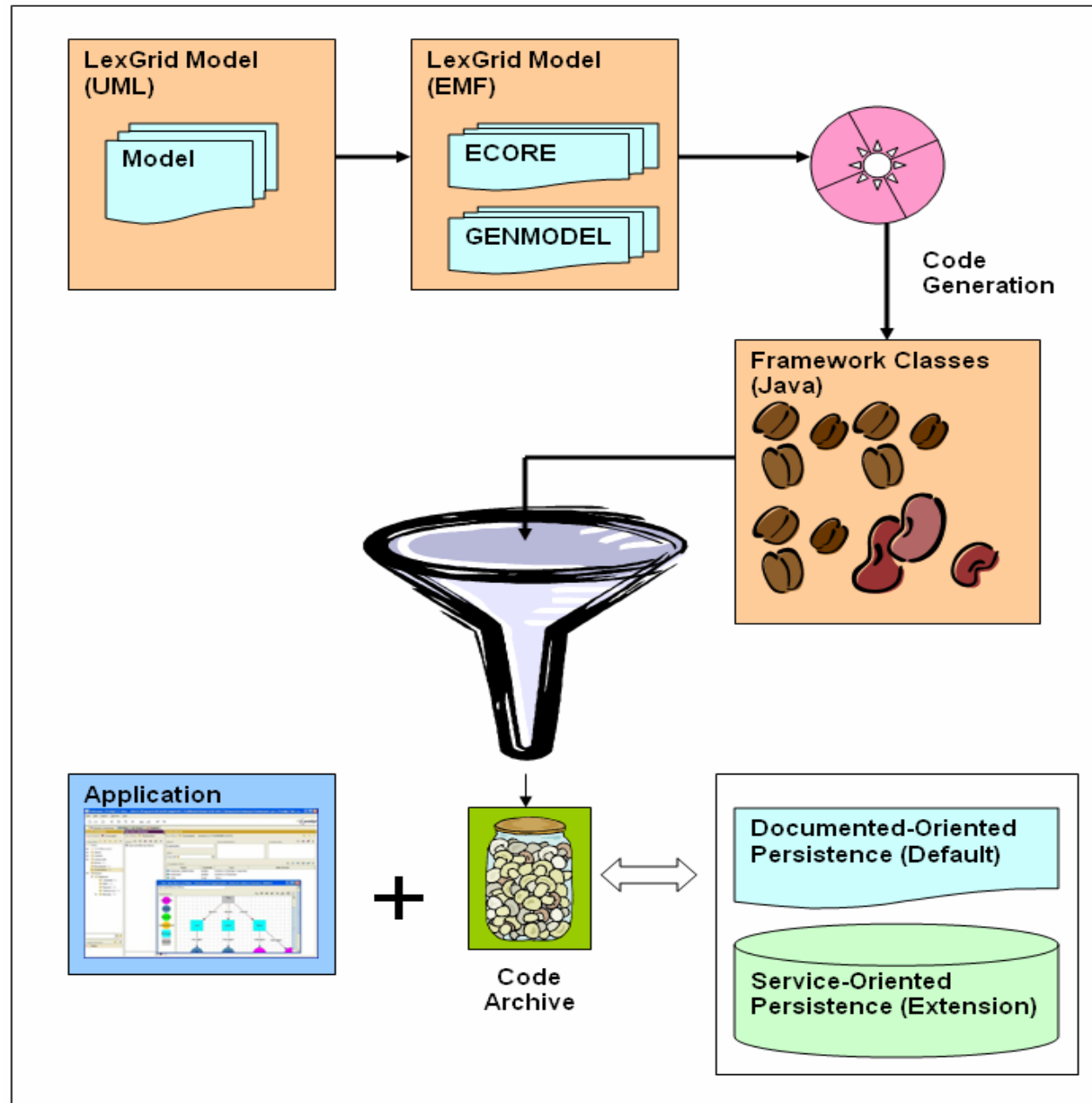


Eclipse Modeling Framework

- **Model in XMI (XML Metadata Interchange) format**
- **EMF Project**
 - **ECORE**
 - **GENMODEL**
- **Generated Code can be customized**
- **Easy to Update & Regenerate**




EMF





Eclipse Modeling Framework

<http://www.eclipse.org/emf/>



eclipse project
universal tool platform

EMF home

SDO

XSD

Downloads

Installation

Update Manager

Documentation

FAQs

Release Notes

EMF Corner

What's New, CVS?

Open Bugs

Newsgroup

tools

Downloads

CDT

GEF

COBOL

Hyades

EMF

VE

UML2

XSD

Eclipse home

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EMF

Eclipse Modeling Framework

Eclipse Modeling Framework (EMF)

EMF is a modeling framework and code generation facility for building tools and other applications based on a structured data model. From a model specification described in XMI, EMF provides tools and runtime support to produce a set of Java classes for the model, a set of adapter classes that enable viewing and command-based editing of the model, and a basic editor. Models can be specified using annotated Java, XML documents, or modeling tools like Rational Rose, then imported into EMF. Most important of all, EMF provides the foundation for interoperability with other EMF-based tools and applications.

EMF includes the [XML Schema Infoset Model \(XSD\) project](#) and an [EMF-based implementation of Service Data Objects \(SDO\)](#).

XML Schema Infoset Model (XSD)

XSD is a library that provides an [API](#) for manipulating the components of an XML Schema as described by the [W3C XML Schema](#) specifications, as well as an API for manipulating the DOM-accessible representation of XML Schema as a series of XML documents, and for keeping these representations in agreement as schemas are modified. [\[more\]](#)

Service Data Objects (SDO)

Service Data Objects (SDO) is a framework that simplifies and unifies data application development in a service oriented architecture (SOA). It supports and integrates XML and incorporates J2EE patterns and best practices. [\[more\]](#)

What is EMF?

EMF consists of three fundamental pieces:

- **EMF** - The core EMF framework includes a [meta model \(Ecore\)](#) for describing models and runtime support for the models including change notification, persistence support with default XML serialization, and a very efficient reflective API for manipulating EMF objects generically.
- **EMF.Edit** - The EMF.Edit framework includes generic reusable classes for building editors for EMF models. It provides
 1. Content and label provider classes, property source support, and other convenience classes that allow EMF models to be displayed using standard desktop (JFace) viewers and property sheets.
 2. A command framework, including a set of generic command implementation classes for building editors that support fully automatic undo and redo.
- **EMF.Codegen** - The EMF code generation facility is capable of generating everything needed to build a complete editor for an EMF model. It includes a GUI from which generation options can be specified, and generators can be invoked. The generation facility leverages the JDT (Java Development Tooling) component of Eclipse.

News

NEW Jul 7th - [Version 2.1.0](#) Release build (2.1.0) is available for [download](#).

NEW Jul 6th - [What's New in 2.1?](#) overview published.

NEW Jul 6th - [EMF 2.1 vs. E 2.0.1](#) performance results published.

- [What's New in EMF 2.1?](#) Overview

- [EMF 2.1 Release Review Present](#)

- [EMF Release Notes](#)

- [What's New \[more\]](#)

Eclipse Modeling Corner

Wanted to [contribute](#) models, project files, ideas, utilities, or code to [EMF](#) or [XSD](#)? Now you can!

Have a look, post your comments, your code, or just read what other written. [Feedback here](#).

Related links

EMF at work

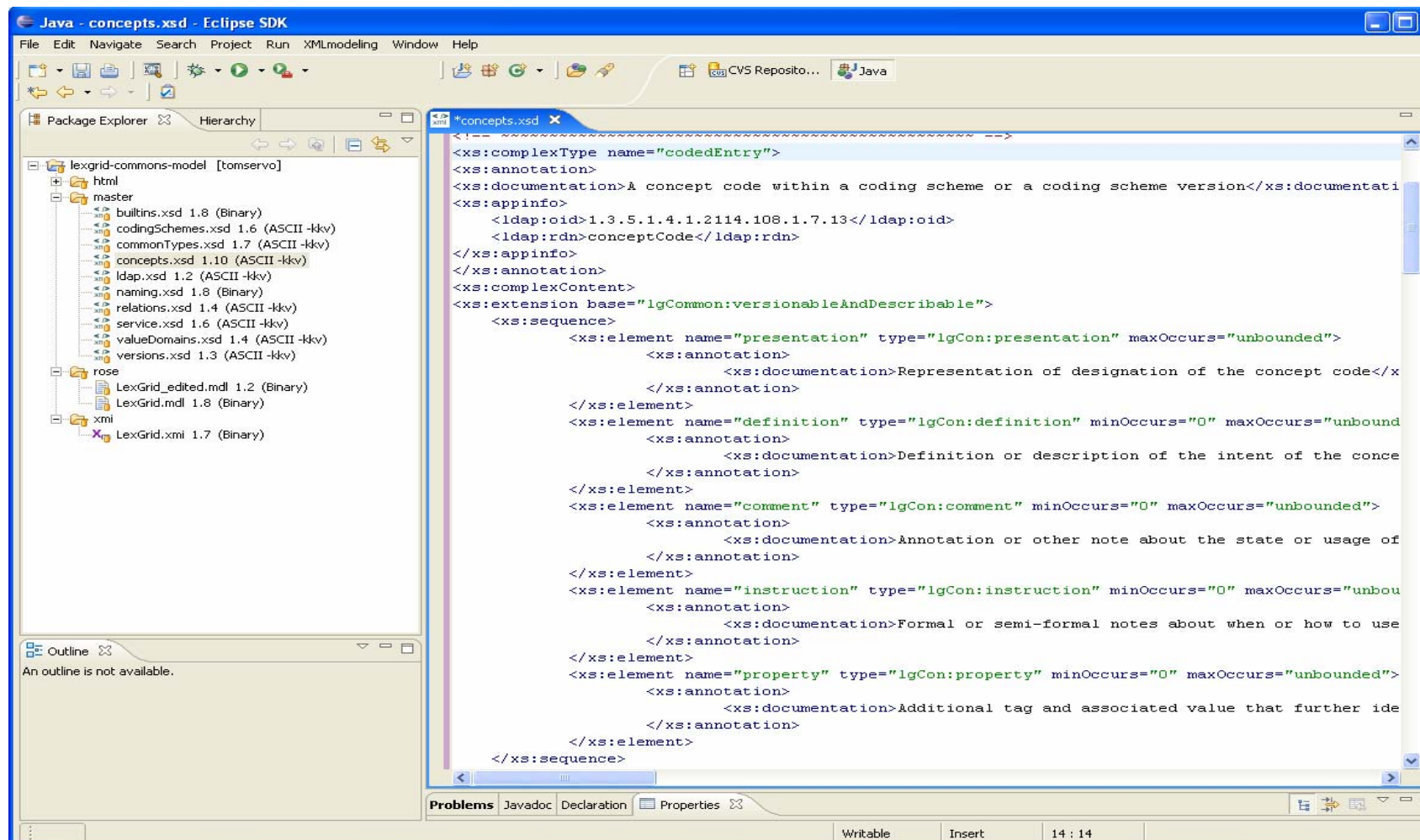
- **Model &
Representation**
- **Protégé Content**
- **Mapping**
- **Output**

EMF at work

- **Model & Representation** → **LexGrid Model in XML Schema**
- **Protégé Content** → **FMA**
- **Mapping** → **FMA to LexGrid Model**
- **Output** → **LexGrid XML Document**

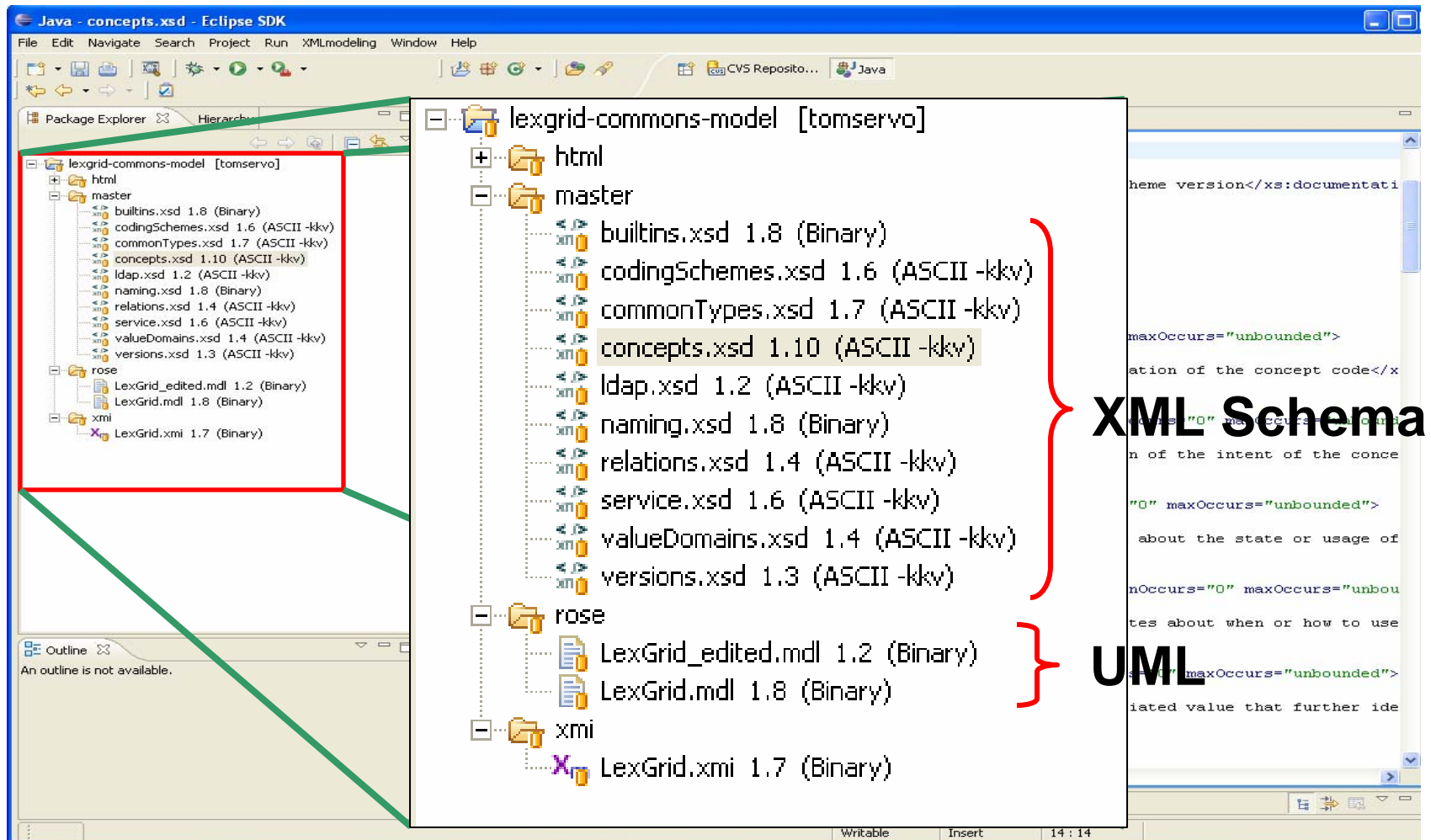
EMF at work

Model Representation



EMF at work

Model Representation

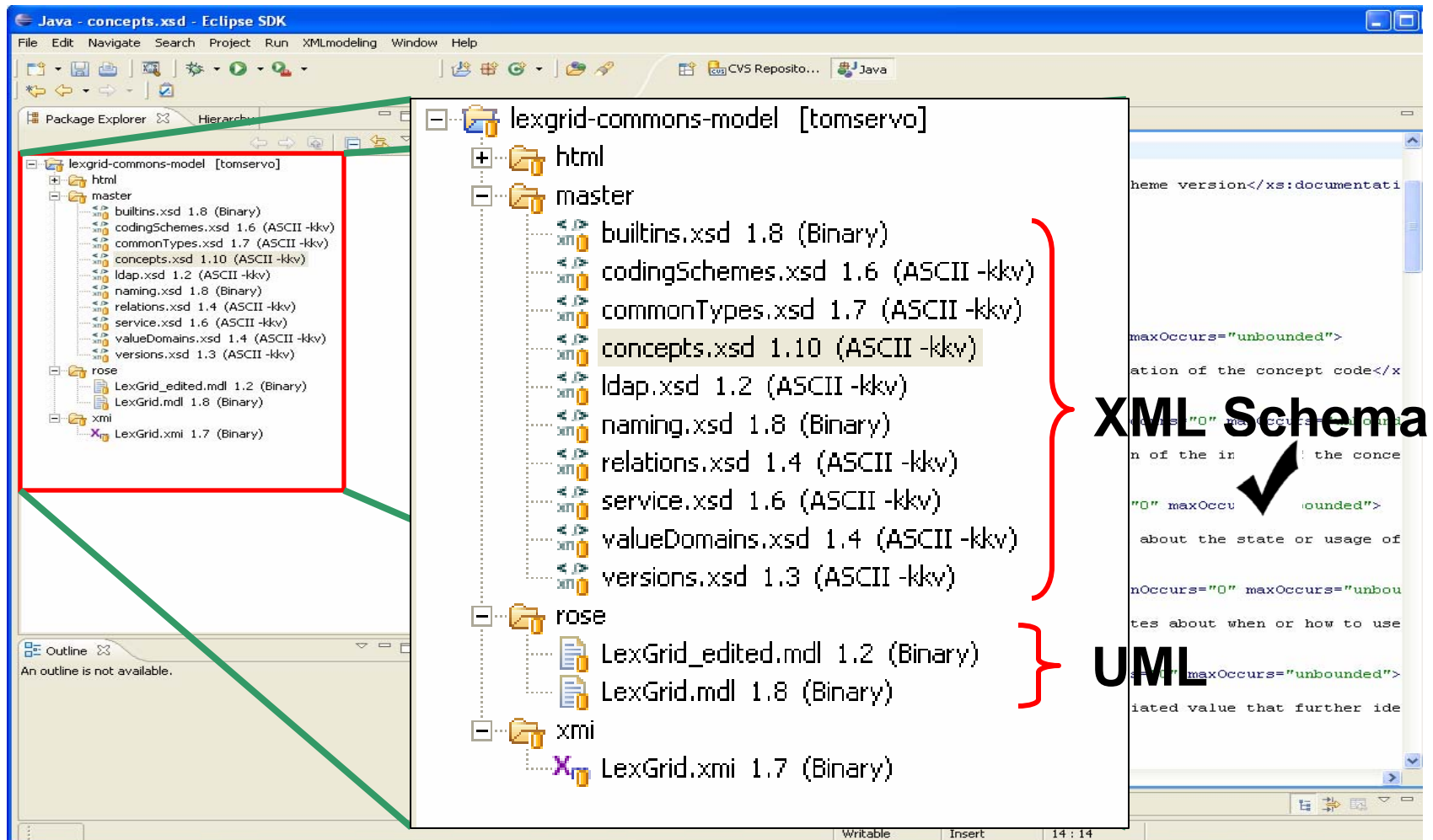


XML Schema

UML

EMF at work

Model Representation



XML Schema ✓

UML

EMF at work

Model Representation (XSD)

```
<xs:complexType name="codedEntry">
  <xs:annotation>
    <xs:documentation>A concept code within a coding scheme or a coding scheme version</xs:documentation>
  </xs:annotation>
  <xs:appinfo>
    <ldap:oid>1.3.5.1.4.1.2114.108.1.7.13</ldap:oid>
    <ldap:rdn>conceptCode</ldap:rdn>
  </xs:appinfo>
</xs:complexType>
<xs:annotation>
  <xs:documentation>Representation of designation of the concept code</xs:documentation>
</xs:annotation>
<xs:complexType>
  <xs:extension base="lgCommon:versionableAndDescribable">
    <xs:sequence>
      <xs:element name="presentation" type="lgCon:presentation" maxOccurs="unbounded">
        <xs:annotation>
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        </xs:annotation>
      </xs:element>
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        <xs:annotation>
          <xs:documentation>Formal or semi-formal notes about when or how to use the concept</xs:documentation>
        </xs:annotation>
      </xs:element>
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        <xs:annotation>
          <xs:documentation>Additional tag and associated value that further identifies the concept</xs:documentation>
        </xs:annotation>
      </xs:element>
    </xs:sequence>
  </xs:extension>
</xs:complexType>
```

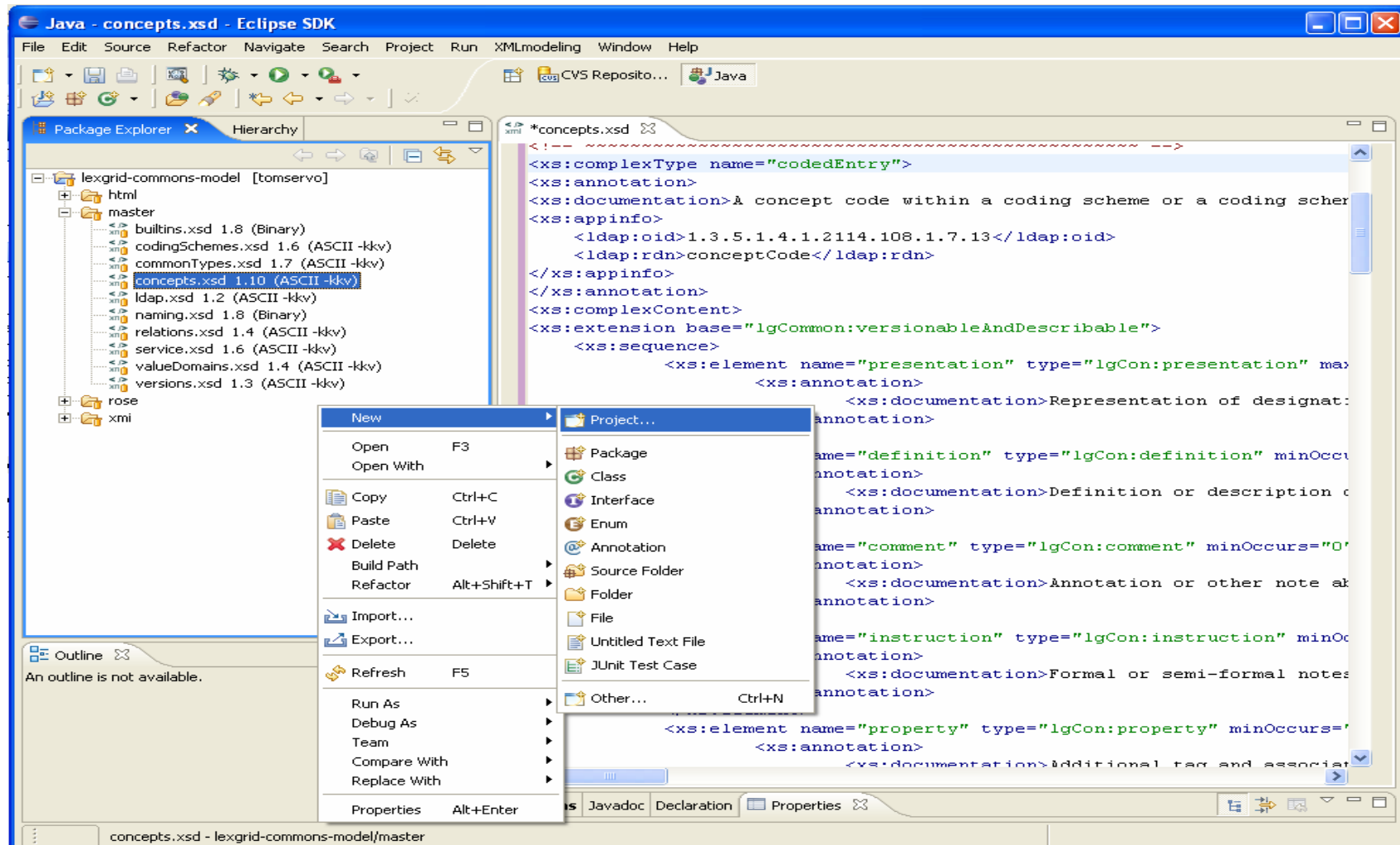
EMF at work

Model Representation (XSD)

```
<xs:complexType name="codedEntry">
  <xs:annotation>
    <xs:documentation>A concept code within a coding scheme or a coding scheme version</xs:documentation>
  </xs:annotation>
  <xs:appinfo>
    <ldap:oid>1.3.5.1.1.1.2114.108.1.7.13</ldap:oid>
    <ldap:rdn>conceptCode</ldap:rdn>
  </xs:appinfo>
</xs:complexType>
<xs:complexType name="conceptCode">
  <xs:annotation>
    <xs:documentation>Representation of designation of the concept code</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="presentation" type="lgCon:presentation" minOccurs="1" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation>Representation of designation of the concept code</xs:documentation>
      </xs:annotation>
    </xs:element>
    <xs:element name="definition" type="lgCon:definition" minOccurs="0" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation>Definition or description of the intent of the concept code</xs:documentation>
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      </xs:annotation>
    </xs:element>
  </xs:sequence>
</xs:complexType>
```

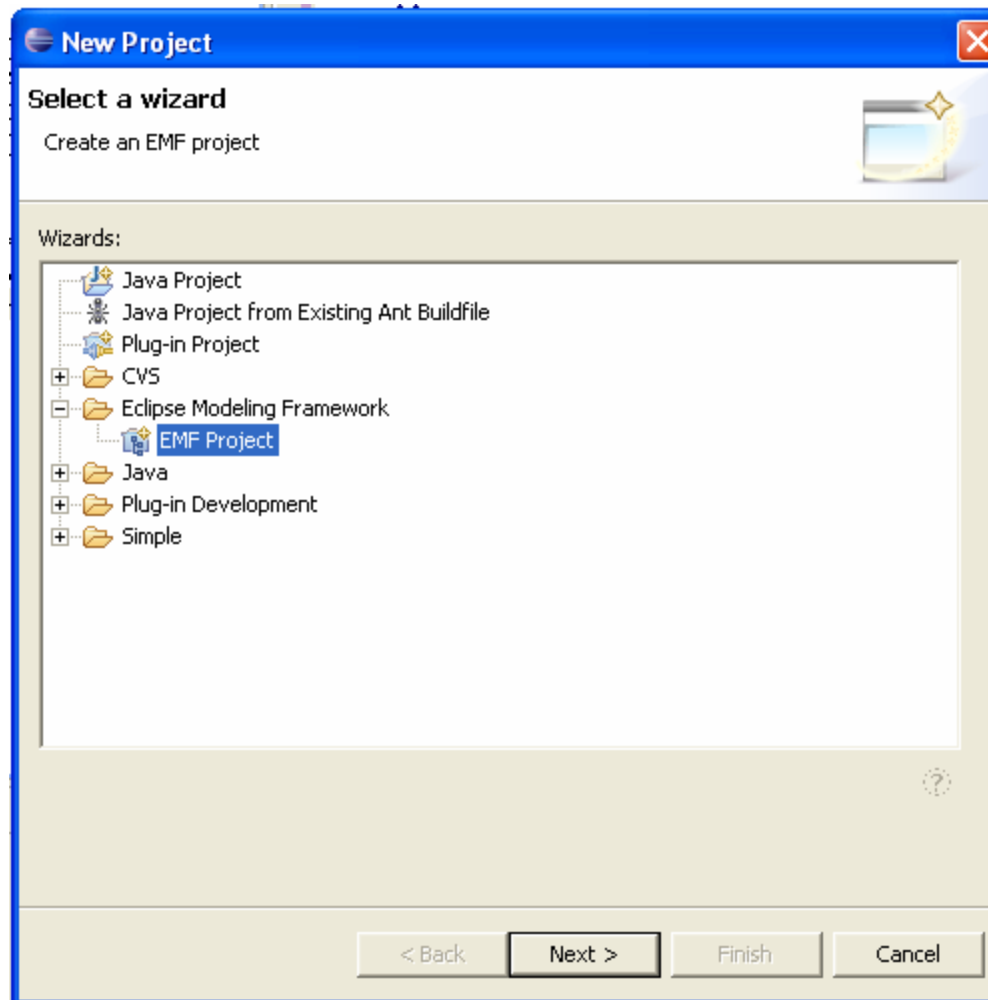
EMF at work

Create an EMF Project



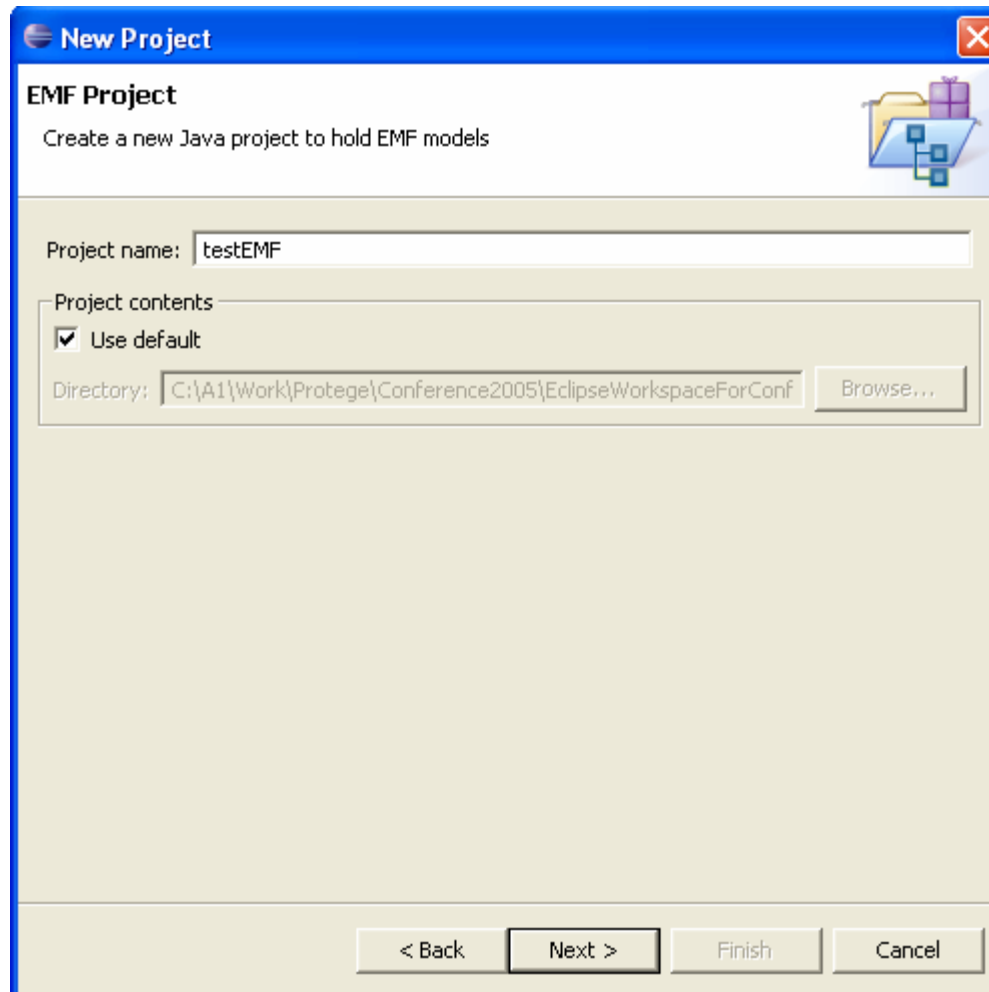
EMF at work

Create an EMF Project



EMF at work

Create an EMF Project



New Project

EMF Project
Create a new Java project to hold EMF models

Project name:

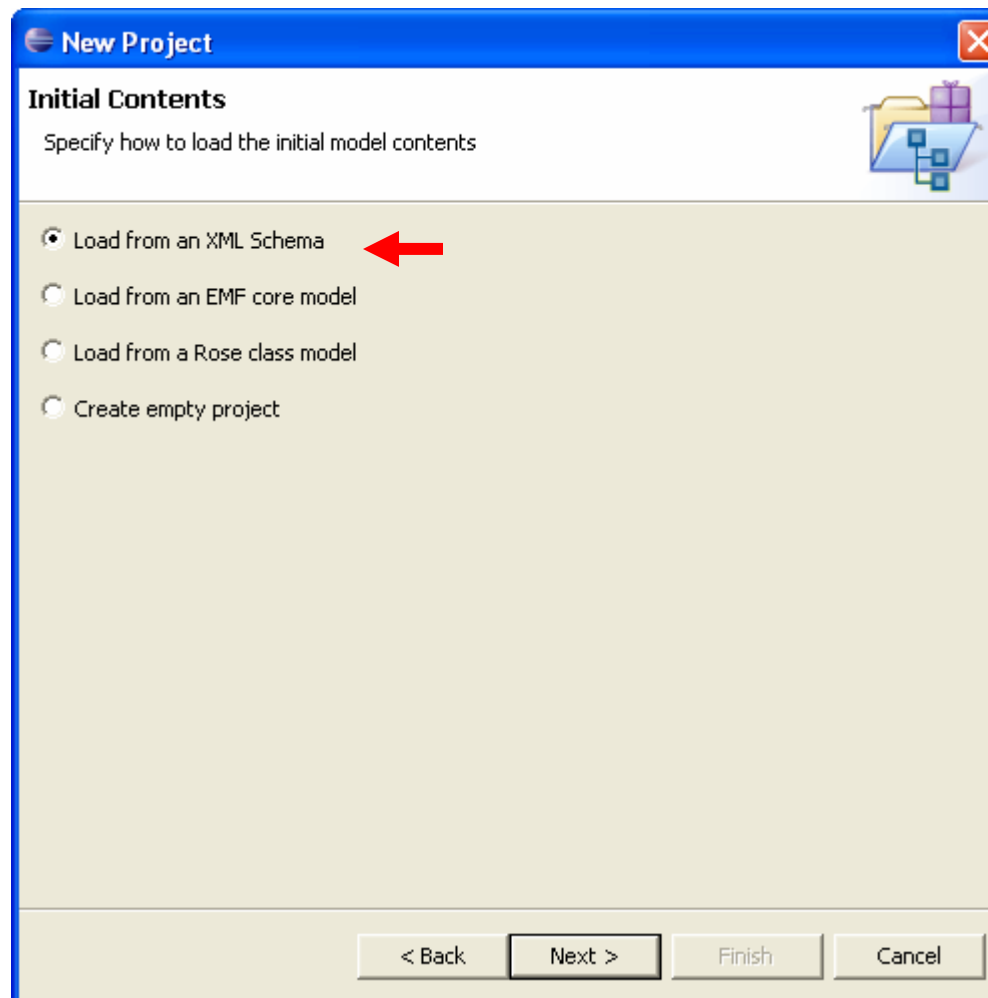
Project contents
☒ Use default

Directory:

< Back Next > Finish Cancel

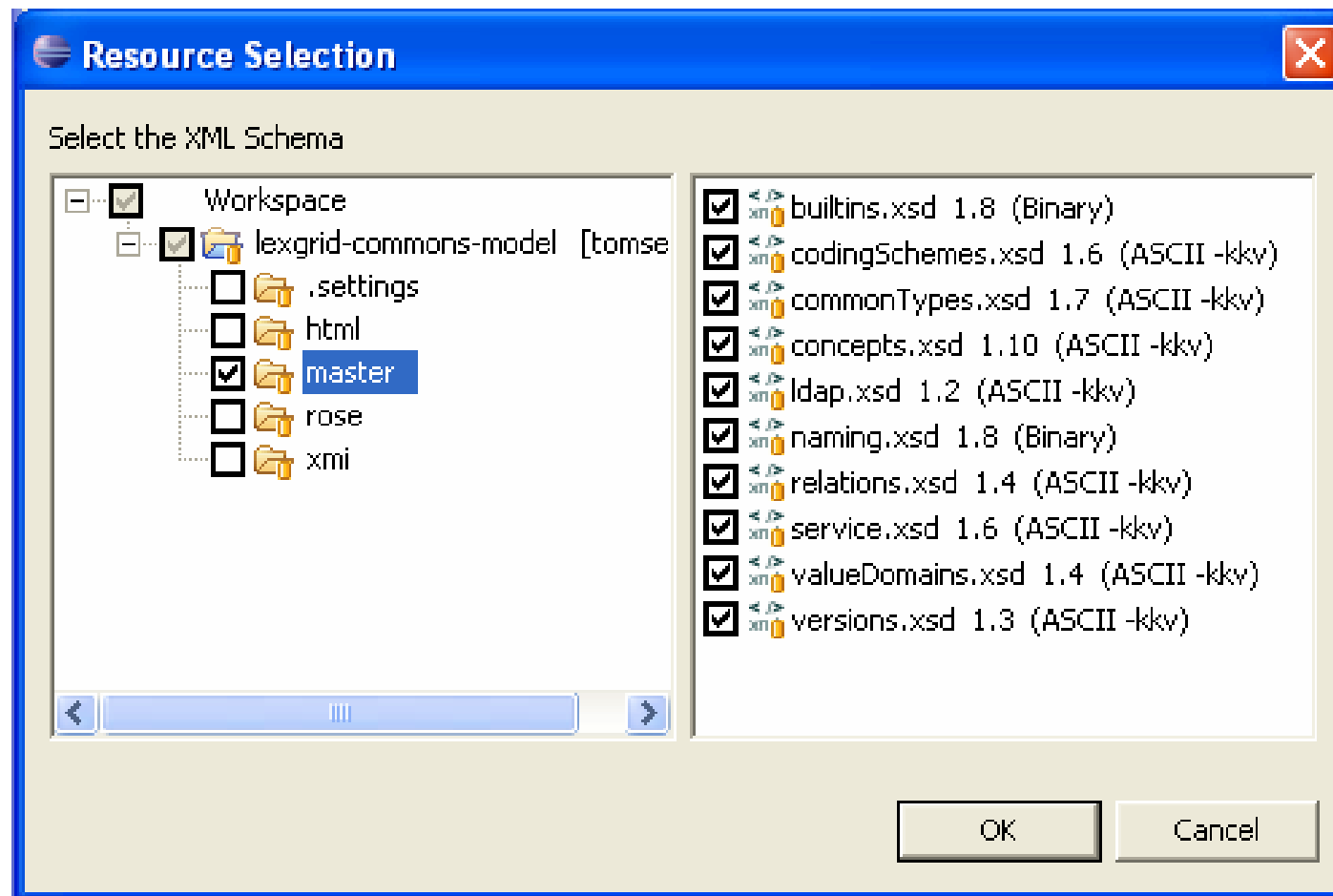
EMF at work

Create an EMF Project



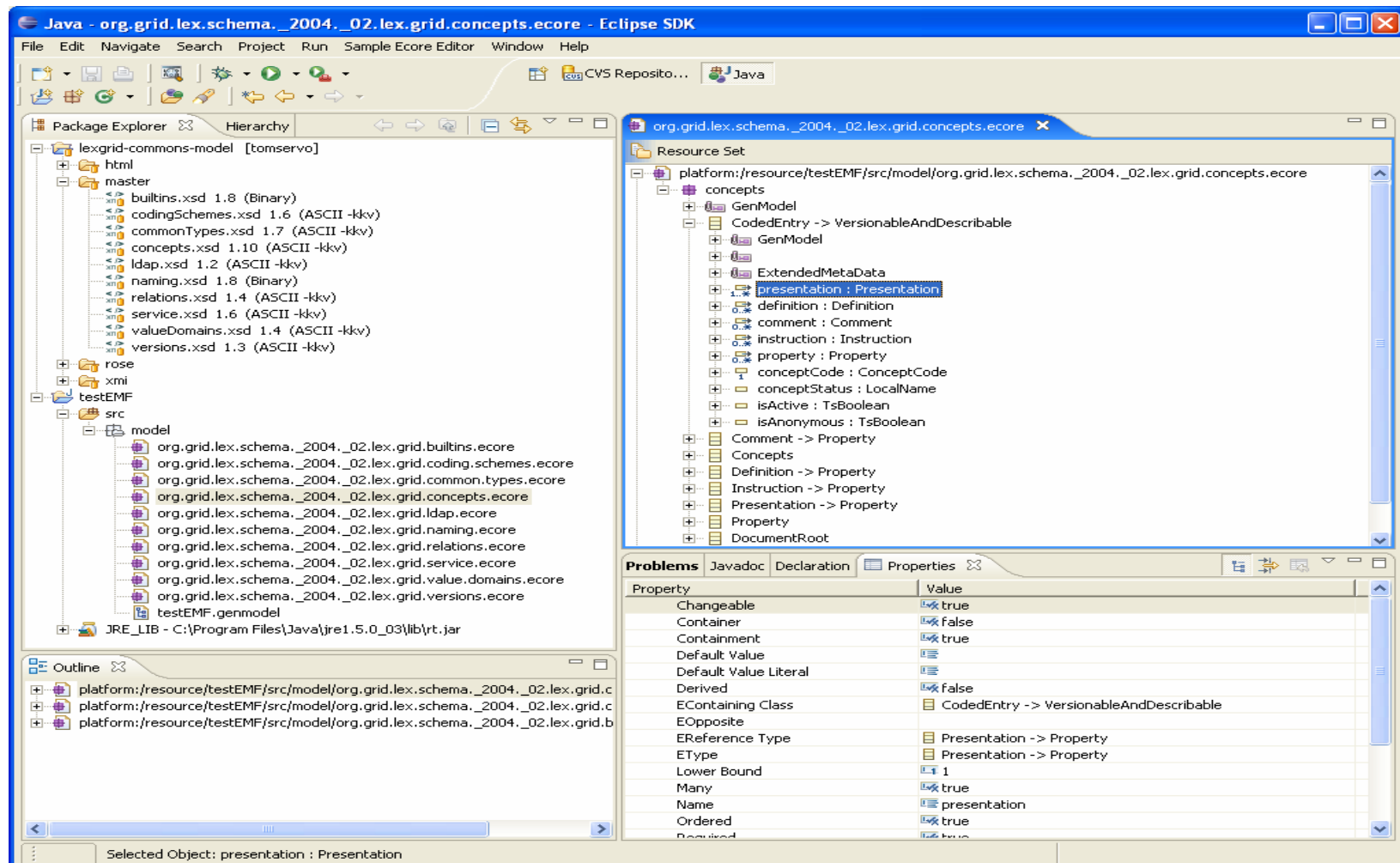
EMF at work

Create an EMF Project



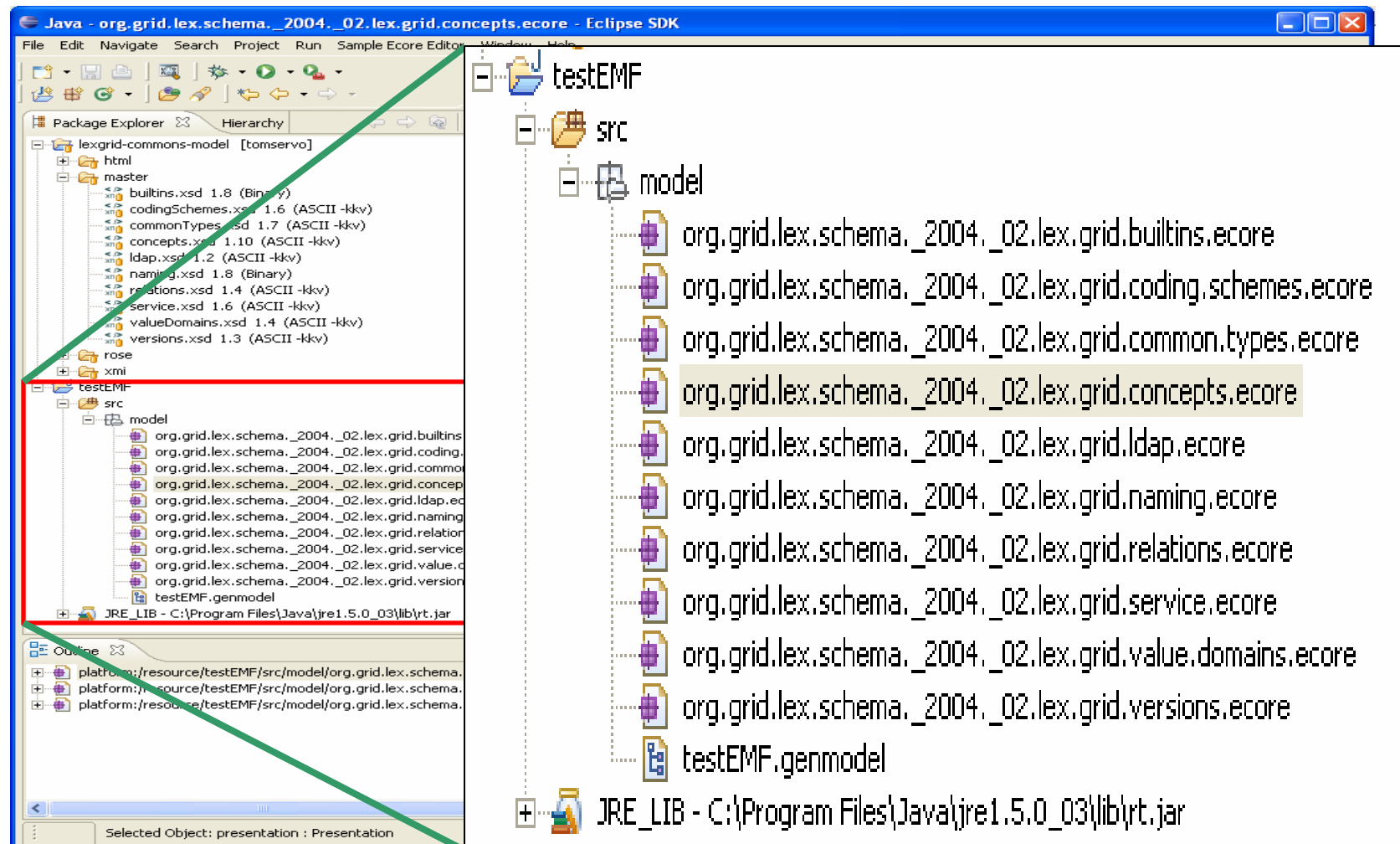
EMF at work

EMF Project Components



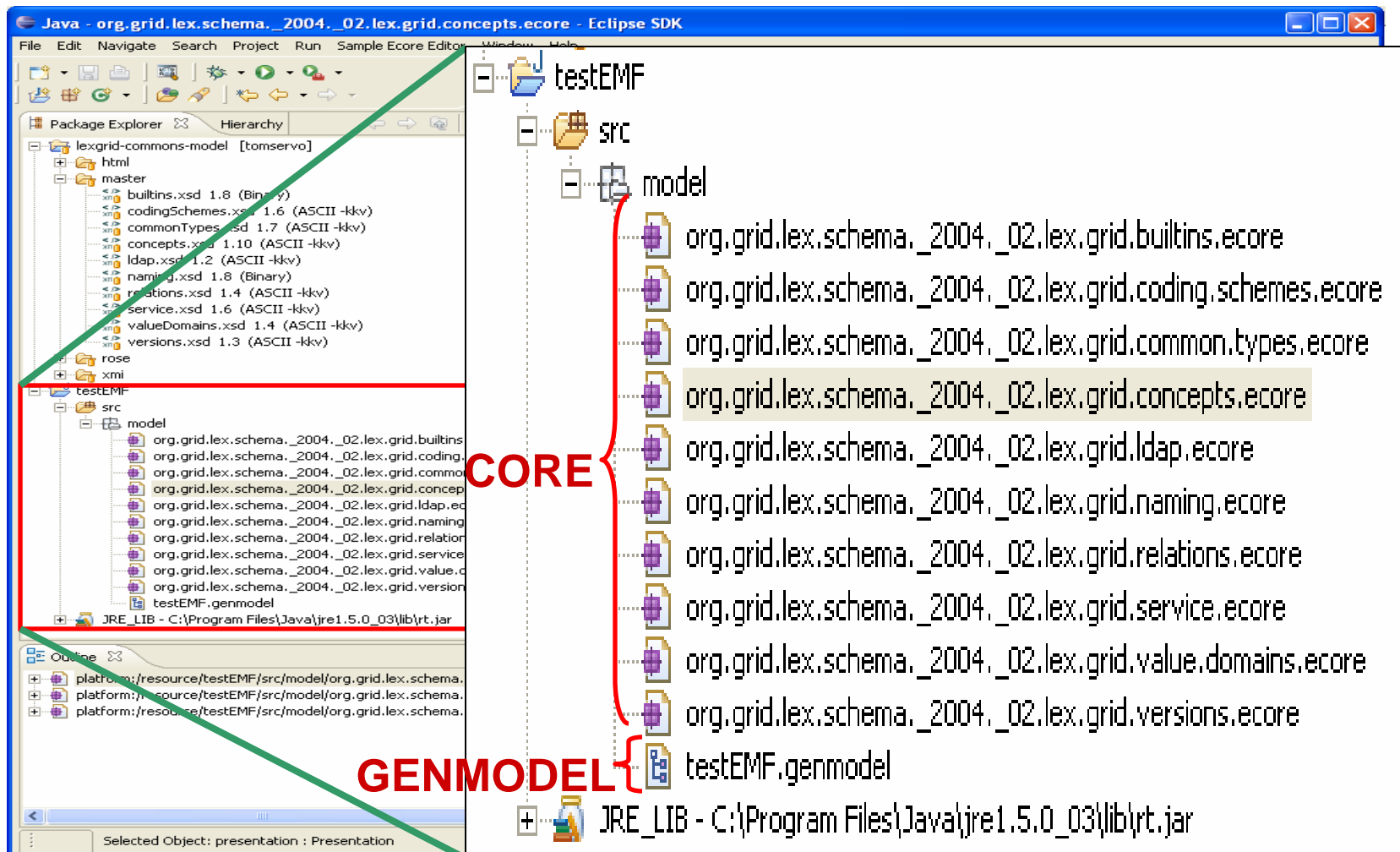
EMF at work

EMF Project Components



EMF at work

EMF Project Components



CORE

- org.grid.lex.schema._2004._02.lex.grid.builtins.ecore
- org.grid.lex.schema._2004._02.lex.grid.coding.schemes.ecore
- org.grid.lex.schema._2004._02.lex.grid.common.types.ecore
- org.grid.lex.schema._2004._02.lex.grid.concepts.ecore
- org.grid.lex.schema._2004._02.lex.grid.ldap.ecore
- org.grid.lex.schema._2004._02.lex.grid.naming.ecore
- org.grid.lex.schema._2004._02.lex.grid.relations.ecore
- org.grid.lex.schema._2004._02.lex.grid.service.ecore
- org.grid.lex.schema._2004._02.lex.grid.value.domains.ecore
- org.grid.lex.schema._2004._02.lex.grid.versions.ecore

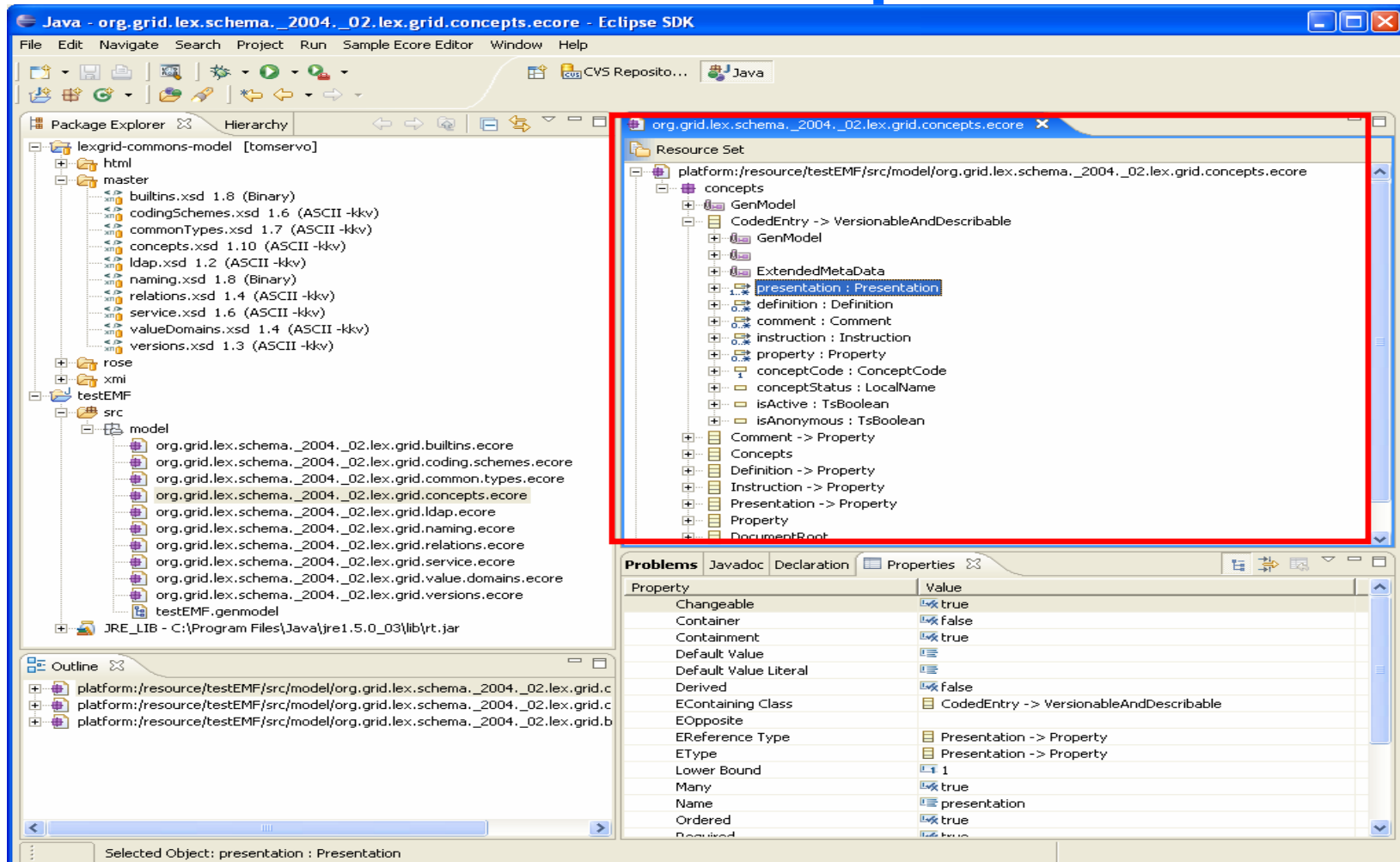
GENMODEL

- testEMF.genmodel

JRE_LIB - C:\Program Files\Java\jre1.5.0_03\lib\rt.jar

EMF at work

EMF CORE Component



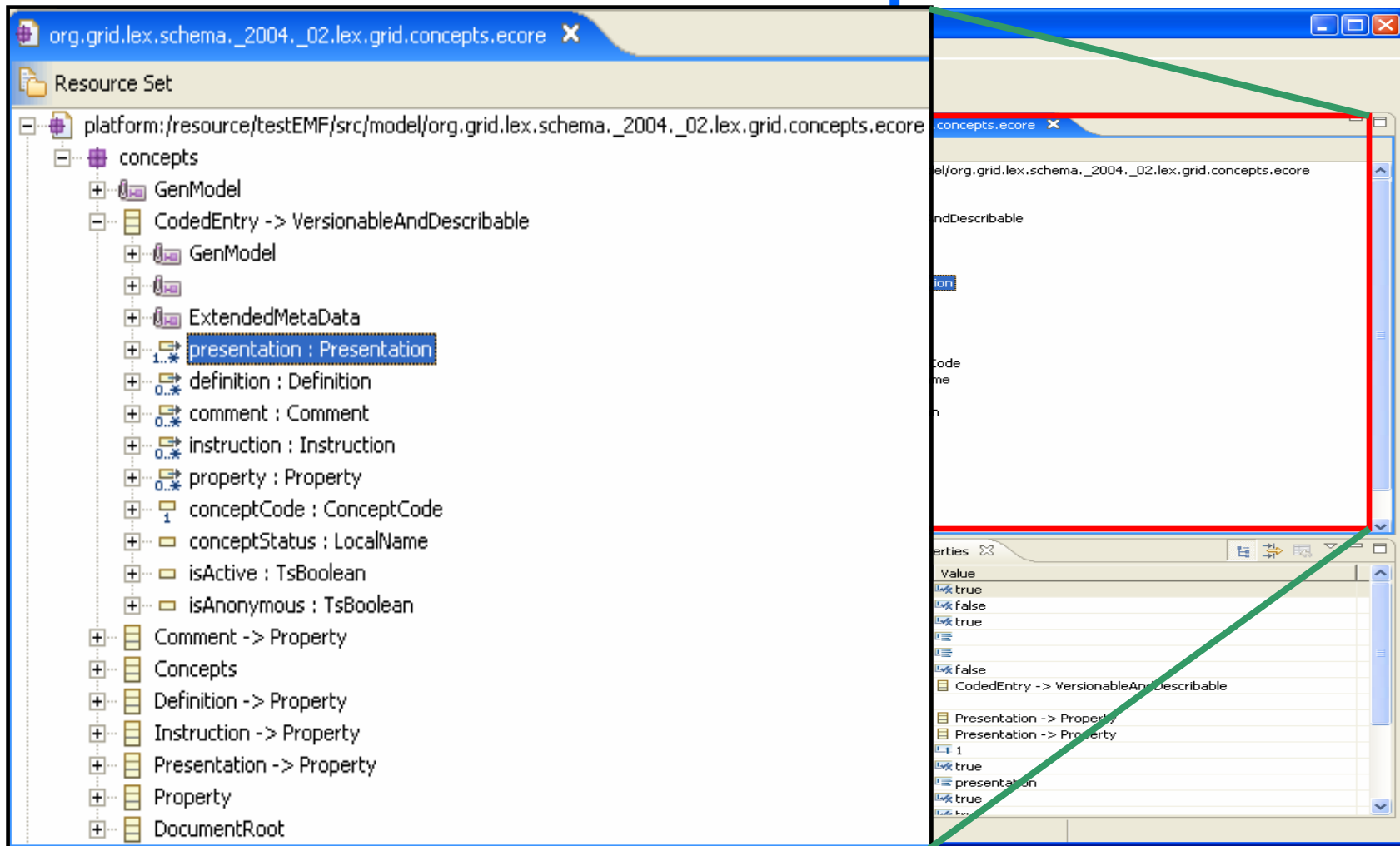
The screenshot shows the Eclipse IDE with the following components:

- Package Explorer:** Displays the project structure. The `testEMF` project is expanded, showing the `src` folder and the `model` package. The `model` package contains several Ecore models, including `org.grid.lex.schema._2004._02.lex.grid.concepts.ecore`.
- Resource Set:** Displays the contents of the selected Ecore model. The `concepts` package is expanded, showing the `GenModel` and `CodedEntry` classes. The `presentation` property is highlighted.
- Properties:** Displays the properties of the selected `presentation` property. The table below shows the properties and their values.

Property	Value
Changeable	<input checked="" type="checkbox"/> true
Container	<input checked="" type="checkbox"/> false
Containment	<input checked="" type="checkbox"/> true
Default Value	
Default Value Literal	
Derived	<input checked="" type="checkbox"/> false
EContaining Class	CodedEntry -> VersionableAndDescribable
EOpposite	
EReference Type	Presentation -> Property
EType	Presentation -> Property
Lower Bound	1
Many	<input checked="" type="checkbox"/> true
Name	presentation
Ordered	<input checked="" type="checkbox"/> true
Required	<input checked="" type="checkbox"/> true

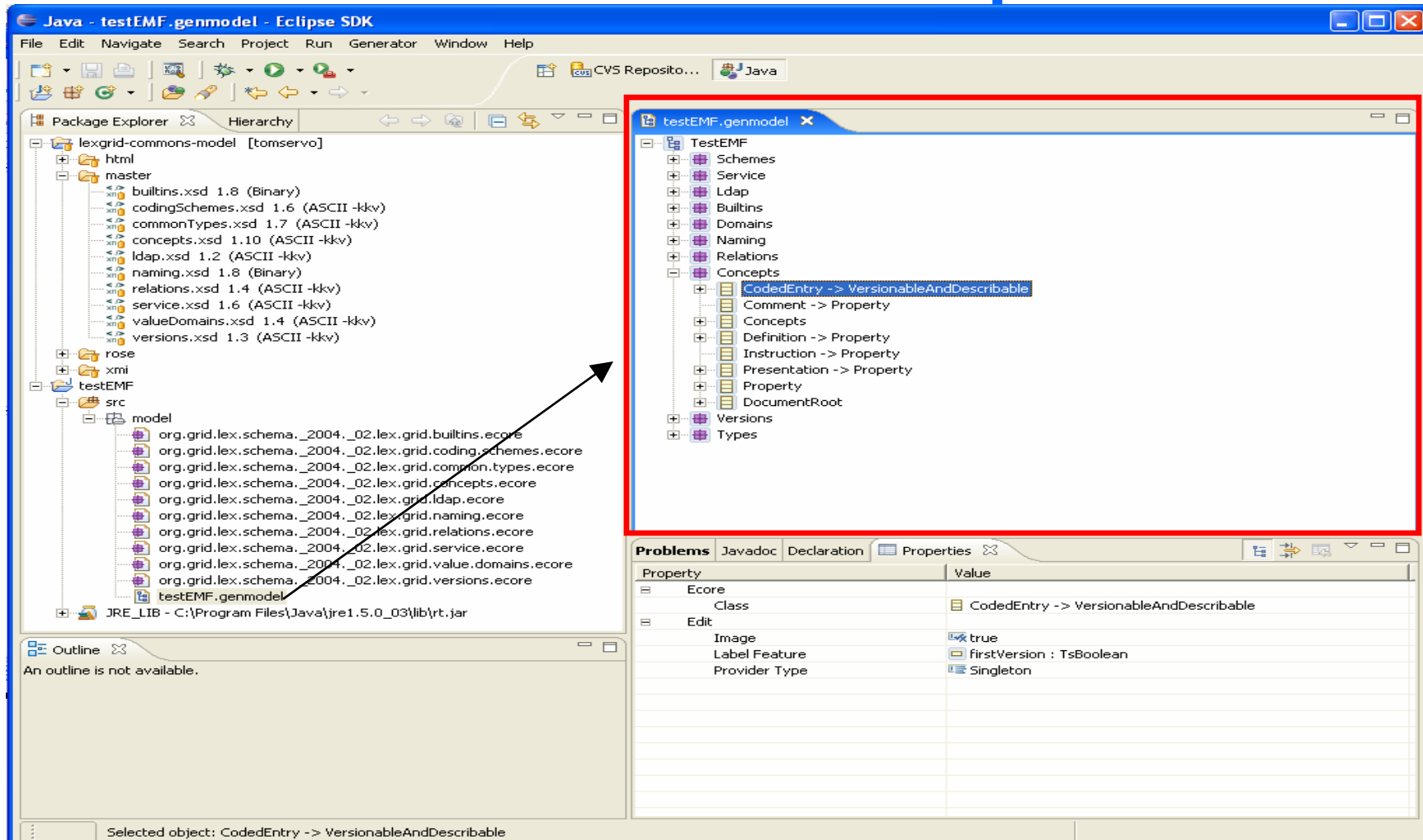
EMF at work

EMF CORE Component



EMF at work

EMF GENMODEL Component



The screenshot displays the Eclipse IDE interface for the 'testEMF.genmodel' project. The Package Explorer on the left shows the project structure, including the 'testEMF' package and its sub-packages. The 'testEMF.genmodel' editor on the right shows the 'TestEMF' package with various classes. The 'CodedEntry -> VersionableAndDescribable' class is selected, and its properties are shown in the Properties view at the bottom right.

Package Explorer (Left):

- lexgrid-commons-model [tomservo]
 - html
 - master
 - builtins.xsd 1.8 (Binary)
 - codingSchemes.xsd 1.6 (ASCII -kqv)
 - commonTypes.xsd 1.7 (ASCII -kqv)
 - concepts.xsd 1.10 (ASCII -kqv)
 - ldap.xsd 1.2 (ASCII -kqv)
 - naming.xsd 1.8 (Binary)
 - relations.xsd 1.4 (ASCII -kqv)
 - service.xsd 1.6 (ASCII -kqv)
 - valueDomains.xsd 1.4 (ASCII -kqv)
 - versions.xsd 1.3 (ASCII -kqv)
 - rose
 - xmi
 - testEMF
 - src
 - model
 - org.grid.lex.schema._2004._02.lex.grid.builtins.ecore
 - org.grid.lex.schema._2004._02.lex.grid.coding.schemes.ecore
 - org.grid.lex.schema._2004._02.lex.grid.common.types.ecore
 - org.grid.lex.schema._2004._02.lex.grid.concepts.ecore
 - org.grid.lex.schema._2004._02.lex.grid.ldap.ecore
 - org.grid.lex.schema._2004._02.lex.grid.naming.ecore
 - org.grid.lex.schema._2004._02.lex.grid.relations.ecore
 - org.grid.lex.schema._2004._02.lex.grid.service.ecore
 - org.grid.lex.schema._2004._02.lex.grid.value.domains.ecore
 - org.grid.lex.schema._2004._02.lex.grid.versions.ecore
 - testEMF.genmodel

testEMF.genmodel (Right):

- TestEMF
 - Schemes
 - Service
 - Ldap
 - Builtins
 - Domains
 - Naming
 - Relations
 - Concepts
 - CodedEntry -> VersionableAndDescribable
 - Comment -> Property
 - Concepts
 - Definition -> Property
 - Instruction -> Property
 - Presentation -> Property
 - Property
 - DocumentRoot
 - Versions
 - Types

Properties View (Bottom Right):

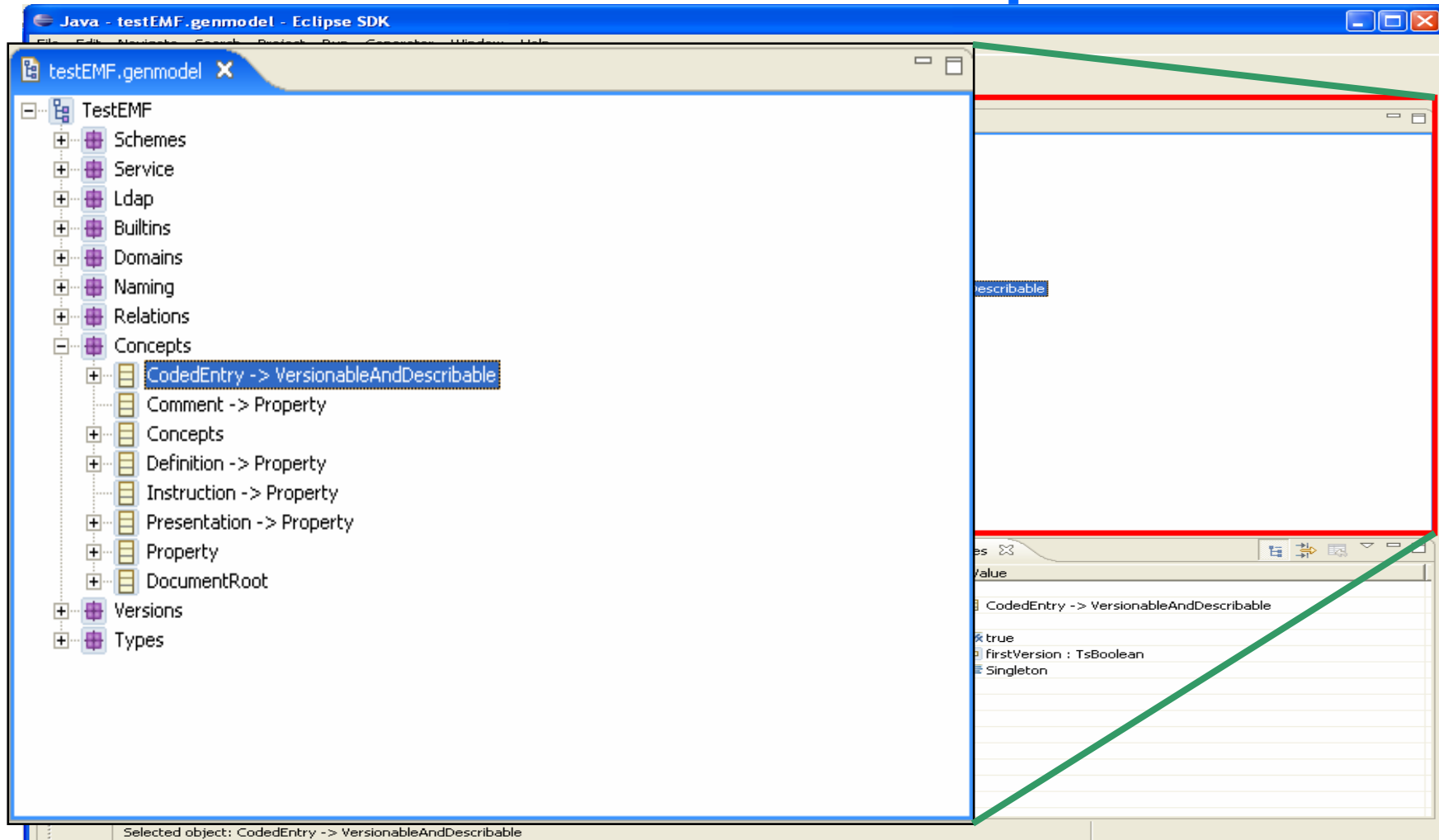
Property	Value
Ecore	
Class	CodedEntry -> VersionableAndDescribable
Edit	
Image	true
Label Feature	firstVersion : TsBoolean
Provider Type	Singleton

Selected object: CodedEntry -> VersionableAndDescribable



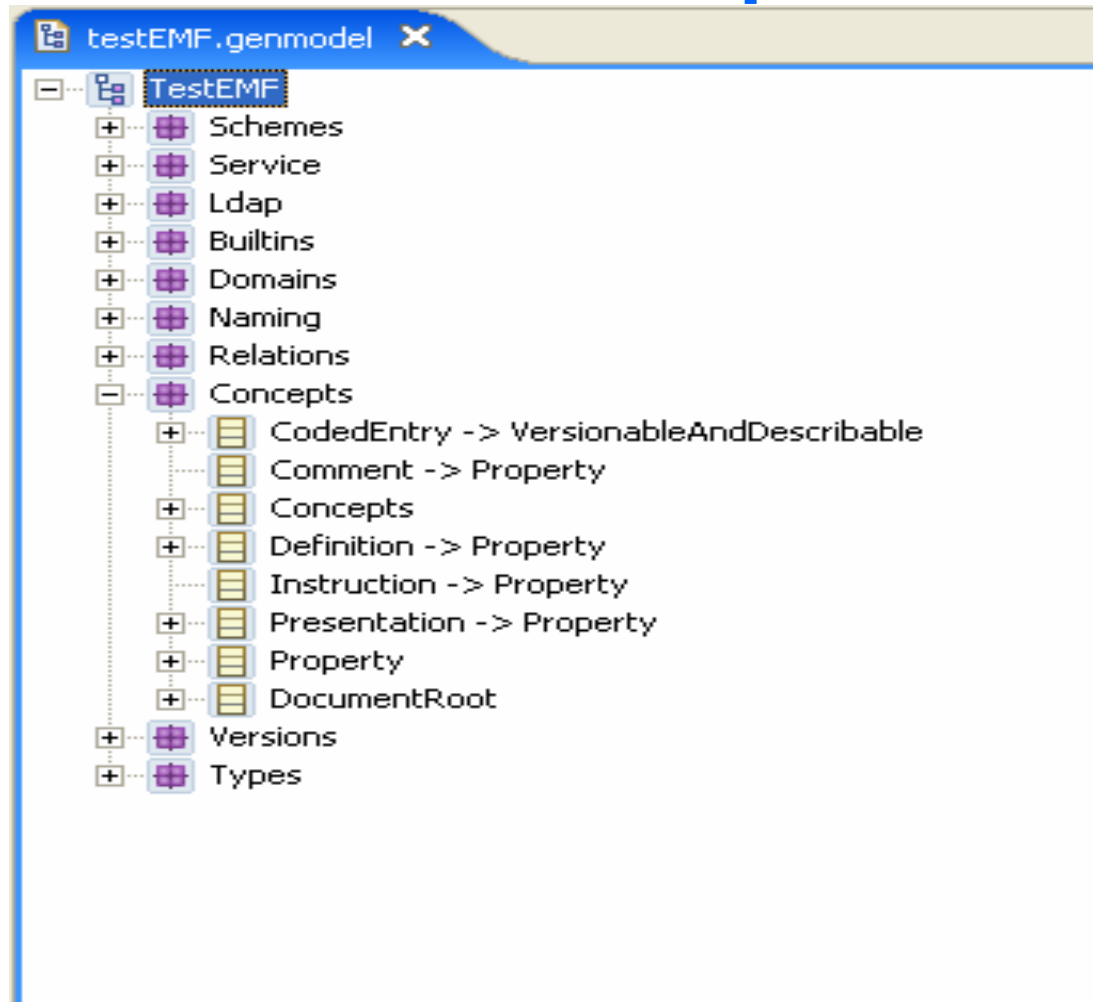
EMF at work

EMF GENMODEL Component



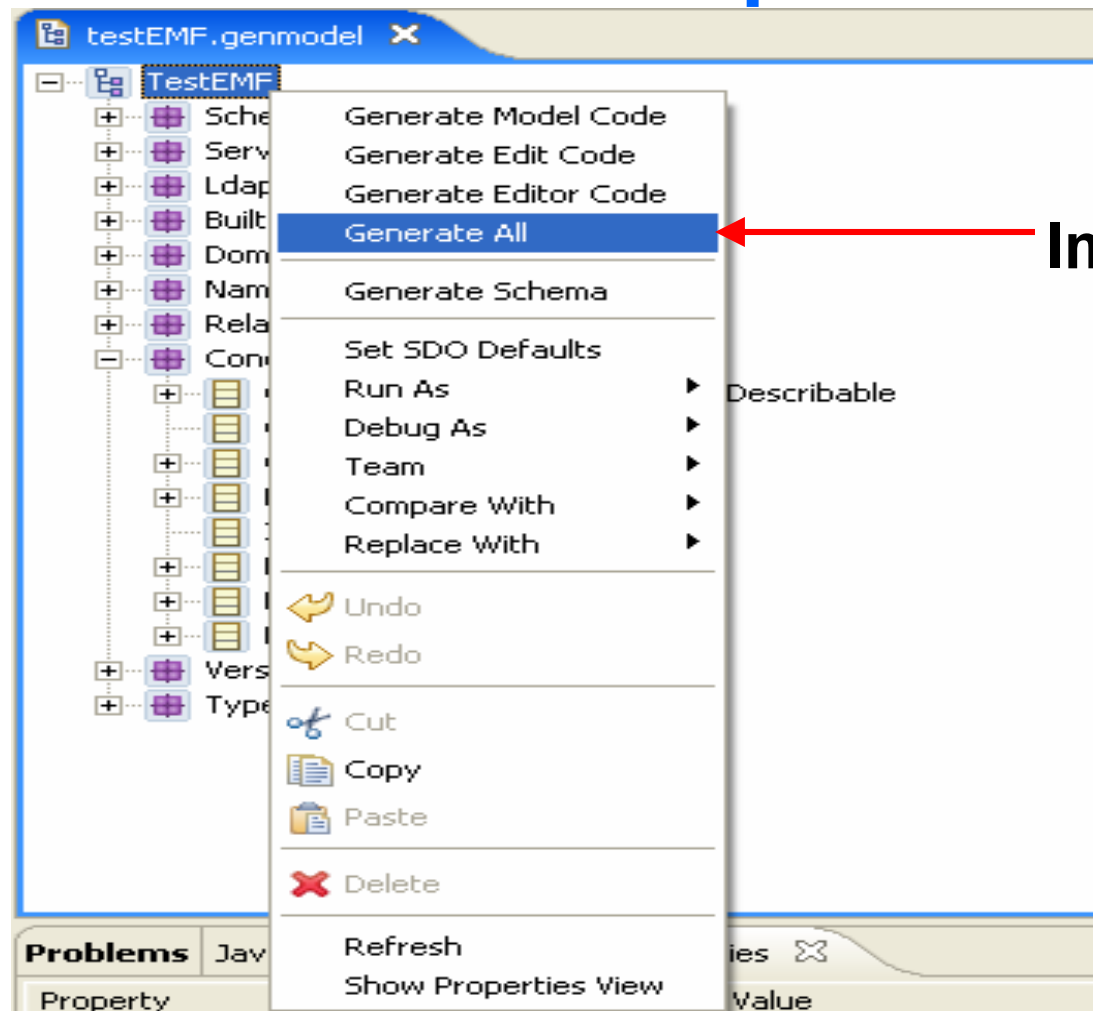
EMF at work

Generate Implementation



EMF at work

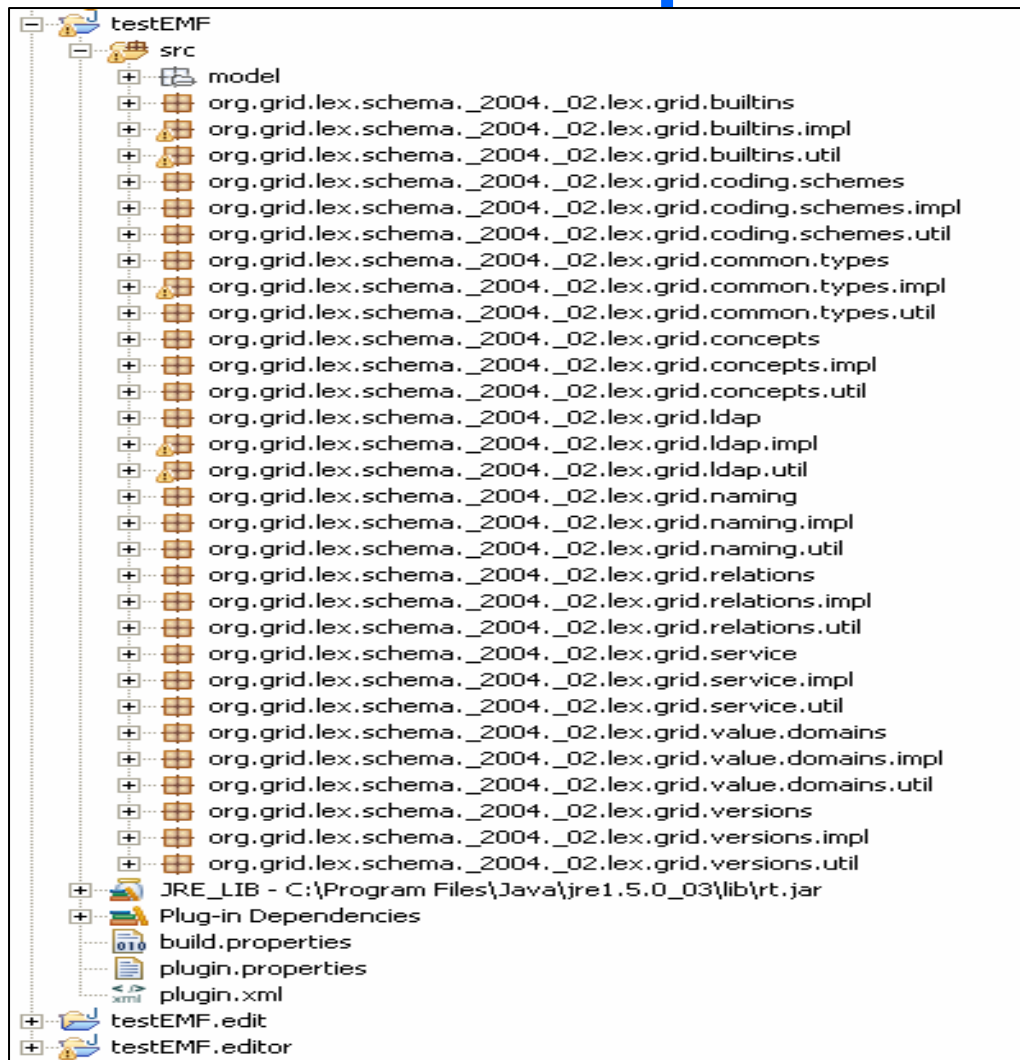
Generate Implementation



**Generates
Implementation**

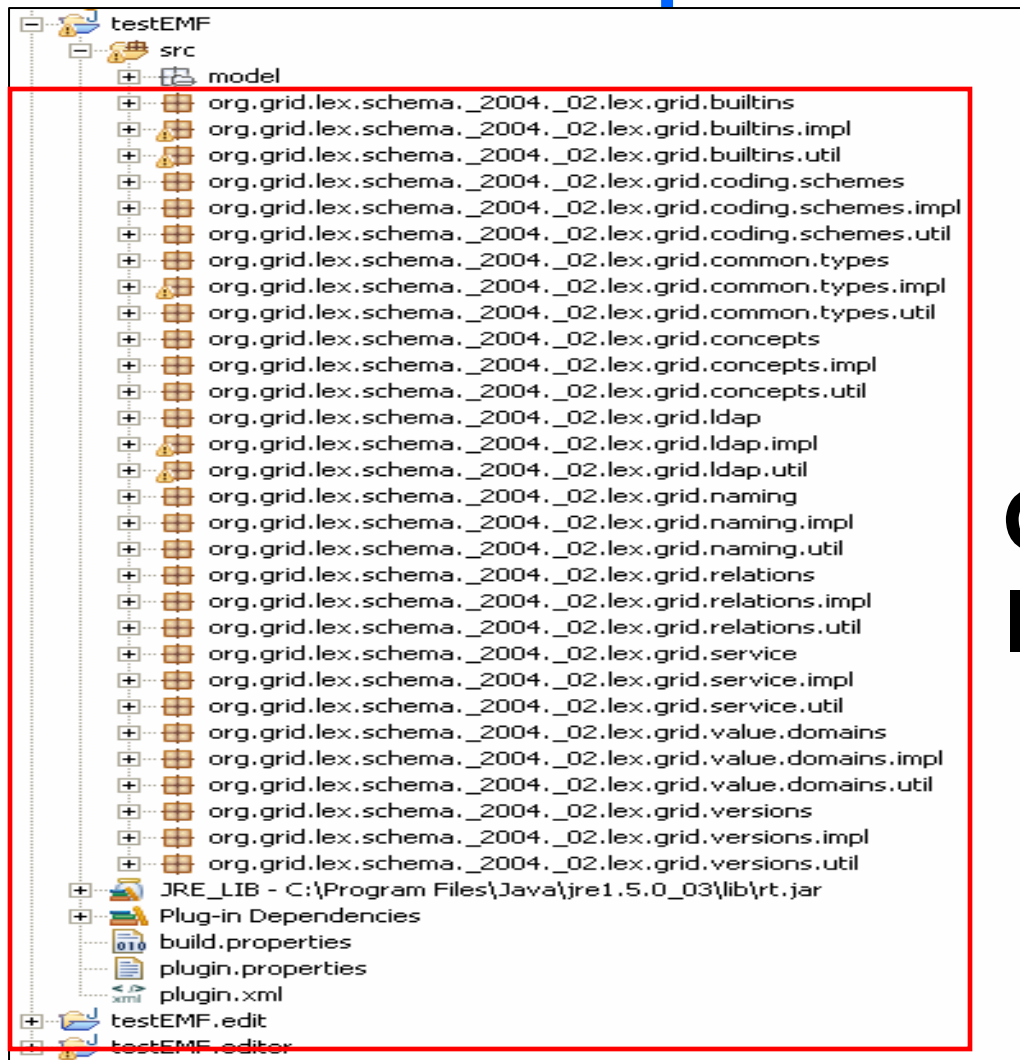


EMF at work Implementation





EMF at work Implementation



**Generated
Implementation**

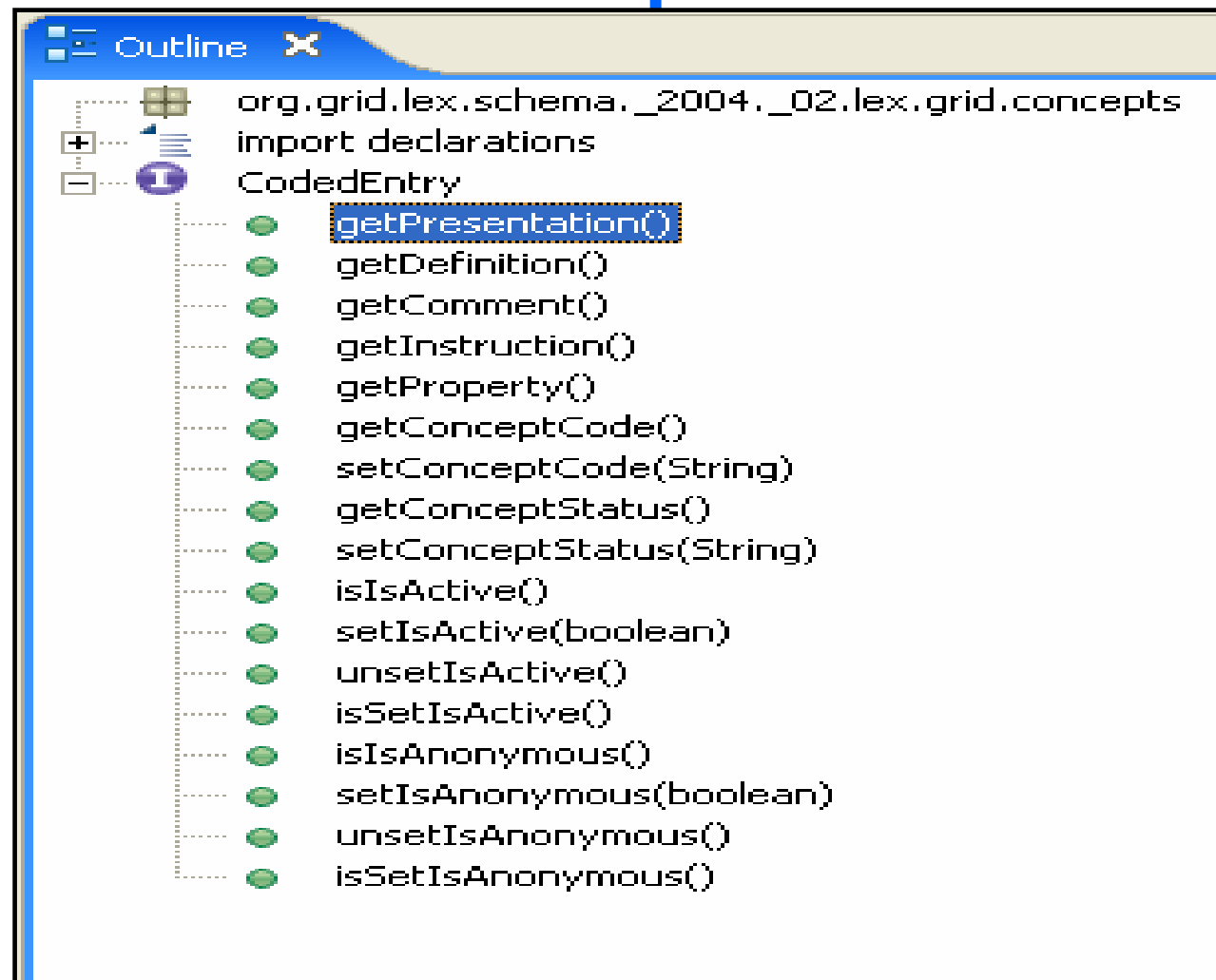
EMF at work

XML Schema Snapshot

```
<xs:complexType name="codedEntry">
  <xs:annotation>
    <xs:documentation>A concept code within a coding scheme or a coding scheme version</xs:documentation>
  </xs:annotation>
  <xs:appinfo>
    <ldap:oid>1.3.5.1.1.1.2114.108.1.7.13</ldap:oid>
    <ldap:rdn>conceptCode</ldap:rdn>
  </xs:appinfo>
</xs:annotation>
<xs:complexContent>
  <xs:extension base="lgCommon:versionableAndDescribable">
    <xs:sequence>
      <xs:element name="presentation" type="lgCon:presentation" maxOccurs="unbounded">
        <xs:annotation>
          <xs:documentation>Representation of designation of the concept code</xs:documentation>
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        <xs:annotation>
          <xs:documentation>Additional tag and associated value that further identify the concept code</xs:documentation>
        </xs:annotation>
      </xs:element>
    </xs:sequence>
  </xs:extension>
</xs:complexContent>
</xs:complexType>
```

EMF at work

Generated Implementation



EMF at work

Generated Implementation

```
*
* @generated
*/
public class CodedEntryImpl extends VersionableAndDescribableImpl implements CodedEntry {
    /**
     * The cached value of the '{@link #getPresentation() <em>Presentation</em>}' containment
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @see #getPresentation()
     * @generated
     * @ordered
     */
    protected EList presentation = null;

    /**
     * The cached value of the '{@link #getDefinition() <em>Definition</em>}' containment ref
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @see #getDefinition()
     * @generated
     * @ordered
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    protected EList definition = null;

    /**
     * The cached value of the '{@link #getComment() <em>Comment</em>}' containment reference
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     */
    protected Comment comment = null;
}
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EMF at work

Generated Implementation

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     * <!-- end-user-doc -->
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     * @ordered
     */
    protected EList comment = null;
}
```

**More
implementation
classes
snapshots**

**Later in this
presentation**

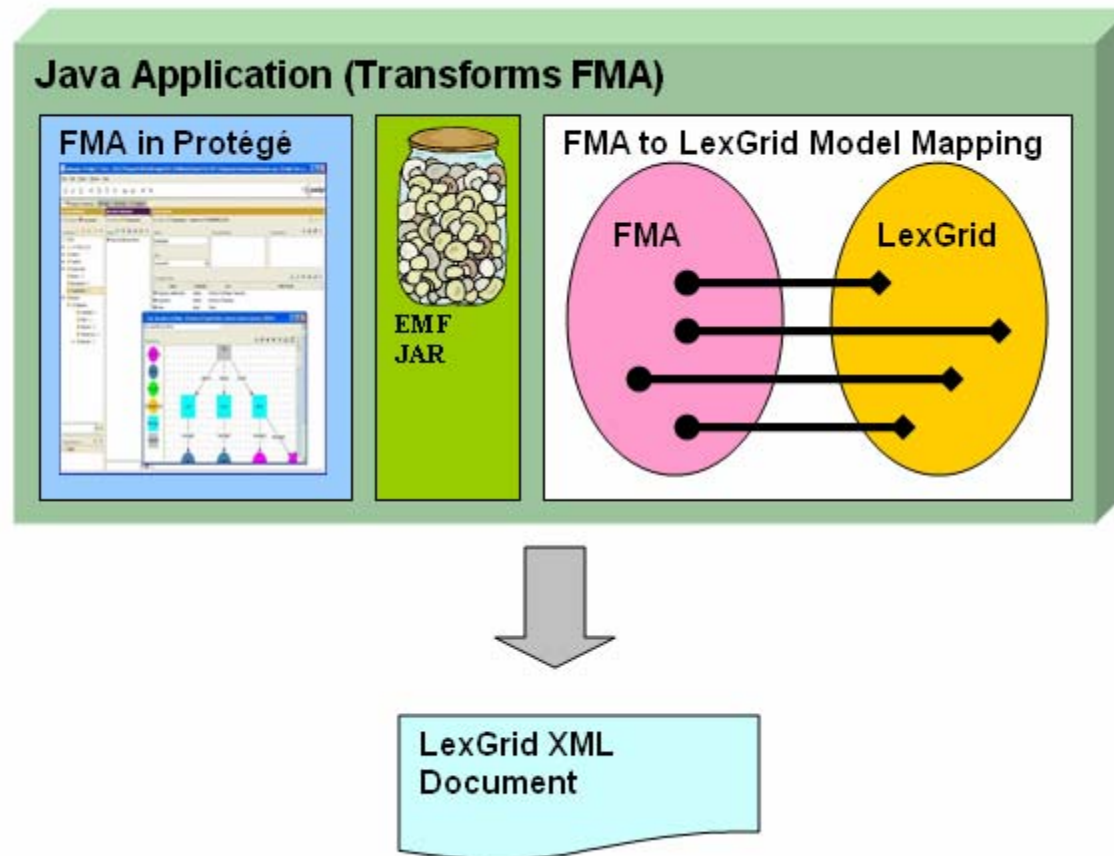
EMF at work

- **Customize the implementation**
 - **Before & After Generation**
- **Make EMF implementation available by either :**
 - **Create and include as an Archive**
 - **Application dependent on EMF implementation classes.**

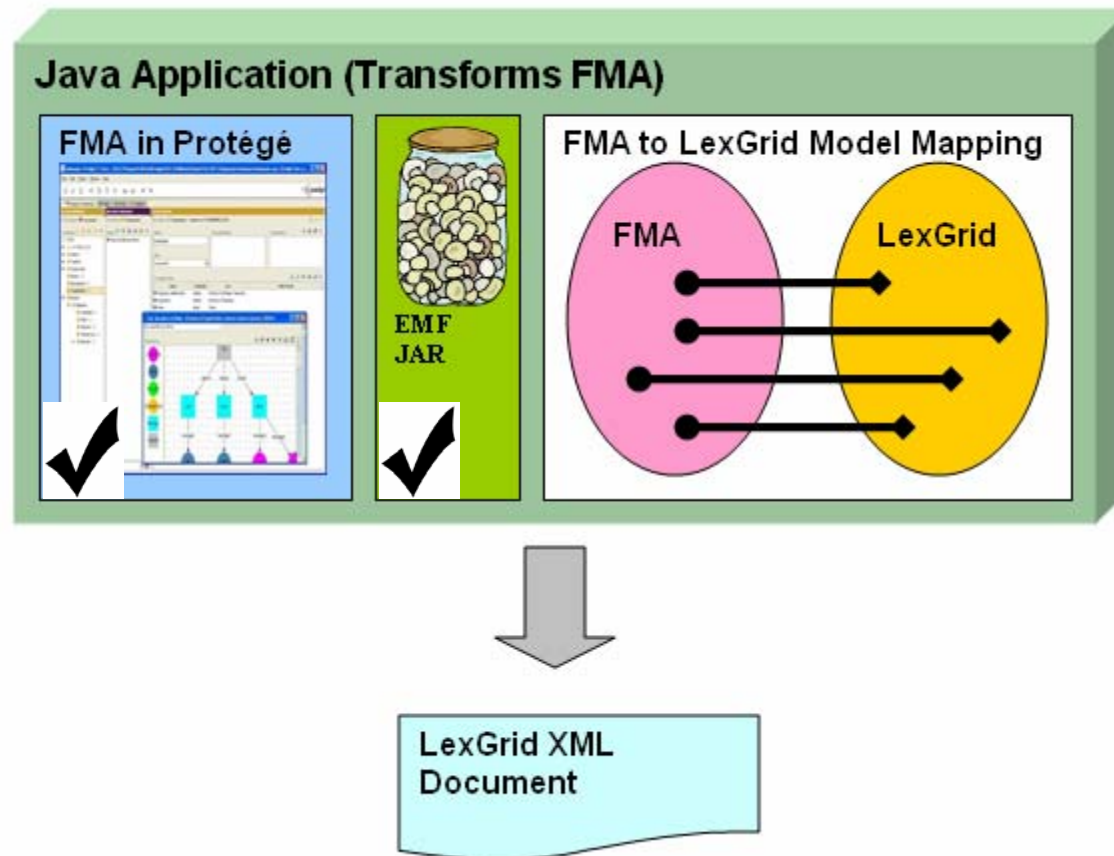
EMF at work

- **Customize the implementation**
 - **Before & After Generation**
- **Make EMF implementation available by either :**
 - ✓ • **Create and include as an Archive**
 - **Application dependent on EMF implementation classes.**

EMF at work



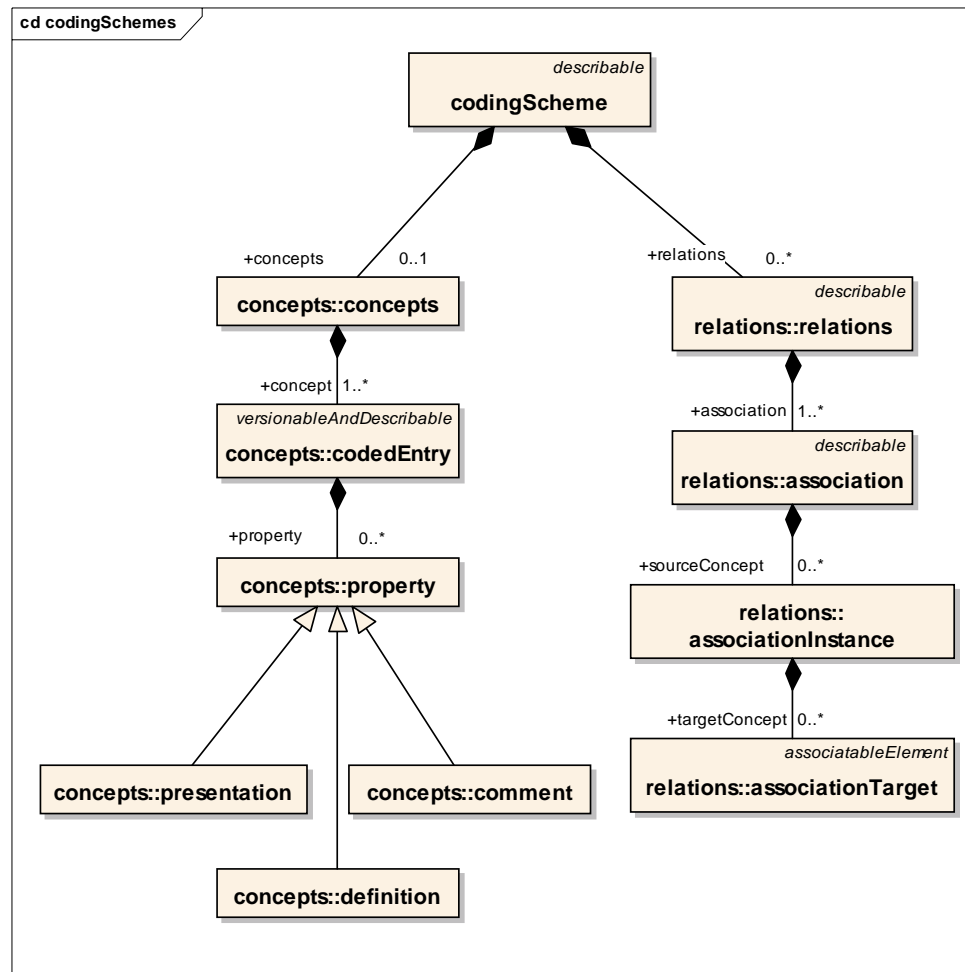
EMF at work



LexGrid Model

- **Developed by Mayo Biomedical Informatics Group**
- **Formal model of terminology**
- **Explicit definition of entities & objects used in LexGrid tooling**
- **Supports non-semantic entities (from the toolkit perspective) as name/value pair**

LexGrid Model Information Model (partial)

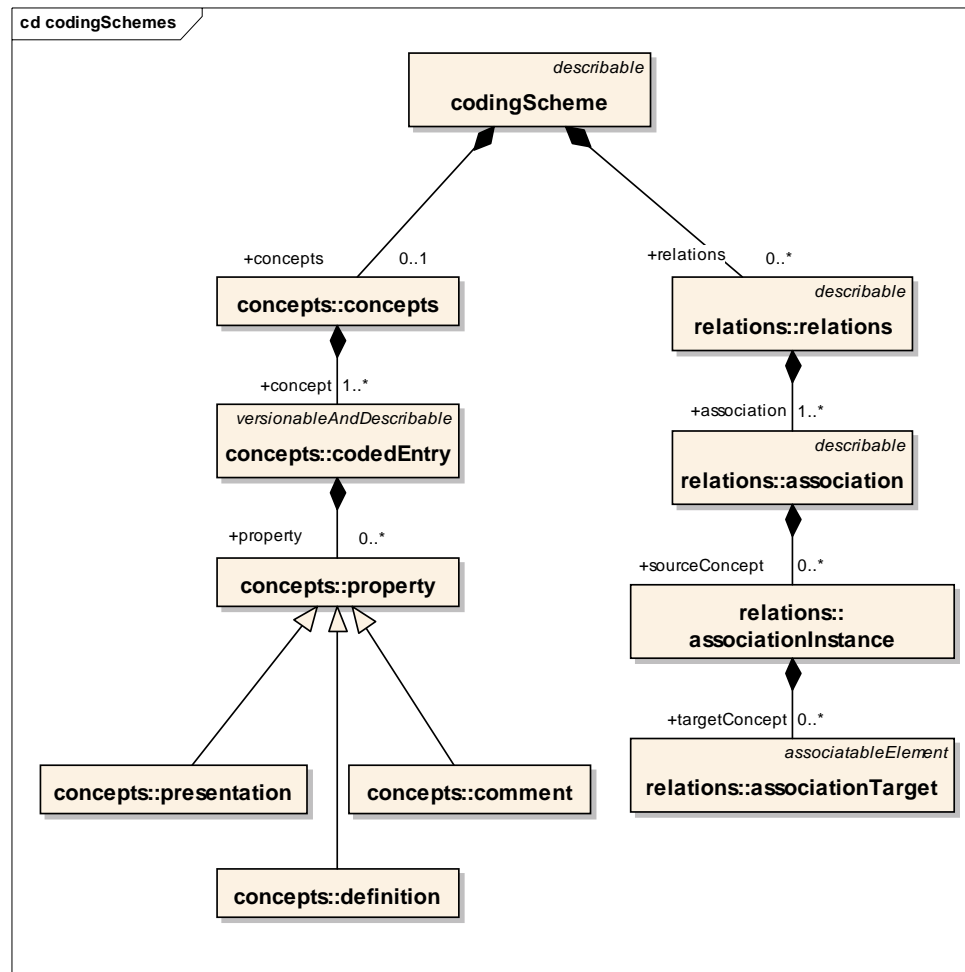


LexGrid Model

Coding Scheme Node

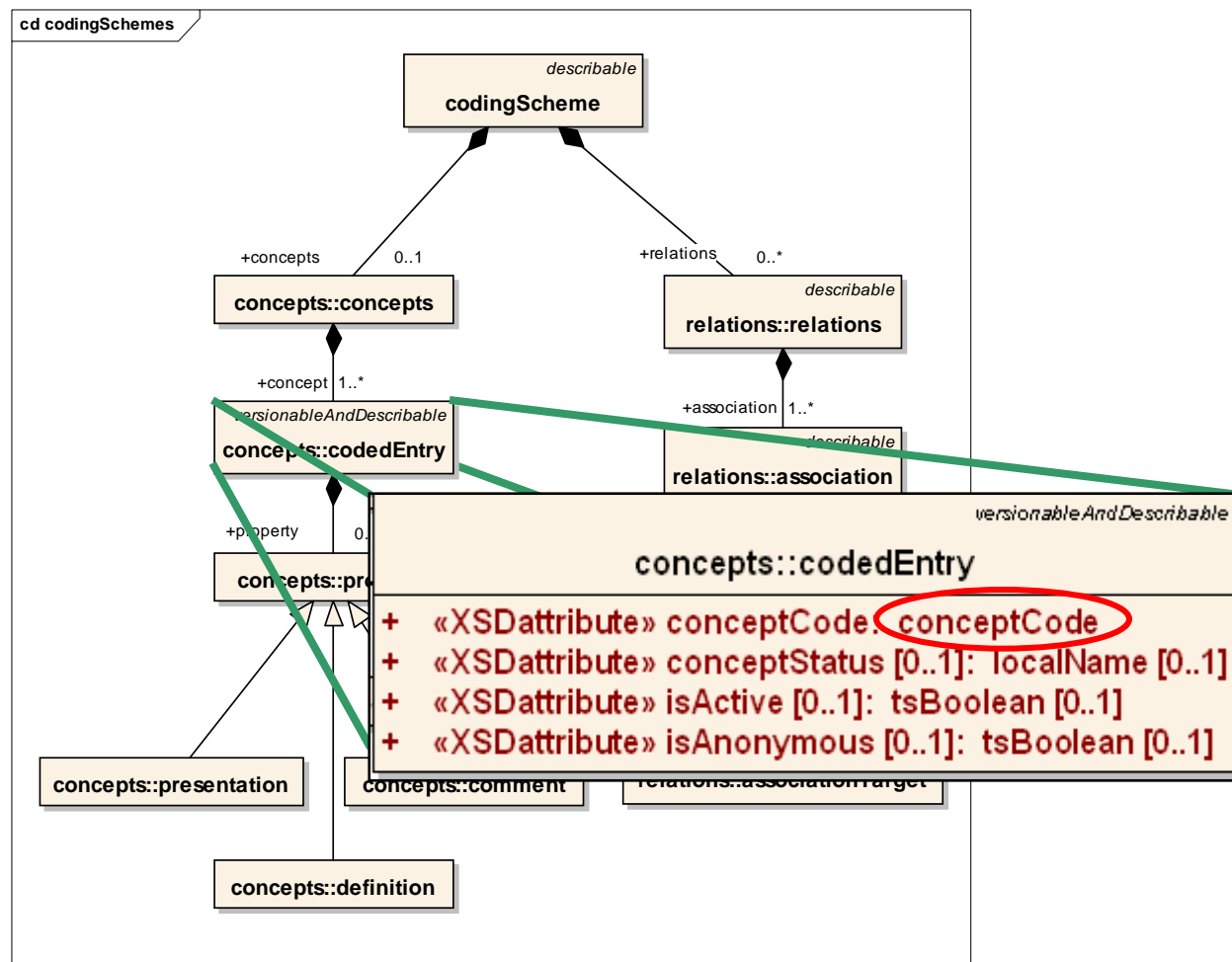


LexGrid Model Information Model (partial)



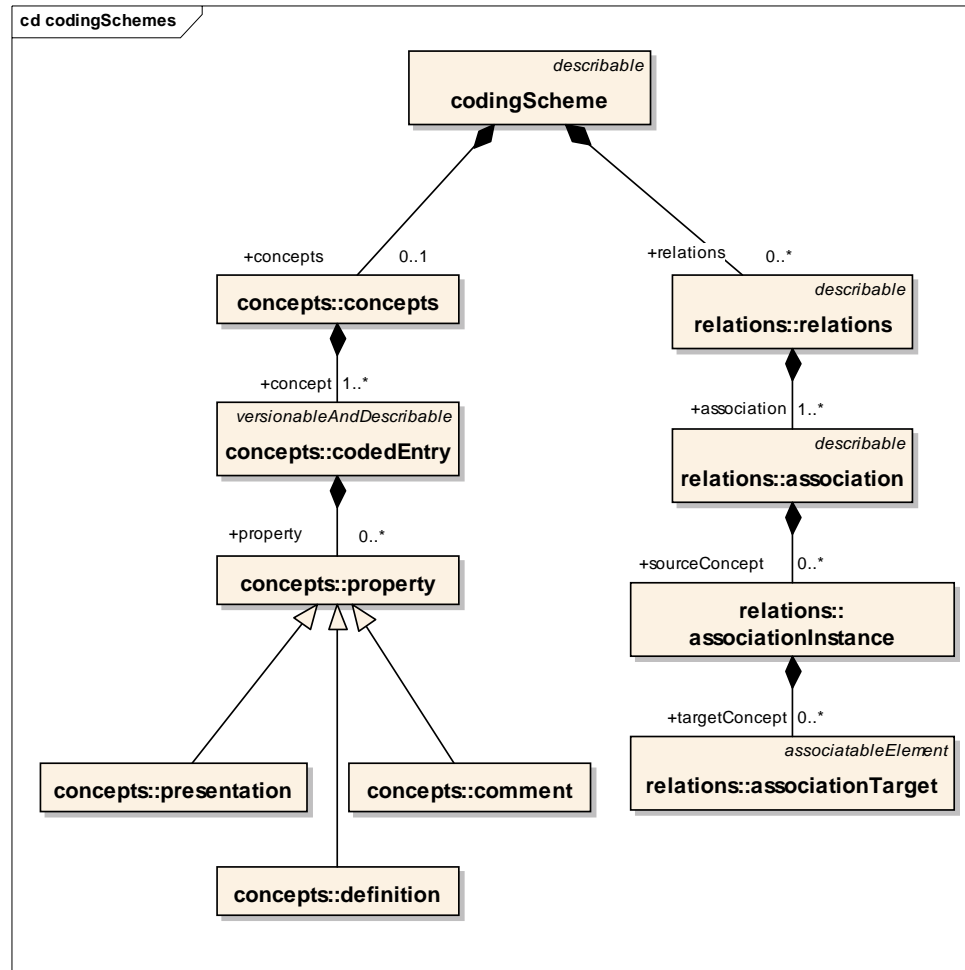
LexGrid Model

Coded Entry



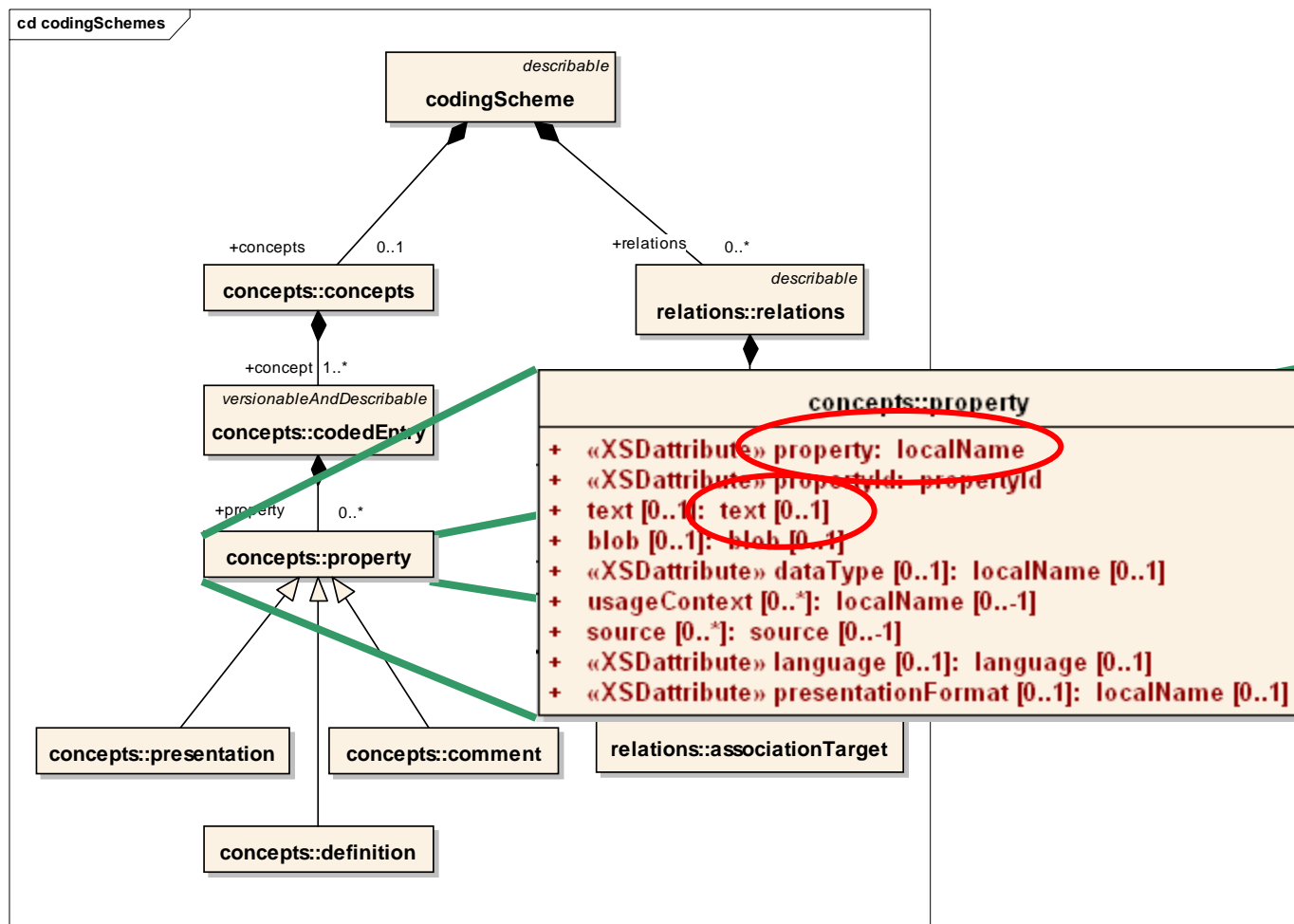
LexGrid Model

Information Model (partial)

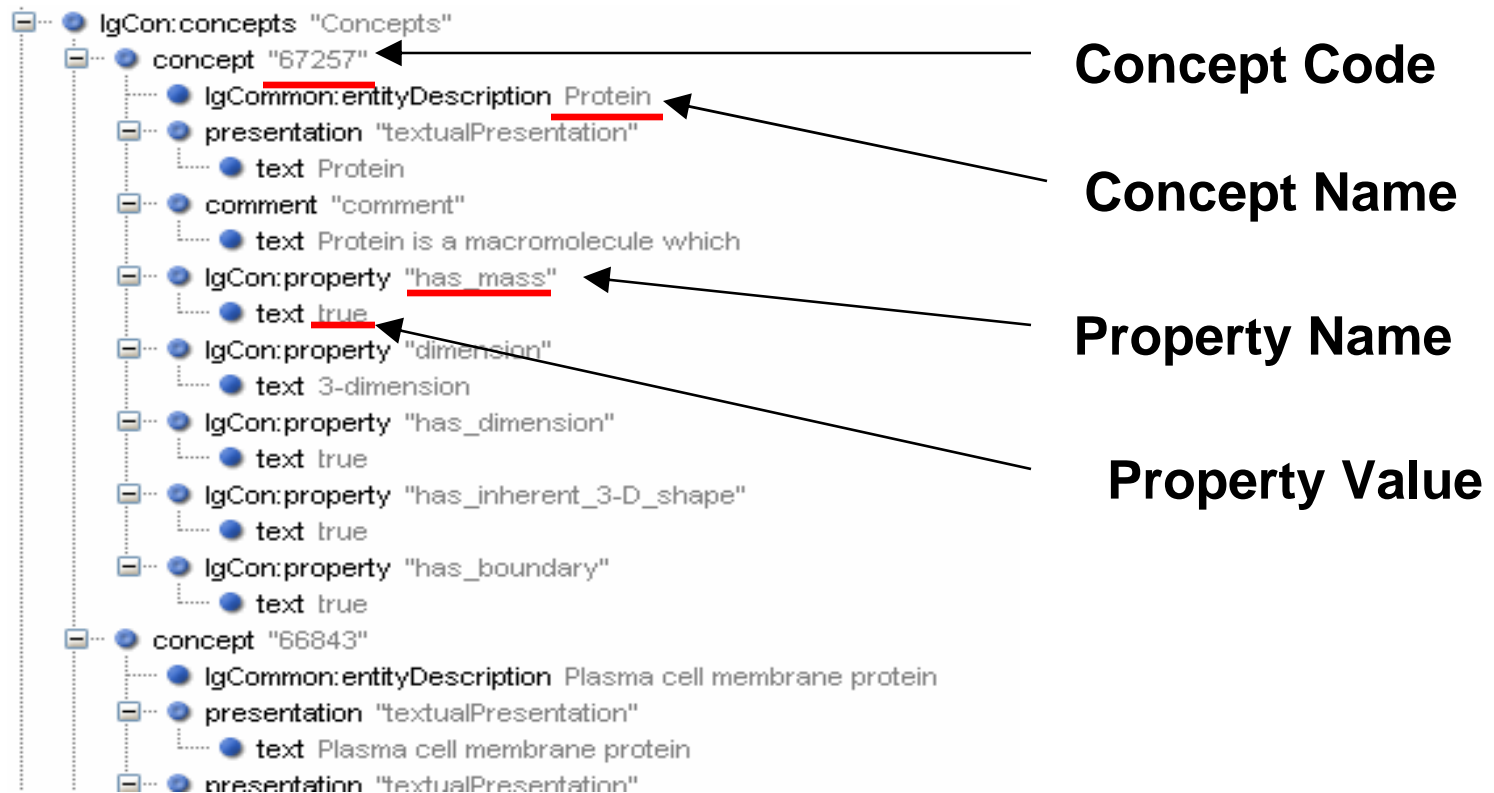


LexGrid Model

Concept Property

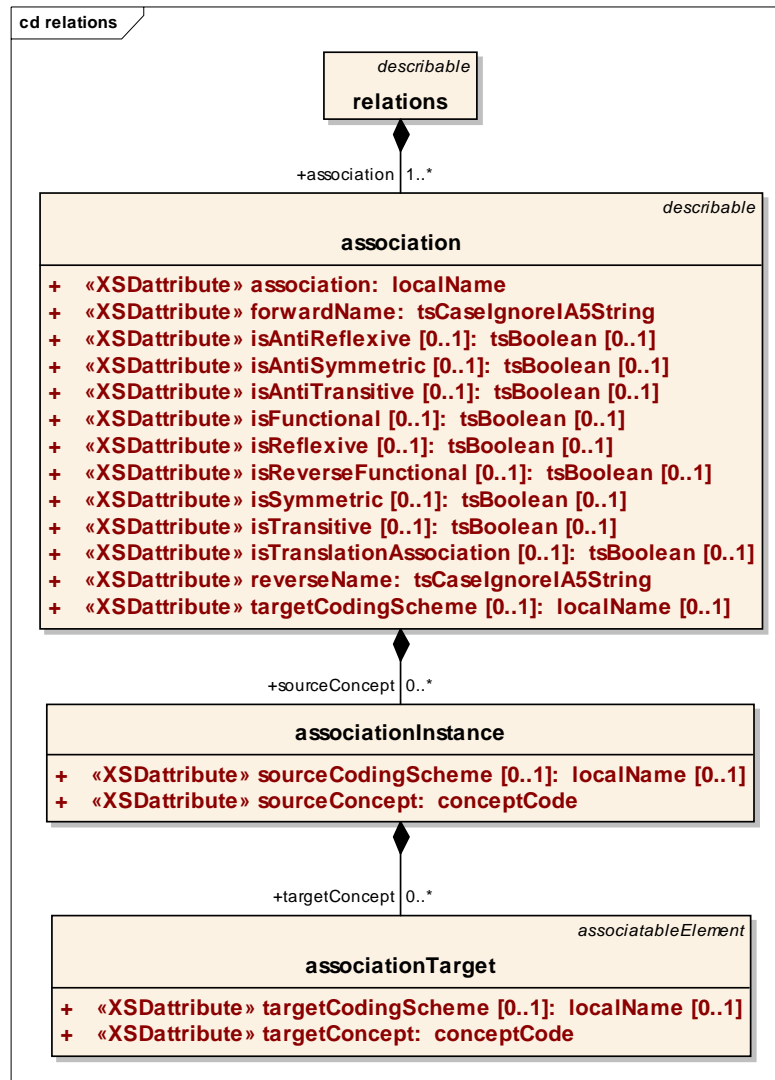


LexGrid Model CodedEntry Node

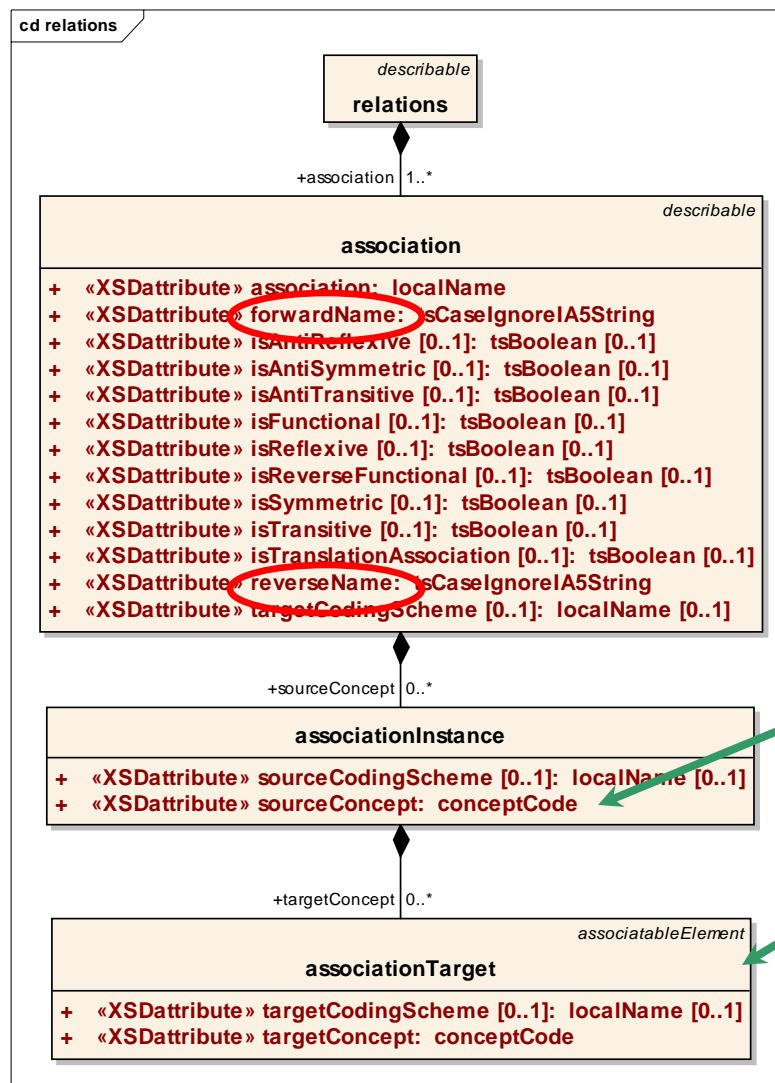


LexGrid Model

Association Node



LexGrid Model Association Node

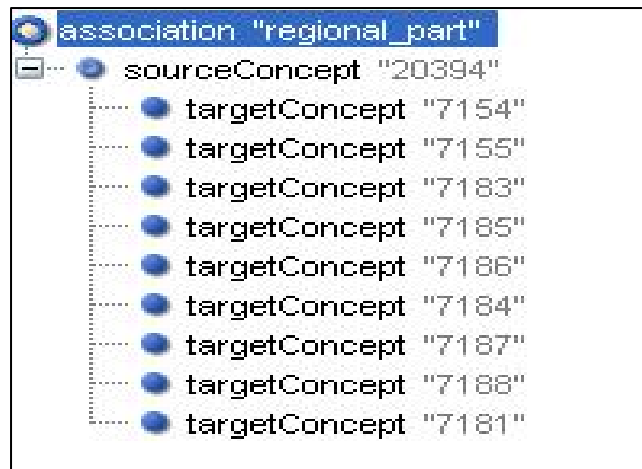


Source concept

Target

(concept / Data)

LexGrid Model Association Node

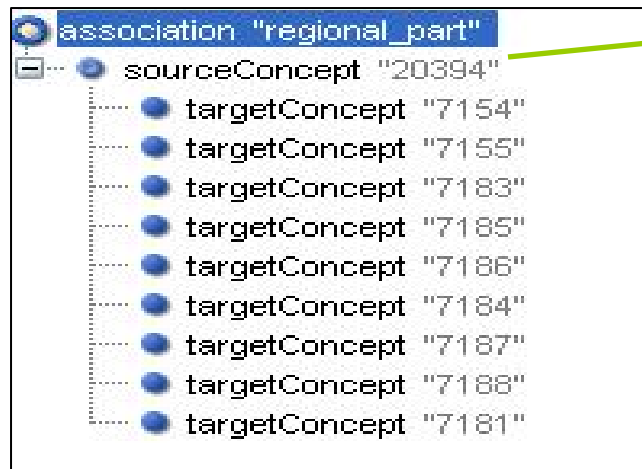


```
<association association="regional_part" forwardName="regional_part" reverseName="regional_part_of">
  <sourceConcept sourceConcept="20394">
    <targetConcept targetConcept="7154"/>
    <targetConcept targetConcept="7155"/>
    <targetConcept targetConcept="7183"/>
    <targetConcept targetConcept="7185"/>
    <targetConcept targetConcept="7186"/>
    <targetConcept targetConcept="7184"/>
    <targetConcept targetConcept="7187"/>
    <targetConcept targetConcept="7188"/>
    <targetConcept targetConcept="7181"/>
  </sourceConcept>

  <!-- SOME MORE ASSOCIATION INSTANCES HERE -->

</association>
```

LexGrid Model Association Node



Body (has regional parts)

Head
Neck
Upper limb
Right Upper limb
Left Upper limb
Lower limb
Right Lower limb
Left Lower limb
Trunk

Source

Targets


```
<association association="regional_part" forwardName="regional_part" reverseName="regional_part_of">
  <sourceConcept sourceConcept="20394">
    <targetConcept targetConcept="7154"/>
    <targetConcept targetConcept="7155"/>
    <targetConcept targetConcept="7183"/>
    <targetConcept targetConcept="7185"/>
    <targetConcept targetConcept="7186"/>
    <targetConcept targetConcept="7184"/>
    <targetConcept targetConcept="7187"/>
    <targetConcept targetConcept="7188"/>
    <targetConcept targetConcept="7181"/>
  </sourceConcept>

  <!-- SOME MORE ASSOCIATION INSTANCES HERE -->

</association>
```


LexGrid Model

[*http://informatics.mayo.edu*](http://informatics.mayo.edu)

 **MAYO CLINIC**
College of Medicine

Informatics

Search

 LexGrid

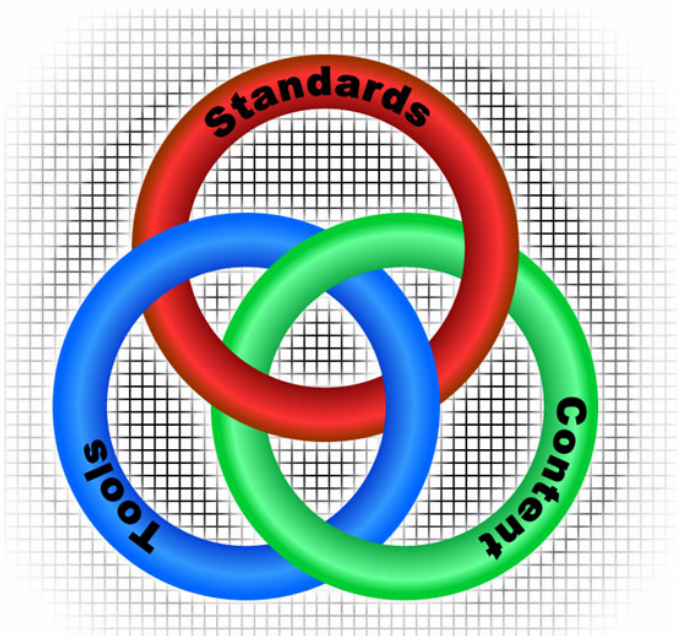
[What's New](#) [Download](#)

[LexGrid](#)

☒ **LexGrid**

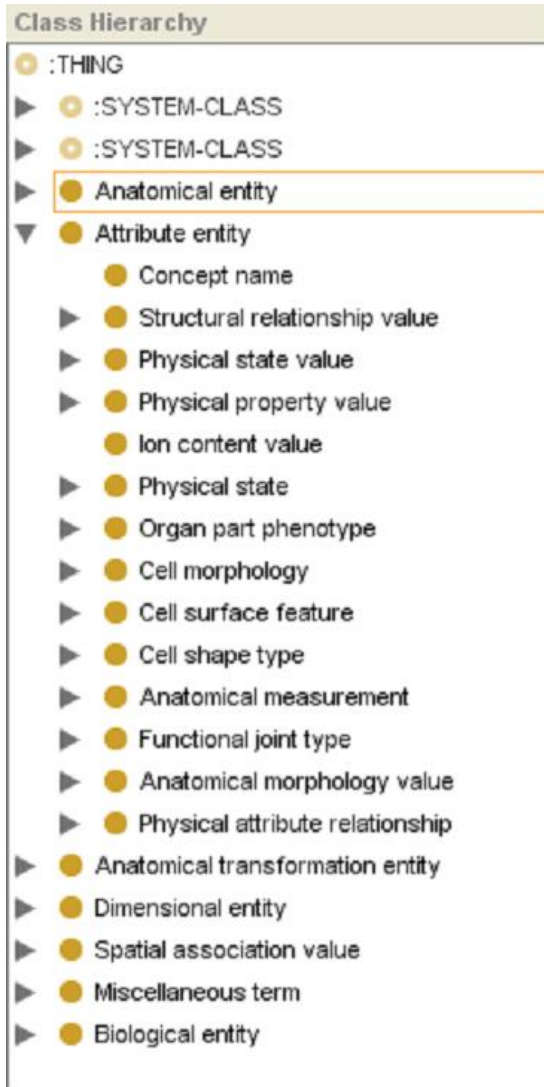
- What's New
- Quick Start Links
- [About LexGrid](#)
- [Represent Content](#)
- [Access and Edit Content](#)
- [Publish Content](#)
- [Demos](#)
- Downloads
- [About Us](#)

The Lexical Grid



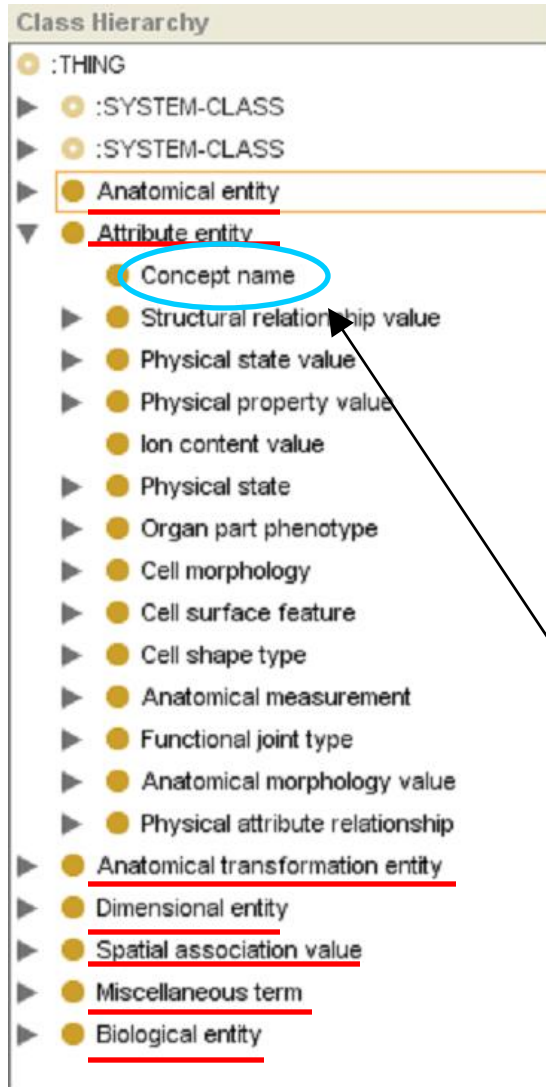


FMA (Protégé)





FMA (Protégé)



Root Nodes

- Anatomical entity
- Attribute entity
- Anatomical transformation entity
- Dimensional entity
- Spatial association value
- Miscellaneous term
- Biological entity

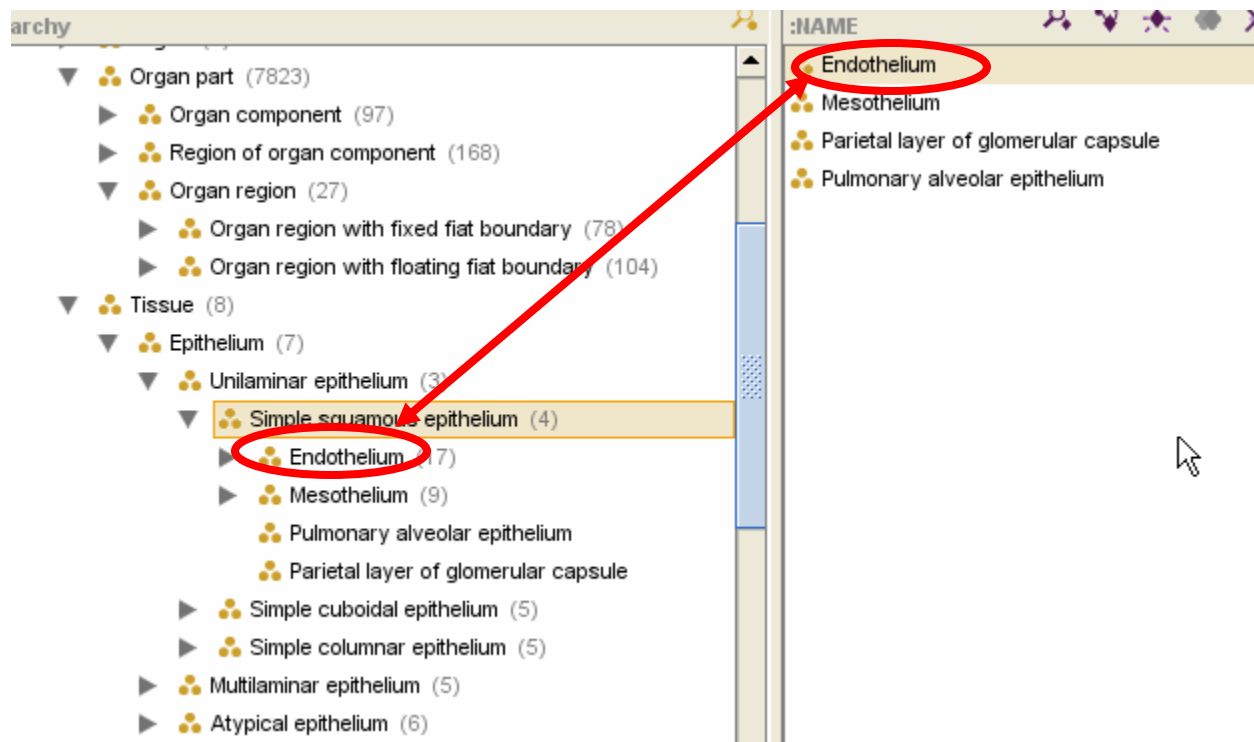
“Concept name”

Has > 130,000 instances
correspond to FMA
concept names & add
more information to them

FMA Mapping to LexGrid

- **Both Protégé CLS and Protégé Instance map to LexGrid Coded Entry**
 - **Meta-Class / CLS / Instance distinction in FMA model is pragmatic decision – not “ontological”**
 - **Most FMA classes are both**
 - **Exception is “Concept name”, which is strictly descriptive**

FMA Mapping Classes and Instances



FMA Mapping to LexGrid

Slot Type decides Category

Slot type in FMA	LexGrid
String with values “Preferred name”, “name”, “Synonyms”, “Eng-Equivalent”	Presentation
String with other values	Property

FMA Mapping to LexGrid

Slot Type decides Category

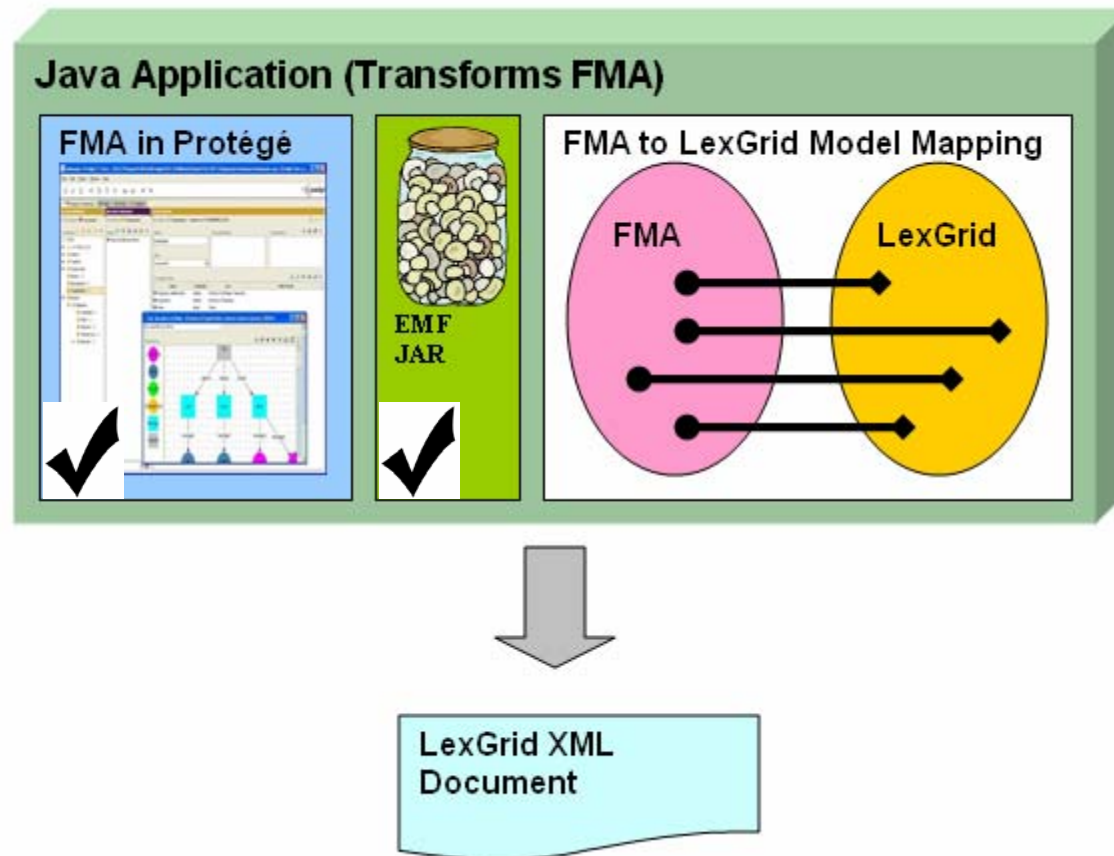
Slot type in FMA	LexGrid
“definition”	Definition
:Documentation	Comment
Protégé CLS or Instance	Association
Boolean	Property {true false}
Other	Property

FMA Mapping to LexGrid

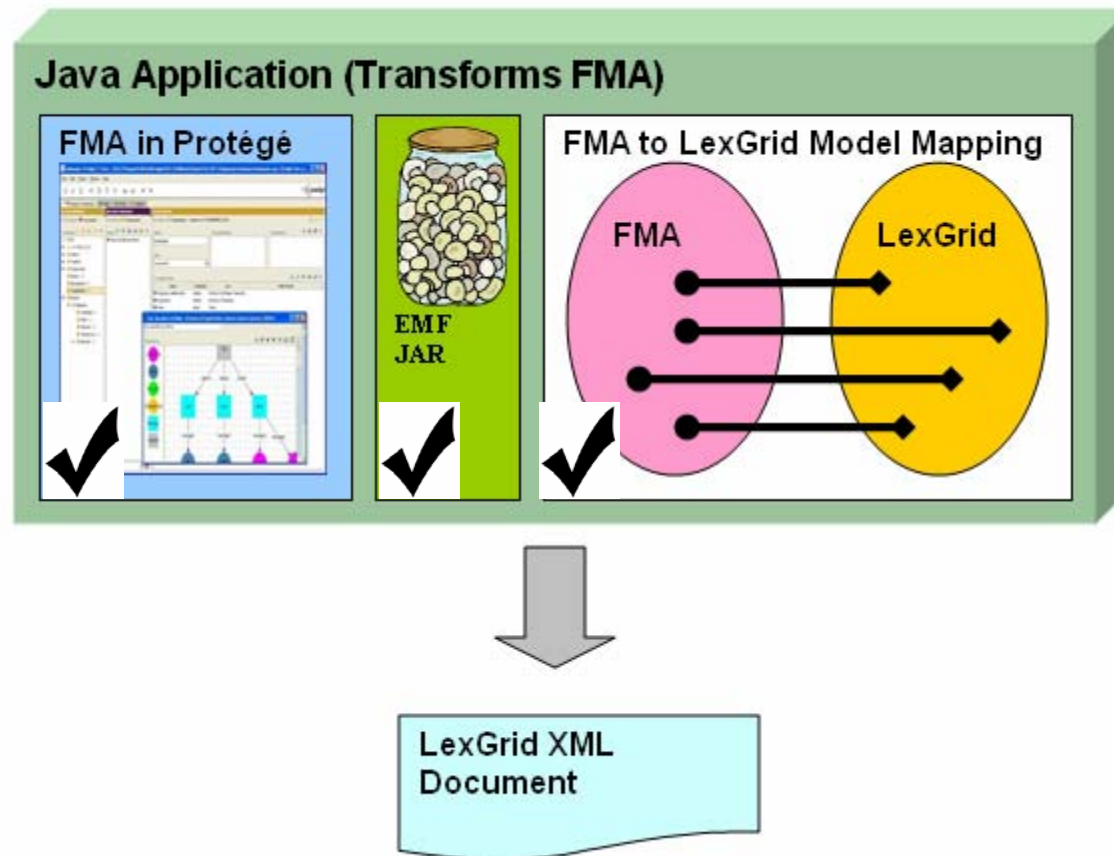
Slot Type decides Category

Slot type in FMA (Instances of ‘Concept name’)	LexGrid
“Authority” “Source” “Language” “TA ID” “Eponym”, ...	Presentation or its attributes

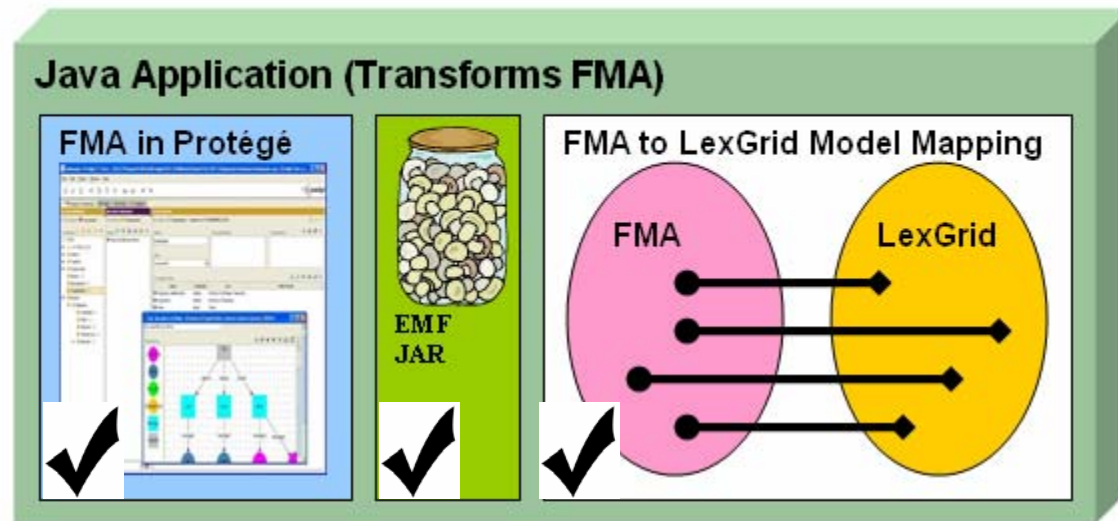
EMF at work



EMF at work



EMF at work



LexGrid XML
Document



NOW

**Create objects
using Generated
EMF Classes**

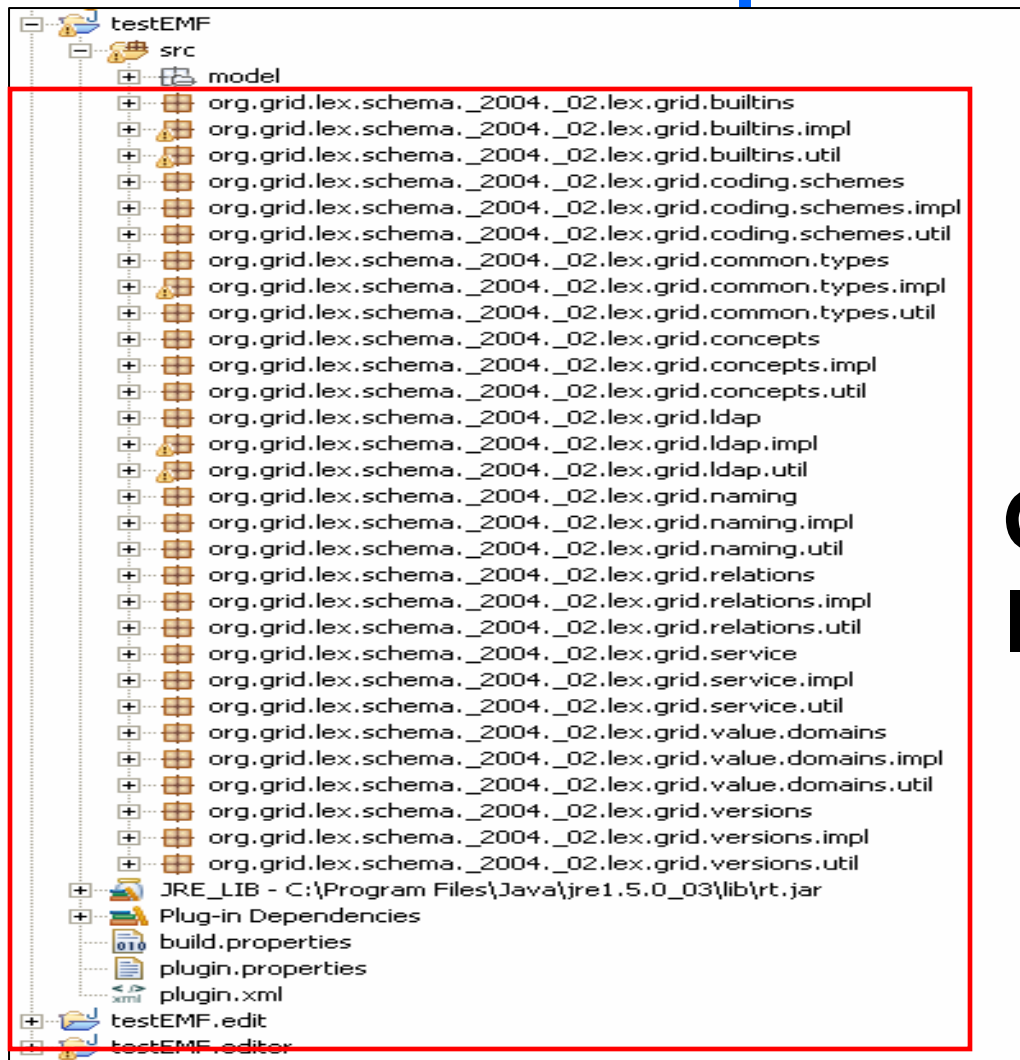
AND

**Generate XML
output file**



EMF at work

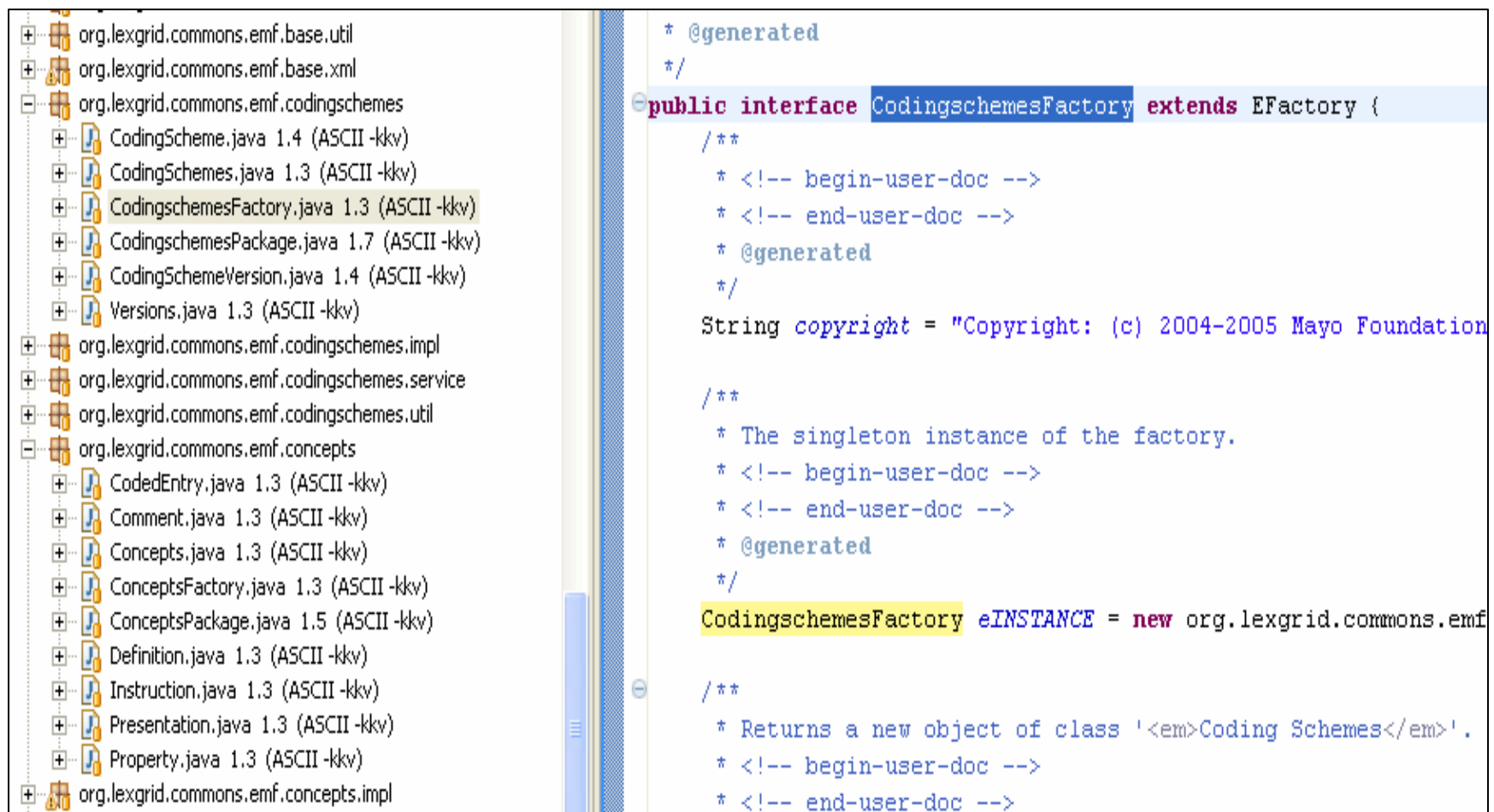
Generated Implementation Classes



**Generated
Implementation**

EMF at work

Generated Implementation Classes



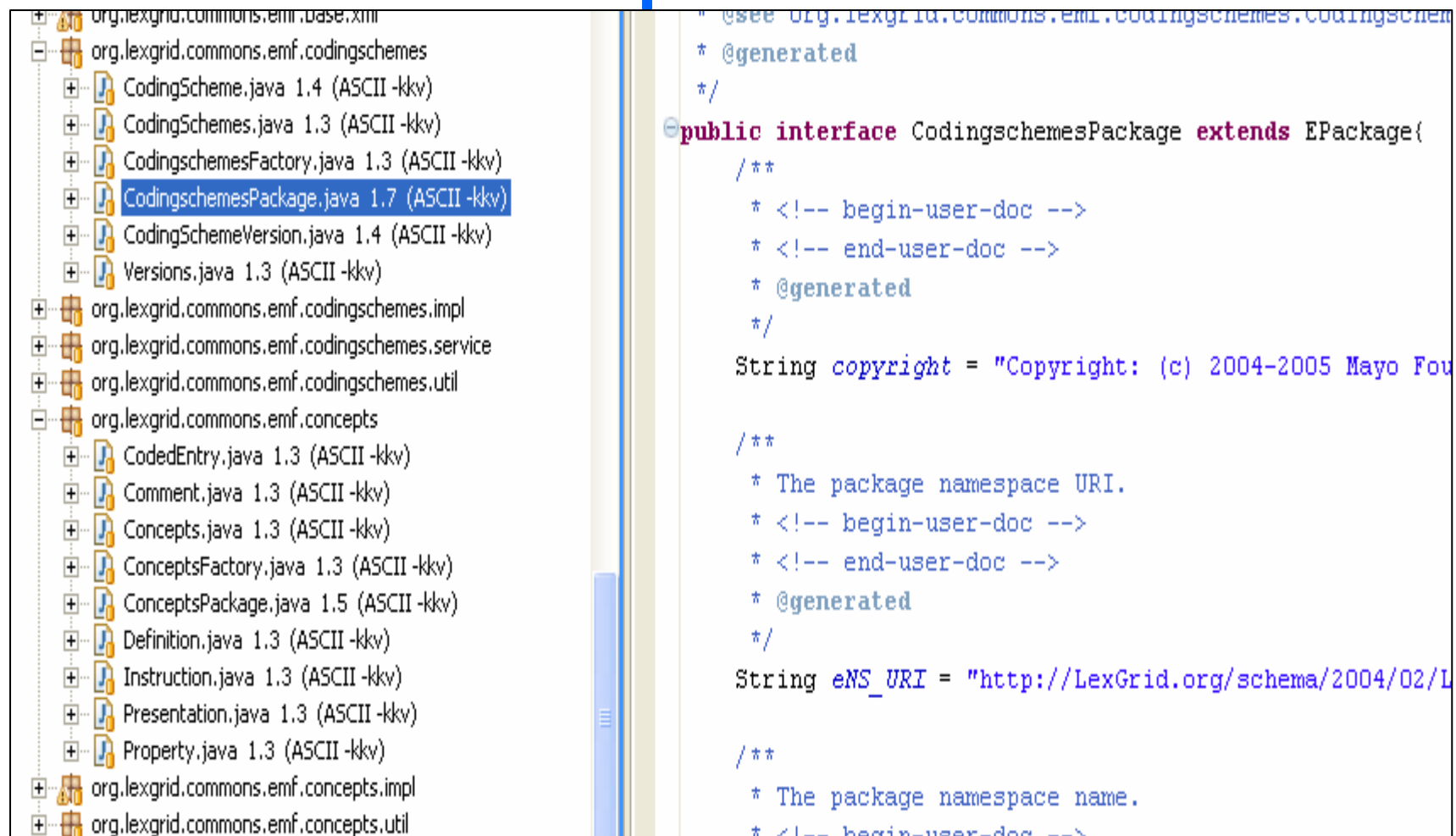
```
* @generated
*/
public interface CodingschemesFactory extends EFactory {
    /**
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @generated
     */
    String copyright = "Copyright: (c) 2004-2005 Mayo Foundation

    /**
     * The singleton instance of the factory.
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @generated
     */
    CodingschemesFactory eINSTANCE = new org.lexgrid.commons.emf

    /**
     * Returns a new object of class '<em>Coding Schemes</em>'.
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
```

EMF at work

Generated Implementation Classes



```

org.lexgrid.commons.emf.base.xml
org.lexgrid.commons.emf.codingschemes
  CodingScheme.java 1.4 (ASCII -kkv)
  CodingSchemes.java 1.3 (ASCII -kkv)
  CodingschemesFactory.java 1.3 (ASCII -kkv)
  CodingschemesPackage.java 1.7 (ASCII -kkv)
  CodingSchemeVersion.java 1.4 (ASCII -kkv)
  Versions.java 1.3 (ASCII -kkv)
org.lexgrid.commons.emf.codingschemes.impl
org.lexgrid.commons.emf.codingschemes.service
org.lexgrid.commons.emf.codingschemes.util
org.lexgrid.commons.emf.concepts
  CodedEntry.java 1.3 (ASCII -kkv)
  Comment.java 1.3 (ASCII -kkv)
  Concepts.java 1.3 (ASCII -kkv)
  ConceptsFactory.java 1.3 (ASCII -kkv)
  ConceptsPackage.java 1.5 (ASCII -kkv)
  Definition.java 1.3 (ASCII -kkv)
  Instruction.java 1.3 (ASCII -kkv)
  Presentation.java 1.3 (ASCII -kkv)
  Property.java 1.3 (ASCII -kkv)
org.lexgrid.commons.emf.concepts.impl
org.lexgrid.commons.emf.concepts.util

```

```

/* See org.lexgrid.commons.emf.codingschemes.Codingschemes
 * @generated
 */

public interface CodingschemesPackage extends EPackage {

    /**
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @generated
     */
    String copyright = "Copyright: (c) 2004-2005 Mayo Fou

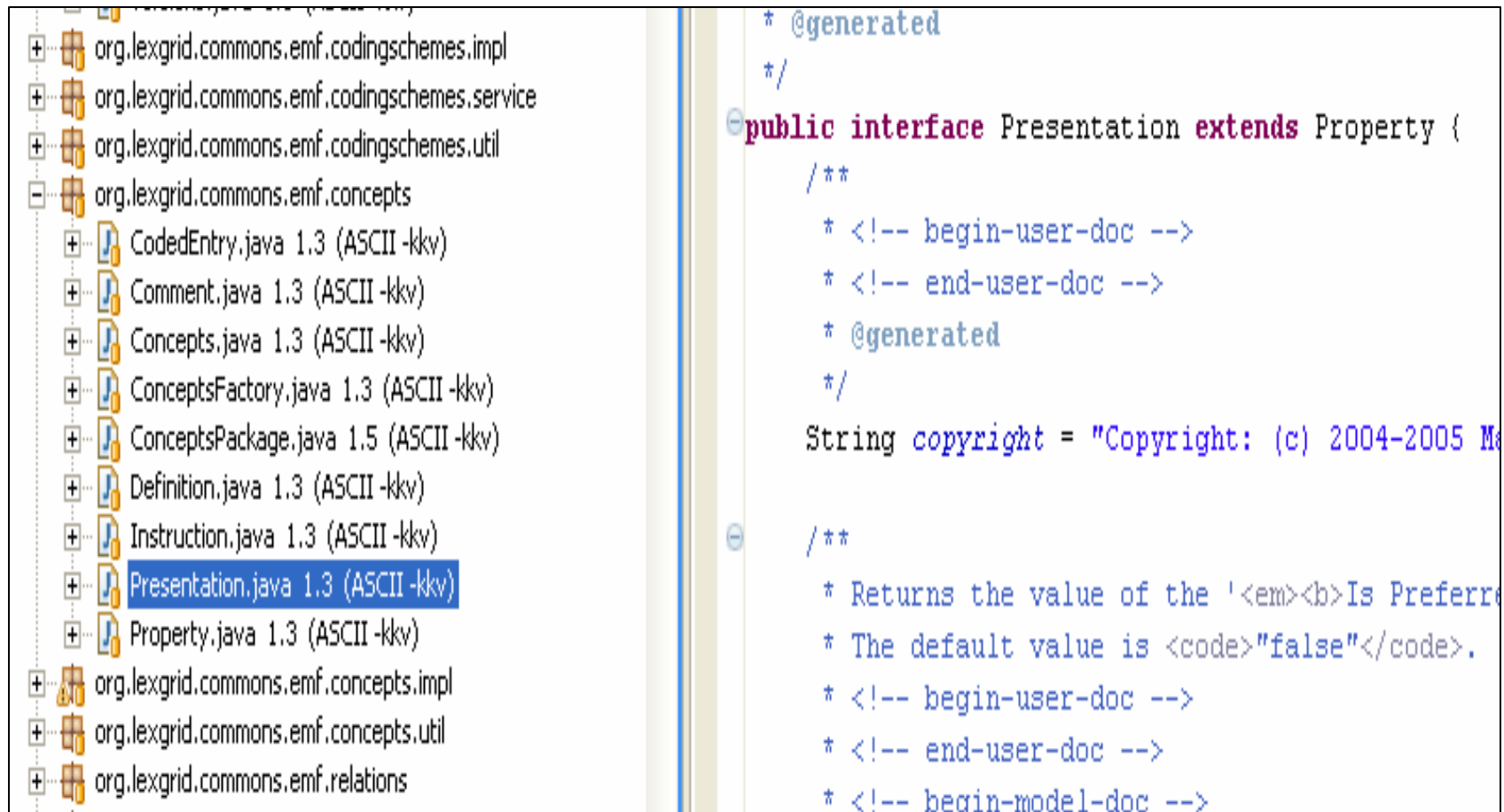
    /**
     * The package namespace URI.
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @generated
     */
    String eNS_URI = "http://LexGrid.org/schema/2004/02/L

    /**
     * The package namespace name.
     * <!-- begin-user-doc -->

```

EMF at work

Generated Implementation Classes



The screenshot displays an IDE interface. On the left, a project tree shows the following structure:

- org.lexgrid.commons.emf.codingschemes.impl
- org.lexgrid.commons.emf.codingschemes.service
- org.lexgrid.commons.emf.codingschemes.util
- org.lexgrid.commons.emf.concepts
 - CodedEntry.java 1.3 (ASCII-kkv)
 - Comment.java 1.3 (ASCII-kkv)
 - Concepts.java 1.3 (ASCII-kkv)
 - ConceptsFactory.java 1.3 (ASCII-kkv)
 - ConceptsPackage.java 1.5 (ASCII-kkv)
 - Definition.java 1.3 (ASCII-kkv)
 - Instruction.java 1.3 (ASCII-kkv)
 - Presentation.java 1.3 (ASCII-kkv)**
 - Property.java 1.3 (ASCII-kkv)
- org.lexgrid.commons.emf.concepts.impl
- org.lexgrid.commons.emf.concepts.util
- org.lexgrid.commons.emf.relations

The right pane shows the source code for `Presentation.java`:

```
* @generated
*/
public interface Presentation extends Property {
    /**
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * @generated
     */
    String copyright = "Copyright: (c) 2004-2005 M

    /**
     * Returns the value of the '<em><b>Is Preferred</b></em>'
     * The default value is <code>"false"</code>.
     * <!-- begin-user-doc -->
     * <!-- end-user-doc -->
     * <!-- begin-model-doc -->
```

EMF at work

Factory Classes

```
private CodingschemesFactory csFactory = new CodingschemesFactoryImpl();  
private RelationsFactory relationsFactory = new RelationsFactoryImpl();  
private ConceptsFactory conceptFactory = new ConceptsFactoryImpl();  
private NamingFactory nameFactory = new NamingFactoryImpl();
```



EMF at work

Create Coding Scheme

Creates Coding Scheme

```
CodingScheme  csclass = null;
try
{
    init(kb);

    csclass = csFactory.createCodingScheme();
    csclass.setCodingScheme("FMA");
    csclass.setFormalName("Foundational Model of Anatomy");
    csclass.setRegisteredName("urn:oid:2.16.840.1.113883.6.119");
    csclass.setDefaultLanguage("English");
    csclass.setRepresentsVersion("1.2.0");
    csclass.getLocalName().add("FMA");
    EList supportedLanguages = csclass.getSupportedLanguage();

    SupportedLanguage lang = nameFactory.createSupportedLanguage();
    lang.setLocalName("English");
    lang.setUrn("urn:oid:2.16.840.1.113883.6.84:en");
    supportedLanguages.add(lang);

    lang = nameFactory.createSupportedLanguage();
    lang.setLocalName("Latin");
    lang.setUrn("urn:oid:2.16.840.1.113883.6.84:la");
    supportedLanguages.add(lang);

    EList supportedFormats = csclass.getSupportedFormat();
    prepareSupportedFormats(supportedFormats);

    EList supportedDataTypes = csclass.getSupportedDataType();
    prepareSupportedDataTypes(supportedDataTypes);
}
```


EMF at work

Create Concept

```
CodedEntry con = conceptFactory.createCodedEntry();
con.setConceptCode(conceptCode);

String description = getEntityDescriptionFromObj(concept);
if (description != null)
    con.setEntityDescription(description);

Comment [] comments = getCommentsFromObj(concept);
if (comments != null)
    for(int i = 0; i < comments.length; i++)
        con.getProperty().add(comments[i]);

Definition [] definitions = getDefinitionsFromObj(concept);
if (definitions != null)
    for(int i = 0; i < definitions.length; i++)
        con.getProperty().add(definitions[i]);

processSlots(concept, con, false);
```

EMF at work

Create Relation

```
// Relations
allRelations_ = relationsFactory.createRelations();
allRelations_.setDc("relations");

// Creating the relation instance
firstRelation_ = cscClass.getRelations();
firstRelation_.add(allRelations_);
allAssociations_ = allRelations_.getAssociation();

// Add HasSubtype
hasSubTypeAssocClass_ = relationsFactory.createAssociation();
hasSubTypeAssocClass_.setAssociation("hasSubtype");
hasSubTypeAssocClass_.setForwardName("hasSubtype");
hasSubTypeAssocClass_.setReverseName("isA");
hasSubTypeAssocClass_.setIsTransitive(true);
hasSubTypeAssocClass_.setIsSymmetric(false);
hasSubTypeAssocClass_.setIsReflexive(true);
allAssociations_.add(hasSubTypeAssocClass_);

relations_.add(firstRelation_);
```



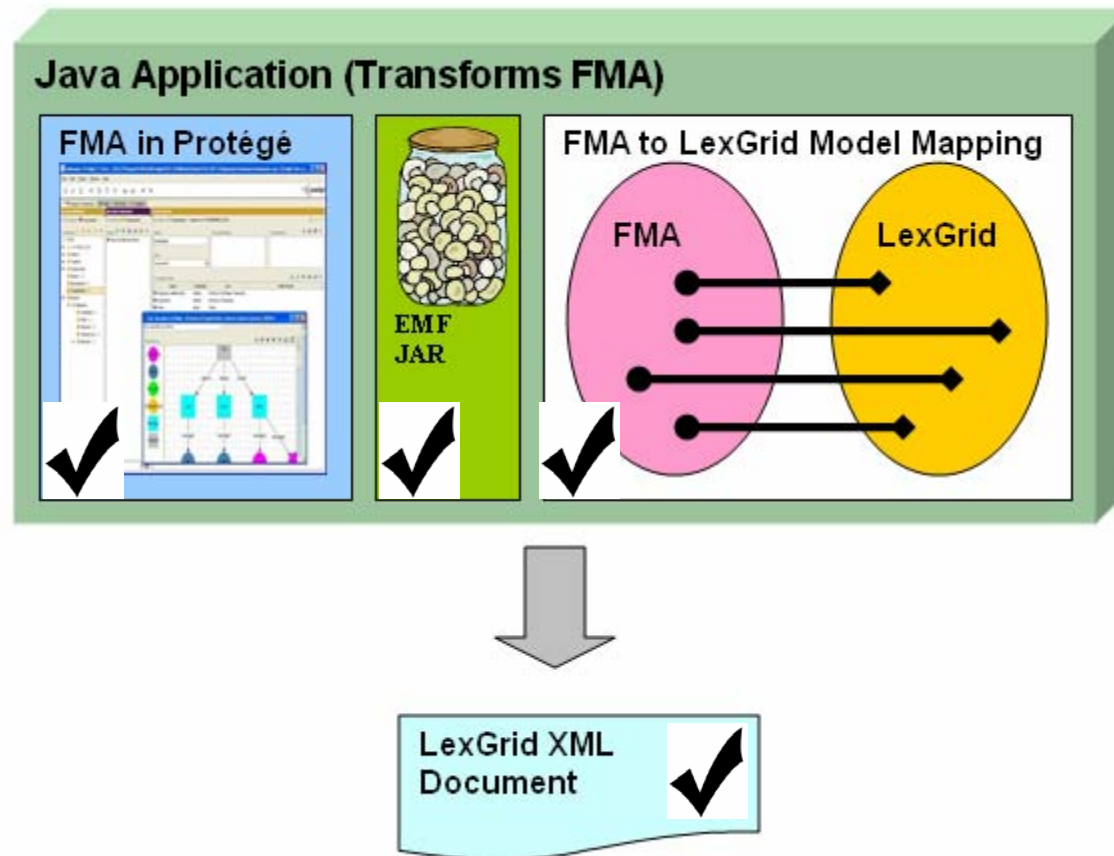
EMF at work

XML Serialization

```
XMLResource xmlrsc = new XMLResourceImpl();  
xmlrsc.getContents().add(cscclass);  
  
XMLMap mapping = getXMLMappings();  
  
if (mapping != null)  
{  
    Map mp = new HashMap();  
    //System.out.println("Got the mappings...");  
    mp.put(XMLResource.OPTION_XML_MAP, mapping);  
    xmlrsc.save(new FileOutputStream("testFMA.xml"), mp);  
}
```

These classes are from Ecore framework
e.g.
package org.eclipse.emf.ecore.xmi.impl

EMF at work



FMA (LexGrid XML Snapshot)

```
<?xml version="1.0" encoding="ASCII"?>
<codingScheme codingScheme="FMA" formalName="Foundational Model of Anatomy" registeredName="urn:oid:2.16.840.1.113883.6.119" defaultLanguage="en">
  <localName>FMA</localName>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:en">English</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:la">Latin</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:de">German</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:es">Spanish</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:fr">French</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:ru">Russian</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:Greek">Greek</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:Italian">Italian</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:Filipino">Filipino</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:Japanese">Japanese</supportedLanguage>
  <supportedLanguage urn="urn:oid:2.16.840.1.113883.6.84:Chinese">Chinese</supportedLanguage>
  <supportedFormat urn="urn:oid:2.16.840.1.113883.6.10:text_plain">text_plain</supportedFormat>
  <supportedProperty>comment</supportedProperty>
  <supportedProperty>definition</supportedProperty>
  <supportedProperty>instruction</supportedProperty>
  <supportedProperty>textualPresentation</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:slot_synonym">slot_synonym</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:dimension">dimension</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_dimension">has_dimension</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_boundary">has_boundary</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_mass">has_mass</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_inherent_3-D_shape">has_inherent_3-D_shape</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:physical_state">physical_state</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:polarity">polarity</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:state_of_determination">state_of_determination</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:cell_appendage_type">cell_appendage_type</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:contact_type">contact_type</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:coordinate">coordinate</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:laterality">laterality</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:adjacent">adjacent</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:anatomical_arbitrary">anatomical_arbitrary</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:partition">partition</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:shared_unshared">shared_unshared</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:view">view</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:percentage">percentage</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:number_of_pairs_per_nucleus">number_of_pairs_per_nucleus</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:ploidy">ploidy</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:state">state</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:cell_layer">cell_layer</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_trunk">has_trunk</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_branch">has_branch</supportedProperty>
  <supportedProperty urn="urn:oid:2.16.840.1.113883.6.119:has_shape_type">has_shape_type</supportedProperty>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Alberts_94">Alberts_94</supportedSource>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Bloom_Fawcett_94">Bloom_Fawcett_94</supportedSource>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Fawcett_81">Fawcett_81</supportedSource>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Grays_99">Grays_99</supportedSource>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Gene_Ontology">Gene_Ontology</supportedSource>
  <supportedSource urn="urn:oid:2.16.840.1.113883.6.119:Cornelius_Rosse">Cornelius_Rosse</supportedSource>
```













FMA (LexGrid XML Snapshot)

- codingScheme "FMA" ←
- localName FMA
- supportedLanguage "urn:oid:2.16.840.1.113883.6.84:en" English
- supportedLanguage "urn:oid:2.16.840.1.113883.6.84:de" German
- supportedProperty textualPresentation
- supportedProperty "urn:oid:2.16.840.1.113883.6.119:has_dimension" has_dimension
- supportedProperty "urn:oid:2.16.840.1.113883.6.119:has_boundary" has_boundary
- supportedProperty "urn:oid:2.16.840.1.113883.6.119:has_mass" has_mass
- supportedProperty "urn:oid:2.16.840.1.113883.6.119:has_shape_type" has_shape_type
- supportedSource "urn:oid:2.16.840.1.113883.6.119:Grays_99" Grays_99
- supportedSource "urn:oid:2.16.840.1.113883.6.119:Gene_Ontology" Gene_Ontology
- supportedSource "urn:oid:2.16.840.1.113883.6.119:Cornelius_Rosse" Cornelius_Rosse
- supportedAssociation "urn:oid:2.16.840.1.113883.6.119:hasSubtype" hasSubtype
- supportedAssociation "urn:oid:2.16.840.1.113883.6.119:attributed_part" attributed_part
- supportedAssociation "urn:oid:2.16.840.1.113883.6.119:regional_part" regional_part
- supportedAssociation "urn:oid:2.16.840.1.113883.6.119:constitutional_part" constitutional_part
- supportedDataType "urn:oid:http://protege.stanford.edu:Any" Any
- supportedDataType "urn:oid:http://protege.stanford.edu:Boolean" Boolean
- supportedDataType "urn:oid:http://protege.stanford.edu:Class" Class
- supportedDataType "urn:oid:http://protege.stanford.edu:Float" Float
- supportedDataType "urn:oid:http://protege.stanford.edu:Instance" Instance
- supportedDataType "urn:oid:http://protege.stanford.edu:Integer" Integer
- supportedDataType "urn:oid:http://protege.stanford.edu:String" String
- supportedDataType "urn:oid:http://protege.stanford.edu:Symbol" Symbol
- supportedRepresentationalForm "urn:oid:2.16.840.1.113883.6.119:Abbreviation" Abbreviation
- + ● lgCon:concepts "Concepts" ←
- + ● lgRel:relations "relations" ←




























Transformation Example

- **Concept “Body”**
- **LexGrid Editor tool (Mayo)**
- **Observe Mappings:**
 - **FMA Content with Protégé**
 - **Transformed LexGrid content with LexGrid Editor**

Concept “Body” (FMA)

▼  Material physical anatomical entity(67165)	
▼  Anatomical structure(67135)	
▼  Body(20394)	Definition
 Male body(67811)	Anatomical structure
 Female body(67812)	There is only one hu
▶  Principal body part(7153)	
▶  Subdivision of principal body part(67504)	
▶  Organ system(7149)	
▶  Organ system subdivision(67509)	
▶  Organ(67498)	Comment
▶  Organ part(82472)	
▶  Tissue(9637)	

“Body” (FMA) - Attributes

FMAID <input type="text" value="20394"/>	Develops From   	Location   
Physical State <input type="text" value="Solid"/>	<input type="text"/>	<input type="text"/>
Has Shape   	Nerve Supply   	Non-English Equivalent   
<input type="text"/>	<input type="text"/>	<ul style="list-style-type: none"> ◆ Corps ◆ Körper ◆ Cuerpo ◆ Corpo
Preferred Name   		
<input type="text" value="◆ Body"/>		
Arterial Supply   	Venous Drainage   	Synonym   
<input type="text"/>	<input type="text"/>	<input type="text"/>

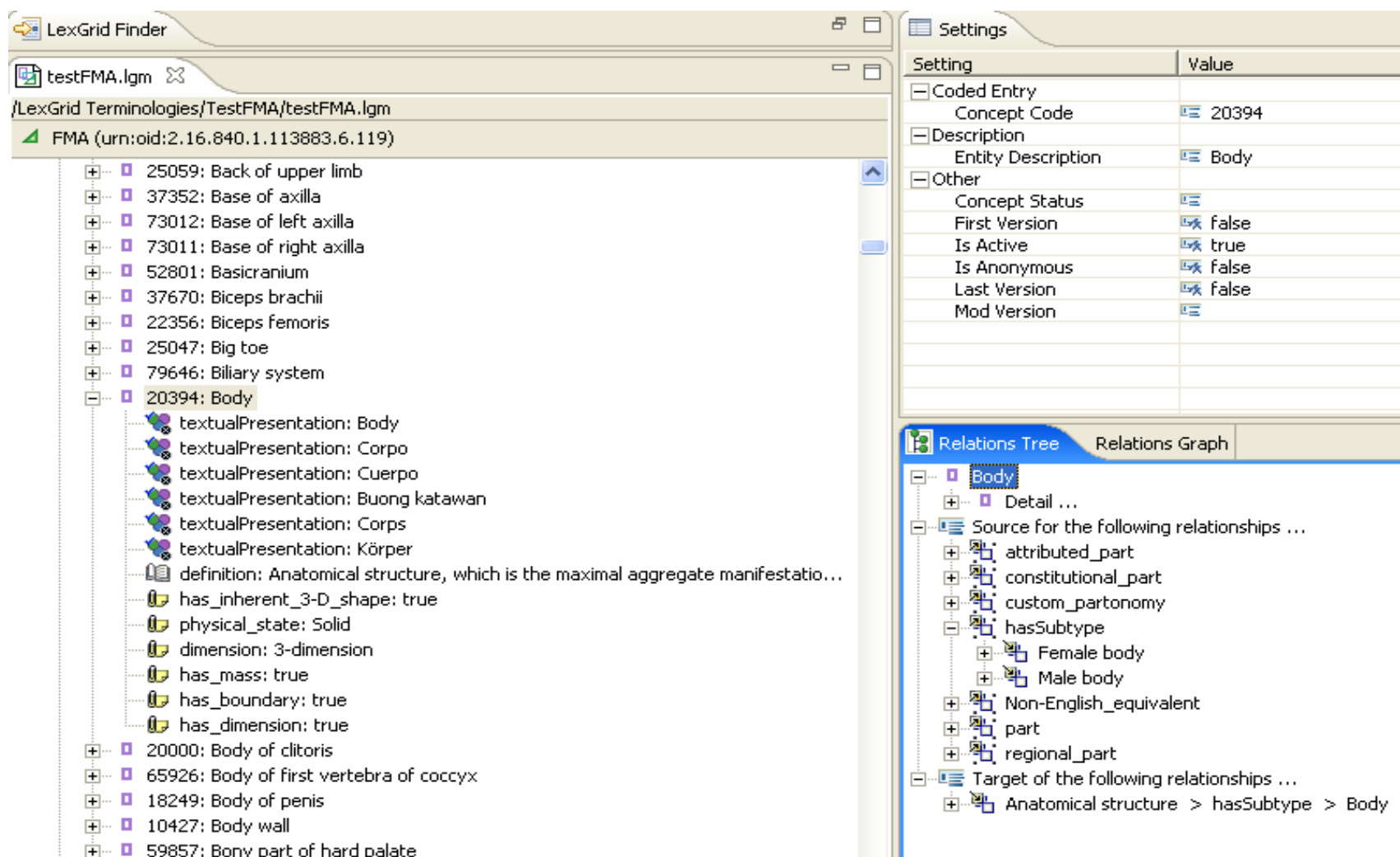
Concept “Body” (LexGrid)

```
<concept conceptCode="20394">
  <lgCommon:entityDescription>Body</lgCommon:entityDescription>
  <presentation property="textualPresentation" propertyId="P8" isPreferred="true">
    <text>Body</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language38355" language="Filipino">
    <text>Buong katawan</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language37742" language="Spanish">
    <text>Cuerpo</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="authority32777" language="French">
    <source>Robert_Baud_PhD</source>
    <text>Corps</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language38164" language="Filipino">
    <text>Corpo</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language37437" language="German">
    <text>Körper</text>
  </presentation>
  <definition property="definition" propertyId="P1">
    <text>Anatomical structure, which is the maximal aggregate manifestation
      of an individual member of the species Homo sapiens;
      it is completely surrounded by skin. Examples: There is only one human body.</text>
  </definition>
  <lgCon:property property="physical_state" propertyId="P4" dataType="Symbol">
    <text>Solid</text>
  </lgCon:property>
  <lgCon:property property="has_boundary" propertyId="P7" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_inherent_3-D_shape" propertyId="P2" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_dimension" propertyId="P6" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_mass" propertyId="P3" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="dimension" propertyId="P5" dataType="Symbol">
    <text>3-dimension</text>
  </lgCon:property>
</concept>
```

Concept “Body” (LexGrid)

```
<concept conceptCode="20394">
  <lgCommon:entityDescription>Body</lgCommon:entityDescription>
  <presentation property="textualPresentation" propertyId="P8" isPreferred="true">
    <text>Body</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language38355" language="Filipino">
    <text>Buong katawan</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language37742" language="Spanish">
    <text>Cuerpo</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="authority32777" language="French">
    <source>Robert_Baud_PhD</source>
    <text>Corps</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language38164" language="Filipino">
    <text>Corpo</text>
  </presentation>
  <presentation property="textualPresentation" propertyId="Language37437" language="German">
    <text>Körper</text>
  </presentation>
  <definition property="definition" propertyId="P1">
    <text>Anatomical structure, which is the maximal aggregate manifestation
      of an individual member of the species Homo sapiens;
      it is completely surrounded by skin. Examples: There is only one human body.</text>
  </definition>
  <lgCon:property property="physical_state" propertyId="P4" dataType="Symbol">
    <text>Solid</text>
  </lgCon:property>
  <lgCon:property property="has_boundary" propertyId="P7" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_inherent_3-D_shape" propertyId="P2" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_dimension" propertyId="P6" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="has_mass" propertyId="P3" dataType="Boolean">
    <text>true</text>
  </lgCon:property>
  <lgCon:property property="dimension" propertyId="P5" dataType="Symbol">
    <text>3-dimension</text>
  </lgCon:property>
</concept>
```

Concept “Body” (LexGrid)



The screenshot displays the LexGrid Finder application interface. The main window shows a list of concepts under the 'FMA (urn:oid:2.16.840.1.113883.6.119)' terminology. The concept '20394: Body' is selected, and its details are shown in the right-hand pane.

Concept Details:

- 25059: Back of upper limb
- 37352: Base of axilla
- 73012: Base of left axilla
- 73011: Base of right axilla
- 52801: Basicranium
- 37670: Biceps brachii
- 22356: Biceps femoris
- 25047: Big toe
- 79646: Biliary system
- 20394: Body
 - textualPresentation: Body
 - textualPresentation: Corpo
 - textualPresentation: Cuerpo
 - textualPresentation: Buong katawan
 - textualPresentation: Corps
 - textualPresentation: Körper
 - definition: Anatomical structure, which is the maximal aggregate manifestatio...
 - has_inherent_3-D_shape: true
 - physical_state: Solid
 - dimension: 3-dimension
 - has_mass: true
 - has_boundary: true
 - has_dimension: true
- 20000: Body of clitoris
- 65926: Body of first vertebra of coccyx
- 18249: Body of penis
- 10427: Body wall
- 59857: Bony part of hard palate

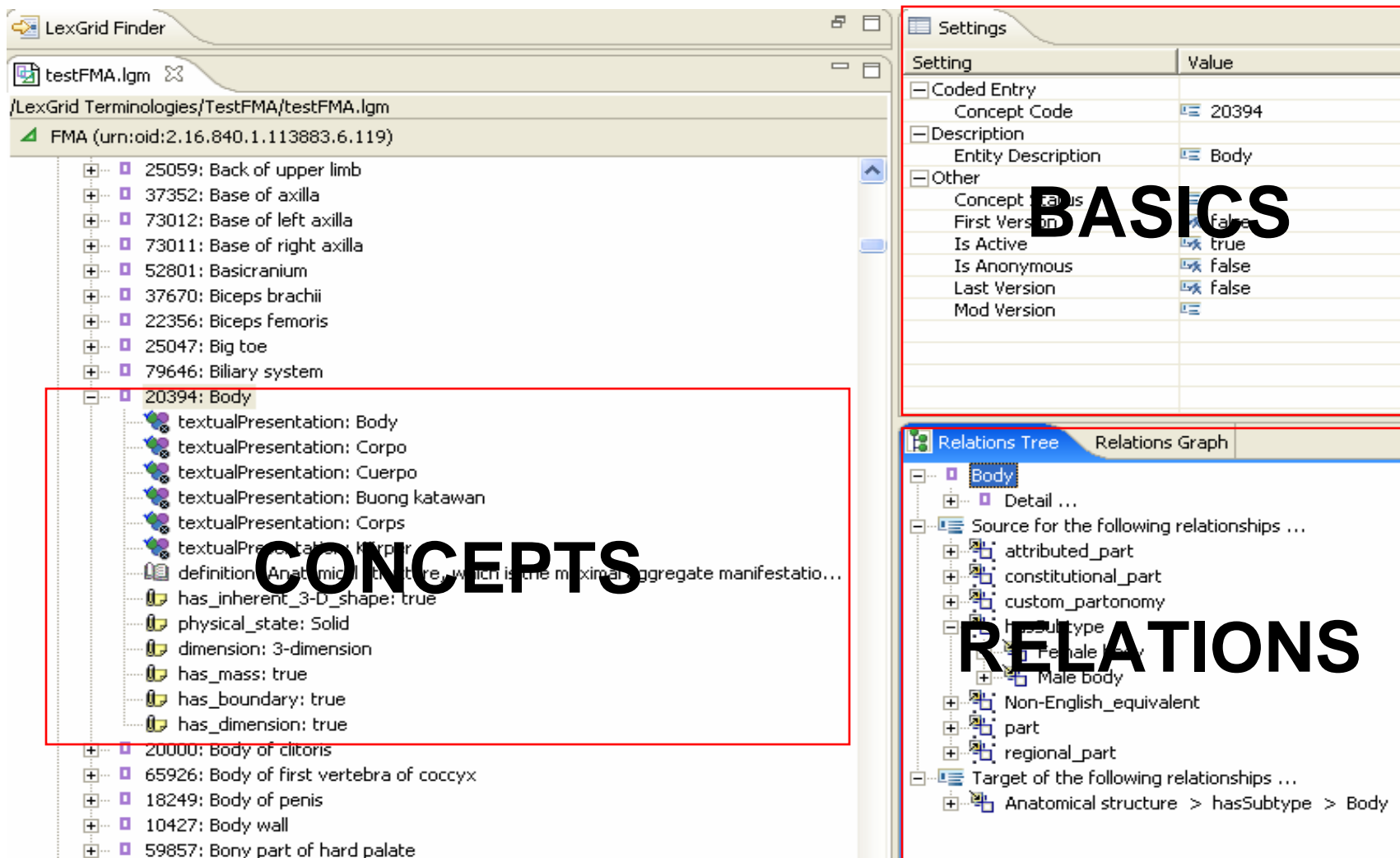
Settings:

Setting	Value
Coded Entry	
Concept Code	20394
Description	
Entity Description	Body
Other	
Concept Status	
First Version	false
Is Active	true
Is Anonymous	false
Last Version	false
Mod Version	

Relations Tree:

- Body
 - Detail ...
 - Source for the following relationships ...
 - attributed_part
 - constitutional_part
 - custom_partonomy
 - hasSubtype
 - Female body
 - Male body
 - Non-English_equivalent
 - part
 - regional_part
 - Target of the following relationships ...
 - Anatomical structure > hasSubtype > Body

Concept “Body” (LexGrid)



The screenshot displays the LexGrid Finder application interface. The main window shows a list of terminologies, with 'FMA (urn:oid:2.16.840.1.113883.6.119)' selected. The left pane shows a hierarchical list of concepts, with '20394: Body' expanded. The right pane shows the 'Settings' and 'Relations Tree' for the selected concept.

CONCEPTS

- 25059: Back of upper limb
- 37352: Base of axilla
- 73012: Base of left axilla
- 73011: Base of right axilla
- 52801: Basicranium
- 37670: Biceps brachii
- 22356: Biceps femoris
- 25047: Big toe
- 79646: Biliary system
- 20394: Body**
 - textualPresentation: Body
 - textualPresentation: Corpo
 - textualPresentation: Cuerpo
 - textualPresentation: Buong katawan
 - textualPresentation: Corps
 - textualPresentation: Körper
 - definition: Anatomical structure, which is the maximal aggregate manifestatio...
 - has_inherent_3-D_shape: true
 - physical_state: Solid
 - dimension: 3-dimension
 - has_mass: true
 - has_boundary: true
 - has_dimension: true
- 20000: Body of clitoris
- 65926: Body of first vertebra of coccyx
- 18249: Body of penis
- 10427: Body wall
- 59857: Bony part of hard palate

BASICS

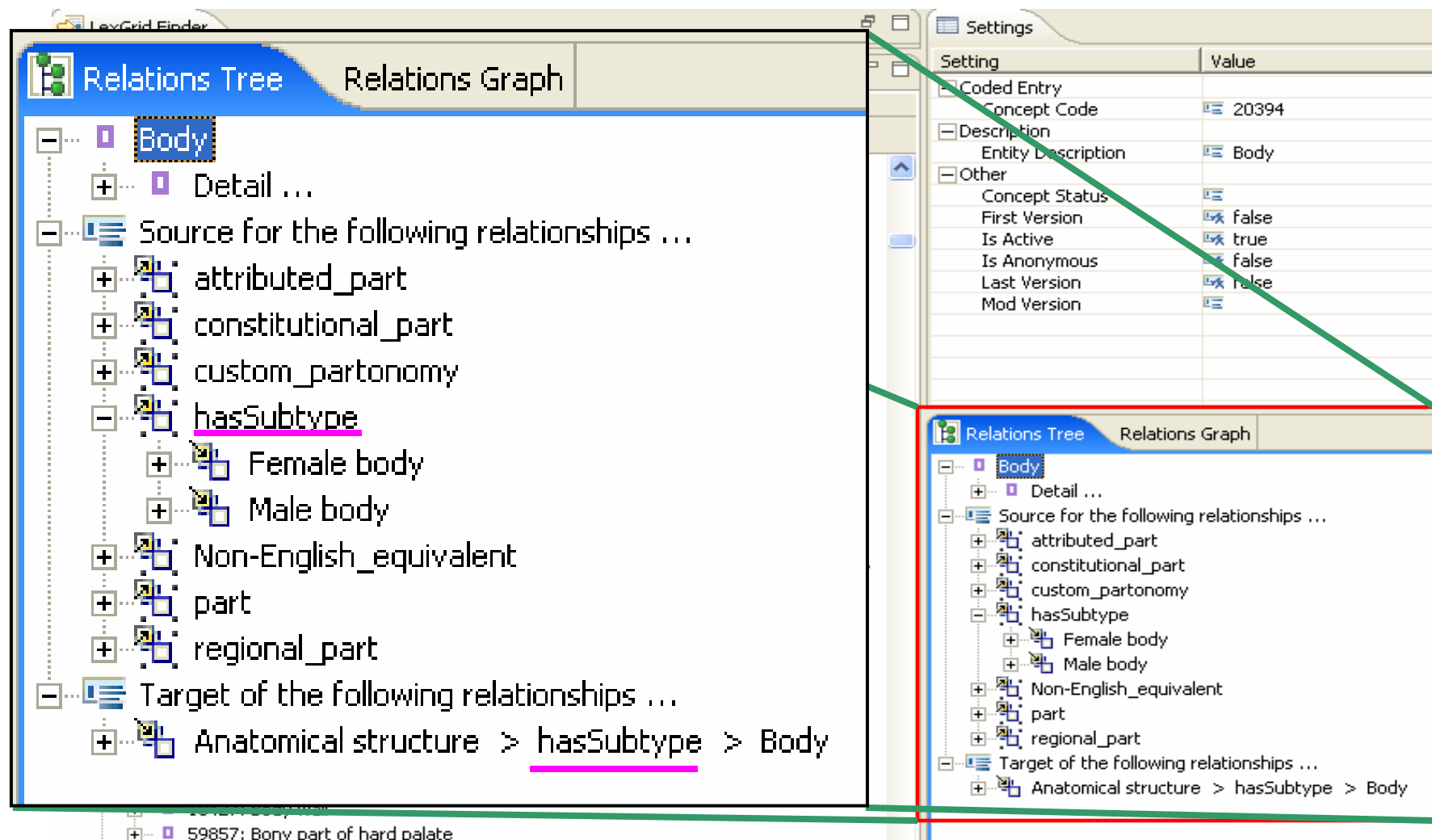
Setting	Value
Coded Entry	
Concept Code	20394
Description	
Entity Description	Body
Other	
Concept Status	active
First Version	false
Is Active	true
Is Anonymous	false
Last Version	false
Mod Version	

RELATIONS

Relations Tree

- Body**
 - Detail ...
 - Source for the following relationships ...
 - attributed_part
 - constitutional_part
 - custom_partonomy
 - hasSubtype
 - Female body
 - Male body
 - Non-English_equivalent
 - part
 - regional_part
 - Target of the following relationships ...
 - Anatomical structure > hasSubtype > Body

Concept “Body” (LexGrid)



The screenshot displays the LexGrid Finder interface, which is used for managing medical concepts and their relationships. The interface is divided into several panes:


- Relations Tree:** This pane shows a hierarchical tree of relationships for the selected concept, 'Body'. The tree is expanded to show the following structure:
 - Body** (selected)
 - Detail ...
 - Source for the following relationships ...
 - attributed_part
 - constitutional_part
 - custom_partonomy
 - hasSubtype (highlighted in pink)
 - Female body
 - Male body
 - Non-English_equivalent
 - part
 - regional_part
 - Target of the following relationships ...
 - Anatomical structure > hasSubtype > Body (highlighted in pink)

- Relations Graph:** This pane is currently empty.
- Settings:** This pane displays various settings for the concept, including:

Setting	Value
Coded Entry	
Concept Code	20394
Description	
Entity Description	Body
Other	
Concept Status	
First Version	false
Is Active	true
Is Anonymous	false
Last Version	false
Mod Version	

A green line is drawn across the interface, connecting the 'Body' concept in the Relations Tree to the 'Body' concept in the Settings pane. A red box highlights the 'Body' concept in the Relations Tree and the 'Body' concept in the Settings pane.

“Body” (FMA) - Attributes

For Class:  Body(20394) (instance of Anatomical structure(67135), internal name is Body)

Definition

Anatomical structure, which is the maximal aggregate manifestation of an individual member of the species Homo sapiens; it is completely surrounded by skin. Examples: There is only one human body.

Comment





☒ Has Dimension **Dimension** 3-dimension ☒ Has Boundary **Bounded By**

☒ Has Mass

☒ Has Inherent 3-D Shape **Inherent 3-D Shape**

Part Of


Part

-  Respiratory system(7158)
-  Cardiovascular system(7161)
-  Musculoskeletal system(7482)
-  Alimentary system(7152)

Attributed Part

related part	anatomical/arbitrary	shared/unshared	partition
Head(7154)	Anatomical	Unshared	Partition 1
Neck(7155)	Anatomical	Unshared	Partition 1
Trunk(7181)	Anatomical	Unshared	Partition 1
Right upper limb(7185)	Anatomical	Unshared	Partition 1

“Body” (FMA) - Attributes





For Class:  Body(20394) (instance of Anatomical structure(67135), internal name is Body)

Definition
Anatomical structure, which is the maximal aggregate manifestation of an individual member of the species Homo sapiens; it is completely surrounded by skin. Examples: There is only one human body.

Comment

☒ Has Dimension
☒ Has Mass
☒ Has Inherent 3D Shape

Part Of

-  Respiratory system(7158)
-  Cardiovascular system(7161)
-  Musculoskeletal system(7482)
-  Alimentary system(7152)

Attributed Part

related part	anatomical/arbitrary	shared/unshared	partition
Head(7154)	Anatomical	Unshared	Partition 1
Neck(7155)	Anatomical	Unshared	Partition 1
Trunk(7181)	Anatomical	Unshared	Partition 1
Right upper limb(7185)	Anatomical	Unshared	Partition 1

“Body” (FMA) - Attributes

For Class:  Body(20394) (instance of Anatomical structure(67135), internal name is Body)

Definition

Anatomical structure, which is the maximal aggregate manifestation of an individual member of the species Homo sapiens; it is completely surrounded by skin. Examples: There is only one human body.

Comment





☒ Has Dimension Dimension: 3-dimension ☒ Has Boundary Rounded By:

☒ Has Mass

☒ Has Inherent 3-D Shape Inherent 3-D Shape:

Part Of

Part

-  Respiratory
-  Cardiovascular
-  Musculoskeletal
-  Alimentary

Attributed Part

related part	anatomical/arbitrary	shared/unshared
Head(7154)	Anatomical	Unshared
Neck(7155)	Anatomical	Unshared
Trunk(7181)	Anatomical	Unshared
Right upper limb(7185)	Anatomical	Unshared

☒ Has Dimension Dimension: 3-dimension ☒ Has Boundary

☒ Has Mass

☒ Has Inherent 3-D Shape Inherent 3-D Shape:

“Body” (FMA) - Attributes

For Class:

Definition
Anatomical structure completely surrounded by other structures

Comment

☒ Has Dimension

☒ Has Mass

☒ Has Inherent 3-D Shape

Part Of

Part

- Respiratory system(7158)
- Cardiovascular system(7161)
- Musculoskeletal system(7482)
- Alimentary system(7152)

Attributed Part

related part	anatomical/arbitrary	shared/unshared	partition
Head(7154)	Anatomical	Unshared	Partition 1
Neck(7155)	Anatomical	Unshared	Partition 1
Trunk(7181)	Anatomical	Unshared	Partition 1
Right upper limb(7185)	Anatomical	Unshared	Partition 1

Part Of

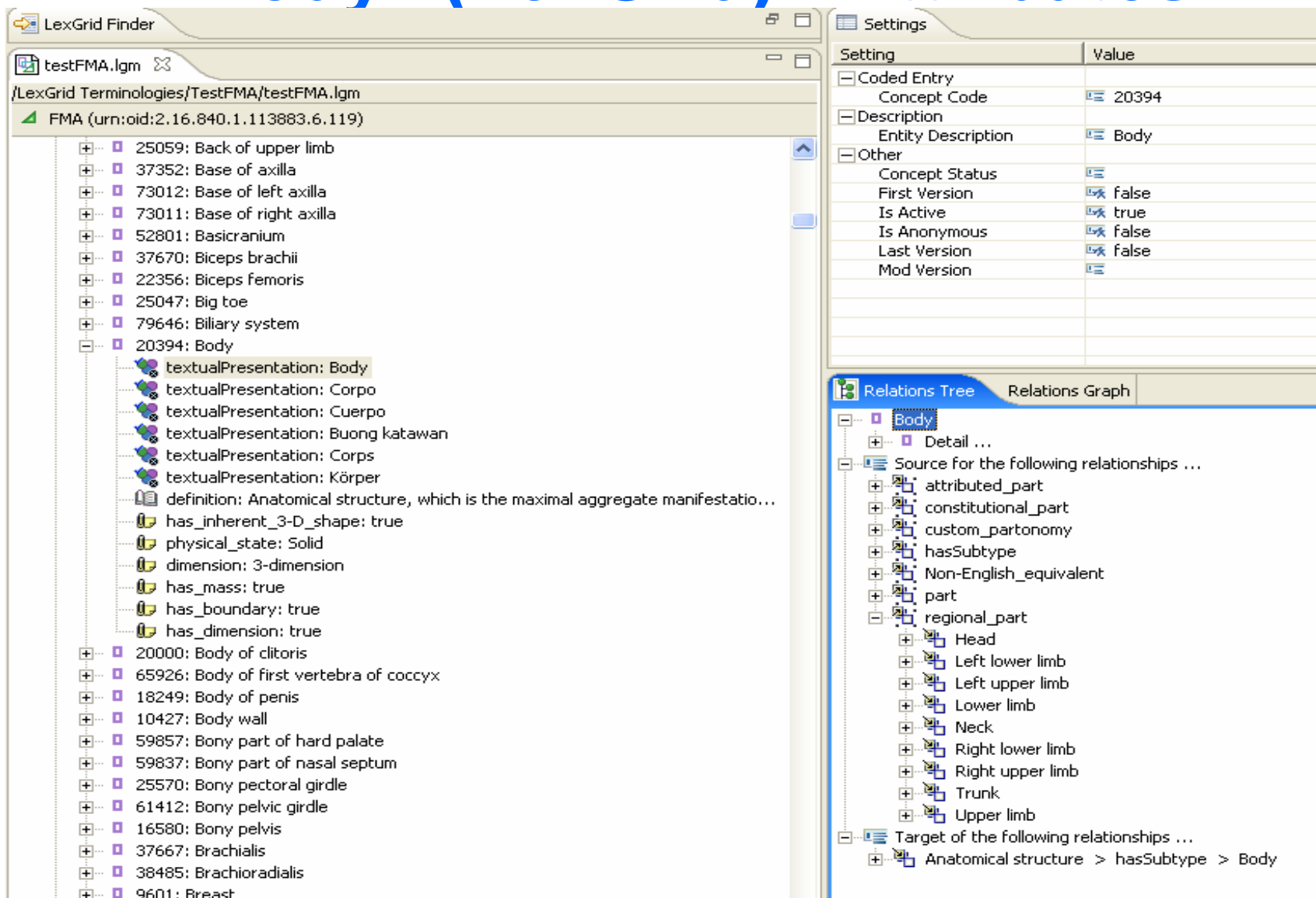
Part

- Respiratory system(7158)
- Cardiovascular system(7161)
- Musculoskeletal system(7482)
- Alimentary system(7152)

Attributed Part

related part	anatomical/arbitrary	shared/unshared	partition
Head(7154)	Anatomical	Unshared	Partition 1
Neck(7155)	Anatomical	Unshared	Partition 1
Trunk(7181)	Anatomical	Unshared	Partition 1
Right upper limb(7185)	Anatomical	Unshared	Partition 1

“Body” (LexGrid) - Attributes

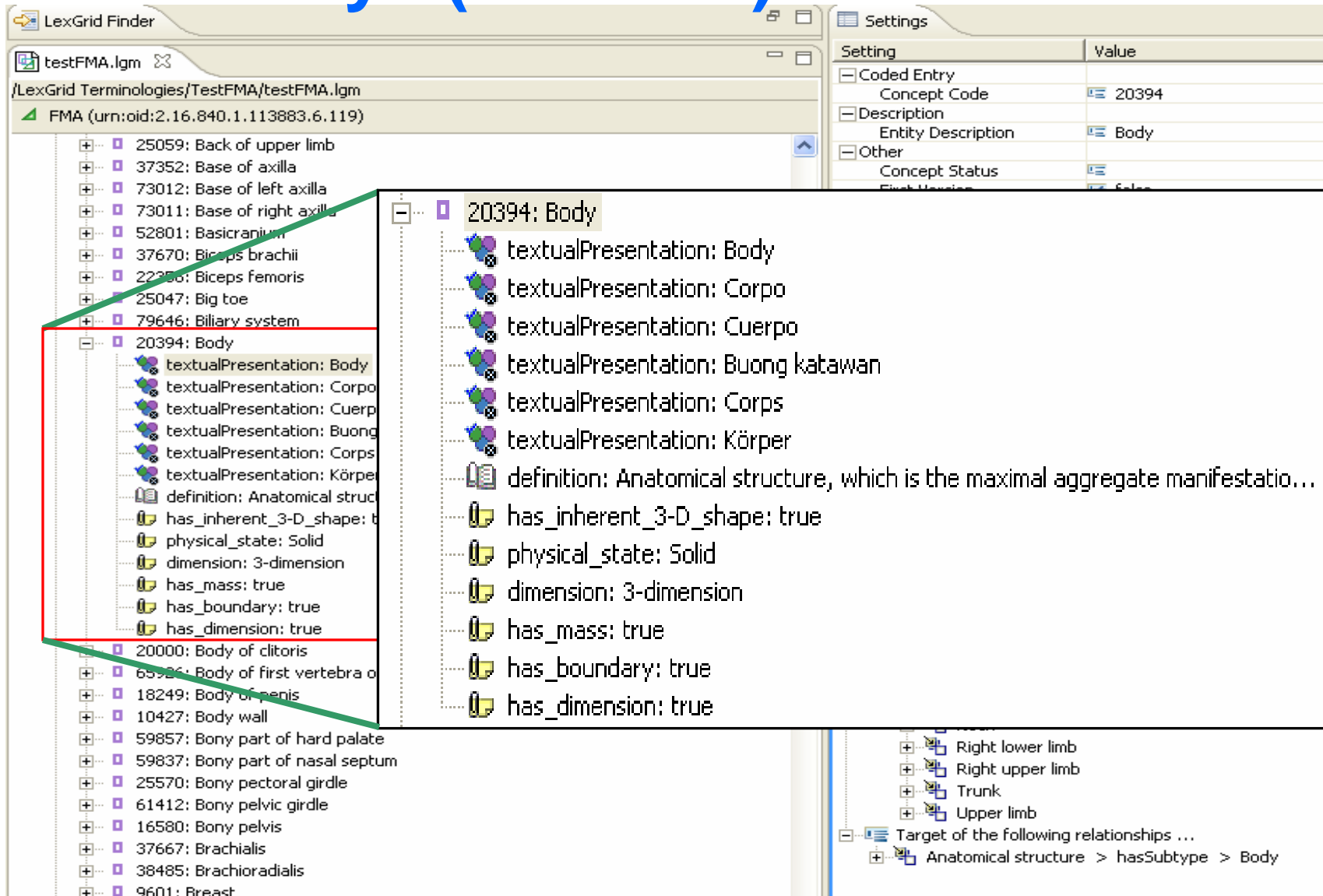


The screenshot displays the LexGrid Finder application interface. The main window shows a tree view of terminologies under the file 'testFMA.lgm'. The 'FMA (urn:oid:2.16.840.1.113883.6.119)' terminology is expanded, and the '20394: Body' concept is selected. The concept's attributes are listed below it, including textual presentations in various languages and specific attributes like 'has_inherent_3-D_shape: true' and 'dimension: 3-dimension'.

On the right, the 'Settings' panel shows the configuration for the selected concept. The 'Coded Entry' section has 'Concept Code' set to '20394'. The 'Description' section has 'Entity Description' set to 'Body'. The 'Other' section shows 'Concept Status' as 'true', 'First Version' as 'false', 'Is Active' as 'true', 'Is Anonymous' as 'false', 'Last Version' as 'false', and 'Mod Version' as 'true'.

Below the settings, the 'Relations Tree' panel shows the relationships for the 'Body' concept. It lists various relationships such as 'attributed_part', 'constitutional_part', 'custom_partonomy', 'hasSubtype', 'Non-English_equivalent', 'part', and 'regional_part'. The 'regional_part' relationship is expanded, showing sub-regions like 'Head', 'Left lower limb', 'Left upper limb', 'Lower limb', 'Neck', 'Right lower limb', 'Right upper limb', 'Trunk', and 'Upper limb'. The 'Target of the following relationships ...' section shows the path 'Anatomical structure > hasSubtype > Body'.

“Body” (LexGrid) - Attributes



The screenshot shows the LexGrid Finder application. The main window displays a tree view of terminologies. The 'FMA (urn:oid:2.16.840.1.113883.6.119)' terminology is selected. Under 'FMA', the '20394: Body' concept is highlighted with a red box. A green box highlights the '20394: Body' concept in the left pane. The right pane shows the detailed view of the '20394: Body' concept, including its textual presentations and attributes.

Settings

Setting	Value
Coded Entry	
Concept Code	20394
Description	
Entity Description	Body
Other	
Concept Status	Active
First Version	1.0

20394: Body

- textualPresentation: Body
- textualPresentation: Corpo
- textualPresentation: Cuerpo
- textualPresentation: Buong katawan
- textualPresentation: Corps
- textualPresentation: Körper
- definition: Anatomical structure, which is the maximal aggregate manifestatio...
- has_inherent_3-D_shape: true
- physical_state: Solid
- dimension: 3-dimension
- has_mass: true
- has_boundary: true
- has_dimension: true

20000: Body of clitoris

65326: Body of first vertebra

18249: Body of penis

10427: Body wall

59857: Bony part of hard palate

59837: Bony part of nasal septum

25570: Bony pectoral girdle

61412: Bony pelvic girdle

16580: Bony pelvis

37667: Brachialis

38485: Brachioradialis

9601: Breast

Right lower limb

Right upper limb

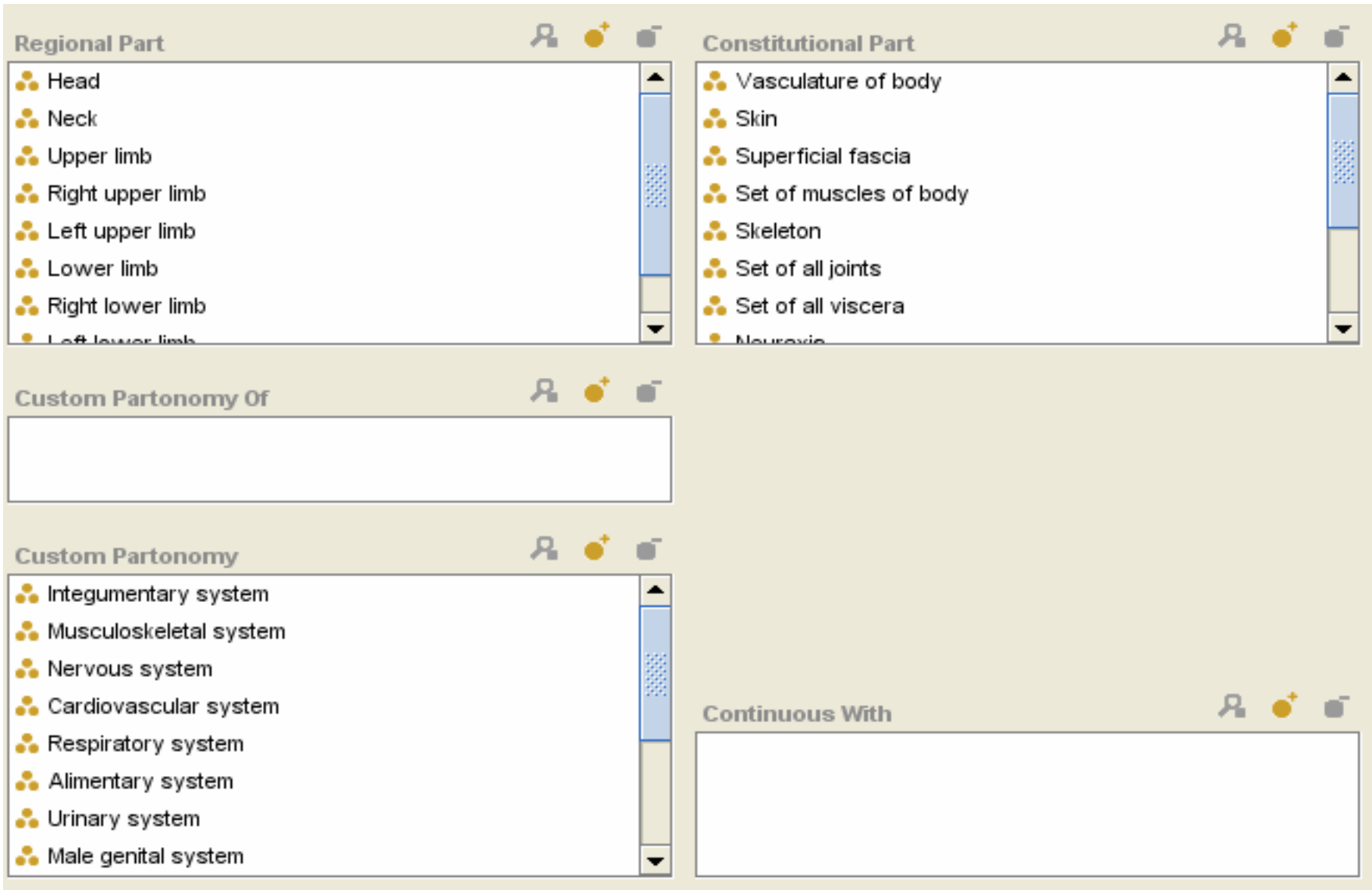
Trunk

Upper limb

Target of the following relationships ...

- Anatomical structure > hasSubtype > Body

“Body” (FMA) - Relations



The screenshot displays the FMA (Foundational Model of Anatomy) interface, which is organized into several panels for exploring anatomical relations. Each panel includes a title, a list of terms, and a set of icons (a person, a plus sign, and a minus sign) for interaction.

- Regional Part:** A list of anatomical regions including Head, Neck, Upper limb, Right upper limb, Left upper limb, Lower limb, Right lower limb, and Left lower limb.
- Constitutional Part:** A list of body parts including Vasculature of body, Skin, Superficial fascia, Set of muscles of body, Skeleton, Set of all joints, Set of all viscera, and Nervous system.
- Custom Partonomy Of:** A text input field for defining a custom partonomy.
- Custom Partonomy:** A list of body systems including Integumentary system, Musculoskeletal system, Nervous system, Cardiovascular system, Respiratory system, Alimentary system, Urinary system, and Male genital system.
- Continuous With:** A text input field for defining continuous relations.

“Body” (LexGrid) - Relations

Body

- Detail ...
- Source for the following relationships ...
 - attributed_part
 - constitutional_part
 - custom_partonomy
 - hasSubtype
 - Non-English_equivalent
 - part
 - regional_part
 - Head
 - Left lower limb
 - Left upper limb
 - Lower limb
 - Neck
 - Right lower limb
 - Right upper limb
 - Trunk
 - Upper limb
- Target of the following relationships ...
 - Anatomical structure > hasSubtype > Body

37667: Brachialis
38485: Brachioradialis
9601: Breast

Settings

Setting	Value
Coded Entry	
Concept Code	20394
Description	
Entity Description	Body
Other	
Concept Status	
First Version	false
Is Active	true
Is Anonymous	false
Last Version	false
Mod Version	

Relations Tree Relations Graph

Body

- Detail ...
- Source for the following relationships ...
 - attributed_part
 - constitutional_part
 - custom_partonomy
 - hasSubtype
 - Non-English_equivalent
 - part
 - regional_part
 - Head
 - Left lower limb
 - Left upper limb
 - Lower limb
 - Neck
 - Right lower limb
 - Right upper limb
 - Trunk
 - Upper limb
- Target of the following relationships ...
 - Anatomical structure > hasSubtype > Body

“Body” (LexGrid) - Relations

LexGrid Finder

Contained text (no wildcard) or regular expression

20394

testFMA.lgm

/LexGrid Terminologies/TestFMA/testFMA.lgm

FMA (urn:oid:2.16.840.1.113883.6.119)

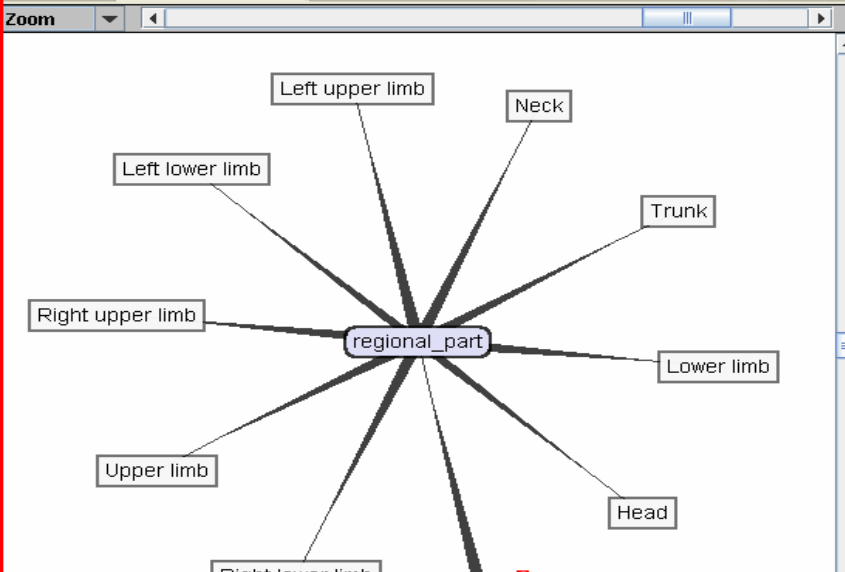
- 24217: Back of thorax
- 52801: Basicranium
- 37670: Biceps brachii
- 22356: Biceps femoris
- 25047: Big toe
- 79646: Biliary system
- 20394: Body**
- 20000: Body of clitoris
- 18249: Body of penis
- 10427: Body wall
- 59857: Bony part of hard palate
- 59837: Bony part of nasal septum
- 25570: Bony pectoral girdle
- 61412: Bony pelvic girdle
- 37667: Brachialis
- 38485: Brachioradialis
- 9601: Breast
- 46488: Buccal part of mouth
- 46834: Buccinator
- 9599: Bulbo-urethral gland
- 19729: Bulbospongiosus
- 25245: Buttock
- 45633: Capillary plexus
- 7161: Cardiovascular system
- 50095: Carotid body
- 59838: Cartilaginous part of nasal septum
- 23082: Cervical rotator
- 46476: Cheek
- 24216: Chest
- 46495: Chin
- 54376: Clivus of basicranium
- 15649: Coccygeal body
- 19088: Coccygeus
- 30438: Compressor urethrae
- 61006: Conchal part of pinna
- 37664: Coracobrachialis
- 35005: Cornu of coccyx
- 46794: Corrugator supercilii
- 55663: Corticomedullary organ
- 26014: Costoclavicular ligament
- 9025: Costoxiphoid ligament
- 46417: Cricothyroid muscle

Settings

Setting	Value
Association Instance	
Source Concept	20394
Source Coding Scheme	

Relations Tree Relations Graph

Zoom



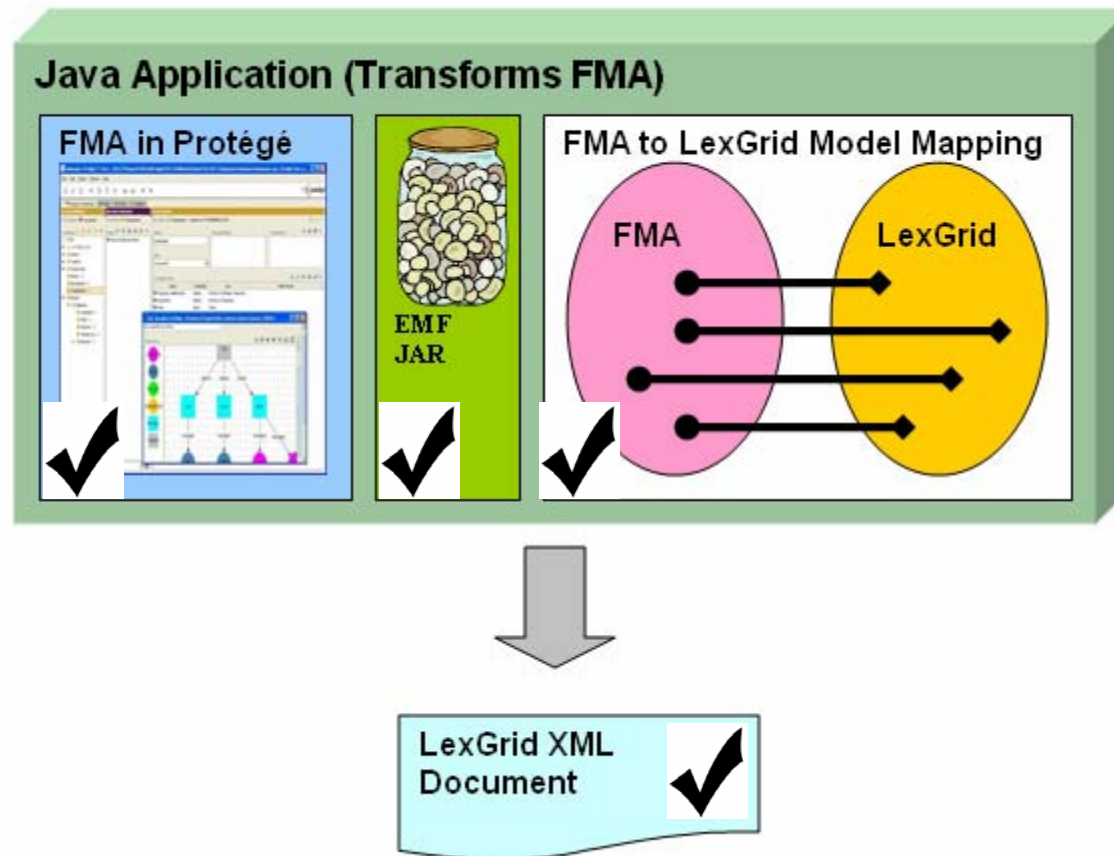
```

graph TD
    regional_part --- Left_upper_limb[Left upper limb]
    regional_part --- Neck
    regional_part --- Trunk
    regional_part --- Lower_limb[Lower limb]
    regional_part --- Head
    regional_part --- Body
    regional_part --- Right_lower_limb[Right lower limb]
    regional_part --- Upper_limb[Upper limb]
    regional_part --- Right_upper_limb[Right upper limb]
    regional_part --- Left_lower_limb[Left lower limb]
  
```

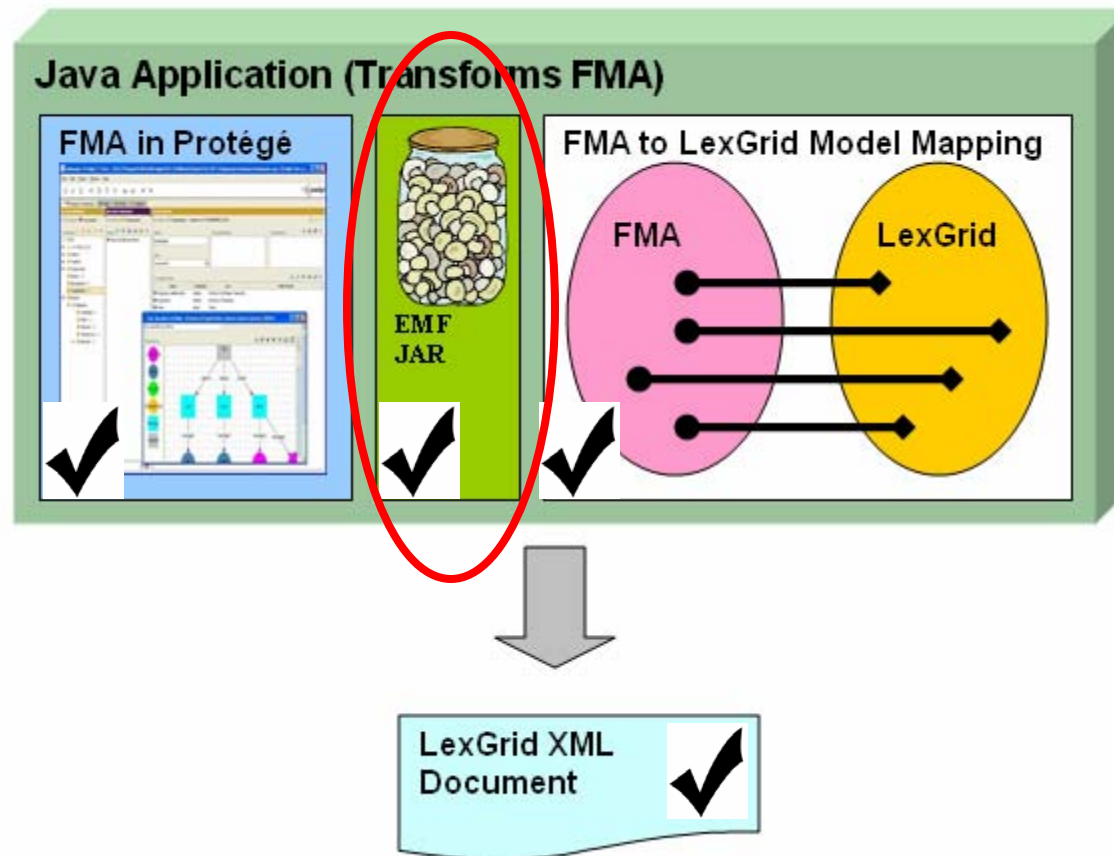
Current Status

- **Transformation tool is a Java application**
- **Possible to make a Protégé plug-in**
- **Need to Isolate “Mapping to LexGrid Model” from EMF implementation**

EMF at work

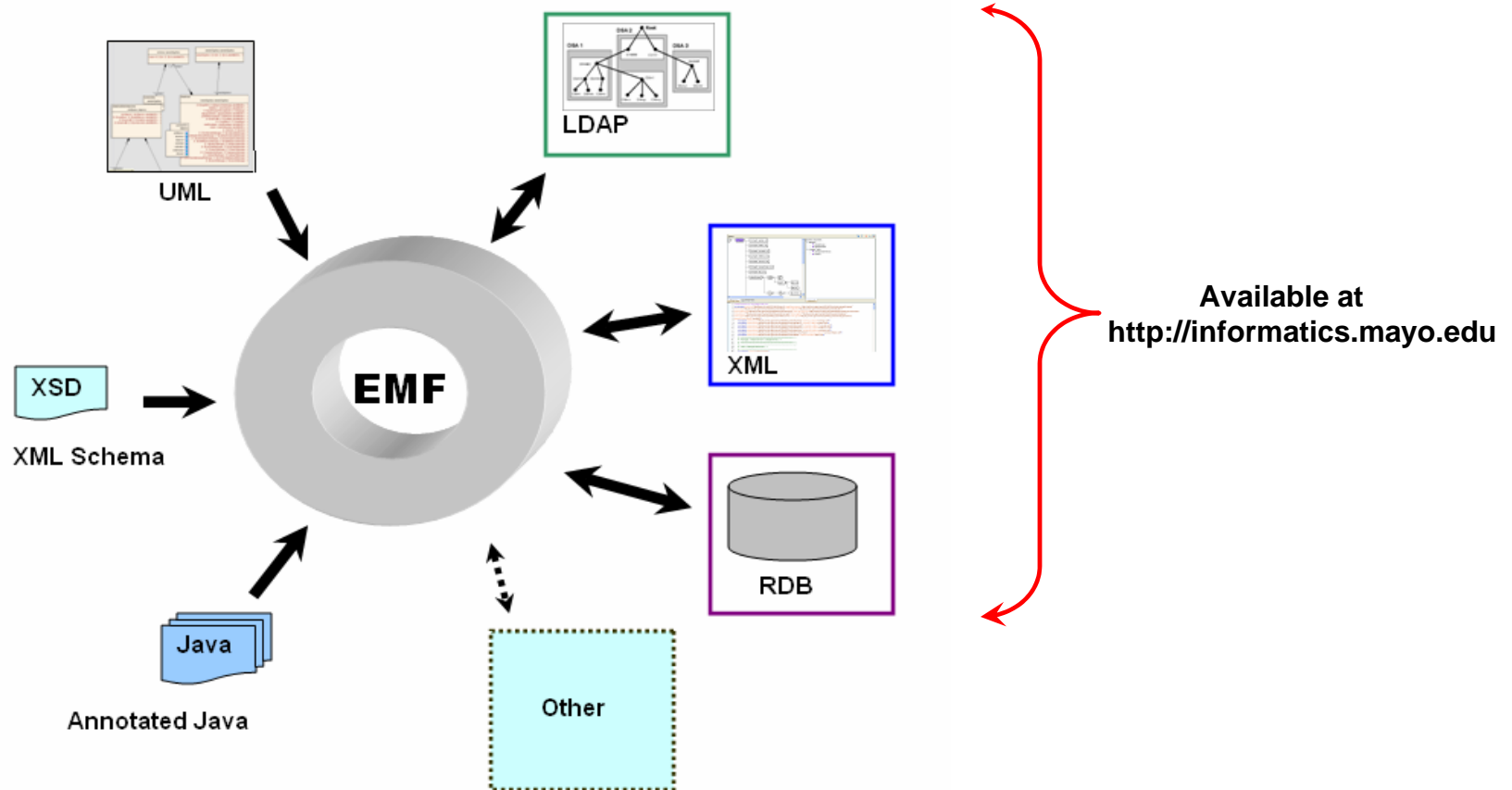


EMF at work



Current Status

EMF as a Hub



Conclusion

- Easily used EMF to work with user model and generate code
- Successfully
 - Converted FMA content to LexGrid Model
 - Used EMF to create LexGrid XML output document
- EMF as a hub

Thanks!

- **Harold Solbrig**
- **Thomas Johnson**
- **Dr. Christopher Chute**

Thanks!

Protégé Conference Organizers

Questions ?



Questions ?

<http://informatics.mayo.edu>

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