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Departamento de Informática

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FrameWeb

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FrameWeb

- Framework-based Design Method for Web Engineering:
  - *Architectural design;*
  - *Web-based Information Systems (WISs);*
  - *Framework or container-based.*
- Masters dissertation [Souza, 2007];
- Evolutions since 2015, work in progress.

https://nemo.inf.ufes.br/projects/frameweb/

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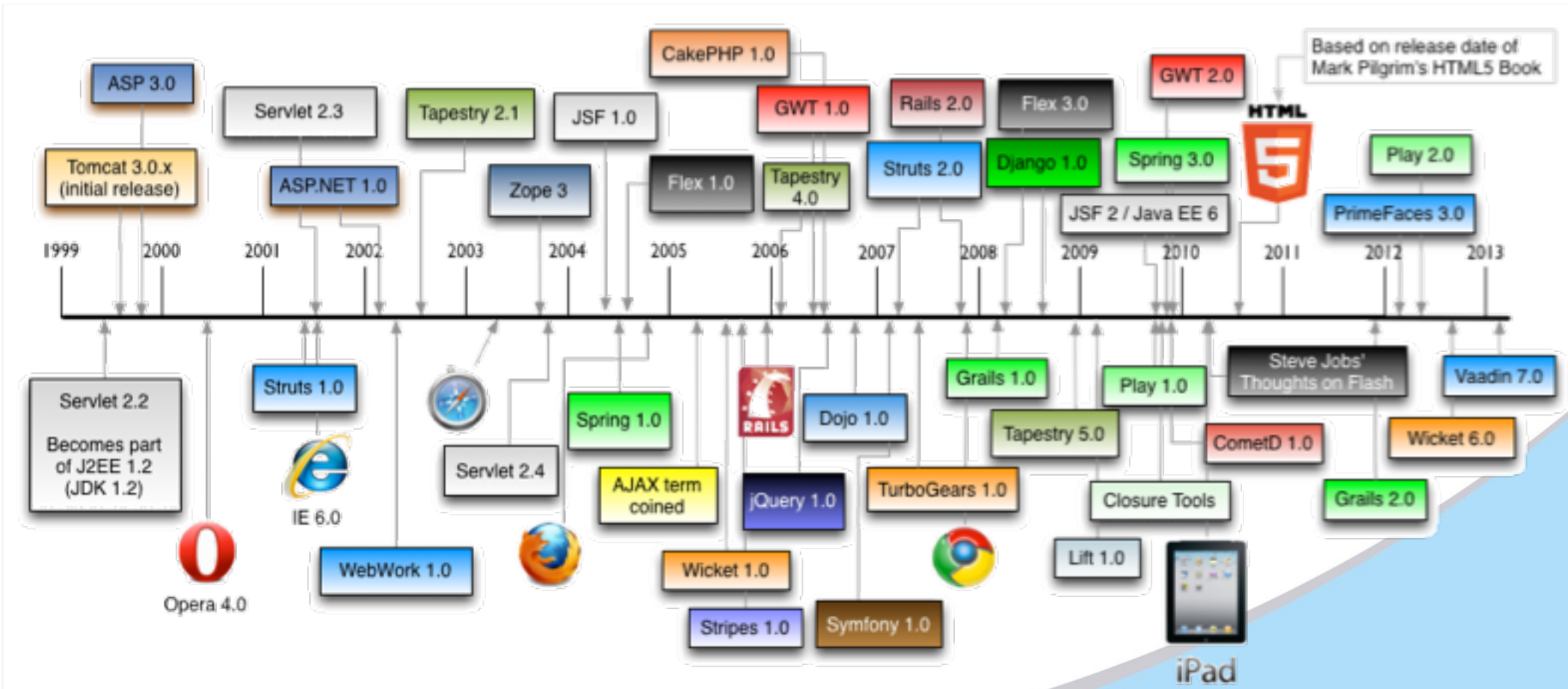
Frameworks



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Motivation

- Use of frameworks:
  - *Promote robust architectures;*
  - *Increase productivity (if WIS is not trivial);*
  - *State-of-practice (especially for the Web);*
  - *Drive the definition of standards;*
- Bring frameworks to architectural models:
  - *Lack of proposals;*
  - *More power (and responsibility) to software architects;*
  - *Code generation (MDD).*

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FrameWeb in a nutshell

- Definition of a basic architecture;
  - *Separation of concerns in layers;*
  - *Use of frameworks;*
- A UML profile for construction of architectural models:
  - *Entity model;*
  - *Persistence model;*
  - *Application model*
  - *Navigation model.*

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Categories of frameworks

Front Controller

Dependency Injection

Object/Relational Mapping

Decorator

Aspect-oriented Programming

Authentication & Authorization

Current focus of FrameWeb

Front Controller

Dependency Injection

Object/Relational Mapping

Decorator

Doesn’t really affect models

Authentication & Authorization

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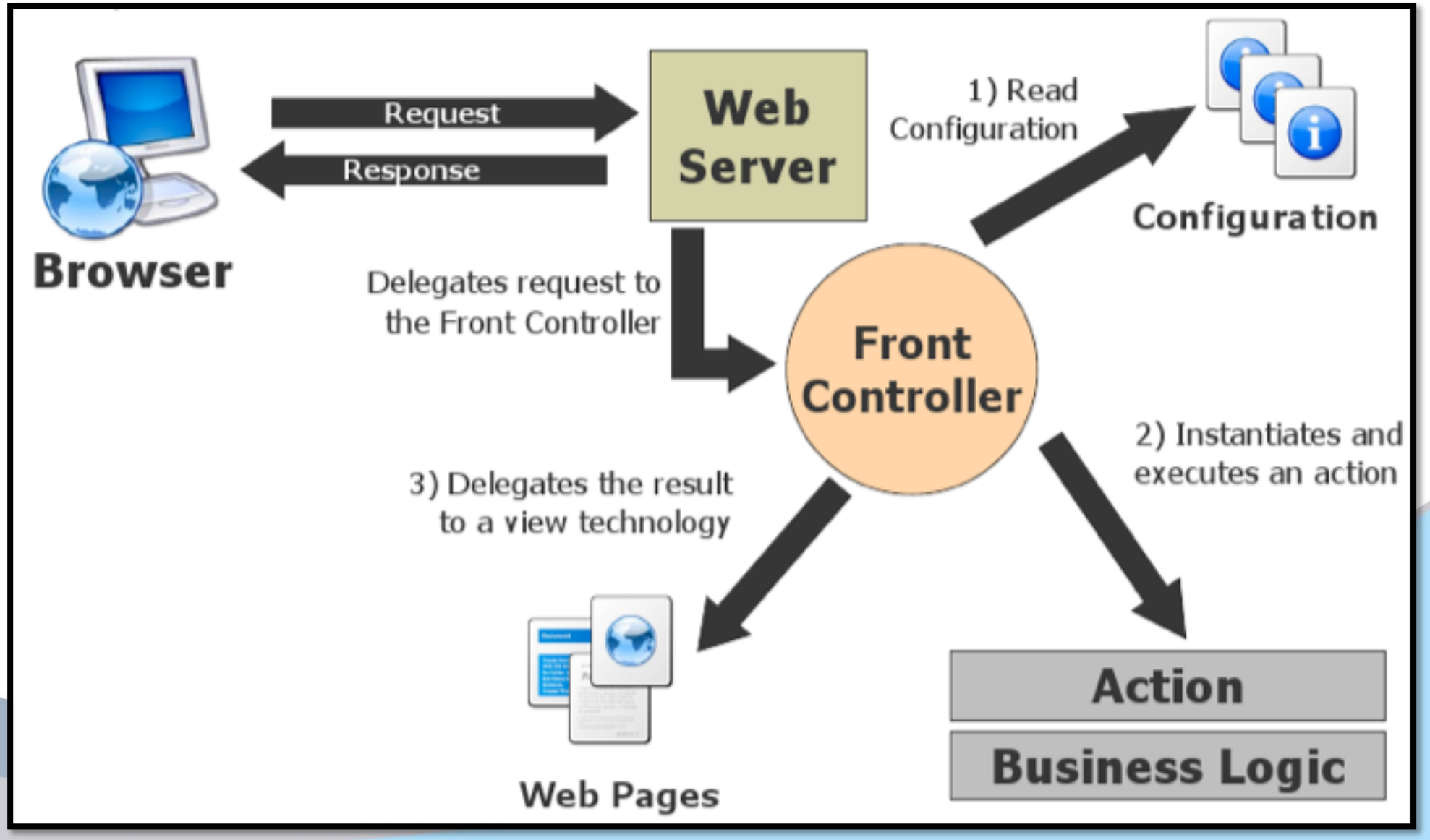
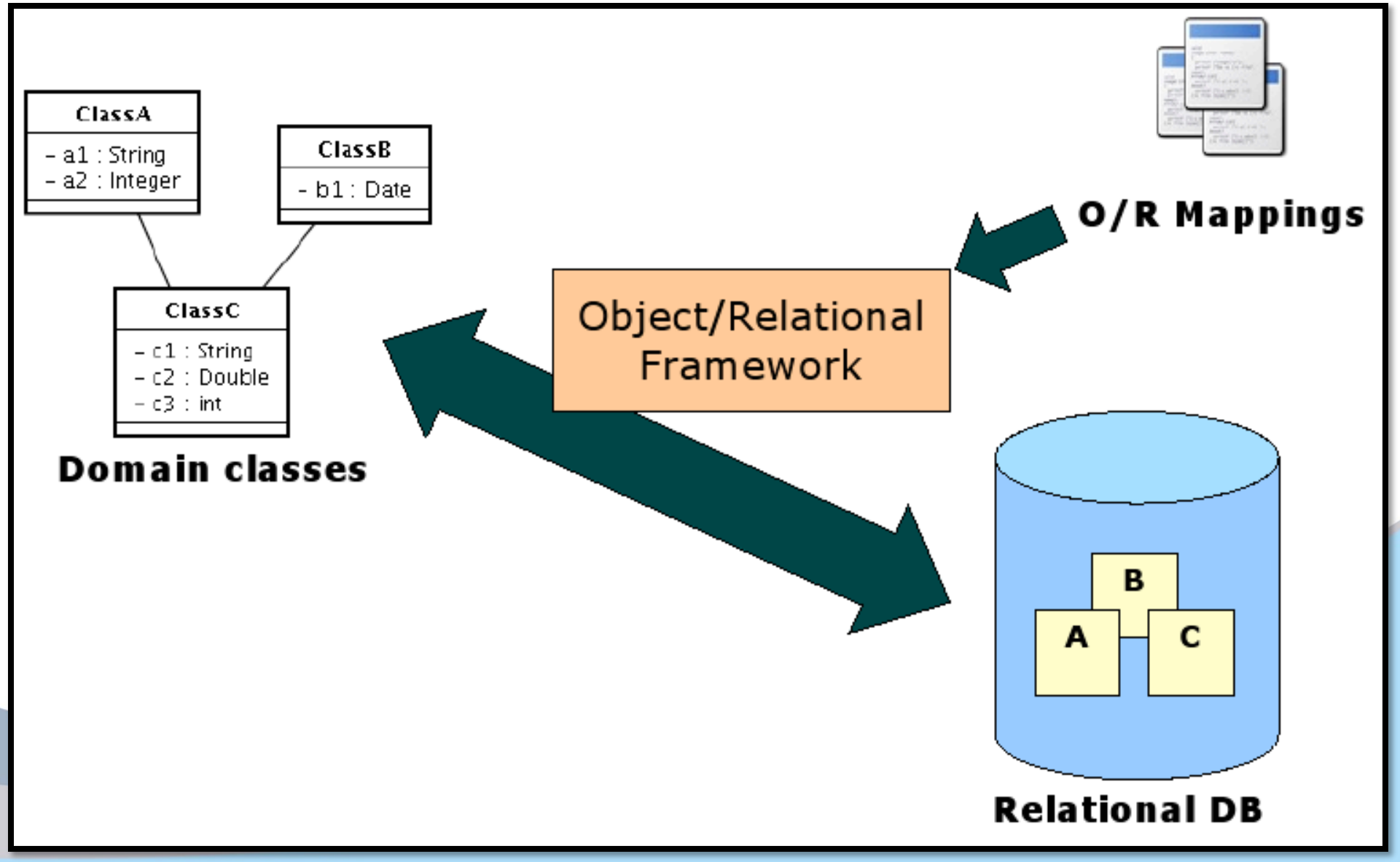
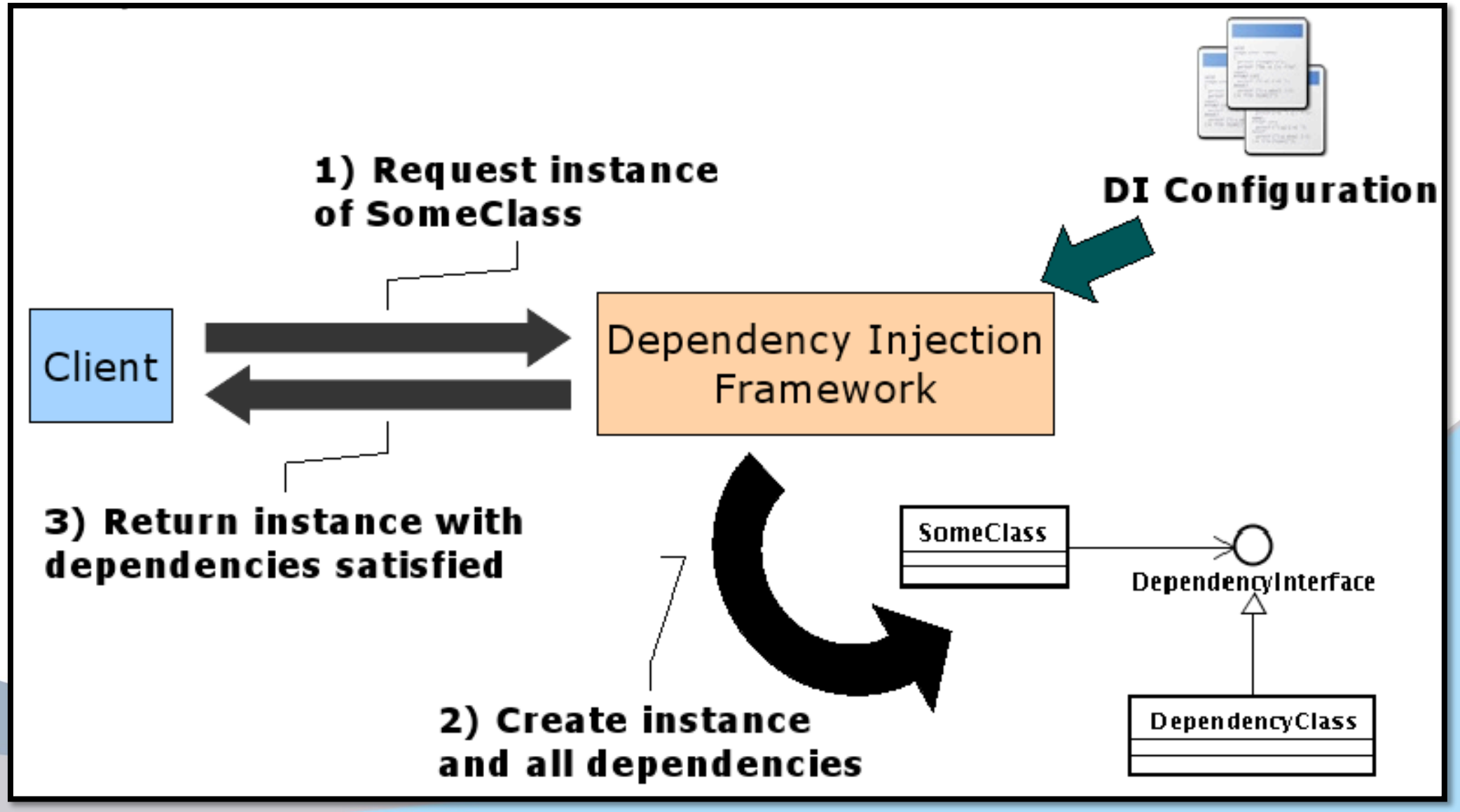
Front Controller framework



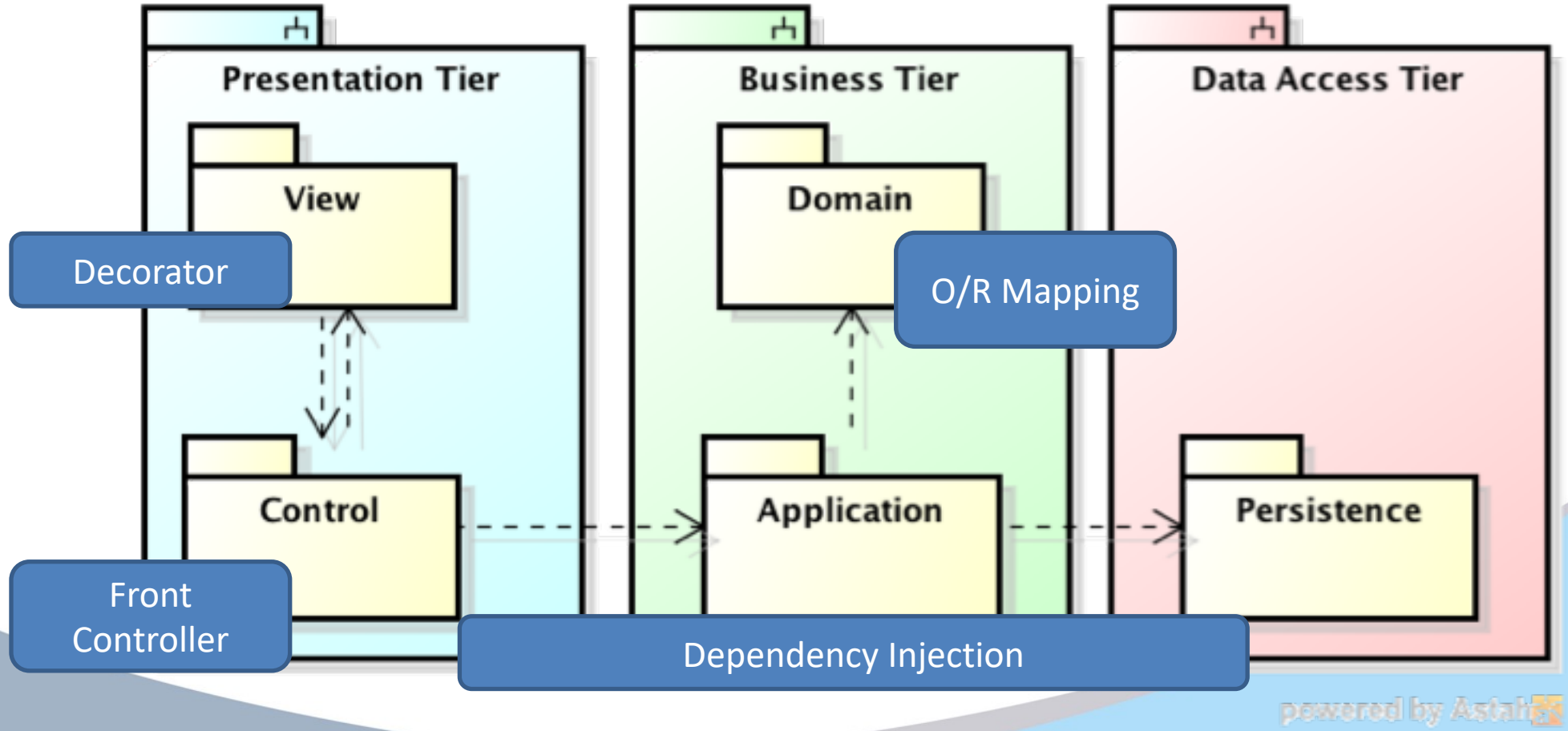
Object/Relational Mapping framework



Dependency Injection framework



Proposed architecture



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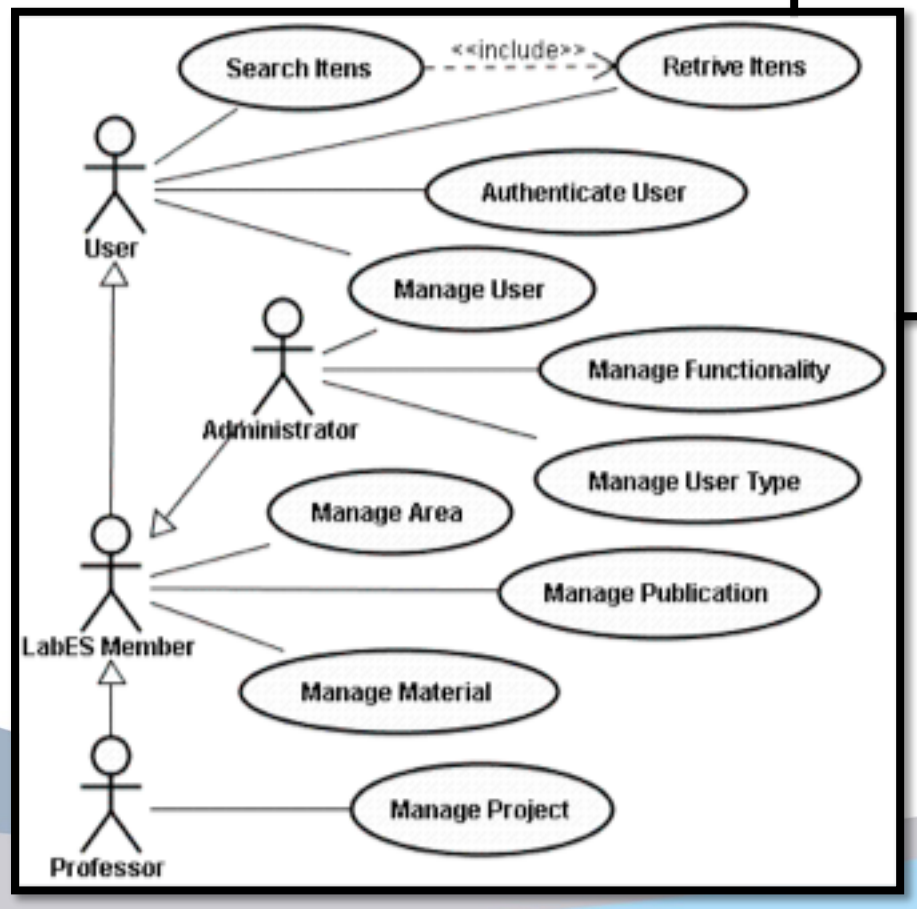
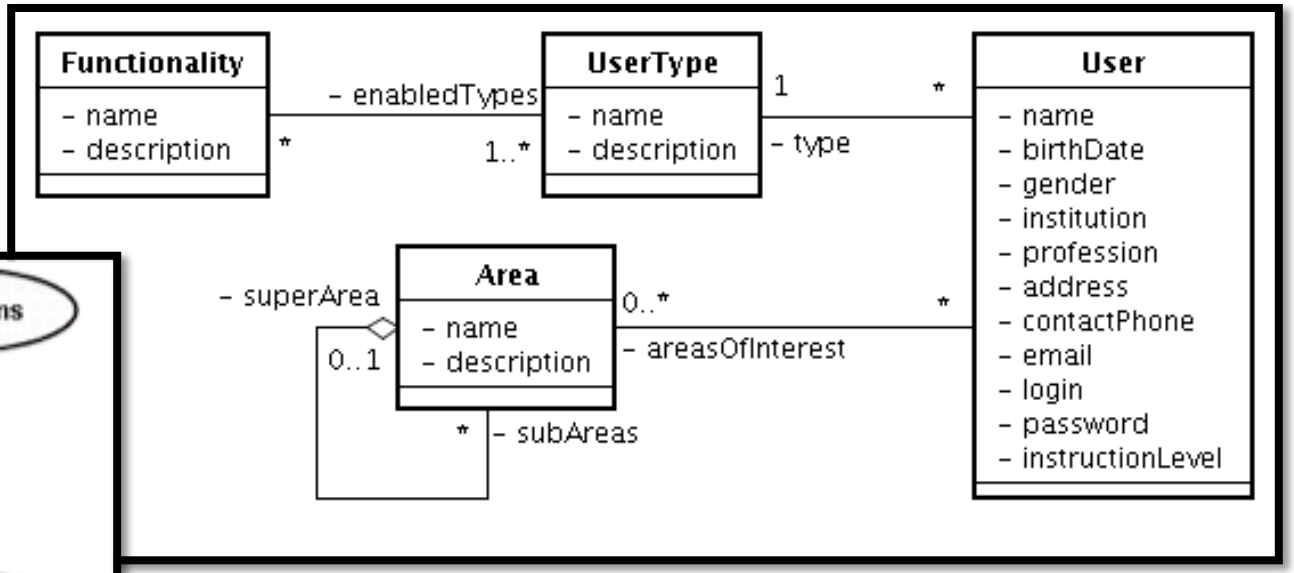
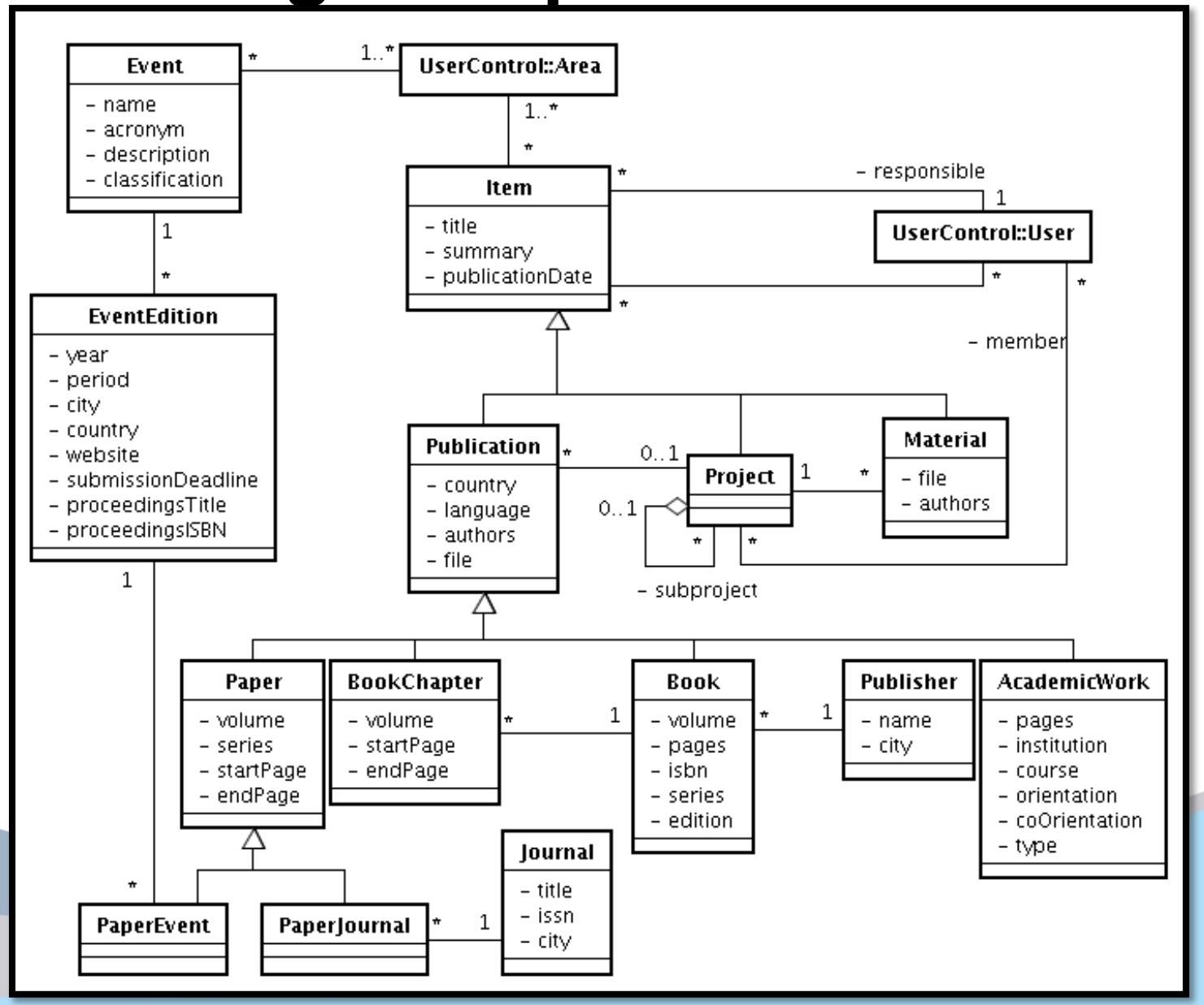
Original frameworks (2007)

Running example – LabES Portal





Running example – LabES Portal



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Entity Model

- UML class diagram;
- O/R mappings added to classes via UML extensions;
- Use of sensible defaults;
- Guides the implementation of:
  - *Classes of the Domain package;*
  - *O/R mapping for these classes.*

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Entity Model – UML Extensions

O/R Mapping	Extension	Possible Values
If the class is persistent, transient or mapped (not persistent itself, but its properties are persistent if another class inherits them)	Class stereotype	<<persistent>> <<transient>> <<mapped>>
Name of the table in which objects of a class will be persisted	Class constraint	table=name (class name)
If an attribute is persistent or transient	Attribute stereotype	<<persistent>> <<transient>>
If an attribute can be null when the object is persisted	Attribute constraint	null not null
Date/time precision: store only the date, only the time or both (timestamp)	Attribute constraint	precision = (date | time | timestamp)
If the attribute is the primary-key of the table	Attribute stereotype	<<id>>

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Entity Model – UML Extensions

O/R Mapping	Extension	Possible Values
How the ID attribute should be generated: automatically, obtained in a table, use of IDENTITY column, use of SEQUENCE column or none	Attribute constraint	generation = (auto | table | identity | sequence | none)
If the attribute represents the versioning column.	Attribute stereotype	<<version>>
If an attribute should be stored in a large object field (e.g.: CLOB, BLOB)	Attribute stereotype	<<lob>>
Name of the column in which an attribute will be persisted	Attribute constraint	column=name (attribute name)
Size of the column in which an attribute will be persisted	Attribute constraint	size=value
If the association should be embedded (instead of having its own table, the associated child class' attributes are placed in the parent's table)	Attribute stereotype	<<embedded>>

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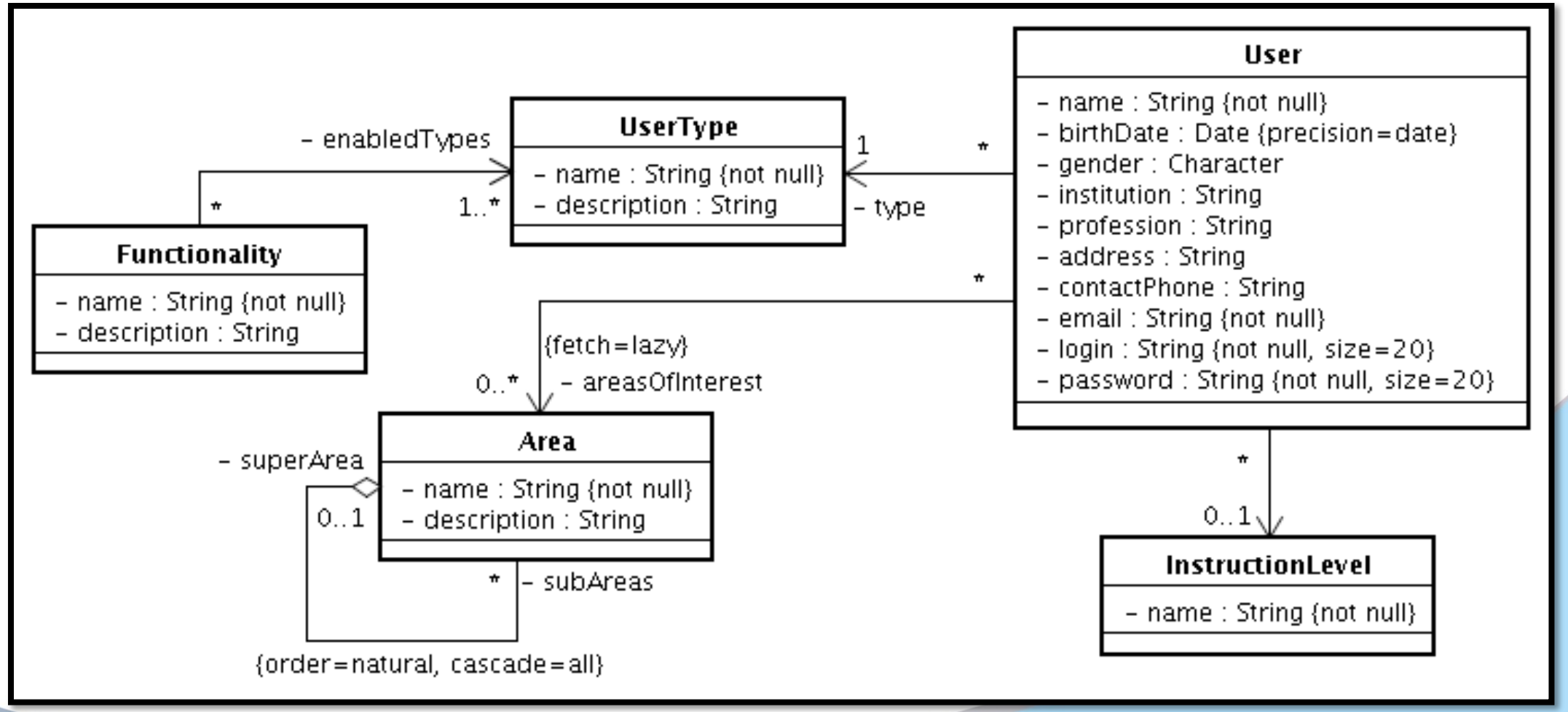
Entity Model – UML Extensions

O/R Mapping	Extension	Possible Values
Inheritance mapping strategy: one table for each class using UNION, one table for each class using JOIN or single table for the entire hierarchy	Inheritance stereotype	<<union>> <<join>> <<single-table>>
Type of collection which implements the association: bag, list, set or map	Association constraint	collection = (bag | list | set | map)
Order of an association's collection: natural ordering (implemented in code) or order by columns (ascending or descending)	Association constraint	order = (natural | column names [asc | desc])
Cascading of operations through the association: nothing, persists, merges, deletions, refreshs or all	Association constraint	cascade = (none | persist | merge | remove | refresh | all)
Association fetching strategy: lazy or eager.	Association constraint	fetch = (lazy | eager)

Entity Model – LabES Portal



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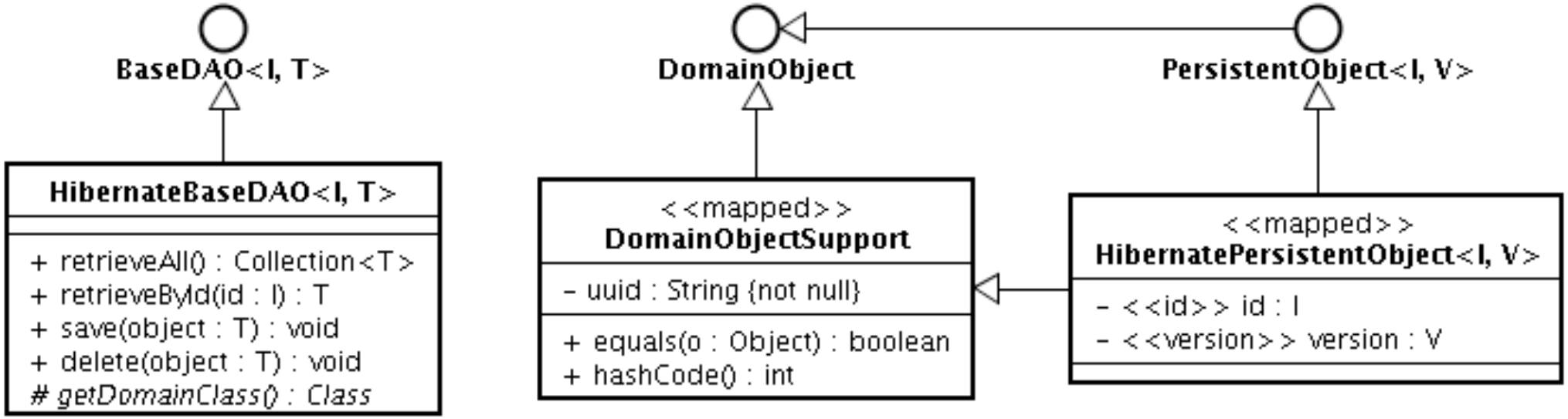
Persistence Model

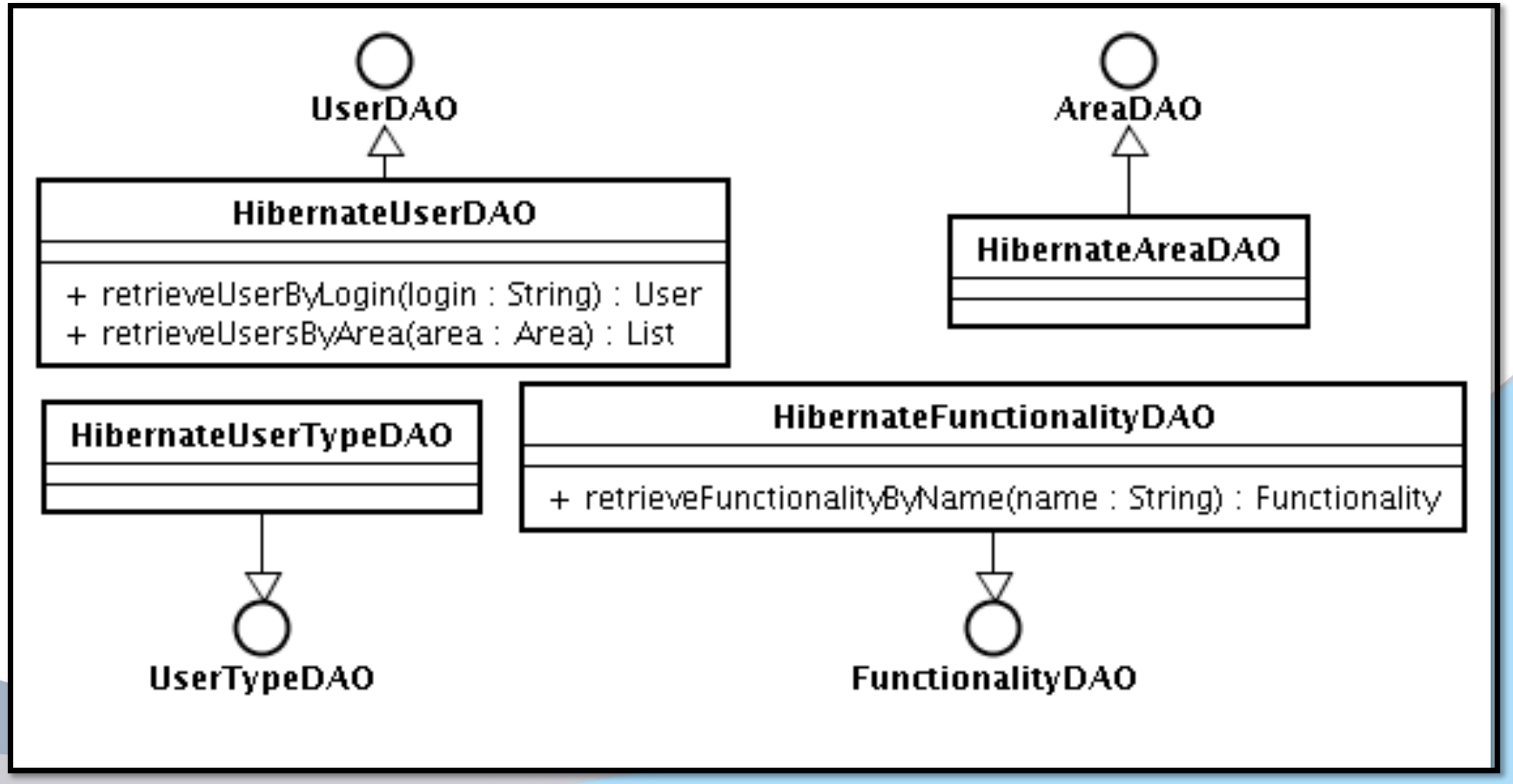
- UML class diagram;
- Based on the DAO pattern;
  - *Use of base DAO (e.g., JButler[1]) recommended;*
  - *DAOs show domain-specific operations (usually queries);*
- No UML extensions needed;
- Guides the implementation of:
  - *Classes and interfaces of the Persistence package.*

[1] http://github.com/dwws-ufes/jbutler/

Persistence Model – Base DAOs



Persistence Model – LabES Portal



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Navigation Model

- UML class diagram;
- Component types and controller configuration added to classes via UML extensions;
- Use of sensible defaults;
- Guides the implementation of:
  - *Classes of the Control package;*
  - *Web pages of the View package;*
  - *Front Controller framework configuration.*

Navigation Model – UML Extensions

- The type of each component is specified using UML stereotypes:

Stereotype	Component type
(none)	An action class, to which the Front Controller framework delegates the execution of the action.
<<page>>	A static or dynamic Web page.
<<template>>	A template that is processed by a template engine and is transformed into a Web page. 
<<form>>	An HTML form.
<<binary>>	Any binary file that can be retrieved and displayed by the browser (e.g.: images, reports, documents, etc.).

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Navigation Model – UML Extensions

- The meaning of dependency associations depend on their source and destination:

From	To	Meaning
Page / template	Action class	A link in the page/template that triggers the execution of the action.
Form	Action class	Form data are sent to the action class when the form is submitted.
Action class	Page / template	The page/template is shown as one of the results of the action class.
Action class	Binary file	A binary file is shown as one of the results of the action class.
Action class	Action class	An action class is executed as result of another. This process is known as “action chaining”.

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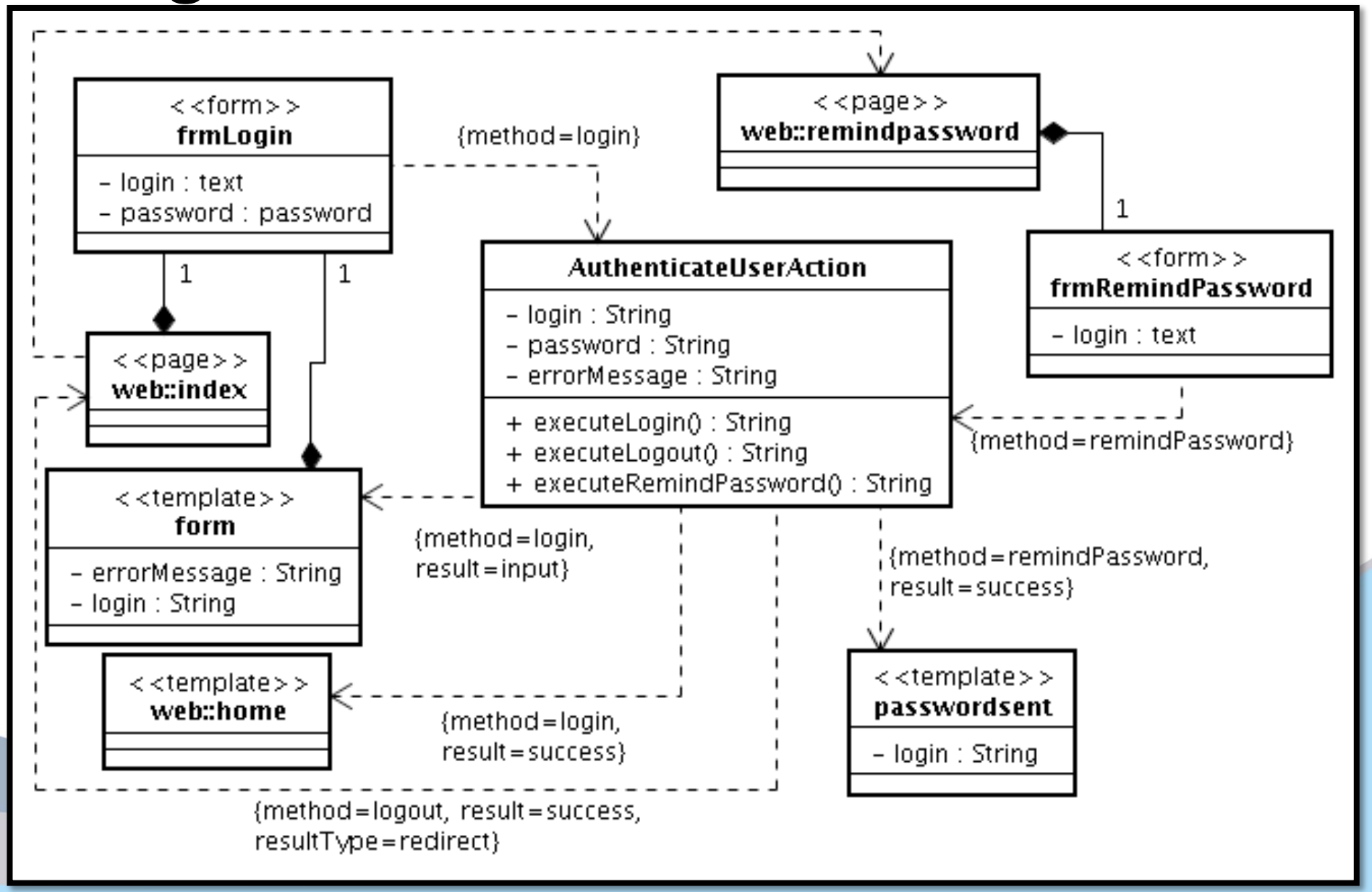
Navigation Model – UML Extensions

- Finally, UML constraints on dependencies configure the Front Controller framework:
  - *Which method to call: method=name;*
  - *Which result to display: result=name;*
  - *Which result type to use: resultType=(binary | chain | dispatch | redirect | template).*

Navigation Model – LabES Portal



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Application Model

- UML class diagram;
- No UML extensions needed;
- Guides the implementation of:
  - *Classes and interfaces of the Application package;*
  - *Configuration of Dependency Injection framework.*

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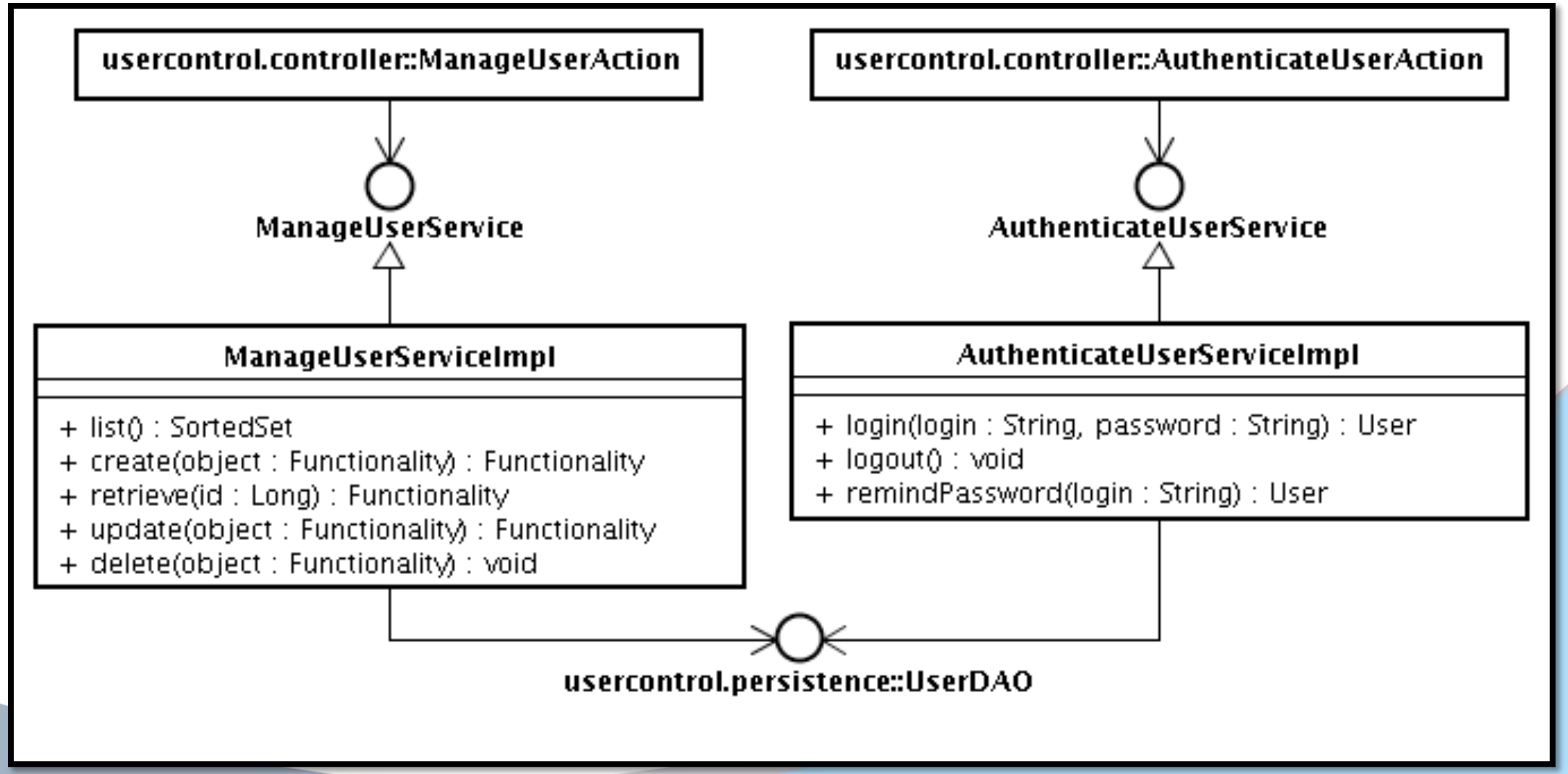
Application Model – LabES Portal



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FrameWeb 2.0: 2015 and forward...

- Some of the main limitations of the approach:
  - *The models may not be suited to other framework instances. What if I use JSF, CDI and JPA?*
  - *The UML extensions do not prevent designers from including elements that do not belong in the model;*
  - *There are no tools to help developers build models, verify models, generate code, etc.*

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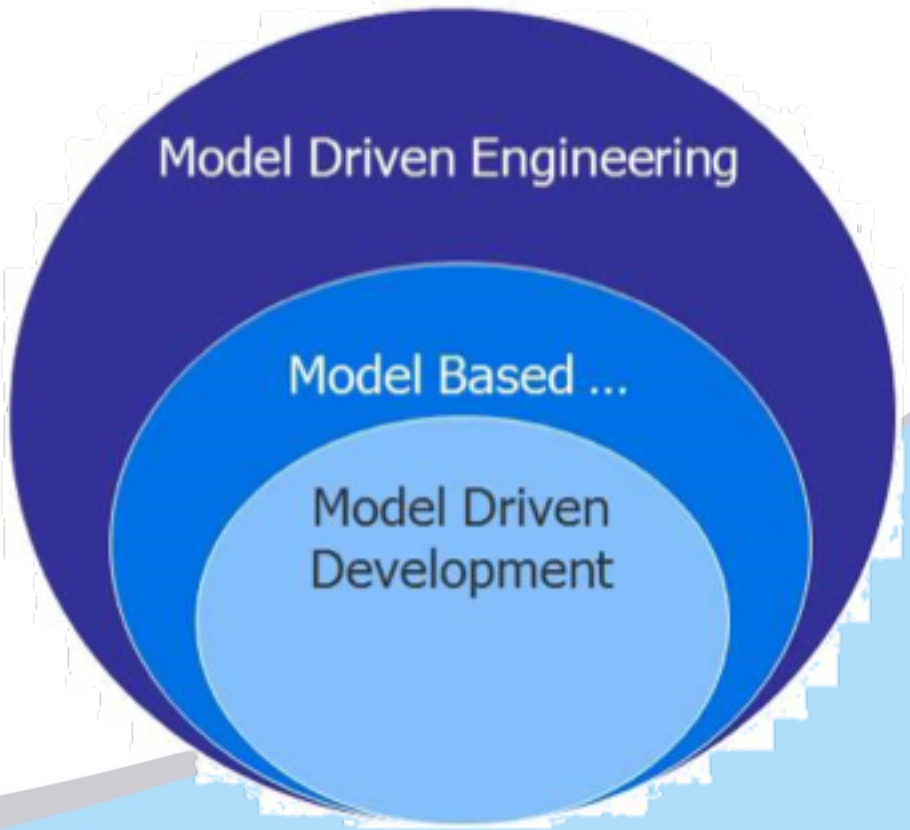
FrameWeb 2.0: 2015 and forward…

- Proposals:
  - *Adopt MDD concepts in the method;*
    - http://www.omg.org/cgi-bin/doc?omg/03-06-01
  - *A base (common) meta-model for FrameWeb using the MDD concepts;*
  - *An extensible set of packages suited to specific framework instances (e.g., Struts², JSF, VRaptor, etc);*
  - *FrameWeb Editor (CASE tool).*
- [Martins & Souza, 2015; Martins, 2016].

Model-Driven Development (MDD)

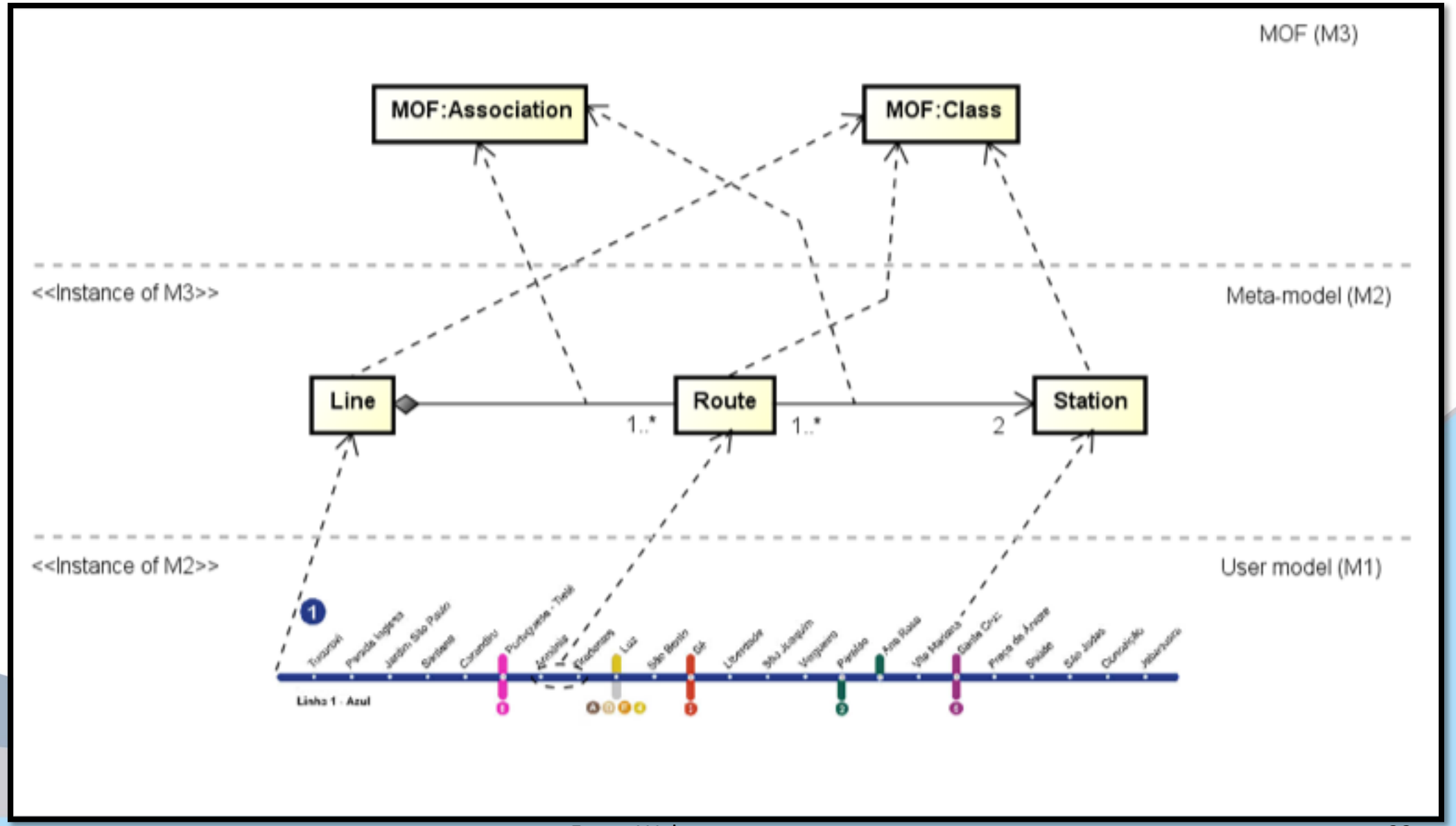
- Key characteristics of Model Driven Development:
  - The model **is** the design;
  - The model will grow, evolve and extend;
  - There is a flow from abstraction to abstraction;
  - Implementation is directed derived from the model.



[Martins, 2016]

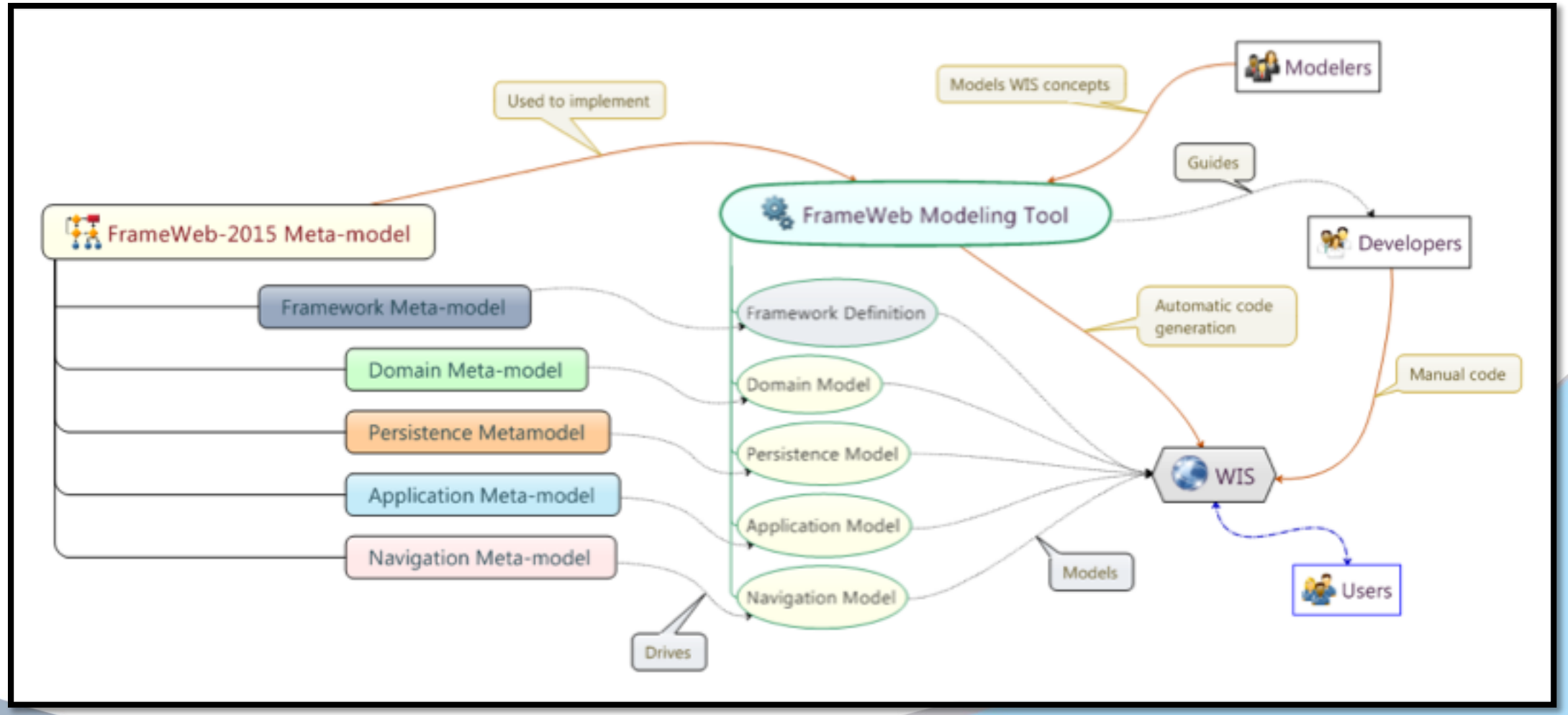
MDD: Language Definition

[Martins, 2016]



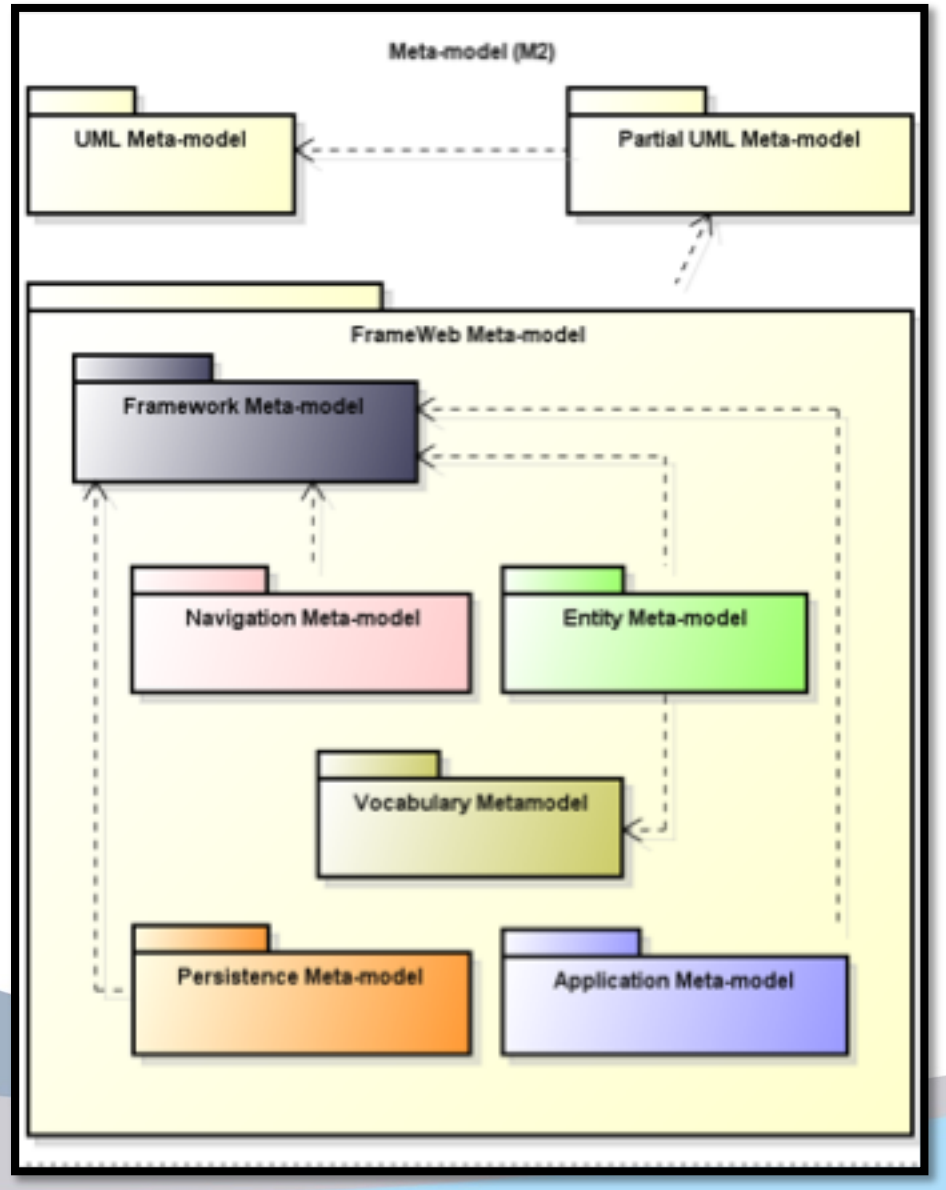
FrameWeb 2.0 (FW-15)

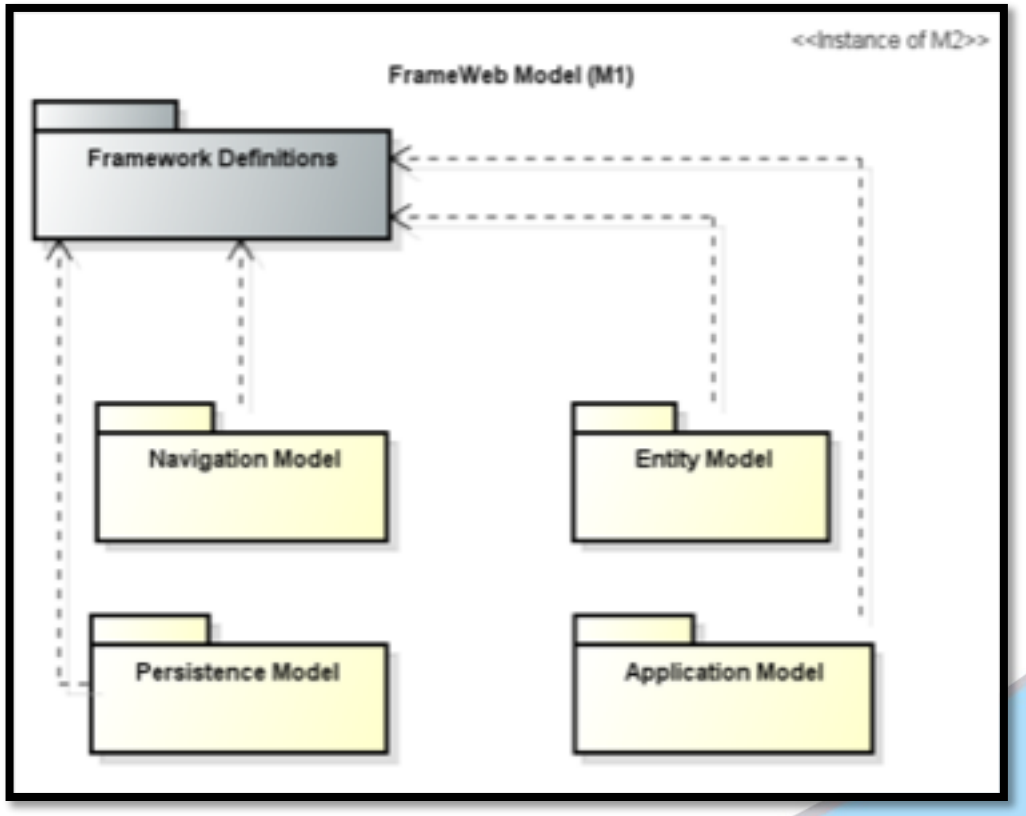
[Martins, 2016]



FrameWeb Language Definition

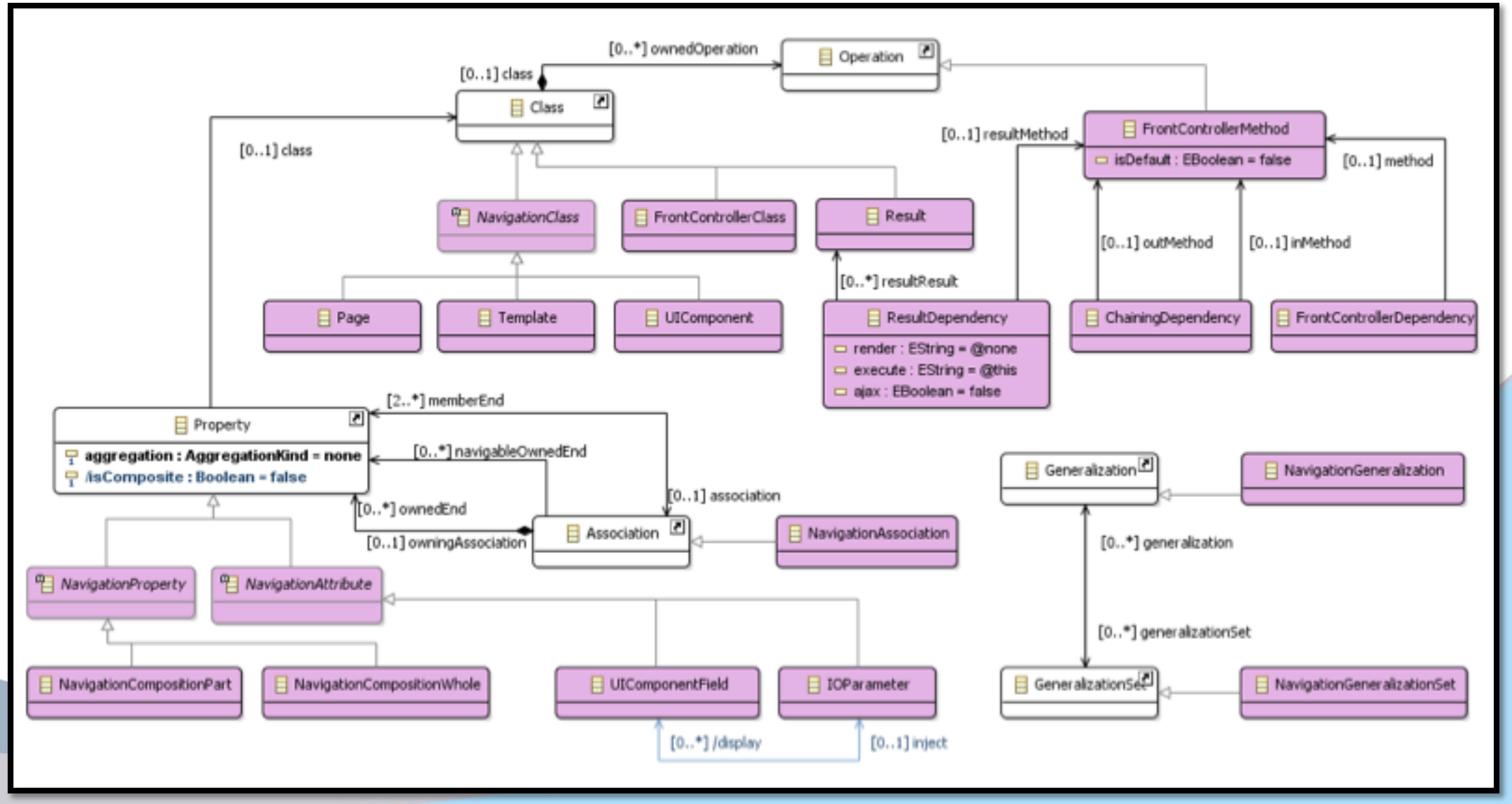
[Martins, 2016]





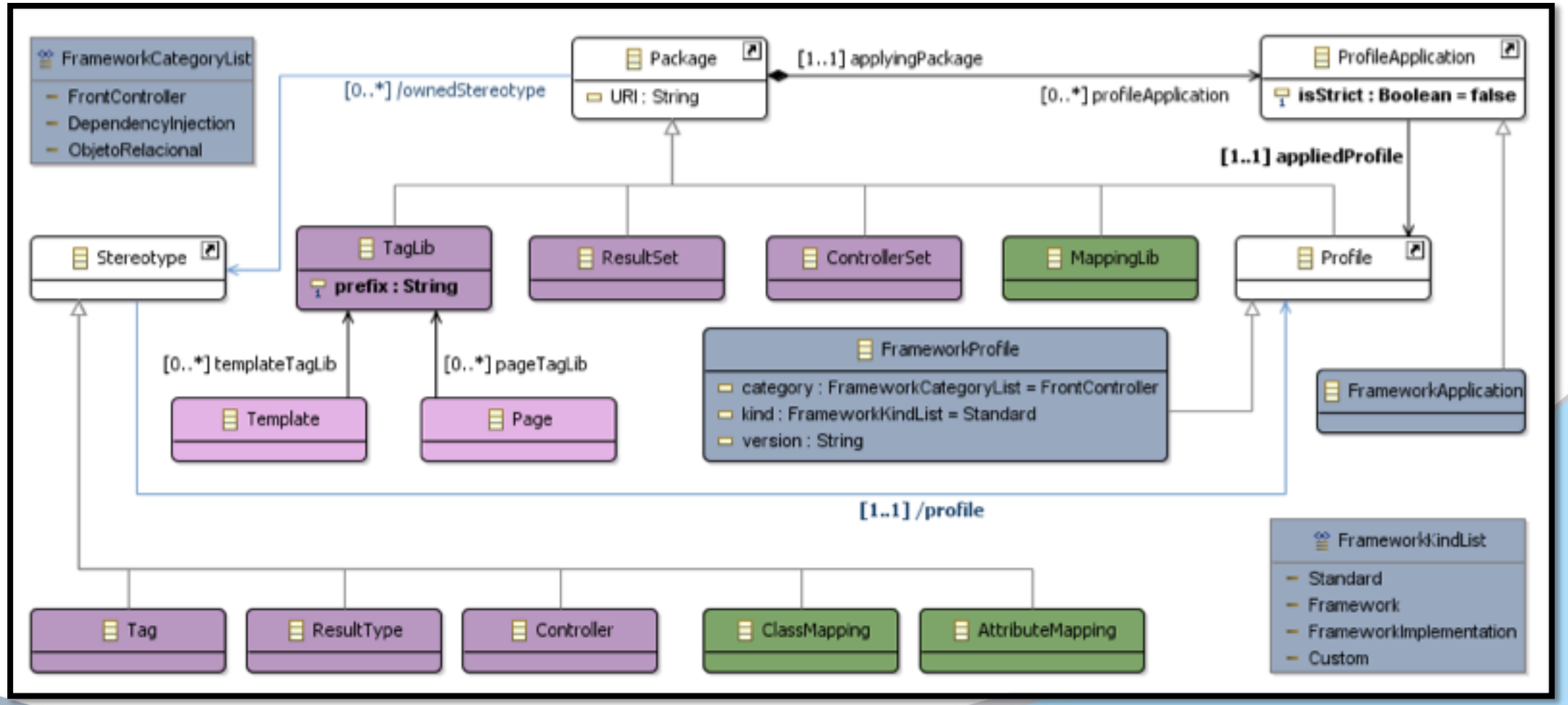
Navigation Meta-model

[Martins, 2016]



Framework Meta-model

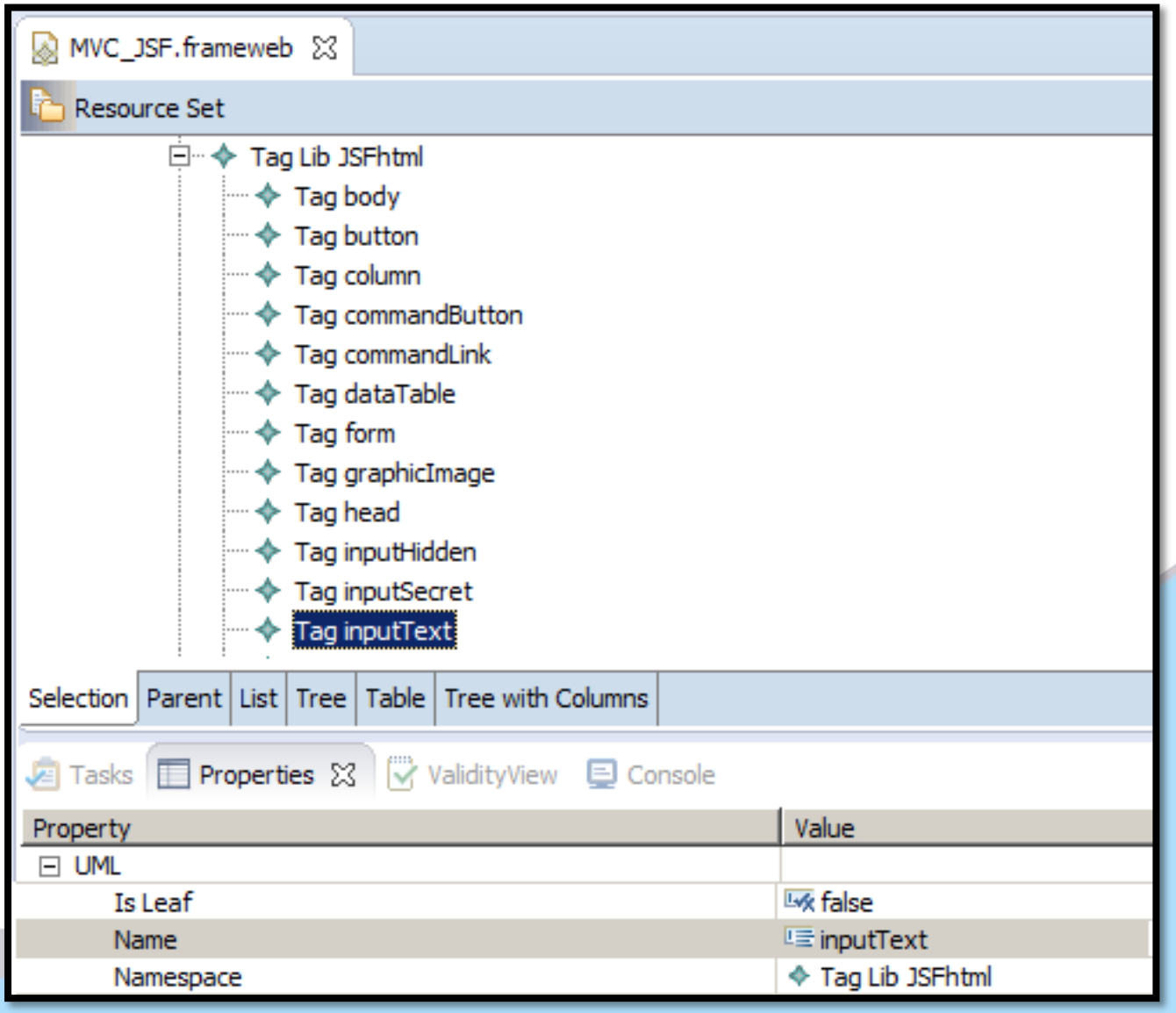
[Martins, 2016]



FrameWeb Framework Definition

- JSF definition:

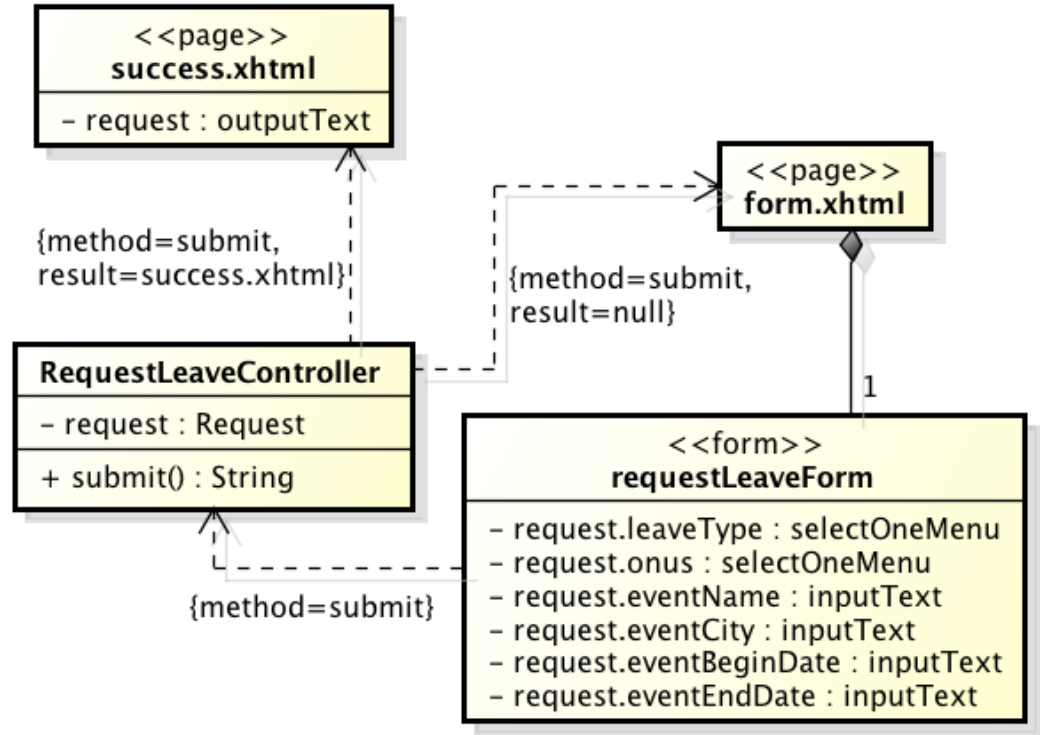
[Martins, 2016]

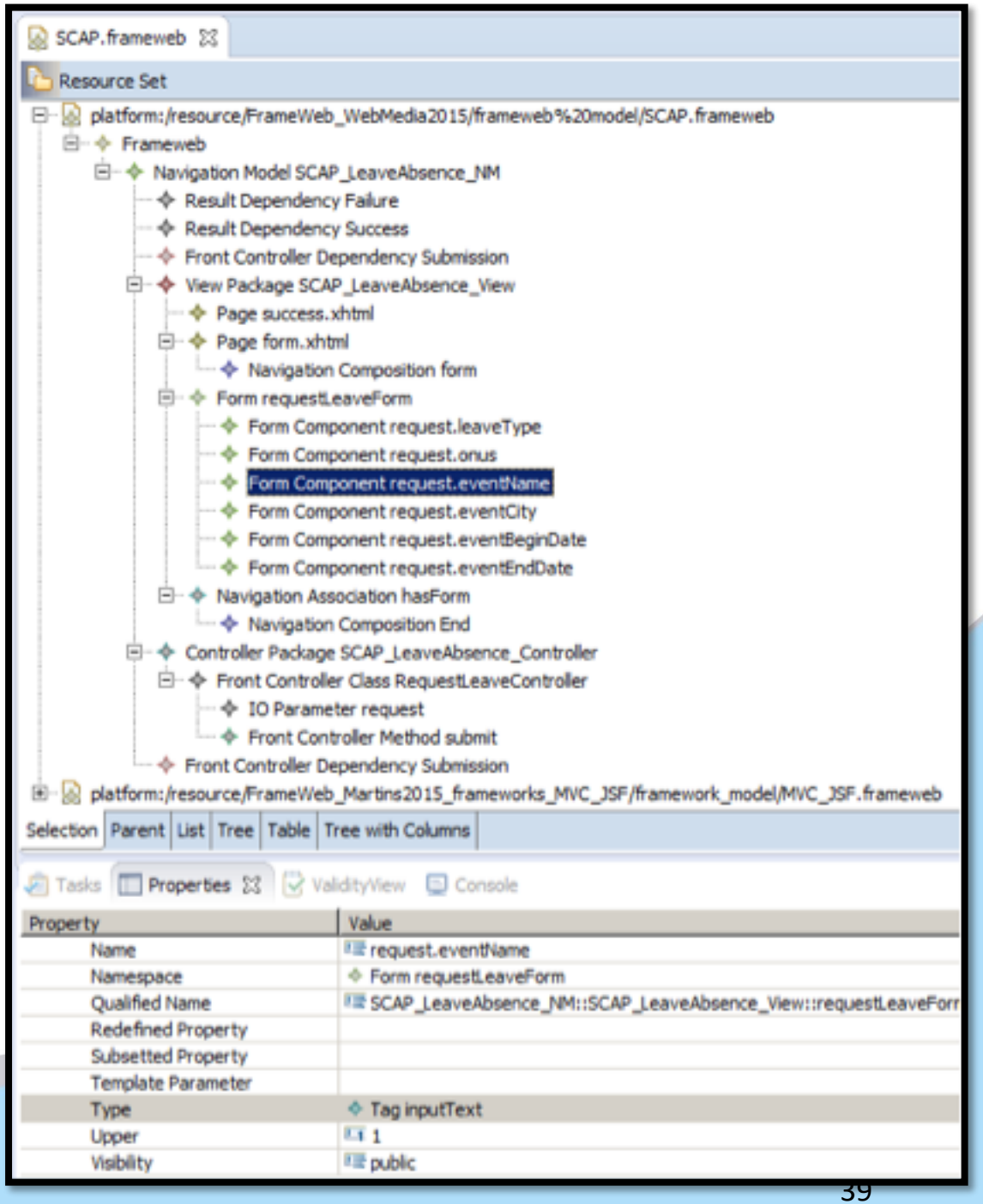


Navigation Model

- SCAP on JSF:

[Martins, 2016]

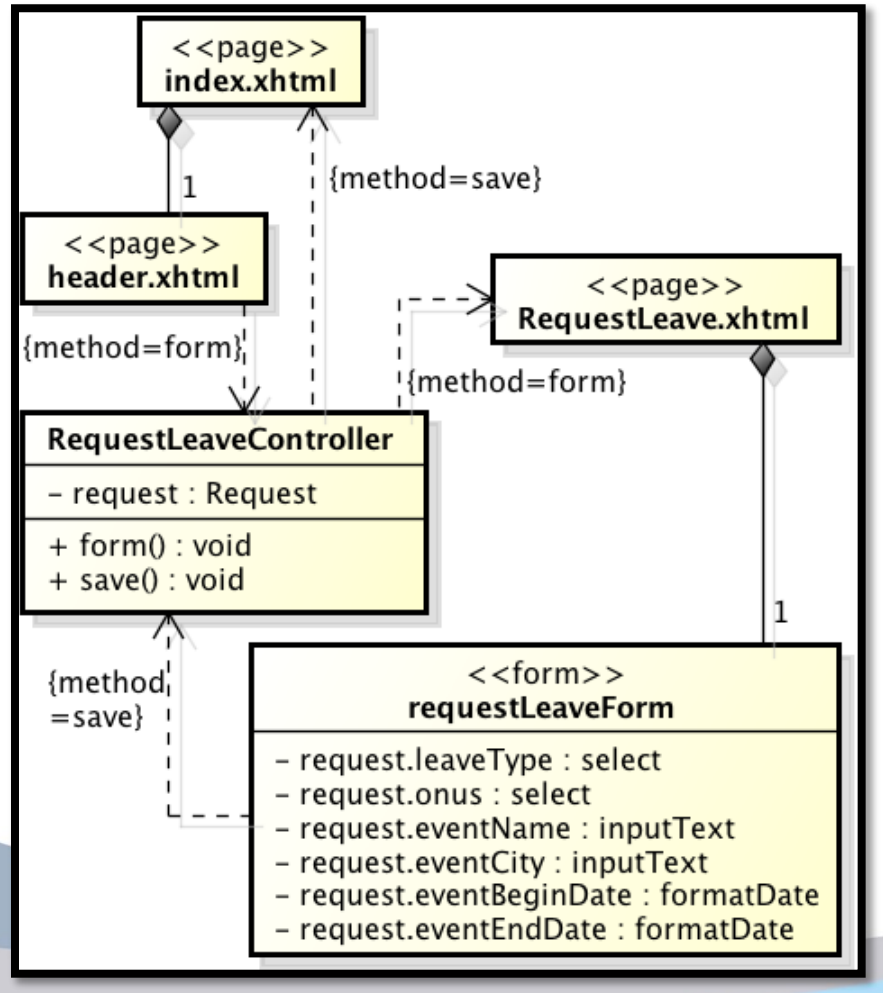


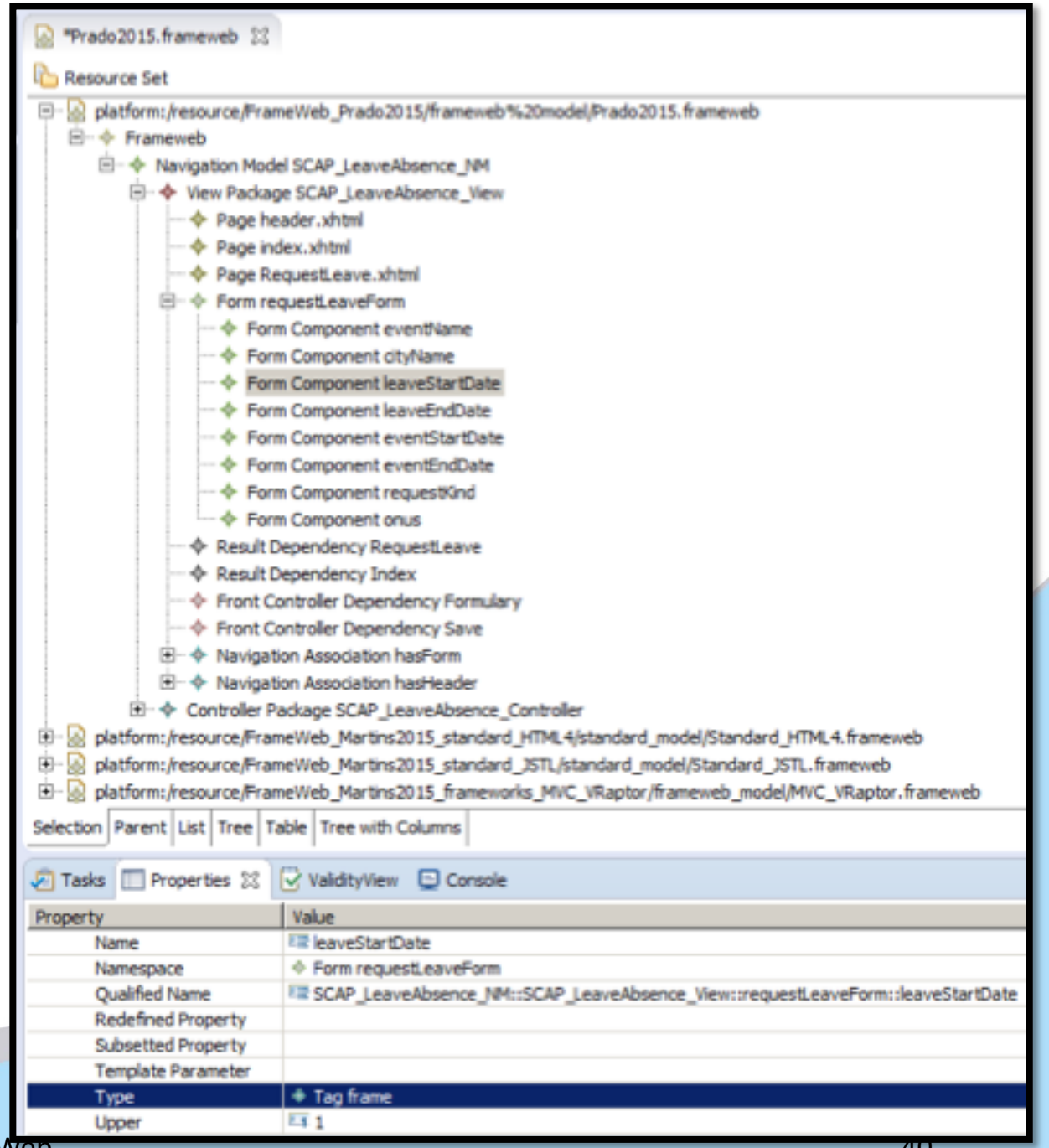


Navigation Model

- SCAP on VRaptor:

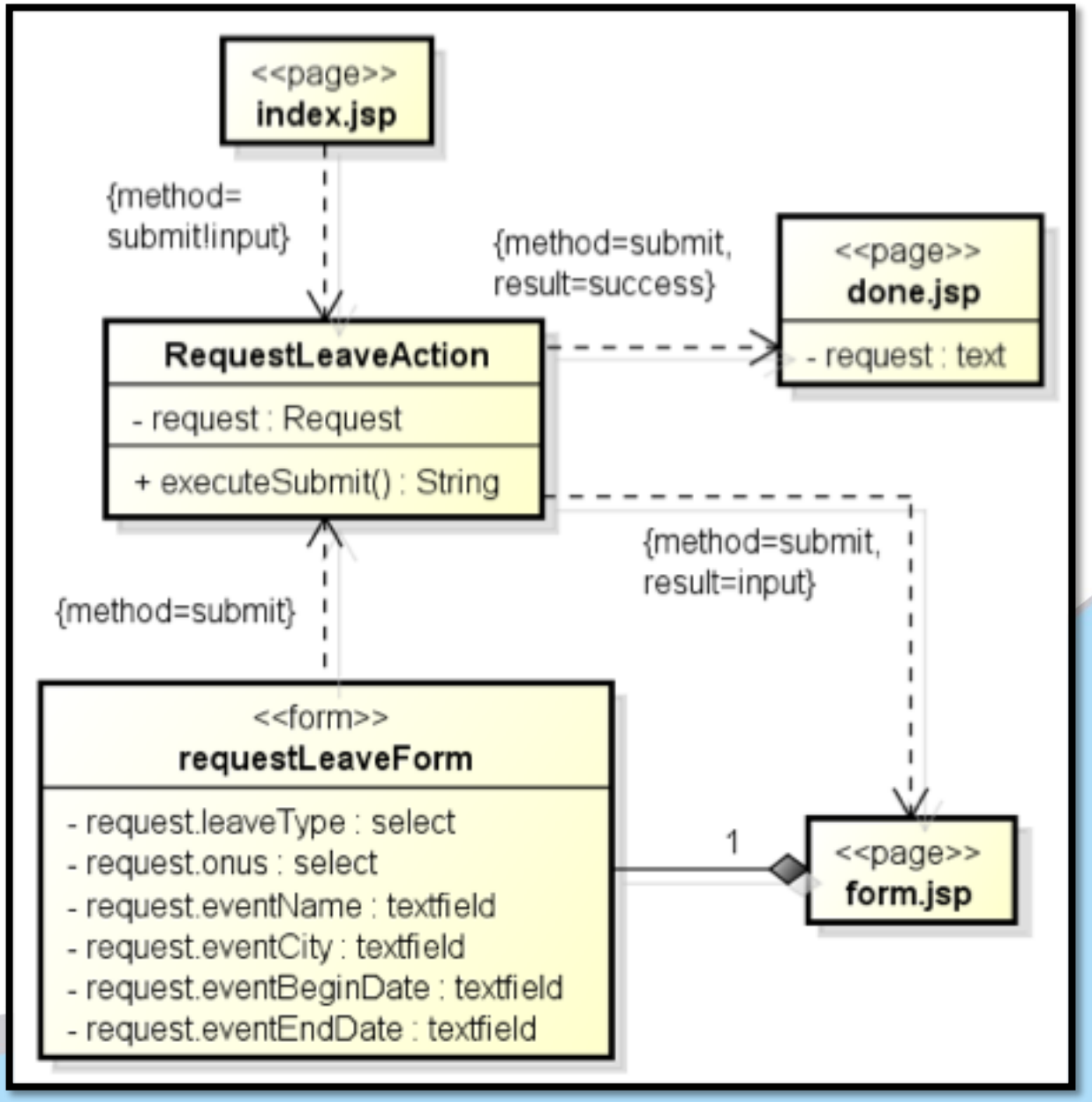
[Martins, 2016]





Navigation Model

- SCAP on Struts[2]:



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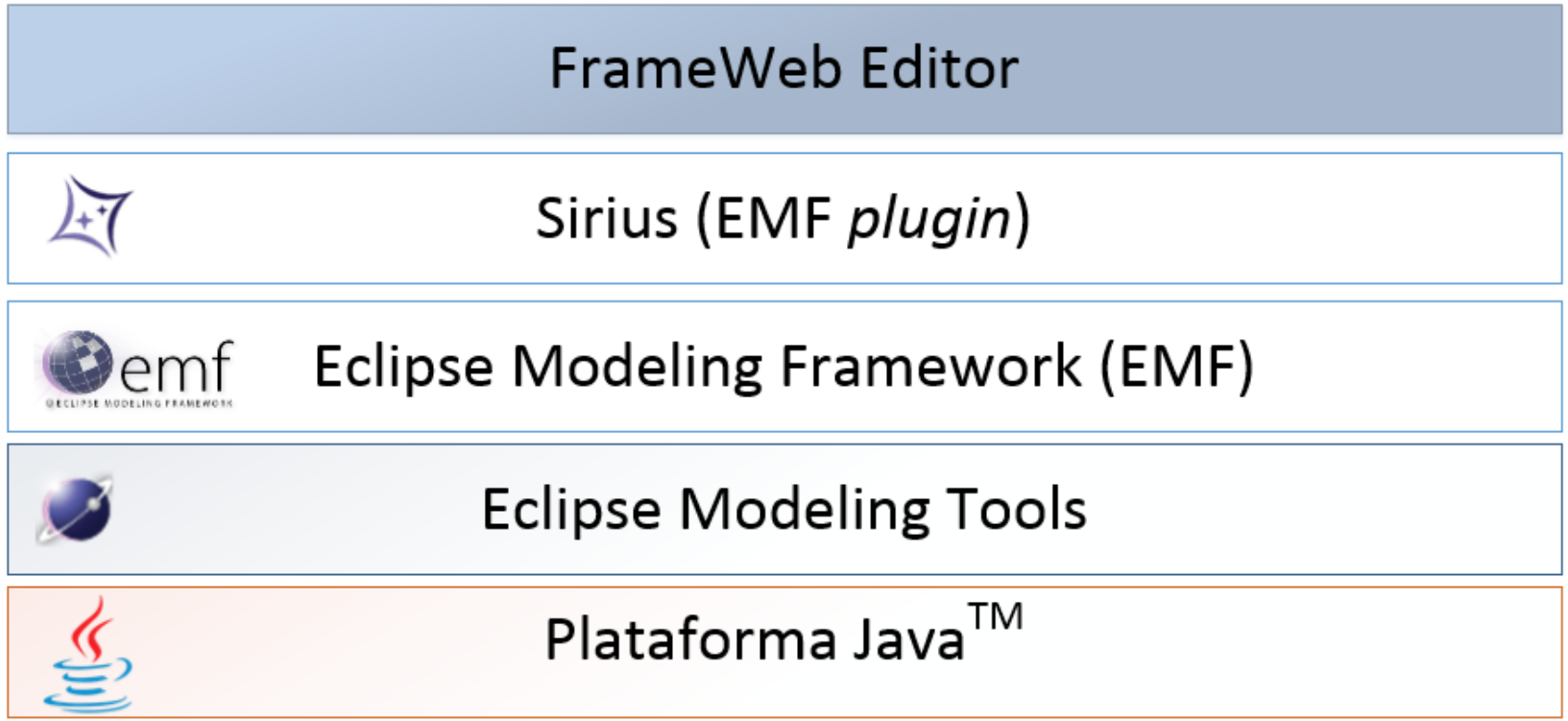
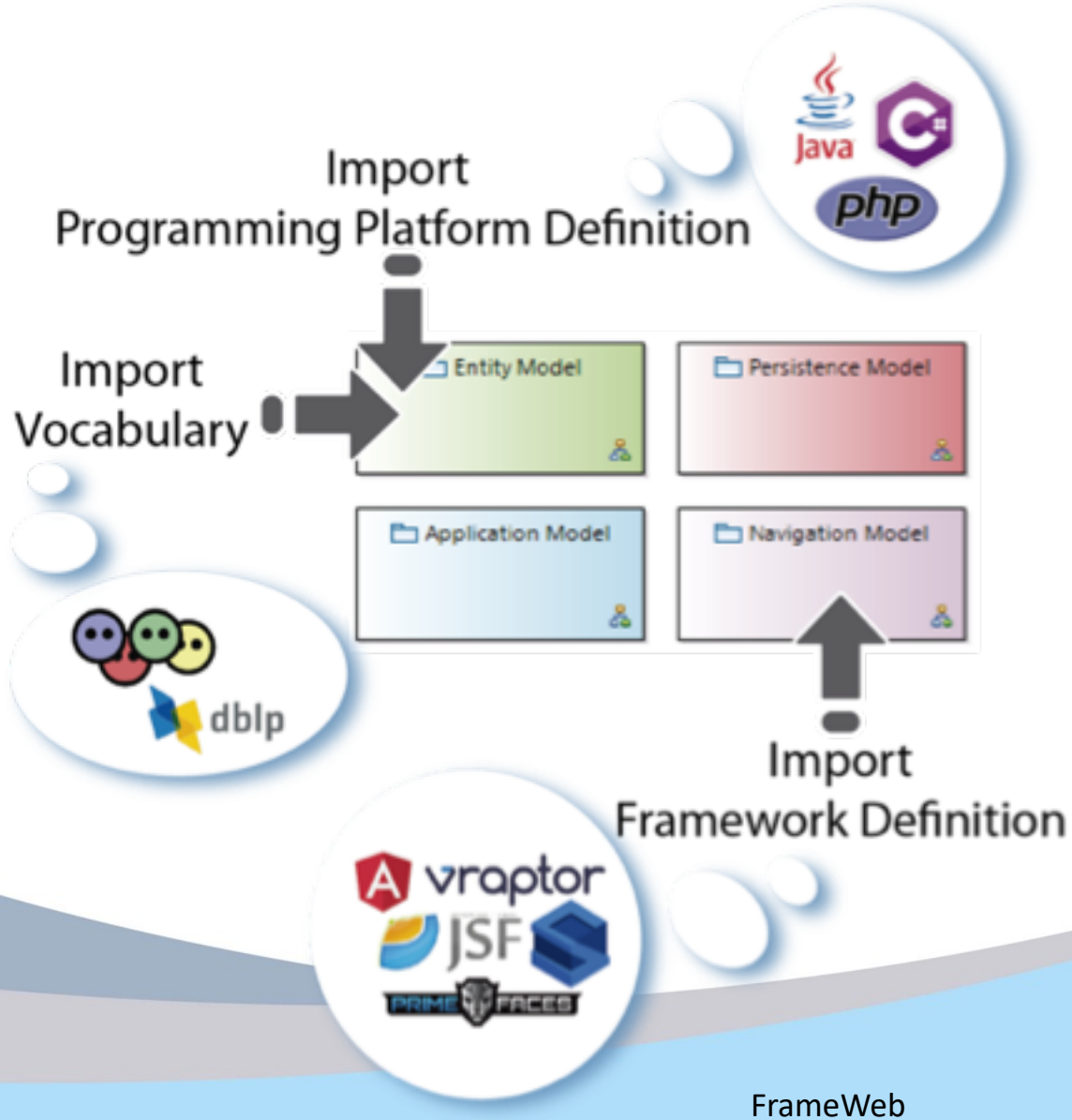
FrameWeb Editor

[Campos & Souza, 2017]



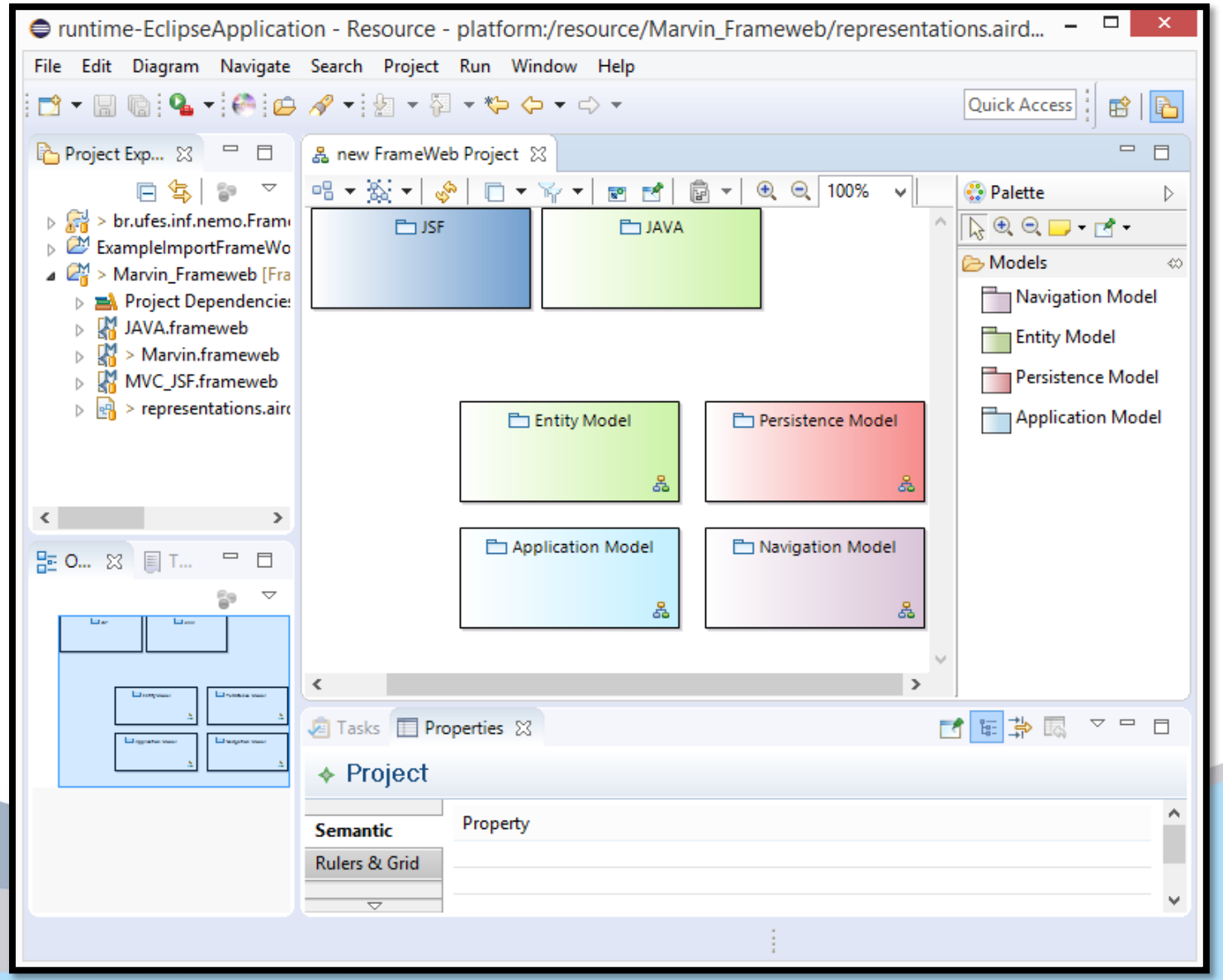
FrameWeb Editor

[Campos & Souza, 2017]



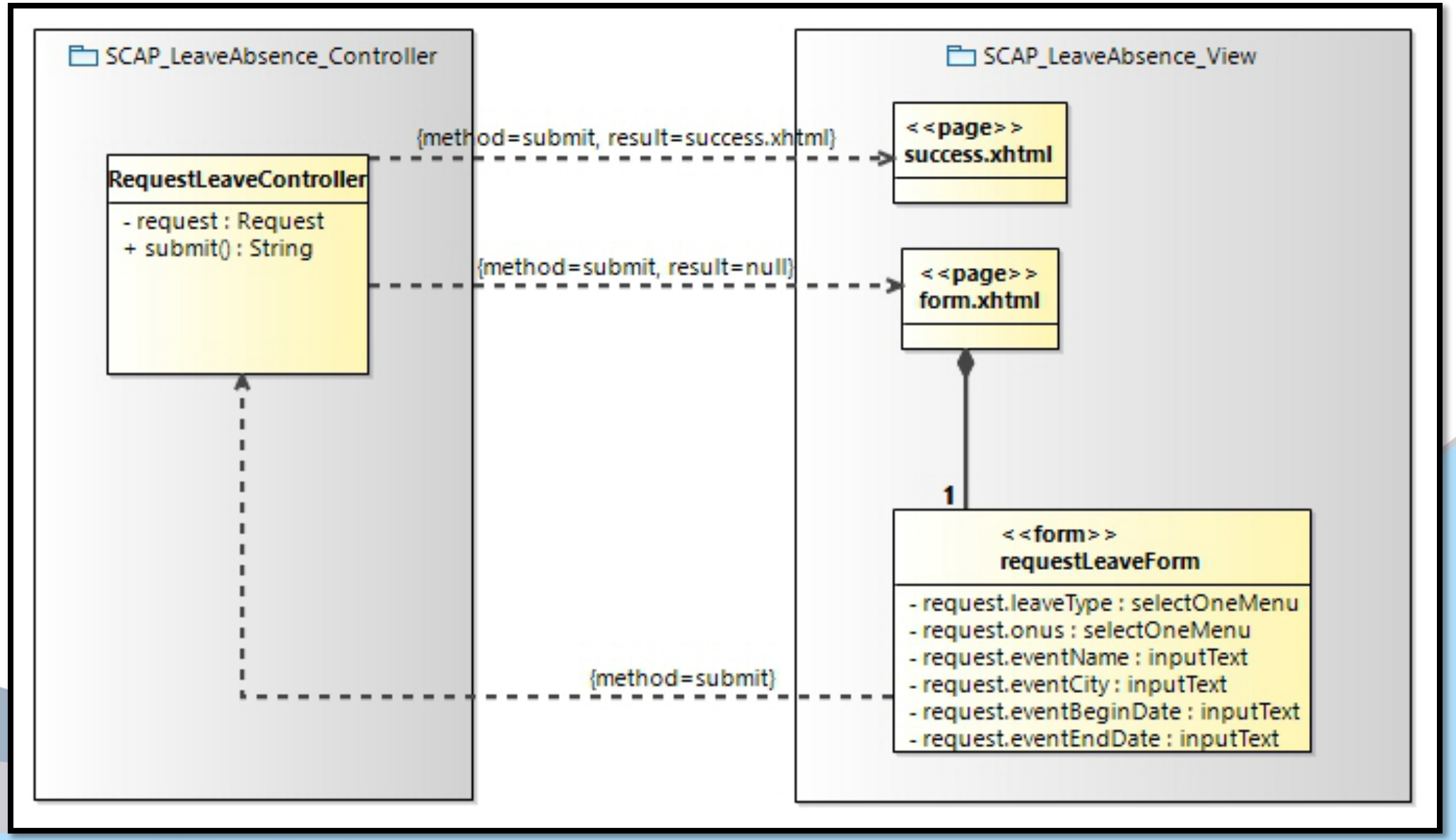
FrameWeb Editor

[Campos & Souza, 2017]

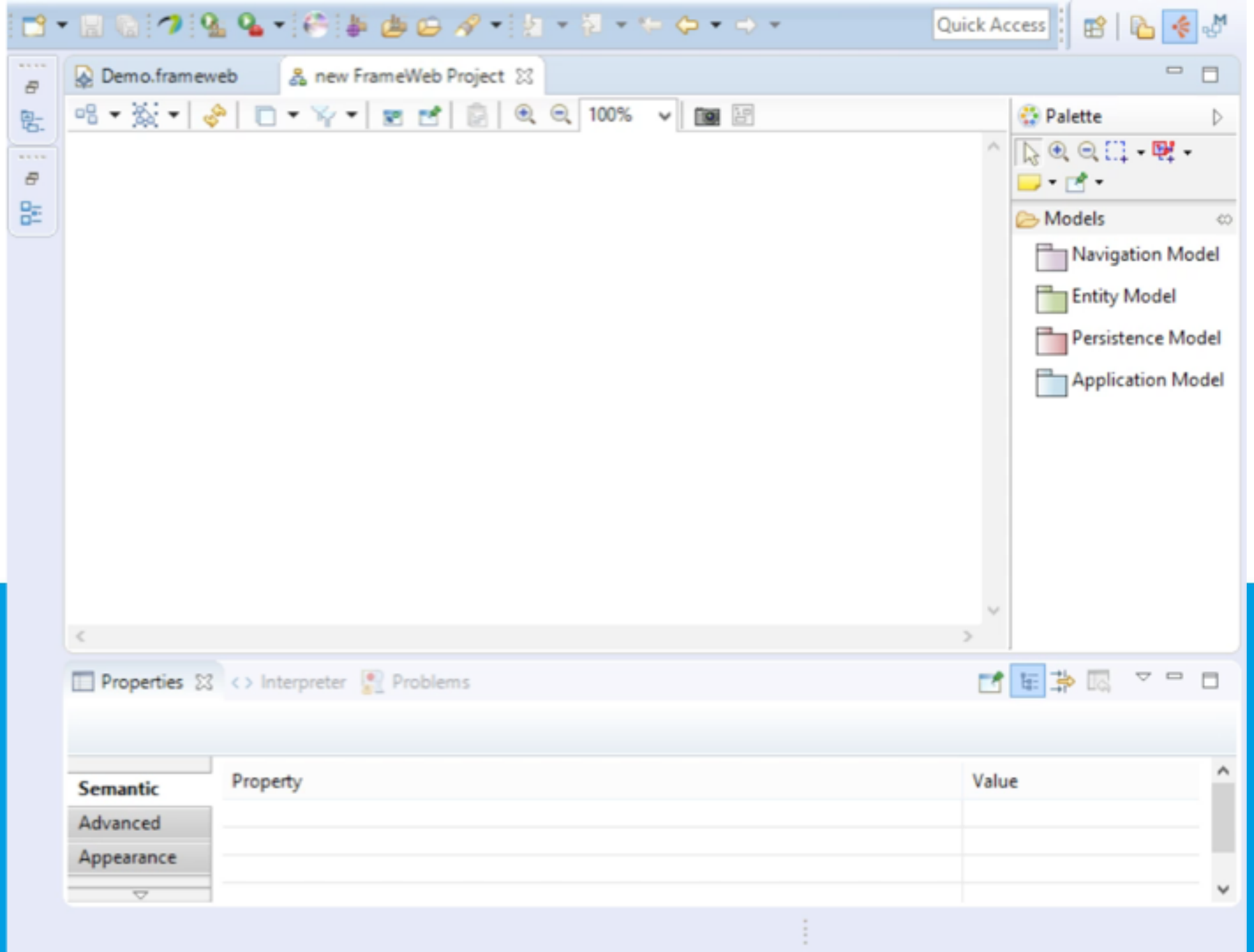


FrameWeb Editor

[Campos & Souza, 2017]

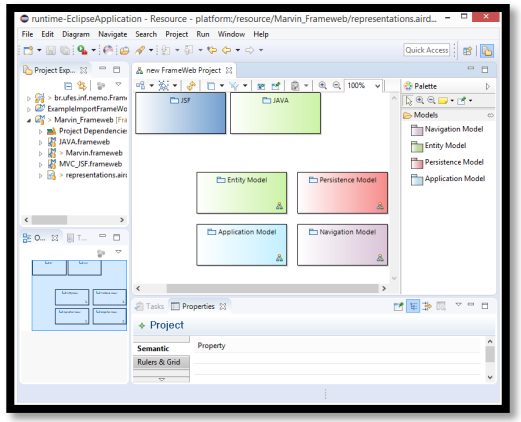


[Campos & Souza, 2017]



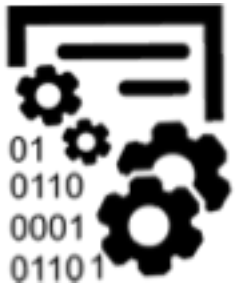
Code generation

[Almeida et al., 2017]



EDITOR

XML (.frameweb)



GENERATOR

CODE

Code generation

```
<ownedAttribute xsi:type="frameweb:UIComponentField"
name="login.user" visibility="private">
  <type xsi:type="frameweb:Tag"
href="MVC_JSF.frameweb#//JSFhtml/inputText"/>
</ownedAttribute>
```

[Almeida et al., 2017]

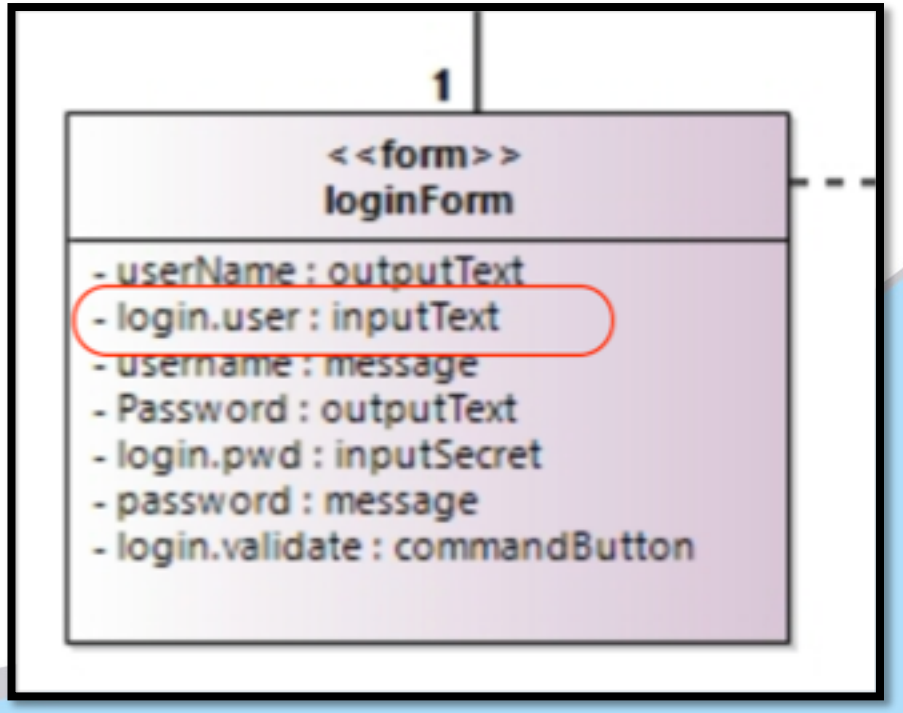
Part of the .frameweb file

```
<h:inputText id="FW_ID"
value="#{FW_VALUE}" />
```

Template

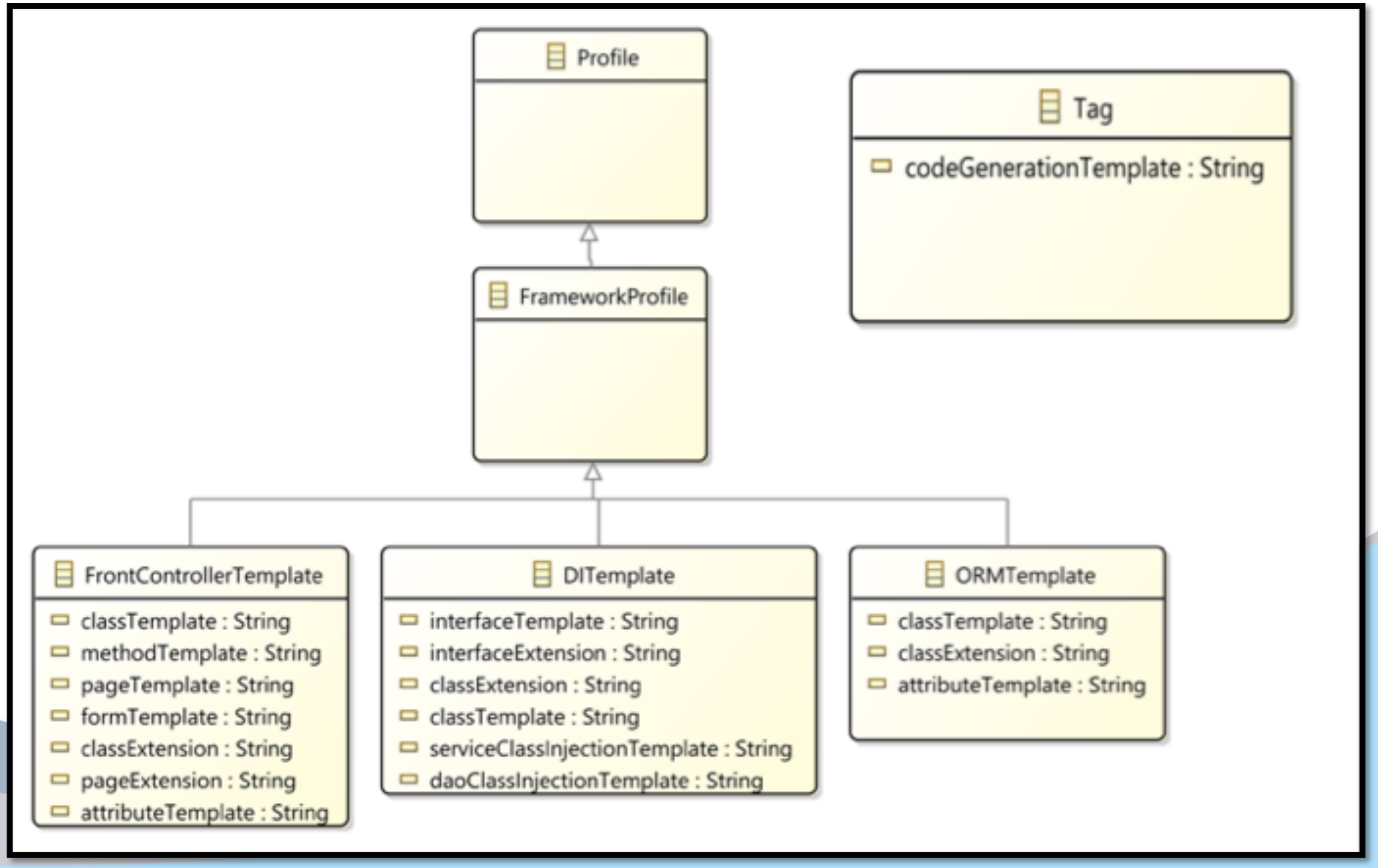
```
<h:inputText id="login_user"
value="#{login.user}" />
```

Generated code



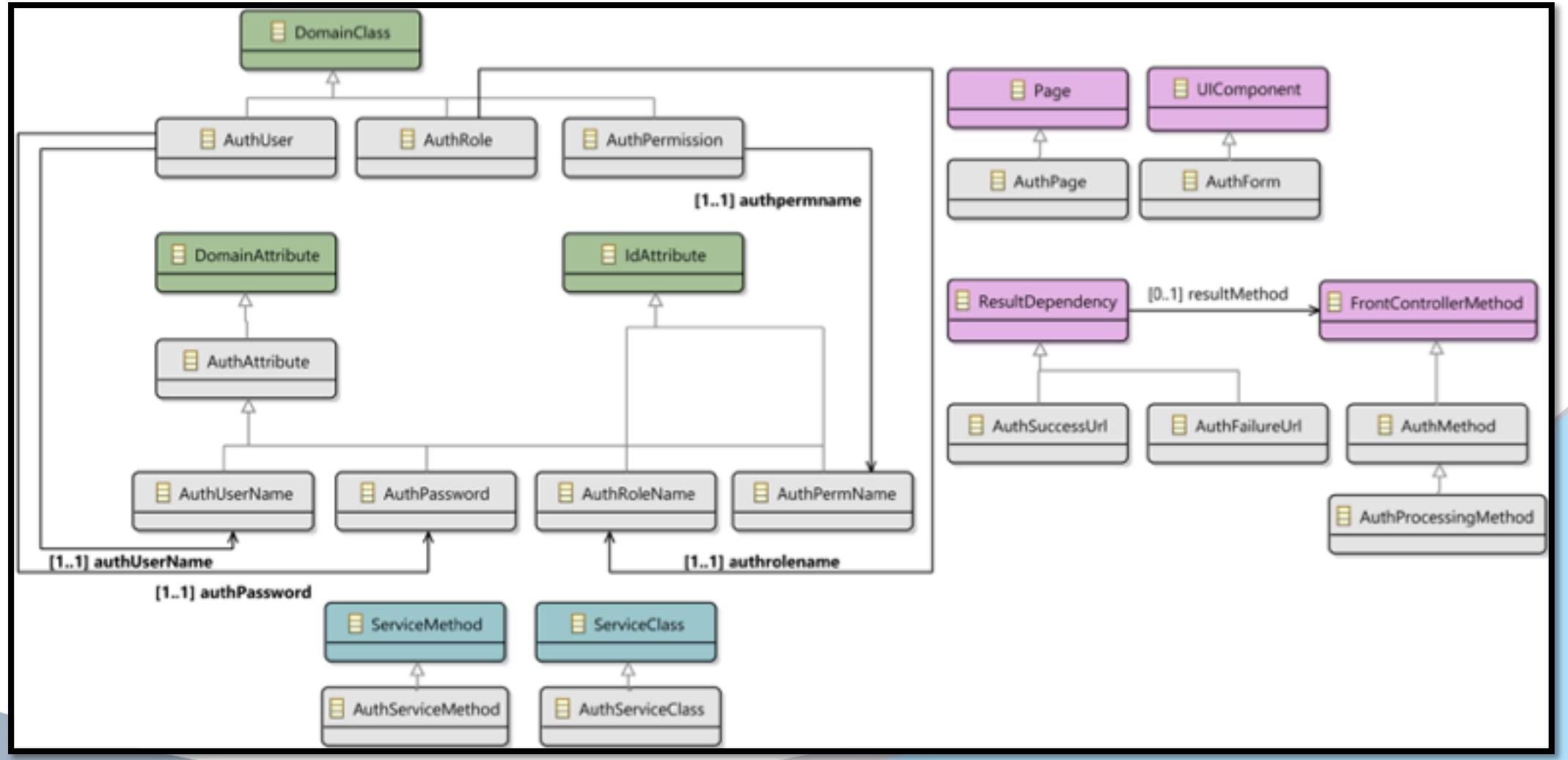
Code generation – Meta-model

[Zupeli & Souza, 2017]



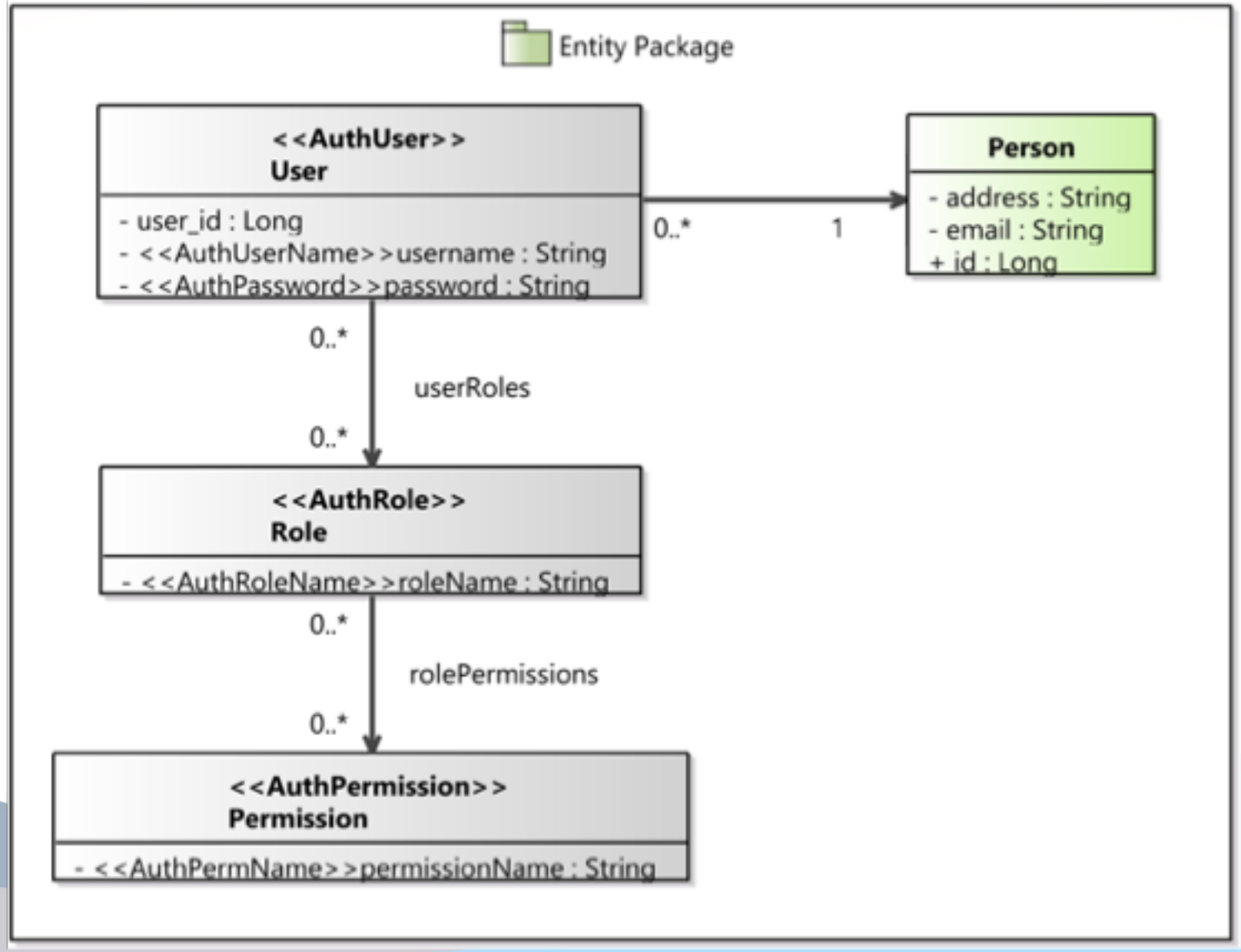
Role-based Access Control – Meta-model

[Prado & Souza, 2018]



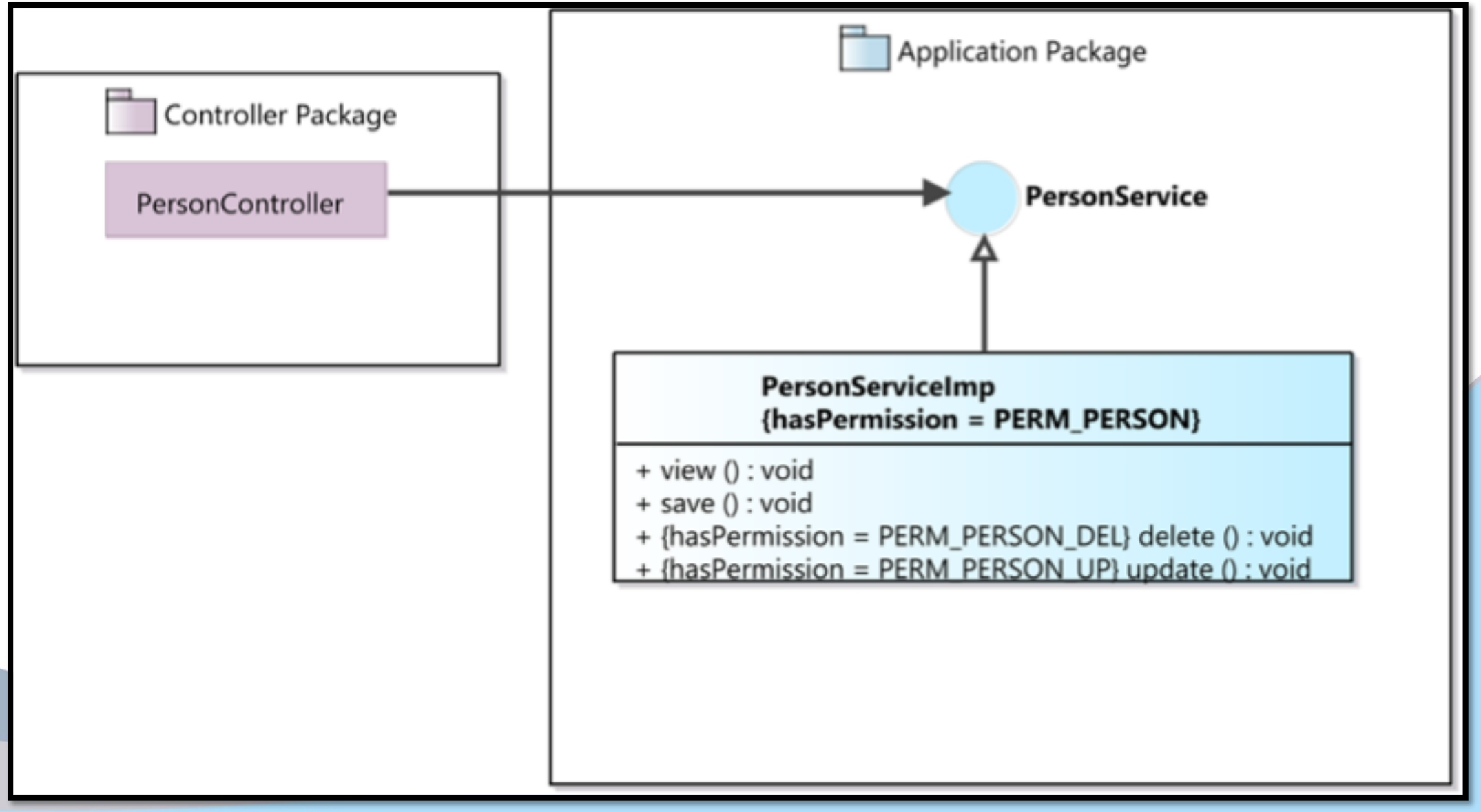
Role-based Access Control – Entity Model

[Prado & Souza, 2018]



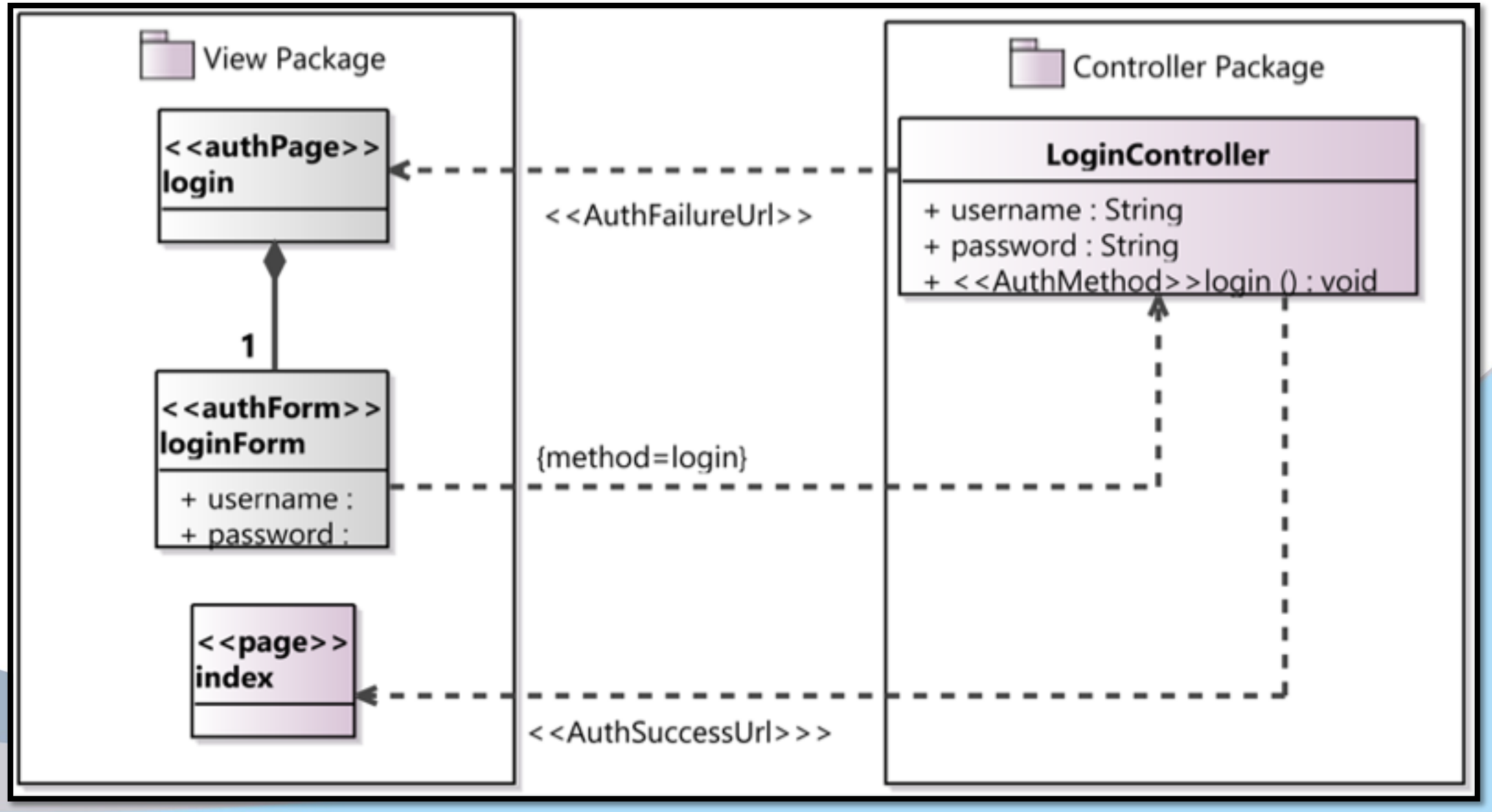
Role-based Access Control – Application Model

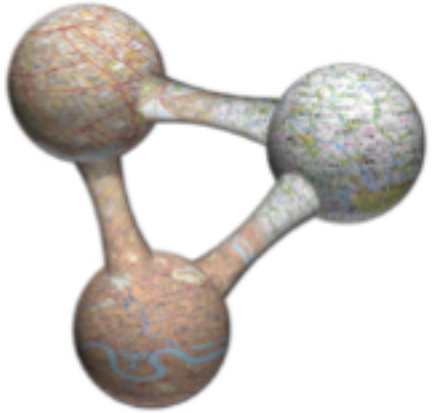
[Prado & Souza, 2018]



Role-based Access Control – Navigation Model

[Prado & Souza, 2018]





S-FrameWeb / FrameWeb-LD

(Semantic FrameWeb / FrameWeb for Linked Data)

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S-FrameWeb

- Masters dissertation (2007 – Souza, Falbo & Guizzardi);
- Evolutions since 2016, work in progress;
- Domain analysis -> Domain ontology;
- Use of (simplified) ODM (Ontology Definition Metamodel, by OMG) for the Domain Model;
  - *Basis for the FrameWeb Entity Model;*
- Struts^2 extension switched between human and software output.

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FrameWeb-LD: 2016 and forward…

- Some of the main limitations of the approach:
  - *Outdated Ontology Engineering process and modeling language;*
  - *Does not take into account many principles and best practices of Linked Data;*
  - *New technology (LD frameworks, triple stores, etc.) has been developed in the mean time.*

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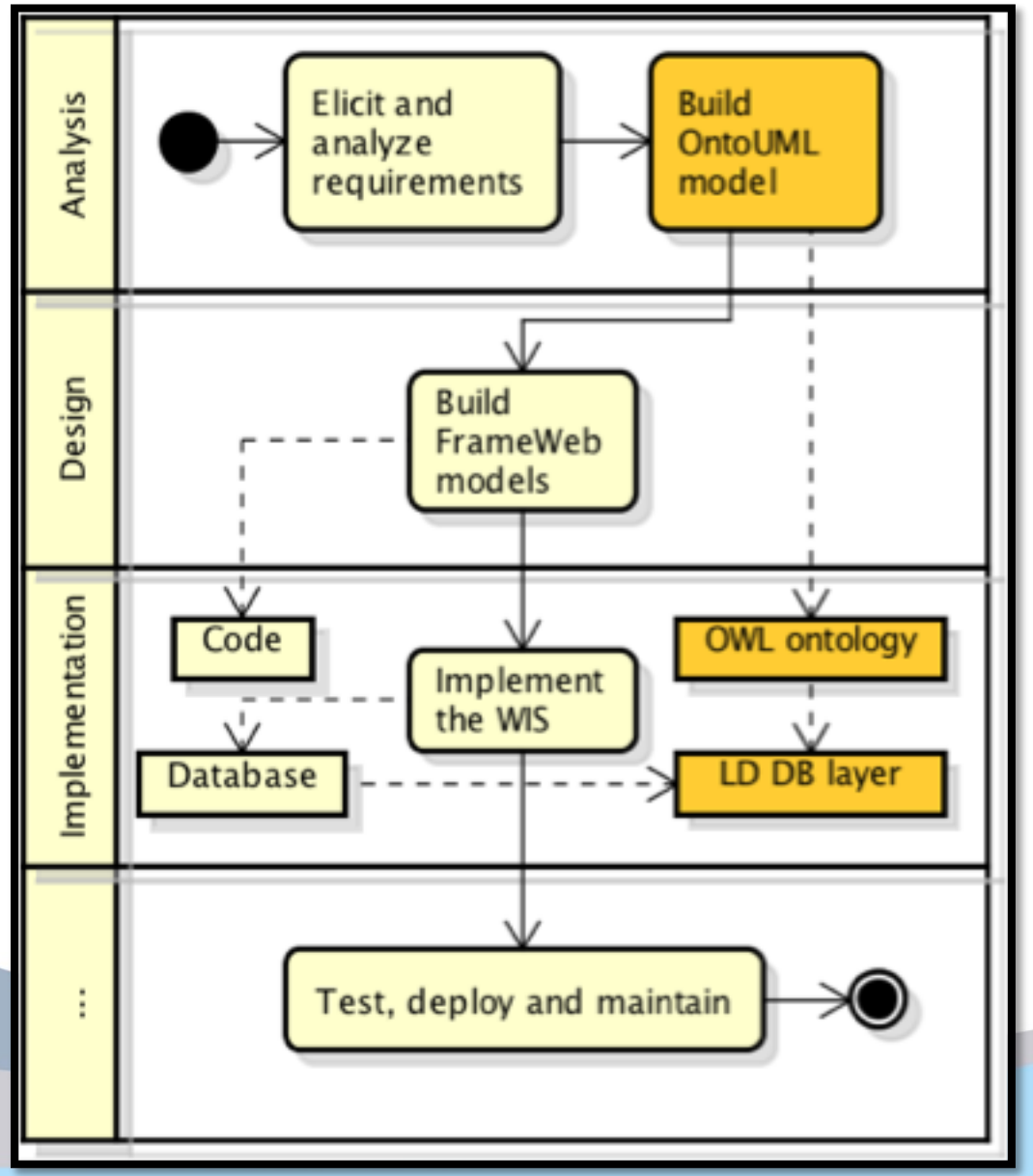
FrameWeb-LD

- Proposals:
  - *Use the SABiO approach for Ontology Engineering:*
    - http://www.inf.ufes.br/~falbo/files/SABiO.pdf;
  - *Use the OntoUML language and its extensions:*
    - http://www.inf.ufes.br/~gguizzardi/OFSCM.pdf;
    - https://www.facebook.com/ontoumleditor.
  - *Build a Semantic/LD layer on top of FrameWeb 2.0.*
- [Celino et al., 2016].

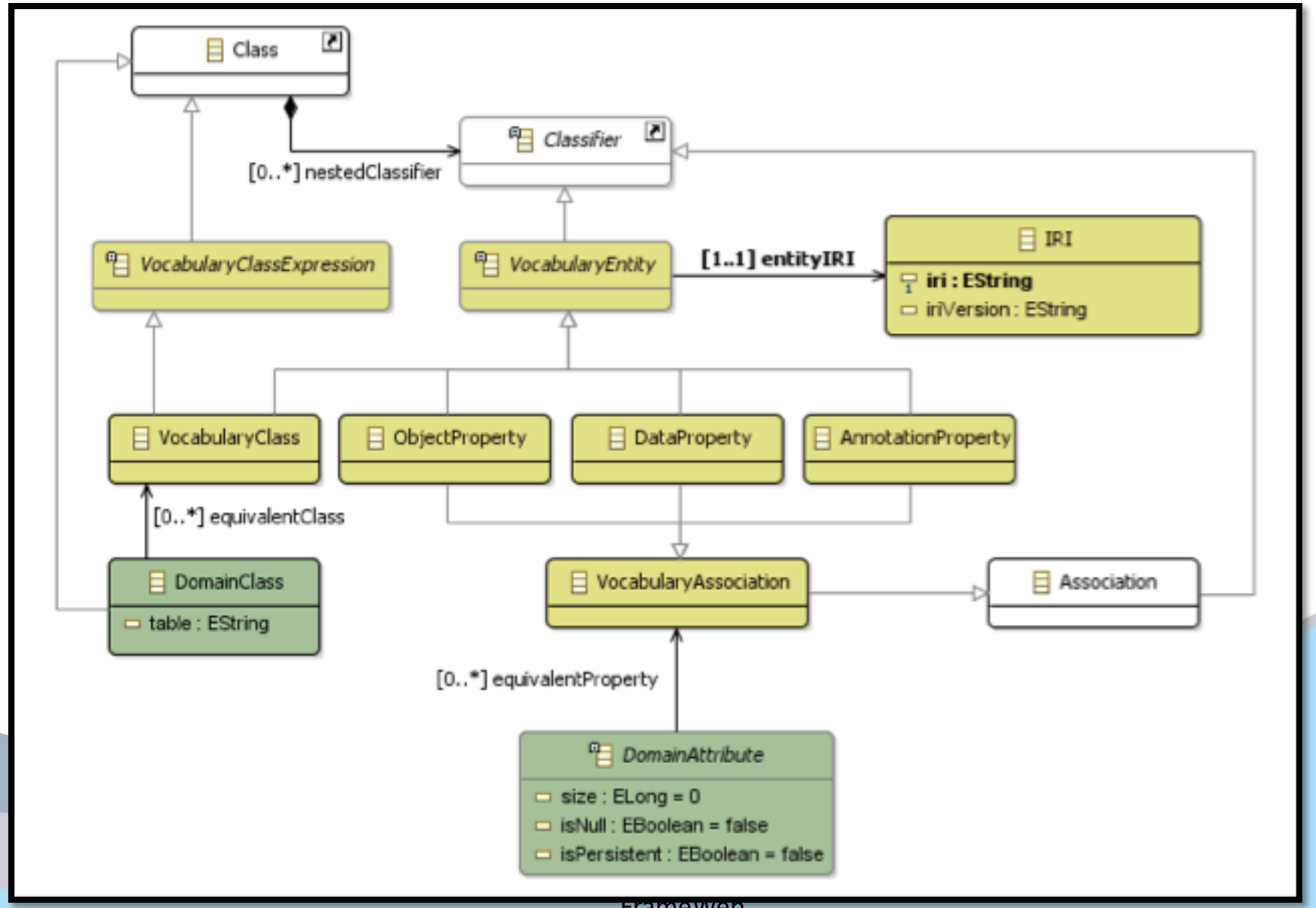
FrameWeb-LD: process

[Celino et al., 2016]



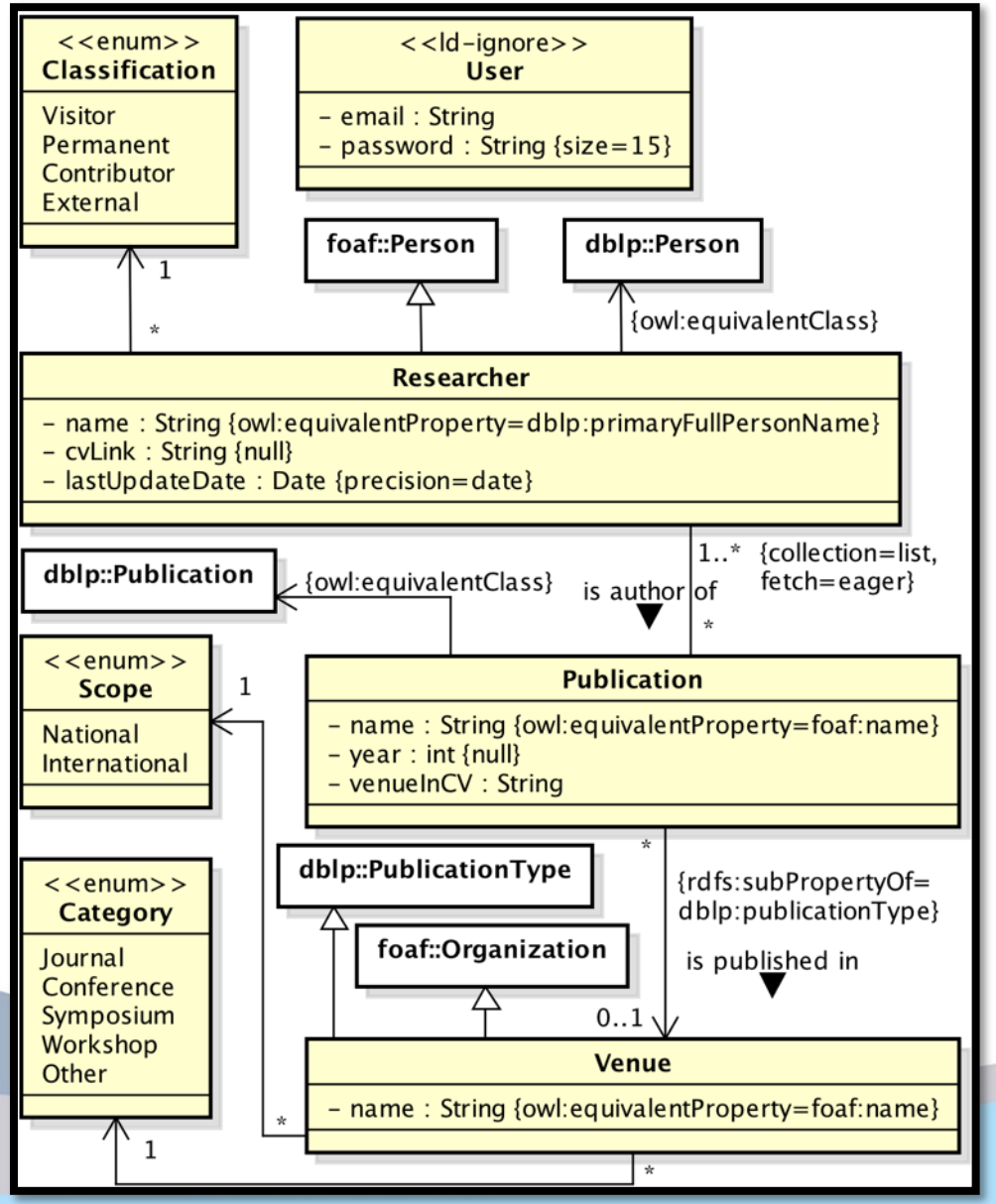
FrameWeb-LD: Vocabulary Meta-model

[Celino et al., 2016]



FrameWeb-LD: entity model with vocab

[Celino et al., 2016]



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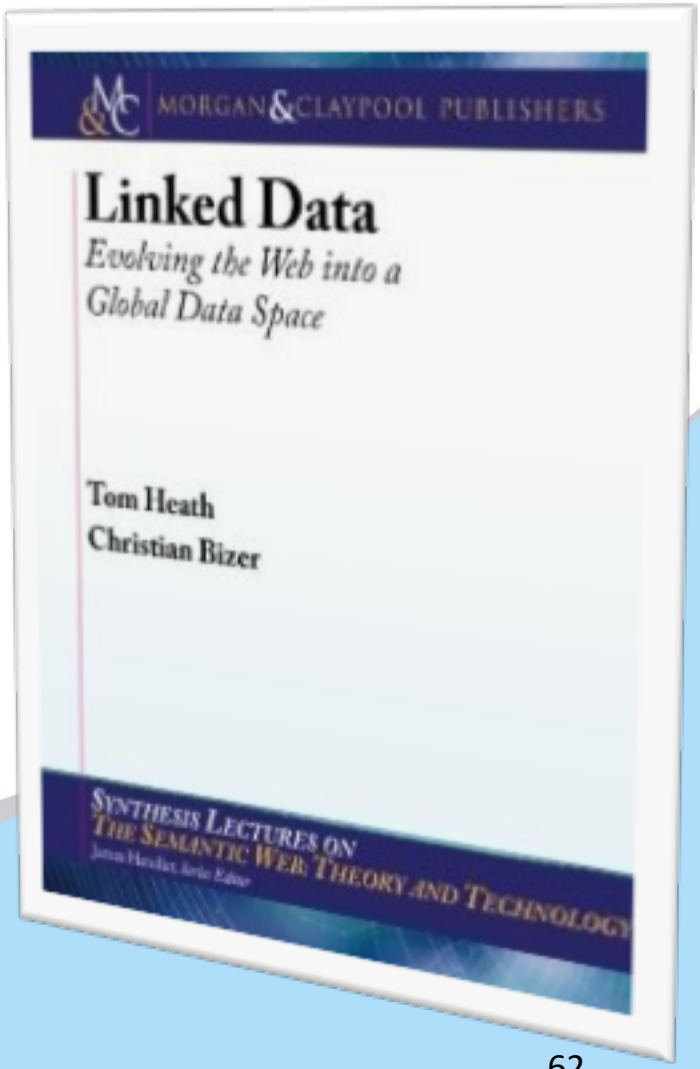
FrameWeb-LD: D2RQ generation

```
@prefix c2d: <http://dev.nemo.inf.ufes.br/owl/c2d.owl#>

# Table Researcher
map:Researcher a d2rq:ClassMap;
        d2rq:dataStorage map:database;
        d2rq:class c2d:Researcher;
        d2rq:classDefinitionLabel "Researcher";
        rdfs:subClassOf foaf:Person;
        owl:equivalentClass dblp:Person;
        .
map:Researcher_name a d2rq:PropertyBridge;
        d2rq:belongsToClassMap map:Researcher;
        d2rq:property vocab:Researcher_name;
        d2rq:propertyDefinitionLabel "Researcher name";
        owl:equivalentProperty dblp:primaryFullPersonName;
        d2rq:column "Researcher.name";
        .
```

FrameWeb-LD: 2016 and forward…

- Work on challenges of the Semantic Web:
  - *Vocabulary mapping;*
  - *ID resolution;*
  - *Provenance tracking;*
  - *Data quality assessment;*
  - *Performance and scalability issues;*
  - *Semantic Web Services;*
  - *Tools, tools, tools!*
  - *Etc.*



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- V. E. S. Souza, **"FrameWeb: um Método baseado em Frameworks para o Projeto de Sistemas de Informação Web,"** Universidade Federal do Espírito Santo 2007;
- Equivalent to the following, in English:
  - *V. E. S. Souza and R. A. Falbo,* ***"FrameWeb – A Framework-based Design Method for Web Engineering,"*** *in Proc. of the 2007 Euro American Conference on Telematics and Information Systems, 2007.*
  - *V. E. S. Souza and R. A. Falbo,* ***"FrameWeb – A Framework-based Design Method for Web Engineering,"*** *in Proc. of the 2007 Euro American Conference on Telematics and Information Systems, 2007.*
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  - *V. E. S. Souza, R. A. Falbo, and G. Guizzardi,* ***"Designing Web Information Systems for a Framework-based Construction,"*** *in Innovations in Information Systems Modeling: Methods and Best Practices, 1 ed., T. Halpin, E. Proper, and J. Krogstie, Eds., IGI Global, 2009, pp. 203-237.*

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