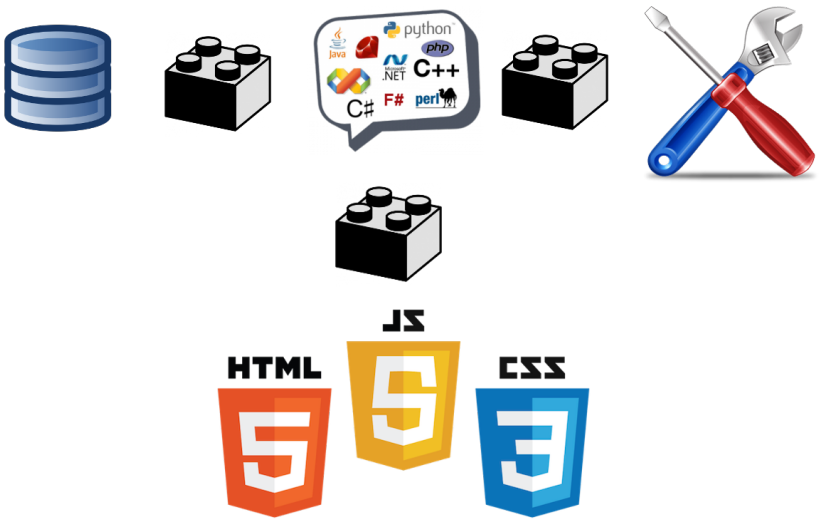
Simple Rule Inference from Configuration File

Kirill Levitin

July 21, 2015

How to build an enterprise software



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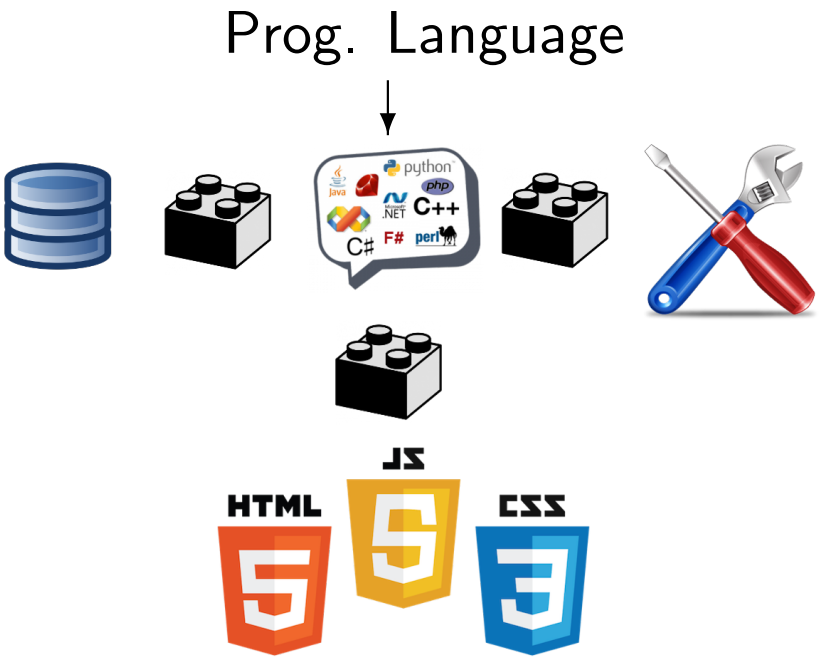
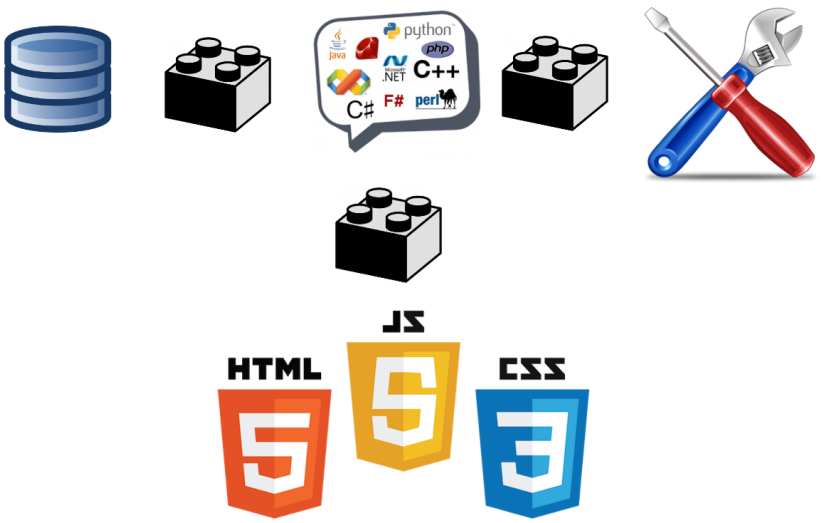


How to build an enterprise software

Database

Prog. Language



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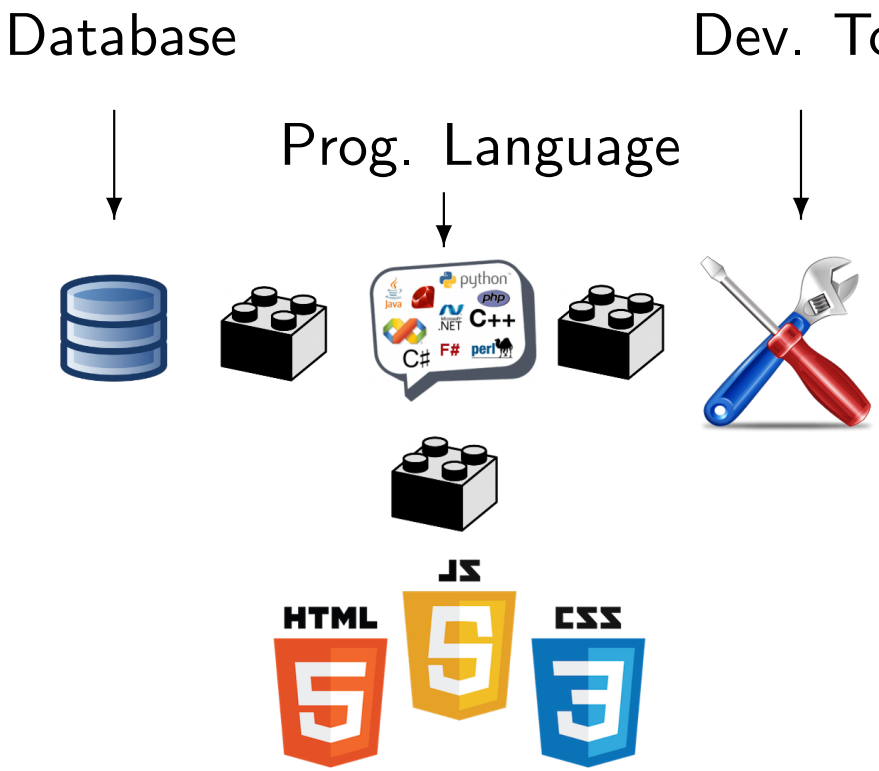

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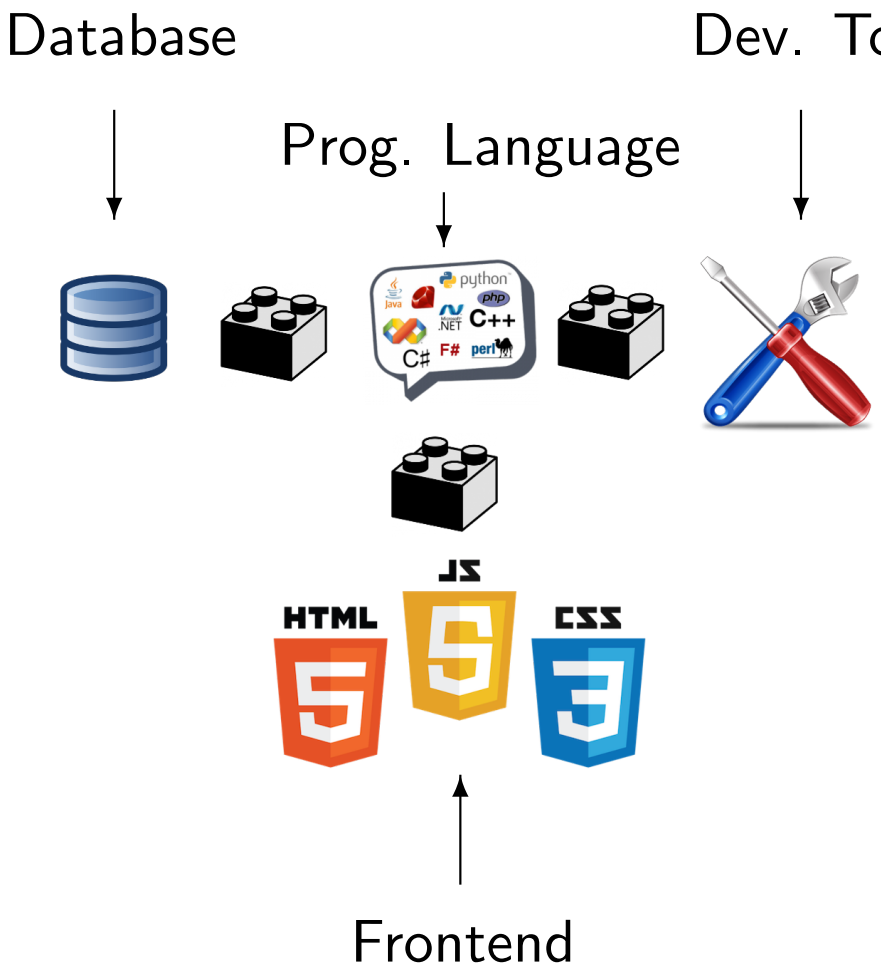

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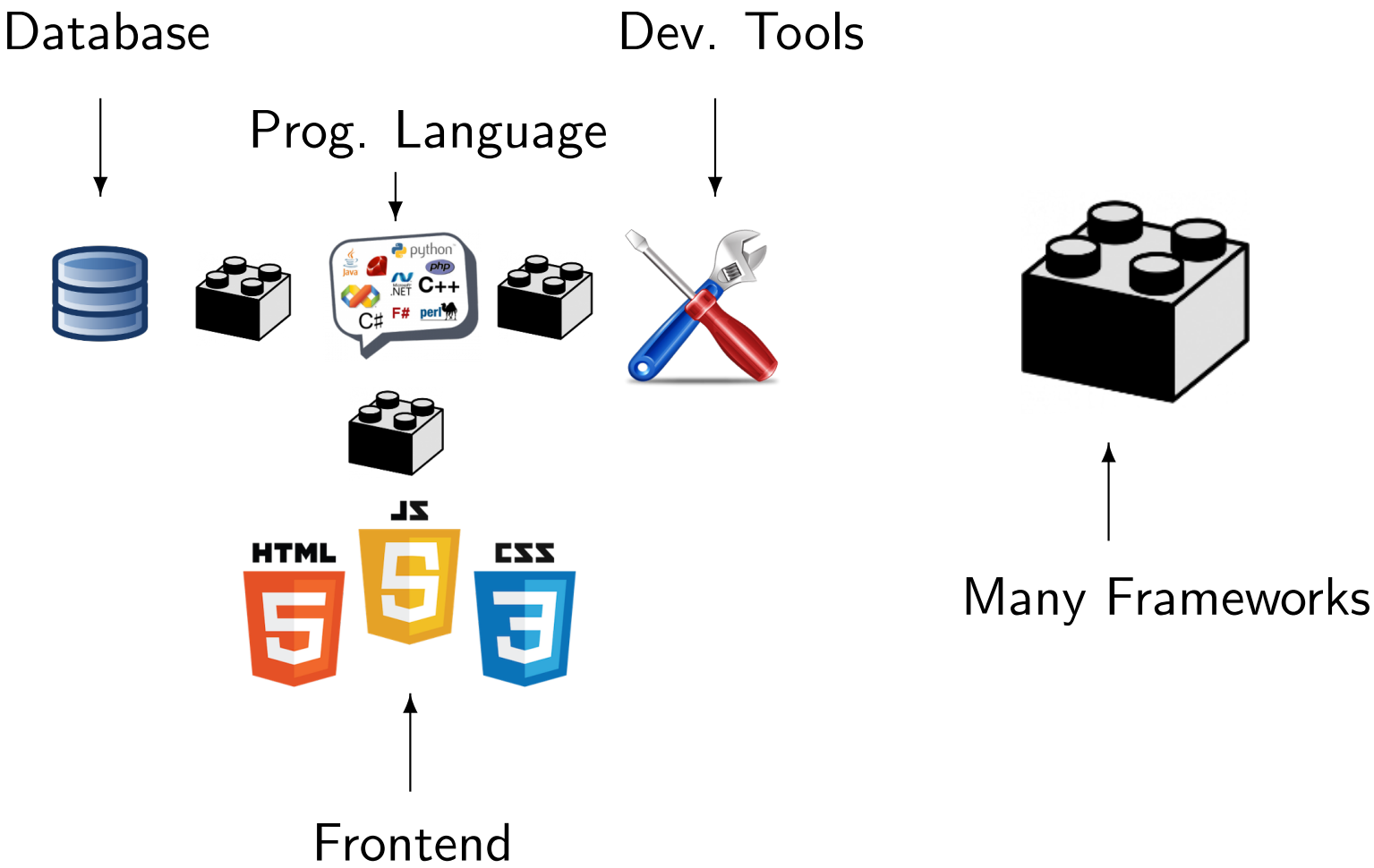

Small Example from J2EE Realization

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Many Frameworks

Software is not only a source code

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Programming Language

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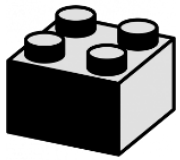
Programming Language

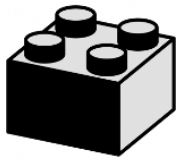


Frameworks

Software is not only a source code

Programming Language

XML Configuration Files



Frameworks

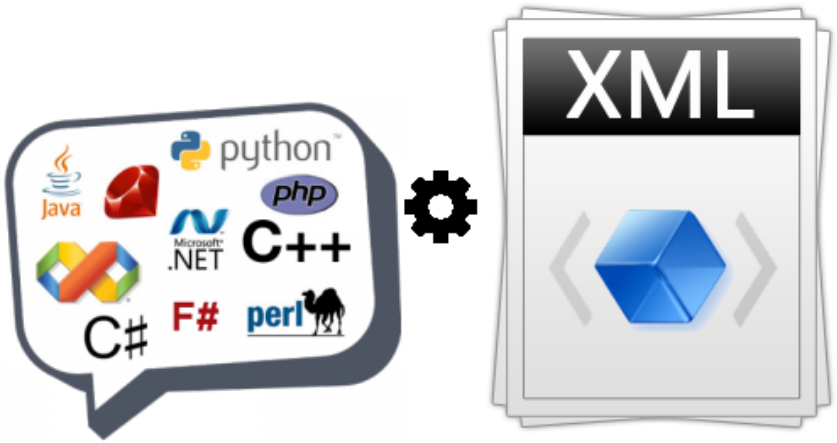
Motivation

Motivation

A **lot** of work has been done to analyse source code

Little work has been dedicated to XML configuration files

Motivation



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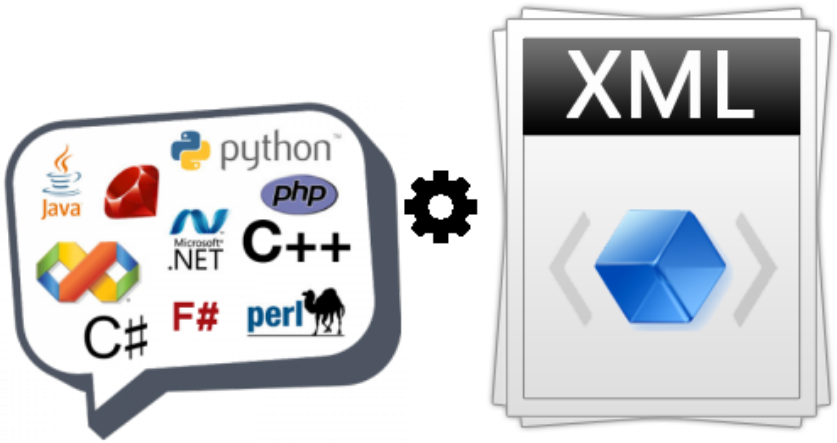
Motivation



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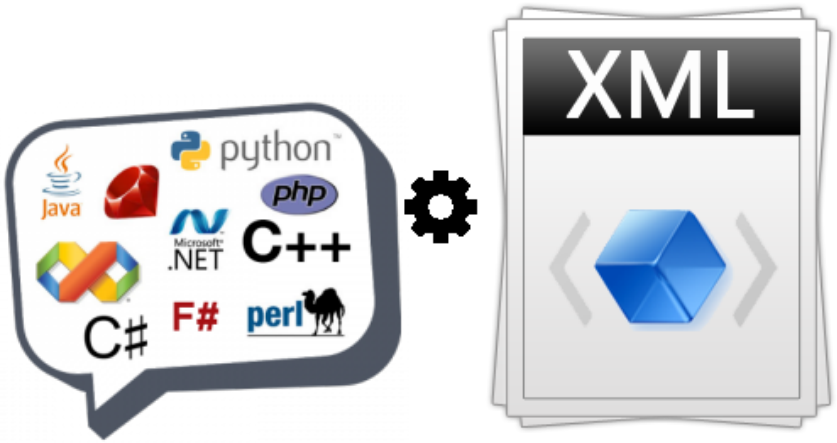
- analyse **both**, source code and XML files,

Motivation



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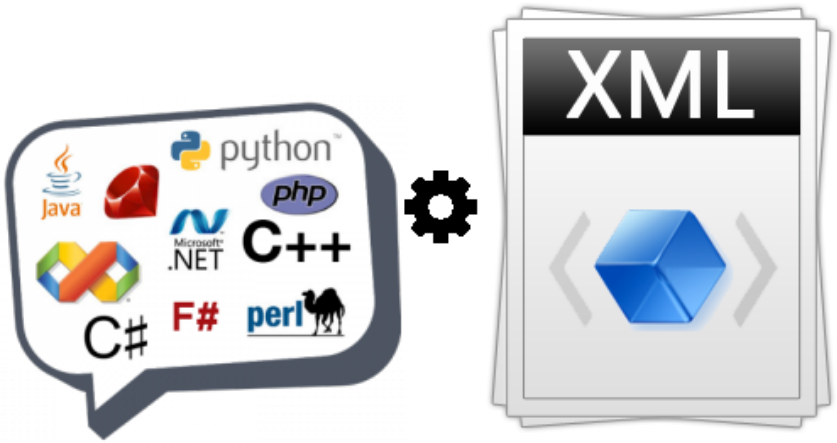
- **link** them together in one model,

Motivation



We will

- analyse **both**, source code and XML files,
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- discover **patterns**

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- auto completion,
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- ...

Example

```
<jpa:repositories base-package="ch.unibe.scg.persistence.repository" />
```

```
package ch.unibe.scg.persistence.repository;

public interface UserRepository extends JpaRepository<StudentEntity, Long> {

}
```

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Example

```
<bean id="oracleDataSource" class="org.springframework....">
    ....
</bean>

<bean id="oracleEntityManagerFactory" class="org.springframework....">
    <property name="dataSource" ref="oracleDataSource" />
    ....
</bean>

<bean id="transactionManager" class="org.springframework....">
    <property name="entityManagerFactory" ref="oracleEntityManagerFactory" />
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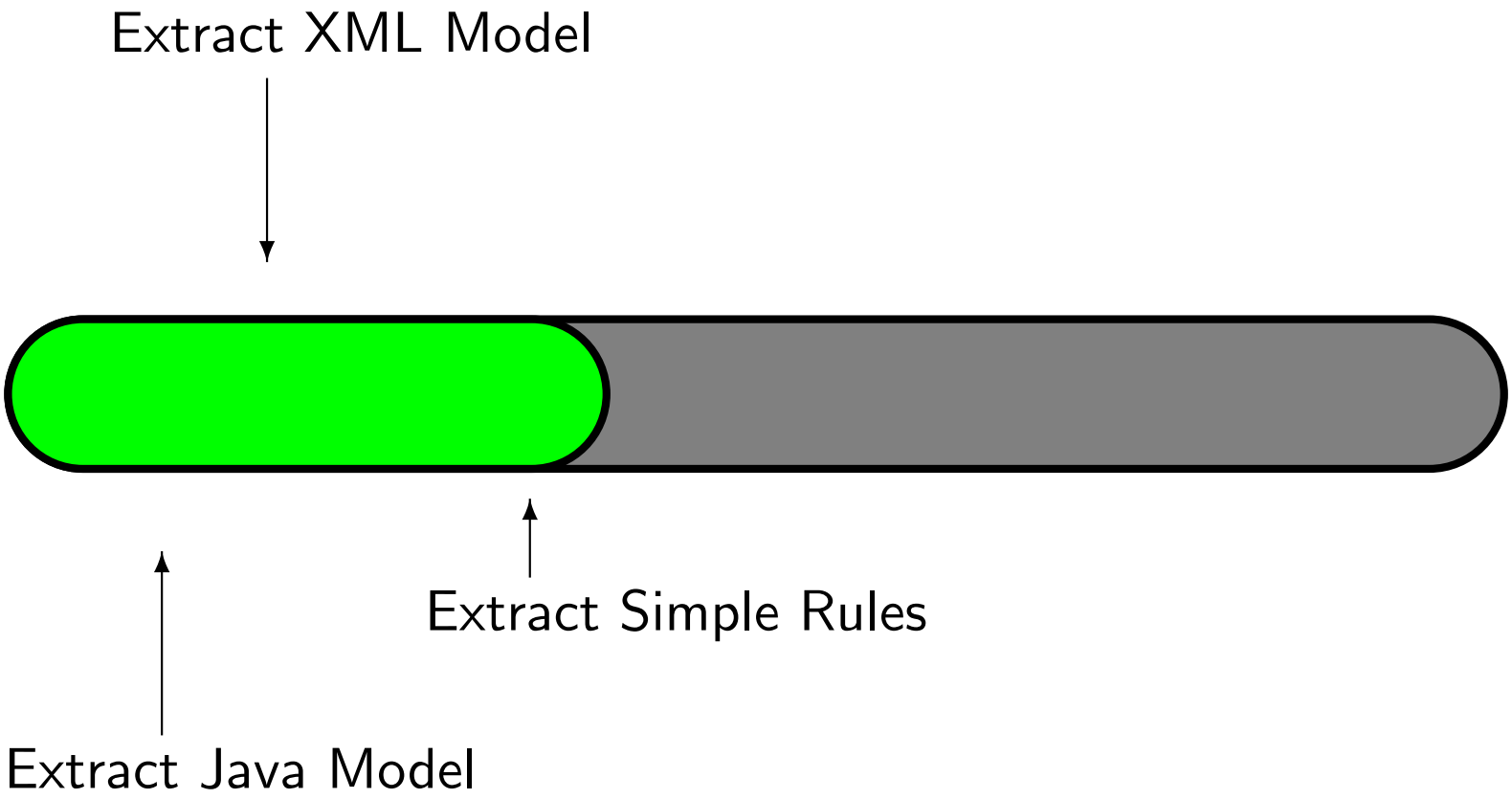

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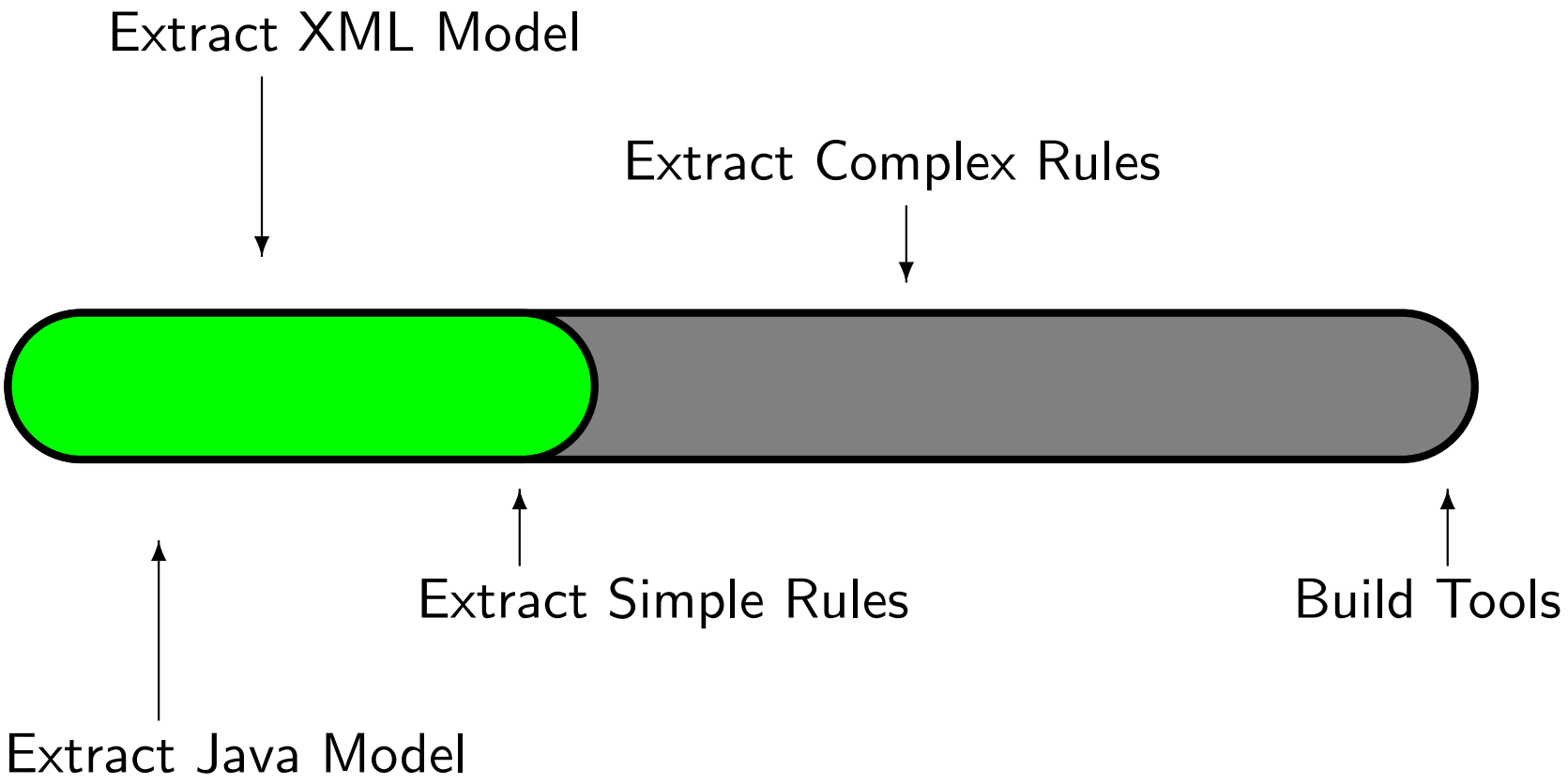
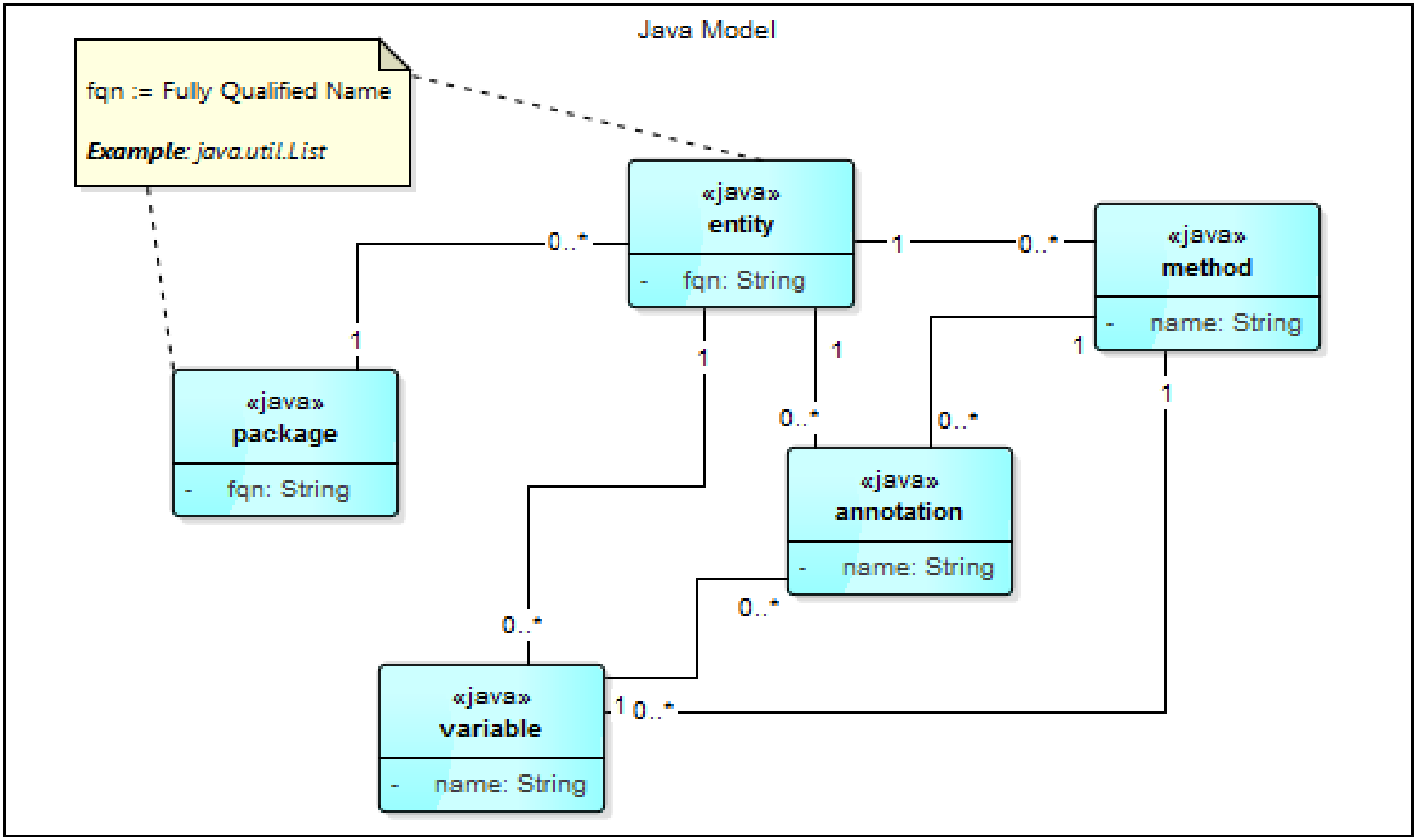
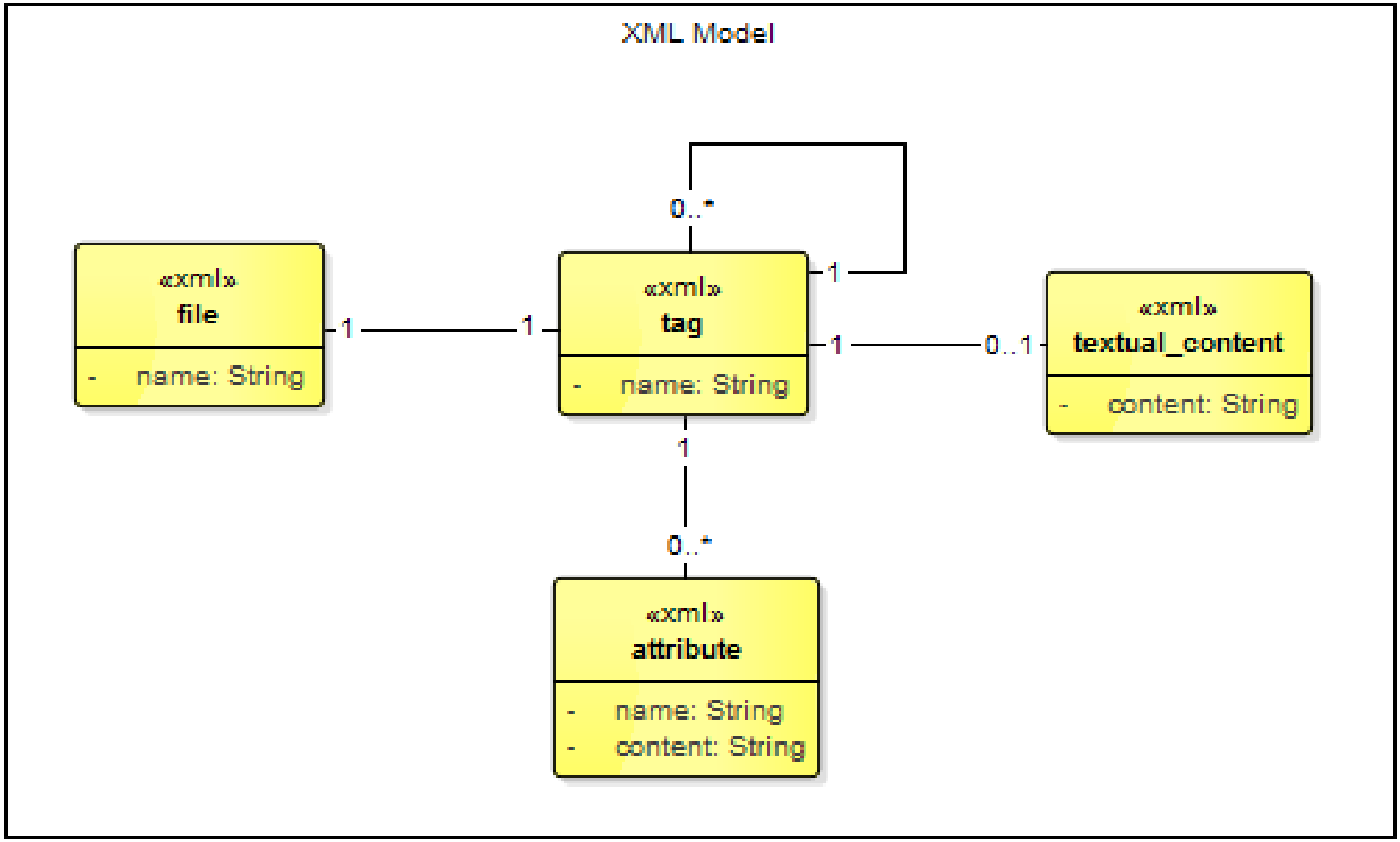

Extract XML Model
Extract Complex Rules
Extract Simple Rules
Build Tools
Extract Java Model

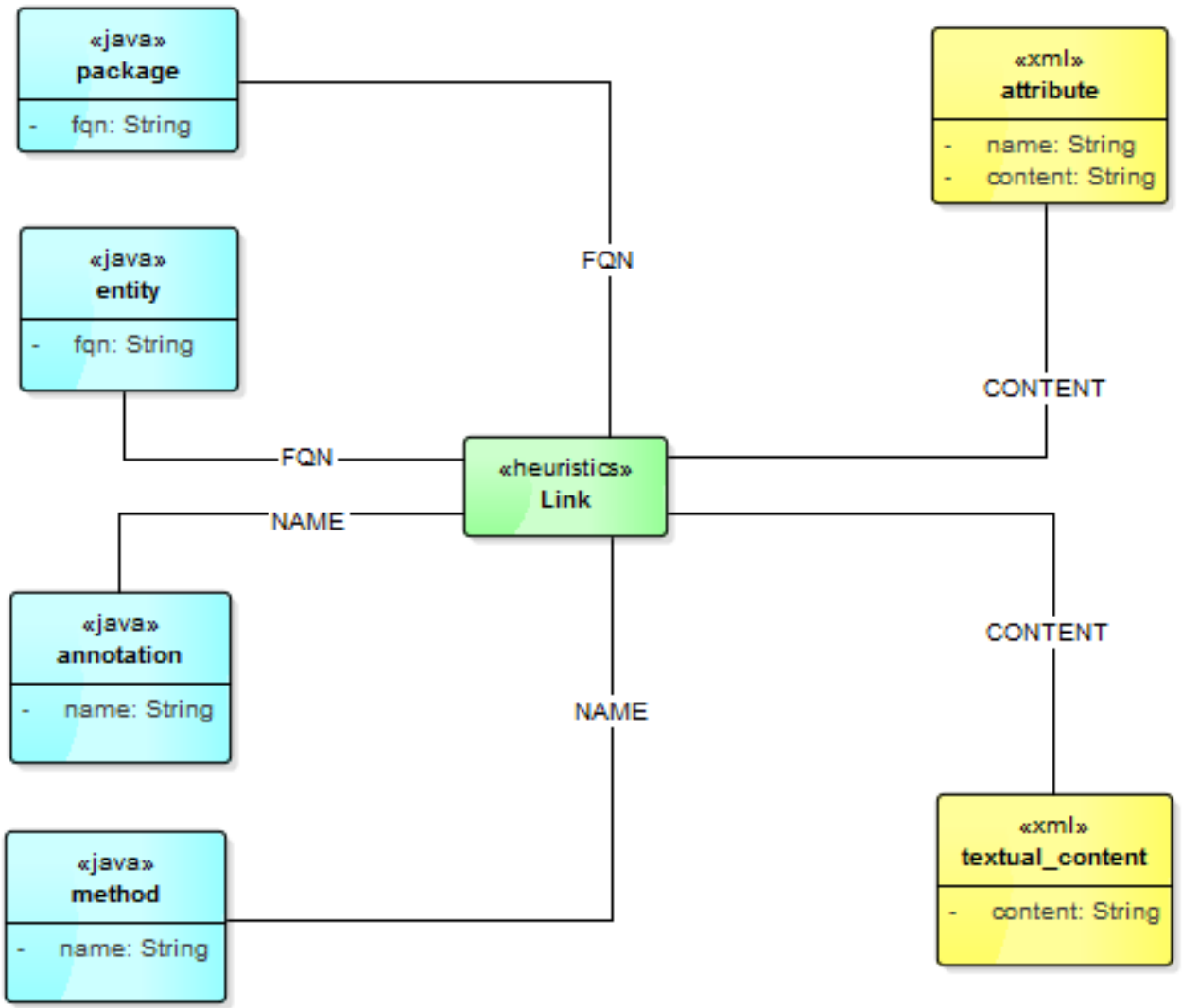
Extract Java Model



Extract XML Model



Link Java and XML Model



Calculate Support

$SUP\,(Link)$:= How often is the given Link's **template** found in all projects

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Example:
We have found $beans.bean.class = 4000$ in our 110 projects $\Rightarrow$

$$SUP\,(beans.bean.class) = 4000$$

Calculate Hit

$HIT\,(Link) :=$ How often is the given Link found in all projects

Calculate Hit

$$HIT\,(Link) := \text{How often is the given Link found in all projects}$$

Example:
In our 110 projects
$|beans.bean.class.X \Rightarrow \exists Entity^{FQN} = X| = 1000 \Rightarrow$

$$HIT\,(beans.bean.class) = 1000$$

Calculate Probability

$P(Link) :=$ Probability that the given Link **exists** in a project

Calculate Probability

$P\left(Link\right) :=$ Probability that the given Link **exists** in a project

Example:

$$P\left(beans.bean.class.X \Rightarrow \exists Entity^{FQN} = X\right) = \frac{HIT(beans.bean.class)}{SUP(beans.bean.class)}$$

Results

$\approx$ **110 Projects**

Java:

- $\approx$ 10 000 Entities
- $\approx$ 50 000 Methods
- $\approx$ 30 000 Annotations

XML:

- $\approx$ 5 000 Files
- $\approx$ 50 000 Tags
- $\approx$ 80 000 Attributes
- $\approx$ 70 000 Textual Contents

Results

$Probability > 90\%$; $Hit > 10$, $Framework = Spring$

Link	Type	Prob	Hit
beans.job.decision.decider	$Entity^{Name}$	97.44%	39
beans.job.step.tasklet.chunk.writer.bean.class	$Entity^{FQN}$	100%	25
beans.repositories.transaction-manager-ref	$Method^{Name}$	100%	23
beans.authentication-manager...data-source-ref	$Method^{Name}$	100%	13
beans.authorization-server.token-service-ref	$Method^{Name}$	91.67%	12
beans.flow.step.tasklet.ref	$Entity^{Name}$	100%	12
flow.var.class	$Entity^{FQN}$	91.67%	12
flow.var.name	$Entity^{Name}$	91.67%	12

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Where is $beans.bean.class \Rightarrow Entity.FQN$?

Frameworks

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<bean id="oracleDataSource" class="org.springframework...">
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<bean id="oracleEntityManagerFactory" class="org.springframework...">
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<bean id="transactionManager" class="org.springframework...">
    <property name="entityManagerFactory" ref="oracleEntityManagerFactory" />
</bean>
```

Calculate Hit

$HIT\,(Link)$:= How often is the given Link found in all projects **or** the definition refers to a framework

Calculate Probability

$P(Link)$:= Probability that the given Link exists in a project **or** the definition refers to a framework

Used Frameworks

SPRING	(.*)(springframework)(.*)
MAVEN	(.*)(maven\.apache\.org)(.*)
JAVAFX	(.*)(javafx\.com)(.*)
LIQUIBASE	(.*)(liquibase\.org)(.*)
WEBSPHERE	(.*)(websphere\.ibm\.com)(.*)
SOAPUI	(.*)(eviware\.com\/soapui)(.*)
GREPCONSOLE	(.*)(\/grepconsole)(.*)
JAVAEE_DEPLOYMENT	(.*)(java\.sun\.com\/xml\/ns\/javaee)(.*)
JAXB	(.*)(java\.sun\.com\/xml\/ns\/jaxb)(.*)
JAXWS	(.*)(java\.sun\.com\/xml\/ns\/jax-ws)(.*)
JAVA_SUN	(.*)(java\.sun\.com)(.*)
W3_ORG	(.*)(www\.w3\.org)(.*)
GOOGLE	(.*)(google\.com)(.*)
YAHOO	(.*)(yahoo\.com)(.*)
APACHE	(.*)(org\.apache)(.*)
MOZILLA	(.*)(www\.mozilla\.org)(.*)
NETBEANS	(.*)(www\.netbeans\.org)(.*)

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Probability $> 90\%$; *Hit* > 10, *Framework* $=$ *Spring*

Link	**Type**	**Prob**	**Hit**
beans.bean.class	$Entity^{FQN}$	90.56%	4 312
beans.repositories.base-package	$Package^{FQN}$	96.39%	83
beans.bean.property.list.bean	$Entity^{FQN}$	98.18%	55
beans.bean.property.bean.property.class	$Entity^{FQN}$	100%	51
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beans.bean.class $\Rightarrow$ *Entity.FQN* is now under the result

Next Steps

Find complex rules

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- Association rule learning *(FP-growth algorithm)*

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- Association rule learning *(FP-growth algorithm)*
- Pattern mining in a model-graph

Overview

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Programming Language

XML Configuration Files

Frameworks

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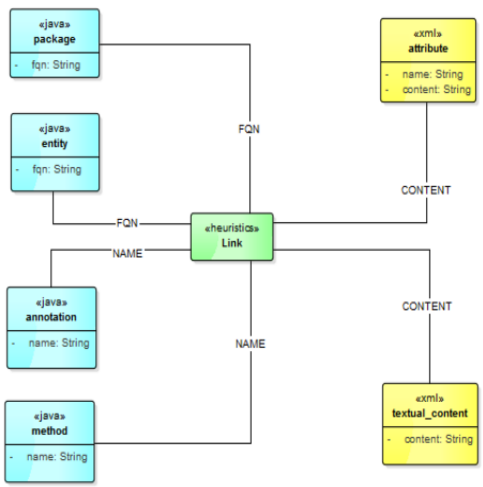

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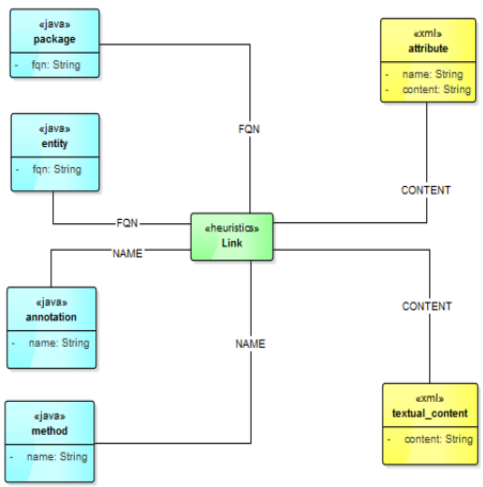

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