Apache Marmotta

for

Multimedia Management

Jakob Frank, Thomas Kurz

http://marmotta.apache.org/

APACHECON EUROPE

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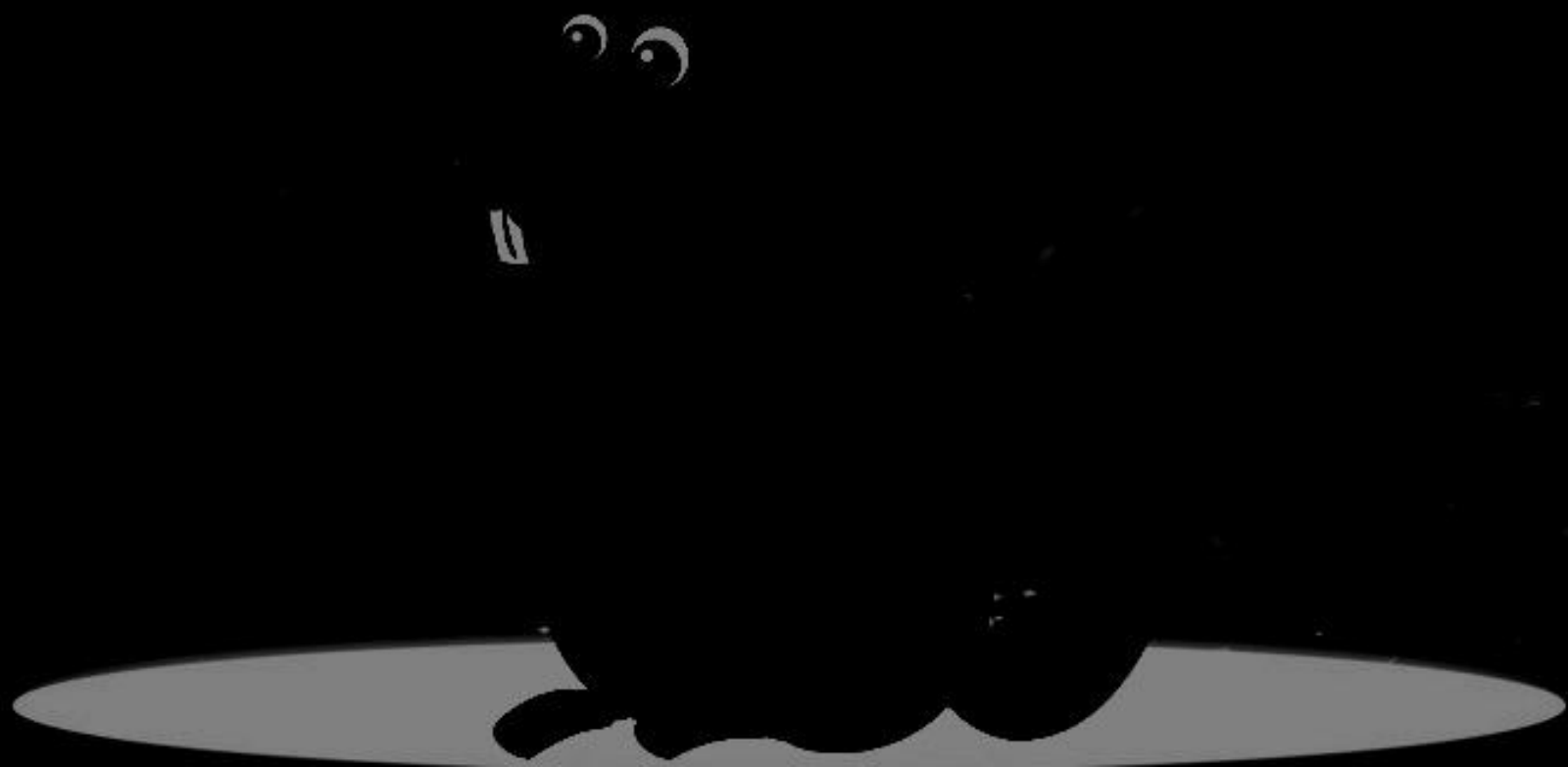BUDAPEST, HUNGARY
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- Researcher at **Salzburg Research**
- Solution Architect at **Redlink GmbH**
- ASF Committer of **Marmotta**

Thomas Kurz

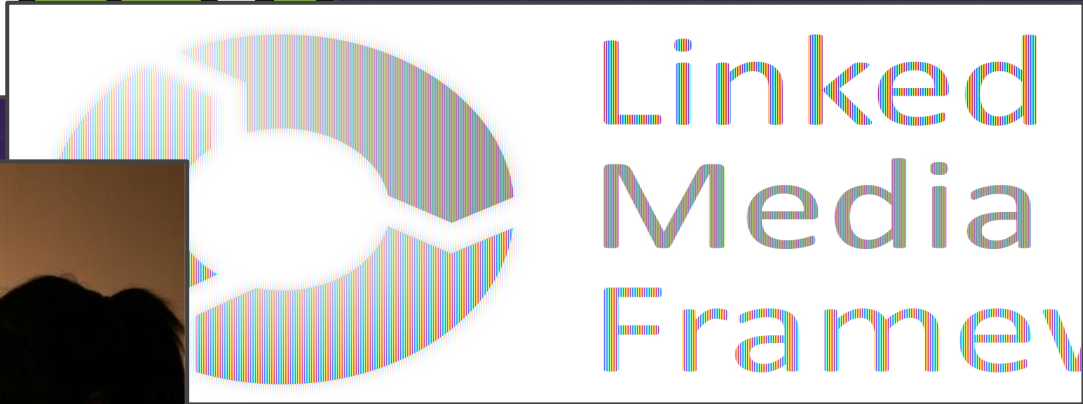- Researcher at **Salzburg Research**
- Solution Architect at **Redlink GmbH**
- ASF Committer of **Marmotta**

Kiwi

Apache Linda

Linked Media Framew

The Marmotta will be with you. Always.

729 Commits 7 Contributors

Apache Marmotta ™

Outline

Part I : Apache Marmotta

- Basics of the Semantic Web
- Apache Marmotta Linked Data Server
- Marmotta Modules and Libraries

Part II: Linked Media

- What is Linked Media
- Semantic Media Annotation
- Extending backend to Media Storage and Retrieval

Why we need a Semantic Web ?

Slide from James Hendler (Univ. Maryland)

What is RDF?

- RDF = Resource Description Framework
  - formal language for describing web resources and relationships in between
  - based on a directed labeled graph, represented as triple model (Subject - Predicate - Object)
  - several syntaxes (RDF/XML, Turtle, ...)
- RDFS = RDF Schema
  - formal language for describing possible instances of the graph (classes and predicates)
- both specified by W3C (~ 1998)

What is SPARQL?

- SPARQL is an RDF Query Language specified by W3C (v1.1. March 2013)
- SQL-like syntax

```
PREFIX uni : <http://example.org/uni/>
SELECT ?name
FROM <http://example.org/personal>
WHERE {
    ?s uni:name ?name.
    ?s a uni:Lecturer.
}
```

What is Linked Data?

1. Use URIs to denote things.

2. Use HTTP URIs so that these things can be referred to and looked up ("dereferenced") by people and user agents.

3. Provide useful information about the thing when its URI is dereferenced, leveraging standards such as RDF, SPARQL.

4. Include links to other related things (using their URIs) when publishing data on the Web.

What is Apache Marmotta?

- ## Linked Data Server
  full Linked Data stack
  incl. Content Negotiation and LDP

- ## SPARQL Server
  SPARQL 1.1 query, update, protocol

- ## Linked Data Development Environment
  collection of modules and libraries for building Linked Data applications

- ## Community of
  Open Source Linked Data Developers

Linked Data Server

- easily setup to provide your (RDF-)data as Linked Data on the Web

- human- and machine-readable read-write data access based on HTTP content negotiation

- Query and interlink you data using SPARQL and LDPath

- reference implementation of the Linked Data Platform

SPARQL Server

- full support of SPARQL 1.1 through HTTP web services

- SPARQL 1.1 query and update endpoints

- implements the SPARQL 1.1 protocol (supports any standard SPARQL client)

- fast native translation of SPARQL to SQL in the KiWi triple store

- lightweight Squebi SPARQL explorer UI

Linked Data Development

- ## modular server architecture
  - combine exactly those features you need

- ## collection of independent libraries for common Linked Data problems:
  - access Linked Data resources (and even some that are not Linked Data): **LDClient**
  - simple and intuitive query language for Linked Data: **LDPath**
  - Sesame Triplestore based on a SQL database: **KiWi Triplestore** optional: **Versioning & Reasoning**

Marmotta Community

- discuss with people interested in getting-things-done in the Linked Data world

- build applications that are useful without re-implementing the whole stack

- thorough software engineering process under the roof of the Apache Software Foundation

- Join us!
  - users@marmotta.apache.org
  - dev@marmotta.apache.org
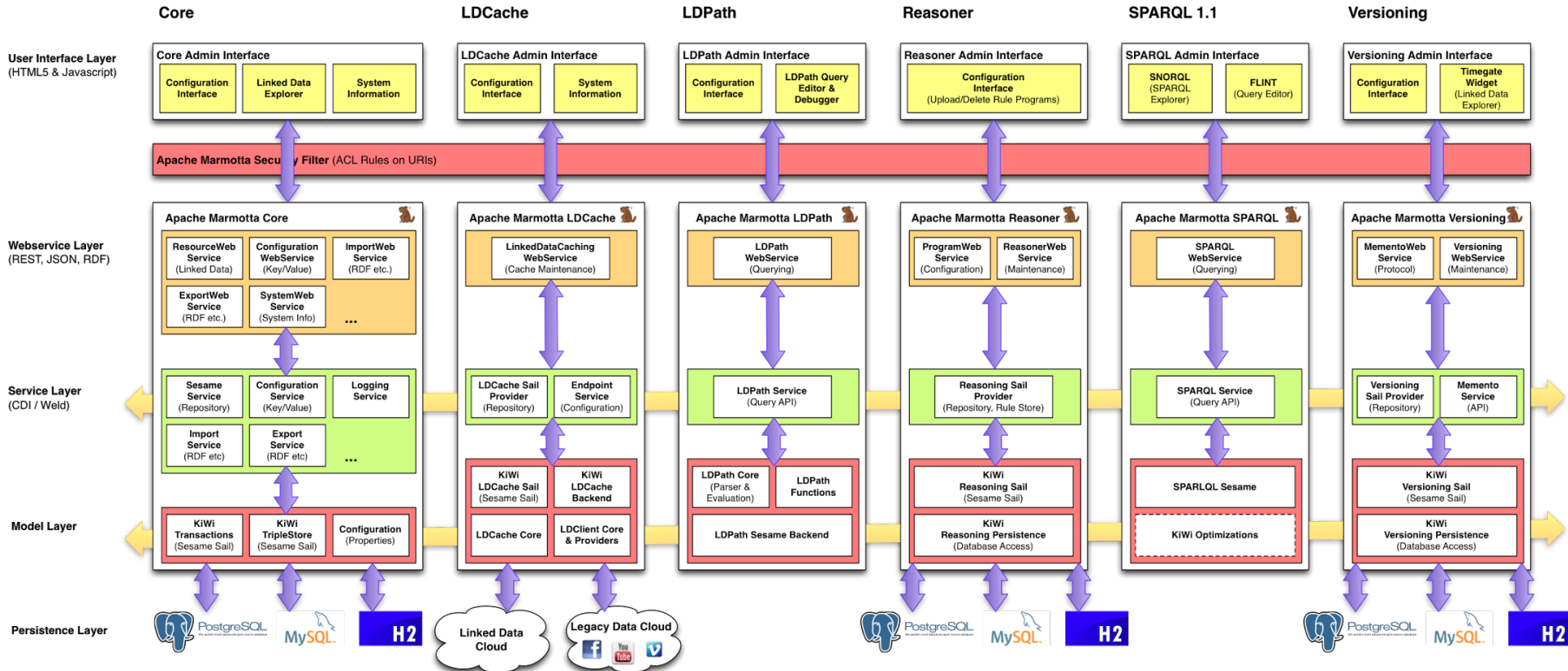
Apache Marmotta Platform

- JavaEE web application

- service oriented architecture using CDI (J2EE)

- REST web services using JAX-RS (RestEasy)

- CDI services found in the classpath are automatically loaded

Platform Architecture

Marmotta Core

- Core functionalities:
  - Linked Data access
  - RDF import/export
  - Admin/Configuration UI
- Platform glue code
  - Service and Dependency injection
  - Triple Store
  - System configuration
  - Logging

Marmotta Backends

Choose the one that fits your needs best:

- ## KiWi (Marmotta)

    - based on relational database (PostgreSQL, MySQL, H2)

    - highly scaleable

- ## Sesame Native

- ## BigData

    - based on BigData clustered triple store

- ## Titan Graph DB

    - backed by HBase, Cassandra or BerkeleyDB

Marmotta SPARQL

- ## SPARQL 1.1 HTTP endpoint
    - ### SPARQL 1.1 protocol
    - ### endpoints for query & update
- ## SPARQL explorer UI (Squebi)

with KiWi Triplestore:

- ## Translation of most SPARQL constructs into native SQL for improved performance

Marmotta LDPath

- Query language designed for the Linked Data Cloud

- path based navigation starting at a resource, following links across the Cloud

- limited expressivity (c.f. SPARQL) but full Linked Data support

```
@prefix foaf: <http://xmlns.com/foaf/0.1/>;
@prefix gn:   <http://www.geonames.org/ontology#>;

name = foaf:firstName :: xsd:string;
friends = foaf:knows / fn:concat(foaf:firstName, " ", foaf:surname)
    :: xsd:string;
country = foaf:based_near / gn:parentCountry / gn:name :: xsd:string;
```

Marmotta LDCache

- transparently access Linked Data resources from other servers as if they were local

- support for wrapping some legacy data sources (e.g. Facebook Graph)

- local triple cache, honors HTTP expiry and cache headers

SPARQL does not work well with LDCache, use **LDPath** instead!

Marmotta Reasoner

with KiWi Triplestore:

- rule-based sKWRL reasoner
- datalog-style rules over RDF triples, evaluated in forward-chaining procedure
- truth maintenance

```
@prefix skos: <http://www.w3.org/2004/02/skos/core#>

($1 skos:broaderTransitive $2)  -> ($1 skos:broader $2)
($1 skos:narrowerTransitive $2) -> ($1 skos:narrower $2)
($1 skos:broaderTransitive $2), ($2 skos:broaderTransitive $3)
                                -> ($1 skos:broaderTransitive $3)
($1 skos:narrowerTransitive $2), ($2 skos:narrowerTransitive $3)
                                -> ($1 skos:narrowerTransitive $3)
($1 skos:broader $2)  -> ($2 skos:narrower $1)
($1 skos:narrower $2) -> ($2 skos:broader $1)
```

Marmotta Versioning

with KiWi Triplestore:

- transaction-based versioning of all changes to the triple store

- implementation of Memento protocol for exploring changes over time

- snapshot/wayback functionality (i.e. possibility to query the state of the triple store at a given time in history)

Linked Media

is a "Web scale layer of structured, interlinked media annotations (...) inspired by the Linked Data movement for making structured, interlinked descriptions of resources better available online."

Lyndon J. B. Nixon. The importance of linked media to the future web: lime 2013 keynote talk - a proposal for the linked media research agenda. WWW Companion Volume, page 455-456. International World Wide Web Conferences Steering Committee / ACM, (2013).

"Give me the <u>spatio-temporal snippet</u> that shows <u>Lewis Jones</u> <u>right beside</u> <u>Connor Macfarlane</u>"

Media Fragment URIs

"... a media-format independent, standard means of addressing media fragments on the Web using Uniform Resource Identifiers."

[W3C Recommendation: Media Fragments URI 1.0 (basic)]

http://test.org/video.mpg?t=10,20&xywh=10,20,30,40

the spatial range having a dimension from 30 to 40 pixels with upper-left point (10px, 20px) from video.mpg on domain test.org from second 10 to 20.

"The Open Annotation Core Data Model specifies an interoperable framework for creating associations between related resources … ."

http://www.openannotation.org/spec/core/

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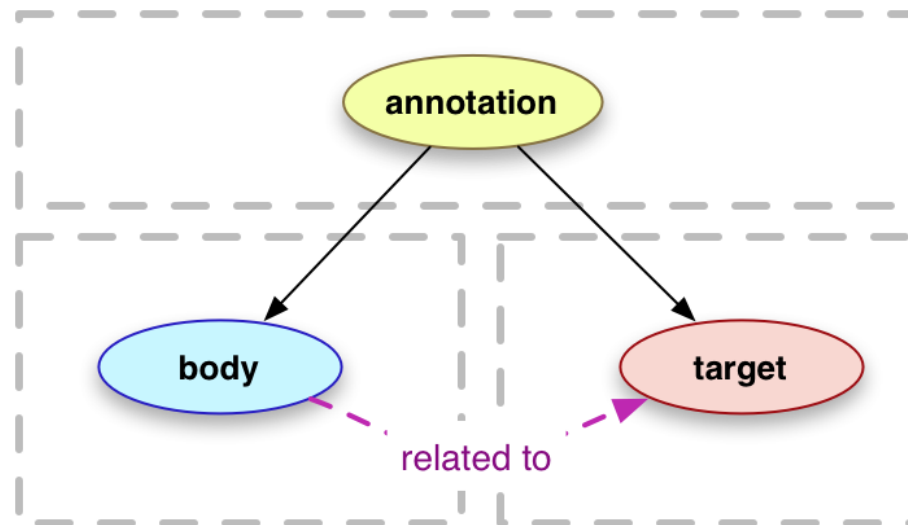
SPARQL-MM

"... is a multimedia-extension for SPARQL 1.1 implemented for Sesame. By now it supports relation and aggregation functions for Media Fragments URI 1.0 ... ."

https://github.com/tkurz/sparql-mm

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX mm:   <http://linkedmultimedia.org/sparql-mm/ns/1.0.0/function#>


SELECT ?f1 ?f2 (mm:boundingBox(?f1,?f2) AS ?box) WHERE {

    ?f1 rdfs:label "a".

    ?f2 rdfs:label "b".

    FILTER mm:rightBeside(?f1,?f2)

}
```

SPARQL-MM

	Relation Function	Aggregation Function
Spatial	mm:rightBeside	mm:spatialIntersection
	mm:spatialOverlaps	mm:spatialBoundingBox
	…	…
Temporal	mm:after	mm:temporalIntersection
	mm:temporalOverlaps	mm:temporalIntermediate
	…	…
Combined	mm:overlaps	mm:boundingBox
	mm:contains	mm:intersection

Apache Marmotta

```java
public class ImageWebservice extends LdpWebService {

 @GET @Produces("image/*")

 public Response GET(..., @QueryParam("xywh") Rectangle rectangle) {
   if(rectangle != null) {


      // get mimetype for uri with LdpService

      // get binary data with LdpBinaryStoreService

      // read and crop image with ImageIO


      return Response.ok().header("Content-Type",mimetype).entity(image).build();
    }

    return super.GET(uriInfo, type, preferHeader);
 }
}
```

You can find and download the demo example code at https://github.com/wikier/apache-marmotta-tutorial-iswc2014.

thanks!

http://marmotta.apache.org/