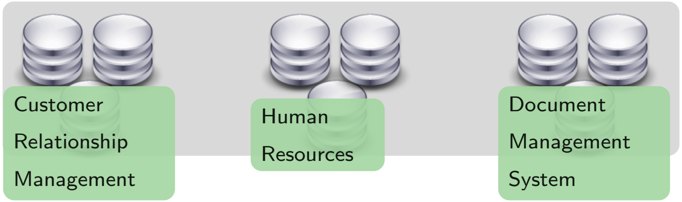
Protecting your RDF data

Nuno Lopes, Sabrina Kirrane, Axel Polleres, Alessandra Mileo

Data Integration in an Enterprise



Data Integration in an Enterprise

Customer Relationship Management
Human Resources
Document Management System

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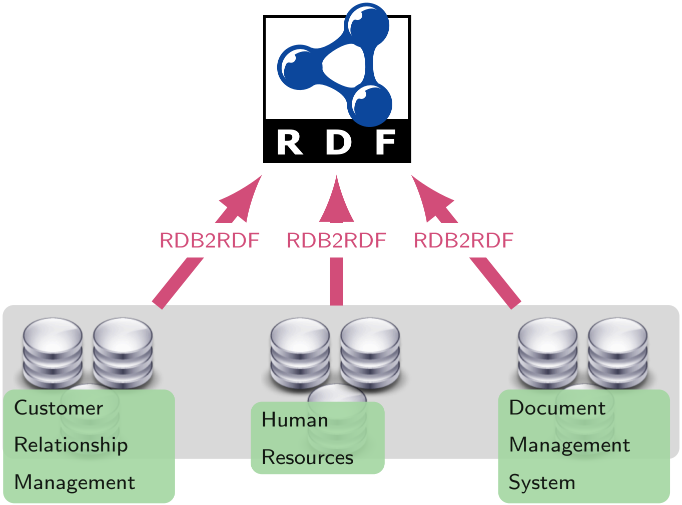

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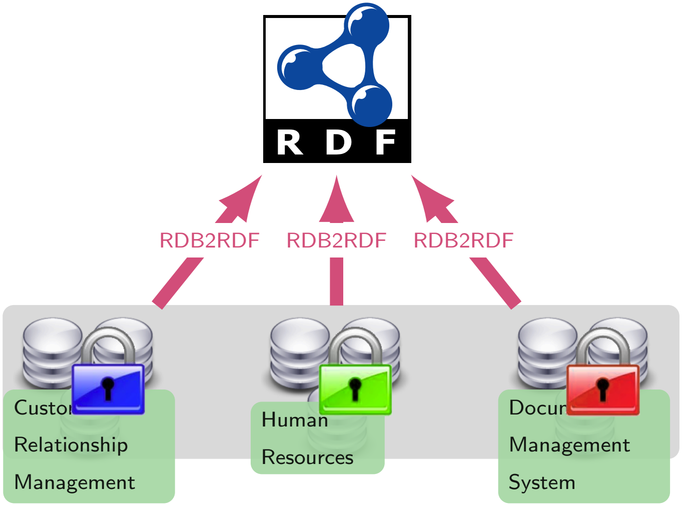

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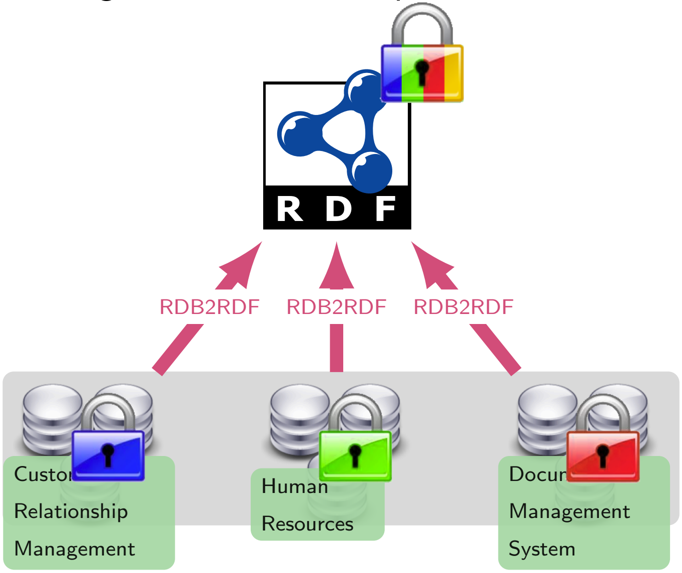

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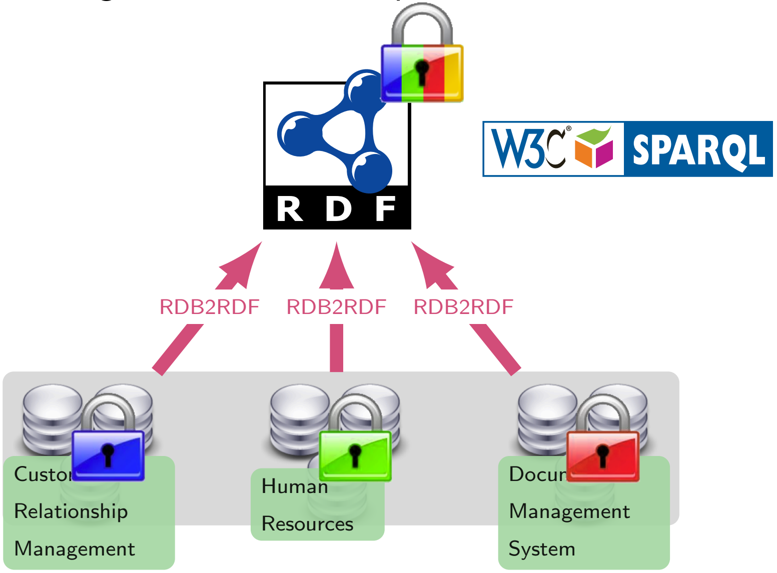

Data Integration in an Enterprise

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Authorisation

Data Integration in an Enterprise

Authentication

Authorisation

Existing Annotated RDF(S) domains

Annotations refer to a specific **domain**

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Temporal:

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:joeBloggs :worksFor :westportCars :[2010,2012]
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:joeBloggs :worksFor :westportCars :0.5
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Further extensions

RDFS inferences

SPARQL queries

Enterprise Data Example

Triples from: HR system and DMS system

Example RDF data

```
:joeBloggs :worksFor :westportCars .
:joeBloggs :salary 80000 .
:johnSmith :worksFor :westportCars .
:johnSmith :salary 40000 .
:joeBloggs :warnedFor :NonAttendance .
:joeBloggs :username "jb" .
:johnSmith :username "js" .
:warnedFor dom :OneWeekSuspended .
```

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How to add access control to this RDF data?

AC: Entities

Annotation Entities

- Entities present in the original systems:

$$jb, js, hr, emp$$

Represent users, groups, or roles

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  Represent users, groups, or roles
- Attributes:

$$age = 30$$

- Negated literals:

$$\neg js$$

AC: Annotation Values

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:joeBloggs :salary 80000 :???
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Annotation values specify entities which:

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:joeBloggs :salary 80000 :hr
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- allowed access: `hr`

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```

Annotation values specify entities which:

- allowed access: `hr`
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AC: Annotation Values

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:joeBloggs :salary 80000 :[hr,-js]
```

Annotation values specify entities which:

- allowed access: `hr`
- denied access: `-js`
- must satisfy each credential: `[hr,-js]`

AC: Annotation Values

```
:joeBloggs :salary 80000 :[[hr,-js],[jb]]
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Annotation values specify entities which:

- allowed access: `hr`
- denied access: `-js`
- must satisfy each credential: `[hr,-js]`
- must satisfy any set of credentials : `[[hr,-js],[jb]]`

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:joeBloggs :salary 80000 :[[hr,-js],[jb]]
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Annotation values are the body of the rules in a Datalog program:

$$\begin{aligned} &\leftarrow \quad hr, \neg js. \\ &\leftarrow \quad jb. \end{aligned}$$

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given the facts from the authentication service, if *access* holds the user is allowed to access the triple.

Annotated RDF(S) Inferences

Inference rules are **independent** of the annotation domain

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RDFS "domain" (dom) rule:

```
   ?prop dom ?Class .
   ?x ?prop ?y .
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```

```
   :warnedFor dom :OneWeekSuspended .
   :joeBloggs :warnedFor :NonAttendance .
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Annotated RDFS "domain" (dom) rule:

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   ?prop dom ?Class .   ?v1
   ?x ?prop ?y .        ?v2
⇒ ?x type ?Class .
```

```
   :warnedFor dom :OneWeekSuspended .      [[emp]]
   :joeBloggs :warnedFor :NonAttendance . [[hr], [jb]]
⇒ :joeBloggs type :OneWeekSuspended .
```

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⇒  ?x type ?Class .    [???]  Annotation of inferred triple?
```

```
   :warnedFor dom :OneWeekSuspended .     [[emp]]
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Inferring Annotation Values

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   :warnedFor dom :OneWeekSuspended .     [[emp]]
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$$access \leftarrow emp.$$

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$$access \leftarrow jb.$$

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   :warnedFor dom :OneWeekSuspended .     [[emp]]
   :joeBloggs :warnedFor :NonAttendance . [[hr],[jb]]
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$$access \leftarrow emp, hr.$$

$$access \leftarrow emp, jb.$$

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   :warnedFor dom :OneWeekSuspended .    [[emp]]
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```

$$access \leftarrow emp, hr.$$
$$access \leftarrow emp, jb.$$

Conjunction $(+)$ further restricts access to the triple.

Merging Triples

Additional rule to merge annotations of the same triple:

```
   :joeBloggs :salary 80000 .        [[hr,-js]]
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⇒  :joeBloggs :salary 80000 .        [???]
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Disjunction ($\cup$) maintains the access restrictions.

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The Access Control Annotation Domain

- the *representation* of the annotations: `[[hr,-js],[jb]]`
- operator for inferring of annotations: $+$
- operator for merging annotations: $\cup$
- *empty* ($\perp$) annotation: $[]$
- *universal* ($\top$) annotation: $[[jb],[js],\ldots]$ (union of all entities)

Permission Management

```
:johnSmith type :Employee                :[[js]] .
:johnSmith :username "js"               :[[js]] .
:johnSmith :worksFor :westportCars      :[[hr]] .
:johnSmith :salary 40000 .              :[[hr]] .
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Every :Employee can access their own information:

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   ?X :username ?U .
   ?X ?P ?O               :?λ1 .
⇒  ?X ?P ?O               :?λ1∪ [[?U]] .
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AnQL AC Query

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SELECT * WHERE { ?person :salary ?salary .    }
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Query results

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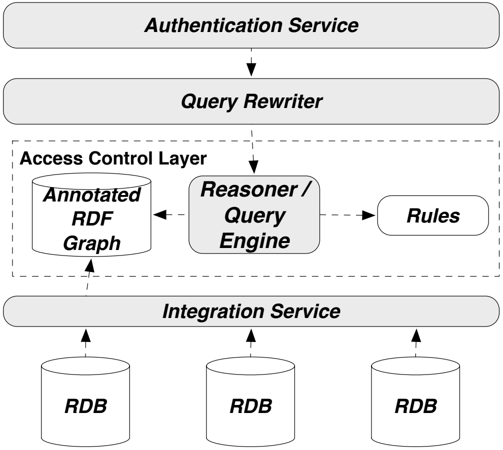
Architecture



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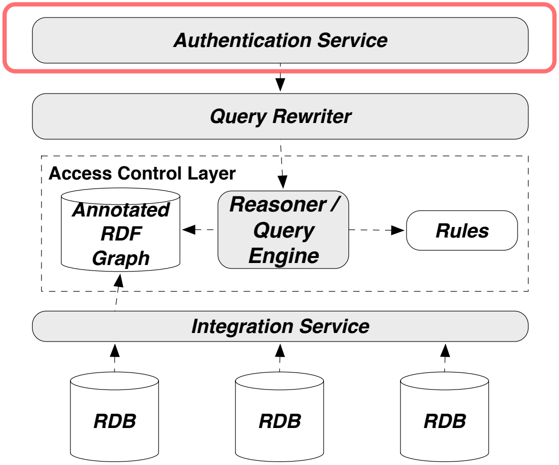

Not covered: Provides the users credentials: [[*js*]]

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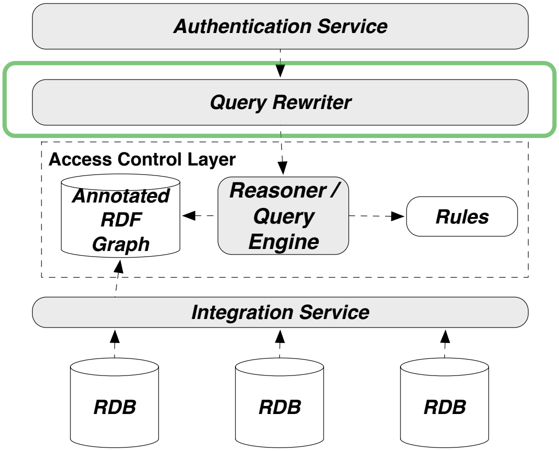

Input: SPARQL queries
Output: AnQL queries

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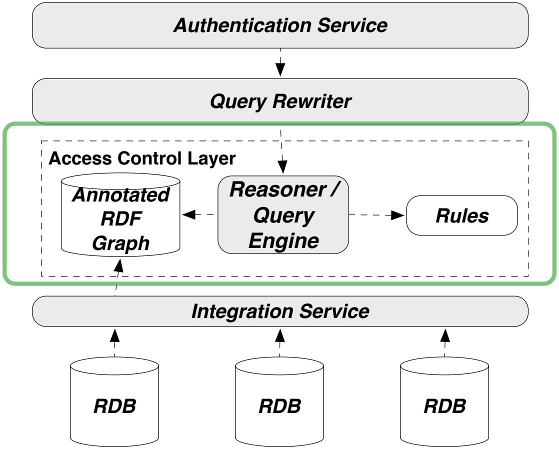

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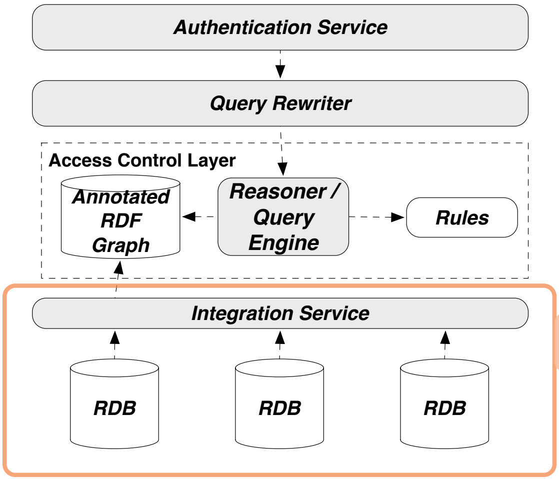

Not covered: Data converted to RDF

Conclusions

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Thank you! Questions?