Karlsruhe Institute of Technology

Future Challenges for Linked APIs

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INSTITUTE OF APPLIED INFORMATICS AND FORMAL DESCRIPTION METHODS (AIFB)

Agenda

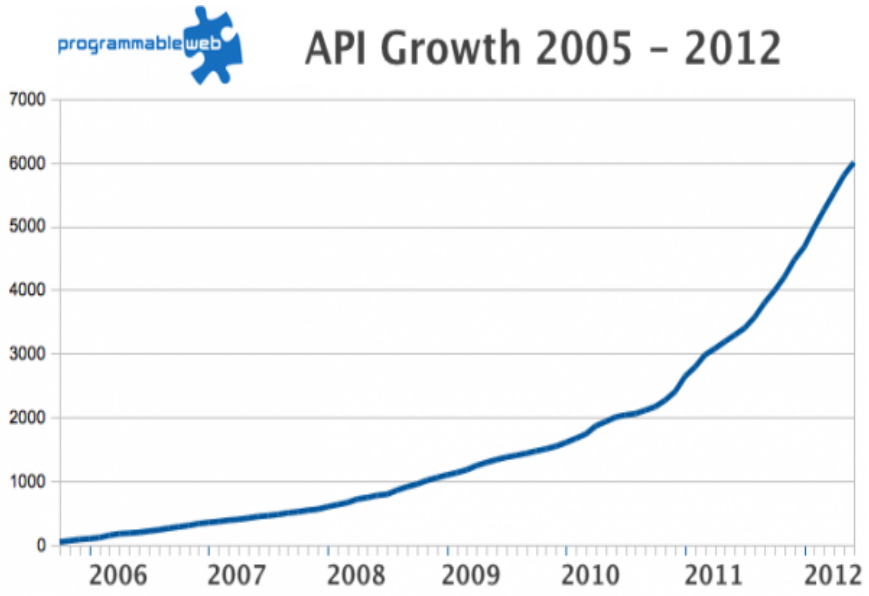
- Motivation
- Linked APIs
  - Descriptions
  - Interaction
  - Wrapping
- Identifying Challenges
  - Survey
- LAPIS Catalogue
- Conclusion

MOTIVATION

Motivation

- Data is often dynamically created as a result of some calculation carried out over input data (e.g., weather information)
- Data can change frequently (e.g., moving objects)
- Service endpoints, forms and APIs are used to trigger functionalities in the Web and the real world and provide access to dynamic and static data sources

- An important role plays **Representational State Transfer (REST)**
  - Focused on the Web architecture



[1]http://programmableweb.com

Resource-driven Programming with REST

- A resource is anything with which a client is able to interact
  - Data object (e.g., a blog post)
  - Real world object (e.g., car, movie, person…) projected onto the Web by making the information associated with it (i.e., its state) accessible
  - HTTP Verbs as methods to interact with resources

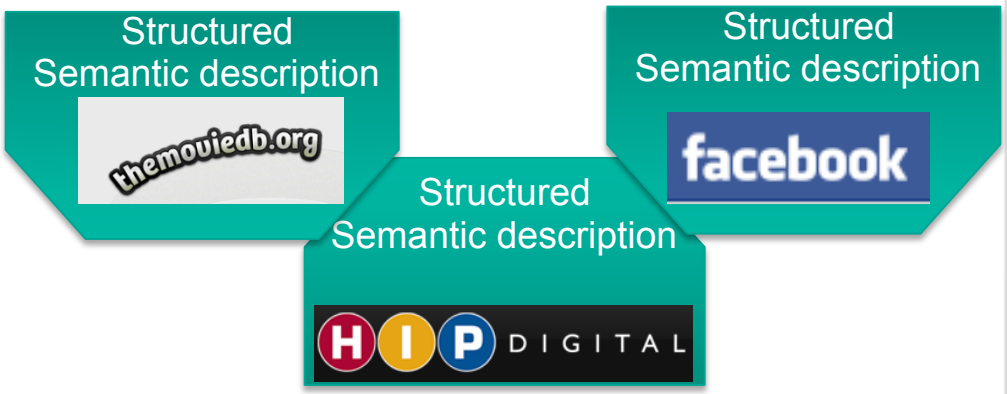
- Representations of the resources include links to other relevant resources
  - E.g. the representation of a person on a social network contains links to it's friends
  - Used by clients for the interaction
  - Clients discover the links during run time (late binding), which enables flexible evolution of services and data sources

Challenges to Address

- REST allows service providers to use arbitrary formalisms to represent resources and links
  - ➡ Developers have to gain a deep understanding of every API by reading textual descriptions
- Applications (clients) are supposed to follow links as found during runtime of the application. However, developers have to define their desired interaction at design time
  - ➡ Developers have to write individually tailored code to consume services in applications

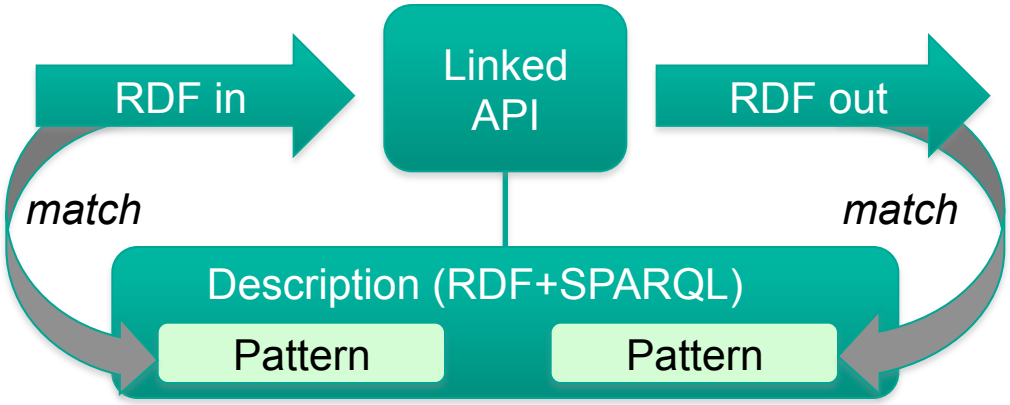
Benefits of Structured Semantic Descriptions

- Increased value comes from combinations of services and APIs
  - Structured service/API descriptions ease the composition process considerably and allow to execute several tasks automatically (e.g., data matching, discovery, repair)



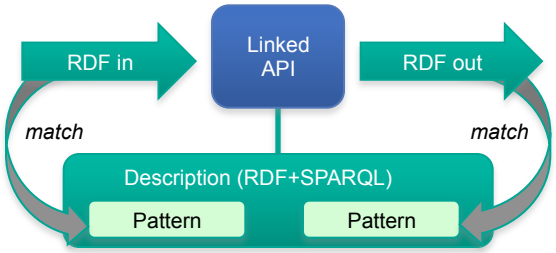
LINKED APIS

Linked API Architecture



- LAPIS bring together REST and Linked Data
- Resource representation in RDF
- LAPIS consume and produce RDF data
- LAPIS are described with graph pattern
  - Representing the structure of input and output data
  - Accessible in the Web

Linked API URI

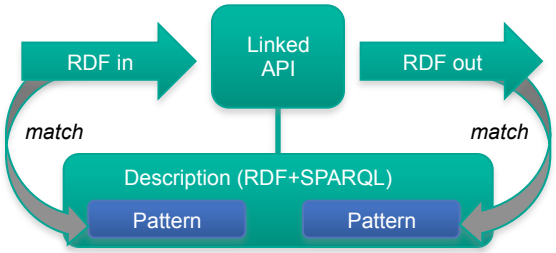


- As an example consider a RESTful movie service:
  - Ordering a movie is possible at an entry URI:

http://service.org/Movie/order

(identifies the set of all movie orders)

Linked API Description



- As an example consider a RESTful movie service:
  - Ordering a movie is possible at an entry URI:

    http://service.org/Movie/order

  - **Input** and **output description** for ordering a movie:

In:

```
?x a dbp:movie.
?x dc:name ?name.
```

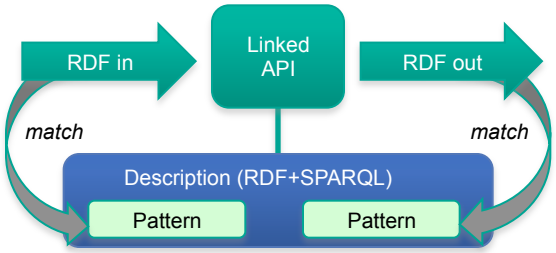
„A movie and its name“

Out:

```
?y a mov:Order.
?y db:content ?x.
?y ex:price ?p.
```

„An order, its content and its price“

Linked API Description



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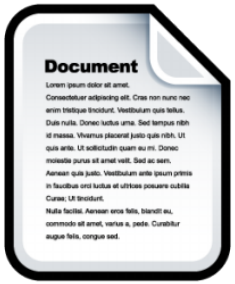
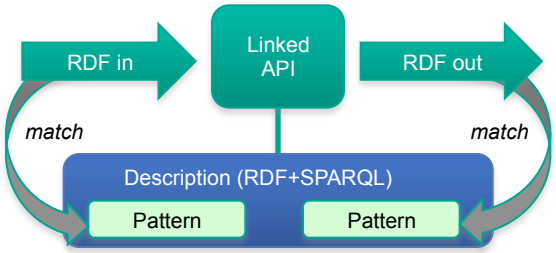
```

Embedded description document



Linked API Description

- As an example consider a RESTful movie service:
  - This service is identified with the URI:

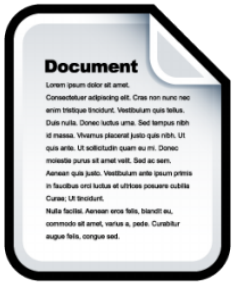


http://service.org/Movie/order

HTTP OPTIONS
Accept: text/N3

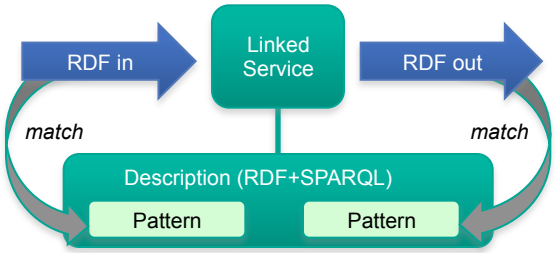
200 (OK)
Allow: OPTIONS, POST

The description can be retrieved via OPTIONS, where also the HTTP verb is given.



Linked API Invocation (POST)

- Service Execution via HTTP POST:
  - POST RDF data that matches the input pattern to the service resource
  - The service response adheres to the output pattern



http://service.org/Movie/order

HTTP POST

```
dbp:Blade_Runner a dbp:movie;
dc:name “Blade Runner”.
```

match

In:

```
?x a dbp:movie.
?x dc:name ?name.
```

Response

201 created
Location: mov:001

```
mov:001 a mov:Order.
mov:001 db:content dbp:Blade_Runner.
mov:001 ex:price “10€”.
```

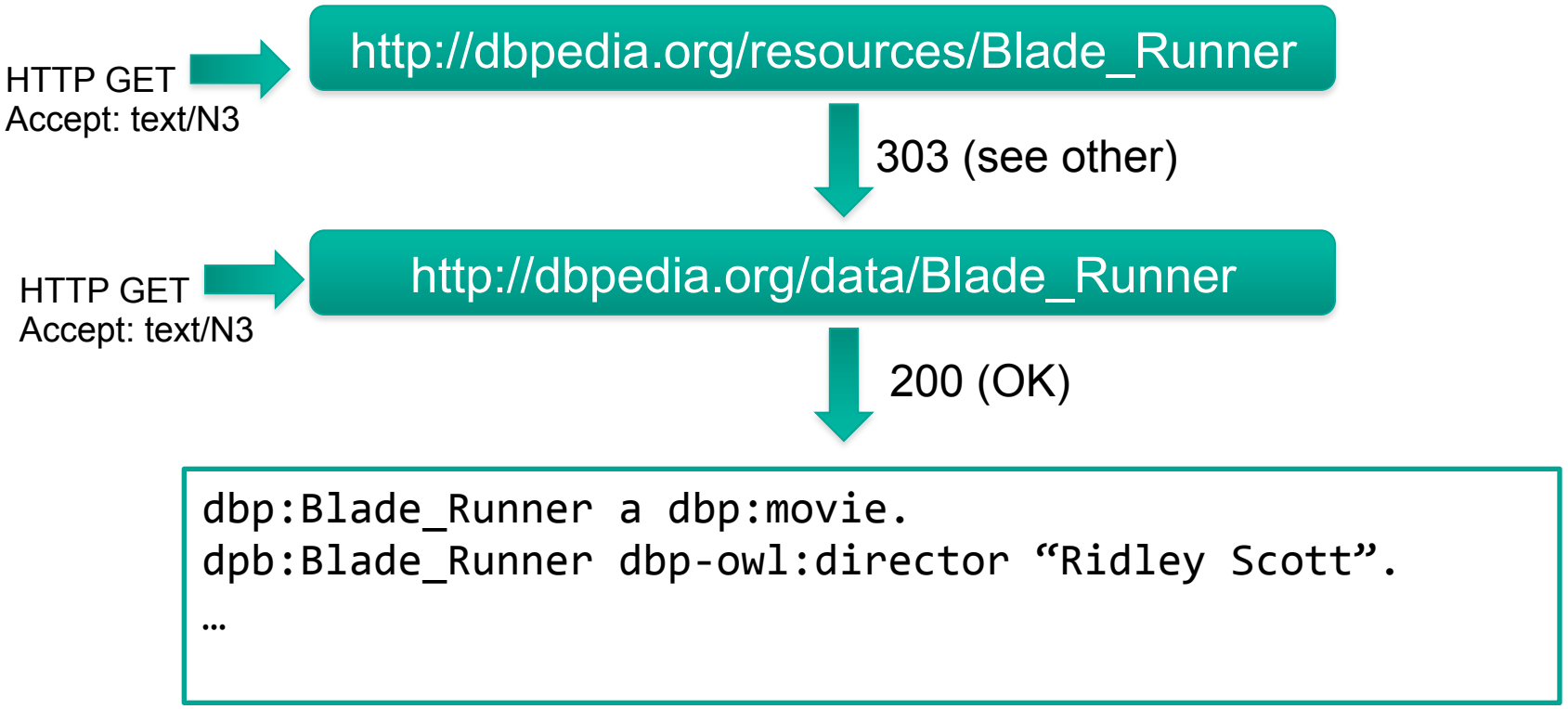
match

Out:

```
?y a mov:Order.
?y db:content ?x.
?y ex:price ?p.
```

Linked API Invocation (GET)

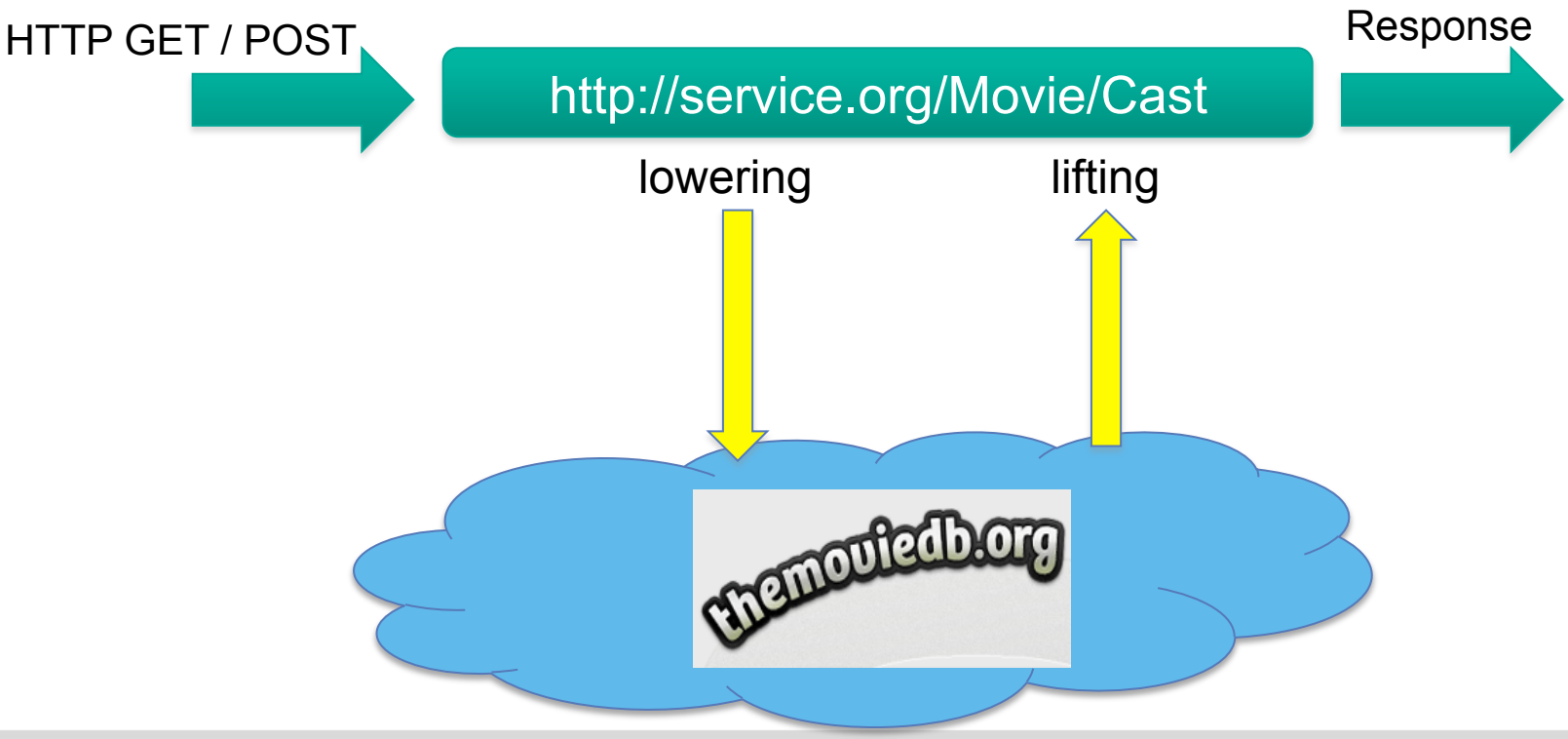
- Linked Data implements GET on resources by design:



Leveraging Existing Services

- Existing Web APIs can be wrapped to consume and produce Linked data

  ➡ valid Linked API



Benefits at a Glance

- Easy data integration due to Linked Data
- Capability to evolve dynamically due to REST
- High degree of automation possible with semantic descriptions

IDENTIFYING CHALLENGES

Survey Overview

- 20 undergraduate students
  - some programming experience
  - new to programming with Web APIs (REST)
- Task:
  - Develop at least one Linked API
  - Develop an application that makes use of at least two Linked APIs
  - Time: 4 months
  - Students are allowed to leverage existing not Linked Data-based APIs to create wrapper
  - Report about their experience
- Not a representative survey, but empirical indicators

Identified Problems

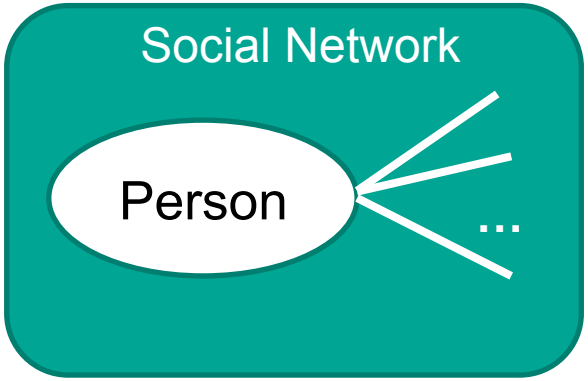
- Clustered and summarised reports:

Problem	# Students (n=20)
Response time of composed API	14
API limitations	14
Missing directories	12
No standard formalism for API descriptions	8
Complexity of RDF	3

- Similar problems supports the claim of recurring issues

Response Time and General Limitations

- Reasons for *slow response time (14 students):*
  - Response time of underlying wrapped API
  - Necessary time for the interaction between APIs and multiple API calls
  - E.g., GET all information about the friends of a person on a social network



- *API limitations (14 students)* refers to insufficient functionality and constraints of the underlying APIs
  - E.g., a maximum number of API calls per day
  - Usually external circumstances (e.g., business aspects)
  - *10 of the 14 students tried to replace the initially considered API*

Missing Directories and Description Formalism

- *Missing directories (12 Students)*
  - Identification of suitable APIs for use in an application
  - Replacement of not functional APIs
  - API development (to create links to other relevant resources)

- *No standard formalism for API descriptions (8 Students)*
  - How to serialise the graph pattern (embedded in RDF vs. direct N3)
  - A vocabulary for the description
  - Minimal set of properties to describe (e.g., input and output data)
  - A way of attaching description to an API resource (HTTP OPTIONS vs. HTTP Header vs. link in resource representation).

Next Challenges and Rewards

- A common standard minimal description mechanism for Linked APIs based on graph patterns
- Methods for an automated identification and comparison of APIs that leverage the descriptions
- The development of methods and systems to enable a scalable interaction and composition of Linked APIs

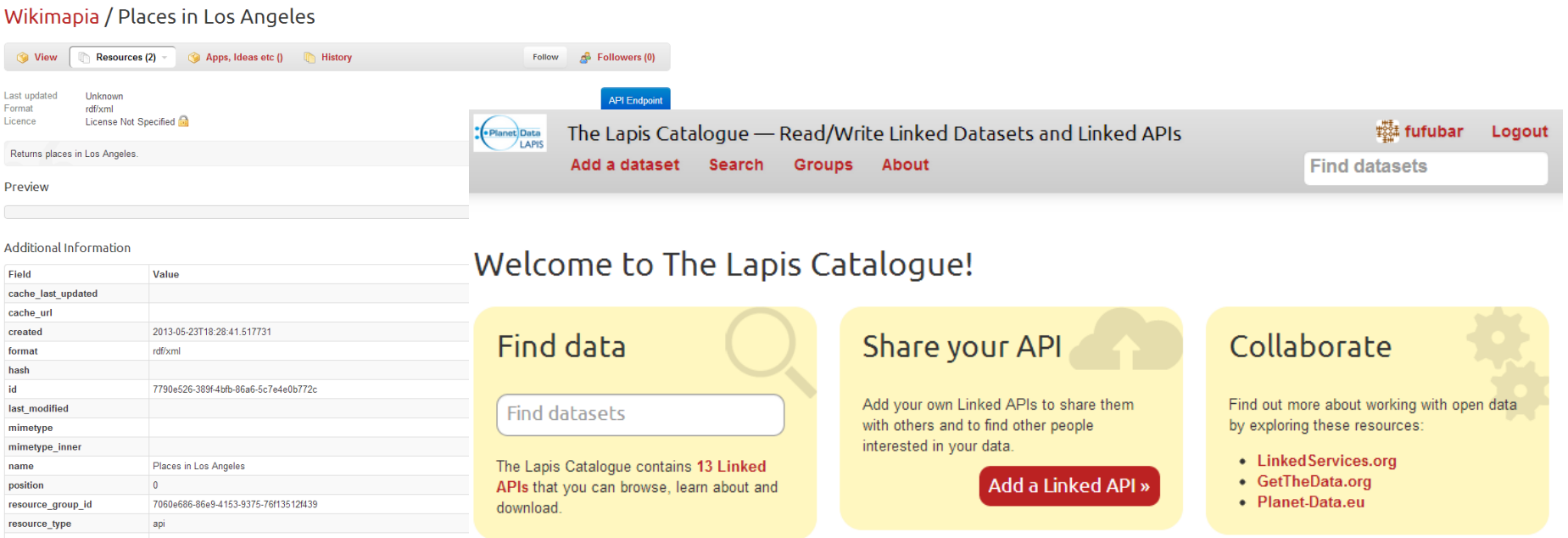
- Benefits of using Linked APIs:

Benefit	# Students (n=20)
Easy data integration	17
High modularity of composed APIs	14
Simplicity of interaction with API	9

LAPIS CATALOGUE

LAPIS Catalogue[1] Overview

- Open directory, where providers can register Linked APIs
  - Based on CKAN
  - Information like name, URI, author, license, maintainer, existing links and example calls



[1]http://lapis.planet-data.eu/
[2]http://ckan.org/

LAPIS Catalogue Purpose

- The LAPIS catalogue serves as hub for Linked APIs to support researchers, developers and providers in their tasks:
  - Evaluation of approaches related with Linked APIs
  - Survey the current developments and the adoption of approaches
  - Search Linked APIs for application development
  - Promote APIs for public use
  - Complementing the offered functionality of APIs (interlinking)

- Function between Datahub[1] and ProgrammableWeb[2]

[1]http://datahub.io/
[2]http://www.programmableweb.com/

CONCLUSION

Summary

- Challenges to address:
  - A common standard minimal description mechanism
  - Methods for an automated identification and comparison
  - Methods and systems to enable a scalable interaction and composition of Linked APIs

- Benefits to gain:
  - Easy Data Integration
  - High modularity
  - Simplicity of use

Thank You

Summary

- Challenges to address:

Problem	# Students (n=20)
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- Benefits to gain

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