Understanding the Hidden Web

Pierre Senellart

17 June 2005

The Hidden Web

Definition (Hidden Web)

The set of webpages (which may or may not be dynamically generated) not accessible from the hyperlinked structure of the World Wide Web.

Size estimate (2001) : 500 times larger than the surface Web.

How to understand it and benefit from its content?

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Purpose

- Intensional indexing of the Hidden Web
- High-level queries
- $\Rightarrow$ a semantic search engine over the Hidden Web

In a fully, unsupervized, way!

Difficult and broad problem. Possible restriction to some domain (e.g. publications).

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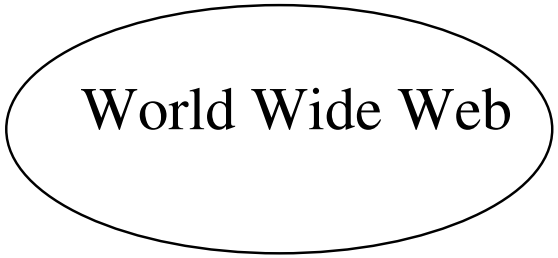

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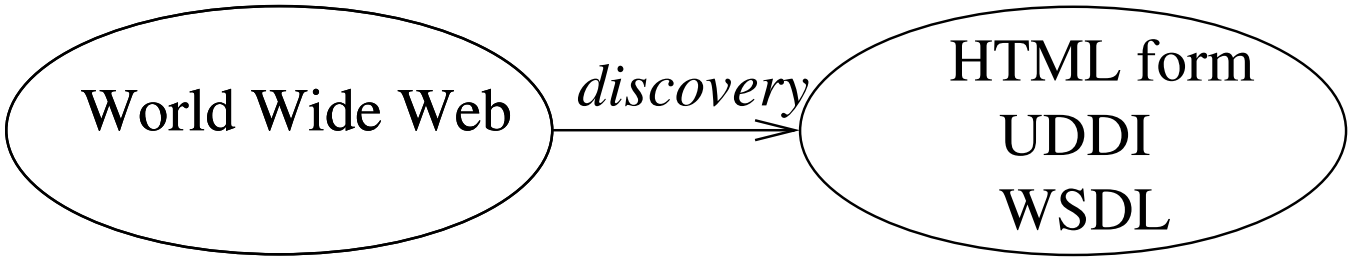

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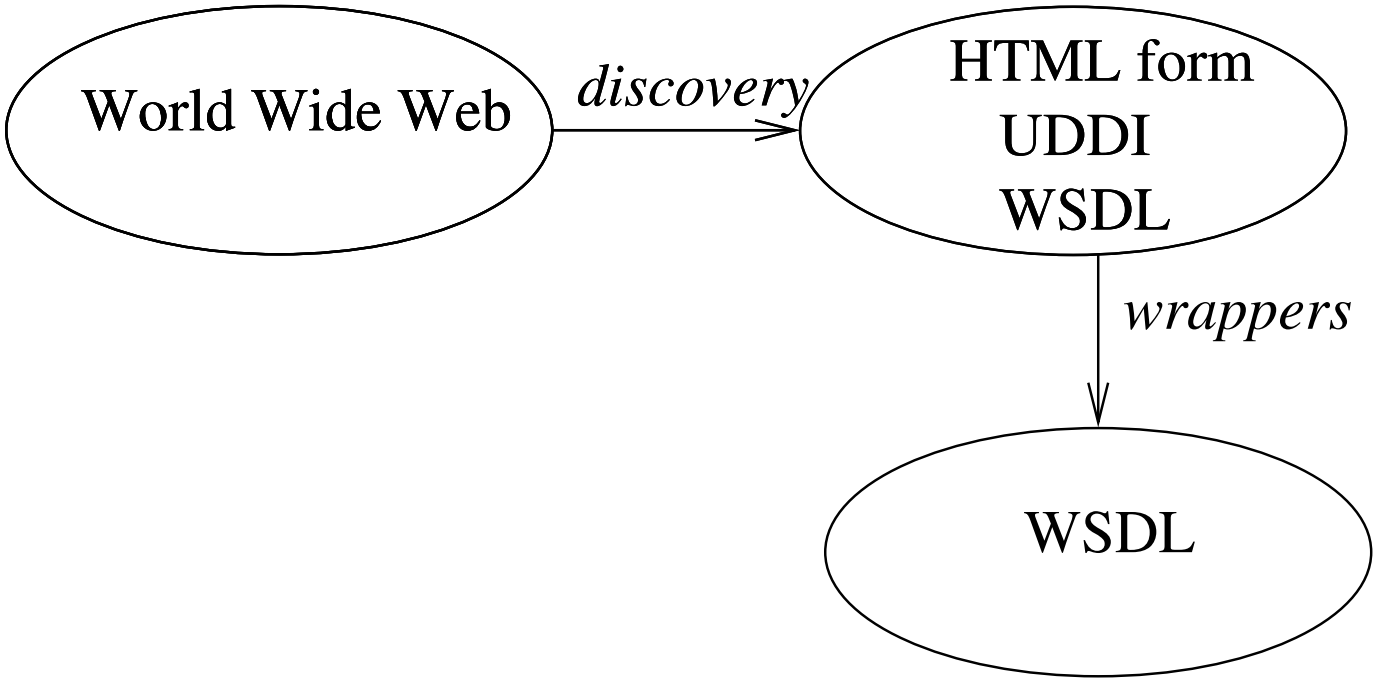

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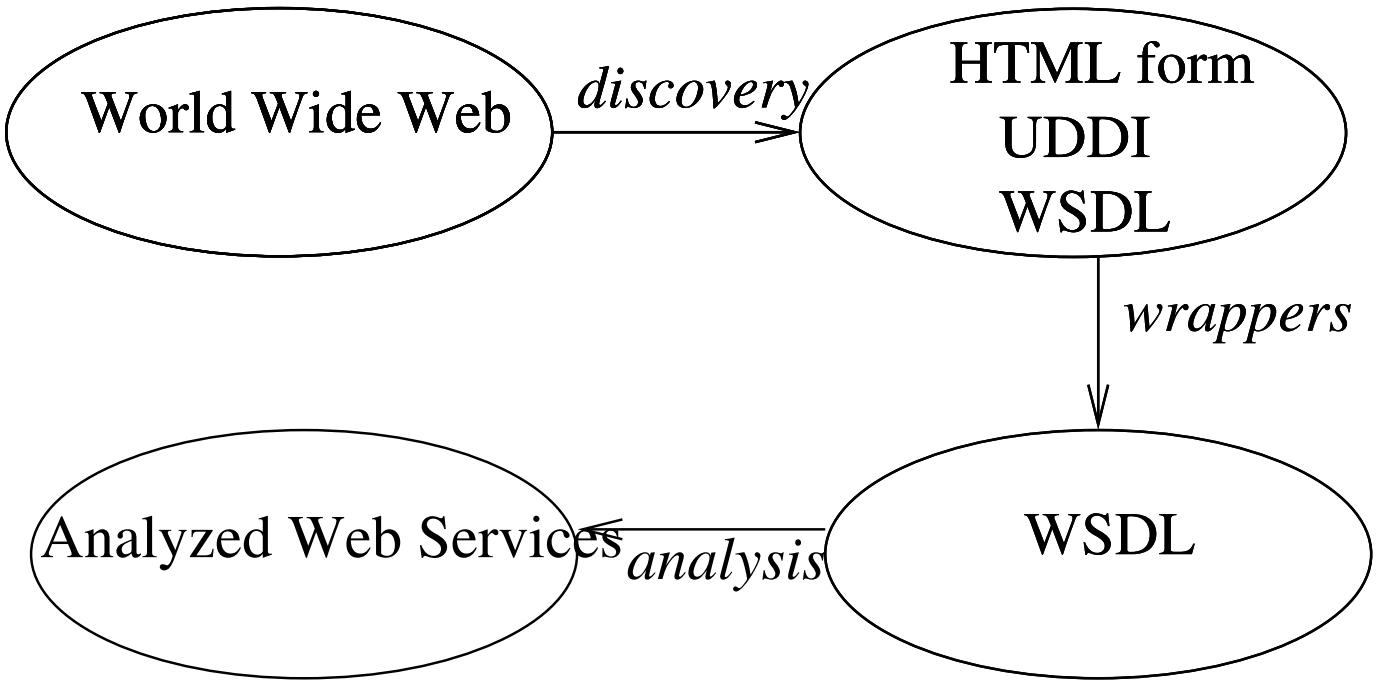

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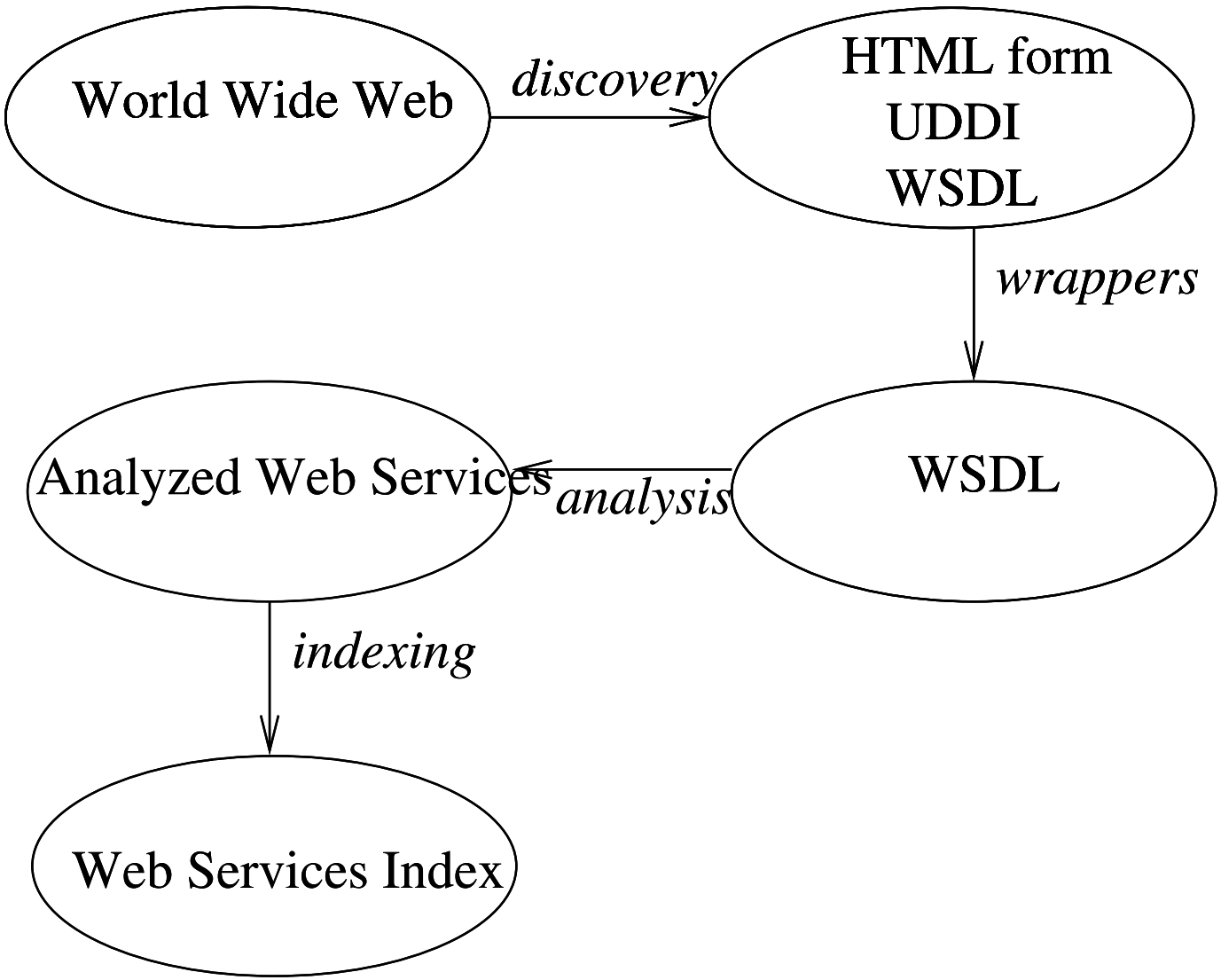

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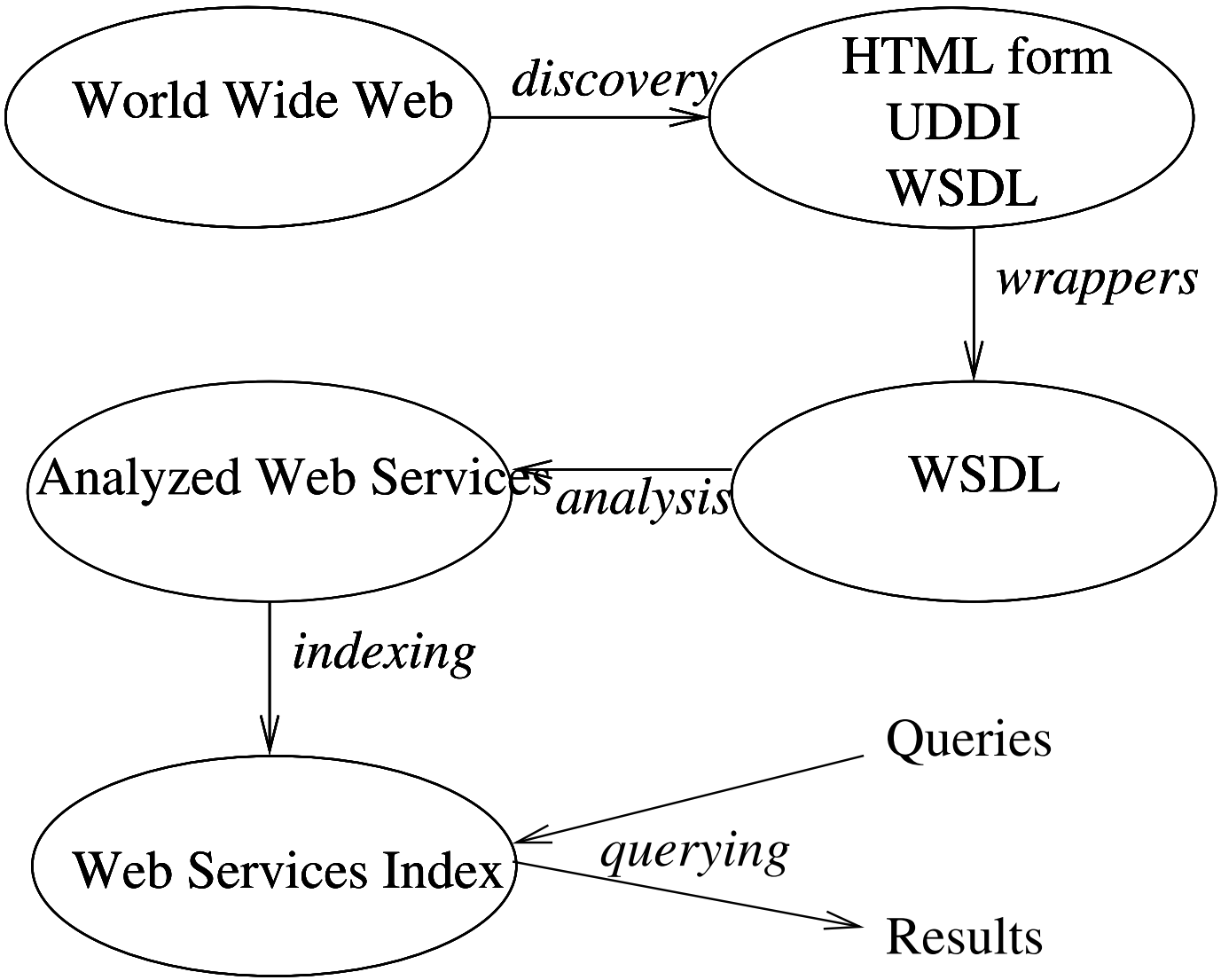

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Web Service Discovery

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Crawling the World Wide Web for:

- HTML forms implementing a Web Service
- UDDI registries
- WSDL descriptions
- Other resources (XML, HTML, Web as a full-text index…)

Only interested in Web Services with no side effects:

Ok	Not Ok
Yellow Pages	Booking services
Publication databases	Mailing list management
…	…

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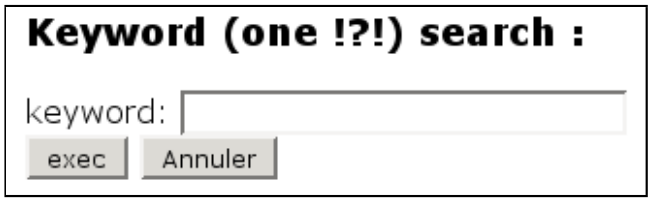

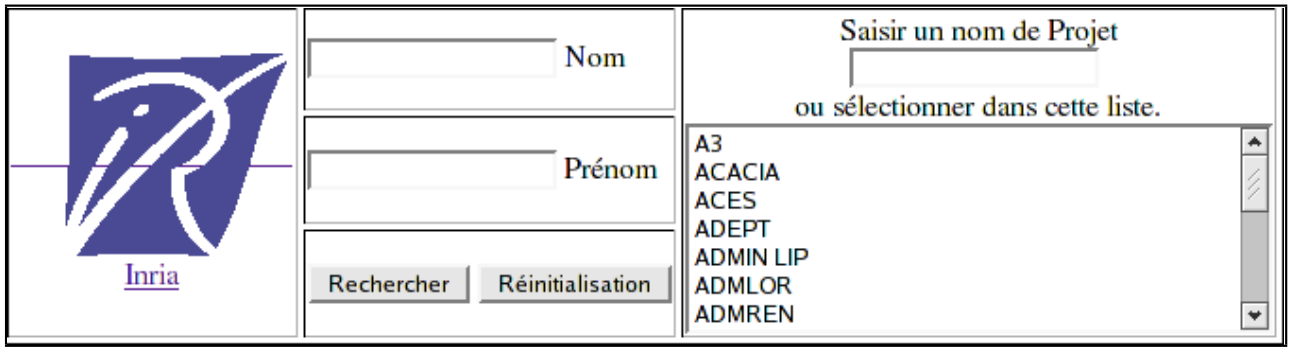

Issues

- What are the relevant form fields?
- What is the concrete type of each field?
- What is the label of each field?

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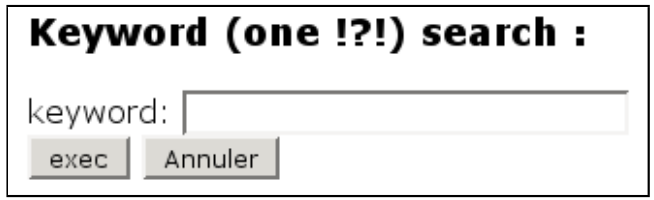

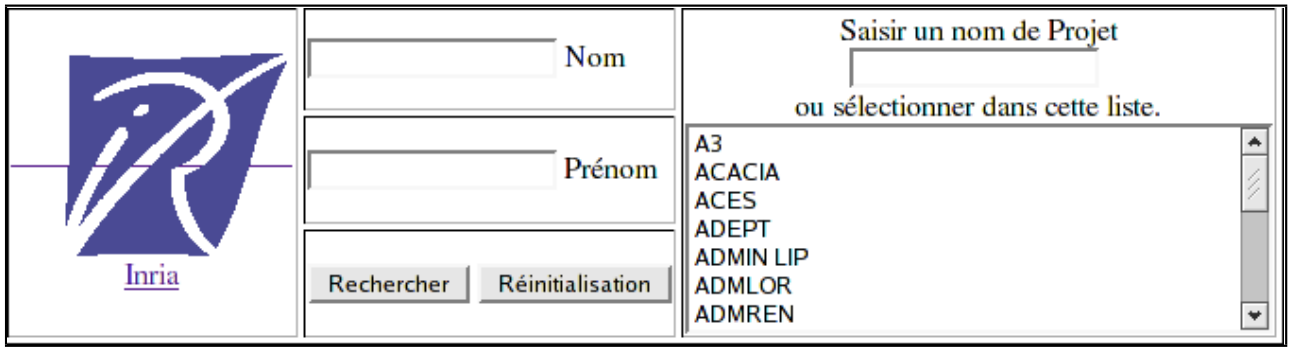

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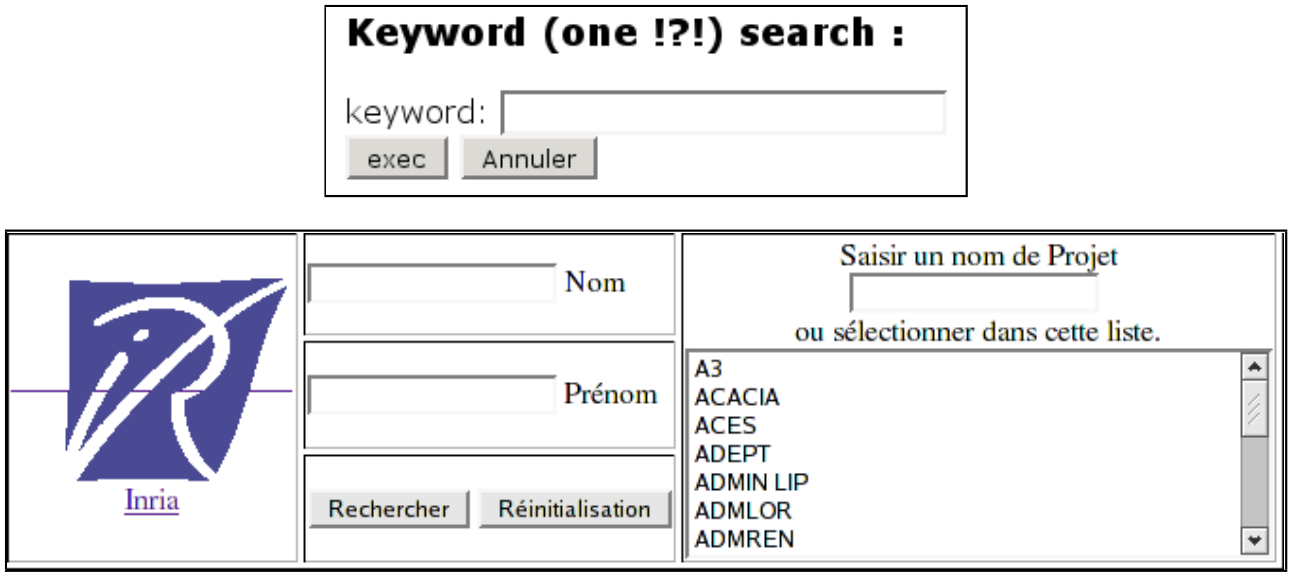

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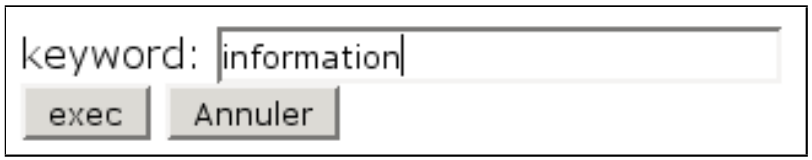
- With dictionary words



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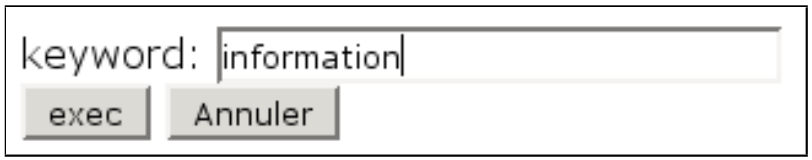

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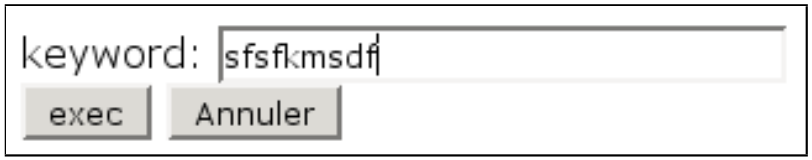

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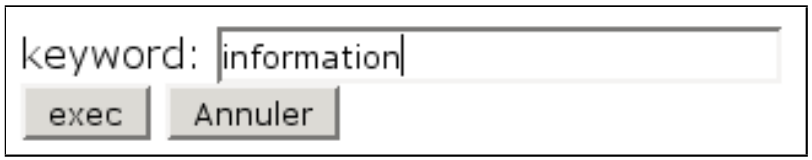

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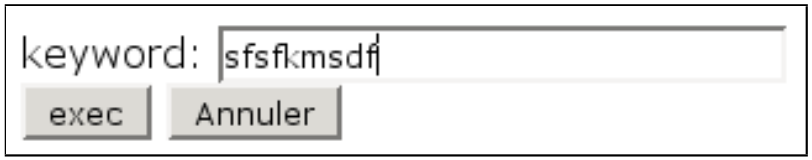

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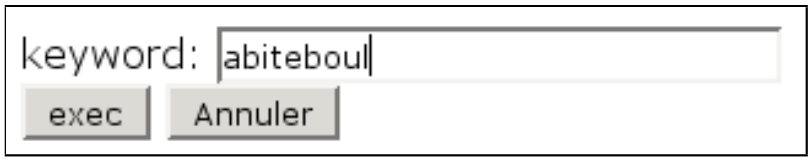

Query-answer webpages

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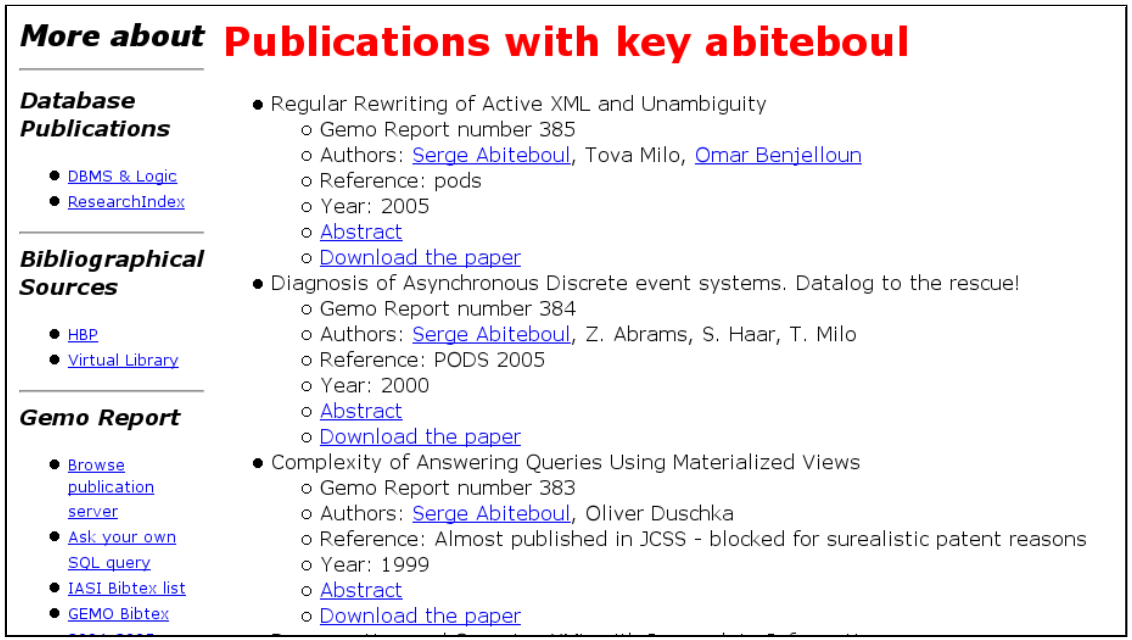
Extract data from query-answer webpages.



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- DBMS & Logic
- ResearchIndex

Bibliographical Sources

- HBP
- Virtual Library

Gemo Report

- Browse publication server
- Ask your own SQL query
- IASI Bibtex list
- GEMO Bibtex

Publications with key abiteboul

- Regular Rewriting of Active XML and Unambiguity
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- What part of the webpage contains the answer?
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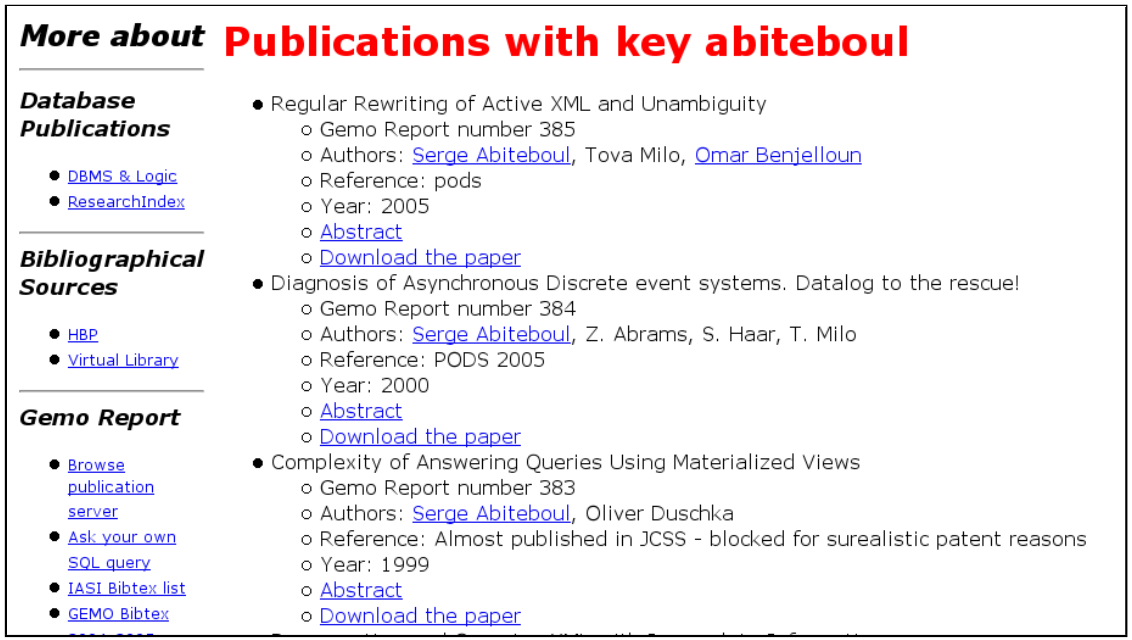

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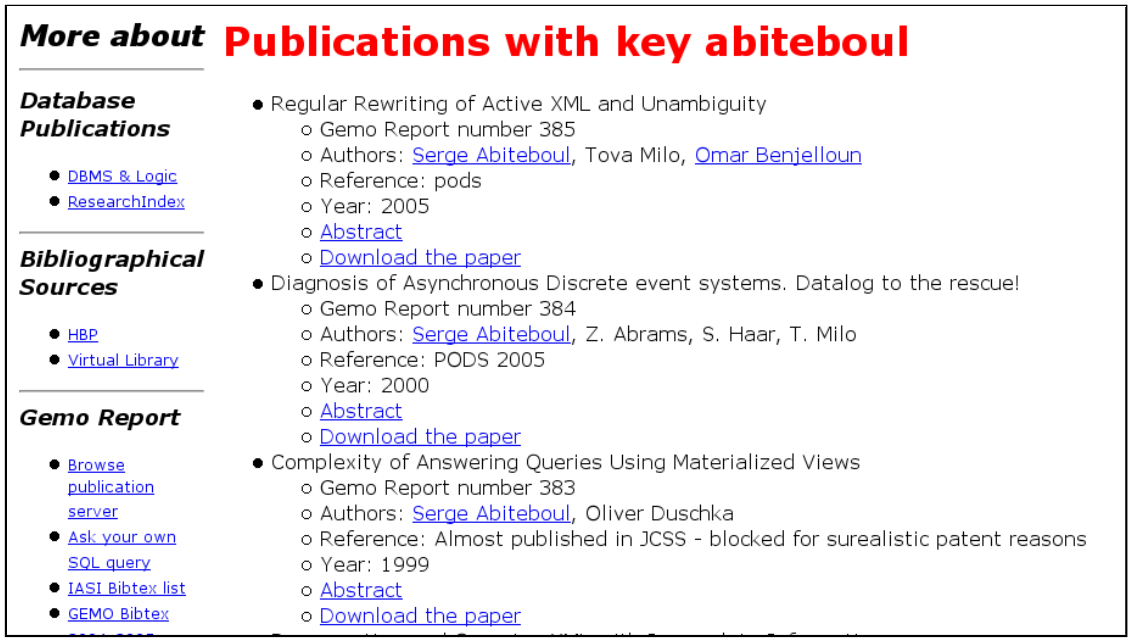

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Example: ROADRUNNER information extraction engine

Publication of Gemo with key	Publications with key	
Publication of Gemo with key abiteboul	Publications with key abiteboul	

_C_	Gemo Report number	
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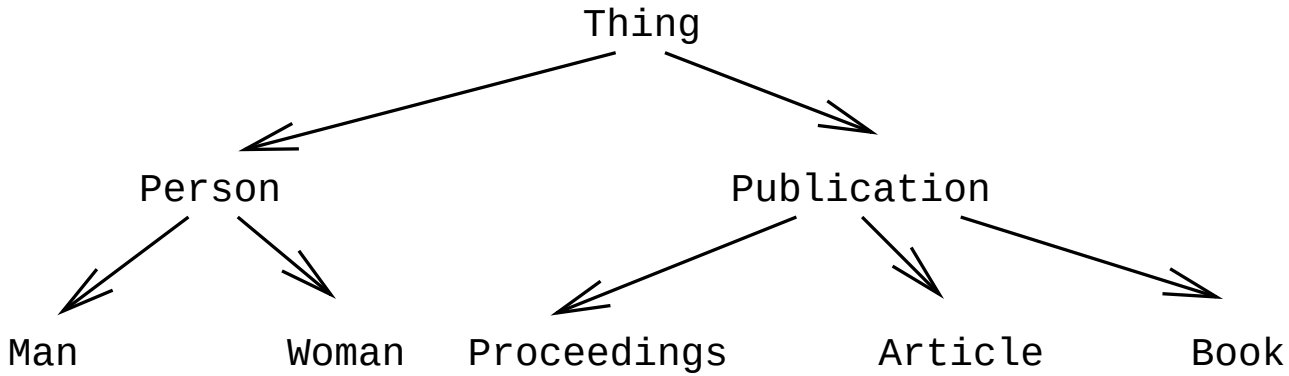
Conceptual Model

- IsA ontology of concepts (simple DAG)



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  - `AuthorOf(Person,Publication)`
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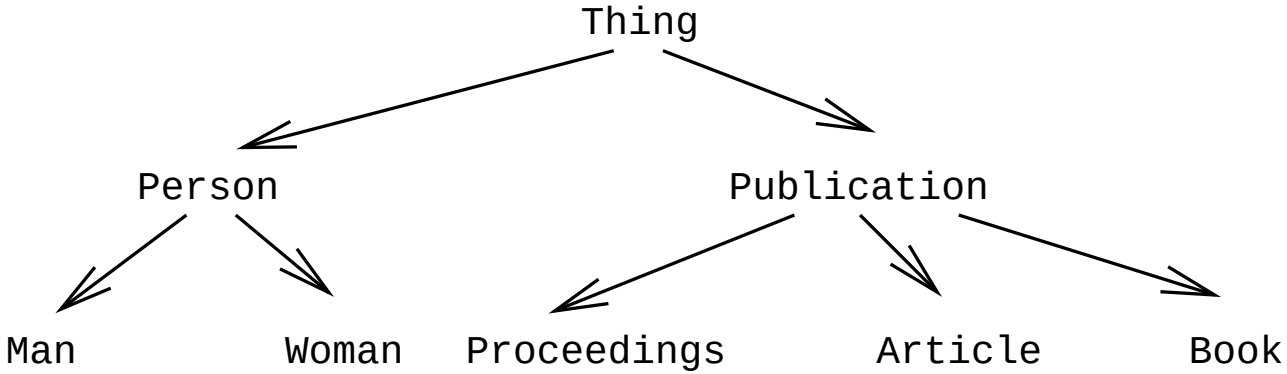

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Semantic representation of a service

What is a service described by?

- A *n*-uple of typed input parameters
- A complex (= nested) type of its output
- Semantic relations between inputs and outputs

Definition (Complex types)

S: set of concepts

$$T \longleftarrow S | < T, \ldots, T > | T*$$

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Services and queries

Example

Service giving authors from publication titles

$$A^* \leftarrow \texttt{WrittenBy}(P,A), \texttt{HasTitle}(P,T), \text{Input}(T)$$

Example

Query:

$$\langle A, T^* \rangle^* \leftarrow \texttt{WrittenBy}(P,A), \texttt{Article}(P), \texttt{HasTitle}(P,T), \texttt{KeywordOf}(\text{“xml”}, P)$$

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Managing extensional information

How to represent extensional information (i.e. documents) in this formalism?

Definition

A document is a service with no input.

Complex types: natural representation of a DTD.

(Disjunctions `a|b` simulated by `(a?,b?)`).

Semantic Interpretation of a Service

How to analyze a Web Service?

- Field labels, variable names, tag names
- Concrete type descriptions (e.g. `\d{4}-\d{2}-\d{2}` is a date)
- Linguistic analysis of plain text descriptions and pages linking to the service

Note: Extracting concepts is easier than extracting relations between concepts.

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Given a query, represented as an Analyzed Web Service, how to know which known web services to query?

Issues

- Subsumption of input/output parameters
- Missing input parameters
- Composition of webservices

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Differences with classical database querying

Three main differences:

- Information can be queried only through *views* (Local As View)
- Nested types
- Incomplete information

Three sources of complexity!

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Web Service Semantic Interpretation Process

Understanding the Hidden Web

Pierre Senellart

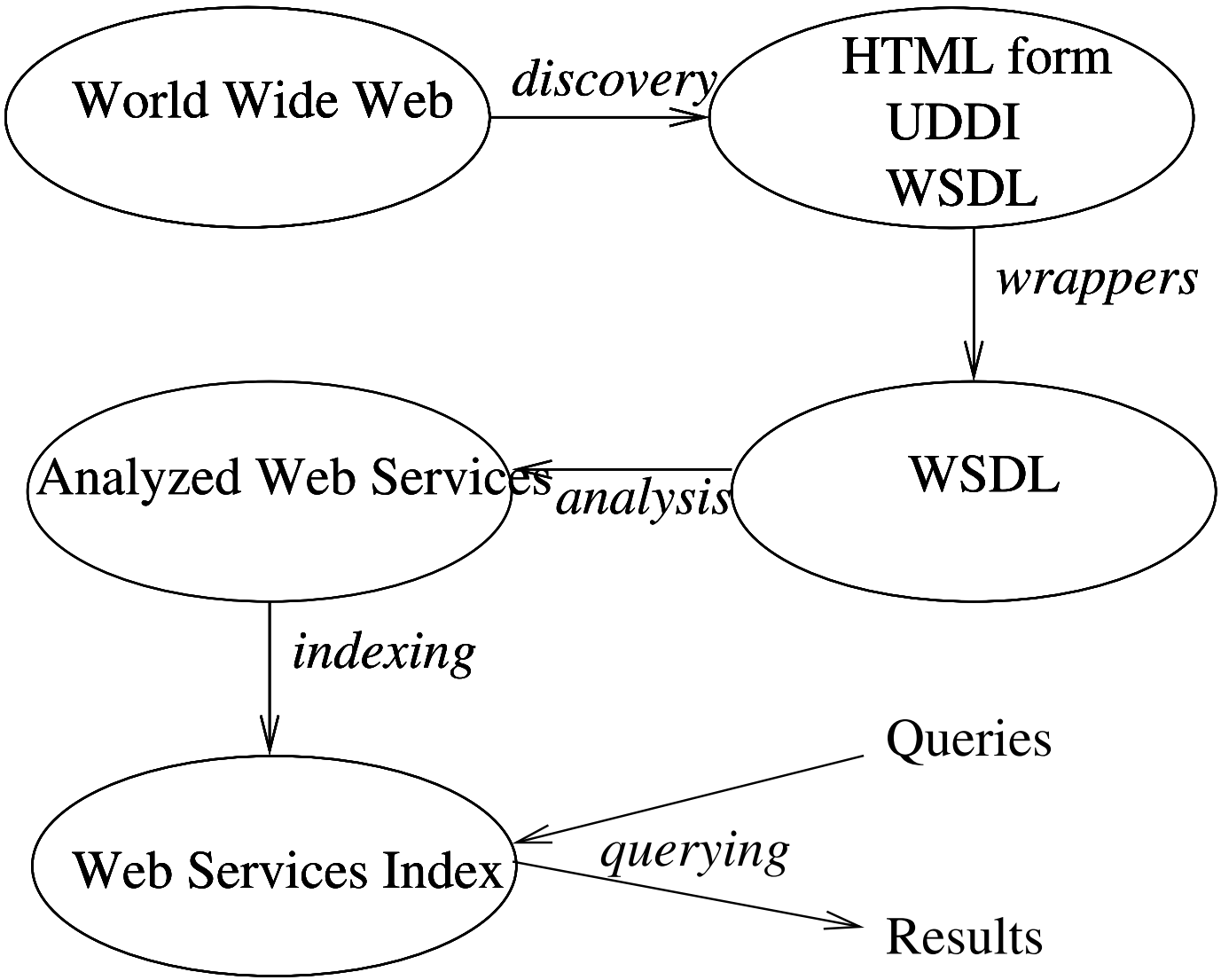
Introduction

Process description

Discovery

Wrappers

Semantic Analysis

Indexing and Querying

Summary