

SKOS vocabularies for ad-hoc recommendations: flexible scientific publication retrieval on the Semantic Web

Lisa Wenige

Chair of Business Information Systems, Friedrich-Schiller-University of Jena

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Agenda

SKOS

vocabularies
for ad-hoc
recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

- Introduction: Publication Retrieval
- Linked Open Data (LOD) & SKOS vocabularies
- The SKOS Recommender
- Future Work & Summary

Publication Retrieval: OPAC search

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vocabularies
for ad-hoc
recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Gesamter Bestand Musikarchiv Exilsammlungen Buchmuseum

Titel ? und

Person ? und

Inhaltsverzeichnis ? und

Schlagwörter ? und

Jahr zum Beispiel: 1948-1980 oder 1976- oder 1955 ?

Neu verzeichnet in der Deutschen Nationalbibliografie in den Reihen:

A B C G H M T O N → Alle → Keine ?

von bis (optional):

→

Publication Retrieval: search engine technology

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for ad-hoc
recommendations

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Introduction

LOD

The SKOS

Recommender

Future Work
& Summary

The screenshot displays the vufind search engine interface. At the top left is the logo 'vufind' with the tagline 'Search. Discover. Share.'. On the top right, there are links for 'Login' and '0 in der Auswahl', and a language dropdown menu set to 'Deutsch'. The search bar contains the text 'Business Management', with a search button and a link to 'Erweitern'. Below the search bar, the results are categorized by 'Ähnliche Schlagwörter... innerhalb Ihrer Suche.' with links to 'Management (2176)', 'Industrial management (605)', 'International business enterprises (536)', 'Business (467)', 'Information technology (394)', and 'Business enterprises (359)'. A summary line indicates 'Treffer 1 - 20 von 6361 für Suche: "Business Management", Suchdauer: 2.06s' and a 'Sortieren' dropdown set to 'Relevanz'. A filter section on the right titled 'Suche einschränken' includes 'Institution' (Villanova University 6361), 'Bibliothek' (Falvey Library 6361), and 'Format' (Buch 6180, Online 2438, Conference Proceeding 192, Zeitschrift 88, Video 62). The main results list shows one item: 'IT in business : a manager's casebook / Veröffentlicht 1999. Inhaltsangabe: "...Competition and Business Impact -..." Signatur: U917.6106 Standort: Mehrere Standorte'. A 'Zu den Favoriten' link is visible next to the item.

Publication Retrieval: recommender systems (RS)

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recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Katalog der UB Würzburg (1/164)

| << >> |

E-Business-Management

Gestaltung von Geschäftsmodellen in der vernetzten Wirtschaft

Autor: [Maaß, Christian](#)

Ort, Verlag, Jahr: Stuttgart, Lucius & Lucius, 2008


Umfang: XXIV, 297 S.

Schlagwort: [Electronic Commerce](#) , [Management](#)

ISBN: 978-3-8252-2991-7 , 3-8252-2991-2 , 978-3-8282-0418-8

[Inhaltsverzeichnis](#) | [Beschreibung](#) | [Permalink](#)

[in die Merkliste](#) | [übergeordnete Titel](#)

 **bibtip** Andere Nutzerinnen und Nutzer interessierten sich auch für:

-  [Bächle, Michael: E-Business \(2010\)](#)
 -  [Chaffey, Dave: E-business and e-commerce management \(2009\)](#)
 -  [Meier, Andreas: eBusiness & eCommerce \(2008\)](#)
 -  [Schmeken, Gregor Mark: Erfolgreiche Strategien für E-Commerce \(2007\)](#)
 -  [Rubió, Jordi: Das Privatleben der deutschen Frühdrucker in Spanien \(1966\)](#)
- [mehr ...](#)

The role of recommender systems

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for ad-hoc
recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

- User perspective
 - Dealing with the information overload
 - Discovery of yet unseen items
 - Personalization of search
- Information provider perspective
 - Enhancement of traditional reader advisory services
 - Loyalty through usability
 - Increase of click through rates
 - Automatic adaption to media usage patterns

Types of recommender systems: CF

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recommendations

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Introduction

LOD

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Future Work
& Summary

Users were also interested in ...



Andere Nutzerinnen und Nutzer interessierten sich auch für:



[Bächle, Michael: E-Business \(2010\)](#)



[Chaffey, Dave: E-business and e-commerce management \(2009\)](#)



[Meier, Andreas: eBusiness & eCommerce \(2008\)](#)



[Schmeken, Gregor Mark: Erfolgreiche Strategien für E-Commerce \(2007\)](#)



[Rubió, Jordi: -Das Privatleben der deutschen Frühdrucker in Spanien \(1966\)](#)

[mehr ...](#)

Collaborative filtering (CF) systems:

- Users are referred to publications of like-minded peers
- Based on: access statistics, loan history

Types of recommender systems: CB

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Introduction

LOD

The SKOS
Recommender

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& Summary

Related articles ...

Works Councils, Training Activities and Innovation: A Study of German Firms

Building on the notion of general and specific human capital proposed by Becker (1962), the paper highlights the importance of employee training practices undertaken in firms as an important tool for human resource and knowledge management and focuses on the role of works councils as a specific form... Ausführliche Beschreibung

Erscheinungsjahr:	2014-03-10
VerfasserInnen:	Cantner, Uwe; Gerstberger, Wolfgang; Roy, Ipsita
Institutionen:	Wirtschaftswissenschaftliche Fakultät, Friedrich-Schiller-Universität Jena
Beschreibung:	application/pdf
Schriftenreihe:	Jena Economic Research Papers
Schlagwörter:	employee training practices knowledge management generalized training firm-specific technical training works councils innovation radical innovation
Klassifikation:	jel-J5, jel-M53, jel-O3
Publikationsform:	Buch / Working Paper
Anmerkungen:	Number 2014-006
Nachweis aus Datenbank:	RePEc - Research Papers in Economics
Verfügbarkeit:	zum Volltext Weitere Zugänge

Zitieren E-Mail Exportieren In Merkliste speichern teilen tweet & +1



Ähnliches Themenspektrum

- Works councils, training activities and innovation: A study of German firms von: Cantner, Uwe Veröffentlicht: (2014)
- Works councils, training activities and innovation : a study of German firms von: Cantner, Uwe Veröffentlicht: (2014)
- Co-determination and innovation von: Kraft, Kornelius Veröffentlicht: (2009)
- Mehr

Ähnliches Autorenpektrum

- Works councils, training activities and innovation: A study of German firms von: Cantner, Uwe Veröffentlicht: (2014)
- Works councils, training activities and innovation : a study of German firms von: Cantner, Uwe Veröffentlicht: (2014)
- Approaching the Agora - Determinants of Scientists' Insertions to Purse Academic Entrepreneurship von: Goethner, Maximilian Veröffentlicht: (2009-10-02)
- Mehr

Content-based (CB) systems:

- Users are referred to similar publications
- Based on: publication metadata

Problems of recommender systems

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Context: publication retrieval

- Data sparsity
- Data quality
- Data silos
- Preprocessing
- Filtering limitations

Linked Open Data

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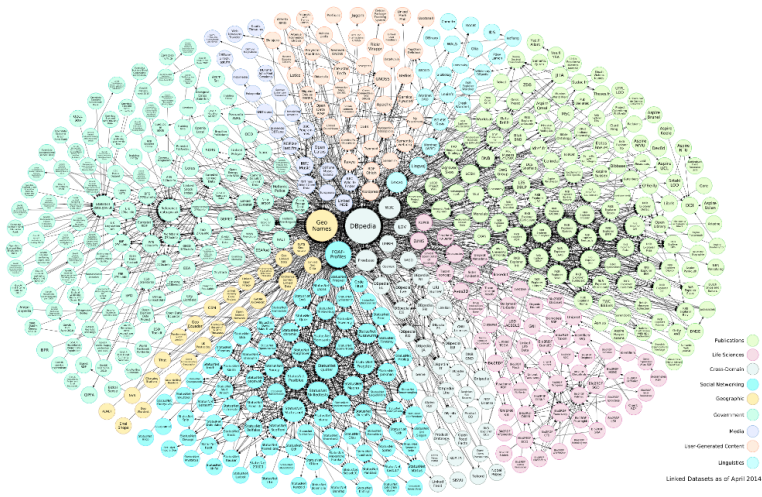
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LOD

The SKOS
Recommender

Future Work
& Summary



The potential of LOD for publication retrieval

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recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Openness



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recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Comprehensiveness

- Billions of data triples
- Abundance of bibliographic information
 - 10 % of LOD resources are "Publications" metadata
 - Additional bibliographic resources from "Life Sciences" or "Geography"

Adaptability & Exploratory Search

- Expressiveness of Semantic Web data models (RDF, OWL)
- Increased potential for personalization tasks

The potential of LOD for publication retrieval

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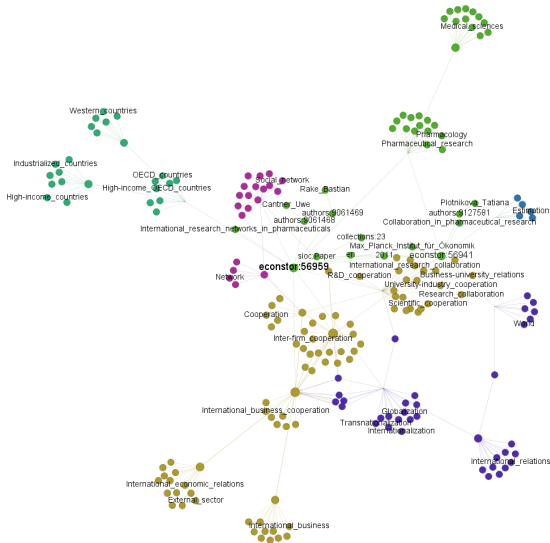
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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary



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for ad-hoc
recommendations

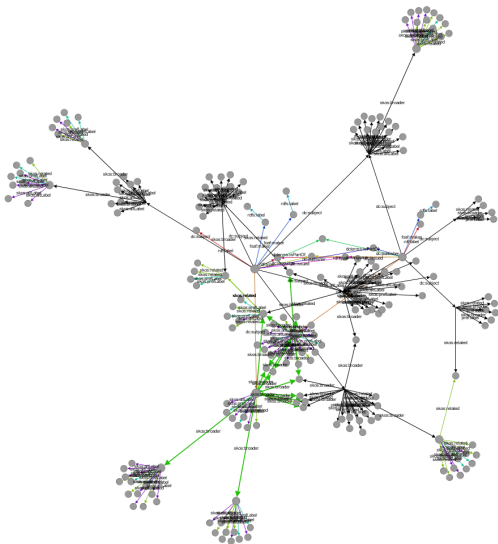
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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary



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Introduction

LOD

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Recommender

Future Work
& Summary

Opportunities for (digital) libraries

- Enhancement of local databases
- Independence from loan statistics (privacy issues)
- Increase of user engagement
- Seamless integration of external sources

Using SKOS vocabularies

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Future Work
& Summary

Challenges of LOD

- Data Quantity
- Data Heterogeneity
- Data Federation

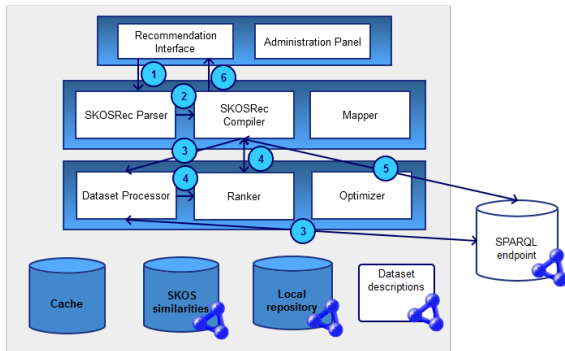
Simple Knowledge Organisation Systems (SKOS)

Data Quantity SKOS concepts are URIs (No NLP)

Data Heterogeneity SKOS annotations are widely adopted

Data Federation SKOS enables mappings to other thesauri

Architecture and Workflow



- 1 Parse SKOSRec query with preferred items and constraints
- 2 Deconstruct query into its constituent parts
- 3 Retrieve IC values and the mapping of relevant resources
- 4 Score and rank the resources
- 5 If required, retrieve additional information from the most similar resources
- 6 Output the result set to the recommendation interface

SKOSRec Grammar

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& Summary

```
RecQuery      ::= PROLOGUE Federation SelectPart?
                SimProjection Aggregation? ItemPart*

Federation    ::= 'From' IRIREF 'To' IRIREF*

SelectPart    ::= SELECTQUERY

SimProjection  ::= 'Recommend' _Var_ ItemLimit

Aggregation   ::= 'Agg' IRIREF

ItemLimit     ::= 'Top' INTEGER

ItemPart      ::= 'Pref' (DECIMAL)? (VarPart | IRIPart)

IRIPart       ::= IRIREF (ConceptSim)? (WherePart)?

VarPart       ::= VAR (ConceptSim)? (WherePart)

ConceptSim    ::= 'C-Sim' Relation DECIMAL

Relation      ::= ( < | > | <= | >= | = )

WherePart     ::= 'Based□on' WHERECLAUSE()
```

Ad-hoc recommendations

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recommendations

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Introduction

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Future Work
& Summary

Constrained similarity

$$\text{freq}(c) = |\{q \in \mu_r(?x) : c \in \mu_r(?c)\}| \quad (1)$$

$$n = \max\{\text{freq}(c) \mid c \in C\} \quad (2)$$

$$\text{sim}(q, p) = \sum_{c \in C} -\log\left(\frac{\text{freq}(c)}{n}\right) \quad (3)$$

Relevant items

$$P_p = (p, \text{subject}, ?c) \text{ AND } (?x, \text{subject}, ?c) \quad (4)$$

$$\Omega_r = \{\mu_r|?x \mid \mu_r \in \llbracket P \rrbracket_D\} \bowtie \{\mu_r|?x, ?c \mid \mu_r \in \llbracket P_p \rrbracket_{AG}\} \quad (5)$$

Ad-hoc recommendations: SPARQL graph patterns

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recommendations

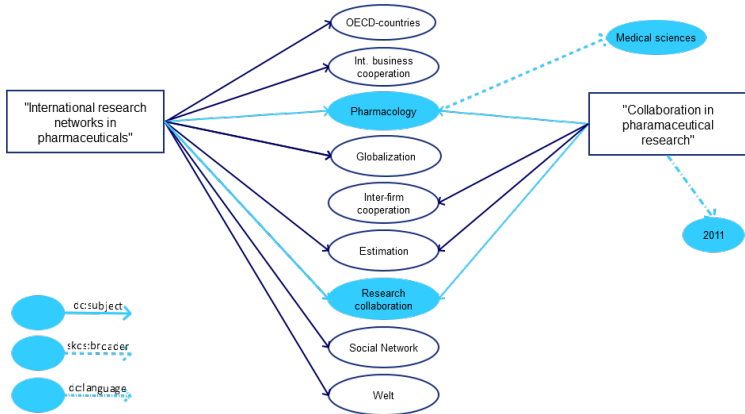
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Introduction

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The SKOS
Recommender

Future Work
& Summary



Ad-hoc recommendation: Query Example I

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Introduction

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Future Work
& Summary

SKOSRec query

```
PREFIX [...]  
  
RECOMMEND ?publication TOP 3  
PREF <econstor:56959>  
BASED ON {  
?publication skos:broader* stw:15658-5 .  
?publication dc:issued >= '2000' .  
}
```

Ad-hoc recommendations: Query Example I

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Introduction

LOD

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& Summary

- Publication Title:
International research networks in pharmaceuticals
- Constrained by:
 - skos:broader* "Medical sciences"
 - dc:issued >= "2000"

Results

- *"The dynamics of knowledge networks in medicine"*
- *"Knowledge understanding and the dynamics of medical innovation"*
- *"Collaboration in pharmaceutical research"*

Ad-hoc recommendation: Query Example II

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

SKOSRec query

```
PREFIX [...]  
  
SELECT DISTINCT ?collection WHERE {  
  ?publication dc:isPartOf ?collection.  
}  
RECOMMEND ?publication TOP 3  
AGG <econstor_collections:438>  
PREF ?publication  
BASED ON {  
  ?publication dc:isPartOf <econstor_collections:438>  
}
```

Ad-hoc recommendations: Query Example II

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Introduction

LOD

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& Summary

- Series Title:

**Schriften aus dem Institut für Forstökonomie,
Universität Freiburg**

- Retrieval Task: Recommend related series
- Result: *"Arbeitsberichte aus der vTI-Agrarökonomie"*

Flexible recommendations

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recommendations

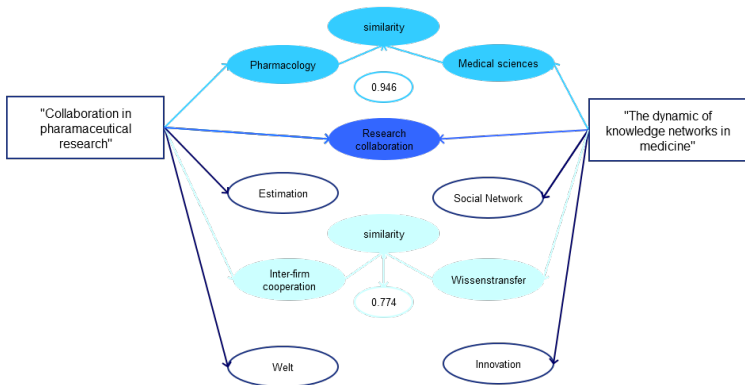
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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary



Flexible recommendations: Query Example III

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

SKOSRec query

```
PREFIX [...]
```

```
RECOMMEND ?publication TOP 3
```

```
PREF <econstor:56959> C-SIM >= 1.0
```

```
PREFIX [...]
```

```
RECOMMEND ?publication TOP 3
```

```
PREF <econstor:56959> C-SIM >= 0.75
```

Flexible recommendations: Query Example III

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Publication Title:

International research networks in pharmaceuticals

Results for similarity = 1

- *"Trade in health services"*
- *"The dynamic of knowledge networks in medicine"*
- *"Reconstructing global governance networks"*

Results for similarity ≥ 0.75

- *"National and international developments in technology"*
- *"International cooperation on innovation"*
- *"Fairneß im Standortwettbewerb?"*

Virtual Data Integration: Query Example IV

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The SKOS
Recommender

Future Work
& Summary

SKOSRec query

```
PREFIX [...]  
  
FROM  
<http://localhost:8890/sparql>  
TO  
<http://202.45.139.84:10035/.../agris/sparql>  
RECOMMEND ?publication TOP 3  
PREF <econstor:29513>
```

Virtual Data Integration: Query Example IV

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Future Work
& Summary

Publication Title: **Towards a sustainable biomass strategy** (econstor:29513)

SKOS Matching

- "Bioenergy" (stw:14171) — "Bioenergy" (agrovoc:16526)
- "Pollution" (stw:15763-1) — "Env. degradation" (agrovoc:34821)
- "World" (stw:16809-5) — "World" (agrovoc:24920)
- "Sustainable dev." — "Sustainable dev." (agrovoc:39332)

Dataset Description SPARQL endpoint, access information

Resource Mapping Mapping between different resource expressions

Results

- *"Aspekte des Gewässerschutzes und der Gewässernutzung beim Anbau von Energiepflanzen"* (agris:AV2012055570)
- *"Status, development and prospects of using bioenergy crops in the world and in Serbia"* (agris:RS2011003019)

Future Work: Evaluation

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recommendations

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Introduction

LOD

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Recommender

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& Summary

- Can the "SKOS strategy" compete with NLP methods?
- How do different concept similarity thresholds affect recommendation lists?
- Do users find it helpful to use advanced query patterns?

Future Work: Evaluation

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recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

SKOS Recommender

Linked Data-enabled on-the-fly Recommendation

[Home](#) [Evaluation](#) [Contact](#)

The SKOS Recommender

The SKOS Recommender is a Linked Data-enabled query-based recommender system. It provides a SPARQL-like language (SKOSRec) for preference specification and computes recommendations at runtime. Similar resources are identified through concepts from SKOS thesauri as many datasets on the Semantic Web use them to annotate their resources. Triple matching is facilitated through usage of elements from the W3C SPARQL specification in the SKOSRec query language. Thus, the system enables specialized queries that take advantage of Linked Data from SPARQL endpoints. In summary, the system supports the following features:

- On-the-fly Recommendations
- Flexible Similarity Detection
- SPARQL Integration
- Virtual Data Integration

About us

The SKOS Recommender is developed and maintained at the [Chair of Business Informatics](#) at the Friedrich-Schiller-University Jena.

Future Work: Evaluation

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vocabularies
for ad-hoc
recommendations

Lisa Wenige

Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

SKOS Recommender

Linked Data-enabled on-the-fly Recommendation

[Home](#) [Evaluation](#) [Contact](#)

User Study: Recommender Systems for Scientific Publication Retrieval

Thank you for participating in our evaluation! Your help is very much appreciated and will help us to improve our system. The survey will take you just a few minutes. You will be asked to evaluate results from 4 different query types that generate recommendations for scientific publications from an Open Access repository of academic literature in economics, named EconStor. During the evaluation, sufficient instructions are provided at each step.

First of all, please answer a few demographic questions.

Q1. Your age range

under 20 ▾

Q2. Your Gender

female ▾

Summary

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vocabularies
for ad-hoc
recommendations

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

- Large amount of unused bibliographic information
- LOD and SKOS vocabularies are well suited for recommendation tasks
- The SKOS Recommender
 - Ad-hoc recommendations
 - SPARQL endpoint access
 - Virtual data integration
- The SKOSRec query language
 - SPARQL integration
 - Similarity calculation

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Introduction

LOD

The SKOS
Recommender

Future Work
& Summary

Thank you for your attention
Any questions?