

Evaluation Strategies and Methods

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Agenda for Today

- Scenario
- Important Notes
- Four Different Types of Evaluation Strategies
- Case Studies
- Limitations
- Summary and take home message

Scenario

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Using the knowledge acquired in this course you have developed a new method for knowledge acquisition.

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But there are questions unanswered:

- How do you show that your effort is better than existing work?
- If no such work exists (“Pioneer” status): How do you know that your work simply “works”?

Important Notes / 1

Without evaluation there is no proof that your discovery/
work is correct and significant

A good evaluation design takes time to be constructed

Evaluation helps you to support your claims /
hypotheses

Important Notes / 2

It is often not possible to evaluate everything! - Only fractions/samples!

Creativity is needed

Evaluation techniques are not carved in stone.
Therefore no definitive recipe exists.

This is not a complete list of evaluation techniques (by far)

Overview of Approaches of Ontology Evaluation

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Four different approaches:

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Overview of Approaches of Ontology Evaluation

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Comparison to a Golden Standard

Use another ontology, corpus of documents or dataset prepared by experts to compare own approach

Example: Comparison to WordNet, ConceptNet etc.

A more detailed example will be shown later on.

Application-Based Approach

Normally the new ontology will be used in an application.

A “good” ontology should enable the application to produce better results.

Problems:

- Difficult to generalize the observation on other tasks
- Depending on the size of the component within the application
- Comparing other ontologies is only possible if they can also be inserted into the application

Data-driven Approach

Comparing the ontology to existing data (e.g. a corpus of textual documents) about the problem domain to which the ontology refers.

Example:

- The overlap of domain terms and terms appearing in the ontology can be used to find out how good the ontology fits the corpus.

Assessment of Humans

What is done: Undertaking a *human subject study*

Study participants evaluate samples of the results.

The more people you have the merrier!

An important factor is the agreement between test subjects!

Example will follow later on!

Different Levels of Evaluation / 1

- Lexical, vocabulary, concept, data
 - Focus on the included concepts, facts and instances
- Hierarchy, taxonomy
 - Evaluating is_a relationships within the ontology
- Other semantic relations
 - Examining other relations within the ontology (e.g. is_part_of)
- Context, application
 - How does the ontology work in the context of other ontologies/ an application?
- Syntactic
 - Does the ontology fulfill the syntactic needs of the language it is written in?
- Structure, architecture, design
 - Checks predefined design criteria of the ontology

Different Levels of Evaluation / 2

Overview of which approaches to ontology evaluation are normally used for which levels [Brank]

Level	Approach to evaluation			
	Golden standard	Application-based	Data-driven	Assessment by humans
Lexical, vocabulary, concept, data	x	x	x	x
Hierarchy, taxonomy	x	x	x	x
Other semantic relations	x	x	x	x
Context, application		x		x
Syntactic	x			x
Structure, architecture, design				x

2 Case Studies

Evaluation of a Goal Prediction Interface:

- Example for human assessment

Evaluation of a method to improve semantics in a folksonomy

- Example for comparison to a golden standard and data-driven approach

Case Study 1: Goal Prediction Interface

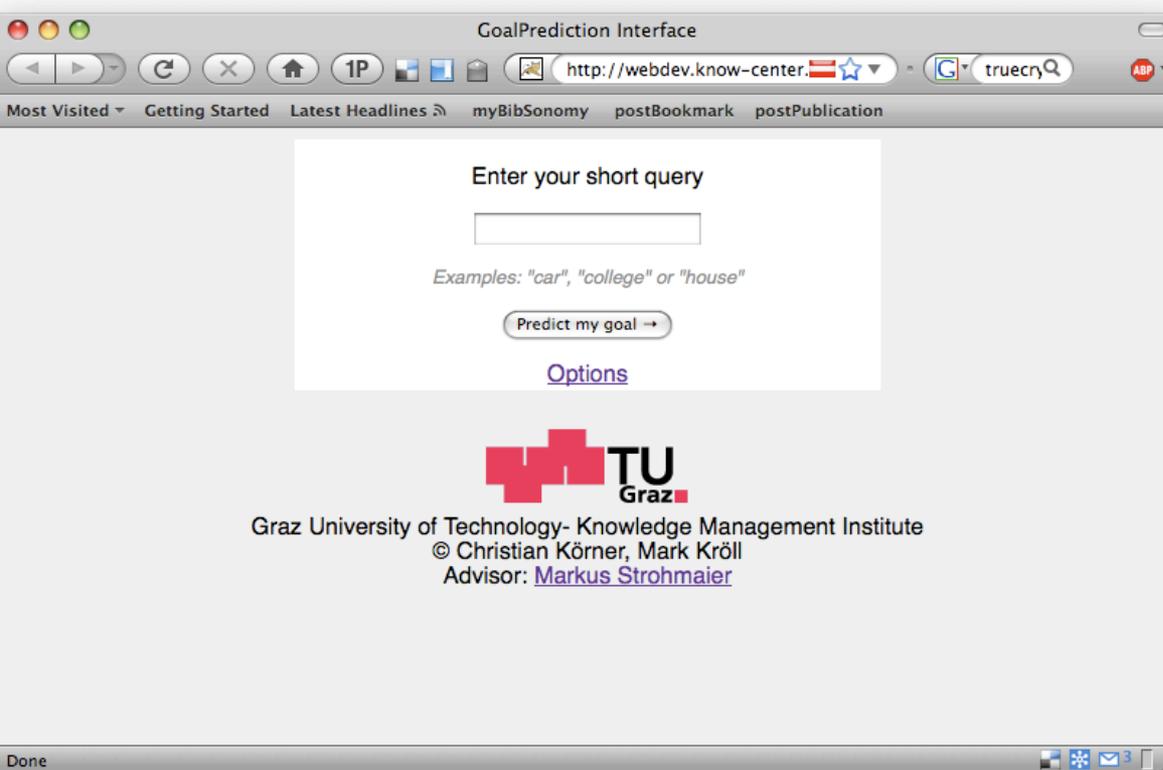
Predicts a user's goal based on an issued search query

uses search query log information

Case Study 1: Goal Prediction Interface

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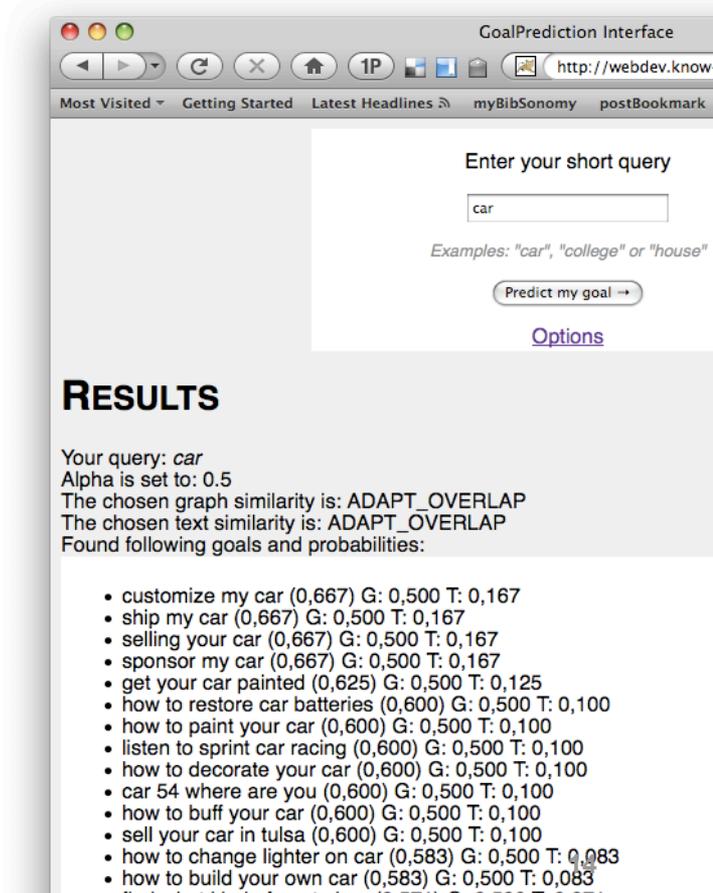
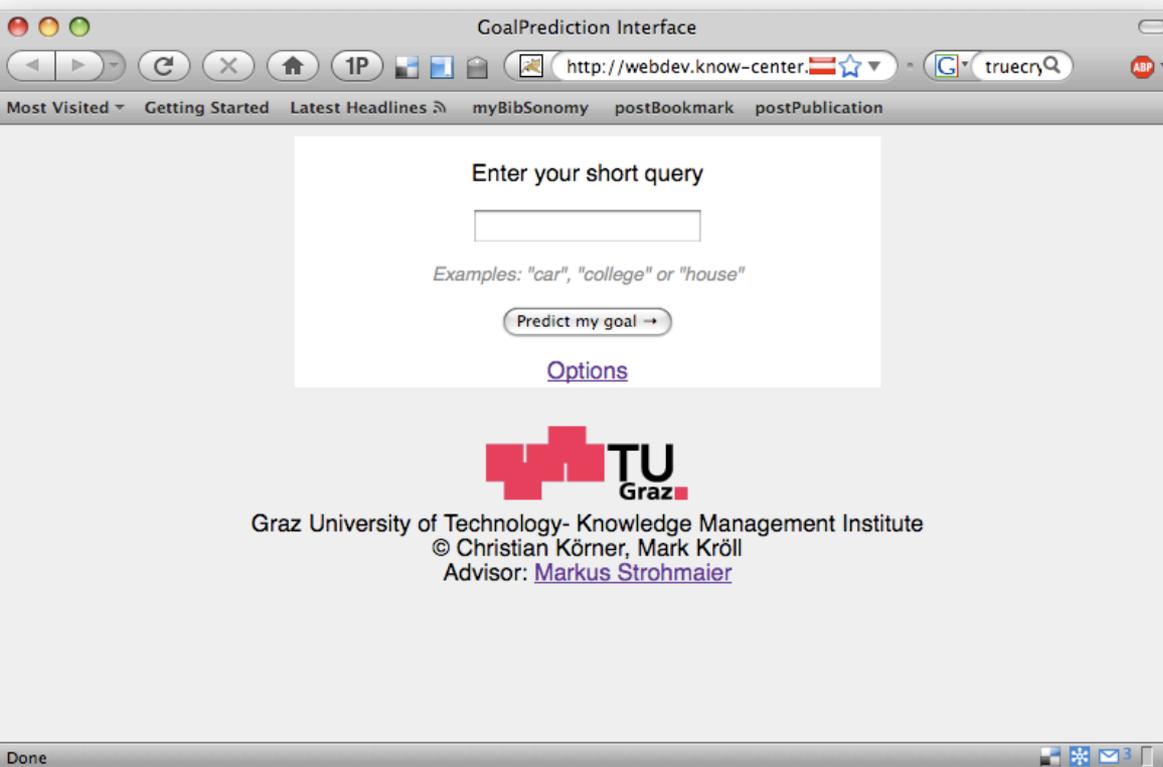
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Case Study 1: Goal Prediction Interface

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The Goal Prediction Interface

<http://webdev.know-center.tugraz.at:8080/GoalPredictor/>

Evaluating the Goal Prediction Interface / 1

Three configurations with different parameter settings were selected for testing

Preprocessing:

- a set of 35 short queries was drawn from the AOL search query log
- unreasonable queries were removed (e.g. “titlesourceinc”)
- Test participants were from Austria, therefore queries like “circuit city” and other brands were removed

Evaluating the Goal Prediction Interface / 2

System received the 35 queries as input

For each of the queries the top 10 resulting goals were collected

Query: playground mat

buy playground equipment

how to build a swing set

covering dirt in a playground

buy children plastic slides

how to raise money for the playground

how to weave a basket fifth grade project

Evaluating the Goal Prediction Interface /

3

User had to classify the resulting goals into three classes

Relevance Classes and Examples

- **Class 1:** *Plausible User Intention* - The proposed query represents a likely goal the user wants to achieve.
Query: “anime”
Intention: “how to draw manga” or “how to draw anime”
- **Class 2:** *Potential User Intention* - The proposed query represents an unlikely but possible user goal.
Query: “Boston herald”
Intention: “getting around Boston”
- **Class 3:** *Clear Misinterpretation or Mismatch:* The proposed query has no relation with the initial query.
Query: “car” Intention: “improve loudspeaker system”

Evaluating the Goal Prediction Interface /

4

Examples of the classification:

Query: playground mat	Classification	Note
buy playground equipment	1	
how to build a swing set	1	
covering dirt in a playground	1	
buy children plastic slides	2	unlikely
how to raise money for the playground	2	unlikely
how to weave a basket fifth grade project	3	mismatch

Evaluating the Goal Prediction Interface / 5

5 annotators labeled the top 10 results for 35 queries
which were produced by three different configurations

Test participants had to label the best result set

This way the best configuration should be identified

- However for this task the agreement between the participants had to be calculated

Inter-Rater Agreement / 1

also known as Cohen's kappa

$$\kappa = \frac{\text{Pr}(a) - \text{Pr}(e)}{1 - \text{Pr}(e)},$$

Pr(a).... relative observed agreement among testers

Pr(e).... hypothetical probability of chance agreement

Inter-Rater Agreement / 2

K	Interpretation
0.0 - 0.2	Slight agreement
0.21 - 0.4	Fair agreement
0.41 - 0.6	Moderate agreement
0.61 - 0.8	Substantial agreement
0.81 - 1.0	Almost perfect agreement

Inter-Rater Agreement / 3

Inter-Rater Agreement / 3

		Rater A	Rater A
		Yes	No
Rater B	Yes	20	5
Rater B	No	10	15

Inter-Rater Agreement / 3

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$$(0.7 - 0.5) / (1 - 0.5) = 0.4$$

Interpretation: Fair agreement

Evaluating the Goal Prediction Interface /

6

Average $\kappa = 0.67$

- indicating substantial agreement

Raters	κ
I - II	0.57
I - III	0.65
I - IV	0.62
I - V	0.60
II - III	0.66
II - IV	0.77
II - V	0.71
III - IV	0.73
III - V	0.66
IV - V	0.73

In 83 % of the cases configuration 3 was chosen for the best result set

Configuration 3 also had the best precision (percentage of relevant goals)

	Configuration 1	Configuration 2	Configuration 3
Precision	0.43	0.39	0.72

Case Study 2: Semantics in Folksonomies

Subject of Analysis: Data inferred from *folksonomies*

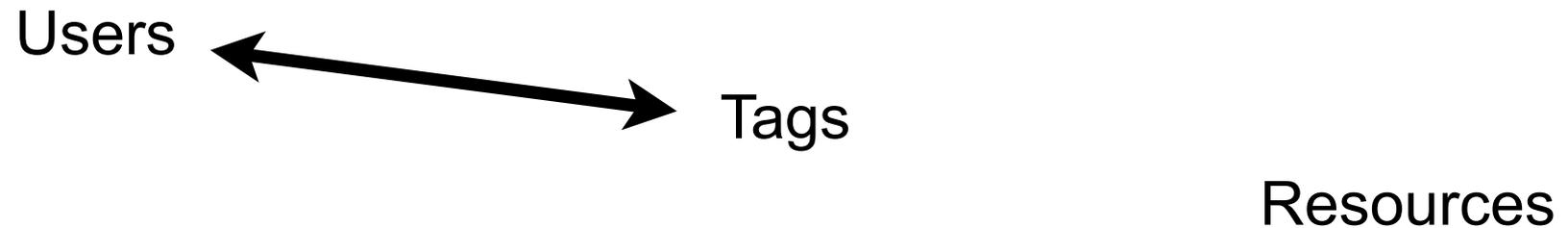
Users

Tags

Resources

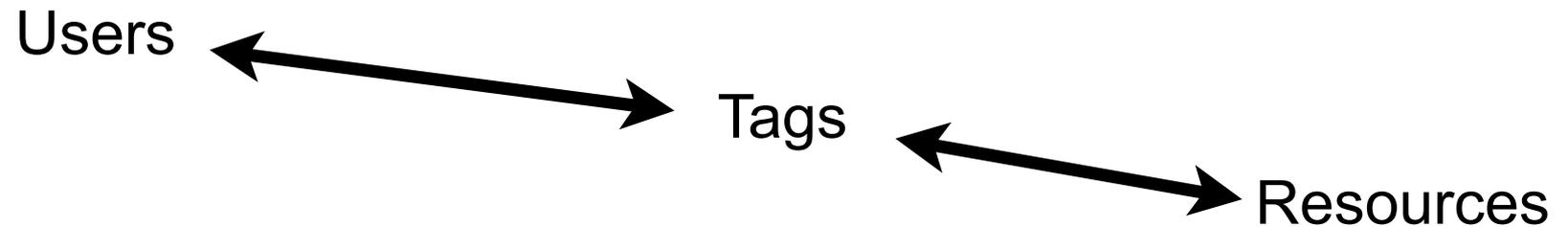
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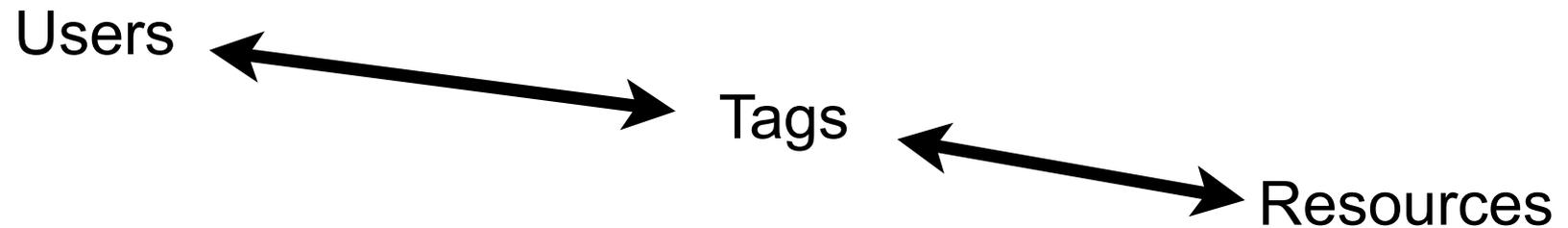
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Subject of Analysis: Data inferred from *folksonomies*



abr accident actualitat add **allows** amb apple applications assigned attached **avery**
big black book-tags bookmark canal cat category catherine chinese cinema collar
 common **design dog dtd** encyclopedia files **find flats**
 flickr folders free gift help holiday html **keyword**
label like online **photos** popular restaurant
 simply used videos wikipedia works xhtml



Case Study 2: Semantics in Folksonomies

Based on user behavior we created a (sub-)folksonomy
which produces better tag semantics (synonyms)

We showed that tagging pragmatics influence
semantics in folksonomies

Case Study 2: Semantics in Folksonomies

Needed:

“Ground Truth” or “Golden Standard” - verified knowledge from a trusted resource

and/or

Baseline for calculations (naive or other measures)

Evaluating semantic similarity / 1

In an experiment we used four different measures to extract the users which contribute more to the semantics in a folksonomy.

Objective: find the method which works best to identify synonyms of tags in a social tagging platform (del.icio.us).

Evaluating semantic similarity / 2

For each measure:

- By using cosine similarity on the tag vectors we computed for each tag its most similar tag.

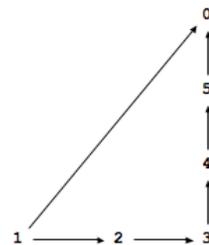
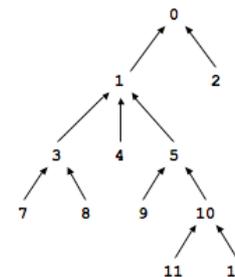
Question: How do we quantify the performance of each measure apart from anecdotal evidence?

Evaluating semantic similarity / 3

Simple approach:

WordNet distance

- length of path between two concepts which are contained within WordNet
- “The farther away two concepts are the more dissimilar they are”
- Disadvantages:
 - Does not take the structure of the network into account
 - Does not deal with multiple paths



Evaluating semantic similarity / 4

Solution for these problems:

- Jiang-Conrath Distance

Jiang-Conrath Distance

combines lexical taxonomy structure with the statistical information of a corpus

combined approach:

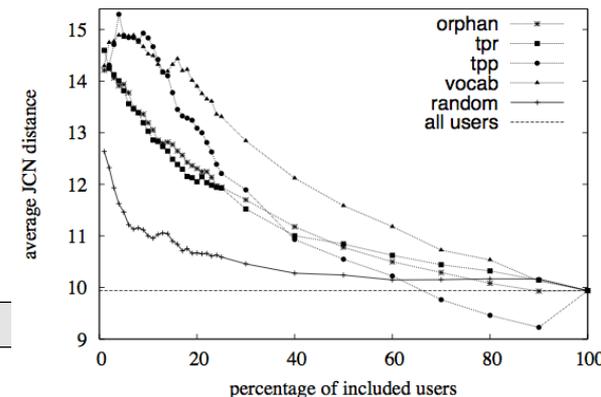
- edge-based (distance) approach
- node-based (information content) approach

[JiangConrath]

Evaluating semantic similarity / 5

What we did:

- For each tag we computed the most similar tag according to cosine similarity of the tag vectors produced by the four measures
- for each of these these tag pairs we computed the Jiang-Conrath distance (if both tags were present in WN)
- After that we calculated the average JCN distance of all mapped tag pairs and took this as an indicator for the semantic quality in our sub-folksonomy



Evaluating semantic similarity / 6

What we did cont.:

- As baselines we
 - selected random users from the folksonomy
 - used the complete folksonomy
- for both baselines the same procedures as described before were applied

We showed:

- the best measure for the selection of the users
- not the complete folksonomy is needed for the emergence of the semantics within
- some users in a folksonomy generate “semantic noise” which does not facilitate the emergence of semantic structures in folksonomies
- tagging pragmatics influences semantics in folksonomies

Limitations of this evaluation

only applies to words found in WordNet

- no slang or memes (“rick rolled”)
- no abbreviations (“UC LA”)

It is always important to tell the limitations your approaches and evaluations have!

Summary

Four different types of evaluation strategies

- Comparison to a *Golden Standard*
- Using your ontology in an application -
Application-based
- Comparison with a source of data -
Data-driven
- Performing a human subject study -
Assessment by Humans

2 case studies

- Goal Prediction Interface
- Semantics in Folksonomies

Take home message(s)

Evaluation is a key factor for proofing that your work is correct

Good evaluation design takes time

Evaluation methods are manifold. There exists no absolute guide to evaluations.

Be creative!

Thank you for your attention!

References

[Brank] Brank, J.; Grobelnik, M. & Mladenić, D. (2005), A Survey of Ontology Evaluation Techniques, *in* 'Proc. of 8th Int. multi-conf. Information Society', pp. 166--169.

[Cohen] Cohen, J. (1960). A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement*, 20(1):37.

[Budanitsky] A. Budanitsky and G. Hirst, "Semantic Distance in Wordnet: An Experimental, Application-Oriented Evaluation of Five Measures," *Proc. Workshop WordNet and Other Lexical Resources, Second Meeting of the North Am. Chapter of the Assoc. for Computational Linguistics*, 2001.

[JiangConrath] J. J. Jiang and D. W. Conrath. Semantic Similarity based on Corpus Statistics and Lexical Taxonomy. *In Proc. of the International Conference on Research in Computational Linguistics (ROCLING)*. Taiwan, 1997.