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# Ontology matching evaluation using GIS services



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# Outline

- Introduction
- Structure Preserving Semantic Matching
- Evaluation: two test cases
  1. Evolution scenario: *syntactic and semantic alterations*
  2. Classification comparison
- Performance evaluation
- Conclusions and future work

# Introduction

How do we use matching ?

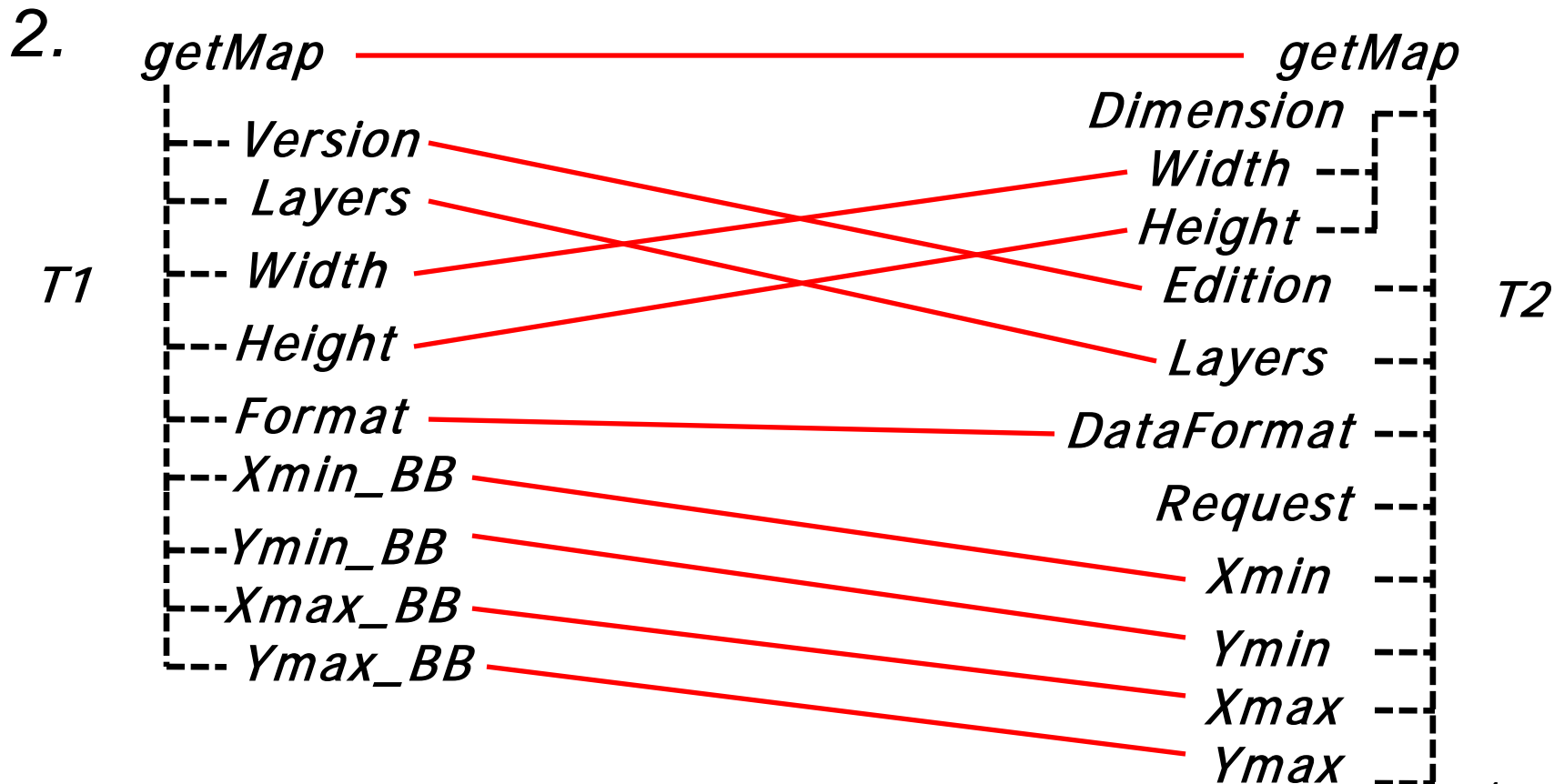
1. **(Web Service Discovery)** to allow service providers to determine how similar their own *service descriptions* are to those required by service requestors (*service invocations*).
2. **(Web Service Invocation)** to allow service providers to understand how they may satisfy the requirements of service requestors. This is done through building up a map between each element of a service description to each element of a service invocation.

Ontology matching approach:

- **Structure Preserving Semantic Matching (SPSM)**. The semantic matching *preserves* some structural properties (e.g., functions are matched to functions and variables are matched to variables)

# SPSM

1. The **similarity** (*Treesim*) between service invocation signature (*tree T1*) and service description signature (*tree T2*) is **0.64**



# Test cases

## **TC1:** *Syntactic and semantic robustness* test:

- Using alteration operations on Web service operation signatures
- The probability, assigned to each alteration operation, has been changed from the lower value (0.1) to the maximum value (0.9)

## **TC2:** *Classification robustness* test:

- Comparison between a manual classification and the one computed by SPSM

# TC1: Evaluation dataset

- **80 trees** were built out of the Geographic Web services
- **4 alteration operations + 1 combination:**
  - Meaning and syntactic alterations
- **20 alterations** for each tree, for each alteration operation and for each probability
  - total matching tasks for each alteration operation: 14.400
  - total matching tasks (including 10 statistical repetitions): ca. 700.000

# TC1: alteration operations

## **Original signature:**

*find\_Address\_By\_Point( point, address\_Finder\_Options, part)*

- 1. Replace a node name with an unrelated one (Brown corpus) :**  
*point* → *cable*
- 2. Add or remove a label in a node name (Brown corpus):**  
*find\_Address\_By\_Point* → *find\_By\_Point*
- 3. Alter syntactically a label (add, delete and change characters):**  
*find\_Address\_By\_Point* → *finm\_Address\_By\_Poioat*
- 4. Replace a label in a node name with a related one**  
(synonyms, hyponyms, hypernyms from Moby and WordNet 3.0)  
*address\_Finder\_Options* → *location\_Finder\_Options*
- 5. Combination of 3. and 4.**  
*address\_Finder\_Options* → *lfctin\_Finder\_Options*

# TC1: evaluation methodology

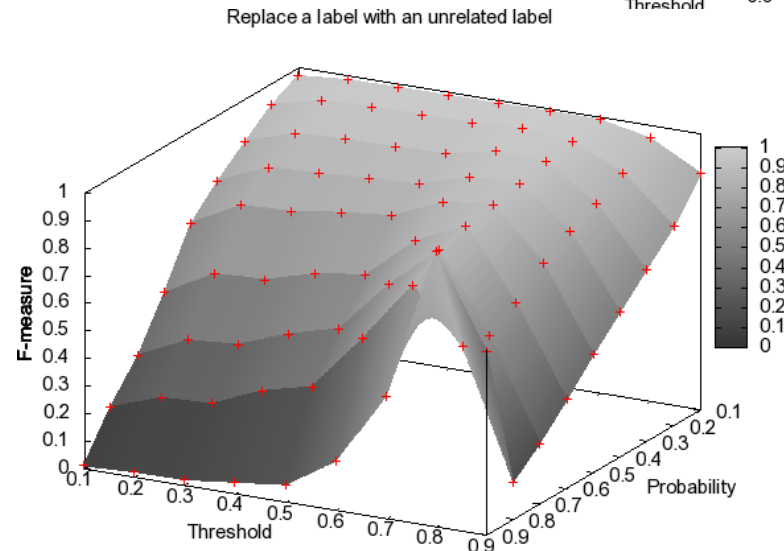
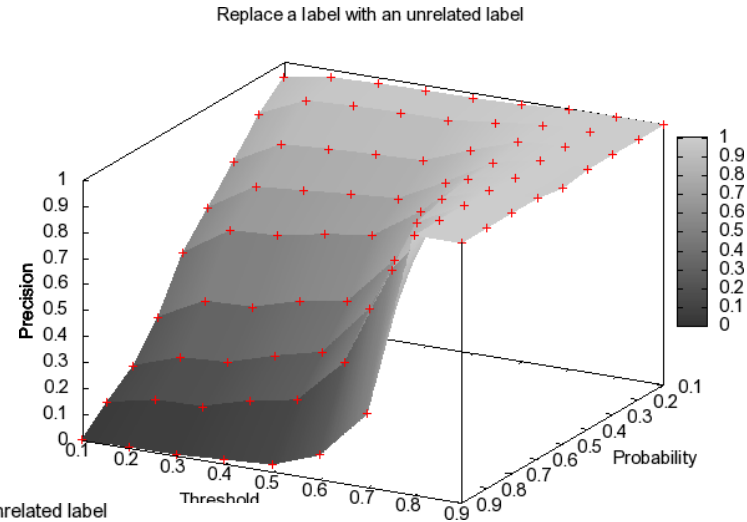
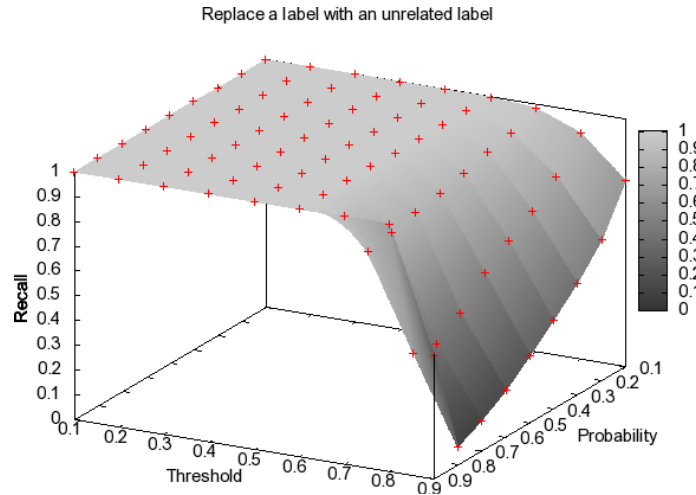
- Initially, to each pair of signatures is assigned a starting similarity.
  - *ExpScore*  $\leftarrow 1$
- Alteration operations application:
  - *ExpScore reduction*
- Recall, Precision and F-measure values can be computed. Ingredients:
  - *ExpScore*
  - *TreeSim* (SPSM)
  - Variable acceptance (cut-off) threshold
- Results: average on 10 repetitions
  - average standard deviation: 1.3%





# TC1: evaluation results, example

- *Replace a node name with an unrelated node name*



# TC1: SPSM vs baseline (edit distance)

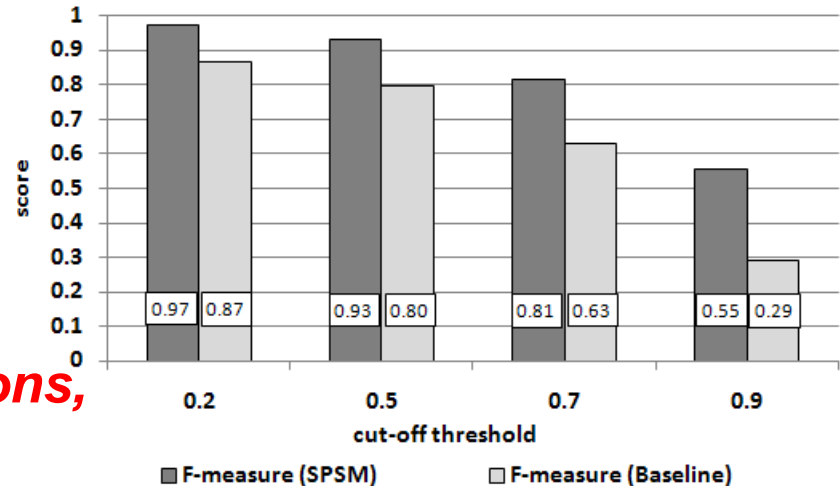
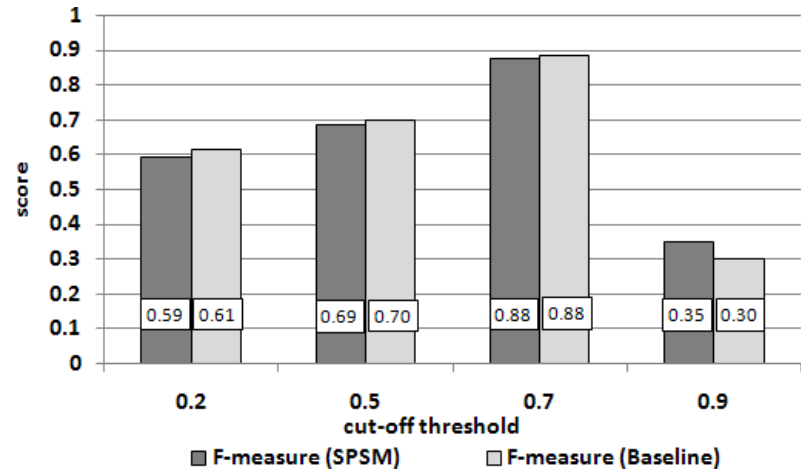
- *Syntactic alterations*  
(alteration probability = 0.6)
- *Meaning alterations*  
(alteration probability = 0.6)

*F-measure of SPSM matcher:*

- *equivalent for syntactic alterations,*
- *+20% for meaning alterations*



***SPSM matcher: “best of both worlds”***



# TC2: evaluation dataset and setup

- **Selected set** (50) of GIS Web service operations.
- **Manual** classification:
  - WSDL description
  - Eliminate some general operations
  - Refine classification by regrouping operations

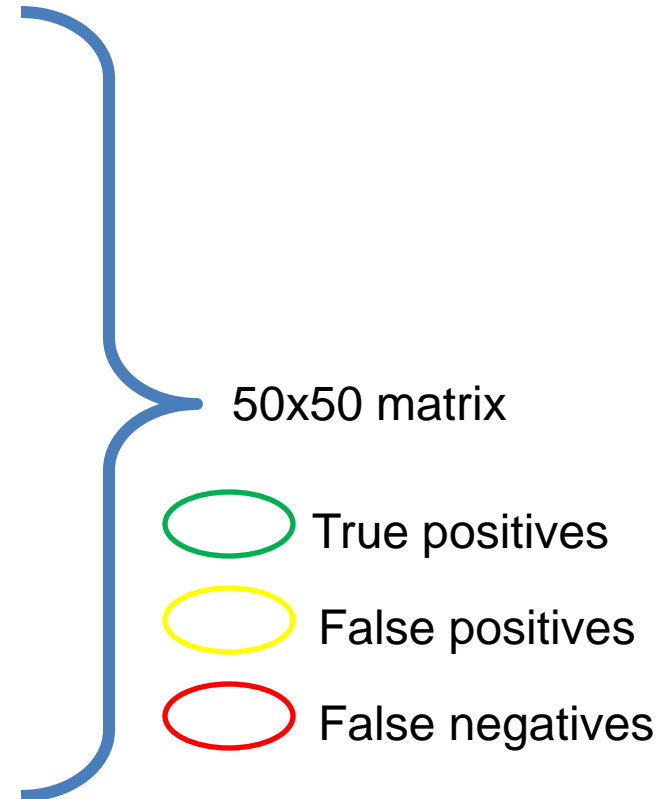
# TC2: evaluation methodology

## Manual classification, example

	Operation 1	Operation 2	Operation 3	Operation 4
Operation 1	1	1	1	0
Operation 2	1	1	1	0
Operation 3	1	1	1	0
Operation 4	0	0	0	1

## SPSM classification, example

	Operation 1	Operation 2	Operation 3	Operation 4
Operation 1	1	0.76	0.22	0.52
Operation 2	0.76	1	0.57	0.54
Operation 3	0.22	0.57	1	0.12
Operation 4	0.52	0.54	0.12	1



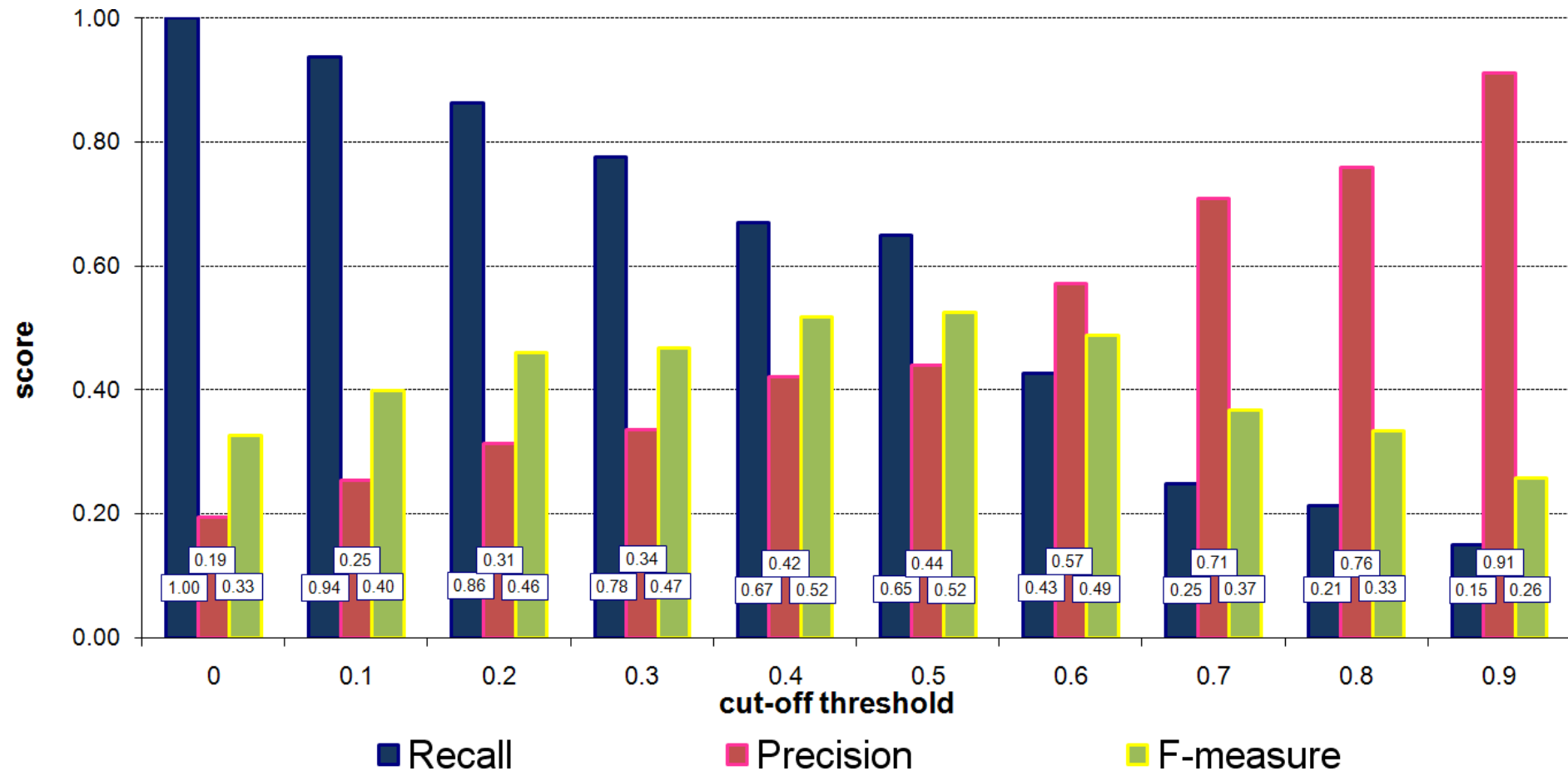
Cut-off Threshold = 0.5

$|\text{Relevant}| = 10$ ,  $|\text{Retrieved}| = 12$ ,  $|\text{True Positives}| = 8$

Recall = 0.8; Precision = 0.67; F-measure = 0.73

# TC2: evaluation results

- Best F-measure: 52%



# Performance evaluation

- Setup: standard laptop Intel Centrino Core Duo **CPU-2Ghz, 2GB RAM, Windows Vista** O.S., no applications running but a single matching system.
- Average **numbers of the parameters** of the WSDL operations: **4**
- Efficiency:
  - Execution Time per matching task: **43 ms**
  - Quantity of main memory during matching tasks: less than **2.3Mb** (than the standby level)

# Conclusions and Future work

- **Results:**
  - Test case 1. Evaluation results: **+20%** in comparison to the baseline
  - Test case 2. SPSM supports classification of real world web services with **best F-measure around 52%**
- **Applicability:**
  - It can be applied to web service discovery and invocation
  - It is robust and it can be used at run-time
- **Future work:**
  - Use **domain specific (GIS) and/or multilingual thesauri**, e.g. Gemet, Agrovoc and Eurovoc for semantic matching
  - Compare results in **“live” environments with community of users**, e.g. e-Health, e-Response and GIS
  - **Geo-data similarity evaluation**, e.g. INSPIRE themes and GIS schema specifications



# Thank you for your attention !

## QUESTIONS ?

This work has been supported  
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[www.openk.org](http://www.openk.org)

(Matching: WP3)

