Aligning Sense Inventories in Wikipedia and WordNet

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Motivation

Aligning Sense Inventories

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Many NLP tasks rely on sense information:

- Word Sense Disambiguation
- Semantic Relatedness
- Machine Translation
- Semantic Search

WordNet

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Many NLP tasks rely on sense information:

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WordNet

✓ precise taxonomy

textual information

size

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✗ size	✓
multilingual	✓

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Two main benefits:

1. enhanced sense representation
2. increase of sense coverage

Alignment on sense level

WordNet

- precise taxonomy
- textual information
- size
- multilingual

Motivation
Aligning Sense Inventories

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WordNet

- S: (n) **damper** (a movable iron plate that regulates the draft in a stove or chimney or furnace)
- S: (n) **damper**, muffler (a device that decreases the amplitude of electronic, mechanical, acoustical, or aerodynamic oscillations)
- S: (n) **damper** (a depressing restraint) *"rain put a damper on our picnic plans"*

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WIKIPEDIA
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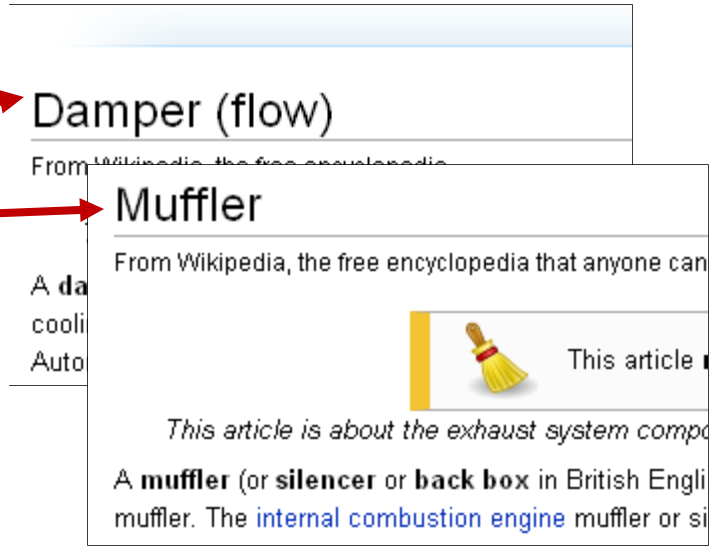

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Damper (flow)

From

A da

cooli

Auto

Muffler

From Wikipedia, the free encyclopedia that anyone can

This article

This article is about the exhaust system compo

A **muffler** (or **silencer** or **back box** in British Engli

muffler. The internal combustion engine muffler or si

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Damper (food)

From Wikipedia, the free encyclopedia

For other uses of the term "damper", see Damp

Damper is a traditional Australian soda bread prep
Australian dish. It is also made in camping situatior

Damper was originally developed by stockmen who

Related Work

Alignment of Wikipedia and WordNet

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- Main focus on Wikipedia's **category** system and **infoboxes**
  - goal: semantically enriched ontology
  - e.g., Suchanek et al., 2007, Toral et al., 2008, 2009, Ponzetto and Navigli, 2009

- Two works consider Wikipedia's **articles** and WordNet
  - Ruiz-Casado et al., 2005: Simple English Wikipedia
    - automatic mapping based on string comparison methods
    - no analysis regarding the complementarity of senses
  - Mihalcea, 2007: Wikipedia as a source of sense annotations
    - manually mapped Wikipedia articles to WordNet synsets

Related Work

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Our contributions:
- Analysis of sense coverage / complementarity
- Dataset with human annotations
- Insights for the (fully) automatic alignment

- Two w
  - Ruiz
    - automatic mapping based on string comparison methods
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How to build an aligned sense inventory?

Two-step Approach

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1. Extraction of potential sense pairs
2. Disambiguation of these pairs

Synset	Gloss + Examples	Article Title	First Paragraph (shortened)
doctor, medico, doc, MD, physician, Dr.	*a licensed medical practitioner; "I felt so bad I went to see my doctor"*	*Physician*	*A physician, medical practitioner, doctor of medicine, or medical doctor practices medicine, and is concerned with [· · ·]*
doctor, medico, doc, MD, physician, Dr.	*a licensed medical practitioner; "I felt so bad I went to see my doctor"*	*Doctor (title)*	*Doctor (gen.: doctoris) means teacher in Latin. The word is originally an agentive noun of the verb docre ('to teach'). It has been used continuously as [· · ·]*

WordNet

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Synset	Gloss + Examples	Article Title	First Paragraph (shortened)
doctor, medico, doc, MD, physician, Dr.	*a licensed medical practitioner; "I felt so bad I went to see my doctor"*	*Physician*	*A physician, medical practitioner, doctor of medicine, or medical doctor practices medicine, and is concerned with [· · ·]*
doctor, medico, doc, MD, physician, Dr.	*a licensed medical practitioner; "I felt so bad I went to see my doctor"*	*Doctor (title)*	*Doctor (gen.: doctoris) means teacher in Latin. The word is originally an agentive noun of the verb docre ('to teach'). It has been used continuously as [· · ·]*

WordNet

WIKIPEDIA
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How to build an aligned sense inventory?

1. Extraction of potential sense pairs

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- S: (n) **handwriting**, hand, script (something written by hand) *"she recognized his handwriting"; "his hand was illegible"*

- for each synonymous word extract all
  - articles with title matching word
  - articles with redirect matching word
  - with or without description tag

- examples
  - article *Script (typefaces)*
  - article *Script(comics)*
  - article *Penmanship* has redirect *Handwriting*

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# extracted Wikipedia senses	# WordNet senses	
None	12,493	15.2%
One	27,973	34.1%
More than one	41,649	50.7%

How to build an aligned sense inventory?

2. Disambiguation of potential sense pairs: Human annotations

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- dataset:
  - 38 synsets yield 297 potential sense pairs
  - 7.82 articles per synset on average

- annotation task:
  - four human annotators
  - label either as same sense or not
  - annotations reliable, inter-annotator agreement:
    - Ao = 0.97, multi-kappa = 0.84

How to build an aligned sense inventory?
Analysis

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- 21 synsets aligned with at least one article

- 17 synsets not aligned
  - entry in disambiguation page: 4 (ongoing work)
  - article title / redirect did not match synset words: 2
    (already included in the new version)

How to build an aligned sense inventory?
Analysis

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- S: (n) **bandwagon** (a popular trend that attracts growing support)

?

Bandwagon effect

From Wikipedia, the free encyclopedia

consider link labels

anyone interested in partaking – most famously t
rld, Leary ultimately joined the bandwagon of "aci
neeting between Kesey and Leary would resolve

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```

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- 17 synsets not aligned
  - entry in disambiguation page: 4
  - article title / redirects did not match synset words: 2
  - remaining not in Wikipedia !

Two main benefits:

1. enhanced sense representation
2. increase of sense coverage

Conclusions
Lessons learned

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- article – synset is an appropriate level of granularity (cf. Mihalcea, 2007)
- two main benefits:
  - enhanced sense representation
  - complementarity of senses

precise taxonomy ✓
textual information ✓
size ✓

- two-step approach: candidate **extraction** and **disambiguation**
  - extraction:
    - consider link labels and process disambiguation pages
  - disambiguation:
    - high-inter annotator agreement motivates automation

Future Work

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- generate larger dataset for evaluation
- perform automatic alignment
  - text similarity measures
  - ...

- integrate other resources
  - sense inventories, dictionaries
  - e.g. YAGO

Thank you for your attention!

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Ubiquitous Knowledge Processing

KTS
Klaus Tschira Stiftung gemeinnützige GmbH

e-learning center of research excellence

Bundesministerium für Wirtschaft und Technologie

VolkswagenStiftung

Deutsche Forschungsgemeinschaft DFG

Emmy Noether-Programm
Deutsche Forschungsgemeinschaft DFG

http://www.ukp.tu-darmstadt.de

Backup Slides

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Terminology

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WordNet

- S: (n) **damper** (a movable iron plate that regulates the draft in a stove or chimney or furnace)

Dictionary entries. Encyclopedia articles are about a person, or a group, a concept, a place, a thing, an event, etc. In some cases, a word or phrase itself may be an encyclopedic subject, such as Macedonia (terminology) or truthiness; however, articles rarely, if ever, contain several *distinct* definitions or usages of the article title. Articles about the cultural or mathematical

WordNet sense

Wikipedia sense

How to build an aligned sense inventory?

2. Disambiguation of potential sense pairs: Human study

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- examples:

WordNet	Wikipedia
<configuration, constellation>: an arrangement of parts or elements	**<Configuration (mathematics)>:** In mathematics, especially geometry, a configuration is an
<alignment>: the spatial property possessed by an arrangement or position of things in a straight line or in parallel lines	**<Typographic alignment>**: In typesetting and page layout, alignment or range, is the setting of text flow or image placement …

Why synset and not word sense level?

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- S: (n) **handwriting**, hand, script (something written by hand) *"she recognized his handwriting"; "his hand was illegible"*

- the only difference is the number of extracted potential Wikipedia articles
- it is more likely that we extract the appropriate Wikipedia article if we consider all synonymous words in a synset

- if we can align on synset level, we can also align on word sense level

Application of an aligned sense inventory

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- Increase of sense coverage
- Representation contains relational information from WordNet and encyclopaedic information from Wikipedia (multilingual)

- Ability to automatically acquire sense-tagged corpora in a mono- and multilingual fashion
  - For each WordNet synset, the article text of the aligned Wikipedia sense can be automatically extracted similar to Mihalcea, 2007
- Conversion of sense-tagged corpora (e.g. Senseval) to another sense representation
- Use Wikipedia content to extract new sense frequency values

- Enhance Wikipedia articles with synonyms (e.g. as redirects)

How to build an aligned sense inventory?
Analysis

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- 21 synsets aligned with at least one article

- 17 synsets not aligned
  - 4 of them as entry in disambiguation page
  - for 2 of them appropriate article could not be extracted
  - remaining synsets not in Wikipedia (one third)

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- S: (n) **bandwagon** (a large ornate wagon for carrying a musical band)

?

Bandwagon
From Wikipedia, the free encyclopedia

Bandwagon may refer to:

- a wagon which carries a band of musicians in a parade or for promotional purposes. Other uses

process of disambiguation pages

Subject of our ongoing work