TECHNISCHE UNIVERSITÄT DARMSTADT

JoBimText:

A framework for distributional semantics

Tutorial at the NLDB 2015

By

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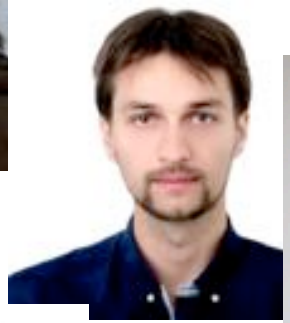
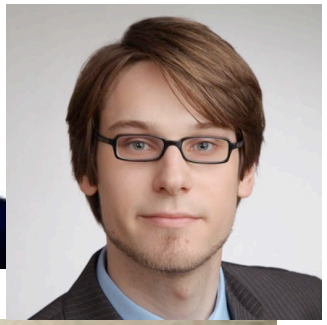
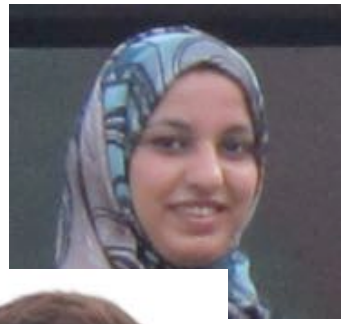
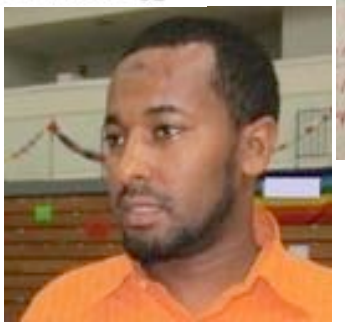
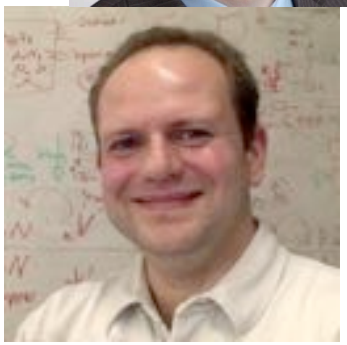
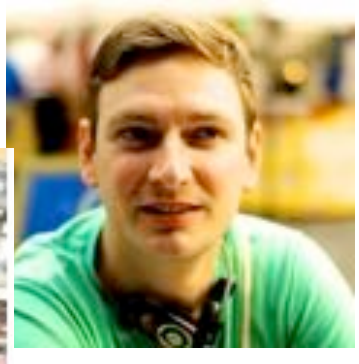




Language
Technology





Timetable

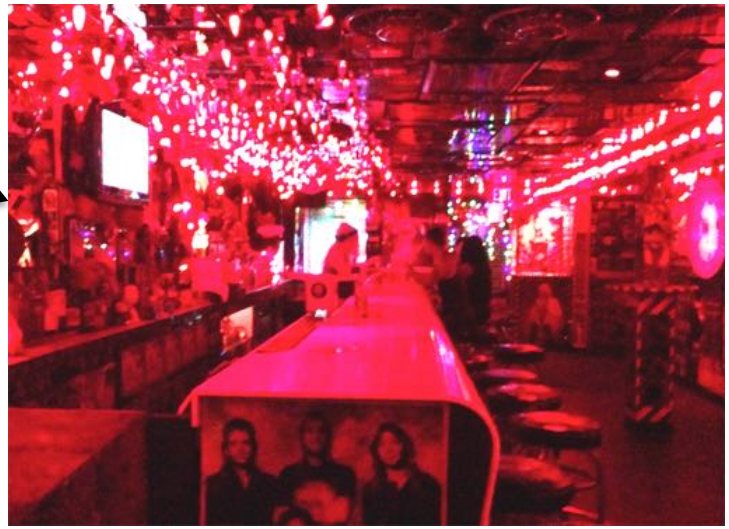
- 9:00 – 9:30 Methods and Applications in JoBimText
- 9:30 – 10:40 Access Semantic Models
- 11:00 – 12:40 Computing Semantic Models

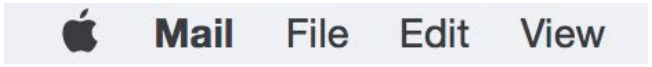
Requirements

- Part II
  - Internet
  - Eclipse
  - Example project:
    - NLDB.org -> Workshop Tutorial -> https://sites.google.com/site/jobimtexttutorial/ -> Resources -> example project for Eclipse
- Part III
  - Install Virtualbox https://www.virtualbox.org/
  - Download VM:
    - …. -> Resources -> prepared VM image
- Part I & II:
  - Commands
    - … -> Resources -> joBimText Tutorial Practice Commands

Understanding Text

The bar serves delicious beer

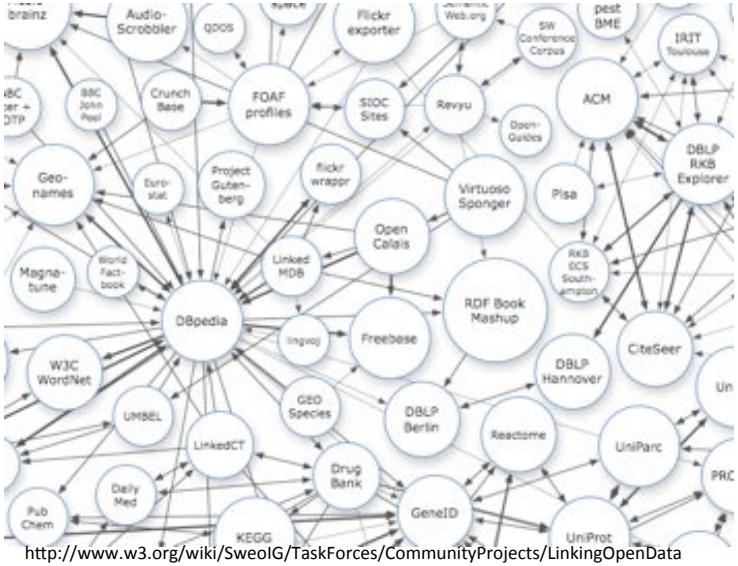




Click on Mail in the menu bar

Use Dictionaries or Ontologies

Photo by zeh fernando under Creative Commons licence



http://www.w3.org/wiki/SweoIG/TaskForces/CommunityProjects/LinkingOpenData

Advantages:

- Sense inventory given
- Linking to concepts
- Full control

Disadvantages:

- Dictionaries have to be created
- Dictionaries are incomplete
- Language changes constantly: new words, new meanings …

"give a man a fish and you feed him for a day…

Motivation for JoBimText

"Structure from nothing,
get your knowledge for free"

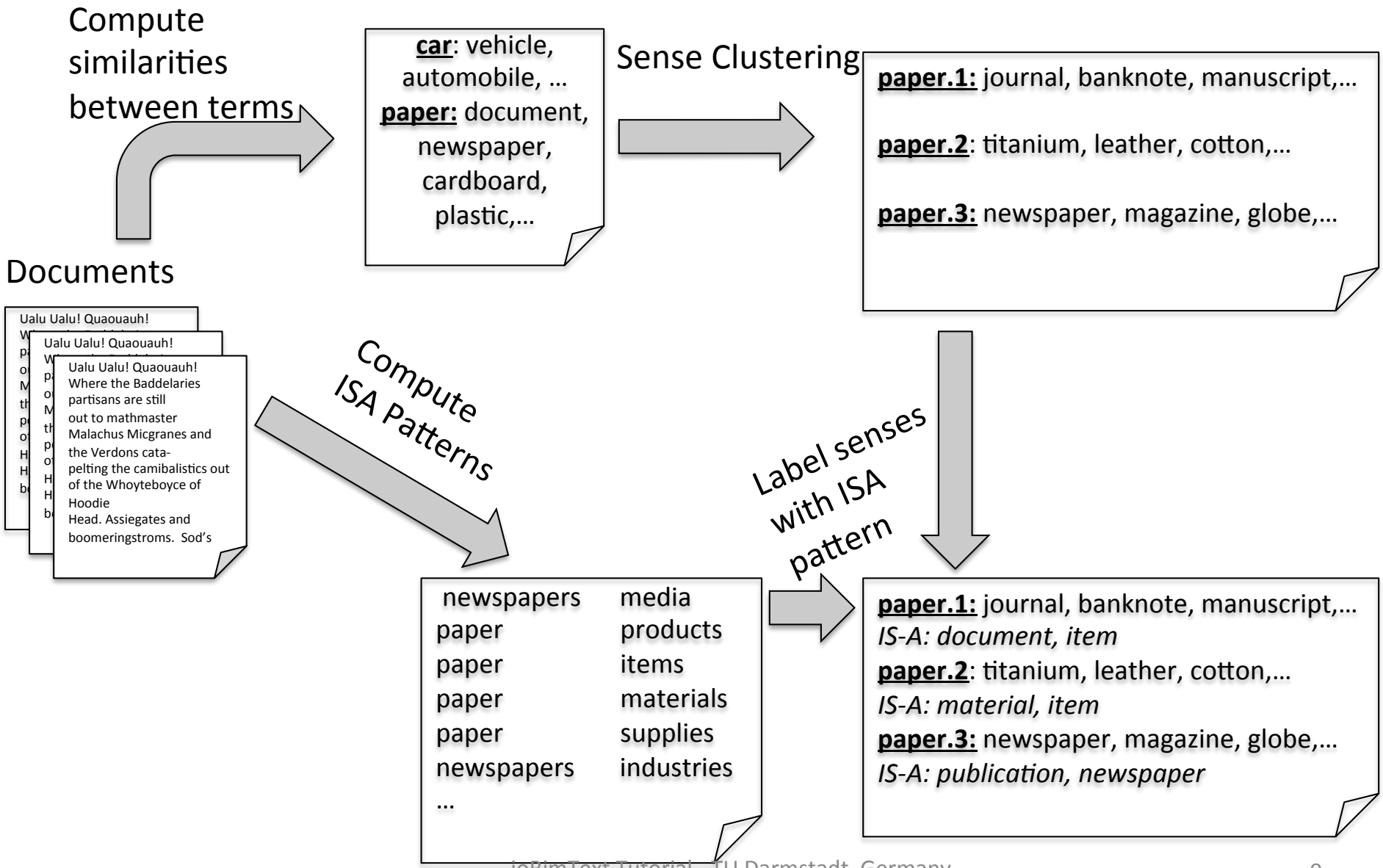
- Combine distributional method
- Use Methods which scale to large data
- Provide everything for free (source, models)

Distributional Semantics

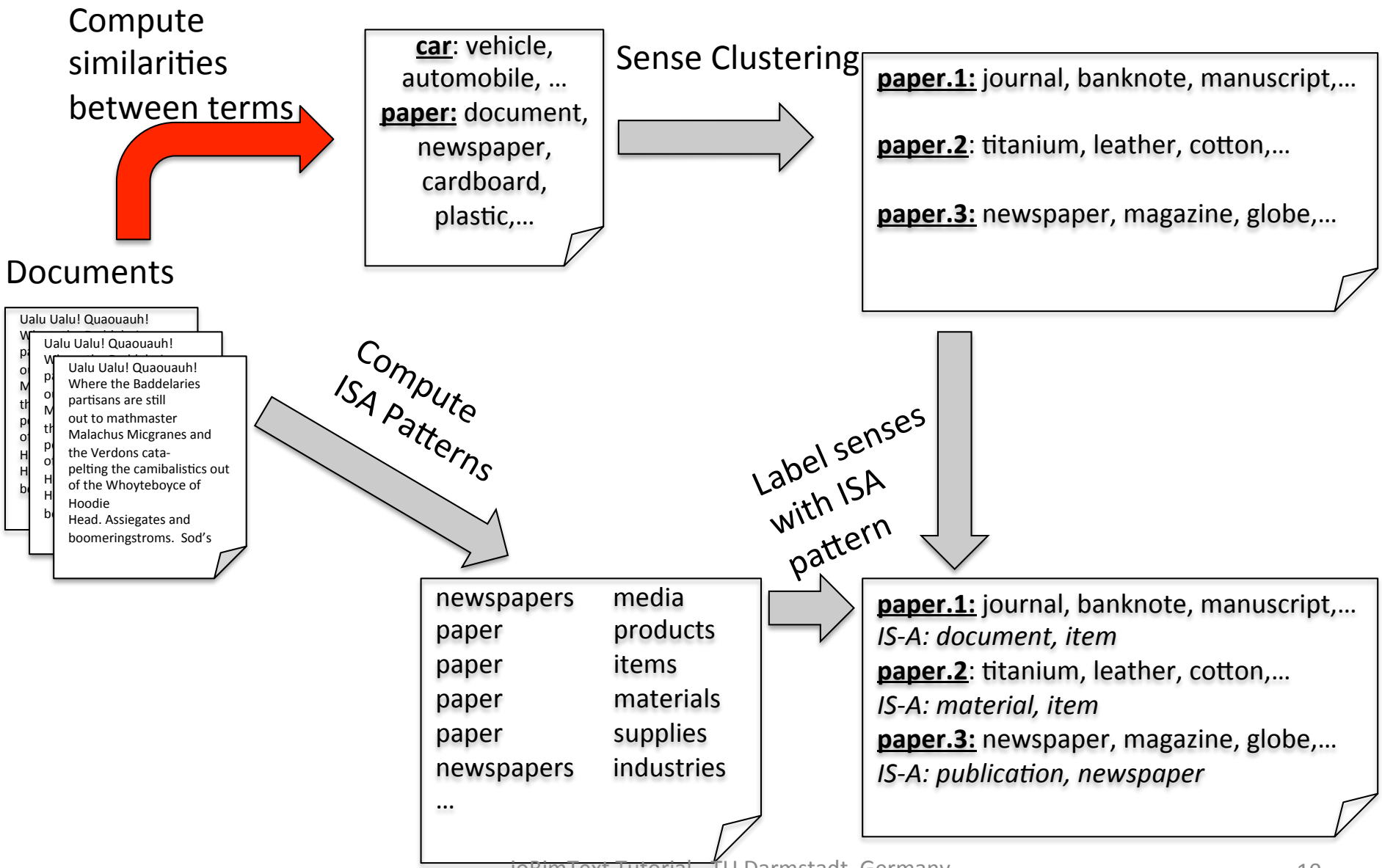
- Based on the distributional hypothesis
  (popularized by First 1957)

"a word is characterized
by the company it keeps"

The world of JoBimText



The world of JoBimText



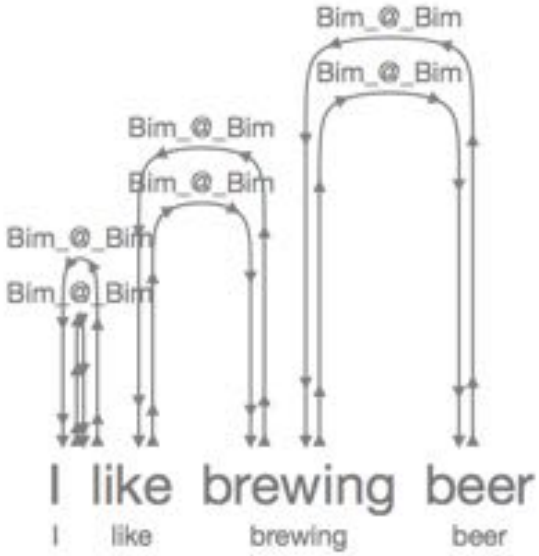
Computing Similarities

- @@-Operation - Extract Terms and Context
  - Terms (Jo): e.g. word, lemma, ngram, sentence, image
  - Context (Bim): e.g. neighboring words, dependency parses, words describing image

- Similarity Computation
  - Compute similarities between Jo's [and also Bim's]

Example: Trigram @@-Operation

- Input: I like brewing beer.
- Holing Operation:
  - Extract Relations
  - Extract Jo – Bim

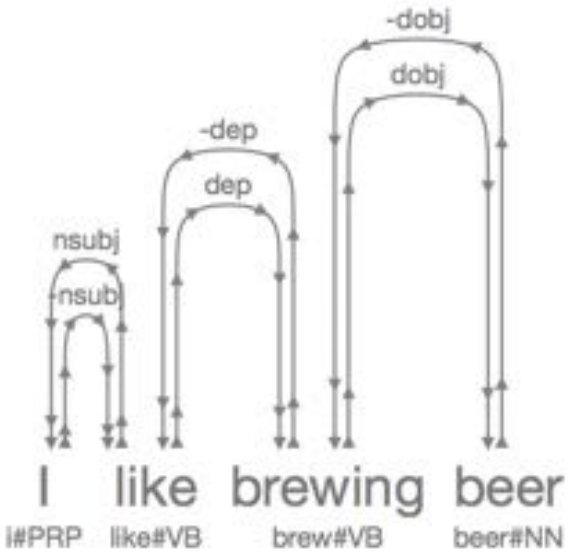


Relations
Trigram(_,I,like)
Trigram(I,like,brewing)
Trigram(like,brewing,beer)
Trigram(brewing,beer,_)

Jo	Bim
I	Trigram(_,@,like)
like	Trigram(I,@,brewing)
brewing	Trigram(like,@,beer)
beer	Trigram(brewing,@,_)

Example: Parsing @@-Operation

- Input: I like brewing beer.
- Holing Operation:
  - Parsing and Lemmatization
  - Relations
  - Extract Jo – Bim



Jo	Bim
like#VB	nsubj(I#PRP,@)
like#VB	dep(brew#VB,@)
Brew#VB	dobj(beer#NN,@)

Jo	Bim
I#PRP	nsubj(@, like#VB)
brew#VB	dep(@, like#VB)
beer#NN	dobj(@, brew#VB)

Computing Similarities

Output Holing Operation

Jo	Bim
like#VB	nsubj(I#PRP,@)
like#VB	dep(brew#VB,@)
brew#NN	dobj(beer#NN,@)
...	...

Jo Bim Counts

Jo	Bim	Count
beer#NN	dobj(sell#VB,@)	1997
beer#NN	dep(brew#VB,@)	803
beer#NN	nn(garden#NN,@)	2000
...	...	...

Jo Counts

Jo	Count
beer#NN	3125
like#VB	75324
brew#NN	1354
...	...

Bim Counts

Bim	Count
nsubj(I#PRP,@)	100024
dep(drink#VB,@)	75324
dobj(beer#NN,@)	1354
...	...

Pruning

Jo	Bim	Sig.
beer#NN	nn(bottle#NN,@)	19132.32
beer#NN	dobj(drink#VB,@)	18432.94
beer#NN	amod(@,cold)	16425.42
...	...	...

Significance Scores

Jo	Bim	Sig.
beer#NN	dobj(sell#VB,@)	9424.32
beer#NN	dep(brew#VB,@)	354.24
beer#NN	nn(garden#NN,@)	7054.32
...	...	...

LMI, PMI, LL

Aggregate Per Bim

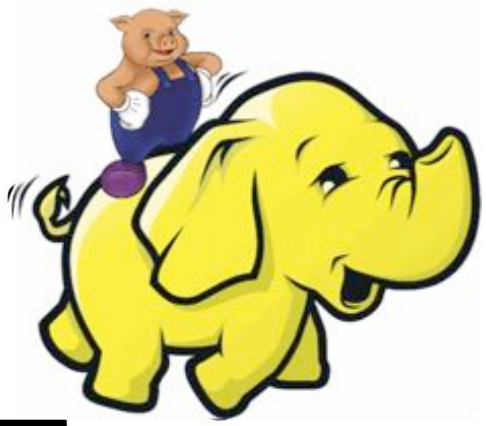
Bim	Jos
dobj(drink#VB,@)	beer#NN wine#NN water#NN coffee#NN soda#NN cola#NN ...
dep(brew#VB,@)	Coffee#NN beer#NN ale#NN lager#NN ...
...	...

Count Similar Jos

Jo 1	Jo 2	Count
beer#NN	wine#NN	153
beer#NN	coffee#NN	50
wine#NN	water#NN	203
beer#NN	lager#NN	243
...	...	...

Sort & Prune similar Jos

Jo 1	Jo 2	Count
beer#NN	beer#NN	1000
beer#NN	ale#NN	700
beer#NN	lager#NN	243
beer#NN	wine#NN	201
...	...	...



Hadoop
Pig

Distributional Thesaurus based on Jo's

Similar terms for beer using dependency parses on Newspaper data

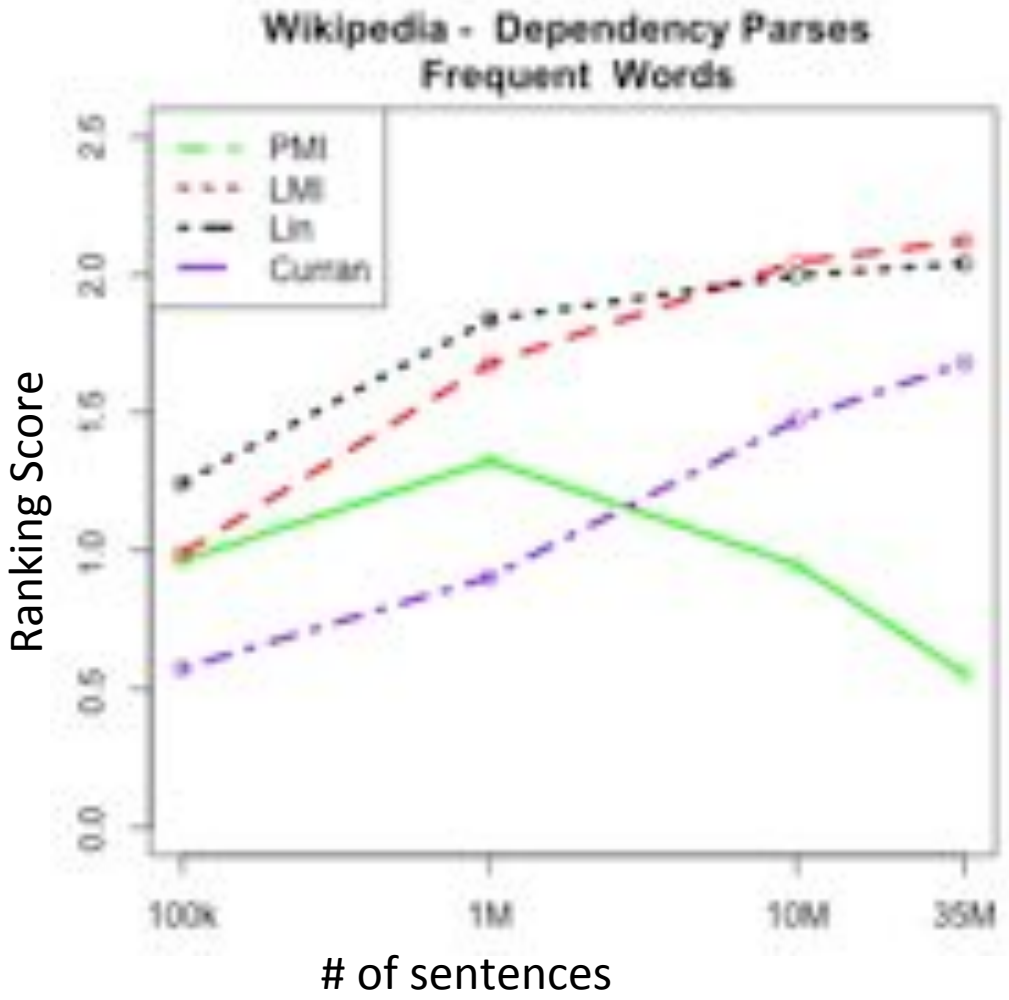
beer#NN	711
drink#NN	190
wine#NN	183
soda#NN	179
coffee#NN	175
beverage#NN	168
liquor#NN	155
tea#NN	154
lager#NN	140
champagne#NN	138
vodka#NN	136
whiskey#NN	126
ale#NN	126
milk#NN	119

Similar terms using n-grams and trigram holing based on medical data

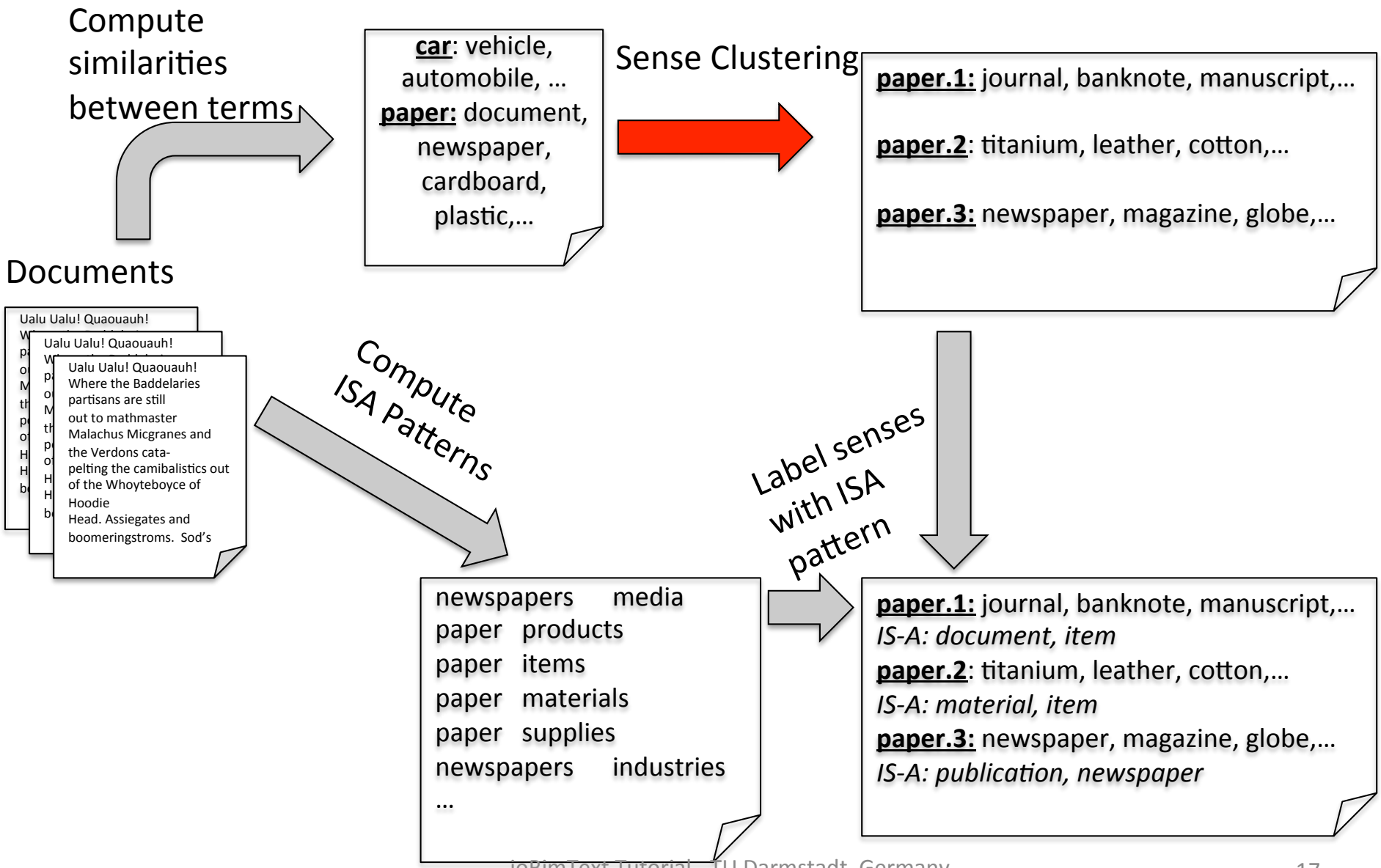
red blood cells	1000
erythrocytes	167
red cells	101
RBCs	43
human erythrocytes	33
and goats	27
platelets	27
peripheral blood lymphocytes	25
and cattle	24
RBC	23
red blood cell	22
reticulocytes	22
faeces	20
cell volume	20

Performance of our method

- Evaluate against manually created thesaurus
- Compare:
  - Our method with two significance measures (LMI & PMI)
  - Two other approaches (Lin, Curran)
- Best Results with our method when using large corpora
- Our method scales better



The world of JoBimText



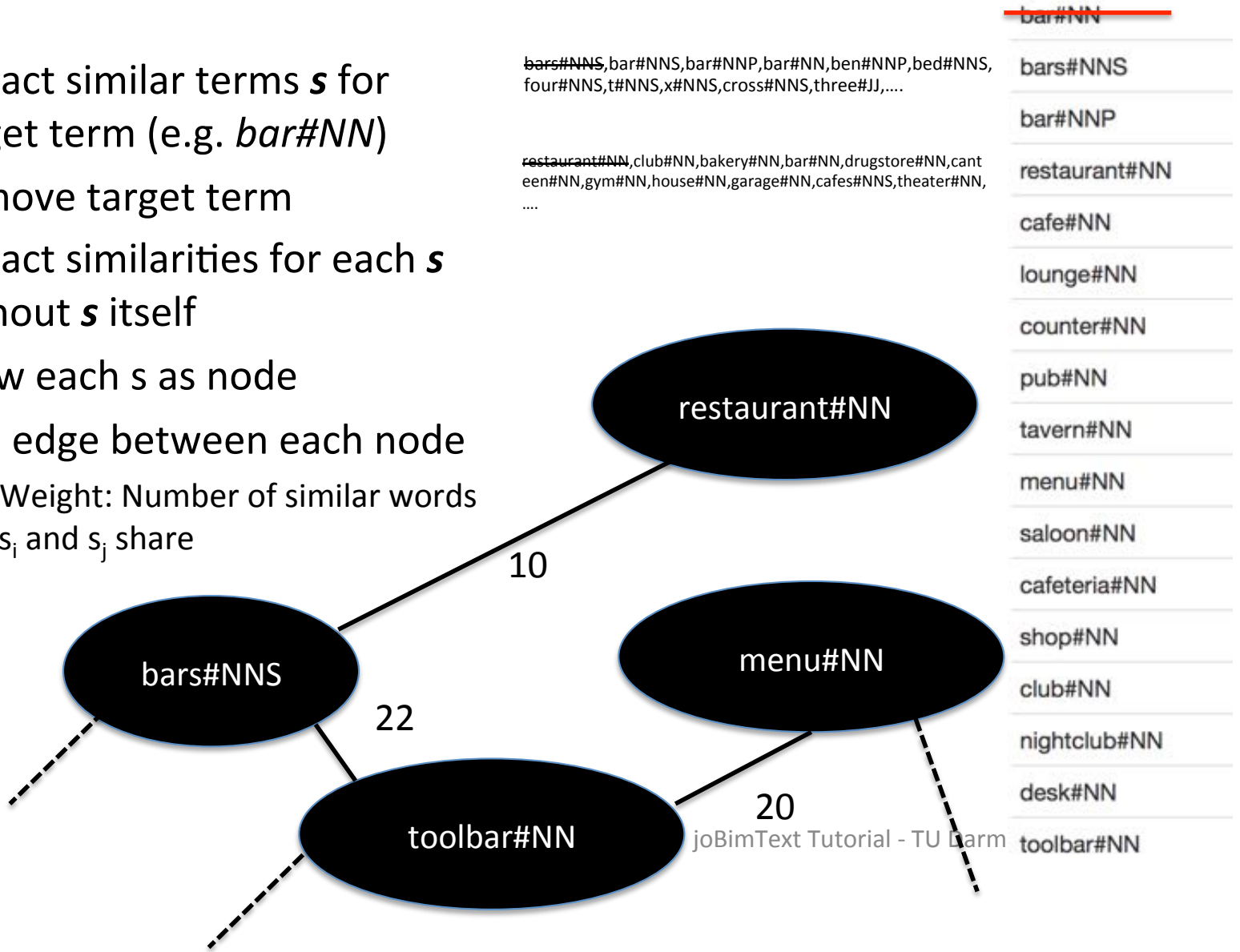
Computing Sense Cluster

- Use graph based Chinese Whispers
  - Pros:
    - No number of clusters needed
    - Time linear with the number of nodes
  - Contra:
    - non-deterministic
    - Does not converge

C. Biemann (2006): Chinese Whispers - an Efficient Graph Clustering Algorithm and its Application to Natural Language Processing Problems. Proceedings of the HLT-NAACL-06 Workshop on Textgraphs-06, New York, USA.

Building Graph

- Extract similar terms ***s*** for target term (e.g. *bar#NN*)
- Remove target term
- Extract similarities for each ***s*** without ***s*** itself
- Draw each s as node
- Add edge between each node
  - Weight: Number of similar words s_i and s_j share

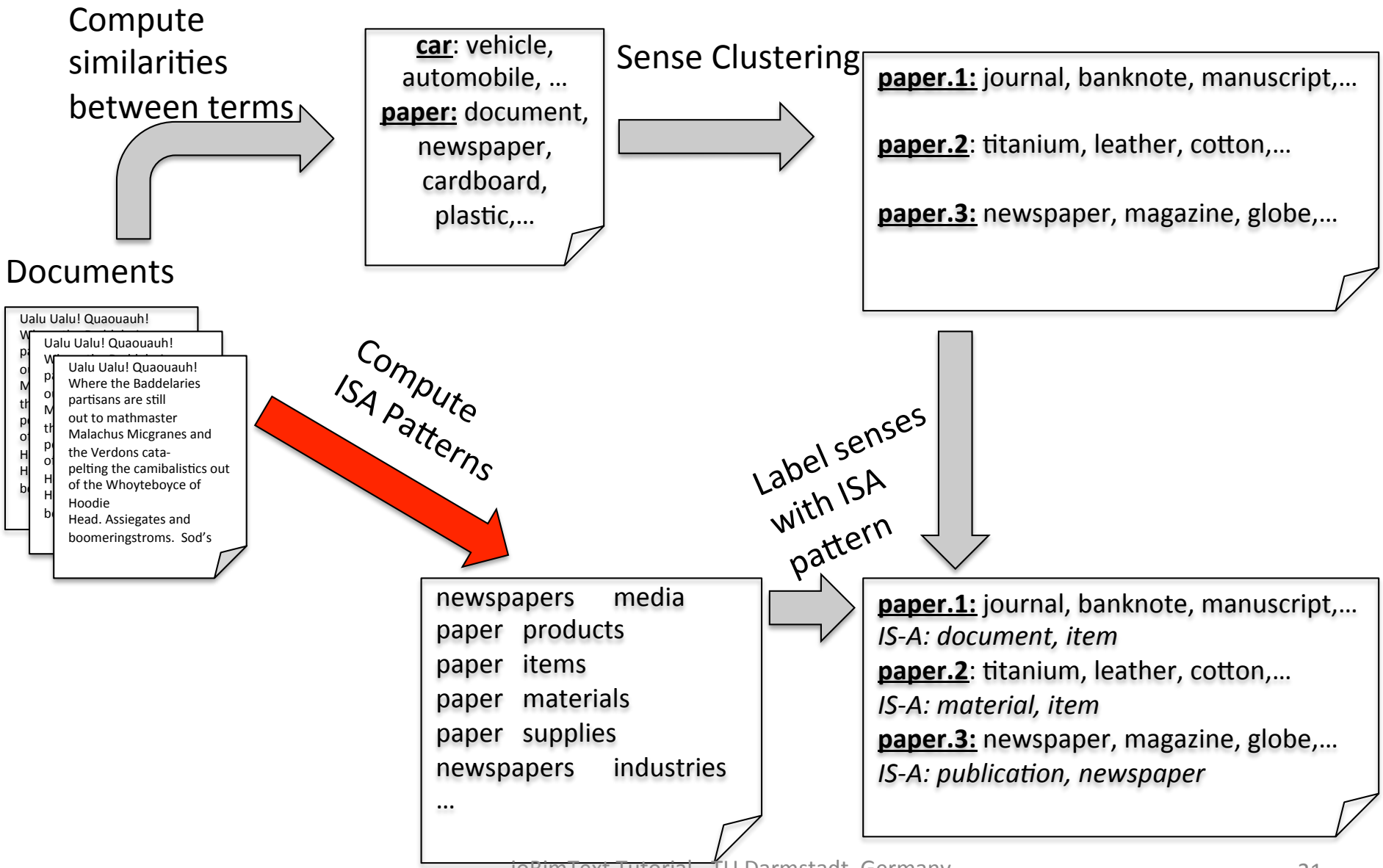


Clustering DT entries

bar#NN

Riedl M., Steuer R., Biemann C. (2014): Distributed Distributional Similarities of Google Books over Centuries. Proceedings Fourth International Conference on Language Resources and Evaluation (LREC 2014), Reykjavik, Iceland

The world of JoBimText



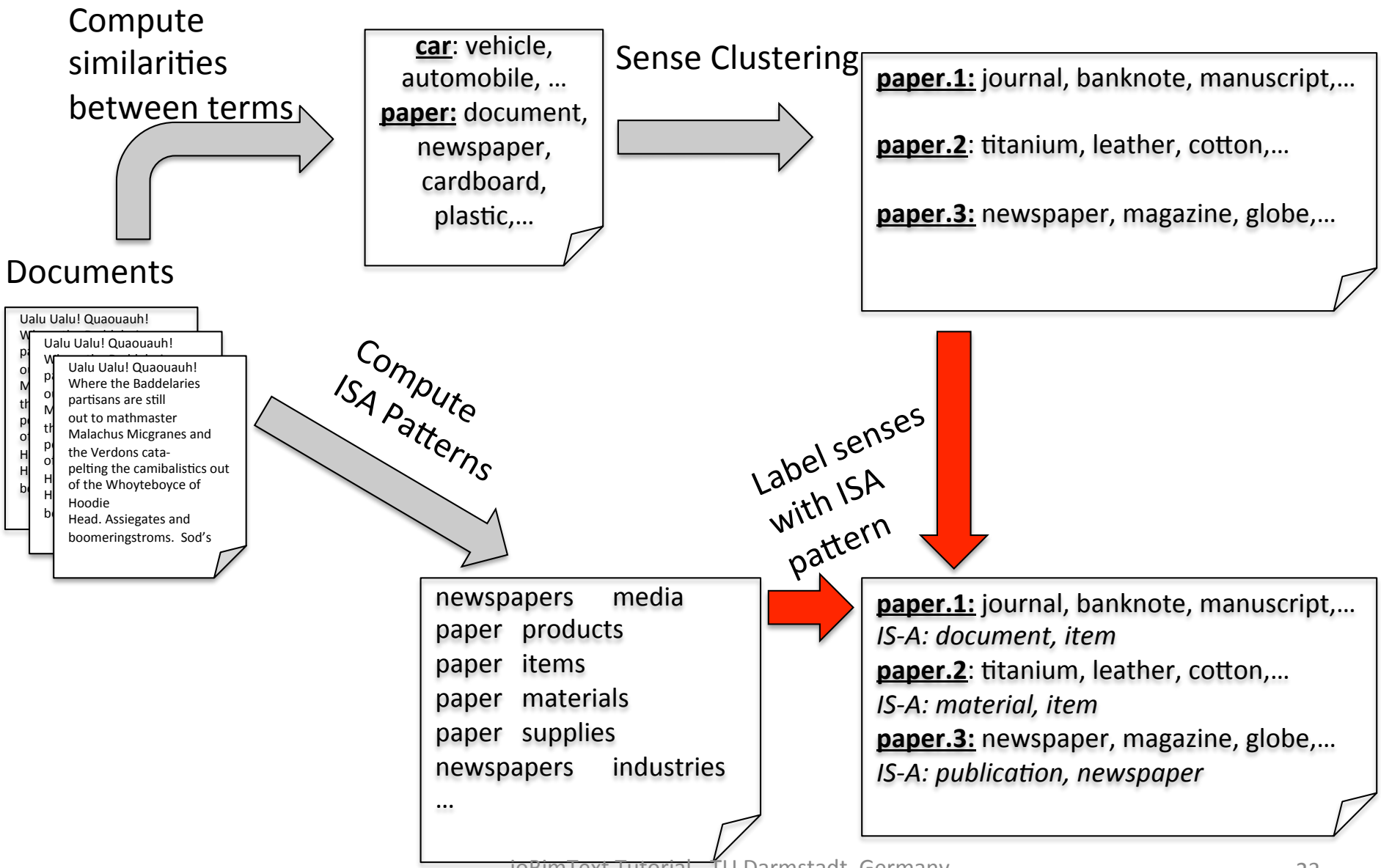
Cluster Labeling with IS-A Relations

- Run Hearst IS-A patterns
  (e.g. `NP such as NP, NP and NP`) on a
  large collection of text and store (noisy) IS-A pairs
  with their frequency, if above a threshold

bird flu ISA flu	829
bird flu ISA avian influenza	42
bird flu ISA infection	42
bird flu ISA influenza	27
bird flu ISA pandemic	27
bird flu ISA avian flu	16
bird flu ISA vaccine	15

Hearst, M. Automatic Acquisition of Hyponyms from Large Text Corpora, Proceedings of the Fourteenth International Conference on Computational Linguistics, Nantes, France, July 1992.

The world of JoBimText



Per-Cluster IS-A Pattern Counts

viral gastroenteritis ISA gastroenteritis 555
viral gastroenteritis ISA illness 27
viral gastroenteritis ISA stomach flu 24
viral gastroenteritis ISA cause 15

bird flu ISA flu 829
bird flu ISA avian influenza 42
bird flu ISA influenza 27
bird flu ISA avian flu 16

chicken pox ISA pox 2390
chicken pox ISA virus 93
chicken pox ISA infection 76
chicken pox ISA symptom 43
chicken pox ISA illness 38

infection(3310937) disease(1748000) virus(817950) cause(783692) symptom(578480) fever(375228) condition(209022) illness(192675) complication(161158) influenza(155469)

influenza#0 viral gastroenteritis, bird flu, pulmonary anthrax, h1n1, tularaemia, west nile fever, mumps, influenza a, herpes zoster, respiratory infection, uri, phn, chicken pox, ...

influenza#1 trivalent influenza vaccine, antiviral, influenza vaccine, amantadine, peramivir, chemoprophylaxis, influenza vaccination, vaccine, poultry, chickenpox vaccine, ...

peramivir ISA inhibitor
peramivir ISA option
peramivir ISA neuram

antiviral ISA medication 6

influenza vaccine ISA vaccine 1532
influenza vaccine ISA 2010-XX-XX 8
influenza vaccine ISA LAIV 8
influenza vaccine ISA table 8
influenza vaccine ISA contrast 6

vaccine(38566) drug(9990) agent(5004) vaccination(3960) treatment(2796) inhibitor(1504) medication(792) oseltamivir(752) medicine(448) zanamivir(396)

- Sum counts of ISA hypernym per cluster
- Multiply by number of times it was found by the cluster members

Gliozzo A., Biemann C, Riedl M., Coppola B., Glass M. R., Hatem M. (2013): JoBimText Visualizer: A Graph-based Approach to Contex–tualizing Distributional Similarity. Proceedings of the 8th Workshop on TextGraphs in conjunction with EMNLP 2013, Seattle, WA, USA

What's next

- Word Sense Induction System
  - Align sense cluster to word within sentence
- Semantic Search Engine
- Collapsed dependencies (for English and German)
- Multiword Expression Detector

NF-kappa B
transcription factors
transcription factor
I kappa B alpha
activated T cells
nuclear factor
human monocytes
gene expression
T lymphocytes

hausse des prix
mise en oeuvre
prise de participation
chiffre d' affaires
formation professionnelle
population active
taux d' intérêt
politique monétaire
Etats - Unis

APPLICATIONS FOR JOBIMTEXT

Solving OOV problem for POS tagging

- POS-tagging is hard for unknown words, which have not been observed in the training
- Schema: replace the unknown words with the most similar known word from an n-gram DT
- tag new sentence with standard POS tagger

OOV acc. PTB, TreeTagger

1-dimensional: 37.8%

2-dimensional: 74.1%

Knowledge-based Word Sense Disambiguation (Lesk-style)

A patient fell over a stack of magazines in an aisle at a physiotherapist practice.

customer	rose	pile	field	physician	session
student	dropped	copy	hill	attorney	game
individual	climbed	lots	line	psychiatrist	camp
person	increased	dozens	river	scholar	workouts
mother	slipped	array	stairs	engineer	training
user	declined	collection	road	journalist	meeting
passenger	tumbled	amount	hall	contractor	work
..	surged	ton	driveway	…	…
	…	…	…		

Zero word overlap

WordNet: S: (n) magazine (product consisting of a paperback periodic publication as a physical object) "tripped over a pile of magazines"

jumped	stack
woke	tons
turned	piece
drove	heap
walked	collection
blew	bag
put	loads
fell	mountain

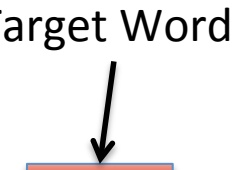
Overlap = 2

Overlap = 1

Overlap = 2

Tristan Miller, Chris Biemann, Torsten Zesch, Iryna Gurevych (2012): Using Distributional Similarity for Lexical Expansion in Knowledge-based Word Sense Disambiguation. Proceedings of COLING-12, Mumbai, India

Lexical Substitution using JobimText



Given: Sentences

This book is more than just a compendium of conference papers , however ….

Goal:

Find substitutions for target word that fit into the context

Evaluation:

Compare substitutions against gold standard

(several measures exist)

document 2;presentation 1;treatise 1;article 1;manuscript 1;

#Annotators

Lexical Substitution Results

Ranking using only DT

Ablation test for two different domain datasets

open domain [1]

	GAP	P@1
w/o n-gram features	47.3	48.9
w/o distr. thesaurus	49.8	55.0
w/o POS features	51.6	56.3
w/o WN features	51.7	57.0
Our model (all)	**52.4**	**57.7**

medical domain [2]

System	MAP	P@1
Baseline	0.6408	0.5365
ALL	0.7048	0.6366
w/o DT	0.5798	0.4835
w/o UMLS	0.6618	0.5651
w/o Ngrams	0.7009	0.6252
w/o POS	0.7027	0.6323

- significantly improvement with DT

[1] Supervised All-Words Lexical Substitution using Delexicalized Features György Szarvas and Chris Biemann and Iryna Gurevych In Proceedings of NAACL-HLT 2013, Seattle, USA
[2] Martin Riedl, Michael R. Glass, Alfio Gliozzo, 2014, Lexical Substitution for the Medical Domain, In Proceedings of EMNLP 2014, Doha, Qatar

Any Questions or Comments?

question#NN	comment#NN
query#NN	remark#NN
doubt#NN	suggestion#NN
concern#NN	statement#NN
issue#NN	commentary#NN
complaint#NN	feedback#NN
dilemma#NN	assertion#NN
idea#NN	announcement#NN
uncertainty#NN	speech#NN
matter#NN	criticism#NN