LingPy – A Python Library for Quantitative Tasks in Historical Linguistics

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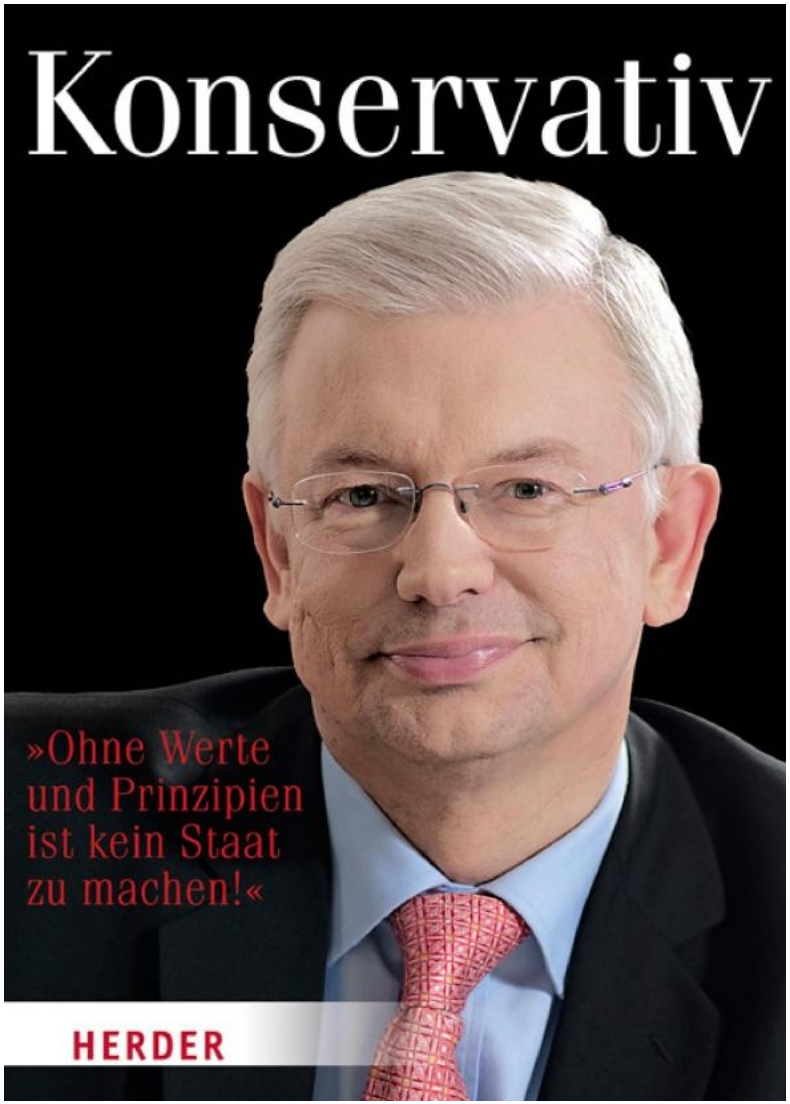
Introductory Remarks

What the *** is historical linguistics?

Introductory Remarks



Introductory Remarks

Konservativ kommt nicht von Konserve!

Angela Merkel (10. April 2000)

Introductory Remarks

konservativ

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Part of Speech	adjective
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Introductory Remarks

English *conservative*
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"antiquated"

Middle Latin *conservativus*
"protective"

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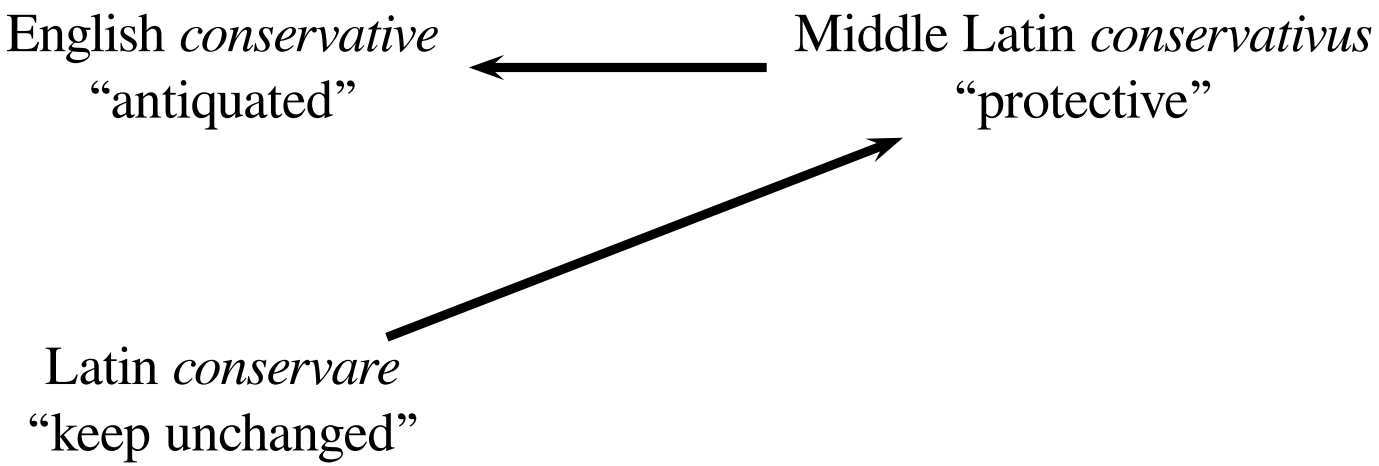

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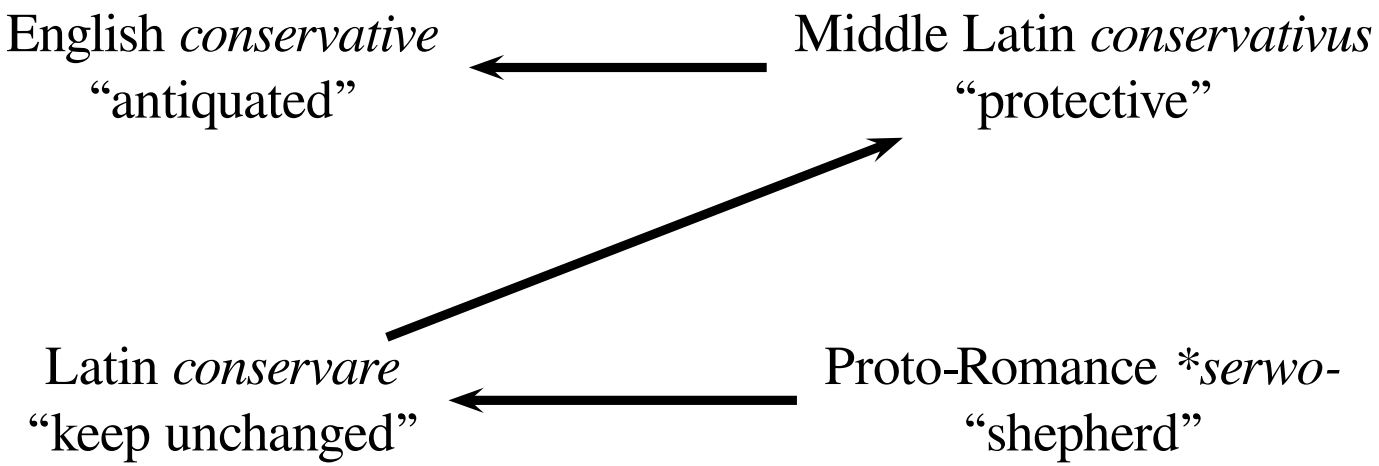

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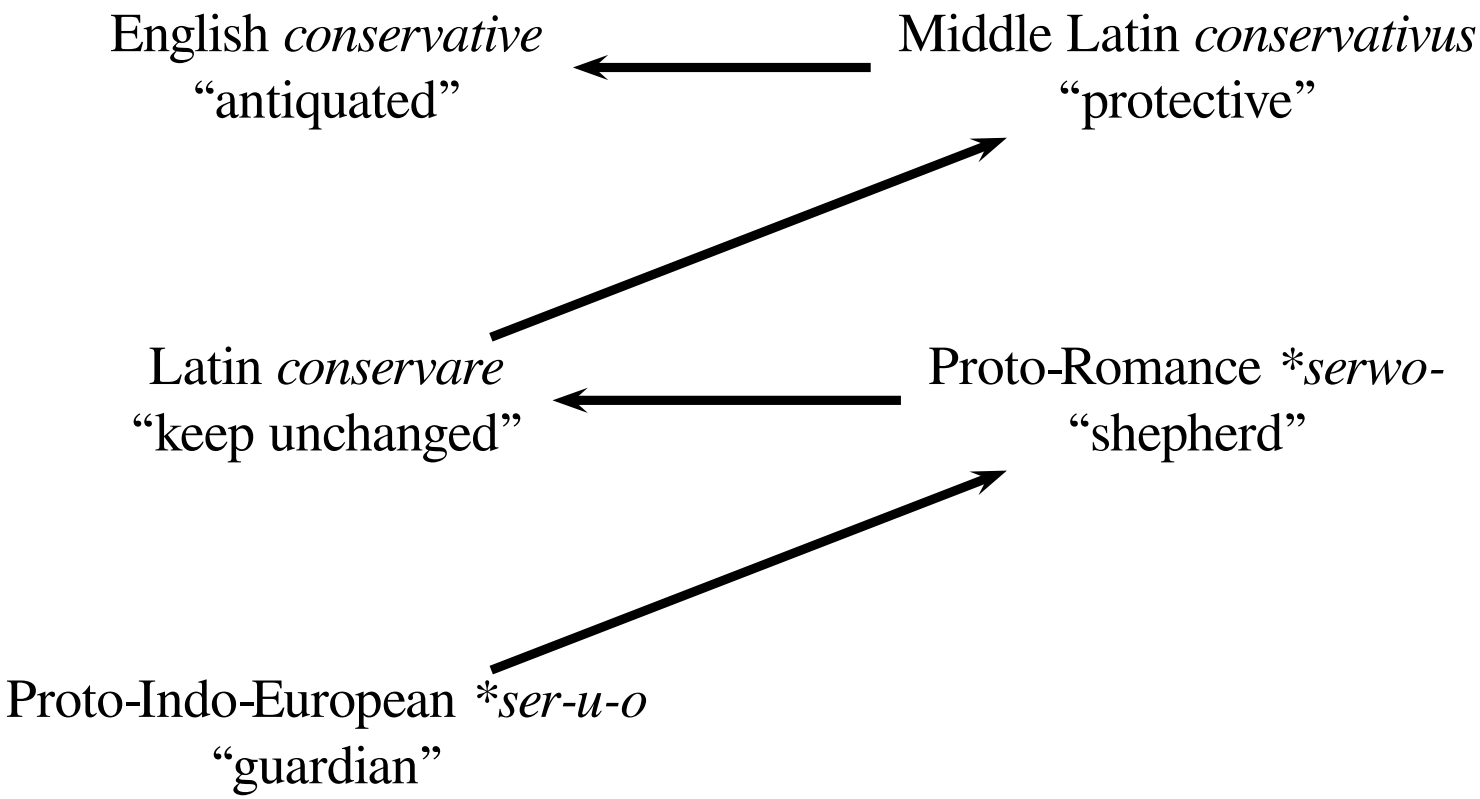

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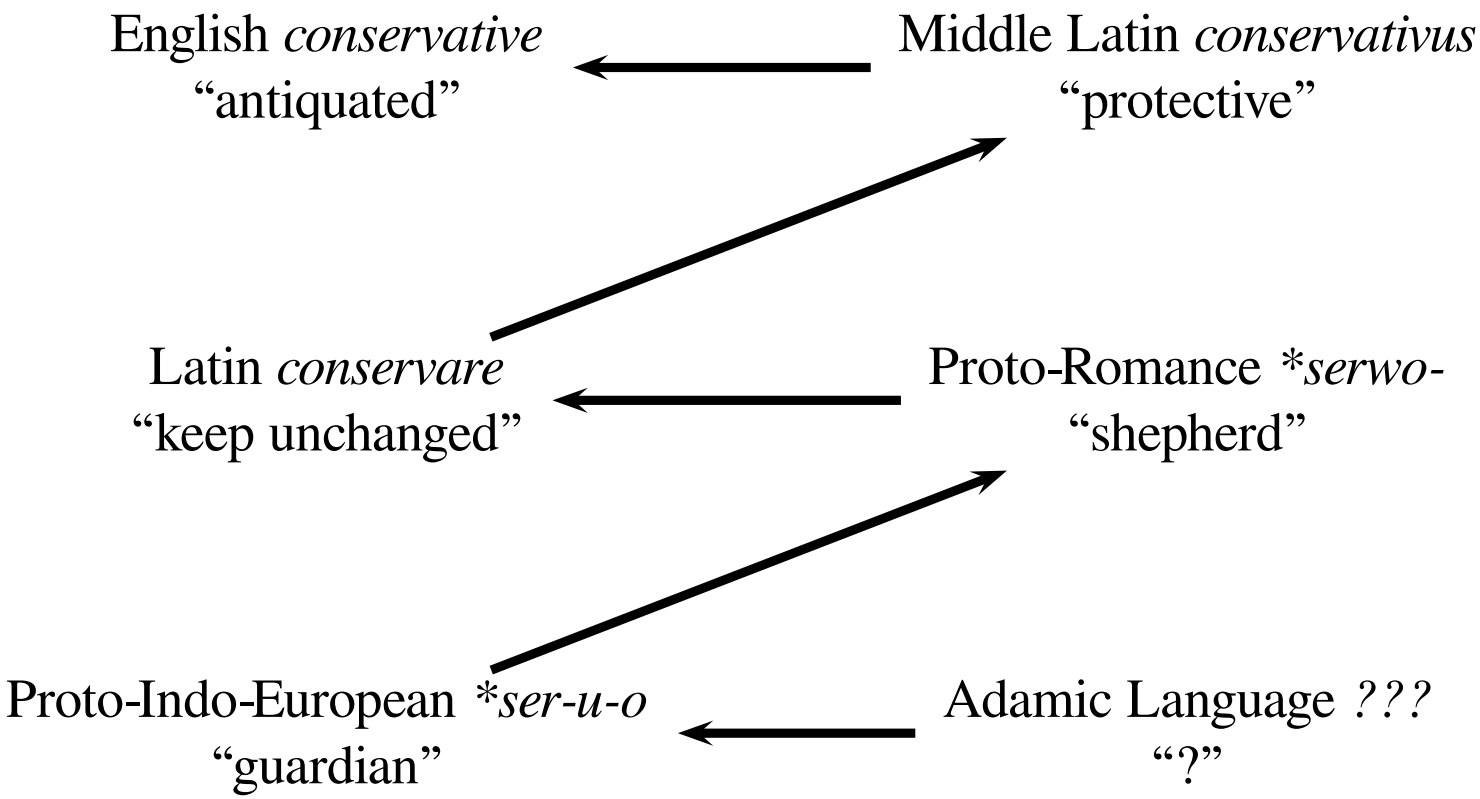

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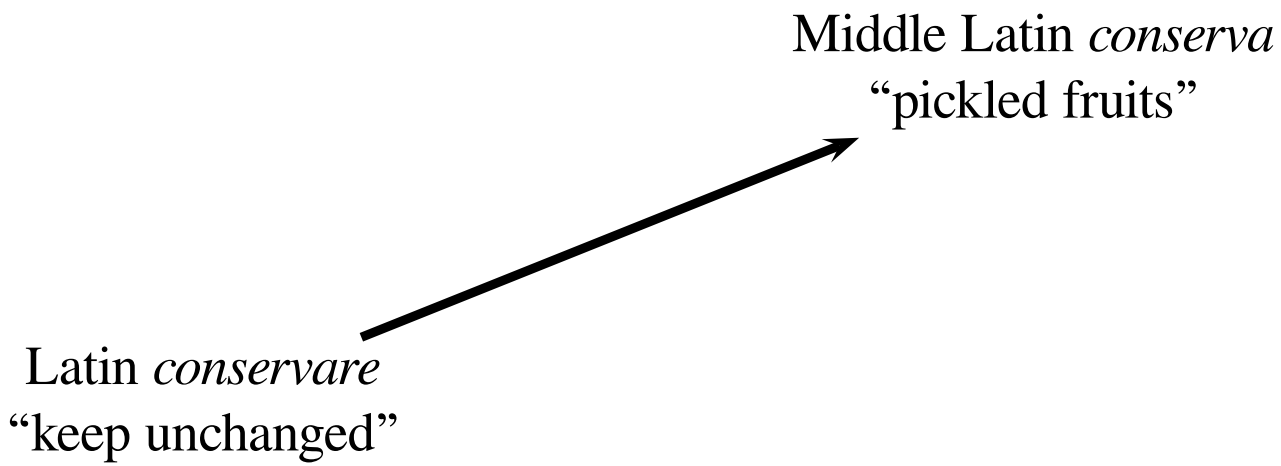

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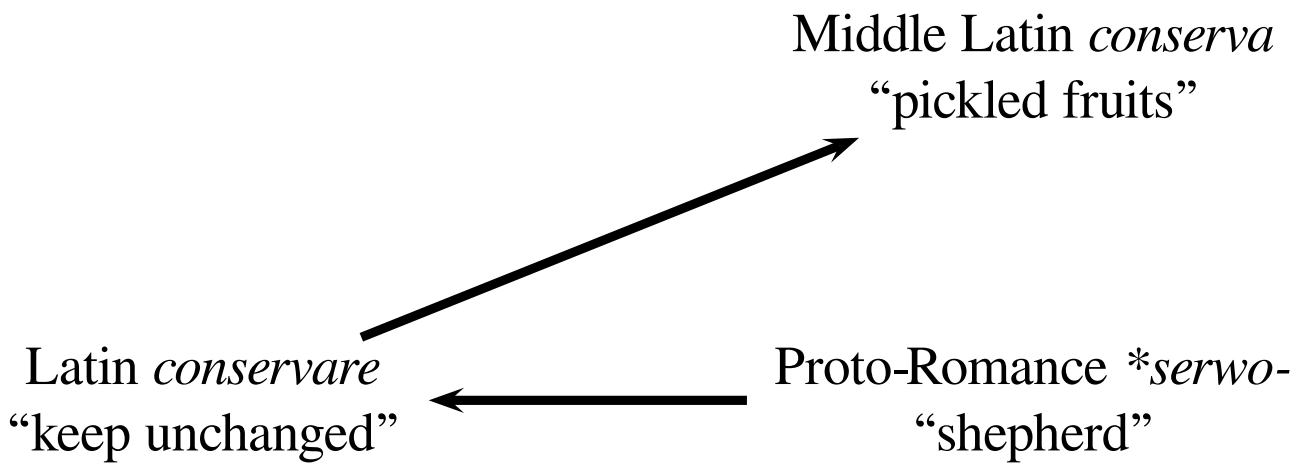

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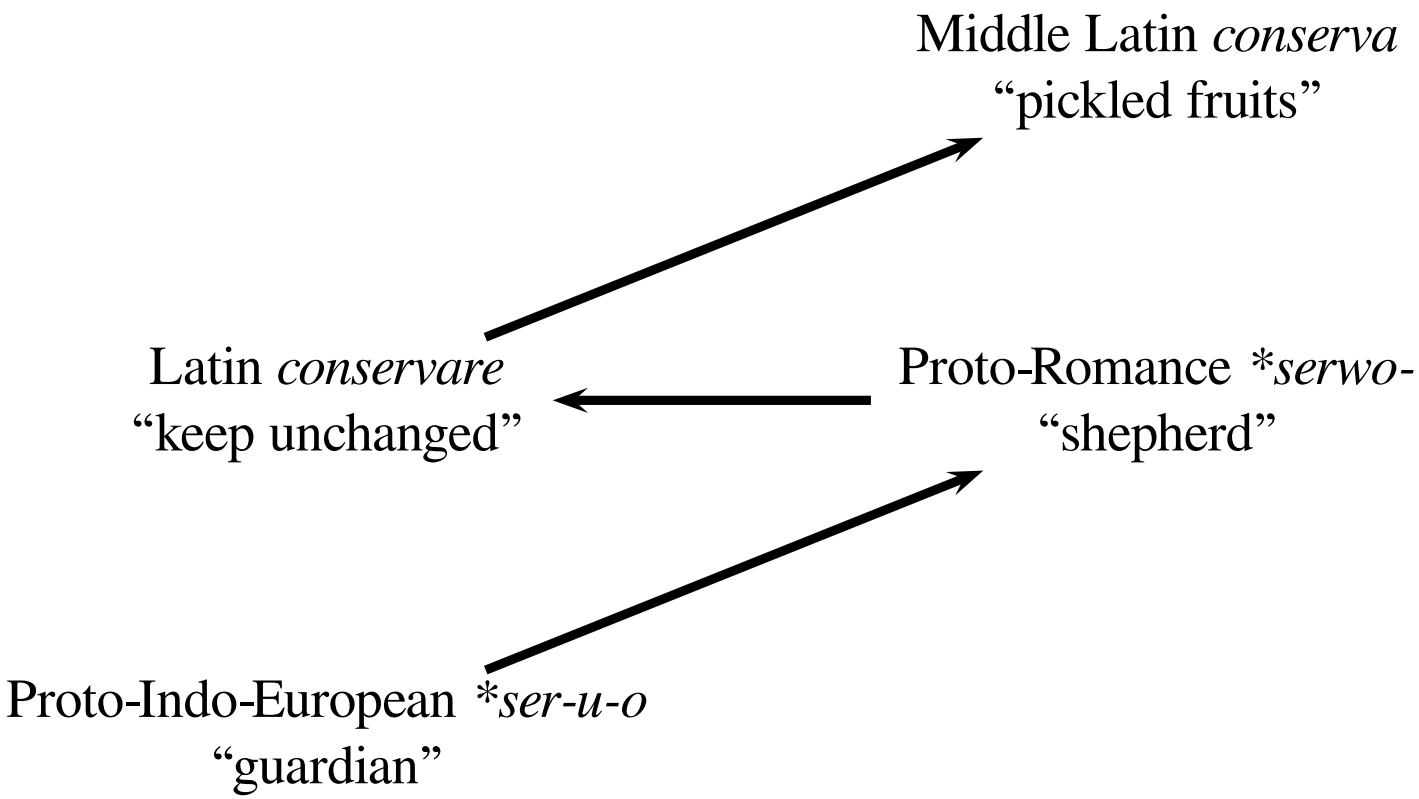

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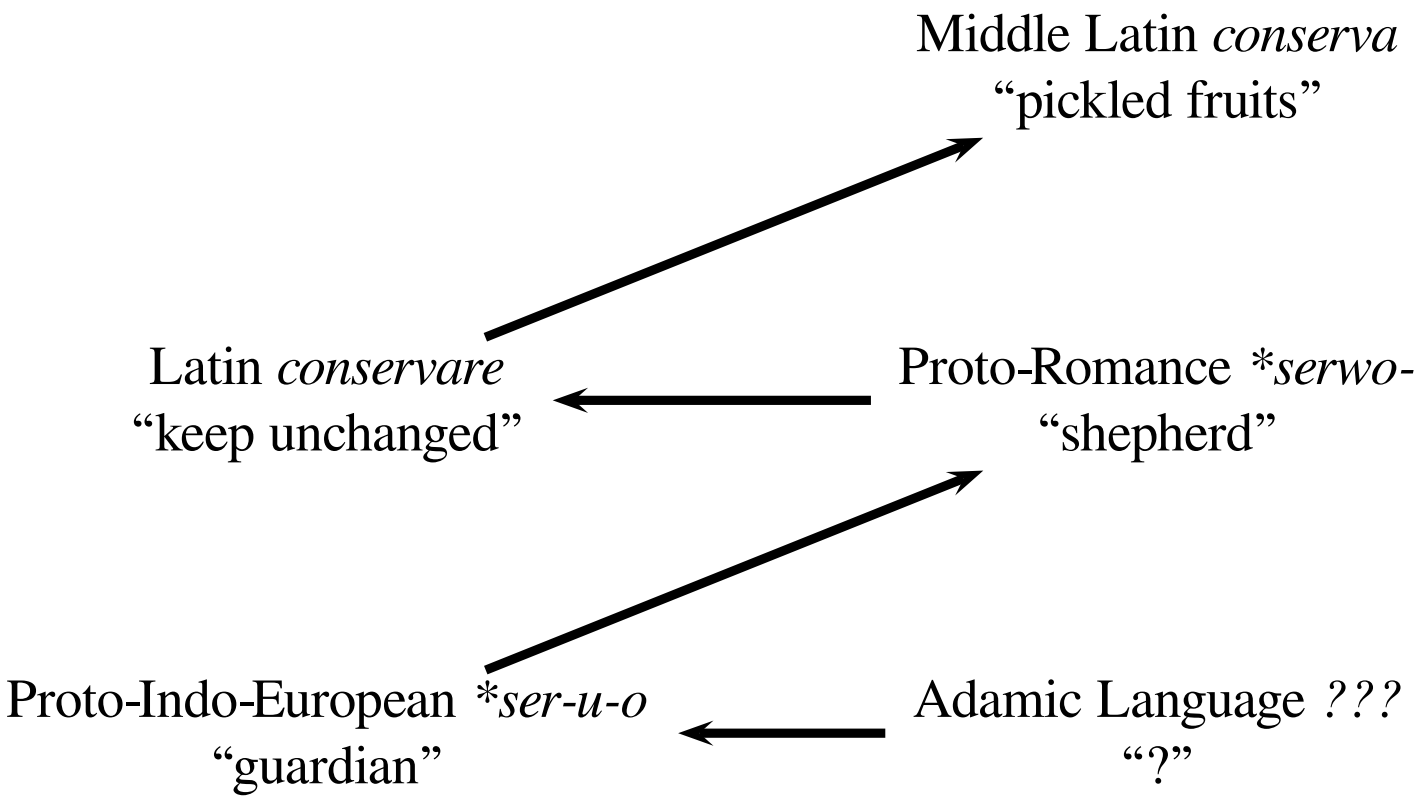

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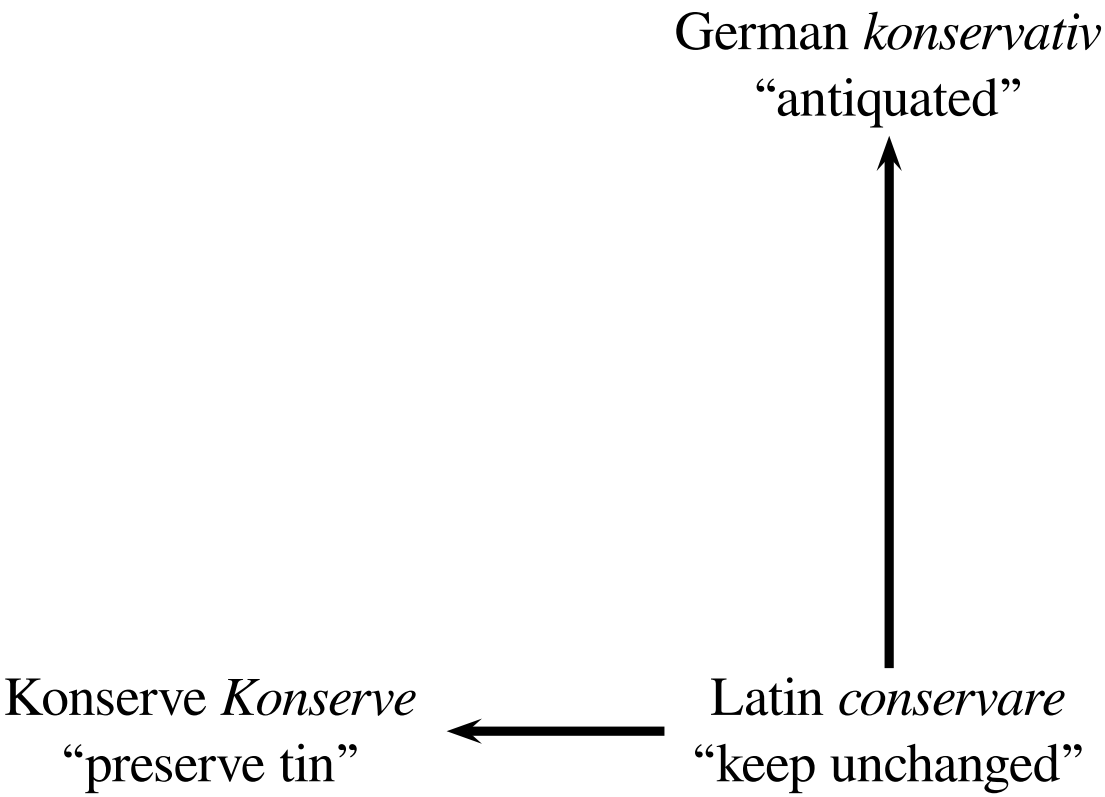

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Q. E. D.

Introductory Remarks

What the *** is historical linguistics?

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What the *** is historical linguistics?

Historical linguistics is a (scientific) discipline that does not specifically care about what words mean, but where they come from...

Structure of the Talk

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- LingPy can be invoked from the Python shell or inside Python scripts (examples are given in the online documentation).

Current Features

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- tokenize phonetic sequences

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- carry out pairwise alignment analyses of phonetic sequences
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- automatically search for cognates and etymologically related words in multilingual word lists

Basic Ideas

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- **adapt common techniques for sequence comparison and phylogenetic reconstruction to the specific needs of historical linguistics (general idea)**

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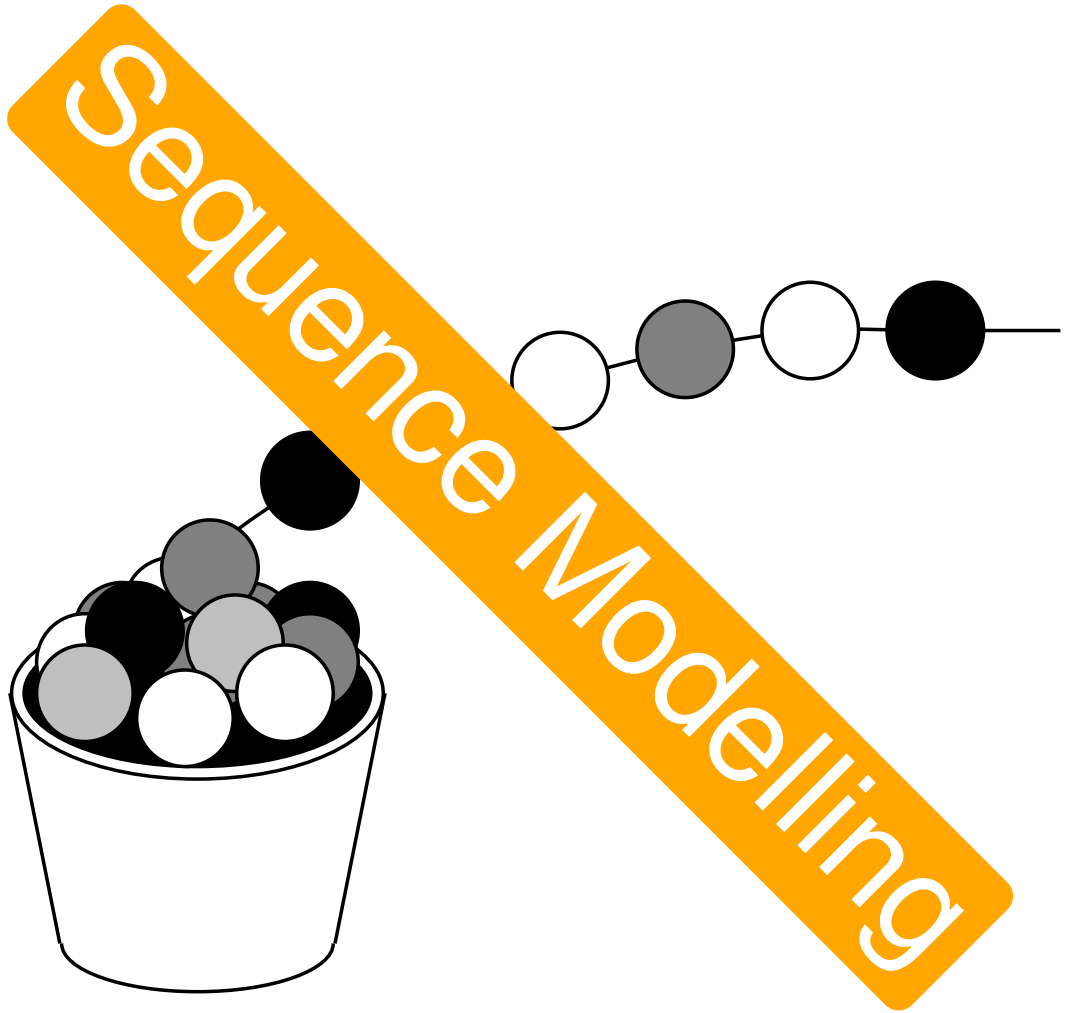
- **adapt common techniques for sequence comparison and phylogenetic reconstruction to the specific needs of historical linguistics (general idea)**
- construct realistic models of phonetic sequences by distinguishing external and internal representations (module `lingpy.sequence`)
- compare sequences in a way that closely reflects common linguistic theory (module `lingpy.compare`)
- compare languages in a way that closely reflects the basic methods of historical linguistics (module `lingpy.lexstat`)


Sequence Modeling

Excursus: Sequence Similarity

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Synchronic Sequence Similarity

Sequences are judged to be similar if the segments of the sequences are phonetically similar (‘phenotypic resemblence’, Lass 1997).

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Diachronic Sequence Similarity

Sequences are judged to be similar if the segments of the sequences correspond *systematically* ('genotypic resemblence', Lass 1997).

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Greek	mati	'eye'	≈	Malay	mata	'eye'
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German	$ts^haːn$	'tooth'	≈	English	tʊːθ	'tooth'
Spanish	etʃo	'fact'	≈	French	fɛ	'fact'

Paradigmatic Aspects

Sound Classes

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Sounds which often occur in correspondence relations in genetically related languages can be clustered into classes (types). It is assumed “that phonetic correspondences inside a ‘type’ are more regular than those between different ‘types’” (Dolgopolsky 1986: 35).

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k	g	p	b
tʃ	dʒ	f	v
t	d	ʃ	ʒ
θ	ð	s	z

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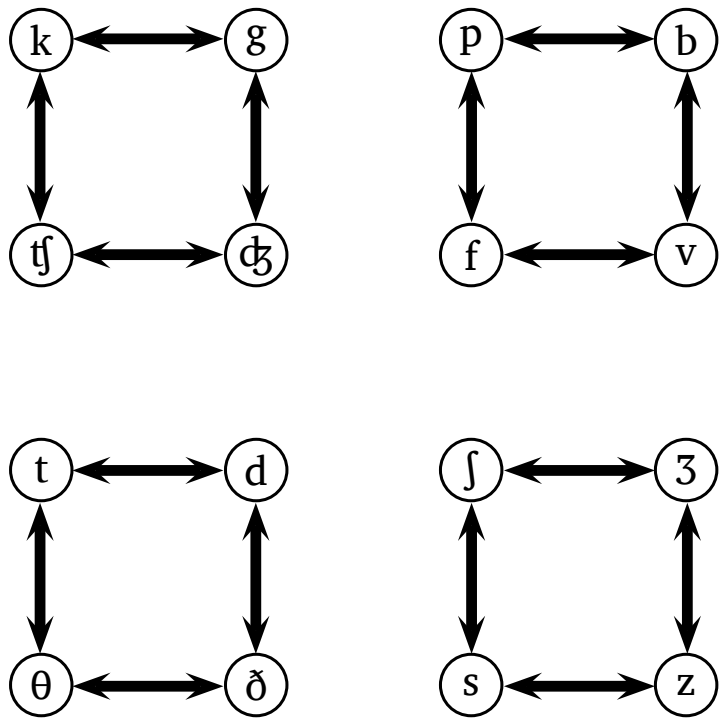

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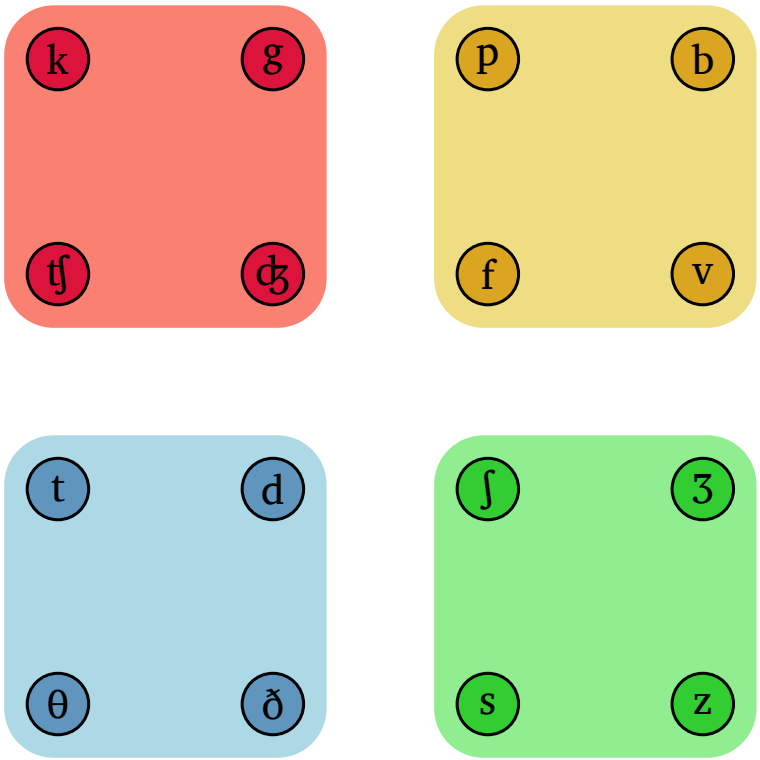

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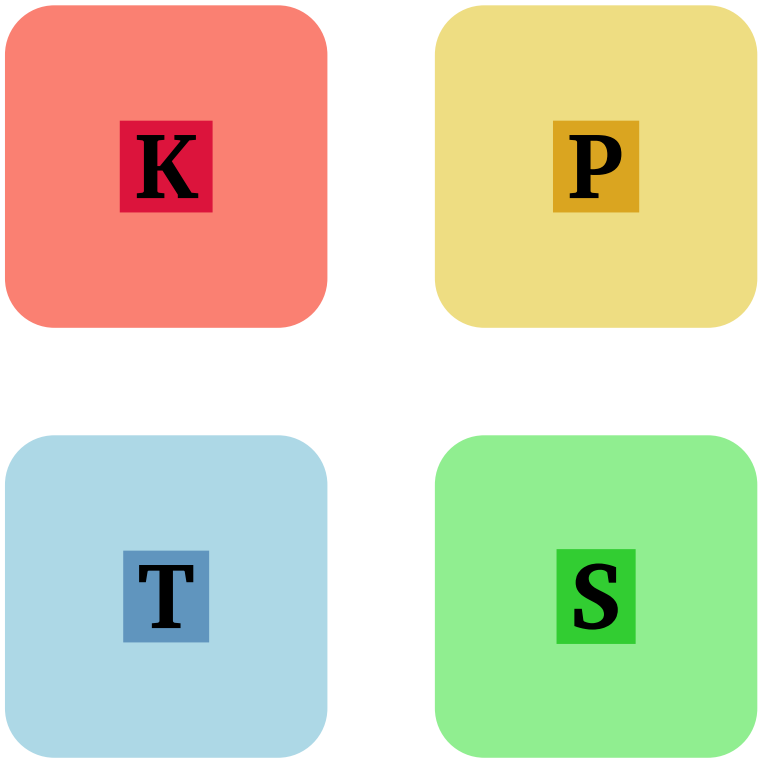

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- based on the relative strength of all sites in a phonetic sequence, substitution scores and gap penalties can be modified when carrying out alignment analyses

Syntagmatic Aspects

j a b ə l k a

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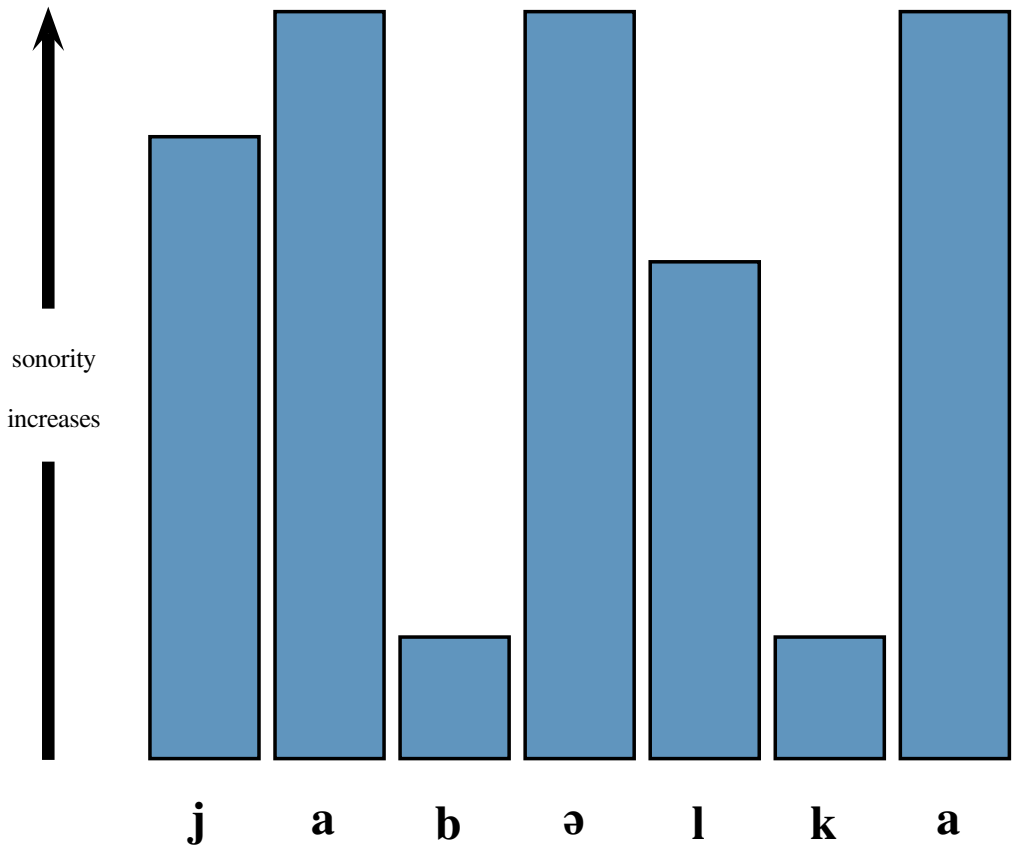

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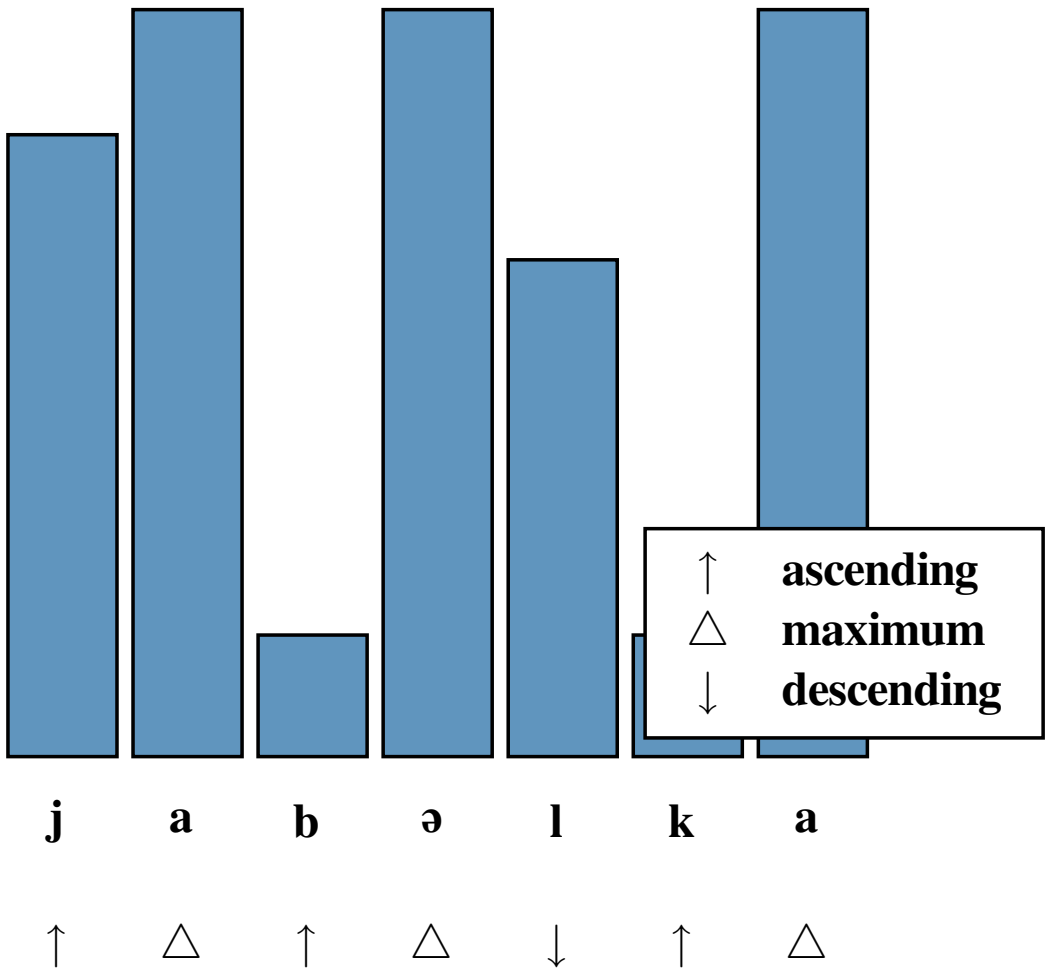

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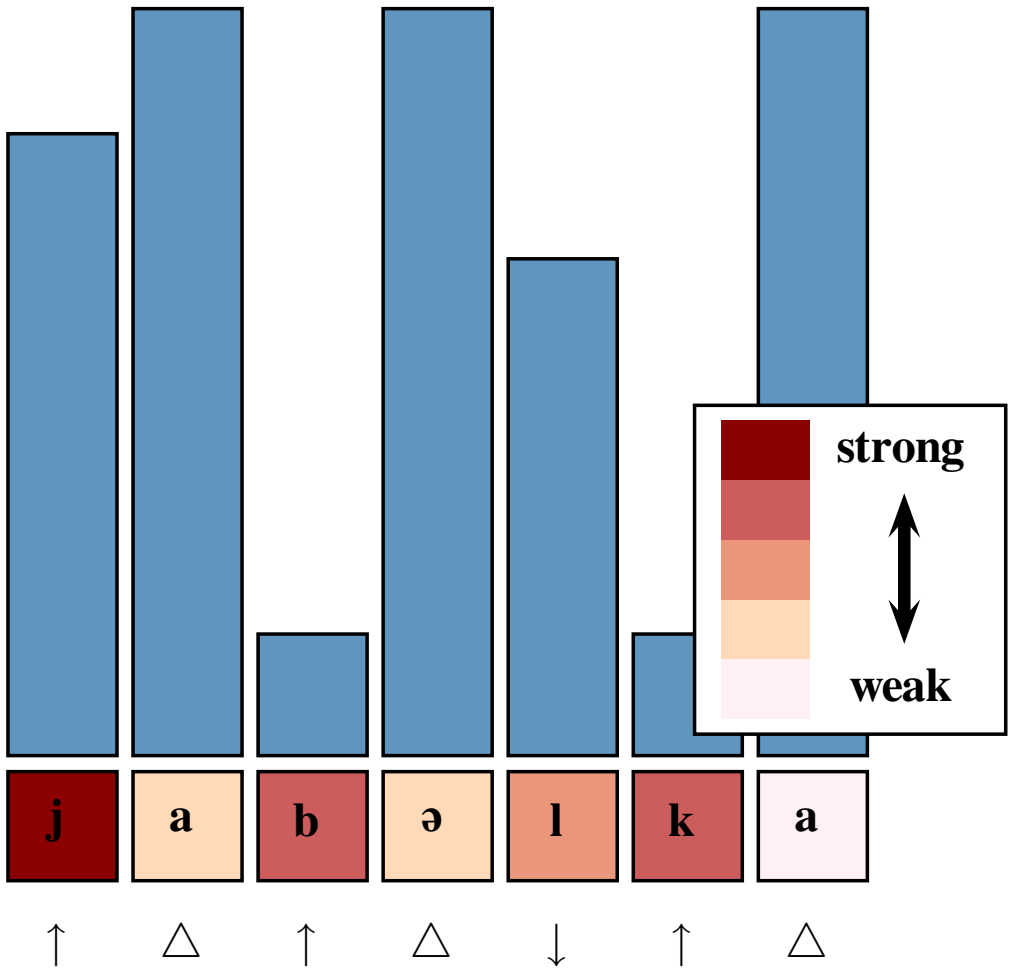

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#VcCvcCvCv$
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Phonetic Alignment

Excursus: Alignment Analyses

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In alignment analyses, sequences are arranged in a matrix in such a way that corresponding elements occur in the same column, while empty cells resulting from non-corresponding elements are filled with gap symbols.

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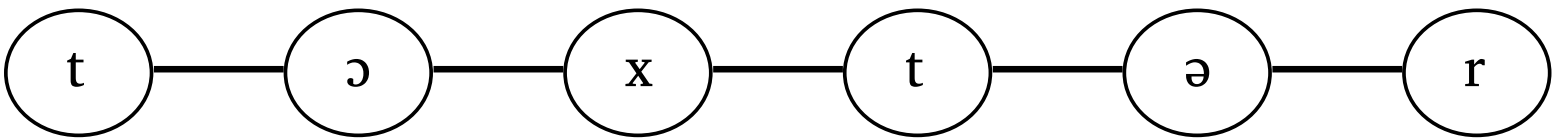

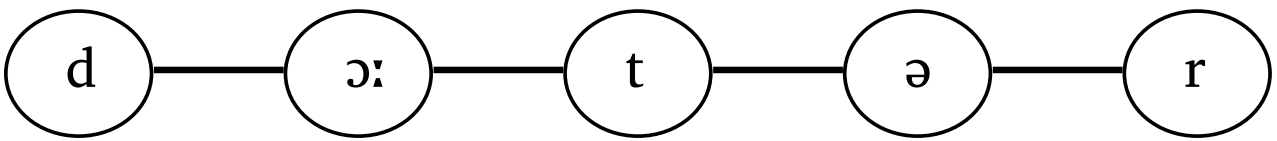

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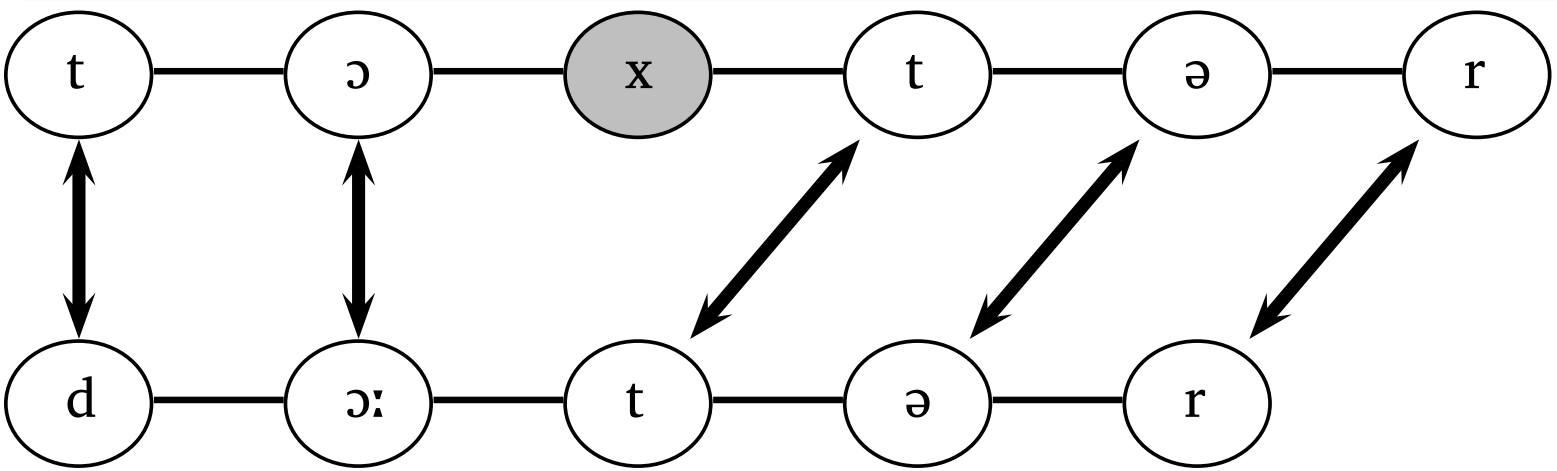

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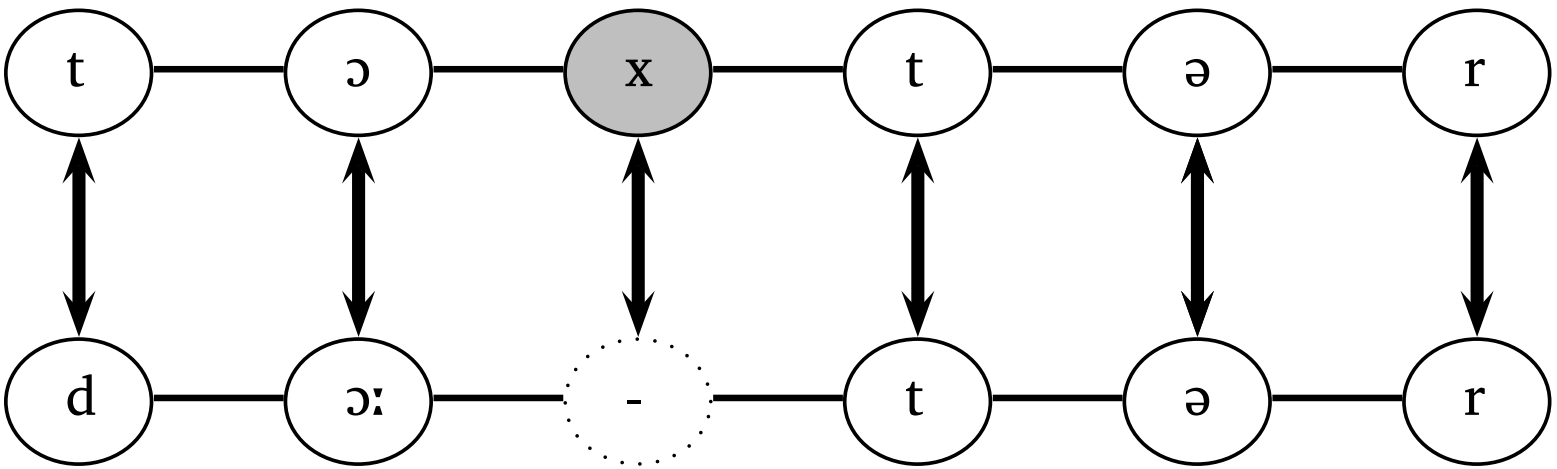

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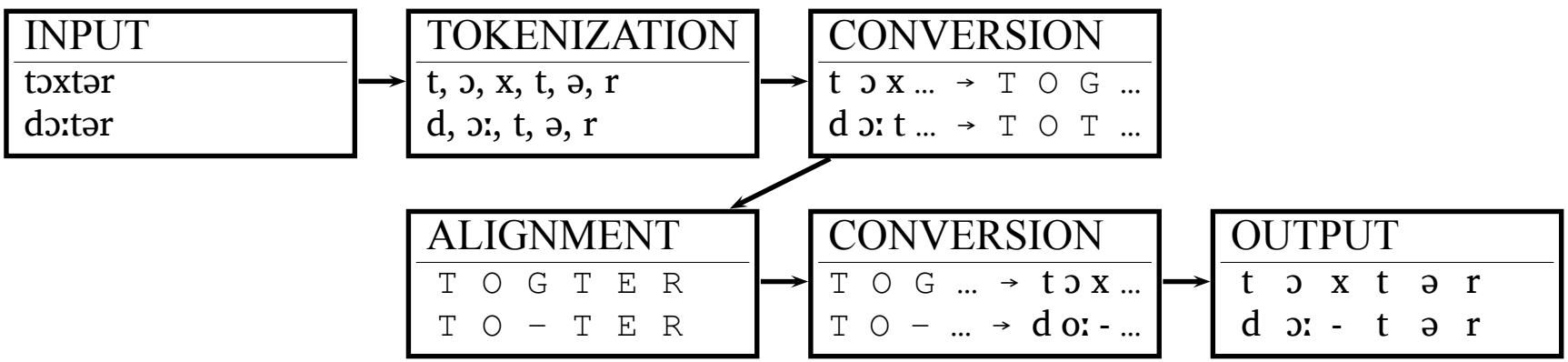

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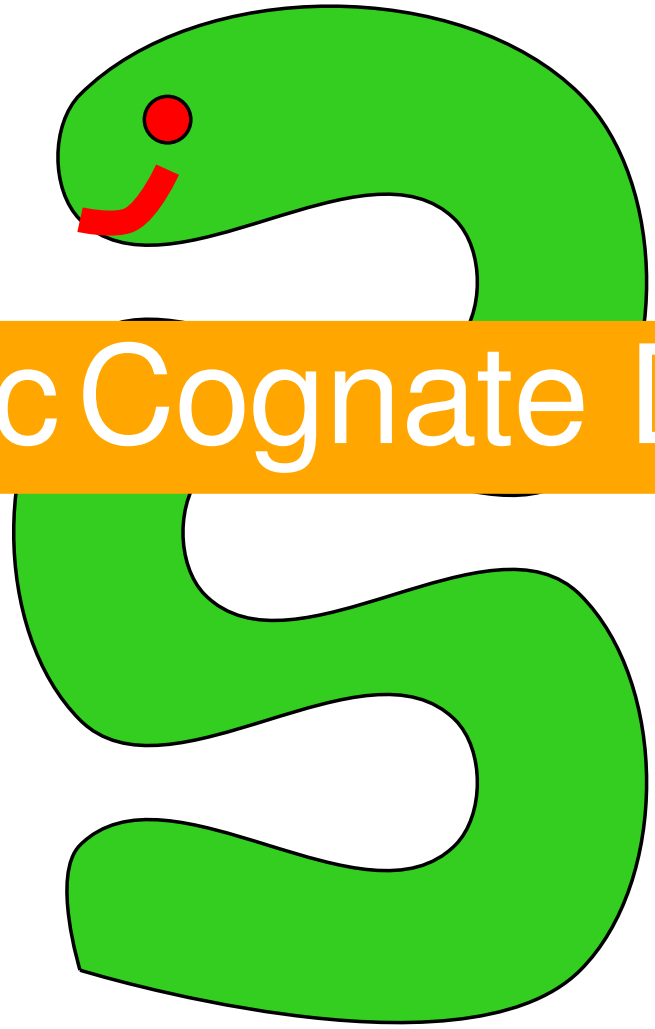
k  ɔ  n  z  ɛ  r  v  a  t  iː f
k  ɔ  n  z  ɛ  r  v  -  -  ə  -
0.3
```

Example

Taxon	Alignment									
Xiangtan	-	i	-	24	d	əɯ	12	-	-	-
Qingdao	-	i	-	42	tʰ	ou	-	-	-	-
Xi_an	-	ə	r	21	tʰ	ou	-	-	-	-
Wuhan	-	ɯ	-	213	tʰ	əu	-	-	-	-
Guangzhou	j	i	t	2	tʰ	ɐu	21	-	-	-
Nanning	j	i	t	22	tʰ	ɐu	21	-	-	-
Xianggang	j	ɐ	t	2	tʰ	ɐu	21	-	-	-
Nanning	j	ɐ	t	22	tʰ	ɐu	21	-	-	-
Taibei	l	i	t	44	tʰ	au	24	-	-	-
Xiamen	l	i	t	5	tʰ	au	-	-	-	-
Jian_ou	m	i	-	33	tʰ	e	33	-	-	-
Shexian	n	i	-	22	tʰ	iu	44	-	-	-
Fuzhou	n	i	ʔ	5	tʰ	au	53	-	-	-
Shantou	z	i	k	5	-	-	-	-	-	-
Shantou	z	i	k	5	tʰ	au	55	-	-	-
Haikou	z	i	t	3	-	-	-	-	-	-
Haikou	z	i	t	3	h	au	31	-	-	-
Taoyuan	ŋ	i	t	22	tʰ	eu	11	-	-	-
Meixian	ŋ	i	t	1	tʰ	eu	11	-	-	-
Wenzhou	ɳ	i	-	213	d	ɤu	-	-	-	-
Wenzhou	ɳ	i	-	213	d	ɤu	31	v	ai	213
Nanchang	ɳ	i	ʔ	5	tʰ	u	02	-	-	-
Tunxi	ɳ	ie	-	11	tʰ	iu	44	-	-	-
Suzhou	ɳ	iə	ʔ	3	d	ʏ	13	-	-	-
Shanghai	ɳ	ɪ	ʔ	1	d	ɤ	13	-	-	-
Kunming	ʐ	ə	-	31	tʰ	əu	31	-	-	-
Hefei	ʐ	ə	ʔ	5	tʰ	ɯ	-	-	-	-
Xining	ʐ	ɛ	-	44	tʰ	ɯ	24	-	ɛ	24
Jinan	ʐ	ɿ	-	21	tʰ	ou	-	-	-	-
Changsha	ʐ	ɿ	-	24	t	əu	-	-	-	-
Zhengzhou	ʐ	ɿ	-	24	tʰ	ou	-	-	-	-
Lanzhou	ʐ	ɿ	-	13	tʰ	ou	13	-	-	-
Yinchuan	ʐ	ɿ	-	13	tʰ	əu	-	-	-	-
Haerbin	ʐ	ɿ	-	53	tʰ	ou	-	-	-	-
Beijing	ʐ	ɿ	-	51	tʰ	ou	1	-	-	-
Huhehaote	ʐ	ɿ	-	55	tʰ	əu	31	-	-	-
Pingyao	ʐ	ʌ	ʔ	53	t	əu	13	-	iᴇ	13



Automatic Cognate Detection

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Language-Specific Similarity Measure

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Meaning	German	Dutch	English
"tooth"	*Zahn* [ts aːn]	*tand* [t ɑnt]	*tooth* [t oːθ]
"ten"	*zehn* [ts eːn]	*tien* [t iːn]	*ten* [t ɛn]
"tongue"	*Zunge* [ts ʊŋə]	*tong* [t ɔŋ]	*tongue* [t ʌŋ]

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Meaning	Shanghai	Beijing	Guangzhou
“nine”	[tɕ iɤ^{35}]	Beijing [tɕ iou^{214}]	[k ɐu^{35}]
“today”	[tɕ iŋ^{55}tsɔ^{21}]	Beijing [tɕ iɚ^{55}]	[k ɐm^{53}jɐt^{2}]
“rooster”	[koŋ^{55} tɕ i^{21}]	Beijing[kuŋ^{55} tɕ i^{55}]	[k ɐi^{55}koŋ^{55}]

Automatic Cognate Detection

LexStat (List 2012b)

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- LexStat yields **transparent** decisions which can be directly examined by the researcher

Automatic Cognate Detection

ID	Items	German	English	Swedish
1	hand	hant	hænd	hand
2	woman	fraʊ	wʊmən	kvina
3	know	kɛnən	nəʊ	çɛna
3	know	vɪsən	-	ve:ta
…	…	…	…	…

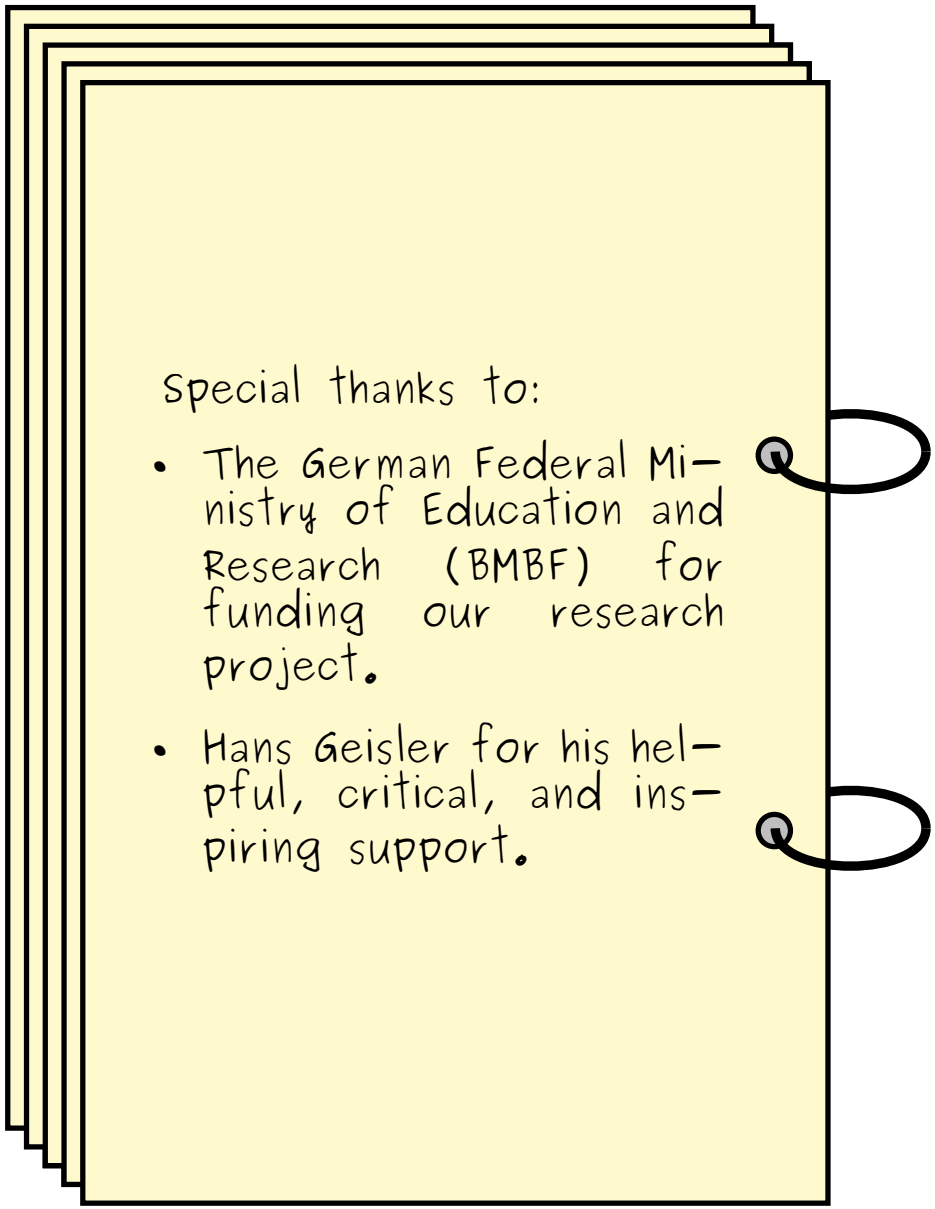
Automatic Cognate Detection

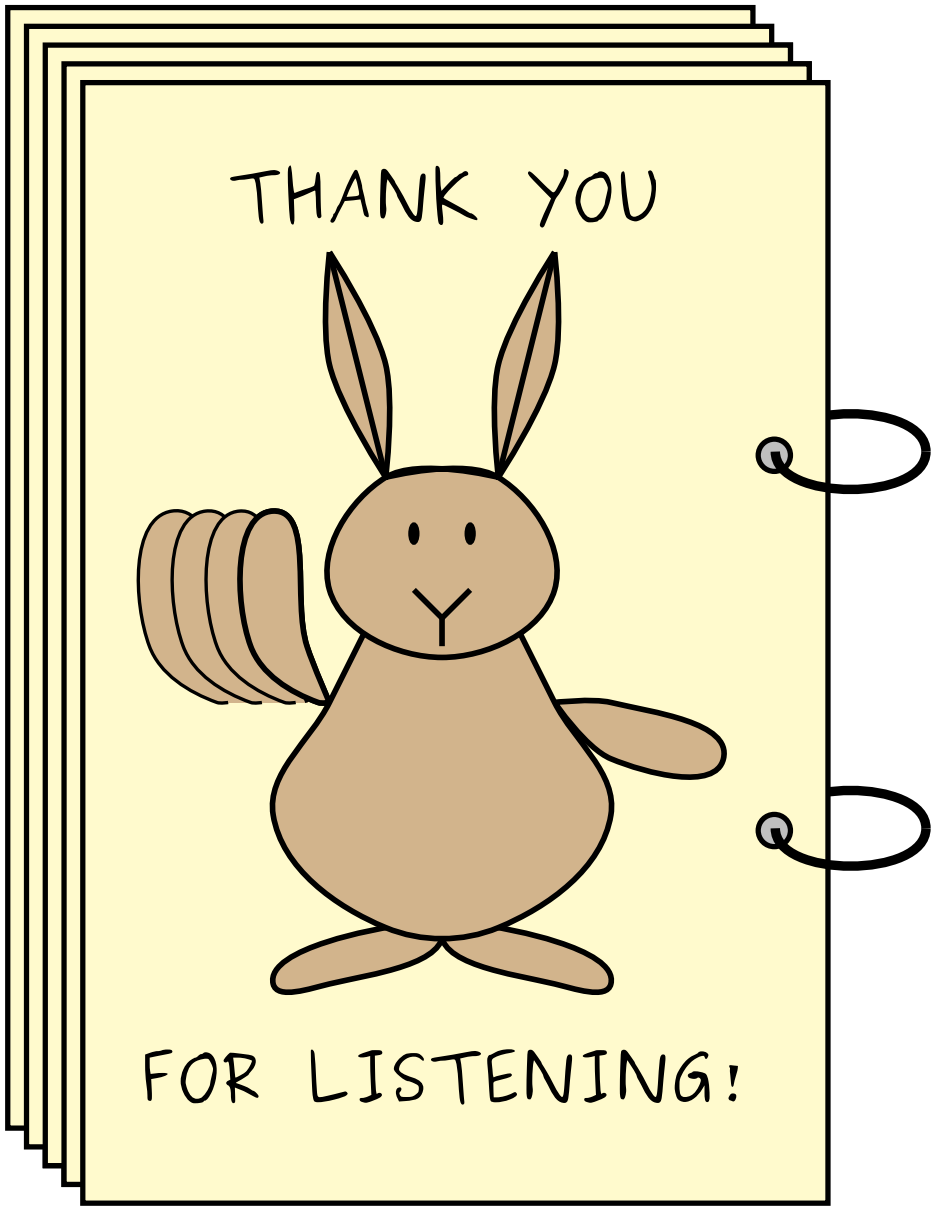
ID	Items	German	COG	English	COG	Swedish	COG
1	hand	hant	1	hænd	1	hand	1
2	woman	fraʊ	2	wʊmən	3	kvina	4
3	know	kɛnən	5	nəʊ	5	çɛna	5
3	know	vɪsən	6	-	0	ve:ta	6
…	…	…	…	…	…	…	…

Automatic Cognate Detection

Basic Concept: *belly* (ID: 4)			
CogID	**Language**	**Entry**	**Aligned Entry**
6	Danish	ɔnʌliwˀ	--
7	German	baux	b au x
7	Dutch	bœyk	b œy k
7	Swedish	buk	b u k
7	Norwegian	bʉːk	b ʉː k
8	English	bɛlɪ	--
9	Swedish	maːge	m aː g e
9	Norwegian	mɑːgə	m ɑː g ə
9	Danish	mæːvə	m æː v ə
10	Icelandic	kʰvɪːðʏr	--


What's next?
*deh3-


Special thanks to:
• The German Federal Ministry of Education and Research (BMBF) for funding our research project.
• Hans Geisler for his helpful, critical, and inspiring support.


THANK YOU
FOR LISTENING!