Verborum mutatae significationes

Tracking Semantic Change in Latin with Distributional Semantic Models

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Motivation and Outline

limiting data flood

	PHI	PL 1-60
tempus	12k	26k
cibus	1,7k	19k

overcoming biases

caro → *corpus* ? *fructus* ?

detecting patterns

- *distant reading* (Moretti)
- *macroanalysis* (Jockers)

side effects

- formalisation
- towards empirical definition of meaning

1. Methodology
   - Distributional Semantics
   - Corpora
2. Syntagmatic Perspective: tempus
   - Collocational stability
   - Clustering collocations
3. Paradigmatic Perspective: cibus

Method: Distributional Semantics

Distributional Hypothesis

"the degree of semantic similarity between two words (or other linguistic units) can be modelled ... as a function of the degree of overlap among their linguistic contexts" (Baroni and Lenci 2010)

DSMs in linguistics

- general: Turney and Pantel 2010
- accessible: Widdows 2004
- diachronic semantics: Heylen et co. 2008-
- Latin: Bamman and Crane 2011

	sacer	lego	ciuilis	gero	infero
liber	73	422	0	9	0
uolumen	234	158	0	12	0
bellum	38	16	481	831	331
pugna	0	0	8	37	17

Table: Similarity Matrix

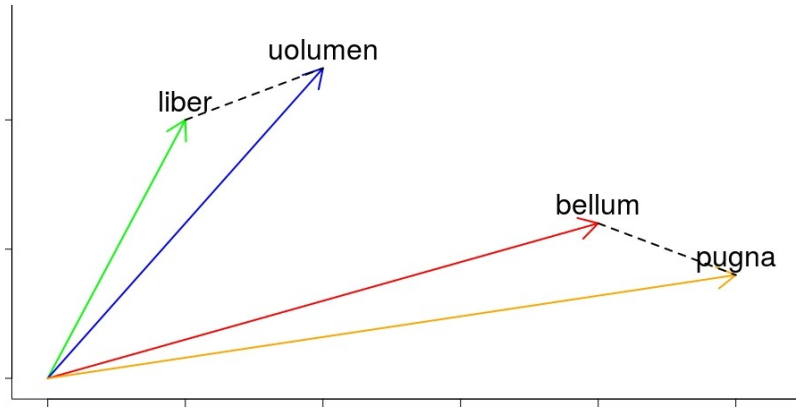


Figure: Measuring Distance

Method: Work Flow and Corpora

Workflow

1. frequency table

Term	Property	Freq
doceo	iudex	4
periculum	repello	3
visus	forma	4
addo	membrum	2

2.  `wordspace` package by Stefan Evert:
   - weighting raw counts
   - matrix reduction
3. word similarity functions
   - `pair.distances()`
   - `nearest.neighbours()`

Corpora

The PHI

- time: 2 BC - 6 AD
- ca. 8M tokens
- ca. 16k lemmas
- ca. 95k word forms

The PL 1-60

- time: 1 AD - 6 AD
- ca. 22M tokens
- ca. 16k lemmas
- ca. 115k word forms

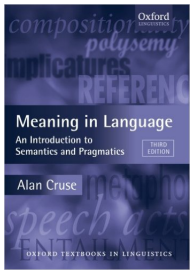
Syntagmatic Perspective: *tempus*

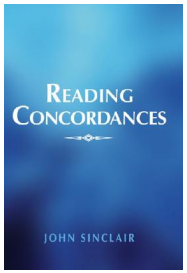
Collocation Extraction

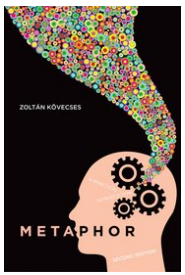
1. wide window
   vos tot milibus civium Romanorum^{5L} uno^{4L} nuntio^{3L} atque^{2L} uno^{1L} tempore necatis^{1R} quo^{2R} tandem^{3R} animo^{4R} esse^{5R} debetis
2. association strength
   - Dice: $\frac{2 \cdot f_{AB}}{f_A + f_B}$
   - minimum sensitivity: $min(\frac{f_{AB}}{f_A}, \frac{f_{AB}}{f_B})$
3. empirical collocations $\rightarrow$ clustering

Terminology

- **empirical** collocation $\approx$ co-occurrence: no lexicalization required (Evert 2009)
- lexical semantics, concordance analysis, CMT







Tempus: collocational stability (PHI)

Attested in 5 periods	Attested in 4 periods	Attested in 3 periods
vernus	annus	bellum
	brevis	medius
	certus	persona
	dies	venio
	differo	
	longus	
	praesens	
	spatium	

Tempus: collocations by century (PHI)

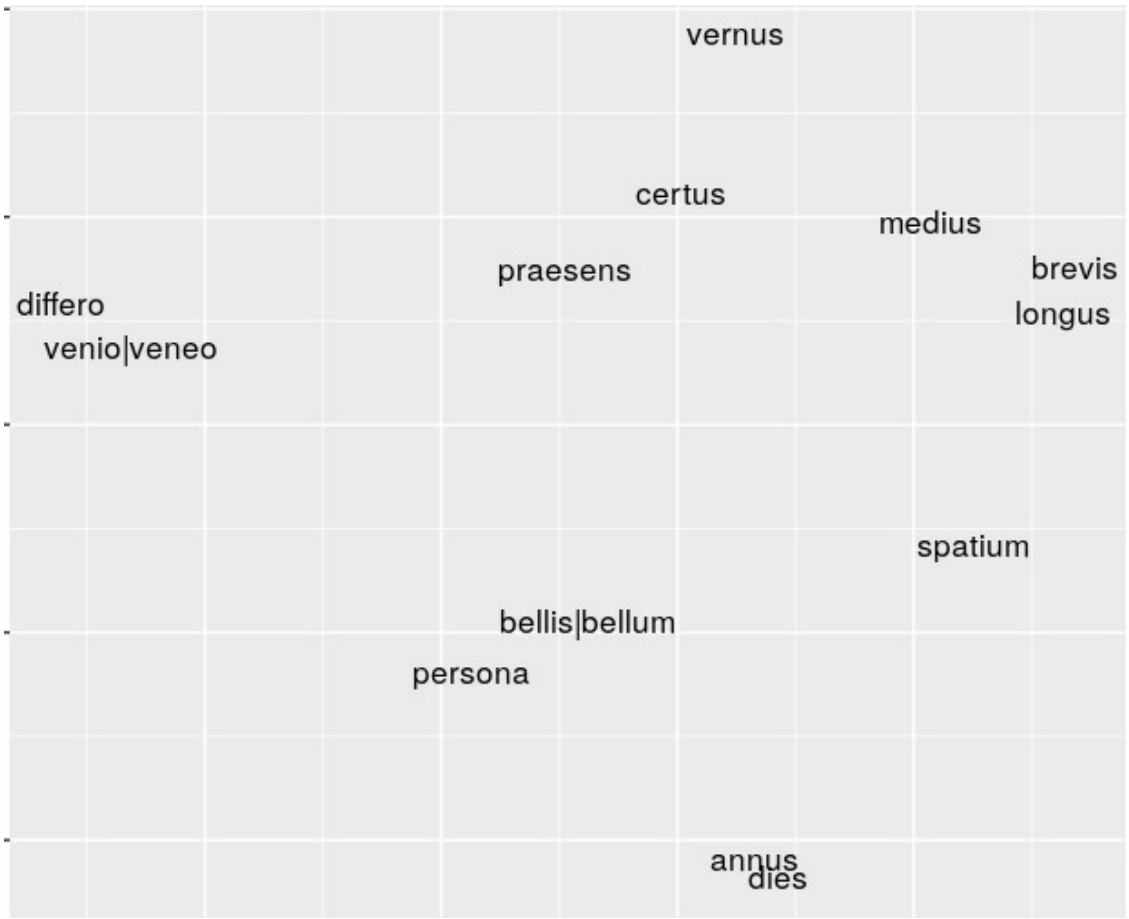
2 BC	1 BC	1 AD	2 AD	3 AD	4/5 AD	6 AD
occasio	**brevis**	**longus**	**spatium**	**vernus**	adverbium	mors
venio	aetas	**annus**	**brevis**	nox	**praesens**	testamentum
loquor	**certus**	nox	**longus**	medicus	futurus	**medius**
annus	publicus	**brevis**	momentum	hora	particeps	**certus**
quaero	superus	**certus**	diverto	verus	praeteritus	specto
terra	reliquus	tero	adverbium	orbis	perfectus	fructus
dies	**annus**	locus	syllaba	**annus**	**vernus**	possessio
video	Caesar	**dies**	aestivus	duco	significo	pubertas
	persona	nascor	vicis	urbs	autumnalis	condicio
	spatium	exiguus	disciplina	nomen	praetereo	manumitto

Table: 10 strongest collocations by period

period A	period B	shared	%
1	-1	18	36
2	1	11	22
2	-1	9	18
6	1	7	14
2	4/5	7	14

Table: Overlap of the collocations

Tempus: clustering recurring collocations (PHI)



Time is Space

longus, *brevis*, *medius*, *spatium*

movement

venio, *differo* (?)

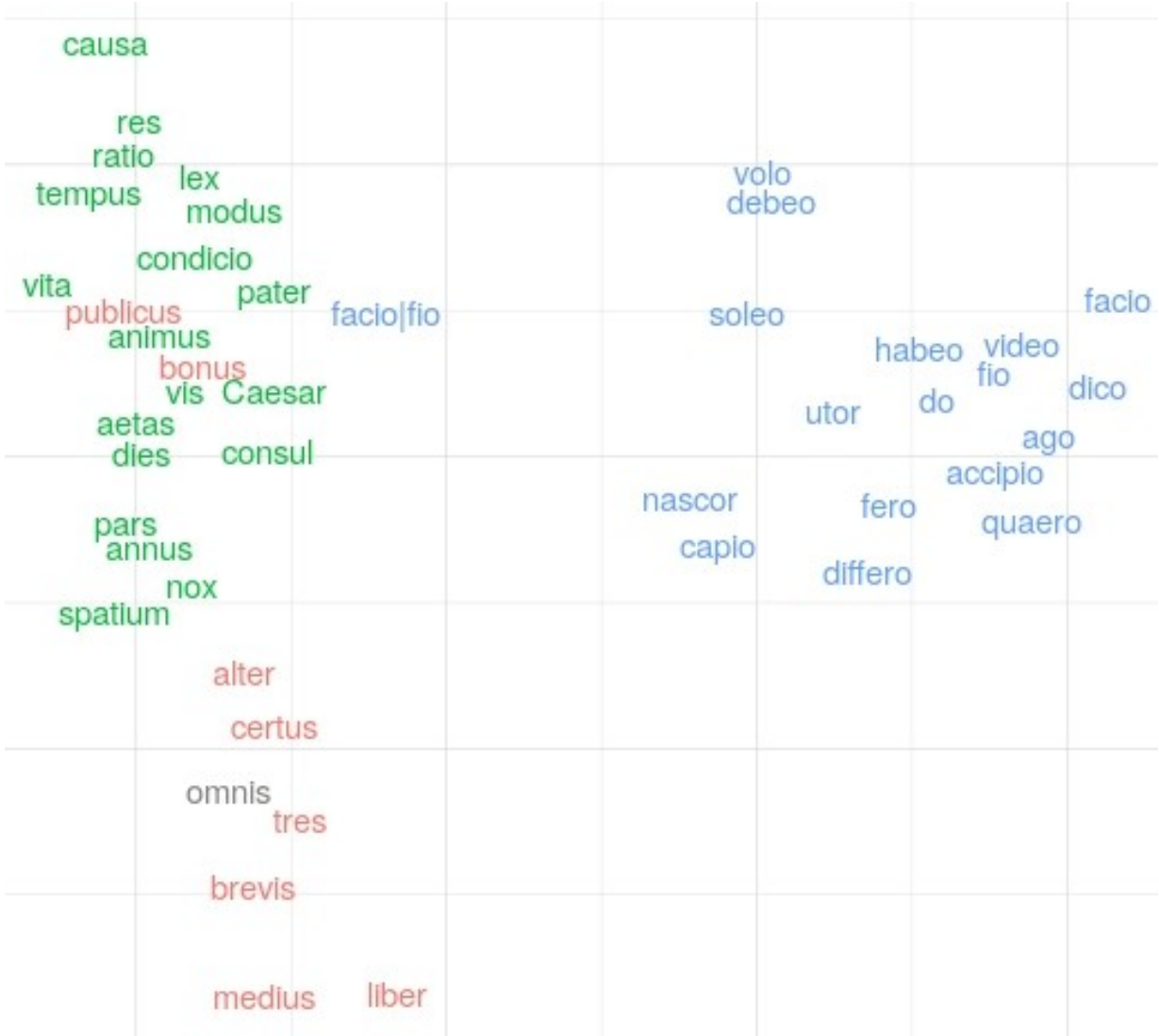
tempus + G

belli

hyponyms

annus, *dies*

Tempus: clustering all collocations (PHI)



Tempus: clustering nominal collocations (PHI)

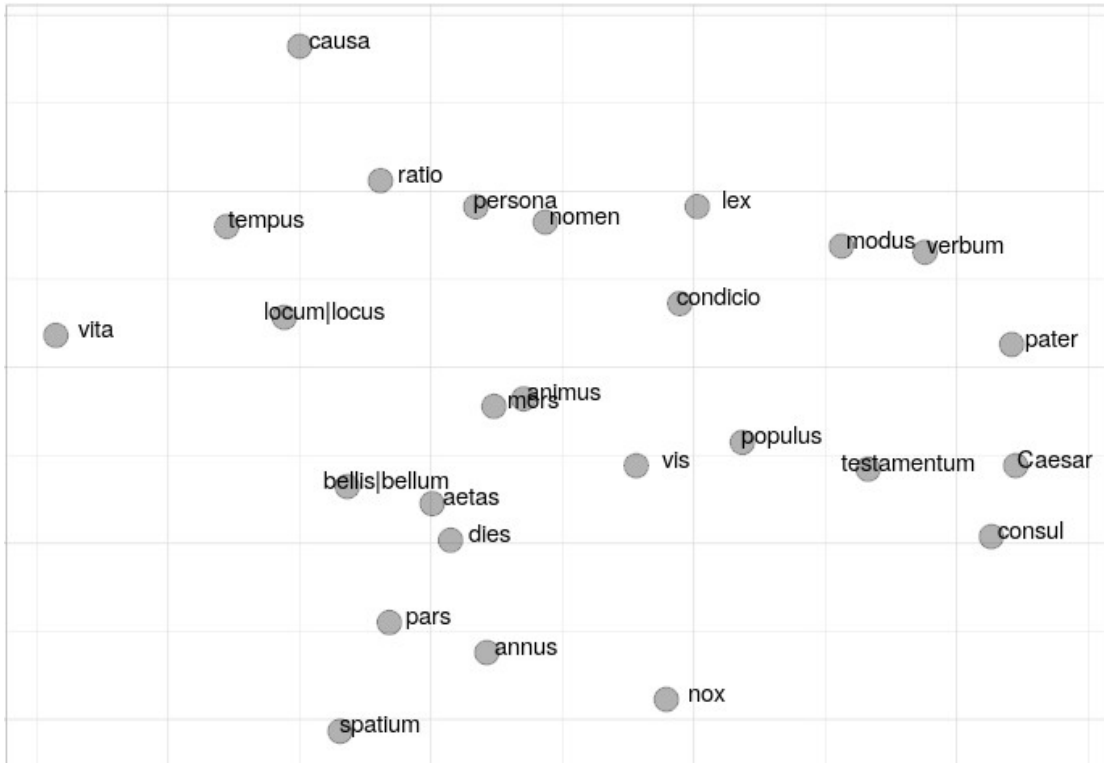


Figure: *Tempus*. Noun collocates

Time is Space

spatium

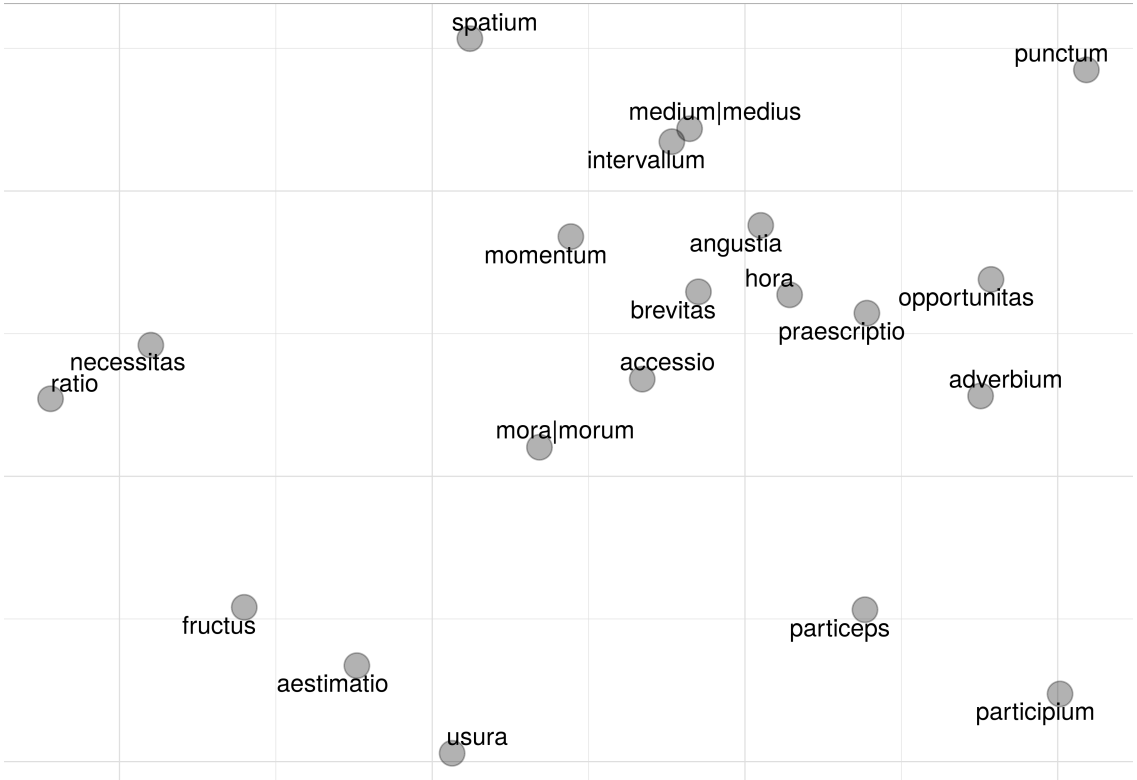
tempus + G

- hyponyms and near synonyms: *annus*, *dies*, *nox*, *aetas*
- various activities: *bellum*, *vita*

socio-political terms

- actors: *populus*, *Caesar*, *consul*
- law: *vis*, *lex*, *condicio*, *testamentum* (usually Iust. *Dig.*)

Temporis: clustering nominal collocations (PHI)



Time is Space

spatium, *intervallum*, *angustia*, *brevitas*

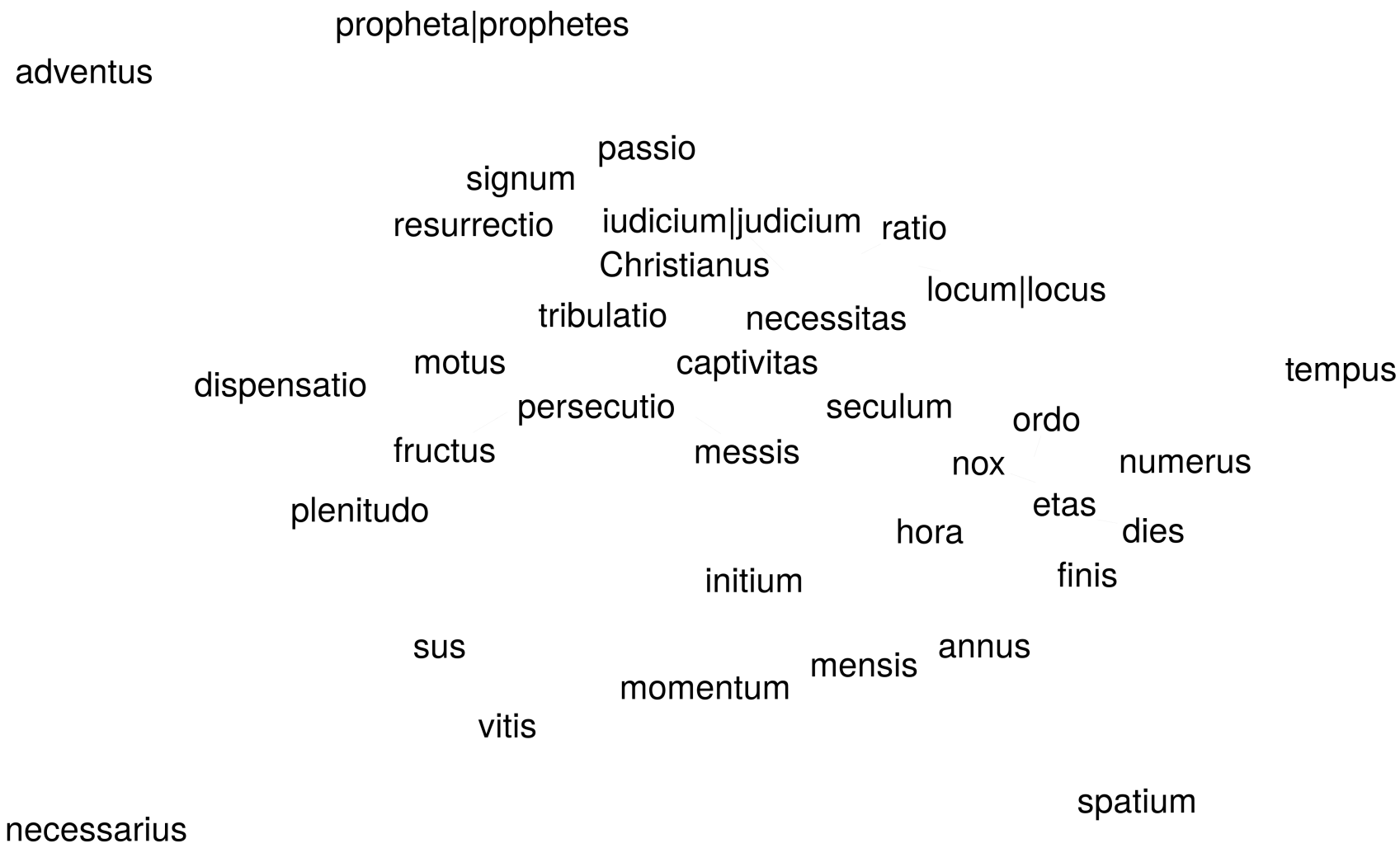
Time is Money

fructus, *aestimatio*, *usura*

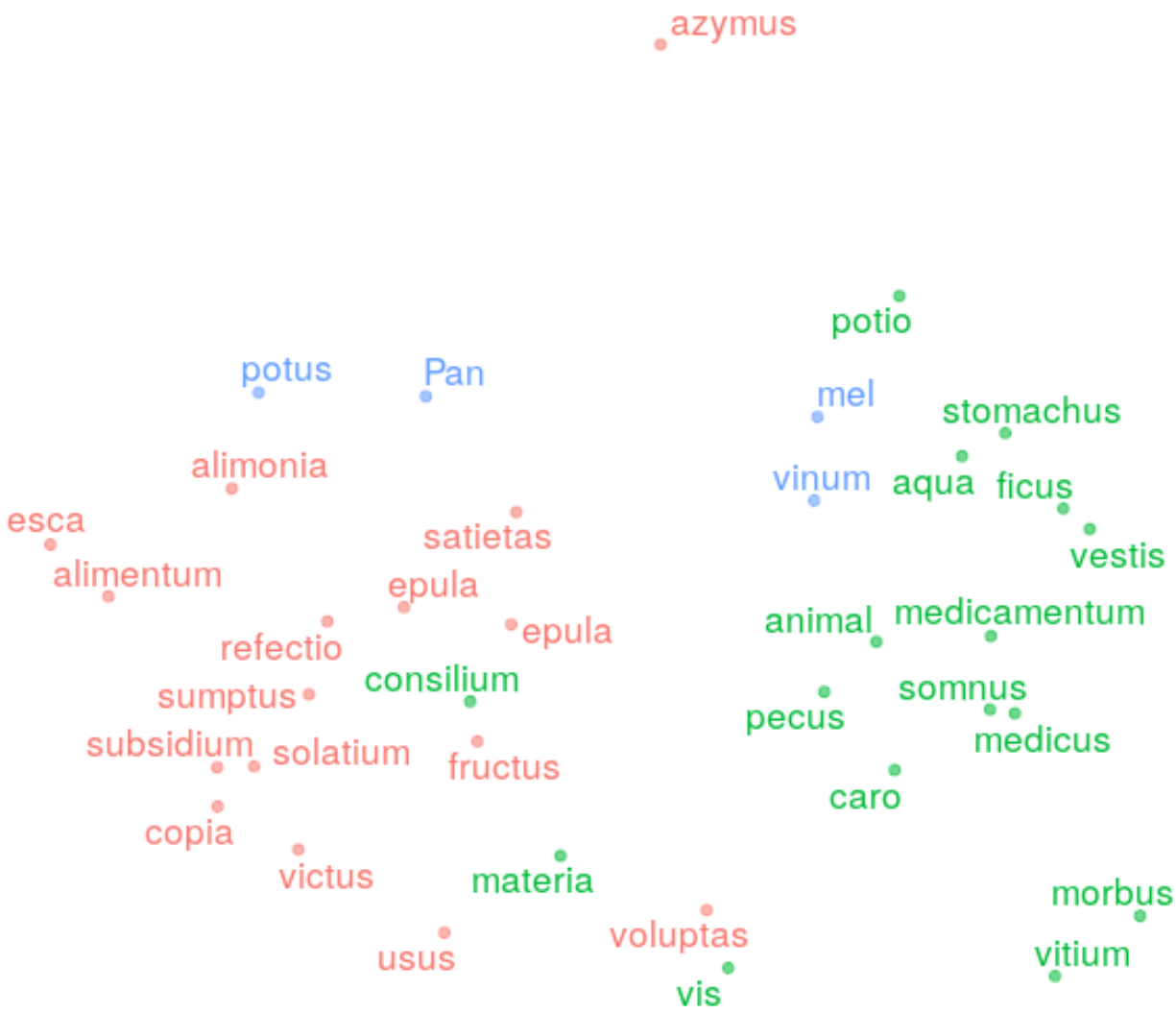
Figure: *Temporis*. 20 strongest nominal collocates

Tempus: clustering all collocations (PL)

Tempus: clustering nominal collocations (PL)



Paradigmatic perspective: *cibus* (PHI + PL)



Conclusions

- the DSMs are exploratory technique, do not provide out-of-the-box interpretation
- specific task (e.g. metaphor extraction) require targeted query and a finer setup
- room for improvement
  - cluster coherence
    - balancing the corpus
    - narrowing collocational window
    - refining properties (semantic and syntactic role)
  - better understanding of retrieved phenomena (arguments, semantic preference, semantic prosody, topical properties)

Thank you!

Questions?

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Our Projects: eDictionary

http://scriptores.pl/elexicon/en

Our Projects: eCorpus

http://scriptores.pl/en/efontes/