LiLa: Linking Latin

Building a Knowledge Base of Linguistic Resources for Latin

The LiLa Team
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First LiLa Workshop: *Linguistic Resources & NLP Tools for Latin*
Milan | 3-4 June 2019

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme - Grant Agreement No. 769994.

Outlook

Why, What & How (M. Passarotti)

LiLa Architecture (F. Mambrini)

Resources-1: Derivational Morphology & Valency Lexicon (E. Litta)

Resources-2: Latin WordNet (G. Franzini & A. Peverelli)

NLP-1: Part-of-speech Tagging & Lemmatisation (F. M. Cecchini)

NLP-2: Upcoming Resources in LiLa & a New Initiative (R. Sprugnoli)

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Research question
State of affairs

We have built and collected (for Latin and other languages):

- Textual Resources
- Lexical Resources
- NLP Tools

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Scattered and unconnected

Research need
Making sense

To make sense of this quantity of empirical data:

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To make sense of this quantity of empirical data:

- to extract maximum benefit from our research investments

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- to impact and improve the life of Classicists through exploitable computational resources and tools

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From Information to Knowledge

2018-2023

A collection of interoperable linguistics resources (and NLP tools) described with the same vocabulary for knowledge description

Interlinking as a Form of Interaction

LiLa is based on an ontology made of:

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- **Individuals**: instances of objects (one specific token, lemma etc.)

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  Labels from a restricted vocabulary of knowledge description:
  `hasLemma`, `hasPoS`

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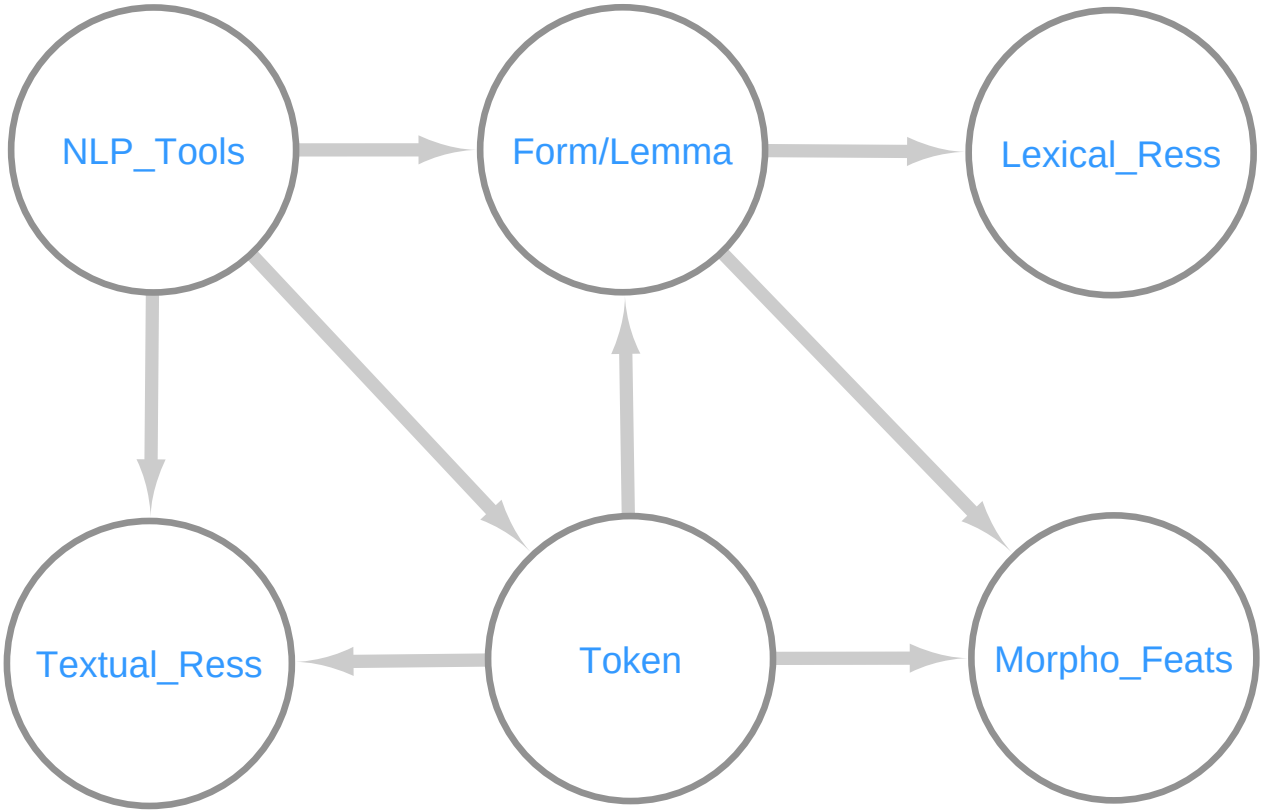
Each component of the ontology is uniquely identified through a URI.

LiLa Knowledge Base

Lexically-based architecture and (meta)data sources



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General principles

"Reuse standards, reuse standards, reuse standards"…

The golden rule:

Reuse as many standards as you can.

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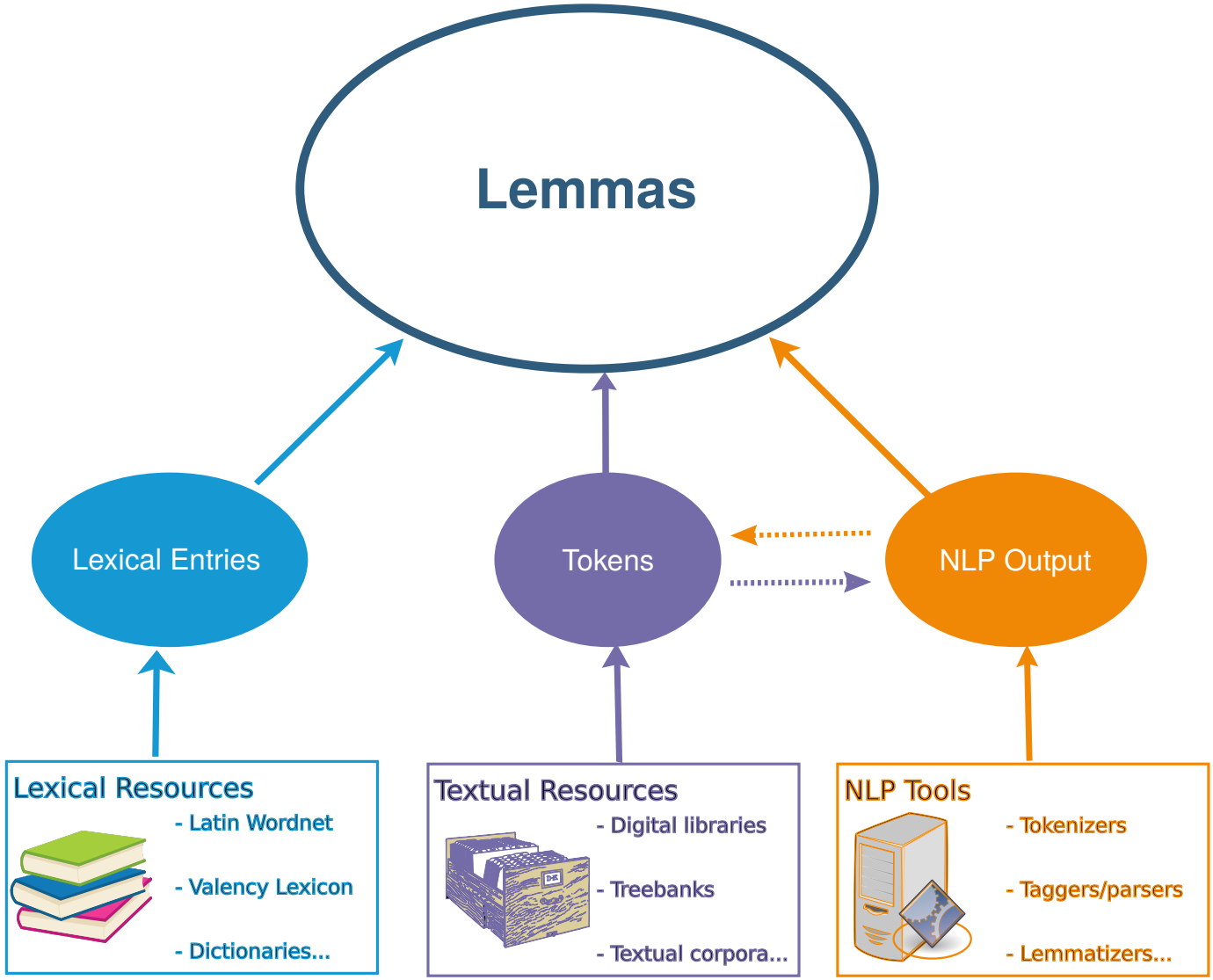
LiLa is based on:

- the `Ontolex` family, for lexical information
- the `OLiA` bundle, for PoS tagging
- `NIF` (and `POWLA`?) for corpus annotation

“In the beginning was… the Lemma!"

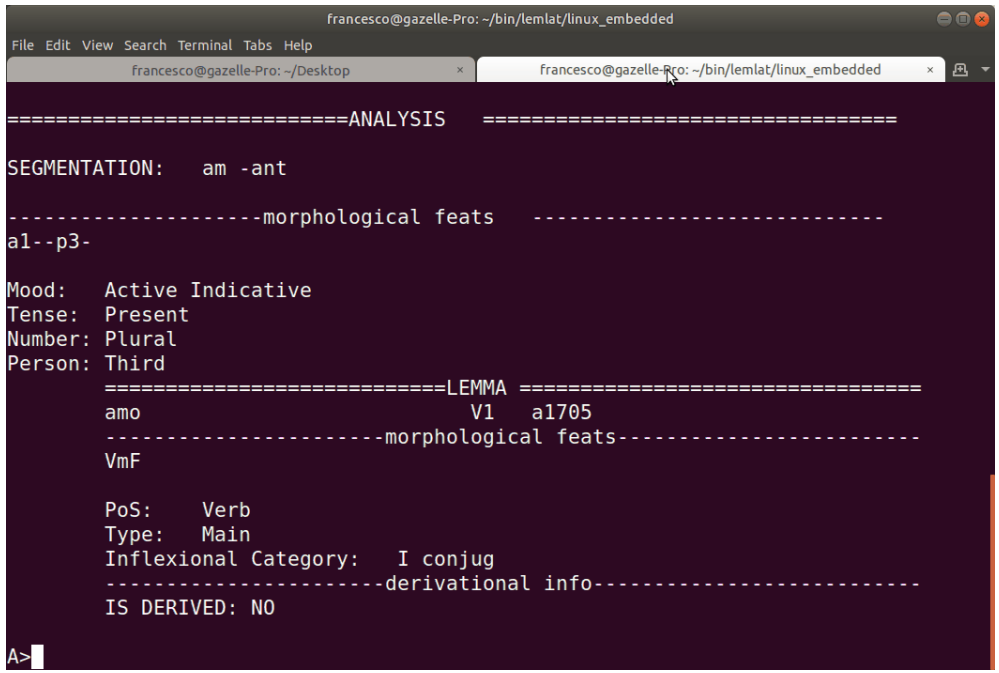
The lemma as gateway to linguistic resources



LEMLAT

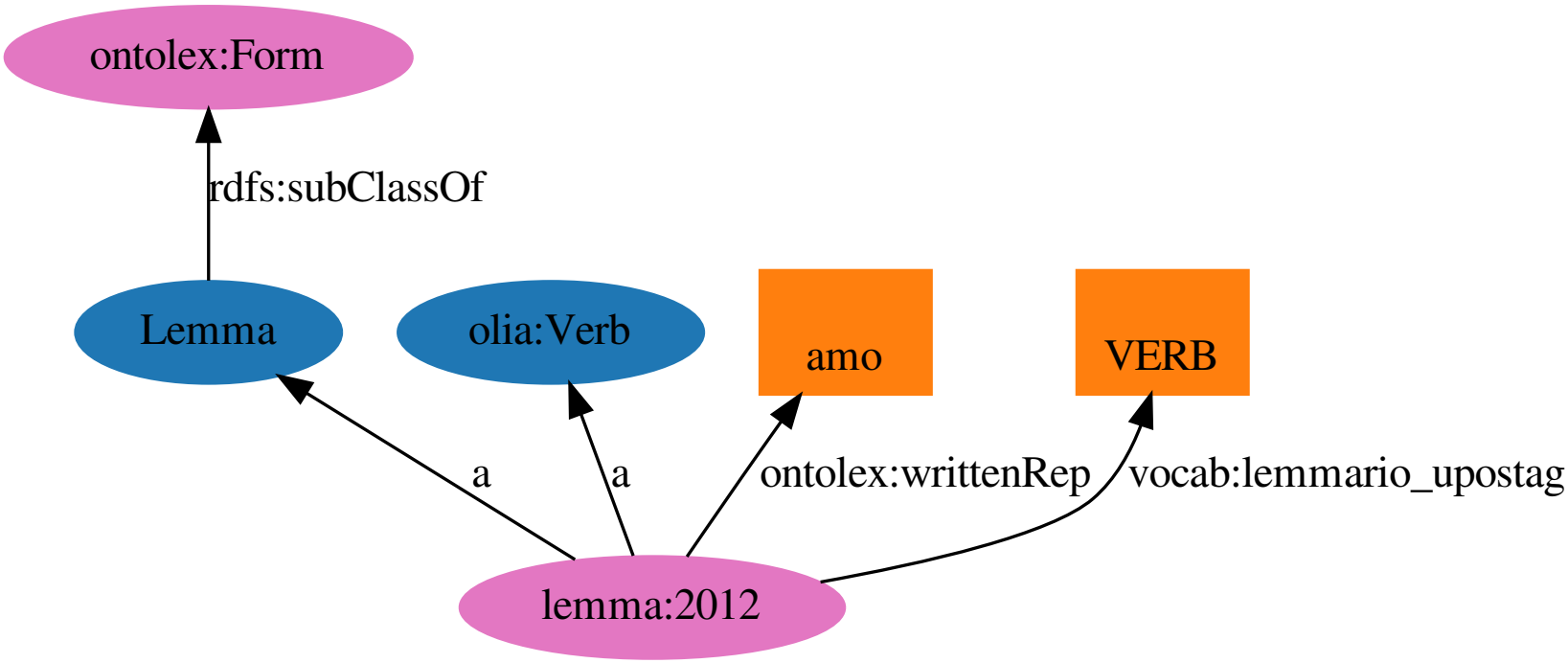
http://www.lemlat3.eu/

- 43,432 lemmas from Georges, 1913-1918; *OLD* and Gradenwitz, 1904;
- 82,556 lemmas from Du Cange, 1883-1887;
- 26,250 lemmas from Forcellini, 1940.
- WFL added.



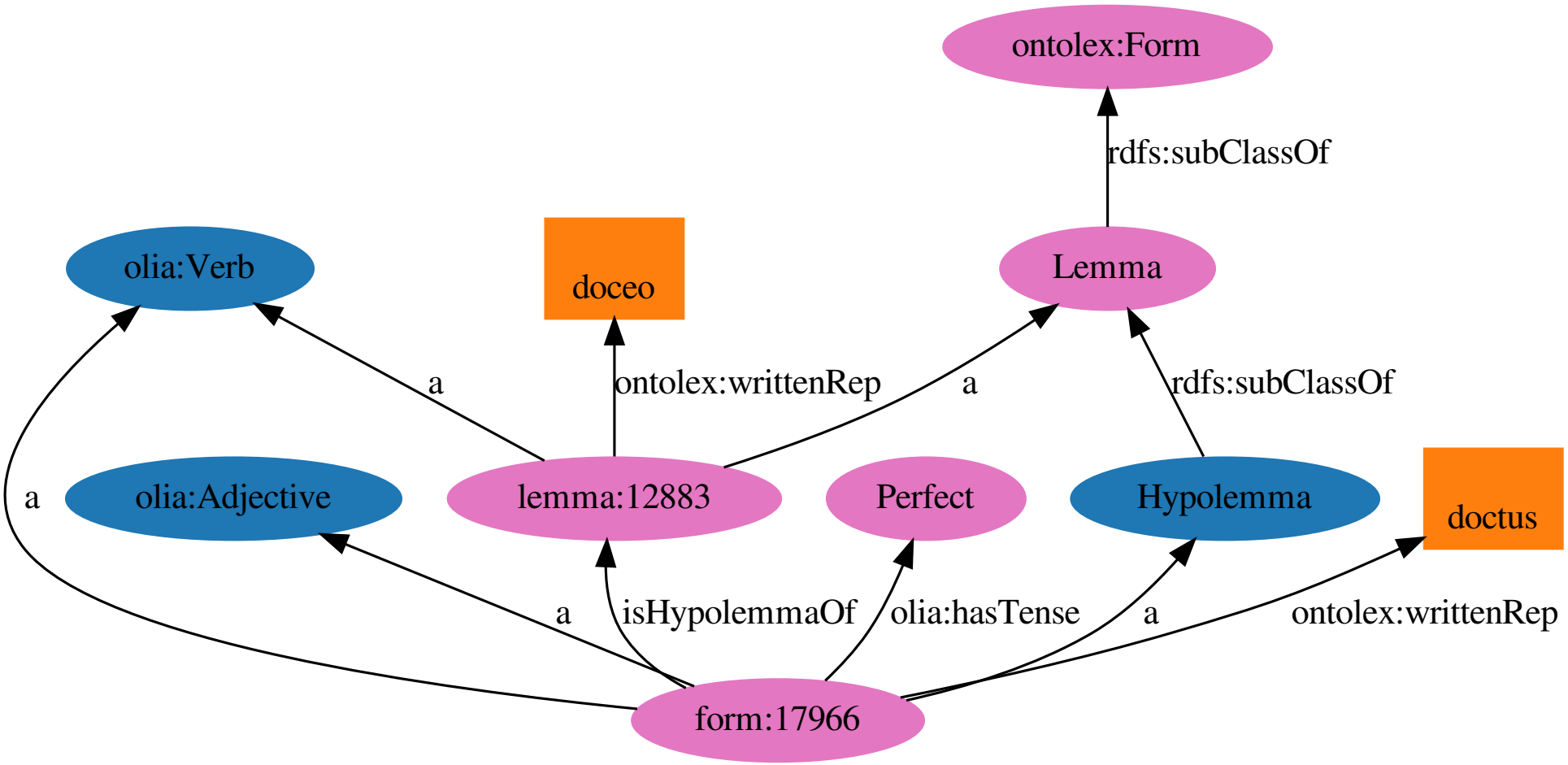
A prototypical case

amo, amare



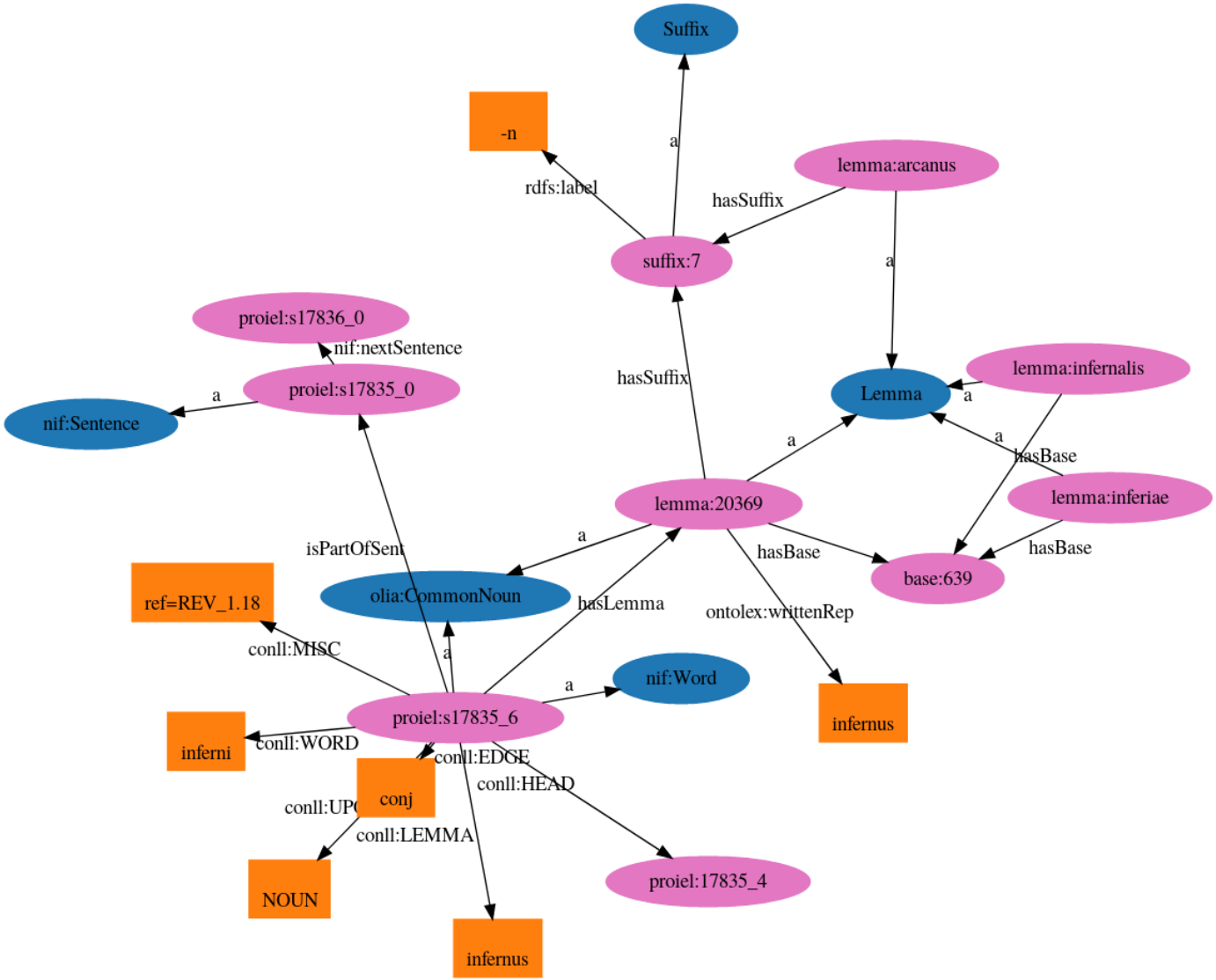
A more complex case: hypolemmas

doctus, -a, -um



Corpora in LiLa

A token from PROIEL (*Rev.* 1.18)



Already available resources and tools

Caution: work in progress!

- PROIEL (Universal Dependencies)
- *Index Thomisticus* Treebank (ITTB), both UD and original
- a portion of the Late Latin Charter Treebank (LLCT) (Timo Korkiakangas)

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Try it out!

`https://lila-erc.eu/data/`

Open challenges

1. Include metadata about authors, texts, editions…

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2. link to distributed content (texts are maintained by their providers)

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3. more lemmatisation!
   - improve the performance of lemmatisers (Flavio, Rachele)
   - agree on an annotation scenario with the content managers

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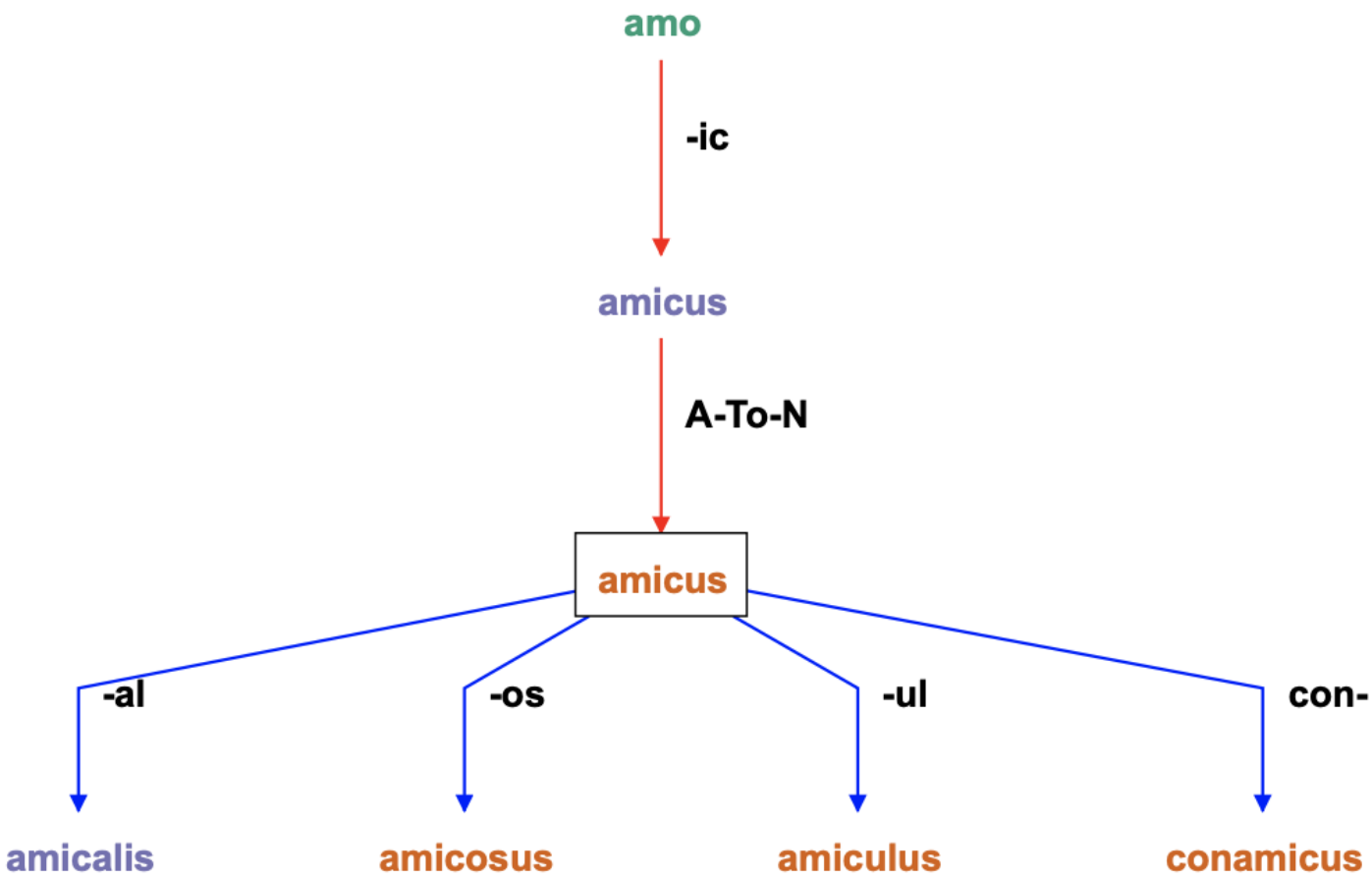
Word Formation Latin (WFL)

Background

WFL: Word formation-based lexicon for Classical Latin

- LEMLAT Base lexical basis
- Word Formation Rules (WFRs) are modelled as directed one-to-many input-output relations between lemmas
- Relationships between lemmas (nodes) of the same “word formation family” are represented as the edges in a **directed graph** with a hierarchical tree-like structure
- Compounding is also shown as an intersection between word formation families
- Can be browsed by WFR, Affix, PoS and Lemma
- 763 WFRs, 32,428 input-output relations.

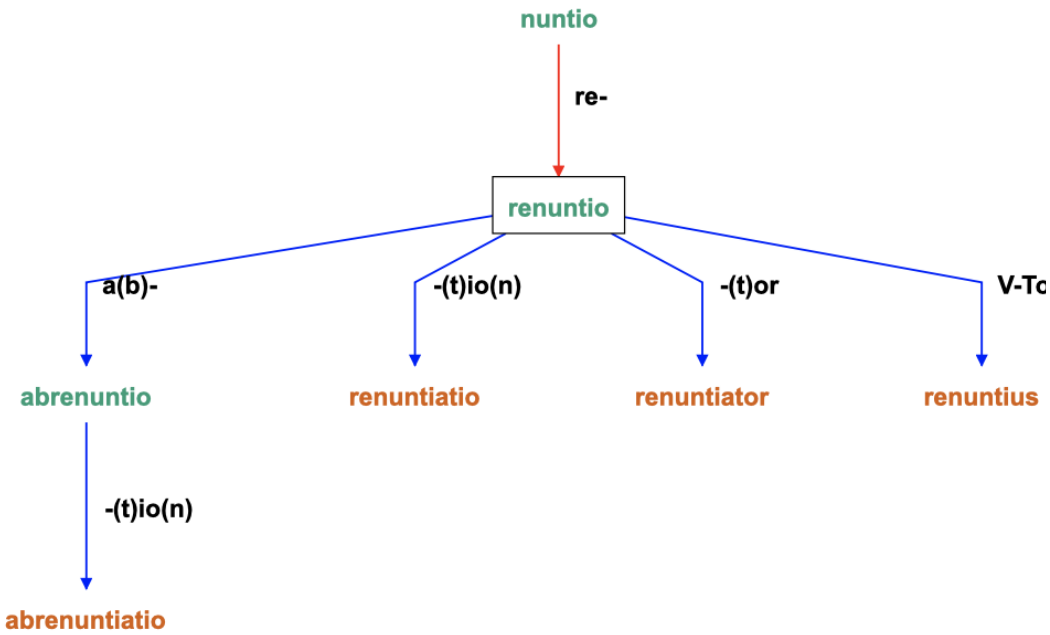
WFL: tree-shaped directed graph

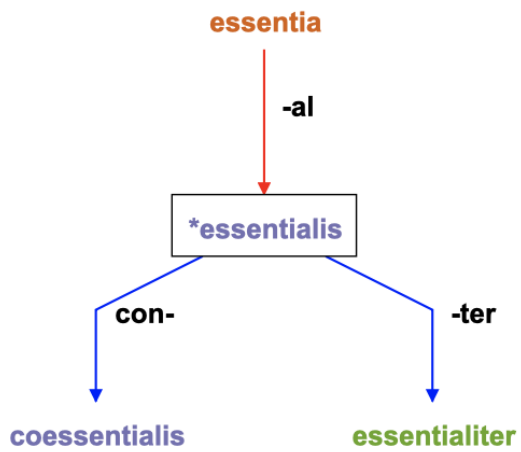


WFL: hierarchical structure
Troubles

But: **directed graphs** are not completely satisfactory in representing the full range of relationships included within a word formation family.
Main problems:

- Directionality
- Non-linear derivations.





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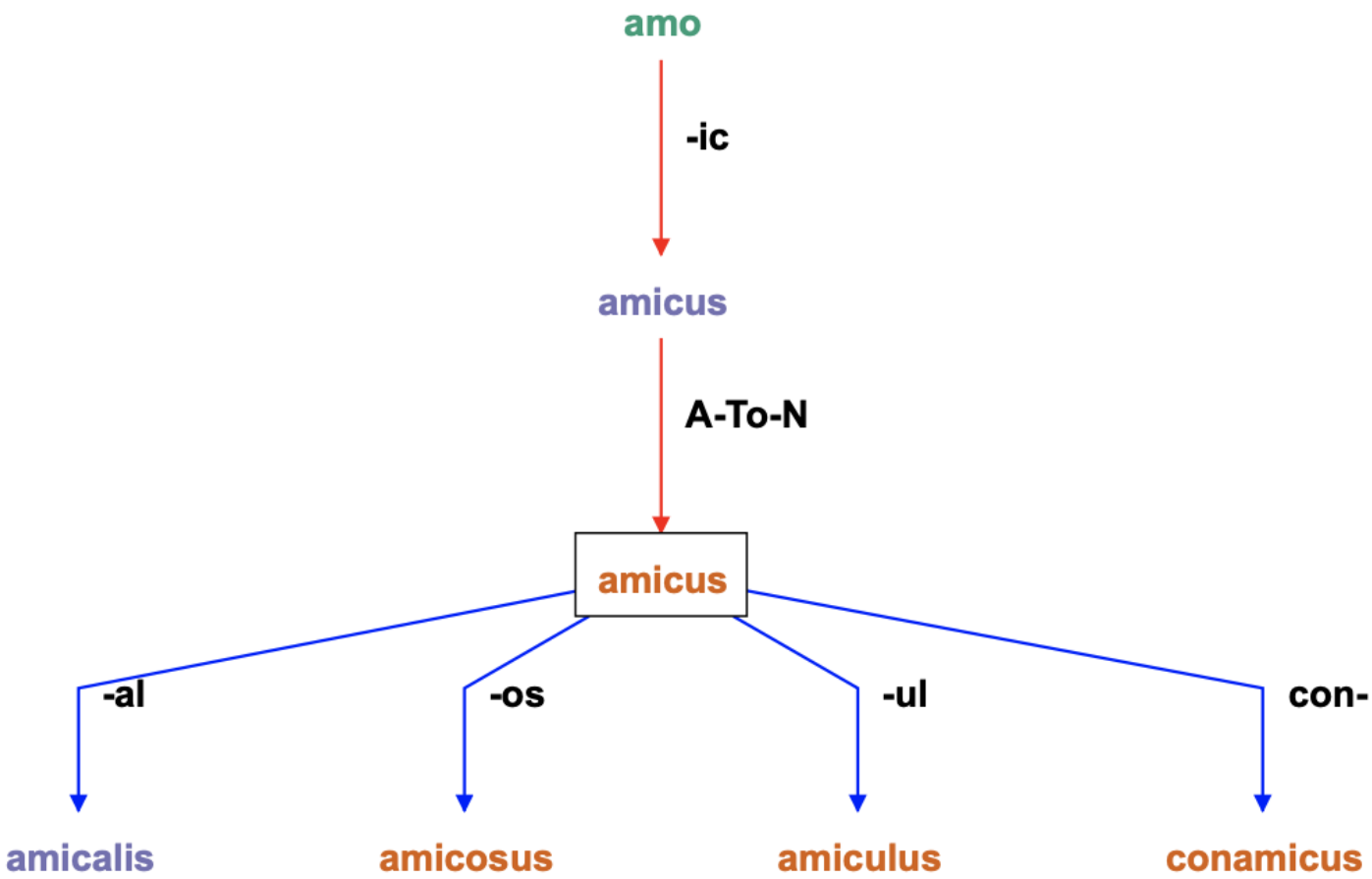


Word Formation in LiLa

New approach to Word Formation:

- Structure: **declarative** rather than procedural
- No directionality
- No morphotaxis.

Words are described in their formative elements => these are organised in classes of objects in the ontology.

Word Formation in LiLa

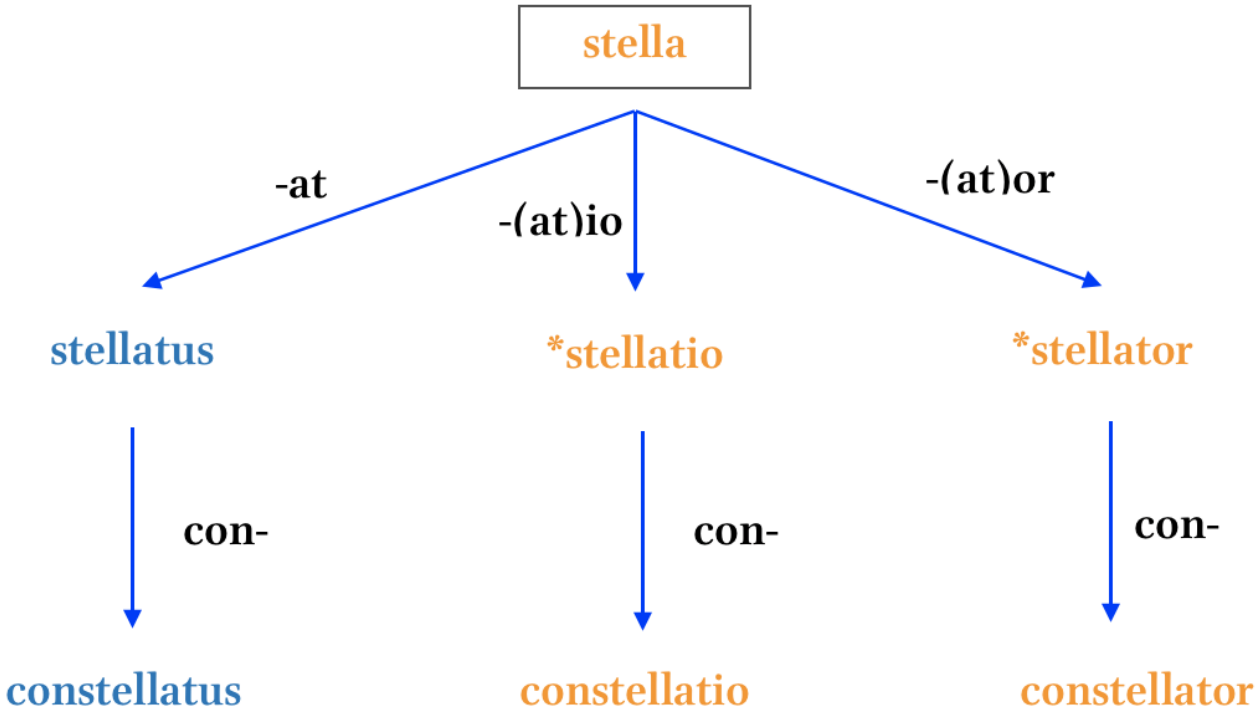
Three classes of objects:

1. Lemmas
2. Affixes (prefixes and suffixes)
3. Bases (connectors between lemmas of the same WF family)

Connected by three possibile relationships:

1. hasPrefix
2. hasSuffix
3. hasBase

Stella


stella
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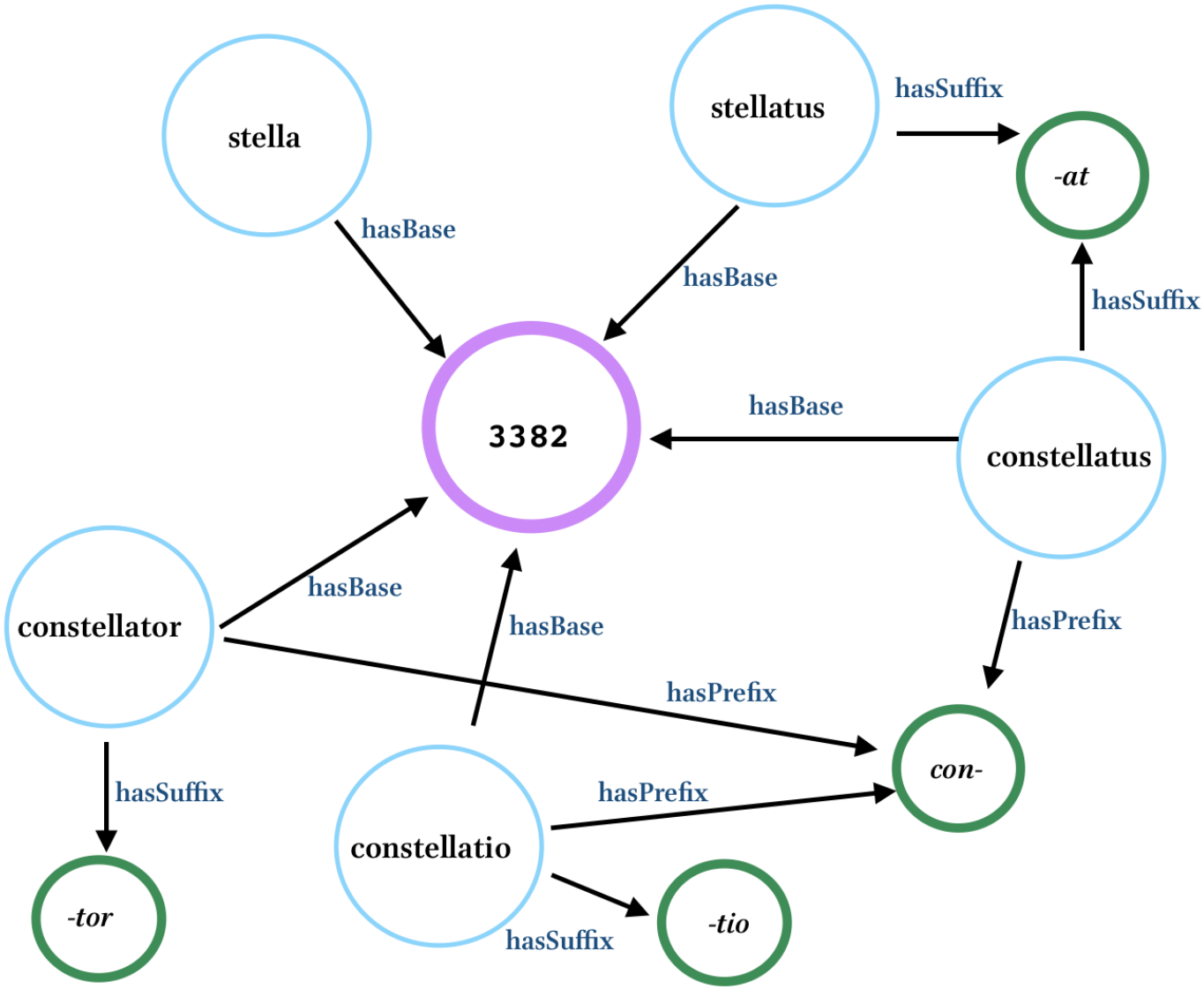
constellator

3382


stella
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hasSuffix
3382
hasBase
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-tio

Latin Vallex: Valency Lexicon for Classical Latin

- Built in conjunction with the semantic and pragmatic annotation of two Latin treebanks:
  - The Index Thomisticus Treebank (Thomas Aquinas),
  - The Latin Dependency Treebank (Classical era).
- Structure inspired by the Valency Lexicon for Czech *PDT- Vallex*.

Latin Vallex
Structure

- Word entries => sequence of frame entries for each lemma.
- Each frame entry => one sense.
- Each frame entry => description of the valency frame + frame attributes.
- Valency frame: sequence of frame slots.
- Frame slot: one complementation of the given lemma.
- Attributes: semantic roles ('functors') used to express types of relations between lemmas and their complementations.

termino – V

- Frame Entry 1 ('to mark the boundaries of something'):
  - Valency Frame:
    - Frame Slot 1: subj.
    - Frame Slot 2: direct obj.
  - Frame Attributes:
    - Functor 1: ACT
    - Functor 2: PAT
- Frame Entry 2 ('to limit something to something else'):
  - Valency Frame:
    - Frame Slot 1: subj.
    - Frame Slot 2: dir. obj.
    - Frame slot 3: *in*+ dir. obj.
  - Frame Attributes:
    - Functor 1: ACT
    - Functor 2: PAT
    - Functor 3: DIR3

- From evidence to intuition-based
- Cross reference Whitaker's Words definitions with *EngVallex* valency frames (English Valency Lexicon developed at Úfal)
- Evaluation and Validation (work in progress)
- Addition of new data.

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WordNet
What is it?

WordNet *[…] is perhaps* ***the most widely used electronic dictionary*** *[…] and serves as the* ***lexicon for a variety of different NLP applications*** *including Information Retrieval (IR), Word Sense Disambiguation (WSD), and Machine Translation (MT).*

Fellbaum (1998, p. 52)

WordNet
Example synset

A **database of synsets** (**sets** of **syn**onymous lemmas)

Synset ID	Lang	Lemma(s)	Definition

WordNet
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Relations between synsets

Hypernymy/hyponymy, meronymy/holonymy, antonymy, entailment, etc.

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Only **two historical language WordNets**.

Latin WordNet (LWN)
Overview

- **Who**: Stefano Minozzi, University of Verona
- **When**: 2004
- **How**: **generated** from the MultiWordNet[1]
- **What**: **limited** coverage
  - **9,378 lemmas**
  - **8,973 synsets**
  - **143,701 relations**
- **How well**: quite noisy

> *La copertura lessicale e* ***i risultati dell'assegnazione automatica necessiterebbero di una ulteriore fase di valutazione e di controllo****.*
>
> Minozzi (2017, p. 130)

[1] http://multiwordnet.fbk.eu/english/home.php

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Latin WordNet (LWN)

LiLa objectives & method

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2. **Phase 2**: **data-driven enrichment** of the LWN by attaching it to textual tokens in LiLa (effectively performing Word Sense Disambiguation).

[2] Andrea Peverelli, Helena Sanna, Edoardo Signoroni, Viviana Ventura, Federica Zampedri.

Examples of noise to be removed:

Lemma	Synset	Definition
ager	n#W0021124	in un database, ogni area in cui vengono registrate le singole informazioni che compongono il record (ad esempio nomi, numeri ecc.).
capitolium	n#06188340	the federal government of the United States.
voco	v#00720710	send a message or attempt to reach someone by radio, phone, etc; make a signal to in order to transmit a message; Hawaii is calling!; A transmitter in Hawaii was heard calling.

E.g. *velociter*

S1 = r#00051957
S2 = r#00082992
S3 = r#00102338
S4 = r#00285860

	S1	S2	S3	S4
Rater 1	1	1	1	0
Rater 2	1	1	1	1
Rater 3	1	1	1	0
Rater 4	1	1	1	1
Rater 5	1	1	0	0

We measure:

- Inter-rater reliability:[3] $A_o = \frac{abs(N_C - N_R)}{N_V}$ → Here: **0.6**
  - A_o = **o**bserved **a**greement
  - N_C = n. of **C**onfirmed assignments
  - N_R = n. of **R**ejected assignments
  - N_V = n. e**v**aluations
- Quality: correctness against a Gold Standard

[3] Percentage of agreement without chance correction.

Latin WordNet (LWN)

Inclusion of LWN in LiLa

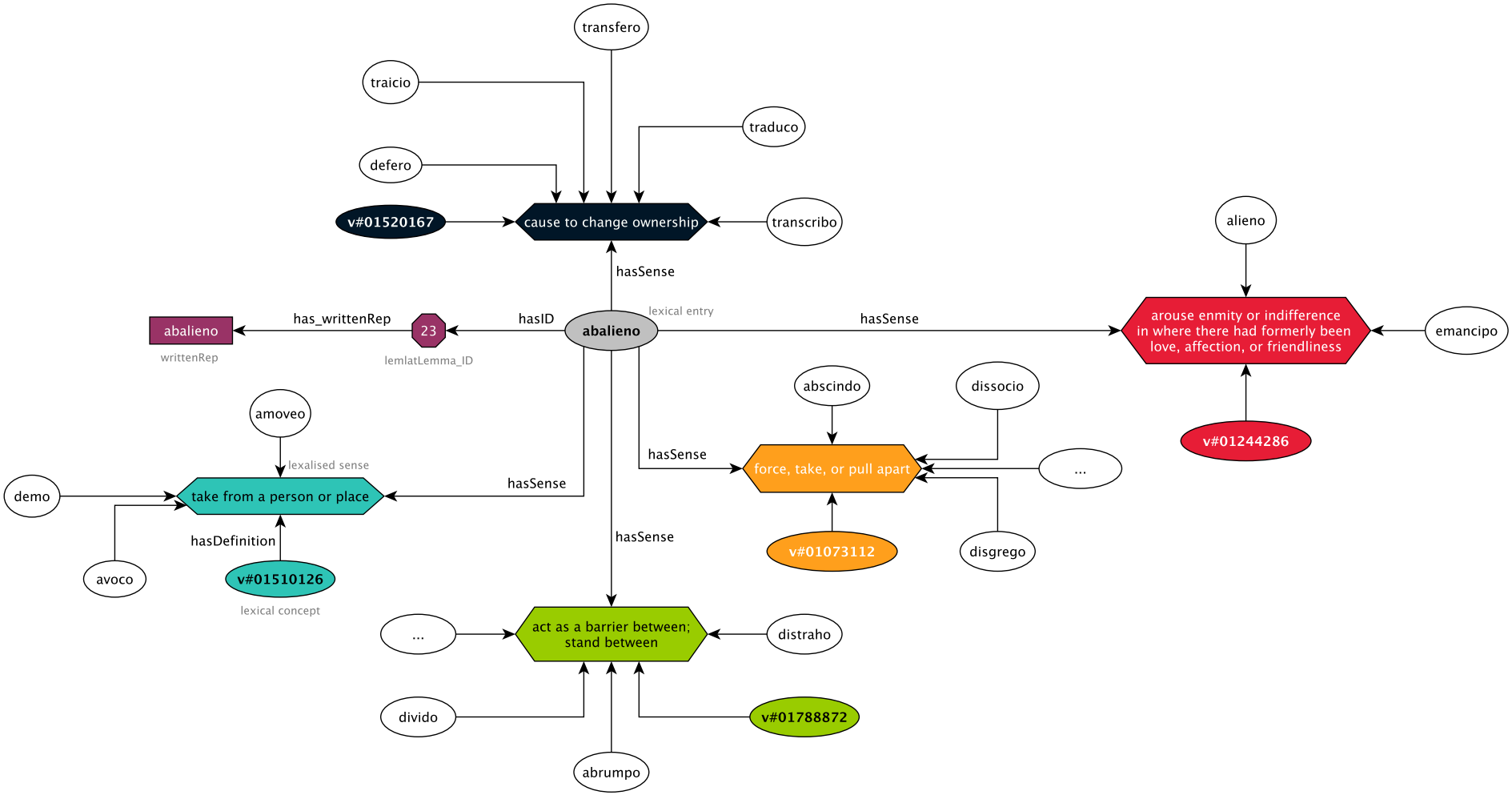

Figure: Graph rendition of the LWN lemma *abalienо*.

Latin WordNet (LWN)

Collaboration with University of Exeter

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The missing link

Lemmatisation and part-of-speech tagging are essential and necessary tasks

- for the linguistical analysis of **Latin**...
  - rich morphology, ambiguity, ...
- ...and the inclusion of textual resources into **LiLa**!
  - the lemma as center stage of its architecture

Lack of annotated resources

Unfortunately, most Latin corpora are not provided with annotation at morphological, grammatical or syntactical level, and not even lemmatisation.

Our goal

To survey the existing tools for Latin lemmatisation and PoS-tagging

To automate annotation of resources and ease their inclusion into **LiLa**

Again, LEMLAT!

http://www.lemlat3.eu/

LEMLAT is a powerful morphological analyser for Latin.

Morphological analysis entails lemmatisation.

```
============================ANALYSIS 6=======================

SEGMENTATION:   aer -e

---------------------morphological feats   ------------------
--bms--

Case:   Ablative
Gender: Masculine
Number: Singular
        ============================LEMMA ====================
        aer                              N3B  2948  m
        ----------------------morphological feats-----------
        NpC

        PoS:    Noun
        Type:   Proper
        Inflexional Category:   III decl
        ----------------------derivational info-------------
        IS DERIVED: NO

============================ANALYSIS 7=======================
```

aere

. . . Aere (f, PROPN)?

. . . Aer (m, PROPN)?

. . . aer (m/f, NOUN)?

. . . aerus (ADJ)?

. . . aes (n, NOUN)?

However, it can not disambiguate according to context!

Part-of-speech taggers and/or lemmatisers

State of affairs

Part of speech ⇜⇝ Lemma

We have selected and collected many tools and models for Latin:

CLTK:	TnT, CRF, 1-2-3-gram backoff, all trained on Perseus
Collatinus:	LASLA
Deucalion	LASLA
LaPOS:	Perseus, IT-TB UD 2.3
NLP-Cube:	UD 2.3 Latin treebanks
NLTK:	TnT, CRF, 1-2-3-gram backoff, all trained on IT-TB UD 2.3
MarMot:	Capitula+PROIEL(+Patr. Lat.+Collex-LA) (Eger et al. 2016), IT-TB UD 2.3
RDRPOSTagger:	IT-TB UD 2.3, PROIEL UD 2.3, Perseus UD 2.3
RNNTagger:	IT-TB
TreeTagger:	IT-TB UD 2.3, IT-TB, OMNIA (Bon 2011), Brandolini
UDpipe:	IT-TB UD 2.3, PROIEL UD 2.3, Perseus UD 2.3

. . . and also the lemmatiser **LatMor** (acontextual), based on the Berlin Latin Lexicon.

We primarily focus on existing models rather than training new ones.

Different viewpoints
Adverbs and participles and more...

Each corpus uses different standards ⇒ Different PoS tagger annotations

perennius 'more lastingly'

- ADV - *perennius*
- ADV - *perenniter*
- ADJ - *perennis*

sanctus 'holy; saint'

- ADJ - *sanctus*
- NOUN - *sanctus*
- VERB - *sancio*

Each annotation standard has its own motivation!
Diachronic changes also have to be taken into account.

Harmonised evaluation

LEMLAT as a common reference

We want to be able to compare automated or manual annotations of parts of speech and lemmas wich follow different standards.

LEMLAT as a lexical hub

We exploit its vast coverage of lexicon and orthographical variants to correctly evaluate all possibilities.

affrementissime 'in a most roaring way'

adfrementissime/affrementissime	ADV/D/…
adfrementissimus/affrementissimus	ADJ/A/QLF/…
adfremens/affremens	VERB/V/VBE/… or ADJ/…
adfremo/affremo	VERB/…

will all be accepted as correct analyses!

We adopt the Universal POS Tags of UD (Petrov et al. 2011) as reference

`https://universaldependencies.org/u/pos/index.html`

Some results

Top3s - Work in progress

De Divinatione by Cicero, 1st c. BC (Gold: LiLa)

PoS:	TreeTagger (Brandolini)	90.7%
	MarMot (Capitula)	88.7%
	UDpipe (PROIEL)	87.1%
Lemmas:	UDpipe (PROIEL)	90.3%
	TreeTagger (Brandolini)	89.9%
	MarMot (Capitula)	89.8%

Confessiones I-III by Augustinus, 4th c. AD (Gold: LiLa)

PoS:	TreeTagger (Brandolini)	93.6%
	MarMot (Capitula)	92.2%
	RDRPOSTagger (PROIEL)	91.6%
Lemmas:	TreeTagger (Brandolini)	95.0%
	MarMot (Capitula)	92.4%
	UDpipe (PROIEL)	92.3%

Hist. Langobardorum Beneventanorum by Erchempertus, 9th c. AD (Gold: Comp. Hist Sem.)

PoS:	MarMot (Capitula)	89.3%
	TreeTagger (Brandolini)	87.7%
	CLTK - CRF	83.9%
Lemmas:	MarMot (Capitula)	85.4%
	UDpipe (PROIEL)	79.6%
	TreeTagger (Brandolini)	79.6%

Remarks and future work

- Wide diachronic coverage seems to be more important than sheer size for training
- Diachronic variations seem to affect lemmatisation more than part-of-speech tagging

Future directions

- Fine-tuned harmonised evaluation, e. g.
  - diachronic point of view
  - evaluation per part of speech
- Training and evaluation of new models
- Survey on existing annotation standards and comparisons
- Automated conversion of annotation standards to UD

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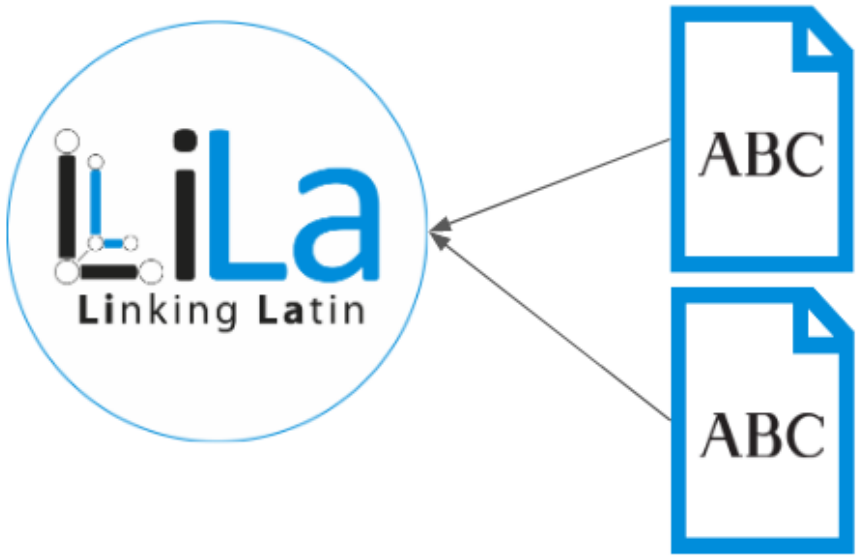
NLP-2: Upcoming Resources in LiLa & a New Initiative (R. Sprugnoli)

Creating, collecting and connecting Latin data

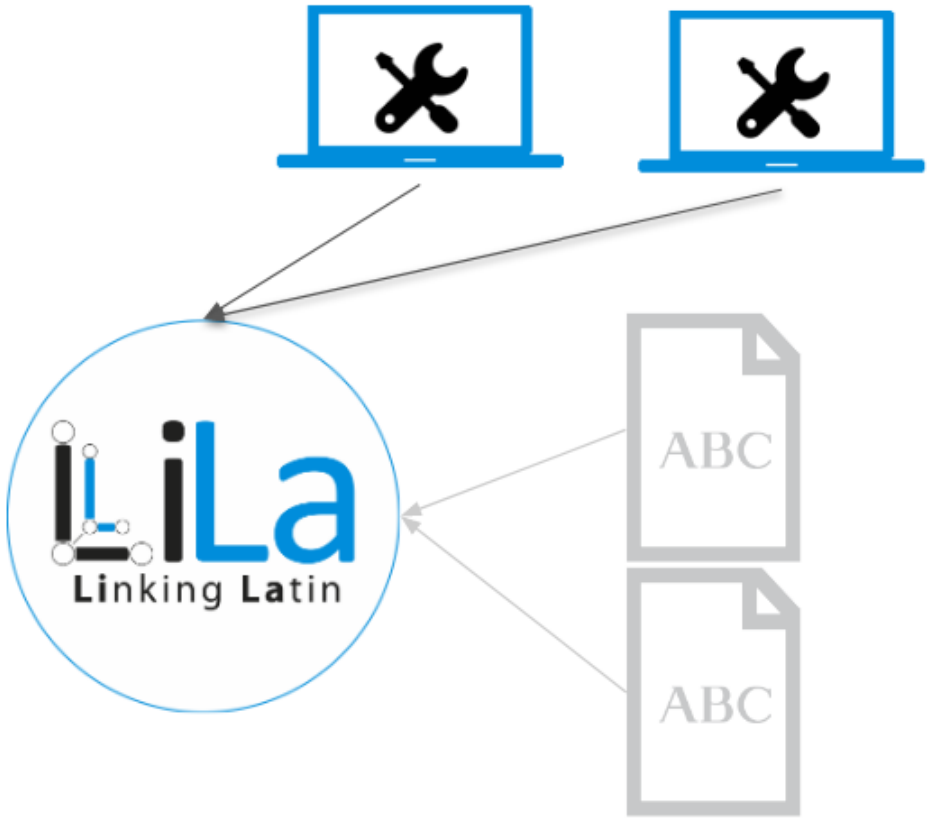
Creating, collecting and connecting Latin data

- Lexical resources



Creating, collecting and connecting Latin data

- NLP Tools



Creating, collecting and connecting Latin data

- Word Embeddings

Creating, collecting and connecting Latin data

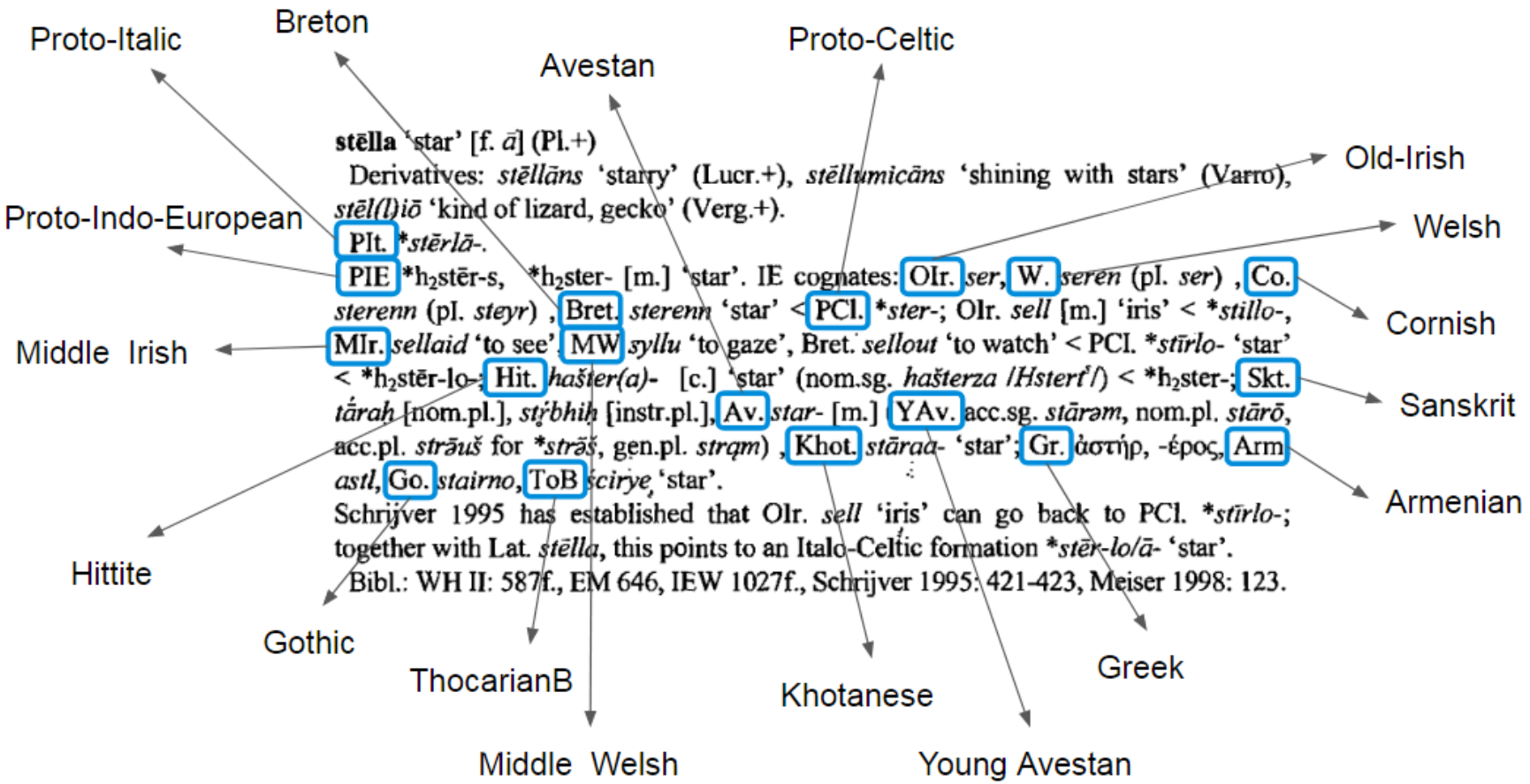
- Annotated corpora

Lexical Resources

- Valency Lexicon
- Latin WordNet
- de Vaan, M. (2008). **Etymological Dictionary of Latin**. Leiden, The Netherlands: Brill.

stēlla 'star' [f. *ā*] (Pl.+)
Derivatives: *stēllāns* 'starry' (Lucr.+), *stēllumicāns* 'shining with stars' (Varro), *stēl(l)iō* 'kind of lizard, gecko' (Verg.+).
PIt. **stērlā-*.
PIE *$h_2$stēr-s, *$h_2$ster- [m.] 'star'. IE cognates: OIr. *ser*, W. *seren* (pl. *ser*) , Co. *sterenn* (pl. *steyr*) , Bret. *sterenn* 'star' < PCl. **ster-*; OIr. *sell* [m.] 'iris' < **stillo-*, MIr. *sellaid* 'to see', MW *syllu* 'to gaze', Bret. *sellout* 'to watch' < PCl. **stīrlo-* 'star' < *$h_2$stēr-lo-; Hit. *hašter(a)-* [c.] 'star' (nom.sg. *hašterza /Hsterʦ/*) < *$h_2$ster-; Skt. *tā́raḥ* [nom.pl.], *stṛ́bhiḥ* [instr.pl.], Av. *star-* [m.] (YAv. acc.sg. *stārəm*, nom.pl. *stārō*, acc.pl. *strāuš* for **strāš*, gen.pl. *strąm*) , Khot. *stāraa-* 'star'; Gr. ἀστήρ, -έρος, Arm. *astl*, Go. *stairno*, ToB *śćirye* 'star'.
Schrijver 1995 has established that OIr. *sell* 'iris' can go back to PCl. **stīrlo-*; together with Lat. *stēlla*, this points to an Italo-Celtic formation **stēr-lo/ā-* 'star'.
Bibl.: WH II: 587f., EM 646, IEW 1027f., Schrijver 1995: 421-423, Meiser 1998: 123.

Information about reconstructed Indo-European forms



NLP tools

Models trained on “Opera Latina”, a corpus manually annotated by the *Laboratoire d’Analyse Statistique des Langues Anciennes* (LASLA) for:

1. Tokenisation
2. PoS Tagging
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4. Inflectional features identification

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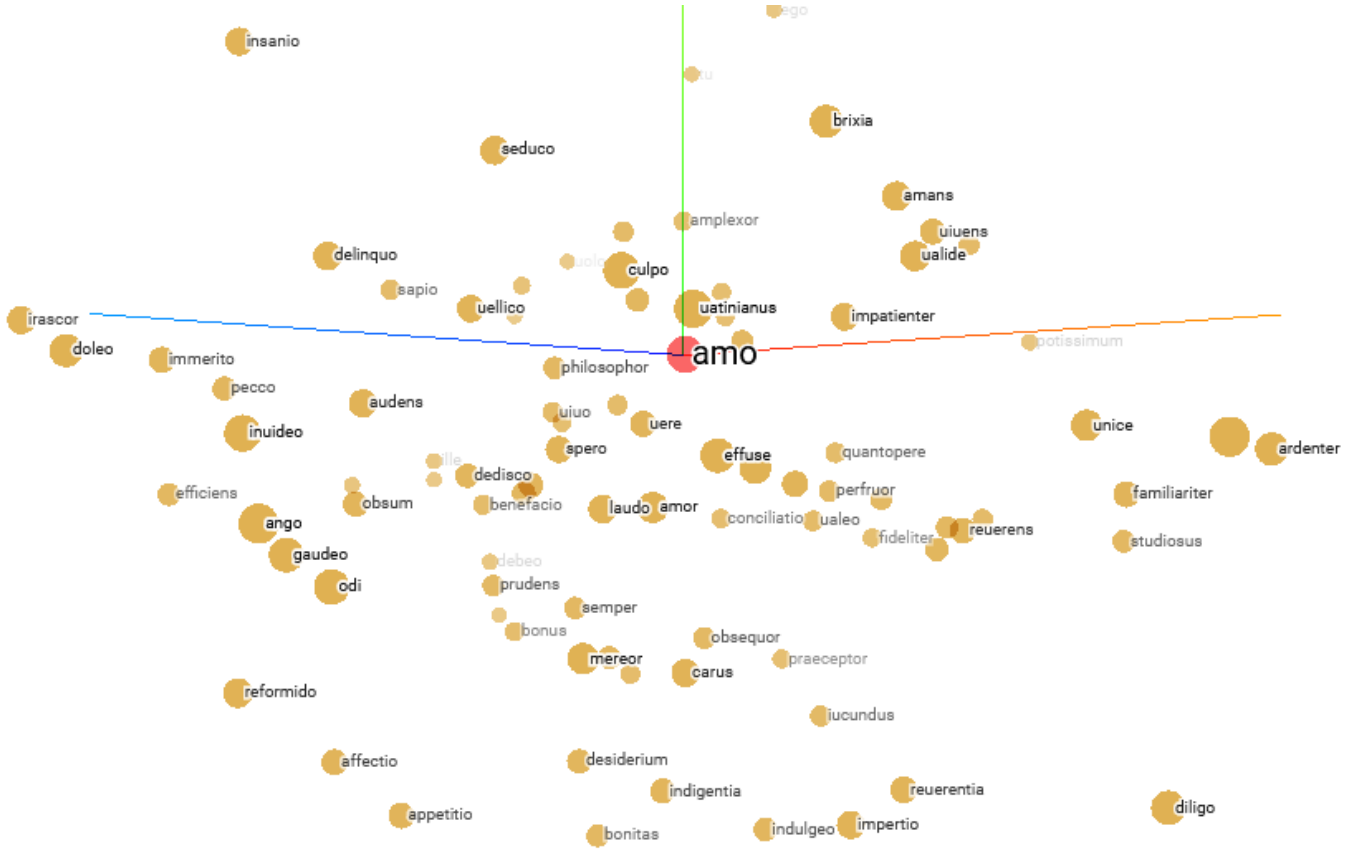
Models trained on:

1. the whole corpus
2. texts by single authors (i.e. author-specific models)

Word embeddings

Pre-trained word vectors learned on the whole LASLA corpus using:

1. word2vec
2. fastText



Word embeddings
word2vec versus fastText

- Different word representations:

FELIX	
word2vec	**fastText**
beatus	infelix
fortunatus	felicitas
inuideo	feliciter
felicitas	fel
infelix	infelicitas
infelicitas	fortunatus
miser	detestor
bonum	gaudeo

IUDICO	
word2vec	**fastText**
puto	abiudico
sum	diiudico
dico	adiudico
debeo	praeiudico
existimo	iudicatum
ergo	iudicium
sapiens	praeiudicium
delibero	dico

Annotated corpora

Ancient Latin texts taken from the Perseus Digital Library:

- different authors (Caesar, Seneca, Cicero, Catullus…)
- different genres (treatises, letters, poems…)
- automatically annotated with our new author-specific models

A new initiative...

How can we promote the development of resources and language technologies for the Latin language?

How can we foster collaboration among scholars working on Latin and attract researchers from different disciplines?

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- Evaluation campaign designed following a long tradition in NLP (MUC, ACE, SemEval, CoNLL…)
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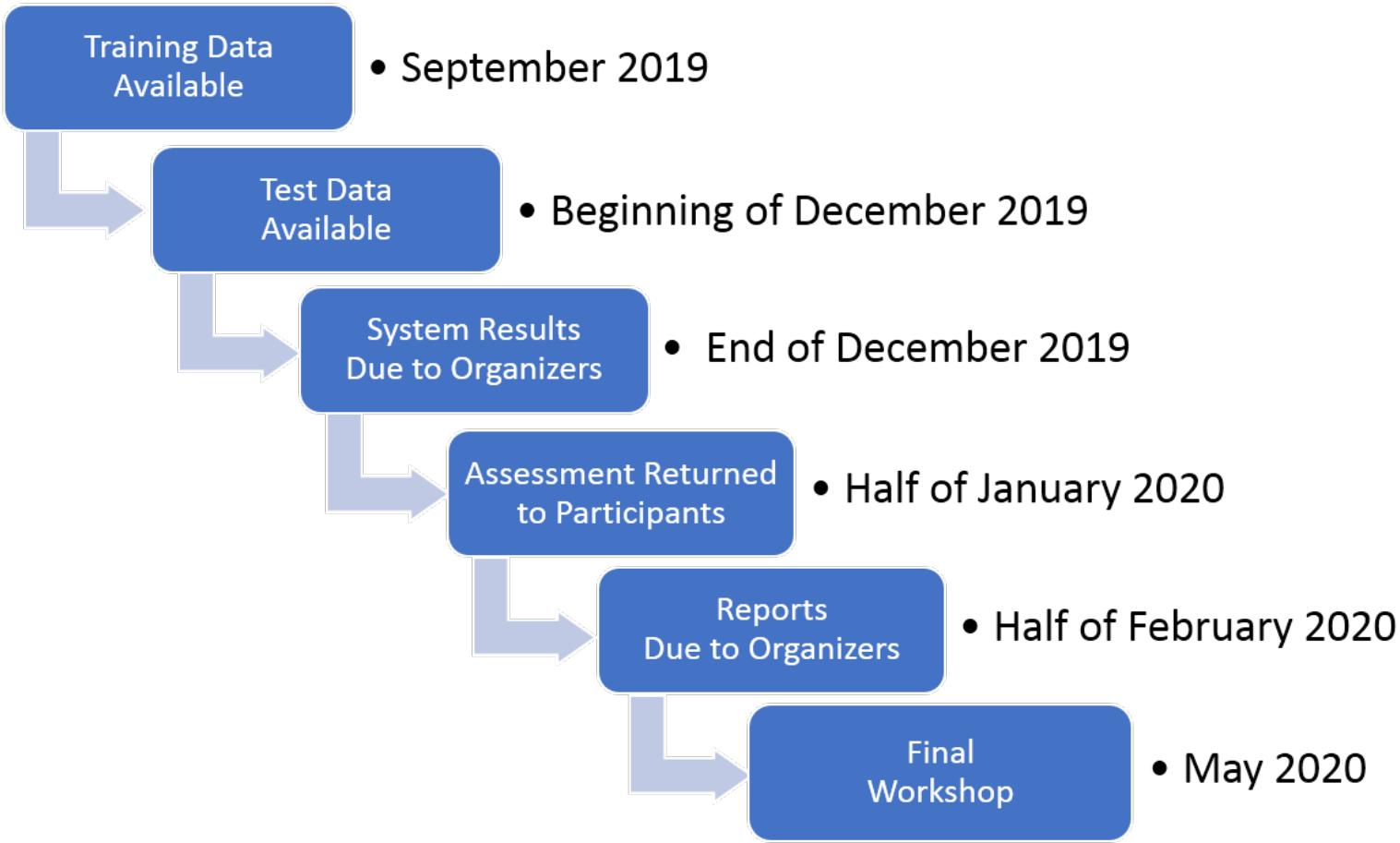
- Evaluation campaign designed following a long tradition in NLP (MUC, ACE, SemEval, CoNLL…)
- Shared tasks, shared training and test data, shared evaluation metrics
- 3 tasks:
  1. PoS tagging
  2. Lemmatisation
  3. Inflectional features identification
- 3 sub-tasks for each task:
  1. Basic
  2. Cross-Genre
  3. Cross-Time

EvaLatin
Tentative Timeline



Thanks!

Get in touch

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Works cited

- Bon, B. (2011) 'OMNIA : outils et méthodes numériques pour l'interrogation et l'analyse des textes médiolatins (3)', Bulletin du centre d'études médiévales d'Auxerre (BUCEMA). URL: `http://journals.openedition.org/cem/12015`, DOI: 10.4000/cem.12015
- Eger, S., Gleim, R. and Mehler, A. (2016) 'Lemmatization and Morphological Tagging in German and Latin: A comparison and a survey of the state-of-the-art', *Proceedings of the 10th International Conference on Language Resources and Evaluation (LREC 2016)*.
- Fellbaum, C. (1998) 'Towards a Representation of Idioms in WordNet', *Proceedings of the workshop on the Use of WordNet in Natural Language Processing Systems (Coling-ACL)*, pp. 52–57.
- Minozzi, S. (2017) 'Latin WordNet, una rete di conoscenza semantica per il latino e alcune ipotesi di utilizzo nel campo dell'information retrieval', *Strumenti digitali e collaborativi per le Scienze dell'Antichità*, 14, pp. 123–133. DOI: 10.14277/6969-182-9/ANT-14-10
- Petrov, S., Das, D. and McDonald, R. (2011) 'A Universal Part-of-Speech Tagset', *arXiv:1104.2086*.