UNIVERSITÀ
CATTOLICA
del Sacro Cuore

From Treebanks to Linked Open Data

The LiLa Project

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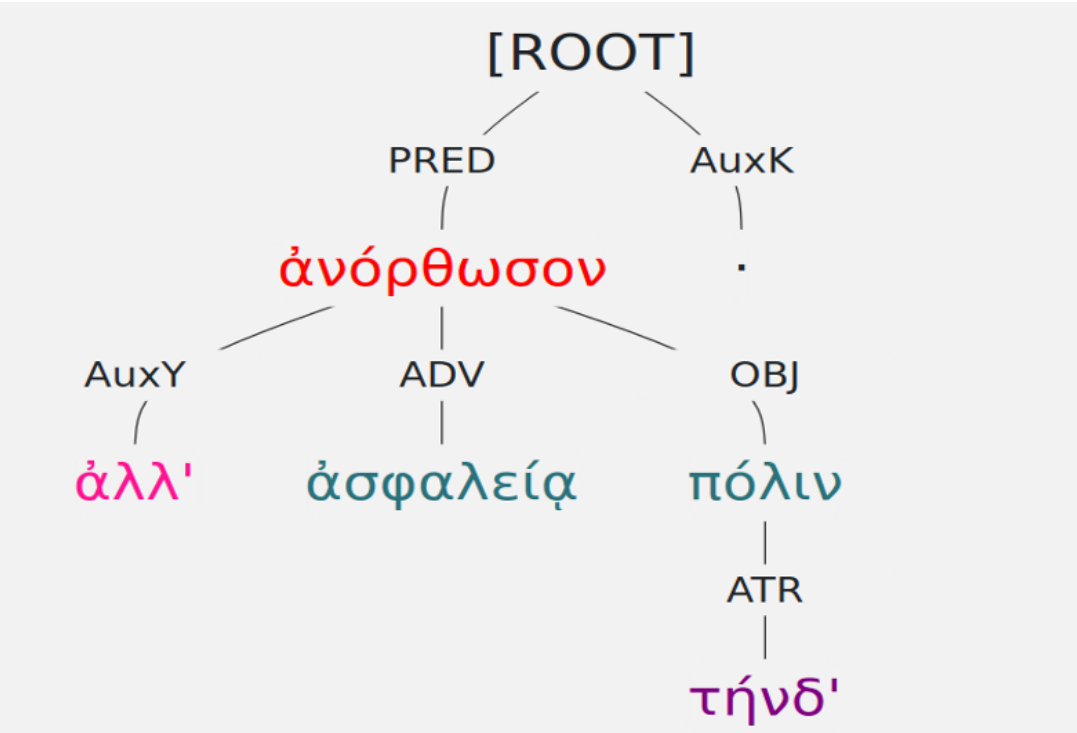
. . . but what is a treebank, again?

- annotated corpus
- split into sentences
- with word-by-word annotation on:
  - morphology
  - syntax
  - perhaps more



4 treebanks of Latin

- Latin Dependency Treebank (2006-): Classical Lat., prose and poetry, about 50k tokens;
- Index Thomisticus Treebank (2006-): Medieval Lat., only 1 author (Thomas Aquinas), about 400k tokens;
- PROIEL (2008): Late and Classical prose, transl. of NT (Jerome's *Vulgate*, 4th CE), plus other prose, about 250k;
- Late Latin Charter Treebank (2011-): 8th-9th century notary documents (charters) from Central Italy, about 250k;
- UDante (2021): complete annotation of the (5) Latin works by Dante Alighieri using the UD schema, about 56k

Universal Dependencies (UD)

http://universaldependencies.org/

- a shared framework
- more than 200 treebanks
- more than 100 languages
- both universal and language-specific annotation

Motivation
Resources for Latin

- Textual Resources
  - Digital Libraries (Perseus), Collections of Texts (LASLA, ALIM, Musisque Deoque, Patrologia Latina, PHI, Library of Latin Texts etc.), Treebanks
- Lexical Resources
  - Valency Lexica (Vallex, IT-VaLex), Latin WordNet, Dictionaries (Du Cange, TLL, OLD, TTLF, DMLBS & DB of Latin Dictionaries c/o Brepols)
- NLP Tools
  - Morphological Analysers (LEMLAT, Words, LatMor), PoS Taggers (TreeTagger, Collatinus, UDPipe), Dependency Parsers (UDPipe), CLTK

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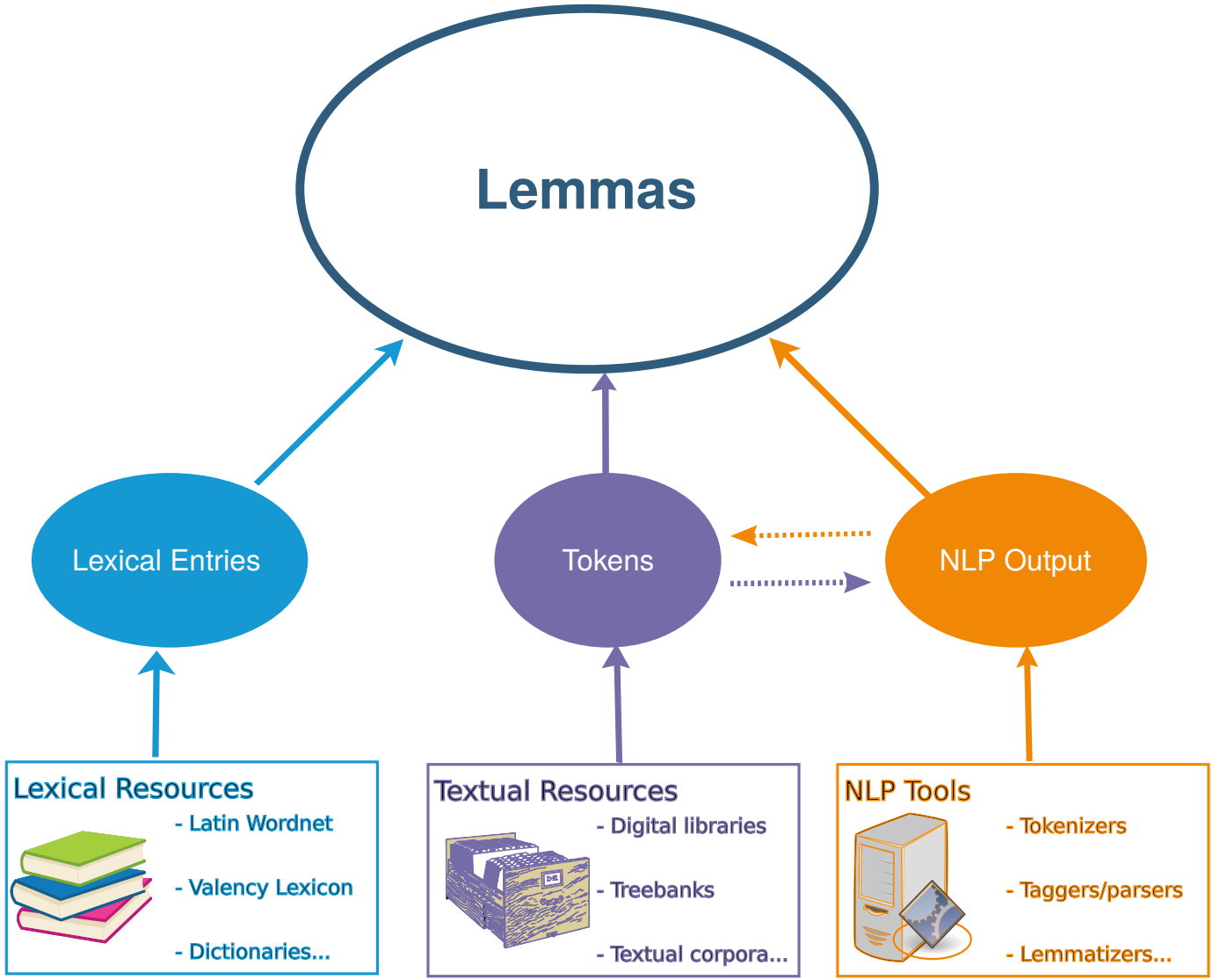
Scattered and Unconnected

Aims

- Create a Knowledge Base of linguistic resources for Latin
  - corpora
  - lexicons
  - NLP tools
- Create common vocabularies to describe them
- Use the LOD paradigm

The lemma

a gateway to Latin linguistic resources



LiLa: Overview

Resources connected and upcoming connections

- **Textual Resources**
  - [x] Index Thomisticus Treebank (*Summa contra Gentiles*): ca. 450,000 nodes
  - [x] **UDante: ca. 55,000 tokens**
  - [x] *Liber Abbaci*, *Chapter VIII*: ca. 30,000 tokens
  - [x] *Querolus sive Aulularia*: ca. 17,000 tokens
  - [ ] PROIEL and LLCT treebanks
  - [ ] Computational Historical Semantics, LASLA and CroALa Corpora
- **Lexical Resources**
  - [x] Word Formation Latin: ca. 46,000 lemmas (Classical Latin)
  - [x] Etymological dictionary of Latin & the other Italic Langs.: ca. 1,400 entries
  - [x] LatinAffectus: ca. 4,000 entries
  - [x] Index Graecorum Vocabulorum in Linguam Latinam: ca. 1,800 entries
  - [x] Latin WordNet: ca. 1,000 manually checked entries
  - [x] Latin Vallex 2.0: Valency Lexicon
  - [x] Lewis & Short Dictionary
  - [ ] Lemma Embeddings
- **NLP tools**
  - [x] Lemma Bank: ca. 200,000 lemmas
- **TOTAL: approximately 15 million triples**

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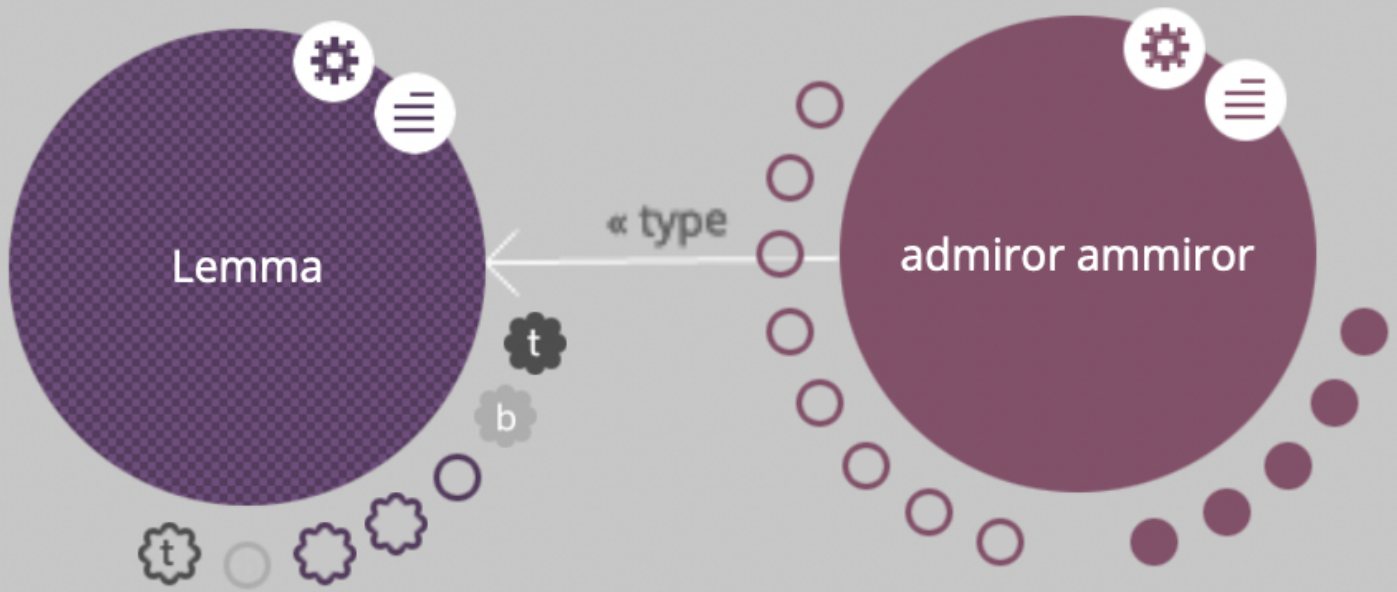
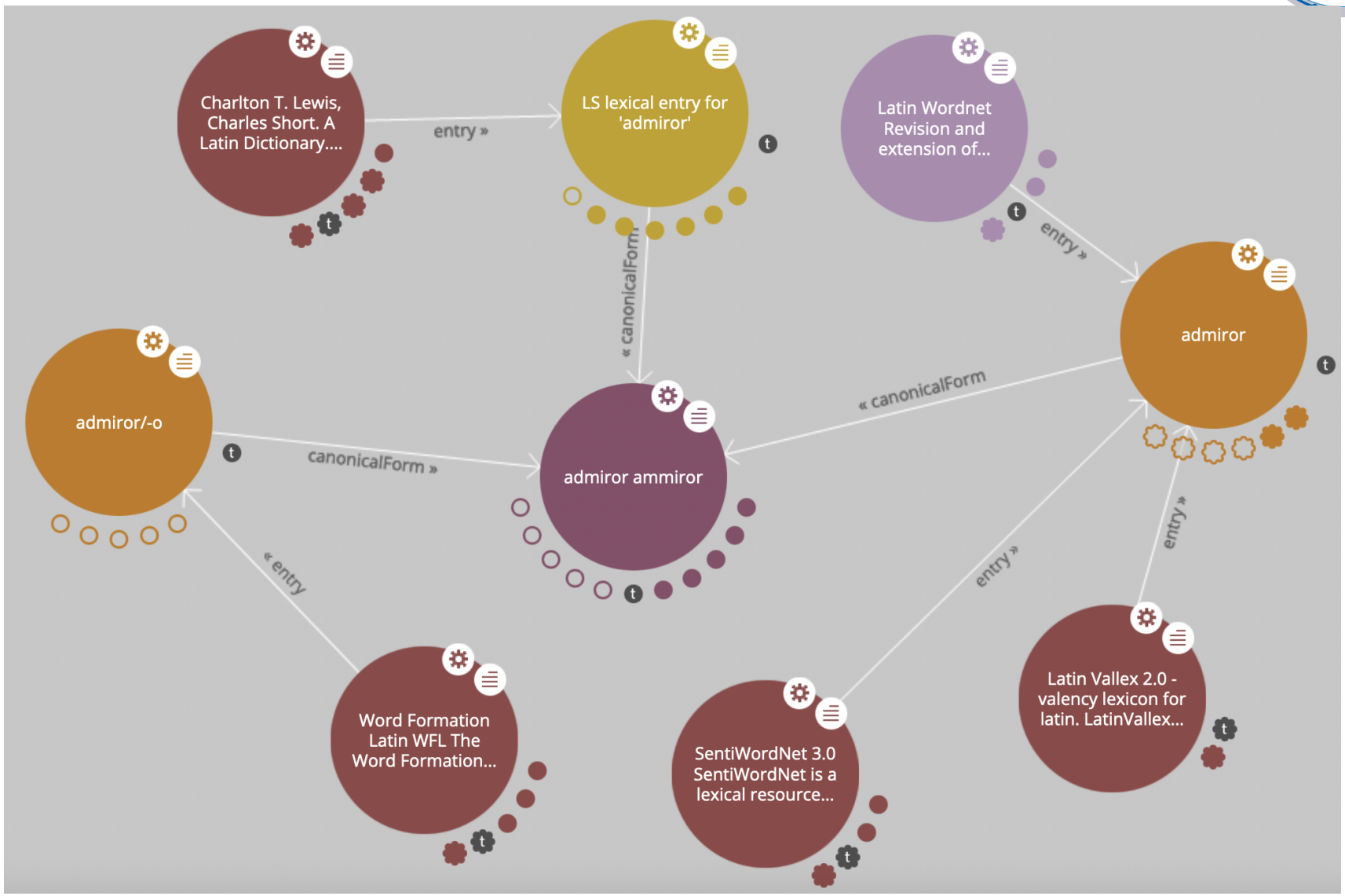
Meet a lemma!

http://lila-erc.eu/data/id/lemma/87541



Lemmas and Lexical Entries



A wealth of interlinked information
that can be queried!

Token 1

Token 2

A wealth of interlinked information
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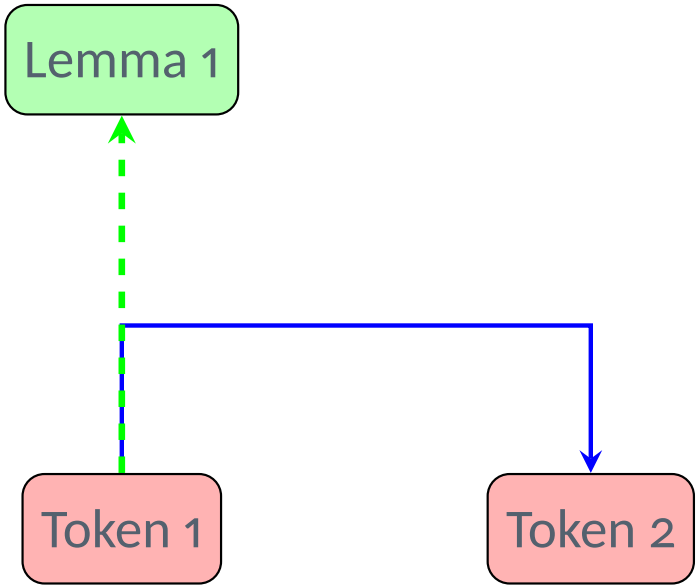

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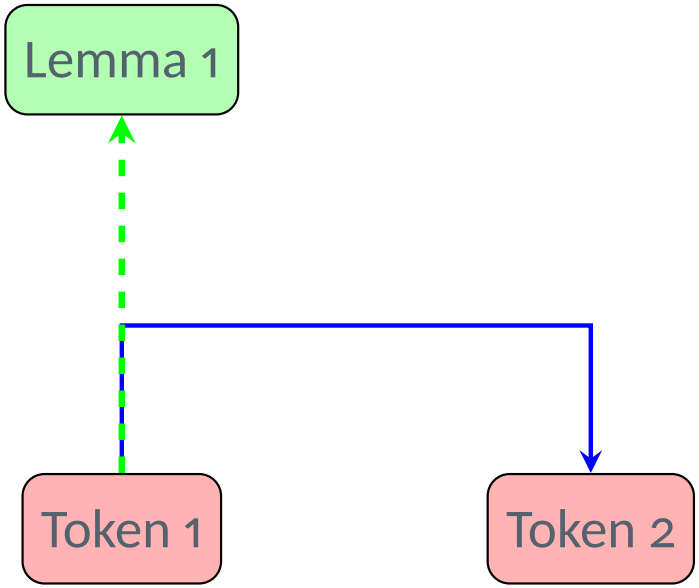

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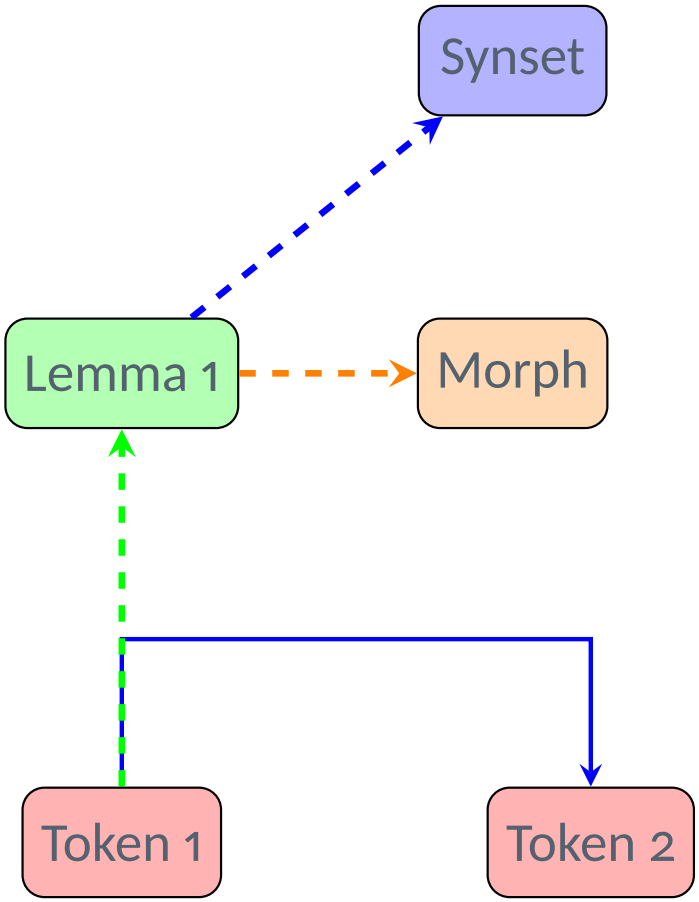

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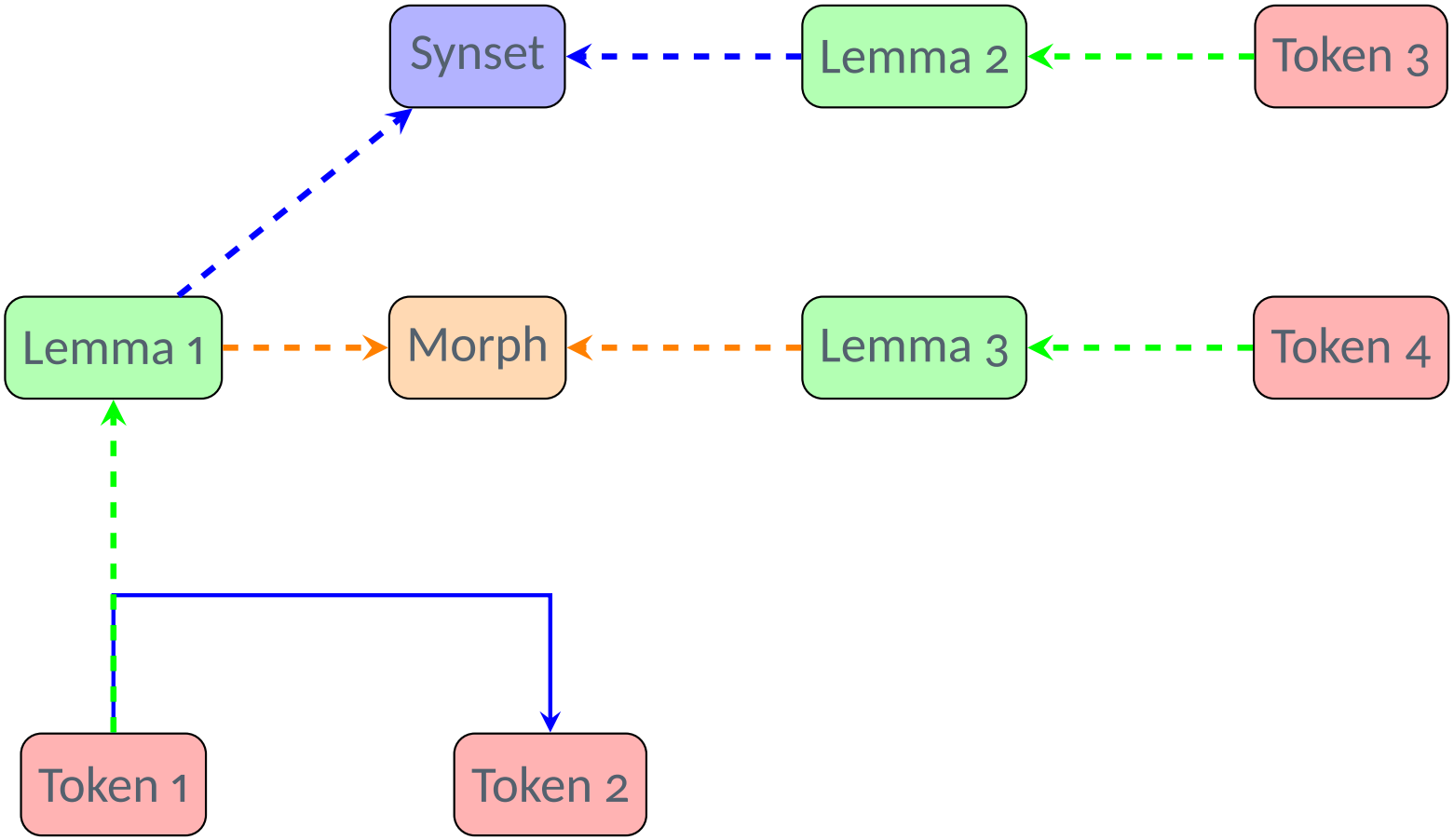
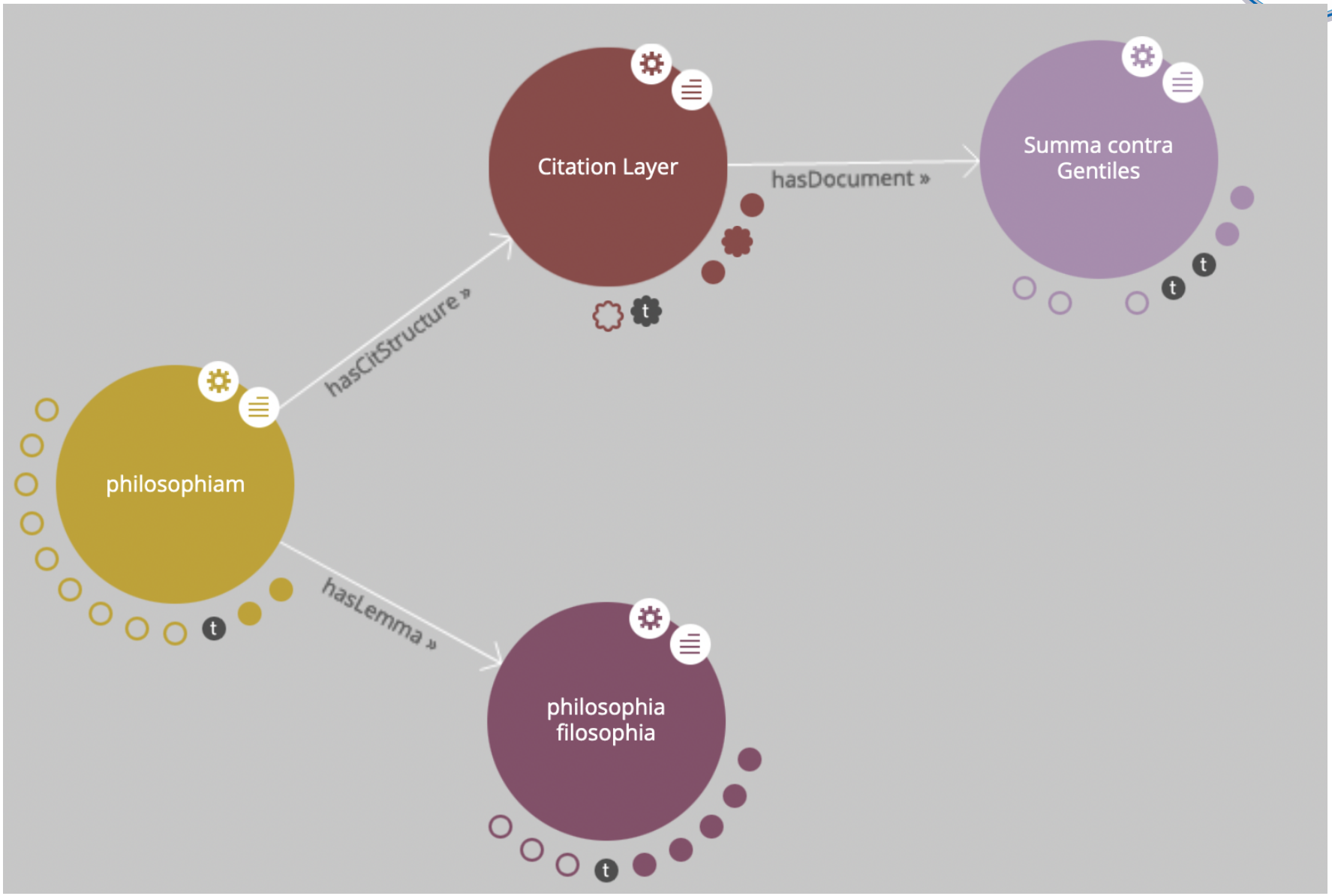


Linked tokens in actions

http://lila-erc.eu/data/corpora/ITTB/id/token/005.SCG*LB1.CP--++1.N.1-1.2-4W4

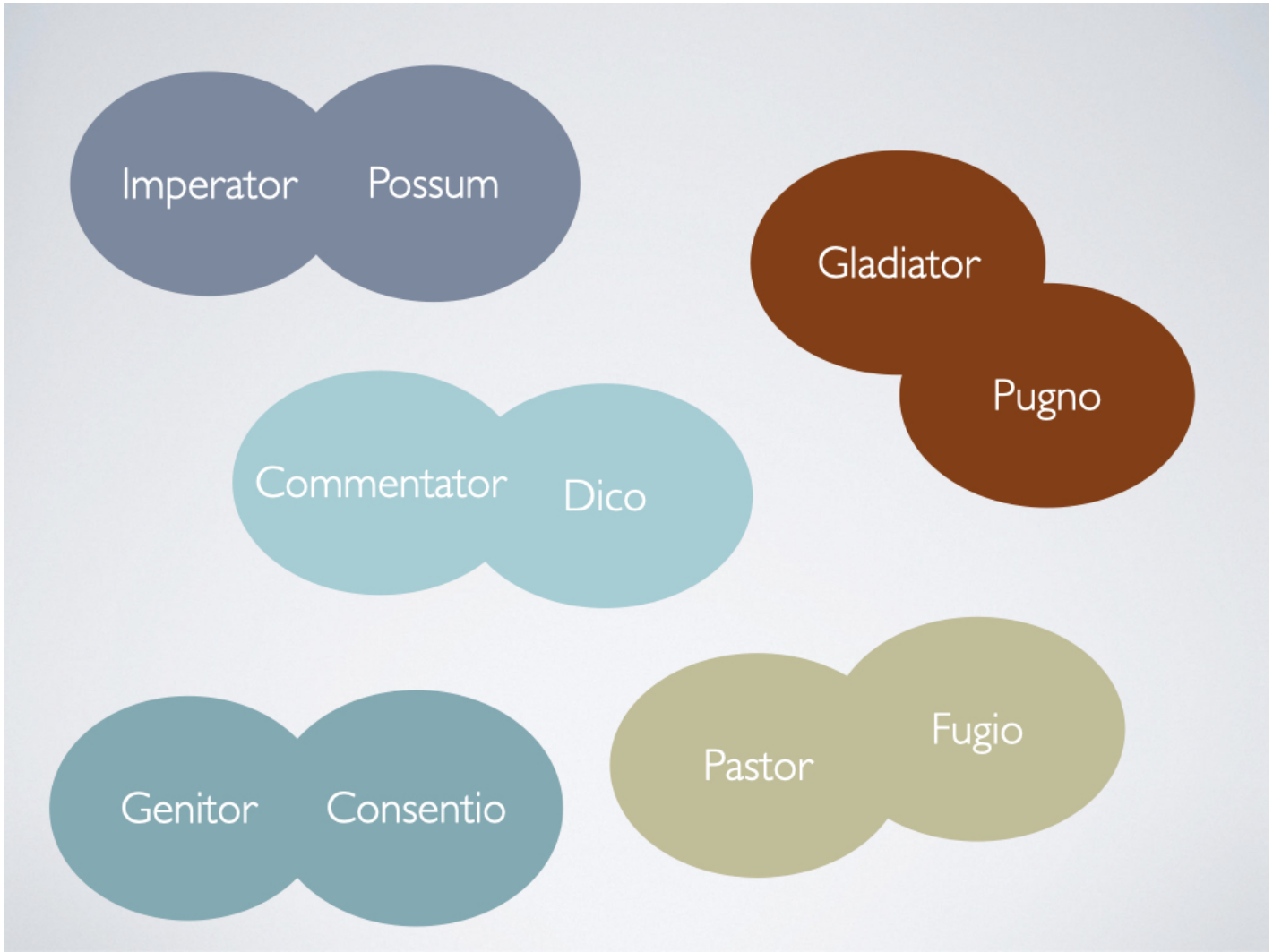


Querying with SPARQL

All verbs that govern subjects formed with affix “-(t)or”


```
SELECT ?g ?headlab ?deplab WHERE {
 SERVICE <http://lila-erc.eu:3030/lemlat/sparql> {
    ?suff a lemlat_base:Suffix ;
      rdfs:label '-(t)or' .
    ?lemma lemlat_base:hasSuffix ?suff ;
      ontolex:writtenRep ?deplab .  }
  GRAPH ?g {
     ?tok lemlat_base:hasLemma ?lemma ;
       conll:EDGE 'nsubj' ;
       conll:HEAD ?head .
     ?head conll:UPOS 'VERB' ;
           lemlat_base:hasLemma ?l .
  }
 SERVICE <http://lila-erc.eu:3030/lemlat/sparql> {
    ?l ontolex:writtenRep ?headlab . }
}
```

Some interesting couplets



Wordcloud of results from the Index Thomisticus

"the Interpreter (of Aristotle, i.e. Averroes) says…"

Conclusions
and future works

- Language is complex! Morpho-syntactic description is not enough to capture all complexities
- LOD provide a way to link treebank annotation and information on other levels (semantics, derivational morphology…)
- a lexically based approach (using lemmas as hub node) is one way to do it!

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- a lexically based approach (using lemmas as hub node) is one way to do it!
- but (future works)…
  - we need to harmonize the tagsets (ontologies)
  - we need to find sustainable, scalable solutions together with the projects that own and maintain the resources

Thanks!
Get in touch

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CIRCSE Research Centre

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https://lila-erc.eu

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