

Querying the Latin Dependency Treebank

An example workflow

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Queries

- What?
 - extracting desired information from a treebank
- How?
 - by designing a query in a query language and by running it on a treebank
- Where?
 - in a program that supports the query language in question
- Why?
 - to answer a research question
- When?
 - now!

The Ancient Greek and Latin Dependency Treebank

Giuseppe G. A. Celano, Gregory Crane,
Bridget Almas & al.

[View the Project on GitHub](#)
PerseusDL/treebank_data

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The Latin Dependency Treebank

The Latin Dependency Treebank contains texts annotated according to the guidelines v. 1.3. The current release (v. 2.1) contains the following texts:

Author	Text	Loci
Augustus	Res Gestae	
Caesar	Commentarii de Bello Gallico	2.1-2.3; 2.5; 2.7; 2.9; 2.14-2.18; 2.32-2.33
Cicero	In Catilinam	1.1-2.11
Jerome	Vulgata	
Vergil	Aeneid	6, 1-336
Ovid	Metamorphoses	
Petronius	Satyricon	26-78
Phaedrus	Fabulae	1-3
Propertius	Elegiae	1.1-1.22
Sallust	Bellum Catilinae	
Suetonius	Life of Augustus	1-55
Tacitus	Historiae	1.1-1.21

Annotators

The Ancient Greek and Latin Dependency Treebanks are built from the work of dedicated students and researchers from across the world. Over 200 people have annotated texts; the hard work of those who have contributed their annotations as part of the official treebanks are within the data.

→ https://perseusdl.github.io/treebank_data/

This project is maintained by [PerseusDL](#)

Hosted on GitHub Pages — Theme by [orderedlist](#)

```

1 <treebank xmlns:saxon='http://saxon.sf.net/' xml:lang='lat' format='aldt' version='1.5'>
2   <date>2015-12-03 08:58:41 +0000</date>
3   <annotator>
4     <short/>
5     <name/>
6     <address/>
7     <uri>http://services2.perseids.org/llt/segtok</uri>
8   </annotator>
9   <annotator>
10    <short/>
11    <name/>
12    <address/>
13    <uri>http://github.com/latin-language-toolkit/arethusa</uri>
14  </annotator>
15  <annotator>
16    <short>Perseids Publications</short>
17    <name>Perseids Publications</name>
18    <address>perseidspubs@gmail.com</address>
19    <uri>http://data.perseus.org/sosol/users/Perseids%20Publications</uri>
20  </annotator>
21  <sentence id='1' document_id='' subdoc='1:prologus' span=''>
22    <word id='1' form='Aesopus' lemma='Aesopus' postag='n-s---mn-' relation='ATR' ref='1:prologus' head='2' />
23    <word id='2' form='auctor' lemma='auctor' postag='n-s---mn-' relation='SBJ' ref='1:prologus' head='5' />
24    <word id='3' form='quam' lemma='quil' postag='p-s---fa-' relation='ATR' ref='1:prologus' head='4' />
25    <word id='4' form='materiam' lemma='materia' postag='n-s---fa-' relation='OBJ' ref='1:prologus' head='5' />
26    <word id='5' form='repperit' lemma='reperio' postag='v3sria---' relation='ATR' ref='1:prologus' head='7' />
27    <word id='6' form='.' lemma='' postag='u-----' relation='AuxX' ref='1:prologus' head='5' />
28    <word id='7' form='Hanc' lemma='hic' postag='p-s---fa-' relation='OBJ' ref='1:prologus' head='9' />
29    <word id='8' form='ego' lemma='ego' postag='p-s---mn-' relation='SBJ' ref='1:prologus' head='9' />
30    <word id='9' form='polivi' lemma='polio1' postag='v1sria---' relation='PRED' ref='1:prologus' head='0' />
31    <word id='10' form='versibus' lemma='versus3' postag='n-p---mb-' relation='ADV' ref='1:prologus' head='9' />
32    <word id='11' form='senariis' lemma='senarius' postag='a-p---mb-' relation='ATR' ref='1:prologus' head='10' />
33    <word id='12' form='.' lemma='' postag='u-----' relation='AuxX' ref='1:prologus' head='0' />
34  </sentence>
35  <sentence id='2' document_id='' subdoc='1:prologus' span=''>
36    <word id='1' form='Duplex' lemma='duplex' postag='a-s---fn-' relation='PNOM' ref='1:prologus' head='4' />
37    <word id='2' form='libelli' lemma='libellus' postag='n-s---mg-' relation='ATR' ref='1:prologus' head='3' />
38    <word id='3' form='dos' lemma='dos' postag='n-s---fn-' relation='SBJ' ref='1:prologus' head='4' />
39    <word id='4' form='est' lemma='sum1' postag='v3spia---' relation='PRED' ref='1:prologus' head='0' />
40    <word id='5' form='.' lemma='' postag='' relation='AuxX' ref='1:prologus' head='0' />
41  </sentence>
42  <sentence id='3' document_id='' subdoc='1:prologus' span=''>
43    <word id='1' form='quod' lemma='quod' postag='c-----' relation='AuxC' ref='1:prologus' head='4' />
44    <word id='2' form='risum' lemma='risus' postag='n-s---ma-' relation='OBJ' ref='1:prologus' head='3' />

```

sentence

word

attribute

<elements> in light blue
angle brackets
attributes in reddish brown
their 'values' in bright blue

Our research question

- Hyperbaton, i.e. discontinuous phrases

hae permanerunt aquae dies complures (Caesar, *B.G.* 1.50.1)

these lasted waters days several

"This time the flood (hae aquae) lasted several days"

- Do Latin prose and poetry differ in their use of hyperbaton?
 - technical formulation: Is the relative frequency of discontinuous noun phrases (NPs) with a same-case premodifier and a non-modifier intervener higher in either genre?

(there are several types of hyperbaton depending on the place of the modifier and on the relation of the NP and the intervening word)

Data

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Caesar	Commentarii de Bello Gallico	2.1-2.3; 2.5; 2.7; 2.9; 2.14-2.18; 2.32-2.33	71 sentences 1,556 words
Cicero	In Catilinam	1.1-2.11	
Jerome	Vulgata		
Vergil	Aeneid	6, 1-336	
Ovid	Metamorphoses		
Petronius	Satyricon	26-78	
Phaedrus	Fabulae	1-3	583 sentences 6,586 words
Propertius	Elegiae	1.1-1.22	
Sallust	Bellum Catilinae		
Suetonius	Life of Augustus	1-55	
Tacitus	Historiae	1.1-1.21	

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ALDT to PML

ALDT format:

```
<sentence id='2' document_id='' subdoc='1:prologus' span='1'>
  <word id='1' form='Duplex' lemma='duplex' postag='a-s---fn-' relation='PNOM' ref='1:prologus' head='4' />
  <word id='2' form='libelli' lemma='libellus' postag='n-s---mg-' relation='ATR' ref='1:prologus' head='3' />
  <word id='3' form='dos' lemma='dos' postag='n-s---fn-' relation='SBJ' ref='1:prologus' head='4' />
  <word id='4' form='est' lemma='sum1' postag='v3spia---' relation='PRED' ref='1:prologus' head='0' />
  <word id='5' form=':' lemma='' postag='' relation='AuxK' ref='1:prologus' head='0' />
</sentence>
```

XSLT stylesheet

PML format:

```
<LM id="2" subdoc="1:prologus">
  <LM id="4" relation="PRED" id2="" form="est" lemma="sum1" pos="verb" person="third_person" number="singular" tense="present" mood="indicative" voice="active">
    <LM id="1" relation="PNOM" id2="" form="Duplex" lemma="duplex" pos="adjective" number="singular" gender="feminine" case="nominative"></LM>
    <LM id="3" relation="SBJ" id2="" form="dos" lemma="dos" pos="noun" number="singular" gender="feminine" case="nominative">
      <LM id="2" relation="ATR" id2="" form="libelli" lemma="libellus" pos="noun" number="singular" gender="masculine" case="genitive"></LM>
    </LM>
  </LM>
</LM>
```

TrEd Treebank Editor with PML-TQ extension

File Node Tree View Macros Setup Help Mode: PMLTQ

New query Import Suggest Connect Configure Edit query Edit node Edit subtree Filters Cut Copy Paste Paste new tree (Un)Expand (Un)Expand all

Add node NOT AND OR 'abc' Equality "a.*" Regexp \$N Name type Relation Add rel Optional

Query Search Count Previous match This match Next match TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml 2 of 2+ 330/332

```
# hyperbaton: discontinuous NPs with same-case premodifier and non-attribute intervener
aldt-sentence $a :=
[ descendant aldt-word $b :=
  [ pos = "noun",
    [ aldt-word $c =
      [ pos = "noun",
        [ relation = "ATR"
          pos in {"noun", "adjective", "pronoun"}
          case = $b.case
        ]
      ]
    ]
  ]
]
```

query window

tree window

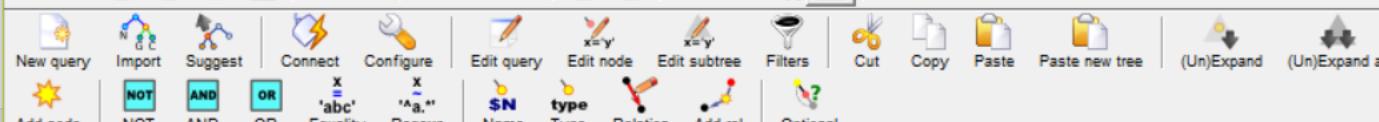
The query window displays a tree query for a hyperbaton pattern. The root node is 'aldt-sentence \$a'. It has a child node 'aldt-word \$b' with the attribute 'pos = "noun"'. This node has a child node 'aldt-word \$c' with the attribute 'relation = "ATR"'. The 'pos' attribute is defined as being in the set {"noun", "adjective", "pronoun"} and the 'case' attribute is set to '\$b.case'. The tree window shows a hierarchical tree structure with nodes labeled with words and their parts-of-speech (e.g., 'scripta PRED', 'propter AuxP', 'est AuxV', 'fabula SBJ', 'Haec ATR', 'homines OBJ', 'illos ATR', 'opprimunt ATR', 'Qui ADV', 'causis ADV', 'innocentes ADV'). Edges represent grammatical relations like PRED, AuxP, AuxV, SBJ, ATR, and OBJ.

PML-TQ query elements ('user-friendly style')

- node types: aldt-word / aldt-sentence
- attributes: relation, form, lemma, pos ...
- relations: child, parent ...
- operators: =, !=, > ...
- naming the nodes: \$a :=
- lists in output: >> for, give, sort by, desc



Style: PMLTQ



TrEd Search-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml

2 of 2+ 331/332



QUERY IS EMPTY!
Pressing 'Insert' to create the first query node, or 'e' to open the query editor!

Tree Query
q-19-01-30_114906

aldt-sentence node
= ROOT
aldt-word nodes

TrEd ver. 2.5124 Tree_Questions(2/2): C:\Users\timot\AppData\Roaming\tred.d\queries.pml

File Node Tree View Macros Setup Help Mode: PMLTQ

New query Import Suggest Connect Configure Edit query Edit node Edit subtree Filters Cut Copy Paste Paste new tree (Un)Expand (Un)Expand all

Add node NOT AND OR Equality Regexp Name type Relation Add rel Optional

Create a new query node (Insert)

Query Search Count Previous match This match Next match TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml 2 of 2+ 331/332

aldt-sentence [];

Tree Query q-19-01-30_114906

aldt-sentence

scripta PRED

propter est fabula AuxV SBJ

AuxP

Haec ATR

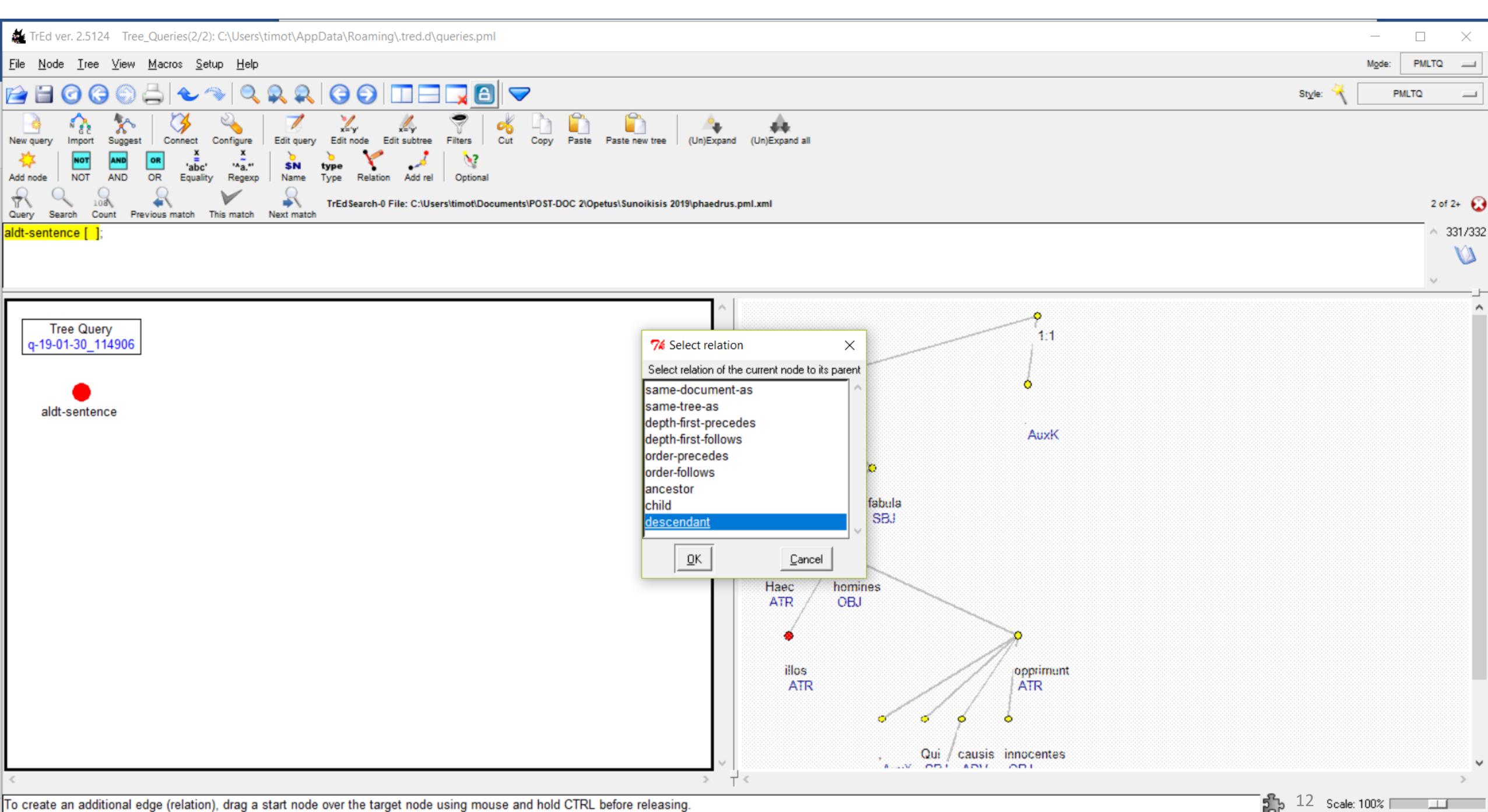
homines OBJ

illos ATR

opprimunt ATR

Qui causis innocentes

1:1 AuxK



TrEd ver. 2.5124 Tree_Questions(2/2): C:\Users\timot\AppData\Roaming\.tred.d\queries.pml

File Node Tree View Macros Setup Help Mode: PMLTQ

New query Import Suggest Connect Configure Edit query Edit node Edit subtree Filters Cut Copy Paste Paste new tree (Un)Expand (Un)Expand all

Add node NOT AND OR 'abc' Equality 'x=a.' Regexp SN Name type Relation Add rel Optional

Query Search Count Previous match This match Next match TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml 2 of 2+ 331/332

aldt-sentence
[descendant aldt-word []];

-> descendant

Tree Query q-19-01-30_114906

aldt-sentence
aldt-word

Select relation
Select relation of the current node to its parent

- same-document-as
- same-tree-as
- depth-first-precedes
- depth-first-follows
- order-precedes
- order-follows
- ancestor
- parent
- sibling
- child**
- descendant

OK Cancel

1:1

AuxK

fabula SBJ

es

ATR OBJ

illos ATR

oppriment ATR

Qui causis innocentes

To create an additional edge (relation), drag a start node over the target node using mouse and hold CTRL before releasing.

13 Scale: 100%

TrEd ver. 2.5124 Tree_Questions(2/2): C:\Users\timot\AppData\Roaming\.tred.d\queries.pml

File Node Tree View Macros Setup Help Mode: PMLTQ

New query Import Suggest Connect Configure Edit query Edit node Edit subtree Filters Cut Copy Paste Paste new tree (Un)Expand (Un)Expand all

Add node NOT AND OR 'abc' Equality 'x.a.*' Regexp Name type Relation Add rel Optional

Query Search Count Previous match This match Next match TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml 2 of 2+ 331/332

aldt-sentence
[descendant aldt-word
[aldt-word []]];

child
descendant

Tree Query q-19-01-30_114906

Select relation

Select relation of the current node to its parent

- same-document-as
- same-tree-as
- depth-first-precedes
- depth-first-follows
- order-precedes
- order-follows**
- ancestor
- parent
- sibling
- child
- descendant

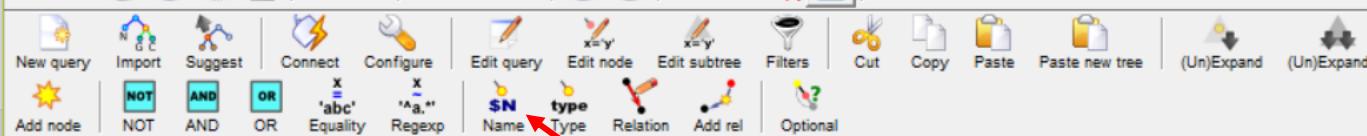
OK Cancel

To create an additional edge (relation), drag a start node over the target node using mouse and hold CTRL before releasing.

14 Scale: 100%



Style: PMLTQ



Query Search Count Previous match This match Next match

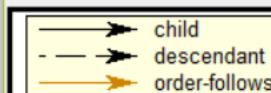
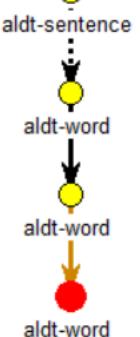
TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml

2 of 2+ X

```
aldt-sentence
[ descendant aldt-word
  [ aldt-word
    [ order-follows aldt-word [ ] ] ]];
```

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node naming key

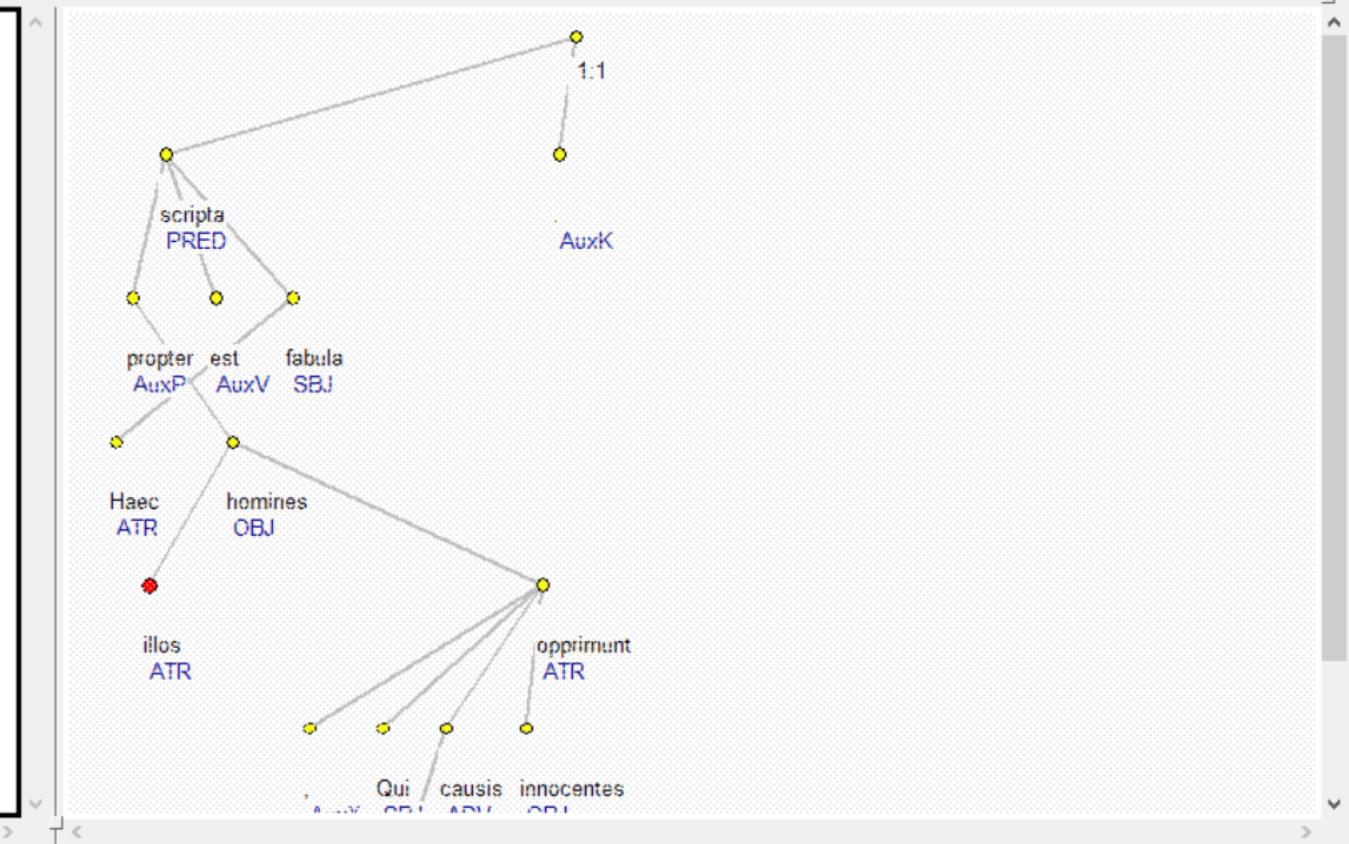
Tree Query
q-19-01-30_114906

'hae permanerunt aquae'

'aqua' (head noun)

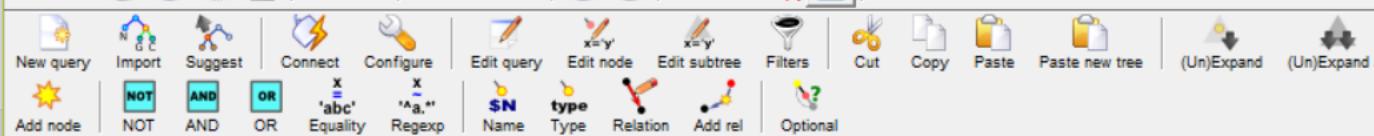
'hae' (modifier)

'permanerunt' (intervener)





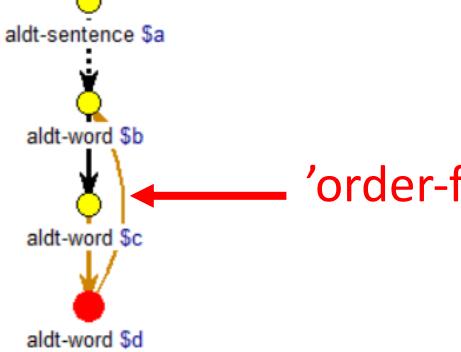
Style: PMLTQ



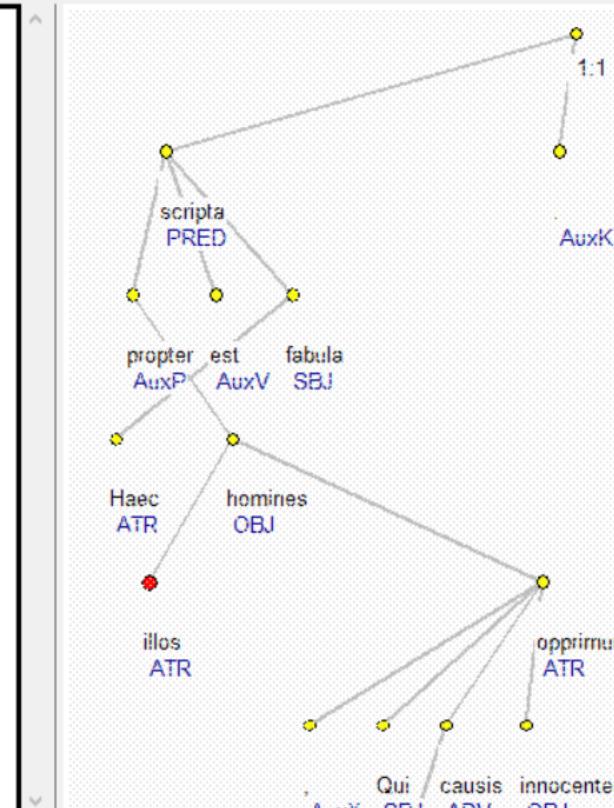
TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml

2 of 2+ 331/332

```
aldt-sentence $a :=
[ descendant aldt-word $b :=
  [ aldt-word $c :=
    [ order-follows aldt-word $d :=
```

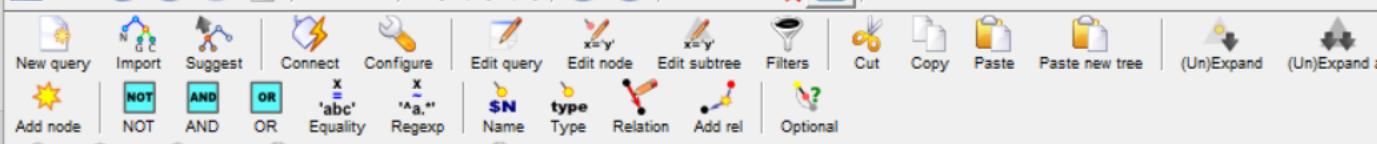
Tree Query
q-19-01-30_114906

'order-follows' arrow from d to b





Style: PMLTQ

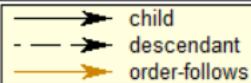
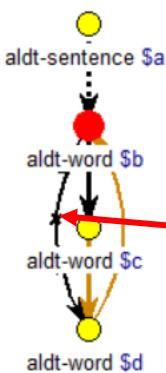


2 of 2+

TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml

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```
aldt-sentence $a :=
[ descendant aldt-word $b :=
  [ !child $d,
    aldt-word $c :=
```

Tree Query
q-19-01-30_114906

negated 'child'
arrow from b to d

Edit query node

```
aldt-sentence $a :=
[ descendant aldt-word $b :=
  [ !child $d,
    aldt-word $c :=
```

```
  [ order-follows aldt-word $d :=
    [ order-follows $b ] ] ] ]
```

? 3x Relation Type Member \$n := []
Attribute != (equals) in { ... } ~ (regexp) < > Function
, and or 0 !0 "... '...' + * / ^ \$ & (concat)
>> Grouping: for/give/sort by Group Function

OK

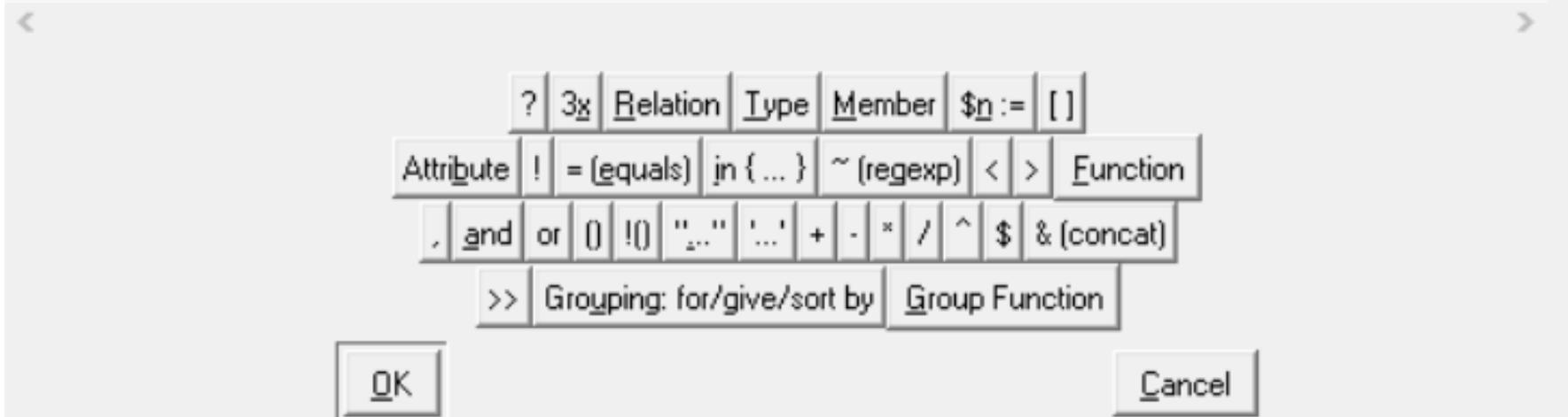
Cancel



74 Edit query node

X

```
aldt-sentence $a :=  
[ descendant aldt-word $b :=  
  [ !child $d,  
    aldt-word $c :=  
    [ relation = "ATR" ] ]  
    syntactic relation  
    order-follows aldt-word $d :=  
    [ order-follows $b ] ]];
```



74 Edit query node

X

```
aldt-sentence $a :=  
[ descendant aldt-word $b :=  
  [ pos = "noun", !child $d,  
    aldt-word $c :=  
      [ relation = "ATR", pos in {"adjective", "pronoun", "noun"}, case = $b.case,  
        orderFollows aldt-word $d :=  
          [ order-follows $b ] ] ]];
```

part-of-speech

case form

? | 3x | Relation | Type | Member | \$n := | []

Attribute | ! | = (equals) | in { ... } | ~ (regexp) | < | > | Function

, | and | or | 0 | !0 | "... | ..." | + | - | * | / | ^ | \$ | & (concat)

>> | Grouping: for/give/sort by | Group Function

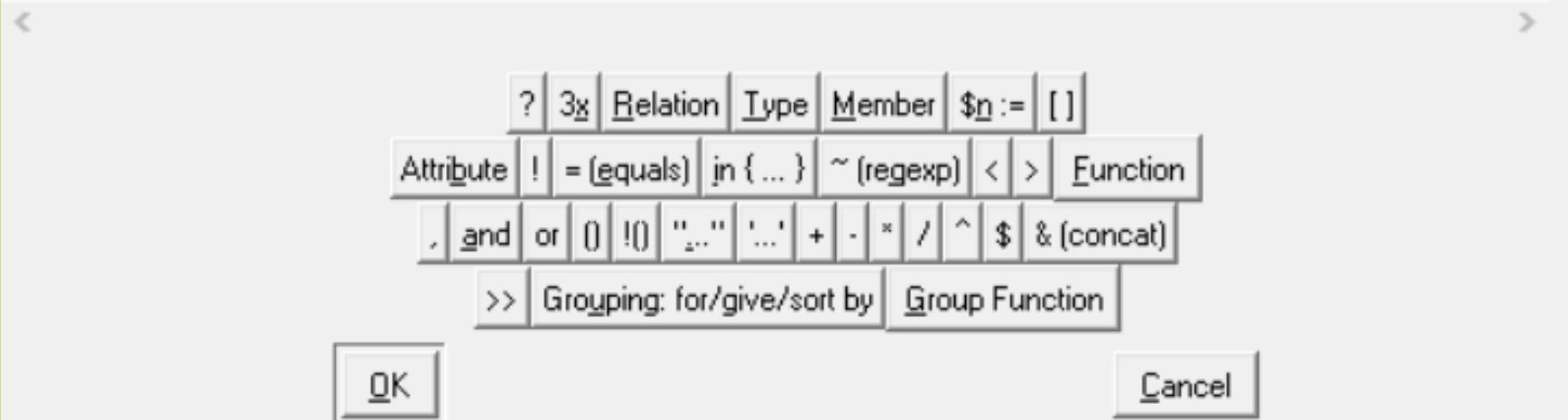
OK

Cancel

74 Edit query node

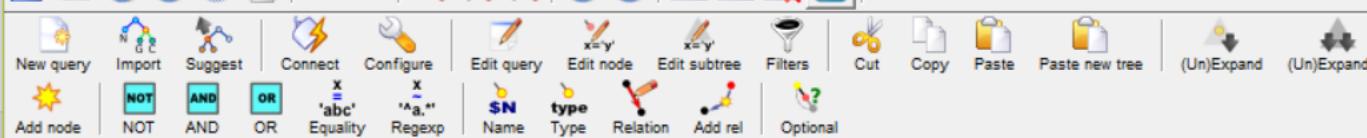
X

```
aldt-sentence $a :=  
[ descendant aldt-word $b :=  
  [ pos = "noun", !child $d,  
    aldt-word $c :=  
      [ relation = "ATR", pos in {"adjective", "pronoun", "noun"}, case = $b.case,  
        order-follows aldt-word $d :=  
          [ order-follows $b ] ] ];  
>> give distinct $a.subdoc,$c.form,$d.form,$b.form
```





Style: PMLTQ



TrEdSearch-0 File: C:\Users\timot\Documents\POST-DOC 2\Opetus\Sunoikisis 2019\phaedrus.pml.xml

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Query Search Count Previous match This match Next match

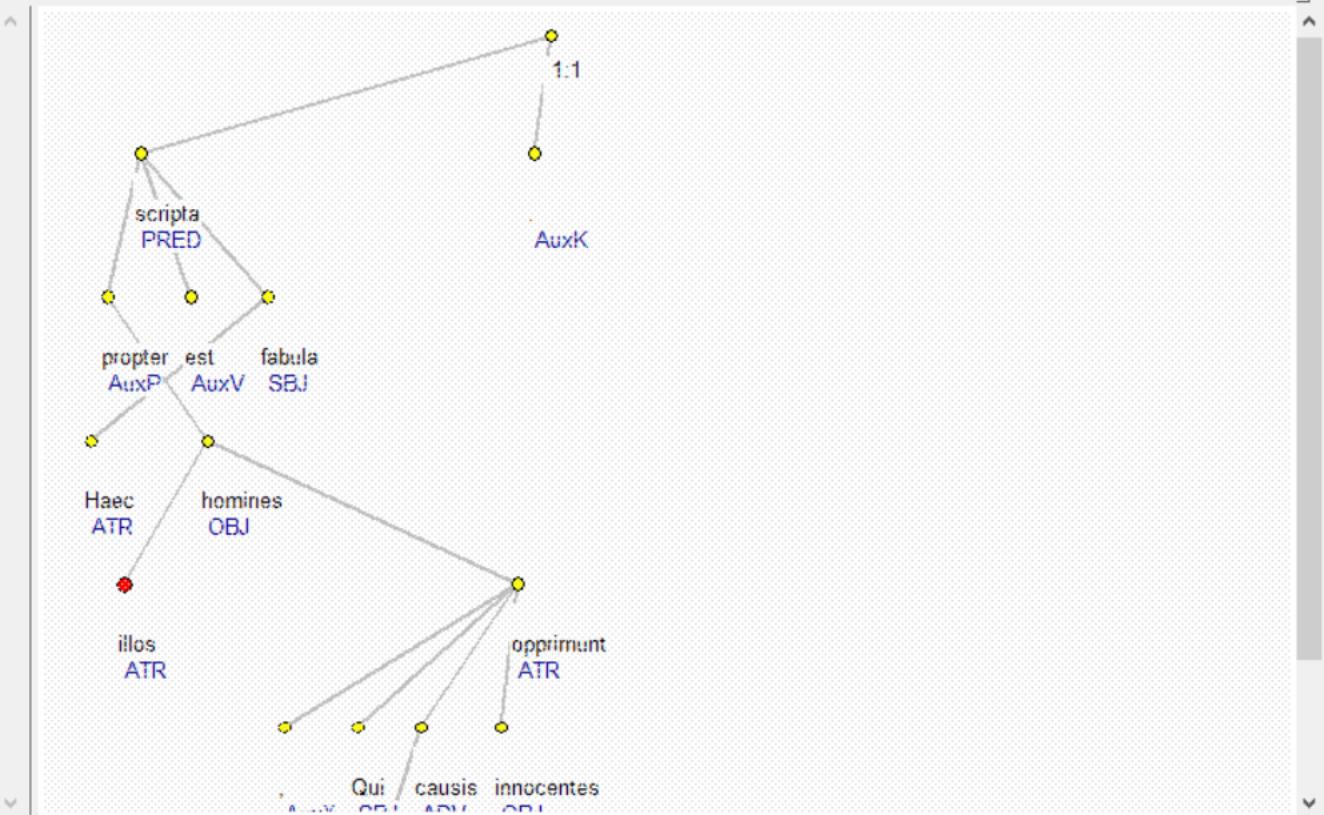
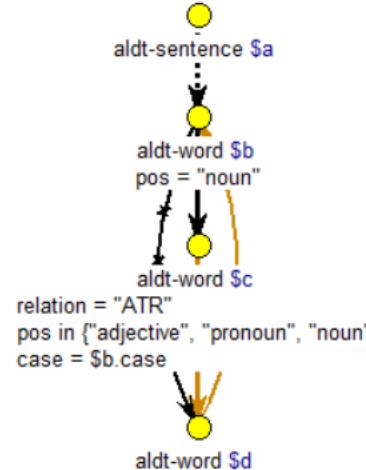
```
order-follows aldt-word $d :=  
[ order-fol... $b ]]]];
```

>> give distinct \$a.subdoc,\$c.form,\$d.form,\$b.form

- child
- descendant
- order-follows

query key

Tree Query
q-19-01-30_114906
Output filters:
>> give distinct \$a.subdoc,\$c.form,\$d.form,\$b.form



76 Results (233 rows) for query q-19-01-30_114906

2.1	crebri	ad	rumores
2.1	crebri	eum	rumores
2.1	omni	pacata	Gallia
2.2	reliquis	-que	Gallis
2.3	ceteris	<u>-que</u>	rebus
2.5	communis	<u>-que</u>	salutis
2.5	reliquis	<u>-que</u>	civitatibus
2.5	Titurium	Sabinum	legatum
2.7	eadem	de	causa
2.9	Q	.	Titurius
2.9	magno	nobis	usui
2.14	magna	inter	auctoritate
2.14	magna	Belgas	auctoritate
2.14	omnibus	<u>-que</u>	armis
2.14	nullum	esse	aditum
2.14	reliquarum	<u>-que</u>	rerum
2.14	magnae	<u>-que</u>	virtutis
2.14	patriam	<u>-que</u>	virtutem
2.18	Eadem	autem	celeritate
2.32	quam	noctu	iniuriam

Search



Save To File

Close

74 Edit query node



```
aldt-sentence $a :=  
[ descendant aldt-word $b :=  
  [ pos = "noun", !child $d,  
    aldt-word $c :=  
      [ relation = "ATR", pos in {"adjective", "pronoun", "noun"}, case = $b.case,  
        order-follows aldt-word $d :=  
          [ !lemma in {"-que1", "que"}, !pos = "punctuation", order-follows $b ] ] ];  
>> give distinct $a.subdoc,$c.form,$d.form,$b.form
```

no -que

no punctuation

?	3x	Relation	Type	Member	\$n := []
Attribute	!= (equals)	in { ... }	~ (regexp)	< >	Function
.	and	or	0 0	"..." ...	+ - * / ^ \$ & (concat)
>> Grouping: for/give/sort by Group Function					
OK			Cancel		

76 Results (211 rows) for query q-19-01-30_114906



2.1	crebri	ad	rumores
2.1	crebri	eum	rumores
2.1	omni	pacata	Gallia
2.5	Titurium		Sabinum legatum
2.7	eadem	de	causa
2.9	magno	nobis	usui
2.14	magna	inter	auctoritate
2.14	magna	Belgas	auctoritate
2.14	nullum	esse	aditum
2.18	Eadem	autem	celeritate
2.32	quam	noctu	iniuriam
2.32	quam	oppidani	iniuriam
2.32	quam	a	iniuriam
2.32	quam	militibus	iniuriam
2.32	iis	quae	armis
2.32	iis	retinuerant	armis
2.32	iis	celaverant	armis
1:prologus		prudenti	vitam consilio
1:1	illos	scripta homines	
1:1	illos	est	homines

Search



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76 Results (129 rows) for query q-19-01-30_114906

2.1	crebri	rumores
2.1	omni	Gallia
2.5	Titurium	legatum
2.7	eadem	causa
2.9	magno	usui
2.14	magna	auctoritate
2.14	nullum	aditum
2.18	Eadem	celeritate
2.32	quam	iniuriam
2.32	iis	armis
1:prologus	prudenti	consilio
1:1	illos	homines
1:1	Haec	fabula
1:2	talem	fabellam
1:2	Alium	regem
1:2	vestrum	bonum
1:3	Suo	habitu
1:3	inani	superbia
1:3	inpudenti	avi
1:3	tristem	notam

Search



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2.1 crebri rumores
 2.1 omni Gallia
 2.5 Titurium legatum
 2.7 eadem causa
 2.9 magno usui
 2.14 magna auctoritate
 2.14 nullum aditum
 2.18 Eadem celeritate
 2.32 quam iniuriam
 2.32 iis armis
 1:prologus prudenti
 1:1 illos homines
 1:1 Haec fabula
 1:2 talem fabellam
 1:2 Alium regem
 1:2 vestrum bonum
 1:3 Suo habitu
 1:3 inani superbia
 1:3 inpudenti avi
 1:3 tristem notam

Genre	Author	Words	Hyperbaton	%
Prose	Caesar	1,556	9	0.6
Poetry	Phaedrus	6,586	119	1.8

Chi-square = 11.98, p < 0.001

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Interpretation of results

Genre	Author	Words	Hyperbaton	%
Prose	Caesar	1,556	9	0.6
Poetry	Phaedrus	6,586	119	1.8

Chi-square = 11.98, p < 0.001

- Research question: “Do Latin prose and poetry differ in their use of hyperbaton?”
 - Yes, if we want to generalize on the basis of this data set.
- Hyperbaton is considered an inherent feature of Latin language, with a specific, partly unexplored, stylistic distribution. (cf. Powell, J. 2010. Hyperbaton and register in Cicero. In E. Dickey & A. Chahoud (eds.), *Colloquial and Literary Latin* (pp. 163-185). CUP. doi:10.1017/CBO9780511763267.011)
- Potential improvements of the research setting: querying a bigger treebank, including all types of hyperbaton, taking syntactic/semantic/metric environment into consideration, ...

Conclusion

- if queried with powerful query tools, treebanks can be asked complicated linguistic-philological research questions
- there are several different types of treebanks and query languages

Links

- Greek and Latin Dependency Treebanks – Perseus Digital Library:
https://perseusdl.github.io/treebank_data/
- PML Tree Query tutorial:
<http://ufal.mff.cuni.cz/tred/documentation/ar01-toc.html>
PML Tree Query online:
<http://lindat.mff.cuni.cz/services/pmltq/#!/home>
- TrEd Treebank Editor download:
<https://ufal.mff.cuni.cz/tred/>
- To get ALDT schema for TrEd and ALDT XSLT stylesheet, send me email to
timo.korkiakangas [ät] helsinki.fi.



Repository

TreeQuery

Treex

More Apps

About



PML Tree Query

Tool for searching and browsing treebanks online

Browse Treebanks

Login

Tutorial

Documentation

Recently Used



HamleDT - Latin

HamleDT is a compilation of existing dependency treebanks (or dependency conversions of other treebanks), transformed so that they all conform to the same annotation style. This is the HamleDT conversion of the Latin Dependency Treebank.



Latin



HamleDT

Featured Treebanks



Universal Dependencies 2.3 – Croatian – SET

Universal Dependencies is a project that is developing cross-linguistically consistent treebank annotation for many languages, with the goal of facilitating multilingual parser development, cross-lingual learning, and parsing research from a language typology perspective.



Croatian



Universal Dependencies 2.3



Prague Dependency Treebank 2.5

The Prague Dependency Treebank 2.5 annotates the same texts as the PDT 2.0. The annotation on the original four layers was fixed or improved in various