Digital Grammar of Greek
Documentary Papyri (PapyGreek),
ERC Starting Grant, No. 758481

UNIVERSITY OF HELSINKI
FACULTY OF ARTS

Sunoikisis Digital Classics - Fall 2020
Session 7

Using Treebanks

Querying Treebanked Corpora for Linguistic Phenomena

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European Research Council
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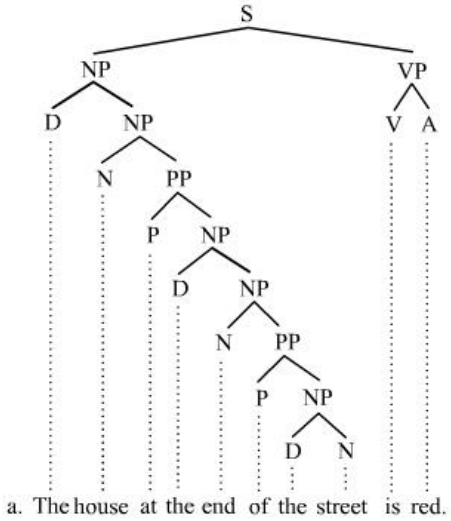
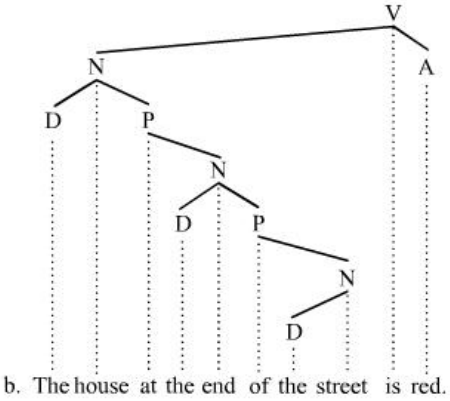
Introduction to Treebanking

- Linguistic analysis of a sentence, showing the syntactic relations between its words
- May include annotation of morphology and semantics
- Constituency vs. Dependency grammar
  - CG - focus is phrase structure
  - DG - focus is individual word



Constituency structure

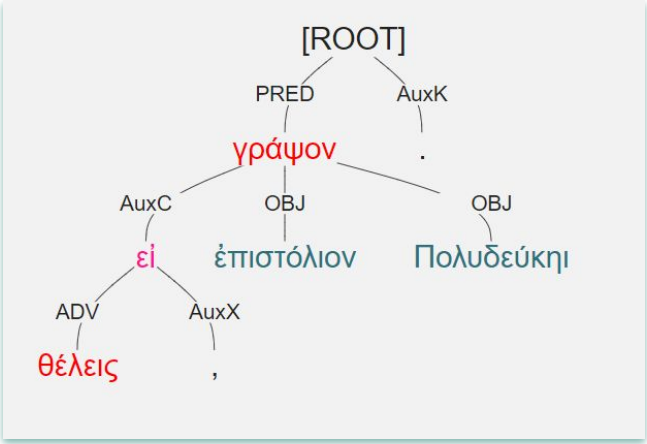


Dependency structure

Source: Tjo3ya (https://commons.wikimedia.org/wiki/File:The_house_at_the_end_of_the_street.jpg)

Introduction to Treebanking

- Main finite verb (or a coordinator) is the head of the tree (ROOT)
- Head <-> dependent relationships between all other words
  - Each word can have **only one head**
  - Words can have one, multiple or zero dependents
  - Head = parent, governor;
  - Dependent = child, descendent;
  - Siblings = words sharing the same parent word
- Relation labels indicate the syntactic function

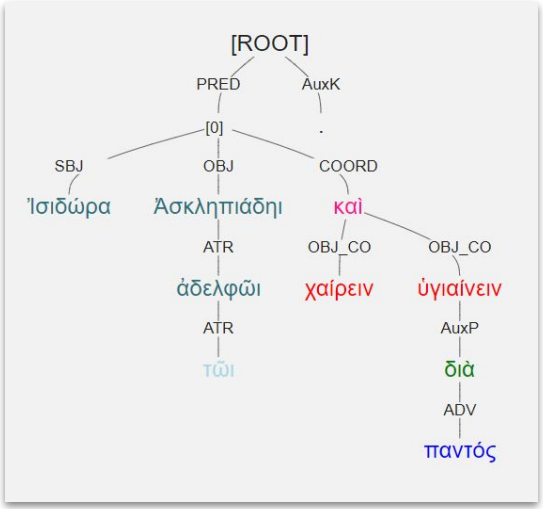


Introduction to Treebanking

- Most Ancient Greek and Latin treebanks are dependency-based:
  - Index Thomisticus Treebank
  - Ancient Greek and Latin Dependency Treebank (AGLDT)
    - Gorman trees
  - PROIEL
  - Pedalion
    - Duke-nlp
  - PapyGreek

Annotation

- Manual annotation usually done through a user interface
- Information recorded as XML:

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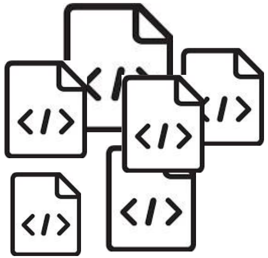
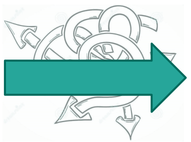
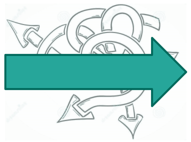
Finding one’s way in the digital forest

From angle brackets to statistics and interpretation





Querying



Instances

Word Distance	Subtree Distance	Lemma	Governor	Hyperbaton	Instance
7	3	ἀργαλέος	Noun	true	Ἔχων τις γυναῖκα πρὸς πάντας τοὺς οἰκείους λίαν τὸ ἦθος ἀργαλέαν ἠβουλήθη γνῶναι εἰ καὶ πρὸς τοὺς πατρῴους οἰκέτας ὁμοίως διάκειται · [334]
6	3	ἀλόγιστος	Noun	true	Πρὸς ἄνδρα μεγαλοπρεπῆ μὲν σώματι , κατὰ ψυχὴν δὲ ἀλόγιστον ὁ λόγος εὔκαιρος . ἐστί [303]
5	1	ἄψυχος	Pronoun	true	Ἀνὴρ κακοπράγμων συνορισάμενος πρός τινα ψευδὲς ἐπιδείξειν τὸ ἐν Δελφοῖς μαντεῖον , ὡς ἐνέστη ἡ προθεσμία , λαβὼν στρουθίον εἰς τὴν χεῖρα καὶ τοῦτο τῷ ἱματίῳ σκεπάσας , ἧκεν εἰς τὸ ἱερὸν καὶ στὰς ἀντικρὺς ἐπηρώτα πότερόν τι ἔμπνουν ἔχει μετὰ χεῖρας ἢ ἄψυχον , βουλόμενος , ἐὰν μὲν ἄψυχον εἴπῃ , ζῶν τὸ στρουθίον ἐπιδεῖξαι , ἐὰν δὲ ἔμπνουν , ἀποπνίξας προενεγκεῖν . εἴπῃ [341]
4	2	πᾶς	Noun	true	Καὶ παραλαβὼν οἴκαδε , πάντα μὲν αὐτῷ προσῆγε τὰ ῥύμματα , πᾶσι δὲ λούτροις ἐπειρᾶτο καθαίρειν . [86]
2	1	δωρητικός	Noun	true	μηδενὸς δὲ ὠνητοῦ προσιόντος , ἐκκαλέσασθαί τινας βουλόμενος , ἐβόα ὡς ἀγαθοποιὸν δαίμονα καὶ κέρδους δωρητικὸν πιπράσκει . [10]
2	2	πολύς	Noun	false	Τοῦ δὲ καὶ τοῦτο εἰς ὠφέλειαν τῶν δεσποτῶν πράττειν φήσαντος · πολλὰ γὰρ αὐτοῖς ᾠὰ τίκτεσθαι παρασκευάζει , διαπορηθεὶς ἐκεῖνος ἔφη · [94]
2	1	μέγας	Noun	false	Ὁ λόγος δηλοῖ ὅτι οἱ τοὺς κρείττονας χλευάζοντες λανθάνουσι μείζονας ἑαυτοῖς τὰς ἀνίας ἐξ αὐτῶν ἐπισπώμενοι . [146]
2	2	περισσός	Noun	false	Καὶ δὴ ἁπάσας ἀθροίσασα παρῄνει αὐταῖς τὰς οὐρὰς ἀποκόπτειν , λέγουσα ὡς οὐκ ἀπρεπὲς μόνον τοῦτο , ἀλλὰ καὶ περισσόν τι αὐταῖς βάρος προσήρτηται . ἐστί [291]
1	1	ξύλινος	Noun	false	Ξύλινόν τις Ἑρμῆν κατασκευάσας καὶ προσενεγκὼν εἰς ἀγορὰν ἐπώλει · [9]
1	1	σφοδρός	Noun	true	οὗ κομισθέντος ἐπὶ τὴν καλιάν , σφοδρὸς ἐμπεσὼν ἄνεμος ἐκ λεπτοῦ καὶ παλαιοῦ κάρφους λαμπρὰν φλόγα ἀνῆψε . [25]
1	1	ἕτερος	Pronoun	false	Ἕτερος δέ τις τοῦτον ἐξαγοράσας ἀνεπτέρωσε τὸν ἀετὸν αὐτίκα . [50]
1	1	παλαιός	Noun	false	" Οὐ θέλω τὴν λύπην τῶν παλαιῶν μου συμφορῶν μεμνῆσθαι , καὶ διὰ τοῦτο τὰς ἐρήμους οἰκῶ . " [73]
1	1	μόνος	Pronoun	true	Ὡς δὲ οὐκ ἔπειθε , προσαγαγὼν ὗν ἣν εἶχε μόνην , παρόντος αὐτοῦ ἐπώλει . [77]
1	1	πᾶς	Noun	false	Καὶ παραλαβὼν οἴκαδε , πάντα μὲν αὐτῷ προσῆγε τὰ ῥύμματα , πᾶσι δὲ λούτροις ἐπειρᾶτο καθαίρειν . [86]
1	1	πρόσφορος	Noun	true	Αἴλουρος ἀκούσας ὅτι ἔν τινι ἐπαύλει ὄρνεις νοσοῦσι , σχηματίσας ἑαυτὸν εἰς ἰατρὸν καὶ τὰ τῆς ἐπιστήμης πρόσφορα ἀναλαβὼν ἐργαλεῖα , παρεγένετο , καὶ στὰς πρὸ τῆς ἐπαύλεως ἐπυνθάνετο αὐτῶν πῶς ἔχοιεν . [106]
1	1	περισσός	Noun	false	Τοῦ δὲ ποιμένος ἀχαριστίαν αὐτῶν κατηγοροῦντος , εἴγε περιττοτέρας αὐταὶ ἐπιμελείας ἐπιτυχοῦσαι καταλείπουσιν αὐτὸν , ἔφασαν ἐπιστραφεῖσαι · [131]
1	1	φιλέρημος	Noun	true	Ἀλκύων ὄρνεόν ἐστι φιλέρημον διὰ παντὸς ἐν θαλάττῃ διαιτώμενον . [198]
1	1	ἕτερος	Noun	false	Ἑτέρα δὲ ἀλώπηξ τῇδε παριοῦσα , ὡς ἤκουσεν αὐτῆς τὸν στεναγμόν , προσελθοῦσα ἐπυνθάνετο τὴν αἰτίαν . [216]
1	1	μέλας	Noun	false	Καὶ ἡ μὲν προβεβηκυῖα αἰδουμένη νεωτέρῳ αὐτῆς πλησιάζειν , διετέλει , εἴ ποτε πρὸς αὐτὴν παρεγένετο , τὰς μελαίνας αὐτοῦ τρίχας περιαιρουμένη . [355]

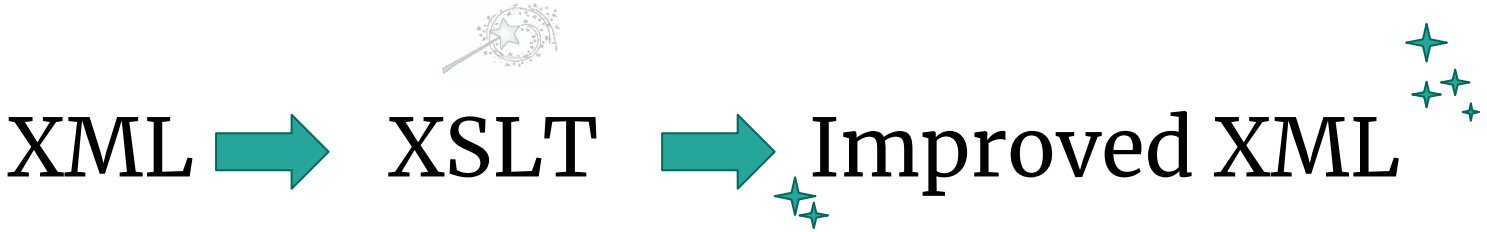
Querying options – (some) tools

- INESS infrastructure for querying PROIEL
  - Tailored for PROIEL's treebanks
    https://clarino.uib.no/iness/page
- DendroSearch (Alek Keersmaekers)
  - Works with a number of corpora using the AGDT annotation format; other texts can be added directly in the tool
    https://github.com/alekkeersmaekers/dendrosearch
- TrEd
  - Graphical editor and tree visualizer
    http://ufal.mff.cuni.cz/tred/
- Iliados, a.k.a. Structural Search (Nick Kallen)
  - http://www.iliados.com/

Querying options - DYI options

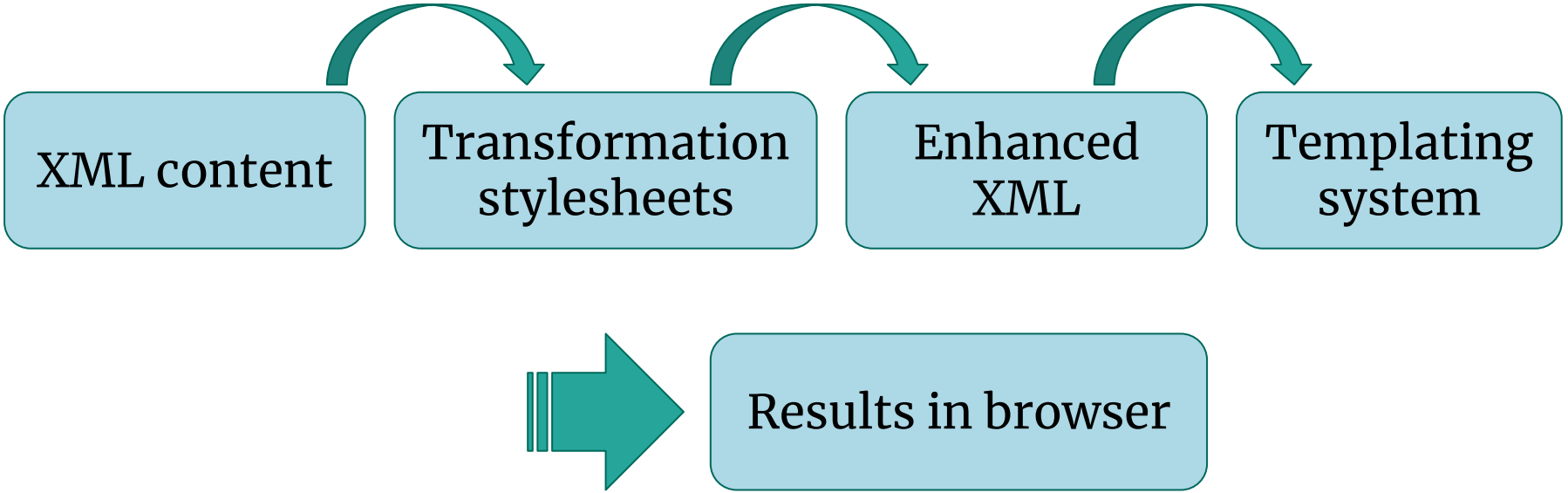
- BaseX - XML database engine with XQuery processor
- gAGDT - graph database based that includes the AGLDT data, developed by Francesco Mambrini. Based on SQL
- Kiln

Kiln platform

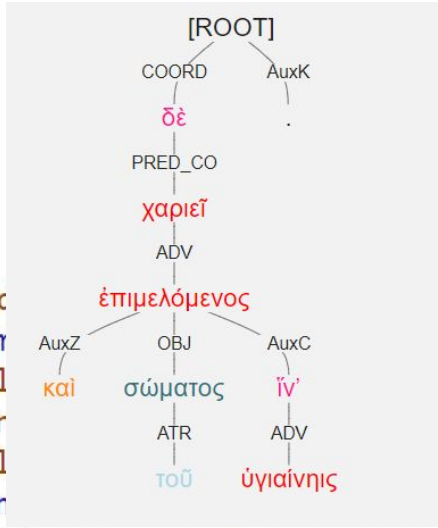


Other formats: HTML, plain text, PDF, PNG, etc.

How it works:


XML content
Transformation stylesheets
Enhanced XML
Templating system
Results in browser

First things first…

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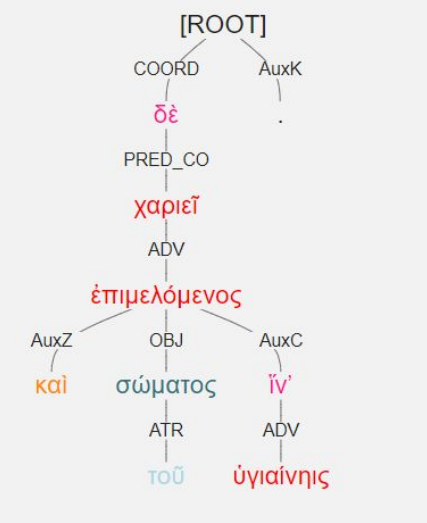
First things first…

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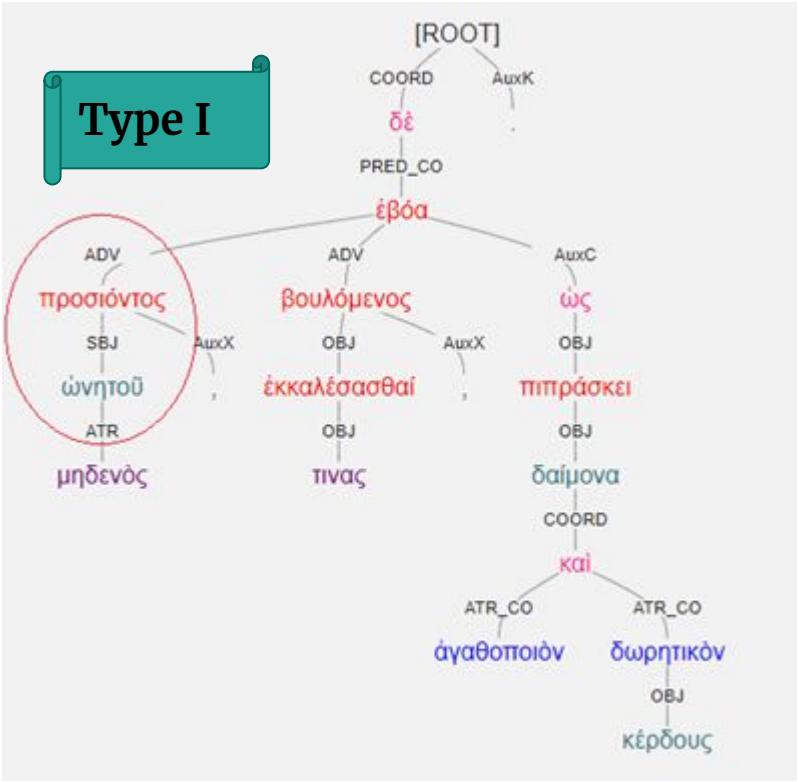
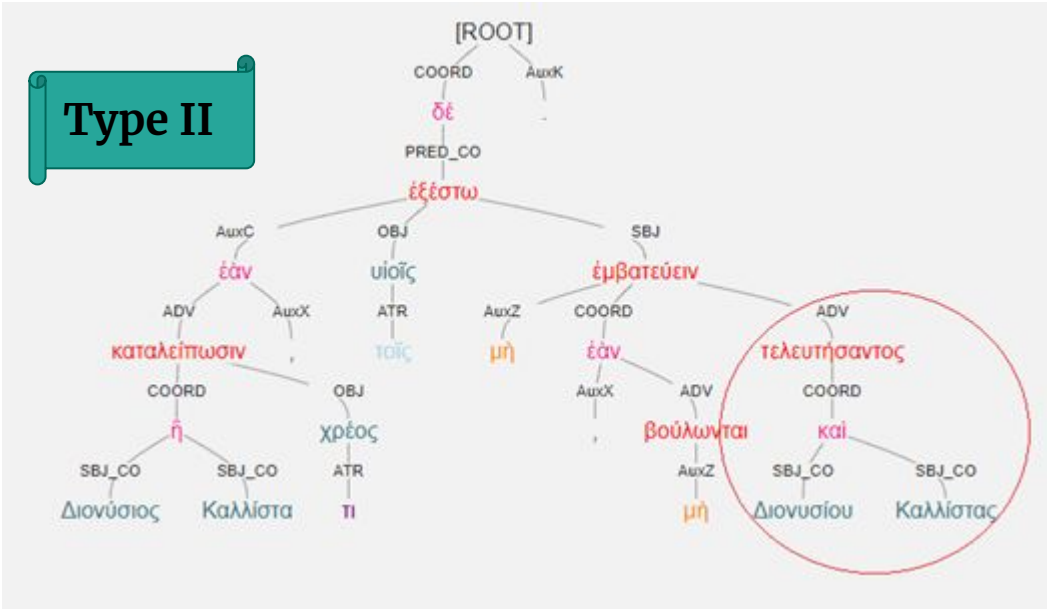
Querying linguistic phenomena - GA

What's a "genitive absolute"?

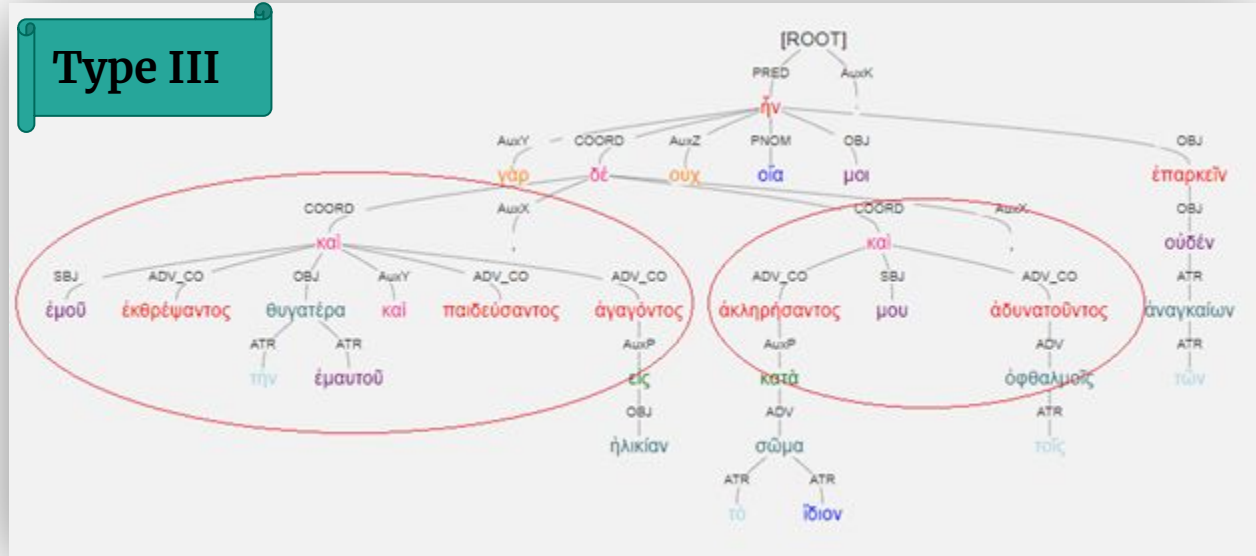
- Similar to Latin's ablative absolute
- Genitive participle serves as the subordinate conjugated verb
- A substantive in the genitive is the agent
- "Loose" - not referring to elements from the main clause
  - ... or does it?
- Let's focus on the standard cases

Genitive absolute in trees





Type III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ἐπαρκεῖν
COORD
AuxX
COORD
AuxX
OBJ
καὶ
καὶ
οὐδὲν
SBJ
ADV_CO
OBJ
AuxY
ADV_CO
ADV_CO
ADV_CO
SBJ
ADV_CO
ATR
ἐμοῦ
ἐκθρέψαντος
θυγατέρα
καὶ
παιδεύσαντος
ἀγαγόντος
ἀκληρήσαντος
μου
ἀδυνατοῦντος
ἀναγκαίων
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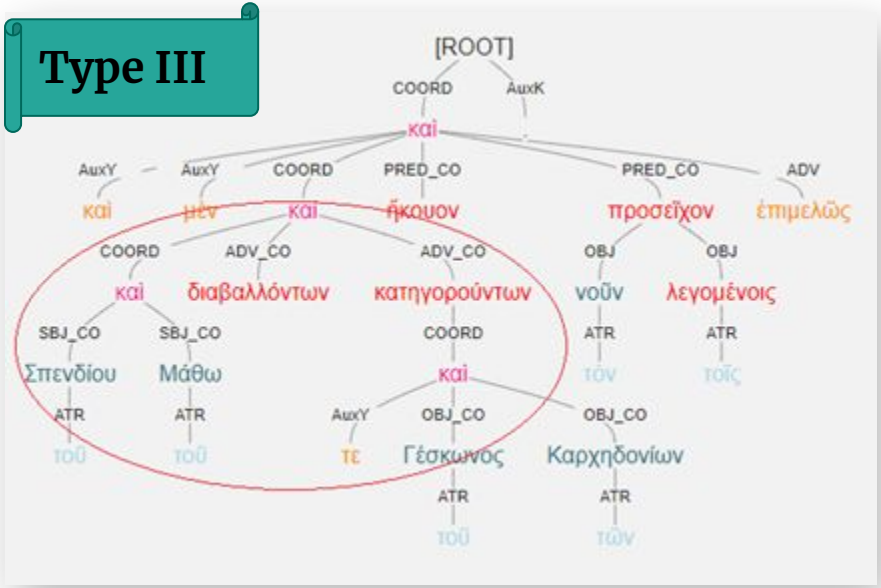
Type III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ADV
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μέν
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προσεῖχον
ἐπιμελῶς
COORD
ADV_CO
ADV_CO
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OBJ
καί
διαβαλλόντων
κατηγορούντων
νοῦν
λεγομένοις
SBJ_CO
SBJ_CO
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ATR
Σπενδίου
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Querying for linguistic phenomena – GA

How can we make this more easily discoverable?

- Querying in XSLT is applying filters:

> Can we give it a specific marker that will allow it to be caught by the appropriate sieve?

Set the rules:

- Possible relations between a participle and a genitive agent in GA
  - Type I - direct parent;
  - Type II - ancestor connected only via coordinating conjunction(s)
  - Type III - sibling, where the agent's parent is a conjunction
  - Type IV - i.e. anywhere in the tree, as long as the path between to it goes only through coordinators

Set the rules:

- The verb from the matrix clause is also annotated as governing the construction:

```
▼<word id="1" form="λαμβάνωσι" lemma="λαμβάνω" postag="v3ppsa---" relation="PRED" head="0" governs-4="4">
 ▼<word id="4" form="ζῶντος" lemma="ζάω" postag="v-sppamg-" relation="ADV" head="1" group="3">
  ▼<word id="5" form="καὶ" lemma="καί" postag="c--------" relation="COORD" head="4" group="3">
   ▼<word id="3" form="πατρὸς" lemma="πατήρ" postag="n-s---mg-" relation="SBJ_CO" head="5" group="3">
      <word id="2" form="τοῦ" lemma="ὁ" postag="l-s---mg-" relation="ATR" head="3"/>
     </word>
   ▼<word id="7" form="μητρός" lemma="μήτηρ" postag="n-s---fg-" relation="SBJ_CO" head="5" group="3">
      <word id="6" form="τῆς" lemma="ὁ" postag="l-s---fg-" relation="ATR" head="7"/>
     </word>
    </word>
  </word>
 </word>
```

Summarize info per construction:

- Which sentence is the construction in?
- What is the value of @group defining all its participants?
- What is the agent's gender?
- What is the number of its governing participle?
- In word order, which one comes first, the agent or the participle?
- What "type" of construction is it, regarding the coordination of the dependency?

```
▼<constructions>
   <construction sentence="1" group="3" masculine="true" feminine="true" constituents-order="mixed" order-in-sentence="vc" number="s" type="2"/>
 </constructions>
```

Overview of preprocessing:

For an individual text:

- Get the preprocessed tree
- Apply transformational stylesheets
- Create an XML document from the result

```
<map:match id="preprocess-genitive-absolute-text" pattern="pp/construction/genitive-absolute/*/*.xml">
  <map:generate src="cocoon:/pp/tree/{1}/{2}.xml"/>
  <map:transform src="../stylesheets/treebank/pp-genitive-absolute-participants.xsl"/>
  <map:transform src="../stylesheets/treebank/pp-genitive-absolute-participants-coords.xsl"/>
  <map:transform src="../stylesheets/treebank/pp-genitive-absolute-participants-governing-verb.xsl"/>
  <map:transform src="../stylesheets/treebank/pp-genitive-absolute-prune-annotations.xsl"/>
  <map:transform src="../stylesheets/treebank/pp-genitive-absolute-constructions.xsl"/>
  <map:serialize type="xml"/>
</map:match>
```

Overview of preprocessing:

For the whole corpus:

- Create a single giant XML from the result trees for each individual text file

```
<map:match id="preprocess-genitive-absolute-corpus" pattern="pp/construction/genitive-absolute/*.xml">
  <map:generate src="cocoon://_internal/dirlist/content/xml/treebank/{1}.xml"/>
  <map:transform src="../stylesheets/admin/dir-to-xinclude.xsl">
    <map:parameter name="prefix" value="cocoon:/pp/construction/genitive-absolute/{1}/"/>
  </map:transform>
  <map:transform type="xinclude"/>
  <map:serialize type="xml"/>
</map:match>
```

And finally…

Nice neat tables:

Number of sentences	1254
Sentences containing genitive absolute constructions	51
Number of files containing genitive absolute	36
Total number of genitive absolute constructions	69

Agent before participle	35
Participle before agent	28
Mixed	6

Text type	Text count	Genitive absolute count
None	71	4
account_receipt	5	3
contract_loan	3	1
contract_sale	2	2
letter	20	6
letter_business	22	4
letter_private	68	12
petition	14	37

Number	Gender	Count
Singular participle	Masculine	23
	Feminine	6
	Neuter	6
Dual participle	Masculine	0
	Feminine	0
	Neuter	0
Plural participle	Masculine	19
	Feminine	2
	Neuter	3

Type	Count
Type 1 - single participle governing single agent	54
Type 2 - single participle governing co-ordinated agents	6
Type 3 - co-ordinated participles sharing a single agent	8
Type 4 - co-ordinated participles governing co-ordinated agents	1

Instances

Text document	Category	Date	Sentences	GA	Type				Singular			Plural			Word order			Constituents order		
					I	II	III	IV	m	f	n	m	f	n	cv	vc	URGH	ap	pa	mixed
p-cair-zen-1-59019	letter	-3	16	1	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0
p-cair-zen-1-59027	letter_business	-3	10	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
p-cair-zen-1-59028	letter_business	-3	10	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
p-cair-zen-1-59031	letter_business	-3	9	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
p-cair-zen-1-59036	letter_business	-3	20	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
p-cair-zen-1-59059	None	– -3	10	2	2	0	0	0	1	0	0	0	0	0	1	0	1	2	0	0
p-cair-zen-2-59245	letter	-3	11	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
p-col-4-66	letter	-3	16	4	4	0	0	0	2	0	0	0	0	0	4	0	0	3	1	0
bgu-3-994-m1	contract_sale	-2	8	1	0	1	0	0	0	0	0	1	1	0	1	0	0	0	1	0
p-dryton-1-11	contract_loan	-2	4	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
p-dryton-1-32	petition	-2	4	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
p-grenf-2-15-m1	contract_sale	-2	6	1	0	1	0	0	0	0	0	1	1	0	1	0	0	0	1	0
p-hels-1-2	petition	-2	6	4	3	0	1	0	1	0	1	2	0	0	3	1	0	2	1	1
upz-1-10	petition	-2	4	3	3	0	0	0	0	2	0	0	0	1	3	0	0	2	1	0
upz-1-111	None	-2	4	2	2	0	0	0	0	0	0	2	0	0	1	1	0	0	2	0
upz-1-12	petition	-2 –	4	4	3	0	1	0	4	0	0	0	0	0	4	0	0	1	2	1
upz-1-13	petition	-2	4	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0
upz-1-18r	petition	-2	12	2	2	0	0	0	1	0	1	0	0	0	2	0	0	1	1	0
upz-1-2	petition	-2	6	3	3	0	0	0	0	1	2	0	0	0	1	0	2	3	0	0
upz-1-22	petition	– -2	11	3	3	0	0	0	0	1	0	1	0	0	1	0	2	1	2	0
upz-1-29-m1-1	account_receipt	-2	2	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0
upz-1-30	account_receipt	-2	1	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0
upz-1-34	petition	– -2	6	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
upz-1-35	petition	– -2	12	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
upz-1-36-m1	petition	– -2	6	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
upz-1-59-m1-1	letter_private	-2	6	6	5	1	0	0	2	0	0	1	0	0	3	3	0	5	0	1
upz-1-6	petition	-2 –	9	7	2	0	4	1	2	0	1	4	0	0	4	0	3	4	2	1
upz-1-60	letter_private	-2	8	1	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0
upz-1-69	letter_private	-2	11	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
upz-1-7-m1-2	petition	-2	6	2	1	1	0	0	0	1	0	1	0	0	0	2	0	0	2	0
upz-1-8	petition	-2 –	7	4	3	0	1	0	1	0	0	2	0	0	1	3	0	2	1	1
p-flor-3-367	letter_private	3	7	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1
p-oxy-14-1666	letter_private	3	13	1	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0
p-bour-25	letter_private	4 – 5	10	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
p-lond-6-1915	letter_private	4	9	1	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
p-mich-13-668-m1	account_receipt	6	3	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0

… all displayed on a single web page.