Digital Philology

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April 11, 2019



Introduction

Digital Ecdotics

Digital Hermeneutics

- **1** Introduction
- 2 Digital Ecdotics
- Digital Hermeneutics
- 4 Conclusion

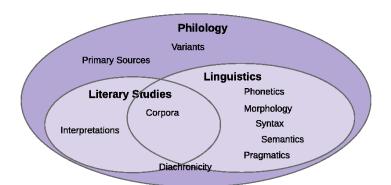


Computational Linguistics and Digital Philology

Introduction

Digital Ecdotics

Digital Hermeneu-





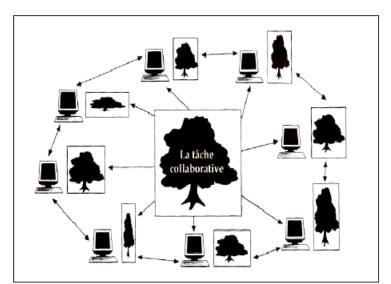
Collaboration vs Cooperation

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion



Collaborative task (Source: Henri et Lundgren-Cayrol, 2001)



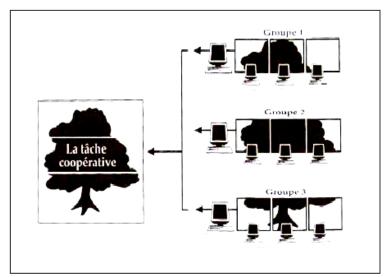
Collaboration vs Cooperation

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion



Cooperative task (Source: Henri et Lundgren Cayrol 2001)

- 5/34 -



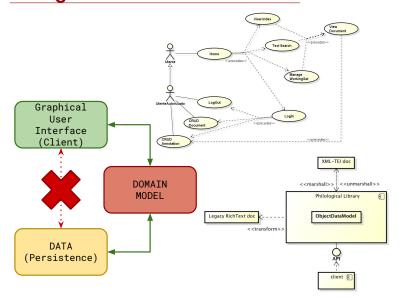
Defining Data Types and APIs for Scholarly Editing

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion



- 6/34 -

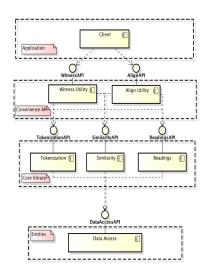


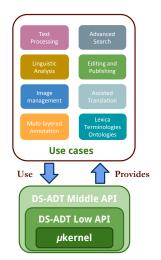
Defining Data Types and APIs for Scholarly Editing

Introduction

Digital Ecdotics

Digital Hermeneutics







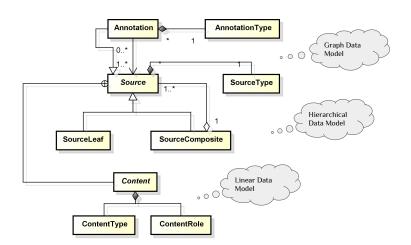
Defining Data Types and APIs for Scholarly Editing

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion



- 8/34 -



The Hermeneutic Circle

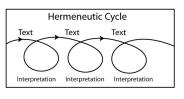
Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion





(image sources: http://bit.ly/1KkmhBU and http://bit.ly/2zv711T)



Introduction

Digital Ecdotics

Digital Hermeneutics

- 1 Introduction
- Digital Ecdotics
- 3 Digital Hermeneutics
- 4 Conclusion



Representation of Textual Phenomena by TEI-XML

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

TEI-P5 (http://www.tei-c.org)

Three chapters of the Guidelines are devoted to codicological, palaeographic and philological issues:

- Chap. 5: Characters, Glyphs, and Writing Modes
- Chap. 10: Manuscript Description
- Chap. 11: Representation of Primary Sources
- Chap. 12: Critical Apparatus

- 11/34 -



Representation of Primary Sources

Introduction

Digital Ecdotics

Digital Hermeneutics

```
<TEI xmlns="http://www.tei-c.org/ns/1.0">
    <teiHeader> --
    <! -- PROBLEMA FRONT -->
    <text type="letter" xml:id="LL1.16" n="LL1.16">
        <body xml:lang="ita">--
```



Representation of Primary Sources

Introduction

Digital Ecdotics

Digital Hermeneutics

```
<s type="sentence" n="s_06">
age enim punctum illud, estne certa <w>pro
<lb n="19"/>portione</w> descriptum, an sit extempore notatum,
<lb n="20"/>ut fieri solet, lineae complendae caussa?
<//s>
```

```
<choice>
<abbr>mag.r</abbr>
<expan>magister</expan>
</choice>
```

```
<gap extent="1" unit="lines"/>
<gap reason="empty_page"/>
```

```
<term subtype="music-term"
ref="#sortita">sortita</term> di
<persName ref="#GBR"
role="tenore">Rubini</persName>
```



Printed Critical Apparatus

Introduction

Digital **Ecdotics**

Digital Hermeneutics

Conclusion

85. πίθηκος καὶ κάμηλος

(Halm 365 Ch. 307)

(Ι) ἐν τυνόδψ τῶν ἀλότων ζώων πίθηκος ἀναςτὰς ὑρχεῖτο. cφόδρα δὲ αὐτοῦ εὐδοκιμοῦντος καὶ ὑπὸ πάντων ἐπικημαινομένου κάμηλος φθονήςαςα ήβουλήθη τῶν αὐτῶν ἐφικέςθαι. διόπερ έξαναςτάςα ἐπειράτο καὶ αὐτὴ ὀρχεῖςθαι. s πολλά δὲ αὐτῆς ἄτοπα ποιούςης τὰ ζῷα ἀγανακτής αντα ροπάλοις αὐτὴν παίοντα ἐξήλαςαν.

πρός τούς διὰ φθόνον κρείττοςιν άμιλλωμένους καὶ **c**φαλλομένους ὁ λόγος εὔκαιρος.

(ΙΙΙ) ἐν cυνόδῳ τῶν ἀλόγων ζώων πίθηκος ἀναςτὰς ὧρχήcατο, cφόδρα δὲ εὐδοκιμήcαc βαειλεὺc ὑπ' αὐτῶν ἐχειροτονήθη, κάμηλος δὲ φθονής αςα ἀναςτᾶς α καὶ αὐτὴ ἐπειρᾶτο όρχεῖςθαι. πολλά δὲ αὐτῆς ἄτοπα ποιούςης ἀγανακτήςαντα s τὰ ζῶα ῥοπάλοις αὐτὴν παίοντα ἐξήλαςαν.

δ μύθος ὅτι οἱ διὰ φθόνον κρείττοςιν άμιλλώμενοι **c**φάλλονται.

85 (III) hanc fabulam inter Accursianos hi tantum codices receperunt CG g Q Plan F Salm (III B)

85 (I) - F Cas Cr O E A B Ba U - Q (I a) (III B)

6 τούτον οπ α Acc

85 (Ι) 1 ψρχήςατο Ε 2 εὐδοκιμήςαντος Β Βα ἐπιτημαινομένου] Reiskia ύποςημ. Ο Ε Α τημαινομένου Cas ἐπαινουμένου F B Ba ἐπαινεθείτα U 3 ήβουλήθη ... έφικέςθαι om, Cas ΑUQ 5 πολλώ Α άτοπα ἐπιχειρούςης Ο ποιηςάςης Α Q 6 παίοντα om. Cas αὐτὰς πεςόντα Ε 7 και ςφαλλομένους] Cas

καὶ ἐφαλλομένους Α εἶτα ἐκ τούτου εφαλλομένους Cr O B Ba καὶ φθονουμένους F desunt haec in EU

(III) 4 supra αὐτης addidit της καμήλου C2 5 παίςαντες C



Location-Referenced Method

Introduction

Digital **Ecdotics**

Digital Hermeneutics

Conclusion

```
<div type="fabula" n="85 I">
 <head>πίθηκος καὶ κάμηλος</head>
 >
   <lb n="1"/>ἐν συνόδω τῶν ἀλόγων ζώων πίθηκος ἀναστὰς ὡρχεῖτο.
   <1b n="2"/>σφόδρα δὲ αὐτοῦ εὐδοκιμοῦντος καὶ ὑπὸ πάντων ἐπιση□
   <1b n="3"/>μαινομένου κάμηλος φθονήσασα ήβουλήθη τῶν αὐτῶν ἐφ□
   <1b n="5"/>πολλὰ δὲ αὐτῆς ἄτοπα ποιούσης τὰ ζῶα ἀγανακτήσαντα
   <lb n="6"/>ροπάλοις αὐτὴν παίοντα ἑξήλασαν.
 >
   <lb n="7"/>πρὸς τοὺς διὰ φθόνος κείττοσιν ἀμιλλωμένους καὶ
   <lb n="8"/>σφαλλομένους ο λόνος εὕκαιρος.
 </div>
[...]
stApp>
 [...]
 <app loc="85_I 7">
   <le> <lem wit="#Cas">καὶ σωαλλομένους</lem></le>
   <rdg wit="#A">καὶ ἐφαλλομένους</rdg>
   <rdq wit="#Cr #0 #B #Ba">εἶτα ἐκ τούτου σφαλλομένους</rdq>
   <rdg wit="#F">καὶ φθονουμένους</rdg>
   <rdg wit="#E #U"><gap reason="desunt haec"/></rdg>
 </app>
 [...]
</listApp>
[...]
```

- 15/34 -



Double-End-Point-Attached Method

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

```
<
  <1h n="7"/>
  < w xml:id="w85.1.7.1">\pi pòc</w>
  < w \times m1 : id = "w85.1.7.2" > TO \hat{v} < /w >
  <w xml:id="w85.1.7.3">διὰ</w>
  <w xml:id="w85.1.7.4">Φθόνος</w>
  <w xml:id="w85.1.7.5">κείττοσιν</w>
  <w xml:id="w85.1.7.6">άμιλλωμένους</w>
  < w \times m1: id = "w85.1.7.7" > \kappa \alpha i < /w >
  <1h n="8"/>
  <w xml:id="w85.1.8.1">σωαλλομένους</w>
  <w xml:id="w85.1.8.2">o</w>
  <w xml:id="w85.1.8.3">λόγος</w>
  <w xml:id="w85.1.8.4">εὕκαιρος</w>
  <pc>,</pc>
[...]
stApp>
  [...]
  <app from="#w85.1.7.7" to="#w85.1.8.1">
    <le>wit="#Cas">καὶ σωαλλομένους</le>>
    <rdg wit="#A">καὶ ἐφαλλομένους</rdg>
    <rdg wit="#Cr #0 #B #Ba">εἷτα ἐκ τούτου σφαλλομένους</rdg>
    <rdq wit="#F">καὶ φθονουμένους</rdg>
    <rdg wit="#E #U"><gap reason="desunt haec"/></rdo>
  </app>
  [...]
</listApp>
[...]
```

[...]

- 16/34 -



Parallel Segmentation Method

Introduction

Digital Ecdotics

Digital Hermeneutics



Representation of Textual Phenomena by Domain-Specific Languages: Context-Free

Grammar grammar CritApp;

Introduction

Digital Ecdotics

Digital Hermeneutics

```
listApp: app+;
app: locAttr (lem LEM_SEP)? rdg (rdg)* NEWLINE;
locAttr: NUM:
lem: (text|gap) witAttr+;
rdg: (text|gap) witAttr+;
text: SPAN+;
gap: GAP;
witAttr: WIT+;
NUM: [0-9]+;
WIT: [a-zA-Z]+;
GAP: [...]:
SPAN: [\u0100-\uFFFF]+;
LEM SEP: ::
NEWLINE: \n:
WS: (' '|EOF)->skip;
```



Representation of Textual Phenomena by DSLs: Script in EuporiaCritAppDsl

Introduction

Digital Ecdotics

Digital Hermeneu-

Conclusion

7 καὶ σφαλλομένους \mathbf{Cas} : καὶ ἐφαλλομένους \mathbf{A} εἶτα ἐκ τούτου σφαλλομένους \mathbf{Cr} \mathbf{O} \mathbf{B} \mathbf{Ba} καὶ φθονουμένους \mathbf{F} [...] \mathbf{E} \mathbf{U}

- 19/34 -



Representation by DSLs: Parsed Result in XML

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

```
stApp>
    <app>
        <locAttr>7</locAttr>
        < lem >
            <text>καὶ σφαλλομένους</text>
            <witAttr>Cas</witAttr>
        </lem>:
        <rda>
            <text>καὶ ἐφαλλομένους</text>
            <witAttr>A</witAttr>
        </rdq>
        <rda>
            <text>εἶτα ἐκ τούτου σφαλλομένους</text>
            <witAttr>Cr O B Ba</witAttr>
        </rda>
        <rdq>
            <text>καὶ φθονουμένους</text>
            <witAttr>F</witAttr>
        </rda>
        <rdq>
            <gap>[...]</gap>
            <witAttr>E U</witAttr>
        </rda>
    </app>
</listApp>
```

- 20/34 -



Visual Presentation of Encoded Data

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion



- nnomine dñi amen . Dominus nofter ilis cps volens cuftodire illuftrem
 pulcram et nobilem civitatem albam misit virum sanctissimů
- pulcram et nobilem civitatem albam misit virum sanctissimü noie thebaldum, daid fideli mhante carmine Nifi dñs cuftodierit
- 4 civitatem frustra vigilat qui custodit eam. Qui quidem vir sanctissim⁹
- advena et de vila montevici i civitate A A pdta albe existens parvulus . didicit suere
- 6 fubtellares . et tota fua adholescentia · cerdonů offitio fungebatur.
- nnomine dñi umen . Dominus nofter ilbs cis volens cuftodire illuftrem
- pulcram et nobilem civitatem albam misit virum sanctissimü noïe thebaldum . daid fideli pphante carmine Nifi dñs cuftodierit
- Accidit cū ifte iam ī in offitio eĕet pfectus q magist fuus ¬ quasi alumpnuf

Pagina I

- [I]n nomine Domini Amen . Dominus nost[er] Jesus Christus volens custodire illustrem
- pulcram et nobilem civitate[m] Albam misit virum sanctissimum
 nomine Thebaldum . David fideli prophetante carmine. Nisi Dominus custodierit
- divitatem frustra vigilat qui custodit eam. Qui quidem vir sanctissimus
 advena et de vila Montevici in civitatem predictam Albe exisstens parvulus, didicit suere
- subtellares , et tota sua adholescentia . cerdonum offitio fungebatur. scita aput civitatem Montisregalis
- 7 Accidit . cum iste iam in offitio esset perfectus quod magister saus. et quasi alumpnus
 - 3 vinculo acerbe
- cause fielt po
- nnomine dñi amen . Dominus
- pulcram et nobilem civitatem
- noie thebaldum . daid

Davide

More Info

- 21/34 -

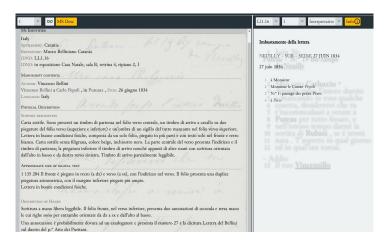


EVT

Introduction

Digital Ecdotics

Digital Hermeneutics





Alignment of Variants

Introduction

Digital **Ecdotics**

Digital Hermeneutics

Conclusion

G. Leopardi, Batracomiomachia (comp.) ~

Hom

Hom.1 Αρχόμενος πρώτης σελίδος χορόν έξ Έλικῶνος Hom.2 έλθεϊν είς έμον ήτορ έπεύχομαι είνεκ' άοιδής, Hom.3 ἢν νέον ἐν δέλτοισιν ἐμοῖς ἐπὶ νούνασι θῆκα, Hom.4 δήριν άπειρεσίην, πολεμόκλουον έργον Άρησς, Hom.5 εύνόμενος μερόπεσσιν ές οδατα πάσι βαλέσθαι Hom.6 πως μύες έν βατράγοισιν άριστεύσαντες

ξβησου.

- C.1.1.1 Sul cominciar del mio novello canto. C.1.1.2 Voi che tenete l'eliconie cime
- C.1.1.3 Prego, vergini Dee, concilio santo,
- C.1.1.4 Che 'l mio stil conduciate e le mie rime:
- C.1.1.5 Di topi e rane i casi acerbi e l'ire.
- C.1.1.6 Segno insolito a i carmi, io prendo a dire.

1826 - 1822

Mentre a noveSul cominciar m'accdel minge arduo novello

O-Muse; Voi che voi datenete l'Eeliconie cime SeendPrete ago, mye-ch'rginil-vestr Dee, co-ancietlio

implorsanto: DatChemi vag 'I mio stil, conduciarmte e le sublimie rime: AnDi topica e litrane io canto-opresi acerbi lontane l'ire, // La-BattagSegno insoliato de'a i topcarmi, eio dpre-lendo a

1822

- B.1.1.1 Mentre a novo m'accingo arduo lavoro.
- B 1 1 2 O Muse, voi da l'Eliconie cime
- B.1.1.3 Scendete a me ch'il vostro aiuto imploro:
- B.1.1.4 Datemi vago stil, carme sublime:
- B.1.1.5 Antica lite io canto, opre lontane.
- B.1.1.6 La Battaglia de' topi e de le rane.

1822 < 1815

GrandMentre impresa disega novo m'accine;go arduo lavoros

O Muse, voi dal l'Eliconie cime A mScende seendte a mete, ch'il vostro ajuto imploro:

Datemi vago stil. carme sublime: Antica lite io canto, opre lontane La Battaglia dei' topi e del le rane.

- A.1.1.1 Grande impresa disegno, arduo lavoro: A 1 1 2 O Muse, voi dall'Eliconie cime
- A.1.1.3 A me scendete, il vostro ajuto imploro:
- A.1.1.4 Datemi vago stil. carme sublime:
- A.1.1.5 Antica lite io canto, opre lontane.
- A.1.1.6 La Battaglia dei topi e delle rane.

- 1 B m'accingo : 1 A disegno = #b colloquiale : #a epico
- * 1 B Mentre a novo m'accingo : 1 A Grande impresa disegno = #b_subordinata #b colloquiale : #a indipendente #a epico
- C Sul ... canto : 1 B Mentre ... lavoro = #c_sintassi_nominale #c_colloquiale : #b_sintassi_verbale
- * 1 C novello : 1 B novo = #c_colloquiale : #b_epico

- 23/34 -

B Scendete a me : 3 A A me scendete = #b ordine standard #b colloquiale :



Querying Encoded Data

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

Encoded data can be accessed by

- Relational databases (SQL)
- XML native databases (xquery)
- Triple stores (SPARQL)
- **...**

- 24/34 -



Introduction

Digital Ecdotics

Digital Hermeneutics

- **1** Introduction
- 2 Digital Ecdotics
- Oigital Hermeneutics
- 4 Conclusion



Linguistic and Stylistic Analyses

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

Linguistic Analyses

- Lemmatization
- Morpho-syntactic Analysis
- Semantic Analysis
- Pragmatic Analysis
- Named Entities

Stylistic Analysis

- Prosodic Analysis
- Metrical Analysis
- Rhetoric Figures
- Stylistic Patterns



Thematic Analysis

Introduction

Digital Ecdotics

Digital Hermeneutics

ESEGUI Q Cancella X		
CERCA I TESTI COLLEGATI: O a tutte le voci selezionate a una qualsiasi delle voci alla prima voce e non alle altre Arbores et virentia - Fiores - Rosa Arbores et virentia - Fiores - Viola		
□ Cerca anche le voci subordinate Associa più temi solo se si trovano: Antro 10 versi v		
▶ CORPORA		
CERCA NELL'INDEX	SFOGLIA L'INDEX RERUM NOTABILIUM ANIMALIA MARGORES ET VIRENTIA DEI ET HEROES MOMINES LOCA	
	► ♥ RES	

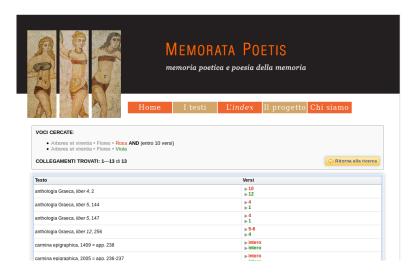


Thematic Analysis

Introduction

Digital Ecdotics

Digital Hermeneutics



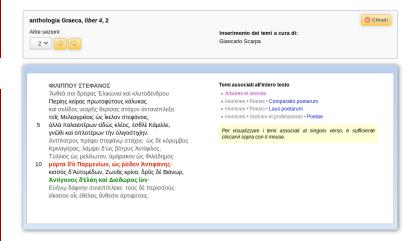


Thematic Analysis

Introduction

Digital Ecdotics

Digital Hermeneutics





Interdisciplinary Approaches to Philological Issues

Introduction

Digital **Ecdotics**

Digital Hermeneutics

Conclusion

```
69 οὔθ' ὑποκαίων οὔθ' ὑπολείβων
70 ούτε δακρύων άπύρων ἱερῶν
71 ὀργὰς ἀτενεῖς παραθέλξει.
```

- [69 ὑπολείβων] #libatio ▼ [69 ὑπολείβων] @vl:69 1 ἀπολείβων Bothe ▼
- ▼ [69 ὑπολείβων] @vl:69 2 ἐπιλείβων Schütz ▼
- [70 οὕτε δακρύων] @vl:70 1 om. Bamberger
- [69 οὕθ' ὑπολείβων ἀπύρων ἱερῶν] {@νl:69 2} {@νi:70 2} #in oblationem libare
- ▼ [69 οὔθ' ὑπολείβων] {@vl:69 2} #in sacrificium libare Fraenkel ▼
- [69 οὔθ' ὑπολείβων_ ἀπύρων ἱερῶν] {@vl:69_2} {@vi:70_1a} #in_sacrificium_libare Wecklein
- [69 οὔθ' ὑπολείβων 70 ἀπύρων ἱερῶν] {@νl:69 1} {!@vi:70 1} #libatio •
- [70 ἀπύρων ἱερῶν] @vi:70 1 #sacrificium #sine igne
- [70 ἀπύρων ἱερῶν] @vi:70 2 #oblatio incruenta #sine igne
- [70 ἀπύρων ἱερῶν / 71 ὀργὰς ἀτενεῖς] {@vi:70_1} @vi:70_1a #sacrificium_reicere
- [70 ἀπύρων ἱερῶν] {@vi:70 1} @vi:70 1b #hominem sacrificare Bollack ■
- [71 ὀργὰς ... παραθέλξει] #ritus_propositum #deos_placare
- ▼ [71 ὀργὰς ἀτενεῖς] #ira deorum ▼

Euporia – Ritual and Religion in Ancient Greek Tragedy



Semantic Querying

Introduction

Digital Ecdotics

Digital Hermeneutics

Conclusion

Euporia Search

t:animal	victima	sacrificium	
bos			
Α.ΡV. 531 βουφόνοις			
A.Se. 276 {ταυροκτονοῦντας			
Ε.ΕΙ. 811 μοσχείαν			
Ε.ΕΙ. 813 μόσχον			
Ε.ΕΙ. 816 ταῦρου			
Ε.ΕΙ. 1143 ἥπερ - ταῦρου,			
Ε.Ηί. 537 βούταν - φόνον			
Ε.ΙΑ. 1113 μόσχοι			
capra			
equus			
Ε.ΕΙ. 817 ἵππους			
victima_animalis			
agnus			
animalia_sicut_ritum_agens			
aves pecus			
A.Se. 275 μήλοισιν			
Ε.Απ. 129 δεξίμηλον			
Ε.ΕΙ. 92 μηλείου - φόνου,			
Ε.Ιο. 229 μήλοισι			
Ε.Ιο. 377 σφαγαῖσι - μήλων			
E.Ph. 632 δεξίμηλ'			
Ε.Su. 1201 τριῶν - μήλων			
praeda			
E.Ph. 573 θυμάτων,			

- 31/34 -



Introduction

Digital Ecdotics

Digital Hermeneutics

- 1 Introduction
- 2 Digital Ecdotics
- **3** Digital Hermeneutics
- 4 Conclusion



Putting All Together

Introduction

Digital Ecdotics

Digital Hermeneutics

- Open Philology not only is collaborative but also cooperative, i.e. open to the extension by third parties
- Robust software design is crucial
- TEI-XML is the de facto interchange format in Digital Humanities, but more compact languages can be used for encoding, if we can translate them in TEI-XML
- many annotation layers can be added in stand-off to our texts and variants



Further Perspectives

Introduction

Digital Ecdotics

Digital Hermeneutics

- Modularization of EuporiaDsl
- Extension of Euporia's functionalities (e.g. autocompletion)
- Multi-user experience by ShareDB Technology