



Gloss.IT.



‘What goes on?’

Researching early medieval glossed corpora using a combined Digital Humanities and Celtic Studies approach

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Annabelle Kienzl & Carolina Mairinger

4th European Symposium in Celtic Studies, Bonn, 28 August 2025

Bild: Uni Graz/Marja Kahiza



Funded by
the European Union

- Project
- Transcription workflow
- Data model / digital editions
- Case study





Project

- **Celtic and Latin glossing traditions**
Uncovering early medieval language contact and knowledge transfer
(ERC-2023-COG #101123203)

Runtime

- June 2024 to May 2029

Our Team

- Bernhard Bauer (PI)
- Francesca Guido (PostDoc Latin & Grammar)
- Paula Harrison (PostDoc Latin & Computus)
- Tristan Repolusk (PostDoc DH & Data Science) - starting in September 2025
- Sina Krottmaier (PreDoc DH)
- Sarah Berghofer (Research Assistant)
- Felix Hutter (Research Assistant)
- Annabelle Kienzl (Research Assistant)
- Carolina Mairinger (Research Assistant)



PRISCIANUS

fl. 512-527 AD

Mauretania - Constantinople

Ars Grammatica (XVIII libri), t.a.q. 526



BEDE

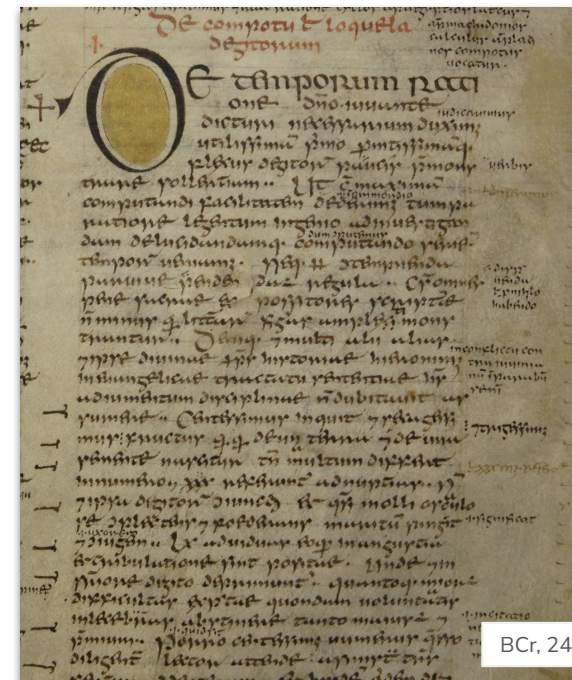
672/3 – 735 AD

Kingdom of Northumbria

De Natura Rerum (DNR), ?

De Temporibus (DT), 703

De Temporum Ratione (DTR), 725

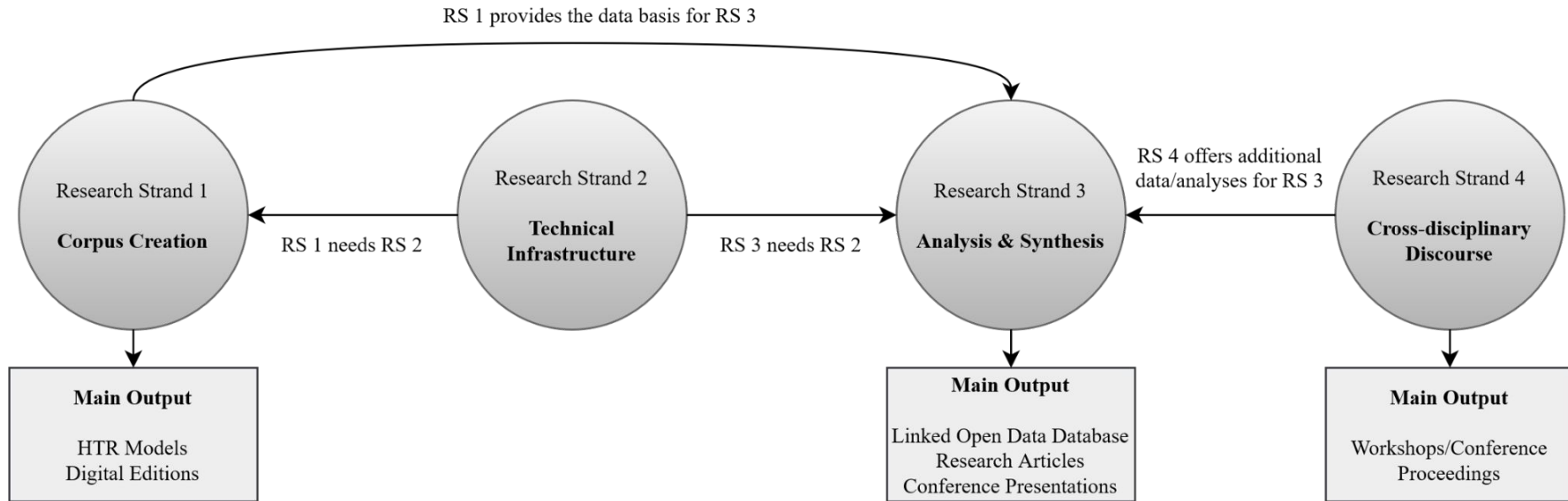


<https://digital.blb-karlsruhe.de/blbhs/content/pageview/13360>

BCr, 24r

CELTIC AREA	CELTIC MILIEU	NONE CELTIC
Aberystwyth, Pen. 540	Leiden, BPL 67	Berlin, Phil. 1832
Angers, MS 477	Paris, MS 10290	Köln, Cod. 200
Karlsruhe, Aug. 132	Paris, NAL 1616	Paris, MS 7501
Karlsruhe, Aug. 167	St. Gallen, MS 251	Valenciennes, MS 174
Paris, MS 10289	Vaticano, Vat. Lat. 1480	Wolfenbüttel, Cod. 50
St. Gallen, MS 904		
Wien, Cod. 15289		

- How and to what extent does early medieval glossing play a role in **exchanging ideas** between centres of learning and scholars?
- What is being glossed? Are there **regional or linguistic differences** in glossing strategies? And if so, why?
- Why do the Celtic-speaking scholars use their vernaculars side by side with Latin? And why is there a substantial number of **vernacular glosses** in one manuscript and very little in another one?
- What triggers **bilingual glossing**?
- How much **Insular Celtic influence** can be seen in the language of the Latin glosses? And to what extent is there intra-Celtic **linguistic exchange and influence**?





eScriptorium

eScriptorium: A Digital Text Production Pipeline for Print and Handwritten Texts using machine learning techniques.



Automatic Transcription

Apply OCR/HTR to images of printed and handwritten documents using shared open models.



Manual Transcription

Make use of an ergonomic user interface leveraging modern browser technology to edit segmentations and transcriptions.



Train Models

Create new models or finetune existing ones to improve automatic recognition.



Import/Export

Import and export models and texts transcriptions in a variety of formats. Access data through a full REST API.

“LanScriptorium”:

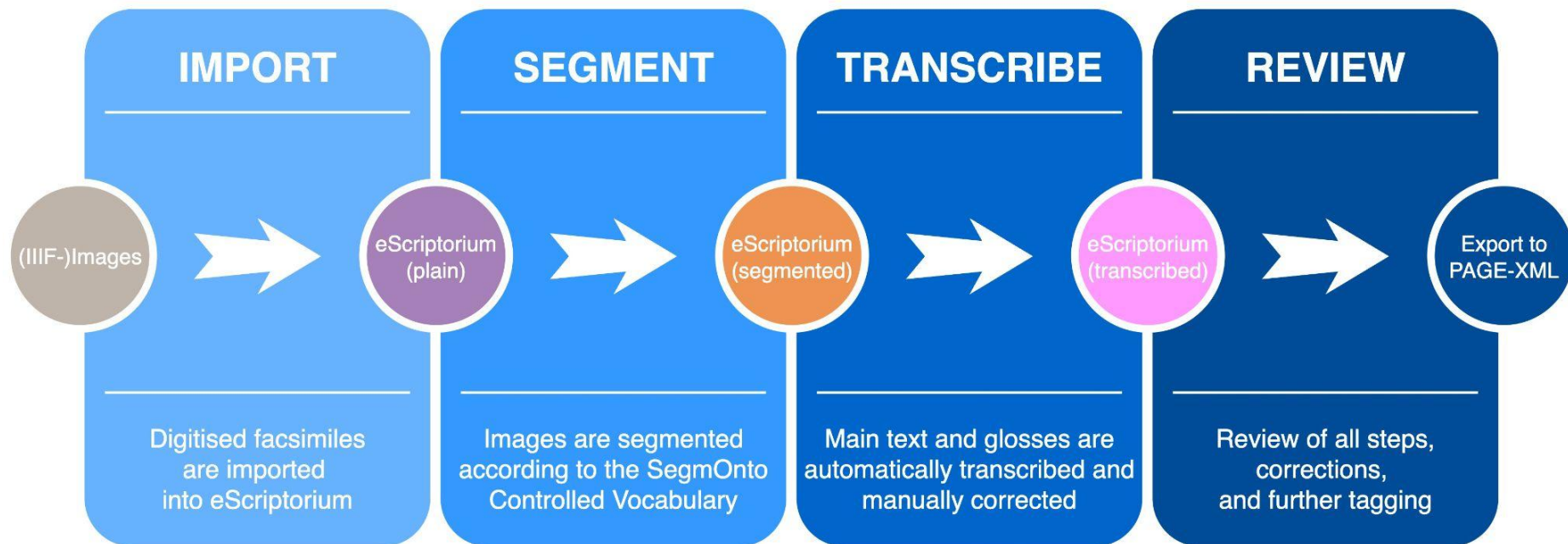
eScriptorium instance (develop 6b3014a5) in subnetwork:

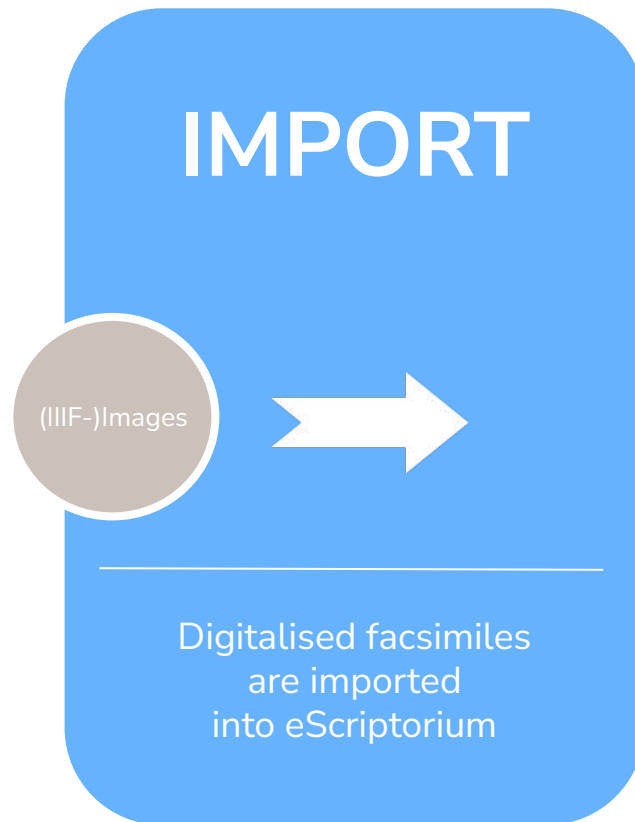
- + ● “Big hosting” neither necessary nor planned
 - Less security issues
 - Less costs (~2100 without GPU)
 - Flexible resources (colleagues can use every PC in the subnetwork)
 - Clearer versioning
 - Maintenance focuses on one pc/instance only
 - NO Import-Export Workflow
-
- ● User management
 - Resource monitoring (Storage, RAM)
 - “One instance only” -> if maintenance is necessary -> workflow pauses
 - Backup systems need to be in place



Workstation

- OS: Linux
- RAM: 64 GB (can get more)
- CPU: Intel i7 14700 (20 Cores, 28 Threads)
- GPU (not yet - but possible)
- 1 TB SSD
- 8 TB HDD





- IIIF is a set of open standards for delivering high-quality, attributed digital objects online at scale.
- **Application Programming Interfaces:**
 - Image API (returns the images)
 - Presentation API (JSON manifests - description)
 - Search API (annotation content of IIIF resource)
- IIIF is backed by a consortium of leading cultural institutions.

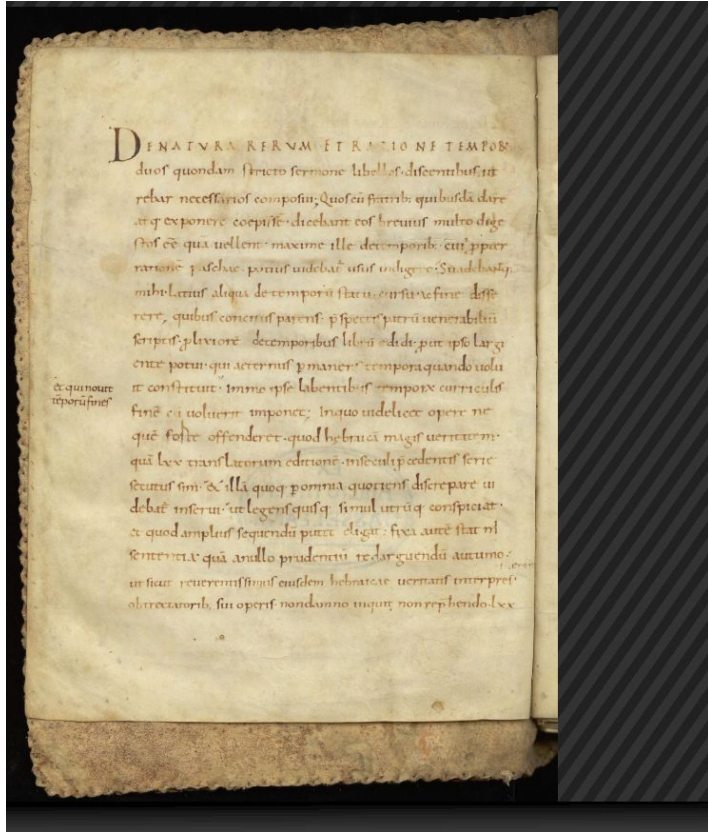




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<https://www.e-codices.unifr.ch/metadata/iiif/csg-0904/manifest.json>




>

— +

Beda, De temporum ratione



Suche in: Beda, De temporum ratione 

Bibliografische Daten

Zitieren und Nachnutzen

Hier finden Sie Downloadmöglichkeiten und Zitierlinks zu Werk und aktuellem Bild.

Handschrift

[METS](#) [MARC XML](#) [Dublin Core](#) [RIS](#) [IIIF Manifest](#) [Mirador](#) [PDF](#)

[DFG-Viewer](#) [OPAC](#) [TOC](#)

Bild

[PDF](#) [Download](#)

Zitierlinks

[Zitierlinks anzeigen](#)

Zitierempfehlung

MLA

Beda, De Temporum Ratione. [886/900] 9. Jh., Ende oder 9./10. Jh.

Bitte das Zitat vor der Verwendung prüfen.

Werkzeuge zur Bildmanipulation

Bildausschnitt teilen

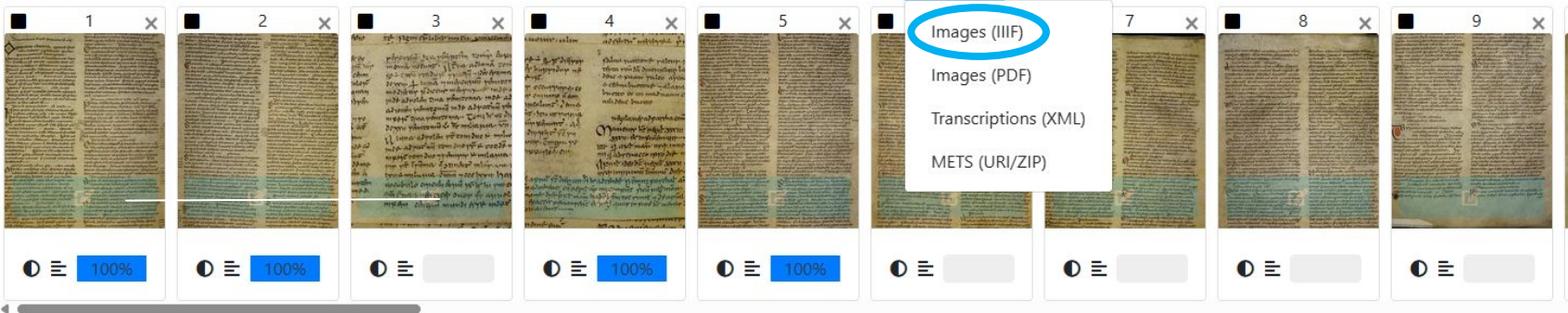
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← Description Ontology Images Edit Models Reports BCR

Drop images here or click to upload.

Select all Unselect all Selected 0/58

Import Export





SEGMENT

eScriptorium
(plain)

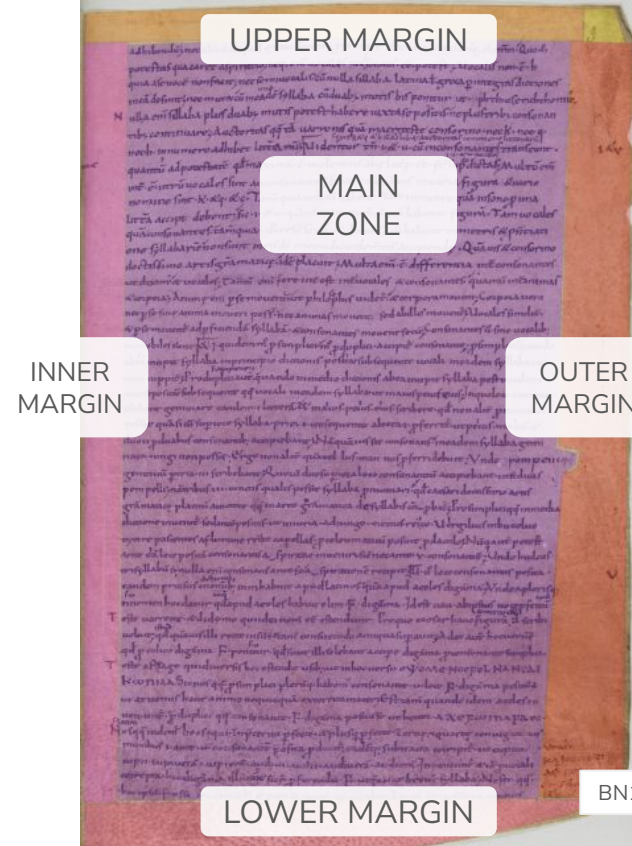
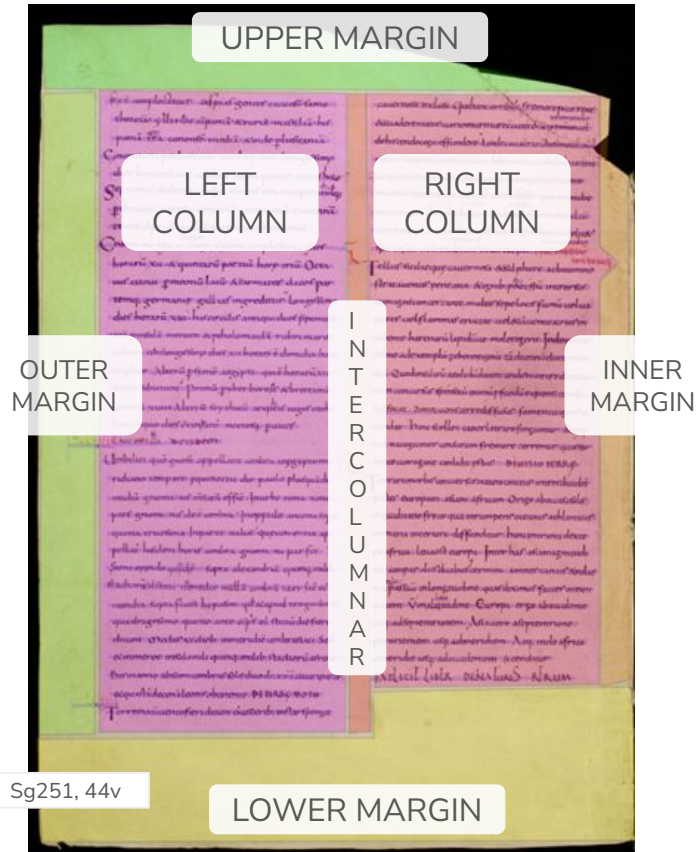


Images are segmented
according to the SegmOnto
Controlled Vocabulary

Segment: Regions



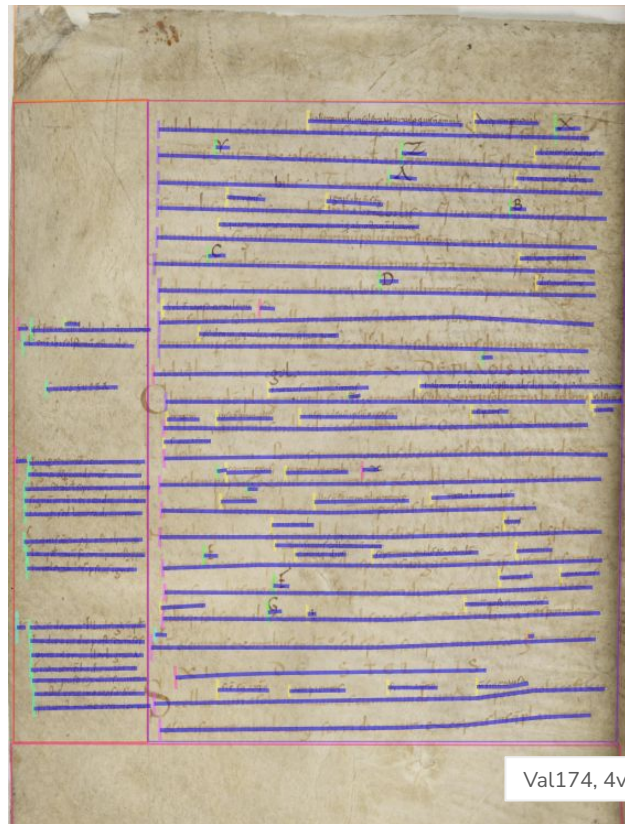
Gloss.IT.



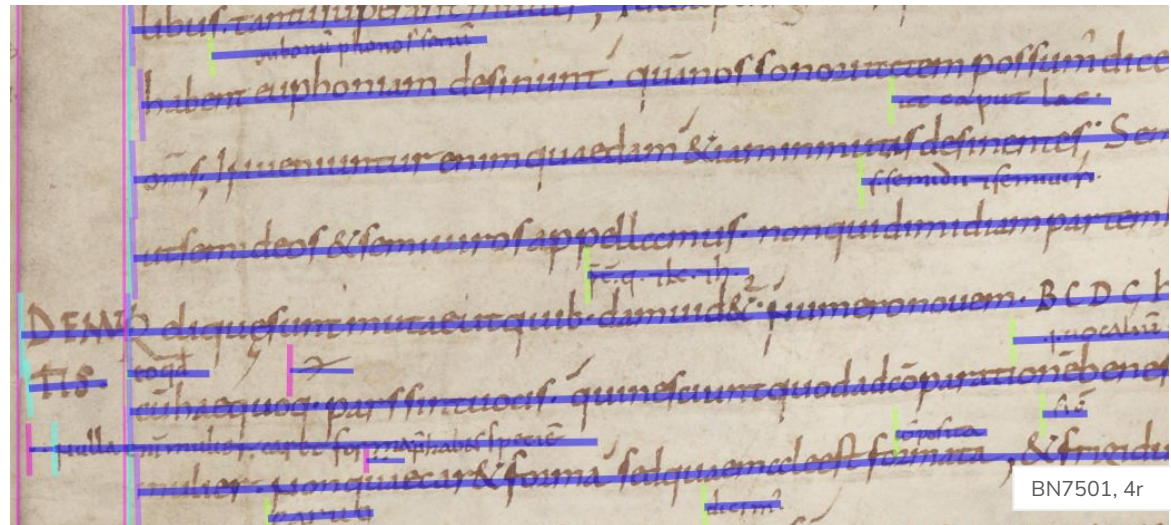
Segment: Lines & types



Gloss.IT.



Val174, 4v



BN7501, 4r

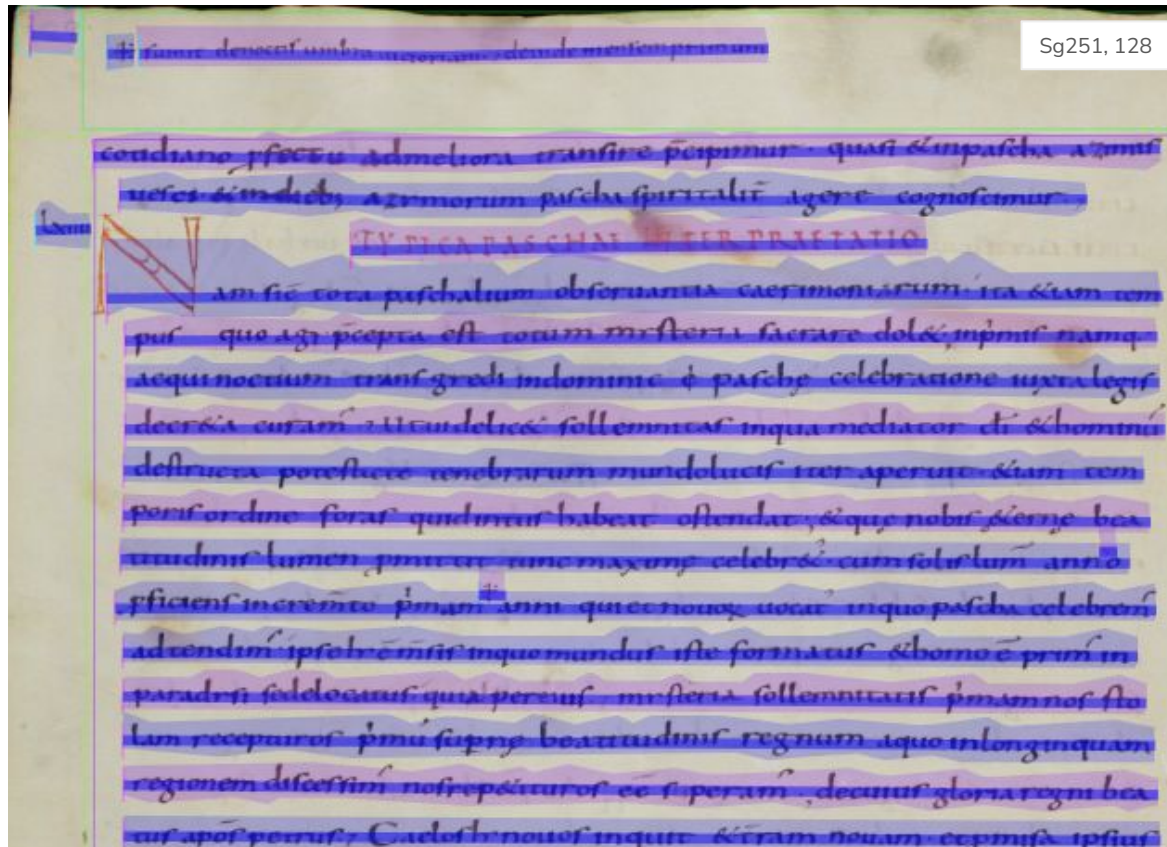
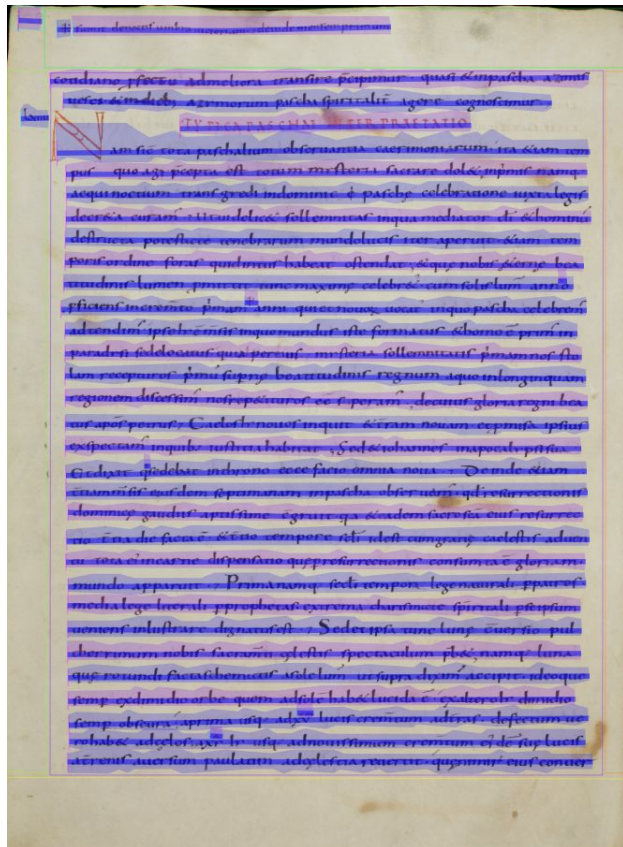
- Interlinear gloss
- Marginal gloss
- Signe-de-renvoi

Segment: Masks



Gloss.IT.

Sg251, 128





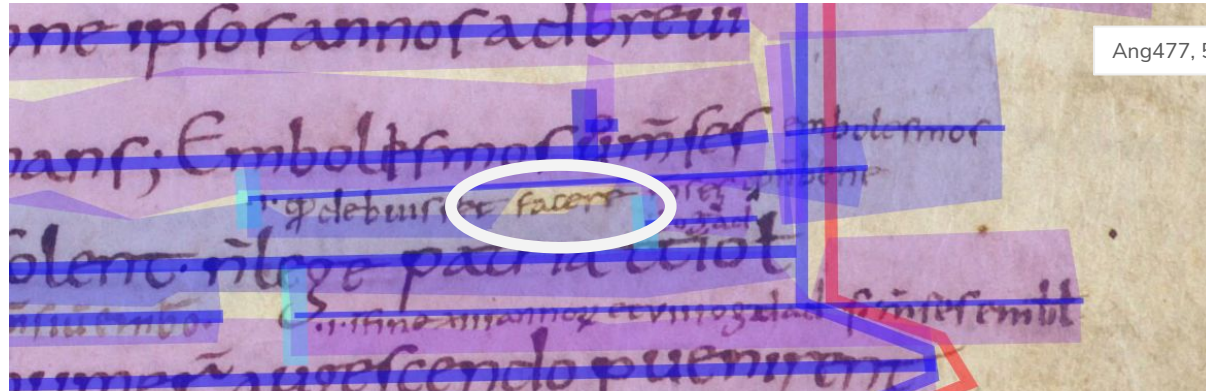
BN10290, 110r

sed fugit interea fuit irreparabile tempus singula dum capiti circū uellam²
amore Idem in eodem interrea rupe est gregibus dum lica iuuentus. Notandi
ergo quod quomodo apud grecos ewc coniunctum cū tewc significat mexpi-
to coytoy preuē mexpit in octentoi metaxi tento coytoi. Sicc' apud nos inter-
ea α'ento metaxi α'ento coytwitewc. est α'iam ubi tam inuenit² politi. (Ling)
In i. georgicon. nec nulla interea est in aratae gratia terre interea posuit² (Ling)
teleitan ton bion teleita. Unam finire. Idem mortem obire. Α'ισι τινος με-
μεριενικτι τοδε στενε τοκαι τις ημερας επικτησκι παρτι ενδη. τινος με-
μεριενικτα και κατα την ημεραν η επικτη και τινος μεριενικτα και κατα την ημεραν

Segment: Masks

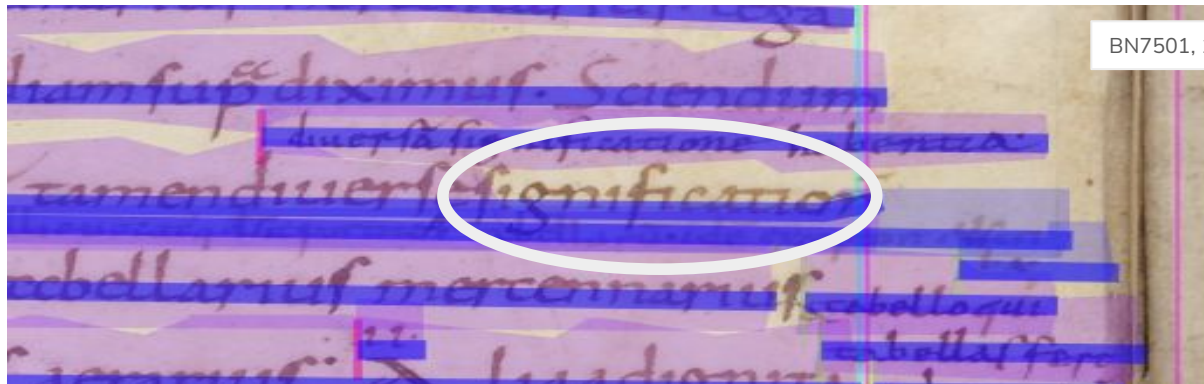


Gloss.IT.

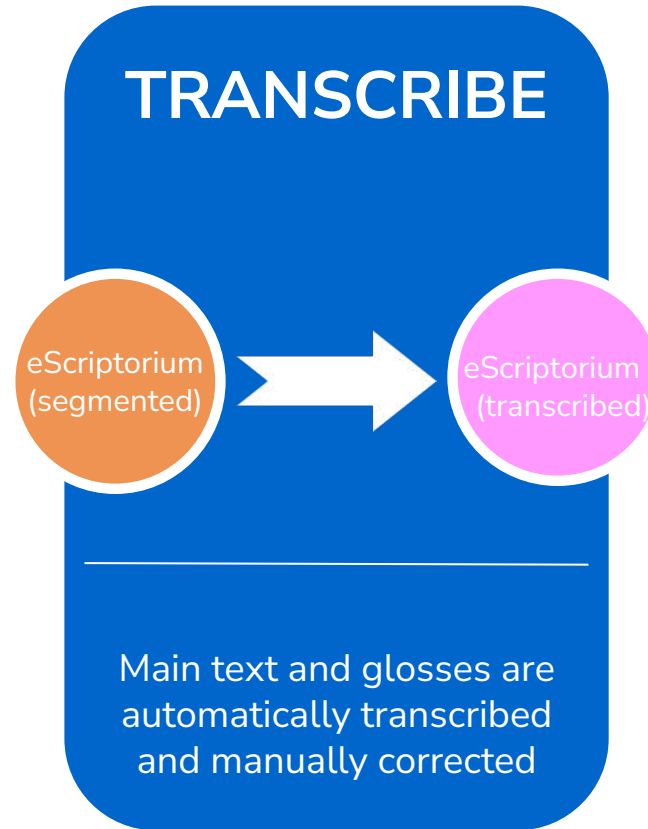


Ang477, 51r

Challenges with
automatic masks
segmentation



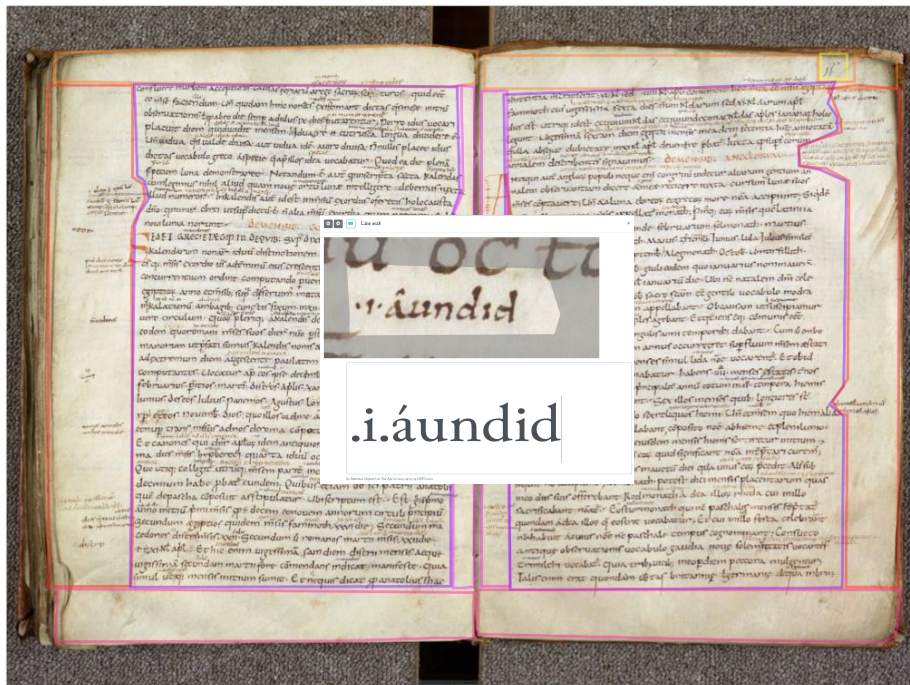
BN7501, 17v

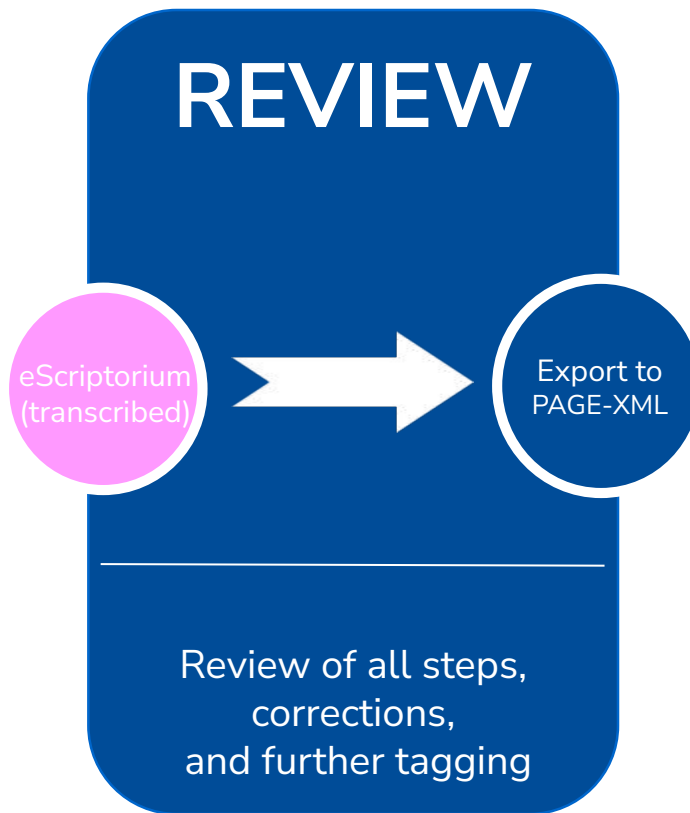


Transcribe

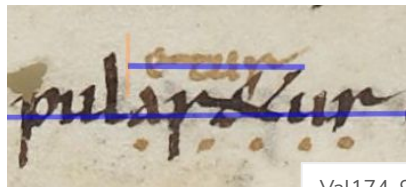


Gloss.IT.

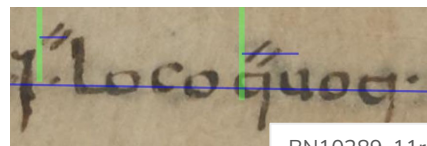
[illegible][illegible]



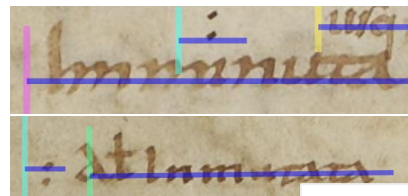
Puncta delentia



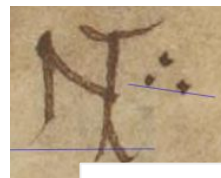
Val174, 92r



BN10289, 11r



Val174, 80v



BN10290, 36v

Signes-de-renvoi
& reading signs



BN1616, 8v

Challenges: Automatic segmentation



Gloss.IT.

Where is the MainZone?

Manuscript page Val174, 30r showing a calendar table with months and days, including text in Latin and a table of numbers.

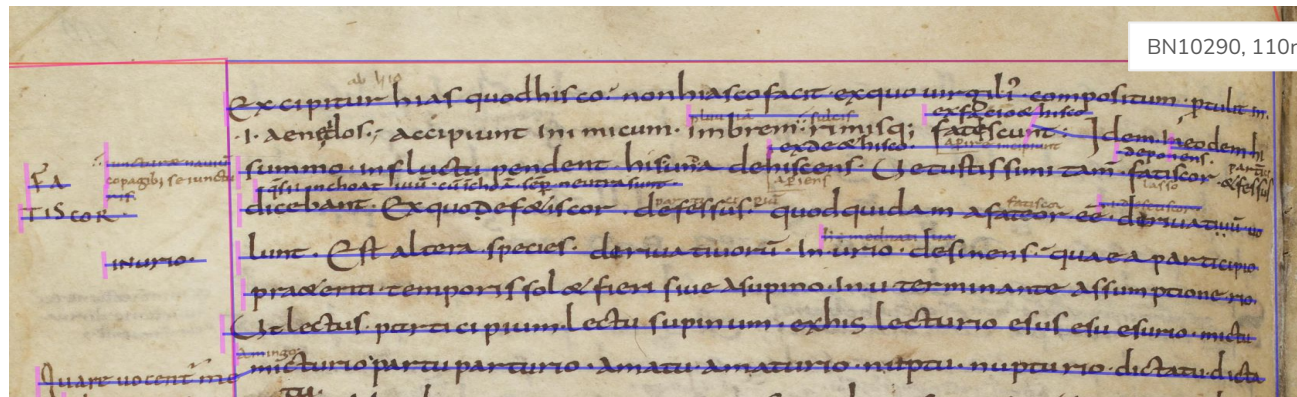
Month	Day	Number	Text
April	I	1	April
April	II	2	April
April	III	3	April
April	IV	4	April
April	V	5	April
April	VI	6	April
April	VII	7	April
April	VIII	8	April
April	IX	9	April
April	X	10	April
April	XI	11	April
April	XII	12	April
April	XIII	13	April
April	XIV	14	April
April	XV	15	April
April	XVI	16	April
April	XVII	17	April
April	XVIII	18	April
April	XIX	19	April
April	XX	20	April
April	XXI	21	April
April	XXII	22	April
April	XXIII	23	April
April	XXIV	24	April
April	XXV	25	April
April	XXVI	26	April
April	XXVII	27	April
April	XXVIII	28	April
April	XXIX	29	April
April	XXX	30	April

Val174, 30r

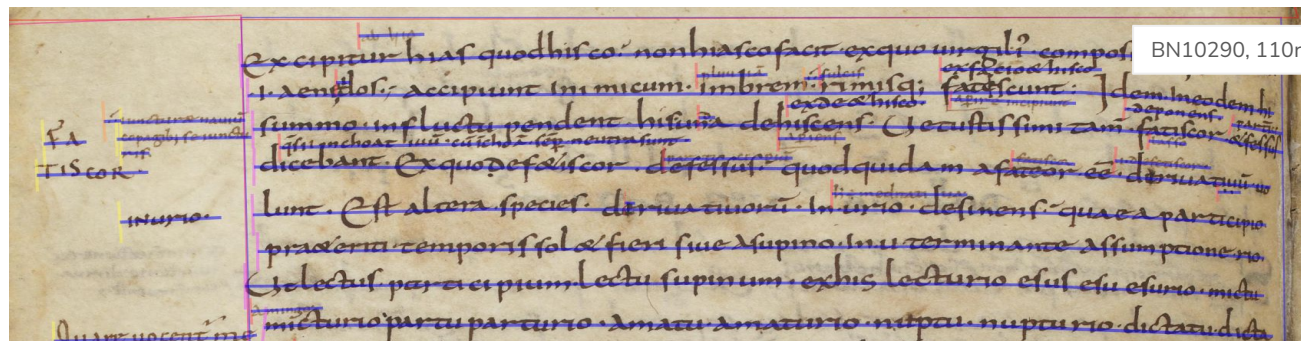
Challenges: Automatic segmentation



Gloss.IT.



Automatic
detection of
baselines

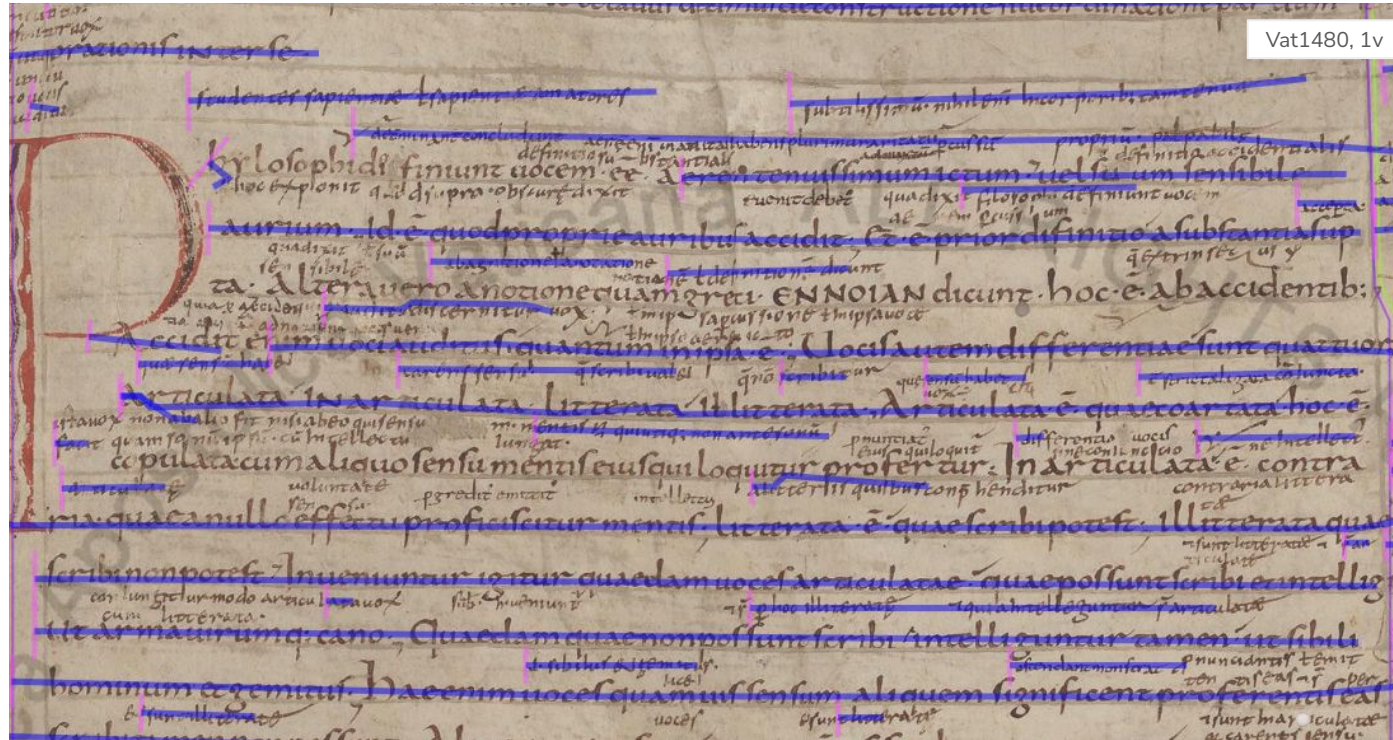


Manual
revision

Challenges: Automatic segmentation



Gloss.IT.



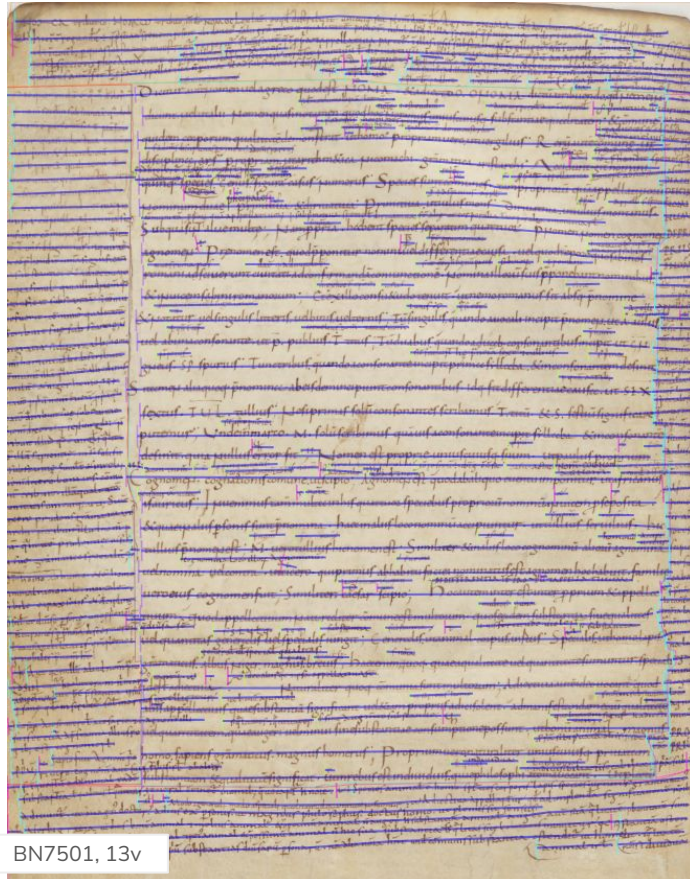
Vat1480, 1v

eScriptorium
finds a lot,
but not
everything

Challenges: Automatic segmentation

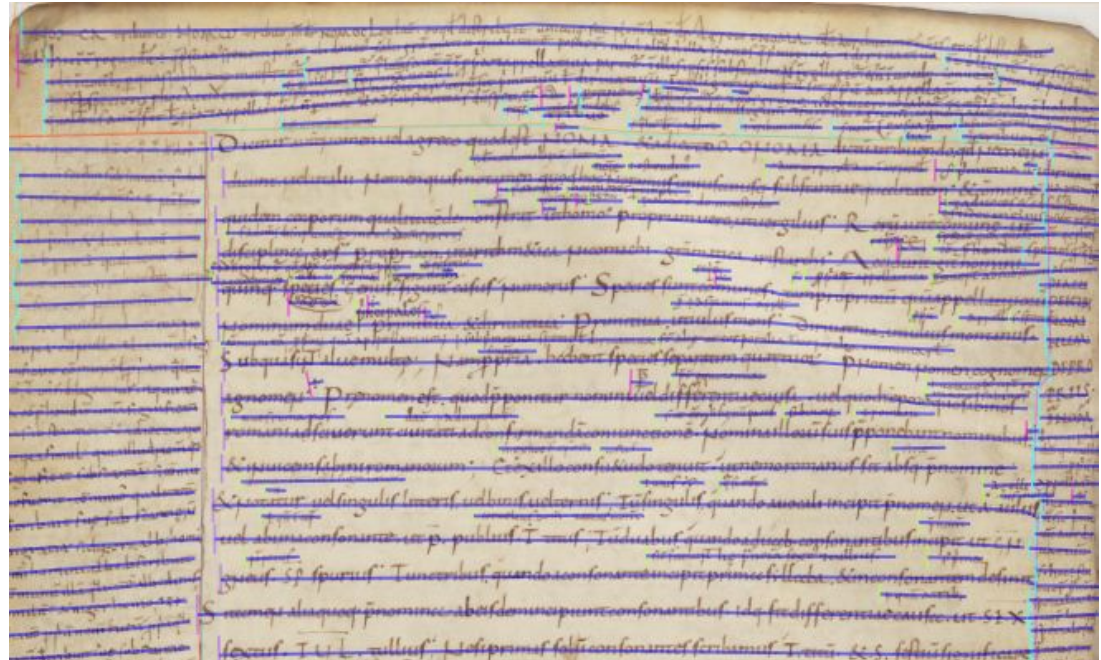


Gloss.IT.



BN7501, 13v

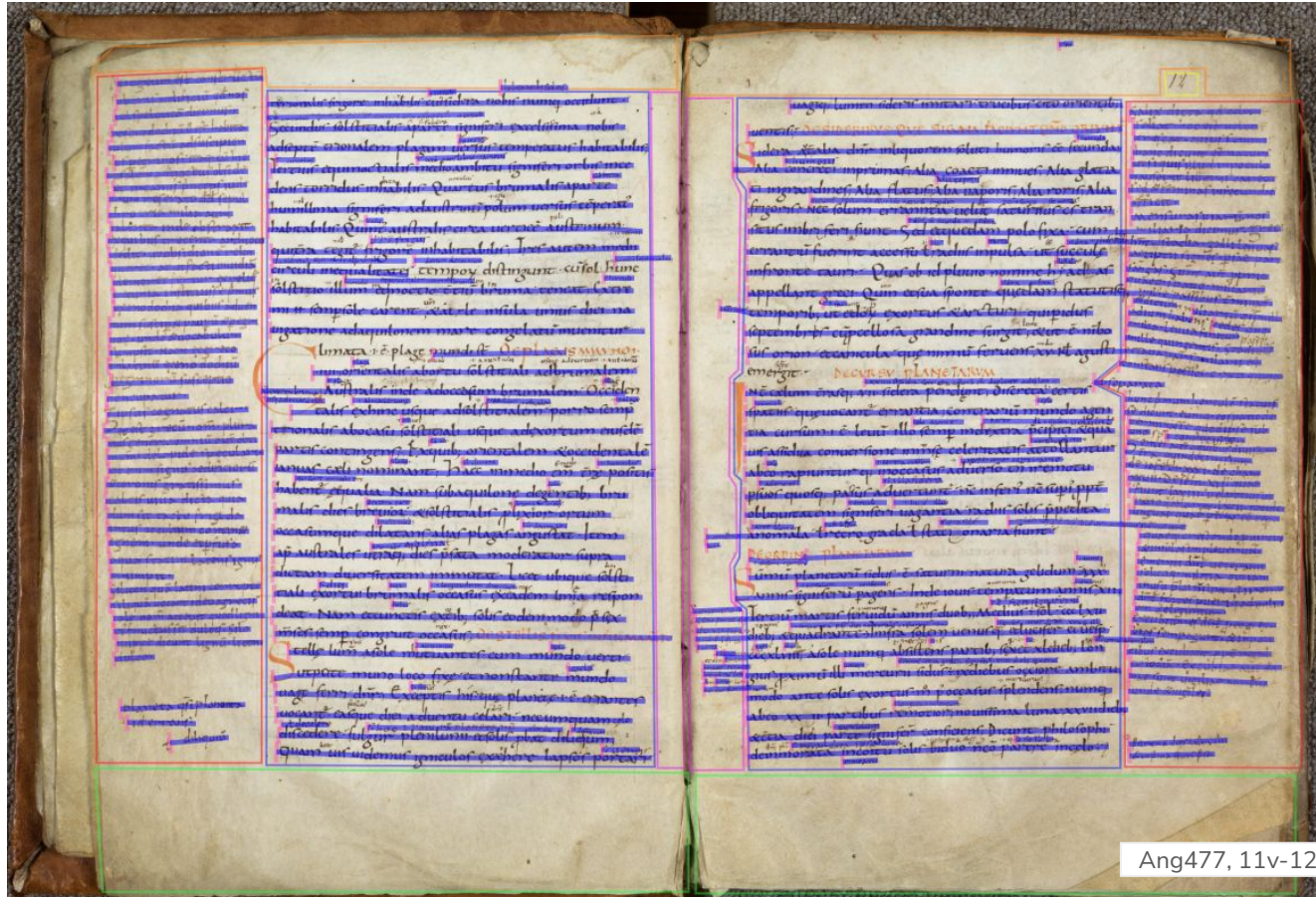
Densely
glossed
pages



Challenges: Automatic segmentation



Gloss.IT.



Ang477, 11v-12r

Challenges: Workload



Gloss.IT.

20 MINUTES PAGE

ad huncmodi laboris liquandoque cervicem posuit in memo-
riam suam circulum unum longe et vix. non solum quo sum-
mus temporis mensis ex ordine comprehendendo imp-
chequum et sequens dominica firmare per se facillime
cul hoc in unum duntaxat quod cum circulo prior
cul alex andrino ubi videret ad inquisitionem for pa-
tem luculorum summi pudenti rationem talis temp-
ab omni pur. tenore produci. Et sic cum melius p-
tionem eius quatuor et octidni. nescio quid ad porcaus of-
ficio. Operosissimum ut ab alex andrino et p-
lus temp- ad idem apostolicum in exercitum. Con-
degent magister probatissimus p-
per beatum maxime curatissimum didicisse ex ip-
e gentiarum gradibus romanis. XLV. DE CANO-
NIS MIS ET COM. M. C. II. BIS. ANNIS.

D iuiditur rursus circuli idem in nobilissimos analogica
 minor quatuordecim quatuordecim in duodecim reat con
 fite obliquitas. Communes quidem sunt idem exen
 torum. Luy dicitur. Embolimus rursus idem exen
 diu concepit. Supponimus namque et hinc commu
 nel coruiss embolimus. Quatuordecim autem commu
 nel. Quatuor embolimus. Septimus communis. Decimus
 embolimus. Unde et decimus communis et decimus emb
 olimus et decimus communis et decimus embolimus.

Val174. 104r

1 HOUR PAGE

1 HOUR PAGE
















BN7501, 2r

BN7501, 2r

ATR-Training/Models (CPU)



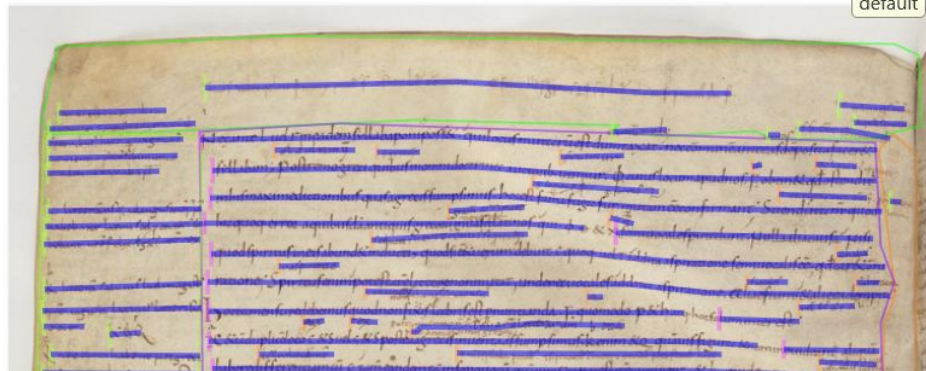
Gloss.IT.

irish_minuscule_third_train	Recognize	21.9 MB	irish_minuscule_second_train	✓	94.5%	Owner	   
irish_minuscule_second_train	Recognize	21.9 MB		✓	91.6%	Owner	  
AngBerKasSgBN1616	Recognize	21.8 MB	Ang477_second	✓	90.8%	Owner	   
Ang477_second	Recognize	21.8 MB	CATMUS Medieval 1.0.0	✓	88.0%	Owner	   

GPU-supported segmentation:

- GPU: Nvidia ADA 4500
- trained on ~35 manually segmented pages
- Detects different zones and gloss-types
- BUT:
 - Still misses a lot
 - Needs a lot more training data!

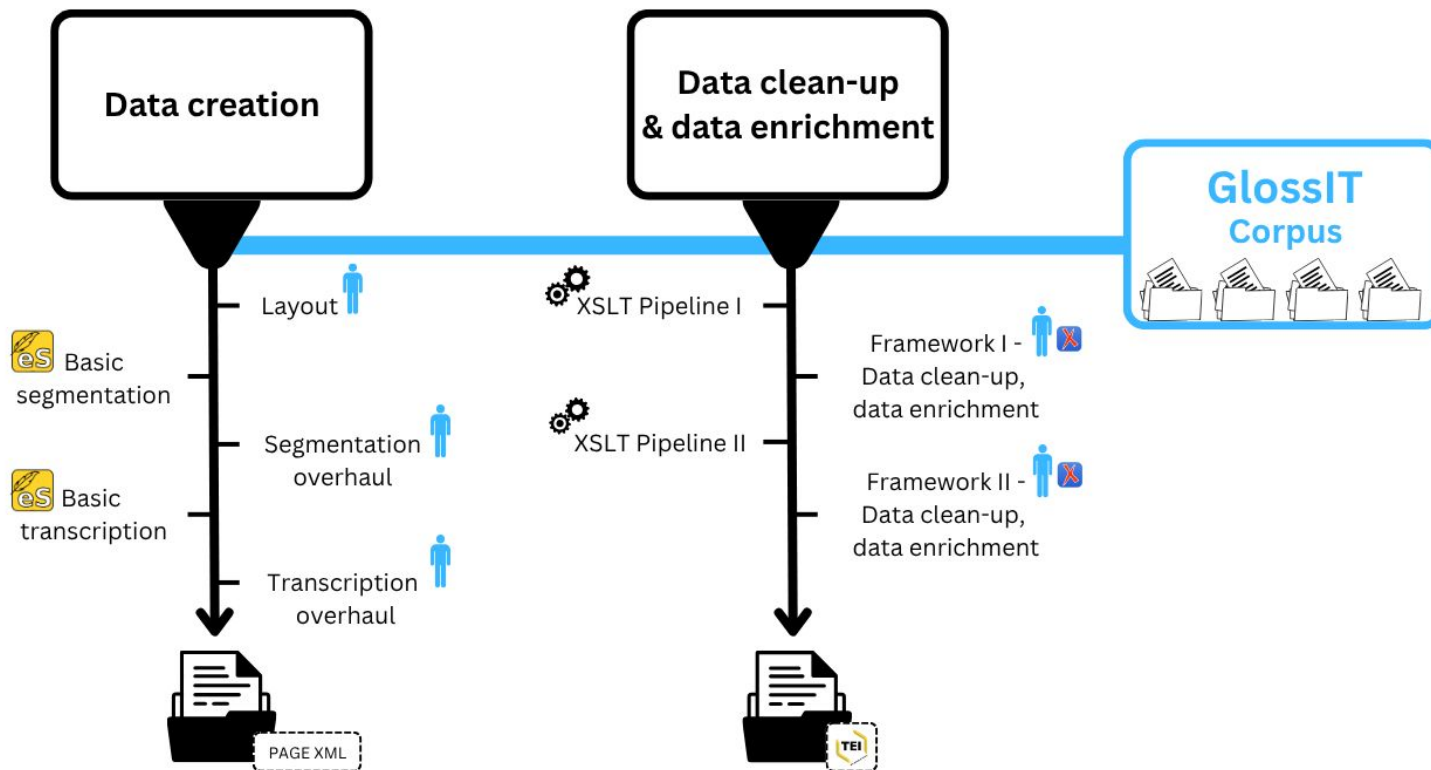
-> Manual intervention needed to produce valuable training data!



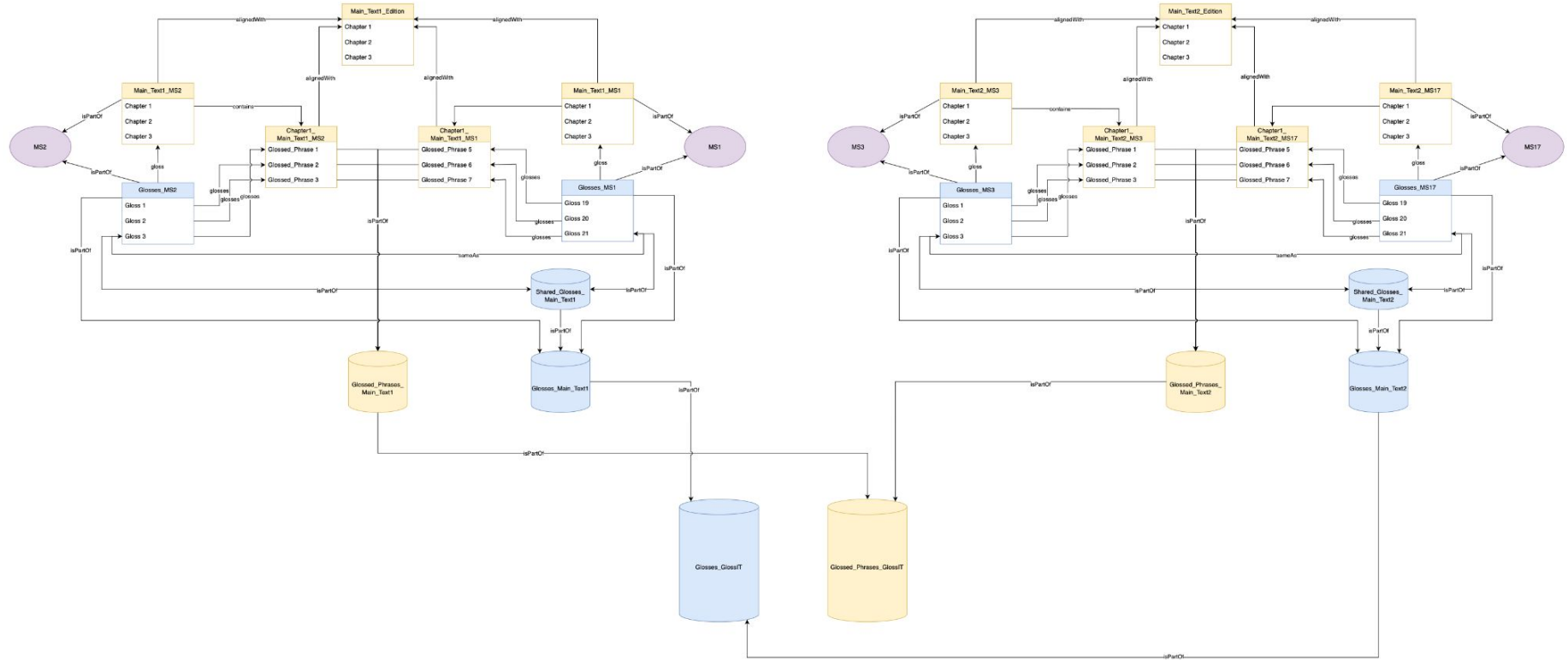
BN7501 - Segmented with GPU trained model

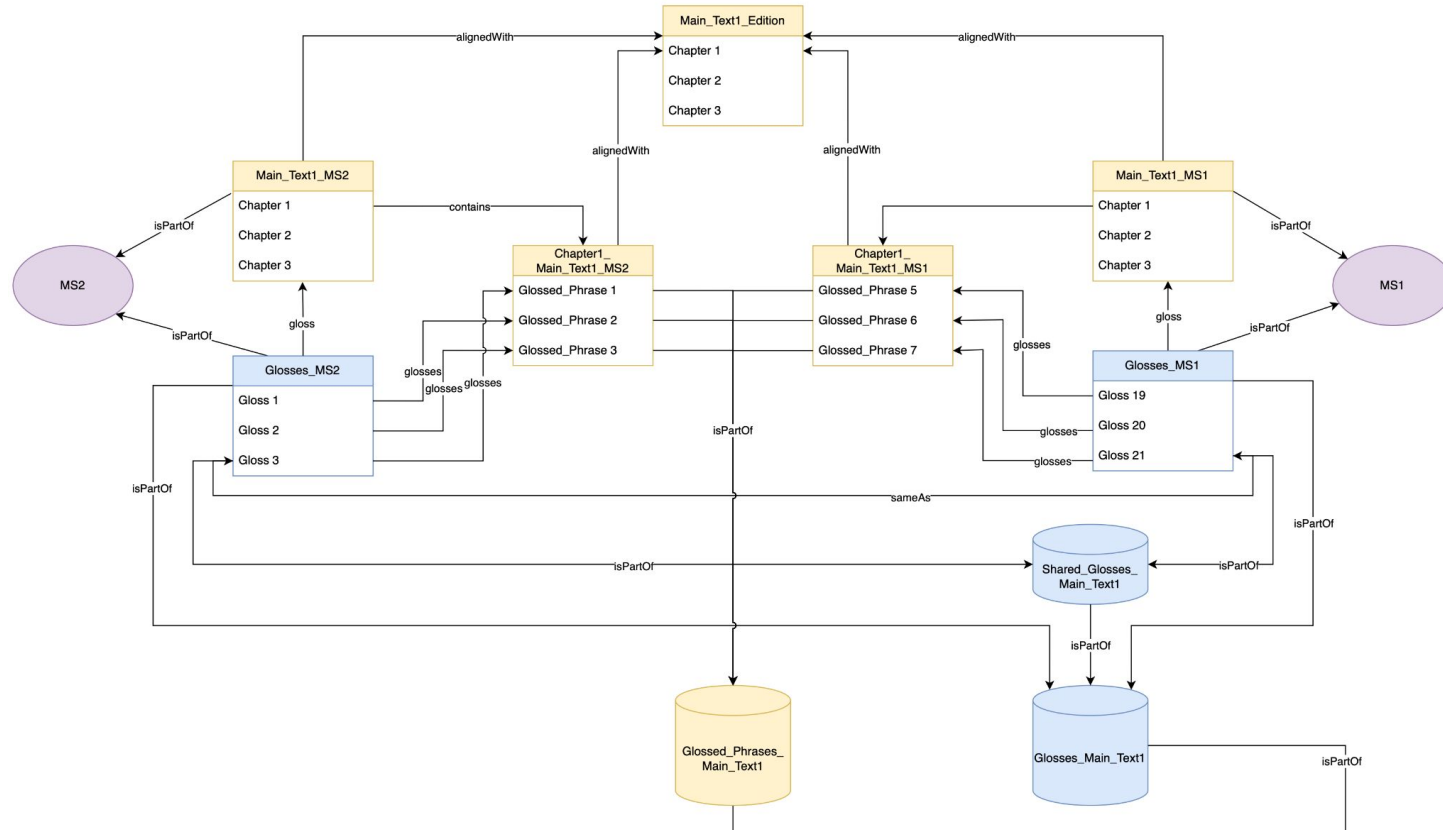


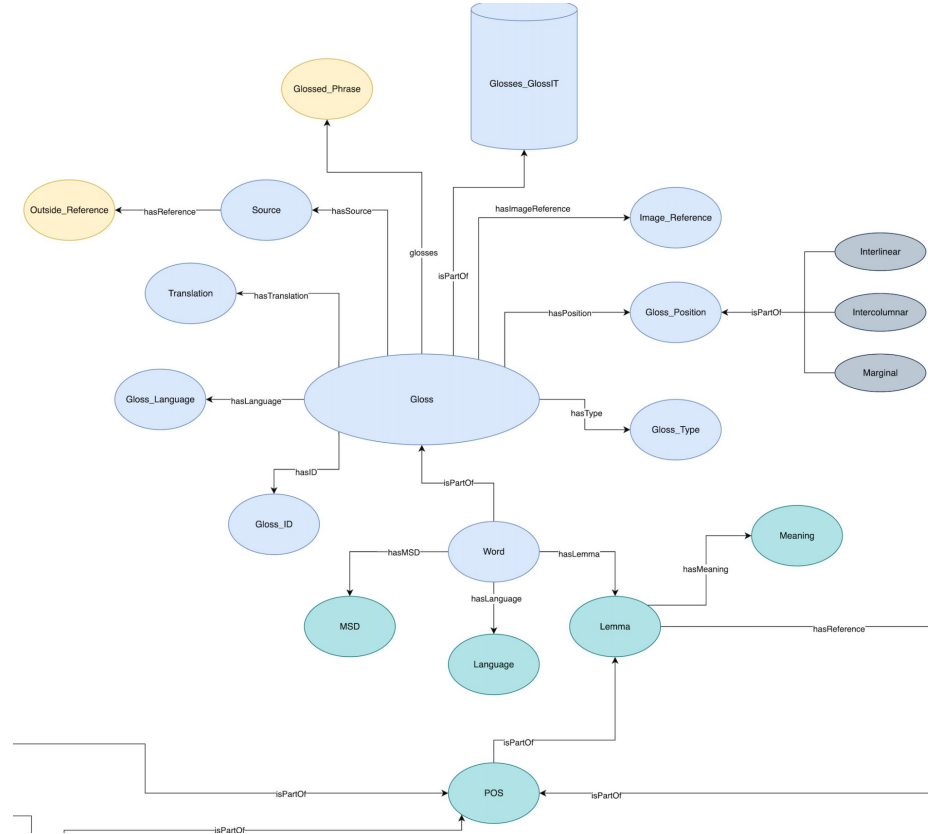
BN7501 - Segmented with a CPU trained model



Data Model: Overview (ERD)









GlossV.i.Be

Early Medieval Glosses And The Question Of Their Genesis A Case Study On The Vienna Bede



41 humanam discursandi ubique ac uictum quae[...]itandi

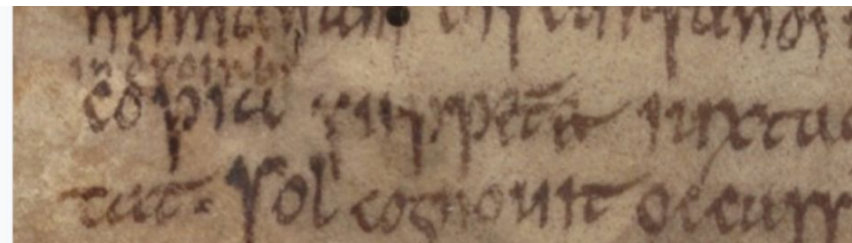
indsoirbe

42 copia suppeteret iuxtaquod in dei laudibus psalmista decan

43 tat. Sol cognouit occasum suum posuisti tenebras et.

44 facta est nox in ipsa pertransibunt omnes bestiae siluarum

cetera



```
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  <ref target="https://digital.onb.ac.at/RepViewer/image?doc=DTL_8650790&img=00000008.jpg&hash=5af078d09f16827f232e850ab1bec13c59557c6cc26f19236e3808fe2e928319329f9ab8be9a5ac9e0a4ef0a459d&h=2000&q=70" type="manuscript"/>
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  <note target="#BVi.01a42.07" type="glossing"><w lemma="copia" msd="nom.sg.fem." pos="NOUN" xml:id="glBVi.01a42.07.0">copia</w></note>
</gloss>
...
<w lemma="in_1" msd="nom.sg.fem." pos="DET" xml:id="BVi.01a42.07.0">ind</w><w lemma="soirbe" msd="nom.sg." pos="NOUN" xml:id="BVi.01a42.07.1">soirbe</w>
```




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  <div type="work" n="DTR" xml:id="MS1_WORK" >

    <!--Number and title of the chapter in @n; @sameAs is the title as used in the edition xml, i.e. an abbreviation: DTR_XII etc., @xml:id functions similarly, with the edition of the ms
    <div type="chapter" n="I" sameAs="#chapter_in_edition" xml:id="MS1_WORK_I">
      <pb facs="#IMAGE" n="fol. 1r" url="abcd"/>

      <!--This only applies to two-columned manuscripts-->
      <cb n="a"/>

      <!--To make sure that we can address and access each line we have to use <ab>-->
      <ab xml:id="MS_Chapter_Fol_Line" ana="#line" facs="#eSc_line_1"><w xml:id="word1">Elementa</w>
        <w xml:id="word2">sibimet</w>
        <w xml:id="word3">sicut</w>
        <w xml:id="word4">natura</w>, <w>sic</w>
        <w xml:id="word5">etiam</w>
        <w xml:id="word6">situ</w>
        <w xml:id="word7">differunt</w>.</ab>

      <gloss xml:id="gloss1" type="grammatical" subtype="etymological" ana="#la #sga" target="#word1" rend="InterlinearLine:gloss">
        <!--Text of the gloss-->
        <w>.i.</w>
        <w lemma="" msd="" pos="" xml:id="">glossa</w>
        <w lemma="" msd="" pos="" xml:id="">
          <abbr>
            <ex>est</ex>
            <am>+</am>
          </abbr>
        </w>

        <!--Translation of the gloss into English-->
        <note type="translation"/>
        <!--Commentary on the editorial issues-->
        <note type="editorial"/>
        <!--Commentary on the gloss itself-->
        <note type="content"/>
      </gloss>
      <!--This only applies to two-columned manuscripts-->
      <cb n="b"/>
    </div>
  </div>
</body>
```




- Beda, *De Temporum Ratione*, I (ed. Jones 268-273)
De computo uel loquela digitorum
“Calculating or speaking with the fingers”
- 7 manuscripts
BN1616, Ang477, Ber1832, BCr, Kas4, Sang251, Val174
- Ca. 700 glosses
Latin, OB

BAUER, Bernhard, 2019: ‘The interconnections of St Gall, Stiftsbibliothek, ms 251 with the Celtic Bede manuscripts’, *Keltische Forschungen* 8, 31–48.

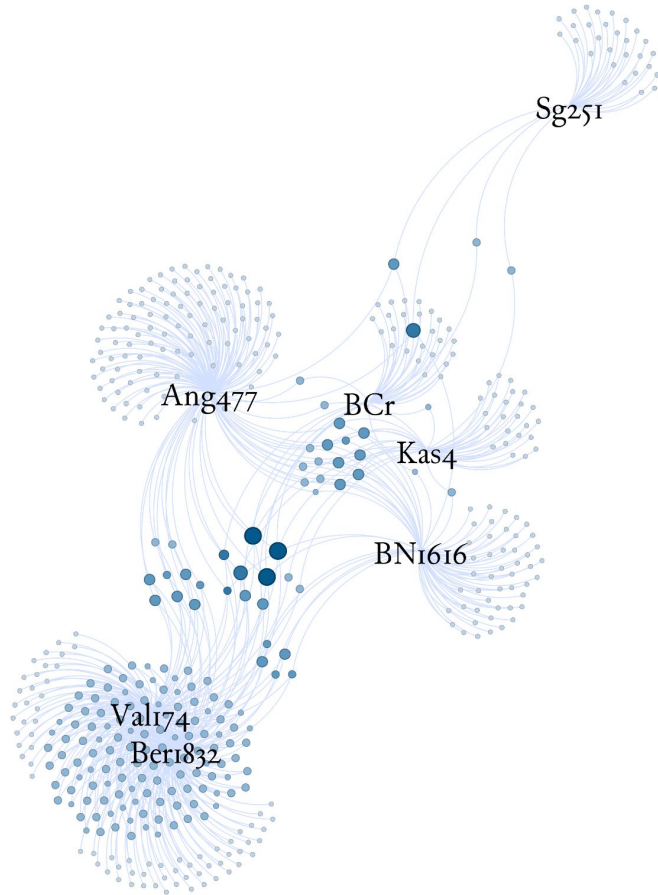
Numbers



Gloss.IT.

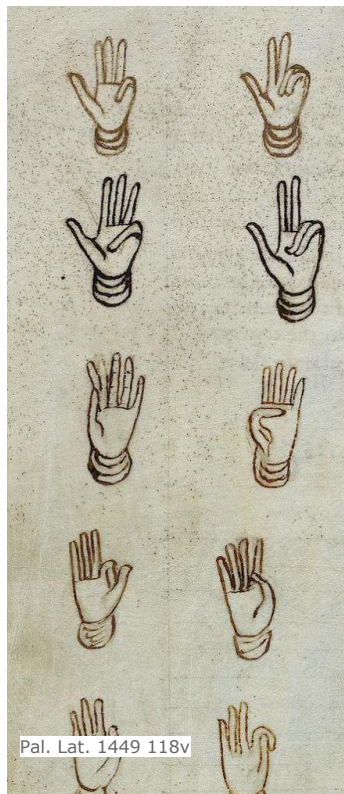
MS	1a	1b	2	Section 3	4	5	Unclear
Ang477	23	16	37	2	25	25	6
BCr	8	6	7		4	8	4
Ber1832	28	36	56	10	31	31	6
BN1616			35	2	20	17	
Kas4	9	6	14		9		3
Sg251	4	6	5		12	5	
Val174	26	38	50	9	23	23	9





- Gephi
- Yifan Hu
- Force-directed
- Nodes are (parallel) glosses

Case Study: The Main Text (Structure & Contents)



(1) 1-24

Introduction: why you should learn *computus*

(2) 25-71

How to count on your fingers (1 to 100.000)

(3) 72-75

Brief reference to a second type of *computus*

(4) 75-87

Communicating at a distance with numbers

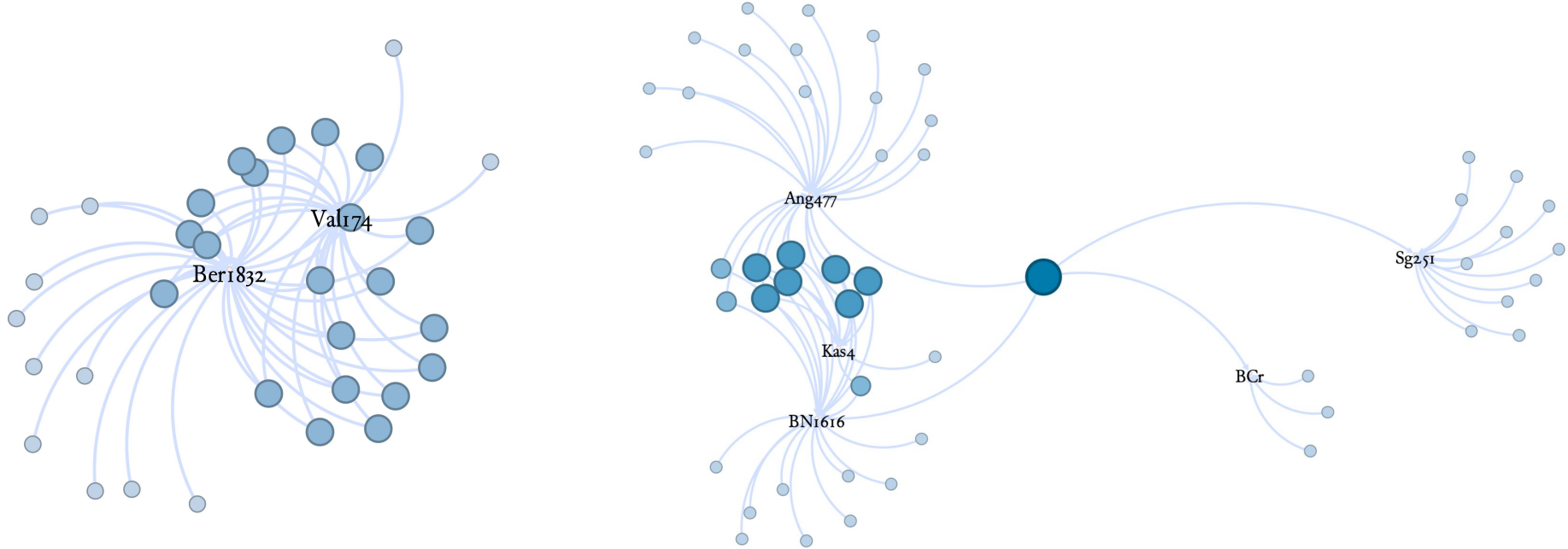
(5) 88-104

Cryptographic techniques & Greek alphabet

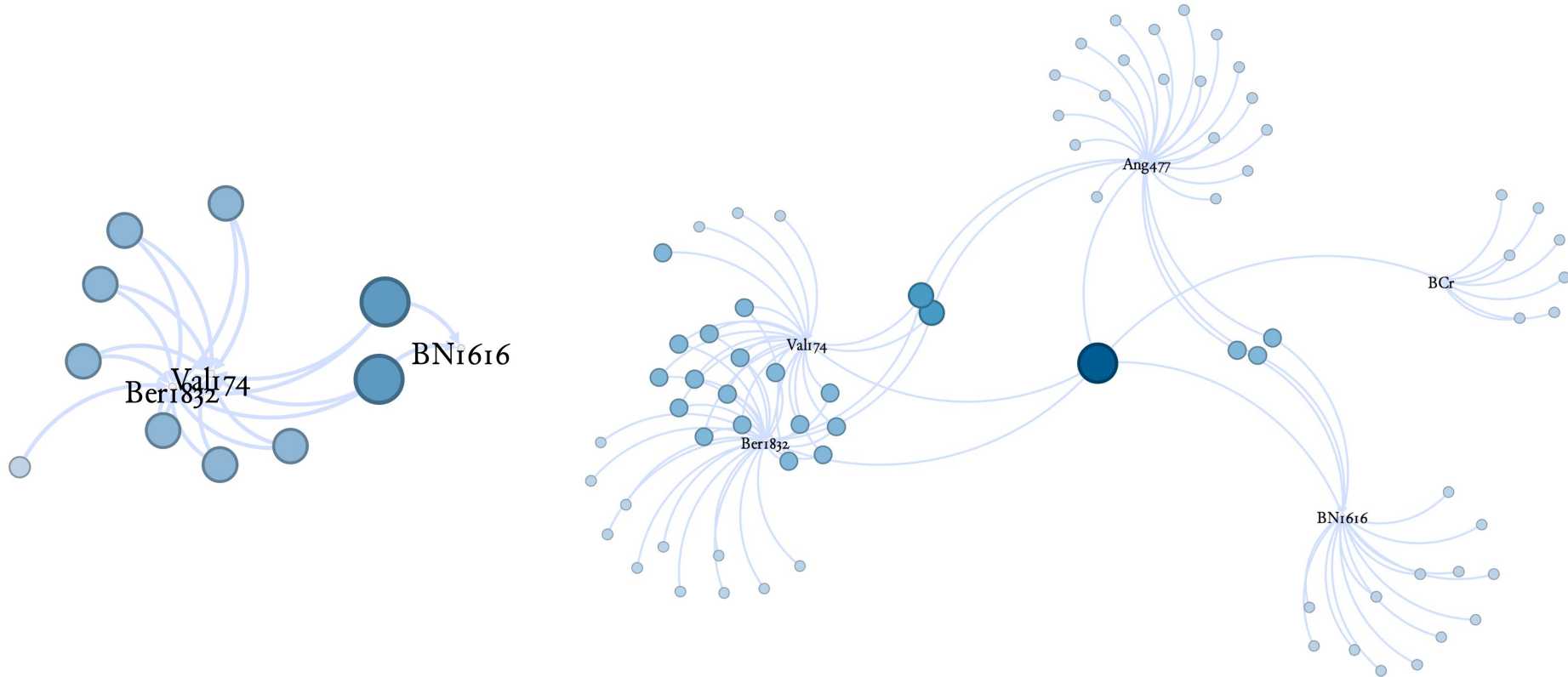
(6) 105-107

Introduction to the next subject, on *tempora*

Network Analysis: Section 4



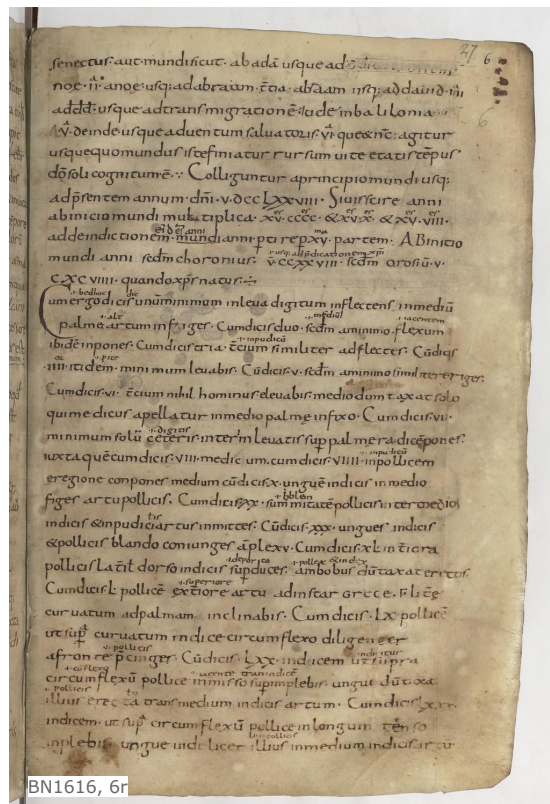
Network Analysis: Section 3 & 5



Case Study: BN1616 “Liber lunaris”

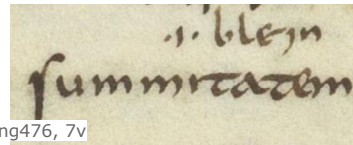


Gloss.IT.

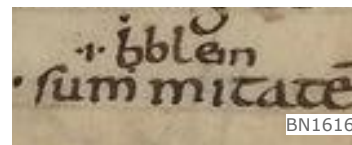


BN1616, 6r

- Paris, BN, nouv. acq. lat. 1616
- IX ex. / X 1/2 (post AD 903?)
- Loire valley, prob. Fleury
- Collection of texts on computus
- Bede, *DTR* I, 25-107 (foll. 6r-7r)
- Latin/OB glosses



Ang476, 7v



BN1616, 6r

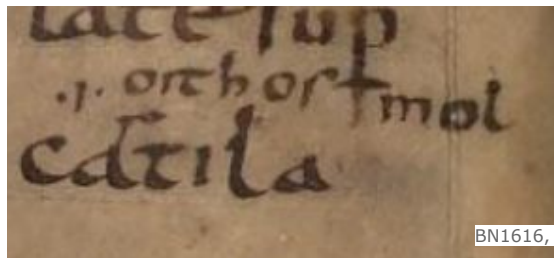
Case Study: *cartilagini* (DTR, I 58-60)



Gloss.IT.

*Triginta millia cum dicis, eadem prona, sed erecta, pollicem **cartilagini** medii pectoris immittes (DTR, I 58-60)*

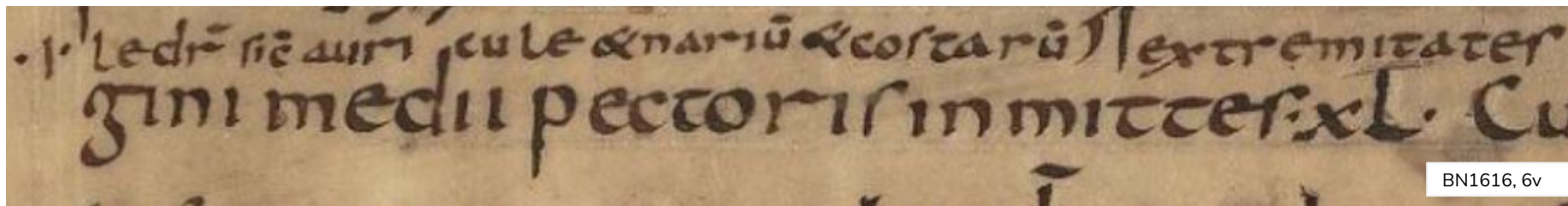
When you say “thirty thousand”, place it flat but upright with the thumb on the **breastbone**.



BN1616, 6r

.i. Oithos mol

.i. ledř sič auri cule &nariũ &costarũ extremitates

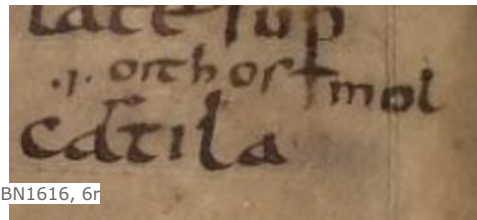


BN1616, 6v

Case Study: *cartilagini* (DTR, I 58-60)



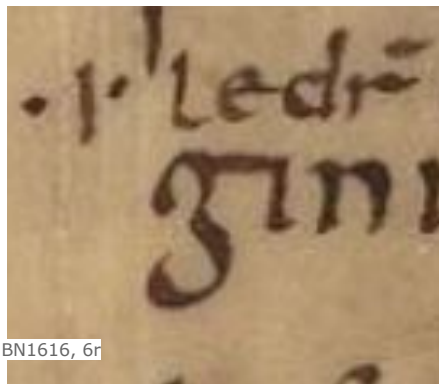
Gloss.IT.



BN1616, 6r

.i. *Oithos mol.*

Obscur. *Oith-* serait-il un correspondant de l'irl. *Ucht* “poitrine” (cf. “*pectoris*”) ? Dans ce cas, seul -osmol rendrait “*cartilagini*”, mais “*cartilagini*” est aussi glosé *ledr̃*.



BN1616, 6r

.i. *ledr̃*

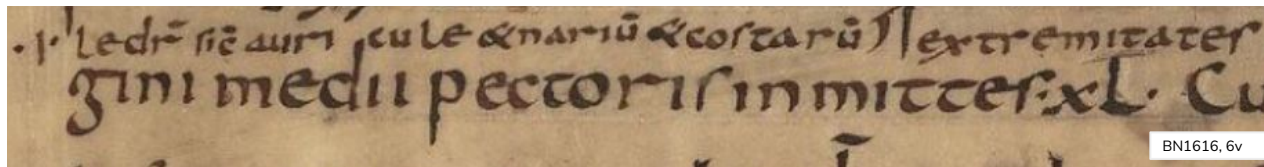
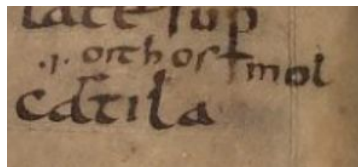
Ledr... contient certainement un radical ayant le sens de “cuir”, correspondant au gall. *Lledr*, bret. moy. *lezh*, mod. *ler* “cuir”. Le cartilage est ici défini probablement par sa consistance analogue à celle du cuir. Le nom du “cuir” celt. **letro* de *(p)*letro*, aurait été emprunté en Germanique; cf. l'angl. *leather*. [...] Un dérive **ledrin*, possible ici aurait signifié “de cuir” ?

FLEURIOT, Léon, 1964: *Dictionnaire des Gloses en Vieux-Breton* (Paris).

Case Study: *cartilagini* (DTR, I 58-60)



Gloss.IT.



BN1616 .i. oith os molle dñ sič auricule & nariũ & costarũ extremitates

BER 1832 Cartilago dñ illud os molle qđ in pectore sit.

Val174 Cartilago dñ illud os molle qđ in pectore sit.

Ang477 .i. meid bronn. mollitię pectoris

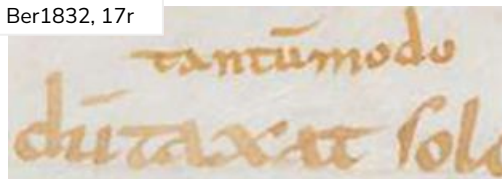
Is. Etym.
11.1.88 *Cartilagines ossa mollia et sine medulla, quod genus auriculæ et narium discrimen et costarum extremitates habent; siue opercula ossuum, quae mouentur. Et dictae cartilagines quod leni attritu carent dolorem dum flectuntur.*

Case Study: *dumtaxat* gl. Cicero *sine dubio*

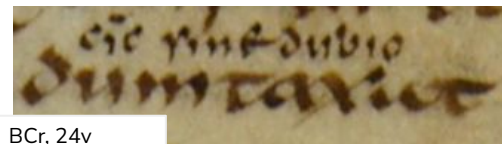
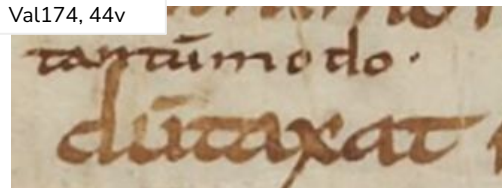


Gloss.IT.

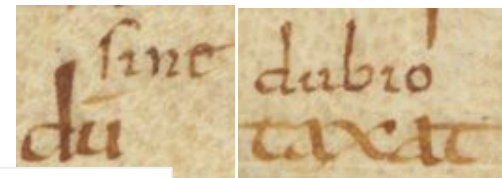
Ber1832, 17r



Val174, 44v



BCr, 24v



Kas4, 4v

*Cum dicis sex, tertium nihilominus eleuabis, medio **dumtaxat** solo, qui medicus appellatur, in medium palmae fixo. (DTR, I 29-31)*

When you say “six”, you lift up the third finger, while only the finger in between, which is called medicus, is fixed in the middle of the palm.
(translation, Wallis)

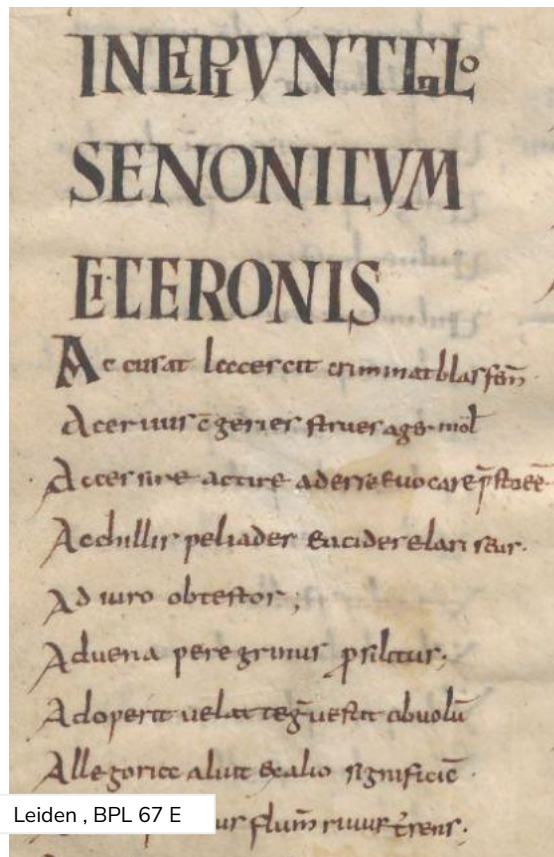
*Cum dicis septuaginta, indicem (ut supra) circumflexum pollice immisso superimplebis, ungue **dumtaxat** illius erecto trans medium indicis artum.*

When you say “seventy”, you fill the index finger, bent as before, by inserting the thumb, with its nail upright, through the middle joint of the index finger
(translation, Wallis)

Case Study: *dumtaxat* gl. Cicero *sine dubio*



Gloss.IT.



Synonima Ciceronis, “Accusat lacerat”

- Ed. critica Gatti 1994
- 250 synonymic entries
- Leiden Universiteitsbibliotheek, BPL 67 E IXth cent. (first quarter), north-western France, foll. 61v-65v.

174. Nempe, quippe, *sine dubio*, quin, quin immo, *dumtaxat*, alioquin, namque.
(ed. Gatti 1994)

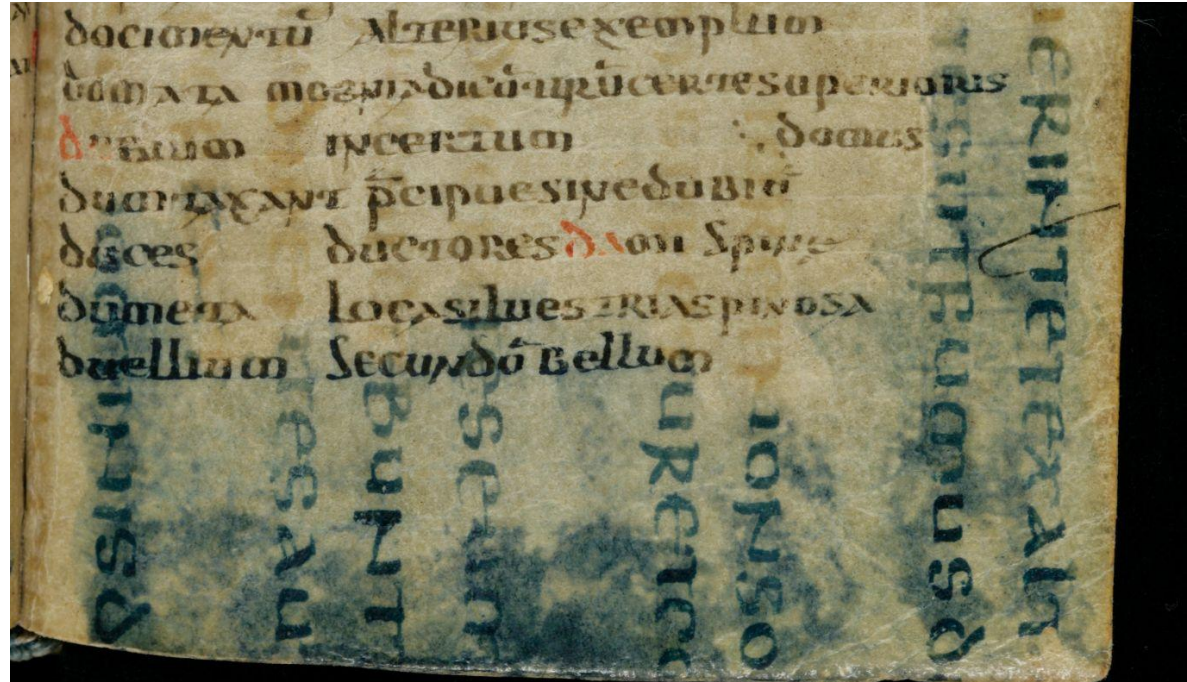
Case Study: *dumtaxat* gl. Cicero sine dubio

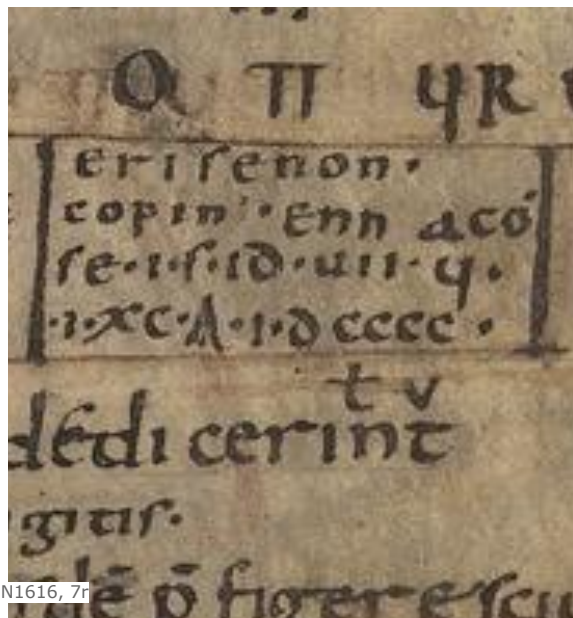


Gloss.I.T.



Sang. 912 Abba-Ababus-Glossar





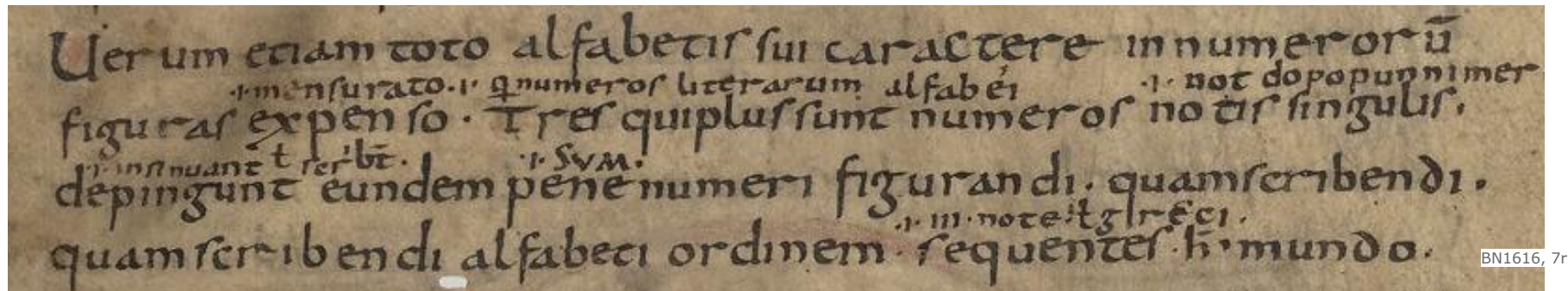
Uerum toto alphabeti sui caractere in numerorum figuras expenso, tres qui plus sunt numeros notis singulis depingunt, eudem pene numeri figurandi, quem scribendi alphabeti ordine sequentes hoc modo: (DTR, I 92-95)

Indeed, having employed the entire alphabet in the representation of numerical figures, they depict three additional numbers with individual characters, following almost the same order for representing numbers as they do for writing the alphabet, in this manner:

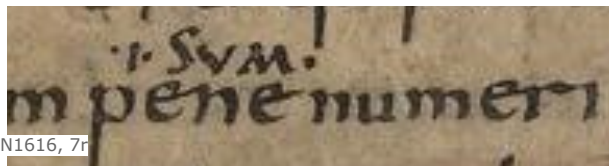
Case Study: *tres numeros* (DTR, I 58-60)



Gloss.IT.



BN1616, 7r



BN1616, 7r

sum

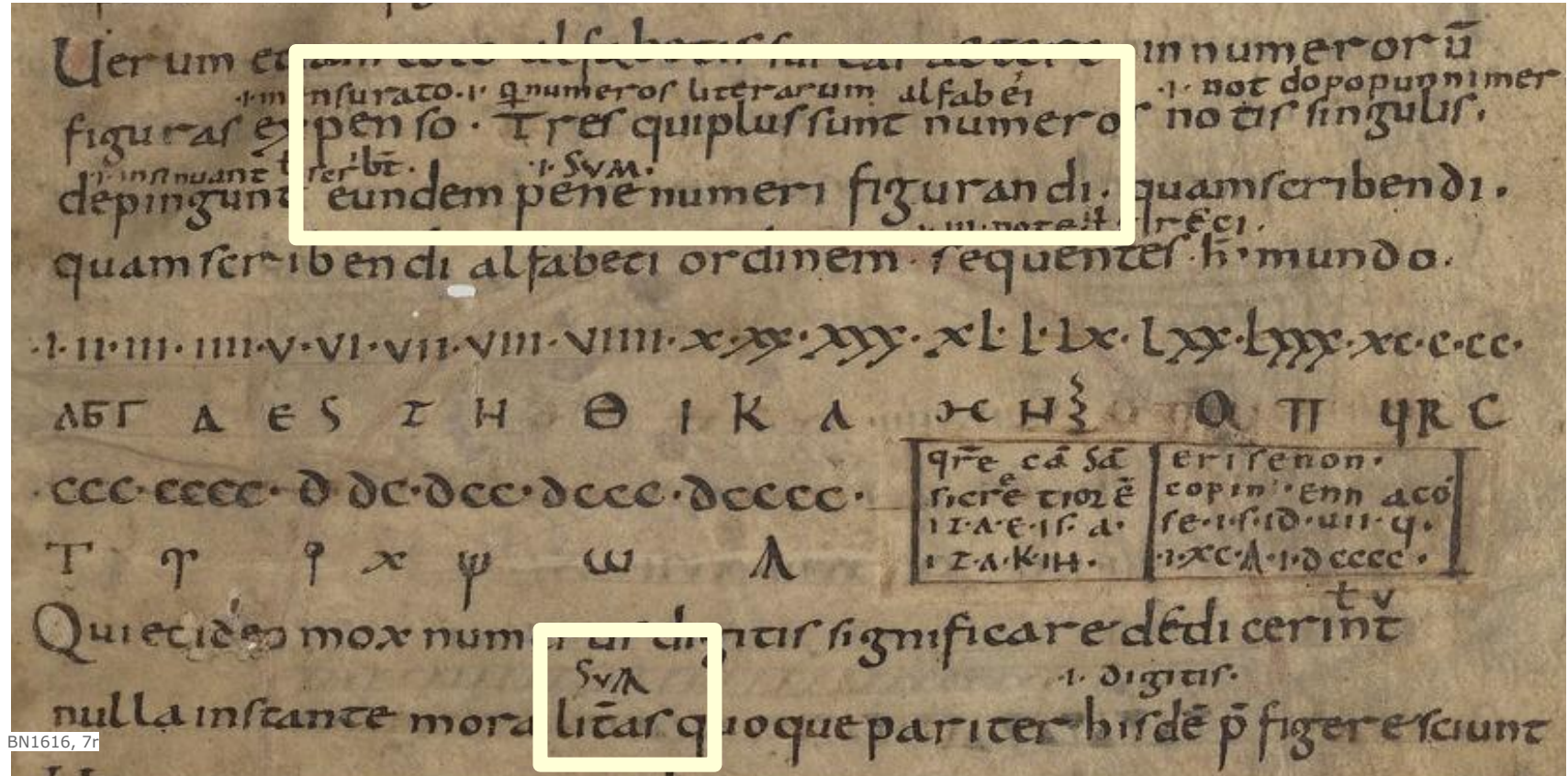
Sur “pene” glose sans doute “*numeri*” dans “*tres qui plus sunt numeros notis singulis [...]*”. *Sum* paraît analogue au cornique *sum* “nombre”, ex. Beunans Meriasek v. 1604. C’est un emprunt au latin “*summa*”.

FLEURIOT, Léon, 1964: *Dictionnaire des Gloses en Vieux-Breton* (Paris).

Case Study: *tres numeros* (DTR, I 58-60)



Gloss.IT.

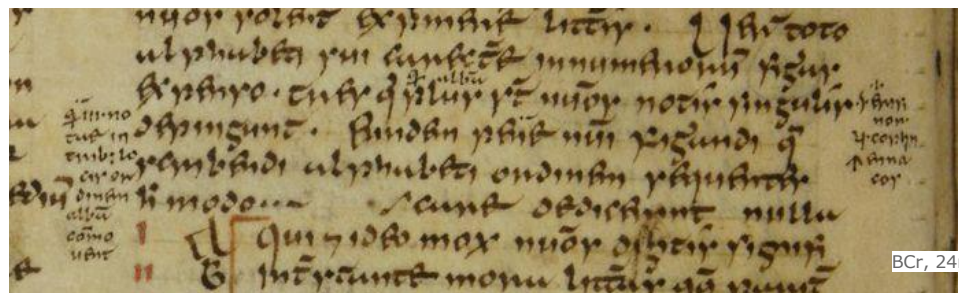


BN1616, 7r

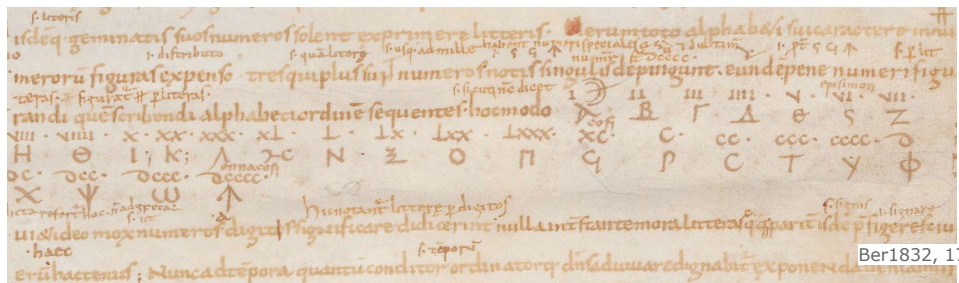
Case Study: tres numeros (DTR, I 58-60)



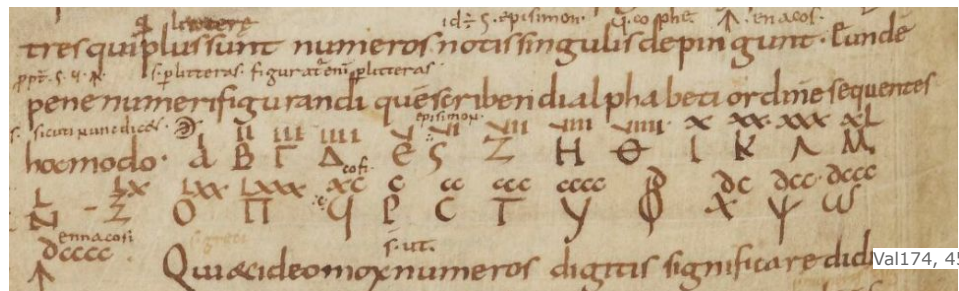
Gloss.IT.



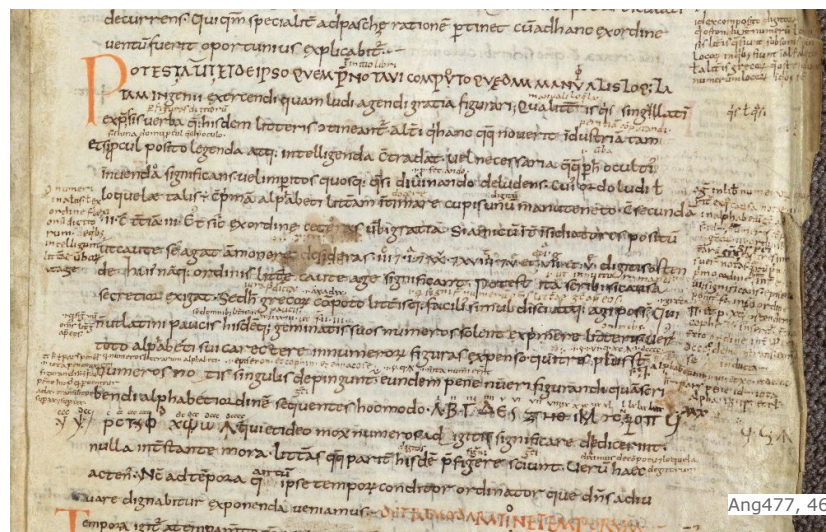
BCR, 24rb



Ber1832, 17v



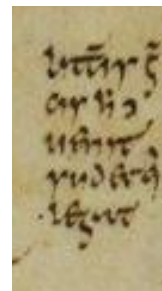
Val174, 45v



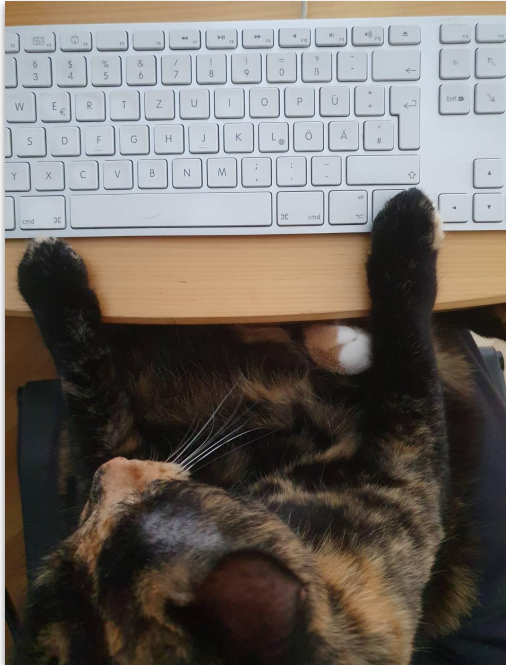
Ang477, 46r

Litteris graecis
hoc conuenit:
sudet qui legat

BCr 24v, intercolumnar gloss



Thank you for your attention!



Dörte Ceccarelli (CCO)



Theodor (CDO)