

# A Digital History of Concepts Related to Modality and Tonality

## Some Opportunities and Challenges

*Séminaire Épistémologie de la musicologie numérique.  
Les approches mixtes (quantitatives/qualitatives)*

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# 1. Ontologies and their application to music-theoretical sources

## Some elements of definition

- ❑ Computational ontologies are a means to formally model the structure of a system, i.e., the relevant entities and relations that emerge from its observation, and which are useful to our purposes (Guarino et al. 2009).
- ❑ The underlying conceptualisation of the system to be modelled is “formal”, “explicit” and “shared” (Studer et al 1998).

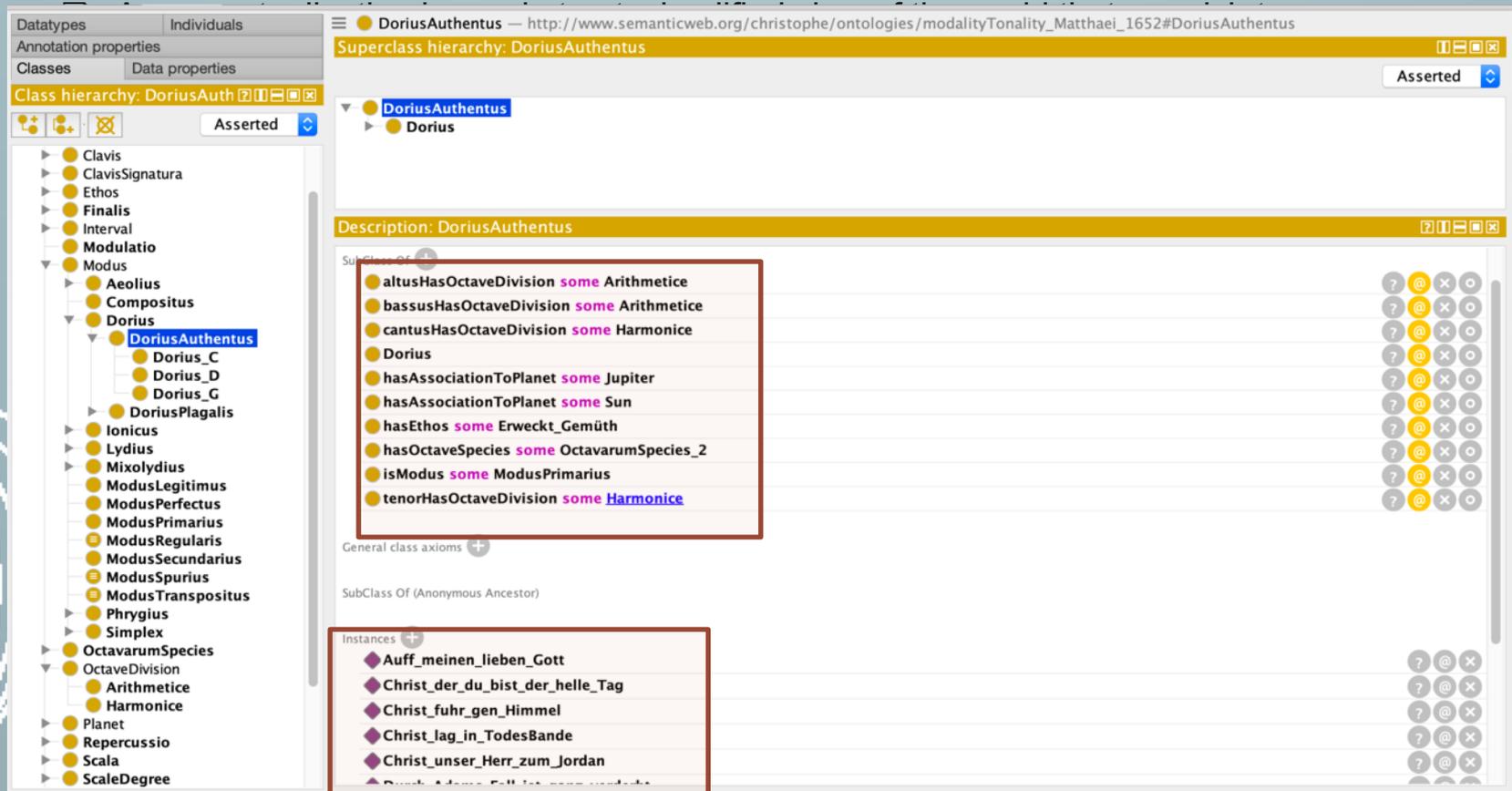
# 1. Ontologies and their application to music-theoretical sources

## Conceptualisation

- ❑ A conceptualisation is an abstract, simplified view of the world that we wish to represent for some purpose (Genesereth & Nilsson 1995).
- ❑ This conceptualisation implies two dimensions:
  - The *intension* indicates the content of a concept that constitutes its formal definition.
  - The *extension* indicates the concept's range of applicability by naming the particular objects that it denotes.
- ❑ Concepts are defined in relation to one another: the specific value of a concept depends on its structural position within the system, i.e. its extension and intension.
- ❑ The conceptualisation is made explicit by specifying the concept's intension and extension.
- ❑ Concepts can never be reduced to isolated terms but have to be inferred from higher textual units (sentences, paragraphs, etc.).
- ❑ Concepts can never be found as such in the text, but are invoked through it by means of an interpretation.

# 1. Ontologies and their application to music-theoretical sources

## Conceptualisation



The screenshot displays a Semantic Web browser interface for the ontology `DoriusAuthentus`. The browser address bar shows the URL: `http://www.semanticweb.org/christophe/ontologies/modalityTonality_Matthaei_1652#DoriusAuthentus`.

**Superclass hierarchy: DoriusAuthentus**

- DoriusAuthentus
  - Dorius

**Description: DoriusAuthentus**

SubClass Of:

- altusHasOctaveDivision **some** Arithmetic
- bassusHasOctaveDivision **some** Arithmetic
- cantusHasOctaveDivision **some** Harmonice
- Dorius
- hasAssociationToPlanet **some** Jupiter
- hasAssociationToPlanet **some** Sun
- hasEthos **some** Erweckt\_Gemüth
- hasOctaveSpecies **some** OctavarumSpecies\_2
- isModus **some** ModusPrimarius
- tenorHasOctaveDivision **some** Harmonice

General class axioms +

SubClass Of (Anonymous Ancestor)

Instances +

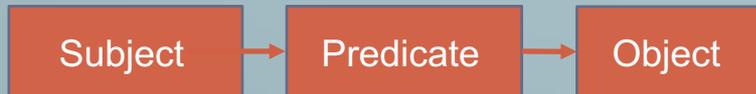
- Auff\_meinen\_lieben\_Gott
- Christ\_der\_du\_bist\_der\_helle\_Tag
- Christ\_fuhr\_gen\_Himmel
- Christ\_lag\_in\_TodesBande
- Christ\_unser\_Herr\_zum\_Jordan
- Death\_Adams\_Fall\_in\_garden\_of\_eden

The left sidebar shows a class hierarchy for `DoriusAuthentus`, including subclasses like `Dorius_C`, `Dorius_D`, `Dorius_G`, and `DoriusPlagalis`. The main area shows the description of the `DoriusAuthentus` class, including its superclasses and instances.

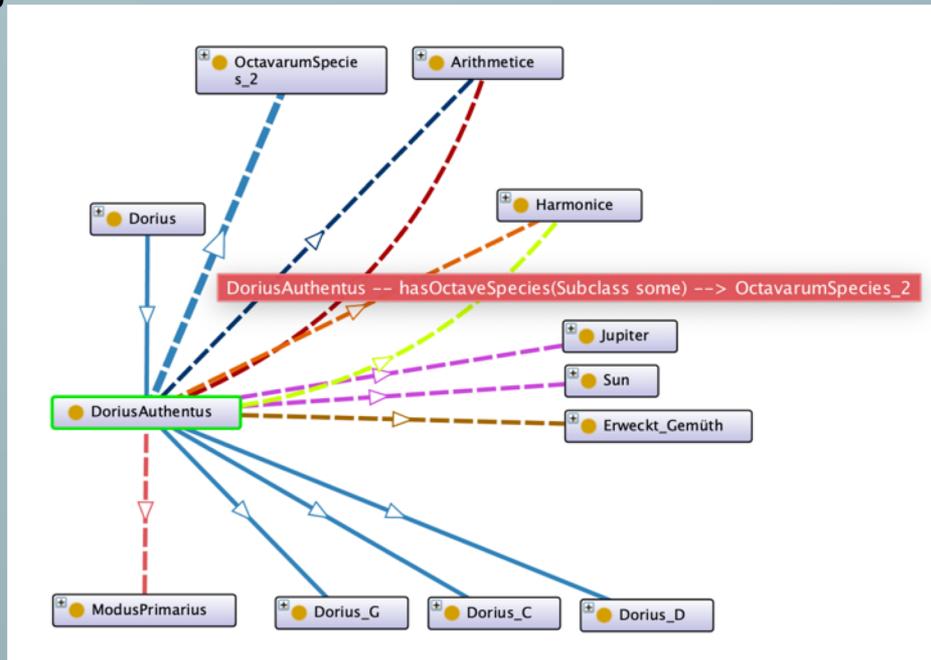
# 1. Ontologies and their application to music-theoretical sources

## Formal and explicit representation

- ❑ The conceptualisation is formal: built on predicate logic with a vocabulary consisting of objects, properties, relations and functions.
- ❑ An atomic sentence is a predicate applied to a set of concepts according to the model:



- ❑ Objects and their relations may be characterised and specified, quantified, etc.
- ❑ The language commonly used for building ontologies – Web Ontology Language (OWL) – builds on RDF, a standard model that uses URIs to name the relationship between things in a triple.



## 2. Benefits from a musicological and historical perspective

Make things explicit and trackable

So ist auch dieses allhier nöthig zu erinnern/ daß Ionius Modus, wenn er in Naturali vnd Regulari Systemate gesezet/ vmb einen Ton höher; Wenn er aber in Systemate transposito gefunden/ per tertiam inferiorem aufm d fide, gar sequentiſch/ weil er in regulari zu niedrig vnd so schläffrig/ in Transpositio aber zu hoch

83

hoch/ vnd den Sängern vnbequem zu singen ist/ kan Musiciret werden/ wie aus folgenden Exemplis zu sehen.

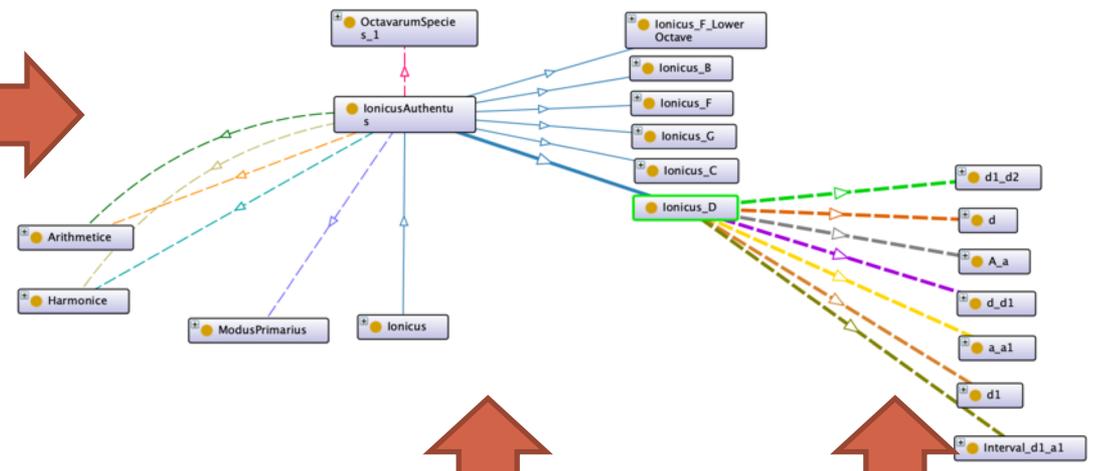
Ionius regularis. Per Tonum minorem elevatus.

Ionius transpositus. Per tertiam depreſius.



Es ist aber nicht allzeit von nöthen/ daß man in der Noten/Partitur, oder auch im General/daß/ ein jeden Gesang in quintam oder quartam transponire, sondern nur/ wie es in den Noten an ihm selbst gefunden wird/ daß in ſe/ vnd schreibe: Einmal die Transposition, sonderlich per quintam, in den Noten viel leichter/ als in der deutschen Buchstaben Tabulatur zu observiren vnd zu begreiffen ist: diweil man sich gar leichtlich einen andern Clavem signatam formen an imaginiren, vnd sich dar nach richten kan. Ob aber einer oder der ander dessen nach angewöhnet/ sich anfangs so bald nicht darin finden möcht/ der selbe kan den rechten Clavem signatam vff ein klein papirlein schreiben/ vnd form mit Wachs an die Linien kleben/ so hat er es vor sich/ wie ers haben wil. Inmassen ich dann in meiner Terpsichore bey etlichen Courranten zweyerley Claves signatas, propter transpositionum vff den Instrumenten in form an gezeichnet; Vnd etwas davon vmb besserer nachrichtung willen vor die einfältigen allhier bezuſegen/ nicht vndienlich erachte.

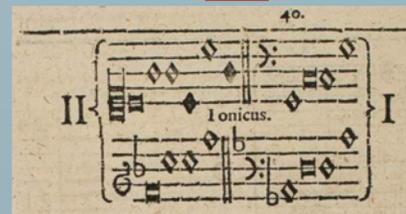
Praetorius, 1619, 82-83



40.

II } I

Ionius.



IREMUS Praetorius, 1619, 40

Schematismus sonneret Hypoionici regularis.

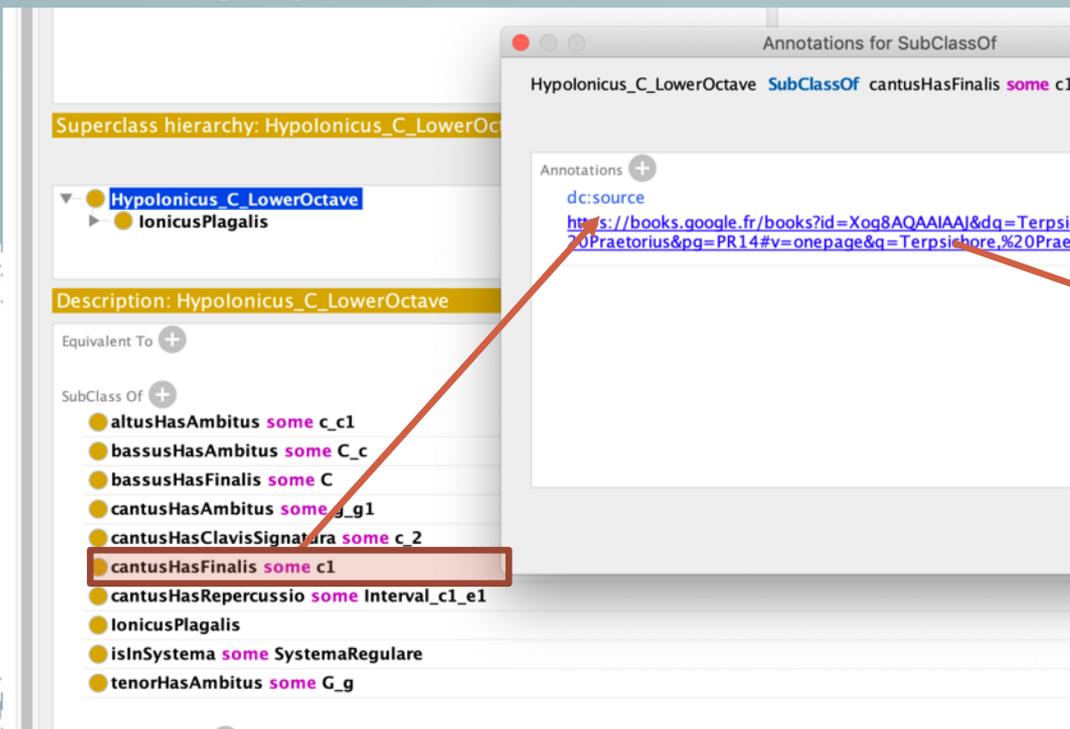
B. T. A. C. 12. HYPOL.



Praetorius, 1619, 45

## 2. Benefits from a musicological and historical perspective

Make things explicit and trackable



Annotations for SubClassOf

Hypolonicus\_C\_LowerOctave SubClassOf cantusHasFinalis some c1

Annotations +

dc:source  
<https://books.google.fr/books?id=Xog8AQAAIAAJ&dq=Terpsichore,%20Praetorius&pg=PR14#v=onepage&q=Terpsichore,%20Praetorius>

Superclass hierarchy: Hypolonicus\_C\_LowerOctave

- Hypolonicus\_C\_LowerOctave
  - IonicusPlagalis

Description: Hypolonicus\_C\_LowerOctave

Equivalent To +

SubClass Of +

- altusHasAmbitus some c\_c1
- bassusHasAmbitus some C\_c
- bassusHasFinalis some C
- cantusHasAmbitus some g\_g1
- cantusHasClavisSignatura some c\_2
- cantusHasFinalis some c1**
- cantusHasRepercussio some Interval\_c1\_e1
- IonicusPlagalis
- isInSystema some SystemaRegulare
- tenorHasAmbitus some G\_g

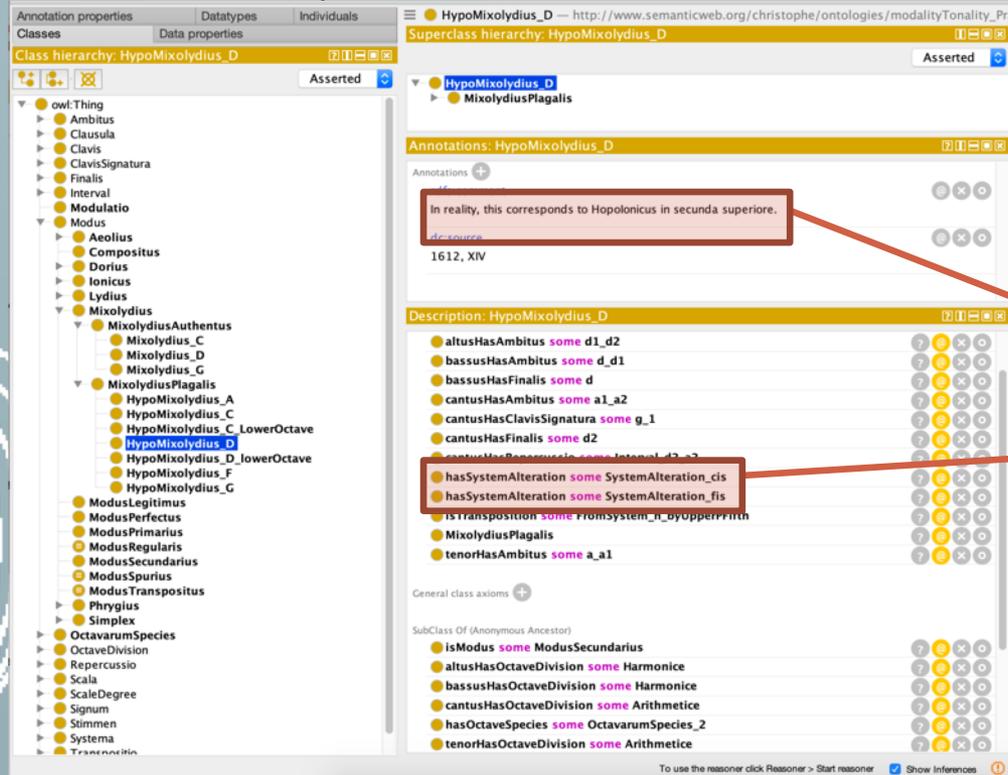


Praetorius (1612, xiv)

## 2. Benefits from a musicological and historical perspective

Make things explicit and trackable

□ Comment concepts:



The screenshot shows the IREMUS ontology editor interface. On the left, a class hierarchy tree is visible, with **HypoMixolydius\_D** selected. The main panel displays the **Annotations: HypoMixolydius\_D** section, which includes a text annotation: "In reality, this corresponds to Hypolonicus in secunda superiore." Below this, a list of properties is shown, with two highlighted: **hasSystemAlteration some SystemAlteration\_cis** and **hasSystemAlteration some SystemAlteration\_fis**. The bottom of the interface shows general class axioms and subClassOf relationships.



The image shows a page from Praetorius's work (1612, xiv) with musical notation and text. The page is divided into four columns, each representing a different mode: **Hypolonicus, all- in 11. Modus.**, **HypoMixolydius, alius 8. Modus.**, **Aeolius, vulgò 9. vel 10. Modus.**, and **Regulariter.**. The notation includes staves with notes and clefs, and text labels such as "in Secunda superiore.", "in Secunda inferiore.", "in Quarta inferiore.", and "in Quinta superiore.". A red box highlights the "4.2. in Quinta superiore." entry, which is linked by a red arrow to the corresponding annotation in the ontology screenshot.

Ontology of Praetorius (1612 and 1619)

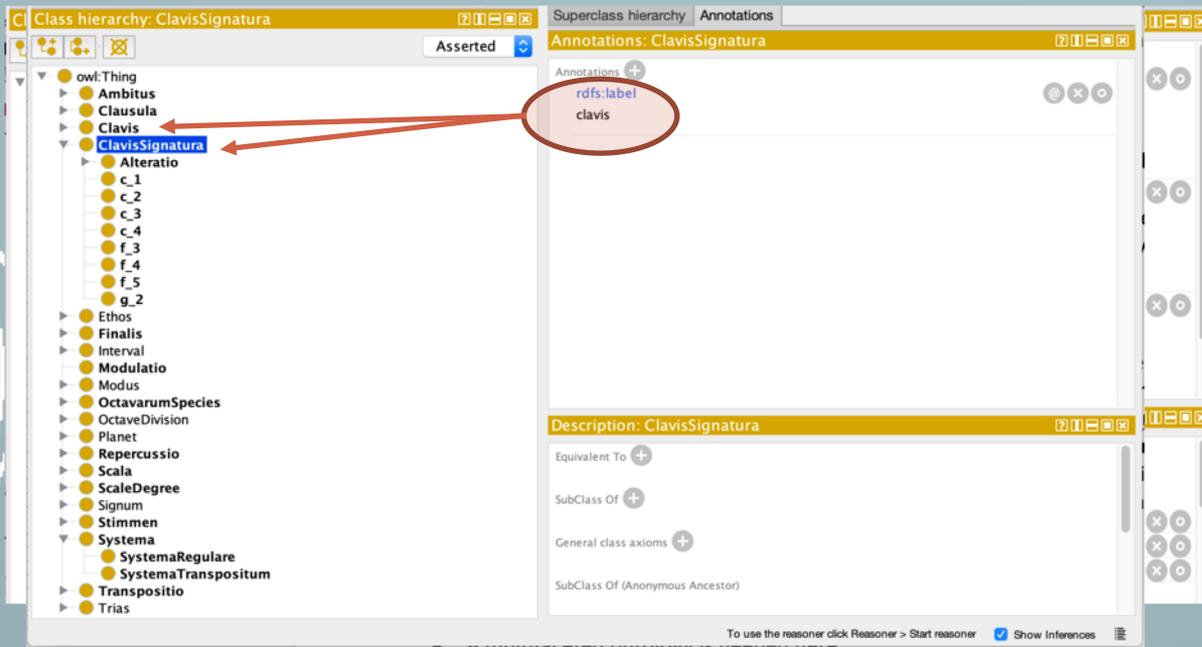
Praetorius (1612, xiv)



## 2. Benefits from a musicological and historical perspective

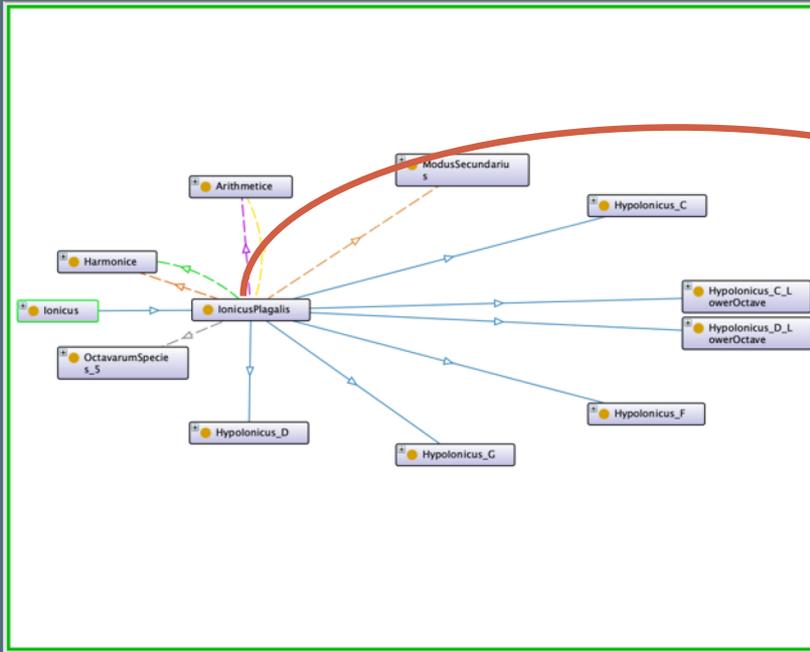
### Explore, analyse and compare theoretical frameworks

- ❑ Make a clear distinction between the way a concept is called and its formal definition: A concept may have different names (“labels”), which all relate to the same thing. On the contrary, a single label may relate to different concepts.

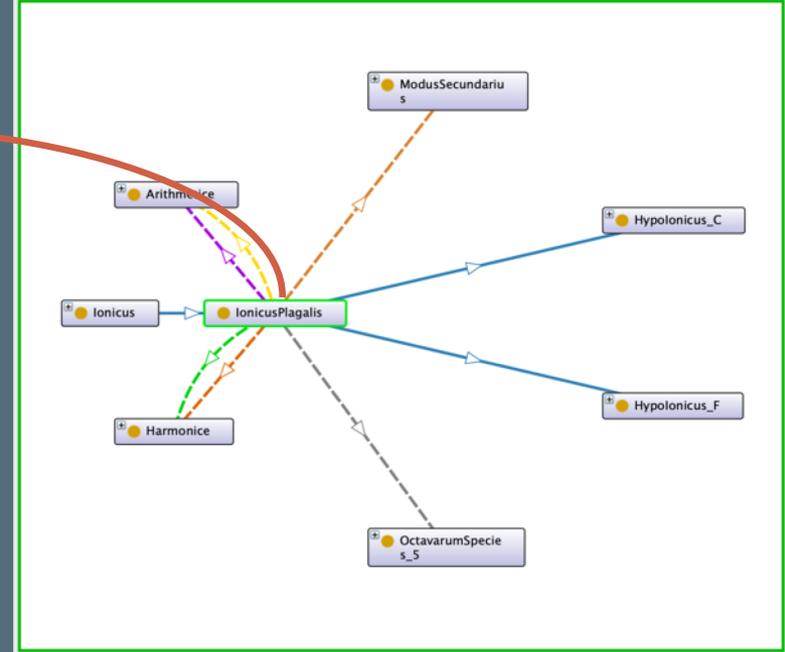


The screenshot displays an ontology editor interface. On the left, a class hierarchy tree is shown with 'ClavisSignatura' selected. The right pane shows the 'Annotations: ClavisSignatura' section, where the annotation 'rdfs:label' is circled in red. A red arrow points from this circle to the 'ClavisSignatura' class in the hierarchy. Below the annotations, the 'Description: ClavisSignatura' section is visible, showing various logical relationships like 'Equivalent To', 'SubClass Of', and 'General class axioms'.

## 2. Benefits from a musicological and historical perspective



Modelling of *Ionicus plagalis*, Praetorius (1612, 1619)



Modelling of *Ionicus plagalis*, Matthaei (1652)

## 2. Benefits from a musicological and historical perspective

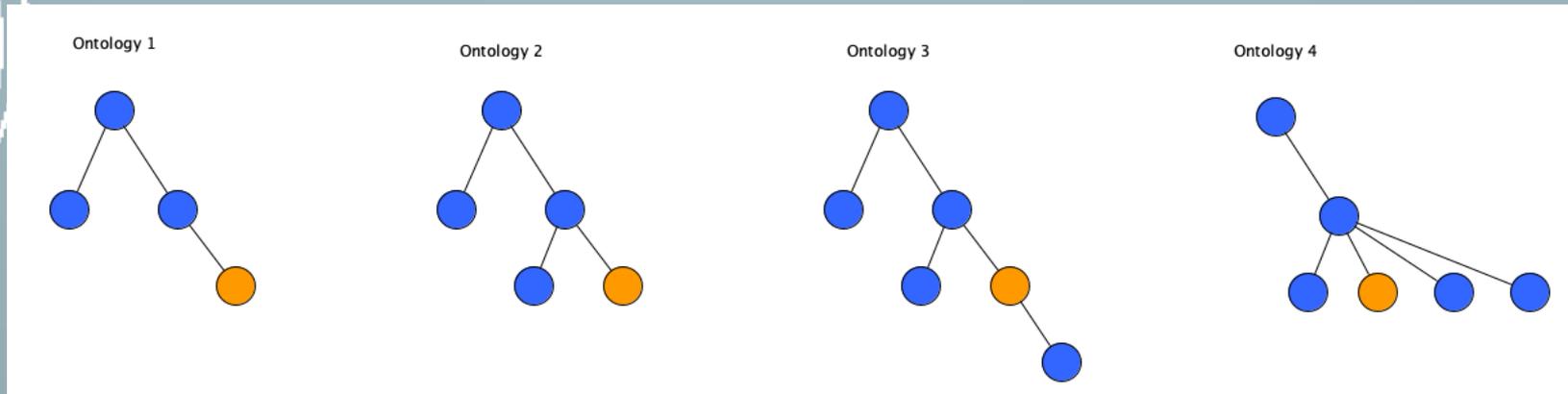
### Explore, analyse and compare theoretical frameworks

- ❑ Make a clear distinction between the way a concept is called and its formal definition: A concept may have different names (“labels”), which all relate to the same thing. On the contrary, a single label may relate to different concepts.
- ❑ Align individual terms of distinct ontologies to explore their senses and their history (model: *Handwörterbuch der musikalischen Terminologie*).
- ❑ Align concepts of distinct ontologies in order to see how the concept evolves in time.

## 2. Benefits from a musicological and historical perspective

### Explore, analyse and compare theoretical frameworks

- ❑ Clear distinction between the way a concept is called and its formal definition: A concept may have different names (“labels”), which all relate to the same thing. On the contrary a single label may relate to different concepts.
- ❑ Align individual terms of distinct ontologies to explore their senses and their history (model: *Handwörterbuch der musikalischen Terminologie*).
- ❑ Align individual concepts of distinct ontologies in order to see how the concept evolves in time.
- ❑ Juxtapose individual ontologies in order to explore how the position of a specific concept evolves.



## 3. Current limitations and challenges

### Addressability and Ontology comparison

- ❑ Necessity to address very heterogeneous material – texts, images, musical examples, schemata, etc. – at various micro- and macrostructural levels.
- ❑ As ontologies grow, it becomes difficult to compare them and to grasp their inner structure effectively.

#### Technical need to:

1. make highly heterogeneous material addressable at a granular level;
2. conceive additional tools to effectively grasp conceptual variations.

### 3. Current limitations and challenges

#### Close and distant reading

- ❑ Identifying concepts and definitions, writing properties, making references to the source and annotating an ontology are highly time-consuming tasks.
- ❑ A computer assisted exploration of the sources, in order to identify linguistic properties (of definition, characterisation, observation or description), might constitute a suitable starting point for conceiving an ontology.

Glarean_1557_2.txt	EST INFIMA DIAPEN[REDACTED] TE CHORDA.[REDACTED] Primus igitur	Modus est ex D, in d. Secundus[REDACTED] ex A, in a. Tertius ex E, in e. Quartus ex [h] in b
Dedekind_1590.txt	s doctrina Modorum.[REDACTED] [REDACTED] Artificum	Modus est inventio docta bonorum.[REDACTED] Quâ faciles hominum possunt impellere
Dedekind_1590.txt	as aut Quintas illa frequenter:[REDACTED] Tertia quemgenerat,	modus est rarissimus ille.[REDACTED] in
Listenius_1515.txt	m%/iton(os)#G-, siue) ut[REDACTED] alij uocant) semitoniü, qui	modus est tenuis &; remis=
Listenius_1537.txt	[REDACTED]CAPVT IX.[REDACTED] De Modis seu interuallis.[REDACTED]	MOdus est uocis ad uocem
Listenius_1515.txt	#G+G#G-[REDACTED] #G+G#G-[REDACTED] DE MODIS MVSICAE.[REDACTED]	Modus est uocum inter se
Glarean_1557_1.txt	[REDACTED]Von Hypoelio dem zehenden Modo[REDACTED].[REDACTED] DJser	Modus ist Aeolio vnderwo
Glarean_1557_1.txt	Von Phrygio dem drit-[REDACTED] ten Modo[REDACTED].[REDACTED] DJser	Modus ist auch einer von c
Glarean_1557_1.txt	hypomyolydio dem[REDACTED] achten Modo[REDACTED].[REDACTED] DJser	Modus ist dem sibenden v
Glarean_1557_1.txt	o hatt / bedeiht es[REDACTED] einen von der gleichen zal. Diser	Modus ist[REDACTED] Dorio vnde
Herbst_1642.txt	[REDACTED]II. Hypodorius[REDACTED].[REDACTED] Dieser [REDACTED]	Modus[REDACTED] ist einfältig v
Glarean_1557_1.txt	Dctau / Hypophrygio / wie im[REDACTED] xv. cap. anzeigt. Diser	Modus ist etwas ruch / itè
Glarean_1557_1.txt	: / re la / hatt mi la / nitt re sol / wie Dorius. Di=[REDACTED] ser	Modus ist fast der erst inn
Glarean_1557_1.txt	nffzehen[REDACTED] den capittel mer daruö gemeldet ist. Diser	Modus[REDACTED] ist gar gericht
Herbst_1642.txt	[REDACTED]VI. Hypolydius[REDACTED].[REDACTED] Dieser [REDACTED]	Modus[REDACTED] ist von Natur
Herbst_1642.txt	[REDACTED]IV. Hypophrygius[REDACTED].[REDACTED] Dieser [REDACTED]	Modus[REDACTED] ist von Natur
Herbst_1642.txt	poæolius[REDACTED].[REDACTED] Dieser zehende [REDACTED]	Modus[REDACTED] ist von Natur
Herbst_1642.txt	[REDACTED]XII. Hypojonicus[REDACTED].[REDACTED] Dieser [REDACTED]	Modus[REDACTED] ist von Natur
Herbst_1642.txt	[REDACTED]Phrygius[REDACTED] der dritte [REDACTED]	Modus[REDACTED] ist von Natur

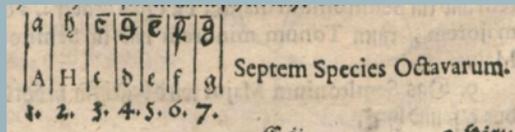
#### Methodological need to:

1. combine close and distant reading;
2. articulate hand-made modelling with computer-assisted semantic analysis.

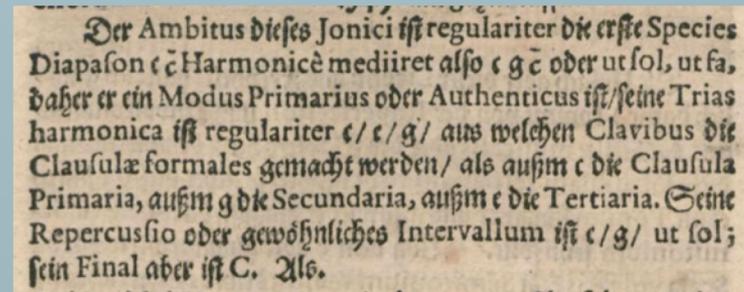
### 3. Current limitations and challenges

#### Dynamic and context-dependent knowledge production

- ❑ The knowledge captured in an ontology is static in nature. However, signification arises dynamically and is context dependent:
  - ❑ Significations can change within the source.



Matthaei, 1652, p. 19



Matthaei, 1652, p. 75

### 3. Current limitations and challenges

#### Dynamic and context-dependent knowledge production

- ❑ The knowledge captured in an ontology is static in nature. However, signification arises dynamically and is context dependent:
  - ❑ Significations can change within the source.
  - ❑ Some elements are implicit and have to be completed.
  - ❑ Different, sometimes conflicting, levels of description can coexist.

121.  
**Das XLI. Cap.**  
**Von der Versekung der Modorum.**

¶ Udem Ende soll alhier ein Tabellichen angefügēt werden / wie die reduction geschehen könne/ die Erkantniß derselben / geschehet allemahl durch die progression des semitonii, einmahl in der quinta, zum andern in der quarta, als:

			1	2	3	4
Jönicus	hat in	3	cd	de	ef	fg
Dorius	seiner	2	de	ef	fg	ga
Phrygi9	quinta	1 Grad	ef	fg	ga	ab
Lydius	das Se-	4	fg	ga	ab	bc
Mixolydi9	mito-	3	ga	ab	bc	cd
Æolius	niß im	2	ab	bc	cd	de
			Quinta			

123.

tig hievon zuhandeln/ so wollen wir es bey diesem wenigen betwenden lassen. Denn wenn wir nach unserm temperirten Clavier / da eine octava 12. claves hat / gehen würden / so könnten wir jedem clavi wieder 12. modos nach der alten disposition zu eigenen / und hätten also in gesamt 144. modos. Dieses nun alles anzuführen / ist ganz unnöthig und zu weitläufftig. Vide Conradum Matthæi de Modis Musicis,

124.

¶ G. S. 2. misstet/ oder ob der Jönicus, Dorius, Phrygius oder einander der erste sey / worüber unterschiedlicher Zwistigkeiten entstanden sind; gnung wenn wir die Natur der Harmonia und was dem Anhängig ist/ verstehen; Weil aber die Music (wie schon gedacht) heutiges Tages gang anders / und nur etwa 4. modi im Gebrauch sind/ als Jönicus, mit dem mixolydio. und Dorius mit dem Æolio, mehrentheils in dem ambitu der quarta vermischet/ so können dannhero nicht mehr als 2. modi anjeko statuiret worden/ und ist auch so gar unnatürlich nicht / wenn wir fein ordentlich damit verfahren. Sehen wir an den Lydius, so ist

### 3. Current limitations and challenges

#### Dynamic and context-dependent knowledge production

- ❑ The knowledge captured in an ontology is static in nature. However, signification arises dynamically and is context dependent:
  - ❑ Significations can change within the source.
  - ❑ Some elements are implicit and have to be completed.
  - ❑ Different, sometimes conflicting, levels of description can coexist.
  - ❑ The interpretation of a sign as a concept heavily relies on the reader.
  - ❑ Could predicate logic affect the way a source is read and modelled ?

#### Epistemological need for multifaceted ontologies where:

1. different readings can at the same time coexist and lead to shared representations;
2. knowledge completion by the analyst could be made more explicit;
3. viewpoints derived from historical sources can engage into dialogue with a 21<sup>st</sup> century perspective on modality and tonality.

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## **Bibliography**

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