

THE MUSIC ENCODING INITIATIVE

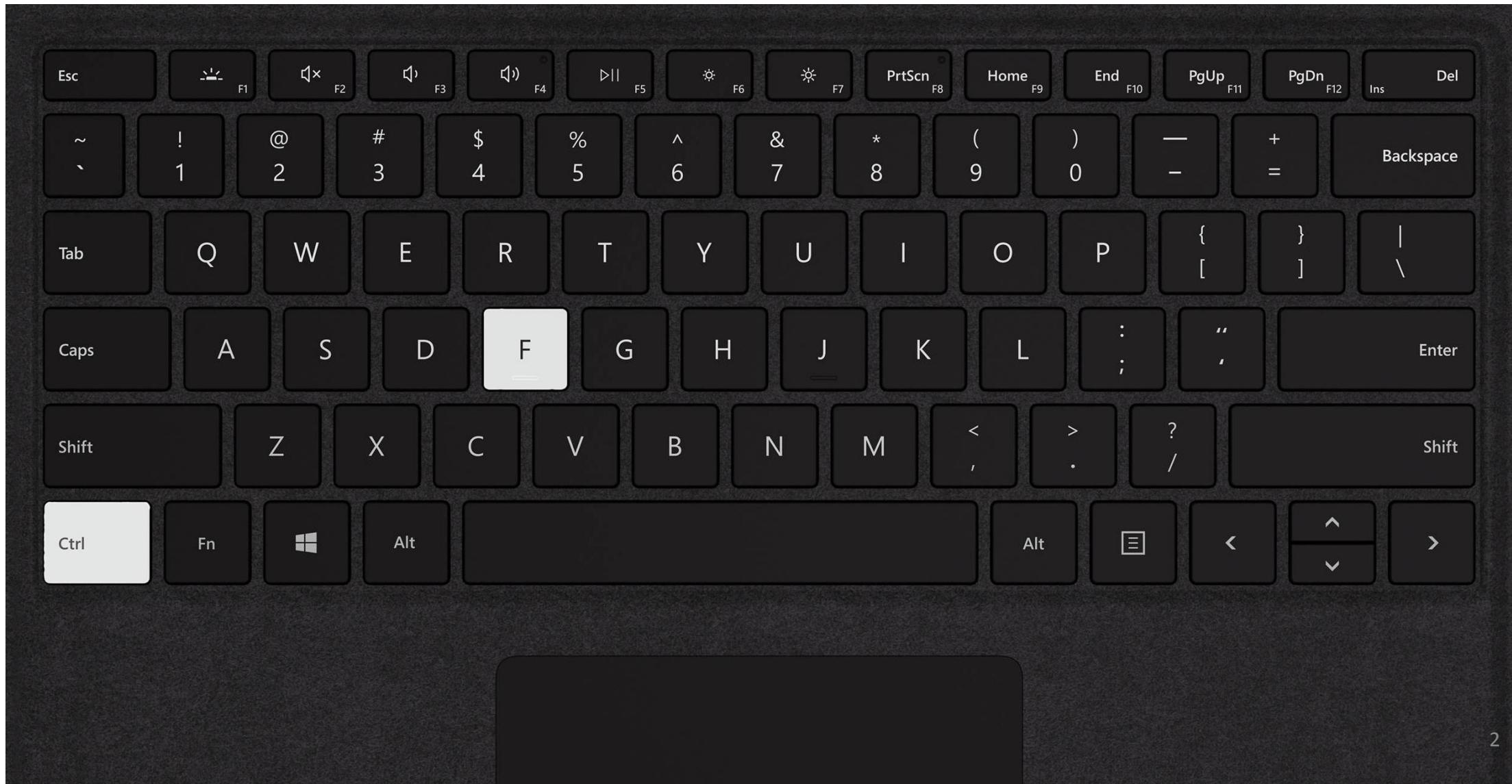
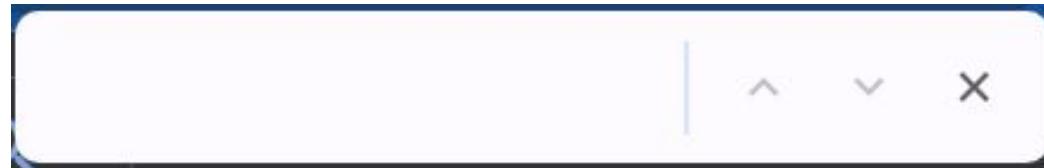
ENCODING OF EARLY MUSIC

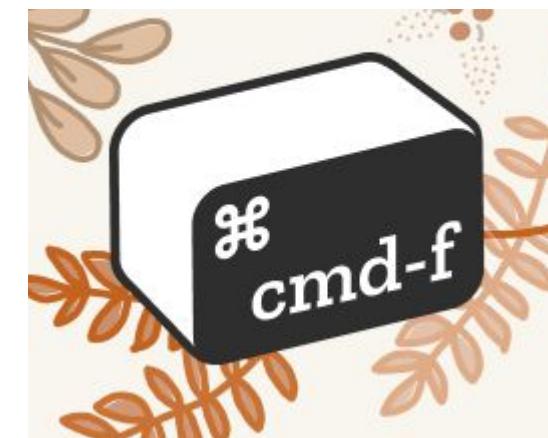
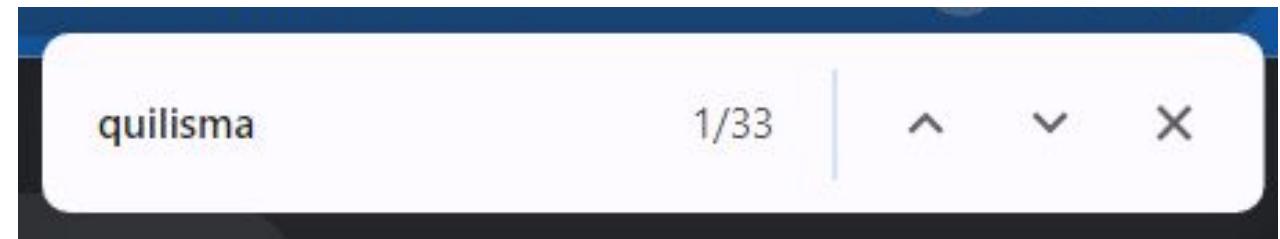
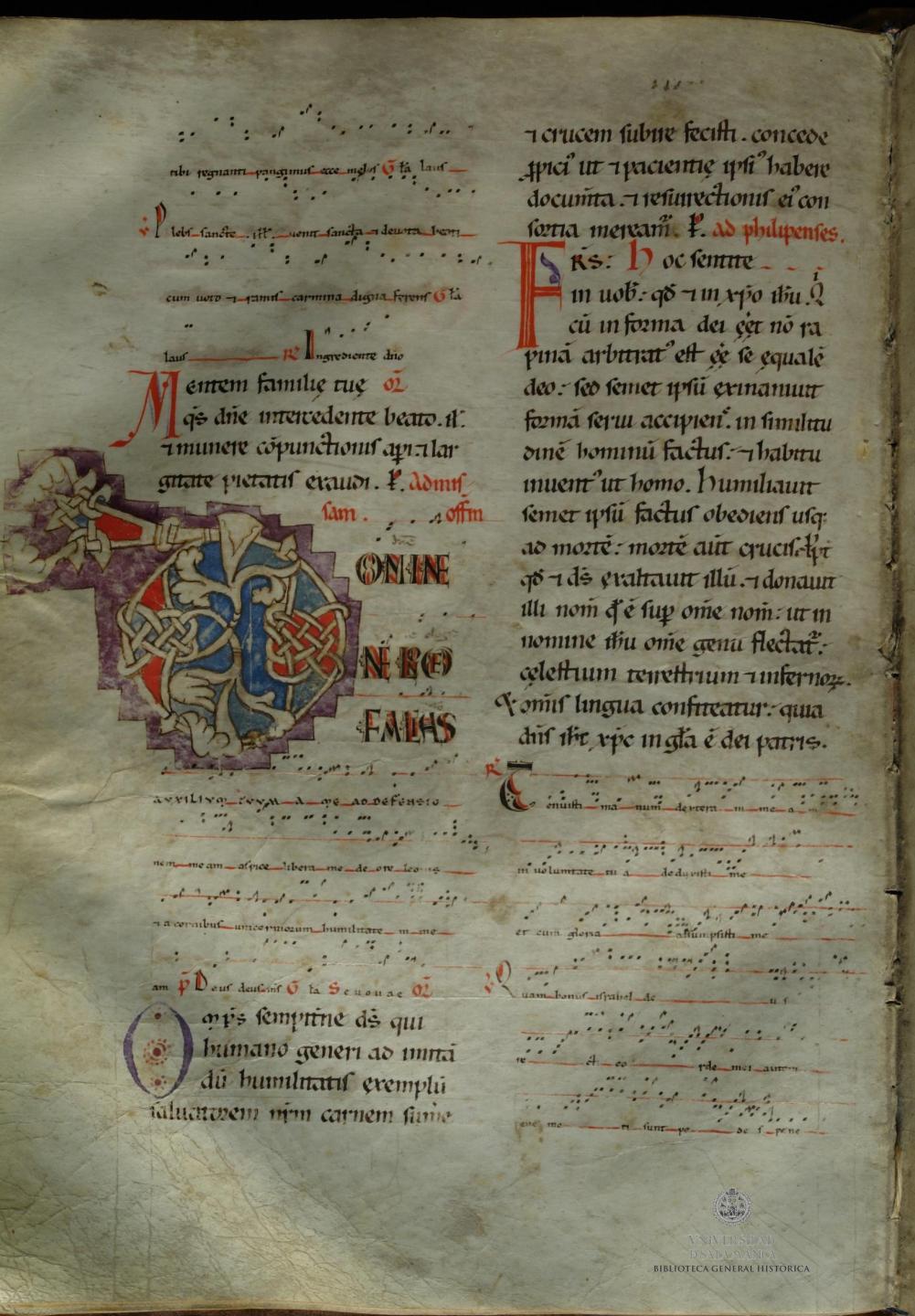
Martha E. Thomae, Elsa De Luca

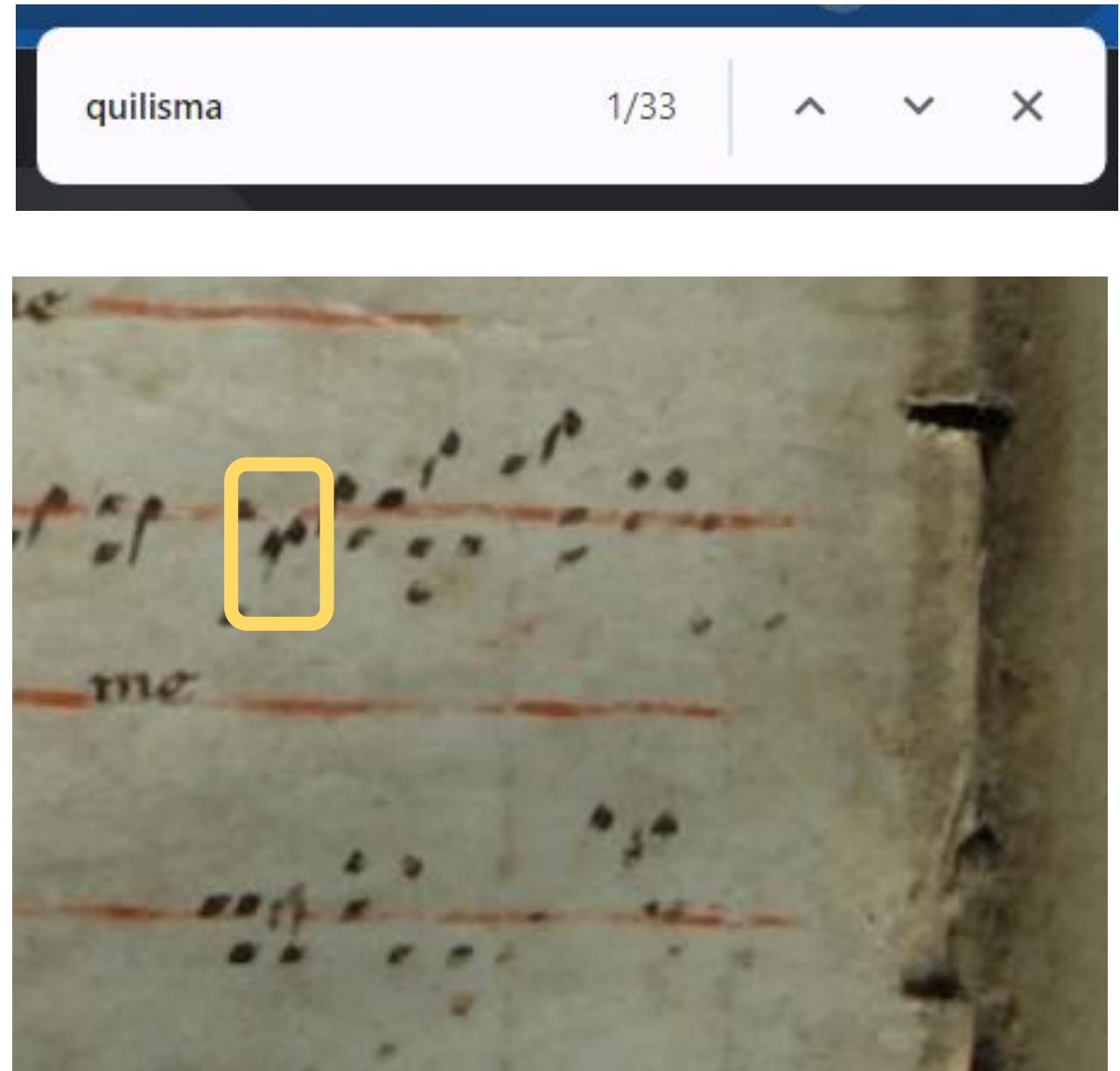
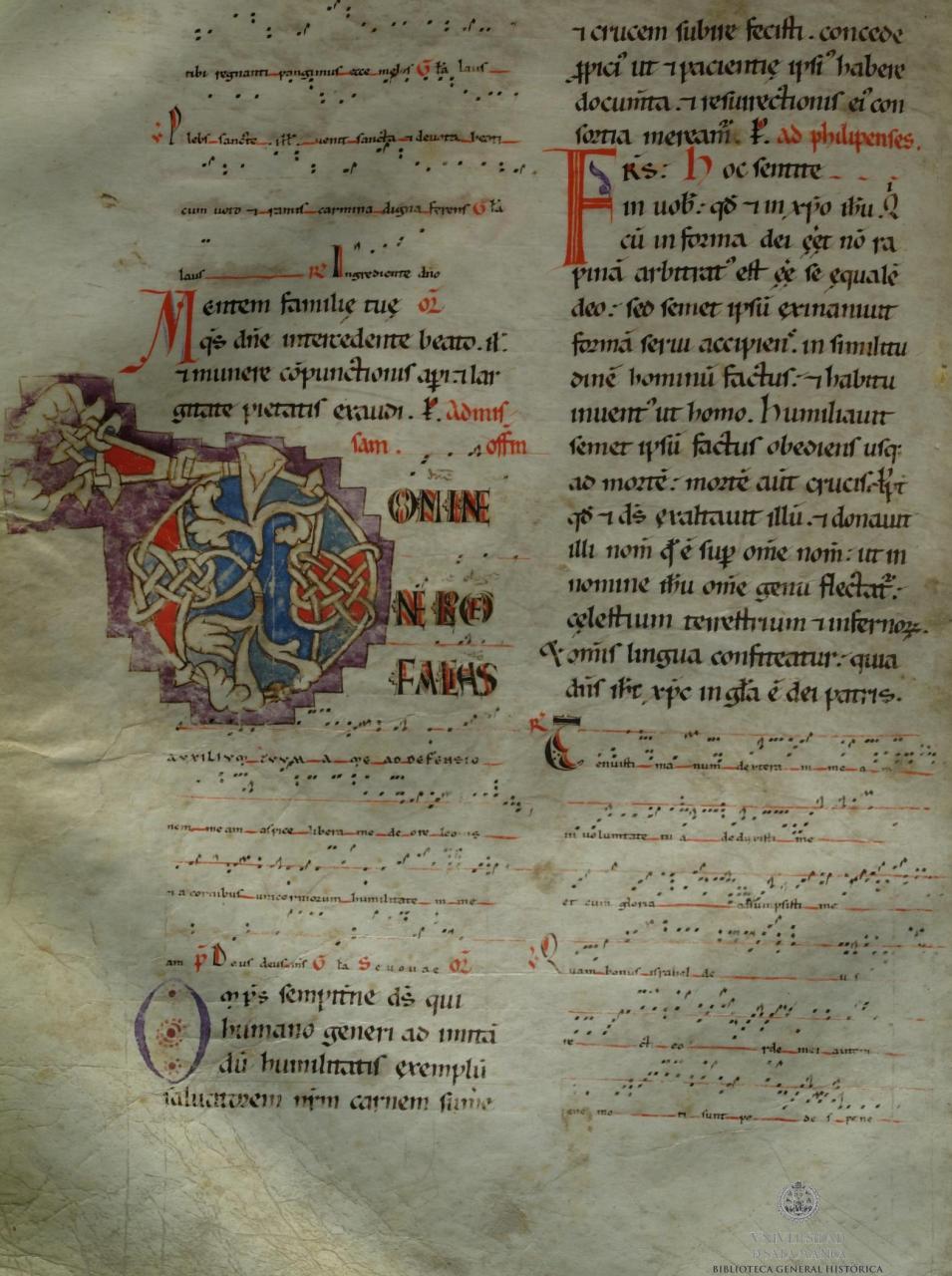
CESEM-IN2PAST, Universidade NOVA de Lisboa



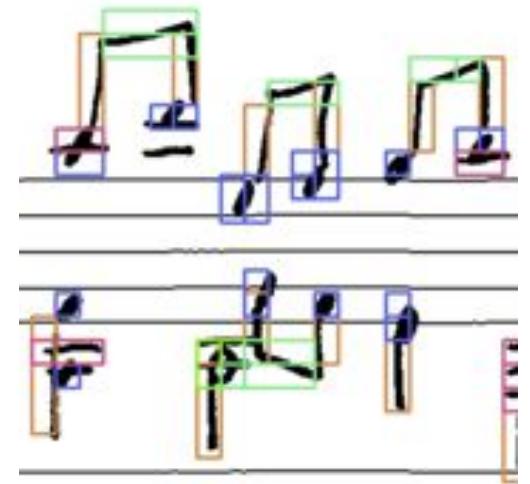
<https://tinyurl.com/4jjtkpu7>







Optical Music Recognition (OMR) is the transformation of images of music notation into digital representations with limited direct human involvement.



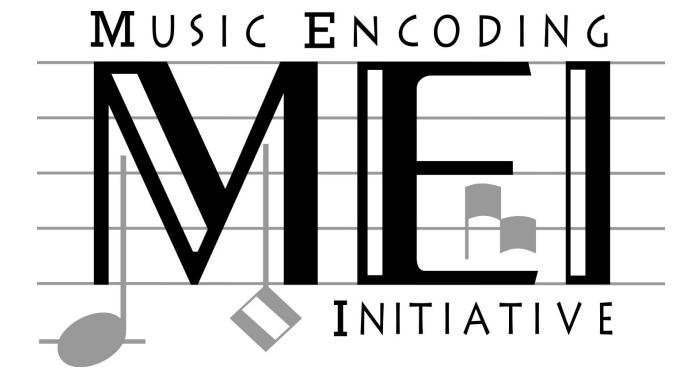
Why Would We Want to Encode Music

- Machine-readable files → ask the computer:
 - Perform searches
 - Melodic search
 - Search for ornamental neume shapes
 - Look for melismatic passages
 - Music analysis
 - Cross-comparsion
 - Compute the mode based on: finalis, repercussio, and range

Why Would We Want to Encode Music in MEI?

The Music Encoding Initiative (**MEI**), inspired by the Text Encoding Initiative (**TEI**), is a joint effort of an open and cosmopolitan community of technologists, musicologists, musicians, librarians, and music enthusiasts who discuss and approve rules aiming at

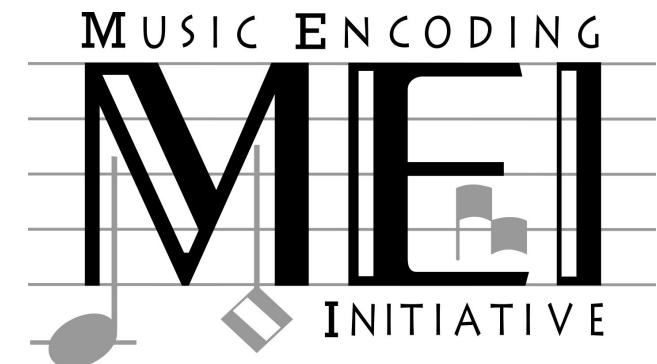
fully capturing music documents into a machine-readable format



Why Would We Want to Encode Music in MEI?

The image shows a musical score for piano and voice. The piano part is represented by black keys on a keyboard. The vocal part has lyrics: "wun - derschö - nen Mo - nat Mai, als al le". Below the score is the corresponding MEI XML code:

```
<measure n="5">
  <staff n="1">
    <layer n="1">
      <note pname="c" oct="5" dur="8" dots="1" stem.dir="down">
        <verse n="1">
          <syl wordpos="i" con="d">Wun</syl>
        </verse>
      </note>
      <note pname="b" oct="4" dur="16" stem.dir="down">
        <verse n="1">
          <syl wordpos="m" con="d">der</syl>
        </verse>
      </note>
      <note pname="b" oct="4" dur="16" stem.dir="up">
        <verse n="1">
          <syl wordpos="m" con="d">schö</syl>
        </verse>
      </note>
      <note pname="d" oct="5" dur="16" stem.dir="up">
        <verse n="1">
          <syl wordpos="t">nен</syl>
        </verse>
      </note>
      <note pname="f" oct="4" dur="16" stem.dir="up" accid="sharp">
```



OMR recognizes the symbols on the page

MEI provides information on the *meaning* of the musical symbols

Why Would We Want to Encode Music in MEI?

MEI (or *Music Encoding Initiative*) is a machine-readable format that allows for the encoding of [early music](#) among other things:

- Neume | Mensural | Tablature (plus common Western music notation, CMN)
- Rich metadata
- Relation to facsimiles & recordings
- Markup for Analysis and Harmonies
- Scholar editions

Why Would We Want to Encode Music in MEI?

MEI (or *Music Encoding Initiative*) is a machine-readable format that allows for the encoding of [early music](#) among other things:

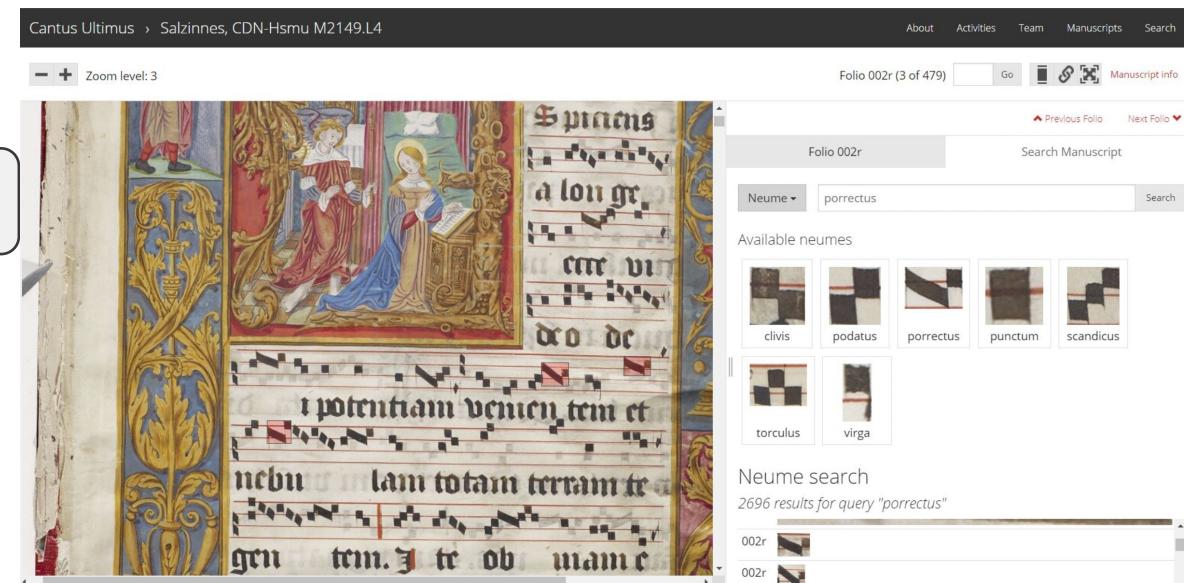
- Neume | Mensural | Tablature (plus common Western music notation, CMN)

- Rich metadata

- Relation to facsimiles & recordings

- Markup for Analysis and Harmonies

- Scholar editions

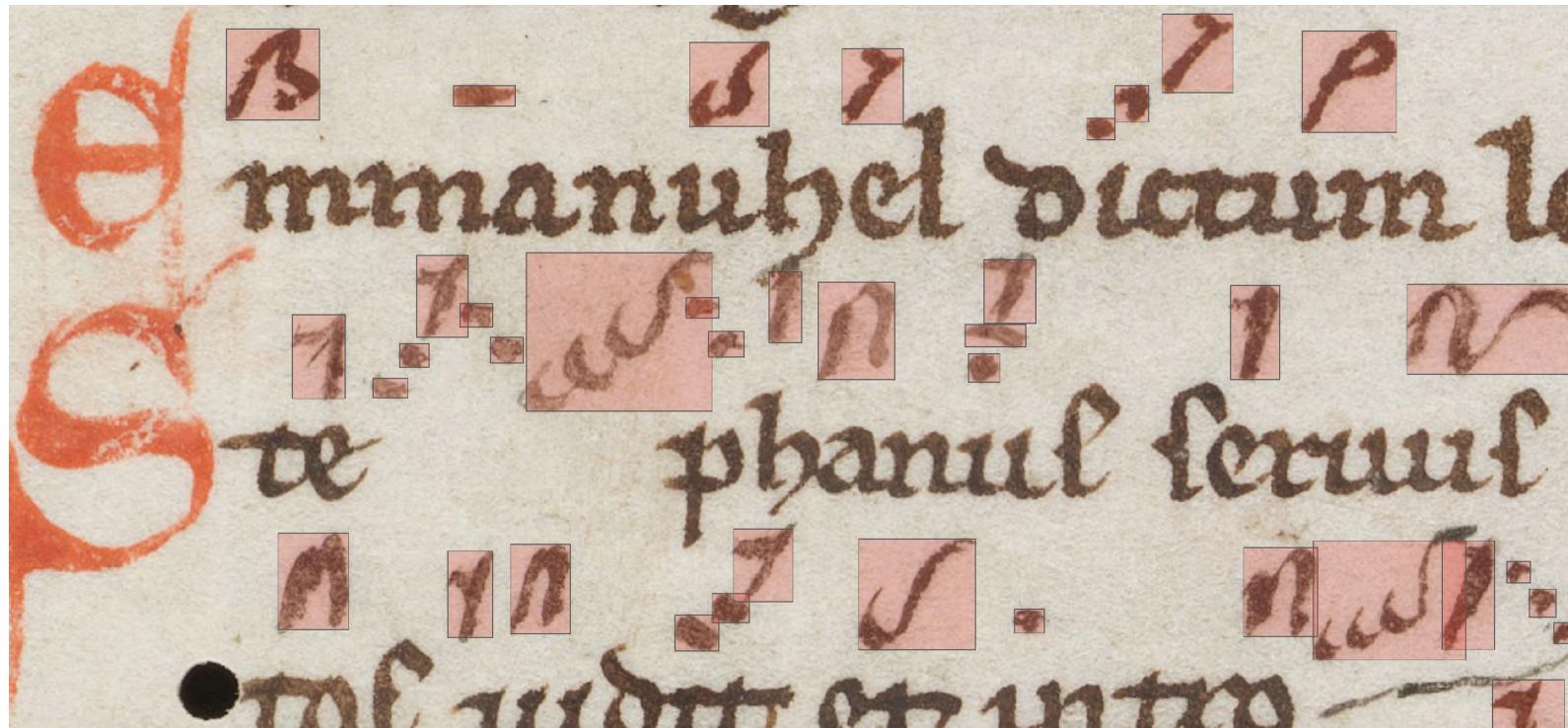


Two practical examples #1



```
<neume>
  <nc curve= "a"/>
  <nc tilt="ne" intm="d"/>
</ neume >
```

Two practical examples #1



Two practical examples #2

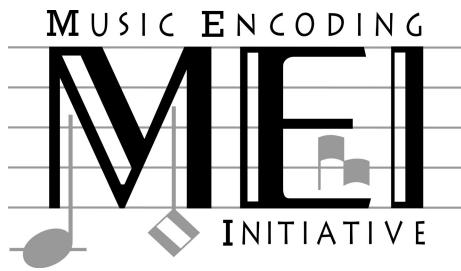


```
<neume>
  <nc tilt="ne"/>
  <nc tilt="se" relen="s" intm="d"/>
</neume>
```



```
<neume>
  <nc tilt="ne"/>
  <nc tilt="se" relen="l" intm="d"/>
</neume>
```

MEI is a hierarchical **system of tags** employed to describe in a machine-readable language the notation of a specific manuscript



```
---  
    <syllable xml:id="m-43558eee-8a6a-11ee-a3f2-3645f29ecd15">  
        <syl xml:id="m-43558f20-8a6a-11ee-a3f2-3645f29ecd15">Fi</syl>  
        <neume xml:id="m-43558f52-8a6a-11ee-a3f2-3645f29ecd15">  
            <nc loc="0" xml:id="m-43558f8e-8a6a-11ee-a3f2-3645f29ecd15"/>  
            <nc loc="-2" xml:id="m-43558fc0-8a6a-11ee-a3f2-3645f29ecd15"/>  
            <nc loc="0" tilt="ne" xml:id="m-43558ff2-8a6a-11ee-a3f2-3645f29ecd15"/>  
        </neume>  
    </syllable>  
    <syllable xml:id="m-43559024-8a6a-11ee-a3f2-3645f29ecd15">  
        <syl xml:id="m-4355904c-8a6a-11ee-a3f2-3645f29ecd15">li</syl>  
        <neume xml:id="m-4355907e-8a6a-11ee-a3f2-3645f29ecd15">  
            <nc loc="0" xml:id="m-435590b0-8a6a-11ee-a3f2-3645f29ecd15"/>  
        </neume>  
    </syllable>  
    <syllable xml:id="m-435590d8-8a6a-11ee-a3f2-3645f29ecd15">  
        <syl xml:id="m-4355910a-8a6a-11ee-a3f2-3645f29ecd15"/>  
        <neume xml:id="m-4355913c-8a6a-11ee-a3f2-3645f29ecd15">  
            <nc loc="0" xml:id="m-43559178-8a6a-11ee-a3f2-3645f29ecd15"/>  
        </neume>
```

A blue bracket on the left side of the XML code groups the first two syllables. A blue arrow points to the start of the first syllable. A yellow box highlights the 'Fi' character in the first syllable's 'syl' tag. A pink bracket groups the second syllable, and a pink arrow points to its start. A yellow box highlights the 'li' character in the second syllable's 'syl' tag. The XML code continues below these examples.

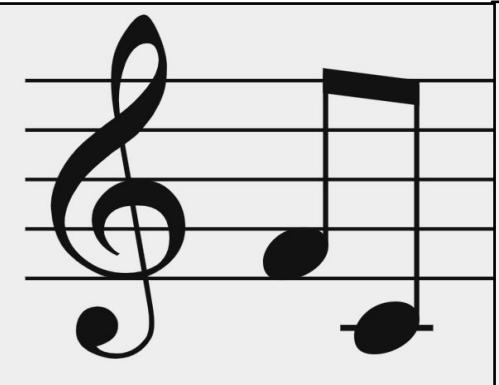


Short Introduction to MEI



Music Encoding Initiative (MEI)

- A community and a format
- **The format:** Encodes music notation in XML (*eXtensible Markup Language*)
 - Hierarchical encoding (tree structure)
 - Its core objects are **elements** (tags, e.g. `<note>`)
 - Opening tags & closing tags → when there is content in between
 - Self-closing tags → when there is no content to be included in between tags
 - Uses **attributes** to define the properties of elements
 - XML does not "do" anything, it is just information wrapped in tags
- **Goal:** Encode a wide variety of music documents



`<beam>` **Opening tag**

`<note pname="f" oct="4" dur="8"/>` **Self-closing tag**

`<note pname="c" oct="4" dur="8"/>`

`</beam>` **Closing tag**



XML is a hierarchical encoding system



```
<neume>
  <nc tilt="e" />
  <nc tilt="n" intm="u" />
</neume>
```

<neume> is the parent element

= Sign representing one or more musical pitches

<nc> is a child element

= Sign representing a single pitched event, although the exact pitch may not be known

@tilt is an attribute of <nc>

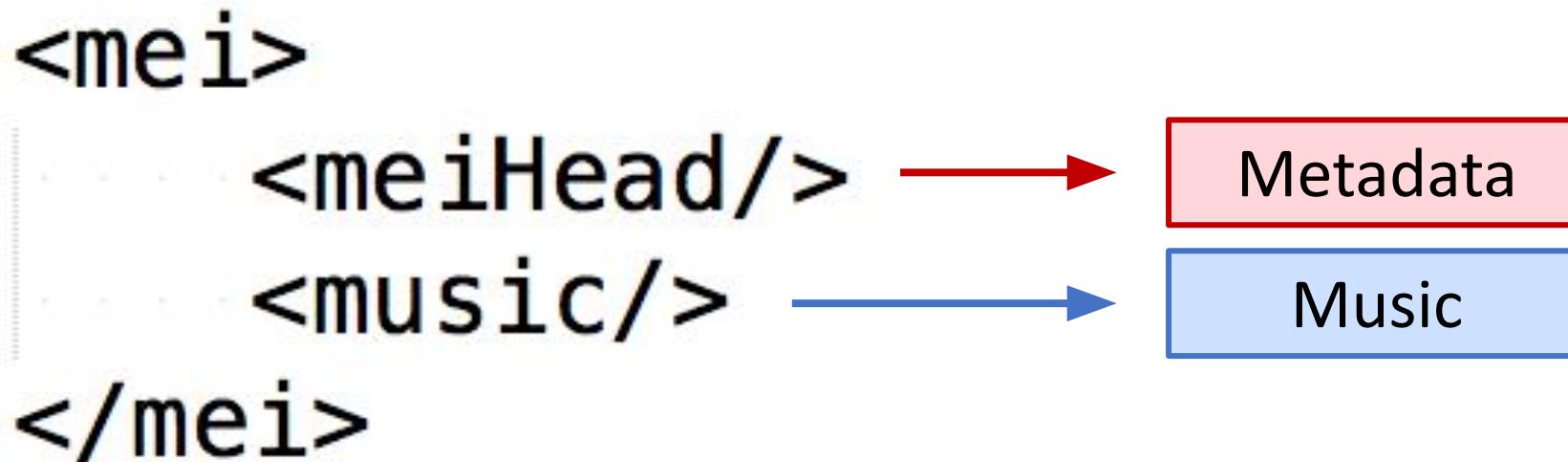
= Direction of the pen-stroke

@intm is an attribute of <nc>

= Encodes the melodic interval from the previous pitch

Basic Structure of an MEI File

Basic Structure of an MEI File



Basic Structure of an MEI File

```
<mei>
  <meiHead/> → Metadata
  <music/>
</mei>
```

<meiHead> basic elements

```
<mei>
  <meiHead>
    <fileDesc>
      <titleStmt>
        <title></title>
      </titleStmt>
      <pubStmt/>
    </fileDesc>
  </meiHead>
  <music/>
</mei>
```

TUTORIALS
[https://music-encoding.org/
resources/tutorials.html](https://music-encoding.org/resources/tutorials.html)

XML Basics and Minimal MEI
File Structure

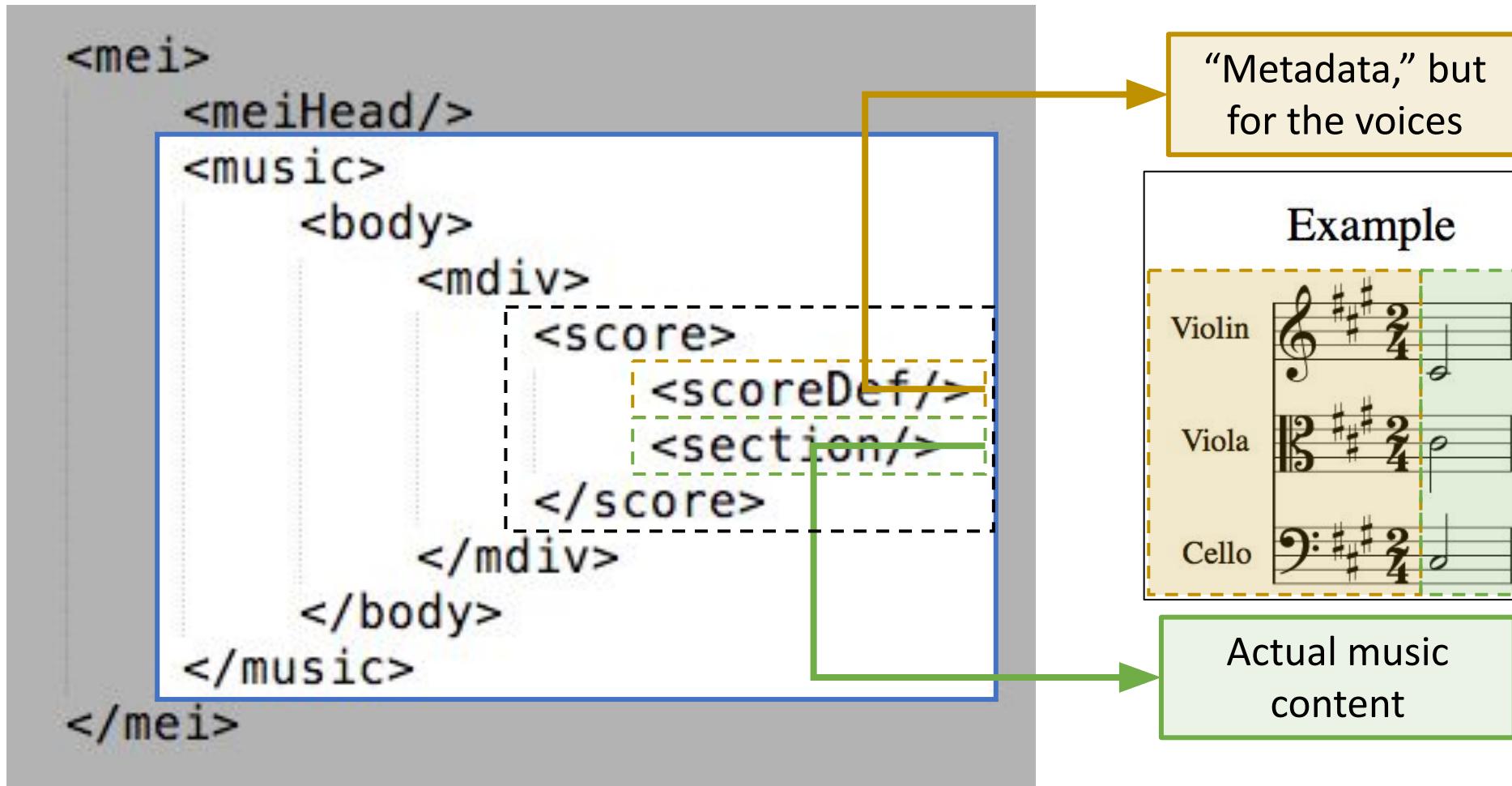
Outermost basic structure of
an **MEI-conformant** document
(conforms to the **schema** of MEI)

Basic structure
of a “valid” MEI file

Basic Structure of an MEI File

```
<mei>
  ...
    <meiHead/>
    <music/> → Music
</mei>
```

<music> basic elements



<music> basic elements

```
<mei>
  <meiHead/>
  <music>
    <body>
      <mdiv>
        <score>
          <scoreDef />
          <section/>
        </score>
      </mdiv>
    </body>
  </music>
</mei>
```

“Metadata,” but
for the voices

Example

A musical score example showing three staves. The top staff is for Violin, the middle for Viola, and the bottom for Cello. Each staff has a treble clef, a key signature of two sharps, and a common time signature. A dashed orange box highlights the first measure of each staff, which consists of a quarter note followed by a half note.

Violin

Viola

Cello

<scoreDef> - General Information for Voices

```
<score>
  <scoreDef>
    <staffGrp>
      <staffDef n="1"/>
      <staffDef n="2"/>
      <staffDef n="3"/>
    </staffGrp>
  </scoreDef>
  <section/>
</score>
```

General information for **ALL voices**

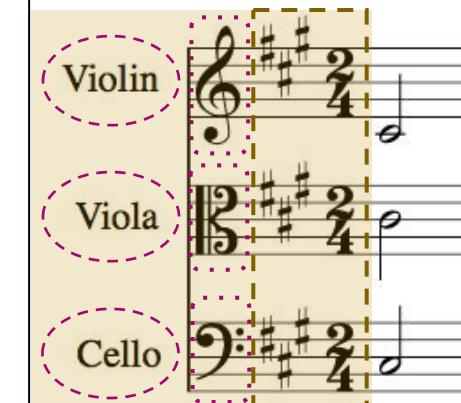
- Meter
- Key

Specific information for **EACH voice**

- Clef
- Label
- **Number of staff-lines (@lines)**
- **@n**

required for validation

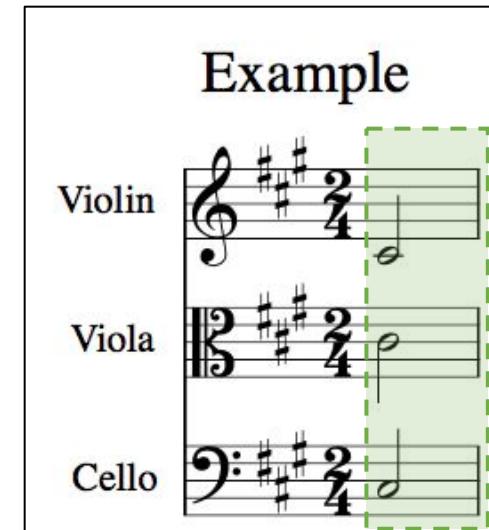
Example



<https://music-encoding.org/guidelines/v5/content/shared.html>

<music> basic elements

```
<mei>
  <meiHead/>
  <music>
    <body>
      <mdiv>
        <score>
          <scoreDef/>
          <section/>
        </score>
      </mdiv>
    </body>
  </music>
</mei>
```



Actual music content

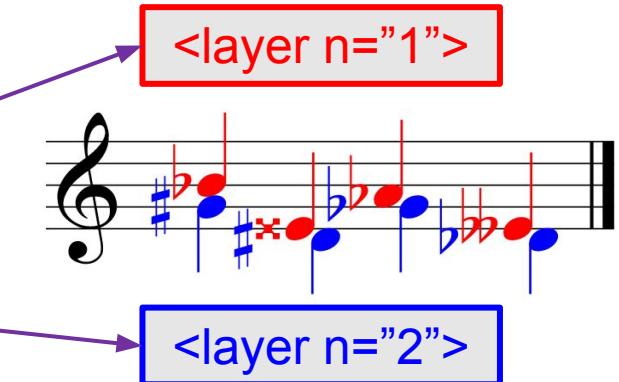
<section> - Actual Music

```
<score>
  <scoreDef/>
  <section>
    <measure n="1">
      <staff n="1">
        <layer>
          <!-- MUSIC WITHIN THE STAFF -->
        </layer>
      </staff>
      <staff n="2"/>
      <staff n="3"/>
    </measure>
    ...
    <measure n="20"/>
  </section>
</score>
```

<https://music-encoding.org/guidelines/v5/content/shared.html>

<section> - Actual Music

```
<score>
  <scoreDef/>
  <section>
    <measure n="1">
      <staff n="1">
        <layer>
          <!-- MUSIC WITHIN THE STAFF -->
        </layer>
      </staff>
      <staff n="2"/>
      <staff n="3"/>
    </measure>
    ...
    <measure n="20"/>
  </section>
</score>
```



<https://music-encoding.org/guidelines/v5/content/shared.html>

Early Music has No Measures!

```
<score>
  <scoreDef/>
  <section>
    <measure n="1">
      <staff n="1">
        <layer>
          <!-- MUSIC WITHIN THE STAFF -->
        </layer>
      </staff>
      <staff n="2"/>
      <staff n="3"/>
    </measure>
    ***
    <measure n="20"/>
  </section>
</score>
```

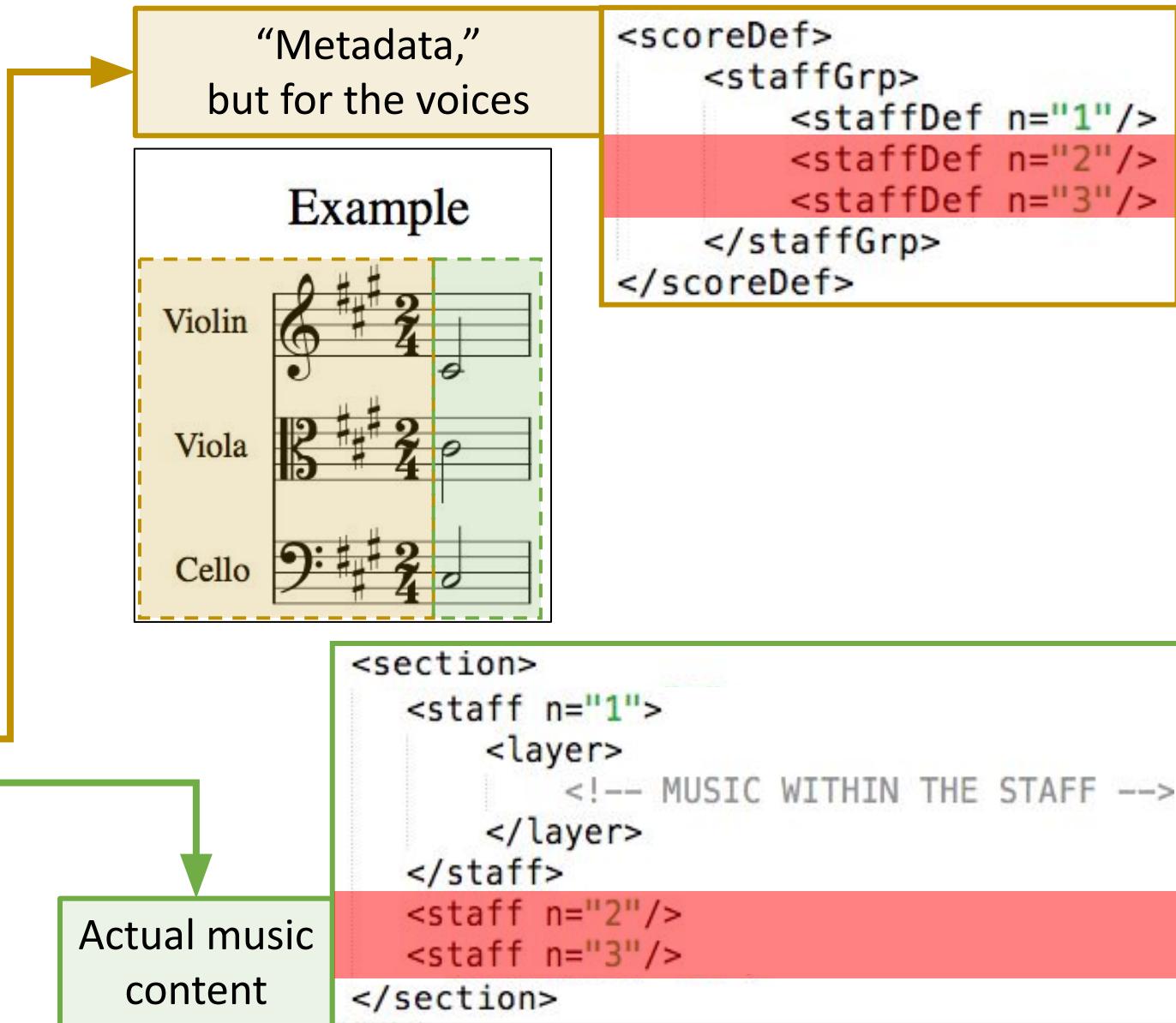
Monophonic Music has a Single Staff

```
<score>
  <scoreDef/>
  <section>
    <staff n="1">
      <layer>
        <!-- MUSIC WITHIN THE STAFF --&gt;
      &lt;/layer&gt;
    &lt;/staff&gt;
    &lt;staff n="2"/&gt;
    &lt;staff n="3"/&gt;
  &lt;/section&gt;
&lt;/score&gt;</pre>
```

Common Structure for Monophonic Music

```
<mei>
  <meiHead>
    <fileDesc>
      <titleStmt>
        <title></title>
      </titleStmt>
      <pubStmt/>
    </fileDesc>
  </meiHead>

  <music>
    <body>
      <mdiv>
        <score>
          <scoreDef/>
          <section/>
        </score>
      </mdiv>
    </body>
  </music>
</mei>
```



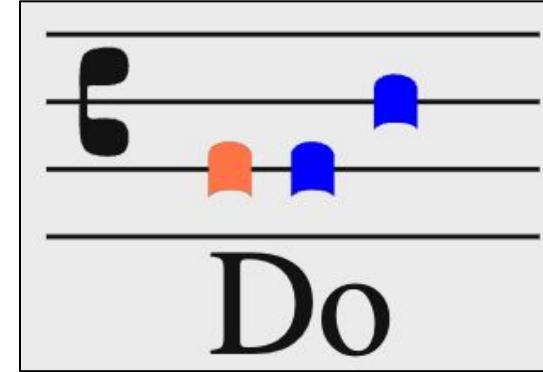
MEI for Neume Notation

Most neume notation is used to set music to an existing text. Therefore, the “syllable” is the fundamental unit of structure, with the neumes themselves serving as a means of “sonifying” the text.

Therefore, the syllable element provides high-level organization in this repertoire.

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume



```
<syllable>
  <syl>Do</syl>
  <neume>
    <nc loc="2" />
  </neume>
  <neume>
    <nc loc="2" />
    <nc loc="4" />
  </neume>
</syllable>
```

Elements

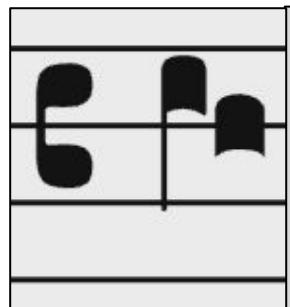
- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume

Attributes of neume components:

- Pitch
 - ❖ @pname = c | d | e | f | g | a | b
 - ❖ @oct = ... 2 | 3 | 4 ...
 - ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
 - ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...
- Shape
 - ❖ @tilt: direction of penstroke = n | s | se | ...
 - ❖ @curve = c | a
 - ❖ ...

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume



```
<neume>
  <nc pname="d" oct="3" tilt="n" />
  <nc pname="c" oct="3" />
</neume>
```

Attributes of neume components:

○ Pitch

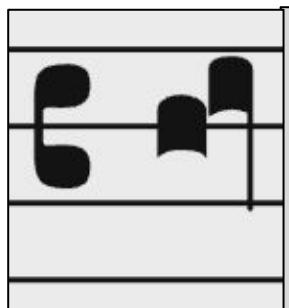
- ❖ @pname = c | d | e | f | g | a | b
- ❖ @oct = ... 2 | 3 | 4 ...
- ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
- ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...

○ Shape

- ❖ @tilt: direction of penstroke = n | s | se | ...

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume



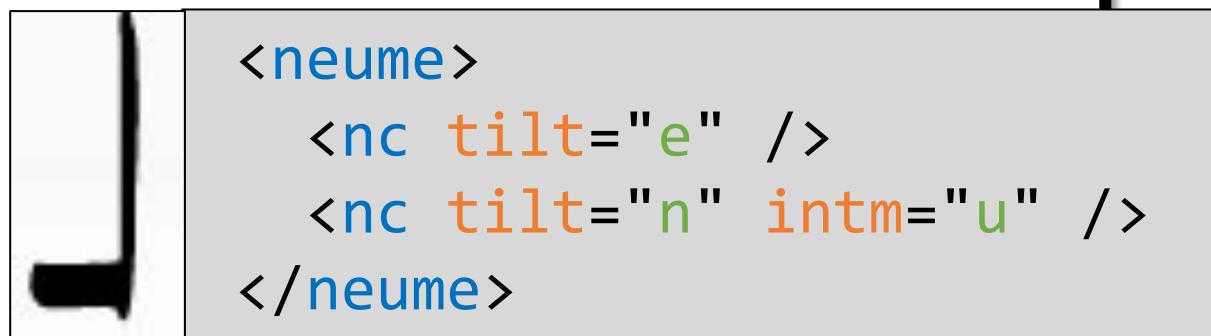
```
<neume>
  <nc loc="4" />
  <nc intm="1" tilt="s" />
</neume>
```

Attributes of neume components:

- Pitch
 - ❖ @pname = c | d | e | f | g | a | b
 - ❖ @oct = ... 2 | 3 | 4 ...
 - ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
 - ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...
- Shape
 - ❖ @tilt: direction of penstroke = n | s | se | ...
 - ❖ @curve = c | a
 - ❖ ...

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume



Attributes of neume components:

- Pitch
 - ❖ @pname = c | d | e | f | g | a | b
 - ❖ @oct = ... 2 | 3 | 4 ...
 - ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
 - ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...
- Shape
 - ❖ @tilt: direction of penstroke = n | s | se | ...
 - ❖ @curve = c | a
 - ❖ ...

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume



```
<neume>
  <nc tilt="ne" />
  <nc tilt="se" curve="c"
    intm="d" />
</neume>
```

Old hispanic notation

Attributes of neume components:

- Pitch
 - ❖ @pname = c | d | e | f | g | a | b
 - ❖ @oct = ... 2 | 3 | 4 ...
 - ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
 - ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...
- Shape
 - ❖ @tilt: direction of penstroke = n | s | se | ...
 - ❖ @curve = c | a
 - ❖ ...

Elements

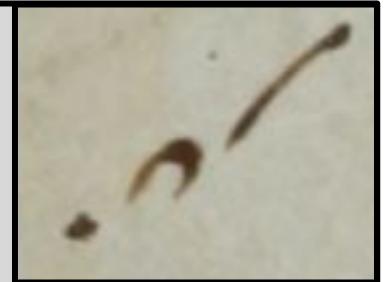
- <syllable>
 - **One** <syl> child
 - **One or more** <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume
 - <nc> can have children too:
 - <episema>
 - <oriscus>
 - <hispanTick>
 - <quilisma>
 - <liquescent>
 - <strophicus>

https://music-encoding.org/guidelines/v5/elements/nc.html#mayContain_class_tab

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume
 - <nc> can have children too:
 - <episema>
 - <hispanTick>
 - <liquescent>
 - <oriscus>
 - <quilisma>
 - <strophicus>

```
<neume>
  <nc tilt="e"/>
  <nc>
    <oriscus/>
  </nc>
  <nc tilt="ne" intm="u"/>
</neume>
```



St. Gall

Elements

- <syllable>
 - One <syl> child
 - One or more <neume> children
 - neume component <nc> children, these are the individual notes that form part of the neume
 - <nc> can have children too:
 - <episema>
 - <oriscus>
 - <hispanTick>
 - <quilisma>
 - <liquescent>
 - <strophicus>

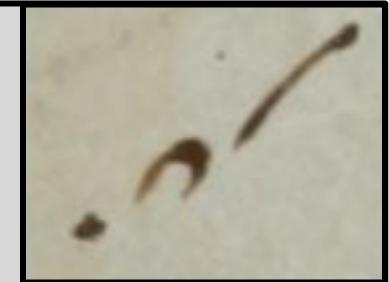
Attributes for <episema>:

- ❖ @form 'v' (vertical) or 'h' (horizontal)
- ❖ @place placement on <nc>

Attributes for <liquescent>:

- ❖ @curve direction of curve
- ❖ @looped boolean (when present, 'true')

```
<neume>
  <nc tilt="e"/>
  <nc>
    <oriscus/>
  </nc>
  <nc tilt="ne" intm="u"/>
</neume>
```



St. Gall

Attributes of neume components:

- ❖ `@pname` (pitch name) {[`a-g`] | `unknown`}
- ❖ `@oct` (octave number) {[`0-9`]}
- ❖ `@rellen` (length of pen stroke relative to previous `<nc>` in the neume) {`s` = shorter | `l` = longer}
- ❖ `@tilt` (direction of pen stroke) {`n` | `ne` | `e` | `se` | `s` | `sw` | `w` | `nw`}
- ❖ `@con` (connection to the previous `<nc>` in the neume) {`g` = gapped | `l` = looped | `e` = extended}
- ❖ `@ligated` {`true` | `false`}

Attributes of neume components in staffless notation:

- ❖ `@intm` (melodic interval relative to previous `<nc>` in the neume) {`u` = up | `d` = down | `s` = same}
- ❖ `@s-shape` (described by the direction of the initial penstroke) {`n` = north | `s` = south | ...}
- ❖ `@curve` (pen stroke) {`c` = clockwise | `a` = anti-clockwise}



```
<neume>
  <nc tilt="ne"/>
  <nc tilt="se" rellen="s" intm="d"/>
</neume>
```



```
<neume>
  <nc tilt="ne"/>
  <nc tilt="se" rellen="|" intm="d"/>
</neume>
```

Neumatic connections

Neutral – High – Low neumes

```
<neume>
  <nc curve="a"/>
  <nc tilt="ne" relen="l" intm="u"/>
  <nc tilt="se" relen="s"
    intm="d" curve="c"/>
</neume>
```



```
<neume>
  <nc tilt="se"/>
  <nc con="g" tilt="ne" relen="l"
    intm="u"/>
  <nc tilt="se" relen="l" intm="d"/>
</neume>
```



```
<neume>
  <nc tilt="se"/>
  <nc tilt="ne" relen="l" intm="u"/>
  <nc tilt="se" intm="d"/>
</neume>
```



```
<neume>
  <nc s-shaped="s"/>
  <nc con="l" tilt="ne" intm="u"/>
  <nc tilt="se" relen="s" intm="d"/>
</neume>
```



Let's Encode a Music Example

Using **mei-friend**: <https://mei-friend.mdw.ac.at/>

Hec luva
michael archagelē
o ut nō pereā
Secūt angelū
tamē pli ha
ureū mī manū su
incensā mu lta et ascen
dit fu mi sa to matum in cōspectu
de i alle luva. **C**ō. **G**ē

nedicite omes angeli dñi dominiū hymnū dici
te et super exaltati e umm se cu la.
Scri francesi. **I**ntra.
Gaudemus oēs.
Xos iusti medi. **H**ec luva
Bic fiam ciscus paupe
r et mo dicus celū dñies ingre
ditur hymnū **bocym** nī ce le stibusho
Off. veritas mea. **C**ō. fidelis scrūs.
Transtano. **S**. Petri archiepi. **I**ntra.
Statutū ei. et illa de cō vniō mīs.
Festivitas oīmstōr ut illo. Martini ep̄. **E**cce
sacerdos ma gnius marti nūs gemma sa
cerdotum quē principēm fecit domi nu s vt sit no

Let's start

- We will encode together a small example in MEI step by step
 - We will use **mei-friend**, a web-based MEI editor
 - Now, open the [skeleton MEI file](#) in mei-friend



Minimal MEI file structure

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-model href="https://music-encoding.org/schema/5.0/mei-Neumes.rng"
type="application/xml" schematypens="http://relaxng.org/ns/structure/1.0"?>
<?xml-model href="https://music-encoding.org/schema/5.0/mei-Neumes.rng"
type="application/xml" schematypens="http://purl.oclc.org/dsdl/schematron"?>
```

XML schema definitions

```
<mei xmlns="http://www.music-encoding.org/ns/mei" meiversion="5.0">
```

Opening tag of root element with namespace declaration

```
<meiHead>
  <fileDesc>
    <titleStmt>
      <title>Basic MEI Mensural skeleton</title>
    </titleStmt>
    <pubStmt></pubStmt>
  </fileDesc>
</meiHead>
```

Header with file description and title statement (all metadata goes here)

```
<music></music>
```

Music tag

```
</mei>
```

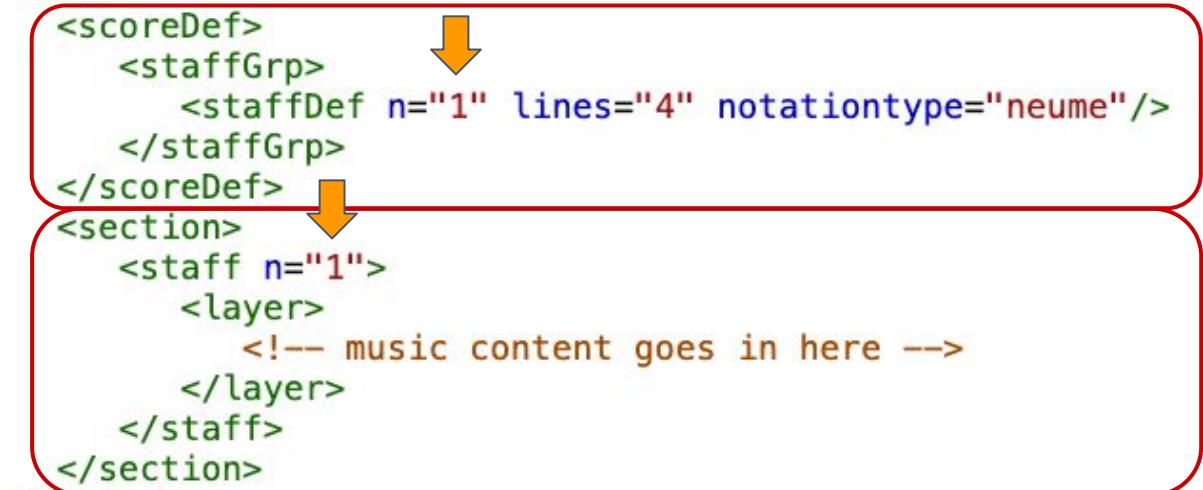
Closing tag of root element



The skeleton of the body of music for “neumes”

- The score definition `<scoreDef>` contains the definitions for the whole score, staff groups, and every single staff
- `<staffDef>` needs at least `@n` and `@lines`
- Use `@notationtype = neume` when dealing with neumatic notation
- `<section>` is used to separate music data segments
- `<staffDef>` and `<staff>` are linked by assigning the same number in `@n`
- A `<staff>` may contain several `<layer>` elements for multiple parts

```
13 <music>
14   <body>
15     <mdiv>
16       <score>
17         <scoreDef>
18           <staffGrp>
19             <staffDef n="1" lines="4" notationtype="neume"/>
20           </staffGrp>
21         </scoreDef>
22         <section>
23           <staff n="1">
24             <layer>
25               <!-- music content goes in here -->
26             </layer>
27           </staff>
28         </section>
29       </score>
30     </mdiv>
31   </body>
32 </music>
```





Add a clef in the staff definition

- Add clef attributes to <staffDef>:
 - Add @clef.shape = C
 - Add @clef.line = 4



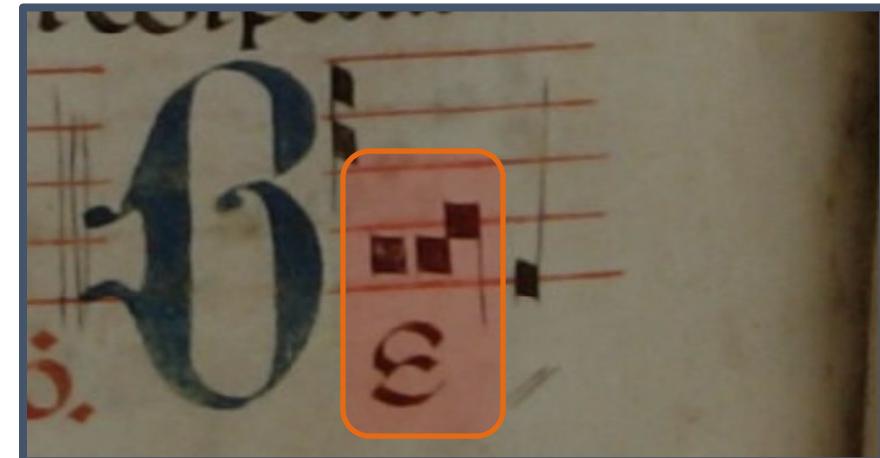
```
17 ▼ <scoreDef>
18 ▼   <staffGrp>
19     <staffDef n="1" lines="5" notationtype="neume" clef.shape="C" clef.line="4"/>
20   </staffGrp>
21 </scoreDef>
```

Add the children of layer: syllable and their children



- Add a `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>Be</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)

25 ▾	<code><syllable></code>
26 ▾	<code><syl>Be</syl></code>
27	<code><neume></neume></code>
28	<code></syllable></code>

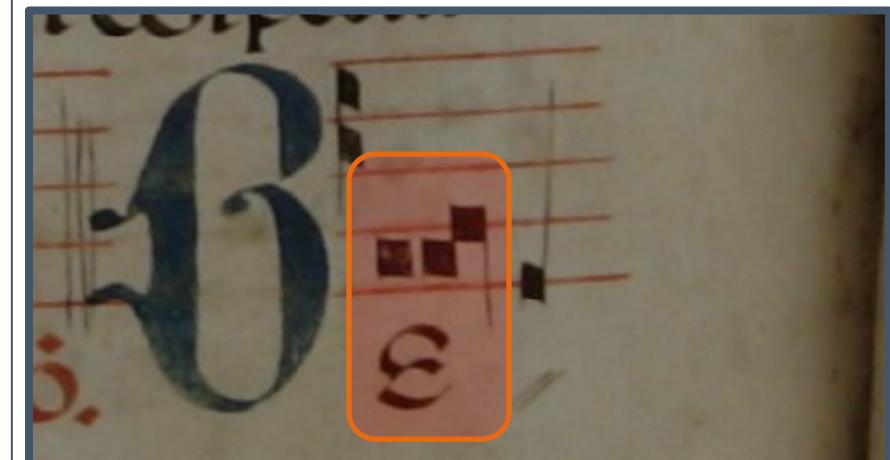




Add the children of layer: syllable and their children

- Fill in the one `<neume>` with its three neume components `<nc>`
 - For the **first** `<nc>`, add attributes `@pname = e` and `@oct = 2`
 - For the **second** `<nc>`, add attributes `@pname = e` and `@oct = 2`
 - For the **third** `<nc>`, add attributes `@pname = f` and `@oct = 2`
 - And add `@tilt = s` to the **third** `<nc>`

```
25 ▼ <syllable>
26 ▼   <syl>Be</syl>
27 ▼   <neume>
28     <nc pname="e" oct="2"/>
29     <nc pname="e" oct="2"/>
30     <nc tilt="s" pname="f" oct="2"/>
31   </neume>
32 </syllable>
```





Add the children of layer: syllable and their children

- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>ne</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)

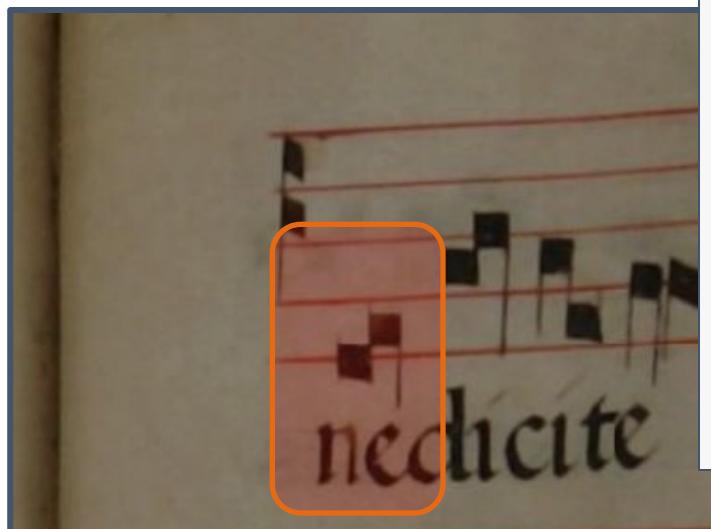
The image shows a page from a medieval manuscript. At the top, there are four horizontal red staves with black neumes. Below the staves, the Latin text 'nedicite omnes angeli domini dominum' is written in a Gothic script. The word 'nedicite' is partially visible on the left, with the first note highlighted by an orange square. To the right, the text continues with 'omnes angeli domini dominum'. A blue box contains numbered steps for XML structure:

33 ▾	<code><syllable></code>
34 ▾	<code><syl>ne</syl></code>
35	<code><neume></neume></code>
36	<code></syllable></code>



Add the children of layer: syllable and their children

- Fill in the one <neume> with its two neume components <nc>
 - For the **first** <nc>, add attributes @pname = d and @oct = 2
 - For the **second** <nc>, add attributes @pname = e and @oct = 2
 - And add @tilt = s to the **second** <nc>



A screenshot of a computer screen displaying a medieval manuscript page. The page shows musical notation on red lines and the text "nedicite". A specific neume is highlighted with an orange square box. To the right of the image is a code editor window showing XML code:

```
33 ▼ <syllable>
34 ▼   <syl>ne</syl>
35 ▼   <neume>
36     <nc pname="d" oct="2"/>
37     <nc tilt="s" pname="e" oct="2"/>
38   </neume>
39 </syllable>
40 ▼ <syllable>
```



Add the children of layer: syllable and their children

- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>di</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)

40 ▾	<code><syllable></code>
41 ▾	<code><syl>di</syl></code>
42	<code><neume></neume></code>
43	<code></syllable></code>



Add the children of layer: syllable and their children

- Fill in the one <neume> with its two neume components <nc>
 - For the **first** <nc>, add attributes @pname = g and @oct = 2
 - For the **second** <nc>, add attributes @pname = a and @oct = 2
 - And add @tilt = s to the **second** <nc>

The image shows a portion of a medieval manuscript. At the top, there are four horizontal red staves with black neumes. The second staff from the top has a red rectangular box highlighting a specific neume. Below the staves, the Latin text "nedicite omnes angelorum dominum" is written in a large, dark, Gothic-style font.

40 ▾	<syllable>
41 ▾	<syl>di</syl>
42 ▾	<neume>
43	<nc pname="g" oct="2"/>
44	<nc tilt="s" pname="a" oct="2"/>
45	</neume>
46	</syllable>



Add the children of layer: syllable and their children

- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>ci</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)

47 ▾	<code><syllable></code>
48 ▾	<code><syl>ci</syl></code>
49	<code><neume></neume></code>
50	<code></syllable></code>

nedicite omes angeli dñi dominum



Add the children of layer: syllable and their children

- Fill in the one `<neume>` with its two neume components `<nc>`
 - For the **first** `<nc>`, add attributes `@pname = g` and `@oct = 2`
 - For the **second** `<nc>`, add attributes `@pname = e` and `@oct = 2`
 - And add `@tilt = n` to the **first** `<nc>`

The image shows a section of a medieval manuscript. At the top, there are four horizontal red staves with black neumes. Below the staves, the Latin text "nedicite omnes angeli domini dominum" is written in a large, dark, Gothic script. A red rectangular box highlights the first neume on the second staff from the left.

47 ▾	<code><syllable></code>
48 ▾	<code><syl>ci</syl></code>
49 ▾	<code><neume></code>
50	<code><nc tilt="n" pname="g" oct="2"/></code>
51	<code><nc pname="e" oct="2"/></code>
52	<code></neume></code>
53	<code></syllable></code>

Add the children of layer: syllable and their children



- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>te</syl>`
 - Add `<neume>` elements for each neume related to the syllable (two `<neume>` elements in this case)

54 ▾ `<syllable>`
55 ▾ `<syl>te</syl>`
56 `<neume></neume>`
57 `<neume></neume>`
58 `</syllable>`



Add the children of layer: syllable and their children

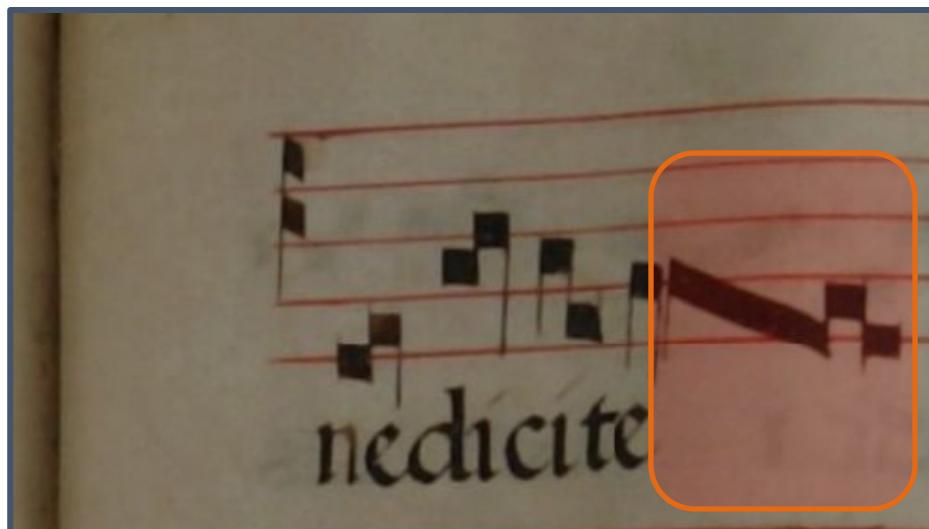
- Fill in the **first <neume>** with one neume component <nc> (the liquescent shape shown in the manuscript)
 - For the <nc>, add the pitch-related attributes @pname = f and @oct = 2
 - Then add @curve = c
 - Finally, add a child <liquescent> to the <nc>

```
55 ▼ <syl>te</syl>
56 ▼ <neume>
57 ▼   <nc curve="c" pname="f" oct="2">
58     <liquescent/>
59   </nc>
60 </neume>
```



Add the children of layer: syllable and their children

- Fill in the **second <neume>** with its four neume components **<nc>**
 - For the **first <nc>**, add attributes **@pname = f** and **@oct = 2**
 - For the **second <nc>**, add attributes **@pname = d** and **@oct = 2**
 - For the **third <nc>**, add attributes **@pname = e** and **@oct = 2**
 - For the **fourth <nc>**, add attributes **@pname = d** and **@oct = 2**
 - Add **@tilt = n** to the **first <nc>**
 - And add **@ligated = true** to the **first and second <nc>**

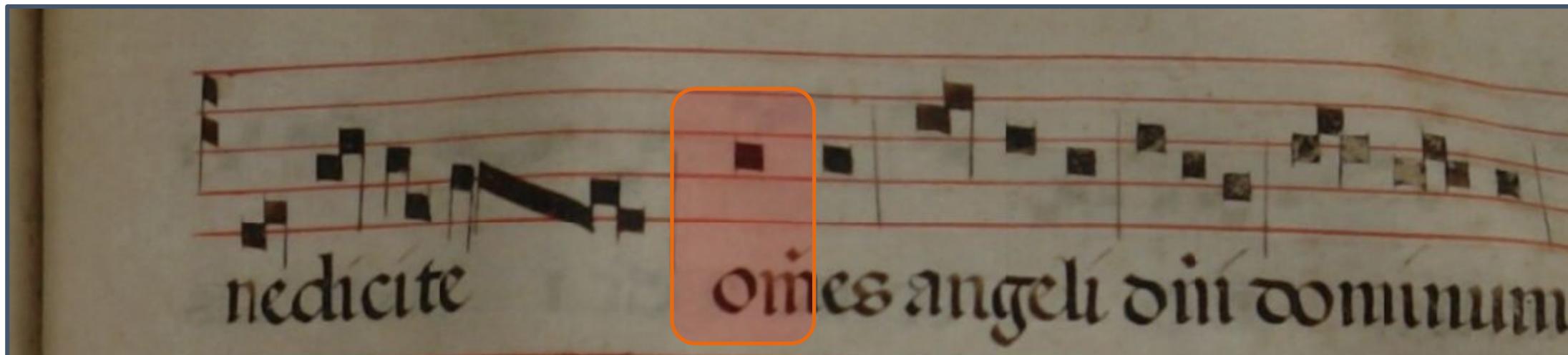


```
61 ▾ <neume>
62   <nc ligated="true" tilt="n" pname="f" oct="2"/>
63   <nc ligated="true" pname="d" oct="2"/>
64   <nc pname="e" oct="2"/>
65   <nc pname="d" oct="2"/>
66 </neume>
```

Add the children of layer: syllable and their children



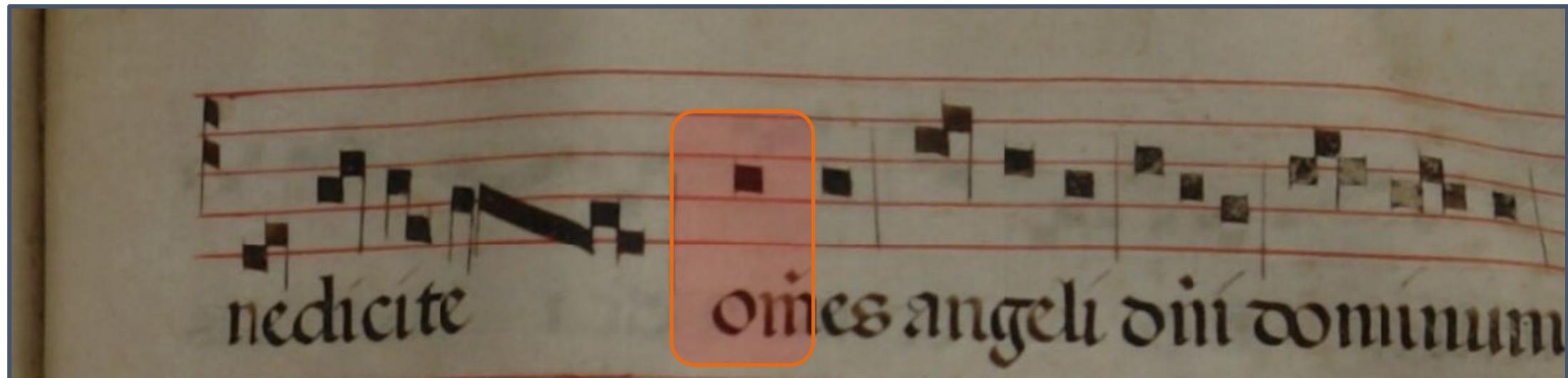
- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>om</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)



Add the children of layer: syllable and their children



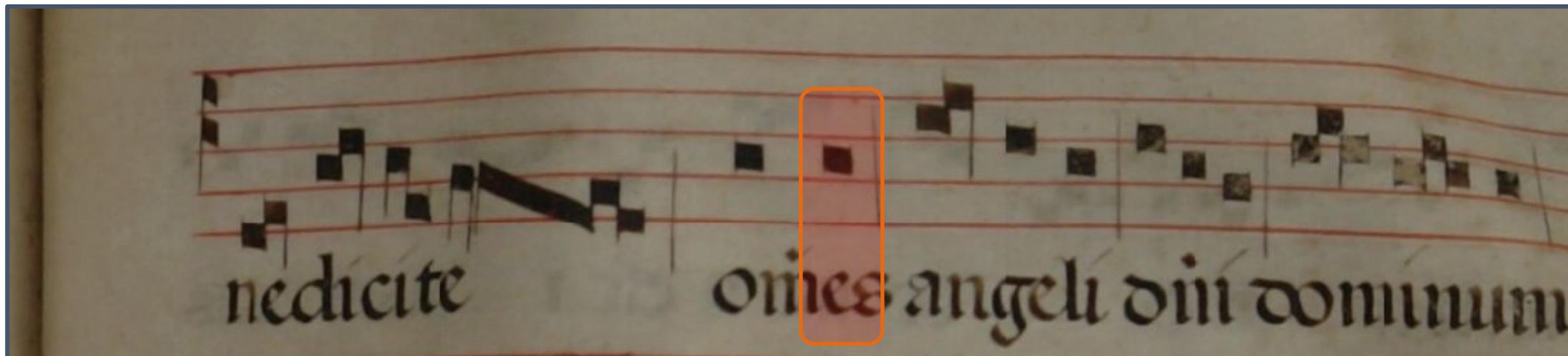
- Fill in the one <neume> with its one neume components <nc>
 - For the <nc>, add attributes @pname = g and @oct = 2



Add the children of layer: syllable and their children



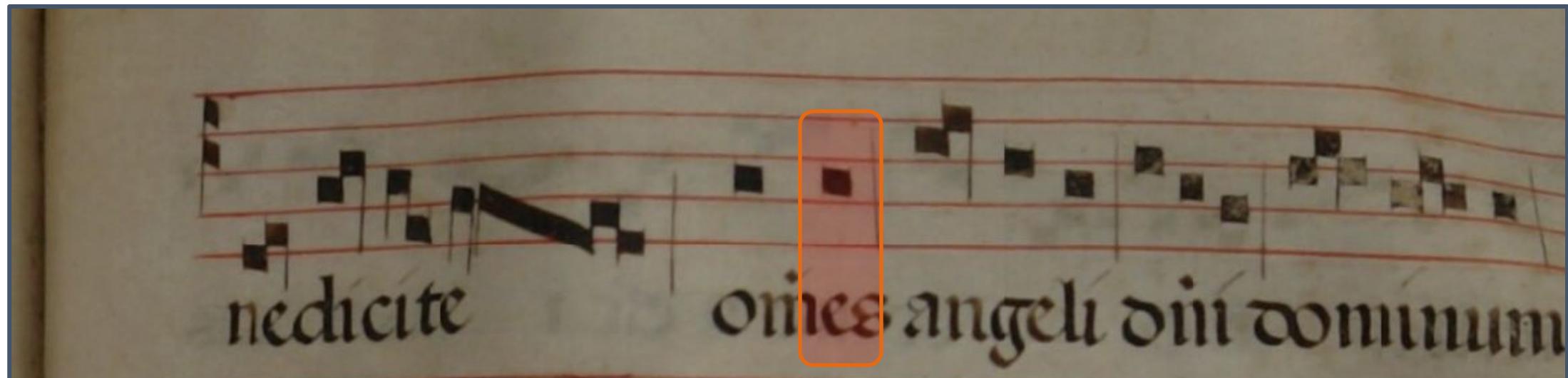
- Add another `<syllable>` element inside the `<layer>`
- Add the following two children of `<syllable>`:
 - Add one `<syl>` element
 - Within the `syl` opening tag (`<syl>`) and its closing tag (`</syl>`), add the text of the corresponding syllable `<syl>nes</syl>`
 - Add `<neume>` elements for each neume related to the syllable (one `<neume>` in this case)



Add the children of layer: syllable and their children



- Fill in the one <neume> with its one neume components <nc>
 - For the <nc>, add attributes @pname = g and @oct = 2



Resources

<https://music-encoding.org/>

- Tutorials on MEI: <https://music-encoding.org/resources/tutorials.html>
- Guidelines → Chapter 6: Neume Notation
(<https://music-encoding.org/guidelines/v5/content/index.html>)
- Elements reference: <https://music-encoding.org/guidelines/v5/elements.html>



MEI Tutorials

On this page, you'll find a number of small tutorials for MEI, each of them introducing a specific feature.

If you're about to start learning MEI, we recommend to start with the [5 minute Quickstart](#) tutorial, which will let you encode a very simple melody with MEI.

If you're about to write a new MEI tutorial, we recommend to start with the [Writing tutorials](#) tutorial, which will provide backgrounds about the necessary steps. Please also have a look at our list of missing tutorials on [Github](#).

External tutorials & related material

For community-created resources including tutorials and teaching material, see [Community-Created Pedagogy & Praxis Resources](#).

For a Spanish translation of the tutorials, see [Tutorialles en español](#).

Available Tutorials



BEGINNERS: XML basics and minimal MEI structure

A short tutorial about the basics of XML & MEI



BEGINNERS: Quickstart

A 5-minute Quickstart tutorial for MEI



ADVANCED: Incipit encoding

An advanced tutorial on how to encode incipits in MEI



BEGINNERS: Chords

A short tutorial about chords in MEI



BEGINNERS: Rests

A short tutorial about rests in MEI



ADVANCED: Understanding ODD

An advanced tutorial on the internal structure of MEI



ADVANCED: Customizing MEI (WIP)

Creating custom MEI profiles



META: Writing Tutorials

An Introduction to writing MEI tutorials



MEI Guidelines (5.0)

- [1 Introduction to MEI](#)
- [2 Shared Concepts in MEI](#)
- [3 Metadata in MEI](#)
- [4 Repertoire: Common Music Notation](#)
- [5 Repertoire: Mensural Notation](#)
- [6 Repertoire: Neume Notation](#)
- [7 Repertoire: String Tablature](#)
- [8 Lyrics and Performance Directions](#)
- [9 Text Encoding](#)
- [10 Analysis Markup and Harmonies](#)
- [11 Scholarly Editing with MEI](#)
- [12 Facsimiles and Recordings](#)
- [13 Linking Data](#)
- [14 Integrating MEI with other Standards and Formats](#)

MEI Version: 5.0 (#eb14650)

🔍

Guidelines

Modules

Elements

Model Classes

Macro Groups

Attribute Classes

Data Types



Guidelines

Modules

Elements

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Data Types

6.1 Overview of the Neumes Module

The MEI Neumes Module represents the community's attempt to create a standardized set of rules that encapsulate in a logical, systematic, and unequivocal way the musical information represented and conveyed by Western European neumatic notations (beginning with the late ninth century and continuing to the printed books of the twentieth). Most neume notation is used to set music to an existing text. The syllable is the fundamental unit of structure, with the neumes themselves serving as a means of "sonifying" the text. A syllable may be expressed via one or more neumes, with the particular neume shape chosen depending on the pitch contour that is being employed and the desired interpretation.

The `syllable` element is used as the primary organizational element for neume notation within a `layer` element. Within `syllable`, the `syl` element defined in the `MEI.shared` module is used for encoding the textual content, while the `neume` and `nc` elements are used to encode the neumes themselves. Within these Neumes Module elements, other standard MEI mechanisms are available to accommodate, for example, editorial or critical markup.

6.1.1 Basic four elements

The following four elements are the fundamental components of the Neumes Module:

<> [<syllable>](#)

Neume notation can be thought of as "neumed text". Therefore, the syllable element provides high-level organization in this repertoire.

Neume notation can be thought of as "neumed text". Therefore, the syllable element provides high-level organization in this repertoire.

<> [<syl>](#)

Individual lyric syllable.

(syllable) – Individual lyric syllable.

6.1.1 Basic four elements

6.1.1.1 <syllable>

6.1.1.2 <syl>

6.1.1.3 <neume>

6.1.1.4 <nc>

6.1.1.5 Custos attributes

6.1.1.6 Episema attributes

6.1.1.7 Liquescent attributes

6.1.1.8 Old Hispanic tick attributes

6.1.1.9 Quilisma attribute

6.1.1.10 Significative letters attribute

6.1.1.11 Note

6.1.1.12 Basic Encoding – Syllable

6.1.1.13 Manuscripts

6.1.1.14 Bibliographic References



Guidelines

Modules

Elements

Model Classes

Macro Groups

Attribute Classes

Data Types

<nc>

Sign representing a single pitched event, although the exact pitch may not be known.

Referenced in Chapters:

[6.1.1 Basic four elements](#), [6.4.1 Elements](#), [6.4.2 Neume component attributes](#), [6.5 Bibliographic References](#), [10.1.2.6 Solmization](#)

Module [MEI.neumes](#)

Attributes [compact](#) full definition by class by module

@accid.ges, @altsym, @angled, @artic.ges, @class, @color, @con, @copyof, @corresp, @curve, @deg, @dots.ges, @dur.ges, @dur.metrical, @dur.ppq, @dur.real, @dur.recip, @fac, @follows, @fontfam, @fontname, @fontsize, @fontstyle, @fontweight, @glyph.auth, @glyph.name, @glyph.num, @glyph.uri, @ho, @hooked, @instr, @intm, @label, @layer, @letterspacing, @ligated, @lineheight, @loc, @mfunc, @n, @next, @oct, @oct.ges, @pclass, @pname, @pname.ges, @pnum, @precedes, @prev, @psolfa, @rellen, @resp, @s-shape, @sameas, @staff, @synch, @tilt, @type, @vel, @visible, @when, @x, @xml:base, @xml:id, @y

Member of [model.neumePart](#) Groups elements that may occur within a neume.

Contained By [compact](#) by class by module

<abbr>, <corr>, <damage>, , <expan>, <lem>, <ncGrp>, <neume>, <orig>, <rdg>, <reg>, <restore>, <sic>, <supplied>, <unclear>

May Contain [compact](#) by class by module

<add>, <app>, <choice>, <corr>, <damage>, , <episema>, <gap>, <handShift>, <hispanTick>, <liquefiant>, <orig>, <oriscus>, <quilisma>, <reg>, <restore>, <sic>, <signifLet>, <strophicus>, <subst>, <supplied>, <unclear>

https://music-encoding.org/guidelines/v5/elements/nc.html#attributes_compact_tab



WORK IN PROGRESS

[Guidelines](#)[Modules](#)[Elements](#)[Model Classes](#)[Macro Groups](#)[Attribute Classes](#)[Data Types](#)

6.1 Overview of the Neumes Module

6.1.1 Basic four elements

6.2 Neumes Module Background

6.3 Neume Notation and MEI

6.4 Samples of MEI encodings

6.4.1 Elements

6.4.2 Neume component attributes

6.4.3 Custos attributes

6.4.4 Episema attributes

6.4.5 Liquescent attributes

6.4.6 Old Hispanic tick attributes

6.4.7 Quilisma attribute

6.4.8 Significative letters attribute

6.4.9 Note

6.4.10 Basic Encoding – Syllable

6.4.11 Manuscripts

6.5 Bibliographic References

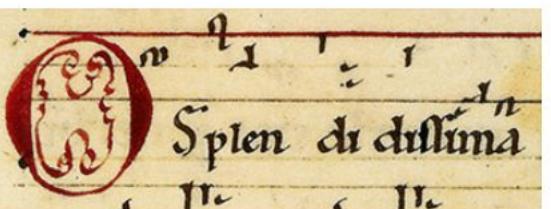


Figure 109.

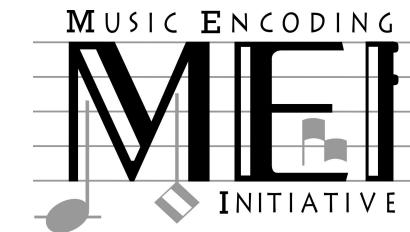
```

<music meiversion="5.0">
  <body>
    <mdiv>
      <score>
        <section>
          <staff n="1">
            <layer>
              <syllable>
                <syl n="initial">
                  <rend color="red">O</rend>
                </syl>
                <neume>
                  <nc oct="3" pname="e"/>
                  <nc oct="2" pname="d"/>
                  <nc oct="3" pname="e"/>
                </neume>
              </syllable>
              <syllable>
                <syl>splen_</syl>
                <neume>
                  <nc oct="3" pname="g"/>
                  <nc oct="3" pname="e"/>
                </neume>
                <neume>
                  <nc oct="3" pname="d"/>
                  <nc oct="3" pname="e"/>
                </neume>
              </syllable>
              <syllable>
                <syl>di_</syl>
                <neume>
                  <nc tilt="n" oct="3" pname="f"/>
                  <nc tilt="se" con="g" oct="3" pname="d"/>
                  <nc tilt="se" con="g" oct="3" pname="c"/>
                </neume>
              </syllable>
            </layer>
          </staff>
        </section>
      </score>
    </mdiv>
  </body>
</music>

```



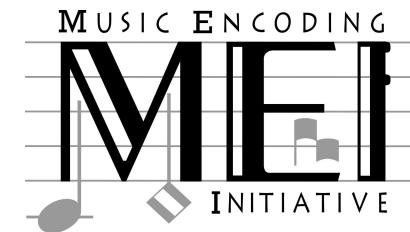
There are **three** main challenges in encoding neumatic notations in



- Convey only partial musical information



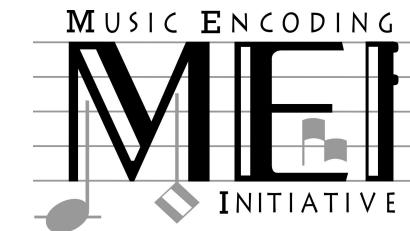
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- Convey only partial musical information
- Great variety of signs and existence of different regional styles of early notation
 - Some regional styles occasionally share graphically similar shapes; these are understood by modern scholars to represent the same, a similar or even a different musical meaning.



There are **three** main challenges in encoding neumatic notations in



- Convey only partial musical information
- Great variety of signs and existence of different regional styles of early notation
 - Some regional styles occasionally share graphically similar shapes; these are understood by modern scholars to represent the same, a similar or even a different musical meaning.
- The neume shapes could either mirror graphically the musical characteristics of the sound being represented or the meaning attached to them was ruled by conventions



What's the impact of these challenges on music encoding?

In the next slides we'll see some **different neume shapes that are given the same name by medieval scribes**.

We start with the oriscus

Ex. from: J. Grier, *Musical Notation in the West*, Cambridge University Press, 2021, p. 30

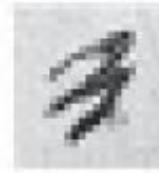
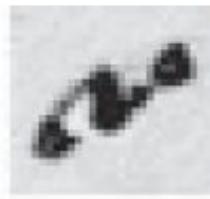
SG 359

Laon 239

Char 47

Albi 44

<oriscus>



Neumatic
Scripts:

St Gall

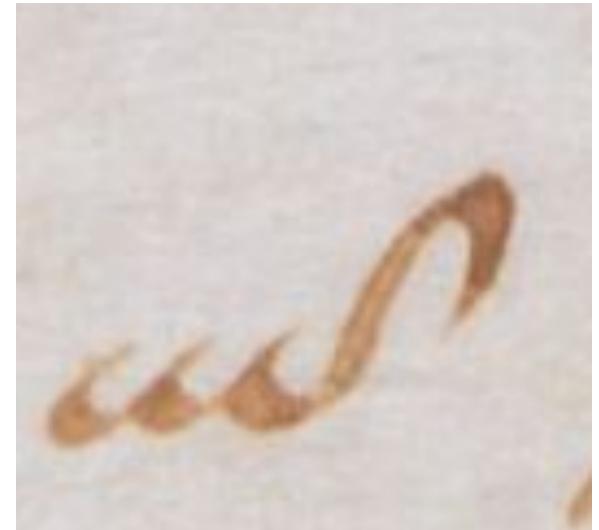
Lotharingian

Breton

Aquitanian

The **quilisma** is a neume found in most early notational dialects, and it gives information on a specific vocal delivery

<quilisma>



It is usually between two notes a third apart. Medieval music theorists spoke of it as a **trembling and rising sound**.

<quilisma>



<oriscus>

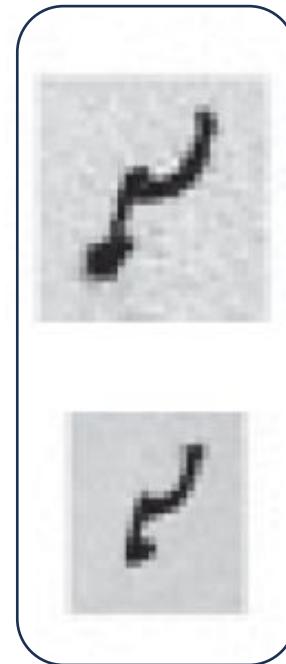


SG 359

Laon 239



Char 47



Albi 44



NOTATIONS: St Gall

Lotharingian

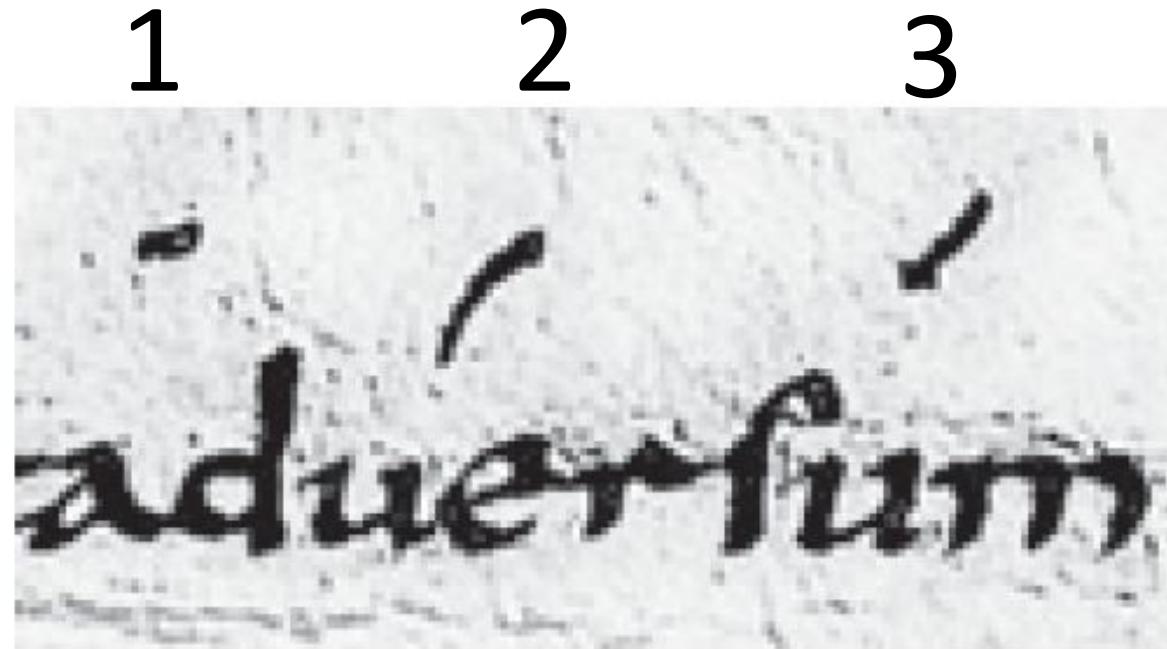
Breton

Aquitanian

Ex. from: J. Grier, *Musical Notation in the West*, Cambridge University Press, 2021, p. 30

The encoding must be conceived as a coherent system of elements and related attributes that allow us to capture the graphic quality of the neumes and their meaning.

The level of graphical sophistication of early notations



1

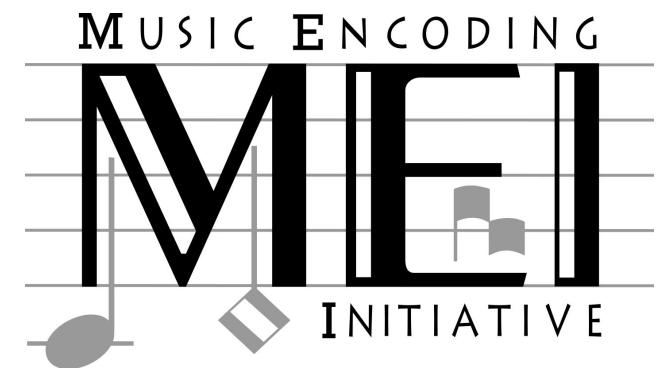
2

3

Chartres 47,
fol. 6v,
adversum

Ex. from: J. Grier, *Musical Notation in the West*, Cambridge University Press, 2021, p. 29

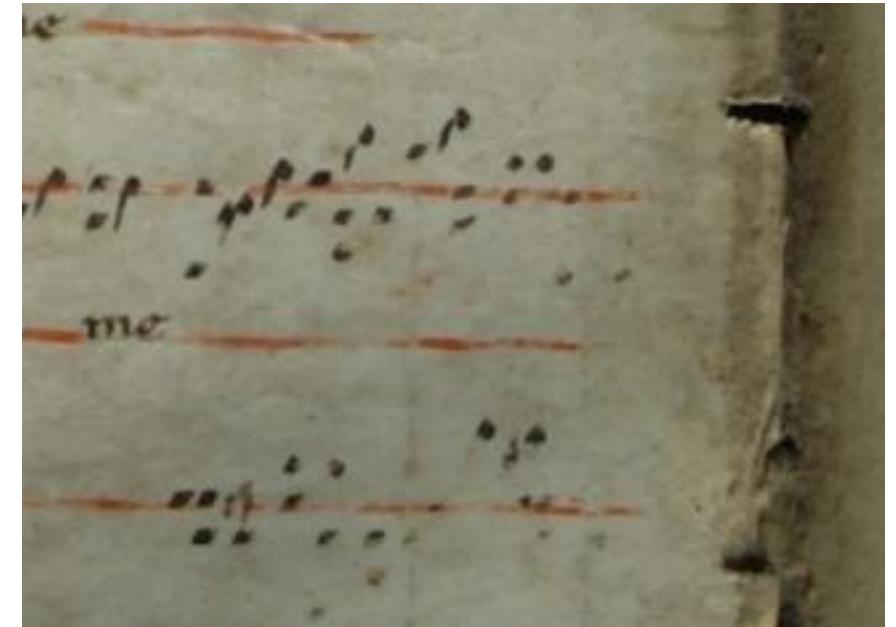
Developing MEI for
early music is great fun
for palaeographers!



Developing MEI for early music is great fun for palaeographers!

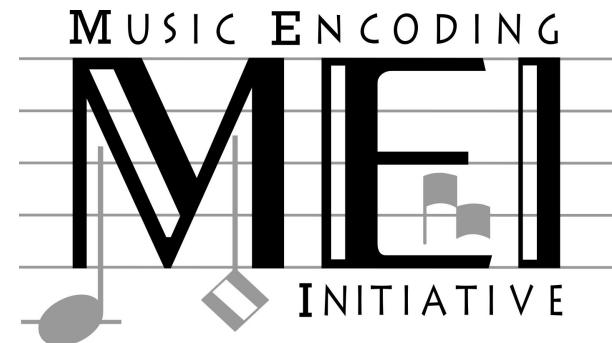


MEI challenges our modern understanding of musical notation and forces us to clarify the difference between what we **see** and what we **know**, or **believe to know**.



The ongoing **digital revolution** holds the potential to unveil unforeseen possibilities which could challenge and overturn traditional research methodologies and allow entirely new opportunities for music research.

Automatic analysis across larger repertoires would probably allow us to discover new patterns of usage and work out the meaning of early neumatic scripts!





```
--> <syllable xml:id="m-43558eee-8a6a-11ee-a3f2-3645f29ecd15">  
    <syl xml:id="m-43558f20-8a6a-11ee-a3f2-3645f29ecd15">i</syl>  
    <neume xml:id="m-43558f52-8a6a-11ee-a3f2-3645f29ecd15">  
        <nc loc="0" xml:id="m-43558f8e-8a6a-11ee-a3f2-3645f29ecd15"/>  
        <nc loc="-2" xml:id="m-43558fc0-8a6a-11ee-a3f2-3645f29ecd15"/>  
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    </neume>  
</syllable>  
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    </neume>  
</syllable>  
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    <syl xml:id="m-4355910a-8a6a-11ee-a3f2-3645f29ecd15">quid</syl>  
    <neume xml:id="m-4355913c-8a6a-11ee-a3f2-3645f29ecd15">  
        <nc loc="0" xml:id="m-43559178-8a6a-11ee-a3f2-3645f29ecd15"/>  
    </neume>
```

Fili quid fecisti



Thank you!



Thank you!

martha.thomae@fcsh.unl.pt

elsadeluca@fcsh.unl.pt



Add the children of layer: syllable and their children

- Fill in the **first** <neume> of this syllable with its neume four components <nc>
 - For the **first** <nc>, add attributes @pname=a and @oct=2
 - For the **second** <nc>, add attributes @pname=g and @oct=2
 - For the **third** <nc>, add attributes @pname=a and @oct=2
 - For the **fourth** <nc>, add attributes @pname=g and @oct=2
- Add @ligated = true to the **first** and **second** <nc>
- And add @tilt = n to the **first** <nc>

