

# THE MUSIC ENCODING INITIATIVE

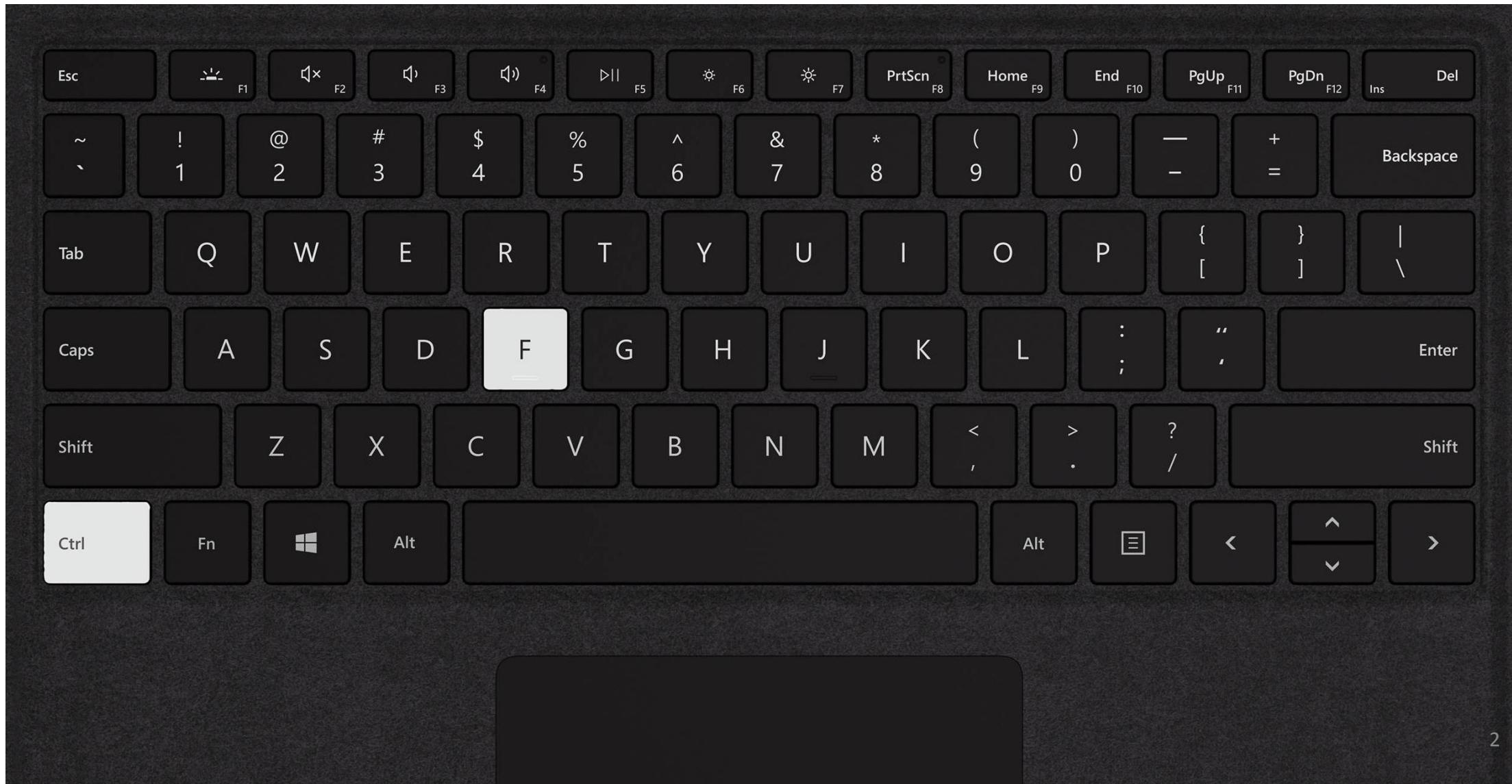
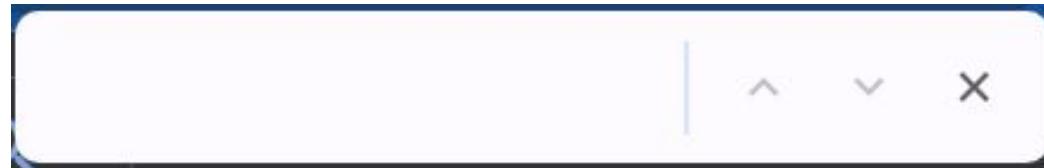
## ENCODING OF EARLY MUSIC

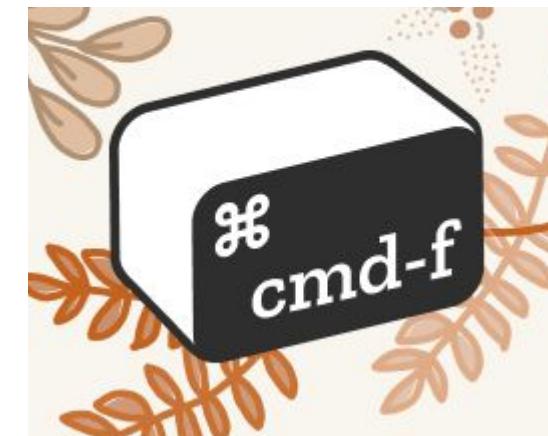
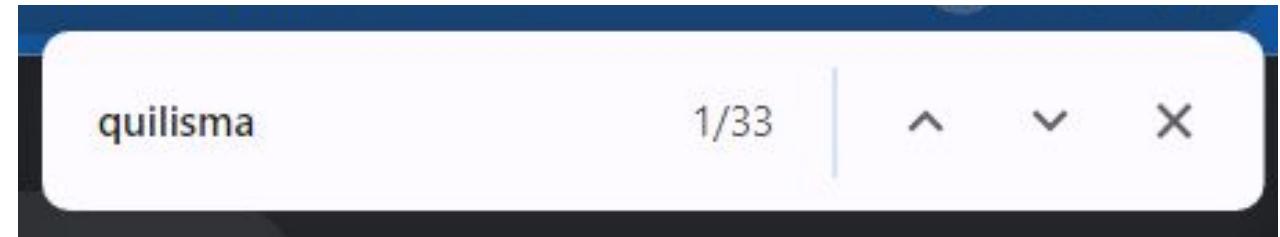
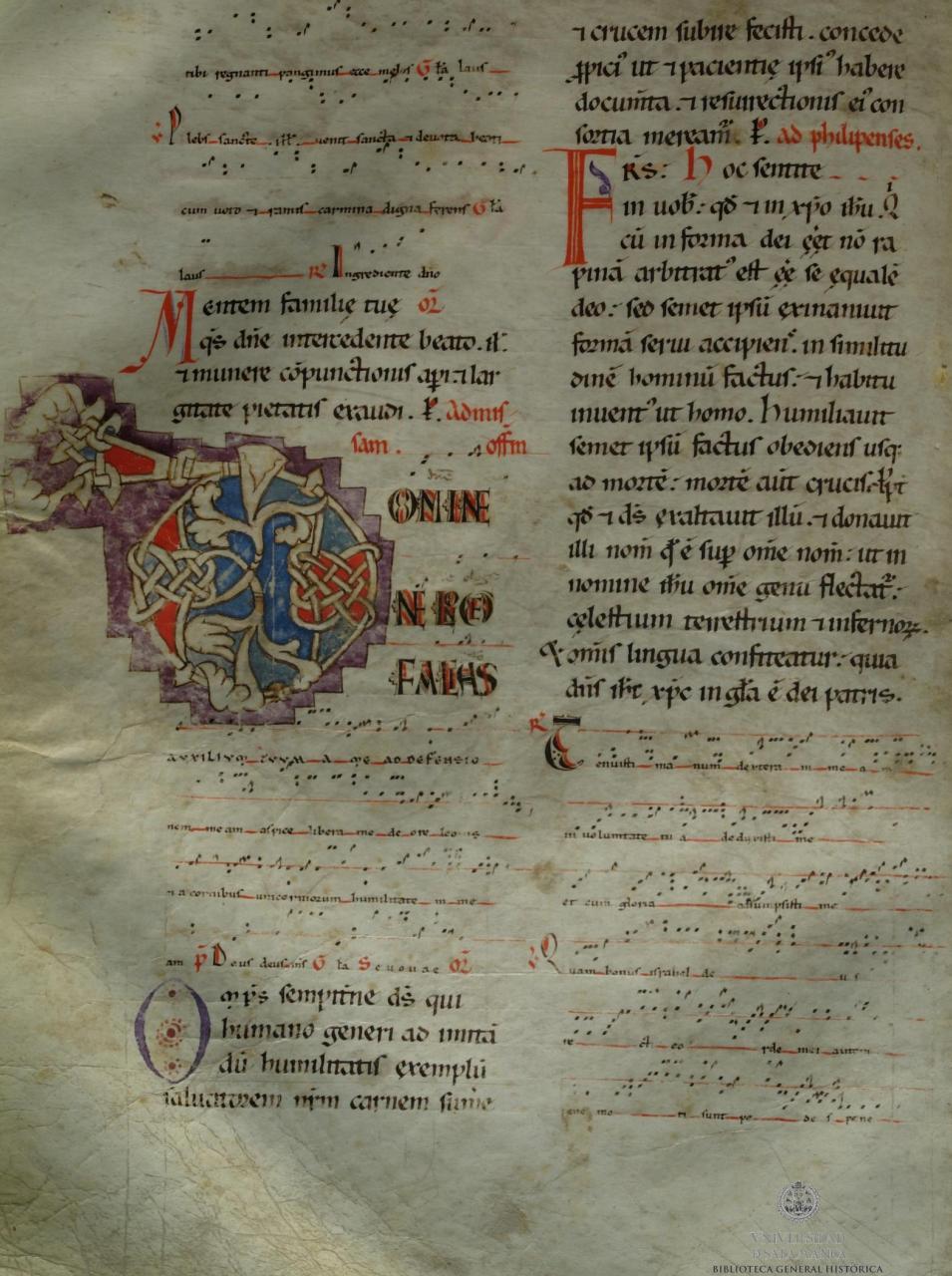
**Martha E. Thomae, Elsa De Luca**

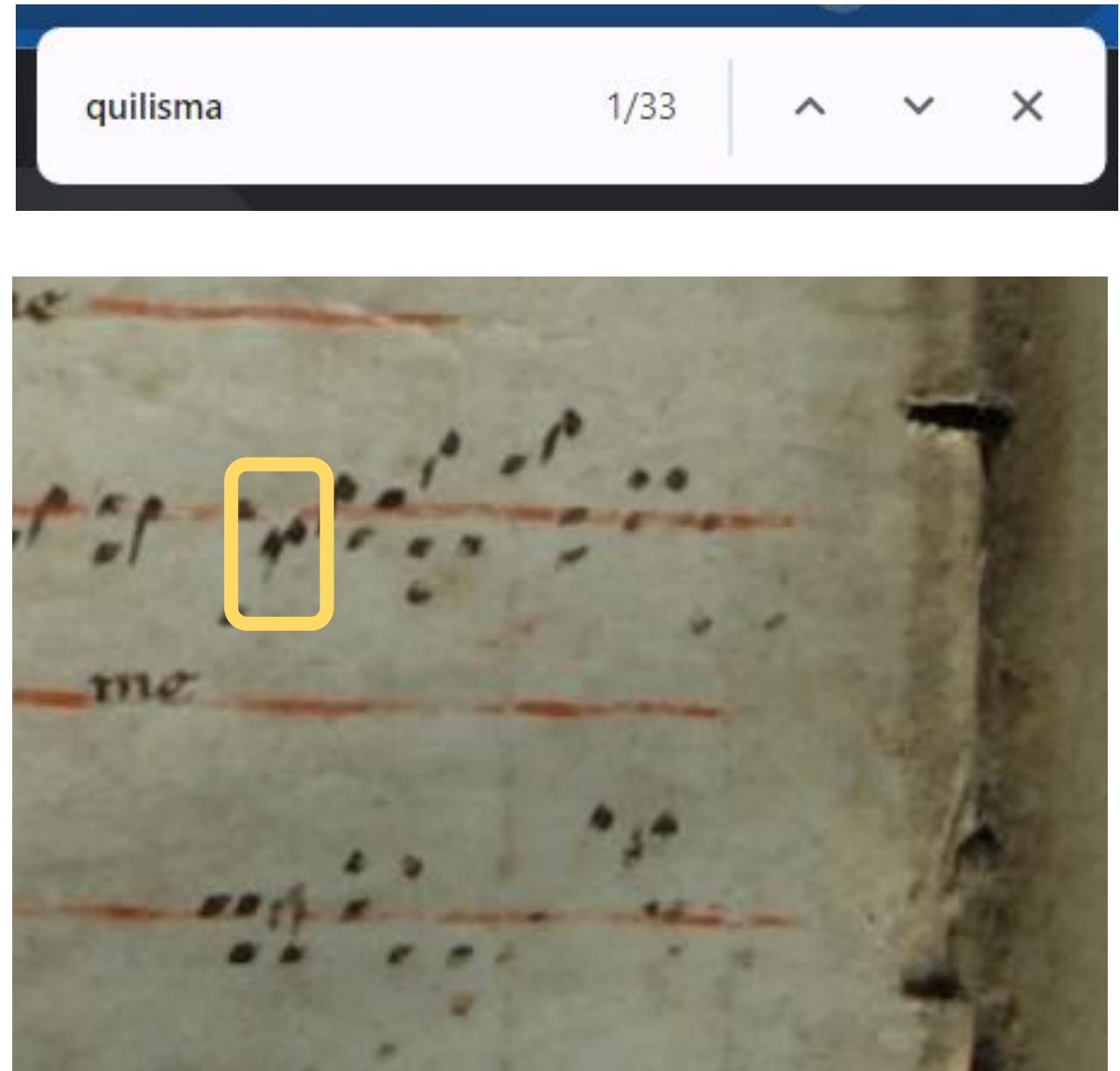
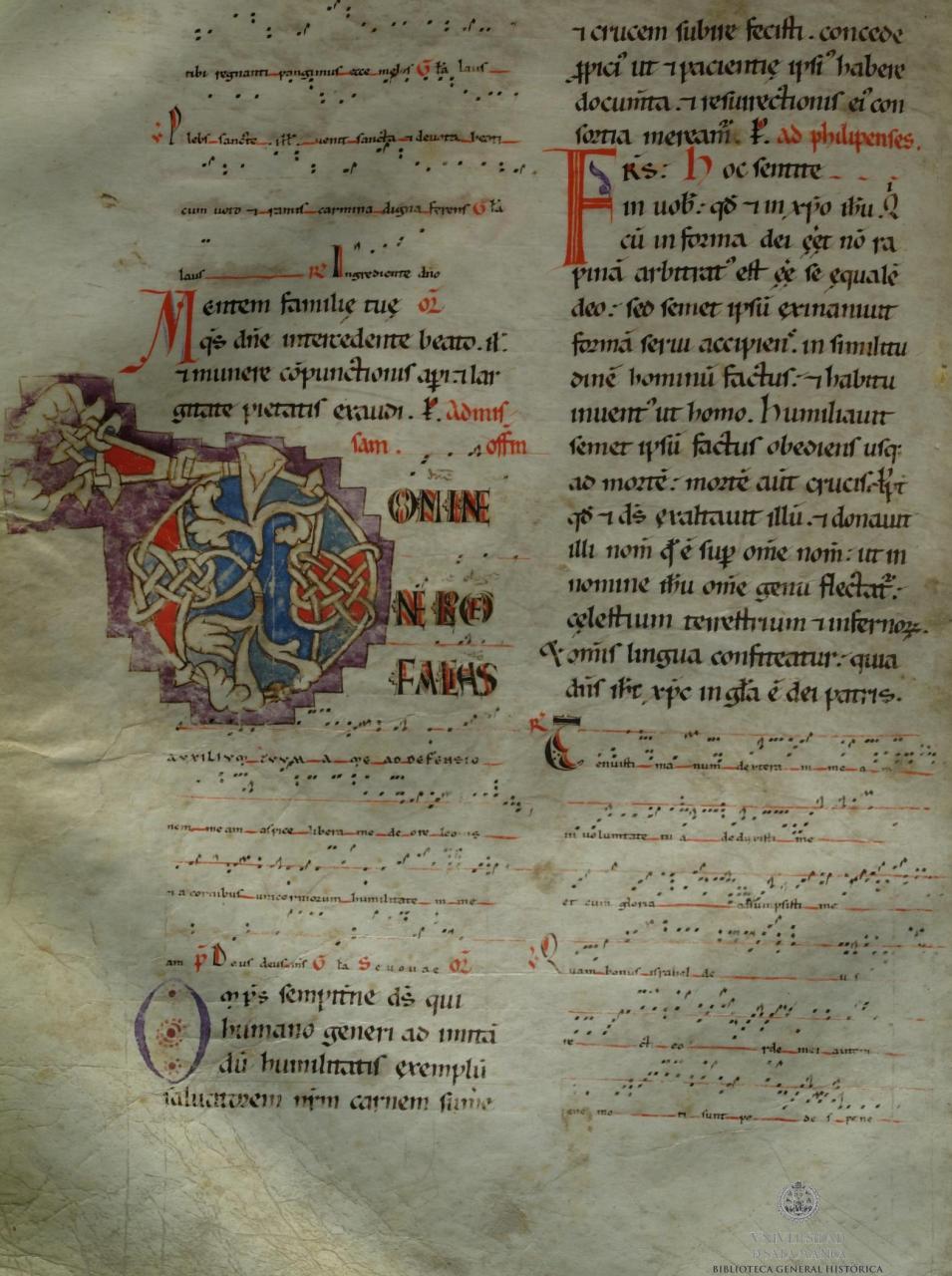
CESEM-IN2PAST, Universidade NOVA de Lisboa



[www.tinyurl.com/4jjtkpu7](http://www.tinyurl.com/4jjtkpu7)







**Optical Music Recognition (OMR)** applied to a music manuscript would generate a file that contains the encoding of all the music information in the book. By means of this file, one can search for a neume shape in the blink of an eye.

OMR is the transformation of images of music notation into digital representations (i.e., machine-readable files) with limited direct human involvement.



# Why Would We Want to Encode Music?

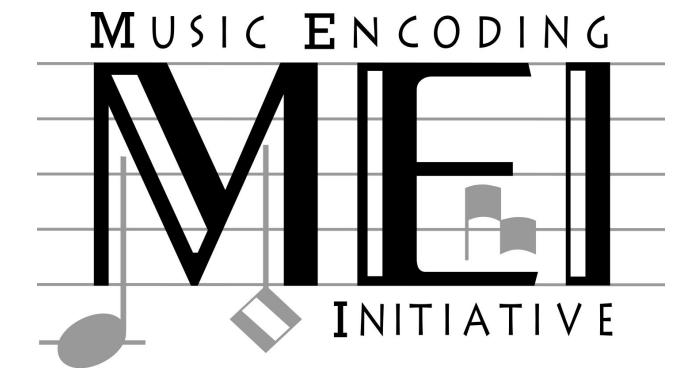
**Machine-readable files** → Ask the computer:

- Perform searches
  - Melodic search
  - Search for particular neume shapes
  - Look for melismatic passages
- Music analysis
  - Cross-comparison
  - Compute the mode of a chant based on features that the computer can extract, like *finalis*, *repercussio* (i.e., most repeated note), and *ambitus* (i.e., 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

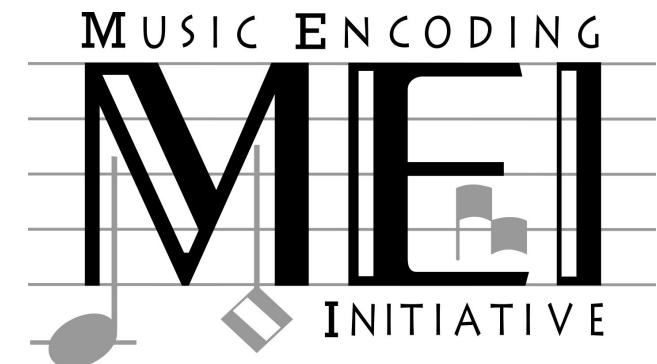
**fully capturing a wide variety of music documents  
into a machine-readable format**



# 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". The MEI XML code below the score defines the musical structure, including measures, staffs, layers, notes, and lyrics (syl). The code uses color coding for different elements like note names, octaves, and stems.

```
<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">
        <verse n="1">
          <syl wordpos="l" con="d">le</syl>
        </verse>
      </note>
    </layer>
  </staff>
</measure>
```



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:

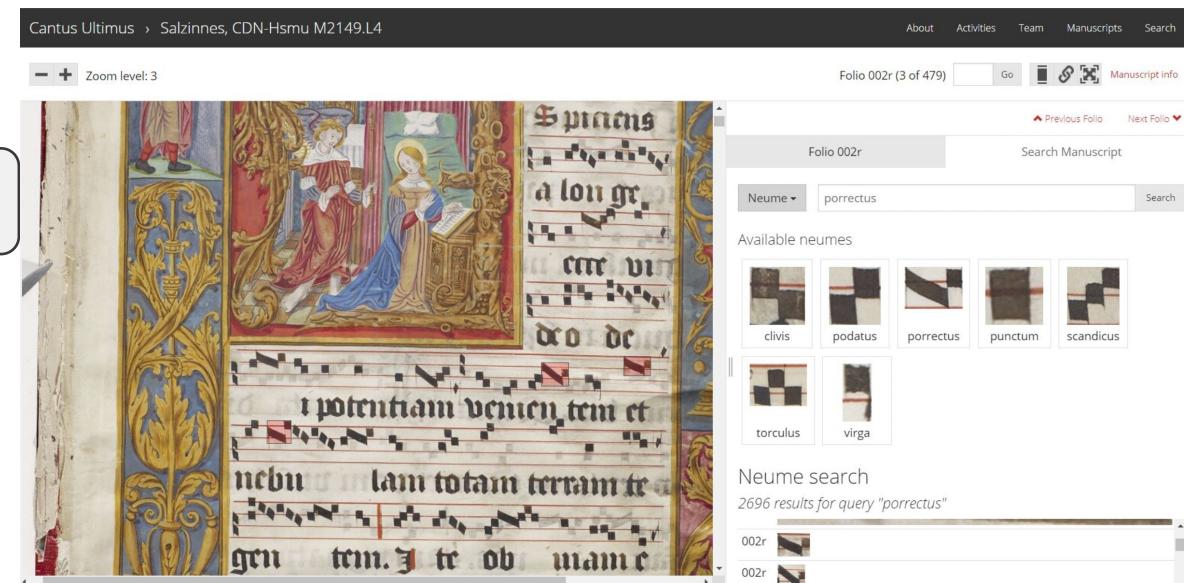
- Neume | Mensural | Tablature (plus common Western music notation, CMN)

- 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

**E**mmmanuel dictum te  
**S**tephanus seruus

## *Two practical examples* #2

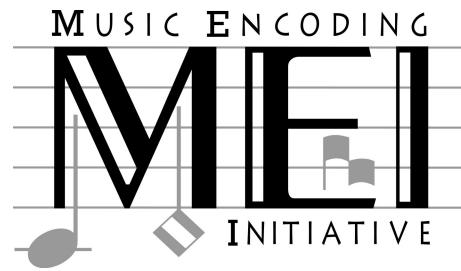


```
<neume>
  <nc tilt="ne"/>
  <nc tilt="se" relen="s" intm="d"/>
</neume>
```



```
<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.

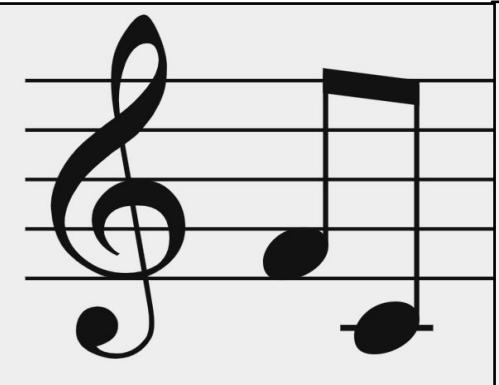


# Short Introduction to MEI



# 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

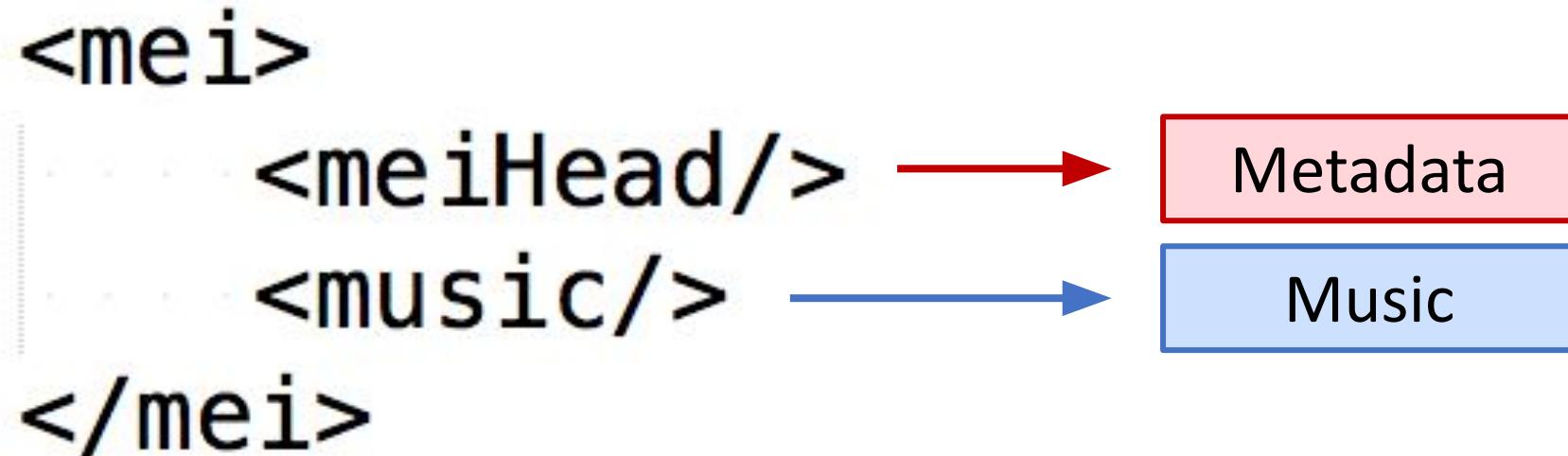
@intm is an attribute of <nc>

= Encodes the melodic interval from the previous neume component

# 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

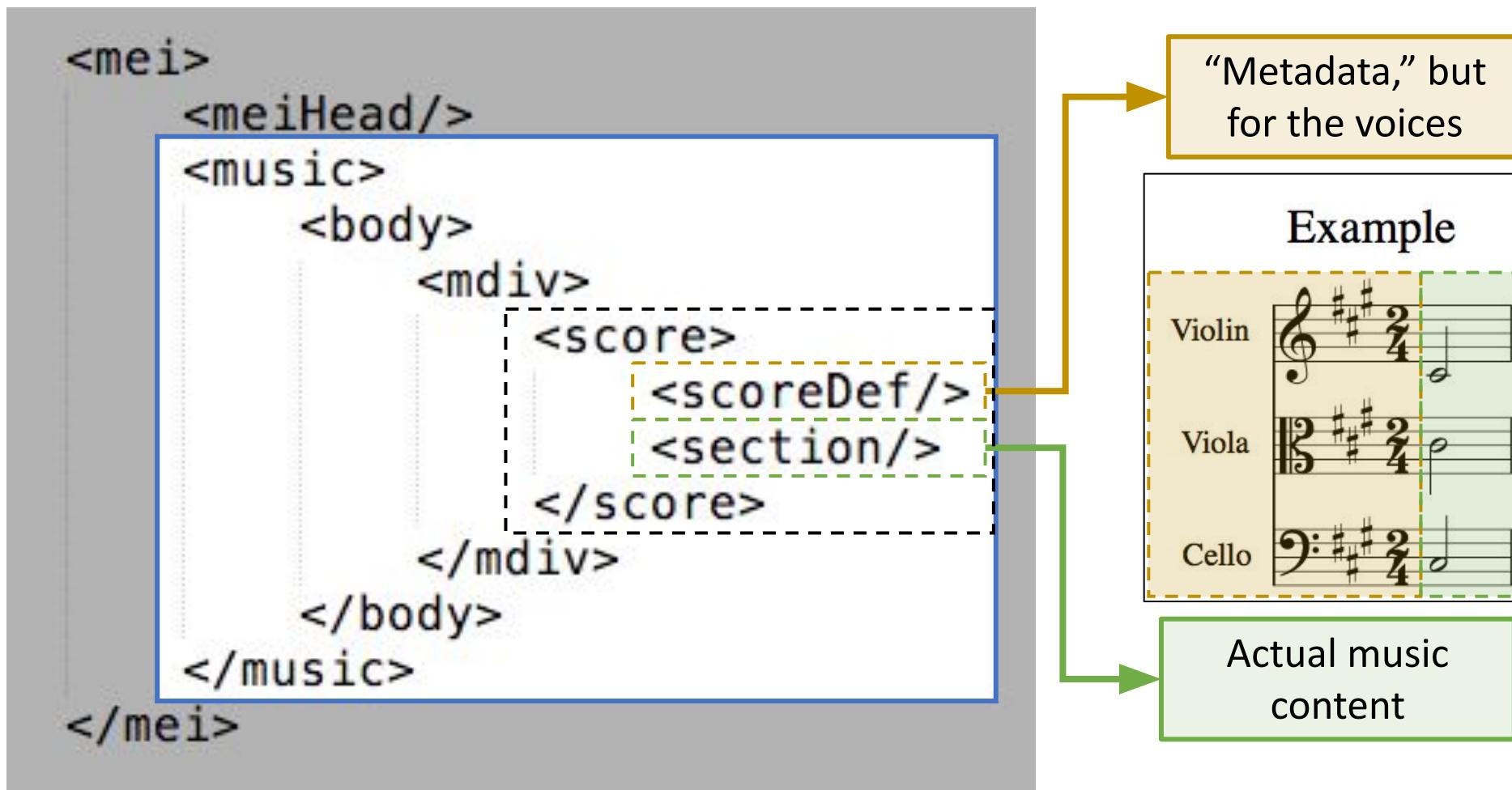


# Basic Structure of an MEI File

```
<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

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**

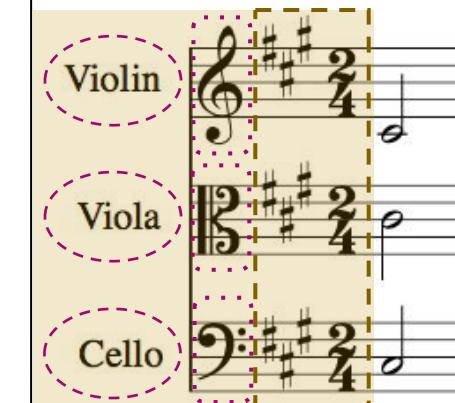
- Meter
- Key

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>
```

Example

A musical score example showing three staves: Violin, Viola, and Cello. The score is in 2/4 time, A major (two sharps), and consists of two measures. The first measure has a quarter note on the second line and a eighth note on the fourth line. The second measure has a quarter note on the third line. A green dashed box highlights the second measure across all three staves.

Violin

Viola

Cello

Actual music content



# <section> - Actual Music

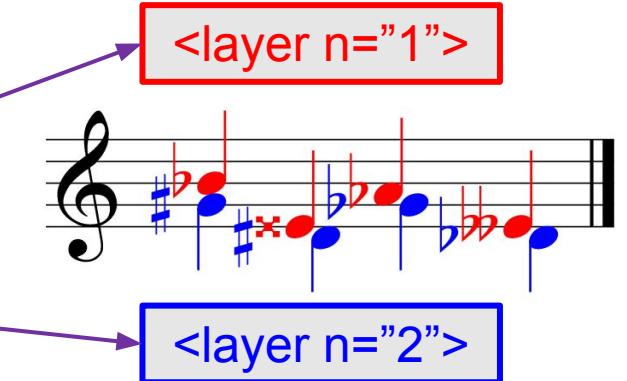
```
<score>
  <scoreDef/>
  <section>
    <measure n="1">
      <staff n="1">
        <layer>
          <!-- MUSIC WITHIN THE STAFF -->
        </layer>
      </staff>
      <staff n="2"/>
      <staff n="3"/>
    </measure>
    ...
    <measure n="20"/>
  </section>
</score>
```

<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

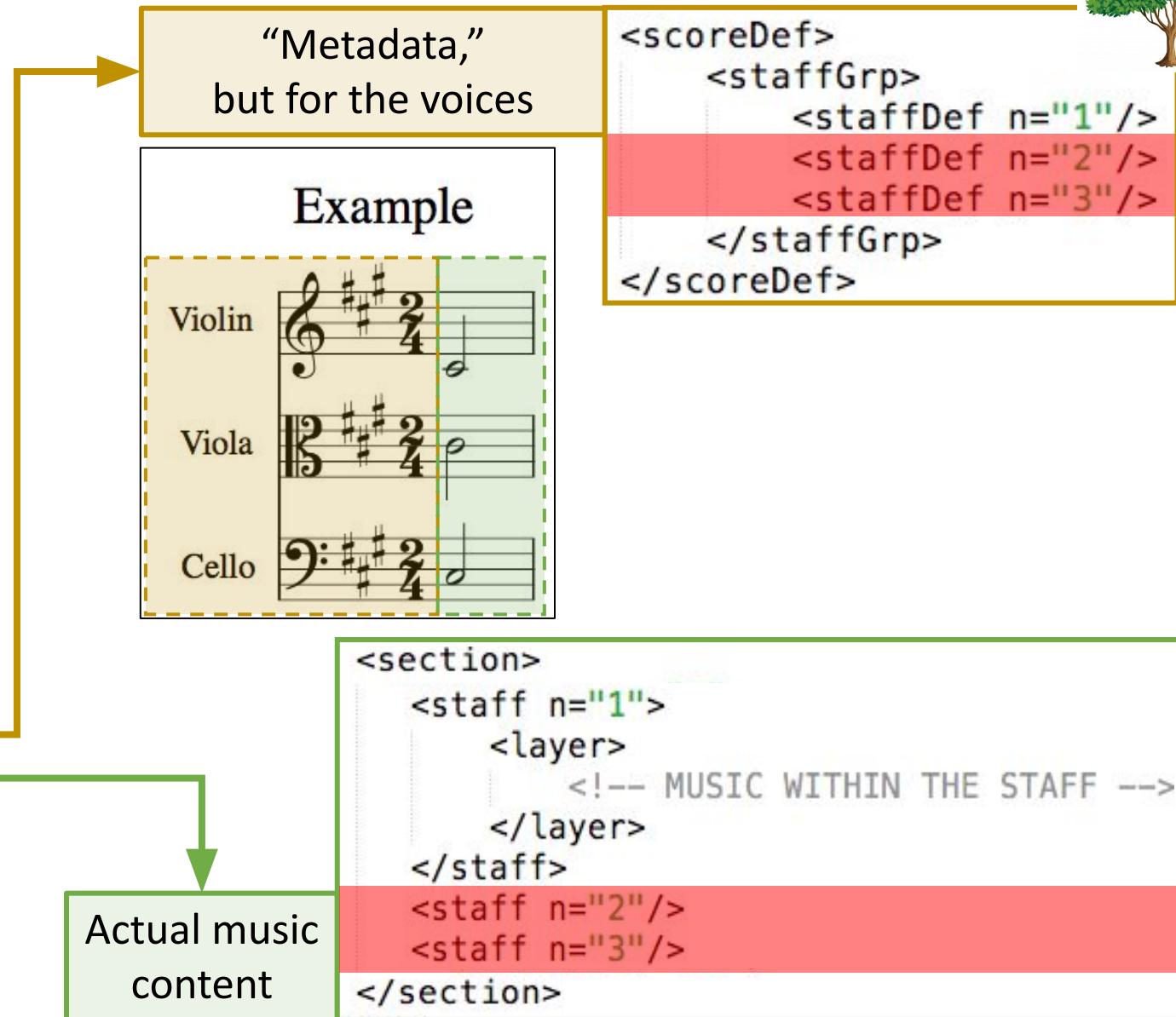
```
<score>
  <scoreDef/>
  <section>
    <staff n="1">
      <layer>
        <!-- MUSIC WITHIN THE STAFF --&gt;
      &lt;/layer&gt;
    &lt;/staff&gt;
    &lt;staff n="2"/&gt;
    &lt;staff n="3"/&gt;
  &lt;/section&gt;
&lt;/score&gt;</pre>
```

# 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>
```



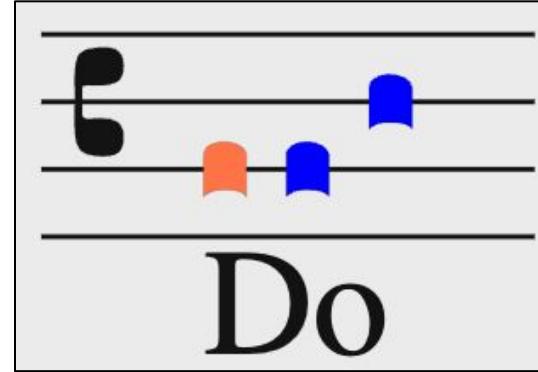
# MEI for Neume Notation

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

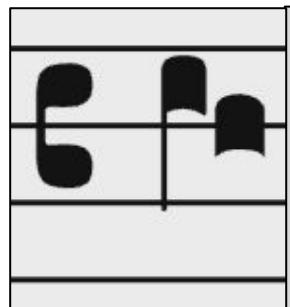
- ❖ @pname = c | d | e | f | g | a | b
- ❖ @oct = ... 2 | 3 | 4 ...
- ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
- ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...

### ○ 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

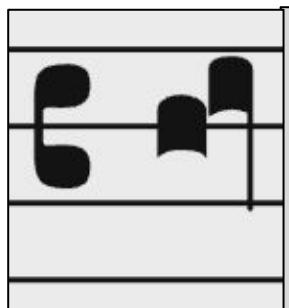
- ❖ @pname = c | d | e | f | g | a | b
- ❖ @oct = ... 2 | 3 | 4 ...
- ❖ @loc: position in the staff (integer, 0 is the first line) = ... -2 | -1 | 0 | 1 | 2 ...
- ❖ @intm: melodic interval (integer: negative, zero, positive) = ... -2 | -1 | 0 | 1 | 2 ...

### ○ 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



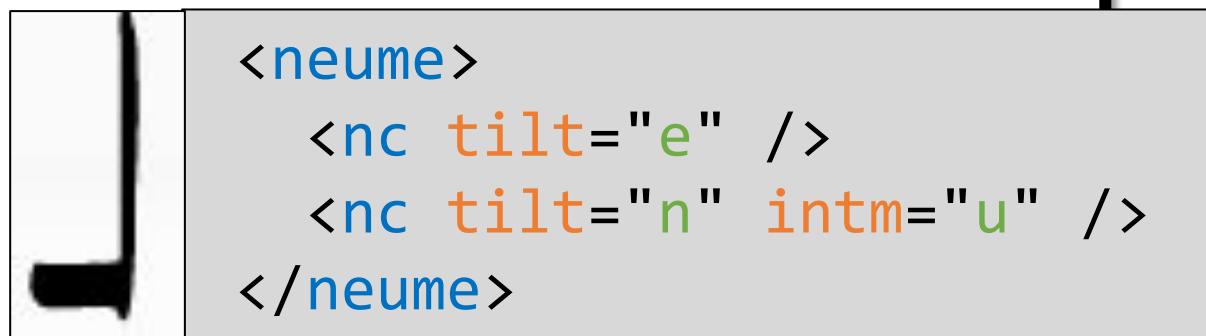
```
<neume>
  <nc loc="4" />
  <nc intm="1" tilt="s" />
</neume>
```

## 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

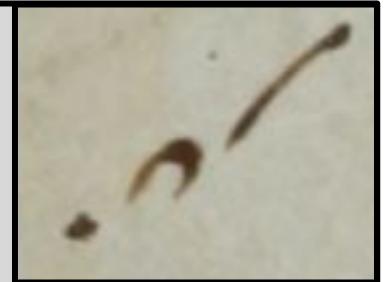
- <syllable>
  - **One** <syl> child
  - **One or more** <neume> children
    - neume component <nc> children, these are the individual notes that form part of the neume
  - <nc> can have children too:
    - <episema>
    - <oriscus>
    - <hispanTick>
    - <quilisma>
    - <liquescent>
    - <strophicus>

[https://music-encoding.org/guidelines/v5/elements/nc.html#mayContain\\_class\\_tab](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>

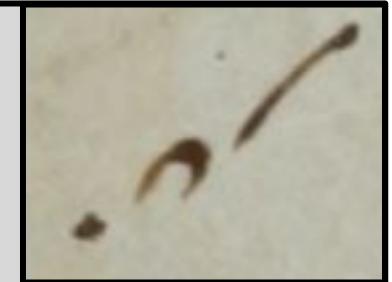
## Attributes for <episema>:

- ❖ @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>
```

# Same melodic contour: Neutral – High – Low | Different neumatic connections

```
<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/>



Editor panel  
(MEI code)

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <?xml-model href="https://music-encoding.org/schema/5.0/mei-all.rng" type="application/xml" so
3  <?xml-model href="https://music-encoding.org/schema/5.0/mei-all.rng" type="application/xml" so
4  <mei xmlns="http://www.music-encoding.org/ns/mei" meiversion="5.0">
5    <meiHead xml:id="m-31bb19b6-abc0-4cbf-b0f6-169c67b5a315">
6      <fileDesc xml:id="m-01dadaef-3dcb-4521-a261-69333e36b1b3">
7        <titleStmt xml:id="m-bd9ae7c6-2c8d-48b8-ba82-4b94407d3c47">
8          <title xml:id="m-402a2186-79f9-4f25-a801-5acd1145497f">MEI Encoding Output (1.0.0)
9        </titleStmt>
10       <pubStmt xml:id="m-6bf82541-43f0-47df-b1d4-0392281dba7b"/>
11     </fileDesc>
12   </meiHead>
13   <music xml:id="mg6szwz2">
14     <facsimile xml:id="m-4e57845f-8555-4122-b53f-ae59303a03a8"><></facsimile>
15     <body xml:id="b02jngs1">
16       <mdiv xml:id="mopqc6s2">
17         <score xml:id="smc64">
18           <scoreDef xml:id="son6y6s2">
19             <staffGrp xml:id="syp81gz1">
20               <staffDef xml:id="skowclt1" clef.line="4" clef.shape="C" lines="5" n="1"
21             </staffGrp>
22           </scoreDef>
23         ...
24       </score>
25     </mdiv>
26   </music>
27 </mei>
```

Rendering panel  
(Verovio, rendering  
engine for MEI  
developed by  
Laurent Pugin)

## MEI Encoding Output (1.0.0)

A musical score visualization showing a single staff with five horizontal lines. There are six black note heads positioned along the staff. Below the staff, the lyrics "Be ne di ci te om nes" are written in a serif font, corresponding to the notes. The Verovio interface toolbar is visible at the top of the rendering panel.



# 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>
```

The XML code shows the structure of a musical score. It starts with a `<music>` tag, followed by a `<body>` tag containing a `<mdiv>` tag. Inside `<mdiv>`, there is a `<score>` tag. Within `<score>`, there is a `<scoreDef>` tag, which defines a `<staffGrp>` containing a `<staffDef n="1" lines="4" notationtype="neume"/>`. After this, there is a `<section>` tag, which contains a `<staff n="1">` tag with a `<layer>` tag. A comment `<!-- music content goes in here -->` is placed within the `<layer>` tag. Finally, there is another `<staff>` tag and a `</section>` tag. The `<scoreDef>` and the `<section>` tags are highlighted with a red rounded rectangle, and two orange arrows point from the list items to these specific tags.



# Add a clef in the staff definition

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



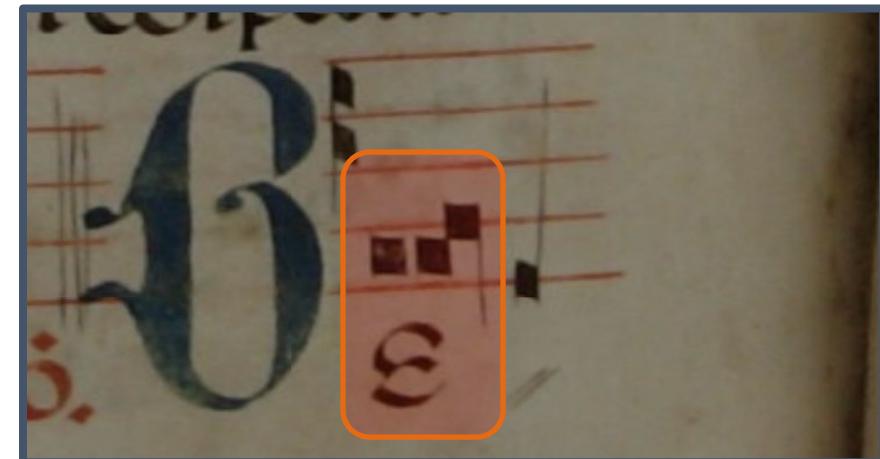
```
17 ▾ <scoreDef>
18 ▾   <staffGrp>
19     <staffDef n="1" lines="5" notationtype="neume" clef.shape="C" clef.line="4"/>
20   </staffGrp>
21 </scoreDef>
```

# 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>&lt;syllable&gt;</code>
26 ▾	<code>&lt;syl&gt;Be&lt;/syl&gt;</code>
27	<code>&lt;neume&gt;&lt;/neume&gt;</code>
28	<code>&lt;/syllable&gt;</code>

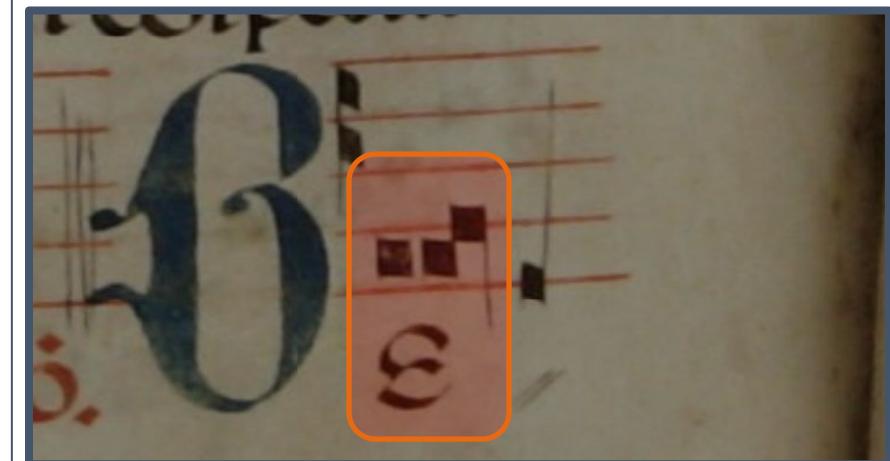




# Add the children of layer: syllable and their children

- 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>
```





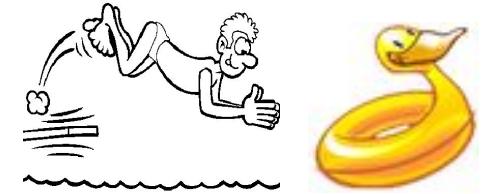
## Add the children of layer: syllable and their children

- 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 lines representing a musical staff. Below the staff, the word "nedicite" is written in a Gothic script. A red rectangular box highlights the first letter "n". To the right of the staff, the text "omnes angeli duci dominum" is visible. A blue rectangular box contains numbered steps for XML structure:

33 ▾	<code>&lt;syllable&gt;</code>
34 ▾	<code>&lt;syl&gt;ne&lt;/syl&gt;</code>
35	<code>&lt;neume&gt;&lt;/neume&gt;</code>
36	<code>&lt;/syllable&gt;</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 photograph of a medieval manuscript page. On the left, there is musical notation on four-line red staves. A specific note on the first staff is highlighted with a red square box. Below the music, the word "nedicite" is written in a large, dark, Gothic-style font. To the right of the word, a vertical list of XML code numbers 33 through 40 is shown, corresponding to the numbered lines of the manuscript.

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>&lt;syllable&gt;</code>
41 ▾	<code>&lt;syl&gt;di&lt;/syl&gt;</code>
42	<code>&lt;neume&gt;&lt;/neume&gt;</code>
43	<code>&lt;/syllable&gt;</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 angelii domini dominum" is written in a large, dark, Gothic-style font.

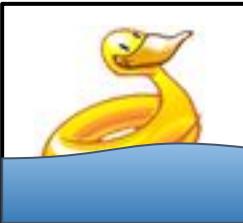
40 ▾	<syllable>
41 ▾	<syl>di</syl>
42 ▾	<neume>
43	<nc pname="g" oct="2"/>
44	<nc tilt="s" pname="a" oct="2"/>
45	</neume>
46	</syllable>



# 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>&lt;syllable&gt;</code>
48 ▾	<code>&lt;syl&gt;ci&lt;/syl&gt;</code>
49	<code>&lt;neume&gt;&lt;/neume&gt;</code>
50	<code>&lt;/syllable&gt;</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 = 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 vertical red rectangle highlights the first neume of the second staff from the left. To the right of this highlighted area, a code editor window displays the XML representation of the musical structure:

```
47 ▼ <syllable>
48 ▼   <syl>ci</syl>
49 ▼   <neume>
50       <nc tilt="n" pname="g" oct="2"/>
51       <nc pname="e" oct="2"/>
52   </neume>
53 </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>te</syl>`
  - Add `<neume>` elements for each neume related to the syllable (two `<neume>` elements in this case)

A photograph of a page from a medieval manuscript. The page features musical notation on four-line red staves and the text "nedicite omnes" in a Gothic script. An orange rectangle highlights the word "te" in the text, which corresponds to the highlighted "syl" element in the XML structure below.

54 ▾	<code>&lt;syllable&gt;</code>
55 ▾	<code>&lt;syl&gt;te&lt;/syl&gt;</code>
56	<code>&lt;neume&gt;&lt;/neume&gt;</code>
57	<code>&lt;neume&gt;&lt;/neume&gt;</code>
58	<code>&lt;/syllable&gt;</code>



# 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>**

The image shows a portion of a medieval manuscript. On the left, there is musical notation consisting of vertical stems with small black dashes on them, arranged in two parallel horizontal lines. An orange rectangular box highlights the first four stems from the left. Below the music, the Latin text "nedicite omes angelorum dominum" is written in a Gothic script.

```
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>
```



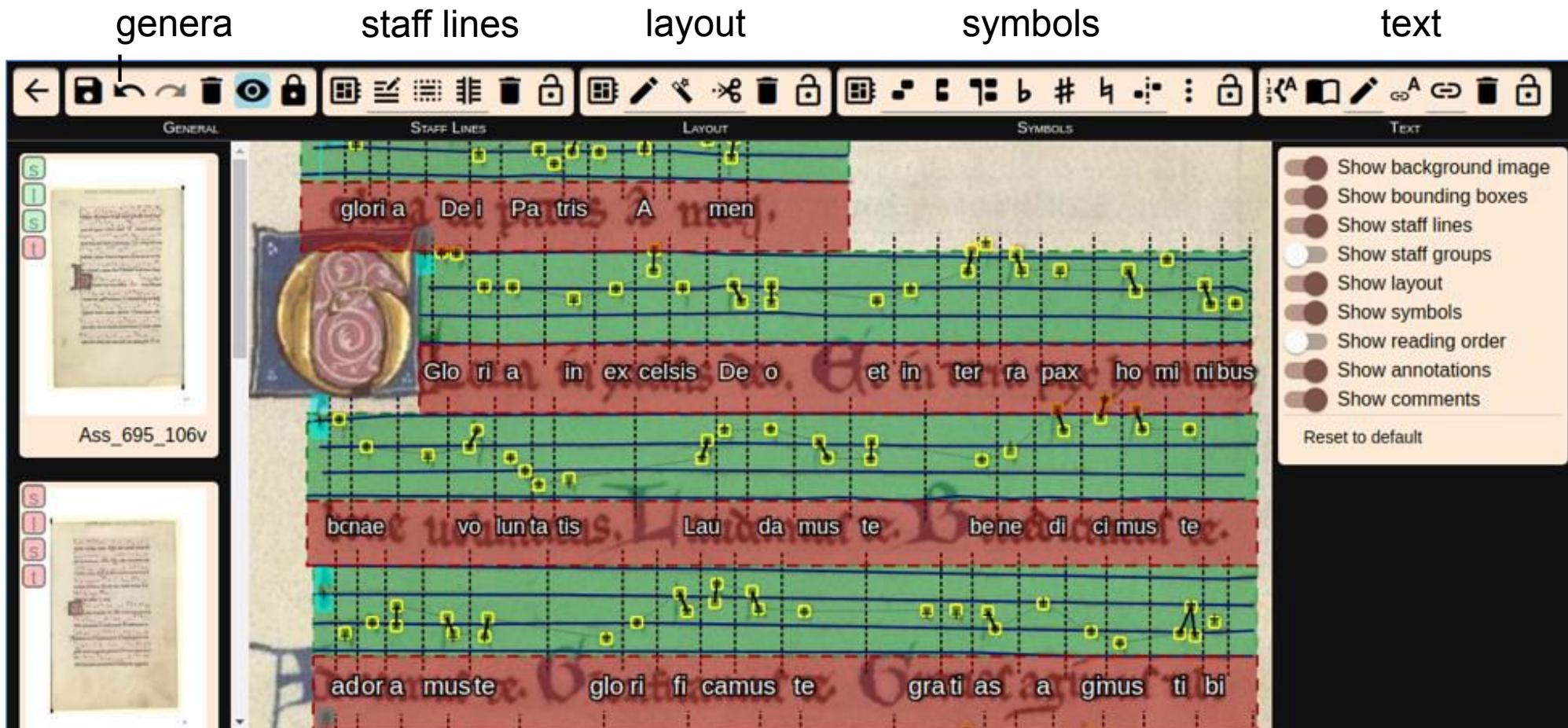
# Optical Music Recognition (OMR)

# Some OMR Frameworks for Neume Scripts

OMMR4all

**SIMSSA** | : Single Interface for Music  
| : Score Searching and Analysis

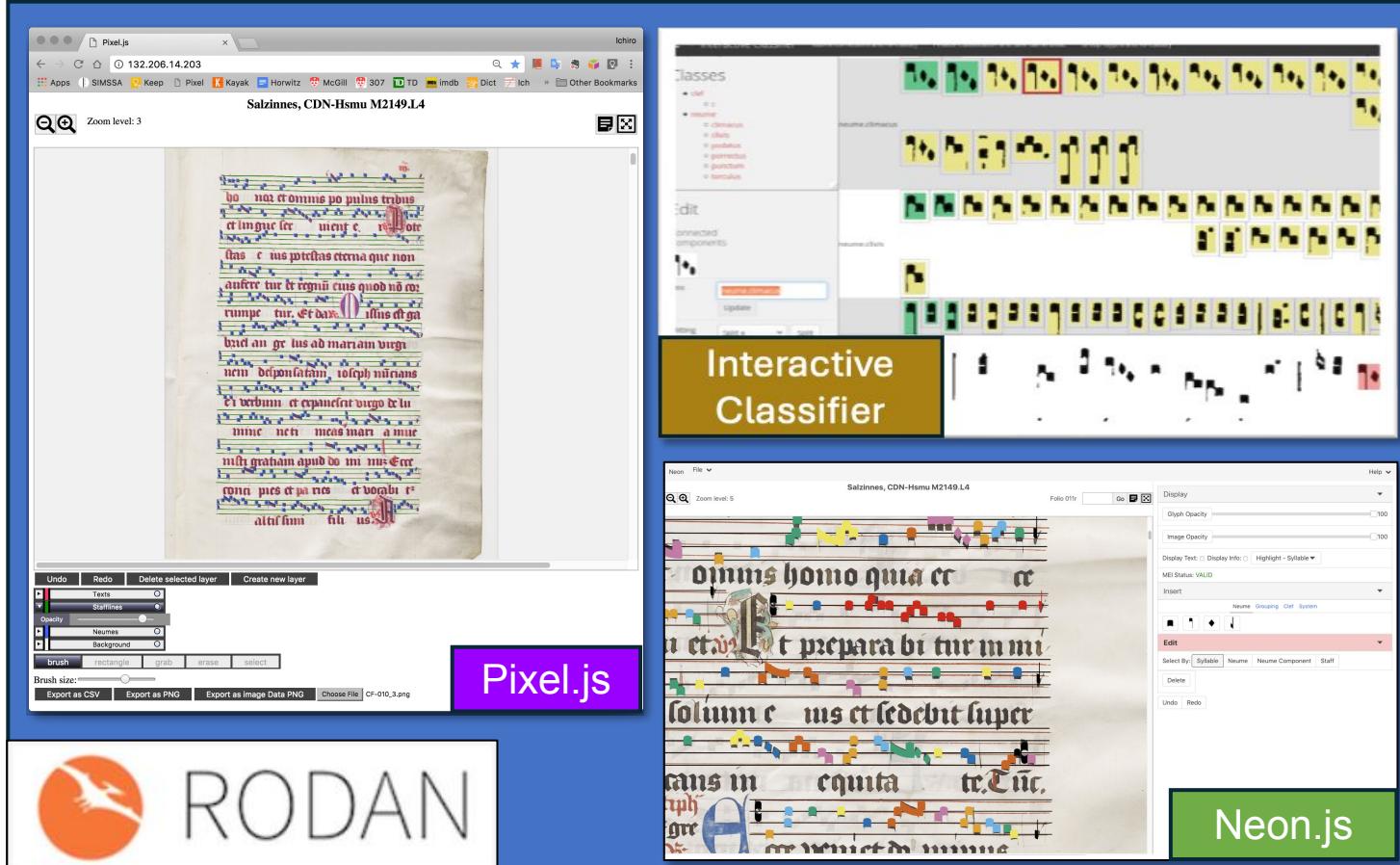
# OMM4All



*OMMR4All was created by **Cristopher Wick** (University of Würzburg), and it is being used in the **Corpus Monodicum** project*

Alexander Hartelt & Jan Hajíč: Collaborative digital editions with OMMR4All (DHEMR 2021/1 sess. 3):  
<https://youtu.be/hX9pGOdfbZ8?feature=shared>

# OMR Workflow used at the Single Interface for Music Score Searching & Analysis (SIMSSA) Project

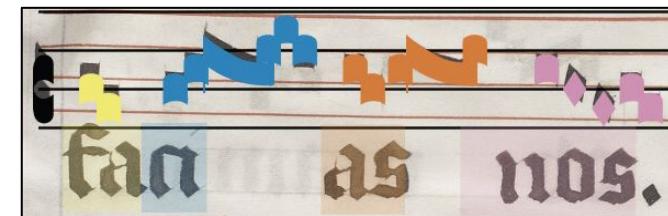


Martha Thomae: Making Rodan work for you (DHEMR 2021/1, Session 2)  
[https://youtu.be/\\_TeGXG9Fh2M?si=v\\_IQOBysIGi7GtLL](https://youtu.be/_TeGXG9Fh2M?si=v_IQOBysIGi7GtLL)

The **SIMSSA** project is  
directed by **Ichiro Fujinaga**  
(McGill University)

# OMR Workflow used at the Single Interface for Music Score Searching & Analysis (SIMSSA) Project

The screenshot shows a medieval musical manuscript page from Salzinnes, CDN-Hsmu M2149.L4, Folio 011r. The manuscript features four-line red staves with various neumes (dots and dashes) and some larger note heads. Below the staves, there is Latin text in a Gothic script. The right side of the interface contains a control panel with sections for 'Display' (controlling opacity of glyphs and images), 'Insert' (buttons for Neume, Grouping, Clef, and System), and 'Edit' (buttons for Delete, Undo, and Redo). A green banner at the bottom reads 'Neon.js Neume Editor Online'.



Martha Thomae: Making Rodan work for you (DHEMR 2021/1, Session 2)  
[https://youtu.be/\\_TeGXG9Fh2M?si=v\\_IQOBysIGi7GtLL](https://youtu.be/_TeGXG9Fh2M?si=v_IQOBysIGi7GtLL)

The **SIMSSA** project is  
directed by **Ichiro Fujinaga**  
(McGill University)

# 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

Minimal structure  
of a valid MEI file

## 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

Encoding your  
first melody

Structure of all  
the encoding  
within <music>

If you're about to write a new MEI tutorial, we recommend to start with the [5 steps to writing a MEI tutorial](#). These will provide backgrounds about the necessary steps. Please also have a look at the [List of minimum elements](#).

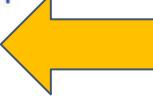
## External tutorials & related material

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

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



# 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

Model Classes

Macro Groups

Attribute Classes

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



## <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>, <del>, <expan>, <lem>, <ncGrp>, [<neume>](#), <orig>, <rdg>, <reg>, <restore>, <sic>, <supplied>, <unclear>

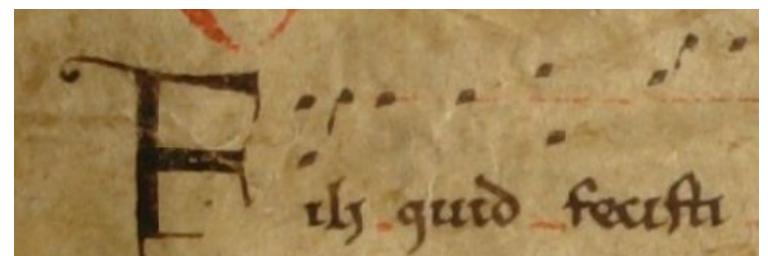
May Contain [compact](#) by class by module

<add>, <app>, <choice>, <corr>, <damage>, <del>, <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](https://music-encoding.org/guidelines/v5/elements/nc.html#attributes_compact_tab)



```
--> <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-a3f2-3645f29ec  
</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">quid</syl>  
    <neume xml:id="m-4355913c-8a6a-11ee-a3f2-3645f29ecd15">  
        <nc loc="0" xml:id="m-43559178-8a6a-11ee-a3f2-3645f29ecd15"/>  
    </neume>
```



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# Thank you!

[marthathomae@fcsh.unl.pt](mailto:marthathomae@fcsh.unl.pt)

[elsadeluca@fcsh.unl.pt](mailto:elsadeluca@fcsh.unl.pt)