

The Road Not Taken^{*}

MusicXML, Other Notation Standards, and a Case Study

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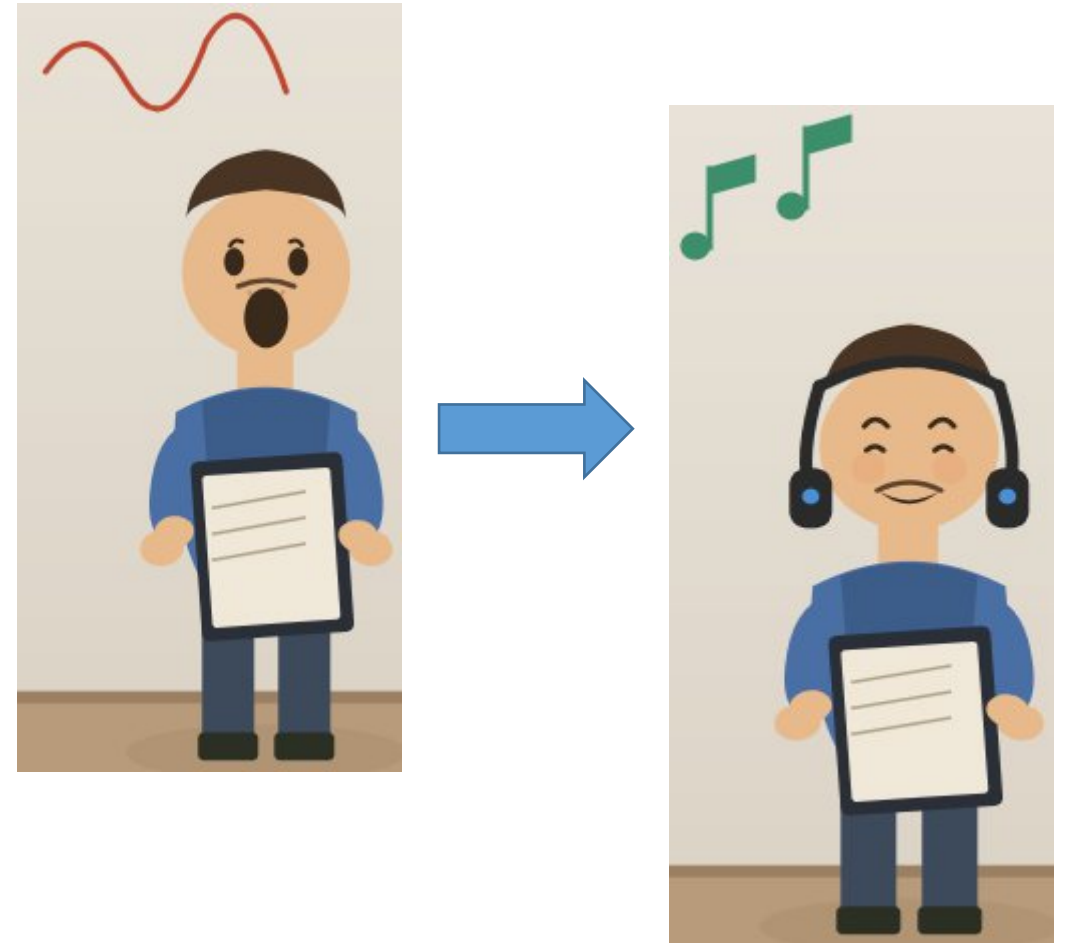
^{*}A Choir Member's Tale

A retired markup geek joined a choir...



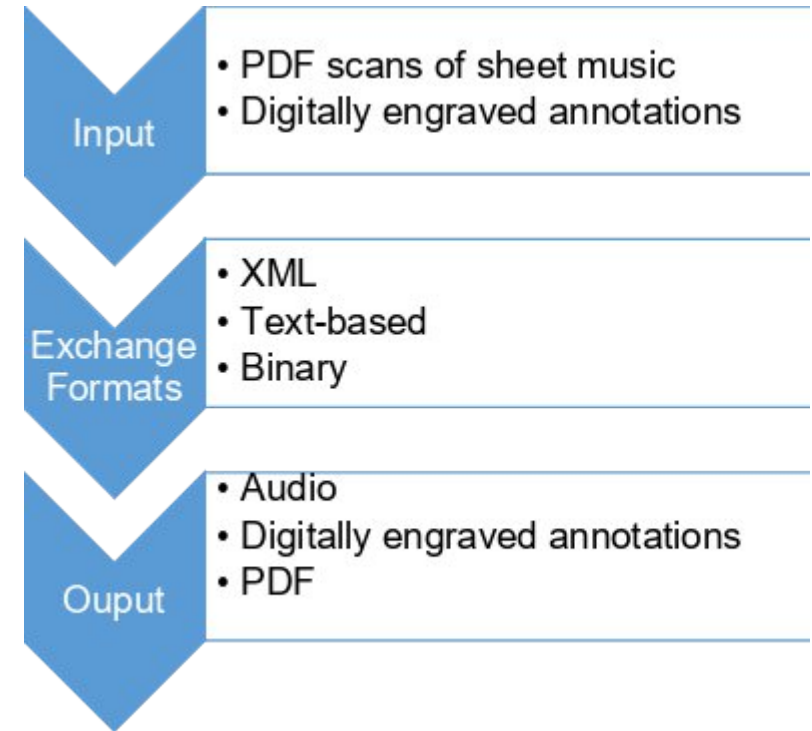
...and discovered the need for practice tracks

- Why?
 - We sing in four-part SATB harmony (Soprano, Alto, Tenor, Bass)
 - Most of us lack perfect pitch
 - No piano accompanist during practice at home
- Solution
 - Sing along with a part-dominant MP3 audio track



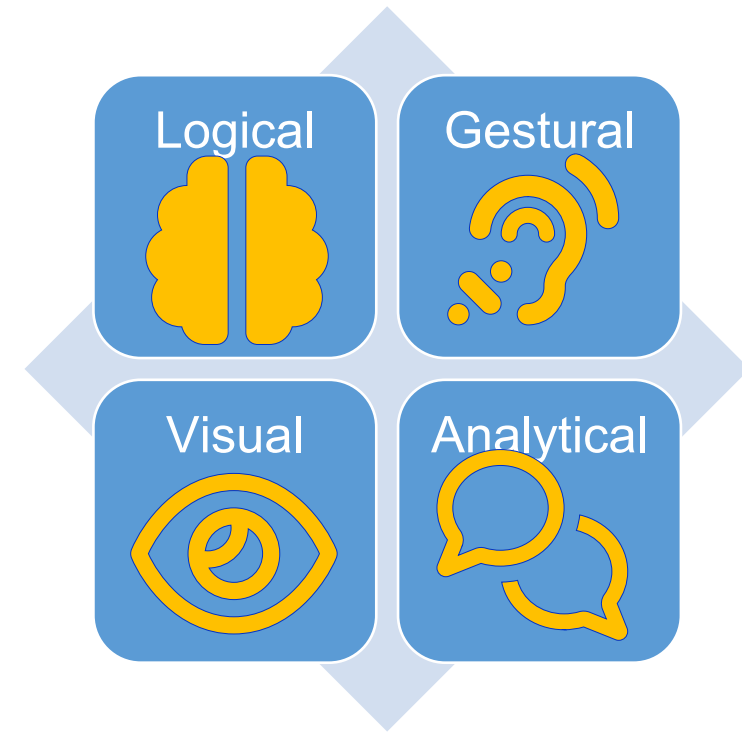
Music Notation Data Ecosystem

- More than notes on a staff
 - Temporal information
 - Lyrics
 - Dynamics
 - Annotations
- Instrument-specific symbology (e.g., percussion rhythm, guitar tablature, lead solos)
- Multiple format paradigms: XML, text-based, and binary audio data
- Representation and exchange standards



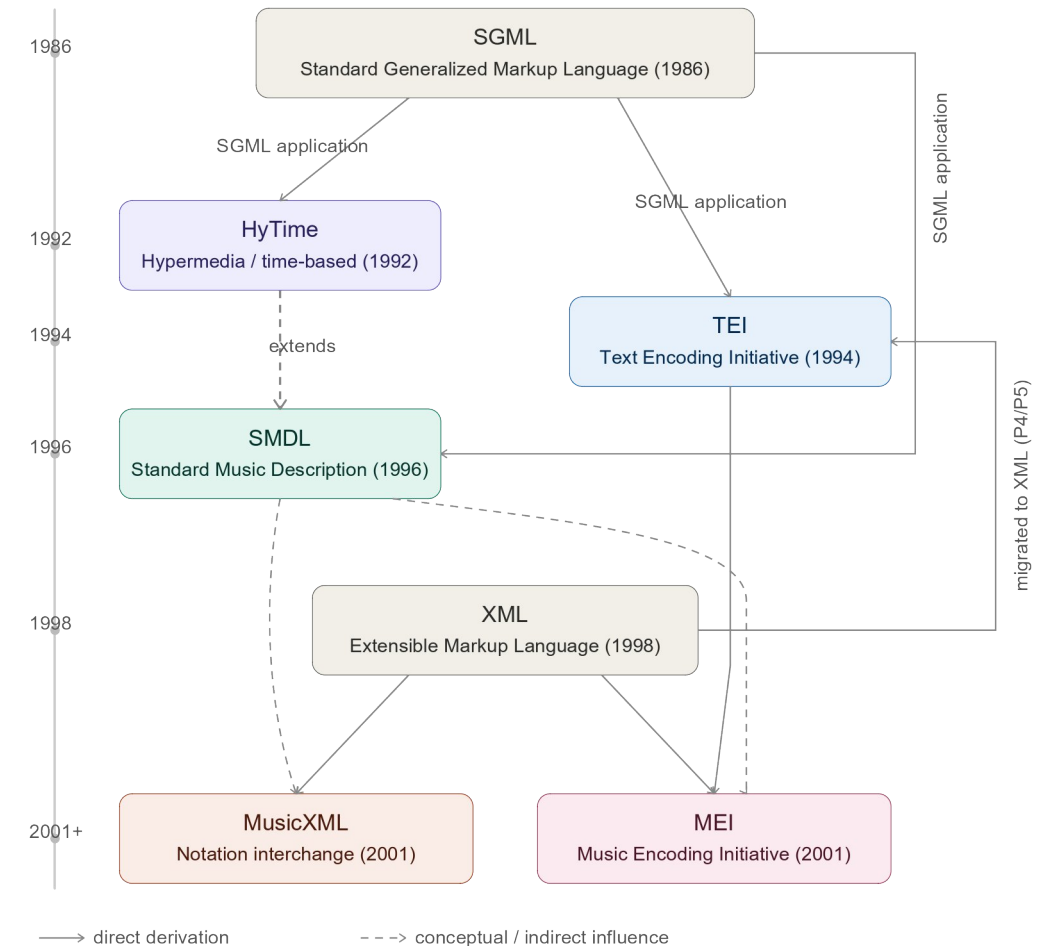
Standard Music Description Language (SMDL)

- Inspired by Mockingbird: Early 1980s visual music notation editor
- Proposed in the late 1980s as an SGML application
- Four music representation domains
- Standardized in 1996 as an application of HyTime (ISO/IEC 10744), but failed commercially



The XML Era: MusicXML and MEI

- MusicXML
 - Tailored toward commercial developers, publishers, and mainstream software applications
 - Prioritizes clarity, explicitness, and broad software interoperability
- Music Encoding Initiative (MEI)
 - Scholarly focused research community
 - Shares traits with the Text Encoding Initiative (TEI)
 - Employs "One Document Does-it-all" (ODD)



Architectural Trade-offs: Clarity vs. Concision

- Adaptation of SMDL Domains
 - MEI: foundational
 - MusicXML: stylistic
- Design Divergence:
 - MusicXML: clarity over concision
 - MEI: concision over clarity
- Conversion between MEI and MusicXML is possible but lossy

MusicXML	MEI
Developer-friendly	Scholar-friendly
Verbose	Compact
Element-driven	Attribute-heavy

Common non-XML text formats

- ABC Notation
 - Full-featured
 - Popular for folk and traditional music
- ChordPro
 - Lightweight syntax for interspersing chords within lyrics
 - Accommodates embedded markup and alternate tuning systems

```
X:1
T:Speed the Plough
M:4/4
C:Trad.
K:G
|:GABc dedB|dedB dedB|c2ec B2dB|c2A2 A2BA|
  GABc dedB|dedB dedB|c2ec B2dB|A2F2 G4:|
|:g2gf gdBd|g2f2 e2d2|c2ec B2dB|c2A2 A2df|
  g2gf g2Bd|g2f2 e2d2|c2ec B2dB|A2F2 G4:|
```

G
Mama's got a squeeze box

She wears on her chest

And when Daddy comes home

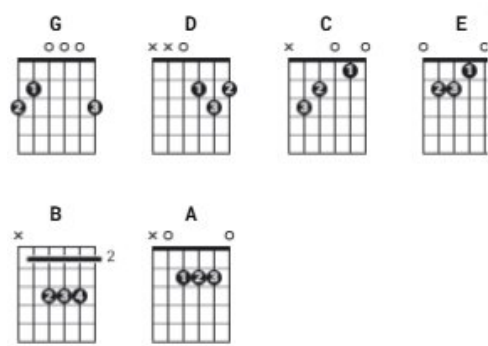
He never gets no rest

D **(D**)**
'Cause she's playing all night

C
And the music's all right

D
Mama's got a squeeze box

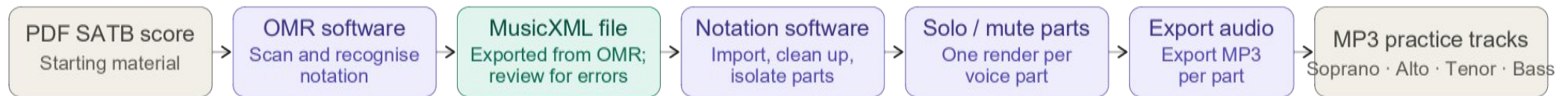
C **G** **(G*)**
Daddy never sleeps at night



The image displays six guitar chord diagrams arranged in two rows. The top row contains G, D, C, and E. The bottom row contains B and A. Each diagram shows a six-string guitar fretboard with fingerings indicated by numbers 1-4 and 'x' for muted strings. The G chord is at the 3rd fret (G-B-D-G-B-D). The D chord is at the 2nd fret (D-F-A-D-F-A). The C chord is at the 3rd fret (C-E-G-C-E-G). The E chord is at the 1st fret (E-G-B-E-G-B). The B chord is at the 7th fret (B-D-F-B-D-F). The A chord is at the 5th fret (A-C-E-A-C-E).

A MusicXML-Enabled Audio Workflow

- Step 1: Input a printed SATB score saved as a standard PDF
- Step 2: Optical Music Recognition (OMR) software scans and recognizes notation to export a MusicXML file
- Step 3: Graphical user interface (GUI) notation software imports the MusicXML file
- Step 4: Human review and manual correction of OMR syntax/symbol glitches
- Step 5: Isolate vocal parts (e.g., soloing or muting specific tracks)
- Step 6: Render and export part-dominant MP3 practice tracks



Case Study:

The Road Not Taken

- Test piece: Randall Thompson's SATB arrangement of Robert Frost's poem
- Software utilized: MuseScore Studio (Desktop application with the Audiveris OMR engine)
- Structural characteristics of the opening measures:
 - Measures 1 to 3: Piano introduction with no vocal performance
 - Measure 4: SATB vocal lines begin on the very last beat
 - MuseScore optimization: Compresses the first three measures of the bass part into a single multi-measure rest

Original
Score

Andante moderato (♩ = 70)

SOPRANO
ALTO
TENOR
BASS

PIANO

p legato

pp 5

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Bass
Part



Andante moderato (c. 70) ♩

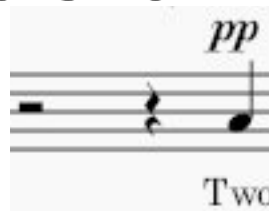
3

pp

Two roads di-verg'd in a yel - low wood And sor-ry I could not

Code Breakdown: MusicXML vs. MEI

Measure 4 contents:



MusicXML Implementation

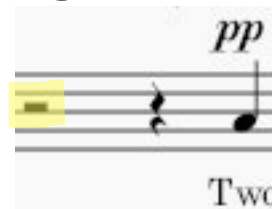
```
<measure number="4" width="171.33">
  <note default-x="12.5" default-y="-20">...</note>
  <note default-x="79.8" default-y="-20">...</note>
  <direction placement="above">...</direction>
  <note default-x="124.66" default-y="-25">...</note>
</measure>
```

MEI Implementation

```
<measure xml:id="m5whiv7" n="4">
  <staff xml:id="m2s1" n="1">
    <layer xml:id="m2s1l1" n="1">
      <rest xml:id="r24yt50" dur="2" />
      <rest xml:id="r1q586h6" dur="4" />
      <note xml:id="ndqlisi" dur="4" pname="c"
        oct="3">
        <verse xml:id="v4uysp7" n="1">
          <syl>Two</syl>
        </verse>
      </note>
    </layer>
  </staff>
  <dynam xml:id="dg1fszy" label="pp" staff="1"
    startid="#ndqlisi">pp</dynam>
</measure>
```

MusicXML vs. MEI: Half Rest

Measure 4 contents:



MusicXML Implementation

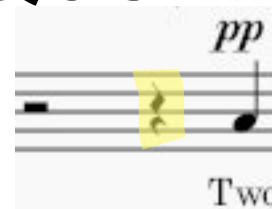
```
<measure number="4" width="171.33">
  <note default-x="12.5" default-y="-20">
    <rest/>
    <duration>8</duration>
    <voice>1</voice>
    <type>half</type>
  </note>
  <note default-x="79.8" default-y="-20">...</note>
  <direction placement="above">...</direction>
  <note default-x="124.66" default-y="-25">...</note>
</measure>
```

MEI Implementation

```
<measure xml:id="m5whiv7" n="4">
  <staff xml:id="m2s1" n="1">
    <layer xml:id="m2s1l1" n="1">
      <rest xml:id="r24yt50" dur="2" />
      <rest xml:id="r1q586h6" dur="4" />
      <note xml:id="ndqlisi" dur="4" pname="c"
        oct="3">
        <verse xml:id="v4uysp7" n="1">
          <syl>Two</syl>
        </verse>
      </note>
    </layer>
  </staff>
  <dynam xml:id="dg1fszy" label="pp" staff="1"
    startid="#ndqlisi">pp</dynam>
</measure>
```

MusicXML vs. MEI: Quarter Rest

Measure 4 contents:



MusicXML Implementation

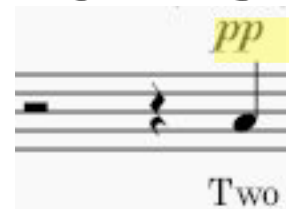
```
<measure number="4" width="171.33">
  <note default-x="12.5" default-y="-20">...</note>
  <note default-x="79.8" default-y="-20">
    <rest/>
    <duration>4</duration>
    <voice>1</voice>
    <type>quarter</type>
  </note>
  <direction placement="above">...</direction>
  <note default-x="124.66" default-y="-25">...</note>
</measure>
```

MEI Implementation

```
<measure xml:id="m5whiv7" n="4">
  <staff xml:id="m2s1" n="1">
    <layer xml:id="m2s1l1" n="1">
      <rest xml:id="r24yt50" dur="2" />
      <rest xml:id="r1q586h6" dur="4" />
      <note xml:id="ndqlisi" dur="4" pname="c"
        oct="3">
        <verse xml:id="v4uysp7" n="1">
          <syl>Two</syl>
        </verse>
      </note>
    </layer>
  </staff>
  <dynam xml:id="dg1fszy" label="pp" staff="1"
    startid="#ndqlisi">pp</dynam>
</measure>
```

MusicXML vs. MEI: Pianissimo Dynamic

Measure 4 contents:



MusicXML Implementation

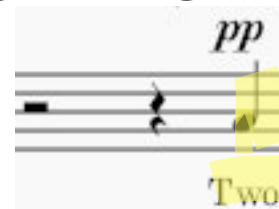
```
<measure number="4" width="171.33">
  <note default-x="12.5" default-y="-20">...</note>
  <note default-x="79.8" default-y="-20">...</note>
  <direction placement="above">
    <direction-type>
      <dynamics default-x="3.1" default-y="9.1"
        relative-y="10">
        <pp/>
      </dynamics>
    </direction-type>
    <sound dynamics="36.67"/>
  </direction>
  <note default-x="124.66" default-y="-25">...</note>
</measure>
```

MEI Implementation

```
<measure xml:id="m5whiv7" n="4">
  <staff xml:id="m2s1" n="1">
    <layer xml:id="m2s1l1" n="1">
      <rest xml:id="r24yt50" dur="2" />
      <rest xml:id="r1q586h6" dur="4" />
      <note xml:id="ndqlisi" dur="4" pname="c"
        oct="3">
        <verse xml:id="v4uysp7" n="1">
          <syl>Two</syl>
        </verse>
      </note>
    </layer>
  </staff>
  <dynam xml:id="dg1fszy" label="pp" staff="1"
    startid="#ndqlisi">pp</dynam>
</measure>
```

MusicXML vs. MEI: C Note on “Two”

Measure 4 contents:



MusicXML Implementation

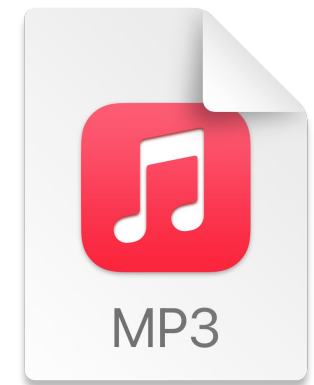
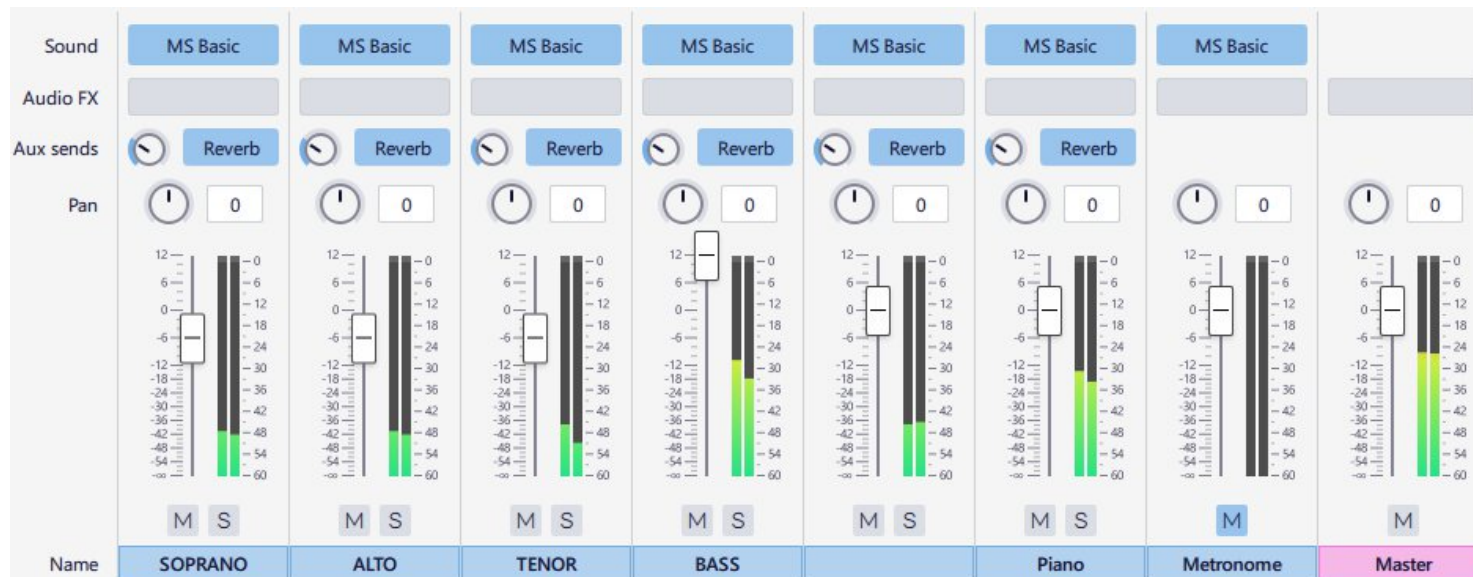
```
<measure number="4" width="171.33">
  <note default-x="12.5" default-y="-20">...</note>
  <note default-x="79.8" default-y="-20">...</note>
  <direction placement="above">...</direction>
  <note default-x="124.66" default-y="-25">
    <pitch>
      <step>C</step>
      <octave>3</octave>
    </pitch>
    <duration>4</duration>
    <voice>1</voice>
    <type>quarter</type>
    <stem>up</stem>
    <lyric number="1" default-x="6.5"
      default-y="-40.32" relative-y="-30">
      <syllabic>single</syllabic>
      <text>Two</text>
    </lyric>
  </note>
</measure>
```

MEI Implementation

```
<measure xml:id="m5whiv7" n="4">
  <staff xml:id="m2s1" n="1">
    <layer xml:id="m2s1l1" n="1">
      <rest xml:id="r24yt50" dur="2" />
      <rest xml:id="r1q586h6" dur="4" />
      <note xml:id="ndqlisi" dur="4" pname="c"
        oct="3">
        <verse xml:id="v4uysp7" n="1">
          <syl>Two</syl>
        </verse>
      </note>
    </layer>
  </staff>
  <dynam xml:id="dg1fszy" label="pp" staff="1"
    startid="#ndqlisi">pp</dynam>
</measure>
```

Final Audio Rendering

- Use mixer GUI to elevate the bass track and lower the volume of the SAT tracks
- Playback synthesizes standard choral syllables ("Aahs") for reference tracking
- Synthesis engine converts score notation to internal MIDI sequencer instructions
- Software synthesizer processes the MIDI stream directly into MP3 format



Conclusion

- Design paths diverge
- Early SGML music standards chose total abstraction
 - Valuable legacy of conceptual frameworks
 - But no commercial implementations
- MEI chose scholarly concision
 - A feature-rich home for research and complex musicology
- MusicXML chose developer simplicity
 - Markup verbosity and redundancy
 - But minimizes software development hurdle

