

Larger goals in representation: Data archiving, interchange, and analysis

MUSIC 253/CS 275A
STANFORD UNIVERSITY

Durable (non-audio) encoding projects

Single-focus

- Folk-music collections (esp. German)
- Music-manuscript finding aids

Multi-focus (vertical integration)

- MuseData (classical/orchestral-chamber)
- KernScores (classical/keyboard)
- Choral Public-domain Library (CPDL)

Characteristics of most

- Representation: Neither *time* nor *space* is a dominant consideration
- Central aim: **Repurposable data**, interoperability
- Examples
 - *Archiving*: canonical format that facilitates interoperability
 - *Interchange*: canonical format that is easily interpreted by sending and receiving systems whose formats may be unknown
 - *Analysis*: flexible format that can be modified to suit a range of needs (can sometimes be distilled from richer format)

Common distinguishing features

Monophonic encodings

- EsAC, P&E (monophonic)

Polyphonic encodings

- MuseData (polyphonic)

All ASCII

All accessible

Markup and interchange codes

- MusicXML, MEI

Essential feature sets

- Humdrum (Toolkit)

Not ASCII

Not accessible

De facto datasets (e.g. SCORE repertories)

(1) Folk music research (network)

EsAC network model (1982-1994)

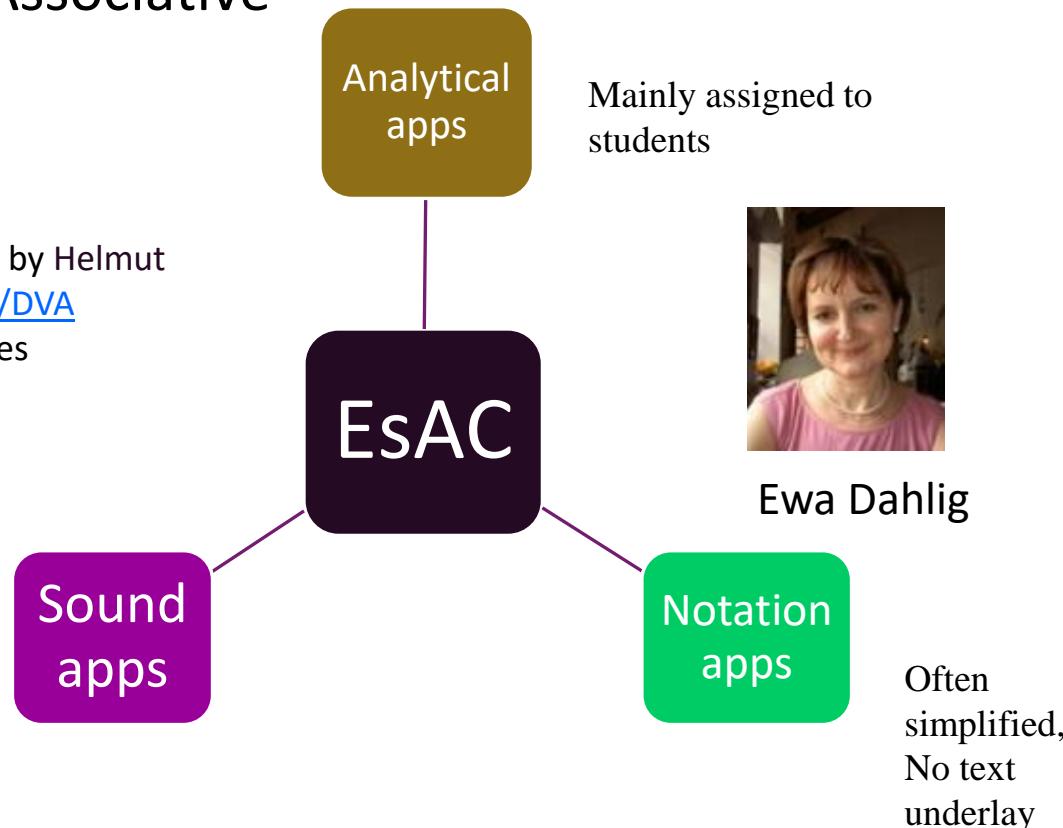
EsAC = Essen Associative

PC-era model

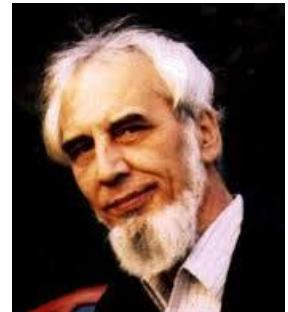
Developed in Essen, DE, by Helmut Schaffrath from the [Kiel/DVA archive](#) and other sources

esac-data.org

Often transcribed by hand

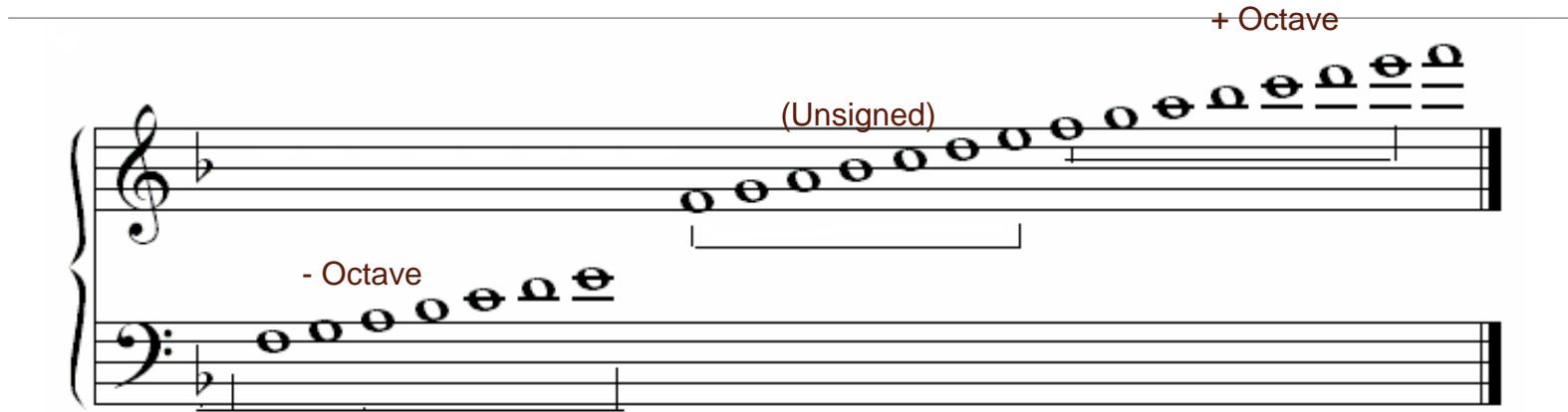


Reflected widely used 19th century typescript encoding foundation



Above: H.
Schaffrath,
L: Ewa Dahlig

Essen Associative Code (EsAC)



Music rep. in general

- **Pitch** name
- Pitch inflection
- Octave name or number

EsAC specifics

- **Pitch** = number
- Inflection = symbol
- Octave = symbol

See <http://www.esac-data.org>

EsAC code vs other codes

Pitch relative to a “tonic”

ESAC: +1 +3 +5 +3 ++1_ +5 +3 +2 +1 +6_ +1 +2 +1 7 +3 +2 +5 +4 +2#_+3_

a JIANPU: i 3 5 3 i 5 3 2 4 6 4 2 i 7 3 2 5 4 #2 3

b DARMS1: 26E 28E 30E 28E 33Q 30E 28E (etc.)

c DARMS2: 6E 8E 10E 8E 13Q 10E 8E (etc.)

d SCORE: c5/e/m/ g/e/c6/g5/e/m/ d/f/ a/ f/ d/ m (etc.)
ex4/ q/ex4/

e MTeX: \a 5 \a 7 : \a 9 \a 7 \u12 \a 9 \a 7 \u (etc.)

Duration relative to a stated value

Octave relative to central 8ve

Mozart trio (EsAC with 5 data translations)

<http://esac-data.org/>

<http://kern.humdrum.org/search?s=t&keyword=essen&type=Text>

Sample EsAC record

F [BALLADE]

CUT [Schloss in Oesterreich
Es ligt ein schlos in Ostereich,]
CNR [das ist gar wol erbawet]
REG [Mitteleuropa, Deutschland]
SRC [1, S. 250]

1549 gedruckt in Nuernberg]

KEY [Q0024A 08 F FREI]

MEL [1_ 1_2_3_4_ 5_3_1_0_
1_ 3_4_5_1_ 1_-7-6-7_1_-6_ -5_0_
5_ 5_5_6_.56_ 5_4_3_0_
6_ 5_2_3_1_ -7_1_2_3_ 212_ 1_ //] >>

FCT [Ballade, Gefangenschaft, Hinrichtung, Tod, Vergeltung]

CMT [Kleinere Melodievarianten aus anderen Quellen abgedruckt.

Refrainartiges Anhaengsel an der letzten Zeile.]

Schloss in Oesterreich Es ligt ein schlos in Ostereich,



Music one field in a text database

EsAC: Essen Folksong Collection

Monophonic music (8500 songs)

Purposes

- Archiving
- Comparing versions
- Teaching
- Sound output

Contributions

- Earliest model of analysis
(Leppig, 1987)

Code-recode comparison

R: nearest matches for
Mozart trio



Analytical recoding

Pitch and duration uncoupled

The diagram shows a comparison between a piece by Mozart and two other pieces from the collection. An arrow points from the "Code-recode comparison" box to three musical scores. The top score is labeled "First lines Mozart" and "Mozart". The middle score is labeled "B0397" and the bottom score is labeled "E0699A". All three scores are in G major, 3/4 time.

(2) Collaborative music indexing: RISM's Plaine & Easie (P&E) Code

- Designed in 1967 for music-indexing
- Most widely used in the RISM database of music manuscripts (60+ countries)
 - 60+ countries
 - 2.3 million entries (c1.75 million currently online)
 - Most fields (of 112) bibliographical; one music field for encoded incipits
 - Original purpose: to attribute anonymous manuscripts

Website: <https://rism.info/>

Advanced search



All Fields Beethoven Fifth Symphony

and Title Title

and Composer Composer

and Incipit beginning via piano keyboard (with transposition) Incipit beginning via piano keyboard (with transposition)

and Previous Searches

b'' c'' c'''

Treble Clef

Clear Search

5 result(s)

Select titles:
all none

1. Beethoven, Ludwig van <1770-1827>
Symphonies (Excerpts) - D minor; LvBWV op.125, ; KinB 125;
Manuscript copy; D-RUI Sa 118

2. Beethoven, Ludwig van <1770-1827>
Symphonies (Fragments) - C minor; LvBWV op.67, ; KinB 67;
Autograph manuscript; D-B Mus.ms.autogr. Beethoven, L. v.,
Mendelssohn-Stiftung 20

3. Beethoven, Ludwig van <1770-1827>
Symphonies - C minor; LvBWV op.67, ; KinB 67; Autograph
manuscript; D-B Mus.ms.autogr. Beethoven, L. v., Mendelssohn-
Stiftung 8

View Online ▾

Simple search

ethoven, Ludwig van: Sinfonien; orch; c-Moll; op.67 , 1807

ltext [Scanseite] - Druckseite Blättern Zoom

[1] - 1

Plaine & Easie Code

Monophonic

Industrial strength (interfaces with MARC et al.)



```
@clef:C-4  
@keysig:xF  
@timesig:c/  
@data:{8.A6A}/'4.Dt8D4.Ct8D/{8.E6C},8(A)'E4DtE/{8.Ft3GE}8(D)-2-/
```



```
@clef:F-4  
@keysig:xF  
@timesig:c  
@data:qq,3{DnF'D}r/2Fqq,3{DnF'D}r2Aqq3,{DF'D}r/b1B,qq3{EG'C}r/1A//
```

Manual: <https://www.iaml.info/plaine-easie-code>

RISM advanced search engine

Beethoven's Fifth Symphony Listing in RISM

Source description

Title on source: Sämtliche | SINFONIEN | von | L. VAN BEETHOVEN | für das Pianoforte | zu zwei und vier Händen | arrangirt von F. W. MARKULL. | Zu zwei eleganten und billigen Ausgaben. | Inhalt: | No. 5. Sinfonie ... Op. 67. C-moll zweihändig | ... | N°o. 5. vierhändig. | (193) | WOLFENBÜTTEL, | Druck und Verlag von L. Holle.

Plate or publisher number: 193

Material:

- 1 part - pf 4hands - 45 p.

Print: 1845-1855; Wulfenbüttel; Ludwig Holle, Print; 33,5 x 26,5 cm

Incipits

1.1.1 pf 4hands 1, 2/4 Allegro con brio; c



1.2.1 pf 4hands 2, 3/8 Andante con moto; A|b



1.2.2 pf 4hands 1, 3/8 Andante con moto; A|b



1.3.1 pf 4hands 2, 3/4 Allegro; c



1.3.2 pf 4hands 1, 3/4 Allegro; c



1.4.1 pf 4hands 1, c Finale -- Allegro; C

(3) Full-score repositories

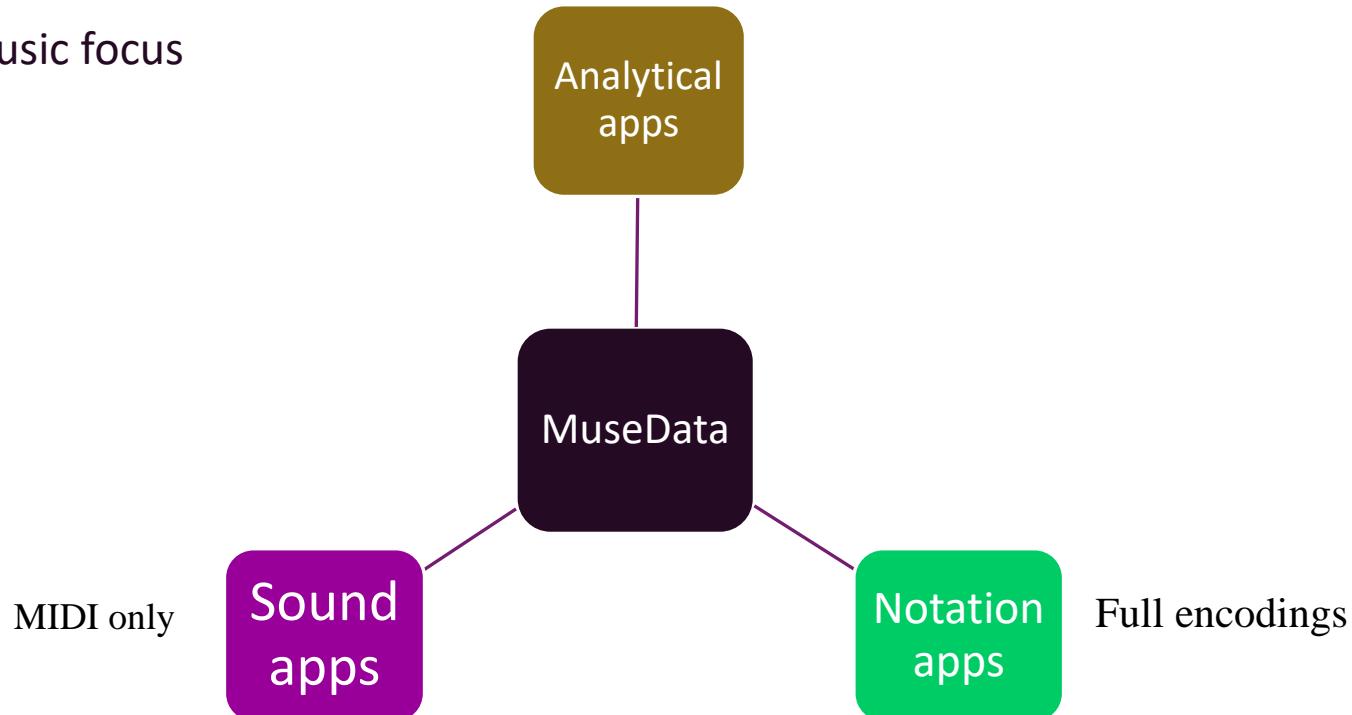
MuseData : overview



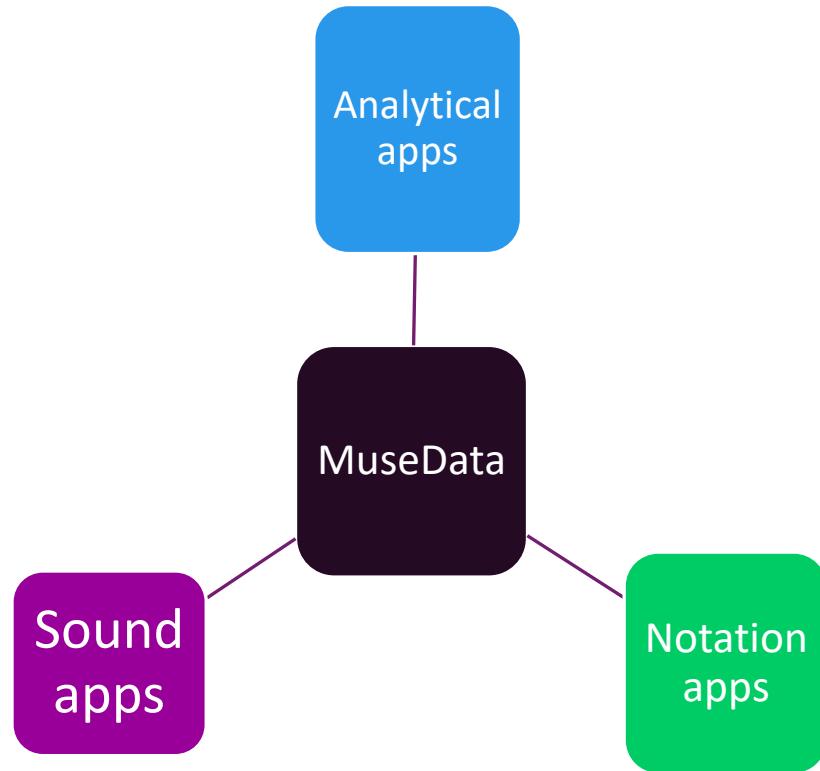
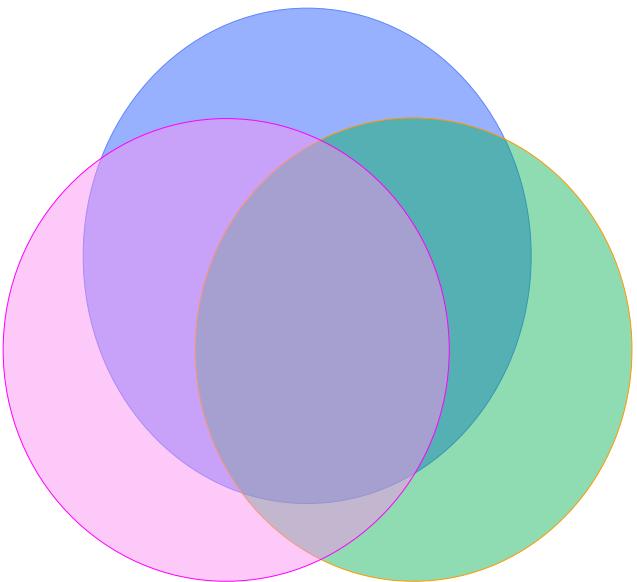
- Developed by Walter Hewlett (from 1982)
- Served by CCARH
- Many implementations, extensions, refinements by Craig Sapp
- Largest verified dataset online

MuseData's “solar” network models

Classical music focus



Comparison of models



Part/score orientation in MuseData

1. Encode voice by voice for full movement
2. Add lyrics, other refinements
3. Repeat until all movements are encode
4. Assemble score

The image shows two horizontal staves of musical notation. The top staff consists of five staves, each with a different instrument name above it: *clarinet in A*, *violin I*, *violin II*, *viola*, and *violoncello*. The bottom staff also consists of five staves, with the first three being blank and the last two containing musical notes. The notation includes various musical symbols such as clefs, sharps, flats, and rests. The entire image is framed by a thick purple border.

MuseData: encoding

old.musedata.org

Two-step process

- MIDI-level data
- Non-sounding data

Serial processes

Storage formats

- Stage 1 (pitch, duration)
- Stage 2 (stems, lyrics, etc)
- Internal format (notation)

The screenshot shows a navigation menu with links to About MuseData, Repertoires, Works and Title Numbers, Sources, Data Formats (including MuseData, Humdrum, MIDI1, and MIDI+), and Legal Considerations. Below the menu is a search bar labeled "Search: []" and a link to "[Printable Scores/Parts | MIDI1 files for listening]". The main content is a table listing compositions encoded by various composers:

composer's name	number of encoded compositions	movements (approx.)	PDF files (by work)
Johann Sebastian Bach	417	1534	51 (418 pages)
Ludwig van Beethoven	10	58	9 (1339 pages)
Arcangelo Corelli	72	363	0
Antonín Dvořák	1	0	0
George Frederick Handel	80	904	0
Franz Josef Haydn	87	352	12 (693 pages)
Benedetto Marcello	1	3	0
Wolfgang Amadeus Mozart	47	171	0
Giovanni Rovetta	1	9	0
Georg Philipp Telemann	109	553	0
Antonio Vivaldi	56	168	12

Encoding in multiple domains: Actualities



Work Information

<i>Composer</i>	Haydn, Franz Joseph
<i>Title</i>	Symphony in E-flat Major
<i>Popular Title</i>	Drumroll
<i>Scholarly catalog num.</i>	H I:103
<i>Copyright notice</i>	Copyright (c) 1994, 2000 Center for Computer Assist
<i>Copyright message</i>	Rights to all derivative editions reserved.
<i>Copyright message</i>	Refer to licensing agreement for further details.
<i>Scholarly catalogue</i>	Thematisch-bibliographisches Werkeverzeichnis (A.
<i>Derived from</i>	Dover Edition; reprint of Eulenburg Edition
<i>Encoding state</i>	stage2
<i>Error reports</i>	None [Submit error report]

Musical Data

	<i>kern</i>	<i>MIDI</i>	<i>PDF</i>	<i>SCORE</i>	<i>stage2</i>	<i>parts</i>
<i>Entire work</i>	all	all	all	all	all	
<i>By movement:</i>						
1. Adagio -- Allegro con spirto	01	01	01	01	01	01 02 03 04 05 06 07 08 09 10 11 12 13 13z14 14z15 16 17 s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11 s12
2. Andante	02	02	02	02	02	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11
3. Menuetto and Trio	03	03	03	03	03	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11
4. Finale	04	04	04	04	04	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11

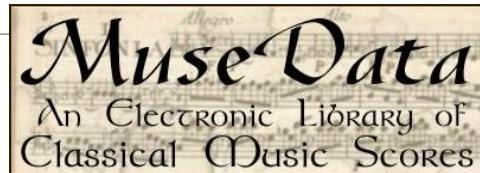
Adagio

The musical score shows ten staves for various instruments: 2 Flauti, Oboe 1, 2, Clarinet 1, 2 in B♭, Fagotto 1, 2, Corno 1, 2 in E♭, Tromba 1, 2 in E♭, Timpani in E♭, B♭, Violino I, Violino II, Viola, and Violoncello e Basso. The score includes dynamic markings like *p*, *p*, *sost.*, and *pp*. The *Solo* part is indicated for the Fagotto 1, 2 staff, and the *Solo Intrada* part is indicated for the Timpani staff. The *v.c.* marking is at the bottom of the Violoncello e Basso staff.

musedata.org

Encoding in multiple domains: samples

From PDF list



Haydn, Franz Joseph	Symphony in E-flat Major, H I:99 Symphony in G Major ("Military"), H I:100 Symphony in D Major ("The Clock"), H I:101 Symphony in B-flat Major, H I:102 Symphony in E-flat Major ("Drumroll"), H I:103
Vivaldi, Antonio	Concerto in E Major ("La Primavera"), Op. 8, No. 1 Concerto in G Minor ("L'Estate"), Op. 8, No. 2 Concerto in F Major ("L'Autunno"), Op. 8, No. 3 Concerto in F Minor ("L'Inverno"), Op. 8, No. 4 Concerto in E-flat Major ("La Tempesta di Mare"), Op. 8, No. 5 Concerto in C Major ("Il Piacere"), Op. 8, No. 6 Concerto in D Minor, Op. 8, No. 7 Concerto in G Minor, Op. 8, No. 8 Concerto in D Minor, Op. 8, No. 9 Concerto in B-flat Major ("La Caccia"), Op. 8, No. 10 Concerto in D Major, Op. 8, No. 11 Concerto in C Major, Op. 8, No. 12

From MIDI file list

Beethoven, Ludwig van	Piano Concerto No. 2 in B-flat Major, Op. 19 Violin Concerto in D Major, Op. 61 Symphony No. 5 in C Minor, Op. 67
Haydn, Franz Joseph	Symphony in D Major, H I:1 String Quartet in C Major, H III:57 Symphony in E-flat Major, H I:99 Symphony in G Major ("Military"), H I:100 Symphony in D Major ("The Clock"), H I:101 Symphony in B-flat Major, H I:102 Symphony in E-flat Major ("Drumroll"), H I:103 Symphony in D Major ("London"), H I:104

Work Information

<i>Composer</i> Haydn, Franz Joseph <i>Title</i> Symphony in E-flat Major <i>Popular Title</i> Drumroll <i>Scholarly catalogues</i> <i>Copyright notice</i> <i>Copyright message</i> <i>Copyright message</i> <i>Scholarly catalogue</i> <i>Derived from</i> <i>Encoding state</i> <i>Error reports</i>	H I:103 Copyright (c) 1994, 2000 Center for Computer Assisted Research in the Humanities Rights to all derivative editions reserved. Refer to licensing agreement for further details. Thematisch-bibliographisches Werkeverzeichnis (A. van Hoboken) Dover Edition, reprint of Eulenburg Edition stage2 None [Submit error report]
Musical Data	
<i>Entire work</i>	<i>kern</i> <i>MIDI</i> <i>PDF</i> <i>SCORE</i> <i>stage2</i> <i>parts</i>
<i>By movement:</i>	<i>all</i> <i>all</i> <i>all</i> <i>all</i> <i>all</i> <i>all</i>
1. Adagio -- Allegro con spirito	01 01 01 01 01 01 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 #01 #02 #03 #04 #05 #06 #07 #08 #09 #10 #11 #12 #13 #14 #15 #16 #17
2. Andante	02 02 02 02 02 02 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 #01 #02 #03 #04 #05 #06 #07 #08 #09 #10 #11 #12 #13 #14 #15 #16 #17
3. Menuetto and Trio	03 03 03 03 03 03 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 #01 #02 #03 #04 #05 #06 #07 #08 #09 #10 #11 #12 #13 #14 #15 #16 #17
4. Finale	04 04 04 04 04 04 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 #01 #02 #03 #04 #05 #06 #07 #08 #09 #10 #11 #12 #13 #14 #15 #16 #17 #18

MuseData uses

- Performing editions
- Study scores (see Dover Publications)
- Experimental psychology (Krumhansl, Palmer)
- Data modeling (MusicXML)
- Data interchange
- Source comparison (musicology)

Comparison of sources: Corelli Sonata Op. 5, No. 1

The image displays a musical score comparison across five sources, arranged vertically. The sources are: Corelli 1700 (top), Manchester MS 1, Geminiani, Manchester MS 2, and Corelli 1700 (bottom). The music is in common time, C major (two sharps), and consists of two staves. The top staff starts with a bass note followed by a treble note. The bottom staff starts with a bass note followed by a treble note. The notation includes various slurs, grace notes, and trills. The Geminiani and Manchester MS 2 versions show significant differences in the realization of the trills compared to the other sources.

Handel's Messiah

Halleluia chorus



46

and He shall reign for
ever and e - ver, for e ver and e ver, for
ever, and He shall reign for e ver and e - ver,
and He shall
reign, and He shall reign for e ver, for e ver and e ver, for e ver and e ver, for

Alternative readings: Vivaldi—Juditha triumphans

Notation for *viola d'amore* (retunable)

The musical score consists of four staves. The top staff is labeled "JUDITHA" and contains five blank measures. The second staff is labeled "Viola d'amore" and features a treble clef, a key signature of two flats, and a 3/8 time signature. It contains six measures of music, starting with a forte dynamic and including various slurs and grace notes. The third staff is labeled "Violin 1" and the fourth staff is labeled "Violin 2", both sharing the same treble clef, key signature, and time signature. They provide harmonic support with sustained notes and simple rhythmic patterns.

1.15 Aria: Quanto magis generosa

A close-up view of the Viola d'amore staff from the previous score, showing measures 6 through 11. The instrument plays a continuous line of eighth-note chords, primarily in the G minor chord (G-B-D). The bassoon provides harmonic support with sustained notes below the viola d'amore.

Viola d'amore (Vivaldi, Juditha)

Brentner: part for *viola d'amore* with tuning key



Viol D'amour.

March

Handwritten musical score for Viola d'amore, featuring two staves of music with various notes and rests. The first staff begins with a treble clef, and the second staff begins with a bass clef. The score is written on five-line staff paper.

