Our Vision of the Future

* The entire repertory of classical music will be available free on the internet.

* The data can be downloaded either piecemeal or in bulk for any purpose the user desires.

* Possible uses include:

<table>
<thead>
<tr>
<th>Application</th>
<th>Technology Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Searches and reference; checking data, expanding knowledge of repertory.</td>
<td>Display, search engines + indices</td>
</tr>
<tr>
<td>2. Historical and other studies; determining attribution.</td>
<td>Display, analytic tools</td>
</tr>
<tr>
<td>3. Music analysis; understanding methods of composition and modes of performance.</td>
<td>Display, possible AI applications</td>
</tr>
<tr>
<td>4. Printing of scores/parts for occasional, one-time use or for commercial publishing of both digital and hardcopy editions.</td>
<td>Display, printing at various sizes</td>
</tr>
<tr>
<td>5. Sound; listening to existing works and creating new ones.</td>
<td>Realistic artificial sound, AI applications</td>
</tr>
</tbody>
</table>

All of the above applications presuppose

* the existence of one or more massive databases of music in several formats

* with software that is able to access the data and convert it to a format desired by the user.
I suspect that there will never come a time when there is total convergence on an established set of formats for representing musical data.

Reasons:

* Music is complicated to represent
  -> and as a result, representations are often application dependent.

* Representations that attempt to be universal
  -> are complex and can be difficult to work with.
  -> For specific applications it is often easier to develop a new representation than to try to use an existing one.

* There will always be commercial opportunities in this field.
  -> Commercial enterprises will often have their own proprietary ways of representing musical data.

* This is a field which is still in early development.
  -> We can expect that new knowledge will lead to new forms of representation and more powerful and easy-to-use software.

* I expect AI will play a major role in the future design of databases and their formats.
Just as with formats, I suspect that there will never come a
time when all available musical data will be found in one massive
database.

* I view musical databases as organic entities,
  -> which grow, flourish, and eventually become obsolete;
  -> to be replaced by newer forms
  -> with the data, itself, being preserved and transformed
      as it moves from one database to the next.

* At the present time, there are perhaps several dozen public or
  semi-public databases of music.

* There may also be several times that number of private databases
  developed by individuals or small groups and used
  exclusively by them.
  -> (I am not including in this group individuals who have built
      private collections by simply downloading or purchasing
      sets of data).
How does the CCARH database fit into this picture?

<table>
<thead>
<tr>
<th>Music XML (data export)</th>
<th>----&gt;</th>
<th>CCARH source database musedata</th>
<th>&lt;-----</th>
<th>SCORE .pmx files (Leland Smith)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kern files (for analysis)</td>
<td></td>
<td>page files (scores, parts, postscript)</td>
<td></td>
<td>MIDI (sound)</td>
</tr>
</tbody>
</table>

4.
The Musedata representation is focussed on source data.

It is not driven by a specific application; nor is it particularly application friendly.

But it has the advantages of openness, adaptability, and simplicity.

Particular features of Musedata
- Flat files, organized in a Linux-type tree structure
- Accessible data, 7-bit ASCII code
- Data organized in columns. Column placement is an integral part of the format.
- Expandable
- Possible Outputs: display sound analysis hardcopy
  Other capabilities: searchability
  (using derivative database structures)

Our style of working
- The incremental method
- Structured for building and adding on
- The incremental style of programming

Database structure

The best way to understand the musedata format is to review its historical development.
Fuga I.

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Fuga I.

a4

253
846 2
Bach Gesells
chaft xiv

4 2
27 0 32 8
4 4 0 1 2
measure 1
rest 4
C4 4
D4 4
E4 4
F4 6
G4 1
F4 1
E4 4
A4 4
measure 2
D4 4
G4 6
A4 2
G4 2
F4 2
E4 2
F4 2
E4 2
D4 2
C4 2
D4 2
C4 2
B3 2
measure 3
A3 4
F#4 4
G4 12
F#4 2
E4 2
F#4 4
Fuga I.

---

253  <- number of records in this file
846 2  <- BWV (work) number, Movement number
Bach Gesells  <- source
chaft xiv

4.2  <- number of tracks; this track number
27 0 32 8  <- number of measures; key; divisions per measure; divisions per quarter note
4 4 0 1 2  <- time signature (two numbers, e.g., 4 4); clef (0 = treble clef);
measure 1  <- beginning of first measure
rest 4  <- rest; number of divisions       (1 division = 32nd note, see above)
C4 4  <- C4 is middle C; number of divisions (4 divisions = 8th note)
D4 4  <- more notes, etc.
E4 4
F4 6
G4 1
F4 1
E4 4
A4 4
measure 2  <- beginning of second measure
D4 4
G4 6  <- notice that duration includes the tie.
A4 2
G4 2
F4 2
E4 2
F4 2
E4 2
D4 2
C4 2
D4 2
C4 2
B3 2
measure 3
A3 4
F#4 4
G4 12
F#4 2
E4 2
F#4 4

---
253 253
846 2 846 2
Bach Gesells  Bach Gesells
chaff xiv  chaff xiv

4 2
27 0 32 8
4 4 0 1 2
measure 1  measure 1
rest 4  rest 32
C4 4 measure 2
D4 4 rest 28
E4 4 G4 4
F4 6 A4 4
G4 1 B4 4
F4 1 measure 3
E4 4 C5 6
A4 4 D5 1
measure 2 C5 1
D4 4 B4 4
G4 6 E5 4
A4 2 A4 4
G4 2 D5 6
F4 2 E5 2
E4 2 D5 2
F4 2 C5 2
E4 2 measure 4
D4 2 B4 2
C4 2 G4 2
D4 2 A4 2
C4 2 B4 2
B3 2 C5 2
measure 3 B4 2
A3 4 C5 2
F#4 4 D5 2
G4 12 E5 2
F#4 2 D5 2
E4 2 E5 2
F#4 4 F#5 2
Fuga I.

Bach Gesells
chaft xiv

253
B46 2
Bach Gesells
chaft xiv

4 2
27 0 32 8
4 4 0 1 2
measure 1
rest 4
C4 4
D4 4
E4 4
F4 4
G4 1
F4 1
E4 4
A4 4
measure 2
D4 4
G4 6
A4 2
G4 2
F4 2
E4 2
F4 2
E4 2
D4 2
C4 2
D4 2
C4 2
B3 2
measure 3
A3 4
F#4 4
G4 12
F#4 2
E4 2
F#4 4

<-- track 1 of 4
<-- first measure
<-- 32 divisions = 1 whole measure
<-- note 28 divisions = 16 (half note) + 4 (8th note)
<-- C5 is the C one octave above middle C
<-- D5 etc.
<-- B4 is in the middle C octave

<-- # = sharp

11.
Fuga I.

Bach Gesellschaft xiv

253 253 253
Bach Gesellschaft xiv Bach Gesellschaft xiv

4 2 4 1 4 3
4 4 0 1 2 4 4 0 1 2 4 4 0 1 2
measure 1 measure 1 measure 1
rest 4 rest 32 rest 32
C4 4 C5 6 G3 4
D4 4 D5 1 A3 4
E4 4 E5 2 E4 4
F4 6 F4 6 F4 6 F4 6
A4 2 A4 2 A4 2 A4 2
B4 4 B4 4 B4 4 B4 4
measure 2 measure 5 measure 4 measure 4
D4 4 D4 4 D4 4 D4 4
E4 2 E4 2 E4 2 E4 2
F4 2 F4 2 F4 2 F4 2
G4 2 G4 2 G4 2 G4 2

Fuga I.

Bach Gesellschaften

- 253
- 846 2
- Bach Gesellschaften
- 4 2
- 27 0 32 8
- 4 4 0 1 2
- measure 1
- rest 4
- C4 4
- D4 4
- E4 4
- F4 6
- G4 1
- F4 1
- E4 4
- A4 4
- measure 2
- D4 4
- G4 6
- A4 2
- G4 2
- F4 2
- E4 2
- F4 2
- E4 2
- D4 2

- C5 6
- C5 1
- B4 4
- E5 4
- A4 4
- D5 2
- E5 2
- D5 2
- C5 2
- B4 2

- G3 4
- A3 4
- D4 1
- B3 4
- E4 4
- G3 1
- F3 5
- A3 4
- D3 4

13.
Fuga I.

Three Problems:

1. Incompleteness

2. Inflexibility

3. Hard coding of tracks
Prelude I.

The Track Problem
Prelude I.

The Track Problem
Prelude I.

The Track Problem
Prelude VII.

The Track Problem

18.
Conversion from stage1 to stage2

---

81/87/94 W. Hewlett
WK#: B46
MU#: 2
Bach Gesellschaft
WTC I: Prelude and Fugue in C major
Fugue
Track 2
1 2

concept of group -->
4 2
memberships

Group memberships: sound openc
sound: part 2 of 4
openc: part 2 of 4
&

become the "$" record

Initial conversion from stage 1 to stage 2

measure 1 <-- removed

rest 4
c4 4
d4 4
e4 4
f4 6
g4 1
f4 1
e4 4
a4 4

measure 2

D4 4
G4 6 <-- replaced with
8th tied to 16th

measure 3

A3 4
F#4 4
G4 12 <-- replaced with
quarter tied to 8th

measure 4

19.
The column system of representation
------------------------------------------

I. Notes/Rests

columns 1-8: pitch/rest + duration (in time tics, right justified to column 8)
examples C4 D4 E4 (C4 = middle C)
Bb3 C4 D4 Ef4 (B-flat scale) E4 F#4 G4 (E-minor scale)

column 9: tie flag "-" = tie

columns 10-14: blanks (13 and 14 available for optional use)

column 15: track number (optional)

column 16: blank

columns 17-22: note description

column 17: note type (letter code, Longa to 256th note) (also cue-size notes)

column 18: dot flag (. . ; ! one dot to quadruple dot)

column 19: actual accidental flag (#, n, f, etc., 8 possibilities)

columns 20-22: Two digits, separated by a colon (:), used for tuples

column 23: stem direction u = up, d = down

column 24: staff number (" ") = 1)

column 25: blank

columns 26-31: beams (up to six levels = 256th note)
[c = start beam
= = continue beam
] = end beam
... / = forward hook
\ = backward hook

columns 32-43: other notations, in no particular order or column

Some examples: Ties, Slurs, Tuples Articulations and Accents
- = tie           > = horizontal accent
( = open slur    . = staccato
) = close slur    _ = legato

Ornaments Other Indications and Codes

\t = tr.            F = upright fermata
\r = turn           p = piano (pp, ppp, etc.)
\n = wavy line (trill) f = forte (ff, fff, etc., fp)
\M = mordent       m = mezzo (mp, mf)

Technical Indications Z = sfz (also sf)
\n = up bow         Zp = sfp
\n = down bow       R = rfz
1, 2, 3, 4, 5 = fingering + = cautionary accidental

columns 44-80: text: multiple lines of text set off by |

example: Deck|See|Fast

20.
The column system of representation

II. Bar lines
   columns 1-7:  type of bar  e.g. measure = regular bar line
                 mdouble = (light) double bar line
                 mheavy2 = light-heavy double bar
   column 8:     empty
   columns 9-12: optional bar number for this bar (left justified)
   columns 13-16: blank or for optional use
   columns 17-80: flags: some examples  F = fermata sign over bar line
                   start-end# = start ending #
                   stop-end# = stop ending #
                   disc-end# = discontinue ending # line
                   :: = repeat backward
                   :: = repeat forward

III. Musical directions:
   column 1:    "w"
   columns 2-5: blank
   columns 6-8: optional forward offset (right justified)
   columns 9-14: blank and optional information
   column 15:   track number (optional)
   column 16:   blank
   columns 17-18: type of direction (two codes possible)
                  examples:  D = left justified ASCII string
                               (may be combined with types E,F,G,H,J)
                  E = begin wedge
                  F = end wedge (may be combined with types D,G,H,J)
                  G = letter dynamics  (given in ASCII string)
                               (may be combined with types D,E,F,H,J)
                  H = begin dashes (after words)
                  J = end dashes (may be combined with types D,G)
   column 19:   location flag (optional)
   column 20:   blank
   columns 21-23: numerical parameter (e.g., wedge spread)
   column 24:   staff number ('=' = 1)
   columns 25...: ASCII word string  used in D,G

Examples:
1. cresc.   ---   ---   ---   ---   ff
   Starting record: DH    cresc.
   Ending record: JG    ff

2. f <decreasing wedge> p
   Starting record: GE 15 f
   Ending record: FG  0 p

3. <increasing wedge> p
   Starting record: E   0
   Ending record  FG 15 p
Fuga I.

$ R:8 \ Q:8 \ T:1/1 \ C1:4 \ C2:22$

Musical attributes: key, divspq, time, clefs

1. (track 1) rest duration, track, staff
2. (track 2) note data: pitch, duration, track,
   type of note, extension dot(s)
   stem direction, staff number
   beaming information

3. backup command (to start of measure)
4. (track 3) rest (staff 2)
5. backup command
6. (track 4) rest (staff 2)

Bar line

1. (track 1) half note rest
eight rest

backup command (to start of measure)
tie
Fuga I. (system 2, bars 4, 5, and 6)

measure 4
B4 2 1 s u1 [ ]
G4 2 1 s u1 ==
A4 2 1 s u1 ==
B4 2 1 s u1 ]]
C5 2 1 s u1 [ ]
B4 2 1 s u1 ==
C5 2 1 s u1 ==
D5 2 1 s u1 ]]
E5 2 1 s u1 [ ]
D5 2 1 s u1 ==
E5 2 1 s u1 ==
F#5 2 1 s # u1 ]]
G5 4 1 e u1 [ ]
B4 4 1 e u1 ]
| Bar line | (track 1) > four 16ths
| Bar line | > beamed
| Bar line | > together
| Bar line | >
| Bar line | etc.

back 32
G4 4 2 e d1 [ ]
F4 4 2 e d1 =
E4 4 2 e d1 =
D4 4 2 e d1 ]
C4 4 2 e d1
| backup command | (track 2) > four 16ths
| backup command | > beamed
| backup command | > together
| backup command | >

rest 4 2 e 1
rest 4 2 e 1
G4 4 2 e d1 -
back 32
rest 4 3 e 2
G3 4 3 e u2 [ ]
A3 4 3 e u2 ==
B3 4 3 e u2 ]]
C4 6 3 e. u2 [ ]
D4 1 3 t u2 =][
C4 1 3 t u2 ]]]
B3 4 3 e u2 [ ]
E4 4 3 e u2 ]
| backup command | (track 3) eight rest
| backup command | note data: pitch, duration, track,
| backup command | type of note, stem direction
| backup command | staff number = 2
| backup command | beaming information

back 32
rest 32 4 2
B4 2 1 s u1 [ ]
G4 2 1 s u1 ==
A4 2 1 s u1 ==
B4 2 1 s u1 ]]
C5 2 1 s u1 [ ]
B4 2 1 s u1 ==
C5 2 1 s u1 ==
D5 2 1 s u1 ]]
E5 2 1 s u1 ==
F#5 2 1 s # u1 ]]
G5 4 1 e u1 [ ]
B4 4 1 e u1 ]
| Bar line | (track 4) rest (staff 2)
| Bar line | Bar line

23.
Print Suggestions

------------------------

I. What is the purpose?

* It is possible using an automated process to produce reasonably good musical output from musedata files.

* The output can be improved by adding print suggestions to the files.

* Compactness is a desirable quality in musical output, but making something compact can introduce spacing and overstrike problems.

* It turns out that many of these clashes can be "fixed" if their vertical and/or horizontal positions can be adjusted slightly.

II. How does this work?

* For items represented in columns 32 to 43 of a note/rest record, what is needed is the column number of the item.

* If, for example, you have a fermata (F) indicated in column 35, the suggestion C35:y-10 will move the fermata up 10 units.

* A print suggestion record must follow directly after the data record and must have the letter "P" in column 1. In the example above the print suggestion record would look like this:

  P  C35:y-10

* It is possible to have more than one suggestion in a P record.

III. The print suggestion feature has many other uses:

  1. Position of slurs (over notes, under notes)
  2. Orientation of ties (overhand, underhand)
  3. Suggestions for representing beamed notes with repeaters
  4. Suggestions for musical directions
     for example: c<#> where # is between 0 and 15
     \theta = print always (default)
     bit 0 set = print in parts     bit 2 set = print if top part in score
     bit 1 set = print in score     bit 3 set = print if bottom part in score
  5. Suggestions for treatment of whole measures
     for example: Cl:] = use system justification to force
     this bar line to the end of a system.

     This is used to adjust the layout, e.g., For page turns in musical parts.
Print Suggestions (continued)
-------------------------------------

There is also a long list of general print suggestions.

The field designator for a general print suggestion is C8:
Examples of some suggestion codes:

\begin{itemize}
\item d\# = default height for time words and other musical designations.
\item f\# = default font for musical directions in "*" records
\item h\# = alter the minimum allowed space between notes
    \# = percentage of default size (100 = default)
\item k\# = various operational flags (defaults are 0)
    \begin{itemize}
    \item bit 0: (For two or more tracks)
        0 = allow overstrike when there is a dot-difference 1 = do not overstrike
    \item bit 1: (For printing new key signatures)
        0 = don't print a new key signature if it is the same as the previous one
        1 = always print a key signature even when it hasn't changed
    \item bit 2: (Chords with white and black notes)
        0 = don't allow a mixture of white and black notes in chords
        1 = allow mixture of white and black notes
    \item bit 3: (For suppression of the key signature)
        0 = normal 1 = suppress printing of the key signature (for timpani parts, etc.)
    \item bit 4: (For assigning editorial slurs)
        0 = normal (no assignment) 1 = '{ }' and "z x" combinations are editorial slurs
    \item bit 5: (For printing new clef signs)
        0 = normal (large clefs, only at start of measure) 1 = always use large clefs
    \item bit 6: (For printing sforzandos)
        0 = normal (Z = sf or sfz) 1 = abbreviated (Z = fz)
    \item bit 7: (For printing unisons in chords)
        0 = normal (side-by-side) 1 = over-strike
    \end{itemize}
\item p\# = minimum distance between notes (expressed as percent of the default).
\item q\# = duration which is assigned the minimum distance
    \begin{itemize}
    \item 0 = recompute default (from this point onward)
    \item 1 = whole notes  \ldots  8 = eighth notes, 16 = sixteenth notes, etc
    \end{itemize}
\item s\# = space between grand staffs measured in multiples of ledger lines times 10
    (e.g. 100 = 10 ledger lines).
\item t\# = global tuplet placement
    \begin{itemize}
    \item # = 0: use default
    \item # = 1: place tuplet near note heads
    \item # = 2: place tuplet near note stems (beams)
    \item # = 3: place all tuplets above notes
    \item # = 4: place all tuplets below notes
    \end{itemize}
\item v\# = location of text below music # = number of scale steps (x 10)
    (default approx. 150)
\end{itemize}

All print suggestions in a musedata file are optional and can be overridden by a music typesetting program.
THE I-FILE FORMAT
================================

* I-Files come in two types: linear and page specific.
  -> A linear file represents one voice or part in its entirety.
  -> A page specific file represents one or more parts (a musical score)
      on a single page. We call this a music page file.

* A music page file consists of a list of glyphs (characters from a music font)
  and their location on the page.
  -> A musical note, for example, consists of a note head, one or more pieces of
     stem, possibly a flag, an accidental, and some leger lines, etc., etc.

* From a technical point of view, the order of the glyphs in the list
  shouldn't matter (as long as the x,y position is specified).
  -> But for purposes of editing, some choices of ordering are better than others.
  -> Let us imagine, for example, that we want to move the musical note
     to a new (x,y) position on the page.
  -> In order for the note to stay together, we must move all parts of
     it by the same amount.
  -> It makes sense, therefore, to think of the note as a single unit, even
     though it has several parts.

* To implement this concept, we define something we call an OBJECT.
  -> The object is our basic unit of musical notation.
  -> The object may consist of several glyphs, as in the case of a note.
  -> The glyphs, themselves, we call SUB-OBJECTS, because they are members
     of the thing we call an object.
  -> The position of sub-objects is specified in relation to the object to
     which they belong.
  -> This way, if we want to move a note, we simply move the object, and
     all the parts of it (the sub-objects) will move together.

* All basic units of musical notation (objects) are attached to a STAFF LINE.
  -> It therefore makes sense to specify the location of an object in relation
     to the staff line to which it belongs.
  -> This way, if we move a staff line, all notes and other notation connected
     with that line will move together.

* All staff lines belong to a SYSTEM.
  -> A system may have one or more staff lines associated with it.
  -> As before, it makes sense to specify the location of a staff line in
     relation to the system to which it belongs.

* Systems represent the highest level in the location hierarchy on the page.
  -> The location of a system is therefore specified by absolute (x,y)
     co-ordinates on the page.

* To summarize, let us take the example of a sharp (#) attached
  to a note. The absolute (x,y) of that sharp will be:

    The absolute location of the system (x,y), plus
    the (dx,dy) offset to the staff line in the system, plus
    the (dx,dy) offset to the note on the staff line, plus
    the (dx,dy) offset to the sharp (#) from the note.
THE I-FILE FORMAT (continued)

* Much of musical notation can be represented in the manner described thus far.
  * Notes, rests, text attached to a note, musical ornaments, articulations
  * Dynamics, musical directions, bar lines,
  * Time signatures, key signatures, clefs,
  * basically anything that stands by itself on the musical page.

* There is a class of things, however, that should not be represented as objects, because the position of these things depends on the position of more than one object. Items in this class include:
  * ties, beams, slurs, tuplets (and their brackets),
  * endings, long trills, transposition lines,
  * dynamic wedges, and dashes associated with changes in dynamics, tempo, etc.

* We call this class of things, SUPER-OBJECTS, because their position (and shape) depend on more than one object.

* In actual fact, most super-objects are printed using glyphs from the music fonts.

* However, they are not represented in the music page file in this manner, because if we move a object which has a super-object associated with it, the position and the shape of that super-object (and therefore the glyphs that comprise it) will change.

* A music page file consists of list of variable length records. The order of the records is an integral part of the representation. There are 12 types of records. The character in column one of a record identifies its type.

<table>
<thead>
<tr>
<th>Record Type</th>
<th>Identifier (column 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header Record</td>
<td>Z</td>
</tr>
<tr>
<td>Page oriented text</td>
<td>X</td>
</tr>
<tr>
<td>System (page oriented)</td>
<td>S</td>
</tr>
<tr>
<td>Staff Line</td>
<td>L</td>
</tr>
<tr>
<td>Objects</td>
<td>J</td>
</tr>
<tr>
<td>Sub-objects</td>
<td>K</td>
</tr>
<tr>
<td>Text (form of sub-object)</td>
<td>T</td>
</tr>
<tr>
<td>Words (form of sub-object)</td>
<td>W</td>
</tr>
<tr>
<td>Attribute (form for sub-object)</td>
<td>A</td>
</tr>
<tr>
<td>Super-objects</td>
<td>H</td>
</tr>
<tr>
<td>End of Music Line</td>
<td>E</td>
</tr>
<tr>
<td>System Bar</td>
<td>B</td>
</tr>
</tbody>
</table>

* The basic location hierarchy is: System - Line - Object - Sub-object.
  * The order of records in the music page file reflects this hierarchy.
  * A system record remains active in the list until a new system record is encountered.
  * A staff line record remains active until an End of Music Line record is encountered.
  * Objects on a staff line are listed in the time order (left to right) in which they occur on the staff line.
  * The sub-objects that belong to an object are listed directly below the object.
  * System bars are listed after the last staff line of a system has been fully represented.
  * Page oriented text should be listed before or between systems.
  * Header records belong at the beginning of the file.
Haydn Op64, No.1, 1st movement

Allegro moderato

Violino I

Violino II

Viola

Violoncello

5

10

mf
Violino I

Violino II

Viola

Violoncello

x and y Units are in "dots"  300 dots = 1 inch.

Origin x,y = <0,0> is top left of page  x increases to the right; y increases going down

Data types (column 1): S=system, L=line, J=Object, K=Sub-object, W=word (a sub-object),
E=end of line, B=barline
All of this to indicate the position of the glyphs that are the heart of the
music printing system.

X 21
S 0 500 240 105 714 4 "[...]
L 0 0 0 0 0 * 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violino I
E *
L 210 0 0 0 0 * 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violino II
E *
L 420 0 0 0 0 * 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Viola
E *
L 630 0 0 0 0 * 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violoncello
E *
B 1 1 0

Notesize: 21 dots between staff lines
System:  x=500 y=240 is location on page.  length=105
Line: y position = 0 is offset relative to the system
J (Object)  x,y position (-326,63) offset relative to the line
W (Word)  x,y position (0,0) offset relative to the object
E indicates End of line
Line: y position = 210 is offset relative to the system
Types of Objects: N=note, R=rest, D=directive, K=key, C=clef, T=time signature, B=barline, G=grace note, Q=cue note, F=figured harmony, S=symbol

Sub-objects are music glyphs
A Word (W) is a form of sub-object

X 21
S 0 500 240 1750 714 4 "[. . . .]" length of system is now 1750 dots height is 714 dots
L 0 0 0 0 0 × 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violino I
J C 4 7 63 2 6913 0 0
K 0 0 33
K 0 0 34
E *
L 210 0 0 0 0 × 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violino II
J C 4 7 63 2 6913 0 0
K 0 0 33
K 0 0 34
E *
L 420 0 0 0 0 × 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Viola
J C 13 7 42 35 6913 0 0
J Object is a Clef x,y position (7,63) is offset relative to the line
K is Sub-Object (a glyph) The treble clef is made up of
two glyphs, 33 and 34

In this case, the Object is the glyph (glyph number is 35).

E *
L 630 0 0 0 0 × 0 21 0
J D 0 -326 63 1 6913 0 0
W 0 0 39 Violoncello
J C 22 7 21 36 6913 0 0
E *
B 1 1 0
S 0 500 240 1750 714 4 "{. . . . .}"
L 0 0 0 0 0 * 0 21 0
(lines removed to create space)
J B 1 230 1 82 6913 576 0
J N 8 262 185 7 1 0 0
K 1 0 45
K 0 0 42
K -1 0 45
K 5 0 45
K 0 0 59
K 0 -32 59
A D 24 48
J N 6 371 84 3 3457 1152 2 1 2
K 0 0 43
K 36 -9 44
A D 9 48
J N 5 429 185 5 4753 432 2 2 1
K 1 0 45
K 0 0 43
K -1 0 45
K 5 0 45
A D 3 48
H 2 B 72 4 112 2 2 53
H 1 S 12 0 0 0 0 0 0 0
J N 6 469 73 3 5185 144 2 3 4
K 0 0 43
K 38 0 44
A D 9 48
J N 5 527 94 2 6481 432 2 4 3
K 0 0 43
A D 3 48
H 4 B 61 4 112 2 2 53
H 3 S 12 0 0 0 0 0 0 0
J B 2 568 1 82 6913 144 0
E *
L 210 0 0 0 0 * 0 21 0
J D 0 -326 63 1 6913 0 0
etc.

Object: Barline (bar 1) Glyph-82
Object: Next note, half-note
   lots of Sub-objects (glyhgs) to display this

This note object has 2 super-objects (nos. 1 and 2)
   Super-object 1 is a slur; super-object 2 is a beam.
   The stems will be added when the beam is drawn.

This note object has 2 super-objects (nos. 1 and 2)
   The stems will be added when the beam is drawn.

H Super-object number 2: This one a beam
H Super-object number 1: This one a slur

(Two more super-objects)

Object: Barline (bar 2) Glyph-82

Next staff lines
Preludium

X 46 575 120 Praeludium IV.
S 0 580 240 1750 226 1 "{(.)}"
L 0 0 0 0 0 × 170 14
J D 0 -300 42 1 6913 0 0
W 0 0 39
J C 4 5 42 2 6913 0 0
K 0 0 33
K 0 0 34
J C 22 5 1814 36 6913 0 0
J K 4 57 0 4 6913 0 0
K 0 0 63
K 15 21 63
K 30 -7 63
K 45 14 63
J K 4 57 1000 4 6913 0 0
K 0 14 63
K 15 35 63
K 30 7 63
K 45 28 63
J T 684 142 0 2 6913 0 0
K -10 28 77
K -10 56 75
J T 684 142 1000 2 6913 0 0
K -10 28 77
K -10 56 75
J N 6 181 42 2 1 0 1 1
K 0 0 43
A D 1 8
J N 9 181 1035 3 1 0 1 2
K 0 0 41
K 32 0 44
A D 12 8
J N 6 222 49 2 577 288 1 1
K 0 0 43
A D 1 8
J N 6 263 56 2 1153 288 1 1
K 0 0 43
A D 1 8
J N 6 384 63 2 1729 288 1 1
K 0 0 43
A D 1 8
J N 6 345 56 2 2305 288 1 1
K 0 0 43
A D 1 8
J N 6 386 70 5 2881 288 1 1
K 1 0 45
K 0 0 43
K -1 0 45
K 2 0 45
A D 1 8
H 1 B 45 2 108 6 2 1 1 1 1 3
J N 7 427 21 5 3457 288 0
Super Object: Beam (six notes)
Object: Note C#5

Text Record: Title
System No. 1
Lines No. 1 & 2
Object: Clef
Object: 2nd Clef
Object: Key signature
Object: 2nd Key signature
Object: Time signature
Object: 2nd Time signature
Object: Note G#4
Attribute: duration 1/8th
Object: Note C3 (2nd line)
Sub-object: note head
Sub-object: dot
Attribute: duration 12 8ths
Object: Note F#4

Object: Note E4
Object: Note D#4
Object: Note E4
Object: Note C#4

36.
### Glyph Numbers for the Music Font

4.1 The glyph numbers appear mainly as the fourth field of sub-objects. Occasionally one finds a glyph number in field 6 of an object. The table below shows the shapes assigned to the various glyph numbers.

<table>
<thead>
<tr>
<th>1. large clefs</th>
<th>7. full size stems</th>
<th>12. vertical lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 treble (top)</td>
<td>59 full length up</td>
<td>82 full length bar</td>
</tr>
<tr>
<td>34 treble (bottom)</td>
<td>60 full length down</td>
<td>83 quarter length bar</td>
</tr>
<tr>
<td>35 C-clef</td>
<td>61 notesize up</td>
<td>84 full leng. thick bar</td>
</tr>
<tr>
<td>36 bass</td>
<td>62 notesize down</td>
<td>85 qtr. length thick bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>86 full leng. dotted bar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. large time signatures</th>
<th>8. accidentals</th>
<th>13. horizontal lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 common time</td>
<td>63 sharp</td>
<td>89 begin/end hook</td>
</tr>
<tr>
<td>38 alle breve time</td>
<td>64 natural</td>
<td>90 solid line (30 dots)</td>
</tr>
<tr>
<td></td>
<td>65 flat</td>
<td>91 dash line (30 dots)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. full-size note heads</th>
<th>9. editorial brackets</th>
<th>14. articulations (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>39 longa</td>
<td>90 double sharp</td>
<td>93 horizontal accent</td>
</tr>
<tr>
<td>40 breave</td>
<td></td>
<td>94 ^ accent</td>
</tr>
<tr>
<td>41 whole</td>
<td>91 square left</td>
<td>95 ^ accent</td>
</tr>
<tr>
<td>42 half</td>
<td>92 square right</td>
<td>96 staccato dot</td>
</tr>
<tr>
<td>43 quarter</td>
<td>93 round left</td>
<td>97 ^ stricht</td>
</tr>
<tr>
<td></td>
<td>78 round right</td>
<td>98 ^ stricht</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. full-size dot, leger line</th>
<th>10. big numbers</th>
<th>15. repetition (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44 dot</td>
<td>71 0</td>
<td>186 signet sign</td>
</tr>
<tr>
<td>45 leger line</td>
<td>72 1</td>
<td>107 circle + cross sign</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. full-size rests</th>
<th>11. staff lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 whole</td>
<td>81 full-size staff</td>
</tr>
<tr>
<td>47 half</td>
<td></td>
</tr>
<tr>
<td>48 quarter</td>
<td></td>
</tr>
<tr>
<td>49 eighth</td>
<td></td>
</tr>
<tr>
<td>50 add-eighth</td>
<td></td>
</tr>
<tr>
<td>51 short up-eighth</td>
<td></td>
</tr>
<tr>
<td>52 short down-eighth</td>
<td></td>
</tr>
<tr>
<td>53 up-eighth</td>
<td></td>
</tr>
<tr>
<td>54 down-eighth</td>
<td></td>
</tr>
<tr>
<td>55 up-sixteenth</td>
<td></td>
</tr>
<tr>
<td>56 down-sixteenth</td>
<td></td>
</tr>
<tr>
<td>57 up-add-flag</td>
<td></td>
</tr>
<tr>
<td>58 down-add-flag</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. full size flags</th>
<th>16. dynamics (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 short up-eighth</td>
<td>188 p</td>
</tr>
<tr>
<td>52 short down-eighth</td>
<td>189 m</td>
</tr>
<tr>
<td>53 up-eighth</td>
<td>110 f</td>
</tr>
<tr>
<td>54 down-eighth</td>
<td>111 s</td>
</tr>
<tr>
<td>55 up-sixteenth</td>
<td>112 z</td>
</tr>
<tr>
<td>56 down-sixteenth</td>
<td>113 r</td>
</tr>
</tbody>
</table>

37.
Final summary
-----------------------------------

* Early databases in music consisted mainly of the captured keystrokes from the data entry portion of music display programs.
  \( \rightarrow \) DARMS, Plaine-and-easie, and SCORE .mus files are three examples that come to mind.

* The next step up was the development of data formats that were used directly by music printing programs.
  \( \rightarrow \) The SCORE .pmx files and the Finale Enigma files are two that fall in this category.

* The next step up is what I would call application independent databases.
  \( \rightarrow \) Our musedata format, the humdrum format and the MEI format are three examples.

* What sets application independent databases apart from the others is that they seek to represent the various elements of music independent of whatever software might be written to use the data.

* Our goal in setting up the format for musedata was to provide a way to encode vast quantities of historical musical literature --
  \( \rightarrow \) literature that is now fixed in time and doesn't for the most part change, and
  \( \rightarrow \) literature for which the coding could be done once and not have to be redone every time a new edition is created.