From Sound to Input and Output

MUSIC 253/CS 275A
STANFORD UNIVERSITY
Experimental MIDI controllers

- **Yamaha Tenori-on** controller for “drawing” music input
- **Haken Audio Continuum**: High-end audio
- **Roli Seaboard Rise**: gesture
- **MIDI controller with iPhone cradle**
- **Linnstrument**: (expression)
Alternative MIDI instruments

MIDI horn: Gary Lee Nelson
MIDI trumpet: Dexter Morrell
MIDI chelletto ("little cello"): Chris Chafe Chafe
MIDI violin: Yamaha
MIDI guitar: Zeta Music/Gibson

Akai wind Controller (2016)
MIDI as an adjunct to other sound tech

MIDI data can be synchronized with other kinds of data
- Video, animations
- Electronic instruments
- Software routines

https://www.youtube.com/watch?v=3ZOzUVD4oLg

Max Mathews’ Radio Baton
“Pitch” in MIDI = key number

- Absolute (MIDI C's)
  - 36 etc.
  - 48 C 8ve below Middle C
  - 60 Middle C
  - 72 C 8ve above Middle C
  - 84 etc.

Manufacturing variations:
Middle C = 60
Middle C = 48
Key-number pitch is *absolute*; Tonal music notation pitch is *relative*.

- **Absolute key number**
  - 36 etc.
  - 48 C 8ve below Middle C
  - 60 Middle C
  - 72 C 8ve above Middle C
  - 84 etc.

- **Absolute pitch** = “70”

- **Single factor**

- **Tonal pitch names are contextual**
  - A#/Bb

*Guido: separation of name and inflection*
  - CC
  - C
  - c (Middle C)
  - c'
  - c"
Data divergence (sound/notation)

Event-based system

Sounding pitch captured in MIDI

Transposing instruments
“Black notes” only representation means **no distinction** between A#/Bb
MIDI transcription

Debussy: “Clair de lune”
- Via MIDI transcription
- Via print
**Duration: Implied vs. real (MIDI)**

*Upper row:* The first six notes of this piece are written in notes of equal duration. == **Quantized**

*Lower row:* The actual sounding durations are variable. == **Unquantized**
Tempo and quantization

Software may have tempo controls; MIDI hardware does not

Quantized MIDI files suited to transcription

Unquantized MIDI files: expressive, not suited to transcription
Sequencers

- Piano roll
- Event list
- Staff notation
- Virtual keyboard

Online sequencer:
https://onlinesequencer.net/
MIDI data organization

Event-based system

Part- major systems

Affects Finale, Sibelius
Early MIDI file types

Vertically organized

- 0 = monophonic music [merged single track]
- 1 = polyphonic music [multiple tracks]

Horizontally organized

- 2 = accommodates rhythmically independent tracks

See MMA file: http://www.midi.org/aboutmidi/tut_midifiles.php
MIDI data for notation

“Pitch” < Key number

“Duration” = Clock time

- Articulation
  - But pizzicato = Gen. MIDI 45
  - Staccato

Dynamic range < velocity

“Tempo”

- < ratio of quarter to whole

Meta-events

- Key signature
- Meter signature
- Lyrics
- Copyright notice

Example 1.1 Second trio from the Mozart Clarinet Quintet, K. 581 (“Mozart trio”).
“Chunks” (file sections)

- **Header chunks** (MThd): what to expect in the data
  - Byte segments address
  - Chunk type
  - Header length
  - Number of tracks
  - Meaning of *delta* times
  - Time code
  - Slight differences by format type (0, 1, 2)
- **Track chunks** (MTrk):
Standard MIDI File Format (SMFF)

“Chunks” (file sections)
  ◦ Header chunks (MThd)
  ◦ **Track chunks** (MTrk): sequential data
    ◦ Iterative process
      ◦ Delta [difference] time [elapsed time since last even]
    ◦ Event
  ◦ Event types
    ◦ **MIDI events** (note on, note off et al.)
    ◦ **Meta-events** (see above; often textual)
    ◦ **System-exclusive events** (hardware-specific, proprietary)
## General MIDI “instruments”

<table>
<thead>
<tr>
<th>TIMBRE</th>
<th>GENERAL MIDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>256 slots (extended set)</td>
</tr>
<tr>
<td></td>
<td>• 128 standard</td>
</tr>
<tr>
<td></td>
<td>• 128 proprietary</td>
</tr>
<tr>
<td>Woodwind</td>
<td>Many synthetic slots</td>
</tr>
<tr>
<td>Brass</td>
<td>Quality varies by category</td>
</tr>
<tr>
<td>Percussion</td>
<td>• Strings</td>
</tr>
<tr>
<td>Voice</td>
<td>• Woodwind</td>
</tr>
<tr>
<td></td>
<td>• Brass</td>
</tr>
<tr>
<td></td>
<td>• Percussion</td>
</tr>
<tr>
<td></td>
<td>• Tuned and/or “dry” percussion</td>
</tr>
<tr>
<td></td>
<td>• Voice (try MIDI Oohs and aahs)</td>
</tr>
</tbody>
</table>

**Standard MIDI file format**
- Level 1 1988
- Level II—1999