

2018 Fall
CTP431: Music and Audio Computing

Musical Interface and Sequencer

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Musical Instrument

- Performers interact with instruments in various ways
 - key striking, plucking, blowing, bowing
 - Expressions: continuous/discrete, dynamics, subtlety
 - Monophonic / polyphony
 - Learning curve, virtuosity, challenge/boredom for different musical instruments



Digital Musical Instrument (DMI)

- In DMI, controller and tone generator are de-coupled
 - Controller: capture gesture data and convert them to musical events
 - Tone generator: synthesize musical tones



Musical Controllers



MIDI Keyboard



AXiS-64

<https://www.youtube.com/watch?v=pQ4nPcGCGIs>



Haken Continuum

<https://www.youtube.com/watch?v=PnBhR8RLJN8>



Pad
Controller

Musical Controllers



Wind Controller



Guitar Controller



Drum Controller

New Controllers



Radio Baton (by Max Mathews)



Virtual Slide Guitar

<https://www.youtube.com/watch?v=alJ-8kd8rFs>

<https://www.youtube.com/watch?v=3ZOzUVd4oLg>

New Controllers



Reactable

<https://www.youtube.com/watch?v=Mgy1S8qymx0>

Guthman Musical Instrument Competition:
<http://www.guthman.gatech.edu/>

NIME (New Interfaces for Music Expressions):
<http://www.nime.org/>

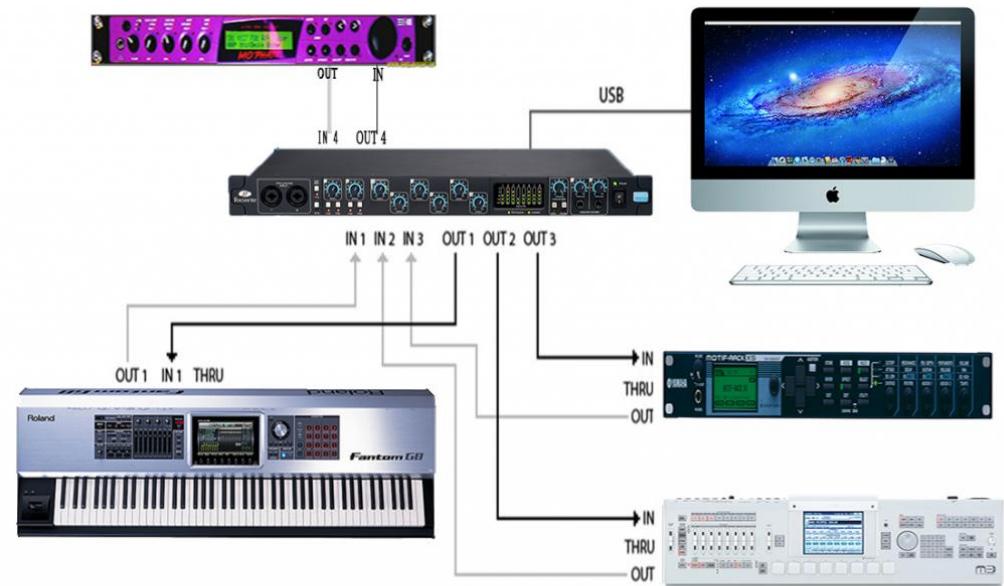
Inside the Controllers

- Sensors
 - Button (or switch), potentiometer (knob), resistive (rubber, photo-resister), optical, accelerometer, gyro, microphone, camera...
 - Physical actions: push, rotation, velocity, pressure, location, ...
 - <http://www.sensorwiki.org/doku.php>
- Micro controllers
 - AD converter (continuous input), input port (discrete input)
 - Map the captured input to musical protocols: MIDI, Open Sound Control (OSC)



Musical Instrument Digital Interface (MIDI)

- Standard protocol of musical events
- Why MIDI?
 - Need of musical communication among different vendors' instruments
 - Store music events (score or performance) for composers
- Hardware
 - 5-pin cables, separate in/out in coils
 - 31250 bits per second
- Software (Protocols)
 - Note number/velocity, control data



MIDI Message Format

	Status Byte	Data Byte1	Data Byte2
Note Off	1000 xxxx	Note Number	Velocity
Note On	1001 xxxx	Note Number	Velocity
Note Pressure	1010 xxxx	Note Number	Velocity
Control Change	1011 xxxx	Ctrl. Number	Ctrl Value
Program Change	1100 xxxx	Prog. Number	-

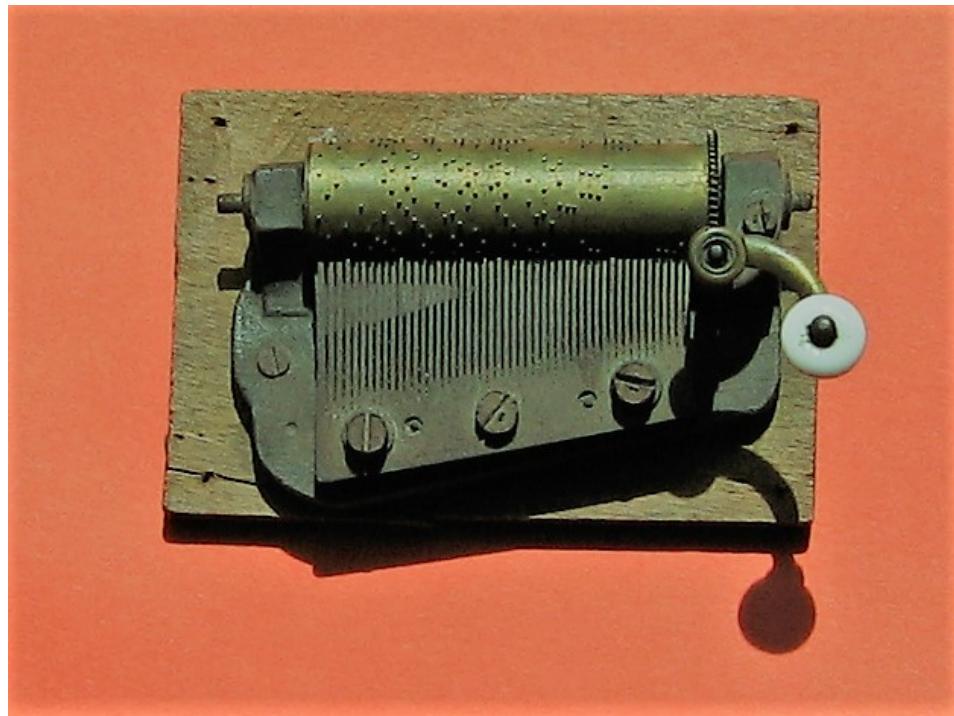
xxxx: channel number (0-15) Data byte: 0-127 (MSB is 0)

Web MIDI

- Support MIDI on web browsers
 - W3C Editor's draft: <http://webaudio.github.io/web-midi-api/>

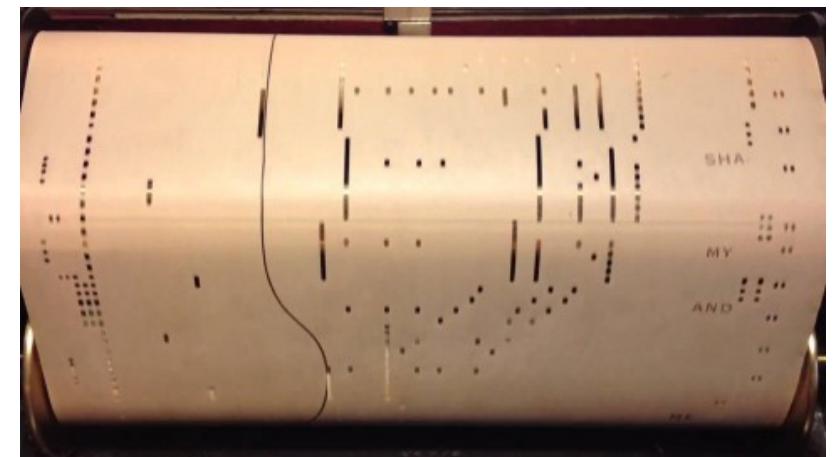
Sequencer

- Music Box: the oldest sequencer?



Sequencer

- Piano Roll (in player piano)



Piano Roll

Disklavier



Step Sequencer

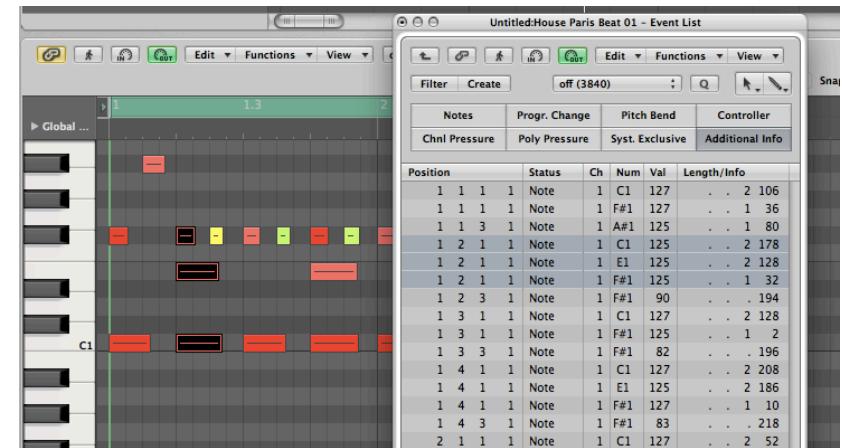


Roland TR-808
(Analog Sequencer + Drum Machine)

<https://www.youtube.com/watch?v=YeZZk2czG1c>

MIDI Sequencer

- Record, Edit and Playback MIDI Messages
 - Tempo (BPM) and time stamps are added
 - Time-stamped MIDI messages are stored as a MIDI file
- MIDI Representations
 - MIDI Events
 - Piano Rolls
 - Music Notation (Music Score)
- Most DAWs have MIDI sequencers
 - Sonar, Cubase, Logic, ...



Web Examples

- Step Sequencers
 - <http://webaudiodeemos.appspot.com/MIDIDrums/index.html>
 - <http://patterns.sketch.com/>
 - <https://io808.com/>
 - <https://mohayonao.github.io/cubic-sequencer/>
- Piano-Roll-type Sequencers
 - <https://onlinesequencer.net/>