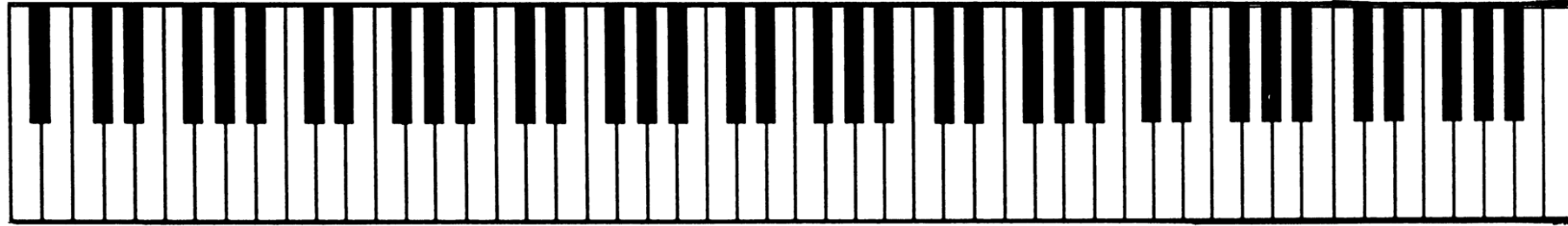


MIDI and extended pitches

Tuning and Temperament

“Pitch”: Notated pitch *relative* to key



- Absolute key number Pitch names are **contextual**
 - 36 etc.
 - 48 C 8ve below Middle C
 - 60 Middle C
 - 72 C 8ve above Middle C
 - 84 etc.
- Absolute pitch = “90”

F#/Gb/E##

MIDI: Tuning, temperament, expression

- Max Mathews, CCRMA: Radio Baton (emphasized expression—tempo, dynamics)
 - <https://www.youtube.com/watch?v=3ZOzUVD4oLg>

Pitch and timbre: Music V and CSound

- **Approaches that define sounds**

- Music V: Max Mathews (Bell Labs, 1960s, 1970s)

- Csound: Barry Vercoe (MIT, 1980s, 1990s)

- score

- scot

- Strengths:

- **decimal** system using **cents** (**frequency**)

- Instruments can be arbitrary (scot)

- Arbitrary objects can be encoded (*pling* command)

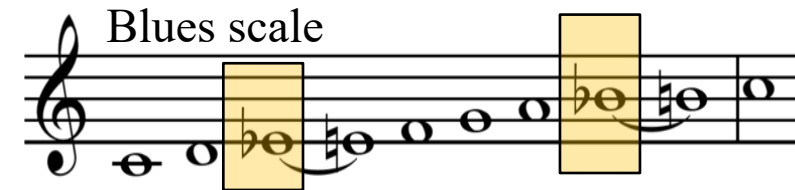
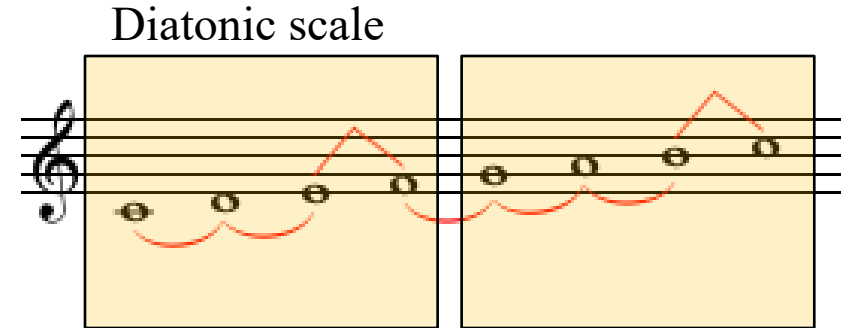
- **Canonical Csound Reference Manual:** <http://csounds.com/manual/html/indexframes.html>

Tutorial: <https://www.youtube.com/watch?v=rkBIUrJoJ3Y>

Shortcomings: tuning, Temperament

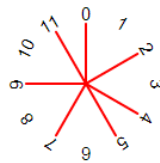
Pitch

- Non-Western
- Non-equally tempered
- Interpretation of accidentals (inflections)

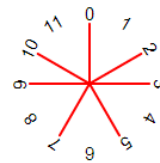


Modes vs. chromatic scale

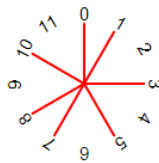
Ionian Mode (I)



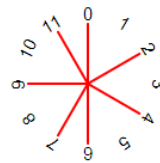
Dorian Mode (II)



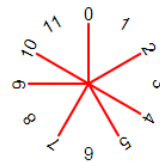
Phrygian Mode (III)



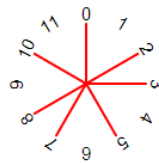
Lydian Mode (IV)



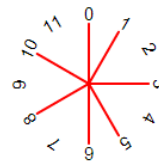
Mixolydian Mode (V)



Aeolian Mode (VI)

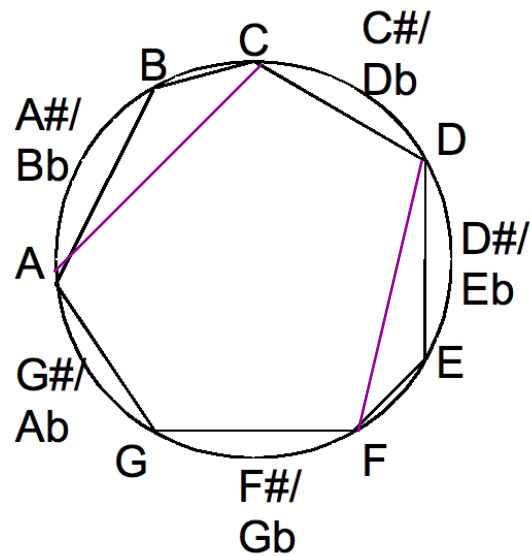


Locrian Mode (VII)



Mapping (or not) to the chromatic scale

- Diatonic=8 tones
- **Chromatic=12 tones**
- Pentatonic=5 tones



Lady playing tanpura, c. 1735

MIDI vis-à-vis Notation

- Enharmonic accuracy hard to guarantee when input is MIDI-based
- Inherent non-alignment of key numbers vis-à-vis note names
- One more bit-based MIDI extension: Hewlett's MIDIPlus
- See <https://patents.google.com/patent/US5675100A/en?inventor=Hewlett+Walter+B.&q=Hewlett+Walter+B.>

Method for enharmonic accuracy

Key number = 90

Note name depends on **context**

Captured bit specifies name:

00 not known

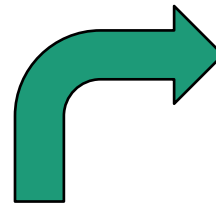
01 Gb

10 F#

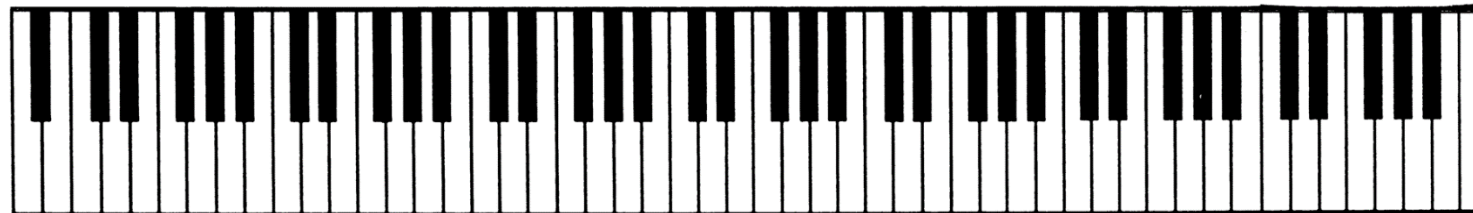
11 Ex (E##)

Pitch names are **contextual**

F#/Gb/E##



BINARY →	x	64	32	16	8	4	2	1
DECIMAL ↓								
88		1	0	1	1	0	0	0
89		1	0	1	1	0	0	1
90		1	0	1	1	0	1	0
91		1	0	1	1	0	1	1
92		1	0	1	1	1	0	0



MIDI Plus

(How to make MIDI enharmonically accurate)

- **Method**

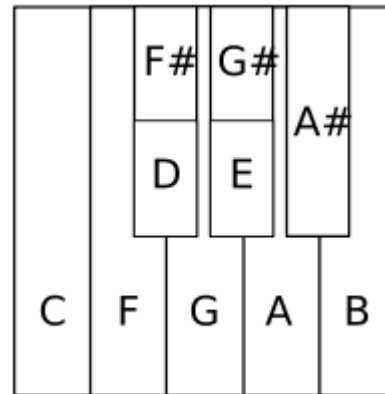
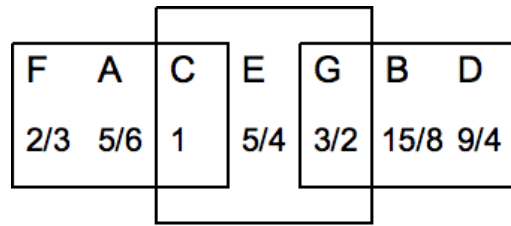
Reassign two bits from velocity byte

- US Patent #5675100 (1996)
- http://www.google.com/patents?id=6RclAAAAEBAJ&pg=PA2&source=gbs_selected_pages&cad=4#v=onepage&q&f=false

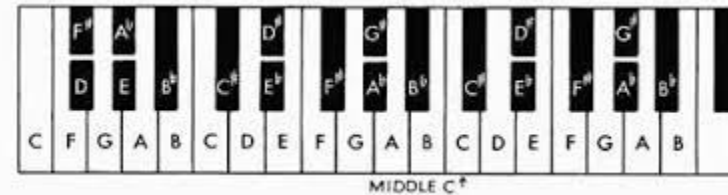
BINARY → DECIMAL ↓	x	64	32	16	8	4	2	1
88		1	0	1	1	0	0	0
89		1	0	1	1	0	0	1
90		1	0	1	1	0	1	0
91		1	0	1	1	0	1	1
92		1	0	1	1	1	0	0

Non-equal temperament

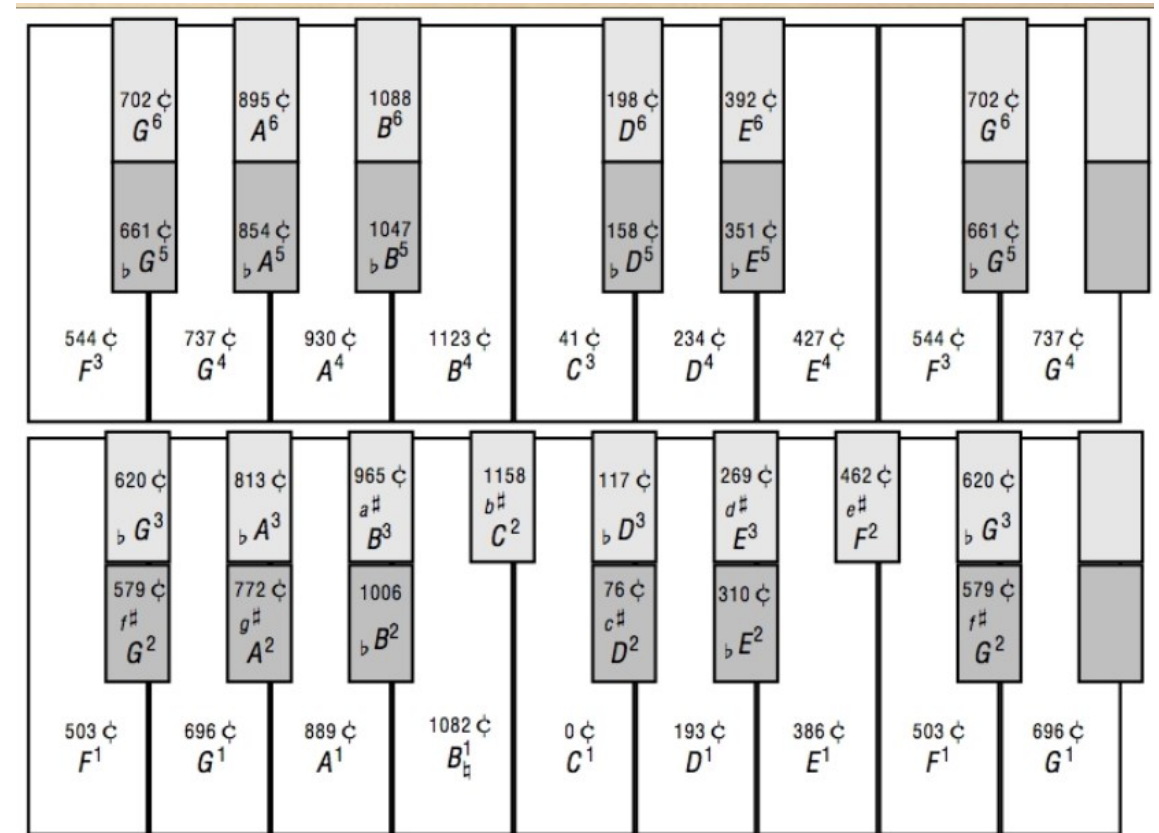
- Baroque tunings
 - “Just” intonation
 - Meantone
 - Werckmeister III



- Arbitrary 8ve arrangements (“short octaves”, split keys)



Vicentino's enharmonic harpsichord (pitch equivalents in cents)



Music for enharmonic harpsichord (from c. 1550) by Martino Pesenti (c. 1650)

Roland digital harpsichord series (1988--)

Three modes

- Equal-tempered

- Meantone

- Werckmeister III

Two acoustic contexts

- Room

- Hall

Two “instruments”

- Organ

- Harpsichord

Five “stops”

- Harpsichord 1-manual

- Harpsichord 2-manual

- Flemish

- Lute

...

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



MIDI in use: Historical vs digital harpsichords

- Original 16th-century instrument: National Music Museum, Vermilion, SD
 - <https://www.youtube.com/watch?v=aq9iwjyq6u0>
- Alteration of tuning, temperament
 - https://www.youtube.com/watch?v=W2gOI1p_0iM [Vallotti tuning, English Renaissance music]
- Split keys, Renaissance harpsichords:
 - <https://www.youtube.com/watch?v=D00veRacKH0>