Converting MIDI Notes to ABC Notes in Pencil Code

By Jesse M. Heines

Comparing Scratch [4] to Pencil Code [3] for teaching computing through music immediately reveals a major difference: Scratch represents notes as MIDI numbers, while Pencil Code represents notes as letters using ABC notation [1]. To someone who reads music, Pencil Code is clearly preferable because it is far easier to map for, example, a major third to C and E than 60 and 64. But to those who generate music algorithmically, ABC is not as easy as MIDI. For example, a major third in the key of D is not D and E; it is D and F#. Using MIDI values, however, the interval is always 4 semitones: 62 (D) + 4 = 66 (F#), just as before.

The Problem: Pencil Code is written in CoffeeScript [4], “a little language that compiles into JavaScript.” Thus, one would think to use the `string.fromChar` Code function to convert numeric MIDI to alphabetic ABC. Unfortunately, the conversion is not that straightforward, because ABC notation is based on a C scale, with A and B above G. That throws out a simple conversion. The 4th octave, the one that begins on middle C, is represented by all capital letters: C D E F G A B. For the 5th octave, apostrophes are added: C’ D’ E’ F’ G’ A’ B’. For the 6th octave, two apostrophes are added, and so on to the higher octaves. For the 3rd octave, the one below middle C, commas are added: C, D, E, F, G, A, B. And, as you can probably guess from the pattern, for the 2nd octave, two commas are added and so on to the lower octaves.

A Solution: If one wants both the clarity of ABC notation and the algorithmic power of MIDI values, a conversion is indeed necessary. The code below runs in Pencil Code and plays the chromatic scale from C3 to C6 by passing MIDI values 48 (C3) through 84 (C6) to a `MIDItoABC` function that is generalized to convert any MIDI value to its proper representation in ABC notation and play it for a specified duration.

A Note on ABC Duration Notation: Unrelated to MIDI but germane to ABC, duration strings are based on quarter notes, which have a duration of 1. A half note has a duration of 2, and a whole note a duration of 4. Going the other way, an eighth note has a duration of 1/2, designated as “2”. Similarly, a 16th note has a duration of “4”, and a 32nd note has a duration of “8”.

The code below includes a test routine to play the chromatic scale from C3 to C6 with random note durations from a half note (“2”) to a 32nd note (“8”).

```coffeescript
# PencilCode script to convert MIDI numbers to ABC notation notes
# by Jesse M. Heines, Umass Lowell, Version 4.2, February 2, 2016

# define an array of chromatric notes beginning with middle C

# function to convert a MIDI number to an ABC note
MIDItoABC = (midi, duration=1) ->

  # test that a MIDI number has been supplied
  if midi is undefined
    return NaN

  # compute desired octave (octave 4 starts at middle C)
octave = parseInt((midi-12)/12)

  # initialize the suffix string of commas or apostrophes
  suffix = ""

  # add commas or apostrophes as appropriate for desired octave
  if octave < 4
    suffix += "," for [1..abs(octave-4)]
  else if octave > 4
    suffix += "'" for [1..octave-4]
  
  # return value
  MIDImap[midi % 12] + suffix + duration

# test: play chromatic C3 to C6 with random note durations
for k in [16..01]
  duration = random ["2", ",2", ",/2", ",/4", ",/8"]
  play MIDItoABC(k, duration)
```

References
1. ABC Notation: http://abcnotation.com

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