

# MidiTrans


A visual language for manipulating  
standard MIDI files

*Roger Hartley*

A musical staff with five lines, featuring several notes with stems and flags. The notes are positioned on the first, second, and third lines from the bottom. The title 'MidiTrans Overview' is centered on the staff in a blue, sans-serif font.

# MidiTrans Overview

- a general purpose visual language
- special purpose structures and operations for standard MIDI files
- meant to work closely with Windows-based sequencers
- it compares to Cakewalk's CAL, and Opcode's MAX

A musical staff with five lines, featuring several notes with stems and flags. The notes are positioned on the first, second, and third lines from the bottom. The title text is centered over the staff.

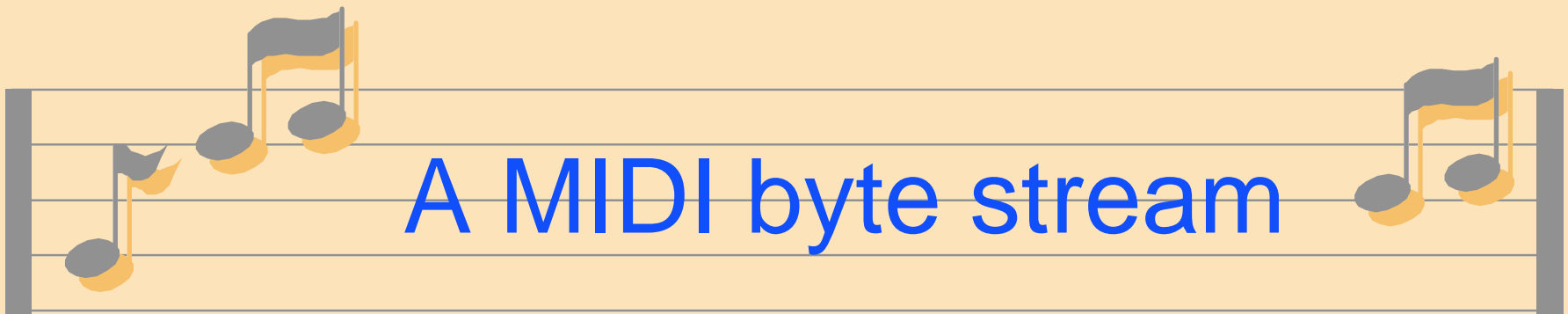
# The Music Instrument Digital Interface

- a real-time protocol for controlling sound modules (synthesizers)
- operations include noteon, noteoff, program (sound) change etc.
- no persistent form (no time-stamping)
- universal standard among all synthesizer manufacturers (since 1984)

A musical staff with five lines, featuring several notes with stems and flags. The notes are positioned on the first, second, and third lines from the bottom. The title 'Standard MIDI files' is centered in blue text over the staff.

# Standard MIDI files

- packaged MIDI byte streams, with time-stamping of operations
- persistent in file form
- transportable, exchangeable, platform-independent
- instrument-independent via GM (and GS) standards



noteon: pitch=3C (middle C), velocity=2D (lowish)

95 3C 2D 85 3C 3C 95 3E 27 85 3E 1F 95 40 44 85 40 24 95 41 3E 85 41 50

noteoff: pitch=3C, velocity=3C

# A Standard MIDI File



file header

track header

track trailer

```

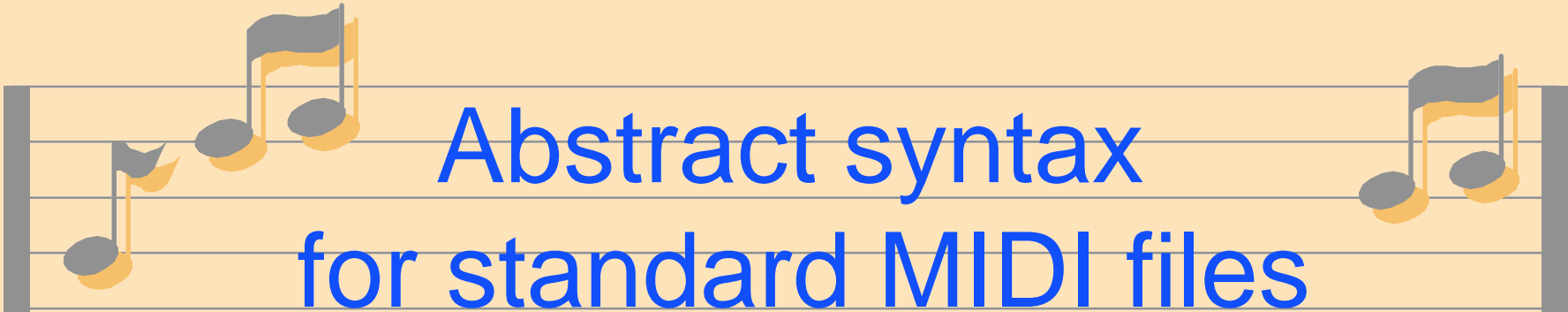
0000 : 40 54 68 64 00 00 00 06 00 01 00 02 00 78 40 54 MThd.....xMT
0010 : 72 68 00 00 00 19 00 FF 58 04 04 02 18 08 00 FF rk.....X.....
0020 : 59 02 00 00 00 FF 51 03 05 B8 D8 00 FF 2F 00 40 Y.....Q...0../.M
0030 : 54 72 68 00 00 00 D9 00 FF 21 01 00 00 FF 03 06 Trk...0...!.....
0040 : 74 61 68 65 20 31 8B 20 95 3E 48 00 34 49 00 3B take 1. .>H.4I.;
0050 : 55 86 69 3E 00 03 3B 00 0A 34 00 56 37 58 00 2D U.i>..;..4.U7[.-
0060 : 52 04 34 55 86 39 2D 00 03 34 00 07 37 00 69 34 R.4U.9-..4..7.i4
0070 : 52 04 56 3E 00 3B 62 86 5C 3B 00 0A 34 00 5A 37 R.U>.;b.\;..4.27
0080 : 62 03 34 6F 00 2D 50 86 56 2D 00 03 34 00 07 37 b.4o.-P.U-..4..7
0090 : 00 66 32 55 00 3C 62 03 39 71 86 50 39 00 00 3C .f2U.<b.9q.P9..<
00A0 : 00 0A 32 00 50 37 62 00 2D 40 00 34 67 86 46 2D ..2.P7b.-M.4g.F-
    
```

timestamp

noteon

timestamp

noteon



# Abstract syntax for standard MIDI files

- F = File
- FH = File Header
- T = Track
- TH = Track Header
- TT = Track Trailer
- S = Timestamp
- C = MIDI event
- N = number of tracks
- F = format (0, 1 or 2)
- R = resolution (subdivision of quarter)
- FL = length of the file in bytes
- TL = length of track in bytes
- TN = track number
- M = MIDI event
- X = meta-event
- $F ::= FH \{ T \}^1$
- $T ::= TH \{ S C \}^0 TT$
- $FH ::= FL N F D$
- $TH ::= TL TN$
- $C ::= M | X$
- $M ::= \text{NoteOn} | \text{NoteOff} | \text{ProgramChange} | \text{Controller} | \text{PitchBend} | \text{Pressure}$
- $X ::= \text{Tempo} | \text{KeySignature} | \text{TimeSignature} | \text{Text} | \text{SystemExclusive} | \text{Marker} | \text{TimeCode}$
- $S ::= \text{a number of ticks since the last event (see R)}$

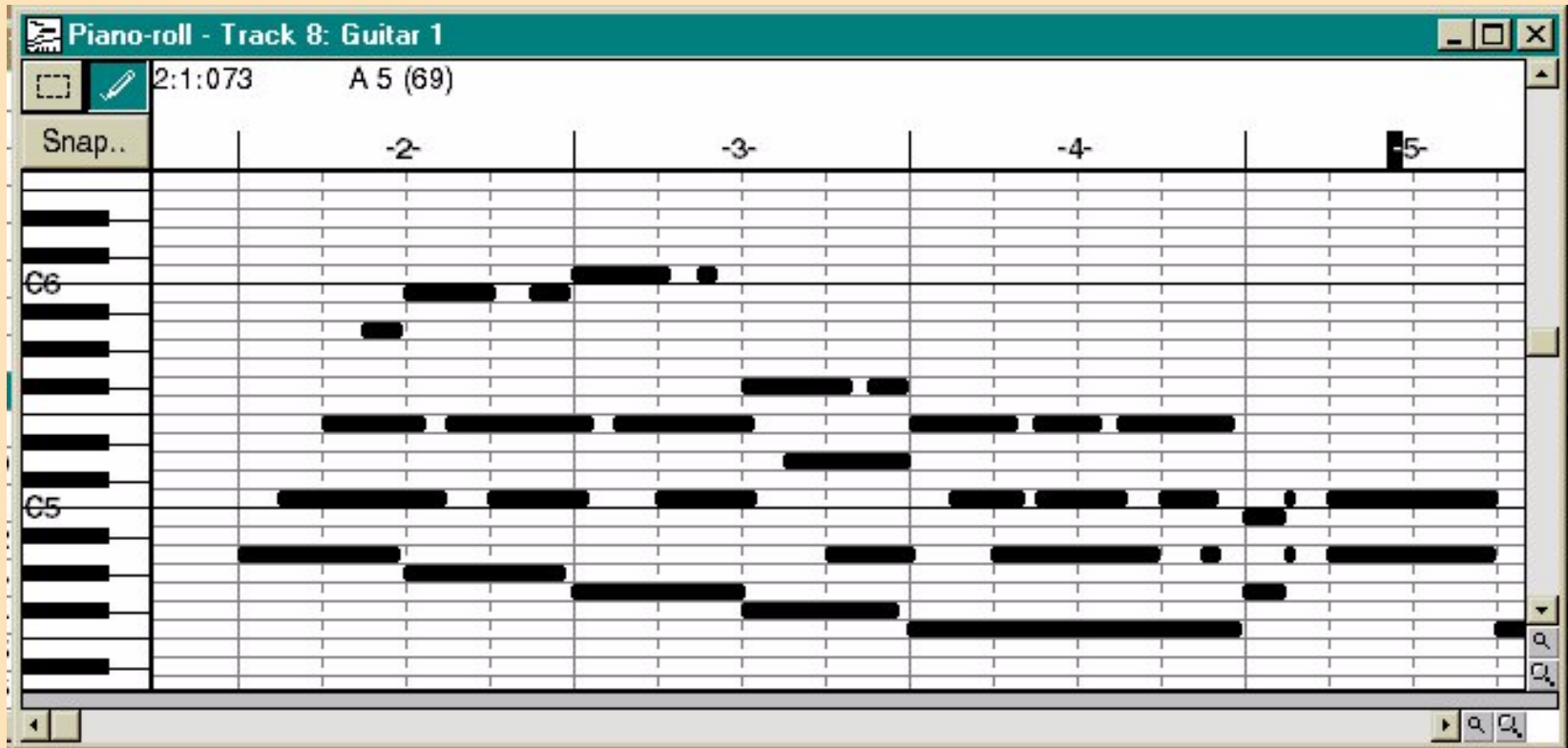
A musical staff with five lines, featuring several notes with stems and flags. The notes are positioned on the first, second, and third lines from the bottom. The title 'Software sequencers' is written in blue text across the middle of the staff.

# Software sequencers

- create/read/write/edit/manipulate MFFs
- allow editing through piano roll, event list, or standard musical score symbols
- can apply standard, fixed filters, mapping functions, and quantization



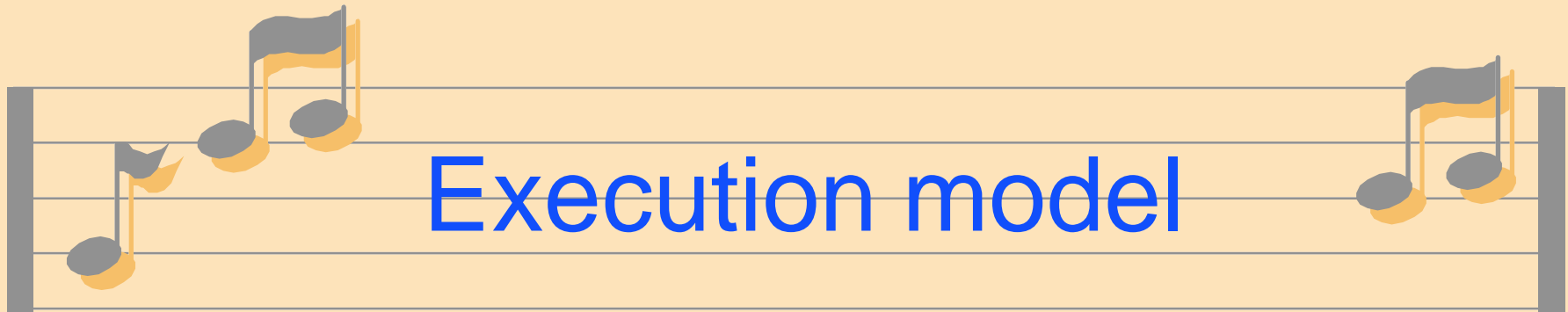
# Piano roll (Cakewalk)



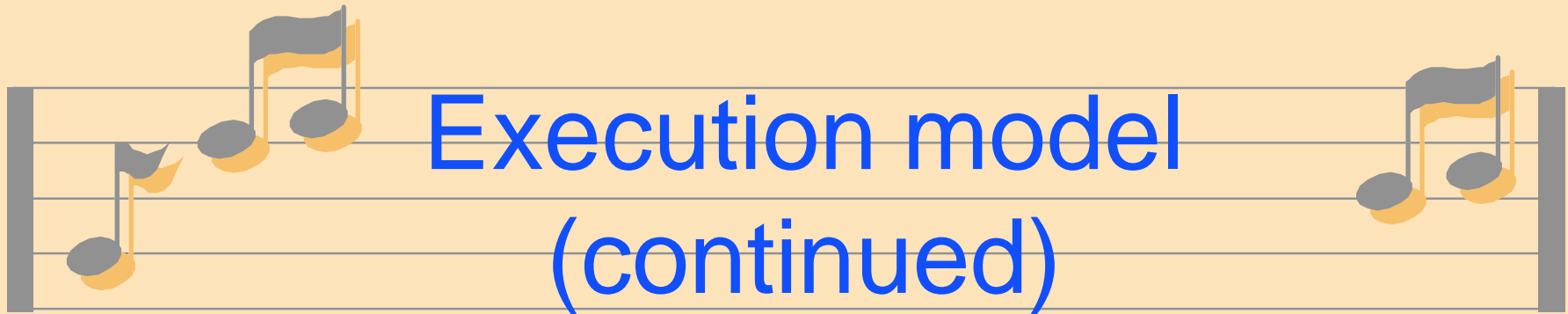
A musical staff with five lines, featuring several notes with stems and flags. The notes are positioned on the first, second, and third lines from the bottom. The title 'MidiTrans: the language' is centered on the staff in blue text.

# MidiTrans: the language

- VL: dataflow with mutable structures
- human-readable (ASCII) form
- general purpose: types, data structures, control structures, operations
- special purpose: types for pitch, times; data structures for tracks, event lists
- “functional” looping : generate/collect



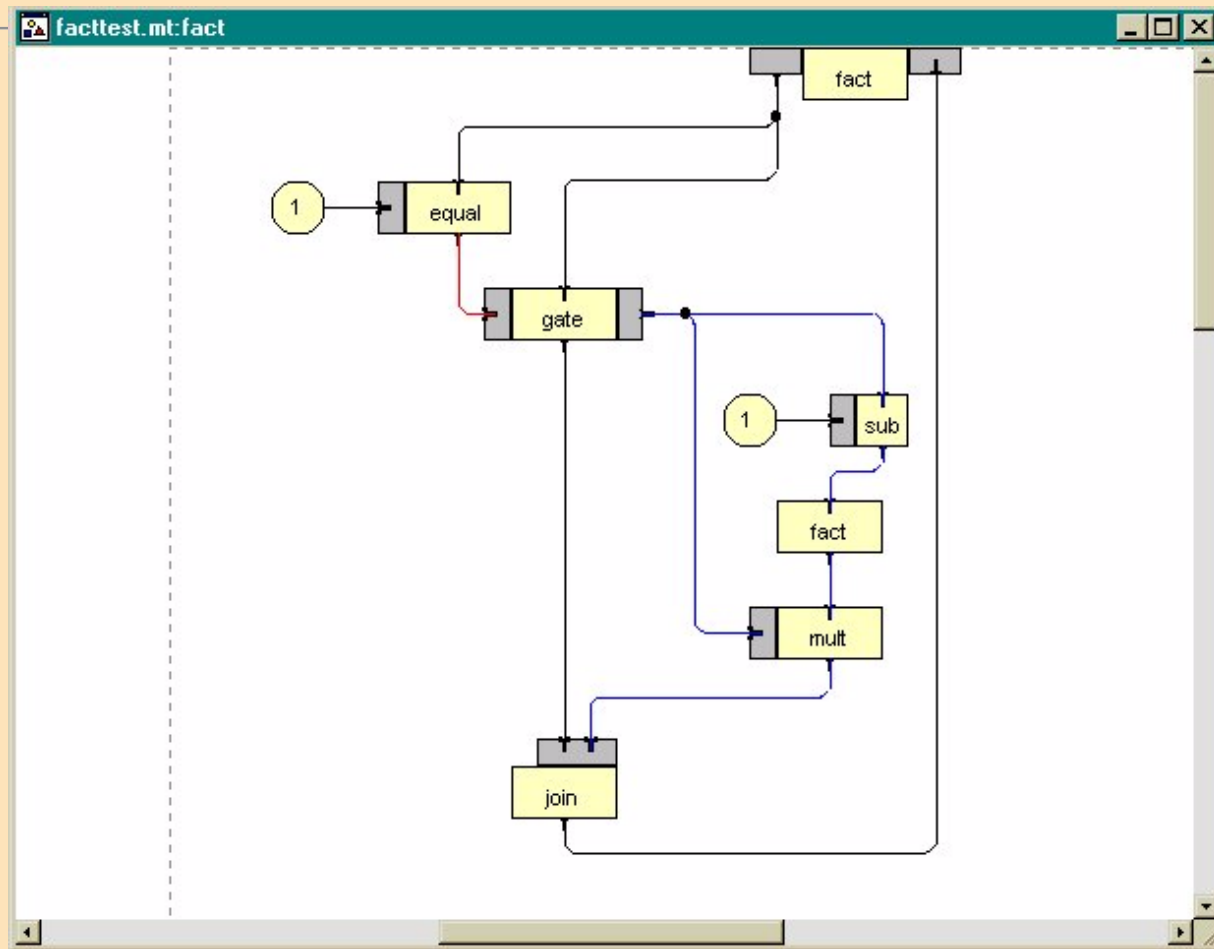
- depth-first search through a multiply-rooted tree
- nodes are operations
- links carry data and are strongly-typed
- plug and socket metaphor for connections
- connections can be split

A musical staff with five horizontal lines. On the left, there are three notes: a quarter note on the first line, a quarter note on the second line, and a quarter note on the second space. On the right, there are two notes: a quarter note on the second space and a quarter note on the second line. The notes are black with yellow stems and flags.

# Execution model (continued)

- intelligent connection layout
- tracing and breakpoints through a “show” operation and the show-stopper interface
- modularity: each subprogram has its own (scalable) window
- subprograms can retain state

# Ex. 1: Factorial

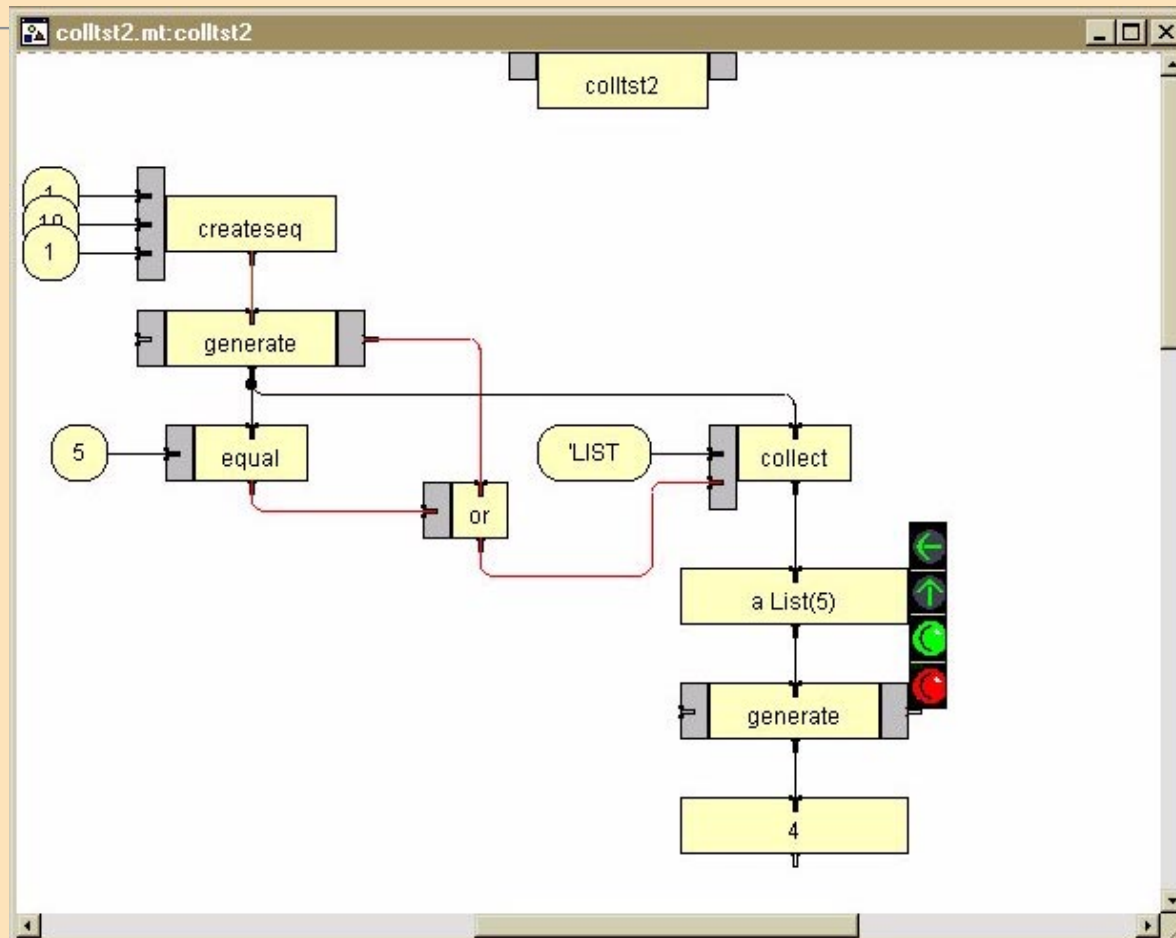




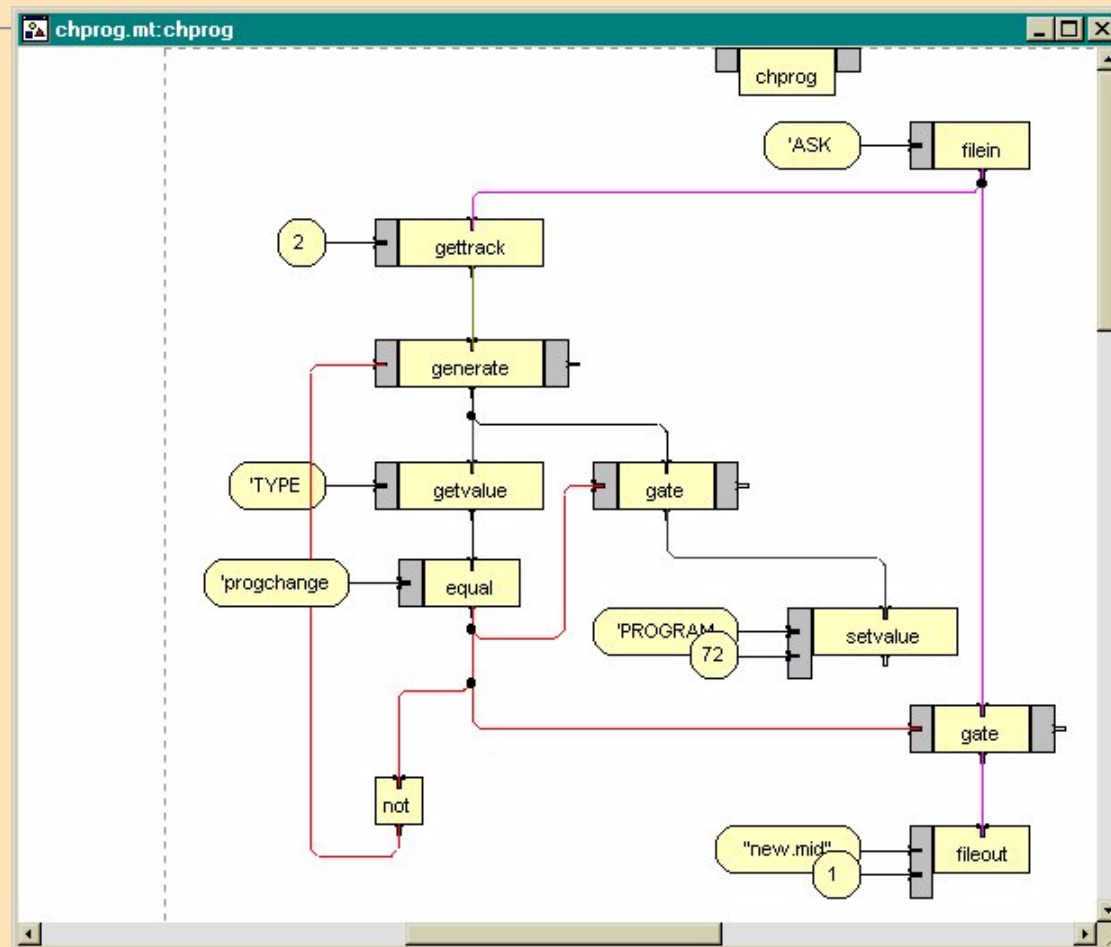
# MT form of factorial

```
define (1) fact (1)
{
  *1:2 <
    1 equal -225@90 *1000 ]
  *1000 gate -165@150 (
    *1001:2 <
      1 sub 15@210 | fact -15@270
        | *1001 mult -15@330 *1003 ]
    >
    | *1003 join -165@420 *2 ]
  )
  >
}
```

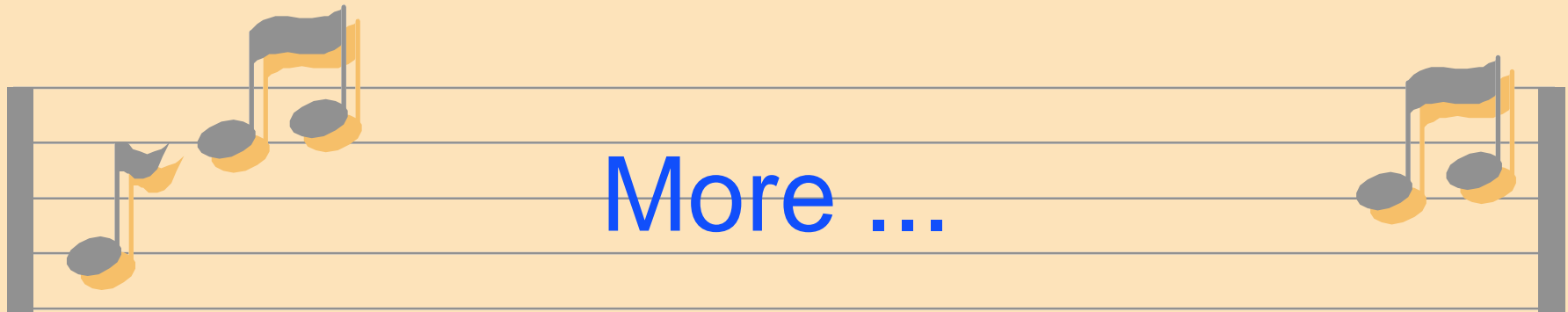
# Ex 2: Generate/Collect



# Ex3: Change program







- use of clipboard for direct transfer to/from a sequencer
- play module for auditioning changes
- compiler
- included files for library functionality
- dialogs for requesting input values