Command Line Algorithmic Music System (CLAMS)

M. Edward (Ed) Borasky

2023-02-23

Me and Forth

Me - retired scientific applications programmer

- I got paid to write
  - Assembly
  - Fortran
  - Awk / sed / grep / *nix shell
  - Perl
  - R

I learned for hobby projects

- Lisp
- Forth
- Ruby

I never learned

- APL
- C/C++ / Java / C# / Objective C / D / Rust / Go
- PHP
- Python
- JavaScript

Forth

- late 1980s
  - learned Forth via HESForth on Commodore 64
- mid-late 1990s
  - primary Forth engine was HP100LX Palmtop PC
  - wrote some articles for FORTH Dimensions
  - wrote some trading system software
  - used mostly hforth and Tom Almy's Forth compiler
  - later ran the Forth from Jack Woehr's *Forth: The New Model*
  - Google is drawing a blank on which Forth that was

Why I stopped writing Forth

- by 1999 I had faster machines that ran my code in Perl
- I wasn't using it at work
- I was learning Linux and R at work

(Two sunspot cycles pass . . .)

He's baaack! And he brought . . . CLAMS!

CLAMS goal

- algorithmic music composition and performance . . .
- live . . .
- in real time . . .
- on a Raspberry Pi Pico!

Inspirations

- Hierarchical Music Specification Language (HMSL)
  - long history and experience with experimental composers
  - currently being actively enhanced!
  - https://github.com/philburk/hmsl.git
- FORMULA - FORth MUsic LAnguage
  - designed for improvisation in real time
  - contained a real-time operating system
  - David P. Anderson and Kuivila (1989), D. P. Anderson and Kiuvila (1991)
- *Live Coding: A User's Manual* (Blackwell et al. 2022)
- The TOPLAP Manifesto
  - "Show Us Your Screens"
  - https://toplap.org/wiki/ManifestoDraft

CLAMS architecture

- a domain-specific language implemented in Forth
- conceptually, ChucK (https://chuck.cs.princeton.edu/), (Salazar et al. 2014) semantics with Forth syntax
  - low-level words: digital synthesis and microcontroller audio
  - mid-level words: construct signal flow graph
  - high-level words: provide performance interface

Forth base: zeptoforth

Highly optimized!

- subroutine-threaded
- allows inline expansion of words
- many primitives in assembly

Close to the metal

- word sets for nearly all the RP2040 hardware
- has an RP2040 assembler
- can compile to RAM or flash
- real-time operating system capabilites

zeptoforth on GitHub

- repository: https://github.com/tabemann/zeptoforth
- wiki: https://github.com/tabemann/zeptoforth/wiki

Road map

Initial hardware: Pimoroni Pico Audio Pack

- https://shop.pimoroni.com/products/pico-audio-pack

Proof of concept (v0.2.5)

- direct digital synthesis
- sine / triangle / sawtooth / pulse wave of any frequency
- maybe a filter and envelope generator and low-frequency oscillator
- maybe two oscillators and frequency modulation
- early to mid March

First release (v0.5.0)

- all synthesis / audio I/O words
- goal is everything you can do in Csound 7
  - https://flossmanual.csound.com/
- late March / early April

Second release (v0.7.5)

- signal flow graph
- possibly other RP2040-based hardware
- late April / early May

Full release (v1.0.0)

- live performance user interface
- possibly other microcontroller audio hardware
- optimistically, late July
- realistically, September
  - I want something other people can use at this point!

Stretch goal

- R / Forth interface
- Make Forth a first-class citizen in RStudio and Quarto
- Will not be zeptoforth
- Probably either gforth or pforth

CLAMS on the web

- GitHub: https://github.com/AlgoCompSynth/CLAMS
- blog: https://algocompsynth.github.io/CLAMS-Blog/
- this presentation: https://github.com/AlgoCompSynth/CLAMS/blob/main/presentations/CLAMS-intro.pdf

References

Anderson, D. P., and R. Kiuvila. 1991. "Formula: a programming language for expressive computer music." *IEEE Computer* 24 (7): 12–21. https://doi.org/10.1109/2.84829.

Anderson, David P., and Ron Kuivila. 1989. "Continuous Abstractions for Discrete Event Languages." *Computer Music Journal* 13 (3): 11–23. http://www.jstor.org/stable/3680007.

Blackwell, A. F., E. Cocker, G. Cox, A. McLean, and T. Magnusson. 2022. *Live Coding: A User's Manual*. Software Studies. MIT Press.

Salazar, S., A. Kapur, G. Wang, and P. Cook. 2014. *Programming for Musicians and Digital Artists: Creating Music with ChucK*. Manning.