

Command Line Algorithmic Music System (CLAMS)

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Section 1

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

- 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

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

Section 2

(Two sunspot cycles pass ...)

Section 3

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 Kiuivila (1991)
 - ▶ Python successor: Numula
<https://github.com/davidpanderson/Numula/wiki>
- *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, ChuckK (<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 live performance interface

Section 4

Forth base: zeptoforth

Highly optimized!

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

Close to the metal

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

zeptoforth on GitHub

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

Section 5

Road map

Proof of concept (v0.2.5) - Software

- direct digital synthesis / sine wave of any frequency
- maybe two oscillators and frequency modulation
- maybe “triangle” / “sawtooth” / “pulse” waves
- maybe a filter and envelope generator and low-frequency oscillator
- target date: 2023-03-17

Proof of concept (v0.2.5) - Hardware

- Pimoroni Pico Audio Pack
 - ▶ ships from the UK
 - ▶ one in hand
 - ▶ <https://shop.pimoroni.com/products/pico-audio-pack>

First release (v0.5.0) - Software

- will re-scope project after proof of concept!
 - ▶ need to assess audio performance constraints
- all synthesis / audio I/O words
- goal is all synthesis algorithms in Csound 7
 - ▶ <https://flossmanual.csound.com/>
- target date: 2023-05-12

First release (v0.5.0) - Hardware

- Waveshare Audio Expansion Module for Raspberry Pi Pico
 - ▶ ships from China
 - ▶ on order
 - ▶ <https://www.waveshare.com/pico-audio.htm>

Second release (v0.7.5)

- signal flow graph interpreter
- target date: 2023-06-16

Full release (v0.9.0+)

- live performance user interface
- possibly port to other audio microcontrollers
- target date: 2023-07-14

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. Kiuivila. 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 ChuckK*. Manning.