

# CLAMS-Forth for Forth Nerds

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# The Prime Directives

## Forth 2012 compatibility?

- ▶ Extended subject of Forth 2012 (Forth 200x Committee 2012) standard
- ▶ Not all CORE words implemented
- ▶ Some non-standard word sets implemented
- ▶ But ...
  - ▶ CLAMS-Forth words *in* Forth 2012 work the same way.

## Run on a Raspberry Pi Pico WH

- ▶ Documentation: (Raspberry Pi Ltd Accessed 2023-11-18)
- ▶ RP2040 CPU: Dual-core Arm Cortex M0+ with 264 KiB of SRAM
- ▶ Co-processors for division and digital signal processing
- ▶ I/O state machine (PIO) and ***oodles*** of real-world connectivity
- ▶ 2 MiB of flash
- ▶ 2.4 GHz WiFi / Bluetooth
- ▶ \$7US with debug connector / headers for breadboarding
- ▶ Dozens of compatible devices!

## Initial target device: Pimoroni PicoVision

- ▶ Documentation: (Pimoroni Ltd Accessed 2023-11-18)
- ▶ Raspberry Pi Pico W
- ▶ “GPU” - an overclocked RP2040
- ▶ I2S audio output
- ▶ HDMI output
- ▶ MicroSD card
- ▶ USB
- ▶ ~ \$37US

## Premature optimizations / extensions

- ▶ Dictionary split between RAM and flash
- ▶ Subroutine threading / inline compiling / assembly
- ▶ Engine in assembly
- ▶ Top of stack / stack pointer in registers
- ▶ Engine in assembly
- ▶ Support multiprocessing, multitasking, and halfword arithmetic
- ▶ High-performance vector block floating point DSP library

## Build with Raspberry Pi Pico C/C++ SDK

- ▶ Documentation: (Raspberry Pi Ltd Accessed 2023-10-22)
- ▶ Reference: (Smith 2021)
- ▶ Why require Pico SDK?

## Why?

Because coding libraries / drivers are ***each*** multi-month projects in ASM / Forth!

- ▶ USB
- ▶ WiFi / Bluetooth
- ▶ I2S audio / HDMI
- ▶ SD card
- ▶ FreeRTOS



## Project status / road map

## Rough schedule

- ▶ 2023-11-17: Most of the inner interpreter is done
- ▶ Text interpreter should be done November 24
- ▶ Basic colon compiler should be done December 1
- ▶ I2S audio / HDMI should be done December 8
- ▶ Spend the rest of 2023 building PicoVision demos!!

# Implementation Details

# Workflow

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# Languages

# The Forth virtual machine

# The dictionary

# The terminal and USB serial I/O



## I2S audio output

## HDMI video output

## References

Forth 200x Committee. 2012. “Forth 2012 Standard.” Forth 200x Committee.

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Pico w.” <https://www.raspberrypi.com/documentation/microcontrollers/raspberry-pi-pico.html>; Raspberry Pi Ltd.

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[https://www.raspberrypi.com/documentation/microcontrollers/c\\_sdk.html](https://www.raspberrypi.com/documentation/microcontrollers/c_sdk.html); Raspberry Pi Ltd.

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