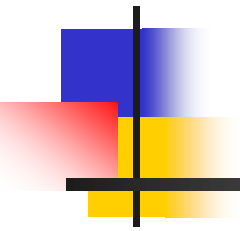
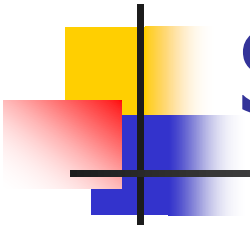


STM32F4eForth

Silicon Valley FIG

June 28, 2014

Chen-Hanson Ting



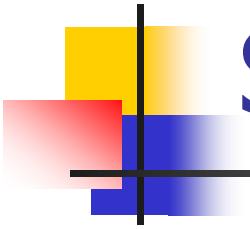
Summary

- STM32F407-Discovery Board
- STM32F407VG Microcontroller
- Keil uVision 5.10 MDK Tool Set
- eForth Implementation
- Demo

STM32F407-Discovery Board

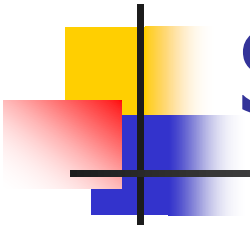
- STM32F407VG Microcontroller
- PC board 2-1/2”x3-3/4”
- ST-Link USB Debugging Port
- 3 Axis Accelerometer
- A Ton of Peripherals

STM32F407-Discovery Board

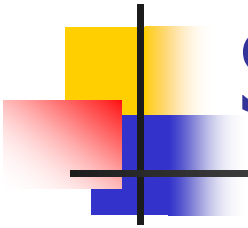


- DigiKey Item# 497-11455-ND, $14.90
- Ridiculously Complicated ARM Cortex M4 Microcontroller
- Horrible Thumb2 Instruction Set
- Horrible Examples in C
- Horrible 1713 Page Reference Manual

STM32F407 Microcontroller

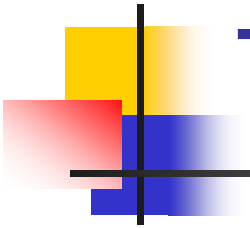


- 32-bit Cortex M4 CPU
- 1 Mbytes flash
- 192 Kbytes RAM
- 168 MHz clock
- GPIO, timers, USART, ADC, DAC, SPI, I^2C, CAN, USB, …, you name it.



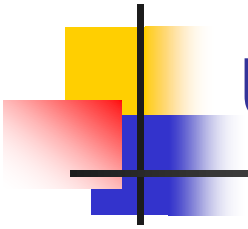
STM832F407 Microcontroller

- THUMB2 Instruction Set
- Nested Interrupt Controller for Pre-emptive Multitasking
- Up to 140 IO Pins
- 17 Timers, 6 USART, 2 USB, etc.
- Floating Point Instructions



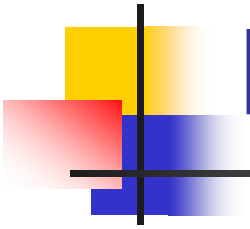
THUMB2 Instruction Set

- Combination of 32-bit ARM Instructions and 16-bit Thumb Instructions
- Immediate, Direct, and Indirect Memory References
- All Multiplication Instructions Known to Man
- Bit manipulation
- 32-bit Floating Point Numbers



uVision 5.10 Tool Set

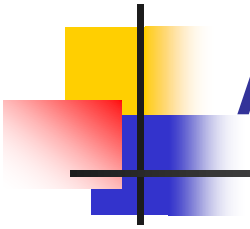
- Visual Development Environment
- ST-Link for debugging / programming
- 3rd Party Tools
  - Altium, TASKING VX-Toolset
  - Atollic TrueSTUDIO
  - IAR Embedded Workbench (EWARM)
  - Keil MDK-ARM



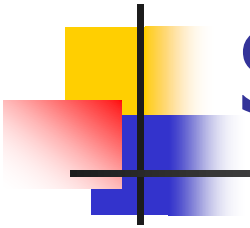
Horribe C Examples

- 202 Mbytes of Examples
- I only looked briefly at the Blinky example. Impossible to comprehend.
- Huge library code
- Amazing that it actually works.

ARM eForth Implementation

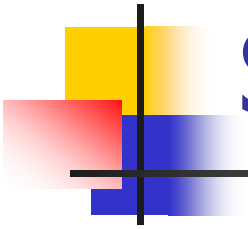


- ARM7 Forth on GameBoyAdvance
- ARM7 Forth on ADuC7024
- SAM7eForth on at91sam7x256



STM32F4eForth

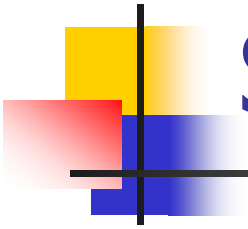
- Based on Sam7eF.s
- Boot code to lit LEDs and send message through the USART1 port
- Use internal 16 MHz clock
- Disable all interrupts. Retain only the Reset Vector
- eForth is in Flash memory.



STM32F4eForth Demo

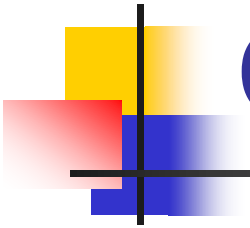
- Connect Discovery Board to PC through USB.
- USART1 is connected to HyperTerminal on another PC, through a Arduino Uno Board without the ATmega328 chip.
- uVsion assembles eForth, and downloads it to Discovery.

STM32F4eForth Demo



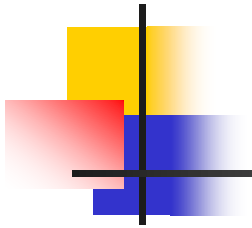
- On boot-up, Discovery lits LEDs and send out boot message.
- eForth starts with:

  ARM7 eForth v7.01

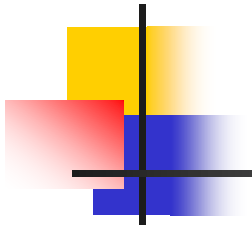


Conclusions

- Discovery is the cheapest ARM microcontroller board ever.
- It shows how much pain C programmers are willing to suffer in using microcontrollers
- It can be a very good platform to teach Forth and the very advanced ARM chips.



Questions?



Thank You.