

# 328eForth for Arduino Uno

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SVFIG



# Summary

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- eForth 1 Implementations
- eForth 2 Implementations
- ATmega328P
- AmForth
- 328eForth v2.1
- AVR Studio 4 Tool Suite
- HyperTerminal
- Bill Ragsdale's Applications
- eForth Tutorials
- Conclusion



# eForth 1 Implementations

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- eForth Model in 8086
- Direct Thread Model
- 30 Primitives
- Ported to 8051, Z80, 8096/8098, 80386, 68000, 6805, 68HC11, 68HC12, 68HC16, Hitachi H8/532, MIPS, Power PC, Transputer, M56002, Java



# eForth 2 Implementations

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- Subroutine Thread Model
- Optimized for performance
- Ported to 8051, 6805, 68HC12, Analog Devices AD2181, 80386, Philips 80C51XA, ADuC7020, Atmel AT91SAM7, STM8S105, eP32, C



# ATmega328P

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- 8 Bit microcontroller, 131 instructions
- 20 MIPS at 20 MHz
- 32KB Flash, 2 KB RAM, 1 KB EEPROM
- 3 Counter/Timers
- 6 Channels 10-bit ADC
- USART, SPI, I<sup>2</sup>C, ISP
- 23 Programmable I/O lines
- 1.8-5.5 V



# AmForth

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- NIH, Not Invented Here
- Indirect Thread Model
- Hundreds of little files
- Inefficient flash programming
- Cannot be simulated in AVR Studio 4, because of the IJMP instructions
- All words are in lower case, and it is case sensitive
- Strange error handling



# 328eForth v2.1

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- Subroutine Thread Model
- Fully optimized
- Uniform byte addressing
- Case insensitive
- Interpreter is in Bootloader section
- Optimized flash programming
- Visible words are reduced to 140 for ease of learning



# AVR Studio 4 Tool Suite

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- AVR Assembler 2
- AVR Simulator 2
- In-system Programming with AVRISP  
mkII



# HyperTerminal

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- Arduino 0022 supplies USB to UART driver
- 19,200 Baud, 8 data bits, 1 stop bit, no parity, no flow control
- 900 ms delay after sending each line of text
- Send Text File option to download file to Uno



# Bill Ragsdale's Applications

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- Hello-world.txt
- Marker.txt
- Io-core.txt
- Flasher.txt
- Tone.txt
- Keyer.txt
- Chronometer.txt
- Dump.txt



# eForth Tutorials

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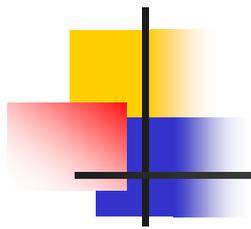
- 17 Tutorial lessons on
  - Terminal interface
  - Word games
  - Math
  - Calendar
  - Sines and cosines
  - Square root
  - Random numbers
  - Guess a number



# Conclusion

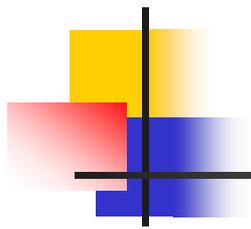
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- ISP is very pleasing
- Flash memory in ATmega328 can endure 10,000 erase-write cycles
- Ping-pong flash buffers optimize flash programming
- 2.1 us per empty FOR-NEXT loop at 16 MHz
- ATmega328P is forced to be compatible with eForth



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Questions?



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Thank you.