

ARM Open Source Development

G Bulmer

Overview

- * Arduino
- * Beyond Arduino
 - * STM32F4 Discovery
- * Embedded Development

Arduino

Open Source Project

Microcontroller

- Atmel ATmega168/328

IDE - Processing

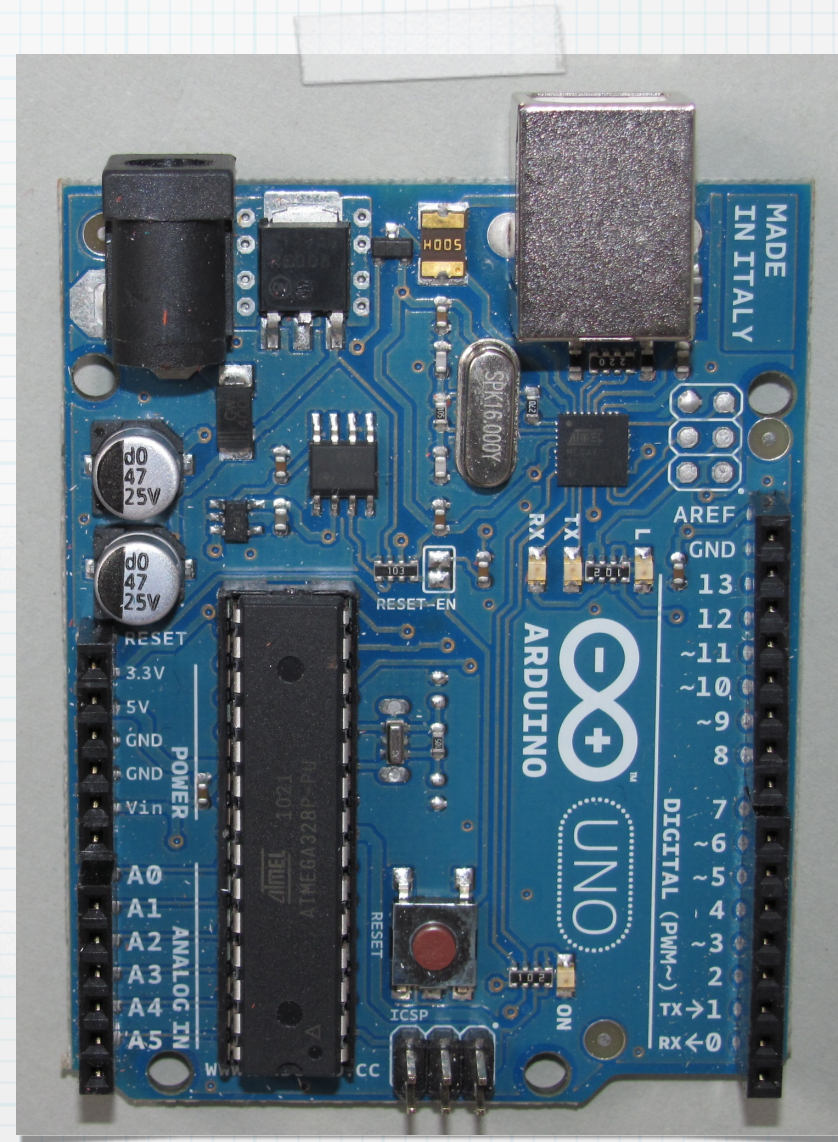
Libraries - Wire

Community

Team

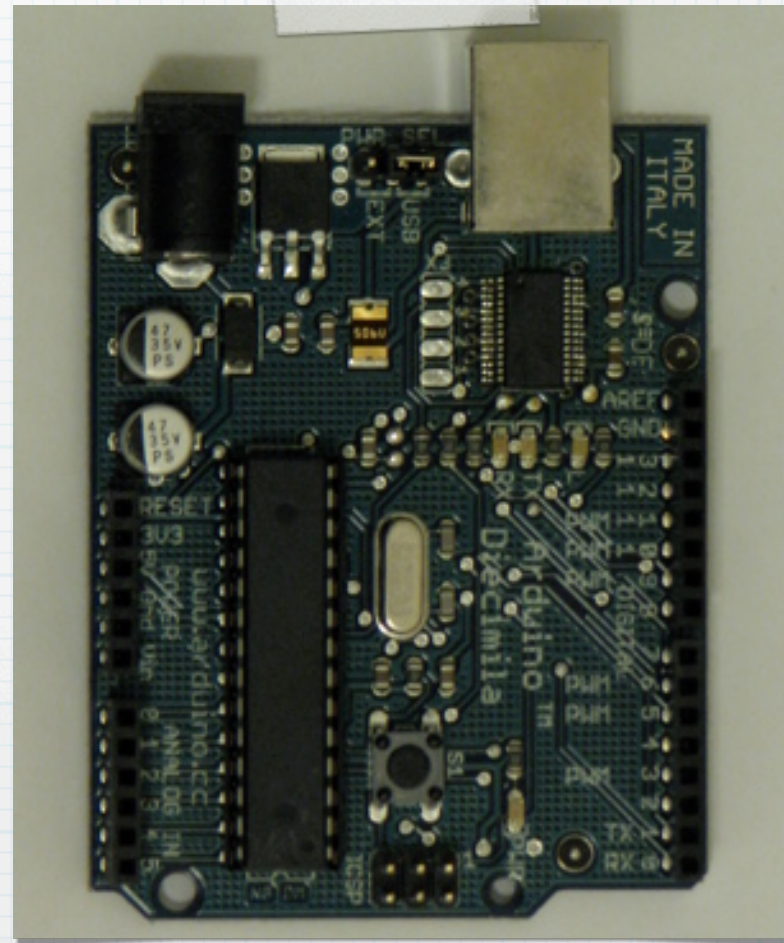
Trademark 'Arduino'

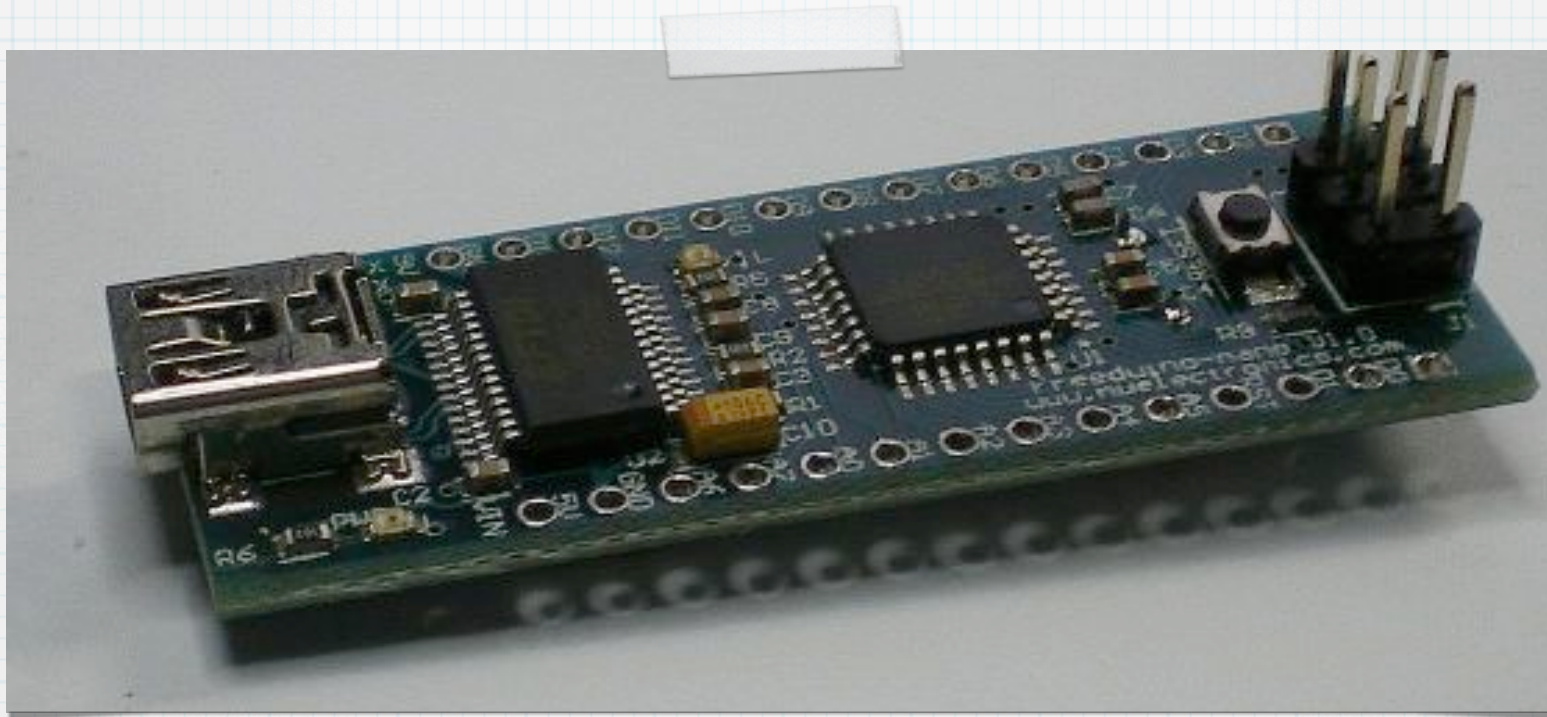
- Freeduino



Arduino Open Source Hardware

- * www.Arduino.cc
- * Low-cost (£14)
- * 6 ADC, 6 PWM, 6 Digital, I2C, SPI, UART
- * Open H/W & PCB CAD
- * USB (no ISP needed)
- * Standard H/W I/F

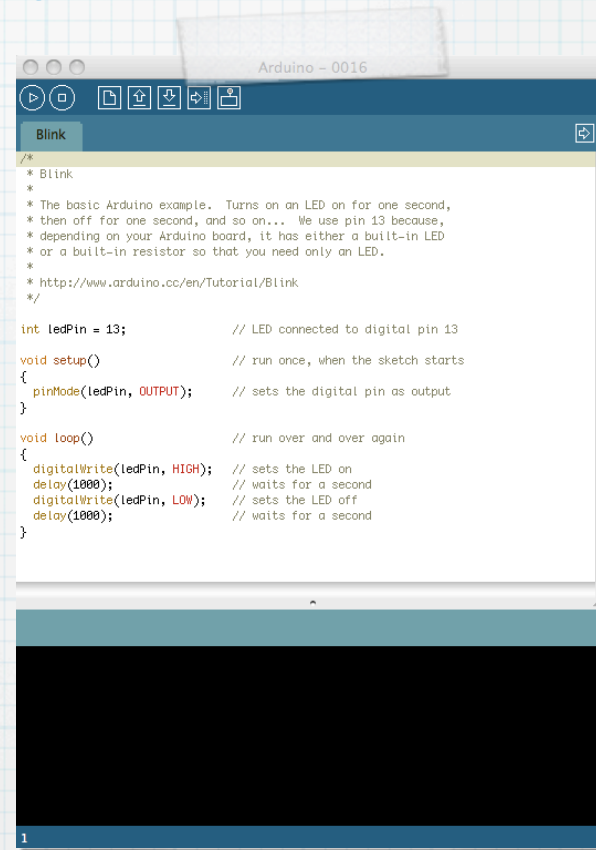




Arduino Nano small robot control

Arduino Open Source Software

- * Open Source IDE
- * Win, Mac, Linux
- * GNU CC, AVRdude,
- * Many Free Examples
- * Libraries
- * 'Simplified C'



What comes after Arduino?

Arduino Nano = 20 I/O

Robots = 20+ I/O

6 = motors

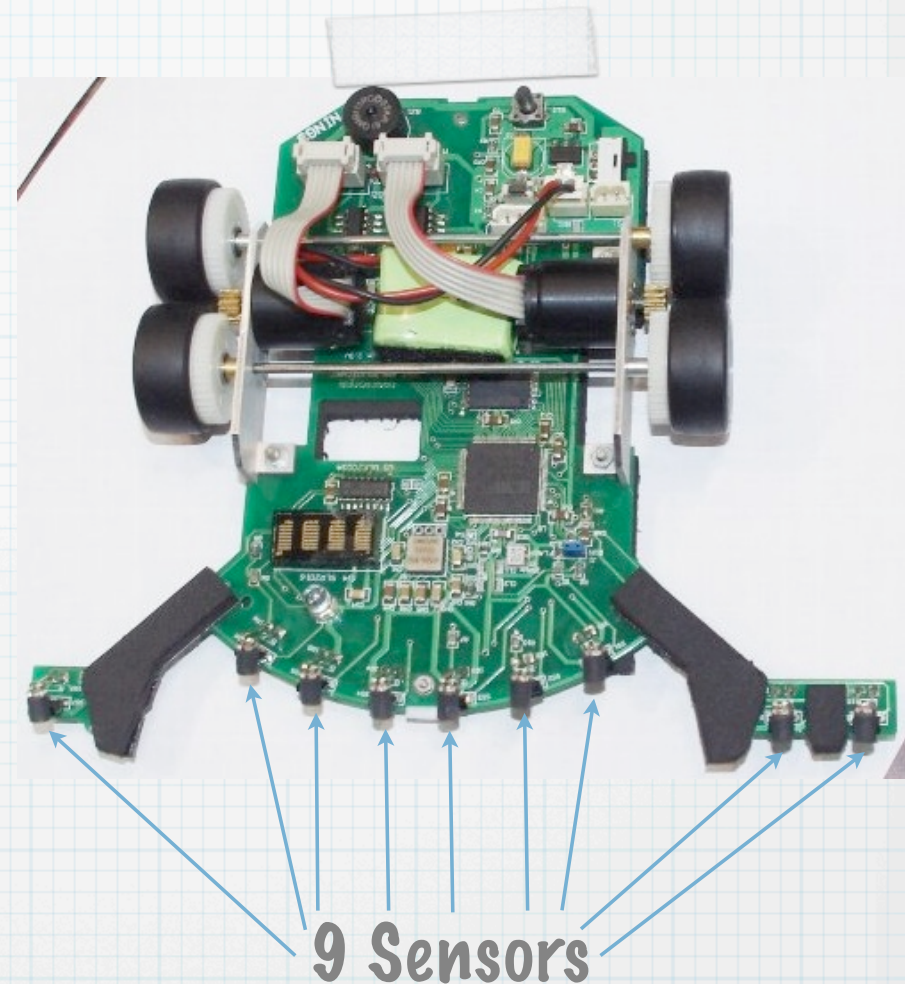
4 = encoders

10 = sensors ADC + battery

2+ = emitter control

2+ = gyro/accelerometer

...

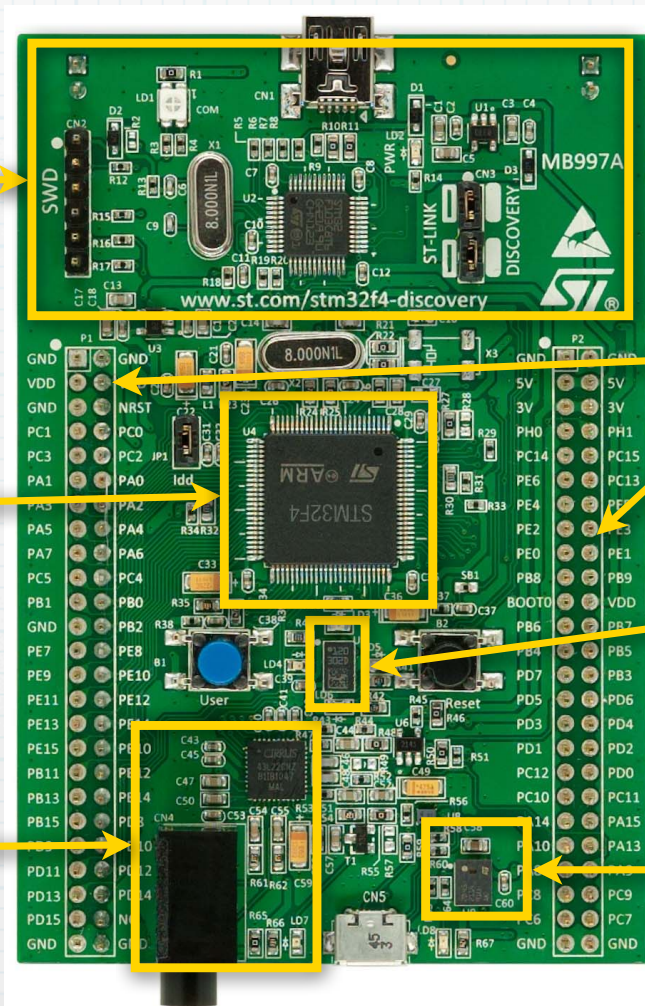


STM32F4-DISCOVERY

Debug
JTAG-SWD

STM32F4
MCU

Stereo Audio
+ Headphones



84 I/O
pins

3-Axis
Accelerometer

Digital
Microphone

H/W Comparison

	ArduinoUNO	STM32F4 64pin	Diff
CPU	AVR	ARM Cortex-M4	
Width (bits)	8	32	4x
Clock (MHz)	16	168	11x
Flash kB	32	512 - 1000	16x - 32x
RAM kB	2	192	96x
I/O	20 + (2	44 + (2 USB + 2)	~2x
ADC (ksps)	8 x 10	16 x 2400 (x3)	720x
USART/UART	1 (-USB)	4/2	6x
I2C	1	3	3x
SPI	1	3	3x
Timers/PWM	3/6	2/8+8/24	5x

H/W Special Features

CPU	ATmega AVR	STM32F4	Diff
ADC	10 bit	12 bit (x3)	7.2MHz Synch
Quadrature	-	4	∞
DMA		2 x 8	∞
RTC	-	1	∞
DAC	-	12 bit Stereo	∞
I2S/ SD-IO	;-	1, 1	∞
USB/OTG		1/1	∞
CAN		1	∞
Ethernet		1	∞
Other		Camera/Mem...	

E9.96 + VAT

ARM Cortex-M0/3/4

- * ARM pre-Cortex

- * ARM+Thumb

- * Assembler Irqs

- * JTAG

- * Simple Irq HW

- * Cortex-M

- * Thumb2

- * C - no assembler

- * Serial Wire Debug

- * NVIC

- * Sys tick

Serial Wire Debug (SWD)

- * ARM designed
- * Packet-orientated (not JTAG)
- * Access: Memory/Peripheral/CPU regs
- * Breakpoints/Datawatch/Single step
- * Two Wires + ground

GNU GCC

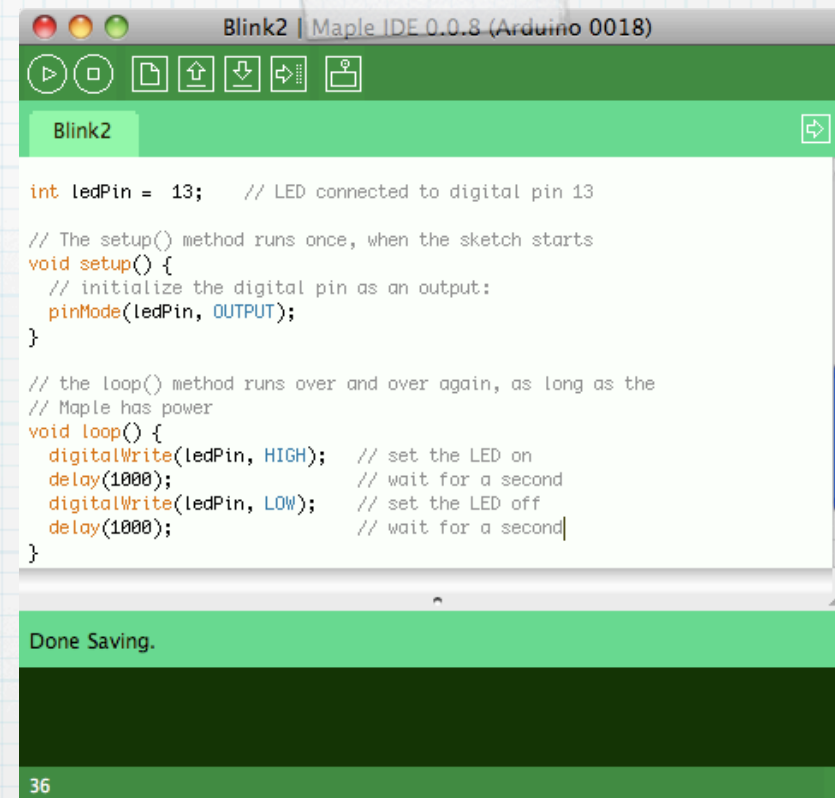
- * C/C++ compiler: gcc
- * fract, accum, sat
- * Link-Time-Optim.
- * assembler: as
- * linker: ld
- * librarian: ar
- * disassembler: objdump
- * elf to bin/hex: objcopy
- * source debugger: gdb
- * Mentor Sourcery
CodeBench Lite

STM32F4 Software

- * ST Micro: STM32F4 Peripheral Library
 - * Simple Startup
- * C stdlib - sourceware.org/newlib
- * WIP: libmapple
 - * github.com/gbulmer/openstm32sw

WIP - Software

- * LeafLabs Maple
- * ARM gcc
- * arm-none-eabi-gcc
- * Wire-ish + libmaple
- * USB Bootloader



```
int ledPin = 13; // LED connected to digital pin 13

// The setup() method runs once, when the sketch starts
void setup() {
  // initialize the digital pin as an output:
  pinMode(ledPin, OUTPUT);
}

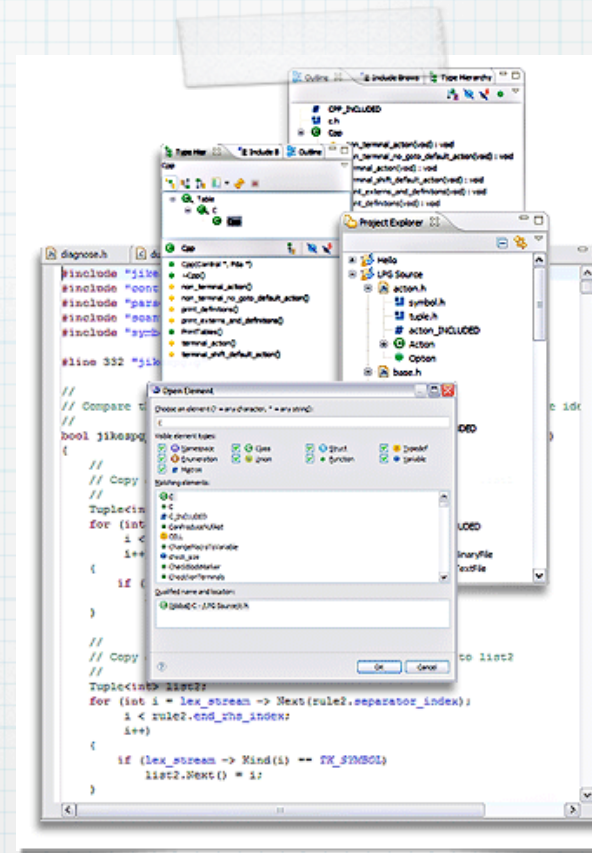
// the loop() method runs over and over again, as long as the
// Maple has power
void loop() {
  digitalWrite(ledPin, HIGH); // set the LED on
  delay(1000);                // wait for a second
  digitalWrite(ledPin, LOW);  // set the LED off
  delay(1000);                // wait for a second
}
```

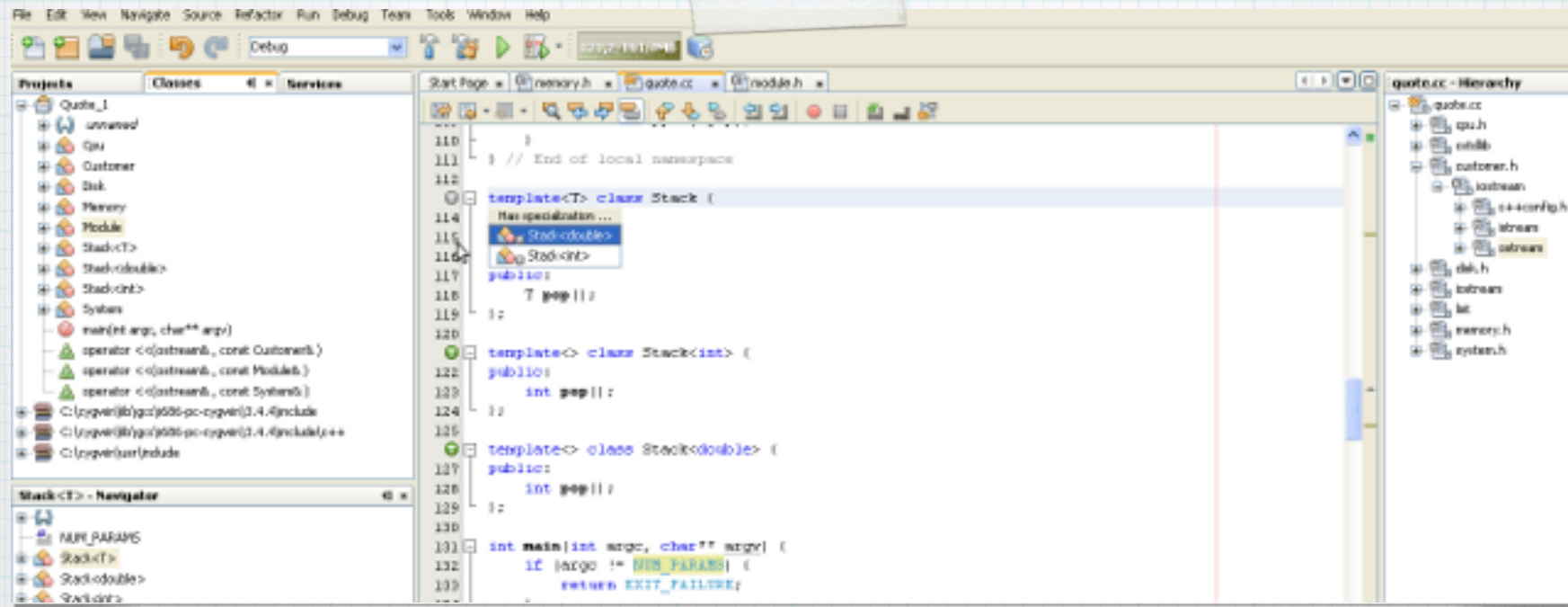
Done Saving.

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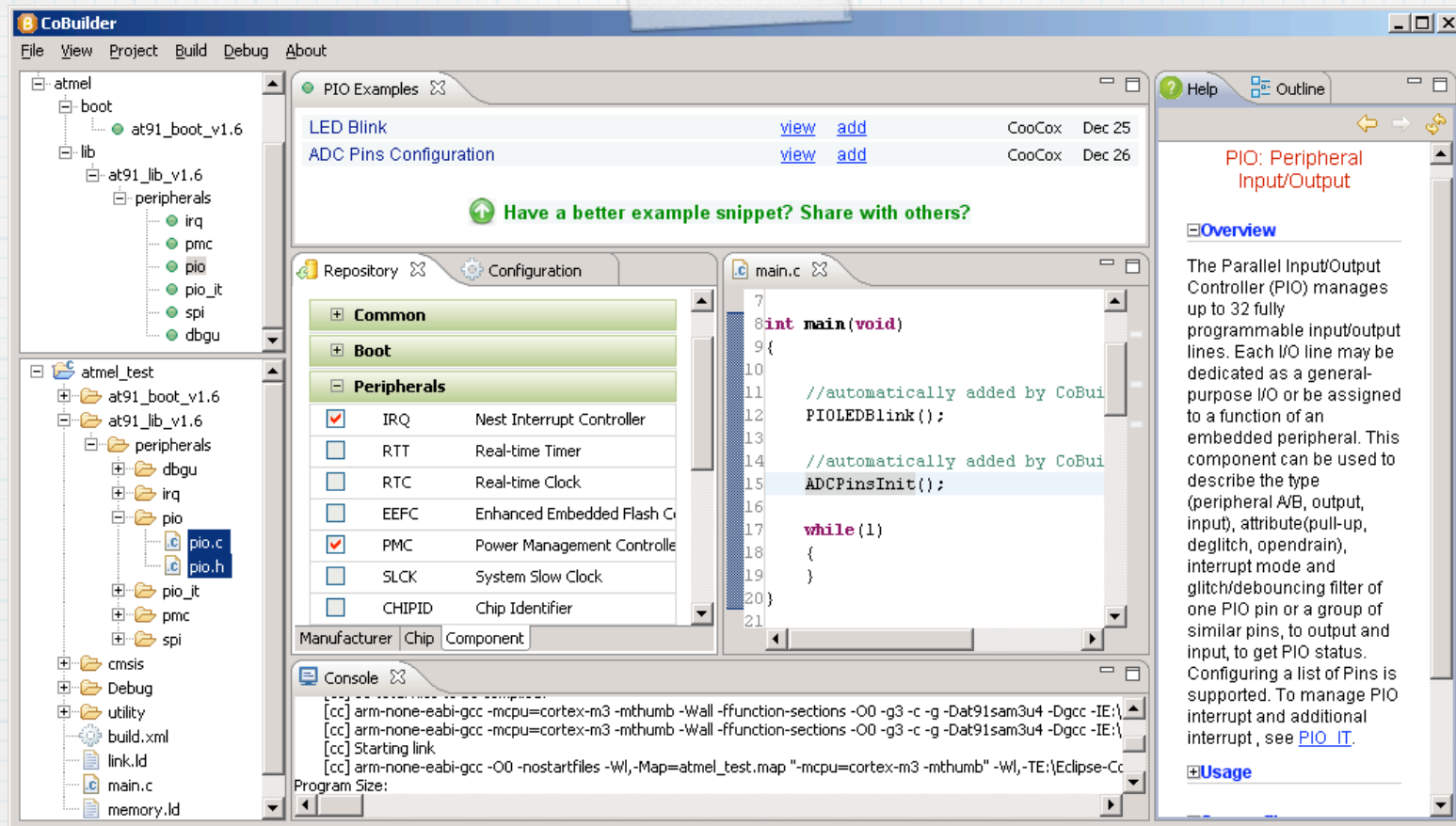
Eclipse CDT

- * Open Source IDE
 - * C/C++ Development Tool (CDT)
 - * IDE in Java
 - * Uses GCC + GDB





NetBeans - C/C++ development



CooCox - ARM Cortex development

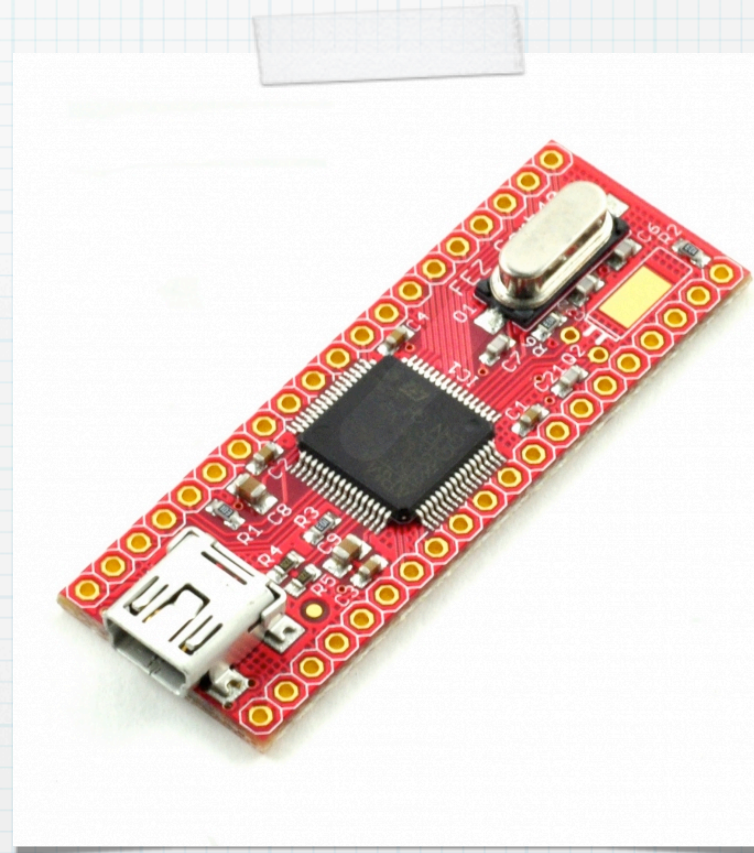
ST Micro STLINK/V2

- * JTAG & JTAG-SWD
- * £18.90
- * [texane/stlink](https://github.com/texane/stlink)
- * github.com
- * Code upload & gdb debug server



GHI FEZ Cerb40 STM32F4

- * Microsoft TinyCLR
- * .NET micro framework
- * C#
- * \$24.95
- * 40pin
- * 2" x 0.75"



Summary

- * Free & Open Source
- * Toolchains & IDEs
- * Libraries
- * £9.96+VAT
- * leafflabs.com
- * github.com/gbulmer/openstm32hw
[openstm32sw](https://github.com/gbulmer/openstm32sw)

