

The Beagle Bone

by Mark A. Yoder

Mark.A.Yoder@Rose-Hulman.edu

Boris

- ...speaks for himself
- Watch carefully



What did you see?

- Small Size
- Powered by USB
- Easy to add audio
- Network over USB
- USB drive
- Web server
- Integrated Development Environment
- Speech synthesis
- Linux command line

Overview

- Me - Out-of-the-box
- You – Out-of-the-box
- Introductions
 - Me
 - Black Bone
- Technical Details
- You – More Labs
- Teaching with the Bone
- Questions and Wrap Up

You – Out-of-the-box

Getting Started

1. Plug the BeagleBone into your computer via USB.
2. Open the new drive that appears.
3. Open **START.htm** with Chrome or Firefox.
4. Return to browser window with **START.htm** and scroll down to **Step 3** to find <http://192.168.7.2> and click on it.
5. Explore.
6. Click on the title Cloud9 IDE (<http://192.168.7.2:3000>).
7. Continue with lab handouts.

Cloud 9 IDE

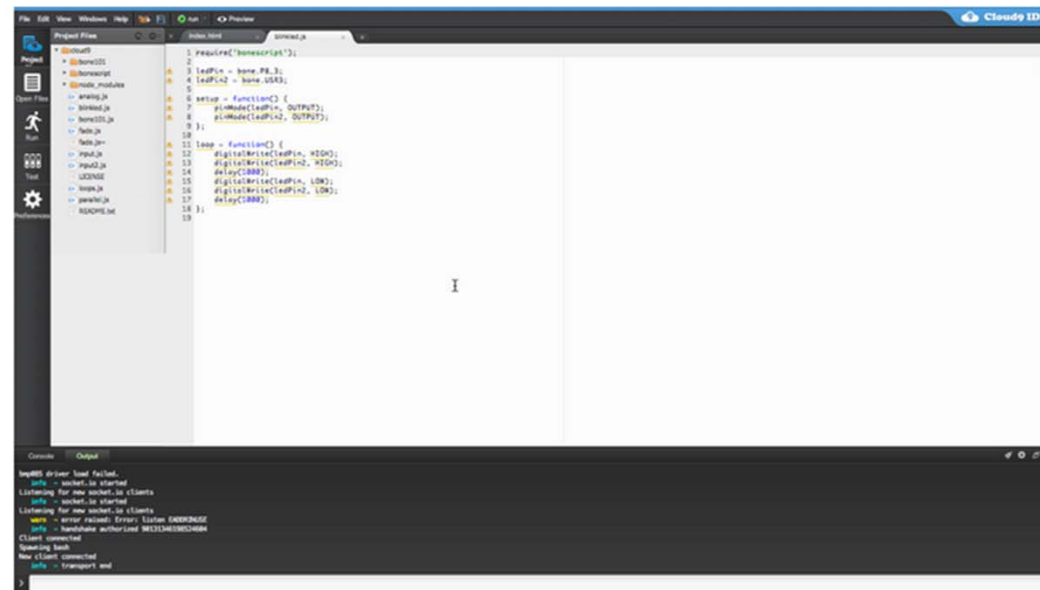
- Zero-install integrated development environment
- Go to <http://192.168.7.2:3000>

Click
Cloud9 IDE

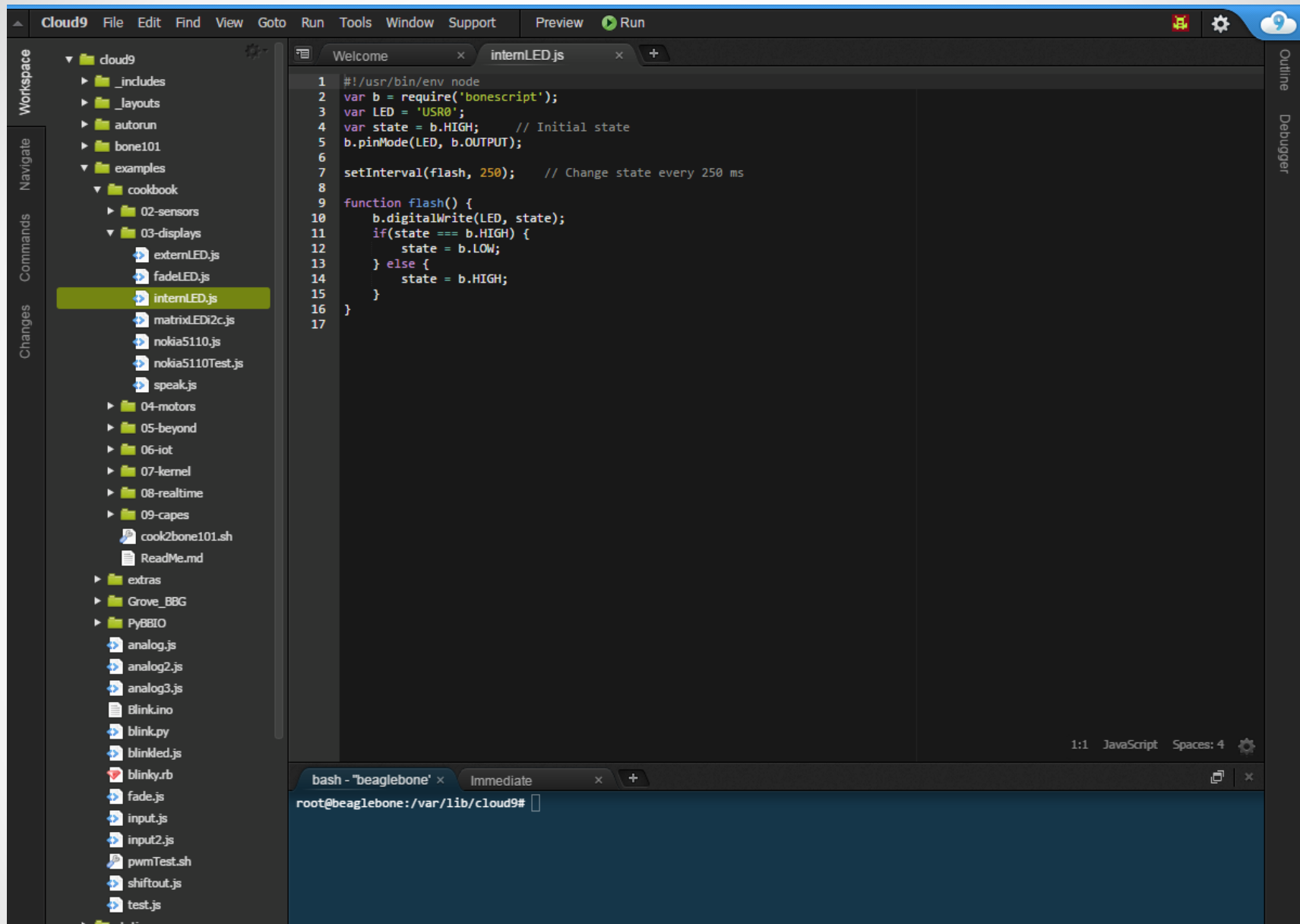
Cloud9 IDE

To begin editing programs that live on your board, you can use the Cloud9 IDE.

Click on the "Cloud9 IDE" link above to start the editor.



As a simple exercise to become familiar with Cloud9 IDE and the BoneScript JavaScript library, creating a simple application to blink one of the 4 user programmable LEDs on the BeagleBone is a good start.



Labs

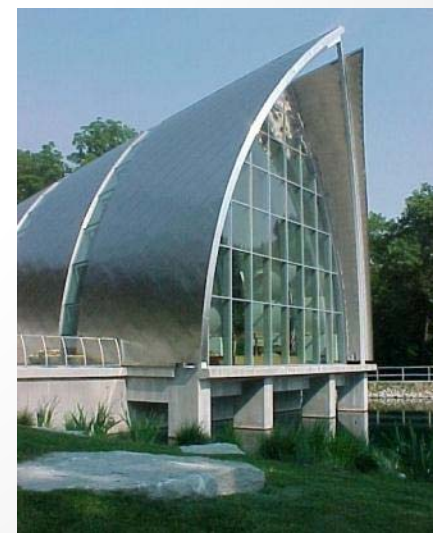
- 01 Blink an LED
- 02 Read a switch
- 03 SensorTag
- 04 Read a variable resistor (optional)
- 05 Turn a servo motor (optional)

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Rose-Hulman Institute of Technology

- Private engineering school
- About 2000 students
- Teaching
- Don't grant PhDs
- Small masters program
- Terre Haute, Indiana, USA
- #1 ranking 17 years running
 - US News & World Report
- #4 ranking Brookings Institute
- **All students have laptops**



Family



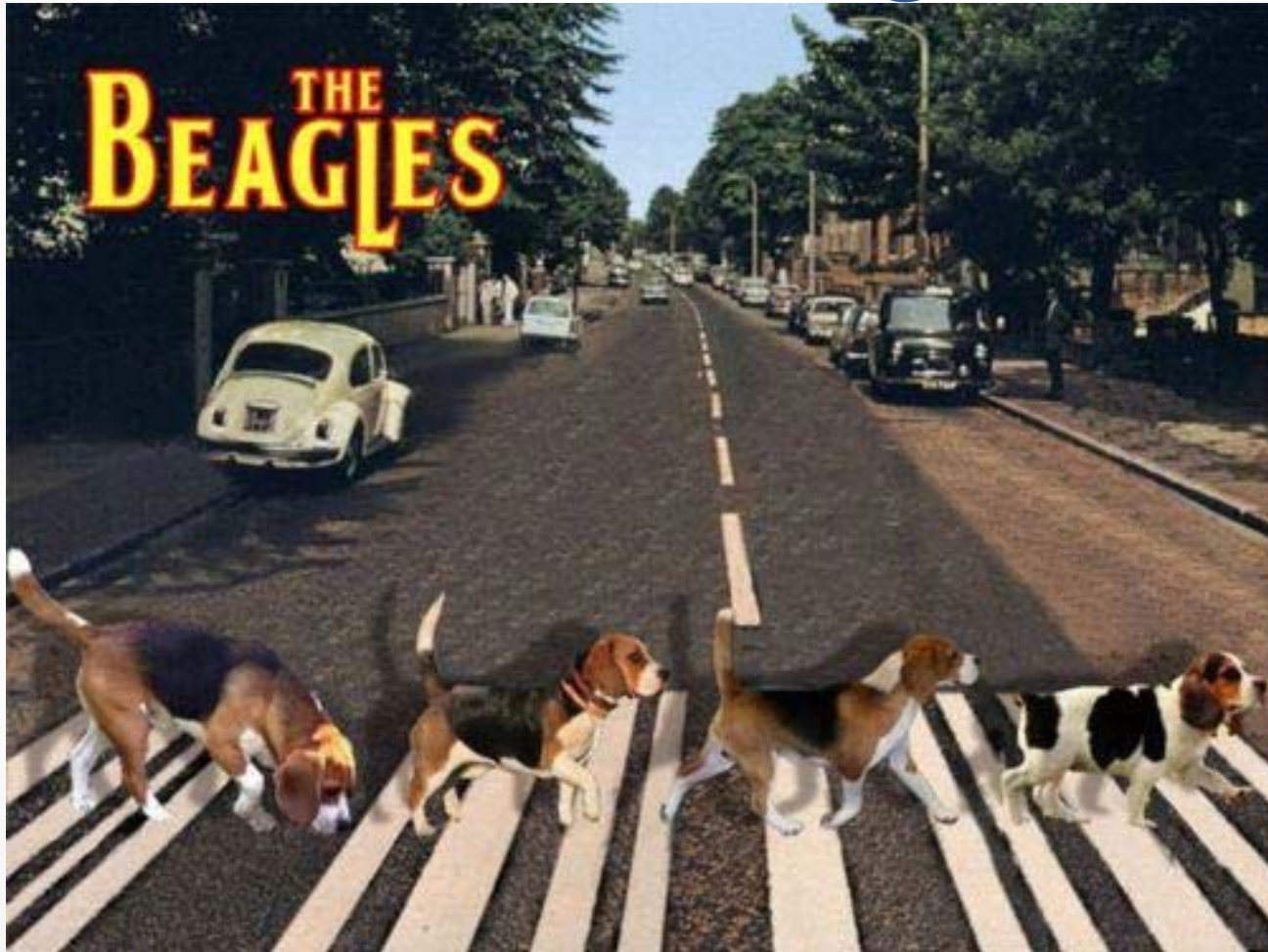


INSTITUTE OF TECHNOLOGY





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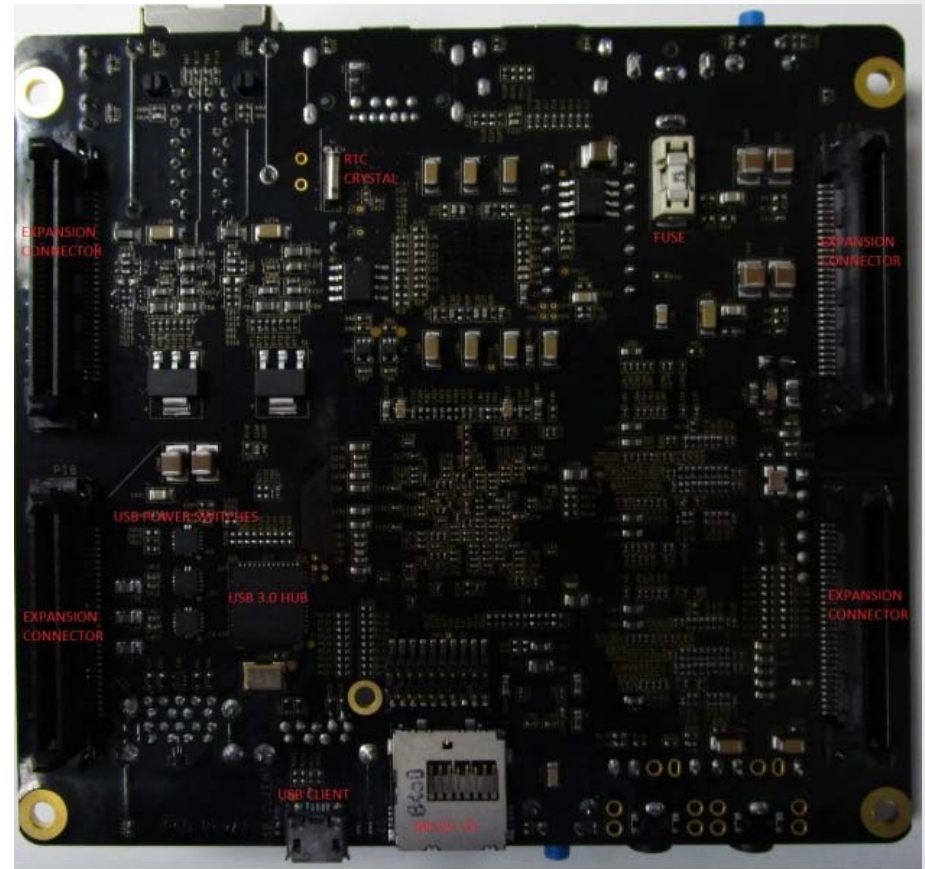
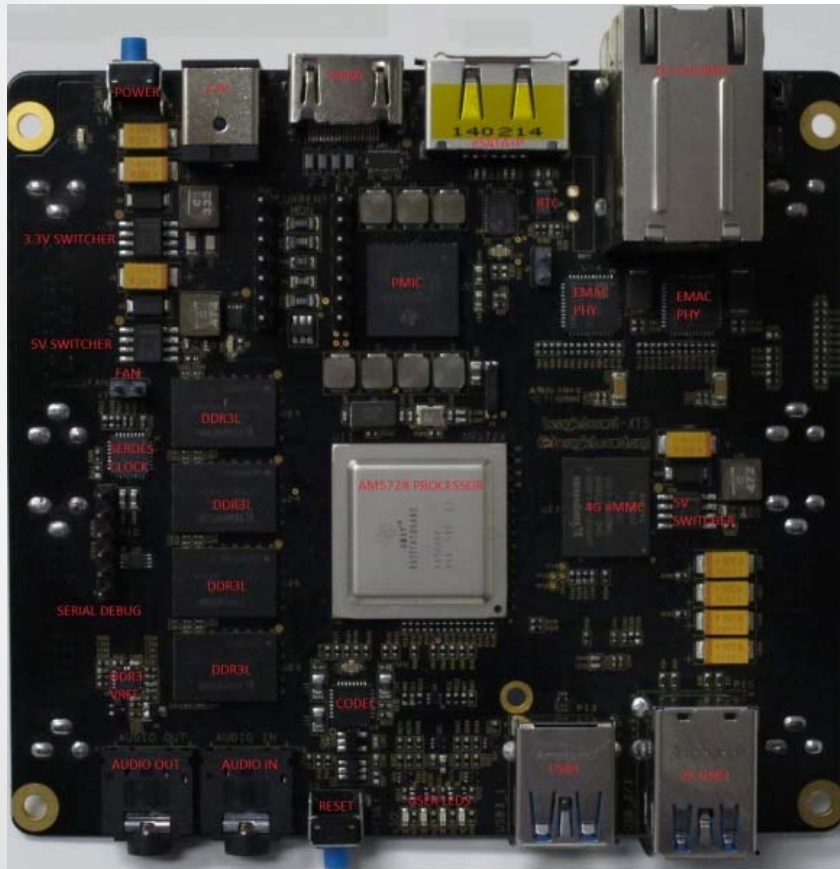
Introducing...



BeagleBone Family

	BeagleBoard	BeagleBoard-xM	BeagleBone	BeagleBone Black
Board				
Quick summary	The original open hardware, ARM-based development board	All features of the original BeagleBoard with extra memory	Low-cost, open-source community platform with plug-in board expansion	Next-generation BeagleBone featuring 1-GHz processor
Memory	256KB L2 cache	512MB DDR2	256MB DDR2	512MB DDR3
Special features	2D/3D graphics accelerator, HD video capable, USB powered	1-GHz processing power, Four- port hub with 10/100 Ethernet	USB-powered, 10/100 Ethernet, USB JTAG	2G/4G eMMC, onboard HDMI, USB, Ethernet and HDMI interfaces
Price (\$U.S.)	\$129	\$149	\$89	\$45/\$55

BeagleBoard x15



x15

BeagleBoard-X15	
Processor	Dual ARM Cortex-A15 @ 1.5GHz. Sitara AM5728
Graphics	Dual Core SGX544 3D, 532MHZ
DSP	Dual C66x, 700MHZ
Video Accelerator	IVA, 532MHZ
Graphics	GC3230 2D BTBLT
GP ARM Cores	DUAL ARM M4, 212MHZ
SDRAM	2GB DDR3L, Dual 32bit bus, Non-ECC 533MHZ
Onboard Flash	4GB, 8bit Embedded eMMC
PMIC	PS659037
Debug Support	20-pin CTI JTAG, Serial debug header
PCB	4.2" x 4", 12 layers
Indicators	(2) Power, (4) Ethernet, (4) User Controllable
HS USB 3.0 Host	(2) Type A 900ma (1) 1800mA (1)
USB 2.0 Host	(4) 500mA
USB 2.0 Client	(1) micro USB Type B
Ethernet	(2) 10/100/1000 RJ45
SATA	(1) eSATA Connector- Powered 500mA
LCD Ports	(2) Via Expansion
PCIe	(2) Channels via expansion
Camera Ports	(1) Via expansion
SD	(1) microSD
User Input	(1) Reset Button (1) Power Button
HDMI	(1) Full Size connector, 24b 1920x1080 60FPS, EDID
Audio	HDMI and AIC3104 (Stereo In/Out)
Expansion	(4) 60 pin dual row headers
GPIO pins	157
UARTs	7
SPI/I2C/CAN	1/1/1
PRU Pins	185
Real Time Clock	8pin RTC with optional battery backup, I2C I/F
Current Taps	(4) 5V, 3.3V, VDD_MPU, VDD_DSP, VDD_CORE
Weight	TBD
Power	12VDC@TBD

Capes expand BeagleBone



Breadboard



Breakout



LCD
7", 4.3" or 3.5"



DVI-D



CANBus



RS232



RS485



VGA



Battery



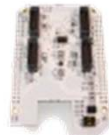
Profibus



Proto



RF-CC1101
CC2500
CC2530



Weather



Camera



CAN



**DVI-D
w/Audio**



Audio



**BeBoPr 3D
Printer**



Radar

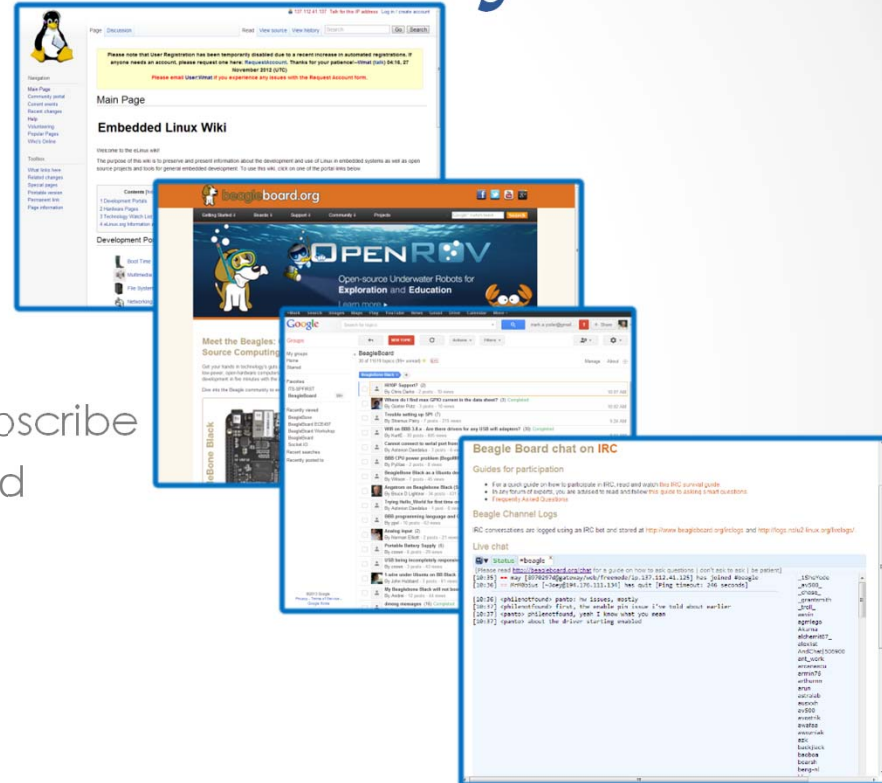


LVDS

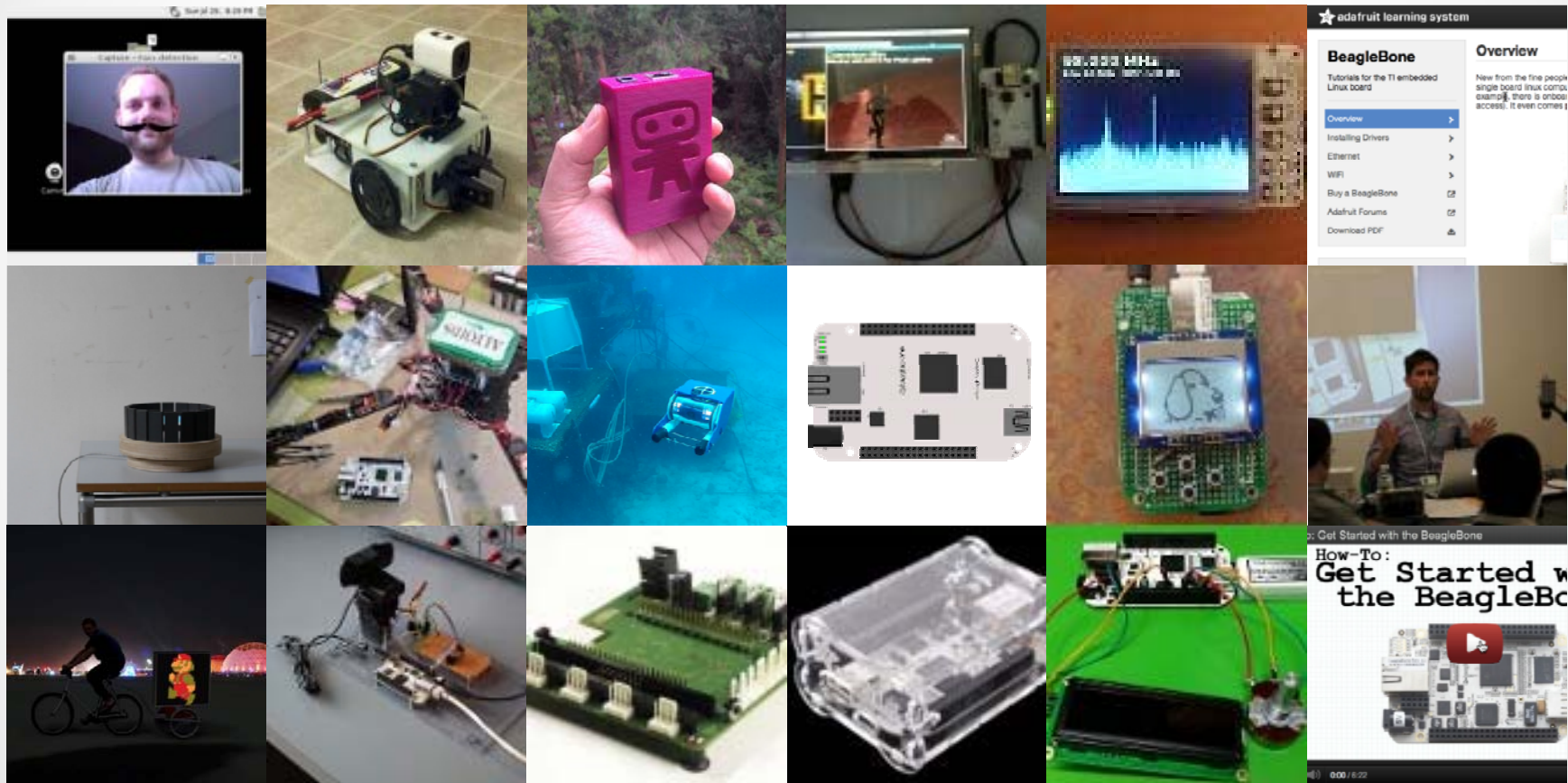


The Community

- eLinux.org
- Google Group
- IRC
- beagleboard.org
 - beagleboard.org/newsletter-subscribe
 - beagleboard.org/getting-started

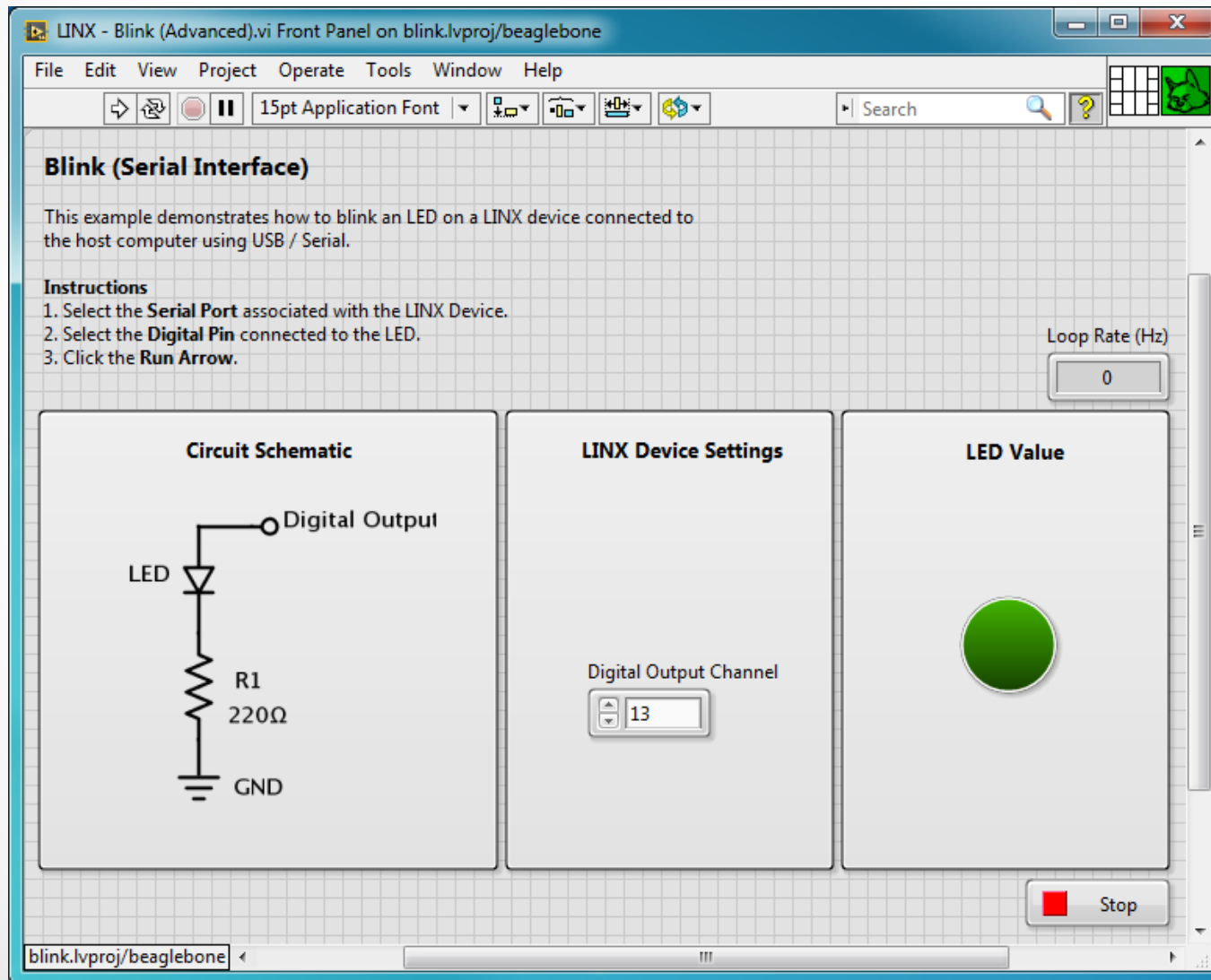


Projects



<http://www.youtube.com/watch?v=NJk81eCuqu0>

LabVIEW





- "OpenROV is a Do It Yourself telerobotics community centered around underwater exploration and education"
- There is an OpenROV Cape
http://circuitco.com/support/index.php?title=BeagleBone_ROV

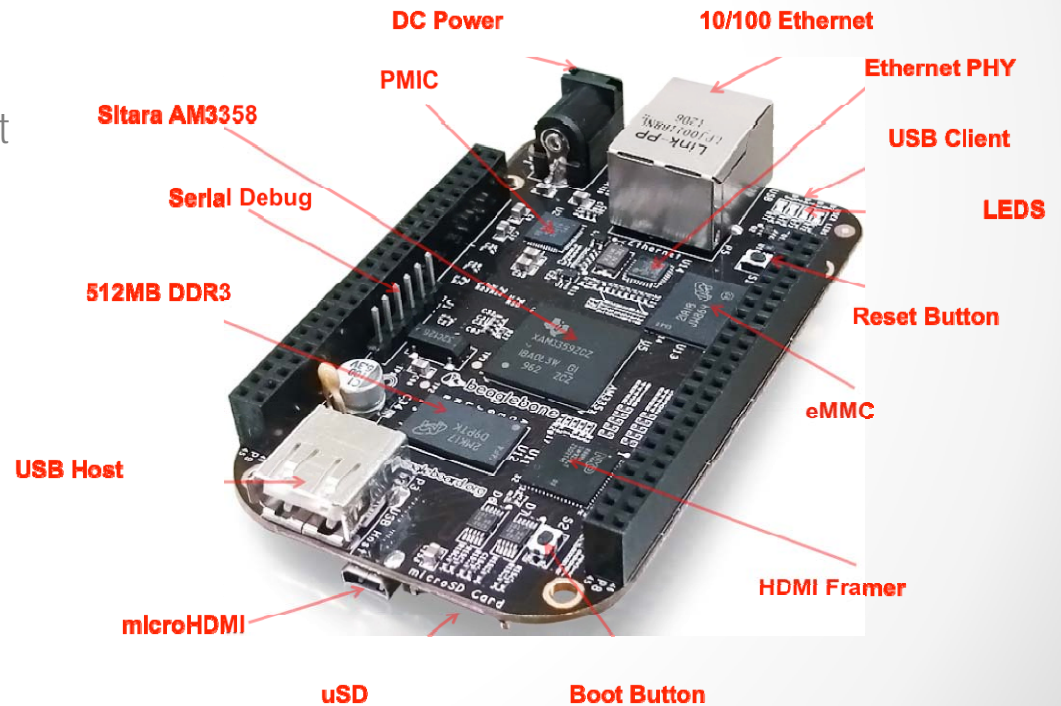


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Technical Details

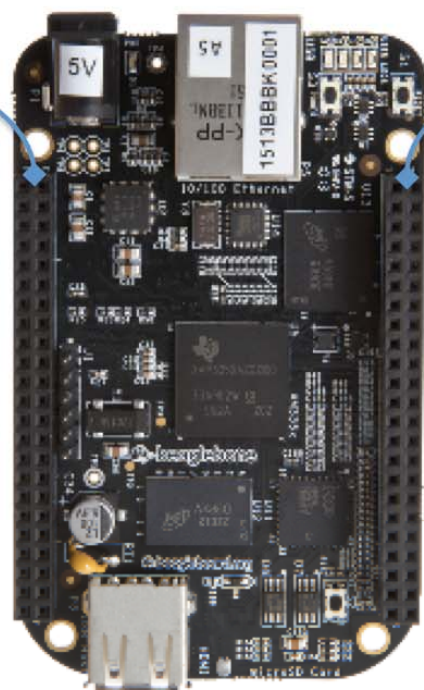
- Hardware
 - System on Chip
 - Pin Outs
- Software
 - Quick to learn – BoneScript
 - Easy to use – Shell Scripts
 - Powerful – C



<http://bone.Support/bone101/>

Cape Expansion Headers

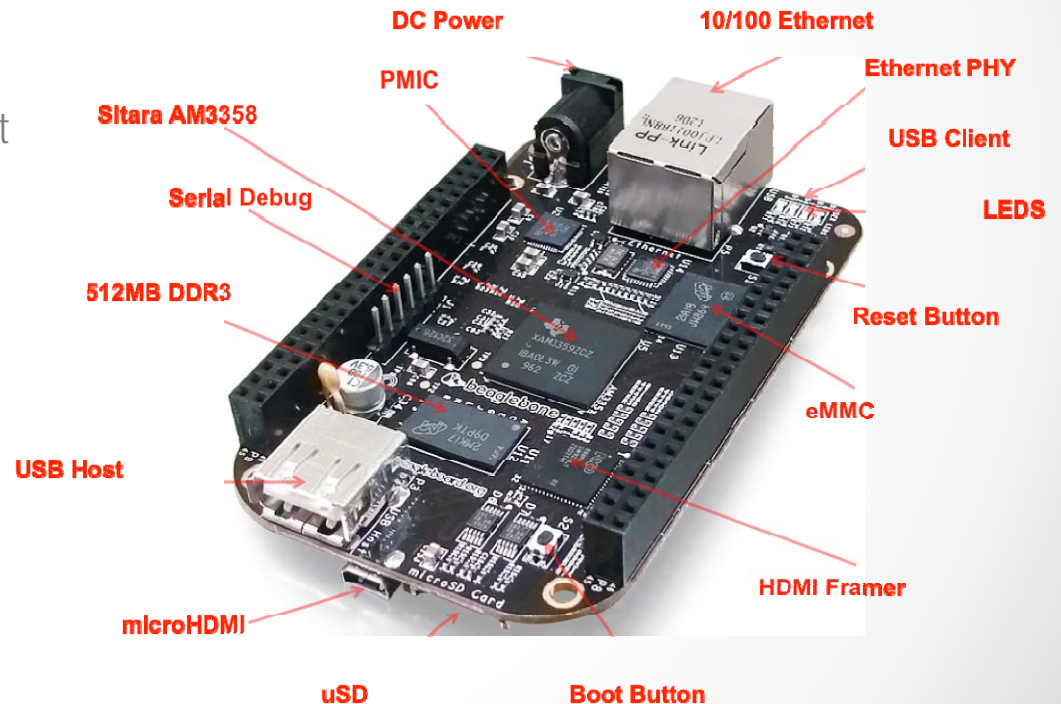
P9				P8			
DGND	1	2	DGND	DGND	1	2	DGND
VDD_3V3	3	4	VDD_3V3	MMC1_DAT6	3	4	MMC1_DAT7
VDD_5V	5	6	VDD_5V	MMC1_DAT2	5	6	MMC1_DAT3
SYS_5V	7	8	SYS_5V	GPIO_66	7	8	GPIO_67
PWR_BTN	9	10	SYS_RESETN	GPIO_69	9	10	GPIO_68
UART4_RXD	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
UART4_TXD	13	14	EHRPWM1A	EHRPWM2B	13	14	GPIO_26
GPIO_48	15	16	EHRPWM1B	GPIO_47	15	16	GPIO_46
SPI0_CS0	17	18	SPI0_D1	GPIO_27	17	18	GPIO_65
I2C2_SCL	19	20	I2C2_SDA	EHRPWM2A	19	20	MMC1_CMD
SPI0_D0	21	22	SPI0_SCLK	MMC1_CLK	21	22	MMC1_DAT5
GPIO_49	23	24	UART1_TXD	MMC1_DAT4	23	24	MMC1_DAT1
GPIO_117	25	26	UART1_RXD	MMC1_DAT0	25	26	GPIO_61
GPIO_115	27	28	SPI1_CS0	LCD_VSYNC	27	28	LCD_PCLK
SPI1_D0	29	30	GPIO_122	LCD_HSYNC	29	30	LCD_AC_BIAS
SPI1_SCLK	31	32	VDD_ADC	LCD_DATA14	31	32	LCD_DATA15
AIN4	33	34	GNDA_ADC	LCD_DATA13	33	34	LCD_DATA11
AIN6	35	36	AIN5	LCD_DATA12	35	36	LCD_DATA10
AIN2	37	38	AIN3	LCD_DATA8	37	38	LCD_DATA9
AIN0	39	40	AIN1	LCD_DATA6	39	40	LCD_DATA7
GPIO_20	41	42	ECAPPWMO	LCD_DATA4	41	42	LCD_DATA5
DGND	43	44	DGND	LCD_DATA2	43	44	LCD_DATA3
DGND	45	46	DGND	LCD_DATA0	45	46	LCD_DATA1



LEGEND
POWER/GROUND/RESET
AVAILABLE DIGITAL
AVAILABLE PWM
SHARED I2C BUS
RECONFIGURABLE DIGITAL
ANALOG INPUTS (1.8V)

Technical Details

- Hardware
 - System on Chip
 - Pin Outs
- Software
 - Quick to learn – BoneScript
 - Easy to use – Shell Scripts
 - Powerful – C



<http://bone/Support/bone101/>

BoneScript

- Familiar Arduino function calls...
...exported to the browser
- Buttons will run code in your browser that will impact the LEDs on your BeagleBone
- The exact code used in the browser is given
 - [digitalWrite\(\)](#)
 - [digitalRead\(\)](#)
 - [analogRead\(\)](#)
 - [attachInterrupt\(\)](#)
 - [readTextFile\(\)](#)
 - [writeTextFile\(\)](#)

<http://bone/Support/bone101/>

Other Languages

- Out-of-the-box the bone can run
 - C
 - C++
 - bash
 - perl
 - Python
 - JavaScript
- Go, Java, Ruby, Erlang and many, many, many more are very easy to install

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Continue with Labs

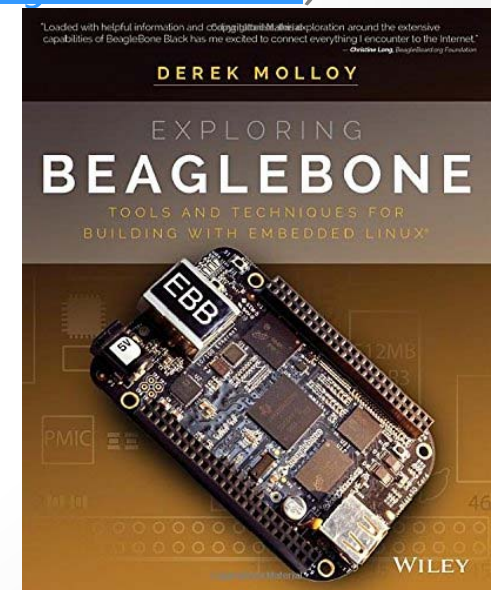
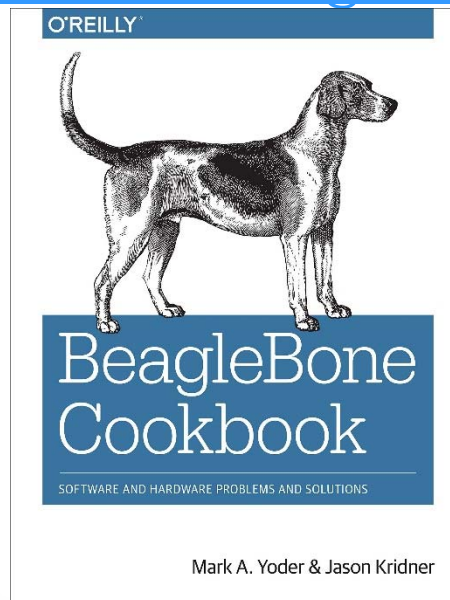
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Teaching with the Bone

- How do you get going?
- Attend a tutorial
- Derek Molloy (<http://derekmolloy.ie/beaglebone/>)
- Yoder's wiki (<http://elinux.org/Category:ECE597>)
- Texts
- Community
- univ@ti.com



Derek Molloy

Electronic Engineering Education and Innovation



derekmolloy.ie

Home

Course Notes

Embedded Systems

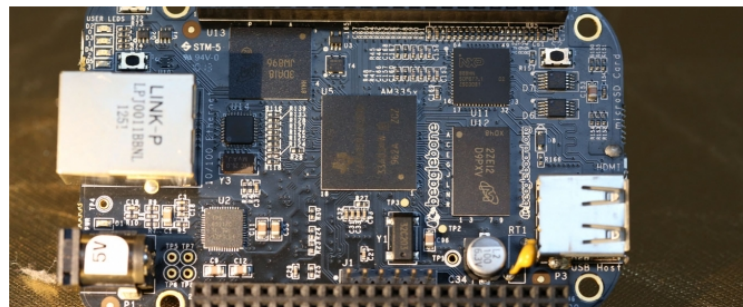
General

Blog

Other

The Beaglebone

Home / The Beaglebone



Introduction

I have developed a full series of videos on the Beaglebone – an Embedded Linux device that is perfect for getting started. The Beaglebone original retailed for about €85 and all of the first set of videos are based on this board. Later videos will describe the Beaglebone Black, which is a more powerful device but interestingly it retails for the lower cost of €45.

Getting Started

In the first video I introduce the Beaglebone – a low-cost high-performance 720MHz ARM A8 device with 256MB of DDR2 Memory. It has full support for 10/100 Ethernet, USB client support, JTAG debug via USB. It has 64 GPIOs, 7 x 12-bit ADCs, and support for canbus and LCDs. The pin layout is like the arduino where you can place "capex" on the board. The Beaglebone boots using the MicroSD card into embedded Linux (Angstrom). In this video I will demonstrate the first steps with the board and I will discuss how you can use embedded Linux to send or receive

Derek Molloy on Add to circles

Search ...

Tags

angstrom apache avconv
beaglebone
beaglebone black
bitbake build building c++ C920
connman cpu curl disk distribution
easydriver ffmpeg git gparted https
index.php iso Java kernel LED LEDs linux
live-cd nmap opencv portscan re-size
resize RTP SOURCE stepper motor UDP
url vdi Video virtualbox VLC Wordpress
x264 zeus

Categories

<http://derekmolloy.ie/beaglebone/>

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2013 TI G x Workshop x germany x BeagleRn x BeagleRn x Category x UserRoc x

elinux.org/Category:ECE497

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Category:ECE497

ROSE-HULMAN Embedded Linux Class by Mark A. Yoder

Categories relating to the course ECE497. (Electrical and Computer Engineering – ECE)

Subcategories

This category has the following 2 subcategories, out of 2 total.

A

- Adafruit

S

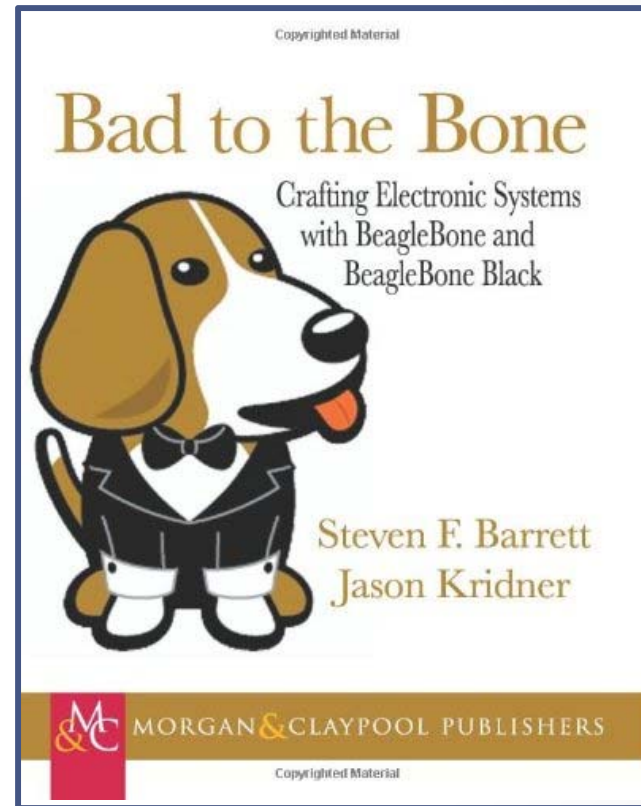
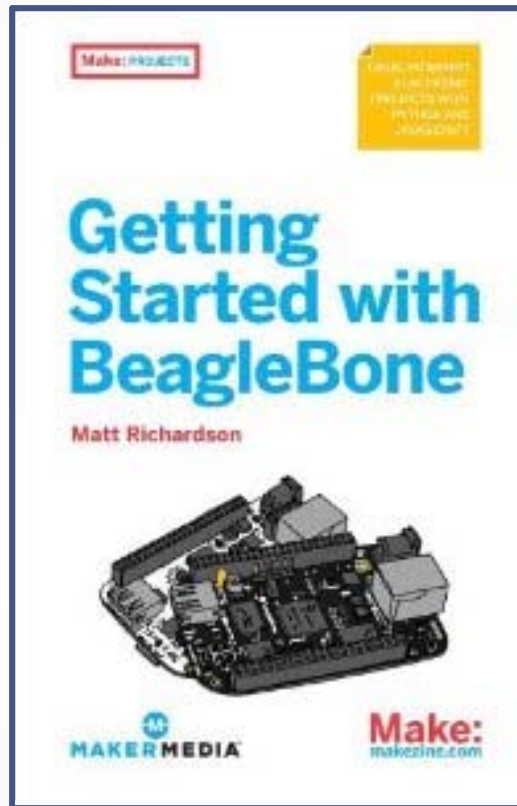
- SparkFun

Pages in category "ECE497"

The following 110 pages are in this category, out of 110 total.

	E cont.	S
• ECE497 - 32-bit Embedded Linux, Rose-Hulman	• EBC Exercise 16 git	• SparkFun: 0.5" Force Sensitive Resistor
• ECE497 Related Courses	• EBC Exercise 16 git - Fork and Pull	• SparkFun: ADXL335, three-axis accelerometer
• Embedded Beagle Class	• EBC Exercise 16 git Workshop Version	• SparkFun: BMP085 Barometric Pressure Sensor
• ECE497 Instructor's Guide	• EBC Exercise 17 Using ALSA for Audio Processing	• SparkFun: Flex Sensor
• Ti AM33XX PRUSSv2	• EBC Exercise 18 Using the DSP for Audio Processing	• SparkFun: HMC5883L Magnetometer
• EBC Embedded Beagle Class Topics	• EBC Exercise 19 DSS2 and sysfs	• SparkFun: IR Receiver Breakout Board
A	• EBC Exercise 20 The Display SubSystem (DSS)	• SparkFun: ITG-3200, Triple-Axis Gyro
• ECE497 SPI Project	• EBC Exercise 21 Running Audio and Video	• SparkFun: ITG-3200, Triple-Axis Gyro Display
• Adafruit: 16x24 Red LED Matrix Panel		
• Adafruit: 2-Axis Thumb Joystick		

Supporting Texts



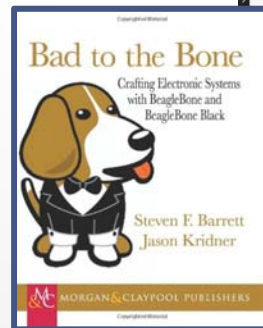
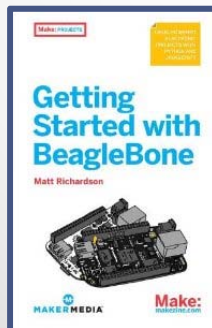
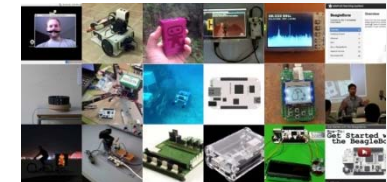
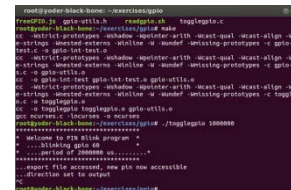
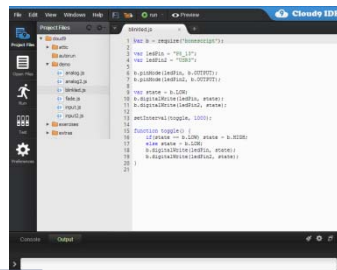
MORGAN & CLAYPOOL PUBLISHERS

Questions?

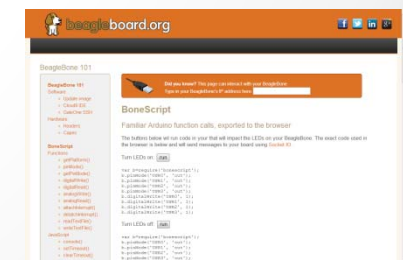
- Small
- Inexpensive
- Standard interfaces
- Expandable
- Big support community
- Powerful
- Easy to use
- Low power



\$45/\$55



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