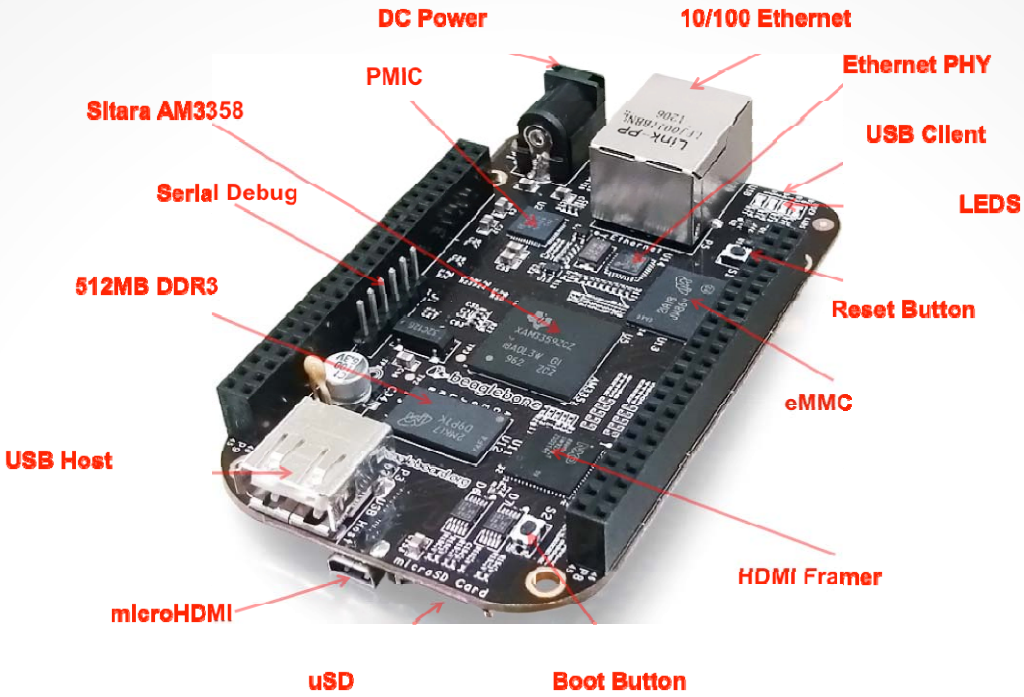

The Beagle Bone

by Mark A. Yoder

Mark.A.Yoder@Rose-Hulman.edu

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Boris

- …speaks for himself
- Watch carefully

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What did you see?

- Small Size
- Powered by USB
- Fast to boot
- 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
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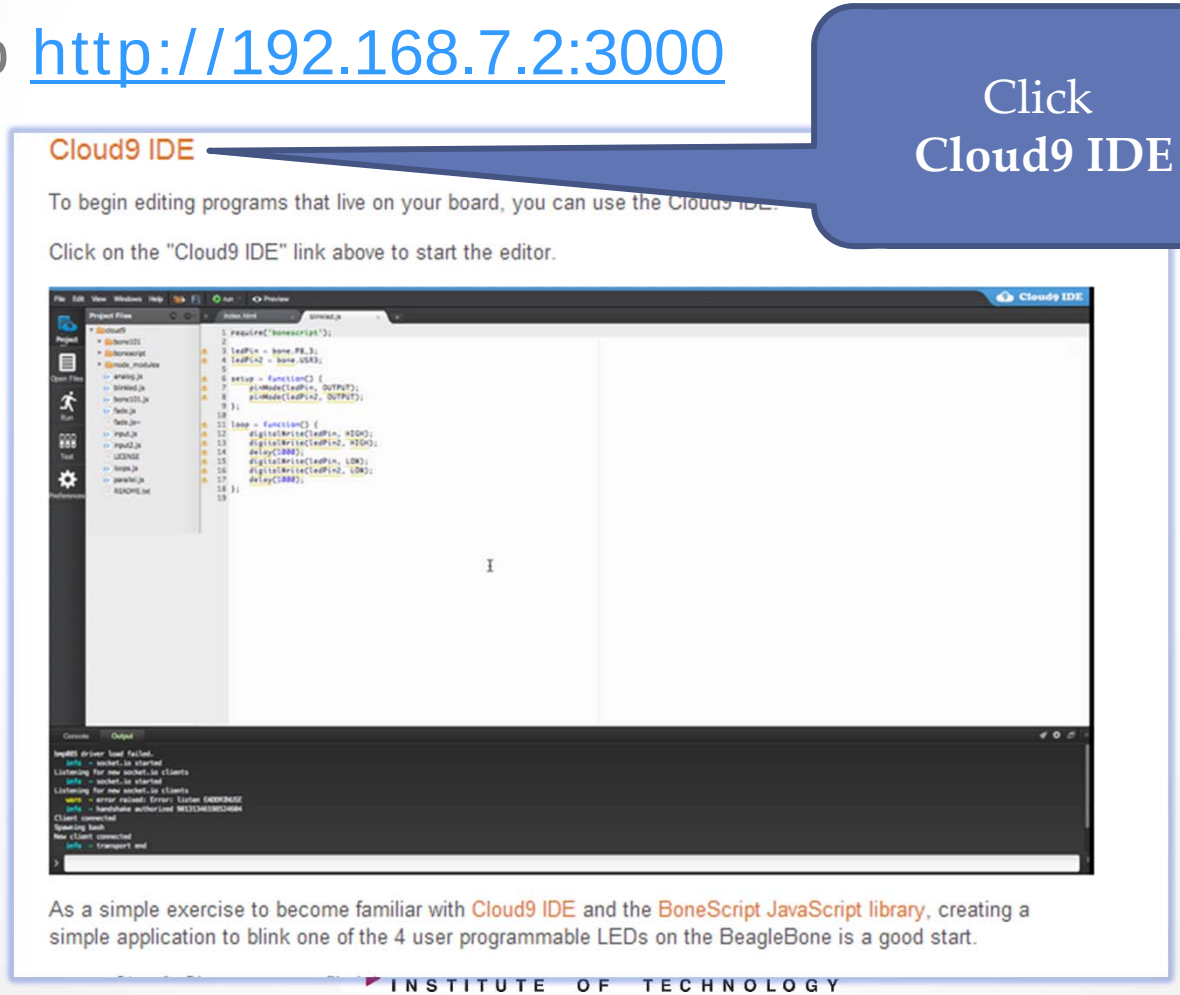
You – Out-of-the-box

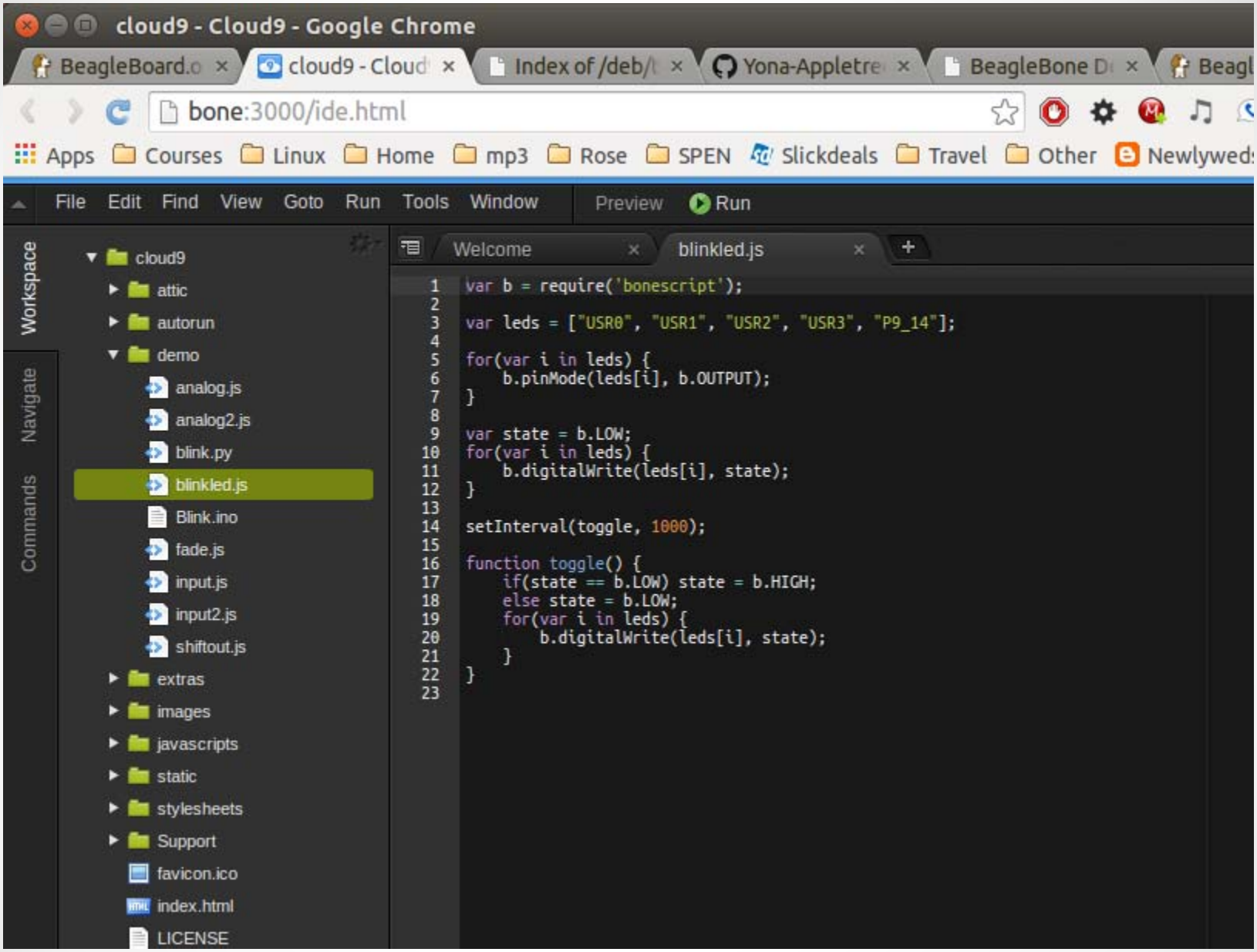
Getting Started

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. Install driver for your OS. (You'll have to click Install several times.)
5. Return to browser window with **START.htm** and scroll down to **Step 3** to find http://192.168.7.2 and click on it.
6. Explore.
7. Click on the title Cloud9 IDE (http://192.168.7.2:3000).
8. Continue with lab handouts.

Cloud 9 IDE

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





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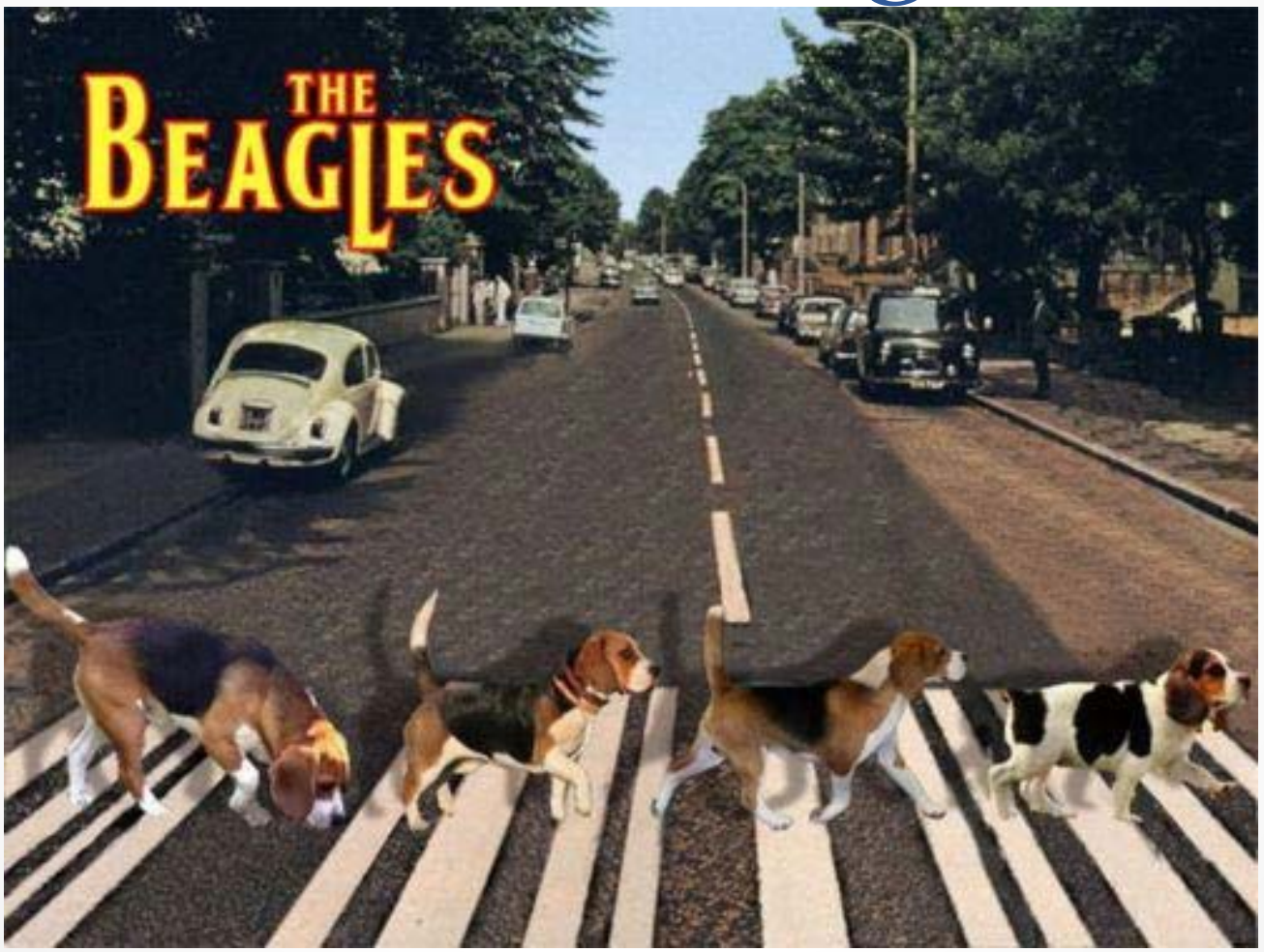
Introducing…



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- http://www.youtube.com/watch?feature=player_embedded&v=blvkerJr5wE

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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**

New

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Capes expand BeagleBone

Breadboard

Breakout

LCD
7”, 4.3” or 3.5”

DVI-D

CANBus

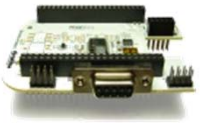
RS232

RS485

VGA

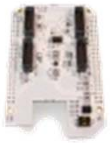
Battery

Profibus



Proto

RF-CC1101
CC2500
CC2530



Weather

Camera

CAN

DVI-D w/Audio

Audio

BeBoPr 3D Printer

Radar

LVDS

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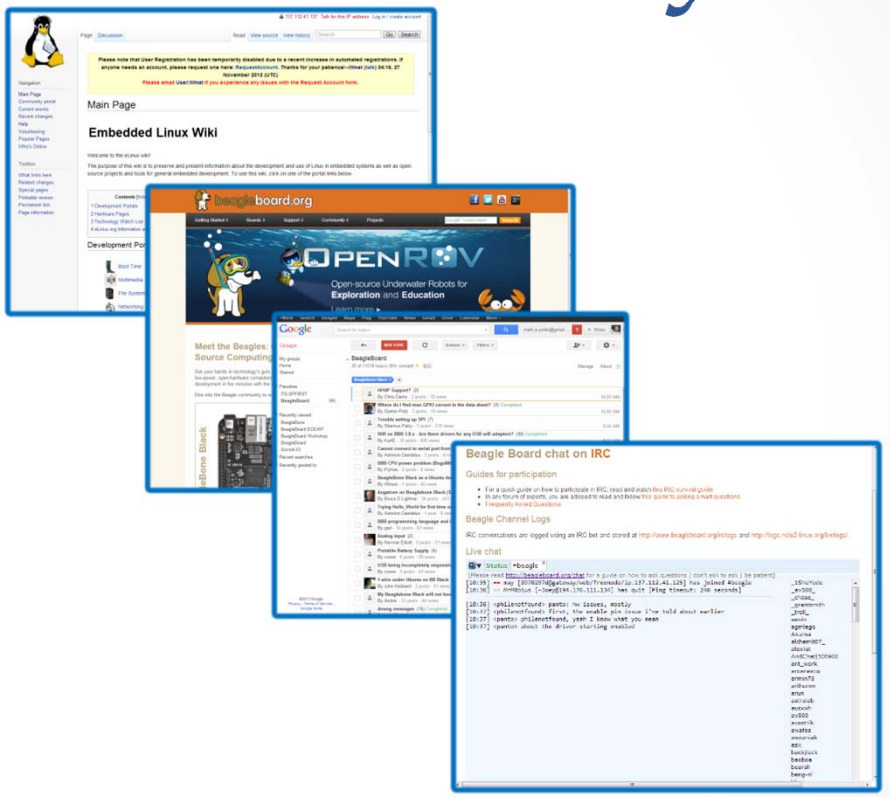
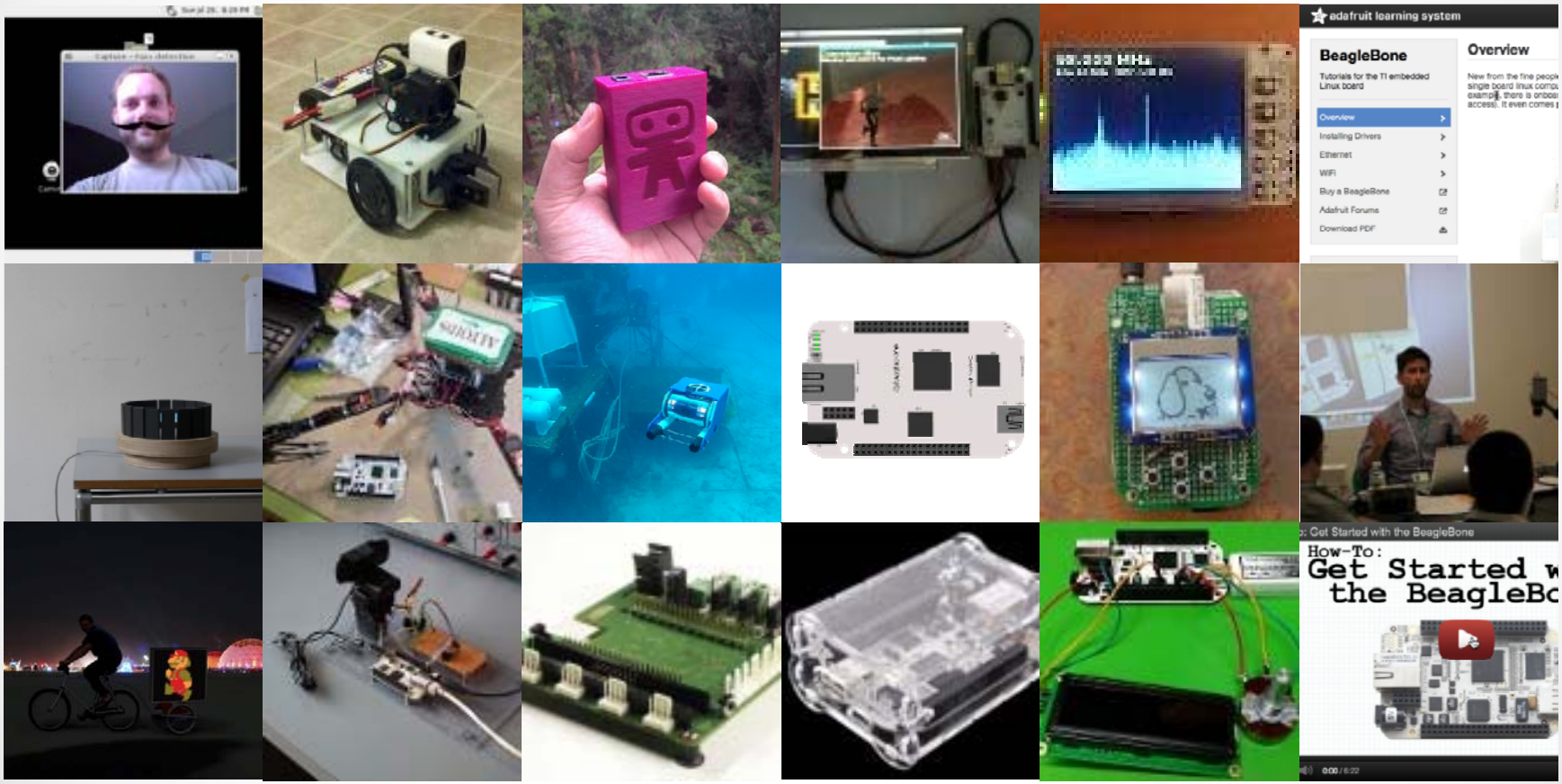
The Community

- eLinux.org
- BeagleBoard.org
- Google Group
- IRC

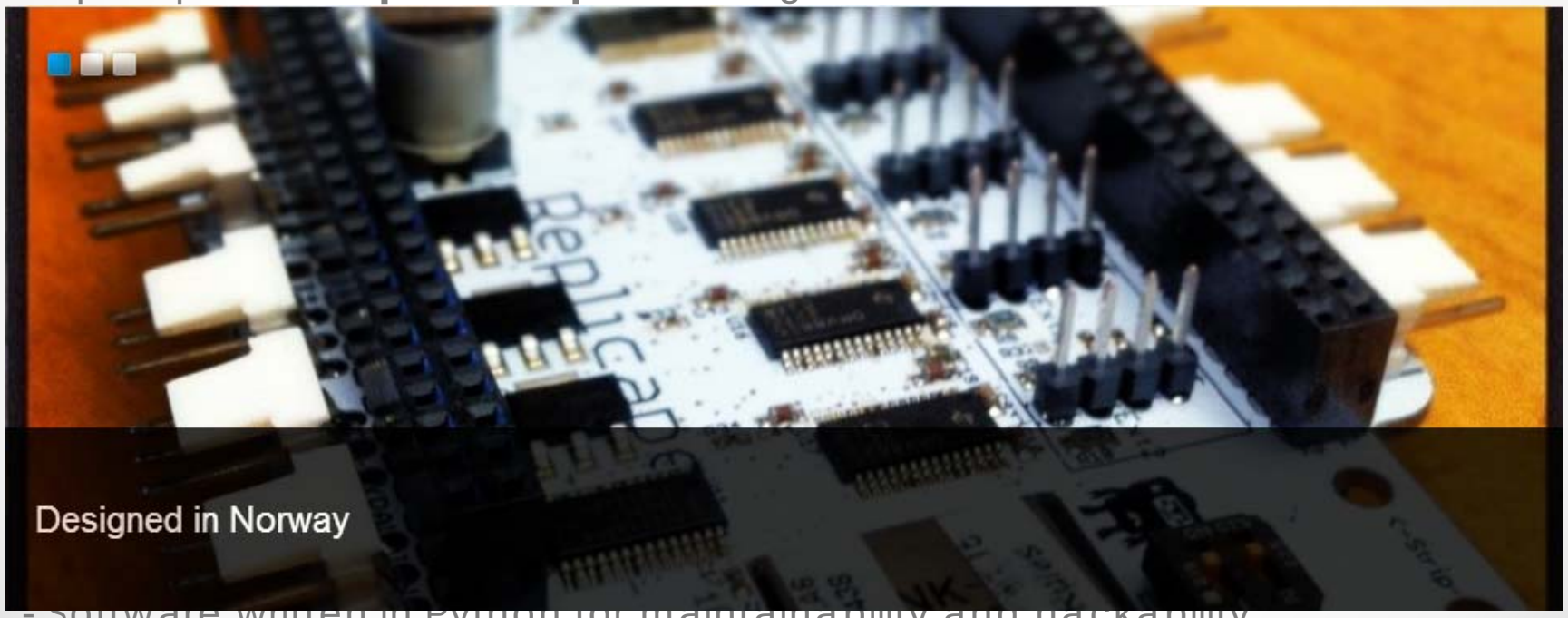


Projects



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

Replicape is a **3D printer cape** for BeagleBone



- Software written in Python for maintainability and hackability.
  http://www.youtube.com/watch?feature=player_embedded&v=7Sxl5geo10w

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- "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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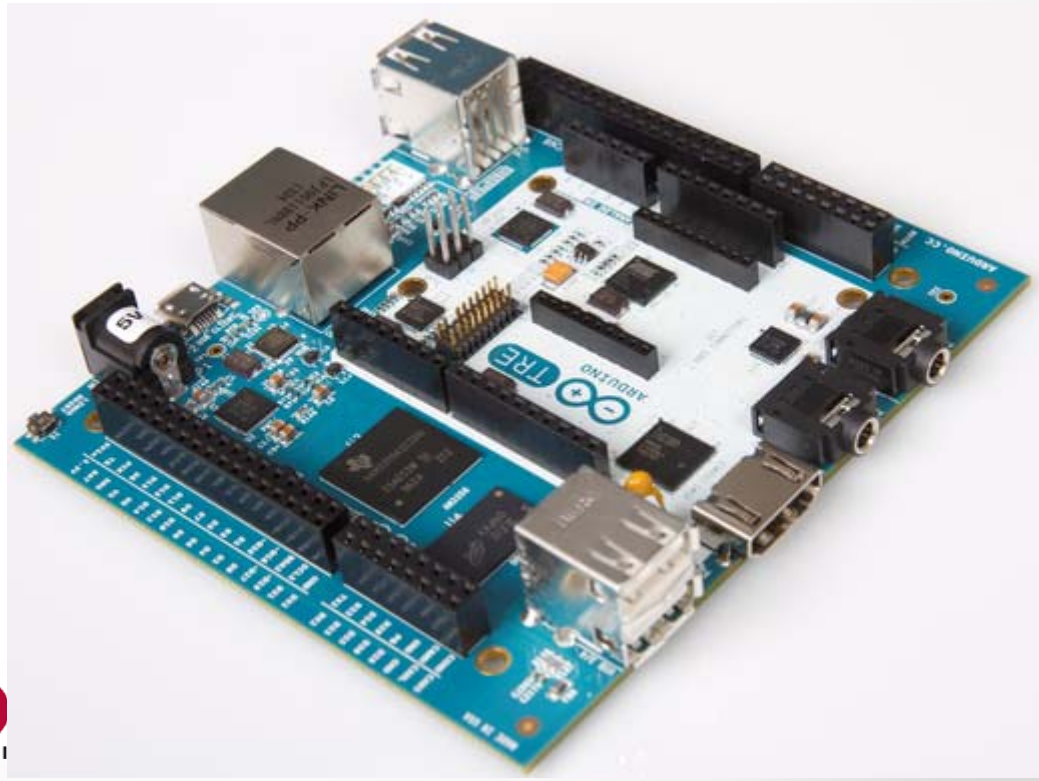
- BeagleBoard and Arduio combined



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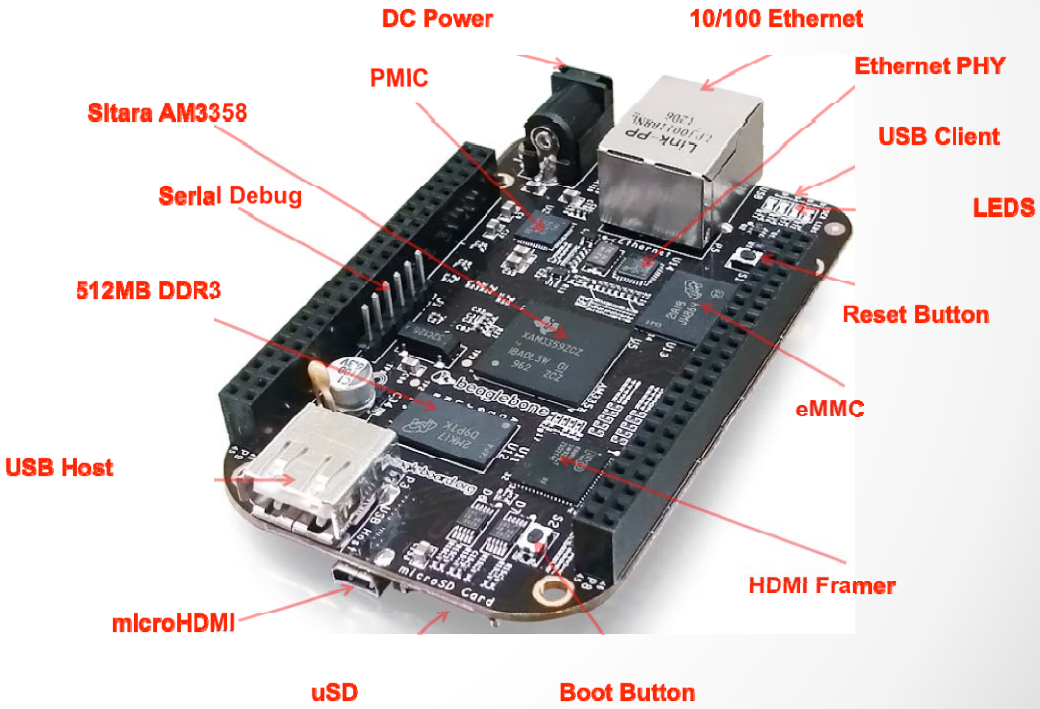
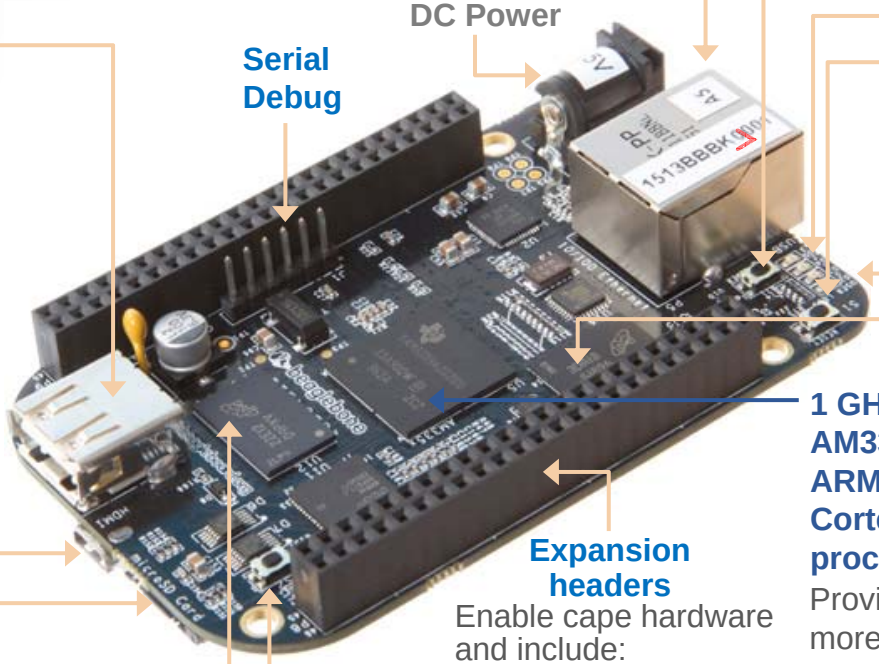
Technical Details

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



http://bone/Support/bone101/

BeagleBone Black-ready to use for $45/$55



10/100 Ethernet

USB Host
Easily connects to almost any everyday device such as mouse or keyboard

microHDMI
Connect directly to monitors and TVs

microSD
Expansion slot for additional storage

512MB DDR3
Faster, lower power RAM for enhanced user-friendly experience

Serial Debug

DC Power

Boot Button

Power Button

LEDS

Reset Button

USB Client
Development interface and directly powers board from PC

2 or 4 GB on-board storage using eMMC
- Pre-loaded with Debian Linux Distribution
- 8-bit bus accelerates performance
- Frees the microSD slot to be used for additional storage for a less expensive solution than SD cards

1 GHz Sitara AM335x ARM® Cortex™-A8 processor
Provides a more advanced user interface and up to 150% better performance than ARM11

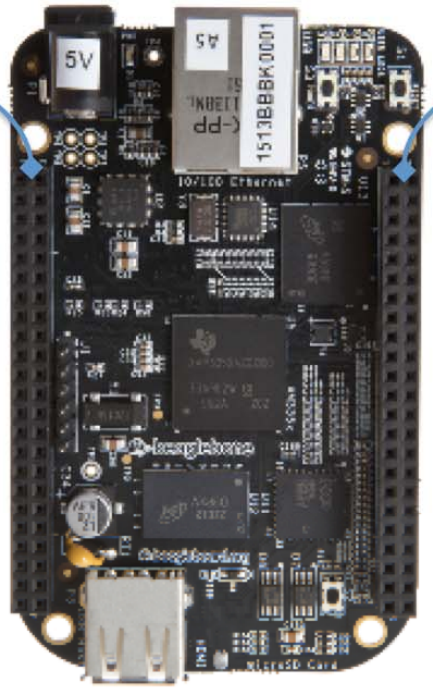
Expansion headers
Enable cape hardware and include:
- 65 digital I/O
- 7 analog in
- 4 serial
- 2 SPI
- 2 I2C
- 8 PWMs
- 4 timers
- And much much more!

Included in price:
- **Power supply ~ $10**
- **USB network cable ~ $3**
- **2GB on-board storage $5-$10**
- **PRU for real-time tasks typically on FPGA ~ $20**

Cape Expansion Headers

P9

DGND	1	2	DGND
VDD_3V3	3	4	VDD_3V3
VDD_5V	5	6	VDD_5V
SYS_5V	7	8	SYS_5V
PWR_BUT	9	10	SYS_RESETn
UART4_RXD	11	12	GPIO_60
UART4_TXD	13	14	EHRPWM1A
GPIO_48	15	16	EHRPWM1B
SPI0_CS0	17	18	SPI0_D1
I2C2_SCL	19	20	I2C2_SDA
SPI0_D0	21	22	SPI0_SCLK
GPIO_49	23	24	UART1_TXD
GPIO_117	25	26	UART1_RXD
GPIO_115	27	28	SPI1_CS0
SPI1_D0	29	30	GPIO_122
SPI1_SCLK	31	32	VDD_ADC
AIN4	33	34	GNDA_ADC
AIN6	35	36	AIN5
AIN2	37	38	AIN3
AIN0	39	40	AIN1
GPIO_20	41	42	ECAPPWM0
DGND	43	44	DGND
DGND	45	46	DGND



LEGEND
Power/Ground/Reset
Available Digital
Available PWM
Shared I2C Bus
Reconfigurable Digital
Analog Inputs (1.8V)

P8

DGND	1	2	DGND
MMC1_DAT6	3	4	MMC1_DAT7
MMC1_DAT2	5	6	MMC1_DAT3
GPIO_66	7	8	GPIO_67
GPIO_69	9	10	GPIO_68
GPIO_45	11	12	GPIO_44
EHRPWM2B	13	14	GPIO_26
GPIO_47	15	16	GPIO_46
GPIO_27	17	18	GPIO_65
EHRPWM2A	19	20	MMC1_CMD
MMC1_CLK	21	22	MMC1_DAT5
MMC1_DAT4	23	24	MMC1_DAT1
MMC1_DAT0	25	26	GPIO_61
LCD_VSYNC	27	28	LCD_PCLK
LCD_HSYNC	29	30	LCD_AC_BIAS
LCD_DATA14	31	32	LCD_DATA15
LCD_DATA13	33	34	LCD_DATA11
LCD_DATA12	35	36	LCD_DATA10
LCD_DATA8	37	38	LCD_DATA9
LCD_DATA6	39	40	LCD_DATA7
LCD_DATA4	41	42	LCD_DATA5
LCD_DATA2	43	44	LCD_DATA3
LCD_DATA0	45	46	LCD_DATA1

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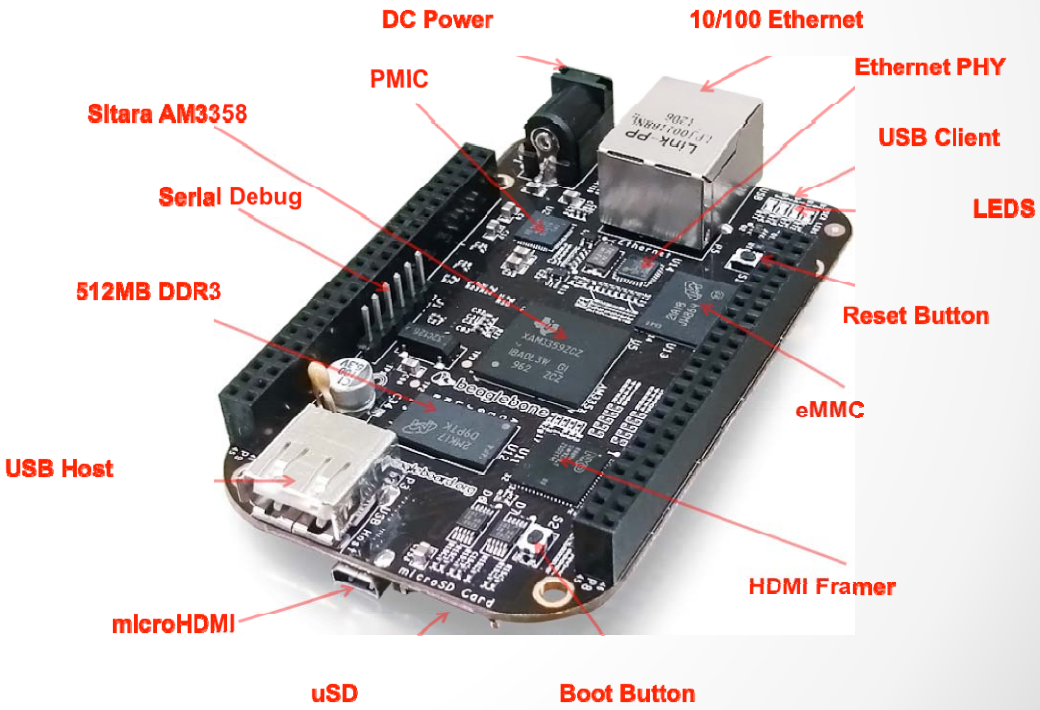

http://bone/Support/bone101/

BoneScript

- Familiar Arduino function calls…

…exported to the browser

- Buttons will run code in your broswer 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/

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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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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:ECE497)
- Texts
- Community

Derek Molloy

http://derekmolloy.ie/beaglebone/

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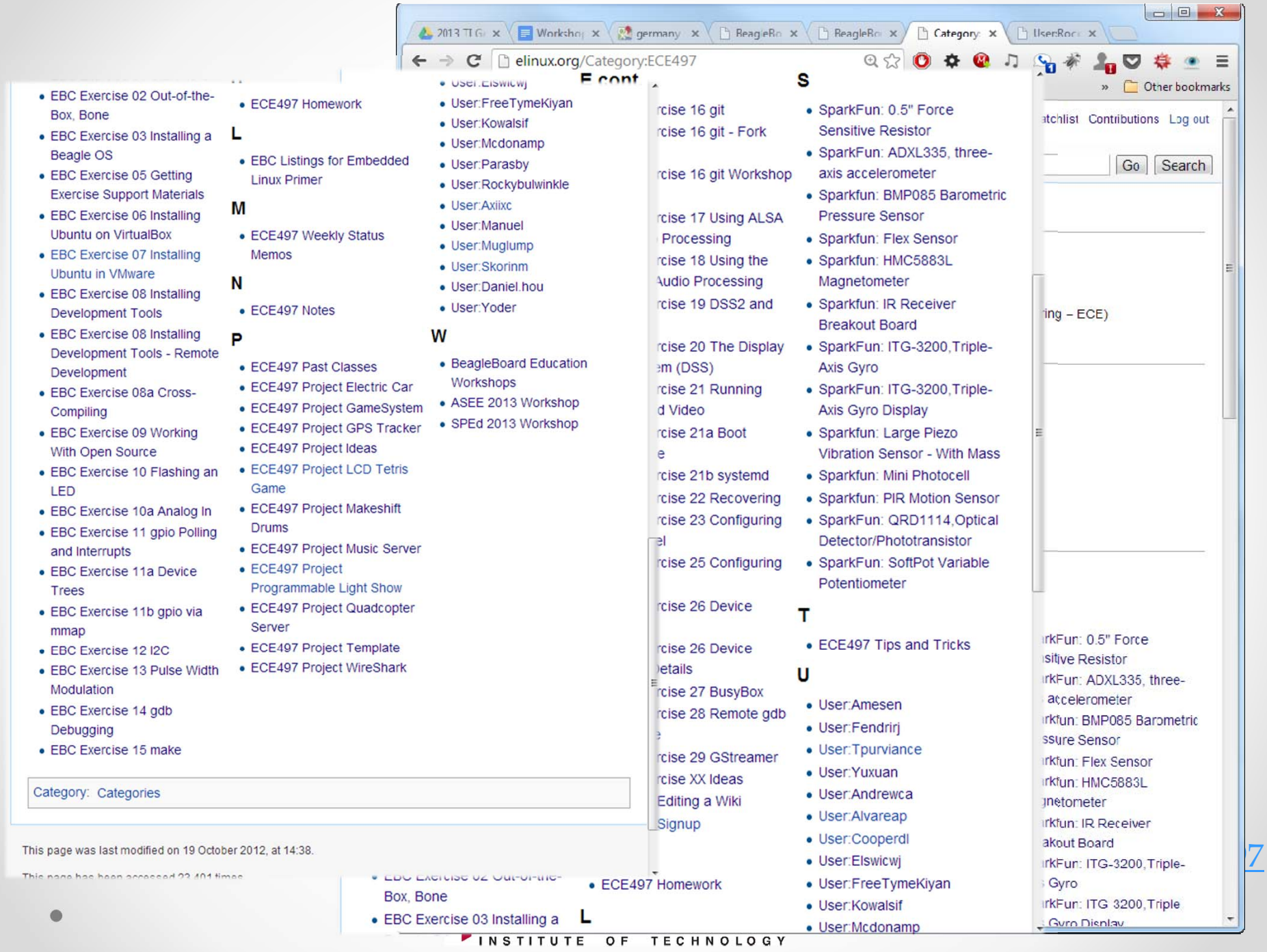
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EBC Exercise 08 Installing Development Tools - Remote Development
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EBC Exercise 10 Flashing an LED
EBC Exercise 10a Analog In
EBC Exercise 11 gpio Polling and Interrupts
EBC Exercise 11a Device Trees
EBC Exercise 11b gpio via mmap
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ECE497 Project WireShark
ECE497 Homework
User:FreeTymeKiyan
User:Kowalsif
User:Mcdonamp
User:Parasby
User:Rockybulwinkle
User:Axiixc
User:Manuel
User:Muglump
User:Skorinm
User:Daniel.hou
User:Yoder
W
BeagleBoard Education Workshops
ASEE 2013 Workshop
SPEd 2013 Workshop
S
SparkFun: 0.5" Force Sensitive Resistor
SparkFun: ADXL335, three-axis accelerometer
Sparkfun: BMP085 Barometric Pressure Sensor
Sparkfun: Flex Sensor
Sparkfun: HMC5883L Magnetometer
Sparkfun: IR Receiver Breakout Board
SparkFun: ITG-3200,Triple-Axis Gyro
SparkFun: ITG-3200,Triple-Axis Gyro Display
Sparkfun: Large Piezo Vibration Sensor - With Mass
Sparkfun: Mini Photocell
Sparkfun: PIR Motion Sensor
SparkFun: QRD1114,Optical Detector/Phototransistor
SparkFun: SoftPot Variable Potentiometer
T
ECE497 Tips and Tricks
U
User:Amesen
User:Fendrirj
User:Tpurviance
User:Yuxuan
User:Andrewca
User:Alvareap
User:Cooperdl
User:Elswicwj
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User:Kowalsif
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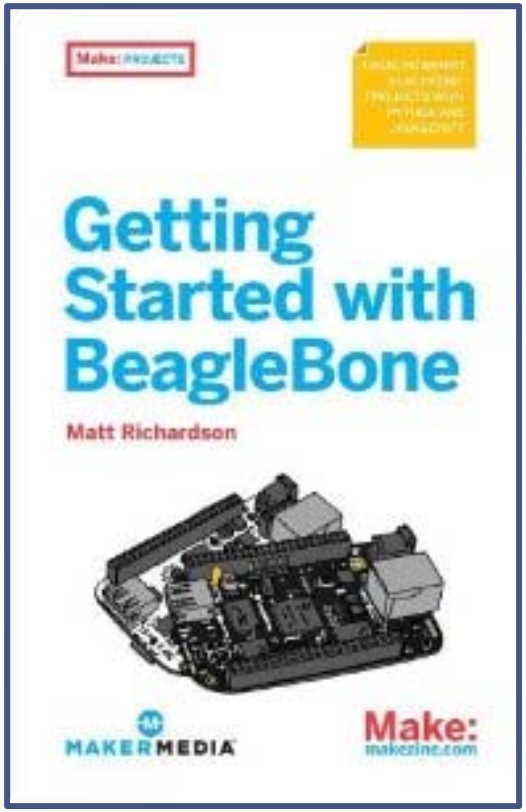
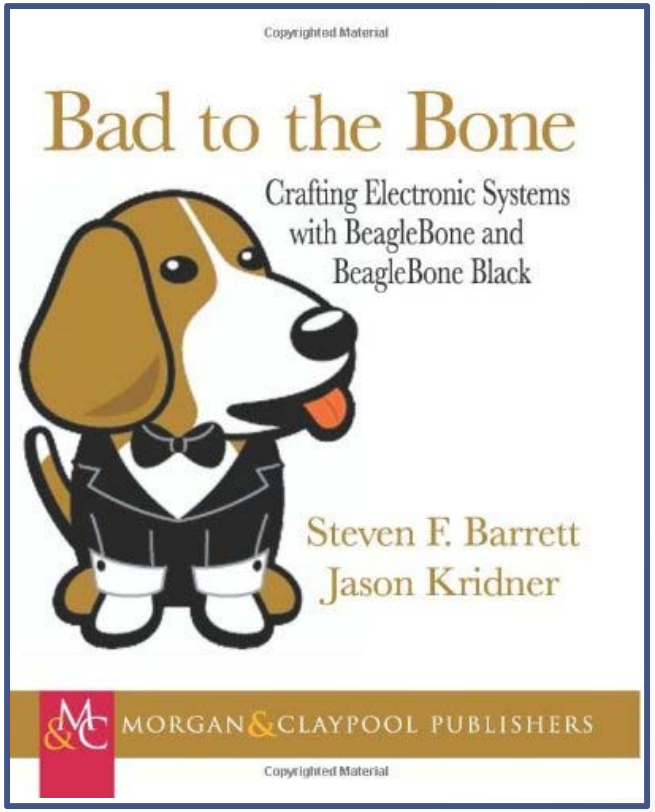
Texas Instruments

beagleboard.org

Supporting Texts





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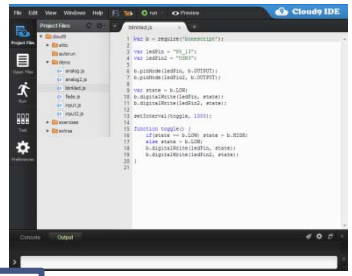
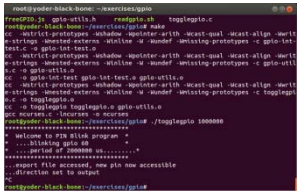
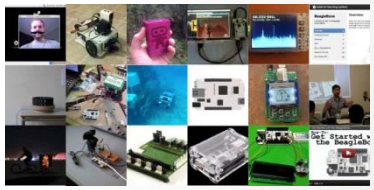
Questions?

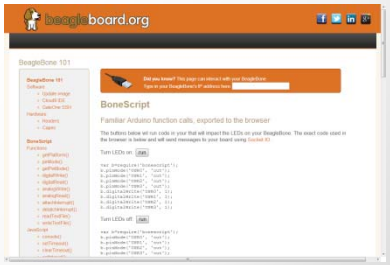
- Small
- Inexpensive
- Standard interfaces
- Expandable
- Big support community
- Powerful
- Easy to use
- Low power
-
-
-

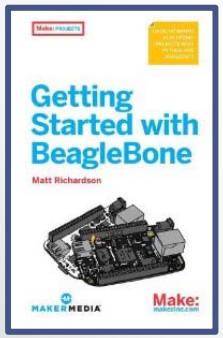
$45/$55

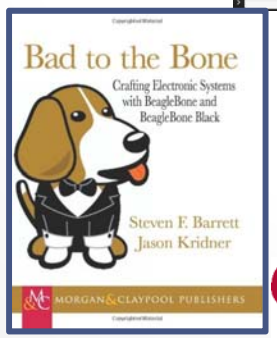












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