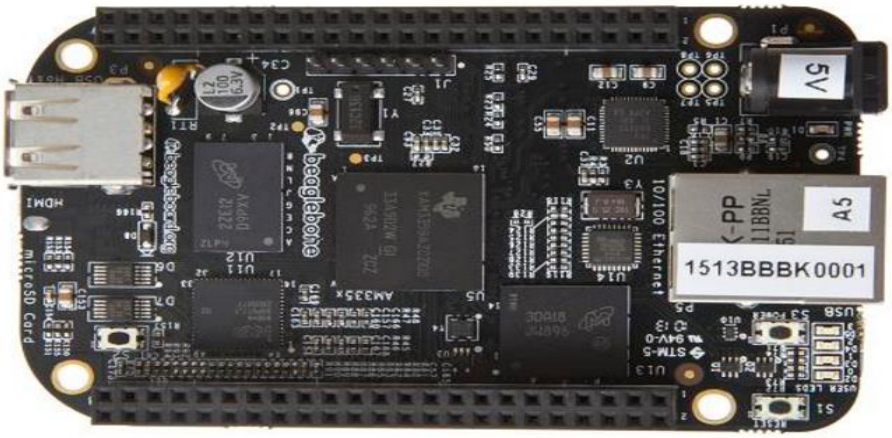
ECEN 5803- Mastering Embedded System Architecture

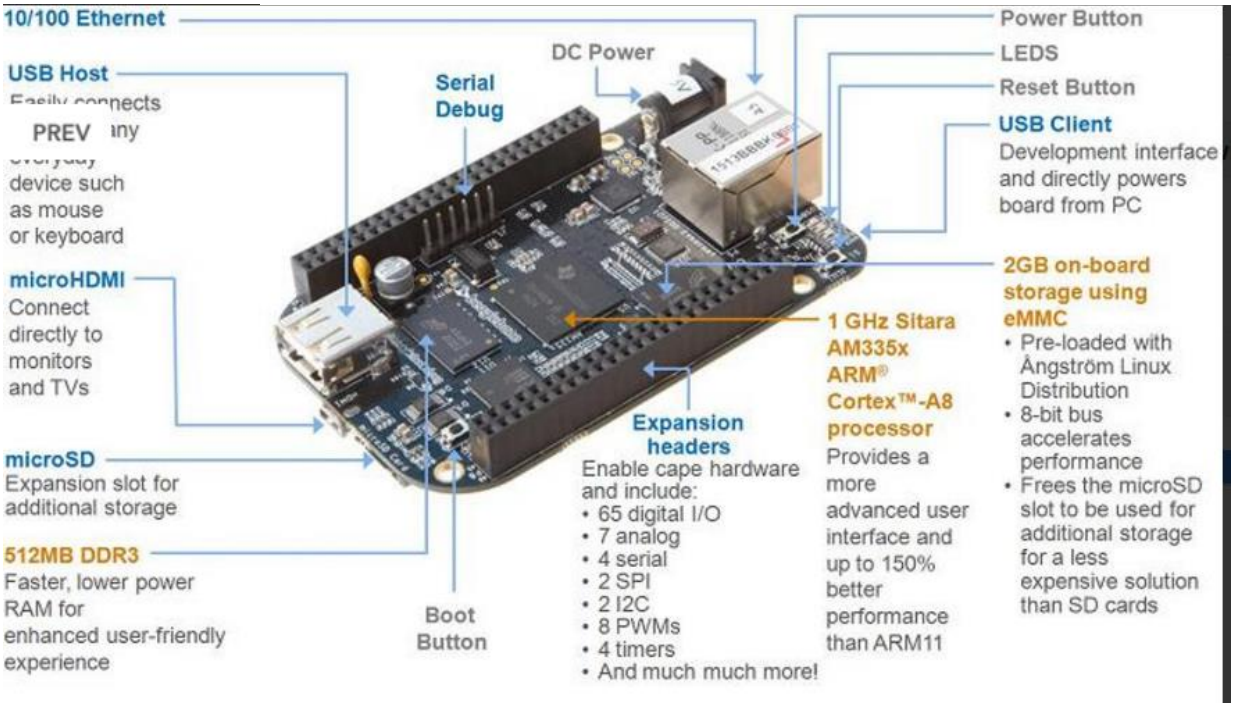
Practical Homework set 4

Due 2021/11/05

INTRODUCTION

BEAGLEBONE BLACK





BeagleBone Black is a low-cost, open source, community-supported development platform for ARM® Cortex™-A8 processor developers and hobbyists. Boot Linux in under 10-seconds and get started on Sitara™ AM335x ARM Cortex-A8 processor development in less than 5 minutes with just a single USB cable.

BeagleBone Black ships with the Debian GNU/Linux™ in onboard FLASH to start evaluation and development. Many other Linux distributions and operating systems are also supported on BeagleBone Black including:

- Ubuntu
- Android
- Fedora

BeagleBone Black's capabilities can be extended using plug-in boards called "capes" that can be plugged into BeagleBone Black's two 46-pin dual-row expansion headers. Capes are available for, VGA, LCD, motor control, prototyping, battery power and other functionality. More information.

Visit the BeagleBone Black Support Community

FEATURES

BeagleBone	
Example Applications	Robotics, motor drivers, Twitter printer, data backup, SDR base station, USB data acquisition and more
Board size	3.4" x 2.1"
DDR memory	512 MB
Development environment	Fully functional terminal interface directly in the browser and the ability to run Python, Ruby and INO Sketches directly in the Cloud9 IDE, in addition to JavaScript on Node.JS and in your web browser
Ethernet	On-chip 10/100 Ethernet
JTAG	Optional
Memory	Memory: 4GB eMMC memory that's pre-loaded with Debian GNU/Linux™distribution and that frees up your microSD card slot
More info	Product Details
Power Options	Via USB or 5V DC input
Processor	1GHz AM3359 Sitara ARM Cortex-A8
USB	1-port USB 2.0 Host 1-port USB 2.0 Client

Version Date	14 May 2014

GETTING STARTED

This video shows how to get started with BeagleBone Black:
https://youtu.be/MSbJ45OnajE

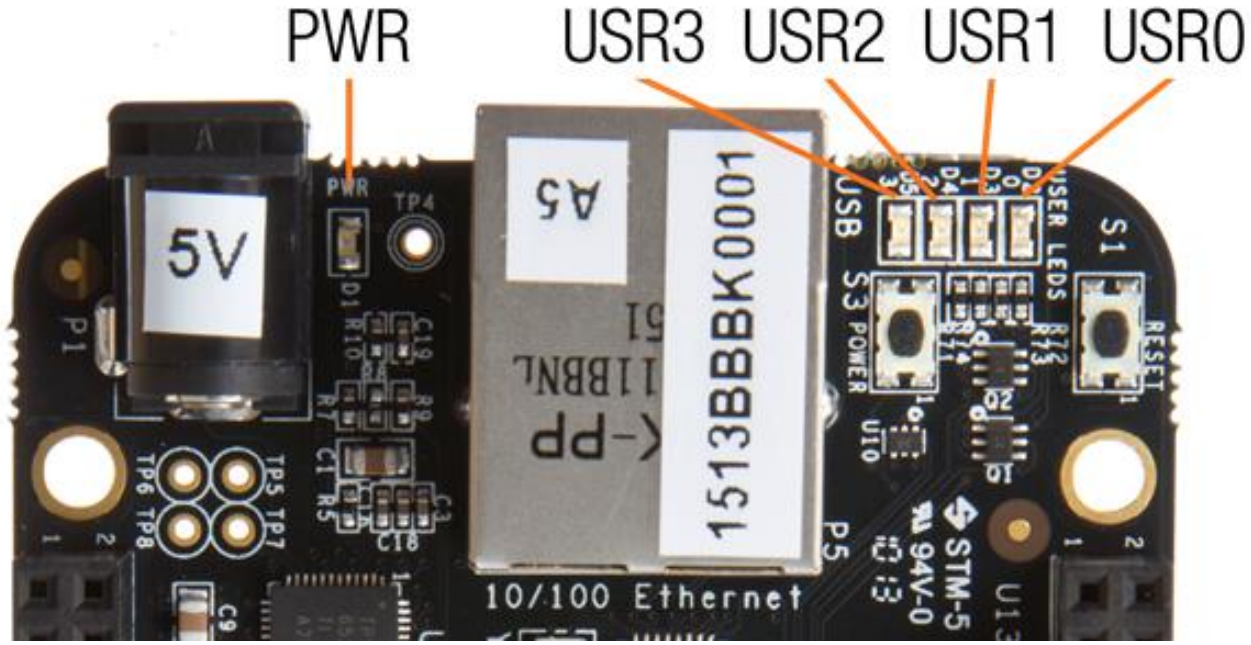
NOTE: You will need a 4 or 8 GB microSD card to complete this lab

Step 1

PLUG IN YOUR BEAGLE VIA USB

Use the provided USB cable to plug your Beagle into your computer. This will both power the board and provide a development interface. BeagleBone Black will boot Linux from the on-board 2GB or 4GB eMMC. Either BeagleBone Black or original BeagleBone may also boot from a microSD card. Original BeagleBone is provided with a pre-configured 4GB microSD card.
BeagleBone or BeagleBone Black will operate as a flash drive providing you with a local copy of the documentation and drivers. Note that this interface may not be used to re-configure the microSD card with a new image, but may be used to update the boot parameters using the uEnv.txt file.
You'll see the PWR LED lit steadily. Within 10 seconds, you should see the other LEDs blinking in their default configurations.

- USR0 is configured at boot to blink in a heartbeat pattern
- USR1 is configured at boot to light during microSD card accesses
- USR2 is configured at boot to light during CPU activity
- USR3 is configured at boot to light during eMMC accesses



Step 2

INSTALL DRIVERS

Install the drivers for your operating system to give you network-over-USB access to your Beagle. Additional drivers give you serial access to your board.

Operating System	USB Drivers	Comments
Windows (64-bit)	64-bit installer	If in doubt, try the 64-bit installer first. • **Note #1:** Windows Driver Certification warning may pop up two or three times. Click "Ignore", "Install" or "Run" • **Note #2:** To check if you're running 32 or 64-bit Windows see this: http://support.microsoft.com/kb/827218. • **Note #3:** On systems without the latest service release, you may get an error (0xc000007b). In that case, please install the following and retry: http://www.microsoft.com/en-us/download/confirmation.aspx?id=13523. • **Note #4:** You may need to reboot Windows. • **Note #5:** These drivers have been tested to work up to Windows 10
Windows (32-bit)	32-bit installer	
Mac OS X	Network Serial	Install both sets of drivers.
Linux	mkudevrule.sh	Driver installation isn't required, but you might find a few udev rules helpful.

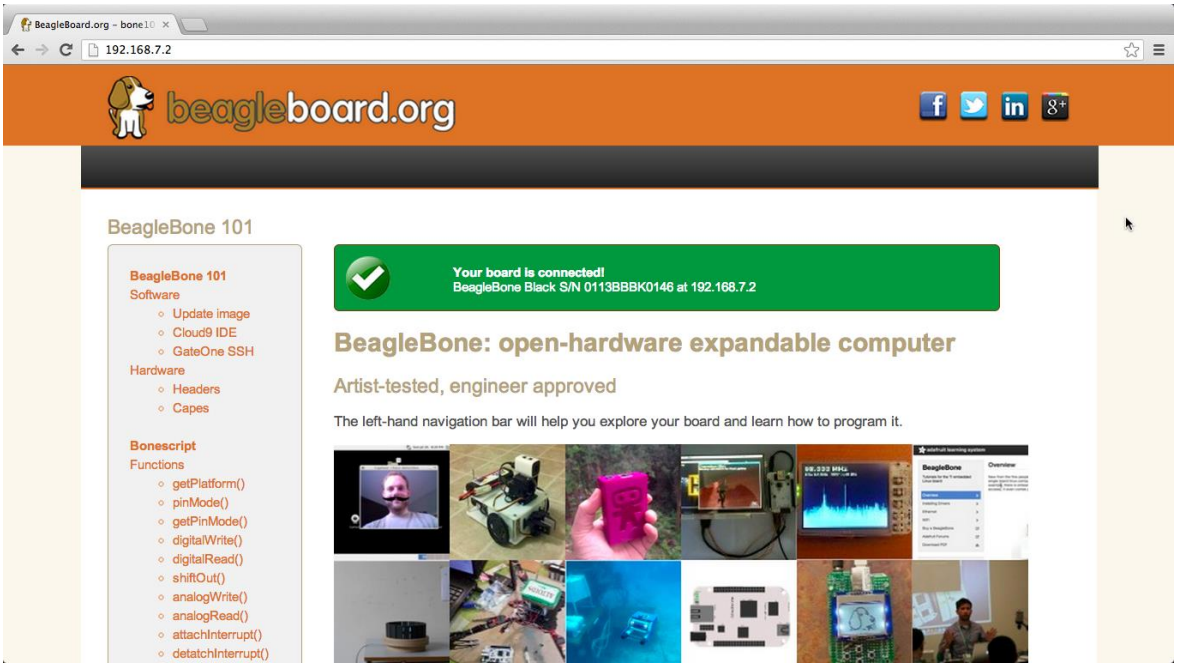
Note: Additional FTDI USB to serial/JTAG information and drivers are available fromhttp://www.ftdichip.com/Drivers/VCP.htm.
Note: Additional USB to virtual Ethernet information and drivers are available from http://www.linux-usb.org/gadget/and http://joshuawise.com/horndis.

Step 3

BROWSE TO YOUR BEAGLE

Using either Chrome or Firefox (Internet Explorer will **NOT** work), browse to the web server running on your board. It will load a presentation showing you the capabilities of the board. Use the arrow keys on your keyboard to navigate the presentation.

- Click here to launch: http://192.168.7.2
  Older software images require you to EJECT the BEAGLE_BONE drive to start the network. With the latest software image, that step is no longer required.



TROUBLESHOOTING

DO NOT USE INTERNET EXPLORER.

One option to browse your board is to use this node-webkit based application (currently limited to Windows machines):beaglebone-getting-started.zip.

Virtual machines are not recommended when using the direct USB connection. It is recommended you use only network connections to your board if you are using a virtual machine.

When using 'ssh' with the provided image, the username is 'root' and the password is blank.

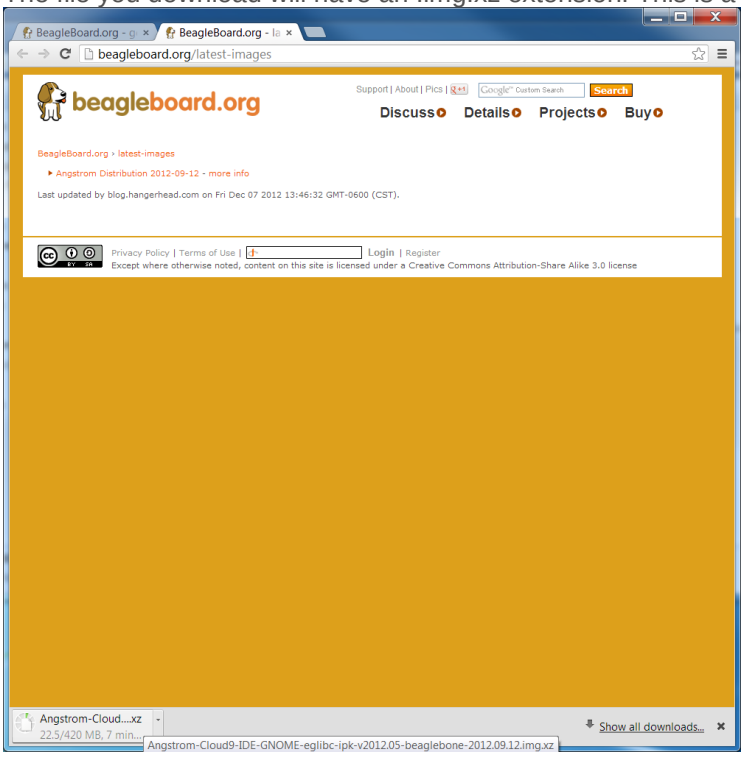
Visit beagleboard.org/support for additional debugging tips.

UPDATE LINUX ON SD CARD

UPDATE BOARD WITH LATEST SOFTWARE

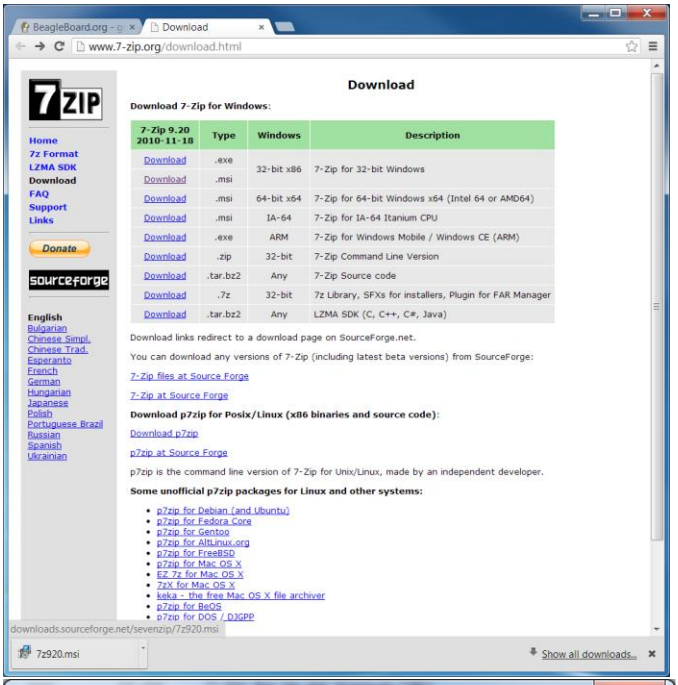
STEP #1: DOWNLOAD THE LATEST SOFTWARE IMAGE

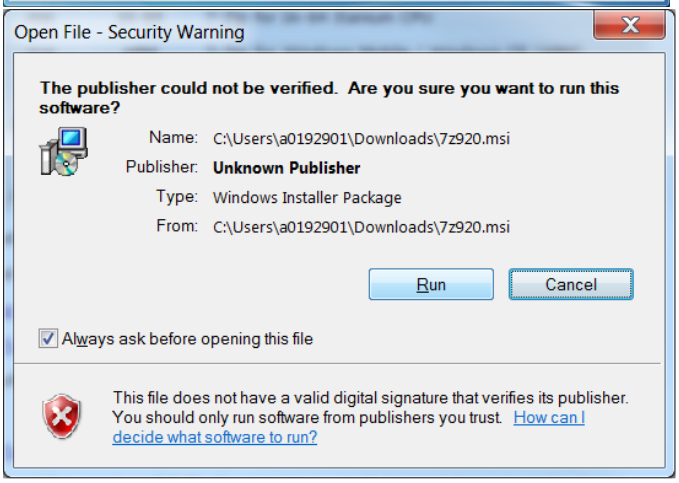
Download the desired image from http://beagleboard.org/latest-images.
Note: Due to sizing necessities, this download may take 30 minutes or more.
The file you download will have an .img.xz extension. This is a compressed sector-by-sector image of the SD card.



STEP #2: INSTALL COMPRESSION UTILITY

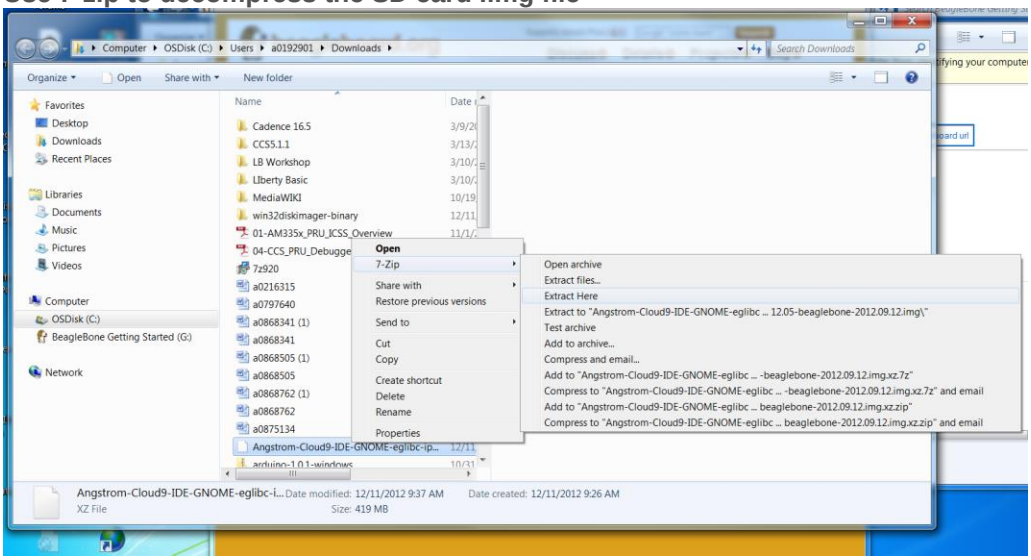
Download and install 7-zip. You can also find this utility program in the ECEN5803Resources folder on the Google drive.





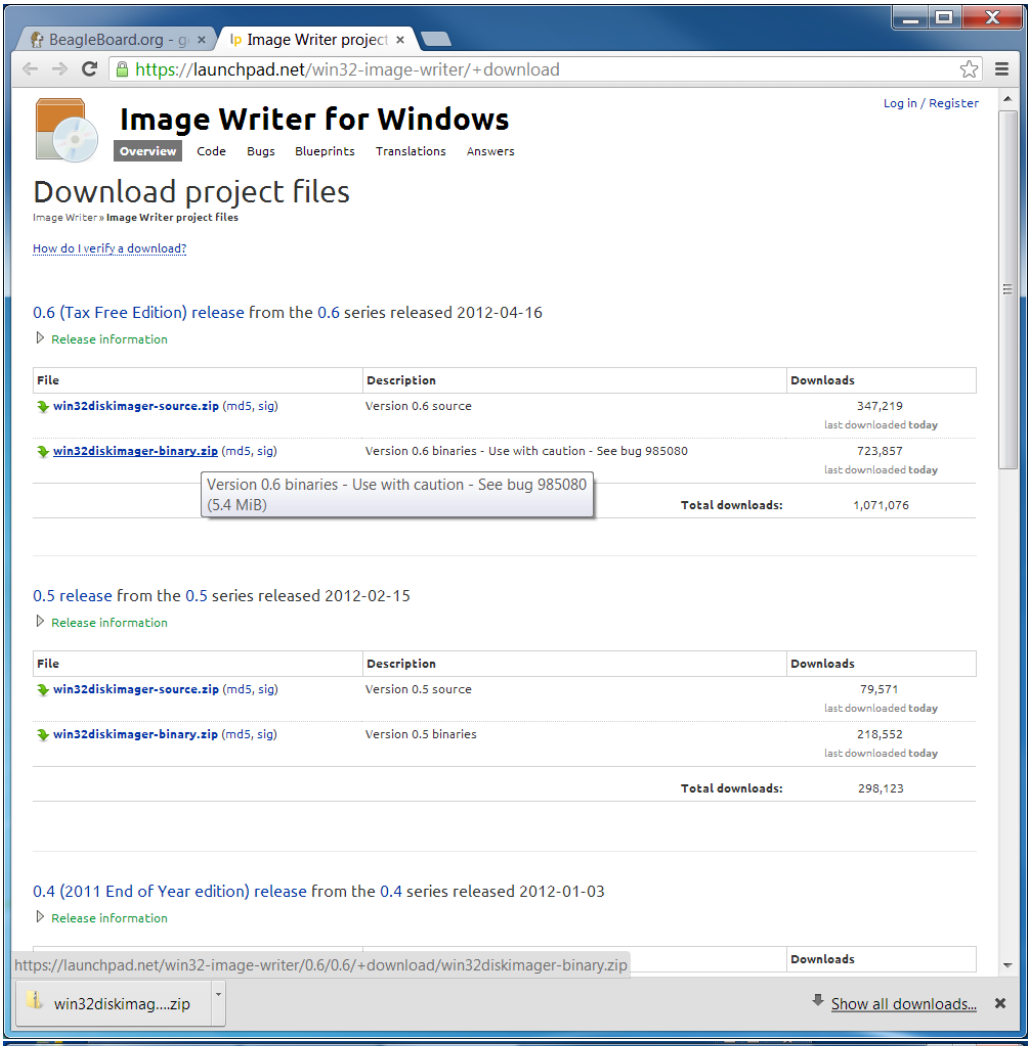
STEP #3: DECOMPRESS THE IMAGE

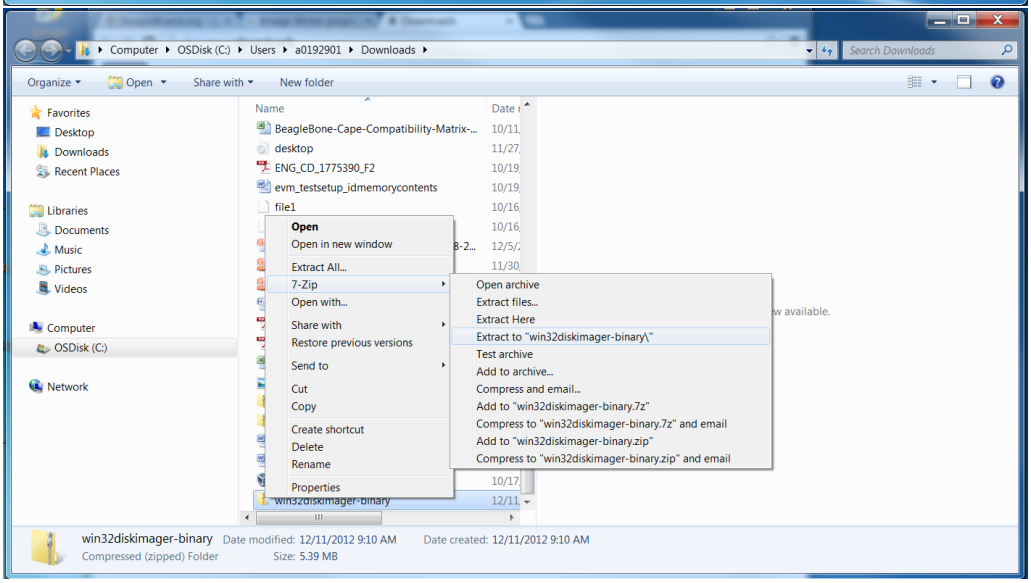
Use 7-zip to decompress the SD card .img file



STEP #4: INSTALL SD CARD PROGRAMMING UTILITY

Download and install Image Writer for Windows. Be sure to download the binary distribution. Also available on the ECEN5803Resources drive.





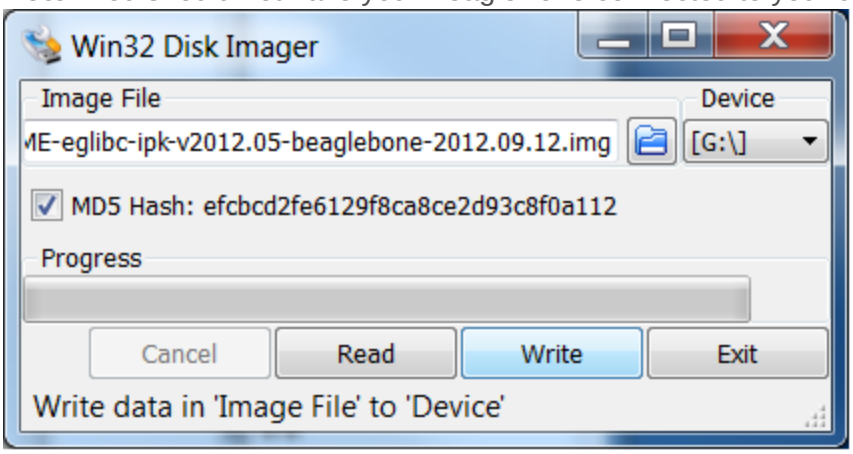
Some general help on programming SD cards can be found on the Ubuntu Image Writer page.

STEP #5: CONNECT SD CARD TO YOUR COMPUTER

Use the provided microSD card to SD adapter or a USB adapter to connect the SD card to your computer.

STEP #6: WRITE THE IMAGE TO YOUR SD CARD

Use either the Ubuntu Image Writer or instructions on its page to write the decompressed image to your SD card.
Note: You may see a warning about damaging your device. This is fine to accept as long as you are pointing to your SD card for writing.
Note: You should not have your BeagleBone connected to your computer at this time.



STEP #7: EJECT THE SD CARD

Eject the newly programmed SD card.

STEP #8: BOOT YOUR BOARD OFF OF THE SD CARD

Insert SD card into your (powered-down) board, hold down the USER/BOOT button (if using Black) and apply power, either by the USB cable or 5V adapter.
If using an original BeagleBone, you are done.
Do not write any images to the on-board eMMC as suggested in the next paragraph, which is left here FYI.
If using BeagleBone Black and desire to write the image to your on-board eMMC, you'll need to follow the instructions at http://elinux.org/Beagleboard:BeagleBoneBlack_Debian#Flashing_eMMC. When the flashing is complete, all 4 USRx LEDs will be steady on or off. The latest Debian flasher images automatically power down the board upon completion. THIS CAN TAKE UP TO 45 MINUTES. Power-down your board, remove the SD card and apply power again to be complete.

OTHER CURRENTLY AVAILABLE SOFTWARE IMAGES

Some of the starting images below involve multiple steps to produce an SD card image or otherwise change some of the steps above, so be sure to read all the instructions on their pages. Choose the starting point you want, download or produce the SD card image and follow the steps above.
At the time of release, not all of these distributions support BeagleBone Black, but should soon.

- Texas Instruments releases: Android, Linux, StarterWare (no OS)
- Linux: Debian, Angstrom Distribution, Ubuntu, ArchLinux, Gentoo, Sabayon, Buildroot, Erlang, Fedora
- Other: QNX, FreeBSD
- Projects page

HARDWARE DOCUMENTATION

The BeagleBoneBlack wiki page documents all of the known hardware issues, as well as the latest available software, hardware documentation and design materials.
Time to read that manual and check out the design materials: BeagleBone Black Docs.
Links to design materials for various releases can be found at beagleboard.org/hardware/design.

Questions:
Note: Submit Screenshots to validate your output for each of problem requirements given below.

Q1: BOOT AND RUN DEBIAN LINUX

1. Using the Getting Started instructions above, boot Linux. If Debian Linux is not resident in the eMMC, you may need to create the image on and SD card and boot from there.
2. How much memory is used by the code? (What is the image size?) Think about how you might determine this.
3. Capture a screen shot of a Linux terminal window.
4. Blink the LEDs from the command shell. See http://elinux.org/EBC_Exercise_10_Flashing_an_LED, for hints on how to do this.
5. Connect the HDMI output to a monitor using an HDMI Cable and adapter if necessary. Adapters are available in the lab. Reboot the system – what do you see?

Q2: CREATE AN ANGSTROM LINUX IMAGE

1. From http://beagleboard.org/latest-images download the latest Angstrom image, and use the Getting started and Update Linux instructions above to create an SD with the Angstrom image. If this seems problematic, try the instructions here: http://downloads.angstrom-distribution.org/demo/beaglebone/. A working image is also available on the ECEN5803Resources drive at https://drive.google.com/open?id=1enLLbtM1mF34IyFR3lEFsnk-yK64z-4j .
2. How much memory is used by the code? (What is the image size?)
3. Capture a screen shot of a Linux terminal window.
4. Blink the LEDs from the command shell. See http://elinux.org/EBC_Exercise_10_Flashing_an_LED, for hints on how to do this.
5. Connect the HDMI output to a monitor using an HDMI Cable and adapter if necessary. Reboot the system – what do you see?
6. Record your observations. How is the Angstrom image different from the Debian image?

Grading Rubric

Q1) - [5 points] 1 point each

Q2) - [6 points] 1 point each