Hands-on Lab: BeagleBone Black Board

COSC2440: Computer Organization and Architecture

Due Date: Oct. 04, 2017

Show your TA the blinking light to receive credit!

You must attend your assigned lab to receive credit!

Dr. Kevin Long

A) *Original Instructions:* https://github.com/gnawali/purple/blob/master/assignment/hw5.md

B) Installation:

(1) Everything is installed in the lab's PCs in PGH376.

(2) If you like to use your laptop instead of lab's machines, then you need to download & install the necessary tools.

(a) If you are at the lab, you may copy the folder "BeagleBone" from the C drive and install everything inside "Windows 10 Installation" folder.

(b) If you don't have access to the lab machine, then download the following files:

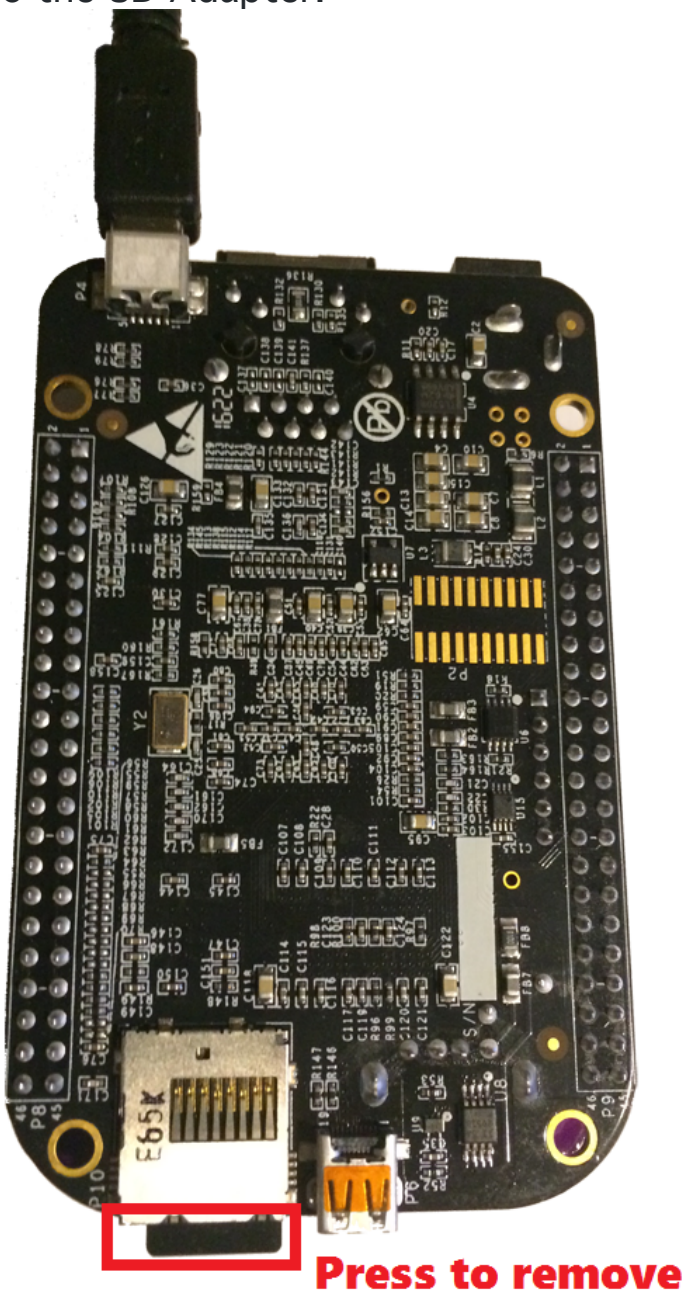
1. OS Image [about 700MB], then extract the file using 7-zip: https://debian.beagleboard.org/images/bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img.xz
2. 7-zip: http://www.7-zip.org/download.html
3. Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
4. BeagleBone Black Board Drivers: http://www.1-2-3-4-5-6.net/beaglebone/black/BONE_D64_signed.zip
5. Putty: http://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

If you prefer to use your laptop, please download/install everything before coming to the lab. Also, these instructions are for Windows, but you may use your Mac if wish to do so. Refer to A) Original Instructions to figure out instructions for Mac.

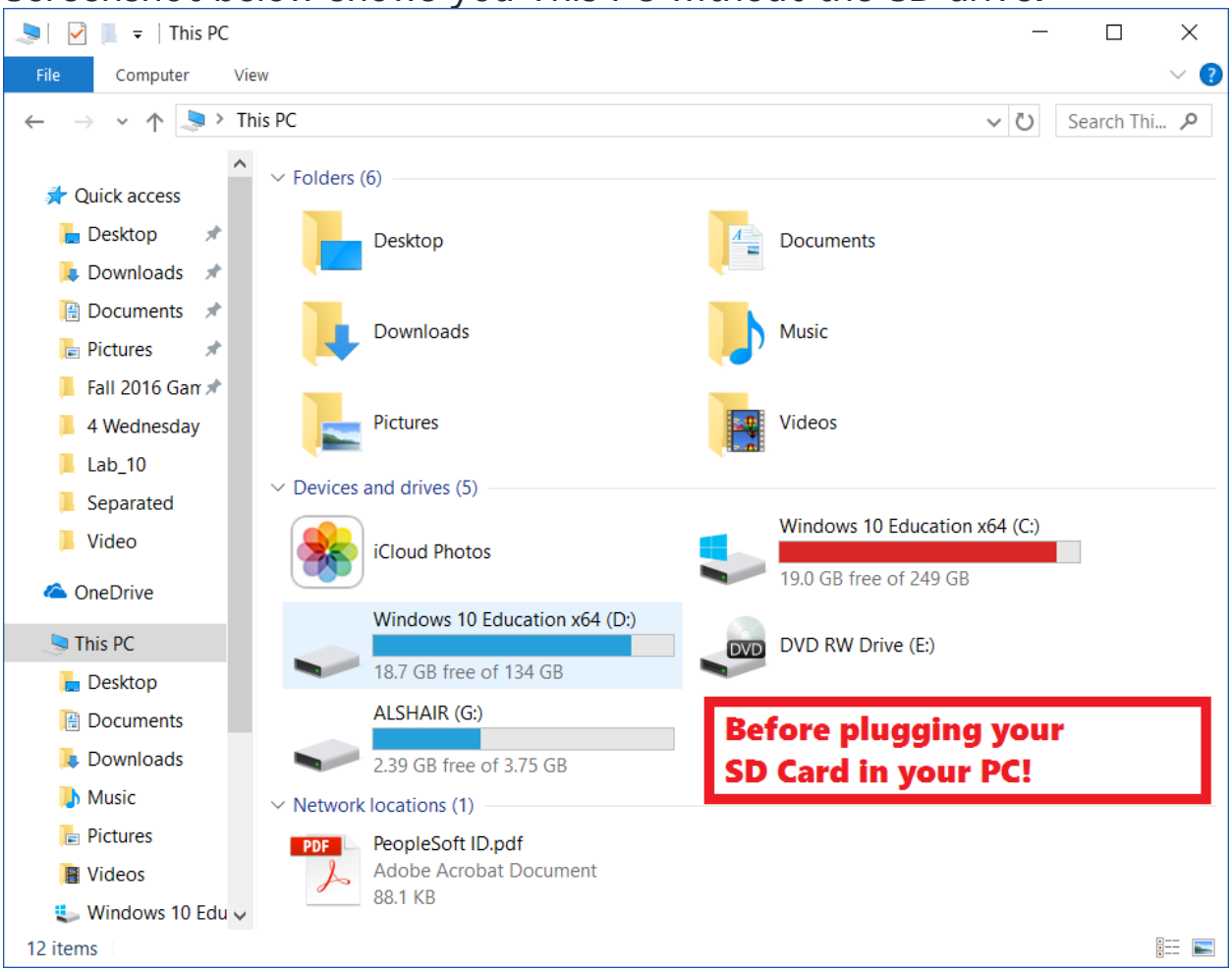
C) Lab Instructions

Step 0: Remove the USB cable that connects the board with the PC from the PC if it is connected.

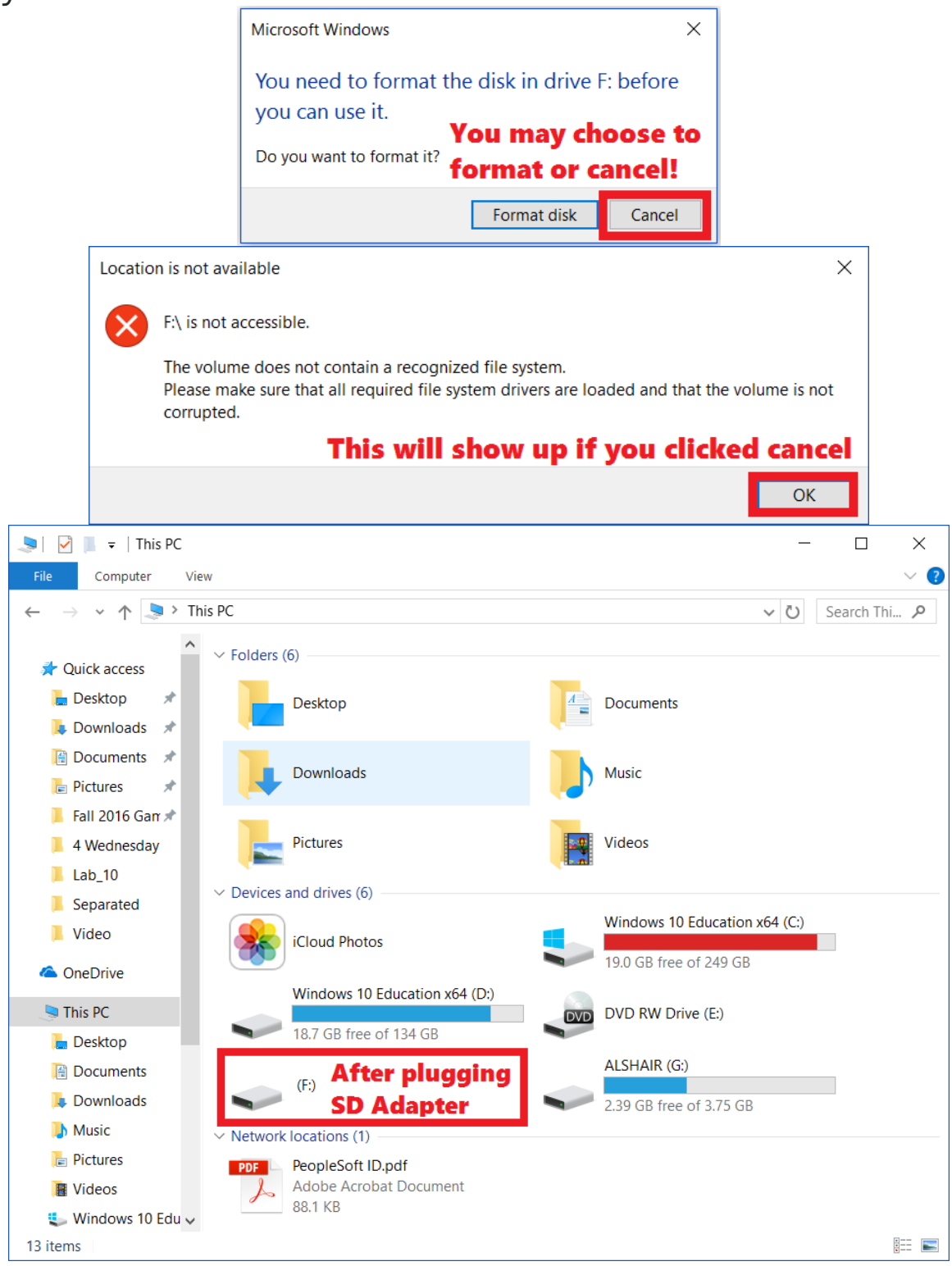
Step 1: Remove the micro SD card from the bottom of the board, then insert it into the SD Adapter.



Screenshot below shows you This PC without the SD drive.

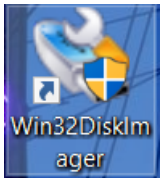


Step 2: Insert the SD card in your PC. Screenshot below will show you new drive that you cannot open and it may ask you to format it. In my case the SD drive is F, in your case it maybe more likely D or any other letter.



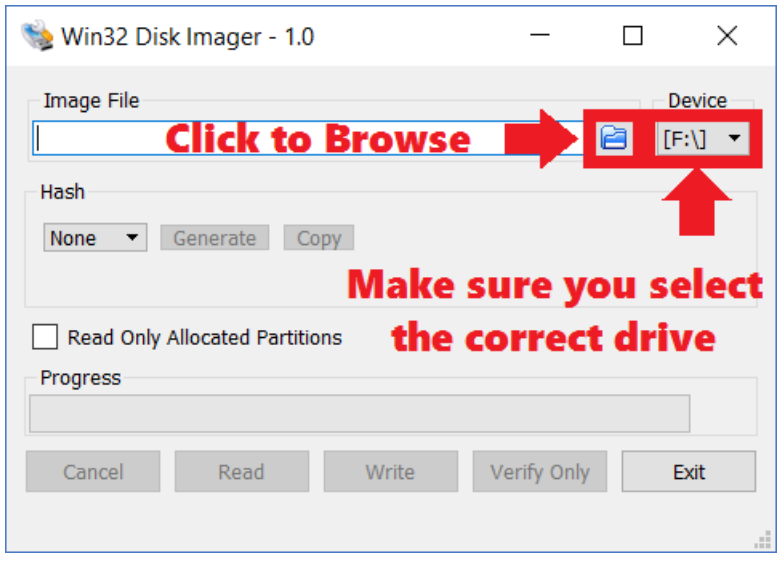
Step 3: Open "**Win32DiskImager**" application, if you are using the lab PC, it should be in the desktop.

If you are not using the lab's PC. Then download and install it from: https://sourceforge.net/projects/win32diskimager/



Step 4: Make sure you select the correct drive, in my case, it is F. Then click the open file icon.

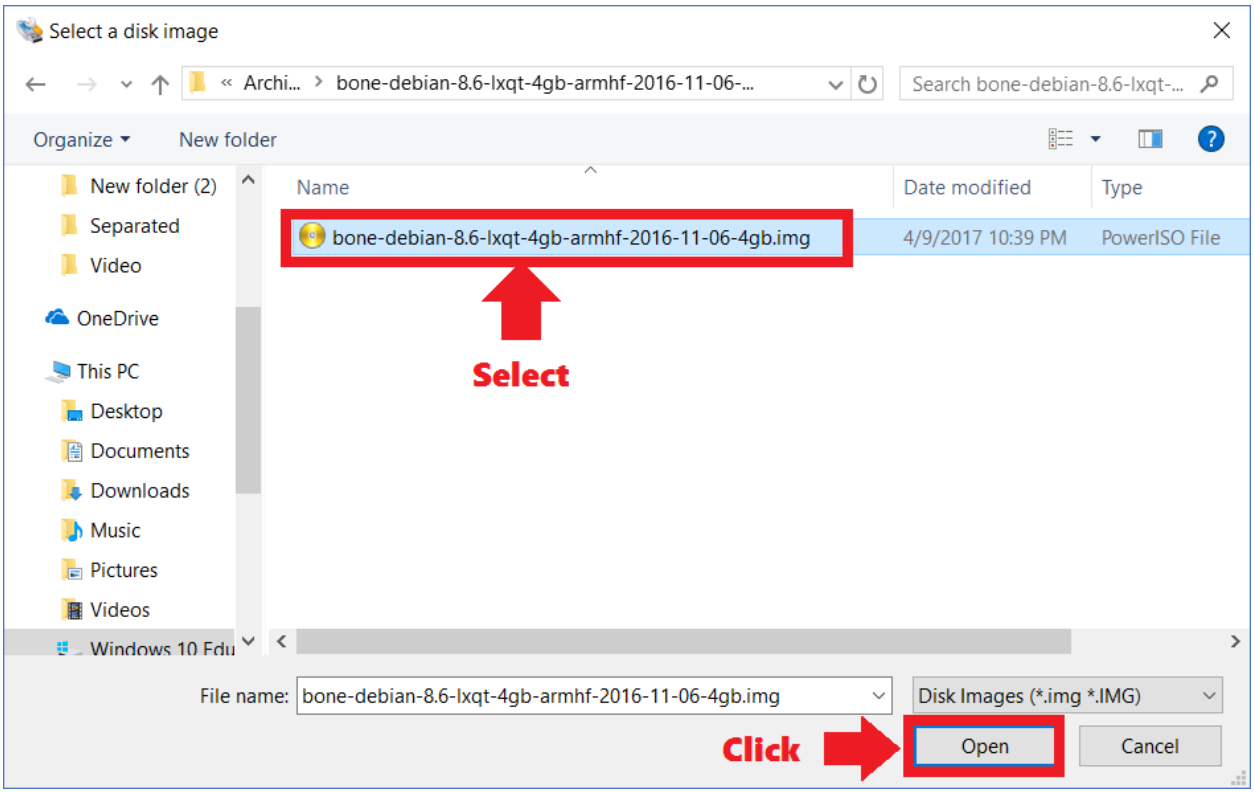
If you remove the SD card from the PC while the "Win32DiskImager" app is open, you must close and reopen the "Win32DiskImager" app to be able to recognize the SD card after you insert it in the PC.



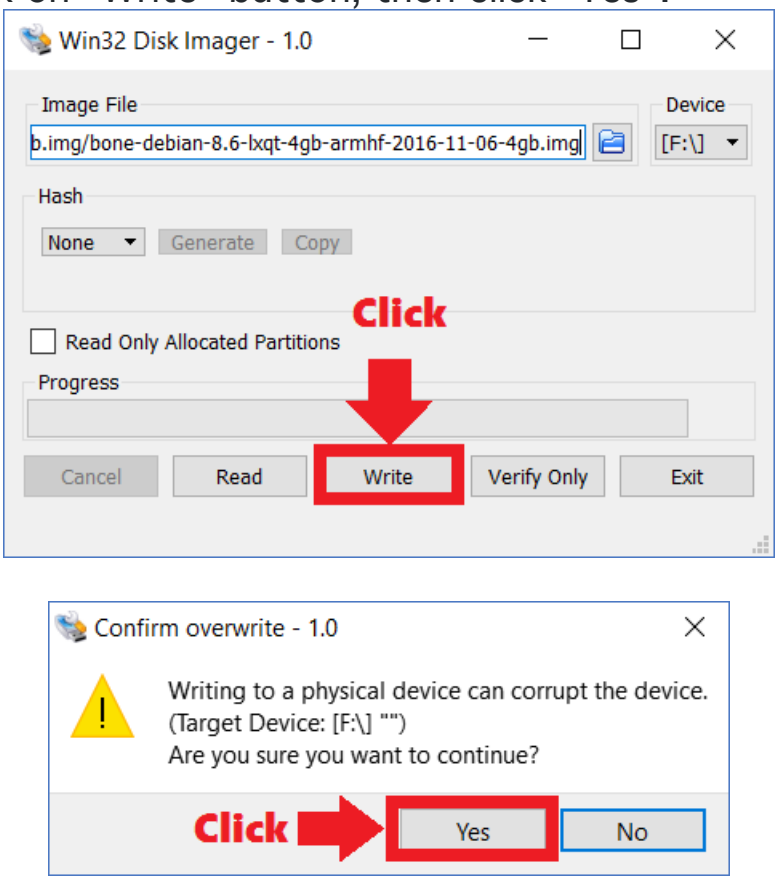
Step 5: Select the correct image, "**bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img**"

If you are using the lab's PC, the file should be saved in the C drive: "C:\BeagleBone\Architecture Image\bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img\bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img"

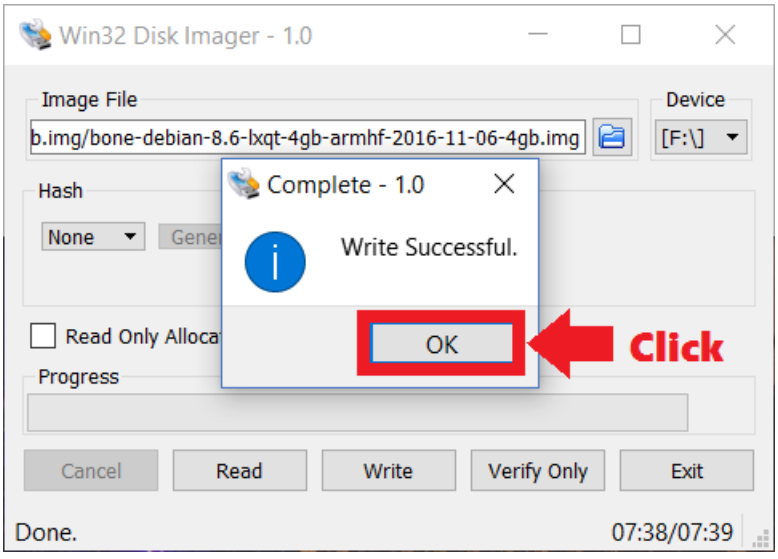
If you are not using the lab's PC. Then you will need to download the image from: https://debian.beagleboard.org/images/bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img.xz
You need to extract the image from the downloaded file by right clicking on the file after download is complete and selecting "**7-zip**" then "**Extract to "bone-debian-8.6-lxqt-4gb-armhf-2016-11-06-4gb.img/""**
If you don't have 7-zip, download and install it from: http://www.7-zip.org/download.html



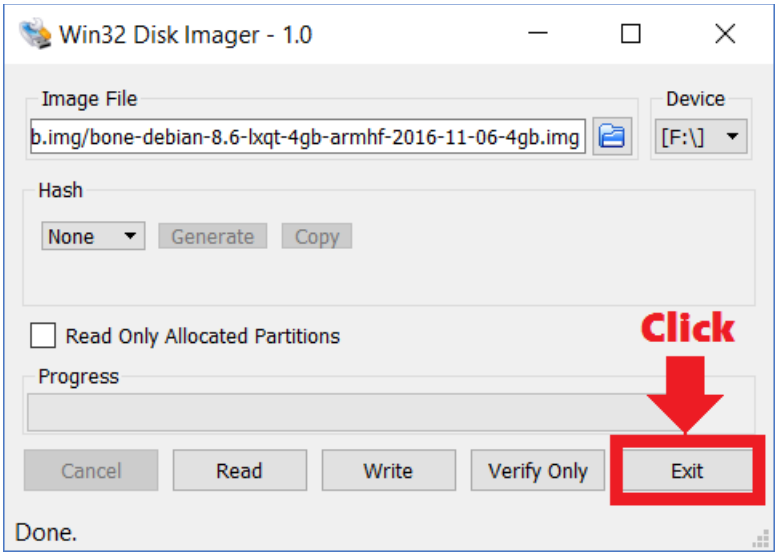
Step 6: Click on “Write” button, then click “Yes”.



Step 7: Wait for approximately 10 minutes or less while the app is burning the image into the SD card. At the end, you will receive a message that the write was successful. Click OK.

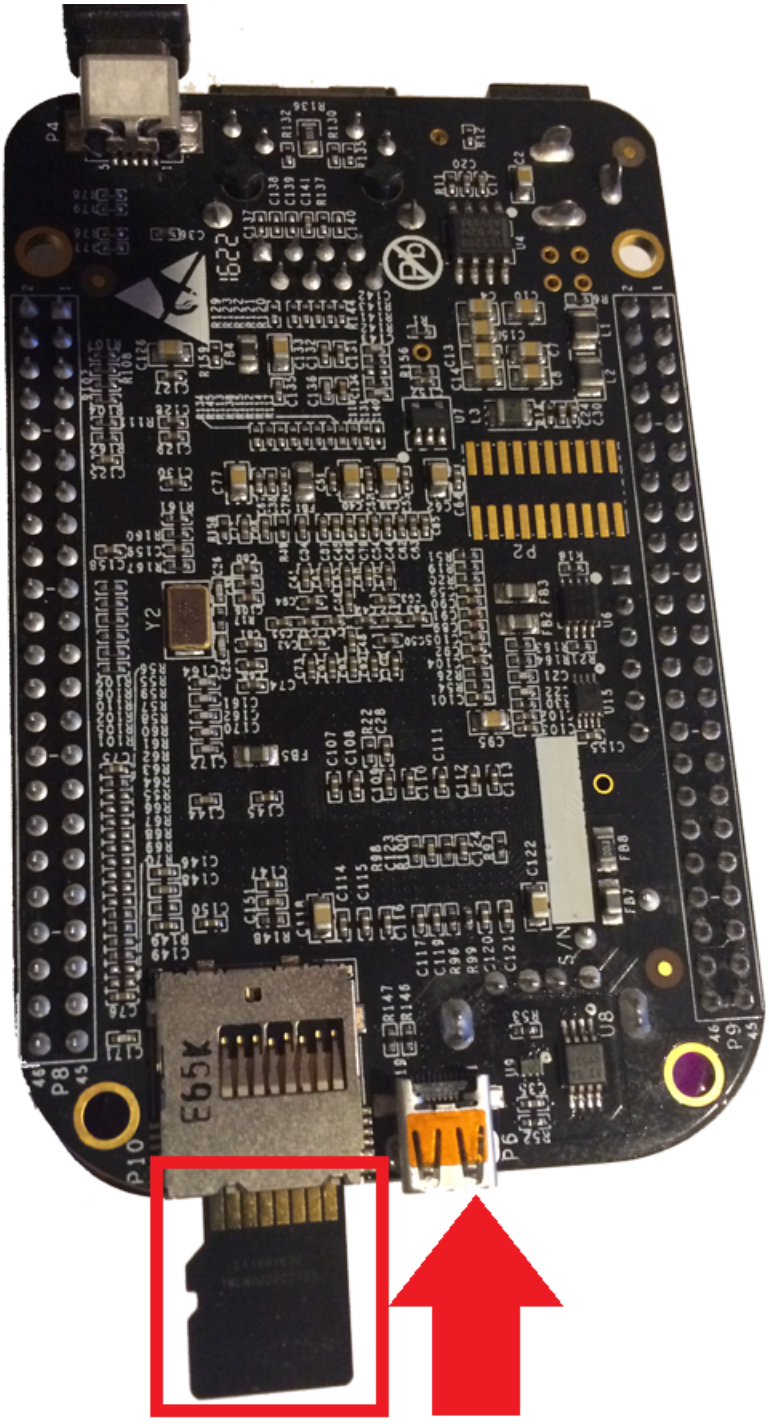


Step 8: Click on “Exit” button to exit the “Win32DiskImager” app.



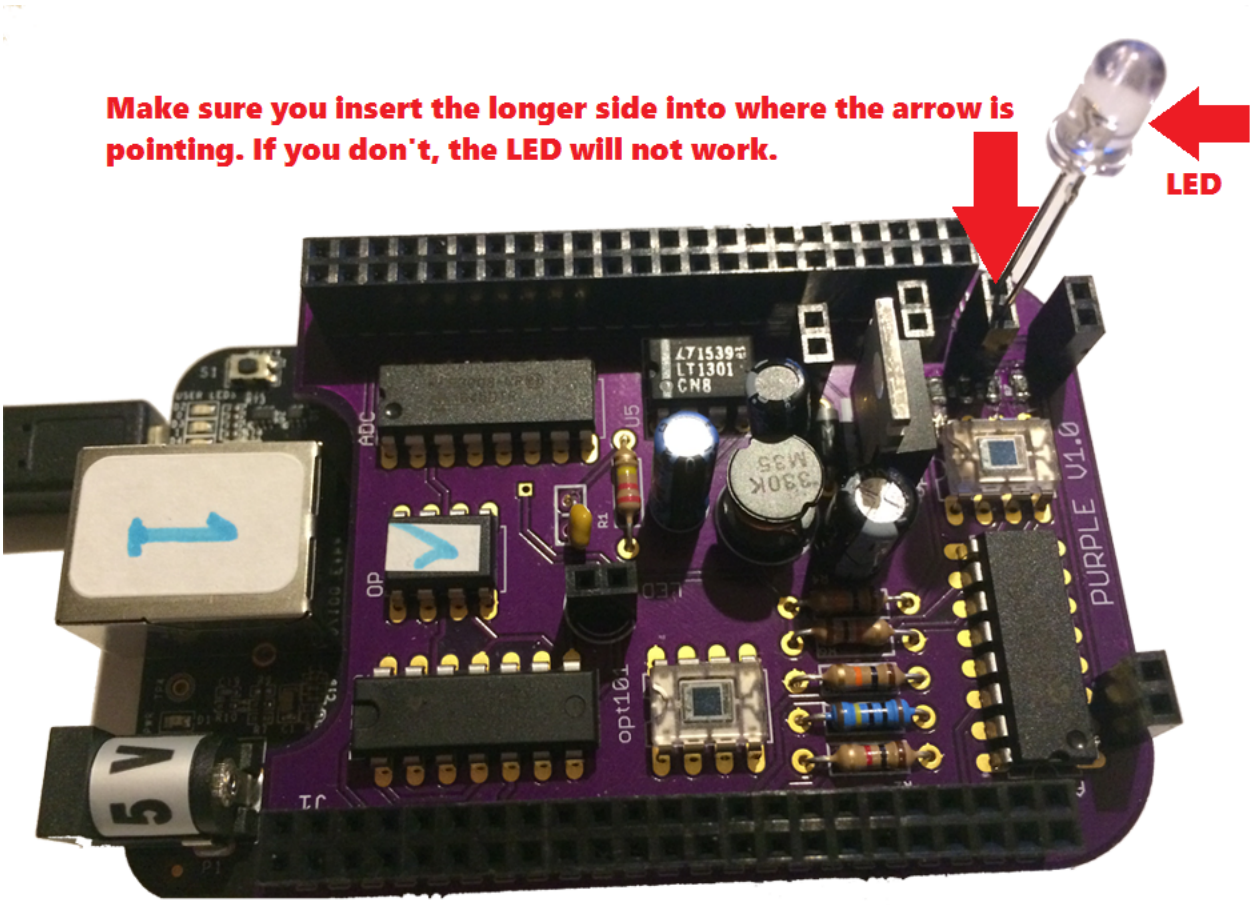
Step 9: Remove the SD adapter from the PC, then remove the micro SD card from the SD adapter.

Step 10: Insert the micro SD card in your BeagleBone Board.



Insert Micro SD Card into your board

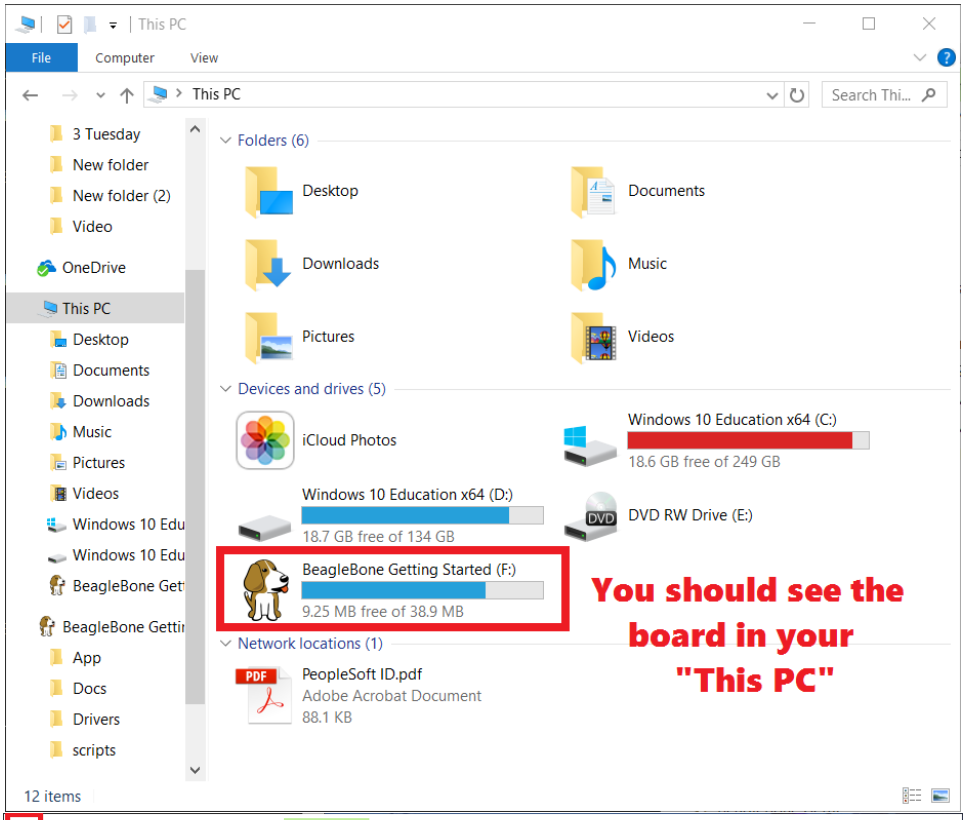
Step 11: Insert LED into your board as shown in the screenshot below:

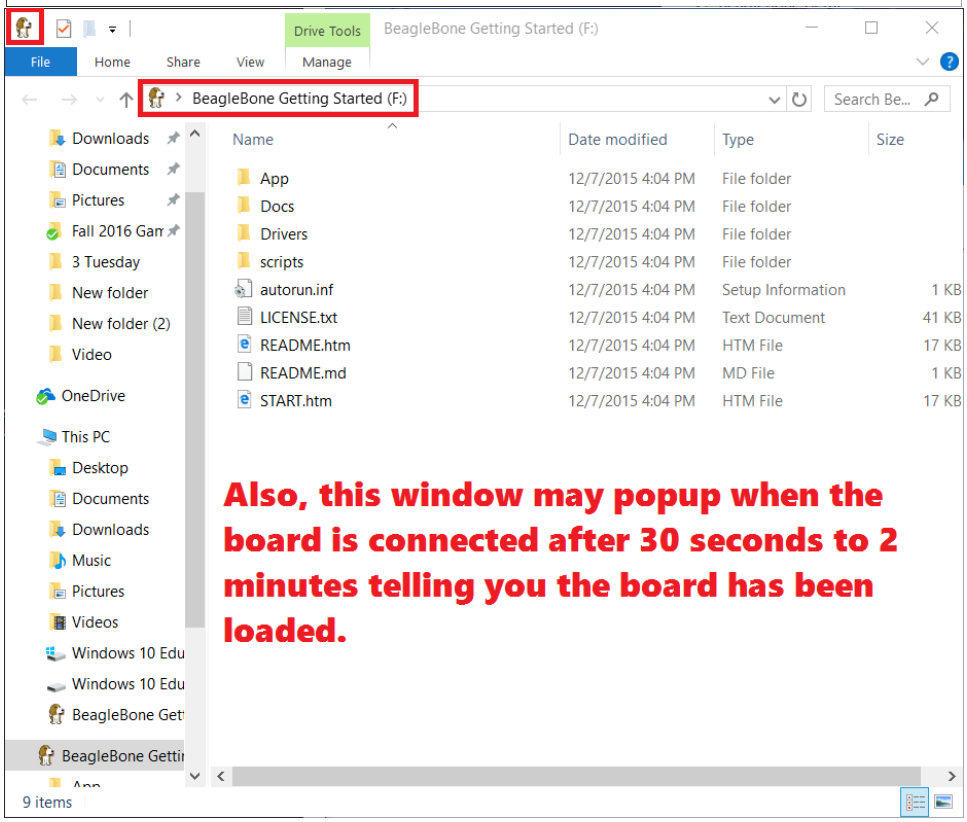


Step 12: Connect the USB cable to your board and PC.

If you are not using lab's PC, download and install the board drivers from: http://beagleboard.org/getting-started#step2

Step 13: Wait until your PC is reading the board. This could take 30 seconds to 2 minutes.


This PC
File
Computer
View
This PC
Search Thi...
3 Tuesday
New folder
New folder (2)
Video
OneDrive
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
Windows 10 Edu
Windows 10 Edu
BeagleBone Get
BeagleBone Gettir
App
Docs
Drivers
scripts
Folders (6)
Desktop
Documents
Downloads
Music
Pictures
Videos
Devices and drives (5)
iCloud Photos
Windows 10 Education x64 (C:)
18.6 GB free of 249 GB
Windows 10 Education x64 (D:)
18.7 GB free of 134 GB
DVD RW Drive (E:)
BeagleBone Getting Started (F:)
9.25 MB free of 38.9 MB
Network locations (1)
PeopleSoft ID.pdf
Adobe Acrobat Document
88.1 KB
12 items
You should see the board in your "This PC"


Drive Tools
BeagleBone Getting Started (F:)
File
Home
Share
View
Manage
BeagleBone Getting Started (F:)
Search Be...
Downloads
Documents
Pictures
Fall 2016 Gam
3 Tuesday
New folder
New folder (2)
Video
OneDrive
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
Windows 10 Edu
Windows 10 Edu
BeagleBone Get
BeagleBone Gettir
Name
Date modified
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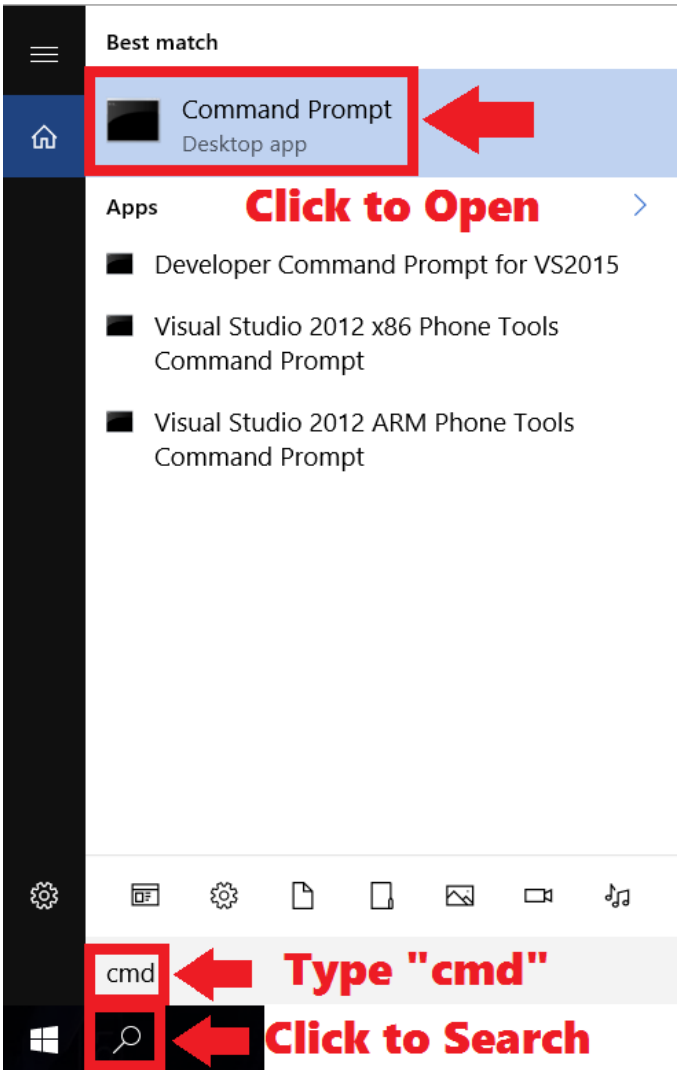
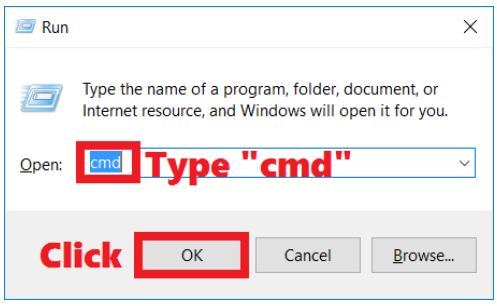
Size
App 12/7/2015 4:04 PM File folder
Docs 12/7/2015 4:04 PM File folder
Drivers 12/7/2015 4:04 PM File folder
scripts 12/7/2015 4:04 PM File folder
autorun.inf 12/7/2015 4:04 PM Setup Information 1 KB
LICENSE.txt 12/7/2015 4:04 PM Text Document 41 KB
README.htm 12/7/2015 4:04 PM HTM File 17 KB
README.md 12/7/2015 4:04 PM MD File 1 KB
START.htm 12/7/2015 4:04 PM HTM File 17 KB
9 items
Also, this window may popup when the board is connected after 30 seconds to 2 minutes telling you the board has been loaded.

Step 14: You need to make sure that you are ready to SSH to the board. To do this, **open the Command Prompt** by going to search and type "**cmd**".



OR click on "**Windows Key + R**", then type "**cmd**", then pressing **OK**.



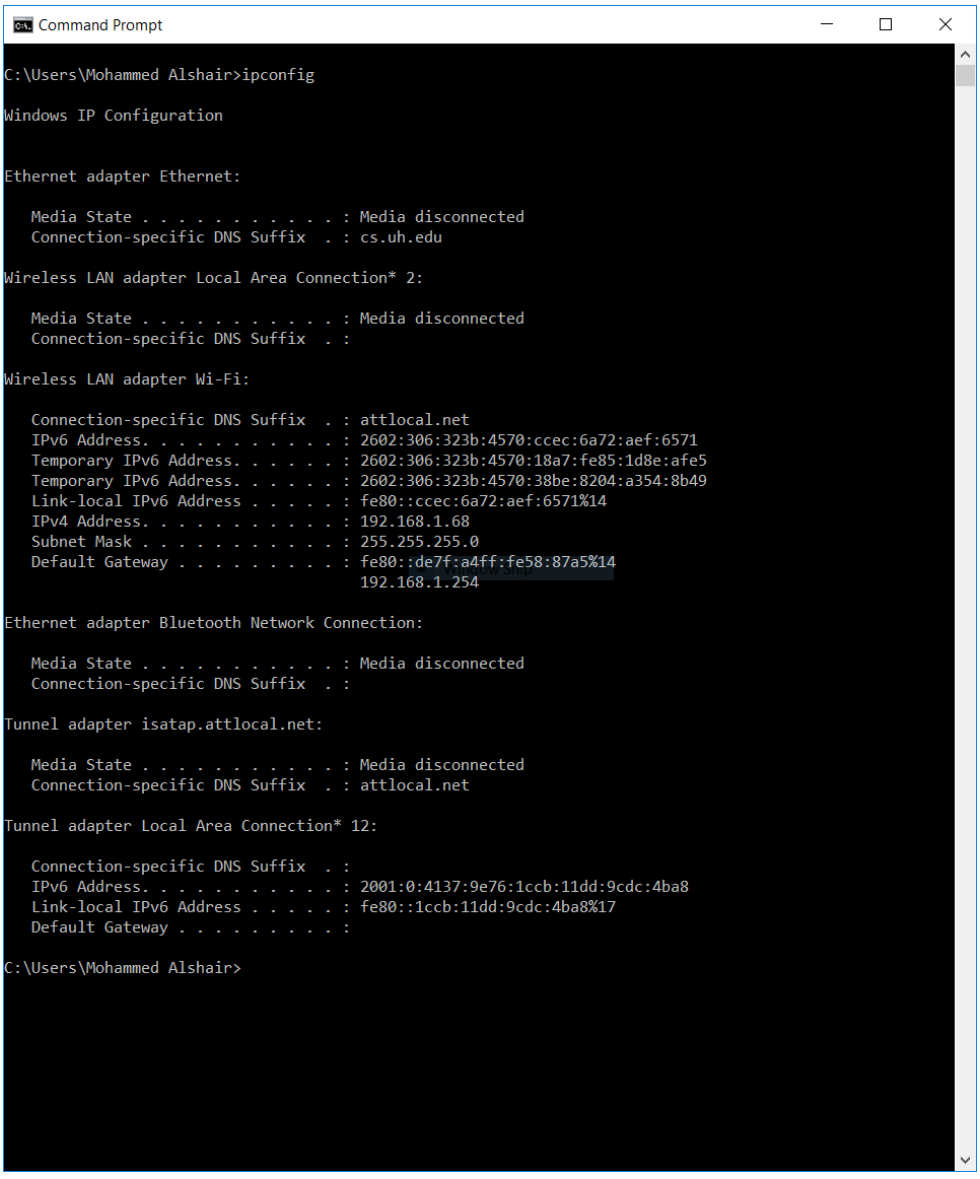
Copy the following highlighted lines including the empty line:

```
cls
ipconfig

```

Paste to the command prompt by right clicking at the location of the cursor.

We need to look for IP address: 192.168.7.1 to determine if the device is ready to SSH to it or not.

This screenshot does NOT show the IP address 192.168.7.1



```
cls
ipconfig
```

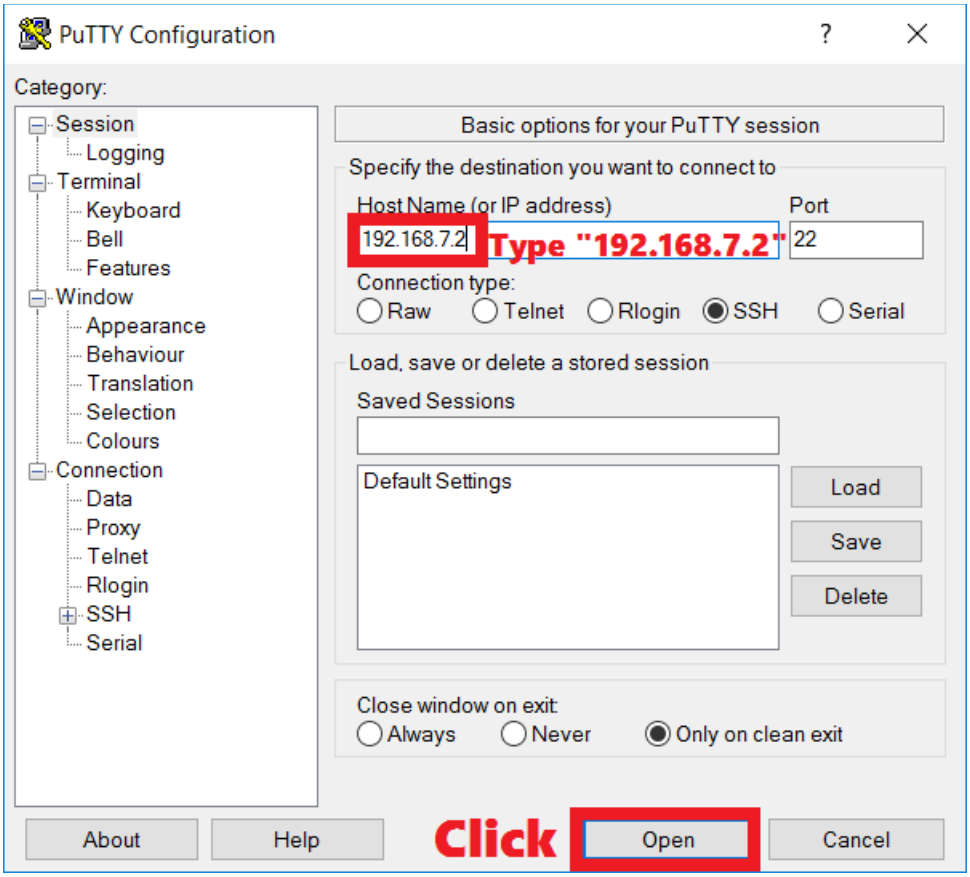
You need to **keep re-entering** the above commands until you see the IP address, **192.168.7.1** as shown in the screenshot below:

Step 15: Open "**Putty**" application, if you are using the lab PC, it should be in the desktop.

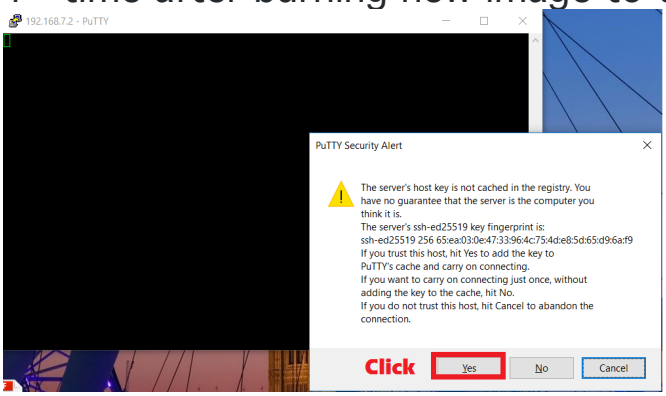
If you are not using the lab's PC. Then download and install it from:
http://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

Step 15: Enter the following IP address under "Host Name (or IP address), then click Open:

192.168.7.2

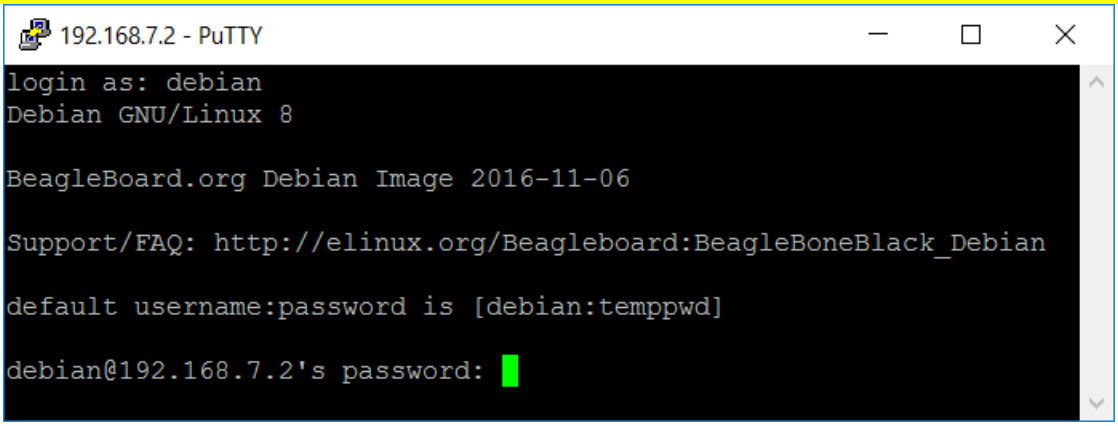


Step 16: Click "**Yes**". This usually shows up once when you connect for the 1st time after burning new image to the SD card.



Step 17: Enter the following username, then press enter:

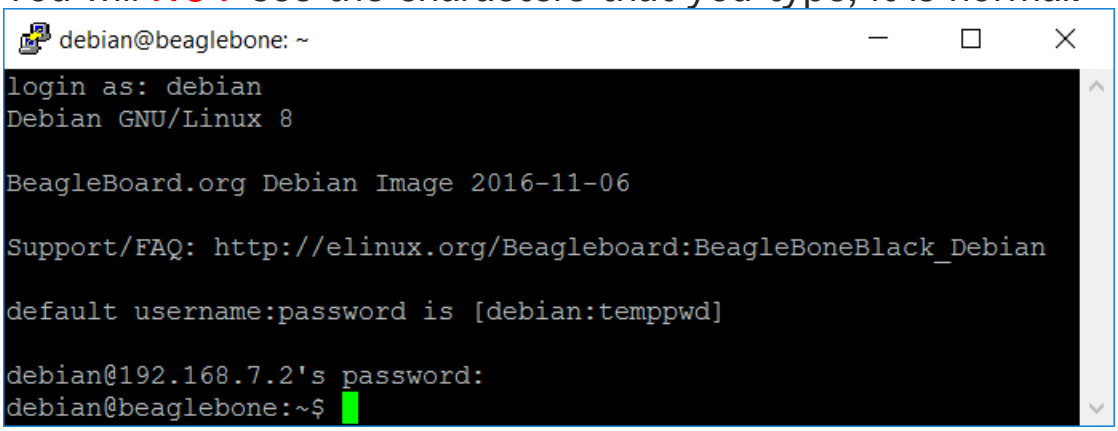
debian



Step 18: Enter the password shown in the screen, then press enter (it should be):

temppwd

*** You will NOT see the characters that you type, it is normal.

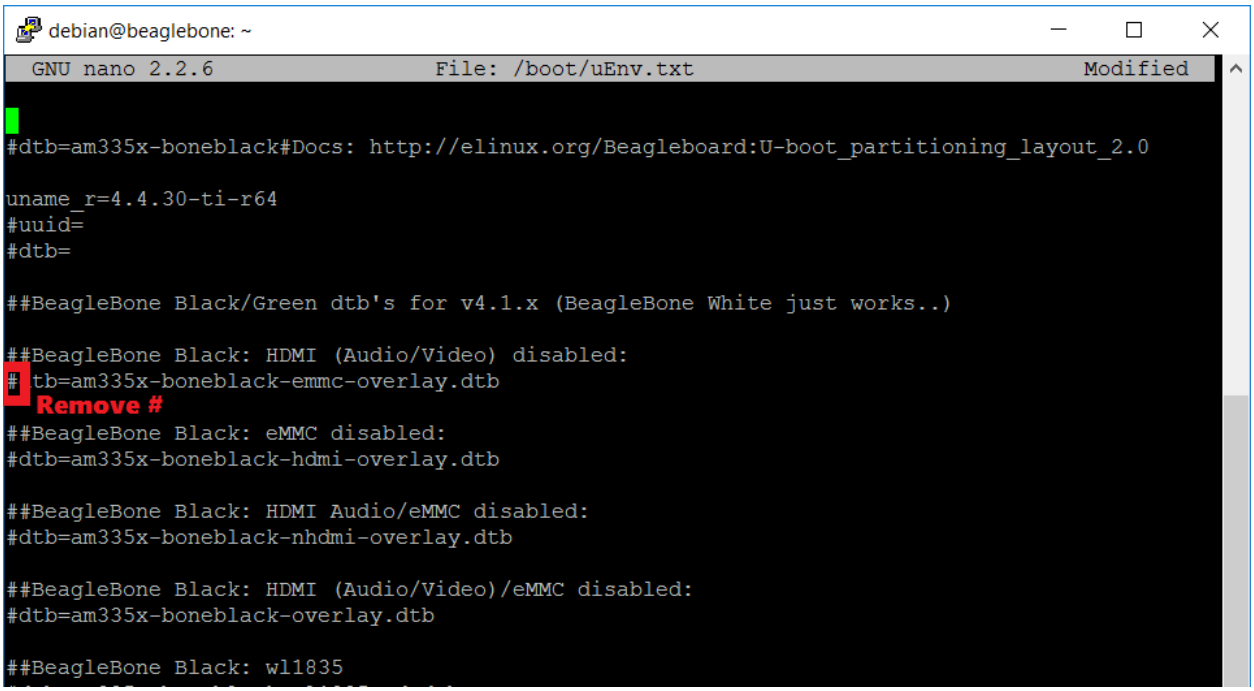


Step 19: Copy the following highlighted lines including the empty line:

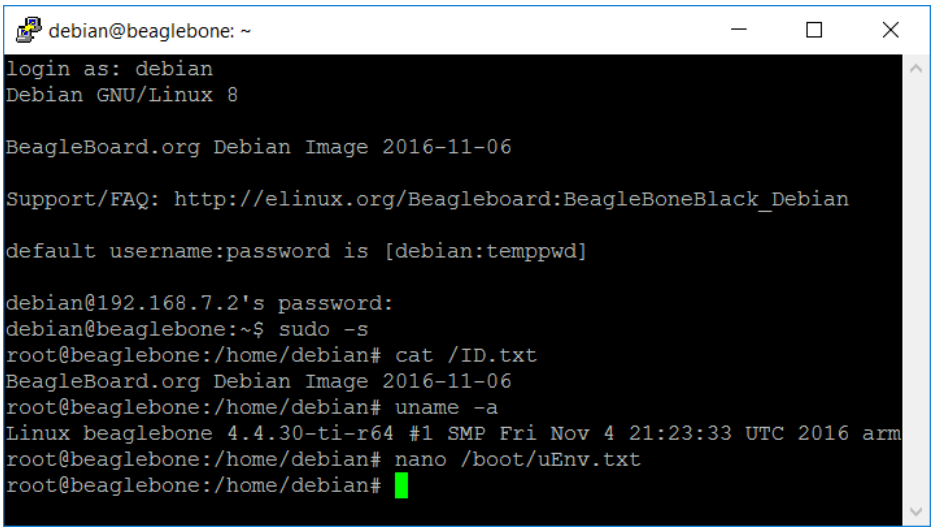
```
sudo -s
cat /ID.txt
uname -a
nano /boot/uEnv.txt

```

Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 20: Change **Line 10** from
#dtb=am335x-boneblack-emmc-overlay.dtb
TO
dtb=am335x-boneblack-emmc-overlay.dtb
By removing **#** at the beginning of the line.



Step 21: Press "**Ctrl+X**", then press "**Y**" for yes, then press "**Enter**" to exit the file.



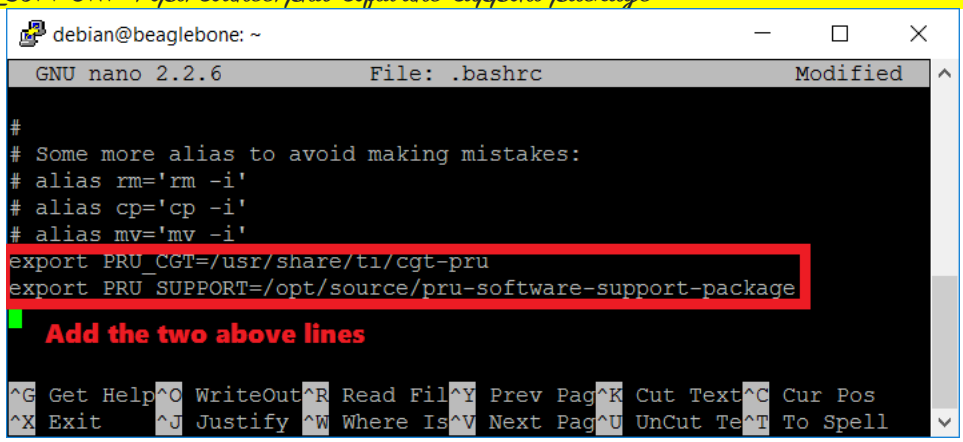
Step 22: Copy the following highlighted lines including the empty line:

which clpru
cd
nano .bashrc

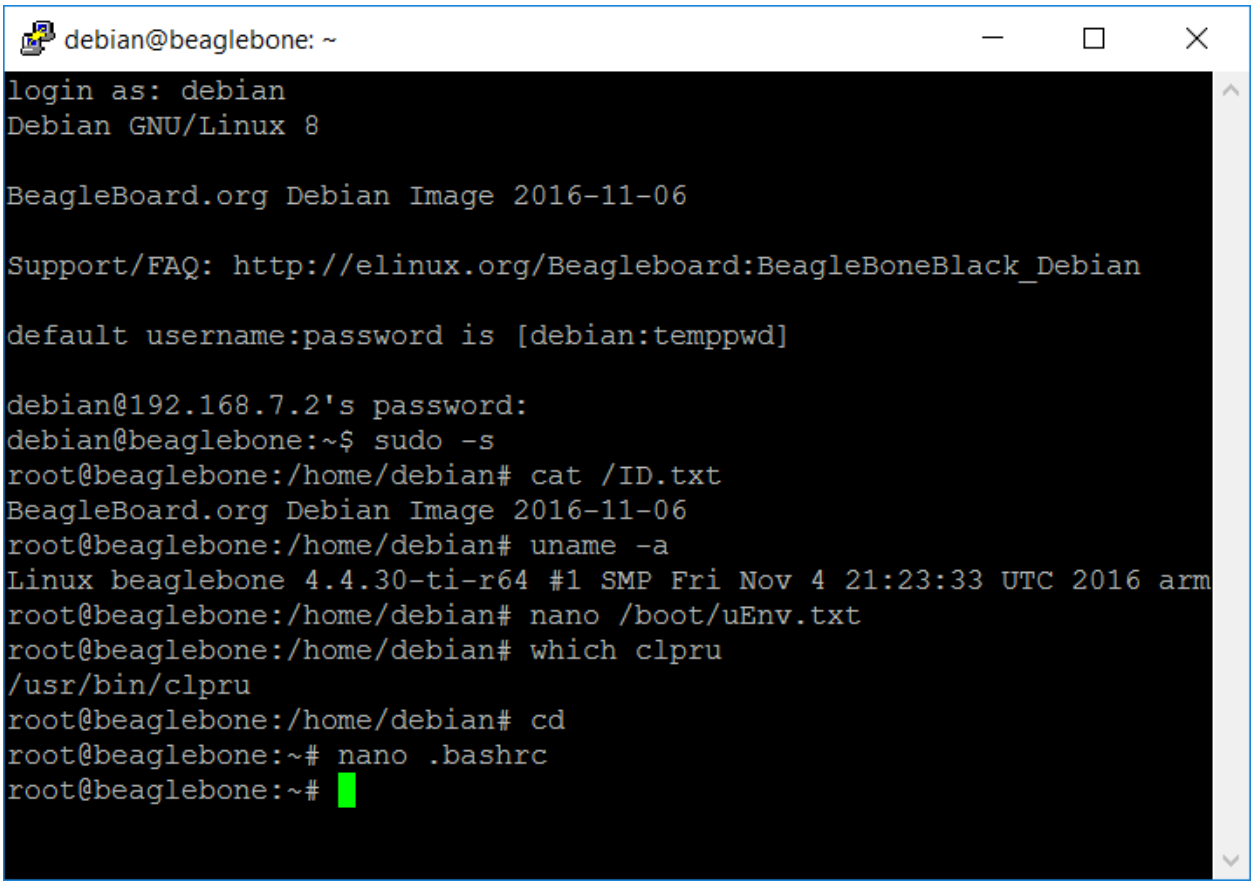
Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 23: Copy and paste the following two lines to the bottom of the file:

export PRU_CGT=/usr/share/ti/cgt-pru
export PRU_SUPPORT=/opt/source/pru-software-support-package



Step 24: Press "**Ctrl+X**", then press "**Y**" for yes, then press "**Enter**" to exit the file.



Step 25: Copy the following highlighted lines including the empty line:

```
sudo -s
$PRU_CGT
cd $PRU_CGT
mkdir -p bin
cd bin
ln -s `which clpru` .
ln -s `which lnkpru` .
cd /opt/source/dtb-4.4-ti
nano src/arm/am335x-boneblack-emmc-overlay.dts

```

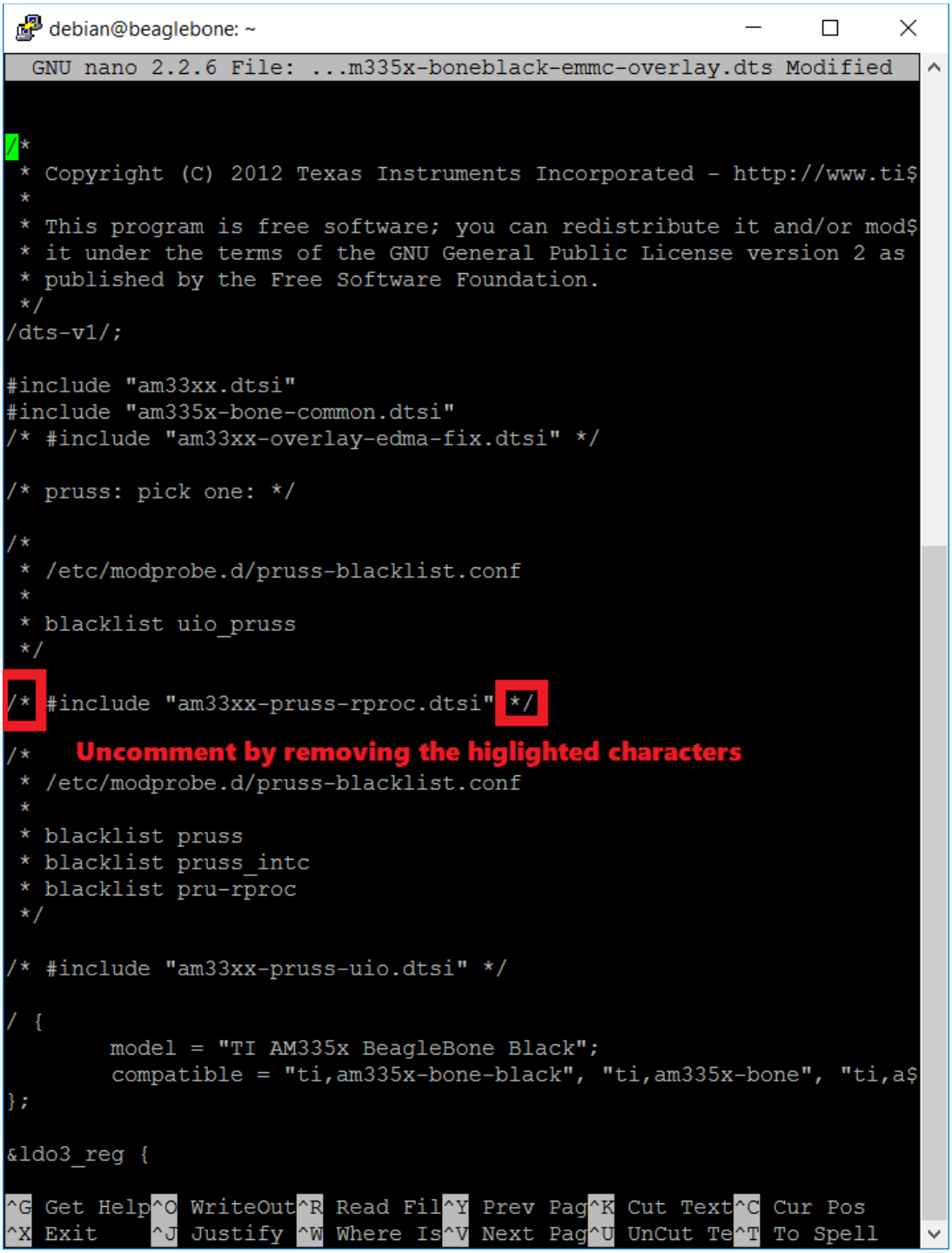
Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 26: Uncomment **Line 22** by changing **Line 22** from
/* #include "am33xx-pruss-rproc.dtsi" */

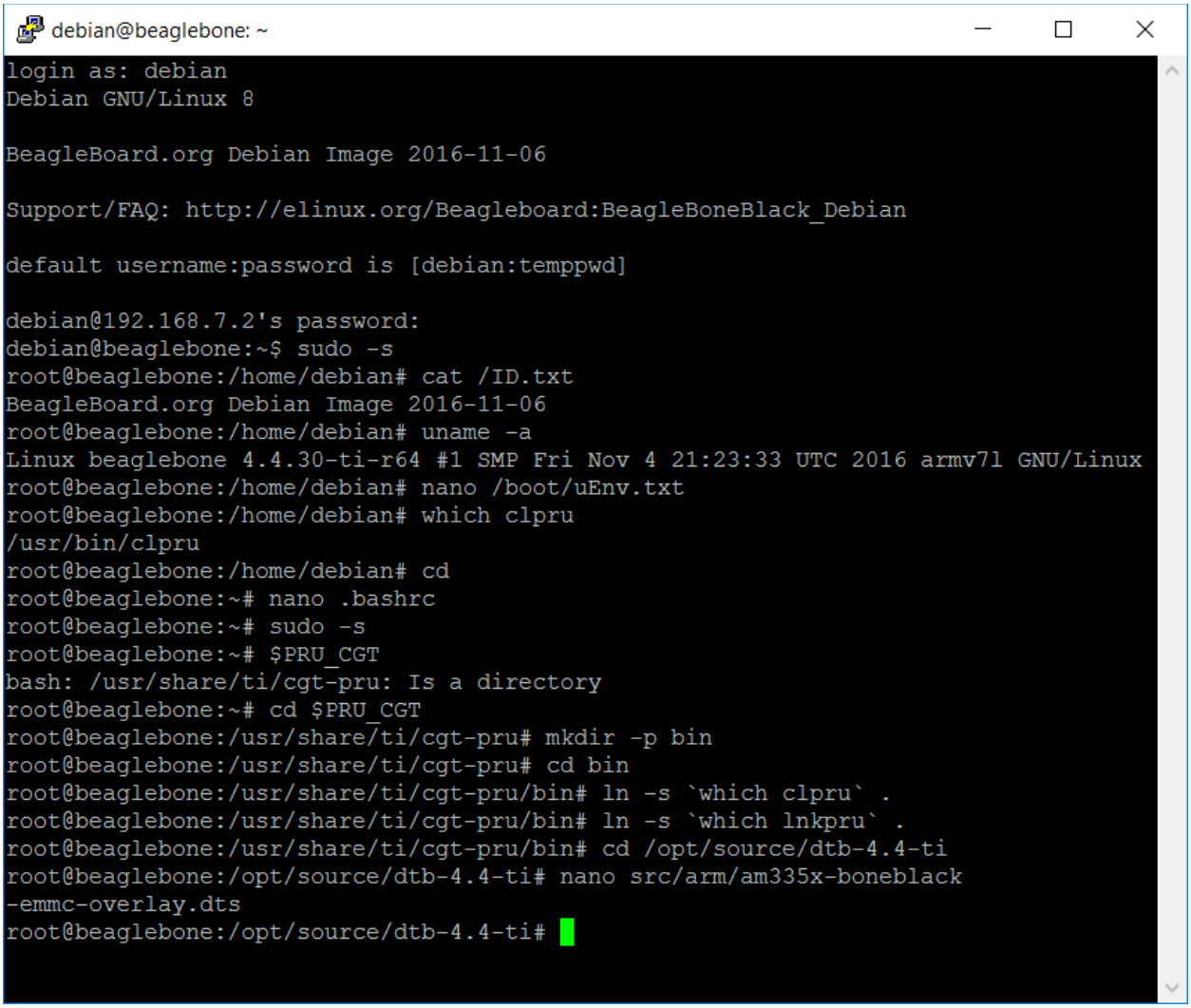
TO

#include "am33xx-pruss-rproc.dtsi"

By removing /* at the beginning of the line and */ at the end of the line.



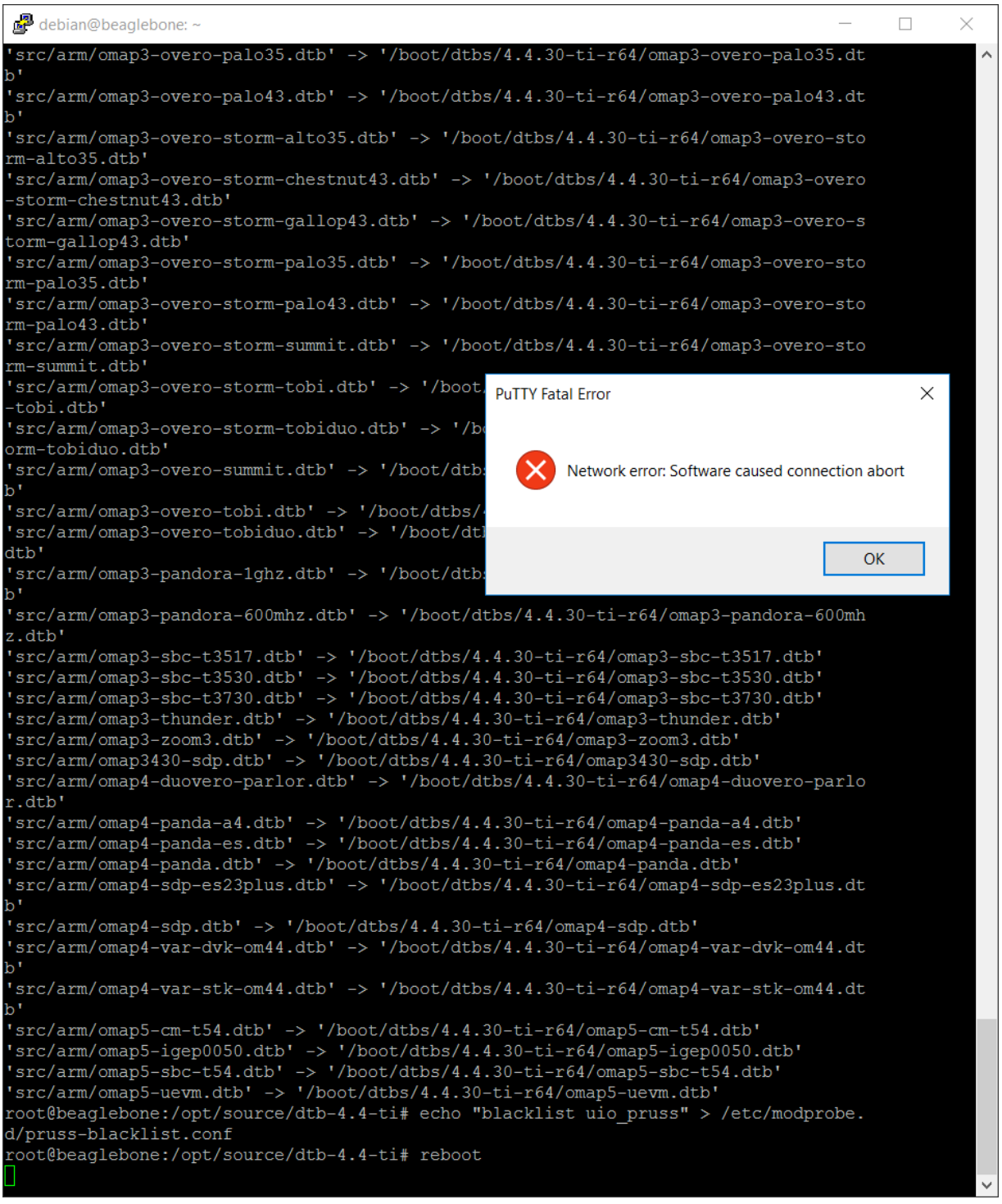
Step 27: Press "**Ctrl+X**", then press "**Y**" for yes, then press "**Enter**" to exit the file.



Step 28: Copy the following highlighted lines including the empty line:

```
make
make install
echo "blacklist uio_pruss" > /etc/modprobe.d/pruss-blacklist.conf
reboot
```

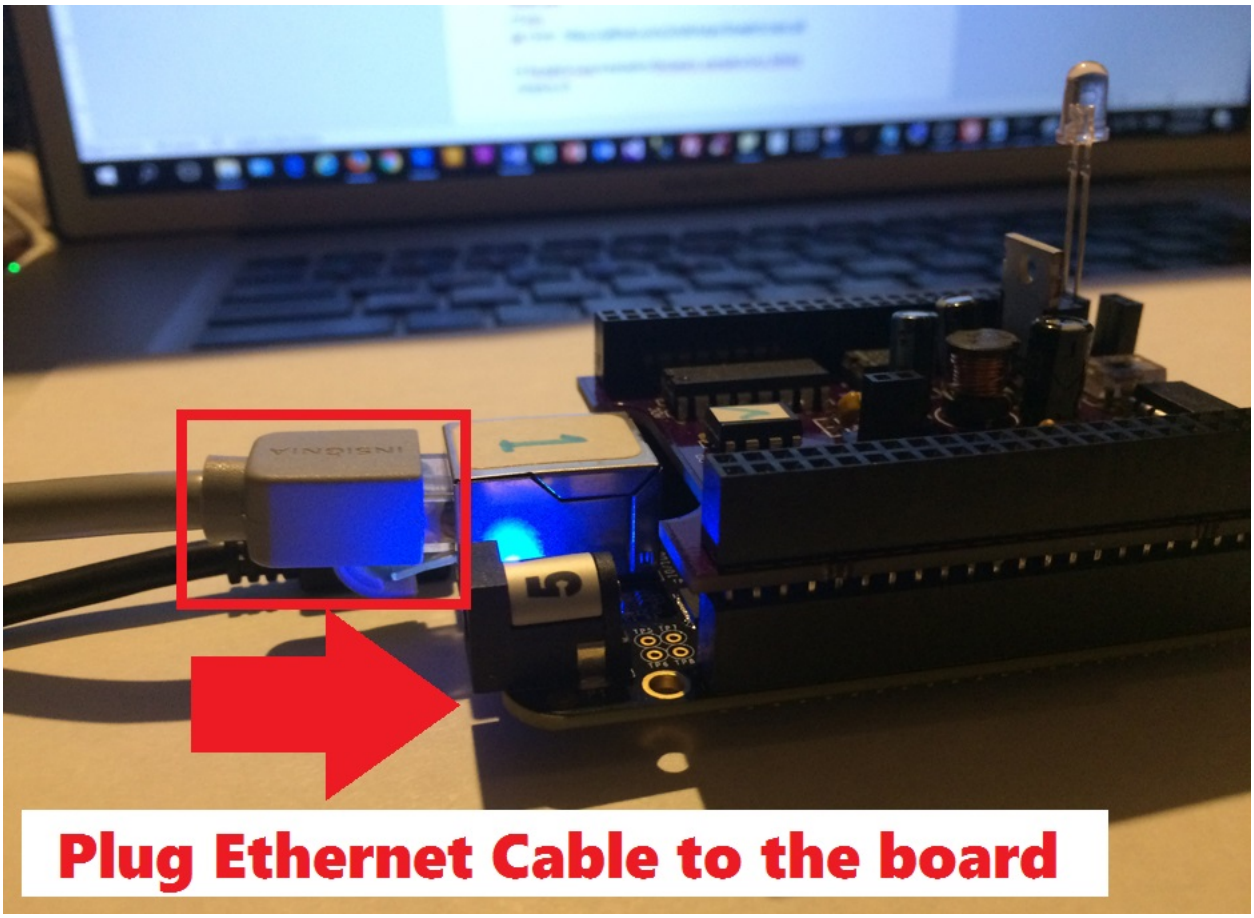
Then Paste to the putty command prompt by right clicking at the location of the cursor.



Step 29: Reboot command will disconnect you from the board. When that happens, you need to click OK, then close putty command prompt. Then **repeat the following steps** to reconnect to the board:

Step 13, Step 14, Step 15, Step 16, Step 17, Step 18

Step 30: Connect the ethernet cable to your board.

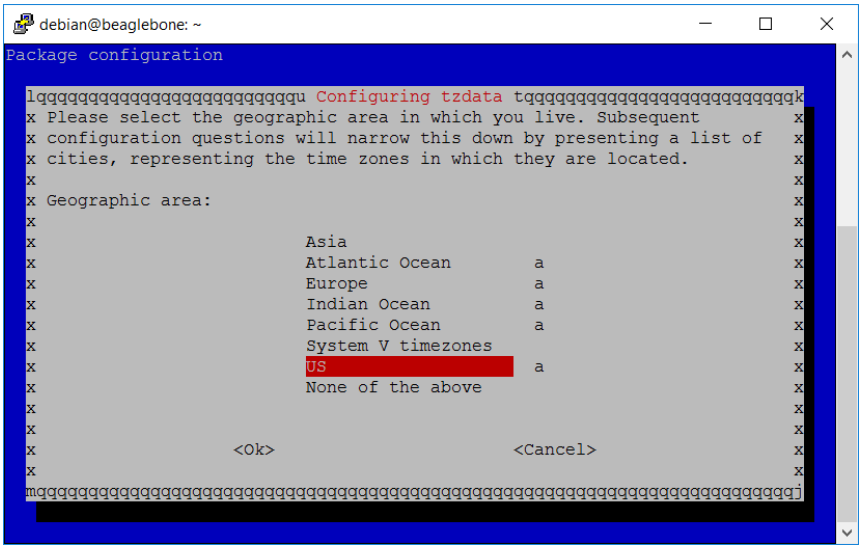


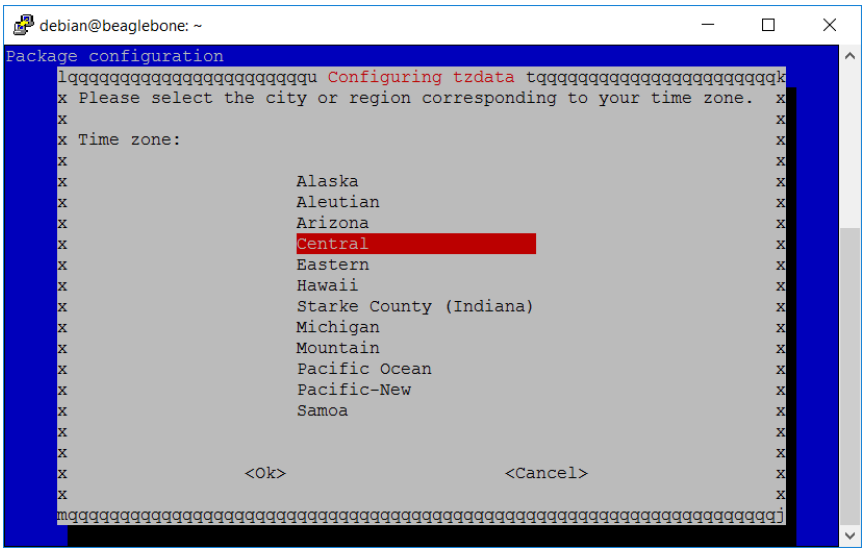
Step 31: Copy the following highlighted lines including the empty line:

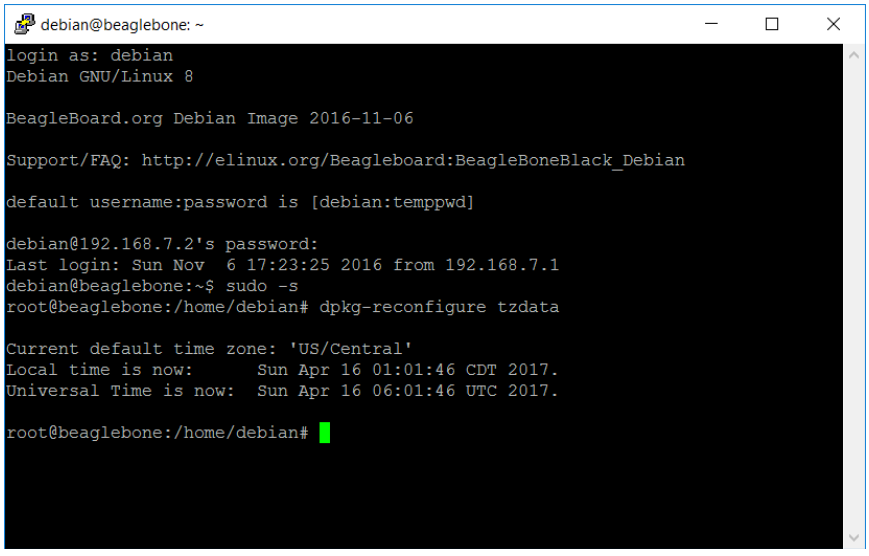
```
sudo -s
dpkg-reconfigure tzdata
```

Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 32: Select "**US**", then press "**Enter**", then select "**Central**", then press "**Enter**" as shown in the screenshots below:


debian@beaglebone: ~
Package configuration
Configuring tzdata
Please select the geographic area in which you live. Subsequent configuration questions will narrow this down by presenting a list of cities, representing the time zones in which they are located.
Geographic area:
Asia
Atlantic Ocean
Europe
Indian Ocean
Pacific Ocean
System V timezones
US
None of the above
<Ok>
<Cancel>

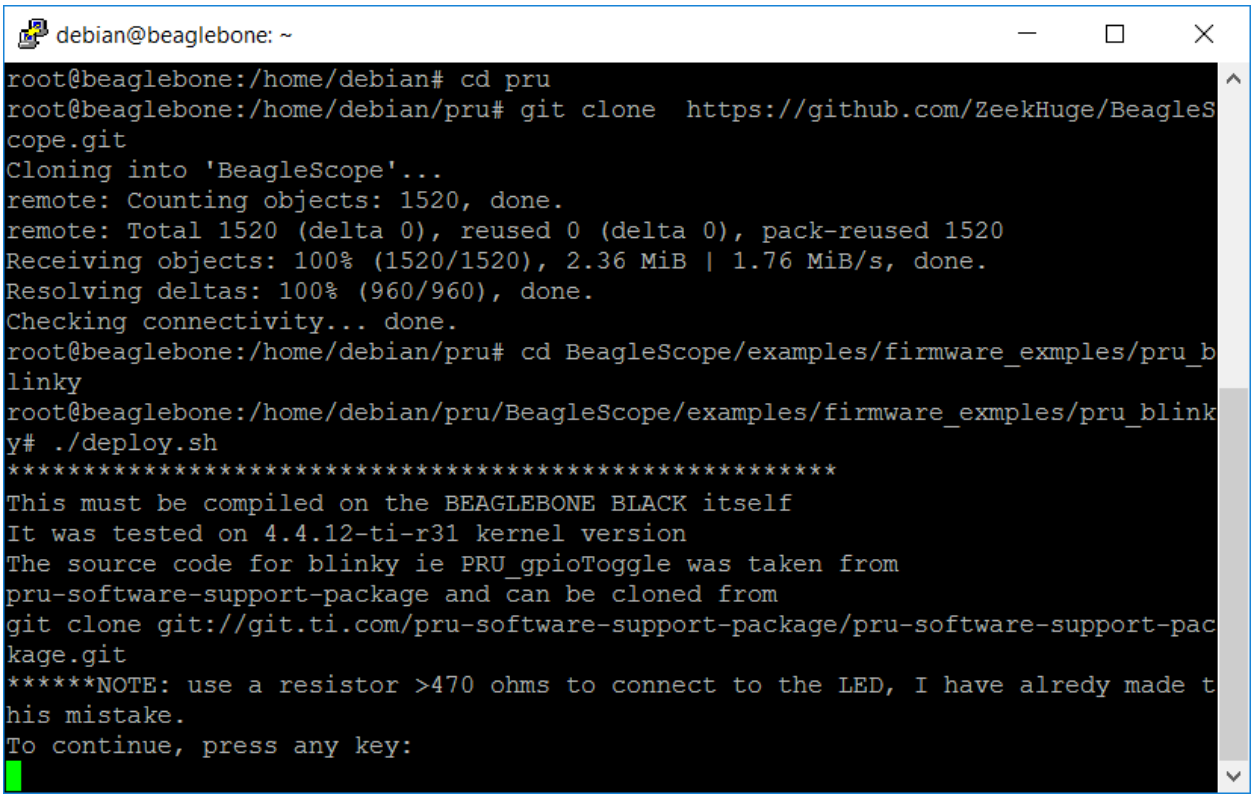

debian@beaglebone: ~
Package configuration
Configuring tzdata
Please select the city or region corresponding to your time zone.
Time zone:
Alaska
Aleutian
Arizona
Central
Eastern
Hawaii
Starke County (Indiana)
Michigan
Mountain
Pacific Ocean
Pacific-New
Samoa
<Ok>
<Cancel>


debian@beaglebone: ~
login as: debian
Debian GNU/Linux 8
BeagleBoard.org Debian Image 2016-11-06
Support/FAQ: http://elinux.org/Beagleboard:BeagleBoneBlack_Debian
default username:password is [debian:temppwd]
debian@192.168.7.2's password:
Last login: Sun Nov 6 17:23:25 2016 from 192.168.7.1
debian@beaglebone:~$ sudo -s
root@beaglebone:/home/debian# dpkg-reconfigure tzdata
Current default time zone: 'US/Central'
Local time is now: Sun Apr 16 01:01:46 CDT 2017.
Universal Time is now: Sun Apr 16 06:01:46 UTC 2017.
root@beaglebone:/home/debian#

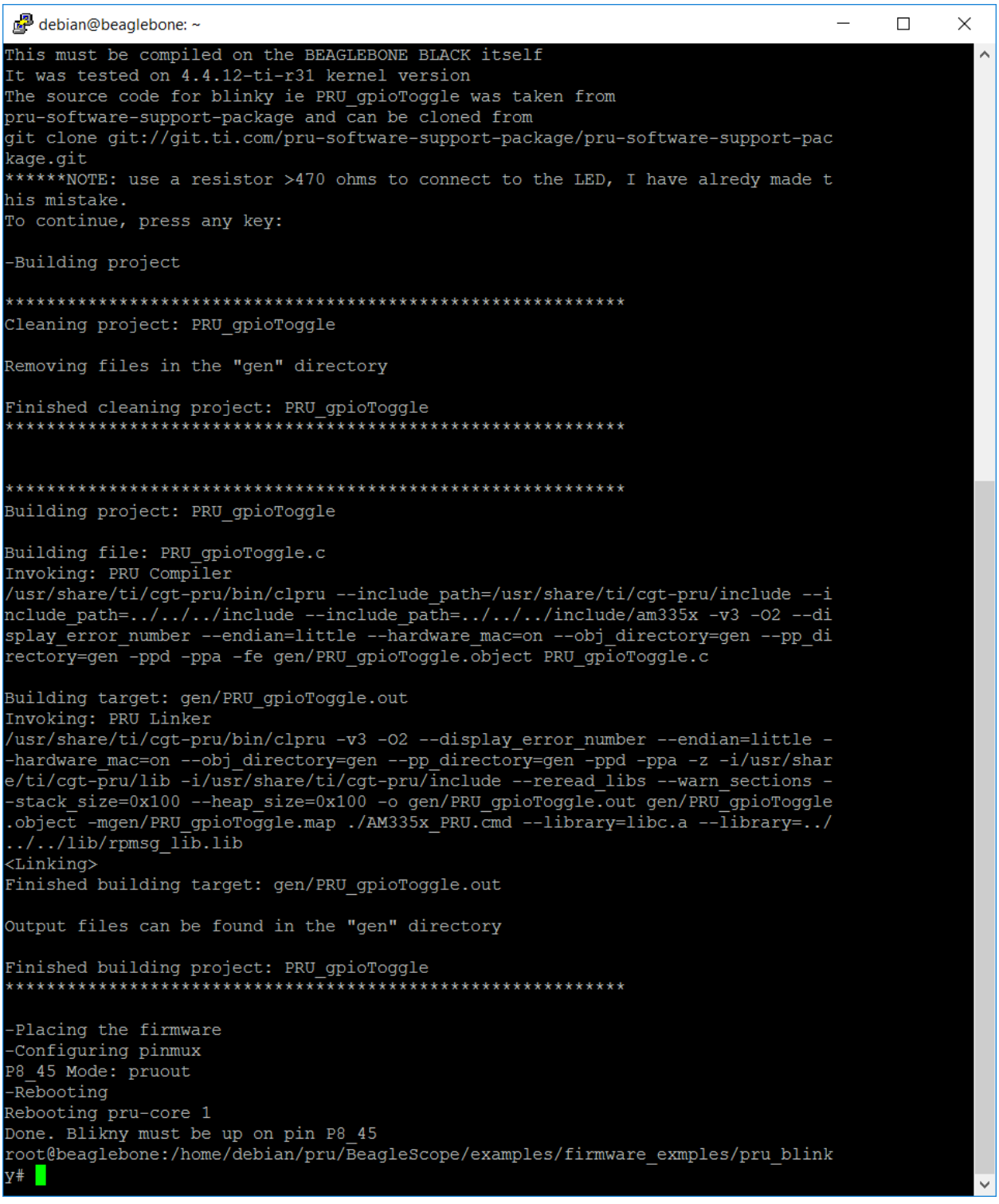
Step 33: Copy the following highlighted lines including the empty line:

```
mkdir pru
cd pru
git clone https://github.com/ZeekHuge/BeagleScope.git
cd BeagleScope/examples/firmware_exmples/pru_blinky
./deploy.sh
```

Then Paste to the putty command prompt by right clicking at the location of the cursor.



Step 34: Press "**Enter**" to continue. If you don't see any errors, then you should see the LED blinking every 1 second.



Step 35: Copy the following highlighted lines including the empty line:

nano PRU_gpioToggle/PRU_gpioToggle.c

Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 37: Scroll down to the end of the file and change **Line 57 [before the last 2 lines in the file]** from

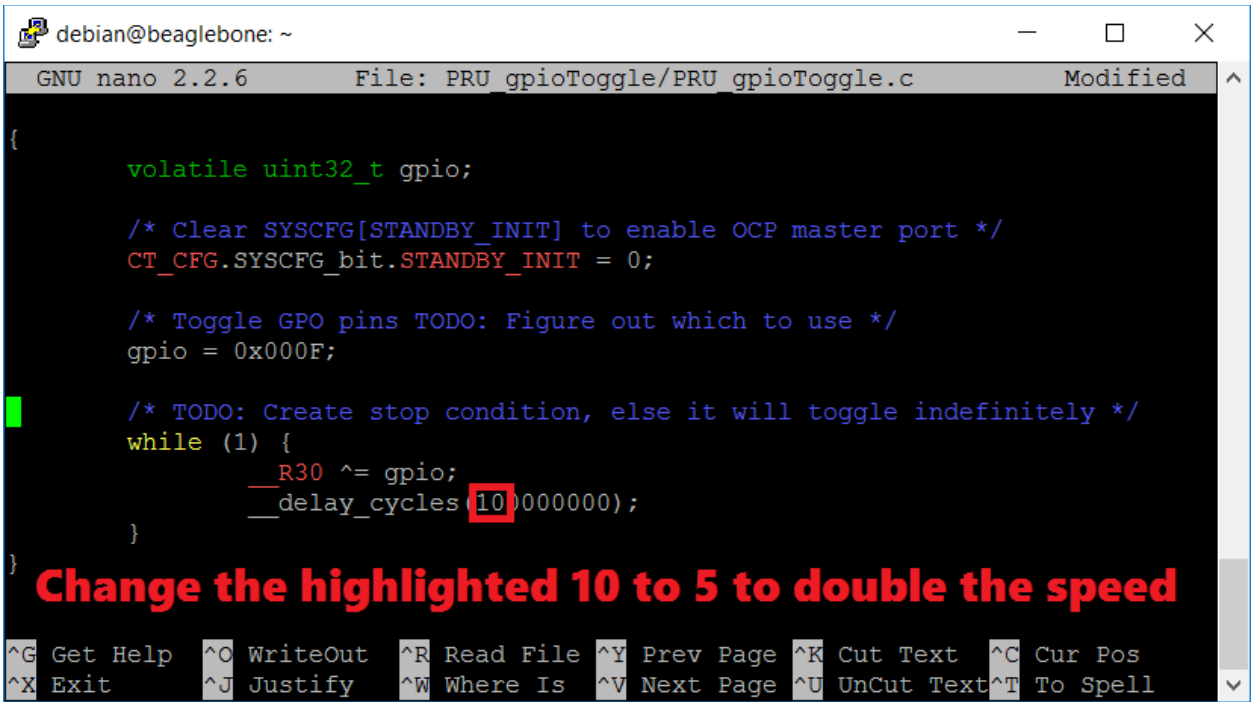
```
__delay_cycles(100000000);
```

TO

```
__delay_cycles(50000000);
```

By changing 10 at the beginning of the line to 5.

This will double the speed of blinking. You may increase or decrease the number of cycles to slow down or speed the blinking time!



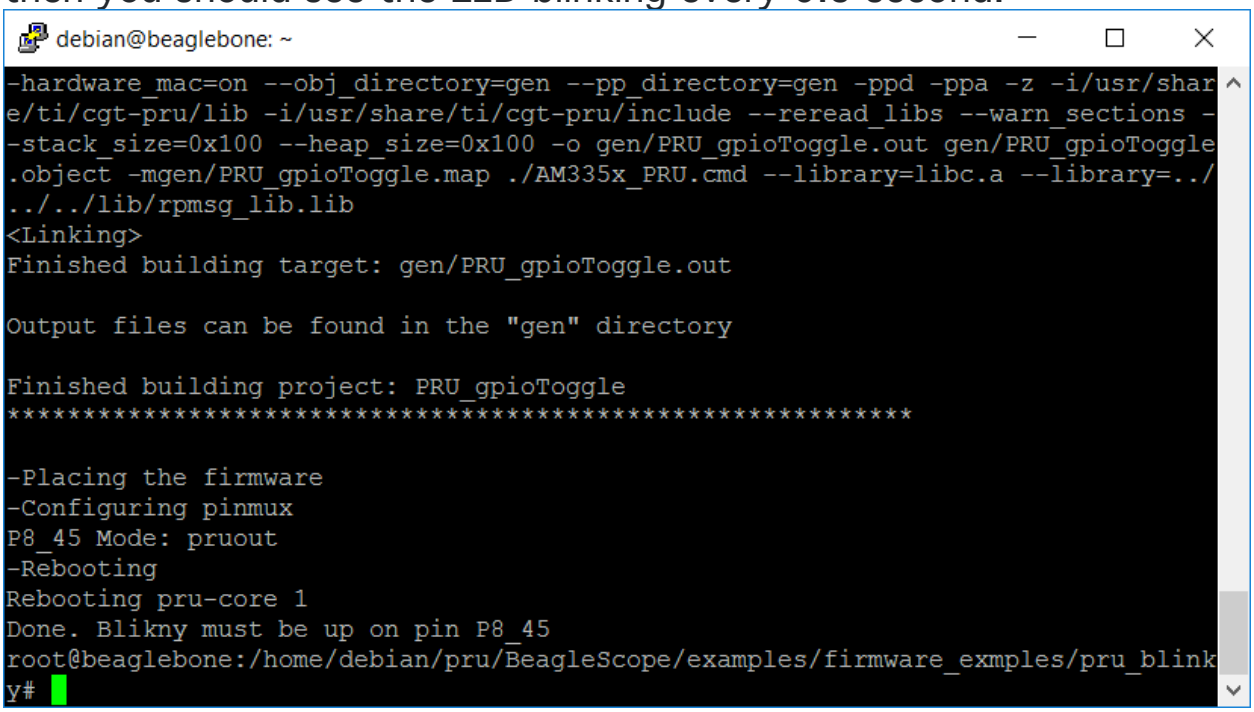
Step 38: Press "**Ctrl+X**", then press "**Y**" for yes, then press "**Enter**" to exit the file.

Step 39: Copy the following highlighted lines including the empty line:

```
./deploy.sh

```

Then Paste to the putty command prompt by right clicking at the location of the cursor.

Step 40: Press "**Enter**" to continue. If you don't see any errors, then you should see the LED blinking every 0.5 second.



Final Step: Show your TA the blinking light to receive credit