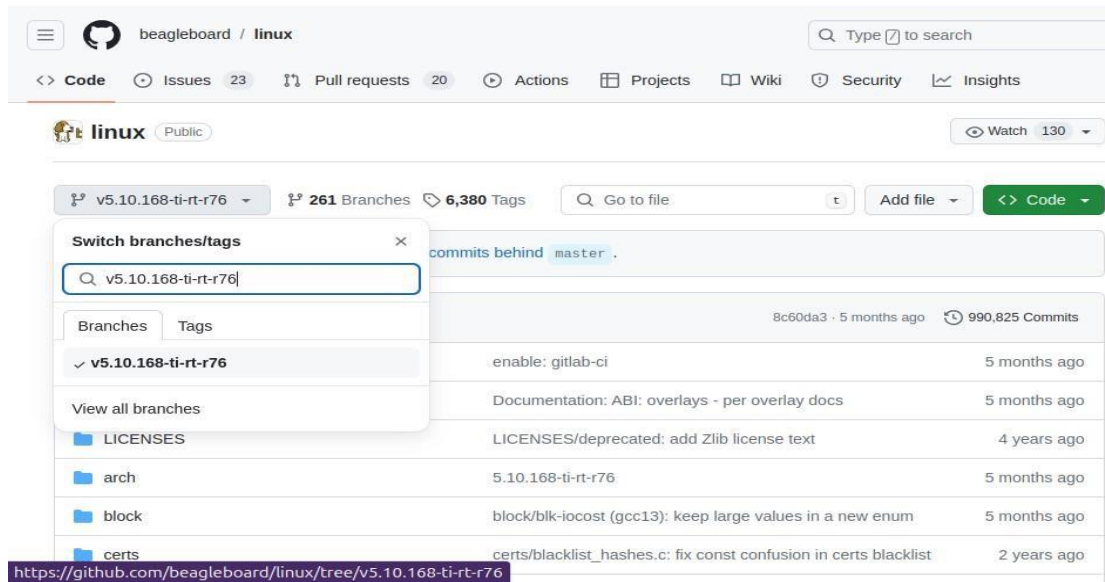


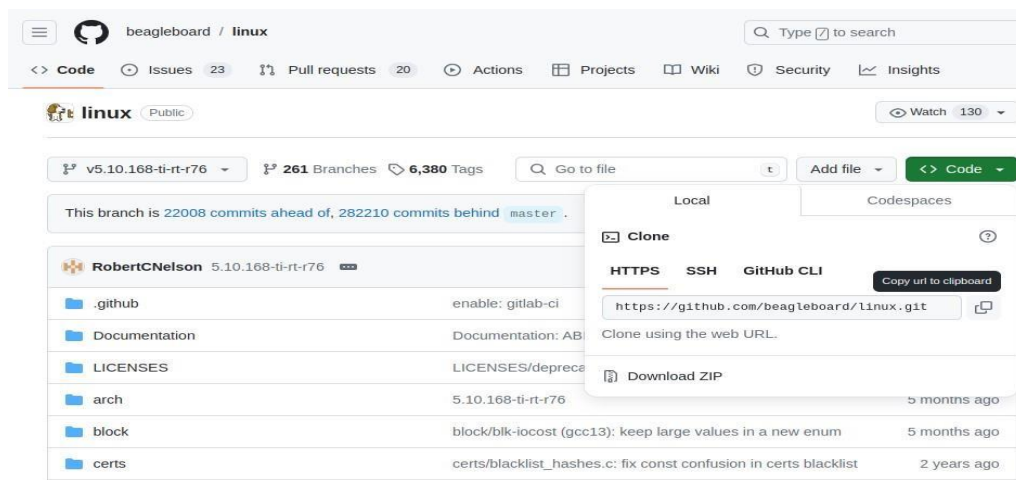
Updating latest Kernel image v5.10.168-ti-rt-r76.

Step 1: Selecting Latest Kernel Source.

- Go to the Beagle Board GitHub repository located at <https://github.com/beagleboard/linux>.
- Switch to the branch **5.10.168-ti-rt-r76**.

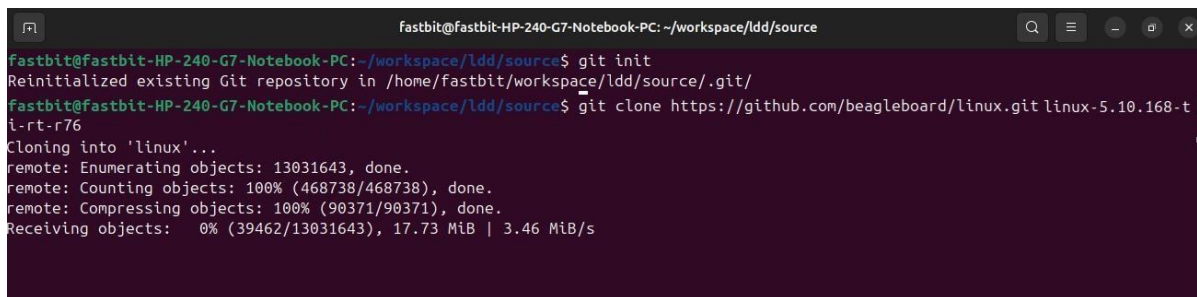


- Copy the link in the code option.



Step 2: Clone the kernel:

- Open the terminal and navigate to the source folder of your workspace. Once you are in the desired directory, run the command:
git init
- After initializing the Git repository, you can proceed to clone the repository by pasting the copied URL from Git and providing a name for the cloned repository. Here is the command:
- **git clone https://github.com/beagleboard/linux.git**
- Execute the command “**git checkout 5.10.168-ti-rt-r76**” to switch to the desired branch in the Git repository.

A terminal window screenshot with a dark background. The title bar shows 'Fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source'. The terminal text shows the execution of 'git init' which reinitializes an existing repository, followed by 'git clone https://github.com/beagleboard/linux.git linux-5.10.168-ti-rt-r76'. The cloning process is shown with progress bars for enumerating, counting, and compressing objects, and receiving objects at 17.73 MiB. The final state shows the repository is cloned into 'linux' and the user is on the '5.10.168-ti-rt-r76' branch.

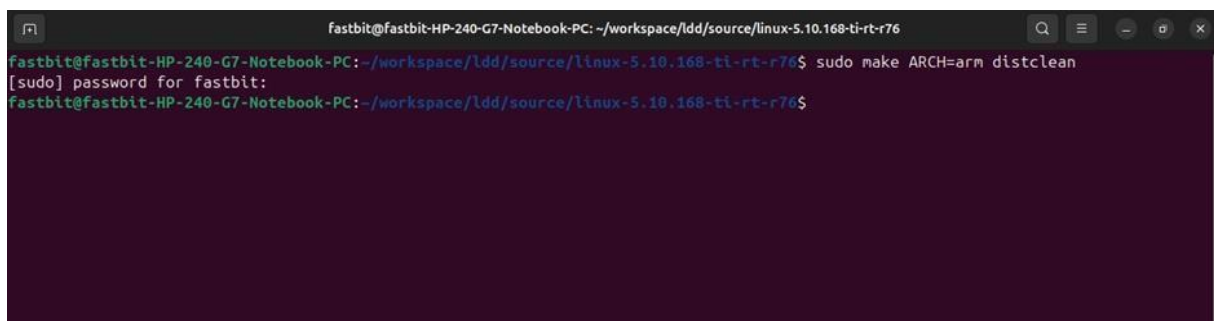
```
Fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source$ git init
Reinitialized existing Git repository in /home/fastbit/workspace/ldd/source/.git/
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source$ git clone https://github.com/beagleboard/linux.git linux-5.10.168-ti-rt-r76
Cloning into 'linux'...
remote: Enumerating objects: 13031643, done.
remote: Counting objects: 100% (468738/468738), done.
remote: Compressing objects: 100% (90371/90371), done.
Receiving objects: 0% (39462/13031643), 17.73 MiB | 3.46 MiB/s
```

Step 3: Kernel Compilation steps.

Set up the host using these commands below.

- a. **sudo apt-get update**
 - b. **sudo apt-get install build-essential lzop u-boot-tools net-tools bison flex libssl-dev libncurses5-dev libncursesw5-dev unzip chrpath xz-utils minicom wget git-core**
 - c. **sudo apt-get install-y libgmp-dev**
 - d. **sudo apt-get install libmpc-dev**
 - e. **sudo apt-get install liblz4-tool**
1. Removes all the temporary folder, object files, images generated during the previous build. This step also deletes the .config file if created previously.

make ARCH=arm distclean

A terminal window screenshot showing a command being executed. The terminal title bar reads 'fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76'. The command prompt shows 'fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76\$ sudo make ARCH=arm distclean'. The next line shows the password prompt '[sudo] password for fastbit:' followed by a blank line. The final line shows the prompt 'fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76\$'.

2. creates a .config file by using default config file given by the vendor.
make ARCH=arm bb.org_defconfig

```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$ sudo make ARCH=arm distclean
[sudo] password for fastbit:
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$ sudo make ARCH=arm bb.org_defconfig
HOSTCC scripts/basic/fixdep
HOSTCC scripts/kconfig/conf.o
HOSTCC scripts/kconfig/confdata.o
HOSTCC scripts/kconfig/expr.o
LEX scripts/kconfig/lexer.lex.c
YACC scripts/kconfig/parser.tab.[ch]
HOSTCC scripts/kconfig/lexer.lex.o
HOSTCC scripts/kconfig/parser.tab.o
HOSTCC scripts/kconfig/preprocess.o
HOSTCC scripts/kconfig/symbol.o
HOSTCC scripts/kconfig/util.o
HOSTLD scripts/kconfig/conf
#
# configuration written to .config
#
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$
```

3. This step is optional. Run this command only if you want to change some kernel settings before compilation.

make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi-hf-menuconfig

4. Kernel source code compilation. This stage creates a kernel image "uImage" also all the device tree source files will be compiled, and dtbs will be generated

make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi-hf-uImage dtbs LOADADDR=0x80008000 -j4

```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76
LZ4 arch/arm/boot/compressed/piggy_data
CC arch/arm/boot/compressed/misc.o
CC arch/arm/boot/compressed/decompress.o
CC arch/arm/boot/compressed/string.o
SHIPPED arch/arm/boot/compressed/hyp-stub.S
SHIPPED arch/arm/boot/compressed/lib1funcs.S
SHIPPED arch/arm/boot/compressed/ashldi3.S
SHIPPED arch/arm/boot/compressed/bswapsdi2.S
AS arch/arm/boot/compressed/hyp-stub.o
AS arch/arm/boot/compressed/lib1funcs.o
AS arch/arm/boot/compressed/ashldi3.o
AS arch/arm/boot/compressed/bswapsdi2.o
AS arch/arm/boot/compressed/piggy.o
LD arch/arm/boot/compressed/vmlinux
OBJCOPY arch/arm/boot/zImage
Kernel: arch/arm/boot/zImage is ready
UIIMAGE arch/arm/boot/uImage
Image Name: Linux-5.10.168
Created: Sat Jun 22 12:48:10 2024
Image Type: ARM Linux Kernel Image (uncompressed)
Data Size: 11145728 Bytes = 10884.50 KiB = 10.63 MiB
Load Address: 80008000
Entry Point: 80008000
Kernel: arch/arm/boot/uImage is ready
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$ ls
```

OR

make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-zImage dtbs LOADADDR=0x80008000 -j4

```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76
OBJCOPY arch/arm/boot/Image
Kernel: arch/arm/boot/Image is ready
LDS arch/arm/boot/compressed/vmlinux.lds
AS arch/arm/boot/compressed/head.o
LZ4 arch/arm/boot/compressed/piggy_data
CC arch/arm/boot/compressed/misc.o
CC arch/arm/boot/compressed/decompress.o
CC arch/arm/boot/compressed/string.o
SHIPPED arch/arm/boot/compressed/hyp-stub.S
SHIPPED arch/arm/boot/compressed/lib1funcs.S
SHIPPED arch/arm/boot/compressed/ashldi3.S
SHIPPED arch/arm/boot/compressed/bswapsdi2.S
AS arch/arm/boot/compressed/hyp-stub.o
AS arch/arm/boot/compressed/lib1funcs.o
AS arch/arm/boot/compressed/ashldi3.o
AS arch/arm/boot/compressed/bswapsdi2.o
AS arch/arm/boot/compressed/piggy.o
LD arch/arm/boot/compressed/vmlinux
OBJCOPY arch/arm/boot/zImage
Kernel: arch/arm/boot/zImage is ready
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$ sudo
make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- modules -j4
```

5. This step builds and generates in-tree loadable(M) kernel modules(.ko).

make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-modules -j4


```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-rt-r76
LD [M] sound/soc/ti/snd-soc-davinci-mcasp.ko
LD [M] sound/soc/ti/snd-soc-omap-dmic.ko
LD [M] sound/soc/ti/snd-soc-omap-hdmi.ko
LD [M] sound/soc/ti/snd-soc-omap-mcbsp.ko
LD [M] sound/soc/ti/snd-soc-omap-mcpdm.ko
LD [M] sound/soc/ti/snd-soc-ti-edma.ko
LD [M] sound/soc/ti/snd-soc-ti-sdma.ko
LD [M] sound/soc/ti/snd-soc-ti-udma.ko
LD [M] sound/soundcore.ko
LD [M] sound/usb/6fire/snd-usb-6fire.ko
LD [M] sound/usb/bcd2000/snd-bcd2000.ko
LD [M] sound/usb/caiaq/snd-usb-caiaq.ko
LD [M] sound/usb/hiface/snd-usb-hiface.ko
LD [M] sound/usb/line6/snd-usb-line6.ko
LD [M] sound/usb/line6/snd-usb-pod.ko
LD [M] sound/usb/line6/snd-usb-podhd.ko
LD [M] sound/usb/line6/snd-usb-toneport.ko
LD [M] sound/usb/line6/snd-usb-variak.ko
LD [M] sound/usb/misc/snd-ua101.ko
LD [M] sound/usb/snd-usb-audio.ko
LD [M] sound/usb/snd-usbmidi-lib.ko
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$
```

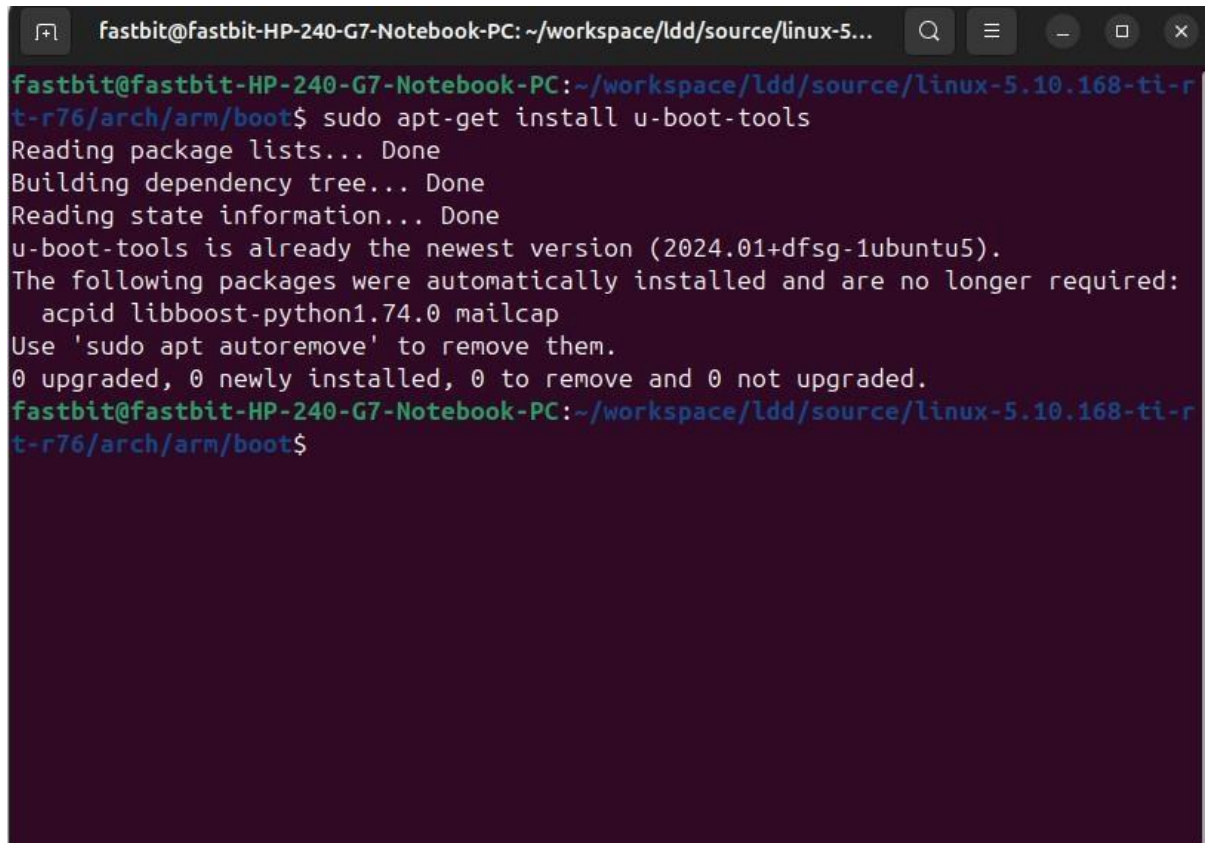
6. This step installs all the generated .ko files in the default path of the computer (/lib/modules/<kernel_ver>)
sudo make ARCH=arm modules_install.

```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5...
INSTALL sound/soc/ti/snd-soc-davinci-mcasp.ko
INSTALL sound/soc/ti/snd-soc-omap-dmic.ko
INSTALL sound/soc/ti/snd-soc-omap-hdmi.ko
INSTALL sound/soc/ti/snd-soc-omap-mcbsp.ko
INSTALL sound/soc/ti/snd-soc-omap-mcpdm.ko
INSTALL sound/soc/ti/snd-soc-ti-edma.ko
INSTALL sound/soc/ti/snd-soc-ti-sdma.ko
INSTALL sound/soc/ti/snd-soc-ti-udma.ko
INSTALL sound/soundcore.ko
INSTALL sound/usb/6fire/snd-usb-6fire.ko
INSTALL sound/usb/bcd2000/snd-bcd2000.ko
INSTALL sound/usb/caiaq/snd-usb-caiaq.ko
INSTALL sound/usb/hiface/snd-usb-hiface.ko
INSTALL sound/usb/line6/snd-usb-line6.ko
INSTALL sound/usb/line6/snd-usb-pod.ko
INSTALL sound/usb/line6/snd-usb-podhd.ko
INSTALL sound/usb/line6/snd-usb-toneport.ko
INSTALL sound/usb/line6/snd-usb-variak.ko
INSTALL sound/usb/misc/snd-ua101.ko
INSTALL sound/usb/snd-usb-audio.ko
INSTALL sound/usb/snd-usbmidi-lib.ko
DEPMOD 5.10.168
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-rt-r76$
```

Step 4: Convert the zImage format kernel image to uImage.

Note: During the kernel compilation, if only the zImage is generated, you can continue with step 4. Otherwise, you can skip step 4 and proceed directly to step 5.

1. Install the u-boot tools by using the command
sudo apt-get install u-boot-tools.

A terminal window screenshot showing the command 'sudo apt-get install u-boot-tools' being executed. The output indicates that u-boot-tools is already the newest version (2024.01+dfsg-1ubuntu5) and lists several packages that were automatically installed and are no longer required: acpid, libboost-python1.74.0, and mailcap. It suggests using 'sudo apt autoremove' to remove them. The terminal shows 0 upgraded, 0 newly installed, 0 to remove, and 0 not upgraded. The prompt is 'fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5.10.168-ti-r76/arch/arm/boot\$'.

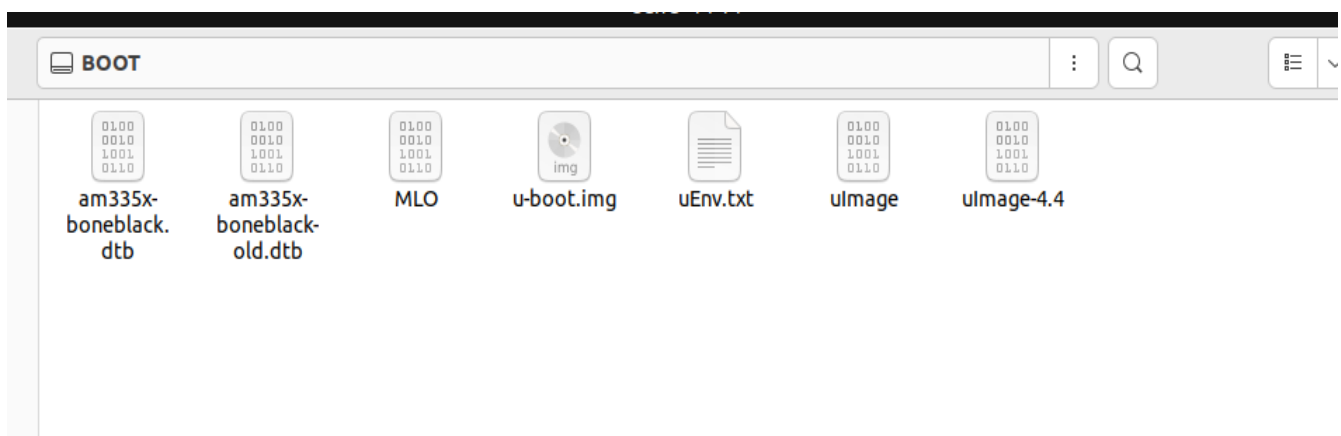
```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5...
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-r76/arch/arm/boot$ sudo apt-get install u-boot-tools
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
u-boot-tools is already the newest version (2024.01+dfsg-1ubuntu5).
The following packages were automatically installed and are no longer required:
  acpid libboost-python1.74.0 mailcap
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-r76/arch/arm/boot$
```

2. Once you have this installed, then you need to take your zImage file and determine its file path.
workspace/ldd/source/linux_5.10.168_BBB/arch/arm/boot/
3. Enter the command in the directory to convert the **zImage** to **uImage**.
mkimage -A arm -O linux -T kernel -C none -a 0x82000000 -e 0x82000000 -n "Linux kernel uImage" -d arch/arm/boot/zImage uImage.

```
fastbit@fastbit-HP-240-G7-Notebook-PC: ~/workspace/ldd/source/linux-5...
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-r
t-r76$ sudo mkimage -A arm -O linux -T kernel -C none -a 0x82000000 -e 0x8200000
0 -n "Linux kernel uImage" -d arch/arm/boot/zImage uImage
Image Name:   Linux kernel uImage
Created:      Sat Jun 22 15:47:18 2024
Image Type:   ARM Linux Kernel Image (uncompressed)
Data Size:    11145728 Bytes = 10884.50 KiB = 10.63 MiB
Load Address: 82000000
Entry Point:  82000000
fastbit@fastbit-HP-240-G7-Notebook-PC:~/workspace/ldd/source/linux-5.10.168-ti-r
t-r76$
```


Step 5: Updating uImage, DTB and Copying Modules to SD Card.

1. Insert the SD card into a card reader and open it on your computer.
 - Access the boot partition.
 - Rename the existing **uImage** file to **uImage-back**.
2. Open the terminal and navigate to the source directory:
cd linux-5.10.168-ti-rt-r76/arch/arm/boot/
3. Copy the **uImage** file to the SD card's boot partition:
cp uImage/media/<username>/BOOT/
4. Open the **/lib/modules/** directory and - Copy the newly created folder to the SD card's root file system:
cd /lib/modules/
ls
sudo cp -a 5.10.168/ /media/ <username>/ROOTFS/lib/modules/
5. Sync the changes to ensure data is written to the SD card properly
sync
6. Open the source directory in the terminal
7. Navigate to **/arch/arm/boot/dts**.
8. Copy the dtb file to the BOOT partition using the command
cp am335x-boneblack.dtb /media/<username> /BOOT/



Step 6: Boot the beagle bone black by using the SD card.

1. Unmount the SD card from the PC and insert it into the SD card slot of the beagle bone black board.
2. Boot the board from the SD card.