

# Kernel Programming

## Exercise 1

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## Step by step procedure for Kernel installation

### 1. Get Linux Kernel Source Code :

The source code of the Linux kernel *linux-4.3.3.tar.xz*, available in <http://www.kernel.org/>, is downloaded and extracted in the `/usr/src` directory.

### 2. Configure the Kernel :

`make defconfig` is used to configure the kernel. `defconfig` has some default configuration for Linux kernel. It produces a `.config` file that is a configuration file containing the different functionalities of the kernel.

### 3. Compile the Kernel :

`make` is used to compile or build the kernel.

### 4. Compile the modules :

`make modules` is used to build the different modules of kernel.

### 5. Install Kernel modules :

`make modules_install` is used to install all the kernel modules build in the last step.

### 6. Install the Kernel :

`make install` is used to finally install the kernel. It adds three file to the `/boot` directory namely :

- `vmlinuz-4.3.3`
- `config-4.3.3`
- `System.map-4.3.3`

It also automatically updates the grub about the new kernel installed.

## Files created during the kernel build process

### • `System.map-4.3.3` :

It a symbol file for the kernel containing list of functions and addresses. It maps the entry points and addresses of all the functions and data structures in the kernel.

### • `config-4.3.3` :

It is the configuration file that contains all the configuration selections (functionalities) for the kernel.

### • `vmlinuz-4.3.3` :

The `vmlinuz` is the abbreviation of Virtual Memory LINUX gZip, is a compressed Linux kernel executable. It is capable of loading the operating system into memory

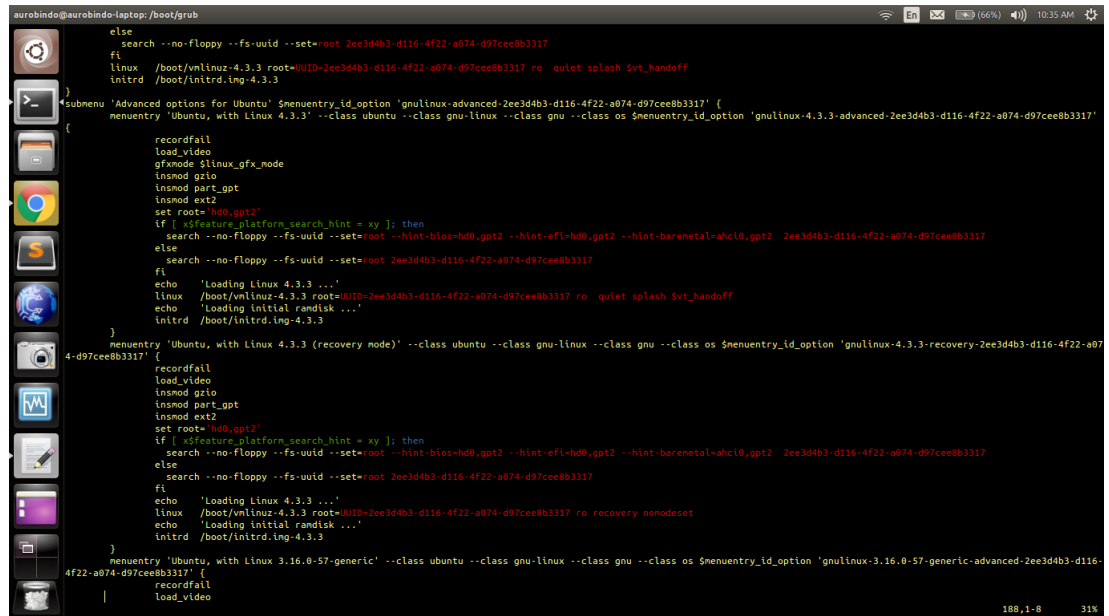
### • `initrd.img-4.3.3` :

The initial RAM disk (`initrd`) is an initial root file system that is mounted when no real root file system is available. The modules are loaded first in `initrd` to make the real file systems available and then the real root file system is loaded.

The above files are stored in `/boot`.

## GRUB details

The GRUB menu list is stored in `/boot/grub/grub.cfg`.

A terminal window titled 'aurobindo@aurobindo-laptop: /boot/grub' displays the contents of the GRUB configuration file. The window has a dark background with a sidebar on the left showing various application icons. The terminal text shows the GRUB configuration for Ubuntu 4.3.3, including search paths, root settings, and menu entries for both the standard boot and recovery modes. The configuration uses UUIDs for disk identification and includes instructions for loading the kernel and initrd. The status bar at the bottom right of the terminal shows '188,1-8' and '31%'.

```
else
  search --no-floppy --fs-uuid --set=root 2ee3d4b3-d116-4f22-a074-d97cee8b3317
fi
linux /boot/vmlinuz-4.3.3 root=UUID=2ee3d4b3-d116-4f22-a074-d97cee8b3317 ro quiet splash $vt_handoff
initrd /boot/initrd.img-4.3.3
}
submenu 'Advanced options for Ubuntu' $menuentry_id_option 'gnulinux-advanced-2ee3d4b3-d116-4f22-a074-d97cee8b3317' {
  menuentry 'Ubuntu, with Linux 4.3.3' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-4.3.3-advanced-2ee3d4b3-d116-4f22-a074-d97cee8b3317' {
    recordfail
    load_video
    gfxmode $linux_gfx_mode
    insmod gzio
    insmod part_gpt
    insmod ext2
    set root='hd0,gpt2'
    if [ x$feature_platform_search_hint = xy ]; then
      search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2 --hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2 2ee3d4b3-d116-4f22-a074-d97cee8b3317
    else
      search --no-floppy --fs-uuid --set=root 2ee3d4b3-d116-4f22-a074-d97cee8b3317
    fi
    echo 'Loading Linux 4.3.3 ...'
    linux /boot/vmlinuz-4.3.3 root=UUID=2ee3d4b3-d116-4f22-a074-d97cee8b3317 ro quiet splash $vt_handoff
    echo 'Loading initial ramdisk ...'
    initrd /boot/initrd.img-4.3.3
  }
  menuentry 'Ubuntu, with Linux 4.3.3 (recovery mode)' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-4.3.3-recovery-2ee3d4b3-d116-4f22-a074-d97cee8b3317' {
    recordfail
    load_video
    insmod gzio
    insmod part_gpt
    insmod ext2
    set root='hd0,gpt2'
    if [ x$feature_platform_search_hint = xy ]; then
      search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2 --hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2 2ee3d4b3-d116-4f22-a074-d97cee8b3317
    else
      search --no-floppy --fs-uuid --set=root 2ee3d4b3-d116-4f22-a074-d97cee8b3317
    fi
    echo 'Loading Linux 4.3.3 ...'
    linux /boot/vmlinuz-4.3.3 root=UUID=2ee3d4b3-d116-4f22-a074-d97cee8b3317 ro recovery nomodeset
    echo 'Loading initial ramdisk ...'
    initrd /boot/initrd.img-4.3.3
  }
  menuentry 'Ubuntu, with Linux 3.16.0-57-generic' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-3.16.0-57-generic-advanced-2ee3d4b3-d116-4f22-a074-d97cee8b3317' {
    recordfail
    load_video
```

Figure 1: Snapshot of the grub.cfg showing entry for the Linux kernel 4.3.3