ComS 252 Homework 7: Compiling a custom kernel

Group assignment (with 5% penalty per group member)

Due October 19, 2021

1 Objectives

For this assignment, you will configure, compile and install a custom kernel from source code. Part of your grade is based on how *small* you can make your kernel (including modules) by turning off features. Of course, you must not turn off necessary features. Some important tips for this assignment:

1. You are strongly encouraged to take careful notes for each attempt, and to utilize the "Snapshot" feature of VirtualBox. For best results, take snapshots of *completely shut down* virtual machines, *before* you build the kernel.

2. For more information, consult

   - Chapter 15 of the textbook
   - http://kernelnewbies.org/FAQ
   - The README file distributed with the kernel source.

3. A large but working kernel is worth many more points than a small but broken one. For full credit, though, you will need to build a small kernel, with most features turned off.

2 Download

Download the virtual machine `Hw07.ova`. Accounts are `root` and `user` with passwords `rootpw` and `userpw`, as usual. You should not need to install any packages for this assignment. However, you will need to download the kernel source.

3 Check sound

Part of this assignment is to be sure that your custom kernel supports the sound card. So, before you begin, you need to make sure that sound is working on the VM. The VM is already configured for sound, but in case you need to debug it, you should run `alsamixer` to adjust the volume and `alsaunmute` to make sure the sound is not muted. There is a sound file in directory `/home/user/audio`, which you should be able to play using the `play` utility:

```
play (soundfile)
```

When you play the file, it should be audible on your host machine (assuming of course that your host machine has working sound).

Sound can be a little finicky in VirtualBox; if the sound player hangs in Linux, try disabling and re-enabling audio output (by clicking the speaker icon on the bottom of the VirtualBox window). Another thing to try is to switch the audio controller between `ICH AC97` and `Intel HD Audio` in the Audio settings for the VM.

4   Obtain the kernel source

Go to http://www.kernel.org to obtain a recent, *stable* or *longterm* kernel, with version number between 5.10.66 and 5.15.0. The text–based web browser, `lynx`, is installed; you are encouraged to use this to download the source tarball. Note that the submission script expects the following:

- The source tarball is in `/home/user`; do not delete it after unpacking it.

- The tarball was unpacked in `/home/user`.

I recommend to take a snapshot after unpacking the source files, so you can easily revert back for each configuration attempt.

5   Configure the kernel

Configure the kernel, as `user`, using one of the methods discussed in lecture. You should configure a kernel that will run on, and support the hardware of, the *virtual* machine, not the host machine. Similarly, your kernel should support the current filesystem types that the virtual machine uses. You do not need to support other types of hardware or filesystems. In particular, your kernel must support (at least)

- the RAM and motherboard of the VM;

- the drive(s) and filesystem(s) on the VM, otherwise your system will fail to boot;

- the network interface of the VM, so you can submit your work when you have booted from your kernel;

- and the sound card of the VM.

There are *lots* of device drivers enabled by default, and most or all of the unnecessary device drivers will need to be disabled to obtain a small kernel.

6   Name the kernel (IMPORTANT!)

After you complete the configuration, but before you build the kernel, edit the `Makefile` and set the `EXTRAVERSION` to be the list of ISU usernames of your group, separated by dashes. This will become part of the kernel name. For example, in a group of one, use:

```
EXTRAVERSION = -username
```

If you are installing version 5.10.66 of the kernel, then this will cause your kernel to be named

```
5.10.66-username
```

If you are working in a group, concatenate all the usernames with dashes at the front, in any order. For example:

```
EXTRAVERSION = -username1-username2-username3
```

The Turnin script expects to find your username(s) in the kernel name, otherwise it does not think it is "your" kernel. If for any reason you need additional text, then you may add extra text at the end of the list of usernames, separated by another dash. For example:

```
EXTRAVERSION = -username-7
```

Theoretically, you can build and install multiple kernels by changing this text (and running "`make clean`") between builds, assuming you have enough drive space. However, you are encouraged to instead use the snapshot feature of VirtualBox.

7 Compile the kernel

Compile the kernel and the modules, as `user`. This can take a **long** time, especially if lots of kernel features are turned on. Check any "Energy Saving" settings of your machine; you don't want to check on your kernel build after 3 hours, only to find that your computer went to sleep after the first 15 minutes.

8 Install the kernel

Install the kernel (i.e., copy the kernel image and modules to the appropriate place). You must do this as `root`. It is *strongly* recommended that you use the appropriate `make` target(s) for this, rather than copying by hand.

9 Test your kernel

Boot into your kernel (it should appear in the GRUB menu) and make sure everything works, especially your network connection and sound card. The login screen (and the GRUB menu entry) should show your kernel name, for example:

```
Fedora 28 (Twenty Eight)
Kernel 5.10.66-username on an x86_64 (tty1)

Hw07 login:
```

10 Submitting your work

Boot into your kernel, login as `root`, and run `Turnin yourISUusername` to automatically submit your work. If you worked in a group, run `Turnin` once with the usernames of everyone in your group. Check the `man` page for `Turnin` for more information. If your kernel does not boot, you can boot into the original kernel and run `Turnin` for partial credit.