Laboratory Exercise 4

cpe 453 Winter 2026

Due by 11:59:59pm, Wednesday, February 18th.
The Laboratory Exercises may be done with a partner.

Laboratory Exercises: MINIX Scavenger Hunt, Part II

It's finally time to take the plunge and build a modified MINIX system. For this task, go to the same system you used for the Minix Scavenger Hunt I lab and re-familiarize yourself with the system. You may need to re-read the following man pages:

usage(8)	MINIX configuration and usage guide. This is also included on the CD-ROM in MINIX/INSTALL.TXT so you can read the installation instructions (esp. make hdboot) *before* installing the system.
monitor(8)	describes the MINIX boot monitor process
boot(8)	describes the MINIX boot procedure

1. **Build a modified kernel**

   Modify the MINIX kernel so that whenever the system is idle—there are no runable processes—the cursor will be displayed on top of an @ symbol. To do this will require a single block of code (to print the @ then back up on top of it):

   ```
   if ( something ) {
       printf("@\b");
   }
   ```

   And, depending on where you put it, the *something* could be as simple as TRUE.

   The question, of course, is "where?"

   The MINIX kernel source is all in /usr/src. To build a kernel image, go to /usr/src/tools and run make image[1]. This will produce a kernel image called, appropriately, "image." Copy this file to the /boot/image directory, reboot using shutdown(8), select "Start Custom MINIX 3" option, and it'll be running.

   (See the usage(8) man page for other options for making kernels.)

   In case things go wrong, remember what you learned about the boot monitor from reading the man page, reboot to your old stable kernel, and try again.

   Once you get it going, use it for a little while, but you'll probably want to put the old kernel back pretty quickly. A kernel that prints "@" every time it has nothing to do quickly grows tiresome.

   Among other things, be sure to read the man page for:

shutdown(8)	the polite way to shut down or reboot a running unix system. For example, "**shutdown -h +10**" to halt the system in 10 minutes, or "**shutdown -r now**" to reboot immediately.

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[1] "hdboot" is actually the target you want, but you know that because you read the usage(8) man page, right?

2. **Test it**

   Before relegating your modified kernel to the curiosity cabinet, devise a test to verify that your modification really does only display the "@" when the system is idle. Include your test, explanation, and results in your report.

Tricks and Tools

Measure Twice, Cut Once

As you know by now, operating systems are rather complex entities. Whether installing the system or modifying the kernel, be sure to read the documentation and thoroughly understand the implications of your decisions before you put them into effect.

Keep Backups

Measuring twice won't save you if you meant what you did. Keep backups of everything you do. The entire kernel source directory is less than a megabyte. The entire disk image used by your simulator probably isn't all that big. Look into:

tar(1)	The Unix Tape ARchive program. Useful for making backups.
	E.g.: `tar cvf safe.tar /usr/src/kernel`
svc(1), co(1), ci(1)	The Shell Version Control system, patterned after RCS.

Remember that you can use the boot monitor to choose a particular kernel to run. (You did read the man page, right?)

Make sure it works

Don't think you have it right; be sure. One of the things I'm going to look for in your writeup is an experiment that demonstrates that you have the right solution. Think: How can you test kernel modification?

Watch the clock

If you're using Bochs, be careful of its clock. Remember that it runs fast, and a fast clock that gets set back to an earlier time (upon restart, say) can cause programs that depend on dates—such as `make(1)` and the boot loader to behave in odd ways. Be sure that whatever is happening makes sense to you.

What to turn in

For the Laboratory Exercises: a written laboratory report describing approaches taken, problems encountered, solutions developed, and lessons learned. The format of the report is described in the writeup for Lab 2.

Submit via `handin` to the `lab04` subdirectory of the `pn-cs453` account, as a pdf or text file.[2]

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[2]I only have LibreOffice, and you don't want to see what it'll do to your nicely crafted Word document. . .