COEN 177: Operating Systems
Lab assignment 6: Minix operating system

Objectives

1. To setup a virtual machine and install Minix as a guest operating system
2. To understand Minix sufficiently to modify and re-build the Minix kernel

Guidelines

In the next two labs, you will be working on Minix operating system. Minix (mini-Unix) is a Unix-like operating system based on a microkernel architecture. Andrew S. Tanenbaum has created a number of MINIX versions for educational purposes[1]. These include Minix 1.0 in 1987, Minix 1.5 in 1991, Minix 2.0 in 1997, and Minix 3 in 2005. Minix 3 [2] is not specifically educational but rather a highly reliable and self-healing microkernel OS. Minix 3 has been a free and open-source software distributed under the BSD permissive free software license.

In this lab, you will install, run, and rebuild Minix. You will need a virtual machine on top of which Minix will run.

Getting started with Minix on the ECC Systems

If connecting remotely, use NoMachine to connect to the ECC Linux systems with a GUI. To use Minix on the ECC Systems requires a GUI interface and cannot be done with the terminal alone. Instructions for how to setup NoMachine are at this link. Once you are able to access the SCU Linux machines, you may proceed to the next step to setup MINIX.

To install and run Minix on the ECC Systems, make use of VirtualBox and a provided system image in /local/Vbox.

Start by launching VirtualBox, either by opening a terminal and running the command `virtualbox`, or by going to the Activities menu, selecting Show Applications, going to the next page, and clicking on Oracle VirtualBox.

Before creating a virtual machine, select Expert Mode on the far right, then click the three dots menu on Tools, select Networks, go to Host-only Networks, and click Create to create a network called `vboxnet0`. Under the Properties menu, select DHCP Server, Enable Server, and Apply.

Return here if you had to delete MINIX:

In VirtualBox, select File > Import Appliance.

Set Source to Local File System and File to `/local/Vbox/minix3-1-7.ova`, expand the Settings tab and set MAC Address Policy to Generate new MAC addresses for all network adapters, then click Finish.

Click the settings gear for the newly created virtual machine, go to Network, ensure that Adapter 1 has Enable Network Adapter checked, Attached to is set to Host-only Adapter, and Name is set to `vboxnet0`

Start the VM. To attach your keyboard to the VM, click on the region where text from MINIX appears (this may happen automatically the first time). To detach from the VM and get your cursor back, press Right Ctrl.

Note that it will immediately prompt you to launch default or custom MINIX, selecting default automatically after a short delay. You may have to select otherwise for certain kernel changes to take effect (the kernel is self-healing)

After a brief delay, MINIX will request a username to login with. The initial username for MINIX is `root`.

Inside of the VM, type `passwd` to give the system a password. Make sure it's a password you'll easily remember (ask yourself, how secure does this particular system need to be? What would it take for someone to access it?)

Find the IP address for the VM by typing `ifconfig` at the MINIX command line (ignore the netmask).

Return here if you had to reboot MINIX:

[1] https://en.wikipedia.org/wiki/MINIX

[2] http://www.minix3.org

Launch the FTP daemon in MINIX by typing `tcpd ftp in.ftpd &` at the MINIX command line. This is how you will transfer files between the host and guest systems.

For GUI access to the files inside the VM, go to the host machine's file browser, select Other Locations, and in the Connect to Server box, type `ftp://<IP>`, replacing `<IP>` with the IP address from `ifconfig`. For terminal access to the files inside the VM, type `ftp <IP>` at the host machine's terminal instead. Once it prompts you, enter your MINIX username and password and you will connect to the root user's home directory, `/root`

Note that the FTP command line interface does not support editing files, only copying them with `get` and `put`

It is *not recommended* to work on files inside the VM, because it is entirely possible to brick the VM by corrupting the bootable OS, at which point it is no longer feasible to retrieve any files. If this happens, reinstall MINIX.

The files you must find and edit in this lab (to change the copyright statement to include your name) can be found somewhere in the `/usr/src` directory tree. Note that logging in to MINIX as root will always start you in the root user's home directory, `/root`

To find a specific string, for example `pattern`, in an unspecified file directly under the directory (for example) `/dir`, use the command `grep "pattern" /dir/*` at the MINIX command line. You will need to substitute in your own string to search for and file path. Keep in mind that grep in MINIX does not allow for recursive file path expansion, so the path `/dir/*`, again for example, would only match the file `/dir/file.txt`, but not the file `/dir/sub/file.txt`--to match that, you would need to set the file path to `/dir/sub/*`, or even `/dir/*/*`

Once you have modified a file and wish to see the effects of your changes, go to the MINIX command line and type `make world` while in the `/usr/src` directory (you may need to use `cd`). This will (slowly) recompile MINIX.

When that finishes without errors, type `shutdown`, then type `exit` and *immediately* press `2`. This simulates a full power cycle of the machine, allowing you to boot into custom MINIX as detailed earlier. Once you are in custom MINIX, you can simply type `reboot` instead, as that will keep you in the same kernel mode. If you now need to restart FTP, return to "Return here if you had to reboot MINIX". **Do not log in after rebooting if you wish to show the TA a modification to the copyright statement! You cannot scroll up and will have to reboot again!**

If your VM freezes/crashes during/after a reboot, you may have to use a fresh MINIX image. Close MINIX, right click Remove the MINIX VM in VirtualBox, and start again from "Return here if you had to delete MINIX".

If modifying OS modules (CPU scheduling, memory management, etc.) you may wish to have a clean copy of the kernel source. This can be created with the command `cp -r /usr/src /usr/src.clean`, and the copy can be retrieved by reversing the arguments.

Changing the Kernel

To get credit for the lab, you must change the copyright statements printed out by the kernel during bootup to include your name and show them being printed to the TA. Look for something unique from the copyright message printed at bootup (there are several scattered throughout the `/usr/src` tree, make sure to find the correct one), use `grep` as directed above to find the file it came from, add your own message including your name, rebuild the kernel, with `make world` from the `/usr/src` directory, `reboot` the system, and see whether your changes took effect.

Please explore the source code of Minix and familiarize yourself with the main directories under /usr/src. This is your first step into modifying the Minix kernel! The next lab will involve more in-depth alterations to MINIX.

Additional Resources:

- Minix Wiki: https://en.wikipedia.org/wiki/MINIX
- Minix user guide: https://wiki.minix3.org/doku.php?id=usersguide:start
- Minix installation guide: https://wiki.minix3.org/doku.php?id=usersguide:doinginstallation

Requirements to complete the lab

1. Show the TA your running Minix system.

2. Write up a description of your steps. Imagine you are writing a guide for a class-mate unfamiliar with setting up a Minix system image, and provide instructions guiding them to the point where they can also modify the boot-up messages and rebuild a Minix system (either under VirtualBox on the ECC linux systems, or on your own system). .

Please start the text file with a descriptive block that includes at minimum the following information:

```
//Name:
//Date:
//Title: Lab6 –
//Description:
```