#### COEN 177: Operating Systems

**Lab assignment 6: Minix operating system**

**Objectives**

##### To setup a virtual machine and install Minix as a guest operating system

##### 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]](#footnote-0). 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]](#footnote-1) 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](https://www.scu.edu/engineering/labs--research/labs/engineering-computing-center/connect-to-the-ecc-linux-platform-using-the-graphical-interface/). You may have change the NoMachine connection file to connect specifically to linux215<##>.dc.engr.scu.edu to get the right machine, replacing <##> with a value from 01 to 24. 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:**

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 filepath. Keep in mind that grep in MINIX does not allow for recursive file path expansion, so the pattern /dir/\*, again for example, would only match the file /dir/file.txt, but not the file /dir/sub/file.txt

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".

##### **Alternative Approach: Installing Minix under virtualbox (STRONGLY DISCOURAGED, NOT TESTED!)**

To install Minix on your own system, without using the prebuilt image provided, you can follow the instructions below instead.

1. Download virtual box from <https://www.virtualbox.org> and install on your computer to support virtualization, decompress, run and configure with RAM and hard drive
2. Download Minix (minix\_R3.3.0-588a35b.iso.bz2), decompress, and save as a .iso image file
3. Configure your Virtual Machine to boot from the downloaded (ISO image), login as root (no password required), then run the setup script
4. Reboot from the installed Minix on disk (and not the ISO image) and then should be ready for use.
5. When logged in again, install common packages, by typing at the prompt sign the following commands:  
   #**pkgin update**

**#pkgin\_sets**

You may setup a password for the root user and create other users!

1. Obtain Sources from the Git repository and clone under usr/src directory, by typing at the prompt sign the following commands:  
   **# cd /usr**  
   **# git clone git://git.minix3.org/minix src**

Important: **Read *src/docs/UPDATING***and follow the details

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:

1. https://en.wikipedia.org/wiki/MINIX [↑](#footnote-ref-0)
2. http://www.minix3.org [↑](#footnote-ref-1)