Setting up your Virtual Machine for CSC 362

This class is designed around each student using a virtual machine, a technology that allows you to run an entire operating system on a simulated computer - a computer within a computer. This allows us to have a consistent Linux environment for everyone in the class to use, regardless of what hardware or operating system each student is using. The only challenge with this is that your hardware is doing double-duty, acting as two separate computers. CPUs are fast enough where this isn't really an issue, but on smaller/older systems setting aside RAM for a complete second computer inside your system can be a challenge. The ideal system will have at least 8GB of RAM and 40GB of free storage (disk/SSD) space.

More on RAM size: The class virtual machine will run in as little as 1.5GB RAM, which will fit on a computer with 4GB of RAM. While this isn't ideal, it will work for all programming tasks, but you might not want to use Firefox inside the virtual machine (and *definitely* not with multiple tabs open). If you have less than 8GB of RAM and want to try this, you can decrease the memory allocated to the VM after you set up the VM. However, if you're in this situation, I'd really recommend that you upgrade the RAM in your system to at least 8GB if possible - it will really help throughout your computer science classes! Conversely, if you have 12 GB or more of RAM in your system, you can consider increasing the allocated RAM to 4GB, which might make it run more smoothly.

Virtual machines run on your computer using "Virtual Machine Manager" software, and this is different depending on whether you have an Intel-based computer (Windows, Mac, or Linux) or a newer Apple system (one that uses an M1 or M2 processor). See the appropriate section below for your computer.

Intel CPU Systems (most people)

VirtualBox is a free virtual machine manager from Oracle, which runs on pretty much any operating system (Windows, MacOS, or Linux).

Here are the steps to get up and running with the CSC 362 virtual machine:

1. Download and install VirtualBox: Go to the VirtualBox website and click on the big "Download VirtualBox 7" button to go to the download page. Click on the correct download link for the system you are installing this on (Windows, OS X, or Linux) and follow the installation instructions. You can just click "Next" and accept the defaults. There is also a link to download the "extension pack" -- while this is not necessary for the CSC 362 class, it does provide some additional capabilities (like the ability to use USB ports in your virtual machine) and if these are capabilities you would like to enable then you can go ahead and install that.
2. Download the CSC 362 virtual machine "appliance" (CSC-362-IntelCPU.ova) from the Google Drive folder at this link. Note that this is a large file (3.5 GB), so can take

a while to download. If you have a very fast Internet connection, it should download in 10 minutes; a medium speed (10 Mbps) will take almost an hour; and on a slower connection you may need to just leave it overnight to download. If you have a slow connection at home, you could consider downloading it to a thumb drive from a UNCG campus lab.

3. Start VirtualBox, and in the "File" menu select "Import Appliance..." Select the file you just downloaded, and click "Next". Again, just accept the defaults, and there shouldn't be any problems. If you need to lower the RAM used by the virtual machine (the "More on RAM size" above), do that after the import is complete and before you go on to the next step.
4. Take a "Snapshot" of this VM so you can restore it to its initial state if you mess something up accidentally. To do this, select the new VM in VirtualBox and then click the icon to the right of the name (looks like a 3-item bullet list -- this is the "Tools" button) and select "Snapshots". This puts the Snapshots info in the right pane of the VirtualBox control window, and you can click on "Take" at the top to take a snapshot. It will ask for a name, so just use something like "Initial Snapshot". We'll talk a little about snapshots and how they can be used in class.
5. Use the "Start" button (with the green arrow) in VirtualBox to boot up the virtual machine to make sure it works.
   VERY IMPORTANT: When finished do NOT just close ("Power off") the virtual machine. You must either select "Save the machine state" when you close the VM, or you can do a full shutdown of the virtual machine's operating system. Doing anything else can lead to corrupted files in your virtual machine, and much much pain and suffering on your part.

Things that can go wrong: The VirtualBox install and VM import are pretty solid and work smoothly most of the time. But "most of the time" is not the same as "all of the time." If you have problems, here are the first things to check:

- There are some BIOS settings that enable hardware support for virtual machines, and these should be enabled. Most systems have these enabled by default, but if you have problems and aren't sure then reboot your system and go into the BIOS setup and look for virtualization settings. While different computers have different organization of the BIOS features, my laptop has a top-level settings category named "Virtualization Support" with two pages under that for settings. The virtualization settings should all be set to "Enabled."
- I have not experienced this, but some people have reported that VirtualBox has problems running when Windows Hyper-V is enabled (a competing virtual machine monitor). To check this in Windows 10, go into your settings and search for "Hyper-V" -- there should be some settings that come up under "Turn Windows features on or off" -- make sure Hyper-V is not enabled.

Newer Apple Macbooks and Desktops

For the last few years, new Apple systems have used a custom CPU (sometimes called "Apple Silicon" or an M1 or M2 processor). Virtualbox does not (yet?) support running native VMs on these systems, so you'll have to use a different virtual machine monitor program called UTM. Here are the steps to get this up and running:

1. Download and install UTM: Go to the UTM website, and click "Download" to get the "dmg" (disk image) file for installation. If you don't know how to install a DMG, it's really pretty easy - the one sentence instruction (and some other info) is in the UTM Installation Documentation. Note that you can also install from the Mac Apple Store, which is a little simpler, but they'll charge you $9.99 for doing it that way. The part of that fee that Apple doesn't take goes to the developers, which is a nice way to thank them for providing free software.
2. Download the CSC 362 virtual machine image (CSC-362-Apple.utm.zip) from the Google Drive folder at this link. Note that this is a large file (3.2 GB), so can take a while to download. If you have a very fast Internet connection, it should download in 10 minutes; a medium speed (10 Mbps) will take almost an hour; and on a slower connection you may need to just leave it overnight to download. If you have a slow connection at home, you could consider downloading it to a thumb drive from a UNCG campus lab.
3. The virtual machine image is in a compressed archive (ZIP), so your first step is to extract the uncompressed image. To do that, go into Finder and select the file in the "Downloads" folder. Double click on this file and you'll get a pop-up saying "Expanding ...." - wait for that to finish, and you'll see a "CSC 362.utm" file (it's really a folder, but "disguised" a little), which should be around 14 GB.
4. Open the UTM application, and then under "File" at the top of the screen select "Open" to open the "UTM" file created in the previous step. This will add the virtual machine to UTM, and then in the UTM window you can select it and hit the "play" button to start it up. After the VM starts, I'd recommend expanding it to full screen to increase the resolution a little. As with Virtualbox, the way you shut down the VM when you are finished working is important. I'm not as experience with UTM as I am with Virtualbox, but it seems to have worked pretty well when I have either clicked the "Pause" button at the top of the VM window or when I've done a clean OS shutdown inside the virtual machine.

Notes: While I have tested this on a borrowed Mac, including having run all of the CSC 362 assignments in the VM to make sure they work, I am not an "Apple person" and don't have a lot of insight on how to fix things that might go wrong. Hopefully everything will go smoothly if you're using UTM, but if not we can try to work through any problems. While this seems to do everything that is needed, some helpful improvements (such as changing the screen resolution, enabling cut-and-paste, or running it out of somewhere more sensible than the "Downloads" folder) are things you'll need to figure out. If you find any errors in these instructions or if you have any tips/observations that might be useful for future students, please send them to me so I can update these instructions.

Information on VM accounts and passwords

When you boot the system, you will automatically be logged in as user `student`. There are other accounts on the system for various exercises, but your primary working account should be `student`.

Passwords: Like all modern Ubuntu systems, there is no root password and you cannot log in as root directly -- use sudo from the student account. All user accounts that can be logged in to have a password set that is the first letter of the username followed by the four characters "pass". For example, the password on the `student` account is "`spass`". No, this is not secure, but you shouldn't have this up so that it is accessible from anywhere other than your own computer.

There are several other accounts on the system that are useful for different tasks and assignments, and the password for each account is always the first letter of the account name followed by "`pass`". In other words, the password for account "`alice`" is "`apass`".