Lab Assignment 1
Released: Aug 29, 2024
Due date: Sep 10, 2024, 11:59pm
Total points: 100

Assignment Description

Setting up the work environment is your first Assignment. You have to do this individually.

Briefly, you need to install the virtual box first, then import the image of a virtual machine. This image includes Ubuntu and the OS161 environment. Please follow the instructions below.

Step 1: Assuming you are using Windows operating system, download VirtualBox **for Windows hosts** from https://www.virtualbox.org/wiki/Downloads

Note that we have not tested it for MAC OS. If you are using MAC OS, please download the VirtualBox for MAC OS and give it a try. If you have issues, get in touch with us.

If you are using ARM based MAC (M1, M2 etc.), please see the link in additional resources section at the end to be able to download and install a VirtualBox Preview Build for ARM machines. Note that the preview build is not tested.

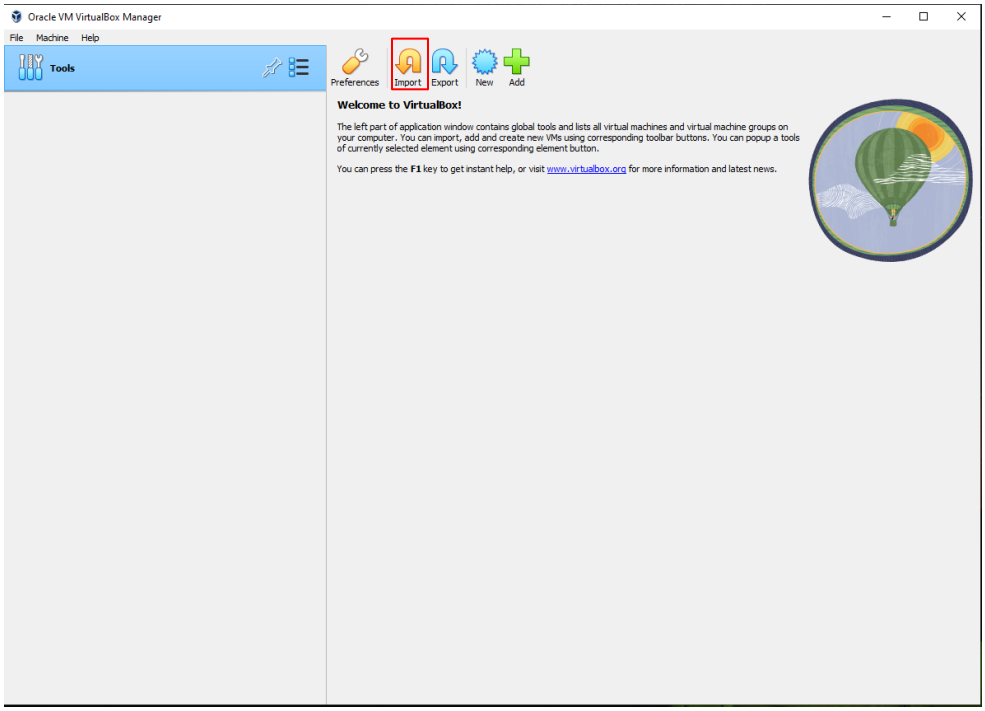
Step 2: Once you finish installing the virtual box, download the .**ova** file from the following link and save it on your desktop (or in a specific folder).

https://www.dropbox.com/s/ddhqhtjbm6dqrg6/OS161Env.ova?dl=0

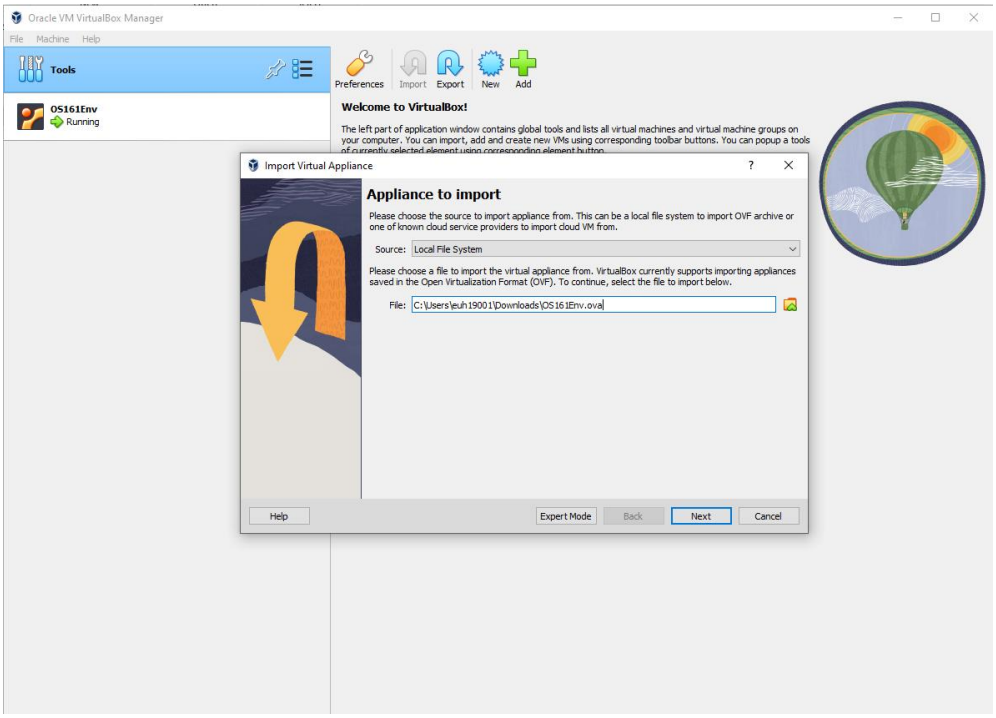
Step 3:

In this step, you need to export the VM on your VirtualBox.

For that, first, launch the Virtualbox application. Next, click on “Tools”. Next, click on “Import” on the right panel.

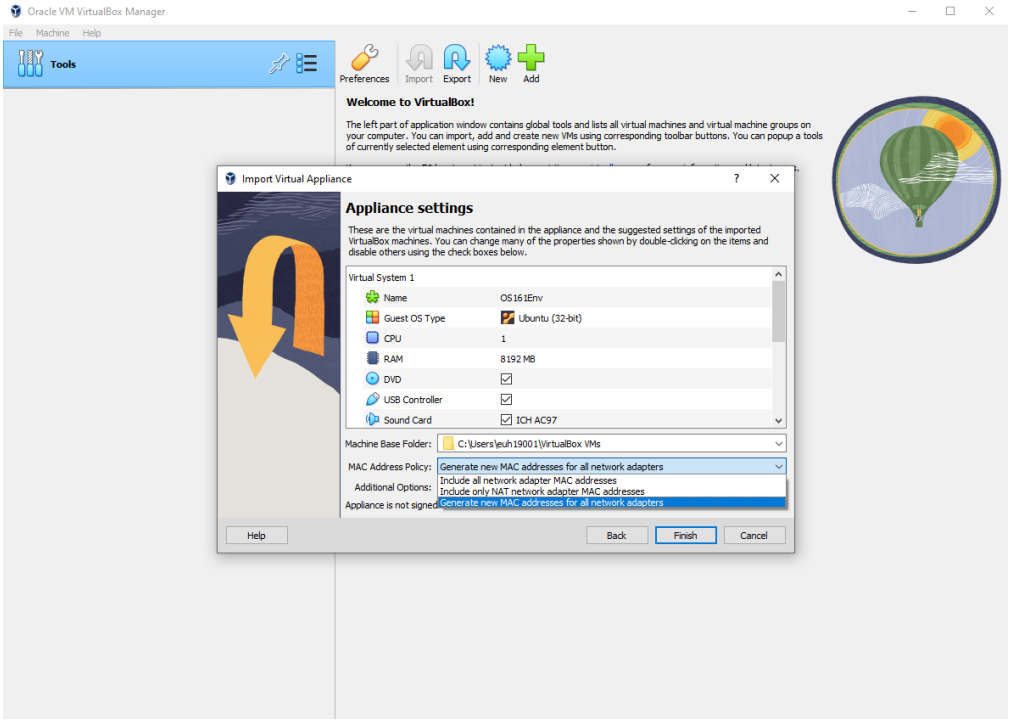


After clicking “Import”, you will need to select the .ova file you downloaded. See the interface below.

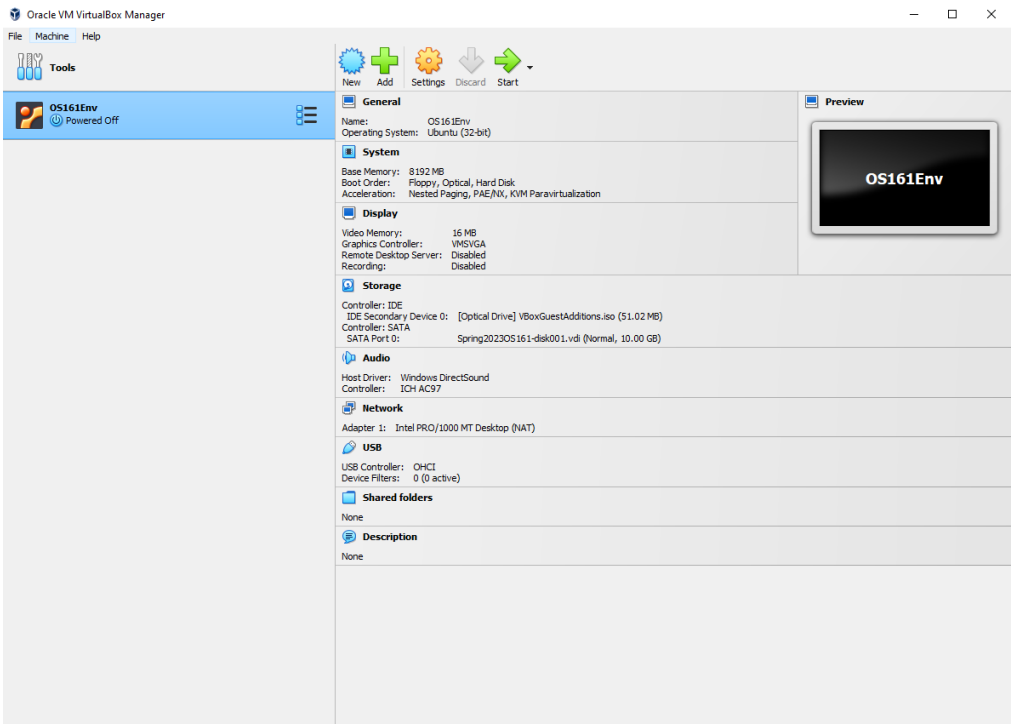


Next, select “Generate New MAC address for all network adapters” as shown below. Then, click “Finish”.

Sit back and relax while the VM gets imported.



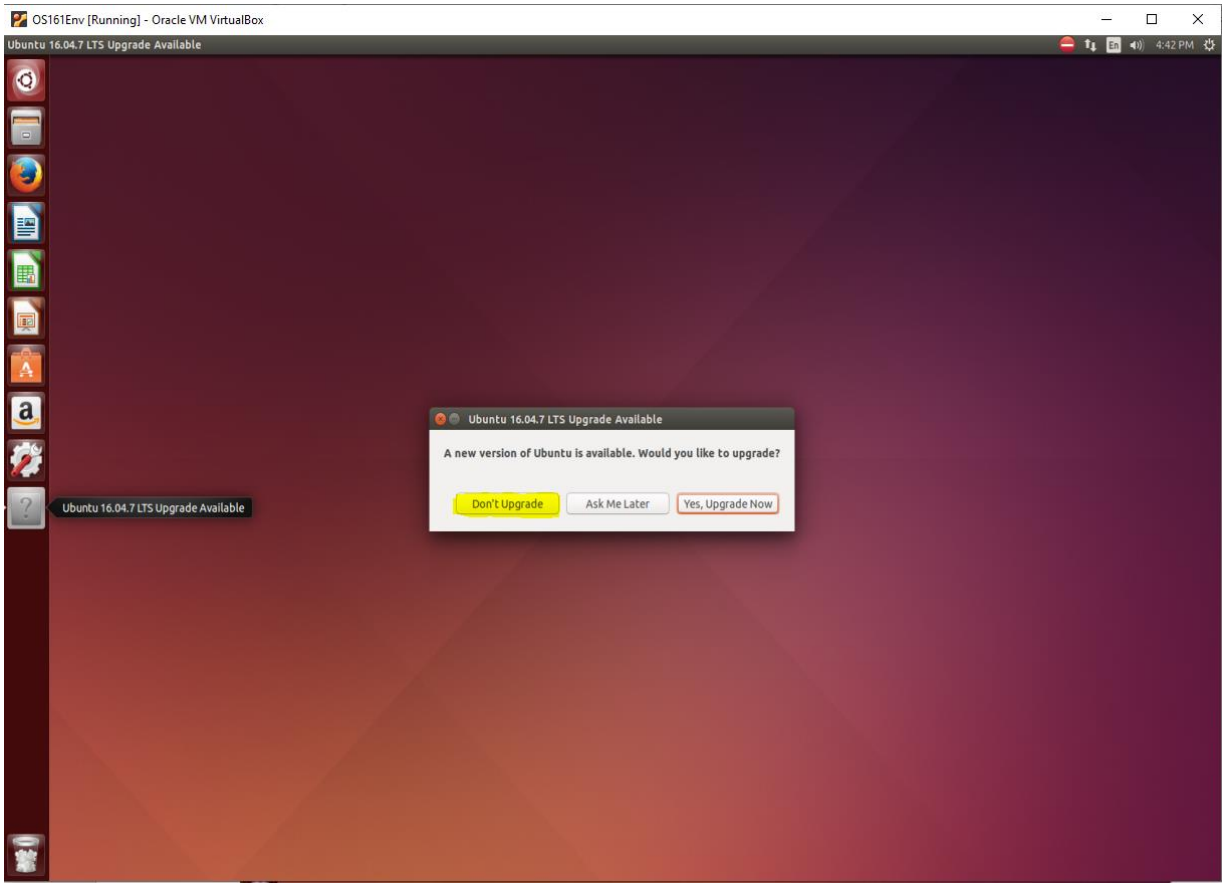
Once the VM gets imported, start the VM by double-clicking the “OS161Env” as shown below.



Step 4:

After Ubuntu is loaded, you will see a popup as shown below.

PLEASE DECLINE THE UPGRADE BY SELECTING “Don’t Upgrade” (highlighted in yellow). We will not upgrade the Ubuntu to the most recent version which can break the OS161.



Note that the password for root user is set to “os161user”

Running the OS161

Step 1: Adjust Your Shell's Command Path

First, launch a terminal in Ubuntu.

To run OS161, we need to add two directories ($HOME/sys161/bin and $HOME/sys161/tools/bin) to our shell's search path.

There are multiple ways to do that.

The **first way** is to execute the following command **(not recommended).**

export PATH=$HOME/sys161/bin:$HOME/sys161/tools/bin:$PATH

Note that setting these variables the above way only works in the shell or window where you execute the above commands. You will **need to re-execute this command** each time you reboot Ubuntu or open a new shell to ensure that the proper path is set and used for future logins and for other newly created shells.

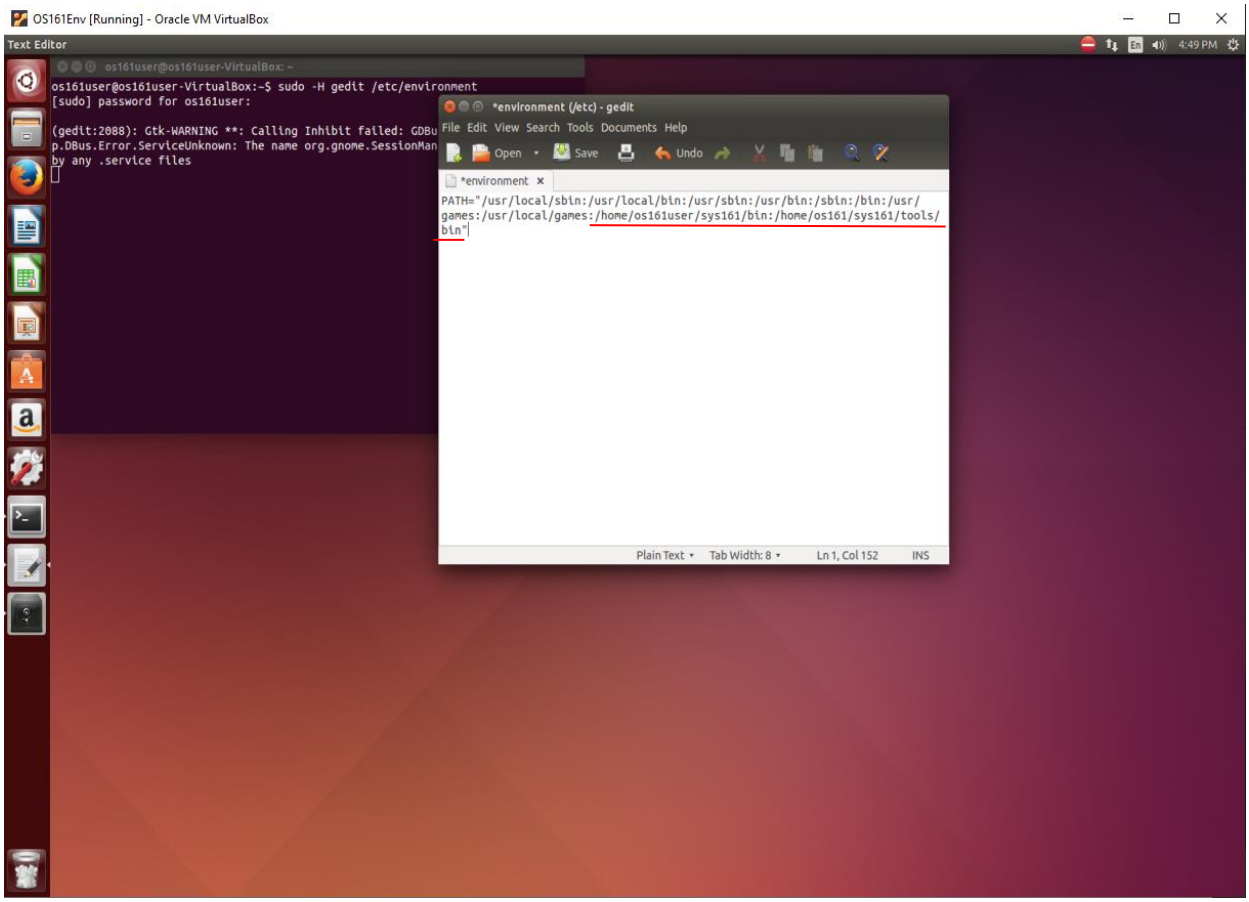
The **second (recommended) way** is to permanently change your PATH variable by modifying the environment file. To do that, first execute the following command.

sudo -H gedit /etc/environment

The OS will ask for the root password **(which is set to "os161user").**

Go to the next page to see the rest of the instruction.

It will open the environment file. Now, modify the PATH variable to make it look as follows –



Notice how I added the underlined part. Note that "/home/os161/sys161/tools/bin" is all together, although they are shown in separate lines.

Note that you need to restart the machine so that this PATH **change will take effect.**

Once you are done updating the PATH variable and restart the machine, you can check the current setting of the PATH environment variable using the command as follows -

printenv PATH

Configure and Build OS/161

Step 1: Configure and Build OS/161

The next step is to configure OS/161 and compile the kernel. Do the following:

```
cd cs4300-os161

cd os161-1.11

./configure --ostree=$HOME/cs4300-os161/root --toolprefix=cs4300-


cd kern/conf


./config ASST0


cd ../compile/ASST0


make depend
make
make install
```

The string *ASST0* in the commands above indicates that you are working on assignment 0. For Assignment *X*, replace *ASST0* with *ASSTX* in the commands above. The make install command will create a directory called $HOME/cs4300-os161/root ($HOME refers to your home directory), into which it will place the compiled kernel in a file called kernel-*ASST0*. It will also create a symbolic link call kernel referring to kernel-*ASST0*. Check the $HOME/cs4300-os161/root directory to make sure that your kernel is in place.

Next, build the OS/161 user level utilities and test programs:

```
cd $HOME/cs4300-os161/os161-1.11
make
```

Step 2: Try Running OS/161

You should now be able to use the SYS/161 simulator to run the OS/161 kernel that you built and installed. Type the following commands.

cd $HOME/cs4300-os161/root

sys161 kernel-ASST0

You should see some output that looks something like this:

sys161: System/161 release 1.99.05, compiled Apr 28 2011 21:49:59

OS/161 base system version 1.11
Copyright (c) 2000, 2001, 2002, 2003
President and Fellows of Harvard College. All rights reserved.

Put-your-group-name-here's system version 0 (ASST0 #1)

Cpu is MIPS r2000/r3000
336k physical memory available
Device probe...
lamebus0 (system main bus)
emu0 at lamebus0
ltrace0 at lamebus0
ltimer0 at lamebus0
hardclock on ltimer0 (100 hz)
beep0 at ltimer0
rtclock0 at ltimer0
lrandom0 at lamebus0
random0 at lrandom0
lhd0 at lamebus0
lhd1 at lamebus0
lser0 at lamebus0
con0 at lser0
pseudorand0 (virtual)
OS/161 kernel [? for menu]:
The last line is a command prompt from the OS/161 kernel. For now, just enter the command q to shut down the simulation and return to your shell.

Deliverable:

Once you finish installing OS161 by following the instructions above, boot OS161, and take a screenshot of OS161 running and upload on HuskyCT!

That's it! You are done with this assignment.

Additional Resources:

1. To install VirtualBox on ARM based MACs, try downloading the Developer preview for macOS / Arm64 (M1/M2) hosts from this link (scroll down to VirtualBox 7.0.8) - https://www.virtualbox.org/wiki/Download_Old_Builds_7_0 or try downloading the latest development snapshot from https://www.virtualbox.org/wiki/Testbuilds. NOTE: None of these preview builds are tested by us.

2. If you see that the VM is aborted with “WHvCapabilityCodeHypervisorPresent”, please see the discussion and follow the steps present here - https://forums.virtualbox.org/viewtopic.php?t=105752