

Running the OS/161 Docker container (CSE4001)

The following steps assume that you have Docker already installed on your computer. If you need to install Docker, follow the instructions from the following link. There, you will find installation instructions for Linux, Mac, and Windows:

https://github.com/FITSEC/docker_images/tree/main/cse4001_vnc/docker_help

There are two OS/161 containers that were created for CSE4001:

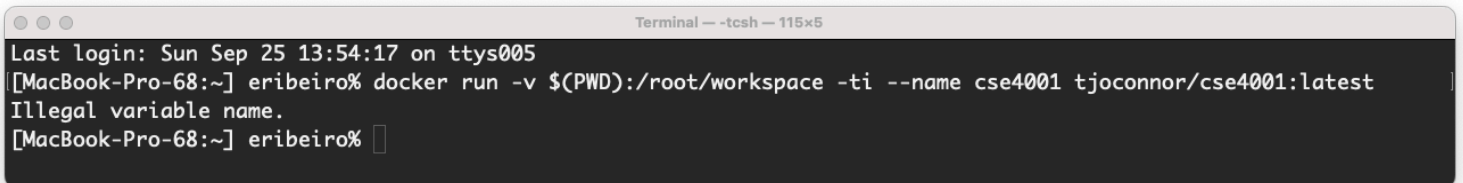
- A **terminal-based container** (https://github.com/FITSEC/docker_images/tree/main/cse4001)
- A **GUI-based container** (https://github.com/FITSEC/docker_images/tree/main/cse4001_vnc/docker_help)

The Terminal-Based Container (Example using Mac OS X, Intel)

Open the Unix terminal and run:

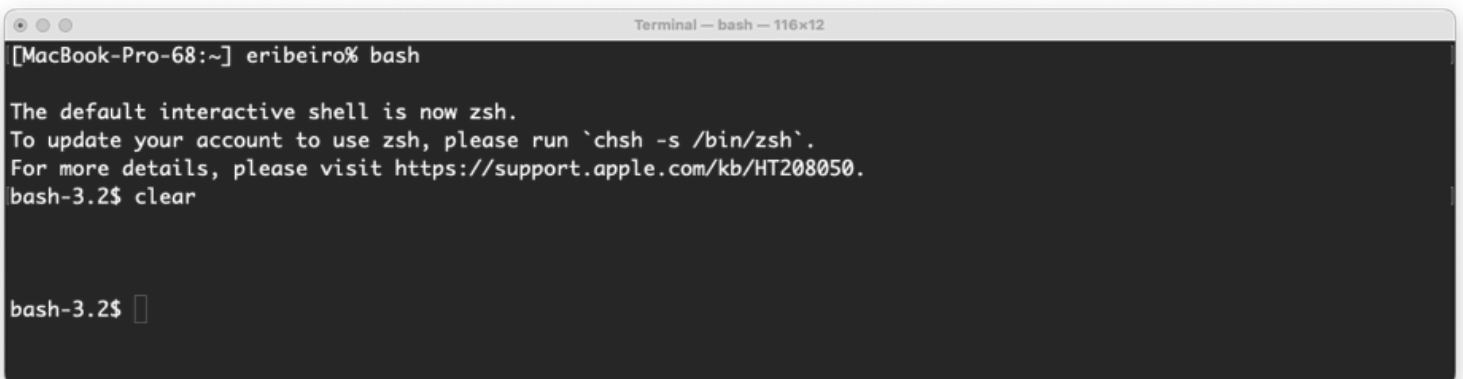
```
docker run -v $(PWD):/root/workspace -ti --name cse4001 tjoconnor/cse4001:latest
```

Make sure your shell is bash. The docker runs on a bash shell. If your terminal runs another shell, type **bash** to start a bash shell on the same terminal. If run the above docker command on a shell that is not bash, then you might see an error such as the one in the figure below.

A terminal window titled "Terminal - tcsh - 115x5" showing the output of the docker command. The prompt is [MacBook-Pro-68:~] eribeiro%. The command is docker run -v \$(PWD):/root/workspace -ti --name cse4001 tjoconnor/cse4001:latest. The output is "Illegal variable name." followed by the prompt [MacBook-Pro-68:~] eribeiro%.

```
Terminal - tcsh - 115x5
Last login: Sun Sep 25 13:54:17 on ttys005
[MacBook-Pro-68:~] eribeiro% docker run -v $(PWD):/root/workspace -ti --name cse4001 tjoconnor/cse4001:latest
Illegal variable name.
[MacBook-Pro-68:~] eribeiro%
```

To run the bash shell, simply type **bash** on your terminal, i.e.:

A terminal window titled "Terminal - bash - 116x12" showing the output of the bash command. The prompt is [MacBook-Pro-68:~] eribeiro%. The command is bash. The output is "The default interactive shell is now zsh. To update your account to use zsh, please run `chsh -s /bin/zsh`. For more details, please visit https://support.apple.com/kb/HT208050. bash-3.2\$ clear" followed by the prompt bash-3.2\$.

```
Terminal - bash - 116x12
[MacBook-Pro-68:~] eribeiro% bash

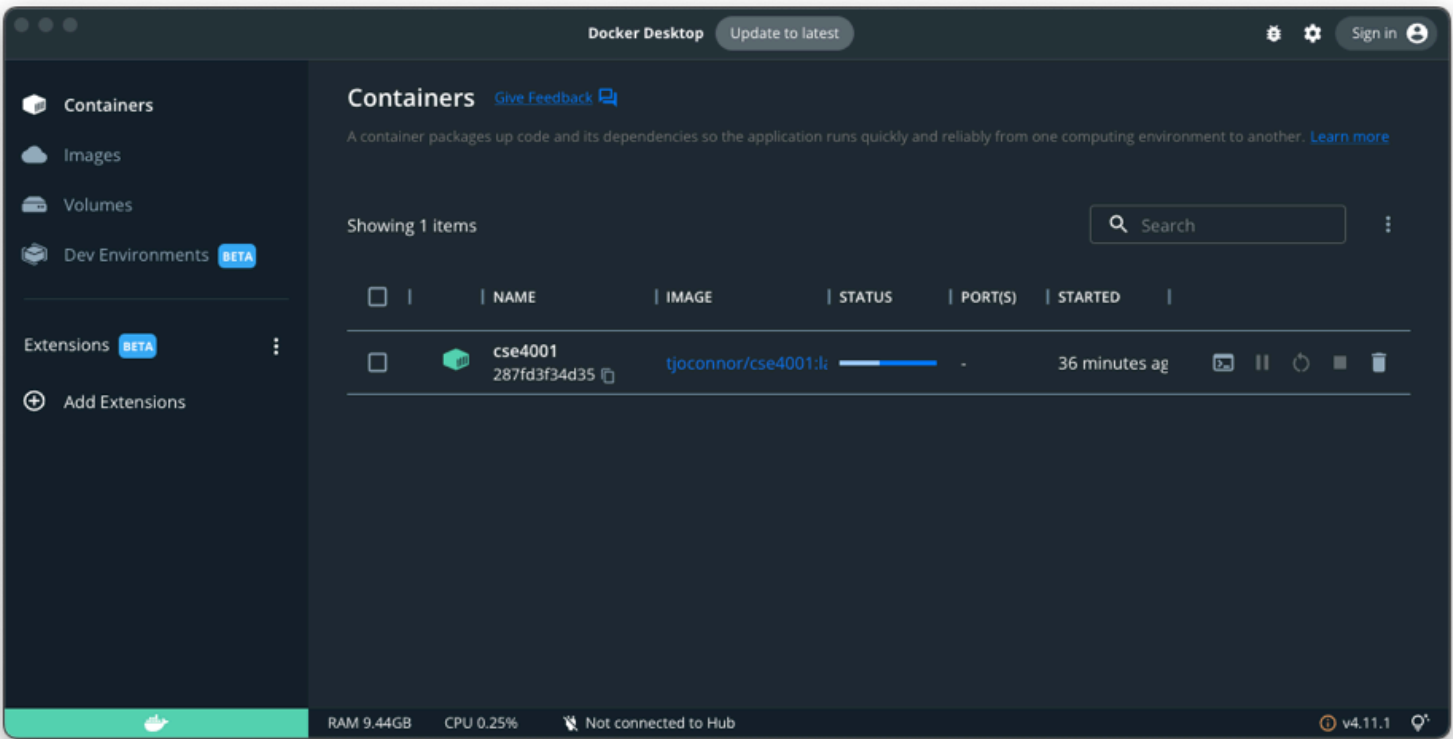
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
bash-3.2$ clear

bash-3.2$
```

Now that your terminal's shell is bash, (re-)run the docker command to start (or download) the container. The container is a large file so it will take a few minutes to download. Once it is ready, the terminal will show the following information:

```
root@287fd3f34d35: ~/os161 — com.docker.cli • docker run -v /Users/eribeiro:/root/workspace -ti --name cse4001 tjoconnor/cse4001:latest -- 106x11
bash-3.2$ docker run -v $(PWD):/root/workspace -ti --name cse4001 tjoconnor/cse4001:latest
Unable to find image 'tjoconnor/cse4001:latest' locally
latest: Pulling from tjoconnor/cse4001
3b65ec22a9e9: Already exists
82208a7e45b2: Pull complete
e94db6b89f75: Pull complete
26ba6fe58ba9: Pull complete
a3ed95caeb02: Pull complete
Digest: sha256:f8fdfdbb1c6d300c1a1b3d79b53cc1553febc584062317e77ca6bf40cbc628b1
Status: Downloaded newer image for tjoconnor/cse4001:latest
root@287fd3f34d35: ~/os161#
```

In addition to the information displayed on the console, you should also see the container listed on the Docker Desktop application, i.e.:



Very important!!! Do not re-run the docker container command. Just use the Docker Desktop's pause, stop, play buttons to control the container's running status. You do not want to re-run the docker container "installation" command unless you want to reset the container to its original clean state (i.e., all previously edited files will be lost).

If the container is already running, just click on the terminal icon besides the container name listed on the Docker Desktop. If it is not running, click on the play button and then click on the terminal icon to open the container's terminal. Start the container and look around to see its content:

```
root@287fd3f34d35: ~/os161 — com.docker.cli - docker exec -it 287fd3f34d35964eba9947b6716ee25ff04553de5042be3a29645c4a68e527ba /bin/sh — 120x5
[MacBook-Pro-68:~] eribeiro% docker exec -it 287fd3f34d35964eba9947b6716ee25ff04553de5042be3a29645c4a68e527ba /bin/sh
# bash
root@287fd3f34d35:~/os161# ls
root  src  toolbuild  tools
root@287fd3f34d35:~/os161#
```

For example, you can type `bash` to change the shell, and then type `ls` to see the content of the current directory. You will see a directory called `src`, which contains the source code of the basic kernel.

To boot OS/161, go to directory `~/os161/root` and run the following command:

```
sys161 kernel
```

This command will start OS/161. You should see the OS/161 menu as shown in the figure below.

```
root@287fd3f34d35: ~/os161/root — com.docker.cli - docker exec -it 287fd3f34d35964eba9947b6716ee25ff04553de5042be3a29645c4a68e...
root@287fd3f34d35:~/os161# cd root
root@287fd3f34d35:~/os161/root# ls
LHD0.img  bin          hostinclude  kernel          lib  sbin          testbin
LHD1.img  hostbin      include      kernel-DUMBVM  man  sys161.conf  testscripts
root@287fd3f34d35:~/os161/root# sys161 kernel
sys161: System/161 release 2.0.8, compiled Aug 14 2022 20:57:14

OS/161 base system version 2.0.3
Copyright (c) 2000, 2001-2005, 2008-2011, 2013, 2014
  President and Fellows of Harvard College.  All rights reserved.

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

356k physical memory available
Device probe...
lamebus0 (system main bus)
emu0 at lamebus0
ltrance0 at lamebus0
ltimer0 at lamebus0
beep0 at ltimer0
rtclock0 at ltimer0
lrando0 at lamebus0
random0 at lrando0
lhd0 at lamebus0
lhd1 at lamebus0
lser0 at lamebus0
con0 at lser0

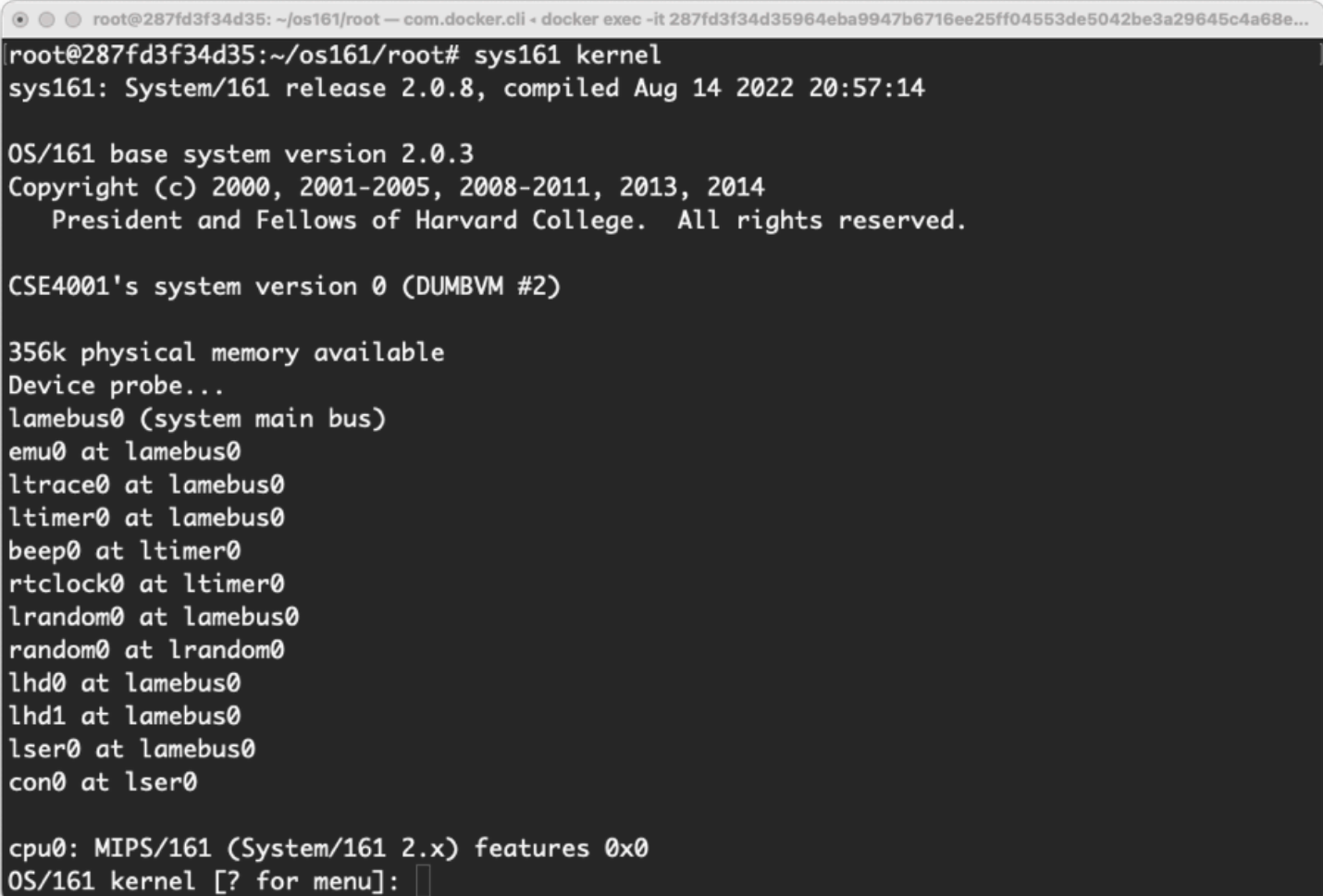
cpu0: MIPS/161 (System/161 2.x) features 0x0
OS/161 kernel [? for menu]:
```

To practice making a small change to the kernel source code and building the kernel, change the string "Put-your-group-name-here's system version 0 (DUMBVM #1)" that shows in the first lines as OS/161 initializes. This string is located in `~/os161/src/kern/main.c`. In the following example, the changed string is "CSE4001's system version 0 (DUMBVM #1)". Editing the program can be done using the editors VIM or VI, or some other source-code editor.

Rebuild the kernel:

```
cd ~/os161/kern/compile/DUMBVM
bmake depend
bmake
bmake install
```

Go to the root directory and boot OS/161. The initialization string should now show the changes that were made, i.e.:



```
root@287fd3f34d35: ~/os161/root — com.docker.cli • docker exec -it 287fd3f34d35964eba9947b6716ee25ff04553de5042be3a29645c4a68e...
root@287fd3f34d35:~/os161/root# sys161 kernel
sys161: System/161 release 2.0.8, compiled Aug 14 2022 20:57:14

OS/161 base system version 2.0.3
Copyright (c) 2000, 2001-2005, 2008-2011, 2013, 2014
  President and Fellows of Harvard College.  All rights reserved.

CSE4001's system version 0 (DUMBVM #2)

356k physical memory available
Device probe...
lamebus0 (system main bus)
emu0 at lamebus0
ltrace0 at lamebus0
ltimer0 at lamebus0
beep0 at ltimer0
rtclock0 at ltimer0
lrandom0 at lamebus0
random0 at lrandom0
lhd0 at lamebus0
lhd1 at lamebus0
lser0 at lamebus0
con0 at lser0

cpu0: MIPS/161 (System/161 2.x) features 0x0
OS/161 kernel [? for menu]:
```