

CIS-350
INFRASTRUCTURE TECHNOLOGIES

LAB 3

Due: See Blackboard

Objectives: Learn about **Unix/Linux**

You will work the Unix labs on the High Performance Computing cluster – HPC (Cardinal Research Cluster – CRC) at the University of Louisville. The CRC has been available for use by faculty, staff, and students since 2009. Below you will find some interesting information about the research computing platforms, hardware, software, and network infrastructure at UofL.

Research Computing Platforms

The current research computing cyber infrastructure at the University of Louisville provides a variety of systems for use in computational research. Available systems include a general-purpose high-performance distributed-memory cluster, a high-memory SMP system which is also a statistics server, an informatics data management cluster, and a visualization server. All research systems are housed in the University's secure data center, administered by a team of specialized HPC system administrators, and supported by a team of research computing consultants. The cluster shares 100 TB of storage for home directories, software, and computing scratch space.

Facts about the distributed-memory cluster:

- 312 IBM iDatplex nodes each with two Intel Xeon quad-core processors for 2496 total cores
- Each node has 16 GB or 32 GB memory
- Estimated peak performance of 20+ TFLOPS

The SMP system has:

- 16 IBM Power6 4.7GHz CPUs
- 128 GB memory

The informatics cluster contains 20+ TB of dedicated storage along with high-performance, high-reliability database servers and associated web and application servers.



Network infrastructure for researchers

The University of Louisville's campuses are served by an 8-gigabit campus backbone network comprised of over 77 miles of fiber in a dual ring configuration. The network can provide 10Mbps, 100Mbps, and 1Gbps Ethernet service for faculty and staff communications needs. The campus wireless network utilizes 54Mbps (802.11g) technology and is widely available across the campuses, with access in scheduled classrooms and in public areas of most buildings.

In addition the University of Louisville is connected to an [Internet2](#) node via dedicated fiber and currently has access to 1 Gbps of bandwidth. Available Internet2 bandwidth will be upgraded to two 10 Gbps links by 2010. The [Internet2](#) connection gives the University of Louisville direct access to the national research and education networks, and enables participation in national networking initiatives such as caGRID/[caBIG](#) and the [TeraGrid](#).

The University of Louisville is also a member of the [Kentucky Regional Optical Network \(KyRON\)](#). This regional optical network is managed and operated through a consortium including the University of Louisville, the University of Kentucky and the Kentucky Council on Postsecondary Education. Participating universities are interconnected using 10Gbps optical links. KyRON will extend the capabilities of the Louisville [Internet2](#) node to the other participating universities throughout the state, and provide new opportunities for collaboration with the other universities in the state.

If you are interested in HPC Software available on CRC, click on the link <http://louisville.edu/it/support/research/software.html>, or click on the link <http://louisville.edu/it/support/research/documentation.html> for other information.

To complete this lab, you need to have:

1. Chapter 10 from the Davis & Rajkumar book, 5th edition, pp. 193-214. This chapter is posted as a .pdf file in Lab 3 folder on Blackboard.
2. A Web link to the *vi* editor commands and Appendix C that describes the syntax of basic Unix/Linux commands. Both the link and Appendix C are posted in the Lab 3 folder on Blackboard.
3. The Virtual Private Network (VPN) and Cardinal Research Cluster (CRC) computer accounts. The user id and the password are the same as for ULink. In case of problems,

see the online documentation at <http://louisville.edu/it/support/research/documentation.html> for information about logging in and using the cluster. You may also send e-mail to it-hpc@louisville.edu with any questions or contact the instructor at jmzura01@louisville.edu

You can do this lab in the College of Business Lab or from your home/office computer.

ASSIGNMENT:

1. Log in to CRC Unix from UofL Campus (for example, COB Lab in Room 054)

- a. Log in to your desktop
- b. You should see the SSH Secure Shell Client software on your desktop.



SSH Secure Shell Client.lnk

- c. Double-click on the client icon.
- d. In the Host Name box, key in *crc1.hpc.louisville.edu* and in the User Name box, key in your ULink user id.
- e. You should see the prompt for password. Key in your ULink password and hit Enter.
- f. Go to step 3.

2. Log in to CRC Unix from Home/Office

- a. In the browser, type in the following URL:
<https://vpn.louisville.edu/prx/000/http/localhost/login> to login to the VPN. (You may have to install the VPN first according to the instructions available at http://louisville.edu/it/accounts/vpn/VPN_Installation-win.pdf. It is a simple one time procedure.)
- b. On the VPN login screen, key in the ULink user id and password and press Enter.
- c. After about 20 seconds, you should get a message: You have successfully logged into the University of Louisville's VPN system. Leave the Browse to URL box below blank.

Browse to URL:

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- d. Follow the steps 1b-1f above. If you do not have SSH Secure Shell Client mentioned in 1b above on your home/office/laptop computer, you can download it for free from https://apps.louisville.edu/software/ressales/customer/free.php?free_cat=5
3. You should see the Unix prompt consisting your *userid@user1\$*. For example, *jmzura01@user1\$*. You are logged in to the Redhat 5.2 x86_64, a Linux variant, on the CRC system. By default, CRC users use the Bourne-again shell (bash) when they first login.
4. You should see the *userid@user1 \$* prompt indicating that you are in the default Bourne shell. The *~] \$* prompt would indicate the C shell. (On other installations you may see the *%* for the C shell.) To get to the C shell, type the command **csh** and press Enter. To return to the Bourne shell type **exit** from the prompt and press Enter. (Note that **exit** will also close CRC Redhat Linux if you key it in from the default Bourne shell.) To go to the Korn shell type **ksh** and press Enter. To return to the Bourne shell type **exit** and press Enter. The tutorial you will follow can be completed using any of the available shells. To delete the entire command line you are entering from the *\$* prompt, hit **CTRL-U**.

5. Work through Unix Tutorial (the mentioned Chapter 10), pages 193-214, paying attention to the notes below referring to specific pages, which will get you through the assignment. Also try to use pipes and filters. For the summary of Unix/Linux commands and the *vi* editor commands refer to the file and the link posted in the Lab 3 folder on Blackboard, respectively. Again, here are some helpful notes on specific pages which will get you through the assignment.

PAGE(S)	HINT
193-215	The figures such as Fig. 10.3 in the tutorial show the following Unix/Linux prompt: [bill@localhost bill]\$. The customized prompt has been created by the specific installation of Unix on which the tutorial was run and represents the owner of the account. On the CRC Redhat Linux you will just see <code>userid@user1\$</code> prompt.
200	When you type pwd the first time, you may write down your working directory, so you will not forget it, but it may be unnecessary because the working directory may always displayed on the screen anyway.
201	When you type ls -d , access to some directories may be disabled and you will only see the period "." or the command will not work. You may try to type ls -a or ls instead.
203	Before you create the directories on this page, type pwd to be sure you are at your own directory. If you are not, type cd . You should then be back in your home directory. Type cd letters to move to the letters subdirectory.
205	You may use <i>nano</i> editor instead of <i>vi</i> editor to create the required files tom , jim , and harriet , etc. Be sure to use filenames as suggested in the textbook.

The **nano** editor is easier than **vi** editor and is more self-explanatory. To access this editor you type, for example **nano tom** and press Enter, where **tom** is a file name. To get help on nano editor commands, type **Ctrl-G** within the editor.

vi editor is a little awkward, so be patient since it will take you some time to get used to it. The **vi** editor has two modes of operation: **Command Mode and Input Mode**. While **vi** is in Command Mode, you can give **vi** commands. For example, in Command Mode you can delete text or exit from **vi**. You can use the **Enter** key, the **Spacebar**, and the **arrow keys** to move the cursor. If your terminal does not have arrow keys, you can use **h**, **j**, **k**, and **l** keys to move the cursor left, down, up, and right, respectively. To enter **vi** editor, type **i** to enter insert mode. You can type anything you want - a short couple of lines is fine. You will need to exit insert mode with **Esc**. You may hear a beep (you are in the Command Mode). Then try typing the **:**. The cursor should go to the bottom to wait for a command. **:wq** will save the file and get you out. (write and quit). To quit without saving your work, type **:q!**. You may use some **vi** commands specified in the link in the Lab 3 folder on Blackboard or use any other source.

Continue the same practice to make files **dick** and **harriet**. Unix recognizes upper and lower case letters as being different, so be consistent.

- 206 After you watch **cat tom dick harriet**, try **more tom dick harriet**. This will be interesting to watch.
- 208 After you create a link from one directory to the other, be sure you change directories and use the **cat** to view the contents of the file. Try **ls -l** to see the protection level in both directories. Are they the same?
- 210 There is a small typo on this page. Instead of typing **cat > book | intro**, type **cat > book / intro** (note a forward slash "/" separating the book directory from a file named intro, not a vertical bar "|" that represents piping).

6. Use the **vi eval** command, where **eval** is the file name, to type in a short evaluation of your experience with Unix and then print it. (SHORT! A few sentences will be fine). As an alternative, you may also use the **nano** editor to type the evaluation. Use the **nano eval** command.

Because the print command (**lp**) is disabled on this installation of Unix/Linux, use the SSH Secure File Transfer Client to transfer the eval file to your desktop and print it from there. (When you download the SSH Secure Shell Client, the SSH Secure File Transfer Client should automatically accompany it. You should see two icons representing the two clients on the desktop. The file transfer procedure from the Unix system to your desktop is pretty self-explanatory.)

7. Submit your evaluation of the Unix Tutorial and indicate on it that you have completed this assignment. In addition, answer the questions on the next page and attach this page to your evaluation.

1. What command displays your working directory? _____
2. What command moves you to the parent directory? _____
3. What command allows one to go to the root directory? _____
4. What command brings you back to the home directory (from anywhere)? _____
5. What command displays all files (including invisible files) and directories in a long form?

6. What command displays the content of a file “tom”? _____
7. What command allows one to obtain the manual on-line help on the *who* command?

8. What steps/commands does one to perform to move a task/process running in foreground to background?
a. _____ b. _____
9. Say, that Unix assigned the id number = 752452 to a task running in background. What command would you use to move this process from background to foreground? _____
10. What command would you use to sort data coming from a file “data” and reroute the sorted output to a file “datasor”? _____
11. Display the content of the directory in a long form. Include invisible files and protect the directory list from scrolling off the screen. _____
12. What command would you use to open the vi editor to create a file “tom”? _____
13. What command would you use to open the nano editor to create a file “tom”? _____
14. What command would you use to remove the directory “kim”? _____
15. Write in pencil a script below file that
 - (a) moves you to your home directory
 - (b) creates 3 directories named “kim”, “jeff”, and “anna” under your home directory
 - (c) copies all files with extension “cpp” from your home directory to the “kim” directory
 - (d) changes your home directory to the “kim” directory
 - (e) displays all files in the “kim” directory protecting the files from scrolling off the screen?