TLEN 5833: UNIX and Linux Systems Administration

REFERENCE TEXT


COURSE DESCRIPTION & OUTCOMES

UNIX and Linux systems appear in many different places, such as machines that maintain your student information, systems that serve up web pages for your online banking, deliver e-mail, route traffic, or protect other systems from malicious attacks. There are many reasons for the widespread use of these systems, both historic and practical: some software was originally developed only under UNIX or Linux, and some tasks & services are simply easier to manage and perform better.

Gaining an understanding of UNIX and Linux systems will enable you to be successful within the larger world of computing & telecommunications. Studying the use of these systems provides an insight into the different issues faced by System Administrators every day, and can help one to build and maintain a multitude of different network-based services & solutions.

This course introduces students to UNIX and Linux System Administration. It includes topics such as: building & deploying systems from scratch, troubleshooting difficult system and network problems, software configuration, account management, basic shell scripting, network configuration and the mitigation of common security vulnerabilities. Upon completion of this course, students will be able to:

- Demonstrate proficiency with the Linux command line interface, directory & file management techniques, file system organization, and tools commonly found on most Linux distributions.

- Effectively operate a Linux system inside of a network environment to integrate with existing service solutions and/or provide its own such as DHCP, DNS, Routing, Network Address Translation, & NTP.
• Demonstrate the ability to troubleshoot challenging technical problems typically encountered when operating and administering Linux systems.

• Identify key performance metrics related to system performance, and routinely collect information on a Linux system to ensure that a given level of service is being met, and system resources are being utilized appropriately.

• Apply configuration management techniques to track modifications made by system administrators over time, and identify discrepancies with system configuration.

• Formulate a backup strategy for a small network of Linux Systems, and deploy it using tools such as dump & restore, rsync, rdiff-backup, or Bacula.

COURSE OUTLINE

Module 1: Fundamentals of UNIX & Linux Systems
Covers the history of UNIX & Linux, comparison of distributions & flavors, installation, navigation of the file system, the command line interface, piping, standard input/output redirection, basic text editors & common tools, shell scripting, storage management, process management, and booting up/shutting down.

Learning Objectives
• Identify the structure of the UNIX file system and demonstrate the ability to navigate it using the bash shell.

• Explain how the UNIX file system is mapped to physical disks and demonstrate the ability to add new storage devices.

• Apply troubleshooting skills to fix a broken fstab, and remove a process attempting to remain hidden from the administrator.

• Describe the core components of a UNIX operating system.

• Explain the lifecycle of a process on UNIX, and how the system boots up.

• Develop a shell script to monitor disk utilization and e-mail the administrator if it goes beyond a configurable threshold.

Module 2: User Account Management
Instructs how to add/modify/remove users & groups, modify UNIX permissions, set password & account policies, create access controls, monitor account activity, and set resource limits.
Learning Objectives
● Develop account and password policies using PAM modules to ensure the fair use, optimal performance, and security of a UNIX system.

● Demonstrate the ability to add, remove, and modify users and groups from the appropriate local database files.

● Design a solution to synchronize or share account and password information across multiple systems.

Module 3: Networking
Reviews the fundamentals of networking and the TCP/IP model, teaches how to remotely administer a large amount of UNIX machines, configure, maintain and troubleshoot essential network services, set up routing, VPN tunnels, and networked file systems.

Learning Objectives
● Configure Linux to act as a host in an IPv4 network and obtain addressing either statically or dynamically.

● Troubleshoot and resolve issues that occur with improper network configuration.

● Explain the process of how domain names are resolved, and how they are organized within the global domain name system.

● Deploy a DNS server capable of acting as an authoritative and recursive resolving server.

● Construct firewall rules using Netfilter/iptables to filter traffic for a specific host or entire network.

Module 4: Software & Configuration Management
Teaches various practices to manage software packages, application updates, to track modifications to system configuration over time, and automate the system installation process.

Learning Objectives
● Describe the basic concepts of software on UNIX, packages, package managers, repositories and update managers.

● Build and deploy software packages using the Redhat Package Manager tools.

● Deploy Puppet to automatically configure new systems, and ensure existing ones do not drift from intended configuration.
Module 5: Logging, Performance Analysis & System Monitoring

Provides an overview of metrics related to system performance, teaches how to analyze and store log files, set up tools to routinely monitor for important events, create automated notifications when system or services are unavailable, and conduct analysis to resolve performance issues.

Learning Objectives

- Construct a centralized logging server that accepts syslog messages from other hosts on the network.
- Demonstrate the ability to use tools such as sar, top, iostat, iperf, and bonnie++ to benchmark and test system performance.
- List key performance indicators related to CPU, Memory, Disk, and Networking.
- Identify causes of poor system performance and remediate them.

COURSE REQUIREMENTS

Regular attendance is required of all students, and course work must be submitted within a prompt and timely manner. Please see the attendance & late assignment policies below for additional details. The course work is broken up into 5 key components: lab assignments, a project, homework, system uptime and quizzes. Please see the grading criteria & scale below for specific information.

You will be provided with several Linux systems hosted within a virtual environment to conduct course work, and it is expected that you will keep the assigned systems in compliance with all University and Campus-wide IT Policies. If a system is not in compliance, a warning will be issued. If the system is not brought back into compliance within a timely manner, it may be subject to a temporary or permanent suspension.

Reading and study material will be provided to students on a weekly basis, and it is expected that it be completed before coming to class. These readings will either be from the required text, documentation, articles or scholarly papers provided by the Instructor. Alternative short videos may also be made available. The study material will help provide foundation for assignments and success in the course depends upon keeping up with them.

All course work must be submitted through the appropriate dropbox on Desire2Learn, which is not the same as dropbox.com. Assignments that require you to turn in multiple files should be submitted in zip ONLY. ALL submitted filenames must start with your Identkey username, example: jeijf2456.zip. Submissions not meeting these requirements will not be accepted and will require resubmission.
Grading Criteria

Labs (35%)
Lab assignments are challenging, hands-on, applied problems in the domain of UNIX/Linux Systems Administration. These assignments are based on real-world tasks that you might be asked to do in a work environment as a UNIX/Linux System Administrator. Grading will be completed by answering a series of related questions in an interview with the instructor or assistant(s).

Quizzes (35%)
In order to properly assess your understanding of the material for this course, a quiz will be given in class as often as every other week. Each quiz consists of no more than 10 questions, and it is strongly recommended that you complete all relevant reading before attempting the assigned quiz.

Project (15%)
The course project will be determined by the student, and the scope should be equivalent to that of a difficult lab assignment. Graduate students must research an issue commonly encountered in UNIX and Linux Systems Administration not discussed in class. Once an issue has been identified, a solution must be proposed and approved by the Instructor before implementation. A proposal must be turned in by the date posted in Desire2Learn. Undergraduates may select a project from a list that will be supplied, and do not need instructor approval to work on one of the projects from the list.

Homework (10%)
Homework assignments will be given to help prepare you for the labs. It will consist of readings, videos, and exercises. The work will be graded pass / fail, and must be completed before the deadline to keep up with the class.

System Uptime (5%)
During the course of the semester, the uptime of the production machines assigned to you will be measured and accounted for. The duration of which the services running on these machines are available will count as part of your final grade. On some labs you will receive credit for a certain number of hours downtime that are be required to complete the lab. Your machines will not be monitored for uptime till a few weeks into the semester and notice will be given in class when monitoring begins.

Grading Scale

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<tr>
<th>Numeric Score</th>
<th>Letter Grade</th>
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<tbody>
<tr>
<td>100 - 95</td>
<td>A</td>
</tr>
<tr>
<td>94 - 90</td>
<td>A-</td>
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<tr>
<td>89 - 87</td>
<td>B+</td>
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### Assignment Redo Policy

During the semester, you will be given the opportunity to earn full credit back on quizzes if you are able to correct your mistakes and answer interview style questions to demonstrate knowledge of the material. You must turn in your corrected submission and visit the instructor or assistant(s) during office hours within one week of having received the grade on your assignment. Attempts done after the one week window will not earn any credit back. This redo policy also applies to homework, and labs, but not the project. You must turn in the corrections on homework or labs by the deadline given in the feedback on the assignment with an error.

### Late Assignment Policy

Points will not be deducted for assignments turned in past the specified deadline, however *assignments submitted over 72 hours late will not be graded and a 0 will be assigned.* The one exception to this policy is the project; late projects will not be accepted unless there is an extenuating circumstance. This policy is in place to ensure fairness to all students, and to prevent excessive burden on myself and the assistant(s).

I understand that there may be extenuating circumstances where you will be unable to attend class, or may be late on an assignment. Please discuss these circumstances with me at least two weeks in advance. If you are unsure of what counts as an extenuating circumstance, here are some examples:

- Serious health illness
- A serious family emergency
- Extraneous work commitments
- Transportation difficulties
- Jury service
- Having to care for someone
- Hospital appointment that clashes with a deadline or examination
- Legal problems
Attendance Policy
Attendance is a requirement of all on-campus students. I reserve the right to penalize your grade by 5% if there are more than 3 unexcused absences. Please note that missing the first week of classes without prior approval will result in being administratively dropped from the course.

STANDARD CU POLICY STATEMENTS

Disability Services
If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and www.Colorado.EDU/disabilityservices

Conflicts with Religious Holidays
Campus policy regarding religious observances requires that faculty make every effort to reasonably deal with all students who, because of religious obligations, have conflicts with scheduled, assignments or required attendance. Notify me at least two weeks in advance of any conflict between a religious holiday and a class activity.

Classroom Behavior
Students and faculty each have responsibility for maintaining an appropriate learning environment. For that purpose, students are expected to be punctual, polite and prepared to engage in discussion with the instructor and class mates. Please turn off your cell phones and place in your bag, pockets, etc., prior to entering the class. Laptops are permitted in class for the purpose of working on the lab assignments.

Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions.

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities.

I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

See policies at: http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code
**Discrimination and Sexual Harassment**
The University of Colorado at Boulder policy on Discrimination and Sexual Harassment (http://www.colorado.edu/policies/discrimination.html) applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550.

Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh

**CU Boulder Honor Code**
All students of CU Boulder are responsible for knowing and adhering to the academic integrity policy of this institution, without exception. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273).

Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion).

Other information on the Honor Code can be found at: http://www.colorado.edu/policies/honor.html  http://www.colorado.edu/academics/honorcode/