ECE 4400/6400 Section 001
Performance Analysis of Local Computer Networks
Spring 2020

Section	001
Meeting Time	9:30am – 10:45am, Tuesday and Thursday
Room	111 Rhodes Annex
Webpage	Canvas
Instructor	Dr. Harlan B. Russell
Office	316 Fluor Daniel Building (EIB)
Email	harlanr@clemson.edu
Office Hours	Thursday/Friday, 3:30-5:00pm Other times by appointment
Prerequisites:	ECE 2720 and ECE 3170
Required textbook:	Joseph Hammond and Peter O'Reilly, Performance Analysis of Local Computer Networks, Addison Wesley, 1986, ISBN 0-201-11530-1. The book is out of print. University Bookstore sells a photocopied version. Used copies are also available from bookstores on the Internet.
Optional supplement:	1. W. Stallings, Local and Metropolitan Area Networks, 6th ed., Prentice Hall, 2000. 2. A. Tannenbaum, Computer Networks, 3rd ed., Prentice Hall, 1996

Introduction and Course Objectives

Computer networks are an essential component of modern day computing infrastructure. In recent years, a multitude of computer network technologies have formed a global infrastructure that pervasively interconnects a broad range of devices, systems, people, and communities in unprecedented ways. From day-to-day personal applications, government, commerce, and societal operations, to research computing, they all depend on the reliable operation and performance of the computer networks. They are the lifelines of our modern day world.

All networks around the globe and in every aspects of our society, while based on a wide range of different networking technologies, are built with local computer networks as the basic building blocks. Regardless of the technology of choice, local computer networks' operation and performance characteristics can be captured in a few simple models applicable to statistical

analyses. Effective use of the analytical models allows one to evaluate computer networks and to design computer networks for specific purposes and constraints.

Offered in spring 2020 to senior undergraduate students and entry graduate students, the course introduces basic networking concepts and methods for modeling and analyzing the performance of local computer networks. Building on random process concepts and basic probability, basic queueing models are constructed and analyzed. The effect of performance requirements on the choice of network solutions is considered, standard architectures and protocols are examined, and practical examples are discussed in the course. Emerging software defined networking (SDN) technology and tools will be used throughout the course for students to directly observe and experiment network performance issues on real networks at varying scales.

By the end of the course, students are expected to be able to:

- Identify standard architectures and protocols of local computer networks
- Utilize standard network models and probabilistic traffic models to analyze local computer networks
- Carry out mathematical calculations required in statistical analyses, including calculus, probability functions, logical and numerical algebra
- Determine suitable models, performance measures, and design factors of local computer networks
- Utilize software defined networking tools to compose and study network protocols and performance

Tentative outline

1. **Review of probability and Calculus** (notes)
2. **Introduction to Networks** (Chap.1)
3. **Protocols and network architecture** (Chap.10)
4. **Introduction to local area networks** (Chap.5)
5. **Data flow in networks and queues** (Chap.3)
6. **Principles of medium access control** (Chap.6 and notes)
7. **Ring networks and Token based MAC** (Chap.7 and 8)
8. **Exams** (1 week)

Assignments

In this course, assignments consist of in-class quizzes, homework, projects, and exams.

Quizzes

There will be a single quiz at the beginning of the semester on probability. It will be given after an in-class probability review.

Homework

There will be homework assignments given periodically throughout the semester. These assignments are designed to allow you to practice the material discussed in class and in the text. Collaboration on homework assignments is permitted and encouraged; however, all students must submit individual assignments. Copying of solutions from other classmates or other sources will be considered academically dishonest and will not be accepted.

Guided Projects

There will be two guided projects given during the course. The guided projects are designed for students to learn hands-on skills for network performance measurement over real network testbeds.

Midterm Exams

There will be two midterm exams given approximately 1/3 and 2/3 of the way through the semester, respectively. **The second exam is cumulative**. **No make-up exams** will be given unless an acceptable reason is presented to the instructor at least one week prior to the exam date.

Final Project

Instead of a final exam, the course requires a final project that demonstrates the understanding of network performance analysis and software tools. The topic is proposed by the student(s) and approved by the instructor, and the topic can be in a wide range of possible contexts. Detailed requirements will be announced. The final project requires a final report, due on the last scheduled lecture, and a final presentation due at the University scheduled final exam time.

Submitting Assignments

Each assignment must be turned in **as a hard copy unless specified otherwise**, **at the start of class, on the day it is due**, unless specified otherwise. No late assignments are accepted, unless accompanied by a formally documented and valid excuse provided prior to the assignment due date. The instructor retains the right to deny late turn-in requests that are avoidable with cautious planning. For accepted late assignments, the instructor retains the right to deduct 20% penalty for each additional day late.

Re-grade Policy

Any re-grade request of an assignment or exam must be submitted in writing on a separate piece of paper **within 24 hours** from the time the graded item is returned. Students should not write any comments or marks on the graded item in question, or the re-grade will not be considered. The instructor retains the right to refuse a re-grade request turned in after the announced period.

Attendance & Participation

In the event that the instructor is late, you may leave 15 minutes after the scheduled class time. Be on the lookout for an email with course updates if this situation were to arise.

You are expected to attend all classes; however, if you anticipate an absence, please notify me beforehand. If you fall ill, *please* do not come to class, but try and let me know as soon as you can. All absences will be dealt with on a case-by-case basis.

Grades

Grades will be weighted as follows:

- 2% Probability quiz
- 8% Homework
- 20% Projects
- 20% First midterm exam
- 20% Second midterm exam
- 30% Final project

ECE 6400 students will have additional homework, exam questions, and reading assignments beyond those given to ECE 4400 students.

All grades will be kept on Canvas (https://clemson.instructure.com). It is your responsibility to ensure all your grades are correct.

The policies in this syllabus are general policies common to all courses in ECE. Course specific information will likely be included in a separate, course specific syllabus. **Students are responsible for reading and understanding the information in both this common syllabus and in the course specific syllabus**.

The syllabus is subject to change based on extenuating circumstances or at the instructor's discretion. **In the event that there is a conflict or discrepancy between the common syllabus and course specific syllabus, the course specific syllabus overrides the common syllabus.**

Attendance

Unless otherwise stated on the course specific syllabus, **students are expected to attend class, and to arrive on time.**

In the event of an **emergency**, students should contact the course instructor, preferably before class or the exam. Students should speak with instructors regarding any scheduled absence as soon as possible and develop a plan for any make-up work, if allowed by the instructor. It is the student's responsibility to secure documentation of emergencies, if required by the instructor. A student with an excessive number of absences may be withdrawn at the discretion of the course instructor.

If the instructor is late, students are expected to wait 15 minutes for the instructor to arrive.

Any further attendance policies in place will be listed on the course specific syllabus and will serve to supplement these policies.

Notification of Absence

The Notification of Absence module in Canvas allows students to quickly notify instructors (via an email) of an absence from class and provides for the following categories: court attendance, death of family member, illness, illness of family member, injury, military duty, religious observance, scheduled surgery, university function, unscheduled hospitalization, other anticipated absence, or other unanticipated absence. The notification form requires a brief explanation, dates and times. Based on the dates and times indicated, instructors are automatically selected, but students may decide which instructors will receive the notification. This does not serve as an "excuse" from class, and students are encouraged to discuss the absence with their instructors, as the instructor is the only person who can excuse an absence. If a student is unable to report the absence electronically, he/she may call the Office of Advocacy and Success at 864-656-0935 for assistance and guidance.

The Office of Advocacy and Success also assists students in identifying various appropriate methods of documenting absences and assists families in using the electronic Notification of Absence system when students are unable to do so themselves.

Academic Continuity Plan

In the event the physical classroom facility becomes unavailable, as determined by the University's administration, class will be conducted in a virtual (online) format. The University issues official disruption notifications through email /www /text notification/social media. When notified, use one of

the following links to navigate to Clemson Canvas where you will find important information about attending class:

- Primary access link: https://www.clemson.edu/canvas
- Secondary access link, if needed: https://clemson.instructure.com/
- You can also use the Canvas Student App.

February 19, 2020, has been declared an E-Learning Day by the university. A real-time test of the Academic Continuity Plan will be conducted.

Inclement Weather Policy

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather related cancellation.

Academic Integrity

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity.

Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

Access Accommodations

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the professor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if possible, but there could be a significant wait due to scheduled appointments. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their professors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: https://www.clemson.edu/academics/studentaccess/index.html .

Anti-Harassment and Non-Discrimination

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This policy is located at http://www.clemson.edu/campus-life/campus-services/access/title-ix/. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 110 Holtzendorff Hall, 864.656.3181 (voice) or 864.656.0899 (TDD).

Online Courses

In an online course, you will interact with the content, instructor, and/or classmates on at least a weekly basis through course assignments, asynchronous discussions and/or synchronous sessions as indicated on the course specific syllabus. Further resources for online courses may be found here: http://www.clemson.edu/online/students/.

Computing technology questions may be sent to ITHELP@clemson.edu.

Emergency Procedures

Emergency procedures have been posted in all buildings and on all elevators. Students should review these procedures for their own safety. Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- Ensure you are signed up for emergency alerts: https://www.getrave.com/login/clemson
- Download the Rave Guardian app to your phone: https://www.clemson.edu/cusafety/cupd/rave-guardian/
- Learn what you can do to prepare yourself in the event of an active threat: http://www.clemson.edu/cusafety/EmergencyManagement/

Copyright Statement

Materials in some of the courses are copyrighted. They are intended for use only by students registered and enrolled in a particular course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: https://clemson.libguides.com/copyright.