PURDUE UNIVERSITY | Elmore Family School of Electrical and Computer Engineering

Engineering Faculty Document No. EFD 74-22
February 18, 2022

Memorandum

To: The College of Engineering Faculty

From: The Elmore Family School of Electrical and Computer Engineering

Re: Course modifications to ECE 46300 Introduction to Computer Communication Networks

The faculty of the Elmore Family School of Electrical and Computer Engineering has approved the changes to the following undergraduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM

ECE 46300 Introduction to Computer Communication Networks Sem. 1, Class 3, Lab 0, Cr. 3.
Prerequisites: ECE 36800

Description: An introduction to the design and implementation of computer communication networks. The focus is on the concepts and the fundamental design principles that have contributed to the global Internet's success. Topics include: digital transmission and multiplexing, protocols, MAC layer design (Ethernet/802.11), LAN interconnects and switching, congestion/flow/error control, routing, addressing, performance evaluation, internetworking (Internet) including TCP/IP, HTTP, DNS etc. This course will include one or more programming projects.

Learning Outcomes: i) an understanding of the fundamental principles underlying packet switching networks, and different Local Area Network technologies. [1,6] ii) an ability to implement network protocols using network socket programming. [1,2]; iii) an understanding of the key principles behind retransmission protocols, congestion control algorithms, and TCP. [1]; iv) an understanding of the basic concepts of routing. [1,6]

TO:

ECE 40863 Introduction to Computer Networks Sem. 1, Class 3, Lab 3, Cr. 4.
Prerequisites: ECE 20875 and ECE 26400 and ECE 36800

ELMORE FAMILY SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
Materials Sciences and Electrical Engineering Building, Room 140
501 Northwestern Avenue, West Lafayette, IN 47907
Office: 765-494-3390

Description: This course provides students with a proper grounding in the fundamentals of computer networking. The course will cover classic concepts such as Internet architecture, naming and addressing, routing, forwarding, reliability, flow control, congestion control, and socket programming. The later part of the course will introduce students to topics such as secure communication, router architecture, datacenter and software-defined network. The course will also provide students with a hands-on experience of building practical and efficient networked systems and applications through various programming labs.

Learning Outcomes: i) an understanding of the architectural principles underlying the Internet design (1); ii) an understanding of the design of various layers in the network stack, including datalink layer, network later, transport layer, and application layer. (1); iii) a familiarity with secure communication, router architecture, software-defined network, and datacenter network. (1); iv) an ability to implement distributed routing, forwarding, and reliability protocols. (1,2,5,6); v) an ability to implement networked applications using socket interface. (1,2,5,6)

Reason: The previous version of ECE 46300 lacked any experience with programming based on course material. This new version will include programming labs to implement the concepts covered in class to build a real-world network. This experience will bridge the gap between the theory and the practice in our computer networks curriculum.

Milind Kulkarni
Associate Head of Teaching and Learning
Professor of Electrical and Computer Engineering

Lecture Outline:

Lectures	Topics
3	Introduction and Background
2	Internet Architecture Principles
5	Data Link Layer – MAC Addressing, ARP, CSMA/CD, Switched Ethernet, MAC Learning, STP
11	Network Layer – IP Addressing, NAT, IP Forwarding, Distance Vector, Link State, BGP, DNS
9	Transport Layer – UDP, TCP Reliability, TCP Flow Control, TCP Congestion Control
4	Application Layer – Web, HTTP, TLS, HTTPS, HTTP/2, QUIC, Socket Programming
1	Secure Communication
4	Router Architecture
3	Datacenter and Software-defined Network
2	Examinations

Lab Outline:

Lab 1: MAC Learning, Forwarding, and STP

Lab 2: Distributed Network Routing Protocols

Lab 3: Reliable Transport

Lab 4: HTTP Web Client and Server

There will be four programming labs. The first two labs (Lab 1 and Lab 2) will be in Python and the last two (Lab 3 and Lab 4) will be in C. Each lab will be 3 weeks long, and must be done in group of at most two students.

ECE 46300: Introduction to Computer Networks

1 Course Description

The goal of this course is to provide students with a proper grounding in the fundamentals of computer networking. The course will cover classic concepts such as Internet architecture, naming and addressing, routing, forwarding, reliability, flow control, congestion control, and socket programming. The later part of the course will introduce students to topics such as secure communication, router architecture, datacenter and software-defined network. The course will also provide students with a hands-on experience of building practical and efficient networked systems and applications through various programming labs.

2 Course Topics

1. Internet Architecture Principles
2. Data Link Layer – MAC Addressing, ARP, CSMA/CD, Switched Ethernet, MAC Learning, STP
3. Network Layer – IP Addressing, NAT, IP Forwarding, Distance Vector, Link State, BGP, DNS
4. Transport Layer – UDP, TCP Reliability, TCP Flow Control, TCP Congestion Control
5. Application Layer – Web, HTTP, TLS, HTTPS, HTTP/2, QUIC, Socket Programming
6. Secure Communication
7. Router Architecture
8. Datacenter and Software-defined Network

3 Prerequisites

Strong programming skills in C (ECE 26400 or equivalent) and Python (ECE 20875 or equivalent) and familiarity with basic data structures (ECE 36800 or equivalent).

4 Learning Resources, Technology, and Texts

1. **Required Material:** Lecture slides on Brightspace.
2. **Additional Reading:** Computer Networks: A Systems Approach (5th edition), by Peterson and Davie, Morgan Kaufmann, 2011, Hardcover ISBN: 9780123850591, eBook ISBN: 9780123850607.

5 Learning Outcomes

A student who successfully fulfills the course requirements will have demonstrated:

1. an understanding of the architectural principles underlying the Internet design.
2. an understanding of the design of various layers in the network stack, including data link layer, network layer, transport layer, and application layer.

3. a familiarity with secure communication, router architecture, software-defined network, and datacenter network.
4. an ability to implement distributed routing, forwarding, and reliability protocols.
5. an ability to implement networked applications using socket interface.

6 Course Schedule

Week	**Topic**	**Programming Lab**
1	Introduction Background Internet Architecture I	
2	Internet Architecture II Data Link Layer I	Lab 0 release
3	Data Link Layer II Data Link Layer III	
4	Data Link Layer IV Network Layer I	Lab 1 release
5	Network Layer II Network Layer III Network Layer IV	
6	Network Layer V Network Layer VI	
7	Network Layer VII Network Layer VIII	Lab 2 release
8	**Midterm Exam**	
9	Transport Layer I Transport Layer II	
10	Transport Layer III Transport Layer IV	Lab 3 release
11	Transport Layer V Transport Layer VI Transport Layer VII	
12	Application Layer I Application Layer II	
13	Socket Programming Secure Communication	Lab 4 release
14	**Thanksgiving Break**	
15	Router Architecture I Router Architecture II Router Architecture III	
16	Software-defined Network Datacenter Network	
17	**Finals Week**	

7 Labs and Exams

Programming Labs — 50% of the grade

1. Lab 0: Setting up the Environment [0%]
2. Lab 1: MAC Learning, Forwarding, and STP [10%]
3. Lab 2: Distributed Network Routing Protocols [10%]
4. Lab 3: Reliable Transport [15%]
5. Lab 4: HTTP Web Client and Server [15%]

In-class Quizzes — 10% of the grade [10 quizzes; each quiz will carry equal credit]

Midterm Exam — 15% of the grade

Final Exam — 25% of the grade

The first two programming labs (Lab 1 and Lab 2) will be in Python and the last two (Lab 3 and Lab 4) will be in C. Each programming lab will be 3 weeks long, and must be done in group of at most two students. Barring extraordinary circumstances (serious medical situations or family emergencies accompanied by verification), **no extensions will be granted for lab submissions**. In-class quizzes and exams must be done individually. Quizzes will be open book and students will be free to collaborate on the solutions while in class. Midterm and Final exams will be closed book with no collaboration allowed. Students who are most active (and helpful) in answering questions on Piazza may receive bonus points.

8 Grading Scale

The breakpoints for letter grades will be decided by the instructor at the end of the semester adjusting for the difficulty level of quizzes, programming labs, and examinations. Normally, the grading follows the trend shown below.

Grade	A+	A	A–	B+	B	B–	C+	C	C–	D+	D	D–	F
Score	95+	90+	85+	80+	75+	70+	65+	60+	55+	50+	45+	40+	$\leq$40

9 Attendance Policy

This course follows Purdue's academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to the instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases falling under excused absence regulations, the student or the student's representative should contact or go to the Office of the Dean of Students website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted for cases of grief/bereavement, military service, jury duty, and parenting leave. For details, see the Academic Regulations & Student Conduct section of the University Catalog website. Guidance on class attendance related to COVID-19 are outlined in the Protect Purdue Pledge for Fall 2021 on the Protect Purdue website.