ECE 69500: Datacenter and Cloud Networks Spring 2023

1   Course Information

Course Number and Title: ECE 69500, Datacenter and Cloud Networks.

CRN: 28957

Section: 037

Campus: West Lafayette

Instructional Modality: Face-to-Face

Lecture Time: Tue, Thu, 4:30–5:45pm in BHEE 226.

Course Credit Hours: 3

Prerequisites: ECE 46300 (Introduction to Computer Communication Networks) or ECE 50863 (Computer Network Systems) or Permission of the instructor.

Course Web Page: https://web.ics.purdue.edu/~vshriva/courses/ece69500sp23/index.html

Course Brightspace Page: https://purdue.brightspace.com/d2l/home/704013

Course Piazza Page: https://piazza.com/purdue/spring2023/ece69500dcn/home

2   Instructor(s) Contact Information

Instructor

Vishal Shrivastav
Assistant Professor of Electrical and Computer Engineering at Purdue University
Office: BHEE 334B, 465 Northwestern Ave., West Lafayette, Indiana 47907–2035, USA
Email: vshriva@purdue.edu
Office Hours: Tue 3–4pm in BHEE 334B

3   Course Description

The modern datacenter and the cloud has emerged as the dominant computing platform that powers most of world's consumer online services, financial, military, and scientific application domains. The goal of this course is to introduce students to the design, implementation, and management of modern datacenter and cloud networks. Lectures will include the presentation and discussion of seminal papers from the field of datacenter and cloud networks, covering a wide-range of topics, including datacenter architecture and topology, datacenter routing and load balancing, datacenter transport, software-defined networking, programmable data plane, in-network computing, multi-tenancy in the cloud, RDMA, resource disaggregation, and optical switching inside datacenters.

4   Prerequisites

ECE 46300 (Introduction to Computer Communication Networks) or ECE 50863 (Computer Network Systems) or Permission of the instructor.

5   Course Topics

1. Datacenter Architecture and Topology
2. Datacenter Routing and Load balancing
3. Datacenter Transport
4. Software-defined Networking
5. Programmable Data Plane
6. In-Network Computing
7. Multi-tenancy in the Cloud
8. RDMA inside Datacenter
9. Resource Disaggregation inside Datacenter
10. Optics inside Datacenter

6   Learning Resources, Technology, and Texts

Required Material: Lecture slides on Brightspace and research papers from the syllabus.

All course materials and grades will be posted on Brightspace. We will use Piazza as the discussion forum to post and discuss questions regarding the course.

7   Learning Outcomes

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

1. an understanding of the design, implementation, and management of datacenter and cloud networks and familiarity with the state-of-the-art technologies in these areas.
2. an ability to critique research papers, work on research projects, and write a research paper.

8   Assignments and Exams

35% — Paper Reviews
Each student is expected to write a 2 to 3 page review of one paper from each course topic, thus totaling 10 reviews. First five reviews will carry 3% credit each, while the last five reviews will carry 4% credit each. A paper review will typically include the paper summary, its strengths and weaknesses, and any suggestions for improvement. No collaboration is allowed for writing the paper reviews.

60% — Term Project
Each student will work on a semester-long project in a group of at most 2 students. Students can either propose their own project or talk to the instructor for project ideas. Any project with significant networking component will be acceptable. The final deliverables will include a technical report and a class presentation about the project. The overall grading will be broken into 3 milestones:
Milestone 1: Problem, Motivation, and Related Work [20%]
Milestone 2: Design and Evaluation Plan [20%]
Milestone 3: Final Report and Presentation [20%]

5% — Attendance and Participation

9   Course Schedule

Week	Dates	Topic
1	Jan 9 – Jan 13	Course Introduction
2	Jan 16 – Jan 20	Datacenter Architecture and Topology
3	Jan 23 – Jan 27	Datacenter Routing and Load balancing
4	Jan 30 – Feb 3	Datacenter Transport
5	Feb 6 – Feb 10	Software-defined Networking
6	Feb 13 – Feb 17	**Project Milestone 1 Presentation**
7	Feb 20 – Feb 24	Programmable Data Plane
8	Feb 27 – Mar 3	In-Network Computing
9	Mar 6 – Mar 10	Multi-tenancy in the Cloud
10	Mar 13 – Mar 17	**Spring Break**
11	Mar 20 – Mar 24	**Project Milestone 2 Presentation**
12	Mar 27 – Mar 31	RDMA inside Datacenter
13	Apr 3 – Apr 7	Resource Disaggregation inside Datacenter
14	Apr 10 – Apr 14	Optics inside Datacenter
15	Apr 17 – Apr 21	**No Lecture** [NSDI Conference]
16	Apr 24 – Apr 28	**Final Project Presentation**

10   Grading Scale

The breakpoints for letter grades is shown below. Typically the final letter grade for a student will be based on their raw cumulative score at the end of the semester (normalized to 100 while accounting for the weight of each assignment and exam). However, the final raw score may be "curved up" to adjust for the difficulty level of assignments and exams, resulting in a potentially better final letter grade. For example, a raw score of 74 (B–) for a student may be curved up to 78 (B) to adjust for the difficulty level. The adjustment factor will be decided by the instructor at the end of the semester, and will be uniformly applied to each student's final raw score. Raw scores will never be "curved down".

Letter Grade	A+	A	A–	B+	B	B–	C+	C	C–	D+	D	D–	F
Score (out of 100)	95+	90+	85+	80+	75+	70+	65+	60+	55+	50+	45+	40+	≤ 40

11   Attendance Policy

This course follows the Academic Regulations: Attendance and Office of the Dean of Students: Class Absences, posted in Brightspace under "University Policies and Statements". The policies state that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance may be taken at the beginning of a class and lateness may be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, students should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to is not possible, student contact the instructor as soon as possible by email. For cases that fall under excused absence regulations, student or student's representative should contact or go to the Office of the Dean of Students (ODOS) website to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted by ODOS for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent medical care. In cases related to COVID-19, please follow the Protect Purdue Updates for the Spring 2023 Semester.

12   Academic Integrity

Students are free to collaborate with anyone or use any available material online for completing their class project. However, unless expressly allowed, students are expected to complete all paper reviews by themselves. A student is considered in violation of the academic honesty policy regardless of whether they are the one "copying" or the one "being copied from". Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace under "University Policies and Statements". Punishments for academic dishonesty are severe, including receiving a failing grade in the course or being expelled from the university. By departmental rules, all instances of cheating will be reported to the Dean of Students. On the first instance of cheating, students involved will receive a 0 on the assignment; the second instance of cheating will result in a failing grade in the course.

Use of Copyrighted Materials: All course materials are subject to Purdue's copyright policies. Students must not share, distribute, or post any material on an online website without checking with the instructor.

13   Nondiscrimination Statement

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on the course Brightspace table of contents, under "University Policies and Statements".

14   Accessibility

Purdue University strives to make learning experiences as accessible as possible. If a student anticipates or experiences physical or academic barriers based on disability, they are welcome to let the instructor know so that they can discuss options. Students are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

15   Mental Health/Wellness Statement

If a student finds themselves beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, they should try WellTrack. Students can sign in and find information and tools at their fingertips, available to them at any time.

If a student needs support and information about options and resources, they should contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are Mon–Fri, 8am–5pm.

If a student finds themselves struggling to find a healthy balance between academics, social life, stress, etc., they should sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help students navigate through barriers and challenges toward their goals throughout the semester. Sign up is free and can be done on BoilerConnect.

If a student is struggling and needs mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If a student or someone they know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours. The CAPS website also offers resources specific to situations such as COVID-19.

16   TaskHuman Service

TaskHuman offers private, real-time, on-demand, 1-on-1 video calls with wellness coaches covering over 800+ topics such as anxiety, mindfulness, reducing stress, clean eating, time management, in-home workouts, relationship tensions, financial issues, spiritual guidance and many more. Students can access these wellness coaches from around the world 24/7. The College of Engineering has an exclusive agreement with TaskHuman which gives students FREE and UNLIMITED access to these resources. Learn more at: https://engineering.purdue.edu/ECE/TaskHuman.

Download TaskHuman

Scan the QR Code to download the TaskHuman App or download the TaskHuman App directly from the App Store or Google Play Store. Create an account – Go to Setting and tap on "Check for Discounts", Insert the code: **purdue63**. Don't see a topic you want or have other questions? Contact Brooke Parks, Senior Lecturer in ECE, at brookeparks@purdue.edu

17   Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students Mon–Fri, 8am–5pm. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund.

18   Emergency Preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. In such an event, information will be provided through course web page, Piazza, and/or email. Students are expected to check the course web page and Piazza, and read their @purdue.edu email on a frequent basis.

Updates and emergency information will be posted on Purdue's home page. Students are urged to sign up for emergency text alerts. Text message sign up procedures can be found at: http://www.purdue.edu/securepurdue/.

For additional information, go to: https://www.purdue.edu/ehps/emergency_preparedness/.