ECE 6363 Data Center and Cloud Computing (2023 Spring)

Course Description

Data center and cloud computing are key technologies in building large-scale Internet services. Almost all major service providers, e.g., Amazon, Microsoft, Google, Facebook, NASDAQ, NYSE, Netflix, rely on data center and cloud platforms for storage, computation, exchange, etc. Most traditional computing and networking equipment vendors, e.g., Cisco, Juniper, Arista, HP, Dell, have been focusing on data center and cloud computing as a strategic area of development and marketing.

This course covers the fundamental knowledge of data centers and cloud computing and offers hands-on opportunities. Topics to be discussed include data center and cloud platform architecture, data center network designs, software-defined networks (SDN), virtualization technologies, traffic engineering, and resource management. Throughout the course we will motivate thinking and interactions using various approaches, such as giving examples, showing animations, discussing research papers, etc. The course includes five labs, eight quizzes, and two exams. Students are expected to learn various tools used in software-defined networks, data centers, and cloud computing.

Corequisite

- ECE 6353 (IAP), or other computer networking course, and knowledge of Python

Materials

- No textbook.
- Research papers, technical articles, and slides will be provided.

Grading policy

- Two Exams: 30% each; 8 Quizzes: 20%; 5 Labs: 20%

Instructor

Minghao Ye
Office: 370 Jay Street, Room 952 E-mail: minghao.ye@nyu.edu

Class Schedule: Online Class (starting from 1/26/2023 Thu)

Office Hours: Thu 10:30 AM – 11:30 AM via Zoom

Course Assistants:

Peixuan Gao pg1540@nyu.edu Boyu Han bh2470@nyu.edu
Chen-yu Yen cyy310@nyu.edu

Class schedule:

- Since it is an online class, there will be no in-person classes.
- A recorded video for the lecture and course materials will be released at Brightspace under "Content" on the dates highlighted in the column of "Week" of the table below.
- You are supposed to complete watching the video and studying the course materials in a week.
- There are a total of 8 quizzes taken online on the dates highlighted in yellow in the column of "Week". On these highlighted dates, you must attend office hours via Zoom to take the quiz with your camera and microphone turned on. All quizzes will start at Thu 10:30 AM for 10 minutes or so, followed by a review of the quiz questions and a discussion of any questions you may have. If you are absent from office hours when taking the quiz, you will not get a grade for your quiz submission.

Week	Lecture
Week1 (1/26)	Overview of data center and cloud computing
Week2 (2/2)	Overview of data center and cloud computing
Week3 (2/9)	Data Center Networks (1) (Crossbar)
Week4 (2/16)	Data Center Networks (2) (Clos, Fat-tree)
Week5 (2/23)	Data Center Networks (3) (FabricPath, PortLand, VL2)
Week6 (3/2)	Traffic Engineering in Data Centers (ECMP, Hedera, Conga)
Week7 (3/9)	10:00 AM-12:15 PM online midterm exam covers Weeks 1-6
3/13-19	Spring Break
Week8 (3/23)	Virtualization and Parallel Programming
Week9 (3/30)	Software-Defined Networking (SDN)
Week10 (4/6)	Load Balancing in Data Centers (Duet, Silkroad, Beamer, Spotlight)
Week11 (4/13)	Lossless Networks in Data Centers (RDMA, PFC, GFC)
Week12 (4/20)	Congestion Control in Data Centers (DCTCP, TIMELY, HPCC-1)
Week13 (4/27)	Flow Scheduling in Data Centers (1) (HPCC-2, D3)
Week14 (5/4)	Flow Scheduling in Data Centers (2) (pFabric, Baraat, Qjump)
Week15 (5/11)	10:00 AM-12:15 PM online final exam covers Weeks 8-14

Lab guidelines:

1. All labs are conducted in real time via Zoom for 2 hours per week.
2. There are a total of 5 labs with time shown below in the NY time zone.
3. You'll be asked to provide your preference for the lab hours at the beginning of the semester, and the course assistants will assign you to one of them based on the number of requests. Note that you will only attend one of the lab hours each week.
4. Some labs require the knowledge of Python. Please practice it before the semester starts.

5. The lab materials will be released at Brightspace under "Assignment". Please download and preview the lab materials before the lab session starts.
6. Each of 5 labs has two sessions that span into two weeks, including a lecture session and a help session. At the beginning of the lecture session (first session), students are supposed to view a lecture video on lab procedure. Then, students should work on their partial assignment (a part of the entire lab assignment) and submit it to Brightspace before the end of the lecture session.
7. Without viewing the video in the lecture session of each lab could cause you unable to finish your assignment by the end of the session. Students that do not attend/stay in the lecture session to work on their partial assignment will not receive a grade for the partial assignment.
8. For the help session (second session) of each lab, students can proceed with the remaining lab tasks and request for assistance from the course assistants if needed.
9. At the end of each lab, students are required to complete a lab report based on their experiment results and submit their lab report in PDF along with their codes/files to Brightspace before the due date specified below.

Lab hours: Mon 2-4 PM (Peixuan) Tue 9-11 AM (Boyu) Thu 8-10 PM (Chen-yu)

Lab schedule: (all based on NY time. You will be assigned to one of the lab hours each week.)

5 Labs with 3 lab hours/week	Mon 2:00-4:00 PM	Tue 9:00-11:00 AM	Thu 8:00-10:00 PM	Lab Report Due (11:59 PM)
Lab1: Linux, Wireshark and Network Debugging Tools	2/6	2/7	2/9	
Lab1 (Help Session)	2/13	2/14	2/16	2/19 Lab1 due
Lab2: OVS, Mininet and SDN Data Plane	2/21 (Tue), 2/20 is Presidents' Day	2/21	2/23	
Lab2 (Help Session)	2/27	2/28	3/2	3/12 Lab2 due
Lab3: RYU and SDN Control Plane	3/20	3/21	3/23	
Lab3 (Help Session)	3/27	3/28	3/30	4/2 Lab3 due
Lab4: Hadoop and AWS	4/3	4/4	4/6	
Lab4 (Help Session)	4/10	4/11	4/13	4/16 Lab4 due
Lab5: Google Cloud and Kubernetes	4/17	4/18	4/20	
Lab5 (Help Session)	4/24	4/25	4/27	4/30 Lab5 due

LATE SUBMISSION OF LAB REPORT: 1-day late: 30% off; 2-day late: 70% off; 3 or more days: no grade; **the report due dates are all in NY time**. No late submission excuses are accepted.

POLICIES AND PROCEDURES ON ACADEMIC MISCONDUCT: Students are encouraged to discuss the labs, reports and homework with each other. However, except for team projects, your written submission, lab reports and exam papers, must be your own work. The first violation of this policy will result in zero point on that assignment and a reduction in your final grade (for

example, from B+ to B). A second violation will result in an F grade of your final grade. For additional information see school's Student Code of Conduct.