Northeastern
College of Engineering

CSYE 6225: Network Structure & Cloud Computing [FALL 2024]

Course Information
Course Title: Network Structure & Cloud Computing Course Number
Course Number: CSYE 6225
Term and Year: Fall 2024
Credit Hour: 4
CRN: 20812

- 12832 (Silicon Valley, CA)
- 20812 (Oakland, CA)

Course Format: Traditional
Location & Time:

- Sa 10am-1pm, Silicon Valley Campus SJ 906 (Silicon Valley, CA)
- R 3pm-6:20pm, Lucie Stern 010 (Oakland, CA)

Syllabus Updated: Aug 26, 2024

Instructor Information
Full Name: Raja Alomari, PhD
Email Address: r.alomari@northeastern.edu
Office Hours: Wed 4-5 PM (Link: Meeting Link - MS Teams) (Sept 4, 2024 - Dec 20, 2024).
Appointment: (Link: Book time with Dr. Alomari) (Sept 4, 2024 - Dec 20, 2024).

Teaching Assistant Information
Full Name: TBD
Email Address:TBD
Office Hours:TBD

Course Prerequisites
CSYE 6200 with a minimum grade of B- or INFO 5100 with a minimum grade of B- or INFO 5100 with a minimum grade of B-

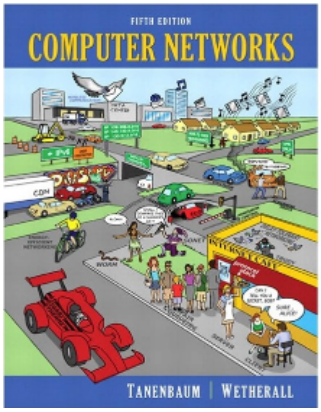
Course Description
Offers a practical foundation in cloud computing and hands-on experience with the tools used in cloud computing. Designed as a foundation course for cloud-aware, adept professionals. Focuses on the fundamentals of cloud computing, the principal areas of cloud architectures, cloud security, cloud governance, cloud storage, cloud virtualization, and cloud capacity. Discusses the Internet evolution that led to cloud and how cloud applications revolutionized Web applications.

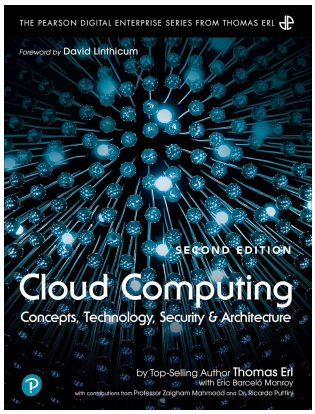
Course Learning Outcomes

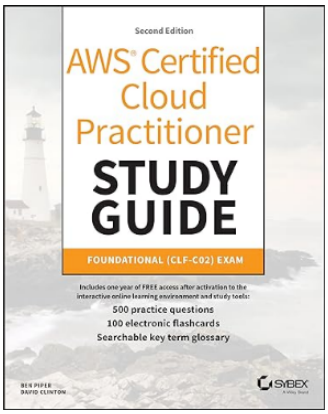
- Computer Networks: Students will obtain a high level understanding of network protocols and topologies in addition to various networking concepts.
- Cloud Computing and IAM: Students will compare cloud deployment models (Public, Private, Hybrid) and service models (IaaS, PaaS, SaaS), and create IAM policies, roles, and keys with appropriate access controls.
- Virtualization and Cloud Compute: Students will distinguish between hypervisor types, virtualization technologies, VMs, and containers, and deploy and manage virtual machines using AWS EC2 and Azure VM.
- Infrastructure as Code (IaC): Students will write and apply IaC scripts using Terraform or AWS CloudFormation, and deploy resources using YAML or JSON, as demonstrated in a case study.
- Cloud Storage and Databases: Students will configure and utilize AWS cloud storage solutions (S3, Glacier, EFS, FSx, EBS) and database services (RDS, DynamoDB) in practical scenarios.
- Cloud Monitoring and Managed Services: Students will set up and interpret cloud monitoring tools (CloudWatch, GCP Monitoring, Wavefront) and manage AWS services (Route53, CloudFront, Lambda, Aurora, Redshift) effectively.
- Cloud Security: Students will explore cloud security measures, including encryption at rest, key management, and apply security solutions (CWPPs, CASB, CSPM, SASE, ZTNA) in real-world scenarios.
- Cloud Architecture and Streaming: Students will design cloud architectures based on AWS Well-Architected Framework, implement VPCs, and disaster recovery solutions, and set up real-time data streaming pipelines with Kinesis or Kafka.
- Industry Use Cases: Students will analyze and present use cases for CloudHealth, CrowdStrike, CASBI, and Netflix, demonstrating their understanding of billing, threat detection, user analytics, and streaming.

Required Tools and Course Textbooks. The nature of this course requires multiple textbooks. The following list includes recommended reading resources, which are not mandatory.

- Computer Networks by Andrew S. Tanenbaum and David J. Wetherall
- Cloud Computing: Concepts, Technology, Security, and Architecture (The Pearson Digital Enterprise Series from Thomas Erl) 2nd Edition
- AWS Certified Cloud Practitioner Study Guide With 500 Practice Test Questions: Foundational (CLF-C02) Exam (Sybex Study Guide)







Tools: The following access and tools will be required to perform your assignments:

- Access to a Linux system (using University credentials).
- Access to AWS, Azure, or GCP. Signup for free access if you do not have one.
- Github account. Create an account if you do not have one.
- Access to a Virtualization environment such as Proxmox (will be provided if you do not have access).

Course Schedule/Topics Covered.

The following is the tentative schedule for this course. Please note that the provided date in each row is for the start of the week and not the actual class meeting date.

Order	Week	Topics	HW & Quizzes
1	Sept 4	● Course overview ● Version Control and GitHub ● Linux Commands and File System	Assignment # 1 out Coding assignment on GitHub Classroom. Requires github account.
2	Sept 9	Introduction to computer networking: Protocols: ● IPv4/IPv6, MAC, TCP & TCP/IP, DNS, OSI, DHCP Concepts: ● Types, Topologies, TCP/IP versus OSI, Metrics, Traffic and Monitoring, Security, Authentication versus Authorization, VPN, Firewall, IoT	Assignment # 1 due Assignment # 2 out Hands-on NW tasks. Requires access to Linux. Submit on Github classroom..
3	Sept 16	Intro and overview of Cloud Computing ● Deployment Model: Public vs Private vs Hybrid Cloud. ● Service Model: IaaS, PaaS, SaaS. Managed vs unmanaged. ● Major public cloud providers. ● IAM: users, roles, policies, action, resource, Access Key, ssh key, trust relationship.	Assignment # 2 due Assignment # 3 out Hands on IAM tasks. Require AWS or other public cloud access. Screen recording or pdf. Quiz 1

4	Sept 23	Virtualization overview: ● Hypervisor Type-1, Type-2, (Desktop, NW, Store, App) virtualization, VM vs Containers. ● Private Cloud Platforms: Proxmox (Open source), VM vCenter/vSphere, Nutanix. ● Public Cloud Virtual Compute AWS EC2/AzureVM. Autoscaling. ● EC2, EBS, ELB, ASG, security group, Security settings and customization. ● Horizontal vs vertical scale.	Assignment # 3 due Assignment # 4 out Hands-on Virtualization technology (Cloud or on-prem) tasks. Requires access to a virtualization technology. Screen recording or pdf.
5	Sept 30	Overview IaC. ● Overview includes: Terraform (Open Source), AWS CloudFormation, Azure Resource Manager, GC Deployment Manager. ● YAML vs JSON. ● Deploy stack and changeset. ● Case study: AWS CloudFormation deployment of EC2.	Assignment # 4 due Assignment # 5 out Hands-on assignment: Use AWS CloudFormation or other IaC technology to deploy an end to end system. Screen recording or pdf. Quiz 2.
6	Oct 7	Cloud Storage (Focused on AWS): ● Object Store (S3/Glacier). ● EFS, FSx, EBS. ● Databases ○ RDS (SQL) ○ DynamoDB (KV, NoSQL)	Assignment # 5 due Assignment # 6 out Hands-on Cloud Storage: Pick two distinct storage technologies and demonstrate their usage. Screen recording or pdf.
7	Oct 14	Midterm Exam	

8	Oct 21	Cloud Monitoring and Observability. ● Logging, CloudWatch, Metrics, Event Bus, Dashboard. ● GCP Cloud Monitoring. ● Use case: Wavefront for Cloud Monitoring.	Assignment # 6 due Assignment # 7 out Hands-on Cloud monitoring: Demo usage of a cloud monitoring technology. Screen recording or pdf.
9	Oct 28	Overview AWS Managed Services: ● Route53 (DNS) CloudFront (CDN) ● Lambda, Aurora, DynamoDB, Redshift, Neptune, Analytics (Glue, Sagemaker, Athena, QuickSight), Lake Formation.	Assignment # 7 due Assignment # 8 out Hands-on assignment: Demonstrate usage of at least 5 AWS managed services. Submission: Screen recording or pdf.
10	Nov 4	Cloud Security: ● Data, applications, and infrastructure. Shared responsibility, Encryption at rest, key management. ● Overview of: CWPPs, CASB, CSPM, SASE, ZTNA. ● Use cases: Netskope, Prisma.	Assignment # 8 due Assignment # 9 out Prepare a report on a trending (startup) in cloud security space. Submission: pdf. Quiz 3
11	Nov 11	Cloud Architecture: ● AWS well-architected Framework. Monolithic vs Microservices. VPC. ● Global infrastructure: Region, Availability Zone, Load Balancing. ● Disaster recovery (DR). ● Use case: eCommerce application architecture.	Assignment # 9 due Assignment # 10 out Prepare one architecture diagram for a system using AWS or other public cloud components. Submission: pdf.

12	Nov 18	Real-time and Streaming ● Overview of real-time processing and streaming. ● Managed vs unmanaged. Kinesis vs Kafka with features such as. Sharding and autoscaling. ● Use case: Realtime ingest pipeline.	Assignment # 10 due Assignment # 11 out Hands on Assignment: Demonstrate usage of AWS Kinesis or Kafka. Submission: Screen recording or pdf.
13	Nov 25	Industry use cases: ● CloudHealth: Billing. ● ClowdStrike: Threat detection ● CASBI: User Behavior Analytics. ● Netflix: Streaming.	Assignment # 11 due Quiz 4
14	Dec 2	Review and recap.	Demos
15	Dec 9	Final Exams	
Note: If the lecture falls on a holiday or canceled for any reason, the topic moves directly to the week after. Note: Quizzes are multiple choice using Canvas (Quiz functionality). Quizzes will be scheduled outside the classroom.			

Assignment Grading

- Assignments: 25%
- Quizzes: 15%
- Midterm: 25%
- Final Exam: 35%

Grading Scale

92 - 100% A	86 - 88% B+	76 - 78% C+	Below 70% F
	82 - 85% B	72 - 75% C	
89 - 91% A-	79 - 81% B-	70 - 71% C-	

Attendance/Late Work Policy

Attendance Policy

Students registered in MGEN courses (INFO, CSYE, and DAMG) are allowed **a maximum of 2 absences per course, with 3 or more absences resulting in an automatic 'F' for that course.** Students are expected to inform their instructors of any absences in advance of the class; if a student is sick long-term or experiences a medical issue that prevents class attendance, it is strongly encouraged that they speak with their Academic Advisor (coe-mgen-gradadvising@northeastern.edu) to learn more about the Medical Leave of Absence. Should a student anticipate being unable to attend 3 or more classes, they should discuss their situation with their Academic Advisor to explore other types of leave in accordance with the University's academic and global entry expectations. International students should review the Office of Global Services webpage to understand their visa compliance requirements.

Teaching Assistants (TAs) or Instructional Assistants (IAs) will be present at each class to collect student attendance.

Late Work Policy

Students must submit assignments by the deadline in the time zone noted in the syllabus. **No late work will be accepted**. Each student is responsible for proper planning and submitting on time.

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is particularly important to the College of Engineering. Your comments will make a difference in the future planning and presentation of our curriculum.

At the end of this course, please take the time to complete the evaluation survey at **https://neu.evaluationkit.com**. Your survey responses are **completely anonymous and confidential**. For courses 6 weeks in length or shorter, surveys will be open one week prior to the end of the courses; for courses greater than 6 weeks in length, surveys will be open for two weeks. An email will be sent to your Northeastern University Mail account notifying you when surveys are available.

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to http://www.northeastern.edu/osccr/academic-integrity-policy/ to access the full academic integrity policy.

MGEN Student Feedback
Students who would like to provide the MGEN unit with anonymous feedback on this particular course, Teaching Assistants, Instructional Assistants, professors, or to provide general feedback regarding their program, may do so using this survey: https://neu.co1.qualtrics.com/jfe/form/SV_cTIAbH7ZRaaw0Ki

University Health and Counseling Services
As a student enrolled in this course, you are fully responsible for assignments, work, and course materials as outlined in this syllabus and in the classroom. Over the course of the semester if you experience any health issues, please contact UHCS.

For more information, visit https://www.northeastern.edu/uhcs.

Student Accommodations
Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit https://drc.sites.northeastern.edu.

Library Services
The Northeastern University Library is at the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals.

For more information and for education specific resources, visit https://library.northeastern.edu
Network Campus Library Services: Northeastern University Library Global Campus Portals

24/7 Canvas Technical Help
For immediate technical support for Canvas, call 617-373-4357 or email help@northeastern.edu

Canvas Student Resources: https://canvas.northeastern.edu/student-resources/

For assistance with my Northeastern e-mail, and basic technical support:
Visit ITS at https://its.northeastern.edu
Email: help@northeastern.edu
ITS Customer Service Desk: 617-373-4357

Diversity and Inclusion
Northeastern University is committed to equal opportunity, affirmative action, diversity, and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration, and an awareness of global perspectives on social justice.

Please visit http://www.northeastern.edu/oidi/ for complete information on Diversity and Inclusion

Title IX
Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty, and staff.

In case of an emergency, please call 911.

*Please visit **https://www.northeastern.edu/ouec** for a complete list of reporting options and resources both on- and off-campus.*