Northeastern
College of Engineering

Multidisciplinary Graduate Engineering
Course Syllabus

Course Information
Course Title: Advanced Cloud Computing
Course Number: CSYE 7125
Term and Year: Summer 2025
Credit Hours: 4
CRN: 53391
Course Format: In-person
Location: Ryder Hall, Room 157

Instructor Information
Full Name: Tejas Parikh
Email Address: t.parikh@northeastern.edu

Course Prerequisites
Graduate level CSYE 6225 Minimum Grade of B

Course Description
Microservices, containers, and container orchestration have fundamentally changed how distributed systems are developed. This course covers a collection of repeatable, generic software design patterns such as the Sidecar pattern, the Ambassador pattern, the Adapter pattern, Event-Driven, Stream & Batch Processing, Containers & Container Orchestration, Replication, Partitioning, Transactions, Consistency, and Consensus to help make the development of reliable distributed systems more approachable and efficient. You will learn the common language and framework these patterns provide. We will try to find valuable ways of thinking about distributed systems and how they work, but also why they work, and what questions we need to ask. After the course, you will be in a great position to decide which technology is appropriate for which purpose and understand how these patterns can be combined to form the foundation of good application architecture. The lectures and assignments aim to help you build skills to develop applications for hybrid cloud and run existing monolithic applications side by side with microservices without a complete rewrite.

Standard Learning Outcomes

- Understand the difference between public, private, and hybrid cloud and be able to pick the right architecture for your computing environment needs.
- Learn advanced cloud computing topics such as DNS, service discovery, load balancing, auto-scaling infrastructure, auto-scaling applications, metrics, monitoring, health checks, and logging.

- Gain hands-on experience with Linux containers and container orchestration.
- Learn to set up secure hybrid cloud environments with Infrastructure as Code concepts.
- Hands-on experience with architecture patterns to aid migration of monolithic applications to the cloud.
- Learn to architect and build microservices using concepts such as polyglot programming, polyglot persistence, scalability, reliability, and operational visibility.
- Learn to implement GitOps, continuous integration, and continuous deployment for applications.
- Understand the challenges of running distributed systems in the cloud and deploying them for high availability and high reliability.
- Learn to extend Kubernetes with Operators.
- Utilize the course content to select technologies you wish to use in your work or company.

Topics Covered

Tentative list of topics covered in this course:

- Hybrid Cloud Computing
- Hybrid Cloud Connectivity & VPC Peering
- Linux containers
- Container Orchestration w/Kubernetes
- Version Control with Git
- Computer Networking for multi-cloud connectivity
- Microservices Architecture, Service Discovery, Load Balancers
- Identity & Access Management
- Infrastructure as Code w/Ansible
- Continuous Integration, and Continuous Deployment w/Jenkins
- Logging with Elasticsearch, Fluentd, and Kibana
- Metrics with Prometheus, and Grafana
- Auto-scaling Applications and Infrastructure
- Sidecar pattern, Ambassador pattern, and Adapter pattern
- Securing cloud applications and infrastructure
- Extending Kubernetes w/Operators written in Go

Required Tools and Course Textbooks

There are no required textbooks for this course. However, you might find books and reading material listed here helpful in mastering the topics covered in this course. Many of these books are available to you free of charge via Northeastern University's Safari Learning Platform (O'Reilly) subscription.

Recommended Books

- Go
    - The Little Go Book

    - The Go Programming Language
- Kubernetes / OpenShift
    - Kubernetes in Action (ISBN: 9781617293726)
    - OpenShift in Action (ISBN: 9781617294839)
- Distributed Systems
    - Designing Distributed Systems (ISBN: 9781491983645). Download ebook from here.
    - Designing Data-Intensive Applications (ISBN: 9781449373320)
- Containers / Docker
    - Docker: Up & Running (ISBN: 9781491917572)
    - Docker in Action (ISBN: 9781633430235)
    - Docker in Practice (ISBN: 9781617294808)
- Git
    - Pro Git (ISBN: 9781484200773)
- Cloud Computing
    - Cloud Computing: Concepts, Technology & Architecture (ISBN: 9780133387520)
    - Google Cloud Platform in Action (ISBN: 9781617293528)
    - Amazon Web Services in Action (ISBN: 9781617292880)
- DevOps / SRE
    - Site Reliability Engineering: How Google Runs Production Systems (ISBN: 9781491929124). This book is also available online for free on Google's site.
    - The Phoenix Project (ISBN: 9780988262508)
    - The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations (ISBN: 9781942788003)
- Linux
    - UNIX and Linux System Administration Handbook (ISBN: 9780131480056)
    - The Linux Command Line (ISBN: 9781593273897)
    - Linux Documentation

Attendance Policy

Students are expected to complete course readings, participate in class discussions or other learning activities during the unit, and complete written assignments for each unit during the time of that unit. It is understood that there might be one week when active participation in ongoing class conversations and learning activities might be delayed. Beyond one week time, if there is an absence or lateness in participation (1) faculty must be notified in advance; (2) grades will be adjusted accordingly.

Assignments

Students will be assigned assignments at the end of the lecture. Assignment due dates will be posted with each assignment. *If you fall behind on an assignment, it will be extremely difficult to catch up as the next assignment depends on it.*

Grading/Evaluation Standards

Grading will be based on the absolute grading system. This grading system assigns a range of point values to a letter grade. The grading is absolute, irrespective of the grades of other students in the class. I do not round scores to the closest percentage.

Late Work Policy

Assignments and Grading are expected to be completed by their respective due date. A 10% penalty applies for every day the assignment submission and/or demo is late after the due date. An assignment that is late 5 days or more will receive 0 points.

Individual Assignment Weightage

Individual assignment weightage can be found in Canvas.

Exams

Details about the logistics of the exam will be shared at least 2 weeks before the exam.

Grade Scale

Grade	Range
A	**100% to 95.0%**
A-	**< 95.0% to 90.0%**
B+	**< 90.0% to 87.0%**
B	**< 87.0% to 84.0%**
B-	**< 84.0% to 80.0%**
C+	**< 80.0% to 77.0%**
C	**< 77.0% to 74.0%**
C-	**< 74.0% to 70.0%**
F	**< 70.0% to 00.0%**

Grade Breakdown:

Assignments & Projects: 50%

Final Presentation: 15%

Quizzes: 35%

End-of-Course Evaluation Surveys

Your feedback regarding your educational experience in this class is particularly important to the College of Professional Studies. 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 Husky 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.

Academic Integrity Violation

Academic integrity violation will result in an automatic F grade in the course. You may also be referred to the Office of Student Conduct and Conflict Resolution for further disciplinary action.

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 http://www.northeastern.edu/drc/getting-started-with-the-drc/.

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 http://subjectguides.lib.neu.edu/edresearch.

24/7 Canvas Technical Help

For immediate technical support for Canvas, call 617-373-4357 or email help@northeastern.edu

Canvas Faculty Resources: https://canvas.northeastern.edu/faculty-resources/

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 www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.

Tentative Course Schedule

Week	Topics Covered
1	• Course Introduction • Containers & Docker
2	• Introduction to Go

3	• Container Orchestration w/Kubernetes
	• Kubernetes Architecture
	• Bastion Host
	• DNS Setup
	  ○ Public Hosted Zones
	  ○ Private Hosted Zones
	  ○ Hosted Zones for Subdomains
	• Minikube & Kind
	• kubeconfig & Kubernetes Contexts

4	• Setup & Teardown Kubernetes Cluster using kops
	• Kubernetes Objects
	• Kustomize
	• Architecting Scalable & Reliable Systems
	• Kubernetes
	  ○ Pod
	  ○ Init Containers
	• VPC Peering

5	• Stateless Services
	• Services & Service Discovery
	• Configuration & Secrets Management
	• Kubernetes
	  ○ ReplicaSets
	  ○ Liveness & Readiness Probe
	  ○ ConfigMap
	  ○ Secret
	  ○ Service
	  ○ Persistent Storage
	  ○ Stateful Services

6	• Persistent Storage • Stateful Services • Kubernetes Deployments • Helm - The Kubernetes Package Manager
7	• CI/CD • Semantic Versioning 2.0.0 • Resource Management for Pods and Containers • Network Policies
8	• Distributed Tracing • Metrics & Prometheus • Logging & EFK
9	• **4th July long weekend - No classes**

10	• Autoscaling Applications • Autoscaling Kubernetes Cluster • Service Mesh w/Istio
11	• Kubernetes Operators

12	• Batch Computational Patterns
	  ○ Queues
	  ○ Event Driven
	  ○ Publish/Subscribe
	• Apache Kafka

13	• Architecture Patterns
14	• TBD
15	• **Final Exam / Presentation / Project Demo**