Course Pages:

1.  http://cs.brown.edu/courses/csci2952-f

Office Hours: After class, or by appointment.

Course Description This course investigates and explores an emerging paradigm for enabling distributed systems and applications at scale, Microservices. In particular, this course builds on the foundations provided by the initial distributed systems offering (i.e., CSCI 0138) and explores how these concepts are used to realize, manage, and orchestrate microservices.

Course Objectives The fundamental objective of this class is to broadly expose students to cutting edge concepts in cloud computing and microservices while simultaneously preparing students to think critically, write scientific reports, and create convincing arguments.

To this end, students will learn to read, discuss, and analyze research papers. Additionally, students will engage in hands-on exercise to better understand opensource software and platforms used within the microservices ecosystem. This will take the form of (a) seminar style discussions, (b) invited lectures from industry experts, and (c) group activities. Collectively, these activities will lay the foundation for the seminar long project. In this project, students will practice both the basic research activities (literature survey, problem definition, problem execution, and evaluation) and investigate the design of novel paradigm for improving microservices management.

Upon completion students should be able to:

- articulate and discuss the design insights underlying modern distributed systems and, in general, the broader space of design choices available to modern distributed systems
- demonstrate the ability to leverage this knowledge to design and create innovative new distributed systems
- develop a deeper understanding of the opensource ecosystem which supports many emerging microservices paradigms

Grading This course will consist of projects, lectures, paper readings, and discussions – each will contribute to your grades.

- Projects: 50%
- Paper Reading Summaries (Talk summaries): 15%
- Class Discussion: 5%
- Paper Presentation: 10%
- Assignments: 20%
Projects and assignments will be due at 11:59pm on the day of the deadline. Paper summaries are due at 11:59pm the night before class. Late summaries will not be accepted — the form closes at 11:59pm ET promptly. You will be allowed 4 missed paper summaries.

**Extra-Credit** There will be extracredit. To do this student will need to focus on (1) enhance a complex services to leverage patterns and combinations of dataplane approaches, or (2) writing a CSUR-style survey paper.

**Workload** In general, students should be prepared to spent 10-15 hours each week. While the course may initially start out demanding fewer hours, towards the middle it ramps up. Distributed systems, as with most systems, is time consuming because you are designing massive systems with high levels of concurrency and complex interactions.

**Late Policy** For the reading summaries, there are no late days. You are allowed to miss four of these assignments. Whereas, for the project milestones and assignments, you are given a collective of three free late days. After that, each late day results in a loss of 10%.

**Collaboration Policy** In general, research is collaborative in nature. A key part of this seminar class requires student to engage in discussion and exchange ideas or to explore outside resources to explore and survey ideas. In part due to this collaborative nature, a clear collaboration policy is essential to avoid any miscommunication.

- **Writing Assignments:** All submitted documents but be fully created by the student. Although we encourage discussions and encourage students to use the internet for additional classification or to better understand other emerging aspects of the general space, ultimately, we require them to submit and write their own original text. Student are not to copy text, images, or other content.

- **Coding Assignments:** While student may use libraries to providing supporting functionalities, they are required to write original code providing the core functionality and logic.

- **Groups or Individual:** The paper summaries and scribe notes should be written individually. Whereas the project milestones are meant to be accomplished in pre-defined groups of twos or threes.

**Textbook**
There is no textbook for this class. The papers are online and can be optionally accessed through ACM’s digital library.

**Assignments**

Assignment 1: [Solo Assignment] Your First Microservice #1 TBD
Assignment 2: [Team Assignment] Virtual Kubecon #1 TBD
Assignment 3: [Solo Assignment] Hands dirty with Operators #1 TBD
Assignment 4: [Team Assignment] Overload Protection #1 TBD

**Project Milestones**

Group Selection #1 TBD Week 4
Project Proposal #2 TBD Week 6
Project MidPoint Checkin #2 TBD Week 10
Project Presentation TBD Last Week of Class
Project Workshop Writeup TBD End of Reading Period
Schedule Background

1. Day [Day 1]: Introduction + Background.
2. Day [Day 2]: Background Continued (ServiceMesh, Service Discovery).
3. Day [Day 3]: Migration to Microservices
4. Day [Day 4]: Cluster Orchestration Systems
5. Day [Day 5]: Continuous Integration and Continuous Delivery (CI/CD)
6. Day [Day 6]: Kubernetes Operators (background for HW#3)
7. Day [Day 7]: CS2592’s Virtual Kubecon (Presentations of HW#2)
8. Day [Day 8]: Overload detection and Avoidance
9. Day [Day 9]: SLA Guarantees
10. Day [Day 10]: (mis)configuration
11. Day [Day 11]: Observability: Tracing
12. Day [Day 12]: Observability: Logging
13. Day [Day 13]: Observability: Metrics
14. Day [Day 14]: Chaos Engineering
15. Day [Day 15]: Diagnosis
16. Day [Day 16]: Storage (Distributed Sagas)
17. Day [Day 17]: TDB
18. Day [Day 18]: TDB
19. Day [Day 19]: TDB
20. Day [Day 20]: TDB
21. Day [Day 19]: TDB
22. Day [Day 20]: TDB