

DSE 503/ECE 598 Systems Foundations of Data Science and Engineering

Course Catalog Description: This course provides an introduction and overview of the underlying building blocks of big data stack architecture and infrastructure. It covers the foundational concepts and techniques of data acquisition, data storage, high-performance computing, and parallel data analysis. It provides hands-on experiments using advanced computing platforms and modern software tools to perform parallel data-intensive computing.

Prerequisites: DSE 502 Programming Foundations of Data Science and Engineering or instructor's permission

Course Learning Outcomes: Upon completing the practicum course, students will be able to:

1. Understand basic requirements of scalable data-intensive applications
2. Understand hierarchical stack architecture and building blocks of a data-intensive system
3. Design software applications that fully leverage modern parallel computing machines
4. Work in project teams to develop successful solutions
5. Write project reports for designing and evaluating a data-intensive system

Course Format: Synchronous online

Instructor: Dr. Yifeng Zhu, Professor of Electrical and Computer Engineering

Office Hours: TBD

Office Address: 271 Barrows Hall

Office Phone: 207-581-2499

Email: Yifeng.Zhu@maine.edu

Class Meeting Time: TBD

Semester: Spring 2021

Textbook (Optional):

1. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, Martin Kleppmann, Publisher: O'Reilly Media; 1st edition (April 18, 2017), ISBN-10 : 1449373321
2. Next Generation Databases: NoSQL and Big Data, Guy Harrison, Publisher: Apress; 1st ed. edition (December 26, 2015), ISBN-10 : 1484213300

Tentative Topics (subject to change)

1. Data storage and retrieval
 - I/O performance analysis
 - File systems, parallel file systems
 - In-memory databases
 - SQL database and Non-SQL database

- Column-oriented storage systems
2. Parallel Computing
 - Performance metrics such as speed up and throughput
 - Data intensive vs compute-intensive applications
 - Fast data analysis based on Spark
 3. Conceptual design big data systems
 - Designing a key-value store
 - Designing a news feed system
 - Designing a YouTube-like video system
 4. Large datasets, challenges and solutions

Course Grading

Quiz and participation	10%
Mid-term	15%
Homework assignments	30%
Project	30%
Paper review and presentation	15%

Homework Policy

- Both homework assignments are due at the beginning of the class on the given due date. **Late work is penalized 20% per day, including weekends.** Once solutions are published, late work cannot be accepted for credit.
- The “Quiz and Participation” will be based on your participation level in the class. You are required to attend lectures. All students are expected to start homework assignments early.

Academic Honesty Statement: Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students with disabilities statement: If you have a disability for which you may be requesting an accommodation, please contact Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

Sexual Violence Policy:

Sexual Discrimination Reporting The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of **sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or**

any form of gender discrimination involving members of the campus, **your teacher is required to report** this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For confidential resources on campus: **Counseling Center: 207-581-1392** or **Cutler Health Center: at 207-581-4000.**

For confidential resources off campus: **Rape Response Services: 1-800-310-0000** or **Spruce Run: 1-800-863-9909.**

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For support services on campus: **Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040** or **911.** Or see the **OSAVP website for a complete list of services at <http://www.umaine.edu/osavp/>**

University of Maine COVID-19 Syllabus Statement

COVID-19 is an infectious disease caused by the coronavirus SARS-CoV-2. The virus is transmitted person-to-person through respiratory droplets that are expelled when breathing, talking, eating, coughing or sneezing. Additionally, the virus is stable on surfaces and can be transmitted when someone touches a contaminated surface and transfers the virus to their nose or mouth. When someone becomes infected with COVID-19 they may either have no symptoms or symptoms that range from mild to severe and can even be fatal. During this global pandemic, it is imperative that all students, faculty, and staff abide by the safety protocols and guidelines set forth by the university to ensure the safety of our campus. All students are encouraged to make the Black Bears Care Pact to protect the health of themselves, the health of others, and the college of our hearts always.

- **Black Bears Care Pact:** <https://umaine.edu/return/black-bears-care/>
- **Symptom checking:** The symptoms of COVID-19 can range from mild to severe, and even people with mild symptoms may transmit the virus to others. Students are encouraged to use the symptom checking app each day before attending class or moving about campus and follow the recommendation prompted within the app. Students should monitor for the following symptoms daily: fever (temperature >100.4F/38.0C) or chills, new cough, loss of taste or smell, shortness of breath/difficult breathing, sore throat, diarrhea, nausea, or vomiting, or the onset of new, otherwise unexplained symptoms such as headache, muscle or body aches, fatigue, or congestion/runny nose.

- **Physical distancing:** Students need to make every effort to maintain physical distancing (6 feet or more) indoors and outdoors including within classrooms. The University classrooms and physical spaces have been arranged to maximize physical distancing. Follow the traffic patterns outlined in each building and outdoor space to avoid crowding. If students are in an academic setting (i.e. clinical or lab class) that requires them to reduce physical distancing, they should follow the instructor's guidelines.
- **Face coverings:** Students must wear appropriate face coverings in the classroom. Face coverings must be worn in indoor and outdoor spaces on campus unless people are alone in a room with a door closed or when they are properly physically distanced and do not expect someone to approach them. When face coverings are removed people are placing themselves and those surrounding them at increased risk for COVID-19.
- **Eating and drinking in classrooms:** Students may not eat or drink in the classrooms and are encouraged to take their food or drink into areas designated for these purposes where they can maintain 6 feet physical distance from others.
- **Hand hygiene:** Proper hand hygiene is an effective measure to prevent the spread of COVID-19. Students should wash their hands often with soap and water or use a hand sanitizer with at least 60% alcohol, especially after using the bathroom, before eating or drinking, and before and after going to class or university spaces such as the recreation center, library, or dining halls.
- **Contingency plans:** Classes will be held in various formats to offer flexibility, compassion, and empathy during these unprecedented times. Under certain circumstances, students or instructors may need to miss classes or in-person classes may be disrupted. Students are expected to notify their instructor if they are unable to attend an in-person or online class but will not be penalized for missing class due to illness or the need to care for a family member affected by COVID-19. If a disruption occurs, your instructor will provide communication and contingency plans.
- **What to do if you have or suspect you have COVID-19:** If you have symptoms of COVID-19 or have been possibly exposed to someone with COVID-19, you should stay home, not interact with others, and contact your health care provider immediately to be tested for COVID-19. You may not attend in-person classes and should suspend interactions with others until you are tested. Prior to receiving test results you should quarantine in your living area according to the Maine CDC guidelines below. Please follow the guidance of your health care professional regarding testing, quarantine, and isolation during the testing process and potential illness period.
- **What to do if someone you know has or may have COVID-19:** If someone you know or that you have had close contact with (defined by the ME CDC as 15 mins or more within 6 feet or less) has tested positive for COVID-19, you should stay home and quarantine according to the guidance of the ME CDC, contact your health care provider, and continue to monitor for symptoms. You may

be required to quarantine and/or be tested for COVID-19 under these circumstances. You may also have been exposed to COVID-19 by someone you do not know, and it is possible that you could be contacted through contact tracing to determine if you were exposed. Everyone should respond to these confidential questions to ensure the safety of themselves and those around them.

- **Maine CDC guidelines:**

<https://www.maine.gov/dhhs/mecdc/infectious-disease/epi/airborne/coronavirus/general-information.shtml>

- **If you have questions or would like additional information related to the University of Maine COVID-19-specific policies or procedures please use the following sources:**

University Webpages: umaine.edu/return and together.maine.edu

COVID-19 Information line: 207.581.2681

Emergency Operations Center Email Contact: umaine.alerts@maine.edu

Course Schedule Disclaimer (Disruption Clause):

In the event of an extended disruption of normal classroom activities (due to COVID-19 or other long-term disruptions), the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.