

# CS 5123: Cloud Computing and Distributed Systems Spring 2021

## Course Information:

Instructor: Arunkumar Bagavathi

Email: [abagava@okstate.edu](mailto:abagava@okstate.edu)

Office: MSCS 215

Instructor office hours: Monday 9:00am – 12:00pm (Online-only)

Instructor office hours Zoom link: Check Canvas

Lectures: Tuesday, Thursday 10:30am – 11:45am

Classroom: Room 040 Stout Hall

Credits: 3

Teaching Assistant: Reza Marzban

TA email: [reza.marzban@okstate.edu](mailto:reza.marzban@okstate.edu)

TA office hours: Tuesdays 3:00pm – 5:00pm (Online-only)

TA office hours Zoom link: <https://zoom.us/j/9698601761>

Prerequisites:

- CS 3443 Computer Systems (with 'C' or better grade) and
- CS 3353 Algorithms and Data Structures 1 (with 'C' or better grade)

OR permission of instructor

- ❖ Basic mathematical and programming skills are mandatory for assignments and project
- ❖ Required fundamentals: of Java and Python programming, and Linux terminal commands

Other information: This course will use Canvas. All course announcements, assignments and project instructions, and course materials will be posted on Canvas

## Lecture Type:

This course will follow hybrid approach. Live stream link will be shared with students after January 17, 2021 and it will be available in Canvas. All lectures will be recorded, and students can access lecture videos any time after the lecture. Students can choose to attend lectures in-class or online. Students choosing to attend lectures in-class should follow the course's COVID guidelines.

**No lectures on:** March 4 and April 13 (OSU Wellness days)

## Course Description

The course gives broad ideas and popular methodologies in cloud computing and distributed systems. The course mainly aims to use distributed computing frameworks like Hadoop MapReduce and Apache Spark for complex data-intensive problems like big data processing, web search, and machine learning. Course lectures, assignments and project will be designed to help students to understand the basics of distributed computing frameworks, some data science concepts, cloud tools and services, and trends in the cloud like Serverless, Edge, and Micro-services.

## Topics

Following is the tentative topics for the course. It is intended to change according to students need and availability of time.

1. Introduction
  - ❖ Virtualization
  - ❖ Data Centers
  - ❖ Types of cloud computing
  - ❖ Cloud services
2. Hands-on with clusters
  - ❖ OSU-CS cluster
  - ❖ AWS
3. Programming models – Batch processing
  - ❖ Hadoop MapReduce
  - ❖ Apache Spark
  - ❖ GraphX
  - ❖ MLlib
4. Programming models – Stream processing
  - ❖ Spark Streaming
  - ❖ Samza/Storm
5. Applications
  - ❖ Web search
  - ❖ Influence modeling
  - ❖ Real-time Data Analysis
6. Edge Computing
  - ❖ TBD
7. Micro-services
  - ❖ Docker
  - ❖ Kubernetes
8. Cloud security

## Course activities and Grading

The course activities consist of programming assignments, quizzes, and a final project. There will be three to five assignments and each assignment will involve significant amount of programming. Students will have one to two weeks to complete each assignment. All assignments will be due at 11:59:59 pm on the scheduled submission date. There will be 4 - 6 quizzes. All quizzes will be conducted at random during the lecture time. The final course project should be a significant implementation project and should have to be approved by the instructor. Project phases include - proposal, implementation, demonstration, and written summary. Grading of the project will be based on grades from all the project phases.

Grading scheme for the course:

Group project: 50%

Assignments: 30%

Quiz: 10%

Class participation: 10%

**Attendance Policy:** Students are expected to attend all sessions of the course and are responsible for knowing all materials covered in the class. A part of the student grade will be determined by class attendance and participation.

**Code of conduct:** We follow OSU students code of conduct *extremely seriously*. Standard penalty for students who jeopardize the code of conduct is suspension from the university. We recommend students to form online groups and discuss about assignments and projects. However, each student should write their answers independently along with list of people they discussed with in the submission.

**Lateness Policy:** This is a tightly packed course with assignments and project. So, there will be no extra time given for assignment and project submission. If there is any good reason for extension, please email the instructor **in advance**.

## Books:

Books are not mandatory for this course. Use of online materials is highly encouraged. Following are some good books for reading:

1. "Hadoop: The Definitive Guide", 4<sup>th</sup> Edition by Tom White
2. "Spark: The Definitive Guide", 2018 Edition by Bill Chambers and Matei Zaharia
3. "Distributed and Cloud Computing: From Parallel Processing to the Internet-of-Things" by Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra
4. "Mining Massive Datasets", Second Edition by Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman

## **University Policies**

### **Student Guidance on Wearing Facial Coverings**

All OSU students, employees, and visitors must wear a facial covering (mask) upon entering any campus building and when near or encountering others. This includes during class and in laboratory settings. Please be aware that additional personal protective equipment (PPE), such as a face shield along with a mask, may be required in certain classroom and laboratory settings. Students who fail to wear their facial covering will be asked to leave the room and return after retrieving their facial covering.

Students who continuously fail to comply with this university expectation will be referred to the Office of Student Support and Conduct for the [Student Code of Conduct](#)'s Failure to Comply policy.

COVID-19 can be spread when people are asymptomatic, which means they do not know they are sick yet. Wearing facial coverings has been shown to reduce the spread of COVID-19 to others. It is important that OSU is a safe place to work and study, and taking this step creates a safe environment for all of us as advised by the CDC. More on facial covering guidelines.

(<https://go.okstate.edu/coronavirus/campus-reopening-plan/plan-at-a-glance/face-coverings.html>)

### **COVID-19 UPDATES**

<https://go.okstate.edu/coronavirus/>

Please visit this webpage for information regarding the university's response to the COVID-19 pandemic, answers to frequently asked questions, and other important updates.

### **ACADEMIC INTEGRITY**

101 Whitehurst/405-744-5627/<http://academicintegrity.okstate.edu>

OSU is committed to maintaining the highest standards of integrity and ethical conduct. This level of ethical behavior and integrity will be maintained in this course. Participating in a behavior that violates academic integrity (e.g., unauthorized collaboration, plagiarism, multiple submissions, cheating on examinations, fabricating information, helping another person cheat, unauthorized advance access to examinations, altering or destroying the work of others, and altering academic records) will result in an official academic sanction. Violations may subject you to disciplinary action including the following: receiving a failing grade on an assignment, examination or course, receiving a notation of a violation of academic integrity on your transcript, and being suspended from the University. Students have the right to appeal the charge

### **COPYRIGHT & FAIR USE POLICY OF COURSE MATERIALS**

Course materials may not be published, leased, sold to others, or used for any purpose other than appropriate OSU-related individual or group study without the written permission of the faculty member in charge of the course and other copyright holders. This paragraph grants you a limited license giving you access to materials for this course, including PowerPoint slides, audio/video recordings, written, or other materials, for appropriate OSU-related educational use only. Lectures should not be recorded without permission from the faculty member and must not be further disseminated or shared. Assignments, quizzes, and exams (individual questions or in its entirety) should not be uploaded to websites offering note-sharing, tutoring, or other academic help (free or by paid subscription).

### **CLASS ATTENDANCE**

Class attendance is a critical component of learning; therefore, you are expected to attend and participate fully in all scheduled class meetings. Many instructors consider attendance so essential that your grade may be affected by your absence. *SOME DEPARTMENTS AND PROFESSORS HAVE MANDATORY ATTENDANCE POLICIES.* If no written attendance policy is provided before the last day to add a class

without instructor permission, no penalty may be assessed for class absences although you may not be permitted to make up certain in-class activities. If you are ill, you should stay home. If you are required to participate in official university-sponsored activities or military training, you should receive an excused absence unless the written course attendance policy indicates otherwise. If you will be absent from class for sponsored activities, you must provide prior notification of the planned absence to the instructor. You may be required to submit assignments or take examinations before the planned absence.

### **COURSE SCHEDULE ADJUSTMENTS FOR SPRING**

Monday, Wednesday, and Friday courses will be scheduled to meet for 45 minutes each class period to allow more time for students to exit and enter classroom spaces. Instructors will be expected to provide additional contact time for these courses to ensure classes meet the required semester credit hour contact minutes.

### **PRE-FINALS WEEK POLICY**

Final examinations are scheduled at the end of each semester and are preceded by pre-finals week, which begins seven days prior to the first day of finals. During pre-finals week, all normal class activities will continue; however, no assignment, test, or examination accounting for more than 5% of the course grade may be given; and no activity or field trip may be scheduled that conflicts with another class. This excludes makeup and laboratory examinations, out-of-class assignments (or projects) made prior to pre-finals week and independent study courses. No student or campus organization may hold meetings, banquets, receptions, or may sponsor or participate in any activity, program, or related function that requires student participation. For additional information, contact the Office of Academic Affairs, 405-744-5627, 101 Whitehurst.

### **EQUAL OPPORTUNITY**

409 General Academic Building/405-744-7607

<https://1is2many.okstate.edu/>

OSU is committed to maintaining a learning environment that is free from discriminatory conduct based on race, color, religion, sex, sexual orientation, gender identity, pregnancy, status as a parent, national origin, disability (physical or mental), age, family medical history or genetic information, political affiliation, military service, protected veteran status, or other non-merit based factors. OSU does not discriminate on the basis of sex in its educational programs and activities. Examples of sexual misconduct and/or sex discrimination include: sexual violence, sexual harassment, sexual assault, domestic and intimate partner violence, stalking, or gender-based discrimination. OSU encourages any student who thinks that they may have been a victim of sexual misconduct or sexual discrimination to immediately report the incident to the Title IX Coordinator (405-744-9153) or Deputy Title IX Coordinator (405-744-5470). If a reporting student would like to keep the details confidential, the student may speak with staff in the Student Counseling Center (405-744-5472) or one of the University's Sexual Assault Victim Advocates (Mon-Fri 8 AM-5 PM, 405-564-2129 or 24 Hour Help Line 405-624-3020).

### **STUDENT ACCESSIBILITY SERVICES**

1202 W. Farm Rd #155/405-744-7116/<http://sds.okstate.edu/>

According to the Americans with Disabilities Act, each student with a disability is responsible for notifying the University of the disability and requesting accommodations. If you think you have a qualifying disability and need accommodations, contact the Office of Student Accessibility Services to start the registration process and to ensure timely implementation of appropriate accommodations. To receive services, you must submit appropriate documentation and complete an intake process to verify the existence of a qualified disability and identify reasonable accommodations. Faculty have an obligation to respond when they receive official notice of accommodations but are under no obligation to provide retroactive accommodations.