Course Information:
Instructor: Arunkumar Bagavathi
Email: abagava@okstate.edu
Office: MSCS 215
Instructor office hours: Tuesdays 9:30am – 12:30pm (Online-only)
Instructor office hours Zoom link: Check Canvas

Lecture mode: Asynchronous online only. Synchronous class session details will be shared on Canvas
Credits: 3

Teaching Assistant: TBA
TA email: TBA
TA office: TBA (In-Person/Online)
TA office hours: TBA
TA office hours Zoom link: TBA on Canvas

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 asynchronous online approach. The instructor will record the lecture videos and post them on Canvas. Each powerpoint file given in the course will be split into multiple video lectures. Some sessions will be given synchronously. However, these lectures will be recorded and posted on Canvas.
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, text analysis, and web search. 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 computing like Fog, 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
4. Programming models – Stream processing
   - Spark Streaming
   - Samza/Storm
5. Applications
   - Web search
   - Influence modeling
   - Real-time Data Analysis
6. Fog & Edge Computing
   - TBD
7. Micro-services
   - Docker
   - Kubernetes
8. Cloud security
Course Schedule:

*Note: Some of the following topics and schedules are tentative. Changes will be made for organized lectures and interesting topics.*

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Events</th>
<th>Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 18</td>
<td>Introduction to Cloud and Distributed computing</td>
<td>Quiz-0 out</td>
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<tr>
<td>January 21</td>
<td>Introduction to Hadoop – HDFS</td>
<td>Quiz-0 due</td>
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<tr>
<td>January 23</td>
<td>YARN architecture</td>
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<tr>
<td>January 25</td>
<td>MapReduce with Hands-on</td>
<td>Assignment-1 out</td>
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<tr>
<td>January 30</td>
<td>MapReduce - extras</td>
<td>Quiz-1 out</td>
<td>Quiz-1 due</td>
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<tr>
<td>February 1</td>
<td>k-Means clustering</td>
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<td>Assignment-1 due</td>
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<tr>
<td>February 6</td>
<td>Introduction to Apache Spark</td>
<td>Assignment-2 out</td>
<td>Quiz – 2 due</td>
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<td></td>
<td>Quiz – 2 out</td>
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<tr>
<td>February 8</td>
<td>Spark Transformations</td>
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<tr>
<td>February 8</td>
<td>PySpark Hands-on</td>
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<td>February 13</td>
<td>Introduction to Information Retrieval</td>
<td>Quiz – 3 out</td>
<td>Quiz – 3 due</td>
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<td>February 15</td>
<td>TF-IDF</td>
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<td>Assignment – 2 due</td>
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<td>February 20</td>
<td>Introduction to Containers</td>
<td>Assignment – 3 out</td>
<td>Quiz – 4 due</td>
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<td></td>
<td>Quiz – 4 out</td>
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<tr>
<td>February 22</td>
<td>Docker</td>
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<td>February 27</td>
<td>Container Orchestration - Kubernetes</td>
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<td>March 1</td>
<td>Containerization hands-on</td>
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<td>March 6</td>
<td>Introduction to Networks</td>
<td>Project out</td>
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<tr>
<td>March 8</td>
<td>Spark GraphX</td>
<td>Assignment – 4 out</td>
<td>Assignment – 3 due</td>
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<tr>
<td>March 20</td>
<td>Spark Graphframes</td>
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<tr>
<td>March 22</td>
<td>Spark Graphframes hands-on</td>
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<td>Project proposal due</td>
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<td>March 27</td>
<td>PageRank</td>
<td>Quiz – 5 out</td>
<td>Quiz – 5 due</td>
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<tr>
<td>March 29</td>
<td>Demo on Cloud services – 1 &amp; 2</td>
<td>Assignment -5 out</td>
<td>Assignment – 4 due</td>
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<td>April 3 and 5</td>
<td>TBA</td>
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<td>April 10</td>
<td>Introduction to Cloud Security</td>
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<td>Project Intermediate presentations due</td>
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<td>April 12</td>
<td>Cloud Security – Symmetric Encryption</td>
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<tr>
<td>April 17</td>
<td>Cloud Security – Asymmetric Encryption</td>
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<td>April 19</td>
<td>Cloud Security – Extras</td>
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<td>Assignment – 5 due</td>
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<td>April 24,26</td>
<td>Final Project Presentations</td>
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<td>Project due</td>
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<tr>
<td>May 1</td>
<td>Final Project Presentations</td>
<td>Quiz - 6</td>
<td>Quiz – 6 due</td>
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Instructor Response Time
Students can email the instructor or use Canvas discussion board to post their questions regarding course materials, assignments, and quizzes. The average response time of the instructor to answer all common queries will be 12 - 16 hours. Students will receive Quiz grades within 1 week after the deadline and Programming Assignments will be graded within 2 weeks after the submission deadline. All grades will be posted on Canvas along with detailed student feedback.

Participation Expectations
CS 4523 / CS 5123 is a programming intensive course. All programming assignments and quizzes will be based on Python programming and PySpark. Students will receive tutorials on PySpark programming in the course. But basic Python programming experience is required for the course. Students require basic knowledge on Linux terminal commands as they will be working with Linux terminals for all assignments.

Students should expect to be working on this course assignments and project for minimum 4 hours a week. If a student has not participated in any discussions, quizzes, or assignments within the first two weeks of class then it is at the discretion of the instructor to submit an academic alert or contact the student directly to discuss options for continuing in the course.

Course activities and Grading
The course activities consist of programming assignments, quizzes, and a final team/individual 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 CST on the scheduled submission date. There will be 4 - 6 quizzes. The final project should be technically strong 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:

**CS 4523:**
- Group project: 30%
- Assignments: 30%
- Quiz: 30%
- Class participation: 10%

**CS 5123:**
- Group project: 30%
- Assignments: 50%
- 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 in discussion boards.

**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, quizzes, and a project. So, there will be no extra time given to any deadlines. 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:


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**University Policies**

**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 all OSU courses. Participating in 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 their entirety) should not be uploaded to websites offering note-sharing, tutoring, or other academic help (free or by paid subscription).

CLASS ATTENDANCE AND PARTICIPATION
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 your grade may be affected by your absence, and 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. Faculty are expected to treat a positive COVID test result as appropriate documentation for an excused absence and are encouraged to remain flexible for students who need to quarantine for other COVID-related issues (e.g., member of household instructed to quarantine). Although instructors may be willing to livestream in-person courses through an online platform, livestreaming is not required or expected. Each instructor will determine how to best assist students with excused absences (including absences due to quarantine requirements) for in-person classes and should include details in their course syllabus.

If you are required to participate in official university-sponsored activities or military training, you should receive an excused absence as discussed in OSU’s Attendance Policy for Students. 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.

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/ https://accessibility.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.

STUDENT SUPPORT AND CONDUCT
328 Student Union/405-744-5470/ https://ssc.okstate.edu/
By enrolling at Oklahoma State University, you accept responsibility for complying with all University policies and contracts, and for local, state and federal laws on- or off-campus that relate to the University’s mission. The Student Code of Conduct educates students about their civic and social responsibilities including policies and procedures involving student misconduct.

In general, the University expects students to aspire to follow and promote the Cowboy Community Standards or integrity, community, social justice, respect, and responsibility.

This course strictly follows OSU’s policies.  
More University Policies: Check the course Canvas page