Distributed Systems and Algorithms
CSCI 4510/6510 – Fall 2019
Prof. Stacy Patterson  http://www.cs.rpi.edu/~pattes3/dsa/

Course Description
This course explores the principles of distributed computing systems, emphasizing fundamental issues underlying the design of such systems: communication, coordination, synchronization, and fault-tolerance. We will study key algorithms and theoretical results and explore how these foundations play out in modern systems and applications like cloud computing, edge computing, and peer-to-peer systems.

Below is a list of course topics and a preliminary schedule. The instructor may change the order and the contents depending on students’ backgrounds and other considerations.

- **Lecture 1**: Introduction to Distributed Systems
- **Lectures 2-3**: Clocks and the ordering of events in distributed systems
- **Lectures 4-5**: The Replicated Log and Dictionary Problem
- **Lectures 6-9**: Distributed Mutual Exclusion
- **Lectures 10-11**: Global Snapshots
- **Lectures 12-13**: Broadcast Algorithms
- **Lectures 14-18**: Distributed Agreement
- **Lecture 19**: Leader Election
- **Lectures 20-21**: Byzantine Agreement
- **Lecture 22**: Commit Protocols
- **Lectures 23-25**: Consistency Models and Replication Algorithms
- **Lectures 26-27**: Consistent Hashing and Distributed Hash Tables
- **Lecture 28**: Amazon Dynamo

Pre-requisites
- CSCI-2300: Introduction to Algorithms
- CSCI-4210: Operating Systems

Learning Outcomes
Upon successful completion of this CSCI 4510 and 6510, a student is able to:
- Understand and apply different models and abstractions for distributed systems
- Describe and analyze key algorithms for distributed systems
- Identify fundamental limitations and impossibility results for distributed systems
- Implement distributed algorithms in real-world distributed computing platforms
- Understand and identify applications of distributed algorithms in real-world systems

In addition, on successful completion of CSCI 6510, a student is able to:
- Read and analyze research papers on distributed systems and algorithms
- Develop and analyze novel distributed algorithms

Textbook
There is no required textbook for this course. All course material will be presented in lecture, and conference and journal papers related to this material will be posted on the course web site.

This text may describe different algorithm variations than those I present in class. You are responsible for learning the algorithms versions and content presented in lecture.
Grading
Grading will be based on the following:

- In Class Quizzes: 55%
- Take-home Quizzes: 10%
- Programming Project 1: 15%
- Programming Project 2: 20%

All grades will be posted in Gradescope.

The following chart will be used to assign course letter grades. Grades will be rounded to the nearest integer. The cutoff points may be lowered, and a different curve may be used for CSCI 4510 and CSCI 6510.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93 – 100</td>
</tr>
<tr>
<td>A-</td>
<td>90 – 92</td>
</tr>
<tr>
<td>B+</td>
<td>87 – 89</td>
</tr>
<tr>
<td>B</td>
<td>83 – 86</td>
</tr>
<tr>
<td>B-</td>
<td>80 – 82</td>
</tr>
<tr>
<td>C+</td>
<td>77 – 79</td>
</tr>
<tr>
<td>C</td>
<td>73 – 76</td>
</tr>
<tr>
<td>C-</td>
<td>70 – 72</td>
</tr>
<tr>
<td>D+</td>
<td>67 – 69</td>
</tr>
<tr>
<td>D</td>
<td>60 – 66</td>
</tr>
<tr>
<td>F</td>
<td>0 – 59</td>
</tr>
</tbody>
</table>

In-Class Quizzes
There will be 6 in-class quizzes. Quizzes are not cumulative. Each quiz will be about 45 minutes. The dates of the quizzes are posted on the course web site. Any change in the quiz schedule will be announced in class at least two weeks before the affected quiz. Requests for quiz regrades must be made within 7 days of their return. Quiz makeups will only be given if you have an excused absence from RPI.

Take-Home Quizzes
There will be 3 take-home quizzes. Each quiz will consist of two or three questions. The format will be similar to quiz questions, but content may come from any lecture prior to the quiz. In-classes quizzes will be announced in lecture, and the quiz questions will be posted on the course website. Each quiz will be due the day of the lecture following its announcement. Take-Home quizzes must be submitted through Gradescope. No late quizzes will be accepted without an excused absence from RPI.

Programming Projects
There will be two programming projects in which students will implement applications using algorithms studied in class. The projects will be done in groups of two, unless the professor approves otherwise. There will be slightly different project requirements for CSCI 4510 and CSCI 6510.

For each project, students must submit their code and a project report and give a demonstration of their application. Late code, reports, and demonstrations will not be accepted.

Students with Special Needs
Federal law requires all colleges and universities to provide specified types of assistance to students with disabilities. If you have such special assistance, please obtain an authorizing memo from Disability Services for Students. Information about a student's special needs will be treated as confidential. Please submit a copy of your authorizing memo to the professor at least two weeks in advance of any affected assignment. Failure to do so may result in a lack of special accommodations.

Academic Integrity
For programming assignments, discussion is allowed, but you must write all of your own code. In-class quizzes will be closed book and will be done independently. The policy take-home quizzes is posted on the course website. Violation of the policies for projects, quizzes, or exams will be considered a breach of academic integrity, and the student will be subject to penalties outlined in The Rensselaer Handbook of Student Rights and Responsibilities, including "an academic (grade) penalty administered by the professor and/or disciplinary action through the Rensselaer judicial process described in this handbook."