Lecturer: Professor Shikharesh Majumdar, Room 5203 Canal Building, 520-2600 (Extn. 5654), email:majumdar@sce.carleton.ca

Office Hours: By appointment

Preequisites: Permission of the instructor

Course Objectives:

This course is concerned with resource management on distributed systems including clouds and grids: concepts, techniques, analysis, and performance. Topics of discussion will include:

- Principles and techniques for management of resources in distributed systems including grids and clouds;
- Management of: computing and storage resources; service level agreements;
- Techniques for: scheduling; allocation;
- Dynamic resource provisioning;
- Techniques for handling heterogeneity;
- Cyber-physical systems and large data sets: sensor networks & resource management techniques for analysis of large data sets.

Basic concepts will be covered through formal lectures. A more informal discussion will take place for addressing current research issues. The students will work on (up to two/three) assignments that will further their understanding of the subject. Each student will take a deeper investigation of a specific topic and make a class presentation based on the available literature on the topic. The student has to complete a course project that will concern the concepts and techniques learnt. The course also has an exam. This exam is for evaluation purposes only and will not be returned to the student. If you want you will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

Learning Outcomes

Understand the motivation and requirements for resource management on distributed systems including clouds and grids

Know the basic units of computation and performance metrics used in parallel/distributed systems

Know the important principles that underlie resource management on parallel/distributed systems
Know resource management algorithms for matchmaking and scheduling on parallel/distributed systems

Understand the role of auto-scaling and know selected autoscaling algorithms

Understand the role of MapReduce in analyzing large data sets and know selected resource management algorithms for handling MapReduce jobs

Able to analyze the performance of resource management algorithms

**Approximate Marking Scheme:**
Assignments: 20%
Class Presentation: 15%
Project: 30%
Exam (in class): 35%

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**General Regulations**

**Student Responsibility:** It is the student's responsibility to remain informed of all rules, regulations and procedures required by their program and by the Faculty of Graduate and Postdoctoral Affairs. Ignorance of regulations will not be accepted as a justification for waiving such regulations and procedures.

**Academic Integrity:** Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: [https://carleton.ca/registrar/academic-integrity/](https://carleton.ca/registrar/academic-integrity/). This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

**Plagiarism:** Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

**Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current *Graduate Calendar, Academic Regulations of the University, Section 9.3.*

**Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at [http://www.carleton.ca/equity/](http://www.carleton.ca/equity/). For an accommodation request, the processes are as follows:

- **Pregnancy or Religious obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after
the need for accommodation is known to exist. For more details see https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf

- **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your *Letter of Accommodation* at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation *(if applicable)*. **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam *(if applicable)*.

- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.

- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

**Copyright on Course Materials:** The materials created for this course (including the course outline and any slides, posted notes, labs, project, assignments, quizzes, exams and solutions) are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

**Health and Safety:** Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf

**Students from the University of Ottawa:** You can request to have access to cuLearn: please see http://gradstudents.carleton.ca/forms-policies/