Course Outline

Professor: Dr. Dorina Petriu
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Office hours: Thursdays, 4:00 - 5:30 pm
Otherwise email me for an appointment.

Calendar Description:
Techniques based on measurements and models, for predicting and evaluating the performance of computer systems. Instrumentation. Simple queueing models and approximations. Techniques for modifying software designs to improve performance.
Also offered at the graduate level, with additional or different requirements, as SYSC 5101, for which additional credit is precluded.
Prerequisites: STAT 3502, and (SYSC 3001 or SYSC 4001).
Lectures three hours a week, laboratory/problem analysis three hours alternate weeks.

Course Description and Objective:

Performance in this course deals with time and capacity characteristics of computer-based systems. When systems are designed for functionality only, the time to complete a response may be so long that the system is ineffective; similarly, its capacity to serve a large number of users may be inadequate making the system uneconomic to use. Both of these problems occur often in practice. Performance engineering that aims at solving these problems is a body of concepts and techniques for evaluating systems and system designs, using measurements and models.

Meeting performance requirements (such as response time, throughput, etc.) is a major concern for all kinds of software products with performance constraints, and especially for real-time systems. Software Performance Engineering (SPE) addresses performance issues throughout the whole software lifecycle and aims to ensure that software products under development will meet their performance requirements. SPE uses predictive performance models to assess different design alternatives at an early stage, before major obstacles to performance are frozen in design and code. This can improve the quality of the final product by helping designers to make informed choices and trade-offs early in the life cycle, when changes are not expensive and open alternatives still exist. As the product evolves, so does the performance model, capturing more system features and producing more accurate results.

The course will cover different basic approaches to performance engineering. Topics will be chosen from measurement techniques, interpreting and comparing results, models that explain capacity constraints and delays (bottleneck models, queueing models), an introduction to hard-real-time delay constraints and schedulability evaluation for embedded systems and software performance engineering.

The goal of this course is to prepare the students to address performance problems in real-time concurrent and distributed systems, such as embedded controllers, enterprise distributed systems, web services-based systems and cloud systems. It will introduce the conceptual framework and the nature of performance problems and solutions, so that the student can go into the field.

The main objective/outcome of this course is to teach the students how to use performance engineering tools for design, experimentation, simulation, visualization, and analysis.
Prerequisites
Students who have not satisfied the prerequisites for this course must: a) withdraw from the course; b) obtain a prerequisite waiver from www.sce.carleton.ca/ughelp, or c) may be deregistered from the course after the last registration deadline.

Lectures:
When: Wednesdays and Fridays, 4:00 - 5:30 pm
Where: ME 4499

Laboratory Sessions:
When: Mondays, 2:30 - 5:30 pm (alternate weeks)
Where: AA 508

Textbook:
The following textbook will be the primary reference:
(free download from http://www.cs.washington.edu/homes/lazowska/qsp/).

References:

Marking Scheme:
20% Assignments
10% Labs
20% Mid-Term Exam (TBD, in-class)
60% Final Exam (Centrally scheduled, 3 hours).

Important Notes
1. To pass this course, a student must obtain an appropriate overall mark (D- or higher), a passing mark (D- or higher) for the final exam and get credit for at least five out of six labs.

2. The final exam will be held during the formal examination period set out in the University Calendar and will be scheduled by Exam Services. The instructor will not accommodate any special requests or alternate arrangements. The final exam is for evaluation purposes only and will not be returned to the student. Students who miss the final exam may be granted permission to write a deferred examination (see the Undergraduate Calendar for regulations on deferred exams).

3. Students who miss the midterm due to illness must provide a valid medical certificate to the instructor no later than 48 hours after returning to campus. The certificate must clearly state the name of the doctor with contact information. Once the certificate has been verified, a make-up midterm examination will be arranged (outside of the class hours).
Lab Periods:

Attendance at the scheduled laboratory periods is mandatory, and attendance will be taken. During the labs, you will work on short exercises that are intended to provide practical experience with tools and techniques related to the concepts presented in the lectures. You will normally be required to demonstrate and submit your lab work by the end of the lab period (or other specified deadline), as indicated in that week's lab handout.

Your work in each lab period will be graded satisfactory, marginal, or unsatisfactory.

- **Satisfactory** (75-100%) means that you were present at the lab and made reasonable progress towards completing the lab exercises. Note that you do not have to finish all the exercises to receive a satisfactory grade.
- **Marginal** (50-75%) means that you made some progress towards completing the exercises, but your solutions to were not sufficiently complete to warrant a satisfactory grade. This grade indicates that you may be falling behind, and should take steps to remedy this situation.
- **Unsatisfactory** (0-50%) means that you were absent from the lab period, or you attended but made little or no progress towards completing the lab exercises. This indicates that you are likely having difficulty understanding important concepts and should seek help from your instructor as soon as possible. You will also receive unsatisfactory if you do not demonstrate or submit your work before the deadline or if it is apparent to the TA that you did not do enough of the lab work on your own; that is, you relied on your colleagues to explain the exercises and provide solutions. If you are absent from a lab period for any reason, it is up to you to do the missed lab work on your own time. Serious long-term illness will be dealt with on an individual basis. In these circumstances, please contact your instructor to discuss appropriate arrangements.

Assignments:

Students are encouraged to discuss issues when working on assignments; however, you are expected to submit your own work for grading (assignments are individual work). There is a fine line between cooperating with your colleagues (discussing problems and ideas) and copying solutions (plagiarism). Not only plagiarism is an instructional offence (see the Undergraduate Calendar), but doing the assigned work by yourself is by far the best way to prepare for the exams.

**Submission:** Assignments are due at midnight of the due date and must be submitted online on cuLearn. When submitting assignments, double check that your material has indeed been submitted.

Late assignments will be graded according to the following policy: a cumulative 10% penalty per day (i.e., 24 hours) with a maximum of two days.

Copyright:

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).
Academic Accommodation
You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation: write to me 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 the Student Guide [https://carleton.ca/equity/?p=191](https://carleton.ca/equity/?p=191).

Religious obligation: write to me 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 the Student Guide.

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). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Health and safety:

Plagiarism:
Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated. Please refer to the section on instructional offenses in the Undergraduate Calendar for additional information.

Tentative Week-by-Week Outline
The following is a tentative outline of the course; it might change, based on time constraints:
Week 1: Performance concepts and requirements.
Week 2: Performance measurement. Workloads.
Week 4: Memory hierarchy effects.
Week 5: Queueing Analysis.
Week 6: Software resources.
Winter Break. Classes are suspended.
Week 7: Layered resource effects.
Week 8: Measurement and tools.
Week 9: Hard real-time systems. Schedulability analysis for hard real-time systems
Week 10: Software Performance Engineering.
Week 11: Software Performance Engineering (continued)
Week 12: Case Study.