Advanced Modeling and Analysis of Workflow Systems

Course Information

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Course Prefix and Number: ISYE 4113
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Course Description

This course will introduce the students to an in-depth modeling and analysis of the workflow dynamics that shape the operation of a broad range of modern applications, ranging from the contemporary production systems to health-care facilities. More specifically, in its primary developments, the course material will be motivated and presented primarily through applications drawn from the high-volume discrete-part manufacturing domain, for specificity and concreteness. But through additional examples, homework and exam problems, it will be further demonstrated how the presented models and methods are also applicable in many other application domains involving a structured workflow, like various logistics and health care operations, and even the broader service industry.

An important attribute of the course is that it does not intend to teach the students only the various models and computational methods that are covered in it, but also the thinking processes and the broader modeling and analytical methodology that underlie the development of the presented results. Developing these perspectives and the corresponding skills is important for an effective application of the course material, and even the adaptation and extension of this material in order to address various nuances and intricacies in those applications that will be encountered by the students in their professional life. The ongoing advent of Generative Artificial Intelligence (AI) and the proliferation of the various Large Language Models (LLMs) render this more profound understanding of the presented models and methods even more imperative, as the students eventually will be called to navigate an effectively exploit all the corresponding information and capability that is provided by these platforms.

Course Learning Outcomes

By enrolling in this course, students will:

1. Understand and appreciate the necessity and the significance of using queueing theoretic-modeling and analysis for the systematic study of the sequential workflows that support the operations of the target application environments.
2. Use effectively the fundamental concepts, terminology, results and methods of the employed queueing theory in the context of the considered applications.
3. Appreciate the role and the significance of a pertinent modeling abstraction as an effective tool for structuring design, analysis and control problems in various application

domains, while controlling the conceptual / representational, analytical and computational complexity of these tasks.
4. Understand the effective / proper use of the presented models (as defined by their structure and their embedded assumptions), their potency, but also their limitations.
5. Understand the complementarity of the presented models and theory with discrete-event simulation.
6. Experience the potential of the current LLM platforms in the course domain.
7. Strengthen their ability to adapt the prototypical developments presented in class, through their composition, adaptation and extension, in order to address additional workflows arising in "real-world" settings.

Course Prerequisites

The main course prerequisite is ISyE 3232. More specifically, you are expected to be comfortable with the stochastic/probabilistic models and the basic queueing theory that are covered in that course.

Also, it is expected that you are familiar with some basic concepts and techniques coming from deterministic optimization theory.

Required Course Materials

1. **G. L. Currry and R. M. Feldman, Manufacturing Systems Modeling and Analysis (2nd ed.), Springer, 2011.** This is the official course textbook, and it will function as a primary base for the course development. A large part of the homework will also be assigned from this book.

2. Additional supplementary material will be provided through (i) a course website accessed from the instructor's homepage, (ii) CANVAS announcements, and (iii) in-class developments.

Grading Policy

Homework: Homework will be assigned every time that a course unit is covered, and its primary intention is to help the students internalize the material by applying it on a set of problem instances. Some of the assigned questions and problems might also serve the additional objective of strengthening the modeling and analytical capabilities of the students by asking them to provide certain extensions and modifications of the results presented in class. Homework can be worked out in teams, but each student must turn in his/her own write-up and any occurring collaboration and interaction must be reported in the write-up itself.

Exams: There will be three exams spread out quite evenly along the semester but their exact dates will be determined based on the course progress. **No collaboration or any other type of interaction is allowed for the exams.**

Grading Scheme:

- Homework: 20% (provided that we shall have a grader)
- Midterm Exam I: 25%
- Midterm Exam II: 25%
- Final Exam: 30%

AI Policy

You are welcome to use the current LLM platforms in the preparation of your solutions for the assigned homework and the exams, but the ultimate responsibility for the final outcome of such a usage is yours.

Attendance Policy

Class attendance is encouraged but optional. However, you are responsible to remain abreast with respect to the in-class and the overall course developments.

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the Student Code of Conduct and the Academic Honor Code, especially Appendix A: Graduate Addendum to the Academic Honor Code.

Allegations of misconduct are handled in accordance with the procedures outlined by the Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct.

Core IMPACTS

Not applicable.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.