MIE 562F Scheduling, Fall 2024

Instructor: Chang Liu email: changy.liu@mail.utoronto.ca

Office Hours: Office: BA8140
Email to make an appointment

TAs: Minori Narita <minori.narita@mail.utoronto.ca>
Rahul Patel <rm.patel@mail.utoronto.ca>

Text: **Required:** Pinedo, M., *Planning and Scheduling in Manufacturing and Services*, Springer, **2nd edition**, 2009.

An electronic version of this book is available (**for free!**) via the library. Follow the link below and you will be prompted for your UTORid. If it doesn't work for you, go to library.utoronto.ca and search for the book in the catalog. You can then download it from there.

link.springer.com.myaccess.library.utoronto.ca/book/10.1007/978-1-4419-0910-7

Website: q.utoronto.ca
Piazza site: https://piazza.com/utoronto.ca/fall2024/mie562

Course Overview

This course takes a practical approach to scheduling problems and solution techniques, motivating the different mathematical definitions of scheduling with real-world scheduling systems and problems. The methodological theme of the course is the use of search (partition, relaxation, and inference) to solve hard combinatorial problems. Topics covered include job shop scheduling, timetabling, project scheduling, and solution approaches including constraint programming, mixed-integer programming, local search, heuristics, and dispatch rules. Also covered will be a brief introduction to stochastic scheduling, complexity theory, decomposition techniques, and information engineering aspects of building scheduling systems for real-world problems. A group project will require the implementation of two or more scheduling algorithms. Evaluation will be based on four assignments, one term test, the project, and the final exam. Students should have the ability to program in Python and a basic knowledge of standard optimization techniques as taught in second- and third-year MIE courses.

All dates/times in this document refer to Toronto time.

Lectures & Tutorials
The course will be taught in-person at the following times:

Lectures:	Tue:	13:10 – 14:00	HA 410
	Wed:	13:10 – 14:00	BA 1230
	Fri:	13:10 – 14:00	WB 119
Tutorials:	Mon:	12:10 – 13:00	BA 2139
	Wed:	12:10 – 13:00	BA 2139

Lectures & tutorials start on Sept 3!

Note that for some weeks, the tutorial and lecture slots will be swapped. See detailed lecture schedule on Quercus.

Communication
Please use the discussion forum on the piazza website. The TAs and I will be monitoring and responding to questions. You should also respond to questions on the message board if you know the answer. I will respond to email and message board postings within 48 hours.

Each student should schedule an individual meeting with the instructor before the end of October (see below).

Planned Topics
See the *detailed lecture schedule* linked from the Quercus homepage.

Marking Scheme

Introduction Video	(Fri, Sept 6, 23:59)	1
Assignment #1	(Fri, Sept 20, 23:59)	3
Assignment #2	(Fri, Oct 4, 23:59)	3
Term Test	(**Wed, Oct 9, 12:10 - 14:00, TBD**)	20
Individual Meeting	(by Fri, Oct 25, 17:00)	1
Assignment #3	(Fri, Oct 25, 23:59)	6
Assignment #4	(Fri, Nov 15, 23:59)	6
Term Project	(multiple deadlines - see project doc)	15
Final Exam	(to be scheduled by FASE)	45
Total		100

Details on each of the course components will be made available on Quercus well in advance of the due dates. A brief description of each follows.

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Introduction Video
A short (30-60 second) video introducing yourself and advertising your skills for a project team. See "Introduction Videos" from the Modules page of Quercus.

Individual Meeting
A short (~10 minute) meeting with the instructor. While we may talk about course content (and I may ask you some questions) this is not an oral exam. And we may not even talk about the course. If you show up and talk to me, you will get full marks.

Please do not wait until the last week of October – my availability will be limited and not all of you can meet with me at the last minute.

Assignments
Assignments will be similar to those in previous years (see Quercus for past assignments).

Term Test
Wed, Oct 9, 2024: 12:10 - 14:00, location TBD: All material up to Lecture 15 inclusive.

Final Exam
The exam will be scheduled by the FASE during the regular exam period.
It will cover all material in the course.

Term Project
The project is a *team effort* to design and implement at least two different scheduling algorithms on a problem of your choice. Teams will consist of 4 or 5 members. See the "Project" module on the Quercus site for details.

Note that the term project is **mandatory**. This means that if you fail to complete it, you will receive a grade of incomplete (INC) on your transcript regardless of the actual mark you have earned in the course.[1]

Learning Outcomes
By the end of this course, the student will be able to:

- identify scheduling problems underlying organizational processes and goals and the role of scheduling problems in information systems
- identify characteristics of scheduling problems including those related to computational complexity
- select, defend, and criticize a variety of mathematical models of and algorithms for scheduling problems depending on their characteristics
- create, evaluate, and compare multiple appropriate mathematical models of and algorithms for scheduling problems
- learn to use existing computational and mathematical tools to solve a variety of scheduling problems

[1] Why am I doing this? Aside from the project being an important part of the course, in a previous term, we observed students in some courses deciding to not complete a group project because they had already passed the course. You can imagine that their team-mates were not very impressed.

Graduate Attributes
This course has the following graduate attributes all at the level of Advanced Application. (For more information see: https://www.engineering.utoronto.ca/files/2018/10/U-of-T-Engineering-Graduate-Attributes_F.pdf).

- GA1: A knowledge-base for engineering.
  - the ability to formulate mathematical models for scheduling problems using a variety of mathematical formalisms
- GA2: Problem analysis.
  - a basic appreciation of computational complexity and how appropriate solution methodologies can be chosen based on the computational complexity of the problem.
  - ability to perform basic proofs of problem complexity
  - identification of key aspects of scheduling problems including resource use, dynamism, and temporal relationships
- GA5: Use of engineering tools.
  - ability to select and use existing optimization tools in the areas of mixed integer programming and constraint programming and to develop specialized heuristic and meta-heuristic algorithms using Python
- GA7: Communications skills.
  - ability to write report documents, speak in front of an audience, and prepare simple videos
- GA12: Life-long learning.
  - ability to independently identify and use existing tutorial and technical material to understand and exploit available engineering tools such as Gurobi, CPLEX, and CP Optimizer

Academic Integrity
With the exception of the term project, the work that you are marked on in this course is individual work. For "take-home" assessments (e.g., assignments), you can use all the course material and material from outside the course to complete the evaluations. However:

- You may not consult any other person either in MIE562 or outside MIE562.
- You may not get another person to do any part of an evaluation.
- You may not post the content of any questions to *any* websites. This includes sites such as Chegg, StackExchange, etc.

The work must be entirely your own.

Consistent with the University regulations on academic integrity (see https://www.academicintegrity.utoronto.ca/), I will pursue the University procedures to the full extent for all cases.

See the project description document for the details of academic integrity rules for the project.

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Video Recording
Lectures (but not tutorials) will be recorded using the OpenCast system. As a result, your participation will be recorded on video and will be available to students in the course for viewing remotely. These lecture captures are not a replacement for attending lecture but may help your learning. Note that not all lectures will be recorded due to technical resources (i.e., the tutorial room cannot use OpenCast) but we will do our best to provide video material.

It is possible that public health regulations may result in a switch to online delivery. If that happens, this course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation, and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

Inclusivity Statement
You belong here. The University of Toronto commits to all students, faculty, and staff that you can learn, work, and create in a welcoming, respectful, and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success.

We expect each of us to take responsibility for the impact that our language, actions, and interactions have on others. Engineering denounces discrimination, harassment, and unwelcoming behaviour in all its forms. You have rights under the Ontario Human Rights Code. If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism, and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can disclose incidents of discrimination or harassment to our Assistant Dean, Diversity, Inclusion and Professionalism through email (marisa.sterling@utoronto.ca) or through a disclosure form (https://www.engineering.utoronto.ca/about/equity-diversity-and-inclusion/disclosing-incidents-of-bias-discrimination-harassment-or-unprofessionalism/). You can also talk to anyone you feel comfortable approaching, including your professor or TA, an academic advisor, the Engineering Equity Diversity & Inclusion Action Group, any staff member, or the U of T Equity Office.

You are not alone. Here (https://www.engineering.utoronto.ca/about/equity-diversity-and-inclusion/) you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

Statement on Accommodations
The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register as soon as possible with Accessibility Services at https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentation-requirements/.
Phone: 416-978-8060
Email: accessibility.services@utoronto.ca

Mental Health Statement
As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. Please note, the University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have a First-Year Advisor, a Departmental Undergraduate Advisor, or a Departmental Graduate Administrator who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage (https://www.engineering.utoronto.ca/mental-health-wellness/). A small selection is also included here:

- Accessibility Services & the On-Location Advisor
- Graduate Engineering Council of Students' Mental Wellness Commission
- Health & Wellness and the On-Location Health & Wellness Engineering Counsellor
- Inclusion & Transition Advisor
- U of T Engineering's Learning Strategist and Academic Success
- U of T Engineering's Mental Health Programs Officer
- My Student Support Program (MySSP)
- Registrar's Office
- SKULE Mental Wellness
- Scholarships & Financial Aid Office & Advisor

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at My Student Support Program (MySSP - https://mentalhealth.utoronto.ca/services/u-of-t-my-student-support-program-my-ssp/) or visiting U of T Engineering's Urgent Support – Talk to Someone Right Now webpage (https://www.engineering.utoronto.ca/talk-to-someone-right-now/).

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Land Acknowledgement

I wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

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