CSI 690: *Numerical Methods*
Fall 2021,

Class modality: Synchronous, in-person and online (via Zoom)
Class time: Thursdays, 4:30 pm - 7:10 pm

Instructor Name: Estela Blaisten
Office location: Research Hall 221, Fairfax campus
Office hours: By appointment for a video-conference meeting (Zoom)
Email address: blaisten@gmu.edu (preferred way of communication)

- ***The class modality is synchronous, in-person/online.*** *Activities and assignments in this course will regularly use web-conferencing software (Zoom) and classroom projection. Students are required to have a laptop/desktop with a functional camera and microphone. Headphones are additionally required for in-person students. In an emergency, online students can connect through a telephone call, but video connection is the expected norm.*
- *All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Similarly,* ***all students in face-to-face and hybrid courses must also complete the Mason COVID Health*** *Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, or Red email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.*
- *Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021,* ***all community members are required to wear a facemask in all indoor settings, including classrooms****. An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks consistently will always be welcome in the classroom.*
- *If the* ***campus closes****, or if a* ***class meeting needs to be canceled*** *or adjusted due to weather or other concern,* ***students should check the course website and your email for updates*** *on how to continue learning and for information about any changes to events or assignments.*
- ***Professor Blaisten does not authorize in anyway the recording*** *of any lecture content in this course. Sharing of video lecture or lab content violates student privacy governed by the Family Education Rights and Privacy Act (FERPA). Additionally, any written, video, or audio content built by Prof. Blaisten for CSI 780 instruction that is shared online externally to GMU is a clear and punishable violation of GMU's Honor Code.*
- *If Professor Blaisten needs to quarantine, the current in-person sessions will reverse to be online for the rest of the semester.*
- *In this classroom, RH249, it is prohibited to bring drinks or food of any sort. Students breaking this regulation are considered unruly and consequences will follow.*

Course Description and Goals

The course introduces the foundations of mathematical methods for solving computationally a variety of scientific problems. Students will develop the ability of solving quantitatively a problem by means of computer implementations.

By the end of this course, students will be able to

1. apply various algorithms for solving numerical problems in computational science
2. appraise theoretical foundations of algorithms
3. develop practical skills for writing computer programs that include numerical methods
4. perform elementary simulations

Prerequisites: Calculus, introductory linear algebra, and **knowledge of a programming language**. An understanding of the basic concepts of differential equations is helpful.

Required Textbooks

Scientific Computing, an Introductory Survey by Michael Heath, 2nd edition, McGraw-Hill

Numerical Methods for Engineers by Steven Chapra and Raymond Canale, 7th edition. For use of other editions, contact the instructor.

Evaluation

There will be weekly sets of homework and two exams. Several short class presentations will be assigned to students along the semester. The grade for this class will be based on your overall performance and participation during the semester. A tentative weight for each component of the grading follows:

Grading scale (points): A (90-100), B (80-89), C (≤79) (with eventual slight variations)

Grading policy:

1) Homework (50%). Each of 12 homework will be graded between 1 and 10. Ten is the best. Only handled-in hard copies will be accepted. Present homework in a report-like fashion.
2) Midterm classroom exam (open book) (20%).
3) Final classroom exam (open book) (20%).
4) Class participation and attendance (10%).

Late assignments: Late assignments will not be accepted unless due to emergency or work-related compelling reasons for part-time students.

Re-do homework policy:

1) Homework graded and returned to you can be redone for a better grade with a penalty of minus 1 point on the final grade.
2) Redo homework should be turned in with the original handout containing the corrections.

Other considerations: If there are any issues related to religious holidays, please inform the instructor the first week of class

Course schedule for Fall 2021 (tentative)

Lecture 1, Sep 2
Numerical methods in science. Approximations and error analysis.

Lecture 2, Sep 9
Systems of linear equations.

Lecture 3, Sep 16
Linear least squares.

Lecture 4, Sep 23
Nonlinear equations. Roots of equations.

Lecture 5, Sep 30
Optimization and minimization

Lecture 6, Oct 7
Interpolation and curve fitting.

Lecture 7, Oct 14
Midterm classroom exam

Lecture 8, Oct 21
Numerical differentiation and integration

Lecture 9, Oct 28
Random numbers and stochastic simulation. Monte Carlo algorithms.

Lecture 10, Nov 4
Boundary value problems for ordinary differential equations

Lecture 11, Nov 11
Partial differential equations

Lecture 12, Nov 18
Fourier transforms

Lecture 13, Dec 2
Applications: Tentatively, simulation of the dynamics of an atomic system

Final exam: will be held at the scheduled date, during the exam week in December.

Course Logistics

The course uses a password protected website for distributing lecture materials and study recommendations. You access the site remotely with a browser (Firefox, Safari, etc).

ID/password instructions will be sent by email to your GMU email.

IT Requirements for the Course

Hardware: You will need access to a Windows, Macintosh, or Linux computer. It can be your own or a platform within Mason. The CDS lab allows you to work remotely in any of 24 linux workstations through SSH (or Putty or equivalent):

cdsXX.mesa.gmu.edu, where XX=01 through 24

The password for the login is the same as your password for email or patriotweb. These workstations do not share the desktops. Therefore, it is recommended that you take note on what computer you work the first time, and then keep working in that computer for the rest of the semester.

To access these workstations you need to install the VPN (Virtual Private Network) and to be logged in to it. For the installation use:

https://its.gmu.edu/service/virtual-private-network-vpn/

Once installed and logged as VPN user (STUDENT VPN), you can connect through SSH or Putty terminal and remotely login into the cdsXX workstations with your Mason ID/passwd.

Software: Computers in this lab have all the needed software. They have installed compilers for Fortran, C, c++. Python and MatLab. If computers in this lab are not used, students are expected to have access to a programming language software suitable for scientific calculations.

Course Policies: Student Responsibilities

Email: Students are responsible for reading and maintaining the content of university emails sent to their Mason email account. Therefore, students are required to activate their email account and check it regularly. All communications from this course will be sent to students solely through their Mason email account. Alternatively, a "forward" can be set to forward any Mason email incoming message to your preferred email account.

Use of phones, cameras, recording, texting in class is not allowed. Students should turn off their smart devices while in the classroom or Zoom-classroom.

- *The use of laptop or a desktop computer is required in this class. You will only be permitted to work on material related to the class, however. Engaging in activities not related to the course (e.g., gaming, email, chat, etc.) will result in a significant reduction in your participation grade.*
- *We will frequently be using the internet as a means to enhance our discussions. We will also be using computers for our in-class writing assignments. Please be respectful of*

your peers and your instructor and do not engage in activities that are unrelated to the class. Such disruptions show a lack of professionalism and may affect your participation grade.

Academic integrity: Students are responsible for their own work and must take on the responsibility of dealing explicitly with consequences to any academic integrity violation. [See Academic Integrity website: https://oai.gmu.edu/distance].

Honor Code and Classroom Conduct: Students must adhere to the Mason Honor Code:

"To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this: Student members of the George Mason University community pledge not to cheat, plagiarize, steal and/or lie in matters related to academic work."
[Honor Code website https://oai.gmu.edu/mason-honor-code/full-honor-code-document/].

This is very important. [See Academic Integrity website: https://oai.gmu.edu/].

Academic honesty policy of the course: Students are expected to abide to the Honor Code. Academic dishonesty will not be tolerated in this class. Exams and homework must reflect individual work. If you have difficulty with the assignments, discuss them with the instructor.

Students with disabilities: Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform the instructor, in writing, at the beginning of the semester [See Office of Disability Services website: https://ds.gmu.edu].

Students that become ill: Students that become ill should follow the Mason health recommendations and steps to follow: [https://shs.gmu.edu/.

University policies: Students must follow the university policies [See University Policies website: https://universitypolicy.gmu.edu/].

Responsible use of computing: Students must follow the university policy for Responsible Use of Computing [See University Policies website: https://universitypolicy.gmu.edu/policies/responsible-use-of-computing].

University calendar: Students should consult the current Academic Calendar [See https://registrar.gmu.edu/calendars]

University catalog: Students should use the current university catalog [See University Catalog website: https://catalog.gmu.edu/].

Student Services

University libraries: University Libraries provide excellent resources for books and journal publications. In addition, there are resources for distance students [See Library website http://library.gmu.edu/for/online].

Writing center: The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. (See Writing Center website: https://writingcenter.gmu.edu/). ESL Help: The program was designed specifically for students whose first language is not English who feel they might benefit from additional, targeted support over the course of an entire semester.

Counseling and Psychological Services: The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See Counseling and Psychological Services website: https://caps.gmu.edu/].

Family Educational Rights and Privacy Act (FERPA): The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights [See Registrar's Office website https://registrar.gmu.edu/ferpa/].