CDS 251 DL2: Introduction of Scientific Programming

George Mason University

Spring 2022

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Credits: 3
Course website: **Blackboard**
Class Hours: T/R 1:30-2:45pm
Class location: Online (synchronous)

Note: Please check the **Safe Return to Campus** webpage regularly as these policies may change during the semester.

Course Description

Focuses on elements of programming using the Fortran language and selected elements of the C language with emphasis on the aspects used in the computational and data sciences. Conducted through a combination of lecture and interactive computer laboratory. Limited to three attempts. (source: **University Catalog 2021–2022**)

This course is structured around three key learning activities: **Weekly class meetings**, **labs**, and **homework**. In class meetings we will review, discuss, explore, and gain experience with the various course materials. Class meetings will also provide students opportunities to test the level of their understanding and skill with the various topics covered. **Labs** will be in the form of short hands-on exercises that will students will begin working on in class. Typically, labs will be a direct continuation of the theme(s) discussed in class meetings will provide an opportunity to gain first-hand experience with. Finally, **Homework** assignments, which will often build on lab assignments work, will give each student an opportunity to work independently on developing their understanding and skills in solving various spcientific programming problems.

Prerequisites/Co-requisites

While not strictly required, it is recommended that students in the course have at least some prior knowledge/familiarity with the following themes:

- CDS-130 (recommended) or basics of computer programming, such as variable types, loops, logical conditions, etc., in any programming language (e.g., Python, R, Matlab, Javascript, Java, C/C++, etc.).
- Basic concepts in calculus (derivation and integration) , matrix algebra, and probability theory.

Required Materials

The course materials (e.g., lecture notes, written examples, etc.) will be made available on Blackboard by the instructor. No textbook is required. From time to time supplementary materials (e.g., scientific articles, technical documentation, book chapters, online resources, etc.) may be provided according to the course needs.

Course Objectives & Learning Outcomes

This course focuses on elements of scientific computing using the Fortran language with emphasis on the aspects used in the computational and data sciences. The "R" language is also covered in the spirit of program prototyping and visualization. The overall objective of this class is to familiarize students with basic concepts of programming and computing in the context of scientific computing applications with emphasis on developing relevant programming skills. This is a 'lab' styled class so students are expected to actively participate by working on selected tasks both in and out of the classroom. Given these characteristics, the **course objectives** are to:

1. Introduce readily available tools using in scientific programming.
2. Explore algorithms and analyze their performance.
3. Survey algorithms that solve basic mathematical problems.
4. Introduce methods of simulation to explore scientific problems.

In view of these objectives, each student is expected to be able to achieve the following **learning outcomes** by the end of the course :

1. Understand capabilities and limitations of computers as pertaining to scientific programming.
2. Utilize various software for the preparation, execution, and analysis of scientific problems.
3. Apply fundamental algorithms to the solution of scientific problems.
4. Manage the input and output of data.
5. Apply scientific computing algorithms in Fortran.

Course Schedule

The planned course schedule is provided in Table 1 below. Please note that the list of topics and homework assignments and their order in this table are tentative and are subjected to change at the discretion of the instructor (any changes will be announced in class before they take effect).

Week	Dates	Topic	Lab (release)	Homework (release)	Exam
1	Jan. 25,27	Introduction to Scientific Computing; POSIX/Unix/Linux primer; Your first Fortran program		1	
2	Feb. 1,3	Binary representations of numbers; Truncation, Rounding, Precision, and Accuracy; Data Types; Flow Control & Operators.		2	
3	Feb. 8,10	Arrays; calculating statistics; Sorting, indexing, and big O.; Intrinsic Functions; File I/O	1	3	
4	Feb. 15,17	Functions and Subroutines; Matrix multiplication, determinants & 2x2 inversion; Easy encryption	2	4	
5	Feb. 22,24	Bubble Sort	3	5	
6	Mar. 1,3	Recursion: Factoral, Fibinacci, & Quick Sort; Gaussian Elimination	4	6	
7	Mar. 8,10	Linear & nonlinear regression; gnuplot	5	7	Midterm
–	Mar. 15,17	Spring recess (no class)			
8	Mar. 22,24	Solving non-linear equations	6	8	
9	Mar. 29,31	Taylor Series; Differentiation; Numerical Integration	7	9	
10	Apr. 5,7	Random Numbers; Histogram generation	8	10	
11	Apr. 12,14	Solving ordinary differential equations	9	11	
12	Apr. 19,21	Simulation with ordinary differential equations	10	12	
13	Apr. 26,28	Introduction to R programming	11		
14	May 3,5	Course summary & recap	12		
	Check relevant **final exam schedule** for the date & time of the final exam				Final

Table 1: Tentative course schedule and important dates.

In case of any discrepancy between the course schedule and Mason's academic calendar, Mason's calendar and announcements takes precedence. If the campus closes or class is canceled due to weather or other concern, students should check Blackboard as well as the Mason website for updates on how to continue learning and information about any changes to events or assignments. As a student you are expected to be familiar with the important dates in the **academic calendar**.

Student assessment in this course

Labs

Labs will be provided weekly (typically from the third week). Each lab will consist of one or more tasks, and students are expected to begin working on their lab in class. In order to receive credit for lab work students must submit their lab work (using the link provided in Blackboard) by the due date whether or not all tasks are completed. A submission without any student work ("empty" submission) will not provide any credit. Students who complete their lab work before the end of a class session may begin working on their homework assignment.

Homework

Homework assignments will typically be provided weekly. Each assignment will contain one or more tasks and have a specific due date and deliverables. Most assignments have one week due dates, a few may be two week. Each assignment may also be assigned a different weight that will be used for calculating the homework score component in the final grade. All assignments are required to be completed and submitted using the link provided in Blackboard.

Exams

The course includes two mandatory exams: one midterm exam and one final exam. The material covered in each exams will be announced in advance. The date of the final exam is determined by the University Registrar's office, please check the relevant **final exam schedule** for the date and time of the final exam.

Course grading policy

Final course grades will be provided according to the undergraduate grading scale (letter grade), as defined in **Academic Policy 3.1**. I reserve the right to "curve" the scale dependent on overall class performance at the end of the semester if I determine that such a grading approach is appropriate. If such a grading approach is used it will not be applied when it negatively affects the letter grade. In order to determine the letter grade a numerical score will be calculated according to the following proportions:

Assessment Type	Quantity	Percentage
Labs	12*	30
Assignments	12*	45
Midterm	1	10
Final exam	1	15
Total		100

Table 2: Table to test captions and labels.

* Please note that this number is tentative and will be adjusted as necessary during the semester. Any changes will be announced in class.

Computing requirements

The course requires access to a standalone computer (i.e. a desktop or a laptop) for various learning activities, including labs, assignments and exams. Generally, a mobile device such as a smartphone, a tablet, or a "Chromebook" is insufficient for this course. Please make sure that the computer you plan to use meets the following minimum requirements:

Hardware

- An Intel-based processor that supports 64-bit system architecture with at least two cores (4 or more recommended).
- At least 4GB of memory (8 or more recommended)
- An integrated or dedicated graphics card that supports 800 x 600 resolution (16bit) or more
- At least 3GB of free disk space
- A high-speed network card (wired/wireless)
- A stable Internet connection with a consistent 1.5 Mbps download speed or higher
- A microphone
- A webcam

Software

- A 64-bit operating system (Windows 10 or higher / Mac OS 10.13 or higher)
- A user account with appropriate account privileges for installing software. If you are using an employer-provided computer for this class it is your responsibility to obtain the necessary user account privileges for instaling the necessary applications and that the computer's security settings will allow you to access and use any electronic course content that is provided.
- A supported up-to-date web browser (you can check which browsers are supported by Blackboard)
- A simple text editor (e.g., Notepad++, Visual Studio Code, jEdit, etc.)
- Adobe Acrobat Reader (free download)
- Zoom videoconferencing tool (see Mason's support page on Zoom for details on how to install and use this software)

Please note that during the course we may use various additional software environments and tools. Information about installing and using such tools will be provided along with the course materials.

Course Policies

Email communication

Students must use their Mason email account to send/receive University information, including communications related to this class. I will not respond to messages sent from or send message to a non-Mason email address. Email messages received Monday to Friday will be answered within 36 hours, Email messages received during weekends or university-observed holidays will be generally answered on the following business day.

Attendance & participation

While attendance is not strictly enforced, students should attend all class meetings and actively participate in them. Such participation essential to the success of the course as well as to the individual and collective learning process as we will often engage in "hands-on" activities. Not attending class will not be considered as a reason for deferral of coursework (see also the "Late assignment submission" section for details).

Late assignment submission

Students are required to submit assessment work by the due date assigned to each work. Late submissions will be subjected to the following late submission policy:

- Up to three weeks late, there will be a penalty of 2% per day. (Weekdays)
- Late work submitted after 3 weeks but by the first reading day (see the semester calendar) will result in a 30% penalty.
- Work submitted after the first reading day will not be accepted.

Exceptions to this policy may be made on a case-by-case basis at the discretion of the Instructor. Requests for deferrals must be made in writing (by email) at least 24 hrs before the assignment due date/time. Deferral of course work is a privilege and not a right, and there is **no guarantee** that a deferral will be granted.

Exams

All students are expected to be available to take a course test at the given date/time. A student who cannot write a course test due to a cause **beyond reasonable control** (e.g., hospitalization/medical emergency, military deployment, etc.) can request (in writing) to make arrangements to complete a test at a different time. If the request is approved, it is the student's responsibility to make the necessary arrangements with the instructor to complete the test.

Incomplete (IN) grade

An Incomplete grade (IN) grade may be requested by a student who is passing a course but who may be unable to complete scheduled course work due to a cause **beyond reasonable control** (e.g., hospitalization/medical emergency, military deployment, etc.). Any requests for an incomplete grade must be submitted in writing no later than the last week of classes, and should clearly indicate the reason for the request. If an IN grade is granted, it is your responsibility to contact the instructor at the end of the semester to make proper arrangements for completing any missing work. For further details on the IN grade please visit the Registrar's Office website.

Use of technology during class meetings

We will frequently use the internet as a learning tool. We will also be using computers for our in-class writing assignments. Please be respectful of your peers and your instructor and do not use technology to engage in activities that are unrelated to the class. Such disruptions show a lack of professionalism. Similarly, please refrain from using mobile devices (such as cell phones) during class time. When using technology on campus students are expected to follow the university policy number 1301: Responsible Use of Computing.

University policies

Student and faculty names and pronouns

Name and pronoun use: If you wish, please share your name and gender pronouns with me and indicate how best to address you in class and via email. I use "he/him/his" for myself and you may address me as “Arie”, “Dr./Prof. Croitoru” or “Dr. C” in email and verbally.

COVID-19: Safe return to campus

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. 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, Red, or Blue 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 will always be welcome in the classroom.

Campus closure or emergency class cancellation/Adjustment

If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard and their Mason email for updates/instructions on how to continue learning and for information about any changes to events or assignments.

Course materials and student privacy

All course materials posted to Blackboard or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class. Videoconferencing will be used during this class as needed. Videorecordings – whether made by instructors or students – of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class. Live video conference meetings (e.g. Collaborate or Zoom) that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.

Recording and/or sharing class materials

Some/All of our synchronous class meetings in this class may be recorded to provide necessary information for students in this class. Recordings will be stored on Blackboard or other University secure site and will only be accessible to students taking this course during this semester.

Photography and/or recording of any kind (audio, video), reuse of course materials, and further dissemination of the course contents is not permitted unless prior written consent of the professor and George Mason University has been given, or if recording is part of a course activity or an approved accommodation plan.

Some kinds of participation in online study sites violate the Mason Honor code: these include accessing exam or quiz questions for this class; accessing exam, quiz, or assignment answers (partial or complete) for this class; uploading of any of the instructor's materials or exams; and uploading any of your own answers or finished work. Always consult your syllabus and your professor before using these sites. You are also encouraged to review a short video on this subject.

Academic Integrity

Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely.

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using the appropriate format for this class. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

Disability Accommodations

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu ; Phone: (703) 993-2474. The course team is committed to working with you and disability services to design and provide solutions for supporting your accommodations.

Diversity and Inclusion

Our university is an intentionally inclusive community that promotes and maintains an equitable and just work and learning environment. We welcome and value individuals and their differ-

ences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age, and disability.

Sexual Harassment, sexual misconduct, and interpersonal violence

George Mason University is committed to providing a learning, living and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and student success. We encourage students who believe that they have been sexually harassed, assaulted or subjected to sexual misconduct to seek assistance and support. University Policy 1202: Sexual Harassment and Misconduct speaks to the specifics of Mason's process, the resources, and the options available to students.

As a faculty member, I am designated as a "Non-Confidential Employee," and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, stalking, sexual exploitation, complicity, and retaliation to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

Other student resources

The university offers a range of services to support students in a variety of ways (a comprehensive list is available available online). Among these services are:

- Counseling and Psychological Services
- The Center for Culture, Equity, and Empowerment
- The Office of Diversity, Integrity, and Inclusion
- Student Support and Advocacy Center
- Student Health services
- The Writing Center

If you are unable to find resource(s) for your specific needs please contact me, your academic advisor, or your home department for help.

Disclaimer: Any typographical errors in this course outline are subject to change and will be announced in class. Some information in this syllabus is subject to change.