

**CDS 251**  
Spring 2021  
**Introduction of Scientific Programming**  
Syllabus

## 1 General Information

**Instructor:** Daniel Sponseller

**Class Days:** Thursdays 1:30 PM - 4:10 PM

**Place:** "In-Class" livestreamed via BlackBoard Collaborative Ultra

**Course website:** Blackboard

**Credits:** 3.0

**Office Hour:** Thursdays 12:00 PM - 1:00 PM, via email/Blackboard.

**Contact method:** Direct email: dsponsel@masonlive.gmu.edu. Message board via Blackboard. Messages will typically be answered within 24-36 hours Monday to Friday; messages sent during the weekend will be answered on the following Monday.

**\*\*\* Special Rules Due to the ongoing COVID-19 pandemic, a few special rules are in effect.**

- This is a 'lab' styled class so students are expected to be in class using the BlackBoard Collaborative Ultra.
- Labs are still expected to be worked on during class time.
- However, credit for any particular lab is given as long as a final version of your lab work is submitted to the professor by midnight on class day.

## 2 Course Objectives

**Description:**

This course focuses on elements of scientific programming 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 main goal of this class is to familiarize students with basic concepts of programming in computational sciences. This course has the following objectives:

- Introduce readily available tools using in scientific programming.
- Explore algorithms and analyze their performance.

- Survey algorithms that solve basic mathematical problems.
- Introduce methods of simulation to explore scientific problems.

### 3 Learning Outcomes

By the end of the course, each student will be able to:

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

### 4 Course Schedule (tentative)

Weeks are approximate time spent on material. Actual Midterm date will be announced in class.

**Week 1:** Introduction to Scientific Computing. Why Fortran. Software you will need. GMU resources. POSIX/Unix/Linux quick primer with BASH. Fortran basic program structure. "Hello World". How to compile and run.

**Week 2:** Binary representations of numbers. Truncation, Rounding, Precision, Accuracy. Data Types. Flow Control. Operators.

**Week 3:** Arrays. Statistics. Sorting. Big O. Indexing. Intrinsic Functions. File I/O.

**Week 4:** Functions and Subroutines. Matrix multiplication. Determinant. 2x2 inverse. Easy encryption.

**Week 5:** Bubble Sort. Big O()

**Week 6:** Recursion. Factorial. Fibonacci. Quick Sort. Linear Algebra. Gaussian Elimination.

**Week 7: Midterm Exam!**

**Week 8:** Least Squares.

**Week 9:** Non-Linear equations.

**Week 10:** Taylor Series. Differentiation. Numerical Integration.

**Week 11:** Random Numbers. Histograms.

**Week 12:** Ordinary Differential equations.

**Week 13:** Simulations.

**Week 14:** "R" programming.

## 5 Course Format

- The course will be part lecture / part lab. About half the class time will be lecture and half will be in class programming practice.
- Labs are done in
- There will be homework each week.
- Most homework due in one week. Consult each homework on Blackboard for actual due date.
- Generous late policy (see below) but you will loose points.

## 6 Course materials

- Lecture notes will be posted to the class page each week.
- The detailed assignments will be posted on the class page.
- Various guides will be on the class page. Students are required to review them.

## 7 Technology Requirements

- Access to a Windows, Macintosh, or Linux computer.
- Permission to install software on above computer.
- A reliable internet connection.

- Alternatively to the above: Ability to reliably use the computer labs at GMU.
- A supported web browser for Blackboard.
- Adobe Acrobat Reader.
- Microsoft Office (freely available to Mason students).
- The course requires the use of a Fortran compiler and other freely available open source software.

## 8 Course Expectations

- Students are expected to already be comfortable using a computer, accessing the internet, and have word processing skills.
- Student will be expected to learn to use developmental tools on their computer.
- Students work should show attention to detail. Getting the right answer is insufficient. Following the guides posted on the class page is required.
- Students are required to regularly check the Blackboard for information.

## 9 Assessment

### 9.1 Lab Work

- Labs are in class work and typically begin on the third week.
- Credit is given for attempting the lab in class whether or not it is completed.
- Students may do other work/homework/questions in class only if their lab is completed.
- No credit is given for late Labs but students are encouraged to complete the lab anyway as most lead directly into the homework.
- One lab participation grade is dropped.

## 9.2 Assignments

- All assignments are required to be completed.
- Most assignments have one week due dates. A few may be two week.
- Assignments might not have equal weights.
- Reports and files are submitted through the "Assignments" section of the Blackboard. Do not email assignments to the instructor's email or through the Blackboard email.

## 9.3 Late Policy

- Up to three weeks late, there will be a penalty of 2% per day. (Weekdays)
- Turned in before reading day, 30% penalty.
- Exceptions to this policy may be made on a case- by-case basis at the discretion of the Instructor.
- Deferral of course work is a privilege and not a right; there is no guarantee that a deferral will be granted.

## 9.4 Exams

- There will be one midterm exam and one final exam. The material covered in the exams will be announced in advance.

## 9.5 Course Grades

Homework assignments will be worth between 50 to 100 points each depending on their complexity. Some assignments may have bonus points available. At the end of the term, the weighted average of the assessments are as follows:

- In Class Lab Participation: 30%
- Assignments and Blackboard Quizzes: 45%
- Midterm Exam: 10%
- Final Exam: 15%

## 10 Other Important Dates

Please refer to Mason's academic calendar for information on important dates and follow Mason's announcements on any calendar changes during the semester. The Mason calendar is available at <https://registrar.gmu.edu/calendars/spring-2021/>

## **11 Student Expectations**

### **11.1 Academic Integrity**

Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See <https://oai.gmu.edu>].

### **11.2 Honor Code**

Students must adhere to the guidelines of the George Mason University Honor Code [see <https://oai.gmu.edu/mason-honor-code/>].

### **11.3 MasonLive/GMU Email**

Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See <https://mail.gmu.edu>].

### **11.4 Patriot Pass**

Access to Mason's online system is done through a personal username and password known as the Patriot Pass. Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See <https://password.gmu.edu/index.jsp> , this link also enables you to reset your password].

### **11.5 Responsible Use of Computing**

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

### **11.6 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 their instructor, in writing, at the beginning of the semester [See <https://ods.gmu.edu>]. Please be proactive and let me know how I can help you with any disability issue.

## 12 Student Services

### 12.1 University Libraries

University Libraries provides resources for students. [See <https://library.gmu.edu>].

### 12.2 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 <https://writingcenter.gmu.edu>]. You can now sign up for an Online Writing Lab (OWL) session as well as face-to-face session in the Writing Center ( see the Tutoring section in the link above).

### 12.3 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 <https://caps.gmu.edu>].

### 12.4 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 <https://registrar.gmu.edu/privacy>].

## 13 Final Notes

- Any typographical errors in this Course Outline are subject to change and will be announced in class.
- The date of the final examination is set by the Registrar and takes precedence over the final examination date reported by the instructor.
- Recording of any kind (audio, video), reuse or remix of course materials, and further dissemination of the course content is not permitted unless prior written consent of the professor and George Mason University has been given.