MA-2923:
Introduction to Modern Scientific Computing*

(Fall 2024)

Learn Programming through Logic

Instructor

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Class

19 Allen: MWF 11:00 – 11:50 AM

Office Hours

MWF 9:30 – 10:30AM, or by appointment

Course Description

(Prerequisite: MA 1713 or equivalent). Three hours lecture. Basic programming skills and applications to scientific computing; iteration and recursion; accuracy and efficiency issues; matrix operations; data interpolation; unconstrained optimization; regression analysis; multiple local minima problems. Prior programming experience is not required.

Course Materials

- **Text**: SEONGJAI KIM, *Programming Basics and AI with Matlab and Python*, Lecture note: Click Programming-Basics-and-AI-Lecture.pdf to download.
- **Reference**: MARK H. HOLMES, *Introduction to Scientific Computing and Data Analysis*, Springer, 2016.

Class Plan

- The students are expected to complete 10-12 sets of homework.
- The students will work on an individual project and a group project, developing and implementing computational algorithms. Students will present results of the group project in the class.
- They will take a mid-term and the final, with the final being comprehensive.
- For Campus 5, the students are expected to complete and turn in assignments via Canvas.

*A preliminary course for MA-4183/6183: Mathematical Foundations of Machine Learning, open in every Spring semester.

Learning Objectives

- To understand how to transform real-world problems to computational problems and how to solve them by applying computational algorithms
- To recognize mathematical issues that arise in scientific computing
- To experience both programming from scratch and the use of existing codes
- It can be considered as **a preliminary course** for ***MA-4183/6183: Mathematical Foundations of Machine Learning***, open in **every Spring semester**.

Content

The course covers the lecture note.

Ch. 1 Programming Basics
Ch. 2 Programming Examples
Ch. 3 Programming with Calculus
Ch. 4 Linear Algebra Basics
Ch. 5 Programming with Linear Algebra
Ch. 6 Multivariable Calculus
Ch. 7 Least-Squares and Regression Analysis
Ch. 8 Python Basics
Ch. 9 Vector Spaces and Orthogonality
Ch. 10 Introduction to Machine Learning
Ch. 11 Principal Component Analysis

Delivery Methods for Campus 5

- A webcam will be installed in the classroom and connected to Canvas for students in Campus 5. Thus for Campus 5, lectures are synchronous through Canvas (WebEx connection).
- All the lectures will be recorded and uploaded on Canvas and YouTube, for students who need flexible time schedules to study. The YouTube URL will be announced in Canvas.

Exams

There will be a mid-term exam and a comprehensive final exam.

- The mid-term will cover Chapters 1–6.
- Final exam will cover all chapters considered.

Homework

Homework will be assigned after each 3-5 hours of lecture and collected within a week. Some problems will require mathematical derivation/proof; however, many more problems will need computer implementation. Students are required not to miss

homework. Late homework submissions may be accepted with a penalty of 15∼20% score reduction per week; this is for unexcused absences only and excused absences will not be penalized.

Projects

The students will work on an individual project and a group project, developing and implementing computational algorithms. Students will present results of the group project in the class.

Campus 5: Discussions and Questions

Students in distance learning are encouraged to post questions and other concerns on discussion board in Canvas and communicate with your class mates. Also you may send emails to the instructor to ask questions.

Evaluation

The students' understanding of the concepts covered in this course will be evaluated by a combination of homework assignments, a mid-term exam, two projects, and the final exam. The overall final grade will be calculated in the following manner:

Homework	25%
Mid-term	15%
Projects	30% (15% each)
The final exam	30%

Final Grade

The standard MSU grading scale will be considered:

$\geq 90\,\%$	A
$80\sim 89.99\,\%$	B
$70\sim 79.99\,\%$	C
$60\sim 69.99\,\%$	D
Below 60%	F

When the average performance of students is lower than a certain level, a curve will be given at the end of the class.

Below are the standard MSU policies in education and learning.

Attendance Policy

This section is a face-to-face instructional class. Per Academic Operating Policy 12.09, students are expected to attend all class meetings in person. Should a student expect a university-excused absence from a class, the student should contact the course instructor of record to inform them of the absence and the reason for it. Special instructions regarding illness and contagious infection are included in the syllabus section entitled: Contagious Infection and Other Health Accommodations for face-to-face instruction.

General Class Information

By attending class, you agree to behave in a manner that allows for you and your classmates to learn effectively. If you disrupt class or behave in any other inappropriate fashion, you will be dismissed from class. Repeated instances of disruptive behavior will result in permanent dismissal. Also, all cell phones must be turned off before entering the classroom and left off until class is dismissed.

Student Honor Code

Mississippi State has an approved Honor Code that applies to all students. The code is as follows: “As a Mississippi State University student, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do." Upon accepting admission to Mississippi State University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. For additional information, please visit: https://www.honorcode.msstate.edu.

Title IX

MSU is committed to complying with Title IX, a federal law that prohibits discrimination, including violence and harassment, based on sex. This means that MSU’s educational programs and activities must be free from sexual discrimination, sexual harassment, and other forms of sexual misconduct. If you or someone you know has experienced sex discrimination, sexual violence and/or harassment by and member of the University community, you are encouraged to report the conduct to MSU’s Director of Title IX/EEO Programs at 325-8124 or by e-mail to titleix@msstate.edu. Additional resources are available at https://www.oci.msstate.edu/focus-areas/title-ix-sexual-misconduct. If you need help, please contact the MSU Safeline at 325-3333.

Student Support Services

Students who need academic accommodations based on a disability should visit the Office of Student Support Services, 01 Montgomery Hall, call 325-3335, or visit the website at http://www.sss.msstate.edu.

University Safety Statement

Mississippi State University values the safety of all campus community members. Students are encouraged to register for Maroon Alert texts and to download the Everbridge App. Visit the Personal Information section in Banner on your mystate portal to register. To report suspicious activity or to request a courtesy escort via Safe Walk, call University Police at 662-325-2121, or in case of emergency, call 911. For more information regarding safety and to view available training resources, including helpful videos, visit ready.msstate.edu.

Attendance policy for Face-to-face Instruction

This section is a face-to-face instructional class. Per Academic Operating Policy 12.09, students are expected to attend all class meetings in person. Should a student expect a university-excused absence from a class, the student should contact the course instructor of record to inform them of the absence and the reason for it. Special instructions regarding illness and contagious infection are included in the syllabus section

entitled: *Contagious Infection and Other Health Accommodations for face-to-face instruction.*

Contagious Infection and Other Health Accommodations for Face-to-face Instruction

Students required to isolate due to symptomatic or asymptomatic contagious infection or quarantine due to potential exposure to contagious infection will be accommodated on a case-by-case basis. Such students must provide an excuse from either the Dean of Students, the Longest Student Health Center, or qualified medical practitioner directing quarantine procedures, and the recommended date of return. Information provided will be enforced at the instructor's discretion.

In cases meriting accommodation, quarantining students may be expected to log into the lecture during the scheduled class time or complete equivalent assignments approved by the instructor. If a student is too ill to participate in a class at the scheduled time, the student may be provided a link to a recording of the lecture or offered a similar accommodation as determined by the instructor.

It is the responsibility of the student to initiate and maintain contact with their instructor(s) regarding their quarantine status. All accommodations are subject to the instructions provided by the Dean of Students', Longest Student Health Center, or qualified medical practitioner.

Continuity of Instruction

In the event that face-to-face classes are suspended due to the pandemic or its effects, the instructor will continue instruction in a manner that best supports the course content and student engagement. In this event, all instructors will notify all students of the change via their university email address (the official vehicle for communication with students). At that time, they will provide details about how instruction and communication will continue, how academic integrity will be ensured, and what students may expect during the time that face-to-face classes are suspended. If a student becomes unable to continue class participation, the student should contact their instructor and advisor for guidance.

Facial Coverings

To safeguard the health of all members of the MSU campus during this global pandemic, the university has reconfigured classroom spaces and adjusted room capacities to assure adequate physical distance between all individuals in each room. In addition, the university has published requirements for the use of face coverings for everyone on campus, including specific requirements for their use in all classrooms, labs, and shared office spaces regardless of physical distancing. In order to mutually protect the students' freedom to learn and the instructor's ability to teach in a safe classroom environment, everyone in this classroom is required to wear a face covering in the classroom in accordance with MSU policy. If a student cannot wear a face covering due to a medical condition, they should request an accommodation via the Office of Disability Support Services. If a student simply doesn't want to wear a face covering, they will not be permitted to remain in the classroom or lab.

Generative AI

Mississippi State University recognizes the introduction of generative artificial intelligence (generative AI) provides opportunities for scholarly rigor, intellectual integrity, and educational excellence. Nevertheless, the use of generative AI also poses issues related to academic integrity. Currently, individual instructors are encouraged to establish class-specific guidelines concerning the use of generative AI within their courses. The student must consult the syllabus for each class they are taking to determine if and to what degree generative AI is allowed.

Mandatory Reporting

Faculty members at Mississippi State University are required to report any information received about possible sexual misconduct. This includes information shared in class discussions or assignments, as well as information shared in conversations outside class. The purpose of reporting is to allow MSU to take steps to ensure a safe learning environment for all. The university also has confidential resources available, who can provide assistance to those who have experienced sexual misconduct without requiring a mandatory reporting duty. Students may access confidential campus resources here: https://www.civilrights.msstate.edu/title-ix-sexual-misconduct/resources.