

Manhattan College

Department of Mathematics

MATH 158 Section 01

Introduction to Mathematical Computation

Spring 2019

Class Time: MR 12:00 pm – 1:15 pm

Class Room: RLC 107

Instructor: Angel R. Pineda, Ph.D.

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Office Hours: Monday 11-11:50 A.M., 3-3:50 P.M., Thursday 11-11:50 A.M. or by appointment.

Textbook: *MATLAB: An Introduction With Applications*, Amos Gilat, Fifth Edition, John Wiley & Sons 2015

Optional Textbook: *More Math Into LaTeX*, George Grätzer, Fourth Edition, Springer 2007

This text is available in PDF from O'Malley Library.

Software:

MATLAB: We will be using MATLAB and the toolboxes included in the student edition. MATLAB is a powerful software used in education, research and industry. Every student and faculty at Manhattan College has access to MATLAB through a university license: <https://www.mathworks.com/academia/tah-portal/manhattan-college-40634592.html>

The license gives you access to MATLAB and many additional toolboxes which you may need (and can download) in the future. For this class, you will need: MATLAB and the following toolboxes: *Curve Fitting*, *Optimization*, *Image Processing*, *Signal Processing*, *Statistics and Machine Learning* and *Symbolic Math*. You can install it and run it in your personal computer. MATLAB can also be used in the computer labs on campus.

LaTeX: This is the typesetting program most commonly used for professional publishing of papers, presentations and books with heavy mathematical content. In this course we will use a web-based distribution: <https://www.overleaf.com/>.

Course Description:

This course is intended to help you become comfortable using personal computers to solve quantitative problems, as well as to experiment with mathematical concepts and techniques. A variety of problems from mathematics, science and engineering will be considered to illustrate the problem-solving process. It will reinforce the programming concepts in the context of applications. The mathematics covered in this class will focus on concepts from calculus and topics covered in high school (such as algebra and trigonometry) but will also explore ideas in more advanced topics like optimization, probability, differential equations and linear algebra which can be explored using computation. You will gain experience in the use of MATLAB, a software package for interactive numerical and symbolic computation, as well as in writing programs of your own. What you learn will prove to be useful in future courses in mathematics, particularly those involving numerical computation, mathematical modeling, and simulation. The skills you will develop are also valuable for any career in mathematics, science or engineering.

Along with using MATLAB to present programming techniques, we will introduce LaTeX as a mathematical typesetting language. LaTeX will be very useful when writing papers and presentations with heavy mathematical content. In this course, LaTeX will be used for selected HW assignments and for class presentations and papers. LaTeX is also used in upper level mathematics courses.

Catalog Description:

Introduction to mathematical problem-solving employing modern software used for mathematical modeling in industry and research. Numerical and symbolic computation including problems from calculus. A variety of problems arising in mathematics, science and engineering.

Pre-requisite: CMPT 101 (Computer Science I), Co-requisite: MATH 186 (Calculus II), MATH 188 (Honors Calculus II) or consent by instructor.

Course Objectives:

After completing this course, the students should be able to:

- Set up and solve application problems using MATLAB
- Typeset documents using LaTeX
- Write programs using functions and loops to solve mathematical problems
- Load data and visualize it
- Interpolate data and fit curves through data
- Solve integrals numerically and analytically
- Solve simple optimization problems
- Solve simple problems in discrete dynamical systems, linear algebra and differential equations

Course Homepage (Moodle):

Here you will find four features that will be used in this course:

- *Email:* make sure that your email on Moodle is one that you check regularly. Homework assignments, announcements and other class related information will be sent via email.
- *Course Information and Documents:* material covered each week, assignments and solution keys.
- *Student Discussion Board:* this online forum allows for students and faculty to communicate about the course.
- *Grades:* students will be able to keep track of their grades online.

Grading:

Homework and quizzes (30 %)

Exam 1 (20 %): February 14

Exam 2 (20 %): April 4

Final Project (30 %)

Initial Project Presentation (in class): April 15

Initial Paper: April 25

Final Project Presentations: Friday May 10, 11 am – 1 pm

Final Paper: Friday May 10, 11 am – 1 pm

The class project will explore a topic of your choice involving mathematical computation. You will work in pairs to develop skills for working in teams. The main idea is for you to find some mathematical problem that you are excited about which uses material from this course. Possible topics could be extensions of material in our text, may come from your own research projects, other classes or from outside sources, for example the Laboratories for Mathematical Exploration by The Mount Holyoke Mathematics Department (and J. William Bruce):

<https://www.mtholyoke.edu/sites/default/files/acad/math/docs/MathLab2015.pdf>

Or for more advanced students this online text of applications from the creator of MATLAB (Cleve Moler):

<http://www.mathworks.com/moler/chapters.html>

Details for the writing project will be given after Exam 1.

Tentative Grading Scale

Percent	93-100	90-92	87-89	83-86	80-82	77-79	70-76	67-69	60-66	0-59
Grade	A	A-	B+	B	B-	C+	C	D+	D	F

The exact grading scale will be determined after the final exam. The numerical scores in the tentative grading scale guarantee the associated letter grade but the instructor may change the scale to the student's benefit.

Dates to Remember

January 21: Martin Luther King Holiday (No Classes)

January 22: Monday Schedule

January 23: Late Registration & Add/Drop Ends

February 14: Exam 1

March 5: Midterm Grades Due

March 11: Abstract Deadline for MAA Metro NY Meeting

March 18-22: Spring Break (No Classes)
April 4: Exam 2
April 15: Initial Project Presentation (in class)
April 16: Last Day to Withdraw from Courses
April 18-22: Easter Holiday (No Classes)
April 24: Monday Schedule
April 25: Initial Paper Due
May 3: Last Day of Classes (Monday Schedule)
May 4: MAA Metro NY Meeting
May 10: Final Presentation and Paper

Class Policies

- Attendance is required. Students are expected to arrive on time.
- Failure to attend a class with an unexcused absence will result in a zero for quizzes given on that day. After four unexcused absences, the appropriate dean will be notified. To receive an excused absence, proper documentation and instructor approval is needed.
- Late homework sets will not be accepted after the solutions are distributed. In case the homework is handed in before the solutions are posted it will be marked 20% off for every day (or part thereof) it is late.
- The lowest HW or Quiz grade will be dropped.
- No make-up exams will be given, unless you have a medical or family emergency. These emergencies require valid documentation. The grade for a missed exam is zero.
- Cell phones (or other technology not related to the class) in the classroom is only allowed with express permission of the instructor for special circumstances. In general cell phone or other potentially disruptive technology use is not allowed in class.

Calculator Policy

A calculator is not required for this course.

Suggestions

- The course requires a time commitment of about 6-9 hours outside of class time per week (2-3 per class hour). The material builds on itself, so it is very important not to fall behind.
- Find a study partner or group.
- Treat your homework and quizzes as a study guide for future exams. Write solutions to problems in a neat and organized fashion.
- I encourage you to come to office hours regularly. I will do my best to help you.

Center for Academic Success

It provides student-centered programs and initiatives designed to enhance the learning experience of all students. The CAS provides one-on-one and small group tutoring in a wide range of subjects, including all core courses at the Writing Center, Learning Center and Leo Learning Center (Leo 117/118). The CAS also provides academic coaching, workshops, supplemental instruction and online tutoring. All of the services are free for students.

Students can now book CAS appointments online by following these steps:

1. Go to <https://manhattan.mywconline.com/>
2. New user? Click "Register for an account" and enter required information. When prompted to enter your email address, be sure to use your manhattan.edu student email.
3. Start searching and booking tutoring, writing center, and peer academic coaching appointments!

Appointments are preferred, but drop-ins are permitted. If you have any questions, please contact the CAS at 718.862.7414, email success@manhattan.edu, or stop by Thomas Hall 3.10 (or Leo 117/118). For more information, visit the CAS website at <https://inside.manhattan.edu/academic-resources/center-for-academic-success/>

Academic Integrity:

As students of Manhattan College, you have each signed The Manhattan College Honor Pledge:

As a Manhattan College student, I will not lie, cheat, or steal in my academic endeavors, nor will I accept the actions of those who do. I will conduct myself responsibly and honorably in all my activities as a Manhattan College student. I am accountable to the Manhattan College community and dedicate myself to a life of honor.

Whenever you put your name on work to be handed in for grading in this class, you are reaffirming the above pledge. Violations of the Honor Code include, but are not limited to, cheating, plagiarism, fabrication, and other forms of academic misconduct. Students should familiarize themselves with the Manhattan College Student Code of Conduct and Academic Policies found at:

<https://inside.manhattan.edu/student-life/dean-of-students/code-conduct.php>

Special Accommodations:

- Students with special needs should bring appropriate documentation to the Specialized Resource Center, <https://inside.manhattan.edu/academic-resources/specialized-resource-center/index.php>, to obtain an Academic Adjustment/Auxiliary Aid form. Bring the completed form to me as soon as possible, and together we will decide on how best to fulfill the adjustments and/or aids listed on the form.
- Student athletes should bring their event schedules to me as soon as possible.

Course Outline:

Typesetting in LaTeX will be introduced during the second week and incorporated throughout the course in writing and presentation assignments.

Chapter 1 Starting with MATLAB

- 1.1 STARTING MATLAB, MATLAB WINDOWS
- 1.2 WORKING IN THE COMMAND WINDOW
- 1.3 ARITHMETIC OPERATIONS WITH SCALARS
- 1.4 DISPLAY FORMATS
- 1.5 ELEMENTARY MATH BUILT-IN FUNCTIONS
- 1.6 DEFINING SCALAR VARIABLES
- 1.7 USEFUL COMMANDS FOR MANAGING VARIABLES
- 1.8 SCRIPT FILES
- 1.9 EXAMPLES OF MATLAB APPLICATIONS

Chapter 2 Creating Arrays

- 2.1 CREATING A ONE-DIMENSIONAL ARRAY (VECTOR)
- 2.2 CREATING A TWO-DIMENSIONAL ARRAY (MATRIX)
- 2.3 NOTES ABOUT VARIABLES IN MATLAB
- 2.4 THE TRANSPOSE OPERATOR
- 2.5 ARRAY ADDRESSING
- 2.6 USING A COLON : IN ADDRESSING ARRAYS
- 2.7 ADDING ELEMENTS TO EXISTING VARIABLES
- 2.8 DELETING ELEMENTS
- 2.9 BUILT-IN FUNCTIONS FOR HANDLING ARRAYS
- 2.10 STRINGS AND STRINGS AS VARIABLES

Chapter 3 Mathematical Operations with Arrays

- 3.1 ADDITION AND SUBTRACTION
- 3.2 ARRAY MULTIPLICATION
- 3.3 ARRAY DIVISION
- 3.4 ELEMENT-BY-ELEMENT OPERATIONS
- 3.5 USING ARRAYS IN MATLAB BUILT-IN MATH FUNCTIONS
- 3.6 BUILT-IN FUNCTIONS FOR ANALYZING ARRAYS

3.7 GENERATION OF RANDOM NUMBERS
3.8 EXAMPLES OF MATLAB APPLICATIONS

Chapter 4 Using Script Files and Managing Data

4.1 THE MATLAB WORKSPACE AND THE WORKSPACE WINDOW
4.2 INPUT TO A SCRIPT FILE
4.3 OUTPUT COMMANDS
4.4 THE save AND load COMMANDS
4.5 IMPORTING AND EXPORTING DATA
4.6 EXAMPLES OF MATLAB APPLICATIONS

Chapter 5 Two-Dimensional Plots

5.1 THE plot COMMAND
5.2 THE fplot COMMAND
5.3 PLOTTING MULTIPLE GRAPHS IN THE SAME PLOT
5.4 FORMATTING A PLOT
5.5 PLOTS WITH LOGARITHMIC AXES
5.6 PLOTS WITH ERROR BARS
5.7 PLOTS WITH SPECIAL GRAPHICS
5.8 HISTOGRAMS
5.9 POLAR PLOTS
5.10 PUTTING MULTIPLE PLOTS ON THE SAME PAGE
5.11 MULTIPLE FIGURE WINDOWS
5.12 PLOTTING USING THE PLOTS TOOLSTRIP
5.13 EXAMPLES OF MATLAB APPLICATIONS

Chapter 6 Programming in MATLAB

6.1 RELATIONAL AND LOGICAL OPERATORS
6.2 CONDITIONAL STATEMENTS
6.3 THE switch-case STATEMENT
6.4 LOOPS
6.5 NESTED LOOPS AND NESTED CONDITIONAL STATEMENTS
6.6 THE break AND continue COMMANDS
6.7 EXAMPLES OF MATLAB APPLICATIONS

Chapter 7 User-Defined Functions and Function Files

7.1 CREATING A FUNCTION FILE
7.2 STRUCTURE OF A FUNCTION FILE
7.3 LOCAL AND GLOBAL VARIABLES
7.4 SAVING A FUNCTION FILE
7.5 USING A USER-DEFINED FUNCTION
7.6 EXAMPLES OF SIMPLE USER-DEFINED FUNCTIONS
7.7 COMPARISON BETWEEN SCRIPT FILES AND FUNCTION FILES
7.8 ANONYMOUS FUNCTIONS
7.9 FUNCTION FUNCTIONS
7.10 SUBFUNCTIONS
7.11 NESTED FUNCTIONS
7.12 EXAMPLES OF MATLAB APPLICATIONS

Chapter 8 Polynomials, Curve Fitting, and Interpolation

8.1 POLYNOMIALS
8.2 CURVE FITTING
8.3 INTERPOLATION
8.4 THE BASIC FITTING INTERFACE
8.5 EXAMPLES OF MATLAB APPLICATIONS

Chapter 9 Applications in Numerical Analysis

- 9.1 SOLVING AN EQUATION WITH ONE VARIABLE
- 9.2 FINDING A MINIMUM OR A MAXIMUM OF A FUNCTION
- 9.3 NUMERICAL INTEGRATION
- 9.4 ORDINARY DIFFERENTIAL EQUATIONS
- 9.5 EXAMPLES OF MATLAB APPLICATIONS

Special Application: Programming of Discrete Dynamical Systems

Chapter 10 Three-Dimensional Plots

- 10.1 LINE PLOTS
- 10.2 MESH AND SURFACE PLOTS
- 10.3 PLOTS WITH SPECIAL GRAPHICS
- 10.4 THE view COMMAND
- 10.5 EXAMPLES OF MATLAB APPLICATIONS

Chapter 11 Symbolic Math

- 11.1 SYMBOLIC OBJECTS AND SYMBOLIC EXPRESSIONS
- 11.2 CHANGING THE FORM OF AN EXISTING SYMBOLIC EXPRESSION
- 11.3 SOLVING ALGEBRAIC EQUATIONS
- 11.4 DIFFERENTIATION
- 11.5 INTEGRATION
- 11.6 SOLVING AN ORDINARY DIFFERENTIAL EQUATION
- 11.7 PLOTTING SYMBOLIC EXPRESSIONS
- 11.8 NUMERICAL CALCULATIONS WITH SYMBOLIC EXPRESSIONS
- 11.9 EXAMPLES OF MATLAB APPLICATIONS

This syllabus may be changed at the instructor's discretion. Any changes will be communicated to the students.