Topics in Mathematics
Numerical Methods
Spring 2019

Math 400
MWF
1:00 - 1:50 pm
Hirt 209

Instructor

Dr. Lauren Williams
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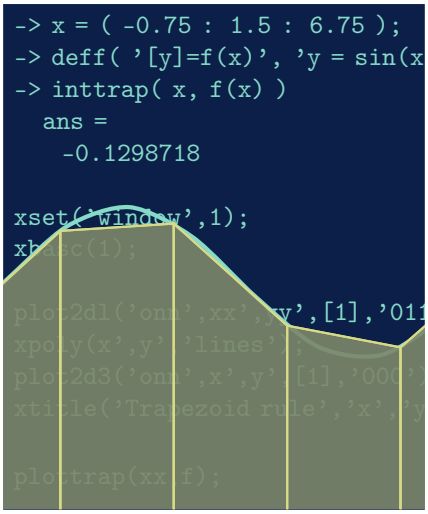
(814) 824-2226



Office Hours

Monday 3:00 - 4:00

Tuesday 12:00 - 1:30

Thursday 8:00 - 9:30

Friday 9:00 - 11:00

and by appointment

Course Description

This course will introduce students to useful numerical algorithms that can be used to solve or approximate a wide variety of problems in the sciences, engineering, economics, and more. In addition, students will learn how to use mathematical software to implement and expand on these algorithms. Topics to be covered include number systems, error, systems of linear equations, interpolation, root approximation techniques, numerical differentiation and integration, eigenvalue problems and matrix forms.

Course Objectives

After successful completion of this course, you will be able to:

- demonstrate an understanding of common numerical methods and their use;
- select appropriate algorithm or technique for a given problem;
- recognize the difference between approximations and an exact solution;
- implement numerical methods in mathematical software;
- explain why a particular numerical method may fail for a given problem;
- analyze the results of a particular method for accuracy;
- communicate your results and analysis using formal mathematical language and notation.

Prerequisites

This course is intended for advanced students pursuing a major or minor in mathematics. Math 150 and Math 265 or instructor permission is required.

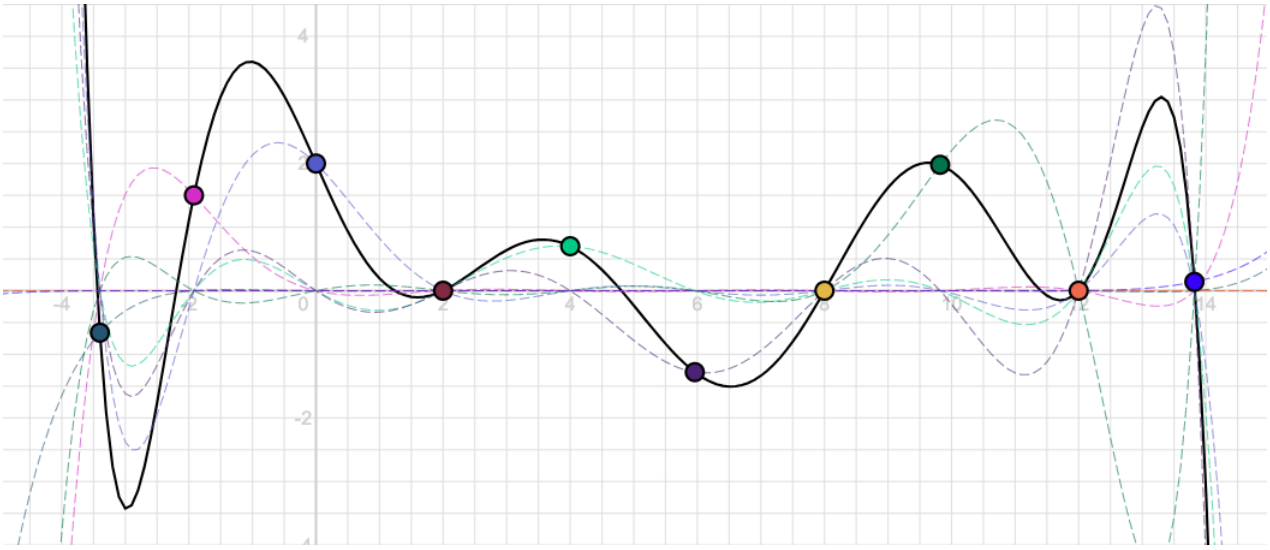
Course Website: http://math.mercyhurst.edu/~lwilliams/Math400/index.php

Required Materials

You will not be required to purchase a textbook or any additional materials. Some materials will be distributed as printouts or pdfs throughout the semester.

The notation and topics used in class will most closely follow along with the textbook *Numerical Analysis* by Richard Burden and J. Douglas Faires. You are not required to purchase this text, but if you would like an additional resource to follow along with, this would be my recommendation. Any edition would be fine - older editions are inexpensive and will still be useful for many years.

Some assignments will require Scilab, a free and open source program for numerical computation. Scilab is available for Windows, Linux, and Mac OS and can be downloaded at https://www.scilab.org/. Scilab runs on any computer with at least 2 GB RAM and 600 MB of available hard disk space. You will need an internet connection for the download only. If you do not have a computer on which you can install Scilab, please let me know as soon as possible so we can make alternate arrangements.



Learning Differences

In keeping with college policy, any student with a disability who needs academic accommodations must call Learning Differences Program secretary at 824-3017, to arrange a confidential appointment with the director of the Learning Differences Program during the first week of classes.

Academic Honesty

Students are required to uphold academic integrity throughout the course. In particular, plagiarism of any sort, unauthorized collaboration on exams, quizzes and other assignments, and other incidences of academic dishonesty will be handled according to the policies set forth in the Student Handbook.

Course Evaluations

Near the end of the semester, you will be asked to complete an online course evaluation. The evaluation will be completed in class during the last two weeks of the semester using any laptop, tablet, or mobile device. The response tool allows you to note aspects of the course that helped you learn, as well as aspects that might be modified to help future students learn more effectively. You will receive an email letting you know when the evaluation window for our class is open. Please note that these course evaluations are anonymous and instructors do not see the results until after the grades for the course are submitted.

Course Components

Homework

There will be 8 homework assignments throughout the semester, typically due one week after they are assigned. You may work together, but keep in mind that these problems may appear on exams, so you are strongly recommended to work through them on your own.

For collected problems, you are expected to submit your final work. Problems involving calculations should include work and an explanation of the steps used to arrive at your answer. Proofs should use formal language and notation. Work should be clear and neatly written.

For some assignments, you may be required to submit the code that you are using to arrive at your solution. You may turn in any Scilab assignments as printouts or email them to me directly.

If you are unable to submit your work in class, you can email a clear scan or photo of your work.

Exams

We will have two midterm exams and a final exam. The final exam will be cumulative, while the midterm exams will focus on more recent material. Exams will be based on homework problems and lecture material. There will not be a coding component of any exams.

You will be able to make up exams for excused absences. If you know in advance that you will not be able to take an exam at its schedule time, please let me know as soon as possible. All make ups must be completed within one week of the exam date. You are required to take the final exam for this course regardless of your average on earlier exams or homework.

The final exam is scheduled for **Friday, May 10, 1:00 pm - 3:00 pm**.

Grading

180 points	**Midterm Exams** Two exams, 90 points each
200 points	**Homework** Eight assignments, 25 points each
120 points	**Final Exam**
500 points	**Total Possible**

Grading Scale

D	D+	C	C+	B	B+	A
298	333	348	383	398	433	448
60%	67%	70%	77%	80%	87%	90%

Course Schedule

Jan	**14**	Class Introduction, Review of Calculus
	16	Number Systems
	18	Error and Computer Arithmetic
	21	*No Class - MLK Day*
	23	Error and Computer Arithmetic
	25	What is an algorithm?
	28	Convergence
	30	Root Finding: Bisection Method
Feb	**1**	Root Finding: Bisection Method
	4	Root Finding: Secant Method
	6	Root Finding: Newton's Method
	8	Root Finding: Newton's Method
	11	Error Analysis
	13	Polynomial Interpolation
	15	Polynomial Interpolation
	18	Cubic Spline Interpolation
	20	Cubic Spline Interpolation
	22	**Exam I**
	25	Numerical Differentiation
	27	Numerical Differentiation
Mar	**1**	Numerical Integration
	4-8	*No Class - Spring Break*
	11	Numerical Integration
	13	Systems of Linear Equations
	15	Matrices: Operations and Special Types
	18	Gaussian Elimination
	20	Gaussian Elimination
	22	Partial Pivoting
	25	Matrix Factorization
	27	Matrix Factorization
	29	Matrix Factorization
Apr	**1**	Vector Norms and Distances
	3	Matrix Norms
	5	Eigenvalues
	8	Eigenvalues
	10	Eigenvalues
	12	**Exam II**
	15	Jacobi Iterative Method
	17	Jacobi Iterative Method
	19	*No Class - Easter Break*
	22	*No Class - Easter Break*
	24	Least Squares Approximation
	26	Least Squares Approximation
	29	Generalized Newton's Method
May	**1**	Generalized Newton's Method
	3	Conclusion
	10	**Final Exam 1:00 pm**

Other Important Dates

January 22
Add/Drop Deadline

March 14
π Day

April 2
Advising Day

April 12
Withdrawal Deadline

May 6
Reading Day

We will attempt to adhere to this schedule as closely as possible. Topics may be covered on other dates, but exams will be held as scheduled.

All changes to the course schedule, including due dates for homework assignments, will be announced in class.