Empowering the Future: How the Distance Math Program Offers Undergraduate Courses to Advanced High School Students in Georgia

slides

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SIMIODE Expo 2024

While we are waiting to start: use the chat to introduce yourself and where you are connecting from, experiences teaching distance and/or for high school.

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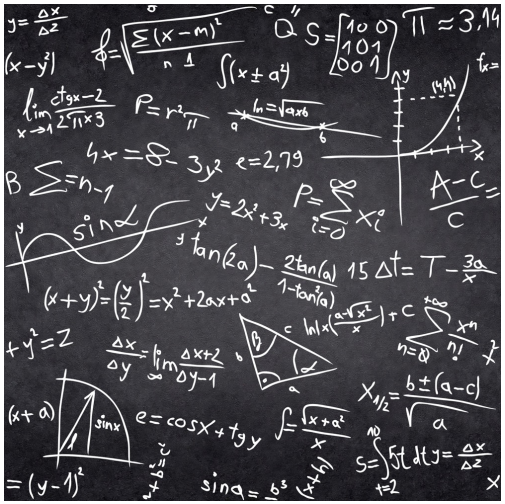
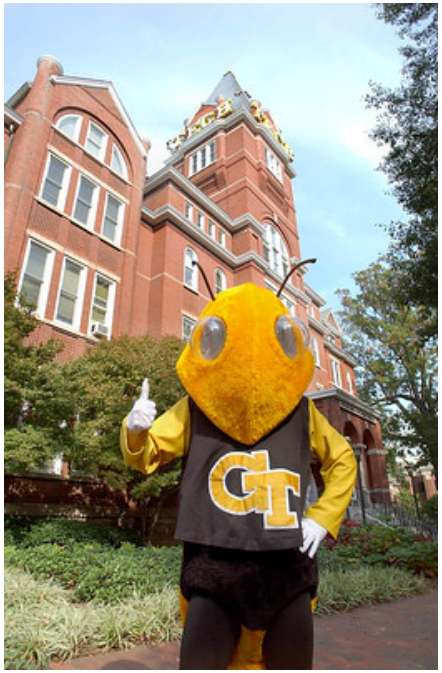
Overview

- Distance Math Program Overview
  - Program structure
  - Enrollment
  - Technologies and procedures
- Differential Equations for High School Distance
- Benefits and Challenges



The Distance Math Program

- A distance learning program offered at Georgia Tech
- Offers undergraduate mathematics courses to Georgia high school students.
- Relies on state funding through **dual enrollment***.
  - Dual enrollment allows students to be enrolled in college(s) and high school.
  - Students receive high school and college credit simulteneously.



* More info on GaDOE website here.

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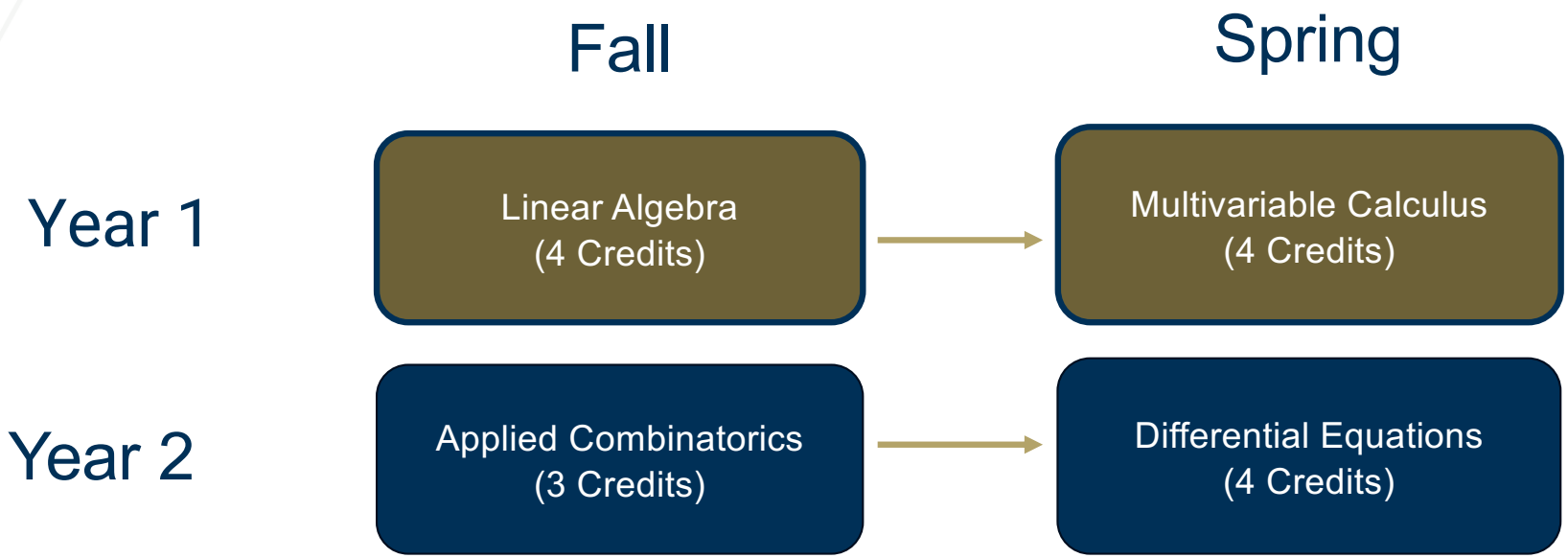
Courses


Fall
Spring
Year 1
Linear Algebra
(4 Credits)
Multivariable Calculus
(4 Credits)
Year 2
Applied Combinatorics
(3 Credits)
Differential Equations
(4 Credits)

Partnerships

- School of Math
  - Course curriculum and instruction
  - Assigns teaching assistants, instructors
  - Director of online learning supports teaching assistants and instructors
- Georgia Tech Professional Education
  - Course design
  - Technology support for students, assistants, instructors
  - Exam administration
- Georgia Tech Admissions
  - Application and enrollment processes

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Application Requirements

- To apply for distance math, students must
  - Be a Georgia resident (out-of-state students not eligible).
  - Have completed AP Calculus BC with **score of 4 or 5**.
  - Submit high school transcript
  - Submit SAT, ACT, or PSAT scores
- More information about application process on GT Admissions website.

Impact

- Roughly half of the distance math students go on to enroll at Georgia Tech.
- Among in-state students admitted to an undergraduate degree program at Georgia Tech, around **1/6 of them completed the Distance Math Program.**

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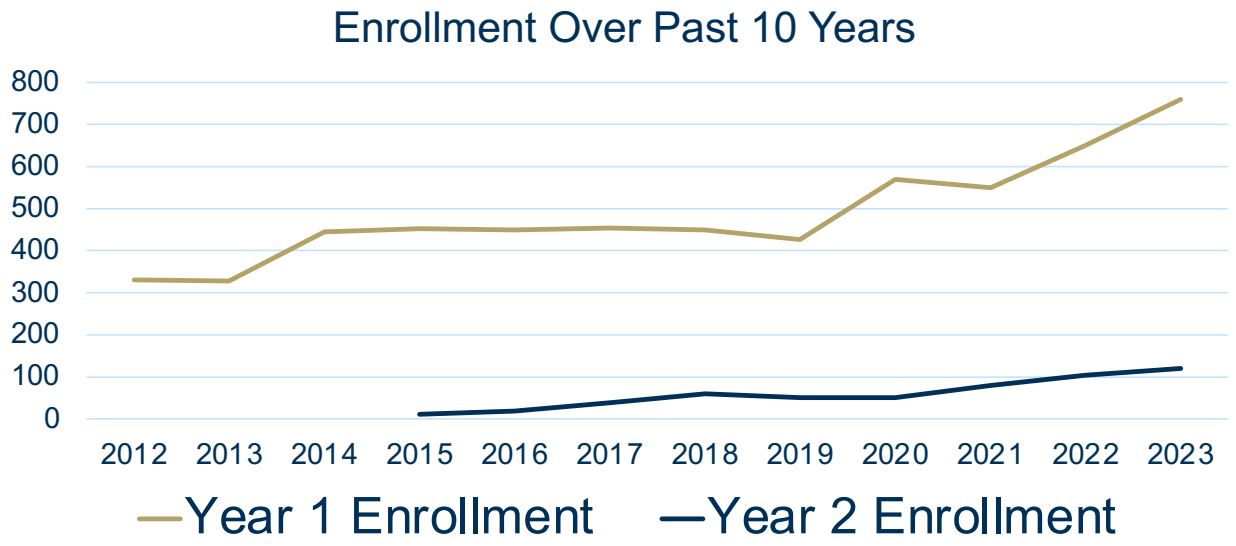
Enrollment Growth

- Program began in 2005 with ~ 30 high school students
- Approximate enrollment now:
  - **Year 1**: 760 students (linear algebra, multivariable calculus)
  - **Year 2**: 120 students (applied combinatorics, differential equations)



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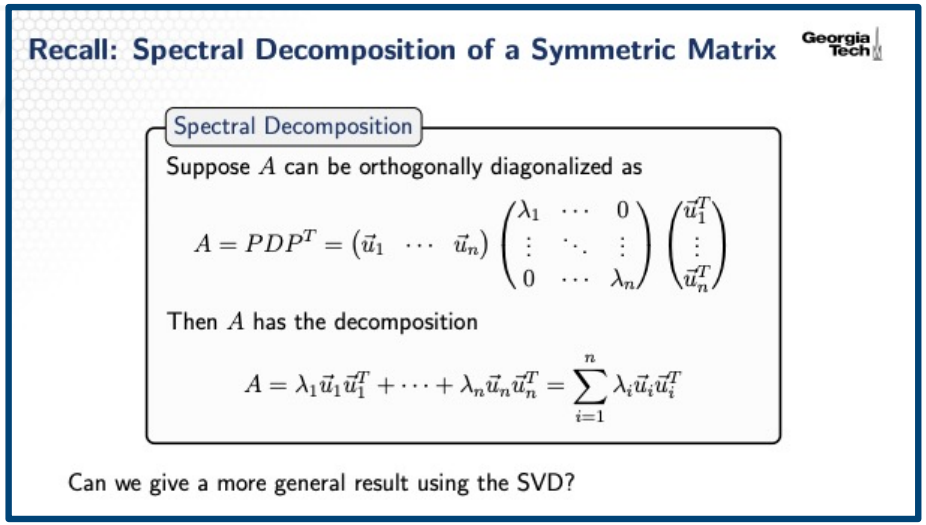
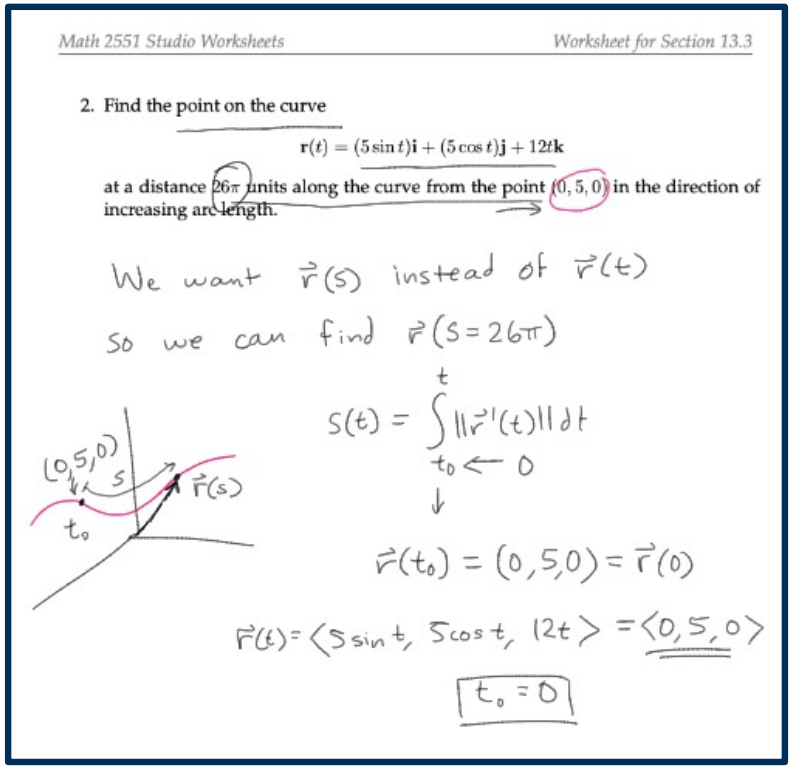
Course Delivery Format

- Asychronous: pre-recorded lectures
- Live studio sessions facilitated by teaching assistants



Lecture Slides Created in LaTeX (beamer)



Teaching Assistants Annotate Worksheets in Live Studio

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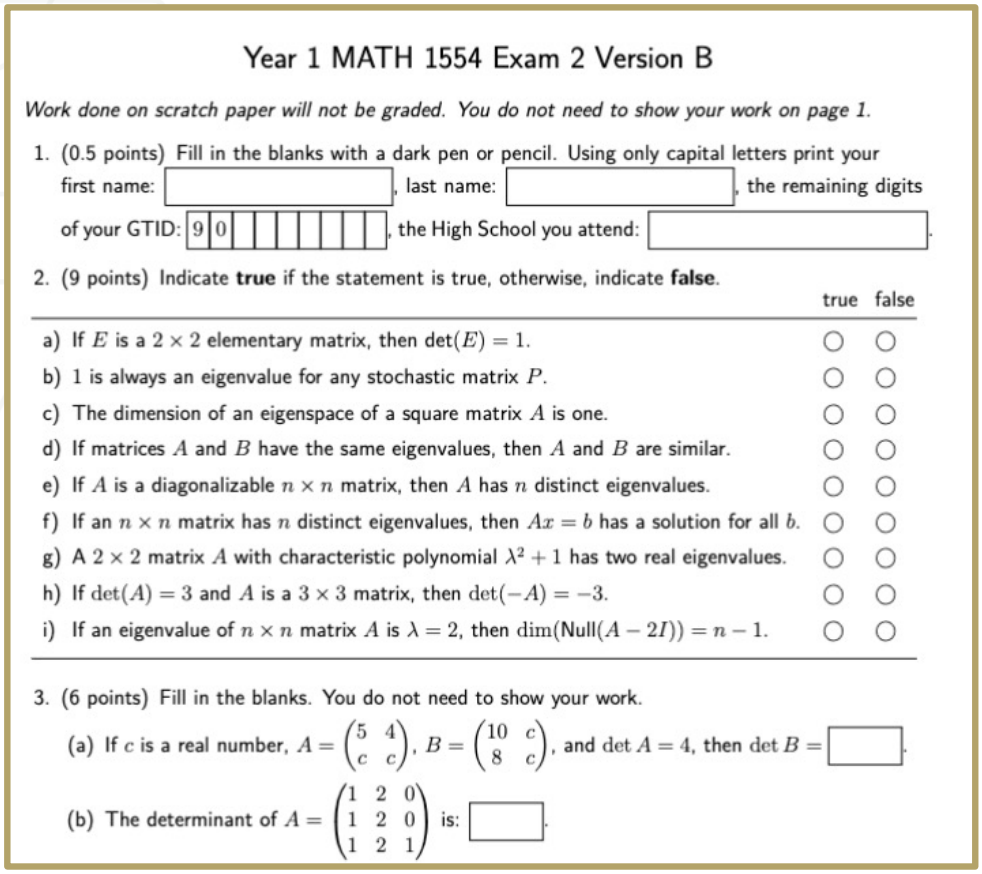
Exam Procedures



Year 1 MATH 1554 Exam 2 Version B

Work done on scratch paper will not be graded. You do not need to show your work on page 1.

1. (0.5 points) Fill in the blanks with a dark pen or pencil. Using only capital letters print your first name: [ ], last name: [ ], the remaining digits of your GTID: [9][0][ ][ ][ ][ ][ ][ ][ ], the High School you attend: [ ].

2. (9 points) Indicate **true** if the statement is true, otherwise, indicate **false**.

	true	false
a) If E is a 2×2 elementary matrix, then $\det(E) = 1$.	○	○
b) 1 is always an eigenvalue for any stochastic matrix P.	○	○
c) The dimension of an eigenspace of a square matrix A is one.	○	○
d) If matrices A and B have the same eigenvalues, then A and B are similar.	○	○
e) If A is a diagonalizable $n \times n$ matrix, then A has n distinct eigenvalues.	○	○
f) If an $n \times n$ matrix has n distinct eigenvalues, then $Ax = b$ has a solution for all b.	○	○
g) A 2×2 matrix A with characteristic polynomial $\lambda^2 + 1$ has two real eigenvalues.	○	○
h) If $\det(A) = 3$ and A is a 3×3 matrix, then $\det(-A) = -3$.	○	○
i) If an eigenvalue of $n \times n$ matrix A is $\lambda = 2$, then $\dim(\text{Null}(A - 2I)) = n - 1$.	○	○

3. (6 points) Fill in the blanks. You do not need to show your work.

(a) If c is a real number, $A = \begin{pmatrix} 5 & 4 \\ c & c \end{pmatrix}$, $B = \begin{pmatrix} 10 & c \\ 8 & c \end{pmatrix}$, and $\det A = 4$, then $\det B =$ [ ].

(b) The determinant of $A = \begin{pmatrix} 1 & 2 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 1 \end{pmatrix}$ is: [ ].

- In-person proctored.
- Each high school has a designated facilitator who is in charge of proctoring.
- Exams graded using Gradescope.

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Exam Procedures

Instructor creates 2 to 5 versions of exam

GT Professional Education distributes exams to high schools

In-person proctored paper exams at high schools

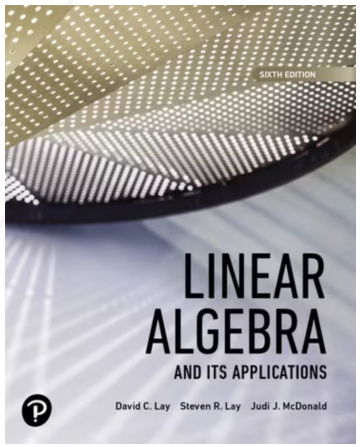
High school facilitator scans paper exams

GT Professional Education uploads exams to Gradescope

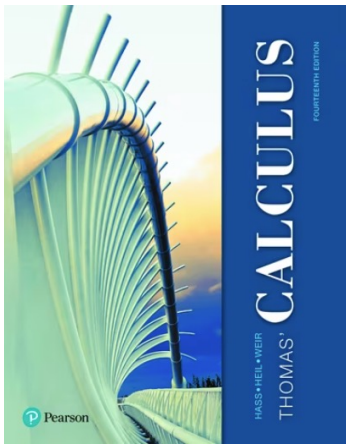
Online grading with team of assistants in Gradescope

Textbooks

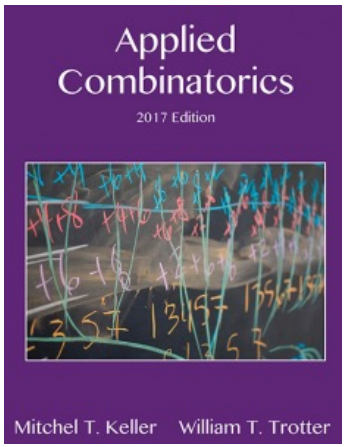
Linear Algebra
Lay 6E



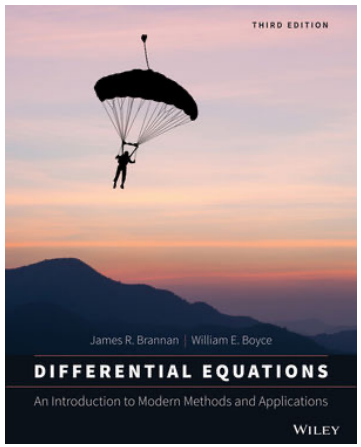
Multivariable Calculus
Thomas 14E



Applied Combinatorics
Keller & Trotter



Differential Equations
Brannan & Boyce 3E



- Using the same textbooks that the on-campus sections use.
- State policy that dual enrolled students not required to pay for textbooks.
- GT Bookstore emails e-textbook codes to students.
- Working on moving to OER ...

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Assistant Team

	Head TA	TAs	Lecture Assistants	Graders	Curriculum Developers
Grade	✓	✓	✓	✓	
Office Hours	✓	✓	✓		
Forum Moderation	✓	✓	✓		
Live online studios	✓	✓			
Course Admin	✓				
Develop Curriculum	✓	✓			✓

	Head TA	TAs	Lecture Assistants	Graders	Curriculum Developers
Year 1	1	1	4	4	7
Year 2	0	1	0	1	0

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Current Challenges → Future Directions

- Publisher homework systems alignment to course
- Textbook costs and code distribution
- Time needed to create multiple exam versions

student assistants

- WebWork
- OER
- AI

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Impact on Other Initiatives

- Distance Math curriculum supported other undergraduate courses and generated momentum for other projects.
- For example:
  - Lecture slides, worksheets, lecture recordings shared with other mathematics faculty.
  - Four-part linear algebra series on EdX.
  - Open Course Project (a DEI initiative).

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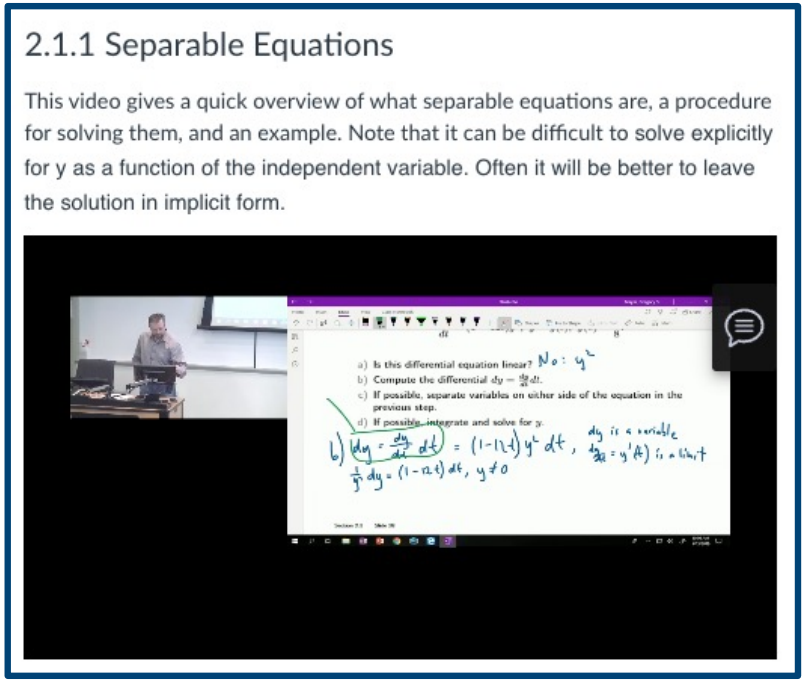
Online Differential Equations

- Spring semesters
- Pre-recorded lectures
- Covers same topics as on-campus sections
    1. First order equations
    2. Linear systems
    3. Second order equations
    4. Numerical methods
    5. Nonlinear equations
    6. Laplace Transform methods

Recorded Video Embedded in Canvas



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Projects in Differential Equations

Using the chat: what challenges do you encounter when you have group project, or think you would encounter, if you were to incorporate them into your class?

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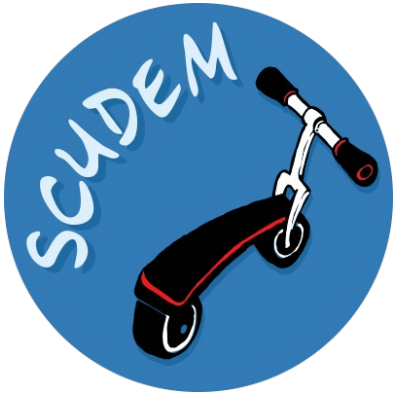
Online Differential Equations Group Project

- Modeled off of the annual SCUDEM challenge
- Students must:
  - Create numerical solution
  - Incorporate a non-linear system with at least two dependent variables
  - Work in group of 2 or 3
  - Write a ~1,500 word essay
  - Choose a topic, but we give suggestions from SIMIODE
- Final project report due at end of semester.
- Project mini-conference where students:
  - Share final report draft on course forum
  - Comment on each other's drafts
  - Reply to comments



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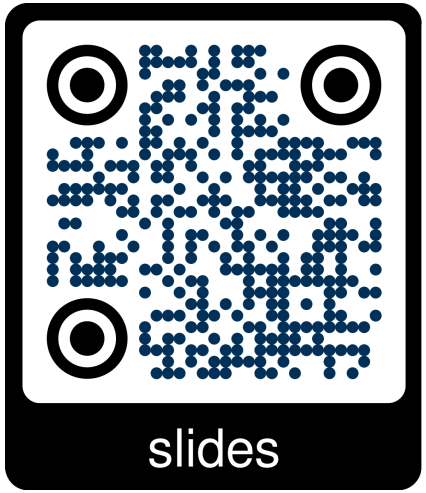
Online Differential Equations Group Project: Rubric

- After a few semesters of grading student projects we have been working on refining a rubric
  - Based on SCUDEM challenge scoring rubric.
  - Addresses some of the common challenges students have in technical writing.
- Download our project instructions and rubric:



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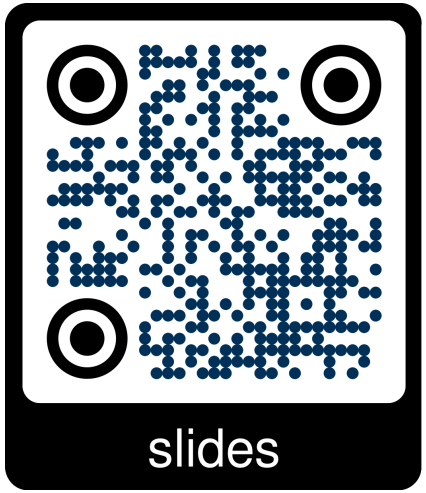
Questions?

- Would be happy to answer any questions that you might have!
- Greg Mayer: greg.mayer@gatech.edu



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