COURSE SYLLABUS

Course Title: **Computational Linear Algebra**

Abbreviated Title As Appears on Transcript: `Comp Linear Algebra`

Course Number: DMAT 335

Credit Hours: 4 credits [semester credit hours]

Course Description: A first course in matrix algebra and linear spaces with emphasis on computational software techniques and geometrical analysis. Topics include matrices, solutions of systems of linear equations, determinants, linear spaces and transformations, inner products, higher dimensional spaces, inverses and pseudoinverses, rank, Singular Value Decomposition, bases, rank, Eigenvalues and Eigenvectors, matrix decomposition and diagonalization.

Prerequisite: Successful completion (C- or higher) of Calculus II or equivalent, or consent of instructor.

Course Workload: 4 semester credit hours • 3 student work hours per credit hour • 14 week Carnegie semester = 168 hours student course workload average

Examination Requirements: Proctored written final examination must be passed at 60% or higher to earn passing grade in course. "B" and "A" grade paths have additional examinations.
See https://www.distancecalculus.com/grades/ for more information.

Course Professor: Robert R. Curtis, Ph.D.<rcurtis@rwu.edu>, <robert@distancecalculus.com>

University Information: Roger Williams University, University College, 1 Empire Plaza, Providence, RI, USA 02903. Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809.
Accredited by New England Commission of Higher Education (NECHE).
See https://www.rwu.edu/academics/accreditation/ for more information.

E-Textbook: *Matrices, Geometry & Mathematica* by Davis/Porta/Uhl

Mathematical Software: Mathematica™ Computer Algebra & Graphing System

ADA ACCOMMODATIONS

Roger Williams University has a continuing commitment to providing reasonable accommodations for students with documented disabilities. Students with disabilities who need accommodations in order to fully participate in this class are urged to contact Student Accessibility Services, as soon as possible, to explore the arrangements needed to be made to assure access. Student Accessibility Services is open Monday through Friday from 8:00AM to 5:00PM Eastern Time; Email: sas@rwu.edu or Voice: 401-254-3841. For more information about SAS, visit https://www.rwu.edu/undergraduate/academics/student-academic-success/student-accessibility-services-sas

Learning Outcomes for DMAT 335 - Computational Linear Algebra

1. To understand the core connection between matrix algebra and a study of systems of linear equations
2. To understand and compute measurements of vectors and their geometry
3. To understand and compute core matrix algebra operations and their geometrical interpretations
4. To understand and compute the fundamental properties of determinants and inverses of matrices, both for square and non-square generalizations
5. To understand and compute Singular Value Decomposition
6. To understand and compute the core concept of rank and its variations
7. To understand and compute Gaussian elimination and other strategies for finding solutions or approximate solutions to systems of linear equations
7. To understand and compute bases, change of bases, spanning and linear independence, kernel and image sets
8. To understand and compute the diagonalization of a matrix, both with Singular Value Decomposition, and Eigenvalue - Eigenvector constructions.

Syllabus Topics Outline for DMAT 335 - Computational Linear Algebra

1. Getting Started
    - 1.1 Email and Chat
    - 1.2 Learning About the Course
    - 1.3 Required Hardware
    - 1.4 Software Fundamentals

2. Vectors
    - 2.1. Geometry of Vectors
    - 2.2. Perpendicular Frames
    - 2.3. Curves in 2D: Change of Frames/Basis
    - 2.4. Dot Products
    - 2.5. Cross Products
    - 2.6. Ellipses and Ellipsoids
    - 2.7. Area and Volume

3. Matrices
    - 3.1 Basics
    - 3.2 Transforming Curves
    - 3.3 Matrix Arithmetic
    - 3.4 Translations and Rotations
    - 3.5 Shears
    - 3.6 Linear Transformations
    - 3.7 Inverses

- 3.8 Determinants
- 3.9 Transposes
- 3.10 Matrix Decomposition: Singular Value Decomposition
- 3.11 Rank
- 3.12 Projections
- 3.13 Higher Dimensions

4. Linear Systems
    - 4.1 Conversion to Matrix Notation
    - 4.2 Gaussian Elimination
    - 4.3 Vector Spaces and Subspaces
    - 4.4 Numerical Considerations
    - 4.5 Applications: Least Square Fit
    - 4.6 Spanning Sets; Basis
    - 4.7 Linear Independence
    - 4.8 Pseudo Inverses
    - 4.9 Approximate Solutions
    - 4.10 Null Space and Image Space

5. Eigenvalues and Eigenvectors
    - 5.1 Diagonalization of a Matrix
    - 5.2 Eigenvalues
    - 5.3 Eigenvectors
    - 5.4 Exponential of a Matrix