Week 0 - Overview of Course

0.1 Opening Remarks
- 0.1.1 Welcome
- 0.1.2 Outline Week 1
- 0.1.3 What You Will Learn

0.2 Navigating this Course
- 0.2.1 How to Navigate this Document
- 0.2.2 Setting Up Your Computer

0.3 Programming with MATLAB
- 0.3.1 Installing MATLAB
- 0.3.2 MATLAB Basics

0.4 Enrichments
- 0.4.1 The Origins of MATLAB

0.5 Wrap Up
- 0.5.1 Additional Homework
- 0.5.2 Summary

Week 1 - Vectors in Linear Algebra

1.1 Opening Remarks
- 1.1.1 Take Off
- 1.1.2 Outline Week 1
- 1.1.3 What You Will Learn

1.2 What is a Vector?
- 1.2.1 Notation
- 1.2.2 Unit Basis Vectors

1.3 Simple Vector Operations
- 1.3.1 Equality (=), Assignment (:=), and Copy
- 1.3.2 Vector Addition
- 1.3.3 Scaling
- 1.3.4 Vector Subtraction

1.4 Advanced Vector Operations
- 1.4.1 Scaled Vector Addition
- 1.4.2 Linear Combinations of Vectors
- 1.4.3 Dot or Inner Product
- 1.4.4 Vector Length
- 1.4.5 Vector Functions
- 1.4.6 Vector Functions that Map a Vector to a Vector

1.5 LAFF Package Development: Vectors
- 1.5.1 Starting the Package
- 1.5.2 A Copy Routine (copy)
- 1.5.3 A Routine that Scales a Vector
- 1.5.4 A Scaled Vector Addition Routine
- 1.5.5 An Inner Product Routine
- 1.5.6 A Vector Length Routine

3.1 Opening Remarks
- 3.1.1 Timmy Two Space
- 3.1.2 Outline Week 3
- 3.1.3 What You Will Learn

3.2 Special Matrices
- 3.2.1 The Zero Matrix
- 3.2.2 The Identity Matrix
- 3.2.3 Diagonal Matrices
- 3.2.4 Triangular Matrices
- 3.2.5 Transpose Matrix
- 3.2.6 Symmetric Matrices

3.3 Operations with Matrices
- 3.3.1 Scaling a Matrix
- 3.3.2 Adding Matrices

3.4 Matrix-Vector Multiplication Algorithms
- 3.4.1 Via Dot Products
- 3.4.2 Via axpy
- 3.4.3 Compare and Contrast
- 3.4.4 Cost of Matrix-Vector Multiplication

3.5 Wrap Up
- 3.5.1 Homework
- 3.5.2 Summary

Week 4 - From Matrix-Vector Multiplication to Matrix-Matrix Multiplication

4.1 Opening Remarks
- 4.1.1 Predicting the Weather
- 4.1.2 Outline
- 4.1.3 What You Will Learn

4**.2 Preparation**
- 4.2.1 Partitioned Matrix-Vector Multiplication
- 4.2.2 Transposing a Partitioned Matrix
- 4.2.3 Matrix-Vector Multiplication, Again

4.3 Matrix-Vector Multiplication with Special Matrices
- 4.3.1 Transpose Matrix-Vector Multiplication
- 4.3.2 Triangular Matrix-Vector Multiplication
- 4.3.3 Symmetric Matrix-Vector Multiplication

4.4 Matrix-Matrix Multiplication (Product)
- 4.4.1 Motivation
- 4.4.2 From Composing Linear Transformations to Matrix-Matrix Multiplication
- 4.4.3 Computing the Matrix-Matrix Product
- 4.4.4 Special Shapes
- 4.4.5 Cost

4.5 Enrichment
- 4.5.1 Hidden Markov Processes

Week 7 - More Gaussian Elimination and Matrix Inversion

Week 8 - More on Matrix Inversion

Week 11 - Orthogonal Projection, Low Rank Approximation, and Orthogonal Bases

11.5.1 The Best Low Rank Approximation

11.6 Enrichment

11.6.1 The Problem with Computing the QR Factorization
11.6.2 QR Factorization Via Householder Transformations (Reflections)
11.6.3 More on SVD

11.7 Wrap Up

11.7.1 Homework
11.7.2 Summary

Week 12 - Eigenvalues, Eigenvectors, and Diagonalization

12.1 Opening Remarks

12.1.1 Predicting the Weather, Again
12.1.2 Outline
12.1.3 What You Will Learn

12.2 Getting Started

12.2.1 The Algebraic Eigenvalue Problem
12.2.2 Simple Examples
12.2.3 Diagonalizing
12.2.4 Eigenvalues and Eigenvectors of 3 x 3 Matrices

12.3 The General Case

12.3.1 Eigenvalues and Eigenvectors of $ n \times n $ matrices: Special Cases
12.3.2 Eigenvalues of $ n \times n $ Matrices
12.3.3 Diagonalizing, Again
12.3.4 Properties of Eigenvalues and Eigenvectors

12.4 Practical Methods for Computing Eigenvectors and Eigenvalues

12.4.1 Predicting the Weather, One Last Time
12.4.2 The Power Method
12.4.3 In Preparation for this Week's Enrichment

12.5 Enrichment

12.5.1 The Inverse Power Method
12.5.2 The Rayleigh Quotient Iteration
12.5.3 More Advanced Techniques

12.6 Wrap Up

12.6.1 Homework
12.6.2 Summary