Contents

Π	Lin	ear Algebra	1		
1	Vectors				
	1.1	The Geometry and Algebra of Vectors	2 2		
	1.2	Length and Angle: The Dot Product	2		
	1.3	Lines and Planes	2		
	1.4	Code Vectors and Modular Systems	2		
2	Systems of Linear Equations 3				
	2.1	Introduction to Systems of Linear Equations	3		
	2.2	Direct Methods for Solving Linear Systems	3		
	2.3	Spanning Sets and Linear Independence	3		
	2.4	Applications	3		
	2.5	Iterative Method for Solving Linear Systems	3		
3	Matrices 4				
	3.1	Matrix Operations	4		
	3.2	Matrix Algebra	4		
	3.3	The Inverse of a Matrix	4		
	3.4	The LU Factorization	4		
	3.5	Subspaces, Basis, Dimension, and Rank	4		
	3.6	Introduction to Linear Transformations	4		
	3.7	Applications	4		
4	Eigenvalues and Eigenvectors				
	4.1	Introduction to Eigenvalues and Eigenvectors	5		
	4.2	Determinants	5		
	4.3	Eigenvalues and Eigenvectors of $n \times n$ Matrices	5		
	4.4	Similarity and Diagonalization	5		
	4.5	Iterative Methods for Computing Eigenvalues	5		
	4.6	Applications and the Perron-Frobenius Theorem	5		
5	Ortho	ogonality	6		
	5.1	Orthogonality in \mathbb{R}^n	6		
	5.2	Orthogonal Complements and Orthogonal Projections	6		
	5.3	The Gram-Schmidt Process and the QR Factorization	6		

CONTENTS	ii	

	5.4 5.5	Orthogonal Diagonalization of Symmetric Matrices Applications	6 6
6	Vector	Spaces	7
	6.1	Vector Spaces and Subspaces	7
	6.2	Linear Independence, Basis, and Dimension	7
	6.3	Change of Basis	7
	6.4	Linear Transformation	7
	6.5	The Kernel and Range of a Linear Transformation	7
	6.6	The Matrix of a Linear Transformation	7
	6.7	Applications	7
7	Distar	nce and Approximation	8
	7.1	Inner Product Spaces	8
	7.2	Norms and Distance Function	8
	7.3	Least Squares Approximation	8
	7.4	The Singular Value Decomposition	8
	7.5	Applications	8

Part II Linear Algebra

Vectors

- 1.1 The Geometry and Algebra of Vectors
- 1.2 Length and Angle: The Dot Product
- 1.3 Lines and Planes
- 1.4 Code Vectors and Modular Systems

Systems of Linear Equations

- 2.1 Introduction to Systems of Linear Equations
- 2.2 Direct Methods for Solving Linear Systems
- 2.3 Spanning Sets and Linear Independence
- 2.4 Applications
- 2.5 Iterative Method for Solving Linear Systems

Matrices

- 3.1 Matrix Operations
- 3.2 Matrix Algebra
- 3.3 The Inverse of a Matrix
- 3.4 The LU Factorization
- 3.5 Subspaces, Basis, Dimension, and Rank
- 3.6 Introduction to Linear Transformations
- 3.7 Applications

Eigenvalues and Eigenvectors

- 4.1 Introduction to Eigenvalues and Eigenvectors
- 4.2 Determinants
- 4.3 Eigenvalues and Eigenvectors of $n \times n$ Matrices
- 4.4 Similarity and Diagonalization
- 4.5 Iterative Methods for Computing Eigenvalues
- 4.6 Applications and the Perron-Frobenius Theorem

Orthogonality

- 5.1 Orthogonality in \mathbb{R}^n
- 5.2 Orthogonal Complements and Orthogonal Projections
- 5.3 The Gram-Schmidt Process and the QR Factorization
- 5.4 Orthogonal Diagonalization of Symmetric Matrices
- 5.5 Applications

Vector Spaces

- 6.1 Vector Spaces and Subspaces
- 6.2 Linear Independence, Basis, and Dimension
- 6.3 Change of Basis
- 6.4 Linear Transformation
- 6.5 The Kernel and Range of a Linear Transformation
- 6.6 The Matrix of a Linear Transformation
- 6.7 Applications

Distance and Approximation

- 7.1 Inner Product Spaces
- 7.2 Norms and Distance Function
- 7.3 Least Squares Approximation
- 7.4 The Singular Value Decomposition
- 7.5 Applications