Matrix Theory and Its Applications (2016 Spring at Nanjing University)

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1 Introduction

A graduate level course provided for master and PhD students at Nanjing University, Nanjing, China.

2 Instructor

Prof. Jinxi Zhao (`http://cs.nju.edu.cn/zhaojinxi/`)

3 Syllabus

1. **Linear space and linear operator**
   - Introduction to linear space
   - Definition of linear space
   - The relationship of vectors in linear space
   - Base, dimension and coordinates
   - Subspace of linear space
   - Hyperplane
   - Base transformation and transfer matrix in linear space
2. **Linear operator and its matrix representation**
   - Linear operator in linear space
   - Isomorphic operators and linear space isomorphism
   - Linear operator and its matrix representation
   - Operations of Linear operator
   - Linear transformation and square matrix
   - Matrix representation of linear operators with different bases
3. **Inner product space**
   - Inner product and Euclidean space
   - The length and angle of vectors
   - Metric matrix

- Orthogonality
- Standard orthogonal base
- Complex inner product linear space

4. **Definition and properties of orthogonal transformation**
    - Unitary matrix and unitary transformation
    - Orthogonal subspace in inner product space
    - Projection Operator of Inner Product Space and Its Matrix Representation
    - Orthogonal projection transformation
    - Matrix representation of projection transformation
    - Properties of projection transformation
5. **Norm linear space and norm**
    - Norm linear space
    - Matrix norm
    - One application of matrix norm
6. **Special products of matrix and their applications**
    - Hadamard product
    - Kronecker product
    - Matrix function
7. **Matrix eigenvalues and matrix decomposition**
    - Matrix eigenvalues
    - Eigenvalues of real symmetric matrices
    - Singular value decomposition of real matrices
    - Matrix decomposition
    - Elementary lower triangular matrix
    - Householder transformation
    - Full rank decomposition
    - Triangulation decomposition
    - QR decomposition
    - Schur's theorem and normal matrix
8. **Generalized inverse matrix and its calculation**
    - Definition of Generalized inverse matrix
    - The calculation method of M-P generalized inverse
    - Applications of generalized inverse matrix