Fundamentals of Linear Algebra

UC Berkeley School of Information

Description

This course is designed to equip students with the basic knowledge in linear algebra that is needed for the Master of Data Science (MIDS). It covers mathematical prerequisites that will appear in later courses, including Machine Learning and advanced electives.

This is one of two self-paced "bridge" courses that students may take to supplement their technical preparation in the early stages of the MIDS curriculum. A companion course, Fundamentals of Data Structures and Algorithms, surveys programming techniques, algorithm development, core data structures used in computer science, and a selection of special topics relevant to data science.

Course Format

The course is divided into four units, which are self-paced. Students can complete the material in any amount of time. Each unit has approximately two hours of asynchronous material, and the course does not include live discussion sections.

The course will include a set of exercises to accompany some lecture segments. These exercises are optional, but students who are interested in fully grasping the material will find them useful. There are no exams, graders, or required assignments for this course.

Text

The course is self-contained and requires no textbook. Some portions of the course track the presentation from Sheldon Axler's *Linear Algebra Done Right*. This text is not required.

Prerequisites

A previous course in calculus is recommended. Students who have had prior exposure to more advanced mathematics may better understand passing references, but the core content of the course is sufficiently self-contained that no prior exposure to advanced mathematics is necessary.

Schedule

Unit 1: Linear Functions

What Is a Function?
What Is a Linear Function?
Affine Functions as Linear Functions
Operations on Real Vectors
Summations and Applications
Vectors as Single-Valued Linear Functions
Operations on Real Matrices
The Matrix-Vector Product
Matrices as Linear Functions
Composition of Linear Functions
The Matrix Product

Unit 2: Linear Systems of Equations

Linear Systems
Types of Linear Systems
Solving Linear Systems by Direct Methods
Gaussian Elimination With Backward Substitution
Elementary Matrices
LU Factorization
Matrix Inverses
Iterative Solution Methods

Unit 3: Linear Maps on Vector Spaces

Vector Spaces
Linear Combinations
Linear Independence and Bases
The Dimension Theorem
Representations of Linear Maps
Differentiation as a Linear Map
Subspaces and Direct Sums
Invariant Subspaces of Linear Maps
Eigenvalues and Eigenvectors
Characteristic Polynomials
Trace and Determinant

Unit 4: Geometry and Inner Product Spaces

Vector Geometry
Inner Product Spaces
Basic Properties of Inner Product Spaces
Orthonormal Sets of Vectors
Adjoints
Singular Value Decomposition
Orthogonal Projections
Least Squares Regression