

Linear Algebra from Scratch: Introduction

Instructor Anthony

GSU Alumni

Udemy Open Course

M.S. in Mathematics with a Concentration in Bioinformatics



Table of Contents

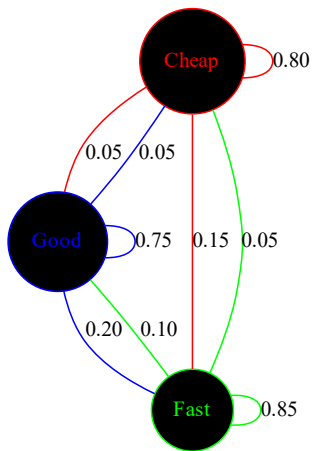
- 1 Why Study Matrices?
- 2 Course Overview
 - Matrices
 - Determinants
 - Vector Spaces
 - Linear Transformations
 - Orthogonality
 - Eigenvalues
 - Matlab & GitHub

Matrices are not Digital Constructions of the Environment



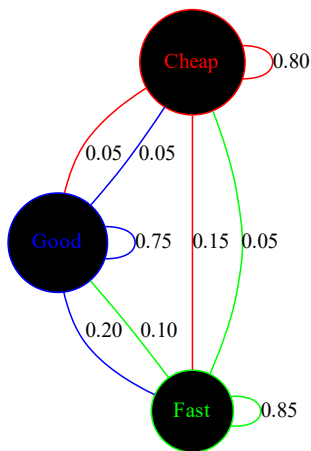
A Matrix is a collection of elements

- 1 $a_1 \sim \text{Cheap}$
- 2 $a_2 \sim \text{Good}$
- 3 $a_3 \sim \text{Fast}$



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$$A' = \begin{bmatrix} 0.80 & 0.05 & 0.10 \\ 0.05 & 0.75 & 0.05 \\ 0.15 & 0.20 & 0.85 \end{bmatrix}$$

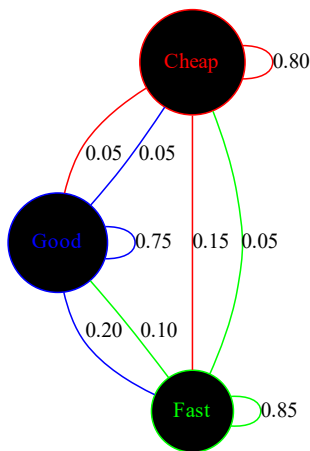


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A Matrix is a rectangular array of elements

Overview.

- 1 Systems of Linear Equations
- 2 Row Echelon Form



Determinants can be calculated for square matrices.

Overview.

- 1 Determinant of a matrix
- 2 Properties of determinants



Vector Spaces preserve linearity

Overview.

- 1 Definitions and Examples
- 2 Subspaces
- 3 Linear Independence
- 4 Basis and Dimension
- 5 Change of Basis
- 6 Row and Column Spaces



A Linear Transformation is a mapping

Definition.

- 1 Definitions and Examples
- 2 The Matrix representation of a linear transformation
- 3 Similarity between Matrices



Orthogonality is the geometric generalization of perpendicular

Definition.

- 1 Inner Product
- 2 Orthogonal Subspaces
- 3 Least Squares
- 4 Inner Product Spaces
- 5 Gram-Schmidt Orthogonalization



Solving the eigenvalue problem is useful to many applications

Overview.

- 1 Eigenvalues and Eigenvectors
- 2 Diagonalization
- 3 Hermitian Matrices
- 4 Singular Value Decomposition
- 5 Quadratic Forms



Coding as an additional exercise for ambitious scholars

Overview.

The Matlab, Python, and other relevant course related content can be found at: **GitHub Link**



References I

- [1] David Harville. *Matrix Algebra From a Statistician's Perspective*. New York: Springer-Verlag, 1997.
- [2] Leon Stephen. *Linear Algebra with Applications (9th Edition)* (*Featured Titles for Linear Algebra*). London, England: Pearson, 2014.