# Proof-Based Math Readings Session: Linear Algebra

2024 Spring

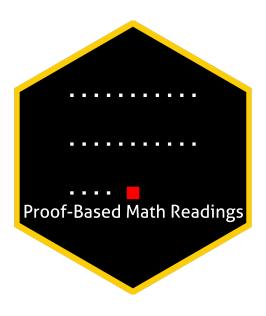
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# 0 Motivation

- Proof-Based Math Readings is a free and independent online reading group where we study mathematics required in economics master's/PhD programs using an intuitive approach.
- This session of the reading group is on *Linear Algebra*.

# 1 Prerequisites

- CGPA: 3.00/4.00
- Book of Proof Richard Hammack (3.3 Edition, 2022)
- Linear Algebra Gilbert Strang (2005)
- Please use our **O** Application Form to join our reading group anytime.
- People who applied will be informed about their application results via email within a week.

### 2 Format

- This session will last 12 weeks from 25 March 2024 to 16 June 2024.
- We will discuss the topics/exercises that we struggle with at Proof-Based Math Readings [Discord].
- We will not have face-to-face/online meetings due to the size of the group.
- Members are expected to read the chapters, and watch the chapter videos from the book's playlist.

# 3 Resources [All are open-access]

# 3.1 Main Book and Main Book's Playlist

Linear Algebra Done Right by Sheldon Axler is our main book for this session because it is well-written, well-structured, open-access, and -most importantly- the author's cat is on the cover photo of the playlist.

- Linear Algebra Done Right Sheldon Axler (4th Edition, 2023, Forthcoming)
- Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Companion playlist to the book)
- Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Solutions by linearalgebras)
- Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Solutions by jubnoske08)
- Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Solutions by solverer.com)

#### 3.2 Supplementary

#### 3.2.1 Linear Algebra

- Essence of Linear Algebra 3Blue1Brown (2023)
- ▶ Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Companion playlist by Robert Won)
- ▶ Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Companion playlist by Jason Morton)
- ▶ Linear Algebra Done Right Sheldon Axler (3rd Edition, 2015, Companion playlist by Felix Leditzky)
- Linear Algebra Elliot Nicholson (2021)
- Mathematical Proofs A Transition to Advanced Mathematics Gary Chartrand, Albert D. Polimeni, Ping Zhang (Chapter 17: Proofs in Linear Algebra, 4th Edition, 2018) and Odd-Numbered Exercise Solutions

#### **3.2.2** Proof

- Book of Proof Richard Hammack (3.3 Edition, 2022)
- ▶ Book of Proof Richard Hammack (3.3 Edition, 2022, Companion playlist by Jeremy Teitelbaum, Chapter 1-12)
- Book of Proof Richard Hammack (3.3 Edition, 2022, Companion playlist by Michael Penn, Chapter 1-14)

# 4 Reading Schedule

• LADR is the abbreviation of Linear Algebra Done Right - Sheldon Axler (4th Edition, 2023).

### **E** LADR, Chapter 1: Vector Spaces

Week 01 🛱 25 March - 31 March

LADR, Chapter 1.A:  $\mathbb{R}^{n}$  and  $\mathbb{C}^{n}$ 

LADR, Chapter 1.B: Definition of Vector Space

LADR, Chapter 1.C: Subspaces

### **■** LADR, Chapter 2: Finite-Dimensional Vector Spaces

Week 02 iii 01 April - 07 April

LADR, Chapter 2.A: Span and Linear Independence

LADR, Chapter 2.B: Bases LADR, Chapter 2.C: Dimension

# **■** LADR, Chapter 3: Linear Maps

Week 03-04-05 **=** 08 April - 28 April

LADR, Chapter 3.A: Vector Space of Linear Maps

LADR, Chapter 3.B: Null Spaces and Ranges

LADR, Chapter 3.C: Matrices

LADR, Chapter 3.D: Invertibility and Isomorphism

LADR, Chapter 3.E: Products and Quotients of Vector Spaces

LADR, Chapter 3.F: Duality

### **E** LADR, Chapter 4: Polynomials

Week 06 **= 29** April - 05 May

There is no subsection in this chapter, so we will read the whole chapter.

#### **E** LADR, Chapter 5: Eigenvalues and Eigenvectors

Week 07-08 **=** 06 May - 19 May

LADR, Chapter 5.A: Invariant Subspaces

LADR, Chapter 5.B: Eigenvectors and Minimal Polynomial

LADR, Chapter 5.C: Upper-Triangular Matrices

LADR, Chapter 5.D: Diagonalizable Operators

LADR, Chapter 5.E: Commuting Operators

#### **E** LADR, Chapter 6: Inner Product Spaces

Week 09-10 **= 20** May - 02 June

LADR, Chapter 6.A: Inner Products and Norms

LADR, Chapter 6.B: Orthonormal Bases

LADR, Chapter 6.C: Orthogonal Complements and Minimization Problems

### **■** LADR, Chapter 7: Operators on Inner Product Spaces

Week 11-12 **= 03** June - 16 June

LADR, Chapter 7.A: Self-Adjoint and Normal Operators

LADR, Chapter 7.B: Spectral Theorem

LADR, Chapter 7.C: Positive Operators

LADR, Chapter 7.D: Isometries, Unitary Operators, and Matrix Factorization

LADR, Chapter 7.E: Singular Value Decomposition

LADR, Chapter 7.F: Consequences of Singular Value Decomposition