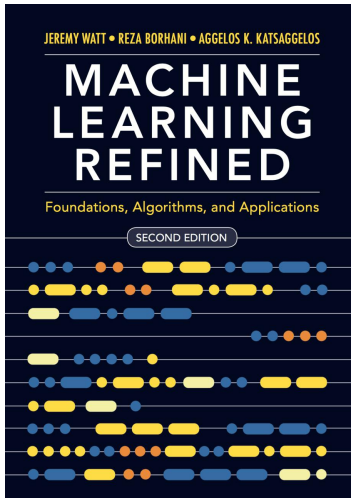
Notions of Linear Algebra & Optimization

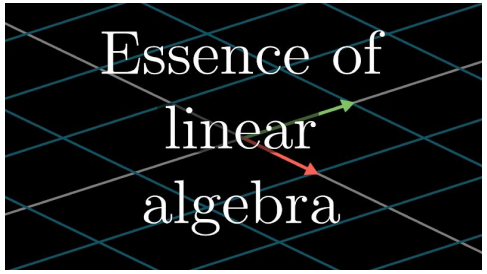
Introduction to Machine Learning course

Resources

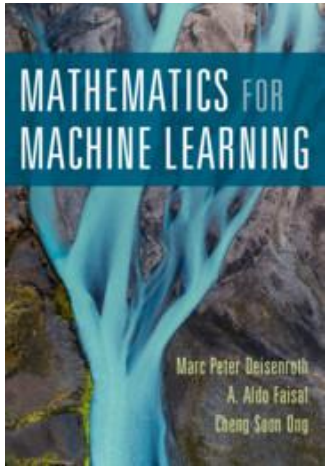
- **Course material** "Machine Learning Refined" book
  - Appendices B and C
  - Chapters 2 and 3
  - Drafts html available on github.com/jermwatt/machine_learning_refined
  - Physical book at LLC (**recommended**)



- **Mandatory** "Essence of linear algebra" series of 3blue1brown on youtube
  - **Videos 1-8 to watch on you own by next session**
  - Videos 9+ in 2 weeks



- Optional "Mathematics for Machine Learning" book
  - For more formal and detailed introduction to linear algebra for machine learning
  - Pdf available for free on mml-book.github.io
  - Chapters 2, 3, 4

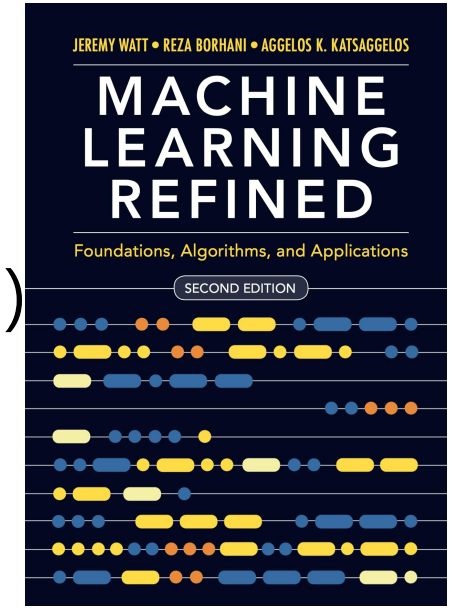


Session 1 – Linear Algebra

1. "Vectors" video from 3Blue1Brown

2. Outlines of Linear Algebra for Machine Learning

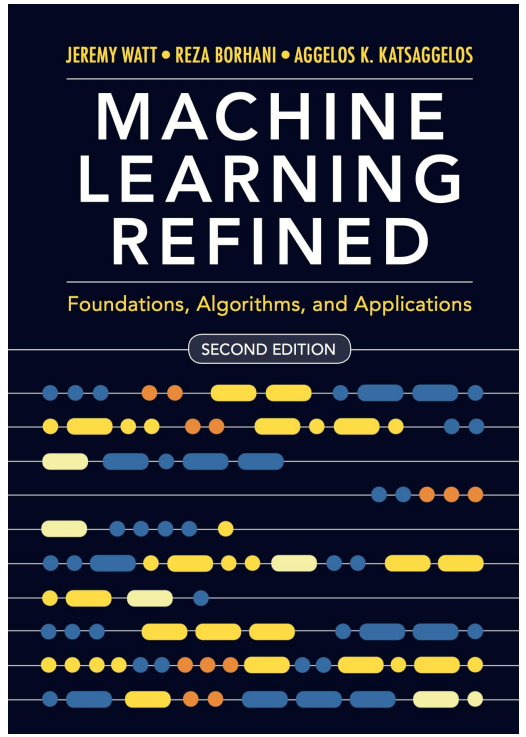
3. Appendix C. Linear Algebra
   C.2 Vectors and Vector Operations
   C.3 Matrices and Matrix Operations
   C.4 Eigenvalues and Eigenvectors (optional)
   C.5 Vector and Matrix Norms



Session 2 – Zero-Order Optimization

1. **Vector Gradients** (to read on your own)
   Appendix B. Derivatives and Automatic Differentiation
   B.2 The Derivative
   B.4 The Gradient

2. Chapter 2. Zero-Order Optimization Techniques
   Read the following links or the slides
   2.2 The Zero-Order Optimality Condition
   2.3 Global Optimization Methods
   2.4 Local Optimization Methods
   2.5 Random Search
   (optional) 2.6 Coordinate Search and Descent



Session 3 – First-Order Optimization

1. Chapter 3. First-Order Optimization Techniques
   3.2 The First-Order Optimality Condition
   3.3 The Geometry of First-Order Taylor Series
   (optional, on your own)
   3.5 Gradient Descent
   3.6 Two Natural Weaknesses of Gradient Descent

2. "Gradient descent, how neural networks learn" video from 3Blue1Brown. Until 13:00.
   Optional, to watch on your own.