Final Integrated Exam Preparation Matrix

Topic from Handout	Book Chapter/Section (Mathematics for Machine Learning)	Book Chapter/Section (Elementary Linear Algebra)	Priority for Exam	Suggested Focus
Solution of Linear Systems	Sec 2.1, 2.2, 2.3	Chapter 1: Sections 1.1, 1.2	★★★★★	Focus on solving systems of equations using Gaussian elimination, REF/RREF forms, and matrix representations.
Vector Spaces	Sec 2.4, 2.5, 2.6, 2.8	Chapter 4: Sections 4.2, 4.3, 4.4	★★★★☆	Study linear independence, basis, rank, affine spaces, and their applications in solving real-world problems.
Analytic Geometry	Sec 3.1, 3.2, 3.3, 3.4, 3.5	Chapter 5: Sections 5.1, 5.2, 5.3	★★★★☆	Review norms, inner products, angles, orthonormal basis, and their applications in geometric interpretations.
Matrix Decomposition I	Sec 4.1, 4.2, 4.3	Chapter 3: Sections 3.1, 3.2, 3.3	★★★★★	Focus on determinants, trace, eigenvalues, eigenvectors, and Cholesky decomposition, and their role in matrix analysis and optimization.

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Matrix Decomposition II	Sec 4.4, 4.5, 4.6	Chapter 7: Sections 7.1, 7.2	★★★★★	Study eigen-decomposition, diagonalization, SVD, and matrix approximations to understand dimensionality reduction and optimization applications.
Vector Calculus I	Sec 5.1, 5.2, 5.3	Chapter 6: Section 6.1	★★★★☆	Master differentiation of univariate functions, partial differentiation, and gradients of scalar and vector-valued functions.
Vector Calculus II	Sec 5.4, 5.5, 5.6	Chapter 6: Section 6.3	★★★★☆	Learn the gradients of matrices, backpropagation, and automatic differentiation techniques for machine learning.
Vector Calculus III	Sec 5.7, 5.8	Chapter 6: Section 6.4	★★★★☆	Explore higher-order derivatives, multivariate Taylor series, and methods to compute maxima and minima in optimization problems.

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Continuous Optimization	Sec 7.1, 7.2, 7.3	Chapter 5: Sections 5.4, 5.5	★★★★★	Study gradient descent, constrained optimization, and Lagrange multipliers for solving machine learning problems.
Nonlinear Optimization I	Sec 4.4, 4.5 (Linear Algebra and Optimization)	Advanced topics in optimization	★★★★☆	Understand advanced concepts like learning rate decay, initialization techniques, and properties of optimization in machine learning, including tuning hyperparameters.
Nonlinear Optimization II	Sec 5.2, 5.3 (Linear Algebra and Optimization)	Advanced topics in optimization	★★★★☆	Learn about challenges in gradient-based optimization, momentum-based learning (e.g., RMSProp, Adam), and other modern optimization techniques.
Dimensionality Reduction and PCA I	Sec 10.1, 10.2, 10.3	Chapter 7: Section 7.3	★★★★★	Focus on problem setting, maximum variance perspective, projection perspective, and steps for PCA implementation.

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Dimensionality Reduction and PCA II	Sec 10.4, 10.5, 10.6, 10.7	Chapter 7: Section 7.4	★★★★★	Study eigenvector computation, low-rank approximation, PCA in high dimensions, and latent variable perspectives.
Mathematical Preliminaries for SVM	Sec 6.4 (Linear Algebra and Optimization)	Advanced optimization concepts	★★★★☆	Learn the Karash-Kuhn-Tucker (KKT) conditions and their role in constrained optimization problems.
Primal/Dual Perspective for Linear SVM	Sec 12.1, 12.2, 12.3, 12.4	Linear programming and numerical methods	★★★★☆	Explore primal/dual perspectives and understand how linear SVMs work using optimization methods.
Nonlinear SVM	Expert Lecture	Advanced SVM concepts	★★★☆☆	Gain an understanding of kernel functions and their applications in nonlinear SVM problems.