Here are some essential things about Mathematics for Machine Learning and Linear Algebra...

Vectors: Operations and Properties

- Introduction to vectors as directed line segments. - Vector addition, subtraction, and scalar multiplication.

Vectors: Modulus, Inner Product, and Projection

- Modulus (magnitude) of a vector. - Inner product (dot product) of vectors. - Deriving the cosine rule from the dot product.
- Visualizing vector projection. - Calculation of vector projection.

Vectors: Changing Basis and Applications

- Introduction to changing coordinate systems. - Representing vectors in different bases.
- Application of changing basis in transformation.

Matrices: Introduction and Transformation

- Introduction to matrices and their representation. - Visualization of matrix transformations in 2D.
- Classification of matrix transformations: scaling, rotation, etc. - Composing multiple matrix transformations.

Matrices: Gaussian Elimination, Inverse, and Determinants

- Introduction to Gaussian elimination for solving linear systems. - Understanding the concept of an inverse matrix.
- Determinants and their role in matrix inverses.

Matrices in Linear Algebra II: Summation, Orthonormal Matrices, and Basis Changes

- Introduction to summation notation and symmetry of dot product.
- Revisiting changing coordinate systems and their applications.
- Performing transformations in a changed coordinate system.
- Definition and properties of orthonormal matrices.
- Constructing an orthonormal basis from arbitrary vectors.
- Application of orthonormal matrices to reflect in a plane.

Eigenproblems: Introduction to Eigenvalues and Eigenvectors

- Introduction to eigenvalues and eigenvectors. - Special cases of eigenvalues and eigenvectors.
- Methods for calculating eigenvectors. - Determining an eigenbasis. - Example of finding an eigenbasis.
- Application of eigenvalues and eigenvectors to Google's PageRank algorithm.

These notes cover the key concepts and topics discussed

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3Blue1Brown's Linear Algebra series offers intuitive visual explanations for fundamental concepts in linear algebra. The series uses animations and geometric insights to help learners grasp complex mathematical ideas.

1. **Vectors and Vector Spaces:**

- Visualizing vectors as arrows in space.
- Vector addition, subtraction, and scalar multiplication.
- Linear combinations and spans.
- Linear independence and basis vectors.

2. **Linear Transformations:**

- Understanding transformations through animations.
- Matrices as transformation operators.
- Image and kernel (nullspace) of a transformation.
- Composition of transformations.

3. **Matrix Multiplication:**

- Visualization of matrix multiplication.
- Associative and distributive properties.
- Matrix-vector products.
- Inverse matrices and determinants.

4. **Eigenvalues and Eigenvectors:**

- Geometric interpretation of eigenvalues and eigenvectors.
- Diagonalization of matrices.
- Applications in understanding dynamic systems.

5. **Singular Value Decomposition (SVD):**

- Decomposing matrices into three fundamental transformations.
- Application in data compression and image compression.

6. **Change of Basis:**

- Coordinate transformations using different bases.
- Understanding change of basis matrices.
- Similarity transformations.

7. **Dot Products and Duality:**

- Geometric interpretation of dot products.
- Orthogonal vectors and orthogonal projections.
- Dual spaces and linear functionals.

8. **Cross Products and Determinants:**

- Geometric interpretation of cross products.
- Determinants as volume scaling factors.
- Cofactor expansion and properties.

15. **Differential Equations and Fundamental Subspaces:**

- Connection between solutions of differential equations and fundamental subspaces.