Mathematics for Machine Learning

Credit = (Coure= 2, TD= 1, TP =0)

Course = 24 hours per semester

Tutorial = 24 hours per semester

Assessment: Attendent=10% Assignment=10%

Class Activities = 10%

Mid-term=30% Final= 40%

Chapter 1: Analytics Geometry

- Introduction to Mathematics for Machine Learning
- What Linear Algebra Is
- Plotting a System of Linear Equations
- Tensors
- Scalars
- Vectors and Vector Transposition
- Norm and Unit Vector
- Basis, Orthogonal, and Othonormal Vectors
- Matrix Tensors
- Generic Tensor Notation

Chapter 2: Tensor Operations

- Tensor Transposition
- Basic Tensor Arithmetic and Hadamard Product
- Tensor Reduction
- Solving Linear System with Substitution
- Soving Linear Systems with Elimination
- Visualizing Linear Systems
- Linear Dependence and Span

Chapter 3: Matrix Properties

- The Forbenius Norm
- Matrix Multiplication
- Symmetric and Identity Matrices
- Matrix Inversion
- Diagonal Matrices
- Orthogonal Matrices

Chapter 4: Eigenvalues and Eigenvectors

- Use case of eigenvectors and eigenvalues
- Affine transformation
- Eigenvalue and eigenvectors
- Matrix determinant
- Determinants of Larger Matrices
- Determinants and Eigenvalues
- Egendecomposition
- Eigenvector and Eigenvalue Application

Chapter 5: Matrix operations for machine learning

- Singular value decomposition
- Data Compression with SVD
- The Moore-Penrose Pseudoinverse
- The Trace Operator
- Principal component analysis (PCA)
- Resources for Further Study of Linear Algebra

Chapter 6: Aumatic Differentiation

- What Automatic Differentiation Is
- Autodiff with PyTorch
- Autodiff with TensorFlow
- The Line Equations as a Tensor Graph
- Machine Learning with Autodiff

Chapter 7: Partial Derivative

- What Partial Derivatives Are
- Calculating Partial Derivatives with Autodiff
- The Chain Rule for Partial Derivatives
- Gradient of Quadratic Cost
- Descending the Gradient of Cost
- The Gradient of Mean Squared Error
- Backpropagation
- Higher-Order Partial Derivatives
- Tangent planes
- Jacobians
- Hessian
- Gradients and Maximina/minima

Chapter 8: Integral Calculus

- Binary Classification
- The Confusion Matrix
- The Receiver-Operating Characteristic(ROC) Curve
- What Integral Calculus Is
- Numeric Integration with Python
- Resources for the Further Study of Calculus

Chapter 9: Role of Statistics in Machine Learning

- Linear Regression to Predict Continuous Values
- Fitting a Line to Point on a Cartesian Plane
- Ordinary Least Squares
- Logistic Regression to Predict Categories
- Role of Bayesian in staticstics

Chapter 10: Optimization using gradient descent

- Optimizations
- Gradient descent in neural network
- Loss function
- Minimizing loss

References and related documents

https://www.coursera.org/learn/machine-learning-calculus

https://www.datacamp.com/tutorial/tutorial-machine-learning-basics-norms
https://www.datacamp.com/tutorial/tutorial-machine-learning-basics-norms
https://ekamperi.github.io/machine%20learning/2019/10/19/norms-in-machine-learning.html

https://www.freecodecamp.org/news/how-machine-learning-leverages-linear-algebra-to-optimize-model-trainingwhy-you-should-learn-the-fundamentals-of-linear-algebra/#:~:text=Linear%20Algebra%20is%20the%20mathematical,as%20vectors%2C%20matrices%20and%20tensors