



ESSENTIAL MATHEMATICS FOR MACHINE LEARNING

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TYPE OF COURSE : New | Elective | UG/PG
COURSE DURATION : 8 weeks (17 Aug' 20 - 9 Oct' 20)
EXAM DATE : 17 Oct 2020

INTENDED AUDIENCE : UNDERGRADUATE AND POSTGRADUATE STUDENTS OF COMPUTER SCIENCE/MATHEMATICS/DATA SCIENCE

INDUSTRIES APPLICABLE TO : Microsoft/Amazon/Intel

COURSE OUTLINE :

Machine learning (ML) is one of the most popular topics of nowadays research. This particular topic is having applications in all the areas of engineering and sciences. Various tools of machine learning are having a rich mathematical theory. Therefore, in order to develop new algorithms of machine/deep learning, it is necessary to have knowledge of all such mathematical concepts. In this course, we will introduce these basic mathematical concepts related to the machine/deep learning. In particular, we will focus on topics from matrix algebra, calculus, optimization, and probability theory those are having strong linkage with machine learning. Applications of these topics will be introduced in ML with help of some real-life examples.

ABOUT INSTRUCTOR :

Prof. Sanjeev Kumar is working as an associate professor with Department of Mathematics, IIT Roorkee. Earlier, he worked as a postdoctoral fellow with Department of Mathematics and Computer Science, University of Udine, Italy and assistant professor with IIT Roorkee. He is actively involved in teaching and research in the area of computational algorithms, inverse problems and image processing. He has published more than 55 papers in various international journals conferences of repute. He has completed a couple of sponsored research projects and written several chapters in reputed books published with Springer and CRC press. So far, he has completed three MOOC courses namely, Numerical Methods, Multivariable Calculus and Matrix Analysis with Applications under NPTEL program.

Prof. S. K. Gupta is an Associate Professor in the Department of Mathematics, IIT Roorkee. His area of expertise includes nonlinear, non-convex and Fuzzy optimization. He has guided three PhD thesis and have published more than 40 papers in various international journals of repute. He has developed four courses for NPTEL in the area of Mathematics.

COURSE PLAN :

Week 1: Linear Independence and dependence of vectors, Basis, Vector Space and Subspaces

Week 2: Linear Maps, Matrix Representation, Eigenvalues and Eigenvectors, Least Square approximation, Minimum normed solution

Week 3: Singular Value Decomposition, Dimensionality Reduction Algorithms

Week 4: Manifold Learning algorithms, Computations with Large and Sparse Matrices in Machine Learning

Week 5: Calculus: Gradients, Jacobian, Hessian Matrix, Conditions for extremum, Convexity

Week 6: Numerical Optimization in Machine Learning, Gradient Descent and other optimization algorithms in machine learning

Week 7: Lagrangian Multiplier method, dual problems and other mathematical Optimization related topics in Support Vector Machines and other Linear Classifiers

Week 8: Conditional probability, chain rule, Bayes theorem, Random Variables and introduction to distributions