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Essential Mathematics for Machine Learning

By Prof. Sanjeev Kumar, Prof. S. K. Gupta | IIT Roorkee

Learners enrolled: 5023

Essential Mathematics for Machine Learning

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.

INTENDED AUDIENCE : UNDERGRADUATE AND POSTGRAUATE STUDENTS OF COMPUTER SCIENCE/MATHEMATICS/DATA SCIENCE
PREREQUISITES : None
INDUSTRIES SUPPORT   : Microsoft/Amazon/Intel/.

Summary

Course Status :	Completed
Course Type :	Elective
Duration :	12 weeks
Category :	• Mathematics

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Start Date

End Date

Enrollment Ends :

Exam Date

26 July 2021

15 Oct 2021

09 Aug 2021

24 Oct 2021 IST

Note: This exam date is subjected to change based on seat availability. You can check final exam date on your hall ticket

This is an AICTE approved FDP course

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(https://www.addtoany.com/share#url=https%3A%2F%2Fonlinecourses.nptel.ac.in%2Fnoc21_ma38%2Fpreview&title=Essential%20Mathematics%20for%20Machine%20Learning%20-%20%20Course)

Course layout

Week 1 : Vectors in Machine Learning, Basics of Matrix Algebra,Vector Space, Subspace, Basis and Dimension.

Week 2 : Linear Transformations, Norms and Spaces, Orthogonal Complement and Projection Mapping, Eigenvalues and Eigenvectors, Special Matrices and Properties.

Week 3 : Spectral Decomposition, Singular Value Decomposition,Low Rank Approximations, Python Implementation of SVD and Low-rank Approximation.

Week 4 : Principal Component Analysis,Python Implementation of PCA, Linear Discriminant Analysis, Python Implementation of LDA.

Week 5 : Least Square Approximation and Minimum Normed Solution, Linear and Multiple Regression, Logistic Regression.

Week 6 : Classification Metrics, Gram Schmidt Process, Polar Decomposition, Minimal Polynomial and Jordan Canonical Form, Some more Matrices Applications in Machine Leaning.

Week 7 : Basics concepts of Calculus, gradient, Jacobian, Chain rule,Change of variables.

Week 8 : Calculus in Python, Convex sets and convex functions, properties of convex functions, Introduction to Optimization.

Week 9 : Numerical Optimization in Machine Learning, Gradient Descent and other optimization algorithms in machine learning.

Week 10 : Optimization using Python, Review of Probability, Bayes theorem and random variable, Expectation and variance.

Week 11 : Discrete and continuous distribution functions, joint probability and covariance, Introduction to SVM, Error minimizing LPP.

Week 12 : Lagrangian Multiplier method, concepts of duality, hard and soft margin classifier, SVM in Python

Books and references

1. W. Cheney, Analysis for Applied Mathematics. New York: Springer Science+Business Medias, 2001.

2. S. Axler, Linear Algebra Done Right (Third Edition). Springer International Publishing, 2015.

3. J. Nocedal and S. J. Wright, Numerical Optimization. New York: Springer Science+Business Media, 2006.

4. J. S. Rosenthal, A First Look at Rigorous Probability Theory (Second Edition). Singapore: World Scientific Publishing, 2006.

Instructor bio

Prof. Sanjeev Kumar

IIT Roorkee

Dr 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

Prof. S. K. Gupta

Dr. 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

Course certificate

The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.

The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).

Date and Time of Exams: **24 October 2021** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.

Registration url: Announcements will be made when the registration form is open for registrations.

The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.

Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Roorkee.It will be e-verifiable at nptel.ac.in/noc (http://nptel.ac.in/noc).

Only the e-certificate will be made available. Hard copies will not be dispatched.

Once again, thanks for your interest in our online courses and certification. Happy learning

G.NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE (For Women)
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Shaikpet, Hyderabad – 500104

Department of Humanities and Mathematics

2022-23

REPORT

FDP on "Essential Mathematics for Machine Learning"

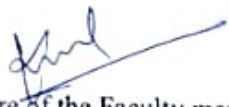Date of program: July to October 2022

Resource person: Prof. S. K. Gupta

Prof. Sanjeev Kumar, Department of Mathematics, IIT, Roorkee.

About the Program:

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, I have been introduced these basic mathematical concepts related to the machine/deep learning. In particular, I have been focused on topics from matrix algebra, calculus, optimization, and probability theory those are having strong linkage with machine learning. Applications of these topics have been introduced in ML with help of some real-life examples in this 12 weeks course.

PRINCIPAL
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Signature of the Faculty member
(Dr. K. Mradula)