

About the Instructor



Dr. G. V. V. Sharma is an Associate Professor in the Department of Electrical Engineering at IIT Hyderabad. He received his PhD in Electrical Engineering from Indian Institute of Technology, Bombay, M. Sc. (Engg.) from Indian Institute of Science, Bangalore, and B. Tech. from Indian Institute of Technology, Guwahati.

Before joining IIT Hyderabad as a faculty, he was employed in the software industry. He works on wireless technologies, but has a passion for developmental engineering; taking technology to the masses. He is currently the coordinator of the Teaching Learning Centre at IIT Hyderabad.

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About IIT Hyderabad

Inventions and innovations are keywords on which the foundation of IITH is based. One of India's eight new IITs – IITH started functioning in August 2008. Currently it offers undergraduate and postgraduate programs in multiple disciplines

In a short span IITH has developed state-of-the-art infrastructure for advanced research and is ranked 8th in the NIRF rankings.

Research is a culture among the faculty and students of IITH. This is evident from the several research projects that are ongoing at IITH. On top of the gamut of sponsored projects from various funding agencies, IITH has active collaboration with industry as well.

IITH also has an innovative academic program where the students are offered fractional credits and the first semester undergraduates are allowed to do a project of their choice. Many more innovations in the academic front are in the offing. IITH always strives to offer an innovative environment where one is not afraid to experiment with high-risk ideas.

5 Day Online Workshop on Matrix Analysis through Python

3rd Nov - 8th Nov 2020

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Highlights

1. Based on high school geometry
2. Zero prerequisites
3. Hands on experience
4. Introduction to Google Colab

Course Objectives

Through this course, participants will be able to acquire a functional knowledge of matrix analysis, which will help the reader comprehend matrix operations employed in research papers in various engineering disciplines. Further, it should also be possible to implement such papers using Python, which is freely available and extensively used in popular areas like Data Science and Artificial Intelligence.

In the process, an introduction to the Google Colab environment is provided, which has pre-installed Python packages, enabling users to start writing Python code without the hassle of setting up the Python environment for various operating systems. In addition, Colab gives users free online access to GPU hardware for fast computations. This will help foster a math computing culture among students in technical institutes across the country.

At the end of the course, each participant will be creating a short lab manual on matrix analysis using the \LaTeX processor on Overleaf. The manual will contain matrix concepts explained through numerical examples and verified using Python scripts.

Participants will also learn how to create and maintain repositories on GitHub by hosting their latex/python source code and collaborating with other users.

Finally, participants will learn how to teach courses online by using apps like Piazza through personalized pedagogy.

Course Contents

Linear Forms

Lines and Planes in 2D and 3D coordinate geometry will be used for introducing basic matrix and vector arithmetic. Row-reduction and echelon forms, rank of a matrix, determinants, matrix norms and systems of equations will be covered in the process.

Quadratic Forms

Conic Sections in 2D will be used for introducing quadratic forms and symmetric matrices. In the process, eigenvalues, eigenvectors, spectral decomposition and characteristic polynomial will be introduced.

Matrix Decompositions

Examples from 2D and 3D geometry will be used for introducing Gram-Schmidt Orthogonalisation, QR decomposition and Singular Value Decomposition (SVD).

Python

Python scripts will be used for numerical matrix computations and generation of 2D and 3D plots to verify theoretical results. In the process, programming aspects of python like functions, libraries like numpy and matplotlib will be covered.

Manual and Codes

-  https://github.com/gadepall/school/blob/master/ncert/linman/gvv_linalg_manual.pdf
-  <https://github.com/gadepall/school/tree/master/ncert/linman/codes>

Methodology

The fundamentals of Matrix Analysis, commonly employed in engineering can be easily introduced through high school mathematics. The first University Education Commission (1948-49) headed by Dr. S Radhakrishnan, had recommended that high school teachers should teach first year university students and university teachers should teach high school students so that the transition between school and college education is seamless. Following the spirit of this recommendation, through this course, an attempt is being made to teach college level matrix analysis through high school geometry.

There will be an inaugural live video session following which, each participant will be assigned a different problem from high school geometry that (s)he will have to solve. The instructor will guide each participant at every step on both theoretical and computational aspects of matrix analysis online. This way, participants will be learning at their own pace and feedback will be instantaneous. Instead of limited interaction on a daily basis, the learning process will be continuous. Finally, each participant will organise their solutions to the various problems assigned to them in the form of an e-book.