



# INVITED TALK

by

**Soumen Sarkar**

Indian Institute of Technology Madras, Chennai

on

**January 29, 2026**

## Lecture 1: Topological Data Analysis: An Introduction for Newcomers

Traditional statistical methods often fail to capture the shape, connectivity, and qualitative structure of such data sets. In the last two decades, significant developments have been made in analyzing the shape and extracting more accurate information from a data set using algebraic topology. In this talk, we'll go through a brief survey of the applications of topological data analysis, which consists of several components, like persistent homology and persistence diagrams/modules. We'll show how topological information can be leveraged to analyze properties of neural networks. Then, we shall explore some practical implications of deep learning in areas such as adversarial detection and model selection.

🕒 10:30 AM

📍 Auditorium, Satyakam Bhawan

## Lecture 2: Dynamics of Polynomial Vector Fields on a Sphere

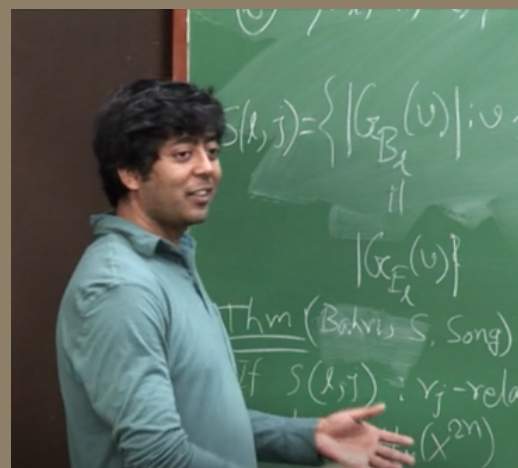
David Hilbert proposed a problem at the beginning of the 1900s. It is known as Hilbert's 16th problem which asks for a bound for the number of invariant algebraic curves in terms of the degree of polynomial vector fields in the plane. This problem is solved for a few particular cases. One can ask a similar question for the polynomial vector fields on the sphere. In this talk, I'll characterize and study dynamical properties of cubic vector fields on the sphere. Then, I'll show that there exist completely integrable cubic vector fields on the sphere and also study the maximum number of various types of invariant circles for homogeneous cubic vector fields on the sphere. Finally, I'll discuss phase portraits of certain cubic Kolmogorov vector fields on the sphere.

🕒 02:30 PM

📍 Room 5, Satyakam Bhawan

**Hemant Kumar Singh**  
Coordinator

**Tarun Kumar Das**  
Head



*Soumen Sarkar*

is an Associate Professor at the Department of Mathematics, Indian Institute of Technology Madras, Chennai. His research interests include topology, geometry, and related areas of algebra. He has earned his Ph.D. from the Indian Statistical Institute, Kolkata, with a thesis on aspects of toric topology under the supervision of Prof. Mainak Poddar. Prior to joining IIT Madras, he held postdoctoral positions in Canada and South Korea, including at the University of Calgary and KAIST.