Graph Theory and its Applications

Dr. Aparna Lakshmanan focuses her research on the mathematical study of **graphs and networks**, using the tools of **algebra** and **topology** to uncover their structure and properties. Graphs are powerful models for representing relationships between entities, and understanding their behavior is crucial for analyzing and designing systems in areas like **computer science, data analytics, and communication networks**. Her work in **algebraic graph theory** applies algebraic methods to study graph invariants, symmetries, and structures, which help in characterizing complex networks, optimizing their design, and ensuring their robustness.

She also works on **topological data analysis (TDA)**, a cutting-edge area that uses ideas from topology to study the "shape" of data. TDA helps to detect hidden patterns, clusters, and holes in large, high-dimensional datasets, offering insights that are often missed by traditional statistical methods.

In addition, Dr. Aparna studies **graph parameters and labeling techniques**, which involve assigning numbers, colors, or labels to the vertices and edges of graphs under certain constraints. These techniques have practical applications in **resource optimization, scheduling, coding theory, and network design**, where efficient configurations are critical.

Through her research, she bridges the gap between pure mathematical theory and real-world applications. Her contributions enable better modeling and analysis of **modern networked systems, large datasets, and communication frameworks**, helping to solve challenging problems in science and engineering while advancing the theoretical foundations of mathematics.