

VIGRE Crew on Combinatorics

The *bandwidth* of a graph $G = (V, E)$ is the smallest number b for which there is a 1-1 mapping f from V to $\{1, 2, \dots, |V|\}$ such that

$$|f(u) - f(v)| \leq b,$$

for all edges uv in E .

Computing the bandwidth of a graph is one of the hardest problems in combinatorial optimization. Even when restricted to trees, this problem remains NP-hard. Because of its hardness, the bandwidth problem has only been solved for very few classes of graphs, in spite of its broad range of applications. The ultimate goal of this project is to characterize all classes of graphs for which the bandwidth problem can be solved efficiently.

Characterizing these classes of graphs is theoretically interesting yet very challenging. Since this research area is not well developed, it leaves many opportunities to everyone, including graduate and even undergraduate students, to make a potentially significant contribution.

Through this project, students (graduate and undergraduate) will learn the basics of complexity theory, will get familiar with various basic classes of graphs, and will learn how to establish and prove or disprove their own conjectures. They will put their results in writing. Hopefully, some of these would be good research papers.