LSU Math Circle Research Proposal

Unavoidable Induced Subgraphs of Graphs with Large Rooted Matchings

**Instructor:** Samuel Weiner  
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**Category:** Combinatorics (Calculus not required)

**Abstract:** In the field of graph theory, a graph is a collection of vertices and edges. Graphs are powerful tools that can be used to model any real-world system, from electrical grids to transportation networks, and even computer storage systems. Some very important systems are characterized by “matchings,” or objects which must exist in pairs. Think of a large group of people, all of whom are married; using graphs, we can model each person as a vertex, where two vertices are connected by an edge if the two corresponding people know each other. Suppose also that if two people are married, then the edge connecting them is colored red. This research project seeks to characterize all of the possible relationships between the people in this group. It is possible that each person only knows their spouse; it is also possible that everybody knows everybody else in the group. But what about all of the in-between scenarios? How many different configurations are there?

If discovered, the result would provide us with knowledge about any system in which we know matchings exist. Such research would be instrumental in improving upon existing computer algorithms relating to search engines, data storage, and more.