Project Title: Domination and Total Domination in Graphs

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Project Summary: A graph G=(V,E) is a combinatorial object consisting of a finite set of vertices V and a set of edges E, which are some 2-element subsets of V. Each edge in a simple graph joins two distinct nodes and there is at most one edge between two distinct vertices. A set $S \subseteq V$ of vertices in a graph G=(V,E) is called a *dominating set* if every vertex $v \in V$ is either an element of S or is adjacent to an element of S. A dominating set is called *minimal* if no proper subset of it is a dominating set. The *domination number* of a graph G refers to the size of a minimum dominating set of G. Computing the domination number, a.k.a. the minimum dominating set problem, is an NP-hard problem; i.e., a polynomial-time exact algorithm solving such a problem does not exist unless P=NP. A dominating set $S \subseteq V$ is a *total dominating set* if the subgraph of G induced by S has no isolated vertices, i.e., if every vertex in the dominating set has at least one neighbor that is also in the dominating set. A graph is called *well*-dominated if all of its minimal dominating sets have the same size. Similar definition applies for *well-totally-dominated* graphs. The size of the minimal dominating set with maximum size is called the *upper domination* number of a graph. Both domination and total domination concepts have attracted attention from many researchers; yet many open research questions still exist. In this project, we will investigate numerous research problems about domination and total domination in graphs such as in well-dominated graphs, well-totally dominated graphs, and upper domination number.