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MATHEMATICS

Trees with integer eigenvalues
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The summer scholarship I did, was attempting to find trees with integer eigenvalues. I first studied literature, namely Spectra of Graph, by Cvetkovic, Doob and Sachs, and then searched for trees with integer eigenvalues.

A little bit of math: Every graph has a corresponding matrix, called the adjacency matrix. A tree is a graph, without any cycles. The eigenvalues of a tree are the eigenvalues of the adjacency matrix. The characteristic equation is the equation that needs to be solved to obtain the eigenvalues.

Trees with integer eigenvalues have only been studied in the past 25 years. A large amount of the research has focused on finding larger diameter trees, and recently some trees of diameter 10 have been discovered in literature.

The work I did for this scholarship was to look at the smaller diameter trees and to try and find as many solutions as possible on the smaller diameter trees, as more solutions have been ignored in the search to find larger diameter trees. The trees that I focused on had diameter 3 and 4.

The method for finding the trees with integer eigenvalues was a combination of computer searches and by trying to solve the characteristic equation analytically.

The scholarship was extremely fun to do. The Big Day In was a great experience and it was good to interact with other mathematics students from around Australia. I also gained valuable experience in presenting. This scholarship is a must for anyone wanting to discover what research is like.