Walks in Graphs[1]

Prof I. Sciriha

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There is a high demand that various networks including social networks, language networks, organizational business networks, biological networks, the electrical grid and the telephone system be optimized. Many techniques are based on the number of walks from various nodes of the network. It is the purpose of this project to determine the conditions for the design of the network to have desirable spectral properties.

On Walk Matrices of Full Rank

Prof I. Sciriha

The *walk matrix* of a finite graph is the matrix of maximum rank whose kth column gives the number of walks of length $k-1$ from each vertex of a labelled graph. It is the aim of this project to explore those graphs that have a square walk matrix. What are the spectral properties of the adjacency matrix of such graphs that distinguish them from other graphs whose walk matrix is not square?

Strongly Regular Graphs

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Strongly regular graphs have interesting combinatorial and spectral characterizations. Their regular properties lend themselves to several applications

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such as in designs and association schemes. The aim of this project is to discover their properties with the help of Mathematica.

On Singular Graphs and their Complement

Prof I. Sciriha

A graph is singular if the kernel ker($\mathbf{A}$) of its adjacency matrix $\mathbf{A}$ has dimension at least one. The vectors in ker($\mathbf{A}$) determine the substructures responsible for the graph to be singular. It is the purpose of this project to use Mathematica to explore the substructures that allow the complement of the graph to be singular or to have other particular eigenvalues.

Fullerene Graphs

Prof I. Sciriha

A fullerene graph is a three–regular planar graph with only pentagonal and possibly hexagonal faces. Their spectral properties reveal energy and structural characteristics in the chemical molecules made up of carbon atoms having the same bond structure as the graph. It is the purpose of this project to use Mathematica to explore the various families of fullerenes and their energy levels.