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On the second largest eigenvalue of certain graphs in the perfect matching association scheme

Defined as the difference between its two largest eigenvalues, the spectral gap of a graph plays an important role on our understanding of its connectivity as observed by Godsil and Royle (2001). Since computing the largest eigenvalue of a graph is generally not too difficult, the crux to understanding the spectral gap of a graph is to compute its second largest eigenvalue. In this talk, we will consider the spectral gap of certain graphs in the perfect matching association scheme. Since these graphs are part of the same association scheme, they have the same eigenspaces. These eigenspaces correspond to irreducible representations of the symmetric group and thus, one could use these irreducible representations to compute the eigenvalues of each graph. In practice, such computations are difficult to perform which makes it difficult to find the eigenspace that realizes the second largest eigenvalue. The focus of my talk will be to identify this eigenspace for selected graphs in the scheme. This is joint work with Himanshu Gupta, Allen Herman, Roghayeh (Mitra) Maleki, and Karen Meagher.