The Key Player Problems on Graphs

Abstract:
Given a graph $G$ and an integer $k$, the Key Player Problem asks for the set of $k$ vertices whose removal will maximally disconnect the graph. In this talk I will present a new formulation of the Key Play Problem as a decision problem, which we have shown to be NP-complete. I will also describe a complementary problem which asks for the $k$ vertices best situated to disperse information across a graph, if for example the graph is modelling a social network. Both problems revolve around the identification of “central” vertices in graphs. Finally I will describe our current progress on the case where $k$ is equal to the vertex connectivity of the graph.

Equitably Colourable Combinatorial Designs

Abstract:
For a combinatorial object of order $v$, the associated spectrum problem is the problem of determining all necessary and sufficient conditions on $v$ so that the object can and will exist. We will investigate the spectrum problem for equitably $\ell$-colourable balanced incomplete block designs. Suppose we have a BIBD($v,k,\ell$) in which the points are coloured with $\ell$ colours $c_1,\ldots,c_\ell$. A block $B$ is equitably $\ell$-coloured if $B$ has $n_i$ vertices coloured with colour $c_i$ ($i=1,\ldots,\ell$) and $|n_i-n_j|\leq 1$ for any $i,j\in \{1,\ldots,\ell\}$. A design is equitably $\ell$-colourable if the points can be coloured with $\ell$ colours such that every block is $\ell$-coloured. Here the associated spectrum problem is the problem of determining conditions on $v$ such that an equitably $\ell$-coloured ($v,k,\ell$)-BIBD exists for fixed $\ell$, $k$, and $\lambda$. This problem was inspired by some recent research on equitably $\ell$-colourable $m$-cycle decompositions of the complete graph.