Signed graphs

Every edge of a **signed graph** is accompained by the sign + or -. They may be encountered in domains of social psychology or social or other complex networks. Simple graphs are recognized as particular cases of signed graphs with all edges positive. In fact, any (simple) graph can be considered as the **underlying** graph for all signed graphs that can be derived by reversing sign of its edges.

Representatives of switching equivalent signed graphs

If S is a subset of a vertex set of a signed graph G and H is a signed graph obtained from G by reversing the sign of each edge joining a vertex in S with a vertex outside S, then G and H are said to be **switching equivalent**. The switching equivalence is an equivalence relation that preserves the eigenvalues. The graphs G and H are said to be **switching isomorphic** if H is isomorphic to a signed graph that is switching equivalent to G. In other words, if there exist a diagonal matrix D of ±1's and a permutation (0,1)-matrix P such that, for the adjacency matrices A_G and A_H, it holds $A_G=D^{-1}(P^{-1}A_HP)D$. Switching isomorphism is also an equivalence relation that preserves the eigenvalues. Moreover, up to the vertex labelling, each of switching isomorphic signed graphs can be chosen to be a representative of the corresponding switching equivalence class. Here are the class representatives having between 3 and 8 vertices.

order	3	4	5	6	7	8
total number	3	12	79	1123	42 065	4 880 753
% of underlying graphs	66.67	50.00	26.58	9.97	2.03	0.23

Cospectral representatives

We say that signed graphs are *cospectral* if they are not switching isomorphic but share the same spectrum. Such signed graphs are known as cospectral mates. No signed graph with at most 4 vertices has a cospectral mate. Here are the connected representatives of switching equivalent signed graphs with 5, 6 or 7 vertices that have at least one cospectral mate. We use the enumeration from the previous table and include disconnected signed graphs as possible cospectral mates. Disconnected signed graphs are easily derived by combining connected ones; They are ordered lexicographically by the number of vertices in the largest component and the number of components.

order	5	6	7
number of those with a cospectral mate	2	131	8219
% in the total number	2.53	11.67	19.54

Every number is a link. The same data can be found at www.math.rs\~zstanic\siggr.htm.