

Alliance Polynomial of a Graph

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Friday, November 8, 2013
11:30am, *ICMAT, Aula Gris 1*

The concepts of alliances in graphs were introduced by P. Kristiansen, S. M. Hedetniemi and S. T. Hedetniemi in 2004. Colloquially speaking, a defensive k -alliance in a graph G is a set S of vertices of G such that every vertex in S has at least k more neighbors in S than it has outside of S . We say that S is an exact defensive k_S -alliance in G and k_S is the exact index of alliance of S , if S is defensive k_S -alliance but is not defensive $(k_S + 1)$ -alliance.

The alliance polynomial of a graph G with order n is defined as follows

$$A(G; x) = \sum_{S \subseteq V} \sigma_G(S) \cdot x^{n+k_S},$$

where $\sigma_G(S) = 1$ if $\langle S \rangle$ is connected and $\sigma_G(S) = 0$ otherwise. We obtain some properties of $A(G; x)$ and its coefficients. In particular, we prove that the path, cycle, complete, wheel and star graphs are characterized by their alliance polynomials. Besides, we study the alliance polynomial for regular graphs. Furthermore, we prove that the family of alliance polynomials of regular graphs with small degree is a very special one, since it does not contain alliance polynomials of graphs which are not regular with the same degree. Also, we obtain (computationally) alliance polynomials for cubic graphs of small order, which verify uniqueness.

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