Counting cycles in graphs with small excess

Robert Jajcay

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A (k, g)-cage is a k-regular graph of girth g that has the smallest number of vertices among all graphs with the parameters k and g. The orders of cages are bounded from below by the well-known Moore bounds, however, the exact orders are not known for the majority of cages. The excess of a cage is the difference between its order and the Moore bound, and a systematic study of the excesses of cages leads to improved lower bounds on their orders. We present some of the most recent improvements based on counting cycles.