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A Nordhauss-Gaddum type problem for the normalized Laplacian spectrum and graph Cheeger constant

For a graph G on n vertices with normalized Laplacian eigenvalues $0 = \lambda_1(G) \leq \lambda_2(G) \leq \cdots \leq \lambda_n(G)$ and graph complement G^c, we prove that

$$\max\{\lambda_2(G), \lambda_2(G^c)\} \geq \frac{2}{n^2}.$$

We do this by way of lower bounding $\max\{i(G), i(G^c)\}$ and $\max\{h(G), h(G^c)\}$ where $i(G)$ and $h(G)$ and denote the isoperimetric number and Cheeger constant of G, respectively.