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Polar convexity and critical points of polynomials

We say that a set A in the complex plane is convex with respect to the pole u, if for any two points x and y in A, the arc from the circle through x,y and u, that does not contain u, is in A. If the pole u is taken to be at infinity, this notion coincides with the usual notion of convexity.

The classical Gauss-Lucas theorem states that the critical points of a polynomial are in the convex hull of its zeros. We use the notion polar convexity to extend the Gauss-Lucas theorem and capture the zeros of the polar derivatives of a polynomial.

In this talk we present basic properties of polar convexity, including duality results between a set and the set of its poles. We give a formula for finding all poles of a set with simple C^3 boundary.