The seminal 2012 theorem of Helton and McCullough states that every semialgebraic matrix convex set is given by a linear matrix inequality (LMI). The purpose of this talk is two-fold. First, we prove that every irreducible polynomial $f$ with convex semialgebraic set $D_f$ must be of degree at most 2 and concave. Second, we present effective algorithms for (a) checking whether $D_f$ is convex; (b) finding an LMI representation $D_f = D_L$ for convex $D_f$. Techniques employed include realization theory, noncommutative algebra and semidefinite programming.

This is joint work with Bill Helton, Scott McCullough, and Jurij Volčič. (Received September 18, 2018)