On the Castelnuovo–Mumford regularity of rings of polynomial invariants

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We show that, when a group acts on a polynomial ring over a field, the ring of invariants has Castelnuovo–Mumford regularity at most zero. As a consequence, we prove a well-known conjecture that the invariants are always generated in degrees at most $n(|G|-1)$, where $n > 1$ is the number of polynomial generators and $|G| > 1$ is the order of the group.

The proof is a mixture of commutative algebra and representation theory.