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The depth of invariants of (infinite) algebraic groups

The depth of invariant rings $K[V]^G$ of finite groups has been a topic in invariant theory for almost 30 years now. The depth is bounded above by the dimension of the invariant ring, and the difference between both numbers is called the Cohen–Macaulay defect. This is the minimal length of a free resolution of $K[V]^G$ over a subalgebra A generated by a homogeneous system of parameters. Thus, the Cohen–Macaulay defect is a measure for the structural complexity of $K[V]^G$. So far, almost nothing has been known about the depth of invariants of (infinite) algebraic groups. Our main result is, that for any reductive group G , which is not linearly reductive, there exists a faithful G -module V such that the Cohen–Macaulay defect of the vector invariants $K[V^{\oplus k}]^G$ is at least $k - 2$ for all k .