

Artinian Gorenstein algebras and punctual schemes

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A Gorenstein sequence H is the Hilbert function $H(A)$ of a graded Artinian Gorenstein algebra A . Suppose that A is a quotient of the polynomial ring $R = k[x_1, \dots, x_r]$ in r variables, whose maximal ideal is $m = (x_1, \dots, x_r)$, and that the socle $0 : m$ of A has degree j . By classical apolarity, or Macaulay duality, H determines a homogeneous polynomial F of degree j , and $H = H_F$ is the sequence of dimensions of the spaces of first, second ..., j -th higher order partial derivatives of F .

Given a Gorenstein sequence H , we consider the family $\text{PGor}(H)$ of all such forms F up to k^* -multiple such that $H_F = H$. The family is a subset of the projective space parametrizing all degree j homogeneous forms F .

We discuss the following questions.

- Q1. Which sequences $H = (1, r, \dots, r, 1)$ are Gorenstein sequences?
- Q2. What is the structure of $\text{PGor}(H)$?
- Q3. What is the relation between $\text{PGor}(H)$ and the Hilbert scheme $\text{Hilb}^s(P^{r-1})$ parametrizing