Setup and the first examples

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1 Notations

All schemes are assumed to be separated. For a "scheme" which is not separated, we will use the term "prescheme".

Let A be a ring. We denote by $\operatorname{Spec} A$ the spectrum of A. For an ideal $I \subset A$, we use $V(I)$ to denote the closed subscheme of $\operatorname{Spec} A$ defined by I.

Let S be $\operatorname{Spec} \mathsf{k}$, $\operatorname{Spec} \mathcal{O}_K$ or an algebraic variety. An S-variety is an integral scheme X which is of finite type and flat over S. For an algebraic variety, we mean a k-variety.

We will use k, K to denote fields, and $\mathbf{k}, \mathbf{K}$ to denote their algebraically closure relatively.

Let X be an integral scheme. We denote by $\mathscr{K}(X)$ the function field of X. For a closed point $x \in X$, we denote by $\kappa(x)$ the residue field of x.

We denote the category of S-varieties by $\mathbf{Var}_S$. We denote by $X(T)$ the set of T-points of X, that is, the set of morphisms $T \to X$.

Let X be an algebraic variety over k. A geometrical point is referred a morphism $\operatorname{Spec} \mathbf{k} \to X$.

When refer a point (may not be closed) in a scheme, we will use the notation $\xi \in X$. We use Z_ξ to denote the Zariski closure of $\{\xi\}$ in X. When we talk about a closed point on an algebraic variety, we will use the notation $x \in X(\mathbf{k})$.

1.1 Separated and proper morphisms

2 Examples

Example 1. Let $\mathbf{k}$ be an algebraically closed field and A the localization of $\mathbf{k}[x]$ at (x). Let $S = \operatorname{Spec} A$ and $X = \operatorname{Spec} A[y]$. There are three types of points in X:

(i) closed points with residue field $\mathbf{k}$, like $p = (x, y - a)$;

(ii) closed points with residue field $\mathbf{k}(y)$, like $P = (xy - 1)$;

(iii) non-closed points, like $\eta_1 = (x), \eta_2 = (y), \eta_3 = (x - y)$.

Date: June 15, 2025, **Author**: Tianle Yang, loveandjustice@88.com