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$(x, y)$ -plane. EXAMPLE 3. Let  $A = k[x, y]$  be as above and  $B = k[x, y, z]$  with  $z = f(x, y)$

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Commutative Algebra is the study of commutative rings, and their modules and ideals. This theory has developed over the last 150 years not just as an area of algebra considered for its own sake, but as a tool in the study of two enormously important branches of mathematics: algebraic geometry and algebraic number theory.

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Further, every ring is commutative (that is,  $xy = yx$  in it), with an occasional exception, which is always marked (normally, it's a ring of matrices). As usual, the additive identity is denoted by 0.

Note that, for any  $x$  in  $R$ ,  $x \cdot 0 = 0$ ; indeed,  $x \cdot 0 = x(0+0) = x \cdot 0 + x \cdot 0$ , and  $x \cdot 0$  can be canceled by adding  $-(x \cdot 0)$ . We allow  $1 = 0$ .

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