



# Ideals, Varieties, and Algorithms (Undergraduate Texts in Mathematics)

*David A. Cox, John Little, Donal O'Shea*

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Algebraic Geometry is the study of systems of polynomial equations in one or more variables, asking such questions as: Does the system have finitely many solutions, and if so how can one find them? And if there are infinitely many solutions, how can they be described and manipulated? The solutions of a system of polynomial equations form a geometric object called a variety; the corresponding algebraic object is an ideal. There is a close relationship between ideals and varieties which reveals the intimate link between algebra and geometry. Written at a level appropriate to undergraduates, this book covers such topics as the Hilbert Basis Theorem, the Nullstellensatz, invariant theory, projective geometry, and dimension theory. The algorithms to answer questions such as those posed above are an important part of algebraic geometry. Although the algorithmic roots of algebraic geometry are old, it is only in the last forty years that computational methods have regained their earlier prominence. New algorithms, coupled with the power of fast computers, have led to both theoretical advances and interesting applications, for example in robotics and in geometric theorem proving. In addition to enhancing the text of the second edition, with over 200 pages reflecting changes to enhance clarity and correctness, this third edition of *Ideals, Varieties and Algorithms* includes: A significantly updated section on Maple in Appendix C; Updated information on AXIOM, CoCoA, Macaulay 2, Magma, Mathematica and SINGULAR; A shorter proof of the Extension Theorem presented in Section 6 of Chapter 3. From the 2nd edition: 'I consider the book to be wonderful. ... The exposition is very clear, there are many helpful pictures, and there are a great many instructive exercises, some quite challenging ... offers the heart and soul of modern commutative and algebraic geometry.' *The American Mathematical Monthly*

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