

# Preface

Projective geometry topics are taught in many degree programs in Mathematics, Physics and Engineering, also because of their practical applications in areas such as engineering, computer vision, architecture and cryptography. The literature on this subject includes, besides the classical extensive treatises, by now very dated from the point of view of language and terminology, some modern textbooks. Among these we mention only ‘E. Casas-Alvero, *Analytic Projective Geometry*, EMS Textbooks in Mathematics (2014)’, whose approach is close to ours and to which we refer the reader for bibliographical references.

This is not one further textbook, in particular it has not been conceived for sequential reading from the first to the last page; rather it aims to complement a standard textbook, accompanying the reader in her/his journey through the subject according to the philosophy of “learning by doing”. For this reason we make no claim to be systematic; rather we have the ambition, or at least the hope, not only to ease and reinforce the understanding of the material by presenting completely worked out examples and applications of the theory, but also to awaken the curiosity of the reader, to challenge her/him to find original solutions and develop the ability of looking at a question from different perspectives. In addition, the book presents among the solved problems some classical geometric results, whose proofs are accessible within the relatively elementary techniques presented here. Hopefully these examples will encourage some readers to learn more about the topics treated here and undertake the study of classical algebraic geometry.

Indeed the starting point of the original Italian version of this work has been our experience in teaching the Projective Geometry course in the undergraduate Mathematics degree program in Pisa, which brought us to realize the difficulties the students encounter. However, the book contains also topics that, although usually not treated in undergraduate courses, can be useful and interesting for a reader wishing to learn more on the subject. Another feature of the text is that not only complex hypersurfaces and algebraic curves are studied, as it is traditional, but considerable attention is paid also to the real case.

The first chapter of the book contains a concise but exhaustive review of the basic results of projective geometry; the interested reader can find the proofs in any textbook on the subject. The goal of this first part is to provide the reader with an overview of the subject matter and to fix the notations and the concepts used later. The following three chapters are collections of solved problems concerning, respectively: the linear properties of projective spaces, the study of hypersurfaces and plane algebraic curves and, finally, conics and quadrics. In solving the problems we have given preference neither to the analytic nor to the synthetic approach, but every time we have chosen the solution that seemed to us more interesting, or more elegant or quicker; sometimes we have presented more than one solution. The difficulty level varies, ranging from merely computational exercises to more challenging theoretical problems. The exercises that in our opinion are harder are marked with the symbol ☕, whose meaning is: “take it easy, get yourself a cup of coffee or tea, arm yourself with patience and determination, and you will succeed in the end”. In other cases, besides giving the solution that is objectively the simplest, we have proposed alternative solutions that require longer or more involved arguments, but have the merit of giving a deeper conceptual understanding or highlighting connections with other phenomena that would not be evident otherwise. We have marked these, so to say, “enlightening” solutions with the symbol ⚡. We have tried to offer in this way a guide to reading the text; indeed, we believe that the best way of using it, once the basic notions given in the theory review have been acquired, is to try to solve the problems presented on one's own, using the solutions that we give for checking and complementing one's personal work.

The necessary prerequisites are limited to some basic notions, mostly in linear algebra, that are usually taught in the first year courses of the Mathematics, Physics or Engineering degree programs.

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