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**AMS-MAA Textbook Submission Form**

*Working title:* Practical Curves: A second course in algebraic geometry

*Expected completion date: December 2023*

*Expected final number of pages and final number of figures: 370, 40*

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*Authors’ addresses: David Eisenbud, 2 Ajax PL, Berkeley CA 94708*

*Joe Harris, Dept of Math. Harvard Univ., Cambridge MA 02139*

*Previous books by Authors (including year, title, publisher):*

By DE:

[**MR3617981**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3617981)**-**[**3264 and all that—a second course in algebraic geometry**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3617981)

[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368)

*Cambridge University Press, Cambridge*, 2016, xiv+616 pp.

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[MSC 14-01](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=pc%3A%2214-01%22)

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[**MR3445368**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3445368)**-**[**Minimal free resolutions over complete intersections**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3445368)

[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Peeva, Irena](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=263618)

[Lecture Notes in Math.](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/serials/profile?seriesId=589), [2152](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=si%3A589%20v%3A2152)

*Springer, Cham*, 2016, x+107 pp.

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[17 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A3445368)

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*Springer-Verlag, New York*, 2005, xvi+243 pp.

**ISBN:**0-387-22215-4

**Reviewed**

**Book**

[381 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A2103875)

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[**MR1730819**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1730819)**-**[**The geometry of schemes**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1730819)

[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368)

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*Springer-Verlag, New York*, 2000, x+294 pp.

**ISBN:**0-387-98638-3; 0-387-98637-5

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**Book**

[177 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1730819)

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[**MR1322960**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1322960)**-**[**Commutative algebra**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1322960)

[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330)

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*Springer-Verlag, New York*, 1995, xvi+785 pp.

**ISBN:**0-387-94268-8; 0-387-94269-6

**Reviewed**

**Book**

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[MSC 13-01](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=pc%3A%2213-01%22)

 Article

[**MR1166800**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1166800)**-**[**Schemes**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1166800)

[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368)

[Wadsworth &amp; Brooks/Cole Math. Ser.](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/serials/profile?seriesId=1750)

*Wadsworth & Brooks/Cole Advanced Books & Software, Pacific Grove, CA*, 1992, xii+157 pp.

**ISBN:**0-534-17606-2; 0-534-17604-6

**Reviewed**

**Book**

[8 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1166800)

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[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Neumann, Walter](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=130560)

[Ann. of Math. Stud.](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/serials/profile?seriesId=650), [110](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=si%3A650%20v%3A110)

*Princeton University Press, Princeton, NJ*, 1985, vii+173 pp.

**ISBN:**0-691-08380-0; 0-691-08381-9

**Reviewed**

**Book**

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[De Concini, Corrado](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=55410); [Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Procesi, Claudio](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=142205)

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*Société Mathématique de France, Paris*, 1982, 87 pp.

By JH:

[**MR3931738**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3931738)**-**[**Fat chance**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3931738)

[Gross, Benedict](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=77400); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368); [Riehl, Emily](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=718246)

*Cambridge University Press, Cambridge*, 2019, xi+200 pp.

**ISBN:**978-1-108-72818-8; 978-1-108-48296-7

**Reviewed**

**Book**

[1 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A3931738)

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[**MR3617981**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3617981)**-**[**3264 and all that—a second course in algebraic geometry**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=3617981)

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*Cambridge University Press, Cambridge*, 2016, xiv+616 pp.

**ISBN:**978-1-107-60272-4; 978-1-107-01708-5

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**Book**

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*Springer-Verlag, New York*, 2000, x+294 pp.

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**Reviewed**

**Book**

[177 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1730819)

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[**MR1631825**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1631825)**-**[**Moduli of curves**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1631825)

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*Springer-Verlag, New York*, 1998, xiv+366 pp.

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**Book**

[411 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1631825)

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[**MR1416564**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1416564)**-**[**Algebraic geometry**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=1416564)

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*Springer-Verlag, New York*, 1995, xx+328 pp.

**ISBN:**0-387-97716-3

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**Book**

[309 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1416564)

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*Springer-Verlag, New York*, 1992, xx+328 pp.

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[752 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1182558)

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[Eisenbud, David](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=62330); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368)

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*Wadsworth & Brooks/Cole Advanced Books & Software, Pacific Grove, CA*, 1992, xii+157 pp.

**ISBN:**0-534-17606-2; 0-534-17604-6

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[8 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1166800)

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[Fulton, William](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=70075); [Harris, Joe](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/author?authorId=194368)

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*Springer-Verlag, New York*, 1991, xvi+551 pp.

**ISBN:**0-387-97527-6; 0-387-97495-4

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**Book**

[2224 citations](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=cp%3A1153249)

[MSC 20G05](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/publications-search?query=pc%3A%2220G05%22)

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[**MR0685427**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=0685427)**-**[**Curves in projective space.**](https://mathscinet-ams-org.libproxy.berkeley.edu/mathscinet/article?mr=0685427)

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*Presses de l'Université de Montréal, Montreal, Que.*, 1982, 138 pp.

**ISBN:**2-7606-0603-1

*Mathematics Subject Classification for this book: 14H*

*1. What is the primary course for which the book is intended?*

*a. Title(s): Please list any course title variations, beginning with the most common.*

*Alebraic Geometry, Algebraic Curves*

*b. Level: If the course is offered at two or more levels, check all pertinent options.*

*\_\_first two years undergraduate \_\_first-year graduate*

*\_\_junior-senior \_\_X advanced graduate*

*c. Usual length of course:*

*\_X\_1 semester \_X\_2 semester \_\_other (please specify)*

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*\_\_undergraduate science/engineering major \_X\_graduate student in science/engineering*

*\_\_undergraduate education major \_\_graduate student in education*

*\_\_Other undergraduate (please specify) \_\_other graduate student (please specify)*

*2. How often did you teach this course? How many students attended your class in average?*

*DE taught it once ~ 20 students. Harris has taught is several times.*

*3. Authors’ brief description of contents, style, prerequisites etc. of this book. Please mention any specific pedagogical advantages or techniques in your book (e.g., learning objectives, helpful reviews/summaries, special exercises or projects, IBL):*

From the Introduction:

Within algebraic geometry, the study of algebraic curves is the oldest topic. Newton already classified all the possible types of real affine cubics. By the middle of the 19th century a rich theory of curves in the complex projective plane was a central topic, overturned by Riemann’s work in mid- century—what became the theory of Riemann surfaces, which introduced techniques of complex analysis into the field. This was taken up and made algebraic as a theory of plane curves by Alexander Brill, Max Noether, F. S. Macaulay and many others. By the end of the century Halphen and others were interested in the classification of space curves as well.

The development continues unabated today: in the second half of the 20th century Grothendieck’s foundations lead to the solution of many classical problems and, in particular, to a firm foundation for the theory of moduli, allowing mathematicians to exploit the fact that algebraic varieties generally come in families parameterized by other algebraic varieties—something that we will return to often in this book. Algebraic Geometry has merged more and more with number theory, and the moduli space of curves plays an important role in String Theory, born from the needs of physicists.

For these reasons, the subject of algebraic curves is one of the richest in algebraic geometry, if not in all of mathematics. Examples abound; if you want to know whether a conjecture is plausible, you can generally find well-understood special cases on which to test it. Some of the fundamental constructions of algebraic geometry, like the construction of moduli spaces and their description, can be carried out in the setting of algebraic curves with a degree of precision and detail far beyond what has been possible in higher dimensions.

The wealth of beauty, both in theory and in examples, certainly makes the study of algebraic curves an attractive prospect. But it comes at a price: to absorb in detail all the things we’ve learned over the centuries about algebraic curves would take years, if not decades. This is, in essence, the conundrum facing anyone who undertakes to write a book on the subject: how to convey the wealth of information (and the many many ways in which our knowledge is incomplete) without writing an encyclopedia.

This is our attempt to do that. Our intended audience is a graduate student considering working in the field of algebraic curves, or a researcher in a related field whose work has led them to questions about algebraic curves. Our goal is to equip the reader with the understanding of both the techniques and the state of our knowledge necessary to read the current literature and work on open problems.

Although mathematicians aspire to understand their subjects deeply, we feel that we learn in stages: in early stages we accept large and difficult results as black boxes and explore the rich examples that they yield. That is how we

DRAFT: July 11, 2023

6 CHAPTER 0. INTRODUCTION

have tried to organize this book: We begin with two chapters that we hope will bridge the gap between first courses in algebraic geometry/commutative algebra at the level, of Fulton’s or Reid’s well-known books [?], [?] and the professional language of invertible sheaves, cohomology and linear series. An ideal background would be Hartshorne’s book [?] or Vakil’s notes [?] but in practice very much less will suffice, if the reader is willing to accept some advanced ideas or look them up at leisure—we have tried to give precise ref- erences where this might be required. Subsequent chapters roughly alternate between expositions of basic techniques (partly without proofs) and families of examples, treated in detail.

More succinctly:

Our goal is to introduce a reader who already has some background in algebraic geometry to some of the fundamental problems and methods of the subject. The early chapters review and complete what the reader might have learned in a first course. In chapter 1 we treat the relationship between divisors, linear series, invertible sheaves, and morphisms to projective space, which are essentially descriptions of different aspects of the same thing. In chapter 2 we prove and discuss the canonical sheaf and the Riemann-Roch theorem, as well as some first applications. This is material that often occurs at the very end of a first course, too late to include its beautiful applications.

The successive chapters more or less alternate between the study of morphisms from curves of a particular genus, and chunks of basic theory: the Jacobian, the Hilbert scheme, the moduli space of curves, the inflectionary study of curves, the Severi variety, linkage of curves in 3-space... . Two chapters are devoted to Brill-Noether theory and a simple proof of the Brill-Noether Theorem. The last two chapters treat the ``good'' components of the Hilbert schemes of curves of low genus and degree, and then Mumford's famous example of an everywhere nonreduced component. We are preparing hints to most of the exercises, which would be included at the end of the book.

Harris has taught courses on this material at Harvard for many years, and Eisenbud has just finished a year-long course at Berkeley using and refining the manuscript.

*4. In order of importance, list four or more features in your book that will benefit students and/or instructors* ***and*** *distinguish it from other texts on the market.*

*(Please include Feature and Benefit (why it is useful).)*

|  |  |
| --- | --- |
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| Readable | Good for a course or independent study |
| Makes professional literature accessible | Physicists and algebraic geometers, among others need to know this subject |
| Lots of exercises, with hints | Opportunities to practice |
| Simplest complete proof of the Brill-Noether theorem | A fundamental tool, not well-known. |

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| Abarello, Cornalba, Giffits, Harris, 2 volumes, 963+386 pp, Springer, 1985 and 2011 | Encyclopedic | Encyclopedic |
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William Fulton

Mihnea Popa

Gavril Farkas

*9. Please list at least six colleagues, professional contacts, and/or students (former or current) who are teaching the course for which your book is intended and who will consider it for adoption.*

*E.g. Professor Jones studied under me and now directs one of the largest programs in the country. She should like the approach I take in my book.*

*Harris has more students in AG (mostly in this field) than anyone else. Look at the math genealogy site.*

*10. Which AMS or MAA book series (see https://bookstore.ams.org/book-series) would you consider the most appropriate for your book and why?*

??

*11. If possible, please provide 5-10 key words or phrases that are not included in the title of your book. These should be words and/or phrases which scholars and instructors would use to find your book’s topic online. The purpose of identifying these words will be to help your titles rise to the top in online search results.*

*1. Riemann Surface 6. Linkage*

*2. Liaison 7. Arithmetically cohen-macaulay*

*3. canonical curve 8. Rational normal scroll*

*4. 9.*

*5. 10.*

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