

Giving away a book

Jim Hefferon

In the early 90's I wrote an undergraduate textbook *Linear Algebra*. While writing it, I found useful the Free software tools that were available under the then-new Linux. Inspired by that, I made the book available for download under a Free license.¹

A Free text was unusual then but today authors do it more often. Since the length of my experience with it may make this book stand out from other freely available ones, I hope some authors considering doing this will find interesting a few things I can say about that experience.

In particular, I will discuss advantages and disadvantages of using \LaTeX for such a project. I will also take this chance to discuss some experiences with this project that have nothing to do with \TeX — sorry.

1 The project

Linear Algebra is for a standard undergraduate course that in the US at least is often taken during a student's second year. I wanted to emphasize developing mathematical maturity in these young math students, up from the more formula-driven early classes toward the more proof-driven later courses (a full description is in the book's Preface). At the time that I wrote it, I knew of no text that was directed toward this goal.

I believe that people use it. For one thing, it is frequently downloaded, about 100,000 times in the last year. Another indicator is that in the decade that has passed it has always been on the front page of a Google search for "linear algebra," and often first on that page.

In addition to the PDF of the text, I offer the full \LaTeX source including a PDF of the fully-worked answers to all exercises, even the proofs.

1. <http://joshua.smcvt.edu/linearalgebra>

Developing the worked answers to all the exercises has proved to be a big part of the book. I'll discuss below some of the associated technical problems but I'll note here that this development contributed greatly to the book's strength. While writing the answers, I made many, many improvements to both the exercises and the section body. It took a long time and it was a lot of work but I highly recommend this practice to authors.

2 L^AT_EX aspects

I put *Linear Algebra* up more than a decade ago (the Wayback Machine knows of it by January, 1998). What I offer now is essentially unchanged from what I offered then. Because I used L^AT_EX, there has been no bit rot—I can still easily build it from scratch. This is a tremendous advantage. An author providing material for free has nothing to gain from time spent on maintenance due to changes in versions of underlying tools.

A number of other advantages to a T_EX-based solution have also become clear with time. Because it produces first-class output, an instructor could use it in class without apology. The source is very small (it fits on a single ancient storage device called a “floppy”), limiting the bandwidth I consume. And, there is a strong ecology of tools available, including editor add-ons, but also including the graphics program MetaPost, which I found very useful.

When I started the project, I knew only a little L^AT_EX. There were fewer packages than today and to do many things I had to do my own macro programming. As many other people have done, I used the just-in-time approach of having a need and consequently poking around in the L^AT_EX source, examining style files, and lurking on, and sometimes daring to ask questions on, the T_EX mailing lists. Gradually, I built up a few style files that did some moderately sophisticated things (they are included in the book source).

I'll try to give a sense for this process by discussing just one area, producing the exercises and their answers.

My first problem was that I wanted to number the exercises in sequence with the theorems. This was an introductory-level problem but I remember that it gave me trouble since solving it required that I read the source of L^AT_EX. Anyone who has made a trip there knows that it is accompanied by considerable head-scratching.

The next problem was harder. I wanted to include the answers to the exercises in the source file, using this format.

```
\begin{exercises}
\item Prove that ..
  \answer{The proof begins ..}
\recommended\item Calculate the ..
  \answer{Let  $x$  be ..}
\end{exercises}
```

Recommended exercises are marked with a check in the margin as a guide for readers going through the book on their own. Note that if an exercise has its own `\item` substructure then the answer is not entered per-item; rather the answer has its own `\item` structure.

While compiling the book, I need \TeX to write the text of the answers to a separate file. I also need to include in that file the exercise number, etc. The answers package was a great help (Mike Piff, thank you!).

However, I had additional constraints. One is that I wanted to produce links in the two PDF files, first from the answer to the question, and also back from the question to the answer. This required some \LaTeX coding that I found tricky. (A problem that I never did solve is that readers must put both the book and answer PDF files in the same directory for the inter-linking to work.)

A second problem with exercise coding was that some instructors told me that they want to assign problems to hand in, and don't want to make up their own exercises, so having all the answers available precludes their using the book. For this, I developed an option that will produce only the answers to recommended exercises. I am not the only person ever to find \TeX 's `if constructs` hard to plumb, but eventually I got it to work. (For a while I offered for download only the answers to recommended exercises. To get the answers to all exercises, people had to write me to swear that they were either teaching the course or else were studying on their own. After a while the absurdity of this became compelling and in any event finding the entire set of answers online by googling became easy, so I now stick to offering all of the answers.)

The final problem, which I never solved, was the awkwardness of correcting \LaTeX errors in the answers. My workflow was to compile the document, which output the answers to a separate file, and then to compile those answers. Any

errors in the answer file results in a report giving line numbers from that file, of course. But that is not the location of the error in the original source file from which I worked. I hacked at this a bit, but at some point I felt that I should be writing the book, not spending all my time on the tool used for the book, and so I never fixed it.

In short, the advantages of L^AT_EX that have proved most useful for this project were its high quality output, its stability, and the widespread availability of tools. The main disadvantage was that to achieve some effects required that I do macro programming, some of which I found hard and time-consuming.

3 Other aspects

Providing the book free for download has had some clearly positive effects.

The biggest positive effect happens when a person says that my providing access to the mathematics enabled them to accomplish something they otherwise could not, often because of their circumstances such as that they are from a developing country. I get perhaps five or six of those emails a year. They make my day.

I also enjoy notes from anyone who has found it useful, either as a student or as an instructor.

Another positive effect is that I get bug reports, typically typos (lately mostly in answers to exercises). I don't know if authors of undergraduate texts distributed from traditional publishers receive many of these but I have had some readers who were quite precise, and that has been helpful.

That is, providing the materials freely has resulted in both exposure and good will that would have been hard to get otherwise.

There have also been some aspects of distributing the material in this way that were more mixed.

The first is that four separate times people have written that they were using the source to translate the text, accompanied by some initial material. Since the equations remain unchanged and the structure of the book is set, it would seem routine to translate the sentences and end with a usable text (I know nothing about translation, though). But, unfortunately, none of these promising projects seems to have been completed.

I also know of two tries at using the source to make a wiki. The first was very well done and contained the full text of the book, including all the illustrations (the author and I cooperated on these since they needed special handling). As with the other kind of translation, though, that I can tell the wiki projects were not successful in the sense that they never became dynamic documents to which people contributed improvements, etc.

The experiences of the wiki authors match my own. When I made the source available I imagined that it would allow some instructors to add or delete sections or exercises to their preference. In particular, at the end of each chapter are three or four sections of topics that are quick applications or developments of the material in the chapter, and I thought these might get some activity. To help this happen, I provide a booklet on how to get the book's source to compile.

With that in mind, on the download page I solicited contributions, starting by imposing on a few colleagues in my department to allow me to use their exams to seed my collection of problems. I also solicited topics including, based on some reader inquiries, something on linear algebra in Quantum Mechanics. However, no contributions have happened (I exchanged emails with one person about the Quantum Mechanics topic but in the end he concluded that it was not possible).

Finally, I will mention one negative aspect of free distribution. Some people have downloaded the book and put versions up for sale on online publishers. This falls within the license but I confess to finding it mildly annoying. One way that it is annoying is that the editions of these are not updated as bugs in the book are fixed, so there are versions for sale when a free version has fewer errors. Perhaps I should put up my own version, but to this point I have preferred to stick to online distribution.

In summary, there are a number of advantages to providing the material freely, including exposure. However, at least this project has not attracted any contributions more extensive than bug reports.

4 Possibilities

Were I starting this project today, I would think about about filling it with interactive goodness. For instance, a graphic could have the user specify two basis vectors in the plane, and when that user mouse-drags a vector around the plane, the graphic could show the coefficients of the basis vectors needed to express the

mouse's vector. Another might show a two-by-two matrix with sliders in the four entries, and display the transformation of the plane resulting from the slid-to values of the entries.

Providing such things was not practical when the book was written. However, today PDF is an open standard so fixing reliance on it as a delivery platform seems safer. And, with PDF allowing the inclusion of JavaScript, there may be a realistic way to get cross-platform interactivity.

Of course, as I mentioned above, the most exciting possibility would be to develop a community of people to contribute such applications. Anyone who watches an active Internet community has to be impressed with the tremendous creativity and energy that can arise when a group of great people get going.

5 Closing

Free distribution has some real advantages (for one, no marketing meetings!) but some trade-offs as well.

Because there are stable standards, including \LaTeX , a private individual can realistically offer a text free for download without maintenance issues. Producing the work in \LaTeX probably involves some coding (this may be mitigated by the fact that there are more \LaTeX packages today than a decade ago, so the need for individual coding may be reduced).

If you are considering such a project, good luck!