UTMOST Instructors Guide

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Abstract

This guide is intended for faculty who have adopted a PreTeXt-authored open textbook for their class, particularly for those in the UTMOST study. It includes ideas for integrating common PreTeXt features into teaching practices as well as specific guides for users of particular textbooks.

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Please report broken links, typos, and other error by filing an issue at the Github repository

1 Common PreTeXt Features

Not every textbook implements all of these, and not all in an identical way, but this is meant to highlight some basic capabilities for integrating structured content into the everyday teaching of a class.

1.1 Judicious Linking

The defining feature of hypertext and, perhaps, the web in general is the ability to link from one resource to another. The structure of PreTeXt is ripe for such, both internally, as you regularly see with exercises citing theorems and sections referenceing previous sections, but can also be done externally.

Instructors are encouraged to link to relevant parts of the text throughout their course materials: in syllabi, in assignments, but also in feedback to students and on dicussion boards. This is often as simple as sharing the relevant URL to the particular resource. You can find the URLs in several places:

Any section or subsection in the text can be linked to easily by simply right-clicking on the section in the table of contents and selecting "Copy Link Location" (or similar).
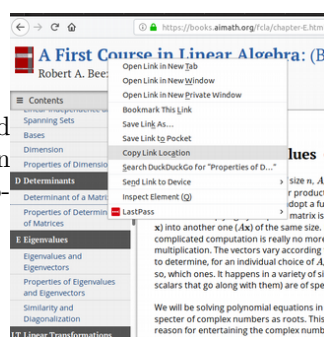

Figure 1.1: Copying URL for a subsection.

Table of Contents

More granular items (technically any division with an `@xml:id` tag) can be linked to directly. An easy way to find the relevant link is to locate the item in the index. Clicking will open a small box (a "knowl") and display the item. There will be an "In Context" link in the lower right. Right-click this to copy the URL.
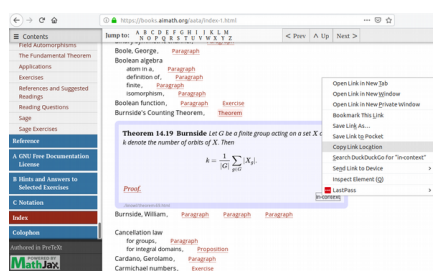

Figure 1.2: Copying URL for an index item.

Index

Others Many divisions in a PreTeXt textbook are decorated with a faint paragraph sign ¶ (known as a "pillcrow"). These are in fact links which center the browswer at that division. Once, clicked, the URL displayed in the browser's address bar can be shared.

1.2 Sage Advice

Sage is an open source language for doing mathematics. It is designed to replicate the functionality of popular computer algebra systems (*Mathematica*, MAPLE, etc.) in a unified, open source environment. It is free and may be downloaded and run locally on a user's personal computer, but many PreTeXt authors deploy what are known as Sage Cells like those seen above. These are one-off computing environments in which snippets of code can be executed and displayed in a browser without need for any installation of software on the user's part. The code can be altered in any way the user sees fit, and the original content can be restored by reloading the page.

Seriously, these things are great.

```
A = matrix(4,5, srange(20))
A.rref()
```

```
[ 1   0  -1  -2  -3]
[ 0   1   2   3   4]
[ 0   0   0   0   0]
[ 0   0   0   0   0]
```

```
var("x,y")
plot3d(x^2+y^2,(x,0,2),(y,0,2))
```

For those who wish to demonstrate or experiment further with Sage, AIM also hosts the the Sage Cell Repository. One can compute directly on the home page or explore the dozens of examples compiled in the wiki.

2 Textbook-Specific Information

This section provides specific information and author-recommendations for adopters of the specific textbooks in the project.

2.1 Abstract Algebra: Theory and Applications
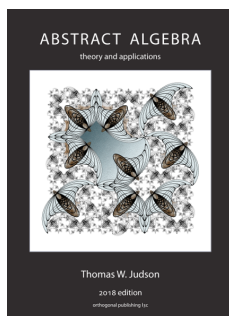
This page provides complementary information for participants of the UTMOST project. Because this is a hosted version for the UTMOST project, it is important for you to be aware of a few additional features of the textbook.

Syllabus Be selective in what you cover in your course. This includes the sections of the textbook as well as the Sage exercises. You can use the chapter diagram that is presented in the Preface to make decisions about what to include or exclude.

Sage The HTML format of the textbook takes advantage of the Sage programming language. Get acquainted with how this textbook uses Sage to learn more about it. Instructors can either assign this section to the students, or spend some time in class to illustrate how Sage works. The cells will take Python commands.

Each section of the HTML format of textbook contains Sage Exercises; they vary in complexity. The goal of these exercises is to get users to use technology to explore structures and make conjectures that would be very difficult to do by hand computation.

For example, the Sage Exercises in Cyclic Groups were written to help readers explore the cyclic patterns of the group of units mod n, $U(n)$, which is sometimes cyclic, sometimes not. By using Sage, users can easily test whether or not the $U(n)$ is cyclic for large values of n and then make a conjecture about what the general case should be.

Sage can be used by typing a command line in a terminal window, in a Sage worksheet, and in the Jupyter notebook; however, the most friendly way to learn Sage is to use the Sage cell server. The Sage cell server allows Sage to

be embedded in any web page. Users can modify and execute the Sage code. If the edited code results in disaster, one only needs to reload the web page to restore the original code. See the Sage Cell Repository for more information.

Reference   This textbook includes a Reference section that includes appendices and the index. Of particular note is the Notation appendix which includes a list of symbolic notation and links to their occurrences in the text.

2.2   Active Calculus
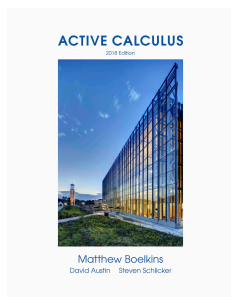
This page provides complementary information to the section Features of the text. Because this is a hosted version for the UTMOST project, it is important for you to be aware of a few additional features of the textbook.

Preview Activities   In addition to the Reading Questions, each section begins with a Preview Activity, meant to be an accessible introduction to new ideas that rely largely on knowledge that students already have. Most Preview Activities can be completed in 15–20 minutes. If students are logged in to the HTML version of the text, the Preview Activities can be completed in the HTML version and the responses reviewed by the instructor. Instructors can incentivize the completion of the Preview Activities by asking the students to put their work on their desks for review in class.

Activities   Each section in the textbook has three Activities (e.g., Activity 1.3.2) that are designed for being done in class by students. There is a PDF Activities Workbook that can be printed so students can use it to work on it in class.

Students using the HTML version of the textbook can revise the responses they provide to the Preview Activity questions before they submit them. Once they are submitted, the instructor can immediately see the responses when logged into their instructor account.

WeBWorK   Almost every Exercises section of the UTMOST HTML format of the textbook includes anonymous WeBWorK exercises that students can complete and receive immediate feedback with unlimited attempts without penalty ("anonymous" here means students' work is not recorded anywhere). The WeBWorK exercises are intended to be more routine than the following non-WeBWorK exercises.

Solutions   This textbook includes an instructor's solution manual with answers and solutions to each Activity and non-WeBWorK exercise in the text. The answers are available in the publicly posted electronic versions (both HTML and PDF). The solutions manual is only available to instructors by direct request by email to the author (boelkinm at gvsu dot edu).

2.3 A First Course in Linear Algebra
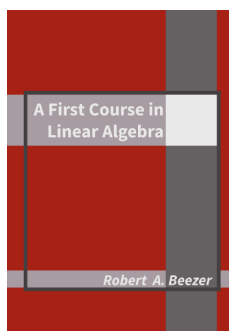
This page provides complementary information to the section "How to Use this Book" in the Preface of the textbook. Because this is a hosted version for the UT-MOST project, it is important for you to be aware of a few additional features of the textbook.

Acronyms This textbook does not use numbering system for the sections. The author uses acronyms to refer to each section, as they encode information about the content. The best way to handle them is to use them in class; students do not have to memorize them; only that they can recall what theorem they use. Every chapter has annotated acronyms for definitions and theorems that remind readers the importance of each of them. Although students get anxious about this, it is not such a big deal.

Of great help to both instructors and students is the Reference chapter. It is organized by the major sections of the textbook. Each section contains all the symbols and terminology used in that section, with a knowl that provides its definition and an "in context" link. Each of these sections is searchable.

Exercises This textbook has three categories of exercises: computational (labeled as C), conceptual (labeled as M), and theoretical (labeled as T).

Proof Techniques The textbook contains a chapter on Proof Techniques that has been included to support students as they build their proving skills. Instructors can remind the students of the techniques that are available and explained in this chapter.

Archetypes The textbook works with examples called Archetypes, labeled with a letter, and ordered alphabetically. The Archetypes provide a range of examples that fit specific properties. They are included to serve as illustrations for how properties work or fail. They can be used to tests conjectures. The students can be encouraged to check them whenever they are learning new material. The archetypes include the relevant theorems.

Topic Order It is not recommended to change the order of the sections in the textbook because each chapter builds upon what has been done before.

Sage The textbook makes heavy use of Sage cells (there are 96 vignettes with Sage cells, a list of which can be found here Sage). These are intended to help students learn to use Sage to do linear algebra and to learn how to do linear algebra by using computational examples. There is a separate GitHub repository that contains 17 Sage worksheets that instructors can use in class (in several output formats, including Jupyter, PDF, etc.). They are "incomplete" and meant to be filled in during class. For some examples, a random elements are generated; in others, a carefully constructed example is explicitly defined. There is a master document with a short description and expected duration

(usually between 5 and 20 minutes) for each. Instructors can do them in class. they can see many different examples in class.

3   UTMOST-Specific Information

This guide is intended for instructors at test sites participating in the UTMOST project (hence the use of second person). It may not be relevant to a general audience.

3.1   Version

Being open-source textbooks, there may be several (maybe dozens) of implementations of your textbook on the open web. It is *very important* you and your students use the UTMOST-specified version of the text.

Different sites have been designated to use either the HTML (online) format of the textbook or the PDF (offline or printed) format. Find the relevant links below.

HTML Format

- Abstract Algebra: Theory and Applications
- Active Calculus
- A First Course in Linear Algebra

You and your students will be given logins for the AIM-hosted version of your textbook. As mentioned, it is crucially important that you use and bookmark this version. The login should persist on a given device so that frequent logging in will be unnecessary.

PDF Format

- Abstract Algebra: Theory and Applications
- Active Calculus
- A First Course in Linear Algebra

3.2   Highlighting

HTML Format   The hosted versions of the texbooks include a feature whereby students can highlight portions of the text and have those highlights persist across different versions. Instructors' versions makes this available as well, though when text is highlighted, they are given the choice to highlight or simply copy the text to the clipboard.

PDF Format   There are many ways to annotate a PDF, but such is not the goal of this document.

3.3 Reading Questions

As you cover material in various parts of the book, it is important you assign the Reading Questions for the relevant sections. The authors have written them as a quick check on readers' comprehension after first exncountering the material of a section. These can be of great help to the researchers, the instructor, and, indeed, the students themselves.

It is at the instructor's discretion exactly when and how exactly to assign these, but it is highly recommended that a small percentage of their grade depend on the completion thereof.

HTML Format With the AIM-hosted versions of the textbooks, students are able to answer the reading question right in their browsers. Their answers can then be displayed in the instructor's version. Whether reading is assigned before or after material is covered in class, a quick scan of the responses can inform the instructor if some material requires further attention.

Researchers will receive and analyze anonymized copies of student responses.

PDF Format for the PDF versions of the textbooks are distributed separately, and can be found by (((FILL THIS IN)))

You may want to set up your LMS so that students can input their responses there. Many systems (e.g., Canvas) have a "Discussions" tool in which the Reading Questions can be posted as prompts and students reply after which their peers' replies become visible.'