Towards a Platform for Modular, Open, Reusable Textbooks

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Abstract. Textbooks often come as printed, linear, standalone, monolithic resources. However, teachers, more often than not, tend to draw from various sources to prepare their courses and modify or complement existing content. We describe a web platform for textbooks based on features of source-control management systems to enable teachers to tailor a specific textbook to their needs. Teachers can each create their own "fork" by reordering, adding, removing, or editing chapters and get clues on potentially broken backward or forward references.

Keywords: textbook, git, modular, open, reusable

1 Context

Our project consists of experimentation and research in the field of computer science textbooks. Teaching computer science in K12 represents a big challenge: while CS has been taught in universities and other higher education institutions for a long time now, teaching CS at lower levels is still relatively new. To quote Raymond Lister [3], "we all agree that we have to teach CS in primary, secondary and high schools. We are all OK about this. But we have to admit that we don't know how to do it!" Just like for the related question of the integration of technology in the classrooms, teachers and their practices are the key factor for success [7]. In many countries that decided to include CS in their curricula, the professional development of teacher is given a lot of consideration. New teaching material is often proposed, sometimes as books, sometimes as web platforms [4].

2 The Problem with Traditional Textbooks

The case of textbooks is complex. Since the emergence of technology and internet, textbooks have changed from being a stable reference, intended to be read by students, to a kind of fragmentable, heterogenous resource, intended as a tool for the teacher to organize students' activities inside and outside the classroom [2, 1]. In a digital and interconnected world, teachers often do not rely on a single resource and do not want to use a single, standalone textbook. Even if work practices might be different depending on the level of teaching, on the field, or on the experience of teachers (beginners/experts), teachers preparing

their courses tend to pick up pieces from different sources and set up their own teaching material that will best fit their needs [6]. The problem is that existing textbooks are often complete manuals intended to be used from A to Z and not meant to be fragmented. They are not thought of as a modular resource. Most web platforms are built the same way. And it makes it difficult for teachers to build learning paths for their students using different pieces of materials from different sources. Moreover, the end result itself is not easily reusable.

In our experience, CS teachers do not share a lot their teaching materials, even if they say that they would be pleased to do it. One of the main obstacles to sharing is that their materials exist in very different formats and they often do not have an adequate sharing platform. When sharing platforms for teachers exist, CS teachers tend to not use them. They need a dedicated platform to their field of teaching so that they can share with their community.

3 A Platform for Open Textbooks

What we can say from this prior analysis is that teachers need a textbook format that is modular and reusable. It must exist in a format that can easily be shared with others on the web.

According to those needs, we have begun building and experimenting with an electronic textbook on a novel web platform based on principles of source-control management. As software developers use source control management tools to collaborate on code when they develop software, we think that we can make a parallel with this usage and propose to work in similar ways while editing a textbook. Although our intent is to replicate some useful features from software such as Git or Mercurial and implement them behind the scenes with this software, we plan to hide the complexity of the actual commands that are run behind a user-friendly, intuitive web interface. On the one hand, newcomers must not be repelled by being exposed to the internals and will never need to know about implementation details; on the other hand, expert users can clone the repository, make changes locally, and push results to the platform for publication.

Here are some of the main features of our proposed solution:

- Textbooks are organized hierarchically into parts, chapters, sections and subsections. Actual page content is provided in an Markdown syntax extended with LaTeX markup and a special syntax meant to plug external commands or plugins.
- Any visitor can view the contents of any textbook.
- Users with an account can "fork" any textbook and thus create a derivative version. Parts, chapters, section, and subsections can be reordered, edited, deleted, or added. The whole history of modifications is kept such that each line can be attributed to its author.
- Small modifications (e.g., correction of a typo) made by a new author can be proposed back to the original author with a mechanism similar to GitHub's pull requests. Larger modifications create alternative versions of the edited pages.

- The platform helps visualize backward and forward references and warns authors when the reordering or deletion of a resources would lead to an inconsistency.
- While viewing any page, visitors can obtain a list of alternative versions that arose from modifications by other authors. Visualization tools help authors identify similar or significantly different versions.
- Text in the book can be easily linked to one or several learning objectives. These objectives are automatically summarized for each chapter, can be used to highlight sections in the book, and can be exported by students for easy reviewing. Section reordering and text editing smartly preserves the linked learning objectives.
- All content is published under a Creative Commons BY-NC-SA license (attribution, non-commercial, share-alike). For each chapter or section, the platform keeps the whole history of modifications and automatically generates an author list according to the profile information of the authors' accounts.

In order to exemplify these features, we are porting, in collaboration with its authors and its publisher, several chapters of the book "Découvrir le numérique" [5]. This book is a paper-based CS textbook for engineers in their first year of study and serves as an introduction to CS. Part of the work will be to transpose the content to make it understandable to high school students (these details are outside the scope of this poster).

The poster discusses usability questions, implementation details, and design decisions we have been led to make in the initial design and implementation of the platform, as well as open issues and early teacher feedback.

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