Leveraging Generative Programming for Software Documentation

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Introduction

Problem:
- **Considerable Duplication:** Handwritten software artifacts often contain repeated information. [1]
- **Lack of traceability:** It is challenging to track the origins and dependencies of various software components. [2]
- **Lack of maintainability:** Maintaining and updating handwritten software is cumbersome and time-consuming. [2]

Solution:
- **Drasil**, a software framework written in **Haskell**, that keeps all software artifacts (requirements, design, code, tests, build scripts, documentation, etc.) synchronized with each other. [2]
- Accomplishes two primary objectives: complete traceability and elimination of knowledge duplication. [2]

Area of Focus:
- This research poster focuses on Drasil's document generation capabilities, specifically the Software Requirements Specification (SRS).
- Users define the SRS once in a single location, and Drasil generates the SRS in various output formats.
- Prior to the work done in this research poster, Drasil could generate documentation in **HTML**, **LaTeX**, and **Jupyter Notebook**.

Objective

Goal:
- Expand Drasil's document generation capabilities by generating Software Requirement Specifications (SRS) in **mdBook**.

What is mdBook?
- mdBook is a command line tool designed for creating books in Markdown. [3]
- Content is authored in **Markdown**, and mdBook converts it into HTML, automatically applying styles and layout to enhance presentation.

Advantages of mdBook:
- **Improved Navigation:** Unlike the existing single-page formats, mdBook separates each section into its own page.
- **Enhanced Styling:** Offers advanced styling and layout options for better readability and organization.
- **Mathjax Support:** Allows you to include mathematical equations and symbols in your documentation using LaTeX. [3]

Workflow

Figure 1: A flowchart detailing the steps followed to achieve the objective.

Results

Figure 2: A flowchart illustrating a simplified version of the document generation process in Drasil. The items highlighted in red represent the contributions from this research poster.

Discussion

- The adoption of mdBook for generating documents within Drasil not only enhances the quality and usability of the documentation but also aligns with the framework's goals of achieving complete traceability and eliminating knowledge duplication.
  - Information is defined once and reused consistently across **all** documentation.
  - Maintaining and updating documentation is simplified, as editing the Drasil source code automatically updates all related documentation.
- With a Markdown definition DSL now established in Drasil, future work can focus on incorporating various Markdown flavors and generating new documentation formats.

Benefits of Generative Programming

Streamlined LaTeX updates: The rendering of the multiplication operator in LaTeX was updated, requiring only a **4-line change of Drasil code**. This small adjustment resulted in approximately **1360 modifications** across **67 files** of generated code, showcasing the efficiency of Drasil's generative approach.

In the graph below, software generated using Drasil required only **1,422** lines of user-written code, resulting in **7,243** lines of generated code. That is approximately a **1:5** ratio!
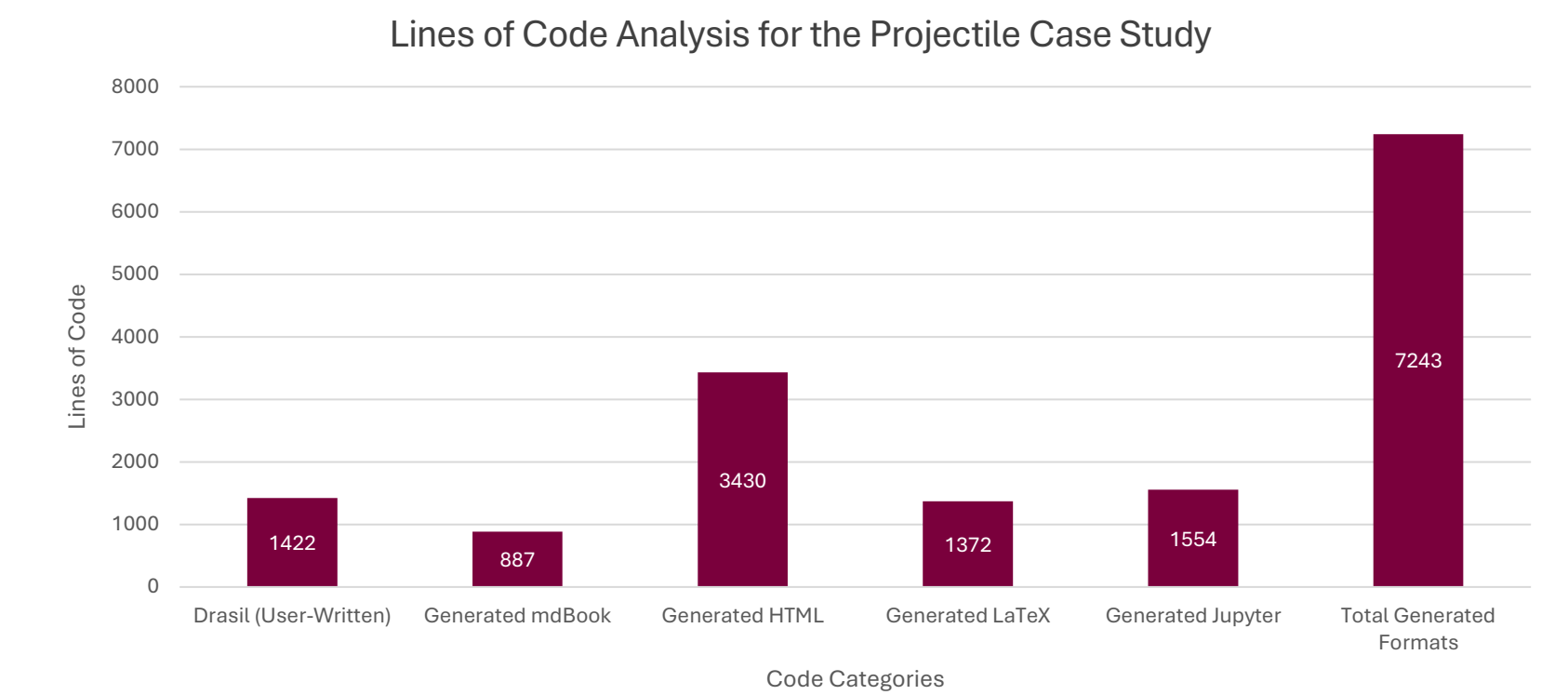

Figure 3: A comparison of user-written code vs. generated code lines.

References

[1] Carette, Jacques & Smith, Spencer & Balaci, Jason. (2023). Generating Software for Well-Understood Domains. 10.48550/arXiv.2302.00740.

[2] D. Szymczak, S. Smith and J. Carette, "POSITION PAPER: A Knowledge-Based Approach to Scientific Software Development," 2016 IEEE/ACM International Workshop on Software Engineering for Science (SE4Science), Austin, TX, USA, 2016, pp. 23-26.

[3] "MdBook documentation," Introduction - mdBook Documentation, https://rust-lang.github.io/mdBook/ (accessed Aug. 8, 2024).

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