User Interface Design Final Report

Jordan Dehmel, 2025

Creating an Open-Source Text Editor for Static Documents with Embedded Running Code

Abstract: When preparing documents in math or computer science courses, PDFs with embedded running code are often desirable. R-markdown (RMD) is one solution to this, but is embedded in the large rstudio application. Previous work has created the JKnit literate programming tool, which is a lightweight and generic command-line alternative to RMD: The current project details iteration on a graphical text editor for JKnit as the final project of CSCI 337 (User Interface Design).

Purpose

This program is aimed at mathematicians and computer scientists who want to create documents with running code in them (as per Knuth's idea of "literate programming") without being limited by bloated or closed-source software. This differs from the use case of jupyter notebooks, which usually aims to run interactively: The goal of `jknit` is to compile to static documentation. The GUI aims to be lightweight and intuitive, specifically targeting those who do not have CLI experience (EG math students).

Requirements

The following things must be true about the final product:

- Interface w/ the CLI
- Avoid bloat
- Be open-source
- Be lightweight and intuitive, targeting those who do not have CLI experience
- For the sake of IT, easy to install

Audience

The users of this software would be mathematicians and computer scientists who want to create documents with running code in them.

The "customers" of this software would be universities. These would be the institutions installing the software, even if no money is changing hands. For the sake of IT, the GUI should aim to be dependency-light, easily-managed, and minimally-invasive.

User Stories (See also UI Test)

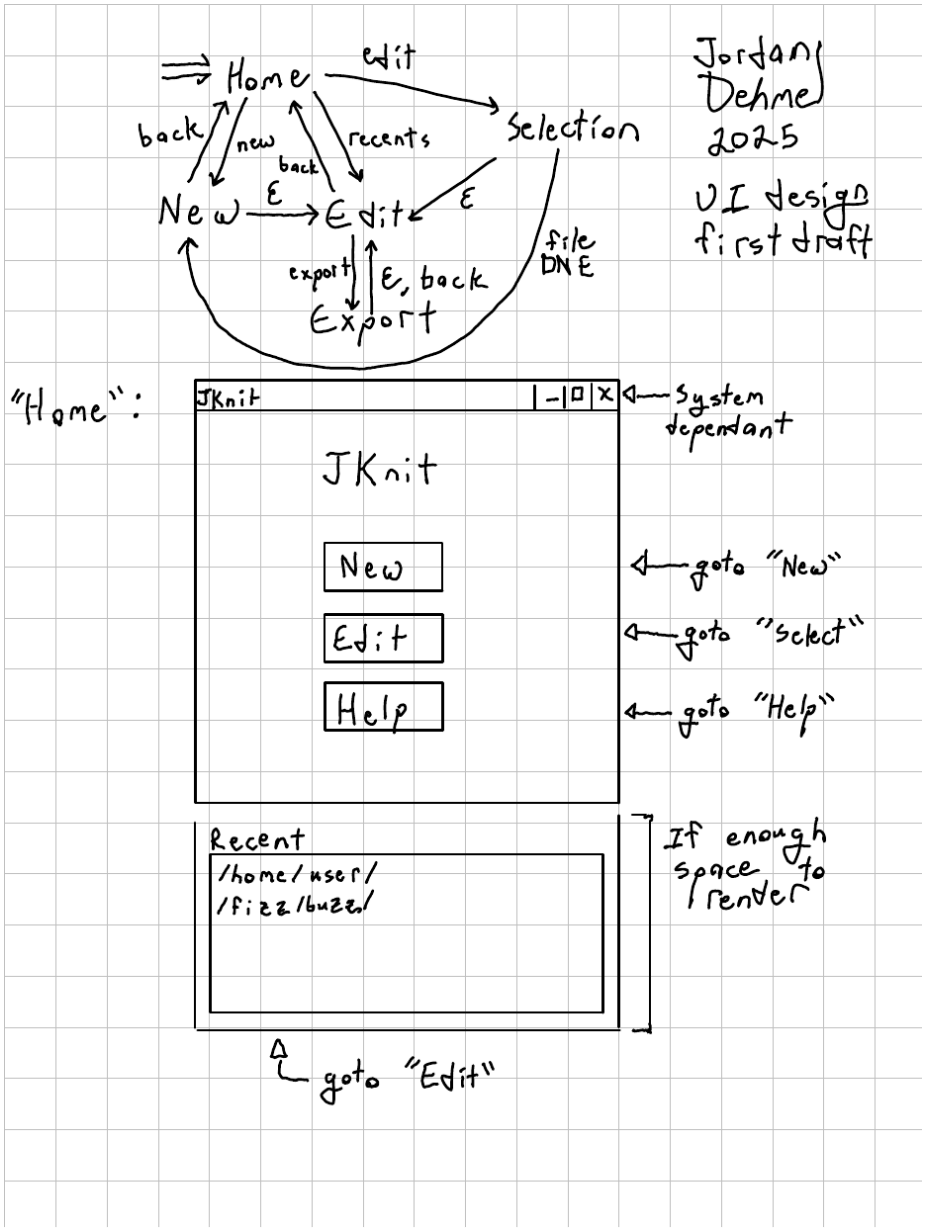
The following are possible user stories:

1. “I need to write a report for my math class”
2. “I need to modify and export a JMD file someone sent me”
3. “I need to quickly explain this software to my students”

First Iteration

The first major iterations were as follows: 1. Paper version 2. Android version 3. First Flutter iteration

Paper UI


Home
edit
Selection
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New
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Edit
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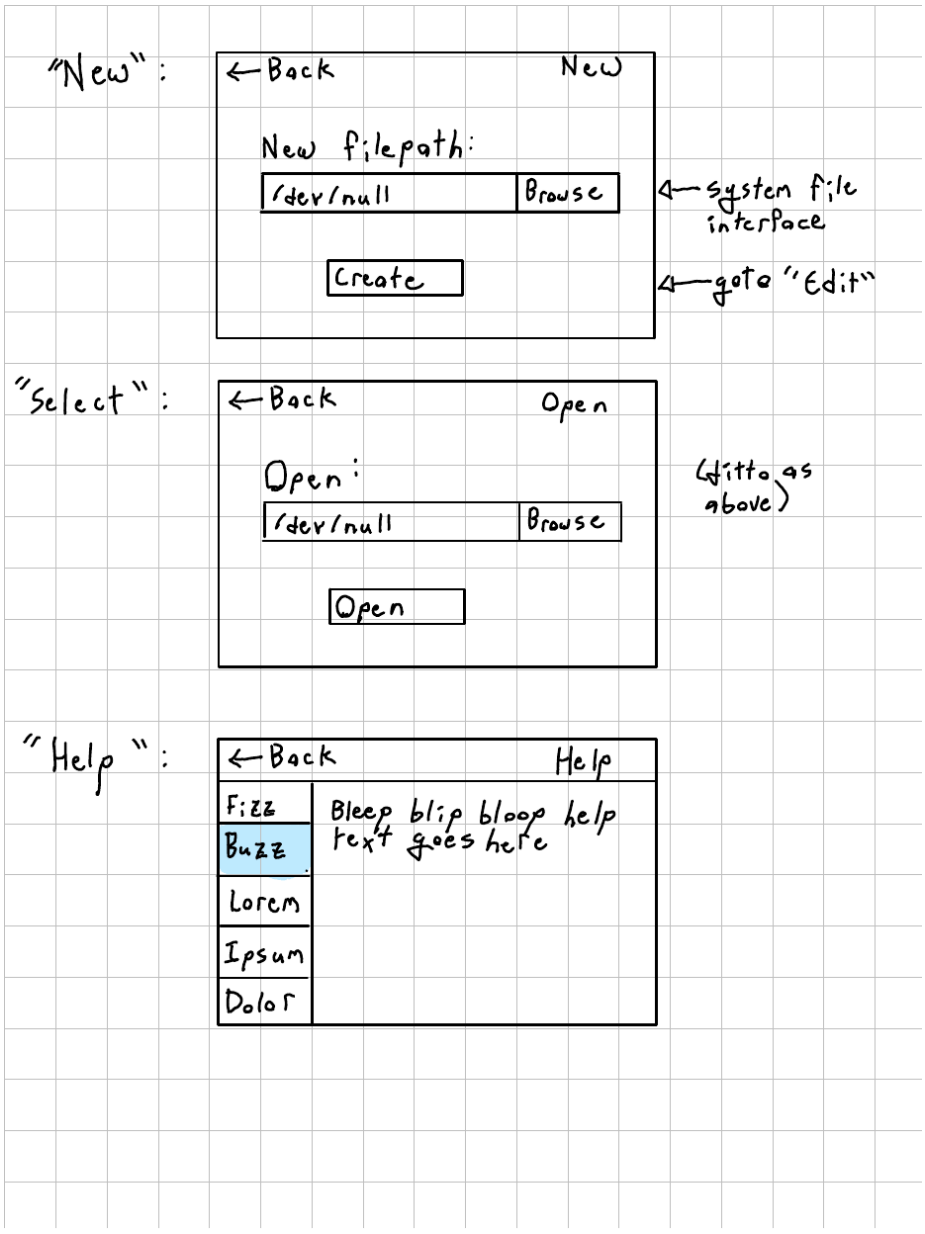
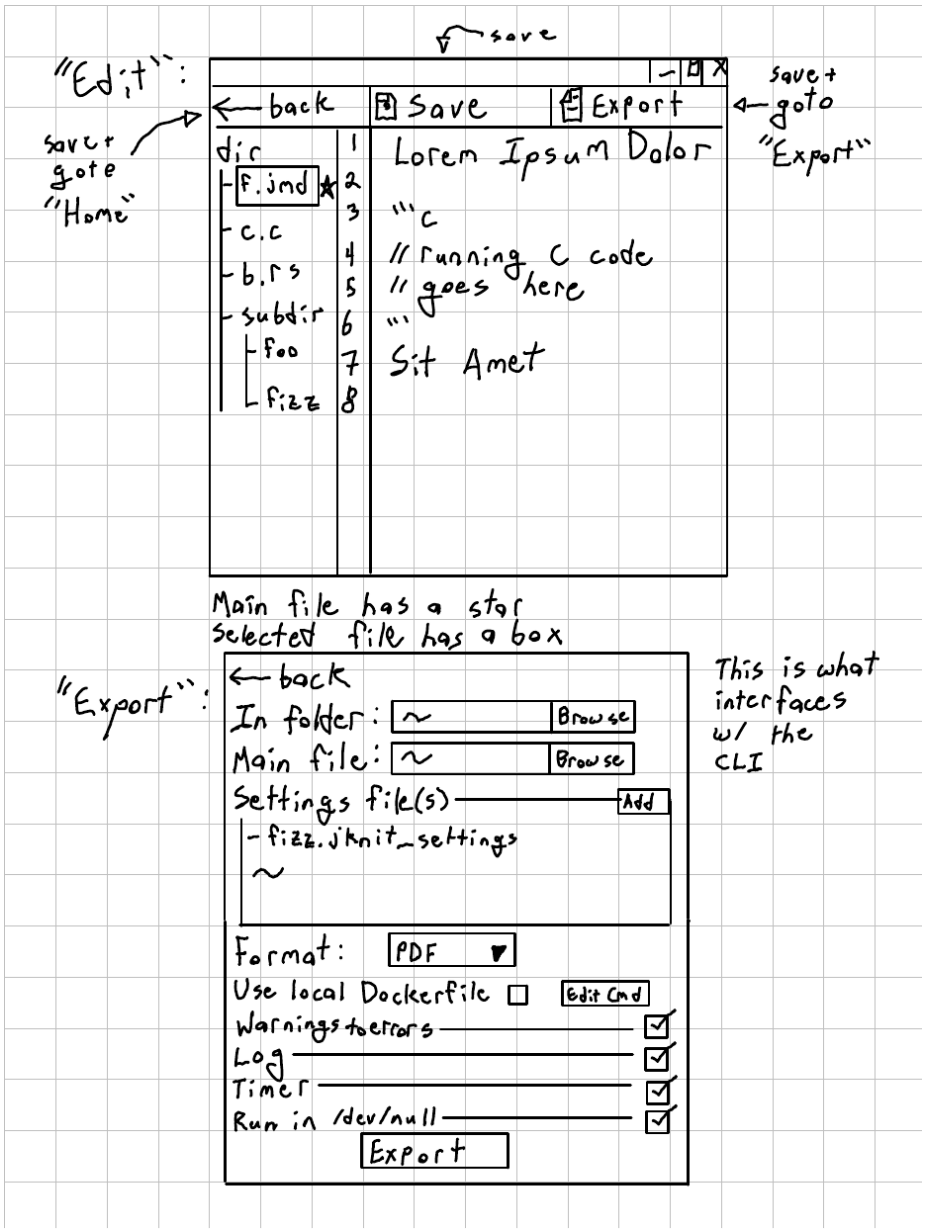
Export
Jordan Dehme 2025
UI design first draft
"Home":
JKnit
JKnit
New
Edit
Help
System dependant
goto "New"
goto "Select"
goto "Help"
Recent
/home/user/
/fizz/buzz/
If enough space to render
goto "Edit"


"New":
← Back
New
New filepath:
/dev/null
Browse
Create
← system file interface
← goto "Edit"
"Select":
← Back
Open
Open:
/dev/null
Browse
Open
(ditto as above)
"Help":
← Back
Help
Fizz
Buzz
Lorem
Ipsum
Dolor
Bleep blip bloop help text goes here



UI Test

Stakeholder Stories / Test Cases

1. "I am an intro to applied math student and I want to create a new document to edit, then a new file in the current document"
2. "I am an intro to applied math student and I want to find out what

the 'Dockerfile' option means in the export menu, then open an existing document named 'hello.jmd' "
3. "I am a teacher and I want to demonstrate how to create and export a document to `markdown` format in my class"

Measuring Success

1. Test case 1 will be considered a success if they are able to create a new document. It will be a partial success if they cannot create a new file. It will be a failure if they are not able to create a new document.
2. Test case 2 will be considered a success if they are able to navigate to the help menu, then to the 'Docker' menu. Then they should be able to navigate back to home and open an existing document. It will be a failure if they are unable to find help or to escape the help menu and open an existing document.
3. Test case 3 will be considered a success if they are able to create a new document, then successfully reach the `export` screen. It will be a partial success if they stop at this point, and a full success if they are able to change the default document type and export. It will be a failure if they are unable to create or export a document.

Experimental Design

- Only the vaguest follow-up questions will be asked after the fact so as not to retroactively influence their opinions

The following are both experimental design points and things I will say to the subject before beginning:

- I will ask them about their experience in CS and math, especially in writing reports
- I will have my paper design and simulate the computer
- I will instruct them to narrate their thoughts and actions, and I will simulate those actions
- I will give them a task that they will try to complete
- For text blocks and dropdowns that I have not detailed in my paper model, I will narrate what will be displayed.

Choosing A Subject

Test subject criteria:

- College student
- In a math / CS class (preferably applied math)
- **Not** an experienced CS person

Post-Test Reflection

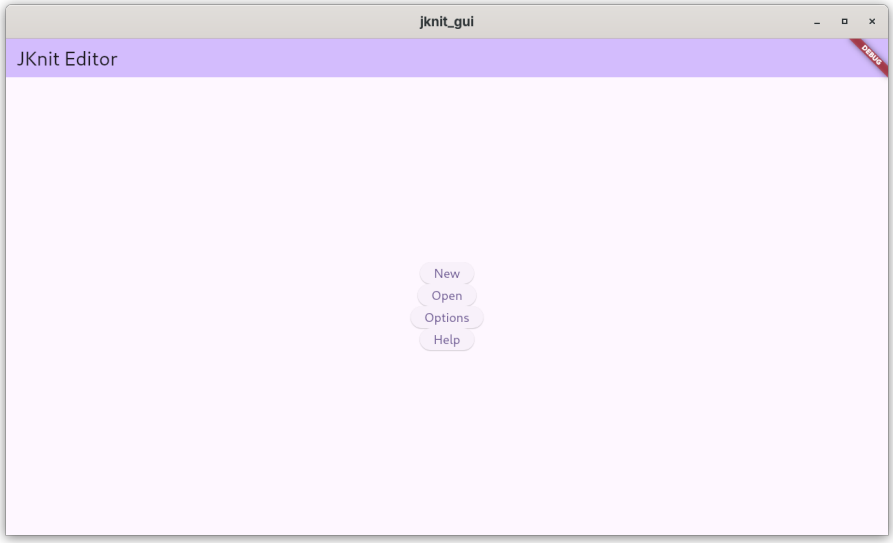
1. Task 1 was a partial success: She was able to create a new document, but there was no clear way to make a new file in that document's folder, and

she made a second document instead.
2. Task 2 was a success with notes. She found it unclear how to find help for a specific keyword, and suggested a search function. She was able to navigate back to the home menu and open an existing document, although she suggested different verbiage for the button doing so.
3. Task 3 was a partial success. She was able to create a new document and navigate to the export menu, but was unable to proceed without further direction. She found this menu overly technical.

The overall impression was that the app was overly technical and lacking in help. A search bar for keyword help and an "advanced settings" submenu would likely solve these problems. The menu's "edit" button should also say something more like "open", and the help menu should be more intuitive.

First Flutter Iteration

The first Flutter iteration was a proof-of-concept. The goal was not so much to make a *pretty* app, but to make a *functional* app. Accordingly, it is sparse and bland but functional.




jknit_gui
New Project
DEBUG
foo.jmd
Select file
Create Project

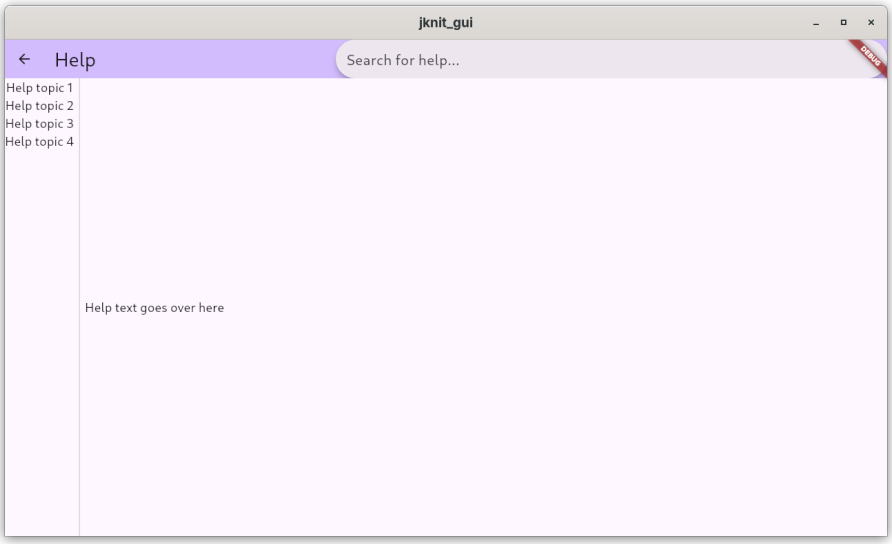

jknit_gui
Open Project
DEBUG
foo.jmd
Select file
Create Project

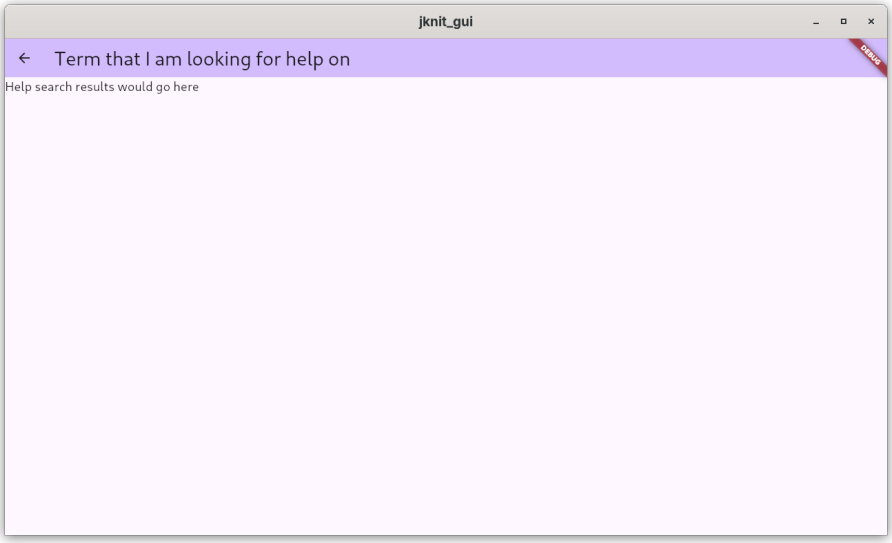

jknit_gui
JKnit Project Editor
DEBUG
Files go over here
Files go over here
Files go over here
Files go over here
Currently open file goes here
Export


jknit_gui
Export Document
DEBUG
Options
Export


jknit_gui
Options
DEBUG
Treat all Warnings as Errors
Enable Log
Enable Timer
Force Fancy Typesetting
Output File Type
LaTeX (.tex)


jknit_gui
Export ERROR
DEBUG
ERROR: Failed to open source ''
(knitting halted)
2





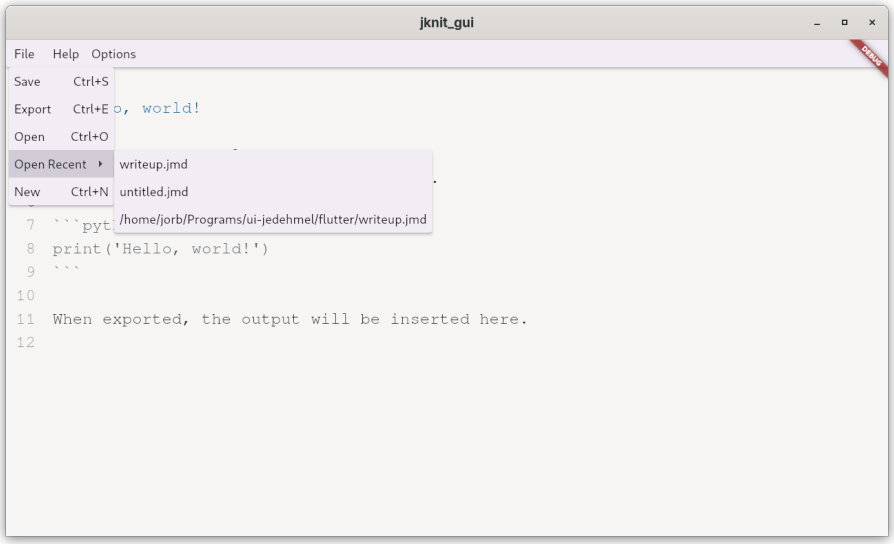
This is a good place to start, and more-or-less reflects the original paper design.

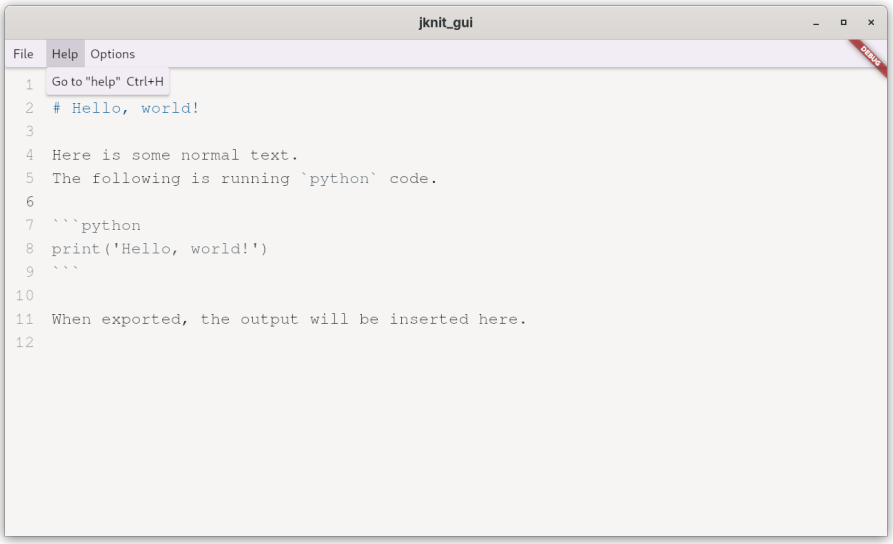
Design Choices Make on UI/UX Principles

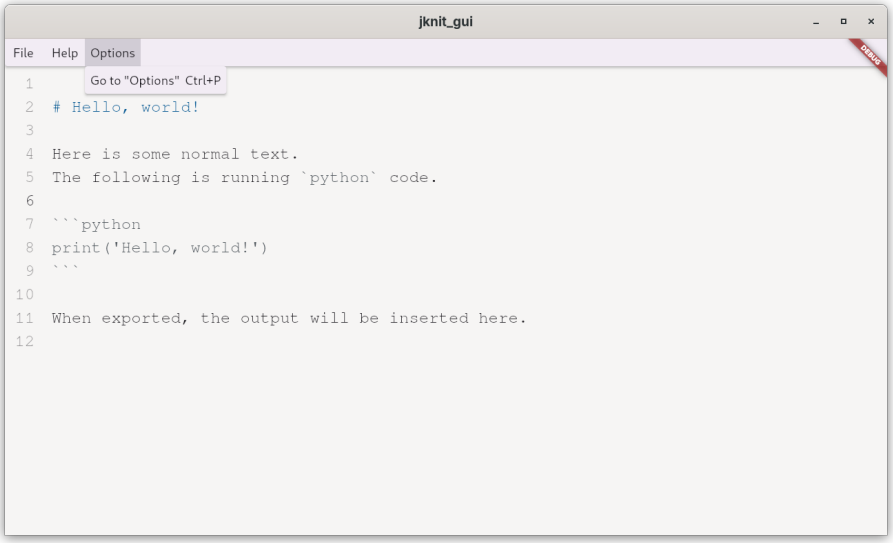
1. Removed home screen, replaced with most recent file editor
    - Users will not usually need this intro: It would only be helpful for first-time users
2. Replaced `New` and `Open` with system dialogues
    - They had previously only contained a button that opened the system

dialogues, and thus were redundant
    - This choice avoids an additional unnecessary step which might have confused or annoyed users
3. Removed initially proposed file bar on left-hand-side of editor
    - A `jmd` document is a single file, so I realized that it was not necessary to have a vscode-style file selector. A single file being open is fine
    - This eliminates wasted space on the screen and removes an opportunity for the user to be confused
4. Made the `Export` screen a pop-up dialogue
5. Centered options in the middle of the screen
6. Left-aligned option labels and right-aligned option toggles
7. Made export error/success a pop-up
8. Added system-style file bar at top of editor
9. Added traditional key bindings in editor
10. Added `recents` tray in editor
11. Added `View` option for exported Markdown documents

Final Product




jknit_gui
File
Help
Options
DEBUG
Go to "help" Ctrl+H
1 # Hello, world!
2
3 Here is some normal text.
4 The following is running `python` code.
5
6 ```python
7 print('Hello, world!')
8 ```
9
10 When exported, the output will be inserted here.
11
12


jknit_gui
File
Help
Options
DEBUG
Go to "Options" Ctrl+P
1 # Hello, world!
2
3 Here is some normal text.
4 The following is running `python` code.
5
6 ```python
7 print('Hello, world!')
8 ```
9
10 When exported, the output will be inserted here.
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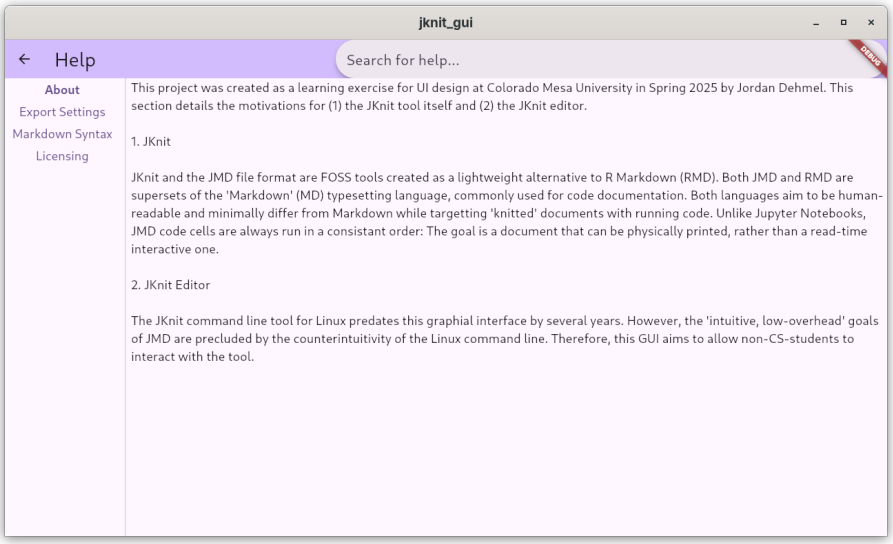
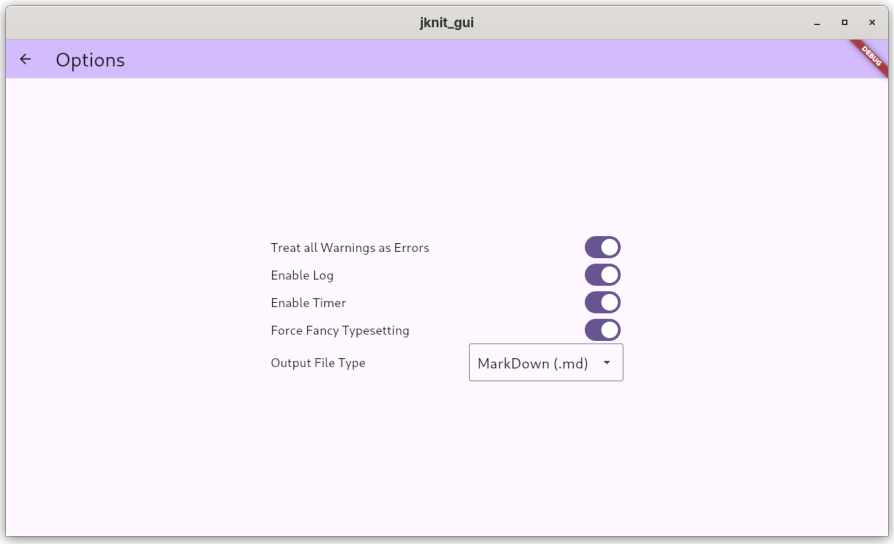
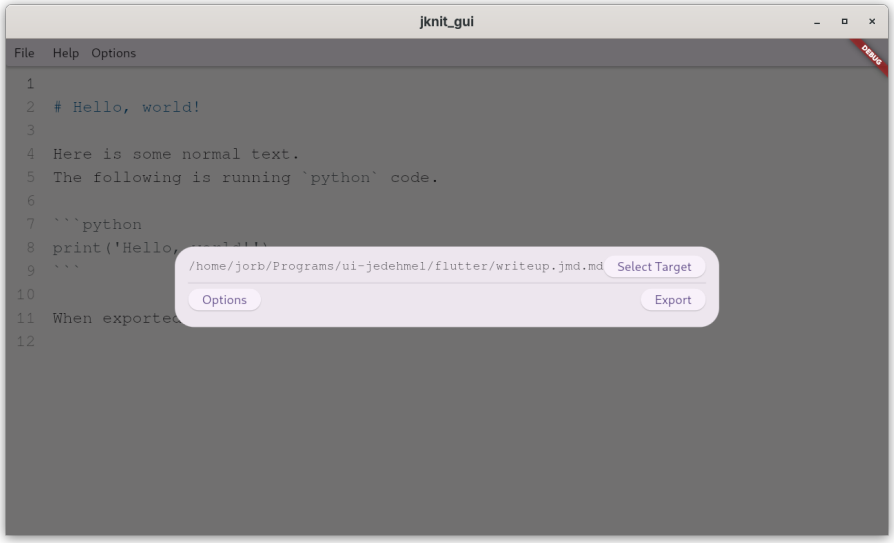
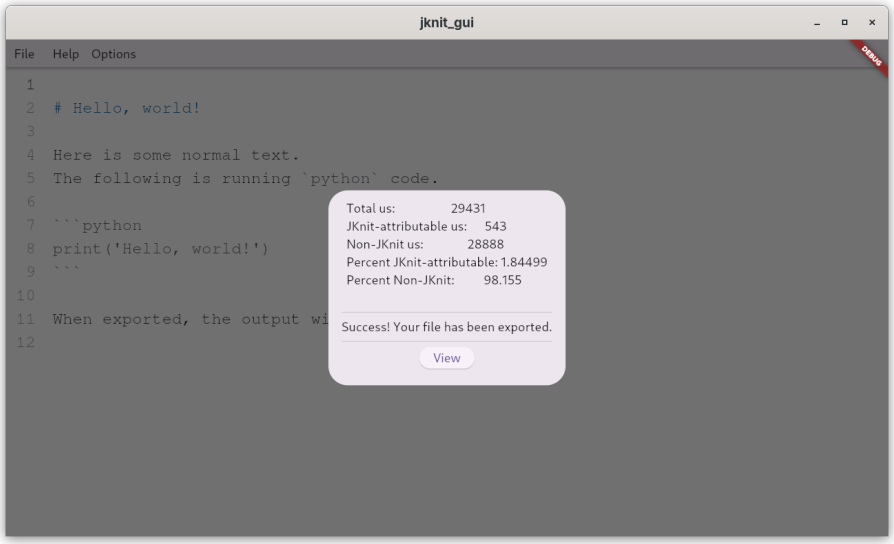

jknit_gui
Help
Search for help...
DEBUG
About
Export Settings
Markdown Syntax
Licensing
This project was created as a learning exercise for UI design at Colorado Mesa University in Spring 2025 by Jordan Dehmel. This section details the motivations for (1) the JKnit tool itself and (2) the JKnit editor.
1. JKnit
JKnit and the JMD file format are FOSS tools created as a lightweight alternative to R Markdown (RMD). Both JMD and RMD are supersets of the 'Markdown' (MD) typesetting language, commonly used for code documentation. Both languages aim to be human-readable and minimally differ from Markdown while targetting 'knitted' documents with running code. Unlike Jupyter Notebooks, JMD code cells are always run in a consistant order: The goal is a document that can be physically printed, rather than a read-time interactive one.
2. JKnit Editor
The JKnit command line tool for Linux predates this graphial interface by several years. However, the 'intuitive, low-overhead' goals of JMD are precluded by the counterintuitivity of the Linux command line. Therefore, this GUI aims to allow non-CS-students to interact with the tool.


jknit_gui
help
DEBUG
Markdown Syntax


jknit_gui
Options
DEBUG
Treat all Warnings as Errors
Enable Log
Enable Timer
Force Fancy Typesetting
Output File Type
MarkDown (.md)


jknit_gui
File
Help
Options
DEBUG
1
2 # Hello, world!
3
4 Here is some normal text.
5 The following is running `python` code.
6
7 ```python
8 print('Hello,
9 ```
10
11 When exported
12
/home/jorb/Programs/ui-jedehmel/flutter/writeup.jmd.md
Select Target
Options
Export



Final Unit Testing

```
jorb@archlinux ~/Programs/ui-jedehmel/flutter (dev)> flutter test --coverage
00:04 +1: All tests passed!
jorb@archlinux ~/Programs/ui-jedehmel/flutter (dev)>
```

Conclusion / Reflection

The final GUI successfully interfaces w/ the CLI, avoids bloat to the extent allowed by Dart/Flutter, is FOSS, and tries to be intuitive for those who do not have CLI experience. It reflects the design decisions taken by existing players in the IDE industry, especially the Visual Studio family of editors. It is easy to install to the extent that Dart/Flutter allows, although Windows operation would be notably impaired by that platform's lack of built-in compilers and interpreters.

The following user stories (including the third test case from the UX test) are achievable in the final product.

1. "I need to write a report for my math class"
2. "I need to modify and export a JMD file someone sent me"
3. "I need to quickly explain this software to my students"
4. "I am a teacher and I want to demonstrate how to create and export a document to `markdown` format in my class"

The first and second boil down to UI design choices: I have tried to make actions like opening, modifying, and exporting as easy as possible. These actions also mirror the precedent for IDEs / text editors, so they shouldn't be difficult for beginners. The third and fourth are explainability limits, and I have tried to keep the design explainable and familiar.

The following two user stories from the UX test were obsoleted after revisions.

1. "I am an intro to applied math student and I want to create a new document to edit, then a new file in the current document"
2. "I am an intro to applied math student and I want to find out what the 'Dockerfile' option means in the export menu, then open an existing document named 'hello.jmd' "

The first was obsoleted because I decided allowing the user to have multiple files in a single document was unnecessarily confusing (reflected in the failure of this test case during UX testing). The second was partially obsoleted, since I did not end up implementing a `Dockerfile` option. However, the underlying principal of looking up help, as well as the clause about opening an existing document, remain valid.

There remain several unfulfilled "strech goals": The aforementioned `Dockerfile` option would add usability and portability (or at least centralize the software dependencies) by allowing users to use containerized environments. Additionally, the unit testing for the project had to be fully restarted after a major design overhaul and thus is not fully-fledged: More rigorous unit testing (and perhaps a coverage report) would allow more confidence in the software.