

Underleaf

By: Joshua Kao, Chris Lal, Harrison & Benjamin Getches

Project Description: [ReadMe](#)

UnderLeaf is a modern, web-based LaTeX editor designed to enhance collaborative mathematics and academic writing. Created by a team of four students from the University of Colorado Boulder, UnderLeaf aims to eliminate barriers to higher education by leveraging innovative technologies and seamless user experiences.

Key features of UnderLeaf include a real-time LaTeX editor with smart templates for common document types like math homework, research papers, and presentations. The platform incorporates AI-powered tools such as a LaTeX Assistant, handwriting recognition for math conversions, and text or photo-to-LaTeX capabilities, making it accessible to users of all technical skill levels.

Collaboration is at the heart of UnderLeaf, allowing users to share notes, join communities, and manage class groups with permissions. Teachers can create announcements and assignments, while friends can connect to co-author documents in real-time. With responsive design and intuitive interfaces, the platform is optimized for both desktop and mobile use.

UnderLeaf is powered by technologies like Handlebars.js, Bootstrap, PostgreSQL, and the OpenAI API. It also ensures security with password hashing, authentication, and secure password resets. Visit the live application at underleaf.onrender.com to experience this innovative tool that bridges academic collaboration and cutting-edge technology

Project Tracker: <https://github.com/users/benjamingetches/projects/1/views/1>

The screenshot shows a project board titled "UnderLeaf Project Board". It is organized into four columns: "IceBox", "Todo", "In Progress", and "Done".

- IceBox:** Contains items like "UnderLeaf #13 Latex strings-> Database, Stored file" and "UnderLeaf #12 Prediction->LaTeX Parser".
- Todo:** Contains items like "UnderLeaf #46 dark mode toggle" and "Draft edit favicon (crop circular)".
- In Progress:** Contains items like "UnderLeaf #16 Styling overhaul" and "Draft rate limit/premium?".
- Done:** Contains items like "UnderLeaf #28 Implementing more of a User Interface with Notes page" and "UnderLeaf #31 Share button & Notes Page progression".

Each item card includes a title, description, status icon, assignee, and a link to the GitHub issue.

DEMO VIDEO: Attached at bottom of document.

VCS: <https://github.com/benjamingetches/UnderLeaf>

Contributions

- A brief (not more than 100 words) from each team member about their contributions.
 - This should include the technologies worked on
 - Features that have contributed to
- You can also include:
 - A screenshot of the project Board
 - A screenshot of the contributions on GitHub

Harrison

My major contributions to this project revolved around the editor page, note sharing and concurrent editing, writing some of the external API calls and lots of internal API routing, as well as in-line AI editing. To accomplish these I utilized a handful of technologies, including using and expanding upon `latex.js`, which is a package that aids in converting LaTeX to HTML, and using `CodeMirror` to implement a real-time editor with syntax highlighting. I had to modify these packages, and write macros to pass context through to the OpenAI API and allow for in-line AI edits.

Chris

My main contribution during this assignment was working heavily on the notes page with the UI, sharing, adding, deleting, and storing a note. Also focused on the friends page creating a friends database, working on the sending/accepting friend requests and overall UI of the page.

Additionally, Harrison and I worked on adding packages with the OpenAI APIs where I found the idea of using a similar OpenAI API however redirecting the prompt to convert English to Latex rather than assisting/scanning Latex writing. Also contributed to the templates page where I created the base structuring/layout of the page.

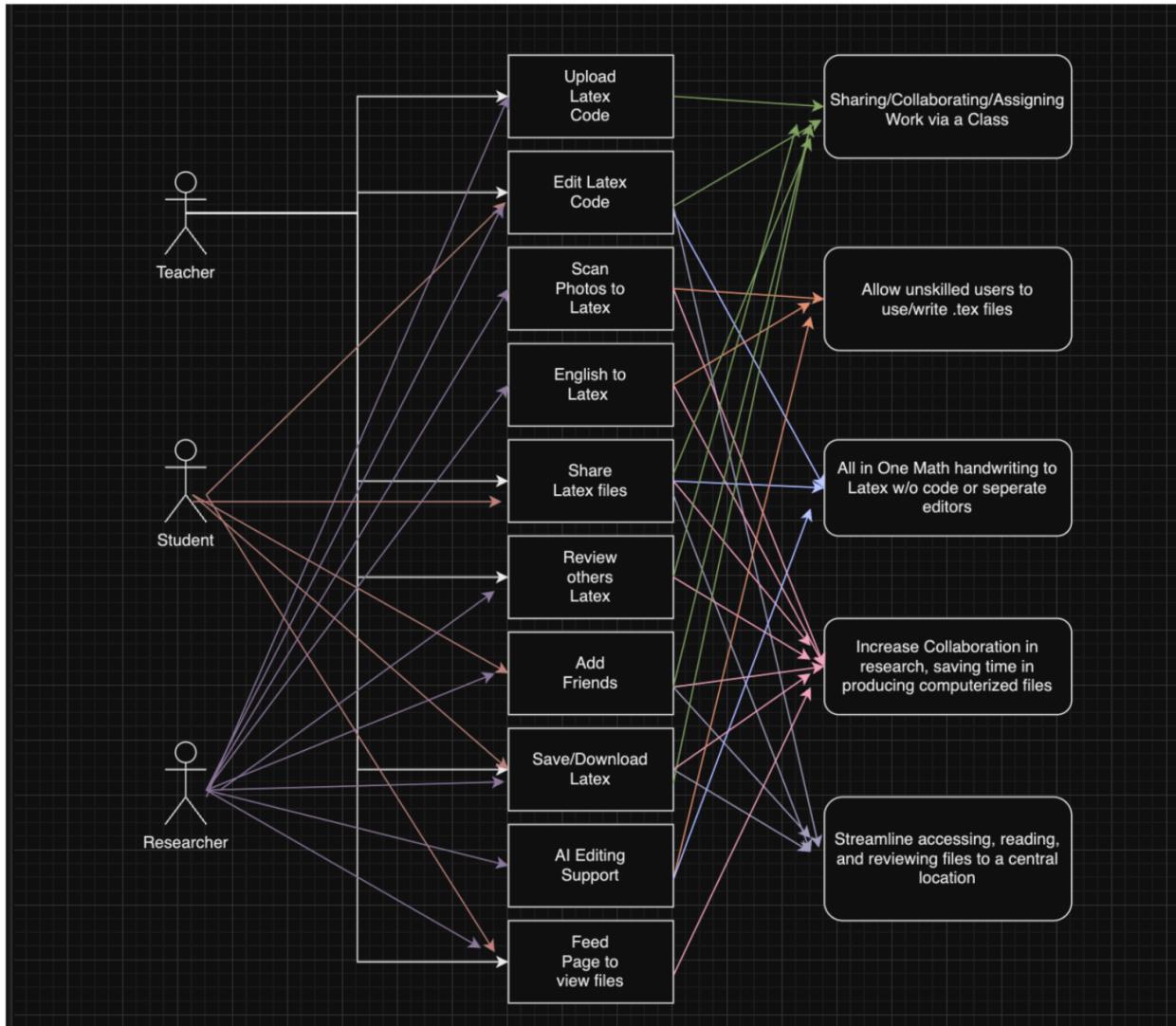
Ben

My main focuses on this projects were surrounding the scanning page, storing and saving those notes, the nav bar, the notifications, forgot passwords (using nodemailer and tokens), as well as the credits/rate limiting features. In addition, I worked on the communities portal, and the unique community views, including user and admin views. I also helped write SQL and route calls with other team members, as some of the work we did in pairs. A big chunk of my work won't be seen, as it was spent building CNNs for character recognition, that we ended up scrapping. That being said, those files are dumped in discord in case anyone cares.

Josh

My main contribution to underleaf was a lot of the database for communities and friends, community page development and unique community page development that allows collaboration between individuals and groups. I also did a password strength feature for more security. Outside of the software I did a lot of branding for the project making the name, logo, and choosing the color theme for the project. For the community pages I worked to get a lot of the bulk of the features out of the way, working on all the HTML and the endpoints in the NodeJs file, and designing the database for the pages in SQL. While Ben helped me a lot with polishing the community pages, fixing bugs, and adding even more features.

Use Case Diagram:



Wireframes:

See Below for Wireframes of different pages

Test results:

In the testing phase, we evaluated four key use cases—public note discovery, community notes, LLM-provided content, and collaborative editing—by inviting students from other classes who were not involved in development to provide objective feedback. Each participant was asked to perform specific actions, such as adding friends and collaborating on notes, establishing a class and assigning work to them, testing their own math with our AI features, and editing a shared note in real time. Their actions and reasoning were recorded, and any deviations from expected behavior were noted. As a result, we identified areas where the interface could be more intuitive. For instance, after

observing that users struggled to locate the share permissions panel, we updated the navigation to highlight collaboration features more clearly. Similarly, the in-line AI editing feature was unclear on what user content was being submitted through to the LLM. We improved the UI, and made a simpler interface that helped users understand what they were asking for help on. Re-running the tests with these refinements confirmed that participants experienced fewer issues, demonstrating that the adjustments improved usability and aligned user behavior more closely with our intended use cases. We also performed extensive testing on each other's features- including but not limited to- prompt injection, XSS, SQL injections, on top of standard use-case testing. We also automated tests on simpler features, like account management and friend requests, but the limited timeframe of the project, and the large scope of some of our features made writing certain tests extremely complicated.

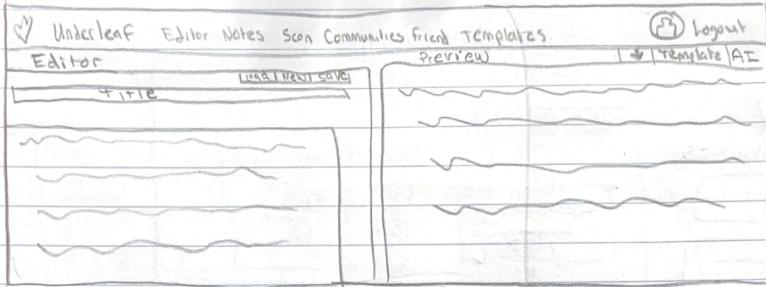
Deployment: Deployed On Render

underleaf.onrender.com

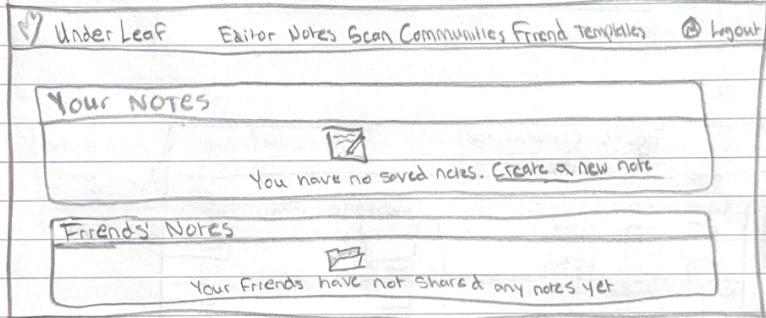
Wireframes for: Editor, Notes, & Scan Page

WIRE Frames For UnderLeaf

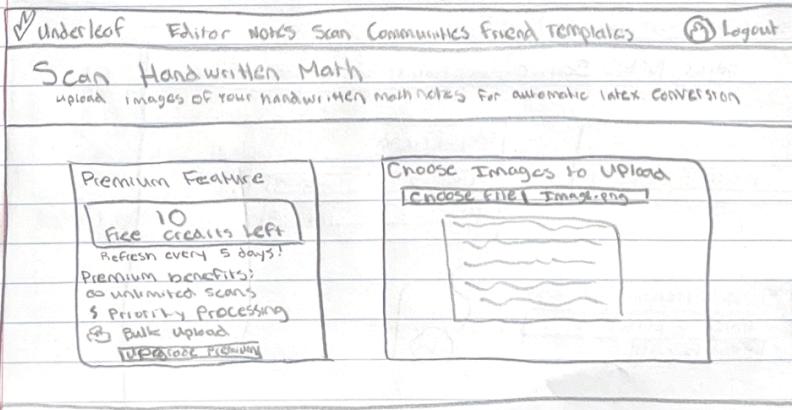
Editor Page



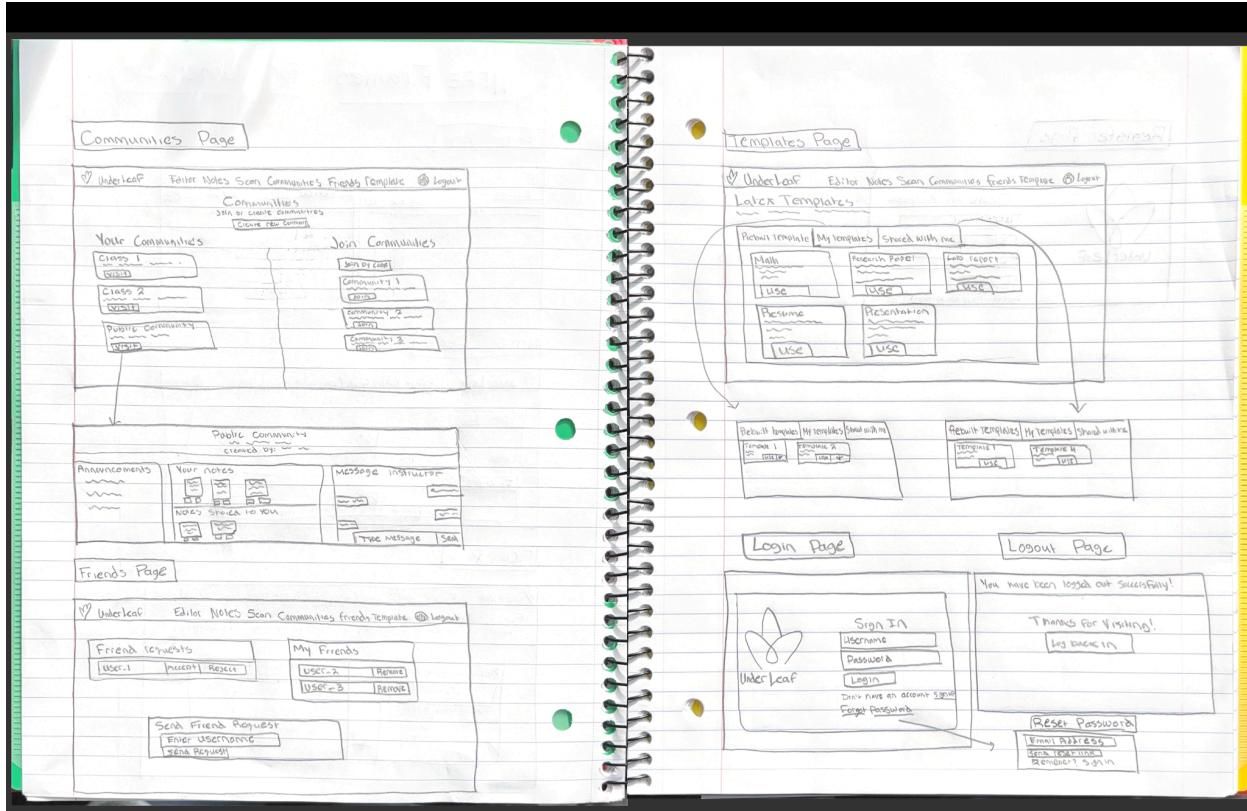
Notes Page



Scan Page



Wireframes for: Communities, Friends, Templates, Login & Logout Page



Wireframes for: Register Page

