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SCUdent Books: A University-Focused Bookselling Platform

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SANTA CLARA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Date: June 15, 2017

I HEREBY RECOMMEND THAT THE PROJECT PREPARED UNDER MY SUPERVISION
BY

Winston Chang

Christina Ciardella

Renee Prescilla

ENTITLED

SCUdent Books: A University-Focused Bookselling Platform

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

COMPUTER SCIENCE AND ENGINEERING



Advisor



Department Chair

SCUdent Books: A University-Focused Bookselling Platform

by

Winston Chang

Christina Ciardella

Renee Prescilla

Submitted in partial fulfillment of the requirements
for the degree of

Bachelor of Science in Computer Science and Engineering
and
Bachelor of Science in Web Design and Engineering

School of Engineering
Santa Clara University

Santa Clara, California
June 15, 2017

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Chapter 1

Introduction

1.1 Motivation

As the beginning of each university semester or quarter commences, so does the rush to acquire books for classes. The search for school books is a busy and important task for many students. However, an entire slew of problems and frustrations emerge with this academic race to gather books. To begin, students have to deal with the traditional frustrations of expensive textbooks sold at the university bookstore which is especially troublesome for those on a tight budget. Additionally, required textbooks for classes may not be available at the bookstore or require restocking which can take an unknown amount of time. Because of this, students turn to cheaper, faster, and more efficient alternatives for acquiring school books including online retailers such as Amazon or Barnes and Noble.

While the Internet makes book shopping appear easier, there exist issues that come with it. Students have to put in more effort ordering online, pay for extra shipping, and wait for their books to arrive. Also, online shopping for books is incredibly decentralized with no convenient platform to cater to students' needs. Students must first spend time finding out which books are required for each class and then spend even more time comparing prices from multiple online retailers. In addition, once a student completes a class he or she may no longer need the book. As a result, the student has no convenient method of disposing the book and must now sell it, throw it away, or keep it. Overall, the process of acquiring books in university is disorganized, stressful, and inconvenient for students.

1.2 Solution

In order to make the book shopping process easier, we chose to create a website where students in the same campus can purchase and swap books with each other, using Santa Clara University as

its initial campus. If a student needs to buy a book for a class, there is a likely chance that other students who have just completed that class still have that book. Students can post pictures of their books and add important information to their posts, such as an asking price, the condition of the book, the class the book was used in, and the student's location on or near campus. Students can also now conveniently learn what books they need and search for them on the website by looking up the book or class number. Class information will be prepopulated in the website database. If a student wants to buy a book from another student, the two can communicate through the website and conveniently arrange to meet on campus to perform the exchange in person. Additionally, the website will be optimized for both desktop and mobile platforms which will provide students convenient access to it at all times.

Our solution removes the hassles that come with the race to acquire school books. Students are no longer burdened with the costly prices of textbooks sold in the university bookstore as the site will provide cheaper alternatives for obtaining books. In addition, there is now a proper centralized system for students to acquire or sell books as they can be exchanged for little to no cost, sold, or given to the exact demographic that needs it at any time. Students looking for books do not have to worry about shipping or ordering online. Not only does this website connect students directly, but it also fosters a sense of community through students meeting with each other in person. Students can share information about the classes the books are about and may find students in the same department or with similar interests. Overall, we want to optimize convenience, cost, and efficiency for all when it comes to obtaining textbooks, and we believe our solution achieves this goal while fostering goodwill among students.

Chapter 2

Requirements

In order to create a good design, we needed to create requirements that our system would follow. As university students who would use this system, we based these requirements on what we wanted to find in a good solution.

We created functional requirements, non-functional requirements, and design constraints. We further categorized the two requirement sections into critical, recommended, and suggested requirements. Critical requirements are mandatory for us to have in our system. Recommended requirements would be beneficial but are not necessary for the system to function.

2.1 Functional Requirements

The system will...

Critical	Recommended
Provide a secure login, account, and user authentication for students	Auto-populate class and required book information to student accounts
Provide a way for students to search, buy, sell, and exchange books as well as remove old book listings	When listing a book to sell, have a recommended price/compare prices feature; prices come from other online stores
Provide a way for students to contact each other	Ability to restore previously listed books
Support usage by multiple users simultaneously	Have an optional filter to hide books with "Business in Progress" tag from Search Results

Table 2.1: Functional Requirements

2.2 Non-Functional Requirements

The system will be...

Critical	Recommended
Responsive for any screen resolution (laptop/mobile/desktop)	Easy to maintain and deployable to other universities for use
Intuitive and straightforward UI	

Table 2.2: Non-Functional Requirements

2.3 Design Constraints

- The system must be web-based
- The system must work on computers and smartphones, specifically on Firefox, Google Chrome, Internet Explorer, and Safari
- The system cannot process online transactions through the site

Chapter 3

Use Cases

The Use Case Diagrams depict the required actions users must take in order to use our system correctly. Note that every diagram immediately follows each use case description.

3.1 Use Case 1: Buying/Swapping a Book

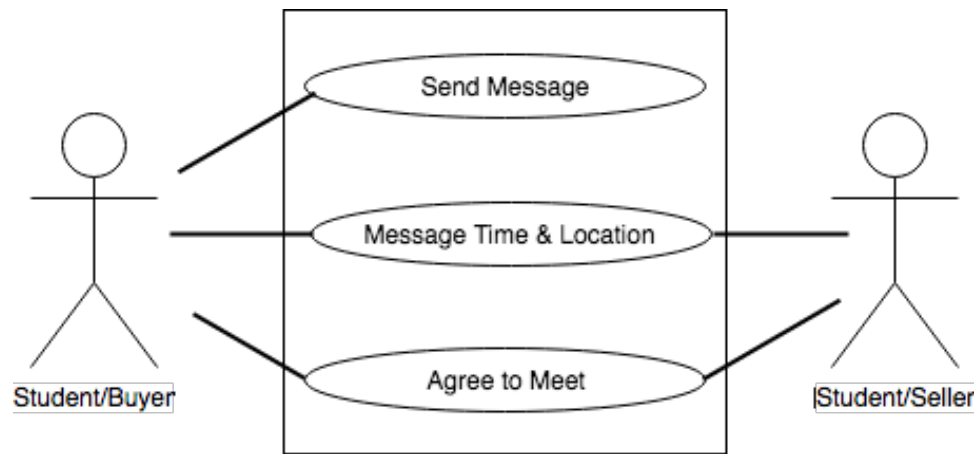


Figure 3.1: Use Case 1 Diagram

Goal: Get in touch with other student to arrange a meeting time and location.

Actor(s): Students (Buyer and Seller)

Precondition(s):

1. Students must have created an account on the website.

Step(s):

1. Student/buyer finds a book they need and sends a message to the seller asking for the book.

2. Selling student agrees to give book to buyer.
3. Both students send messages to each other via an on-site messaging system to provide potential meeting times. They soon agree on a date, time, and location to meet and follow through with the transaction.

Postcondition(s):

1. Seller deletes book listing from his/her account; therefore, the book does not appear as a search result anymore.

Exceptions(s): N/A

3.2 Use Case 2: List Books

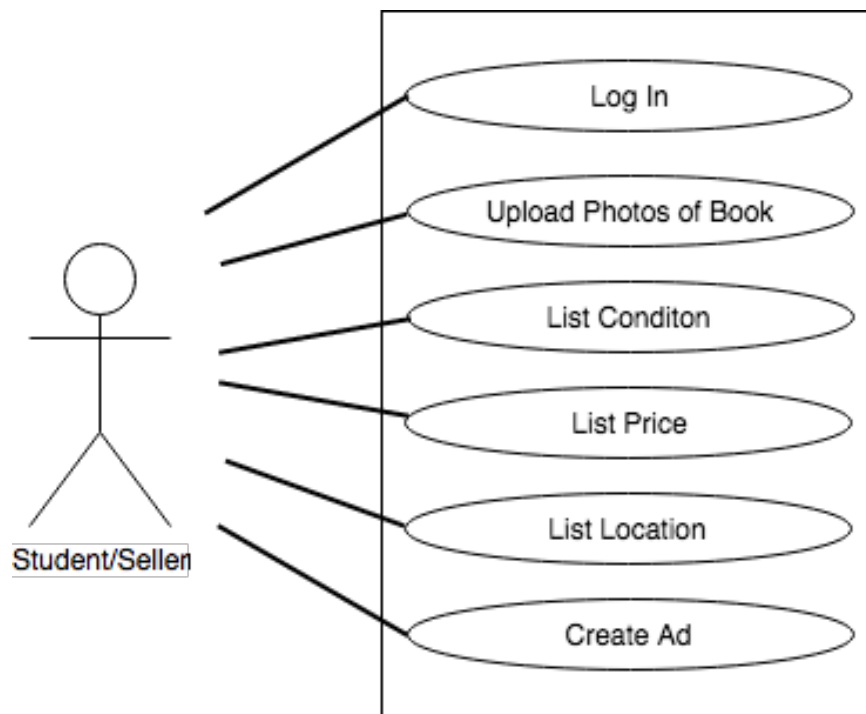


Figure 3.2: Use Case 2 Diagram

Goal: Post information about a textbook for sale on the website

Actor(s): Student (Seller)

Precondition(s):

1. Student must have already made an account on the website.

Step(s):

1. Student logs in to his/her account
2. Student takes photos of the textbook to post online
3. Must add information on the book's condition
4. Give an asking price
5. List book's general location
6. Finish creating the listing

Postcondition(s):

1. An ad for the textbook will be made and appear on the website's search results.

Exceptions(s): N/A

3.3 Use Case 3: Edit Listing

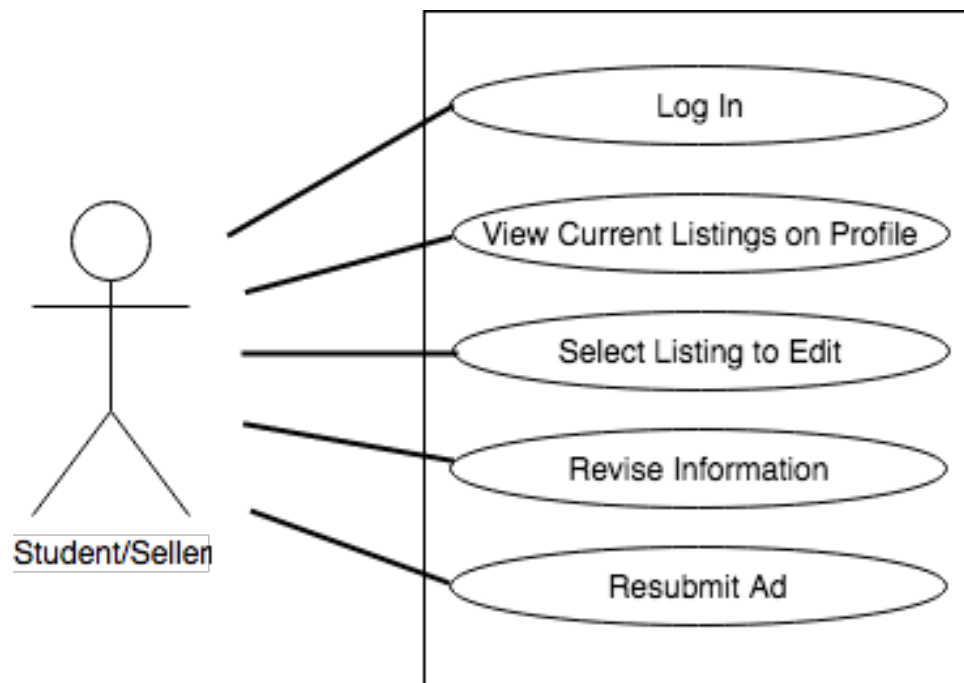


Figure 3.3: Use Case 3 Diagram

Goal: Make changes to a previously posted listing

Actor(s): Student (Seller)

Precondition(s):

1. Student must have already listed a book on the website.

Step(s):

1. Student logs in to his/her account
2. Access all current listings
3. Select particular ad in question
4. Make changes to listing information
5. Resubmit ad

Postcondition(s):

1. Information on ad will be updated with seller's changes.

Exceptions(s): N/A

Chapter 4

Activity Diagram

An activity diagram is a flowchart that shows the dynamics of a system for each type of user interacting with it. We created two activity diagrams for both student buyers and student sellers, seen in Figure 4.1 and Figure 4.2 on the next pages.

4.1 Student Buyer

The student buyer will first login as a user on the website. He or she can search or browse from the available collection of books for a book to purchase or exchange. The buyer will most likely continue to search or browse for books until he or she has found the desired book. Once it has been located, the buyer can message the owner of the book to show his or her interest in purchasing or exchanging the book. Alternatively, upon being logged in, the buyer can instantly message the owner of the book through locating him or her on the site or from a list of previously messaged posts or receiving a response from him or her by notification and replying to it. After messaging the owner, he or she can continue looking for books. Once the buyer no longer desires to perform any kind of task on the website, he or she can logout.

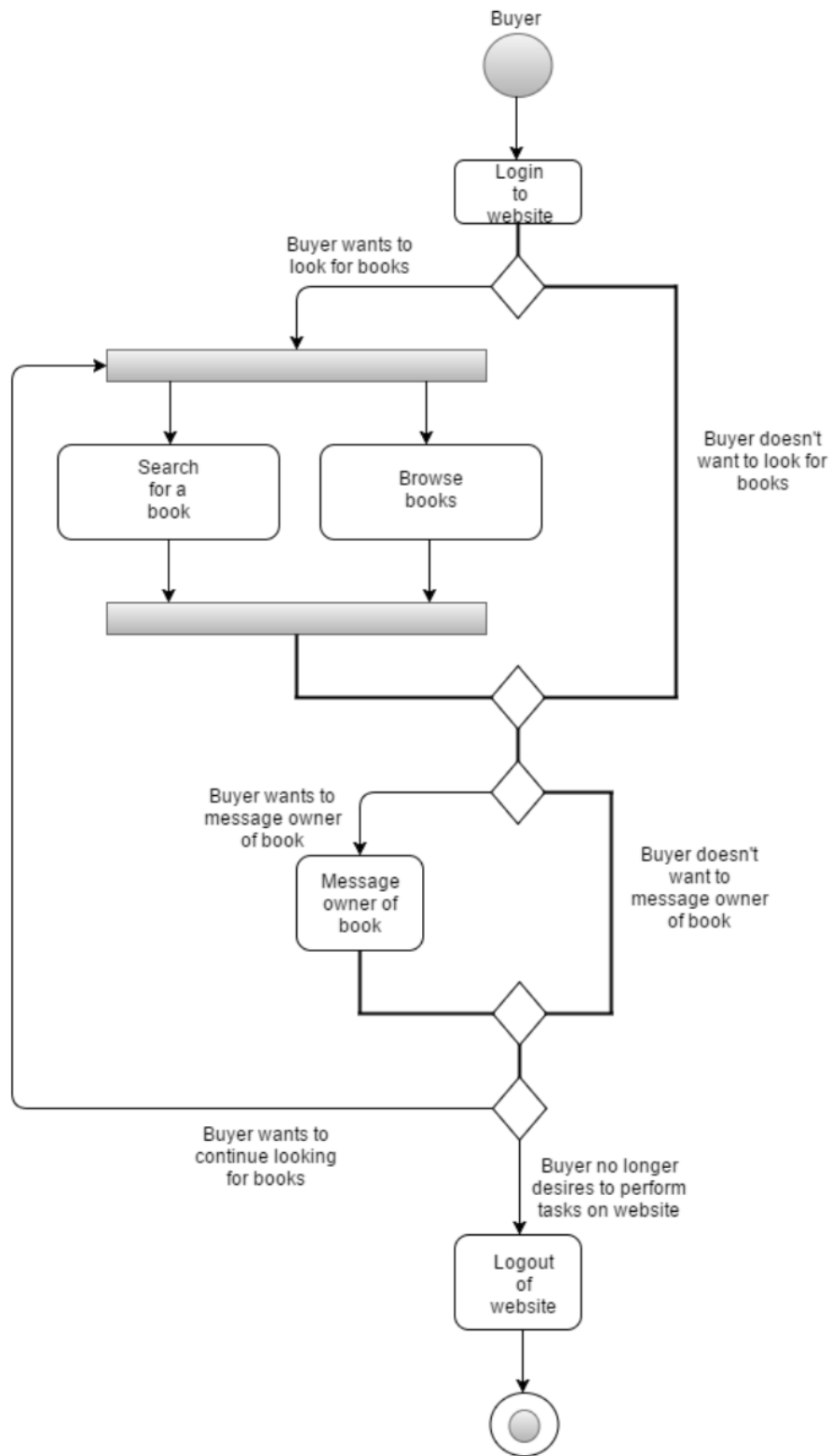


Figure 4.1: Activity Diagram for Student Buyer

4.2 Student Seller

The student seller will first login as a user on the website. He or she can create posts of books for sale or exchange, edit or remove posts, or check messages and notifications at his or her discretion upon logging in. If the seller wants to sell or exchange a book, he or she will first create a post of it which can be edited or removed any time. Next, he or she will check his or her messages and notifications for an interested buyer. After receiving a message from a buyer, the seller can reply to him or her. If the transaction is incomplete or still ongoing, the seller will continue to message the buyer to arrange the transaction. If the transaction is complete, the seller will remove the book post to indicate that he or she no longer possesses it. Otherwise, if a transaction has been cancelled, the seller will wait for a message from another interested buyer. After removing a post, the seller can post more books for sale or exchange, edit or remove other posts, or check messages and notifications. Once the seller no longer desires to perform any kind of task on the website, he or she can logout.

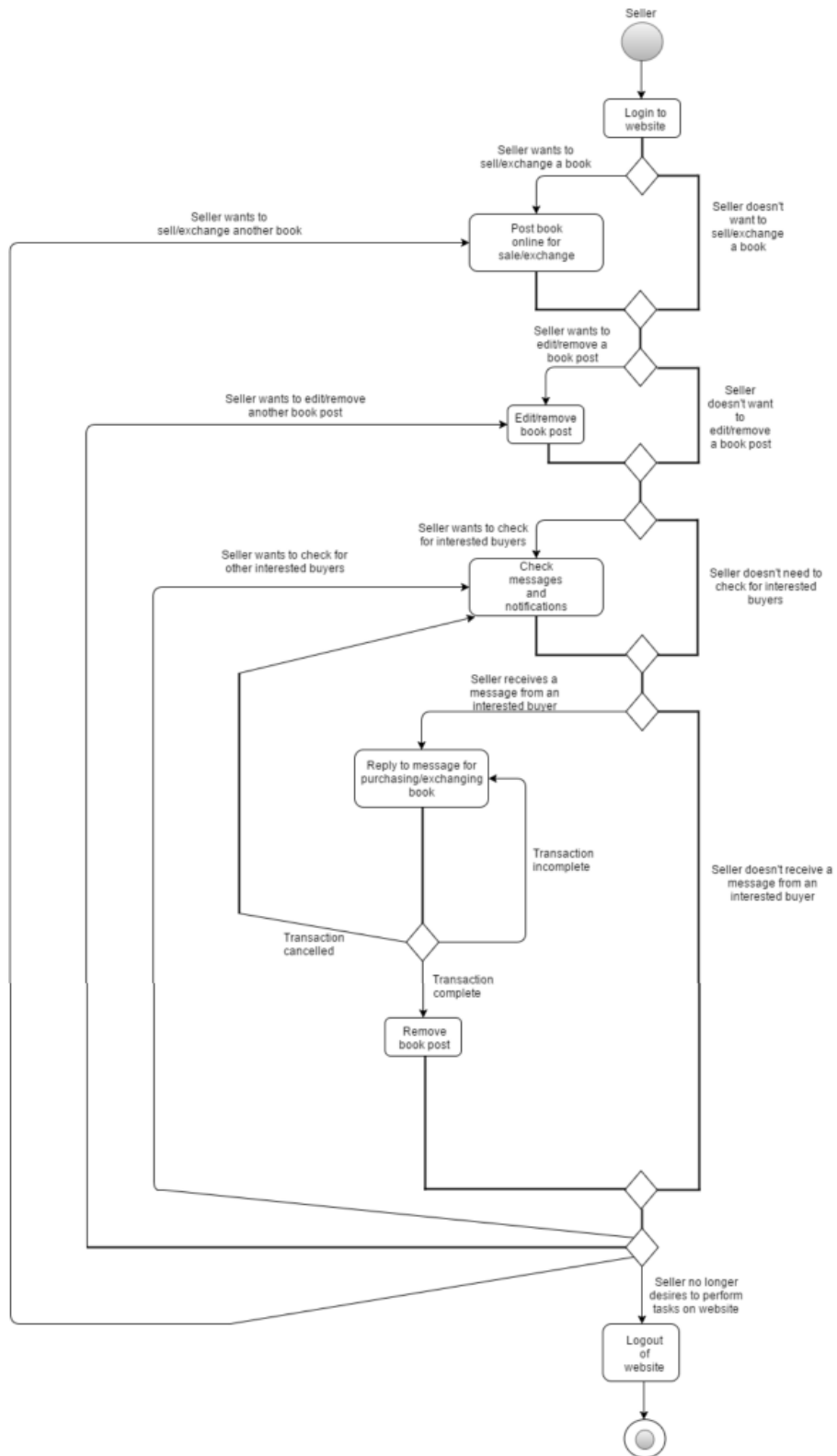


Figure 4.2: Activity Diagram for Student Seller

Chapter 5

Project Design

5.1 Initial Wireframes

Before implementing our project, we first created a series of wireframes. Our wireframes showed the interfaces the users of the system would interact with. Based on our requirements, user cases, and activity diagrams, our web application would have many different types of pages and functions, so we created full wireframes of most of our major pages. These included pages for logging in, the home page, search pages, product pages, message pages, and user profiles.

Figure 5.1 is one of the several wireframes that we created. This wireframe was for the homepage of our website. This is the first page users see when they log in, which has a section for the newest books and a section to browse through books by certain categories. This page also demonstrates several parts of our website design: the main navigation bar, message notifications, and the list of books for sale. The main navigation displays search functionality and links to post a book, view messages, and each user's username. When hovering over the username, a dropdown menu will appear to enable users to click to edit their profile or view their current books. Message notifications will appear at the top of the page until they are clicked. Each book is listed with a photo of the book, appropriate information, and a buy/swap button.

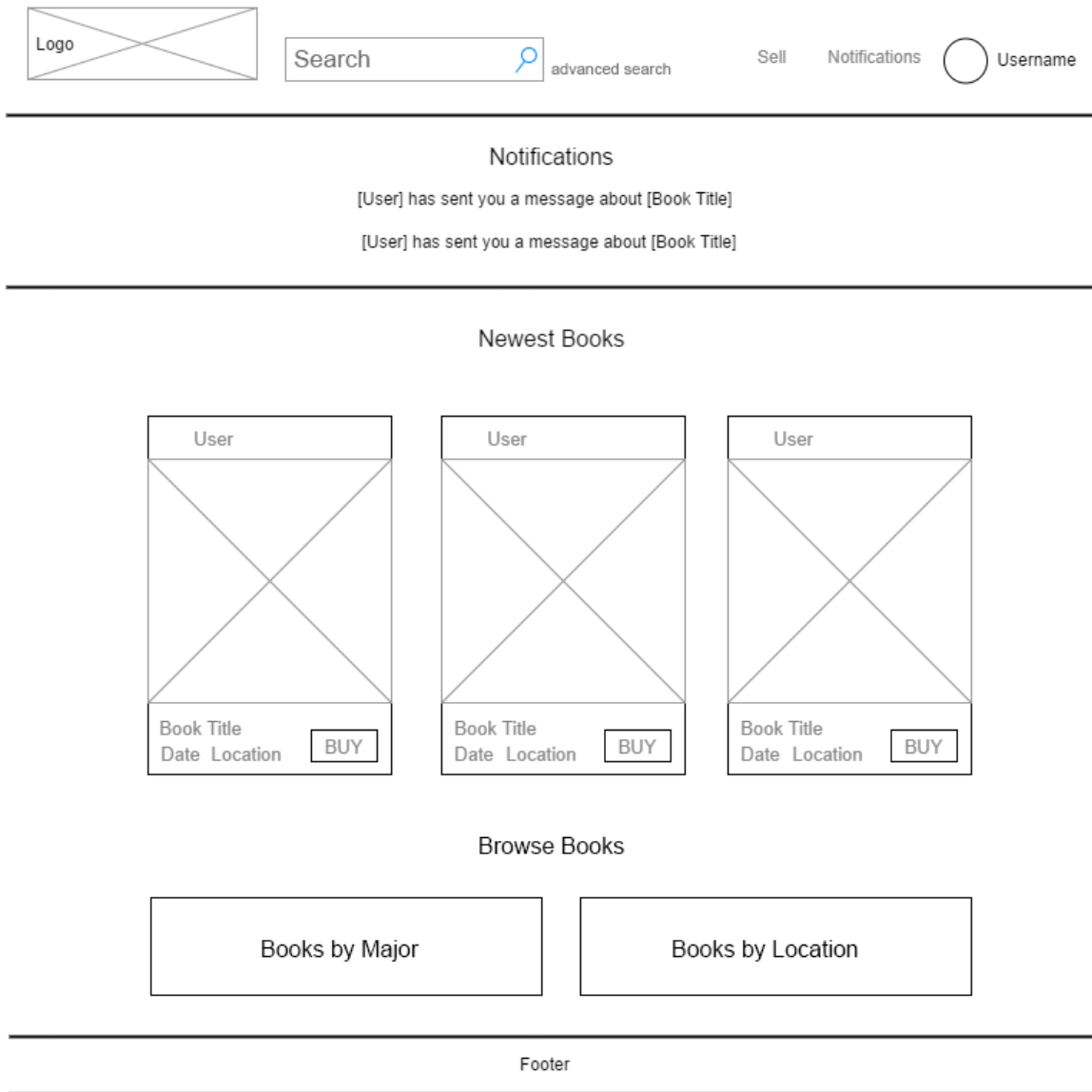


Figure 5.1: Home Page Wireframe

5.2 Final Design

Our final design of SCUdent Books follows our initial wireframes and can execute many of our planned functions for the website. We also implemented additional pages for users to use that we did not sketch initially, but used similar elements from previous wireframes. Here, we will show our completed project and demonstrate how users will go through SCUdent Books.

Once users go to our website, the first thing they see is the homepage, as seen in Figure 5.2 and Figure 5.3. The pages contain the same elements from our initial wireframe. If a user is not logged in or is new to the website, their homepage has a promotional banner and links to register

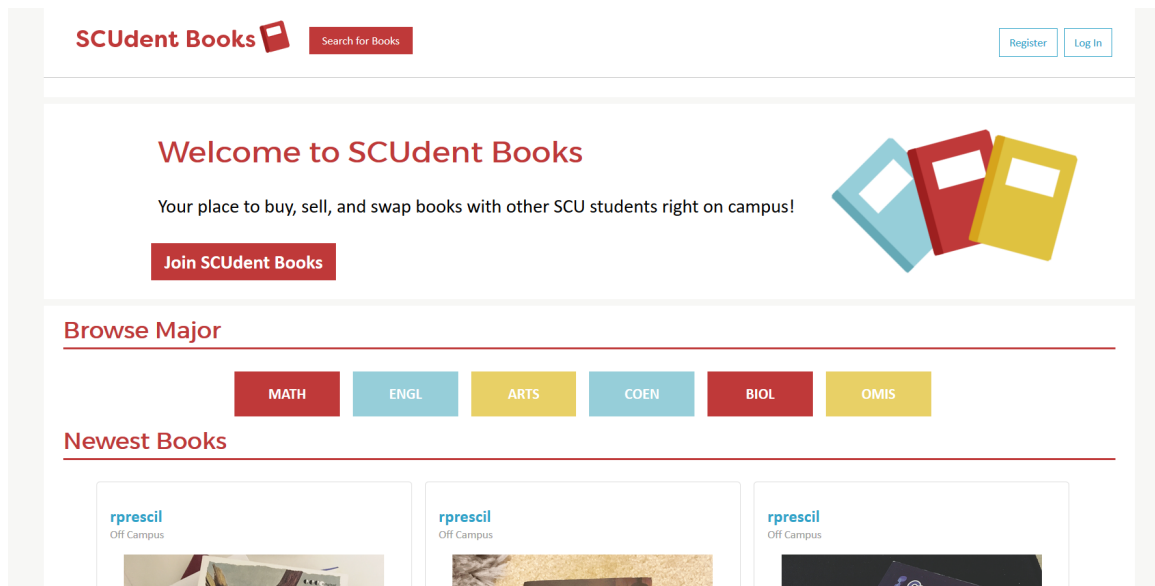


Figure 5.2: Home Page for Logged-out User

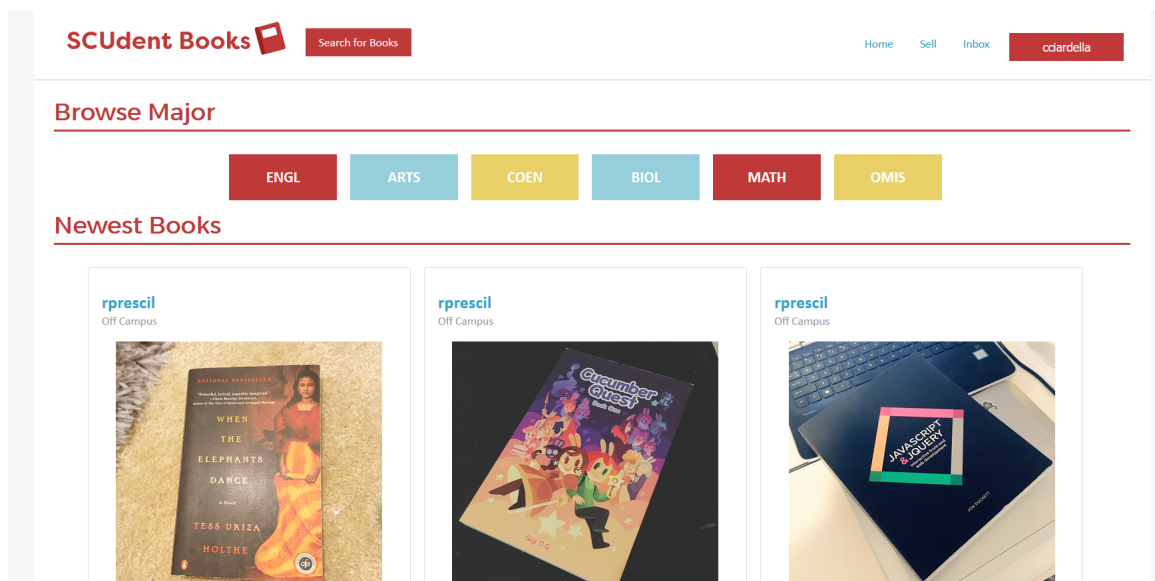


Figure 5.3: Home Page for Logged-in User

for an account, which can be seen in Figure 5.2. If a user is logged in, the promotional banner is removed and the navigation is replaced with the main actions users can go to, as seen in Figure 5.3. We kept the section for browsing books by majors, which updates dynamically depending on the books on the website. On the left side of the navigation bar, there is the SCUdent Books logo and a "Search for Books" button that goes to the search page. On the right side of the navigation bar, there are additional links. "Home" links to the homepage, "Sell" links to the page to post new book listings, "Inbox" links to the user's inbox for message. Clicking on the user's username will bring

up a dropdown menu that contains a link to their profile, a link to the "Manage Books" page where users can manage books, and a button to logout. This user navigation can be seen in Figure 5.4.

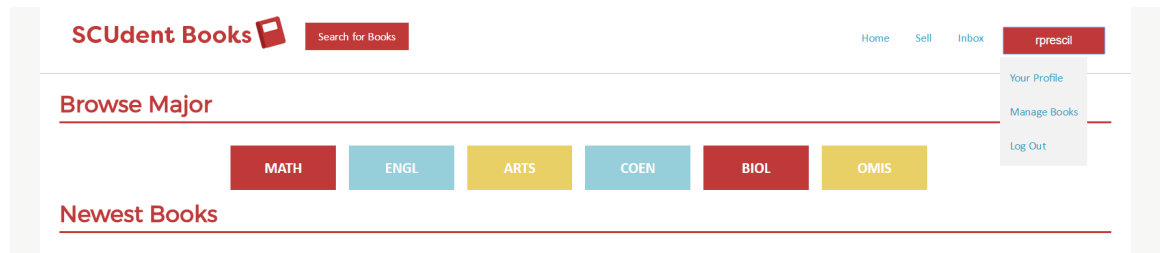


Figure 5.4: User Dropdown Navigation

The screenshot shows the "Become a SCUdent Member!" registration form. It includes a "Required Field" legend and several input fields: Username, Password, Confirm Password, First Name, Middle Name, Last Name, Email Address, and Phone Number. Each required field has a red asterisk. The "Major:" field is a dropdown menu with a list of majors including Accounting, Accounting and Information Systems, Ancient Studies, Anthropology, Arabic, Art History, and Biochemistry. The "Register" and "Log In" buttons from the previous page are visible in the top right corner.

Figure 5.5: User Registration

When a new user needs to create an account, they are taken to the user registration page shown in Figure 5.5. Here, they can input their information and are required to fill in the areas marked with a red asterisk. New users can then choose their majors and minors through various dropdown menus. After creating an account, the new user is prompted to log in with their new credentials.

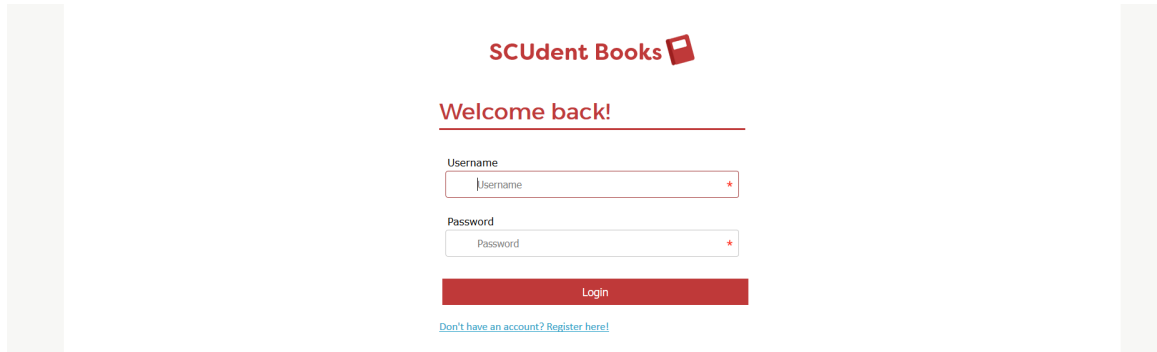


Figure 5.6: User Login Page

If a user isn't logged in, they can't access any parts of the website other than the homepage. They will be directed to the login screen, as seen in Figure 5.6, where they can securely enter their information or click the link to make an account.

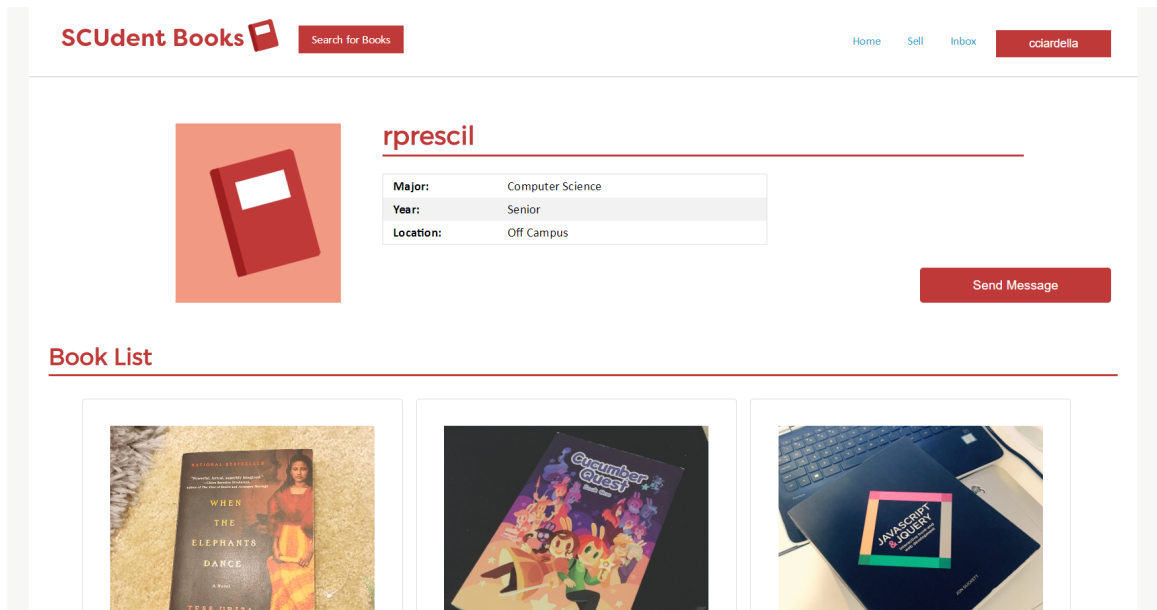


Figure 5.7: User Profile Page

Figure 5.7 shows an example of a user's profile page. Each user has their own profile page and users can view each others profiles through book listings on the website. Each user's page has their basic information displayed, a button to message the user, and a list of books that are available to buy/swap from the user.

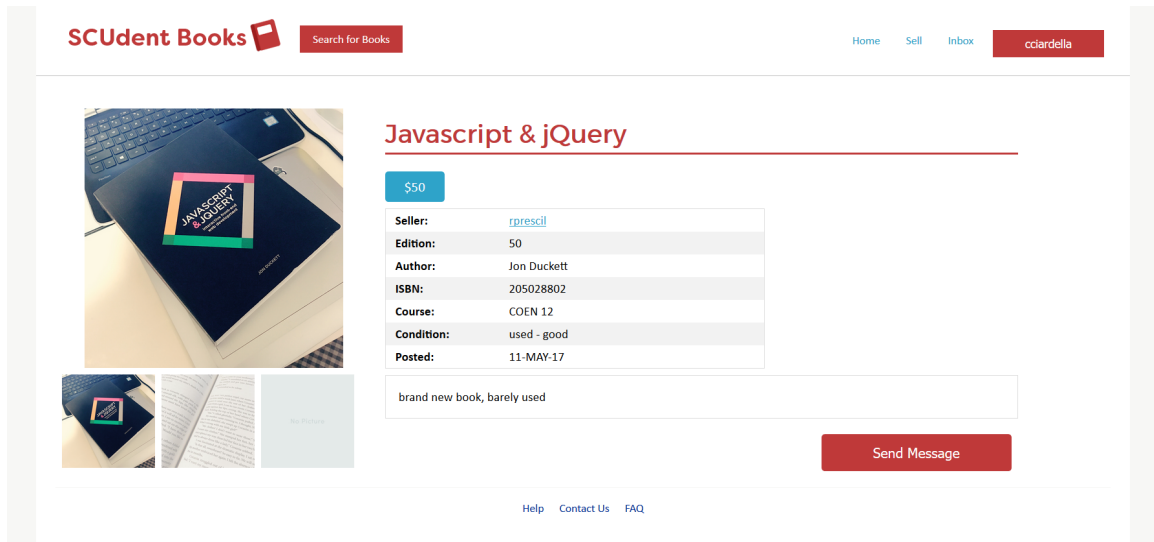


Figure 5.8: Book Listing Page

Figure 5.8 shows a page for an individual book listing. Book listing pages include photos of the book, all information about the book, and a button to send a message to the seller of the book. Below the main book photo is a gallery of three images that can be uploaded by the user; if there is no image uploaded, the website will default to a placeholder image. Clicking any of the three images in the gallery will make the selected image the main photo. Users can also click on the main photo to make it a full-screen popup that is overlaid on the page.

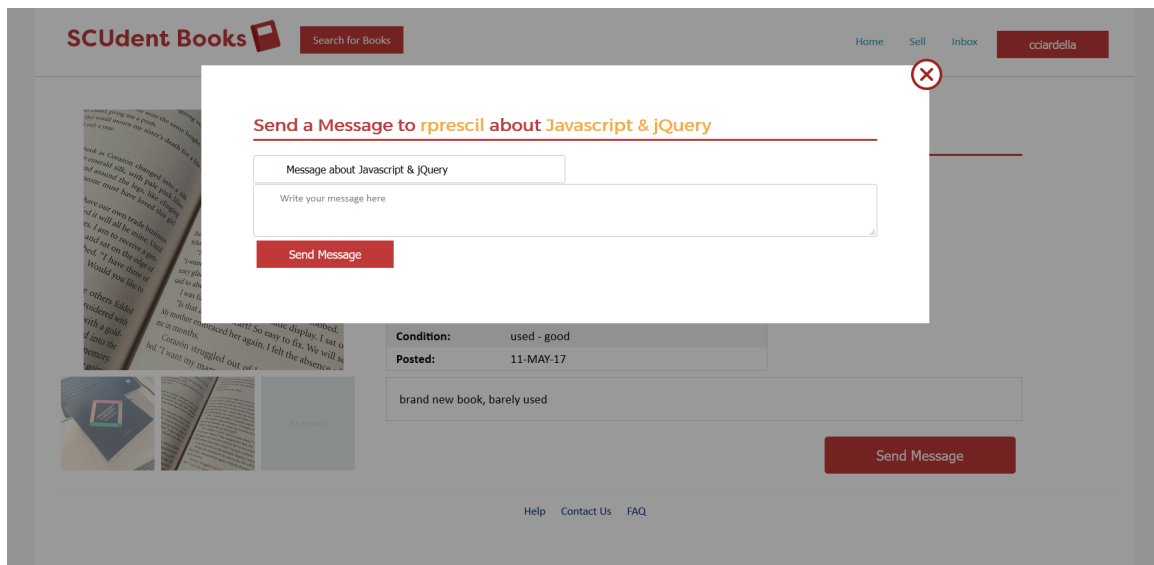


Figure 5.9: Message Pop-up Box

Both the user and book pages have links to message the user, and these buttons will spawn

the popup shown in Figure 5.9. This popup is overlaid over the current page while the main page is darkened. Clicking the "X" button or clicking outside the window will close the popup. The header describes who the message will be sent to and what the message is about. There are two fields for users to enter the title and body of the message. If the user is on a specific book page, the popup header and message title will automatically include the title of the book. Otherwise, the message title will be blank and popup header will not mention the book. Users are able to edit the title or add a new one as well. After writing the message, the user can click "Send Message" and they will be taken to a message confirmation page, as seen in Figure 5.12.

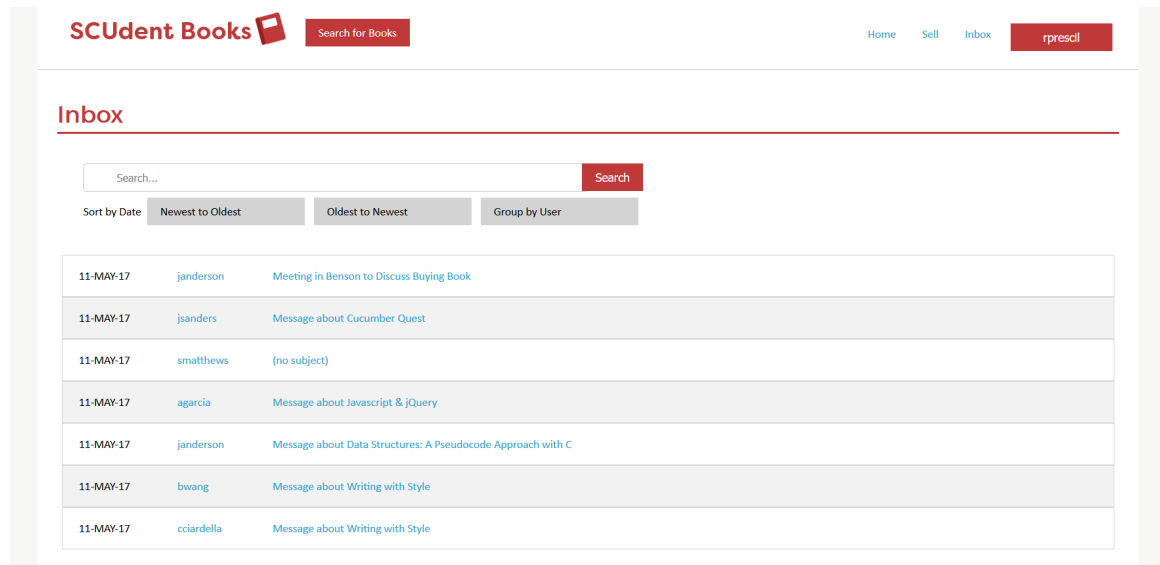


Figure 5.10: Inbox Page

Clicking on the "Inbox" link the navigation will take users to their inbox, seen on Figure 5.10, which shows a list of all their sent and received messages sorted by date. There is a search bar for users to search through messages, and different filters to organize by newest to oldest, oldest to newest, or group all messages by user.

Clicking on a message in the inbox will lead to the individual message's page, seen in Figure 5.11, which displays the entire conversation related to the initial message. It will show the first message that was sent or received at the top of the page. If there were any replies and additional back-and-forth messages between the users, they will appear below in chronological order. There is also a space for users to enter and send a new message, which will then be added to the conversation.

After sending a message through the inbox, book listing pages, and user profile pages, the user will be taken to a confirmation page. This page, seen in Figure 5.12, shows the message title, the message text, and confirmation text showing that it has successfully been sent.

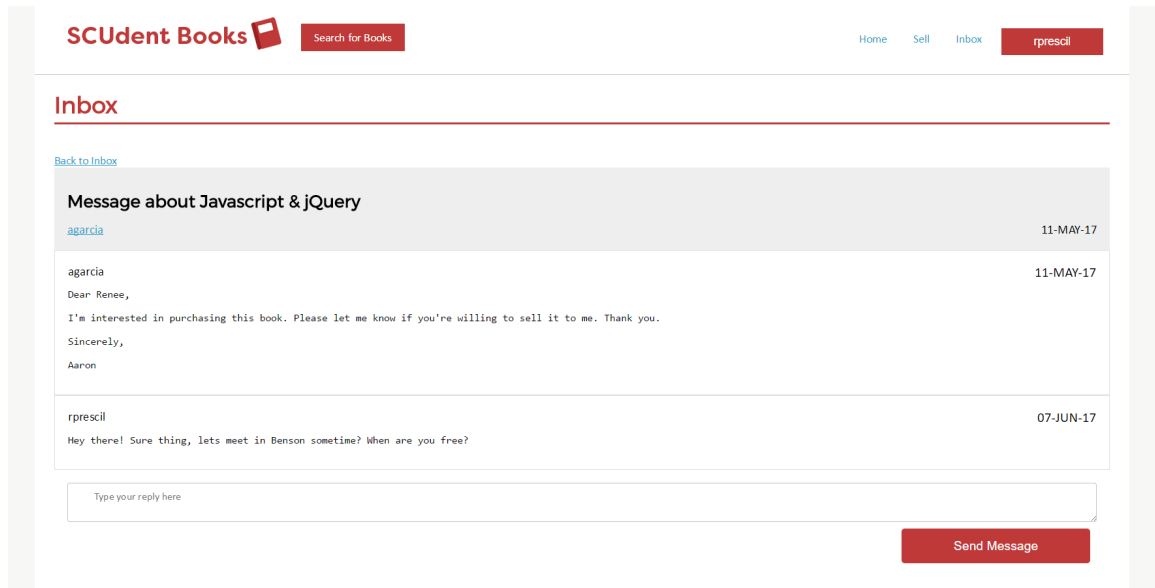


Figure 5.11: Individual Message/Conversation Page

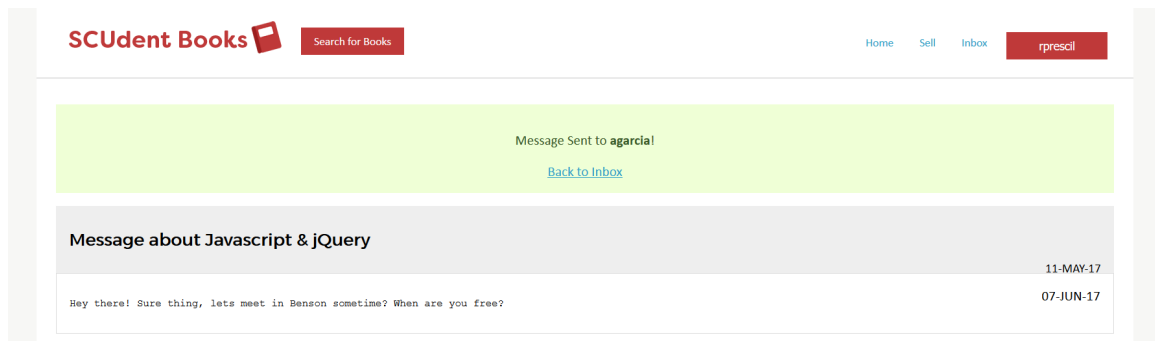


Figure 5.12: Sent Message Confirmation

If a user wants to search for books, the "Search for Books" button in the navigation will lead to the search page as seen in Figure 5.13. The left side of the page has a sidebar where users can enter their desirable search queries. Users can fill out one or several filters for searching. After submitting their search queries, the right column will display all the books that fit that criteria. Users can choose what types of books they're looking for in "Purpose" to find books that are being sold, up for swapping, or both. Users can enter the book title, author, edition, and course number. There are also dropdown menus for choosing departments and prices for books.

SCUdent Books

Search for Books

[Home](#)
[Sell](#)
[Inbox](#)
[rpsrcil](#)

Search

Title:

Author:

Edition:

Department:

Any

Accounting (ACTG)

Aerospace Studies (AERO)

Applied Mathematics (AMTH)

Anthropology (ANTH)

Arabic (ARAB)

Art History (ARTH)

Studio Art (ARTS)

Arts & Sciences (ASCI)

Bioengineering (BIOE)

Biology (BIO)

Course Number:

Purpose:

Any

Swap

Sell

Price:

Any Price

Results

rpsrcil

Off Campus

When the Elephants Dance

Author: Tess Uriza Holthe

11-MAY-17

\$10

janderson

University Villas

Monstress

Author: Lysley Tenorio

11-MAY-17

For Swap

agarcia

Graham Hall

Critical Strategies & Great Questions

Author: John R. Trimble

11-MAY-17

\$50

Figure 5.13: Search Page

To add a book listing, users can click the "Sell" button in the navigation to go straight to the "Add a Book" page, which can be seen in Figure 5.14 and Figure 5.15. Here, users can add all the information related to the book they would like to list and choose whether to swap or sell the book. If a user chooses to sell the book, they can list a price, otherwise they can put '0' if they'd like to swap books with another user instead. Users also have the option to book's condition, write a description of the book, and upload up to three photos. Areas with a red asterisk are required to be filled out. After a user posts a book, they will be taken to the new book's listing page along with a confirmation message similar to one shown in Figure 5.12.

Figure 5.14: First Part of Add Book Page

Figure 5.15: Second Part of Add Book Page

Clicking on the "Manage Books" page in the user dropdown navigation will lead to the "Your Books" page shown in Figure 5.16. Here, users can view and manage all of their book listings. The book listings are displayed similar to other pages on the website, but there is an additional row of icons below each book listing. The first icon of a pen in a square is an "Edit Book" button, which will lead to a page similar to the "Add Book" pages in Figures 5.14 and 5.15. This page will include all of the current book data, including the previously uploaded photos, and users have the option of editing and resubmitting their book listing. The second icon of a trashcan is a "Delete Book" button. If a user wants to delete a book listing, they first click this icon. The website will create a

popup that will ask the user "Are you sure you want to delete this book?" with an option to confirm or cancel. If the user confirms the action, the book will be deleted permanently.

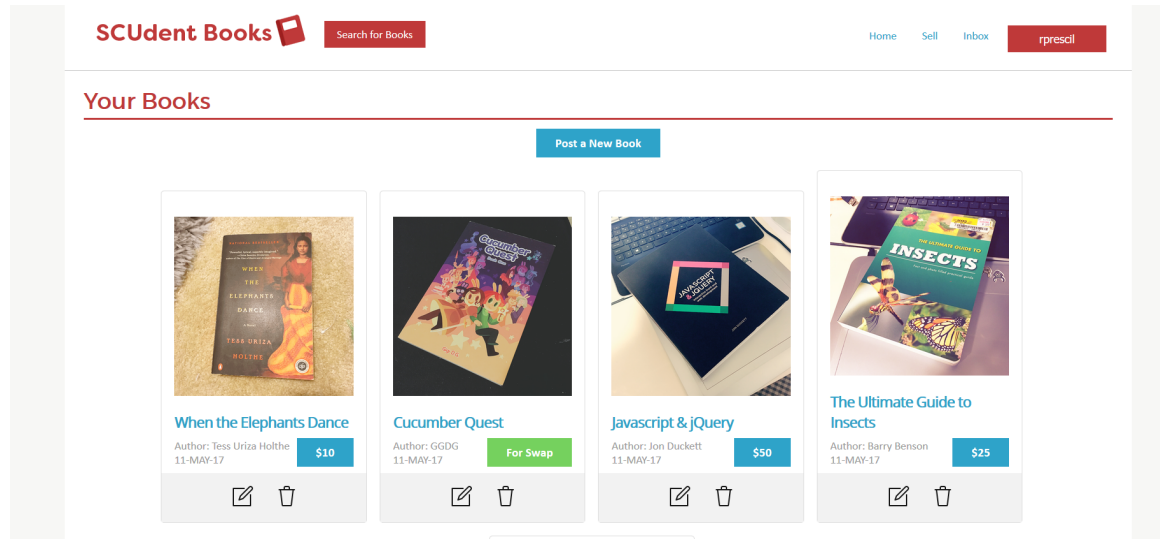


Figure 5.16: Manage Your Books Page

Chapter 6

Technologies Used

6.1 Mock-up and Diagrams

- **Draw.io** - An online web program designed for ease of creating diagrams and sharing with others.
- **Adobe Illustrator** - A vector graphics editor used to create vector graphics. It is often used for graphic and web design.
- **Adobe Photoshop** - A raster graphics editor used to create graphics and manipulate photos. It is often used for digital artwork and design.
- **LaTeX** - A document preparation system for high quality typesetting that uses plain text and markup tagging conventions to commonly produce technical and scientific documents and any type of publishing.

6.2 Implementation

- **Hypertext Markup Language (HTML5)** - HTML is a markup language supported by every web browser. It is used for the semantic design of the webpage.
- **Cascading Style Sheets (CSS3)** - CSS is a style sheet language supported by every web browser. It is used for styling our webpages.
- **Javascript (JS)** - Javascript is a client-side scripting language supported by every web browser. It provides additional functionality to our webpages independent of the server.
- **Hypertext Preprocessor (PHP)** - A server-side scripting language for creating dynamic web pages and store information. It allows for the site to perform back-end functions such as sending automated email.

- **Oracle SQL** - Oracle SQL is a database management system. It stores data on the required books for certain classes and keep track of its users' accounts.
- **Git** - Git is a mature version control system used for managing files, particularly useful when multiple people are collaborating. It is used as our version control system.
- **Github** - Github is a centralized, online git-based host for projects. It is used for hosting our projects code and managing the various code branches.

Chapter 7

Architectural Diagram

The architecture was chosen for our system based on the requirements and the design constraints. Our system is required to be a web application optimized for desktop and mobile platforms that runs on multiple machines including personal computers and mobile devices along with browsers. Given the nature of the web as being intrinsically a client-server architecture, the client-server architecture was chosen. Figure 7.1 shows the client-server model we implemented. In a client-server model, the server hosts, delivers, and manages most of the resources, while the client consumes these services. Clients communicate with the server via the Internet, and the server accesses the data that the client requests. The server can manage multiple clients simultaneously, which is the main reason we chose this architecture. In our system, the clients access the bookstore and data through the internet. The internet is the medium in which the client receives data from the server. The main clients of our system are the university students using either the desktop or mobile platform with all of them requiring access to the website. In this architecture, it is very easy to add and remove clients, making it the obvious choice for a web application that requires many clients at once.

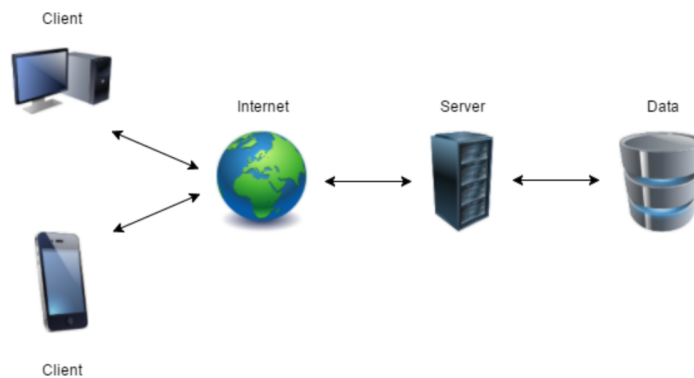


Figure 7.1: Client-Server Architectural Diagram

Chapter 8

Design Rationale

During development, we chose to use certain tools and use certain design features over others. We chose to create SCUdent Books as a web application so that students can access the website on both Windows and MacOS desktops and mobile devices. We also have reasons for choosing aspects of our website design, our graphics tools, and technologies used.

8.1 Graphics Design

To create graphics and mockups during planning and implementation processes, we have decided to use Draw.io, Adobe Illustrator, and Adobe Photoshop. Draw.io is simple to use but has all the necessary tools to create flowcharts and diagrams. We were able to make clear wireframes that aided us in our implementation process. Both Adobe Illustrator and Adobe Photoshop are used to create graphics and have many typography, color, and layout tools. We used Draw.io and Illustrator to help create mockups and wireframes for our initial designs. We also used Adobe Photoshop to explore possible design choices and create design elements for SCUdent Books, such as the logo and book illustrations. We chose these three programs because they had powerful and simple tools that enabled us to create all the graphics we need over the course of development.

8.2 Implementation

For our front-end development, we used HTML5, CSS3, and Javascript. We used these languages because they are the standard coding languages for web development. They are well documented, are compatible with major internet browsers, and they provide many tools for customizing page content and page layout.

For our back-end development, we used PHP and Oracle SQL. PHP is a standard scripting language for web development and can create dynamic web pages; it can also submit data to databases

and retrieve information from them. Oracle SQL is an open source SQL relational database system, where data can be laid out in separate tables while still having relationships with other tables.

We chose these two technologies because they will be vital for us to use to store and use data about users, books, transactions, and messages. PHP and Oracle SQL enable us to display, use, and retrieve any combination of data depending on the entered queries and how our tables are created. Both technologies are also well documented and there are many educational sources about them for us to use during development. We have also chosen PHP and Oracle SQL due to our familiarity with them and our ability to use the Oracle SQL databases provided by Santa Clara University, which are hosted in the Design Center computers.

We used GitHub to help us organize our code and create backups. GitHub is an industry standard in computer engineering project management, and it enables us to store backups and previous versions of our code. It enables us to work on separate branches of our project, which allows each of us to work separately without worrying about altering each others code, and we can combine our code together. Overall, we chose GitHub because it will help us work more efficiently and be organized with our project code and additional documents as well.

8.3 User Interface Design

While designing our web application, we have made several design choices for the user interface to make our website user-friendly. We have referenced other e-commerce websites, such as Etsy and Amazon, and the advertising platform Craigslist, for the functionality and visual elements of our website. We also included elements from social media websites and email services.

- **Book Listing Grid.** One of the first design aspects we created was the layout of our books on many of our pages, including the search, browser, and user profile pages. We chose to lay out listed books in a grid layout, like Etsy, as opposed to a list layout, like Amazon. We did this since we wanted the pictures of the books to be the most important part of each post along with choice information attached. We chose to focus on book photos like this because of many students familiarity of uploading and viewing photo posts on social media websites, like Instagram. Not only is the format familiar and modern for students, it also highlights what the object that will be bought or sold. Unlike Amazon or other retail stores that sell many objects, users focus on the specific books that users are selling, and photos are a prominent way of showcasing each listing.
- **Inbox/Messaging System.** Our inbox/messaging system also models after the messaging

system from e-commerce websites, like Etsy, and mimics email services, like Gmail. The first message in a chain is listed in list of all messages, and if there are replies to that message, they all appear underneath the main message in chronological order. Because many students use email and are familiar with this structure, we decided to implement a similar layout. We also chose to use this method instead of a instant-message type of messaging system because it is easy for users to navigate their inbox. Messages have titles that label what each conversation is about and who it's with.

- **Usability Elements.** We also have designed our website to address various usability heuristics and make our website easy to use. We keep language consistent and use language similar to existing websites to keep actions and locations easy to recognize. There are confirmation pages after successfully posting a book or sending a message. To prevent errors, users are notified when they haven't filled out a required field on forms, filled it incorrectly, or if users are asked to confirm a deletion of a book. When a student is looking at a product page, they can easily click the message button and the form to fill out a message automatically appears on the same page.

Some design aspects we did not fully implement but we planned them to help improve the user experience. In our initial wireframes, we chose to put the notifications as full text lines at the top of the page, rather than simply highlighting the "Notifications" tab in the navigation bar, so users can instantly see who is interested about what book when they log in. In the footer section, we included dummy links to a support page, a contact page, and a link to frequently asked questions. While these links don't go to any pages on our current website, these links would provide additional support to users of the website.

Chapter 9

Testing Procedure

9.1 Test Plan

Our method of testing our website will be as follows: alpha-testers will include us, the programmers, while beta-testers will be a number of 30 to 50 random volunteer students from Santa Clara University (whom we will compensate with \$15 gift cards for their time).

During alpha testing, we will create mock accounts to simulate the experience as one of our users. Each account will have some number of books listed. The three of us plan to test all functionalities to ensure the site is working correctly. These functionalities mainly include buying/swapping, selling, editing books, messaging, and deleting ads.

Once all functionalities are proven to work successfully, our beta testers will provide us feedback through acceptance testing on the usability of our site. This will be done in SCU's Bannan Engineering Centers user study rooms so we can make use of the technology such as eye trackers available. At the beginning of the testing phase, we will give users a brief tutorial on how to use the site, and then allow them to navigate it as they normally would. We will ask users to perform certain tasks to use all the main functionalities of the site, such as putting a book for sale, searching for books for their classes, and messaging other students. As they do so, we will take note of their actions to see if how long it took to make the correct action. A survey written by us will be distributed after the session for them to write down any difficulties or suggestions they had. From their feedback, we will do our best to address any issues or add any suggestions given. There may be more than one beta testing phase: the first for initial user feedback, and the second as a follow-up after some changes are made. While it is impossible to satisfy every single user, we will strive to accommodate as many user needs as possible.

9.2 Test Results

Alpha testing for this project was done constantly throughout the implementation process. We constantly used the website server provided to us by the school to check the layout, navigation, and functionality of the site. Using FTP programs, we remotely accessed the user account with access to the server to upload files.

The main functionalities we needed to work were adding/posting, editing, and deleting book listings, searching for books, creating user accounts, login authentication, and sending messages. At first, we needed to manually create user accounts and add book listings by writing a separate program in Oracle SQL. This allowed us to test login authentication and the search algorithm. Another page separate from the site simply displayed the content of all the tables in our database, which we used for reference often. Later on, we figured out how to add books and users to the database from the site instead of manually. The original code was written in PHP but did not include SQL functions, which were necessary for the site to work given the server provided. Branching off from adding were the editing and deleting books functionalities. Finally, the on-site messaging system was built to keep track of conversations between two users.

Similar to our test plan, we made up several user accounts to test whether the site was working correctly. Each account posted at least one book. One of us logged in as one user and would choose a book from a different user to message about. After a message was sent, we would log in to the other respective user's account to check if the message arrived in his/her inbox, and vice versa. We would also make sure that only the seller was able to make changes to or delete a listing. After editing a listing, we checked its appearance and content on the rest of the site as well as while logged in as a different user. After deleting a listing, we ensured it no longer appeared on the site or in the database.

Because we completed our project later in the year than expected, we were unable to perform any beta testing.

Chapter 10

Development Timeline

To organize the development of our project, we created a Gantt chart for us to follow throughout the school year. The Gantt chart is organized by tasks that are to be completed during certain spans of time. We created three Gantt charts for each quarter to better organize our original goals in each term. For Fall quarter, we focused on developing our project design and our design document. For Winter quarter, our original plan was to implement our project and start user testing. For Spring quarter, we originally planned on completing user testing, writing our thesis paper, and presenting at the Senior Design Conference. Instead, we dedicated most of our Winter and Spring quarter to implementing our project with the latter half of spring devoted to alpha testing for functionality and usability, writing our thesis paper, and presenting at the Senior Design Conference.

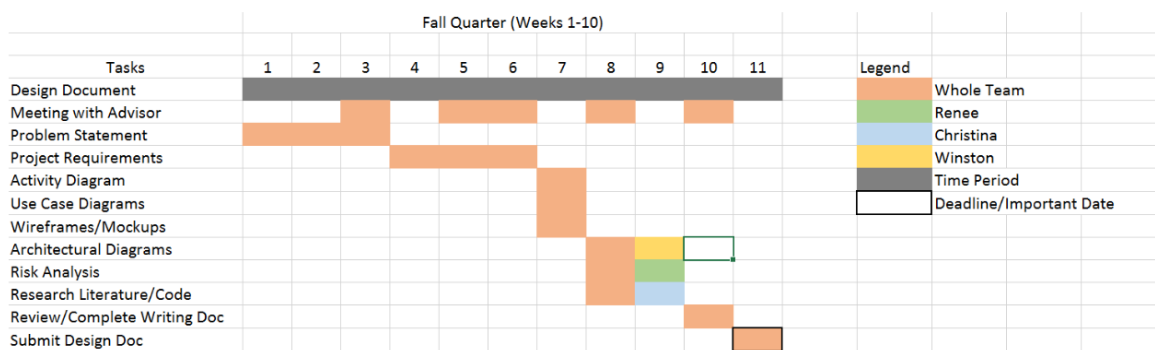


Figure 10.1: Fall Quarter Gantt Chart

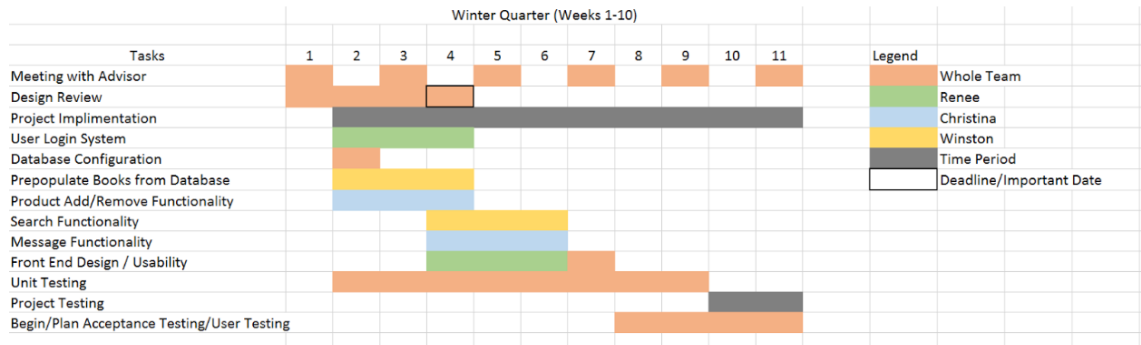


Figure 10.2: Winter Quarter Gantt Chart

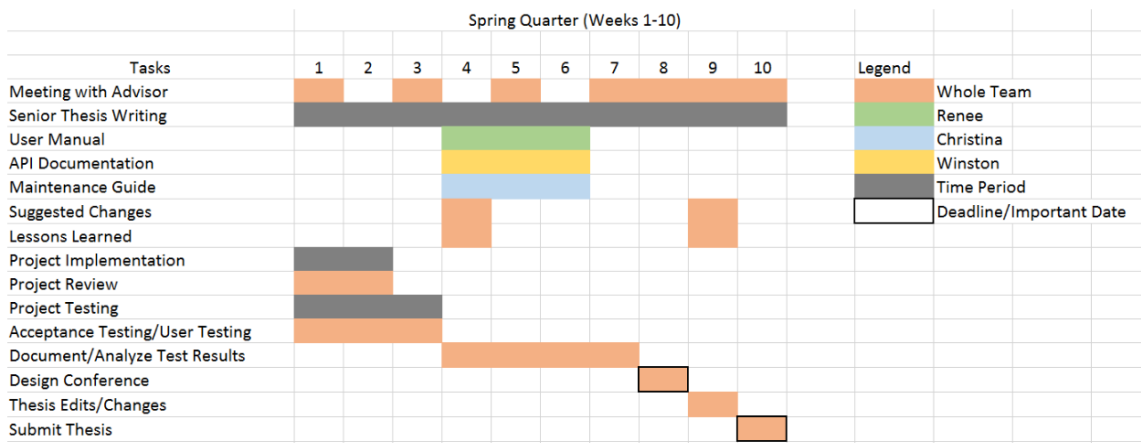


Figure 10.3: Spring Quarter Gantt Chart

Chapter 11

Risk Analysis

There are many possible risks that can happen during our project development. During our initial design process, we created a risk table, seen in Table 11.1, to help us keep track of the possible events and how we can mitigate them from occurring in our development.

11.1 Summary of Columns

Risk Name: The name of event

Consequence: the resulting events

Probability: The chances of the risk occurring

Severity: A scale from 1-10 of the impact that the risk will have

Impact:

$$Probability[0 - 1] \times Severity[1 - 10] = Impact \rightarrow P \times S = I \quad (11.1)$$

Mitigation strategies: Strategies to be taken to pre-emptively lessen the probability of the risk happening or lessening the impact that it will have on our project

Over the course of development, we ran into several of these risks, most notably encountering software bugs, sticking to our schedule, and learning unfamiliar technology. We encountered several bugs over development and spent time debugging and doing alpha testing to fix these bugs. While we were able to fix major bugs that appeared during development, there are still minor bugs that exist on the website currently. Over the school year, we also had issues keeping with our initial development timeline, so we had to plan accordingly and alter some of our goals in order to complete the main functionalities. In addition, while many of us were familiar with MySQL, learning Oracle SQL for the project took some time to get used to and familiarize yourself with it for the project. We discuss more these challenges and what we learned from them in Chapter 13 - Lessons Learned.

Risk Name	Consequences	Probability	Severity	Impact	Mitigation Strategies
Software Bugs	App does not function properly, causing delays in development	1.0	8	8.0	Frequent and effective testing strategies
Sticking to a Schedule	Cannot achieve progress on project, can cause project delays	1.0	7	7.0	Communicate with team members about current progress; Manage workload to reach weekly goals on time
Unfamiliar Technology	Dedicating time to learn technology, which may cause delays in development; Novice mistakes or inefficient coding practices	0.8	7	5.6	Divide work according to team member's strengths; Spend time beforehand to familiarize with current technologies or ask for assistance
User Dissatisfaction	Users are not satisfied and would not consider our system a solution; Must redo system to fit user needs, which may cause delays	0.4	8	3.2	Check in with other users during development and conduct user studies to further understand what users want
Missing Requirements	Failure to satisfy causes delays in development	0.3	8	2.4	Constant checking in with the customer
No/Broken Internet Connection	Students will be unable to access the website easily	0.05	3	0.15	Use phone service data to access the site
ECC/DC Servers Down	Cannot achieve progress on the project; Cannot access databases	0.01	10	0.1	Use a local host or host on an outside server; Create backups
Technology Malfunctions	Data loss which can impede progress	0.01	7	0.07	Handle technology carefully; Backup data using GitHub to avoid data loss; Avoid suspicious websites due to viruses or malware

Table 11.1: Risk Analysis Table

Chapter 12

Future Goals

While we were able to successfully implement most of the requirements that we listed in the beginning, there is still room for potential improvement and growth in the future. For instance, the search functions for the main bookstore and inbox can be improved to search for terms more accurately as they currently return specific search terms but possess bugs that prevent them from functioning perfectly. More features can be added to the inbox messaging system including a notification system for new messages and sorting folders. The user interface will continue to be constantly improved and adjusted accordingly along with the mobile version which will eventually be fully compatible with mobile devices. A report system will be added for users to report malicious activities or content with administrators taking action as a follow up. Eventually, we will scale our site to account for more users and deploy a developer version of our site for other universities to use.

Chapter 13

Lessons Learned

After nearly a year of planning and developing SCUdent Books, all of us have learned important lessons regarding time management and communication. Overall, we believe we worked well together and accomplished a good amount of work. However, some aspects of our teamwork still could use some improvement.

During the development process, our time certainly could have been managed better. While we did initially create development timelines to help assign ourselves roles and deadlines, we did not follow them strictly enough. Because this project was not our sole assignment for school, we often found ourselves lacking enough time to work on it while balancing other schoolwork. Furthermore, we could not predict the workload or difficulty of Winter and Spring quarter classes when we made the timelines in Fall quarter. Due to this lack of knowledge, keeping on track with the timelines proved challenging.

Santa Clara University generously provided our team our own web server and database for this project. However, we only possessed some familiarity using Oracle SQL, which was what the server used, so learning to build the required database tables and navigate the developer took extra time. Had we been more adept with the language earlier, more work such as improvements and extra features could have been done.

We did a decent job sticking to our assigned responsibilities as defined by our development timelines, since our roles were chosen based on our areas of expertise. Occasionally, though, each of us needed extra help from other team members to complete a task. Sometimes, certain parts for one person involved part of another's piece, so either the person working on the part first would write the entire code alone or ask the other partner to take over. The situation was usually clear between the two members involved, but if the third member happened to modify or understand the code for some reason, the situation became more complicated. This brings us to our final lesson in

communication.

To communicate our roles, we shared a common Google Document listing our weekly tasks. We shared contact information with each other and created a group message thread for our thoughts, questions, and scheduling meeting times. The latter method was fairly effective as it was the most reliable way to receive responses quickly. Meeting in person was perhaps the best form of communication for us since important details could have been skimmed over and missed in a long series of messages.

Despite those setbacks, our team succeeded in making what originally began as an idea into a functional and aesthetically pleasing website.

Chapter 14

Societal Issues

Throughout the development of our project, it was imperative for us to consider the societal implications that our project would potentially produce. As engineers, we have a moral obligation to deliver a safe, ethical, and functional product to the public without compromising anyone's morals or safety. The actions that we take during development produce ethical consequences that impact all relevant aspects of the project. It is especially important for us to take into account the ethical ramifications that our project entails given that we are accommodating a large number of university students who rely on the functionality and ethical implications of it. Eventually, when our project becomes deployable for other universities, we must ensure its ethical stability and security to maintain its core values and functionality for future users.

14.1 Ethical

One of the most important ethical aspects of our project to consider was team and organizational ethics. It was essential that we acted ethically internally and with the larger organization involved in the development of our project. Internally, we knew we acted ethically as we remained honest and considerate with each other regarding the project and each others well being. In relation to the larger organization, we knew we acted ethically by obeying all ethical considerations related to each entity involved with the project. The first entity of the larger organization was our advisor, Ben Steichen, who oversaw the development of our project as we reported our progress and status with him and discussed future plans. With him, we always reported our current progress and status along with factual results and data and discussed any questions we had for each other to maintain transparency throughout the development of the project. The second entity of the larger organization was the university's academic and housing departments. As we extracted the list of classes, majors, minors, and housing options to use for our website's data, we were required to represent this

data correctly on the site. The third entity of the larger organization was the university's students and faculty. Because they serve as the users and customers of our website, we must maintain a presentable, honest, and functional product while preventing them from encountering any potential issues in our service. For the project to be successful, all team members were to be treated and treating each other fairly and appropriately. The practical steps we took to ensure this included discussing all matters of conflict with each other to reach a solution on unanimous or majority agreement, assigning all tasks and components fairly and appropriately, allocating time to improving team productivity through bonding, and being considerate of each others contributions and well being.

Another essential ethical ramification to consider was the ethics of our product. To ensure integrity on our research and design project, we made sure that all of the data we presented was factual and our website included all advertised features and capabilities while catering to users and customers. Some processes we had in place to ensure the truthfulness and accuracy of our designs included checking the functionality and usability of the site as advertised in our project specifications. In regards to internal testing, we regularly checked the data manipulated and the functionality to ensure they both correctly matched. We knew our data could be trusted as our Oracle database provided accurate values for everything, our data logs presented accuracy behind our actions, and we received confirmation from each other. In regards to extracting data from academic and housing departments at the university to compile a list of classes, majors, minors, and housing options to use for tags on the site, we compared the list we gathered with the actual list on the school's website to confirm this accuracy. We knew the data we received from each other could have been trusted as we all had access to our database and data logs to keep track of everything. Amongst our team, we disclosed and shared all test and research results to accurately collect data and inform each other of our project status. For our advisor, we did the same to maintain transparency throughout the development of our project. For the Senior Design Conference judges, we presented all findings and test procedures for our project to display the effectiveness of our solution and to explain our development process and provide insight on our decisions.

14.2 Social

One of the biggest potential social ramifications of SCUdent Books involves book transactions between users. Considering our service does not authorize online payment or guarantee the successful delivery of books as all transactions must be conducted in person, students are expected

to successfully complete transactions by performing proper payments and ensuring books are sold or received. Also, students are given responsibility to remove old book posts that have already been sold or exchanged to avoid having other students search for nonexistent books. Additionally, there exists a potential for online harassment and cyberbullying to occur. In the future, we hope to implement a report system that allows students to report any of these malicious or faulty activities to administrators who will take appropriate action.

14.3 Political

It is fairly unlikely that SCUdent Books will produce any significant political impact. However, the politics of Santa Clara University could potentially be affected if our service acquires a decently sized user base. The Dean, President, and other academic authorities could consider the product's impact and possibly make adjustments book prices and materials to accommodate for students' education in acquiring books and educational materials.

14.4 Economic

SCUdent Books allows students to save money by purchasing and exchanging books with other students on the same campus for reasonable prices instead of purchasing expensive books at the university bookstore or online retailers. Additionally, the site is free to use for anyone. One potential issue that could arise is the disruption of the university's bookstore business. Our product could be perceived as a viable competitor to it if students choose our service over its as we serve as a cheaper and more efficient alternative for purchasing, selling, and exchanging books. If this scenario were to ever occur, this may affect the university's profits as the bookstore serves as one of its largest profit outlets.

14.5 Health and Safety

The safety of students in public transactions is a huge concern of our project. Since we do not possess the oversight of monitoring all public transactions, we cannot guarantee the safety of students during public transactions. All we can do is provide safety disclaimers and instructions on our site in the future to ensure students perform the proper precautions and approaches to remain vigilant and safe when conducting public transactions. Additionally, a future report system will enable students to report malicious events that occurred during public transactions with the proper actions to be taken as a follow up.

14.6 Manufacturability

Our project does not possess any manufacturability complications since it is a web based product.

14.7 Sustainability

As time progresses, SCUdent Books will have to be updated accordingly in order to stay relevant and provide a healthy user experience. In regards to this, web technologies will have to be updated when available and the user interface will have to be adjusted accordingly to accommodate a larger variety of users and to be updated with the current web usability principles and guidelines. The database and course, major, minor, and housing options lists will also have to be updated regularly and accordingly. We will strive to establish and maintain SCUdent Books as a core educational web application for university students by sustaining modern functionality and usability on our site along with conducting research of users and the various methods of acquiring and managing textbooks.

14.8 Environmental

Our website is hosted on the Design Center servers. While we designed it to be lightweight and maintainable, data centers require a large amount of energy which would produce carbon footprint. As a result, we are relying on Santa Clara University to maintain proper energy usage in an environmentally friendly way while accounting for carbon neutrality.

14.9 Usability

We designed SCUdent Books with web usability in mind. We wanted to provide users with a wholesome user experience while navigating the site to allow them to perform any desired task with ease and efficiency. In order to accomplish this, we researched a variety of intuitive, practical, and functional web design principles and features and applied them to our site. It is essential that students are able to find the necessary books needed for classes and purchase, sell, or exchange books with each other easily and efficiently as we want our service to be a useful educational tool. Bad website design principles and practices worsen the overall user experience and could turn users away from the site. Students should not feel frustrated or confused in navigating our service.

14.10 Lifelong Learning

Throughout the development of this project, we were able to improve our current skills while learning new ones. Additionally, we were required to think critically and research and create new solutions to overcome obstacles and improve our existing foundation. We gained new knowledge and insight on the current web technologies and usability principles and guidelines. This project motivated us to think and research outside of our daily curriculum to improve ourselves and help us achieve our goals. As engineers, we are tasked with the duty of constantly striving to improve ourselves by being up to date with the current technologies while improving our current skills and knowledge in order to prepare us for the future and allow us to thrive in our industries.

14.11 Compassion

SCUdent Books aids in relieving the suffering of university students facing difficulty in acquiring and managing textbooks effectively and efficiently. Being unable to obtain all of the required educational materials in time for the academic period is incredibly stressful and negatively impacts students' education as they fall behind in schoolwork with the inability to be caught up with the subject matter. In addition, the annual costs of acquiring textbooks on top of the already high costs of tuition and other educational amenities negatively impacts those on a tight budget on a greater scale. Also, the current process of selling and exchanging books is troublesome for those wanting to get rid of some books as they are left with no convenient method of doing so and are left with their own devices of accomplishing this. By creating a university campus focused online bookstore, we are able to reduce the stress of this entire process by providing students with a convenient and centralized platform that allows them to purchase, sell, and exchange books at affordable prices with ease and efficiency while learning about the required materials for their classes. Students will be able to gather all of their required educational materials and be prepared for their curriculum to stay on top of their education and avoid the struggles of acquiring class materials in time for the academic period.

Chapter 15

Conclusion

In conclusion, students are burdened with the struggles to acquire and manage textbooks effectively and efficiently during each academic term. University bookstores sell books at high prices, which is troublesome for those on a tight budget, and require unknown periods of restocking. Also, there are currently no convenient methods of disposing books which requires students to tend to their own devices of doing so. Current solutions to this issue include online stores. However, they are still inefficient processes and decentralized platforms that do not cater to students specific needs. In an attempt to combat this problem, we proposed a solution called SCUdent Books which is an online bookstore that allows university students in the same campus to purchase and exchange books with each other. It would also serve as a centralized platform that allows students to search and learn required books for their classes.

We began development by listing a set of requirements and constraints to follow which would guide us throughout the project. We were then able to produce use cases and activity and architectural diagrams based on these requirements and constraints to visualize the flow and processes of our projects features and capabilities. Afterwards, we were able to construct a series of wireframes. Eventually, we began to develop the implementation of our site using our knowledge of web development. Once we finished building our site, we conducted alpha testing for functionality and usability. Our test results showed that our system was functional and ready for deployment.

Throughout the development of our project, we learned some valuable lessons that would serve as useful for us in the future when we proceed into the industry. The two most important lessons we learned include time management and communication. Even though we created development timelines and roles to set ourselves goals throughout the development of this project, we did not follow them strictly enough which led us to time management and communication issues. We struggled on occasions balancing other schoolwork and this project. In addition, we were not able

to accurately predict our Winter and Spring quarter timelines during Fall which led us to having some difficulty following them when time came. During development, there were several technologies that we were not necessarily familiar with which required extensive research and took up time that could have been spent producing more work. Even though we stuck to our assigned roles and responsibilities for the most part, we were occasionally required to collaborate on certain parts which led to occasional confusions and mistakes. In terms of communication, we created a Google Document that listed our responsibilities and tasks, shared contact information and created a group message thread for quick and remote responses, and arranged meetings in person to discuss progress and future plans. It was greatly beneficial for us that we chose to set responsibilities and roles for each other and set up communication mediums to plan ahead properly and avoid confusion.

Some of the greatest benefits that our system provides for students includes a centralized system that allows university students to purchase and exchange books with each other conveniently on the same campus and search and learn required books for courses without having to browse multiple sites to first find out the required books from the university site and then search for books and compare prices across multiple retailers. Also, our site offers cheap and affordable prices as students can set them compared to potentially higher prices from the university bookstore or online retailers. However, we recognized some disadvantages of our service. While being able to meet on the same campus to conduct transactions may seem like an advantage, it is also a disadvantage in the sense that students will have to meet in person to conduct transactions without the option of delivery for those that prefer it. Online payments are not supported on the site as an option for those that would like that preference as students will have to meet in person to conduct payments during transactions.

We still have potential future work that can be accomplished. The user interface will continue to be updated accordingly along with the mobile version which we plan to eventually become compatible for mobile devices. The search functions for the main bookstore and inbox need to be fixed as they will only search for specific terms but remain bugged for others. The inbox messaging system can be improved with more additional features including a notification system for new messages and sorting folders. We will eventually add a report system for users to report malicious activities or content to administrators who will subsequently take action. In the future, we will scale our site to accommodate more traffic and deploy a developer version of our site for other universities to adopt. Some open problems include professors requesting certain books to be removed from the site and the potential disruption of the university's bookstore business if our product becomes its competitor when enough students use our service over its for purchasing, selling, and exchanging textbooks.

After careful planning, drafting, and development, we were successfully able to implement our solution. SCUdent Books strives for convenience and ease for university students acquiring and managing textbooks during each academic term. The website has been designed and developed with modern and familiar web usability practices and principles in order to provide a wholesome user experience. Overall, our product aims at reducing the amount of time, money, and effort students spend in acquiring and managing books. We hope that our service will eventually be established as an essential educational tool for students to obtain and manage books and learn and discover required class materials.