System Architecture Document

Online Concept Exchange Team

CS 499: Senior Design Project

University of Kentucky

April 15, 2024

Table of Contents

Introduction

Customer

Our customer is Stephanie Fairchild Fister, a teacher and the creator of The Human Domino Effect game. This project was created to help children learn the importance of community and how to better work together through a game-based format. The game is based on 9 building blocks: loving prepared environment, stability, energy for concentration, practiced perception, responsibility, developed abilities, discernment, functional relationships, and resilience. Stephanie tasked us with creating a website for The Human Domino Effect project that will provide resources based on the 9 building blocks in the game and an open, moderated forum for parents to discuss how best to support their children's learning.

Product Vision

- Need/Value:

  Studies have shown that children are more likely to have higher levels of academic achievement and well-being when (both at home and at school) they continuously interact with learning activities that are balanced with play and nutrition, which make them see learning as a fun opportunity. To encourage this mindset in children, they need an optimal home learning environment. Our product provides a place where parents can get ideas to create this optimal home learning environment and reach out to their community for help.

- Customer:

  As mentioned above in the Introduction, our customer is Stephanie Fairchild Fister. She is our correspondent with The Human Domino Effect, as well as the sole

owner and designer of The Human Domino Effect game. She is the primary source of information about the game that our project aims to host.

- Users:

Currently, our product will serve as a pilot for Julius Marks, an elementary school in Lexington, Kentucky. The target users are families of this elementary school that need help creating a home learning environment. On the website, they should learn about The Human Domino Effect's mission and the game, specifically how to incorporate the 9 building blocks into their children's learning at home. They should be able to go to the page for each building block, learn about its importance, and then go to the section associated with their child's age group. This section will host resources on how to incorporate the building block into their home learning environment. They should also have access to a forum on the website where they can reach out to their community, ask for help, and share their own ideas.

The other main users of the website will be educators and healthcare providers that will work as administrators on the platform. They should be able to moderate the forum uploads to make sure they are appropriate. They should also be able to easily upload resources on the building block pages. These include clickable links to agencies or businesses in their community that provide further resources, materials, and services for home learning environments.

- Differentiator:

In our initial conversations with Stephanie, she shared stories about learning environments that were not ideal for children. She expressed how important she thought that the initial learning stages were for children and how she wanted to create a good

basis for their development. The Human Domino Effect game is different from other early childhood educational platforms in that it focuses on providing children and their parents with specific, local means of learning.

The Online Concept Exchange site will be different from other websites with forums because it will be tailored to parents of young children in the Lexington area. It will also be moderated by Stephanie or her team, meaning its content will directly reflect her vision for the future of The Human Domino Effect.

- Background:

The website will be conceptually modeled after The Human Domino Effect game. This game presents a solution to an unfortunately common problem in early childhood development: a lack of stability at home. This often leads to a more difficult learning experience for those children and the goal of the game is to create a healthy and strong basis for children to learn from. The game shows how we as individuals have gradually descended from our ancestors and how we are all connected through language, culture, technology, and other aspects of human experience. The physical game has branding that we hope to replicate in the Online Concept Exchange so that the connection between the ideals of the game and the purpose of the website is clear.

- Justification:

Building this platform as a website will be ideal for accessibility and for the functionality we've planned for. Having an informational side to the website will provide updated information related to Stephanie's mission and to the game. Having a forum side of the site will ensure that parents can provide tips for creating a great learning environment, which Stephanie has expressed interest in. The forum side will also ensure

that parents can access information regarding events and resources specific to Lexington and possibly other cities in the future.

Requirements Overview

The following are the functional requirements for our system:

1. The end product should be a mobile-friendly website.
2. The resource site should contain information and materials (divided by age group) for each of the blocks.
3. The forum site should allow parents to view and create posts to share their ideas.
4. The forum site should have tags or filters that allow parents to narrow posts by block or location.
5. The website should include the mission of the project and how the game works on the home page.
6. The website should have a login system that allows users to edit their accounts and posts.
7. The website should provide a way to contact Stephanie and her team.

Constraints Overview

The following are our design constraints for our system, listed with their consequences:

1. **Branding:** The website colors, layout, and theme must match The Human Domino Effect game to faithfully represent Stephanie's branding and organization.
2. **Mobile-Friendly:** To ensure that parents can access the site no matter what device they are using, we may need to spend extra time on CSS styling.
3. **Future-Proof:** Since this project is completely new, unfinished features are likely. The website should be scalable and future-proofed for teams that will take over the project.

4. **Short Timeline:** The timeline for the project is 3 months, so the focus may need to be narrowed as we approach the deadline in April, especially since the requirements at the start were so broad.
5. **No Budget:** There will be no budget for development, though hosting may require a subscription from a hosting platform. We plan to support this via advertising on the site.

Solution Strategy

Key Decisions

We decided to make a mobile-friendly website, as opposed to a mobile app, because Stephanie and our team agreed that it would provide the most accessible platform for the Online Concept Exchange. We used Flask to provide a simple routing scheme. Many team members had prior experience with Flask, and all had experience with Python. Jinja was used to provide HTML templating to avoid excess and repetitive boilerplate. It also made the website more modular, scalable, and future-proof. We opted for SQLite3 because Python has a prebuilt library for it and it integrates well with Flask and Jinja. We decided to use Agile, a Kanban board, and 2-week sprints to organize our project; each developer picks up stories as they are made available.

Decomposition

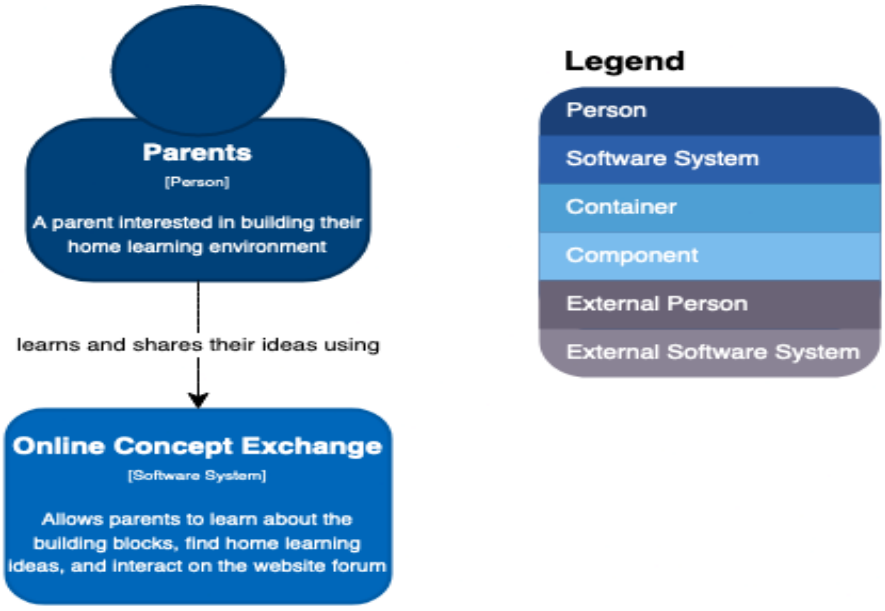
We decomposed the problem into a website with two parts: a resource site and a forum. Both parts share the same frontend templating and backend routing/database, though they differ in the content they will present. Since the resource site is mostly static, its markup is premade and stored in separate files, while the forum draws data dynamically from the database. Both sites are designed for parents primarily. For users with visual impairments, we attempted to include alt-text and Accessible Rich Internet Applications (ARIA) fields where possible.

Quality Goals

Quality Goal	**Description**
Accessibility	Stephanie believes very strongly in the mission of The Human Domino Effect, so she wants the content accessible to as many parents as possible. When visiting the site, users should immediately recognize where information for different aspects of the game are located. The styling should be minimal but intentional, reflecting the colors and format of the game.
Connectivity	One of our differentiating factors is our emphasis on local community resources, starting with Julius Marks Elementary. The resources will be relevant to the parents' area, allowing them to take immediate and concrete action to build their child's home learning environment. The forum will also allow parents to filter posts by their location.
Scalability	Since this is a brand new project with broad requirements, some features may not be feasible within the time frame. This is especially true when the security aspect of the forum is considered. We hope to create a final product that can effortlessly be taken over by the next team who works on the Online Concept Exchange.

Solution Architecture

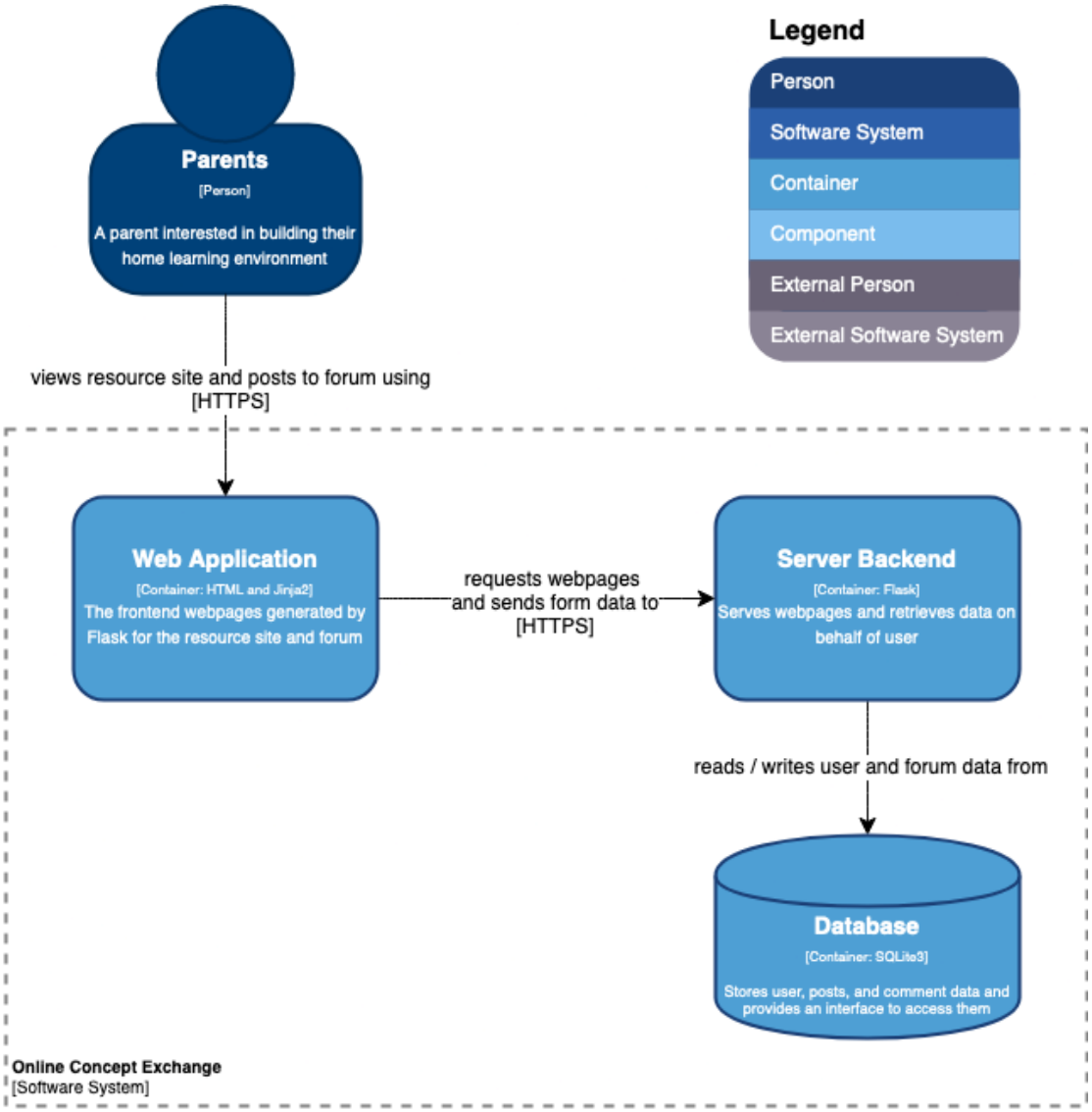
Context Diagram



System Context Diagram for Online Concept Exchange

The System Context Diagram for the Online Concept Exchange gives a brief overview of how users (in this case parents) will be interacting with the overall website. Given the legend, the person (parents) interacts with the software system (the Online Concept Exchange) to learn and share their ideas. The Online Concept Exchange also allows parents to learn about the building blocks of The Human Domino Effect game, find at home learning ideas to bring to their children, and be able to interact with the website forum where other parents can connect with users to exchange ideas and ask questions they may have regarding the game or outside situations.

Container Diagram

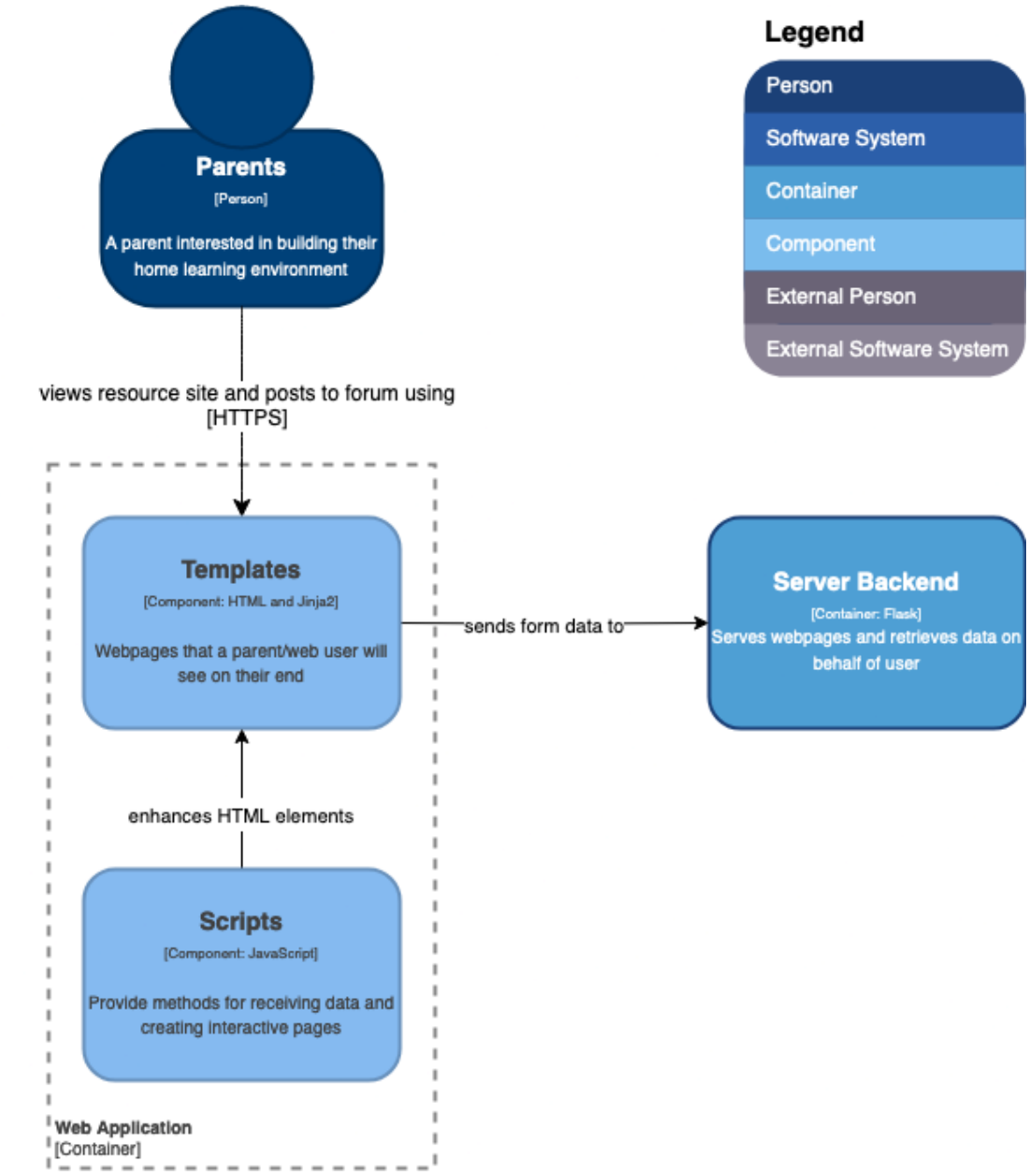


Container Diagram for Online Concept Exchange System

Our container diagram shows how our user will interact with the application and how that application will store data that is sent to and received from it. Our target user, a parent, will access either the resource site or the forum site which will both be accessible as a web application from a browser. That web application will be generated using Flask. The generated application will send any form data like user data, contact information, and login information to the backend. The backend will communicate with the database, which will store all submitted

data to the website and provide that data upon request from the backend. This diagram shows the bulk of our project in an abstract form.

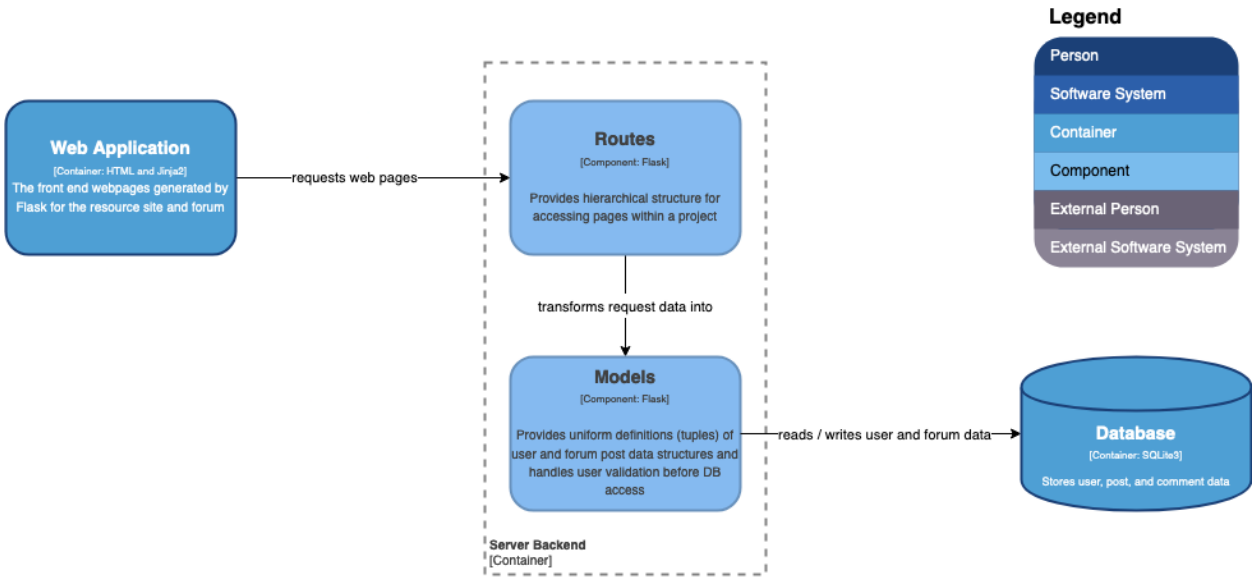
Component Diagrams



Component Diagram for Web Application Container

This diagram displays the Web Application Container which showcases how the user (parents) interact with the web application, and how the web application interacts with scripts

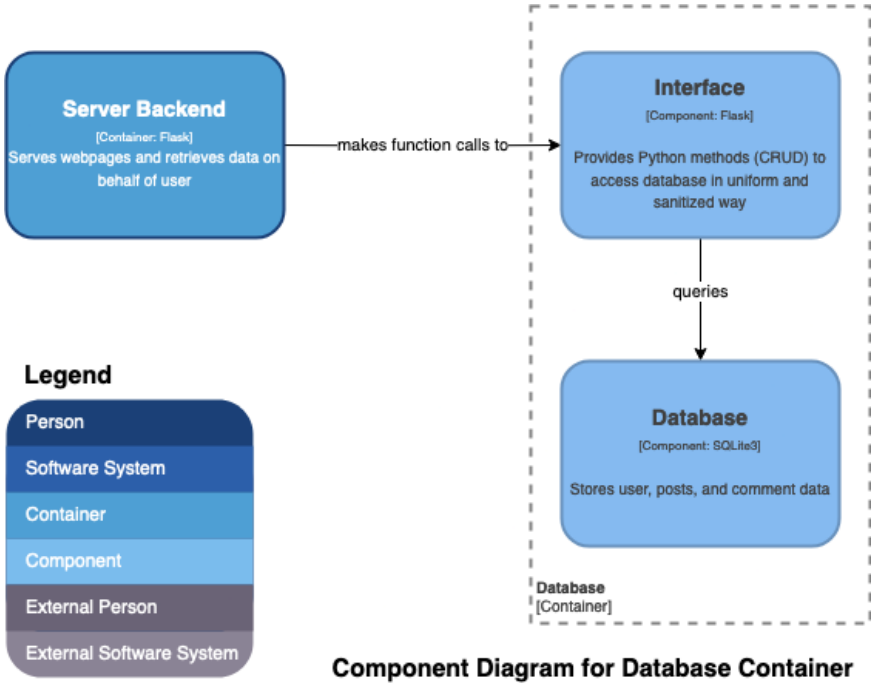
and servers. When a parent is interested in building and growing their at home learning environment, they will view the resource site. The templates will show the interested parents the Human Domino website pages, which will be enhanced by scripts. Because of said scripts, webpages will be interactive by linking to other pages on the site and receiving data in the form of forum posts or login information. These posts are sent to the server backend, which handles the data.



Component Diagram for Server Backend Container

This diagram shows the components that make up the Server Backend Container. The Routes component will generate a webpage for the user based on the URL they enter and any data they provide (such as if they are logged in). For every URL, it uses a distinct HTML/Jinja template from the Web Application container. If the webpage requires data from the database (such as forum posts or viewing user information), it will first send data to the Models component. Models will take in data and create an ordered tuple data structure. This tuple is then sent to the database, which will use the fields in the tuple as a template to grab query parameters and sanitize them before they are placed into the SQL statement. The Models component also

handles user validation, which is a necessary step before accessing a particular user's data in the database.



Component Diagram for Database Container

This diagram displays the contents that make up the database. The interface of the database is a component of Flask and first gets the database and creates one if it has not been initially made. It also contains the functions that create, update, get, and delete the users, posts, and comments. It also contains default values if the user has not input data when creating or updating information. To implement the functions, it queries and writes to the database, which is a component of SQLite3, where the data for the website is stored.

In the Future

Architecture Decisions

We opted for a website that is mobile-friendly instead of a native mobile app. Ease of access for parents and our knowledge of web programming languages motivated this decision. Many team members had prior experience with Python, so we decided to use Flask to add routing to the website and Jinja for templating to provide a single point of maintenance. Since SQLite3 fits well with the other libraries we decided to use, we opted for it with the potential to pivot to PostgreSQL when the project matures.

Quality Requirements

Several of our quality requirements should be easily measured. These include mobile-friendliness, the resources on each block page, and the tags on the forum. On the other hand, it can be difficult to measure how well people understand The Human Domino Effect game itself, since the game is extensive and nuanced. It can also be difficult to measure how usable parents find the website to be. There may be need to survey parents and get feedback on the layout to remedy this.

Risks and Technical Debt

Because this is a brand new project and the requirements are so broad, there will likely be features we are unable to thoroughly complete. At this time, we are placing more emphasis on the resource site, hoping to have a polished home page and resource page for each block. We are still making progress on the forum, but given the complexity of user accounts and posting, we may not be able to completely finish them (especially from a security and safety perspective). We also may not finish administrative controls to moderate posts or add resources as necessary.

Towards the end of the semester, Stephanie met with us and expressed her concerns about moderating a forum on the site. Since she is the sole proprietor of the project, all of the maintenance of the forum would fall onto her shoulders. As a result, she asked us to pivot our efforts and place the forum on hold, for now. The foundation of the forum, especially the interface with the database, is ready for future teams if Stephanie changes her mind and wants a forum as described above. To preserve our original plan for these teams, we left our diagrams and requirements above intact.

For the block pages, since Stephanie did not have resources divided by age group yet, this is absent from the block pages as of the end of the project. We also have a contact page template that is not fully implemented because of spam and security concerns with Stephanie's contact information.

While Julius Marks is the pilot for the website, Stephanie plans to expand the site to other schools and even cities. We hope to code in such a way that, in the future, other groups can easily scale the project to include other cities. Stephanie also requested advertising slots on the website to offset the costs of hosting and moderation. To accomplish this with Google, the site must first be published, so this is not possible at the moment. Furthermore, the other senior design team working on The Human Domino Effect game would like us to add QR codes that integrate with the online game. Since this will require a complex database interface, our other requirements are already so broad, and our priority is the Online Concept Exchange itself, this may not be possible with the remaining time.

A significant potential risk is that Stephanie gave us AI-generated art for the game's characters who come from diverse cultures. Given that AI can magnify the bias in its training data, rather than minimize it, there is potential for caricaturing and appropriating certain cultures.

Stephanie expressed this concern, and so the pictures may need to undergo revision. There are also considerations for copyright infringement and following the license agreement of the generator Stephanie used that must be addressed before publishing.

Glossary

- **Arching blocks:** These are branches of human knowledge (arts, sciences, humanities), which are placed on top of the building block pillars towards the end of the game.
- **Building Blocks:** Building blocks are an engaging way to learn about the framework of human civilization and how we can work together to make our world a better place for everyone. There are nine of them that are built up in the center of the game board. They include: loving prepared environment, stability, energy for concentration, practiced perception, responsibility, developed abilities, discernment, functional relationships, and resilience.
- **Flask:** A library written in Python that allows developers to send the user different webpages based on the URL they enter (i.e., routing).
- **GitHub:** This is a platform that hosts the project repository, or the place where all the code is stored. It also provides a view of the project progress in the Projects tab of the repository. It is named after git, a software that keeps track of changes to code and allows multiple developers to work on features simultaneously
- **Human Domino Effect Game:** a game that was built to teach kids about community and the importance of working together. It contains 9 building blocks, 3 arch blocks, 5 rounds, 7 levels, and 13 characters.
- **Jinja**: A library written in Python that allows developers to create modules or "templates" for parts of webpages that are reused across the site. This helps avoid repetitive code.
- **Julius Marks Elementary:** the elementary school that will use the pilot of the website.

- **Stephanie Fairchild Fister:** Stephanie is the creator of the Human Domino Effect Game. As a teacher herself, her experience motivated the creation of a game centered around humanity's collective learning. This project is an interactive extension of the game.
- **Sprint:** A sprint is a two-week interval of work where each developer will work on a feature (or two) to completion, including design, implementation, and testing. Each sprint involves a retrospective so the developers can constantly improve. This is opposed to the waterfall approach, where all features reach completion only at the end of the semester.
- **SQLite3:** A database software that can store user and forum data. It is a relational database, meaning it stores data in tables like in Excel. It uses Structured Query Language (SQL) to manipulate and query data in the database.