CS 161 Project Design Specification

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CS 161 - Section 01
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Section 1: Project Description

Detailed Description of the End Product: Memory Math-o-rama is an educational game designed to improve a user's arithmetic skills, while also improving cognitive thinking skills. Users will answer the arithmetic questions by flipping two tiles. Users will be timed and mistakes will be tallied. If the user is struggling, the user can request for hints or the solution. Users with an account will have additional features, such as viewing game statistics and logging out. On top of that, users with administrative privileges can view all users and delete non-administrative accounts.

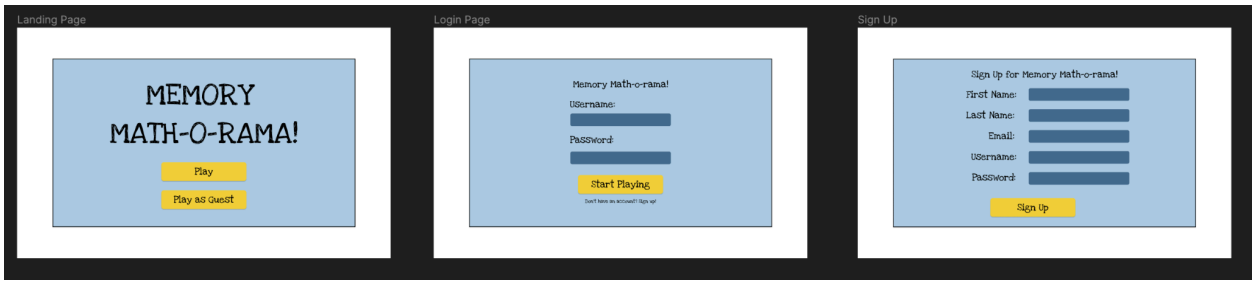
Game Play:

- **Game Description:** At the start of the game, the user will view all the tiles for twenty seconds. After those twenty seconds, the timer will start and the tiles will be flipped over, no longer being able to view the numbers. The user will be asked arithmetic questions such as "Which two numbers add up to 40?" To answer the question, the user will need to flip the two tiles that answer the question. It is important for the user to remember the values or memorize the values quickly on the tiles. If the user flips the incorrect tiles, the tiles will be flipped back around and the mistakes counter will increase by one. If the user flips the correct tiles, a new question will be generated. The user will continue playing until all the tiles are flipped over. After completing the puzzle, the user will be navigated to the Game End Screen.
- **Hint:** If a user is having trouble finding the tiles to answer the question, the user can request a hint for time penalty. When requested, the game will show the values on all the tiles for ten seconds, giving the user a hint by showing them the values of different tiles, which helps them find the answer.
- **Game Solver:** If a user is struggling to answer the question, the user can click on the Solve button. It will flip over the tiles that correctly answer the arithmetic question.

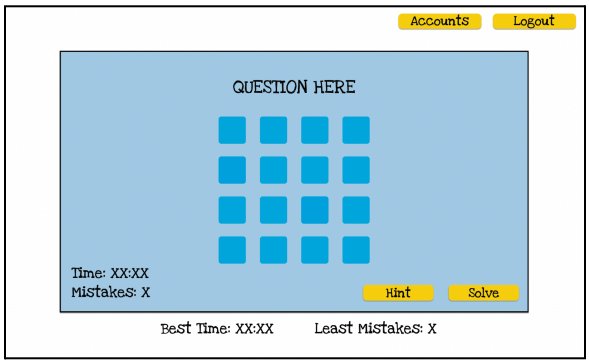
Project Wireframe:

- **Landing Page, Login Page, and Sign Up Page:** In the project, the Landing Page will consist of two options: Play as Guest or Play. If the user chooses to play as a guest, the user will be navigated to the game screen directly. If the user chooses to play, the user will be required to login with a username and password. After logging in, the user will be directed to the game screen. On top of that, if the user doesn't have an account, the user

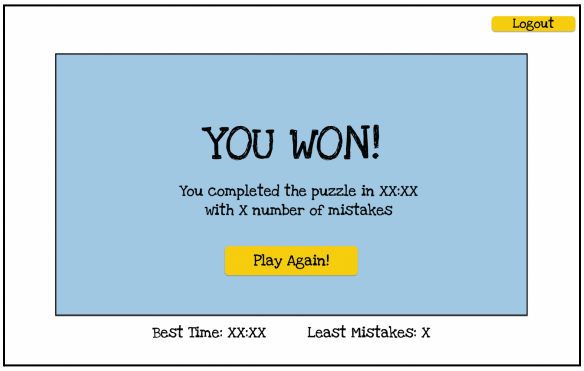
can sign up by navigating to the Sign Up Page to create an account. After creating the account, the user will be redirected to the Login Page to fill out the username and password fields.



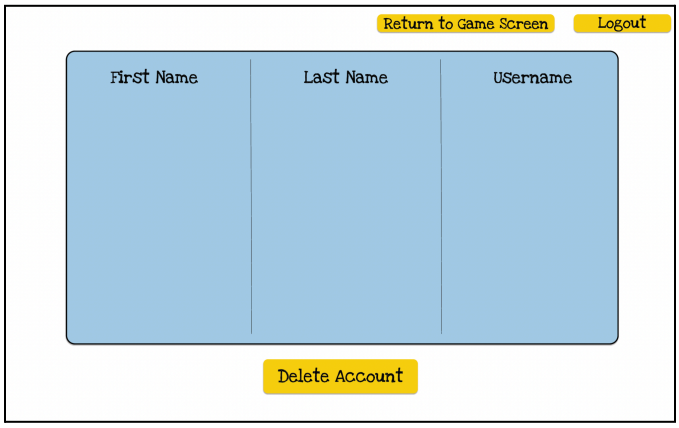
- **Game Screen:** If a user plays as a guest, the game screen will have questions, flippable tiles, a Hint button, and a Solve button. It will also have a timer and an error counter in the right corner. However, if a user logins in, the game screen will also have game statistics and a Logout button. On top of that, if the user has administrative privileges, an Accounts button will also be shown. Here is an example of a game screen of a user with administrative privileges:



- **Game End Screen:** The Game End Screen will include two things: the amount of time the user took to finish the game and the number of mistakes the user made during the game. Here an example of an end game screen of a logged in user:

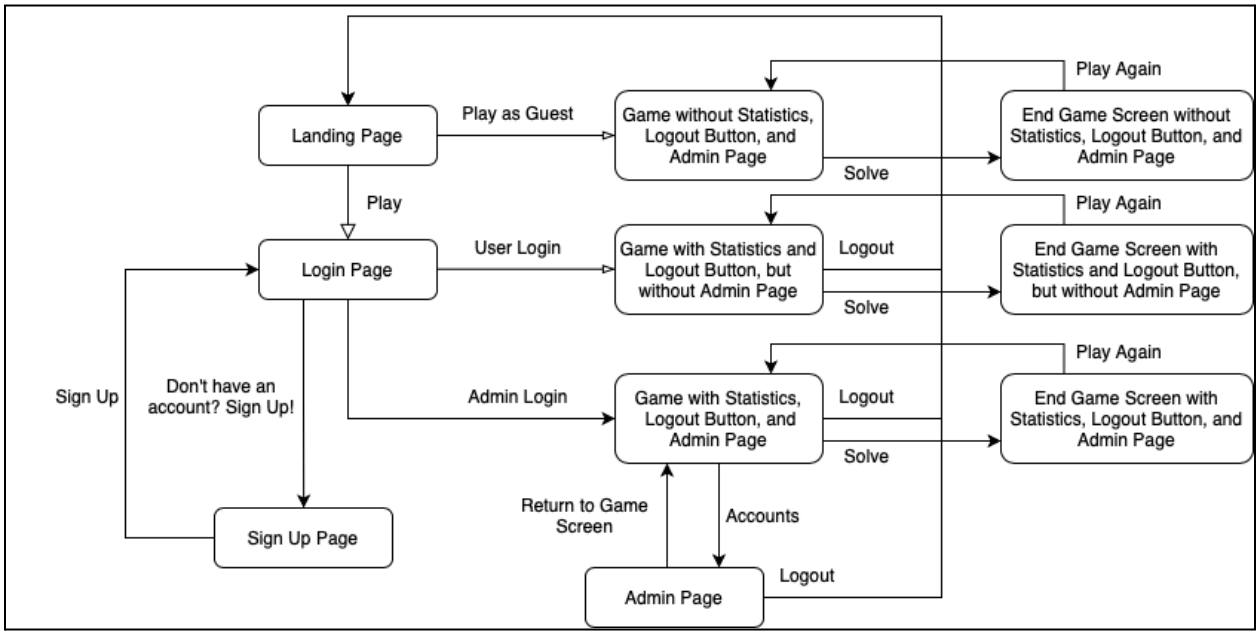


- **Accounts Page:** If a user has admin privileges, the user can navigate to an Accounts Page by clicking on the Accounts Button. The user will have the ability to view all the accounts and delete accounts. Here an illustration of the Accounts Page:



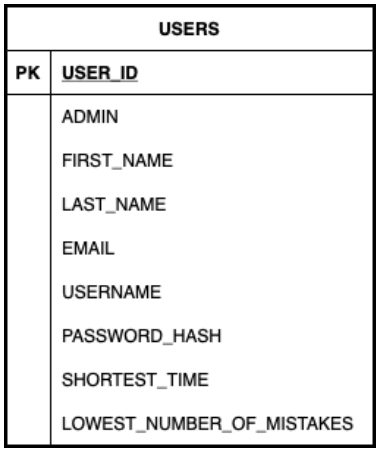
Flowchart:

Here is a visual illustration of the flow in the project:



Database ERD:

For the project, only one table called USERS will be used. It will contain personal information, administrative privileges, and game statistics of each user. Here is the Database ERD:



Methods used in the Puzzle Solver:

- **Generating Numbers on the Grid:** Using a random number generator, the algorithm will generate numbers within a range for each tile in the 4x4 grid.
- **Generating Arithmetic Questions:** Using the values on the grid, the algorithm will generate an arithmetic question that the user can solve by flipping two tiles. It will track the numbers available on the grid and the tiles flipped on the grid to create a solvable arithmetic question.
- **Game Solver:** Using the available values on the grid, the algorithm will traverse each value in the grid. It will utilize a hash set to store the traversed values, creating a more efficient and optimal solution. While traversing the values, the algorithm will perform an arithmetic operation to check for a pair that solves the arithmetic question. Upon discovering the pair of values that correctly solves the arithmetic question, it will flip the corresponding tiles over.

Market Space and Selling Points:

- **Market Space:** The game is targeting young children interested in puzzles, math, and computer science.
- **Selling Points:**
    - Educational Value: It allows the user to improve arithmetic skills, while also boosting cognitive thinking skills.
    - Incentivises Improvement: It incentives improvement through showing top scores (shortest time and lowest number of mistakes)
    - Interactive and User-friendly: It engages the user with an interactive gameplay and user-friendly environment.

Section 2: Functional Specifications

List and Description of Product Features:

- Home Screen: The home screen is essentially the landing page when the user first accesses the game. Users will have the option to play as a guest or play.
- User Authentication:
    - Login: Users can login into account by entering their username and the correct password associated with that username.
    - Password Hash/Encryption: When the password is stored in the database, it will be encrypted and hashed, resulting in a secure game.
    - Logout: Users can log out of the logged in account. When clicking the button, the game statistics data will be saved and the user will be navigated back to the landing page.
    - Sign Up Page: Users can create an account by providing their first name, last name, email, username, and password. After clicking Sign Up, the user information will be added to the USERS table.
- Administrative Privileges: Users with administrative privileges will have the ability to view all users and delete non-administrative users.
- Delete Account: Admin users have the ability to delete accounts of non-administrative users. To create that functionally, the accounts will be removed from the database.
- Creating Questions: Users will get different questions to answer. An algorithm will be used to generate the solvable questions.
- Flip Tiles: Users will flip two tiles to answer the questions. If the user flips the incorrect tiles, the tiles will flip back around. Also, an algorithm will be used to generate the initial values and another algorithm will track the numbers available on the grid and the tiles flipped on the grid.
- View Hints: If the user is stuck, users can click the Hint button to get a hint. However, there will be a time penalty if the user requests for a hint.
- Game Solver: If the user is stuck and is struggling even with the hint, the user can click on the Solve button to get the answer. It will flip over the two tiles that answer the arithmetic question. An algorithm will be used to implement Game Solver functionality.

- Timer: While users play the game, it will display and track the amount of time the user takes to complete the puzzle.
- Mistakes Counter: While users play the game, it will display and track the number of mistakes the user makes.
- Game Statistics: Viewing the game statistics will only be available to logged in users. Those users will be able to view the shortest time they have taken to complete the puzzle and the lowest number of mistakes they have had when completing the puzzle.
- Game End Screen: After completing the puzzle, the user will be navigated to the game end screen. It will include the total time the user took to complete the game and number of mistakes the user made during the game.

Section 3: Deployment

Flask Project Deployment: I will deploy the Flask project with Heroku. First, I will create a Heroku account. Next, I will install Heroku CLI and complete the login process. Afterwards, I will create a file named Procfile in the project's root directory and update the requirement.txt file. Since I made changes to the project, I will commit the changes to Git. Lastly, I will run a command to create a Heroku app and push the Git repository that was created. After pushing the changes, the building and deployment starts. Altogether, following these steps will result in successfully completing the deployment process, since the app will be online and accessible with a website URL.

Section 4: Features with Milestones

Features That Will Be Accomplished In My Major Milestones:

- M1: Setting up Github and Flask App Setup
    - Database ERD
    - Wireframes
- M2: User authentication (Login, Signup and Logout)
    - Initial Database Setup
    - Login Page
    - Sign Up Page
    - Password Hash/Encryption
    - Logout
    - Home Screen

- M3: UI Design (4x4 Grid, Flippable Tiles, and more)
    - Game Screen Page
    - Flip Tiles
    - Timer
    - Game End Screen
- M4: Game Logic Implementation
    - Creating Questions
    - Game Solver
    - Mistakes Counter
- M5: Showing Hints, Saving Game Data, and Admin Privileges
    - View Hints
    - Game Statistics
    - Administrative Privileges
    - Delete Account