Week 4 Progress Report (2/18)

Similar Products:

+ The idea for this project came from the Julia Robinson Mathematics Festival packet (source).

+ I was not able to find an existing online game that was exactly like my product, but some similar games online that dealt with sum puzzles were:
    - Summle: (https://summle.net/) Make sums using tiles at the bottom to reach the target number at the top in 5 steps or fewer.
        - This game does not provide a solution for users, however, users can request hints.

Core Engine:

+ *Algorithm:* A backtracking algorithm will be used to generate all the possible solutions for a given puzzle. Starting with the node that has the given number, for each connected node that hasn't been assigned a value yet, a positive whole number will be assigned to it. All possible assignments will be recursively explored and made sure that the sums equals the values of the node it's connected to. If a solution is found where all nodes are filled with valid numbers, it will be added to a list of possible solutions. Other possible assignments will be tried after backtracking, until all options are exhausted.

+ Since the solution is generated via a brute-force approach that explores all possible combinations of numbers for each node, it can become more inefficient for puzzles that have more nodes and connections, leading to a higher time complexity. Therefore, it is not an optimal solution.

+ *Time Complexity*: $O(m^n * d)$
    - Variables:
        + m: the maximum number of connections a node has
        + n: the number of nodes in the graph
        + d: the maximum number of digits in any number in the graph
    - $O(m^n)$: the number of possible combinations for each nodes
    - O(d): the complexity of calculating the sum of digits for each combination
    - The time complexity will vary depending on the specifics of the graph