Parson’s Programming Puzzle Scoring System Improvement

SAGE Midterm Report

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1. Abstract

In the midterm report, we will talk about the progress we’ve made so far. Our work for this semester includes improving both the scoring system and the score persistence feature. The relevant Epic Gameful Direct Instruction and Feature is Parson's Puzzle 1.2. For the first half of the semester, we focused on Story Parson's Scoring. We successfully designed and implemented an improved scoring algorithm.

2. Implementations

The original scoring system was mainly based on Manhattan distance idea. For each operation in student’s answer, the system tried to align it with its position in the solution by padding Null value in front of the student’s answer. Then the system had a function which utilizes the Manhattan distance idea while taking the above processed student’s answer as an input parameter. The system then multiplied the manhattan distance of each operation to its correct position in the correct sequence by points of the operation and added them together. Finally, the system used the total sum of all operation points

in the correct sequence times the length of the correct sequence to minus the above lowest calculated sum to get the highest final result as the score. As shown above, the logic behind the original scoring system is pretty complex and we decide to design an algorithm which is more concise, easier to understand and performs better in real scenarios.

The old scoring system basically only calculates how many points to deduct from the max possible points. However, the final score is composed of both positive and negative parts under our new scoring system. The new system takes consecutive sequence into consideration. Consecutive sequence here means that the order of operations in the sequence matches the order in the solution. So the consecutive sequence has minimum length 1 and maximum length of the answer. For each student's answer, the new algorithm will find every consecutive sequence, multiplies points of each operation by the length of its sequence, and then add them up as the positive part. For the negative part, for each consecutive sequence, the algorithm will calculate the manhattan distance between it's positions in student's answer and the solution. Then the algorithm multiplies the distance and the average score of the sequence together. The sum of these scores of all sequences will be the negative part. Also, if the operation in student's answer is not in the solution, the points of that operation will also be added to the negative part. The final score is the positive part minus the negative part.
The following table demonstrates how the new system gives better dynamic instructions with an easy scenario. The correct sequence is 'abcd'.

Answer	Old	CS
a	4	1
ab	8	4
abc	12	9
abdc	14	4

Another consideration is that students may not complete the puzzle step by step following the order of the solution. They may work on each subpart and finally connect them all at once. The original scoring system considered each separate chunk of operations as an answer, passed it into the scoring algorithm and finally displayed the maximum scores among all chunks. One drawback of only displaying the maximum score is that the students cannot see any change of the score when they work on the chunks with smaller scores, so they cannot get feedback and instruction dynamically. Instead, the new scoring system will display the sum of all nonnegative scores to help give as many feedbacks for each chunk as possible. The reason why we do not add negative scores is that we do not want to perform score deduction only because they have a new chunk.

3. Limitations & Assumptions

Consider that students may “abuse” the scoring system, we originally wanted to take the number of incorrect moves as another negative component to the final score. However, the way of calculating the number of incorrect moves in the original system doesn’t show real number of incorrect moves but the difference between the number of total moves and correct moves. So, if the student tries to complete the puzzle part by part without any wrong moves in the middle and connect separate chunks together in the end, then the number of total moves will be larger than the number of correct moves, which makes the number of incorrect moves be larger than 0.

Another limitation is that students may not see the feedback for separate chunks when the manhattan distance for that chunk is too large even though the chunk is a correct sequence.

An assumption for the current scoring system is that duplicate operations are not allowed.

4. Future Work

For the rest of the semester, we will focus on the Story Parson's Score Persistence to make sure the scores generated by the new scoring system will be saved to be evaluated.

For the scoring system, we will continuously work on preventing the students from abusing the system. We will improve incorrect moves calculation or adopt new factors as an “punishment” for abusing.