CPSC 481 Capstone Report: 10000 Dice

John Tu, Mauricio Macias, Reeder Loveland

Problem Statement: The problem that we try to solve is building a game called 10000 Dice. 10000 Dice (or Farkle) is a dice game where true to its name, the player tries to score 10000 points before their opponent can.

The rules for 10000 Dice is that each player rolls 6 dice and based on the dice roll result, he or she can select which dice to keep for scoring and which dice to keep rolling. For instance, the player chooses to keep two 1's from the roll and re-roll the remaining four dice. The player can continue to roll the dice until he or she decides to score points and end the turn, or the player cannot score any points at all. The next turn then passes on to the next player, and the game continues on until one player scored at least 10000 points. The first player to score 10000 points wins the game.

The scoring for 10000 Dice is detailed as followed:

- 1 - 100 points

- 5 - 50 points

- Three of a kind of 1 - 1000 points

- Three of a kind of 2 - 200 points

- Three of a kind of 3 - 300 points

- Three of a kind of 4 - 400 points

- Three of a kind of 5 - 500 points

- Three of a kind of 6 - 600 points

- For each number over three of a kind, add the three of a kind amount again (example 3 2's = 200, 4 2's = 400, 5 2's = 600, 6 2's = 800).

- Pairs and Straights: When a player rolls 1,2,3,4,5,6 when rolling all 6 dice, this is a Straight. When a player gets 3 sets of pairs when rolling 6 dice, dice this is called Pairs. Pairs and straights are worth 1500 points.

Approach: The scoring algorithm for this game is using global maximization in order to obtain the highest number of points possible based on the result of the dice roll. For each time the Ai player rolls, they will take all points available and roll again for the global maximum of points on the next roll. Since there is a chance to Zilch on any given turn and lose your points, the AI will keep rolling while there is ample opportunity to score and stop when it becomes too risky to continue. As long as there are at least 3 dice to roll, there is a chance that the Ai can score a triple but after that point they can only score a 1 or a 5. With less than 3 dice the AI will end its turn to preserve the points it already has scored. This will give the AI opportunity to keep rolling as well if they score on all 6 dice with the same reroll criteria on the new dice.

Description: The programming language used for developing 10000 Dice is Python. The window layout for 10000 Dice is based on Tkinter GUI, along with buttons that trigger commands when they are pressed and the message boxes that pop up as a notification on who won or whether the player cannot score any points and must end their turn.

Each of the functions declared in the source code are described below:

- on_closing() displays a confirmation window when the user exits the game.
- randomGen() generates random dice rolls.
- keep_dice(args) selects which dice to keep for scoring, and it does so by having dice buttons being pressed to indicate they are selected and raised for being deselected.
- is_triple_position(args) checks whether there is a three of a kind for the dice.

- calc_points() calculates the total amount of points for the player by counting how many ones and fives there are, as well as pairs, straights, and three of a kind dice.

- reroll() only rolls the dice that are not kept for scoring, and only if at least one of the dice selected counts for scoring points.

- endTurn() ends the current player's turn and adds the points to the total score. Furthermore, if one of the player's total is at least 10000, then display a congratulatory message to the player.

- forget() resets the dice result and number of points.

- reset() resets all the window back to its default settings, including the total scores, number of points, and dice result.

- AITurn() is the function where the AI player makes its moves to score points.

- newWin1() is the main window for the game.

- how_to_play() is the window for instructions on playing the game.

How is the AI implemented for 10000 Dice? We let the AI roll the dice and randomly choose which dice to keep for scoring. It calls the function randomGen() to generate six random dice rolls, and will only select the following below for scoring:

- Ones
- Fives
- Three of a kinds
- Four of a kinds
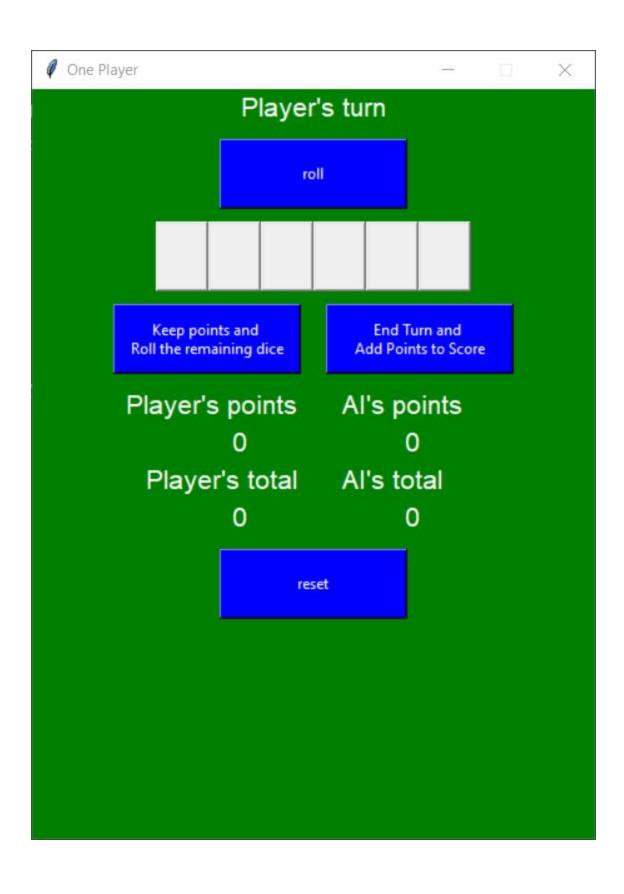- Five of a kinds
- Six of a kinds
- Pairs

- Straights

If there are at least 3 dice not selected and the AI can score points, then the AI will continue rolling to score more points. Otherwise, it will end the turn. If the AI is lucky enough to score all 6 dice, then it gets to take an extra turn in rolling the dice to score points.

Evaluation: After playing through a simple match against the AI player, it turns out as the user player, we barely won against it. For example, in a sample match against the AI player, we are at least a hundred points ahead of the AI player, but somehow, the AI managed to keep pace with us by scoring more points than usual! Fortunately, we managed to secure a decisive victory against the AI player, albeit barely by 250 points apart. Another example of how smart the AI player is that suddenly, the AI player managed to score all 6 of the dice rolled and gets to take an extra turn as a result! I was surprised to find out how the AI managed to achieve such feat. Nonetheless, it was a good match against the computer player, and this project taught us well about how the AI is capable of making the most optimal move in response to the player's.

The AI player is smart enough to score points not only by selecting the ones and fives, but also the pairs, straights, and three of a kind of the same dice number. It was a good match after all, as the AI player can mimic the same move that a human player would do!


Sample screenshots for the game demo against the AI player:

# Player's turn

roll

### Keep points and Roll the remaining dice

### End Turn and Add Points to Score

## Player's points

0

## AI's points

0

## Player's total

0

## AI's total

0

reset

Conclusion: If there are some improvements that can be considered for 10000 Dice, then we can add additional rules into the game, such as instant win if any player managed to roll all six ones during their turn. Furthermore, since the game depends on randomization and luck due to dice rolls involved, it is possible that the AI player may have a one-sided advantage against the human player. Perhaps we may need to adjust its behavior so that if it manages to score points from all 6 dice (excluding 3 of a kind rolls), then it should end its turn properly rather than continuing to roll the dice.

References: (see below for the list of sources used)

Rules on how to play 10000 Dice:

https://www.mtnbrook.k12.al.us/site/handlers/filedownload.ashx?moduleinstanceid=17468&dataid=14501&FileName=10000-dice-game-directions-printable.pdf

Link to play a sample game of Farkle: http://www.playonlinedicegames.com/farkle