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Pig Project Write-up
CMPT Intro Sect. 02

The following files are turned in with this assignment:

Die.java
PigPlayer.java
UserPigPlayer.java
PigGame.java
Simulations.java
SimpleHoldPlayer.java
FourTurnsPlayer.java
WatchOpponentPlayer.java
StrategicPlayer.java

I have also included the following test files:

DieTest.java
PigPlayerTest.java
TestAllPigPlayers.java

As well as the StaticRoll folder for the graphical version of the game.

Although I was able to complete the project and pass all unit tests, as well as complete the simulations and reach optimal values and strategies, this project posed some difficulties for me. Regardless, the most important thing, I feel, that I achieved with this project is a deeper understanding of what Computer Science means to me. Very rarely was this project straight-forward, and there were times in which my confidence in my ability was questioned. However, never once did I feel like straying away from my goal of a Computer Science major. Instead, I was filled with a desire to learn more and improve myself, which I feel was the most valuable aspect of this project.

My StrategicPlayer focused on starting strong and gaining an advantage, and then pulling back and playing more cautiously. Initially, the player will roll until they reach a turn total of 25, and then pass. This will continue until the player reaches a total score of at least 50, signaling the player to assume a holdValue of 10 from then on out. I considered other strategies that could be implemented (including a 'cheat' strategy that would utilize a loaded die), but this strategy worked well against other strategies. Most importantly, it did well against the SimpleHoldPlayer, but it also held the advantage over each other strategy excluding FourTurnsPlayer, which was superior.

The two strategies FourTurnsPlayer and WatchOpponentPlayer were more complex. This was especially true for the FourTurnsPlayer, in which 'four turns' did not mean four turns, but rather four scoring turns. Implementing this specification required much thought, but was eventually successful. WatchOpponentPlayer, meanwhile, had a little more wiggle room. In testing appropriate values for the 'reasonable' and 'number' values, I came to the conclusion that a value of 1 for each was fitting. With a 'number' value of 1, the difference between the two player's scores would always be returned, and nothing less. Then, a 'reasonable' value of 1 results in a hold value that is always one greater than the difference between the two scores. Therefore, the WatchOpponentPlayer always aims to stay at least one point

ahead of the opponent (unless the WatchOpponentPlayer is in the lead, in which case the holdValue is set at the optimal hold value discovered in SimpleHoldPlayer).

1. From a total of 100,000 simulations the player who has the first turn wins approximately 55% of the games, while the second player wins 45%. Therefore, at a hold value of 20, whoever takes the first turn appears to have the advantage. This advantage, however, is not set in stone, as the difference between 55 and 45 is not massive. This advantage likely comes from the ability to set the pace of the game. As long as the first player does not roll a one, 25 points are possible, resulting in the first player already being $1/4^{th}$ of the way to the goal after only one turn.
2. The best holdValue was found by comparing different, relatively close holdValues and gradually decreasing the difference. The first test, for example, compared hold values of 20 and 15, and found the hold value to be in slight favor of 20. This indicated that a hold value of 20 or higher was optimal. 20 and 25 were then tested, and revealed that 20 was still slightly more favorable. Therefore, the optimal hold value existed between 20 and 25. From then on out, 20 was compared to 21, 21 was compared to 22, and so on. Eventually, this method revealed the optimal holdValue to be 24.
3. The best strategy was found using a tournament-style comparison. First, SimpleHoldPlayer was compared to FourTurnsPlayer, which resulted in 52% of the games favoring FourTurnsPlayer. Then, WatchOpponentPlayer was compared to StrategicPlayer, and StrategicPlayer came out on top with a 54% advantage. Finally, FourTurnsPlayer and StrategicPlayer were compared, and FourTurnsPlayer was found to be the best Pig-Game strategy with a winning percentage of 51%.