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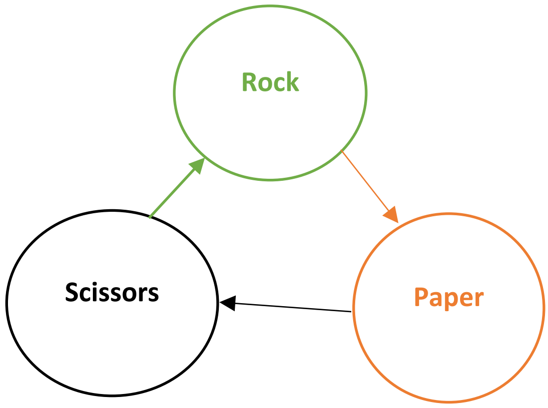
COMP3121 Assignment 3 – Question 2

2) We are required to find the best method to play the Rock (R) – Paper (P) – Scissors (S) game such that we can maximise the number of points that we can finish with.

See given diagram as an overall visual example:



Note that the direction the arrows are pointing in denotes the winner i.e. if Rock and Paper played, the Paper wins meaning the person who played Paper wins a point and the person who played Rock loses a point. Additionally, although it was not explicitly stated in the question, we can also have an occurrence where if the opponent plays Scissors, we can also play Scissors to 'counter' them which would result in a tie and hence no transfer of points (0 points won, 0 points lost).

We know that we start off with zero points initially. Since our player is predictable, they will always start with Rock and play that for a certain number of times and then Paper for a certain number of times and then Scissors for another certain number of times such that $R_a + P_a + S_a = N$. Additionally, we are restricted to play only so many Rock, Paper and Scissors a certain number of times such that $R_b + P_b + S_b = N$.

Now, to gain the maximum number of points, we can either play R or P against the opponent's R throw (i.e. we can either choose to draw or win the point).

Following this, our strategy here is quite simple: to reserve as many Papers to counter as many possible throws of Rock from the opponent, reserve as many Scissors to counter as many throws of Paper from the opponent and reserve as many Rocks to counter as many throws of Scissors from the opponent, meaning we will always win those rounds. Since we know that number of times that the opponent will throw their choices, and that it will be in the order of R, then P and lastly S, we can predict what they will throw next, knowing our own limitations.

Further, if we manage to have any leftovers of R, P or S, then we can use them to counter any throws of R, P or S that the opponent respectively throws in order to obtain a tie meaning we don't stand to lose or gain any points (which is the next best thing).

Since we know how many times the opponent will play R, P or S, we need to find the maximum number of this i.e. if the opponent had 5 R, 2 P and 1 S, then the maximum number will be 5 rock throws. We will then play our own opposing throw that would gain us a point against this max number i.e. we would play P against the opponent's R. If we run out of P throws, we will play the throw that will at least make the current throw a tie i.e. our own R against the opponent's R.

Hence, every time the opponent throws, we will need to find the remaining balance of the opponents' throws and find the new maximum out of their R, P or S throws and adjust our own throws accordingly to win against the new maximum or at least tie against them. If the opponent's throws are instead equally spread, then we will then find our own balance of throws available and choose our maximum R, P or S that we will then save or throw now to obtain the maximum number of points.

As a result, to prove that this is the optimal solution, we consider the situation when we do not take the remaining maximum throws at each stage for both the opponents and our throws. Any other solution would result in throws that will at most get the same maximum number of points (by luck) compared to our algorithm otherwise they will get less points as the algorithm would be fixed on only that hand, without considering the remaining throws. In our case, we are adjusting for the maximum opponent throws in real-time.

End of Solution