The Investigation of an Impartial Normal Play Game

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This project investigated the winning values of the following Nim variant: There exists set A and set B, with some number of elements in each. On a player's turn, the player may reduce set A by x, set B by y, or both sets by z, where x, y, and z are positive integers. The player who takes the last turn, or reduces A and B to zero, wins. "Safe spots" are winning values of sets A and B, such that the player who reduces the sets to the safe spot values will win. By analyzing the relationships between safe spots, a sequence was derived to represent the difference between adjacent safe spots. Subsequently, a recursive equation was developed to represent the sequence. The average distance between safe spots was calculated and found to be equal to phi, where phi is equal to f_n/f_(n-1) as n goes to infinity, where f_n is the nth Fibonacci number. Because of the correlation to the Fibonacci series, the project results may have applications in biology, number theory, geometry, and other fields of math and science.