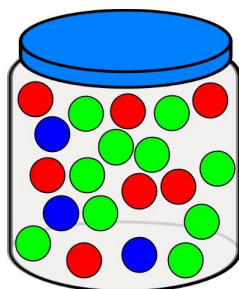# DEPARTMENT OF MATHEMATICS

Math Club

Michigan Epsilon Chapter of Pi Mu Epsilon

Problem of the Fortnight

Drake and Emily play the following game. They start with 2019 marbles in a jar. They take turns, and one turn consists of choosing some positive integer d that divides the current number of marbles in the jar, and then removing d marbles from the jar. Whoever takes the last marble loses. Drake goes first.

For example, on Drake's first turn he could choose to take either 1, 3, 673, or 2019 marbles. If Drake chooses to take 673 marbles then there are 1346 marbles left. So then Emily could choose to take 1, 2, 673, or 1346 marbles for her next turn.

One of the players has a winning strategy (in other words, a set of directions that player can follow that will always lead to winning the game, no matter what the other player does). Which player has a winning strategy, and can you describe their strategy?

Please turn in your solutions to Dr. Patrick Bennett, by noon on **Monday March 11 2019**. Strive for clarity, neatness and legibility! Solutions may be turned into the Math Dept office in **3319 Everett Tower**. Please include your name and email address. Electronic submissions may be sent to **patrick.bennett@wmich.edu**. If you are currently taking a math class, please include the instructor's name and the course number.