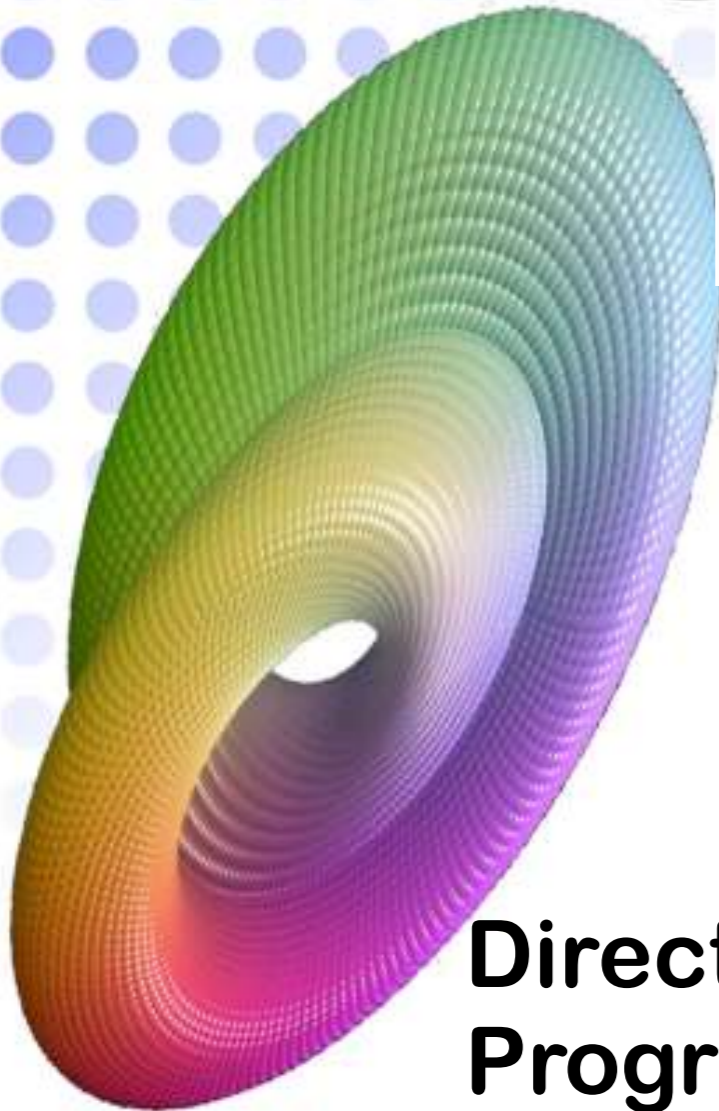
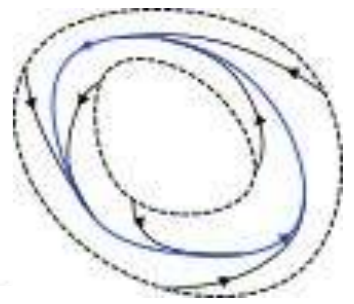


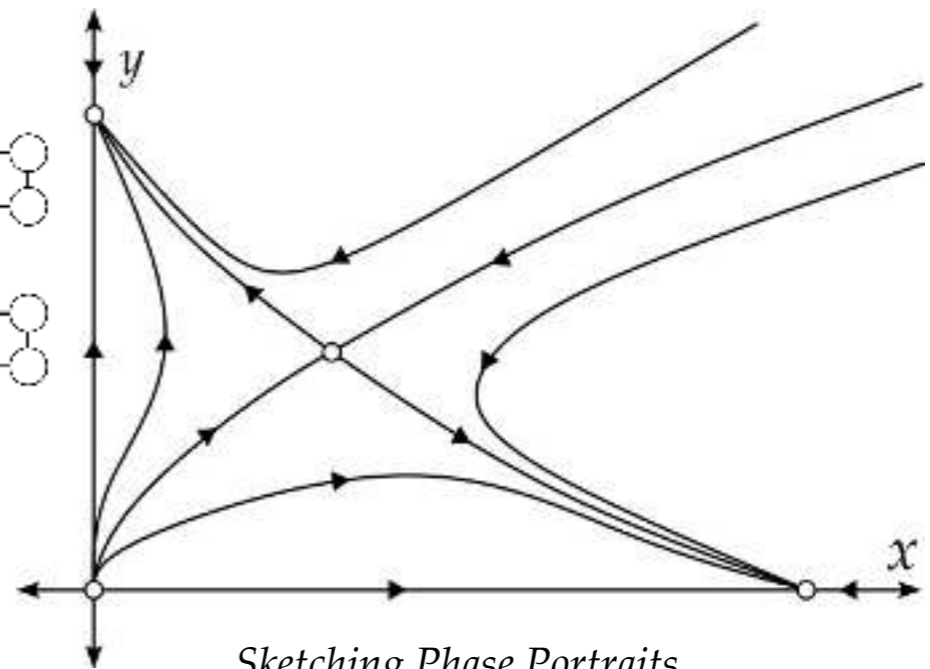
# Michigan Math Club



The dynamics of the chip-firing game are devoted to divisor theory of graphs. It is the game played on graphs by placing an integer number of chips on each vertex. In this talk, we will first play this game by trying to bring every vertex out of debt. Then, we will play the gonality game, which is you place  $k$  chips on the graph, and then an opponent places  $-1$  chips. You win by removing the  $-1$  chip. We will then finish by introducing gonality for specific types of graphs with a short sketch of proofs.

Mentor: Benjamin Bailey

Thursday at 4pm in EH1360  
Pizza + pop outside afterwards!!



*Sketching Phase Portraits*  
Daniel Cross

Continuous dynamical systems are used in a wide range of applications, and a large swath of such systems can be described by nonlinear ordinary differential equations (ODEs). Unfortunately for us, nonlinear ODEs are often extremely difficult to solve, and the solutions can be hard to interpret (if we can even find them!). Luckily, there's an easier way to understand nonlinear systems: drawing a phase portrait. In this talk, I'll give an overview of what a phase portrait can tell us about a dynamical system, as well as a basic method to sketch a phase portrait by hand. I'll conclude with a couple interesting examples of non-planar portraits.

Mentor: Joe Huang

## Directed Reading Program Presentations

08 December 2022

*Rational Points on Elliptic Curves*  
Abigail Hess

Elliptic curves are important for their many applications to cryptography, number theory, and other fields. One interesting area of study is the rational points on elliptic curves, that is, points where both coordinates are rational numbers. In this talk, we will explore their structure and how they exemplify a fascinating link between algebra and number theory.

Mentor: Kaya Lakein

