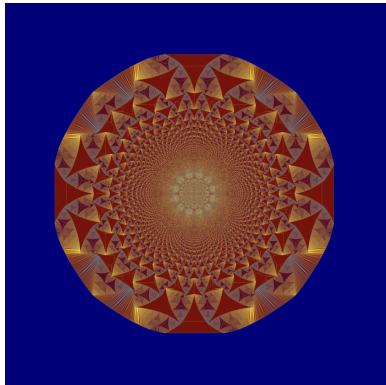


An introduction to chip-firing



Carly Klivans, Brown University

TA:

Ralihe Raúl Villagrán Olivas, Eindhoven University of Technology

Alex McDonough, UC Davis

Agustina Victoria Ledezma, Universidad Nacional de San Lu

Jonathan Nino, University of Washington

References for the minicourse:

- The Mathematics of Chip-Firing, Caroline J. Klivans, CRC Press
<https://www.dam.brown.edu/people/cklivans/chipfiring.html>
(Free pdf download available on this site.)

Slides from the Lectures:

Lecture 1 Basics of chip-firing

Lecture 2 Critical configurations

Lecture 3 Spanning trees and sandpile groups

Lecture 4 Pattern formation

Exercises:

[Exercises 1](#)

[Exercises 2](#)

[Exercises 3](#)

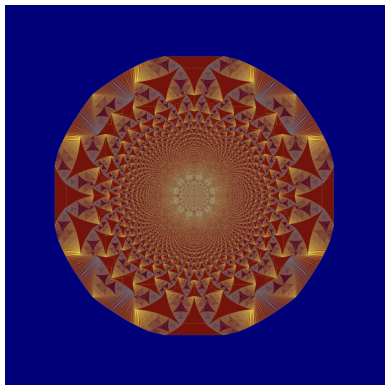
Exercises 4

Resources:

How to obtain Sage

- Installing it directly: [Sagemath](#)
- [Sage cell server](#): on this webpage you can run sage in your browser.
- [Cocalc](#) you can have projects and collaborations in the cloud. They have a freemium service.
- Chip-firing in Sage: https://doc.sagemath.org/html/en/thematic_tutorials/sandpile.html
-

Una introducción al chip-firing



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Referencias para el minicurso:

- The Mathematics of Chip-Firing, Caroline J. Klivans, CRC Press
<https://www.dam.brown.edu/people/cklivans/chipfiring.html>

(La versión pdf puede descargarse de manera gratuita en este sitio web.)

Diapositivas del curso:

Clase 1 Conceptos básicos de chip-firing

Clase 2 Configuraciones críticas

Clase 3 Árboles de expansión y grupos de pilas de arenas

Clase 4 Generación de patrones

Ejercicios:

Ejercicios 1

Ejercicios 2

Ejercicios 3

Ejercicios 4

Recursos: