

# Symbolic Dynamics 2

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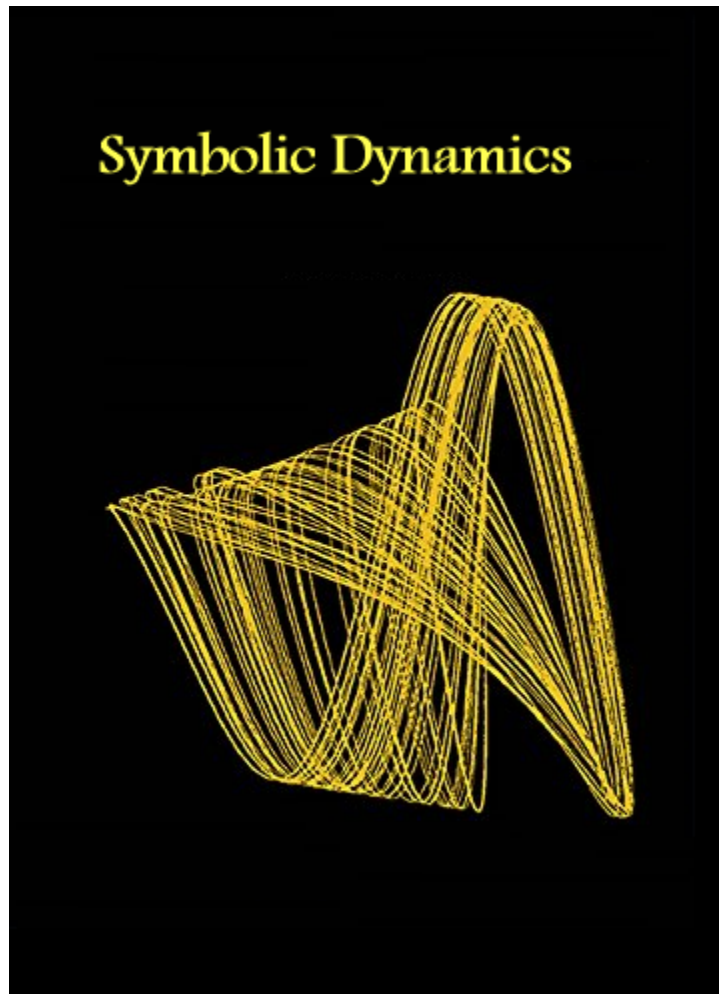
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Class Hours: Wed, 19-21

Class Room: Online

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## Course Description

**Remark:** This course will be a continuation of the previous course (Symbolic Dynamic 1).

This course is about one of the branches of dynamical systems; What a dynamical system is a space with a bunch of rules that on it that tell us what happens to each point in that space; Yet what we want to do is then be able to predict long-term behavior about what happens to the system as you keep applying rule over and over this kind of space the ones.

We look at every abstract but you could think of them as something like planets rotating around the sun and you take a snapshot where each one is once a second and then try to tell me where they will be millions of years into future.

One of the tools we can use in our research is **symbolic dynamics** and what this is a mechanism to take a complicated abstract dynamical system and record it in a simpler way so that we can study it.

Let's say you are standing and observing a traffic light. Then we are going to pretend there's no yellow to make it simpler; it just alternates between red and green; and let's say it changes every 30 seconds, and every 30 seconds. We might down the color of the traffic light using a **0** to say that it's red, and a **1** to say that it's green. Then our pattern will just say **01010...** It will continue like that forever more in the other words this is a super simple pattern, because it's just this little block **01** repeated; all the time it's a periodic pattern.

Now, let's look at that same traffic light, but we don't measure it every 30 seconds. Maybe we measure it every 31 seconds or 32 seconds. When we do this, we might see the same number in a row twice, so this is something that we can detect using symbolic dynamics.

It is really a beautiful part of math to find connections which are not apparent and finding structures; where you didn't know that, they were going to be there to us this is one of the best parts about doing.

## Course Outline

- **Shifts and Dynamical Systems:**
- **Conjugacy:**
- **Finite-State codes:**
- **Finite-to-one Codes and Finite Equivalence:**
- **Degrees of Codes and Almost Conjugacy:**
- **Embeddings and Factor Codes:**

## Prerequisites/Corequisites

We will cover every necessary prerequisites.

## Main References

1. D. Lind and B. Marcus, *An Introduction to Symbolic Dynamics and Coding*, Cambridge University Press, 2021.
2. B. Kitchens, *Symbolic Dynamics (One-sided, Two-sided and Countable State Markov Shifts )*, Springer, 1998.
3. A Ya Belov, Grigorii V Kondakov, Ivan Mitrofanov *Inverse problems of symbolic dynamics* , arXiv preprint arXiv:1104.5605
4. A. Ya. Kanel-Belov, G. V. Kondakov, I. V. Mitrofanov, M. M. Golafshan, 2021, *On the sequence of the first binary digits of the fractional parts of the values of a polynomial*, Chebyshevskii sbornik, vol. 22, no. 1, pp. 482–487.

## **Grading Policy**

- Assignments; (80%)
- Projects. (20%)

## **Assignments**

5 series of homework: each section one homework include of one or two problems

## **Project**

Based on materials of class