



Fall 2023

## WEEK 6 STUDY GUIDE

### The Big Picture

We develop an algorithm that uses a Markov chain to simulate a probability distribution on an intractably large outcome space.

- Under some conditions that are pretty general, Markov chains have powerful long run properties.
- *Steady state* or *stationarity* has a physical interpretation and many uses.
- Many Markov chains, when run for a long time, exhibit different kinds of *balance*. These can be used to identify steady state properties.
- *Monte Carlo* methods use simulation to address problems that are intractable by math or by complete enumeration.
- *Markov Chain Monte Carlo* (MCMC) can be used to simulate probability distributions on intractably large outcome spaces, even when the normalizing constant of the distribution can't be calculated.

### Week At a Glance

Mon 9/25	Tue 9/26	Wed 9/27	Thu 9/28	Fri 9/29
	Lecture	Sections	Lecture	Mega Sections
Homework 5 due at noon	Homework 6 (Due Mon 10/2 5PM)			HW 6 (+Lab 4) Party 2PM - 4PM
Lab 3B due at noon	Lab 4 (Due Mon 10/2 5PM)			
Midterm 1	Skim Sec 10.1-10.3	Work through Ch 10, skim Sec 11.1	Skim Ch 11	Work through Ch 11

## Reading, Practice, and Class Meetings

Book	Topic	Lectures: Instructors	Sections: TAs	Optional Additional Practice
Ch 10, 11	<b>Markov chains</b> <ul style="list-style-type: none"> <li>- 10.1 (covered in Week 5) introduces terminology, notation, and basics, along with a computational approach to the long run</li> <li>- 10.2 narrows down the type of chain we'll be studying, but even the narrowed-down group is pretty large</li> <li>- 10.3 takes a more theoretical approach to the long run</li> <li>- 10.4 has examples and applications</li> <li>- 11.1 is about different kinds of balance, and how one of them can make it easy to identify the other</li> </ul>	<b>Tuesday 9/26</b> <ul style="list-style-type: none"> <li>- Formal discussion of long-run behavior</li> <li>- Balance and detailed balance</li> </ul>	<b>Wednesday 9/27</b> Ch 11: <ul style="list-style-type: none"> <li>- Exercises 3, 4, 5</li> </ul>	<b>Chapter 11</b> Ex 1, 2
Ch 11	<b>Detailed Balance and MCMC</b> <ul style="list-style-type: none"> <li>- 11.2 solves the code-breaking problem with a tiny alphabet, by complete enumeration</li> <li>- 11.3 develops a general Markov chain Monte Carlo method that can be used to solve the problem with a large alphabet</li> </ul>	<b>Thursday 9/28</b> <ul style="list-style-type: none"> <li>- The code breaking problem, with a tiny alphabet</li> <li>- Using MCMC to solve the problem with a large alphabet</li> </ul>	<b>Friday 9/29</b> <b>Lab 4.</b> Please attend – the lab will make much more sense if you do, and it's one of our rare one-week labs.	

There are no exercises at the end of Chapter 10 because the methods of Chapter 11 make many problems easier to solve.