Fall 2025

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 9/29	Tue 9/30	Wed 10/1	Thu 10/2	Fri 10/3
	Lecture	Sections	Lecture	Mega Sections
Homework 5 DUE AT NOON	Homework 6 (Due 5 PM Mon 10/6)			HW 6 Party 2 PM - 5 PM
No lab due.	Lab 4 (Due 5 PM Mon 10/6)		Lab 4 Party 9 PM - 12 PM	
MIDTERM 1	Take a break from 140	Work through Ch 10, skim Sec 11.1	Skim Ch 11	Work through Ch 11

Reading, Practice, and Class Meetings

Book	Topic	Lectures: Professor	Sections: TAs	Optional Additional Practice
Ch 10, 11	**Markov chains** - 10.1 (covered in Week 5) introduces terminology, notation, and basics, along with a computational approach to the long run - 10.2 narrows down the type of chain we'll be studying, but even the narrowed-down group is pretty large - 10.3 takes a more theoretical approach to the long run - 10.4 has examples and applications - 11.1 is about different kinds of balance, and how one of them can make it easy to identify the other	Tuesday 9/30 - Formal discussion of long-run behavior - Balance and detailed balance	Wednesday 10/1 Ch 11: - Exercises 3, 4, 5	Chapter 11 Ex 1, 2
Ch 11	**Detailed Balance and MCMC** - 11.2 solves the code-breaking problem with a tiny alphabet, by complete enumeration - 11.3 develops a general Markov chain Monte Carlo method that can be used to solve the problem with a large alphabet	Thursday 10/2 - The code breaking problem, with a tiny alphabet - Using MCMC to solve the problem with a large alphabet	Friday 10/3 **Lab 4**. Please attend – the lab will make much more sense if you do. You can also use the lab party on Thursday 10/2.	

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