

Chaos and Fractals

CTY Course Syllabus

Week	Day	Session	Topics	PJS ¹ citation
1	Monday	Morning	Welcome to class!	Introduction, pp. 9-15 §§1.1-3, pp. 17-36
		Afternoon	Introductory lecture: The idea of chaos	
		Evening	Functions, composition, and iteration	
	Tuesday	Morning	Fixed and periodic points	pp. 277-9
		Afternoon	<i>continued</i>	
		Evening	The Chaos Game	
	Wednesday	Morning	The Computer May Lie	pp. 49-60
		Afternoon	Sensitivity and the Butterfly Effect	
		Evening	Finish above Essay: What implications does the phenomenon of sensitivity have for our use of calculators in the study of chaotic dynamical systems?	
	Thursday	Morning	Graphical analysis: Time-scale graphs and web graphs	pp. 550-2
		Afternoon	<i>continued</i>	
		Evening	Attraction and repulsion	
	Friday	Morning	Orbit analysis project: What happens between the fixed and periodic points?	
		Afternoon	<i>continued</i>	
	Sunday	Evening	Pascal's triangle I	§2.3, pp. 80-6
2	Monday	Morning	Finish orbit analysis project	
		Afternoon	Essay and discussion: Advantages and disadvantages of each kind of graphical analysis. Ergodic points lecture: Ergodic vs. periodic	
		Evening	Pascal's triangle II	
	Tuesday	Morning	Trip to bookstore for textbooks	§10.3, pp. 485
		Afternoon	Ergodic points investigation using ITERATE	
		Evening	Ergodic points investigation using ORBHIST Introduction to binary arithmetic	

¹PJS: *Chaos and fractals*, Peitgen, Jürgens, and Saupe, Springer 2004

	Wednesday	Morning Afternoon Evening	Finish introduction to binary arithmetic Play-Doh kneading activity The three properties of chaos in the kneading activity Zeno's paradox	§10.4, pp. 496-508
	Thursday	Morning Afternoon Evening	Binary representation of the doubling function Chaos in the doubling function <i>continued</i> Reading and discussion: Laplace's demon; determinism, unpredictability, and chaos	§10.5, pp. 509-519 Introduction, pp. 9-15
	Friday	Morning Afternoon	Chaos in the tent map Finish above Essay: How did we use the binary representation of the doubling function to show that this dynamical system has the mixing property?	
	Sunday	Evening	Finish any remaining dynamical systems worksheets Change of coordinates from tent map to $f(x) = 4x(1 - x)$ Read about Feigenbaum diagram	pp. 541-7, 572-4, 583-94
3	Monday	Morning Afternoon Evening	Classical fractals Compass dimension: How long is San Francisco Bay? Group project prep time	§§1.1-4 §4.2
	Tuesday	Morning Afternoon Evening	Fractals in the forest Finish compass dimension packet Introduction to complex numbers Julia Sets Group project prep time	§13.4
	Wednesday	Morning Afternoon Evening	Mandelbrot set Computer lab – exploring the Mandelbrot set Mathlympics Present group projects	§14.1, 784-7 §14.2-3
	Thursday	Morning Afternoon	SPEs, post-test, goodbyes Final essay: The most interesting/surprising thing you learned in this class. Guest speaker: Peter Elsea, UCSC Electronic Music Program	