Math 375T Dynamical Systems
Spring 2020 Section 53175

Instructor: Lewis Bowen
Email: lpbowen@math.utexas.edu
Webpage: http://www.ma.utexas.edu/users/lpbowen
Class webpage: http://www.ma.utexas.edu/users/lpbowen/m375t/m375t.html
Office: RLM 9.154, phone: 471-1132
Textbook: We will use *An introduction to Chaotic Dynamical Systems* by Robert L. Devaney. This book is available online though the UT Library system with your UT EID.
Recommended supplemental reading: *Introduction to Dynamical Systems*, by Brin and Stuck and/or *A First Course in Dynamics* by Boris Hasselblatt, Anatole Katok, Cambridge, 2003.
Prerequisite: At least one of 365C, 361K, or 367K. Please contact me if you are not sure whether this course is for you.
Course description: A dynamical system consists of a geometric or topological space with a self-map representing the passage of time. The theory focusses on long-term asymptotic behavior. There are a wide-range of applications (weather forecasting, internet search, patterns in prime numbers, etc). This course will serve as an introduction to the main mathematical ideas including recurrence/mixing, hyperbolicity, symbolic dynamics, stable and unstable manifolds, and time permitting we will see some ergodic theory.
Course objectives: Your first objective is mastery of the material. Please read the section in the text that we will be covering before we meet and come to class prepared to ask questions. Once you have mastered the material, it is important to be able to communicate it, both in written form (such as in exams and homeworks) and in verbal form. A good way to test yourself is to explain the material to a fellow undergraduate. Optimally, your fellow undergraduate should be able to follow your explanations and you should not have to check your notes.
Grading policy:

Participation	Homework	Exam1	Exam2	Final
5%	20%	25%	25%	25%

Exam Schedule: (to be announced)

Exam1	Exam2	Final
due Feb 25, Tuesday	due April 7, Tuesday	May 19, Tuesday

Exams: The exams will be take-home. The final will be in class. Calculators, notes and books will not be allowed on the exams or final. To get full credit on an exam problem, you must have the write answer and explain it clearly.
Homework: Homeworks will be due every week (with a few exceptions) at the start of class on the due date. Part of the homework will be on material not yet covered in lecture, in order to challenge you to think beyond what we have covered. The grading will account for this. Grading of homework will be based on both accuracy and clarity. The lowest two homework grades will be dropped. You can upload homeworks to Canvas. Late homeworks will not be accepted.
Participation: From time to time, I might ask you to explain some part of the material in class. There are two reasons for doing this. First, it is important for your education that you are practiced at verbally communicating high level mathematics. Second, it helps me understand your level of understanding, correct any misunderstandings, and adjust my lecture. To receive full credit for participation, you need only show up to class and make an effort.

Tentative Schedule:

Weeks	1	Sections 1.1-1.3: Examples and basic concepts
Week	2	Sections 1.4-1.6: Hyperbolicity, symbolic dynamics
Week	3	Sections 1.7-1.9: Chaos, structural stability
Week	4	Sections 1.10-1.12: Sarkovskii's Theorem, Bifurcation Theory
Weeks	5	Sections 1.13-1.15: Maps of the circle, Morse-Smale maps
Week	6	Sections 1.16-1.19: Homoclinic points, kneading theory
Week	7	Sections 2.1-2.3: Higher-dimensional dynamics, the horseshoe
Week	8	Sections 2.4-2.5: hyperbolic toral automorphisms, attractors
Week	9	Spring Break
Week	10	Sections 2.6-2.7: Stable/unstable manifolds, hyperbolic sets
Week	11	Sections 2.8-2.9: Hopf bifurcation, Henon map
Weeks	12-15	Ergodic Theory
Week	16	Review

Tips: When reading the book, it's good practice to pause before reading a proof and ask yourself what you would do to prove the statement. If time permits, try to prove the result before reading its solution. If you don't know where to start on a homework problem, it's a good idea to make a list of 'things to try' and a list of 'possibly relevant facts' and see if you can find connections. Of course, you can also get help from myself, the TA or your fellow students.

Make-up Policy: There are no make-ups for homework for **ANY** reason. If you have a valid reason (medical or family emergency) for missing an exam, then I will give you an alternative exam, preferably *before* the scheduled exam. Missing an exam without a valid reason will result in a score of zero for that exam. To be excused you must notify me (acknowledged email or written) prior to date of absence if such notification is feasible.

Religious Holy Days: By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.

Q Drop Policy: If you want to drop a class after the 12th class day, you'll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester. Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see: http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop

Student Accommodations: Students with a documented disability may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259 (voice) or 1-866-329-3986 (video phone).

http://ddce.utexas.edu/disability/about/

- Please request a meeting as soon as possible to discuss any accommodations.
- Please notify me as soon as possible if the material being presented in class is not accessible.
- Please notify me if any of the physical space is difficult for you.

Academic Integrity: Each student in the course is expected to abide by the University of Texas Honor Code: As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity. This means that work you produce on assignments, tests and exams is all your own work, unless it is assigned as group work. I will make it clear for each test, exam or assignment whether collaboration is encouraged or not. Always cite your

sources. If you use words or ideas that are not your own (or that you have used in previous class), you must make that clear otherwise you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UTs Academic Honesty Policy which can be found at the following web address:

`http://deanofstudents.utexas.edu/sjs/acint_student.php`

University Resources for Students: The university has numerous resources for students to provide assistance and support for your learning, use these to help you succeed in your classes.
The Sanger Learning Center: Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Centers classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit http://www.utexas.edu/ugs/slc or call 512-471-3614 (JES A332).
The University Writing Center: The University Writing Center offers free, individualized, expert help with writing for any UT student, by appointment or on a drop-in basis. Consultants help students develop strategies to improve their writing. The assistance we provide is intended to foster students resourcefulness and self-reliance. http://uwc.utexas.edu/
Counseling and Mental Health Center : The Counseling and Mental Health Center (CMHC) provides counseling, psychiatric, consultation, and prevention services that facilitate students' academic and life goals and enhance their personal growth and well-being. http://cmhc.utexas.edu/
Student Emergency Services: http://deanofstudents.utexas.edu/emergency/
ITS : Need help with technology? http://www.utexas.edu/its/
Libraries: Need help searching for information? http://www.lib.utexas.edu/
Canvas : Canvas help is available 24/7 at https://utexas.instructure.com/courses/633028/pages/student-tutorials
Important Safety Information from BCAL: If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be anonymous. If something doesnt feel right it probably isnt. Trust your instincts and share your concerns.
Evacuation Information: The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, http://www.utexas.edu/safety/

Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when an alarm or alert is activated. Alarm activation or announcement requires exiting and assembling outside, unless told otherwise by an official representative.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency