

Fall 2021 – Course Syllabus

Course Number: CSC452/652
Course Title: Theory of Computation
Credits: 3
Prerequisites: Grade of at least C in CSC350 or consent of instructor.
Lectures: Mon/Wed 5:30-6:45, Patricia A Sullivan Science 200
Instructor: Chunjiang Zhu
E-mail: chunjiang.zhu@uncg.edu;
Office: Petty 152; <https://uncg.zoom.us/j/5191068080>
Office Hours: Thursdays 9:00am-10:15am; 2:00pm-4:00pm, or by appointment

Catalog Description: Finite state automata and regular expressions, context-free grammars, push-down automata and their use in parsing, overview of language translation systems, models for programming language semantics, computability and undecidability.

Longer Description: In this class we explore the most fundamental question in computer science: What does it mean to compute something? This includes exploring issues such as processes/models that can mechanize computations, problems that can and cannot be solved with different models of computation, and fundamental limitations that restrict what problems can be solved computationally. While the focus of an algorithms class is on how fast problems can be solved by modern computers, this class digs deeper into the fundamental question of what problems are possible to solve in various computational models. The approach in this class is formal, using precise mathematical models and a significant amount of formal reasoning and mathematical proofs.

Student Learning Outcomes: Upon completion of the course students should be able to

1. Understand the basic theoretical models of computability: deterministic and nondeterministic finite automata, pushdown automata, and variants of Turing machines.
2. Design finite automata corresponding to given regular sets, and describe the regular set recognized by a given finite automaton. Do the same with pushdown automata and context-free languages, and with Turing machines and recursively enumerable sets.
3. Comprehend and apply a number of algorithms such as: the subset construction to transform a nondeterministic finite automaton into a deterministic one; the DFA state minimization algorithm to minimize the number of states in a deterministic finite automaton; and conversion algorithms from regular expressions to finite automata and vice-versa.
4. Understand limitations of finite automata (respectively, pushdown automata) and prove that some sets are not regular (respectively, context-free) by using the pumping lemma for regular languages (respectively, context-free languages).
5. Simulate CFGs by NPDAs and vice-versa, that is, convert a given context-free grammar to an equivalent nondeterministic pushdown automaton, and convert a nondeterministic pushdown automaton to an equivalent context-free grammar.
6. Apply algorithms to transform context-free grammars into normal forms such as the Chomsky and Greibach normal forms.
7. Prove that some problems are decidable or undecidable using techniques such as diagonalization and reduction.

Required Textbook:

Michael Sipser. *Introduction to Theory of Computation*, 3rd edition, Cengage Learning, 2013.
ISBN-13: 978-1133187790

You are responsible for all material covered in lecture.

Topics: The topics to be covered are shown below, with estimated times by each topics.

- Class Overview, Mathematical structures and proofs technique review (Chapter 0) [2 classes]
- Regular Languages (Chapter 1) [5 classes]
- Context-Free Languages (Chapter 2) [5 classes]
- The Church-Turing Thesis (Chapter 3) [2 classes]
- Decidability (Chapter 4) [2 classes]
- Reducability (Chapter 5) [2 classes]
- The Recursion Theorem (Section 6.1) [1 class]
- Time Complexity (Chapter 7) [2 classes]
- Advanced Topics [2 classes]

Teaching Methods and Assignments: This class will meet for two 75-minute periods per week, and class meetings will consist of a combination of lecture/presentation, discussion, and in-class exercises. Students must come to class prepared, having done all required readings, and are expected to participate in in-class activities. Grades are based on student work done in assignments and exams.

Assignments: For practice and to demonstrate abilities, students will be given 5-6 assignments over the course of the semester (approximately every two weeks, adjusted to exclude exam weeks). Assignments will include some written problems and some programming problems. Written solutions may be prepared electronically using LaTeX or may be neatly handwritten, and are to be turned in on paper at the beginning of class on the due date. *Do not use a standard word processor such as Word or LibreOffice unless you properly write mathematics using the equation editor capabilities.* Programming problems can be completed in Java, C++, or Python; other languages may be used if pre-approved by the instructor.

Exams: There will be two mid-term exams and one final exam. Tentative dates for each exam are provided on the class web site schedule.

Graduate Students: Students taking this class for graduate credit (as CSC 652) or as a contract honors course will complete a research project on an algorithm topic of their choosing. More information, including a list of potential topics, will be given approximately halfway through the semester.

Evaluation and Grading: Each student work product will be graded, and the student's final grade will be determined by assigning each category of work a weighted score according to the following distribution:

Undergraduates

Assignments	35%
Mid-term Exam 1	20%
Mid-term Exam 2	20%
Final Exam	25%

Graduate Students

Assignments	30%
Mid-term Exam 1	18%
Mid-term Exam 2	18%
Final Exam	24%
Research Project	10%

COVID-19 Policies:

As we return for fall 2021, the campus community must recognize and address continuing concerns about physical and emotional safety, especially as we will have many more students, faculty, and staff on campus than in the last academic year. As such, all students, faculty, and staff are required to uphold UNCG's culture of care by actively engaging in behaviors that limit the spread of COVID-19. Such actions include, but are not limited to, the following:

- [Following face-covering guidelines](#)
- Engaging in proper hand-washing hygiene when possible
- Self-monitoring for symptoms of COVID-19
- Staying home if you are ill
- Complying with directions from health care providers or public health officials to quarantine or isolate if ill or exposed to someone who is ill.

Instructors will have seating charts for their classes. These are important for facilitating contact tracing should there be a confirmed case of COVID-19. Students must sit in their assigned seats at every class meeting and must not move furniture. Students should not eat or drink during class time.

To make it easier for students to hear their instructor and/or read lips and if conditions permit, instructors who are fully vaccinated and who can maintain at least six feet of distance from students may remove their masks while actively teaching if they choose, but will wear a mask at all other times while in the classroom, including during the periods before and after class.

A limited number of disposable masks will be available in classrooms for students who have forgotten theirs. Face coverings will also be available for purchase in the UNCG Campus Bookstore. Students who do not follow masking requirements will be asked to put on a face covering or leave the classroom to retrieve one and only return when they follow the basic requirements to uphold standards of safety and care for the UNCG community. Once students have a face covering, they are permitted to re-enter a class already in progress. Repeated issues may result in conduct action. The course policies regarding attendance and academics remain in effect for partial or full absence from class due to lack of adherence with face covering and other requirements.

For instances where the Office of Accessibility Resources and Services (OARS) has granted accommodations regarding wearing face coverings, students should contact their instructors to develop appropriate alternatives to class participation and/or activities as needed. Instructors or the student may also contact [OARS](#) (336.334.5440) who, in consultation with Student Health Services, will review requests for accommodations.

Other Policies:

- **Attendance Policy:** Attendance will not be taken in class, and is voluntary; however, all students are responsible for everything done or said in class (this can include changes in assignments, due dates, etc.). Many topics covered in this class are challenging, and it is highly unlikely that a student who regularly misses classes will be successful in the course. If attendance becomes a problem, the instructor reserves the right to give pop-quizzes or graded in-class exercises.
- The university allows for a limited number of excused absences for religious observances. Students who plan to take such an absence should notify the instructor at least two weeks in advance so that accommodations can be made.
- It is your responsibility to obtain notes from another student if you miss a lecture. The instructor will not give private instruction for missed lectures nor will the instructor provide personal lecture notes. Get the notes from another student, review the material, and then seek assistance for topics that are not clear.
- **Due dates:** Penalties for late work will be specified in the instructions for each assignment. Make arrangements with the instructor to turn in work early if you will not be in class on the due date.
- **Missed exams:** may be taken only if the student's absence has been excused by the instructor and if the exam is made up on the make-up exam time announced by the instructor.
- **Academic Integrity:** The new Department of Computer Science policy will be enforced. Read it here: <https://compsci.uncg.edu/students/academic-integrity-policy/>
- **Disruptive Behavior:** If you engage in non-course-related or disruptive activities (such as reading email, arriving late or leaving early, sending text messages, doing work for another class) you may be asked to leave the room and counted as absent; persistent behavior of this type may result in your being dropped from the course (see UNCG's [Disruptive Behavior Policy](#)).
- **Commercial services:** Selling class notes and other class materials for commercial gain is a violation of the University's Copyright Policy and of the Student Code of Conduct. Sharing notes for studying purposes, or borrowing notes to make up for absences, without commercial gain, are not violations.
- **Emergency university closure:** Closure of university facilities in response to emergencies (flu outbreak, weather, etc.) does not mean that this class is halted; check Canvas for announcements about how the class will proceed in the event of such an emergency.
- **Academic Accommodations:** The University of North Carolina Greensboro respects and welcomes students of all backgrounds and abilities. If you feel you will encounter any barriers to full participation in this course due to the impact of a disability, please contact the Office of Accessibility Resources and Services (OARS). The OARS staff can meet with you to discuss the barriers you are experiencing and explain the eligibility process for establishing academic accommodations. You can learn more about OARS by visiting their website at <https://ods.uncg.edu/> or by calling [336-334-5444](tel:336-334-5444) or visiting them in Suite 215, EUC.
- **Health and Wellness:** Health and well-being impact learning and academic success. Throughout your time in the university, you may experience a range of concerns that can cause

barriers to your academic success. These might include illnesses, strained relationships, anxiety, high levels of stress, alcohol or drug problems, feeling down, or loss of motivation. Student Health Services and The Counseling Center can help with these or other issues you may experience. You can learn about the free, confidential mental health services available on campus by calling 336-334-5874, visiting the website at <https://shs.uncg.edu/> or visiting the Anna M. Gove Student Health Center at 107 Gray Drive. For undergraduate or graduate students in recovery from alcohol and other drug addiction, The Spartan Recovery Program (SRP) offers recovery support services. You can learn more about recovery and recovery support services by visiting <https://shs.uncg.edu/srp> or reaching out to recovery@uncg.edu.