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CS 340 • Formal Languages and Automata Theory
Fall 2018 • CRN 65976 • 3 credits
MW 10:30-11:45 • D318
University of Hartford

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Office Hours: Dana 335 • M 11:45-3:45, W 11:45-1:30 & 2:20-3:45 and by appointment

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Course Pre-requisites
M221W and CS115
The primary prerequisite for this course is reasonable "mathematical sophistication" and exposure to algorithms. That is, you should feel comfortable with mathematics and proofs; and writing pseudo-code to embody the logic for an algorithm. Specific topics that are useful include a knowledge of graphs, trees, and logic.

Course Description
This course provides an introduction to theoretical computer science. Languages, grammars, and automata will provide a background for a discussion of parsing. Related areas also include recursive definitions, Turing machines, and decidability. Prerequisites: M 221W and CS 115.

The primary focus will be languages restricted by formal rules. The course will cover regular, context-free, context-sensitive and recursively enumerable languages and the automata that recognize them.   Students will also study complexity theory and the types of problems that computers cannot solve.

Theoretical Computer Science combines the elegance of Mathematics with the practicality and excitement of Computer Science. It gives you the license to use algorithms, discrete mathematics, graph theory, number theory, probability theory, functional analysis, topology, logic – the list goes on and on. However, you are much more (or much less, depending on your point of view) than an armchair theoretician. You can actually go out and change the way computers are built, operated, or used. A large number of computer science disciplines started out as branches of theoretical computer science: compilers, databases, programming languages, computer security/cryptography, quantum computing, and computational biology all trace their roots back to theoretical computer science. [Source: http://jonah.cs.elon.edu/sduvall2/courses/csc351/2007spring/index.htm]

Course Objectives
- Understand the linkage between discrete mathematics and automata theory with significant emphasis on proofs by construction.
- Able to define the concepts of languages, grammars and automata.
- Able to design, specify and test deterministic and nondeterministic finite automata that recognize regular languages.
- Able to write regular expressions and regular grammars that produce regular languages.
- Able to illustrate the equivalence of deterministic and nondeterministic automata, regular grammars and regular expressions.
- Able to describe the properties of regular languages and prove closure properties under specific operations.
- Able to identify non-regular languages using the Pumping Lemma.
- Able to design, specify and test grammars and deterministic/nondeterministic pushdown automata that recognize context-free languages.
- Able to transform context-free grammars by removing useless productions, lambda productions and unit productions.
- Able to define Chomsky and Greibach normal forms.
- Able to design, specify and test Turing Machines that recognize recursively enumerable languages,
- Understand and able to illustrate various models of turning machines including off-line, multi-tape, nondeterministic and universal.
- Able to explain the hierarchy of languages studied during the semester.
- Familiar with the concept of and able to illustrate problems that cannot be solved by computers and able to illustrate whether a specific language is decidable.

Expectations
Each student is expected to attend classes and take notes. Read the textbook(s) before attending class. Turn in homework, and other assignments on time. Take quizzes and exams as scheduled. The instructor is available for help during scheduled office hours (check "Instructor Information") and by appointment. Please do not wait until an exam to get help. Seek help as

soon as possible. You will need to allocate about 9 hours of your week outside of class towards this course. This time will be used for the following:
- reading the chapters in the text book assigned
- completing activities in the text book assigned
- completing homework assignments and the project
- studying for your exams/tests

Textbook
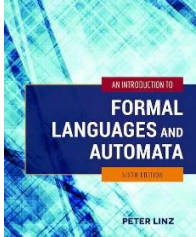
Intro to Formal Languages & Automata
AUTHOR: Linz
EDITION: 6th
COPYRIGHT YEAR: 2017
PUBLISHER: Jones & Bartlett Publishers, Incorporated
ISBN: 9781284077247
http://www.jblearning.com/catalog/9781284077247/

Software
Latest version of JFLAP: http://www.jflap.org/jflaptmp/
If the file downloads as a .zip file, rename the file back to .jar. Do not unzip. Double-click on jflap.jar file to execute.

Hardware Notes
Data is erased from lab computers in the classroom every time you log out. You must remember to manage the various files you use/create accordingly.
Students may choose to use a USB flash drive (jump drive) to store their work.   If so, you will need a 1GB or larger drive and you should bring it to every class. Alternatively, you may upload your files to another location (Google Drive, DropBox, etc.).
Remember that computer storage devices do fail. You are advised to make regular backups of your work using multiple devices. Loss of data due to disk failure is not an acceptable excuse for missing a homework deadline.

Grading Policy

Quality Work: All oral and written work submitted must be of the highest quality. You will be graded on your performance and quality of the work required and not on the amount of time spent nor amount of effort. Any piece of work turned in for a grade is subject to an oral examination and the grade for the work hinges on the result of the student's knowledge, not what is submitted.

Final Grade:

Assignments	50%
Tests	50%

	86.67 to 89.99 = B+	76.67 to 79.99 = C+	66.67 to 69.99 = D+	
>= 94 = A	83.34 to 86.66 = B	73.33 to 76.66 = C	63.33 to 66.66 = D	<= 59.99 = F
90.00 to 93.99 = A-	80.00 to 83.33 = B-	70.00 to 73.33 = C-	60.00 to 63.33 = D-	

Pass/No Pass Option: Students who are registered with a PASS/NO PASS option must receive a final grade of 65 or better to receive a P.

 "My Grades"
Up-to-date grade information is available 24/7 under "My Grades". It also shows your "Weighted Total". This is your up-to-date, cumulative, weighted grade.

Class Participation Policy
Even though class participation is not figured into your final grade, your attendance and participation is crucial to your success in this class. The following should give you a guideline on how to actively and positively participate.

Level of participation	Rubric
A	Actively supports, engages and listens to peers (ongoing)

	Arrives fully prepared at every class
	Plays an active role in discussions (ongoing)
	Comments advance the level and depth of the dialogue (consistently)
	Group dynamic and level of discussion are consistently better because of student's presence
B	Makes a sincere effort to interact with peers (ongoing)
	Arrives mostly, if not fully, prepared (ongoing)
	Participates constructively in discussions
	Makes relevant comments based on the assigned reading material (ongoing)
	Group dynamic and level of discussion are occasionally better (never worse) because of the student's presence
C	Limited interaction with peers
	Preparation, and therefore level of participation, are both inconsistent
	When prepared, participates constructively in discussions and makes relevant comments based on the assigned material
	Group dynamic and level of discussion are not affected by the student's presence
D	Virtually no interaction with peers
	Rarely prepared
	Rarely participates
	Comments are generally vague or drawn from outside of the assigned material
	Demonstrates a noticeable lack of interest (on occasion)
	Group dynamic and level of discussion are harmed by the student's presence
F	No interaction with peers
	Never prepared
	Never participates
	Demonstrates a noticeable lack of interest in the material (ongoing)
	Group dynamic and level of discussion are significantly harmed by the student's presence

Assignment Policy

Work independently All homework assignments are to be worked on independently by each student. Discussions as to what the problem is and very general, top-level solutions are allowed between students. Work may not be copied from another source and will constitute cheating if done so. Any work, or part of your work, that is borrowed from another source must be stated so in the assignment and must be pre-approved by the instructor or preceptor. Failure to do so will constitute plagiarism.   All assignment submitted is subject to an oral examination. Upon the request of the instructor, the student will explain (in person) the work submitted. The grade of the assignment hinges on how well the student knows and understands what was submitted.

Submission Each assignment must be submitted by following instructions posted on Blackboard.   Electronic submissions are due at the end of the day (11:59 pm) on the date due. All assignments must be submitted through Blackboard (View/Complete... link). Do not email your assignment to the instructor; no homework is accepted via email. Similarly, no assignment will be submitted through the Digital Dropbox unless it is pre-approved by the instructor.

Late Penalty Any assignment that is late will receive a deduction of 10% every 24 hours (a day). Work that is more than 3 days late will not be accepted. Assignments of which answers have been given will also not be accepted. For example, if an assignment is due Friday evening and if you turn it in anytime on Sunday, the grade is deducted 20%; any work turned in after the following Monday will receive a grade of 0.

Test and Examination Policy

All exams are closed book exams and typically take the entire class period. Make up exams will not be given except in cases of extremely extenuating circumstances and are pre-arranged.

UH Academic Honesty Policy: Strictly Enforced

University of Hartford Academic Honesty Policy

The purpose of the academic honesty policy is to provide a clear statement to students and faculty of the University's expectations regarding academic honesty and to set forth procedures for the enforcement of that policy. The procedures in this academic honesty policy are administrative functions and are not subject to the same rules as in criminal or civil proceedings. Throughout the following policy, the term college refers to any one of the schools or colleges of the University. The term University-wide program refers to programs such as multimedia Web design and development or the Bachelor of University Studies, which do not reside in a college. The term department chair refers to a department chair or, in the case of colleges that do not have departments, the equivalent of a department chair.

- All students are expected to observe generally accepted principles of scholarly writing in all examinations, compositions, papers, essays, tests, quizzes, reports, and dissertations whether written in the class room or outside. Sources of information used by a student in the preparation of work submitted as a basis for credit, or for a grade, or to satisfy graduate or undergraduate thesis requirements shall be clearly indicated in some conventional manner, such as by the use of quotation marks, footnotes, and bibliography.
- Students are forbidden to submit as their own any project, paper, or creative work that is in whole or part the work of another.
- The use of a term-paper writing service is prohibited. Also prohibited is the use of term papers obtained from the Internet, in whole or in part.
- All examinations and quizzes are to be completed without reference to books or notes except when the instructor of a course shall have given explicit authorization for an "open-book examination" or some other specified sort of assistance. Except as authorized by the instructor, no student is to give or receive assistance in the completion of an examination or a quiz.
- Other examples of academic dishonesty include, but are not limited to, the falsification of academic documents, such as transcripts, registration materials, withdrawal forms, or grade reports, as well as the unauthorized reading, removing, or copying of any academic document or record maintained by any member of the faculty or administration.

The Academic Honesty Policy procedure will be enforced.

Your work for this course (assignments, labs, quizzes, tests, exams) must be completed by you - the student - without the help of external sources such as the Internet or a friend. **Googling answers online is NOT ACCEPTABLE and constitutes academic dishonesty.**

At the first violation of academic dishonesty, the student receives a 0 for the work. On second offense, the student receives an F for the course.

A&S Academic Misconduct Policy: In the event that it is determined that you violated the Academic Honesty Policy, found in "the Source," the dean of your college will be notified and a note will be placed in your permanent file. If previous violations have been filed, any penalty that may be assigned for the offense may be more severe than for a first time offense. If this is the first recorded offense, subsequent violations of the honesty policy may then incur a steeper penalty.

Student Illness Policy

The instructor recognizes that students may occasionally become incapacitated by a brief illness or injury and will be unable to attend class or complete a graded assignment or test on time. In the latter case, you are expected to notify your instructor (in advance if at all possible) that you cannot complete the work due to illness or injury.

Following and quoting from the University of Hartford's Policy of Student Illness as listed on The Source, "the student must:

1. visit the University Health Center, a doctor, or hospital for treatment on the day that you are sick and get documentation of the visit, and
2. email the instructor in advance (or if not possible, within 24 hours of missed class, test, or assignment) to tell his or her that you cannot attend (or complete work) and that you are seeking or have sought treatment.

Allowing you to make up missed tests and assignments is at the instructor's discretion. For extended illness (a week or more), email the academic services office of YOUR college or school. Documentation of treatment is required.

Do not visit the University Health Center after the day you are sick. They will not issue documentation that you were sick on the previous day."

Email & Blackboard

Course materials (announcements, homework assignments, etc.) will be made available through Blackboard at http://blackboard.hartford.edu. Blackboard is to be used as a supplement to class lectures. All important announcements will be made in class. Routine announcements will be made available on Blackboard. However, you are responsible for all announcements and expectations explained in both Blackboard and during class. You are not to rely solely on Blackboard. Your Blackboard account allows you to personalize your information, including your preferred email account. In your "Blackboard Home Page" on the left frame, there is a "Personal Information" link which allows you to edit your information. It is your responsibility to make sure that the email account set here is the one you check regularly and that the Inbox for that email is not rejecting incoming mail.

Participation & Attendance

Students are expected to attend ALL classes and are responsible for missed classes and lecture materials. Again, you are expected to attend every single class during the semester. Additional material will be provided and covered in class as the instructor deems appropriate. Any material and information you miss is your responsibility. No excuses will be accepted for poor grades. If you must be absent from a class, you must let me know either by phone or e-mail and you

are responsible for any material covered or homework assigned. Informing me of your absence does NOT excuse you from any work due that day nor permit you to makeup an exam.

Computer and Other Electronic Equipment-Use Policy

When classes meet in a room equipped with computers, students are expected to use the computers for the purposes of completing assigned work only. At no circumstances will a student be allowed to surf the Internet, check email during a class, or use the computers for any other purpose. In violation, a student will face serious consequences.

Use of any electronic equipment (or otherwise) that is annoying or disrupting is not allowed in class. Such devices include mobile phones, beepers, PDAs, laptops, among others.

Students with Special Needs

Accommodations are provided only to those students who have documented disabilities or student athletes. Please let me know during the first week of class if you qualify for special accommodations.

Course Schedule and Readings:

Live version at:

https://docs.google.com/spreadsheets/d/1ggxrNsgGaGQBYrI2Ml3W4dHYjaJ3Ad1BwQDTA0QHASI/edit?usp=sharing

Subject to Change			
Week	**Date**		**Topics - Read before class**
1	Wed	September 5	Chapter 1 Introduction to the Theory of Computation 1.1 Mathematical Preliminaries and Notation: Sets, Functions, Relations, Graphs, Trees, Proofs 1.2 Three Basic Concepts: Languages, Grammars, Automata 1.3 Some Applications Course Syllabus
2	Mon	September 10	Appendix B: JFlap Chapter 2 Finite Automata 2.1 Deterministic Finate Accepters 2.2 Nondeterministic Finite Accepters 2.3 Equivalence of Deterministic and Nondeterministic Finite Accepters
	Wed	September 12	
3	Mon	September 17	
	Wed	September 19	Chapter 3 Regular Languages and Regular Grammars 3.1 Regular Expressions 3.2 Connection Between Regular Expressions and Regular Languages 3.3 Regular Grammars
4	Mon	September 24	
	Wed	September 26	
5	Mon	October 1	**Test 1**
	Wed	October 3	Chapter 4 Properties of Regular Languages 4.1 Closure Properties 4.2 Elementary Questions about Regular Languages 4.3 Identifying Nonregular Languages
6	Mon	October 8	
	Wed	October 10	
7	Mon	October 15	Chapter 5 Context-Free Languages 5.1 Context-Free Grammars 5.2 Parsing and Ambiguity 5.3 Context-Free Grammars and Programming Languages
	Wed	October 17	
8	Mon	October 22	
	Wed	October 24	
9	Mon	October 29	**Test 2**
	Wed	October 31	Chapter 6 Simplification of Context-Free Grammars and Normal Forms 6.1 Methods for Transforming Grammars 6.2 Chomsky and Greiback Normal Forms
10	Mon	November 5	
	Wed	November 7	

11	Mon	November 12	Chapter 7 Pushdown Automata
	Wed	November 14	7.1 Nondeterministic and Deterministic Pushdown Automata 7.2 Pushdown Automata and Context-Free Languages
12	Mon	November 19	7.3 Deterministic Pushdown Automata and Deterministic Context-Free Languages
	Wed	November 21	**Test 3**
13	Mon	November 26	Thanksgiving Break
	Wed	November 28	
14	Mon	December 3	Chapter 9 Turing Machines 9.1 The Standard Turing Machine
	Wed	December 5	9.2 Combining Turing Machines for Complicated Tasks 9.3 Turing's Thesis
15	Mon	December 10	Chapter 10 Other Models of Turing Machines 10.1 Minor Variations on the Turing Machine Theme
	Wed	December 12	10.2 Turing Machines with More Complex Storage
	Tue 2-4	December 18	**Final Exam**