CSE 4083/5210 Class Syllabus

Formal Languages & Automata Theory

Department of Computer Sciences

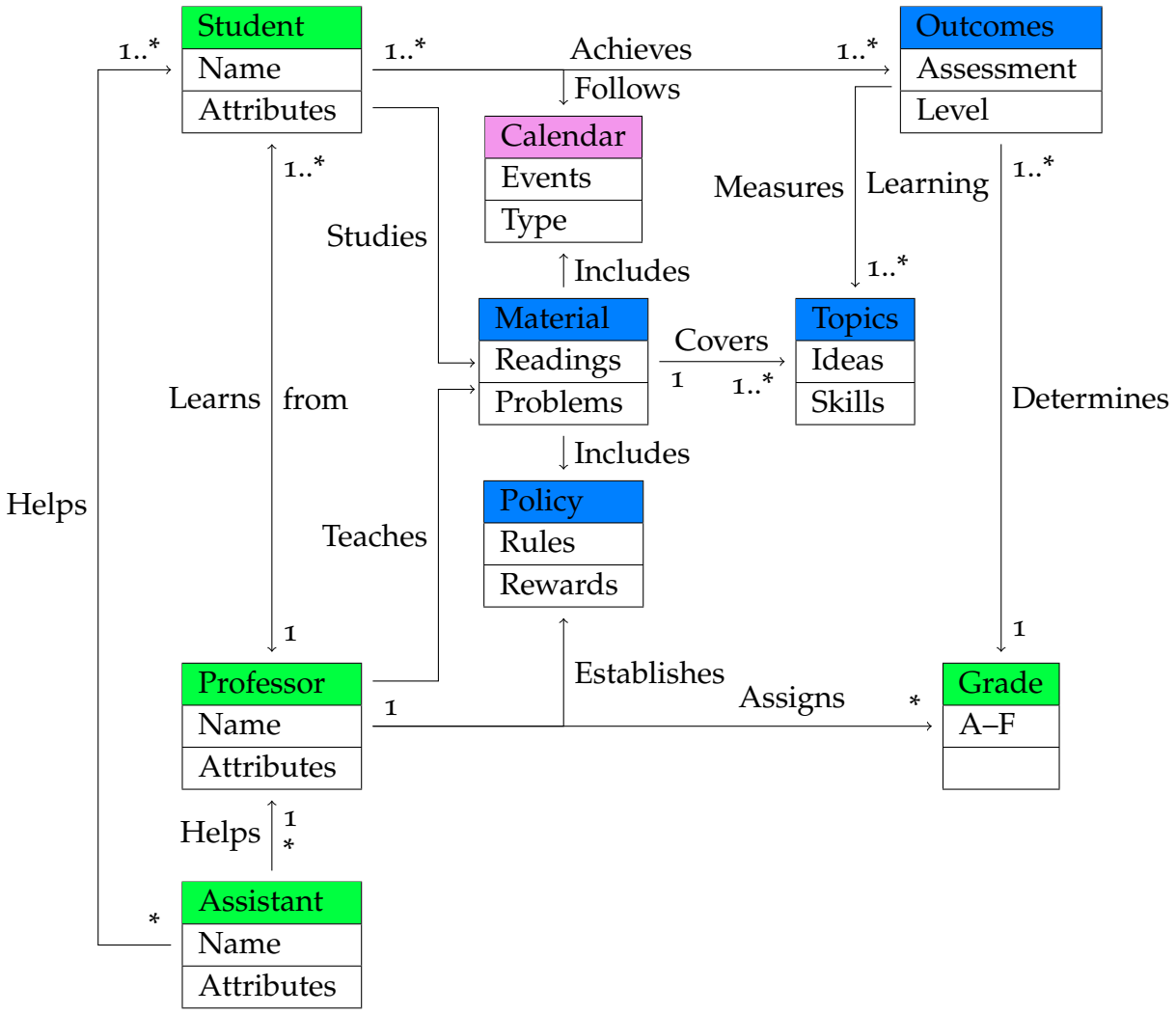
School of Computing

College of Engineering and Computing

Florida Tech

Summer 2018 (May 8, 2018)

The Structure of a Class



Course Description

CSE 4083/CSE 5210 Formal Languages and Automata Theory (Credit Hours: 3). Presents abstract models of computers (finite automata, push-down automata and Turing machines) and the language classes they recognize or generate (regular, context-free and recursively enumerable). Also presents applications of these models to compiler design, algorithms and complexity theory. Prerequisite: CSE 2010, or ECE 2552, ECE 3541.

Class Schedule: Tuesdays and Thursdays, 2:00 to 4:35, Crawford 212, May 14 to July 6

Prerequisites by Topic

Sets & Types, Sequences, Tuples, Propositional and Predicate Logic, Mathematical Induction, Recursive Definitions, Big-O Notation, Relations and Functions

Students, Professor & Assistants

Students

Get to know your fellow classmates. Help each other. The class roster is on the course management system .

The Professor


William David Shoaff


Room 324, Harris Center for Science and Engineering


wds@cs.fit.edu


(321) 674-8066


TR 11:00 – 1:45, by appointment, walk-ins welcome

Assistant

None assigned to this class.

Calendar

The course calendar is stored on the course management system . Florida Tech's Summer calendar can be accesses here.

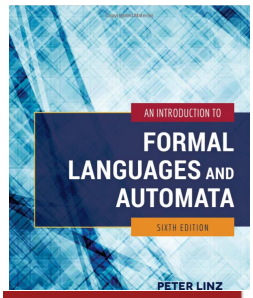
Material

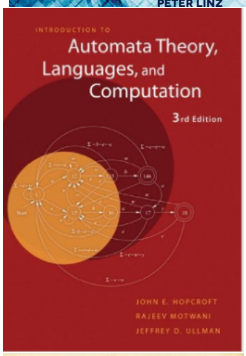
The textbook for this class is (Linz, 2017). The classic text is (Hopcroft and Ullman, 1979). The new version of this classic is (Hopcroft et al., 2006). I also like (Floyd and Beigel, 1994).

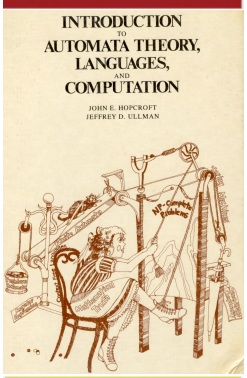
My URL for the class is

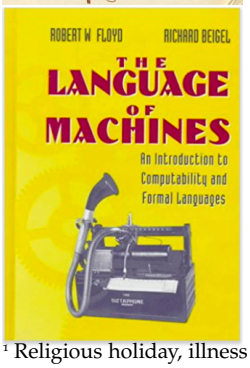
http://cs.fit.edu/~wds/classes/formal

This is stored there This syllabus, as well as other historical information. Grades are stored on the course management system .









Textbook and Reference Slides

- Linz and Busch
- Hopcroft & Ullman et al.

Policy

Attendance The class meets on Tuesdays & Thursday from 2:00 to 4:35. The location is Crawford 212. Attendance is required. If, for some reason [1], you cannot attend class inform your professor as soon as possible. Written documentation is necessary for an absence to be excused.

Rules for quizzes and exams

1. No notes, books, conversations, peeking at a neighbor's answers, note-passing, sign language, mechanical/electrical devices: abacus, camera, telephone, calculator, etc.
2. First violators of rule 1 will receive a 0 for the test. Second violators of rule 1 will receive an F for the course.

Rules for homework

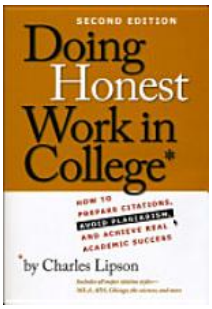
1. You are encouraged to work with other students in the class or with others from whom you can learn.
2. Do not turn in homework when you do not understand the answers. Ask for guidance instead.

Academic integrity

The department enforces an honor code. This honor code establishes a recommended penalty and reporting structure for academic dishonesty.

Offense	Recommended Penalty	Report to
First	Zero on work	Dean of Students
Second	F in course	Dean of Students
Third	Expulsion from Program	UDC

[1] Religious holiday, illness or accident, family emergency, . . .



Florida Tech provides guidelines to help students understand plagiarism, its consequences, and how to recognize and avoid academic dishonesty. Lipson describes three principles for academic integrity (Lipson, 2004).

1. "When you said you did it, you actually did."
2. "When you use someone else's work you cite it, When you use their word, you quote it openly and accurately."
3. "When you present research materials, you present them fairly and truthfully. That's true whether the research involves data, documents, or the writing of other scholars."

Issues and Concerns

1. If you have a disability, inform your teacher. Accommodations can be provided.
2. If you have an academic problem, your teacher can link you to support services.
3. If you have a personal issue, without revealing private information, your teacher can link you to support services.
4. No forms of discrimination, harassment, or assault will be tolerated.

Don't fail in silence!

Richard Ford's advice to new students, The Florida Tech Crimson, Fall 2011, Issue 2

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The Patsy Mink Equal Opportunity in Education Act, aka Title IX:

What is Title IX?

Title IX of the Educational Amendments Act of 1972 is the federal law prohibiting discrimination based on sex under any education program and/or activity operated by an institution receiving and/or benefiting from federal financial assistance.

Behaviors that can be considered "sexual discrimination" include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. You are encouraged to report these behaviors.

Reporting

Florida Tech can better support students in trouble if we know about what is happening. Reporting also helps us to identify patterns that might arise – for example, if more than one complainant reports having been assaulted or harassed by the same individual.

Florida Tech is committed to providing a safe and positive learning experience. To report a violation of sexual misconduct or gender discrimination, please contact Security at 321-674-8111. *** Please note that as your professor, I am required to report any incidences to Security or to the Title IX Coordinator (321-674-8700).** *For confidential reporting, please contact CAPS at 321-674-8050.*

Where to Get Help

1. Your professors (For this class: TR 11:00 – 1:45, or by appointment)
2. Your academic advisor
3. Your teaching assistants
4. The Computer Sciences Help Desk
5. The Academic Support Center
6. Counseling and Psychological Services

Topics

1. Background Material
   - Inductive Proofs
   - Relations and Functions
   - Diagonalization
2. Regular Languages
   - DFA, NFA, and NFA-& epsilon Machines

- Equivalence of DFA and NFA Machines
- Equivalence of NFA and NFA-& epsilon Machines
- Regular Expressions
- Equivalence of Regular Expressions and Finite State Machines
- Closure Properties of Regular Languages
- Pumping Lemma for Regular Languages
- Proving Non-Regularity
- Decision Problems for DFAs and Regular Languages

3. Context-free Languages

- Context-free Grammars, Derivations, Leftmost, Rightmost,
- Ambiguity Inherent Ambiguity, Parse Trees, Normal Forms, etc.
- Proof of Containment of the Regular Languages
- Pushdown Automata
- PDA String Acceptance by Empty Stack, and Acceptance by Final State
- Equivalence of the Two Methods of PDA Acceptance
- Equivalence of PDAs and Context-free Grammars
- Closure Properties of Context-free Languages
- Pumping Lemma for Context-free Languages
- Proving Languages are Not Context-free

4. Recursive and Recursively Enumerable Languages

- Turing Machines
- Definition of Recursive and Recursively Enumerable
- Church's Hypothesis
- Computable Functions
- Methods for Turing Machine Construction
- Modifications of the Basic Turing Machine Model; Multiple Tape
- Multiple Tracks, Non-determinism, etc.
- Equivalence of the Different TM Models and the Basic TM Model
- TMs as Enumerators
- Characterization of Recursive and Recursively Enumerable Sets Enumerators
- Decidability, Undecidability

- Closure Properties of Recursive and Recursively Enumerable Languages
- Non-Recursively Enumerable and Non-Recursive Languages
- The Halting Problem
- Undecidability of the Halting Problem

Proof That Computers Can't Do Everything (The Halting Problem)

Outcomes

By the end of the course, each student will be able to:

1. An ability to apply knowledge of mathematics, science, computing, and software engineering
2. An ability to identify computing and engineering problems, identify and define the requirements, design and conduct experiments, analyze and interpret data appropriate to solving these problems

1. Demonstrate an understanding of abstract models of computing, including deterministic (DFA), non-deterministic (NFA), and Turing (TM) machine models. (1: Fundamental knowledge)
2. Understand the relative computing power of the different abstract machine models. (1: Fundamental knowledge)
3. Demonstrate an understanding of regular expressions and grammars, including context-free and context-sensitive grammars. (1: Fundamental knowledge)
4. Understand the relationships between language classes, including regular, context-free, context-sensitive, recursive, and recursively enumerable languages. (1: Fundamental knowledge)
5. Understand the associations between language classes and machine models. (1: Fundamental knowledge)
6. Understand the associations between language classes and language descriptors (i.e., grammars and regular expressions). (1: Fundamental knowledge)
7. Understand what decidable and undecidable problems are. (1: Fundamental knowledge)
8. Apply advanced proof techniques such as reductions and diagonalization. (2: Scientific, computing, and engineering problem solving)
9. Understand the application of machine models and descriptors to compiler theory and parsing.(1: Fundamental knowledge)

Grades

Your final grade will be based on your performance on quizzes and projects. Projects will be submitted electronically using the submit server.

Grades and their relation to performance

Grade	A	B	C	D	F
Performance	Excellent	Good	Average	Poor	Failure

Student performance is measured in the following ways.

1. Weekly Peer-Graded Homework (20% of grade)
2. Midterm examination (40% of grade)
3. Final examination (40% of grade)

Your score S will be a number between 0 and 100 computed by the formula

$$S = \sum (0.2 \times \text{homework average}) + 0.4\text{midterm} + 0.4\text{final})$$

Extra credit will never be given.
Final letter grades will be assigned based on the range in which your score S falls:

$$(90 \leq S \leq 100) \Rightarrow \texttt{A}, \quad (80 \leq S \leq 89) \Rightarrow \texttt{B}, \quad (70 \leq S \leq 79) \Rightarrow \texttt{C}, \quad (60 \leq S \leq 69) \Rightarrow \texttt{D}, \quad (0 \leq S \leq 59) \Rightarrow \texttt{F}$$

The last day to withdraw for the class with a final grade of `W` is Friday, June 22.

Checking Grades

The course management system is where you can check your grades. Contact your professor when you find an error in your recorded grades. Be able to document the error.

Measure of Success

The target achievement levels for the class are:

- 70% of students will score at or above average (70%) on the final comprehensive examination.

References

Carroll, L., Gardner (Editor), M., and Tenniel (Illustrator), J. (2000). The Annotated Alice: The Definitive Edition. W. W. Norton.

Floyd, R. W. and Beigel, R. (1994). The Language of Machines: An Introduction to Computability and Formal Languages. Computer Science Press, Inc., New York, NY, USA. [page 3]

Hopcroft, J. E., Motwani, R., and Ullman, J. D. (2006). Introduction to Automata Theory, Languages, and Computation (3rd Edition). Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA. [page 3]

Hopcroft, J. E. and Ullman, J. D. (1979). Introduction to Automata Theory, Languages, and Computation. Addison-Wesley. [page 3]

Linz, P. (2017). An Introduction to Formal Languages and Automata, Sixth Edition. Jones and Bartlett Publishers, Inc., USA, 6th edition. [page 3]

Lipson, C. (2004). Doing Honest Work in College: How to Prepare Citations, Avoid Plagiarism, and Achieve Real Academic Success. University of Chicago Press, Chicago. [page 4]