Computer Science Department
cs.salemstate.edu

CSC 400 Theory of Computation (formerly CSC 290) **3 cr.**

Instructor: TBA **Office:** location **Phone:** (978) 542-extension
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Section	Time	Room	Final Exam
nn	days and times	location	date and time

Catalog description:

This course introduces the basic concepts underlying the theoretical study of computing and computers: formal languages, automata, Turing machines, computability, and computational complexity. Three lecture hours per week. Not open to students who have received credit for CSC 290.

Prerequisites: CSC 260 and MAT 214A.

Goals:

The aims of this course are:

CG01: to present the concepts of finite automata, formal languages, computability, and computational complexity;
CG02: to discuss the most important tools and techniques associated with these concepts;
CG03: to explain the importance of these topics to Computer Science;
CG04: to present these topics so as to promote understanding of the ideas rather than the reproduction or construction of formal proofs.

Objectives:

Upon completion of this course, the student will have demonstrated the ability to:

CO01: define the concept of finite automaton and give computer-related examples;
CO02: define the concept of a context-free grammar and give examples;
CO03: define and give examples of regular expressions and regular languages;
CO04: explain the connections between finite automata and regular expressions, with examples;
CO05: explain the connection between context-free languages and pushdown automata;
CO06: define and give examples of a Turing machine;
CO07: explain the concept of undecidability;
CO08: explain the concept of intractability and define the classes P and NP.

Student Outcome vs. Course Objectives matrix

Student Outcome (condensed form)	CO01	CO02	CO03	CO04	CO05	CO06	CO07	CO08
SO-1	✓	✓	✓	✓	✓	✓	✓	✓
SO-2	✓	✓	✓	✓	✓	✓	✓	✓
SO-3								
SO-4								
SO-5								
SO-6	✓	✓	✓	✓	✓	✓	✓	✓

Note:

SO-1 Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

SO-2 Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

SO-3 Communicate effectively in a variety of professional contexts.
SO-4 Recognize professional responsibilities and make informed judgements in computing practice based on legal and ethical principles.
SO-5 Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
SO-6 Apply computer science theory and software development fundamentals to produce computing-based solutions.

Topics:

- review of background material:
  - sets, relations, functions, sequences **DS1(1, 0, 0), DS2(1, 0, 0)**
  - alphabets, strings, languages **AL5(0, 0, 3)**
  - proof methods (mathematical induction, proof by contradiction, the technique of diagonalization) **DS3(1, 1, 0)**
  - digraphs, tree diagrams **DS5(1, 0.5, 0)**
- formal languages and grammars **AL5(0, 0, 7)**
  - regular expressions and regular languages
  - deterministic context-free languages
  - context-free languages
  - context-sensitive languages
  - recursively enumerable languages
  - LL(k) and LR(k) grammars and languages
- finite automata: **AL7(0, 0, 7), AL4(1, 1, 0)**
  - deterministic (DFA)
  - nondeterministic (NDFA)
  - nondeterministic with empty moves (NDFAe)
  - the Pumping Lemma for regular languages
- pushdown automata **AL7(0, 0, 3)**
- Turing machines **IS3(0, 1, 0)**
- random access machines **SF3(2, 0, 0)**
- computability; the Church-Turing thesis **AL4(1, 1, 0)**
- the Halting Problem **AL4(0.5, 0, 0)**
- decidability **AL6(0, 0, 0.5)**
- parallel random access machines **PD5(0.5, 0, 0)**
- computational complexity **AL4(1, 1, 0), AL6(0, 0, 3)**
  - simulations and irreducibilities
  - circuits and circuit complexity
  - the complexity class NC
  - the complexity classes P and NP
  - P-completeness and NP-completeness

Assignments and Examination:

Periodic written homework assignments will be given, including reports on assigned reading in books and journals. Oral presentations on selected topics may also be required. There are several quizzes and one comprehensive final examination.

The final grade will be determined using the following approximate weights:

written assignments	40%
final examination	30%
quizzes and oral presentations	30%

Course Objective / Assessment Mechanism matrix

	Written Assignments	Quizzes	Oral Presentations	Final Examination
CO01	✓		✓	✓
CO02	✓	✓	✓	
CO03	✓	✓		✓
CO04	✓	✓	✓	✓
CO05	✓		✓	✓

CO06	✓	✓	✓	✓
CO07	✓		✓	✓
CO08	✓	✓	✓	✓

Bibliography:

Blum, Lenore; Cucker, Felipe; Shub, Michael; Smale, Steve. **Complexity and Real Computation.** Springer, 1998.

Boolos, George S.; Burgess, John P.; Jeffrey, Richard C. **Computability and Logic. Fifth Edition**. Cambridge University Press, 2007.

Cohen, Daniel I. A. **Introduction to Computer Theory**, **Second Edition**. Wiley, 1996.

Friedl, Jeffrey E. F. **Matering Regular Expressions. Third Edition**. O'Reilly Media, 2006.

Goyvaerts, Jan; Levithan, Steven. **Regular Expressions Cookbook**. O'Reilly Media, 2009.

Greenlaw, Raymond; Hoover, James H. **Fundamentals of the Theory of Computation: Principles and Practice**. Morgan Kauffman, 1998.

Hopcroft, John E.; Motwani, Rajeev; Ullman, Jeffrey D. **Introduction to Automata Theory, Languages, and Computation. Third Edition.** Addison Wesley, 2006.

Kozen, Dexter. **Automata and Computability.** Springer, 1997.

Kozen, Dexter. **Theory of Computation.** Springer, 2010.

Lewis, Harry R.; Papadimitriou, Christos H. **Elements of the Theory of Computation. Second Edition**. Prentice Hall, 1997.

Linz, Peter. **An Introduction to Formal Languages and Automata**. **Fourth Edition.** Jones and Bartlett, 2006.

Martin, John C. **Introduction to Languages and the Theory of Computation**. **Fourth Edition.** McGraw-Hill, 2010.

Moret, Bernard M. **The Theory of Computation**. Addison-Wesley, 1997.

Parkes, Alan, P. **A Concise Introduction to Languages and Machines**. Springer, 2008.

Sipser, Michael. **Introduction to the Theory of Computation. Second Edition.** Course Technology, 2005.

Sudkamp, Thomas A. **Languages and Machines: An Introduction to the Theory of Computer Science. Third Edition.** Addison-Wesley, 2005.

Academic Integrity Statement:

"Salem State University assumes that all students come to the University with serious educational intent and expects them to be mature, responsible individuals who will exhibit high standards of honesty and personal conduct in their academic life. All forms of academic dishonesty are considered to be serious offences against the University community. The University will apply sanctions when student conduct interferes with the University primary responsibility of ensuring its educational objectives." Consult the University catalog for further details on Academic Integrity Regulations and, in particular, the University definition of academic dishonesty.

The Academic Integrity Policy and Regulations can be found in the University Catalog and on the University website (http://catalog.salemstate.edu/content.php?catoid=13&navoid=1295#Academic_Integrity). The formal regulations are extensive and detailed - familiarize yourself with them if you have not previously done so. A concise summary of and direct quote from the regulations: "Materials (written or otherwise) submitted to fulfill academic requirements must represent a student's own efforts". *Submission of other's work as one's own without proper attribution is in direct violation of the University's Policy* and will be dealt with according to the University's formal Procedures. *Copying without attribution is considered cheating in an academic environment - simply put,* ***do not do it!***

University-Declared Critical Emergency Statement:

In the event of a university-declared emergency, Salem State University reserves the right to alter this course plan. Students should refer to www.salemstate.edu for further information and updates. The course attendance policy stays in effect until there is a university-declared critical emergency.

In the event of an emergency, please refer to the alternative educational plans for this course, which will be distributed via standing class communication protocols. Students should review the plans and act accordingly. Any required material that may be necessary will have been previously distributed to students electronically or will be made available as needed via email and/or Internet access.

Equal Access Statement:

"Salem State University is committed to providing equal access to the educational experience for all students in compliance with Section 504 of The Rehabilitation Act and The Americans with Disabilities Act and to providing all reasonable academic

accommodations, aids and adjustments. **Any student who has a documented disability requiring an accommodation, aid or adjustment should speak with the instructor immediately.** Students with Disabilities who have not previously done so should provide documentation to and schedule an appointment with the Office for Students with Disabilities and obtain appropriate services."

Note: This syllabus represents the intended structure of the course for the semester. If changes are necessary, students will be notified in writing and via email.