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Fall 2004

## CS 410/610: Theoretical Foundations of Computing

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# CS 410/610: Theoretical Foundations of Computing

## Syllabus: Fall 2004

Instructor: Professor Sudkamp  
Time: 6:05—7:45 Tuesday, Thursday  
Room: 146 Russ Engineering Center  
Office Hours: 2:00-4:00 Tuesday, Thursday, and by appointment  
Office: 431 Russ Engineering Center  
Email: tsudkamp@cs.wright.edu  
Phone: 775-5118

This course is an introduction to one of the fundamental topics in the theory of computer science: computability theory. Computability theory is concerned with determining whether there is an algorithmic solution to a problem. The study of computability uses the Turing machine as the basic computational model. A Turing machine is a random access, read-write, finite state automaton. The Church-Turing thesis asserts that any problem that can be solved in any algorithmic manner can be solved by a Turing machine.

Some material from CS 466/666 is a prerequisite for this course. It is assumed that the students are familiar with finite state automata, inductive proofs, regular expressions, grammars, and derivation of strings using the rules of a grammar. The text for the course is the second edition of *Languages and Machines: An Introduction to the Theory of Computer Science*. The background material may be reviewed in chapters 1, 2, 3, and 6 of that book.

**Topics:** The topics to be covered in this course include

- Review of naive set theory with emphasis on cardinality, diagonalization, and proofs of nonexistence using self-reference. Countable and uncountable sets. Sections 1.1-1.3.
- Turing machines as language acceptors. Deterministic and nondeterministic machines. Multi-track and multi-tape machines. Turing machines as enumerators. Chapter 9.
- Decision problems. Church-Turing thesis. Undecidability. The halting problem. Problem reduction. The Post correspondence problem. Rice's theorem. Chapter 11.
- Functional characterization of computability. Recursive and mu-recursive functions. Chapters 12, 13.

**Grading:** There will be five exams given during the quarter. Fifty minutes of class on alternating Thursdays will be used for the first four exams. The last of the five exams will be a take-home that will be handed out at the last regularly scheduled class period. The lowest score of the first four examines will be dropped. All students are required to take the last exam and its score cannot be dropped. The grade for the course will be determined by the scores of the four exams (best three out of the first four and the final). Each exam that is counted will make up 25% of the course grade.

Grades will be assigned using the following scale:

- A - 90% or above
- B - 80% - 89%
- C - 70% - 79%
- D - 60% - 69%
- F - below 60%

I reserve the right to adjust (lower) the scale to utilize gaps in the distribution, but this will be done minimally if at all.

The exams for graduate students will contain more problems than the undergraduate exam. These additional problems will be more theoretic in nature, reflecting the added sophistication expected of graduate students. They will also cover material in the readings that may not be represented in any of the assigned homework.

All exams are open book (no notes): it is not the objective of this course to be an exercise in memorization. However, over reliance on the book is a sure-fire way to do poorly on an exam. Know the material before and use the book only as a safety net.

There are no makeup exams except for documented emergencies. Examples of acceptable documentation are a letter from a doctor (on his/her letterhead) indicating that you were unable to take the exam due to illness or a letter from an employer indicating that you will be out of town on company business at the scheduled exam time. A missed exam counts as a 0 and may be dropped as the lowest score.

**Exam Dates:**

- Thursday, September 16
- Thursday, September 30
- Thursday, October 14
- Thursday, October 28
- Tuesday, November 9

There will be homework, both reading and exercises, assigned at each class. The homework will not be collected, but is assigned to increase your understanding of the topics and to help you prepare for the exams. Time will be taken in each class period to

discuss homework assigned in the previous class. I urge you to work together on the homework problems. This makes the entire process more enjoyable and fruitful. Sharing your ideas and listening to those of others will increase your understanding and facilitate the solution of the problem.

**Office Hours:** My office hours for the fall quarter are given on the first page of this syllabus. For students who are not free at these times, see me, email me, or call me and we will arrange a time that is convenient for you. I am also available any time that I am in my office, feel free to drop by. My office is 431 Russ Engineering.

For general questions, you may reach me by email at [tsudkamp@cs.wright.edu](mailto:tsudkamp@cs.wright.edu) or call 775-5118. The e-mail and telephone are for procedural questions such as "when is the exam?" or "what will be covered?" or "what did I miss in the last class when I was kept away by the hurricane?" For answers to homework, exam problems, or help on course topics see me in person.

**Attendance:** Attendance at classes is strongly recommended. If you miss a class, it is your responsibility to obtain class notes from other students to be prepared for subsequent topics. There will be no make-up exams except for documented emergencies.