Course Overview

The goal of the course is to provide students with sufficient background in a variety of topics in computer science to enable them to understand and possibly conduct research in technical areas of Information Systems. One of the immediate goals of the course is to develop sufficient technical skills so that the students could read intelligently and critically technical IS papers that they may encounter in the Rolling Reading seminars, in the technical IS courses and technical IS literature, and later on in their professional life.

After a general introduction to the research issues in technical Information Systems, the course will cover a broad set of topics in computer science, including set theory, computability, finite automata, Turing machines, analysis of algorithms, elements of logic, databases, and software engineering.

Course Materials

The main book for the course is *Discrete Mathematics for Computer Scientists* by John Truss, Addison-Wesley Publishing, Second edition. Additional books for various topics are specified below.

There will be several homework assignments in the class and a take-home exam. Homework assignments will be written or lightweight programming assignments. The students are expected to do their assignments on time. Knowledge of a programming language is assumed.

Course Evaluation

A small number of homework assignments will be given, for 25% of the grade. There will be a written final, for 75% of the grade.
**Class Schedule**

**Week 1-2:** Research Issues in Technical Information Systems; Discrete Math: Induction, proofs, Sets, Relations, Functions, Combinatorics, Ordered Structures

*Reading:* Chapters 1, 3, 4, 5

*Supplemental reading:*


**Week 3 - 6:** Introduction to Algorithms

Sorting, data structures (trees, hash tables, etc.), directed and undirected graphs, algorithm design techniques (divide-and-conquer, dynamic programming, greedy algorithms), analysis of algorithms and complexity theory.

*Reading:* Chapters 8, 9, 10.

*Supplemental reading:*


**Week 7 - 8:** Elements of Theoretical Computer Science

Computable functions, Turing machines, grammars and finite automata. Pumping Lemma. Use of grammars and automata on text search and XML specifications.

*Reading:* Chapter 9

*Supplemental reading:*

1. Davis, M. and Weyuker, E. *Computability, Complexity, and Languages.* Academic Press (Chapters 1-9.)

2. Hopcroft, J. and Ullman, J. *Introduction to Automata Theory Languages and Computation,* Addison-Wesley (Chapters 1-8, 12-13).

**Week 9 - 10 Logic**

Overview of propositional logic; basic concepts of first-order logic (alphabet, well-formed formulas, interpretations, models, validity, satisfiability), logical consequence,
axioms of first-order logic, deductions, soundness and completeness of deductive calculus.

Reading: Chapters 2, 7

Supplemental reading:


**Week 11 -- 13**: Elements of Databases

I assume familiarity with the foundations of relational databases, including some basic knowledge of SQL and the elements of database design theory. This module will cover other aspects of relational databases and will focus on the theory of deductive databases and basics of physical database design and query processing and optimization.

*Recommended books:*


**Week 14**: Information Retrieval Basics

Document modeling, query languages and operations, text and multimedia indexing and searching, searching the web

*Recommended books:*