

Spring 2009

## **MATH 574: Mathematical Theory of Computation**

**Professor: Sylvan Pinsky**

The course is an introduction to the mathematical concepts underlying the theory of computation. This theory places practical limits on what computers can accomplish and categorizes computational problems and algorithms into complexity classes.

### **Textbook**

John E. Hopcroft, Rajeev Motwani, and Jeffrey Ullman: "Introduction to Automata Theory, Languages, and Computation". Addison-Wesley, 3rd Edition", 2007. ISBN 0-321-45536-3.

### **Further References**

Christos Papadimitriou: "Computational Complexity", Addison-Wesley, 1994.

Christos Papadimitriou and Harry Lewis: "Elements of the theory of computation", Prentice-Hall, 1982, second edition 1997.

Jose Meseguer, Miguel Palomino, and Narciso Marti-Oliet, "Notes on Model Checking and Abstraction in Rewriting Logic", University of Illinois at Urbana-Champaign, 2003.

### **About This Course:**

"This classic book on formal languages, automata theory, and computational complexity has been updated to present theoretical concepts in a concise and straightforward manner with increased coverage of practical applications ... providing the most accessible coverage of automata theory available, solid treatment on constructing proofs, many figures and diagrams to help convey ideas, and sidebars to highlight related material." (From the back cover of the text)

### **Topics**

Automata and language theory: Deterministic and non-deterministic finite automata, regular expressions, push-down automata, context free grammars, pumping lemmas.

Computability theory: Turing machines, Church-Turing thesis, decidability, the halting problem.

Complexity theory: Time and space measures, complexity classes P, NP, NL, PSPACE, complements of languages in NP.

Special topics: Practical applications of the theory of computation will be selected from model checking of finite automata, systems biology, protocol analysis, computer security, formal methods, and other areas of potential interest.

**Dr. Pinsky** has twenty three years of experience at the National Security Agency where he served as Chief Scientist, Division Chief for Formal Methods, Technical Director for Formal Methods, Director of the University Research Program, and Scholar-in-Residence within the Office and Research and Development and the National Cryptologic School. This background and experience will be used to select special topics and potential guest speakers consistent with class interests.