

**CAS705: Computability and Complexity**  
**Fall 2005**

**Instructor:** Michael Soltys  
Office: ITB-214, Ext: 27769, Email: *my last name at mcmaster dot ca*

**Lectures:** Mon 2:30–3:20, Wed 9:30–10:20, Fri 10:30–11:20, in ITB/222

**Web Page:** <http://www.cas.mcmaster.ca/~soltys/cas705-f05>

**Textbook:** “Computational Complexity”, by Christos H. Papadimitriou

**Reference:**

“Gems of Theoretical Computer Science”, by U. Schoning and R. Pruim

**Course Outline:** The relationship between problems, algorithms, and languages.  
Computability: finite automata, rewriting systems, Turing machines (linear speedup, robustness, and the Universal Turing machine). Recursive functions and Cobham’s Theorem. Determinism and non-determinism. Recursive and recursively enumerable languages. The Halting problem and the diagonalization technique. Church-Turing thesis, and Rice’s theorem.  
Complexity: classes defined in terms of time, space, and circuits. Uniformity. The reachability method (Savitch’s theorem, and the Immerman-Szelepcsenyi theorem). The P versus NP problem (and Cook’s Theorem), reductions and completeness. The Time and Space Hierarchy Theorems. Randomized and parallel computations. NP and co-NP, propositional proof systems, and Horn clauses. Kolmogorov complexity, and the Shannon principle.

**Marking Scheme:** Six (6) problem sets, best five (5) selected to be worth 10% each, a final exam, worth 40%, and 10% for attendance & participation. No aids will be allowed for the final exam. Missed work will be given a mark of zero, unless proper justification is provided. Since we will discuss the solutions to the problem sets after they are handed in, in principle no extensions will be given.

*The work you submit must be your own.* You may discuss problems with each other; however, you should prepare written solutions alone.

**Academic Integrity:** Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at [http://www.mcmaster.ca/senate/academic/ac\\_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm)  
The following illustrates only three forms of academic dishonesty: 1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained. 2. Improper collaboration in group work. 3. Copying or using unauthorized aids in tests and examinations.