Massachusetts Institute of Technology
6.042J/18.062J: Mathematics for Computer Science
Professors Nancy Lynch and Shlomi Dolev

Handout 1c
September 19, 2000

Course Objectives and Outcomes

Objectives

On completion of 6.042, students will be able to explain and apply the basic methods of discrete (noncontinuous) mathematics to Computer Science problems. They will be able to use these concepts in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

In particular, students will be able to

1. **reason mathematically about basic data types and structures** used in computer algorithms and systems; distinguish rigorous definitions and conclusions from merely plausible ones; synthesize elementary proofs, especially proofs by induction.
2. **model and analyze computational processes** (algorithms and systems) using analytic and combinatorial methods.
3. **apply principles of discrete probability** to model and solve elementary problems of reliability and estimation.
4. **work in small teams** to accomplish all the objectives above.

Learning Outcomes

Students will be able to:

1. **evaluate elementary mathematical arguments** and identify fallacious reasoning (not just fallacious conclusions).
2. **synthesize induction hypotheses and simple proofs** in discrete mathematics using the terminology of elementary mathematical logic.
3. **apply graph theory models** of data structures and state machines to solve elementary problems of scheduling and connectivity.
4. **prove basic properties of numbers**; calculate GCD's and evaluate arithmetic expressions in modular arithmetic.

5. apply the method of invariants and well-founded ordering to **prove correctness and termination of algorithms** and state machines.
6. **derive closed-form and asymptotic expressions** from series and recurrences for growth rates of processes.
7. **calculate numbers of possible outcomes** of elementary combinatorial processes such as permutations and combinations.
8. **calculate probabilities** and discrete distributions for simple combinatorial processes; calculate means and variances.
9. solve problems of estimation and error tolerance by **applying theorems on deviation from the mean**.
10. problem solve and **study in a small team** with fellow students.