

CMSI 282 Problem Set #6
Due April 7, 2009

Note: Pair programming is encouraged for this assignment.

- (1) Is it easier to throw exactly one six with six dice, or exactly two sixes with twelve dice?
 - (a) Give an analysis of the probabilities of these two events.
 - (b) Make *RollingSixes*, a program that uses randomized estimation to answer the same question- and be sure that it confirms your analysis! [From Michalewicz and Fogel, *How to Solve It: Modern Heuristics*.]

- (2) Determine **via a computer program** whether it is possible to construct a pair of six-sided dice with faces that are positive integers that replicates the probabilities of a “regular pair” of six-sided dice- in other words, there will be precisely one way to throw a two, two ways to throw a three, six ways to throw a seven, etc. [From Winkler, *Mathematical Mind-Benders*.]

- (3) Kirkman's Schoolgirl Problem: Fifteen schoolgirls always take their daily walks in rows of threes. How can it be arranged so that each schoolgirl walks in the same row with each other schoolgirl exactly once per week?
 - (a) Give a detailed description of a backtracking algorithm and related data structures for solving this problem. Clearly describe the structure of the search space- i.e., of feasible solutions- and explain precisely how your algorithm extends partial solutions. Well-annotated illustrations will be appreciated.
 - (b) Make *KirkmanSolver*, a program that answers this question.
 - (c) Use randomized estimation to estimate the size (number of nodes) in the backtrack search tree. You are to give a detailed account of the actual experiments- including, e.g., the actual coin flips, or dice rolls, and choices available at each point, etc.- and then report the average and the standard deviation of a **set** of experiments.

[From Dorrie, *100 Great Problems of Elementary Mathematics- Their History and Solution*.]