MATH 636, Fall 2013
Practice Problems
in preparation for Exam 1 on October 17, 2013

The exam covers:

- *Combinatorics: A Guided Tour*, Sections 1.1–1.4, 2.1–2.4 (through page 77)
- Additional topics that are included in the course notes, including Combinatorial proofs, the Principle of Inclusion/Exclusion, the Square-Domino interpretation of Fibonacci numbers.

Below are some questions that practice concepts from the class.

– Book questions: 1.2.6, 1.2.9, 1.2.18, **1.3.5**, 1.3.12, 1.4.8, 2.1.3, 2.1.13, 2.2.7cdf, 2.3.1, **2.3.4**, 2.3.6, **2.4.1**, 2.4.5, **2.4.11**, **3.1.10** (Bolded exercises are especially encouraged.)

– *Challenge questions:* 2.1.16, 2.2.11

P1. Write down a list of all combinatorial interpretations of $\binom{n}{k}$, $\left(\!\binom{n}{k}\!\right)$, and $(n)_k$ from the book.

P2. Use the square-domino interpretation of the Fibonacci numbers to prove that $f_{m+n} = f_m f_n + f_{m-1} f_{n-1}$ for positive integers m and n.

P3. There are many games that have a combinatorial flavor. One of these games is *Tantrix*. (See http://www.tantrix.com/). *Tantrix* tiles have six sides (they're hexagonal); on each tile there are three colored paths (using three out of the four colors red, yellow, green, and blue). These paths leave one of the six sides of the tile and arrive at some other side of the tile. Determine the possible number of tiles that satisfy these criteria. [Hint: draw all possible ways that three pairs of two sides can be paired up. Then figure out in how many ways they can be colored (realizing that rotations may define some sort of equivalence class. Last, realize that the answer is not 56 (the number of tiles in a *Tantrix* set) because there are a few valid tiles that are not included.]