PROBLEM 1. You have nine math books. Five of them are yellow Springer-Verlag texts and four are gray Cambridge University Press texts.

(a) How many ways are there to arrange the books, left to right, along a shelf?

(b) What if the yellow books need to stay together (but their ordering is still important)?

(c) What if, in addition, the gray books need to stay together (and ordering within each color group is important)?
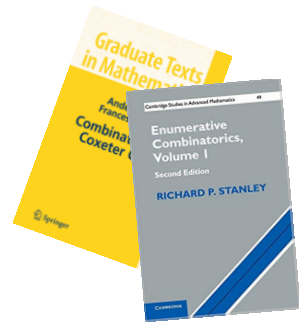
PROBLEM 2. A domino is a list of two, not necessarily distinct, numbers $a, b$ where each of $a$ and $b$ are between 0 and 6, inclusive. We consider the pairs $a, b$ and $b, a$ to be the same.

(a) How many dominoes are there?

(b) Say two dominoes *match* if they share at least one number. Thus, a matching pair will have the form

$$[a|b]\ [b|c]$$

where $a, b, c$ are numbers between 0 and 6, inclusive. How many pairs of matching dominoes are there (where the order of the pair of dominoes does not count)? [Hints: A *double* is a domino with a repeated number, e.g., $[4|4]$. Why can't a matching pair consist of two doubles? Break the problem into two cases depending on whether a double occurs.]

PROBLEM 3. A path on a square grid is called monotonic if it proceeds only by single steps right or up. On a $4 \times 4$ (or $n \times k$) grid, how many distinct monotonic paths go from the bottom left corner to the top right corner?
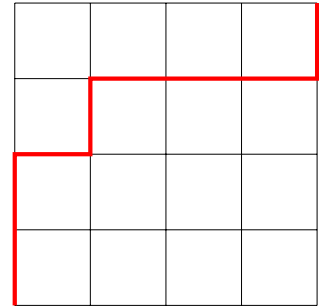
*Challenge*

(a) In Problem 1, what if the only restriction is that the colors appear in a symmetrical pattern about the central book? [Hint: Let $g$ stand for gray and $y$ for yellow. Suppose the first four books have the color pattern $ggyy$. What is the rest of the pattern? How many arrangements have this color pattern? How many possible color patterns are there for the first four books?]