BIG SQUARE POLYOMINOES AND OTHER EXERCISES IN "GAME THEORY".

C.Callesano, *M. Coppenbarger*, Department of Mathematics, Applied Mathematics, cac9322@rit.edu, mecsma@rit.edu.*

The arena of counting problems is usually approached with theoretical intent, and the hope for applications to show themselves as the research progresses. ***Polyominoes*** are figures formed of congruent squares placed so that the squares share a side. One well-known application of common polyominoes is the game "Tetris", where unique shapes must be fit together in an efficient manner. Focusing on "big square" polyominoes allows for us to create the following question:

> Given an $n \times n$ square, placed in the middle of an $(n + 2) \times (n + 2)$ square, how many different polyominoes can you create using k unit squares within the unfilled area?

Since the original shape is an $n \times n$ square, the rules for D_4, the dihedral group of order 8, apply and create 8 basic operations to be performed on the big squares. There are therefore ten subgroups to be analyzed, as in D_4, and each will be analyzed separately. This approach eliminates the possibility of a trivial solution such as $C_{4n, k}$, which seems like a logical and complete formula for counting the shapes, but doesn't account for doubles and symmetries among the polyominoes generated. Subgroups of the squares are determined by the symmetries they posses, for example some will have diagonal symmetry while others rotational symmetry of 90°. Each subgroup has its own formula for determining unique polyominoes of its type, and research continues on how to best and most efficiently combine all formulae into a single concise formula.