

Independent Study Problems and Conjectures
For the Final Week of SEARCH 2006

SET

1. "n-cap" Problems: What is a maximal number of cards containing no SET? Do this for 2-dimensional, 3-dimensional SET, 4-dimensional SET, ...
2. Prove/disprove conjectures previously made for 4-dimensional (the original) SET, not only for 4-dimensional SET, but also for 2-dimensional or 3-dimensional SET (or 5-dimensional SET!)
3. Automated SET Checking: Could you come up with an "efficient" procedure for checking all the possibilities for SETs among, say, 12 cards, using Excel?

Modular Arithmetic

1. Compare modular arithmetic addition tables to symmetries composition tables - Are there some modular arithmetic addition tables that are basically the "same" as a symmetries composition table? Some symmetries composition tables that are essentially different from any modular arithmetic addition tables?
2. Can you construct any groups from parts of modular multiplication tables?
3. Which mods "produce" fields?

Polygons to Polyhedra

1. Method of Perimeter Halving for the Square
 - Are there "bad" choices for the base point X?
 - Is there a maximum number of corners we can have for the polyhedron?
 - Can anything be said about the number of and shape of the polygonal faces of the polyhedron formed by perimeter halving?
2. Method of Perimeter Halving for other polygons, instead of the square: equilateral triangle, regular pentagon, etc.
3. Nets for the Cube and other Regular Polyhedra - How to design nets for polyhedra?

Symmetry

1. Symmetries of Platonic Solids other than the cube and regular tetrahedron

2. Complete the multiplication table for the symmetries of the tetrahedron and compare to the multiplication table for the symmetries of the CMC Pop-up (and the table for the 12-sided base pyramid).
3. Investigate commutativity of the "CMC Pop-up" symmetries multiplication table

Graph Coloring

1. Determining the chromatic polynomial for paths, cycles, complete graphs, and other graphs you find interesting
2. Finding patterns for the chromatic polynomials you have found
3. Constructing applications for graph coloring other than the tour-scheduling problem

Probability Problem coming from Modeling with Excel

What is the probability of reaching into the bag of M&M's and coming out with one of every color? Other questions at

<http://www.mtholyoke.edu/proj/search/2006/student_quest.html>

You can find specific problems and conjectures by following the links at

<http://www.mtholyoke.edu/proj/search/2006/students_06.html>