Final Project Proposal

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Coloring Polyhedra in the Context of Origami

The goal of my final DSA project is to explore using 2-D graphs as representations of 3-D regular polyhedra to solve a problem that I have been plagued with as a modular paper folder: In what color order do I assemble an n-piece modular in order to ensure that there is even color distribution (usually 3 colors) and that no two pieces of the same color are touching?

This problem is two-fold (haha, get it?) as the first concept to tackle would be to get a firm understanding on how to represent polyhedra as 2-D graphs. The second problem is related to the actual modular origami pieces that assemble into these modulars; depending on the modular, one piece actually represents two "edges" of a polyhedron. If I were to represent the pieces as nodes on a graph, I would want that graph to be a *tripartite* graph, so that no two pieces of the same color overlapped.

I see my final deliverable containing a successful algorithm that can explicitly tell me where specific colors should go when assembling a modular with no like-colored adjacent pieces. I would love to test this algorithm on actual origami modulars.

To simplify the problem, I am going to reduce the value of pieces in a module to be a few explicit values: p = 6, 12, 30, 60, 90, 120. I'm more familiar with the geometric structure that arises from that many pieces in a modular. The dream would be to solve this problem for an 120 piece modular - I have one sitting on my desk that has like-colors touching and would love to correct that with certainty. I see a lot of graphs in my future.

Resources I've Looked At

- This explanation of a complete tripartite graph, which will be helpful since the nature of the polyhedron requires that the edges for each node lie in both of the other sets.
- The MIT class Geometric Folding Algorithms: Linkages, Origami, Polyhedra, which, while it doesn't have too much relevance to what I want to tackle, is an absolutely fascinating class and I have lost a couple hours to their super cool lectures. There are also lectures at the end related to protein folding, which I did not look at personally but if someone else has that interest they should definitely check it out.
- This Wikipedia page on polyhedral graphs (hey; I had to start somewhere).