6.849: Geometric Folding Algorithms, Spring 2017

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Problem Set 2

Due: Wednesday, February 22, 2017

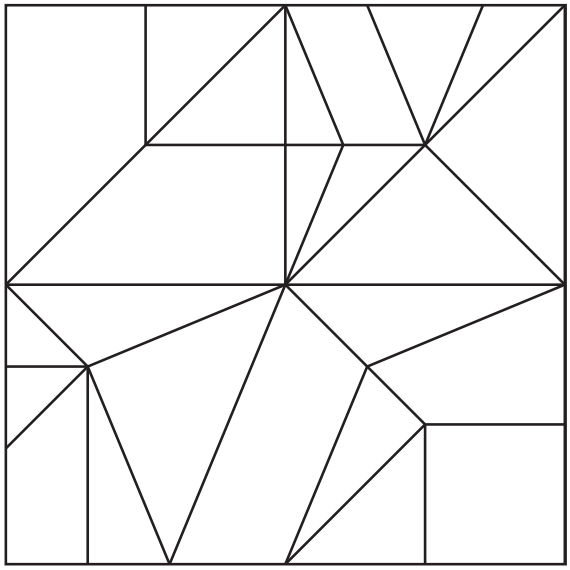
Solve Problem 2.1 and *either* Problem 2.2 or 2.3.

Problem 2.1 [Mandatory, Collaboration OK]. On each problem set, we will ask you to write a problem (solved or unsolved) related to the material covered in class. The problem should be original to the best of your knowledge, so be creative and diverse! Folding can be applied to mathematics, computation, engineering, architecture, biology, and beyond, so write a problem that is related to a field that interests you. If you write a problem whose solution can be solved from the material covered in class, then we may adapt your problem for future problem sets. If you pose a problem whose solution is not yet known, we may try to solve it in class during our open problem sessions, or it may become inspiration for a class project. Feel free to include solutions or commentary for your problem. While writing a problem is required, your submission will be graded generously, so have fun and share with us your exploration of the course material.

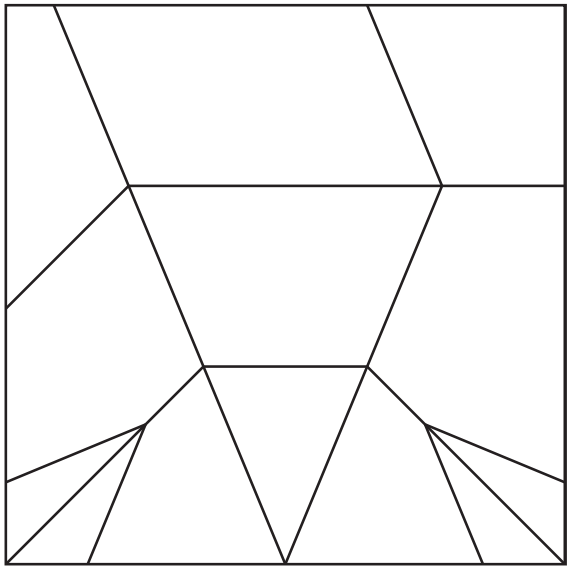
Solve ONE of the two problems below.

Problem 2.2 [Collaboration OK]. Which of the four crease patterns on the following page are flat foldable? Are any simply foldable (foldable by a sequence of simple folds)? Justify each answer by either submitting a flat folding or arguing why the crease pattern cannot fold flat.

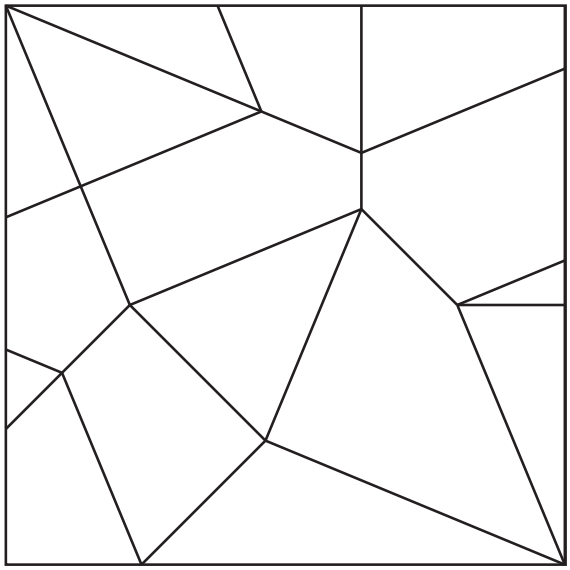
Problem 2.3 [Collaboration OK]. In class, we saw NP-hardness of the 1D "ruler folding" problem. Now consider the related problem about single-vertex flat foldability. Given an (unassigned) single-vertex *hinge* pattern (a crease pattern where all creases are optional), decide whether there is any flat folding that folds at least one of the hinges. Prove that this problem is weakly NP-hard.



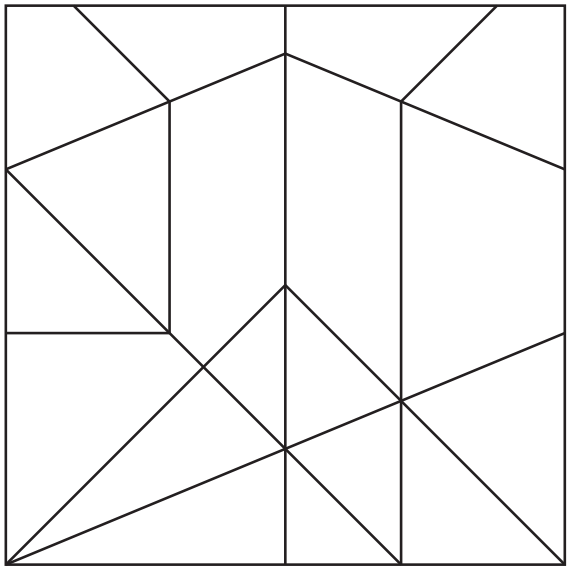
(1) http://courses.csail.mit.edu/6.849/spring17/psets/ps2-cp1.pdf



(2) http://courses.csail.mit.edu/6.849/spring17/psets/ps2-cp2.pdf



(3) http://courses.csail.mit.edu/6.849/spring17/psets/ps2-cp3.pdf



(4) http://courses.csail.mit.edu/6.849/spring17/psets/ps2-cp4.pdf