6.849: Geometric Folding Algorithms

Fall 2012 — Prof. Erik Demaine

Problem Set 1

Due: Tuesday, September 18th, 2012

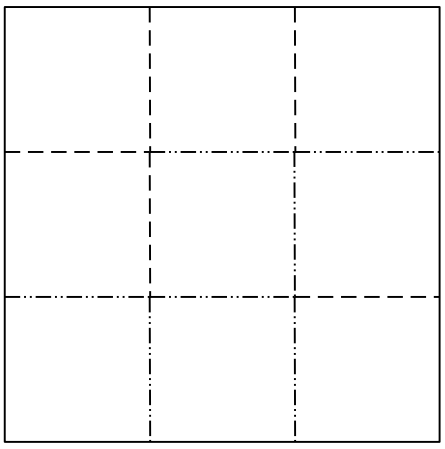
We will drop (ignore) your lowest score on any one problem.

Problem 1. Pose any problem related to folding (mathematical, computational, application, etc.). The problem should be original to the best of your knowledge (though it's fine if it turns out that the problem has been posed or even solved).

Problem 2. For each of the two 3×3 maps linked below,[1] fold along all the creases to obtain a flat packet of 1×1 squares that satisfy the following restrictions. Submit your folded solutions.

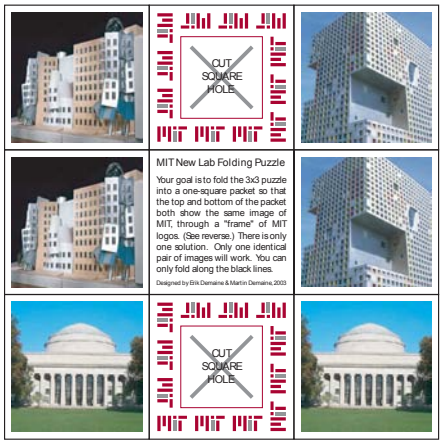
(a) Respect the specified mountain-valley pattern.

(b) The top and bottom of the packet should both show the same image of an MIT building, through a "frame" of MIT logos. (Only one identical pair of images will work.)



(a)

http://courses.csail.mit.edu/6.849/fall12/psets/map_crease_2.pdf



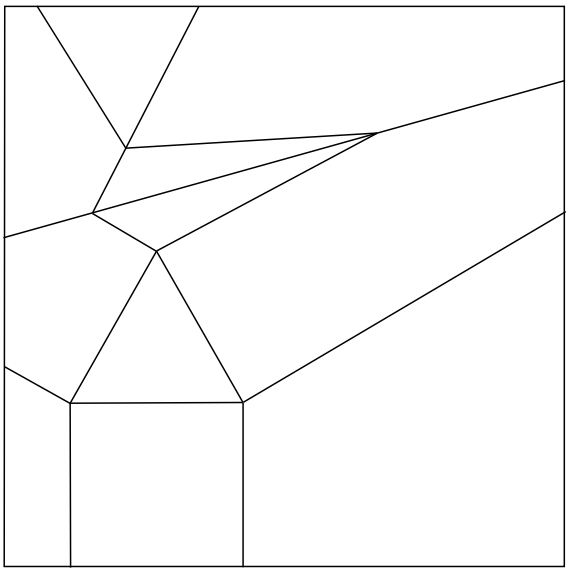
(b)

http://erikdemaine.org/puzzles/LCS2003/

Problem 3. Give a polynomial-time algorithm to compute the minimum number of simple folds needed to fold a given 2D map (mountain-valley pattern), assuming that the map is already known to be flat foldable by simple folds.

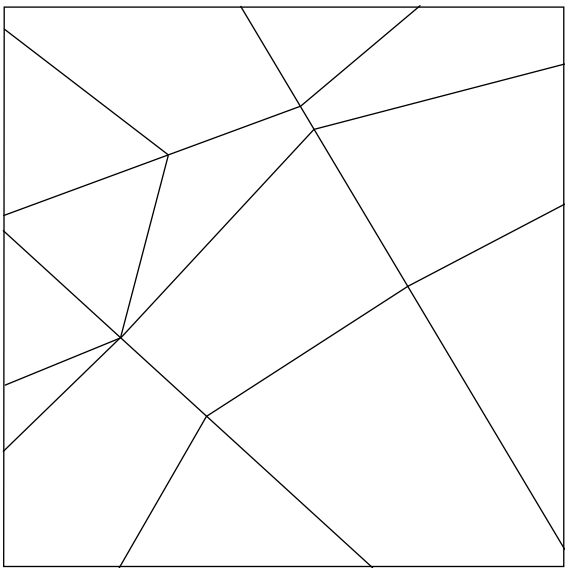
[1] The puzzle in 2(b) was handed out in class. If you missed it, follow the link and print the two-sided PDF on a duplex printer. Note that the puzzle has two sides; only the front side is shown here.

Problem 4. Which of the following crease patterns 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.



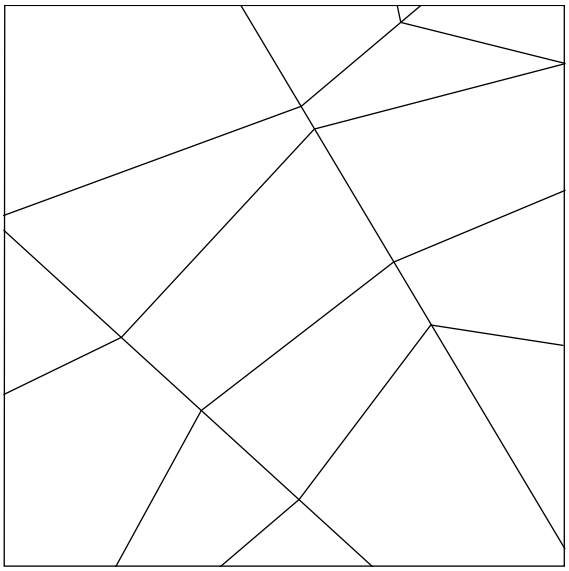
(a)

http://courses.csail.mit.edu/6.849/fall12/psets/ps1a.pdf



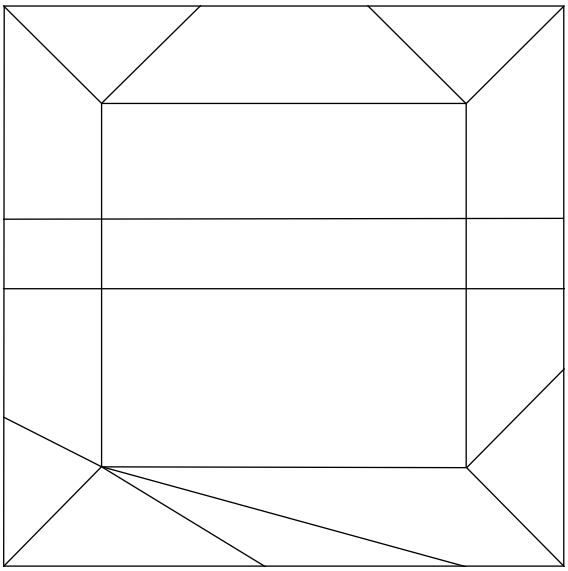
(b)

http://courses.csail.mit.edu/6.849/fall12/psets/ps1b.pdf



(c)

http://courses.csail.mit.edu/6.849/fall12/psets/ps1c.pdf



(d)

http://courses.csail.mit.edu/6.849/fall12/psets/ps1d.pdf

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