Session 7 *(In preparation for Class 7, students are asked to view Lecture 7.)*

Topics for Class 7

Universal hinge patterns: box-pleating history; maze-folding prints.
NP-hardness: simple foldability; crease pattern flat foldability.

Detailed Description of Class 7

This class starts with some artistic examples related to the two universality results covered in Lecture 7: box pleating and maze folding.

Second, we review the NP-hardness proofs from Lecture 7:

- What does hardness really mean?
- Details of the simple fold hardness proof
- Details of the flat foldability hardness proof
- Extension to when given the mountain-valley assignment

Finally, we cover a new (this year) result: 2 × *n* map folding can be solved in polynomial time. (*m* × *n* map folding remains unsolved.)

Topics for Lecture 7

Universal hinge patterns: box pleating, polycubes; orthogonal maze folding.
NP-hardness: introduction, reductions; simple foldability; crease pattern flat foldability; disk packing (for tree method).

Detailed Description of Lecture 7

This lecture covers two main topics:

First, continuing our theme from Lecture 4 on efficient origami design, we'll see how subsets of a single hinge pattern are enough to fold any orthogonal shape made up of cubes, whereas other approaches use a completely different set of creases for each origami model you want. In general, we can fold *n* cubes from an O(n) × O(n) square of paper. In the special case of “orthogonal mazes”, we can waste almost no paper, with the folding only a small constant factor smaller than the original piece of paper. You can try out this yourself using the Maze Folder.

Second, we'll see a few ways in which origami is hard. Specifically, I'll give a brief, practical introduction to NP-hardness, and prove three origami problems NP-hard:

- folding a given crease pattern via a sequence of simple folds;
- flat folding a given crease pattern (using any folded state);
- optimal design of a uniaxial base, even when the tree is just a star.