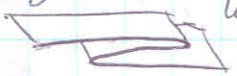
II Paper

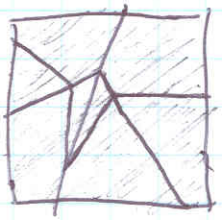
6.885
L1.5
Sept. 8, 2004

Definitions: folded state
folding motion
-subtly with overlapping layers

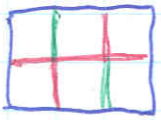


- every folded state of a polygonal piece of paper is reachable by a folding motion [Demaine, Devadoss, Mitchell, O'Rourke 2004]
  ⇒ all about folded states

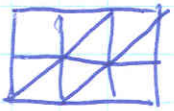
Foldability: which crease patterns fold flat?



- **NP-hard** in general [Bern & Hayes 1996]
- efficient characterization for single vertex [Kawasaki; Justin; Hull 2003]
- **map folding: open**

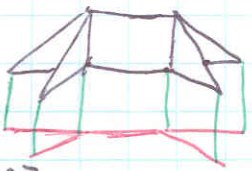


  - solved in 1×n case
  - solved for "simple folds"
  - even simple folds are NP-hard with diagonal creases (45°)



Design:

- any 2D polygon or 3D polyhedron + 2-color pattern can be folded from a (sufficiently large) square [Demaine, Demaine, Mitchell 2001]
  -- BUT: inefficient
- TreeMaker: algorithm for best "tree base" [Lang]
- fold & cut: any pattern of line segments can be simultaneously aligned by a flat fold
  ↳ cut along line ⇒ desired pattern of cuts
  [Demaine, Demaine, Lubiw 1998]



- flattening: any polyhedron (≅sphere) can be flattened without tearing
  [Demaine, Demaine, Hayes, Lubiw 2004]
- tessellations: from tilings [Bateman, Lang, Palmer]
  ↓ algorithms ↓ theory in progress ↓ art
- curved folds: Resch, Huffman