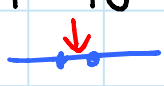
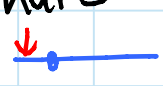



- o Algorithm for testing flat foldability (NEW) of 1D mountain-valley pattern [C2]
- - search (left to right) for segment that's crimpable  OR end foldable 
 - if none found: STOP ~ not flat foldable
 - else: do fold 
merge segments $x, y, z \rightarrow x-y+z$
go back one segment (left of x)
continue search

Correctness:

- doing fold changes foldability only of adjacent segments
- \Rightarrow enough to back up 1 step

Running time: $O(n)$

\uparrow # creases

$$\begin{aligned}
 - \# \text{ right steps} &= n + \underbrace{\# \text{ left steps}}_{= \# \text{ folds done}} \\
 &\leq 2n
 \end{aligned}$$

Amortization: charge left steps to fold just done)

- o Algorithm for testing flat foldability (NEW) of single-vertex mountain-valley pattern
 - mark any start segment (angle)
 - - search (clockwise) for crimpable segment
 - if found: do fold, merge segments
go back (ccw) one segment
 - (addition during class) { if next to start segment:
move start one segment cw
 - continue search
 - if we "loop around" (return to start seg.):
foldable \Leftrightarrow just 2 M's or 2 V's
& 2 equal angles

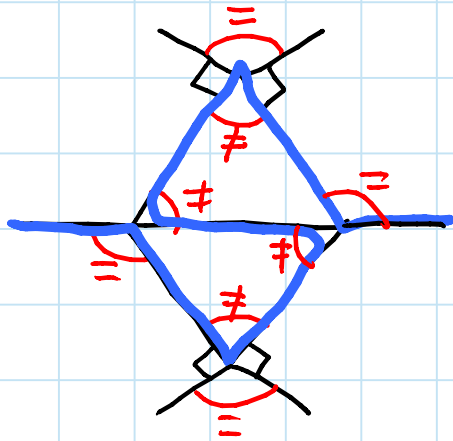
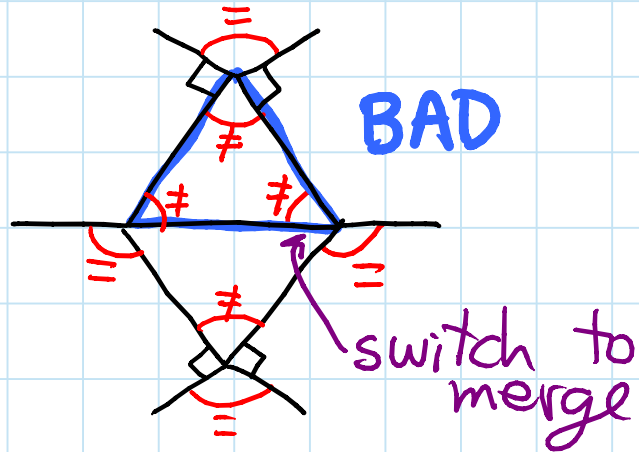
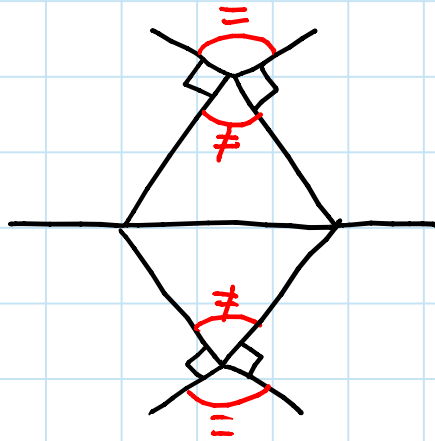
Correctness: maintain invariant that interval from start segment clockwise up to but not including current seg. is uncrimpable

Running time: $O(n)$

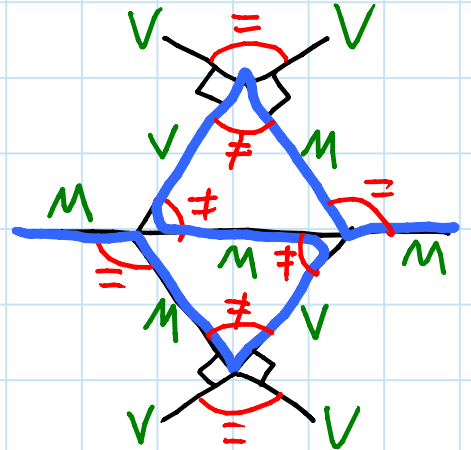
- interval shrinks (on either side) only when doing a fold

Local foldability examples


- generic case: unique pairing (crane)
- each cycle should have even # #'s (i.e. $\text{parity}(\text{cycle}) = \text{parity}(\# \neq \text{'s})$ as in L3)
- general case: merging



PATH,
NOT
CYCLE



○ T-shirt has $>360^\circ$ of material at armpit
→ T-shirt folding video

○ Higher dimensions:
- definition: like  (add layer dim.)
- necessary condition & examples

[Kawasaki 1989]
- graphics examples [Inoue, Itohara, Yajima, Kaino, 2005]

OPEN: characterize single-vertex flat foldability

○ Why flat foldability?

- art e.g. tessellations

- practical storage e.g. airbag folding

- math e.g. Tachi's rigid-foldable quad mesh

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<http://ocw.mit.edu>

6.849 Geometric Folding Algorithms: Linkages, Origami, Polyhedra
Fall 2012

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