6.849	Class 3	Sept. 13, 2012

- Algorithm for testing flat foldability of 1D mountain-valley pattern (NEW) [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 $x, y, z \to x-y+z$
    go back one segment (left of x)
    continue search

Correctness:
- doing fold changes foldability only of adjacent segments

⇒ enough to back up 1 step

Running time: $O(n)$ ← # creases

- # right steps $= n +$ # left steps (= # folds done)

$\leq 2n$

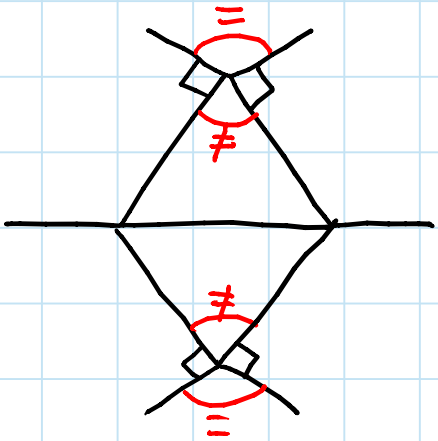
(amortization: charge left steps to fold just done)

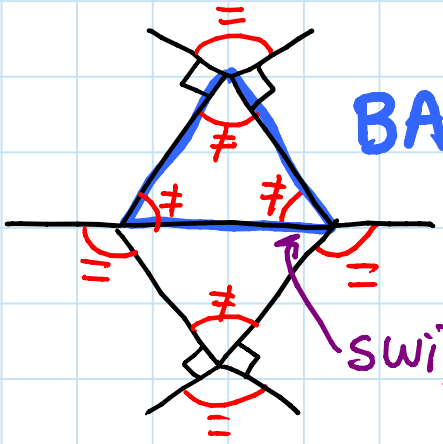
- **Algorithm** for testing flat foldability of single-vertex mountain-valley pattern (NEW)
  - mark any start segment (angle)
  - search (clockwise) for crimpable segment
  - if found: do fold, merge segments
    go back (ccw) one segment
    (addition during class) { if next to start segment:
    move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

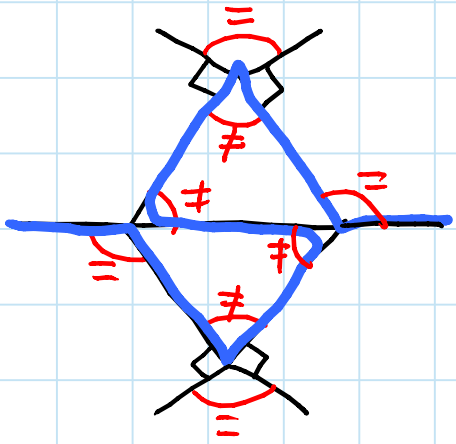
Correctness: maintain invariant that interval from start segment clockwise up to but not including current seg. is uncrimpable

Running time: $O(n)$
- interval shrinks (on either side) only when doing a fold

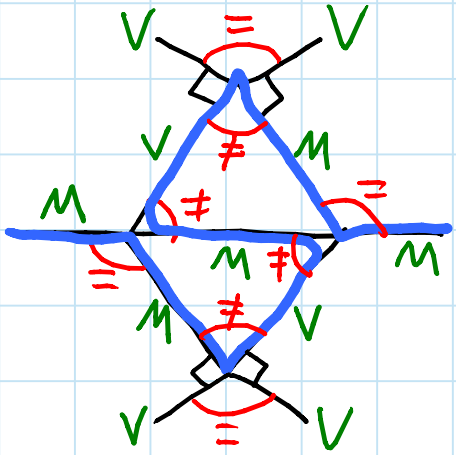
- Local foldability examples
  - generic case: unique pairing (crane)
    - each cycle should have even # ≠'s
      (i.e. parity(cycle) = parity(# ='s) as in L3)
  - general case: merging







PATH, NOT CYCLE



- T-shirt has $>360°$ 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