6.885
L7.5
Sept. 29, 2004

Hardness: [Bern & Hayes 1996]

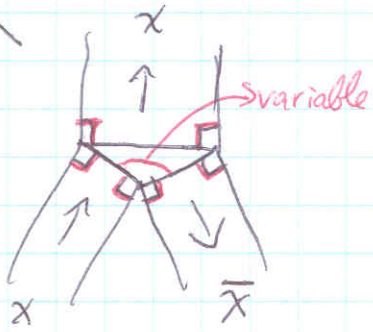
- deciding flat foldability of crease pattern is (strongly) NP-hard
- constructing λ ordering for flat-foldable M-V pattern is too.

Proof: Reduce from "all-positive not-all-equal 3-satisfiability":
are there truth values (assignment) for vars. $x_1, x_2, \ldots$
such that AND$_{(ijk)\ldots}$ Not-All-Equal(x_i, x_j, x_k) ?

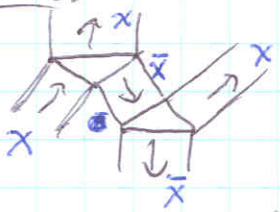
Wire = pleat = two close, parallel creases
- left mountain $\Leftrightarrow$ false

NAE clause = triangular "overtwist"
- can't all be folded the same way (twist is borderline)

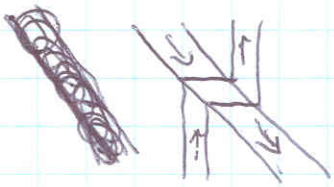
Reflector
- splits input x into two copies, one negated
- also a "turn" gadget — with noise
- note angle varies wire thickness



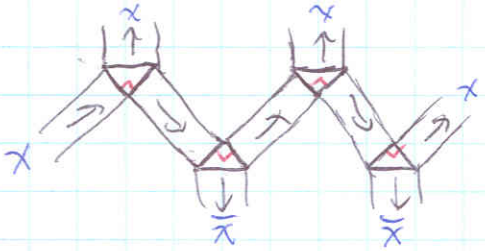
Split: two reflectors



Crossing: only at 90° & 135°



Variable: zig-zag wire



Connections: orient clause

& scaled to $\sqrt{2}$. of wire zig-zag

- send vertical wire directly
- send others by turning negated signal around
- route excess junk to boundary