Mooser’s Train
Raymond McLain, 1967
Mooser’s Train
Raymond McLain, 1967

folding by
Robert Lang
Black Forest Cuckoo Clock, 
opus 182

Robert Lang, 1987
Are there known universal hinge patterns to build poly-some-other-shapes-that-are-not-cubes?
I didn’t understand the point of NP-hardness. Are there examples of actual problems that can't be calculated?
Could we go through one of the NP proofs with a little less hand waving?
[Arkin, Bender, Demaine, Demaine, Mitchell, Sethia, Skiena 2000]
Minor question: in the orthogonal paper reduction, doesn’t this require not folding some of the creases, if we want to make 2 consecutive strips the same direction?
Not All Equal (NAE) clause

crossover

reflector

wire
In the reflector gadget, it looks like all the left sides of the wires, where left is taken relative to the free end of the wire, are equal. How does the reflector negate one of them, then?

[Bern & Hayes 1996]
It looks like the global flat foldability proof proves that globally flat-foldable $$\Rightarrow$$ NAE satisfiability $$\Rightarrow$$ locally flat-foldable, but I don't see where NAE satisfiability $$\Rightarrow$$ globally flat-foldable. (It looks like all that matters is the order of sheets, though, and that those all work out.)
Not All Equal (NAE) clause

crossover

reflector

wire
For global flat foldability, I understand how the gadgets prove (1), but how do they prove (2)?

Global flat foldability:  
1. Deciding flat foldability of given crease pattern is strongly NP-hard  
2. Constructing valid layer ordering for given flat-foldable mountain-valley pattern is strongly NP-hard

[Bern & Hayes 1996]
[Bern & Hayes 1996]
NAE clause

[Bern & Hayes 1996]
2D map folding: [Arkin et al. 2004]
- rectangular paper with axis-parallel creases
- again every crease pattern is flat foldable:
  zig-zag in x then y

OPEN: characterize flat-foldable mountain-valley patterns — even 2xN! [Edmonds 1997]

Simple folds are not as powerful in 2D:
(in contrast to 1D, where we can simulate crimp/end folds)
MIT New Lab Folding Puzzle

Your goal is to fold the 3x3 puzzle into a one-square packet so that the top and bottom of the packet both show the same image of MIT, through a "frame" of MIT logos. (See reverse) There is only one solution. Only one identical pair of images will work. You can only fold along the black lines.

[Demaine & Demaine 2003]
1,368 folded states
NEWS labeling

[Demaine, Liu, Morgan  2012]
top edge view

[Demaine, Liu, Morgan  2012]
top edge view

[Demaine, Liu, Morgan 2012]
constrained

valid

invalid

unconstrained

Ray diagram

east
down

west
up

north

southeast

down

[Demaine, Liu, Morgan 2012]