Origami as Computer Science

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Origami

1. Introduction

"**Origami**" is the name of paper folding and it is a famous traditional art in Asia.

You may think that origami is childish, but recent origami is very fine and a kind of art:

"Devil" designed by Jun Maekawa.

"Rose" designed by Toshikazu Kawasaki.

Recently, "Origami" is known as one of hot topics that is not only art but also science --- *mathematics*, *computer science* --- and that has wide applications including architecture, bioinformatics, and so on…

It can be stretched like spring…

"Spring" designed by Jeff Beynon in **UK!!**

It can be "self-organized"…

Computer Science?

2. Computer Scientific Origami

- Origami is an interesting problem from the viewpoint of *theoretical computer science*.

- What are "basic operations"?
- How many operations do we need?
- Can we find a best way to fold?

"Shell" designed by Toshikazu Kawasaki.

2.0. Basic Operations

- "Huzita-Hatori axiom" contains seven basic folding operations.

Using simple operations, we can solve some "*difficult problem*" like "*trisector any given angle*" that is impossible using rule and compass.

…viewpoint of "Arithmetic"

It can be folded along curves…

"Ammonite" designed by Jun Maekawa.

Hard/Easy?

2.1. Positive Results

- We can find
  - a best (or better) way to fold
  - efficiently (by computer)

  for simple nets.

…viewpoint of "*Algorithm*"

[Example]
Given long straight strip and mountain/valley assignment, we can check if it can be folded flat in linear time.

We can find a flat folding efficiently if it exists …

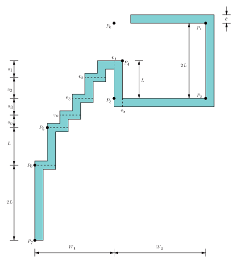
…even if it is a kind of complex.

2.2. Negative Results

- It is intractable to find a way to fold some nets in general.

…viewpoint of "*Computational Complexity*"

[Example]
Given long zig-zag strip and mountain/valley assignment, we have no hope to find a way to be folded flat even if you can use supercomputer!!



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