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正四面体と他のプラトン立体の間の共通の
(辺)展開図に関する研究

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ERATO合宿 2010/11/29-12/1

Folding & Unfolding

Tiling

Puzzle

賞金の懸かった魔方陣

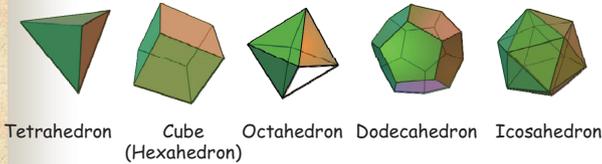
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Introduction

■ Open problem 25.6
(by M. Demaine, F. Hurtado, E. Pegg)

■ Can any **Platonic solid** be cut open and unfolded to a polygon that may be refolded to a **different Platonic solid**?

For ex., may a cube be so dissected to a tetrahedron?



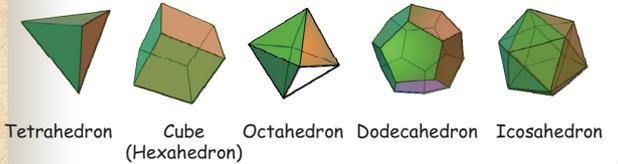
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Introduction

■ Open problem 25.6

Are there polygons that can be folded to two (or more) different Platonic solids?

For ex., may a cube be so dissected to a tetrahedron?



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Introduction

Are there polygons that can be folded to two (or more) different Platonic solids?

Close call ! [O'Rourke]

Regular Octahedron
⇔ Tetramonohedron
(tetrahedron all of whose faces are congruent)

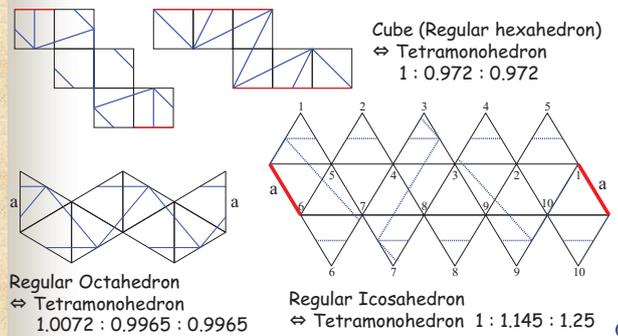
Close call !! [Hirata]

Regular Tetrahedron
⇔ Box $1 \times 1 \times 1.232$

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Are there polygons that can be folded to two (or more) different Platonic solids?

Close calls



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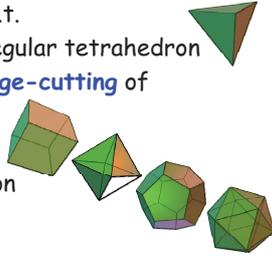
Are there polygons that can be folded to two (or more) different Platonic solids?

Our Results

There exists no polygon P s.t.

- (1) P is a **development** of a regular tetrahedron
- (2) P is a **development by edge-cutting** of

- a regular hexahedron
- a regular octahedron
- a regular dodecahedron
- a regular icosahedron



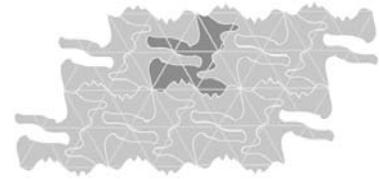
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The Key Theorem

- Theorem [Akiyama 2007, Akiyama Nara 2007]

Let P be a development of a **regular tetrahedron**.

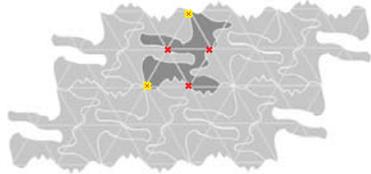
Then, P is a **tiling**. That is, P **fills a plane**.



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The Key Theorem

- Theorem
- P is a development of a **regular tetrahedron** iff
- (1) P has a **p2 tiling**, i.e., tiling by 180° rotations
 - (2) **4** of the **rotation centers** define the triangular lattice
 - (3) no two of the 4 rotation centers belong to the same equivalent class on the tiling



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Conclusion

Open problem:

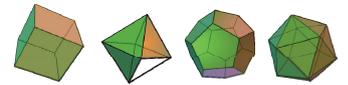
Are there polygons that can be folded to two (or more) different Platonic solids?

Development of



vs

Development of



Future Work: 1.

by ~~edge-cutting~~

2.

Relation among these 4

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