Imagine Math 7 (Mathematics & Culture 2019)

marco abate

GEOMETRIC ORIGAMI

Venezia, March 29th, 2019

what is origami?

what is origami?

- Paper Folding

what is origami?

- Paper Folding
- Square (not always)

what is origami?

- Paper Folding
- Square (not always)
- One piece (not always)

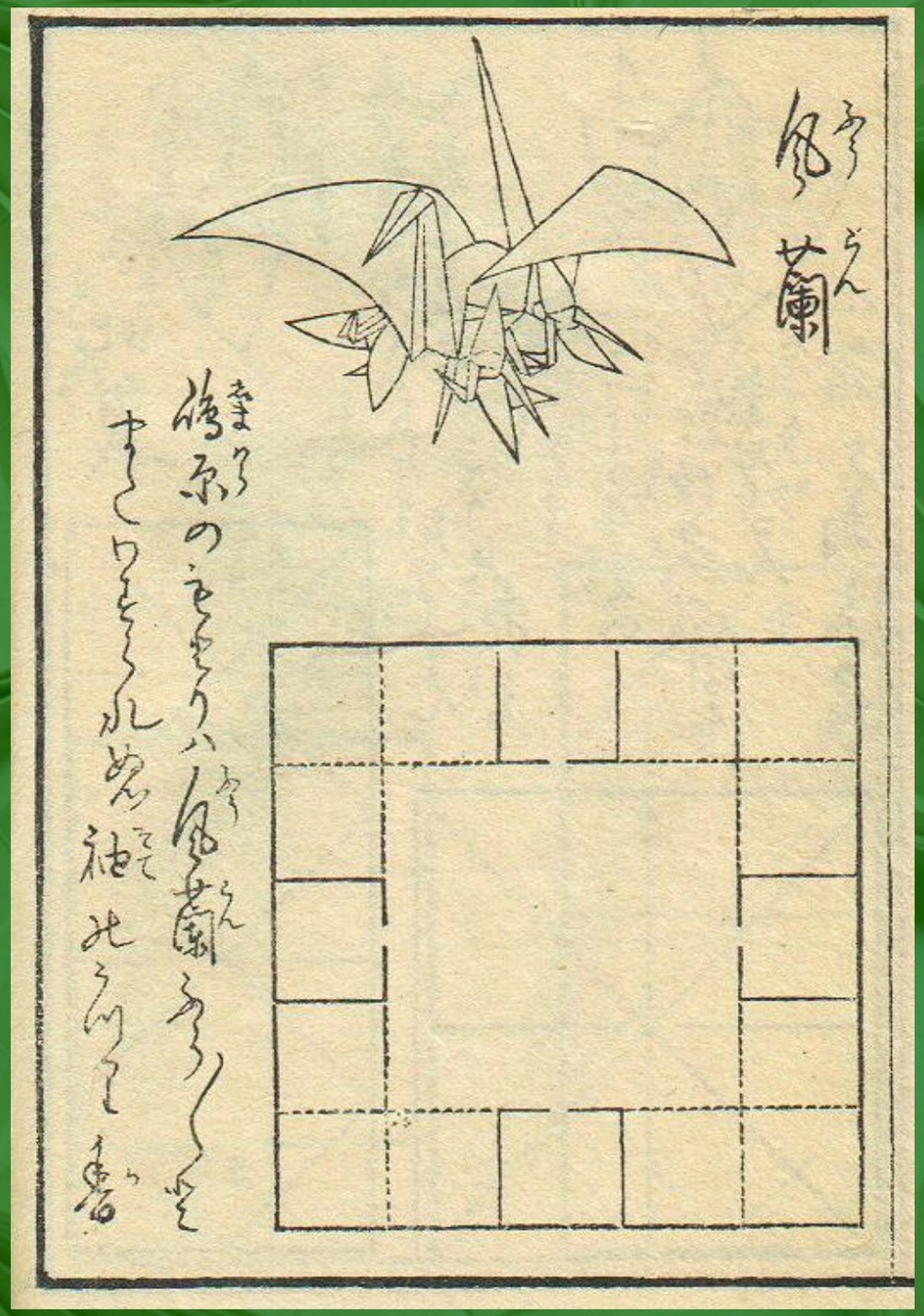
what is origami?

- Paper Folding
- Square (not always)
- One piece (not always)
- No cuts

a very brief history of origami

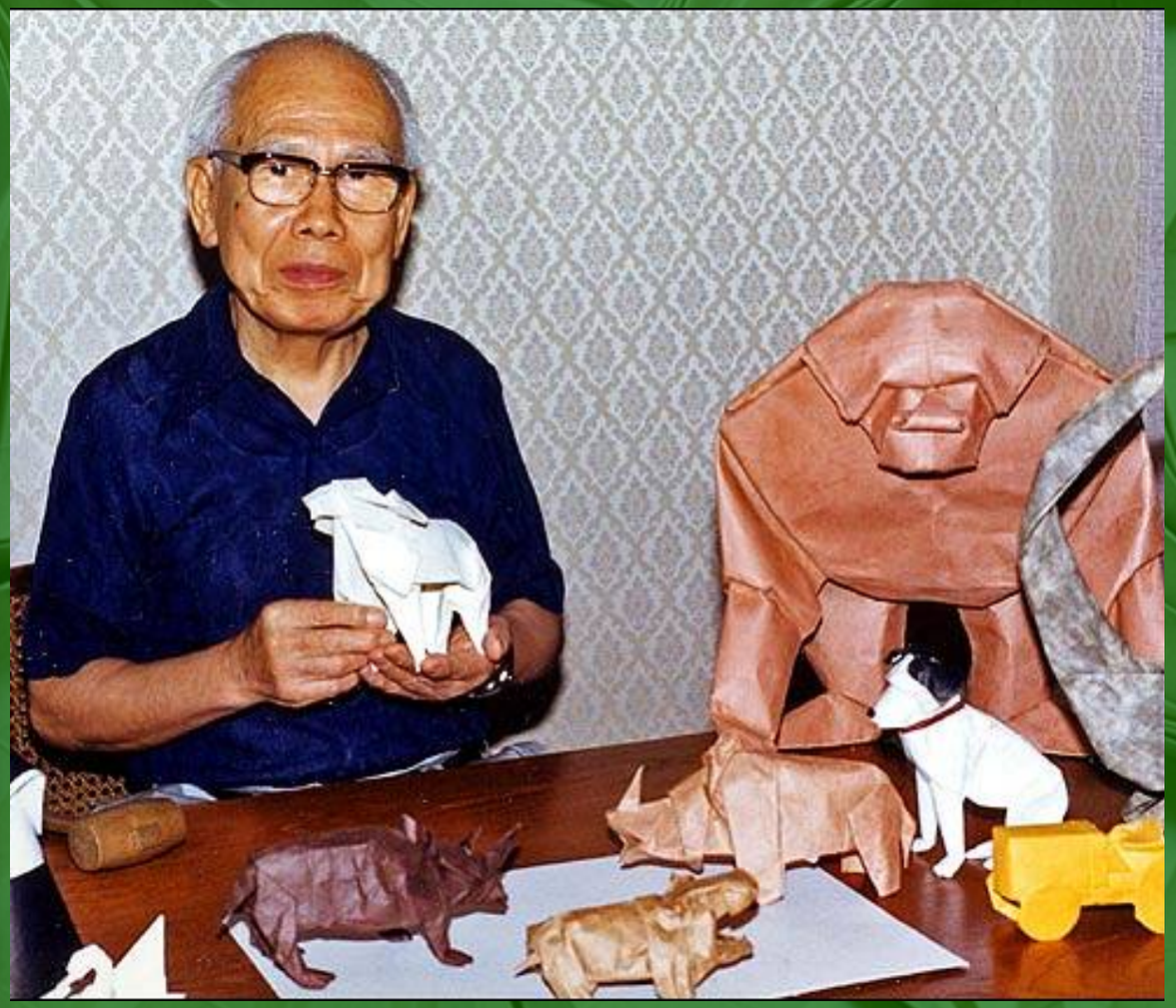
a very brief history of origami

- Japan (about 6th century A.D.?)



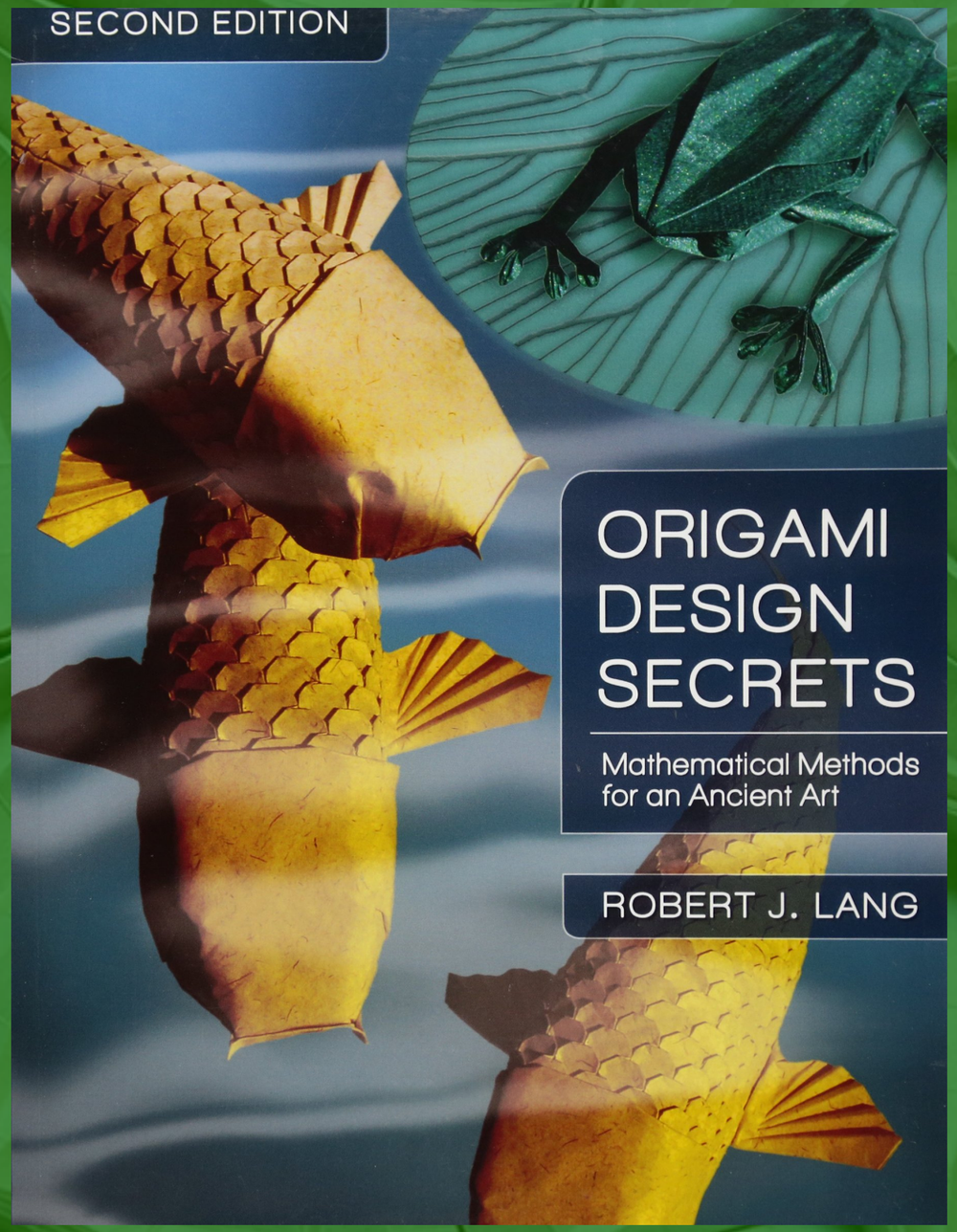
a very brief history of origami

- Japan (about 6th century A.D.?)
- Akira Yoshizawa (1911-2005)



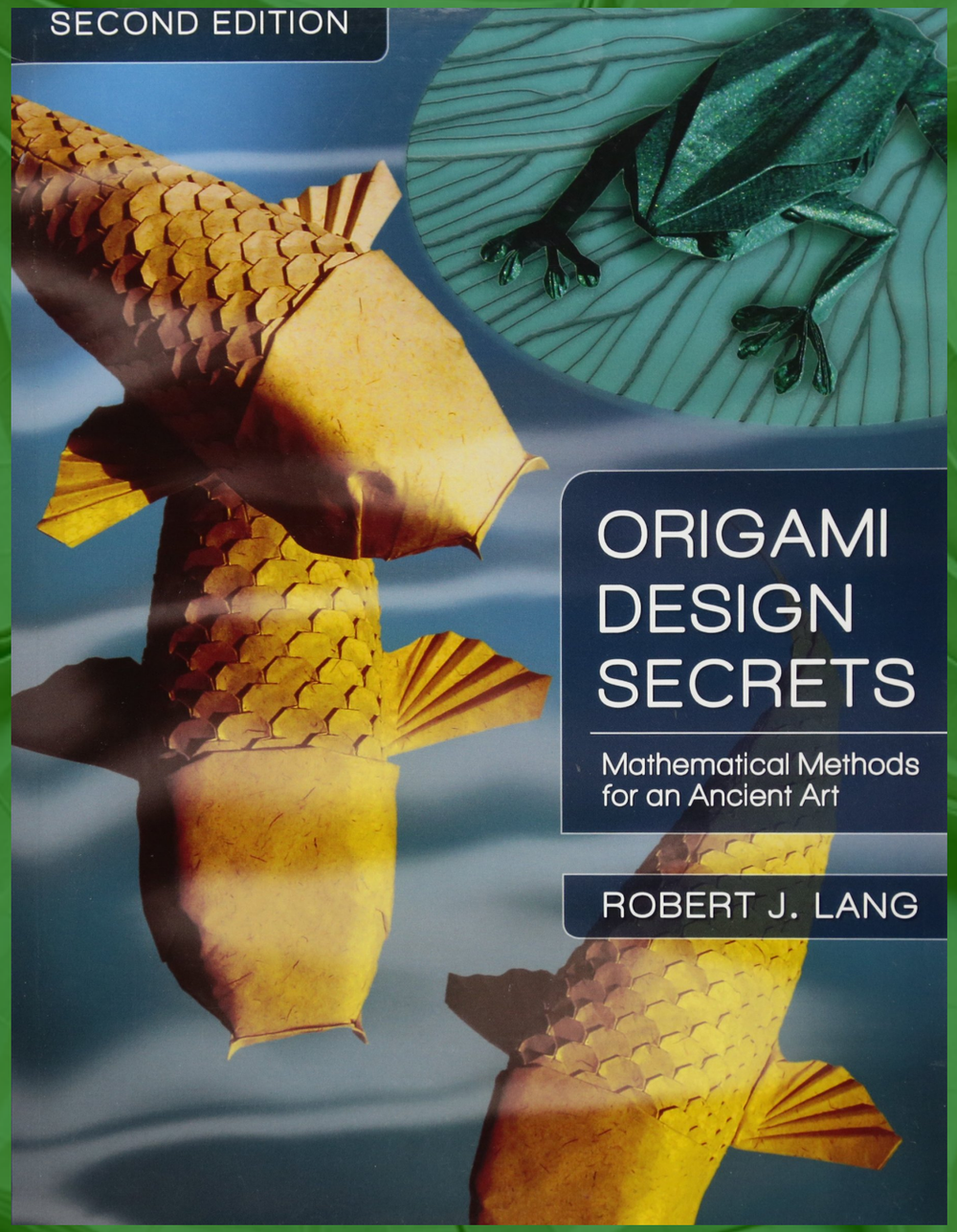
a very brief history of origami

- Japan (about 6th century A.D.?)
- Akira Yoshizawa (1911-2005)
- The bug wars (1990s)



a very brief history of origami

- Japan (about 6th century A.D.?)
- Akira Yoshizawa (1911-2005)
- The bug wars (1990s)
- Everything goes...



figurative origami

ROBERT J. LANG (USA)

figurative origami

SATOSHI KAMIYA (JAPAN)

figurative origami

ROMAN DIAZ (URUGUAY)

figurative origami

QUENTIN TROLLIP (S. AFRICA)

figurative origami

HOANG TIEN QUYET (VIETNAM)

figurative origami

ERIC JOISEL (FRANCE)

geometric origami

geometric origami

geometric origami

- 2D or 3D
- One piece or modular

geometric origami

- 2D or 3D
- One piece or modular
- Local or global folding

geometric origami

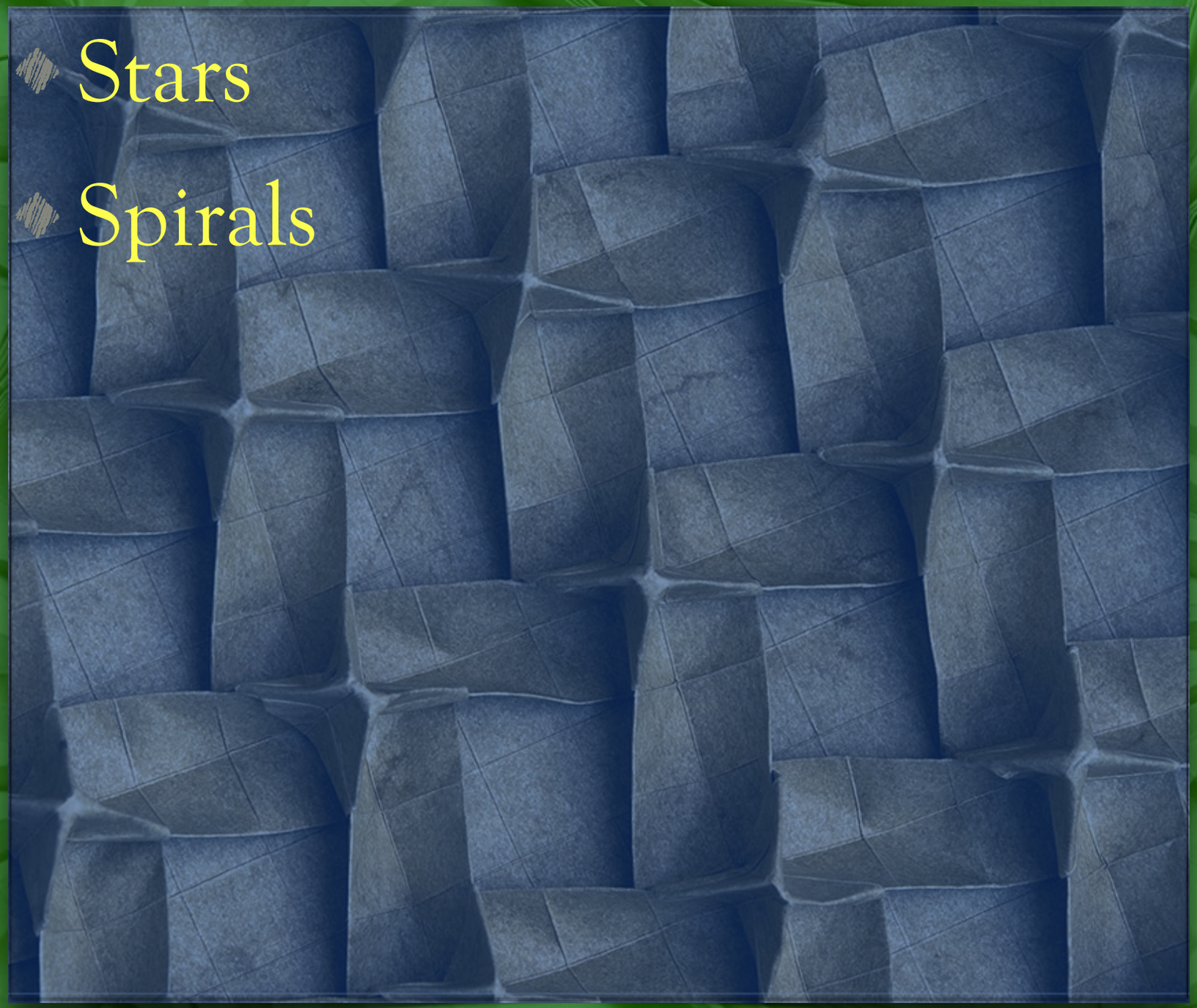
- 2D or 3D
- One piece or modular
- Local or global folding
- Geometrical thinking

geometric origami

- Stars

geometric origami

- Stars
- Spirals



geometric origami

- Stars
- Spirals
- Polyhedra

geometric origami

- Stars
- Spirals
- Polyhedra
- Kusudama (modular)

geometric origami

- Stars
- Spirals
- Polyhedra
- Kusudama (modular)
- Fractal origami

geometric origami

- Stars
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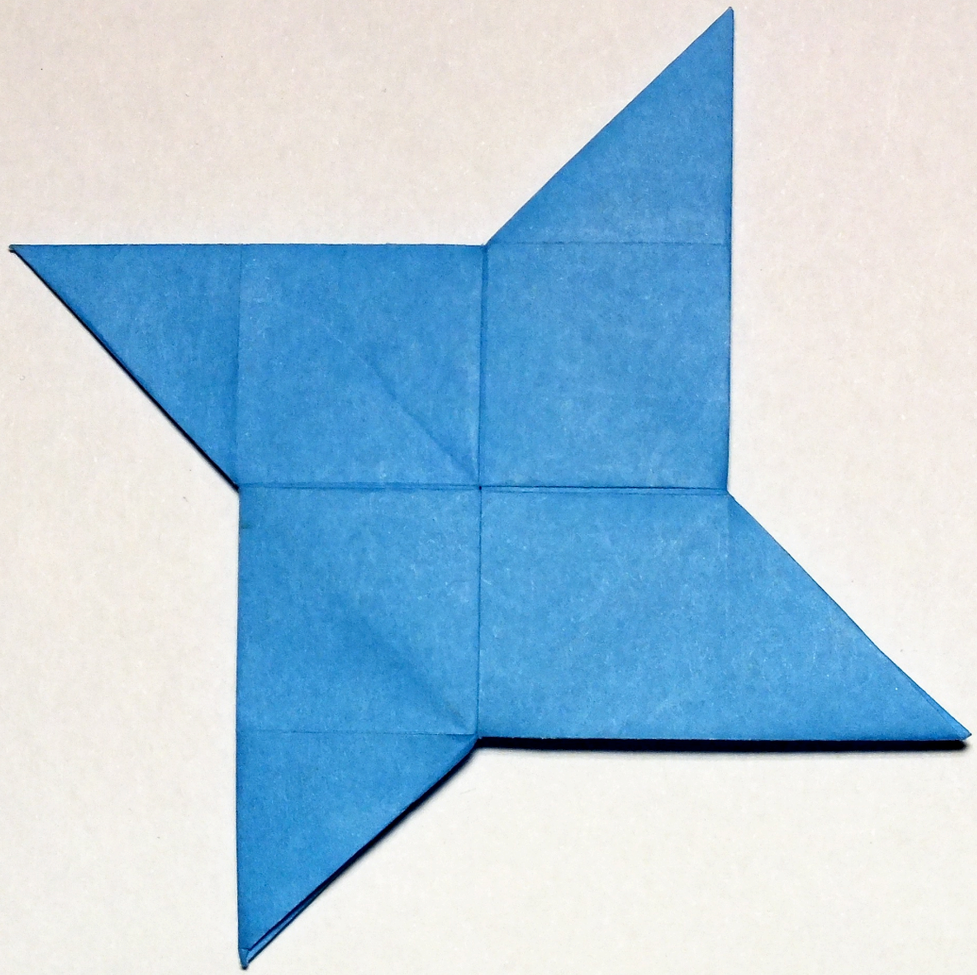
- Kusudama (modular)
- Fractal origami
- Tessellations and corrugations

geometric origami

- Stars
- Spirals
- Polyhedra
- Kusudama (modular)
- Fractal origami
- Tessellations and corrugations
- More...

geometric origami: stars

geometric origami: stars



geometric origami: stars

FRED ROHM (USA)

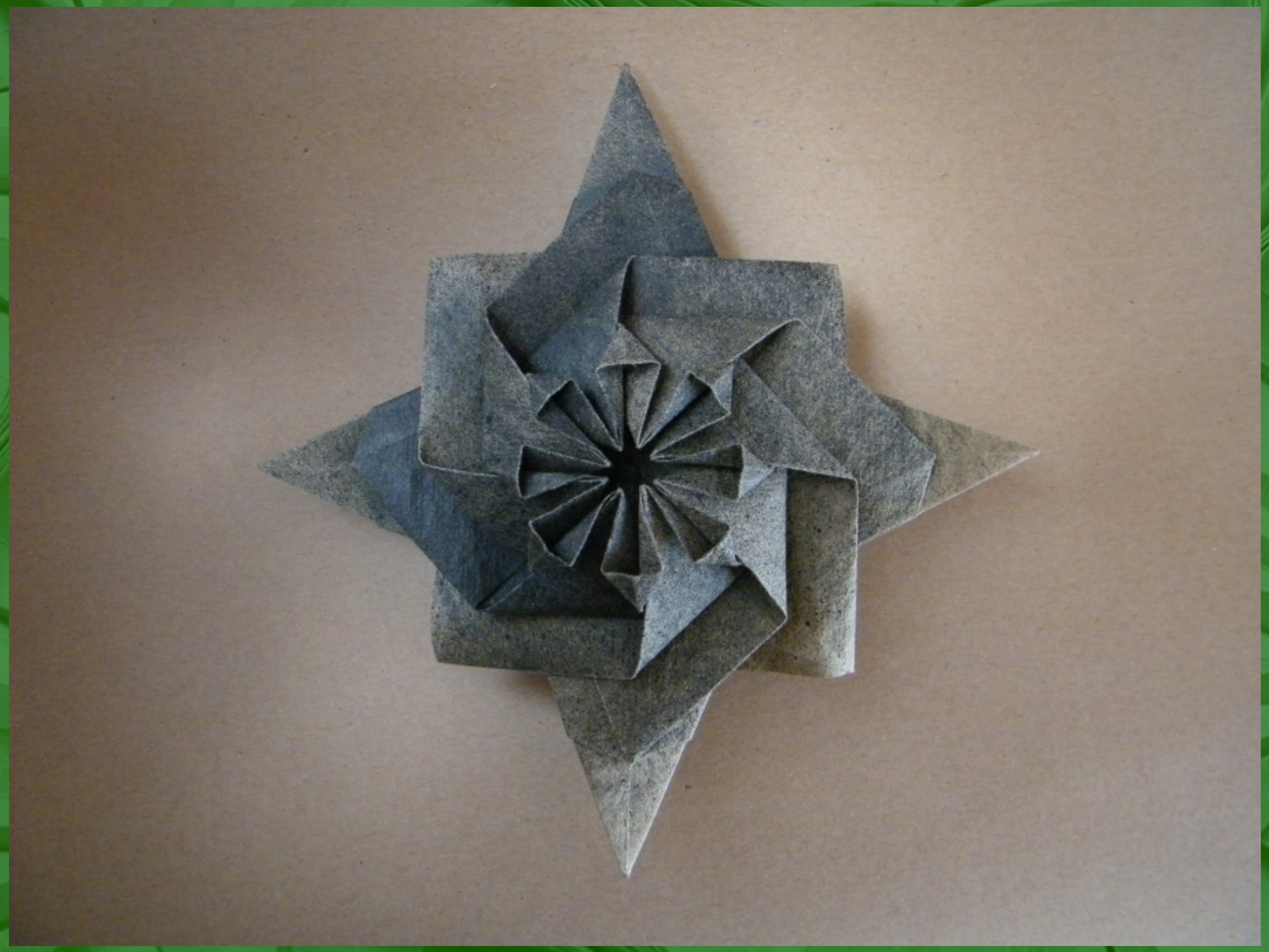
geometric origami: stars

geometric origami: stars

geometric origami: stars

JUAN LOPEZ FIGUEROA (SPAIN)

geometric origami: stars



JUAN LOPEZ FIGUEROA (SPAIN)

geometric origami: stars

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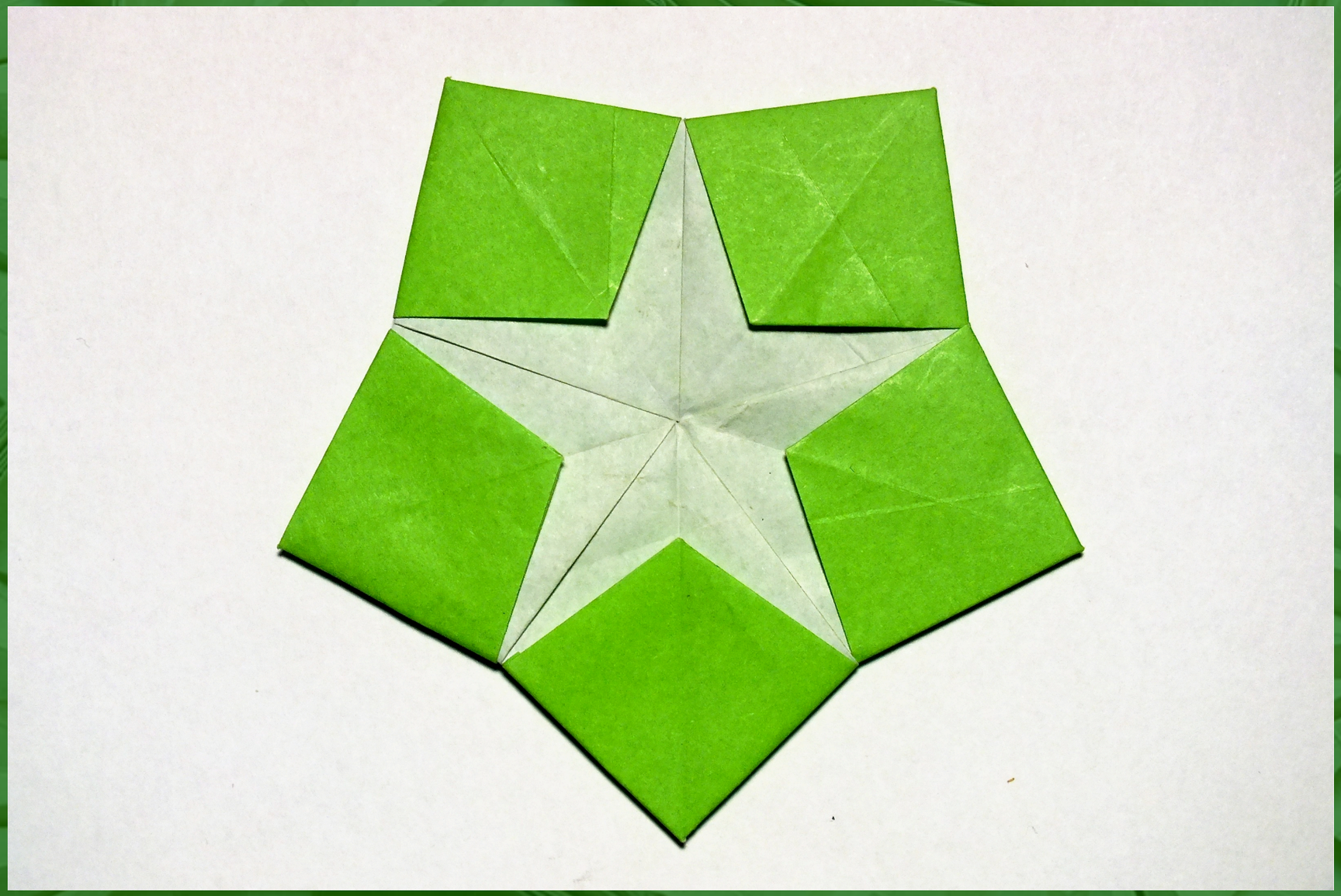
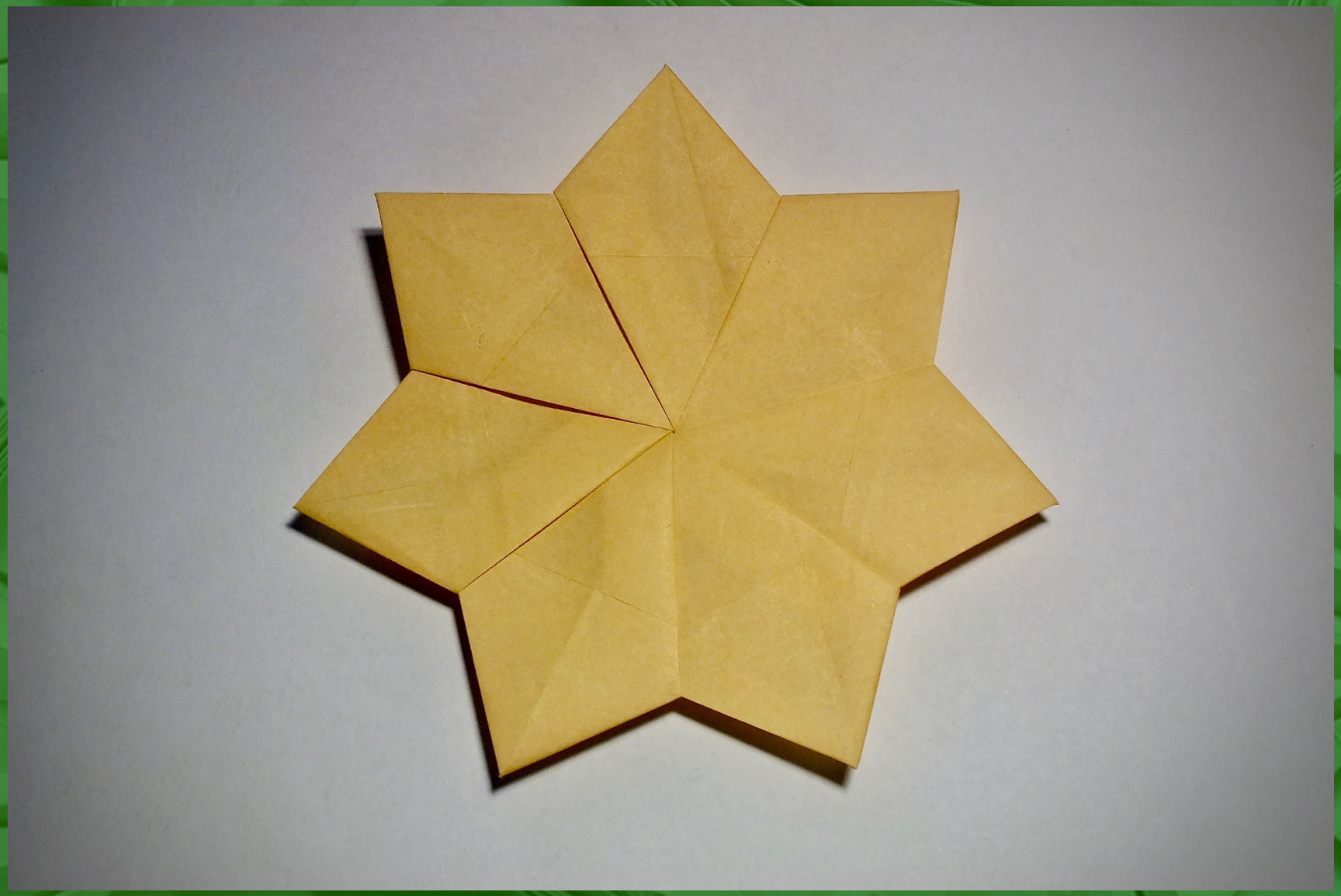


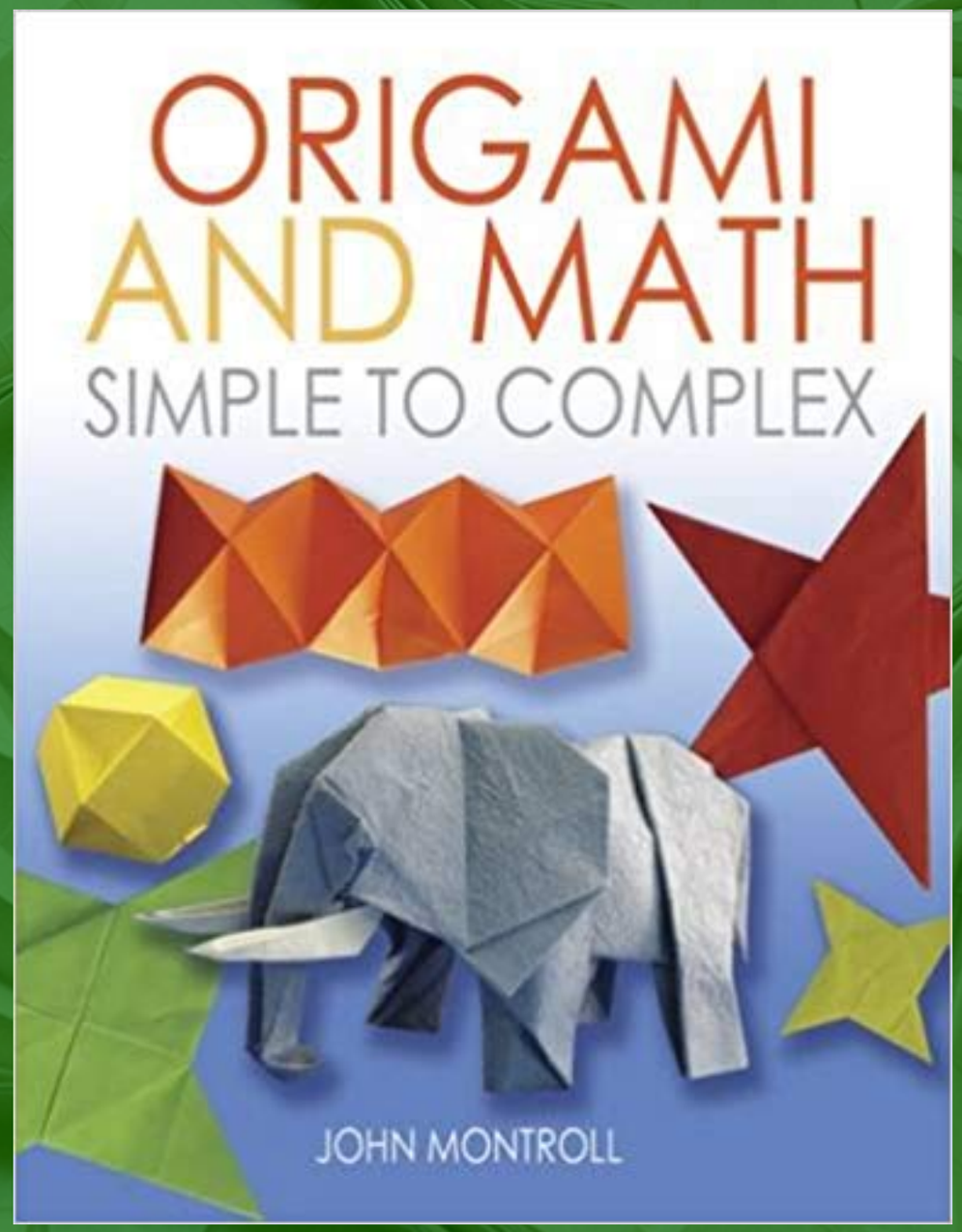
JOHN MONTROLL (USA)

geometric origami: stars



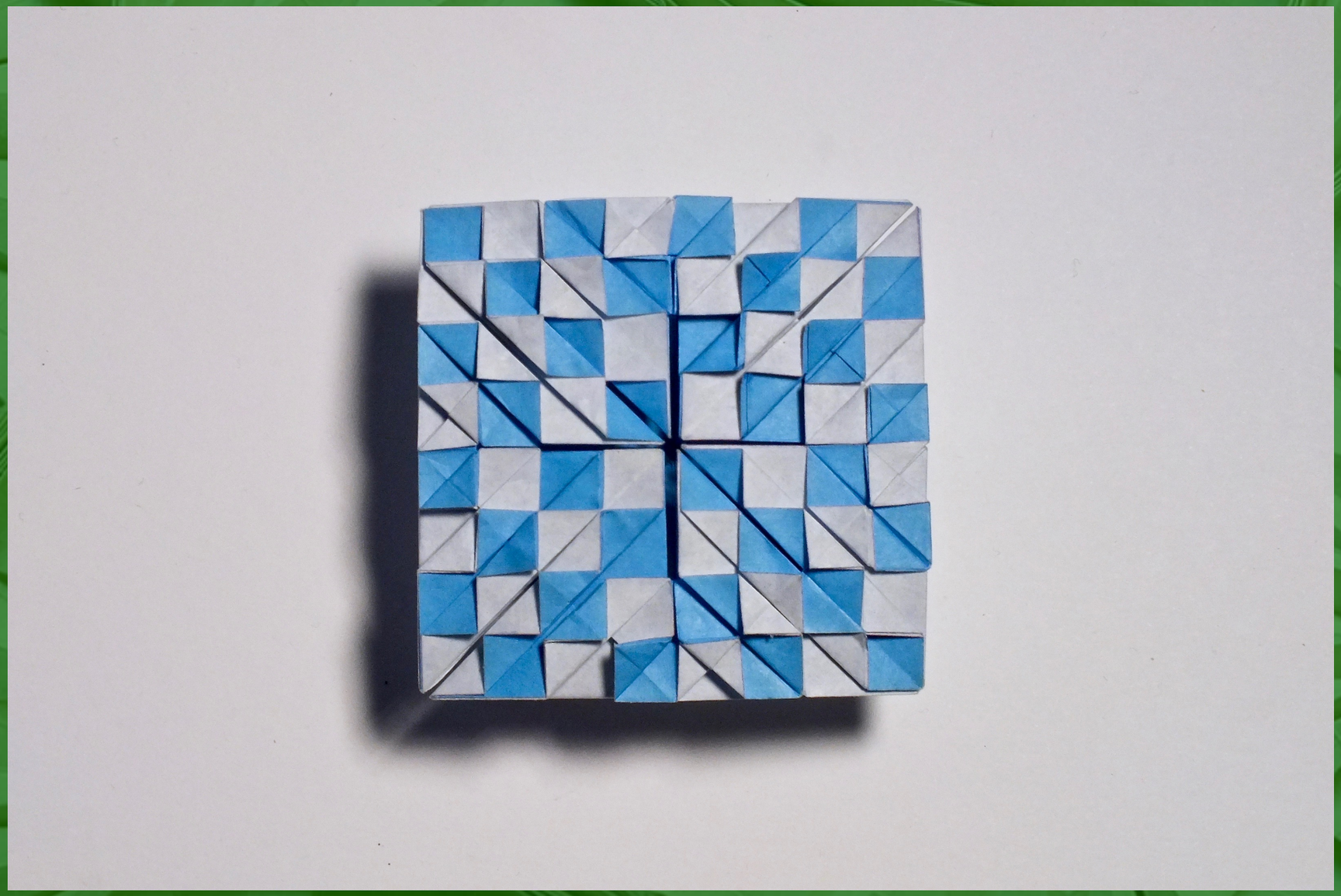
JOHN MONTROLL (USA)

geometric origami: stars



JOHN MONTROLL (USA)

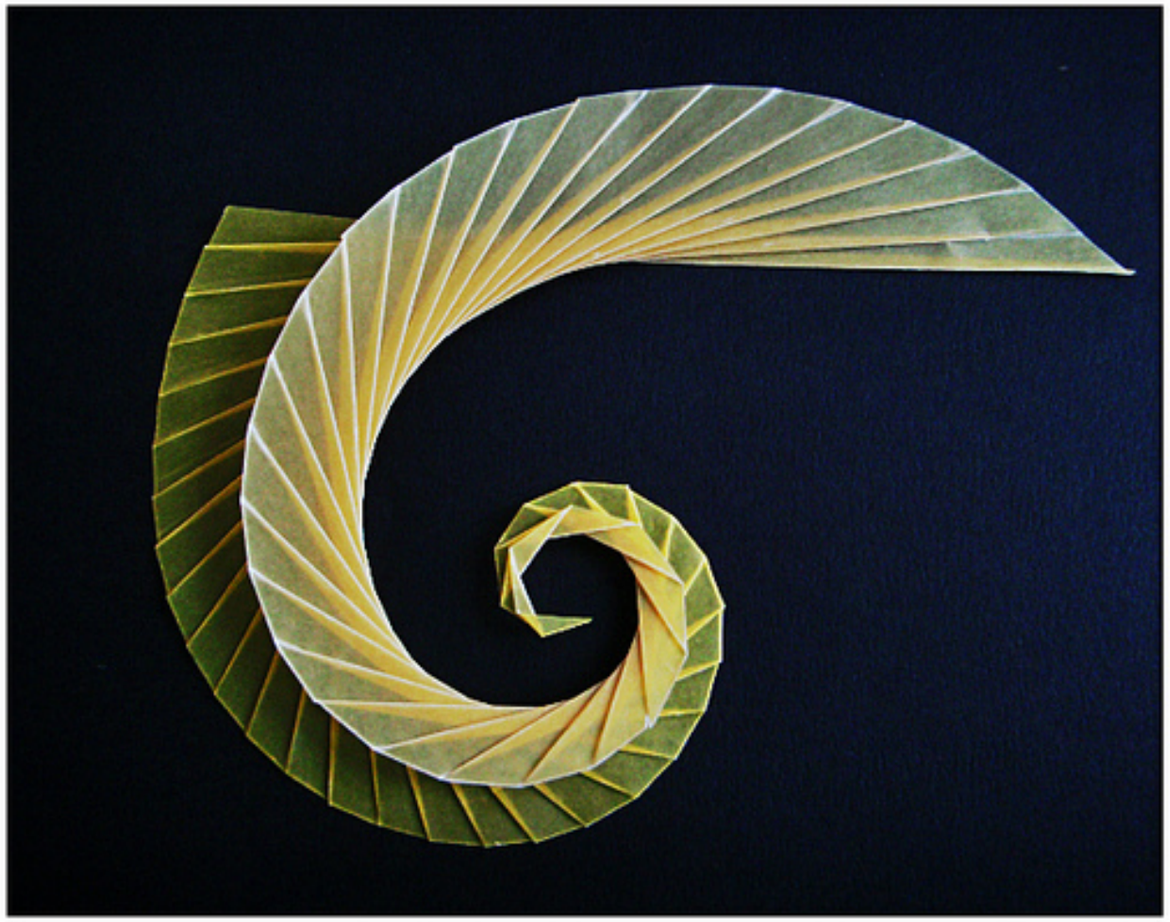
geometric origami: stars

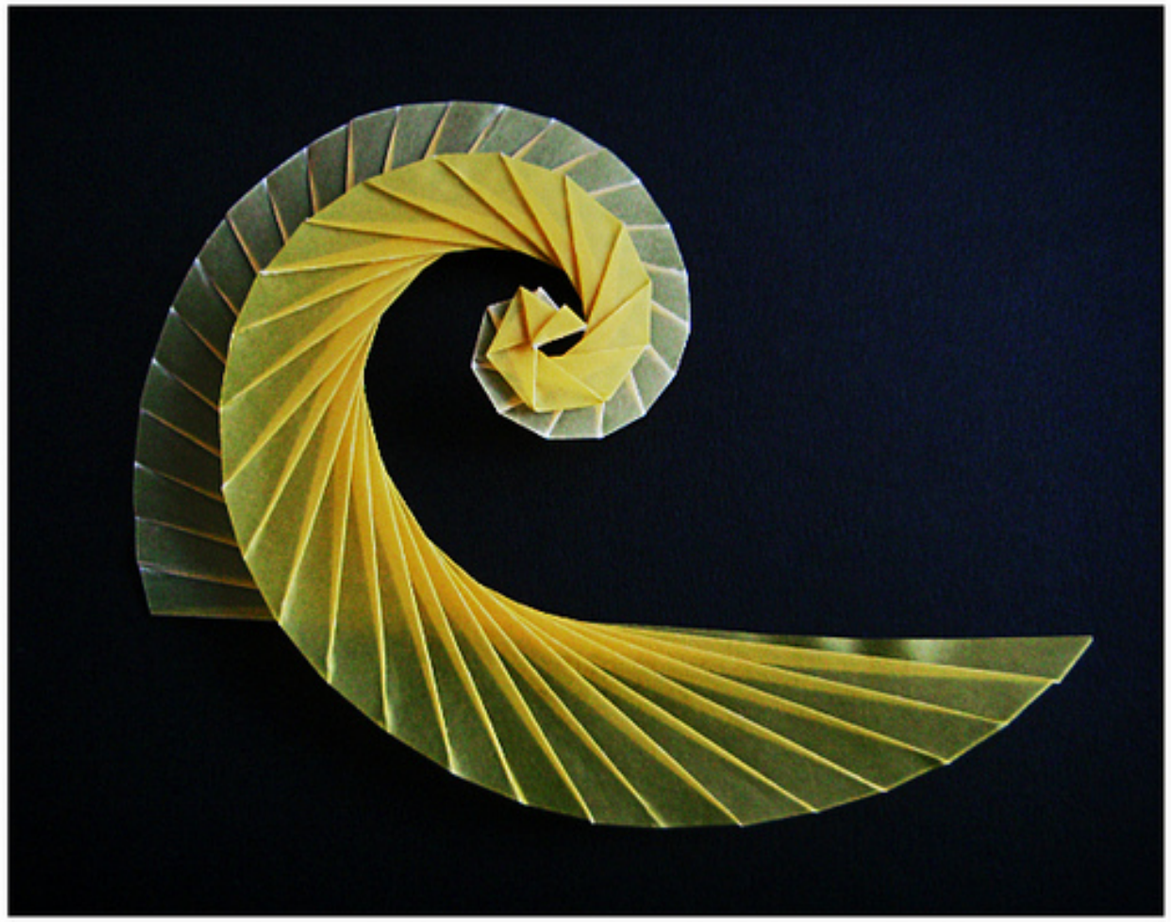


JOHN MONTROLL (USA)

geometric origami: spirals

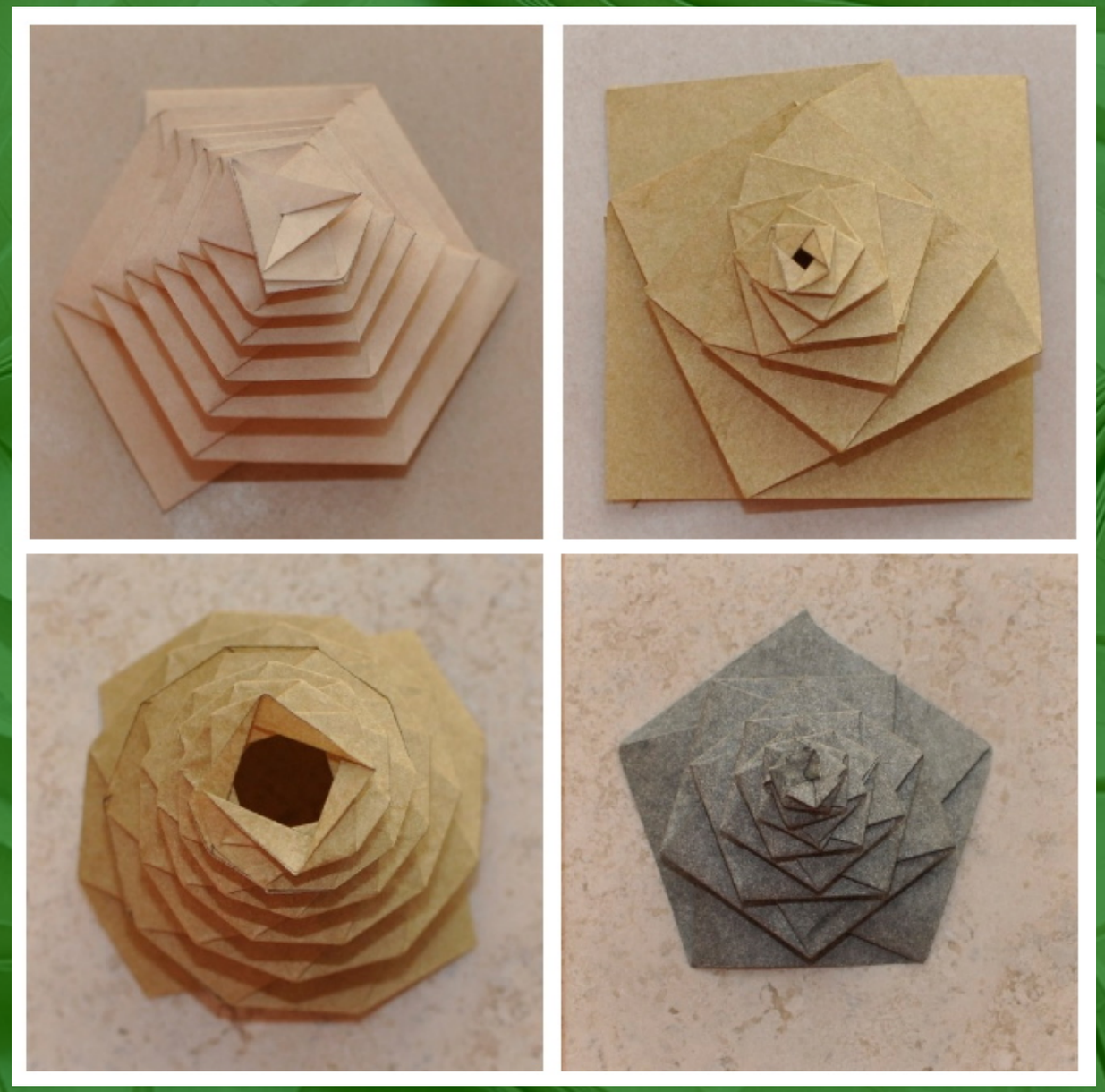
geometric origami: spirals





TOMOKO FUSE (JAPAN)

geometric origami: spirals



TOMOKO FUSE (JAPAN)

geometric origami: spirals

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TOMOKO FUSE (JAPAN)

geometric origami: polyhedra

JOHN MONTROLL (USA)

geometric origami: polyhedra

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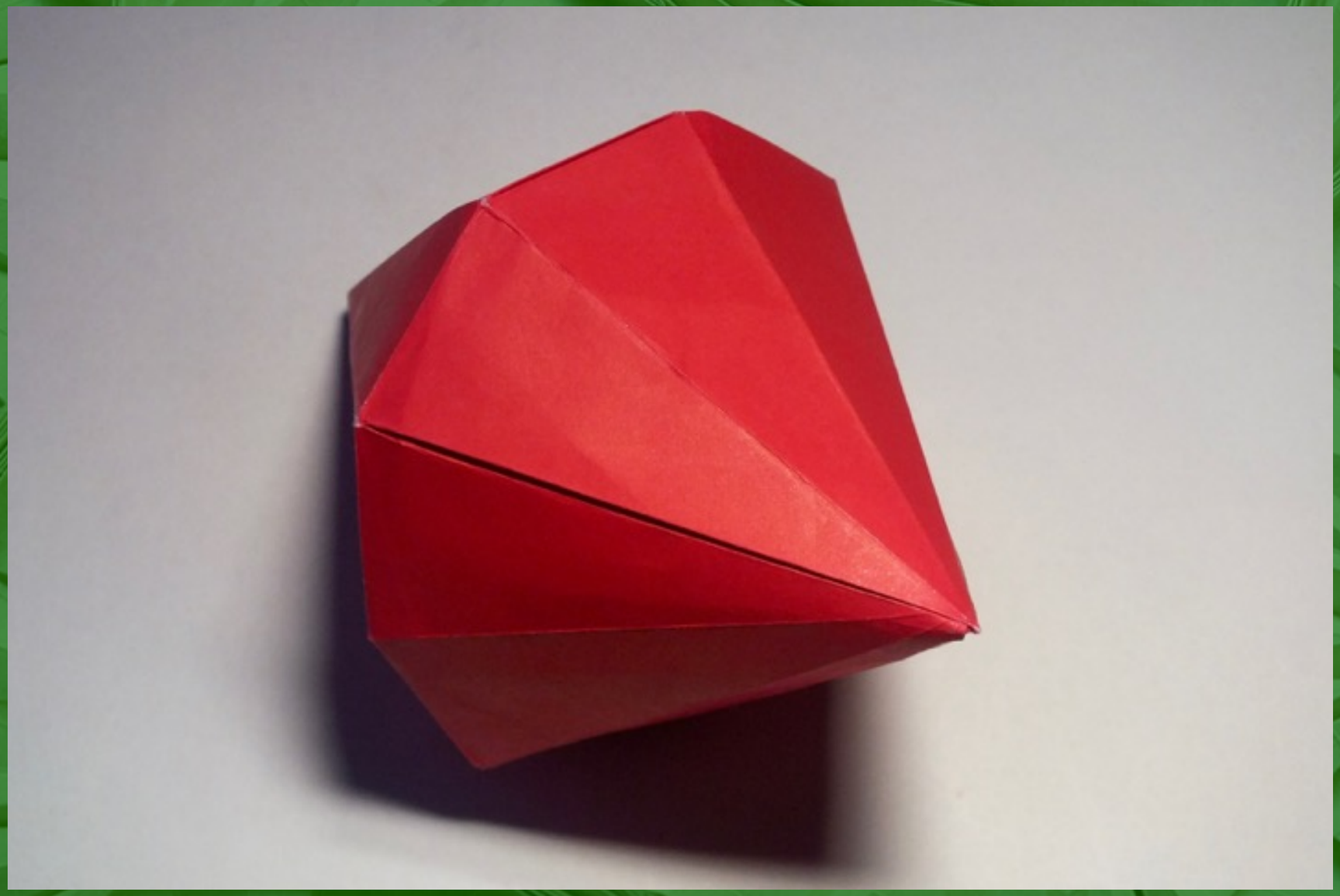
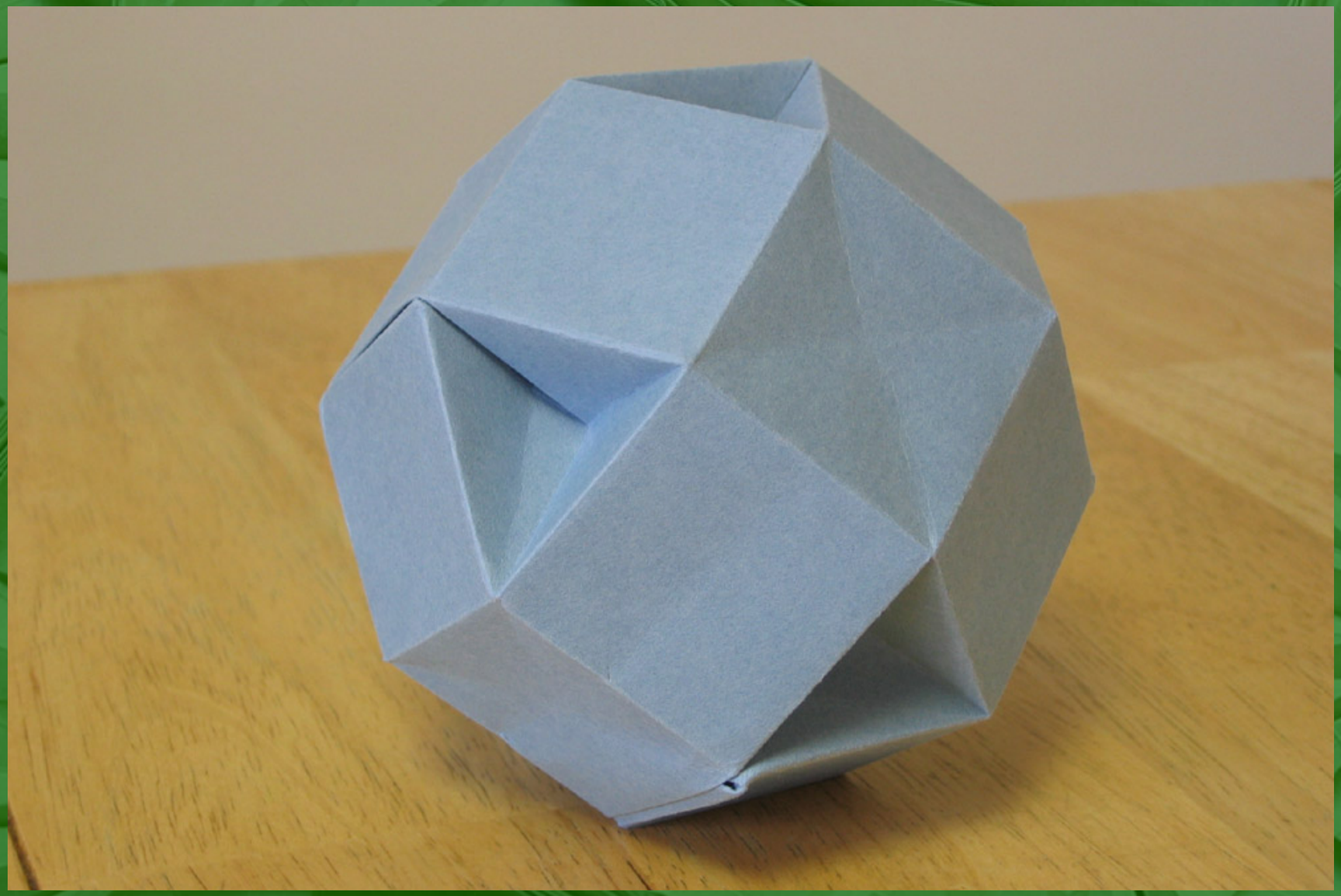


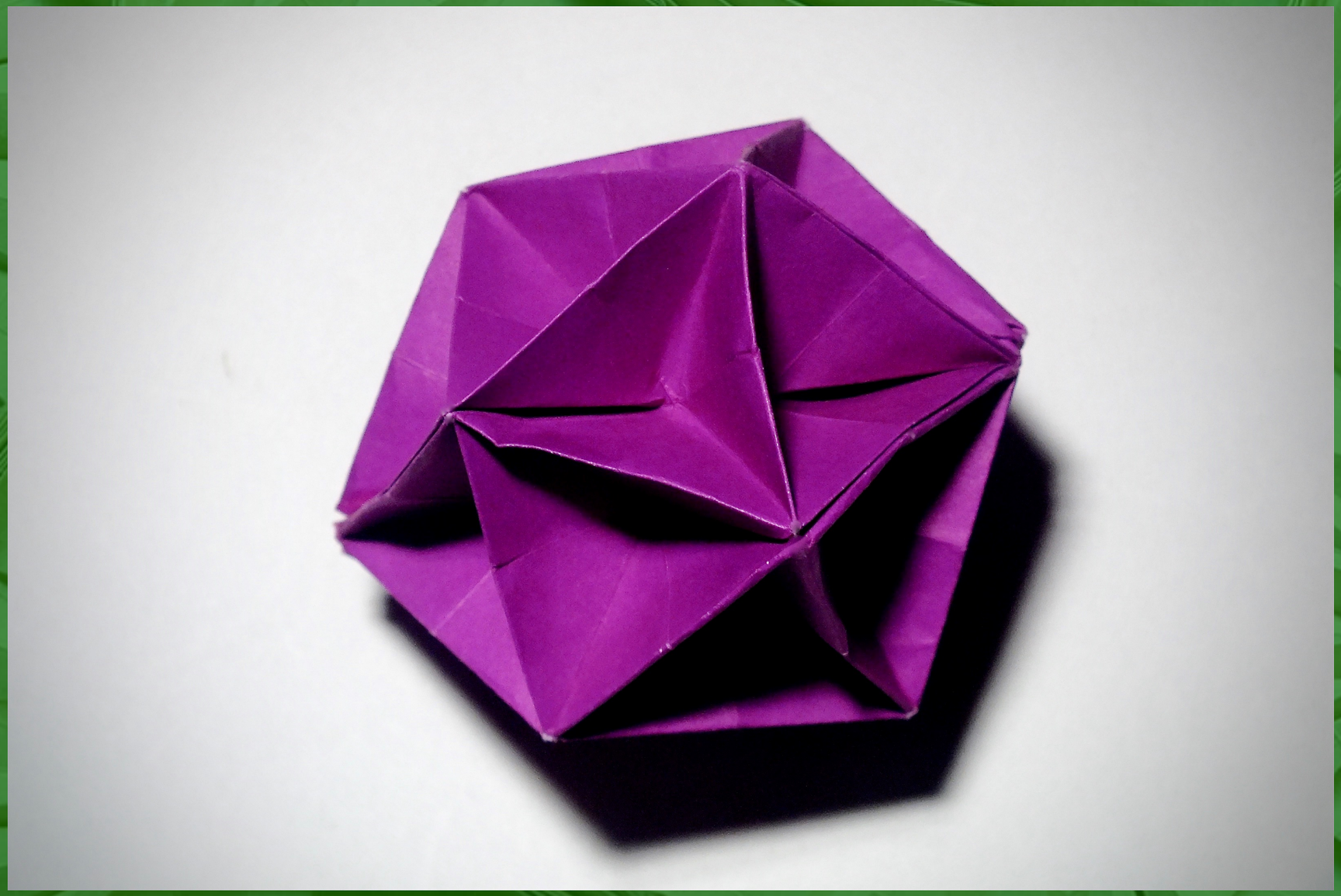
JOHN MONTROLL (USA)

geometric origami: polyhedra



JOHN MONTROLL (USA)

geometric origami: polyhedra



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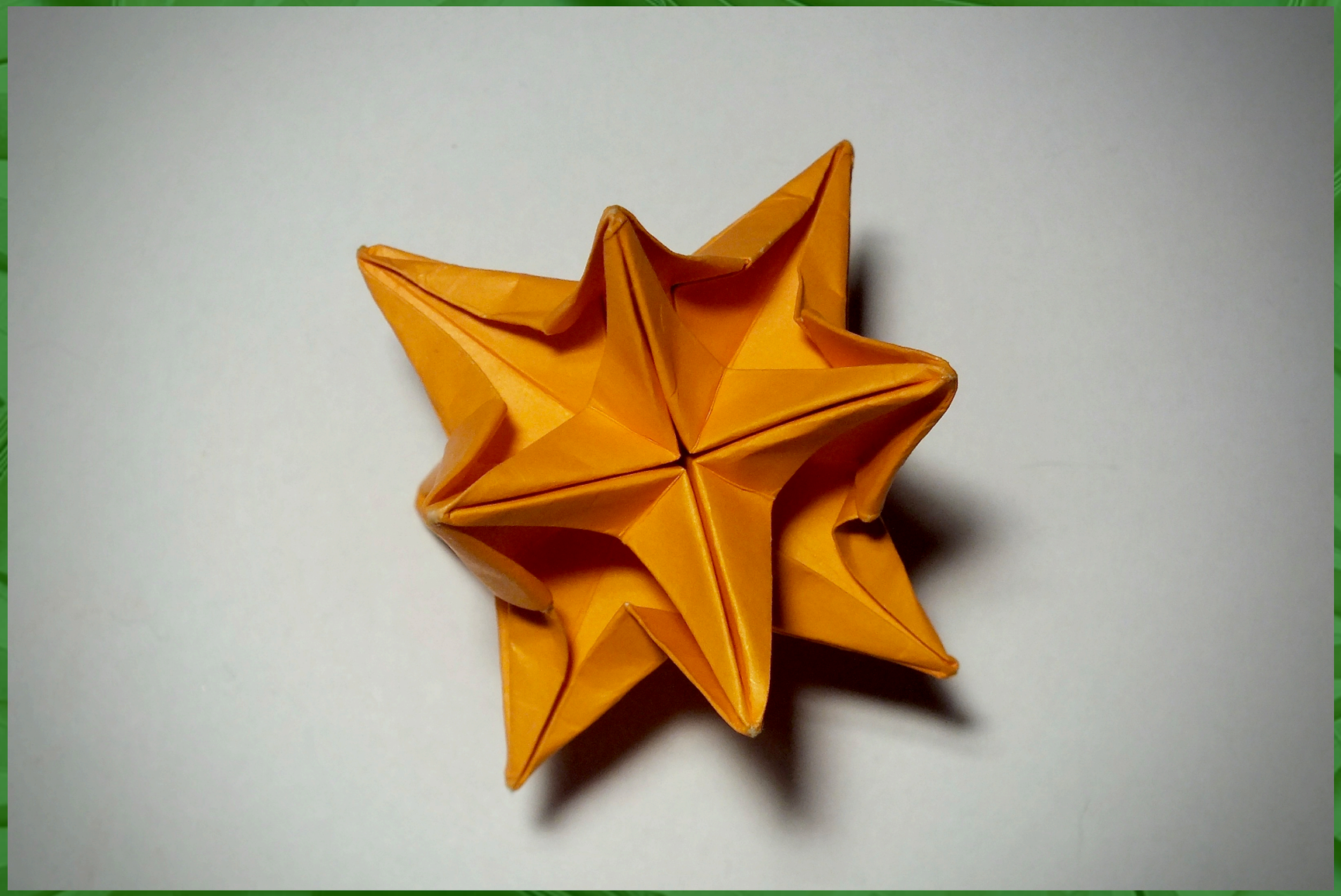

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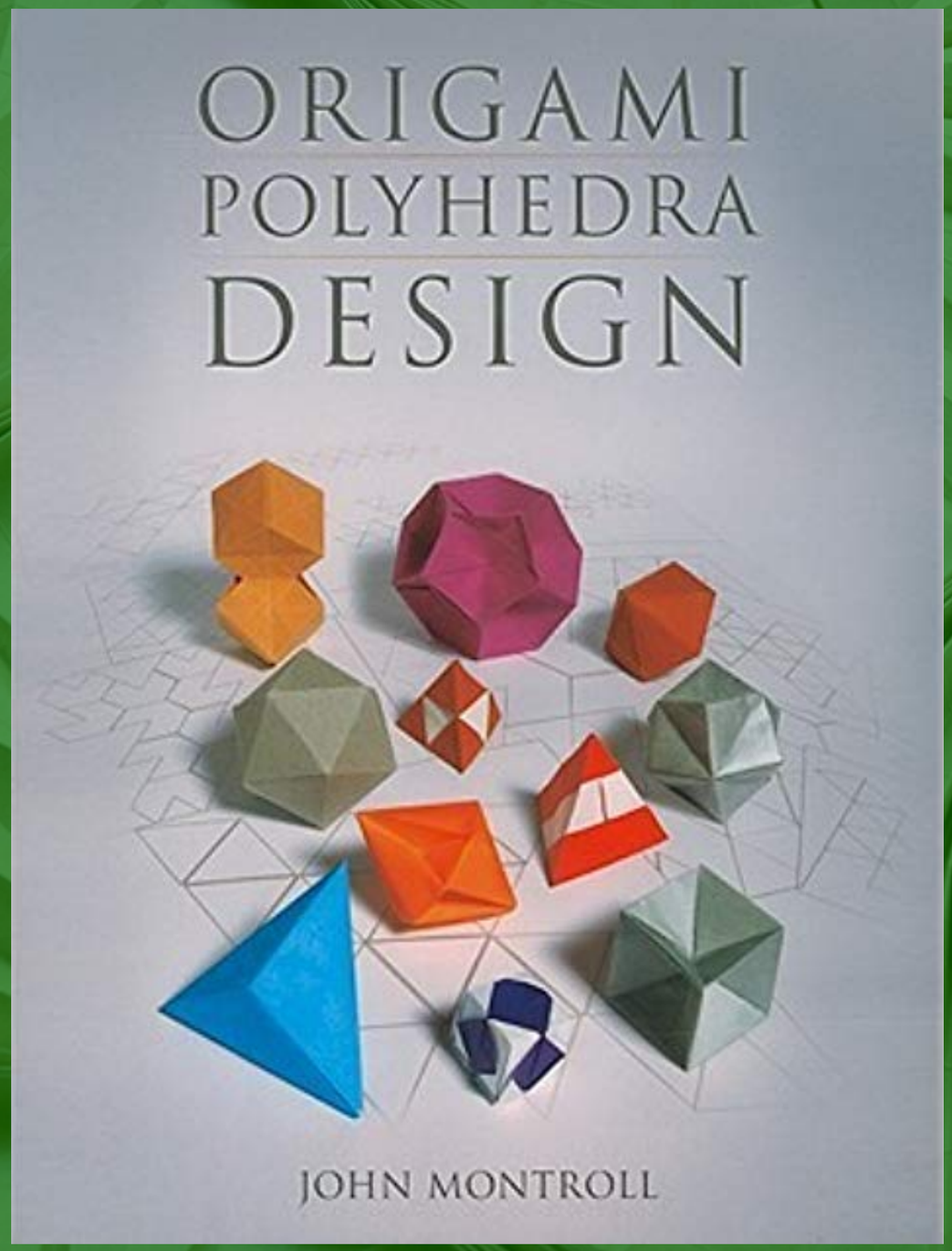
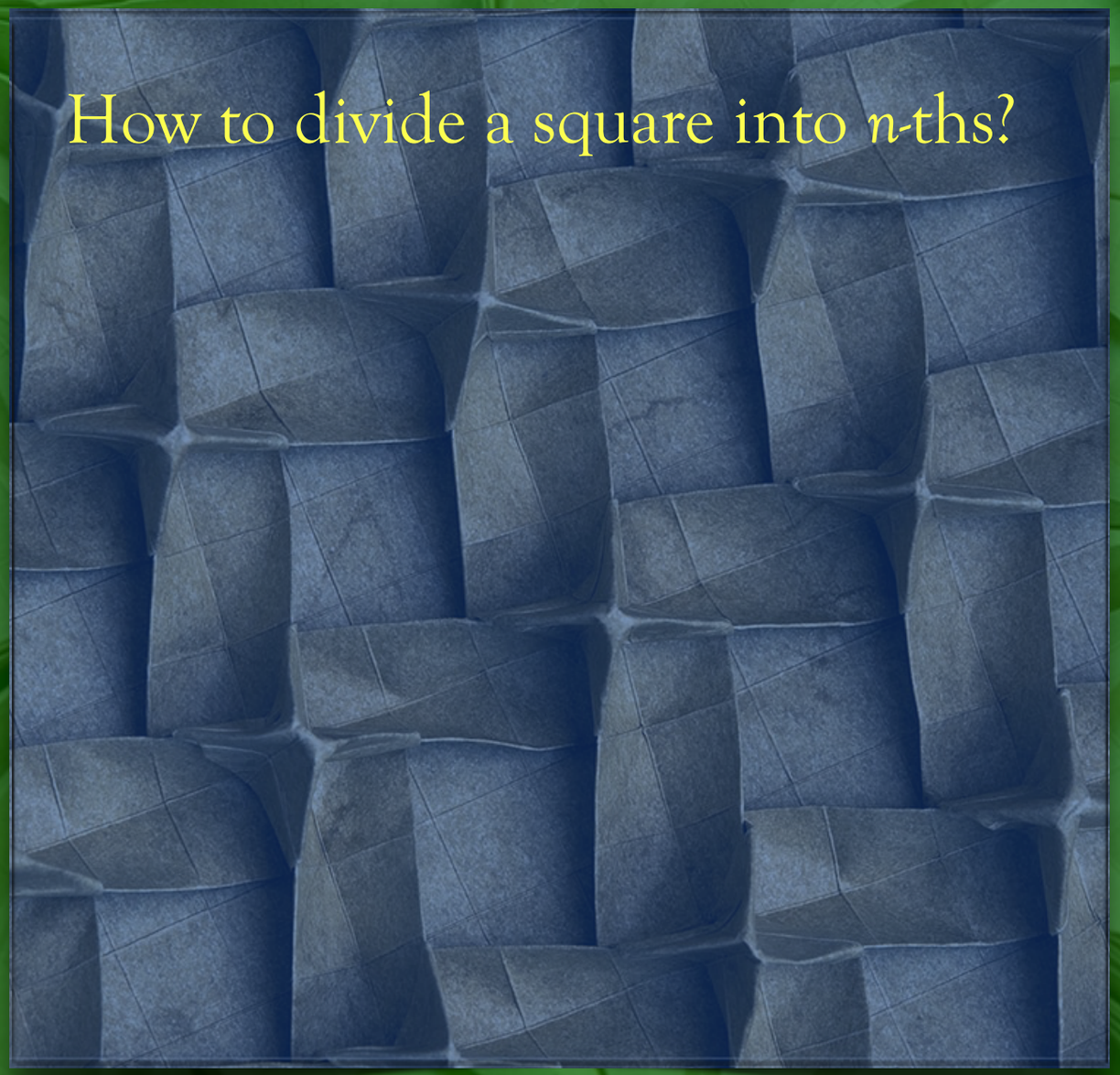


JOHN MONTROLL (USA)

geometrical interlude

geometrical interlude

How to divide a square into *n*-ths?



geometrical interlude

How to divide a square into n-ths?

- Given n, write $n = 2^m + b$ with $b < 2^m$

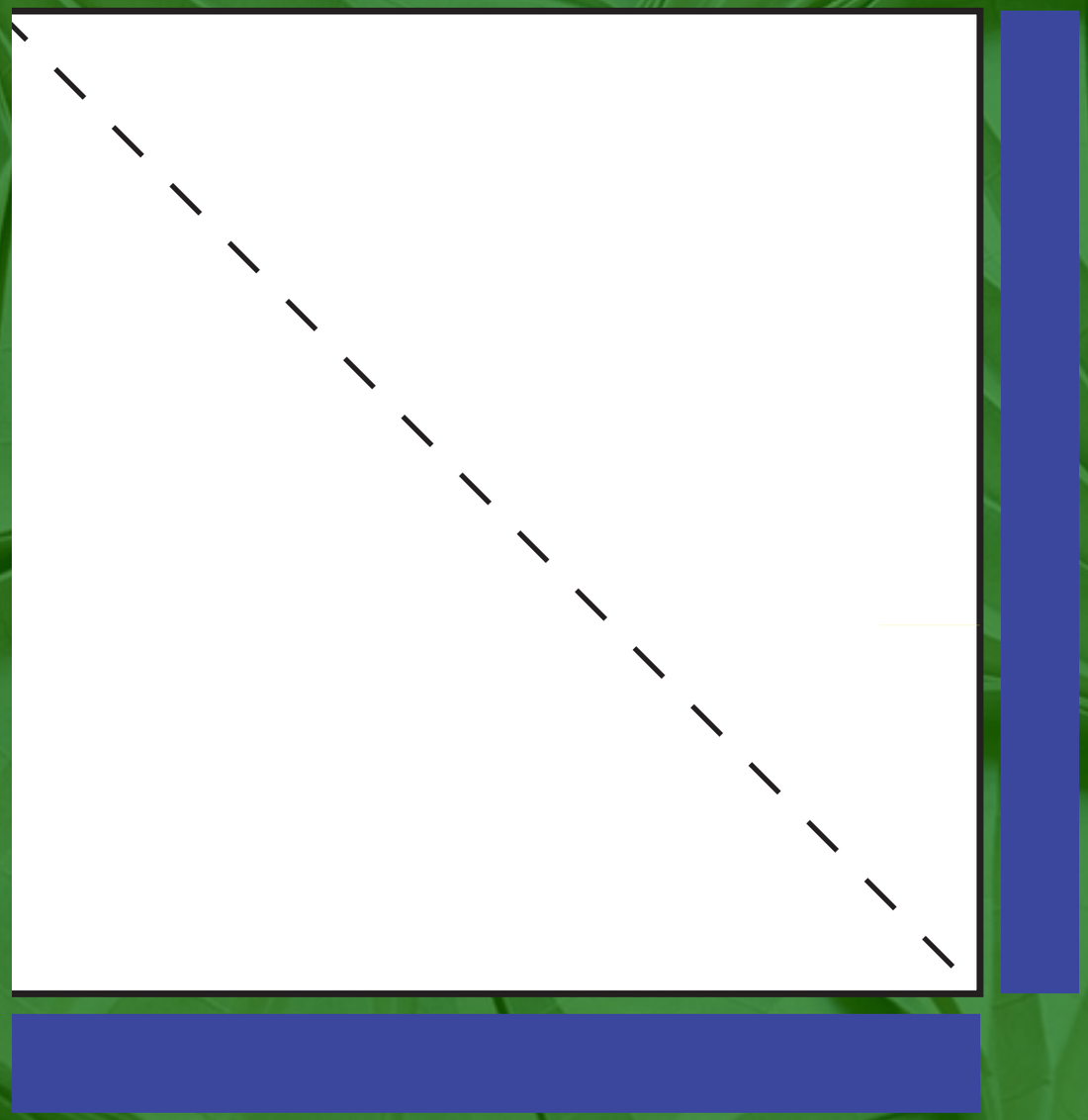
$11 = 2^3 + 3$

geometrical interlude

How to divide a square into n-ths?

- Given n, write $n = 2^m + b$ with $b < 2^m$
- Fold the diagonal

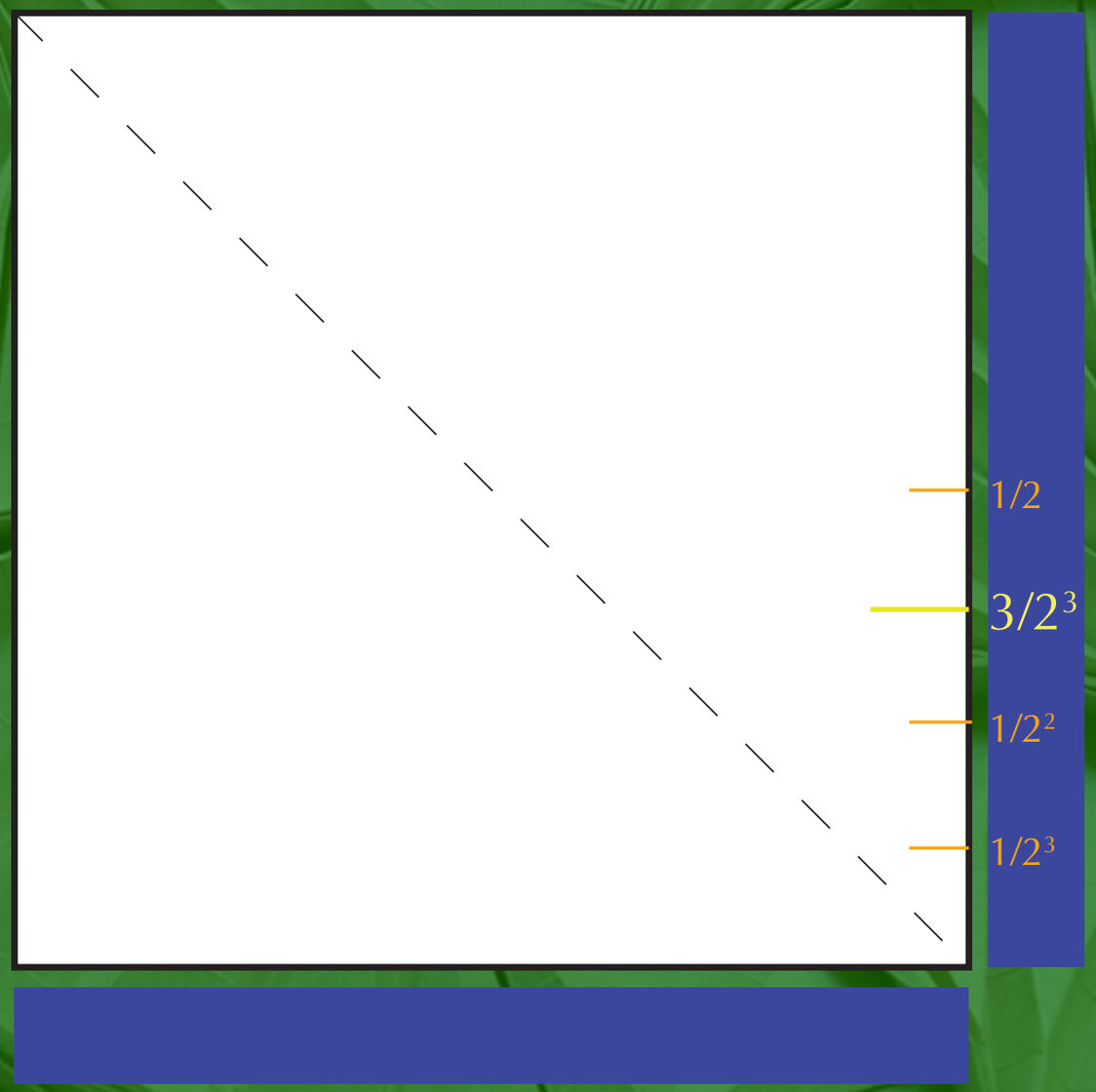
$11 = 2^3 + 3$



geometrical interlude

- How to divide a square into n-ths?
- Given n, write $n = 2^m + b$ with $b < 2^m$
- Fold the diagonal
- Find $b/2^m$ on the right

$11 = 2^3 + 3$



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- Fold from left corner to $b/2^m$

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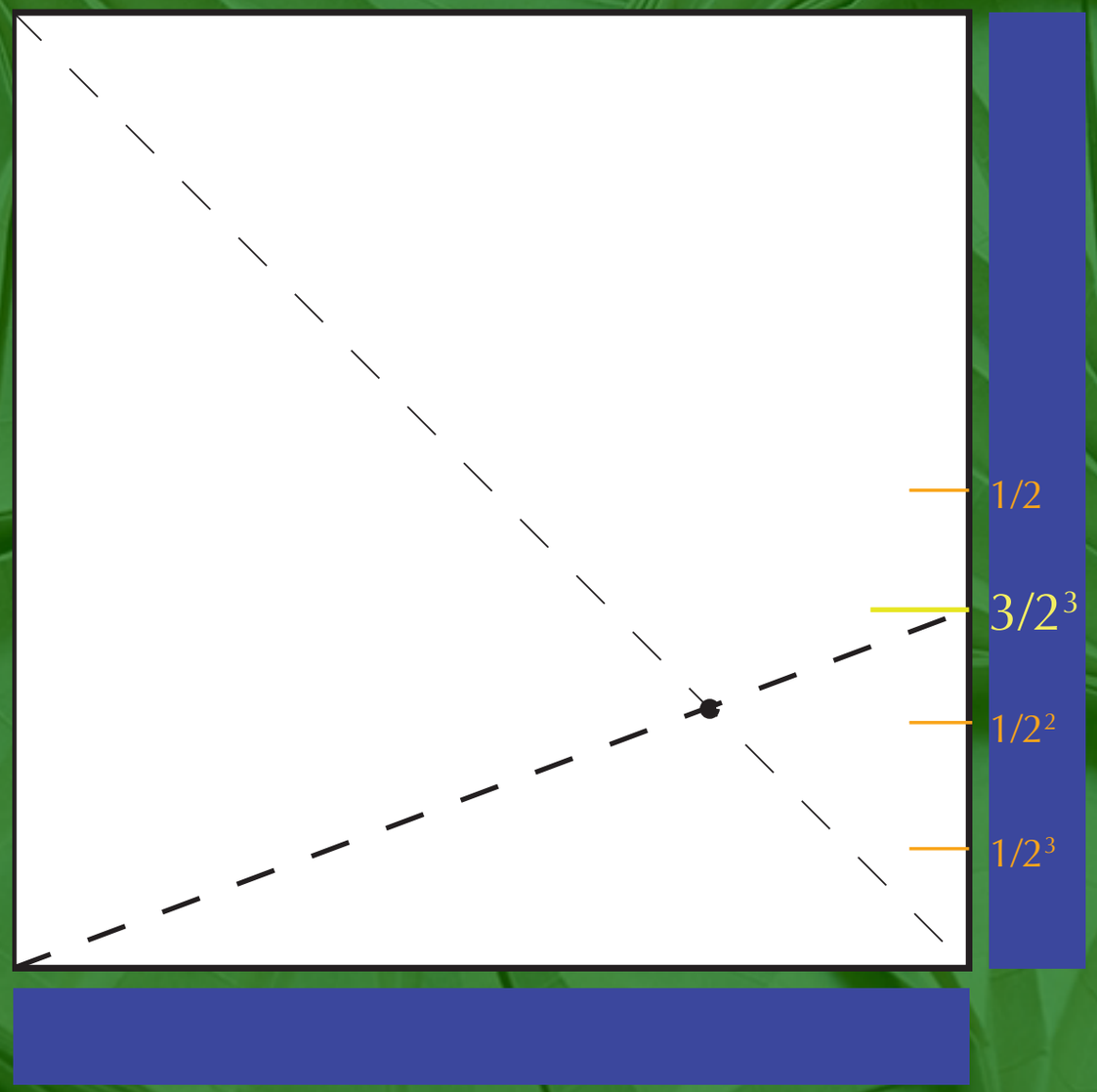

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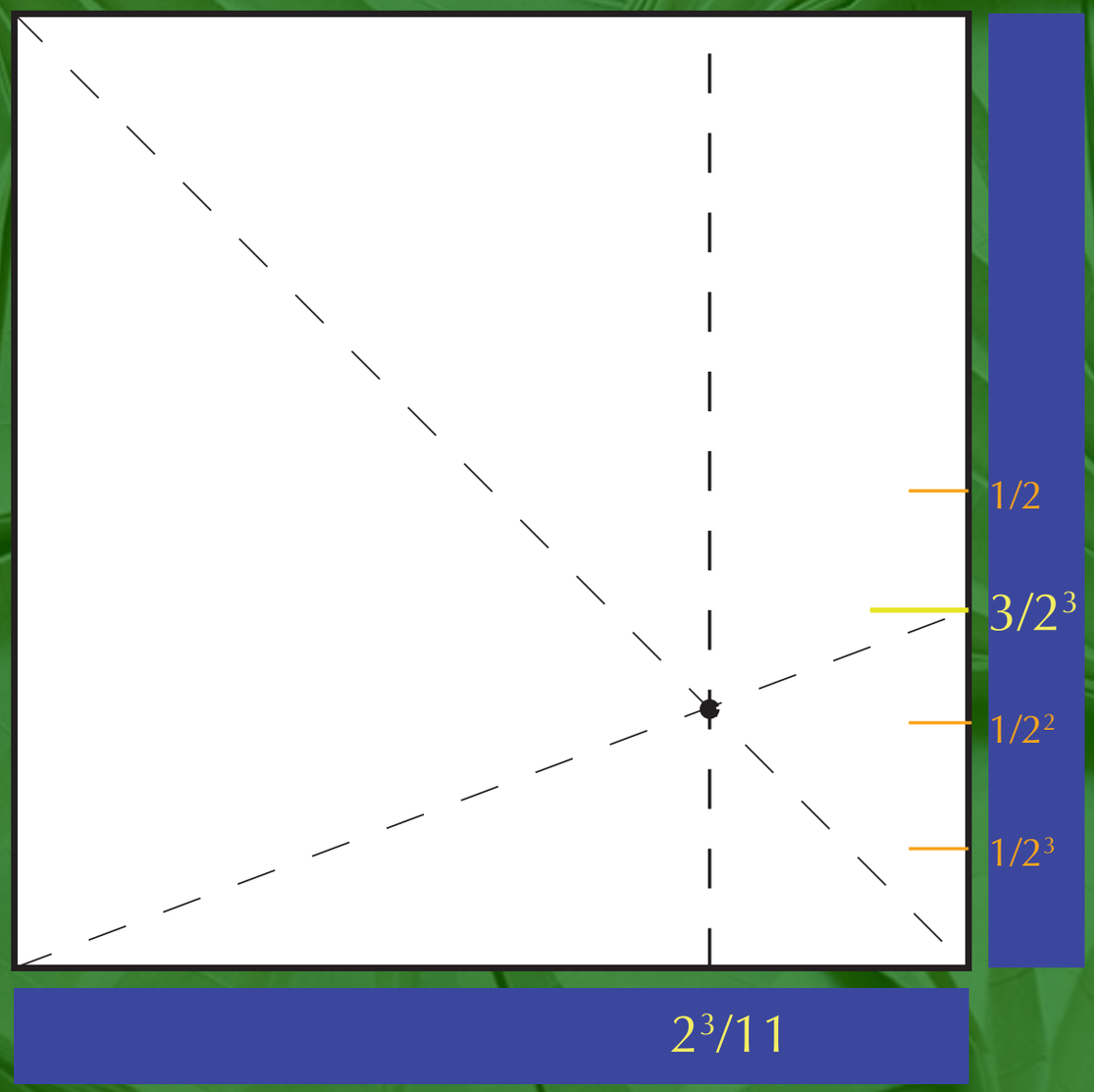
- Fold from left corner to $b/2^m$
- Fold vertically at the intersection with the diagonal: it is $2^m/n$

$11 = 2^3 + 3$

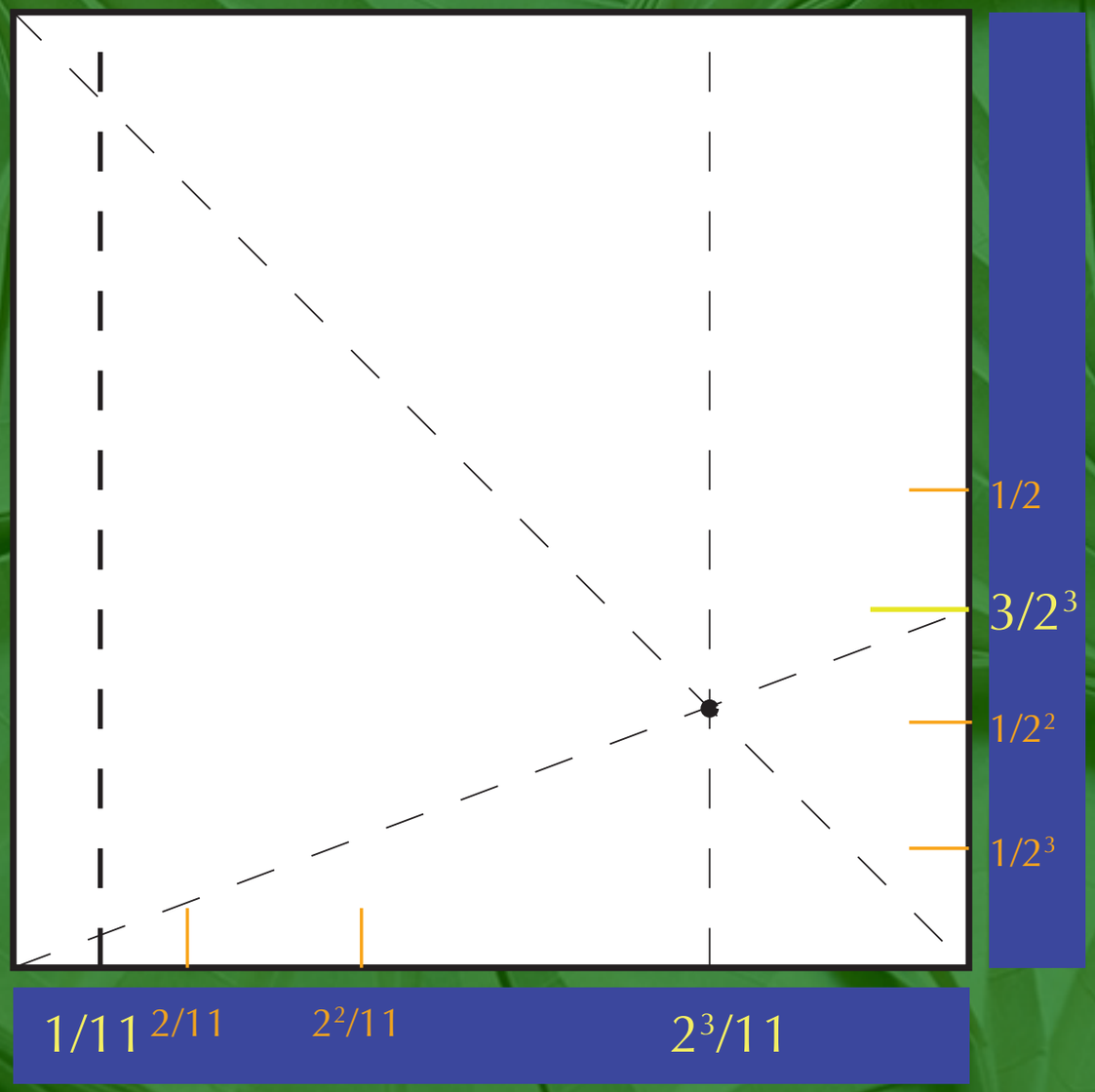


geometrical interlude

How to divide a square into n-ths?

- Given n, write $n = 2^m + b$ with $b < 2^m$
- Fold the diagonal
- Find $b/2^m$ on the right
- Fold from left corner to $b/2^m$
- Fold vertically at the intersection with the diagonal: it is $2^m/n$
- Divide m times by 2 on the left

$11 = 2^3 + 3$



geometric origami: kusudama

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TOMOKO FUSE (JAPAN)

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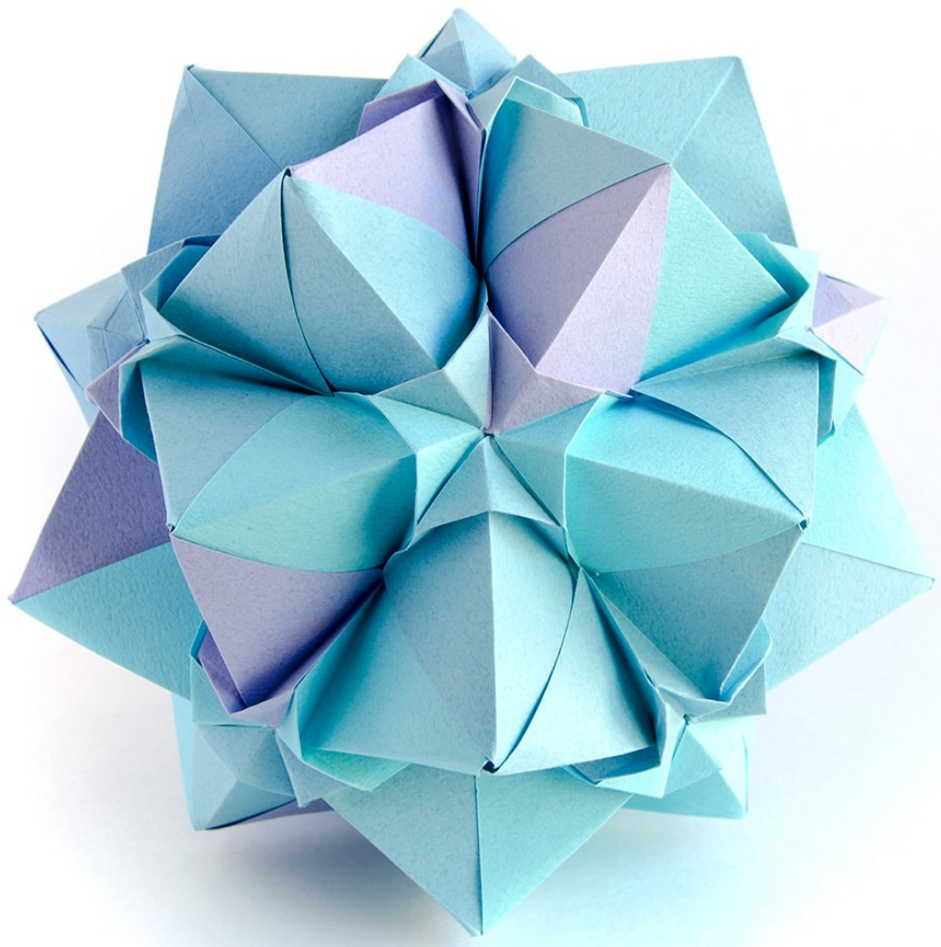
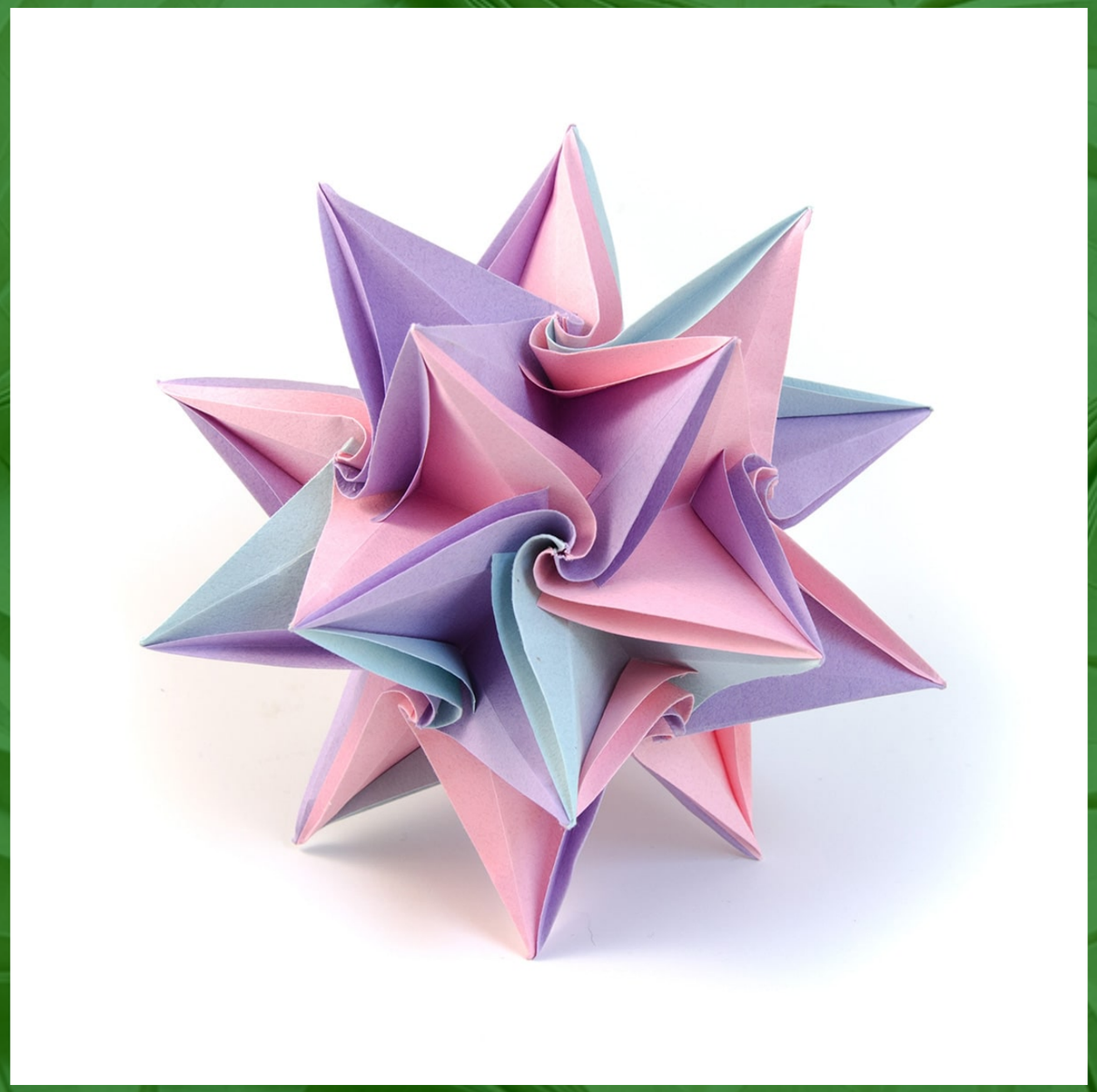


EKATERINA LUKASHEVA (RUSSIA)

geometric origami: kusudama



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geometric origami: kusudama

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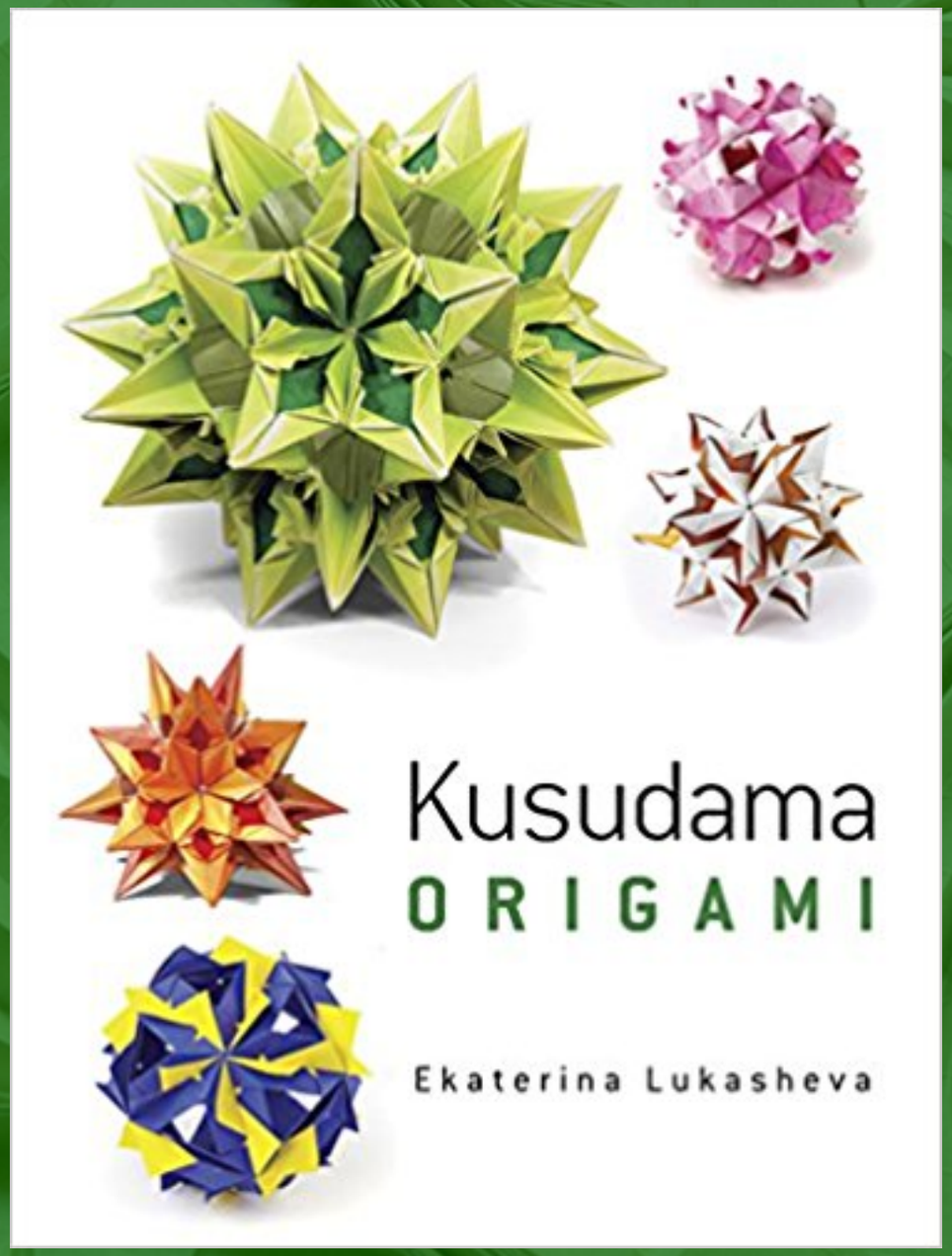

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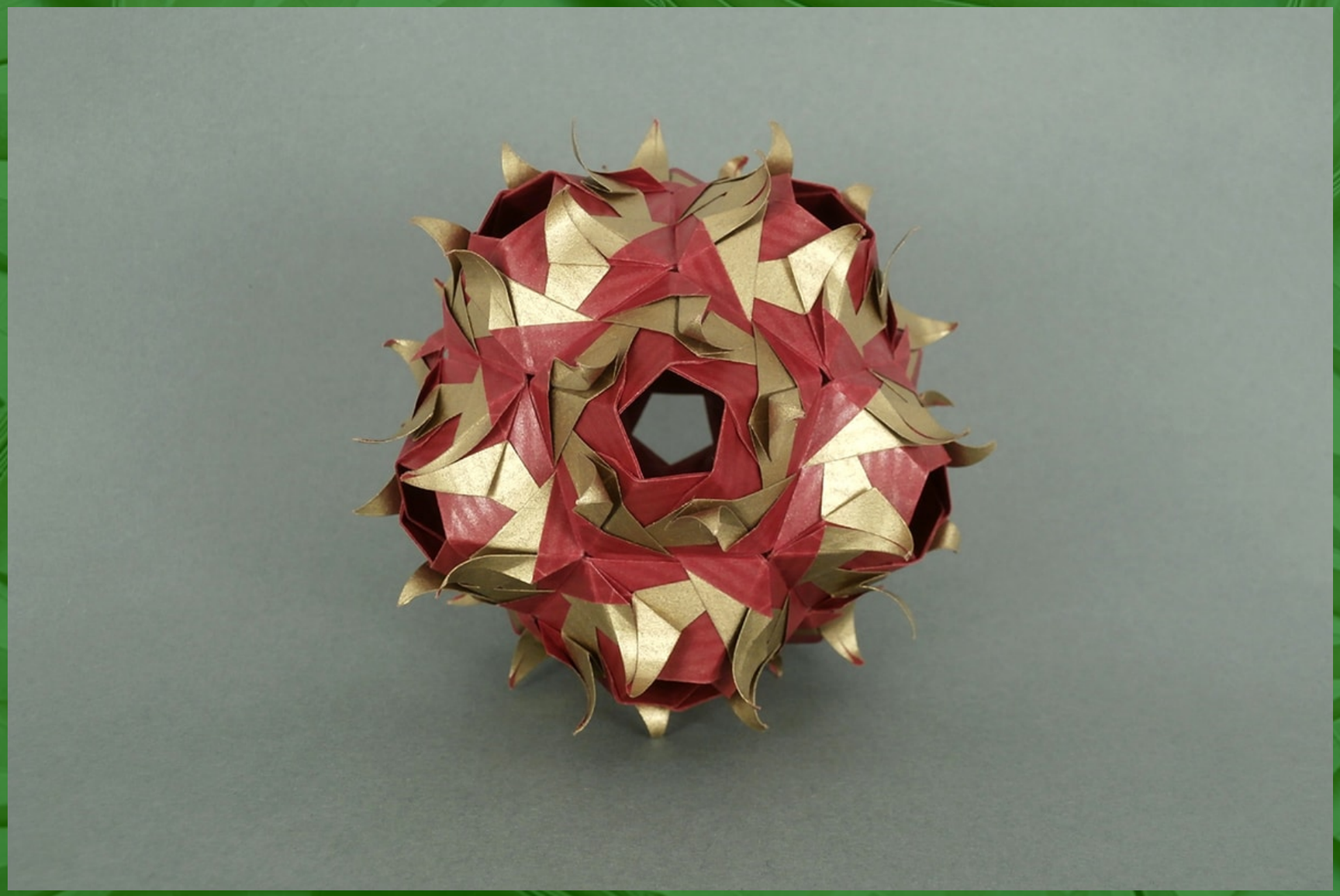
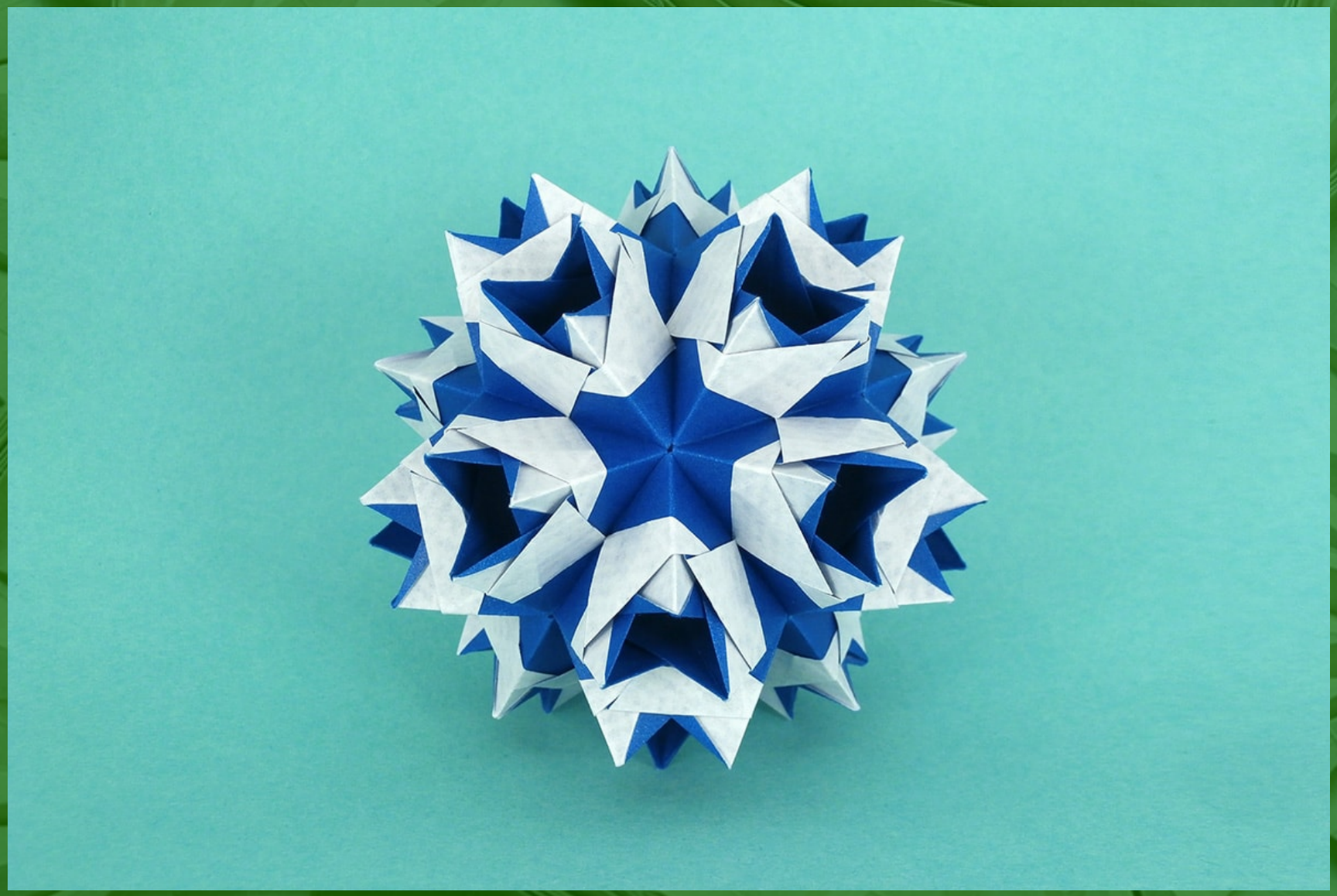


MASHA ATHANASIADI (GREECE)

geometric origami: kusudama



MASHA ATHANASIADI (GREECE)

geometric origami: kusudama

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geometric origami: kusudama

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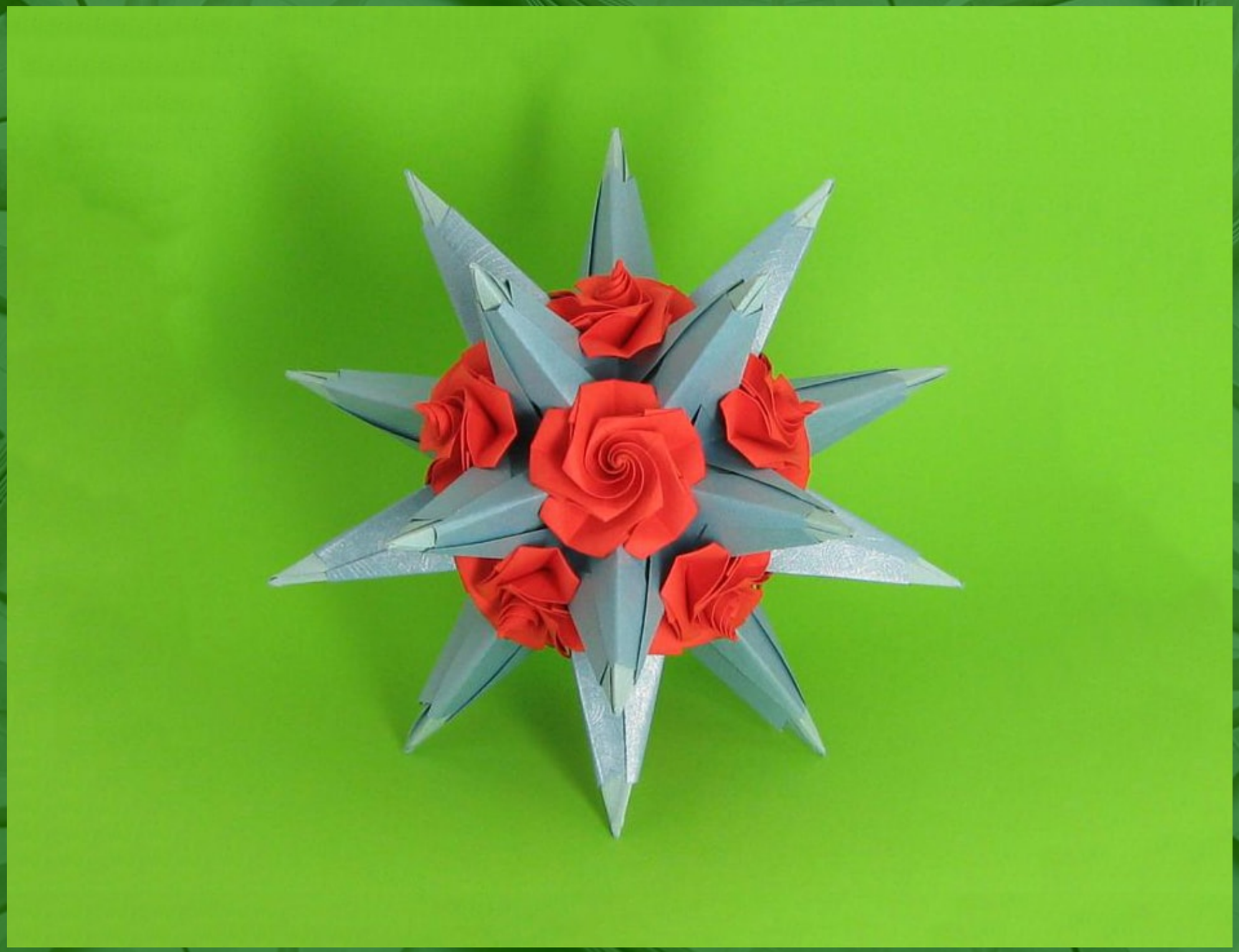
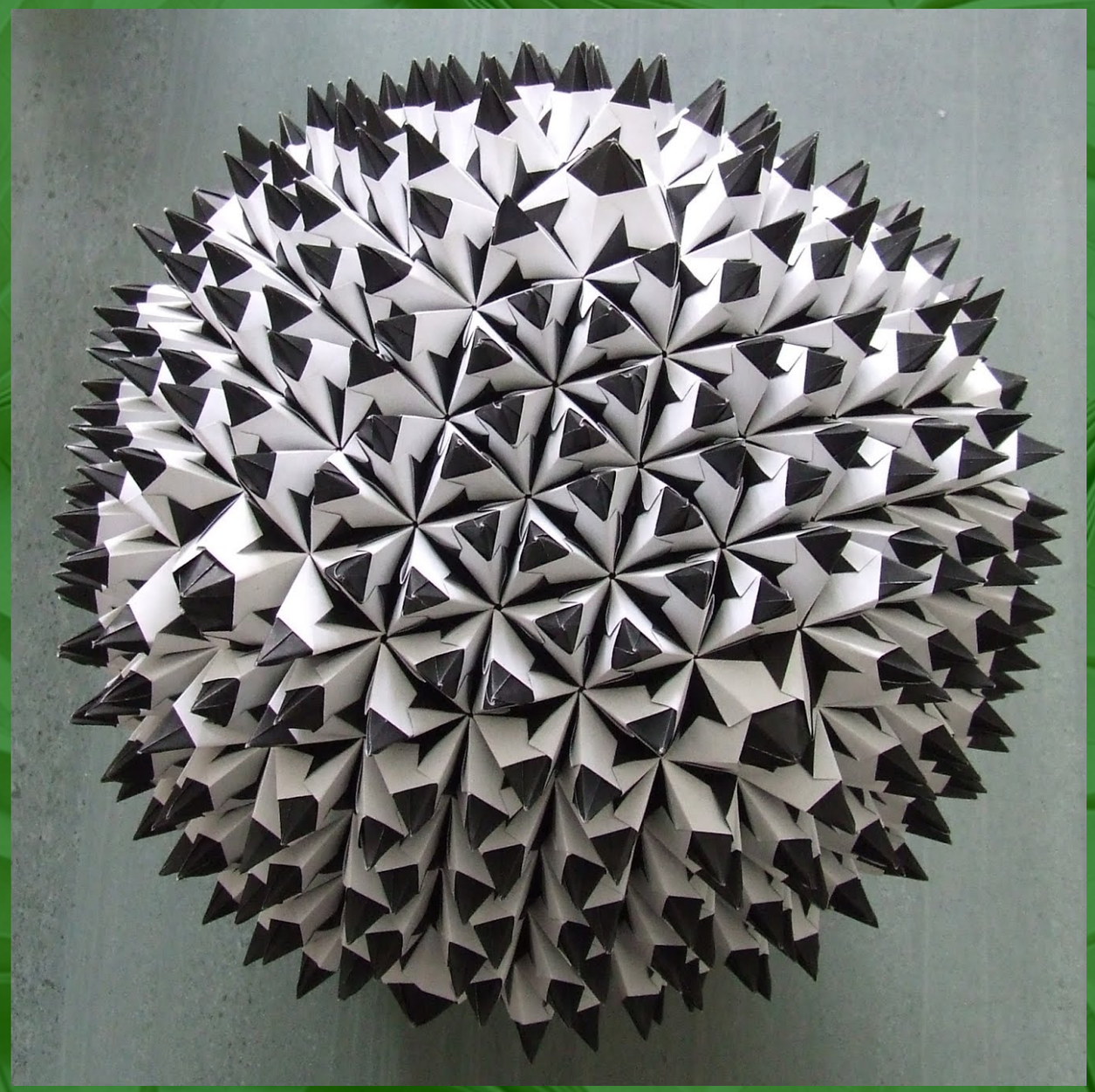
PAOLO BASCETTA (ITALY)

geometric origami: kusudama



PAOLO BASCETTA (ITALY)

geometric origami: kusudama



PAOLO BASCETTA (ITALY)

geometric origami: kusudama

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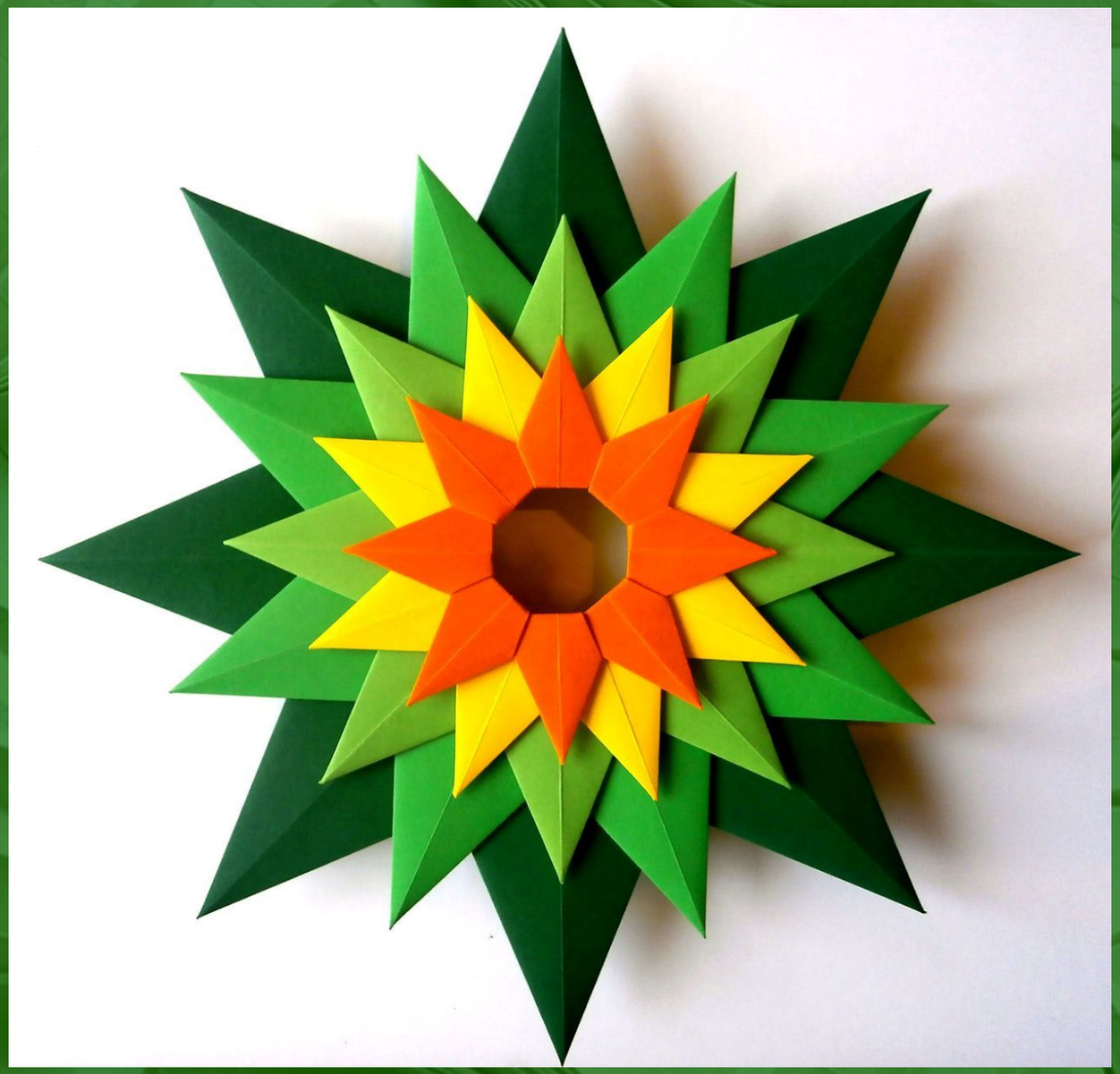


PAOLO BASCETTA (ITALY)

geometric origami: fractals

geometric origami: fractals

SERENA CICALO' (ITALY)

geometric origami: fractals

geometric origami: fractals

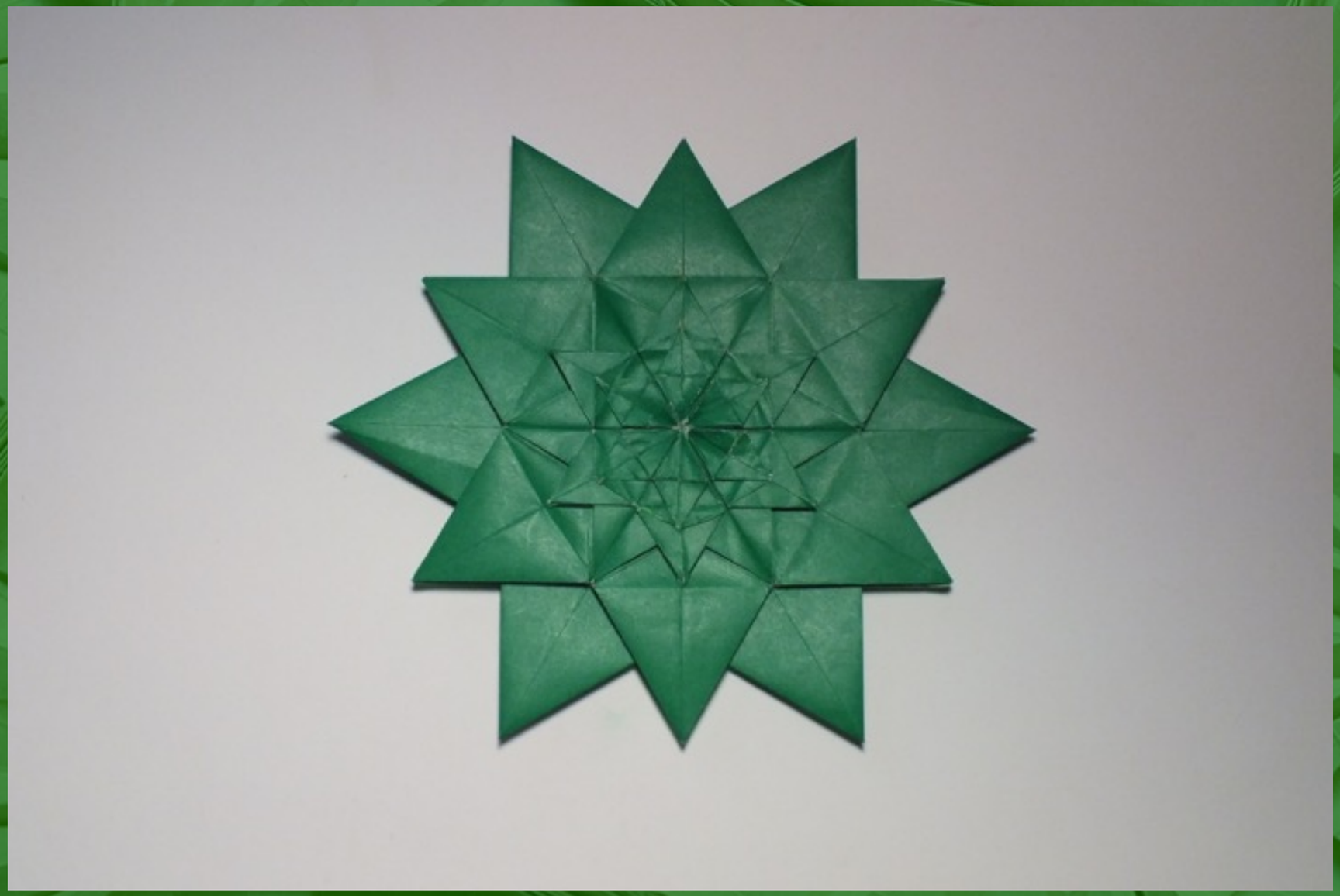
geometric origami: fractals

POLLY VERITY (USA)

geometric origami: fractals

geometric origami: fractals

geometric origami: fractals

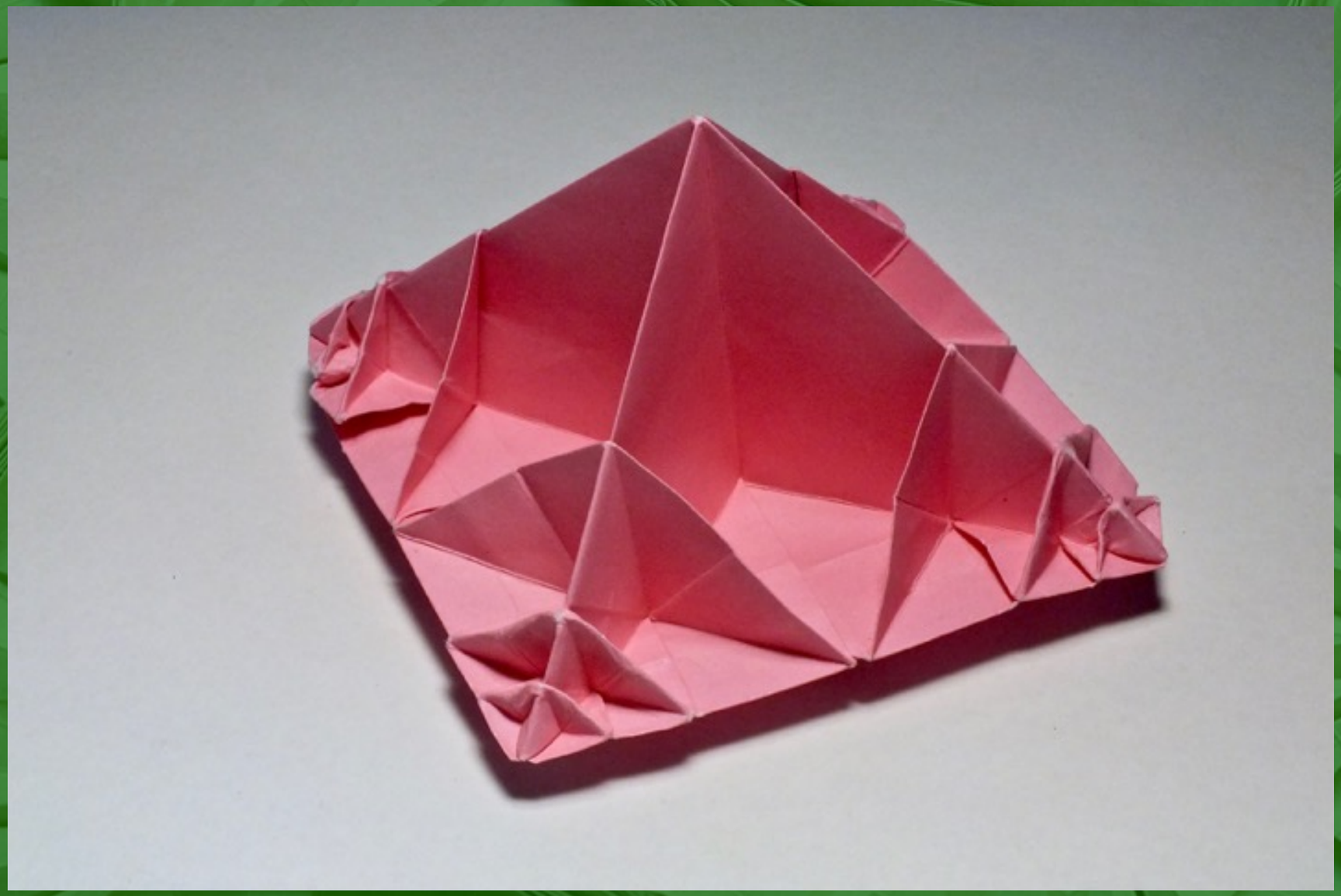


ALESSANDRO BEDER (ITALY)

geometric origami: fractals

geometric origami: fractals

geometric origami: fractals

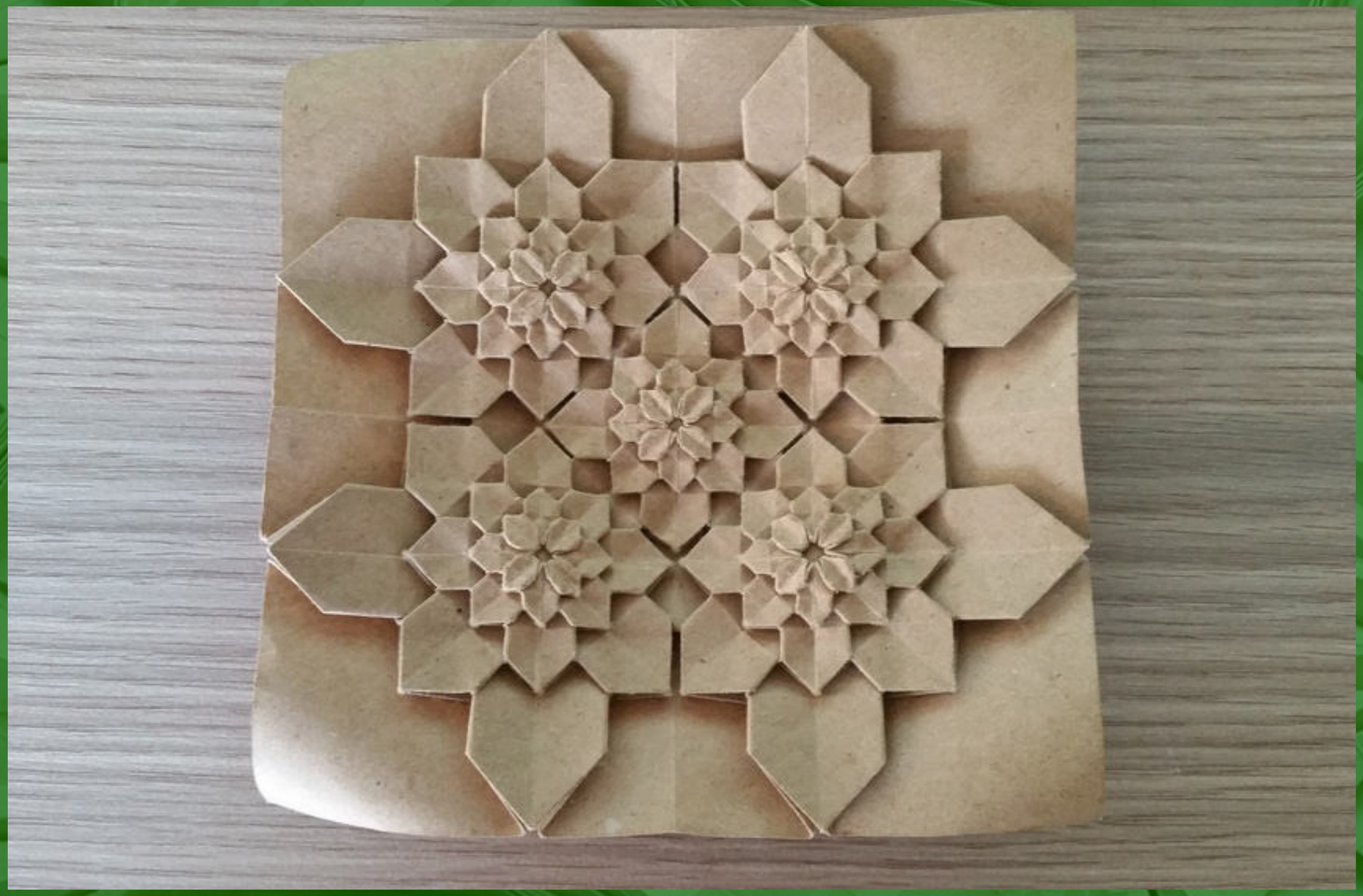


JUN MAEKAWA (JAPAN)

geometric origami: fractals

geometric origami: fractals

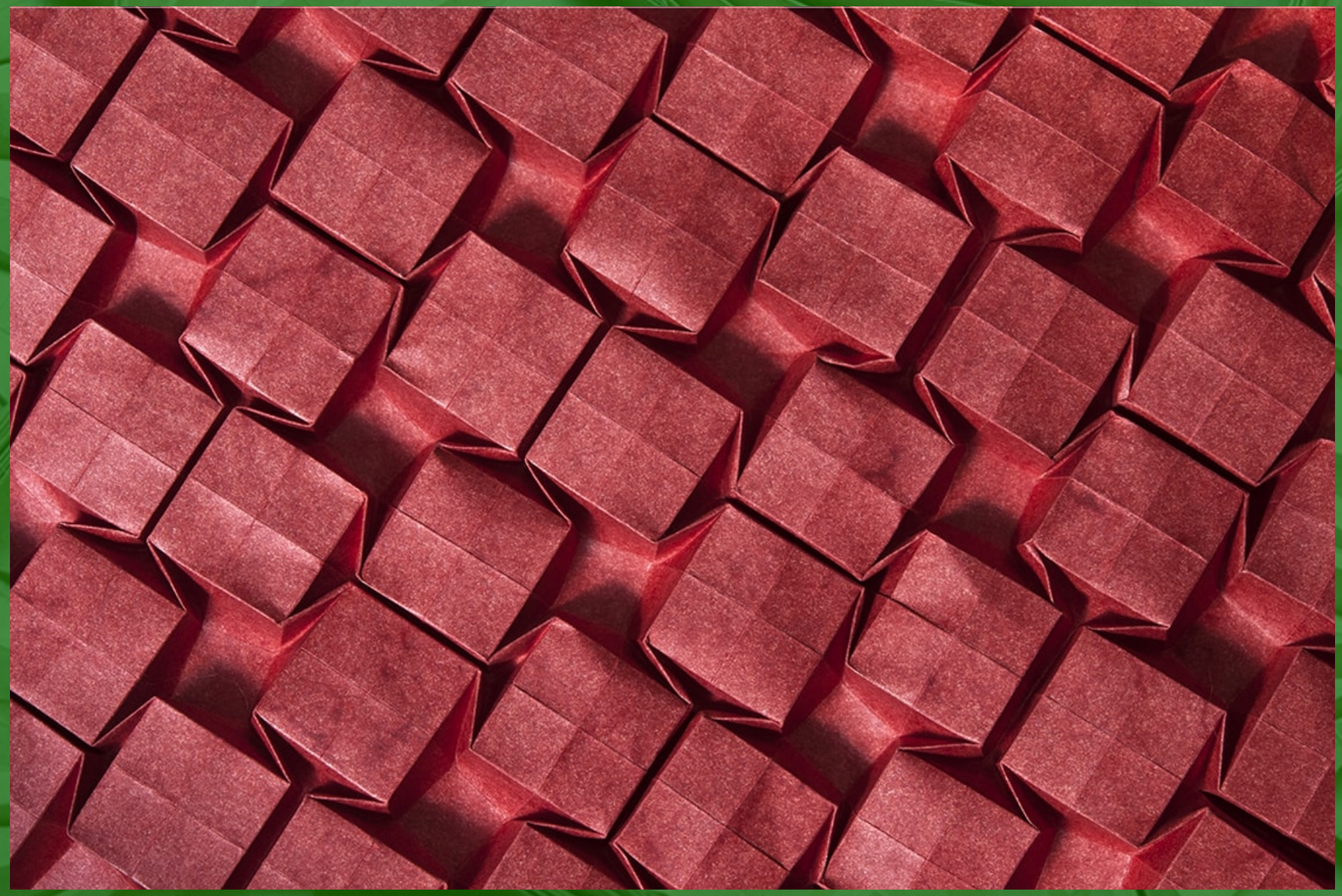
geometric origami: fractals



SHUZO FUJIMOTO (JAPAN)

geometric origami: tessellations

geometric origami: tessellations



ILAN GARIDI (ISRAEL)

geometric origami: tessellations

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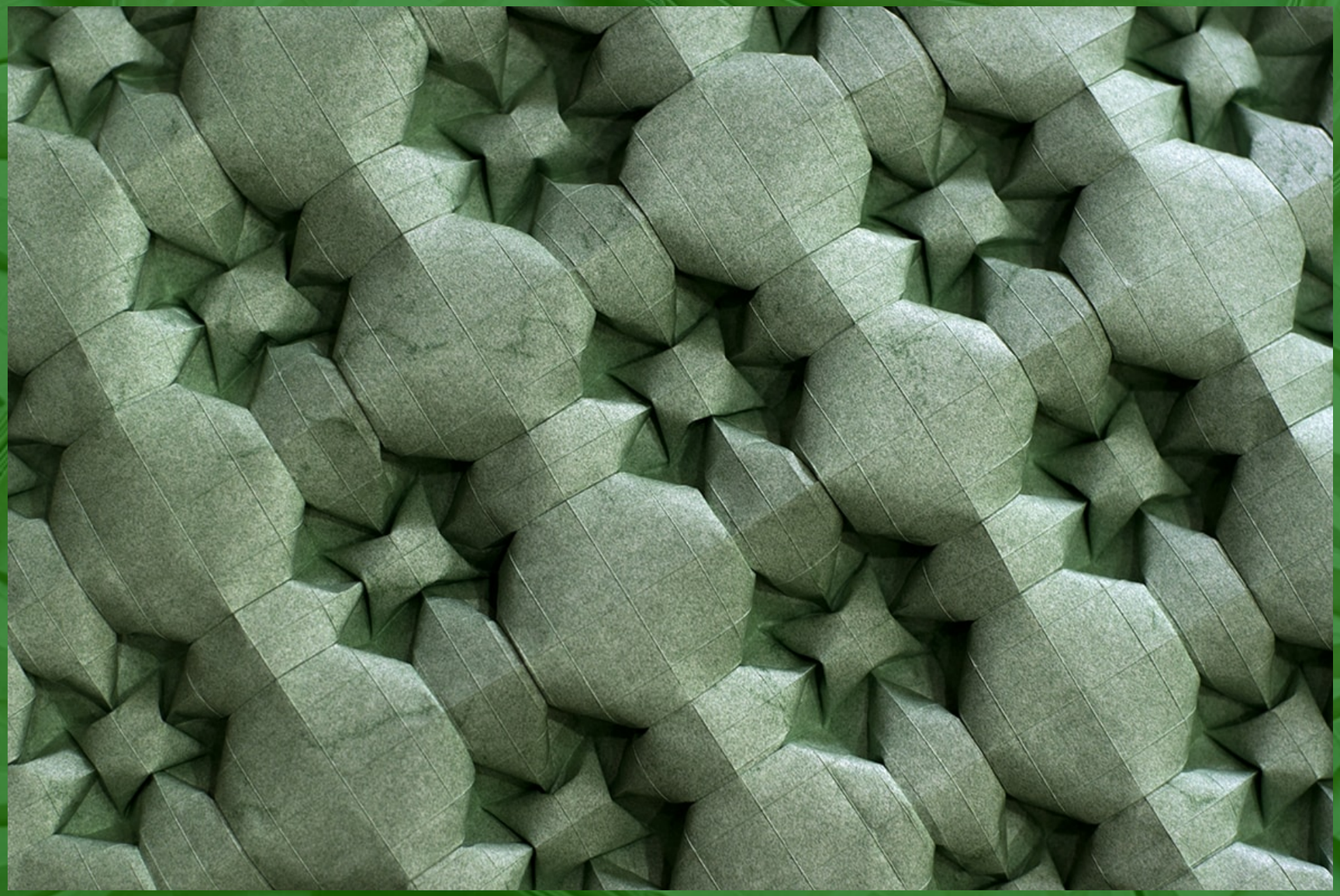
geometric origami: tessellations



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geometric origami: tessellations

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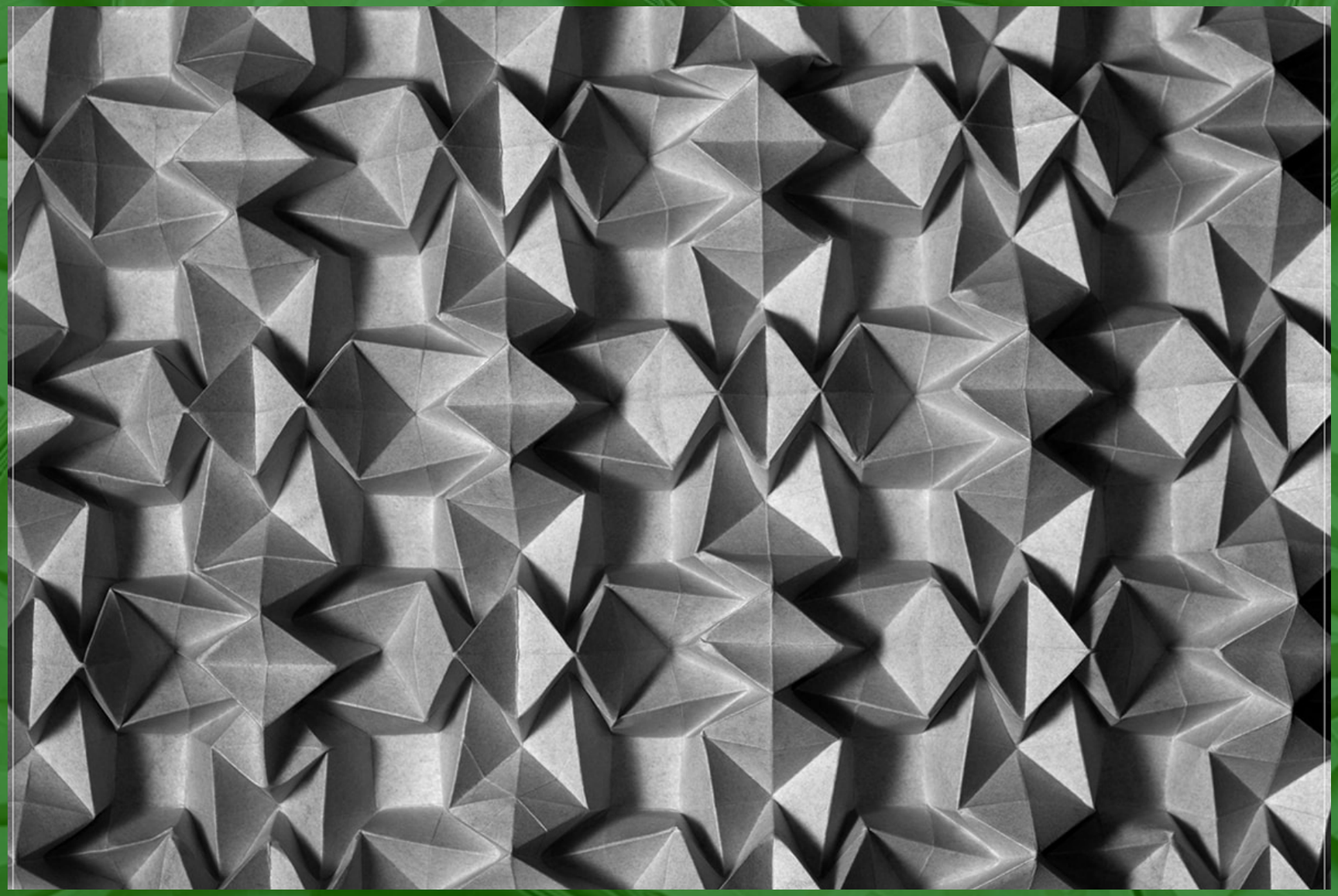
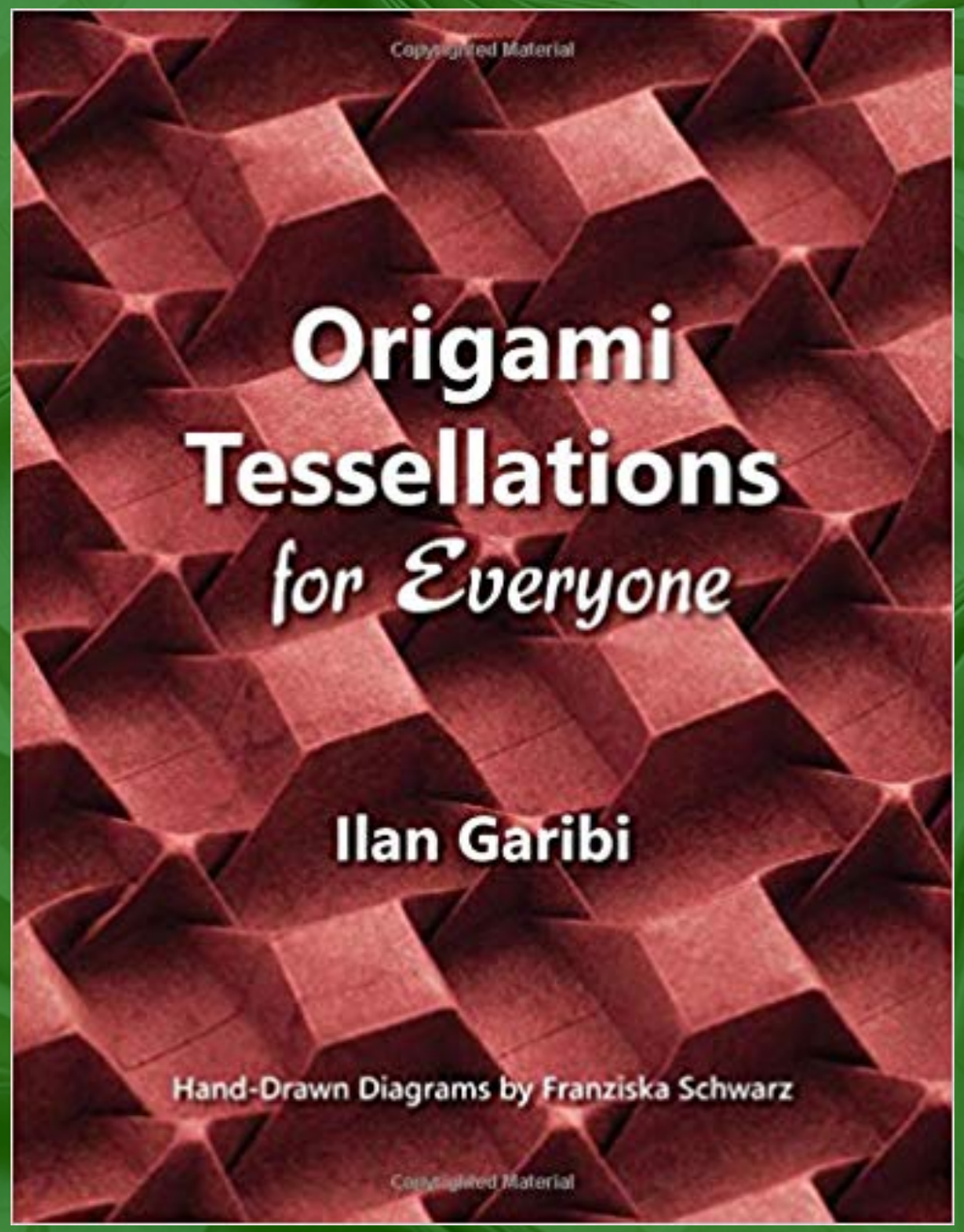


ILAN GARIBI (ISRAEL)

geometric origami: tessellations



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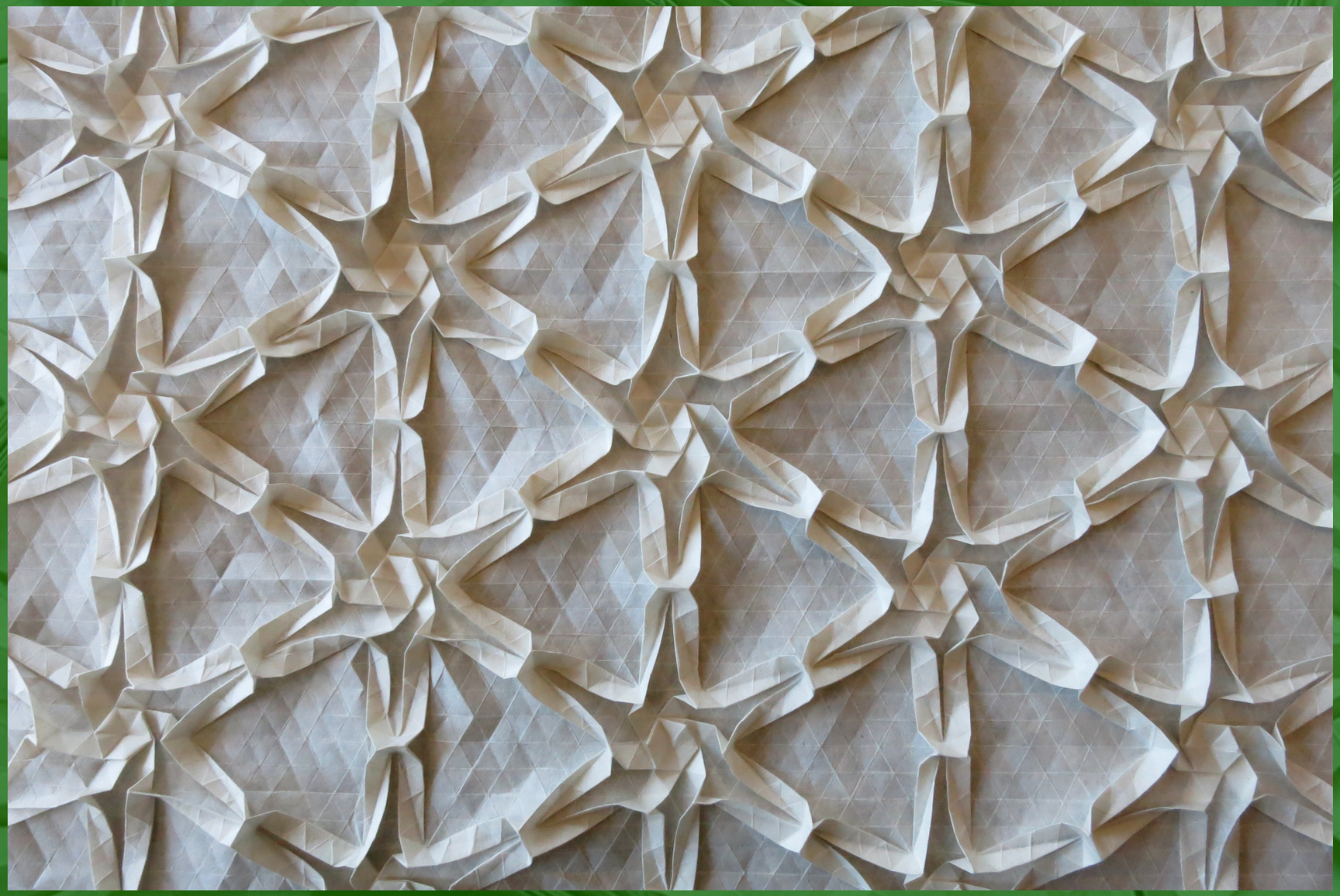

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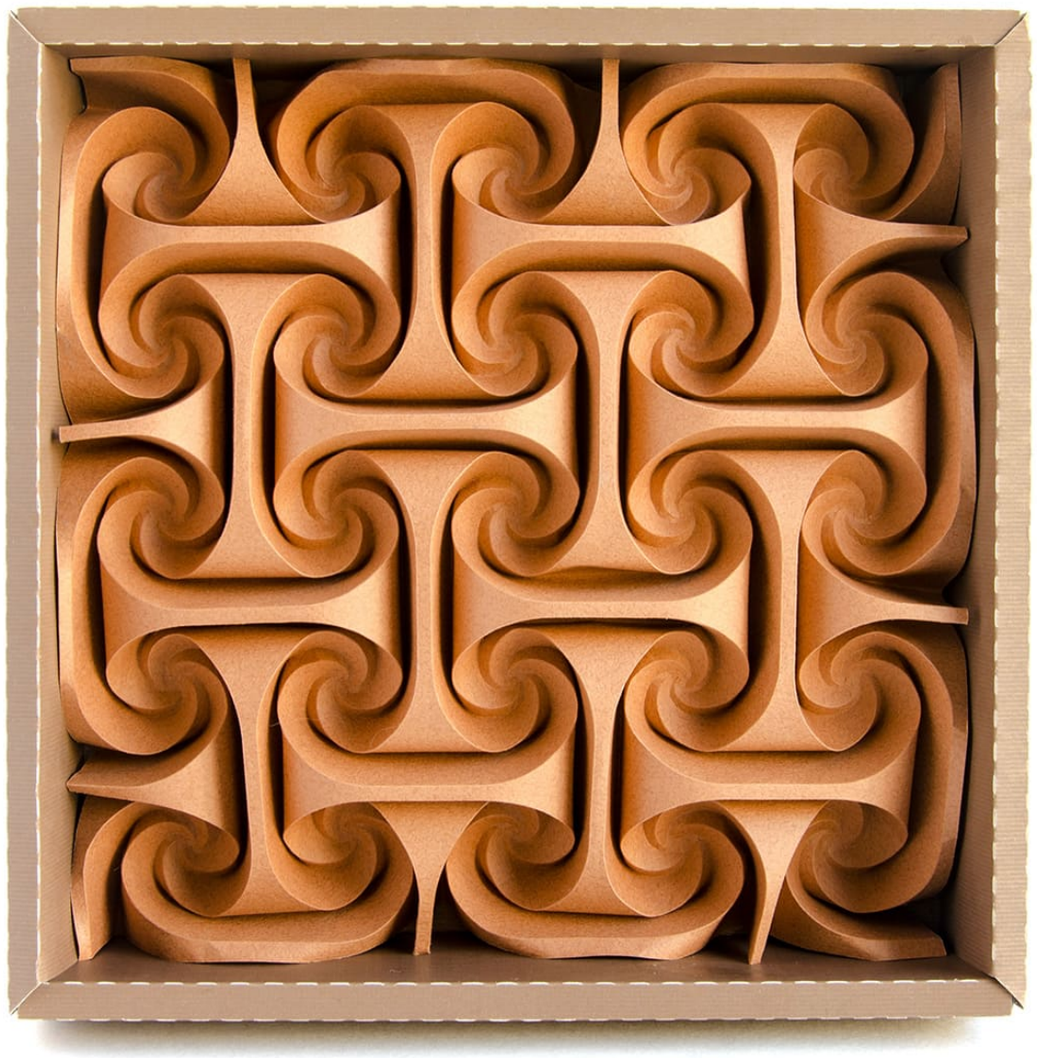
EKATERINA LUKASHEVA (RUSSIA)

geometric origami: tessellations



EKATERINA LUKASHEVA (RUSSIA)

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ALESSANDRO BEDER (ITALY)

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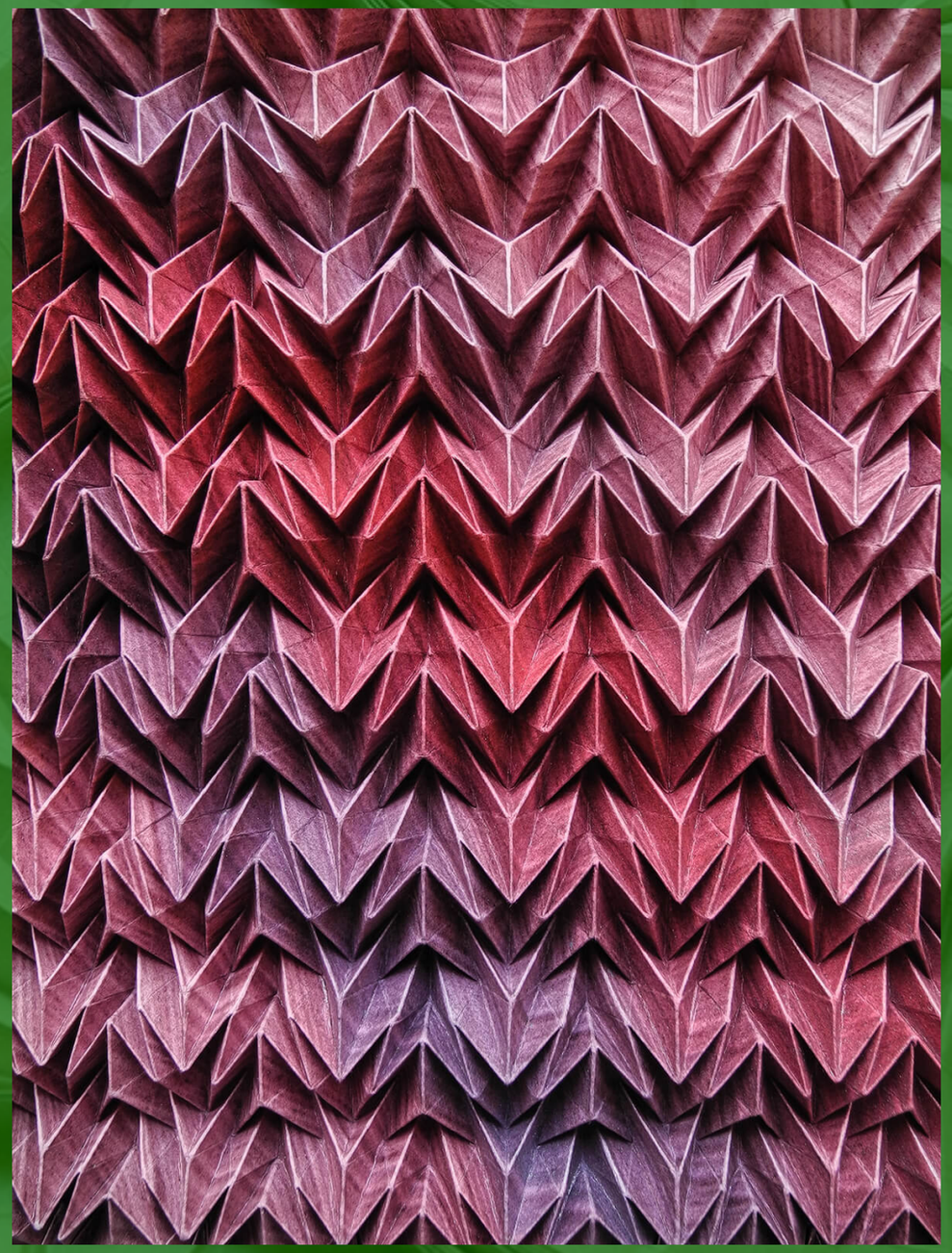
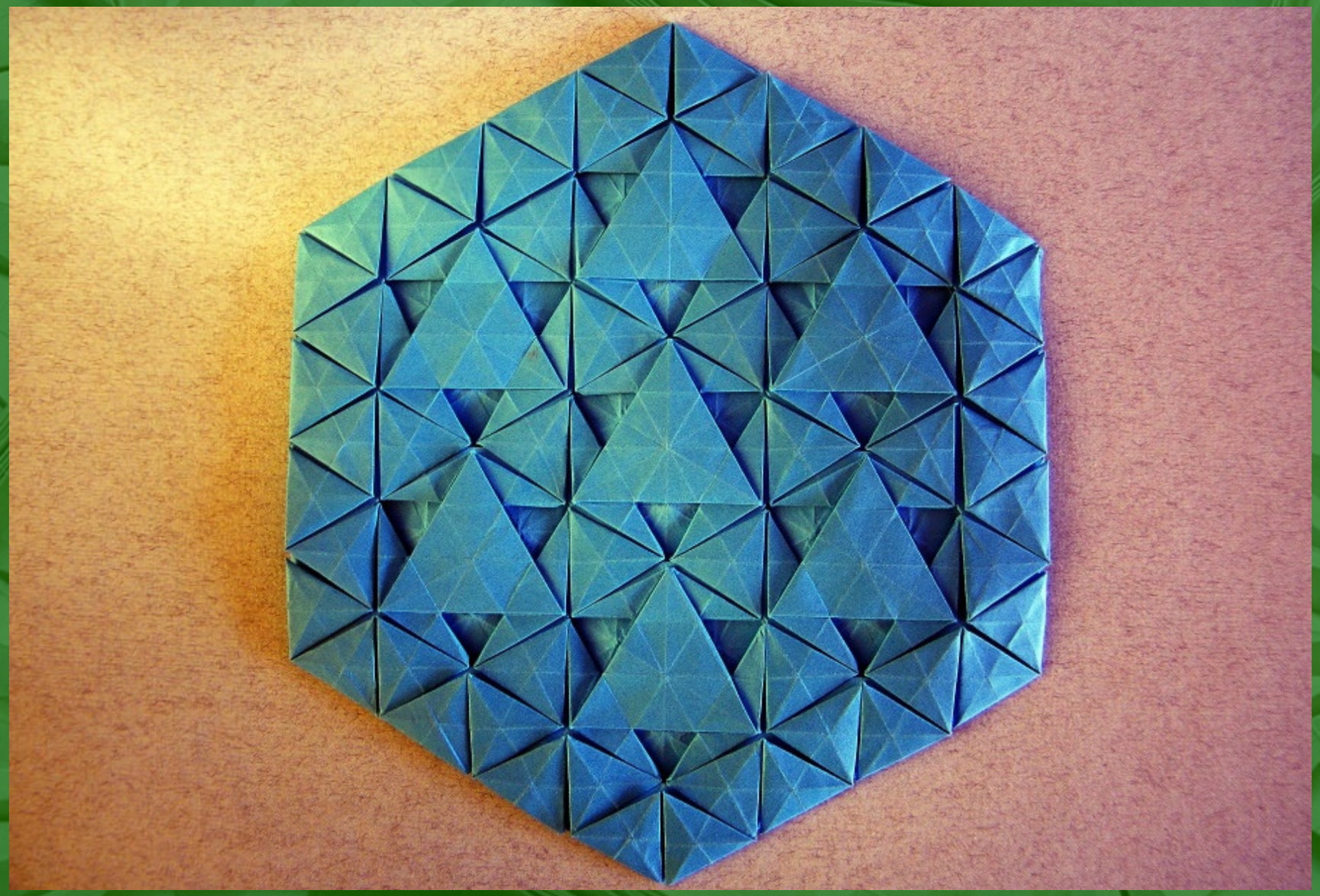


RODIN SCHOLZ (GERMANY)

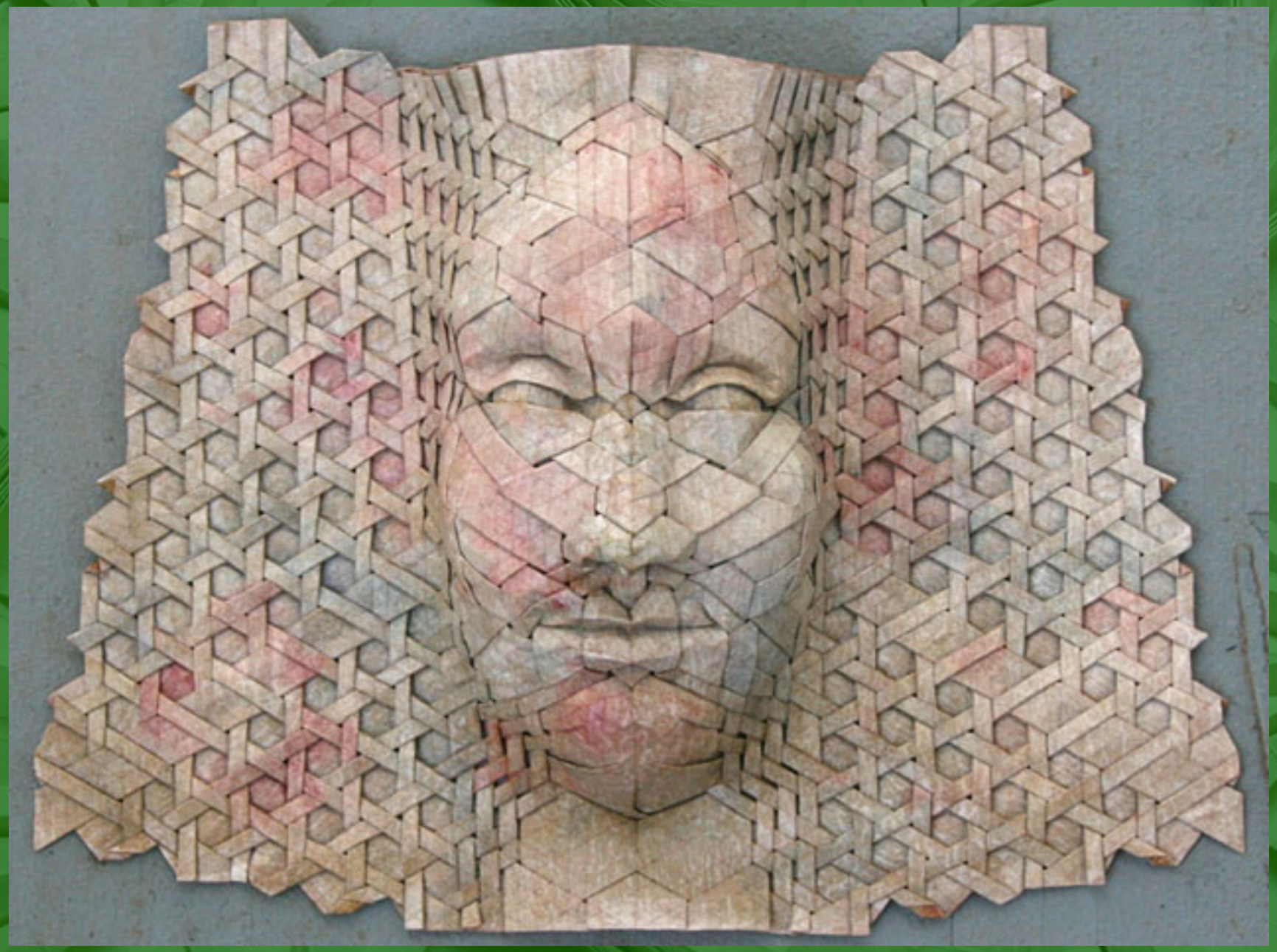
geometric origami: tessellations



RODIN SCHOLZ (GERMANY)

geometric origami: more...

geometric origami: more...



JOEL COOPER (USA)

geometric origami: more...

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geometric origami: more...

geometric origami: more...

geometric origami: more...

REBECCA GIESEKING (USA)

geometric origami: more...

geometric origami: more...

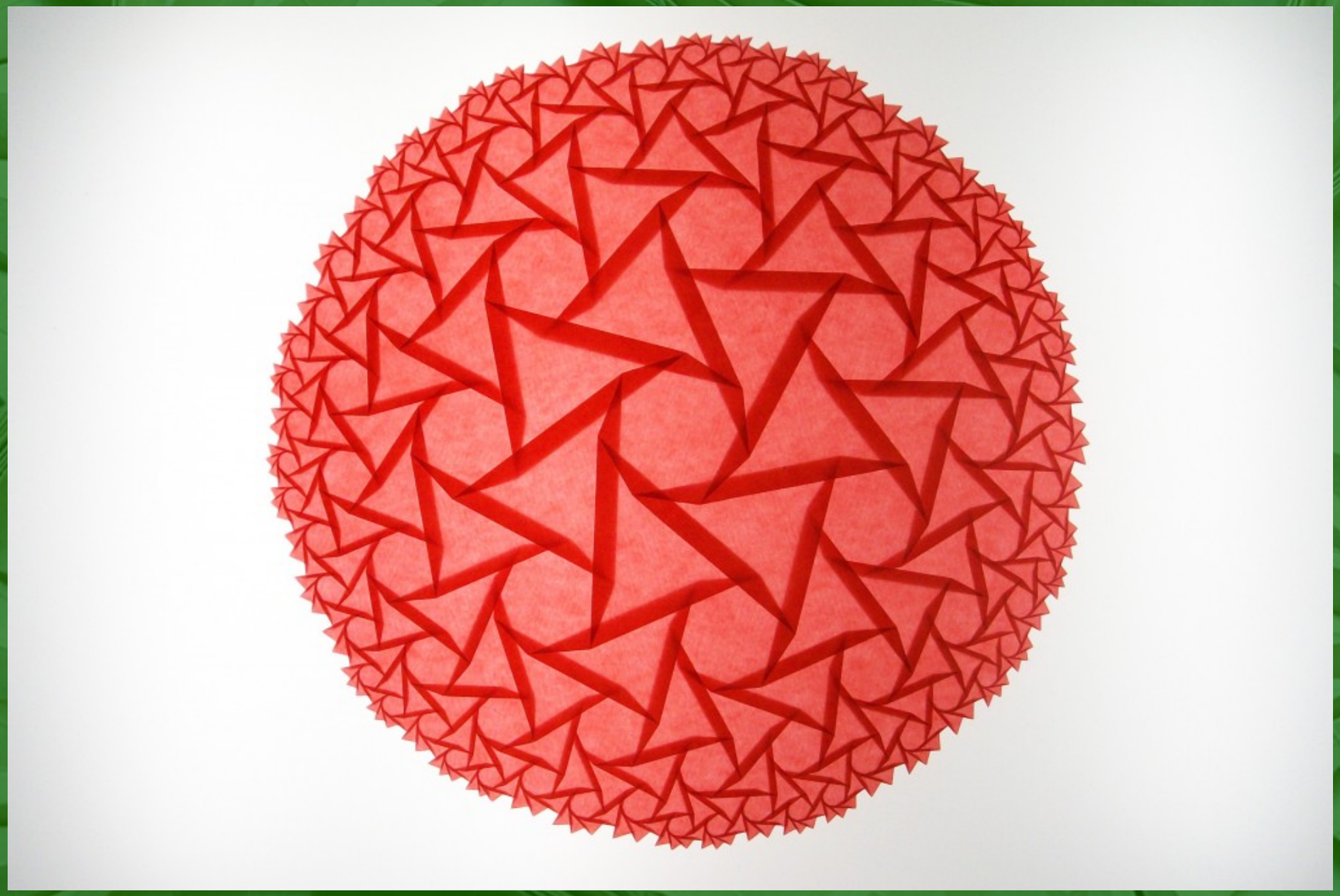
geometric origami: more...

YUKO NISHIMURA (JAPAN)

geometric origami: more...

geometric origami: more...

geometric origami: more…



ROBERT J. LANG (USA)

geometric origami: more...

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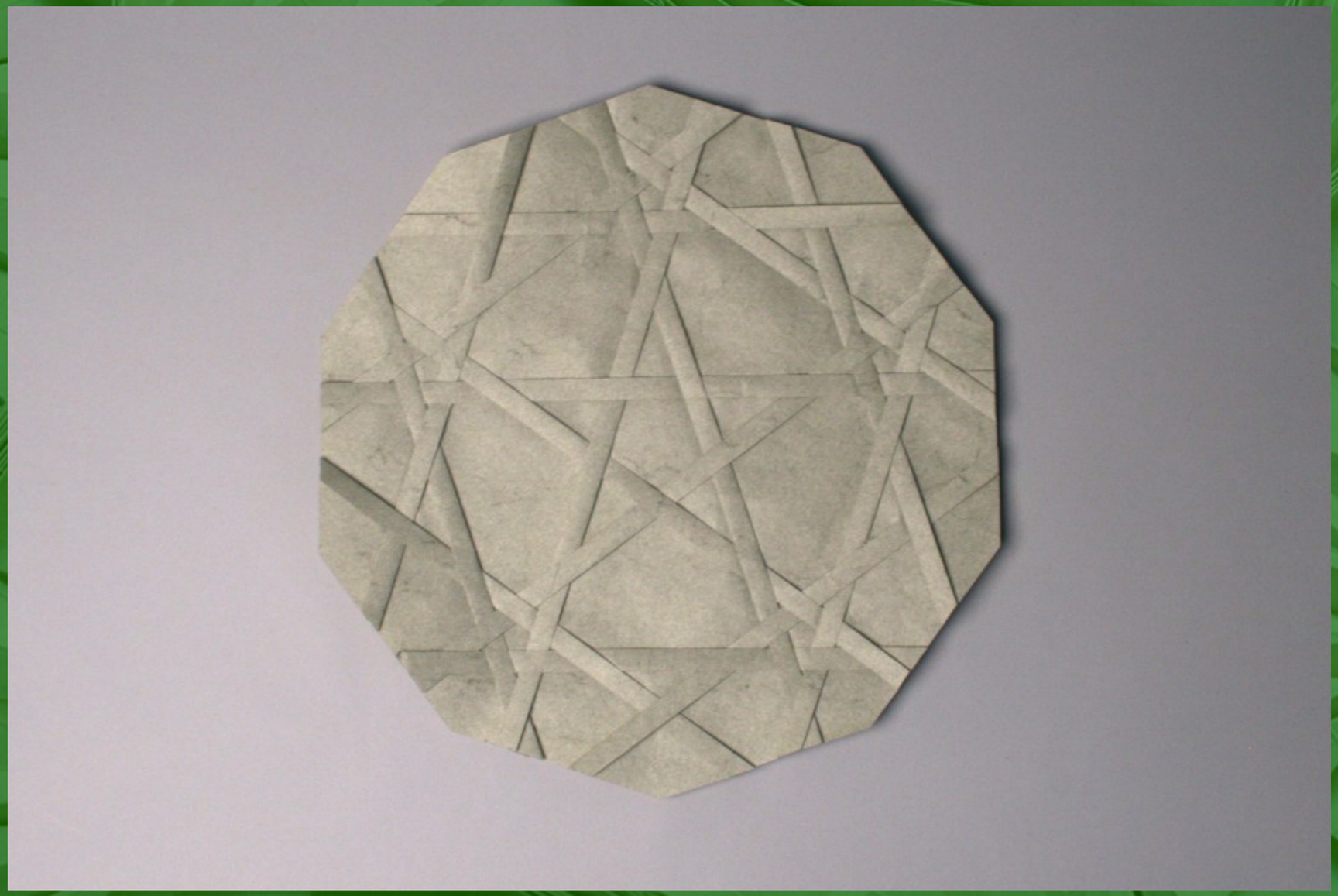

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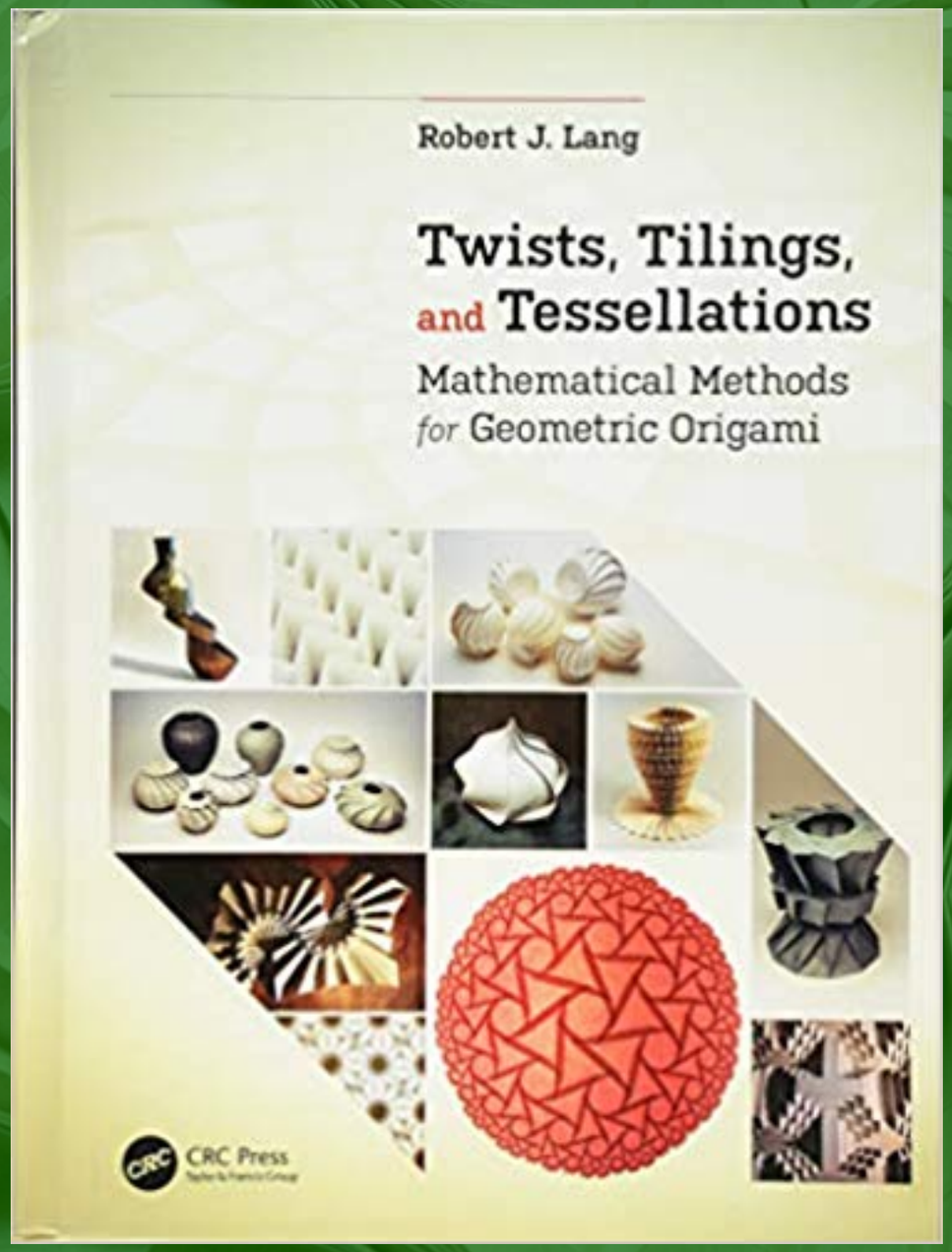

ROBERT J. LANG (USA)

flagstone tessellations

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A flagstone tessellation is a *flat-foldable* origami *crease pattern* P containing a subset F of facets that satisfies the following:

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- In the folded form, the closure of F is simply connected;
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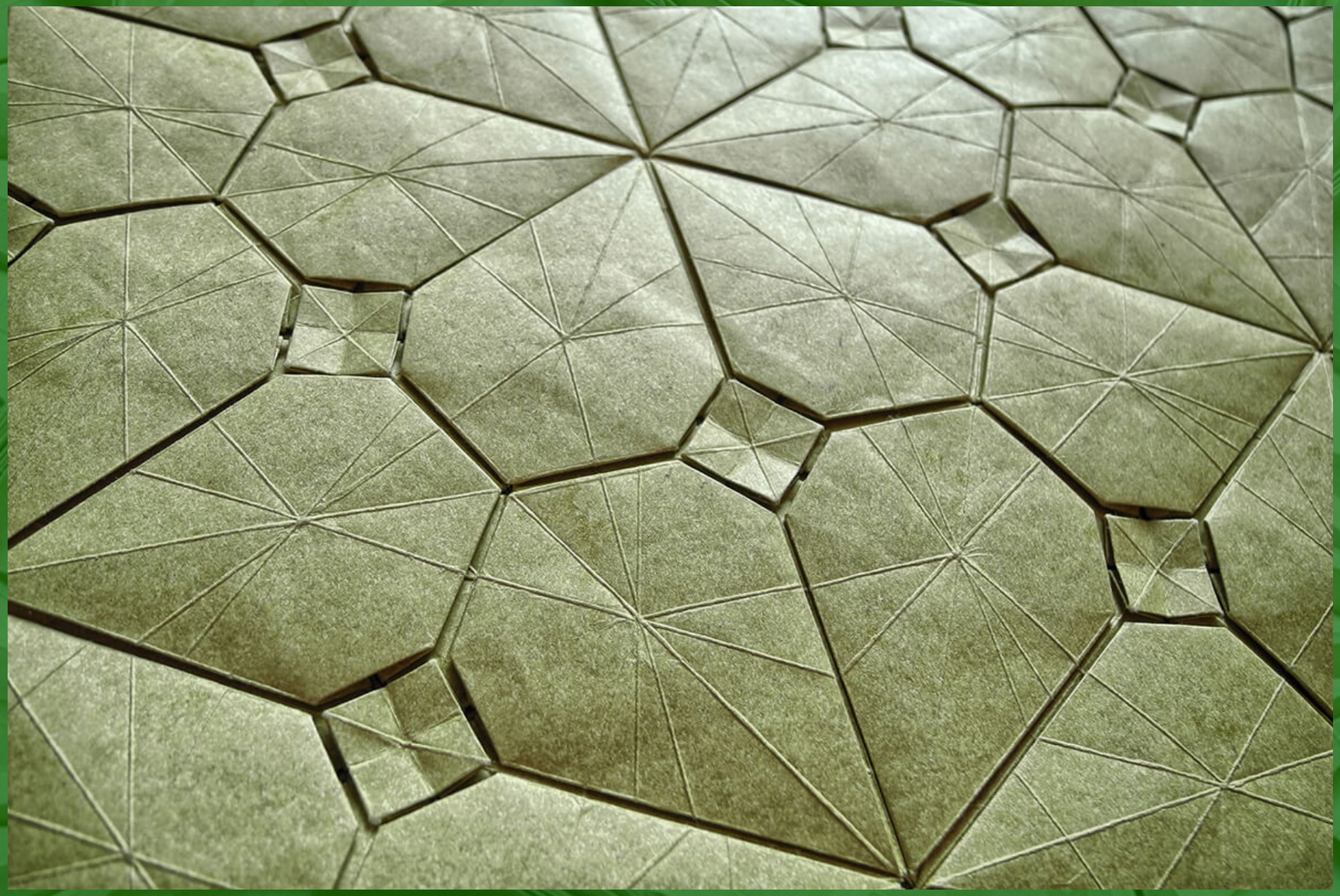
In other words, a flagstone tessellation reproduces a tiling.

flagstone tessellations

flagstone tessellations

ERIC GJERDE (USA)

flagstone tessellations



RODIN SCHOLZ (GERMANY)

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Kawasaki-Justin Theorem:

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Maekawa-Justin Theorem:

- At any interior vertex of a flat-foldable crease pattern the difference between the number of mountain and valley creases has absolute value 2.

flagstone tessellations

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Robert J. Lang: If a tiling consists only of regular polygons and of acute triangles (more generally: satisfies a spiderweb condition on the dual graph) then there is a flagstone tessellation reproducing the tiling and satisfying both Kawasaki-Justin and Maekawa-Justin theorems, and thus potentially flat-foldable.

flagstone tessellations

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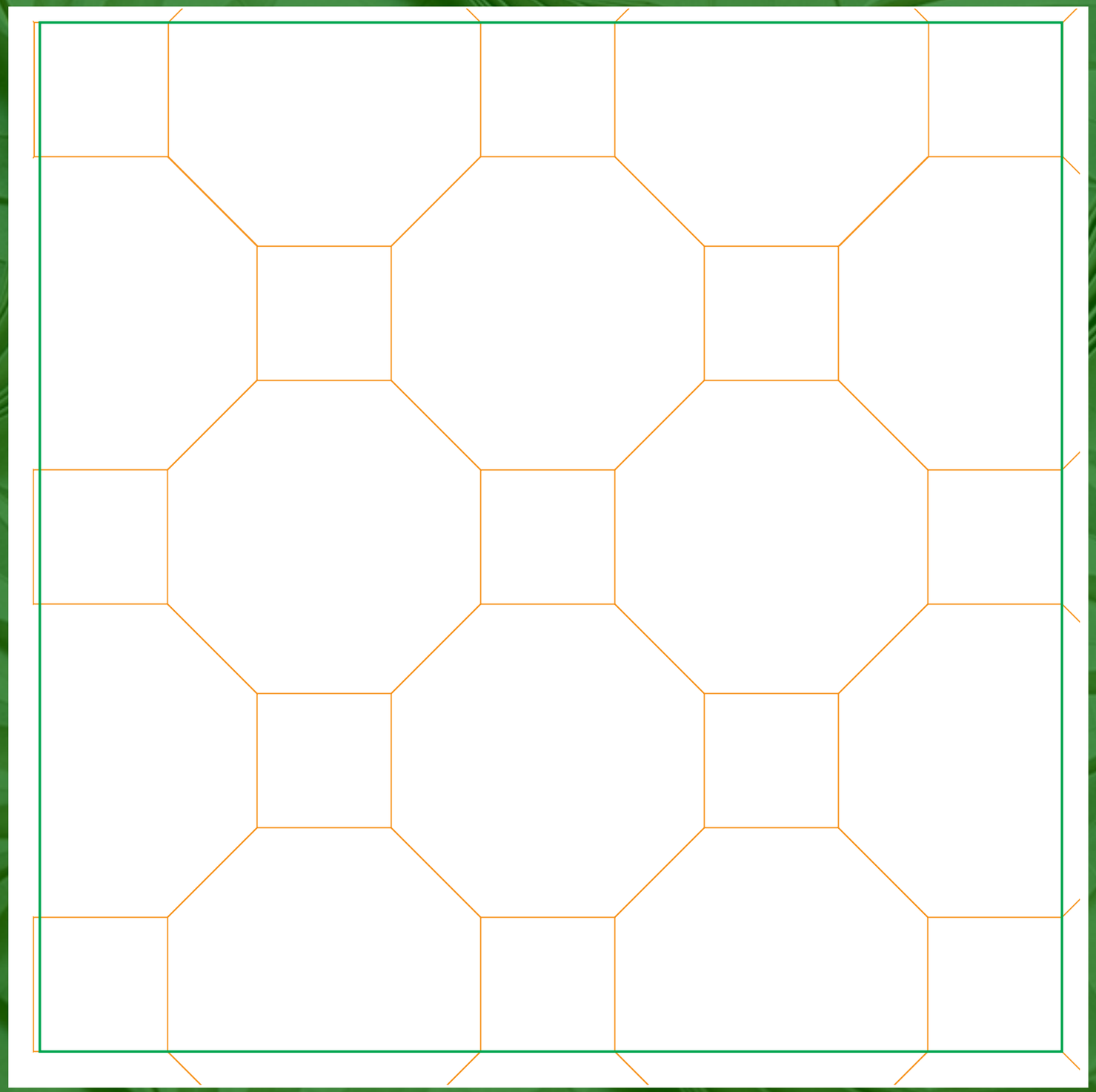

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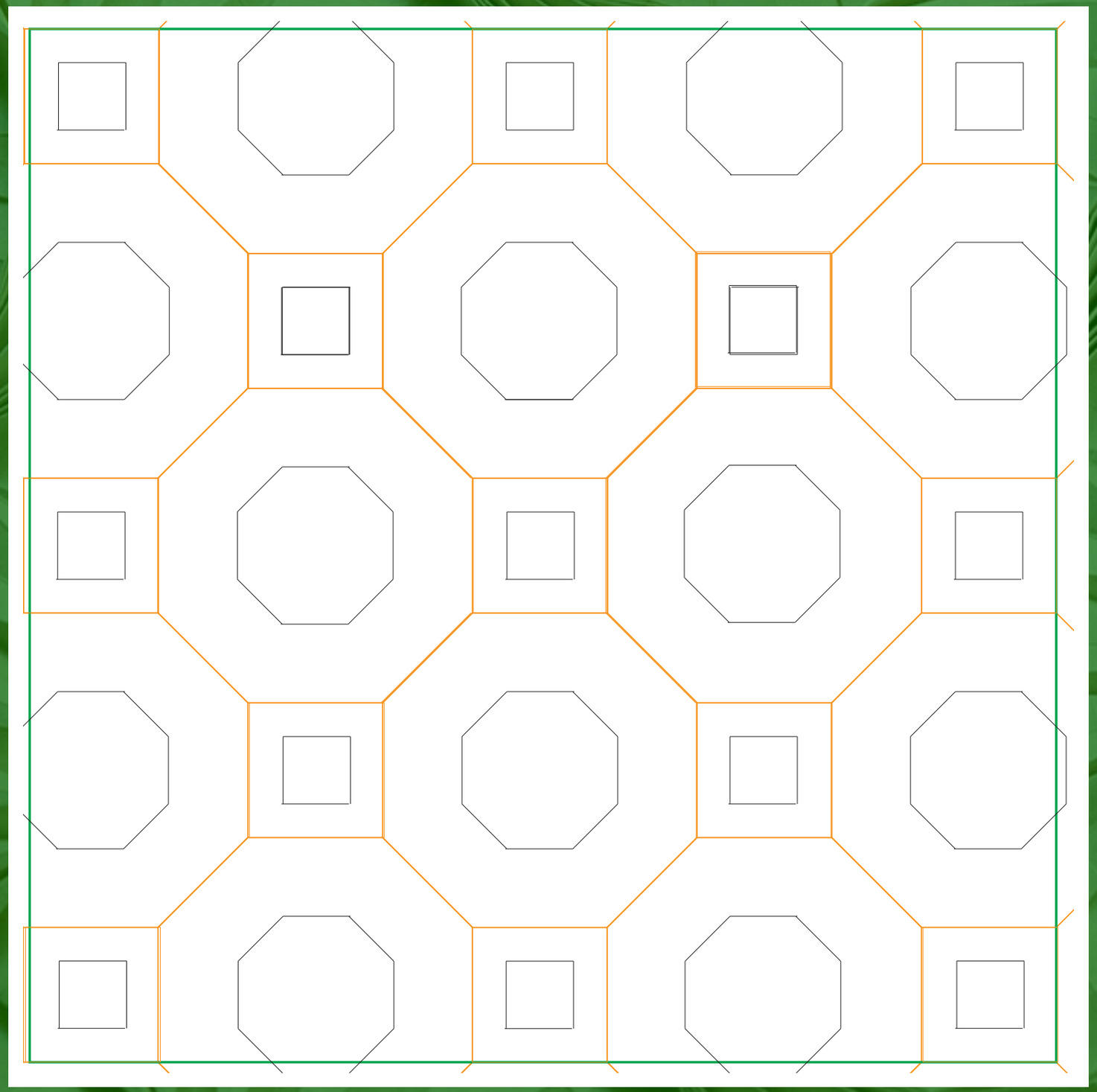

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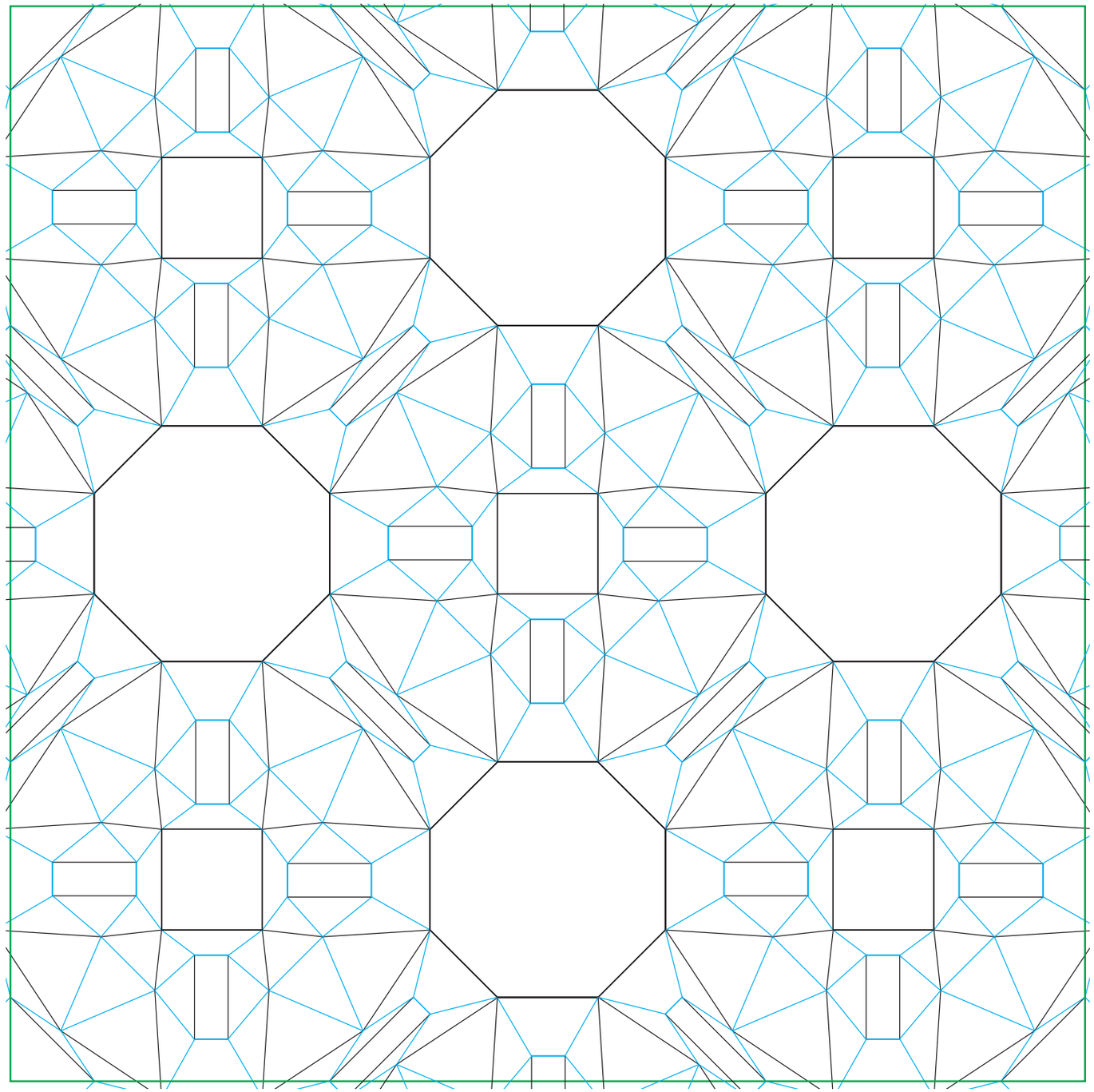

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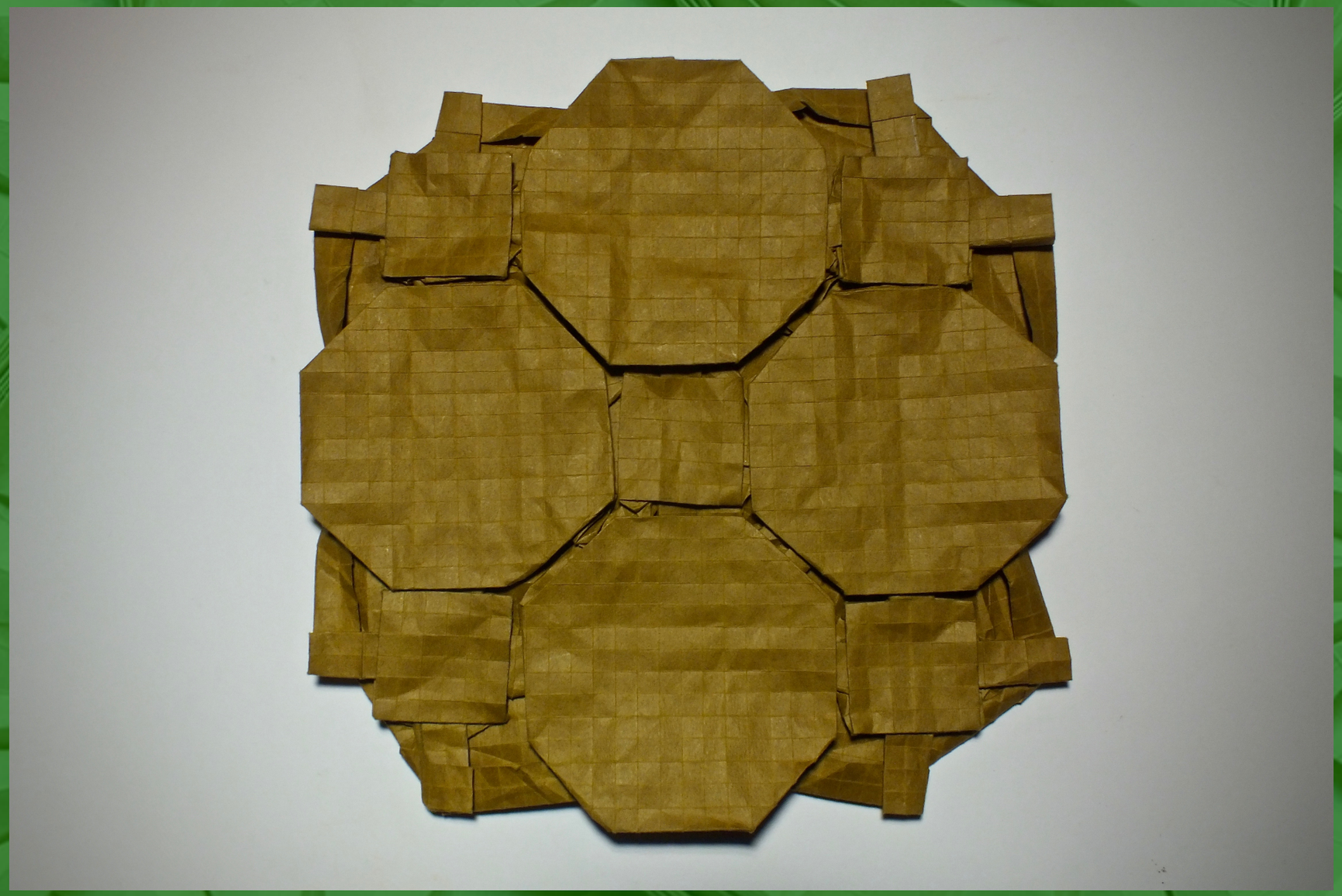

Imagine Math 7 (Mathematics & Culture 2019)

marco abate

GEOMETRIC ORIGAMI

http://pagine.dm.unipi/abate

Venezia, March 29th, 2019