



JMM 2026

# Fractals in Motion: A Math Circle Activity at the Intersection of Dance and Mathematics

Dr. Tara Rodman  
Drama

UCI Clare Trevor School of the Arts

Dr. Jesse Wolfson  
Mathematics

UCI School of Physical Sciences

Dr. Alessandra Pantano  
Mathematics

UCI School of Physical Sciences



- Dr. Alessandra Pantano
- Professor of Teaching
- Mathematics
- UC Irvine

# In collaboration with



**Dr. Tara Rodman**  
**Drama**

UCI Clare Trevor School of the Arts



**Dr. Jesse Wolfson**  
**Mathematics**

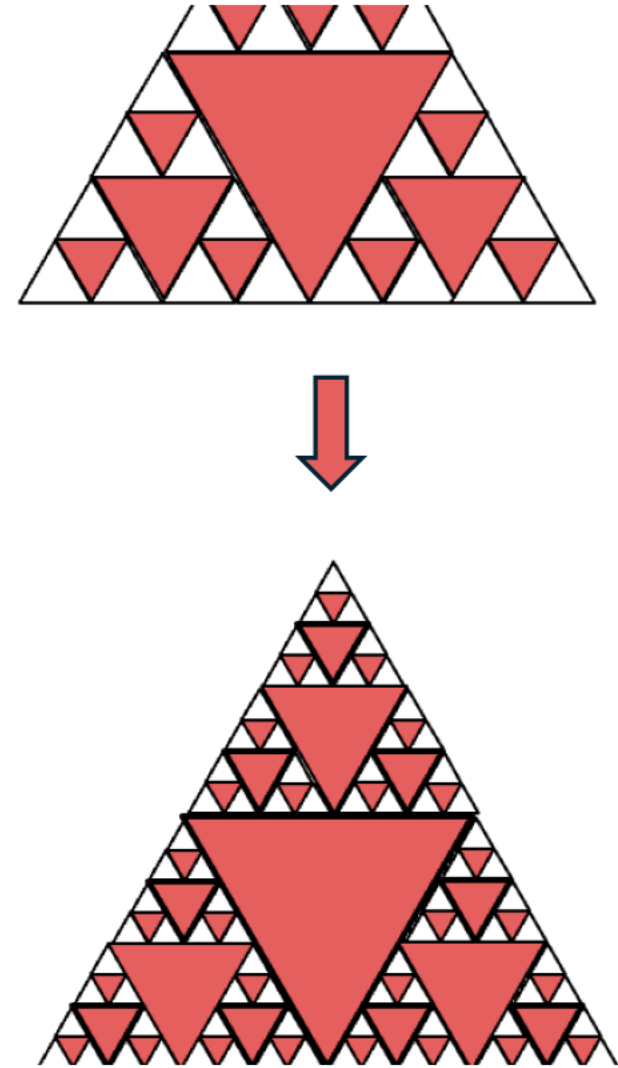
UCI School of Physical Sciences



**Reggie Wilson**  
**Choreographer**

Fist and Heel Performance Group

# Fractals at the UCI Math Circle (2013)



# The Sierpinski Triangle



	Original area	# triangles removed	Area of triangle being removed	TOT Area removed	TOT area left
1 iteration	1	1	1/4	1/4	3/4
2 iterations	3/4	3	1/16	3/16	9/16
3 iterations	9/16	9	1/64	9/64	27/64
...	...	...	...	...	...
n iterations	$(3/4)^{n-1}$	$3^{n-1}$	$(1/4)^n$	$(1/4) * (3/4)^{n-1}$	$(3/4)^n$





- Math proficiency and motivation
- Socio-emotional learning
- Familiarity with college



Empowering Youth



Math Enrichment





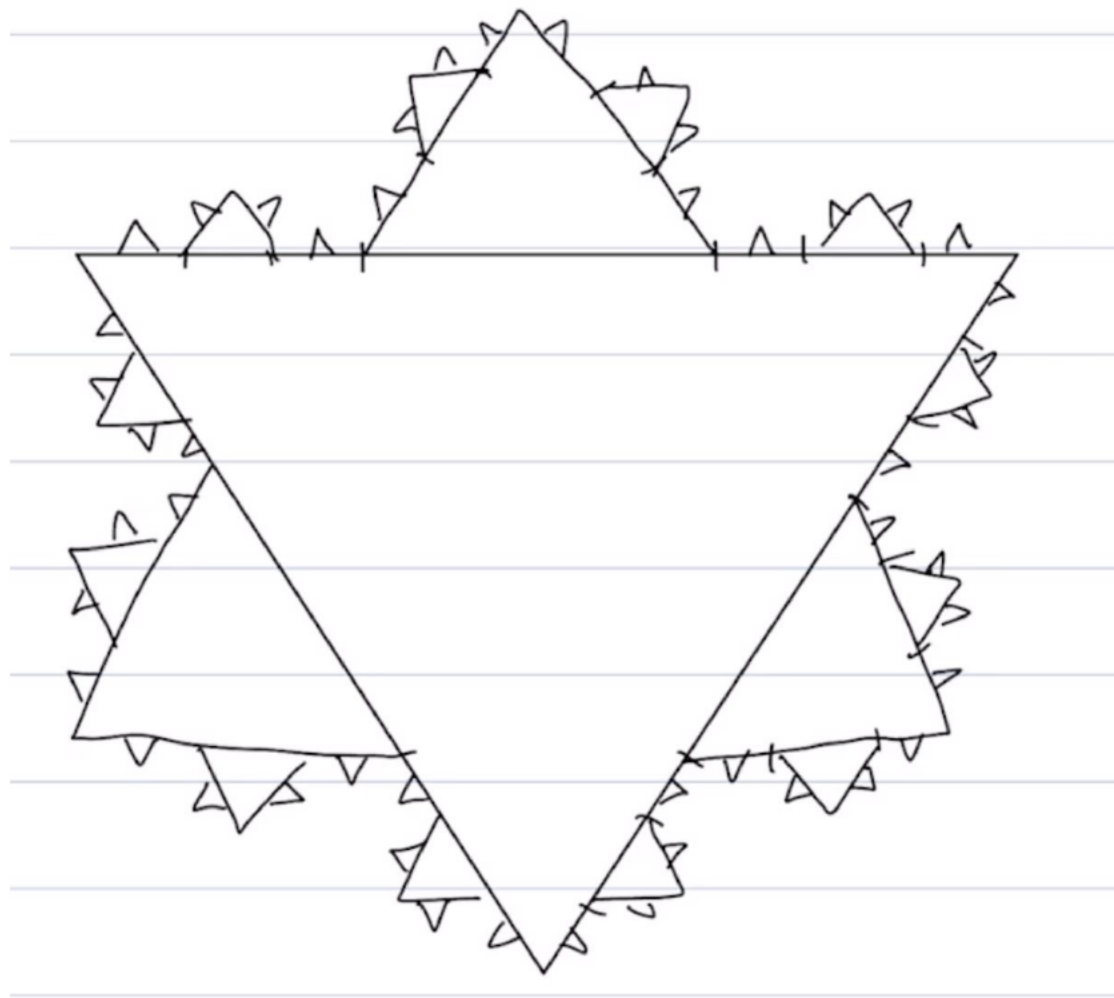
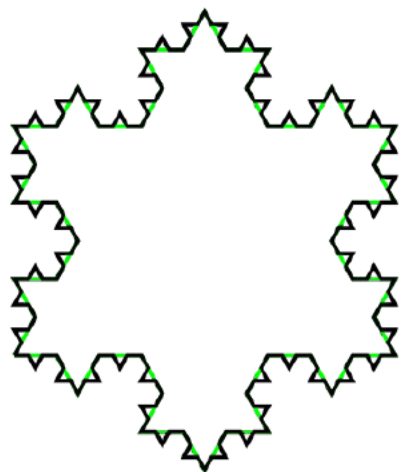
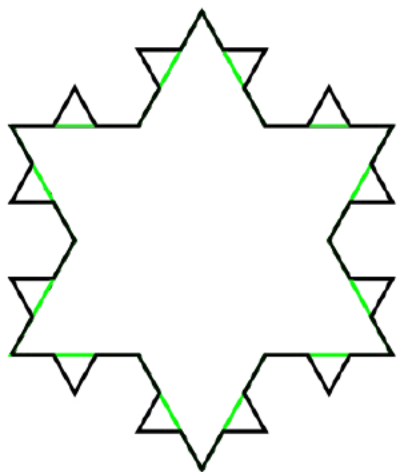
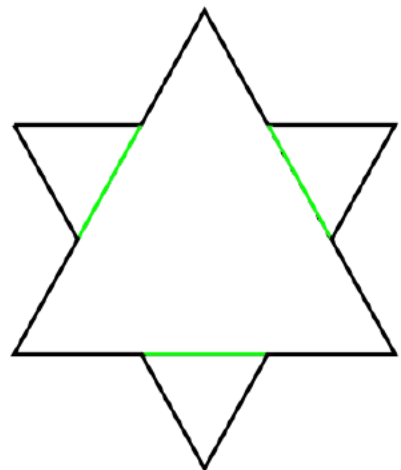
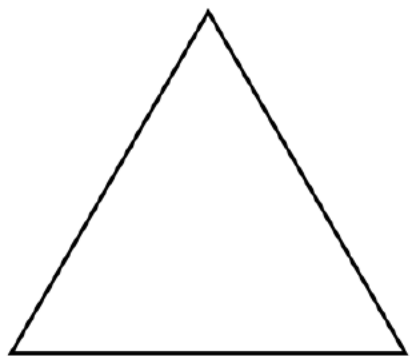


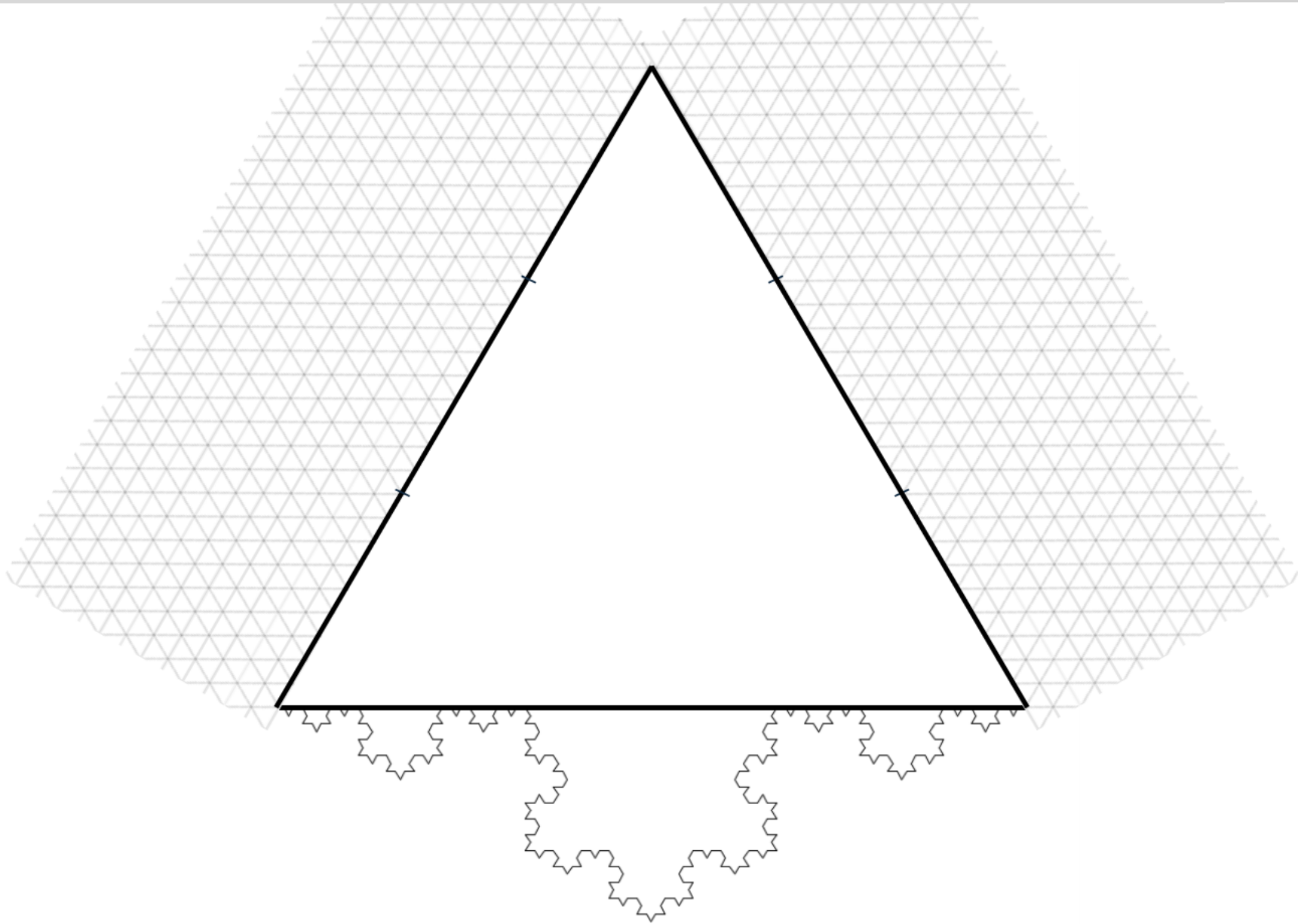
Making fractal activities more collaborative and dynamic



Drawing fractals  
together

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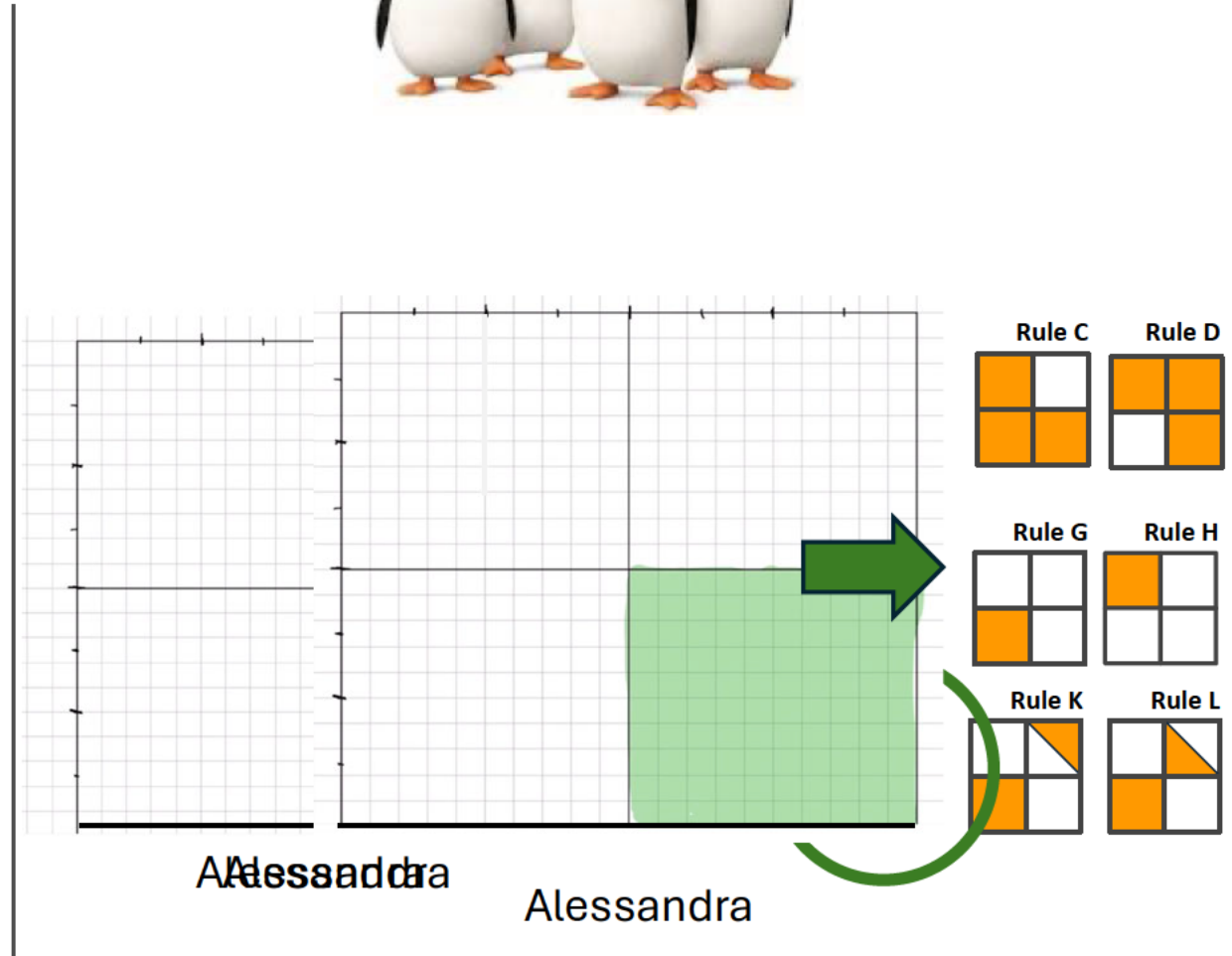




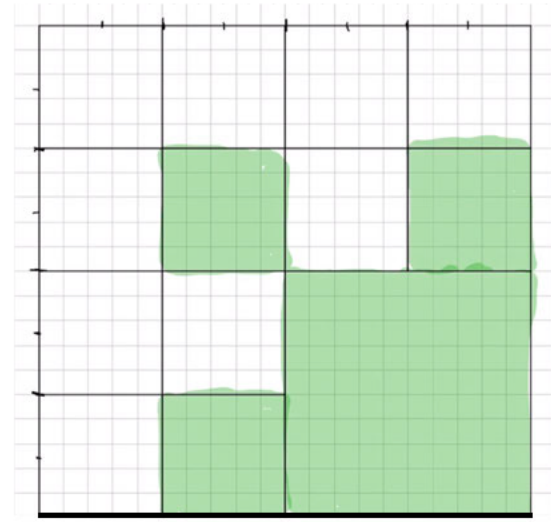
**¡Dibuja & Pasa!**

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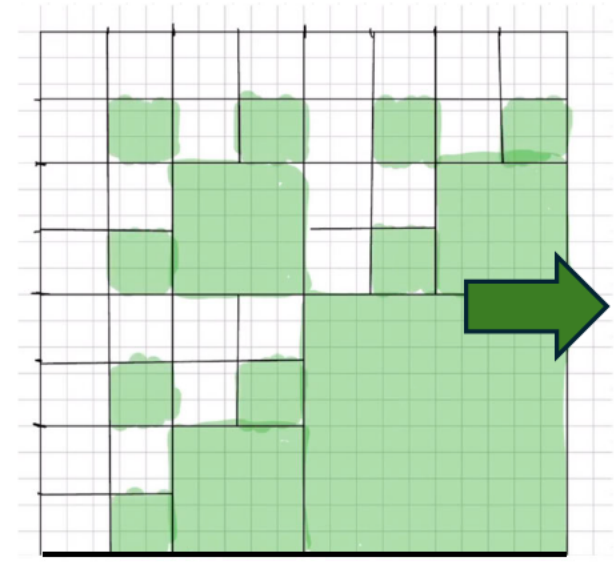
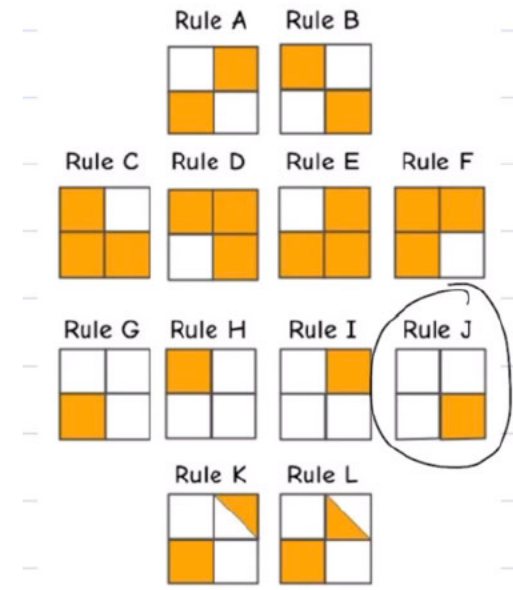
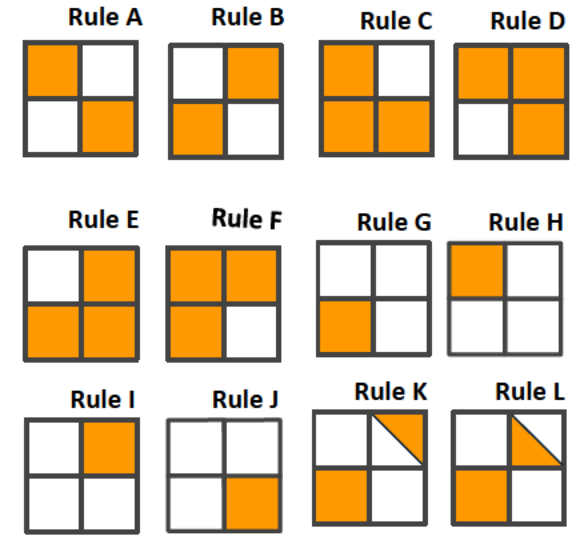
- Make teams of 4-5 students.
- Each student gets a large square, split in 4, and writes their name on it.
- There are 12 possible rules to decorate the square.
- Every student picks a rule and colors their square accordingly.
- Each student passes their (colored) square to the friend on the right.



- You just received a colored square from a friend.
- Look back at the chart of rules
- Decipher which rule was applied.
- Apply that rule to every **blank square**.
- Pass your (colored) square to the friend on your right.
- Repeat!



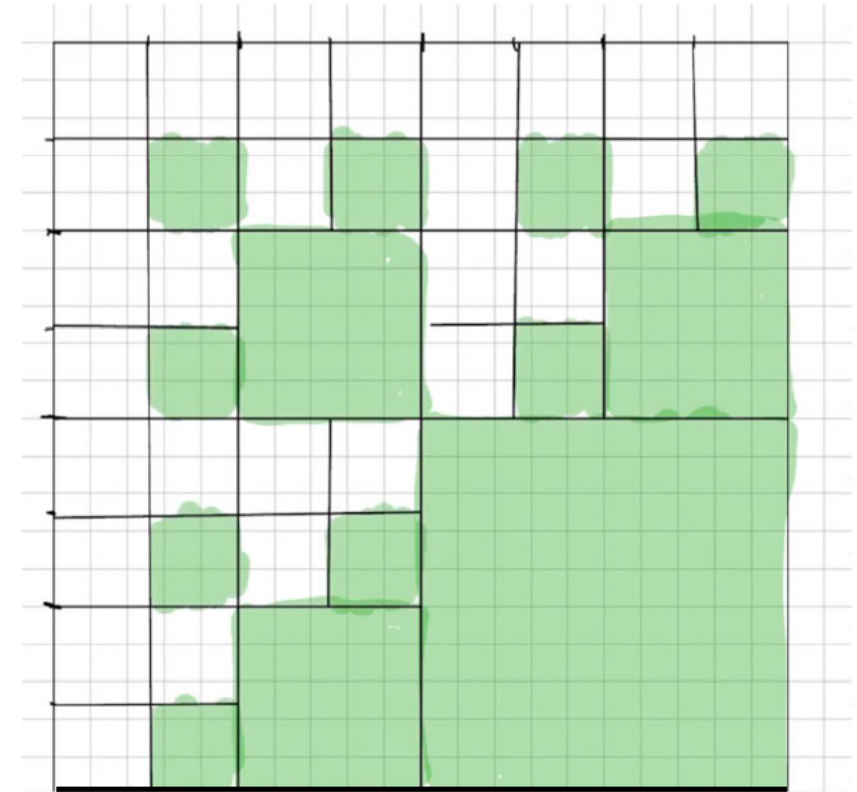
Alessandra



Alessandra

Eventually, as you cycle through the group, you will recover your drawing.

- Was your rule followed correctly all the time?
- What percentage of the original area has been colored?



Alessandra

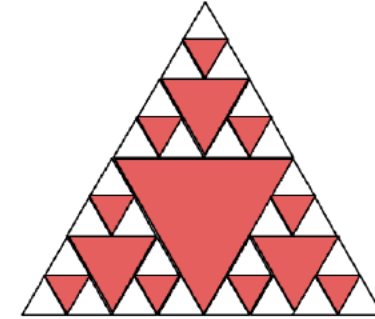
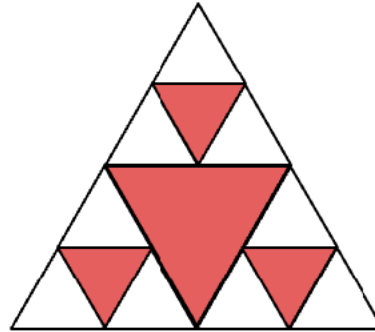
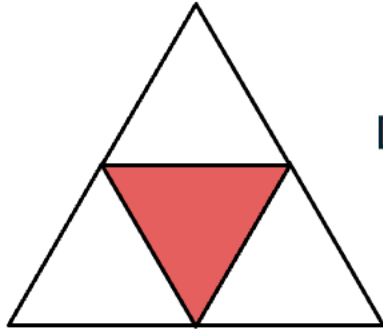
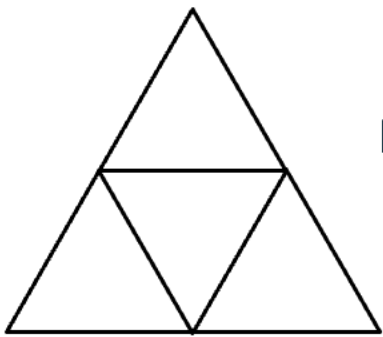
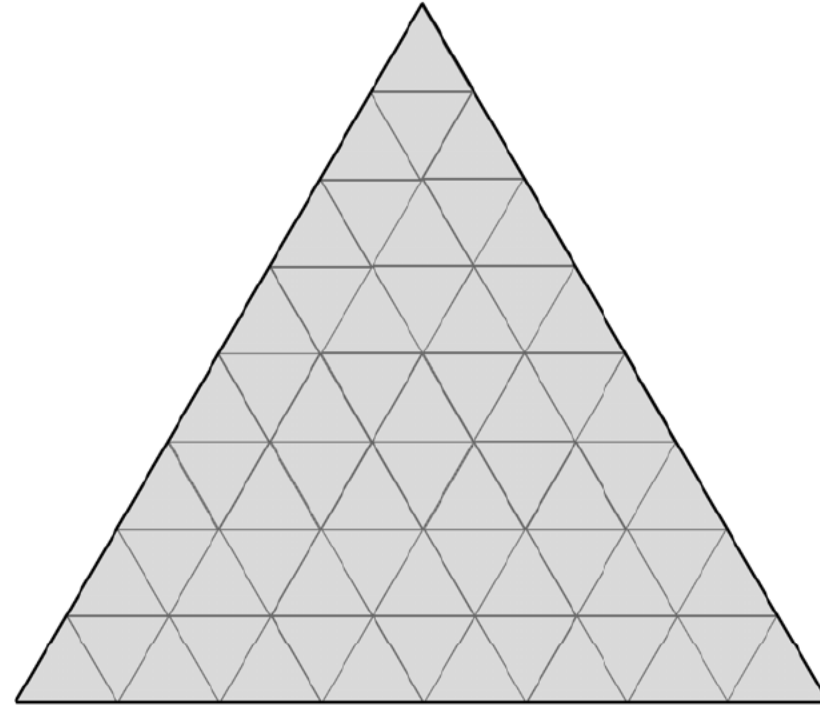
# Building large fractals in 2 or 3 dimensions

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*Each student*

- *receives several copies of a triangular template*
- *colors the template to show 3 iterations of the construction.*

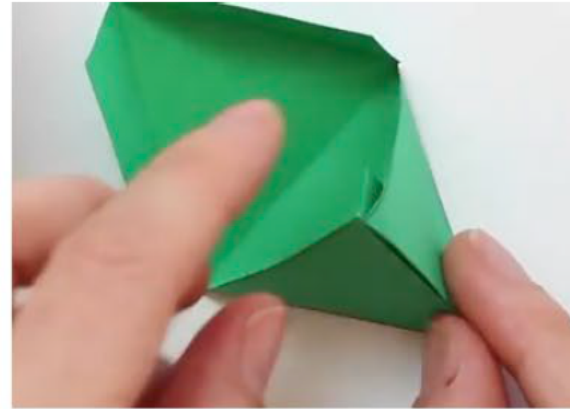
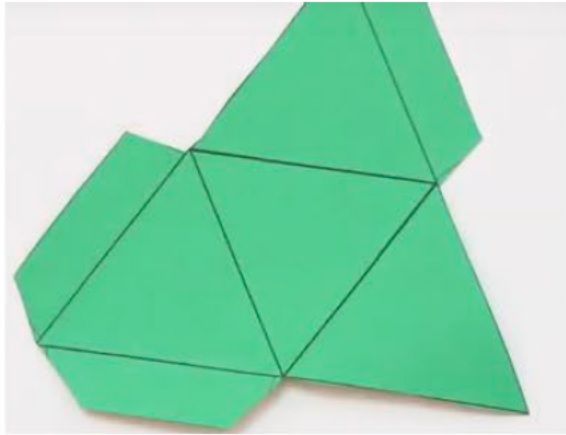
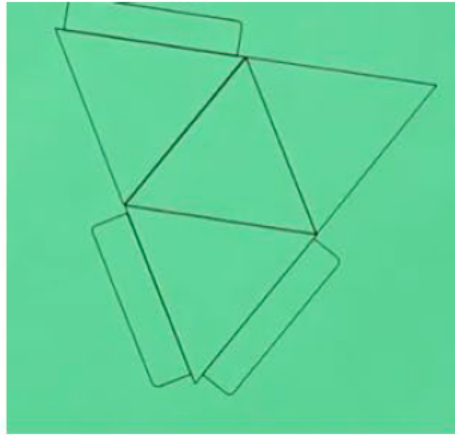
*Then students come together and arrange their triangles on the floor to build a large Sierpinski triangle*



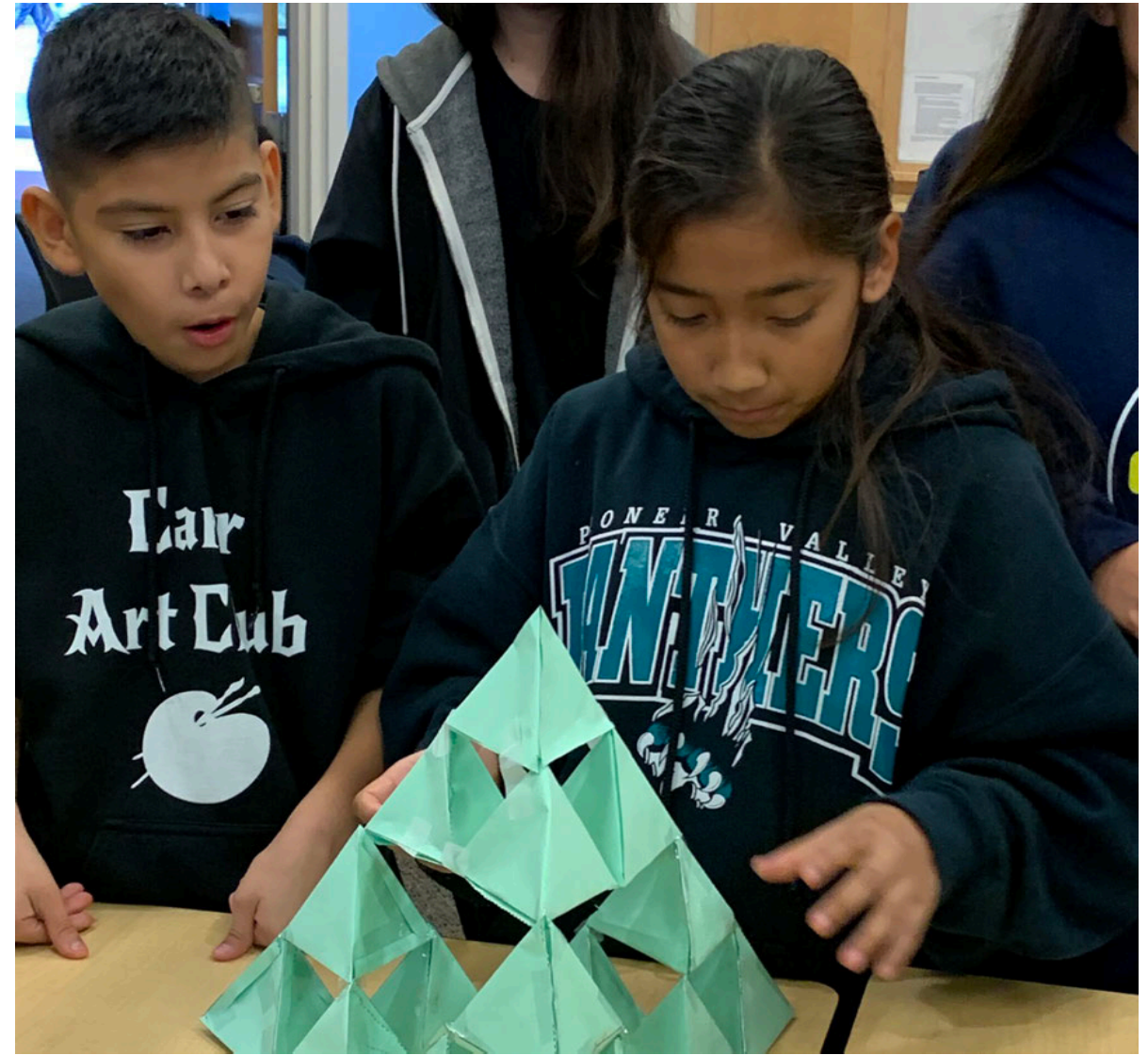


# Build a 3-d fractal

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Survey Time



## Fractal Dances (2017)



**Dr. Tara Rodman**  
**Drama**  
UCI Clare Trevor School of the Arts



**Dr. Jesse Wolfson**  
**Mathematics**  
UCI School of Physical Sciences

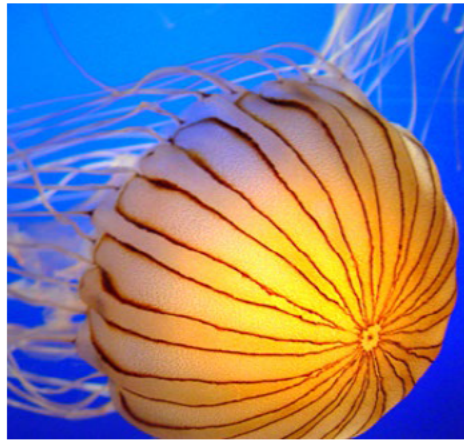
# Symmetry

**Repetition under a transformation.**

A “feature” which is unchanged under a transformation.



HONEYCOMB



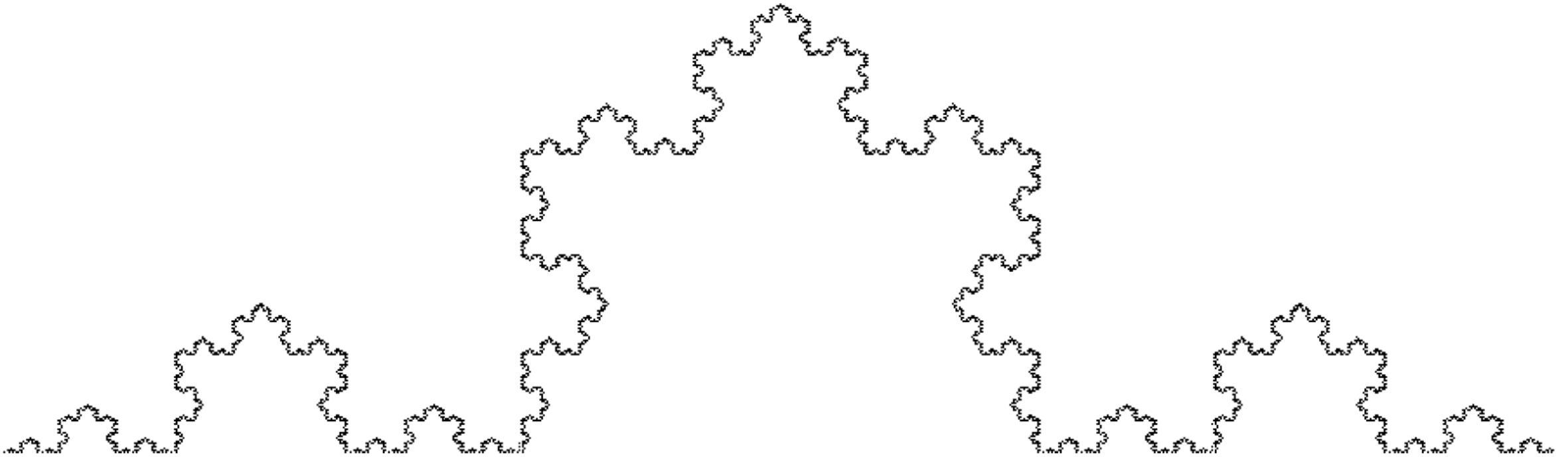
JELLYFISH



PENGUIN

# Fractal Symmetry

The transformation is **dilation** (zooming in/out, stretching, shrinking, scaling)



# Fractal Symmetry

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Repetition across different scales

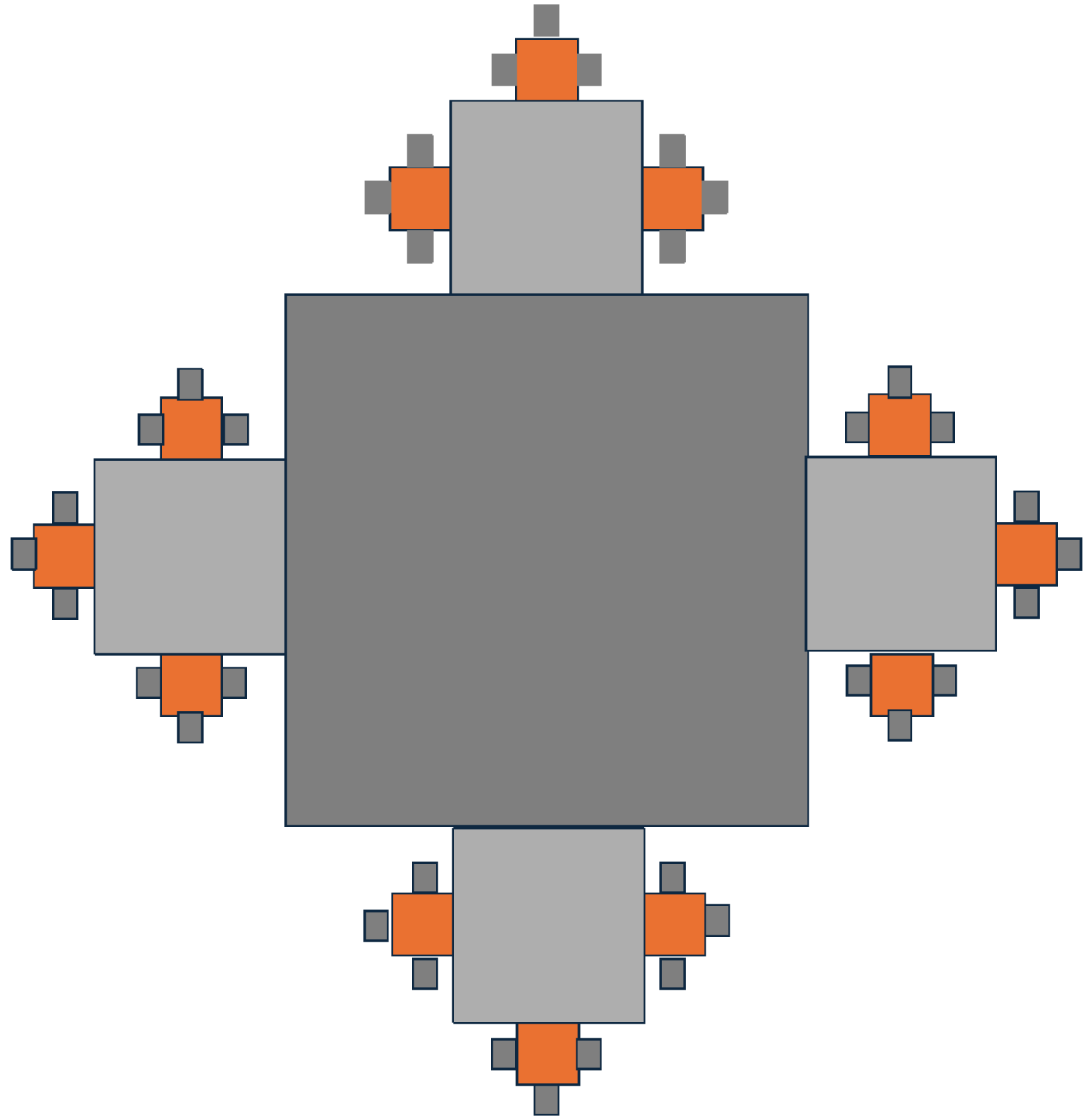


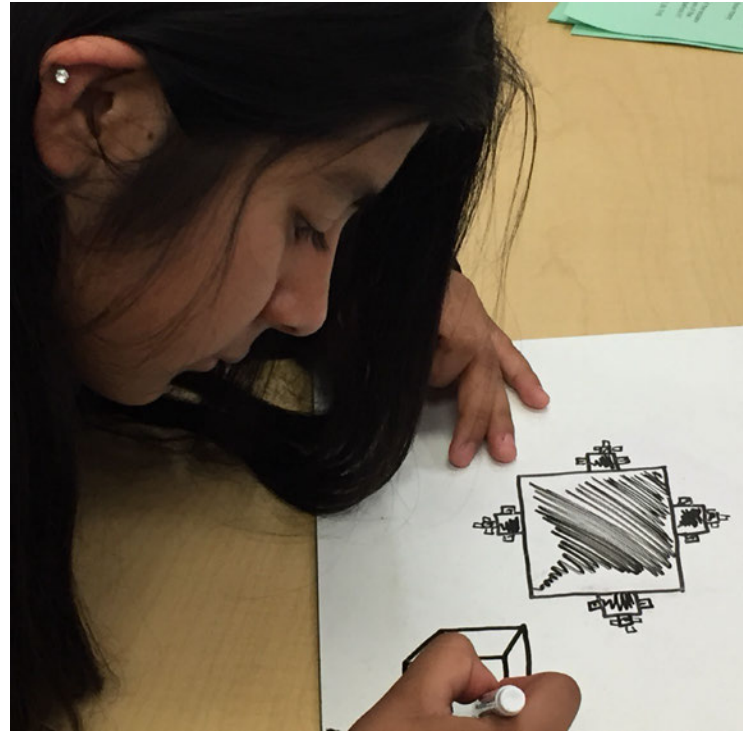
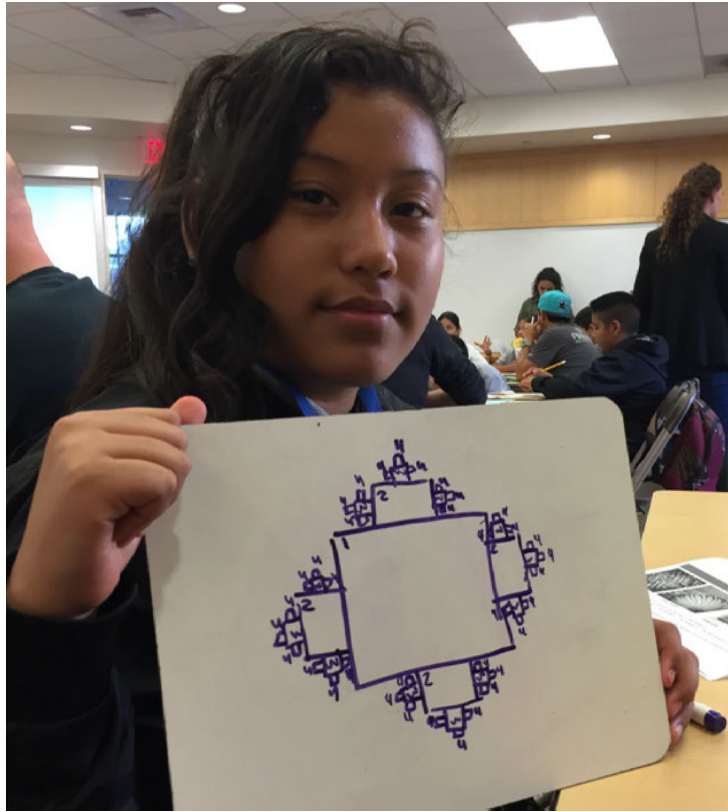
*How would you describe this shape to someone on the phone (who cannot see it)?*

Come to a consensus about a set of instructions, and write them down.

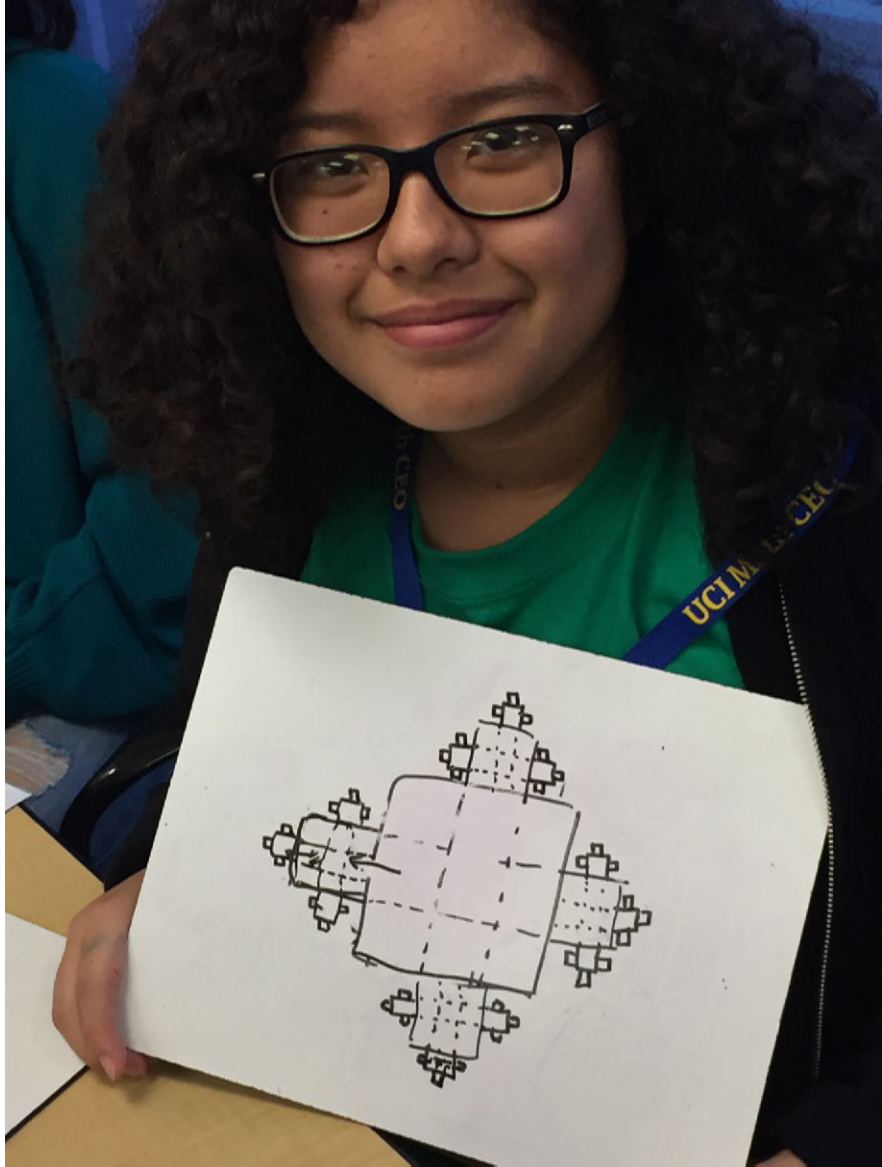
Pass the instructions to your mentor, and ask them to draw **exactly** what the instructions say...

*Did you recover your image?*





Starting with this activity helps students draw the fractals with higher precision.





# Fractal dance

A fractal dance is a dance which contains fractal symmetry.

There is a feature which is repeated across different scales.

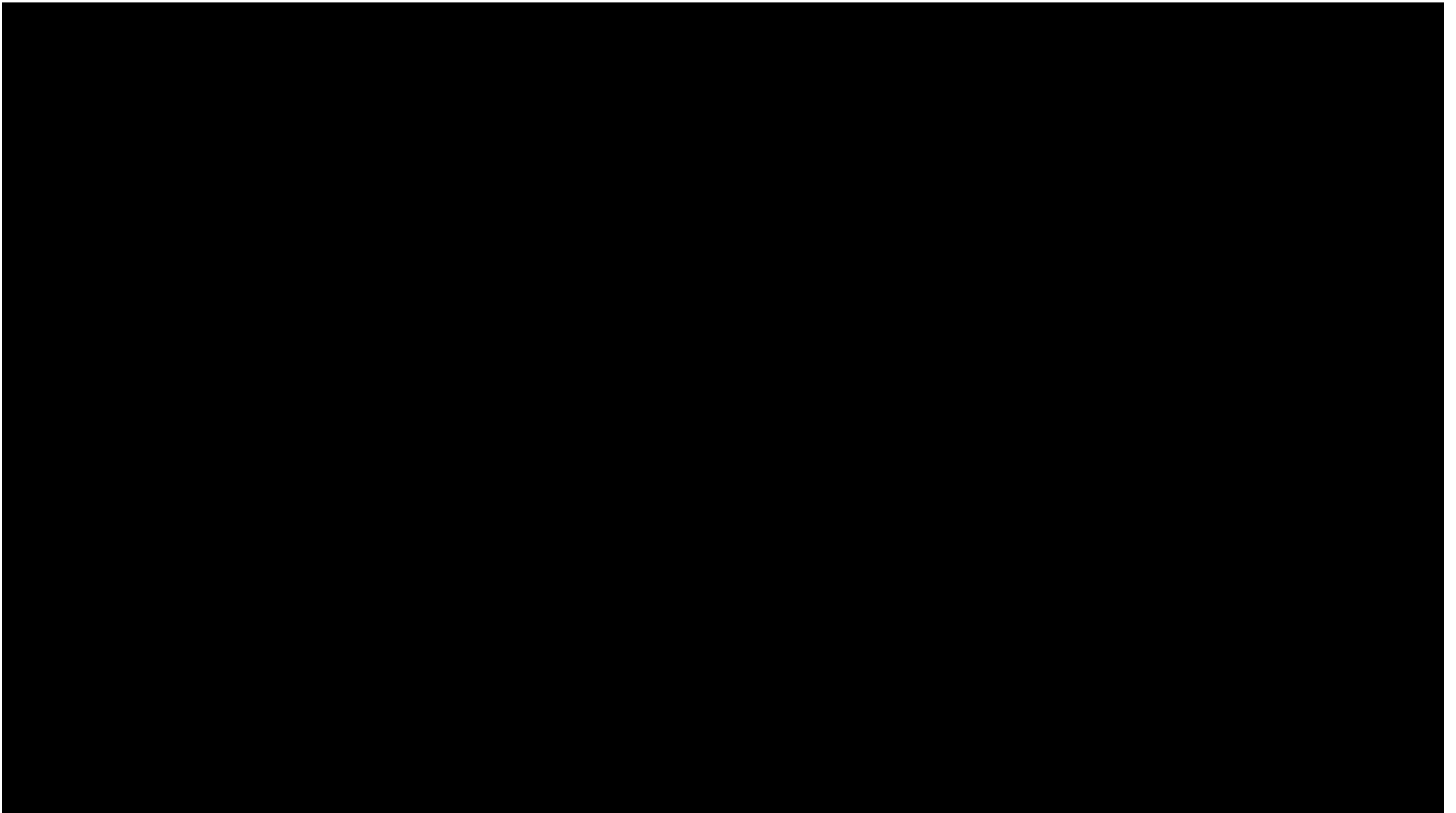


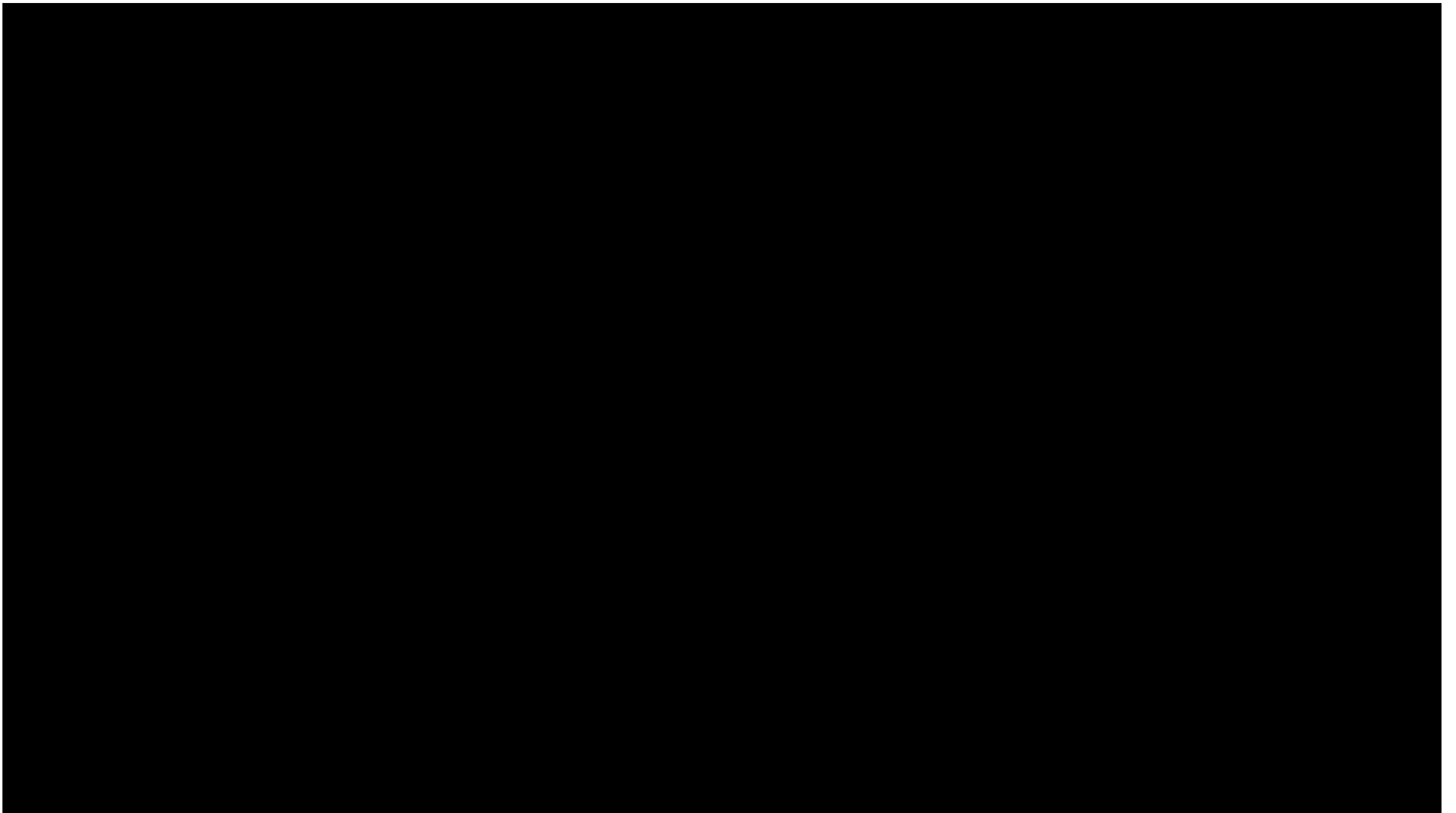






















The long-term collaboration between Jesse Wolfson and Reggie Wilson

## Reggie Wilson: Artistic Director, Choreographer and Performer



Photo credit Antoine Tempé



*Reggie Wilson*

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Graduated in 1988 with a Bachelor of Fine Arts from NYU's Tisch School of the Arts

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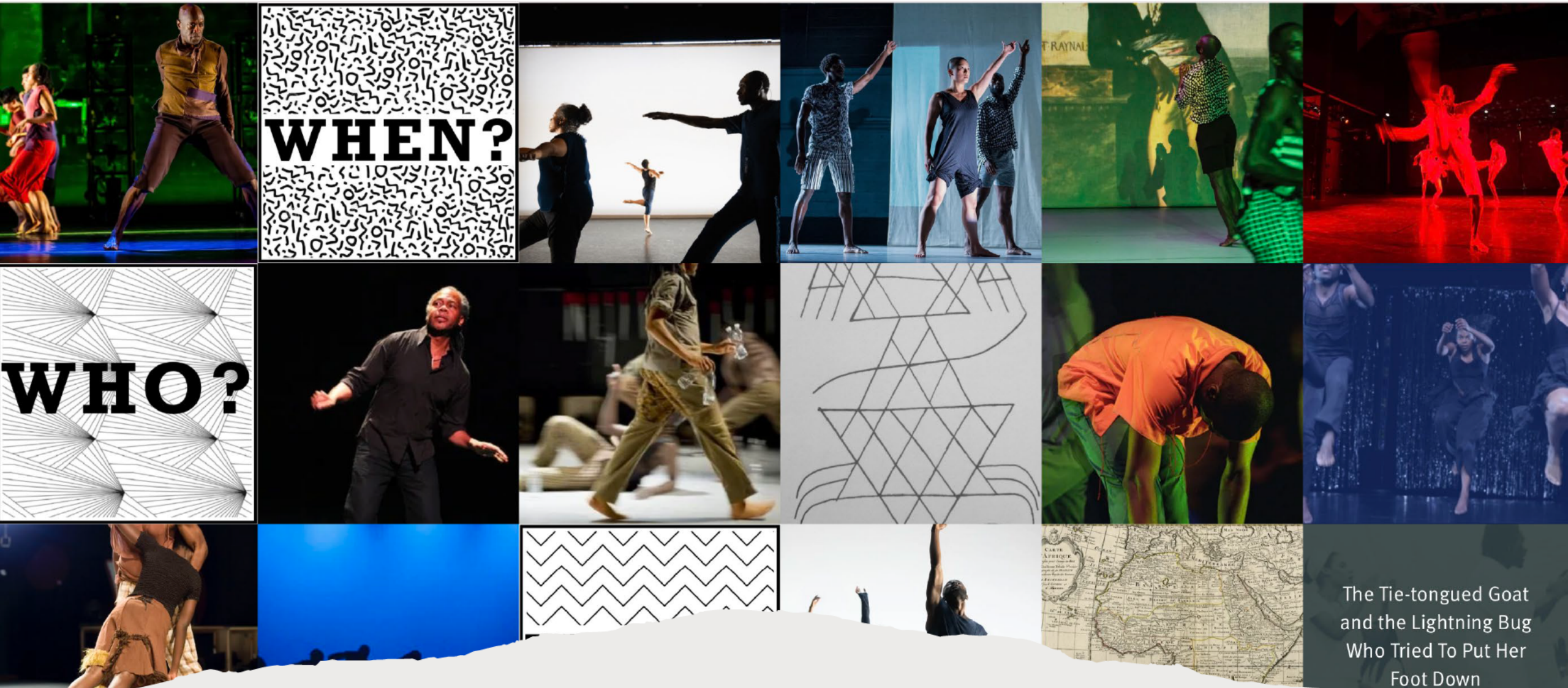
Performed, conducted and taught many projects throughout Africa, Europe, Americas, and the Caribbean

---

Served as a visiting faculty at several universities, including Yale and Princeton

---

Started his own performing company in 1989



**WHEN?**

**WHO?**

The Tie-tongued Goat  
and the Lightning Bug  
Who Tried To Put Her  
Foot Down

FIST AND HEEL PERFORMANCE GROUP

---

His choreography is heavily influenced by the spiritual traditions of the Africa diaspora.



*Reggie Wilson*

---

In 2012, he was developing movement for a new performance piece (Moses(es))

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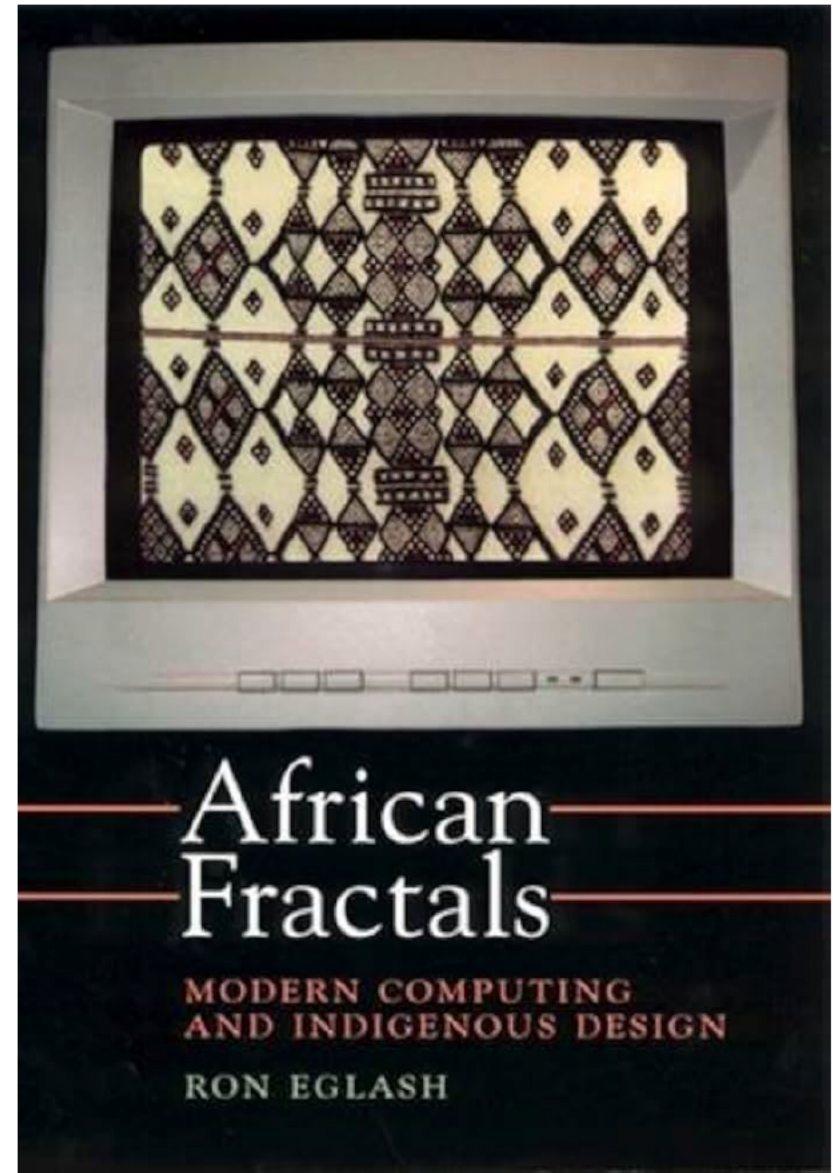
As he was studying traditional African dances, he noticed that many features (rhythms, brief sequences of movement, striking variations in quality and force or tempo) did not fit into the schema of Western dance.

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At the same time, he was reading Ron Eglash's book on "African Fractals"



Ron Eglash

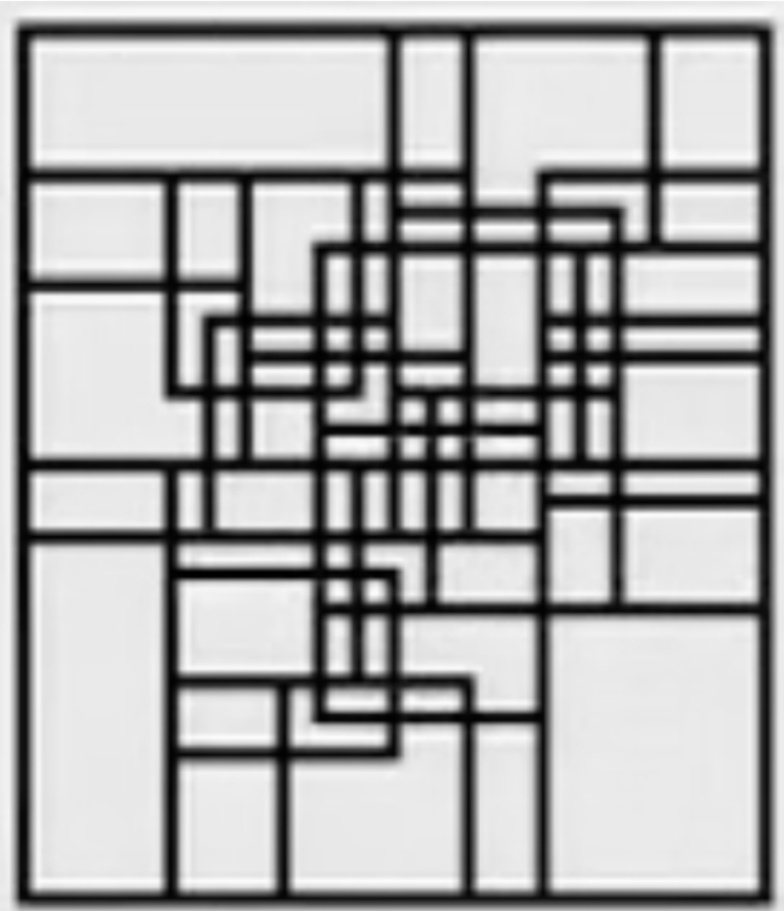


Aerial photo  
of the city of  
Logone-Birni  
in Cameroon

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# A closer look at the royal palace

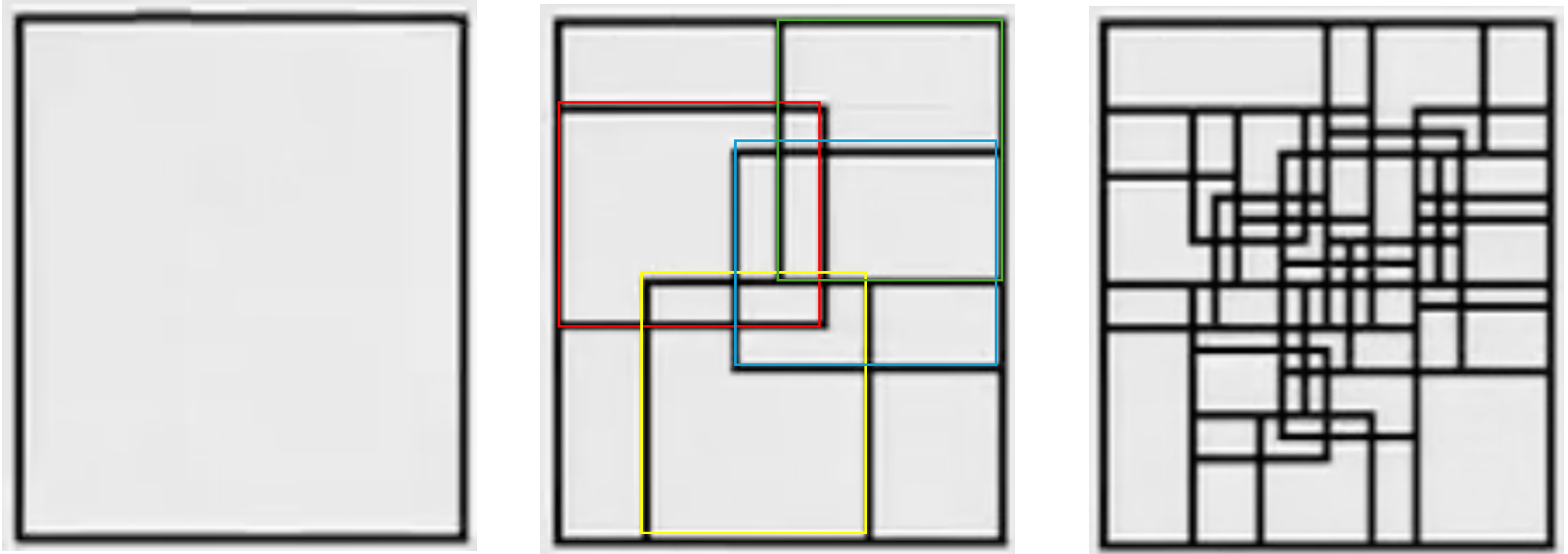


Ron Eglash, "African Fractals"

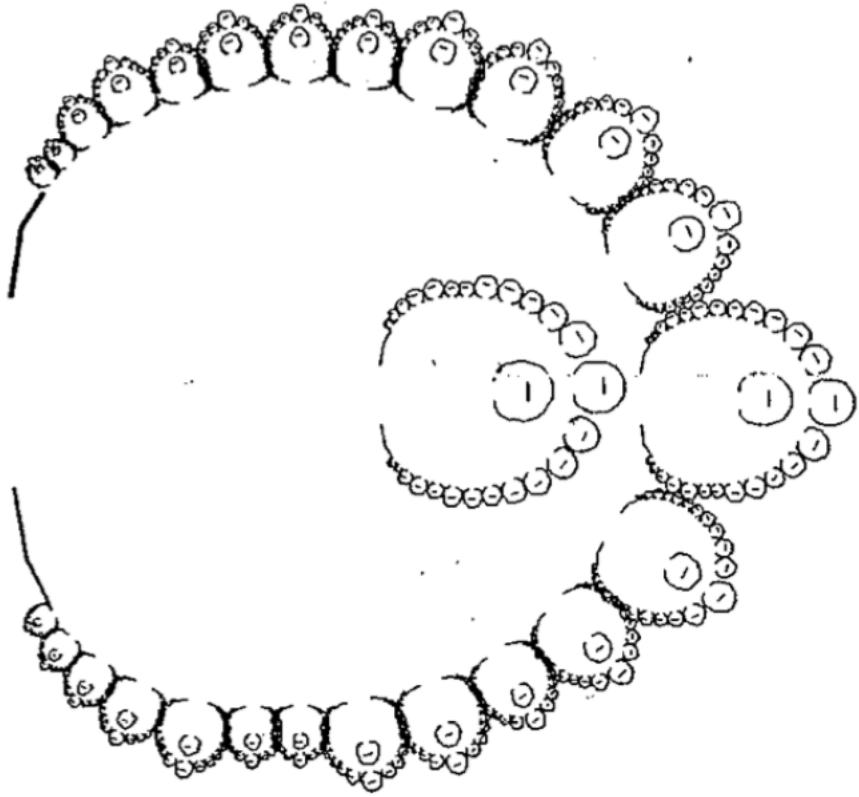


Ron Eglash, "African Fractals"

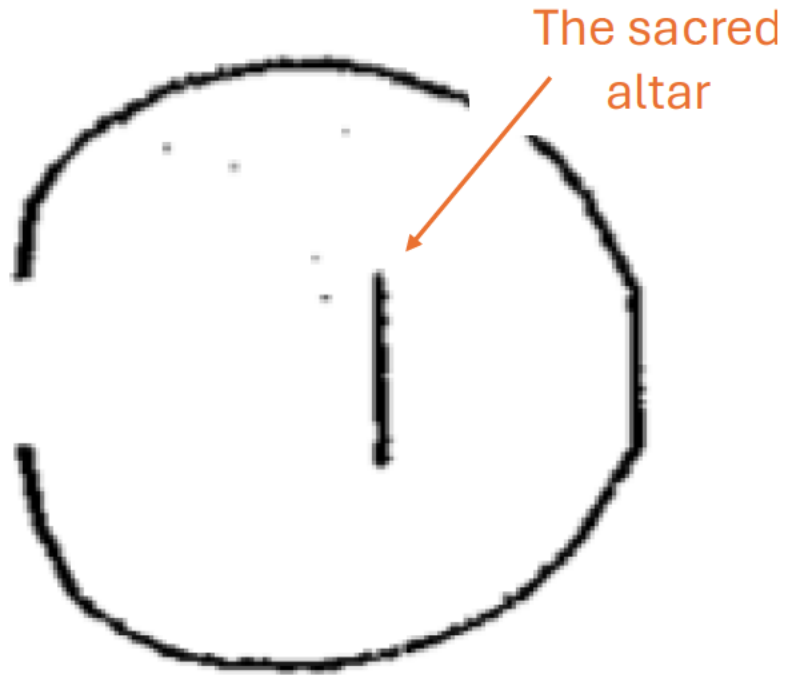
# A fractal model for the palace of the chief in Logone-Birni



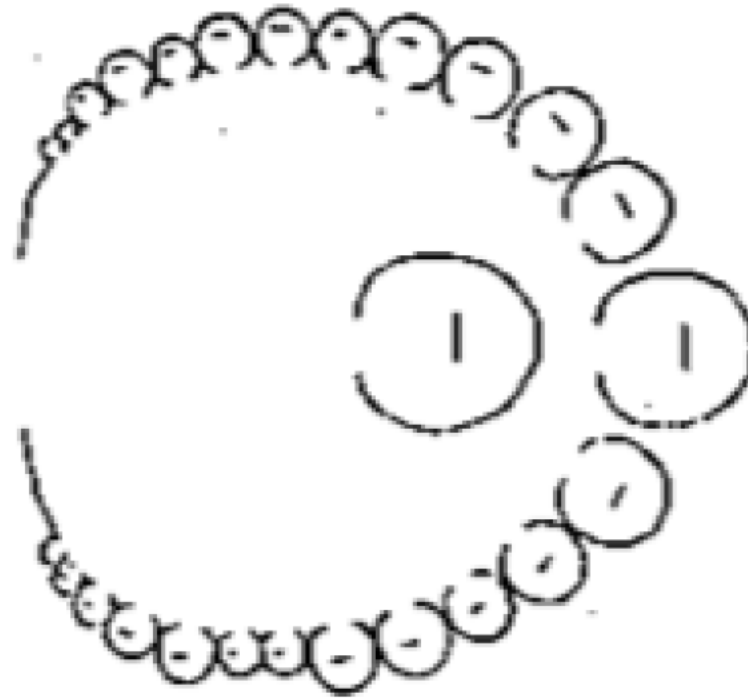
The first 3 iterations



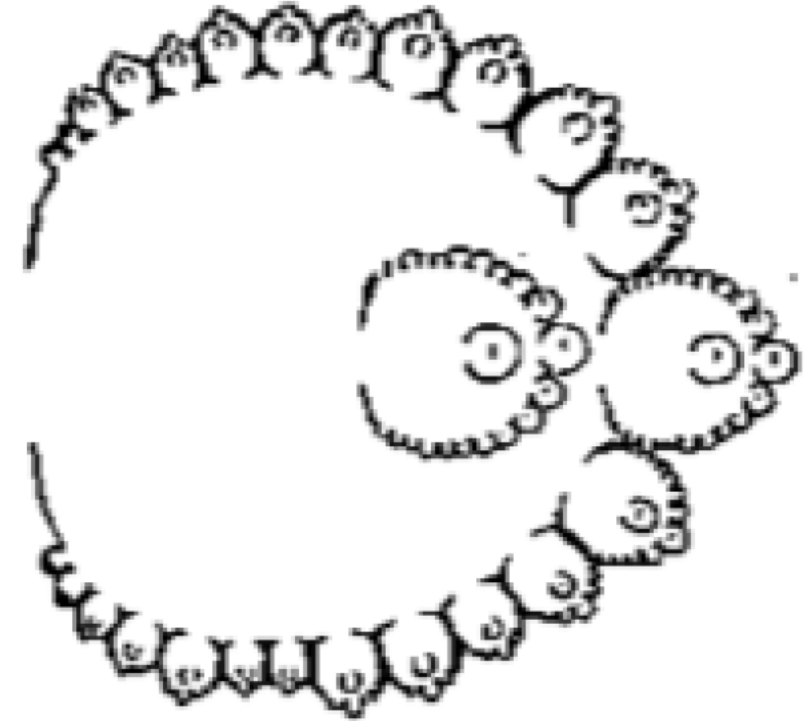
A house



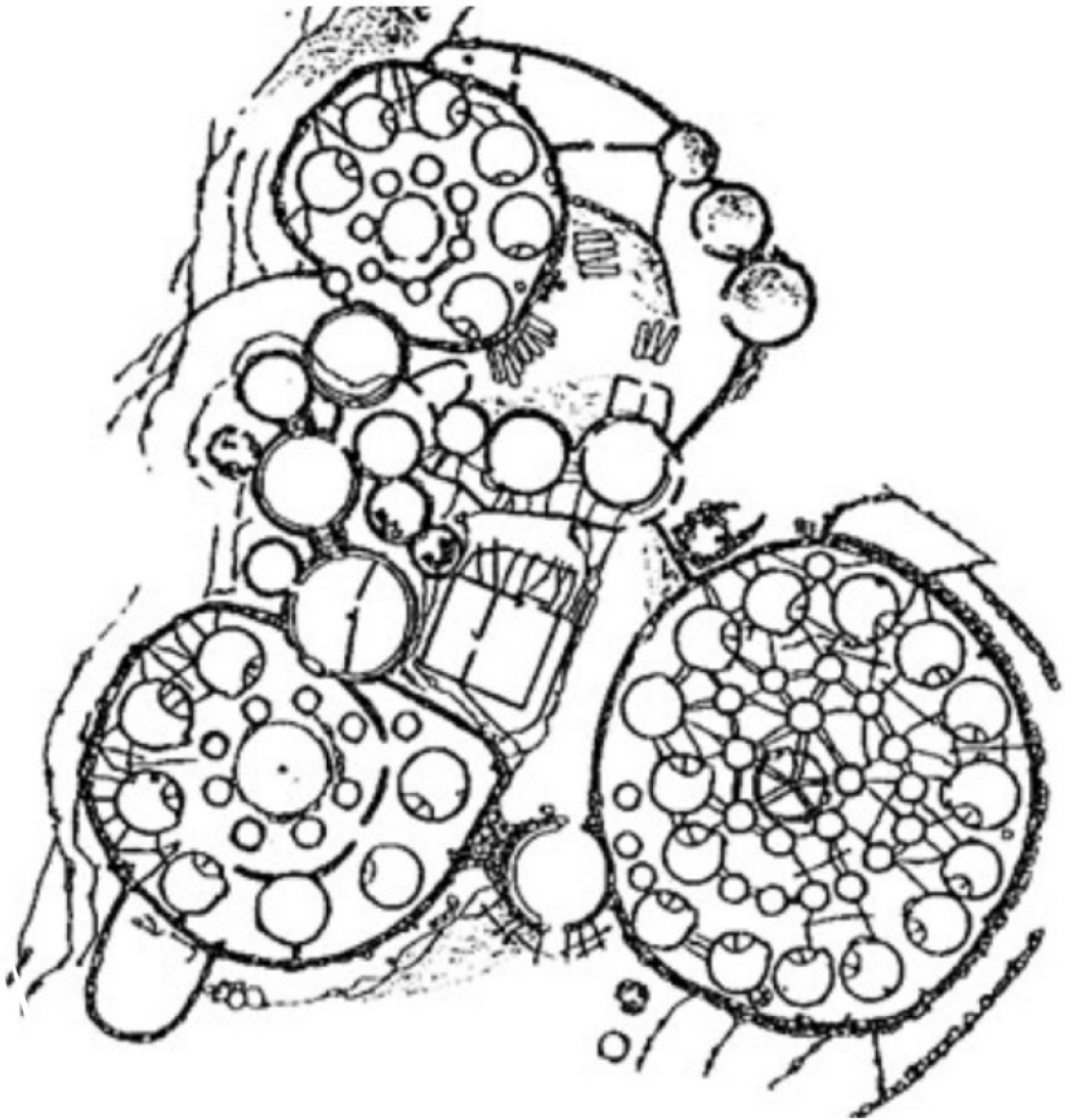
A family enclosure



The settlement



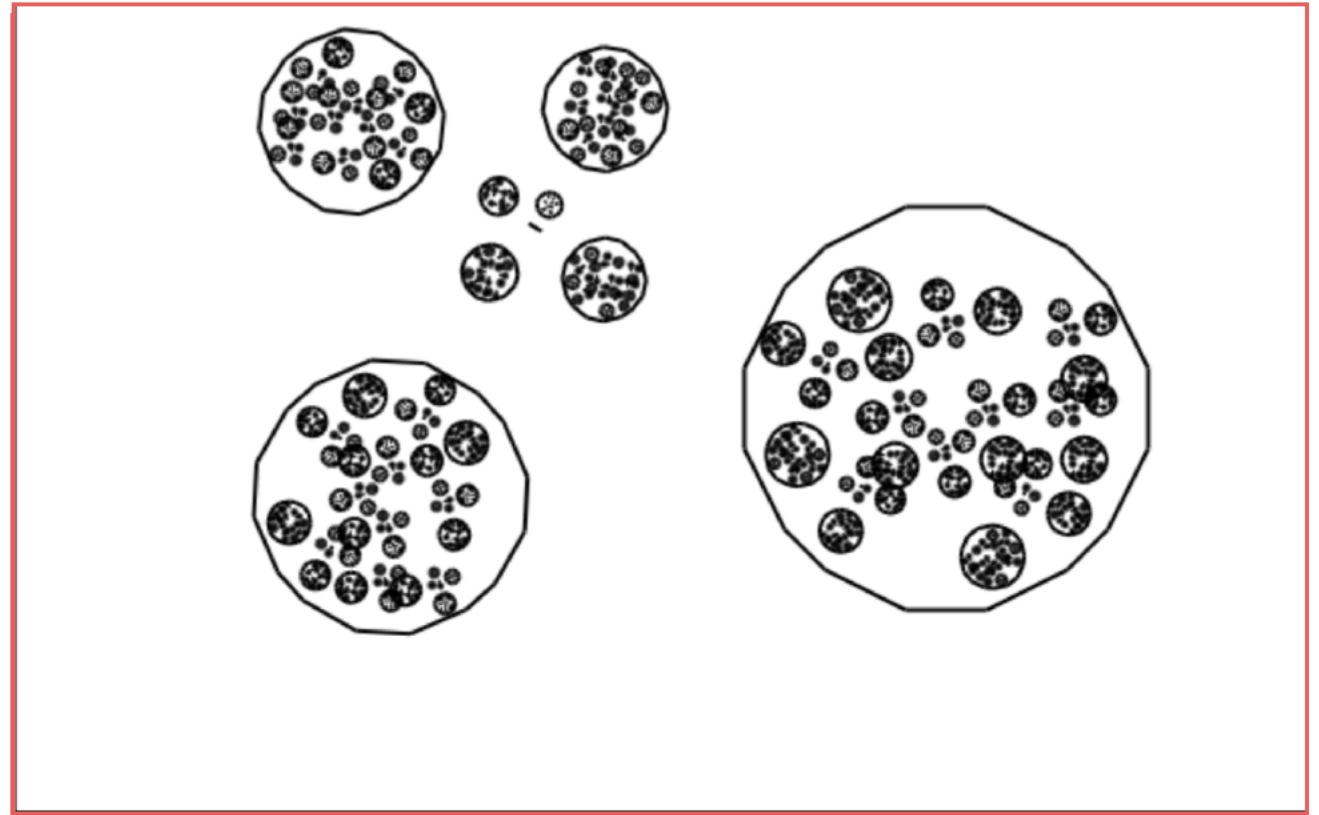
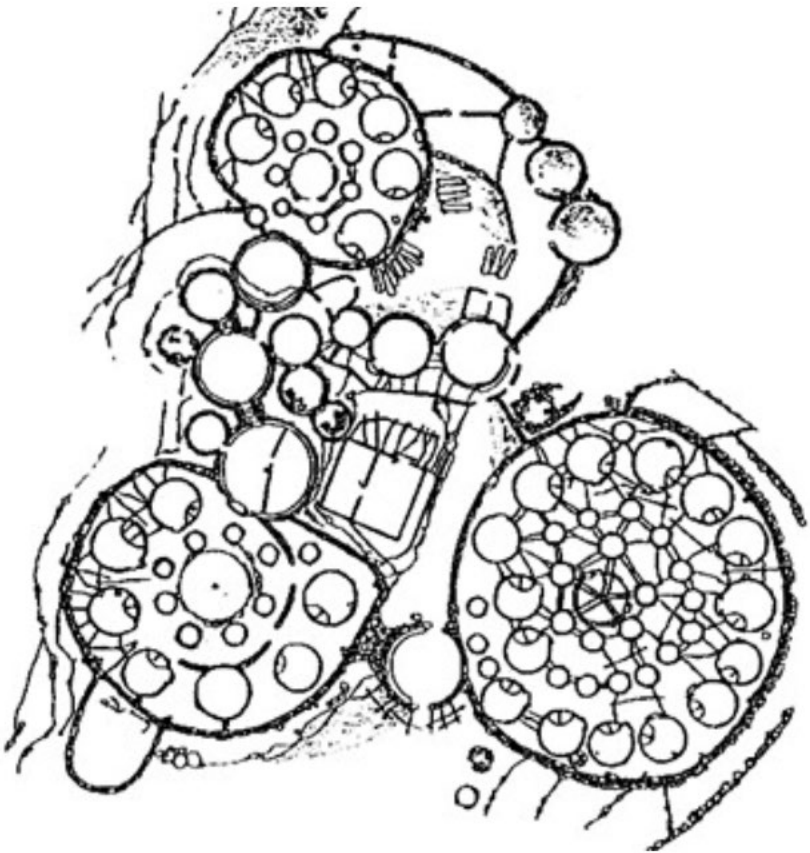
The first 3 iterations



Ron Eglash, "African Fractals"

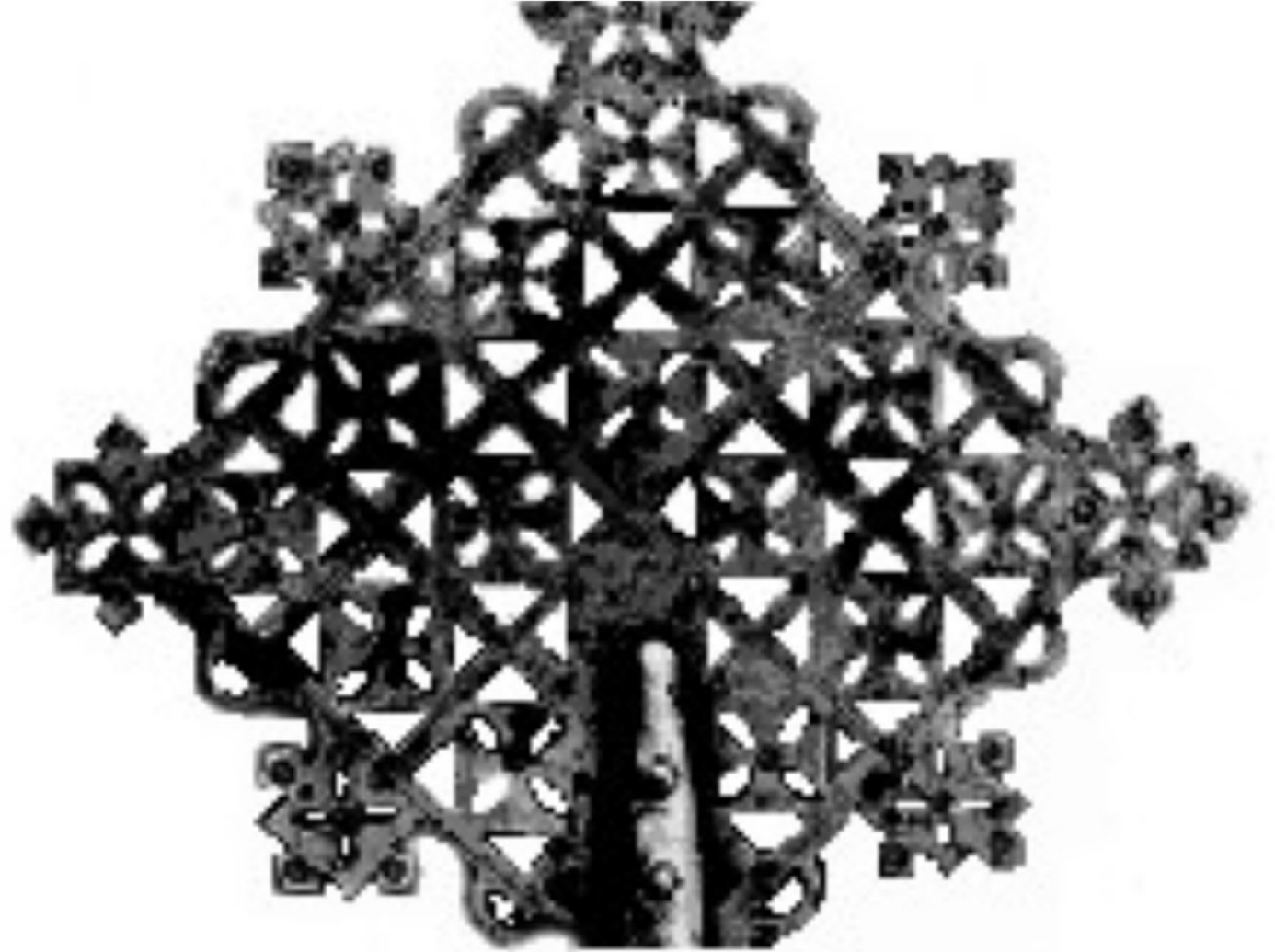
# The first 8 iterations

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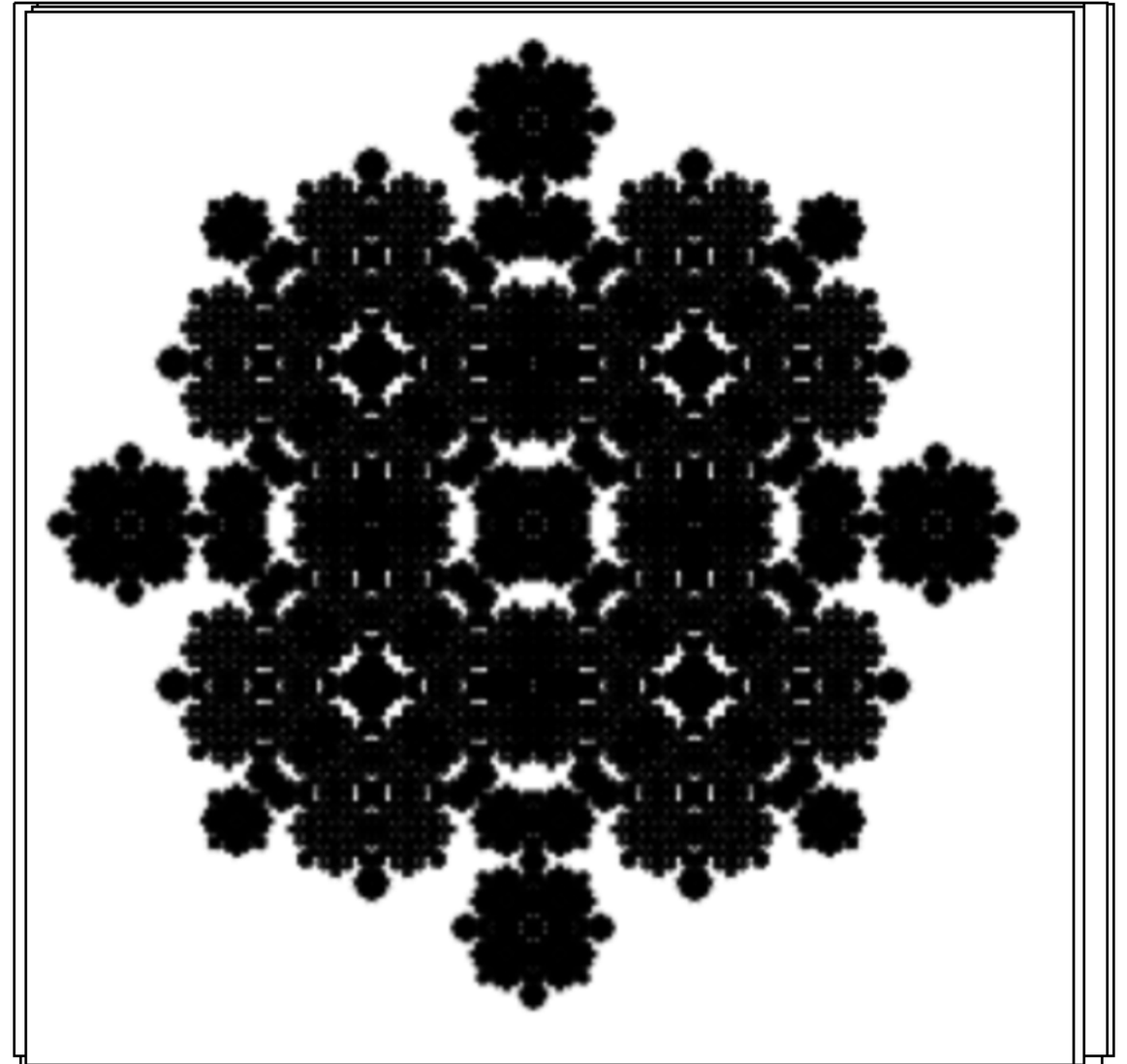


# Fractal symmetry in Ethiopian crosses

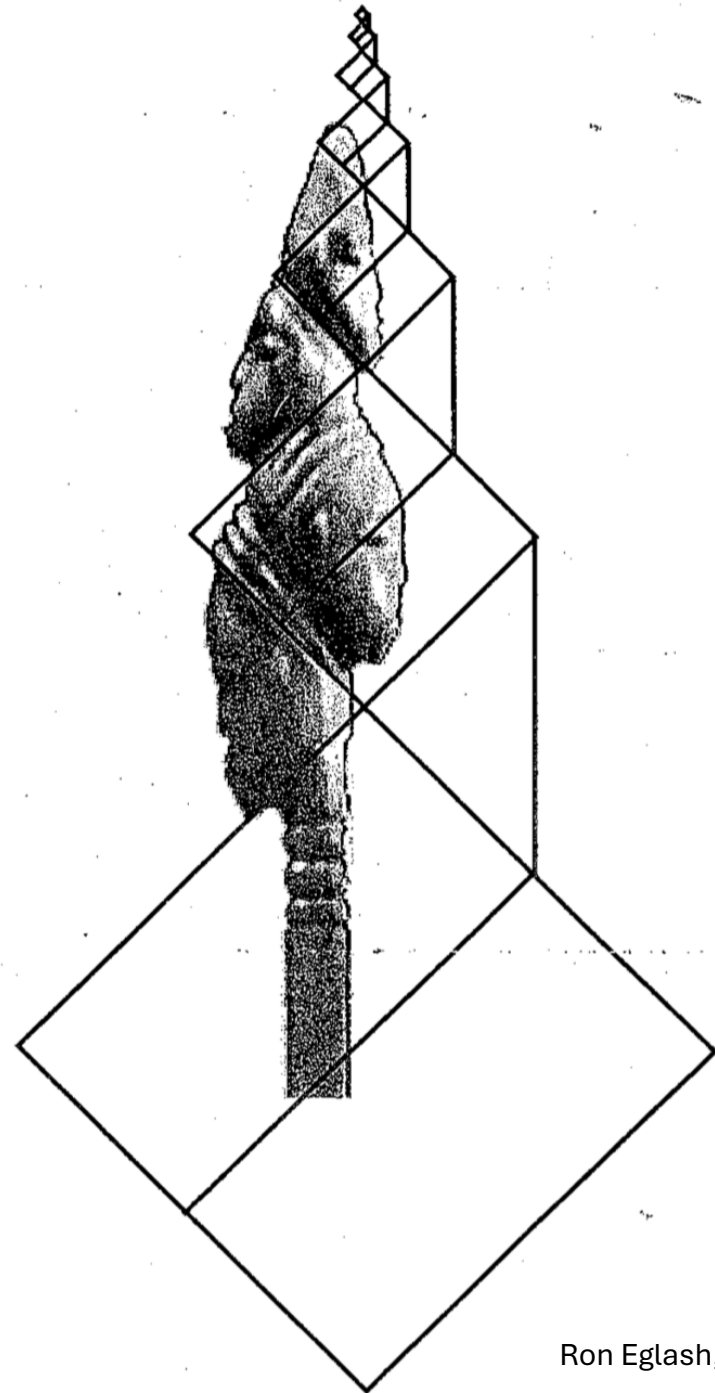
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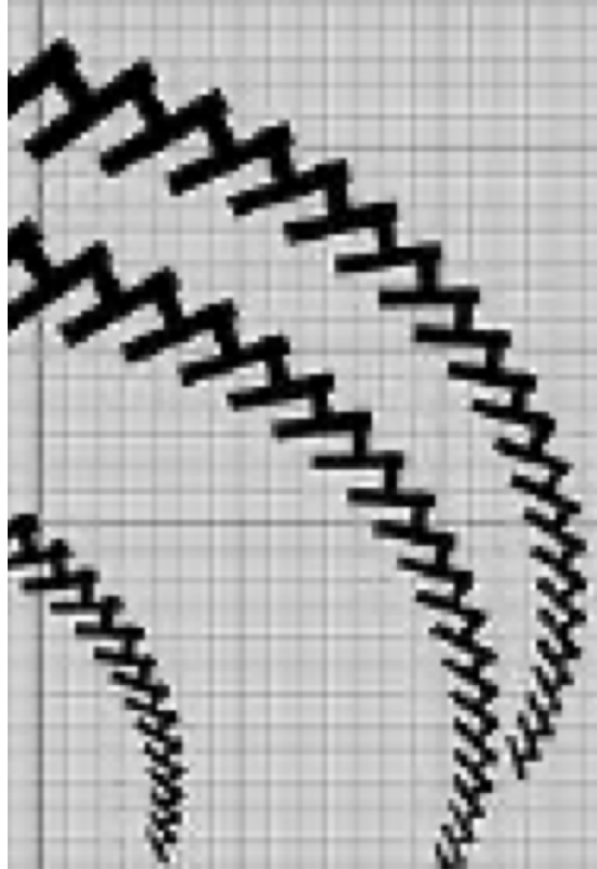
The first 6 iterations



Fractal  
symmetry in  
ivory  
sculpture

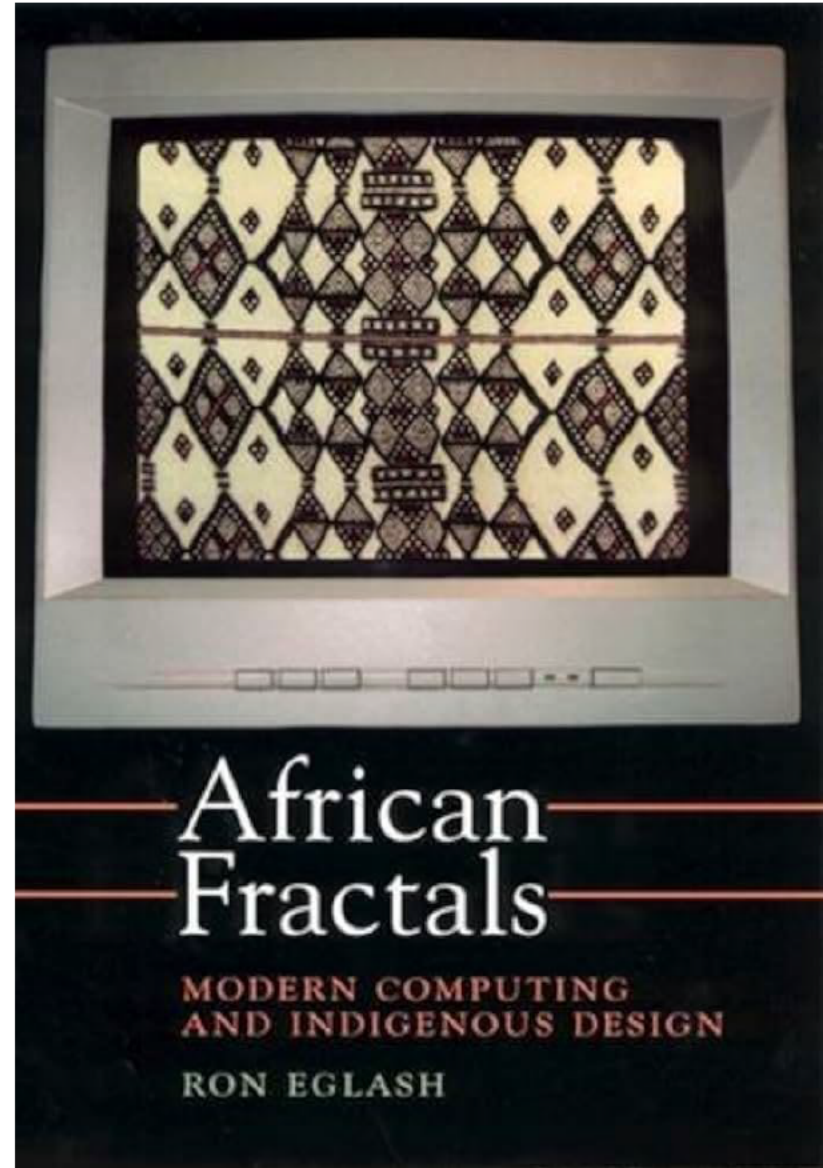


# Fractal symmetry in Ipako Elede braids





Reggie Wilson



# Wilson's Hypotheses

1. Could fractals  
be present in  
Africanist music?

2. Could fractals explain formal features of Africanist music?

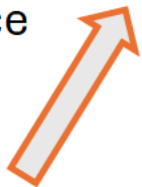
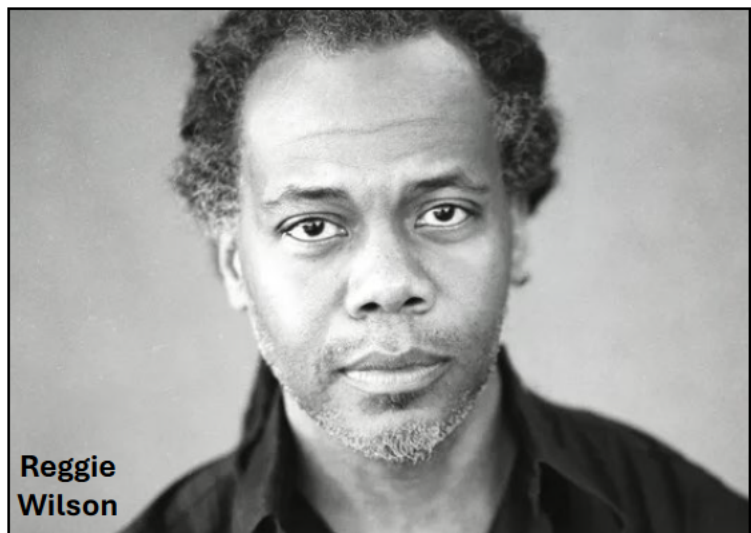


**Susan Manning**, Dance historian at Northwestern University who has made major contributions to understanding the links between modern dance and Black dance.



**Tara Rodman**, now Associate Professor of Drama at UCI, then a PhD student at Northwestern

**Jesse Wolfson**, now Professor of Mathematics at UCI, then a PhD student at Northwestern



**Treat choreography as research:**

- The body carries memory
- Movement transmits history
- Dance is a way to transmit knowledge



*Thinking partners*



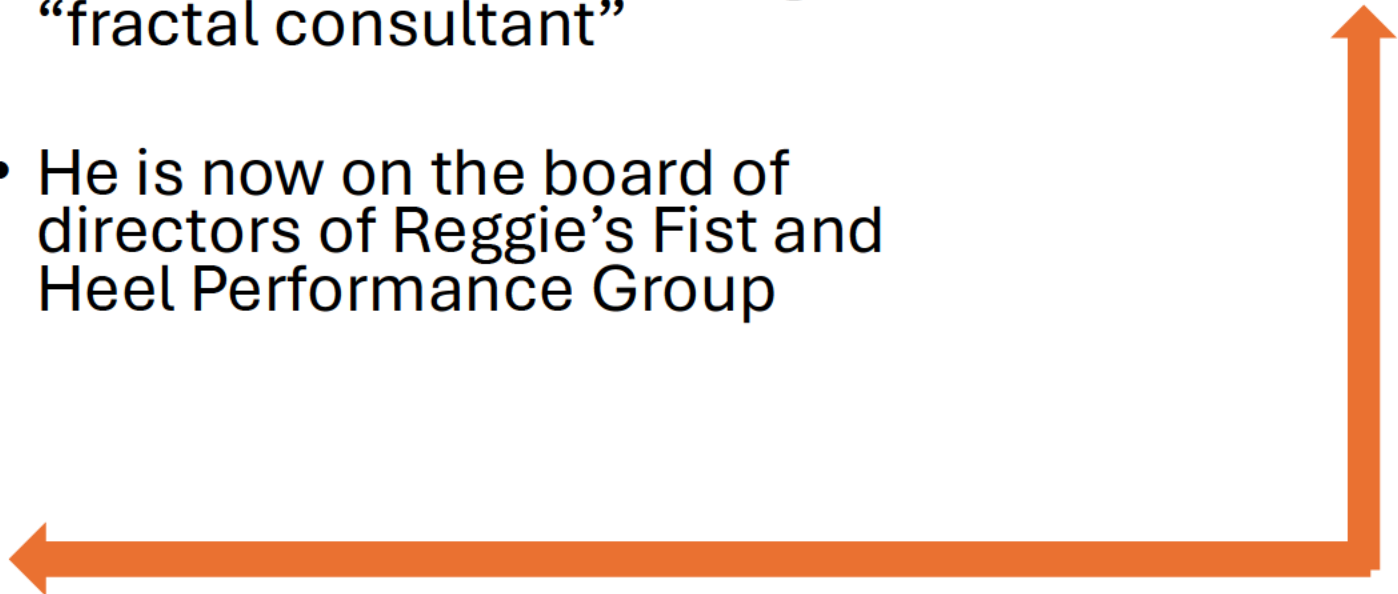
Reggie Wilson

- Collaboration started in 2012
- Reggie was investigating fractal symmetry in connection with his piece Moses(es)
- Jesse offered insights from a mathematical lens, acting as a “fractal consultant”
- He is now on the board of directors of Reggie’s Fist and Heel Performance Group



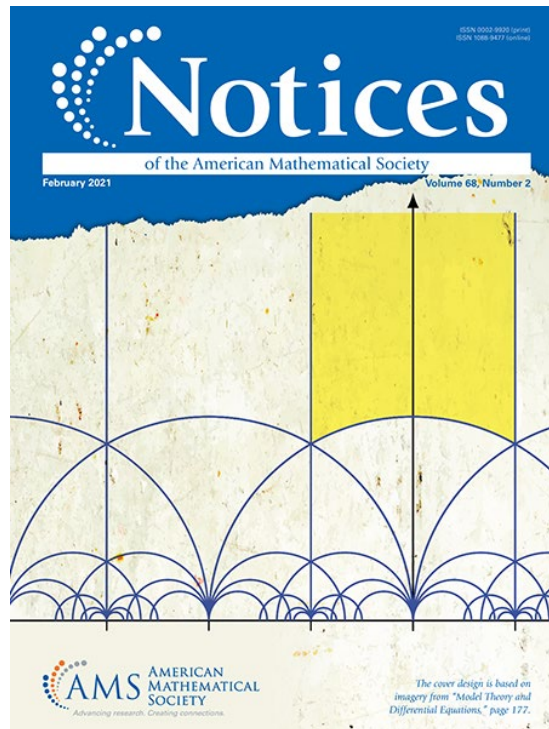
Jesse Wolfson

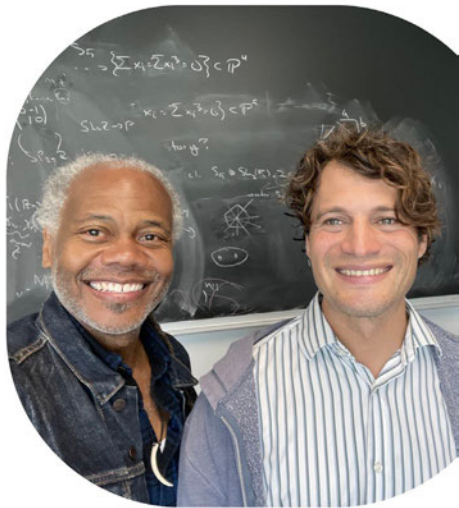
*Thinking  
partners*



# Mathematics and Dance: Notes from an Emerging Interaction

*Reggie Wilson and Jesse Wolfson*





# MAA FOCUS : August/September 2024

## Fractals in Africanist Music

Claudio Gómez-González, Sidhanth Raman, Siddharth Viswanath, Jesse Wolfson



In 2020, Jesse won an NSF career award (DMS-1944862)

---

In Spring 2021, he started bringing Reggie and company member Annie Wang to the UCI campus

---

Worked with Tara and me to design and implement lessons on symmetry and dance to middle schoolers in Math CEO





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| ROXBOROUGH    | AMSTERDAM  |
| SEATTLE       | PARIS      |
| LOS ANGELES   | CARDIFF    |
| BRISTOL       | LONDON     |
| SAN FRANCISCO | LINCOLN    |
| VEGAS         | MELBOURNE  |
| ST. LOUIS     | THE HAGUE  |
| MIAMI         | STOCKHOLM  |

Symmetries are features that are repeated or stay the same under a transformation

---

**Transformations are movements**

---

We can enact symmetries with our bodies



Fist and Heel Performance Group

## The framing

---

1. Rotation (turn in place)

2. Translation (move in one direction without turning)

3. Reflection (mirror)

4. Dilation (stretch, zoom in/out)

Symmetries are features that are repeated or stay the same under a transformation

---

**Transformations are movements**

---

We can enact symmetries with our bodies







---

Middle school students got in groups and worked with trained graduate/undergraduate mentors to design and perform dances with symmetries.

---

The other students had to decipher what symmetries they used.





---

What symmetries did you see?



---

What symmetries did you see?



---

What symmetries did you see?



---

What symmetries did you see?

# Thank you for your participation!



Tara Rodman



Jesse Wolfson



Fist and Heel performance group



Reggie Wilson

