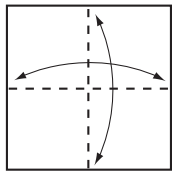
Mathematics of Origami

Shahed Sharif

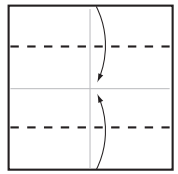
February 2, 2023

Heart

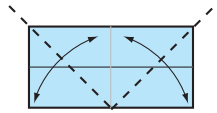


1. Start with your paper white side up. Fold in half and unfold.

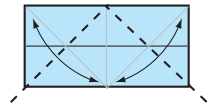
Fold in half the opposite way and unfold.



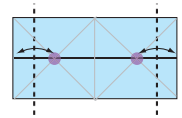
2. Fold the top and the bottom edges into the centre line



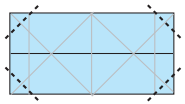
3. Fold the two bottom corners up to the top centre point and unfold



4. Now fold the 2 top corners down to the bottom centre point and unfold.

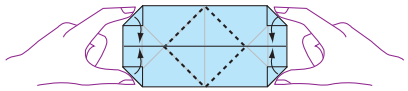


5. Fold the outside edges in to the points shown and unfold.



6. Fold all four corners in to the creases just made.

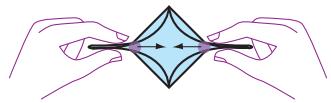
top view



7. Now we are going to form the heart.

Hold the model by the corners, as shown, and bring these corners together

top view



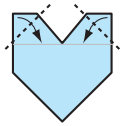
8. Still holding the model together, bring the outside edges toward each other.

side view

9. The model should now look something like this.

Push the bottom diamond together underneath the model.

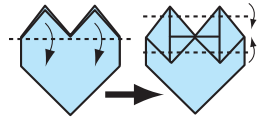
side view



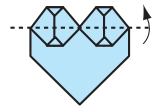
10. Lay flat on the table.

Fold the two top corners down to the crease and unfold

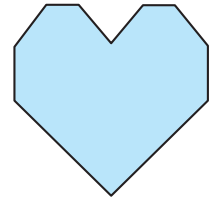
11. Use these creases to inside reverse fold these corners.



12. Fold the uppermost flaps down. Then fold the tips inward

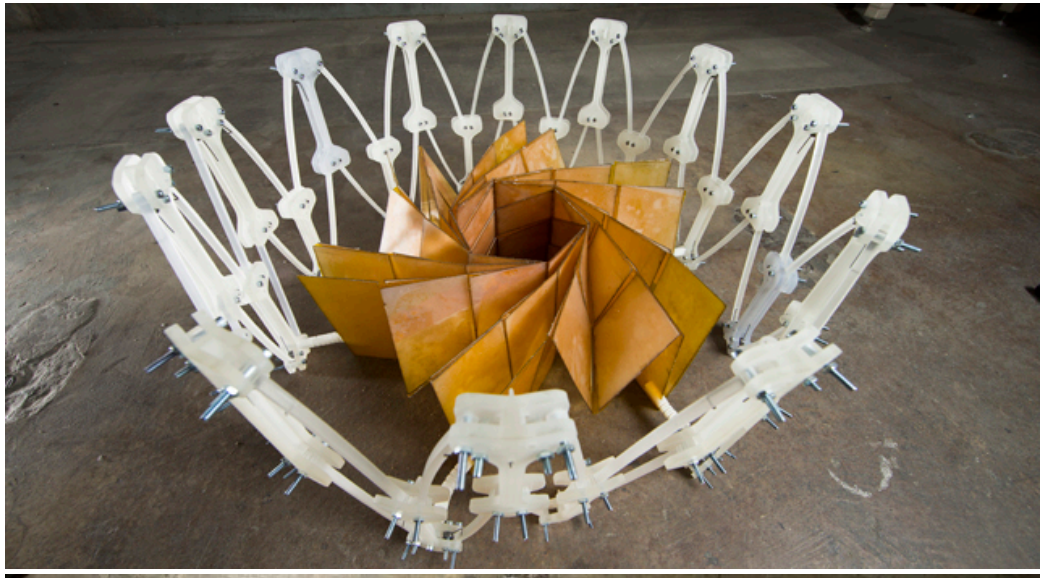


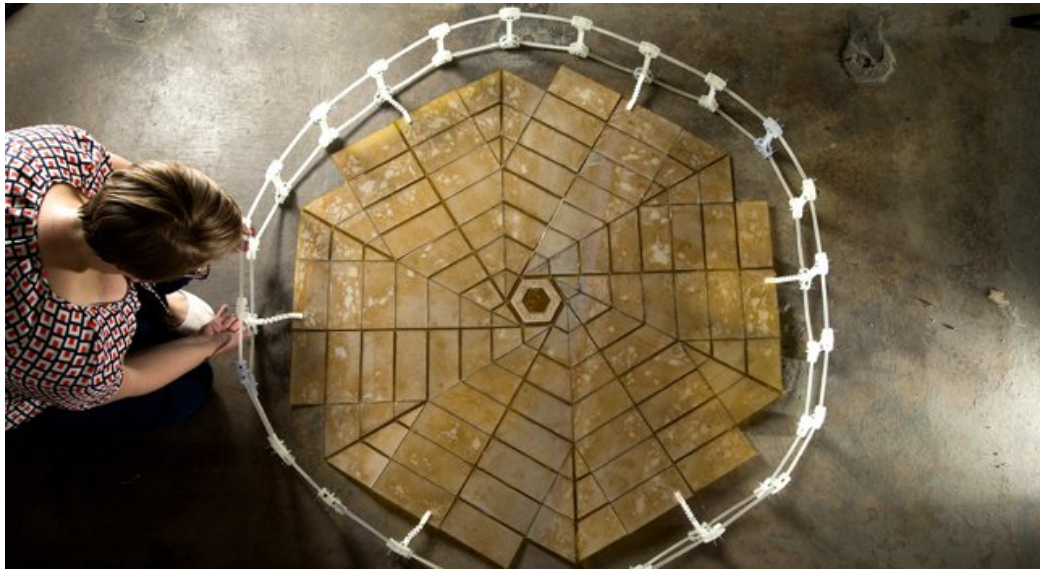
13. Fold the triangles back up.

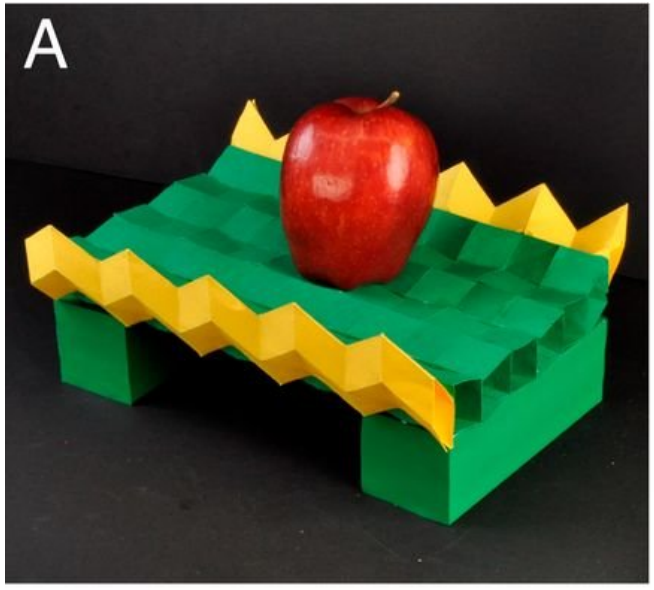


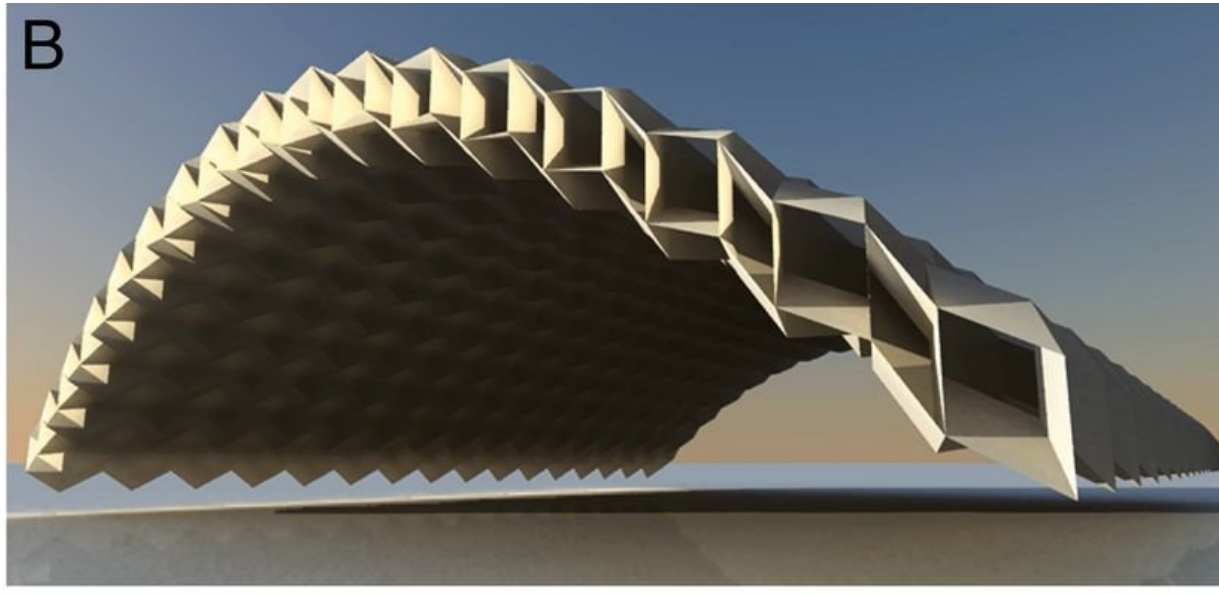
Finished heart!
Give it to someone you love!

Engineering applications





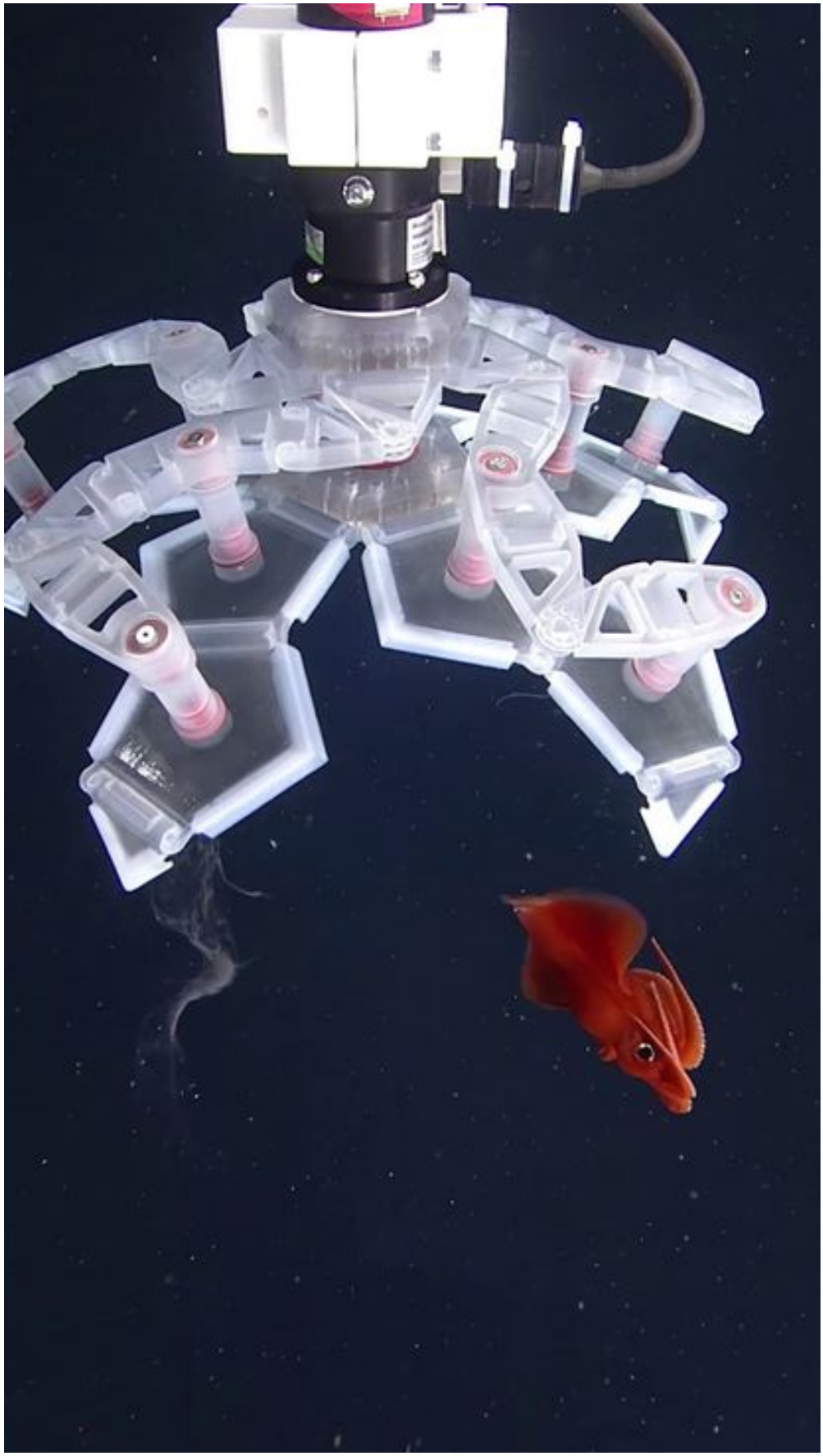

A


B


C


D


E



Huzita-Justin Axioms

1. Given two distinct points, we can make a unique fold through them.

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4. Given a point and a line, we can make a unique fold through the point and perpendicular to the line.

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5. Given two points and a line, if there is a fold through one point that puts the other point onto the line, then we can make that fold.

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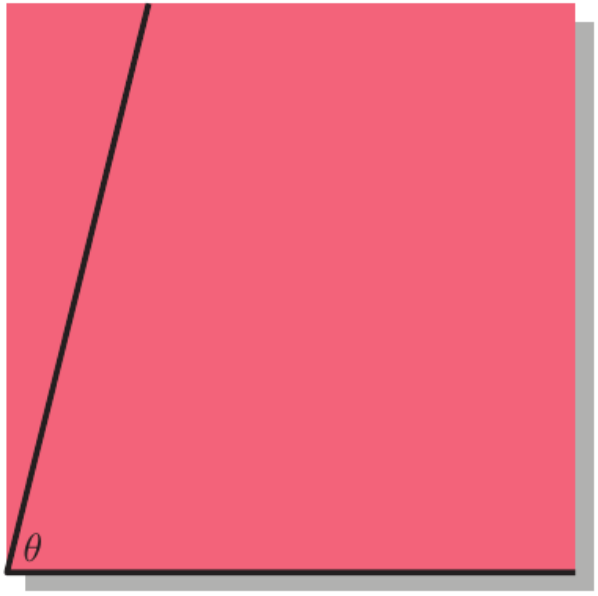
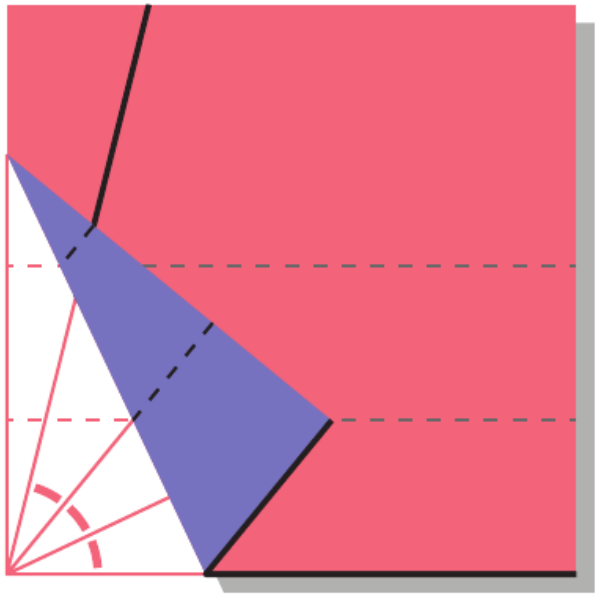
6. (Beloch) Given two distinct points and two distinct lines, if there is a fold that puts each point onto each of the two lines, then we can make that fold.
7. (Hatori-Justin) Given a point and two nonparallel lines, we can make a fold perpendicular to one line that puts the point onto the other line.

Humiaki Huzita

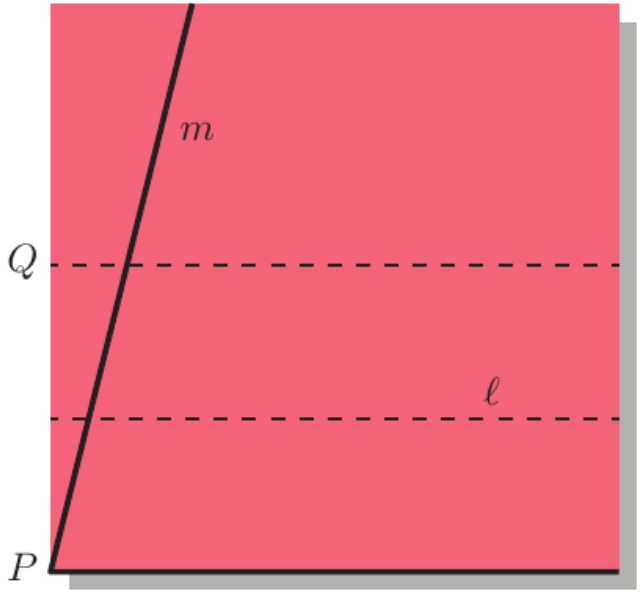
Constructions



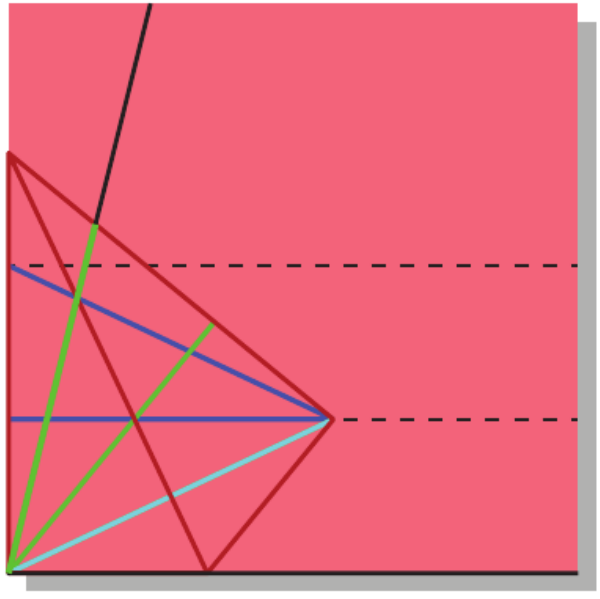
Trisection: 1. Start with an angle θ.



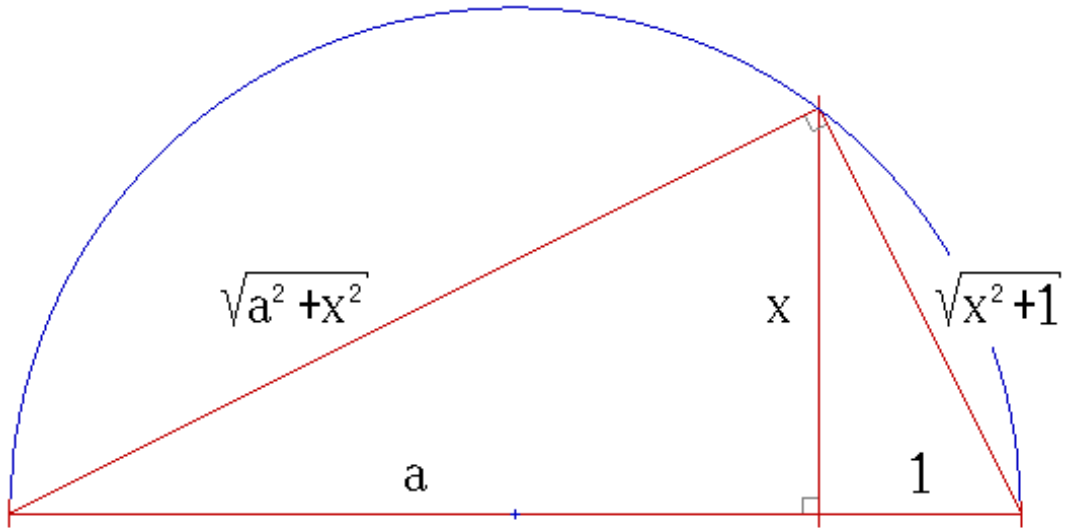
3. Fold P and Q to ℓ and m.



2. Construct two uniformly spaced horizontal lines.



4. The line from the corner to its reflection trisects the angle.



$$a+1 = \sqrt{a^2+2x^2+1}$$

Margherita Beloch