TurtleStitch : A Tool for Mathematical Modeling - From Embroidery to Paper Design

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With Special Guests
Cynthia Solomon & Beth Lloyd

ICERM

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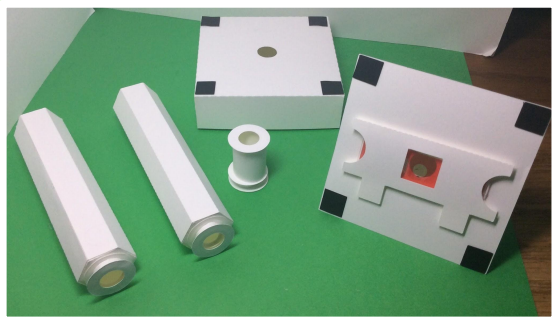
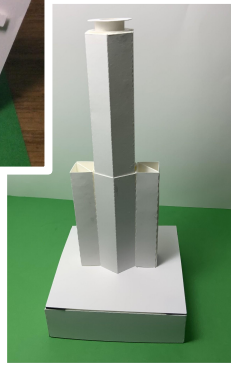
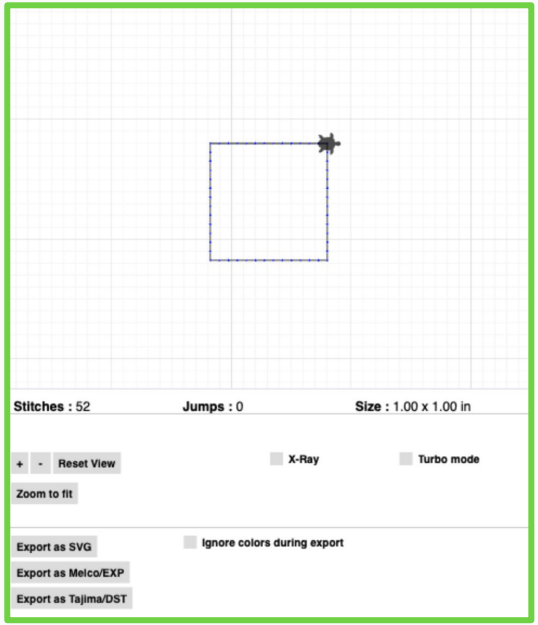




- Former math teacher and creator of 400+ designs that combine code, geometry, art, and making
- Collaborates with Make to Learn Professors Glen Bull at UVA and Michael Littman at Princeton on engineering, math, and fabrication
- Works with Cynthia Solomon, a LOGO pioneer in educational technology.
- Author of two blogs offering free project guides
- Transforms TurtleStitch code into physical objects—from animation with electronic devices to embroidered pillows

What is TurtleStitch?

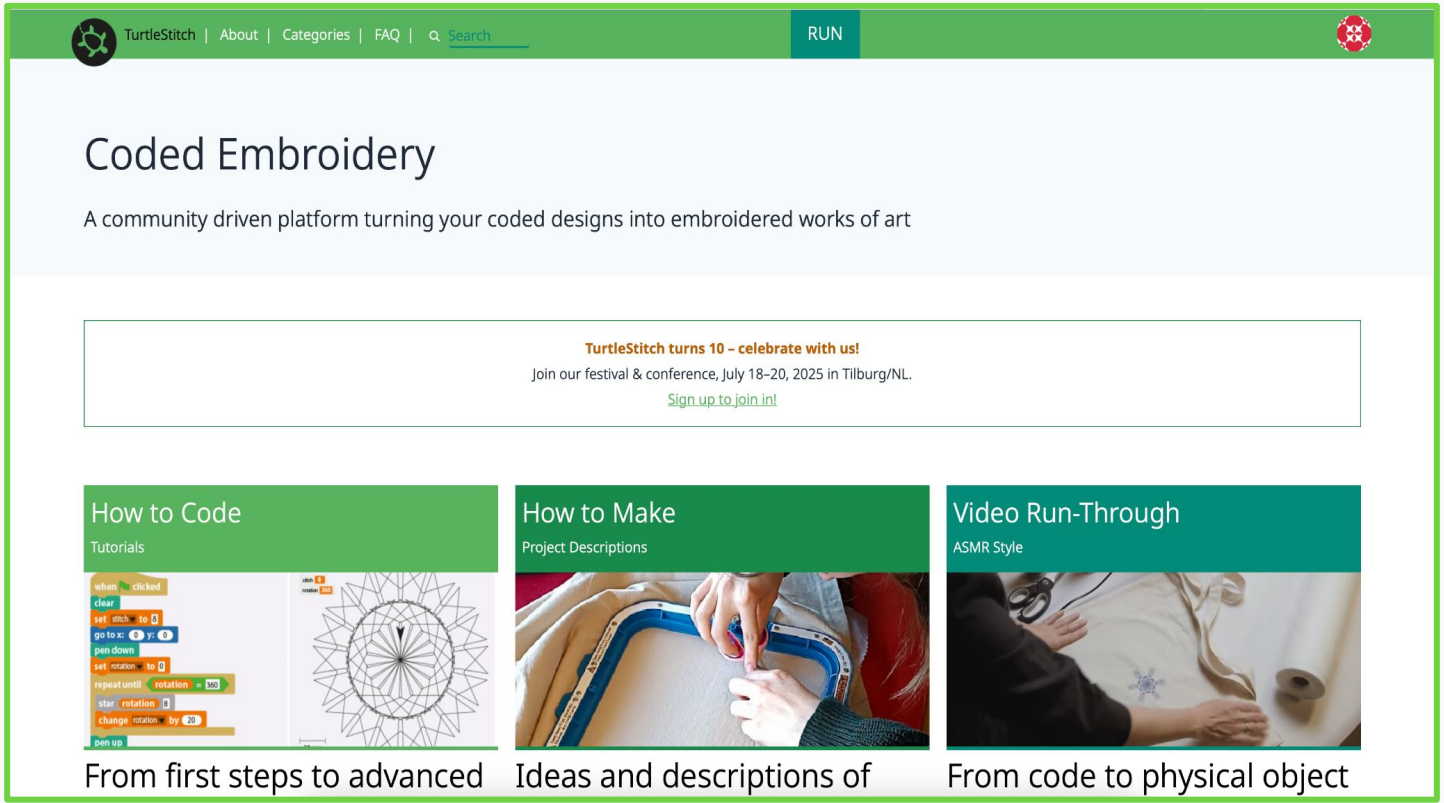
These blocks make a square.
127 steps = 1 inch = 2.54 cm



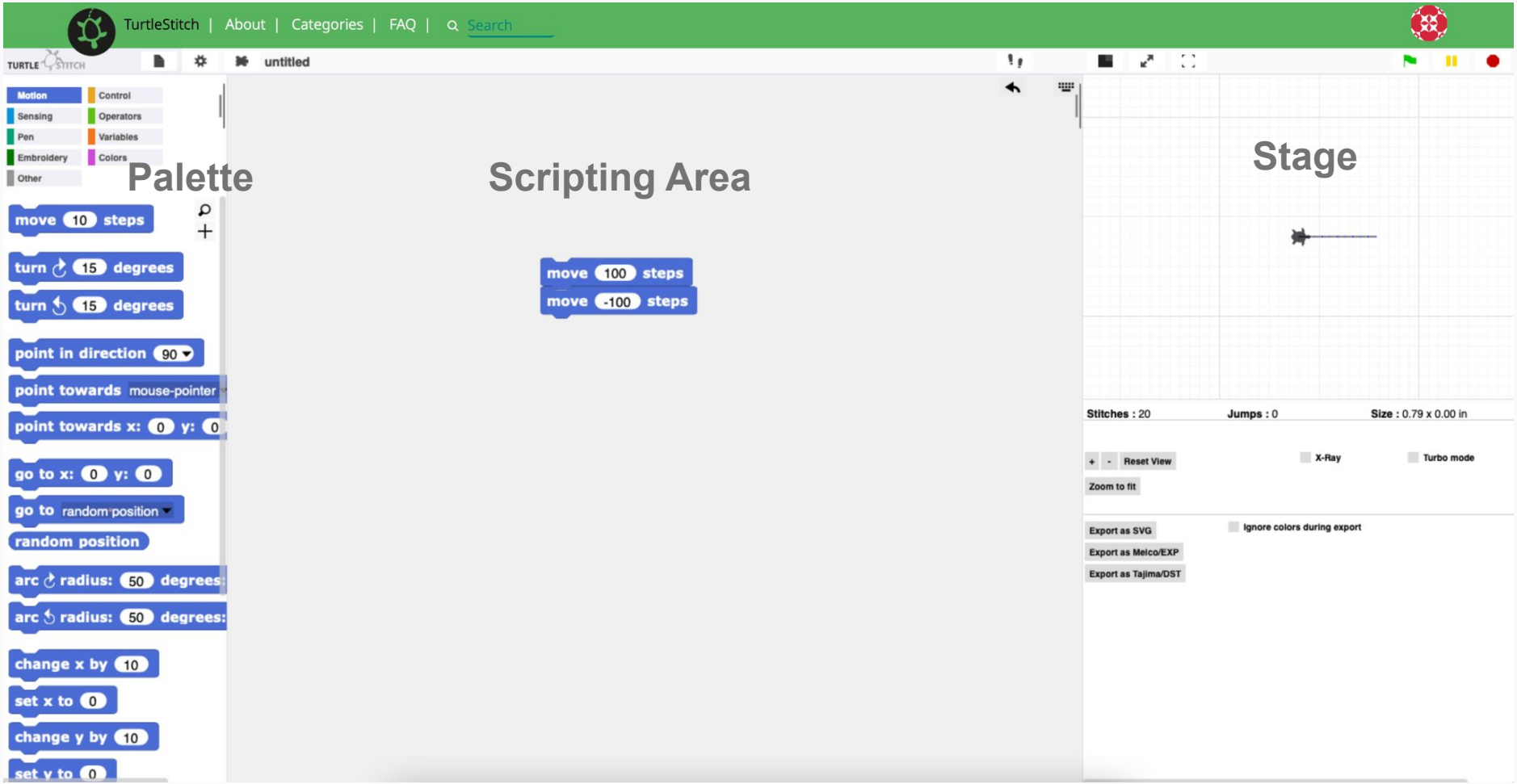
The turtle draws a one inch square.

Getting Started with TurtleStitch

Open https://www.turtlestitch.org in your web browser



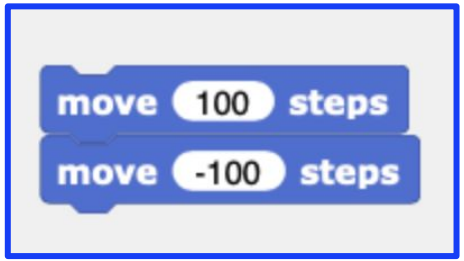
Preparing to Code In TurtleStitch

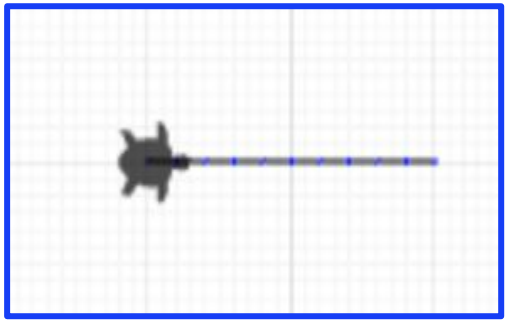


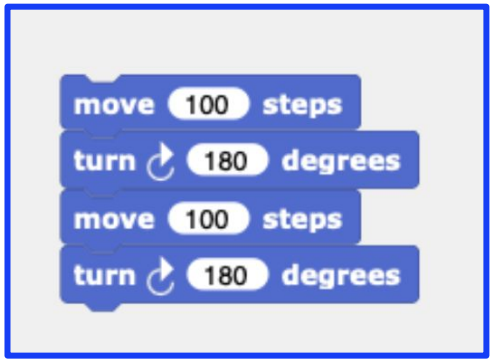
Coding Our First Snowflake

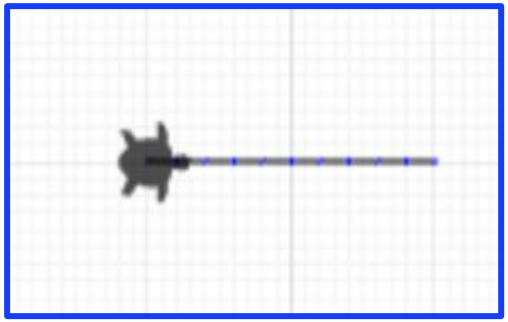
Mission objective: Create a snowflake using TurtleStitch

- **Make a Spoke:**
  - **Drag** out move and turn blocks to scripting area from the palette
  - **Click** on a block to execute the commands
  - Turtle moves on the stage



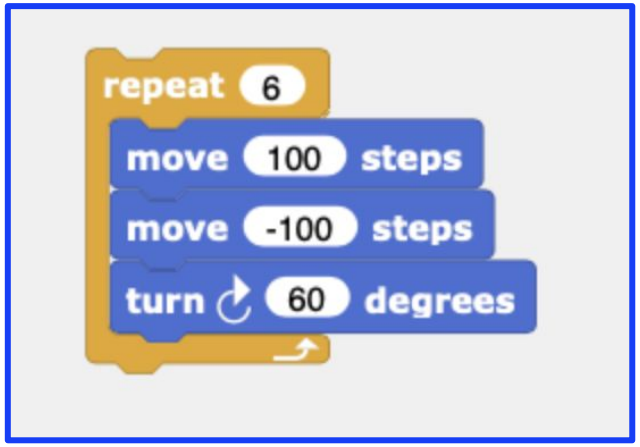


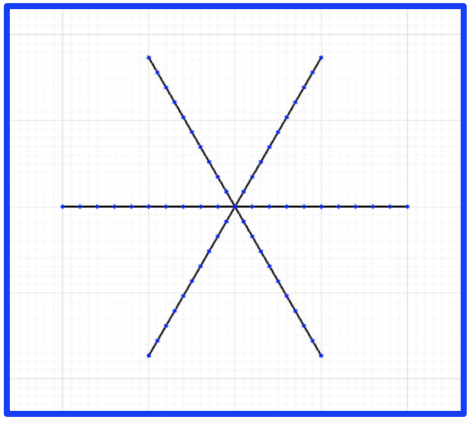




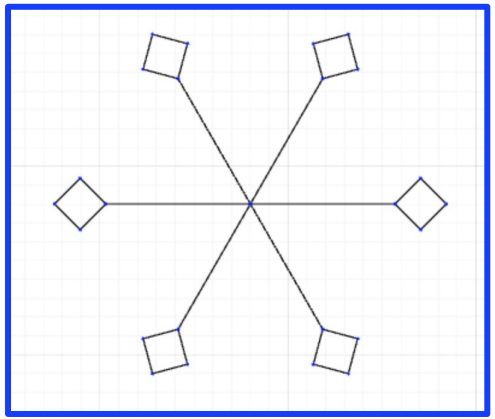
Snowflake Symmetry

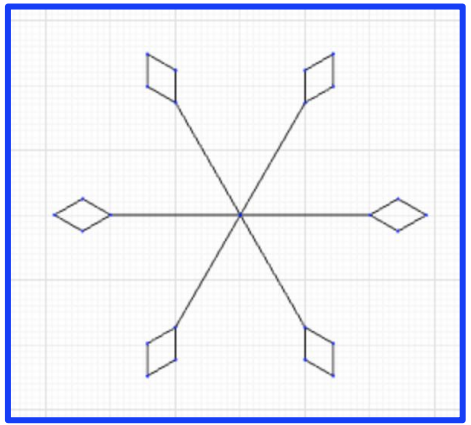
Radial symmetry for six-spoke snowflake:
360° ÷ 6 = 60°

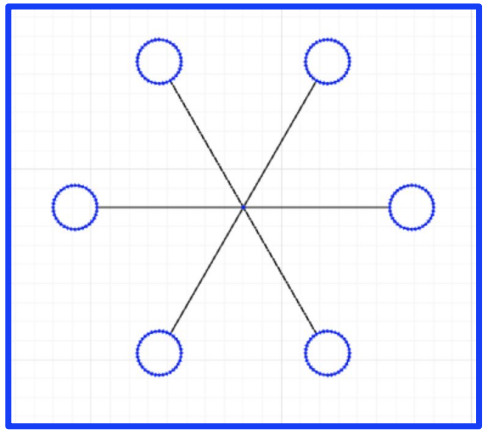




Add Endpoints to Spokes

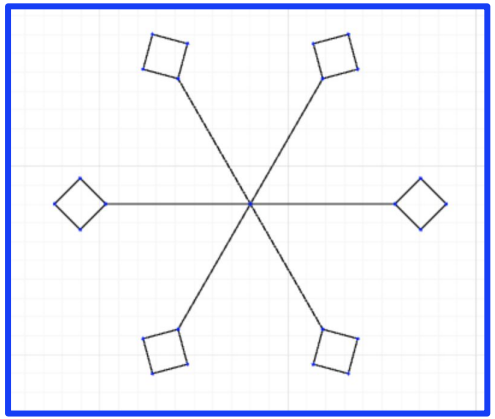


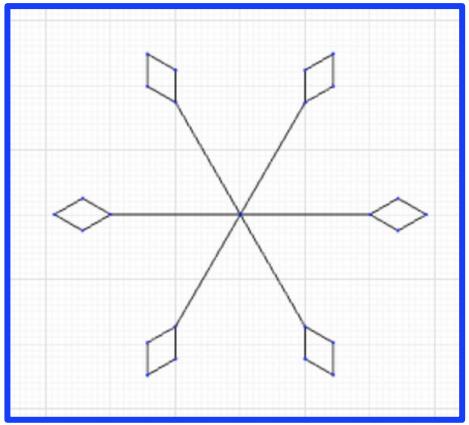




Adding Endpoints to the Spokes

```
repeat 6
move 100 steps
turn 45 degrees
move 25 steps
turn 90 degrees
move 25 steps
turn 90 degrees
move 25 steps
turn 90 degrees
move 25 steps
turn 90 degrees
turn 45 degrees
move -100 steps
turn 60 degrees
```





```
repeat 6
move 100 steps
turn 30 degrees
move 25 steps
turn 60 degrees
move 25 steps
turn 120 degrees
move 25 steps
turn 60 degrees
move 25 steps
turn 120 degrees
turn 30 degrees
move -100 steps
turn 60 degrees
```

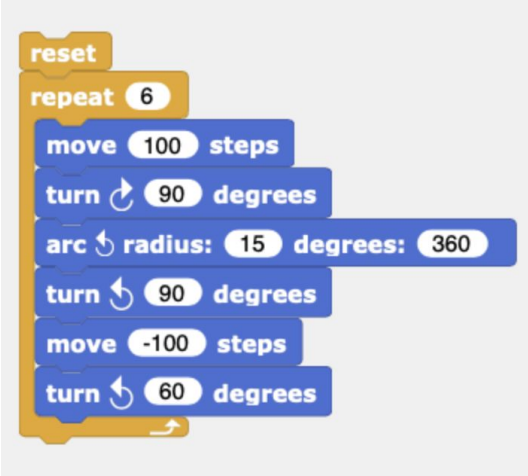
Square Endpoints:

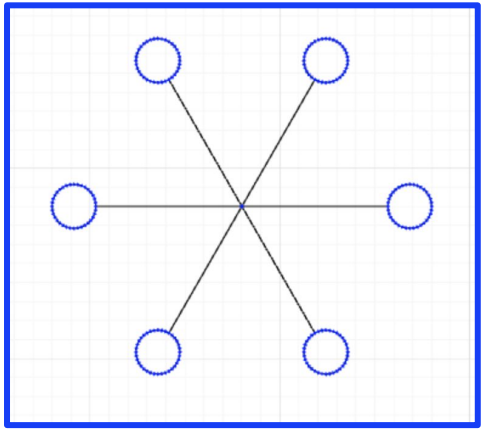
- **First turn:** 45° to position the square.
- **Next four turns:** 90° each to complete the square.
- **Return to center** and turn 60° for next spoke.

Diamond Endpoints:

- **First turn:** 30° to position the diamond.
- **Turns:** 60°, 120°, 60°, 120° to complete the diamond.
- **Return to center** and turn 60° for next spoke.

Adding Circle Endpoints to the Spoke



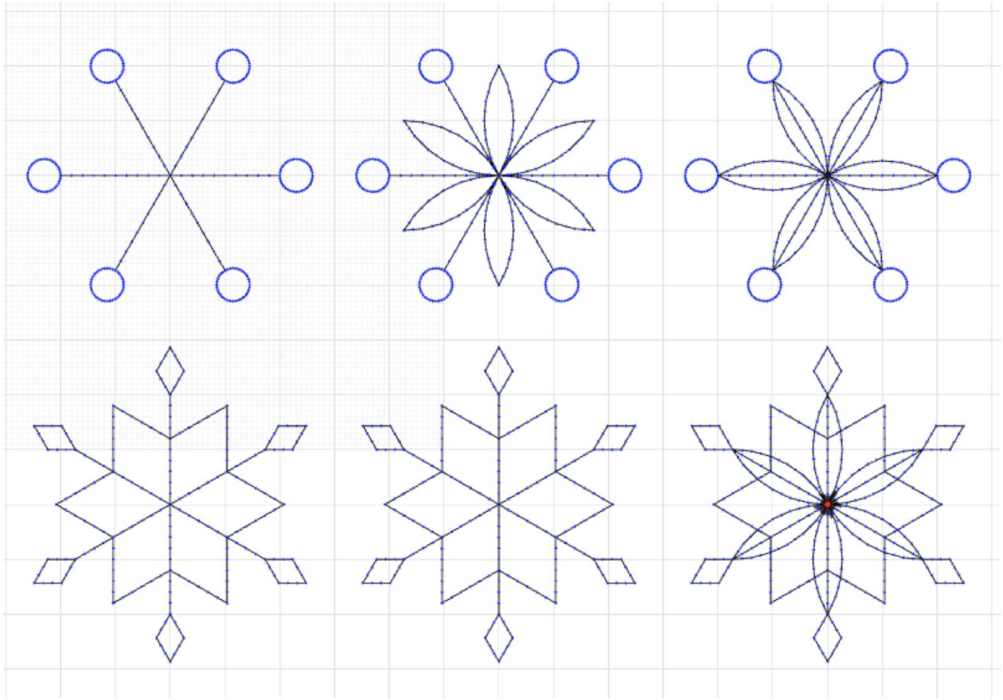


Circle Endpoints:

- **First turn:** 90° to align for the arc
- **Draw** circle with radius 15, 360° arc measure
- **Turn:** 90° to align to the spoke

https://www.turtlestitch.org/run#cloud:Username=Elaine&ProjectName=Snowflake%20Spokes

Adding Complexity To Snowflakes



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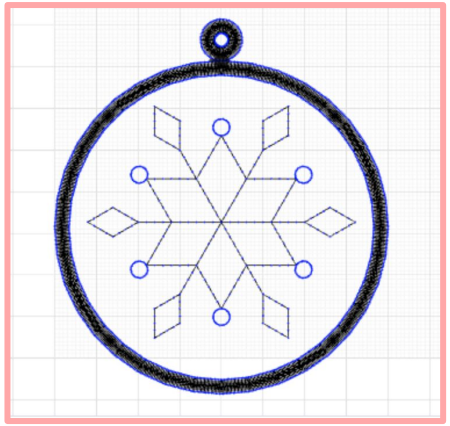
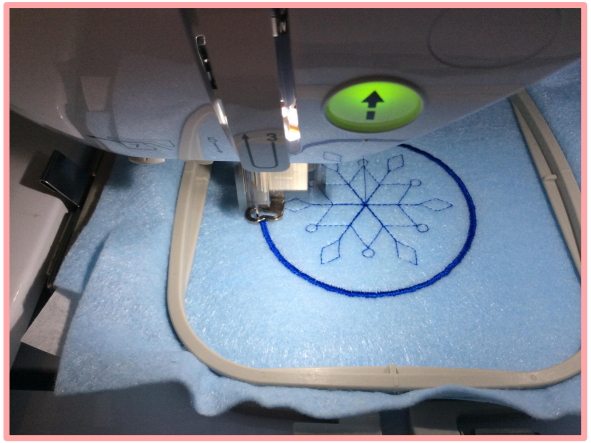
An Embroidered Snowflake

Export



Stitch



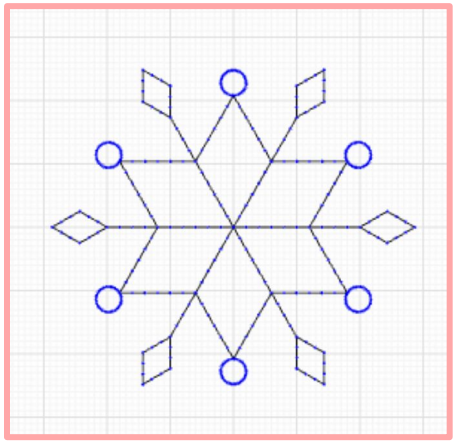
Fabricate

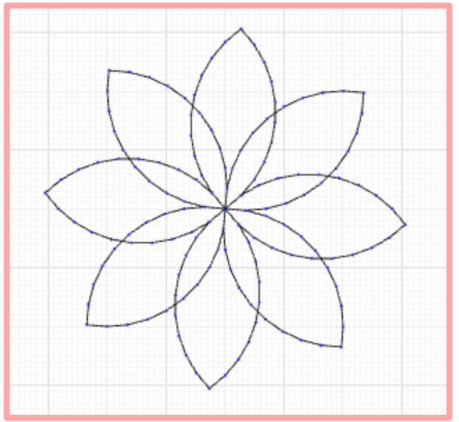
https://www.turtlestitch.org/run#cloud:Username=Elaine&ProjectName=Snowflake%20Ornament%20%233

As the Snowflakes Melt…Math Blooms into Flowers

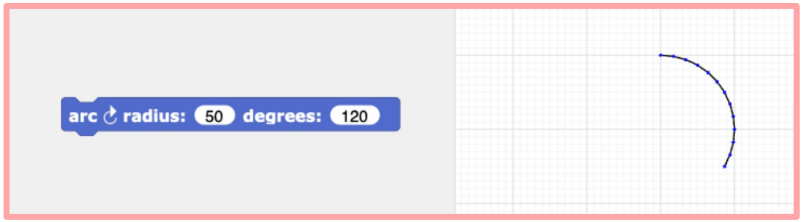
Snowflakes and flowers both have:

- Radial symmetry around a center
- Repeated patterns creating mathematical beauty

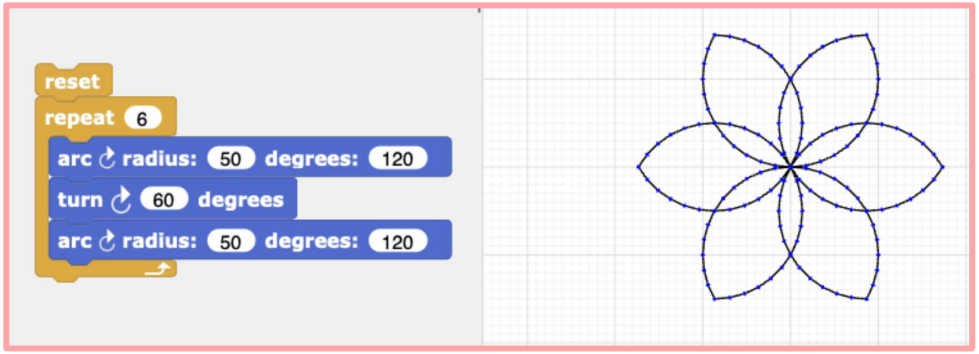




Designing Petals with Arc Block

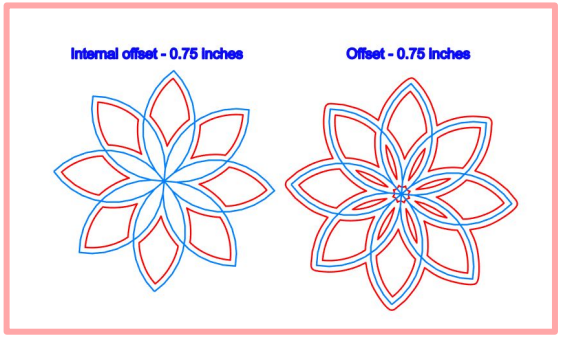


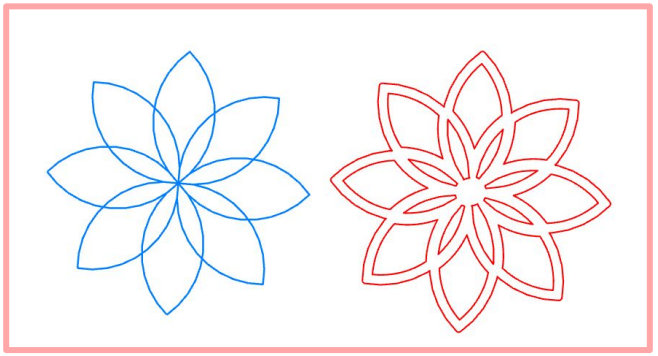
- **Arc block**
- **Turn:** *(180° - arc degrees)* for second side; Ex: *(180° - 120°) = 60°*
- **Repeat arc block**
- **Rotate:** *360° ÷ number of petals*



Constructing a Vase of Flowers

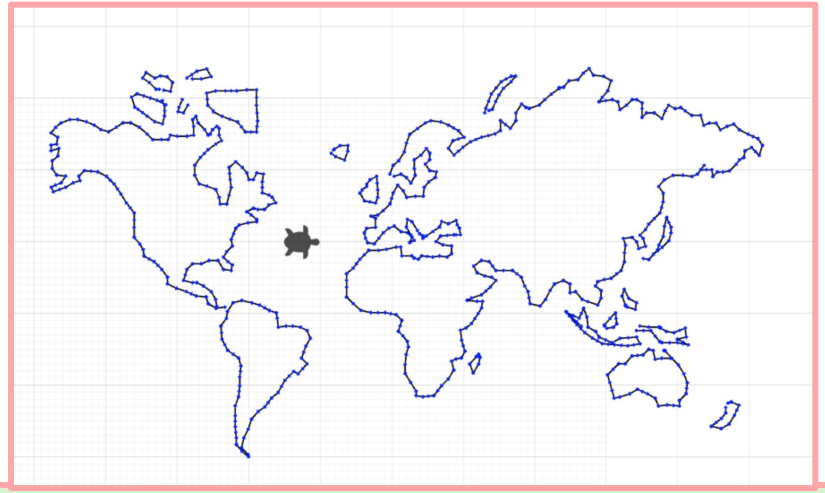
- **Export:** DXF or SVG file
- **Open:** Silhouette Studio
- **Apply:** Offsets
- **Manipulate image**: Scale, modify, or remove elements
- **Cut Out**: Vase and Flowers
- **Fabricate**





- **Blue = original**: TurtleStitch DXF export
- **Red = modified**: Silhouette Studio version
- **Lacy result**: Applied to cube vase

https://www.turtlestitch.org/run#cloud:Username=Elaine&ProjectName=Petal%20Flower



Thank you for discovering the world of TurtleStitch with me!

My TurtleStitch projects can be found at: https://www.turtlestitch.org/user/Elaine

Please visit my blogs:

🌐 papercraftetc.blogspot.com
🌐 turtlestitch.blogspot.com

There, you will find fun projects featuring math-based designs.