Labyrinthoid

Theodora Kunicki

March 2024

1   Introduction

"Labyrinthoid" is my name for a mosaic crochet technique which produces intricate, maze-like patterns with a simple and easy-to-internalize two-line algorithm.

This idea came to me nearly fully-formed, but not without inspiration. I was familiar with the powerful line-based patterns which can be produced with mosaic crochet (MC)[1], although I had never attempted the technique. In a disconnected part of my brain there also floated knowledge of 10 PRINT, a way to generate maze-like structures with a single line of BASIC code[2]. One day, I had an utter bolt from the blue: "I need to recreate 10 PRINT in mosaic crochet!" It felt so obvious and necessary that it almost seemed like a chore.

My first experiments were with copying 10 PRINT directly, using diagonal MC stitches. It worked . . . sort of. The stitches were messy, the technique was difficult to notate, and most of all, it seemed unnatural for MC, which really prefers to work with straight verticals and horizontals – sometimes with a single cheeky diagonal thrown in for good measure. A work composed entirely of diagonals seemed untenable.

Once I'd decided to look for a maze-generating algorithm that was more natural with MC, it only took a little bit of experimentation to settle on the pattern described here.

Figure 1: An early Labyrinthoid piece

---

[1]For instructions on how to do basic mosaic crochet (enough for this project), see the appendices of this pattern.
[2]More information about 10 PRINT is available at `www.10print.org`

2   The Labyrinthoid Algorithm

This is the central algorithm describing how to make Labyrinthoid patterns with mosaic crochet. There are likely readers for whom this will be all that's necessary to recreate the pattern, so I'll provide it first, and expand on it afterwards.

> Set up mosaic crochet as normal, with a foundation row of your first color (1C) and second color (2C), then alternating rows of each color as follows:
>
> - 1C: if you are on an ODD stitch, always SC, otherwise, choose* between SC and DC from the most recent 1C row below you.
>
> - 2C: if you are on an EVEN stitch, always SC, otherwise, choose* between SC and DC from the most recent 2C row below you.
>
> *I use a computer script to "flip a coin" for me. You could also choose based on whatever method you like, deterministic or otherwise.

Some comments on the algorithm:

- The algorithm is very nearly the same for both colors.

- Exactly half of the stitches of any given row will be randomized by a method of your choosing.

- No matter which color is being worked, every other stitch will always be a SC. For one color, it will be every even stitch, for the other color it will be every odd stitch.

  - This means that columns where DCs of a color are "allowed" will alternate between colors.

- Any DCs made in the previous row will always fall on a "must SC" stitch on the currently working row. (If one does not, you have made a mistake.)

  - This makes the "always SC over a DC" rule of MC redundant for this pattern.

- Technically, this algorithm *can* produce swastikas and other recognizable symbols. After a lot of work with the randomized algorithm, I have yet to see a spontaneous swastika, although it's gotten close. Luckily, randomly generated swastikas (or any other kind of symbol) are easily spoiled with a well-placed intentional stitch or two. *You do not have permission to use this technique to intentionally produce hate symbols.*

3   How to "choose"

The fundamental conceit of Labyrinthoid is that about half of its stitches are "chosen" by some method or another. In my own works, I've tried very hard to recreate a truly random distribution of stitches, with a 0.5 probability of either SC or DC, and the probability of any given stitch being independent from the results of all the other random stitches. That is to say, I do nothing to break a long string of one type of stitch, even if it's been *a while* since the other type of stitch made an appearance. Anyone who's taken a basic probability course will recognize these long strings of the same result as being typical of an independent binomial distribution. In my testing, this probability distribution produced the most beautiful, wandering, and complex maze-like patterns.

However, there is no reason why any given Labyrinthoid piece has to follow my procedure for "choosing." There's not even any requirement that SCs and DCs have the same probability of appearing; more SCs than DCs will create a pattern with a strongly horizontal character, whereas more DCs than SCs will produce a pattern with a more vertical character. Here are some alternative ideas for how to "choose":

- Use a different probability distribution – an independent binomial with a p not equal to 0.5 (an unfair coin) is interesting and simple with the tools I will provide. More complex distributions are up to you!

- Choose the stitch solely based on aesthetics – look at the surrounding maze section and choose based on what you feel looks best.

- Use the pattern to encode a real-life probability distribution – are cars turning left or right at the traffic light? Does the first word of the next paragraph of this book have an even or odd number of letters? What about the digits of π? Even or odd? The possibilities are endless.

- Encode non-random data. Try encoding ASCII text or other encodings with what is essentially a weird kind of binary display.

4   Resources for random stitch generation

I have made a simple webapp available at `https://theo-kunicki.github.io/decider/` which can set the overall probability of one stitch over the other, as well as providing an audio tone for each result. My favorite feature of this webapp is that when it's used in a cell phone browser, the next result can be calculated by simply swiping up, which means that you can use one of those little Bluetooth rings designed for hands-free TikTok viewing (for example, this one `https://a.co/d/6UmEBqS`) to generate the next stitch. The TikTok ring combined with the sound cues in my experience make for a very easy crocheting process, and this setup is my recommendation if you choose to use the "fair coin" distribution like I have.

Other random number generating resources exist, but I would especially recommend `https://www.random.org/integers/`. Setting the minimum to 0 and the maximum to 1, this generates independent coin flips (the website also has a "coin flipper" page, but it isn't as useful for our purposes).

5   Trust The Algorithm, a Labyrinthoid Blanket

In my family, "trust the algorithm" is a commonly-uttered phrase, usually in the context of GPS directions. Do you disagree with Google Maps? Don't fight it, just trust the algorithm. You'll get there faster. To me, the phrase represents a sort of surrender of decision-making to computers, and perhaps a motto for one side of the coming AI Wars, who knows?

In any case, as I was first experimenting with Labyrinthoid, I found it difficult to fully implement a "coin flip" probability distribution. My own biases crept in, and pattern suffered. Eventually, I decided to fully embrace the sentiment of "trusting the algorithm," letting the pattern develop at its own pace and in its own way, without my conscious mind intervening. "Trust the algorithm" became such a mantra for my work with Labyrinthoid, I thought it would be a fitting name for the crochet pattern I included in this document.

5.1   Materials

- Valley Yarns Berkshire Bulky in colors "Dark Teal" (first color/1C) and "Dusty Lilac" (second color/2C). 24 balls of each color.

    - 85% Wool, 15% Alpaca
    - 108 yds (99 m) per 100g (3.5 oz)

- 6.5 mm (size K) crochet hook

- Scissors

- (optional) a Bluetooth TikTok scrolling ring and access to `https://theo-kunicki.github.io/decider/`

5.2 Gauge and Finished Dimensions

- Gauge: 40 stitches per 12 inches horizontally, 36 stitches per 12 inches vertically. (But it doesn't really matter; this is a blanket and has a lot of wiggle room for gauge. Feel free to alter step 2(a) below by chaining however many stitches produce a blanket of your desired width, and to alter step 3(k) to produce a blanket of your desired length.)

- Finished dimensions: 4 feet × 6 feet.

5.3 Instructions

1. Before beginning, be sure to familiarize yourself with the basic mosaic crochet technique either through this document's appendices, or online. There are many useful Youtube videos demonstrating MC.

2. Set up MC foundation rows as follows:

   (a) Using 1C, Ch 168 stitches.

   (b) Ch 1, skip that stitch, then SC into the back loop of the next stitch in the chain.

   (c) SC into back loops across the work until every chain stitch (except the first!) has been used to work a SC stitch above.

   (d) Ch 1. Cut yarn and pull the yarn end through the chain stitch, tightening into a knot.

   (e) *Without turning the work*, use a knot or slip stitch to affix yarn of 2C to the right-most 1C SC stitch made in the previous steps.

   (f) Ch 1, then SC into the back loop the same stitch.

   (g) SC into back loops across the work until every 1C SC from the previous row has been used to work a SC stitch in 2C above. You now have two horizontal stripes, the first of 1C and the second of 2C.

3. Work the bulk of the project as follows:

   (a) *Without turning the work*, use a knot or slip stitch to affix yarn of 1C to the rightmost SC from the previous row.

   (b) Ch 1, then SC into the back loop of the same stitch.

   (c) SC 3 through the back loop.

   (d) Work the row according to the first line of the Labyrinthoid algorithm (Section 2), reproduced below, always single-crocheting through the back loop of a stitch and double-crocheting through the front loop. Work the algorithm until 4 sts remain in the row.

   > - 1C: if you are on an ODD stitch, always SC, otherwise, choose* between SC and DC from the most recent 1C row below you.
   > - 2C: if you are on an EVEN stitch, always SC, otherwise, choose* between SC and DC from the most recent 2C row below you.
   >
   > *I use a computer script to "flip a coin" for me. You could also choose based on whatever method you like, deterministic or otherwise.

   (e) SC the 4 remaining sts through back loop. Ch 1, cut yarn, pull yarn through chain stitch, and tighten into a knot.

   (f) *Without turning the work*, use a knot or slip stitch to affix yarn of 2C to the rightmost SC from the previous row.

   (g) Ch 1, then SC into the back loop of the same stitch.

(h) SC 3 through the back loop.

(i) Work the row according to the second line of the Labyrinthoid algorithm (Section 2), reproduced above in step 3(d), always single-crocheting through the back loop of a stitch and double-crocheting through the front loop. Work the algorithm until 4 sts remain in the row.

(j) SC the 4 remaining sts through back loop. Ch 1, cut yarn, pull yarn through chain stitch, and tighten into a knot.

(k) repeat steps 3(a)-(j) until blanket measures 6 feet in length, stopping after a 2C row.

4. Finish work as follows:

(a) *Without turning the work*, use a knot or slip stitch to affix yarn of 1C to the rightmost SC from the previous row.

(b) Ch 1, then SC into the back loop of the same stitch.

(c) SC 167 through back loop.

(d) *Turn work* and chain-stitch across 168 stitches. This is to make the first and last rows match in width.

(e) Ch 1, cut yarn and pull through the chain stitch. Tighten into a knot.

(f) Trim fringe on either side of the work to desired length. Alternatively, weave in ends.

6 Challenge

This work was heavily influenced by computerized generative art like 10 PRINT, but it's intended to be worked entirely by hand (perhaps with a computer in a supporting role for random number generation). It is a well-known fact that, as of this document's writing, there is no such thing as a crochet machine – crochet (unlike knitting or weaving) requires too many degrees of freedom and too much physical coordination for a machine to achieve. Ability to crochet is, then, a perfect benchmark for a robot with human-like dexterity and coordination.

I would like to humbly propose the "Trust The Algorithm" blanket as a standardized challenge for robotic crochet. It's complex but not overly finicky, and the randomized algorithmic element makes for an interesting real-time challenge.

Even if it's not a Labyrinthoid project, I feel that we (the crochet community) should at least all agree on a standardized project as a test for robotics, since crochet is such a mechanically difficult task and has the potential to prove a robot's ability to move with human-like precision. Let this be the beginning of a fruitful discussion.

7 License

A   A brief, gestalt-focused explanation of mosaic crochet

Knowledge of mosaic crochet is fundamental to the Labyrinthoid pattern. Although it can look intimidating at first, mosaic crochet is actually quite simple, and it can be easily learned by anyone who's familiar with both single- and double-crochet stitches.

Mosaic crochet is based off of a horizontal stripe pattern formed by alternating colors of yarn crocheted *on the right side of the work only*, right to left, through the back loops of the stitches in the previous row (this is important). Once two foundation rows of simple horizontal stripes have been established, then for any given stitch, the crocheter has two options:

- single-crocheting through the back loop of the (differently colored) previous row, or,

- double-crocheting through the *front* loop of the (same colored) next-to-previous row of the same stitch, skipping over the previous row's stitch.

A single-crochet will preserve the visibility of the stitch directly below the working stitch, whereas a double-crochet will obscure the previous row's stitch in that column by covering it with a DC of the working color, thereby transforming a "pixel" of the last row's color into a "pixel" of the working row's color. It is important that the crocheter only SC through back loops, in order to leave the front loops of the stitches available for a potential future DC.

The final "rule" to mosaic crochet is that the crocheter must always SC if the previous row's stitch was a DC. This is to maintain the integrity of the fabric, and because two DCs of differing colors cannot overlap each other directly. This rule makes more sense once you've played around with the method somewhat. (In the context of the Labyrinthoid pattern, this rule is redundant, since DCs of color 1 will alternate columns with DCs of color 2, so the two colors will be in columns of their own.)

Because the pattern is worked on the right side only, the yarn must be cut after each row. These loose ends may either be hidden away by sewing them in, or they may be left as a fringe on the work.

B   Step-by-step photographic instructions for mosaic crochet

1. (Using first color.) First create a chain-stitch chain to establish the width of the piece. For instance, if your piece is to be 40 stitches wide, then Ch 40.

2. Once the chain has the appropriate number of stitches, Ch 1 more stitch to turn the work, skip that stitch, and SC across the chain, through the back loops of the established chain stitches. So far, this is exactly like normal crochet, except that we are being careful to always crochet *only through the back loop* of a stitch.

3. When the row of SCs is finished, cut the yarn and Ch 1, pulling the end of the yarn through the chain stitch to form a knot. Make sure the knot will not unravel.

4. (Using second color.) Now, *without turning the work*, fasten your second-color yarn to the back loop of the first stitch in the row with a knot or slip stitch, Ch 1, and SC into the same stitch's back loop to begin your row. Crochet a full row of SCs through the back loops of the row just established, starting at the right side of the work and working left.

5. Cut the yarn and secure it as above. You now have two horizontal stripes: on the bottom, a stripe of your first color, and above that, a stripe of your second color. These constitute the "foundation rows" mentioned above.

6. (Using first color.) *Without turning the work*, fasten your first-color yarn to the back loop of the first stitch in the row with a knot or slip stitch, Ch 1, SC 1 into the same stitch's back loop to fasten the yarn to the previous row.

7. For the remaining stitches in this row, you have two options, either SC through the back loop of the previous row (as in previous steps) or DC down a row to the last row of the same color currently being worked. SC or DC according to the pattern you are following.

   - If you are working the Labyrinthoid pattern, then follow The Algorithm (from Section 2) in this step.

8. SC the final stitch in the row (always through the back loop), then cut and secure the yarn as above.

9. Repeat steps 6-8 as called for by the pattern, alternating yarn color on each row.

That's it! That's mosaic crochet in a nutshell!