Randomizing Your Digits: Generatively Knit Mittens

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Abstract

In this paper, I discuss my explorations in generating patterns for two-color mittens as they were knit. By combining the techniques of stranded knitting and generative art, I was able to develop a pattern that is both pleasurable to knit and produces an interesting pattern on the finished mittens. After sharing an example of a pattern that can be knit generatively, I calculate the uniqueness of each type of mitten knit using these techniques.

Stranded Knitting and Constraints

Traditional hand knit mittens from Latvia are works of art. Using geometric motifs that hold significance to specific regions, the mittens have been knit for centuries for decorative and gift giving purposes [2]. These mittens have even been depicted on Latvian stamps (Figure 1).

Figure 1: *Latvian stamp featuring mittens*

I have been fascinated with knitting mittens in this style for several years, but I have felt tension between knitting a pattern that is interesting (both in process and final product) and knitting a pattern that is easy to remember without needing to continually refer to a diagram. While teaching an introduction to computer science course, I also became interested in generative art. I decided to experiment with using knitting as a medium with which to create generative art.

Prior to knitting any mittens generatively, I developed a set of constraints to structure my experiments. These mittens are knitted with a 'stranded' knitting technique. Two colors are used each row, however only one color is used to knit each stitch. The color that is not being used to knit a stitch is carried along the back of the knitting in what is known as a "float" (Figure 2). If one color is used for too many consecutive stitches, then the fabric may pucker, distorting the pattern because the float can be pulled too tight. Long floats can also become a nuisance to the wearer of the mitten because they can catch on a finger. Thus, the first constraint is that the pattern should alternate between the two colors frequently. A general rule of thumb is that colors should alternate at least every five or six stitches.

Figure 2: *Back of stranded knitting*

The second constraint comes from the geometry of the mitten. The mitten is knit from right to left on four double pointed needles. After knitting across all four of the needles, the needles are joined in the round so that the fabric is knit as a tube rather than flat. For several rows at the top of the mitten stitches are decreased by knitting two stitches together. After finishing the body of the mitten, the thumb is added. The thumb is also knit in the round with decreases at the top of the thumb. The mittens I knit are 72 stitches around. Therefore, the number of stitches I used in any pattern that would be repeated needed to be a factor of 72 and the overall pattern needed to tile a cylinder (Figure 3).

The final set of constraints came from my own personal preferences. I wanted the pattern or rule that determined what color each stitch should be knit to be simple enough to remember without continually referring to a pattern. I find that if I need to frequently refer to a chart that my flow and enjoyment in the creation process is diminished. I decided that the randomness that would generate the pattern should be determined through a binary process, namely flipping a coin.

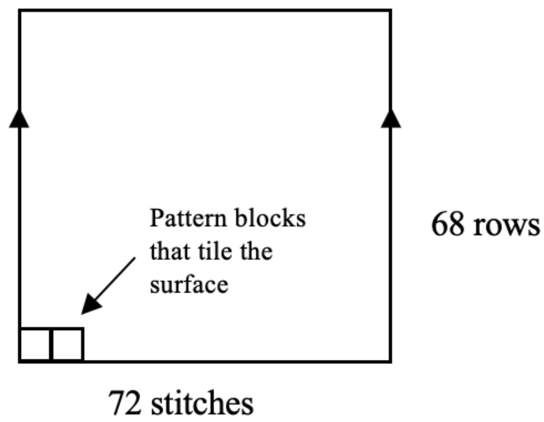

Figure 3: *Diagram of mitten body*

10 Print

The 1982 Commodore 64 computer's user guide included one line of code written in BASIC that generatively produced a maze-like pattern, often referred to as 10 Print [1]. As the program was run, it would continually print either a forward slash or backward slash, randomly chosen by generating a number between 0 and 1. Figure 4 shows an example of the 10 Print pattern that I created using p5.js.

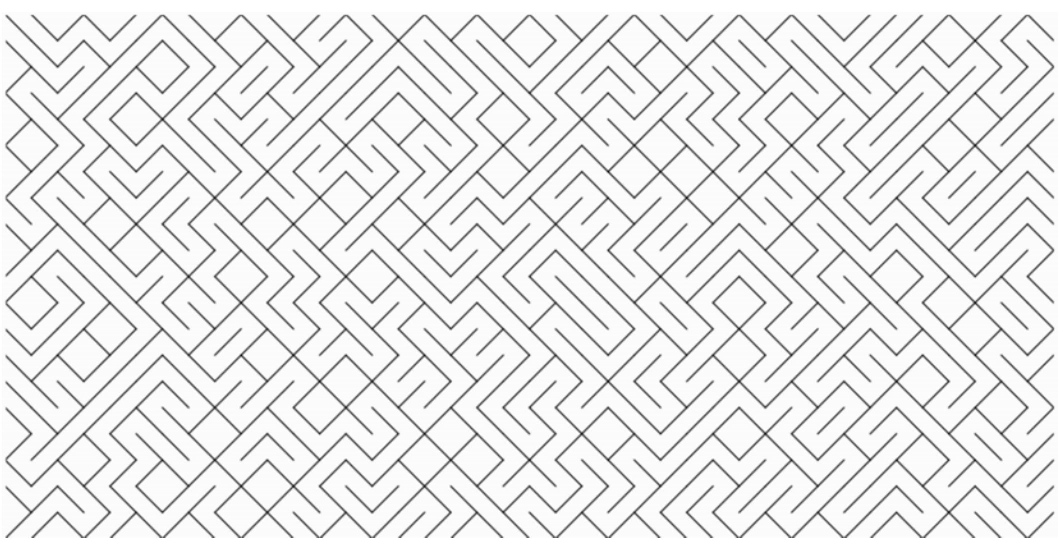

Figure 4: *10 Print pattern generated using p5.js.*

To knit the 10 Print pattern, I conceptualized the mitten as a set of square tiles of six stitches by six stitches. Figure 5 shows a chart that visualizes how the forward and backward slashes were converted into a pattern that could be knit. Every six rows, I flipped a coin 12 times to generate the sequence of forward and backwards slashes. The forward slash was knit when a head was flipped and a backward slash was knit when a tail was flipped. The charts were simple enough that after knitting a few blocks I no longer needed to refer to the chart. The pattern was also easily decreased for the fingertips of the body of the mitten and the thumb.

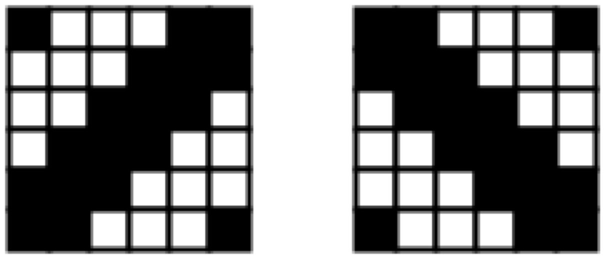

Figure 5: *Charts for pattern blocks: forward slash (left) and backwards slash (right)*

The reader may be wondering why the opposite corners of each block are also knit with the color of the slash. These two blocks of color serve two purposes. First, they helped to make the lines in the finished pattern smoother. I knit a pair of mittens without these two extra dark squares first, and where two slashes came together there were two notches. This could be perceived as merely a cosmetic issue; however, without the extra two dark stiches in each pattern block there are sequences of eight light stitches in a row when a head is flipped and then a tail or a tail and then a head is flipped. This violates the constraints I discussed earlier in this paper.

Conversely, the addition of the dark stitches in the corners creates a small extra "dot" inside the pattern when a head and tail is flipped and then a tail and head is flipped directly above. Figure 6 shows the notches and the extra dots.

Figure 6: *Notches (left) and extra dots (right)*

While the extra dots do not appear in the original 10 Print design, I enjoy the addition they make to the mittens and have embraced them. Below, Figure 7 shows a completed pair of generatively knit mittens.

Figure 7: *Generatively knit 10 Print mittens*

Summary and Conclusions

My favorite part of generatively knitting mittens is the uniqueness of each mitten. The 10 Print mittens are comprised of a total of 176 pattern blocks. Since the 10 Print has two possible patterns for each block there are a total of 2^{176} or 9.58×10^{52} unique 10 Print mittens. Thus, every person who has ever lived could have multiple pairs of each of these mittens without anyone having two mittens the same.

I found the process and the product of generative knitting to be quite enjoyable. While these experiments focused on mittens, any garment knit in the round (such as socks, hats, and cowls) could also be made using these techniques. Knitters can also experiment further with the way that they decide to knit a forward slash or a backwards slash—instead of each possibility having a 50% chance of occurring, other distributions can be explored. Further work can also search for more patterns that meet the criteria for generative knitting.

References

[1] N. Montfort, P. Baudoin, J. Bell, I. Bogost, J. Douglass, M. Marino, M. Mateas, C. Reas, M. Sample, and N. Vawter. *10 Print CHR$(205.5 + RND(1));:GOTO 10,* The MIT Press, 2013.

[2] L. Ozolina. *Knit Like A Latvian,* David & Charles, 2018.