Variations on a Shadow Weave

Reference 1, which describes the weaving language in MetaCreation's Painter application, is prerequisite to the material that follows. An example given there is shadow weave [2, 3]. A textual form of the Painter draft is shown in Figure 1 and the weave is shown in Figure 2.

Shadow Op Art	*name*
1–8–2–828–3–82128–4–8214128–5–821434128–6–8214363412878214365634128|,1	*threading*
1–8–2–828–3–82128–4–8214128–5–821434128–6–8214363412878214365634128|,1	*treadling*
KW–>183	*warp colors*
WK–>183	*weft colors*
1010101001010101101010010101011010100101010110101001010101101010	*tie-up*

Figure 1. Painter Weaving Draft

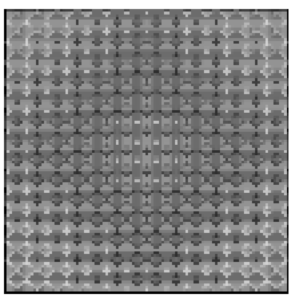


Figure 2. A Shadow Weave

Weaves of this type produce the appearance of shadows (which are more obvious on actual woven fabrics than in images) by alternating light and dark threads in reverse orders in the warp and weft.

The threading and treadling expressions for shadow weaves typically are the same — treadled as drawn in, as is the case here. Therefore we need only consider the threading expression.

W and K stand for white and black, respectively.

The threading expression is a (true) palindrome. This follows from the fact that the pattern palindrome operator, |, has very low precedence and the expression groups like this:

((1–8–2–828 …4363412878214365634128)|,1)

The 1 concatenated at the end converts a pattern palindrome into a true one. The weave looks better when repeated if this last character is omitted, leaving a pattern palindrome. We'll do that here.

The threading expression consists of a sequence of domain runs — "ups and downs" — between other shaft sequences. This is easier to understand graphically than in terms of numbers. Figure 3 shows the threading for the first half of the sequence. The bar at the top shows the colors.

If we look at the operand of the pattern palindrome operator, we see that it has a definite structure:

1–1 –2–2 –3–3 –4–3 –5–5 –6–8214363412878214365634128

where the components in circles have their own structure:

1 = 8
2 = 828
3 = 82128
4 = 8214128
5 = 821434128

Note that these all are true palindromes.

After –6–, the pattern appears to break down,

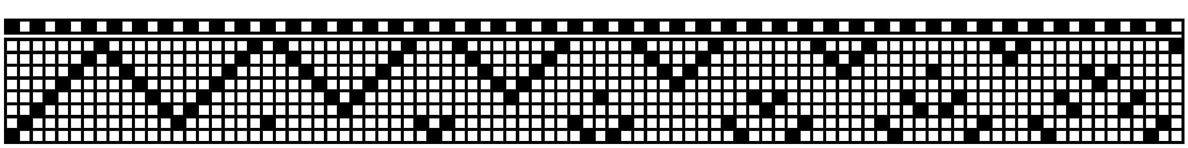


Figure 3. The Threading

although there are similarities with the earlier parts. In fact,

82143634128782143656341 28

is equivalent to

82143634128–7–8214365634128

So we have

1–1 –2–2 –3–3 –4–3 –5–5 –6–6 –7–7

with the continuation of the palindromes between:

6 = 82143634128
7 = 8214365634128

These palindromes can be represented using pattern forms, which makes the underlying structure more evident:

1 = [!8]
2 = [8!2]
3 = [82!1]
4 = [821!4]
5 = [8214!3]
6 = [82143!6]
7 = [821436!5]

The sequence 8241365 runs not only across but also down the center of these palindromic forms — patterns within patterns.

One way to view the overall pattern is as a sequence of anchors for domain runs, which are connected by palindromes. Figure 4 shows the threading draft with the anchors indicated by vertical bars and the palindromes by horizontal bars.

We might ask several questions at this point. The first ones that come to mind are:

- If we modify this pattern in various ways, what kinds of weaves result?
- Is the threading pattern somehow special or just one of a class of patterns that produce interesting weaves?
- If so, how can this class be characterized?

We'll start with the first question — it leads to more than enough to occupy us for now.

We'll take the domain runs as given and concentrate on the sequence of anchors and palindromes. For this, it is easier to deal with character sequences. We'll retain digits for labeling the shafts and use the letters A though G to label the palindromes. Thus, the sequence can be represented as

1A2B3C4D5E6F7G

In terms of pattern forms, this is an interleaving:

[1234567~ABCDEFG]

More formally, we can label the anchor sequence A and the palindrome sequence P, giving

[A ~ P]

Given transformations τ_1 and τ_2 on sequences, we can consider

$[\tau_1(A) \sim \tau_2(P)]$ *general transformations*

One possibility is coupling the anchors and the palindromes, that is $\tau_1 \equiv \tau_2$:

$[\tau_1(A) \sim \tau_1(P)]$ *coupled transformations*

An example of this, using our original notation, is the permutation

6–6 –3–3 –1–1 –4–4 –5–5 –2–2 –7–7

Another possibility is using the identity transformation ι on one but not the other component:

$[\tau_1(A) \sim \iota(P)]$ *anchor transformations*

or

$[\iota(A) \sim \tau_2(P)]$ *palindrome transformations*

Respective examples are the permutations

5–1 –4–2 –3–3 –2–4 –1–5 –7–6 –6–7

and

1–5 –2–6 –3–7 –4–4 –5–3 –6–2 –7–1

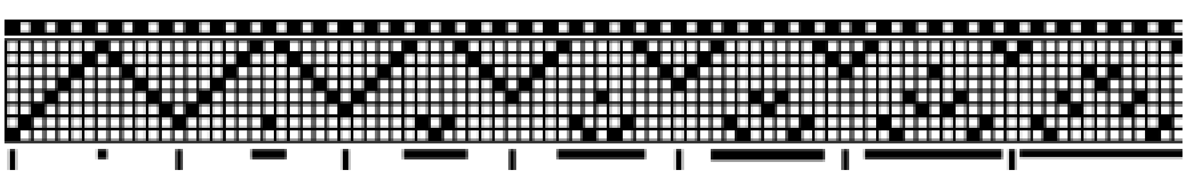


Figure 4. Threading Draft Showing Anchors and Palindromes

We are of course, not limited to permutations. Examples of transformations that are not permutations are the coupled transformation

1–1 –2–2 –3–3 –4–4 –4–4 –3–3 –2–2

and this transformation, which increases the length of the sequence

1–5 –2–6 –3–7 –4–4 –5–4 –6–2 –7–1 –1–5 –2–6

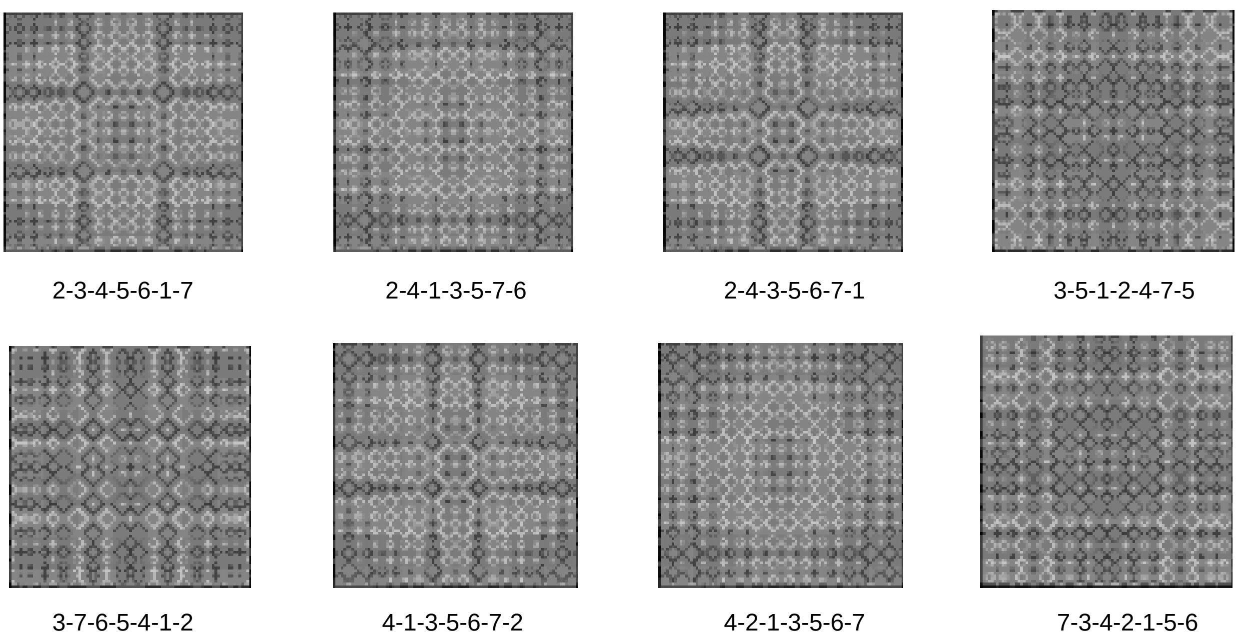
It is, of course, impossible to explore all such transformations. For permutations alone, there are $14! \cong 8.7 \times 10^{13}$ possibilities for the general case.

There are, however, only 7! = 5,040 permutations for the coupled anchor and palindrome cases. We tried all the anchor-sequence permutations to get a feel for how the weaves differ.

No two of the weaves are the same, although many are so similar that the differences cannot be detected without detailed examination. There is some difference in the size of the weaves. This is to be expected, since the lengths of the domain runs change when the anchors do. The size is determined solely by the first anchor. If the first anchor is i, then the weave is $180 + 2i$ threads on a side.

All are visually attractive, at least to us, and the range of design variations is relatively small. The 10 weaves in Figure 3 represent the visual extremes. We might say the pattern is aesthetically robust.

Many other variations on the basic pattern are possible. We'll explore these in a subsequent report.



Figur 4. Example Weaves for Anchor-Sequence Permutations

References

1. *Painter's Pattern Weaving Language,* Ralph E. Griswold, 2004:
http://www.cs.arizona.edu/patterns/weaving/webdocs/gre_pwl.pdf

2. *The Complete Book of Drafting for Handweavers,* Madelyn van der Hoogt, Shuttle Craft Books, 1993.

3. "Putting the Shadow in Shadow Weave", Donna Muller, *Handwoven*, Vol. XIX, No. 4, September/October 1998, pp. 34-40.

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