[The dependency of this material on Painter's Weaving Language raises serious questions about the order of presentation in M.O.]

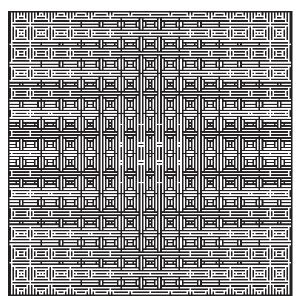
Shadow Weave

Reference Ω.1, which describes the weaving language in MetaCreation’s [get current company name] 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

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*

W and K stand for white and black, respectively.

This draft produces the weave



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.

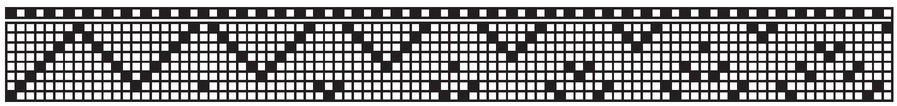
The threading and treadling expressions for shadow weaves typically are the same — treadled as drawn in, as is the case here. Therefore only the threading expression is needed.

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.

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. This figure shows the threading for the first half of the sequence. The bar at the top shows the colors.



The Threading

The operand of the pattern palindrome operator has a definite structure:

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

where the small numbers have their own structure: [Lost a font here and used "small numbers" as a temporary work-around.]

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

8214363412878214365634128

is equivalent to

82143634128–7–8214365634128

So the result is

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

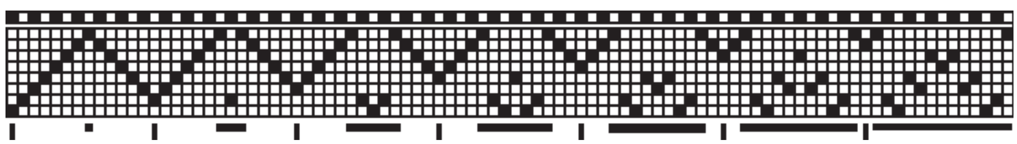
These palindromes can be represented using pattern forms, which makes the underlying structure more evident:

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. The following figure shows the threading draft with the anchors indicated by vertical bars and the palindromes by horizontal bars.



Threading Draft Showing Anchors and Palindromes

There several questions at this point. The first ones that come to mind are:

- If this pattern is modified 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?

Start with the first question, 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. Digits will be used for labeling the shafts and 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, label the anchor sequence $\mathcal{A}$ and the palindrome sequence $\mathcal{P}$, giving

[$\mathcal{A}$ ~ $\mathcal{P}$]

Given transformations τ_1 and τ_2 on sequences, consider

[$\tau_1(\mathcal{A})$~ $\tau_2(\mathcal{P})$] *general transformations*

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

$[\tau_1(\mathcal{A}) \sim \tau_1(\mathcal{P})]$ *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:

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

or

$[\iota(\mathcal{A}) \sim \tau_2(\mathcal{P})]$ *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

This is 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

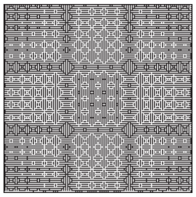
1–5–2–6–3–7–4–4–5–4–6–2–7–1–1–5–2–6

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.

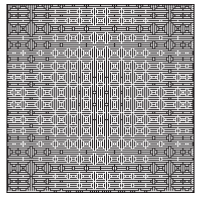
There are, however, only $7! = 5{,}040$ permutations for the coupled anchor and palindrome cases. All the anchor-sequence permutations to give a feel for how the weaves differ.

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.

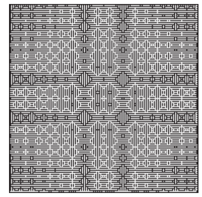
All are visually attractive, at least to us, and the range of design variations is relatively small. The 10 weaves that follow represent the visual extremes. The pattern is aesthetically robust.



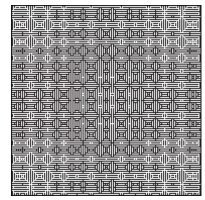
2-3-4-5-6-1-7



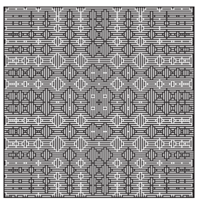
2-4-1-3-5-7-6



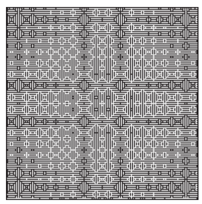
2-4-3-5-6-7-1



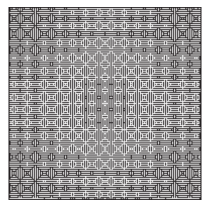
3-5-1-2-4-7-5



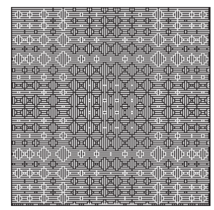
3-7-6-5-4-1-2



4-1-3-5-6-7-2



4-2-1-3-5-6-7



7-3-4-2-1-5-6