“It's Just Matrix Multiplication” Notation for Weaving

Lea Albaugh
(@doridoidea)

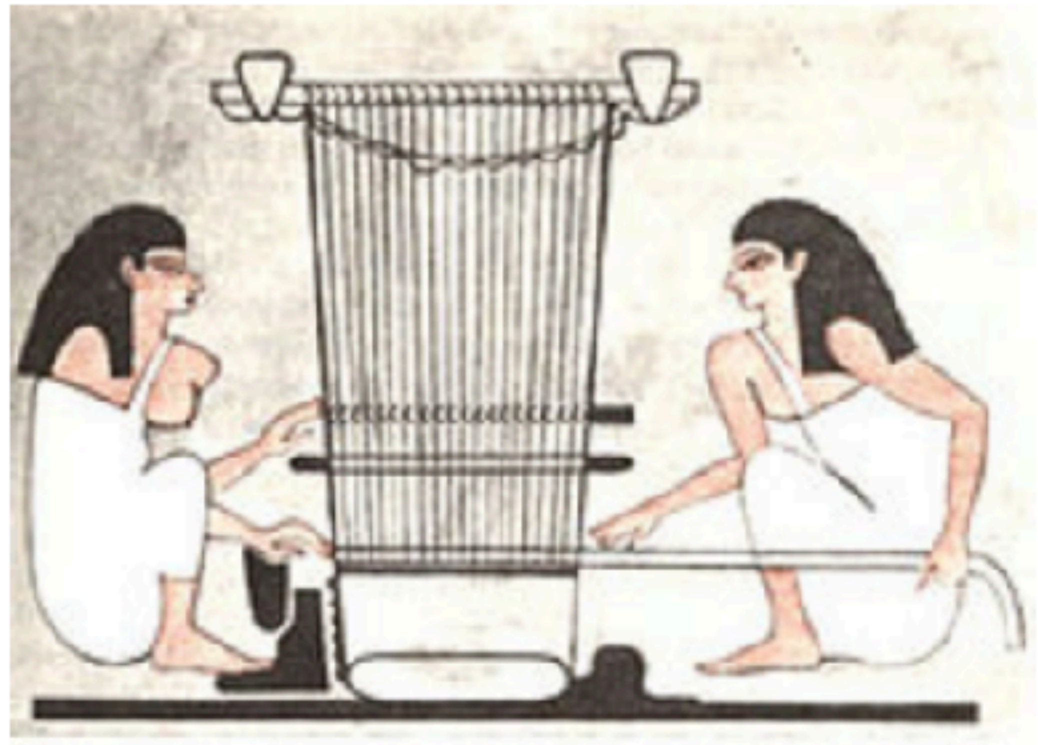
Hugo Weaving

Weaving - Wikipedia

Secure | https://en.m.wikipedia.org/wiki/Weaving

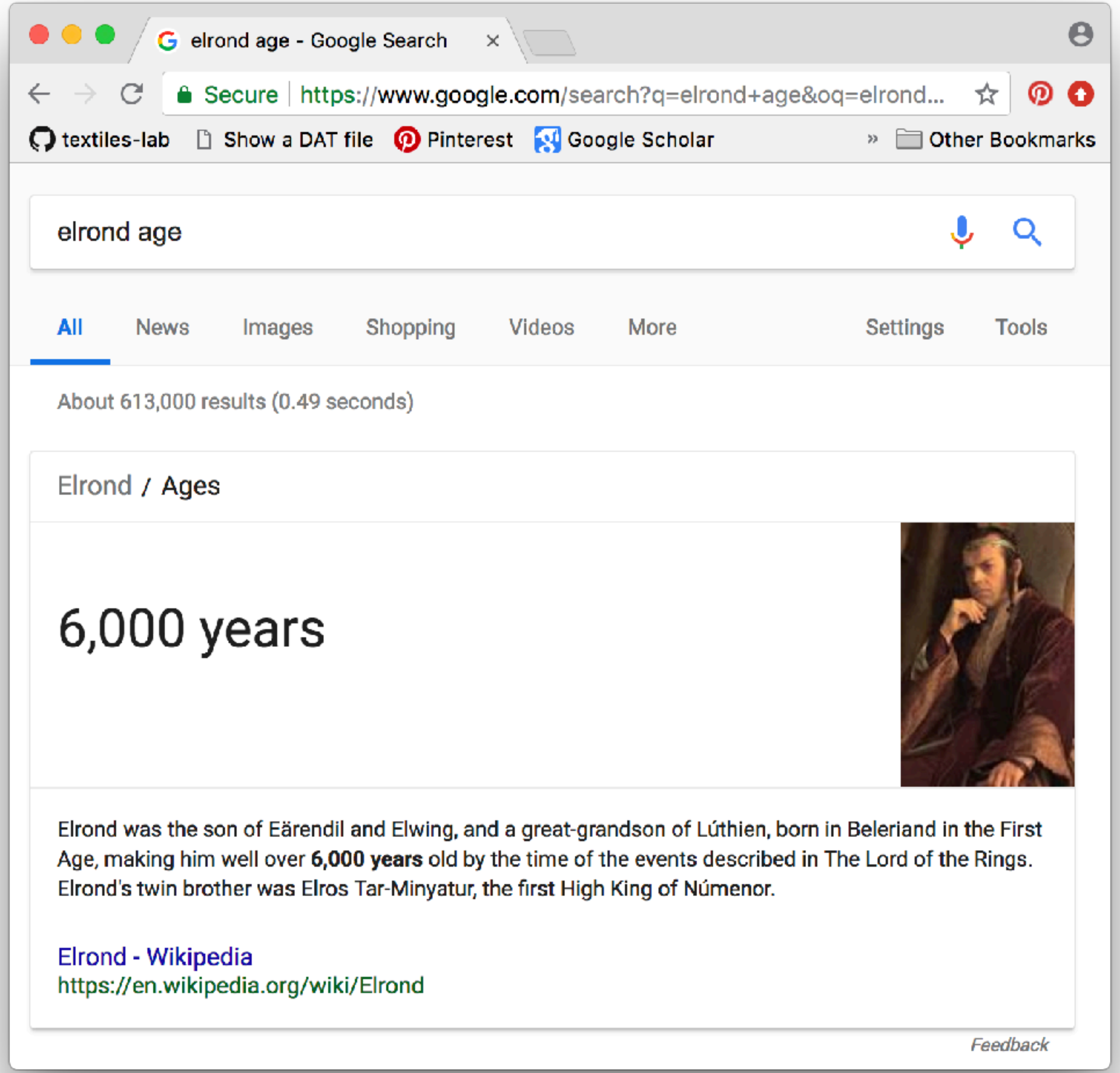
textiles-lab | Show a DAT file | Pinterest | Google Scholar | Dark Sky - Morewo... | Other Bookmarks

History



There are some indications that weaving was already known in the Paleolithic era, as early as 27,000 years ago. An indistinct textile impression has been found at the Dolní Věstonice site.[11] According to the find, the weavers of Upper Palaeolithic were manufacturing a variety of cordage types, produced plaited basketry and sophisticated twined and plain woven cloth. The artifacts include imprints in clay and burned remnants of cloth.[12]

The oldest known textiles found in the Americas are remnants of six finely woven textiles and cordage found in Guitarrero Cave, Peru. The weavings, made from plant fibres, are dated between 10100 and 9080 BCE.[13]

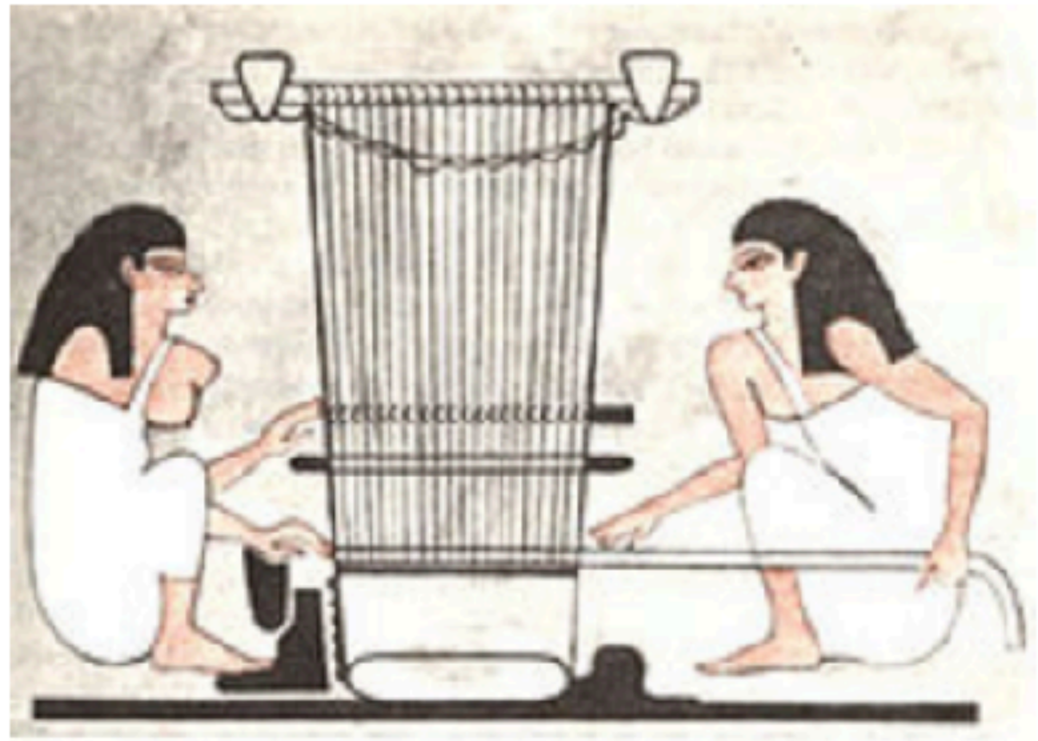

elrond age - Google Search
Secure https://www.google.com/search?q=elrond+age&oq=elrond...
textiles-lab
Show a DAT file
Pinterest
Google Scholar
Other Bookmarks
elrond age
All
News
Images
Shopping
Videos
More
Settings
Tools
About 613,000 results (0.49 seconds)
Elrond / Ages
6,000 years
Elrond was the son of Eärendil and Elwing, and a great-grandson of Lúthien, born in Beleriand in the First Age, making him well over 6,000 years old by the time of the events described in The Lord of the Rings. Elrond's twin brother was Elros Tar-Minyatur, the first High King of Númenor.
Elrond - Wikipedia
https://en.wikipedia.org/wiki/Elrond
Feedback

Weaving - Wikipedia

Secure | https://en.m.wikipedia.org/wiki/Weaving

textiles-lab | Show a DAT file | Pinterest | Google Scholar | Dark Sky - Morewo... | Other Bookmarks

History



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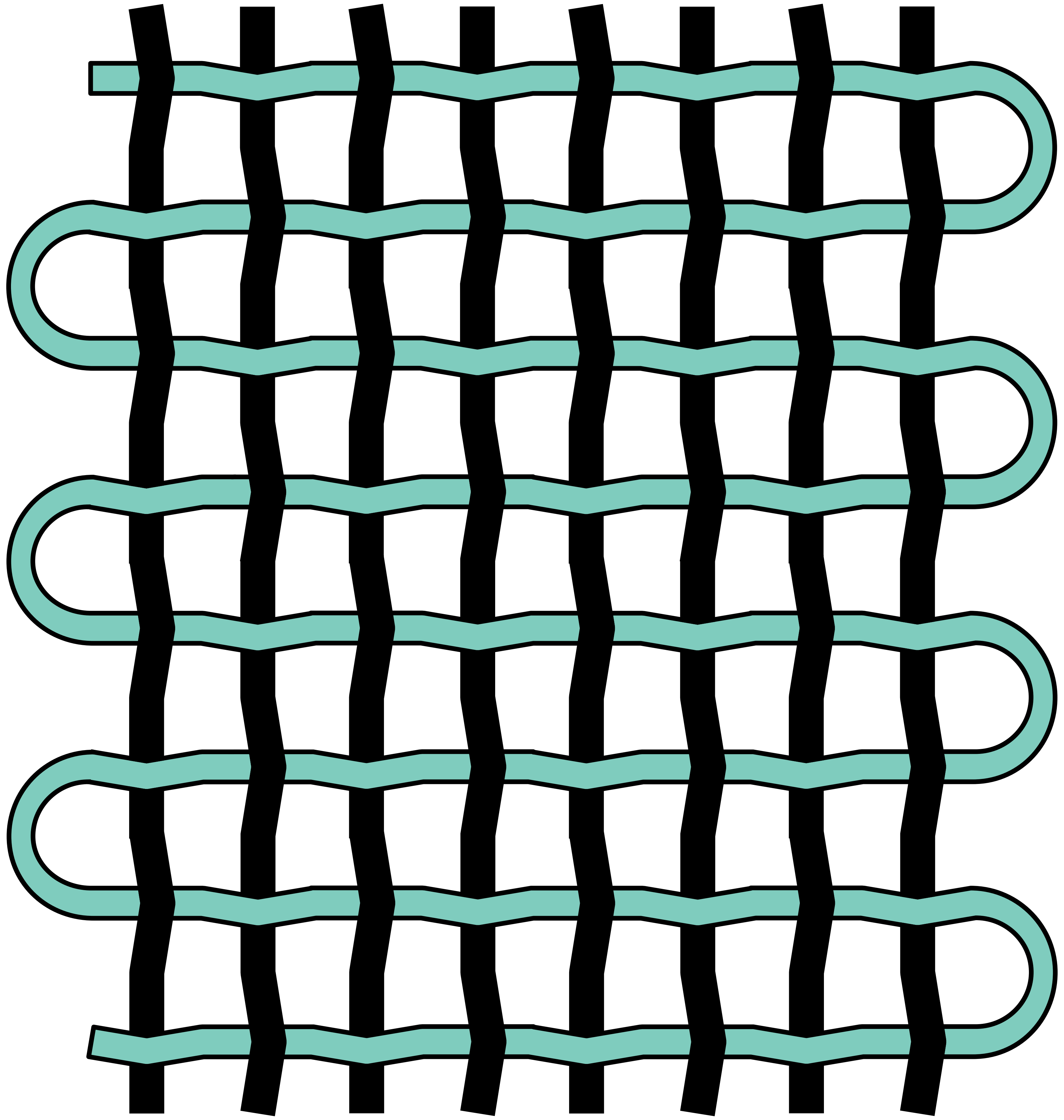
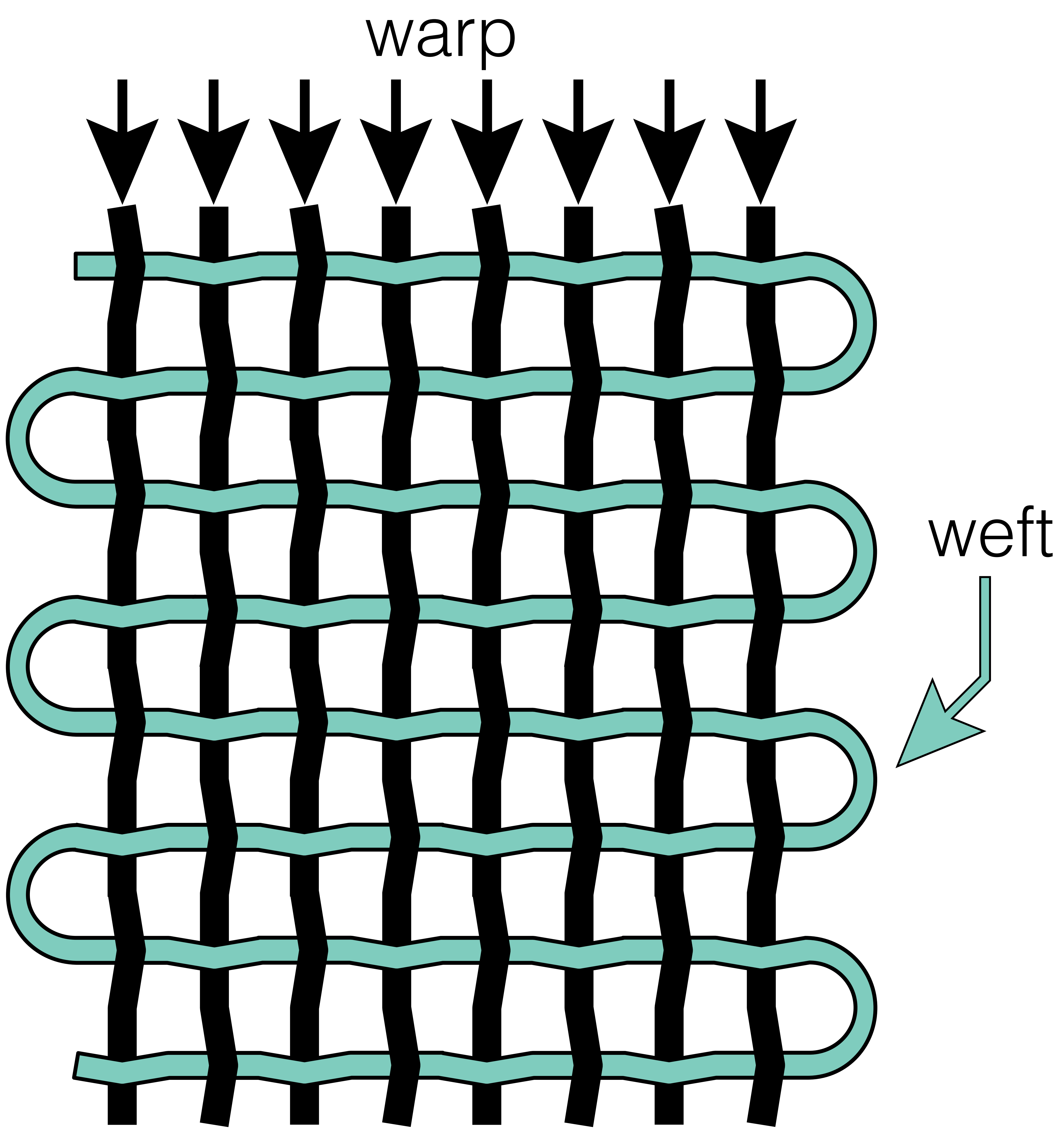
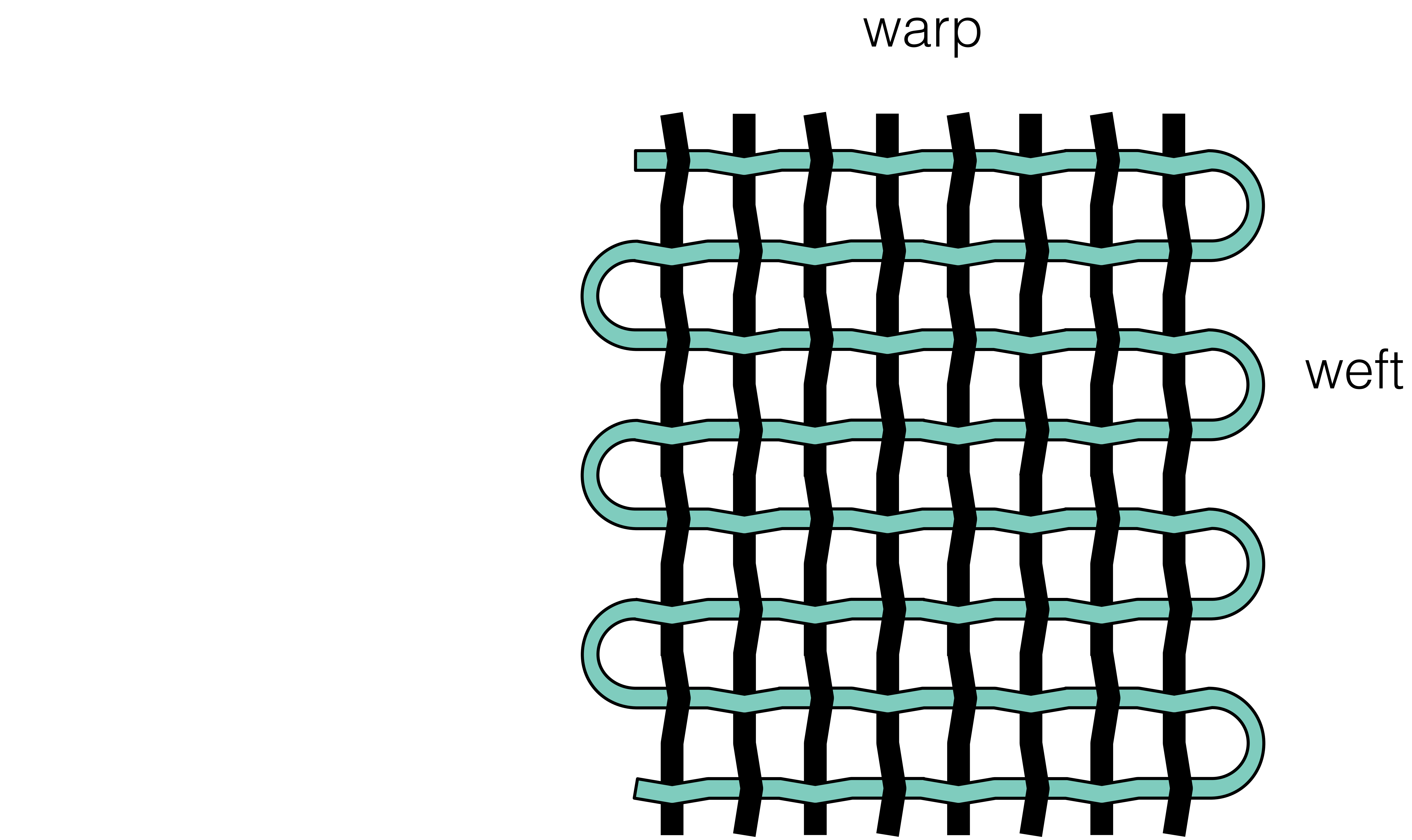
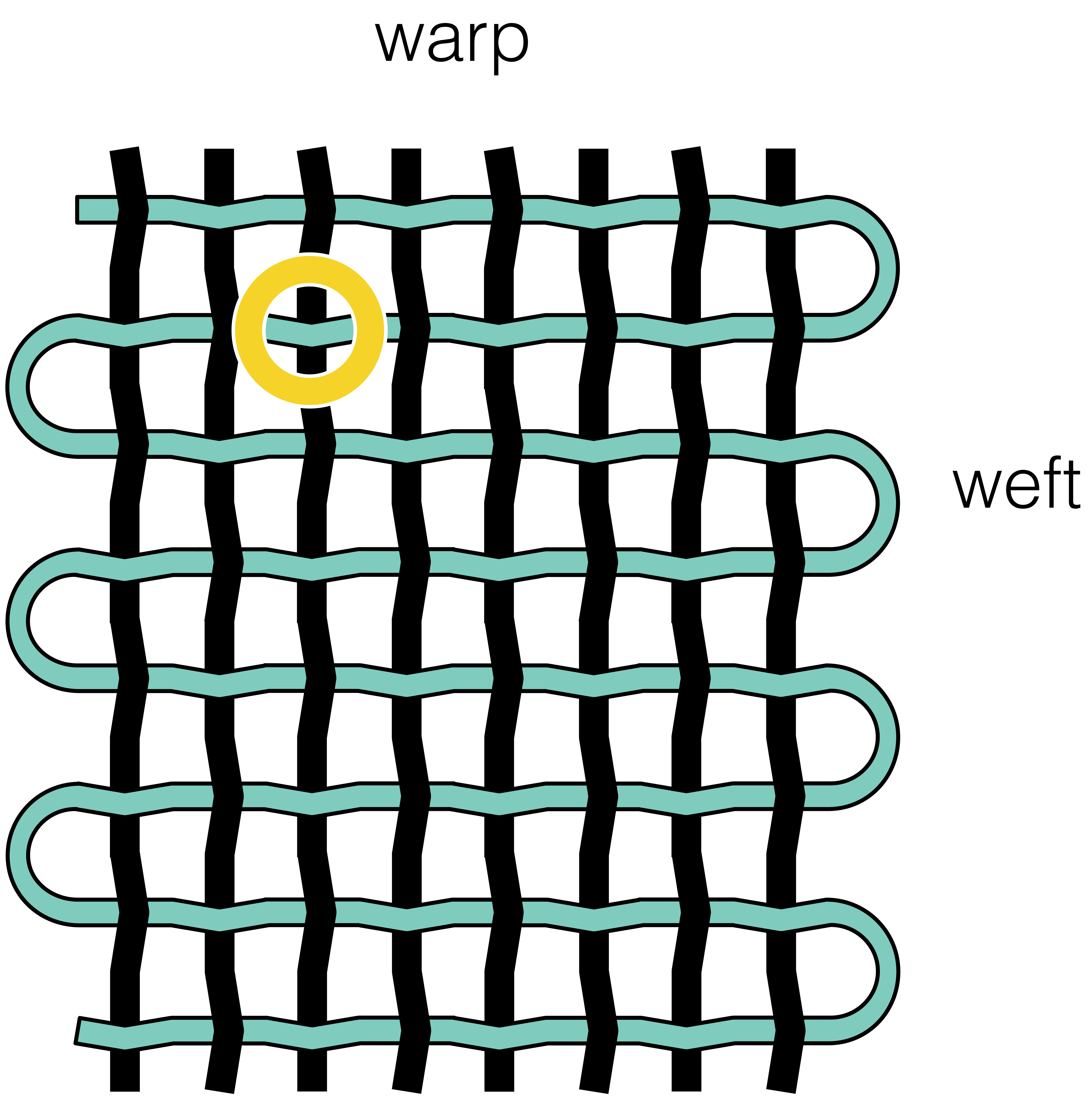


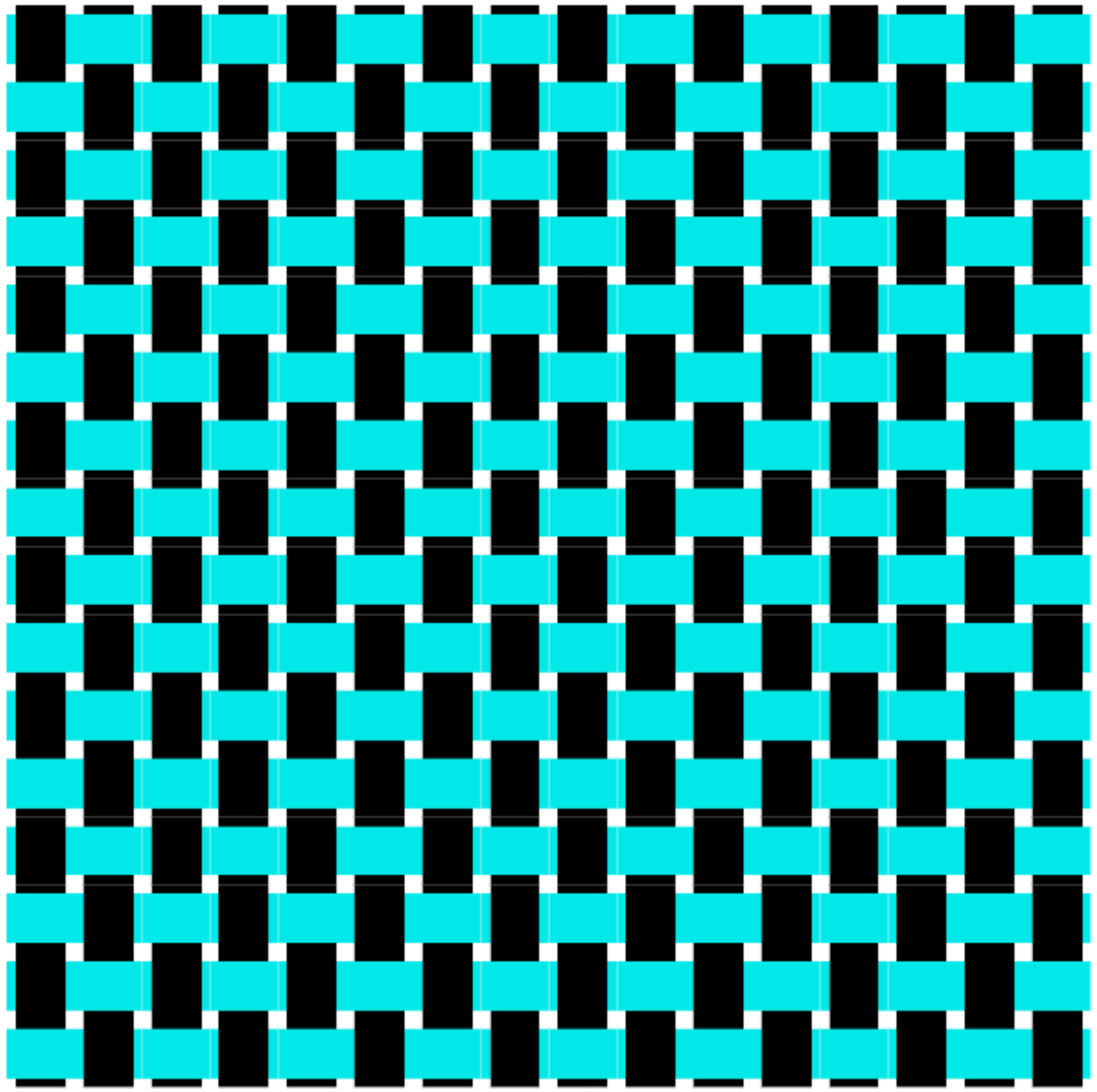

warp
weft



“plain weave”



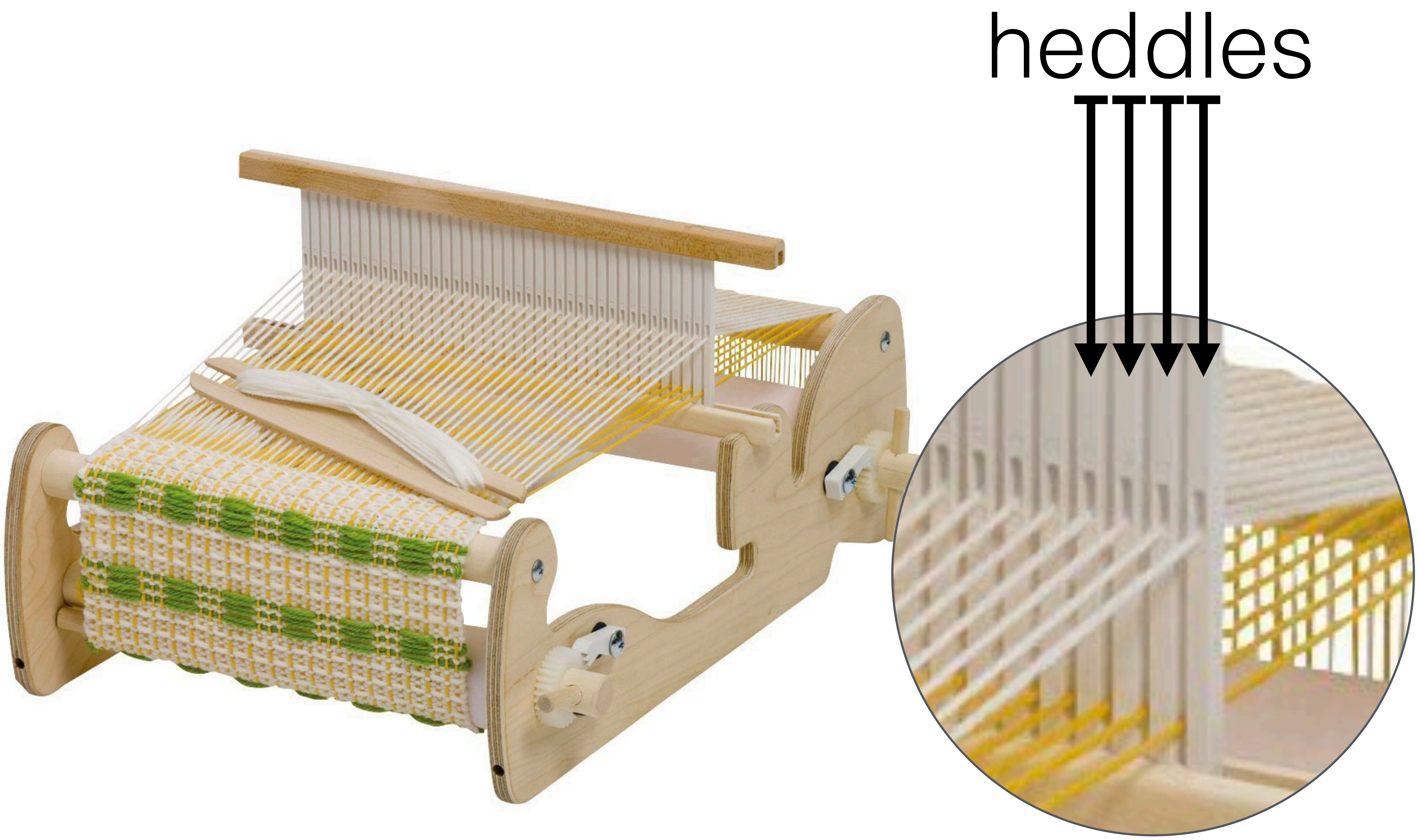
"plain weave"



what even is a loom

“Shed”:
a space between
some warps and others

Schacht “Cricket” rigid heddle loom



Schacht “Cricket” rigid heddle loom

https://commons.wikimedia.org/wiki/File:Jacquard_loom_nmih_3.jpg

https://commons.wikimedia.org/wiki/File:Jacquard_loom_nmih_3.jpg

Schacht “Baby Wolf” four shaft floor loom

shafts/frames

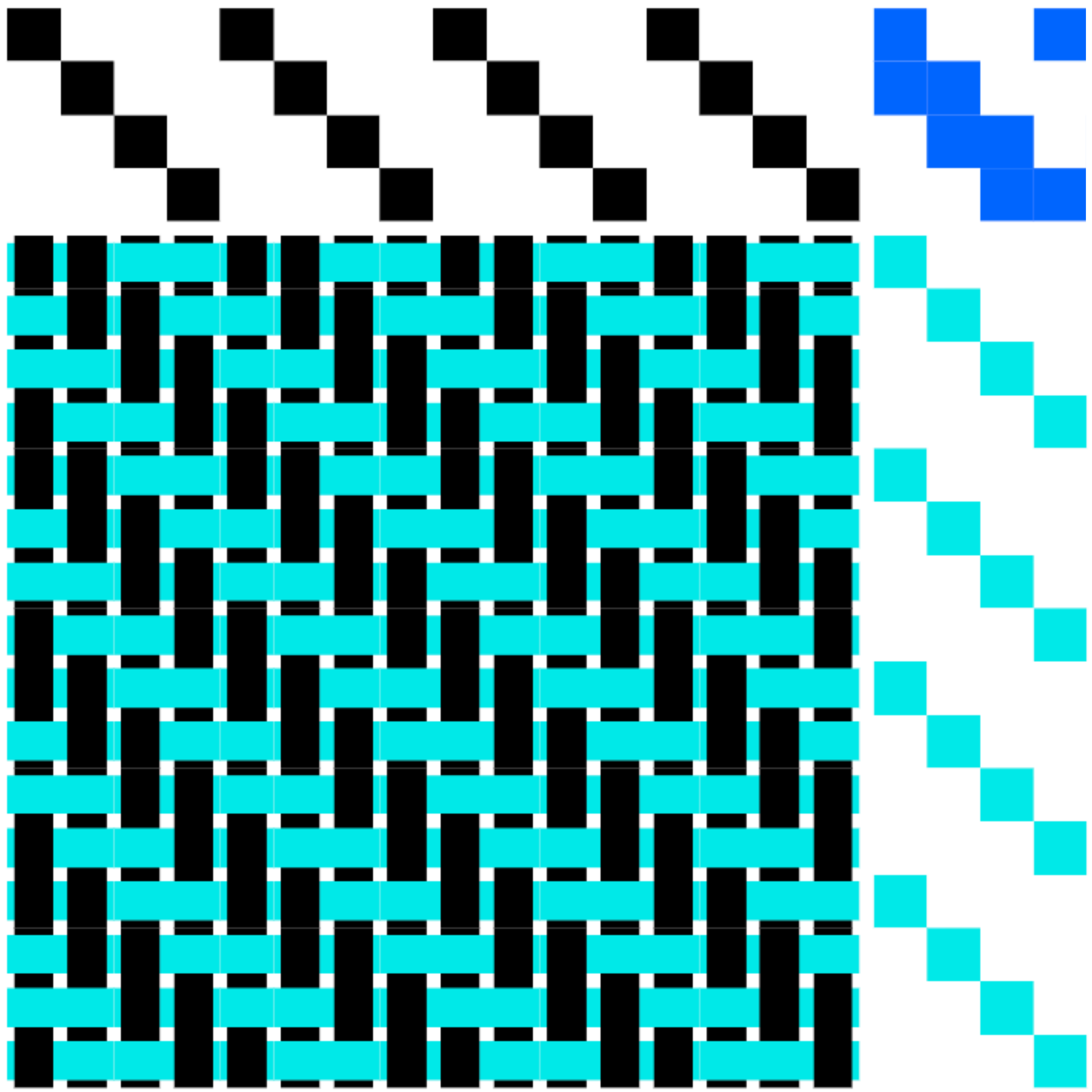
Schacht “Baby Wolf” four shaft floor loom

pedals... 11 of them?
...why?

Schacht “Baby Wolf” four shaft floor loom

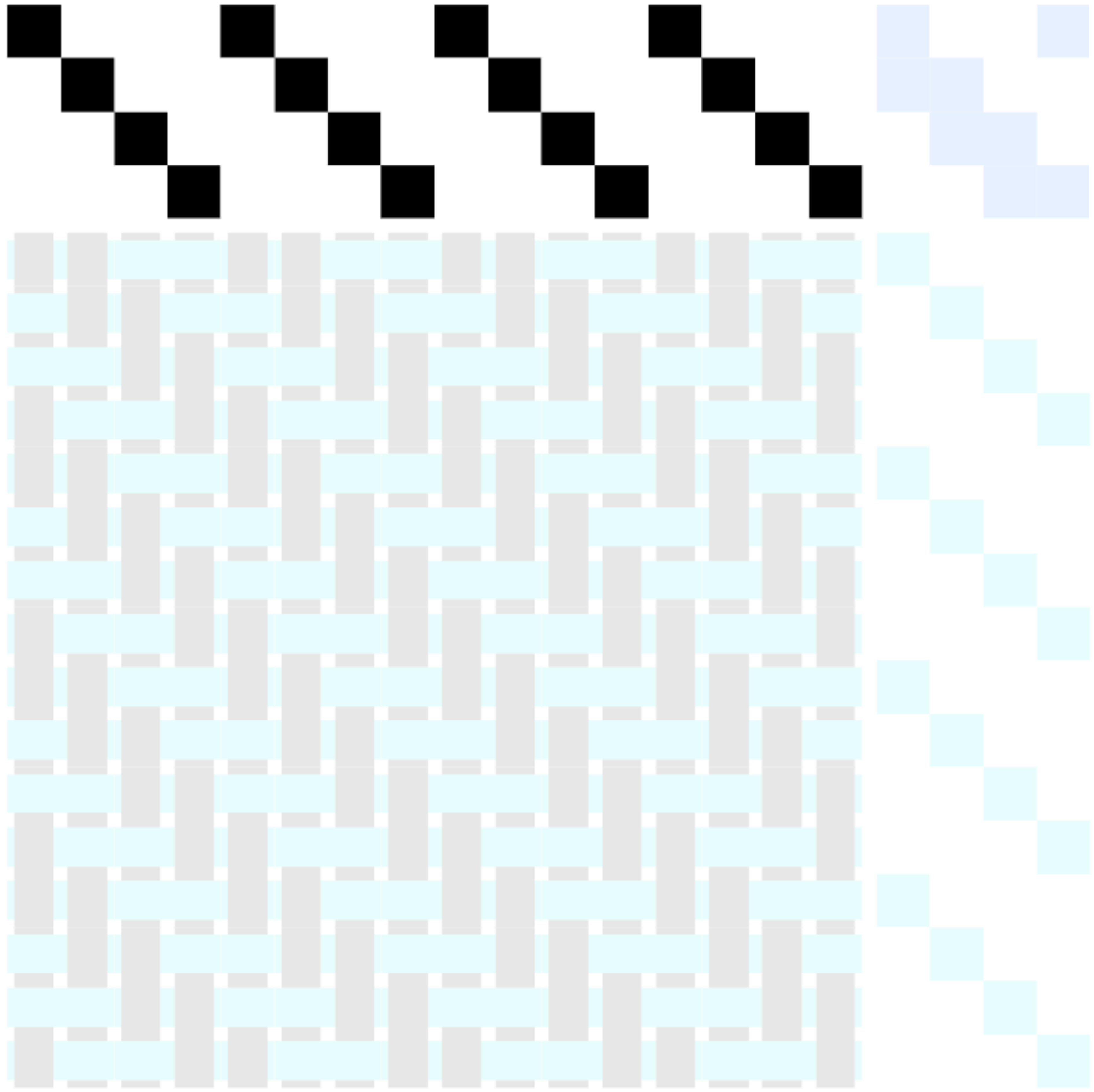
~tie-up~

Schacht “Baby Wolf” four shaft floor loom

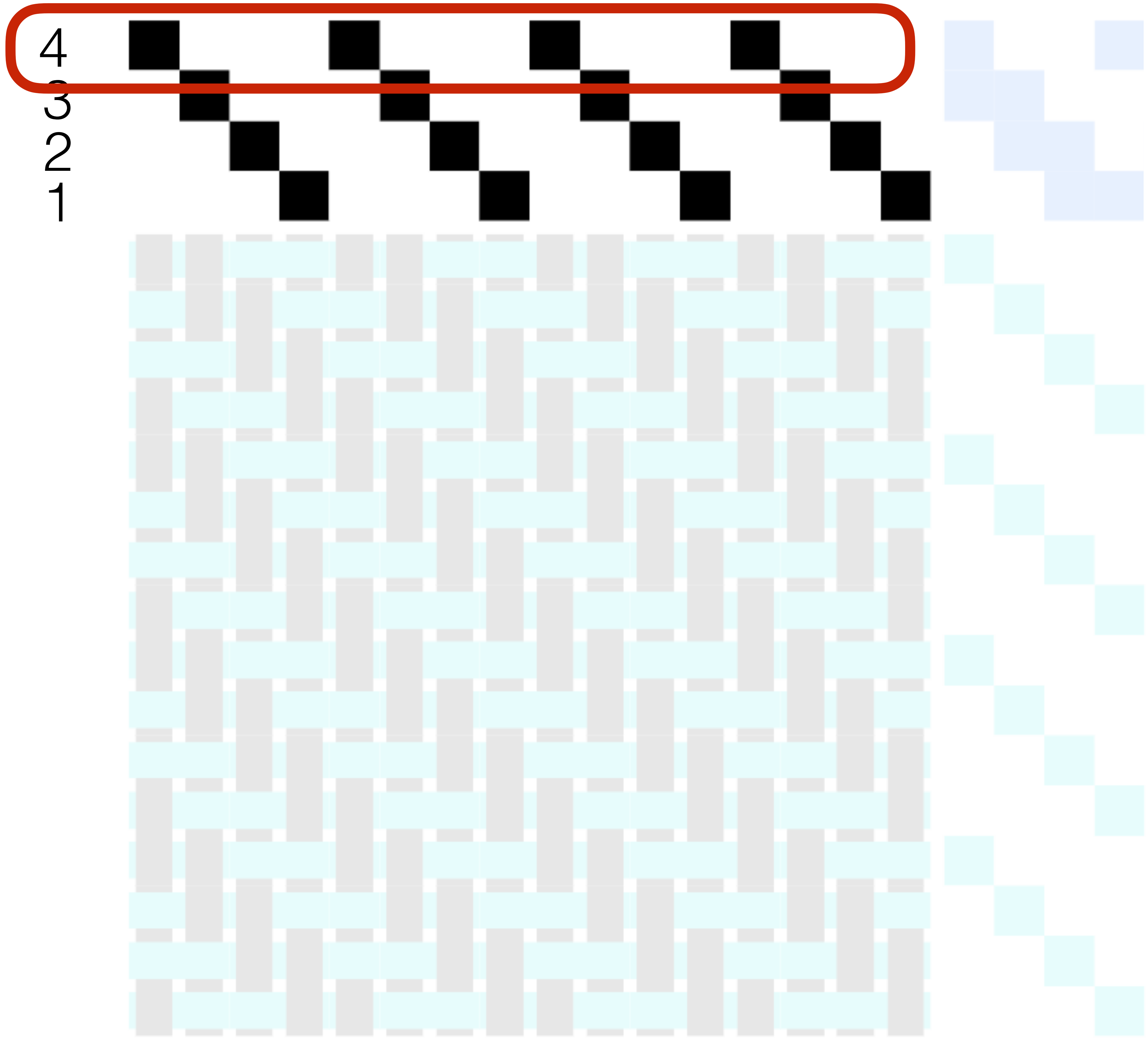


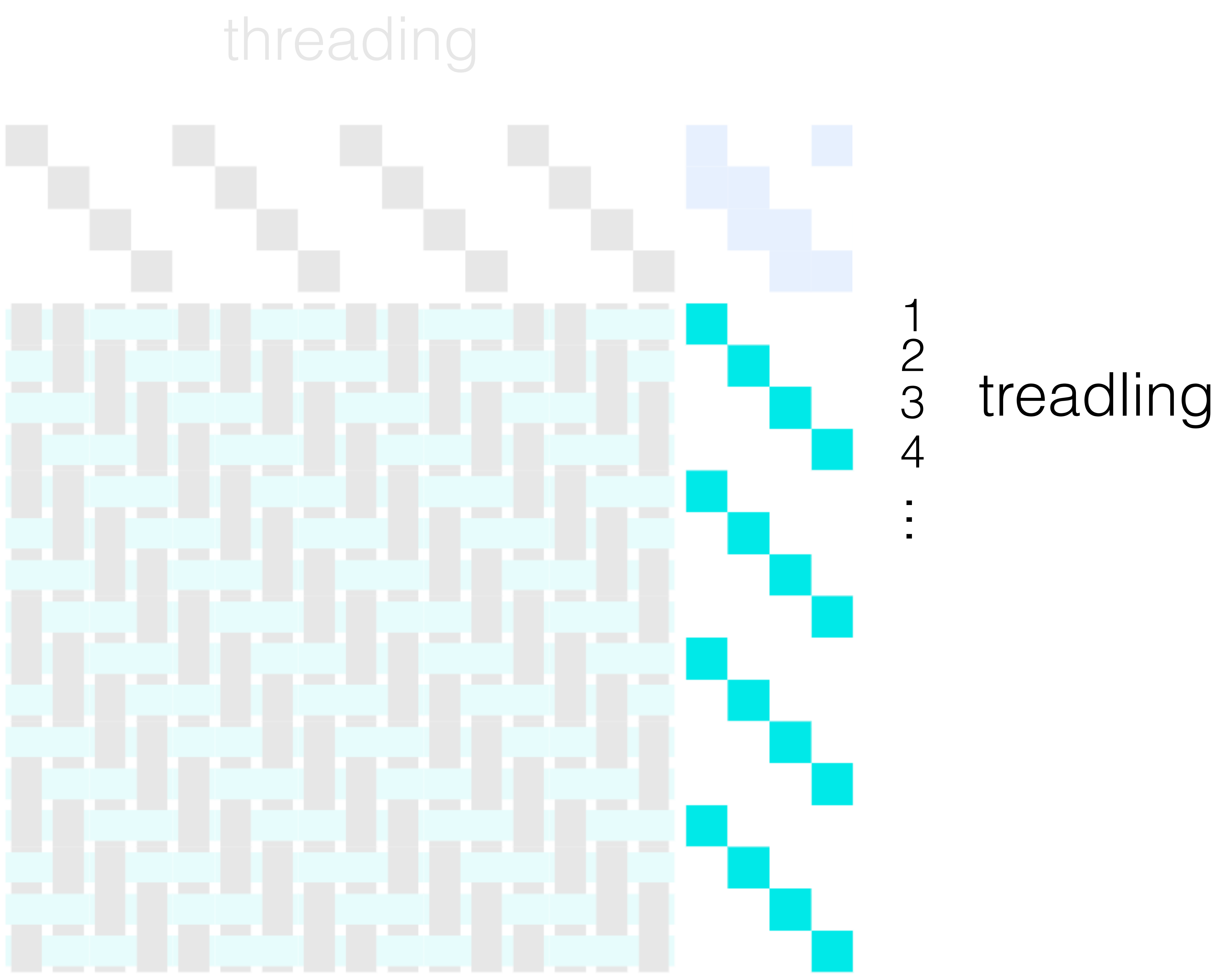
a weaving draft ("2x2 twill weave")

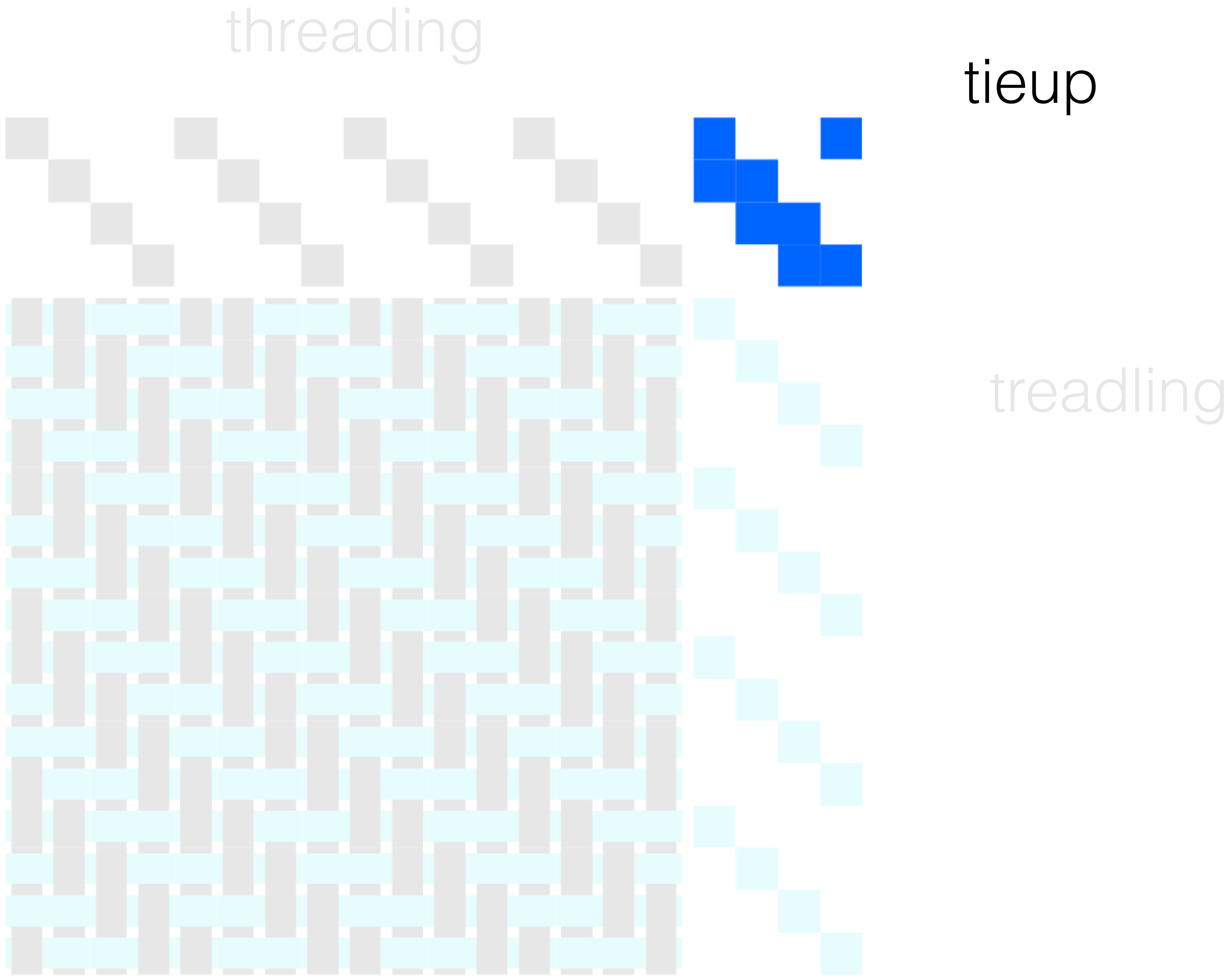
threading

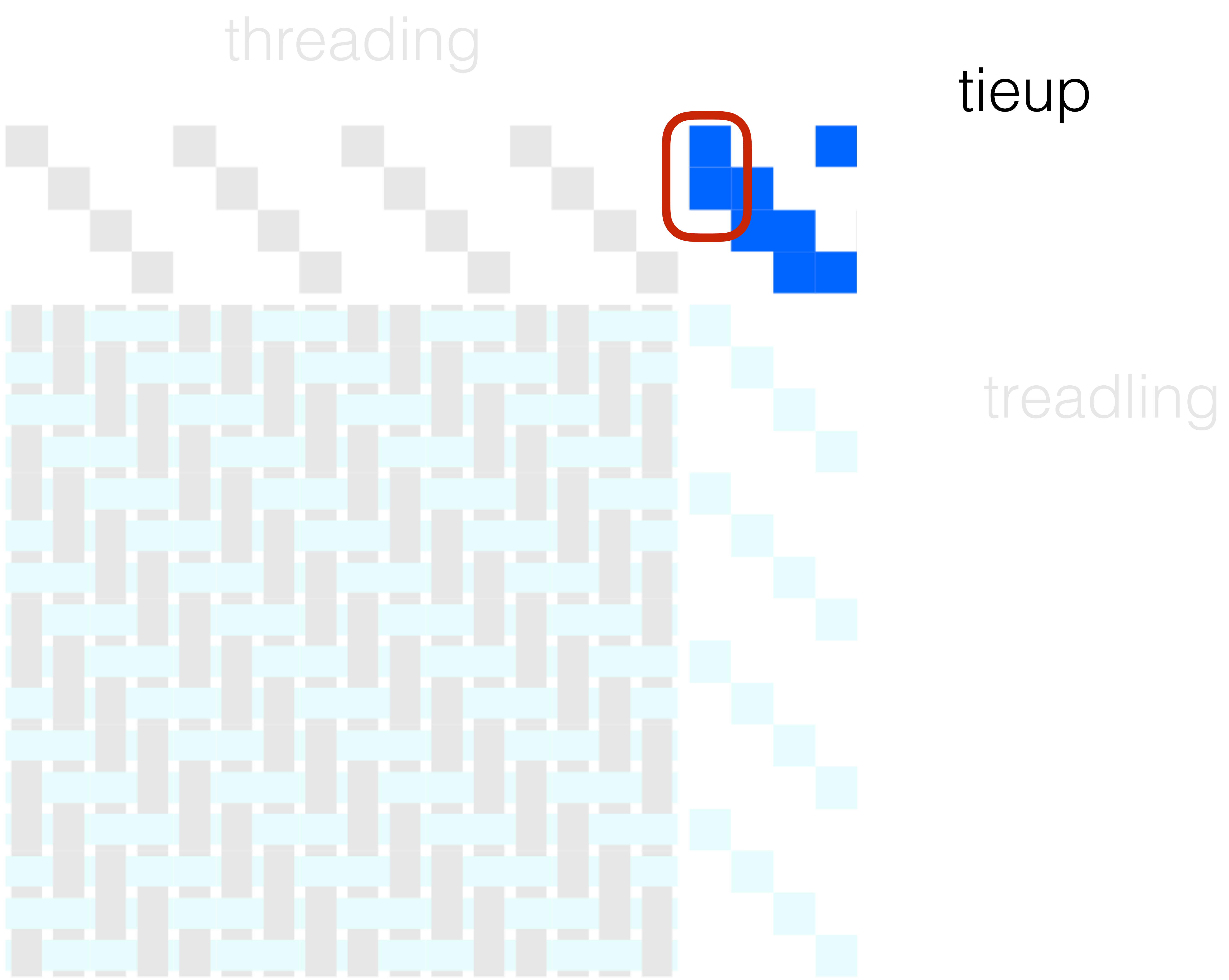


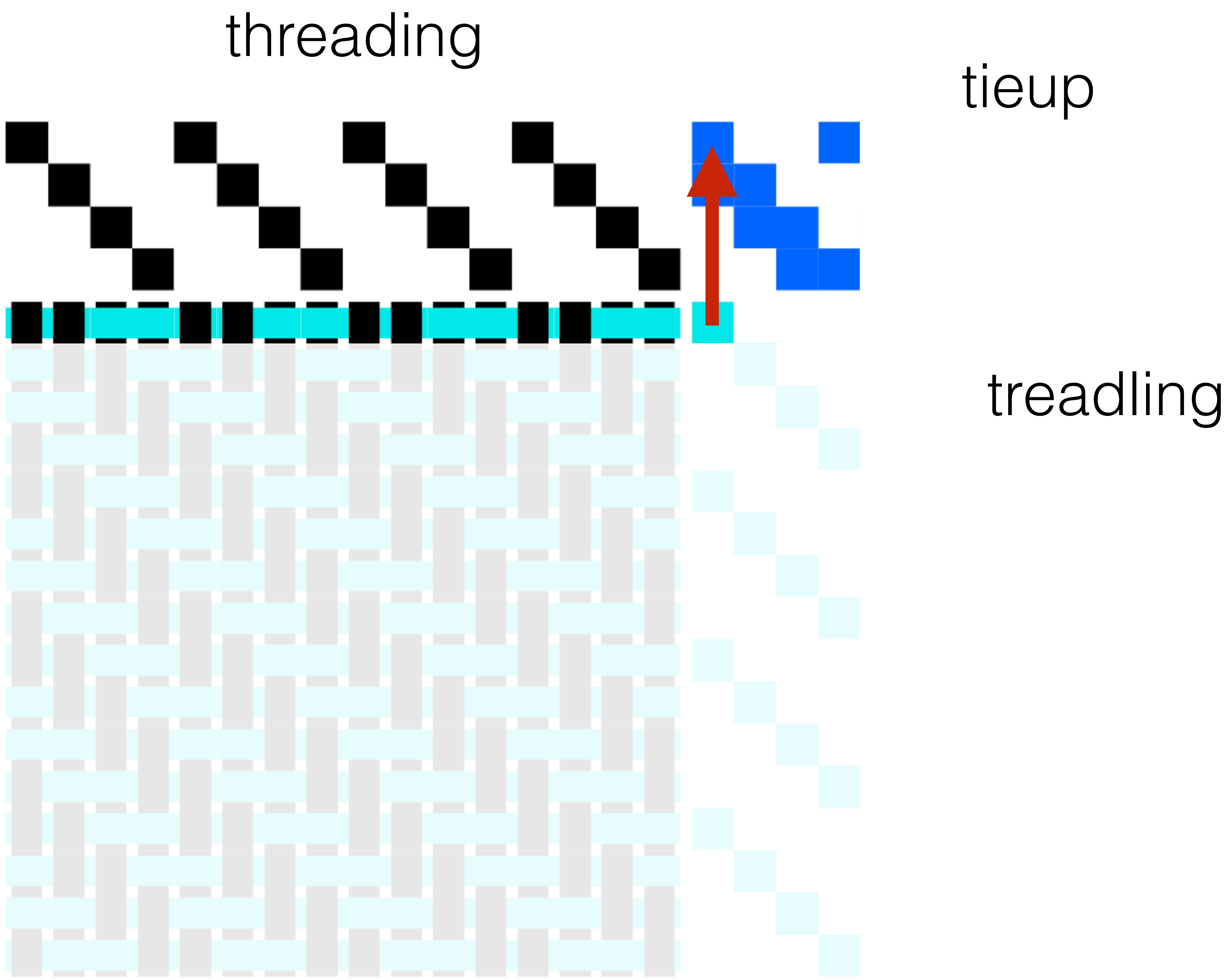
threading

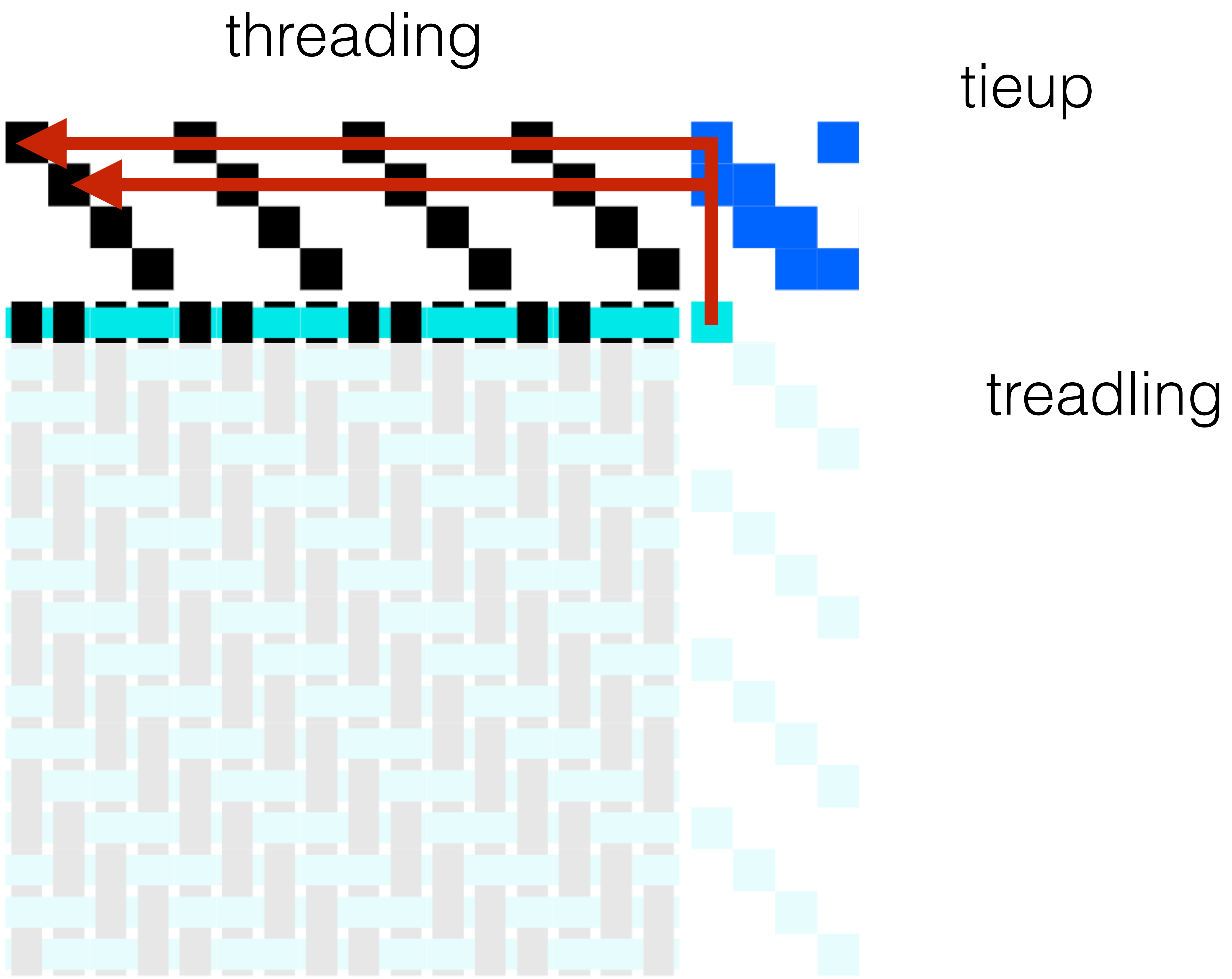


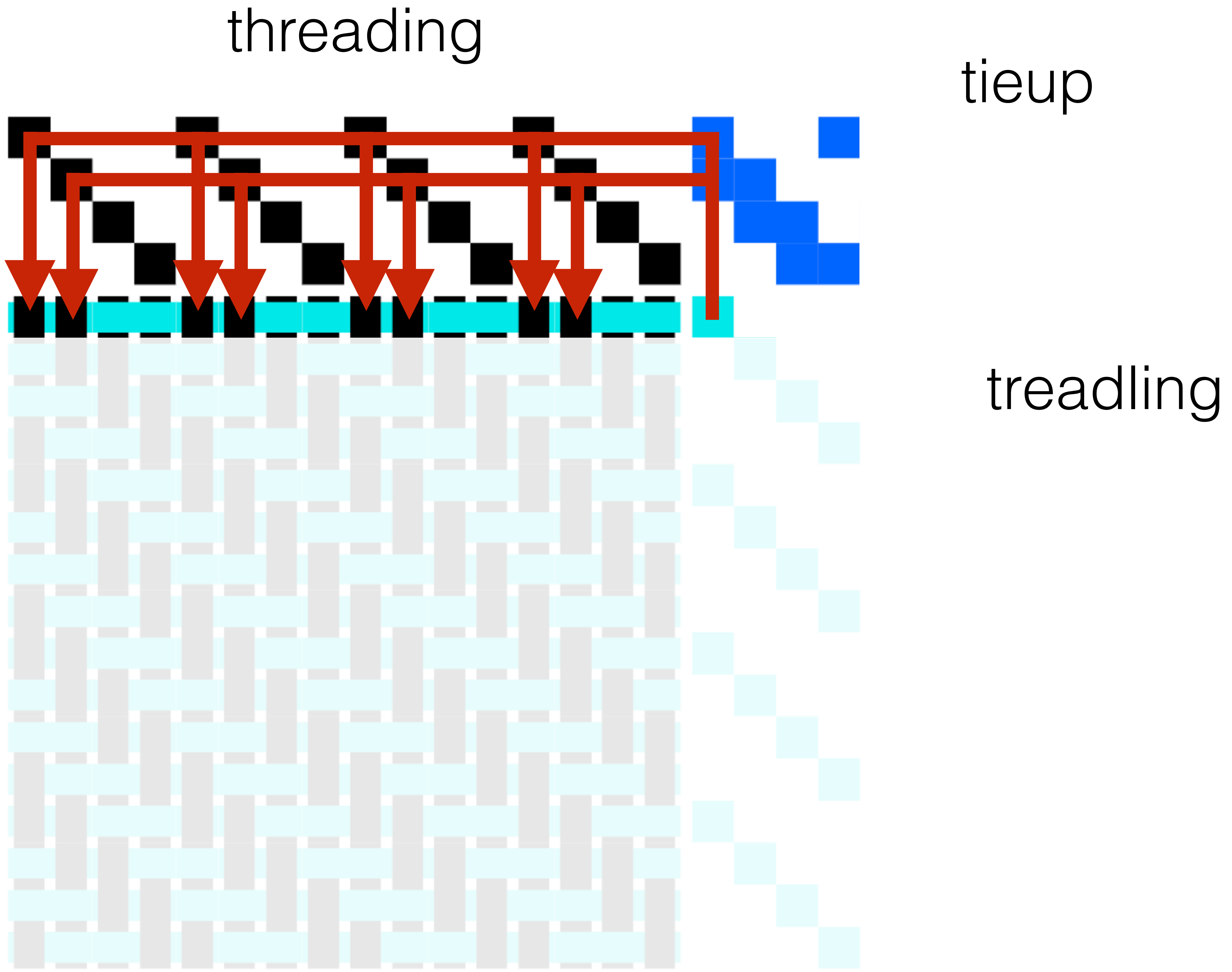

threading
1
2
3
4
⋮
treadling

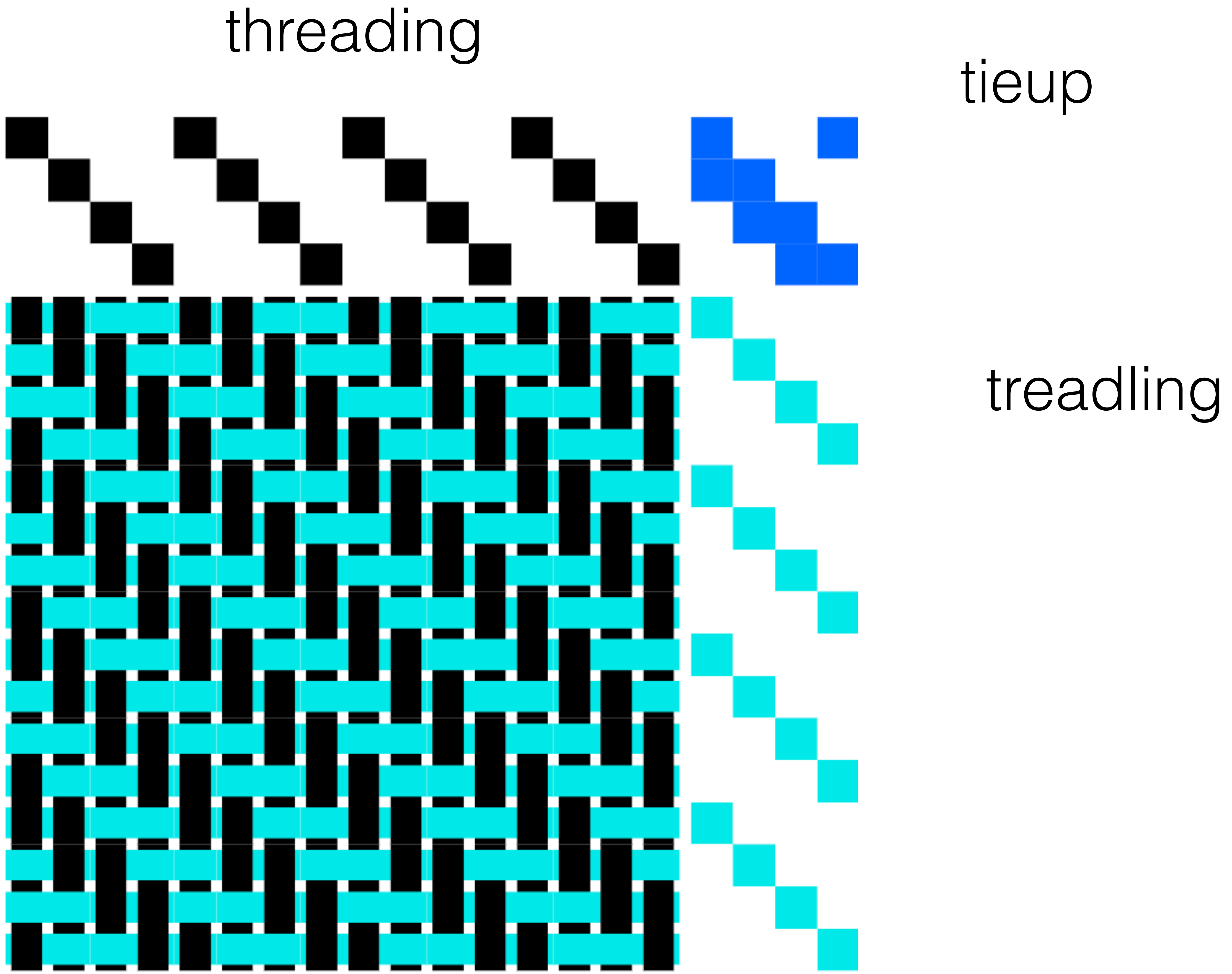

threading
tieup
treadling

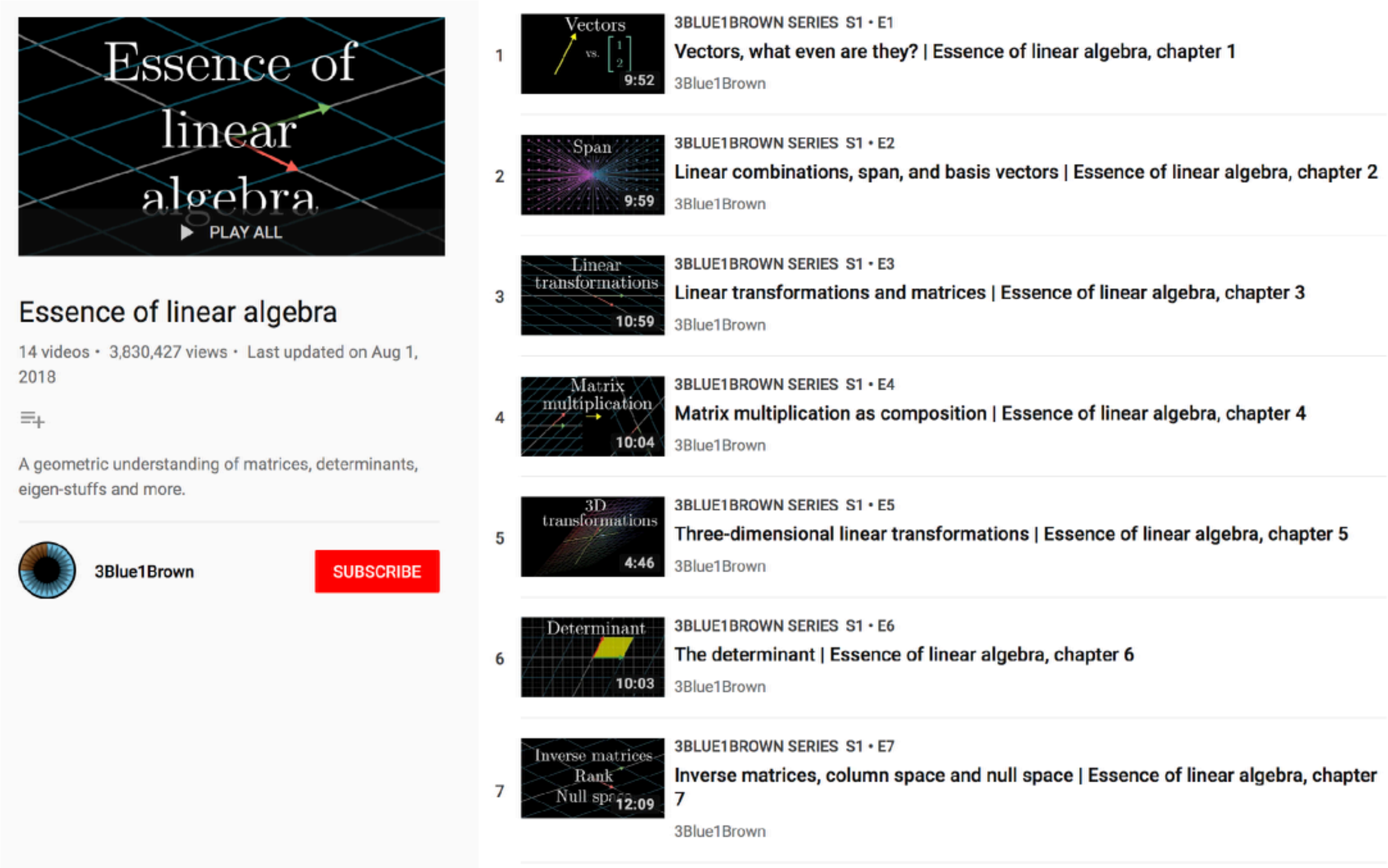

threading
tieup
treadling


threading
tieup
treadling


threading
tieup
treadling


threading
tieup
treadling


threading
tieup
treadling



Grant Sanderson, “3blue1brown”

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

$$B = \begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} & & \\ & & \\ & & \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} (1 \times 10) & & \\ & & \\ & & \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} 10 + (2 \times 13) & & \\ & & \\ & & \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} 10 + 26 + (3 \times 16) & & \\ & & \\ & & \end{bmatrix}$$

$$A \times B =$$

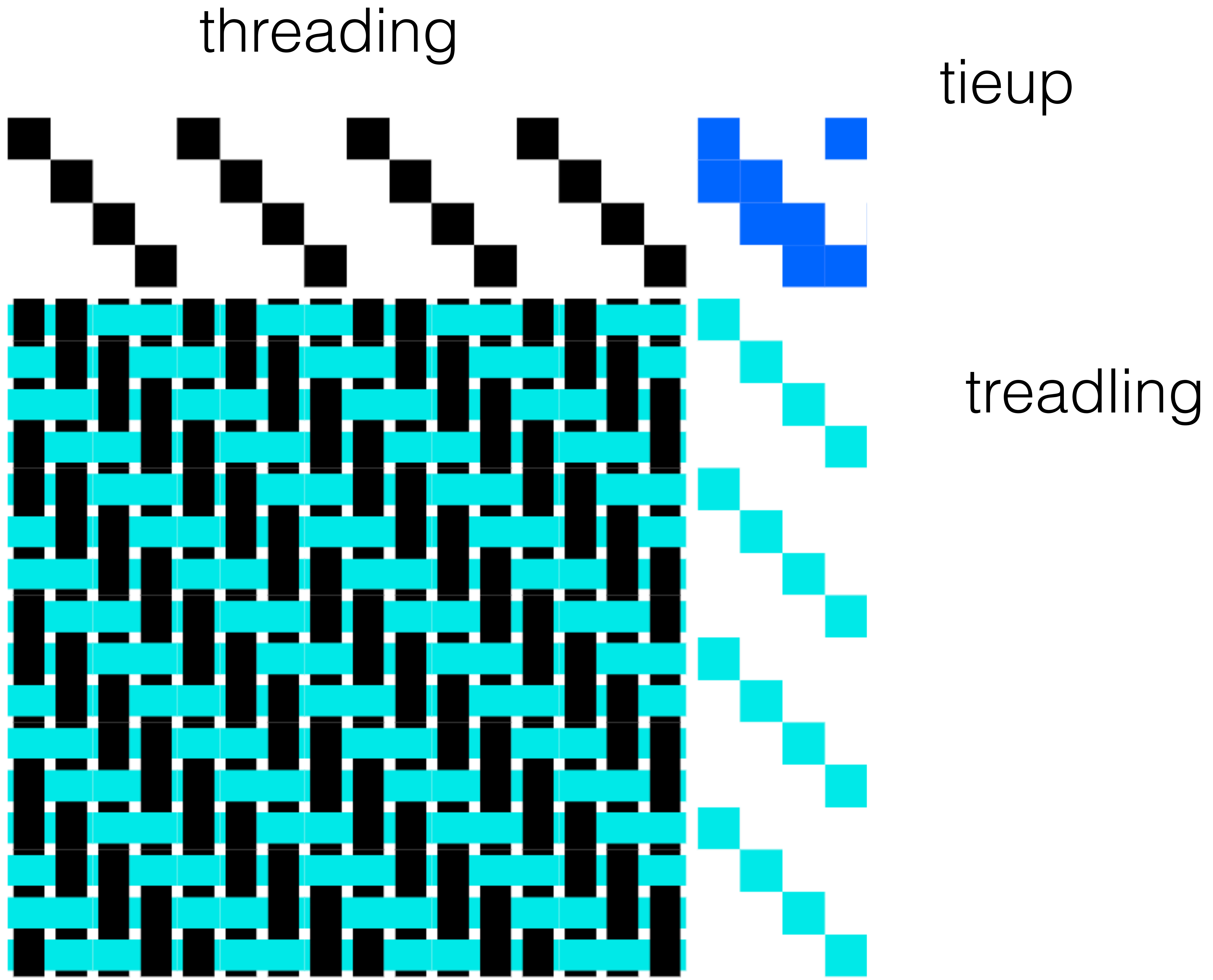
$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

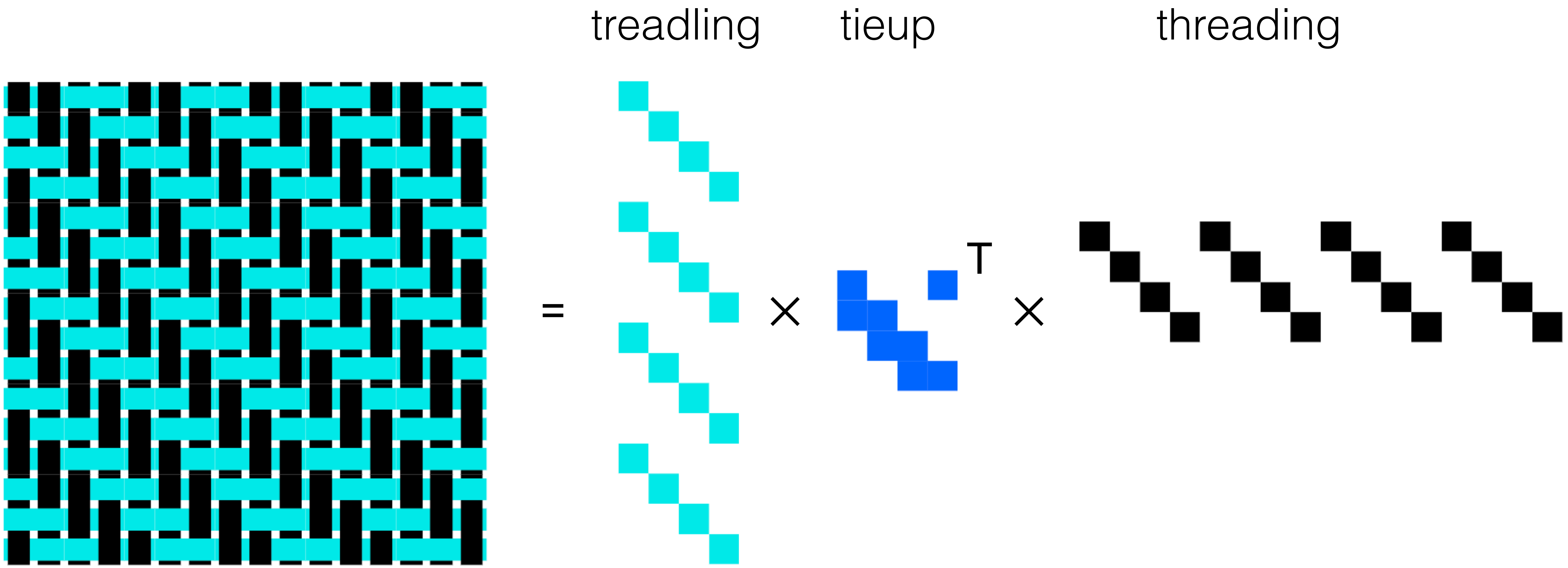
$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} 84 & & \\ & & \\ & & \end{bmatrix}$$

$$A \times B =$$

$$\begin{bmatrix} 10 & 11 & 12 \\ 13 & 14 & 15 \\ 16 & 17 & 18 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \begin{bmatrix} 84 & 90 & 96 \\ 201 & 216 & 231 \\ 318 & 342 & 366 \end{bmatrix}$$


threading
tieup
treadling


treadling
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threading
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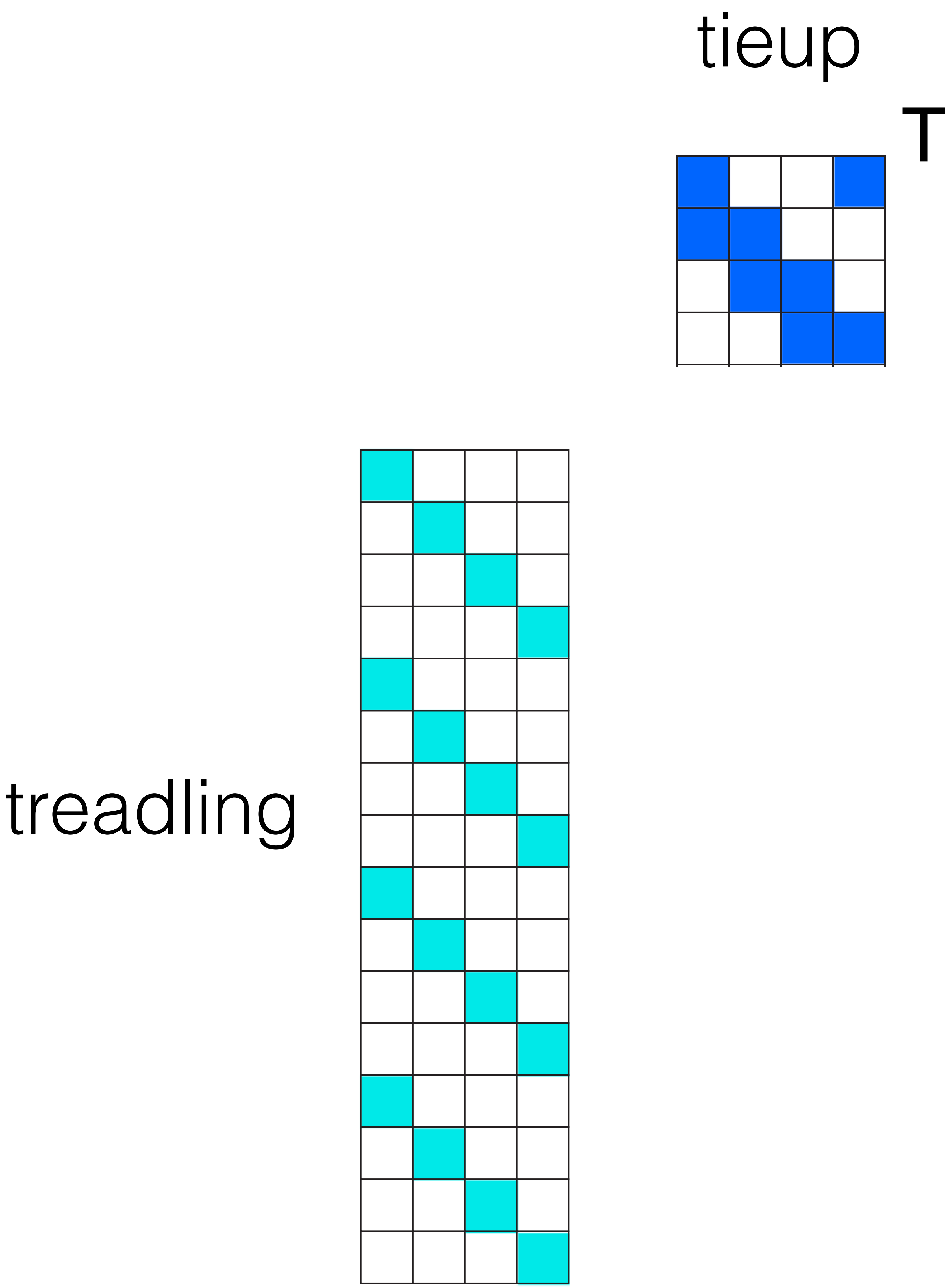
tieup
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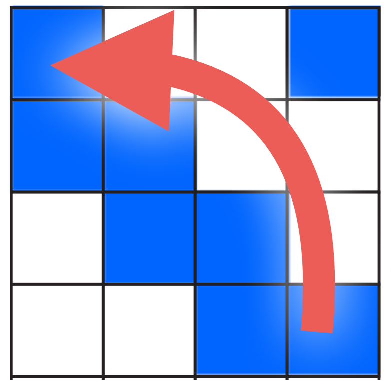
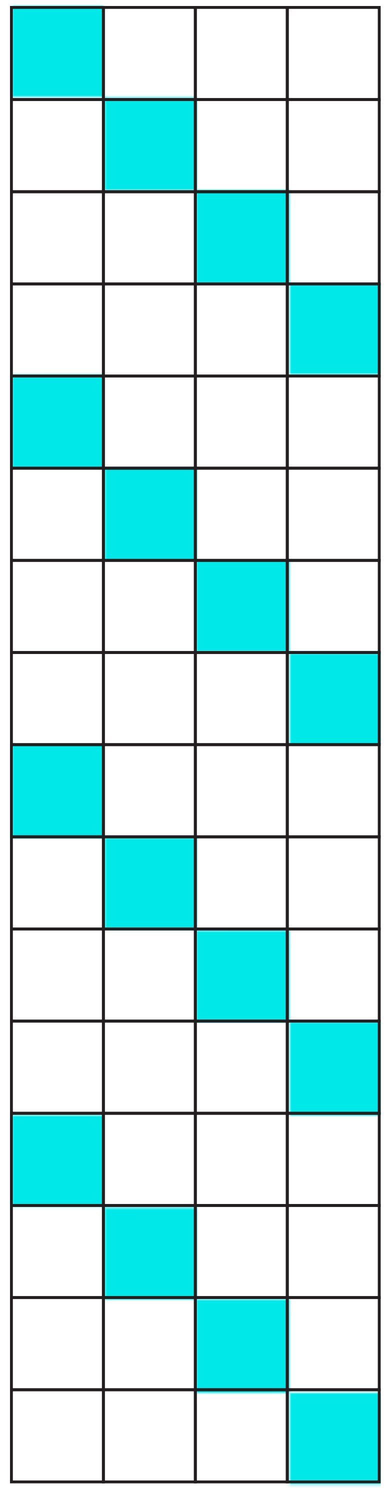
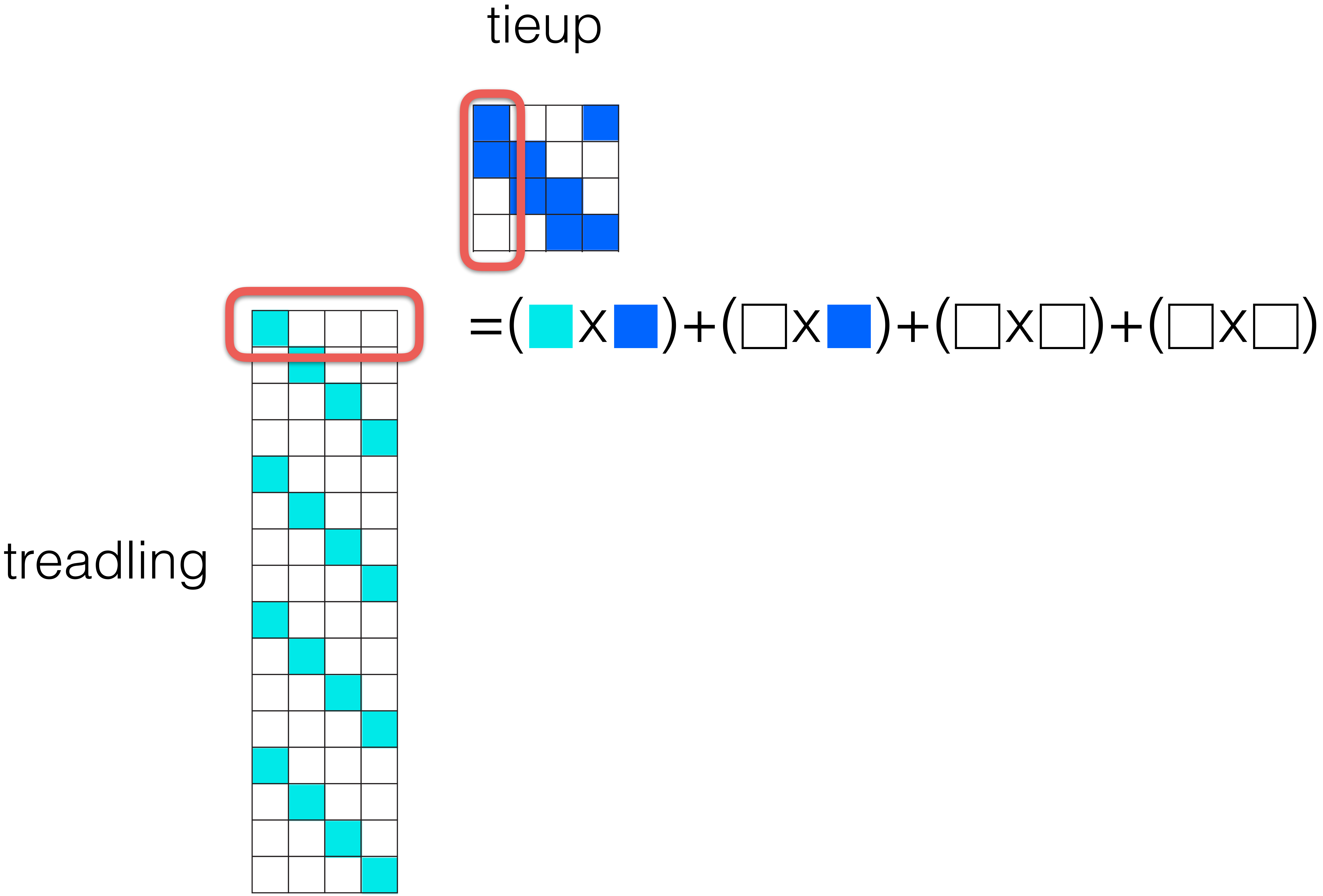
tieup

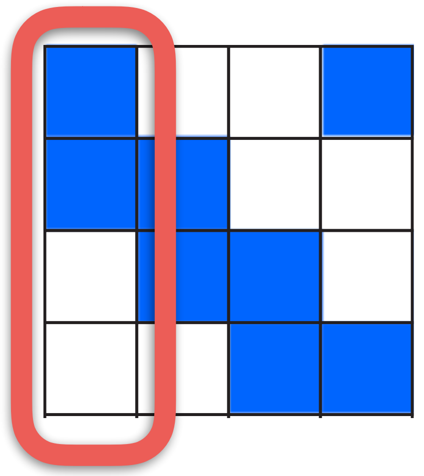


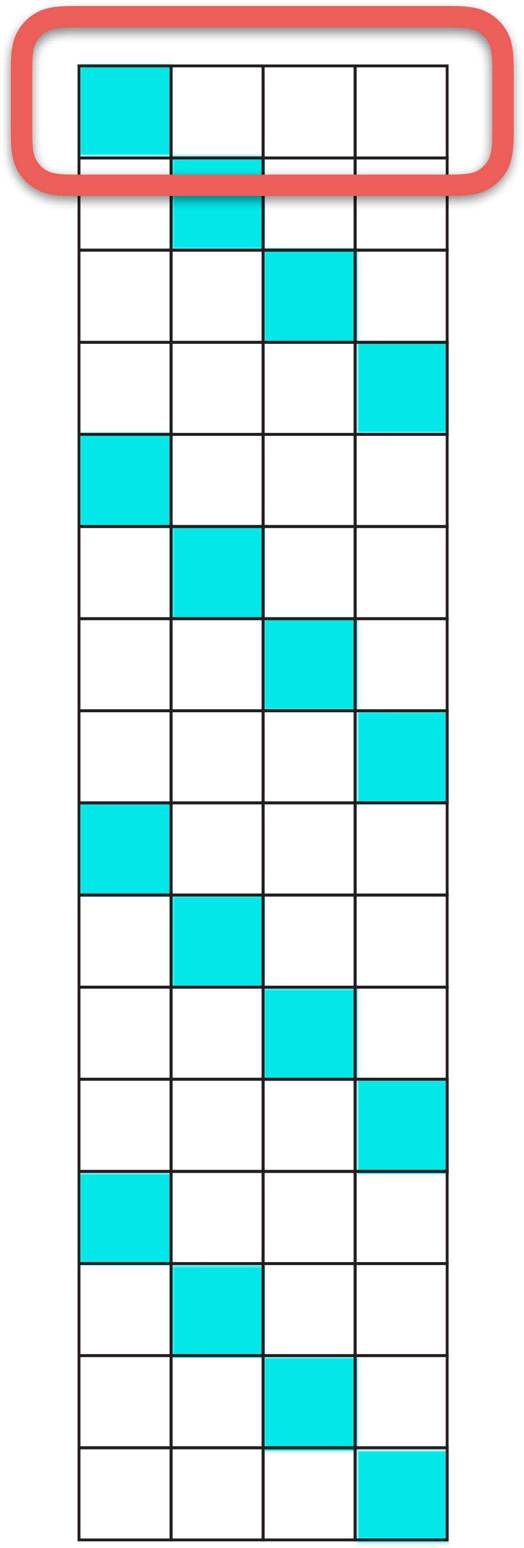
treadling




tieup
treadling

tieup



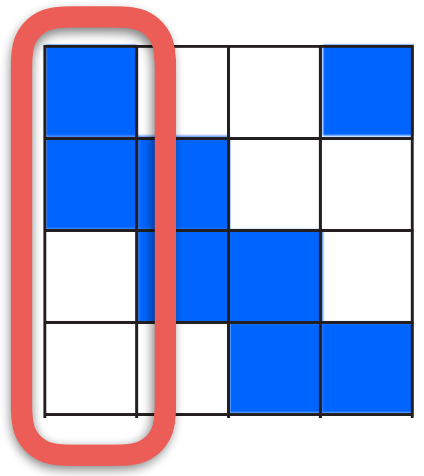


=(■x■)+(□x■)+(□x□)+(□x□)

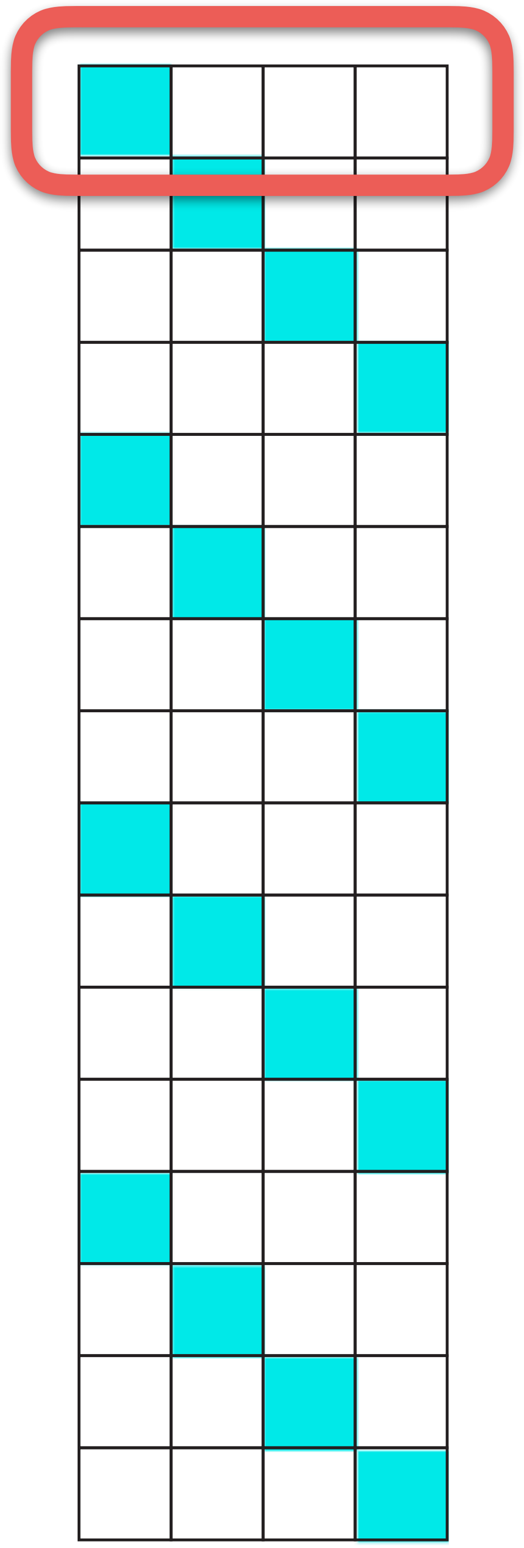
$$=(1 \times 1)+(0 \times 1)+(0 \times 0)+(0 \times 0)$$

treadling

tieup



treadling

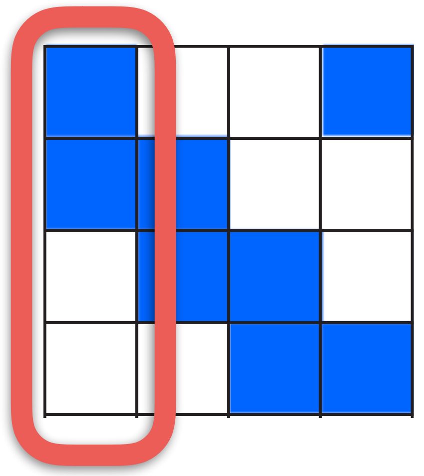


=(■x■)+(□x■)+(□x□)+(□x□)

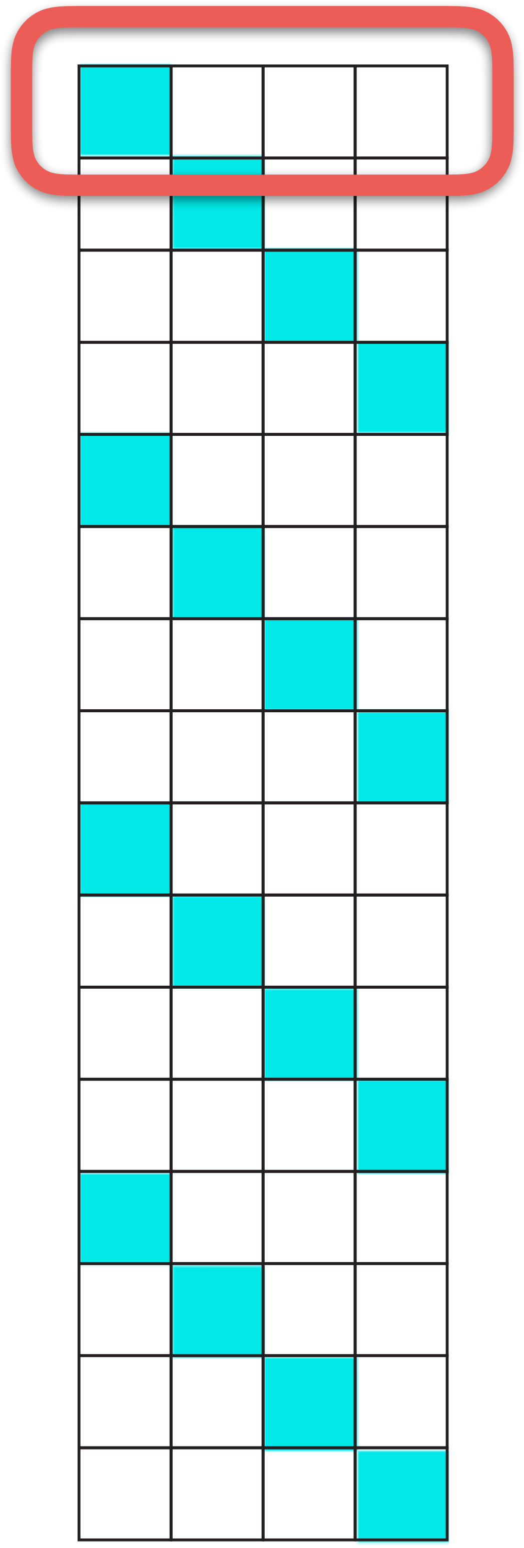
$$=(1 \times 1)+(0 \times 1)+(0 \times 0)+(0 \times 0)$$

$$=1+0+0+0$$

tieup



treadling

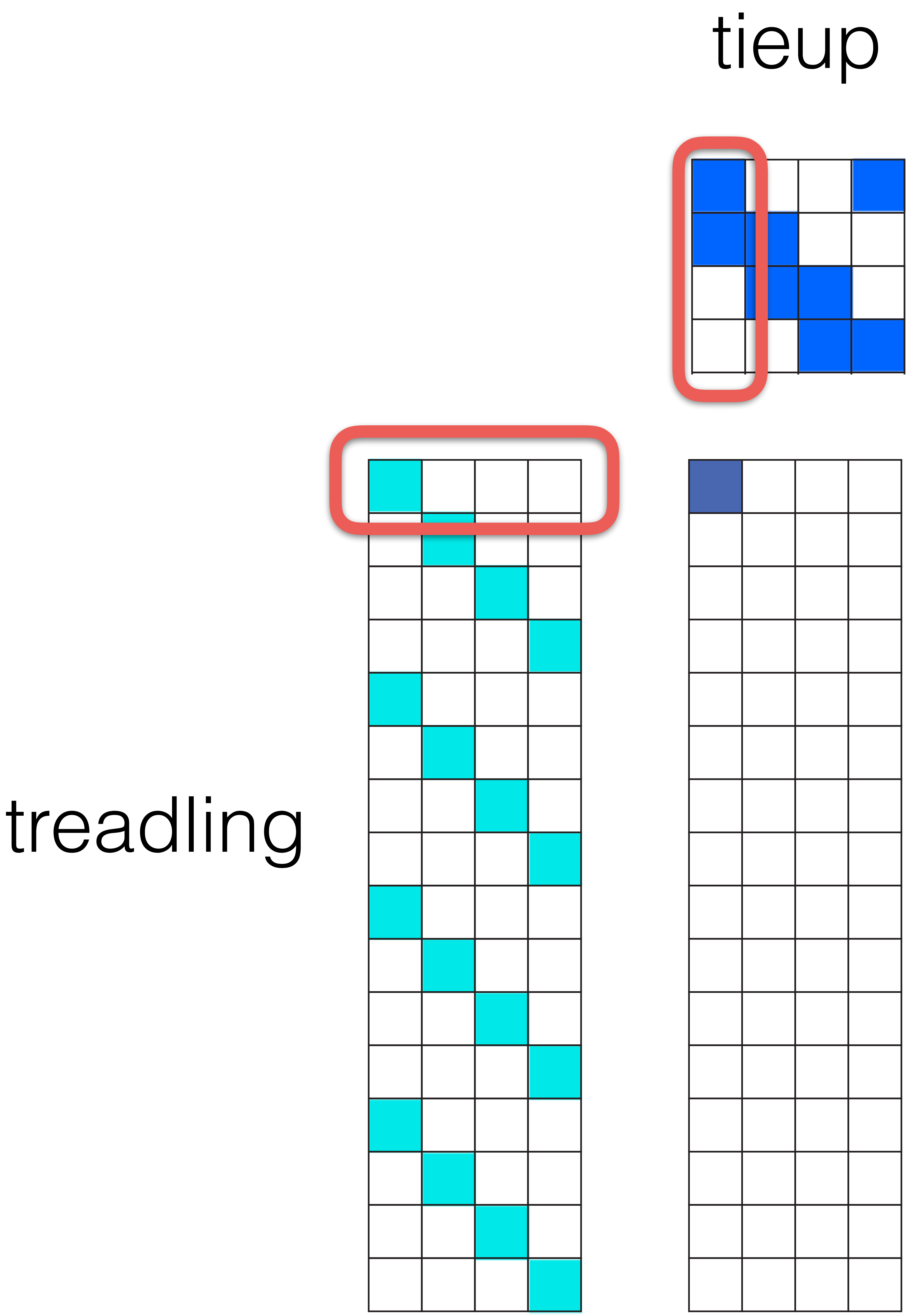


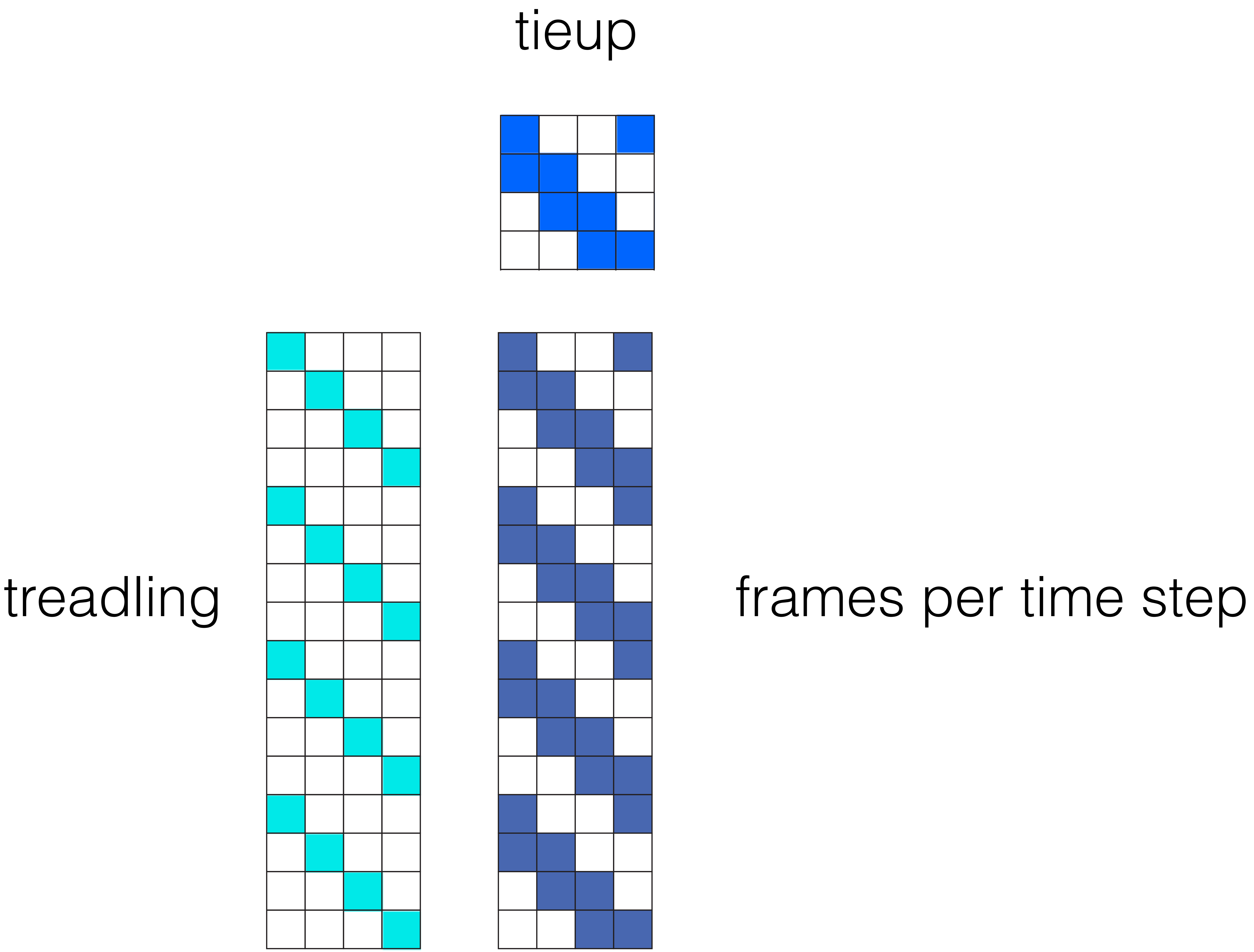
$$=(\blacksquare \times \blacksquare)+(\square \times \blacksquare)+(\square \times \square)+(\square \times \square)$$

$$=(1 \times 1)+(0 \times 1)+(0 \times 0)+(0 \times 0)$$

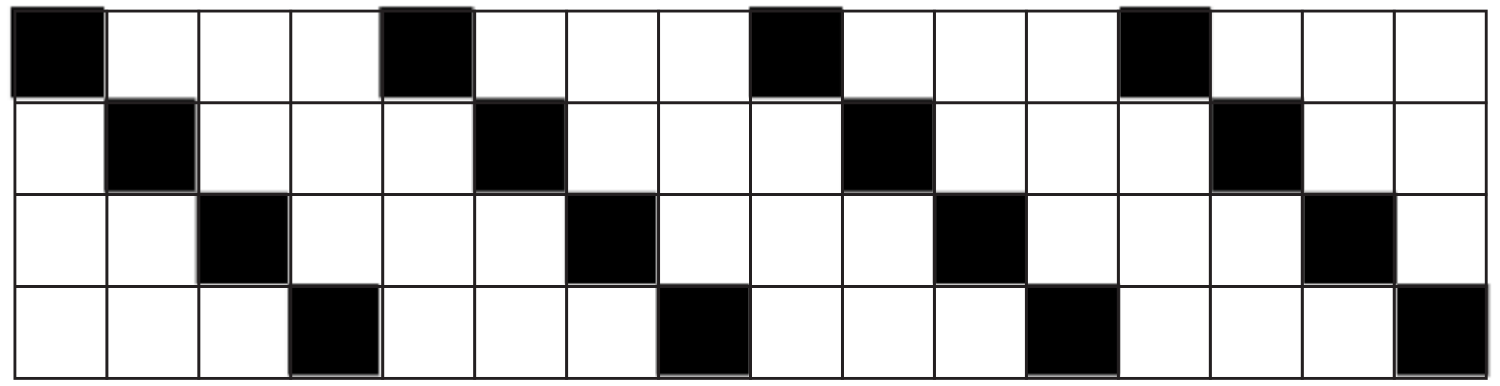
$$=1+0+0+0$$

$$=1$$

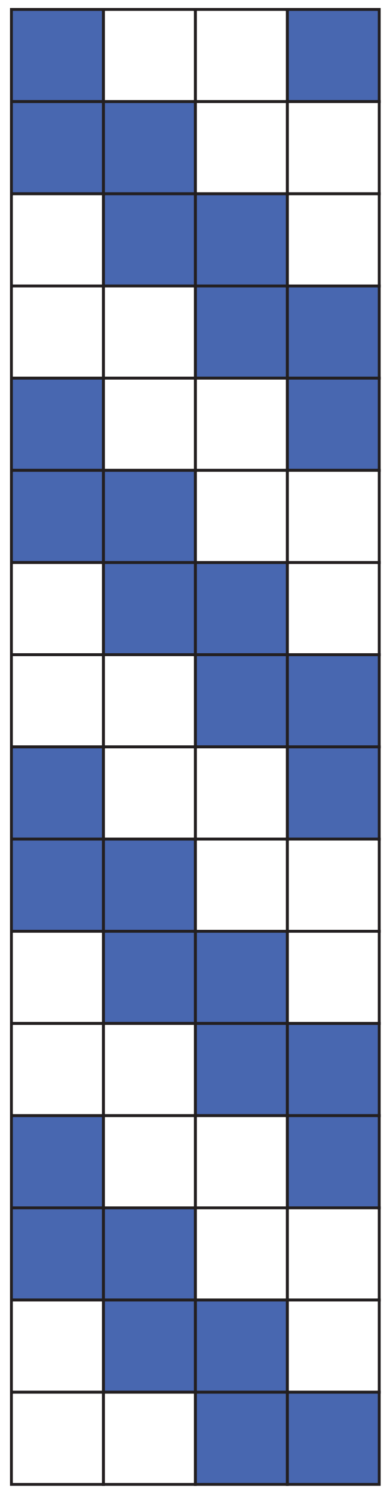

tieup
treadling


tieup
treadling
frames per time step

threading

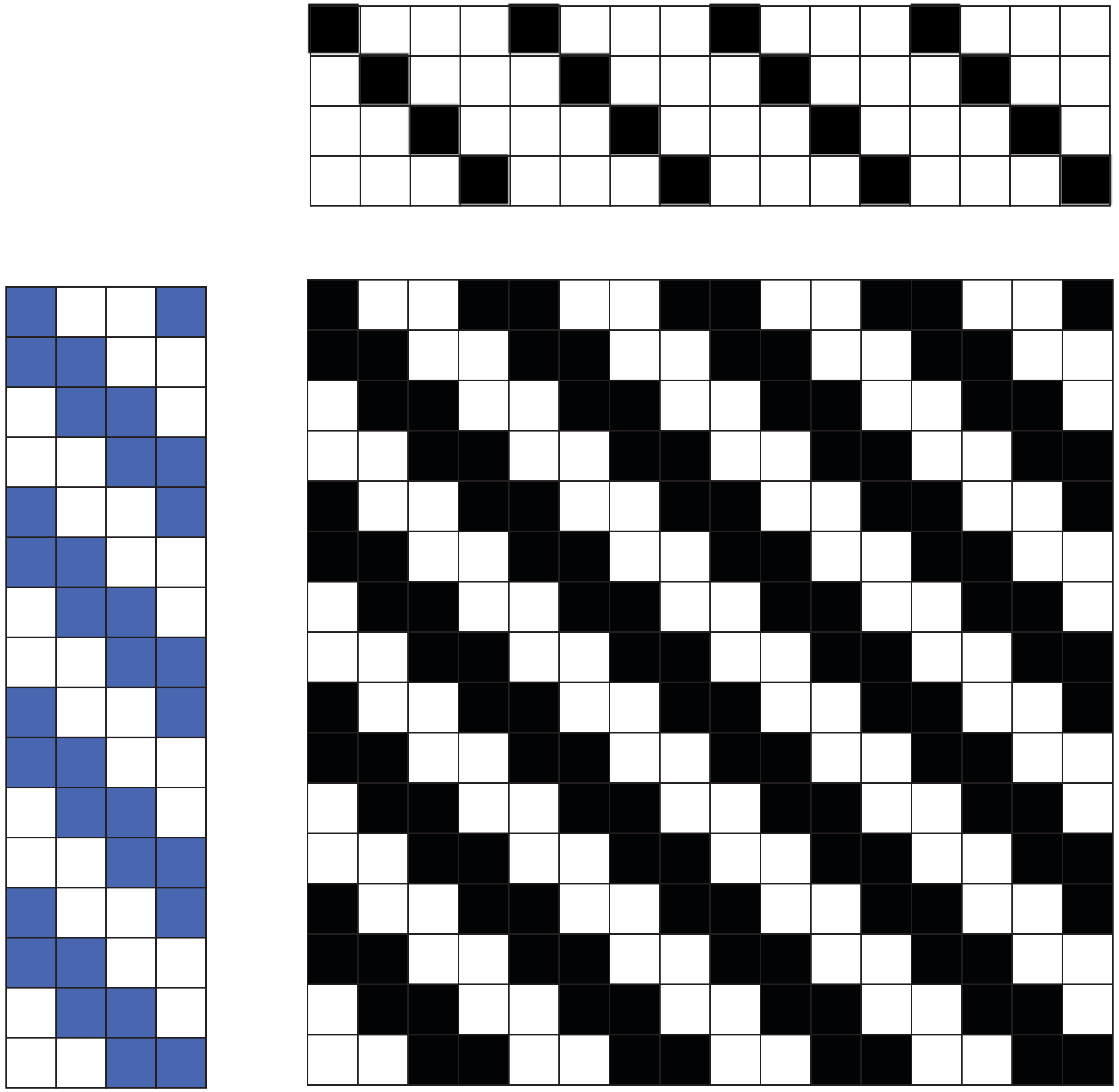


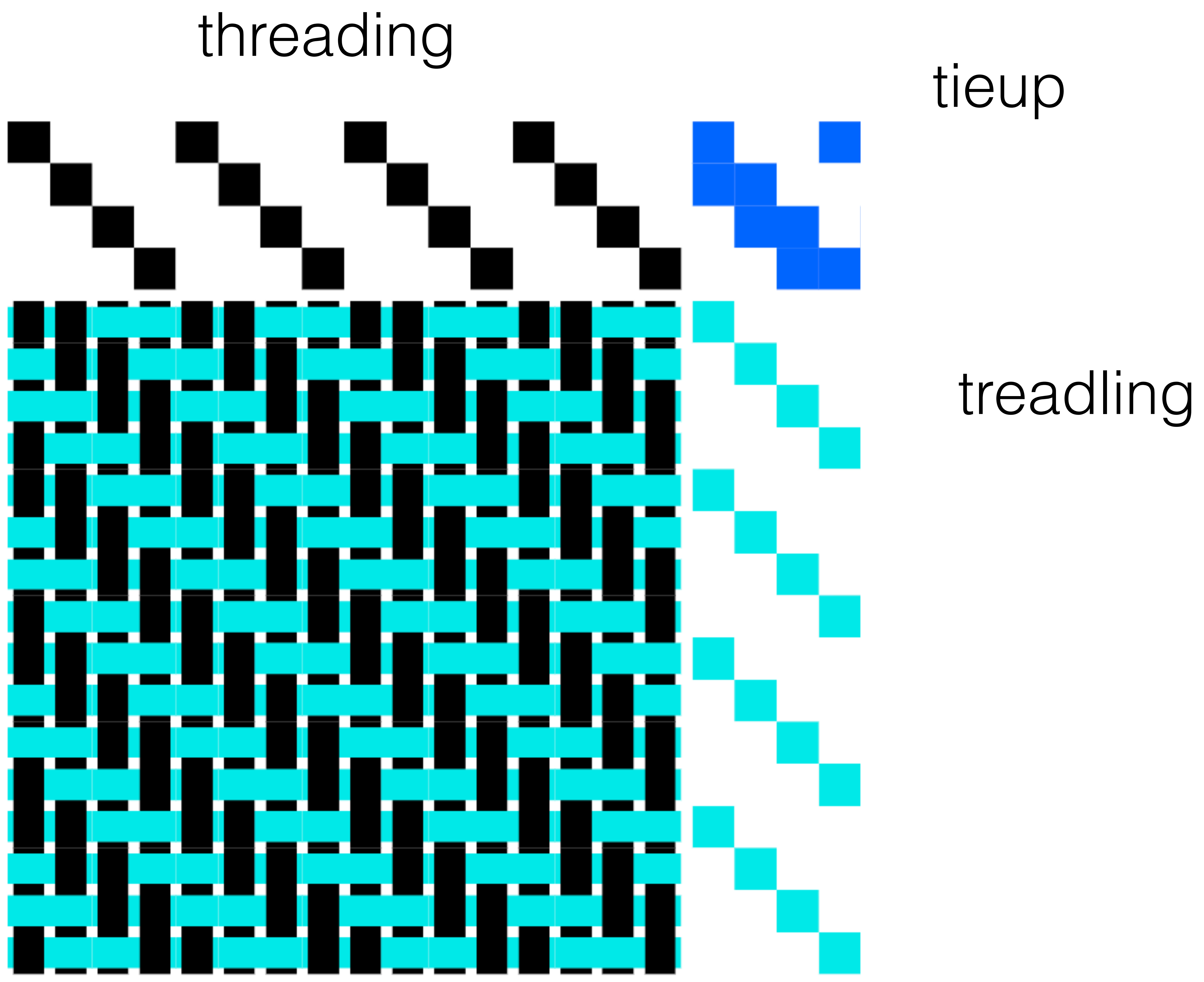
frames per time step

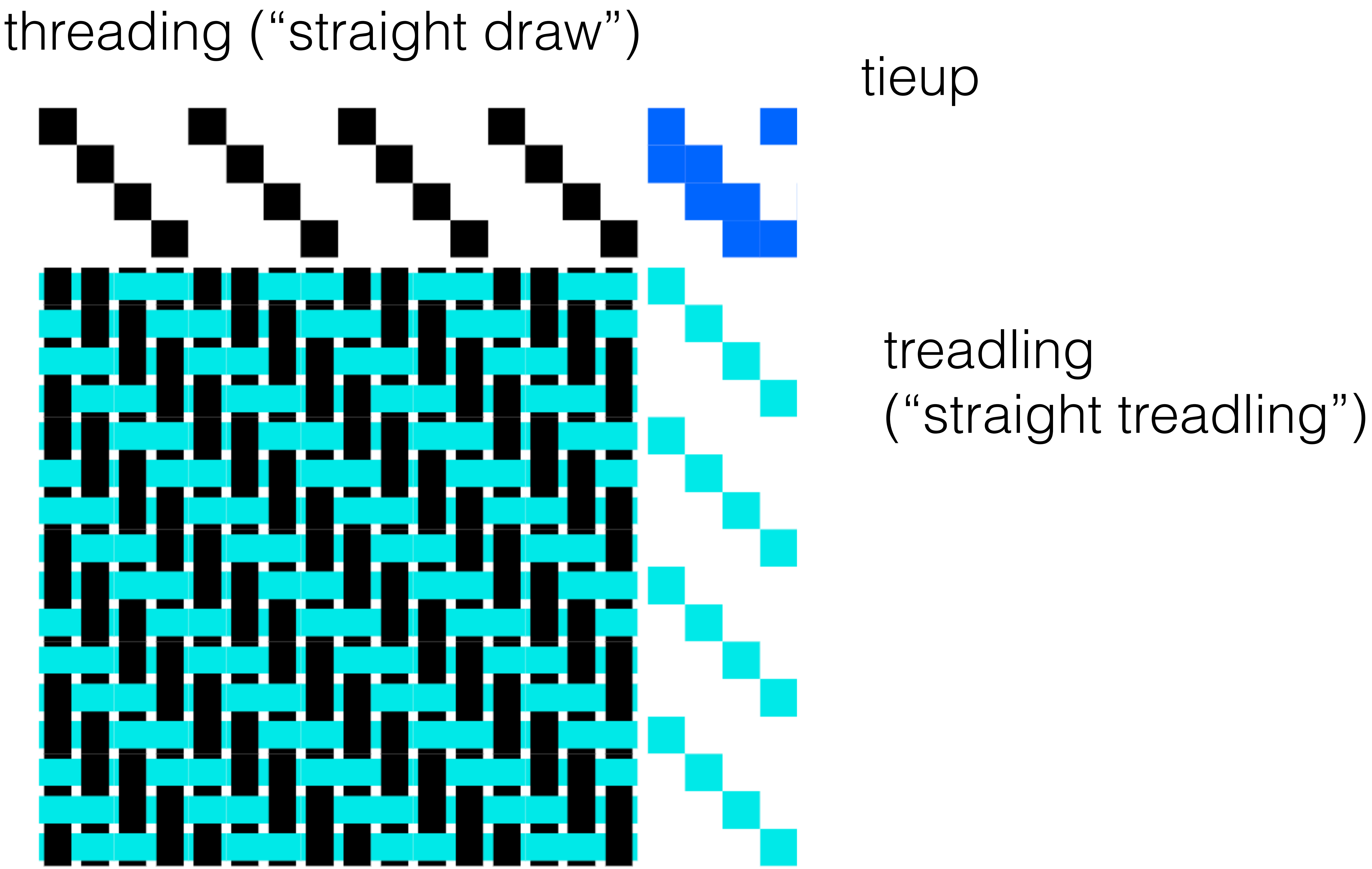


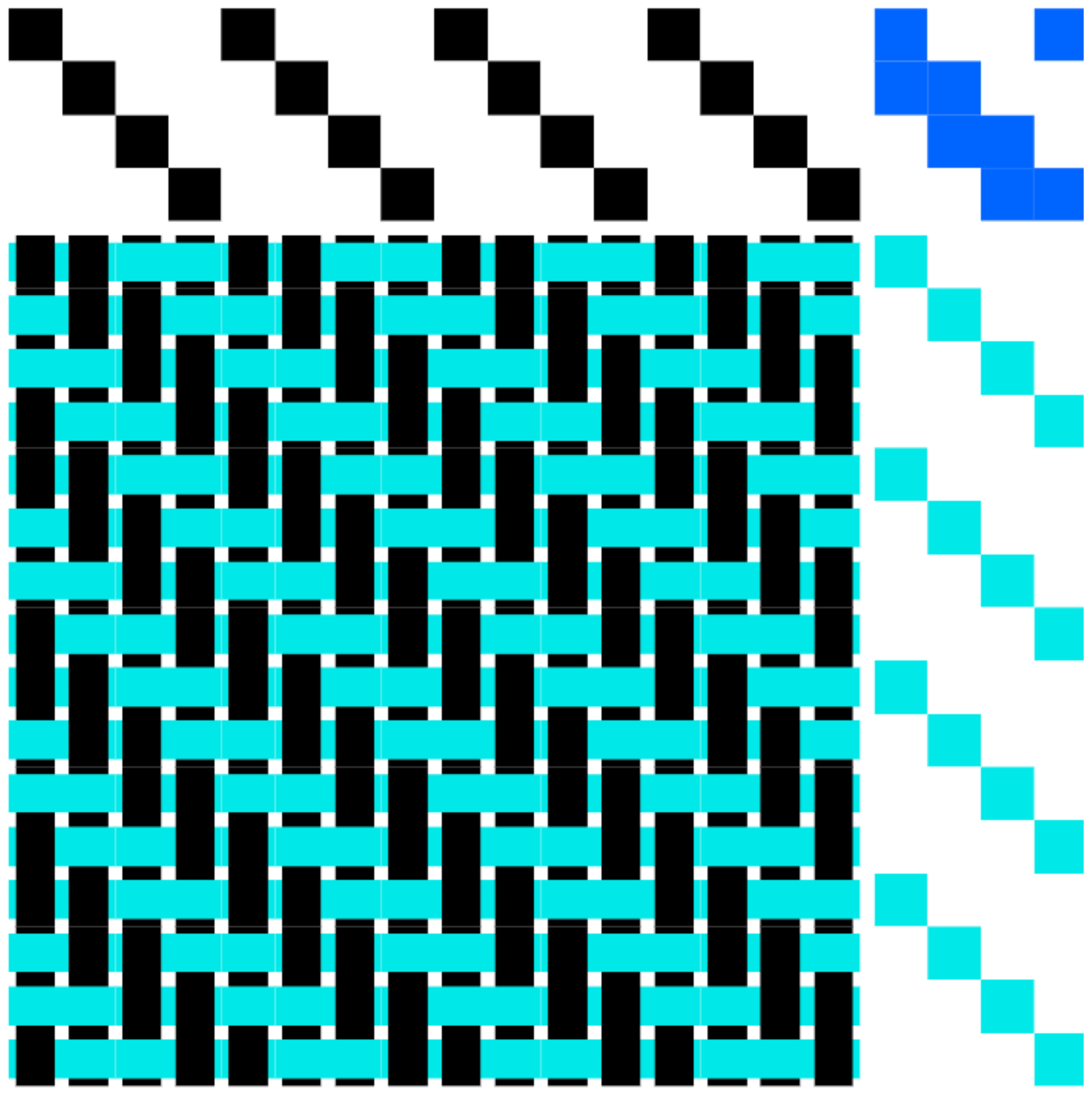
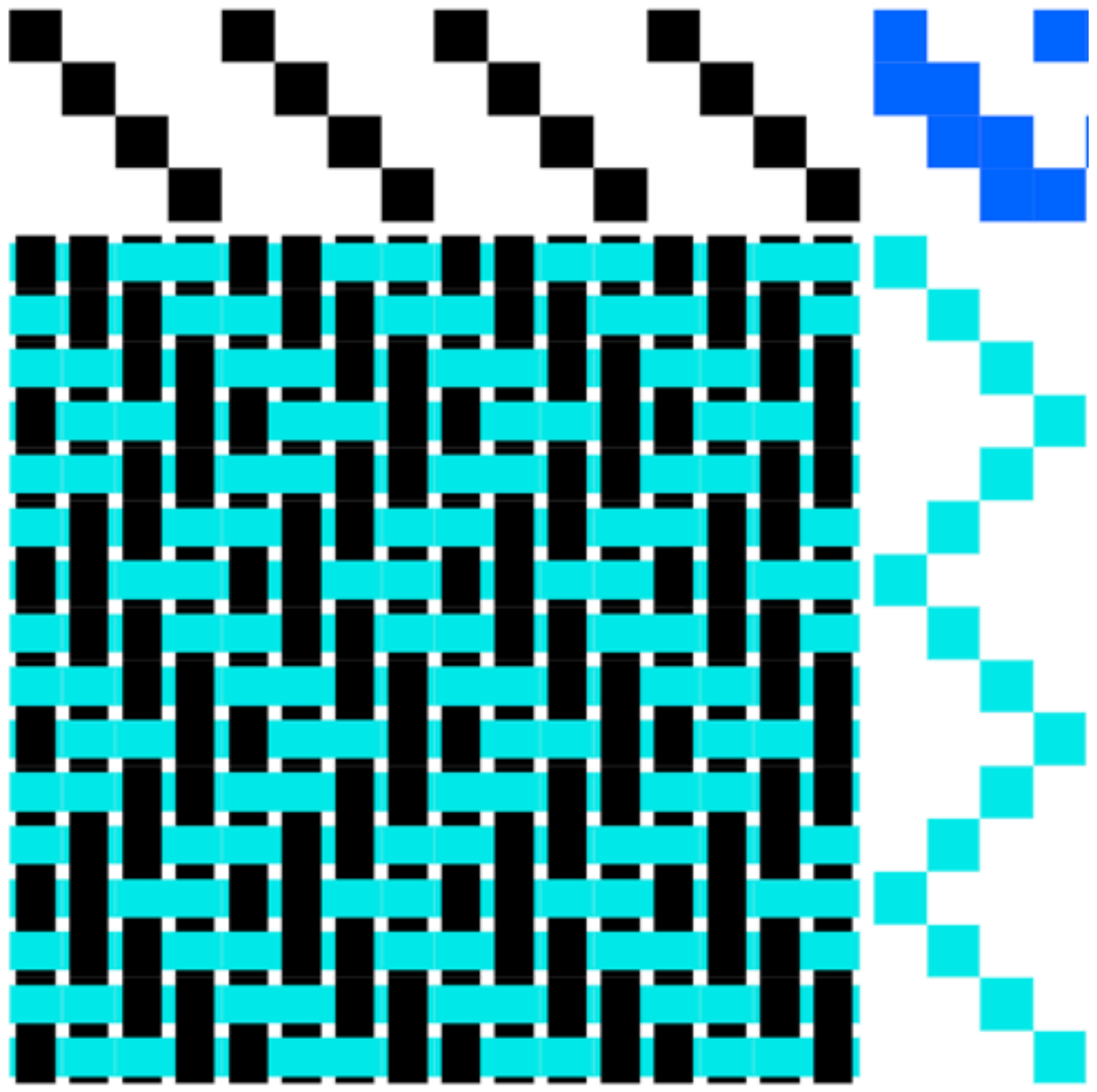
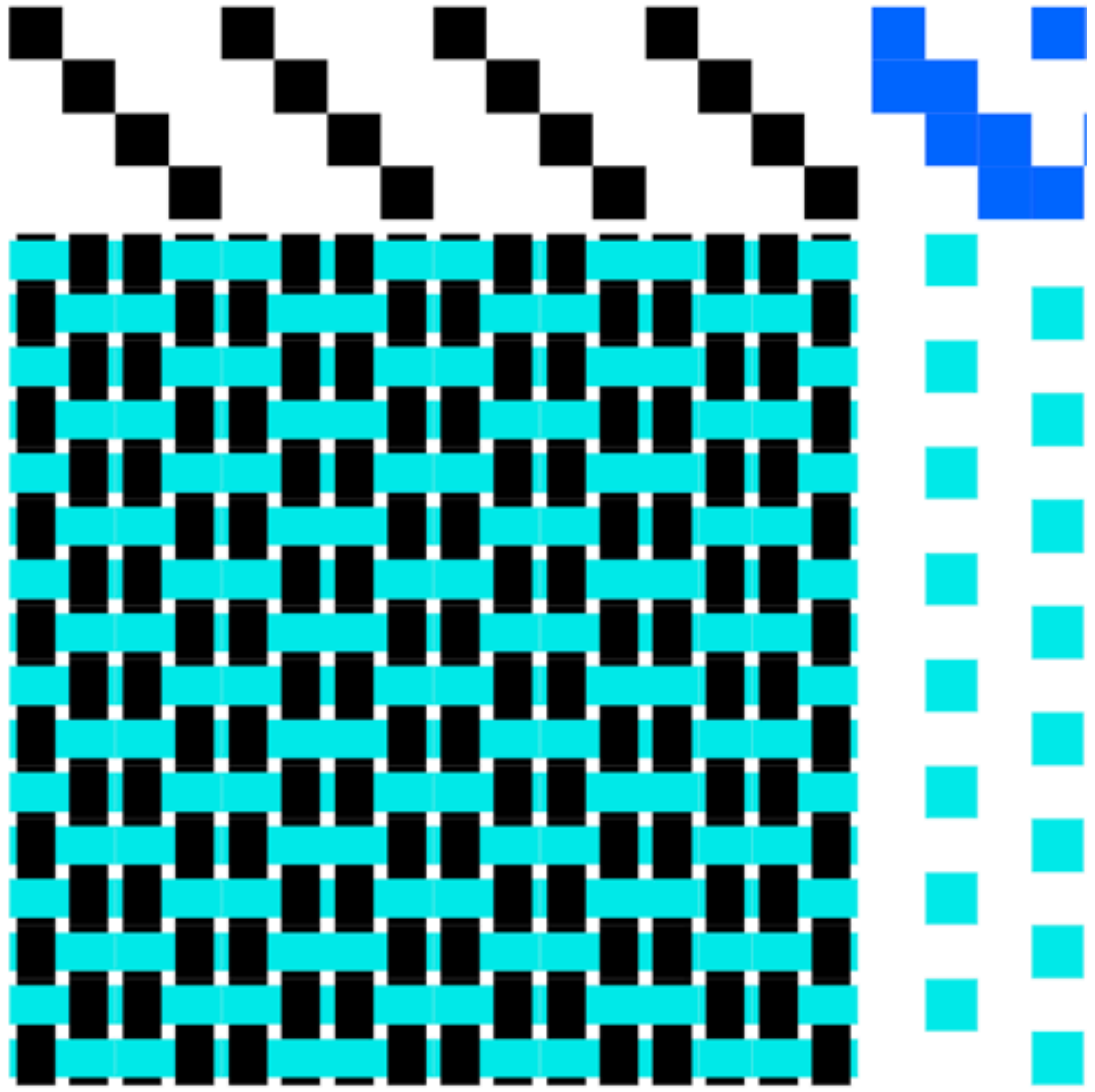
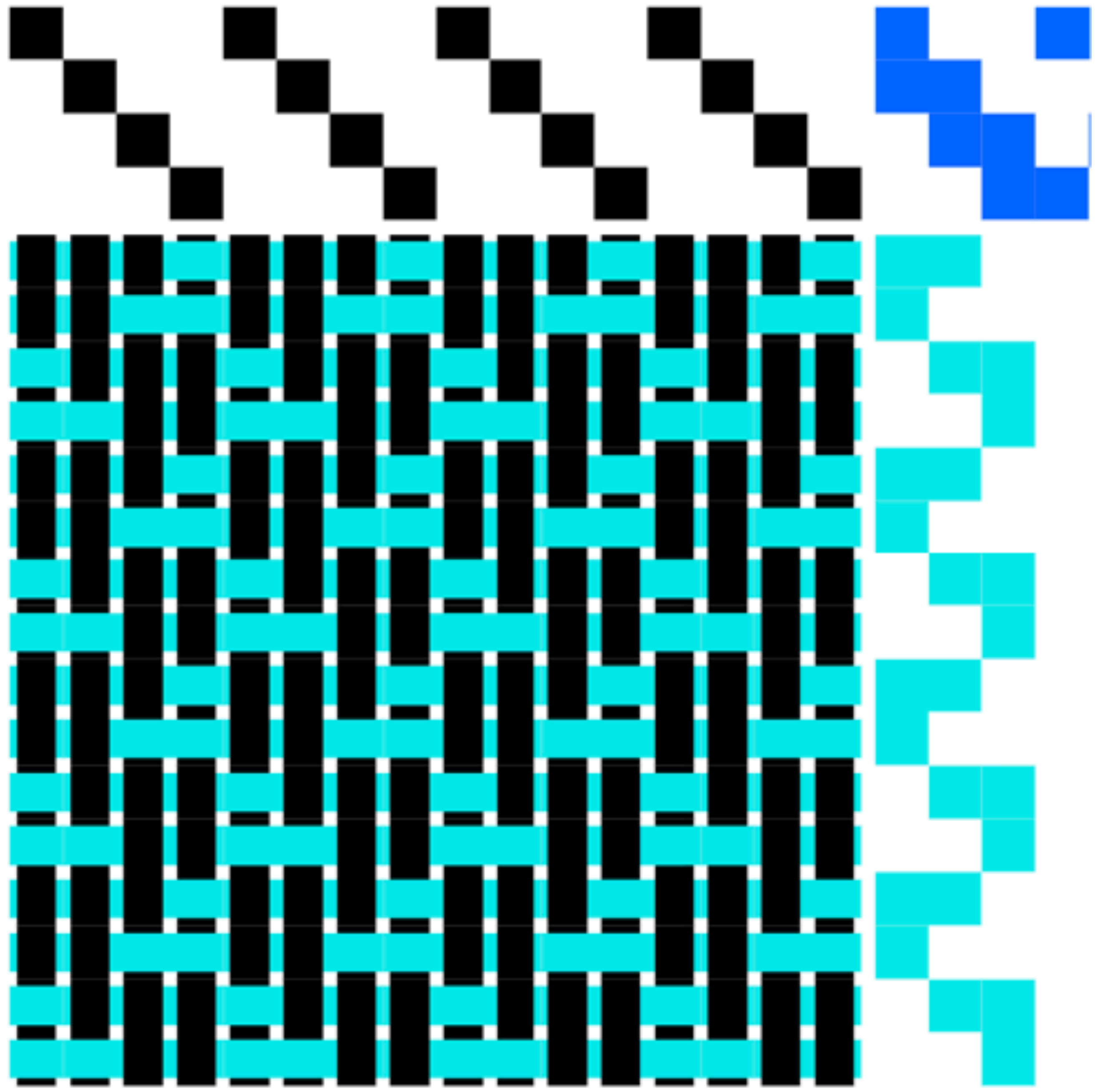
threading

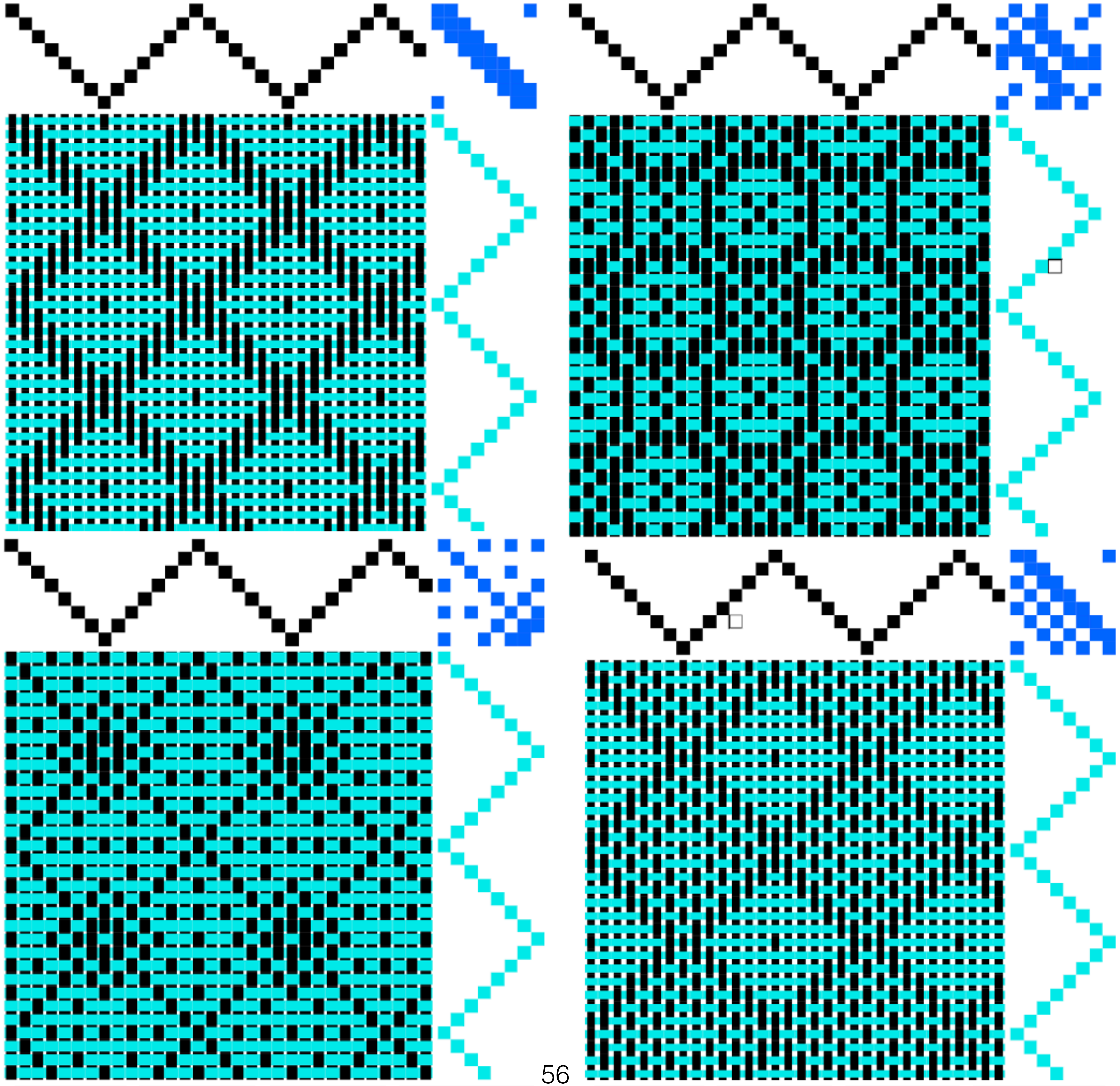
frames per time step




threading
tieup
treadling

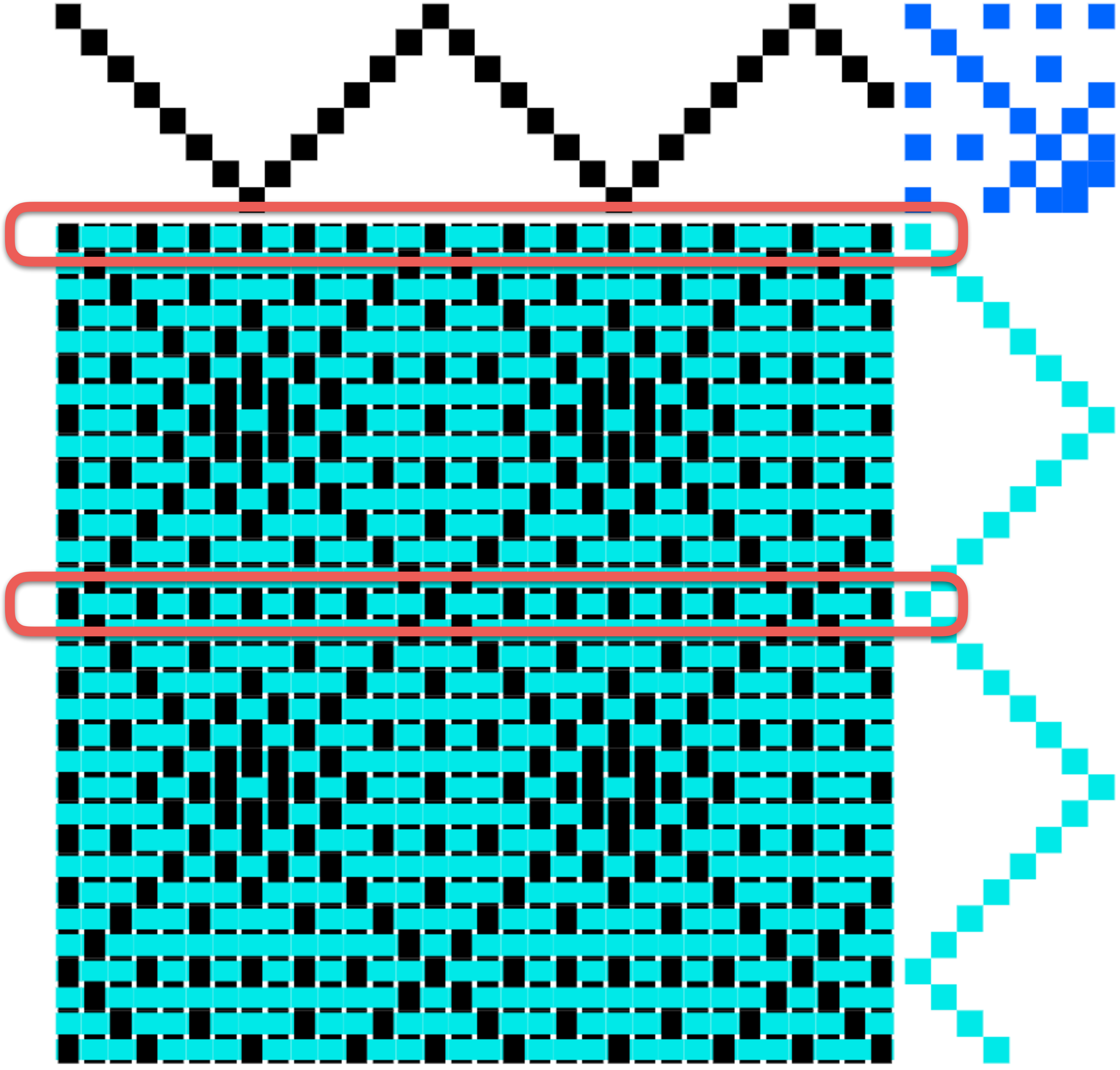

threading (“straight draw”)
tieup
treadling
(“straight treadling”)

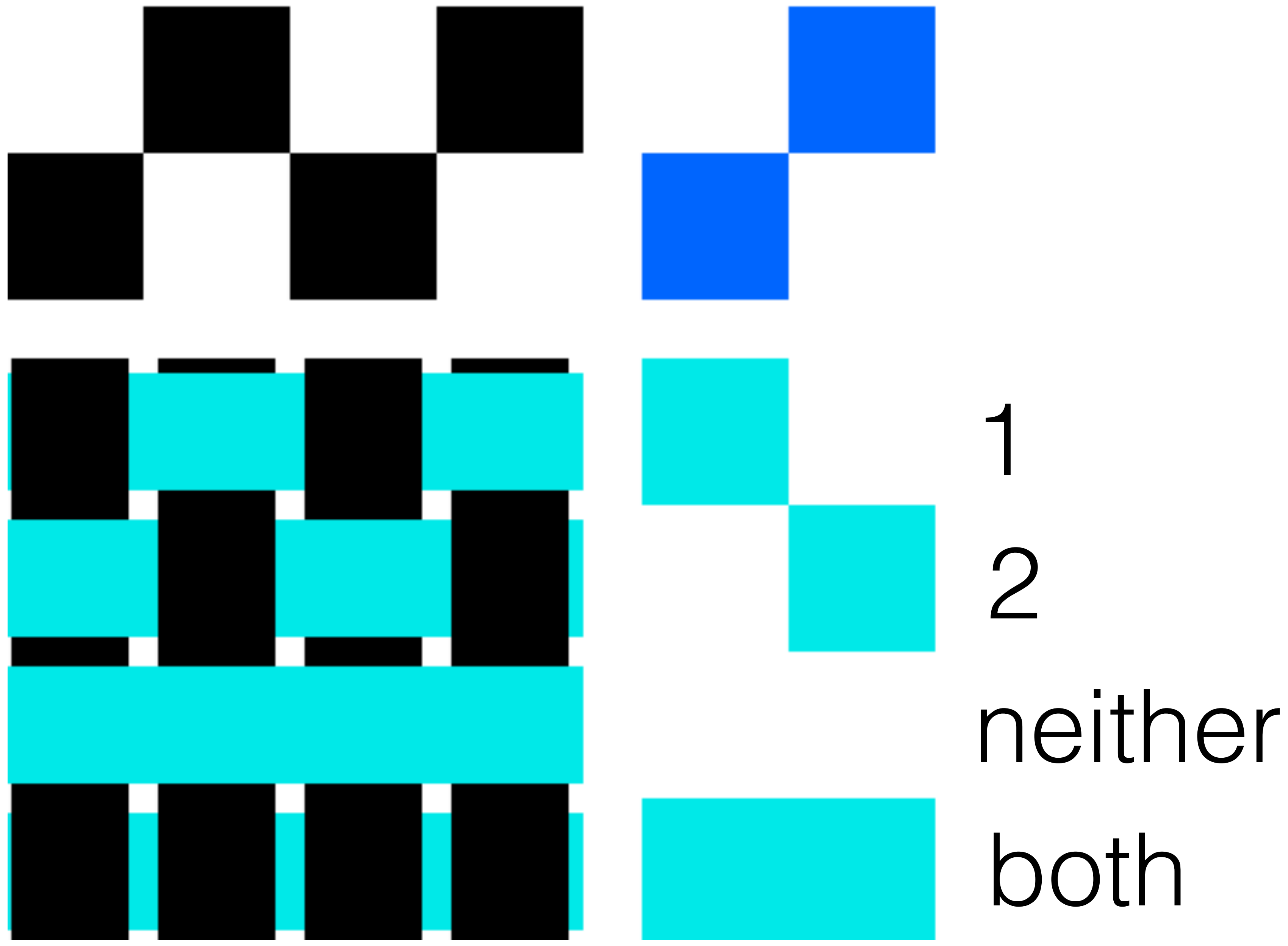







unique pattern rows = combinations of frames available

(minus the useless ones)




1
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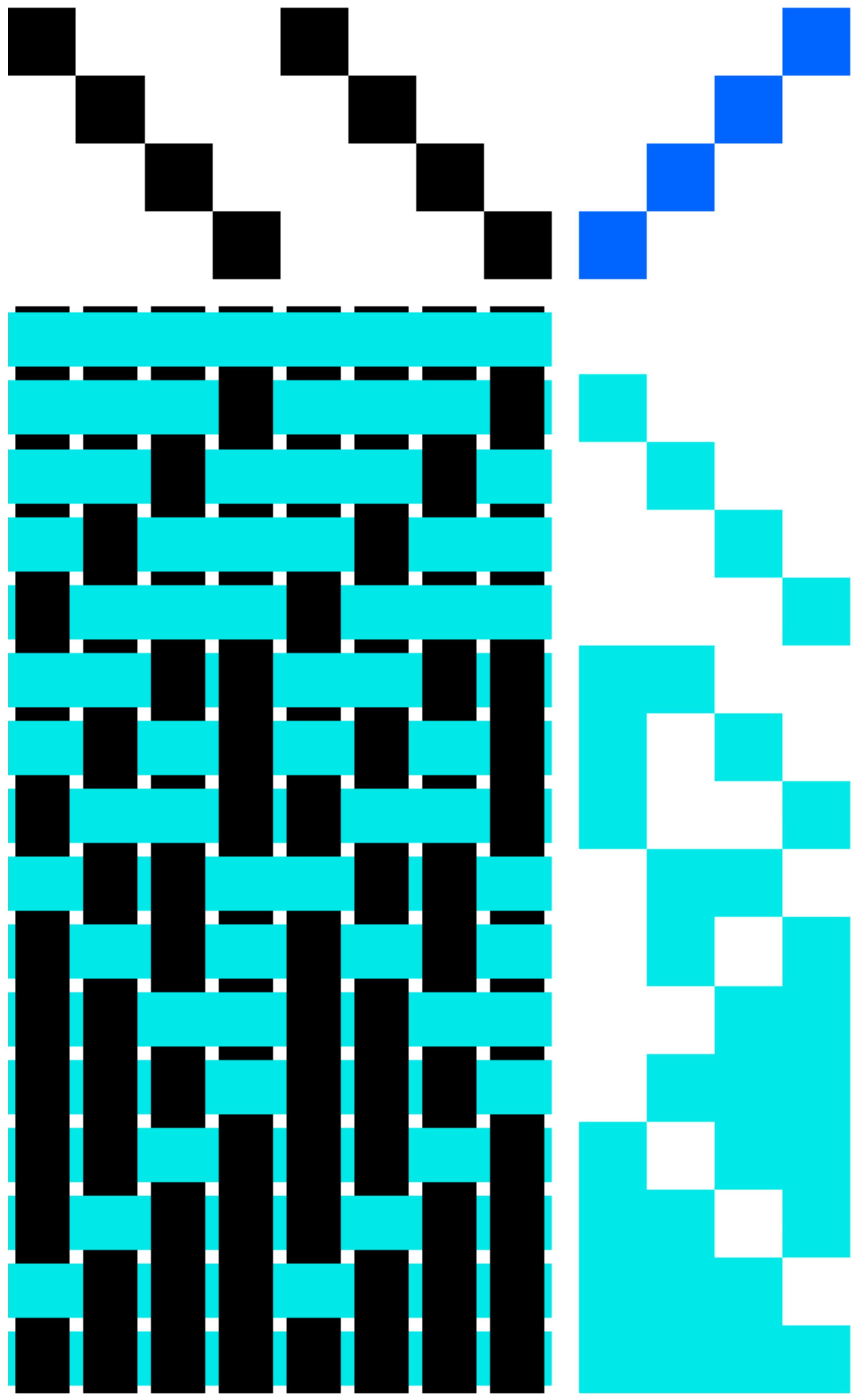
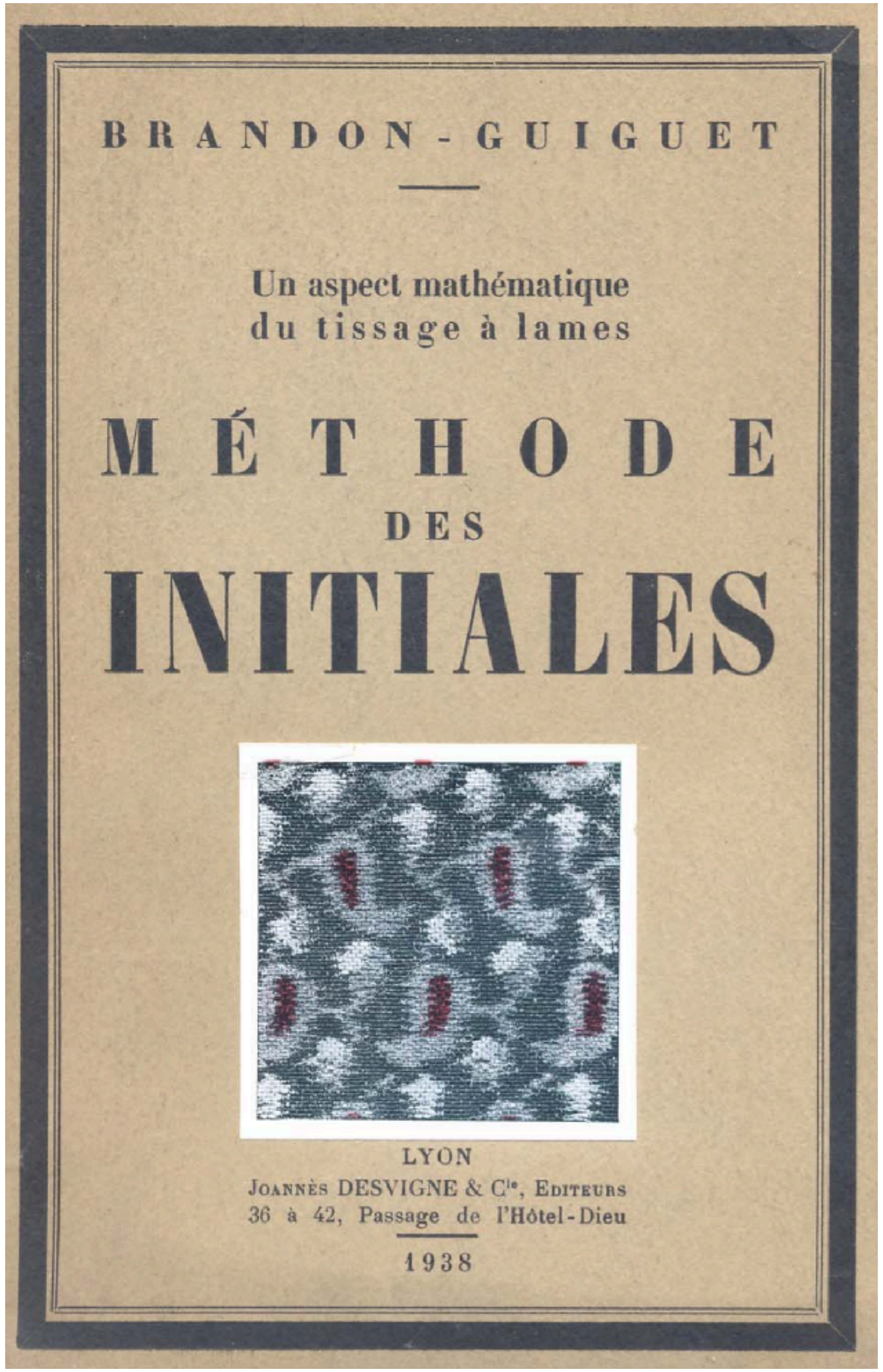
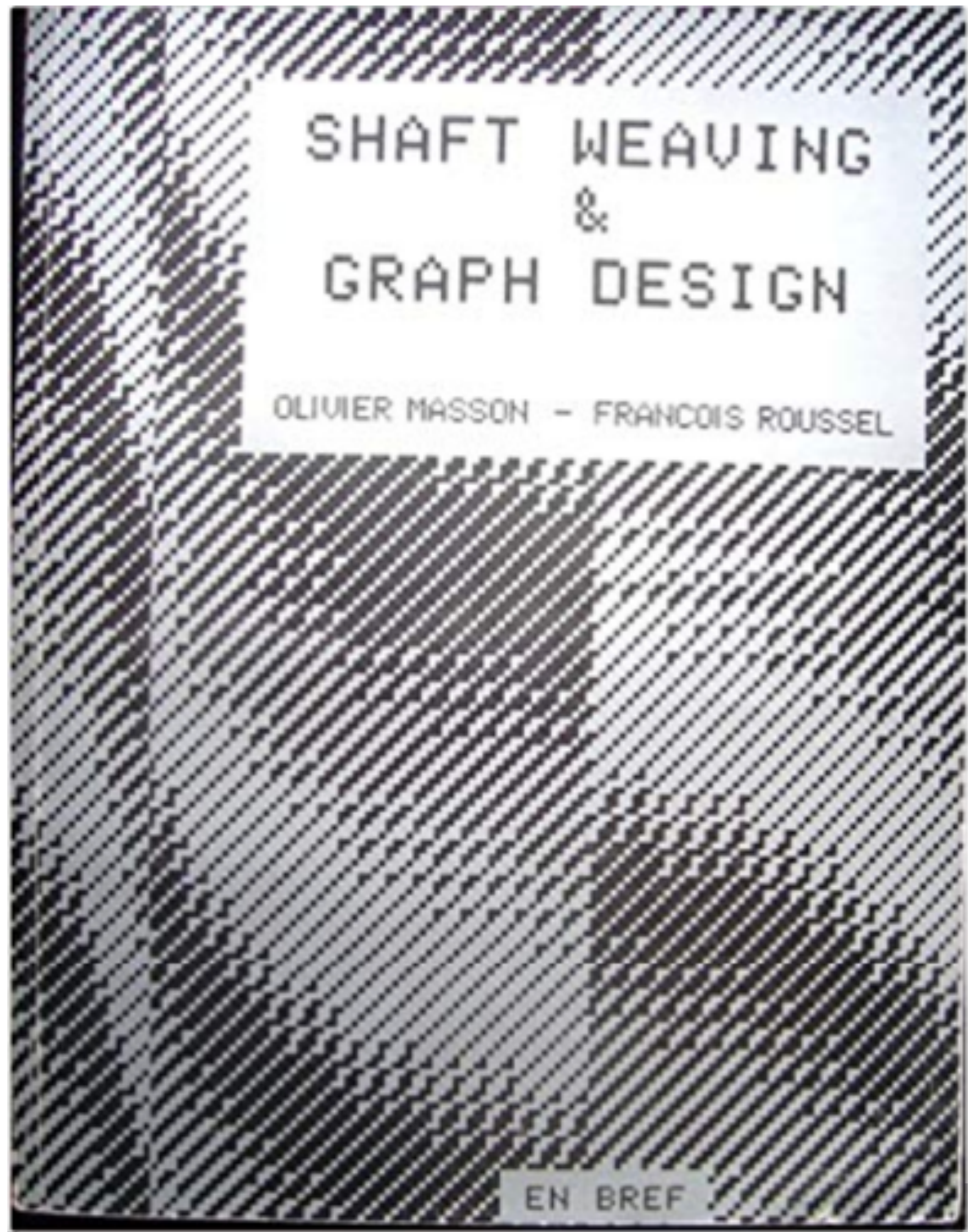
neither
both

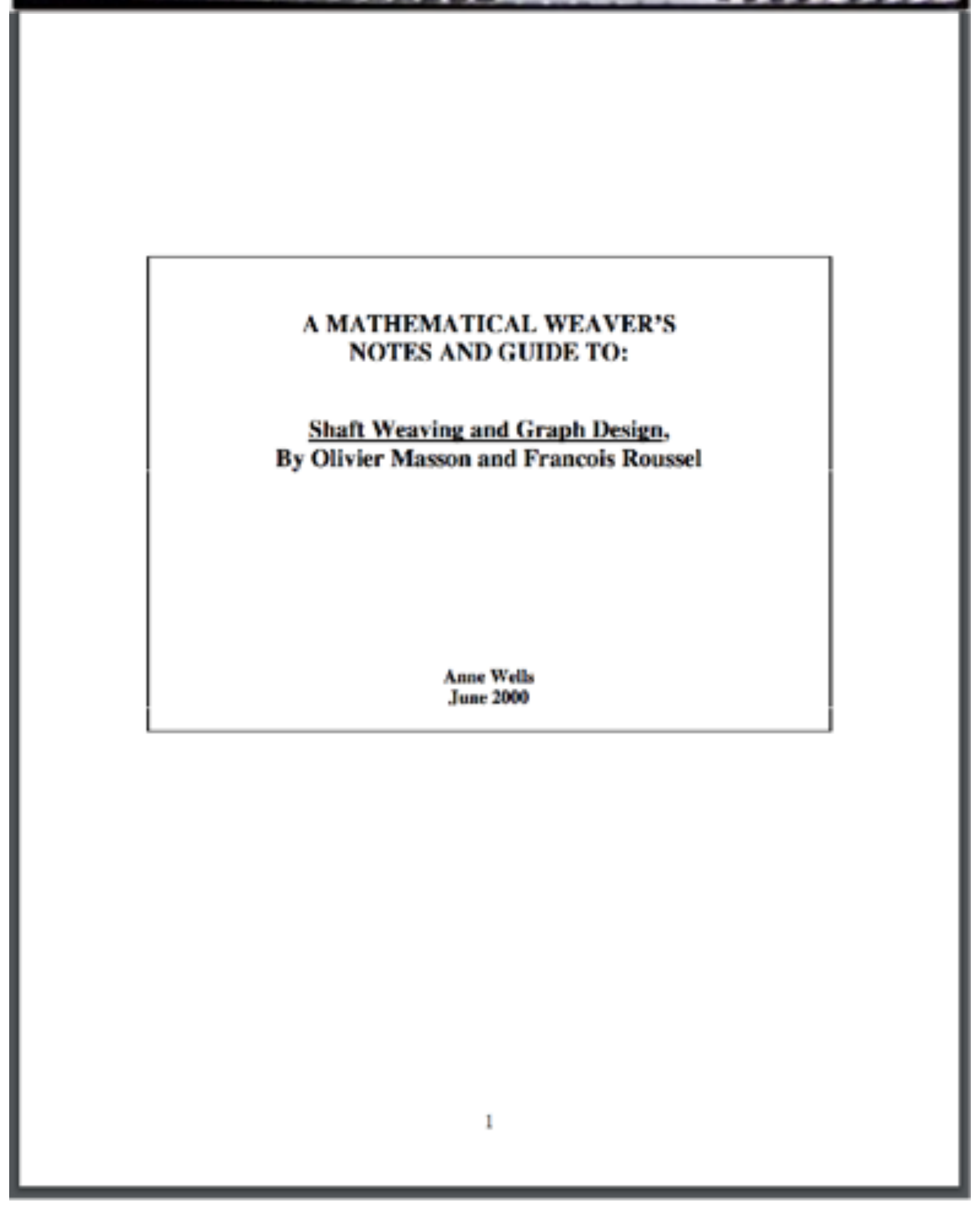


“network drafting”



the original 1938
network drafting monograph:
Brandon and Guiguet's
Méthode des Initiales:
Un aspect mathématique
du tissage à lames




A MATHEMATICAL WEAVER'S
NOTES AND GUIDE TO:

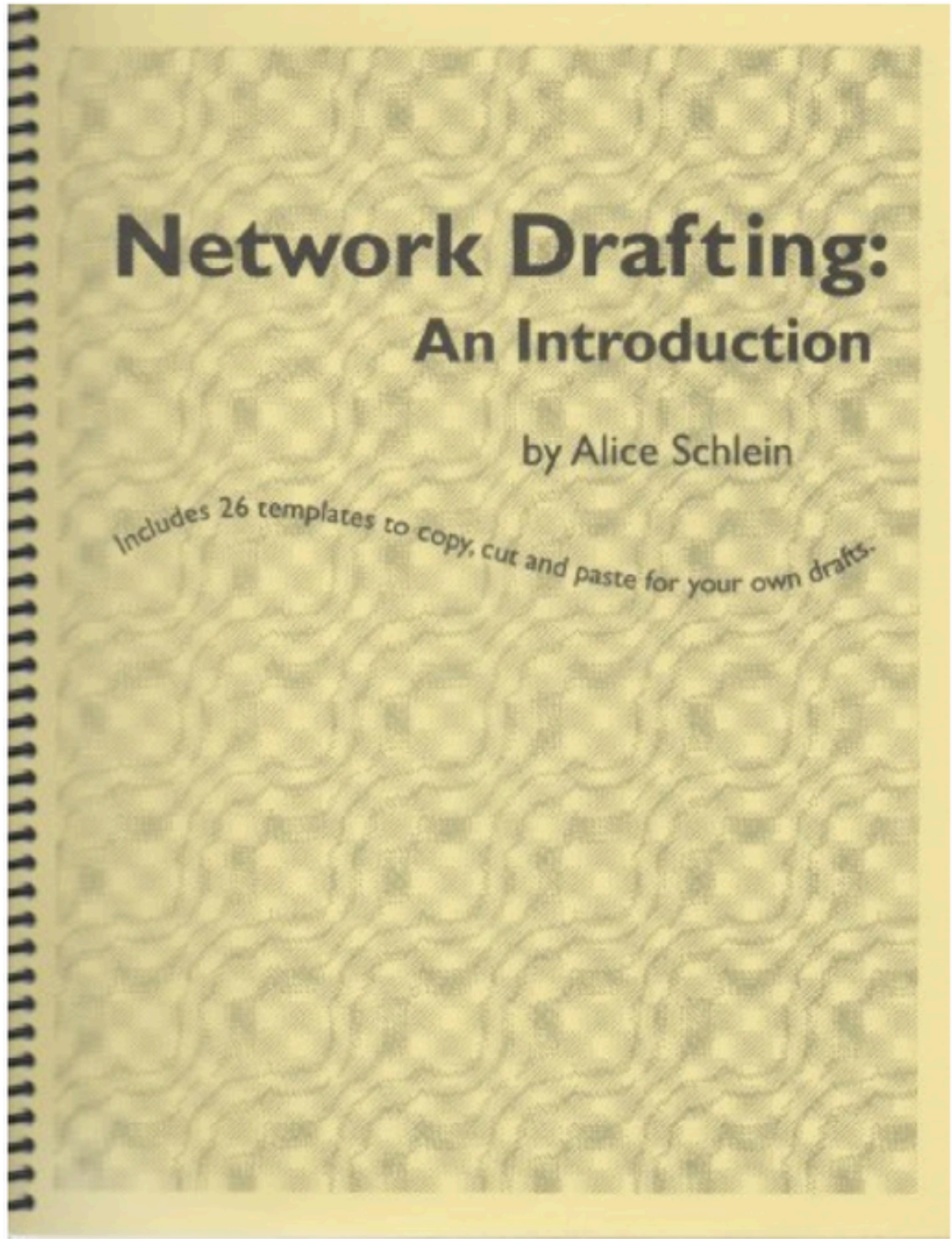
Shaft Weaving and Graph Design,
By Olivier Masson and Francois Roussel

Anne Wells
June 2000

1

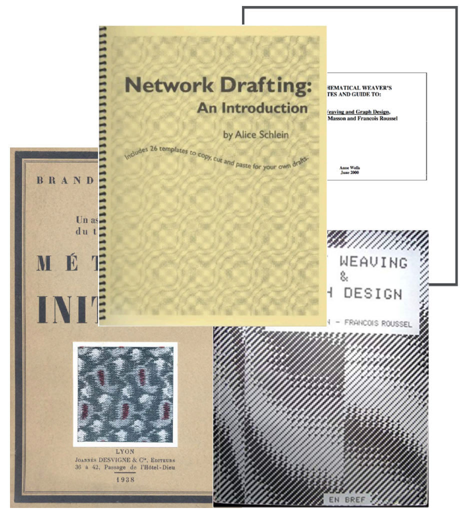
Olivier Masson & Francois Roussel, 1988:
Shaft Weaving and Graph Design

Anne Wells, 2000:
“Weavers Notes & Guide” to Masson & Roussel



Alice Schlein, 1994:
Network Drafting:
An Introduction

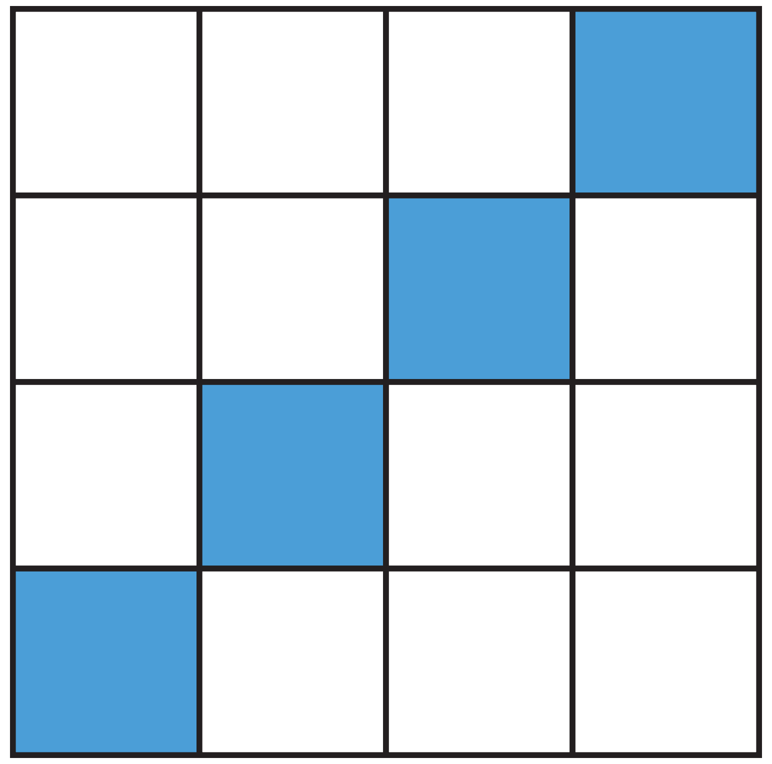

BRANDON-GUIGUET
Un aspect mathématique
du tissage à lames
MÉTHODE
DES
INITIALES
LYON
1938
SHAFT WEAVING
&
GRAPH DESIGN
OLIVIER MASSON - FRANCOIS ROUSSEL
EN BREF
Network Drafting:
An Introduction
by Alice Schlein
Includes 26 templates to copy, cut and paste for your own drafts
A MATHEMATICAL WEAVER'S NOTES AND GUIDE TO:
Shaft Weaving and Graph Design,
By Olivier Masson and Francois Roussel
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
1938
today
personal computing,
and therefore
computer-controlled
hand looms



personal computing,
and therefore
computer-controlled
hand looms

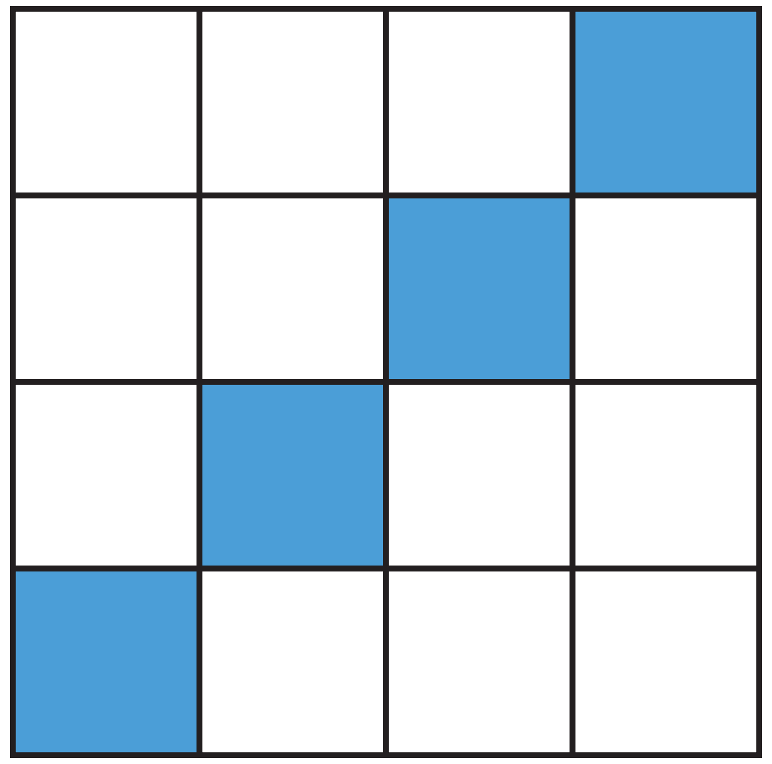
“any cloth structure which can be woven on an **initial threading**
can also be woven on a threading plotted on its associated **network**.”

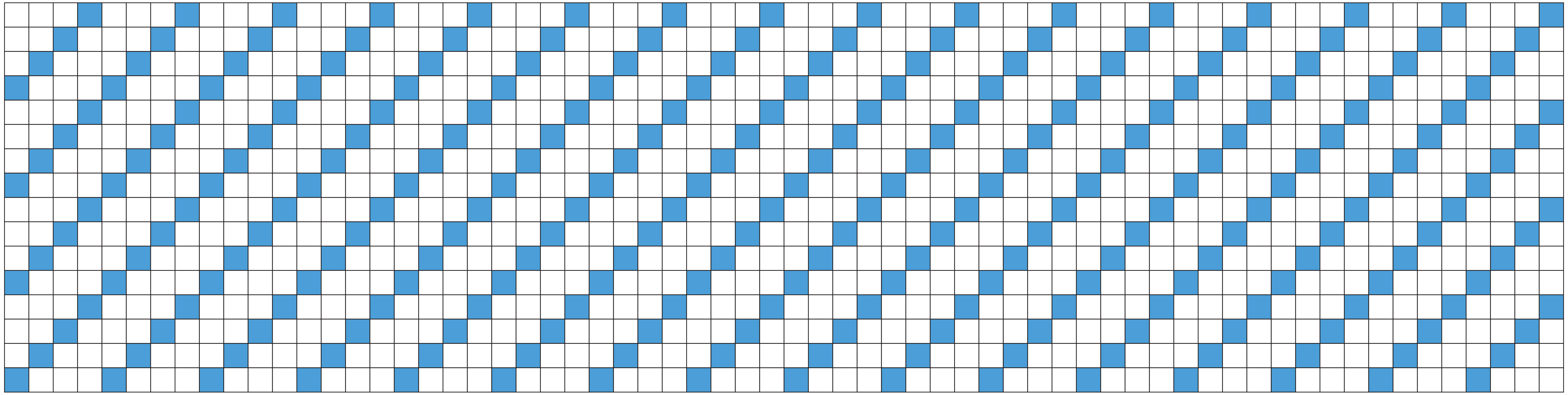
initial



(“straight draw”)

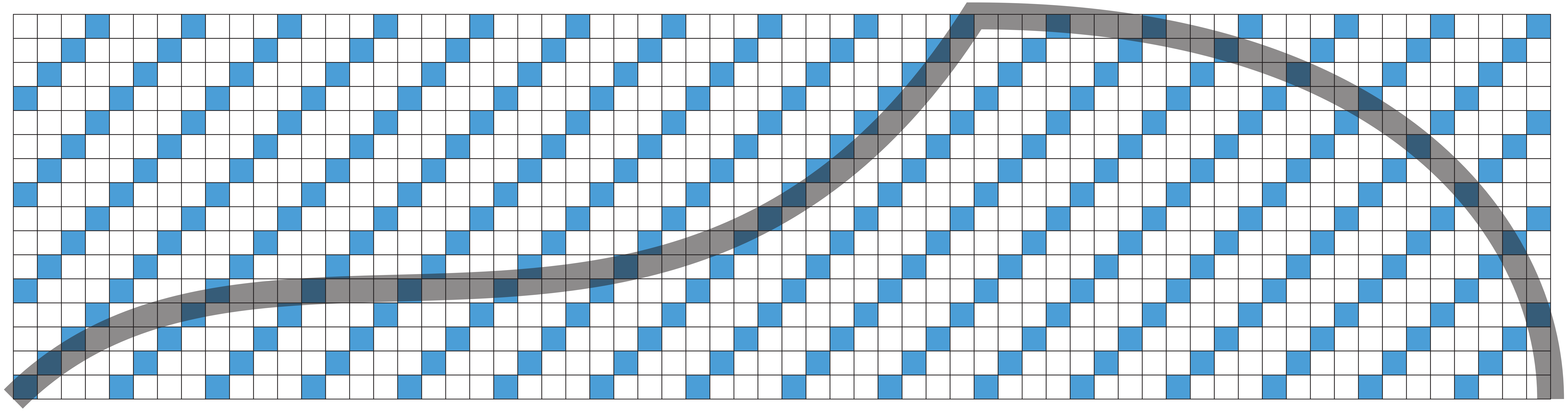
initial



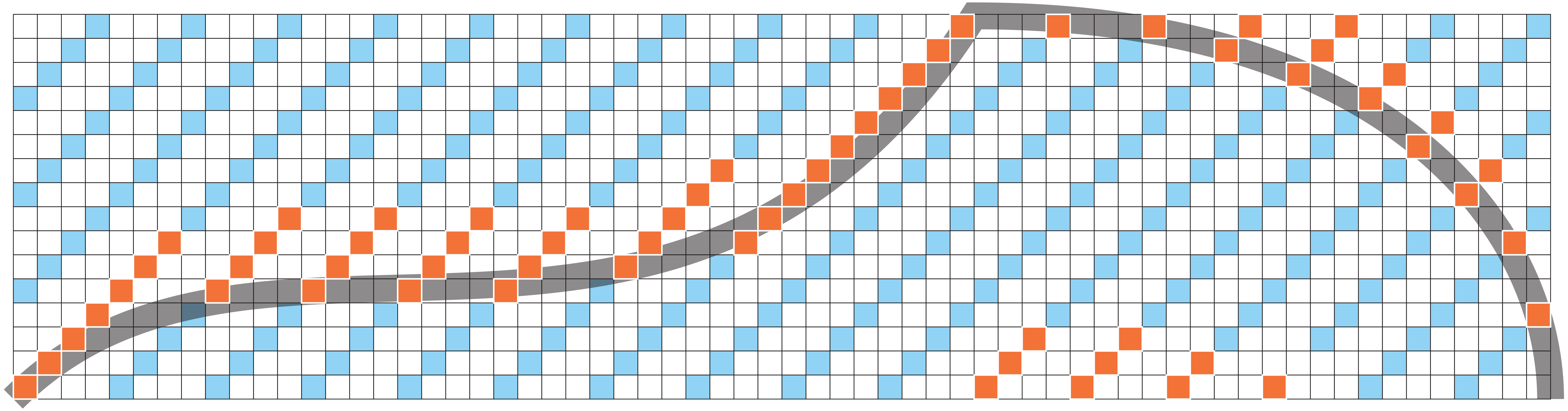


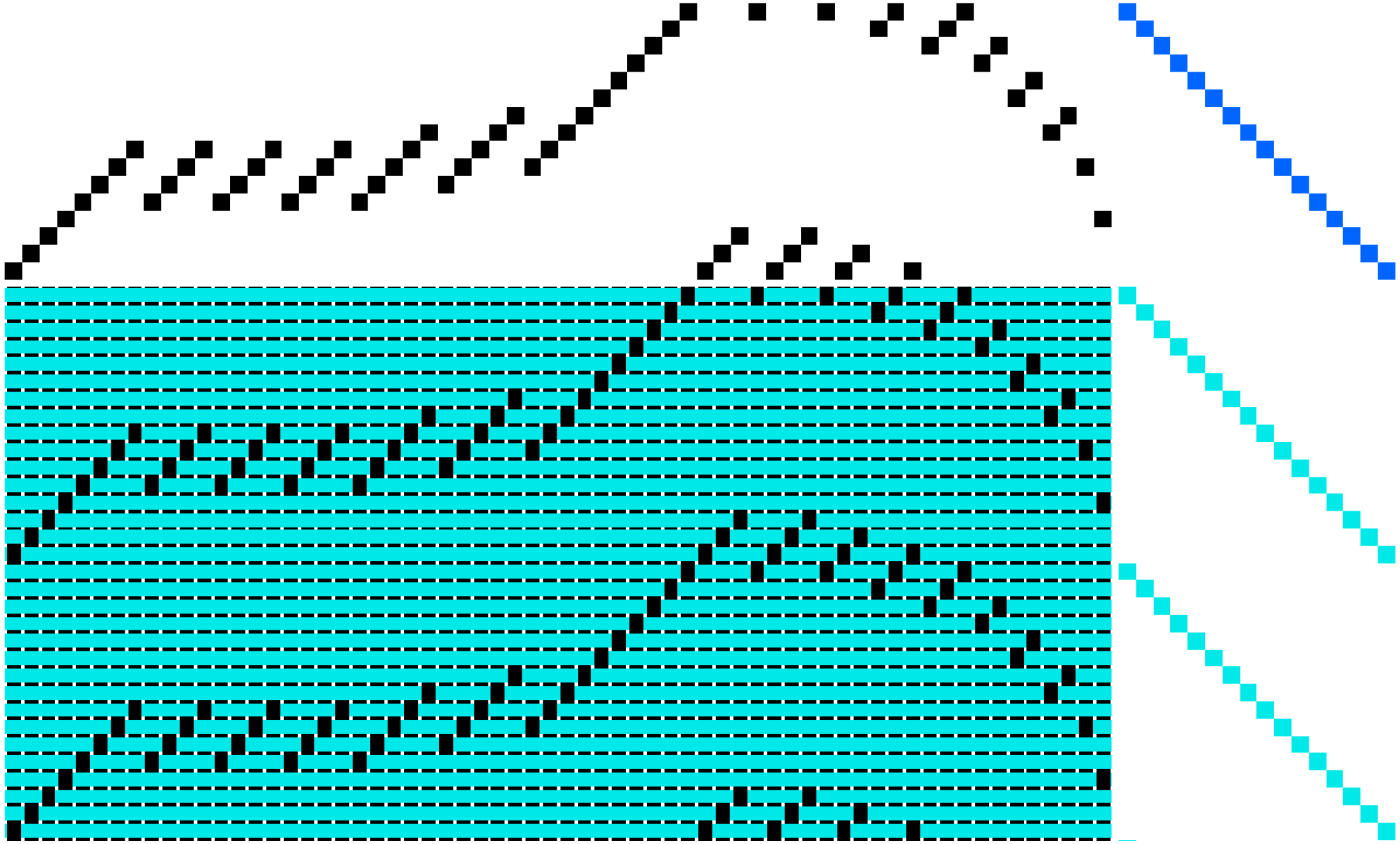
network

network
+
pattern line

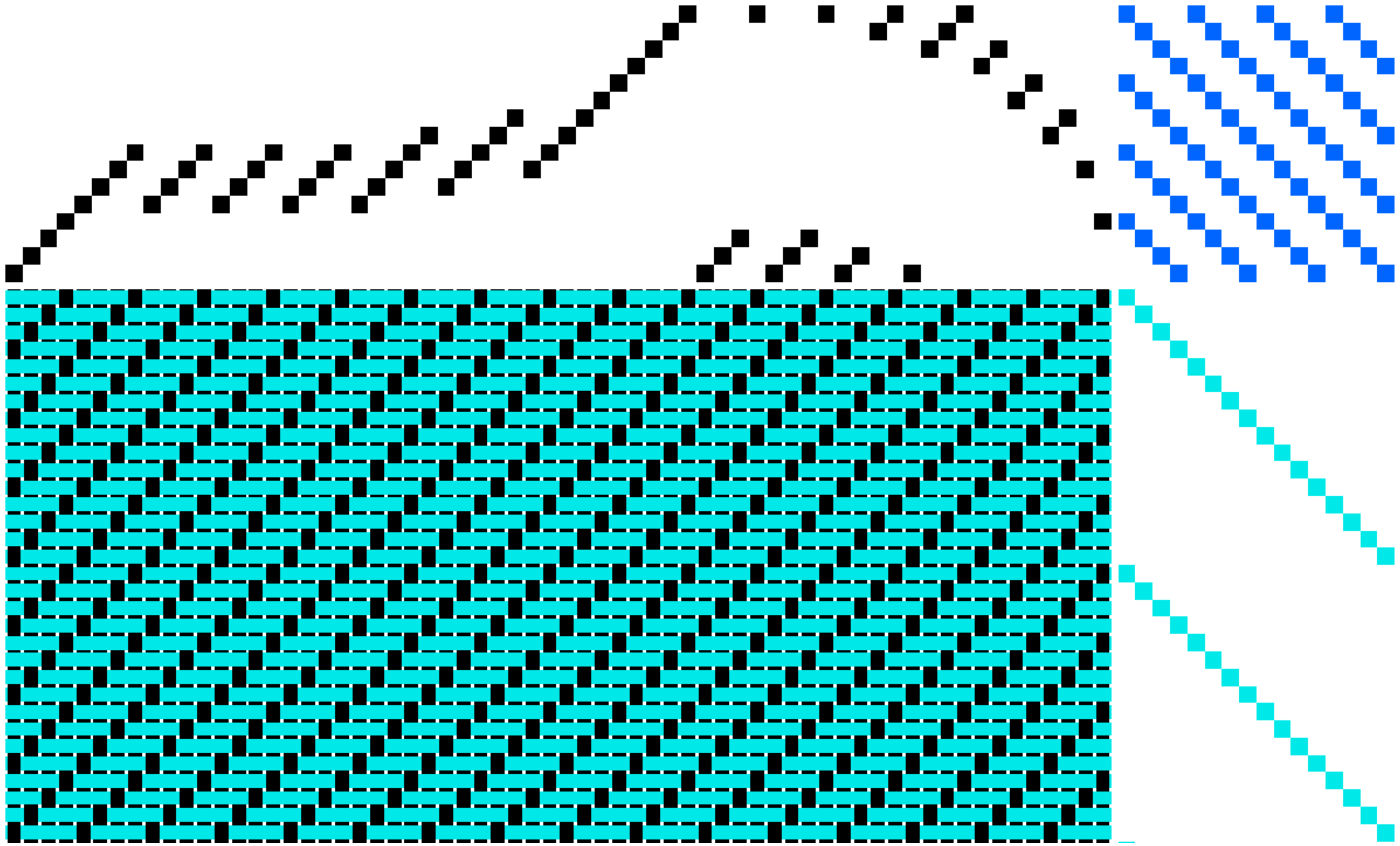


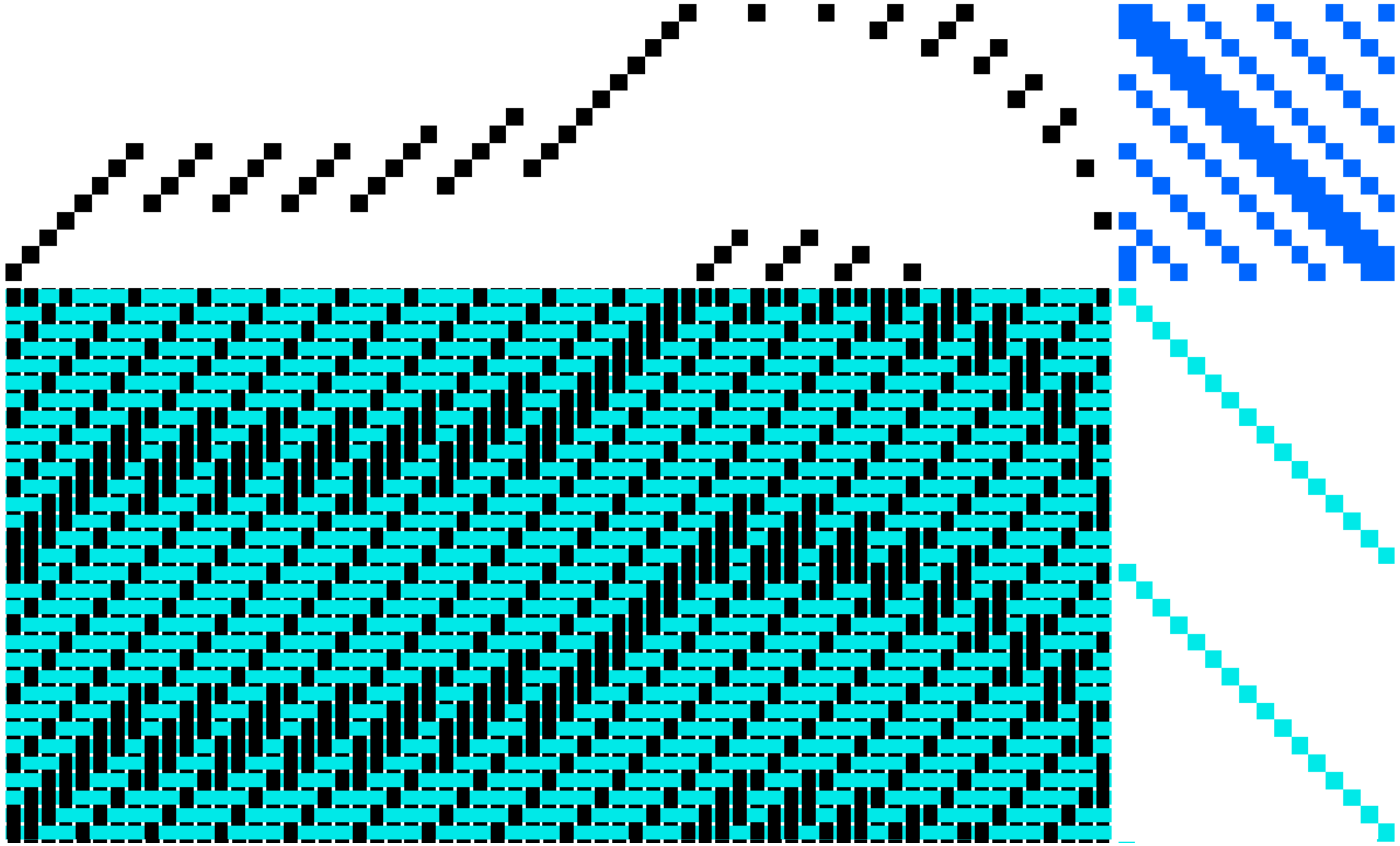
network
+
pattern line

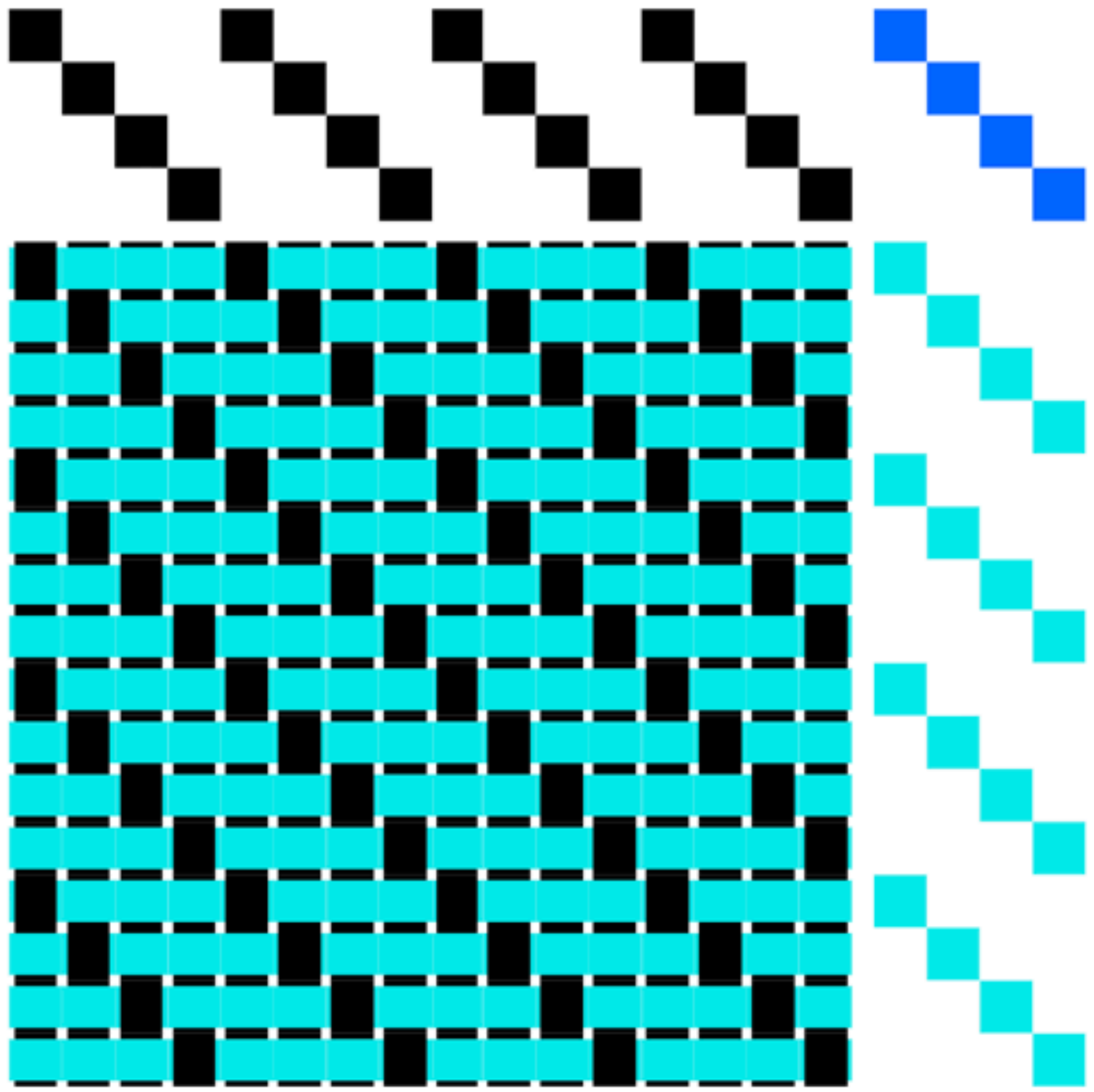




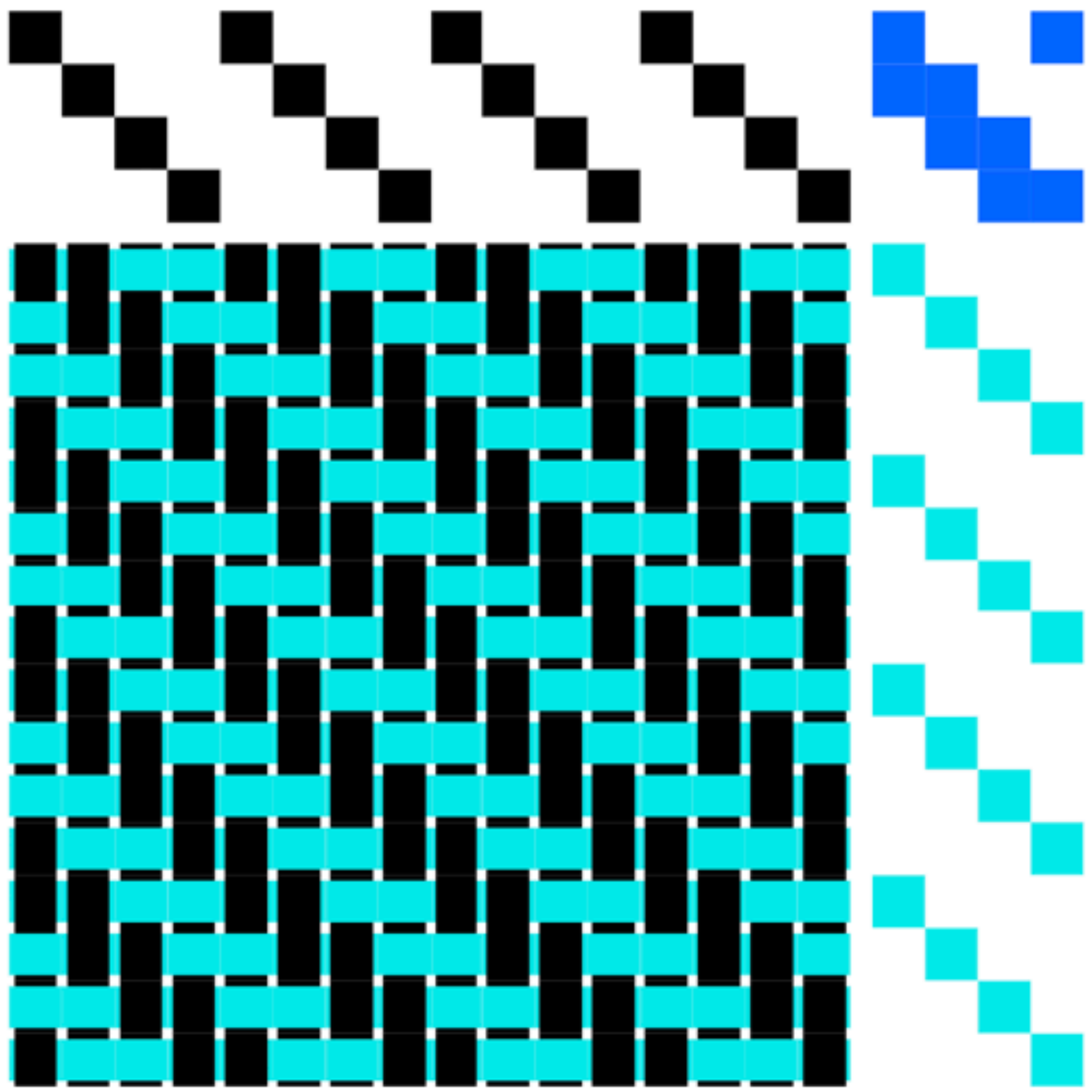
“any cloth structure which can be woven on an **initial threading** can also be woven on a threading plotted on its associated **network**.”



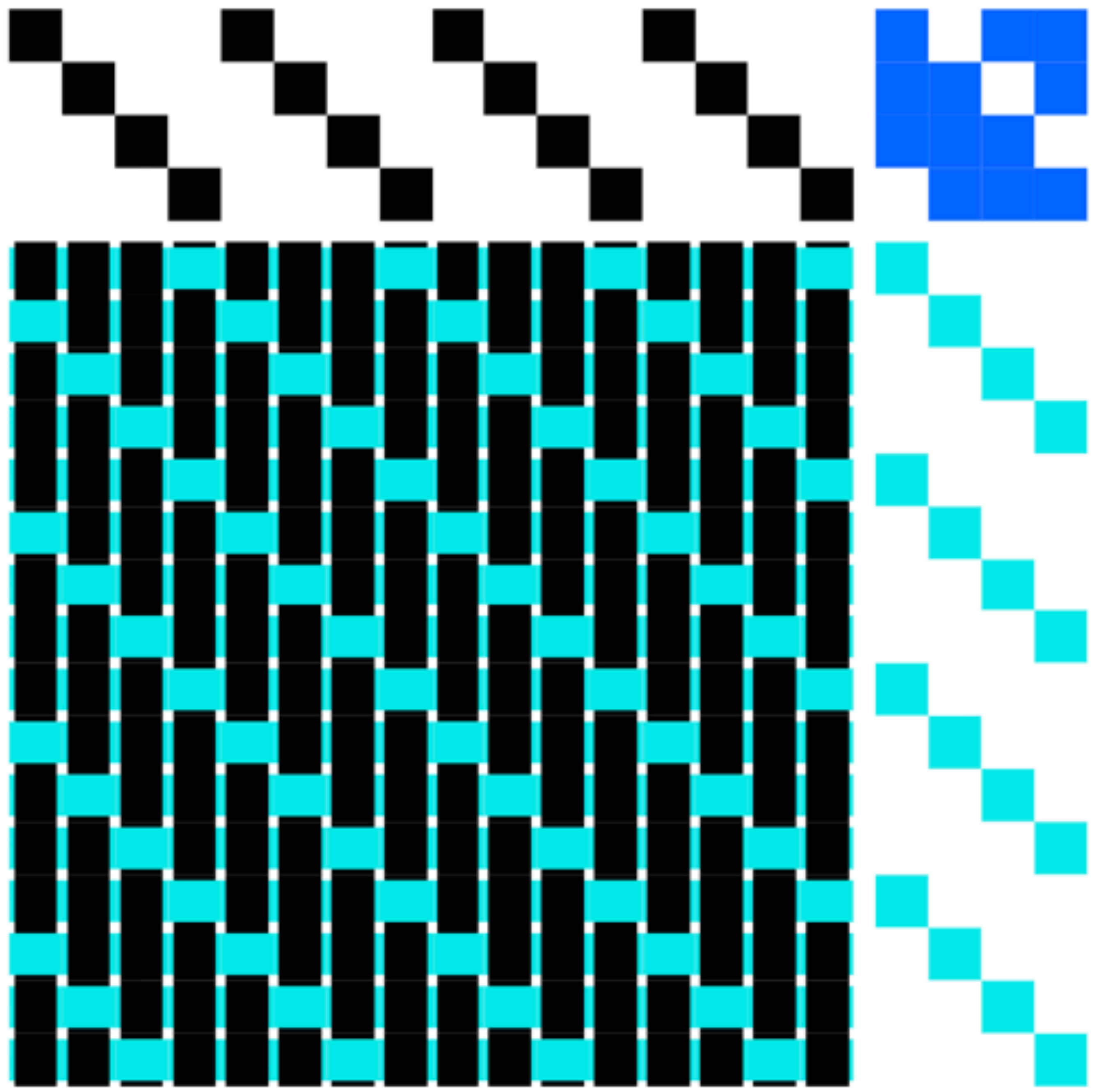




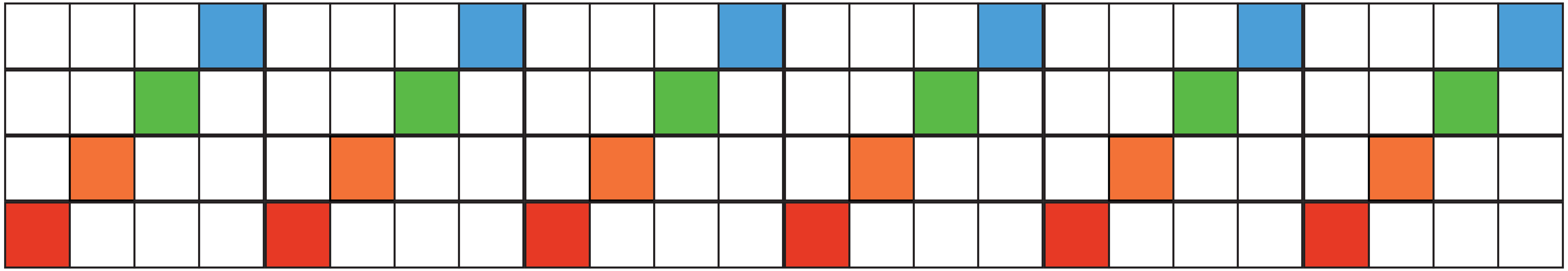
1 x 3 twill

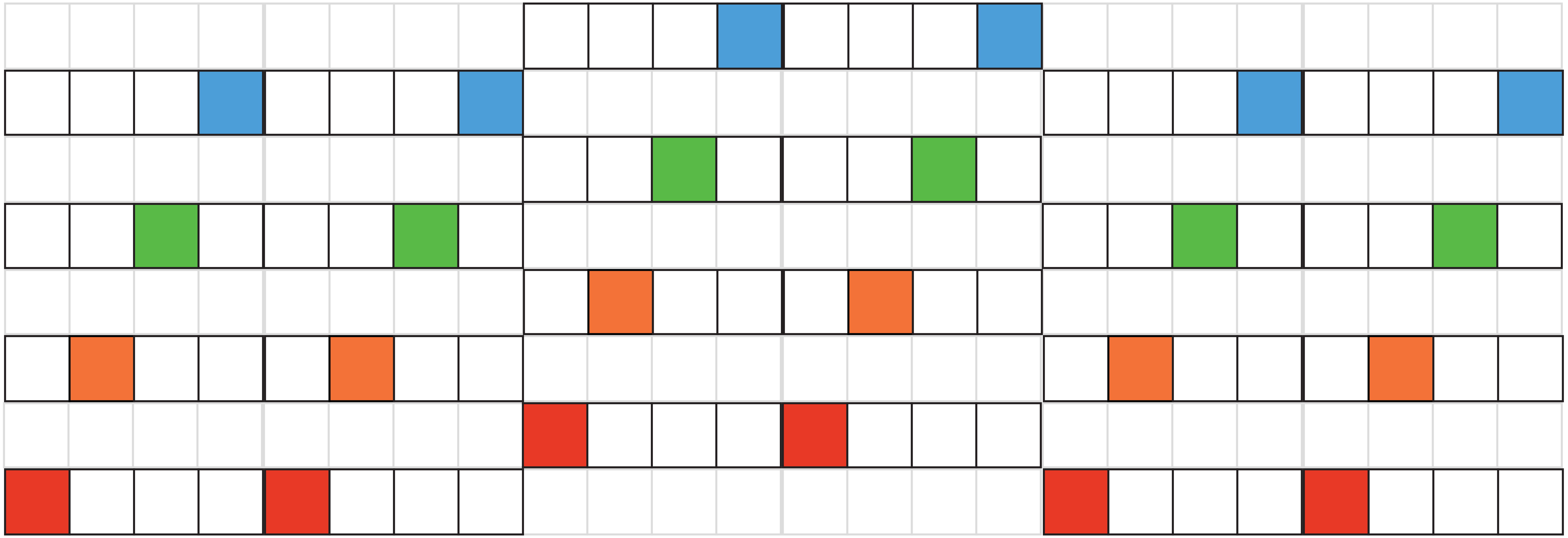


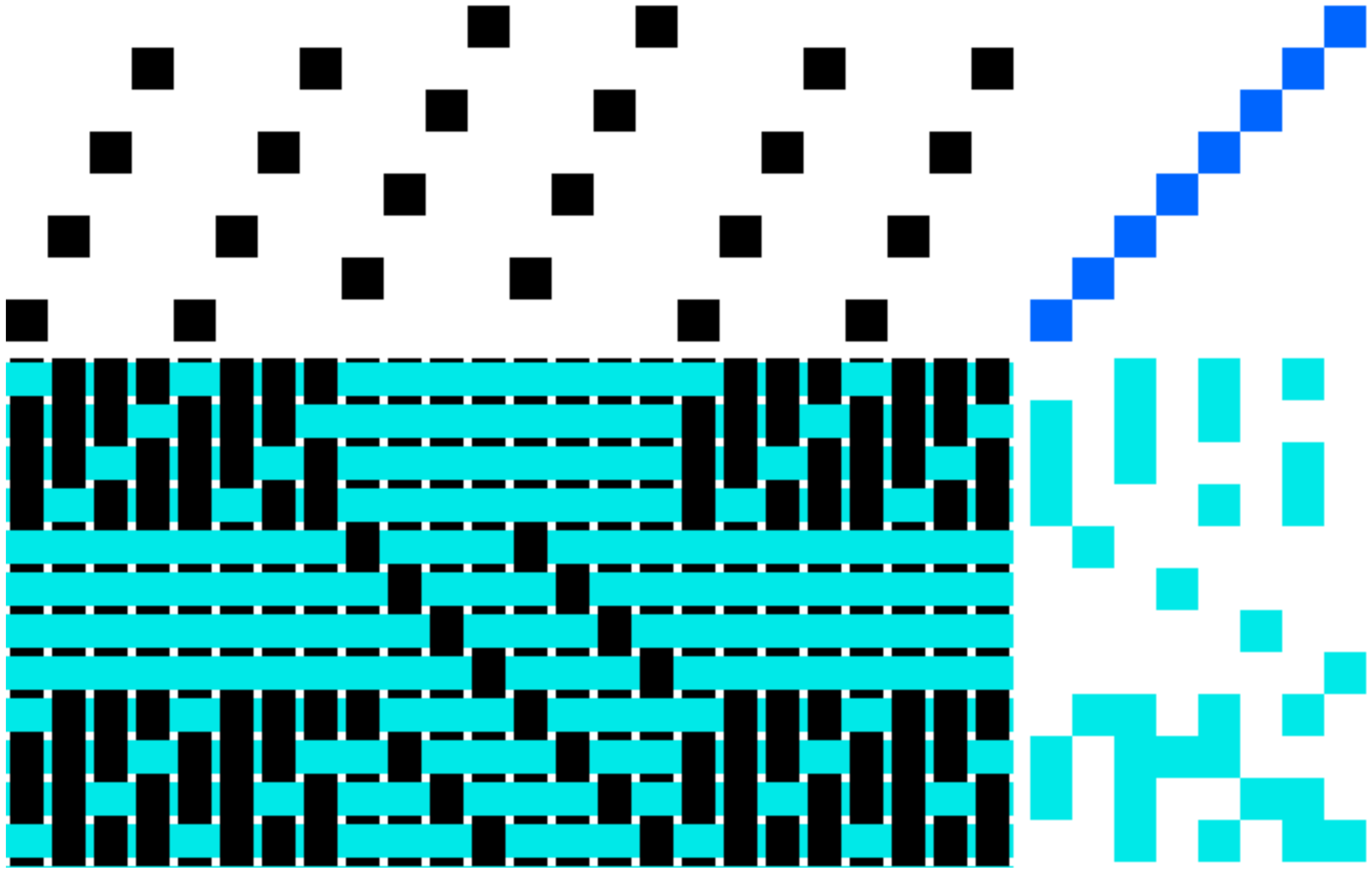
2 x 2 twill



3 x 1 twill



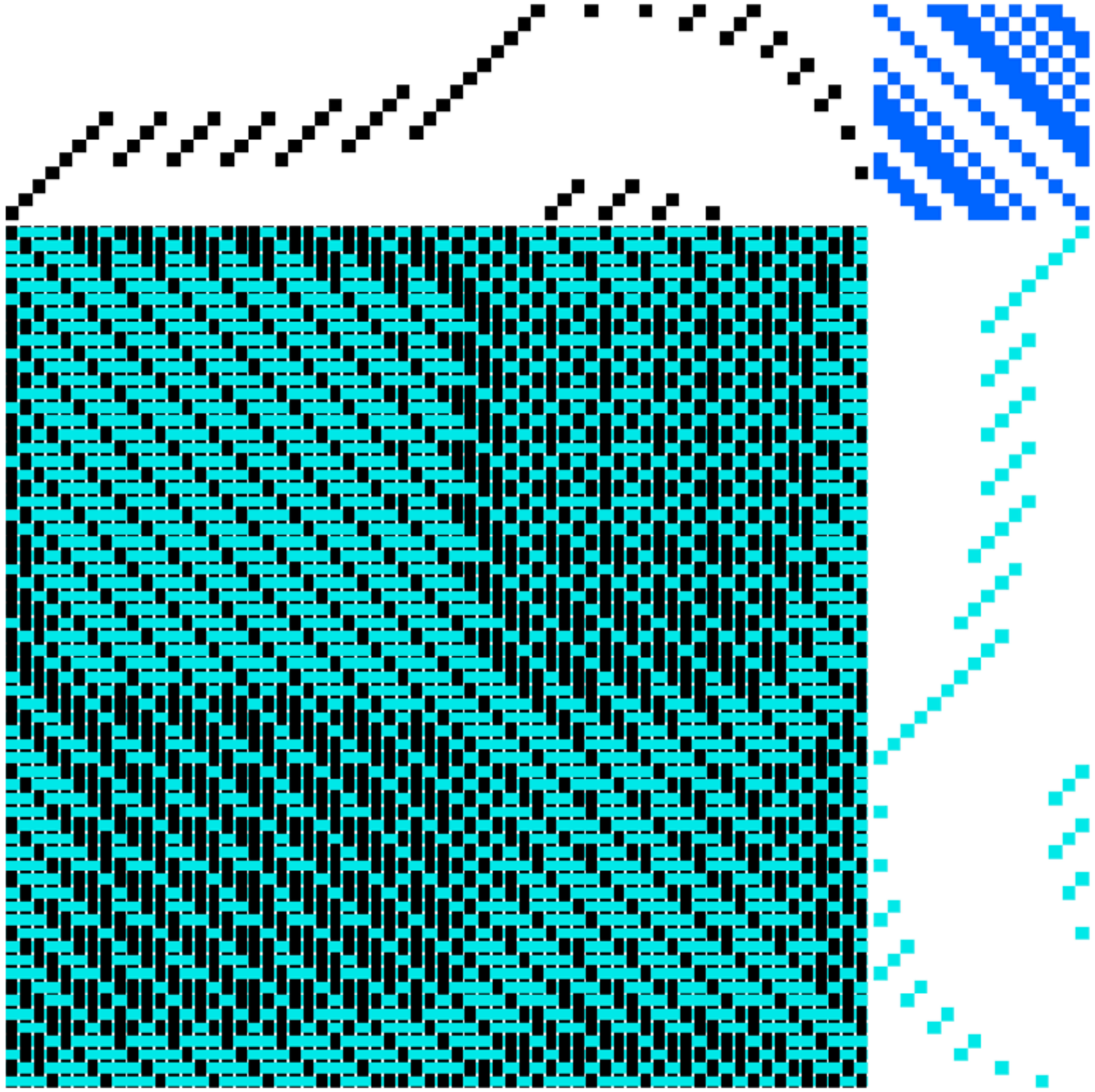


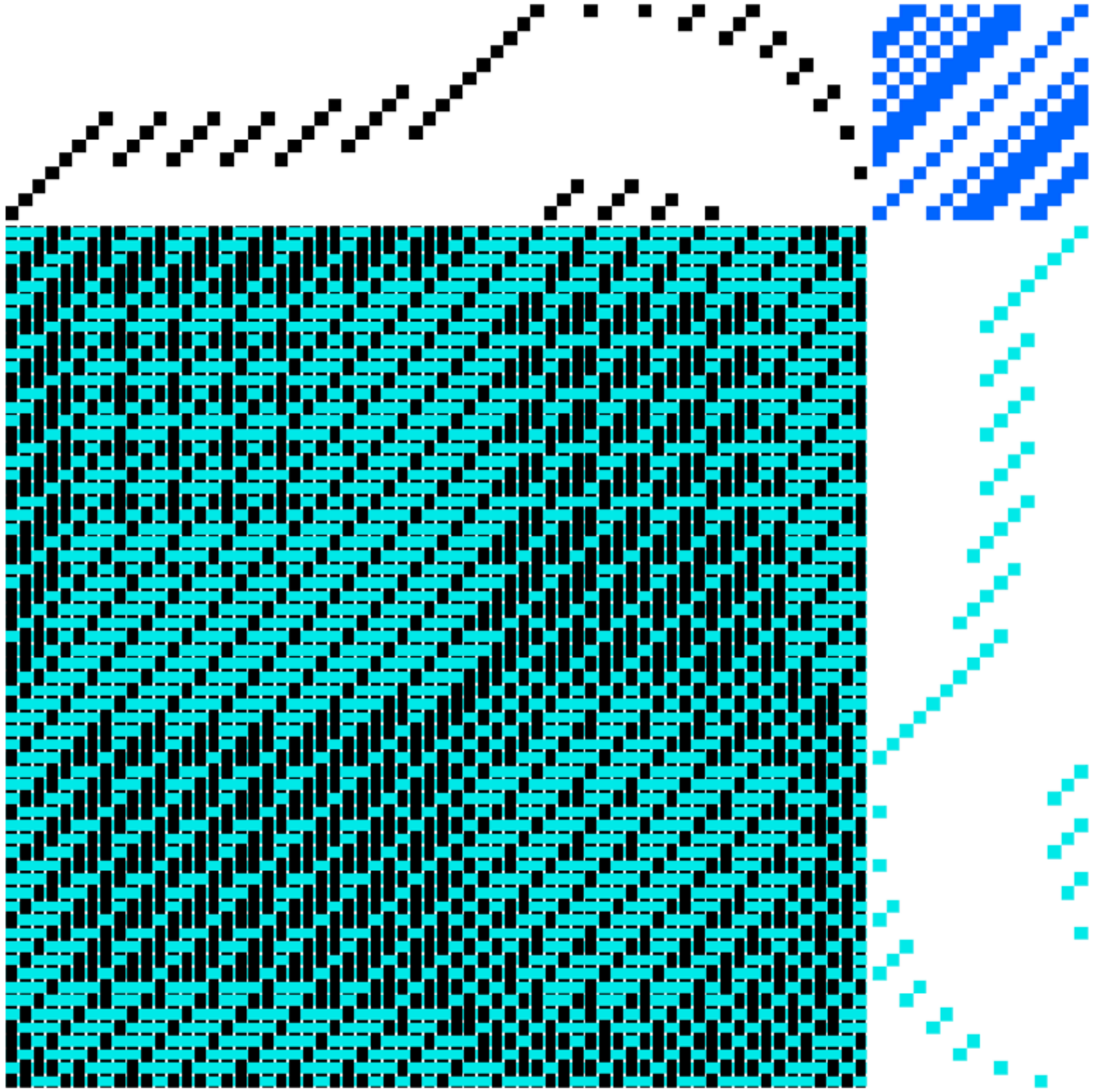


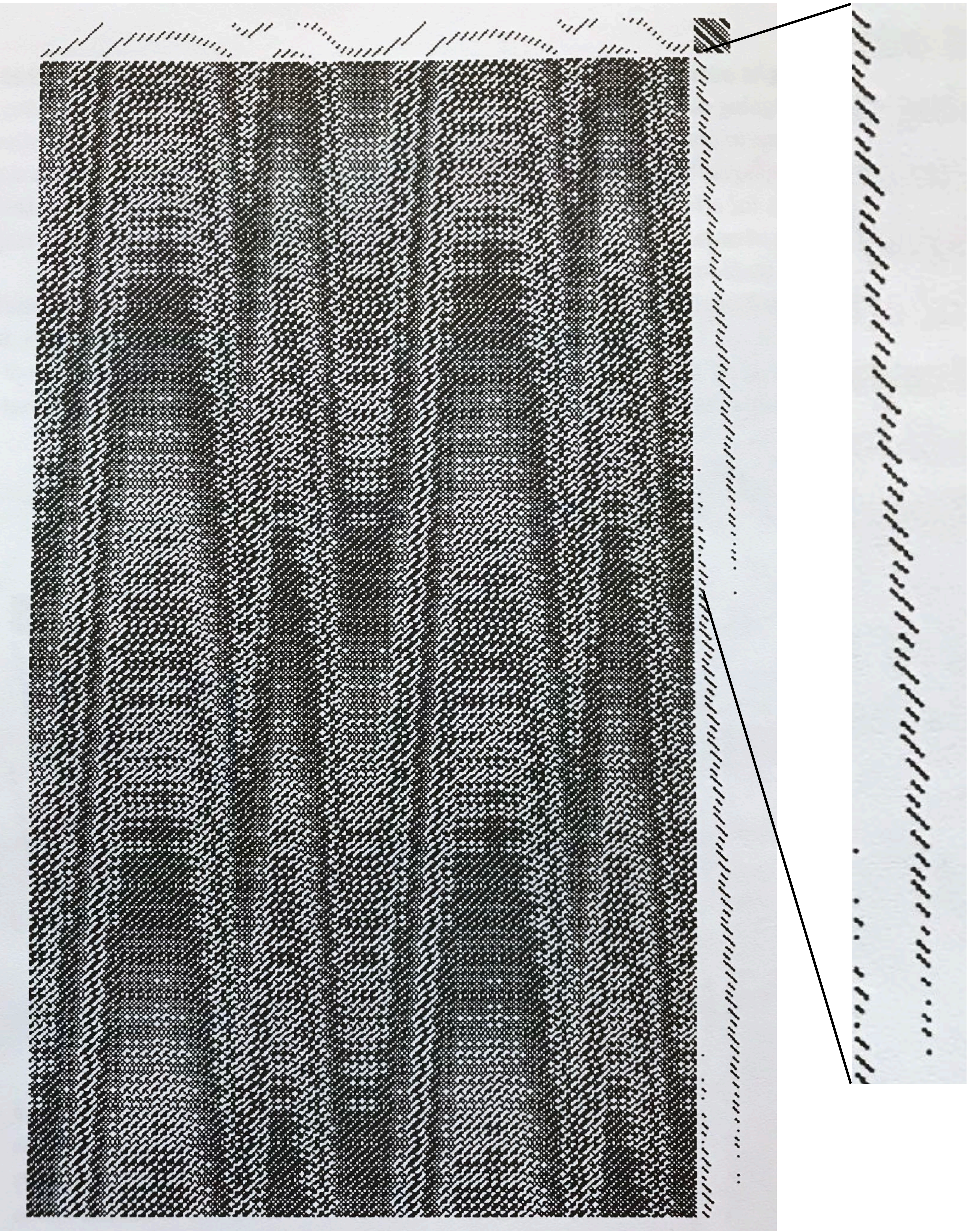
A: 3 x 1 twill

B: 1 x 3 twill

A & B together







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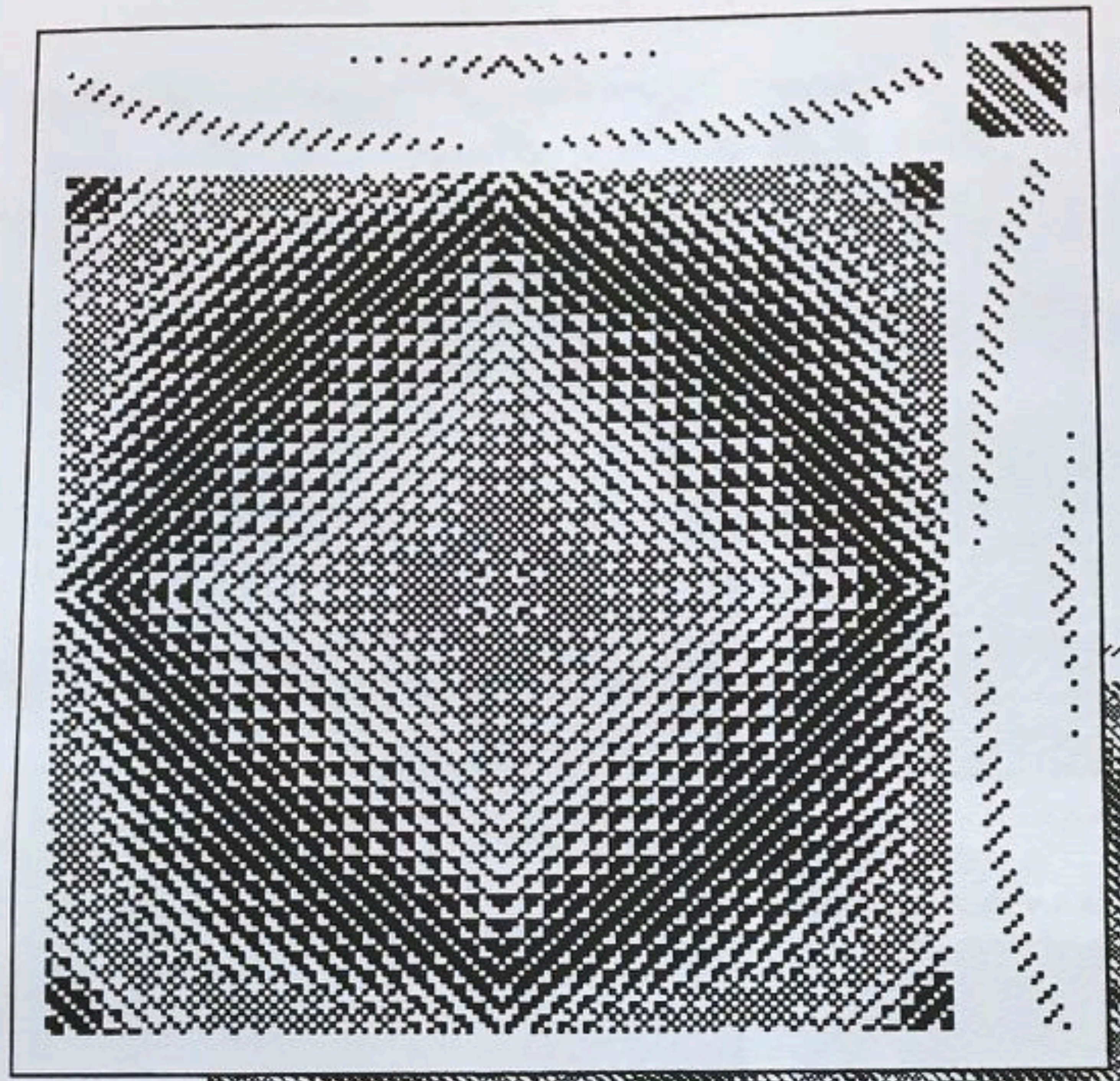
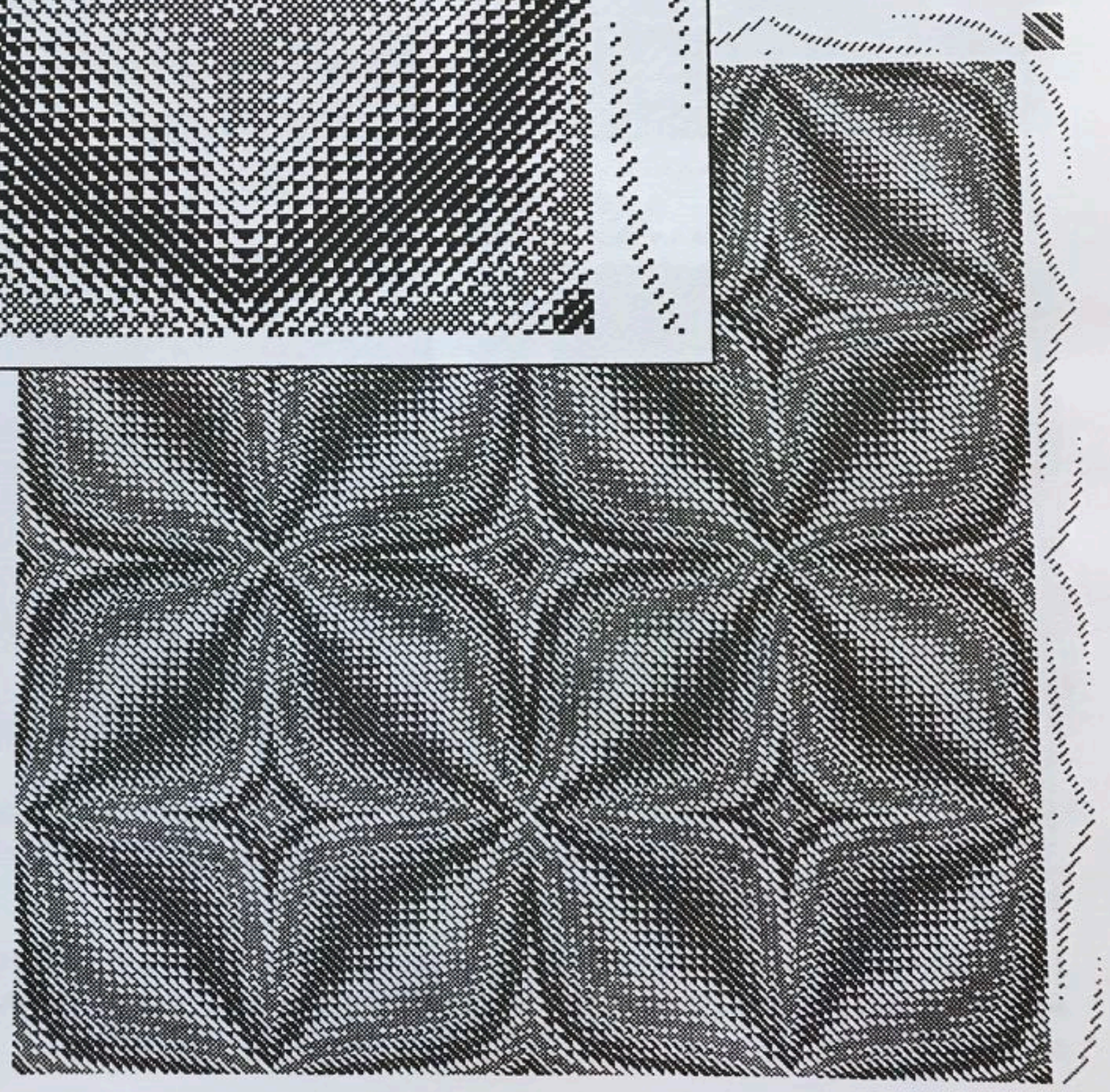


12. A networked twill containing a reverse point.



13. The pattern line for this draft had reverse points inserted before the line was plotted on the network. This keeps all the twill lines running in the same direction and eliminates the problem of long floats at reverse points.

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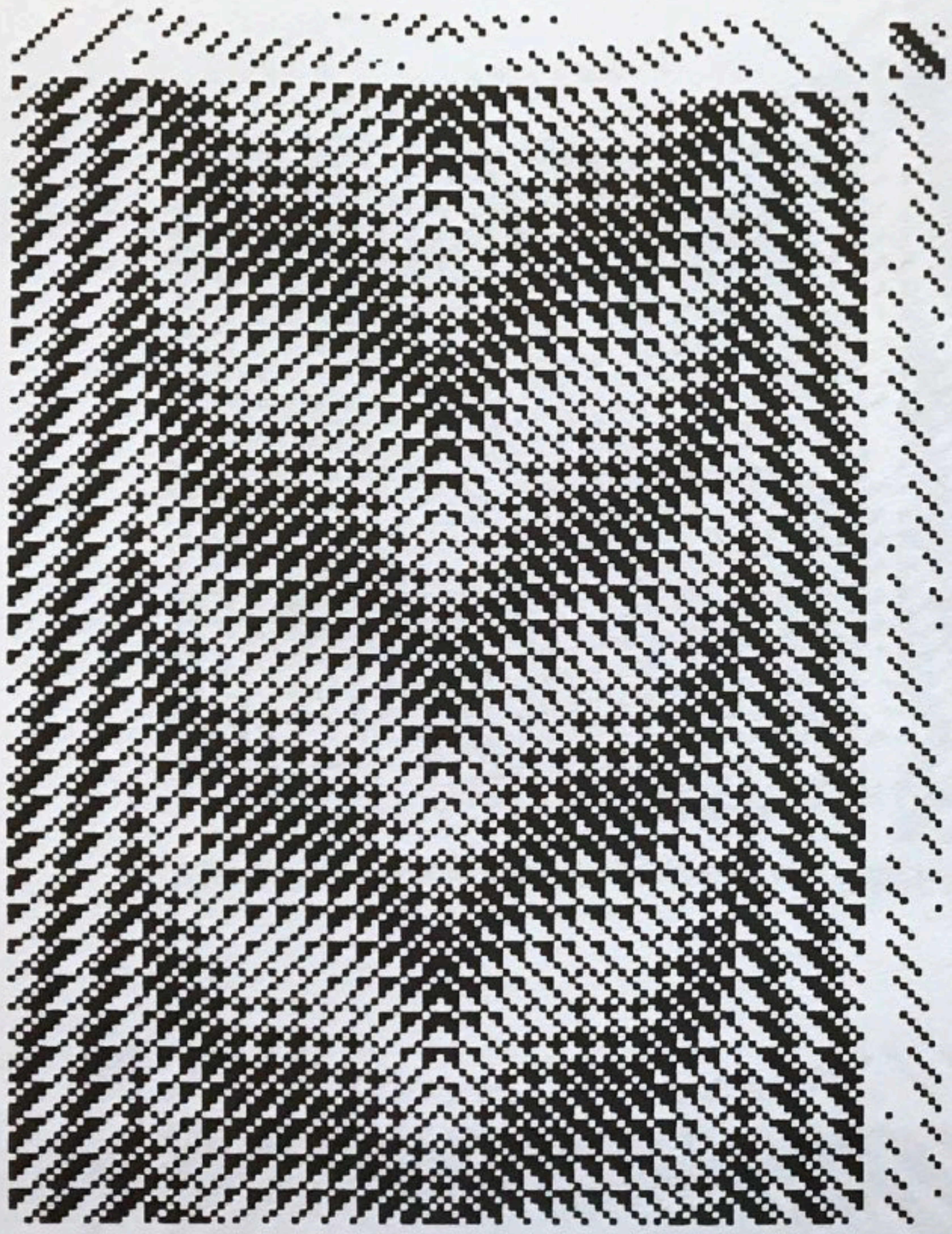
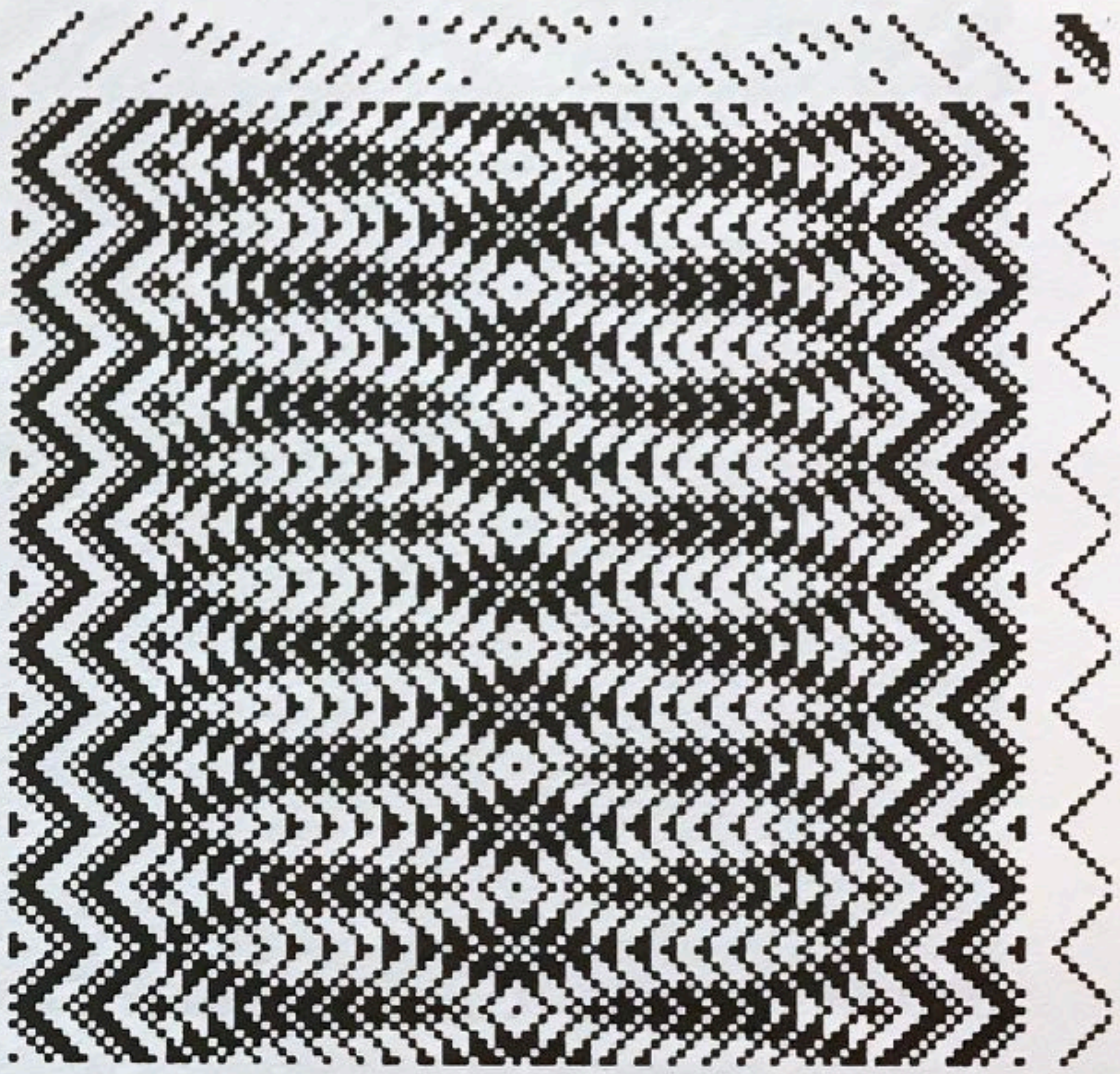


9. Threading from fig.8 woven with an advancing twill treadling and twill tie-up.



10. Threading from fig.8 woven with reverse twill treadling and twill tie-up.

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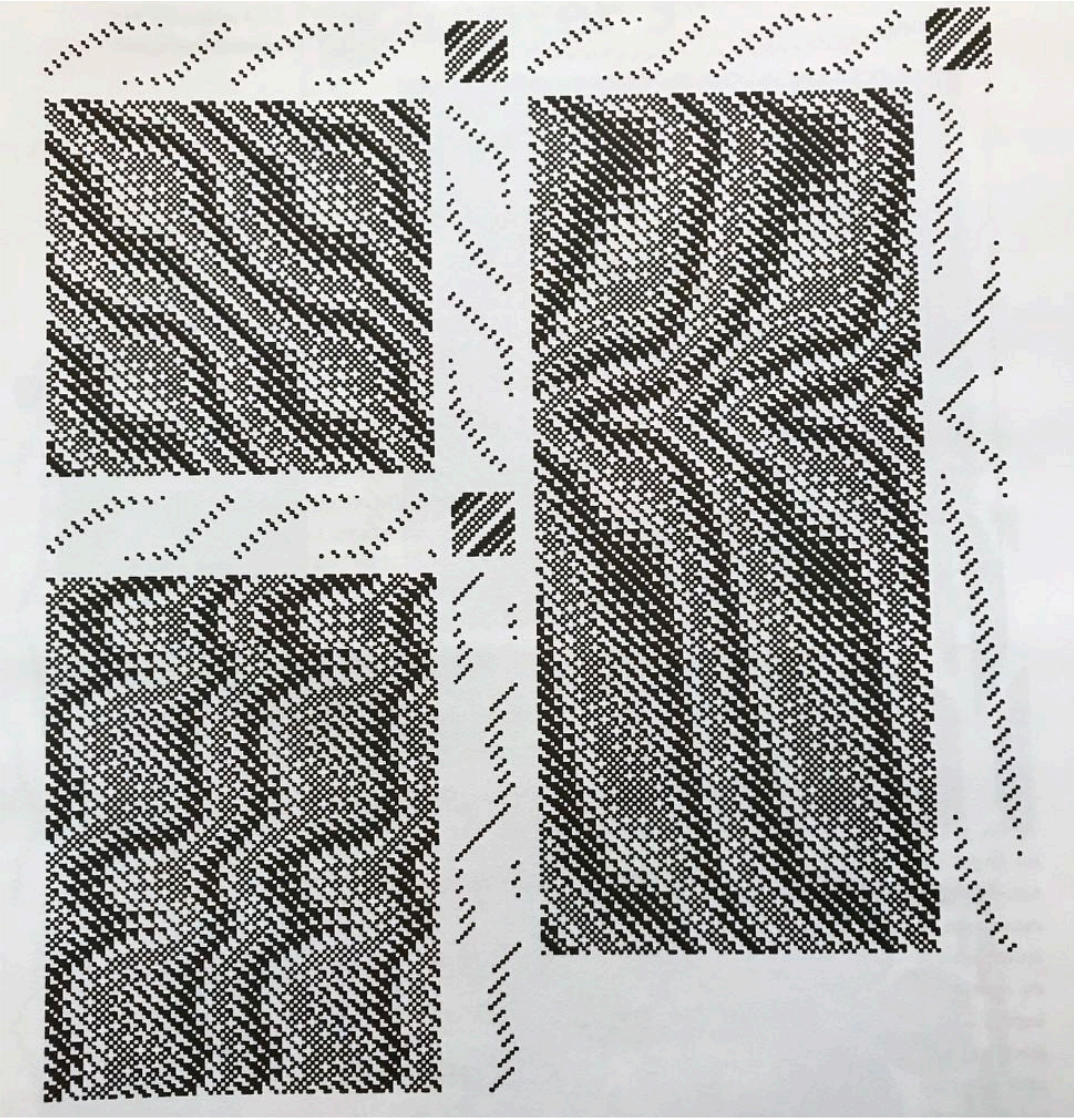

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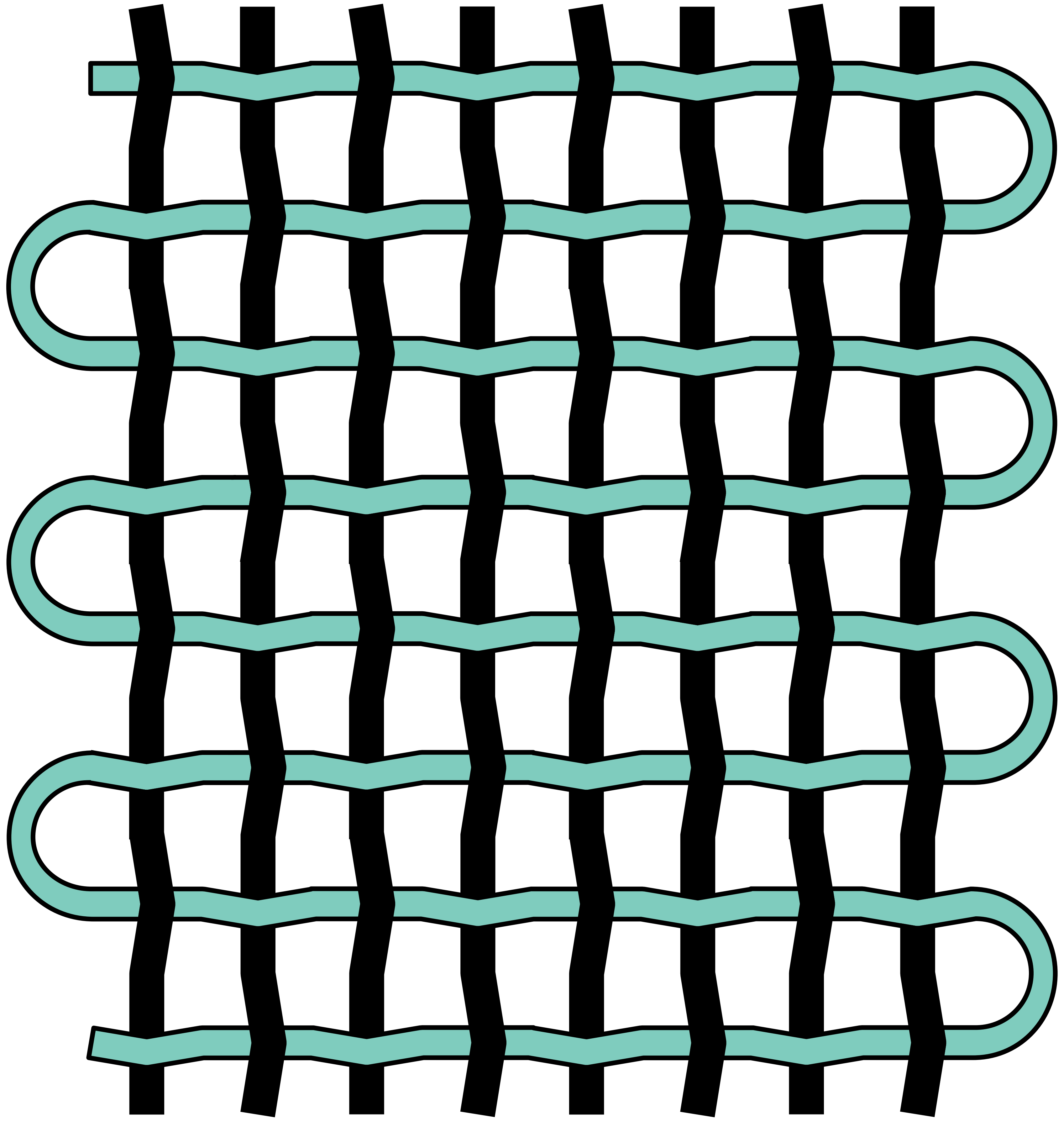
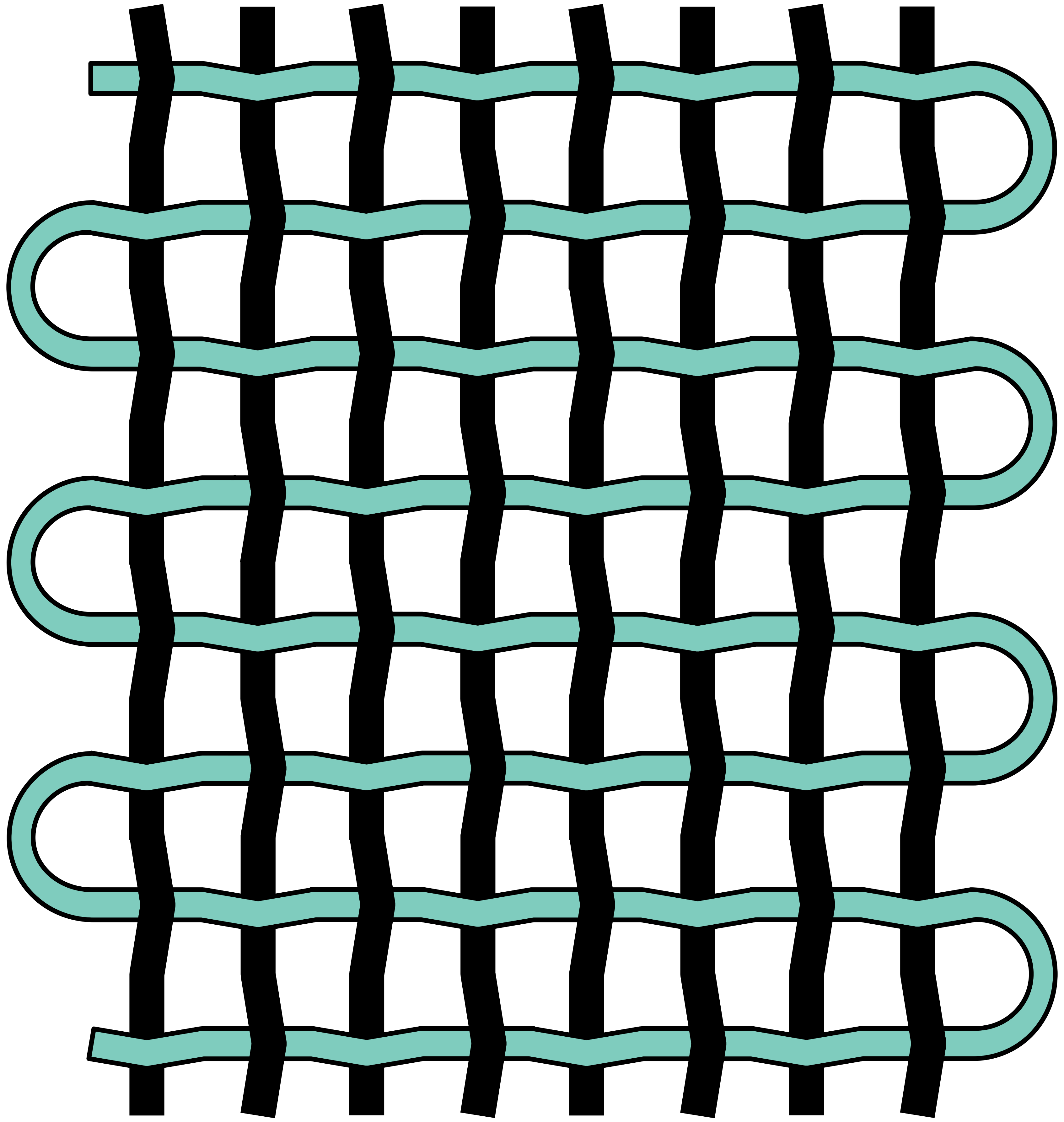
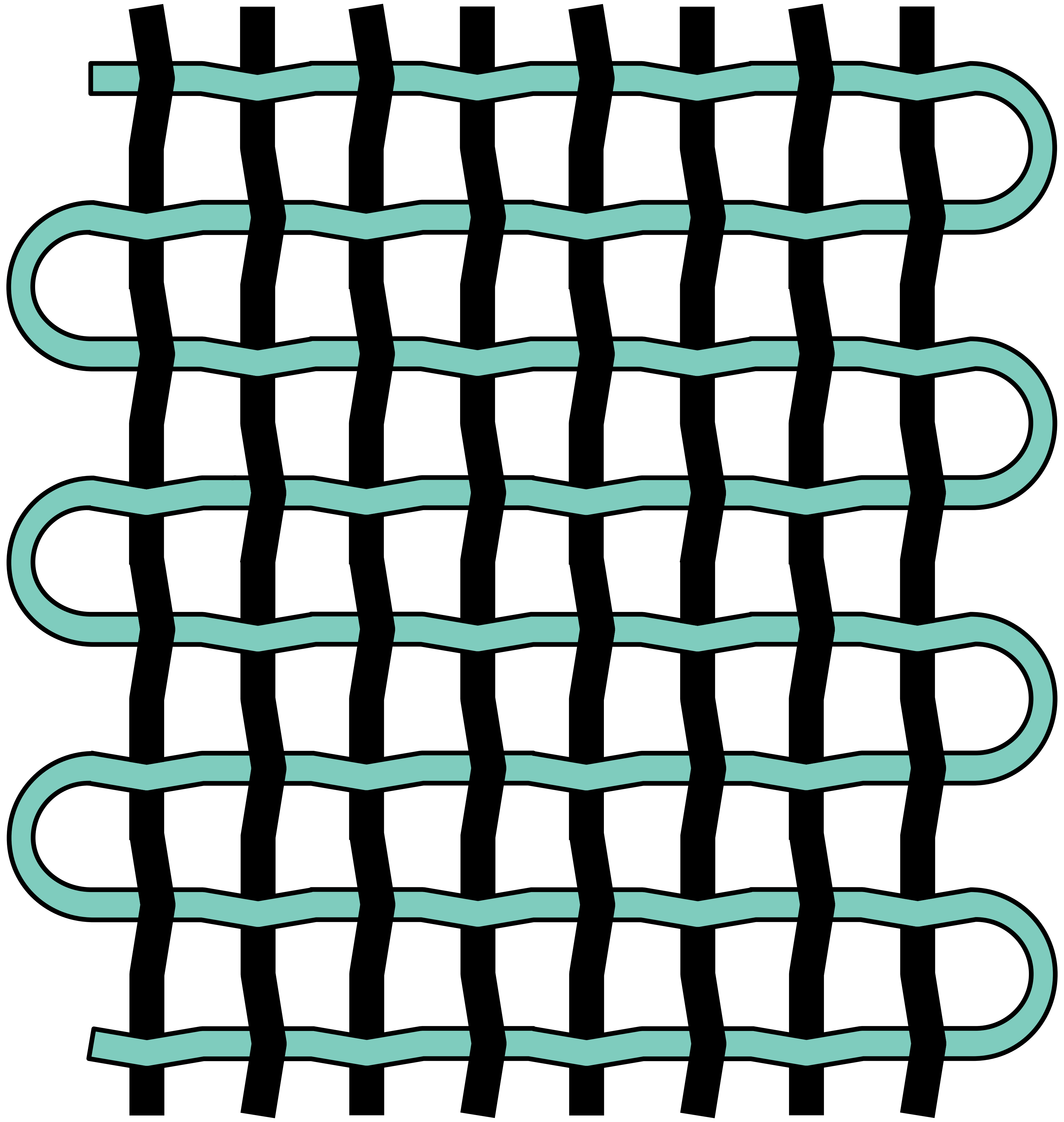
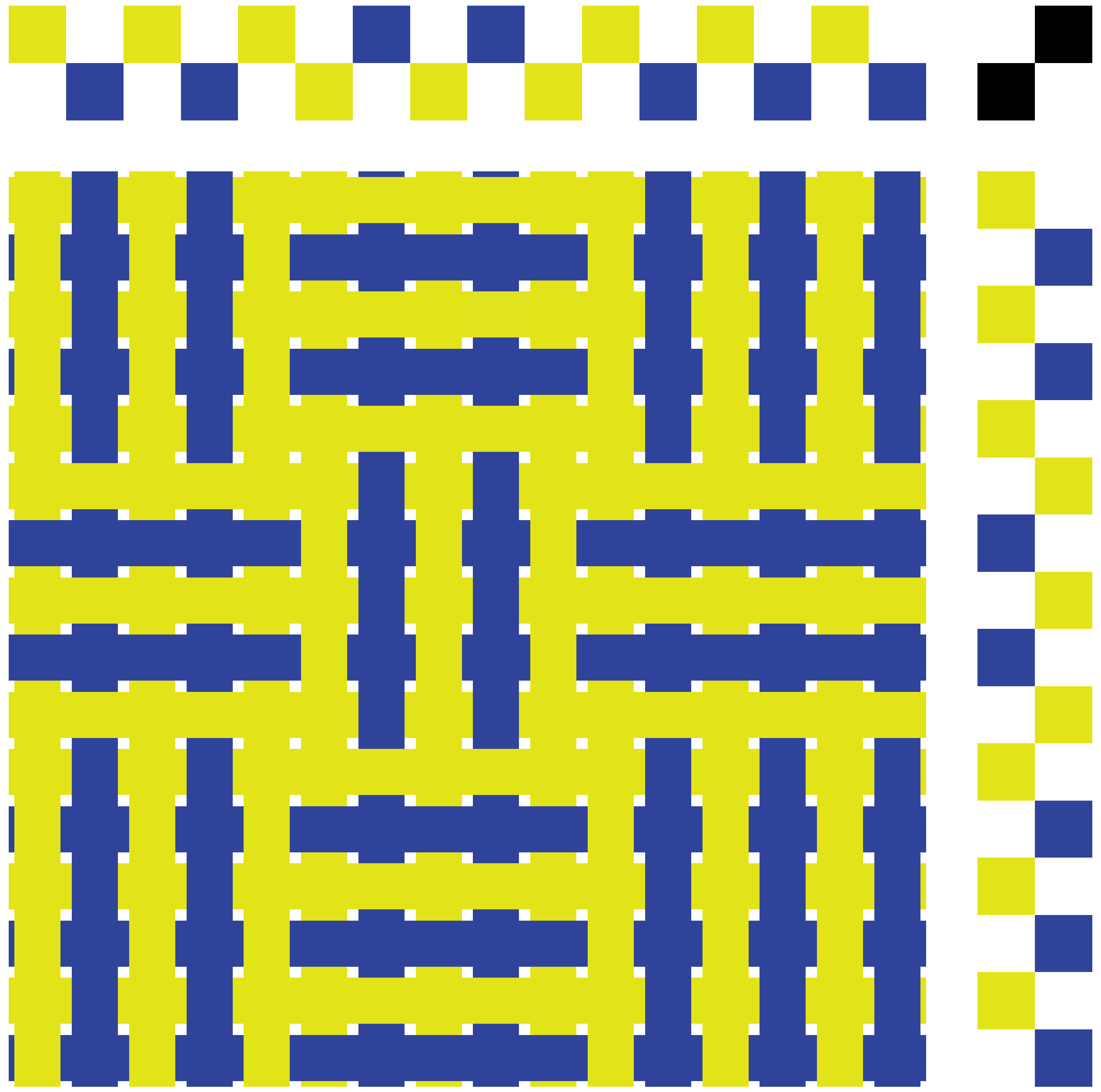
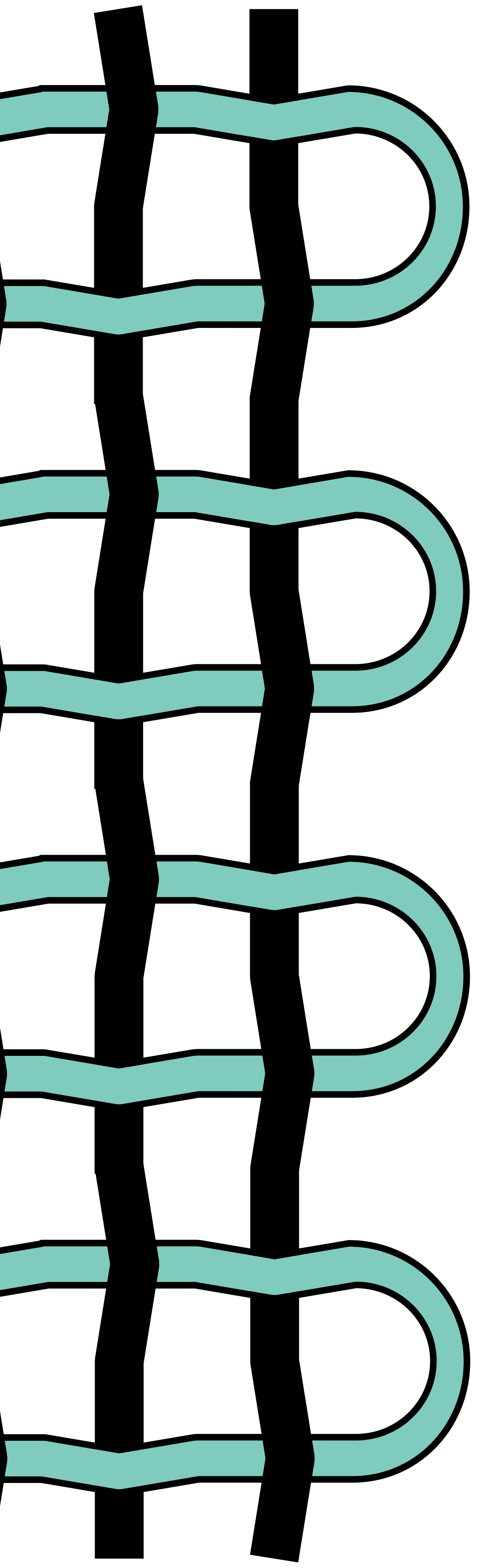
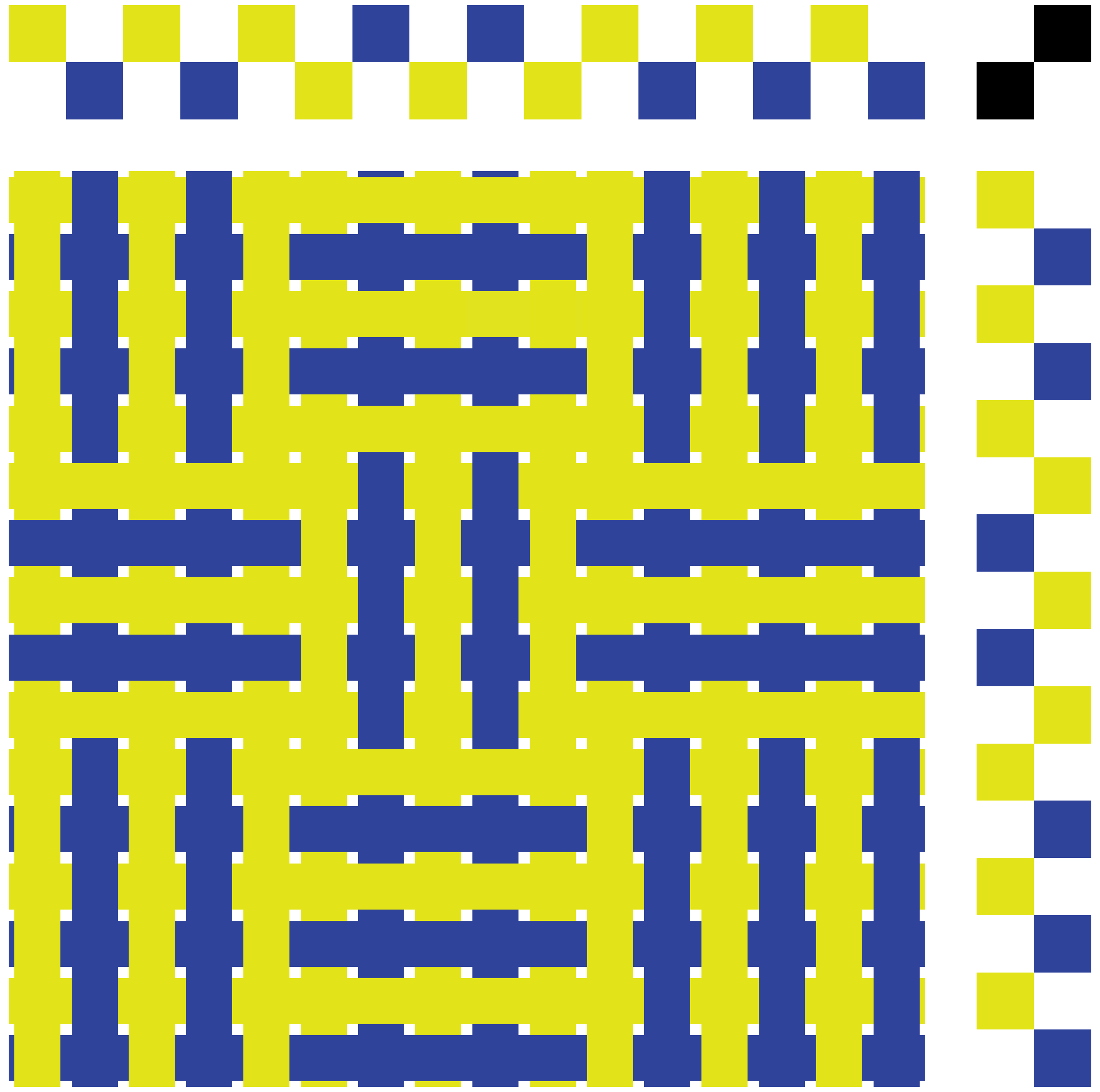


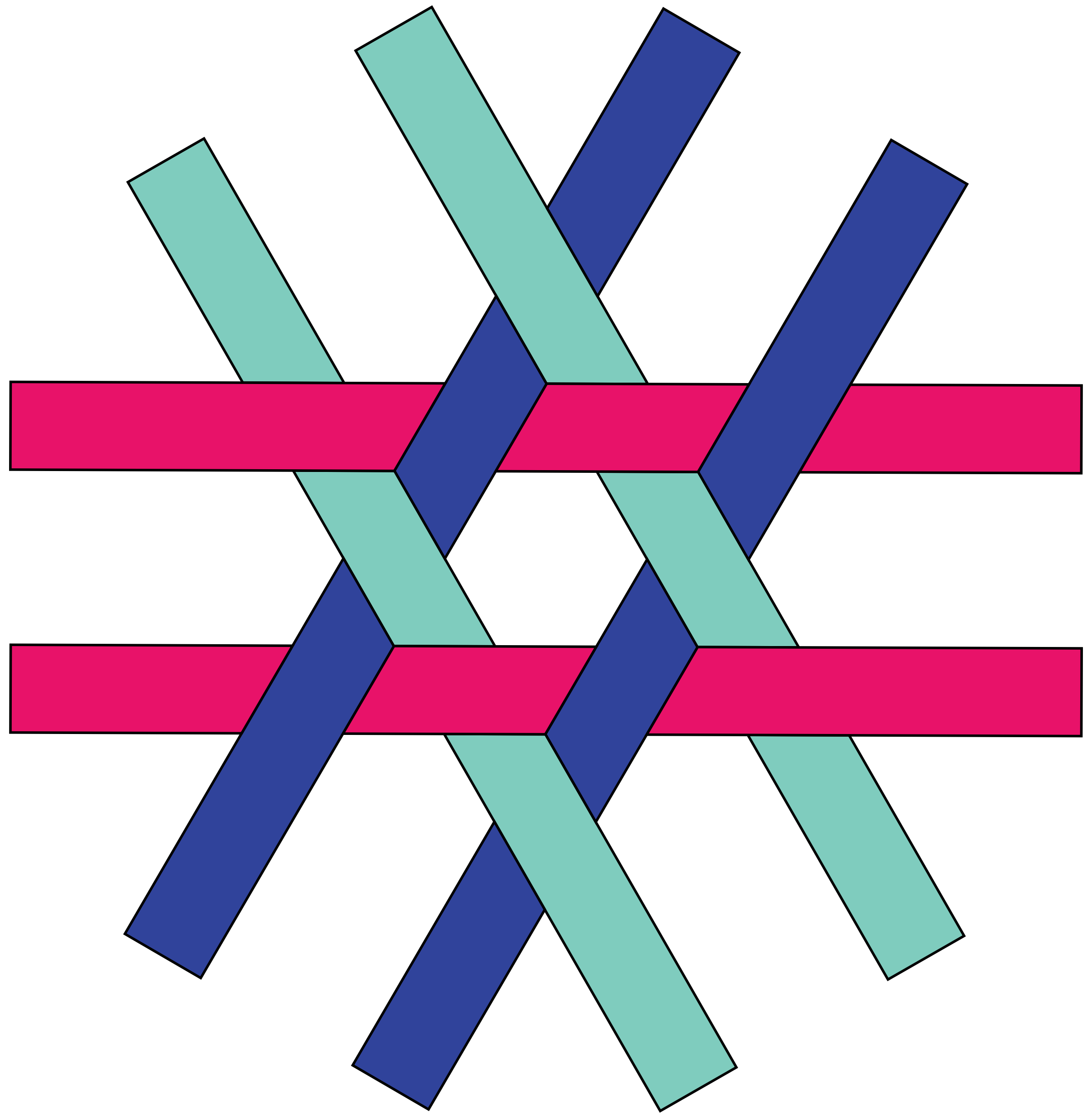


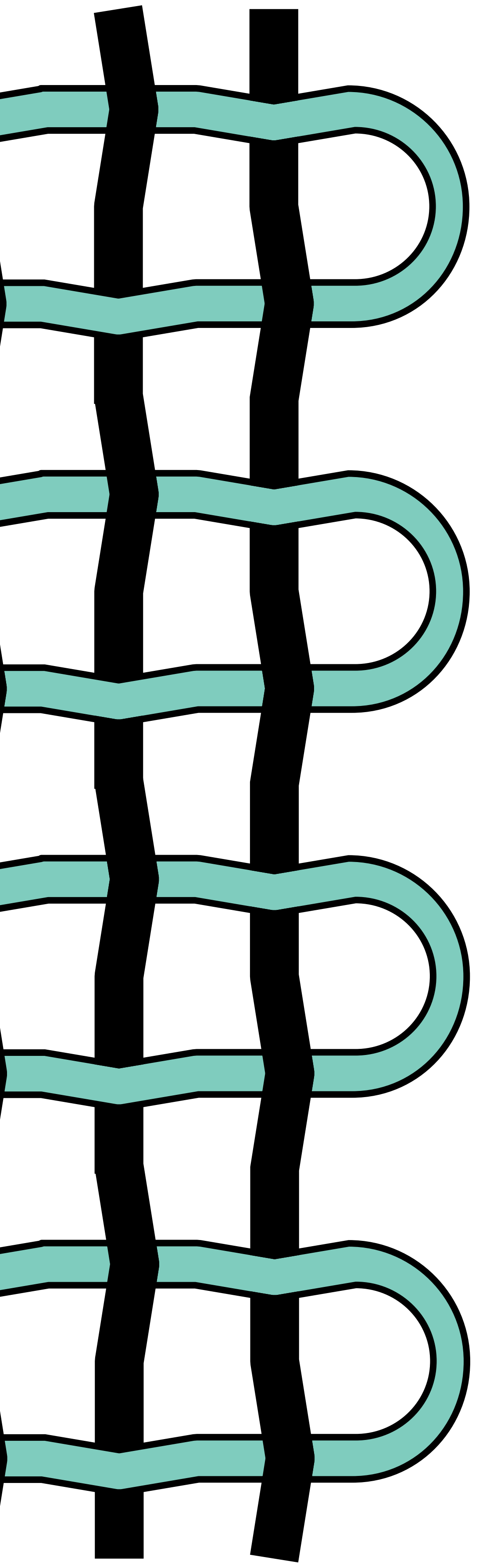


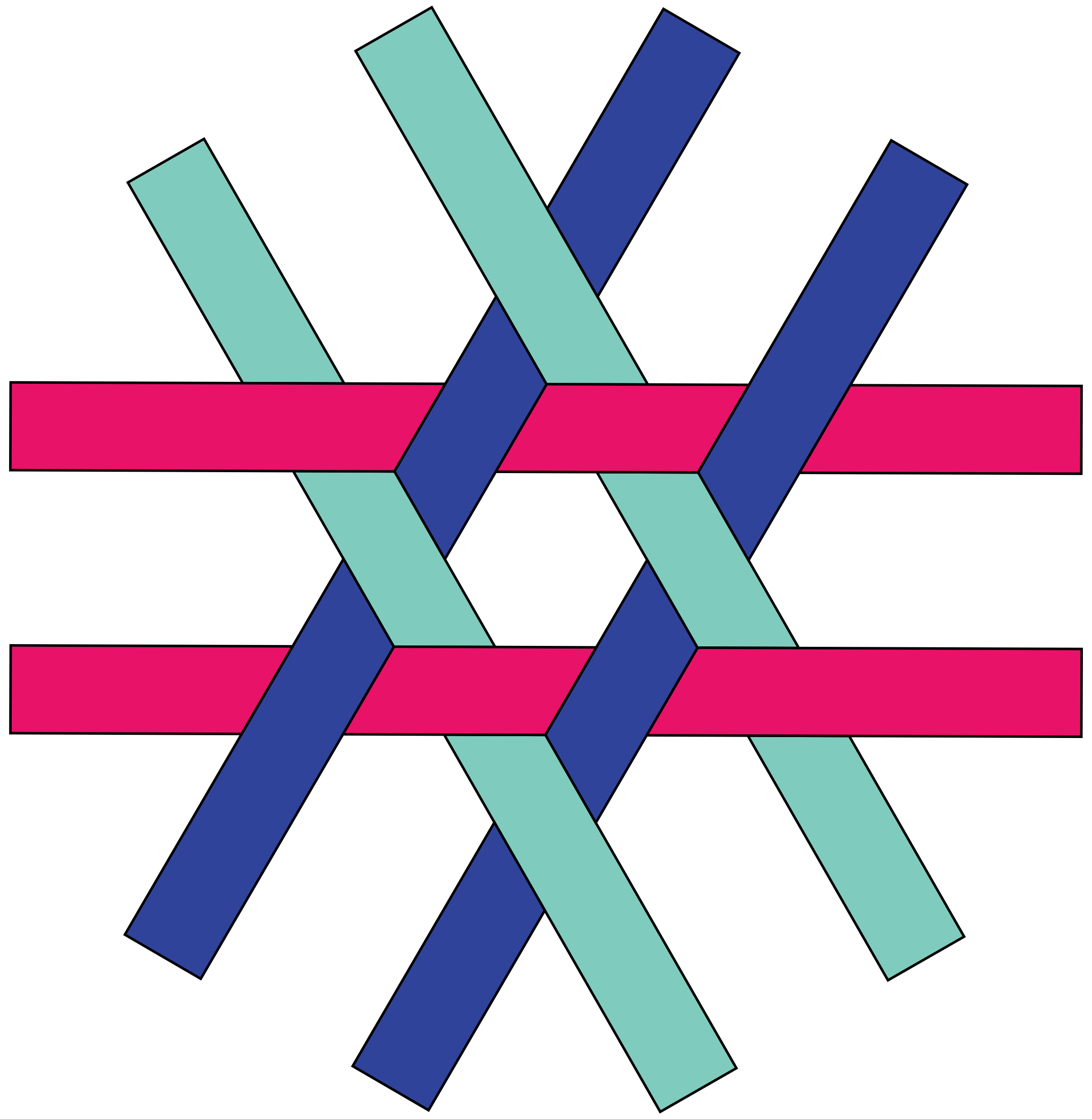
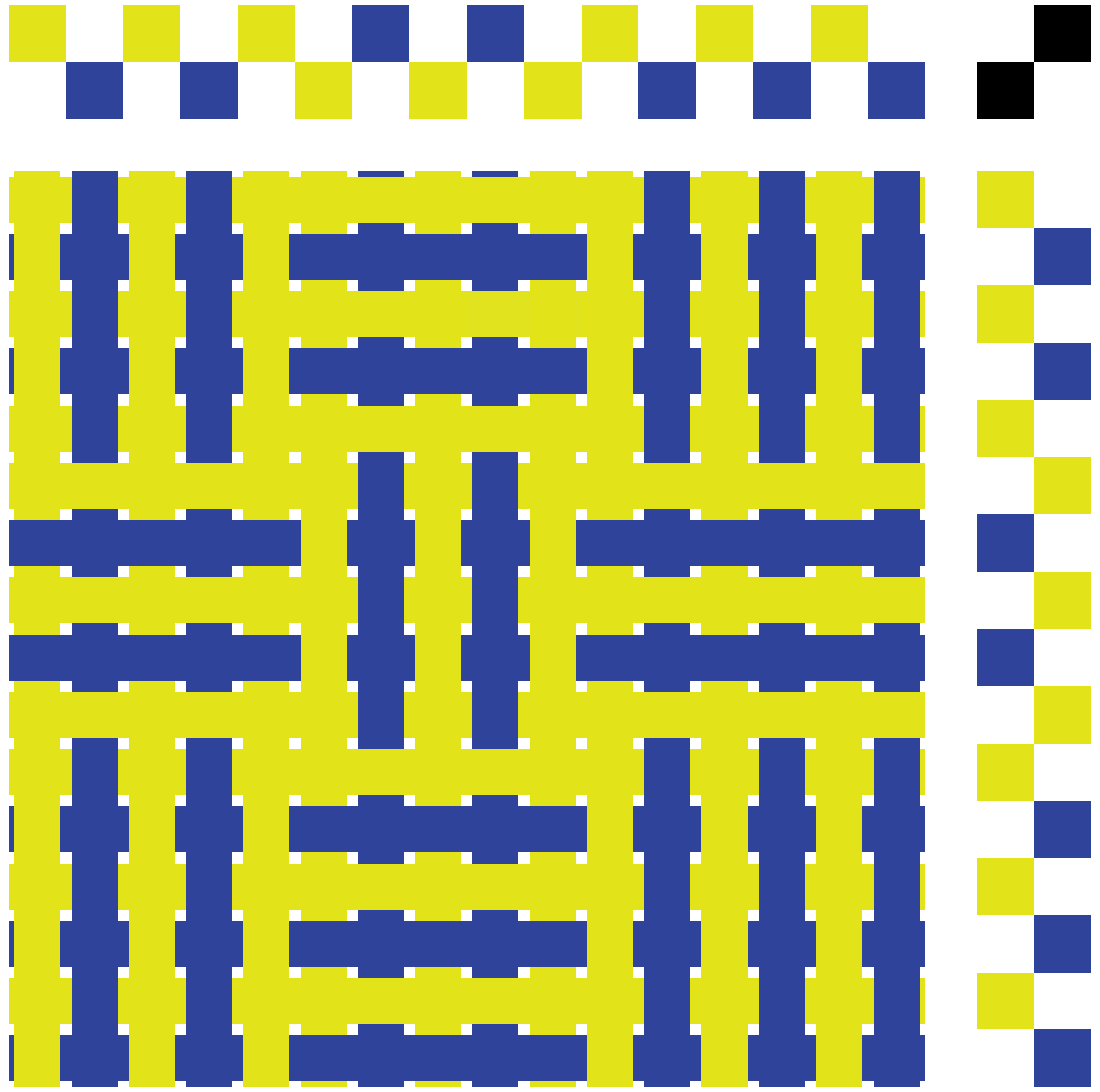
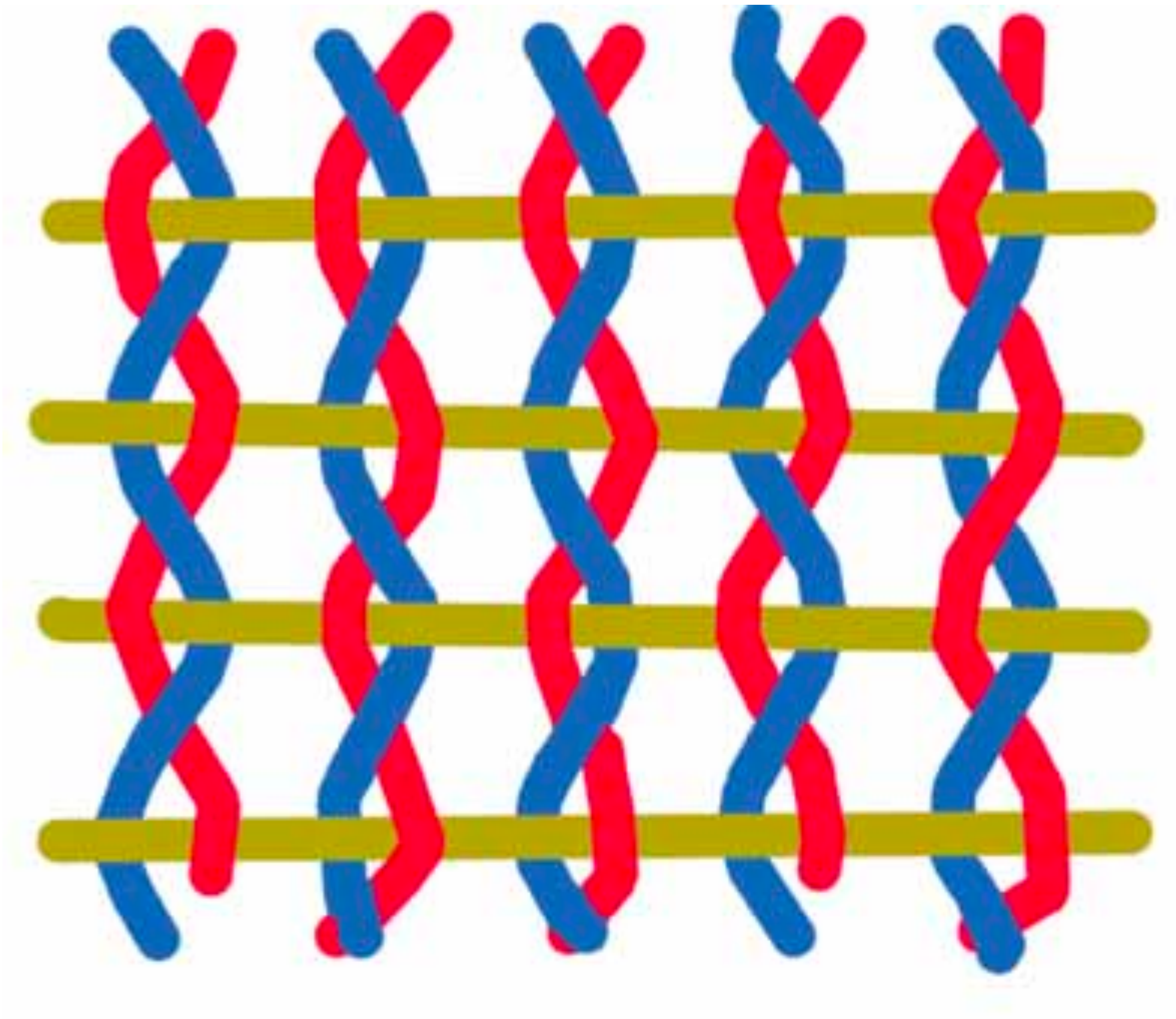






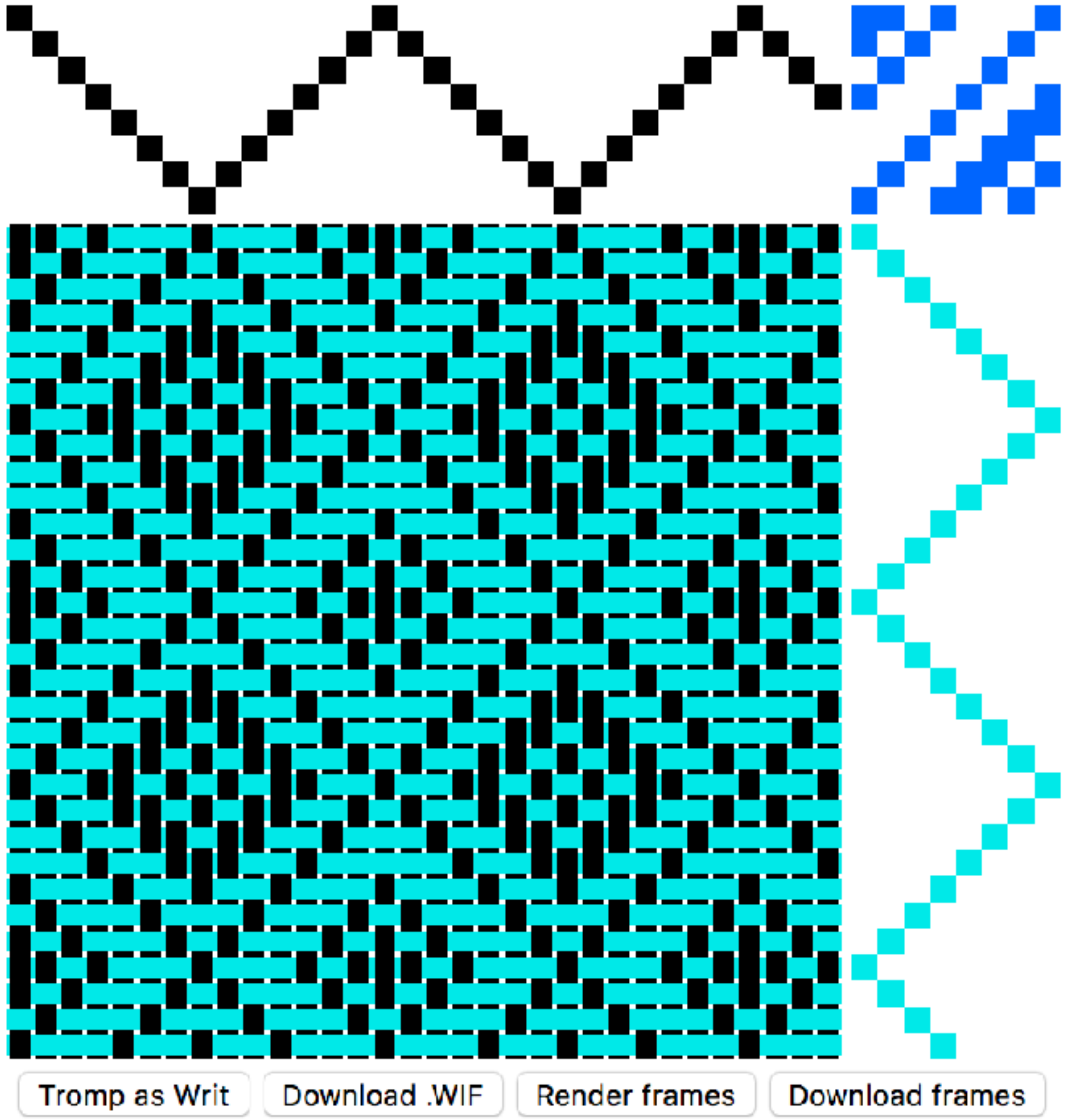




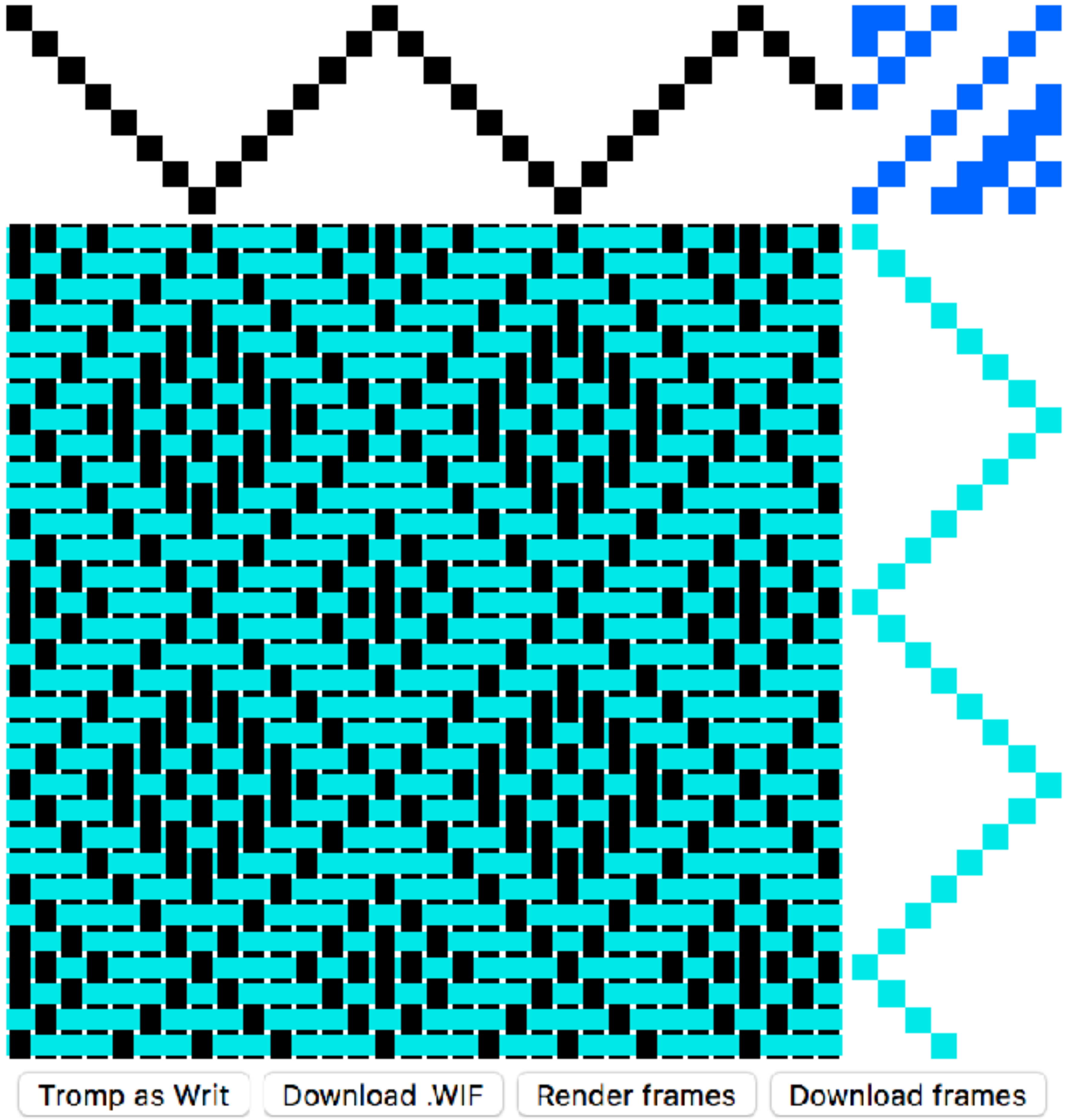




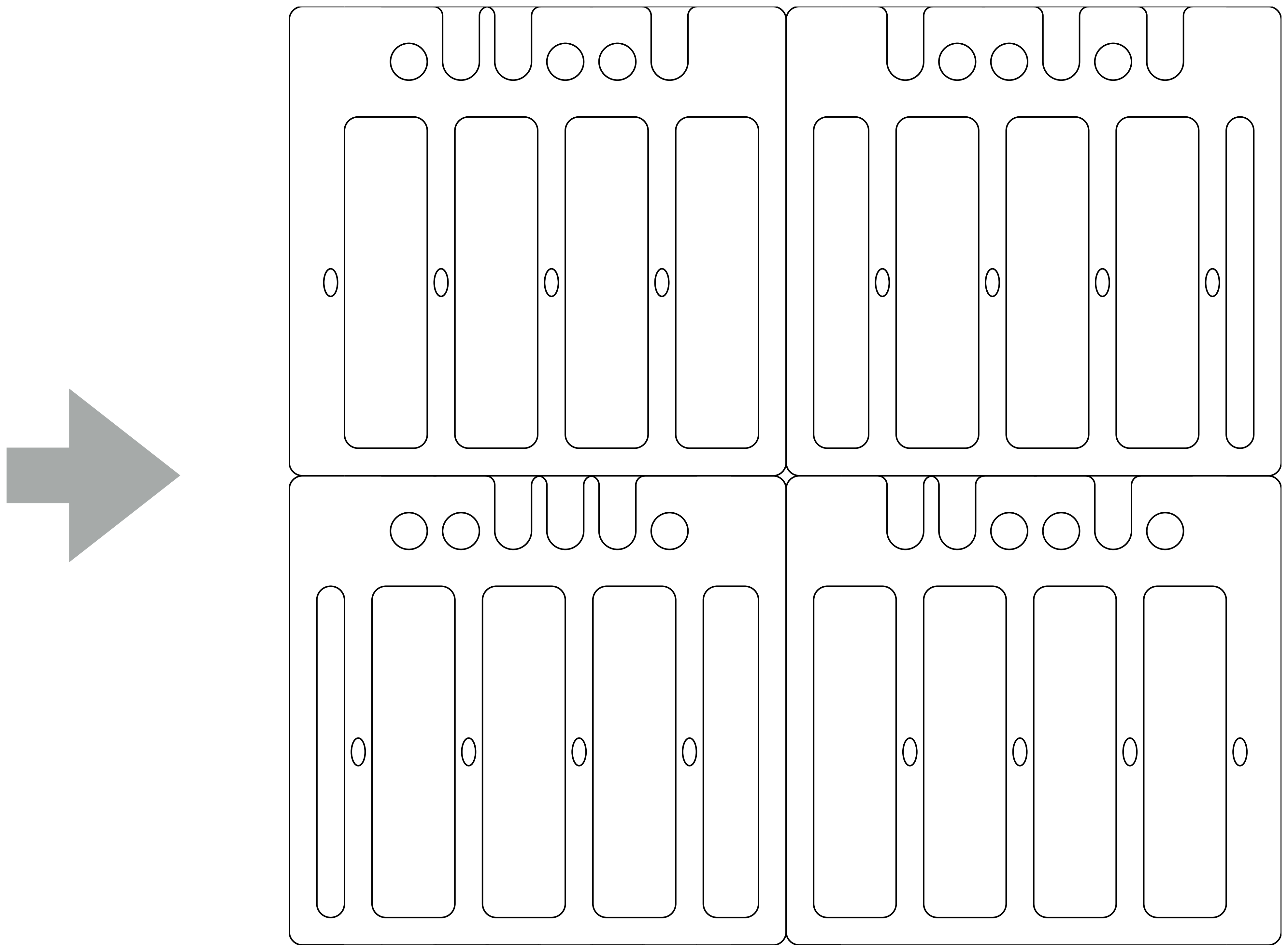
Everyone gets a loom!

lealbaugh.github.io/little-loom/



lealbaugh.github.io/little-loom/





lealbaugh.github.io/little-loom/


5
4
45°
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Lea Albaugh, @doridoidea

lealbaugh.github.io/little-loom/

(Thanks especially to:
William Lovas, Trevor Burns, David Renshaw)

Warp Lifting Plan of Weaving Calculated with Matrices

By Tadashi Fujita, Member, TMSJ

Shiga Prefectural Junior College, Hikone, Shiga Pref.

Abstract

The author sought to establish the relations among the structural designs of weaving, the drawn-in darft, the treadling and the cording plan for warp lifting by means of the multiplication of matrices.

If such matrices are used as the elements consist of the marks of the lifting plan, it has been possible to clarify mathematically the relations among those items above mentioned, and to simplify the drawing of the lifting plan without the sacrifice of accuracy.

1. Introduction

Attempts to systematize the structural designs of weaving mathematically have been made by T. Renaud [1], L. Lejeune and J. Soroge [2], M. Tanaka [3], H. Tsukiyama [4], and T. Broggi [5]. Their works are all interesting as the basis of the theoretical development of the weaving designs.

In the conventional warp lifting plan, weaving designs are filled with marks in the blank spaces of design papers, the drawn-in draft and the treadling are written down, and then the cording plan is built by tracing the marks of the designs, drawn-in draft and treadling.

These procedures, however, are apt to cause errors if the design is complicated. The author has developed a system to express the designs and the weaving plan by matrices to clarify the relation between them by the multiplication of these matrices, and to explain the characteristics of the lifting plan mathematically.

2. Relation Between Design and Cording Plan

2-1. Calculation of cording plan

Fig.1 indicates the lifting plan of $\frac{2}{2}$ broken twill. The weaving design is shown by A, the drawn-in draft by B, the treadling by C and the cording plan by D.

Assuming that a_{ik} denotes the warp up mark ▣ in A, then this design can be represented by a matrix whose elements are a_{ik}. That is to say:

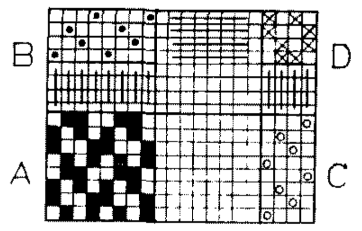


Fig. 1 Lifting plan of $\frac{2}{2}$ broken twill

$$\begin{pmatrix} 0 & a_{12} & a_{13} & 0 \\ a_{21} & 0 & a_{23} & 0 \\ a_{31} & 0 & 0 & a_{34} \\ 0 & a_{42} & 0 & a_{44} \end{pmatrix} \qquad \cdots\cdots(1)$$

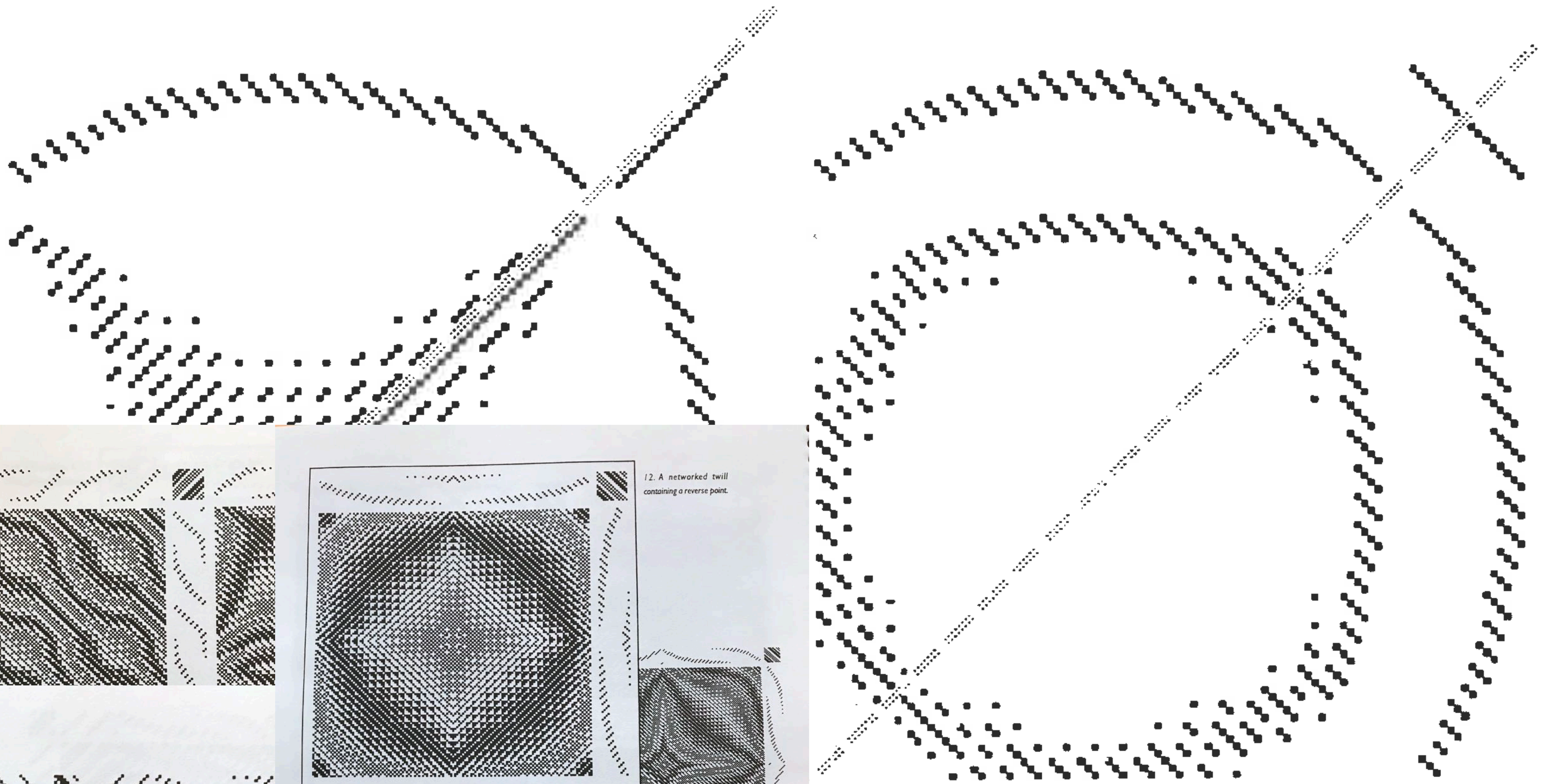
The element 0 of this matrix represents the weft up and the element a_{ik} the warp up. The sub-index k of the element represents the number of warp yarns counted from the left in one repeat; i, the number of weft yarns counted in reverse picking order.

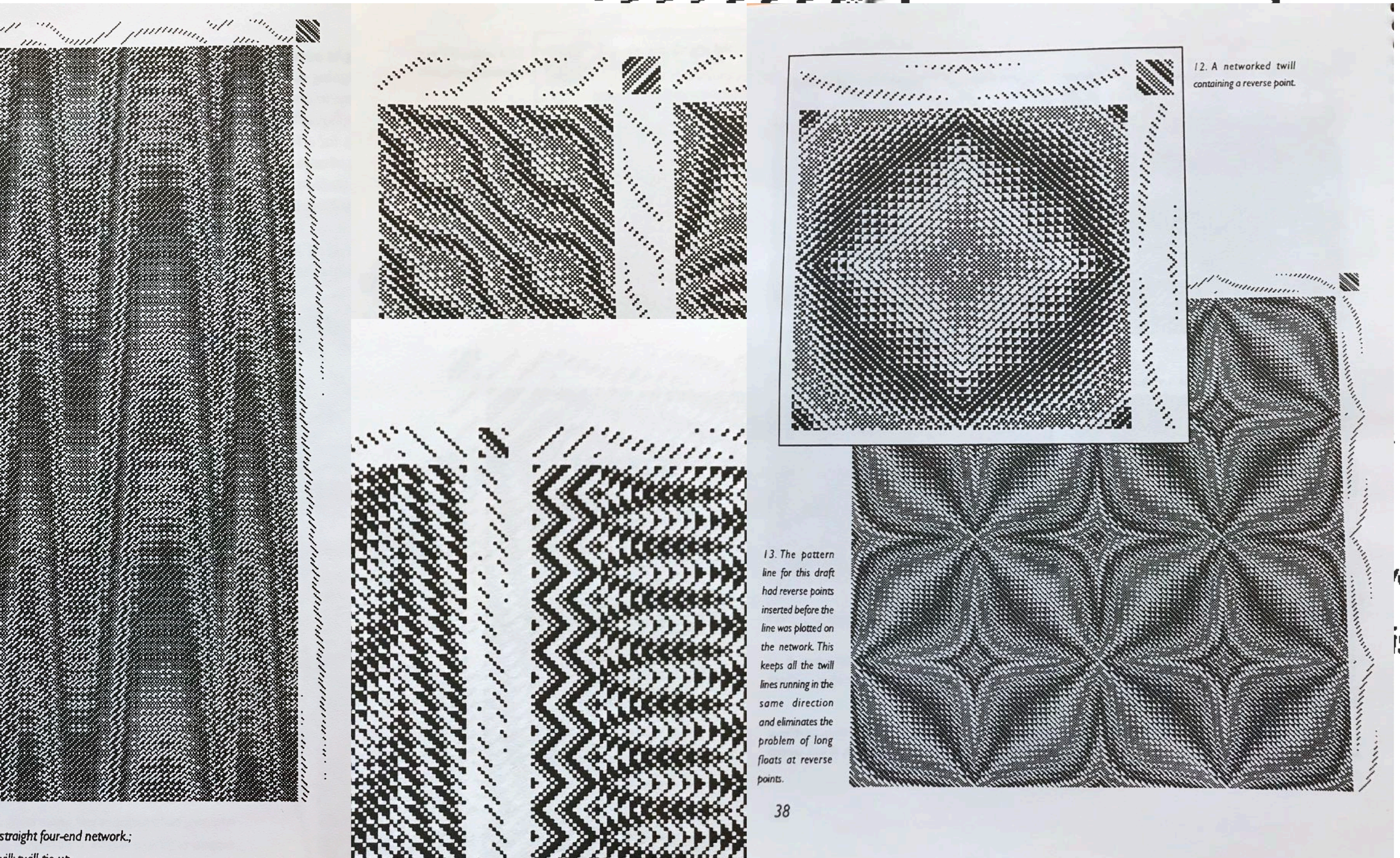
Assume that the points ▣ which warp yarn pass through the mail of heald at B are represented b_{ik}. Then, the matrix of the drawn-in draft whose elements are b_{ik} is as follows:

$$\begin{pmatrix} 0 & 0 & 0 & b_{14} \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ b_{41} & 0 & 0 & 0 \end{pmatrix} \qquad \cdots\cdots(2)$$

In this matrix, the sub-index i of the element is the heald number; k, the warp number and mail number having the same warp.

Assume that the mark ▣ in C is represented by the element C_{ik} which indicates the matrix of treadling: Then, the matrix of treadling is as follows:





down, and the treadling mirrors the threading along this line, and
is perpendicular to the imaginary diagonal, then a rose-type design

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