

Textiles

HTMAA Recitation

2019/11/14

Textile?

tex·tile

/ˈtek, stīl/

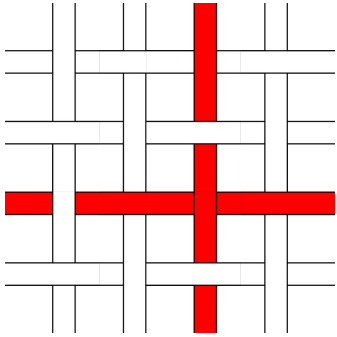
Noun

a type of cloth or woven fabric.

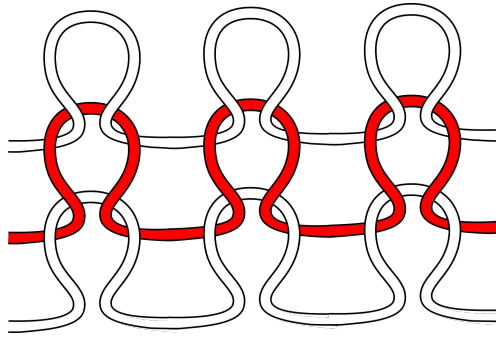
"a fascinating range of pottery, jewelry, and textiles"

Similar: fabric, cloth, material

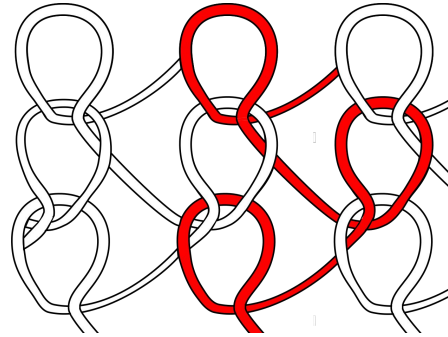
Textiles?



Woven fabric



Weft knitted fabric



Warp knitted fabric

...

...

A (Brief) History Of Textiles

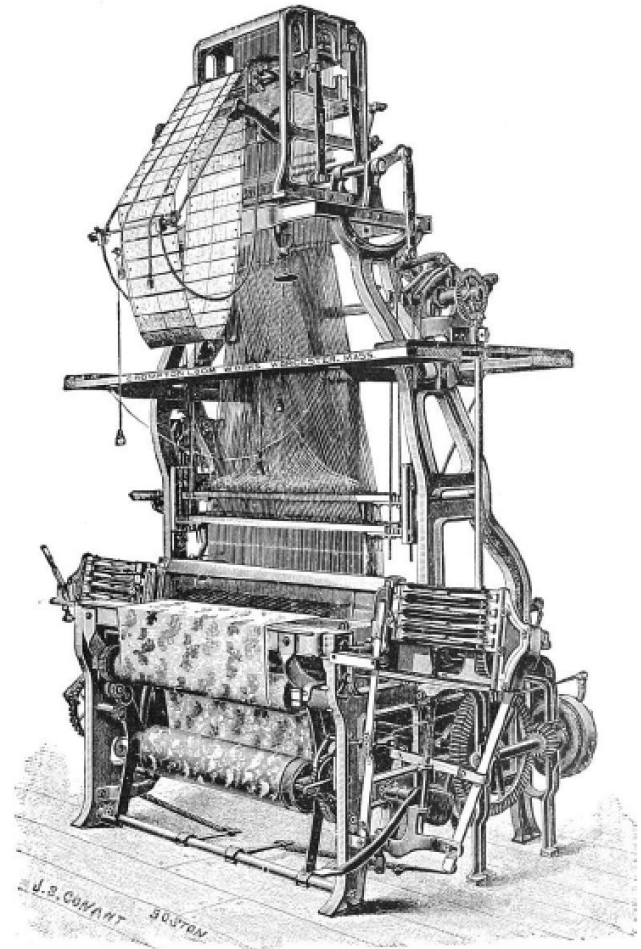
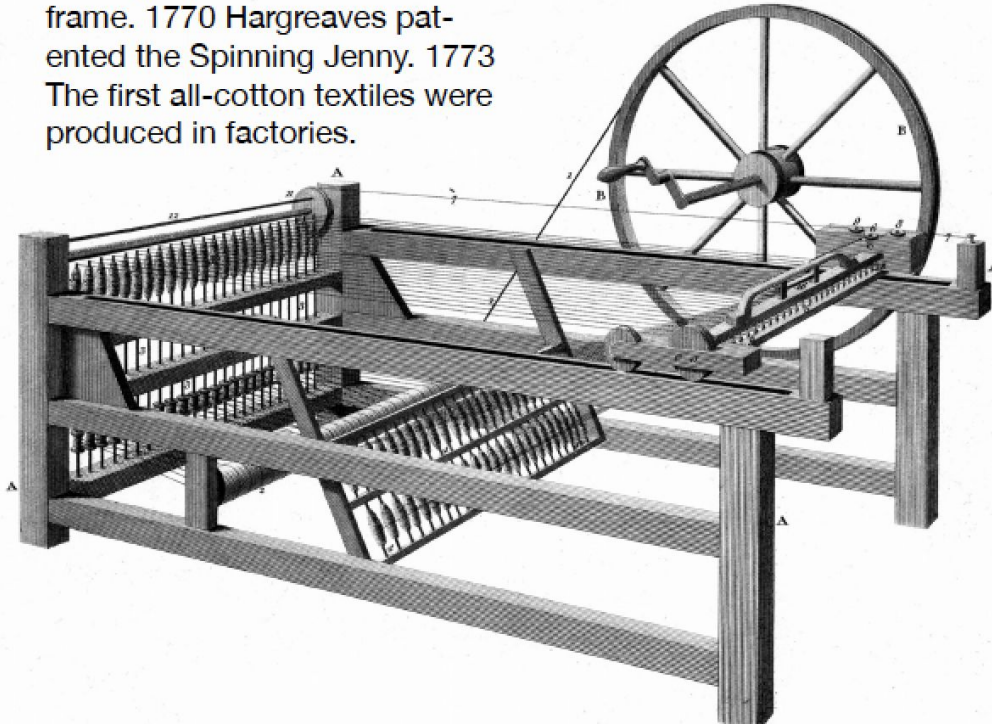
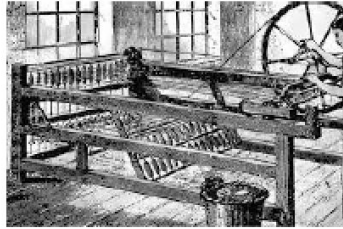
Light history
The golden thread.
Kassia St. Clair

All First peoples of the world made textiles



History of computational textiles

1764 Water frame invented by Richard Arkwright: the first powered textile machine. 1769 Arkwright patented the water frame. 1770 Hargreaves patented the Spinning Jenny. 1773 The first all-cotton textiles were produced in factories.





Industries Including textiles practice :

Fashion

Architecture

Automotive

Interior Design

Tech

Medical

Footwear

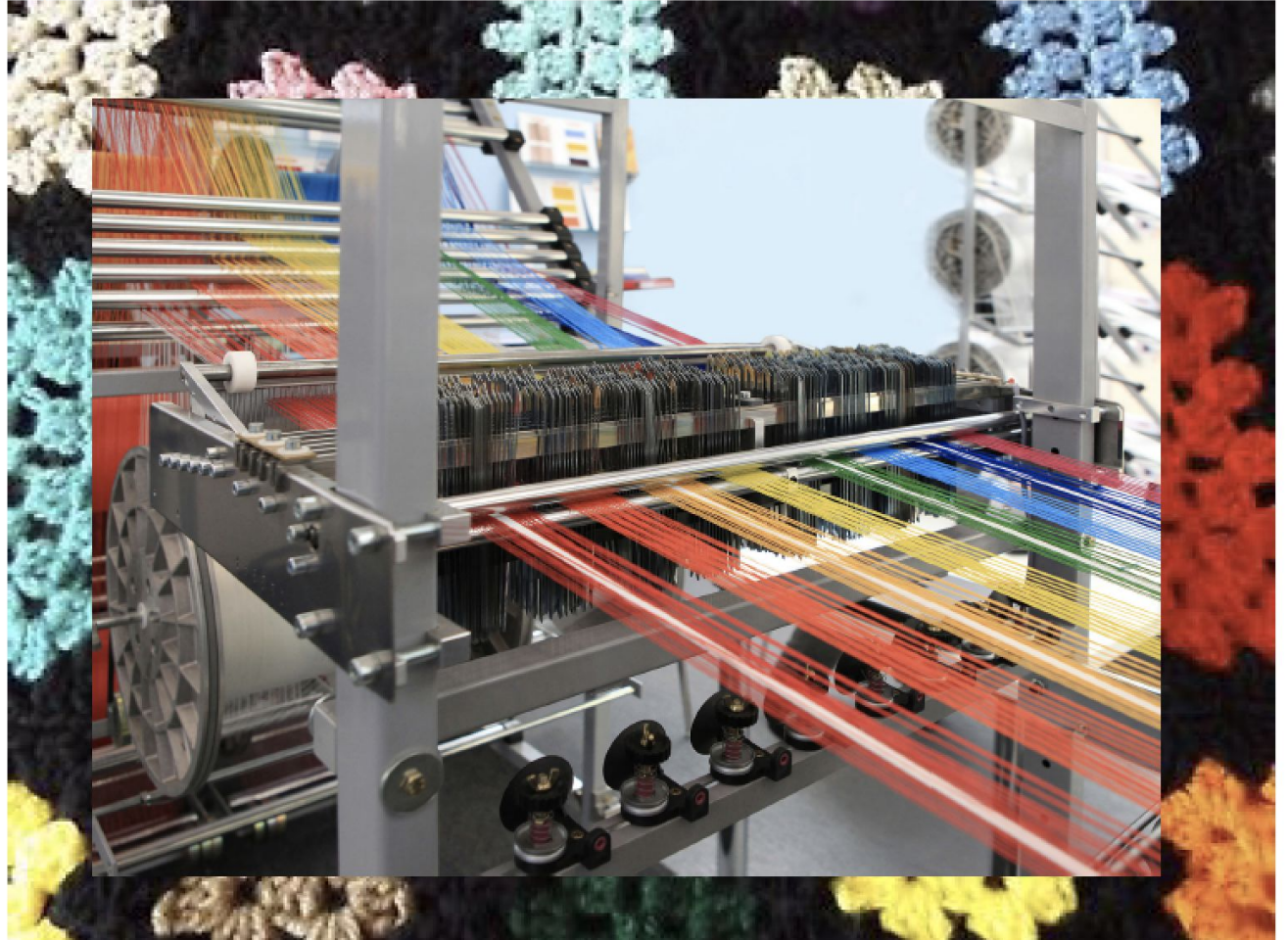
Sportswear

Furniture

Aviation

Space Exploration

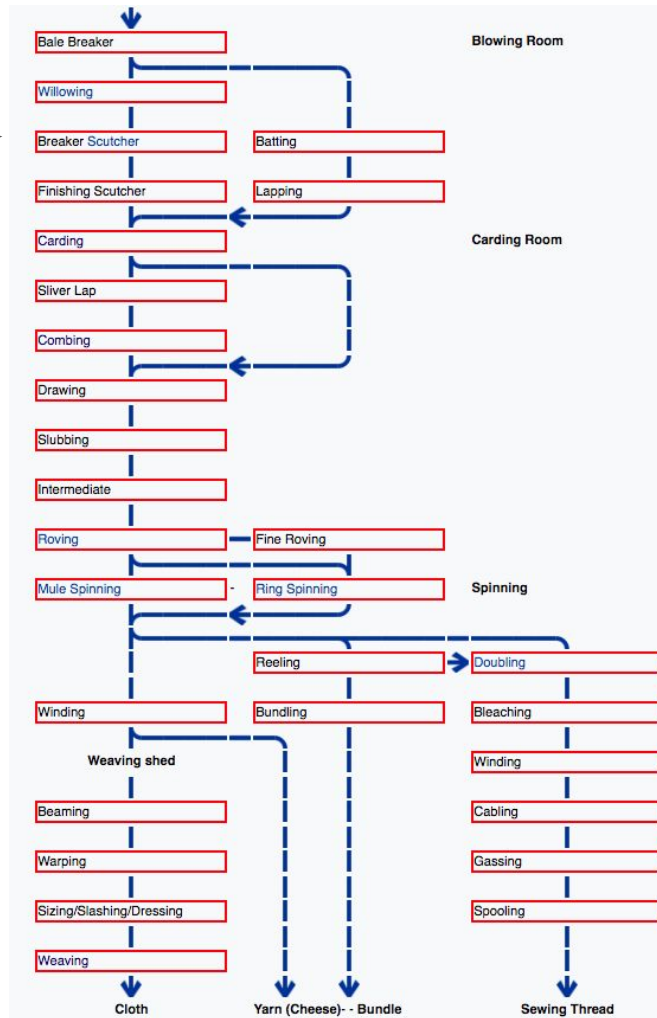
and more !



Textile Processes

Textile Processes:

Fiber Making



Carding / Combing / Spinning / Twisting / Winding / Steaming

- Types of Fibers
(natural vs man-made)
- Types of yarn packages
(skein, balls, cones ...)
- Carding = straighten + separate
into non-parallel nets
- Combing (*) = parallelize fiber
- Spinning instructables



Monofilament Yarn

- Preform to fiber ([n1](#), [n2](#))
- Pellets to fiber

Notably for

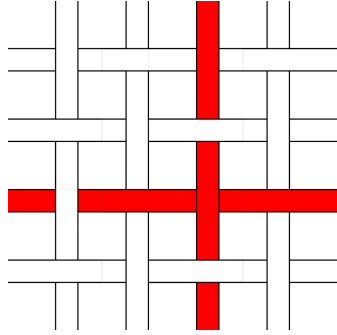
- Fiber optics
- Functional fiber ([AFFOA](#))
- Recycling [plastics into fiber](#)
- 3D printing filament



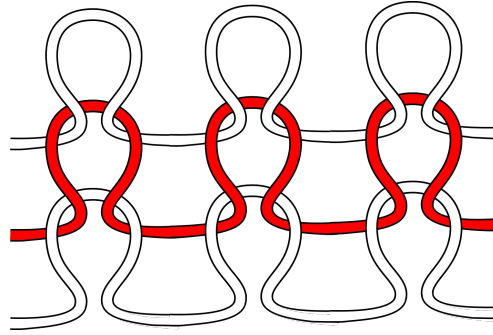
Textile Processes:

Weaving

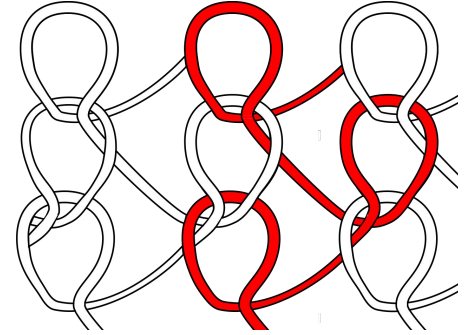
Weaving



Woven fabric

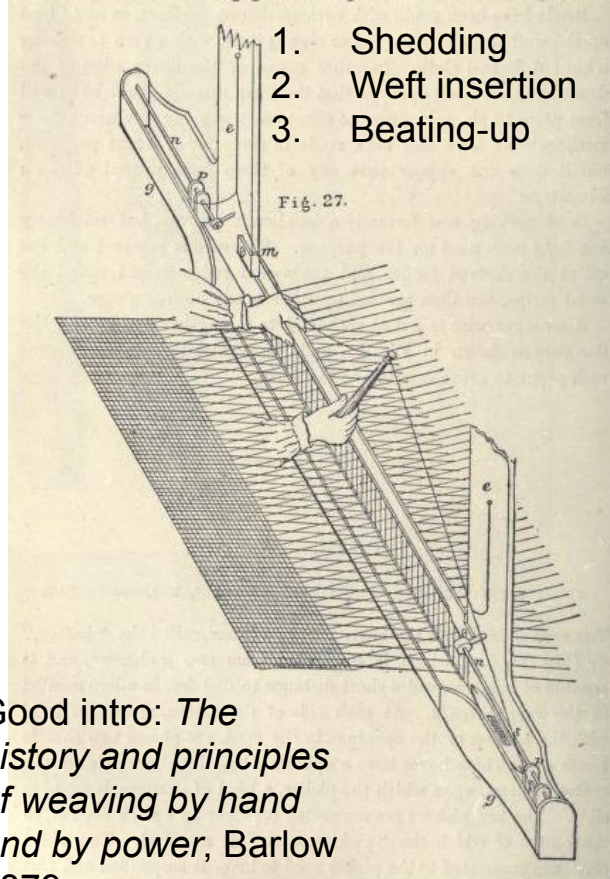


Weft knitted fabric



Warp knitted fabric

Warp, weft, shed, heddle



Good intro: *The history and principles of weaving by hand and by power*, Barlow 1879

Barlow p. 82

heddles



Wikiedia, Loggie-log [Public domain]

Modern reference: *Shuttleless weaving machines*, Talavášek 1981

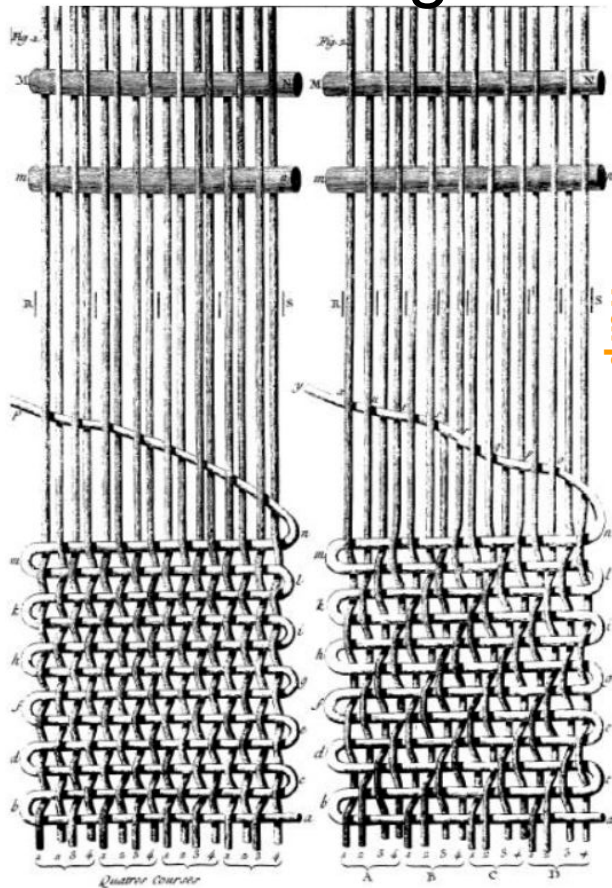
Weaving preparation
requires huge machines



**Warping
machine**

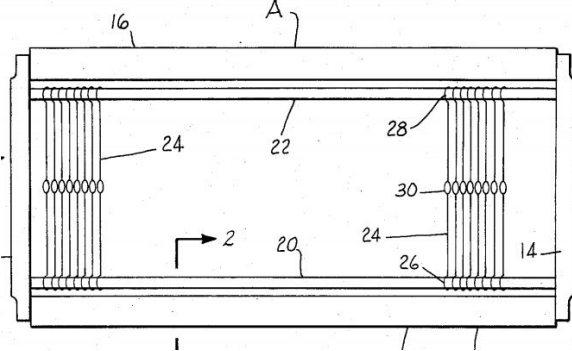
© Alex Zimmer 2018

Shaft weaving

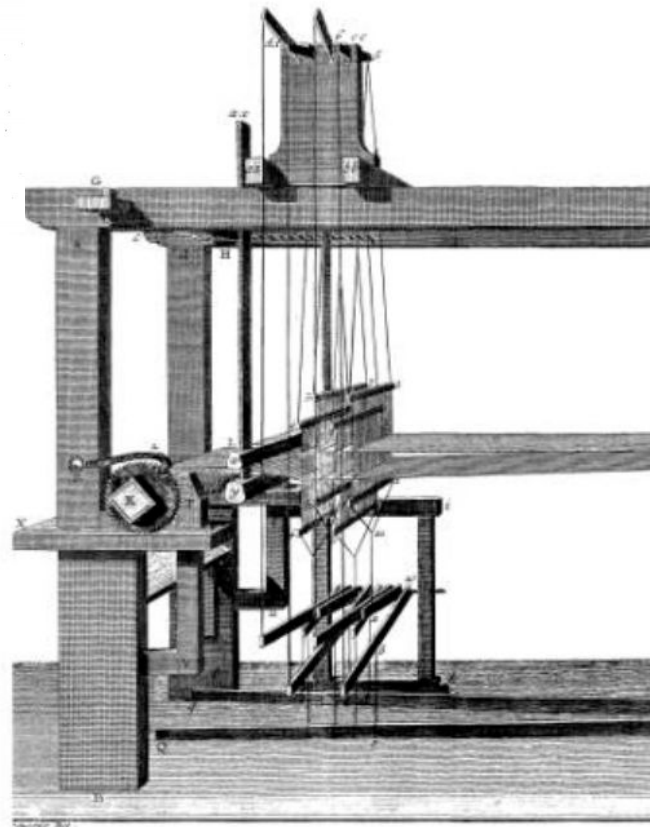


warp

weft



US4633916

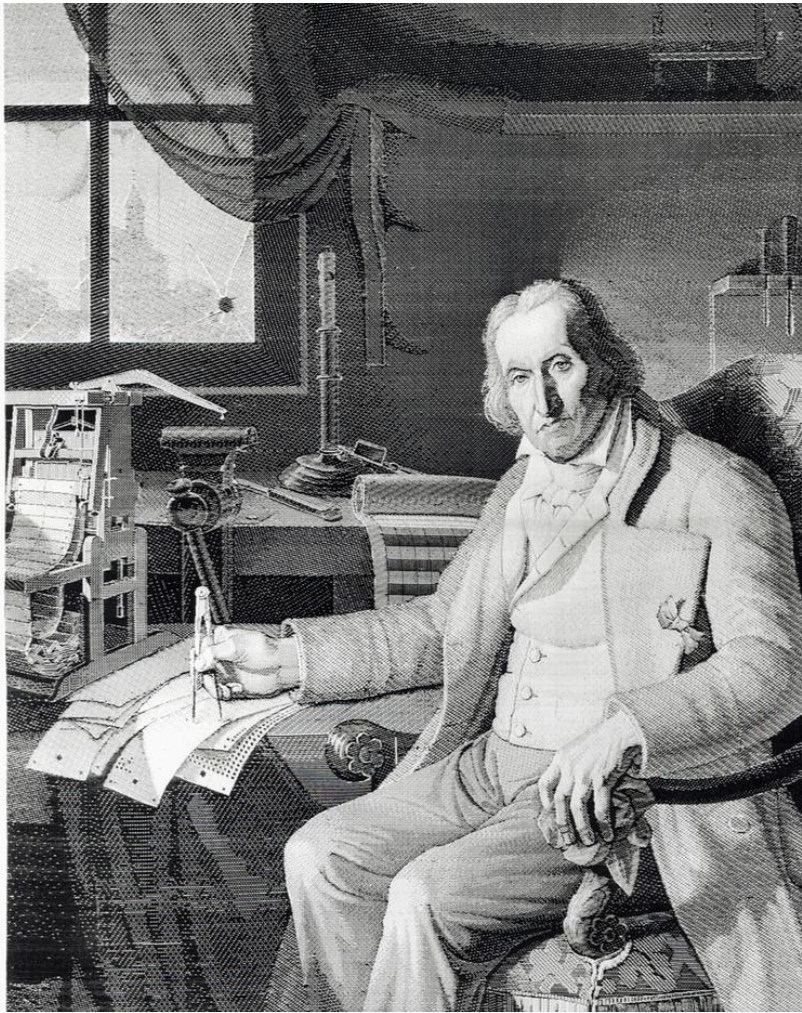


Soierie, Vue Perspective du métier pour fabriquer les étoffes unies

Before Kay 1733, de Gennes 1678
Mimicry of hand motion



Jacquard portrait of Jacquard



Science Museum Group. A la memoire de J.M. Jacquard. 1942-59. Science Museum Group Collection Online. Accessed November 14, 2019. <https://collection.sciencemuseumgroup.org.uk/objects/co44695>.

jacquard weaving of jacquard portrait of Jacquard



<https://www.museum.org/art/collection/search/226344>

Jacquard loom: single end control

- Programmable, but
not a computer



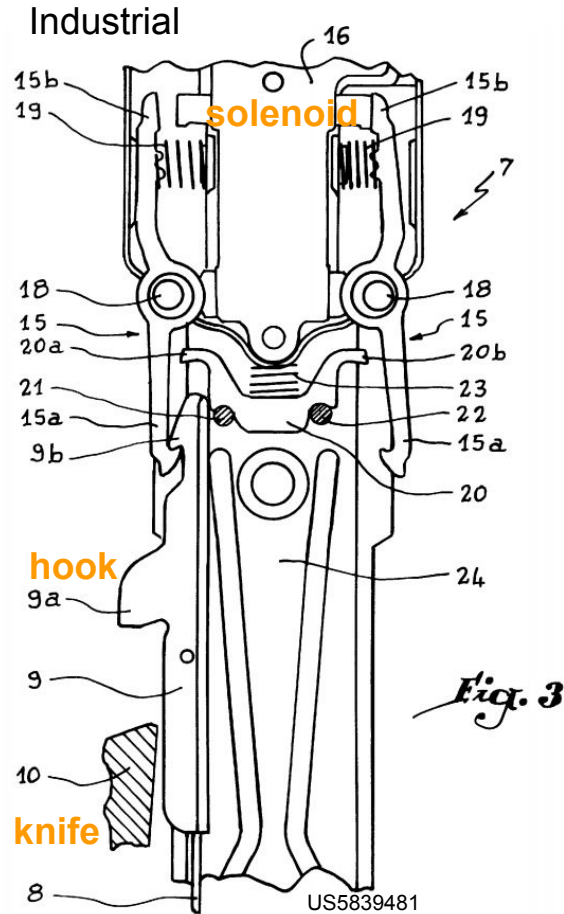
Jacquard weaving quick history

[Awesome animation](#)

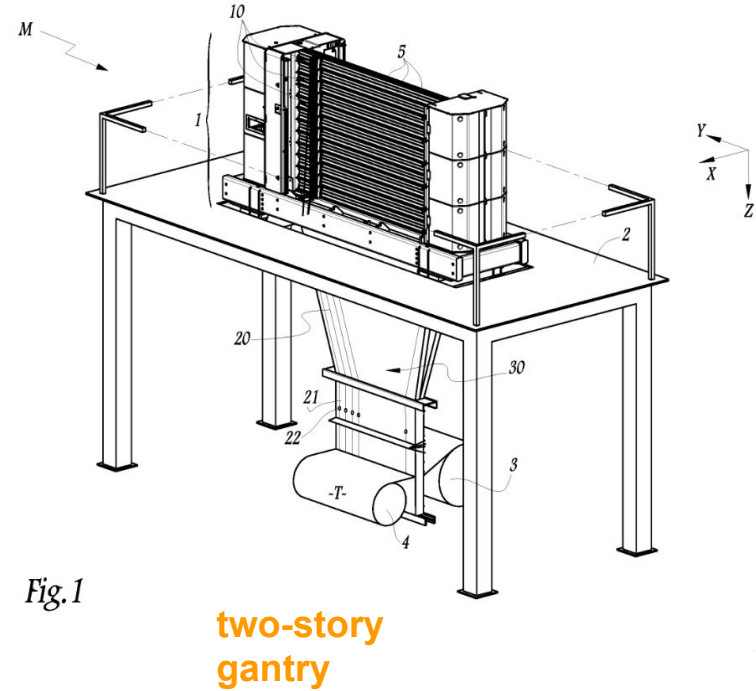
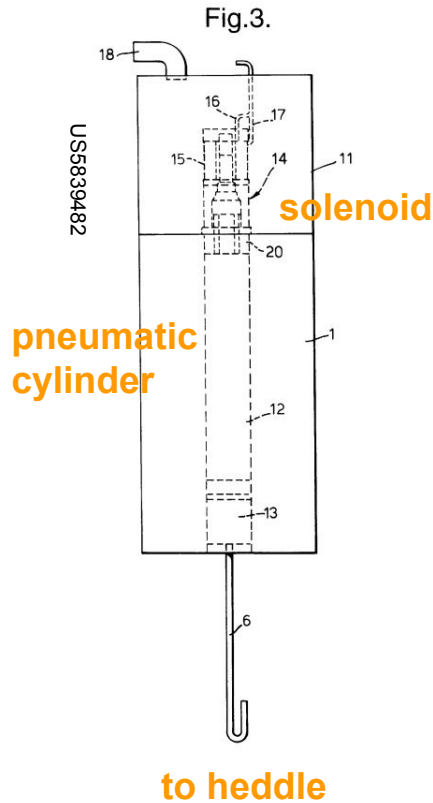


Historical, not history. Thousands in use right now esp. in India

Modern jacquards



Prosumer (still \$50-150k):
<https://www.digitalweaving.no/tc2-loom/>



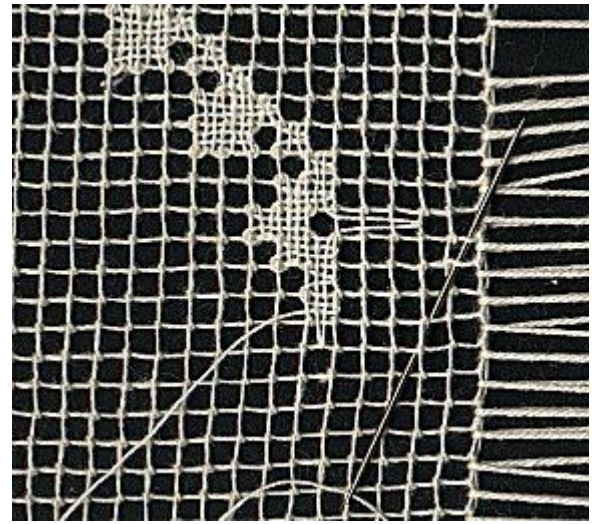
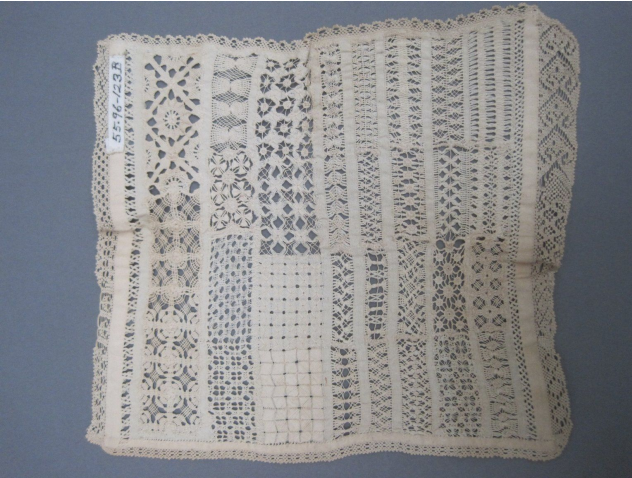
Brute force with
 stepper motors
<https://patents.google.com/patent/US9121116B2>

Textile Processes:

Lace

Lace

- [Bobbin Lace](#)
- [Chemical Lace](#)
- [Lace Knitting](#)
- [Hand vs. machine](#)
- [Leavers lace machine animation](#)



Bobbin Lace

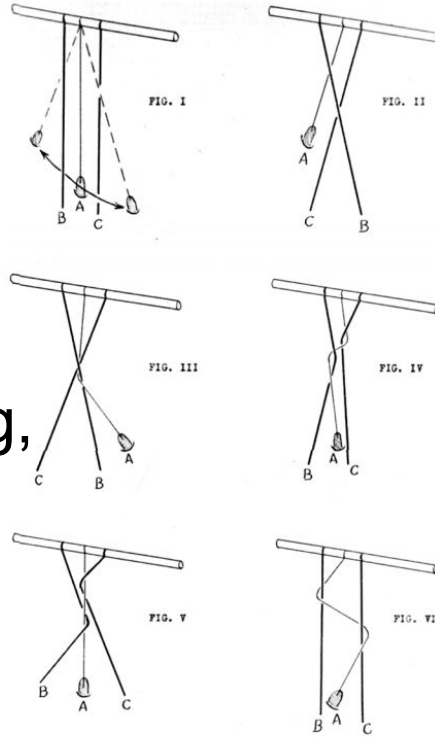
- [Instructables](#)
- [Example](#)
- [Nike patent for lace enclosing shoe forms](#)
- [CATIA product for composite CAD](#)
- [Barmen lace machine](#)



Photo taken by [Blahedo](#) at the museum of the Ursuline Convent in Quebec City in March 2003, CC BY-SA 2.5,

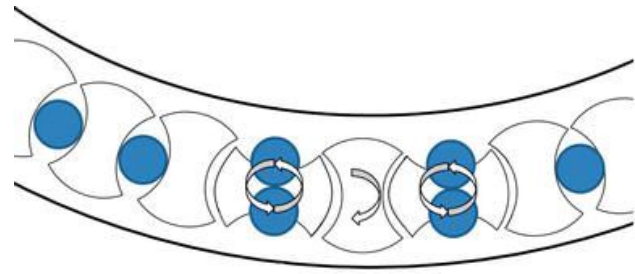
Topologically,
Braiding is lace
Weaving is lace
Chickenwire is lace
Shoelaces are lace
(not knitting, knotting,
or crochet)

Proof weaving is lace:
in fig VI to right, B,C
are warp, A is weft



Theory of lace making by machine

[Leavers lace](#)



[Braiding for composites](#)



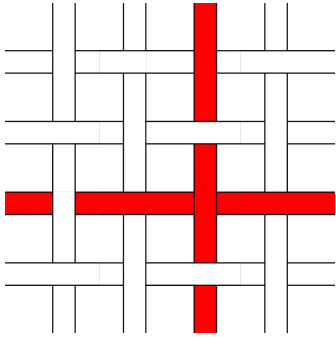
Textile Processes:

Knitting,

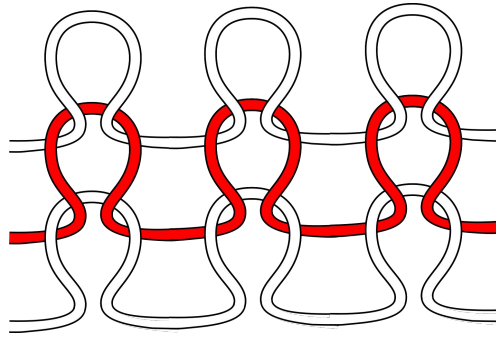
Knotting

and Crochet

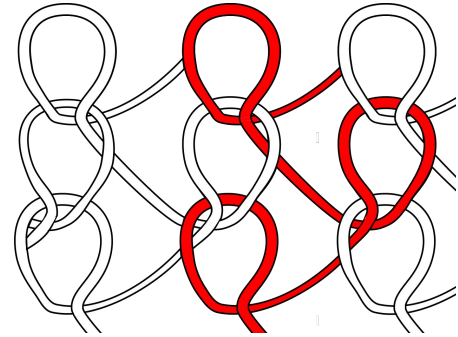
Knitting / Knotting / Crochet



Woven fabric



Weft knitted fabric



Warp knitted fabric

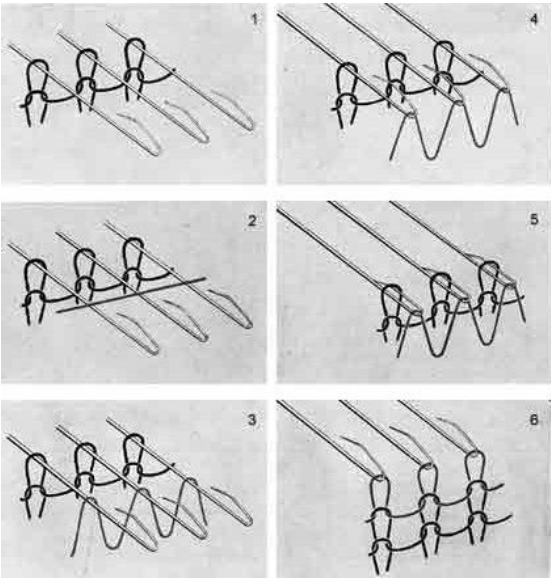
History of Knitting

- [Knitwear: a history unravelled](#)

“The earliest forms of knitting were found in Egypt and the technique is found to have begun in ancient times in the Middle East.”

History of Knitting Machines

- [Stocking Frame](#)
- Invented by [William Lee](#) in 1589
- Used beard needles



By
[Ryj - Own work](#),
Public Domain



@ Ruddington Framework Knitters' Museum

By [John Beniston](#), CC BY-SA 3.0





Coarse Knitting “by hand”

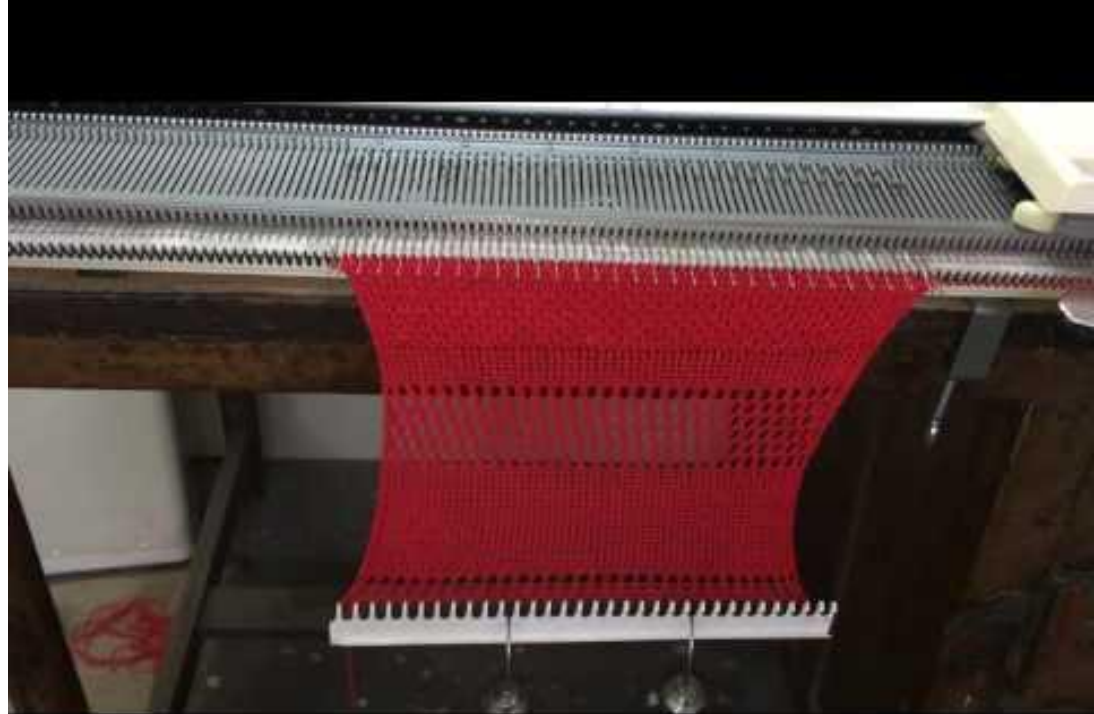


Hand Knitting ([how-to](#): [cast-on](#), [knit stitch](#), [cast off](#))



Domestic Flatbed Knitting

- [All Yarns Are Beautiful](#)
- Brother ([KH910](#) for AYAB[^])
- [Dubied](#)



Flat Knitting Machines

Typically V-bed machines

Manufacturers

- [Shima Seiki](#)
- [Stoll](#)
- [Kniterate](#)
- [Steiger](#)

Makers

- [OpenKnit](#) (-> Kniterate)

Shima Mach2X

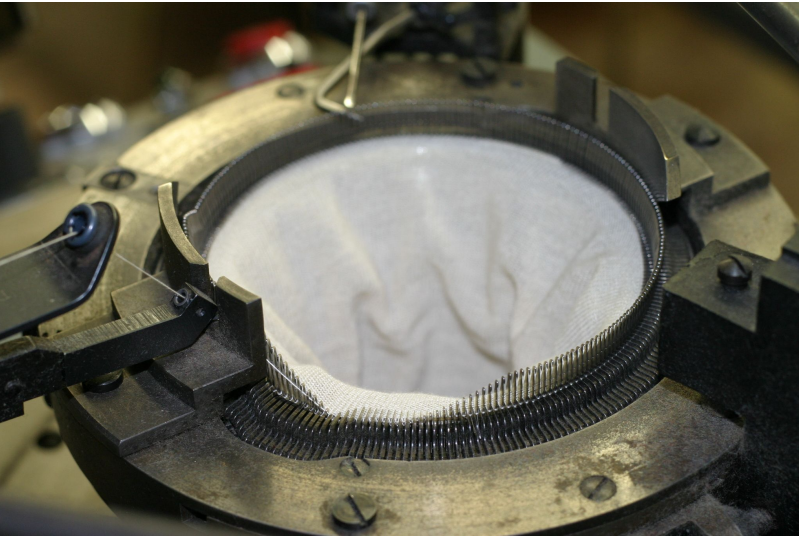


Shima SWG091N2



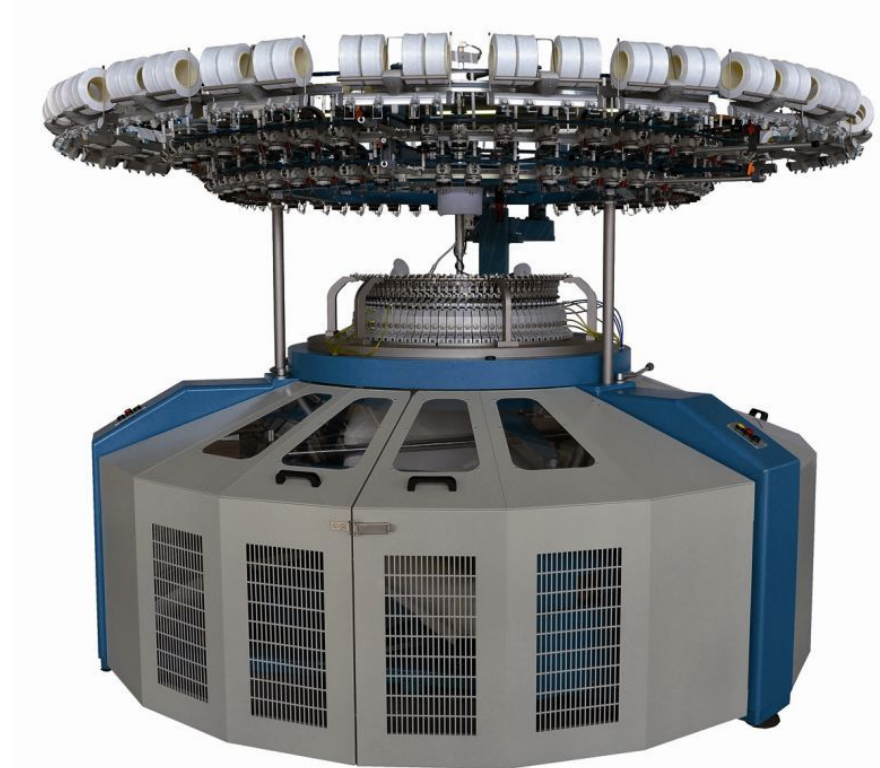
Circular Knitting Machines - Domestic

- [Open Source](#)
- Mostly manual



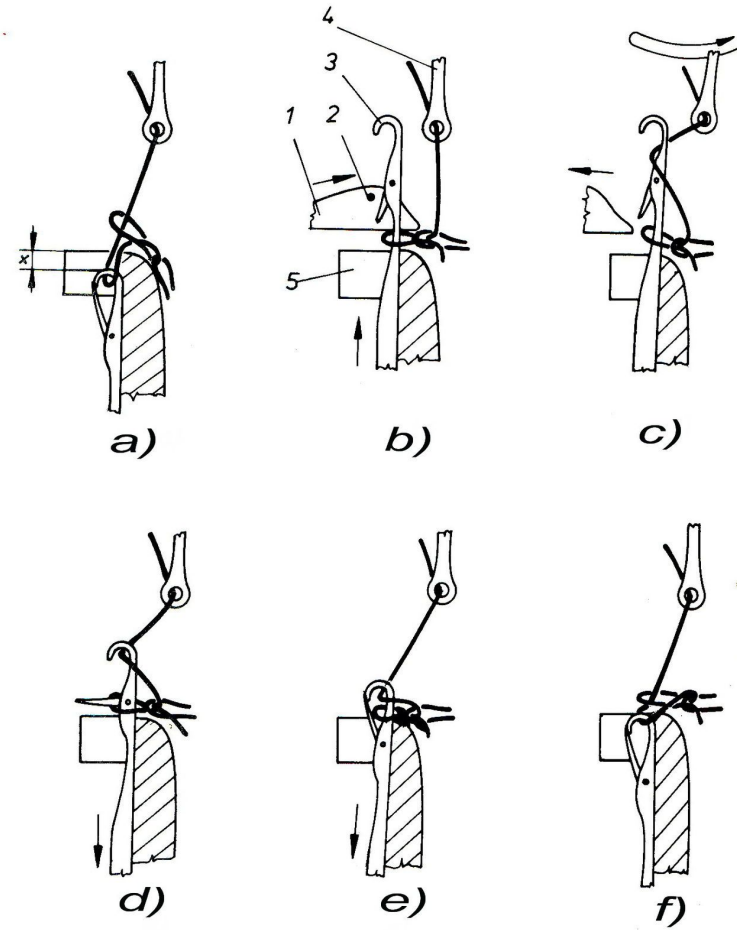
Circular Knitting Machines - Industrial

- [Santoni](#)
- Weft and warp knitting
- Higher throughput (no reversal of carriage direction)
- Can produce tubular as well as flat sheets (by cutting)



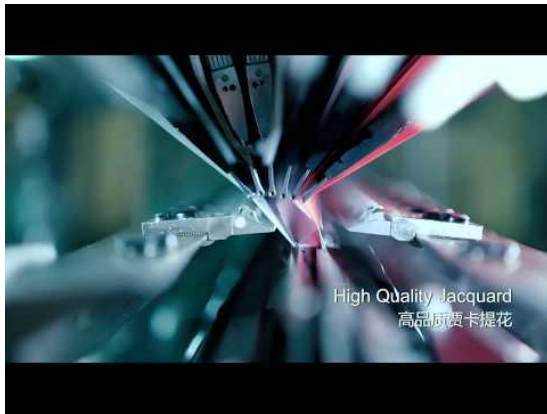
Warp Knitting

- Parallel loop process (fast!)
- The yarn “zigzags along the length of the fabric” (wales)
- Process ([Karl Mayer](#))



Raschel Lace (Raschel Warp Knitting)

- Hybrid warp knitting / weaving
- Mainly used for “lace” and nets
- Named after the French actress [Rachel Félix](#)
- [Karl Mayer](#)
- Modern jacquard raschel selectors are [piezoelectric](#)



Crochet



Crochet is a process of creating textiles by using a crochet hook to interlock loops of yarn. The name is derived from the French term *crochet*, meaning 'small hook's. There is no industrial machines as of today to automate crochet indsutrially

The Big Book of Knit Stitches

360+ Stitches



Cables,
Lace, Ribs,
Textures,
and a Whole
Lot More

From the Editors of Martingale



Crochet Artist : Olek

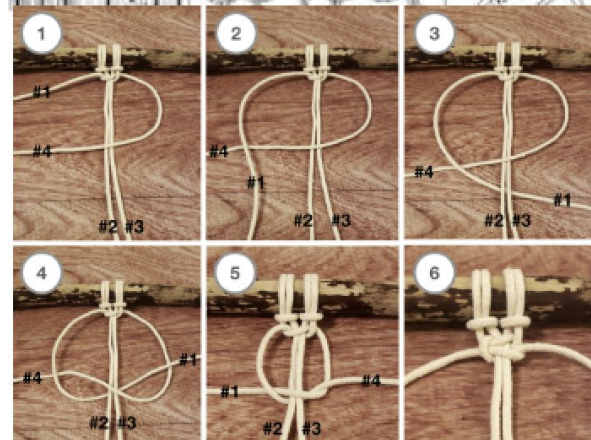
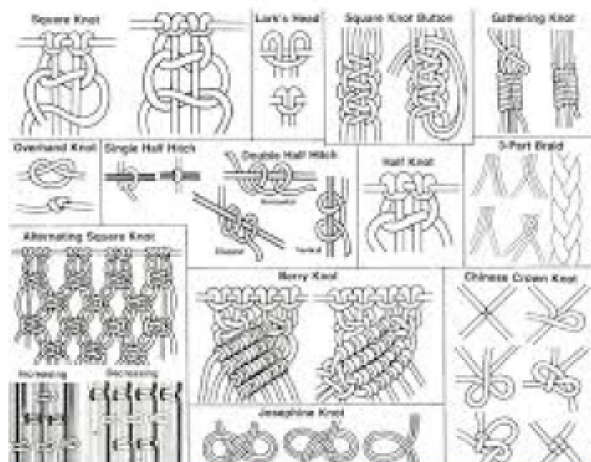


Knotting

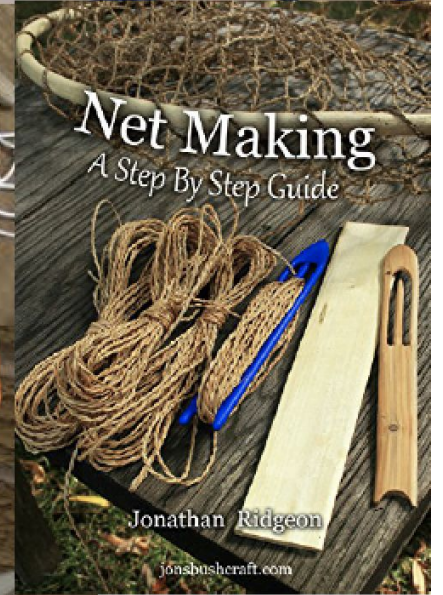
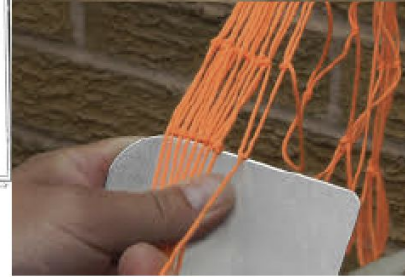
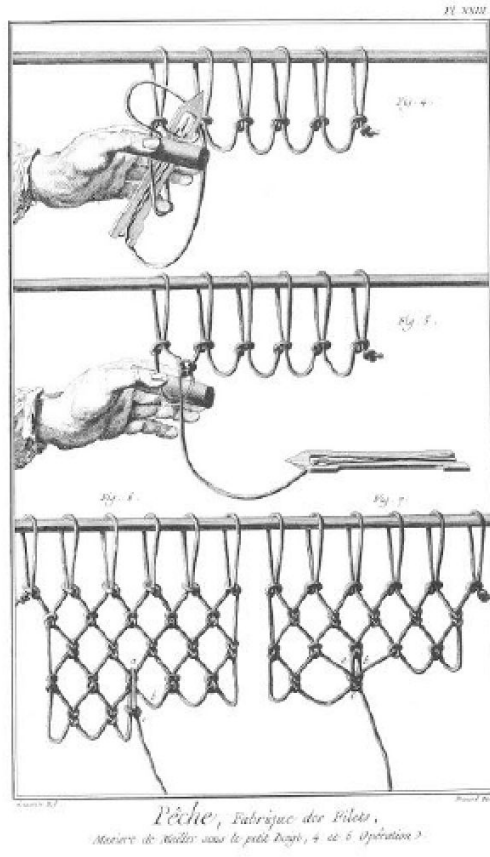
A 5x5 grid of interlocking red and blue knots. Each knot is a complex, multi-component structure that interlocks with its neighbors in a grid pattern. The knots are colored red and blue, and the grid is set against a light gray background. The knots are arranged in a regular, repeating pattern, with each knot in the grid interlocking with its four immediate neighbors (up, down, left, and right). The knots are made of a thick, braided rope, and the interlocking is achieved through a series of loops and crossings that create a stable, interconnected structure. The overall effect is a visually striking and mathematically complex arrangement of knots.

Knotting Variation : Macrame

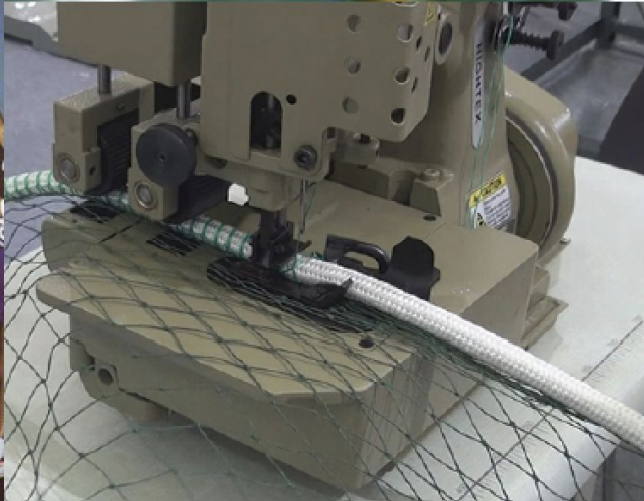
Macrame Knots



Knotting Variation: Net making



Knotting: Industrial Machines



Textile Processes:

Sewing

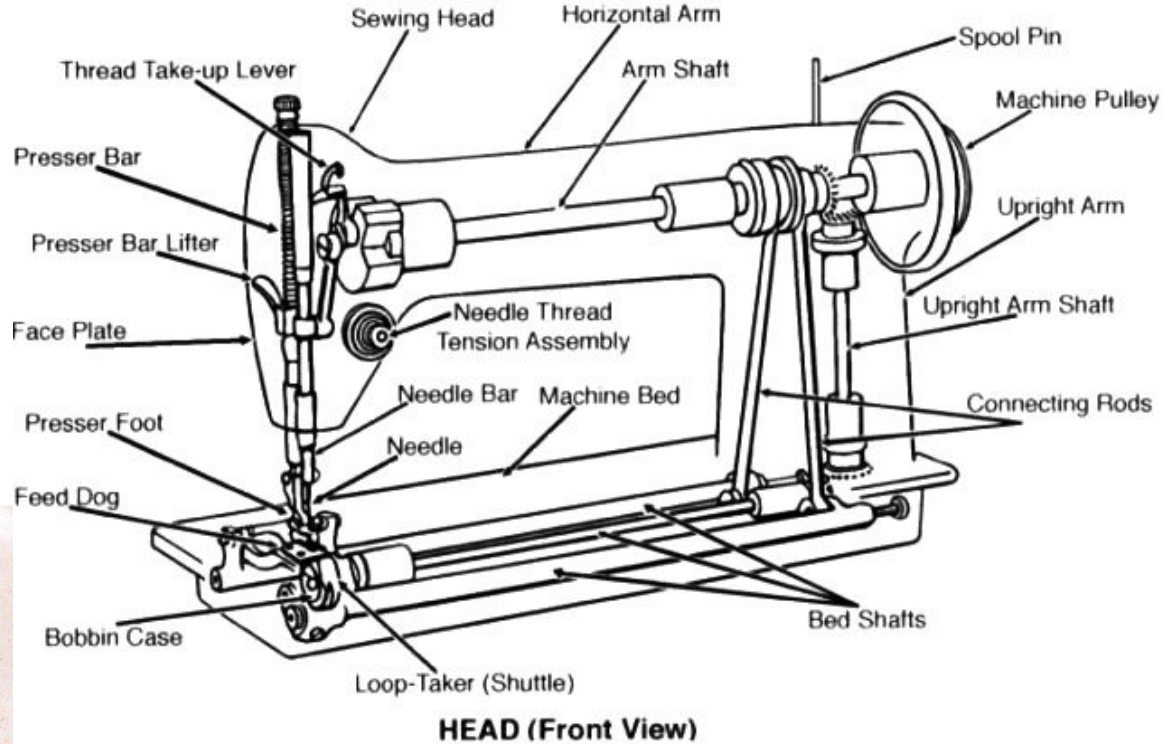
Hand Sewing

- First designs targeted canvas and leather
- Bind multiple pieces of textiles (and non-textiles) together
- [How to sew by hand](#)
- [Different types of stitches](#)



Domestic Sewing

- Various brands
- Various stitches
- Various feet



By [Unknown](#), Public Domain

By [Lombroso - Own work](#), CC0

to secure windings in electric motor before dipping in resin

Industrial Sewing

= many dedicated sewing machines (e.g. securing motors >)

Embroidery

= sewing patterns



Non-woven

Textile Processes

Hand Tufting

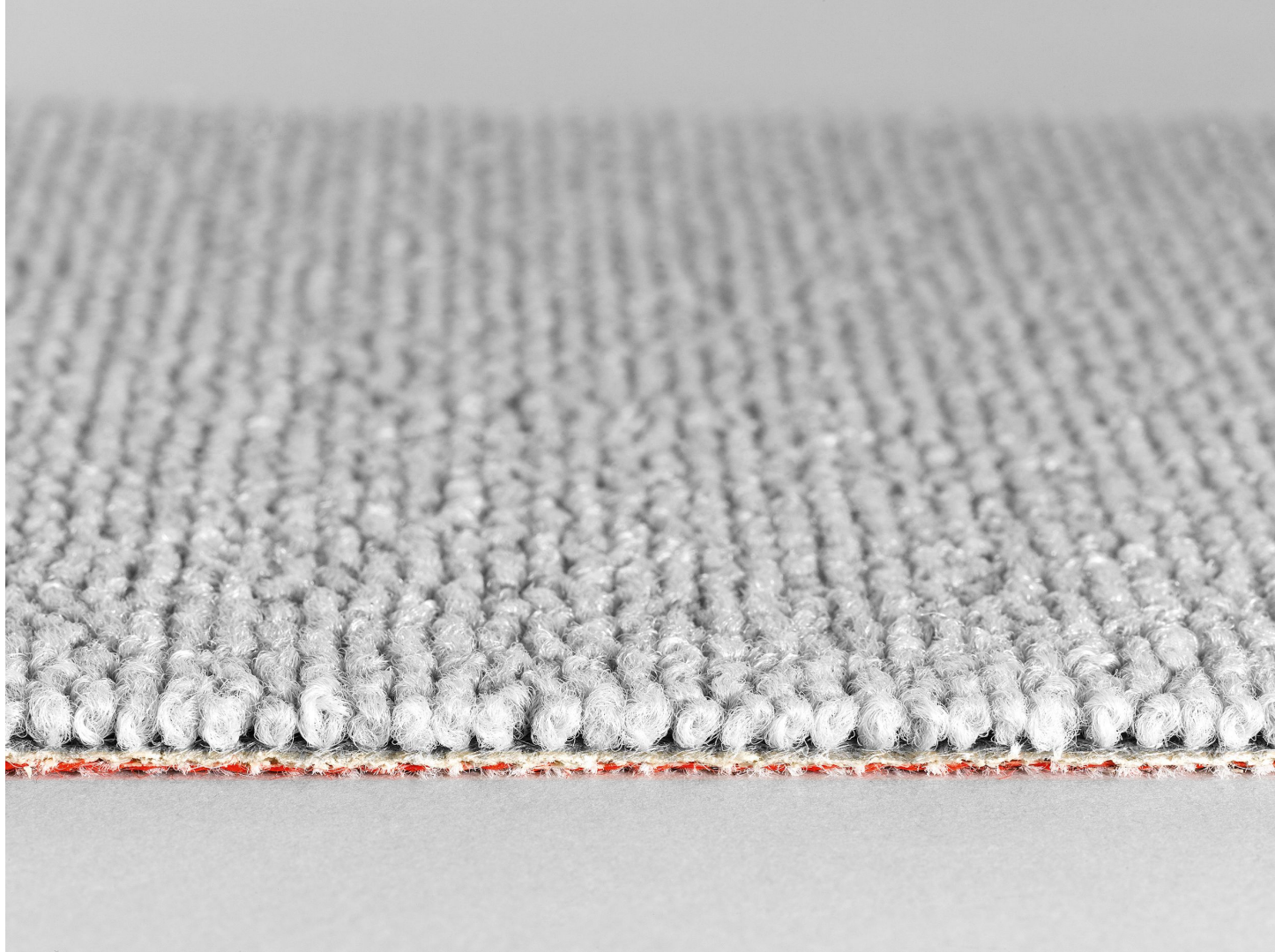


INSIDER

This artist is the master of turfting

Tufting

Groz-Beckert

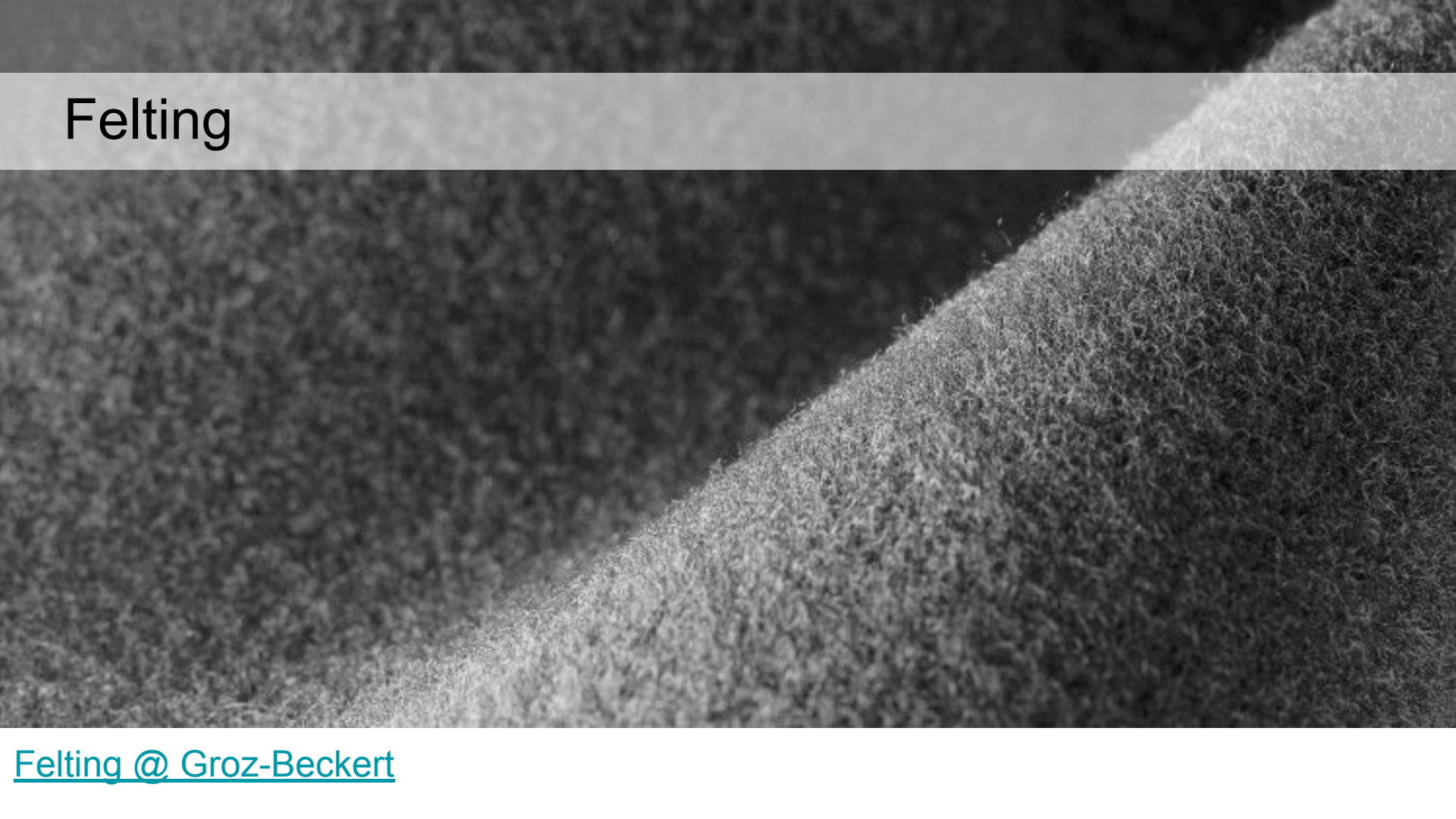


Tufting Machine

[Groz-Beckert](#)



Felting

A close-up, black and white photograph of a dark, textured fabric, likely wool, showing the felting process. The fabric is folded, creating a sharp crease that runs diagonally across the frame. The texture is dense and fibrous, with individual fibers visible. The lighting is soft, highlighting the texture of the wool.

[Felting @ Groz-Beckert](#)

Felting
= tangling

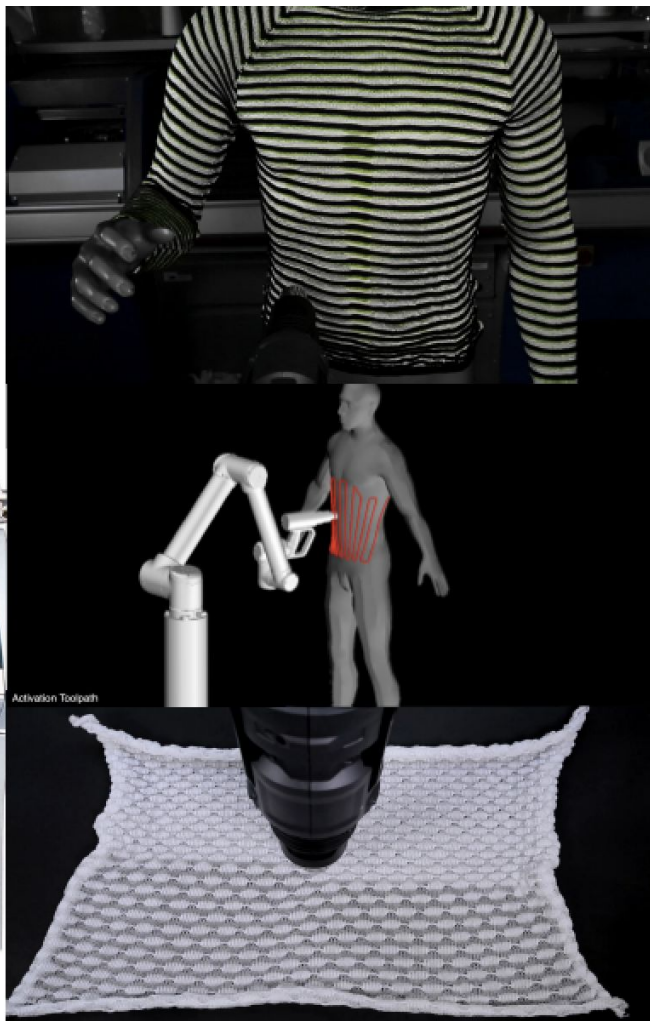
[Details](#)



Individual

Textile Works

Carmel Snow
CNC Knit Researcher Self Assembly Lab MIT



CNC Zero waste fully fashioned 3D knit consulting Agency



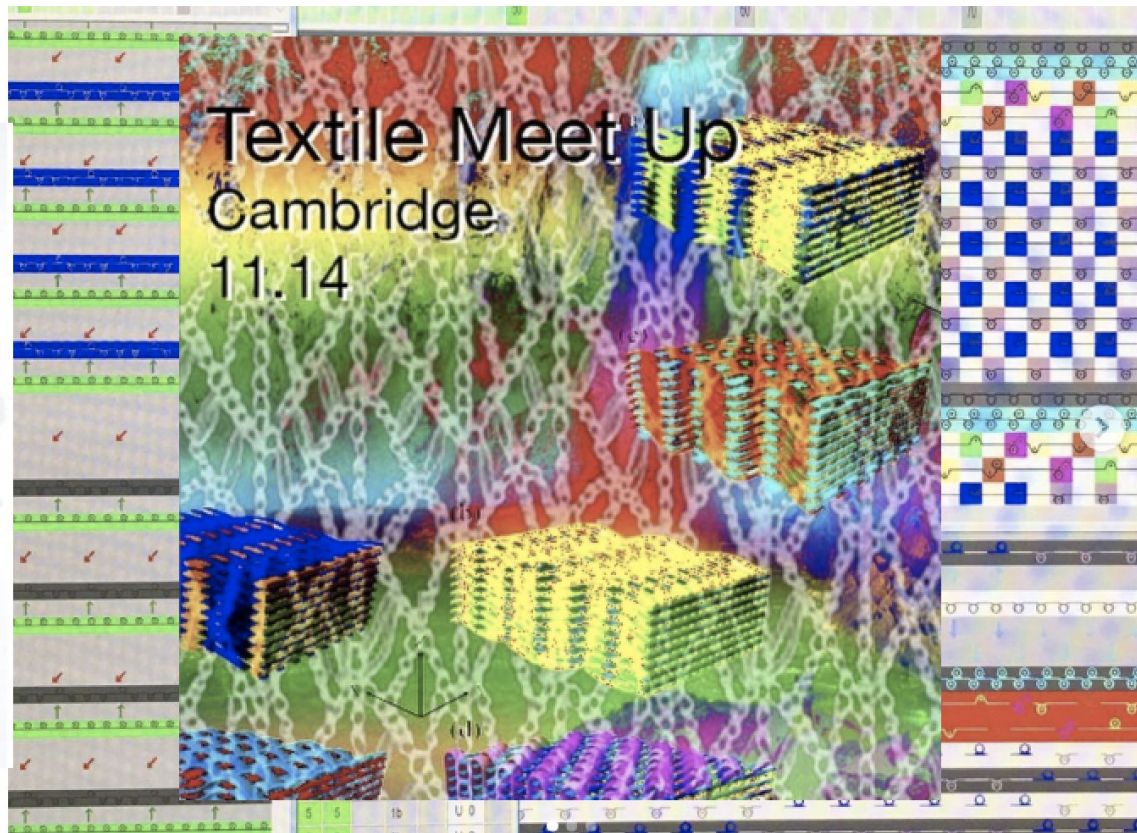
**MINISTRY
OF SUPPLY**

HESPERIOS



Carmel Snow the
artist + Brand devel-
opment





Stay in touch
Carmelsnow.com
Carmels@mit.edu
IG @carmelsnow

Kniterate
Alex
Zimmer
(also
CNC Loom)



Inverse Knitting / New Workflows

Alexandre Kaspar

