

PROJECT PENELOPE: LEARNING FROM THE LOOM

by

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Jovencio de la Paz

This thesis explores the interdisciplinary nature of textile and the value of learning traditional methods for modern application. The structure combines scholarship and personal practice to describe weaving methodology and examine technological advances in the field of jacquard. The basic vernacular of weaving is analyzed and expanded to explore the ways in which jacquard elevates those ideas to expose new opportunities for creativity and ingenuity. Ideas of self and industry are explored on a personal level through the addition of personal weaving projects which illustrate the processes discussed throughout various stages of design. This thesis synthesizes global thinking to engineer effective approaches to integrating technology with traditional practice to further enhance the connection between weaving and technology.

Acknowledgements

I would like to thank Jovencio de la Paz, Dr. Mossberg, and Beth Esponette for their support of my work in Eugene and with this thesis. I would additionally like to thank Barbara Pickett and Eva Basile for their excellence in teaching and deep knowledge of weaving, who taught me everything I know about jacquard. It is with the most sincere of gratitude that I thank these individuals. Their dedication to my education as an artist, designer, student, and person has inspired me both in and out of the classroom. I would especially like to thank Dr. B for her endless enthusiasm throughout this process and her continued willingness to work through any problem. I truly couldn't ask for a better role model and mentor. And to Jovencio: Thank you for teaching me from the very beginning of my weaving practice, for continually pushing me, and for showing me just how much there is to learn. I am excited to see where this adventure you helped start takes me. I would like to take this time to thank the Robert D. Clark Honors College for allowing me this opportunity to express the work I love so much, and for giving me a place to "walk the talk." I am so thankful for the community of scholars and peers who continually inspire me. I would also like to recognize the gracious support of my work through the thesis research fund, without which I would have been unable to study in Florence. Lastly I would like to thank my family for their endless love and genius.

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Preface

Penelope's Tapestry by Barbara Mossberg

A woman's work is never done but what if she herself is the one who makes sure it is not finished? It's true I unravel every day the stories I live by. You know it, I know it. And have five versions and always one more, and then unfinish it, pull it apart, why would I do this, towards what end? I don't think it has anything to do with doubt, do you, that this is the work and that we should be doing it. Is it that if we never finish things, we will never have to say Yes to the drunken suitors in the hall, we will never have to give such doom our hand, to be kissed by the fate that is not our fate.

What Bridegroom do I await to return to me, beaten enough to take on the suitors and kill them all. What will I do then, when my Ulysses returns, will I finish this tapestry, once and for all; and what will my work then be at my loom, what love keep alive, because what I love is doing this work, what I love is sitting in my room, the fray going on down the hall, and I do my patient work, promising myself I will never get this done, not even this poem, this love.

The work of the weaver is the continuation of an ancient tradition. I feel privileged to be a part of a long, timeless lineage that has created textile across the globe and throughout time. To know each step, and commit to each pattern is an intensive creative process that is as deep as it is broad. Each step could be taken further and further. From spinning the fiber to weaving the fiber, to making with the end textile, there is always something to learn and another way to take the practice further. Weaving and the creation of cloth has been happening for millennia, and the understanding of weaving and textile creation continue to influence new advancements in material creation and technology development in order to create textiles that adapt to the changing needs of our world. This paper is meant to explore a fraction of the world of textile as it has come to influence me. It is a journey that spans tradition, geography, materiality, and self.

This thesis is the result of not only traditional academic scholarship and research but experiential “hands on” practice in the field. Therefore the style of this thesis is going to express the integration of scholarship and practice. To constrain the experience

of weaving to words is to ignore the experiential process of weaving. Weaving is not only the physical manifestation of design as woven thread, but the intricacy of the process. It is the steps of creating the warp, threading the loom, designing the pattern, punching the pattern, the clatter of the loom, the frustration of fixing a single broken silk thread. Like this paper, the jacquard is the work of applying scholarly pursuit to something as nebulous as art and creativity. My process of learning, discovering, and growing is reflected through my physical work and my connection to the loom. This process for me has been taking theory and applying it in the way that I have learned best: Through making. My understanding of learning is not linear: Inspiration comes from all sources, and knowledge rarely comes from books. Rather the knowledge I hope to express here comes from verbal tradition, the act of working with others and learning first hand, and finally of spending time addressing problems with the loom.

This paper begins with my first understanding of the loom, and crescendoes to my journey in Florence and Venice with master Italian weavers. While scholarship shouldn't be ignored, I feel that this project was a chance to try new things, to innovate with abandon, and pay homage to the works of the ancient, the contemporary, and the Penelopes of the world. The work of the weaver and the scholar is never done. There are always new things to learn, fresh articles to read, new faces experimenting with their own understanding of textile and tradition. For me this project is the beginning of a lifelong approach to this practice. Weaving is prolific in a way that is both unnoticed and recognized and also anonymous and present. The weaver is rarely acknowledged yet the weavings are everywhere creating, beyond cliché, the fabric of our society and

world. “Weaving is neither traditional craft nor art.”¹ It lies within it’s own nebulous realm, implicating the convergence of tradition and technology. Is it art? Or is it a material to be used for art?

Weaving inherently is bound to technology. Although simple, even the earliest technologies used human ingenuity to create methods of organizing and controlling an otherwise chaotic tangle of thread. It is a study built upon small innovations creating a butterfly effect of knowledge. It is the epitome of art and technology coming together to define the modern computer, and a constant tug of war between tradition and innovation. Beyond the drama and constant push between new and old fabric exists to define the height of our technical achievement throughout time. It is a distillation of our understanding of ourselves, of the world. It is tactile, representational, abstract. The world of fiber and weaving is brought with implicit meaning and understanding the history and achievements that led to today are imperative in understanding the multi-faceted world that lies beyond the object itself.

In this way, to weave is a radical act.

¹ Gherzi, Luciano. (2007). *Weaving is NOT what you think it is*. Jacquard. Firenze, I.T.: Fondazione Lisio Arte Della Seta, 60, 23.

Chapter 1: Understanding the Basics of Weaving

In order to move to the complicated workings of the jacquard loom, I think it is best to begin by demystifying the interworking of the loom. The loom has many incarnations throughout time and across the world. Our studies will therefore focus on harness looms. Though harness looms were not necessarily the direct predecessors to the jacquard loom, they will help illustrate the fundamentals of fabric design and production. This chapter will explore the anatomy of the loom, how we “program” the loom, translating textiles into drafts, and how we can create patterns with these principles. I have included a glossary at the end of this chapter as a simple compendium for understanding the terminology. Terms to appear in the glossary have been bolded for simplification.

Before we get to the loom, it is important to first understand that in weaving there are two types of thread. The **warp** is the vertical set of threads that run through the loom. These vertical threads are raised and lowered to create the pattern. These threads are kept under tension so that when they are lifted² the weft can easily be underneath. The horizontal thread is called the **weft**. The weft is loaded onto a bobbin and into a shuttle. The shuttle is passed under the raised threads to create the fabric. The weavings that I will be working with are called balanced weaves. That means that there are equal amounts of warp and weft showing. The most simple incarnation is that of plain weave. Plain weave creates a “checkerboard” where every other warp thread is lifted to anchor the weft.

² The lifted position is called “opening the shed.”

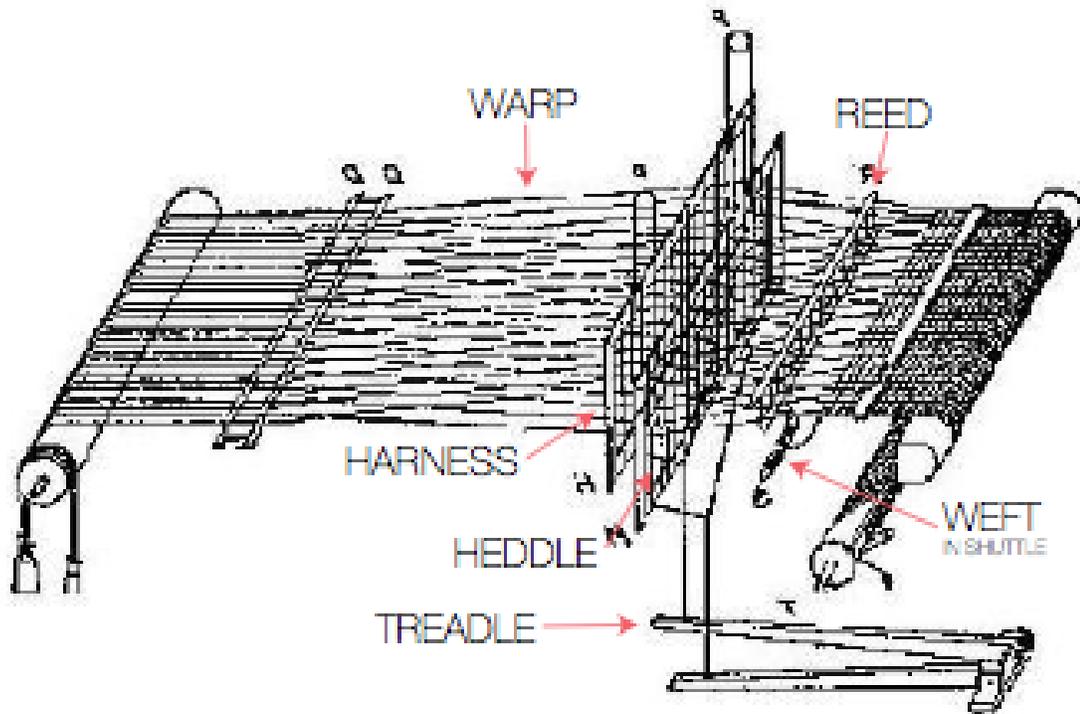


Figure 1: The harness loom³

In order to create even something simple like plain weave, the weaver must first “program” the loom. The first way that we begin to create pattern is through the threading of the heddles. The **heddles** are the needle-like structures which connect the thread to the shaft. The **shaft** is a frame that holds the heddles. The number of shafts help determine the complexity of patterns possible. Looms can come with four, eight, twelve, or more shafts. The shafts are connected to pedals which we call **treadles**. Finally the treadles are programmed with what is called the tie-up. The **tie-up** is the DNA of the weaving. Each treadle can be connected to one or more harnesses, which when pressed will raise the threads housed in those harnesses. The tie-up allows shafts

³ Taken from *Textiles and Clothing*. Text my own.

to be combined to create patterns. Tie ups can greatly alter the number of weave structures attainable on one loom.

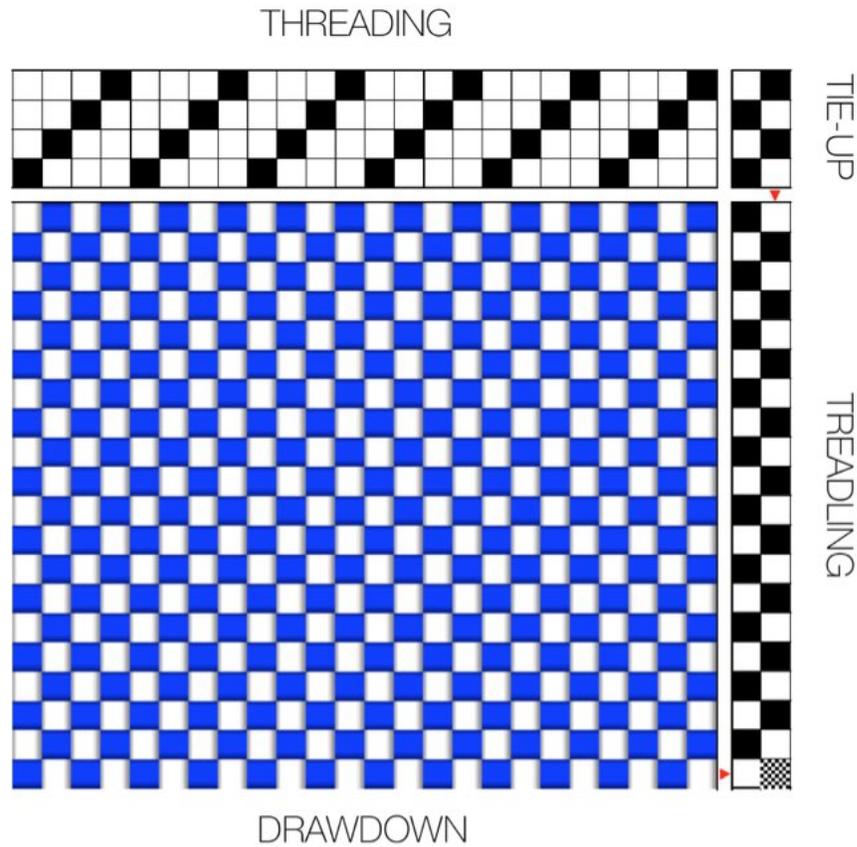


Figure 2: Plain weave draft

In order to communicate these factors to others and be able to replicate patterns, weavers create a draft. A **draft** is a specific type of notation is used to represent the **threading**⁴, the **treadling**⁵, and the tie-up⁶. This combination of these three types of programming is then combined in what is called the **draw down**, or the representation of the pattern. I will use one of the most basic threading designs called a “straight

⁴ The thread through a specific heddle.

⁵ The sequence of pressing the pedals to lift threads and build the pattern.

⁶ How the shafts are attached to the treadles.

draw.”⁷ From the straight draw it is possible to weave plain weave by attaching shafts 1 and 3 to a treadle and shafts 2 and 4 to another treadle.

From the same threading, it is possible to easily change the treadling and tie-up to produce different patterns.

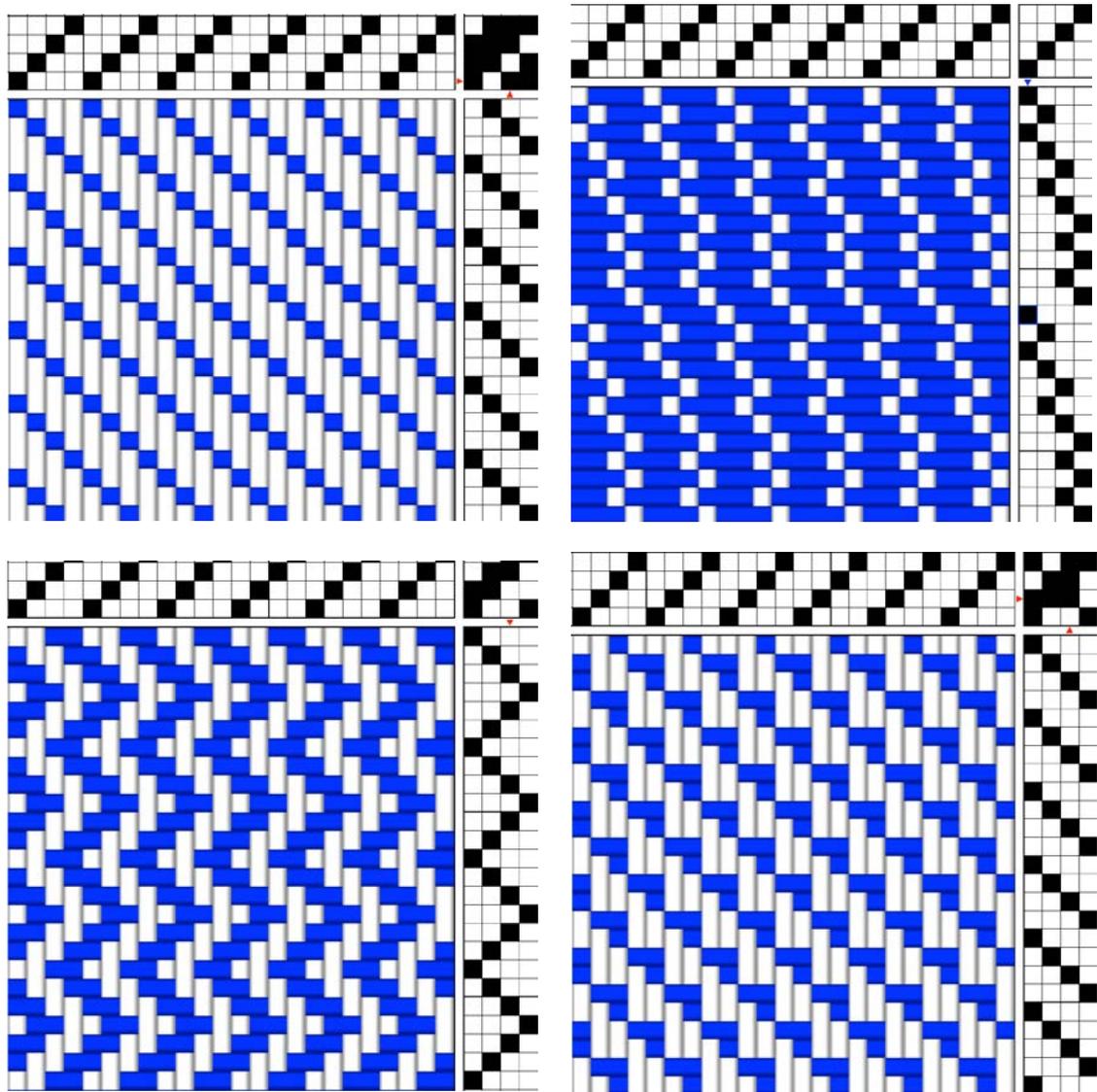


Figure 3: Patterns achieved by changing the tie-up and treadling

⁷ On a 4-shaft loom a straight draw means that threads are passed through the heddles in the order: Shaft 1, Shaft 2, Shaft 3, Shaft 4.

While part of the process of weaving is programming the loom, much of the act of weaving is warding off chaos. Throughout the process of creating the warp⁸, putting it onto the loom, and weaving with it, the weaver must take steps to keep the threads from tangling with one another. This is why at every step there are tools that help the weaver to organize the threads. This can be through the use of a warping board, using string to section the warp⁹, using a reed to organize threads on the loom, using lead sticks to keep the cross in tact on the loom, and using **bobbins** and **shuttles** to organize weft threads. To allow the focus to remain on working towards understanding the jacquard, I do not believe it is necessary to describe these processes in depth. Merely, the work of the weaver is a constant battle to organize a medium which wants to tangle, and the goal is to fight off the chaos by harnessing the nature of the thread to create fabric.

⁸ Called “winding the warp.”

⁹ Once the warp is on the warping board, strings are tied at even intervals to keep the threads from tangling.

Chapter 2: Specifics of Jacquard Practices

The jacquard loom is widely cited as being invented in 1804 by Joseph-Marie Charles¹⁰, however the name jacquard comes from the inventor Joseph Marie Jacquard who has since become synonymous with the invention of this machine. The jacquard machine helped catalyze industrialization of the weaving industry during a period in which traditional ways of practice were giving rise to the power of mass-production. The invention of the loom allowed silk textiles to be produced with efficiency, giving rise to new industries across Europe, especially in Lyon¹¹. Much like changing needs today, the indoctrination of the jacquard loom was met with protest. Draw boys who had previously lifted the threads manually were suddenly out of work. The weavers felt that their job was being attacked, and the new technology quickly rearranged the social structure of the traditional atelier.¹² A practice built on apprenticeships was suddenly in jeopardy, and new jacquard technicians were brought in to de-bug the mechanical components of the loom. Though society and the practice of weaving adapted to these new technologies it was initially met with resistance.

So what exactly is the structure of this radical technology? The jacquard loom is comprised of groups of hooks and needs. These components are connected to the warp threads, and raise and lower the warp by “reading” punched pattern cards. The needles extend into the card, and if there is a hole, the needle goes through and raises that warp

¹⁰ Schlein, A., & Ziek, Bhakti. (2006). *The woven pixel : Designing for jacquard and dobby looms using Photoshop®*. Greenville, SC: Bridgewater Press, 7.

¹¹ Basile, Eva. (2007). *Digital Tapestry*. Jacquard. Firenze, I.T.: Fondazione Lisio Arte Della Seta, 60, 9.

¹² Pickett, Barbara. (2007). *Thoughts on Education and Jacquard*. Jacquard. Firenze, I.T.: Fondazione Lisio Arte Della Seta, 60, 20.

thread. The act of raising a thread on the loom creates opportunity for pattern. This pattern can be created from texture, color, or images. However, even on multi-harness loom there are only so many options you can create with a given threading, tie-up, and treadling. Even with this array of components to change, there are clear limits to the scale and complexity possible. The jacquard loom removes those constraints.

Imagine being able to lift one thread out of hundreds. The jacquard loom makes that possible. Each thread is independently operated, and can be arranged as the designer sees fit. Marcoux notes that “the jacquard mechanism...presents the most practical means for weaving the most detailed images that can be accomplished in weaving structures (Marcoux, 1).” One of the most evident benefits of the jacquard loom is its ability to produce seemingly organic shapes and photographic images. Italian damask and French *tableaux tissés* are physical examples of the exciting properties of the jacquard loom. Damask creates image through the use of opposing weave structures, and is often representational of traditional flora and fauna. The Lyonese *tableaux tissés* are paintings woven in silk and distinguished Lyon as a leader in textiles. The quality of the picture distinguished and catapulted Lyonese companies to fame across Europe for their photographic accuracy in a woven medium.¹³

In many ways the loom is directly linked to technology. In many ways the thread can be thought of as a pixel. In computers pixels are stacked and arranged to create images. It is the smallest unit of color possible, and in many ways echoes even the shape of a single thread crossing over another. Like a computerized image, even

¹³ Basile, Eva. (2007). *Digital Tapestry*. Jacquard. Firenze, I.T.: Fondazione Lisio Arte Della Seta, 60, 9.

organic shapes will be made of stacked squares. However, the density of silk reduces the pixel size to create a high quality image that can be photorealistic in nature. The arrangement of threads for different kinds of satin produces a type of shading that can add depth to the image.

The comparison between weaving and computers in many levels has clear implications. The idea of the thread as a pixel, the act of “programming” the loom, and the binary of raising or lowering a thread directly influenced the invention of the modern computer. In his book *The Computer from Pascal to von Neumann*, Goldstein explores the connection between textile and computer. In it he quotes Lady Lovelace who states that: “We may say most aptly that the Analytical Engine weave *algebraical patterns* just as the Jacquard-loom weaves flowers and leaves (22).” The act of programming the loom to weave fabric operates in similar ways to the binary a computer uses to create, store, and display information. Lifting a thread is in many ways a binary act. It is a yes or no operation similar to the ones and zeroes that comprise coding at the most basic level.

It is no coincidence that the first computers used cards to program them. This was directly influenced by the jacquard loom as a simple and effective way to create and manage information. The story of how these two apparently dissimilar ideas were finally put together is rather miraculous. A man named Billings looked at the chaos of the tabulation of the tenth census in 1880 and wondered aloud that there ought to be some mechanical way of mechanizing this job, something on the principle of the Jacquard loom, whereby holes in a card regulate the pattern to be woven.” While Billings could not conceive how to fit these two ideas together, his young companion,

Hollerith, was a brilliant engineer who took Billing's initial idea and put it into practice. Hollerith realized that these cards could be "prepared by different people in different locations at different times (69)," stored easily, and could even be tabulated by certain characteristics. This allowed him to use the computers for one of the first forms of data analysis: to explore the results from this census.

Today the manual jacquard, though pioneering in its day has fallen out of favor. New technologies such as digital jacquard are once again pairing technology and weaving to ease the job of the weaver in the modern world. As a weaver using these more traditional technologies, I am often asked why traditional jacquard still matters. Why cling to tradition when modern technology allows us to iterate more quickly, re-warp in new ways, and remove many of the time-consuming and physically exhaustive steps to create a similar end result. I believe that there is worth in tradition. There is a history and a beauty of understanding the old ways in order to embrace the best of new technologies. In many ways too it is important to preserve our understanding and the progress of weaving to continually improve practice and innovation¹⁴.

¹⁴ Barbara Pickett argues something similar in her essay *Thoughts on Jacquard and Higher Education*.

Chapter 3: Preparing for Weaving in Italy

In order to understand the world of jacquard we began our preparatory class by looking at how to design a pattern. Much like other weaving, the design is communicated in visual form. The style of this communication is changed slightly and instead of a draft, we use Point Paper. Point Paper is a gridded paper, with each square representing a thread. In general, with a manual jacquard the pattern is automatically repeated by a mechanism over the fabric, so the designer is tasked with designing a smaller part of the pattern. In Eugene, the pattern repeats 4 times. There are 200 threads in each repeat, which is then multiplied 4 times to control all 800 threads. This means that when approaching designing a pattern, the constraints are automatically 200 points wide. The repeat width¹⁵ is specific for each loom.

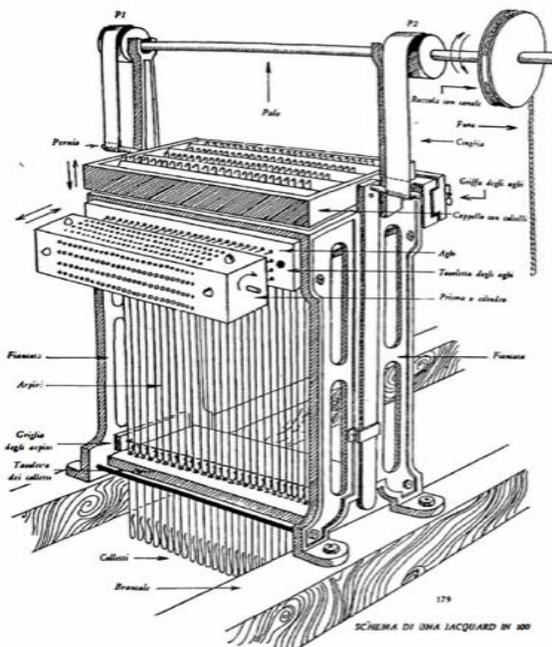


Figure 4: Illustration of the jacquard head¹⁶

¹⁵ The repeat width is the number of threads per repeat.

¹⁶ Taken from Lisio's *Designing Jacquard Textiles*

In order to tell the loom what to do, cards are used. The cylindrical head of the loom holds the cards. The head has evenly spaced holes, which correspond to the holes punched into the card. When the loom is advanced, the mechanism pushes the head into a set of thin pins. If a hole is punched, the pin can go through into the head and will raise that corresponding thread on the loom. As such our loom has 200 pins.

The cards are laced together to create a continuous assembly. The cards are then placed over the head of the jacquard machine, and the strip is connected to form a circular loop of cards. When the pedal is pushed, the pattern advances. The loom is therefore able to cycle through the pattern automatically. The card is comprised of 25 lines of eight holes. Each hole is assigned to a thread, and in total they represent the 200 threads that can be raised or lowered to create the desired pattern. These groups of eight are stacked upon one another to represent one horizontal line of the pattern.

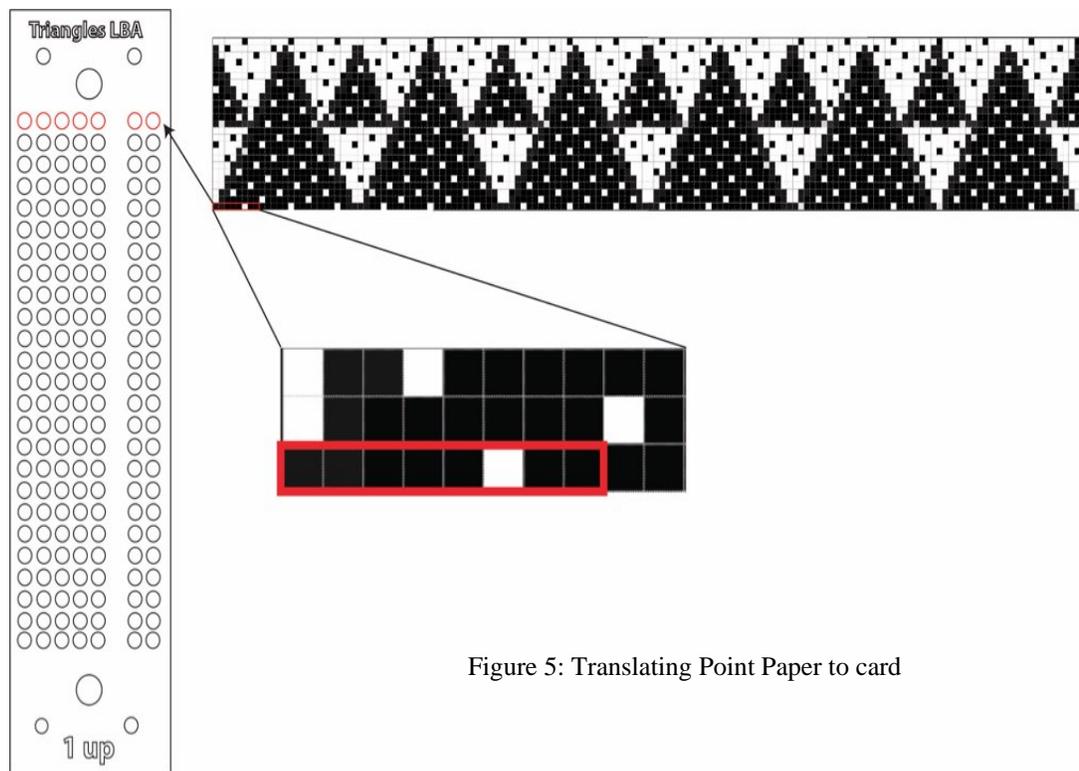


Figure 5: Translating Point Paper to card

The cards are punched one at a time on a special machine. The cards are then laced together on a special surface called a “lacing table” which evenly spaces the cards. The cards are stitched together with two threads which use the two holes on top and bottom to connect the cards into a single length. The cards are punched so that the pattern will be woven face down. This means that as the pattern is being woven on the loom the intended side will be on the back side. The weaver will see the reverse side as they weave the pattern. This is done to protect the preferred side. The weavers hand and tools have oils and other harmful substances that could ruin the loom of the fabric. By weaving the pattern face down the weaver can protect the presentation side to reduce the reweaving and waste. I have found that when lacing cards it is not necessary to pull the lacing too tightly. Putting too much tension on the lacing causes the cards to come loose on the head.

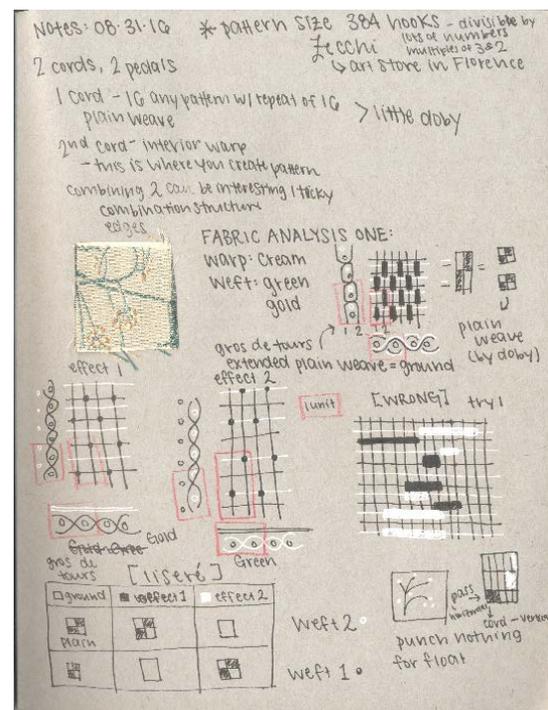
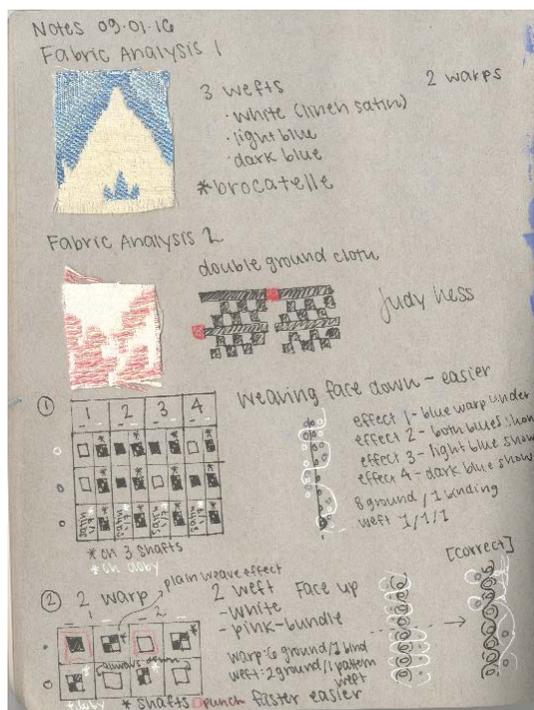
The joined cards are then placed on the loom and tied so that the continuous loop can be read by the machine. The foot pedal is used to “advance” the cards. Pressing the pedal down open the shed. The shuttle is passed and the weft thread is packed tightly using a reed and a beater¹⁷. In order to keep the machine from jamming, it is necessary for the weaver to develop an even pattern of pressing and releasing the pattern. A smooth and slow press down will ensure the shed will open evenly and the pins will not be jammed too quickly through the card. A quick but controlled release of the pedal advances the card through softly engaging the mechanism. Removing the foot too slowly will cause the machine to jam as the mechanism won’t engage properly.

¹⁷ The reed acts as a comb to organize the threads evenly. The beater is the mechanism which houses the reed and allows the weft to be pushed on top of one another to build the pattern evenly.

Chapter 4: The Process of Designing in Italy

Introduction to Designing Jacquard Patterns

We began our studies through inquiries into weave structures. It was a frustrating first few days as we squinted at small squares of fabric pattern under a magnifying glass. The goal of this first foray into the world of jacquard was to understand what it looked like to have more than one weft, and importantly the types of effects we could accomplish through our own designs. We also learned notation methods to examine the fabric in multiple ways. By learning the “Spaghetti and Meatballs” method as it is playfully called by Eva, or European notation, we were able to express the designs using conventions that could translate to other designers. This method allows for a graphic imagining of the inner workings of the weaving. The “meatballs” are a cross-section of the warp, and the “spaghetti” is the representation of weft interaction.



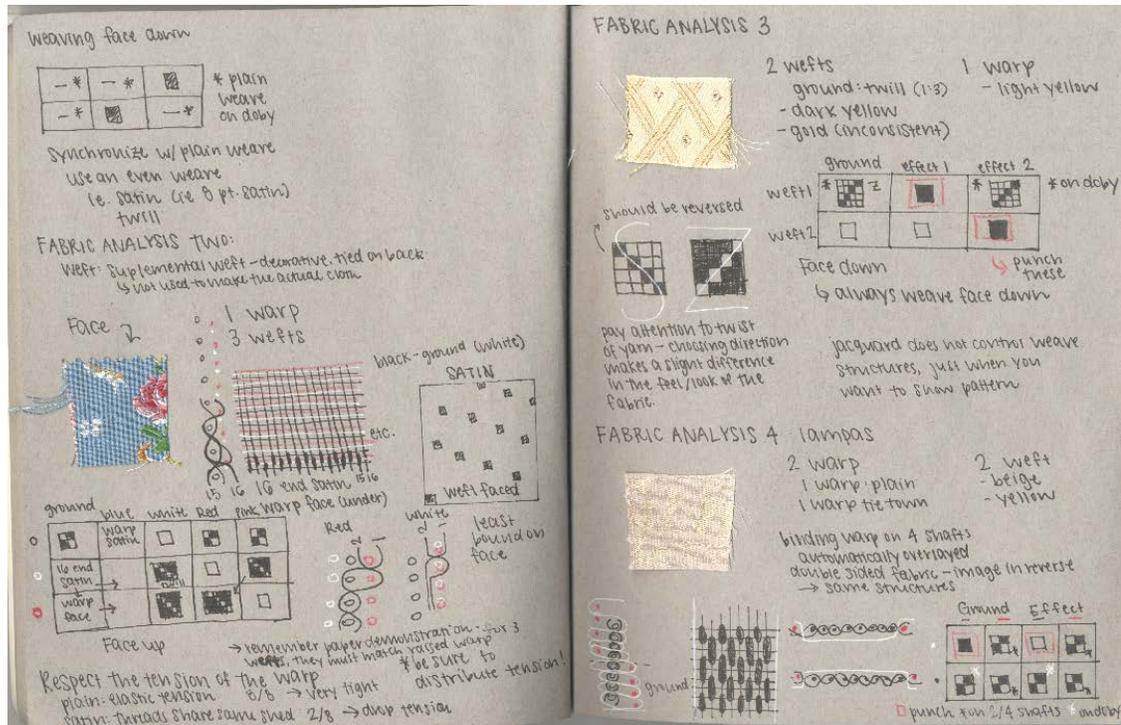


Figure 6. Examples of fabric analysis form my journal

Weaving “Starry Night” Pattern

I began by sketching in my notebook to work out different designs that could translate well to fabric. In order to find subject matter, I looked at images I had taken during my travels to see if there were reoccurring themes that could be worth exploring through design. The first design we decided on was stars. Since the warp of one of our looms was blue, we decided that this could be used as a design element to create a sky for our stars. The motif of stars is used heavily across Europe and was a meaningful representation of the culture and art we saw around us. This first weaving became a more literal way to analyze and unpack the new culture we found ourselves immersed in. As an American in Florence, I felt it especially necessary to pay homage to the

centuries of art practice that has shaped Florence into a cultural and industrial center for fashion through both leather, textile, and art.¹⁸

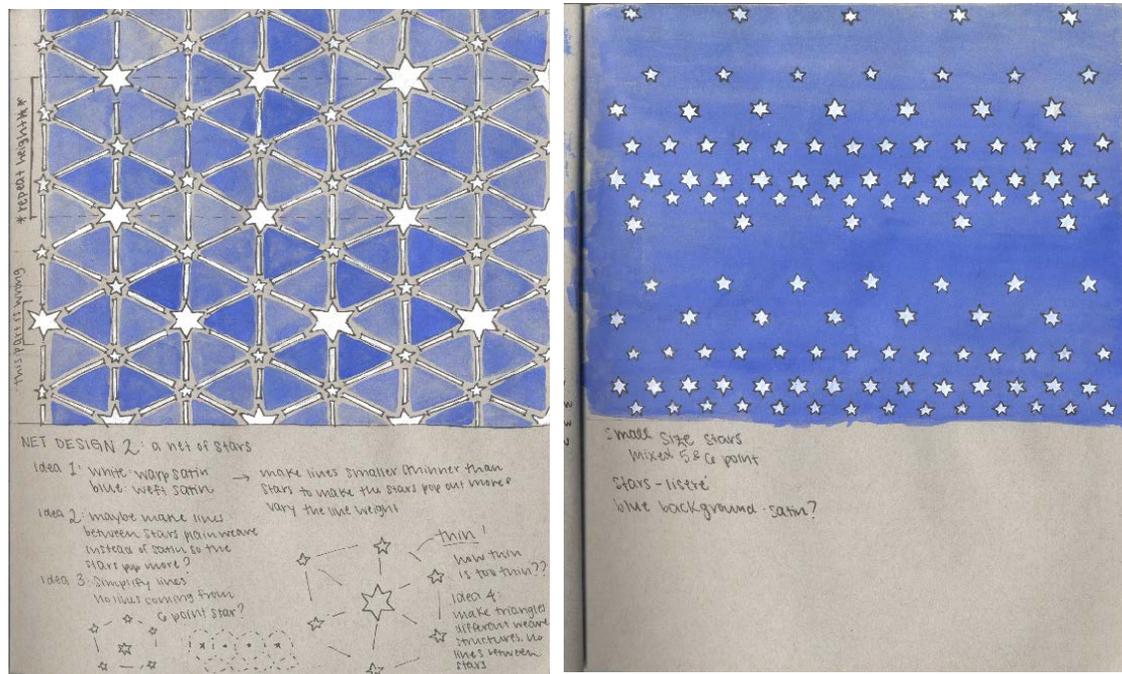


Figure 7: Initial pattern sketches taken from my journal exploring possible star motifs

This pattern would use a liseré effect to create the star pattern. This meant that we would use two wefts. The first weft would be a more structural weft used to create the background for the star pattern. The second weft would be used to create the effect of the stars. This weft is not essential for the structural integrity of the piece and is generally not a specific weave structure. Instead this secondary weft serves as a decorative addition, using anchor points¹⁹ placed for structural integrity. We used only one supplementary warp, but liseré can use multiple colors in the same row to create a wide range of effects.

¹⁸ While parts of this process was done separately, the fabric was designed and woven as a collative team with Emily Stark and Ginna Benson.

¹⁹ Anchor points tack the thread down to reduce the amount of floats. Floats can be easily snagged which can ruin the fabric.

Our next step was to realize our pattern on point paper. Instead of doing it by hand, we used a program called PointCarré. PointCarré is a powerful program designed for weaving and knitting. Its functions are somewhat similar to Illustrator, however it allows for easy mirroring and repeating as well as application of weave structures. As it's function is singular it is tailored to the needs of the weaver and designer. We used an effect to create cosmic clouds in the background which we intended to look like ikat. We called out the two different wefts through color use for easier differentiation during the punching process.

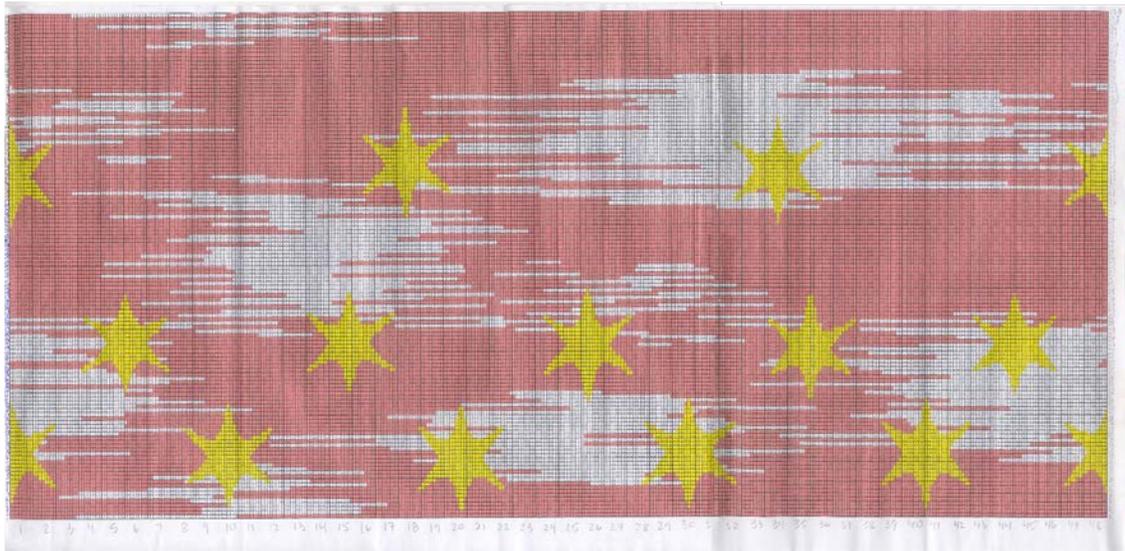


Figure 8: Scan of PointCarré pattern

We used yellow to represent the stars and used peach to represent the structural weft. At Lisio, they have secondary dobbies²⁰ which allow a pattern to be superimposed over the punched cards. This meant that we only had to punch the peach, but did not

²⁰ These loobbies allow a secondary set of strictly pattern cards (i.e. satin) to be superimposed over the pattern. This allows the weaver to exchange patterns with ease and quickly alter the image without have to prepunch all the pattern cards.

have to program a design in PointCarré for these areas. To create the liseré, two sets of cards are punched: One for the liseré effect, and one for the structural weft. The cards are then alternated during lacing to stack the two patterns. The repeat height of the pattern was 128 cards. However, since we had two wefts, we had to punch and lace 256 cards. The lines in between the stars were blank, as we would use the dobbie to overlay the anchor points.



Figure 9: The front of Starry Night Liseré

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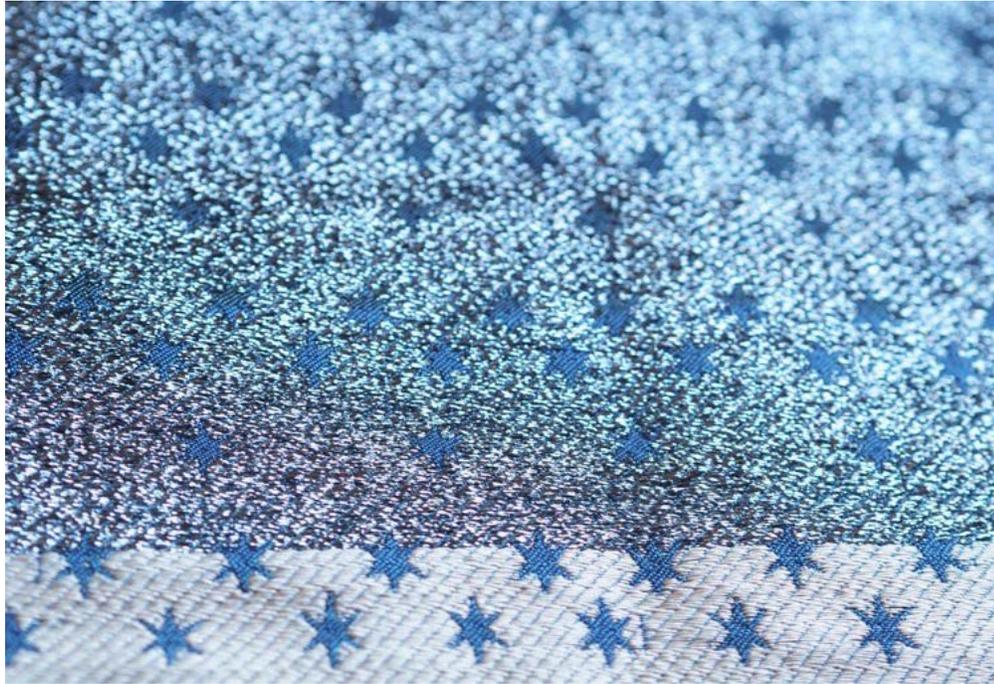


Figure 10: The back of Starry Night Liseré

Geometric Damask

The geometric pattern was inspired by art deco textiles. We began by exploring art books and other resources to find existing patterns that could serve as inspiration for our design. Initial sketches using a deco-style quickly became over-complicated and we realized that in order to create a simple and modern design, we would want to strip down the representation as far as possible. We decided to use two weave structures as this would allow us to punch fewer cards. By punching only one pattern in the design, we could use a doby to overlay the second structure, and we could swap out that structure if we so chose.



Figure 11: Initial sketches of the geometric design

We then began to create our design in PointCarré. We decided that with limited time to design, punch, lace, and weave our pattern that the repeat height would have to be under 100 cards. This design features 88 cards. We only punched the white and black area. The gray sections had pattern applied by the doby. For the weaving itself we used a weft and a warp satin. The pattern was created therefore by revealing more warp or weft to create contrasting shapes.

The weft of the pieces used either metallic or silk threads. As there was only one weft, this pattern wove far more quickly. This allowed us to readily change the color of the thread. My studies focused on gradients and stripes of colors to explore ways to isolate and emphasize different arrangements of the pattern.

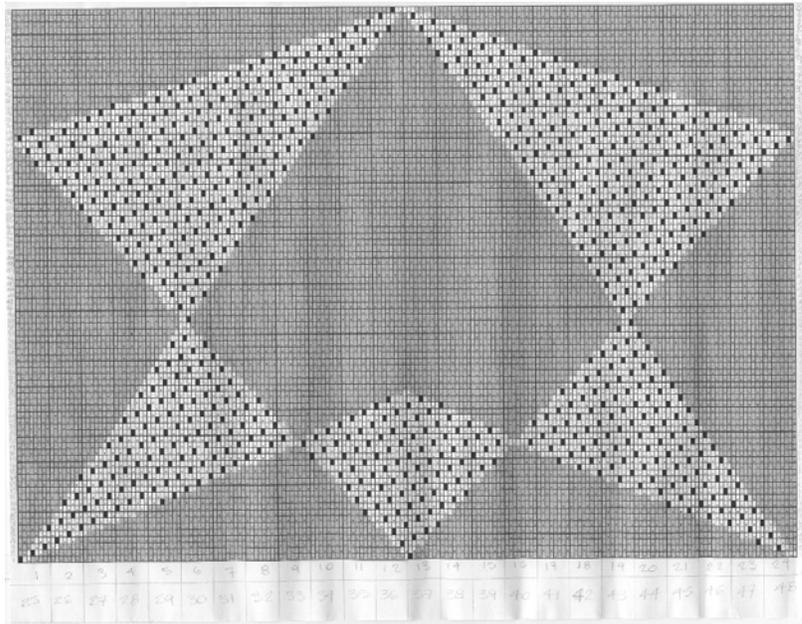


Figure 12: Geometric Damask Point Paper



Figure 13: Geometric Damask in blue stripe



Figure 14: Image of Geometric Damask in gradient of pinks folded

The work conducted at the Lisio Foundation was critical to understanding the finer points of jacquard weaving. With the help of Eva, we were able to realize two patterns and learn two different techniques (liseré and damask) to supplement our understanding of how to accomplish different effects. We were also able to learn about new ways to apply pattern through the addition of a dobby, something we are unable to experience in Eugene.

Chapter 5: The Process of Designing in Eugene

Unlike Italy, Eugene is not a specialized studio for the singular use of jacquard. The Pointcarré software and piano-style punching machine had aided significantly in the designing and punching phases, and I wondered if there was a way to update our current system in Eugene by using different resources. I opted to use Adobe Photoshop and Illustrator to design the pattern, and then create a template in Illustrator to laser cut the cards.

Designing with Illustrator

I designed my pattern with Illustrator as it allows for a wide range of possibilities. I chose to use Illustrator due to its compatibility with Photoshop, its accessibility, and its ease of use. While I worked with line vectors, Illustrator could be effectively used by scanning in a drawing and using Image Trace to create vectors from an original work. Similarly image trace could effectively be used for photographic or other such images.

In order to ensure that the repeat width would match the point paper, I set the canvas width to 200 pixels. On the point paper for our loom in Eugene, there are 25 sets of eight (or 200) total threads that will be repeated automatically by the loom four times. I next decided that initially I wanted to have 50 cards to punch. This meant that my image size would be 50x200 pixels. With my canvas size set, I created my pattern from line vectors and was able to quickly generate a repeat by copying, pasting and resizing the components until the repeat was seamless.

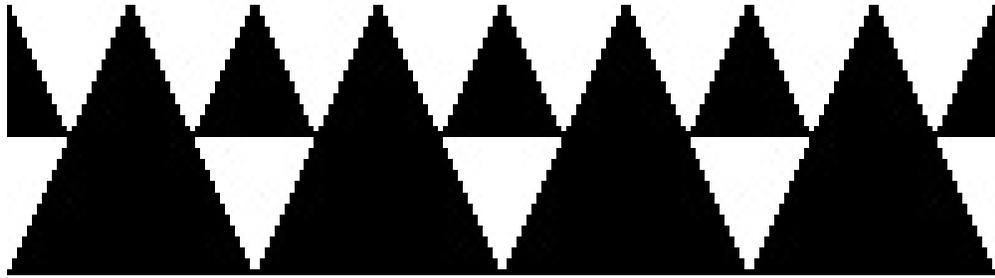


Figure 15: This is the exported vector drawing of my triangles

Applying Pattern with Photoshop

With the base image created, I then imported it into Photoshop to add the pattern. Immediately, I resized the image, to make sure that it was still 200x50 pixels (Image > “Image Size”). I began by changing the threshold to eliminate any grays in the image. Depending on the number of weave structures, this is not always necessary. Since I knew that I wanted only two weave structures (represented by the black and white in this pattern), changing the threshold made my working image only black and white.

In a separate window I created the weave structures I planned to use as they would appear on point paper. I created an 8-end satin and a 6-end satin. I did this by creating a document with the desired number of pixels. To create the 8-end warp satin I used an 8x8 pixel white square. I then used the pencil tool to create my satin by selecting the desired pixel and filling it with black. I then saved the file as a pattern (edit > “define pattern.”) In order to achieve the weft satin I inverted by original pattern (edit > “adjustments” > “invert” OR command+I). I then saved the inverted pattern as a pattern file as well.

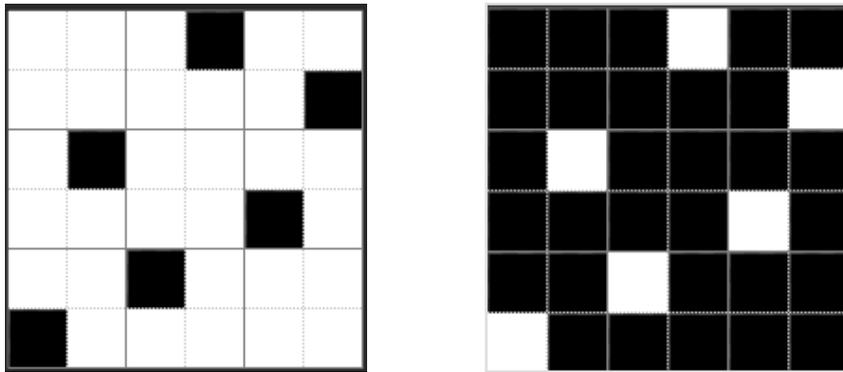


Figure 16: Examples of warp (left) and weft (right) satin created in Photoshop

In order to apply the pattern to my design I then used the Magic Wand tool (command+W). The magic wand tool will select the same colored pixels by clicking in a specific area. Since I was using only two colors, I did not need to adjust the tolerance. The tolerance will allow more or less pixels to be selected. If for example my pattern had many grey, I would want a lower tolerance so that the magic wand would differentiate between the slight differences in gray scale. I selected the white regions first and then filled them with the warp satin (Layer > “New Fill Layer”> “Pattern”). The pattern when filled will automatically multiply itself across the design. I first tried an 8-end satin, before I settled on a 6-end satin, as the repeat appeared more clearly with the 6-end.

I then applied the weft-satin to the black regions and used pattern fill to apply it to these areas. Once this process is complete however, there still remains some hand editing. Due to the placement of the pattern, the line quality may not be as clear as desired, and thus, it may be necessary to clean up the image.

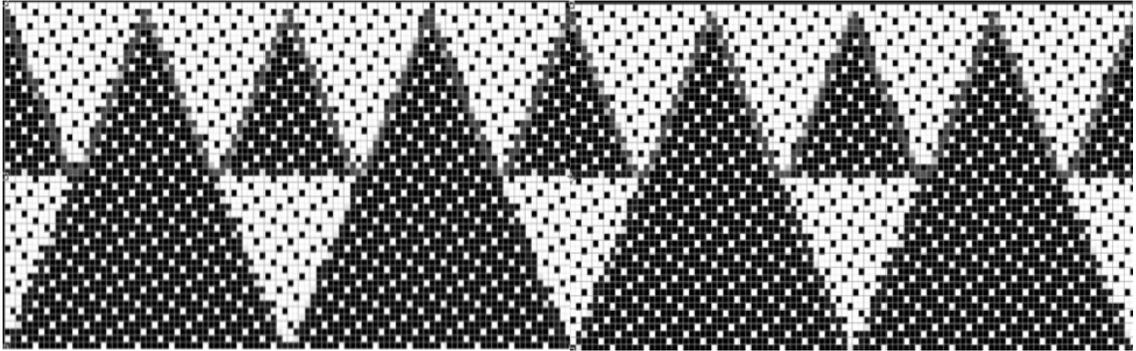


Figure 17: The image after pattern has been applied, before hand-editing

I used the pencil tool to change certain pixels to increase the image quality. I only edited the boundaries between the color changes and the tops of the triangles. I would remove anchor points if there were touching the edge of the adjacent color or were unnecessary at thinner points of the tops of the triangles. I made sure not to remove a point if that would cause a thread to float for more than 9 threads. Having floats that are too long can affect the look of the pattern and may catch over time, shortening the life of the fabric.

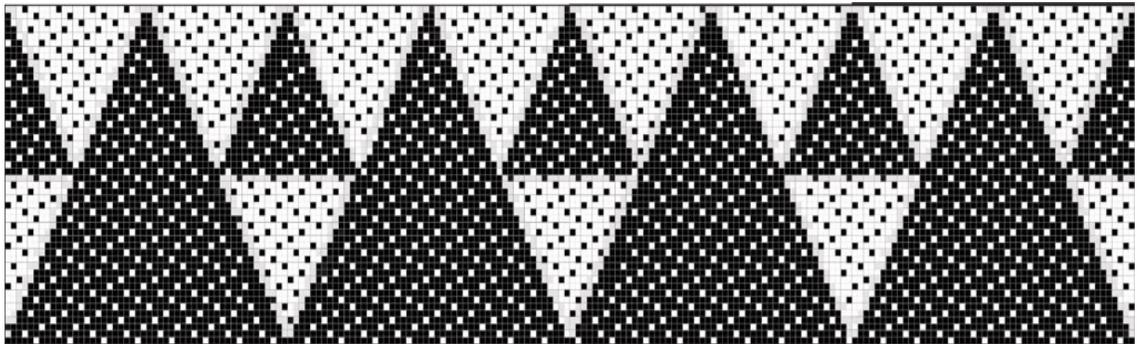


Figure 18: The image after editing.

At Lisio, 50 cards would have been a relatively small repeat, however the loom in Eugene has different constraints. Unlike Lisio, there is no way to manage large patterns of cards, as they will jam the machine. The resolution of the warp is

significantly larger, meaning that a similar repeat height can be achieved with fewer cards. Additionally the laser cutter takes a significant amount of time, meaning that 25 cards could easily be repeatable for future projects.



Figure 19: Shows the newly scaled pattern at 25x200 pixels

I used the process as previously described to apply the warp and weft satin. I decided to use 8-end satin as it is easier to program (each row on a card represents 8 threads), and given the reduced size it would reduce the number of anchor points and improve image fidelity. I hand edited the image to improve the quality. I also added boxes to group the points in sets of 8 width wise to make it easier to program the cards (each of the 25 lines include 8 points of thread).

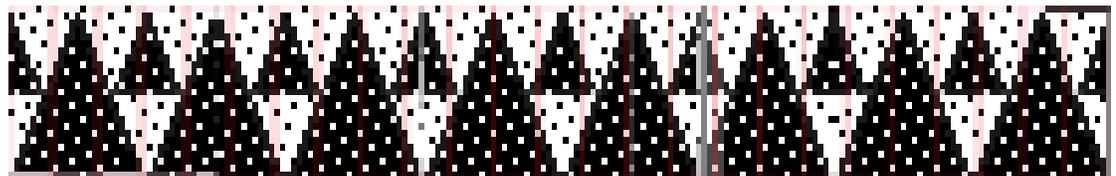


Figure 20: The edited second iteration with 8-end warp and weft satin

“Punching” Cards with the Laser Cutter

In order to program the cards for punching, I first scanned in the punched control card using a Cannon Scanner. I scanned the card in with the face side down as this is how you punch the card, and I wanted to ensure that the pattern would not be reversed. As the spacing between holes is not even at the top and bottom I then

imported the card into illustrator to put circles (Command+L) over the punched holes. This gave me a control card so I knew where all the holes would be.

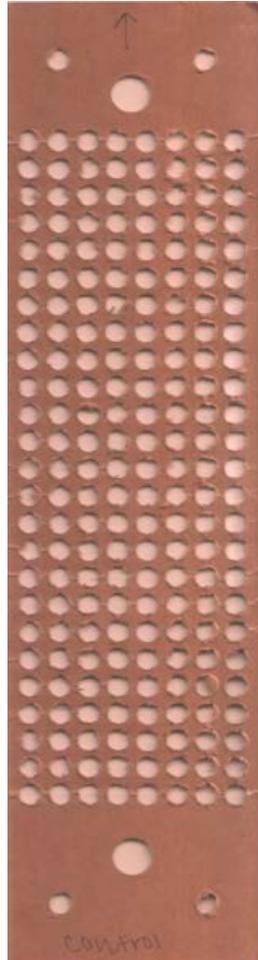


Figure 21: The scanned control card

With the control card formatted, I went row by row and deleted circles to create the pattern, being sure to number the cards at the bottom. I used the Versa Laser cutting template provided by AAA to make sure my cards fit in the bed of the laser. The

template is 32 inches wide by 18 inches tall and uses the cut order of black²², red²³, green²⁴. For my design, the black lines were used for text, which would be etched onto the card. The red lines were the interior circles for threading the cards together and the pattern, and the green was used to cut out the card from the sheet. In order for the program to read the design properly all colors had to be set to 255 (or the highest intensity, with all other colors at zero). This can also be achieved by saving the file in RGB (as opposed to CMYK) format. The line weight for the laser cut file must also be changed to .001 pt.

As the cards are 9.5” tall by 2.375” wide, they could not be double stacked on the template. I therefore created two files so that each file had 13 cards (control card plus 25 pattern cards). What I learned from this process is that using the laser cards while perhaps faster to program, requires significant cutting time. Circles are the most time intensive shape to cut, and without setbacks it would require at least an hour and a half of continuous cutting time. However, as the lasers in Lawrence are older, they can run as much as an hour and twenty minutes of cutting time per template, reaching closer to three hours of continuous cutting time. As such I am not sure that using the laser cutter is a significant time saving method. However, using the laser cutter could minimize the number of errors in the cards, reducing or eliminating corrections. It may also greatly decrease the time needed to fix jammed mechanisms, as the holes are perfectly consistent and do not have ragged edges from dull pins. And finally it

²² Laser etching.

²³ Island cuts.

²⁴ Outer cuts.

alleviates the physical strain that manual punching can incur, reducing pain and fatigue from prolonged use of the punching machine.

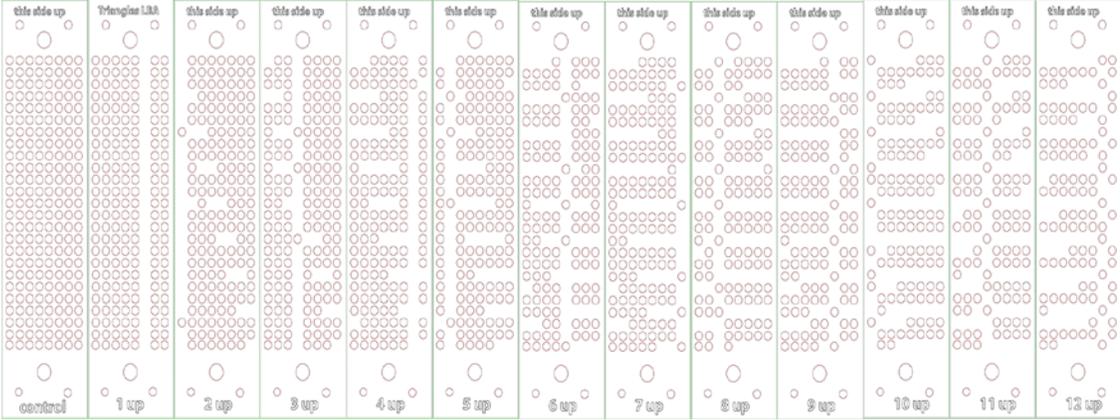


Figure 22: The first template of the illustrator file including the “Control Card.”

Analysis of Techniques

Going through the process of designing, punching, and weaving in Eugene was important in trying to figure out how to streamline the process with updated technologies. Especially with the new addition of the TC2 coming next Fall, using Adobe programs to create patterns for the loom is time efficient and can now be translated for both the TC2 and the manual jacquard loom. Like other computer programs, it allows for rapid ideation and quick changes to weave structure. It is easily editable and allows artists and designers to use multiple workflows to achieve a pattern. It can use scanned images (using image trace) and even edited photographs, which has broad implications for different types of practice.

The new use of the laser cut cards, while perhaps not as fast in practice as in theory does eliminate physical strain, and I believe increases efficiency on the loom. An unexpected outcome from laser cutting the cards was realizing however that the

template would need to be adjusted. I noticed as I was weaving that certain areas had a repeated issue. As it was related across the fabric, this meant that it was a problem with the cards. After trying to adjust numerous parts of the loom, I realized that since the problem was at the beginning of the repeat, it was an isolated area on the card that was not registering. Upon examining the card on the loom I realized that certain holes were not lined up properly with the wood holes on the head. This meant that when the pins are focused into the holes, they were not registering through the hole, and thus were not raising those threads even though the pattern was correct.

This could happen for a variety of reasons. First, It could have been caused by the temperature warping the wood of the head. Since parts of the loom are wood it means that the wood can be influenced by humidity, and can enlarge, shrink, or warp in response to changing temperatures and humidity. I doubt this as one pre-existing pattern I wove did not have the same errors that mine had. In Venice, Bevilacqua had problems with parts of the looms warping or becoming bloated from the humidity in the air. While their temperature and humidity is far more extreme, it could still influence the loom mechanics enough to cause errors.

Secondly it could also have been caused by a lack of servicing of the punching machine. As the pins have settled or moved over time, it could slowly diverge from the original template on the loom. I find this more probable as the same area was having difficulty registering on punched plain cards. My guess is the pattern I wove without these apparent errors was punched at an earlier date before the punching machine had been out of use and not serviced for a long period of time. In order to design cards that

weave more efficiently, it will be necessary to diverge from the control card template and recalibrate it based on the holes on the head of the loom.

The last possibility could be that the heat of the laser warper the cards slightly during cutting. I am skeptical of this since the highest intensity cuts are done at the end, and the rest of the ‘island’ cuts on the card are done previously to preserve the integrity of spacing. However it could be worthwhile to try a different setting to see if warping of the cards due to heat could be a factor. It could also be worth spacing the cards out slightly as the laser cutter went over the separation of the cards twice at a higher intensity, which could have caused warping. By spacing them even slightly, this could alleviate over-exposure from the laser.

Even with the new addition of the TC2 next year, I believe there is still extreme value in first learning the constraints of the manual jacquard. With the understanding of how the jacquard works, future students will be able to understand the differences and similarities between the two which will not only increase their knowledge of weaving, but will allow them to explore weaving. The adage “you have to know the rules to break them” applies to this concept. By learning the methods of tradition, students are able to develop a solid foundation to then explore the possibilities presented by the TC2. My hope is that the work I have done to document and streamline the process will make the manual jacquard more accessible to future students.



Figure 23: Triangular Pattern on the loom

Chapter 6: Reflections

Loomings by Barbara Mossberg

Deus ex machina is not going to happen. I am too fat. Hefty, to be heaved and cranked by pulleys, rescue engines of reprieve and flight. I yearned to be cast as the witch and do my heh heh heh then shriek my little priteee (gleeful snarl you and your pesky little dog). Yet sometimes I feel a hoist, so lifted it is alarming. Yes the headache that grounds me, but I'm making green tea, morning has spilled sun all over this cottage, it is messy with light. For some reason, for no good reason, I am feeling too good, a quiver from inside out. It feels slightly dangerous to feel so well. I had not planned anything special with this day, I am in faded lifeguard shorts and T-shirt, writing, and not going anywhere. I rise to make more tea and it should not feel this good to be alive, Paul Bunyan enough to feel this planetary heave within me, interior lakes where my boots fall, witch enough for brew and glee, Monet enough to paint the water lilies in my core, William O. Douglas enough to do justice to this spacey conviction of sky, of tree—the pine outside the window in the wind, how it is to me just now, enough: I stand Bunyan, swoop with my witch's broom, my breath is Monet's brush, I am of Douglas' opinion: let the trees decide. Maybe not feeling so well because there is the headache and backache so maybe it is happiness. This whatever it is. And I'm *kissing the joy as it flies*, you can't put it down, you have it give it to somebody, a ceremony. Some cause to celebrate, a you: so I'm here mishandling happiness and maybe feeling good or not and wondering if I am up to this size of being, a little intimidated at the largess of epic life, this whatever I can give you, and so I go back to my chair and write these lines, not epic, but some internal Iliad is about to happen, some myth breaking free of tragedy right in me, and I hear wings beating, I tremble, already more than mortal, and ready, when gods consort with us—making a mess of day—the holy chaos of a glimpse of pine against a western September sky— looming

“Looming” defies the visual phenomenon that allows our brain to understand that an object is moving toward us. Looming combines the physiological with the abstract that signals to us what is to come. In many ways the idea of looming spreads to the practice of weaving. Weaving is a multi-sensory experience. It is the rattle of the loom, the clash and clatter of cards moving through the machine. It is the soft thread, hardened by the tension to defy the perception of silk and delicate. It is the sensation of a single thread breaking, and feeling that minuscule twinge in the body. To loom, to weave is to make sense of the world, to create with anonymity a representation of the abstract, or a distillation of the world through representational forms.

Even from its first incarnation, cloth has existed as a necessity, not as art. The pioneering of new methods to create an beautiful fabric has continuously put weaving into a realm more closely linked with engineering and technology than art. The

industrial quality of weaving often removes the artist from view, but opens a world of possibilities that come from joining and advancing an age long tradition. This precarious conversation between art, design, and technology positions jacquard in a special and unique position. The implications of jacquard can be spread across a myriad of topics that encourage interdisciplinary conversations and engage specialties across the arts, humanities, and tech industries.

Weaving pushes champions the precise, the advanced, and working in tandem with technology to redefine our perception of textiles throughout time. This paper was my brave, but small step towards tackling a complicated and deeply entangled faction of textile. This project, a journey of my own to gain as much knowledge as I can. It is a journey of constantly fraying fabric to understand how it was created. It is a journey of synthesizing myself and my experiences into pieces that lie between art and industry. The thesis and the works created by it are meant to take theory, history, and practice and turn them into the tangible. The weavers work is never done, and this project is no exception. Though I have done my best to do justice to my learning in and out of the classroom, there will always be more to learn, more to read, and more to make.

Glossary of Terms

Warp: The vertical threads that run through the loom.

Weft: The horizontal threads which are passed under the raised warp threads in a shuttle.

Heddles: The needle-like objects in the frame which attach warp threads to a shaft.

Shaft: The frames that hold the heddles. They attach to treadles which raise and lower the threads housed inside the harnesses.

Treadles: The pedals which are pressed to raise the threads.

Tie-up: The DNA of the pattern. The treadles are attached to one or more of the harnesses. By combining harnesses, the weaver can raise all of those threads simultaneously.

Draft: Is the visual communication of how to program the loom to achieve a specific pattern. The draft takes into account the threading, treadling, and tie-up to produce the draw-down.

Threading: The threading is a part of draft and tells the weaver the order of heddles to thread.

Treadling: Looms have multiple pedals, so this component communicates the order in which to press the treadles to achieve the pattern. (This is essentially the same as “calling” the program on a computer.)

Draw-down: The draw down takes into account the threading, tie-up, and treadling to create a visual representation of the pattern.

Bobbin: Much like a sewing machine bobbin, the bobbin is a cylindrical object used in weaving to organize the weft thread.

Shuttle: The bobbin full of weft thread is housed in the shuttle. The shape of the shuttles fits easily in the hand and is passed under the raised threads to build the pattern.

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