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WEAVING AND COMPUTATION: CAN TRADITIONAL KOREAN CRAFT TEACH US SOMETHING?

Abstract

This essay explores the intersection of computation and traditional craft, focusing specifically on weaving and the Korean traditional woolen carpet, *modam*. While both weaving and computers operate in binary terms, the essay acknowledges that weaving encompasses more than just binary logic, considering factors such as materiality, embodiment, and imagination. It seeks to explore the deeper connection between weaving and computation, beyond specific devices like punched cards, and how *modam* and its cultural context can shed light on this relationship. The essay also highlights the historical role of women in both weaving and computing, drawing parallels between weavers and the (gendered) body as components of early computational processes. By examining the historical, cultural, and technological nuances of *modam* production, this exploration aims to reveal insights into our present technology and our interaction with it.

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Figure 1: Kilim (*modam*) Korea 1870 - 1930 Gift of Fred Braida to the Textile Museum of Canada, Image Credit: Textile Museum of Canada

Introduction

Recently, I encountered *modam*, a Korean traditional woolen carpet, for the first time in my life at the Textile Museum of Canada. I visited the museum's opening of Gathering, a new exhibition that features 40 pieces from the museum's permanent collection of over 15,000 objects from around the world. There were open calls for artists to make digital responses to their collection which led me to find *modam* in their collection and make a small video about its history, and how the practice slowly disappeared. Not only was I happy to see my work displaying side by side with the *modam*, but I was also taken by the beauty and the magnitude of the object itself. I had only seen it in digital scans and not in reality, so I was at first astonished by the sheer size of the tapestry. Due to its length being greater than the height of the gallery wall, only 2/3 of the tapestry was visible as it was hung on the wall. Therefore, the visual elements of the tapestry were much larger than I expected, in which the central crane was the size of a large rabbit or a medium-sized dog that gave me the illusion of flying right into my face. While I already have numerous questions and curiosities regarding various aspects of the carpet and its arrival in Canada, its size has sparked another significant question in my mind: "What was the purpose behind creating such a large carpet?"

The practice of Korean tapestry remains relatively unknown, even among many Koreans themselves. In fact, there is a common misconception among Koreans that carpets were solely imported from the West, without realizing that traditional carpets were once crafted within our own culture. This is presumably because the rapid industrialization of textile production has led to cultural amnesia and the marginalization of traditional crafts in Korea. As a result, many of the traditional ways of textile production have been forgotten and have fallen out of practice. I'm not an exception to this cultural amnesia and had I not come across the carpet in the Textile Museum of Canada, I would have remained unaware of this fascinating tradition as well. However, records show that patterned wool carpets have existed in Korea since the Three Kingdom Period (57 BCE – 668 CE) and were actively produced during the *Joseon* dynasty (1392-1910). (Paintings in Thread MODAM 30) The production of *modam* decreased in the 17th century arguably because, by then, *ondol*, the traditional Korean underfloor heating system started to be widely supplied in households and people no longer needed carpets to insulate the floor. (Paintings in Thread MODAM 32) No carpets from the early *Joseon* period have survived, and there are more than 100 remaining from the late *Joseon* period (16th-19th century) in the world. (Paintings in Thread MODAM 29) Recently, there has been an effort to introduce *modam* to the public and research them in a few Korean museums such as the *Kyungwoon* Museum and *Daegu* National Museum. They held exhibitions of *modam* in 2016 – 2017 and 2021 respectively.

Weaving, the process of interlacing threads to create fabric, has a rich history that traces back to ancient civilizations such as Egypt, Mesopotamia, and China. While weaving is often associated with textiles and fashion, its contributions to the history of technology are significant. From the development of ancient looms to the modern advancements in textile machinery, weaving has played a crucial role in shaping technological progress and societal development. A significant contribution of weaving to computation technology was the introduction of the punched card-controlled Jacquard loom in the early 19th century. Therefore, the discussion surrounding the involvement of weaving in the advancement of computation has predominantly centred on the importance of the Jacquard loom and the use of punched cards. However, I would like to explore a broader perspective, examining how weaving's influence on computation extends beyond the Jacquard loom. I am particularly intrigued by the involvement of traditional weaving and human labor in the development of computation, with a specific emphasis on exploring the potential contributions of Korean traditional weaving practices and devices that produced objects such as *modam*.

This essay begins with the familiar narrative surrounding the Jacquard loom and its significant impact on the history of computing through the use of punched cards. Then it discusses how weaving has been a binary art form since its beginning and highlights recent discussions that emphasize the broader scope of weaving beyond these specific devices and binary logic. I introduce different aspects of *modam*, the Korean traditional woolen carpet about its history, disappearance, production method etc. Lastly, I explore approaches to incorporate these aspects to consider what we could learn from the traditional Korean weaving.

Punched cards system in Analytical Engine & Tabulating machine

Whether we start the history of computing with Charles Babbage's Analytical Machine or Herman Hollerith's Tabulating machine, it is important to note that both machines used punched cards as a form of information storage and/or automatic control. Punched cards played an important role in computing history and were regularly used to program computers until the 1960s.

Hollerith's tabulating machine used a method of storing information coded as holes punched onto card stock. These cards, made of paper and featuring a grid-like structure, allowed data to be encoded by punching holes in specific locations. For instance, marital status could be represented by a series of holes on the card. When a person marked as married punched out the corresponding spot, the card would be inserted into Hollerith's machine. Metal pins would descend over the card, passing through the punched holes and into small vials of mercury, thus completing the circuit. This completed circuit would then power an electric motor, causing a gear to increment the 'married' count by one. The concept of using hole or a non-hole to represent and store data on paper cards, such as distinguishing between married and unmarried, anticipated information stored in digital form.

Babbage's Analytical Engine used punched cards as a control function. The concept of automatic control, the ancestor of what we now call software, is as important as the information storage to make up a computer. Mechanical control can be traced back to antiquity, to a device that had been used to control machinery for centuries: a cylinder on which were mounted pegs, which tripped levers as it rotated. (Ceruzzi 8) Babbage's Analytical Engine was to contain a number of such cylinders to carry more detailed sequences of operations that are directed by the punched cards. Today we might call it the computer's microprogramming, or read-only memory (ROM) (Ceruzzi 9). Analytical Engine used punched cards for programming the machine by providing three types of cards. His operation cards held instructions for the engine. The variable cards carried symbols and values of variables in equations as well as constants. And his number cards supplied numbers for tables and logs. Like a modern-day computer, the Analytical Engine could make decisions based on its own calculated results; it could do branching, loops or subroutines (Poague 17). Although never fully constructed, Analytical Engine was an ‘automatic computer’ that could guide itself through a series of operations automatically, which foreshadowed computer programs. English mathematician Ada Lovelace wrote hypothetical programs for the Analytical Engine. For this work, she is considered the world’s first programmer. Ada Lovelace was the main collaborator of Babbage’s Analytical Engine who is also known for her famous quote, “It will weave algebraic equations the way a Jacquard loom weaves flowers.” (Poague 16) Lovelace applied her mathematical imagination in envisioning the potential of Babbage's Analytical Engine. She explored the idea of the machine being capable of performing various tasks beyond mere calculations. (O’Shea 121)

Jacquard Loom, before the Analytical Engine & Tabulating machine

Babbage’s invention was based on the punched card system and the formal mechanics of the Jacquard’s loom, an automated weaving loom that used a series of punched cards to create complex patterns more economically. The Jacquard loom was patented in 1804 by the Frenchman Joseph-Marie Jacquard, who implemented punched cards to control the weaving of cloth by selectively lifting threads according to a predetermined pattern (Ceruzzi 8).

The principle of weaving revolves around the movement and positioning of two essential groups of threads: the warp and the weft. The warp refers to the set of vertical threads that are held taut on a loom. These threads can be in one of two positions: up or down, also referred to as front or back. The position of the warp determines the path the weft will take during the weaving process. The weft, on the other hand, represents the horizontal threads that interlace with the warp to create the fabric. The weft thread travels either over or under the warp threads, depending on their respective positions. When the warp is up, the weft will go over it, and when the warp is down, the weft will go under it. The Jacquard loom incorporated a system of punched cards to effectively control the positioning of the warp threads. The process of making a fabric on a Jacquard loom involves a number of steps, including the making of the pattern by hand and transferring it on a checkered point paper (which becomes the “pixel resolution” of the final image), translating the design onto the punched cards, threading the loom (passing each warp thread through the heddles), and the actual weaving process (Fernaeus, et al. 1596). The key feature of this process and the invention of Jacquard loom is again the use of punched cards where fabric patterns are represented in the form of holes and the absence of holes in a long chain of punched cards stitched together (Fernaeus, et al. 1597). When the stitched cards are fed into the loom in a continuous belt, each card comes in contact with the needle board and is pressed against it. The needles that pass through the holes remain in the same position whereas all other needles would be pushed back. In turn, particular heddles that correspond to the needles that stayed in place would be raised, while other heddles would not. In short, the punched holes in each card control which warp threads to be raised per shed, thus creating the weaving pattern. The mechanics of the punched cards could be regarded as the binary representation, making it possible to 'digitize' material objects, creating a form of 'code' only possible to interpret by running it through a mechanical device. It is in this sense the Jacquard loom is often discussed as being a predecessor of the modern-day computer (Fernaeus, et al. 1597).

From the standpoint of loom technology, Jacquard loom completed and perfected the mechanism that automated the loom using punched cards. However, the binary control using holes and non-holes already existed in previous efforts such as Basil Bouchon's invention in 1725 that used a band of perforated paper tape, Jean Baptiste Falcon's invention in in 1728 that introduced a loop of punched cards, and Jacques de Vaucanson's invention in 1745 which was the first automated loom. Jacquard did not invent the binary structure of weaving, let alone the punched card system. What he did was construct the first feasible and widely used mechanism that replaced the human being (so-called drawboy lifting the warp threads on behalf of the weaver thus controlling the weave pattern) with the punched cards to feed in the pattern information.

Digital nature of weaving

However, the connection between weaving and computers cannot be reduced to the role of punched cards. As a computer scientist and a weaver, Martin Davis and Virginia Davis aim to correct the misconception of the Jacquard loom as the ancestor of computers. They argue that the Jacquard loom is no more like a computer than a player piano is, which also operates on punched holes as an input device. Punched cards are only the peripheral device that brings data into or out of the machine which should not be taken for the computer itself (Davis and Davis, 79).

Weaving and digital computers process data in similar ways regardless of the punched cards because to weave means to decide whether a warp thread is to be picked up or not. Therefore, weaving has been a binary art from its very beginning as also stated by the computer pioneer Heinz Zemanek (Harlizius-Klück 179). When referring to the prehistory of processing information, Zemanek states that each crossing of two threads means a digital point (Zemanek 16; Harlizius-Klück 183). When we speak of representing data in weaving as 1s and 0s, or in binary terms, we're speaking of the interlacements that occur when a warp thread is raised, thus covering the weft thread, or not raised, thus covered by the weft thread. The holes on the punched card merely represent which warp threads to be raised.

Ellen Harlizius-Klück intends to widen the view that seems to be fixed upon the Jacquard mechanism. Her article sheds light on the algebraical patterns and codes of weaving that were already present before the Jacquard loom. The punched cards made the pattern algebra of weaving perceivable to someone interested in the construction of calculation engines based on binary logic, like Charles Babbage.

(Harlizius-Klück 179) She argues that a sort of algebra is already involved in operating shafts (movable frames or sets of heddles that control the position of warp threads) or heddles (cords or wires attached to a loom's shafts that hold and control the individual warp threads) in ordinary looms. This algebra was executed as a tacit inference until the first weaving notations were developed, and these weaving-notations resemble the respective loom parts and make the tacit visual algebra of patterns recognizable to non-weavers and in particular, inventors and engineers. (Harlizius-Klück 179) For millennia, pattern weaving was done without notation. Skilled weavers did not make plans in advance, developing each and every step of the process and documenting these single steps in writing. The loom parts, like heddles or shafts, store most of the necessary information and skilled weavers can read bindings and patterns directly from fabric. In this sense, fabric samples were the best and most commonly used memory or storage of patterns (Harlizius-Klück 183). However, the development of pattern notation printed and published made recognizable the tacit algebraic thinking that was already involved in operating shafts and heddles in ordinary looms (Harlizius-Klück 179). Weaving notations revealed algebraic ways to organize threads in groups and subgroups, and how to code the pattern using the loom setup, facilitating the understanding of the interaction between pattern drafting and loom parts for non-weavers. This enabled engineers and inventors to play around with the mechanisms and make attempts at the automated loom (Harlizius-Klück 192). Birgit Schneider, in her article, “Programmed Images: Systems of Notation in Seventeenth- and Eighteenth-century Weaving” overviews weaving as technical image processing. She questions whether the first printed weaving notation could be used as data fed into a control mechanism on the loom. She identifies a precursor for technical image processing in the notations written and published in 1677 by Marx Ziegler, a weaver from Ulm, Southern Germany. These notations encoded images through the arrangement of threads and the tie-ups, which represented the geometric properties of the pattern. (Schneider 143) She is interested in weaving notations from the viewpoint of the prehistory of technical image processing and image coding. (Harlizius-Klück 191) The close connection of code or design and loom construction was also stressed by Hilts: “Loom-controlled pattern weaving is a distinct branch of design in which art and technology are closely interrelated.” (Harlizius-Klück 191)

The true significance and emphasis reside in the ancient practice of weaving and its profound connection to mathematics, emphasizing its inherently digital nature, rather than solely focusing on the Jacquard loom. It is essential to recognize and appreciate the inventive and skillful work performed by weavers on a daily basis, which should not be overshadowed by new tools and inventions. Heinz Zemanek supports this notion, highlighting that various folkloristic weaving devices found across Europe, Africa, and Asia are, in fact, implementations or tools for programmed processes (Zemanek 16; Harlizius-Klück 183). This perspective helps open the door to exploring traditional weaving techniques in non-western regions. It underscores the notion that people, with their expertise and methodical actions, acted as pattern-processors long before the introduction of punch-cards. The roots of computation lie not in some specific device but rather in the disciplined labor of human beings. In this context, I am particularly intrigued by how the production of *modam* could also serve as a technology that enables us to gain a deeper understanding of this connection.

Beyond the digital

However, in their article "Weaving Beyond the Binary," John Paul Morabito explores weaving in a way that goes beyond its disciplinary boundaries and the strict technical aspects it is often associated with. While it is acknowledged that weaving on a loom involves binary logic, the digital aspect is just one of many paradigms encompassed by the practice (Morabito 4). Narrow definitions that reduce weaving to binary overlook the multitude of factors involved. The author seeks to unlock the potential found in the materiality, embodiment, and imagination inherent in weaving. Factors such as scale, length, and width introduce considerations that go beyond binary choices. Variables like color, fiber composition, and texture further expand the possibilities, not constrained by a binary framework. Even the interlacing of threads can be expanded beyond the binary when we shift our focus to the movements within the cloth itself, going beyond the movements dictated solely by the loom (Morabito 5). The author explores multi-layered weaves, such as double, triple, or quadruple weaves, where the cloth offers far more options than a binary system allows. Creating multilayered cloths requires a weaver to consider both the binary movement of the loom and the intricate movements of threads within and between the different layers (Morabito 5). This highlights that weaving is polynary, not binary, referring to phenomena composed of more than two parts. While binary thinking presents an either-or battleground, polynary thinking presents a playground (Morabito 4). Polynary thinking becomes evident when we look beyond the Jacquard loom and emergent technologies, instead focusing on ancient looms where one action sets the conditions for a new set of activities. Ancient and embodied weaving technologies offer a more expansive understanding of weaving that surpasses the categorization of weaving as a rigid space (Morabito 5). The exploration of warp-weighted weaving and the backstrap loom, contributed by Emma Cocker and Jenni Sorkin, is particularly intriguing in this context. In warp-weighted weaving, the process begins with a tablet-woven band that is then rotated to initiate a new weaving. The elongated wefts extend outward to eventually become the warp, and the tablet loom serves as the scaffold for the next weaving, allowing the textile to grow in any direction, defying the linear progression of modern weaving techniques (Cocker 130; Morabito 5). This article is significant as it offers a comprehensive perspective on weaving that transcends the limitations of binary logic. By challenging binary thinking, it has the potential to prompt a re-evaluation of computation itself.

These sources offer compelling insights into why delving into *modam* and its traditional weaving method and practice may deepen our understanding of its potential connection to computation, irrespective of whether it is connected to binary logic or not. There is a potential to bring forth a traditional perspective and explore alternative modes of computation that go beyond the conventional device-oriented binary paradigm. While some historical facts and production elements of *modam* have been explored to some extent, there is still much more to uncover and reveal about this subject. Further research and exploration can unlock its potential as a unique and culturally significant approach to computation and enrich our understanding of technological innovation from a more inclusive and diverse perspective.

Modam, traditional Korean woolen carpet

From fragments of woolen fabric found in ancient relics of the *Gojoseon* period (? – 108 BCE), we can tell that Korea has a long history of woolen textile practice. The earliest known example of woolen fabric is a face veil that was woven with a mixture of sheep wool and dog hair, dating back to the *Gojoseon* period. Fragments of woolen fabrics from the 1st to 2nd century have also been discovered in *Pyeongyang*. Therefore, it is confirmed that ancient Koreans had the technology to spin animal fur and weave woolen fabric. Records show that woolen textiles to spread on the floor such as '*mosuk*' or '*moyok*' have been produced from the Three Kingdoms Period (57 BCE – 668 CE) to the *Joseon* period (1392-1910). (Moon 18) '*Modam*' in various records have different names, however, it is generally made from animal hair and was used not only to spread on the floor but also to hang as canopy. It appears that it was decorated with dyed threads or painted with patterns. *Modam* was considered a valuable and luxurious item, and it was traded as a commodity with China and Japan from the Three Kingdoms period to the *Joseon* Dynasty. Furthermore, it is evidenced by archival photographs that *modam* was also used by the general public in later periods. (Moon 18) It has been confirmed that there exist more than 100 pieces of *modam* artifacts domestically and abroad. Some of them are housed in the Seoul Craft Museum, *Sookmyung* Women's University Museum, *Onyang* Folk Museum, etc. in Korea. Others that transmitted to Japan as '*Joseonchul*' exist in *Kyoto Gion* Foundation and private collections. (Moon 19)

Classification of *Modam* by its production method

The *modam* artifacts date back to the 16th to 19th centuries and can be classified into three types such as tapestry, plain weave, and felt, according to their weaving style. However, as time progressed, tapestry techniques decreased in popularity, giving way to a greater prevalence of painted patterns. The combination of weaving style and design techniques includes tapestry alone, tapestry + painting + printing, plain weave + painting, and felt + painting. As the weave structure became less complex, the patterns were more likely to be painted onto the fabric. (Moon 19) 66% of these *modams* are composed of tapestry with patterns created using the painting or printing techniques. Patterns were created using painting or printing techniques on different textile surfaces. The composition of the design typically consists of a central pattern and a border pattern. The central pattern is usually composed of animals such as phoenixes, lions, tigers, and magpies, as well as flowers such as orchids and plum blossoms, butterflies, and Mountain Hydrangea. The border decoration can be classified into two types: geometric patterns such as diamond stripes, color stripes, palindrome, and Swastika that decorate the top and bottom, and animal and plant patterns such as butterflies, flowers, and birds that decorate the edges. (Moon 20) The tapestry weave structure that takes up the highest percentage of *Joseon* period's *modam* is based on plain weave. However, instead of weft thread passing through the entire width of the fabric, it is partially woven according to the pattern. Fabrics woven in this way have the characteristic of small gaps created in the warp direction because the weft is not continuous. This weave structure is called tapestry in north America, and in countries such as Turkey and Iran, it is called Kilim. (Moon 20) *Modam* artifacts exhibit more simplified weave structure as time went on, which represents the stylistic changes over time. (Moon 21) The tapestry technique is being phased out in favor of simpler plain weaving, and the pattern creation also shifted from being woven to drawn on the surface. This indicates a gradual progression towards a more convenient environment for production. (Moon 23)

Production method

To weave fabric, the three basic processes of raising the warp, passing the weft through, and beating down the weft are essential. The principles of weaving machines can be accomplished by these three basic processes. This can create a plain weave which is the most basic weave. Primitive weaving involved manually raising some of the warp with hands or using tree branches or bone needles. It is assumed that a weaving machine that embodies these basic weaving principles such as the warp-weighted loom would have been used to produce *modam*. Weights of Warp-weighted looms made of soil dating back to 2000 BCE have been found in the Korean peninsula. (Moon 71) Warp-weighted looms are ancient forms of looms used to weave woolen fabrics and were especially used in weaving tapestries that are based on the plain weave technique. Warp-weighted loom uses weights to hold the threads tight and parallel, and we have evidence of this type of loom from ancient pottery. (Broudy 23) The loom uses a rod to separate the threads and weights to keep them taut. The weaver creates a shed, or opening, in the threads by using heddles and rests the heddle rod on supports. The weaver then inserts the weft, or horizontal, threads and uses a sword beater to keep them in place. As the weaving progresses, the woven portion can be rolled up on the top beam, allowing for longer fabrics to be made. Heavier weights were used for tighter weaving, while lighter weights resulted in looser weaving. Weavers could also adjust the tension by attaching more threads to the heavier weights and fewer to the lighter ones. The history of the warp-weighted loom is long, and it has been found in many ancient civilizations, including in Anatolia, Palestine, Crete, and Europe. (Broudy 25) The plain weave structure of *modam* is also found in Korean traditional baskets and mats. The loom utilized to make those baskets and mats has a basic design that primarily functions to hold and tension the warp, with minimal additional components. (Moon 72) The weaving machine for mats currently produced in the

Boseong area of Korea is called "*jariteul*," which is a vertical form of weaving machine. *Jariteul* has a similar operating principle to the traditional *beopteul*, such as having a device on the top of the loom for adjusting the tension of the warp. (Moon 72)

From *Modam* to carpets from the West

The early Joseon period author *Seo Geojeong* (1420~1488) described the interiors of houses on winter days of *Joseon* in his book. “Colorful *modams* are spread on the floor and embroidered curtains are draped around. Charcaol in the furnace blooms red like spring flowers.” (Paintings in Thread MODAM 29) This scene is quite different from the common perception of the living style of a traditional Korean house called *Hanok* with an *ondol* heating system. *Ondol* is traditional Korean underfloor heating system widely supplied by the 17th century. If the interior of a house is heated using *ondol*, there is little need to spread a thick carpet to spread on the floor. Also, curtains are unnecessary as the air inside the house is kept relatively warm. That is why the interior of a *hanok* house with an *ondol* system consists of papered windows and a floor coated with oil paper. (Paintings in Thread MODAM 29) Researchers believe that *ondol* brought drastic changes to the living culture of *Joseon*, especially in housing and cooking. It is believed to be one of the reasons as to why the production of *modam* decreased along with many other factors. (Paintings in Thread MODAM 33) No carpets from the early *Joseon* period have survived, but their images can be found in portraits of figures in official attire from the seventeenth century. Carpets were no longer depicted in portraits after the 17th century and were replaced by figured rush mats from *Ganghwa* Island, known as *hwamunseok*. The next known appearance of a carpet in a portrait comes in the depiction of *Yi Haeung* (1820-1898) from 1880. (Paintings in Thread MODAM 29) There remain a few extant carpets from the late *Joseon* period. Recent discoveries of pieces of *modam* from *Changdeokgung* Palace’s *Seongjeonggak* Hall provide clues about the uses and types of *modam* used in the 20th century royal court. (Paintings in Thread MODAM 37) Additionally, there is evidence that shows the use of *modam* among the public. In a photo taken by Father Nobert in 1911, *modam* used in weddings of ordinary people is shown. In the book, *Viewing the Joseon Dynasty through the Eyes* published in 1986, there are also depictions of women drawing pictures sitting on *modam*. (Paintings in Thread MODAM 37)

Carpets imported from Europe are found in portraits from the early twentieth century. In the June 19th, 1879 issue of *Dongnip Sinmun* (Independence Newspaper), an advertisement appeared selling imported carpets by a foreigner named F.Kalitzky who lived in Korea at that time. This marked the introduction of Western style carpets to Korea. (Paintings in Thread MODAM 38) In the late 19th to early 20th century, *modam* was referred to as *yungjeon*, *dantong*, *mopo*, and *yangtanja* in newspaper articles and advertisements. These articles and advertisements were about domestically produced carpets and in the 1899 issue of *Dongnip Sinmun* it was encouraged as a national industry. (Paintings in Thread

MODAM 37) In the 1920s and 1930s, there was a noticeable increase in advertisements of workshops that taught women how to make, maintain and sell *dantong*. This suggests that *dantong* and *yungjeon* were domestically produced and were *modam* that ordinary people used. (Paintings in Thread MODAM 37)

What could *Modam* teach us?

Despite the existing knowledge revealed about *modam*, there is still much more that is unknown. Questions arise regarding the people and labour involved in the production process, and the culture surrounding *modam* that could unveil a deeper understanding of the social context in which it existed. The detailed production procedure, including the tools and materials, can shed light on the craftsmanship and techniques employed by the makers of *modam*. Examining the correlation between the decline of *modam* and the widespread use of *ondol*, the underfloor heating system raises relevant questions regarding technology. This may uncover intriguing connections between objects and space, namely the architectural infrastructure. Exploring the historical export of *modam* to China and Japan during trade exchanges can offer insight into the cross-cultural significance of this craft. Particularly noteworthy are the carpets transported to Japan during the *Joseon Tongsinsa*, the Korean Mission to Japan, during the 17th century after the two countries restored diplomatic relations following the Japanese Invasion of Korea in 1592. These carpets decorated the *yamaboko* carriages used in the celebrated *Gion Matsuri* festival in Kyoto, which could reveal another intriguing dimension into the production and distribution processes of *modam*.

What striked me the most about the specific *modam* housed at the Textile Museum of Canada when I first encountered the object was its sheer size. It is 1.22 meter wide and 3.06 meter long. This calls attention and raises intriguing questions about its purpose and the individuals involved in its creation. Such a substantial carpet would certainly have required collaborative labour, engaging the skills and expertise of numerous individuals. Who were the skilled artisans involved? What was the intended use or significance of this expansive carpet? The production process of *modam* could tell us something about collaborative craftsmanship that may inform us something about the roots of computation that lie in disciplined and cooperative human labour, rather than solely relying on devices such as punched cards. Lizzie O'Shea's article, "Collaborative Work is Liberating and Effective," gives some valuable insights to this this notion by delving into the intersections of labor culture in the realms of textiles and computing. She explores the historical context of collaborative work through examples such as Ada Lovelace and Charles Babbage's collaboration on the design of the Analytical Engine and the resistance of Luddites against the separation of craftsmanship and care in favor of labor and wages. O'Shea then delves into the evolution of collective and open software development, tracing its roots in the early hacker culture and its transformation with the rise of proprietary software driven by profit motives. She writes, “Some of our most radical new technological developments were a result of teamwork, drawing on multiple people's varied skill sets." (O'shea 131) "Computing began as a small pocket of sophisticated craft labor practiced in a relatively unalienate manner, while the world of capitalist enterprise carried on all around." (O'shea 131) Drawing on the case studies like the hacker culture in the MIT lab and the Linux community, the article examines the relationship between labor, craftsmanship, collaboration, and capitalist modes of production.

The main contributors to the production of *modam* are not entirely known but given the advertising of workshops during the 1920s and 1930s aimed at teaching women how to create, manage and market *modam*, it can be inferred that women played a role in its manufacture. By exploring the production of *modam* and its associated cultural context, could we uncover insights about gendered labor hidden in technological advancements and/or our relationship with technology and machines? The role of women in the history of weaving and computing has been thoroughly explored in Sadie Plant's work, "The Future Looms: Weaving Women and Cybernetics." In this paper, she delves into the traditional perception of weaving as women's work and highlights the significant contributions women made to the early development of computing technologies. This coincides with the early days of information processing in computation when women were predominantly employed to do calculations. Back in the 1930s and 1940s, people who performed calculations were called "computers," and the majority of this work was carried out by women. (Hayles 1) Anne Balsamo, Hayles writes, references this terminology in her book *Technologies of Gendered Body*, when she begins one of the chapters with the line "My mother was a computer," which reflects her mother's actual work as a computer. Balsamo uses this family history to reflect on the gender implications of information technologies. (Hayles 1) An illustration of this idea can be seen in the *Making Core Memory* project, a collaborative project from the University of Washington's Tactile and Tactical Design Lab. The project aimed to recognize the hidden labor involved in assembling core memory—a primitive form of computer storage initially woven by hand by individuals known as "Little Old Ladies." (Rosner et al. 1) The project involved the creation of an electronic quilt and a series of interactive workshops that materialized the efforts of the core memory weavers. Core memory played a pivotal role in computer systems during the early Cold War era, including the Apollo mission computers, where information was stored using threaded wires around magnetized rings. NASA engineers referred to this hardware as "LOL memory" for the "Little Old Ladies" who carefully wove wires around small electro-magnetic ferrite cores by hand. The project highlights the gendered craftsmanship that underlies digital production and acknowledges the often-overlooked contributions made to engineering advancements. (Rosner et al. 1)

Figure 2: Fine Ramie Weaving of *Hansan*, Image Credit: Cultural Heritage Administration of the Republic of Korea

The historical shift from human to machine labor raises an array of issues about the relationship between humans and machines such as the figure of the (gendered) body as a component of the machine. This idea is also present in the relationship between weavers and weaving machines, as the weavers interact closely with the weaving looms, treating them as integral components of the weaving process. This is especially exemplified in back strap looms, one of the oldest weaving technologies where one end of the loom is harnessed around the waist of the weaver with a backstrap. Traditional Korean clothing materials for summer such as ramie and hemp fabrics were woven on back strap looms and the technique of weaving ramie fabric produced in *Hansan*, *Seocheon-gun*, *Chungcheongnam-do* is registered as a UNESCO Intangible Cultural Heritage and is passed down to this day. Directing our attention to ancient looms and embodied weaving techniques such as the back strap loom has the potential to provide us a broader understanding of our connection with technology and computation.

Conclusion

In this essay, I explore the correlation between traditional crafts such as weaving and computation. More specifically, I draw attention to *modam*, the traditional Korean woolen carpet. The ancient form of weaving and its technologies hold untapped potential for revealing a deeper understanding of its connection with computation, beyond the familiar narrative surrounding the Jacquard loom. Traditional craftwork has taught me more valuable lessons about technology than I expected. My experience of working on a weaving loom informed me a lot about physical, tangible forms of interaction with technology. Spending hours manually setting up the loom, passing each thread into the heddles made me feel connected to the machine in an unexpected way. The whole body interacting with the loom, throwing the shuttle across the warp, and controlling treadles to see your pattern emerge on the fabric gave me a sense of control that I'm working with the machine, not dependent on it. Weavers can be comparable to early human labor as computers in the realm of information processing, as both were integral components of the mechanized workforce. In my continuous research, I hope to explore deeper into the historical, cultural, and technological intricacies of *modam* production. I anticipate that this will uncover surprising insights into our present-day technology and our relationship with it.

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