The Kolam Drawing: A Point Lattice System

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Introduction

Kolam is the 5,000-year-old art of making geometric floor drawings with rice flour, practiced by the Dravidian women of South India. This article introduces a point lattice-based method of visual organization that is derived from Kolam drawings. In it, a point lattice formed by a regularly spaced array of points is used to structure visual compositions, as an alternative to a network of orthogonal lines (also known as the grid). First, I show how the point lattice system is used to structure Kolam drawing compositions, including the lattice's construction, types, and uses. Second, through a formal analysis of such a points system in structuring forms, patterns, letters, and layouts in graphic design, I show that this system offers a whole alternate universe of compositional possibilities that are not apparent when graphic designers see a grid not as points, but as a series of constraining straight lines. Through this research, I look inward into the design ethos and tools present in Indian arts and crafts and present its application in contemporary design practice.

The Kolam Drawing: A Dravidian Woman's Tradition

A Kolam drawing is a geometric pattern made at the threshold of a house. It symbolizes a sacred diagram meant to invite deities, ward off negativity, and meditate (see Figure 1). Kolam drawings are solely made by women, where artistic skills are passed on from mother to daughter in a mentor-mentee model of creative practice. Millions of Dravidian women in Tamil Nadu draw Kolam drawings every day before dawn and dusk, using finely ground white rice powder or paste (called Kolapodi in the Tamil language). The drawings are made to fulfill the daily obligation of a Hindu household "to feed a thousand souls."[1] The rice on the floor invites birds and insects for a feast, encouraging a harmonious coexistence.

Expressing their ideas by making art every day is a lifelong pursuit for the Kolam artists, and the process captures female folk-centric experiences in the form of stories illustrated as Kolam drawings. Women come together to create an intimate space where they share artistic knowledge, keenly play with locally found natural materials to make tools and colors, sing folk melodies,

1 Vijaya Nagarajan, *Feeding a Thousand Souls: Women, Ritual and Ecology in India; an Exploration of the Kolam* (New York: Oxford University Press, 2019), 55.

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Figure 1
(Left) A woman making a Kolam drawing on the floor. (Right) A Pulli Kolam drawing on a 6x6 point lattice. Photo by the author. All figures are created by the author.

perform rituals, and hone skills to establish an artistic practice. This creative process culminates in a female-specific canon of Dravidian women's heritage of creative methods, visual style, materials, and symbolism that is shaped through lived experience.

Many terminologies have been used for different Kolam types in academic investigations of Kolam patterns. This study focuses on Pulli Kolam drawings—a term coined by Kolam artists—in which only points and lines are used to create geometric patterns (see Figure 1). Recursive in nature, Kolam drawings often begin with a point and enlarge into intricate geometric patterns. The Kolam-making process can be understood as a rule-based activity; the composition is created by memorizing the path of a line, including all consecutive turns and twists around the points, like a puzzle.

Kolam drawings are based on a regularly spaced array of points, also known as a point lattice. Instead of using a grid in which orthogonal lines cross each other to form a network of identical squares or rectangles, as a guideline for composing layouts for drawings, Dravidian women use points to structure their geometric Kolam compositions. In doing so, they circumnavigate, rope in, or—at times—connect the points with curved and straight lines. As part of the ethnographic research method used for this study, I collected hundreds of Kolam drawings through primary resources. Following a formal analysis of these drawings, I identified the lattice's primary functions in structuring Kolam patterns—findings that I present in the first half of the article.

In the second half, I present a formal investigation into the application of the point lattice system in structuring forms, patterns, letters, and layouts used in contemporary graphic design. The results show that a point lattice functions as a more efficient system of guidelines for complex form and pattern generation than an orthogonal grid. The point lattice supports the creation of different types of customized geometric and curved forms by giving designers a wide array of reference points to connect or navigate, without having to adhere to the strict boundary of an orthogonal module that, by its own rigid framework, supports forms made with straight and diagonal lines. The study introduces designers to an inside-out method of form-making, where a point takes the center-most space around which a form is created, measured, and replicated.

The point lattice system can be used as a visual organization tool in graphic design—one that presents designers with a new way to draft form and opens up a world of compositional possibilities when compared to a grid of its size. Design students and professionals in India can use this work to learn about structural thinking from their design heritage and understand the socio-cultural context specific to the evolution of the point lattice system derived from Kolam drawings. By dividing the layout into culturally familiar geometric ratios, designers develop visual sensibilities in form drafting and graphic pattern making, relevant for communicating with an Indian audience.

Grid as an Object of Inquiry

A grid is a visual organization tool created with an array of intersecting orthogonal lines. In graphic design, the grid is used for the organization of space on a page that helps present visual content with clarity and purpose.[2] From the rigid structure of a modernist grid to the deconstructed post-modernist grid and the fluid and responsive grids made of screen pixels, designers have conceptually and structurally experimented on the grid as a carrier of information; using it, they study new spatial relationships that create fresh visual possibilities for communicating a message. In his book, *Designing Programmes*, Karl Gerstner introduces the concept of a program: an algorithm applied to a set of elements governed by a set of rules to produce different yet cohesive outcomes.[3] The idea of permutations is central to this work, which presents a method and an approach to design. This approach is extented to *Think Program*, which is a synopsis of the exhibition *Designing programs/programming designs* by Karl Gerstner at the Museum of Modern Art in New York in 1973, and in *Kompendium für Alphabeten* (1972; later published as *Compendium for Literates*).[4] Gerstner developed the idea of a flexible or mobile grid that is a formal program to accommodate x unknown items. Gerstner writes: "The difficulty is: to find the balance, the maximum of conformity to a rule with the maximum of freedom. Or: the maximum of constants with the greatest possible variability."[5] This square grid consists of six vertical columns and six horizontal modules, overlaid by grids of one, two, three, and four units, enabling an incredible variety of layout options working in harmony with each other.

2 Josef Müller-Brockmann, *Grid Systems in Graphic Design* (Teufen, Switzerland: Niggli Verlag, 1996), 10.

3 Karl Gerstner, *Karl Gerstner: Designing Programmes* (Zürich: Lars Müller Publishing, 2019).

4 Karl Gerstner, *Think Program: Synopsis of the Exhibition "Designing Programs/Programming Designs"* (New York: Museum of Modern Art, 1973).

5 Gerstner, *Designing Programmes*.

In 1977, Massimo Vignelli designed The Unigrid system for the National Park Service (NPS).[6] The modular grid system allowed the NPS to create brochures in ten basic formats with length-to-width ratios determined by paper sizes that can be cut from one larger sheet of paper. The Unigrid sets up an open framework for the design of brochures, where text, photos, maps, and illustrations can be organized in a variety of ways. It's a robust framework that supports a wide range of graphic possibilities and was later adapted in contemporary web design practices as The Uniweb. Timothy Samara, in his book, *Making and Breaking the Grid*, presents different ways of splitting, splicing, shifting, deforming, and distorting to create an alternative architecture for the orthogonal grid.[7] In the book, *Analog Algorithm: Source-Related Grid Systems*, Christoph Grünberger, Paul McNeil, and Rob Meek introduce a grid-based toolkit that gives the reader techniques to develop new forms, fonts, logos, and patterns.[8] The authors present a design process in which grids are derived from the source or product (e.g., a letter, photograph, or object) and used to generate and analyze analog, algorithm-based, or exploratory form.

The studies listed present a variety of fascinating uses of the grid in organizing visual elements, as well as in producing new forms and patterns. Yet, the first three of these studies remain confined to the orthogonal structure of the grid. When the orthogonal structure of the grid is reinvented (as in *Analog Algorithm*), the principles are applied to specific projects, which limits its use as a universal system of visual organization. In contrast to these limitations, the Kolam point lattice system brings versatility and flexibility to the process of visual organization and form generation. The open point-based structure of the lattice induces a new inside-out method to compose form and demonstrates the use of compositional techniques, such as multiplicity and progression.

Design in India: Research on Kolam Patterns in Graphic Design

Traditional Indian design thinking is rooted in the concept of *Kala*. Singanapalli Balaram[9] and H. Kumar Vyas[10] describe the term *Kala* as the unified concept of all human arts, skills, sciences, and techniques. Balaram writes in his book, *Thinking Design*, "[i]n the West, design emerged as a reaction to mass production, but in India, the story is quite different. The Indian tradition always held art and craft as one unified whole. In the classical Indian Language Sanskrit, there is only one word *Kala* covering both."[11] Before Independent India was influenced by the Industrial Revolution in the late 1940s and early 1950s, the artisan was the innovator, creator, producer, and distributor of a product. In the late 1950s, Charles and Ray Eames were invited to India by the Indian

6 National Park Service, *Unigrid: Design Specifications: National Park Service Information Folder Program* (Washington, DC: Division of Publications, National Park Service, U.S. Department of the Interior, 1978).

7 Timothy Samara, *Making and Breaking the Grid: A Graphic Design Layout Workshop* (Beverly, MA: Rockport Publishers, 2005), 124–84.

8 Christoph Grünberger et al., *Analog Algorithm: Source-Related Grid Systems* (Zürich, Switzerland: Lars Müller Publishers, 2019).

9 Singanapalli Balaram, *Thinking Design* (Los Angeles, CA: Sage, 2011).

10 H. Kumar Vyas, *Design, the Indian Context: Learning the Historical Rationale of the Indian Design Idiom* (Ahmedabad, Gujarat: National Institute of Design, 2000).

11 Balaram, *Thinking Design*, 7.

government to recommend a training program in design. They produced *The India Report*, on the basis of which the National Institute of Design was established in 1961 in Ahmedabad; it was followed by the IDC School of Design in 1969 and the National Institute of Fashion Technology in 1986.[12] The European school of thought that separated fine arts and crafts and machine-made objects deconstructed the concept of *Kala* and distanced the traditional design ethos present in India's three-millennia-old design heritage from its contemporary design values. The primary focus of graphic design education in India is based on modernist and post-modernist principles, but these design movements were born out of cultural and technological influences in the Western world and did not evolve around the Indian user's needs, behaviors, or values. In fact, 65 percent of India's population lives in rural land and remains incredibly diverse, and communication designed on the basis of universal graphic design principles borne out of industrial culture's needs is not the most effective for the majority of the Indian population. Only in recent years have scholars and professionals, such as Singanapalli Balaram, H. Kumar Vyas, Ashoke Chatterjee, and Lalit Kumar Das, started to look back into India's history of arts and crafts to investigate the creative methodology and tools used in these practices and to study their application in contemporary design solutions.[13] Scholars are defining Indian design pedagogy by looking at the needs of an Indian market and the social, economic, and political influence on design with a single goal: How do we define Modern Indian Design and its roots?

Kolam drawings, a traditional art practiced in South India, has recently been the subject of inquiry for Indian design and new media scholars. In their paper "Kolam as Infographics," Lisa Susan Abraham and Biju K Chacko describe Kolam as an infographic in which the dots and lines used to make the drawings act as symbols holding cultural, social, religious, artistic, and mathematical connotations. The authors define infographics "as a type of picture that blends data with design, helping individuals and organizations concisely communicate messages to their audiences," and the audiences in their study are members of the Tamil community.[14] Basing their work on the Lankow, Ritchie, and Crooks methods for visual communication, the authors analyze the effectiveness of Kolam drawings as infographics on factors such as appeal, comprehension, and retention.

In "Untangling the Gridlock," Dimple Bahl seeks to bridge the gap in Indian design education by presenting a comprehensive compendium for the Indian textual and cultural graphic design heritage, including an Indian aesthetic language and design philosophy.[15] The focus of this study is to identify grids found in Jain

12 Charles Eames and Ray Eames, *The India Report* (Ahmedabad, Gujarat: National Institute of Design, 1958).

13 See, e.g., Singanapalli Balaram, "Design Pedagogy in India: A Perspective," *Design Issues* 21, no. 4 (Autumn 2005): 11–22, https://doi.org/10.1162/074793605774597442; H. Kumar Vyas, "Design History: An Alternative Approach," *Design Issues* 22 no. 4 (Autumn 2006): 27–34, http://www.jstor.org/stable/25224073; Ashoke Chatterjee, "Design in India: The Experience of Transition," *Design Issues* 21, no. 4 (Autumn 2005): 4–10, https://doi.org/10.1162/074793605774597514; and Lalit Kumar Das, "Culture as the Designer," *Design Issues* 21, no. 4 (Autumn 2005): 41–53. https://doi.org/10.1162/074793605774597523

14 Lisa Abraham and Biju Chacko, "Kolam As Infographics," SSRN (2017), http://dx.doi.org/10.2139/ssrn.3436320

15 Dimple Bahl, "Untangling the Gridlock," *International Journal of Liberal Arts and Social Science* 1, no. 3 (November 2013): 13–24, https://www.ijlass.org/data/frontImages/gallery/Vol._1_No._3/2.pdf.

scriptures, the Mandala (a geometric configuration of symbols used as a tool for meditation, inspired by the architectural grids used to design Hindu temples), the Janampatri (a document that captures the positions and movements of planets), the Swastika (an auspicious symbol drawn for good luck), and the 5:4 ratio (first witnessed in the town planning in the Harappan cities in the third millennium BCE). Each of these works is very valuable and the first of its kind; however, they lack a methodology to apply the point lattice system used in Kolam drawings, as a compositional tool in graphic design.

Kolam Patterns in Academic Research: Computer Science

Kolam drawings have intrigued theoretical computer scientists researching picture languages that combine sets of units by following defined formal (language theory) rules. Marcia Ascher credits "the Madras group," including Gift Siromoney, Rani Siromoney, Kamala Krithivasan, and K. G. Subramanian, for introducing the use of Kolam drawing patterns to create new types of picture languages.[16]

Nagata and Robinson have extended the applicability of Kolam drawings as tangible pictures for people with a disability. Their paper, "Digitalization of Kolam Patterns and Tactile Kolam Tools" describes two tactile line drawing tools that make Kolam patterns accessible to the visually impaired.[17] One of the two tools was developed as a universal designed cube, with one of six primitive patterns on each of the six sides.

In the research paper, "Fundamental Study on Design System of Kolam Pattern," Kiwamu Yanagisawa and Shojiro Nagata discuss the characteristics of the pattern formation system found in Kolam drawings by converting the patterns into numbers and linear diagrams.[18] The authors wrote a program in the Perl language that automatically generates a Kolam pattern corresponding to each number. The study presents the total number of patterns that can be made on an array of points; it shows that large patterns can be formed by repeating simple patterns and that the patterns can be isomorphic and symmetrical, as well as unique.

The square loop Kolam pattern is defined by Timothy M. Waring in his paper, "Sequential Encoding of Tamil Kolam Patterns," as an orthogonal matrix of dots, around which curved lines are drawn to complete one or many loops.[19] Women in Tamil Nadu call this type of Kolam drawing *pulli* (dot), *kambi* (line), *sikku* (knot), and *nelevu* (curving) kolam. Previous studies from the 1970s and 1980s, by scholars such as Rani Siromoney and K. G. Subramanian, have created sequential languages that represent patterns, based on the gestures made by the artist's hand while making the pattern,

16 Marcia Ascher, "The Kolam Tradition: A Tradition of Figure-Drawing in Southern India Expresses Mathematical Ideas and Has Attracted the Attention of Computer Science," *American Scientist* 90, no. 1 (January-February 2002): 56–63, http://www.jstor.org/stable/27857597.

17 Shojiro Nagata and Robinson Thamburaj, "Digitalization of Kolam Patterns and Tactile Kolam Tools," *Series in Machine Perception and Artificial Intelligence* 66 (2006): 354–63, https://doi.org/10.1142/9789812773036_0024

18 Kiwamu Yanagisawa and Shojiro Nagata, "Fundamental Study on Design System of Kolam Pattern," *Bulletin of the Society for Science on Form* 21 (January 2007): 133–34, https://www.semanticscholar.org/paper/Fundamental-Study-on-Design-System-of-Kolam-Pattern-Yanagisawa-Nagata/65b2149dd9e1b8c98edcac692d2afe75369c795a

19 Timothy Waring, "Sequential Encoding of Tamil Kolam Patterns," *Forma* 27 (2013): 83–92, https://www.researchgate.net/publication/234116828_Sequential_Encoding_of_Tamil_Kolam_Patterns.

including cycle grammar and context-free array grammar.[20] Timothy M. Waring introduces an extension to the square loop Kolam (SLK) patterns in an attempt to create a diverse Kolam gestural lexicon to which more stylistic and fundamental gestures may be added, such as a diagonal gesture not accounted for in previous studies. He also has developed a software program, called NetLogo, for the digitization of SLK patterns using this expandable language. NetLogo uses an interactive graphical interface that allows users to draw the Kolam by clicking on automatically generated gesture-markers.

Computer scientists have researched the algorithmic ideas embedded in Kolam drawings, including symmetry, repetition, and continuous curves; however, they use these characteristics to create picture and array languages, with the goals of expanding on existing picture language theory and producing new languages. Previous studies have focused on the number of possible Kolam drawings that can be systematically made on a specific number of points, in any spatial configuration. This article also focuses on algorithmic ideas embedded in Kolam drawings, including multiplication, progression, symmetry, and repetition, but it does so with the goal of studying these factors as prominent compositional characteristics present in a set of drawings made on a point lattice.

Ethnographic Research Method: Primary Data Collection

The study uses ethnographic research methods, such as participant observation, semi-structured interviews, and archival resources, carried out through fieldwork in Mahabalipuram, Tamil Nadu and in New Delhi, in India. I collected hundreds of Kolam drawings through primary resources, such as the Kolam artists' personal drawing diaries, as well as Kolam drawings made on roads in local neighborhoods of Tamil Nadu and Delhi and drawing books on Kolam patterns found in local markets. Kolam drawings are more than just a collection of geometric patterns. The socio-cultural context in which Dravidian women draw Kolam drawings was studied to understand the significance of the drawing process itself, including the symbolism associated with the repeating shapes, such as points and lines, used in Kolam patterns.

Formal Analysis Method

To identify the point lattice's function in guiding the Kolam forms and patterns, I conducted a formal analysis of the compositional properties of the Kolam drawings collected through my primary research. I followed this analysis with a second formal investigation into the application of the point lattice system in structuring form and pattern used in contemporary graphic design. Together, these

20 Cycle grammar work includes Gift Siromoney, "South Indian Kolam Patterns," Kalakshetra Quarterly 1, no. 1 (1978): 9–14, https://www.cmi.ac.in/gift/Kolam/kola_pattern.htm; Rani Siromoney and K. Subramanian, "Space-filling Curves and Infinite Graphs" in *Graph-Grammars and Their Application to Computer Science*, ed. Hartmut Ehrig et al., (Berlin: Springer Verlag, 1983), 380–91; and Gift Siromoney and Rani Siromoney, "Rosenfeld's Cycle Grammars and Kolam" in *Graph-Grammars and Their Application to Computer Science*, ed. Hartmut Ehrig, Manfred Nagl, Grzegorz Rozenberg (Berlin: Springer Verlag, 1987), 564–79. Context-free array work includes Gift Siromoney et al., "Array Grammars and Kolam," *Computer Graphics and Image Processing* 3, no. 1 (1974): 63–82, https://doi.org/10.1016/ 0146-664x(74) 90011-2; Rani Siromoney, "Advances in Array Languages" in *Graph-Grammars and Their Application to Computer Science*, ed. Hartmut Ehrig, Manfred Nagl, Grzegorz Rozenberg (Berlin: Springer Verlag, 1986) 549–63; and K. Subramanian and Rani Siromoney, "On Array Grammars and Languages," *Cybernetics and Systems* 18, no. 1 (1987): 77–98.

analyses revealed a highly efficient framework for graphic design that can guide customized geometric and curved forms through an array of points.

The Point Lattice System in Pulli Kolam Drawings

This research emphasizes that a point lattice system is used as a tool to organize space and demonstrates the artist's intention to systematize, organize, multiply, and permutate. In the following sections, I present the purpose and construction of the point lattice used to make Kolam drawings.

Orientation

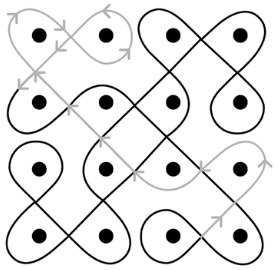
Kolam patterns are drawn deftly by women with the tips of their fingers; they hold pinches of rice powder between the thumb and the first finger and let the powder fall in a continuous line by moving the hand in the desired directions. Learning the skill over many years, an artist bends over and twists, sometimes exceeding a 180-degree turn, to make smooth curves while carefully placing her feet between points and lines. The lattice creates a frame of reference for the artist, orienting her to the drawing she is making as she moves her body in various trajectories and speeds (see Figure 1).

Organization

The artists use the point lattice system to organize the drawing space into identical units and to strategize the placement and movement of lines around the points (see Figure 2). Kolam drawings are recursive in nature, often beginning with a point and enlarging into intricate patterns. The process of making a drawing is a rule-based activity. The rules are illustrated in the form of step-by-step instructions exchanged between a mentor and mentee that are passed from one generation of artists to the next. The artists memorize the starting point of a line and all consecutive turns and twists around the points to create a symmetrical pattern. The point lattice system helps break down the drawing into a recognizable graphic pattern or sequence that is easily retained in memory.

Form-Making

In the first type of Pulli Kolam, an artist draws a Kolam drawing by first laying down an arrangement of equally spaced points that are used to define the movement of a continuous line. The line circumnavigates each point to create a set of repeating shapes at the same scale, such as a square, rhombus, triangle, or circle. The lattice points act as center points for the shapes, created in orientations of 45-, 90-, 135-, and 180-degree angles that are connected at the edges. The drawing is made through a sequence of moves, where a shape



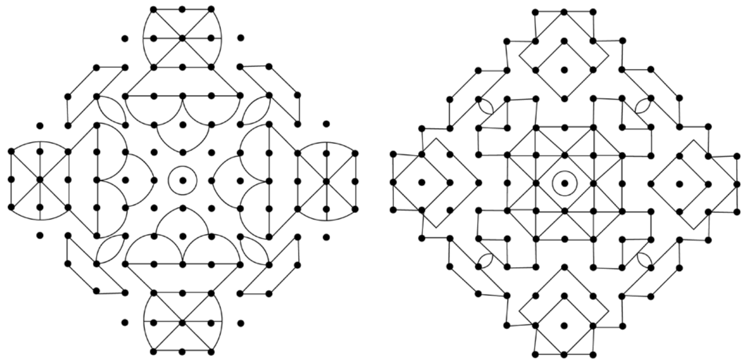


Figure 2
(Left) A Pulli Kolam drawing made on a 4x4 point lattice. (Right) Pulli Kolam variation: connect the points.

does not have to be fully drawn before making more shapes, but parts of shapes are completed at intervals as a single line is overlapped to complete a symmetrical pattern. As a few points are looped with a line and part of the drawing is complete, the line itself begins to work as a framework that guides the rest of the drawing. For a Kolam artist, a point represents a point of origin and end for all beginnings and dissolutions, a straight line signifies development and growth, a knot is an enclosure of protection, and linear patterns suggest sound vibrations or dimensions in space.

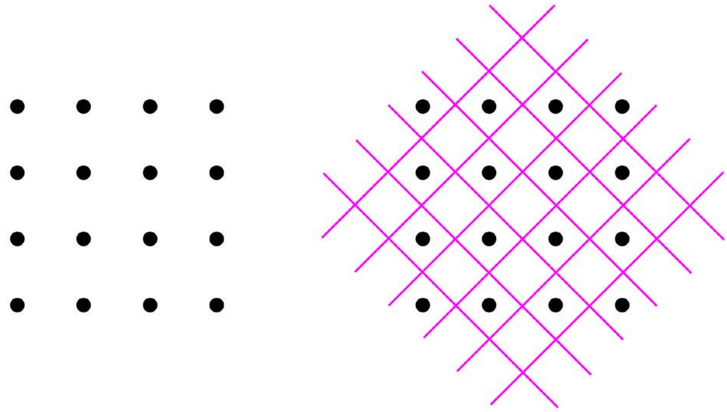
In connect-the-points types of Kolam drawings, artists connect the points with lines to create a drawing with identical symbols rotated in a radial arrangement, instead of drawing the lines looped around the points (with some exceptions). The artists draw symbols made with multiple types of geometric shapes. These perfectly symmetrical symbols represent flowers, birds, trees, and religious objects, such as vases, pots, conchs, lotus flowers, and drums.

Pattern-Making: Multiplicity

When the point lattice system is used to make Kolam drawings, the drawings exhibit properties of multiplicity and progression. A single point lattice can be used to make a variety of different Kolam drawing compositions. By increasing or decreasing the number of points in the lattice, the scale of the drawings can be changed. The Kolam drawings created on a point lattice exhibit the use of design principles, such as symmetry, movement, rhythm, and repetition.

To understand the compositional characteristics of these drawings, a modular grid constructed at an angle of 45 degrees and containing rhombic modules is superimposed on the point lattice (see Figure 3). The modular grid, constructed on the basis of the diagonal arrangement of lines, is seen in the hundreds of Kolam patterns analyzed for this study and applies to most Pulli Kolam drawings (with very few exceptions). The grid has an equal number

Figure 3
The modular grid constructed at an angle of 45 degrees is used to study the diagonal arrangement of lines in a Kolam drawing.



of diagonal columns and rows that function as a network of guidelines supporting the placement of lines in a Kolam drawing. The lattice points are centrally placed in every alternate grid module. The point of intersection for two grid lines typically lies in-between two points from the lattice.

Arrangement
As shown in previous figures, Kolam patterns can be divided into smaller units made of individual shapes, such as a square, rhombus, triangle, circle, semi-circle, knot, dome, or teardrop. Each Kolam pattern is a combination of different shapes or a permutation of the same shapes, where the placement and orientation of shapes change, thus altering the form and counter form of a drawing (see Figure 4). All Kolam drawings made on identical point lattices are about the same width and height. Some drawings make use of a radial arrangement of elements built around a point located at the center of the grid.

Sequence
If the shapes used to compose Kolam drawings were represented as letters, Figure 5 shows the Kolam patterns from Figure 4 in the form of letters, which allows us to see the sequence of repeating shapes present in each drawing.

Progression
The point lattice system expands or contracts to add or subtract an equal number of points in its columns and rows (see Figure 6). The proportion of the number of points in a column to row in a lattice is consistently 1:1, such that the drawings are made on a square framework of 3x3, 4x4, 5x5, and 6x6 points. The greater the number of points in the lattice, the bigger and more intricate is the drawing. Artists can use large lattices to create complicated labyrinth

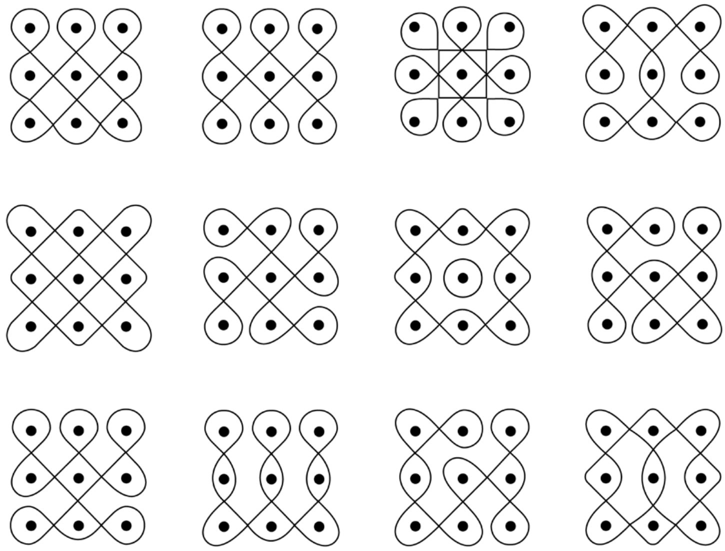


Figure 4
A variety of different Kolam drawings can be drawn on the same point lattice.

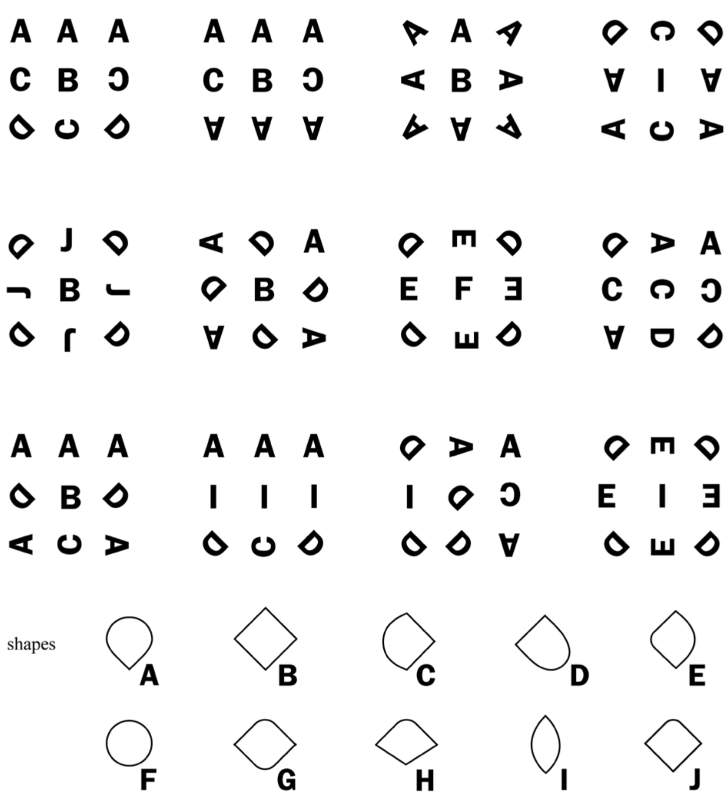


Figure 5
Sequence of shapes: the orientation of the letters signifies the orientation of the shapes.

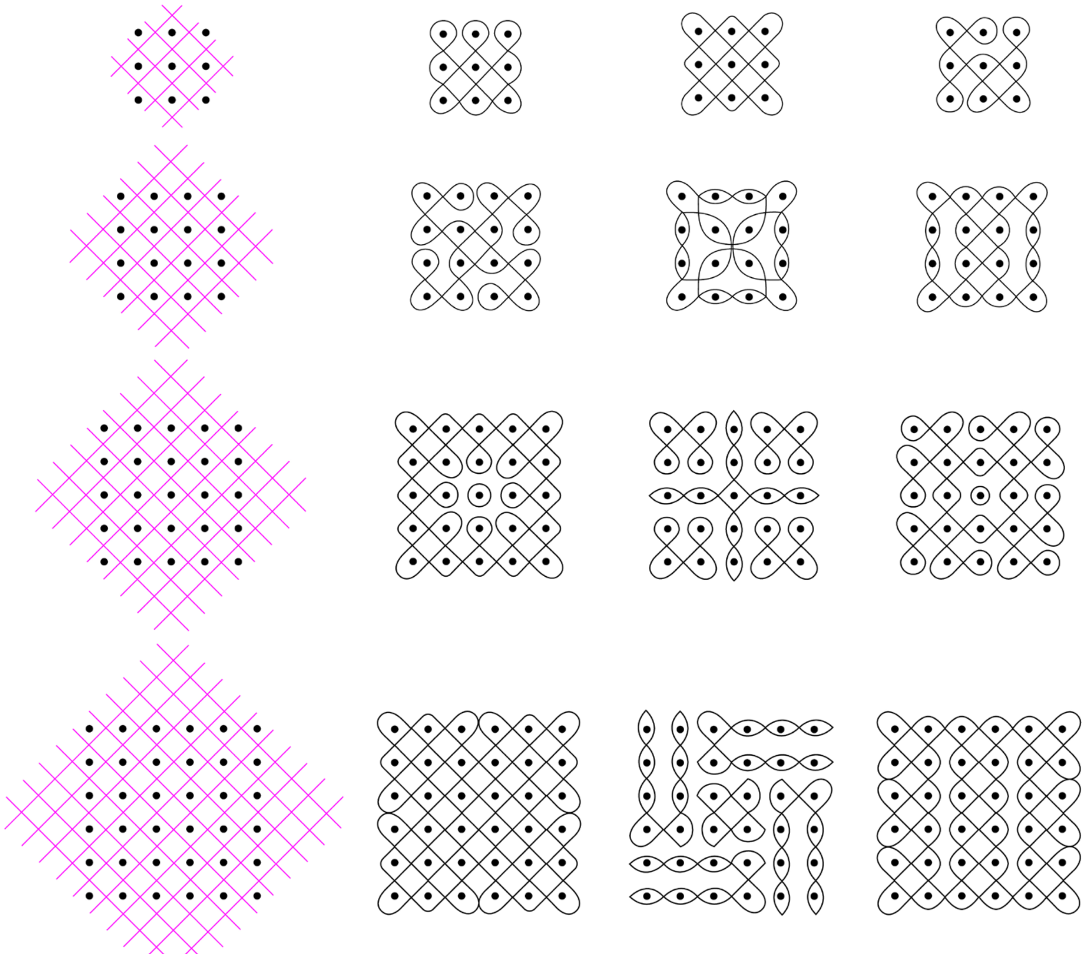


Figure 6
Kolam drawings made on a lattice of 3x3, 4x4, 5x5, and 6x6 points.

drawings, in which endless lines cross and recross around several points to form a labyrinth. Large drawings can be perfectly symmetrical, such that dividing them into four equal sections produces mirror images.

The Kolam Point Lattice System: Application in Graphic Design
The Kolam point lattice is used as a visual organization system consisting of a lattice of points that are connected or circumnavigated by lines to construct forms, patterns, letters, and layouts in graphic design. These design applications of the Kolam point lattice system are demonstrated here in four ways:

1. Form-making—a method to induce variety and flexibility;
2. Pattern-making—a system of permutations and combinations;
3. Letter construction—a framework of proportions; and
4. Layout—an arrangement of diverse units.

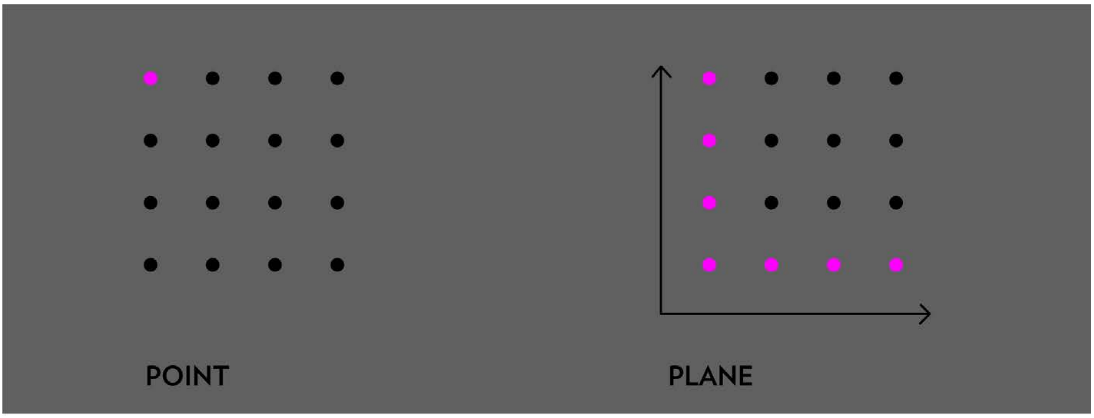


Figure 7
Basic units of the point lattice system.

In the following sections, I first discuss the basic units of the lattice system and then examine each of the above forms of applications that relate to graphic design.

Basic Units
The point lattice system can be studied as a set of points distributed over a two-dimensional plane.

- *Point*: A point indicates a position, has no length or breadth, and is the smallest unit in a point lattice. It multiplies at equally spaced intervals in x and y directions to form a lattice (see Figure 7).
- Plane: A plane is a flat, two-dimensional surface that extends infinitely far. The point lattice lies on an xy-plane used for the construction of two-dimensional forms that can sometimes also engender illusionary three-dimensional forms, as will later be displayed in figure 13.

Form-Making: A Method to Induce Variety and Flexibility
To construct forms on the point lattice, a designer should consider the following variables:

Space distribution with a module vs. a point. In his book *Grid Systems in Graphic Design*, Josef Müller-Brockmann writes about the relationship between grid and space: "The grid divides a two-dimensional plane into smaller fields or a three-dimensional space into smaller compartments. By means of this division into grid fields, the elements of design, viz. typography, photography, illustration, and color, can be disposed in a better way. These elements are adjusted to the size of the grid fields and fitted precisely into them."[21]

21 Brockmann, *Grid Systems in Graphic Design*, 11.

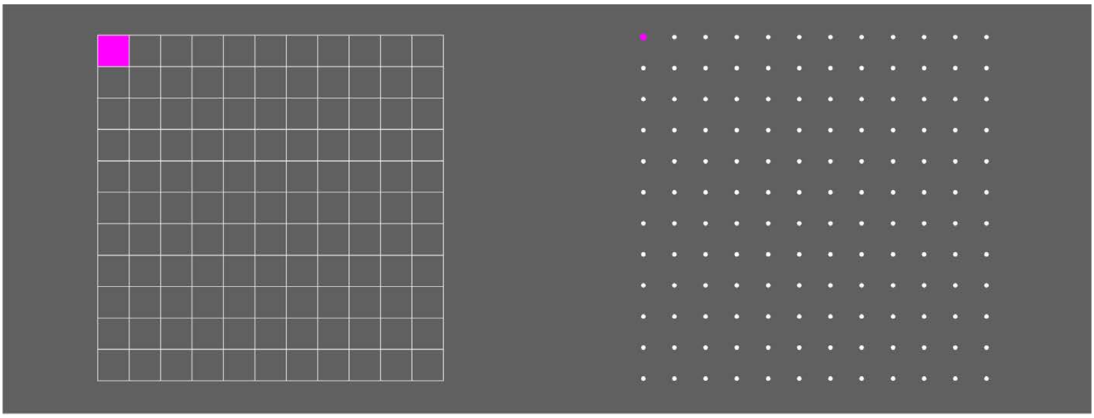


Figure 8
(Left) Square module of a grid. (Right) Basic unit of the point lattice system.

A designer is able to measure the modular grid space in increments of identical square modules (see Figure 8). These square modules are used to structure and place form to create a visual composition. The orthogonal arrangement of the modules limits the grid's potential as a useful framework to support organic, free-flowing, or complicated forms. Meanwhile, in a point lattice, space is distributed and measured in increments of points. A form is drawn on a lattice by connecting or circumnavigating a neutral framework of reference points surrounded by open or blank spaces. A designer can use the same lattice to simultaneously structure a variety of straight, curved, or complicated forms and to explore their permutations and combinations.

Inside-out approach. As a designer draws geometric or organic forms on a grid by using the square modules as guiding units, the designer's focus remains on the construction of the form's outline, based on the module's orthogonal structure. Once the form's outline is complete, the form can be edited based on the visual space enclosed within its boundary.

Through a point lattice system, a designer can apply an inside-out approach to construct forms. The designer can refer to any one lattice point as the center point for drawing a form. The points surrounding the center point act as anchor points in guiding the form's outline (see Figure 9). The designer continually apprehends the distance between the center point and the form's outline, thereby giving attention to the visual area enclosed within the form as it is being drawn. As points are connected or circumnavigated by a straight or curved line, the drawing line itself begins to work as a framework that guides the rest of the drawing, supporting optically improvised form-making.

Figure 9 (Right)
A center point and its surrounding anchor points in a lattice.

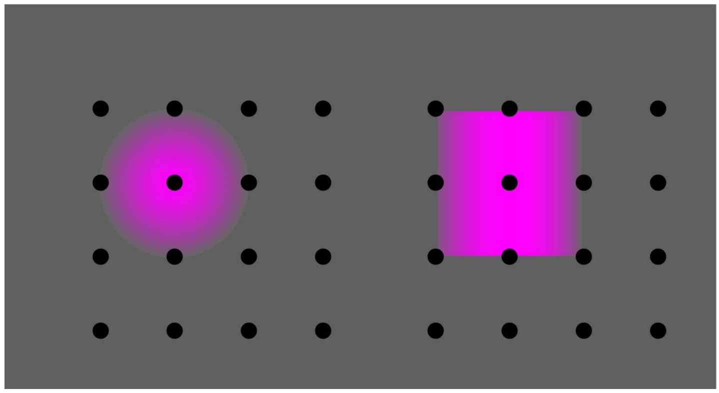
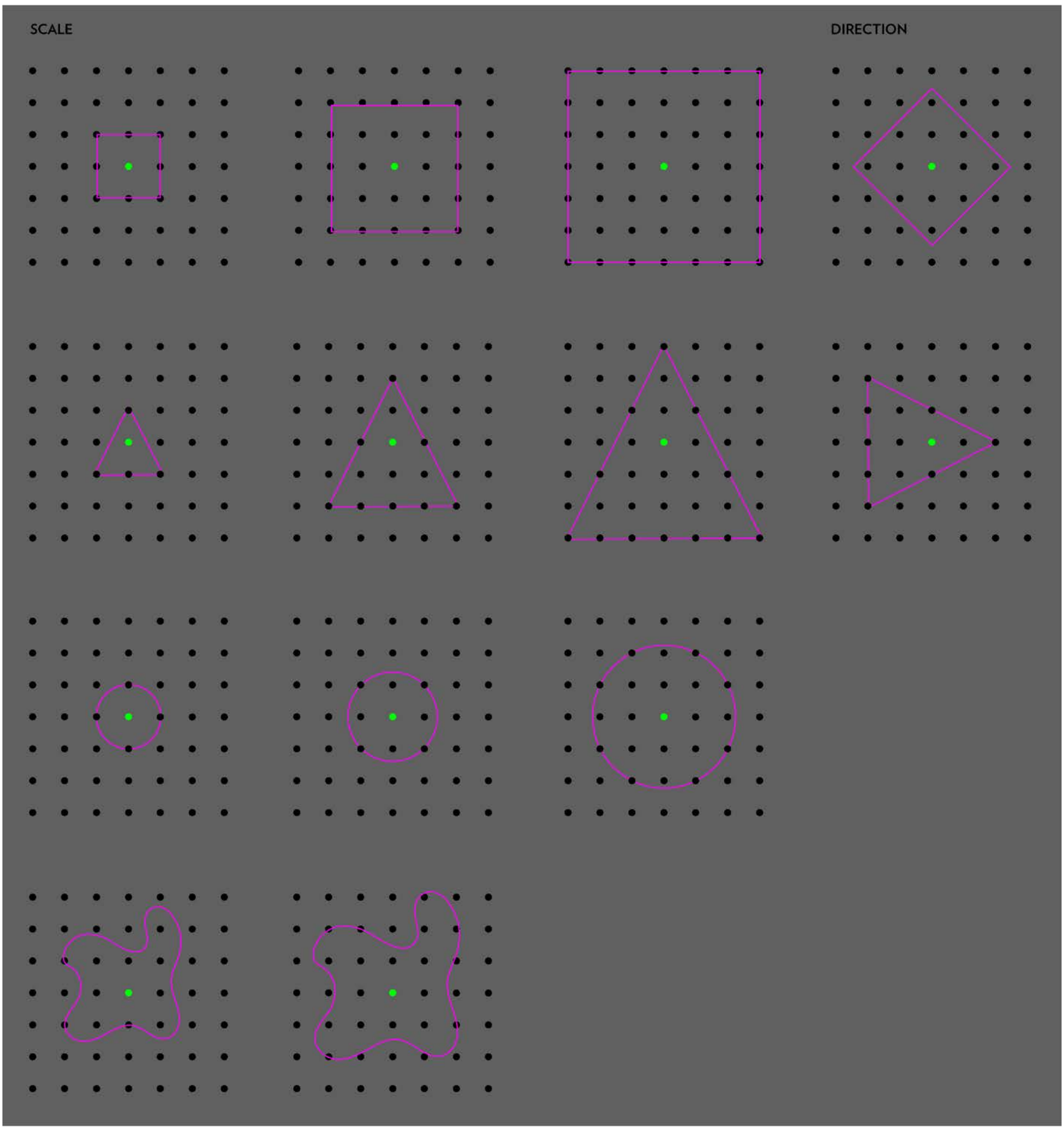


Figure 10 (Below)
The figure shows a square, triangle, circle, and organic form created with a center point on identical lattices. The forms can be resized and their orientation can be changed on the lattice.



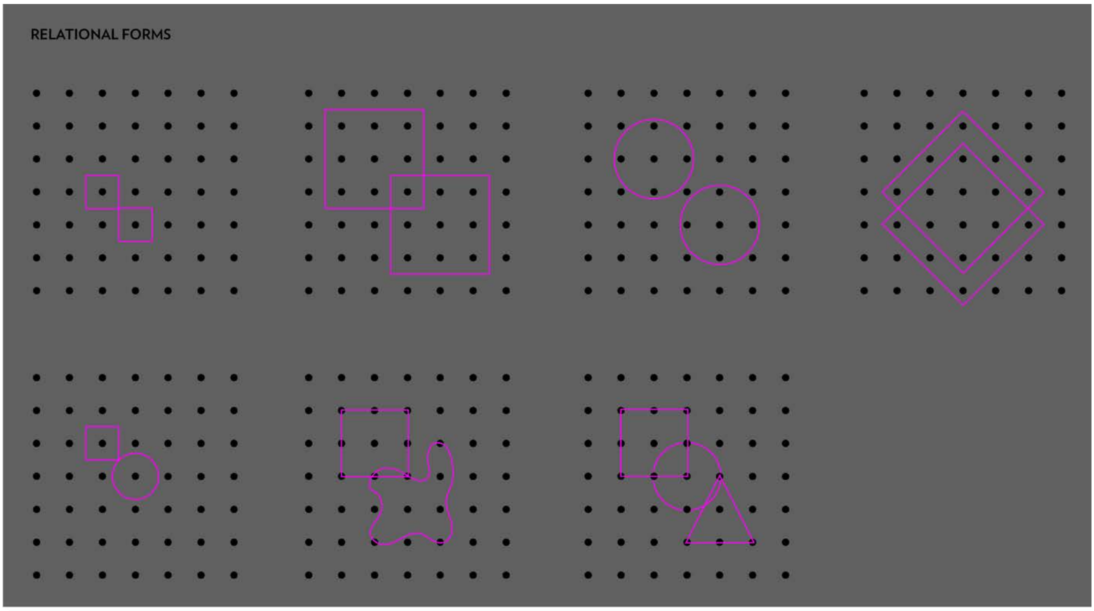


Figure 11
The interrelationship between forms is defined by their proximity to each other on the lattice.

Form and scale. Different types of straight, curved, or organic forms can be created on the point lattice by choosing any point as a center point. A form can be scaled up proportionally by connecting or circumnavigating a set of anchor points (see Figure 10).

Direction. The direction of a form is defined in relation to the observer and to the frame that contains it. The center point is fixed as the form rotates to change its direction on the lattice.

Relational forms. Similar or contrasting forms can be constructed, connected, and overlapped on the same lattice (see Figure 11). The interrelationship between the forms is defined by their proximity to each other on the lattice. Smaller forms can be overlapped or combined to make larger forms.

Complicated forms. Logos, symbols, and icons are drawn by combining different shapes into one unit. A designer structures logos and icons with the use of a construction grid that is specifically built to support proportions envisioned for the resulting form because the rigidity of an orthogonal grid is not ideal for this process. A construction grid is not a pure "grid" made with orthogonal lines; instead, it consists of a set of modified straight and curved shapes that are arranged to serve as the "skeleton" for the logo or icon. Complicated forms can be easily constructed in the free-flowing space of a point lattice because of its wide array of reference points that can be connected with lines to make multiple geometric shapes in varying sizes. The point lattice system can be used to design any complicated form (see Figure 12).

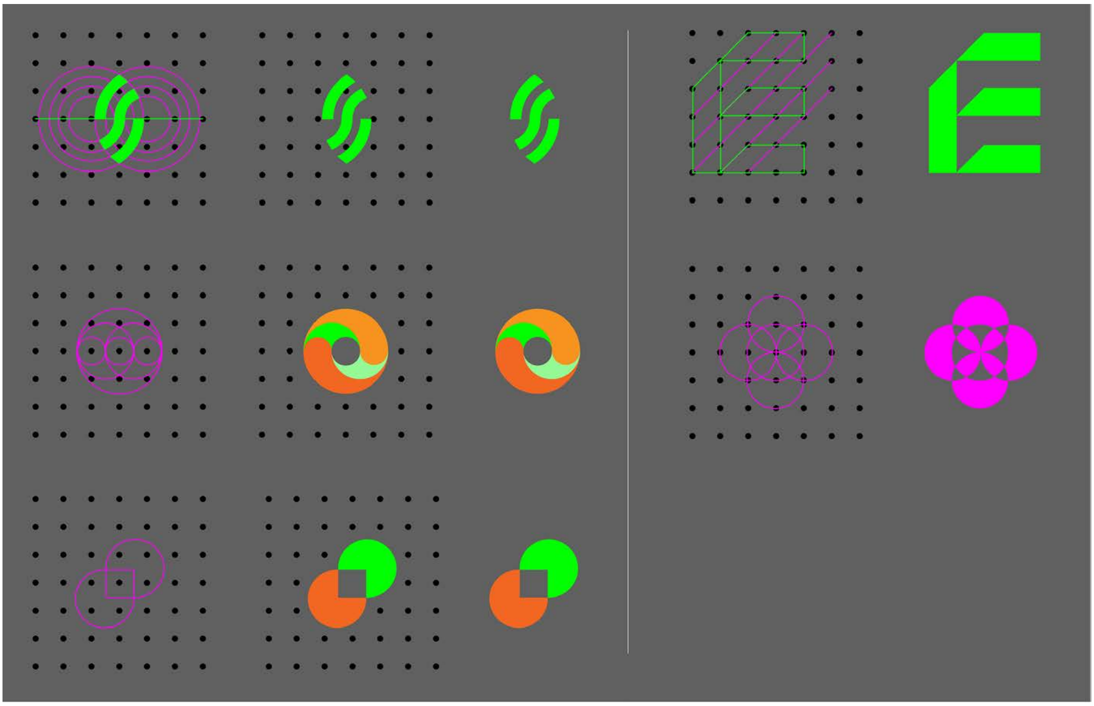


Figure 12
Construction of complicated forms on a point lattice. (Left) Lines circumnavigate the points. (Right) Lines connect the points.

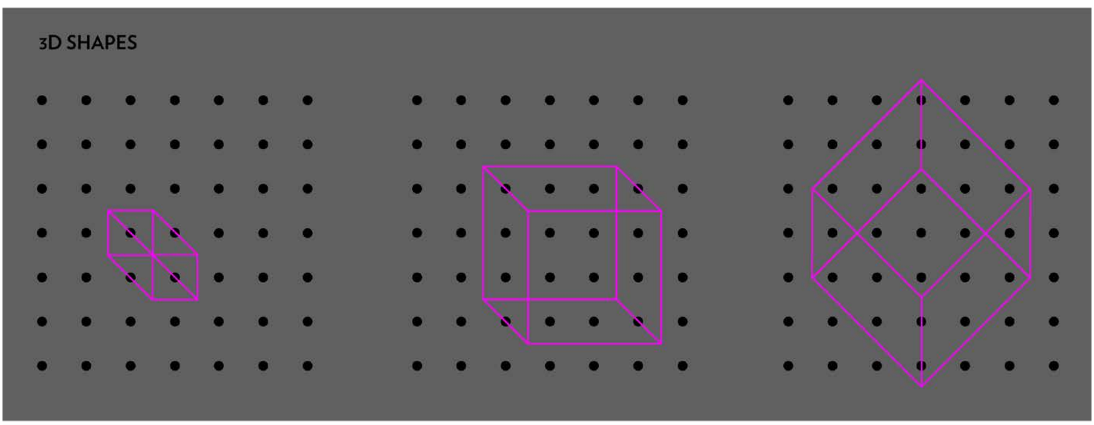


Figure 13
Three-dimensional forms on a two-dimensional point lattice.

Three dimensions. The point lattice exists in a two-dimensional plane. However, the lattice can be used to structure three-dimensional forms, where the sense of volume is illusory (see Figure 13).

Pattern-Making: A System of Permutations and Combinations
When two shapes are placed in adjacent positions on the lattice, the construction of one supports the construction of the other, and the two shapes can be created at once by moving a stroke around the

Figure 14 (Right)
Geometric pattern-making with a single stroke.

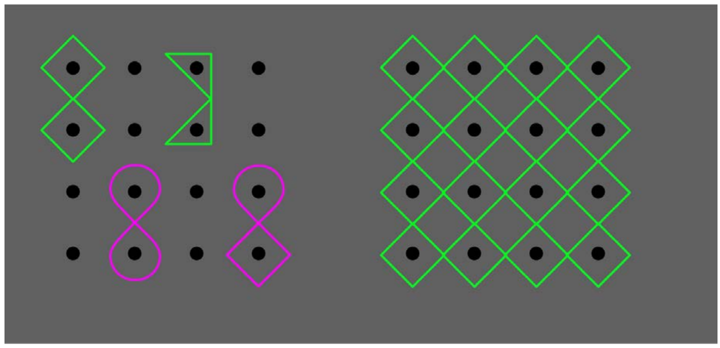
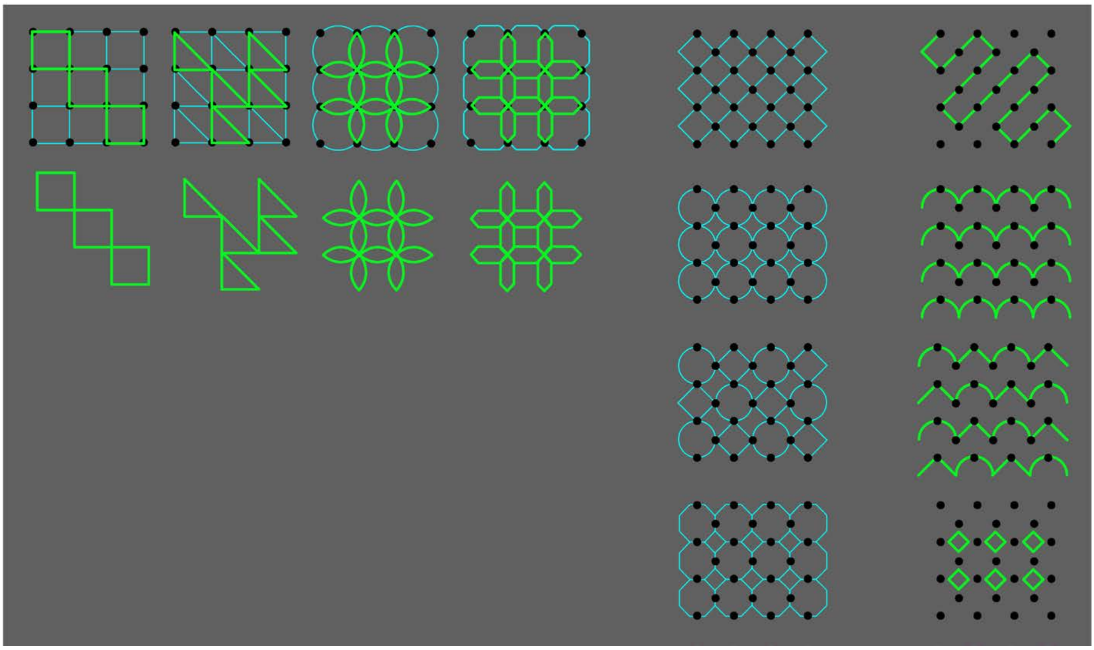


Figure 15 (Below)
Geometric pattern variations on a 4x4 point lattice.



points (see Figure 14). This method is used by the Kolam artists in making free-hand Kolam drawings, where several shapes are drawn at once around adjacent points with a single stroke of the line. The process allows for a rapid repetition of units in permutations and combinations to create patterns.

In addition, instead of roping in the points with lines, the points also can be connected by lines to create a network of geometric shapes, such as a square, triangle, or circle. The same point lattice can be used to create a variety of different patterns. A variation in the arrangement of points can create new kinds of patterns (see Figure 15). The point lattice supports patterns made with different shapes, which is especially helpful when a designer is creating a pattern with both straight and curved lines.

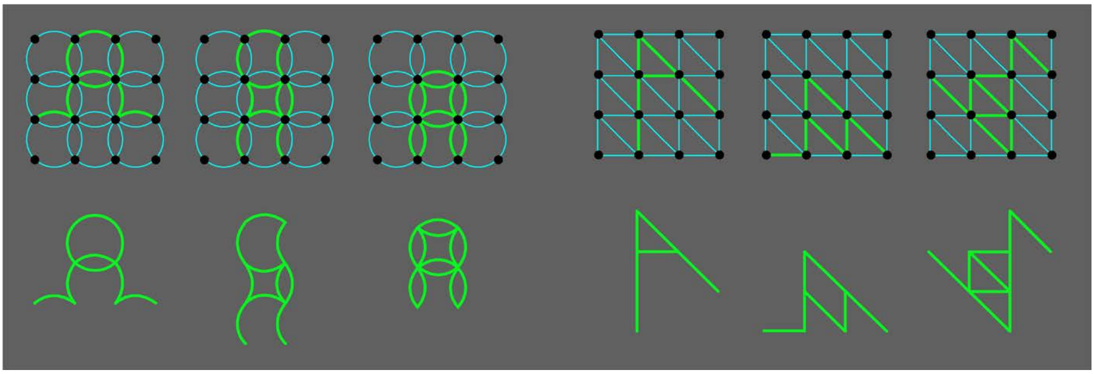


Figure 16
Variations of the letter "A" created on a 4x4 point lattice.

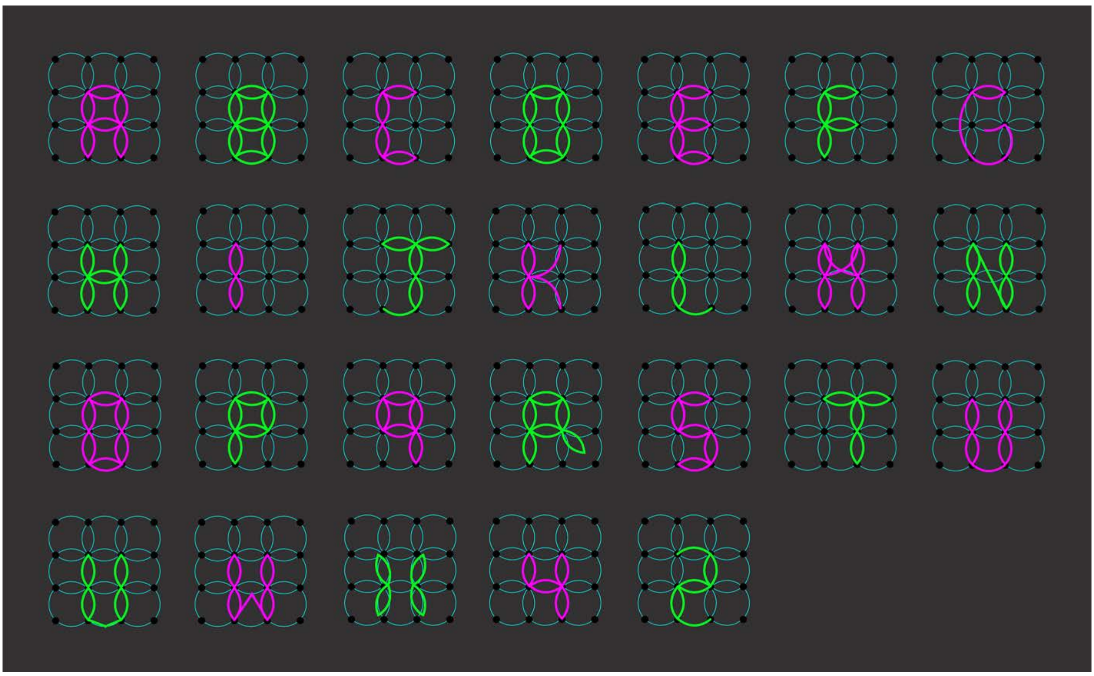
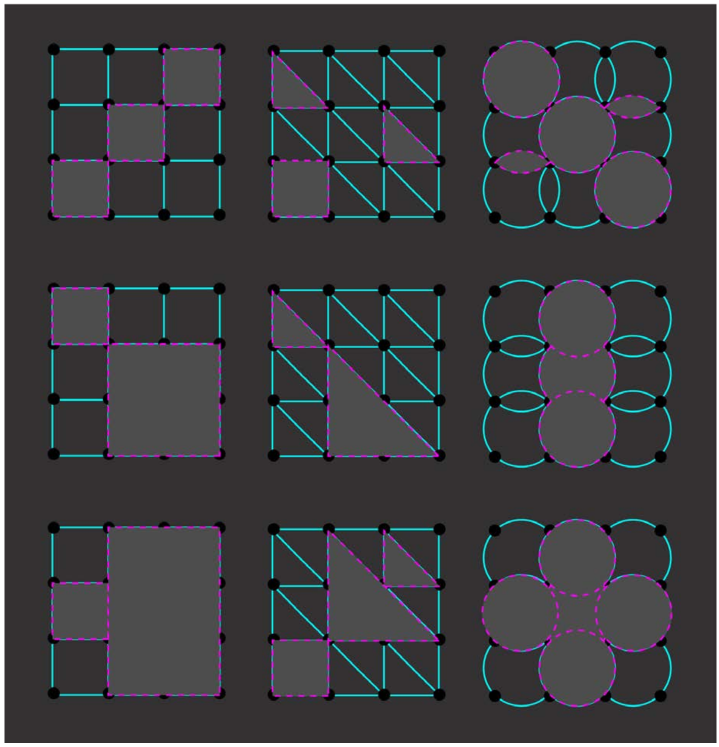


Figure 17
A system of letters A-Z created on a 4x4 point lattice.

Letter Construction: A Framework of Proportions
The patterns created on a point lattice can be used as a framework for a system of letters that retain the geometric proportions of the patterns (see Figures 16 and 17). The same lattice framework can support letters with varying geometric proportions. Two sets of letter systems containing similar proportions can be visually distinct.

Layout: An Arrangement of Diverse Units
A layout or visual composition consists of visual elements, such as image, typography, and illustration arranged in a visually pleasing manner to communicate a message to viewers. A layout can

Figure 18
Layout units on a 4x4 point lattice.



be subdivided into small units that act as a framework for arranging information. A point lattice supports the construction of layout units that can be identical or differently shaped, small or large, and symmetrical or asymmetrical and thus can bring diversity to the layout (see Figure 18). Designers can customize a set of units according to the design problem, which are then repeated to consistently arrange visual elements.

Conclusion

Over the past two centuries, graphic designers have continually experimented with many systems of proportions, culminating in the use of several types of grids. And yet, we see limited educational models for independent grid systems in graphic design that have existed or evolved outside the influence of automation, and that present us with alternative ways to organize space. As a design educator and graphic designer, I am challenged with sharing graphic design history, methodology, and tools with students that are not confined to the Western design heritage of the Industrial Revolution. In the West, historians credit designers, such as Josef Müller-Brockmann, Emil Ruder, and Karl Gerstner, with inventing and popularizing the grid as a means of structuring graphic compositions. But they are overlooking the fact that Dravidian women have been using a system of points and lines to structure their compositions for millennia.

The point lattice system can be used as a visual organization tool in contemporary graphic design and functions as a more efficient system for organic and complex form and pattern making than an orthogonal grid. It allows designers to use a wide array of reference points to make customized geometric forms in various scales on the same lattice, thereby allowing more control over the resulting proportions of a form.