

A VIEW OF INDIA THROUGH KOLAM PATTERNS AND THEIR GRAMMATICAL REPRESENTATION



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Kolam is a form of decorative design that is drawn on the front courtyard of a house in India. Drawing of kolam patterns is more prevalent in South India, especially in the rural parts. With big apartment complexes coming up in cities, the front yard concept is scaled down, but still small patterns are drawn in front of the front door of the apartments. In North India, the patterns are called Rangoli and they are drawn with color powders.

In South Indian villages, the women members of the house get up early in the morning and prepare the surface in the front courtyard by sprinkling water. Sometimes cow dung is also used to wax the floor. This is because cow dung is supposed to have antiseptic properties. Even when the floor is still not completely dry, decorative kolam patterns are drawn, so that they remain there for sometime.

The drawing on the courtyard is carried out by women who deftly design with pinches of rice flour held between their fingers. Figure 1. Nowadays chalk powder is also used. The use of rice flour is motivated by the idea to help ants to get their food easily. The rice powder is said to invite birds and other small creatures to eat it, thus showing how to have a harmonious co-existence. Throughout the day, the drawings get walked on, rained out, or blown around in the wind and new kolams are drawn the next morning. In some places, kolams are drawn twice a day, early in the morning and late in the afternoon.

Kolams are thought to bestow prosperity to homes. It is like a welcome board placed in front of the home. Goddess Lakshmi, the Goddess of prosperity is invited by this action. If kolam is not drawn in front of a house, it amounts to mean that the people in the house are observing grievance. If a death occurs in a family, kolam is not drawn for thirteen to sixteen days depending on the clan to which the family belongs. On the death anniversary of elders also, kolam is not drawn in front of the house. In contrast when a child is born into a family (the birth may be in another town/village), irrespective of the time of the day, the front yard of the house is decorated immediately with kolam. It is to welcome



Figure 1: Kolam Drawing

the new entrant in the family. On happy occasions and festivals, the patterns are large and elaborate.

In wedding halls, kolams are drawn one day prior to the wedding or function using rice flour paste. For this rice is soaked in water for more than an hour and ground nicely. It is made into a watery paste. A small piece of cloth is soaked in it and held between the ring finger and the middle finger and as the hand moves, the thumb presses the cloth so that white liquid flows uniformly and patterns are drawn. After letting it dry for a while, the design looks beautiful and stays for a long time. On the borders and at the central places of the pattern, red powder (kavi) paste is used to make the design more attractive. Kolams are drawn in the pooja room of a house which is place of worship. In temples also large kolams are drawn. Some volunteers do it as it is considered as a kind of service. Nowadays white paints are used in temples so that the patterns stay for a longer time in spite of people walking over it. It is also believed that the lines must be completed (closed curves) symbolically meaning that it prevents evil spirits from entering the shape and hence entering the inside of the home.

It used to be a matter of pride to be able to draw large complicated patterns without lifting the hand off the floor, standing up in between, something like Eulerian circuits. On occasions like Navarathri- meaning nine nights (in South India)(in the north it is called Dasara - meaning ten days)- large patterns are drawn. It starts on the new moon day falling between 16th September to 15th October. In South India at the same time dolls (called Golu) are kept in a decorative way inside the house. It is quite common to have competitions. A group of people visit the houses in a particular area and award prizes to the best Golu and the best kolam patterns.

In the month of Marghazhi (Dec 15th to Jan 15th), people get up very early. Different large designs are drawn everyday. In villages, in some places of the pattern a particular type of flower is kept with a small mud base. It is the flower of the pumpkin plant. Mostly young girls get enthused and learn new designs and show their caliber. In olden days men folk join together in that month early in the morning and go around the streets singing the praise of God. In quite early times, young girls used to get up early, join together go to the river and take bath and while returning singing songs in praise of God. It was thought that such practice would get them good husbands and also it was supposed to be good for the country.

Decoration is not the sole purpose of a kolam. It involves good physical and mental exercises. Bending and drawing the kolam gives strength to the muscles. Drawing properly a pattern needs focus and a good deal of concentration.

Kolam is an interesting tool to stimulate the mind of a person. It develops the memory and concentration powers of a kid when she tries to learn this. It can be practiced on a piece of paper with a pencil or on the floor or board with a chalk.

There is a lot of room for creativity. New designs can be drawn. In many magazines in India, there will be a separate section for women and in that section apart from giving new recipes etc., new kolam patterns drawn by readers are published.

There are different types of patterns in kolam. Usually they are drawn in two ways. One is to use dots and draw curved lines around them. The other one is to draw the dots and join them in a proper manner. Figures 2 and 3 illustrate the two methods.

Some kolams are single patterns (hanging lamp). Figure 4. One method of covering a large area of floor space is to combine some of the smaller design to make a bigger one. Figure 2 shows how four of the first one is combined to form the second one and four of the second combined to form the third one and so on. Here the lines are straight. Making them curved we get a pattern like Figure 5. They may be looked at as patterns having exponential growth.

Figure 6 is another example of how similar designs can be drawn. How big patterns are got from smaller ones can be seen in Figure 7. The other type is by drawing dots and joining them. One such kolam Vilvatham is given in Figure 3. Another design is Kooja (Figure 8). They may be looked at as kolam having polynomial growth. Some kolams are circular in nature. One example is the kolam Hridhya Kamalam. (Figure 9.) It is sometimes interesting to find

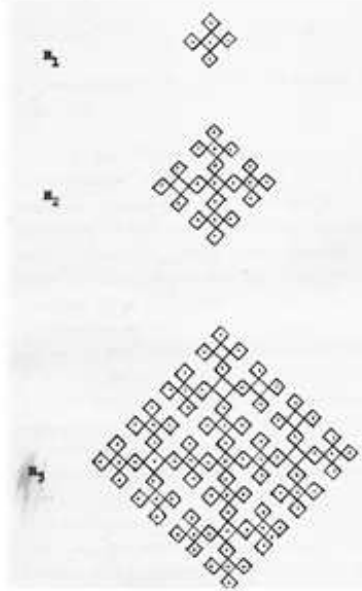


Figure 2: Anklets of Krishna

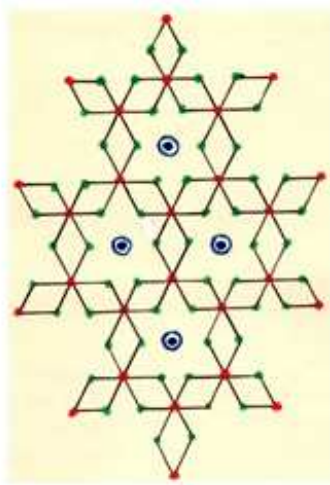


Figure 3: Vilvathalam

out how many lines (closed curves) make up the pattern. Some of the kolams are drawn by a single closed curve (Eulerian circuit). Examples are Krishna Salangai and Hridhya Kamalam.

There are certain beliefs associated with kolam patterns. It is also believed

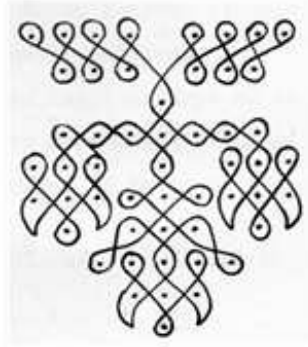


Figure 4: Hanging Lamp

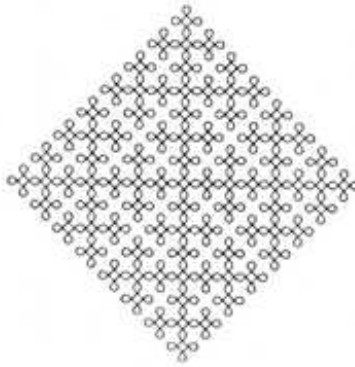


Figure 5: Anklets of Krishna with curved lines

that certain patterns have some effect on the health and wealth of a family. There is a poem called 'Soundharyalahari' consisting of hundred verses. They are in praise of Goddess Adhi Parasakthi and were written by a saint Adhi

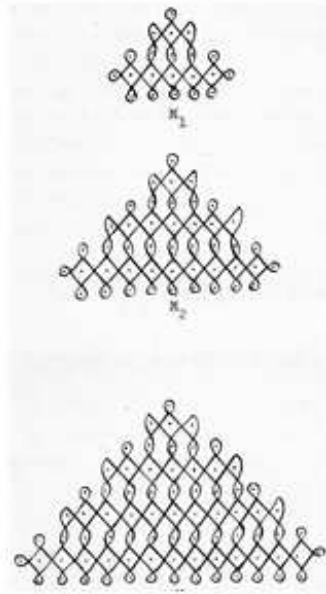


Figure 6: Mountain

Sankara during the tenth century. Each song is believed to have some particular power for ailing or bringing wealth etc. For each verse, there is a particular design and it is believed that if one recites the verse for a specified number of times for a specified number of days after drawing the pattern and placing the idol of Goddess on it and offering a specified dish prepared to the Goddess at the time of finishing, he/she will be relieved of the ailment or get what they wanted. There is also a design called Meru or Srichakra which is kept in temples and in the place of worship in homes. The design is given in Figure 10. This design is said to have some divine power. There are nine levels of closed contours in that and two poets cum composers, Sri Muthuswami Dikeshdar and Sri Uthukadu Venkatasubbayyar, have sung nine songs describing the powers of each level. These songs are sung during the nine day celebration in September/October.

Not only Hindus (main religion in India) but also people from other religions draw kolam patterns. Figure 11 gives a pattern which is drawn on Christmas day.

There have been some attempts to generate kolam patterns using formal grammars [1, 2, 3, 4]. This idea can be used to generate the kolam patterns using computers. Formal language theory was started by the need for a formal grammar for natural languages and programming languages. The grammar usually generates a language consisting of strings of symbols from an alphabet. But later array grammars to generate rectangular arrays of symbols were defined. There are two ways to generate kolam patterns using array grammars. In one

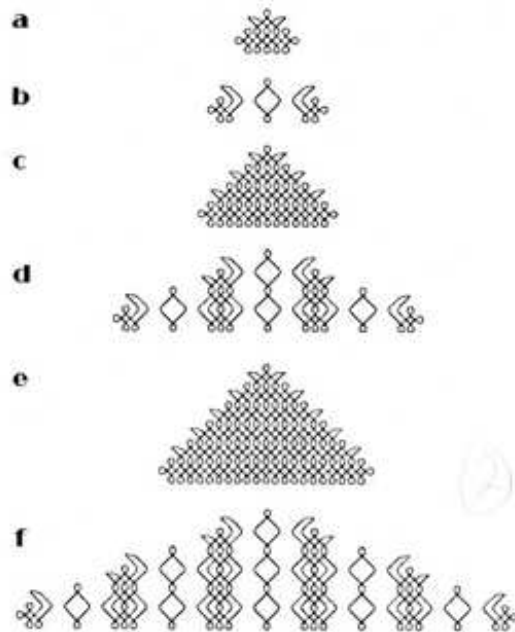


Figure 7: Curves making up the mountain kolam.

method, basic patterns are treated as symbols and an array grammar generates rectangular array made up of these symbols and the arrangement is made properly to connect the basic patterns in a proper manner. Another method is to generate labelled dots and give simple instructions to join them [1]. For example, to generate kolam vilvathalam, an array of green, red and blue dots is generated using array grammar (Figure-3). Simple instructions are given as follows. Join a red dot to the nearest green dots (The six nearest green neighbors for the interior red dot and two nearest green neighbors for the exterior red dots.) Draw small circles around blue dots. This kolam with green blue and red dots and lines joining them is given in figure-3. Patterns which are basically circular in nature like Hridhaya Kamalam are generated in [2].

Another way of generating Kolam patterns by a computer is to generate strings using L-systems and interpret the symbols in the system as move of a cursor. This approach is followed in[3, 4]. L-system is a formal model where parallel rewriting of symbols is considered and the start point is an axiom. The reader is referred to [7] for basic details on grammars and L-systems.

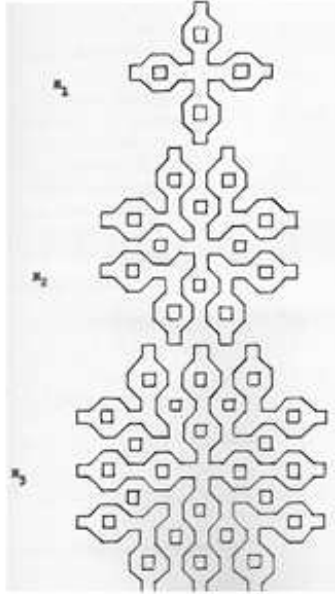


Figure 8: Kooja

L systems are used for a number of applications in computer imagery. It is used in the generation of fractals, plants and for object modeling in 3 dimensions. Applications of L systems can be extended to reproduce traditional art and to compose music. We describe below how L-systems are used to generate kolam patterns.

Here the description of the pattern is captured as a string of symbols. An L system is used to generate this string. This string of symbols is then viewed as commands controlling a LOGO-like turtle. The basic commands used are move forward, make right turn, make left turn etc. Line segments are drawn in various directions specified by the symbols to generate the straight line pattern. Since most of the patterns have smooth curves, the positions after each move of the turtle are taken as control points for B-spline interpolation. We see that this approach is simple and concise. First we see an example of a fractal and then a kolam pattern.

Many fractals can be thought of as a sequence of primitive elements. These primitive elements are line segments. Fractals can be coded into strings. Strings that contain necessary information about a geometric figure can be generated by L-systems. The graphical interpretation of this string can be described based on the motion of a LOGO-like turtle.

A state of the turtle is defined as a triplet (x, y, A) where the Cartesian coordinates (x, y) represent the position of the turtle and angle A , called the turtle's heading, is interpreted as the direction in which the turtle is facing.



Figure 9: Hridhya Kamalam

Given the step size d and the angle δ , the turtle can move with respect to the following symbols.

f : Move forward a step length d . The state of the turtle changes to (x', y', A) , where $x' = x + d * \cos(A)$ and $y' = y + d * \sin(A)$. A line is drawn

between the points (x, y) and (x', y') .

F : Move forward as above but without drawing the line.

$+$: Turn the turtle left by an angle δ . The next state of the turtle will be $(x, y, A + \delta)$. Positive orientation of the angle is taken as anticlockwise.

$-$: Turn the turtle as above but in clockwise direction.

Let S be a string and (x_0, y_0, A_0) be the initial state of the turtle, and step size d , angle increment δ are the fixed parameters. The pattern drawn by the turtle corresponding to the string S is called the turtle interpretation of the string S .

Consider the following L system.

Axiom : $w : f + f + f + f$

production : $f \rightarrow f + f - f - ff + f + f - f$

The above L system is for quadratic 'Koch island' (Figure-12). Here we see how successive patterns are drawn using this L-system. The images correspond to the string generated for different derivation steps n is shown in the following figures. The angle increment δ is 90° . The step size d could be any positive

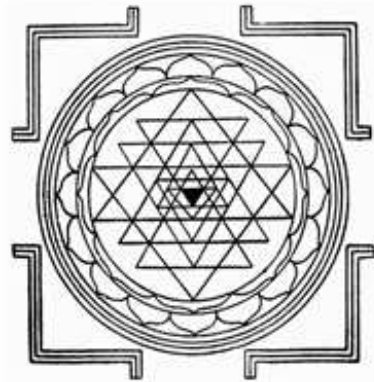


Figure 10: Srichakra

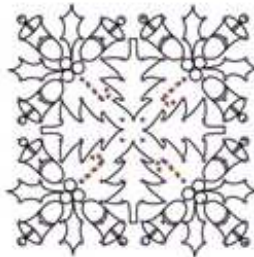


Figure 11: Christmas Kolam

number. The size of the 'Koch island' depends on the step size and the number of derivation steps.

Koch constructions are a specific case of L systems. The initiator corresponds to the axiom in L system. The generator is represented by the single production. Consecutive positions of the turtle can be considered as control points specifying a smooth interpolating curve. B spline interpolation is used for most of the kolam patterns.

Kolam patterns are drawn in a similar way using L-systems. An axiom and rules are given. They are used to generate strings and the symbols in the string are interpreted as moves of a cursor and the kolam is drawn. We give below the L-system for the kolam candies (Mittai Pottalam). The pattern is given in

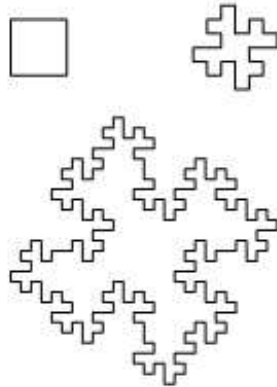


Figure 12: Fractals generated by L system

figure-13. Axiom : (- D - - D)

Productions :

A → f + +ffff - - f - - ffff + +f + +ffff -

- f B → f - - ffff + +f + +ffff - - f - -

ffff + +f C → BfA - - BfA

D → CfC - - CfC

E → EfE - - EfE

Angle increment = 45 degrees

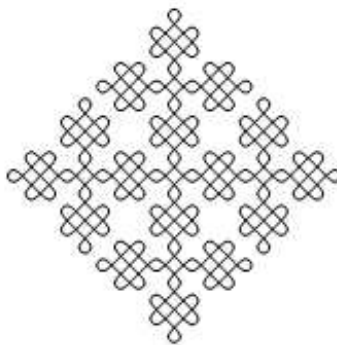


Figure 13: Kolam patterns generated by L system

Kolams are part and parcel of Indian culture. They are not only decorative designs but give good exercise to the brain also. Indians are proud of this tradition and hope this will be appreciated by people from other countries also.

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