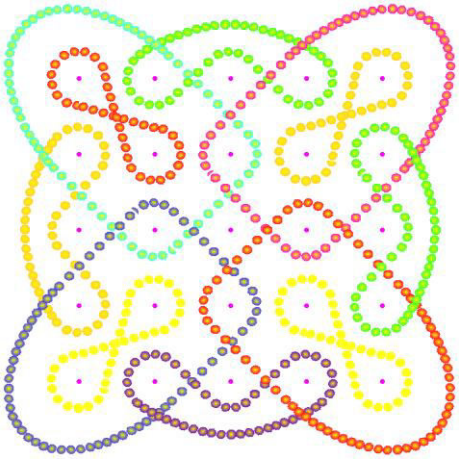
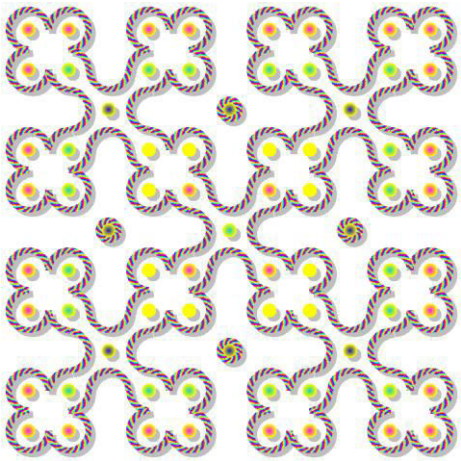


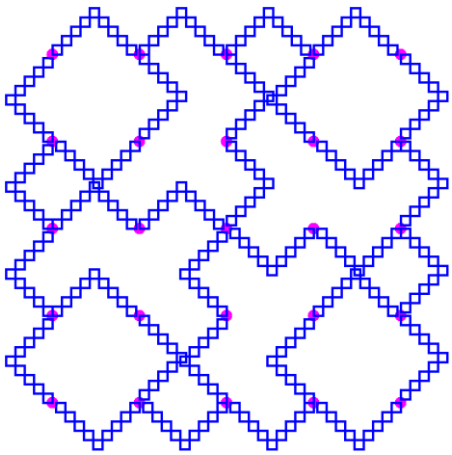


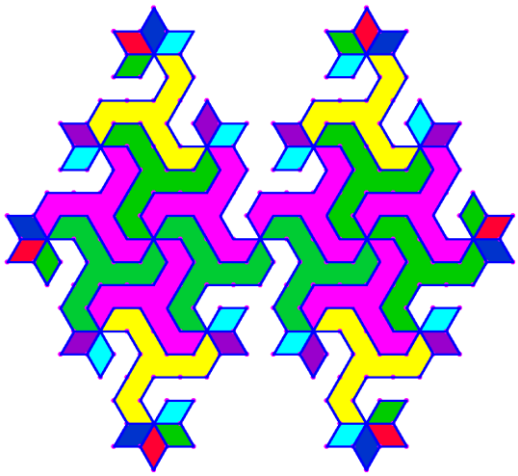
Kolam - A New View

Part 2

Dr. V. Krishnamoorthy

Mrs. Leela Venkatraman





Edition 1.0
support@learnfunsystems.com

Contents

18. Some kolams

Many objects like birds, animals, flowers, musical instruments are drawn as kolams. Special kolams are drawn for festival days like pongal, deepavali and Christmas. In these the articles used on these days are drawn. There was a neighbor whom we called singh maami. She used to draw big beautiful kolams without dots. These showed her fertile imagination and patience. A few of her kolams are given here. In Madurai Mr. Thiagarajan worked as a draughtsman. He had drawn kolams with black ink in white paper in hundreds. Some of them have a new perspective. We can see his patience in his work. We have some of his kolams. In order to appreciate his work we have included some of his works here.

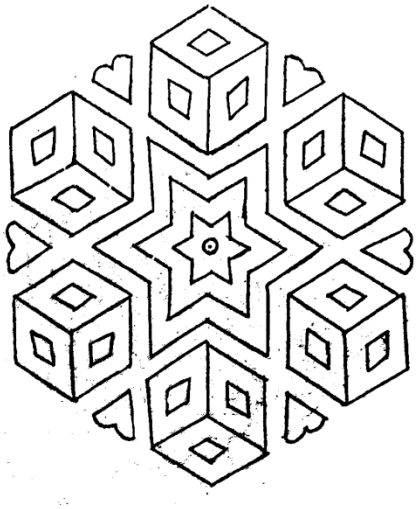
In Dhandiyalangaram of approximately tenth century AD, there are methods to create poems which are written within the images of snakes, maththalam(drum), circles and rays and border kolams. One can see these as basis for kolams.

Kolam over water, kolam under water and kolam in the middle of water are some new changes that has happened in recent years. All these are rangolis. Only in rangoli you use colors. We will see the ways of creating them in this chapter.

In her book 'Feeding a thousand souls', Dr. Vijaya talks about Ms. Chandralekha (1928 - 2006), a choreographer and dancer from Chennai. She had a passion for kolams. She has incorporated kolams in many of his compositions. It is mentioned that each dancer becomes a dot or a line in a 3 dimensional kolam.

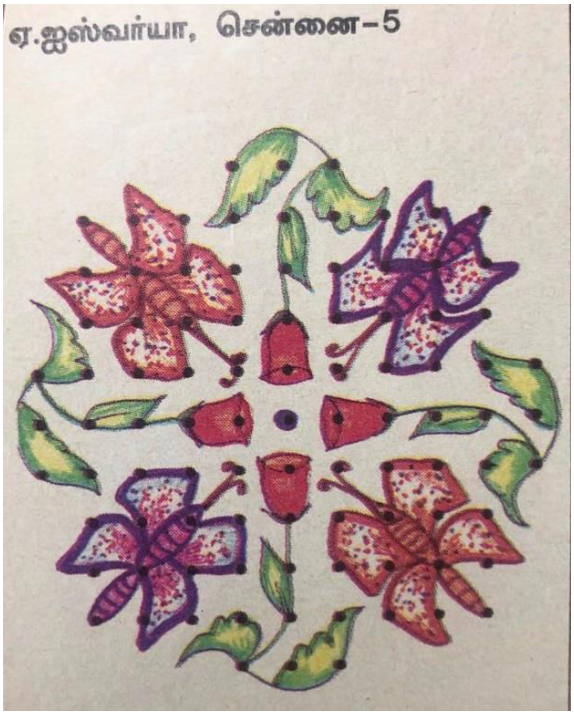
Synchronizing the drawing of a kolam with the singing of a karnatic song also has been accomplished. We will see details of this in this chapter.

A kolam with 3D look



Bharathiyar

Birds etc.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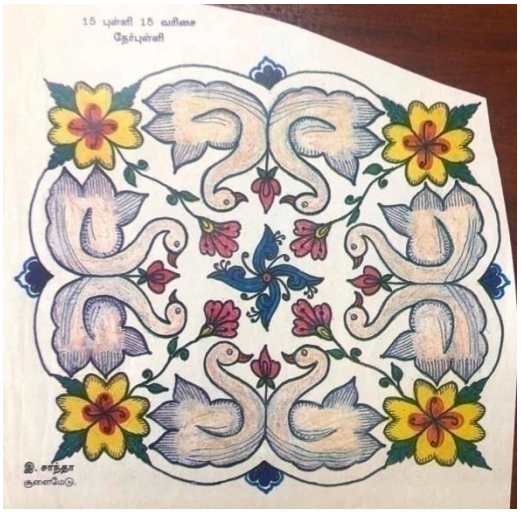
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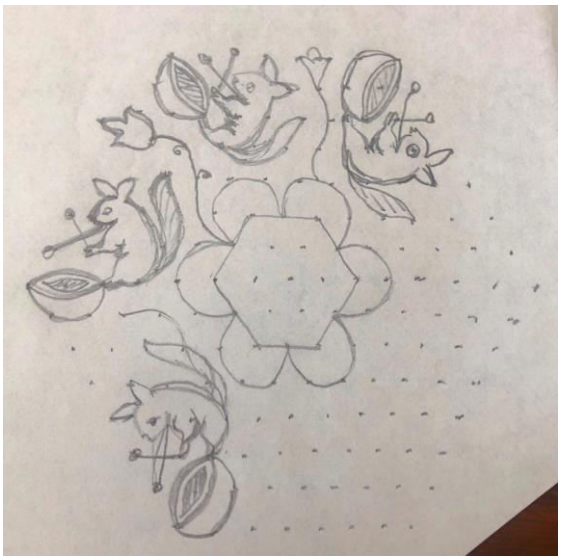

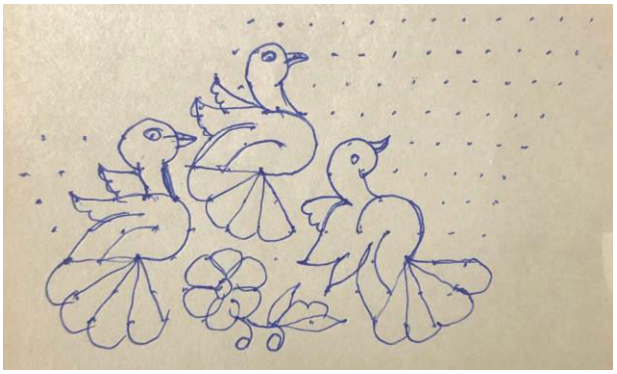

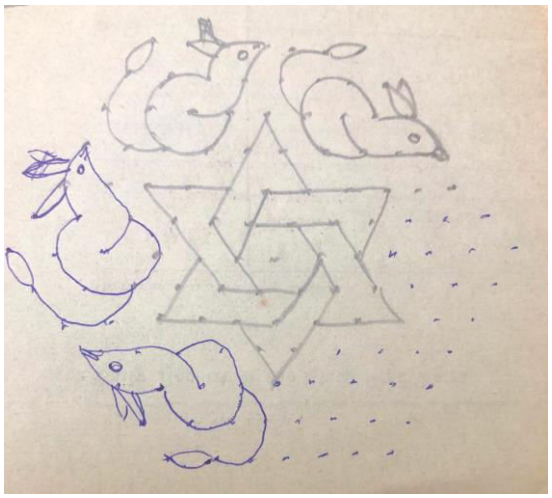

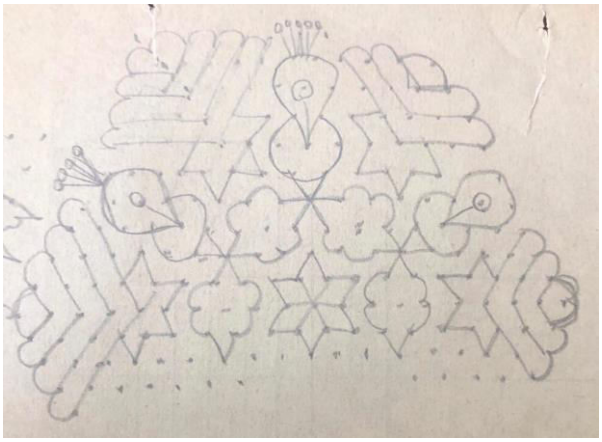

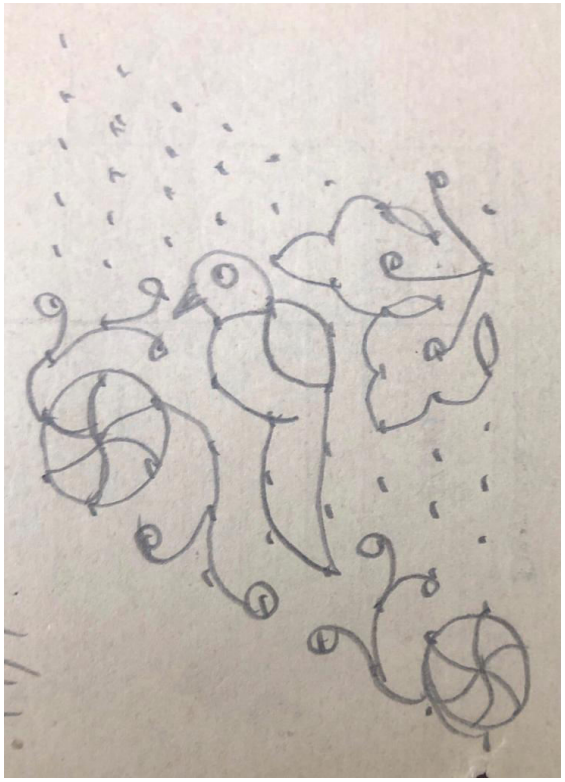

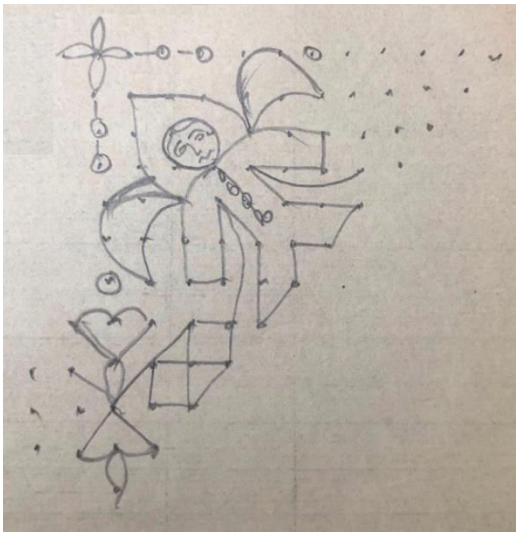

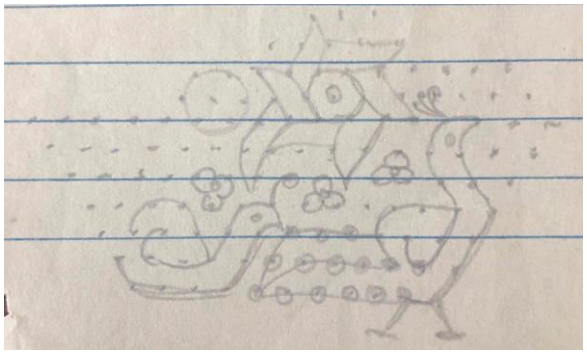

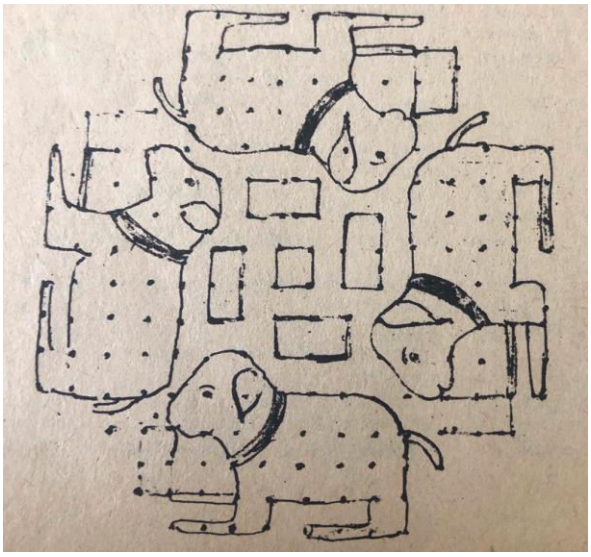

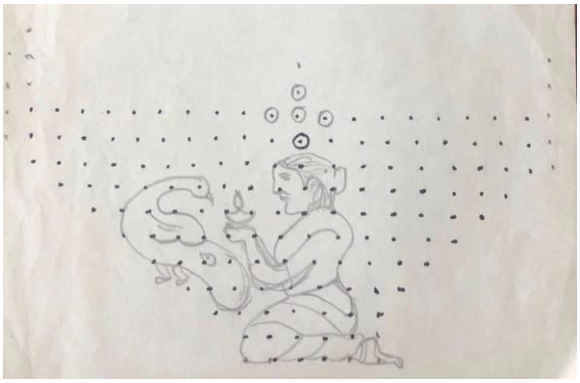

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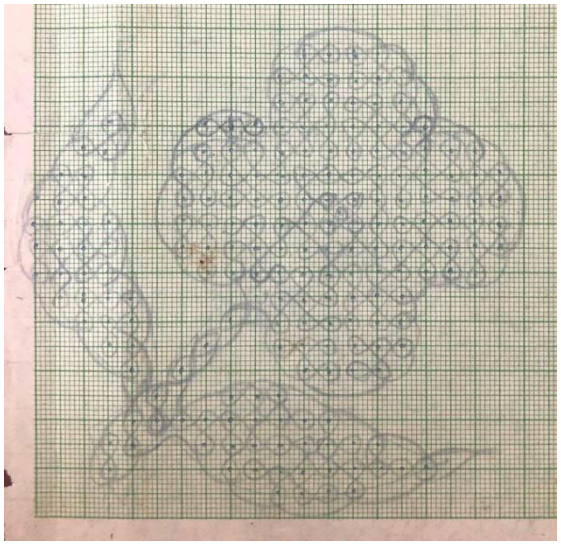

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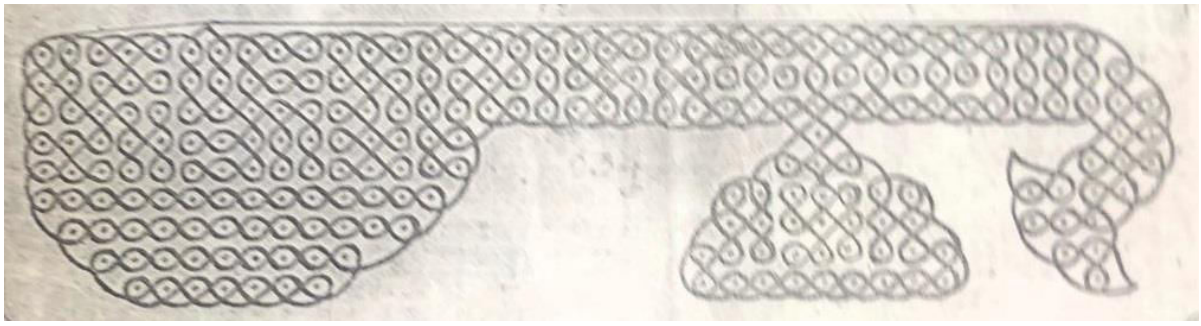
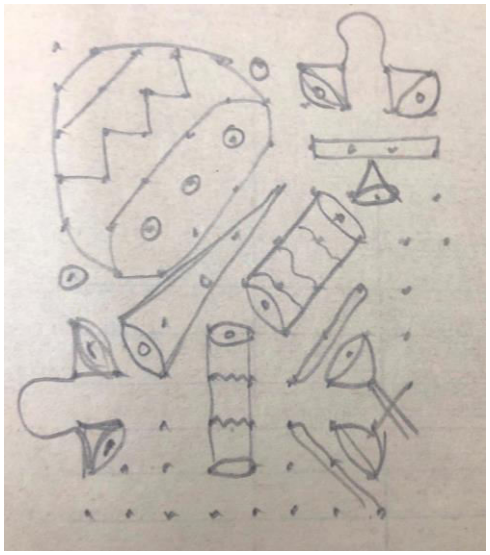
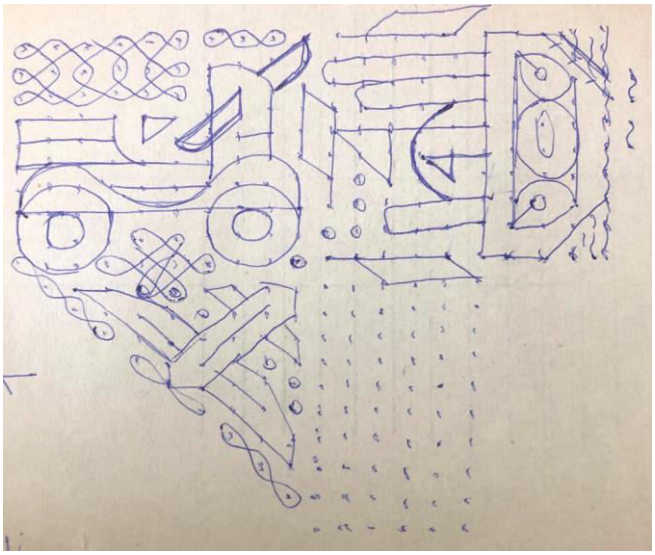
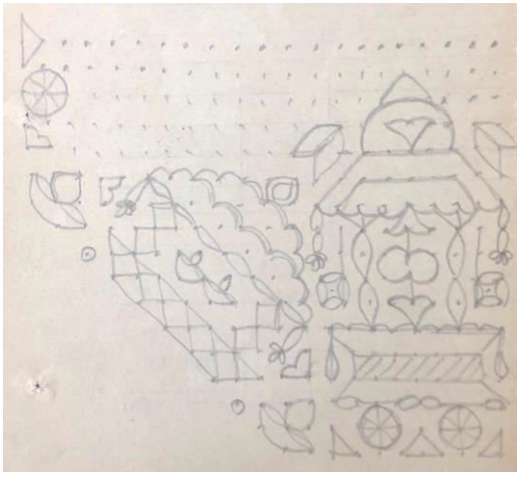
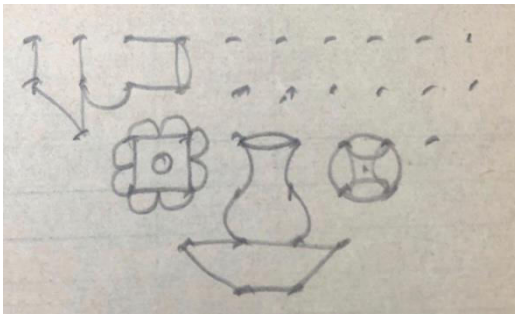


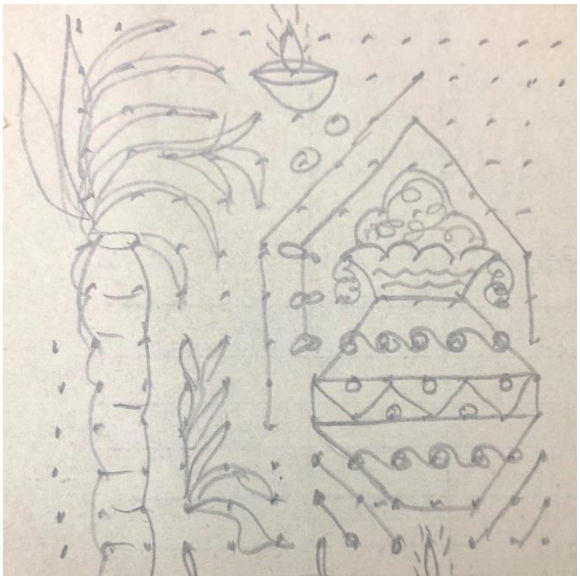


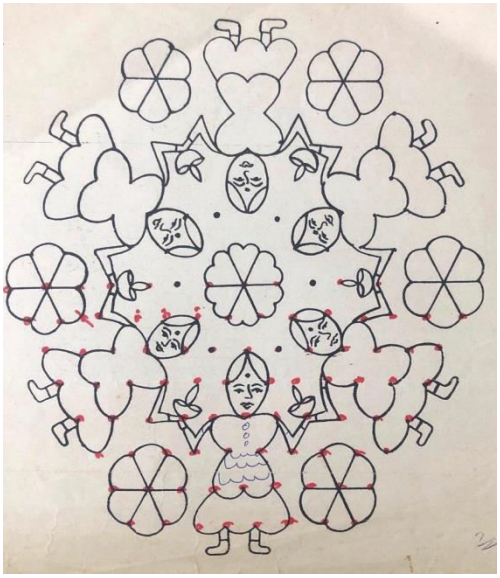


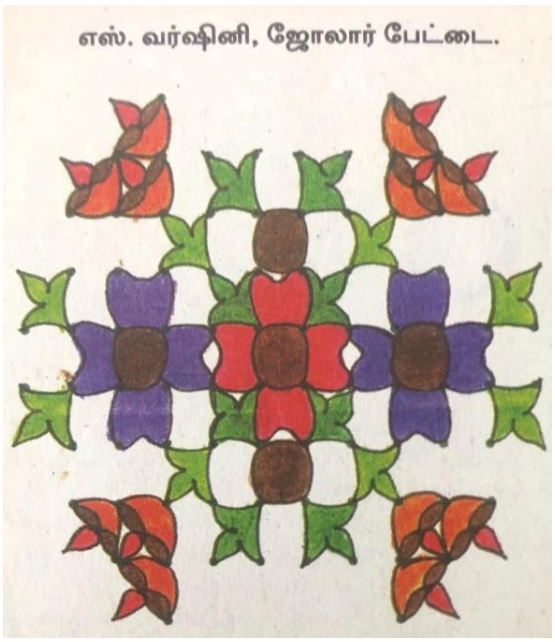




Festival days



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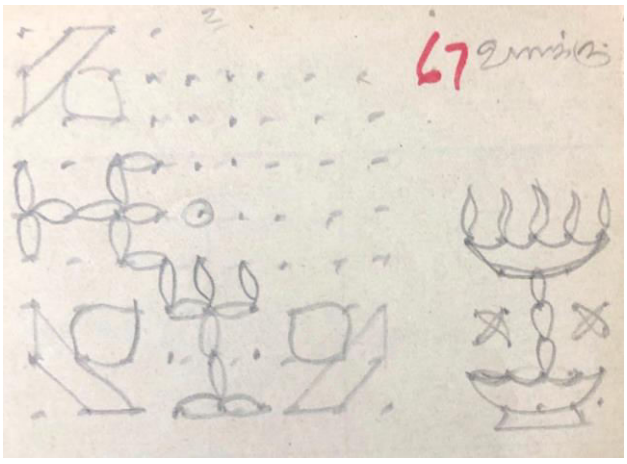
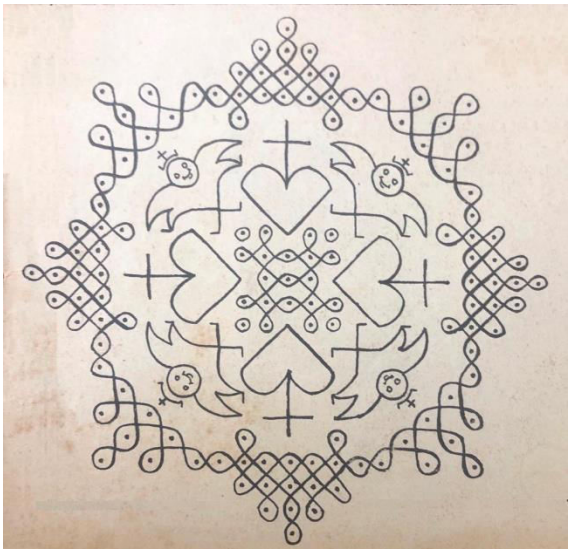
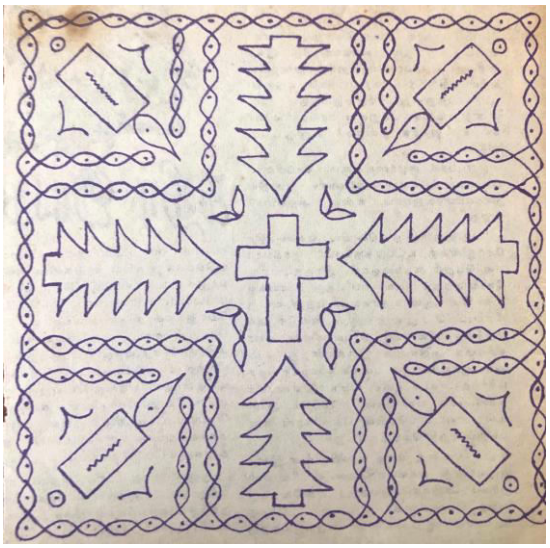
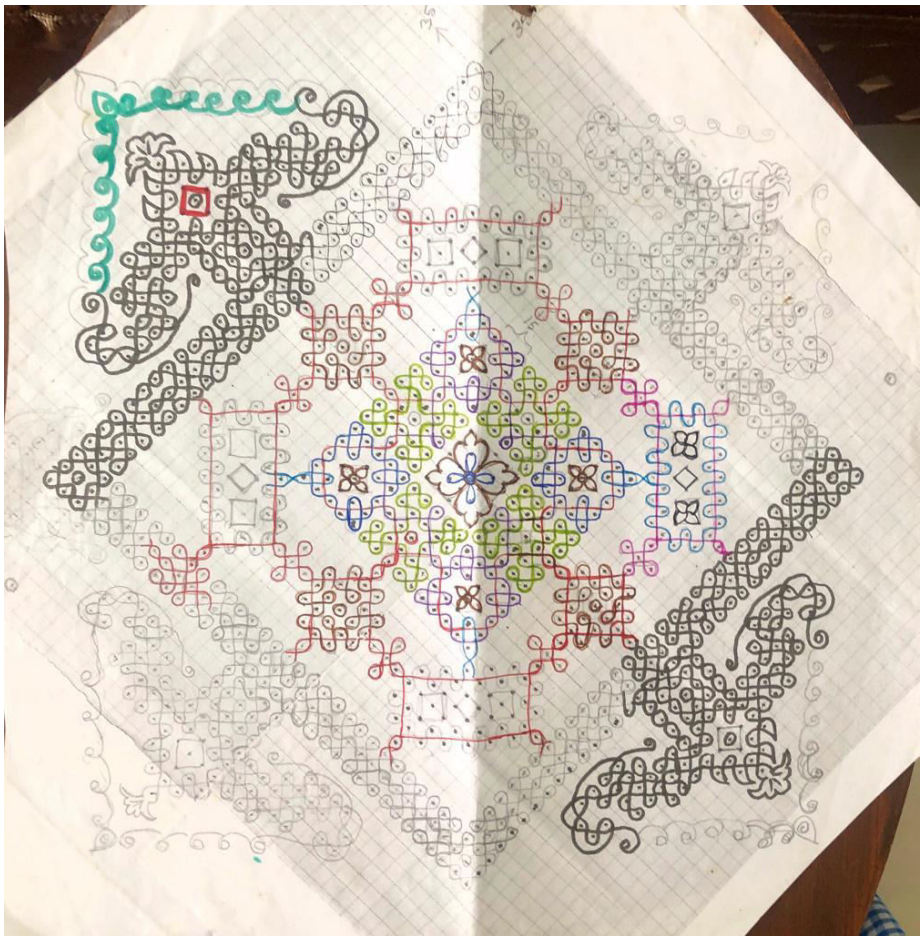
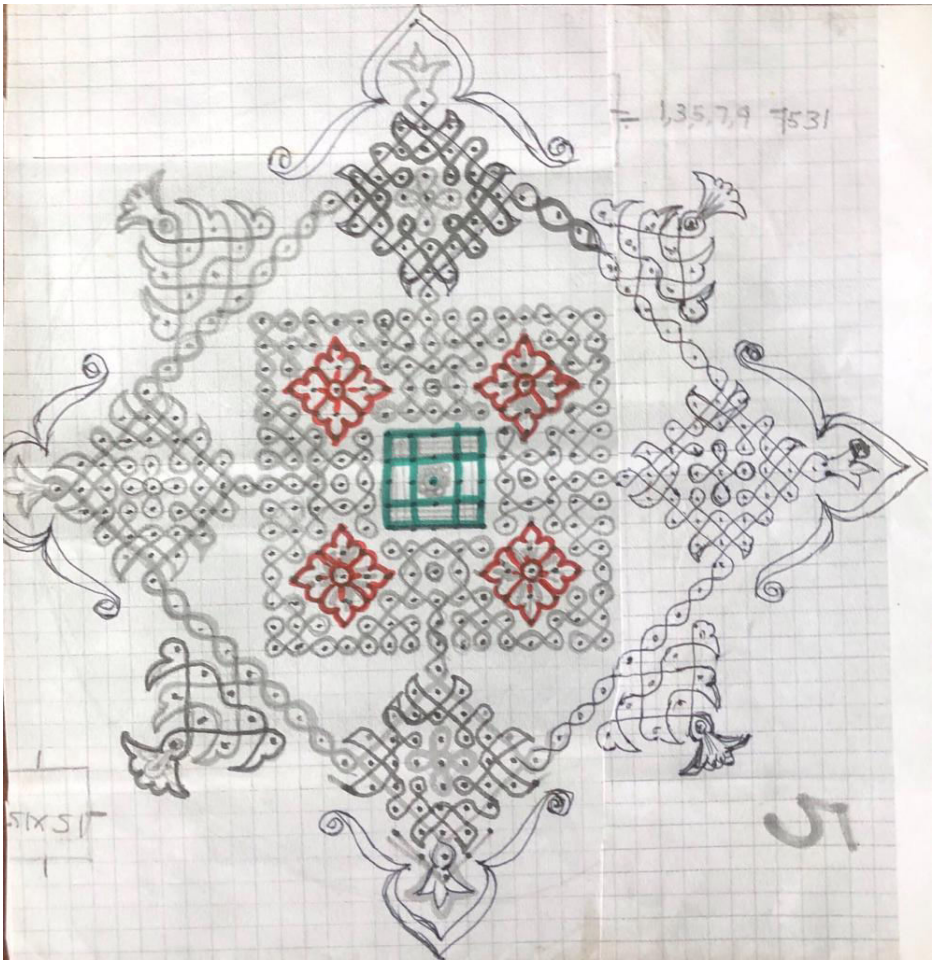






Some big suzhi kolams

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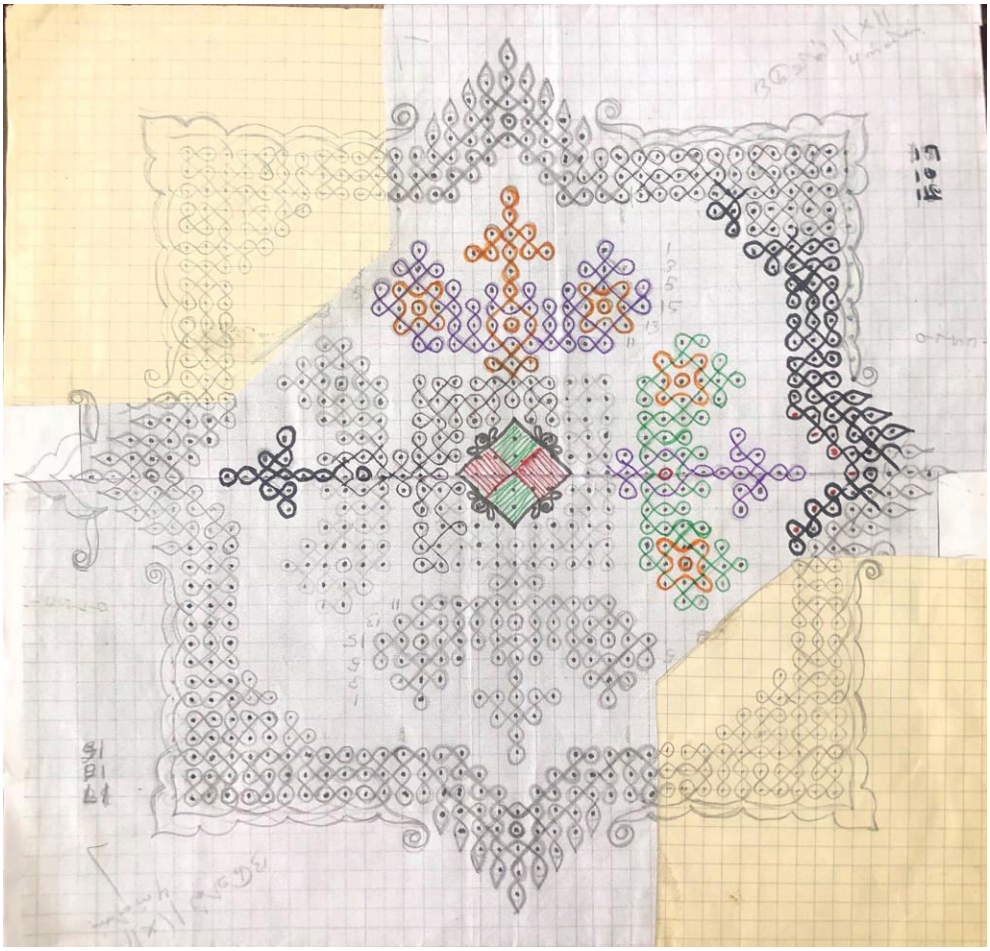

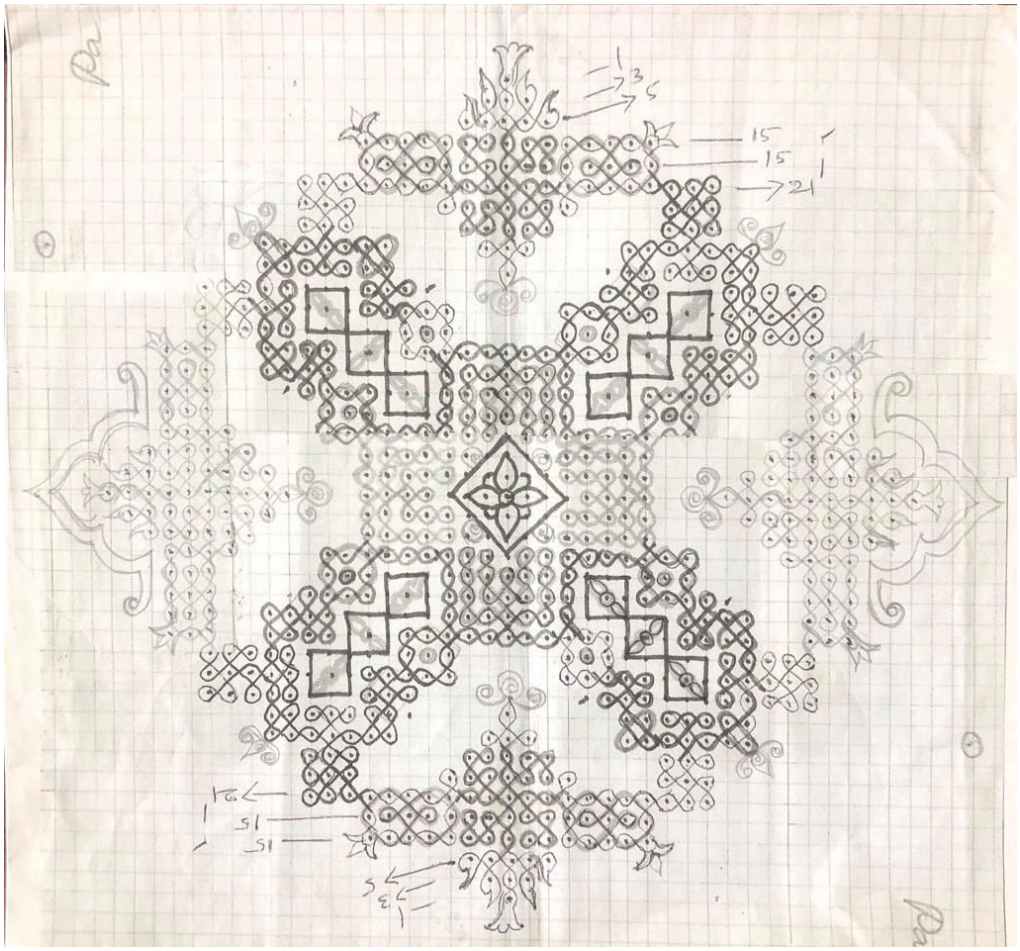
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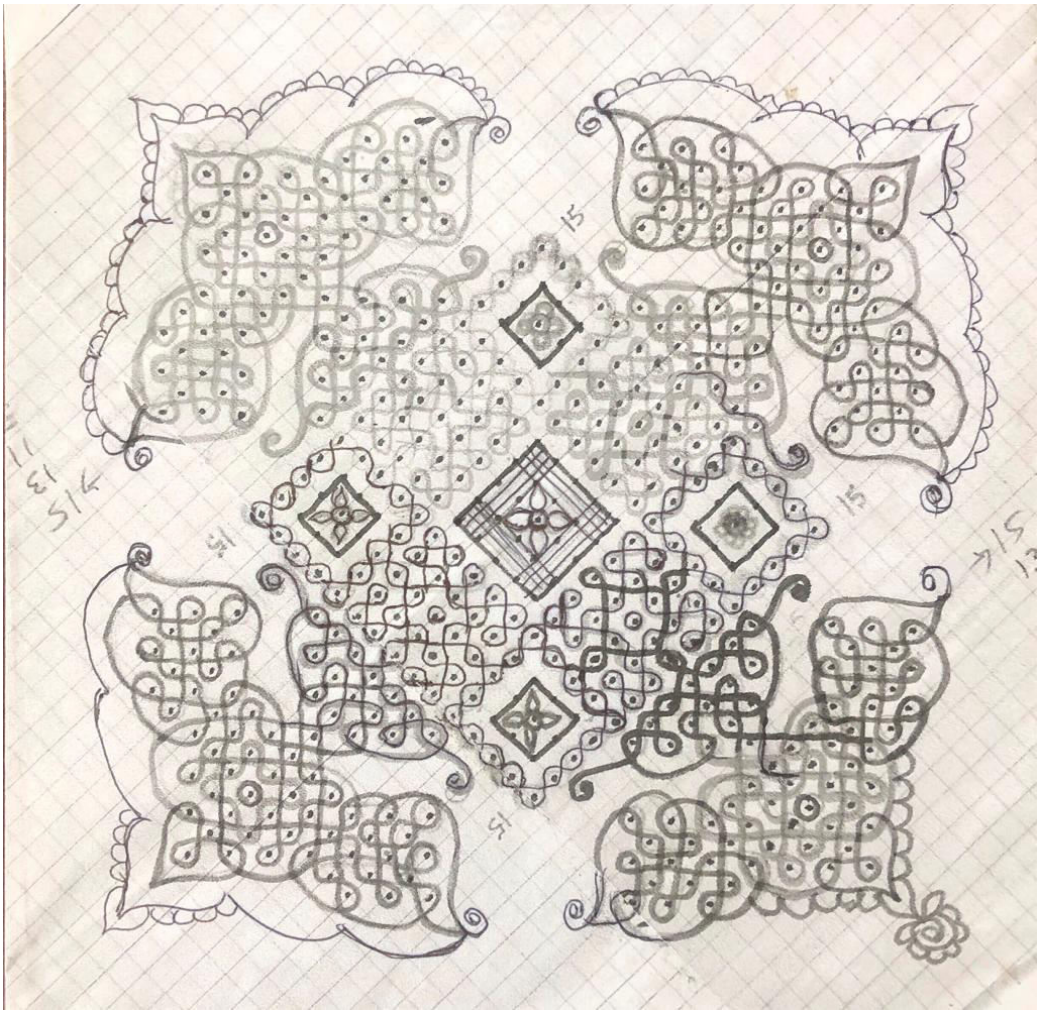
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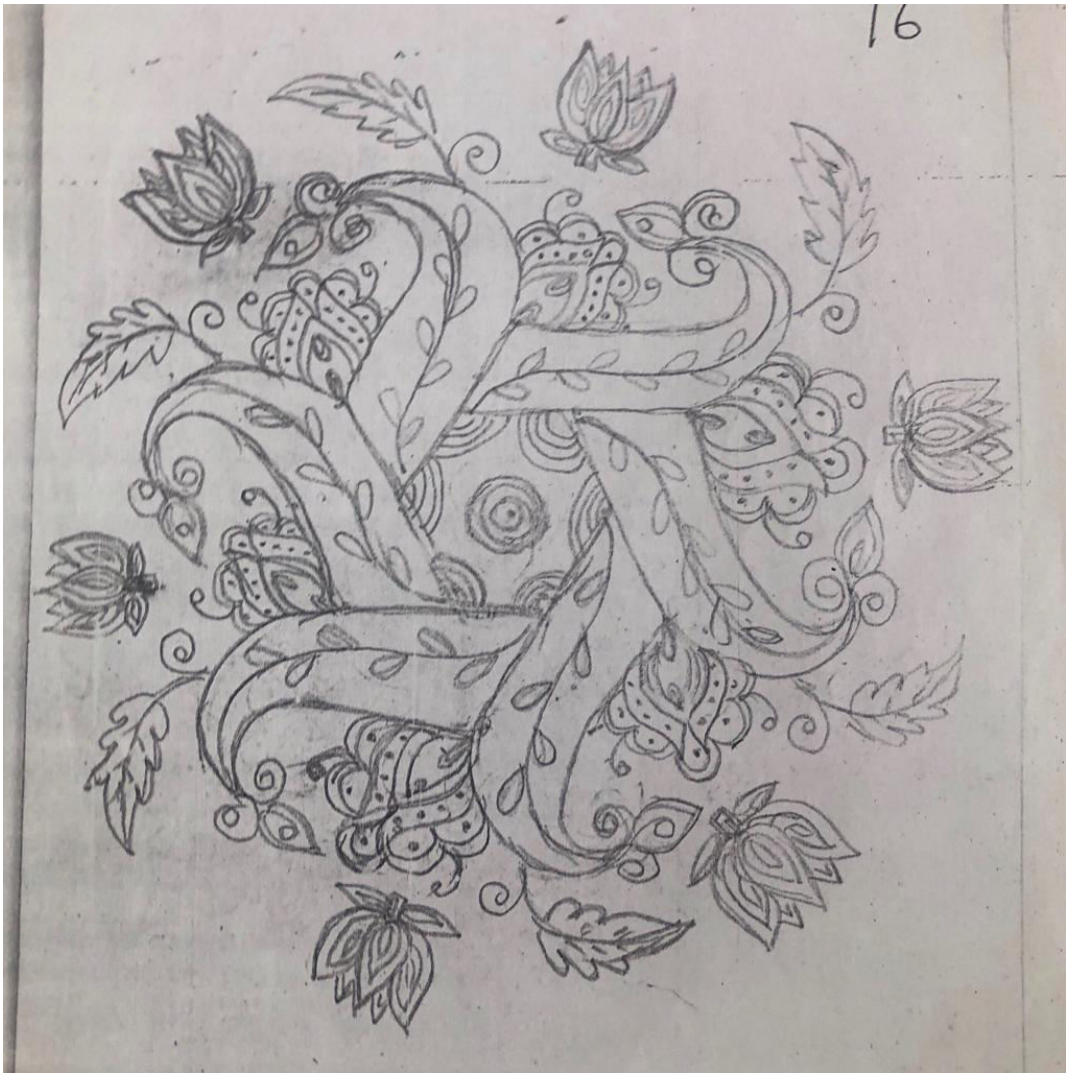
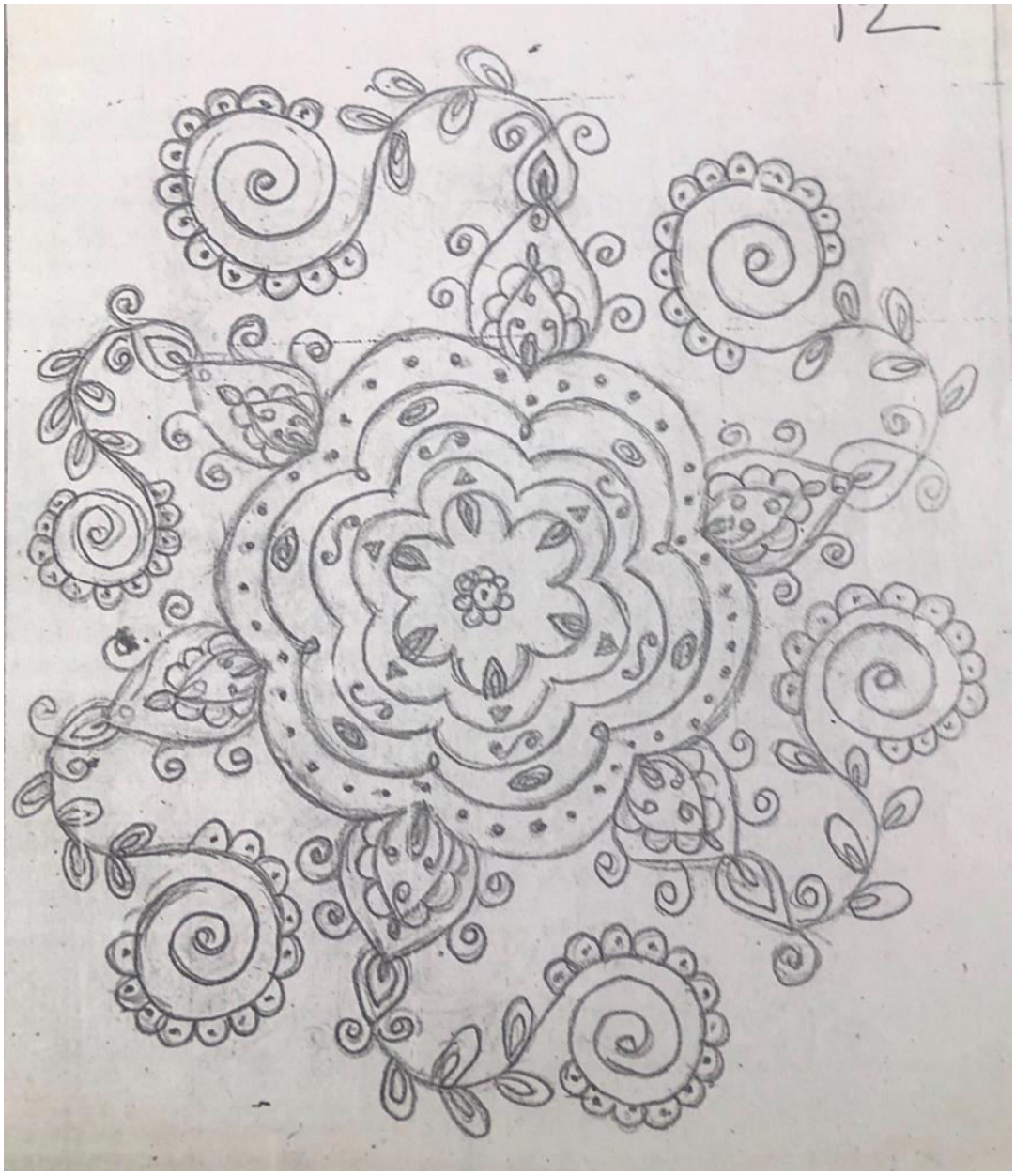
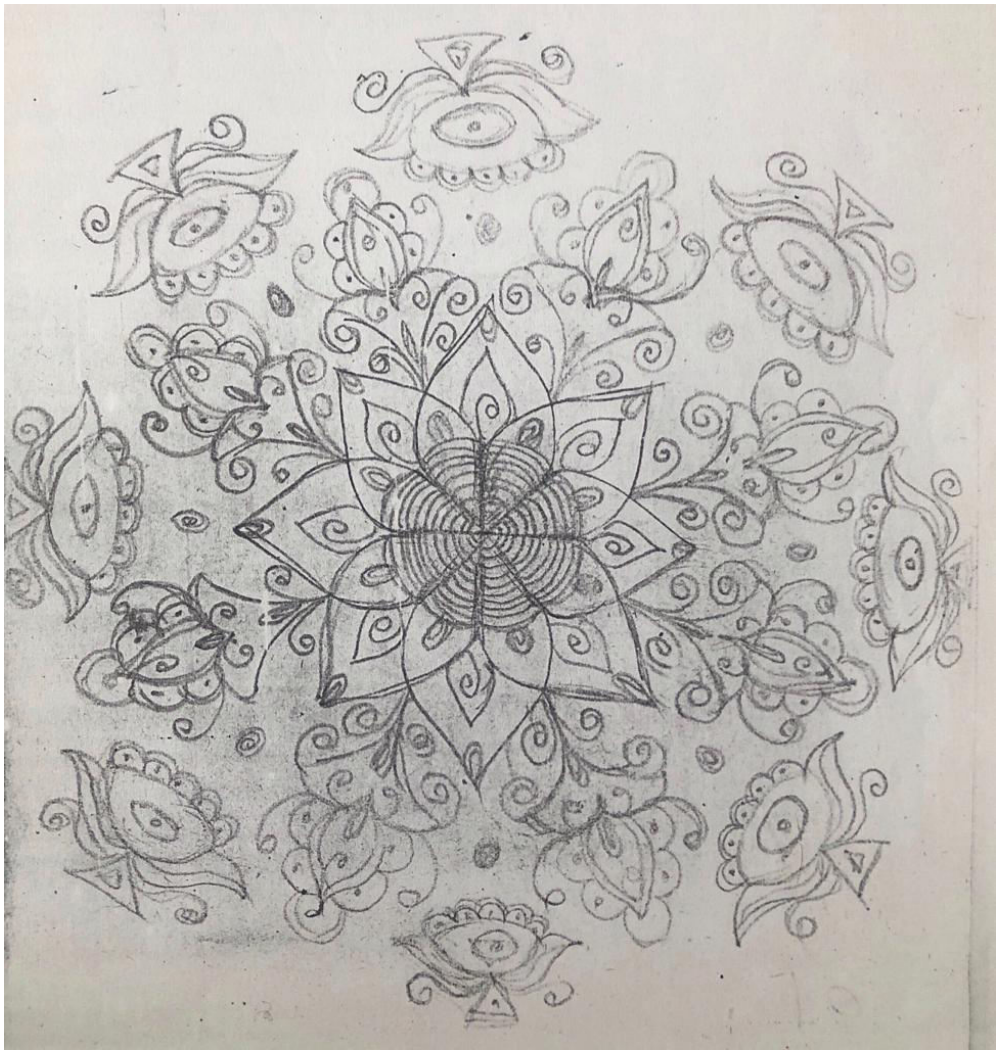
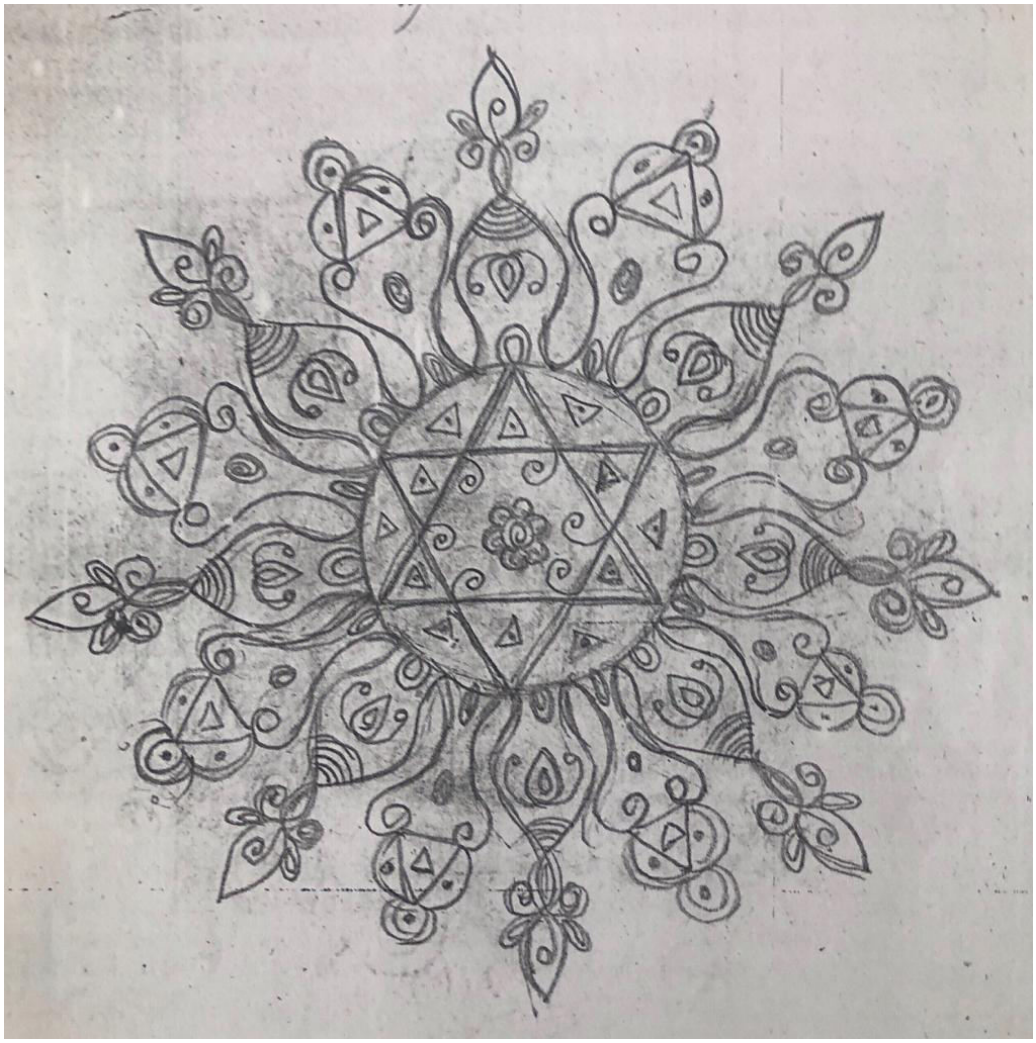
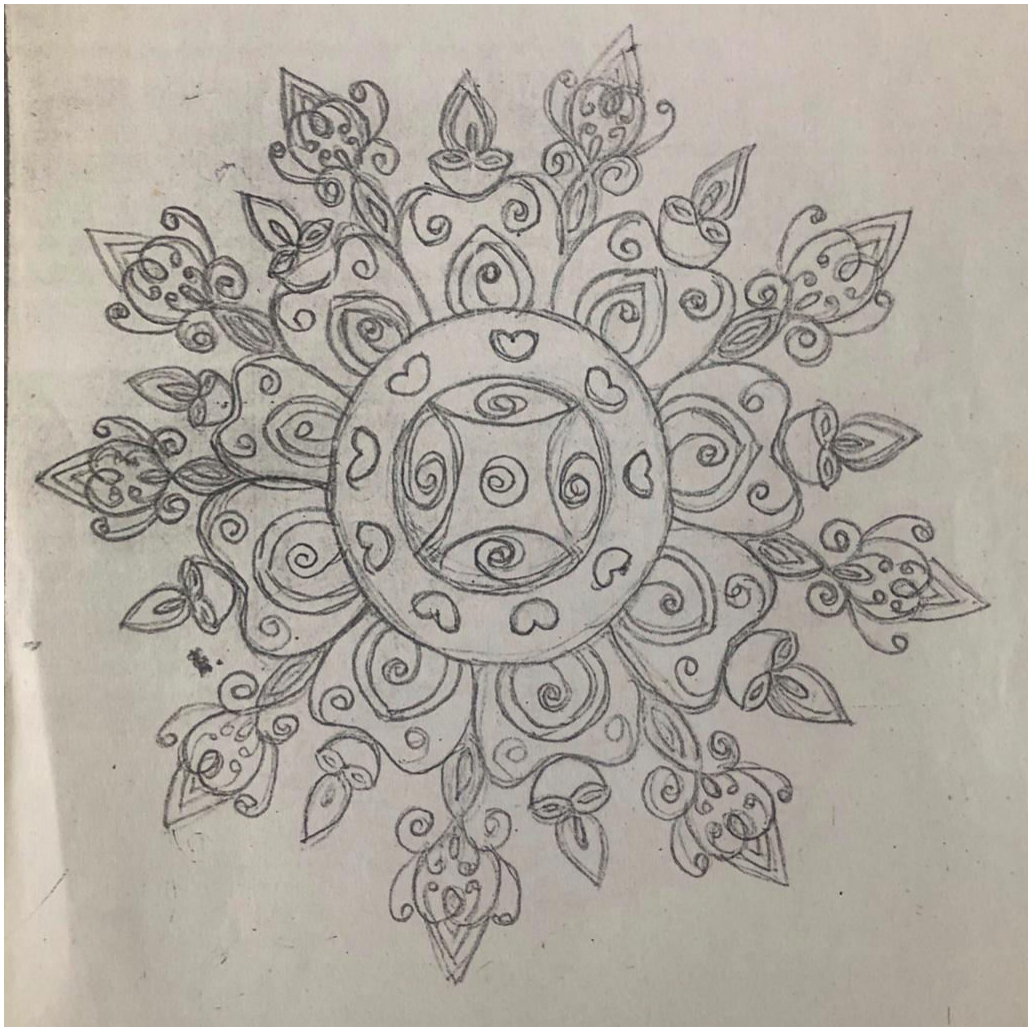
Kolams by Singh mami



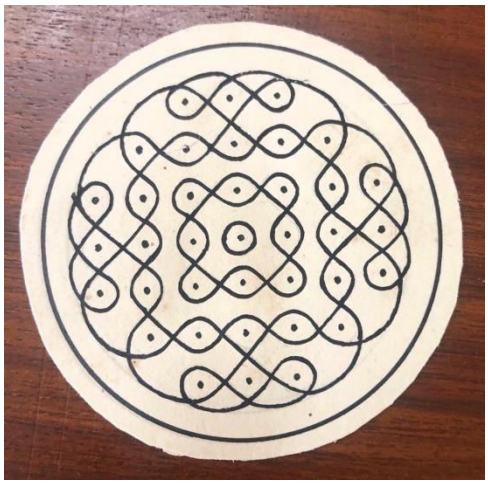


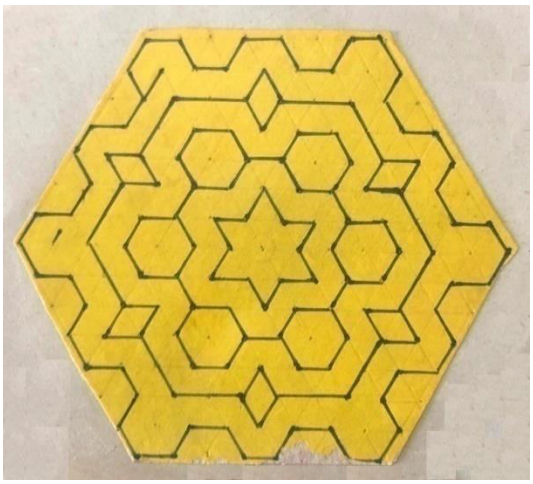


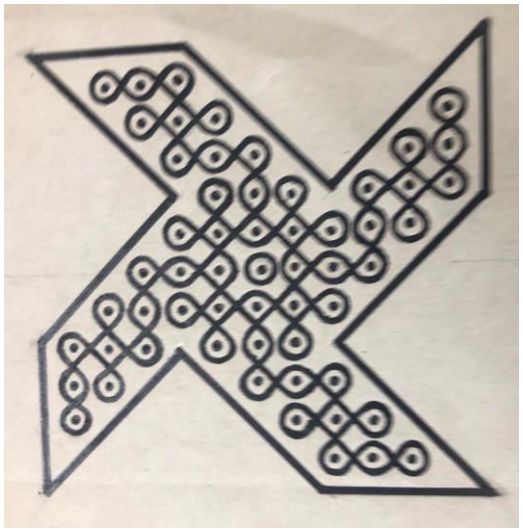


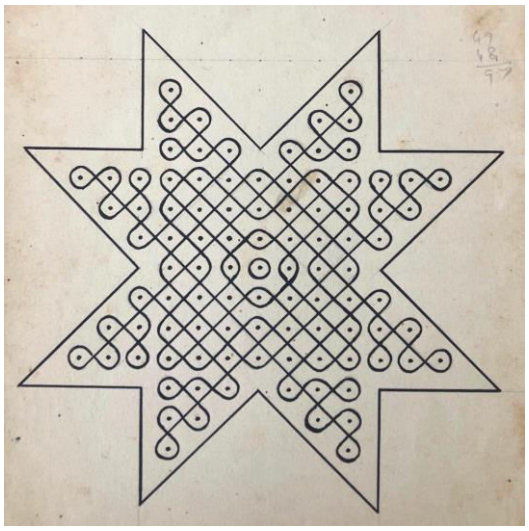


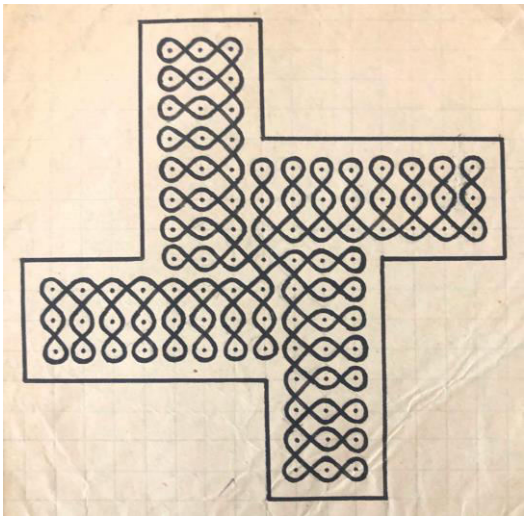
Kolams by Thiagarajan

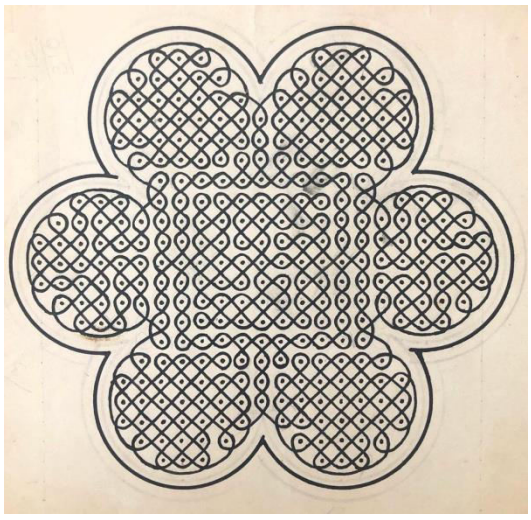


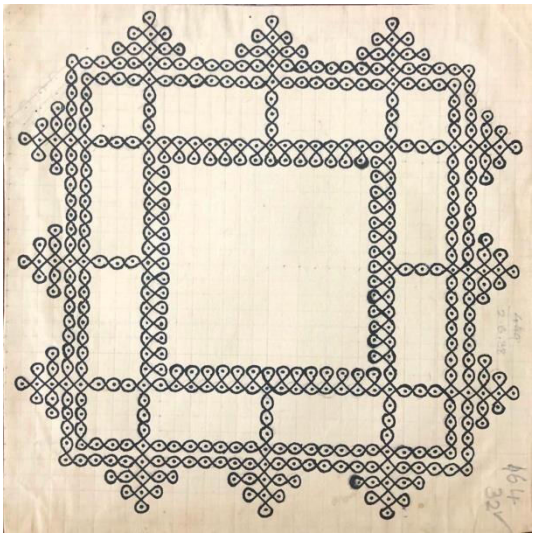


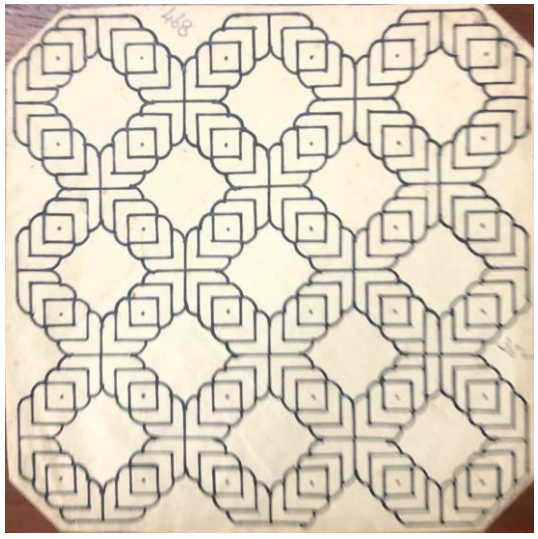


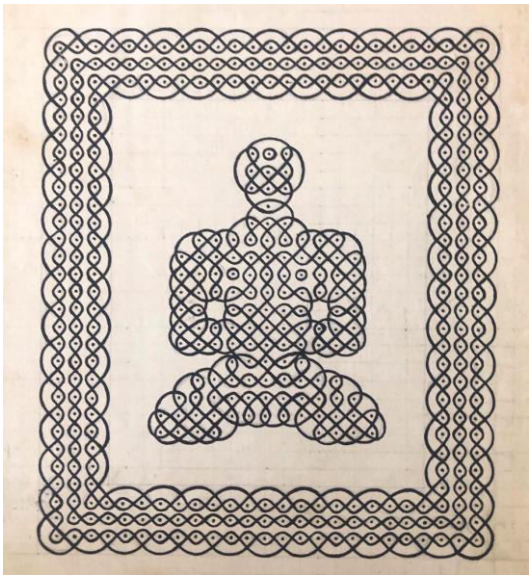


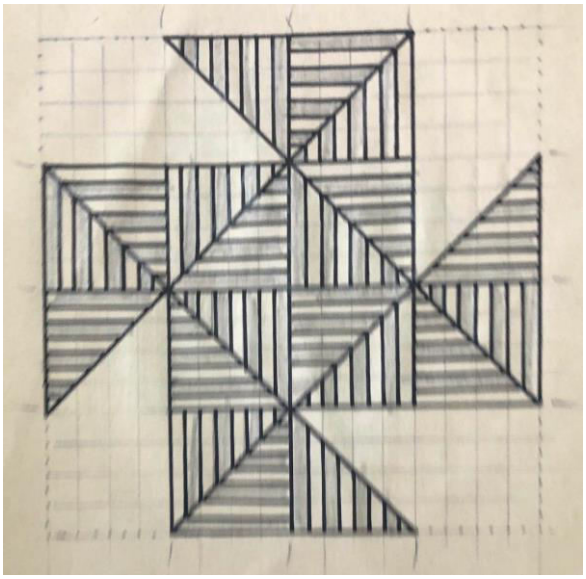




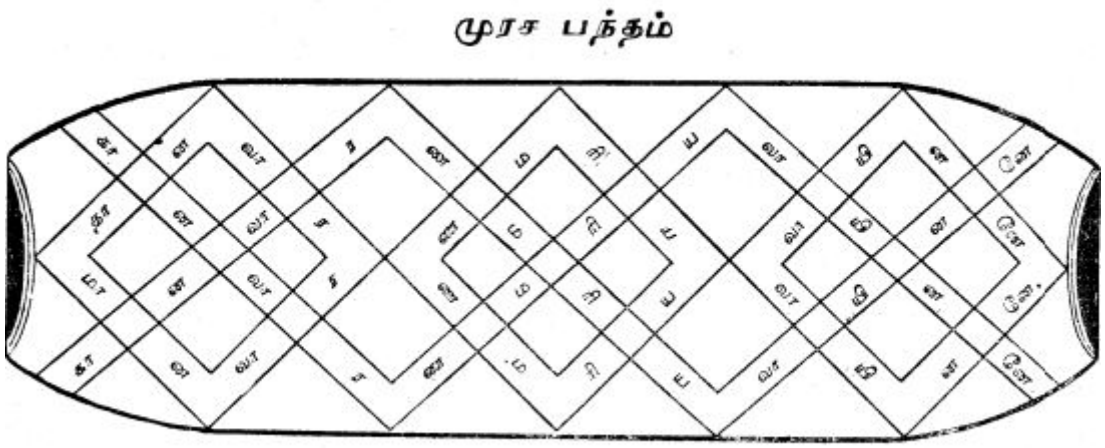


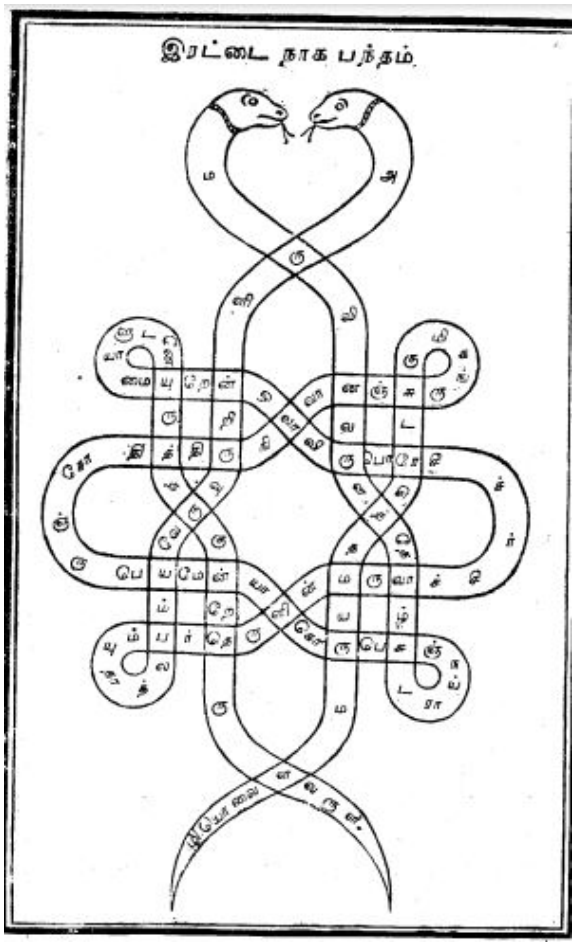


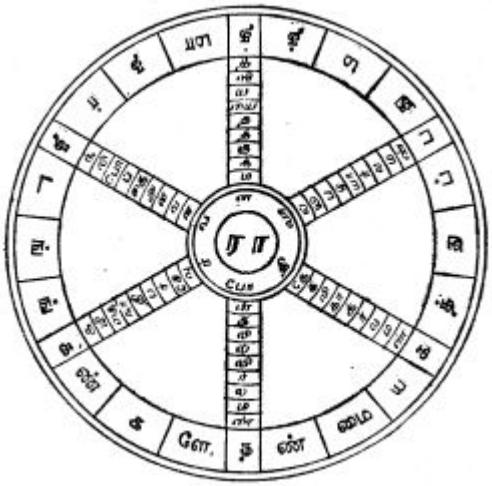


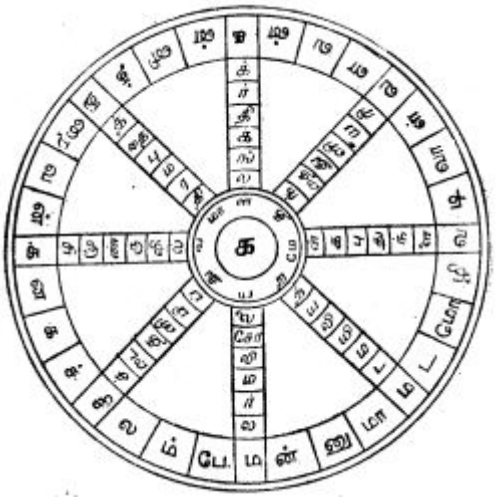


Kolams from Dhandiyalabgaram









Kolams under, above and in the middle of water

To draw a kolam under water, first at the bottom of the water tank, you have to put colorless grease in a thin layer, to the size of the kolam. For this use a paper cut in the middle to make a hole to the size of the kolam. Allow it to dry for a few hours. For every color cut a paper such that holes are formed in the places of that color. Place this over the greased bottom.

Using a fine sieve, put the color powder over the paper. This allows that color to be formed only on the required places. Do this for all the colors one by one. Give time in between for the color to stick to the grease. Allow all the colors to dry. Now put water in the vessel very slowly. Under water kolam is now ready.

Drawing kolam in the middle of water is similar. Here the tub should be such that the radius increases slightly from the bottom to the top. Cut a transparent glass sheet to fit in the middle of the tub. Put some pebbles and coarse sand at the bottom of the tub. This will show that the kolam is in the middle of the tub. Pour water to just above the half mark in the tub.

On the glass plate create a kolam as we do for the under water kolam. Allow it to dry completely. Now lower the glass in the tub, to settle in the middle of the tub. Pour more water slowly to fill the tub. Kolam in the middle of the water is ready.

You need more patience to create a kolam above water. Fill the tub with water. Put off the fan in that area. Above the water sprinkle gentlly a thin layer of French chalk powder. This forms the base for the kolam. Now using the paper cut for each color, as in the case of kolam under water, sprinkle the required colors one by one. For this the paper should be held just above the chalk powder layer. There is a method for this. Use four pins, and pierce near the four corners of the paper from bottom. Now you can move the paper by using the pins protruding above the paper. To show that the kolam is above water, carefully remove small portion of the chalk powder in one place near the rim of the tub. If you do it patiently a kolam above the water is ready to showcase.

You can surprise the viewers by putting all three kolams in one tub. You need lot of patience for this. Make sure that the French chalk is spread only on one side of the tub, so that the bottom is visible. Draw bigger kolam at the bottom and a smaller kolam at the top. Our advance thanks to those who draw these three kolams together and send the photo showing all the three kolams to be added in this book.

Musical kolam

In the seminar on 'Kolam in Tamil Culture' conducted in Thanjavur in 1989, our sister in law Mrs. Sethu bai, drew the musical kolam. She was a music teacher. She sang the song 'varaveena'. When she started the song she started to draw a 10 by 10 kolam. She drew one dot or one line per swaram. When the song was over, the kolam was completed. That is musical kolam. Singing without distraction and drawing the kolam without missing a swaram are important for this.

To draw a musical kolam, first a song has to be chosen. This should be in a simple thaalam. Otherwise there is more chances for distraction. Then a line kolam has to be chosen. The sum of dots and lines in that kolam should be equal to the number of swarams of the song. Next, singing of the song is to be practiced. Then drawing the kolam from memory with

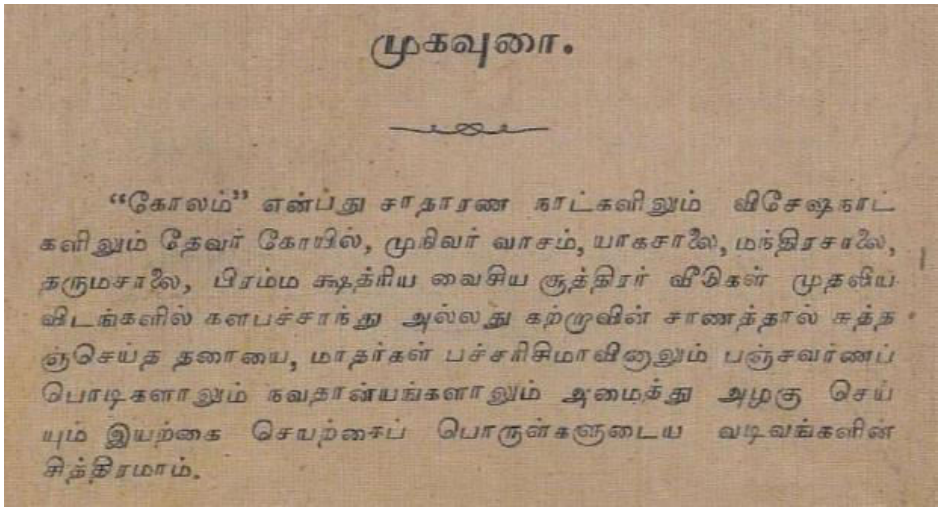
uniform speed has to be practiced. Finally, both should be combined and practiced. This needs a lot of patience, but will receive the appreciation of the audience. Advance thanks for those who send us their video of musical kolam.

19. Kola Rangoli

Rangoli was born in North India. Color is the basis of rangoli. Flowers, birds, objects, people etc. form the themes of rangoli. Tamil nadu is known for kolams with dots. If we color the small areas in between the lines, we can make it a rangoli. We can call it kola rangoli.

This coloring is not new to Tamil nadu. In 1895, Ms. Suppammaal wrote a book on kolam. It was published in Pondicherry, and was entitled 'Kola puththakam'. The preface has this. 'In auspicious days like wedding, bumsavana seemanthonnayanam, vidyaarambam, upanayanam, devepooja, kolams will be drawn using rice flour. In the spaces within the kolam, kungumam, turmaric powder, leaf powder with scent, avuri plant blue powder will be put to make it auspicious and look beautiful. During nava graha pooja time, the nine grains will be spread like that. This has been practiced by aryans for a very long time.

We came to know that this book is available in the University of Toronto's Tamil collection, when we searched for 'கோலப்புத்தகம்' in Roja Muthiah Library's web page.



முகவுரை.

"கோலம்" என்பது சாதாரண காட்களிலும் விசேஷகாட்களிலும் தேவர் கோயில், முனிவர் வாசம், யாகசாலை, மந்திரசாலை, தருமசாலை, பிரம்ம கூதகிய வைசிய சூத்திரர் வீடுகள் முதலிய விடங்களில் களபச்சாந்து அல்லது கற்பூரவின் சாணத்தால் சுத்தஞ்செய்த தரையை, மாதர்கள் பச்சரிசிமாவினாலும் பஞ்சவர்ணப் பொடிகளாலும் கவதான்யங்களாலும் அமைத்து அழகு செய்யும் இயற்கை செயற்கைப் பொருள்களுடைய வடிவங்களின் சித்திரமாம்.

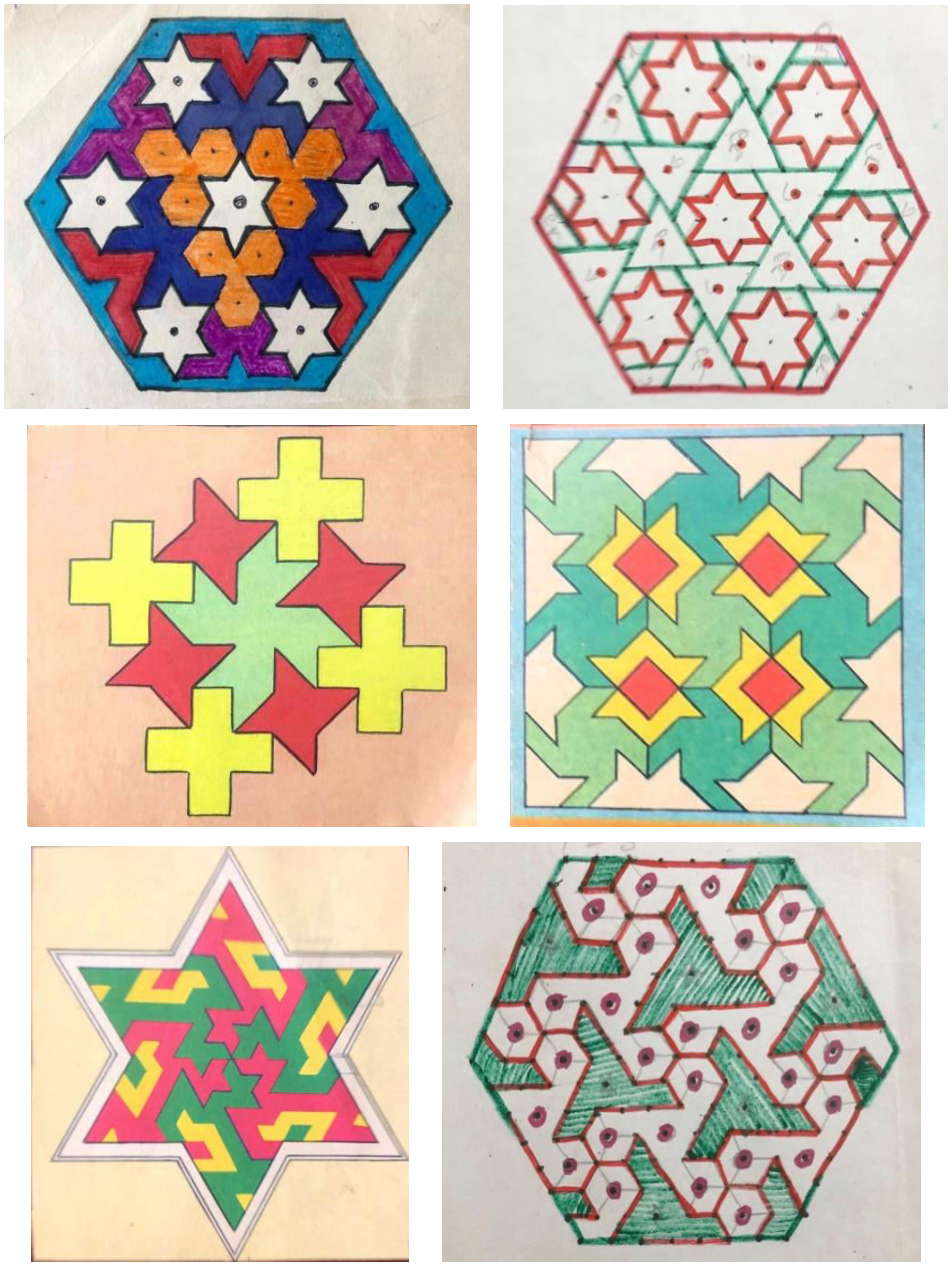
Also we found that ' கோலப்புத்தகம்', a book published in 1889, with the kolams collected by Ms. Sriranga Naachchiyaarammaal, is available in Tamil Virtual Academy. The preface of this book also talks about coloring the kolam. The links for these are available there. By clicking on the books, one can see the books.

When the word rangoli is mentioned, many mean all the art forms like kolam, pervasive in whole of India. So we will see talk about rangoli also.

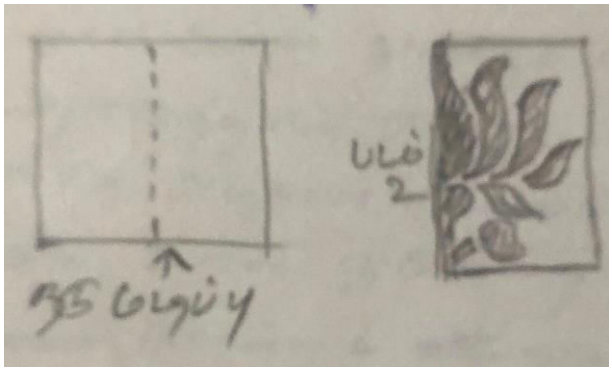
Usually kottu kolam with straight or cross dots are used to get kola rangolis. In our software for creating kolams, the suzhi kolams also can be colored and made into rangolis. We shall see some examples. All these kola rangolis seem to have four side symmetry for straight dots and three or six side symmetry for cross dots.

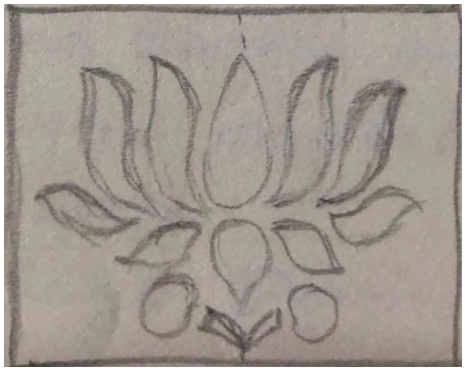
Recently kola rangoli has been popularised by Mr. Savi Thambirasu. He has given an easy method to create cross dot kola rangolis. First draw a star in the middle of the kolam. Then around this draw six stars, equidistant from the middle star. Then join these stars depending on the imagination. This has

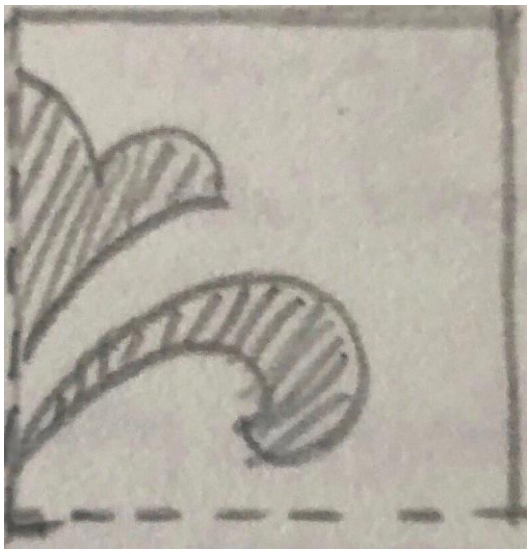
to be done having in mind that opposite sides or all the three or six sides look the same. This will give a kolam with a rotational symmetry of 2, 3 or 6. Then color them such that it respects the symmetry. Two such kola rangolis can be seen below.

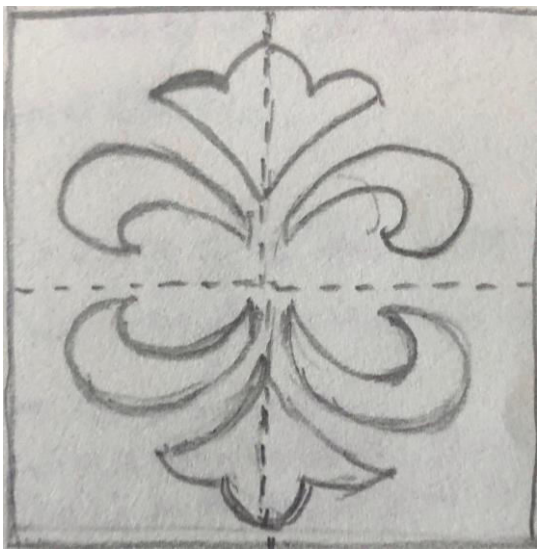


There is a simple way to create a rangoli with one color in the background, and some designs in the foreground. First the background color is sprayed. A paper is taken and the required pattern is cut and removed. This paper is kept on the surface, and a new color is sprayed to form the design. If the paper folded once or twice before cutting, the design gets a symmetry of two or four.









Kola rangolis look beautiful when drawn with multiple colors. Some times, some colors get exhausted, and we have a small number of color powders. There will be suspicion about whether these colors are enough to color the given rangoli. There is a rule for coloring the rangolis. Adjacent areas should be given different colors. The natural question is, when a large kolam is considered what is the minimum number colors needed to color it. Or can you say that with this many colors, any kolam can be colored. The answer is, that, four colors are sufficient to color any kolam. Surprised? There is one more interesting news about this result. The above mathematical theorem has been proved in a different way. Usually a mathematical proof contains logical reasoning written line by line on a paper. But the proof for this coloring theorem contained many many hours of computer time! No proof had been seen before like this!

The kolams above water and below water are really kola rangolis.

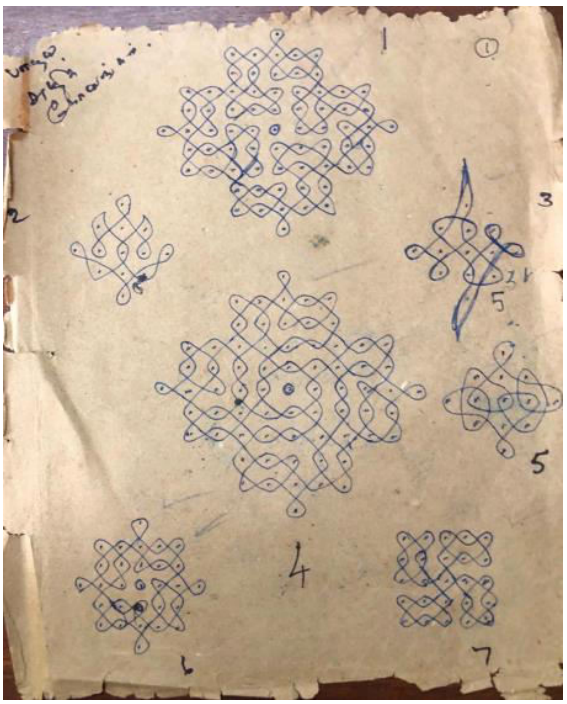
20. A kolam notebook

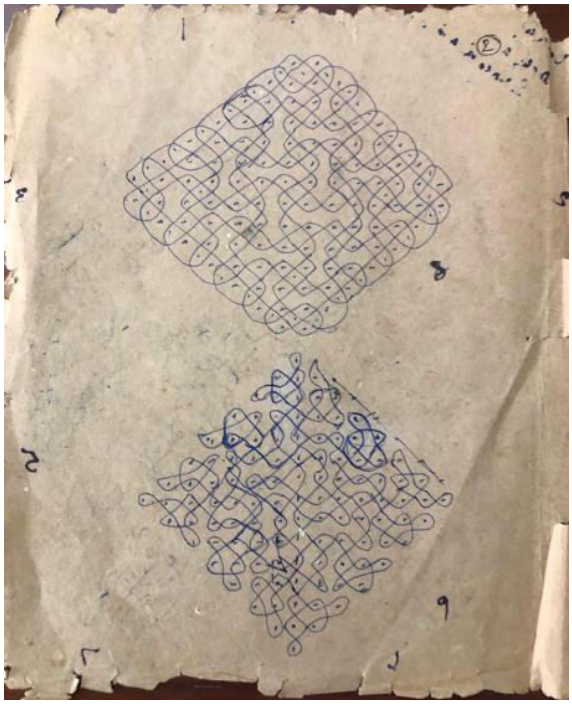
Many cannot afford to buy kolam books. Also there will only be a limited amount of kolams in a book. The way our ladies tackled this problem is the kolam notebooks. Every woman who is interested in kolam will have at least one or two kolam notebooks. They will draw the kolams they liked in that notebook. Sometimes only a part of the kolam will be drawn. They will fill it up when they draw it, using the symmetry. They will note down with how many dots to start and stop, wherever necessary. If a kolam has a name, that also will be noted.

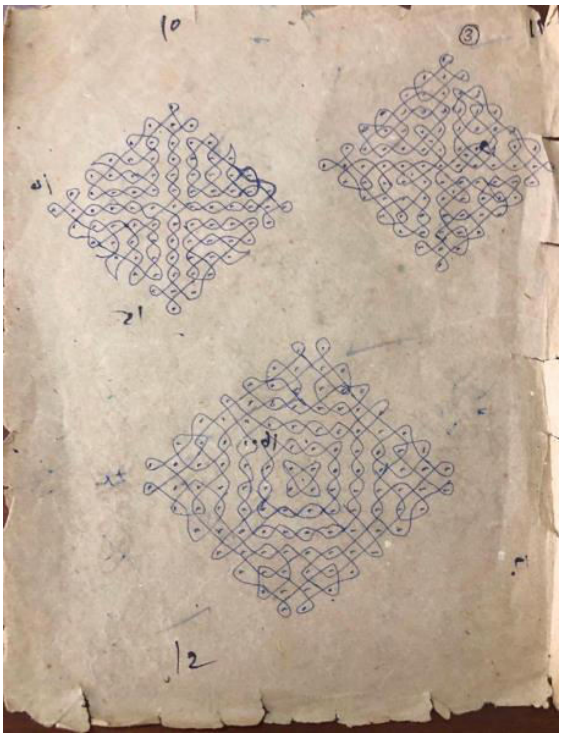
People will not normally lend these notebooks, because, sometimes they will not come back. My first notebook did not return. I have only my second and third notebooks. I started my second notebook in the early years of thousand nine hundred and sixties. I was in Singampunari when I started drawing in this notebook. The pages of this second notebook is shown in this chapter. Already the paper was grey. Also it is now sixty years old. So the background of the pages are grey. The ink on one side have penetrated the paper and can be seen on the other side in some pages.

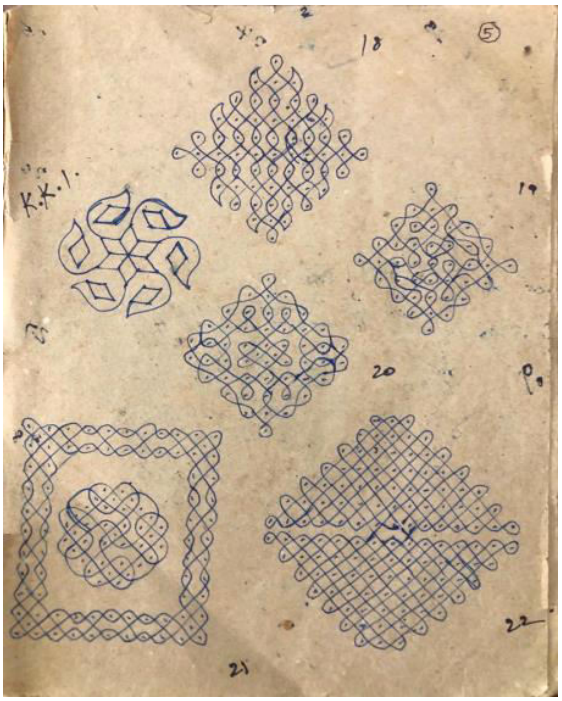
The page numbers are given by me now. The numbers for the kolams have been given already. In some kolams you can see a number with the letters k.k. These are the kolams selected by a friend for copying. The ones with pencil tick mark is the choices of another friend.

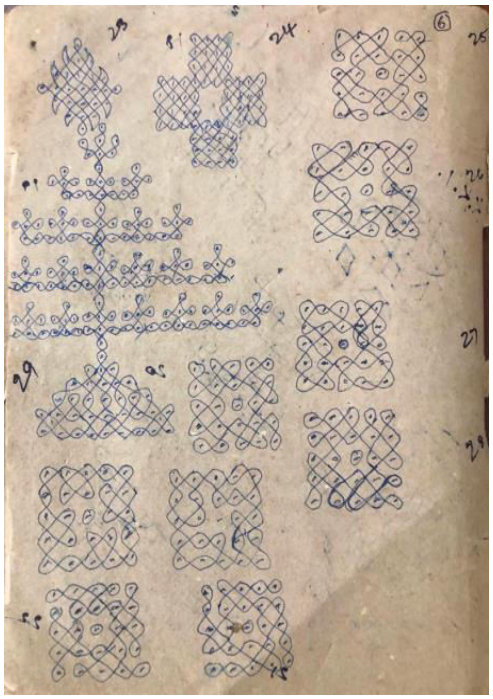
You can see many types of kolams in this notebook. These were drawn by me when I was in my early twenties. That is why these were drawn fully. When you see these kolams you can understand that a lot of patience is required to draw big kolams.

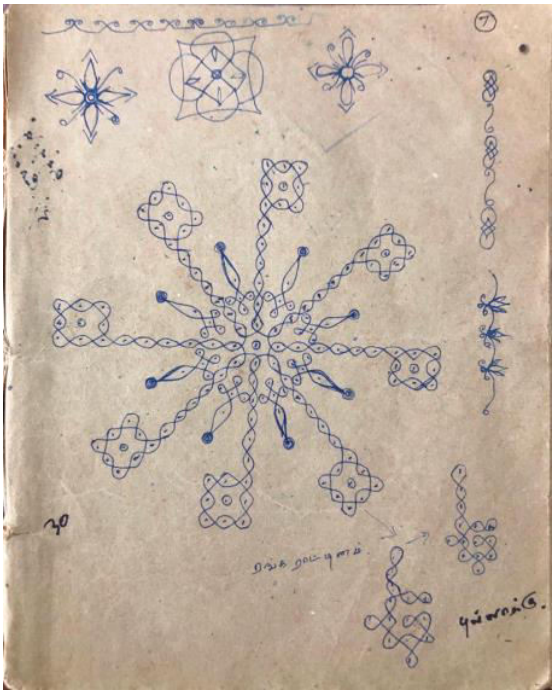


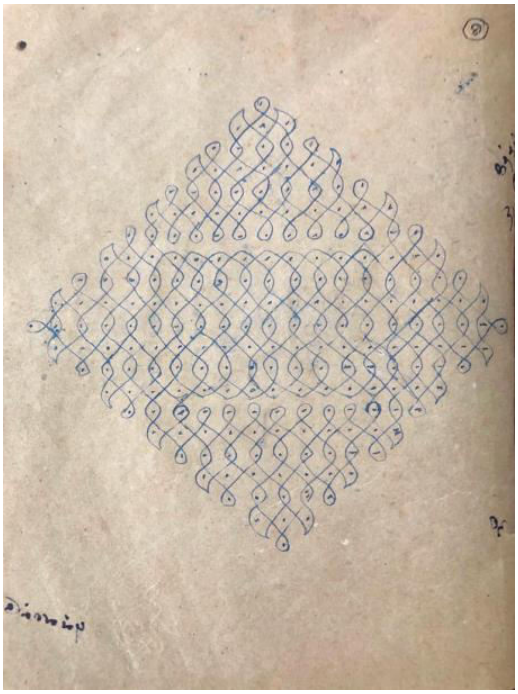


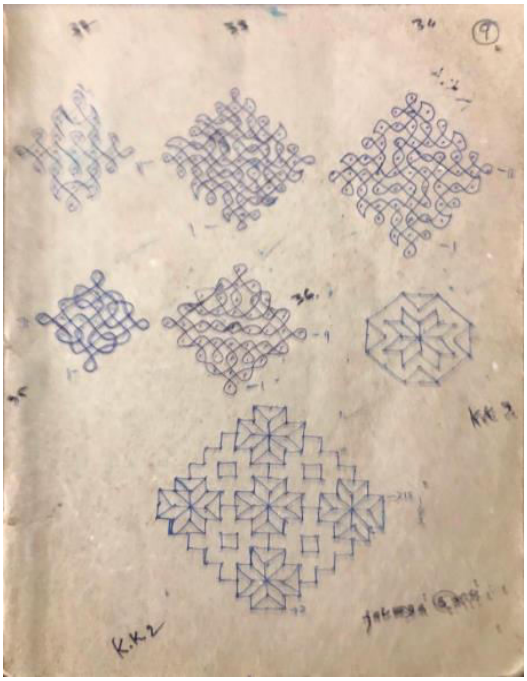








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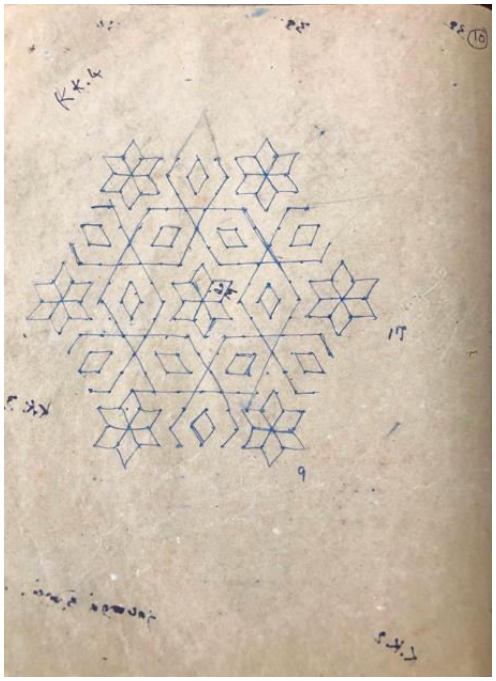
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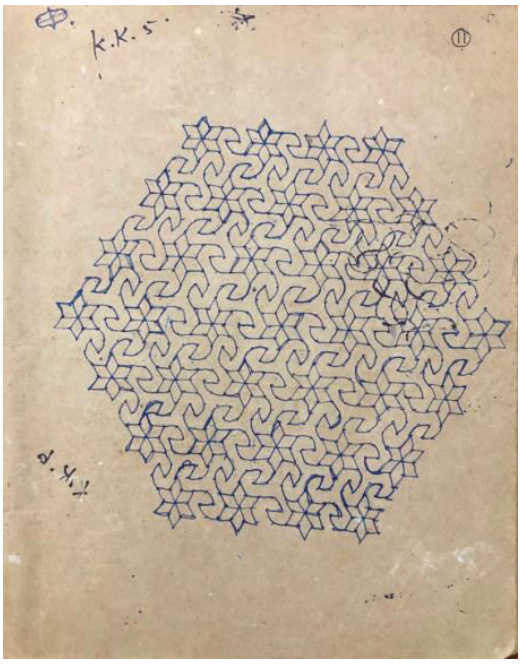
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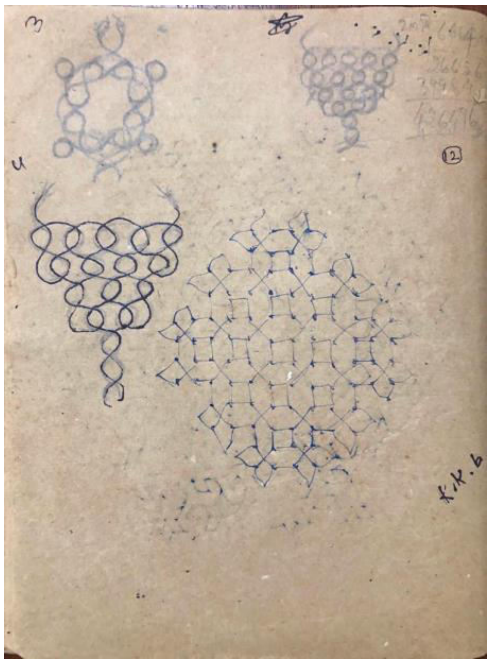
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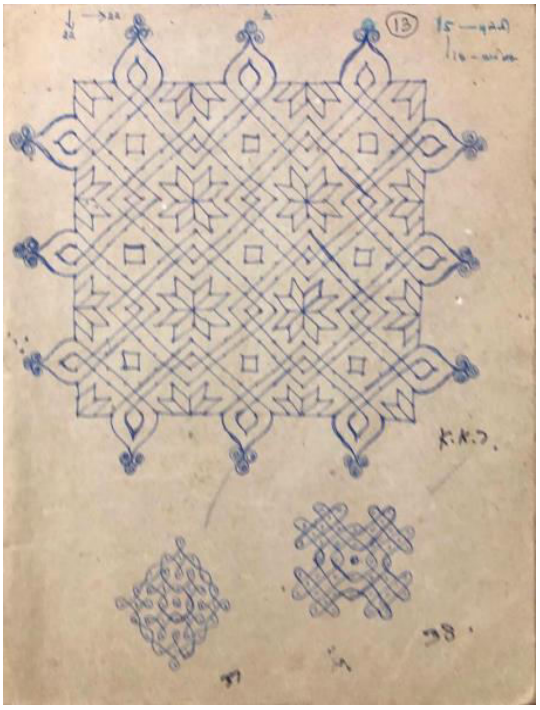

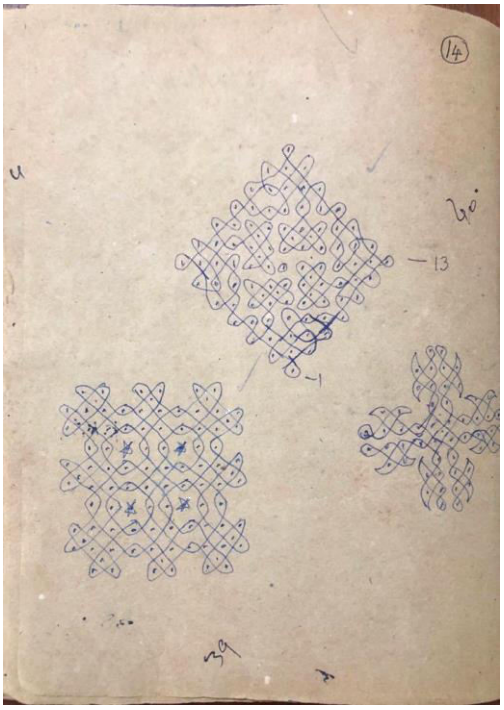

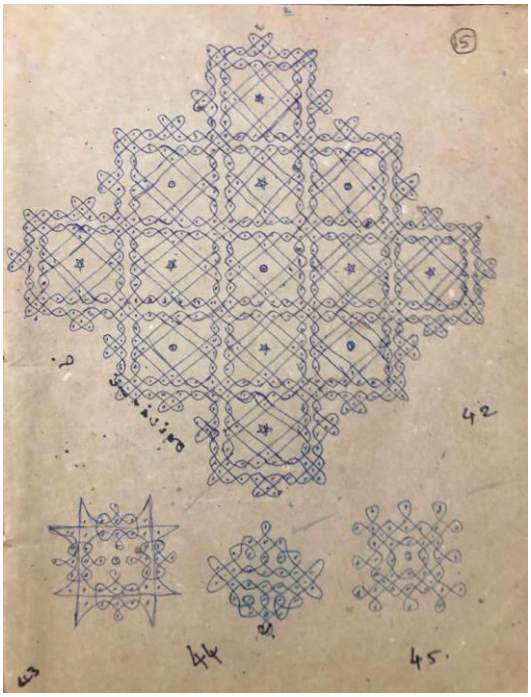

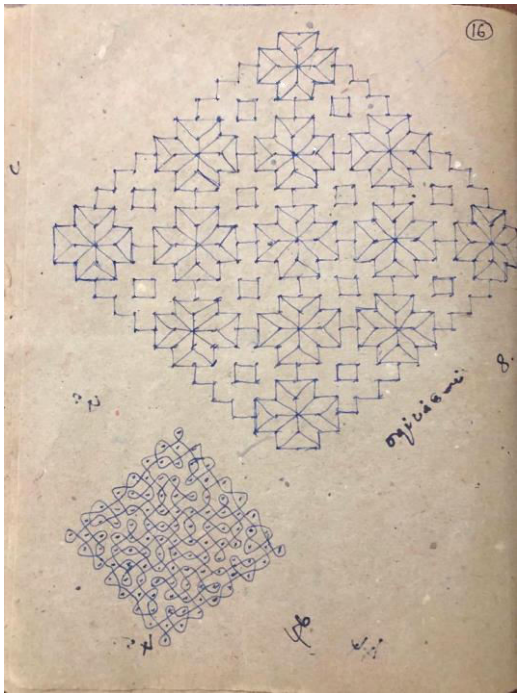

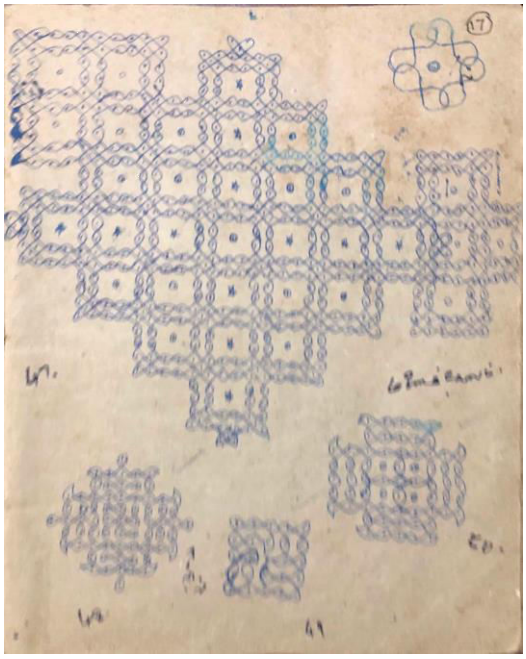

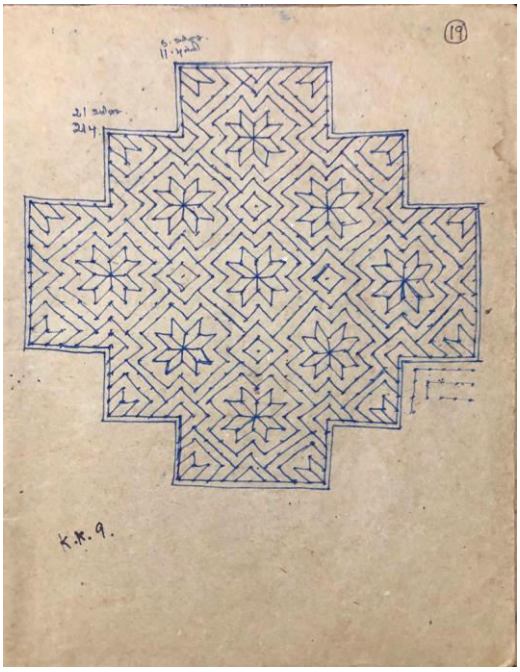

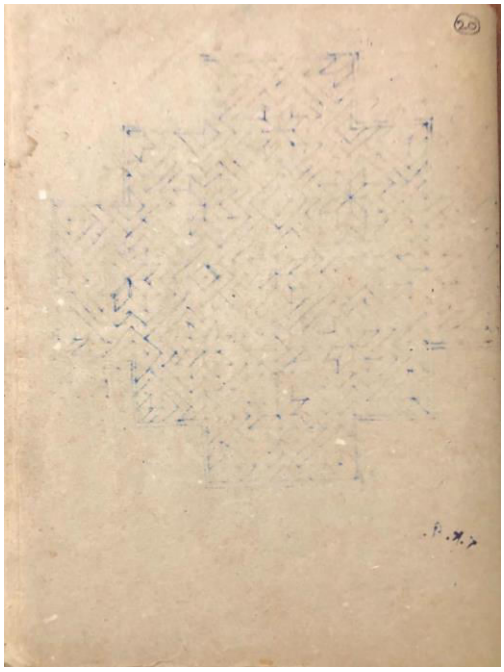

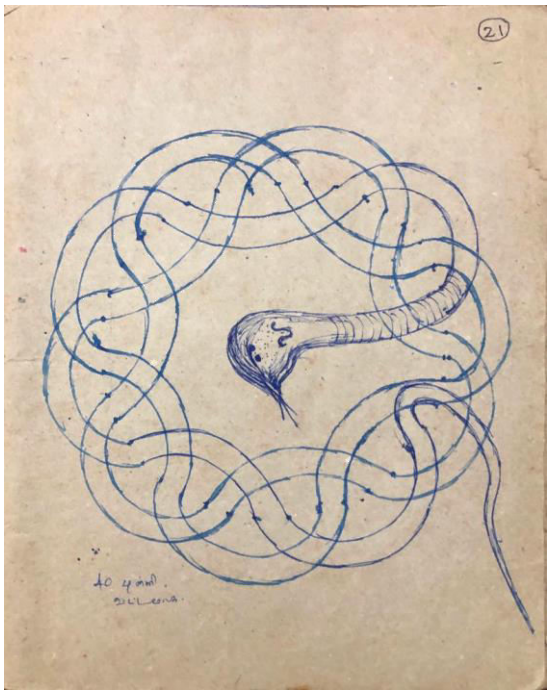
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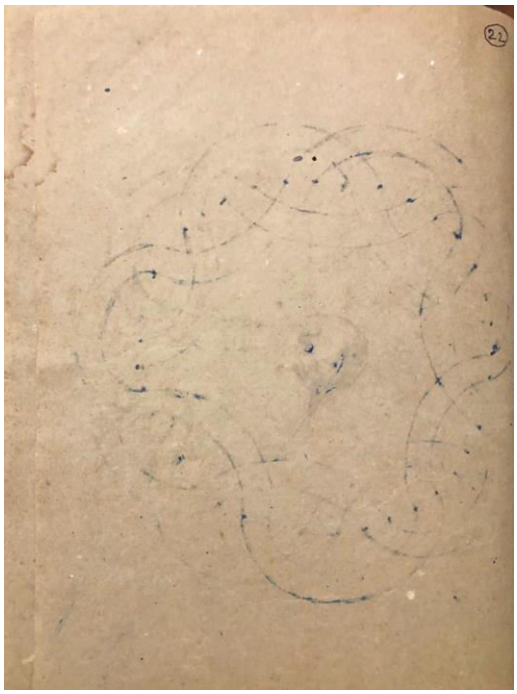
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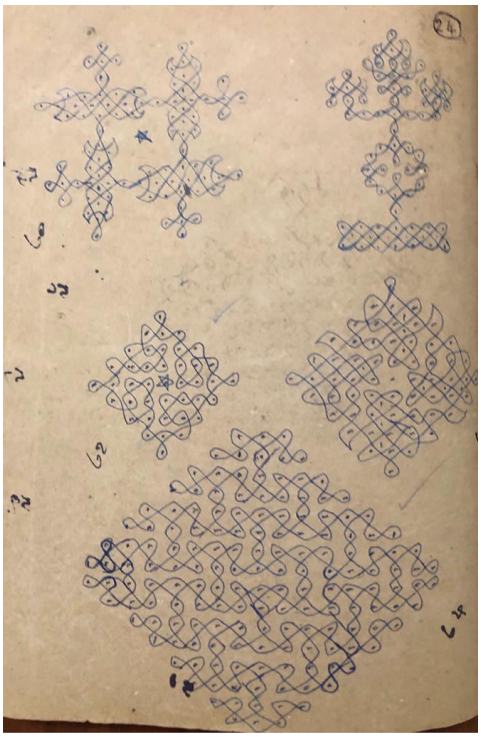
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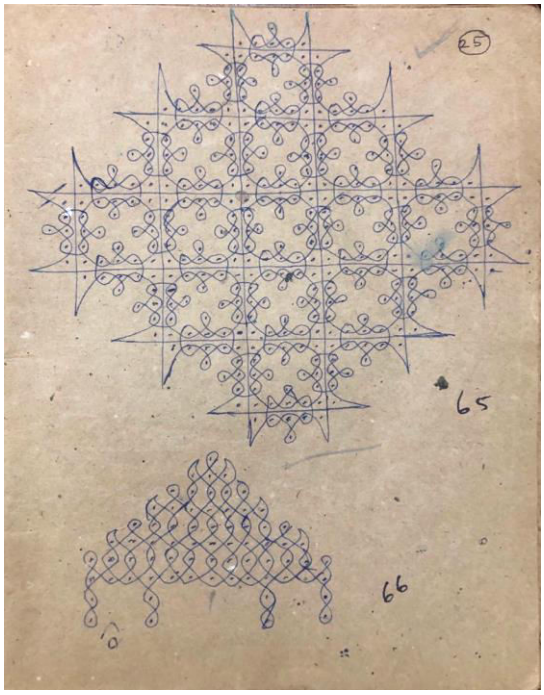
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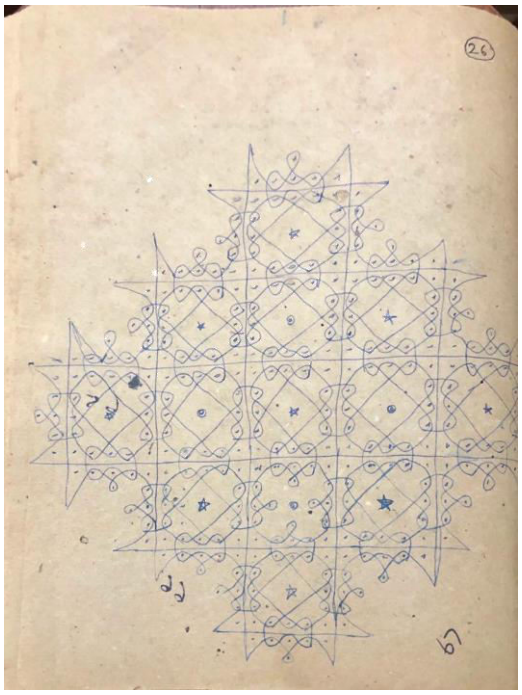
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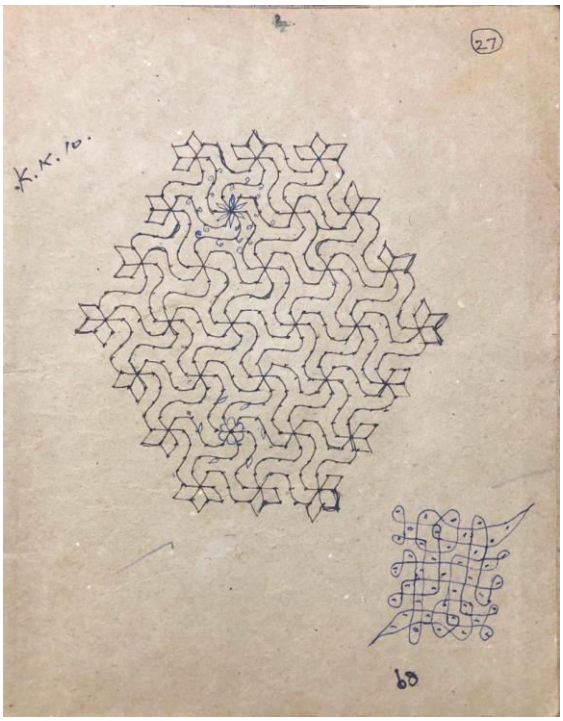
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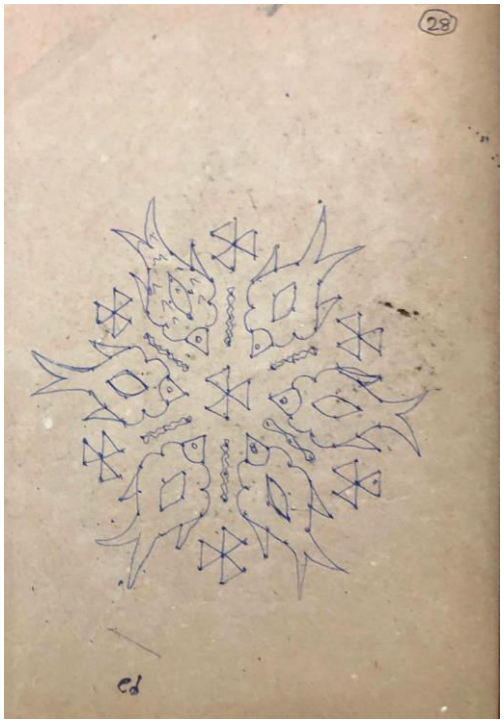
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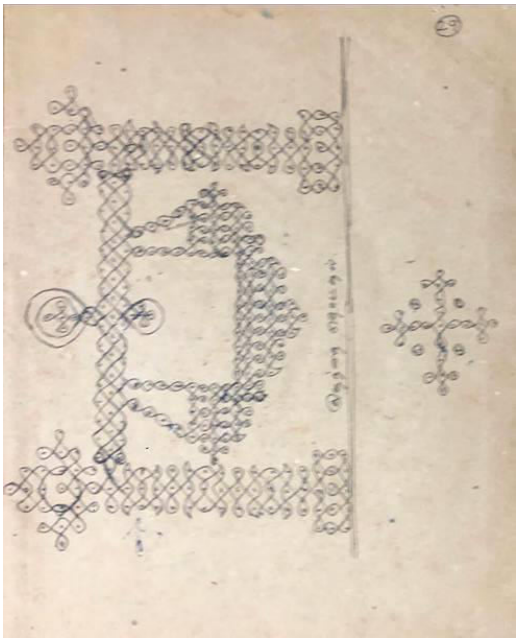
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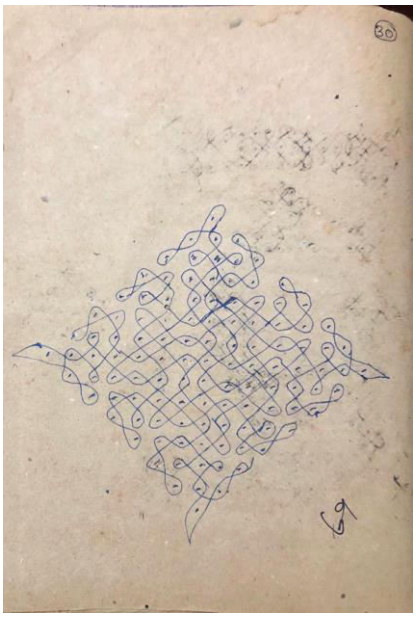
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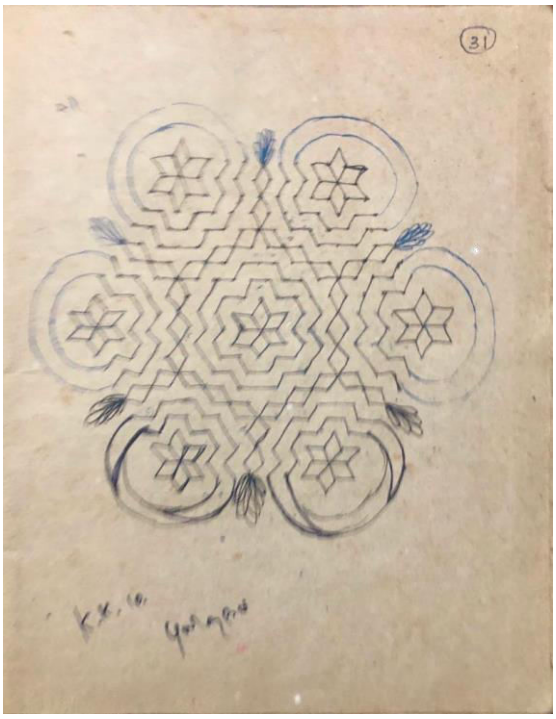
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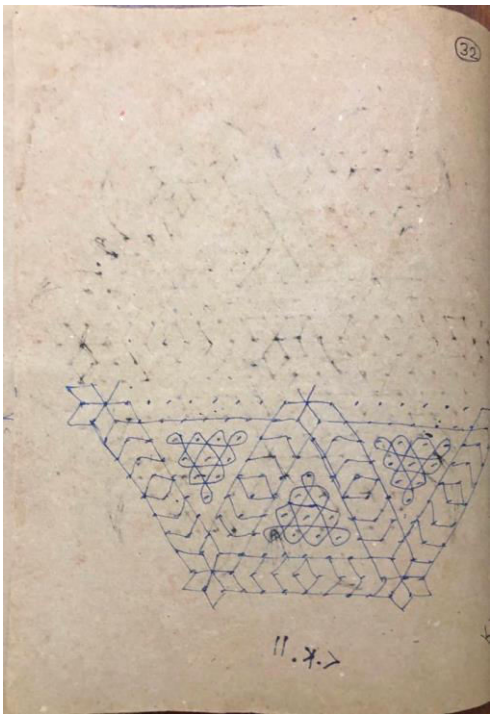
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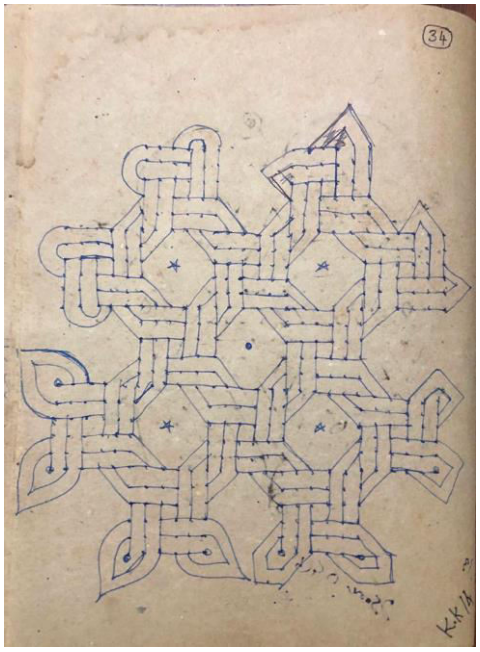
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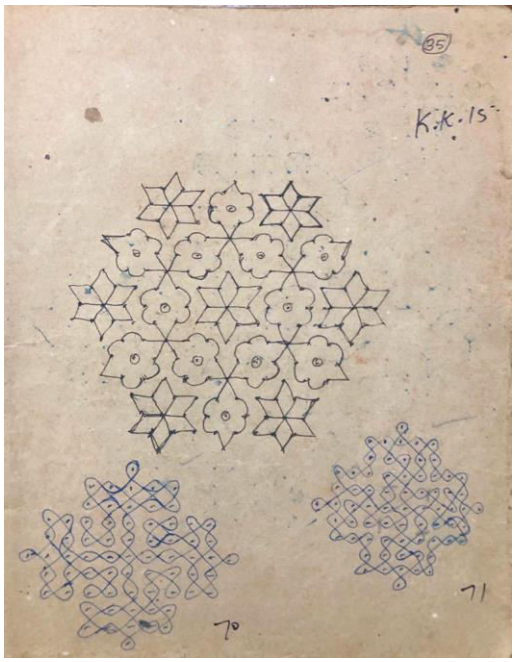
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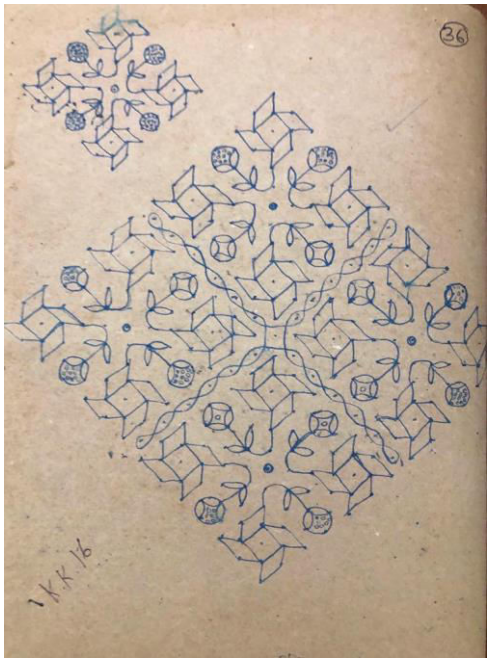
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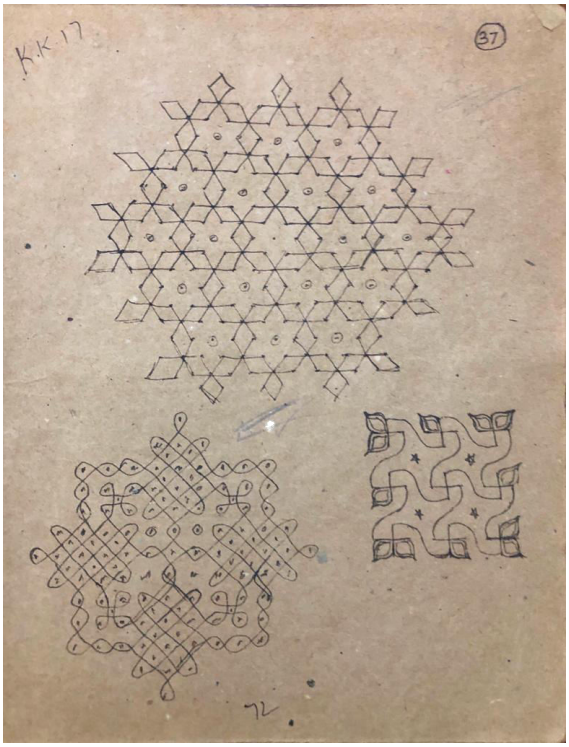

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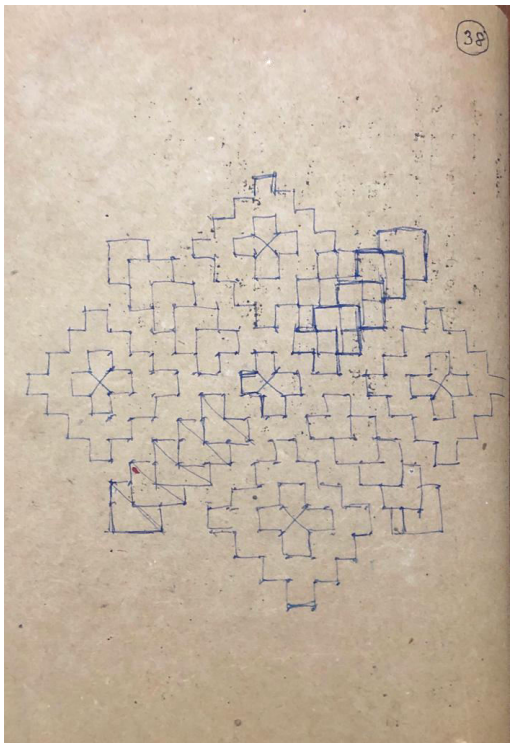

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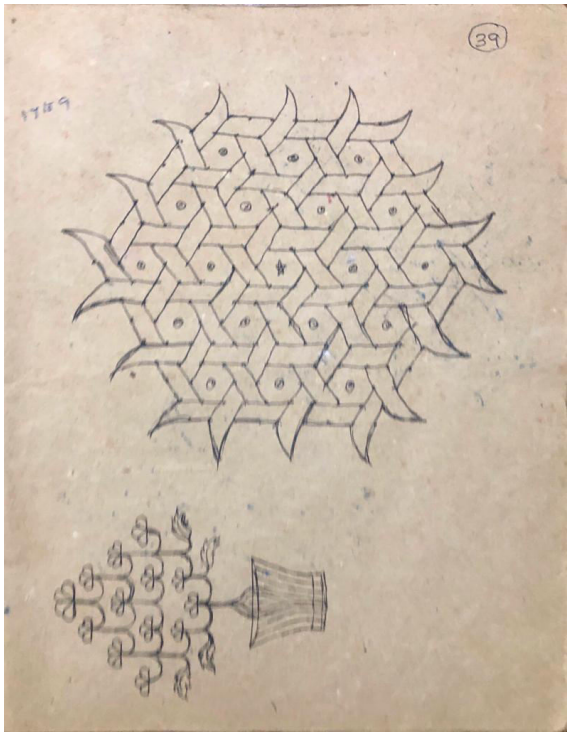

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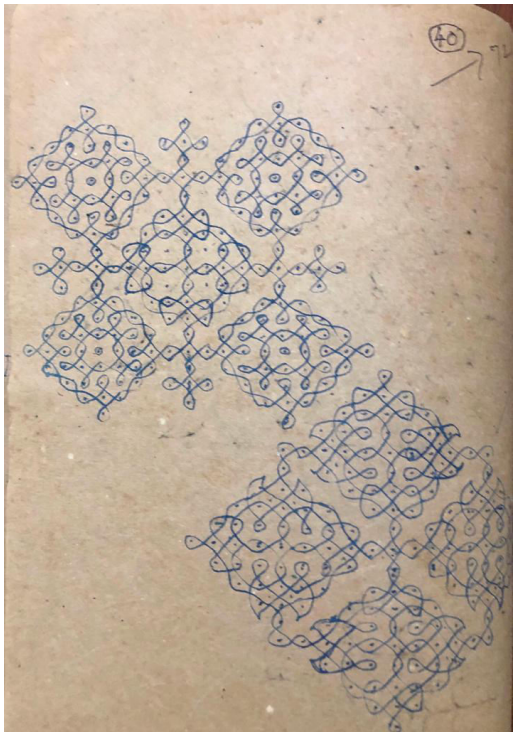


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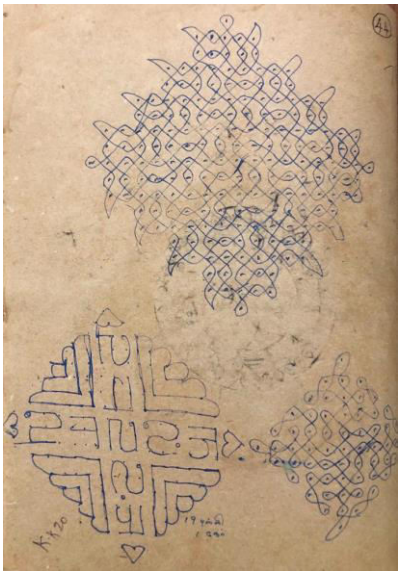
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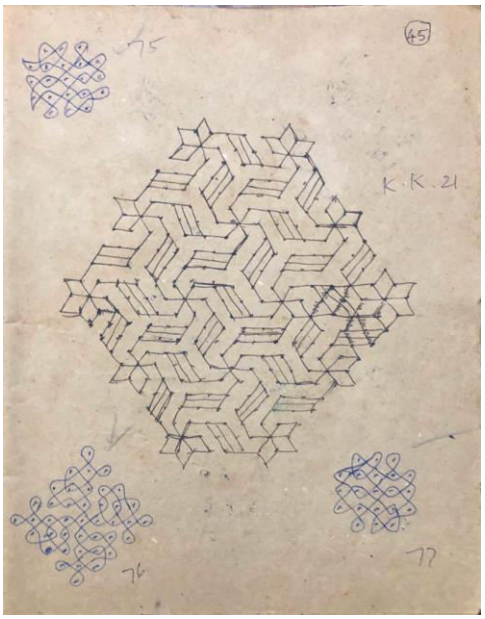
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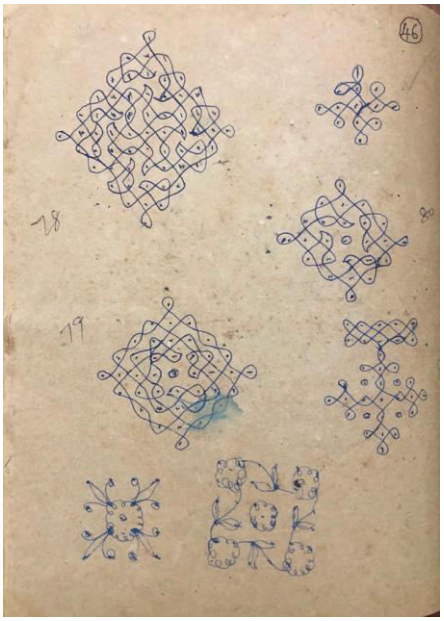
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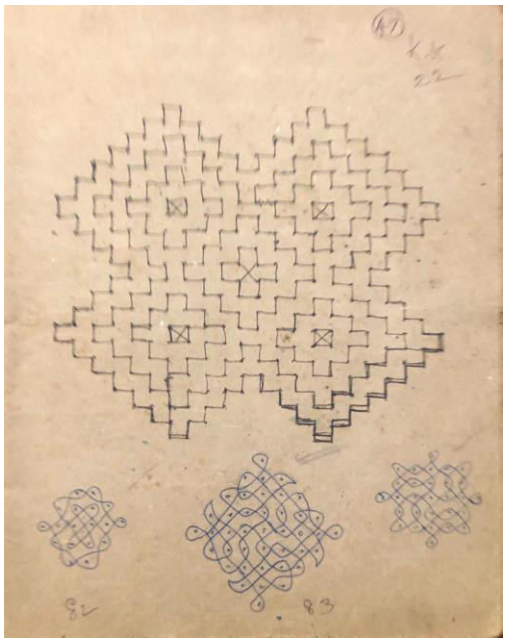
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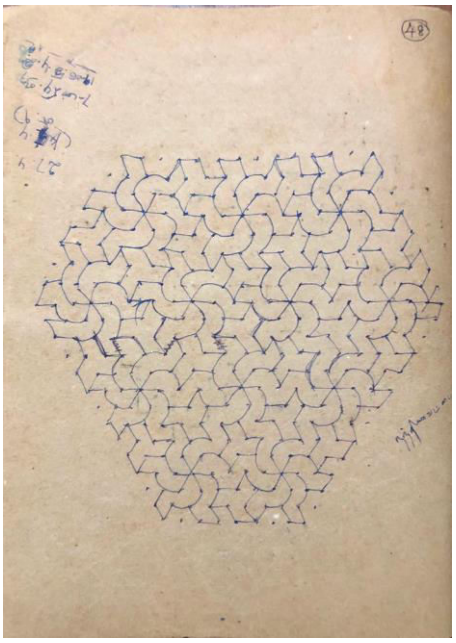
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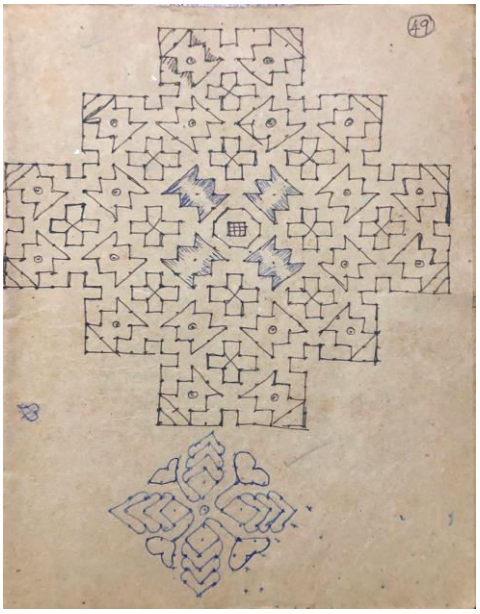
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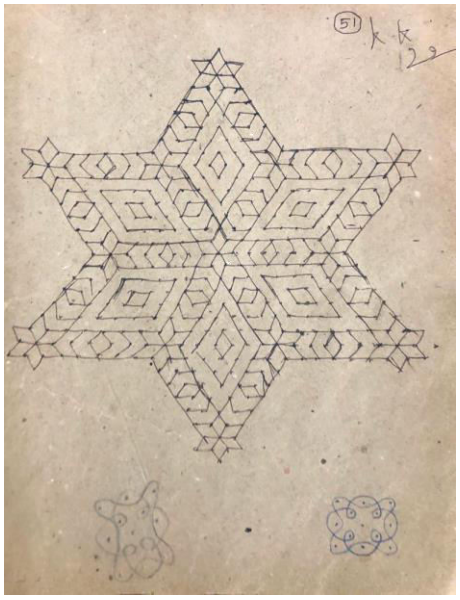
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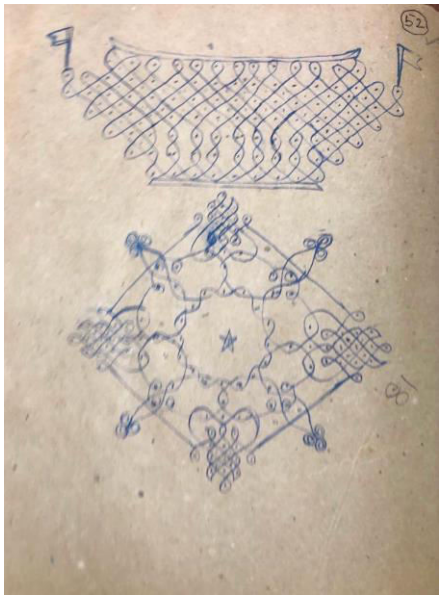
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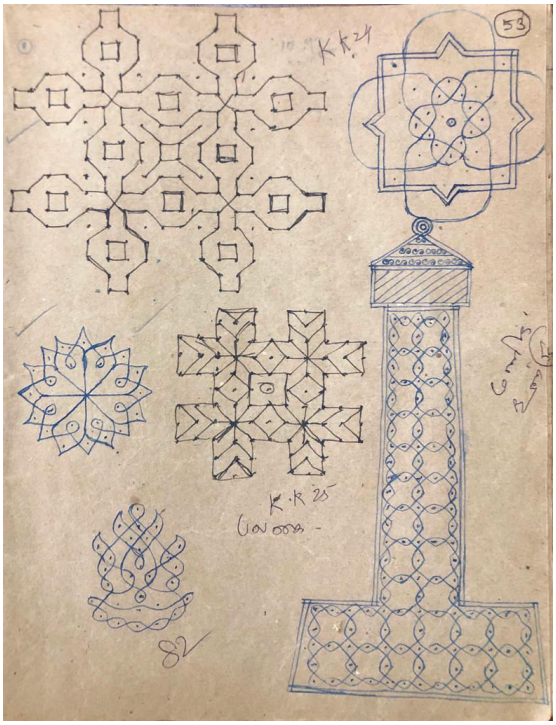
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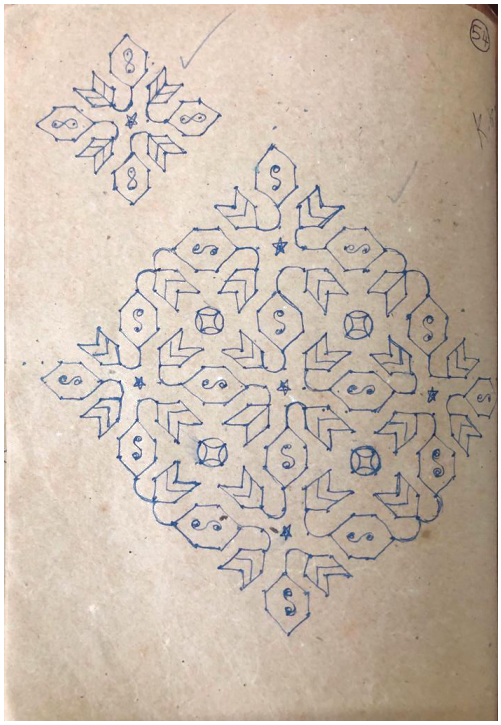
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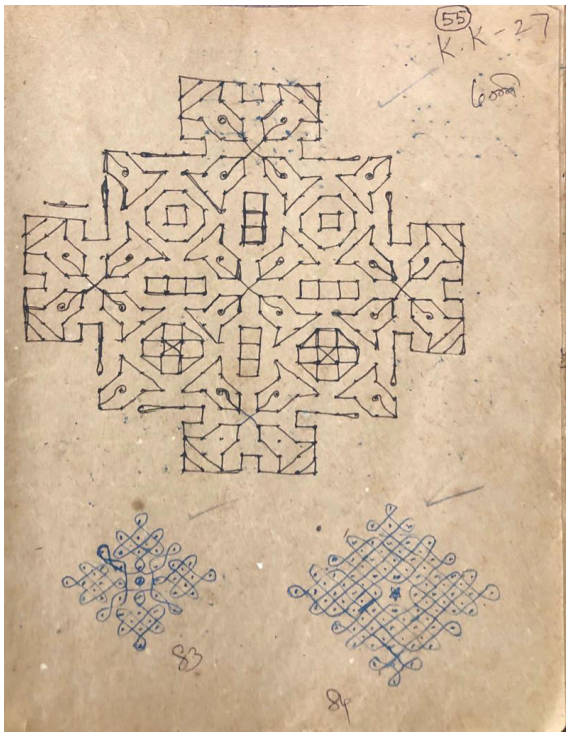
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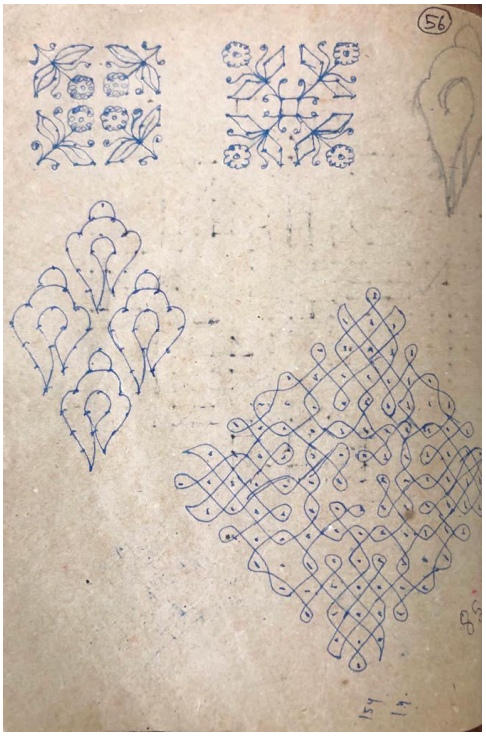
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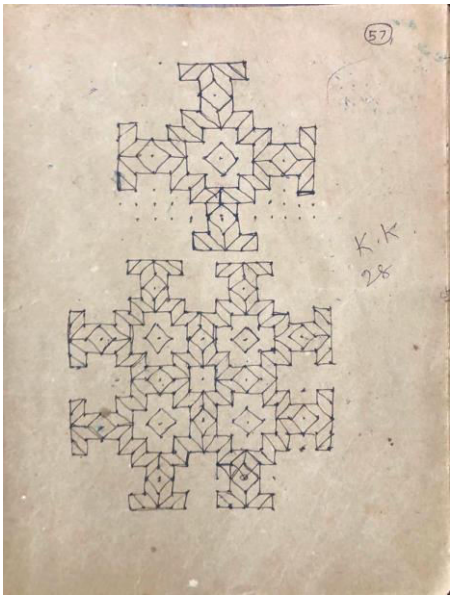
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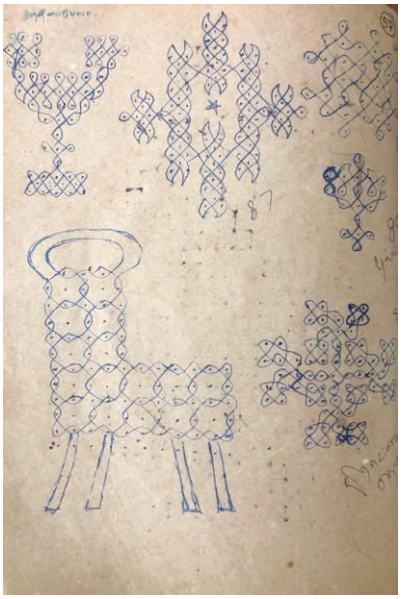


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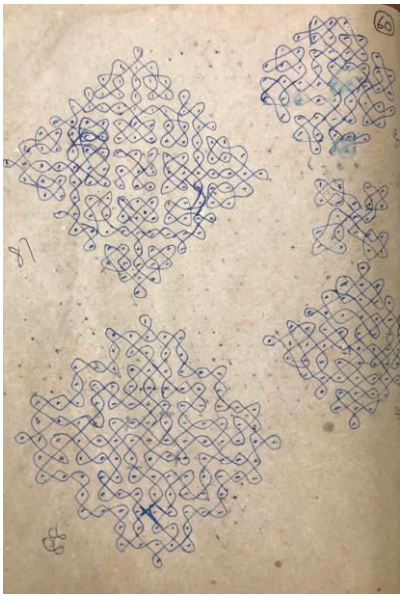
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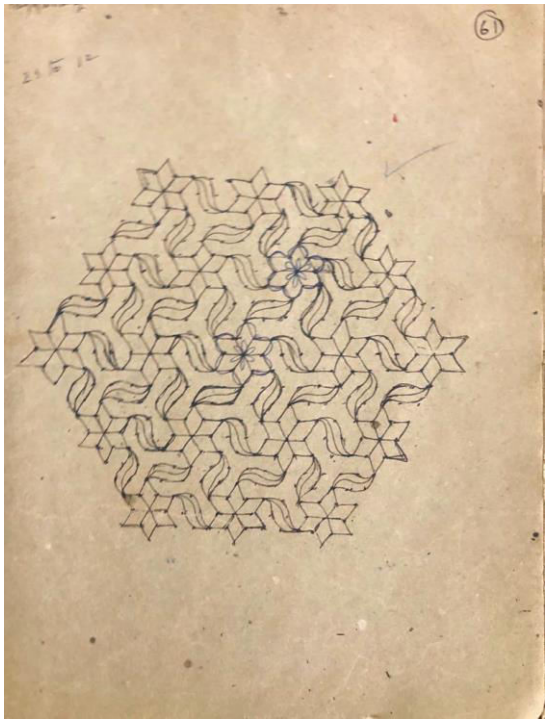
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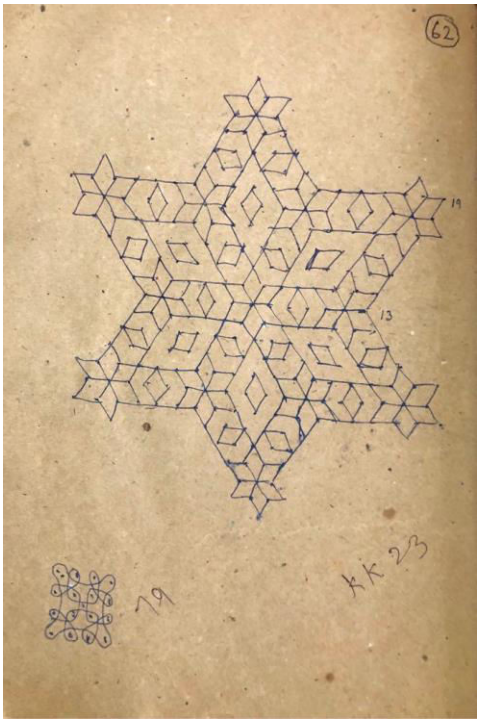
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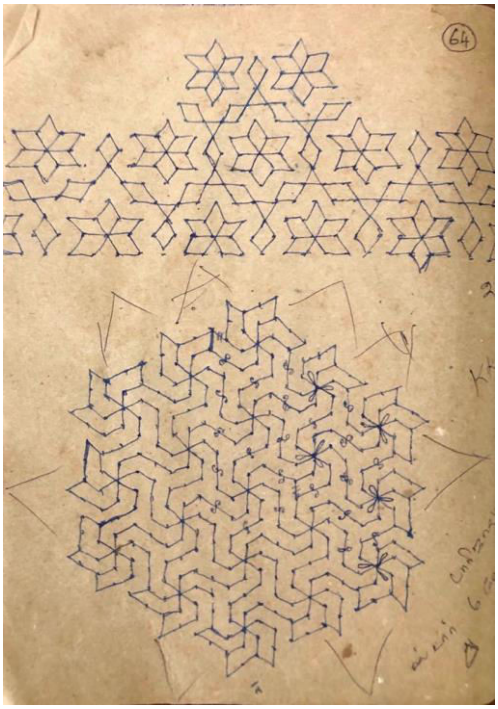
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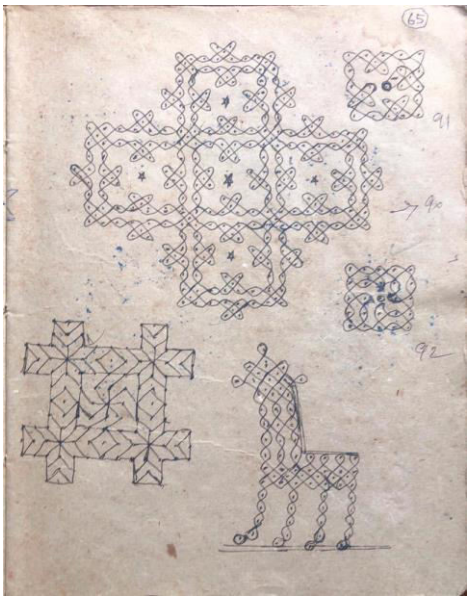

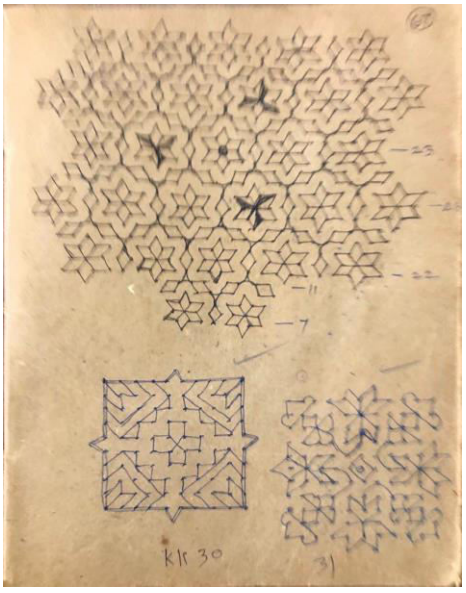

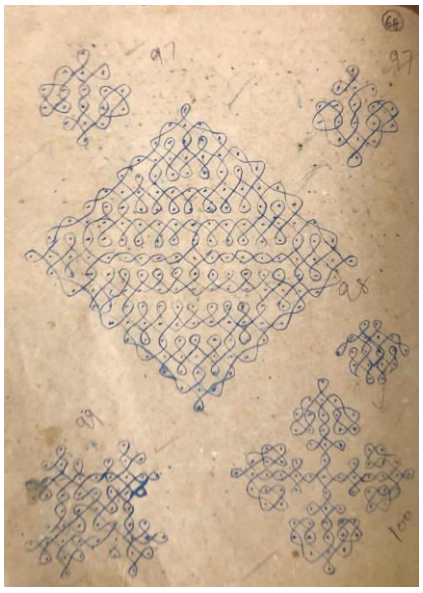

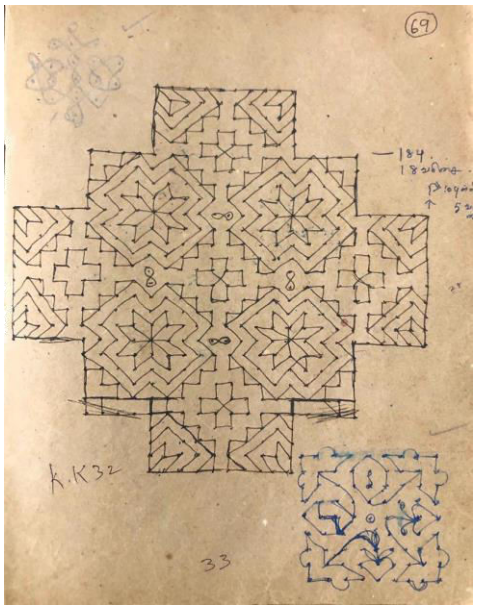
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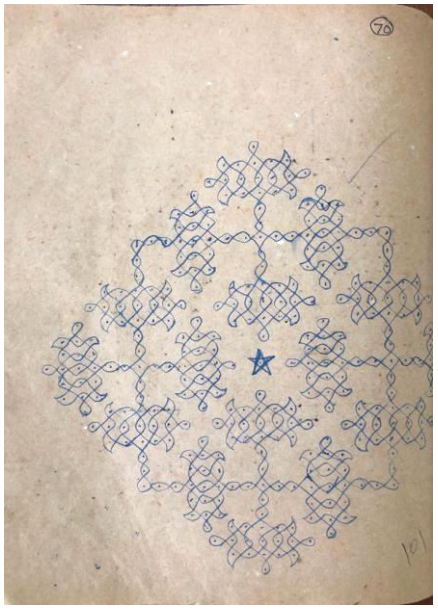
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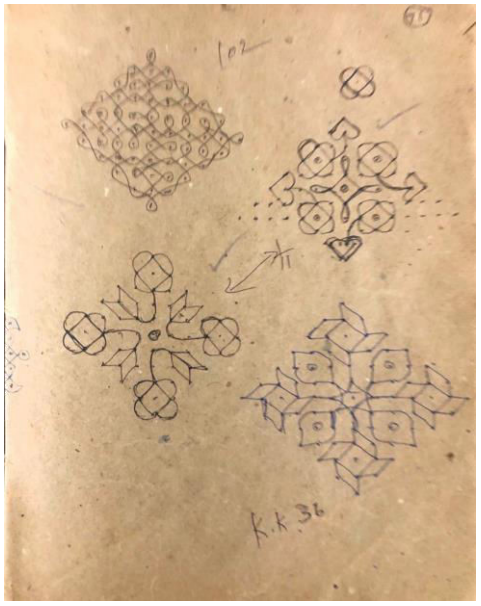
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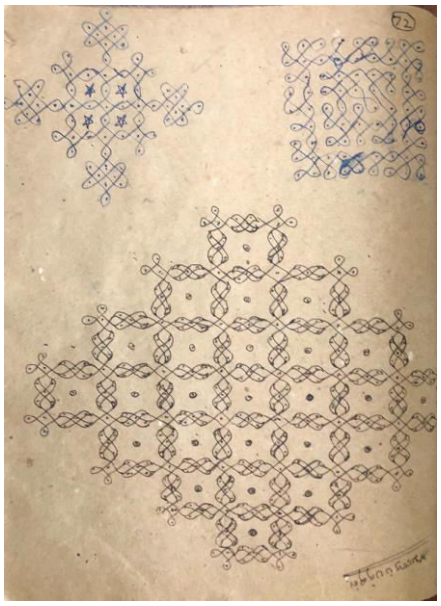
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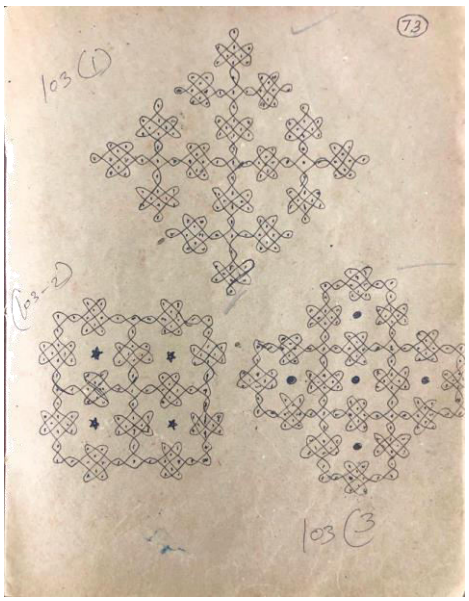
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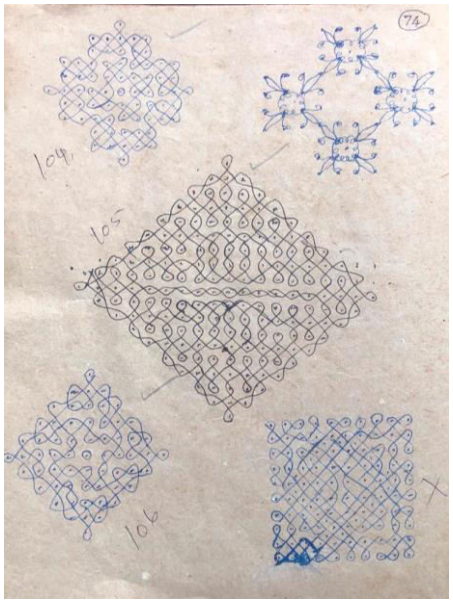
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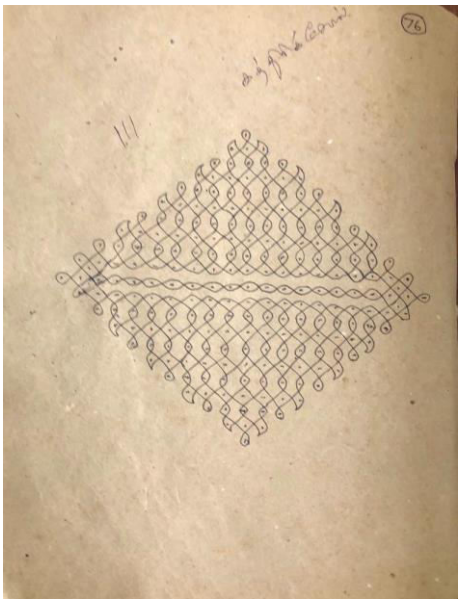
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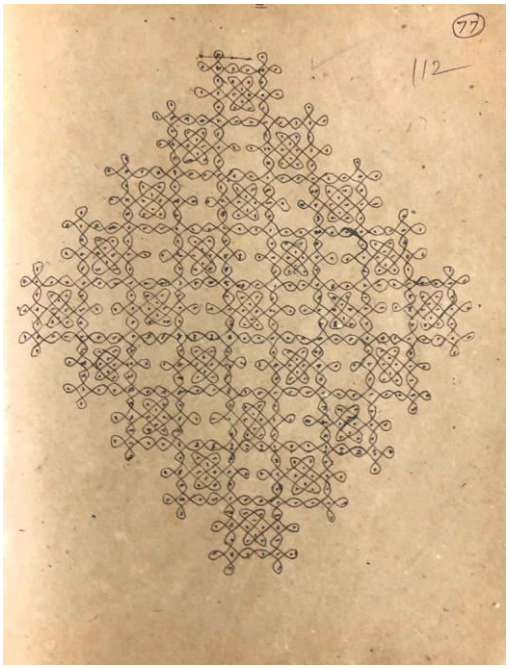
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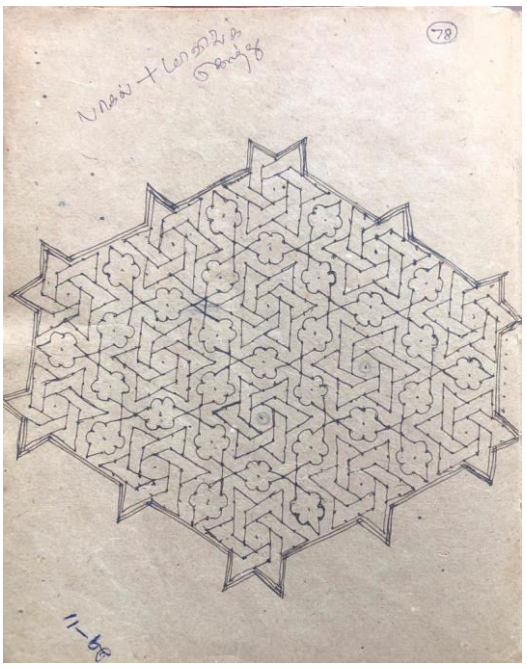
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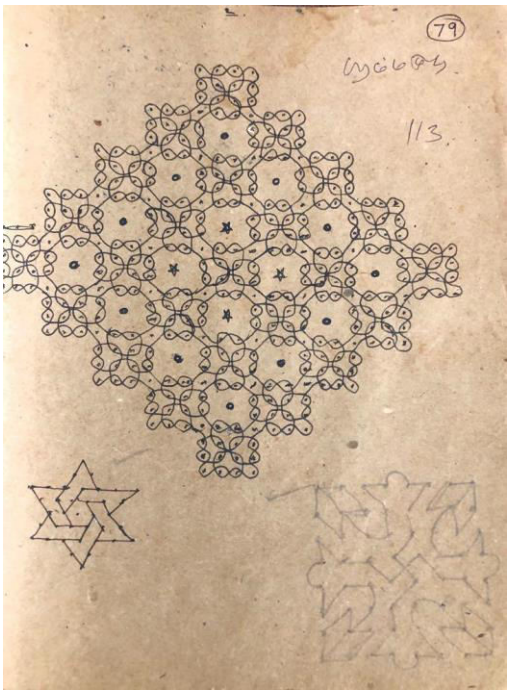
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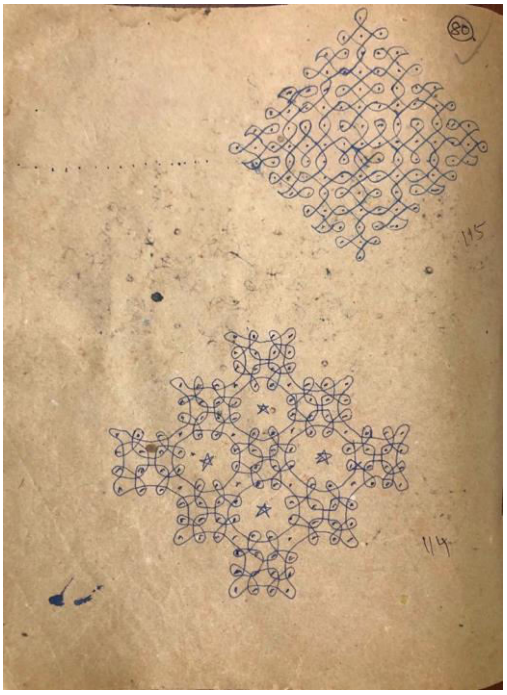
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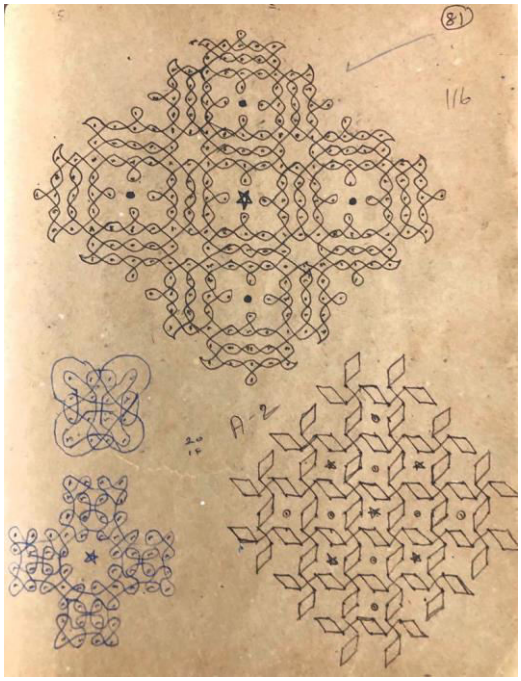
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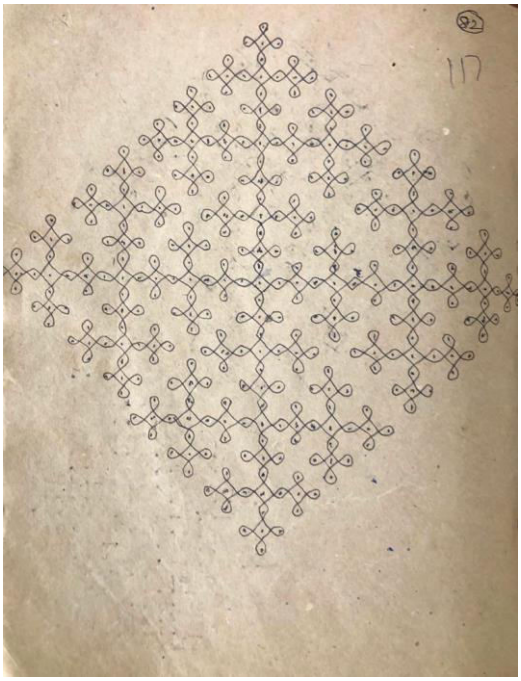
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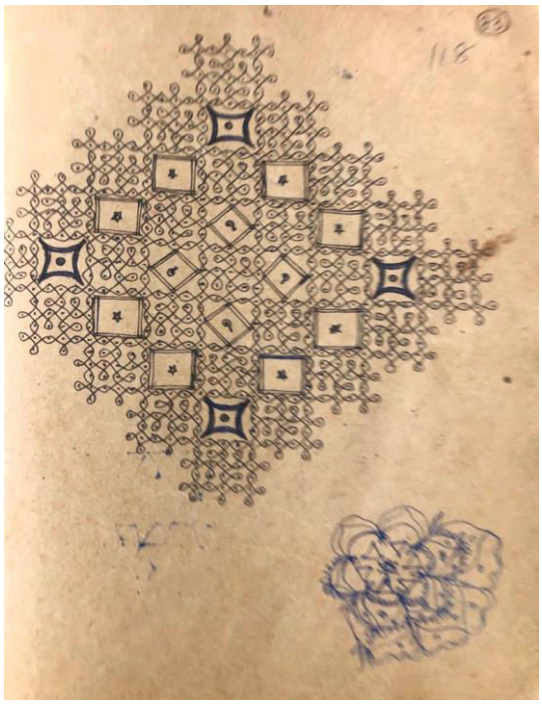
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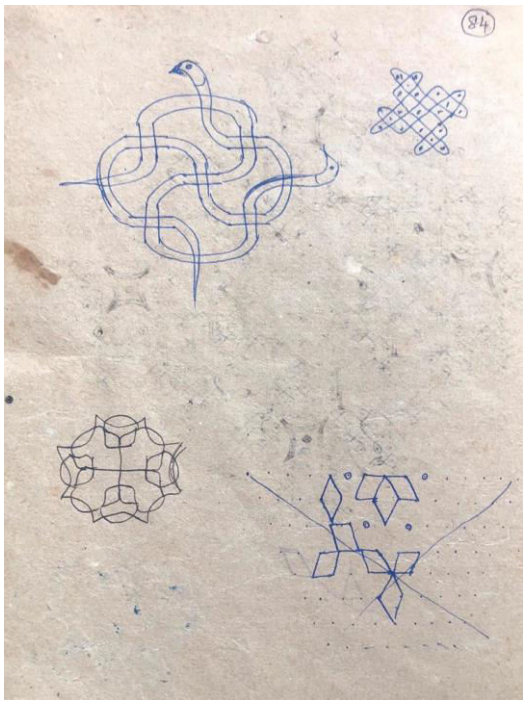
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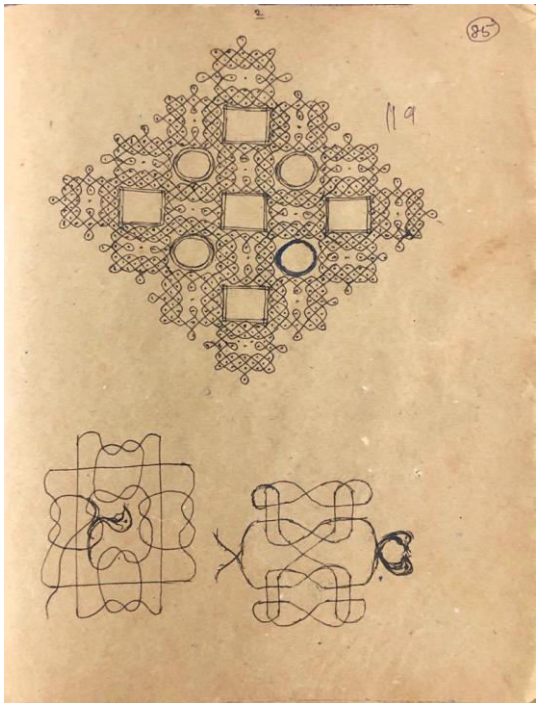
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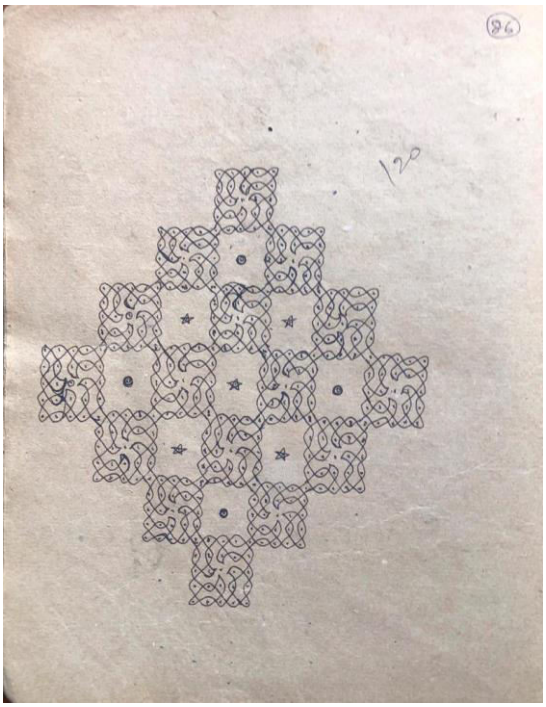
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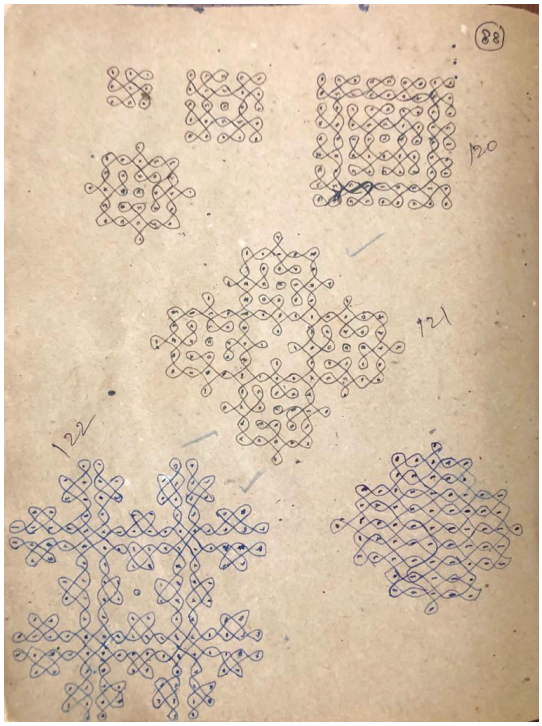
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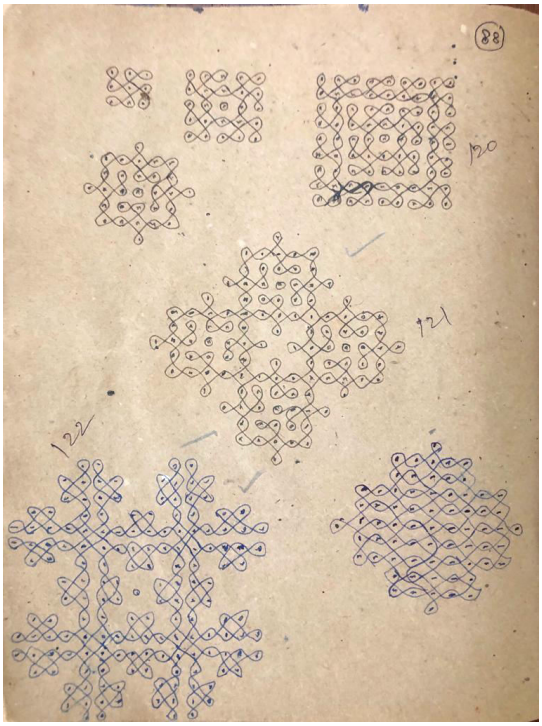
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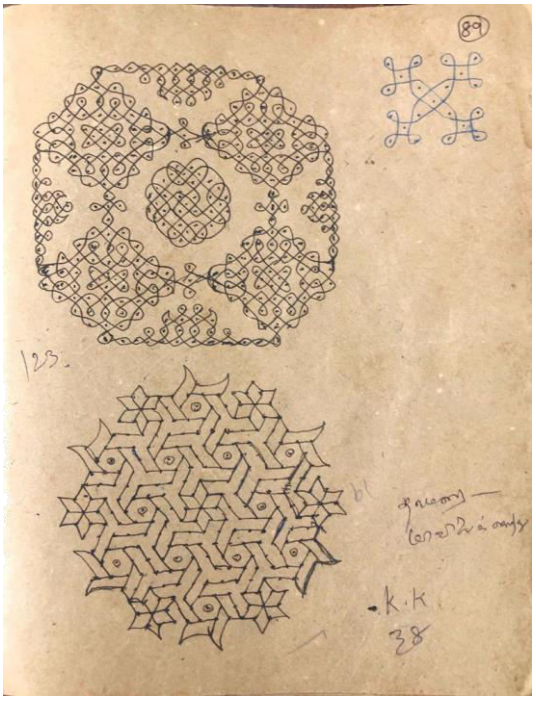
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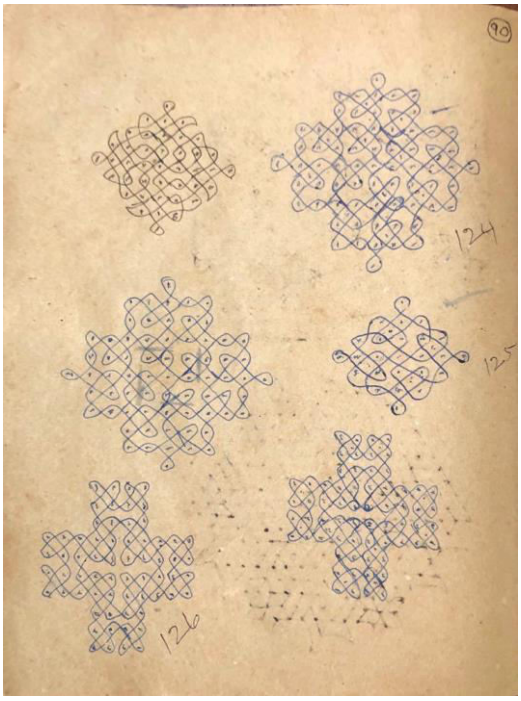
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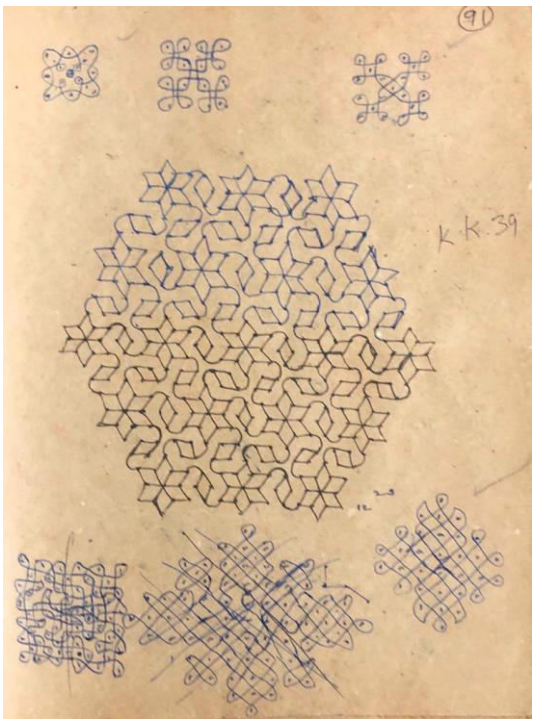
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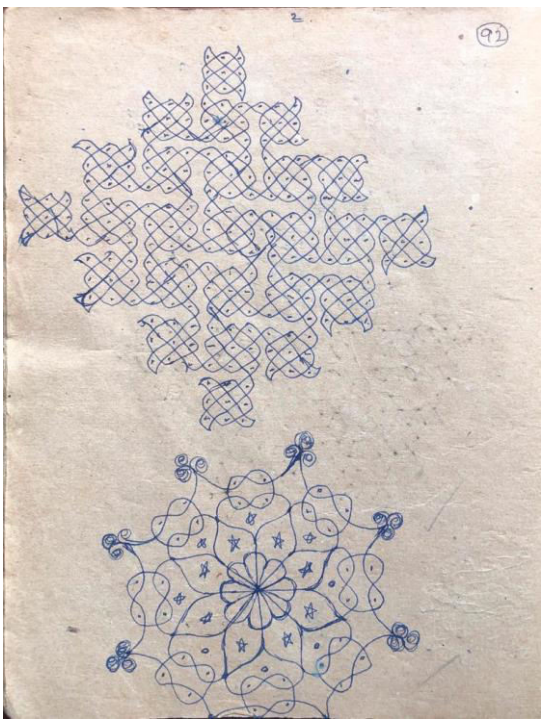
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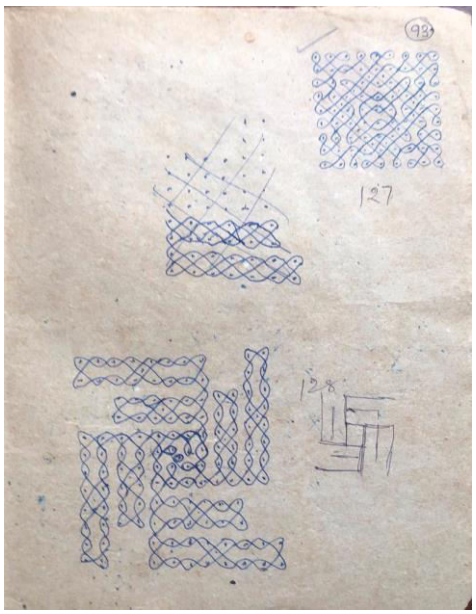
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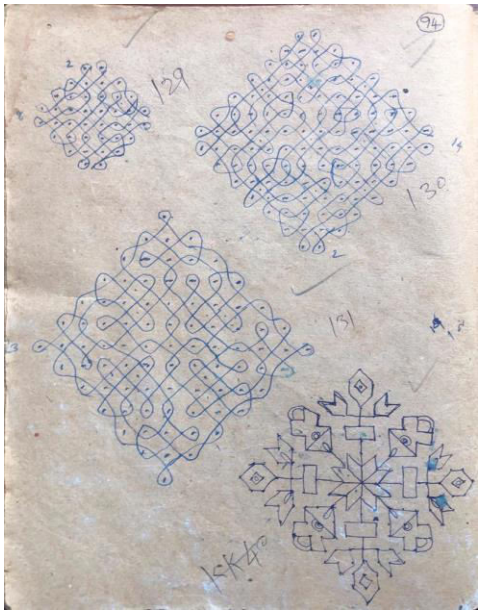
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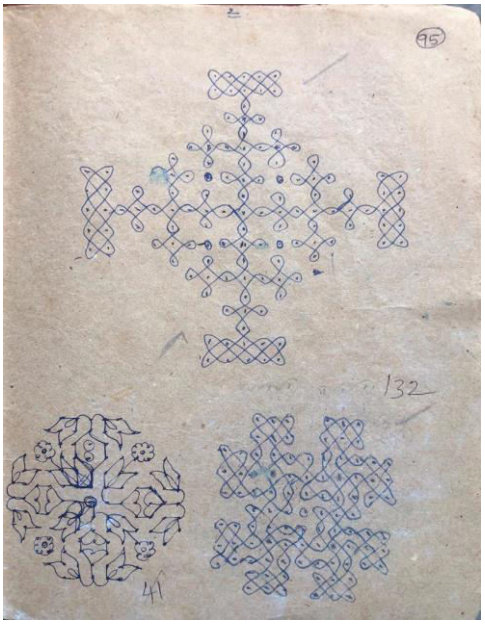
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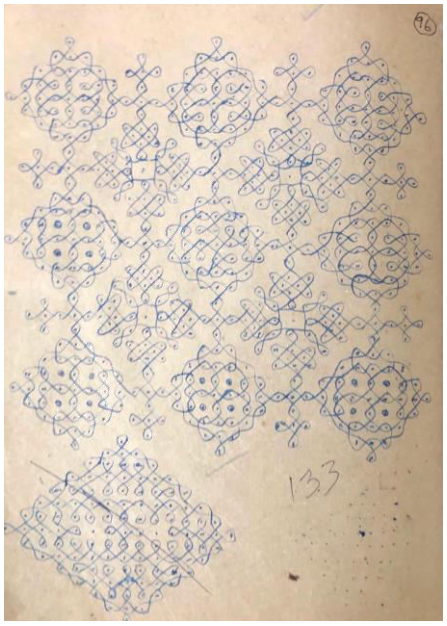
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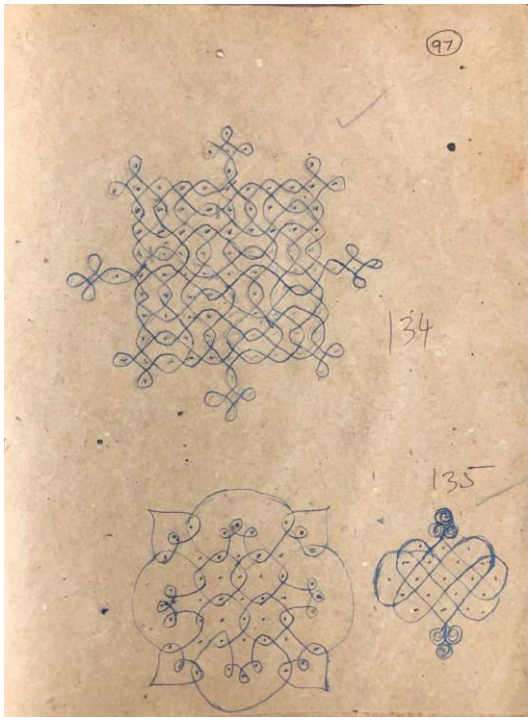
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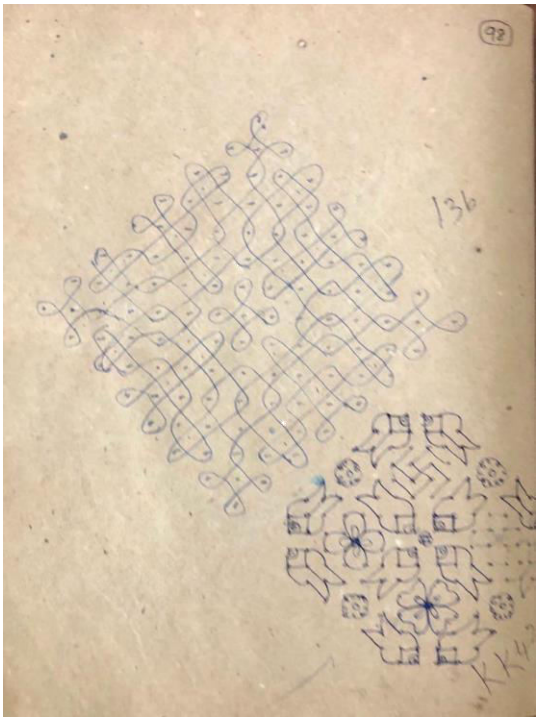
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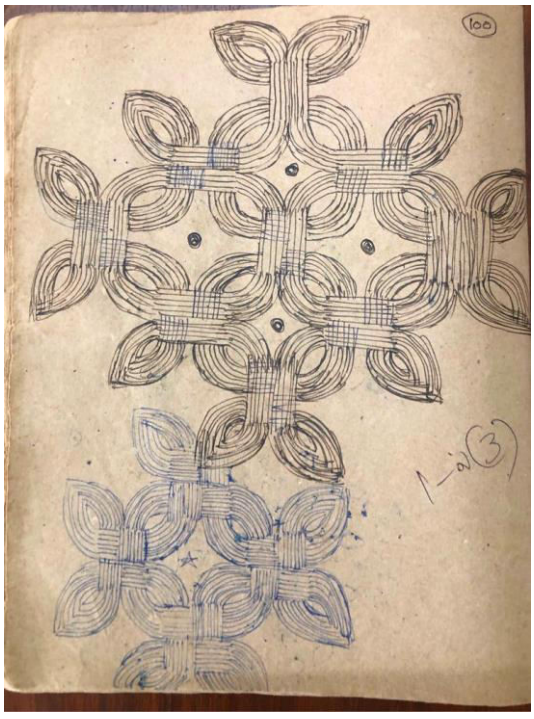
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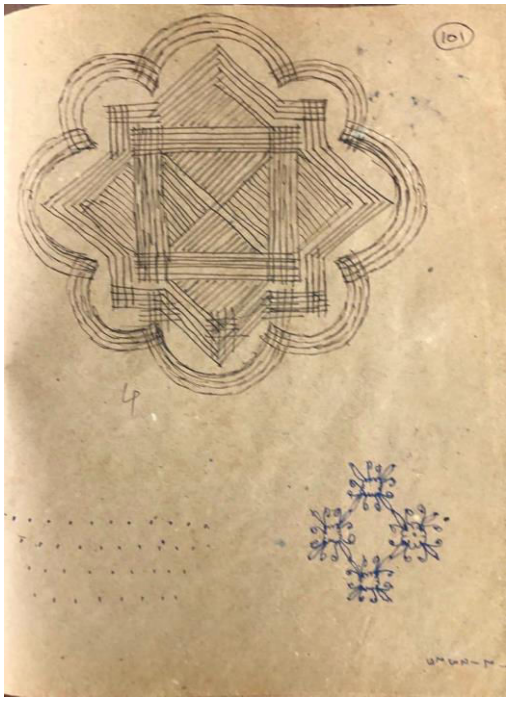
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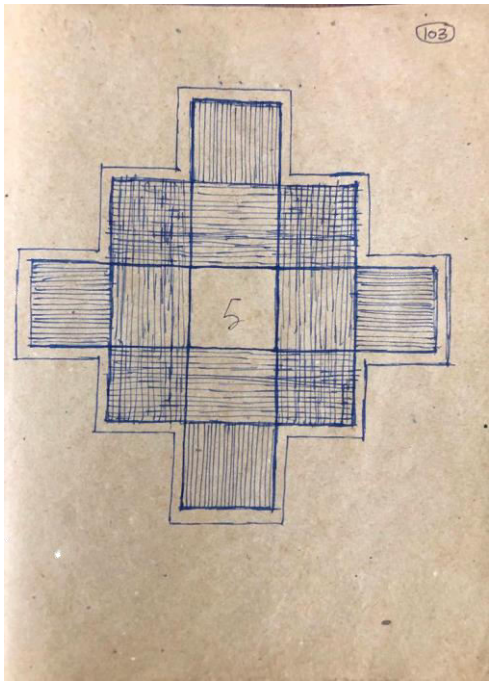
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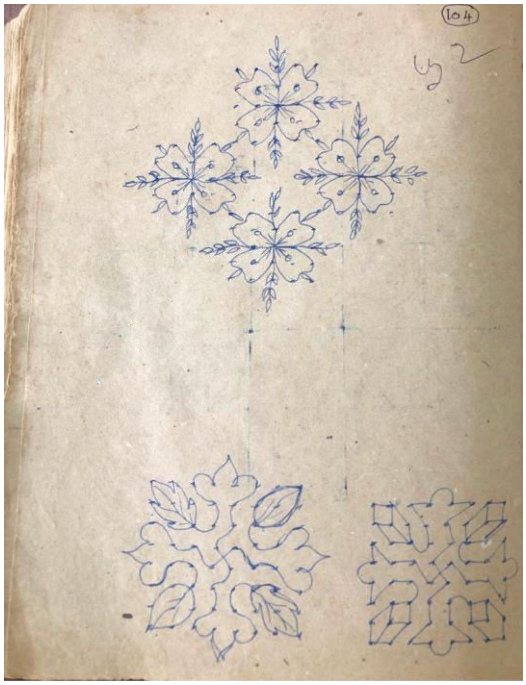
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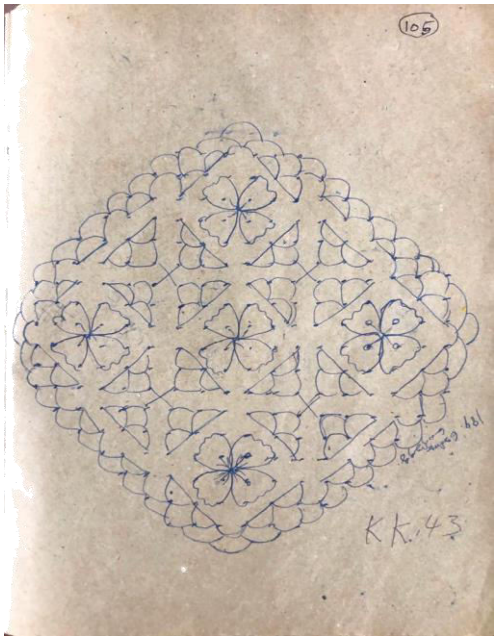
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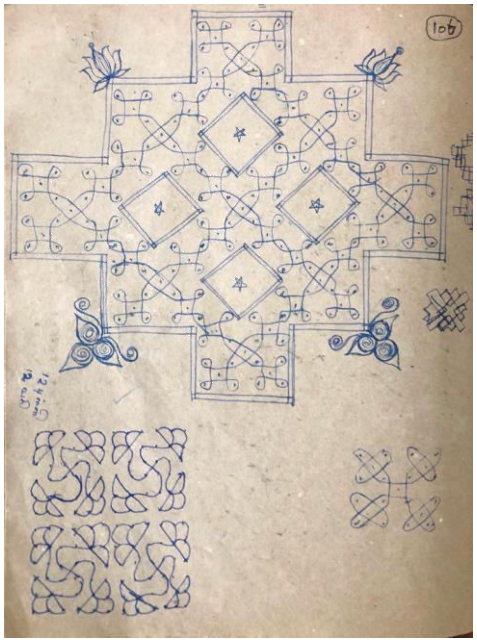
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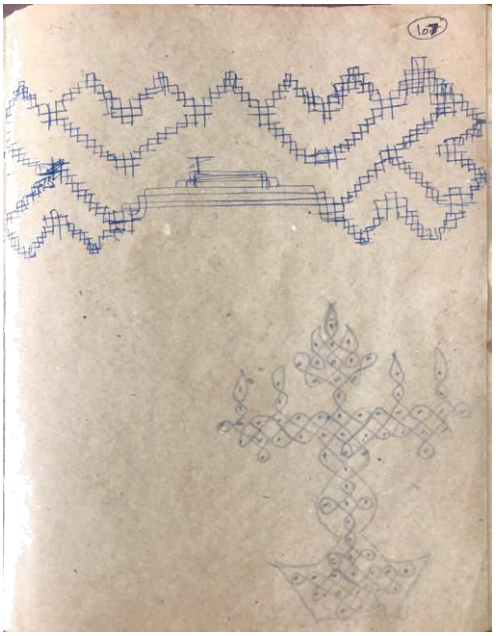
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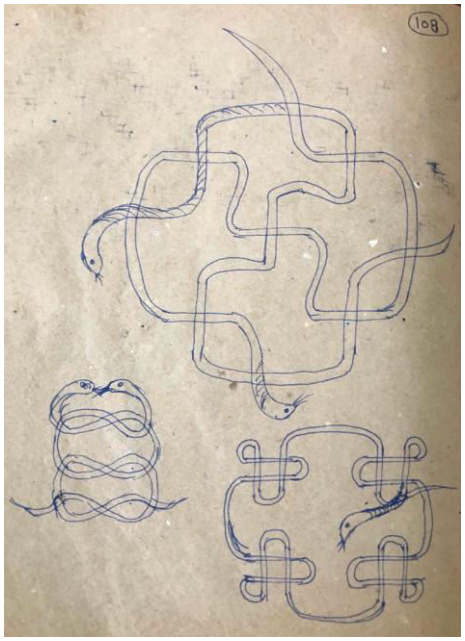
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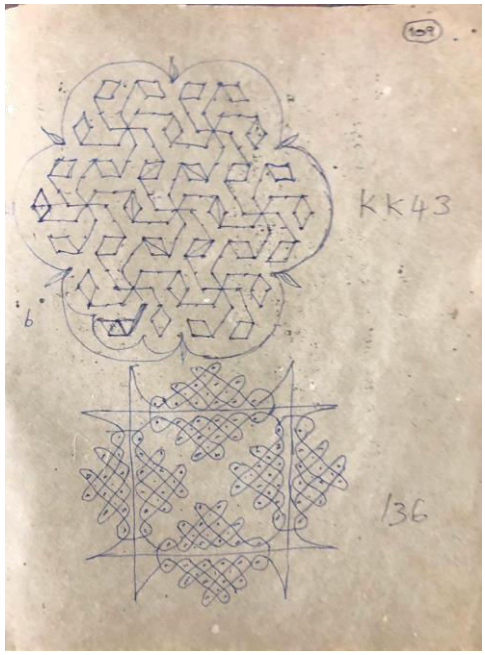
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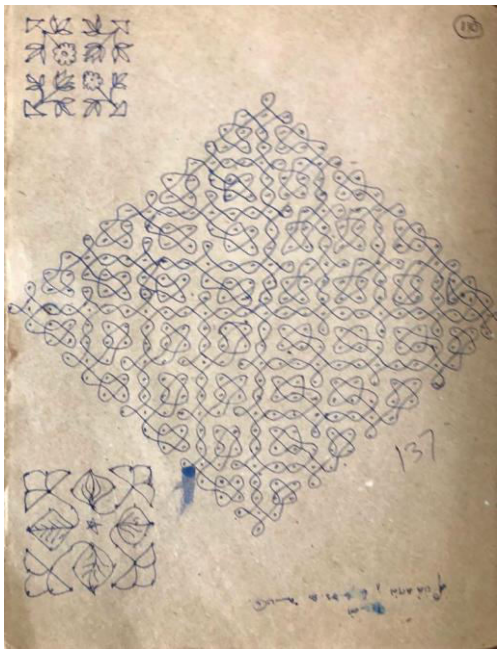
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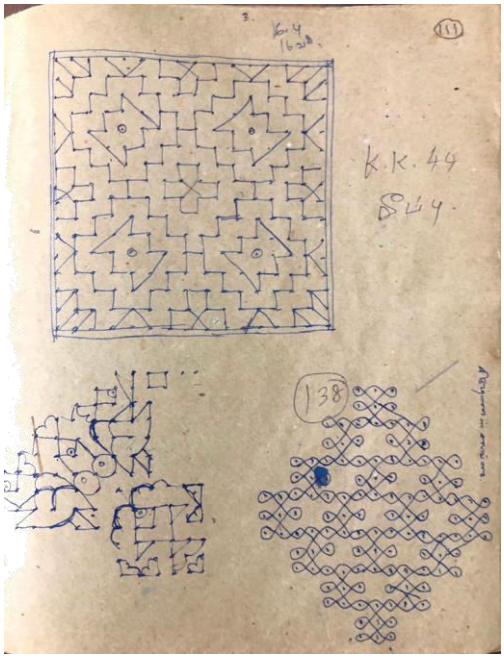
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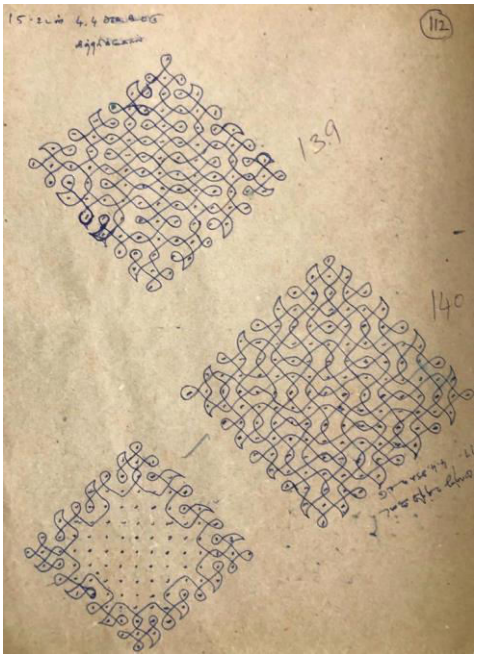
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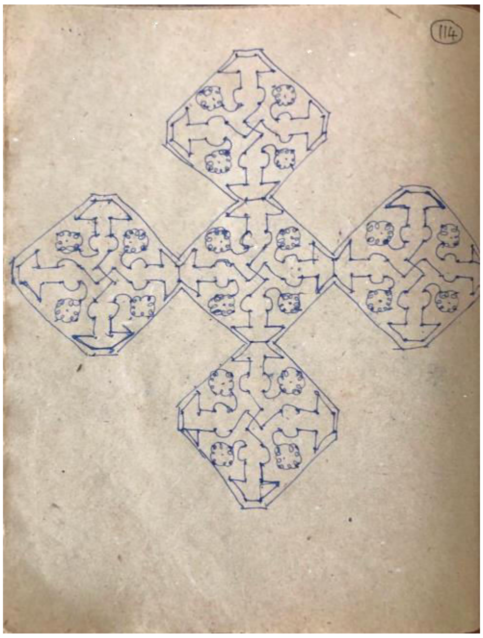
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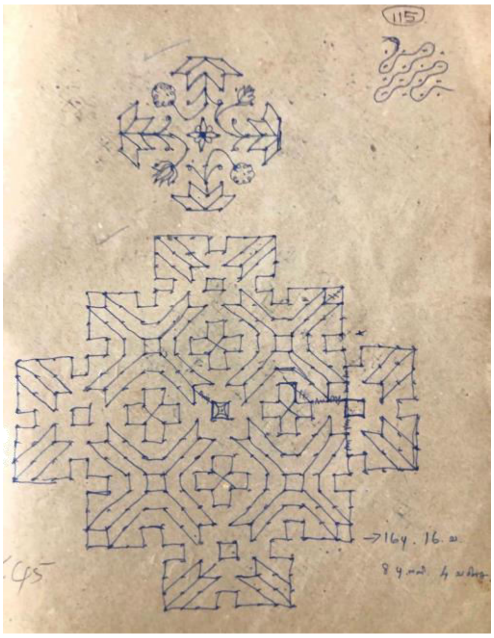
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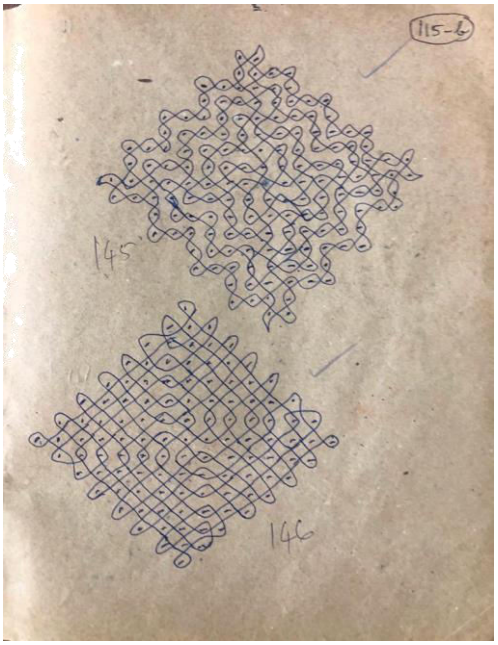
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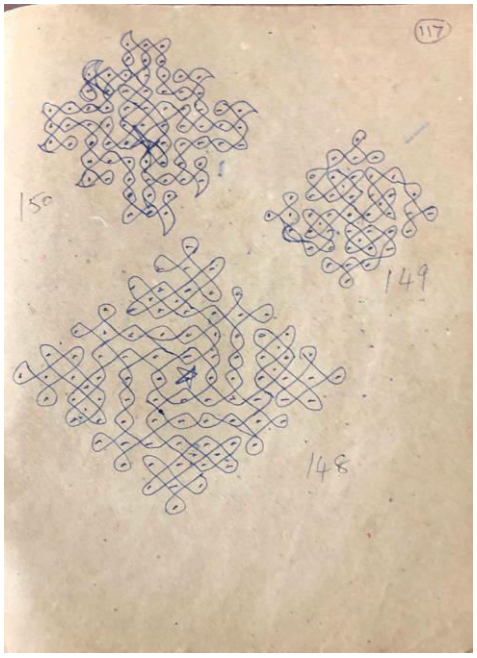
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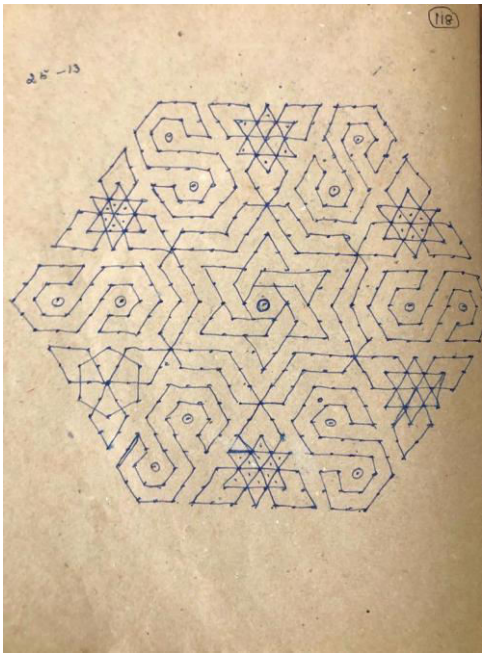
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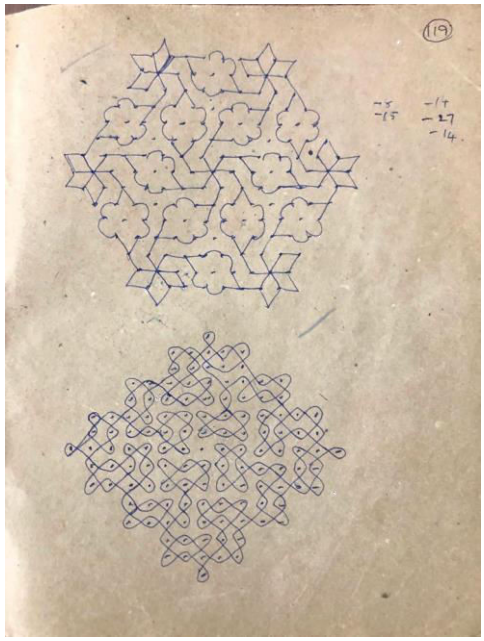
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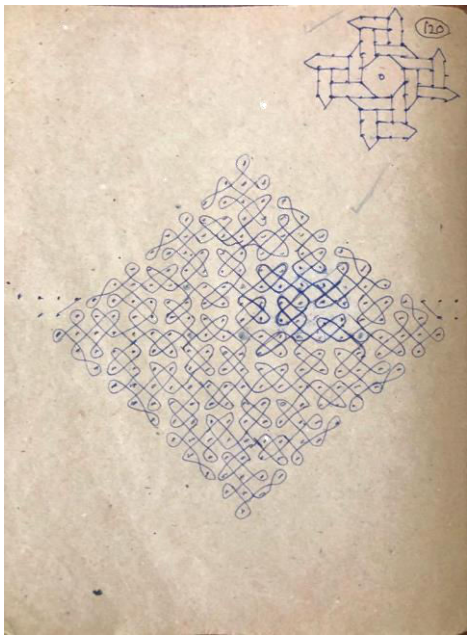
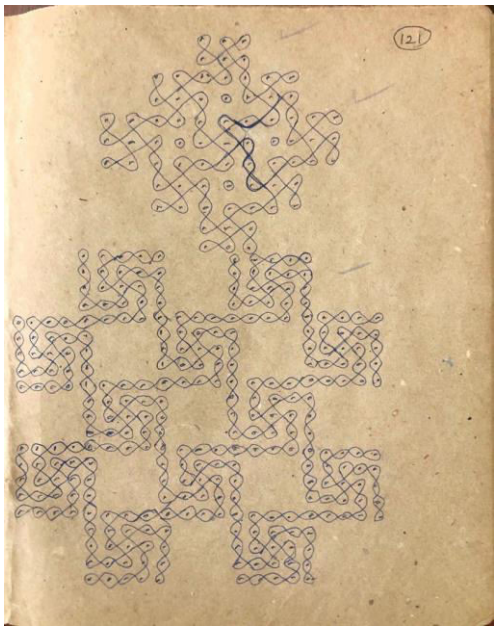

120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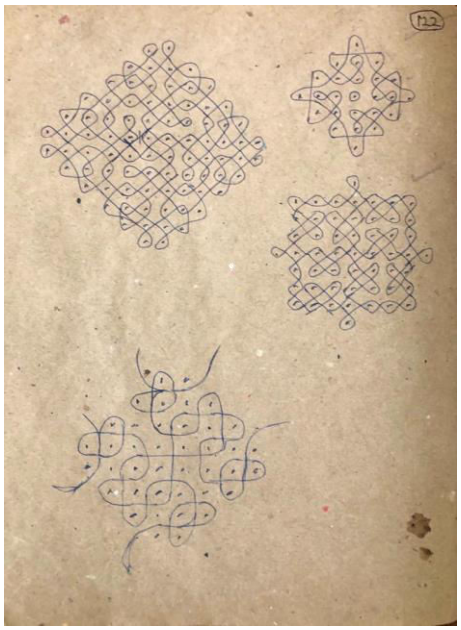
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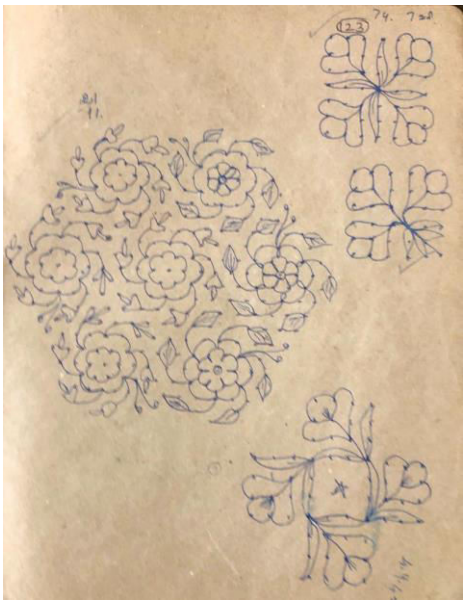
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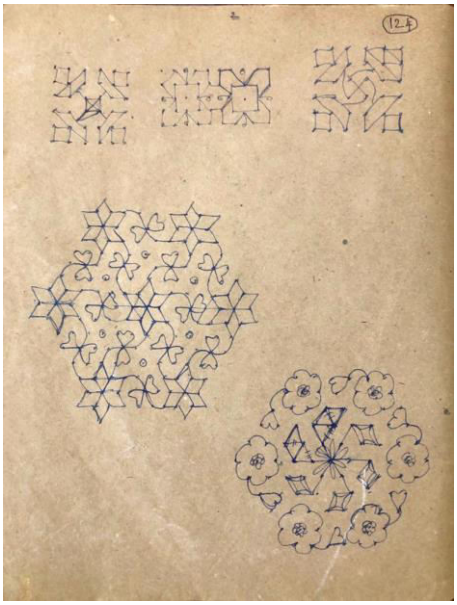
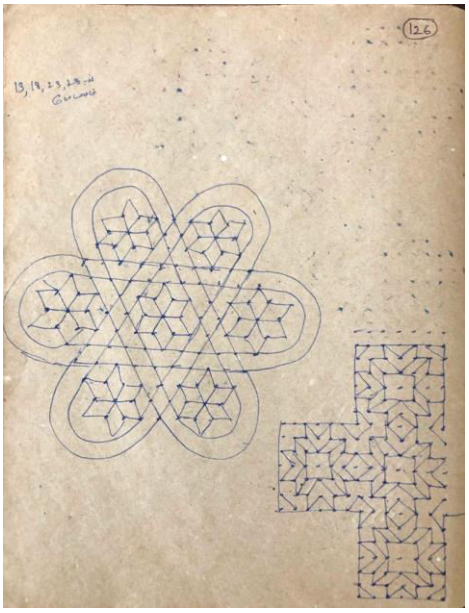

12.4


12.5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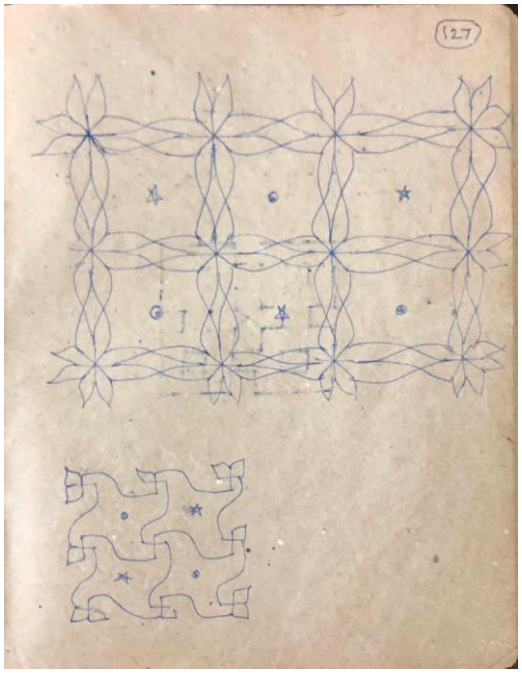
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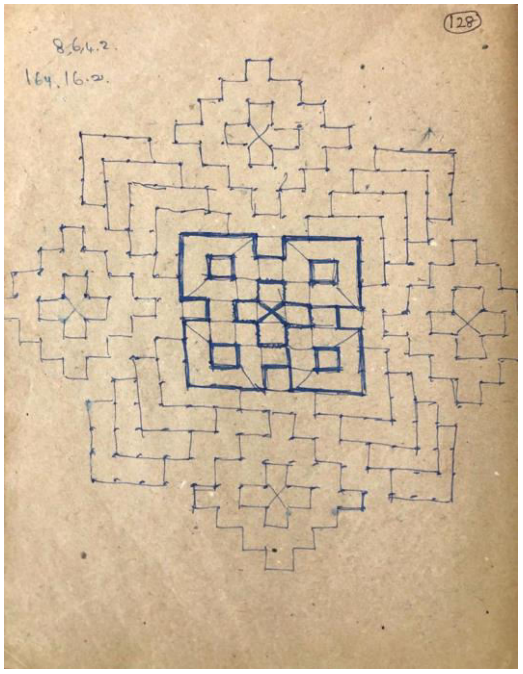
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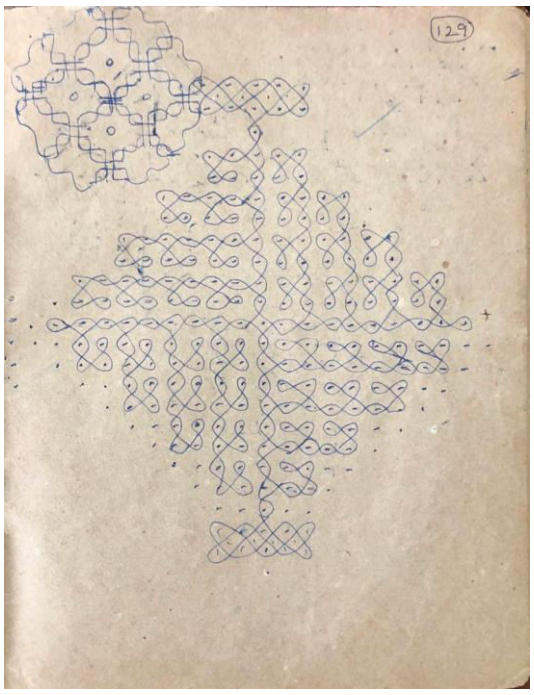
8.6.4.2
164.16.8.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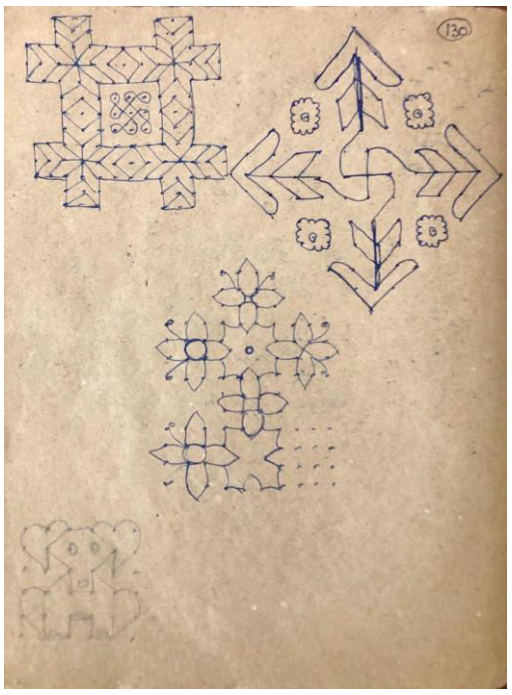
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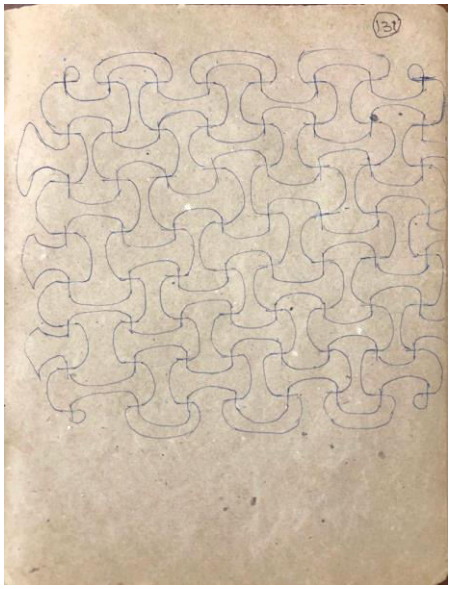
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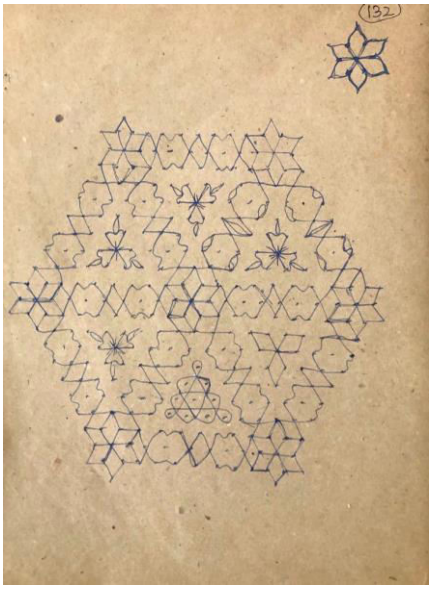
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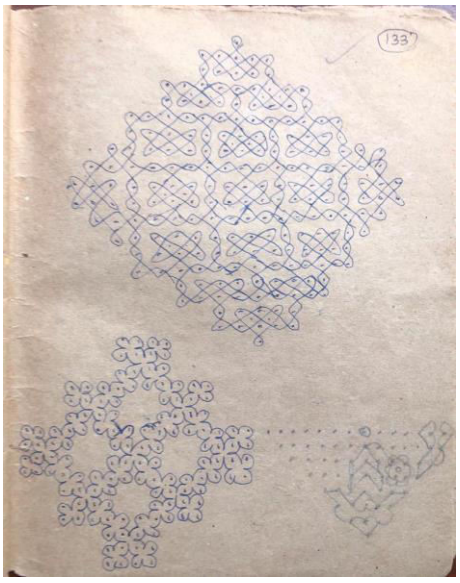
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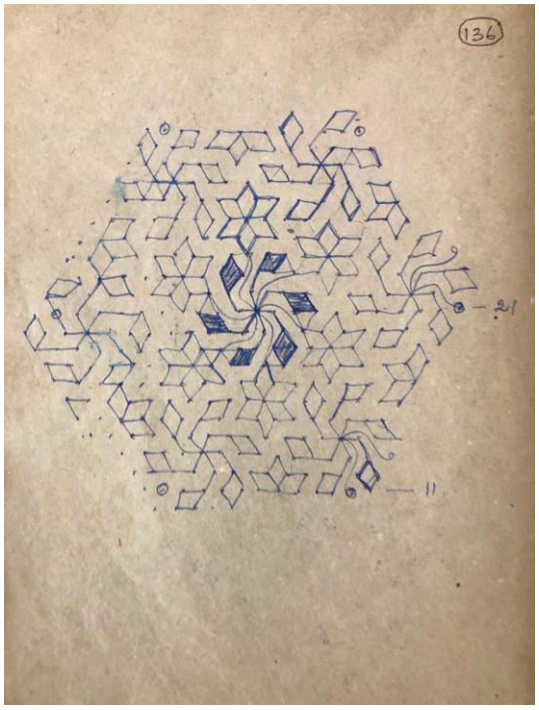
135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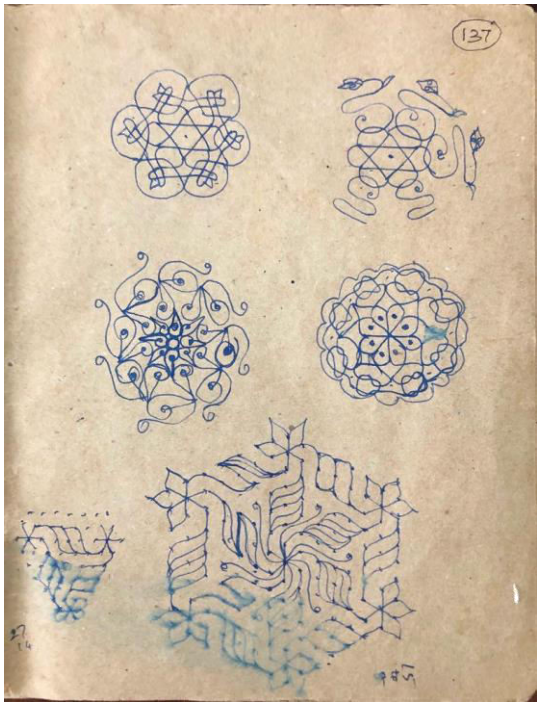
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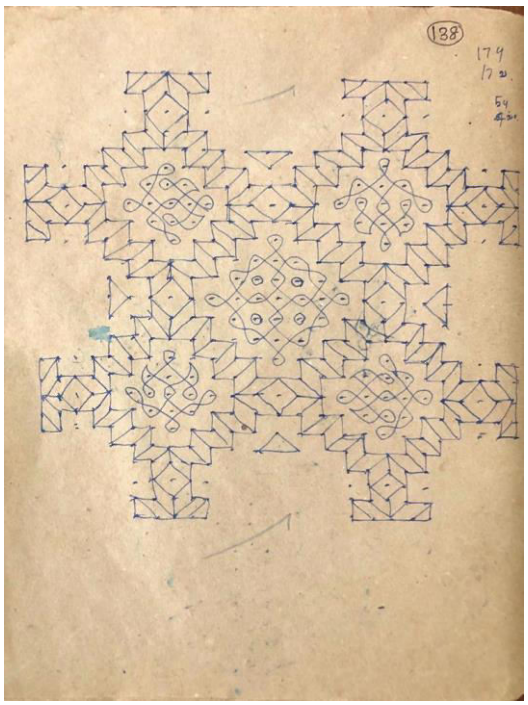
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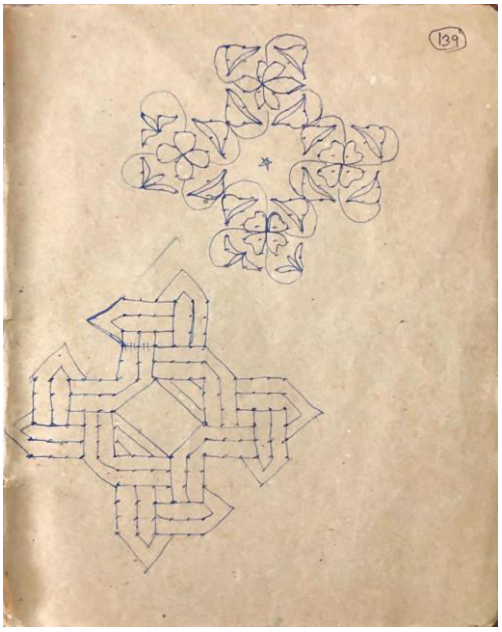
172
54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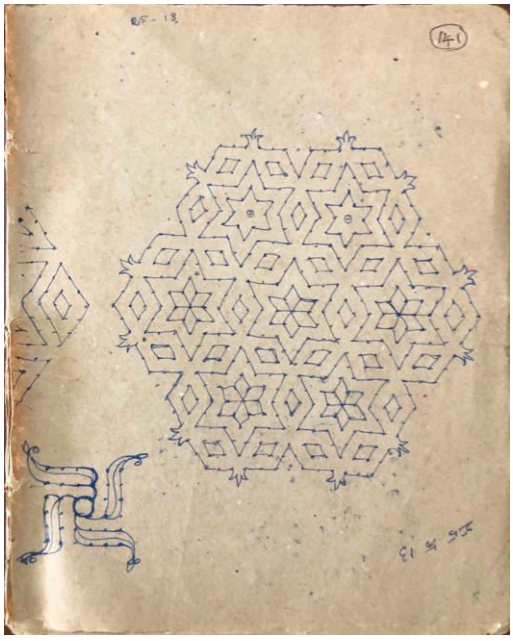
140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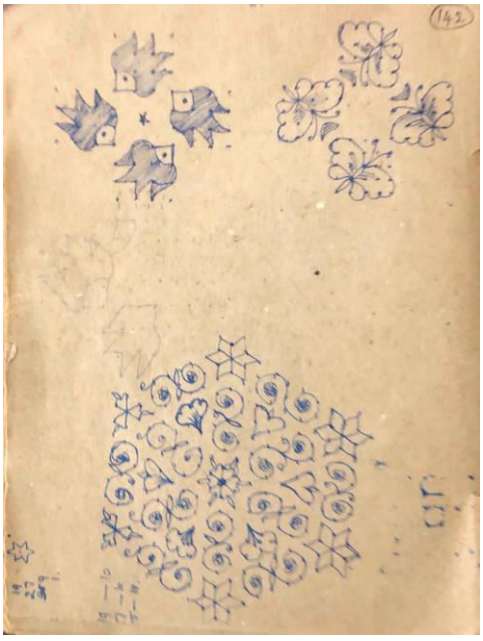
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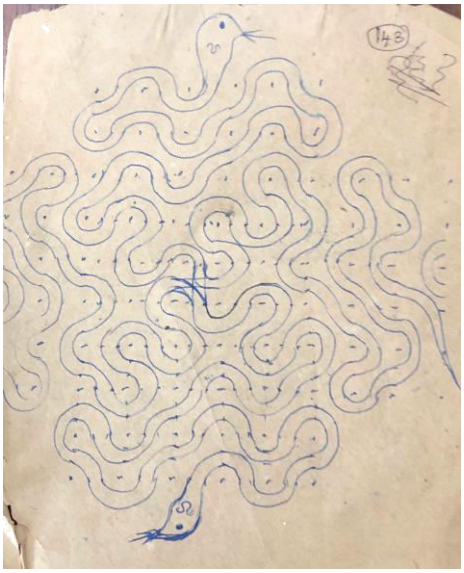
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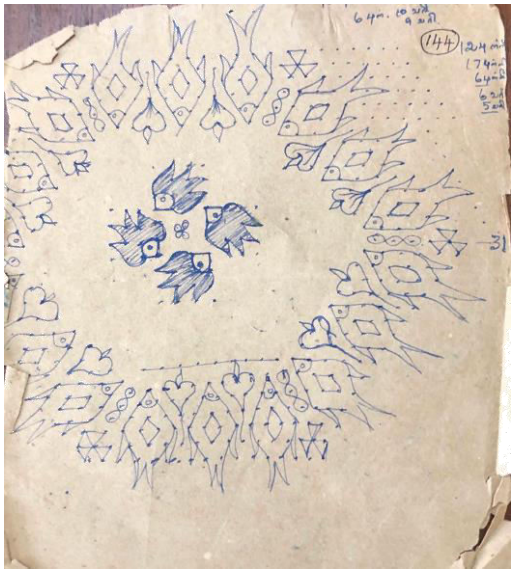
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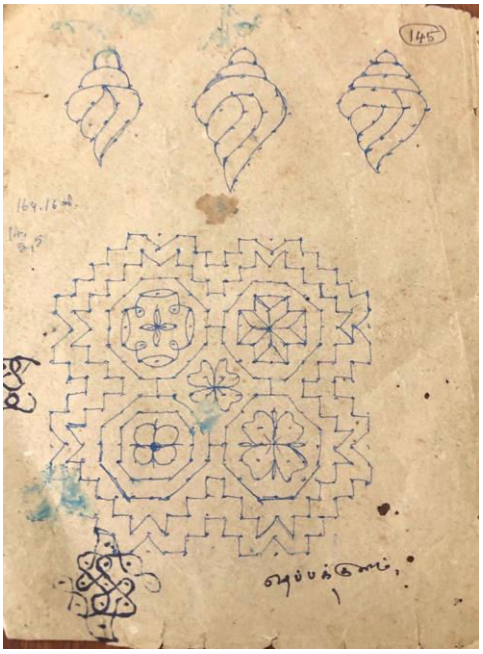
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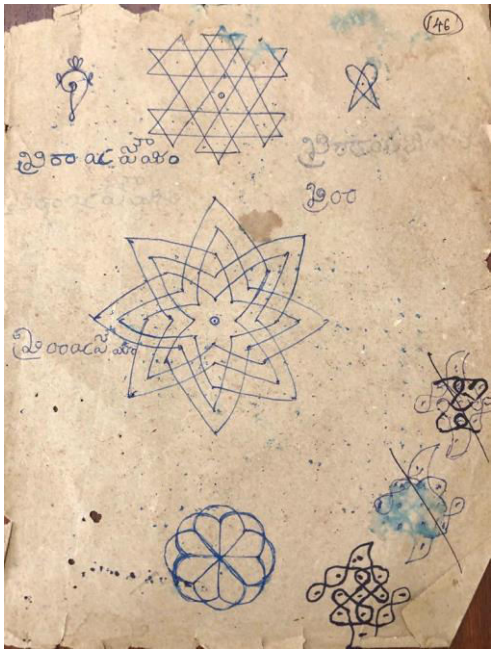

146

21. Kolam software

When we searched for 'kolam software' in the net, we got about half a dozen Android applications. These can also be run on the Windows PC using an Android emulator. KolaSurabi, by Neechchalkaaran works in the browser only. There are some videos in the site kolampodu.com. We shall see some info about these.

Kolam Art - In the start, Gallery comes and stops for long. In this page, many line drawings are shown as 0%. With too many advertisements, we could not do much.

Nithra Kolams - Some information about kolam is available in this. There are many examples of kolams. In the exercise section, one has to draw a kolam using a finger, with the dots shown.

KOLAM 1-11-1 by Agathiya Tamil - One can draw square and diamond shaped kolams with 5, 7, 9, and 11 dots. Colors of background, dots and lines can be changed. Can create and delete lines. Can tell to add or delete joins automatically. Can save kolams. Animation is available, but works with intermittent waiting.

Kolam App - Diamond type kolams with 5, 7, 9, or 11 dots can be drawn in this software. Colors of background, dots and lines can be changed. Can create and delete lines. Can tell which reflections are needed for horizontal and vertical lines. Can share kolams.

Pulli Kolam - Some suzhi kolams are shown in three levels.

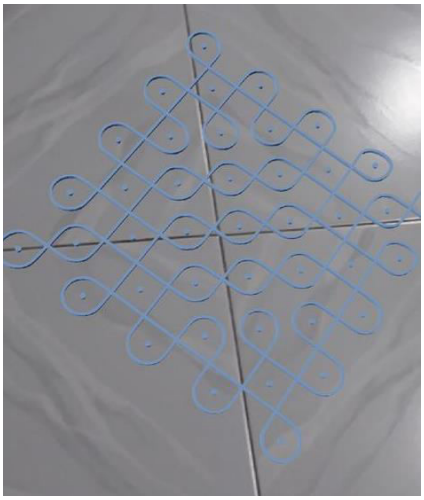
kolam 1.0.0 by Techdasher - This shows kolams under the titles like Margazhi kolams and flowers with 7 dot kolams.

Kolam by BothOfUs - There are five stages. There is no help for using the software.

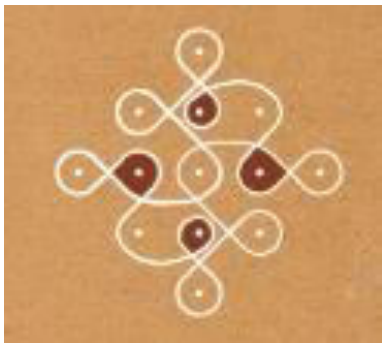
Pulli kolangal by Tamil apps - I didn't have patience to find out how to use this software.

OK Kolam - This app tests the patience of the user. Using a finger one has to draw a 3 by 3 kolam shown. If you draw like this about 20 times, it goes to the next stage. There it shows 4 by 4 kolams. It takes a long time to verify what we have drawn. But seems to work correctly.

Kola Surabi by Neechchalkaaran - http://apps.neechalkaran.com/kolasurabhi is a website. The number of dots has to be chosen between 3 and 20. One of the options in non-linear 1, non-linear 2, star and linear has to be chosen. One of square or rhombus has to be chosen. Then the colors for the background, dots and lines have to be chosen. Now, tapping on the Draw button draws a random kolam with given specifications. The interface can be chosen to be in Tamil, English or Hindi.



Using Augmented Reality, we can see the kolam in 3D. One can draw a kolam in the desired place, and take a photo of that and use it here. It can be seen using a AR device or with an AR app. Some 3D samples can be seen at https://sketchfab.com/neechalkaran. Using Kolasurabi one can create new 3D samples. One sample is shown at https://youtube.com/shorts/4Qn0NbOLwc4

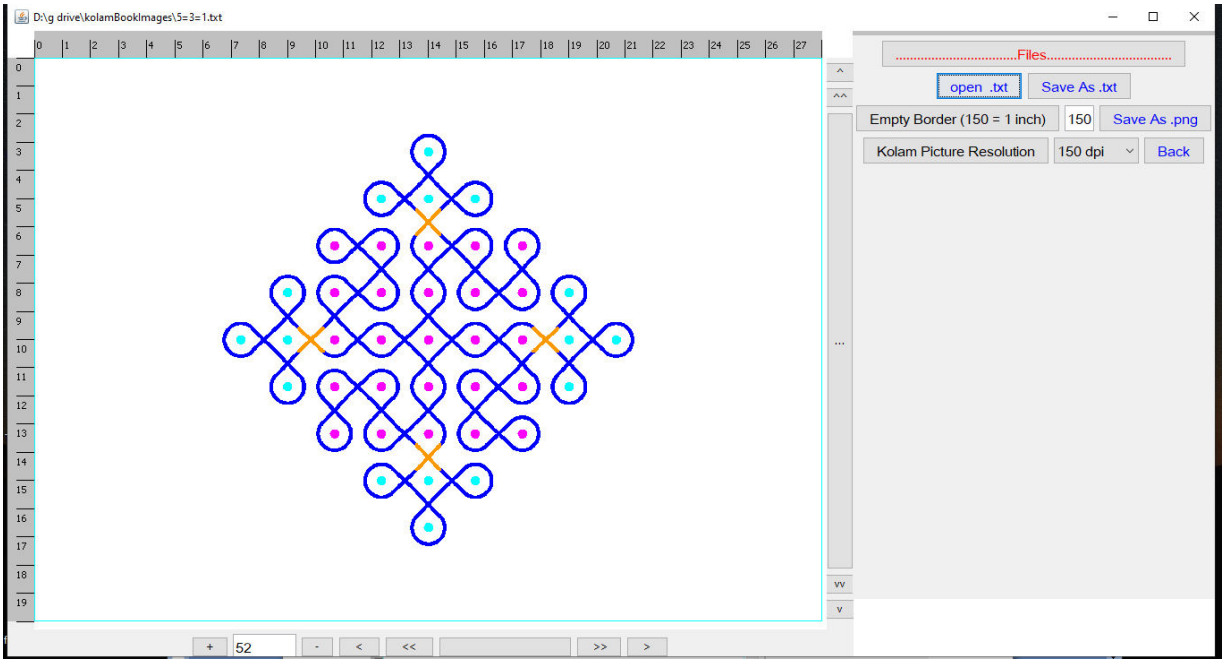
kolampodu.com is a well designed website run by Mrs. Bargavi Mani. She has shown many suzhi kolams under the titles like 2 minutes kolams, border kolams and festival kolams. There are videos showing how to draw kolams using kola powder or kola maavu. She draws the curved lines in new ways. Two of them are shown above. Remembering these new type of curves and the symmetry of the kolam is not an easy task. This is a fantastic exercise for the brain. A video on her says that she lost her memory in an accident, and, when she started practicing kolams she had learnt at her younger days, she has regained her memory. Her website is in English.

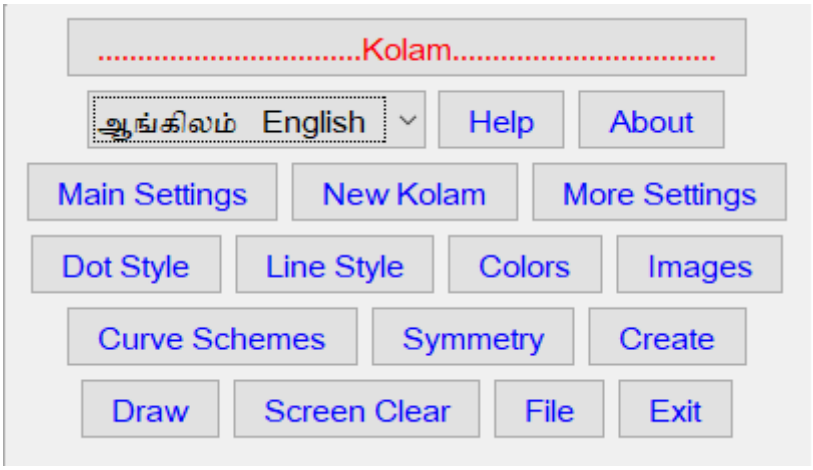
If you have an Instagram account, you can see many kolams in https://www.instagram.com/muraivaasal/.

In the site https://mathigon.org/polypad kolams can be created using the basic building blocks around a dot. In many other websites we can see thousands of kolams.

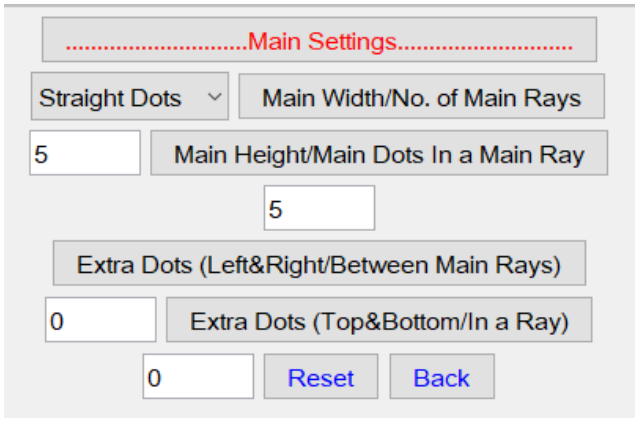
Let us see the software I have created to draw kolams. This software has grown slowly over many years. Since there was no software like that to emulate, and since this is the first time we were doing

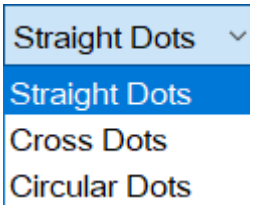
this type of software, we could not determine exactly what to do in the beginning. This lead to many errors, and we had to learn slowly and correct the mistakes. So, this is a software which has evolved step by step. When we add or modify a feature, the code had to be modified accordingly. This works under Windows OS. Can be run in Mac OS using the Windows emulator. Our aim was to create all types of kolam, easily. Representing the dots in the memory for the cross dots was a challenge, since it has to accommodate the handling of the rotational and reflective symmetries.

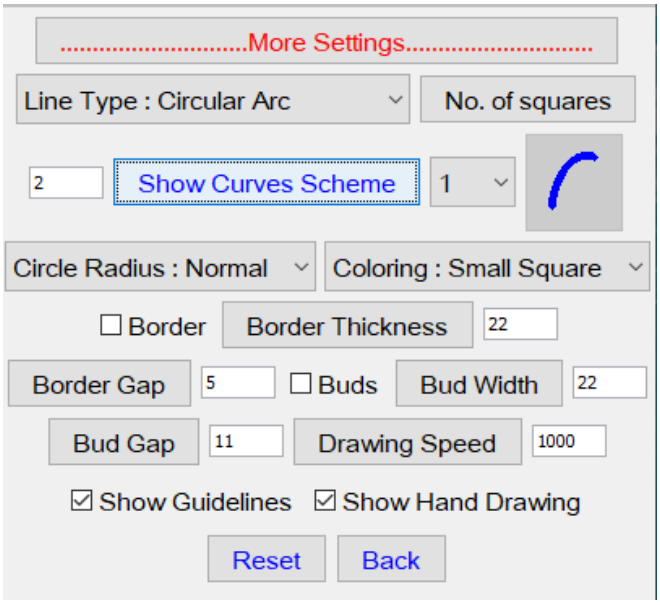


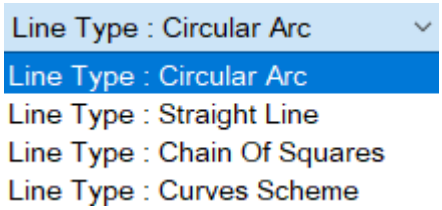


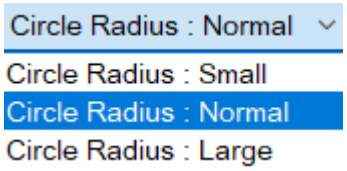
We can have the interface in Tamil or English. If needed, this interface can be easily extended to other languages. Dot size up to 50 by 50 can be set. The thickness and color of dots and lines can be fixed. Even images can be used for dots and lines. Dots and lines can be set to one of about 15 different styles. The dots can be set as straight or cross or circular. Except the number of dots and type of the dots, other properties can be dynamically set in the kolam, different for different lines, within a kolam. This makes it possible to create hybrid kolams. That is, the same kolam can have suzhi and curved lines, straight lines and free hand drawings.

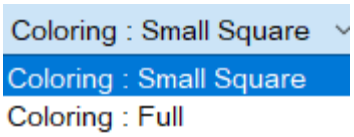






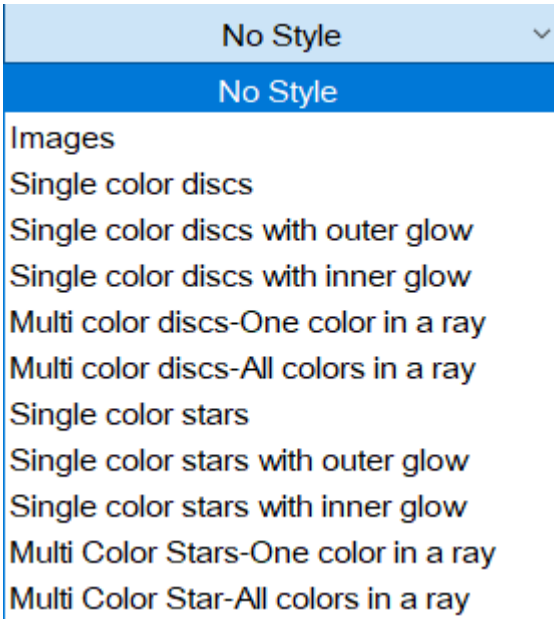


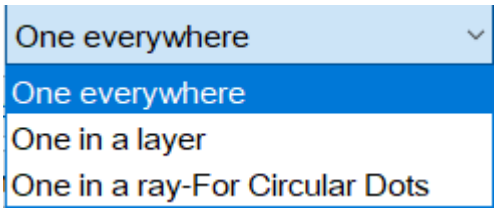


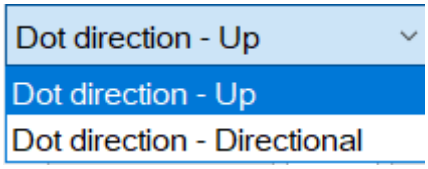


The lines can be of different types. There is provision for katta kolam, and curves depicting our imagination. The circular curve can be of three different radii. We can convert a kolam into a rangoli easily. The bordering of a kolam with red color, called semman is possible.

Dots can be in different shapes.





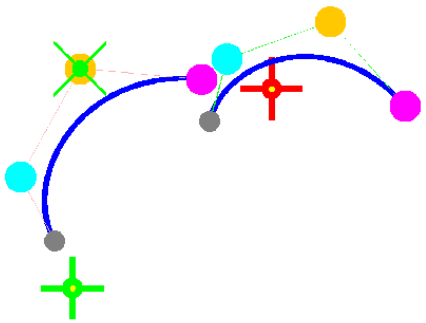


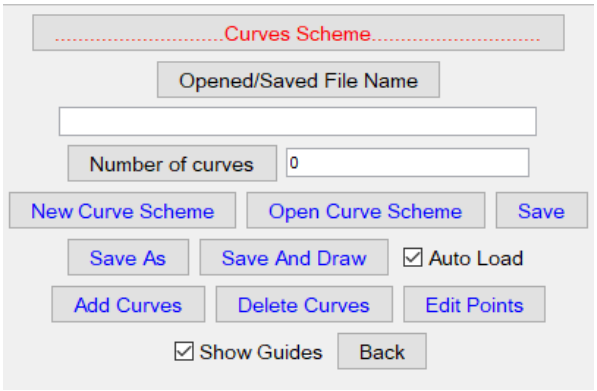
Like dots, the lines can also be of different styles.

For drawing dots and lines in different colors, palettes having up to 16 colors are used. These palettes can be created and modified.

The images required for dots and lines can be chosen.

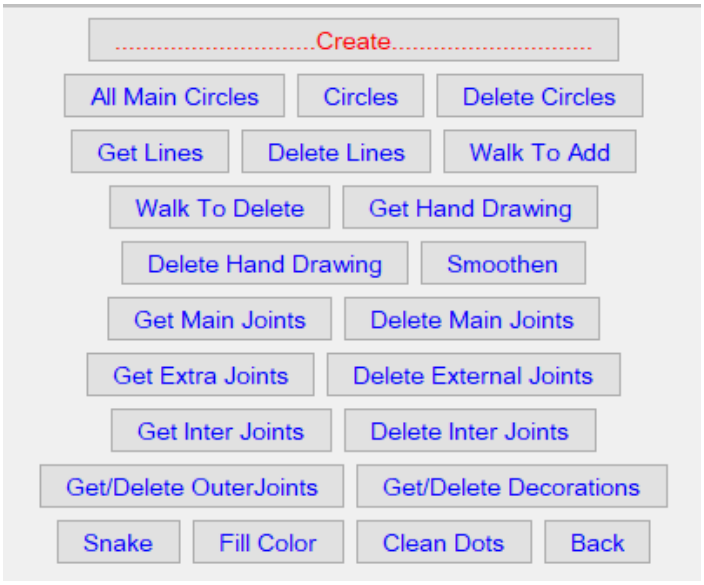
The intricate curves to our design can be created and modified and stored.



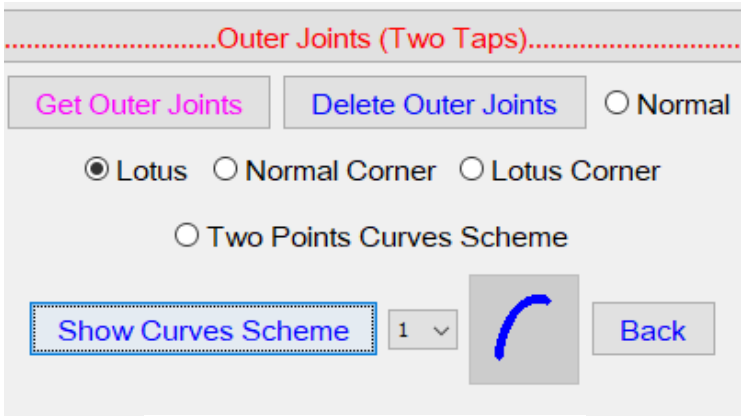


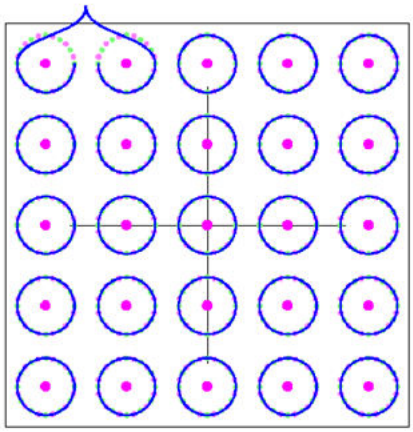
Depending on the requirement of rotational and reflective symmetries, the software will draw many curves or lines, when we draw one line. Not only this assures the required symmetry, but also speeds up the drawing of the kolam.

There is a separate section to create many parts of the kolam in different ways.

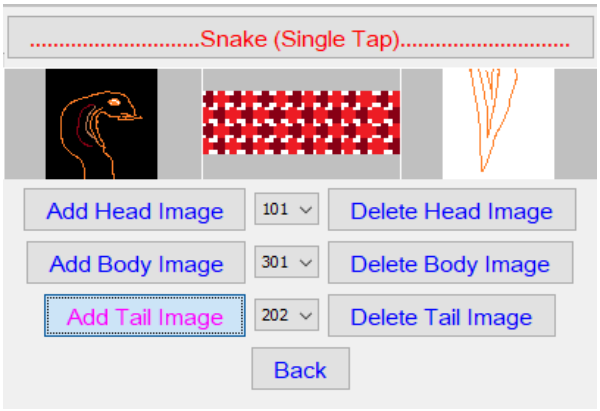


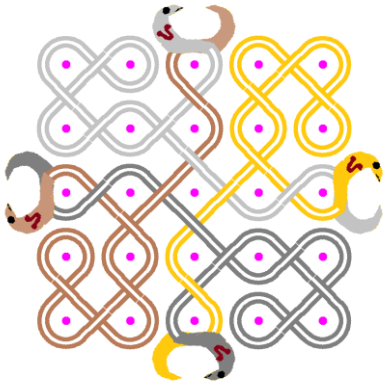
The outer joins can be done in many ways.

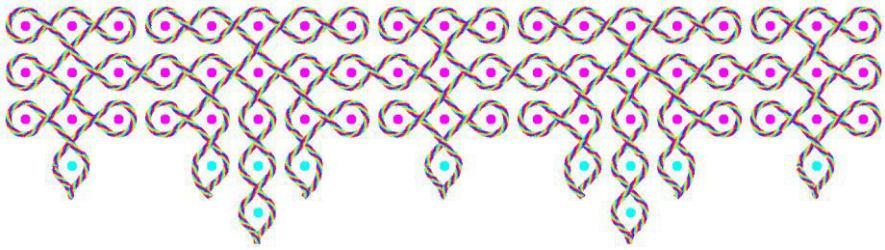




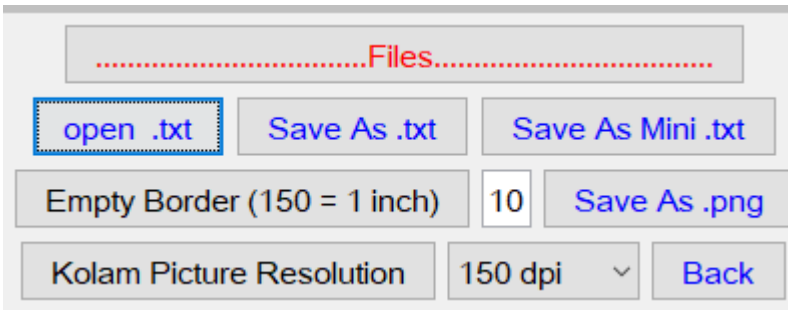
Snake kolams can also be drawn. For this images are needed for the head, body and tail. Each snake can be designed individually. We can specify which body line comes above which body line, to conform to the up-down-up-down principle.

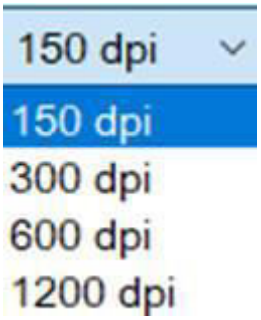






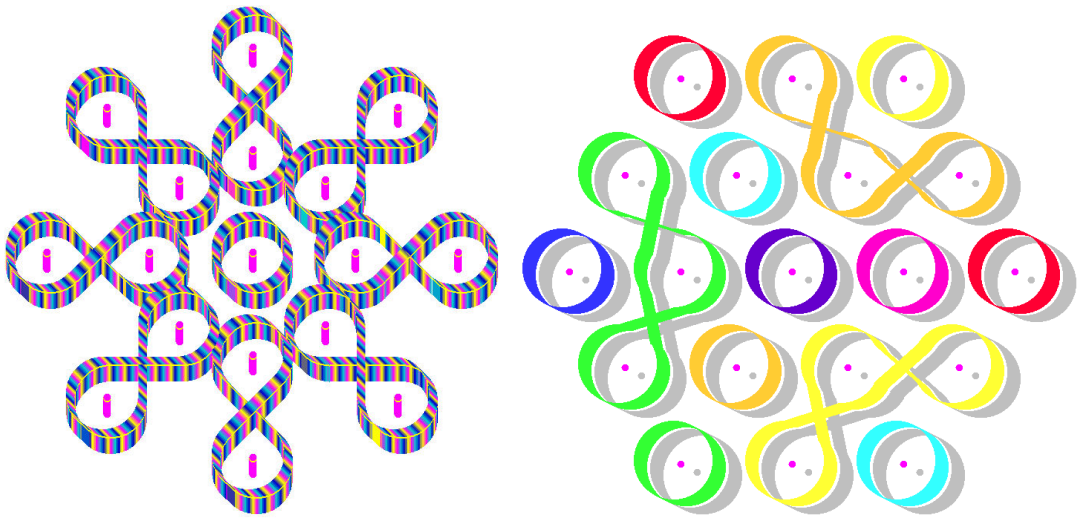
Can create manai kolam and border kolams.





The kolam is stored in two different ways. One is as a png image. This is done in any of the 150, 300, 600, 1,200 DPIs. This allows printing high quality images. The other is as a text file. This allows reopening and modification of a kolam. The space required for this is also very less.

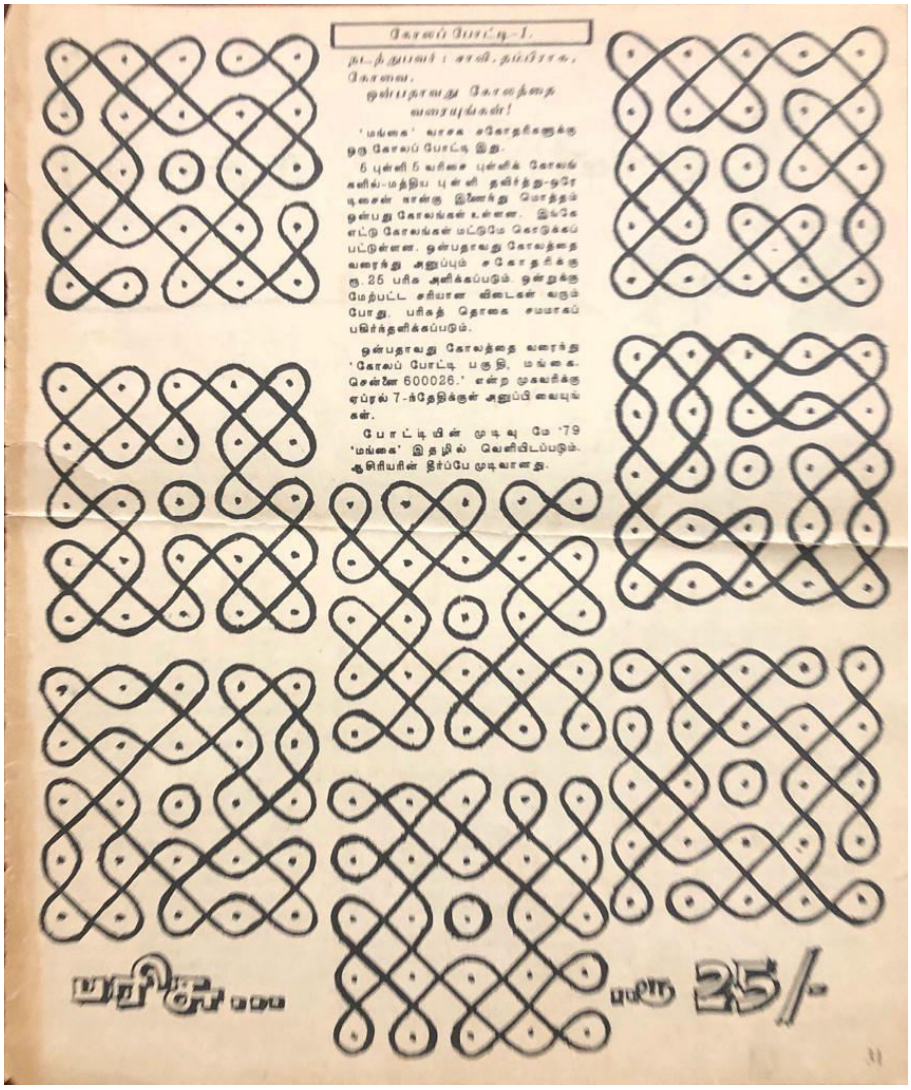
Three strategies are used to get 3D effect. One is as if the lines are drawn using paper roll. The next is having a shadow for the lines and dots. The third one is the lines look like walls. These can also be combined to get more effects.



This is the first and complete software to draw all types of kolams easily. This fulfills my longing for such a software.

22. Kolam software - Puzzles and games

Mr. Savi Thambirasu had conduced kolam competition in the monthly magazine Mangai, starting from April 1979. Some of the types of puzzles posed are as follows. This many number of kolams are there in a particular type. All except one are given here. Find the missing one. Which one is next to these four kolams? Which position disrupts the symmetry of the kolam? Complete the remaining kolam.



For the first competition the prize amount was rupees 25. From the second it has been enhanced to 50 rupees. In the ninth competition, I (Leela) was one of the ten lucky winners, and got rupees five.

We shall see some puzzles created/being created(2013) based on kolam. These are playable on the mobile phones.

1. What is its symmetry?

In this puzzle, one kolam will be shown. 4 answers will be given to the question of what is the rotational symmetry of the kolam. The correct answer has to be chosen. One should know about the symmetries of kolam to play this.

2. Make it symmetric

A kolam will be shown. In that in 1 to 3 places the symmetry would have been destroyed by changing the dots, lines, joins, colors or up-down setting. By changing in a small number of places the symmetry has to be restored.

3. Where is my tail?

One snake kolam will be shown. There will be many snakes in the kolam. One particular head will be specified. The tail of that snake has to be chosen correctly. For this one has to travel through the lines without changing tracks.

4. Snake, rope or toy?

A kolam like snake kolam will be shown. If in one end there is a head and in the other end there is a tail, it is a snake. If both ends have tails, it is a rope. if both ends have a head it is a toy. A line will be chosen, in the middle. One has to tell whether it is a rope, or snake or a toy. For this one has to trace the line without error.

5. How many crossings?

A suzhi kolam will be shown. One point on each of the two chains will be shown. The number of crossings of these two chains has to be chosen from the 4 answers provided. It is important that the player has to concentrate on two chains at a time.

This number has to be even. How?

In suzhi kolam, if we consider a chain, it splits the plane into a number of finite areas and one infinite area. The point on the second chain lies in one of these areas. When you move on the second chain, when you cross an area you have one crossing. To come out of that area you need one more crossing. So, every time you enter and exit an area you use two crossing. Initially you exit an area. Finally you have to enter that area. For this also you need two crossings. So the the total number of crossings is even. What happens if they don't intersect at all? In that case the answer is zero, which is also an even number.

6. Which one is the odd one?

In the given 4 kolams 3 will be of one type, and one will be different. The odd one has to be found out. The difference will be in any one aspect of the kolam. For example, three of the kolams can have four side symmetry, and the other one is not of that type. Three will have the same number of lines, whereas the fourth one will have a different number of lines. In three kolams one line may disrupt the symmetry, whereas in the other one, it may have full symmetry, or symmetry disrupted in two places. Three may have one type of coloring, and the fourth one a different type of coloring.

7. Restore the erased part

A small part of the kolam would erased. By seeing the other part, the symmetry of the kolam has t o be found out, and the erased part should be completed.

8. How many differences?

Find the number of differences between the given two kolams. The differences can be in the color of dots, lines or areas, missing dots, or missing or extra lines, or, in some other property.

9. How many loops?

How many closed loops are there in the given kolam?

10. How many dots?

How many dots are there in the given kolam?

11. Draw the kolam

The kolam will not be shown. One flower will be moving on the lines, one after the other. Seeing this, each loop has to be guessed, and the kolam drawn.

12. Drive the car to the destination

The lines of a kolam are the roads. The road is cut in many places. The car has to be driven from top left of the kolam to the destination in the bottom right. This is similar to a maze puzzle.

13. Eat the candies

Candies will be moving on the lines of the kolam, The player has to jump between the lines, change the direction, move faster and catch the candies. Catching maximum number of candies within short time is the aim. The stage of the game controls the number of dots and the moving speed.

14. Eat the fruits

Fruits will appear in trees represented by lines. They stay there for some time and then fall on the floor. After a short time of falling on the floor they will disappear. A squirrel has to move around the trees or floor and eat only the fruits shown on the top of the screen. The squirrel has to eat as many fruits as possible within a short time..

15. Match the flowers

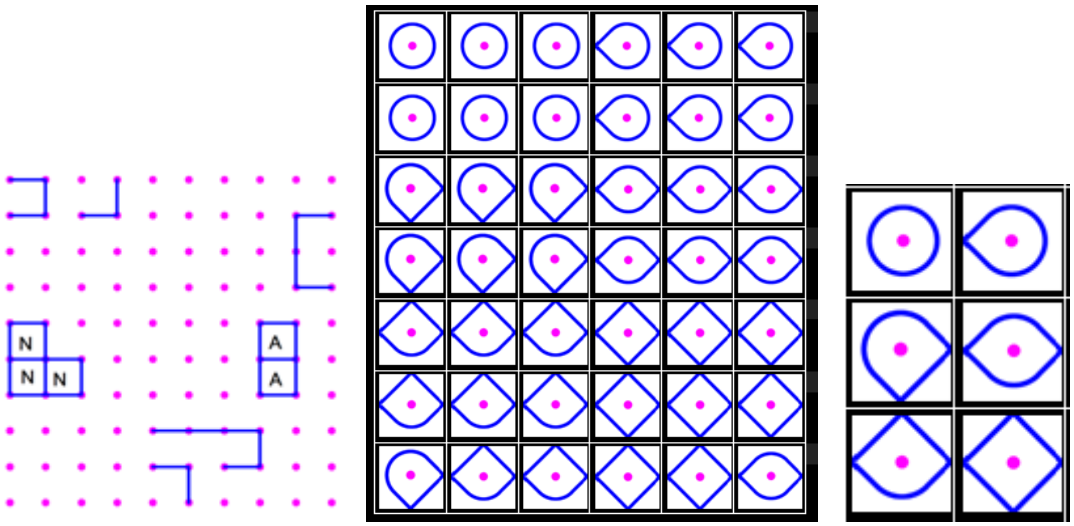
Flowers come in pairs. They move around different loops. The player has to chose the pairs one by one.

23. Kolam games hardware

A game of squares

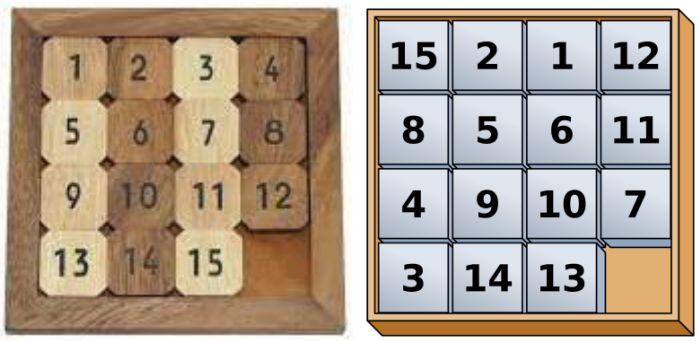
This game has been played in high school days. Two players play this. To start with, about a ten by ten dots are marked on a paper. A player connects two neighboring dots by a horizontal or vertical line. One or two squares can be formed by this action. In case a square or squres are formed, she puts her initials in these squares. Thne continues to add another line. She can continue like this any number of times. Otherwise it is the next player's turn. When all the squares are filled, the game ends. The one with maximum number of squares wins.

In the initial stages, the players will create places where only a few squares can be formed. Even when they know that they can get a few more squares, the will play in such a way that the other player should not get many squares. You can know more about the techniques of the game when you play it. A situation in the middle of the game is shown below.



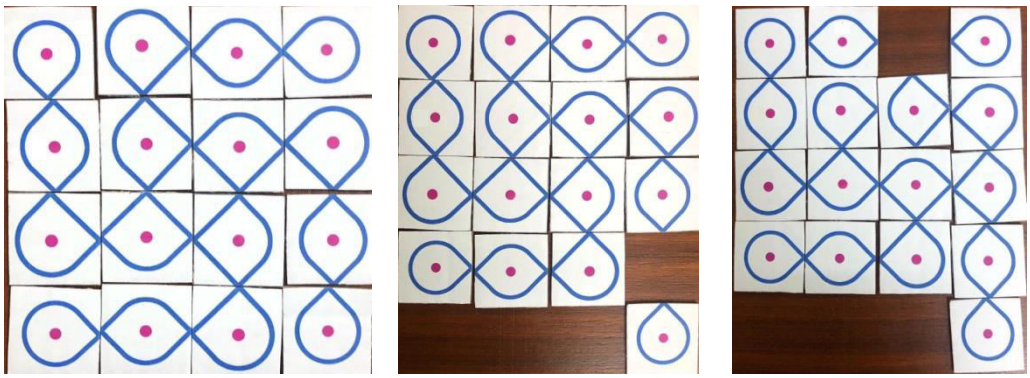
3 games with 84 chips

A game is designed using 84 chips or tiles, each a square with side of about 1 inch. Half of these chips are shown above. In each chip both sides are printed. There are three types of chips. The front and back of these three chips are shown above. In each of these types there are 24, 28 and 32 chips. We have designed a few games using these chips. We will see three of them.



You might have seen a puzzle using small square pieces with numbers 1 to 15, in places in a base with four by four grid. The last place will be kept empty. The pieces can be moved one square at a time, in a vertical or horizontal direction, using the empty square. A configuration in which a sequence of such movements have been made is shown above, in the second figure. One player shuffles like this, and the other player has to restore the correct sequence of the tiles.

This game in a modified form is currently seen in the market. In this a picture is used with 16 tiles. One more square is added below the last tile, to push the sixteenth tile there, so that we have the old puzzle. This seems to have been done to show the square picture in full.



A 4 by 4 kolam which looks the same from all the four sides, seen as a picture of the above mentioned modified puzzle, is one of the games that can be played with the 84 chips. A configuration with 7 movements is shown as the third figure. One player makes these changes. The other player has to restore the kolam.

This game is not as easy as we may think. When there are less than ten movements, it can be restored easily. More the number of movements, more is the difficulty. It is not just easy at all. One has to remember the position of every chip and work on it.

It is not necessary to buy the game from the market to play the game. You can make it yourself for about 10 rupees. First download the picture of the 42 chips from our website learnfunsystems.com.

Take 1 printout and make another 3 copies from that. This will cost about 10, for a black and white printout. Cut the printouts and get the 168 pieces, carefully removing the black portions. Next get the cardboard from the boxes used in many packages. This will be about 2 mm in thickness. Prepare the cardboard to the same size as that of the printout. It will be around 26 mm square. Paste the printouts on both sides of the cardboard, as shown in the figure. Chips created as above are shown in the above pictures.

Of the 84 chips, place the 16 chips forming a 4 side equivalent kolam, on the floor. Then one player rearranges the chips, with specified number of movements. The other player should not see this movement. Only the places for the 16 chips and the place just below the sixteenth chip should be used. To show this boundary, a line may be drawn.

In view of the difficulty in this game, we have split the game into 5 levels. 1 + 6, 1 + 8, 1 + 10, 1 + 12, and 1+ 13 and above. Here the 1 indicates the move of the sixteenth chip to the square below.

There is another game played by two persons. The number of dots and the symmetry will be given. A kolam satisfying these conditions has to be assembled. One who does this first is the winner. The kolam size should be 4 by 4 or 5 by 5. Both players should take the chips from the same 84 chips.

This can be changed to be a one player game. Here the player should create the kolam within a stipulated time. The size should be between 4 by 4 to 7 by 7.

The third game is as follows. Create a kolam of size 3 by 3 to 7 by 7. It should look the same on all four sides. Now collect all the chips, shuffle them and put on the floor. The player has to assemble a kolam from these chips only, which looks the same from all he sides. It is possible that the newly assembled kolam is different from the original kolam.

More similar games

Before we manufactured the kolam professionally for marketing, I saw one message sent by a friend Mrs. Rajam. It was a video of Dr Venkat Gopalan of Penn State University in US. He is drawing a big kolam in that. The link is https://www.facebook.com/100010432574159/posts/pfbid0aciM6xGXxwmnSkxGHHFVCKATbvLpzcydYFaQdYGu5QDhZne4YyvoWtRASzk3Lgptl/?sfnsn=wiwspwa&mibextid=cz6gg9. It is a kolam in

which the straight dots are put with a 45 degree slanting. So, looks like a cross dot kolam. It is astonishing to see the way in which he draws the kolam part by part.

I saw the website kolamtiles.com run by him and one of his friends Dr. Alznauer. There a kolam game with 64 wooden tiles, similar to the one described above is advertised. This is also based on the six basic tiles. It costs US$48, in US. He explains how to draw a kolam using these tiles. First he draws an 8 by 8 kolam. He does it in a new way. First he draws the curved parts of a line. Then he joins them with straight lines. In another video, at https://www.youtube.com/watch?v=WpILruoKREs, he draws a kolam in another new way.

The one we have created has 84 chips, printed differently on both sides. So many more kolams can be generated. It is made up of thick cardboard.

In the Indian market there is another kolam game available. It is called Crazy Kolam. It ha 28 tiles, each making a line around a dot. It costs more than one thousand rupees.

24. Kolam exercises

The exercises to draw a kolam can be classified in many ways. First, exercise to put dots, and then, exercises to draw the lines. These two can be further classified as practiced on computer or mobile phone using fingers, or, on paper with pencil, or, on the floor with kolam powder. We have created an app usable on the mobile phones.

First we shall see the drawing of dots. In this start with straight dots. This is to be done having in mind that the distances between two adjacent dots are the same. You can use a scale or a rope to measure this on the paper or floor. In the case of phones, the system will show the top left and bottom right dots. The player should fill the other dots. Finally the system will show the correct positions. From this one can find the deviations of the dots.

Next, it is a practice to put cross dots. This will be a challenge for many. Let us consider putting dots on the floor or paper. First, the dots in the middle horizontal line has to be put, with equal distance between adjacent dots. Then above that line and below that line dots have to be put. The number of dots gets reduced by one for each line. One dot in a horizontal line, together with two dots near it in the next horizontal line, should make a triangle of equal sides. Note that this is different from the distances in straight dots.

If the middle horizontal line has 2n-1 dots, then stop going up or down, after reaching n dots in that horizontal row. Now you will get a hexagon shaped dots.

In the case of software, the top left and bottom right dots will be shown. The other dots have to be filled in.

Putting dots for a circular kolam is another type. Usually a circular kolam has 8, or, 16, or 32 radials. We will see how to put them on paper or floor. First, draw the dots in the four directions, that is, up, down, left and right. Now put another set of four radials, one in the middle of two already put radials. This gives dots with eight radials. If you now draw another set of eight radials in the middle of already drawn radials, then we get dots with sixteen radials. Doing this step once more will give dots with 32 radials.

Now we will see some exercises in drawing lines in the software. We consider only suzhi kolams here. There are four types of exercises. In the first type, one full kolam will be shown. Seeing that over it the lines are to be drawn, in the case of phones. Similar kolams are to be drawn on paper or floor.

In the second method, only upper half of the kolam will be shown. The player has to draw the full kolam. For this she has to think about rotating the upper part by 180 degrees, so that the kolam will look the same when viewed from top or bottom.

In the third type, one quarter of the kolam will be shown. It has to be rotated by 90, 180 and 270 degrees to complete the kolam.

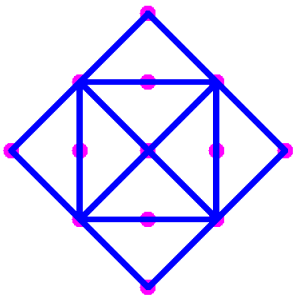
In the fourth type, some loops will be given. These have to be rotated by 90, 180 and 270 degrees to get the full kolam. Normally when a kolam is drawn, it is drawn one loop at a time. While drawing on

the floor, when drawing a loop with a rotation, usually the person changes her position and viewing angle accordingly. If drawing is done on paper, the paper can be rotated as required.

These practices give exercise to the mind and hands and fingers as follows. The shape to be drawn has to be kept in mind, it has to be recalled correctly, the recalled shape has to be drawn with the coordination of hand and fingers. It may be noted that we have already seen that a lady got her memory restored when she started drawing kolams again.

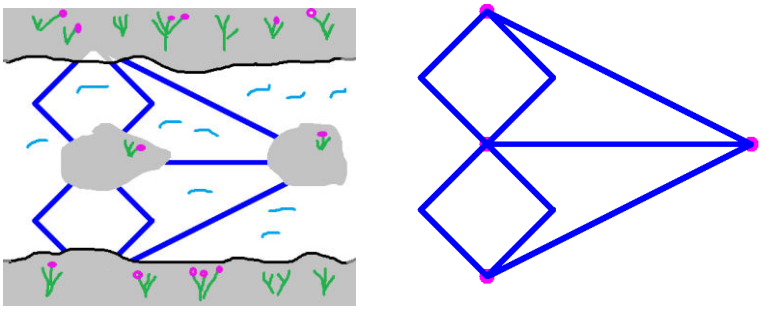
25. Kolam and fundamental maths

Is it possible?



Can you draw this kolam, starting and ending at the same point, without lifting the finger, and, without drawing any line twice? Try this. Not able to do it? Try for some more time. Still not possible? Don't be discouraged. No one can do it! I hear you asking 'how?' Suppose we start at a particular dot. From there we have to visit other dots by entering and then coming out. That means, every time we visit a dot we use two lines, one for entering and one for getting out. Finally suppose we return to the same dot. Here again we have used a line while starting, and one while finishing. So, at any dot we use an even number of lines. Since in the given kolam it is not so, we cannot draw the kolam as specified.

What if we stop at a different dot? Here in the light of the above discussion, we should have an odd number of lines at the starting and ending dots, and an even number of lines at all other dots. Since the given kolam has four dots with an odd number of lines, this also implies that the kolam cannot be traversed as specified, however much one tries!



The starting of this puzzle seems to have originated from Koingsberg, now called Lenigrad. There are two islands in the river flowing through this town. There are seven bridges connecting the islands and the mainland. The question posed was this. Can anyone start at any place, and go through all the bridges exactly once? No body could do that. Euler (1707 -1783) proved that this is not possible. The proof he gave was what we have seen above. He considered the mainlands and the islands as dots, and the bridges as lines joining them. We have got a kolam. Since all the four dots have odd number of lines, we cannot traverse all the lines exactly once without retracing.

Can tell without counting

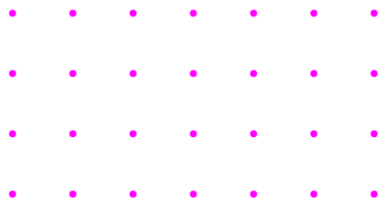
Let us consider a line kolam. It divides the area into some finite areas and one infinite area. Now, just by counting the number of dots and the number of lines can you tell the number of areas without counting? Yes! It is possible. But how? Suppose there are m dots, and n lines. Then the number of areas is n - m + 2. In the Konigsberg problem, m= 4, n= 7. 7 - 4 + 2 = 5. Hence there are 5 areas, one infinite area and four finite areas. Correct? is it not? You can verify this with other kolams also.

Suppose there are p areas. Then there is an equation combining the three numbers m, n and p. That equation is, n - m - p + 2 = 0. So when you know two of these numbers we can get the third number. The equations for these are as follows.

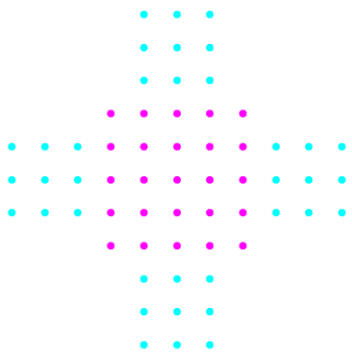
m = n - p + 2. n = m + p -2. p = n - m + 2.

Fast counting of dots

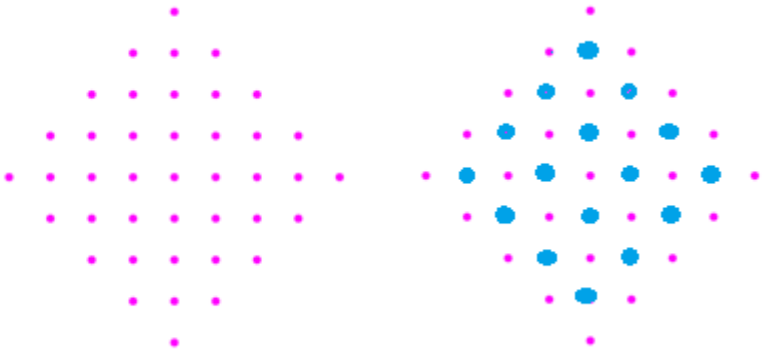
We can have many different shapes for a kolam. To count the number of dots in different shapes of kolams fast, one needs a bit of fundamental maths.



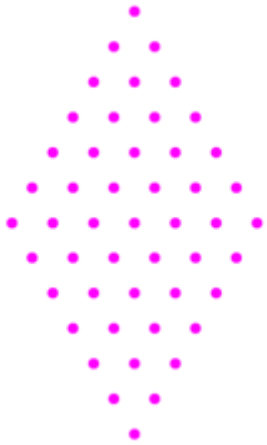
First we will see straight dot kolams. How many dots are there in an m dots n rows kolam? There are m x n dots. In a square kolam with m dots in each side, we have m x m = m^2 dots.



In the above kolam with the inner square of m dots, and the outer squres of n dots, the number of dots is m^2 + 4 x n^2.



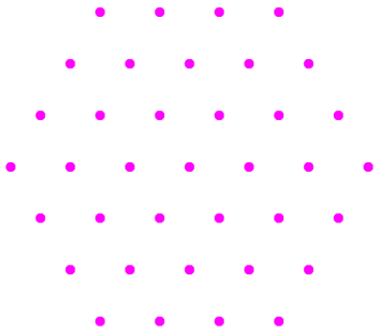
Straight dot kolam can come in the shape of diamond. The number of dots start with 1, increases as 3, 5 etc., and then, after attaining n dots, decreases as n-2, n-4 etc., and stops at 1. To count the number of dots there is an easy way. Tilt your head or the kolam by 45 degrees, and see. You will find a straight dot square grid with 5 by 5 dots, and, one inner straight dot square grid with 4 by 4 dots. Hence the number of dots is $5^2 + 4^2 = 25 + 16 = 41$. Generalising this, if the number of dots in the middle line is m, then the number of dots is $((m+1) / 2)^2 + ((m -1) / 2)^2$.



How many dots are there in a Diamond shape with dots one to seven, and then to 1?

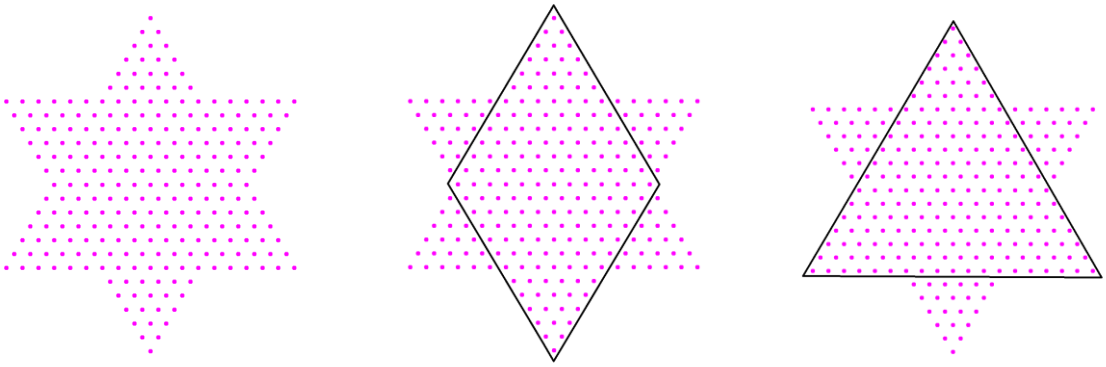
$(2 \times (1 + 2 + 3 + 4 + 5 + 6)) + 7 = (2 \times 21) + 7 = 49$. That is $(2 \times (1 + 2 + ... + (m-1))) + m = (2 \times ((m-1) \times (m)/2)) + m = 2 \times ((m^2 -m) / 2) + m = (m^2 -m) + m = m^2$. This answer can be got very easily if you rotate the screen by about 30 degrees and see. You will see approximately placed dots for a

straight kolam with m rows and m columns. Immediacy the answer m ² springs to the mind!



Many cross dot kolams have the hexagonal shape. If it starts with n starts at the top row and has n dots in the middle row, how many dots are there in the kolam?

If the shape had been a diamond, by adding more dots above and below, as seen above, the number of dots will be m ². But the dots from 1 to n-1 are missing at top, as well as at the bottom. Thus the number of missing dots are 2 x (1 + 2 + ... + (n-1)) = 2 ((n-1) x n) / 2) = n ² – n. In the above kolam, m = 7 and n = 4. Hence the number of dots are 7 ² – (4 ² - 4) = 49 – 16 + 4 = 37.



Cross dot kolams can come in the shape of a star. You can see this as a diamond shaped kolam with added triangles attached on the four sides. In this way, the number of dots can be counted easily.

m ² + 4 x (n ² + n)/ 2 = m ² + 2 x n ² - n. In the figure shown m = 13, and n = 6. Hence totally there are 13 ² + 2 x(6 ² + 6) = 169 + 84 = 253 dots.

This can be calculated in another way also. We can see it as a big triangle starting at the top, with smaller triangles added on the three sides. Let there be dots starting from 1 and going to m, in the big triangle. Let there be dots starting from 1 and going to n, in the small triangles. This has m x (m + 1) / 2 + 3 x n x (n + 1) / 2 dots. In the figure shown, m = 19 and n = 6. Hence the total number of dots is (19 x 20 / 2) + 3 x (6 x 7)/2 = 190 + 63 = 253.

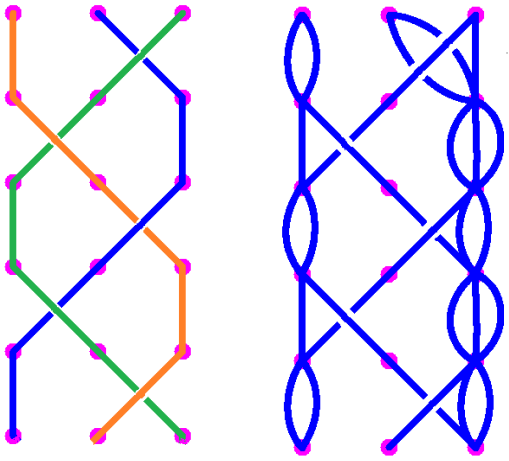
In whatever way we calculate the answer is the same. If we just count the dots one by one it is called the brute force method. If we think and count a bit smartly, it can be done quickly.

Counting the lines and line shapes

This also has to be done smartly. For this, first, the symmetry of the kolam has to be found out. Then find out which parts of the kolam gives the full kolam using the rotation and reflection properties of the kolam. Then count the number of lines or find the line shapes in that part. From this calculate the total lines or shapes in the kolam. While doing this, the lines common to more than one part has to be taken care of.

The plait is also a kolam !

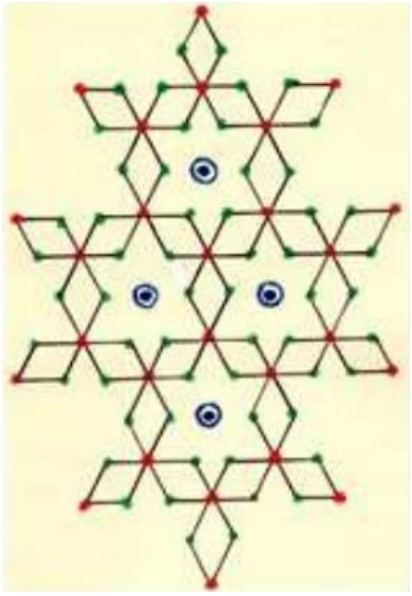
We have seen that snake kolams are pinnal kolams. A kolam which shows which line goes above which line is called a pinnal(woven) kolam. Do you know why this name has come? In weaving, we see which line comes above and which line comes below. Since this property is brought out, that kolam has this name.

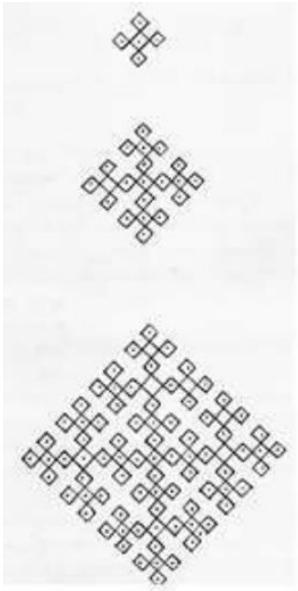


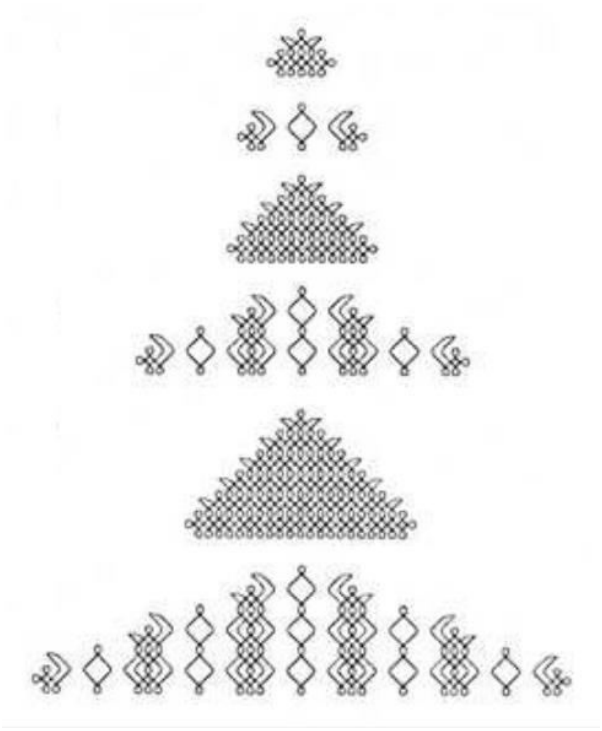
The braid or plait also creates a kolam. How? In the normal plait there are three strands. We can think that they start with three dots and flow as shown in the figure above. There is another type of plait called six legged plait, where six strands are used. Two of them get merged or split in different places. The kolam formed for this plait is also shown above.

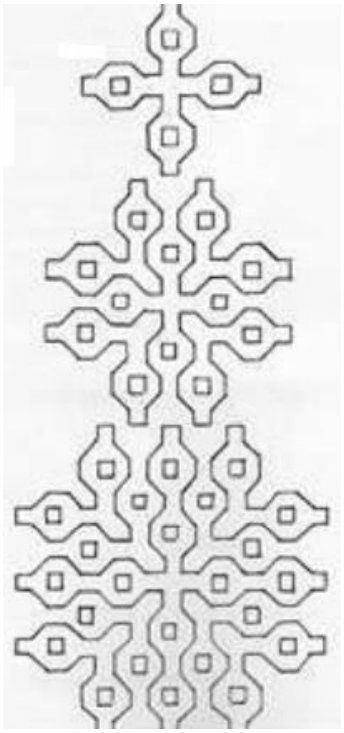
26. Kolam and Higher Maths - An easy introduction

There are many sizes in which the following kolams are drawn. Krishnan anklet, vilva thalam, paahal panthal, mountain, and kooja. The size can be increased without any upper limit. Our ladies have been doing this for centuries. But if we ask them exactly how they do it, it will be an ordeal for most of them.









In the examples shown above, the answers for the first two may be possible for many, after a lot of thinking. It is not easy to do the same for the next two. There is a mathematical way of specifying the drawing of these kolam in all sizes. It is called graph grammar.

The method of creating sentences of a language from its letters is called the grammar for that language. Apart from grammars for the natural languages, there are grammars for artificial languages used in computers. Let us see a simple example for an artificial language.

Let us say the language has got exactly two letters, a and b. Lat us say s means a sentence, and k is an intermediate symbol. Let us say that the symbol s can be replaced by aka. This is written as s -> aka, using the arrow symbol. Like this some other transformations are given below.

k -> kb,

k -> b

Let us see some of the letter sequences that can be got by these transformations.

s -> aka -> aba

s -> aka -> akba -> abba

s -> aka -> akba -> akbba -> abbba

...

Here we have seen how the three sentences aba, abba, and abbba are formed. Like this we can form any sequence where the first and last are 'a's, and all the middle letters are 'b's. This gives an unlimited sequence of sentences.

The specification which says what are the letters, what are the symbols and what are the rules of transformation, is called a grammar.

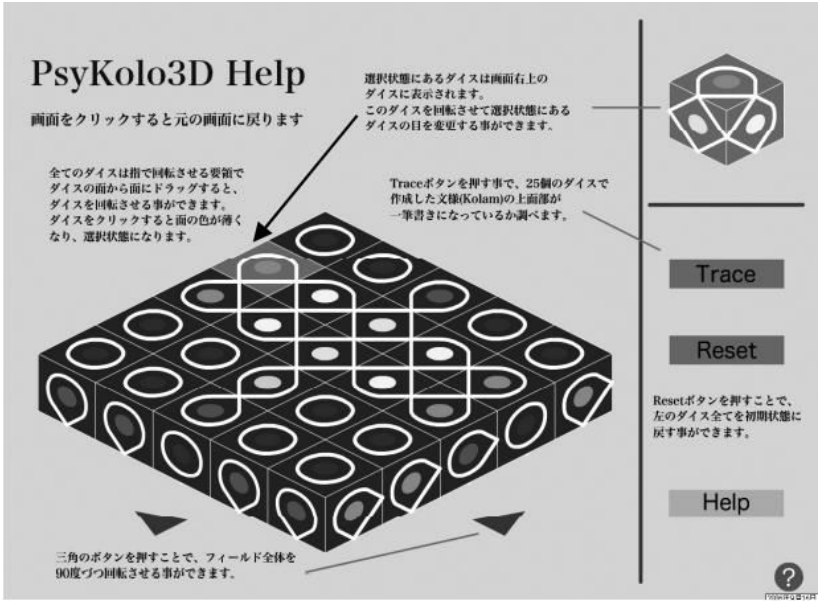
In a grammar, instead of letters it can be pictures or kolams. Letters form one dimensional sequences. Pictures and kolams form two dimensional images. Graph grammar tells what are the basic kolams which are equivalent to letters, and, what are the production rules which tell how a kolam has to be modified in two dimension. Note that a graph is a generalisation of kolam. Some dots and some connections between the dots is called a graph. All the line kolams are graphs. But all the graphs are not beautiful as kolams

There are many types of graph grammars. L-System is one type. Using this and its variations, it has been found that many kolams can be generated. This research is being carried out by the past and present staff of Madras Christian College, including Dr. Gift Siromoney, Dr. Rani Siromaoney, Dr. Kamala Krithivasan, and Dr. K. G. Subramanian. They have written many research papers on this.

You may ask whether there is any use of graph grammars. An article, entitled 'Learning grammars of molecules to build them in the lab' by R. Ramanujam, in The Hindu, dated ninth April, 2022, gives an answer to this question. In designing new compounds with the given properties, Artificial Intelligence and Machine Learning are being used. For the computer to learn anything, it needs many thousands of data. It may even take a few days to learn them. Now, scientists from MIT, USA, and IBM, have found a method to create molecules with desired properties, using only just about 100 data. It uses graph grammars. What an important use!

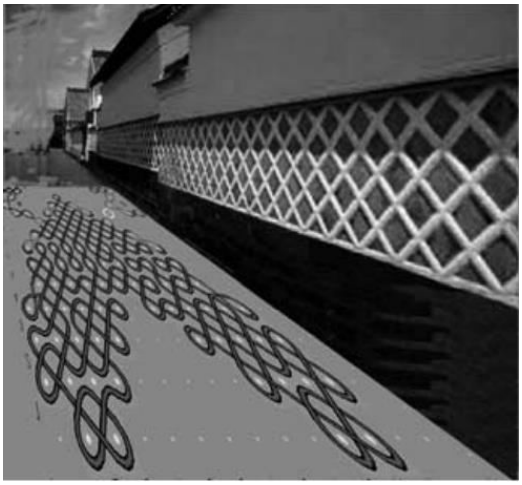
Kiwamu Yanagisawa and Shojiro Nagata, from Japan, have published a research paper entitled Fundamental Study on Design System of Kolam Pattern in 2007. In this they talk about drawing straight dot suzhi kolams using some basic parts.

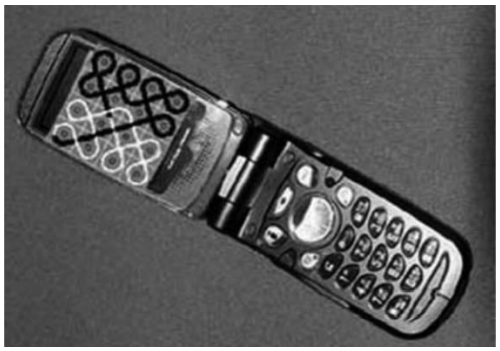
Timothy M. Waring has written a paper on Sequential Encoding of Tamil Kolam Patterns, in 2012. Here he shows how to represent mathematically the joining of two dots which are inclined by 45 degrees to the horizontal line.

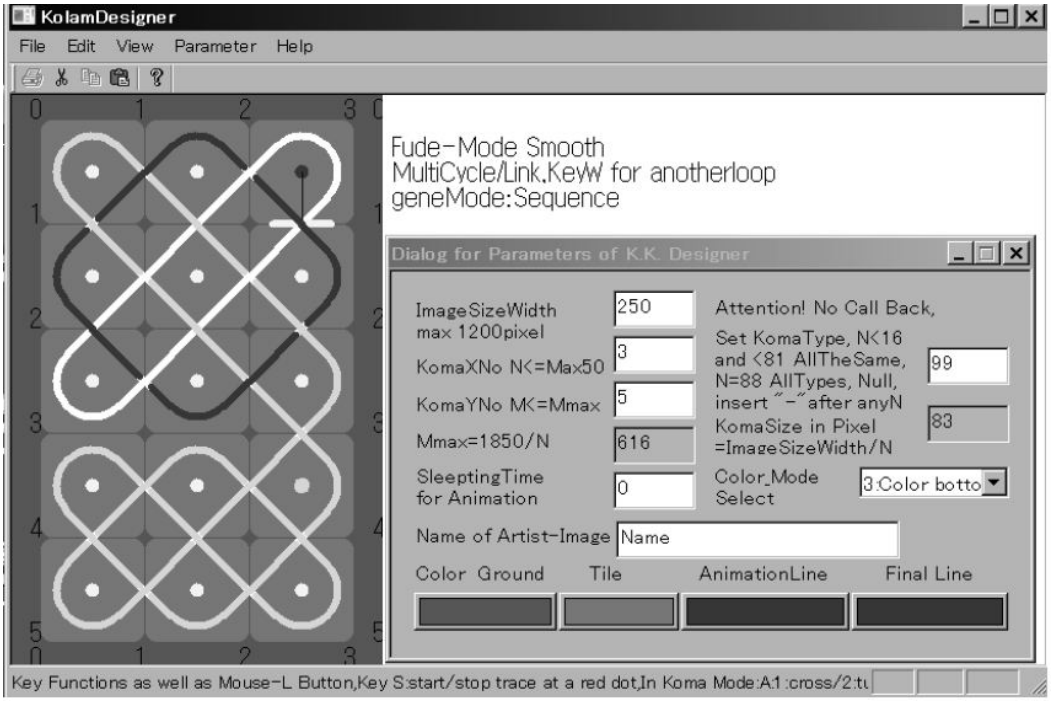


Yasuo Kawai, Kosuke Takahashi and Shojiro Nagata has written a paper entitled PsyKolo3D - Interactive Computer Graphical Content of "Kolam" Design Blocks, in 2007. In that they talk about small cubes with kolam parts printed on all the six sides. They see the creation of kolams using these blocks as a game. They say that these blocks induces the brain to act, in the case of slightly mentally retarded children.

In the enchanting paper entitled Loop Patterns in Japan and Asia, written in 2015, Shojiro Nagata talks about the loop patterns seen in many places. We have given below some of the images from that paper to create an interest in you to read the full paper.






KolamDesigner
File Edit View Parameter Help
Fude-Mode Smooth
MultiCycle/Link,KeyW for anotherloop
geneMode:Sequence
Dialog for Parameters of K.K. Designer
ImageSizeWidth
max 1200pixel
250
Attention! No Call Back,
KomaXNo N<=Max50
3
Set KomaType, N<16
and <81 AllTheSame,
N=88 AllTypes, Null,
insert "-" after anyN
99
KomaYNo M<=Mmax
5
KomaSize in Pixel
=ImageSizeWidth/N
83
Mmax=1850/N
616
SleeptingTime
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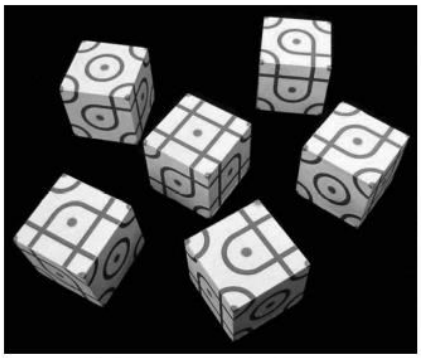
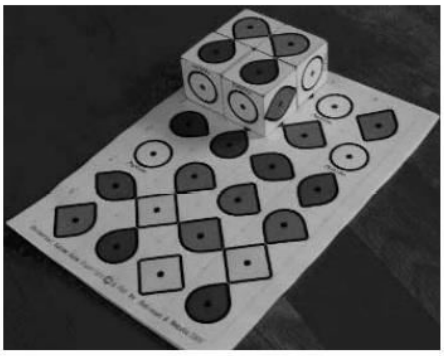
0
Color_Mode
Select
3:Color botto
Name of Artist-Image
Name
Color Ground
Tile
AnimationLine
Final Line
Key Functions as well as Mouse-L Button,Key S:start/stop trace at a red dot,In Koma Mode:A1:cross/2:t

In the paper Digitalization and Analysis of Traditional Cycle Patterns in the World, and Their Contemporary Applications, written in 2007, Nagata talks about creating kolams from smaller parts. In https://arxiv.org/pdf/1503.02130.pdf, Venkatraman Gopalan, Brian Kevin VanLeeuwen have written a paper entitled A topological approach to creating any pulli kolam, an art form from South India. In this they have created a mathematical model by generalising kolam. In that they talk about which kolams can be transformed into which kolams. Here the kolam is assumed to be drawn on a rubber sheet. By pulling the sheets in different places in different ways, one kolam can be made to be another kolam. Such kolams are said to be topologically equivalent. They study this type of transformation.

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