Eleanor's Conjecture Blog Post

If J is odd, not a factor or multiple of a factor of DN, and larger than 1, all the dots will be touched by lines before dot 0 is reached again.

That probably means nothing to you. Here, I'll explain:

Connect the Dots is a procedure, often performed using a code in the program NetLogo. In this procedure, there is a series of evenly spaced dots (you can change how many) around a circle, (you will what me refer to the number of dots as "dot number" and "DN") and lines of equal length are drawn between the dots, and you can change the number of dots you skip (jump size, J).[6]

I began by experimenting with Connect the Dots, and noticed that some of the arrangements touched all of the dots while others didn't. Then I noticed that all of the ones that touched all the dots were odd numbers, and the ones that didn't were even.[7,8]
At that point I was only looking at circles with a dot number of 16, but a little while later I started looking at circles with other dot numbers. And when I looked at those, my observation held up.[7,8]

But then I noticed that if the jump size was a factor of the dot number, then my conjecture didn't work. So I modified my conjecture slightly to include these exceptions. But that modification posed another problem: 1 is a factor of every number, so it was included as something that did not work, but it did. So I modified the conjecture again. But as I was running through all the jump sizes for one dot number [2,3,4,5], I found that some of the jump sizes -- which weren't factors of the dot number -- still worked. But in Connect the Dots, once the jump size reaches half of the dot number, it repeats itself in reverse. So with a dot number of 12, the jump sizes of 5 and 7 will make the same final pattern, and so on. So I figured out that the dot numbers were not hitting all the dots because they created the patterns of factors. So that's why I added the reverse factor part. A reverse factor, as defined by me, is a number that when subtracted from the dot number forms a factor of the dot number.

Originally I was just picking random jump sizes and dot numbers,[1] but then Alex encouraged me to try every jump size for a dot number. I tried that, and my conjecture held up.[2,3,4,5]

One thing that I really liked about the CTD process is that often, the patterns look really cool, though it always takes a bit of time to make them. Drawing them by hand takes a while, and NetLogo runs very slowly.

Note: Pictures and referenced pictures can be found in the gallery below.

Gallery

1.

dn	j	Does it work?
35	3	yes
35	73	yes
35	27	yes
50	27	yes
50	21	yes
50	17	yes
100	77	yes
68	77	yes
36	4	no
36	2	no
36	6	no
36	3	no
36	9	no
36	12	no
36	18	no
50	1	no
50	2	no
50	5	no
50	10	no
50	25	no
50	50	no

2.

d	j	dots all touched?	skipping:
12	1	yes	
12	2	no	odd numbers
12	3	no	all but 0, 3, 6, 9
12	4	no	all but 0, 4, 8
12	5	yes	
12	6	no	all but 0,6
12	7	yes	
12	8	no	all but 0, 4, 8
12	9	no	all but 0, 3, 6, 9
12	10	no	odd numbers
12	11	yes	
12	12	no	

3.

dn	j	dots all touched?	skipping:
15	1	yes	
15	2	yes	
15	3	no	all but 0,3,6,9,12
15	4	yes	
15	5	no	all but 0,5,10

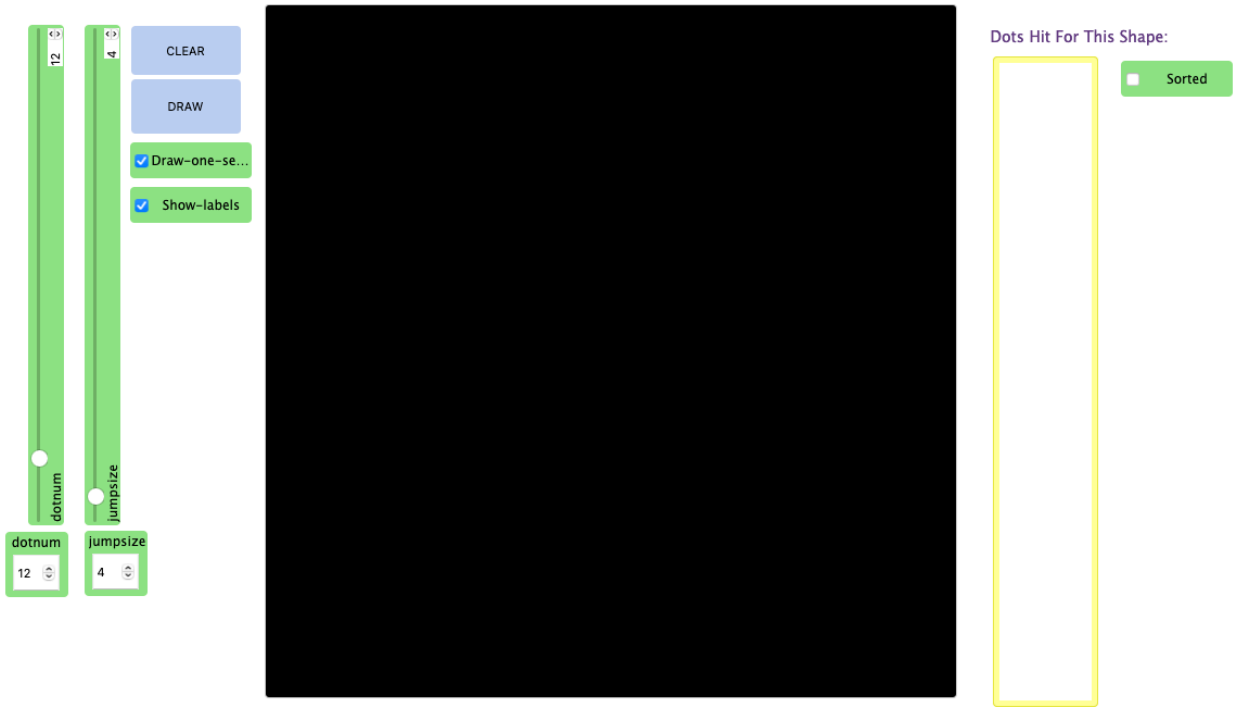
4.

dn	j	all dots touched?	skipping:
9	1	yes	
9	2	yes	
9	3	no	all but 0,3,6
9	4	yes	
9	5	yes	
9	6	no	all but 0,3,6
9	7	yes	
9	8	yes	
9	9	no	all but 0

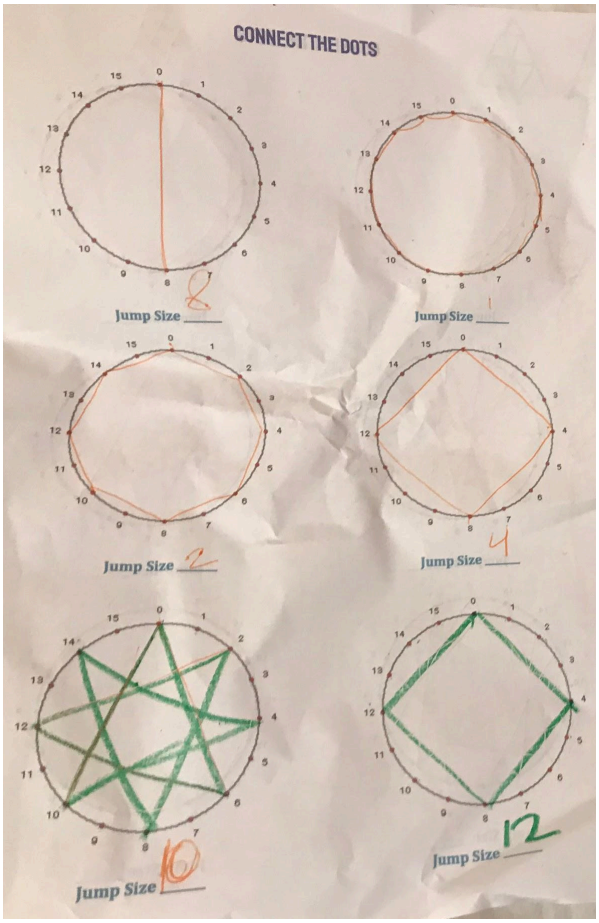
5.

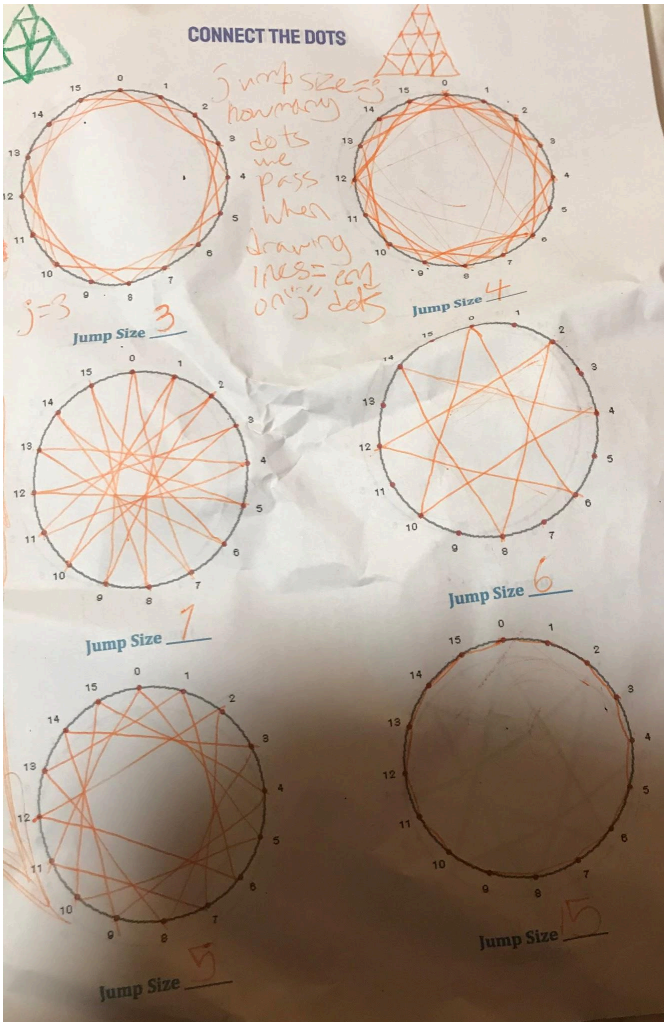
dn	j	all dots touched?	skipping:
10	1	yes	
10	2	no	all but 0,2,4,6,8
10	3	yes	
10	4	no	all but 0,2,4,6,8
10	5	no	all but 0,5
10	6	no	all but 2,4,6,8
10	7	yes	
10	8	no	all but 0,2,4,6,8
10	9	yes	
10	10	no	

6.


12
4
CLEAR
DRAW
Draw-one-se...
Show-labels
dotnum
jumpsize
dotnum
12
jumpsize
4
Dots Hit For This Shape:
Sorted

7.


CONNECT THE DOTS
Jump Size 8
Jump Size 1
Jump Size 2
Jump Size 4
Jump Size 10
Jump Size 12

8. 

9. https://docs.google.com/spreadsheets/d/1ajGLCu1jtP7ikgiaTG5tRmc3zm6mZw8utp8DDva2fl4/edit?usp=sharing