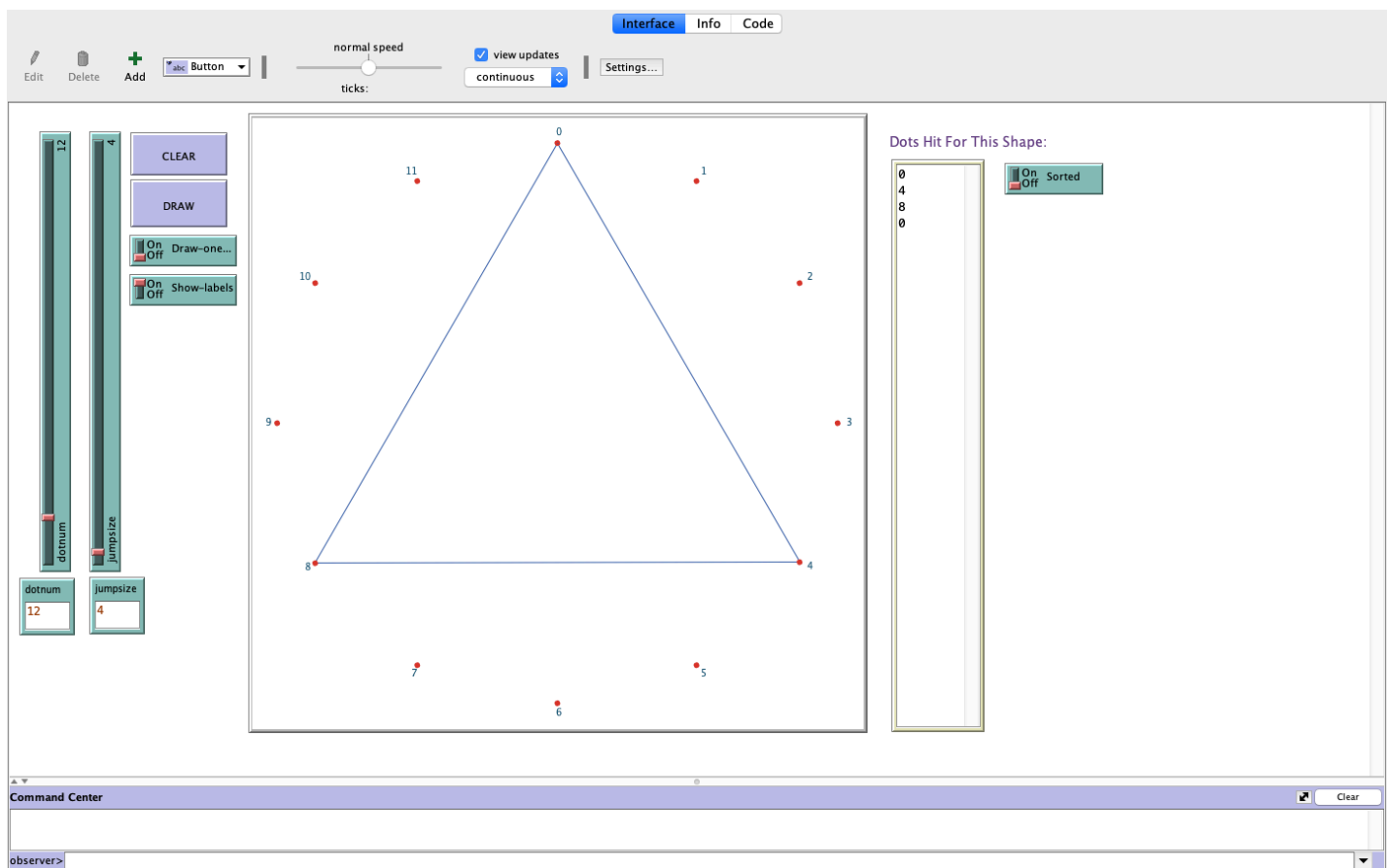


Auden Nash, DRIMAS 2020/2021 trimester 2 project

\*Glossary at the bottom of the post

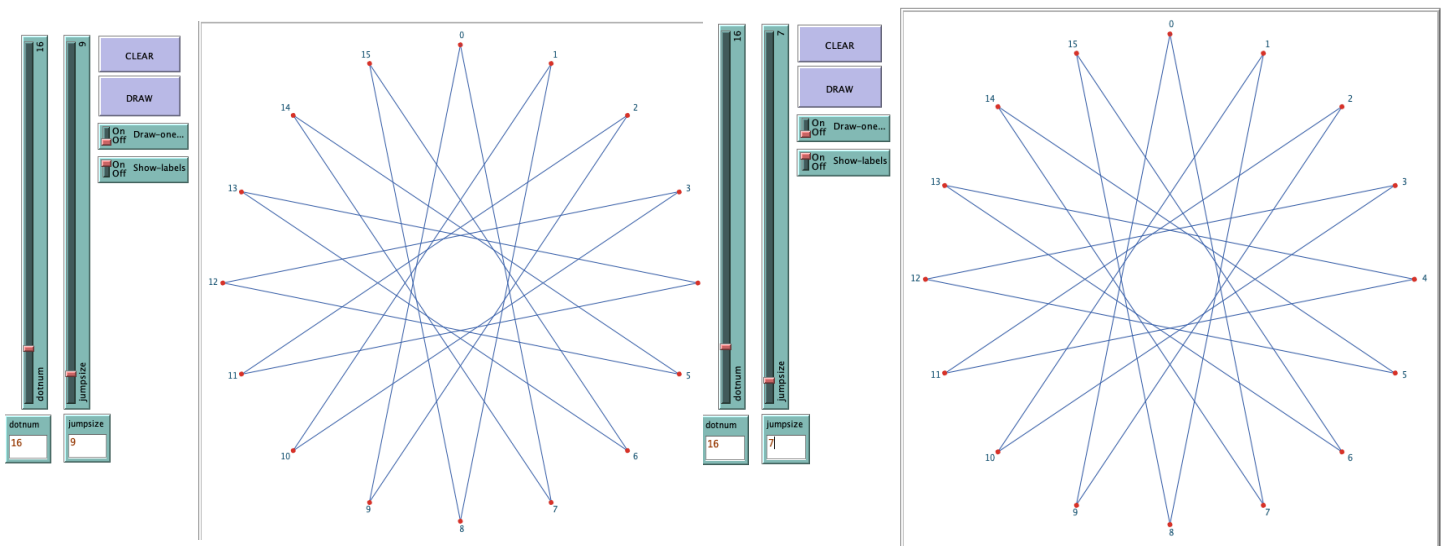
Connect the Dots is a mathematical procedure that has been puzzling mathematicians for decades. It consists of a circle labeled with a certain amount of dots, an equal distance apart on the circle, 0 being at the top of the circle. The variable for the number of dots is known as dotnum. A line stems from 0, connecting to another dot that is a variable known as jumpsize dots away. Another line extends from the second dot, going to a third dot labeled as the number that is the second dot plus one(see screenshot below). This process repeats until a line finally makes a connection to zero, creating an interesting pattern of lines. These lines can cross to make shapes that look like they were drawn by spirographs, they can cross to make polygons, and all kinds of closed shapes. Connect the Dots can also be observed for conjectures, and I am going to share mine with you.



Connect the Dots interface in NetLogo 6.2.0, programmed by Joshua Abrams.

I was originally interested in the angles of jumpsizes and crossing lines. These also help determine the inside area of the shape, and because I didn't know how to calculate the exact inside area, I tried to figure out the connection between jumpsizes, dotnums, and inside area. Previously, before I realized that calculating the inside area would not be probable, I was doing some tests, and I realized that the bigger the jumpsizes was, the smaller the inside area was (the conjecture was actually a little more complicated than this.)

I then began testing this with a dotnum of 16. Previously, I noticed that when the jumpsizes was 9 or 7 the shape looked similar and this result looked almost contrary to my original conjecture. I then began to see that if I took two jumpsizes that summed to 16, their inside area looked almost the same. I then looked again and realized that the inside area was exactly the same. So



I knew I had to change my conjecture to

“As the jumpsizes decreases in numerical distance from 0 or the dotnum to half of the dotnum, the inside area of the figure made by the connecting lines gets smaller. ”

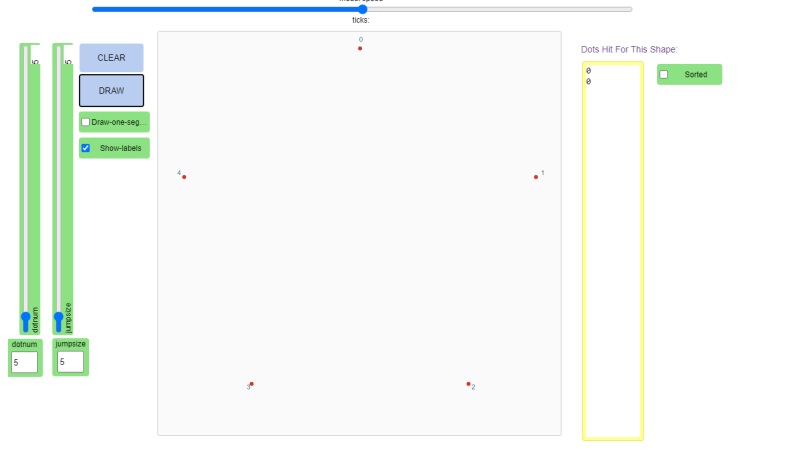
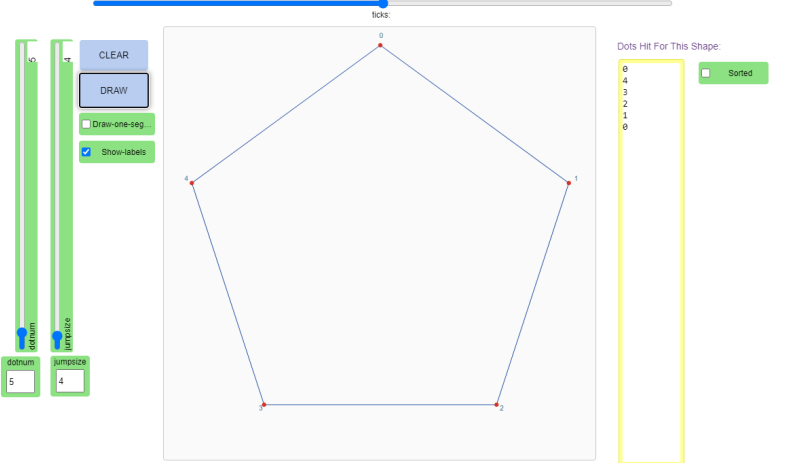
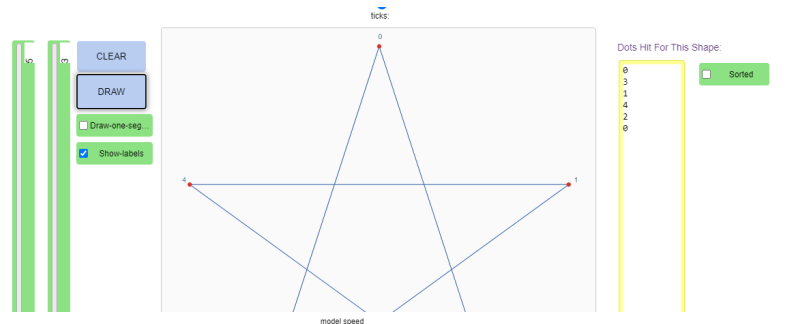
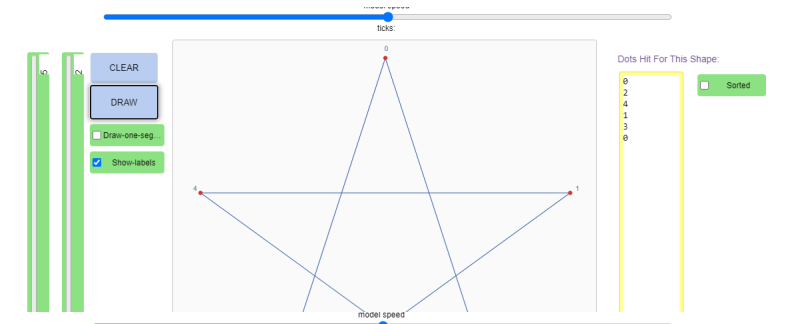
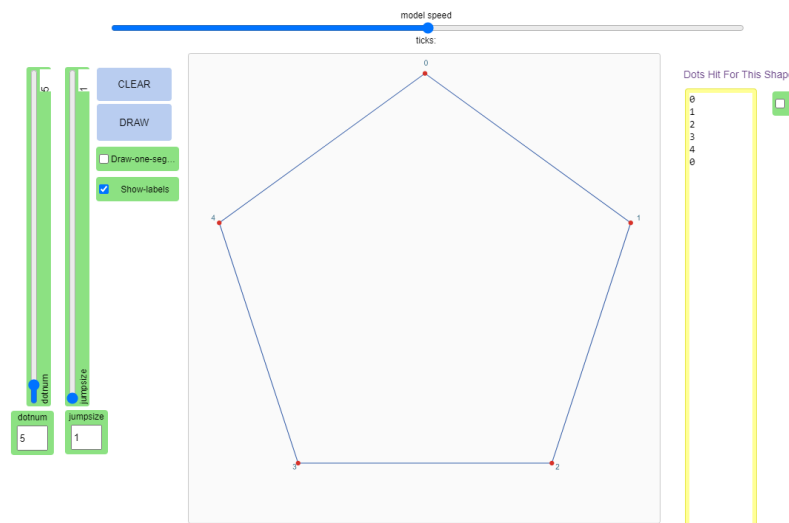
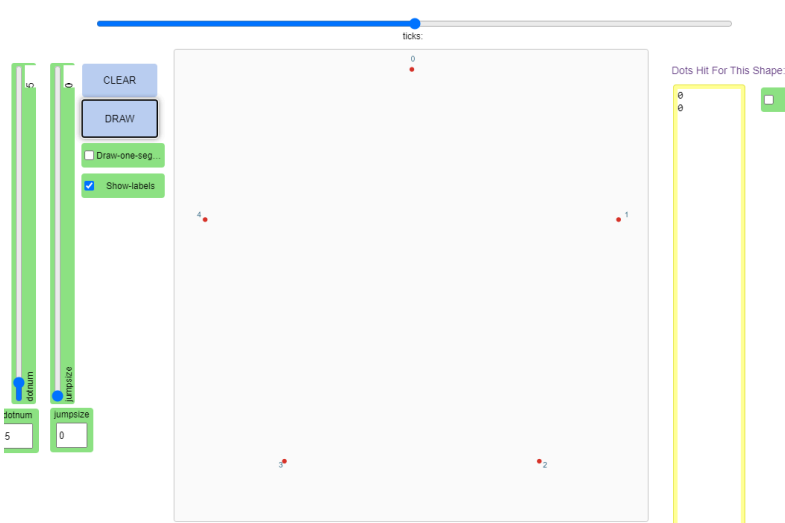
However, I wasn't sure what would happen if I had an odd dotnum with a decimal half. So, I then did some tests and realized that the jumpsizes 10 and 11 with a dotnum of 21 had the same area. Now, as I am writing this, I realize that a jumpsizes of 10.5 and a dotnum of 21 would look the same as a jumpsizes of 8 and a dotnum of 16, keeping the same conjecture.

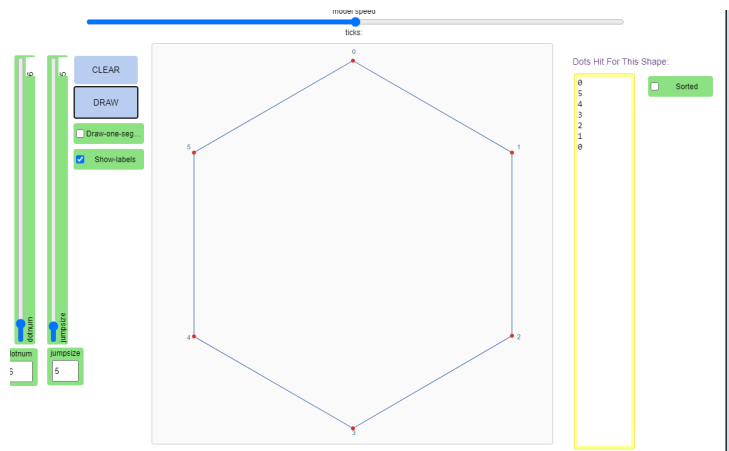
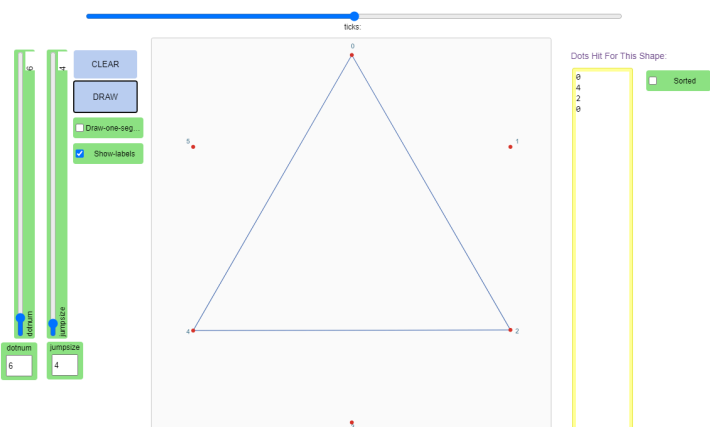
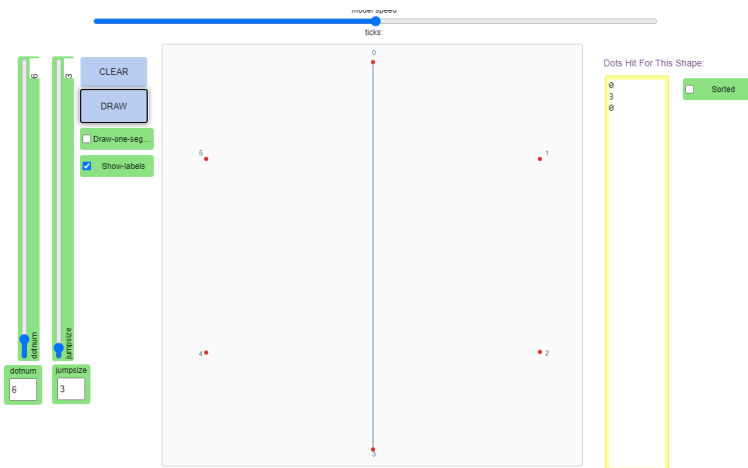
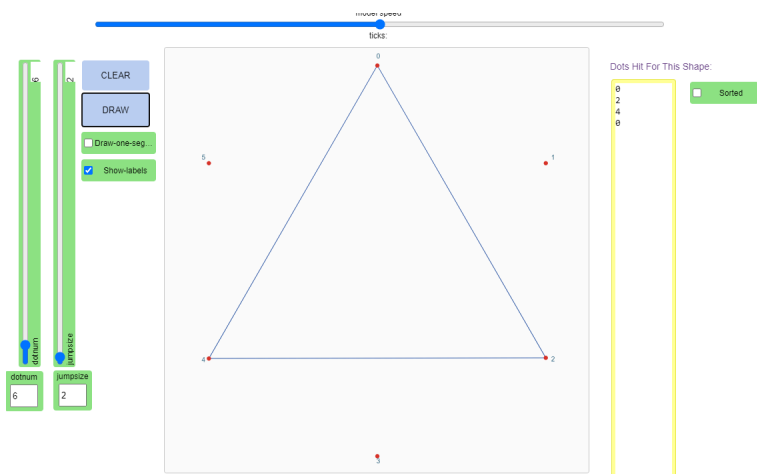
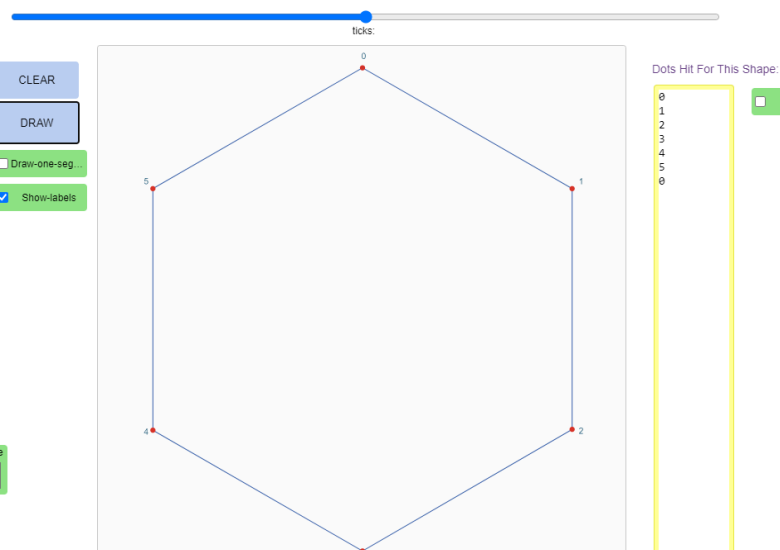
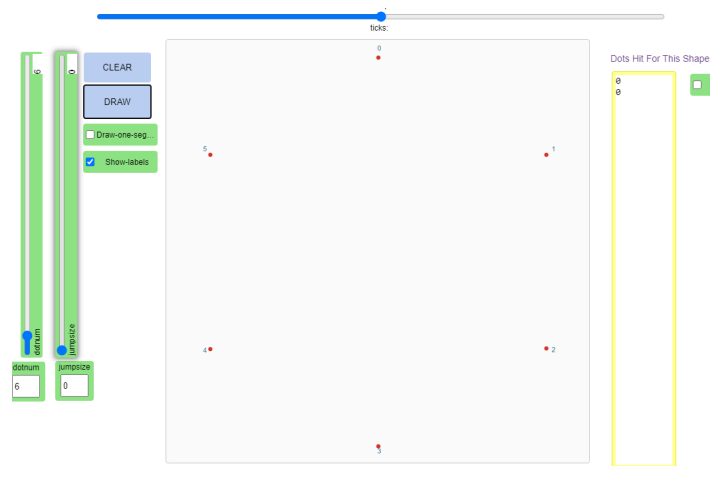
The hardest part of making this was figuring out what my conjecture should be, in the beginning. I was frustrated because I couldn't think of something that would challenge me. However, it was great to have a conjecture and be doing research.

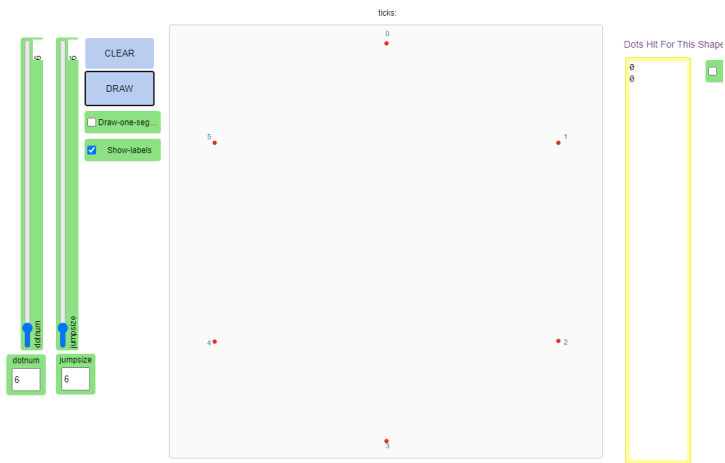
| Dotnum | Jumpsize | Inside Area(relat | Notes                                              | Corrections                                                        |  |  |  |  |  |
|--------|----------|-------------------|----------------------------------------------------|--------------------------------------------------------------------|--|--|--|--|--|
| 16     | 0        | N/A               | No Lines to create Area                            |                                                                    |  |  |  |  |  |
| 16     | 1        | N/A               | No valid comparison                                |                                                                    |  |  |  |  |  |
| 16     | 2        | Smaller           | None                                               |                                                                    |  |  |  |  |  |
| 16     | 3        | Smaller           | None                                               |                                                                    |  |  |  |  |  |
| 16     | 4        | Smaller           | Guessed(based                                      | Verified Inside Area                                               |  |  |  |  |  |
| 16     | 5        | Smaller           | None                                               |                                                                    |  |  |  |  |  |
| 16     | 6        | Smaller           | None                                               |                                                                    |  |  |  |  |  |
| 16     | 7        | Smaller           | None                                               |                                                                    |  |  |  |  |  |
| 16     | 8        | Smaller           | No Area                                            |                                                                    |  |  |  |  |  |
| 16     | 9        | Bigger            | Suspiciously sim                                   | Suspiciously similar notes are now confirmed as "Exactly the same" |  |  |  |  |  |
| 16     | 10       | Bigger            | Suspiciously similar to 6                          |                                                                    |  |  |  |  |  |
| 16     | 11       | Bigger            | Suspiciously similar to 5                          |                                                                    |  |  |  |  |  |
| 16     | 12       | Bigger            | Suspiciously similar to 4                          |                                                                    |  |  |  |  |  |
| 16     | 13       | Bigger            | Suspiciously similar to 3                          |                                                                    |  |  |  |  |  |
| 16     | 14       | Bigger            | Suspiciously similar to 2                          |                                                                    |  |  |  |  |  |
| 16     | 15       | Bigger            | Suspiciously similar to 1                          |                                                                    |  |  |  |  |  |
| 16     | 16       | N/A               | No lines to create Area, Suspiciously similar to 0 |                                                                    |  |  |  |  |  |

| Dotnum | Jumpsize | Inside Area | Notes                                                                 | Corrections |  |  |  |  |  |
|--------|----------|-------------|-----------------------------------------------------------------------|-------------|--|--|--|--|--|
| 21     | 0        | N/A         | No lines to create inside area                                        |             |  |  |  |  |  |
| 21     | 1        | N/A         | No valid comparison                                                   |             |  |  |  |  |  |
| 21     | 2        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 3        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 4        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 5        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 6        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 7        | Smaller     | Guessed(based on patterns, no proof due to spacial issues)            |             |  |  |  |  |  |
| 21     | 8        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 9        | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 10       | Smaller     | None                                                                  |             |  |  |  |  |  |
| 21     | 11       | Equal       | None                                                                  |             |  |  |  |  |  |
| 21     | 12       | Bigger      | Same as 9                                                             |             |  |  |  |  |  |
| 21     | 13       | Bigger      | Same as 8                                                             |             |  |  |  |  |  |
| 21     | 14       | Bigger      | Same as 7                                                             |             |  |  |  |  |  |
| 21     | 15       | Bigger      | Guessed(based on patterns, no proof due to spacial issues), Same as 6 |             |  |  |  |  |  |
| 21     | 16       | Bigger      | Same as 5                                                             |             |  |  |  |  |  |
| 21     | 17       | Bigger      | Same as 4                                                             |             |  |  |  |  |  |
| 21     | 18       | Bigger      | Same as 3                                                             |             |  |  |  |  |  |
| 21     | 19       | Bigger      | Same as 2                                                             |             |  |  |  |  |  |
| 21     | 20       | Bigger      | Same as 1                                                             |             |  |  |  |  |  |
| 21     | 21       | N/a         | No valid comparison, Same as 0                                        |             |  |  |  |  |  |

Other examples include a dotnum of 5 and all jumpsizes from 0-5(inclusive), and a dotnum of 6 and all jumpsizes from 0-6(inclusive). These screenshots at first show a jumpsize increasing from 0 to 5 with a dotnum of 5, and after that, a jumpsize increasing from 0 to 6 with a dotnum of 6. Look at how the inside area changes.







Spreadsheet: [Auden CTD](#)

### Glossary:

Dots - One of the dots labeled with a number that creates a circle in the NetLogo program

Line: The blue, ultra-thin rectangle(looks like a line) that connects two dots in the NetLogo program.

Shape - The closed figure resulting from connecting lines until one line touches the point 0 again(after starting on 0).

Inside Area: The large section in the center of a shape with no lines crossing through it, creating pure white.