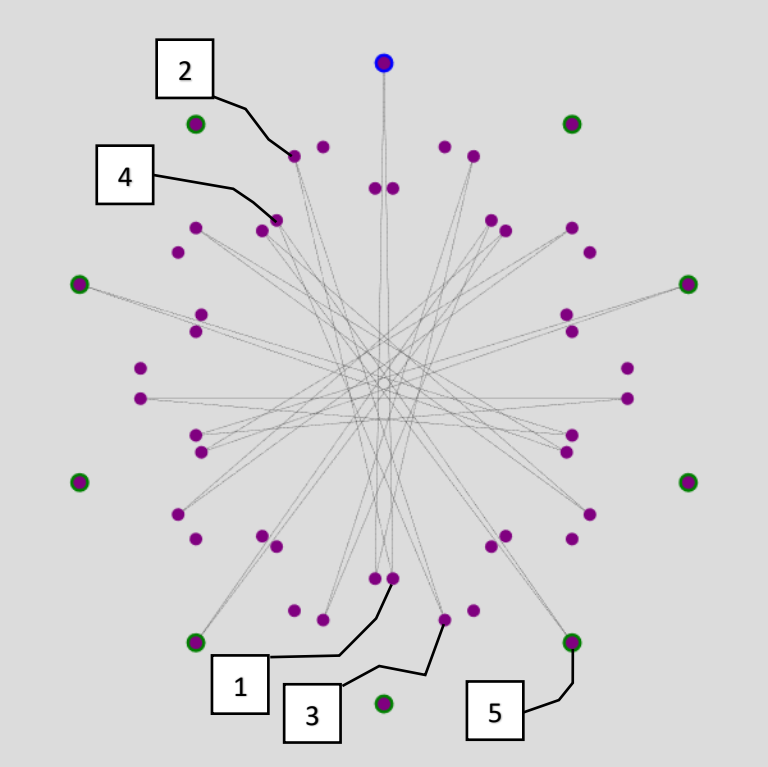
Level Patterns across a Cycle

With ***F*** = 1, the image levels move in and out, one at a time … may look smooth or not as 2.6b discusses. For example, this 30 rotating hearts https://www.playingwithpolygons.com?vertex=30&subdivisions=21&points=293&jumps=13 image appears quite smooth but change ***n*** from 30 to 28 and the image is a jagged starburst. In both instances, ***F*** = 1

When ***F*** > 1, the movements from point to point in terms of level are, in general, larger. The pattern of movement between levels depends on levels available and the initial remainder, ***r***. The level of the first subdivision endpoint is based on the remainder when ***P*** is divided by ***S***. This remainder is described using the MOD function so that this would be described as ***r*** = MOD(***P***, ***S***). The Level of the first endpoint, ***F***, is given by the minimum of r and ***S*** – ***r***. The level of the k^{th} subdivision endpoint is based on the remainder once ***k*P*** is divided by ***S*** in the same fashion.



An example. Let ***P*** = 8 and ***S*** = 5 with ***n*** = 10 and ***J*** = 3. This image is shown to the right with the first cycle noted with the numbers 1-5. Note that half of the subdivisions are not part of the final image, **SCF** = 2. Since ***S*** = 5, there are 2 levels of concentric circles of subdivision points in addition to polygonal vertices.

The 1st point is at Level 2 since the first point is the 3rd subdivision endpoint on the 2nd line of the vertex frame, **3** = MOD(8, 5) because 8 = 1*5 + **3**.

The 2nd point is at Level 1 since **1** = MOD(2*8, 5), the 1st endpoint on the 4th line, 16 = 3*5 + **1**.

The 3rd point is also at Level 1 since **4** = MOD(3*8, 5), the 4th endpoint on the 5th line, 24 = 4*5 + **4**.

The 4th point is at Level 2 since **2** = MOD(4*8, 5), the 2nd endpoint on the 7th line, 32 = 6*5 + 2.

The 5th endpoint is at Level 0 since 0 = MOD(5*8, 5), the endpoint of the 8th line at polygon vertex **4**.

Click Toggle Drawing: https://www.playingwithpolygons.com?vertex=12&subdivisions=13&points=46&jumps=5

It is worth noting that this same Level pattern (2, 1, 1, 2, 0) would occur for any ***P*** which has remainder 2 or 3 when divided by 5. This is why the Level pattern in an image only depends on the first level, ***F***. The level pattern can be found for any ***S*** and ***P*** (and hence ***F*** = MOD(***P***, ***S***)). The table to the right shows the Level patterns given ***S*** = 21. Note the following:

- There is symmetry of ***F*** between remainders above and below ***S***/2.
- Only MOD(***S***,***P***) = 1 or ***S***-1 change by 1 per line.
- Maximum level changes start with ***F*** = 10.
- Some initial remainders have ***C*** < 21. In particular, remainders divisible by 3 have ***C*** = 7 and remainders divisible by 7 have ***C*** = 3. This is true whenever ***S*** is a composite number.

The next document is an Excel file which allows you to examine Level patterns for any ***S*** < 22.

MOD (P,S)=		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	0
1	F	0	1	2	3	4	5	6	7	8	9	10	10	9	8	7	6	5	4	3	2	1	0
2		0	2	4	6	8	10	9	7	5	3	1	1	3	5	7	9	10	8	6	4	2	0
3		0	3	6	9	9	6	3	0	3	6	9	9	6	3	0	3	6	9	9	6	3	0
4		0	4	8	9	5	1	3	7	10	6	2	2	6	10	7	3	1	5	9	8	4	0
5		0	5	10	6	1	4	9	7	2	3	8	8	3	2	7	9	4	1	6	10	5	0
6		0	6	9	3	3	9	6	0	6	9	3	3	9	6	0	6	9	3	3	9	6	0
7		0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
8		0	8	5	3	10	2	6	7	1	9	4	4	9	1	7	6	2	10	3	5	8	0
9		0	9	3	6	6	3	9	0	9	3	6	6	3	9	0	9	3	6	6	3	9	0
10		0	10	1	9	2	8	3	7	4	6	5	5	6	4	7	3	8	2	9	1	10	0
11		0	10	1	9	2	8	3	7	4	6	5	5	6	4	7	3	8	2	9	1	10	0
12		0	9	3	6	6	3	9	0	9	3	6	6	3	9	0	9	3	6	6	3	9	0
13		0	8	5	3	10	2	6	7	1	9	4	4	9	1	7	6	2	10	3	5	8	0
14		0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	7	0
15		0	6	9	3	3	9	6	0	6	9	3	3	9	6	0	6	9	3	3	9	6	0
16		0	5	10	6	1	4	9	7	2	3	8	8	3	2	7	9	4	1	6	10	5	0
17		0	4	8	9	5	1	3	7	10	6	2	2	6	10	7	3	1	5	9	8	4	0
18		0	3	6	9	9	6	3	0	3	6	9	9	6	3	0	3	6	9	9	6	3	0
19		0	2	4	6	8	10	9	7	5	3	1	1	3	5	7	9	10	8	6	4	2	0
20		0	1	2	3	4	5	6	7	8	9	10	10	9	8	7	6	5	4	3	2	1	0
21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0