

```
+ log + spiral: + C + C = 0.2 + sweep + endangle = 360 + size + Size = 38
+ pen + growth + pengrowth = 0.1 + clockwise? + clockwise ? +
```

sweep that we entered in the block is replaced as endangle in this script

```
script variables
x_origin y_origin starting direction beta t tinc roffset
r h start end segments startangle
```

```
pen down
set segments to 5 segments to speed up the completion for each increment
```

```
if clockwise
    set clockwise to true Set the variable clockwise
else
    set clockwise to false
```

```
if clockwise
    if endangle < 0
        set starting direction to
            angle - endangle + atan of 1 / C - 180
    else
        set starting direction to angle + atan of 1 / C
    else
        set starting direction to angle - atan of 1 / C
```

t: the relative angle we use to calculate radius
tinc: increment that each relative angle is changed by
roffset: the radius when relative angle is zero
start and end are the relative angles of the starting and ending point of drawing
x_origin and y_origin are the x and y values of the inner center of the spiral on the canvas
starting direction is the pointing direction at the starting point on the canvas
r is the radius at each different point of the spiral

Note: $\arctan(1/c)$ gives the constant angle between the radial vector and the tangent line for log spiral at any point

Calculate starting direction with the original pointing direction (angle) of the pen. Because sweep(endangle) is the change of degrees of the spiral, we minus the endangle to reverse the degree that it has swept through to find the tangent line. Then, we minus 180 degrees to match the correct drawing direction. This is for drawing the spiral from outside to inside.

When drawing from inside to outside, the tangent angle = $\arctan(1/c)$. we only need to add the original direction (angle) to calculate starting direction

```
if endangle < 0
    set starting direction to
        angle + endangle + 180 - atan of 1 / C
else
    set starting direction to angle - atan of 1 / C
```

Below, the overall shape would be counterclockwise.

(similar as above) rotate the starting direction when drawing from outside to inside. Notice that when the final shape is counterclockwise, we add the endangle instead of minus it. We also minus the angle between the tangent and radial line instead of adding it.

```
set Size to 2 x
Size / e^ of C x degrees to radians abs of endangle
set roffset to Size x e^ of C x degrees to radians 0
if endangle < 0
    set start to abs of endangle
    set end to 0
    set r to Size x e^ of C x degrees to radians abs of endangle
    if clockwise
        set x_origin to
            x position - r x cos of starting direction - start - roffset x cos of starting direction
        set y_origin to
            y position - r x sin of starting direction - start - roffset x sin of starting direction
    else
        set x_origin to
            x position - r x cos of start + starting direction - roffset x cos of starting direction
        set y_origin to
            y position - r x sin of start + starting direction - roffset x sin of starting direction
    else
        set start to 0
        set end to endangle
        set x_origin to x position
        set y_origin to y position
    set t to start
    if end > start
        set tinc to 1
    else
        set tinc to -1
    repeat abs of end - start / tinc / segments
        warp
        repeat segments
            set r to Size x e^ of C x degrees to radians t
            if clockwise = false
                go to x:
                    x_origin + r x cos of t + starting direction - roffset x cos of starting direction
                y:
                    y_origin + r x sin of t + starting direction - roffset x sin of starting direction
            else
                go to x:
                    x_origin + r x cos of t x -1 + starting direction - roffset x cos of starting direction
                y:
                    y_origin + r x sin of t x -1 + starting direction - roffset x sin of starting direction
            set t to t + tinc
            change pen size by pengrowth
            if clockwise
                turn tinc degrees
            else
                turn -tinc degrees
        warp
        repeat abs of end - start / tinc mod segments
            set r to Size x e^ of C x degrees to radians t
            if clockwise = false
                go to x:
                    x_origin + r x cos of t + starting direction - roffset x cos of starting direction
                y:
                    y_origin + r x sin of t + starting direction - roffset x sin of starting direction
            else
                go to x:
                    x_origin + r x cos of t x -1 + starting direction - roffset x cos of starting direction
                y:
                    y_origin + r x sin of t x -1 + starting direction - roffset x sin of starting direction
            change pen size by pengrowth
            set t to t + tinc
            if clockwise
                turn tinc degrees
            else
                turn -tinc degrees
        pen up
```

Calculate the size variable and use it for scaling in many other variables below. The size is scaled to accommodate more or less sweep(endangle) that user entered

roffset is the difference (or "gap") between the Cartesian origin for the spiral and its inner center on Cartesian grid (when the degree is 0)

setting two "markers" to remember and record the process of drawing - two relative angles for a spiral in Cartesian grid. Here, start is more than end because we're drawing from outside to inside (under the condition endangle < 0)

Find out the radius at this point. which is the largest. (again, outside to inside)

From here to the next comment, we calculate the coordinates(x_origin and y-origin for the x and y values) of the origin. The origin identifies where the inner center of the spiral is on the canvas, including taking the gap into account.

Repeating here to find the coordinates when the final shape is counterclockwise

Here, endangle > 0
Thus, start represents the relative degree of the inner center of a spiral.
Also, the x and y value of origin (inner center) is the same as x position and y position of the starting point.

t is the angle that we calculate radius of the spiral at the starting point, which is set to be the same as start - the recall that the variables end and start are set in the blocks above. When we're drawing from inside out, end > start

tinc is the change of each angle. we use the angle to evaluate each radius.
tinc = 1 when we're drawing from inside to outside, the relative angle thus increases in degrees; tinc = -1 when in the opposite situation.

Here, we start to draw the spiral in small increments.
We further divide the small increments in segments to speed up the drawing (through the wrap block)

Calculate the radius at the starting point as r.

Move the pen to the next location of the pen where the overall shape is counterclockwise.

compare with the script above - now that when overall shape is clockwise, we flip the sign of t, so that the relative angle is changing to the other direction. Note that the other variables that we calculated above are automatically taking care of whether we draw from outside to inside or from inside to outside.

Notice that we divided the change of relative angle (sweep) by segments, here we repeat and finish off the shape if there's any remainder from the division. The basic process is same as above