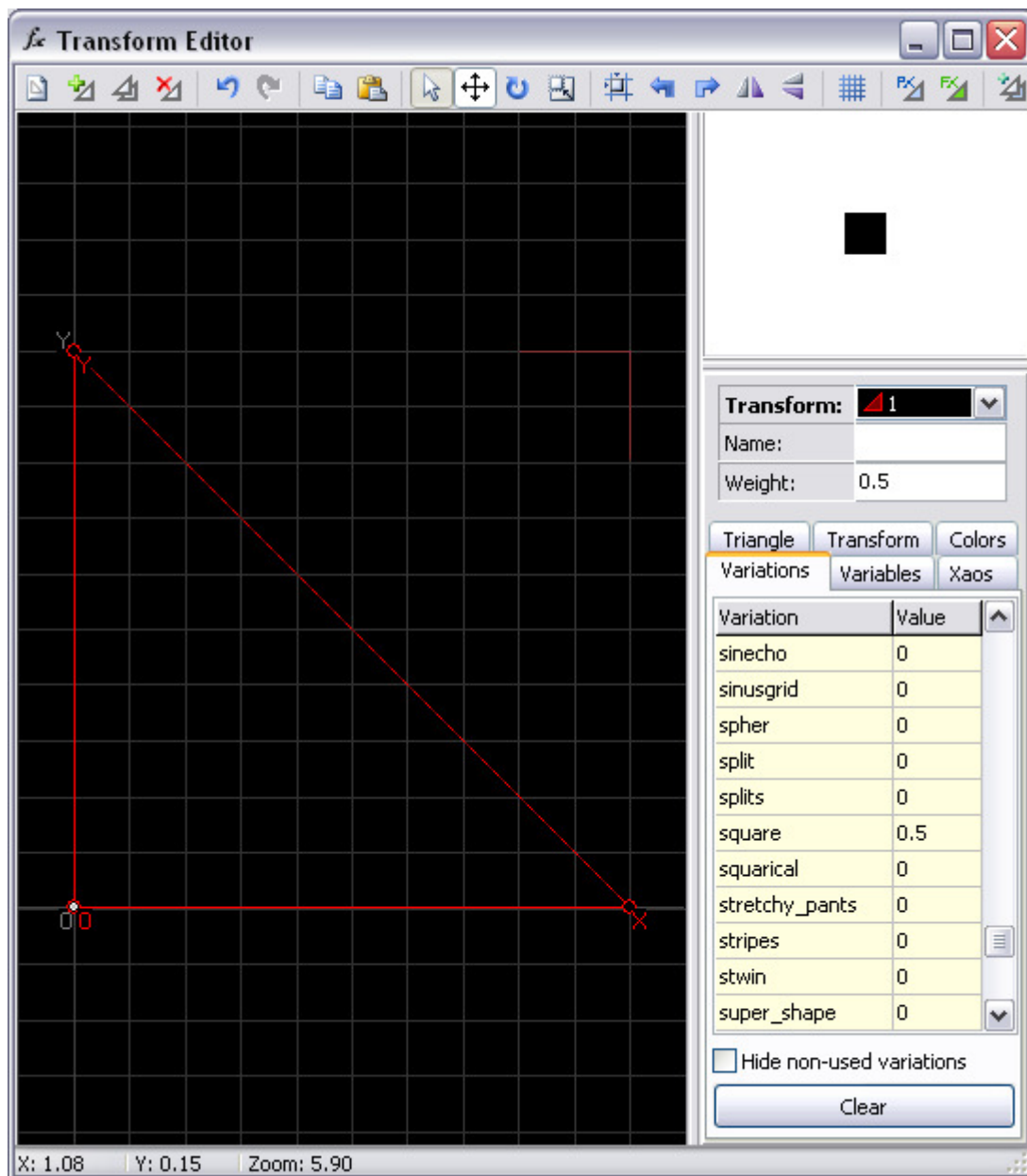# Pythagoras trees: an intermediate level Apophysis tutorial

Introduction

I had some base parameters for this structure from forever ago, but stumbling on it afresh on the web, I thought to derive them again from fresh:

http://en.wikipedia.org/wiki/Pythagoras_tree

So: start with a square base xform - I reduced its weight to 0.5.

Obviously, the structure would be propagated using linear xforms so I added one then looked at the maths. The side of the next branch should be sqrt(2)/2, roughly 0.7071, so I pasted this value as both the linear weight and the xform origin y-value.
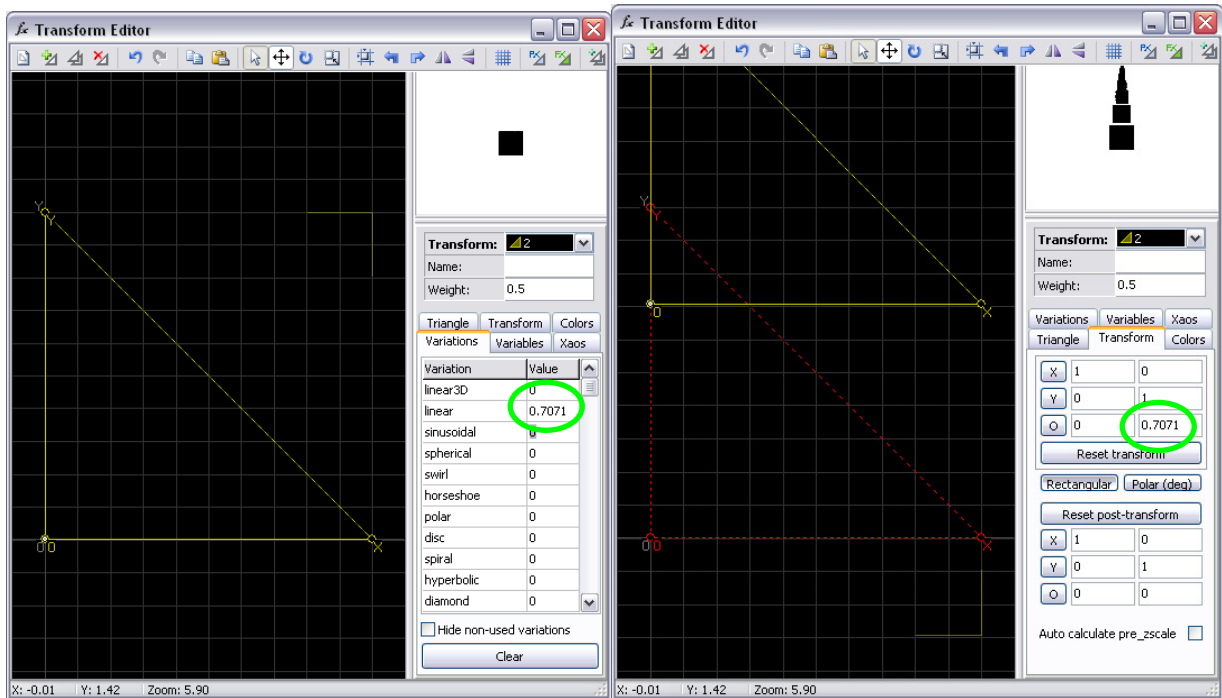
Rotating the xform 45 degrees counter-clockwise began to generate something like one side branch, but an x-offset was required. Cut to the chase, this turns out to be sqrt(2)/4, roughly 0.3536, so this is entered as a negative for the xform origin x-value.
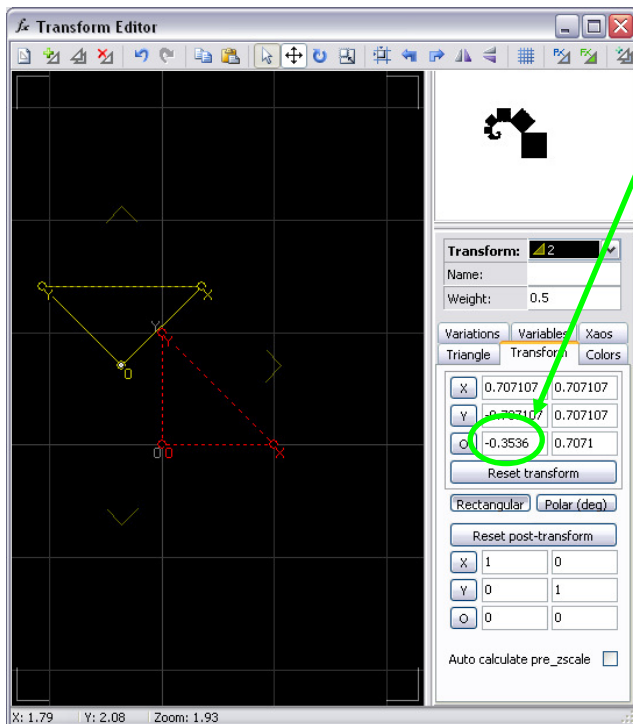
Looking good, but we need the other branch. Rather than repeat the exercise, I just duplicated the xform, switched to World Pivot and flipped it horizontally. Magic! Instant Pythagoras tree!
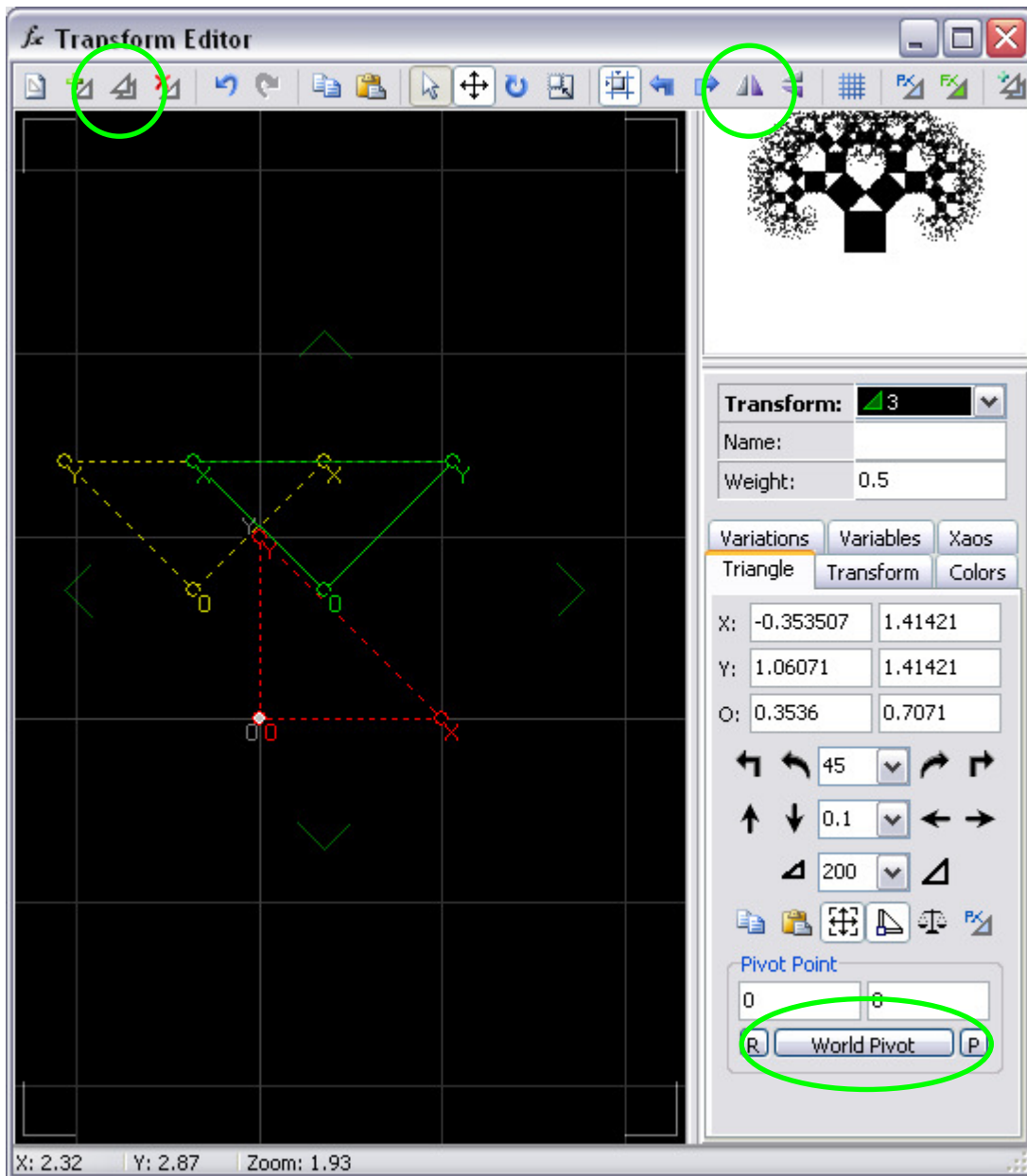
Fades a little towards the edge, though, so increase the weight of xforms 2 and 3 (I doubled them). Can't have a boring mono structure so the colour sliders for xforms 2 and 3 should be dragged across to the right (same value, I just went all the way) plus a little speed added to compensate for the xform weight increase (I found 0.5 to be good). Drag the camera y-position down to centre in the vertical and there we have it, the finished article.

Not exactly art, is it?

Still, it's a classic fractal structure that may now be used as a framework.

The creation of 'Dance, Shiva'

I've chosen this fractal as a learning exercise because it embodies some useful lessons in transform linking, along with an intentional approach.

We can consider that the content of the fractal is provided by the square xform #1, and the form (branching structure) provided by the 2 linear xforms #2 and #3. We wish to retain the form, so these two remain - it's #1 that must change.

A recent fractal of mine, World of stripes (http://ideviant.deviantart.com/art/World-of-stripes-155280859), utilised a pair of pie xforms to create stripes, so I fancied a stripy trunk for my tree! So, #1 turned over to pie then opened out into the orthogonal by linking to polar.

http://www.ultragnosis.com/fractals
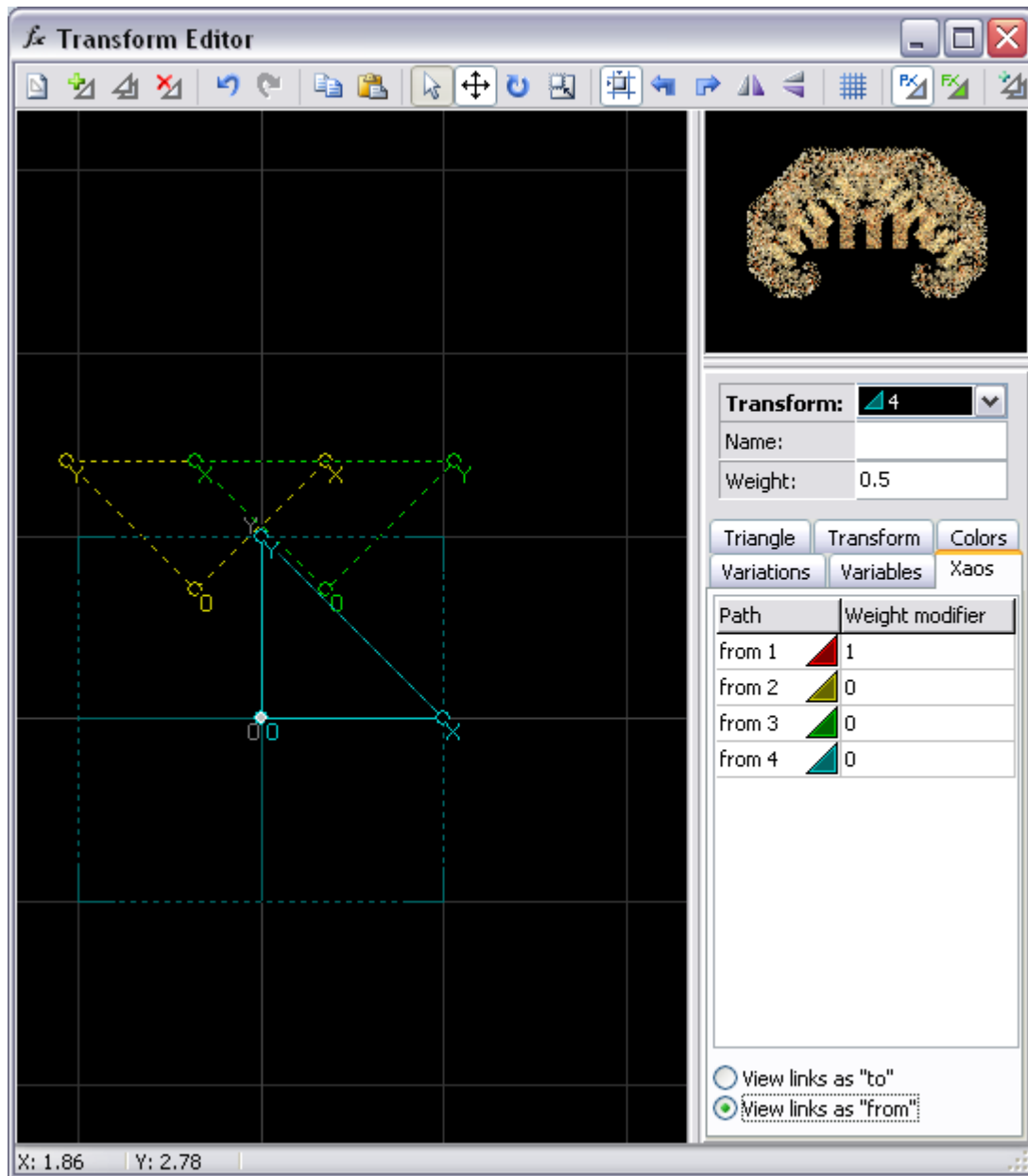
Hmm, that's a bit short! Looks like we need to seriously elongate in the y-direction.

And here I made a discovery: previous experience with linked xforms had demonstrated no difference between them and their own post xforms. Elongating the linked polar xform produced an unexpected effect, so I tried the post anyway. Aha! That's what I was expecting from the xform itself. Mental note.
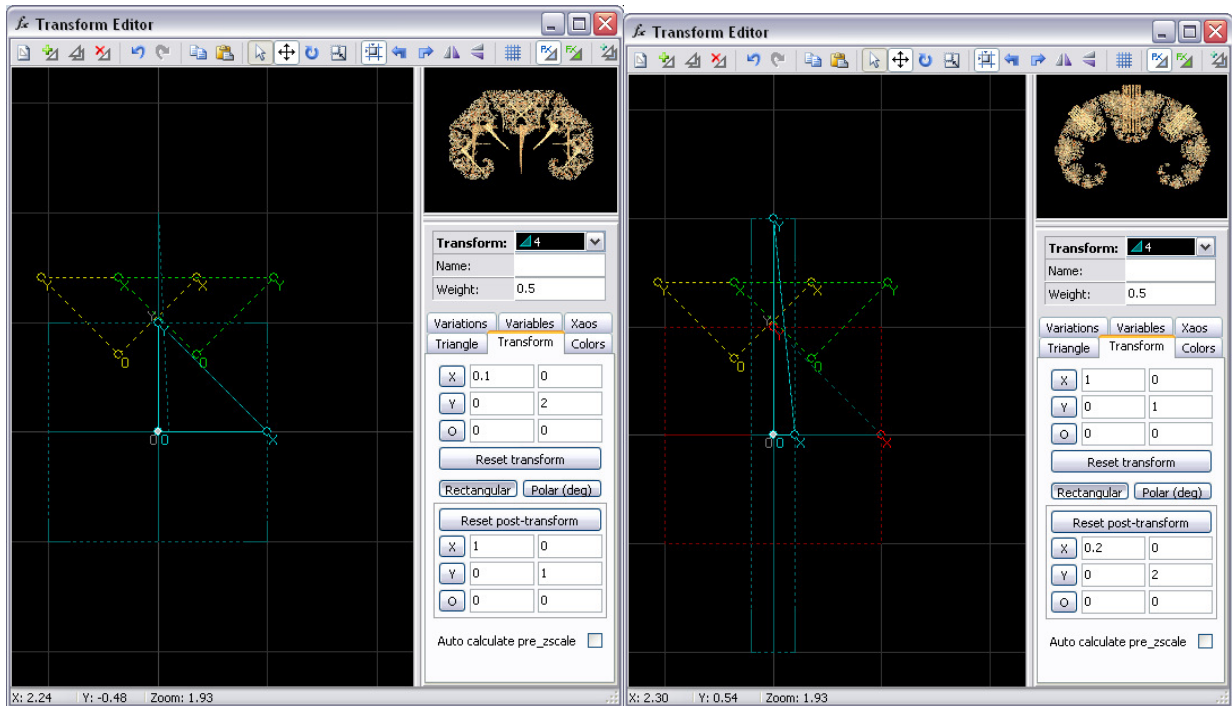
Extending, but in the wrong direction. OK, move down and extend more. Repeat until satisfied. Cool.
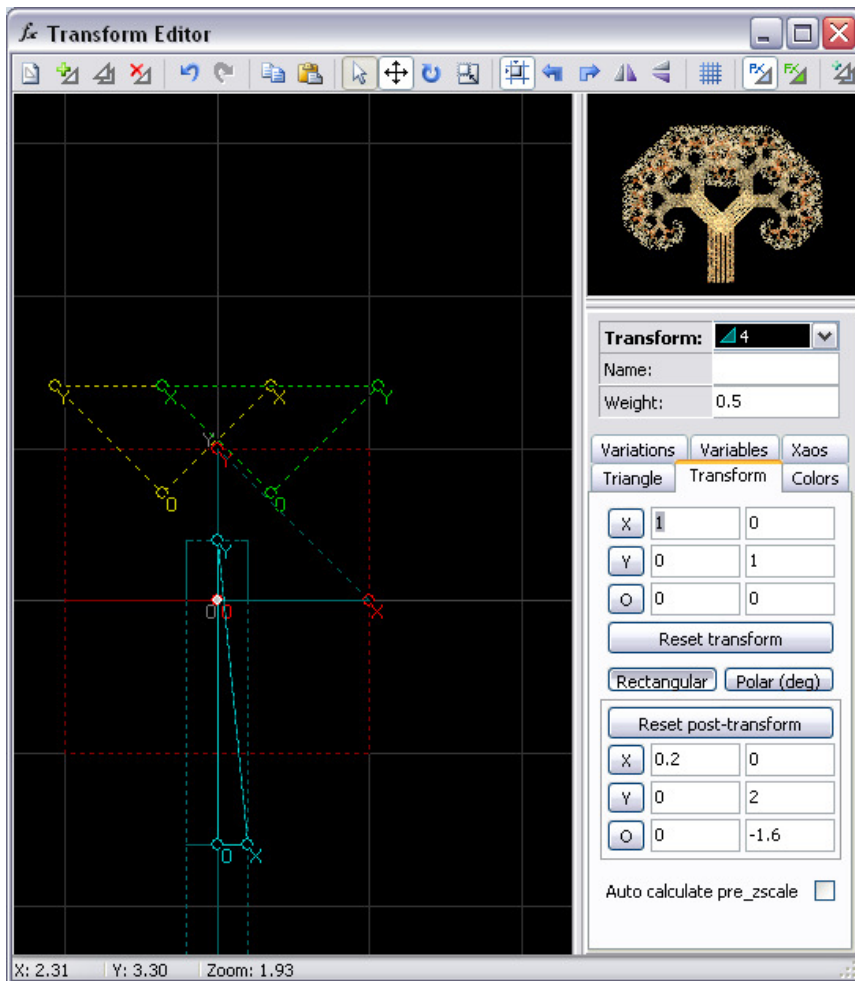
Right, better add in the other stripes. Another useful fact: the Duplicate transform function duplicates everything, including the link structure, so no worries about xaos. Just select xform #1, duplicate, shift the colour slider then calculate the required rotation as pi/slices. Voilà! Stripy-trunked tree. Extra tip: offset the calculated rotation slightly to obtain a hint of depth.
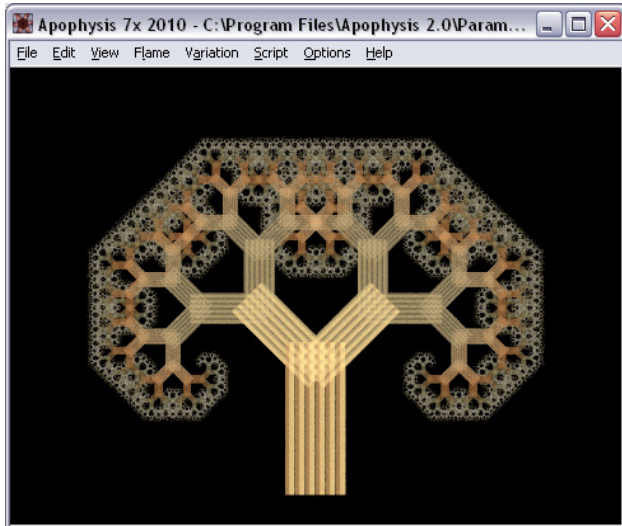

Now, how about a bit of wiggle? The obvious approach is to link the polar to a waves variation. None of the obvious candidates looked right, and I ended up using whorl:
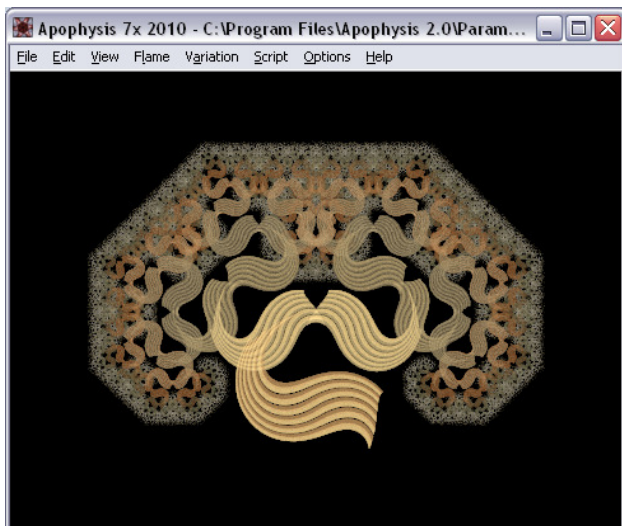

So, just a bit of eye-candy, but we've seen how to build a classic fractal structure from a basic description, use the World Pivot mode, selectively open up polar structures and serial-link transforms. The challenge is to use the framework to produce some original art!

Next steps: doubling

Thinking about the structure, I saw that a doubled version should be possible. Duplicate and vertically flip the linear xforms in World Pivot mode, then rotate each 180 degrees in Local Pivot mode. Follow up with a little ingenuity with xaos (no commerce between the up-pair and the down-pair) and the basic framework is there.
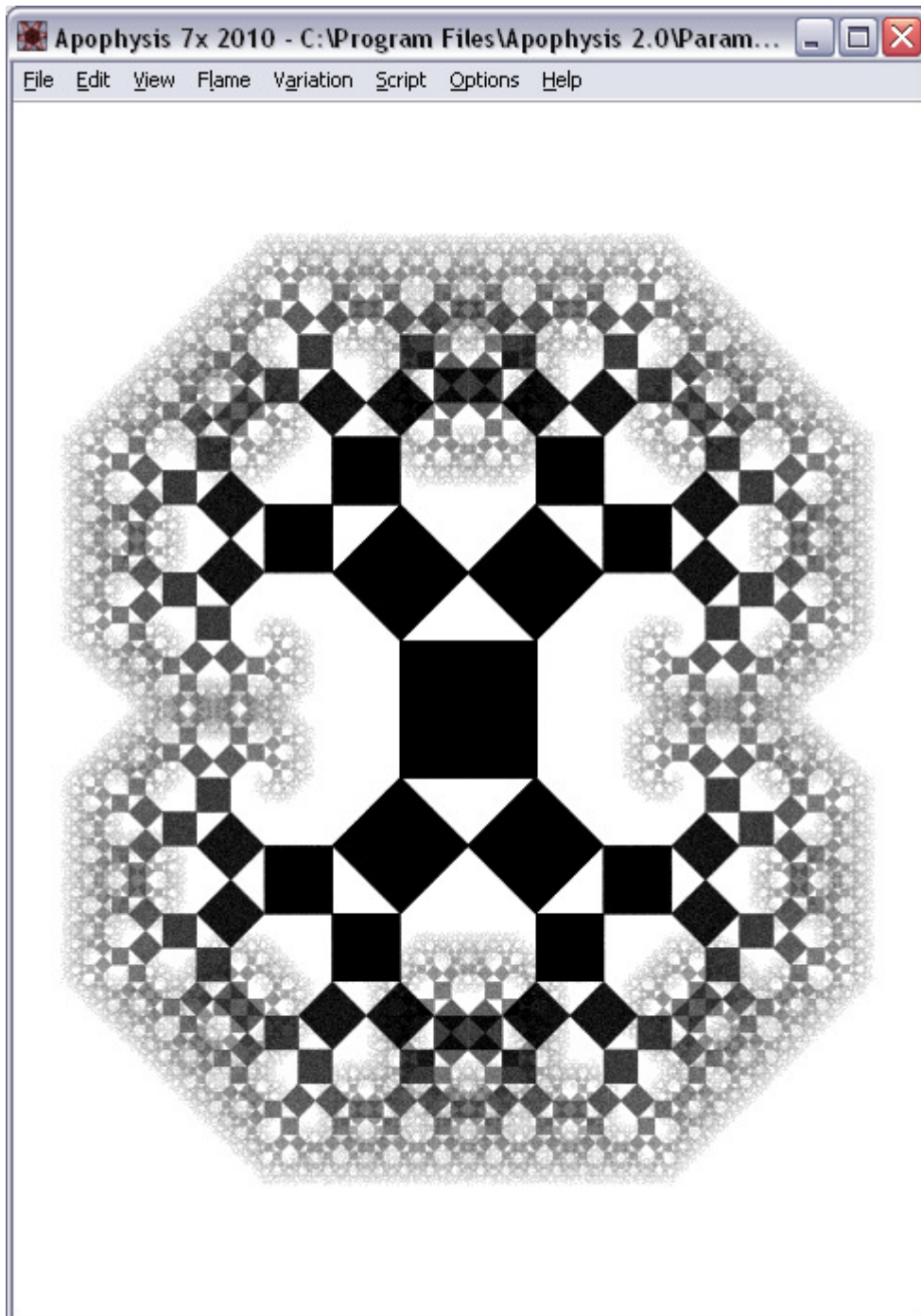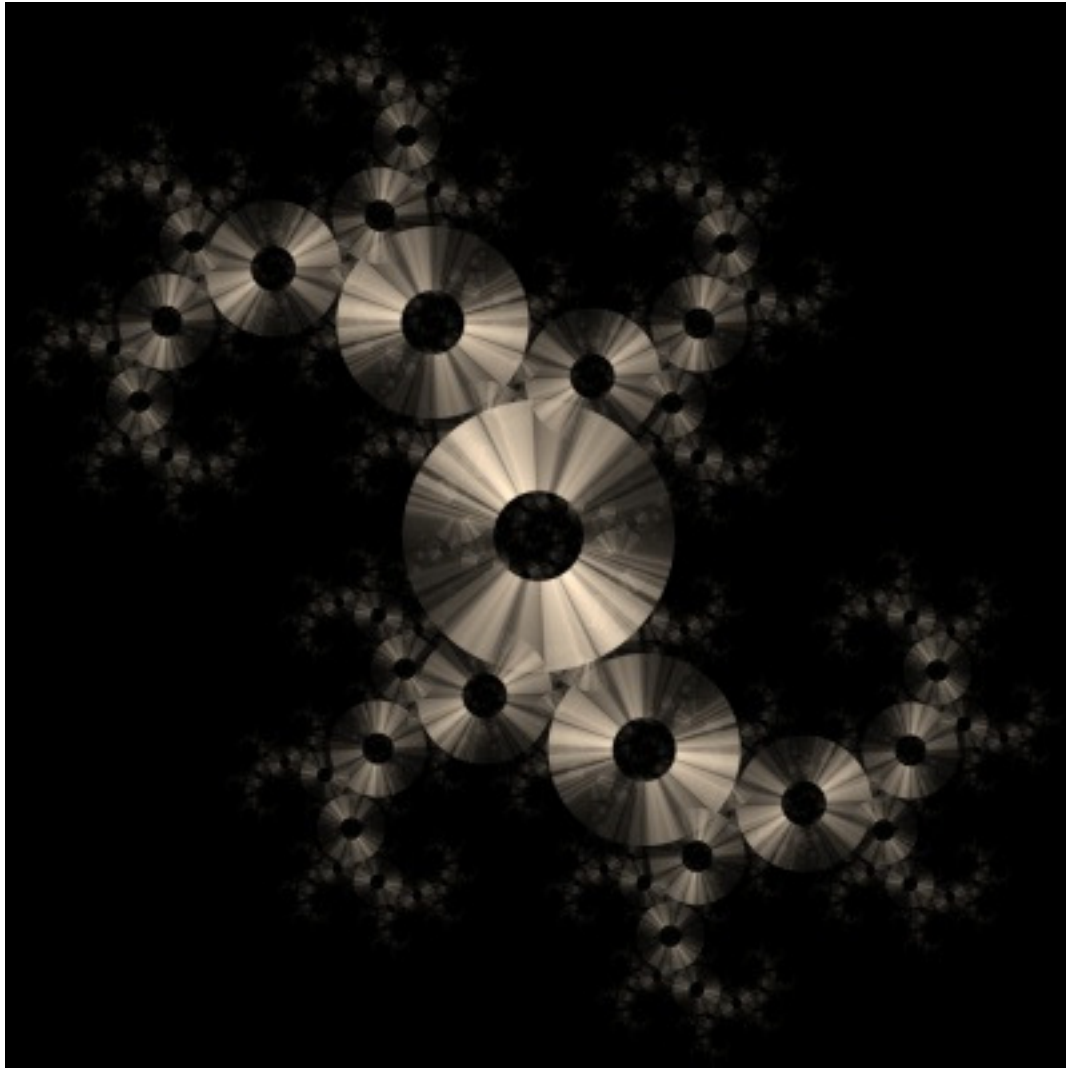

 Something a little more interesting:
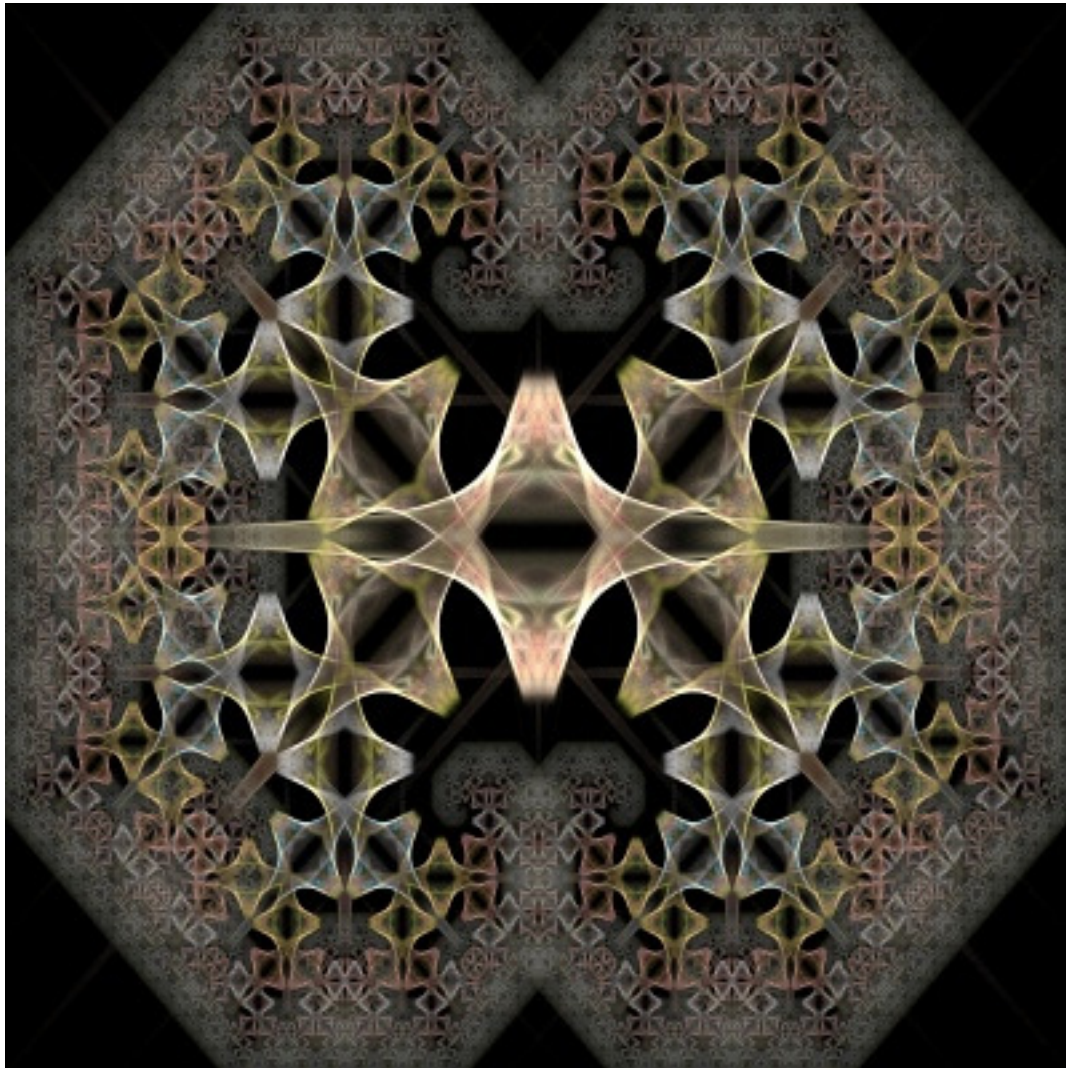
The transverse tree is less interesting:
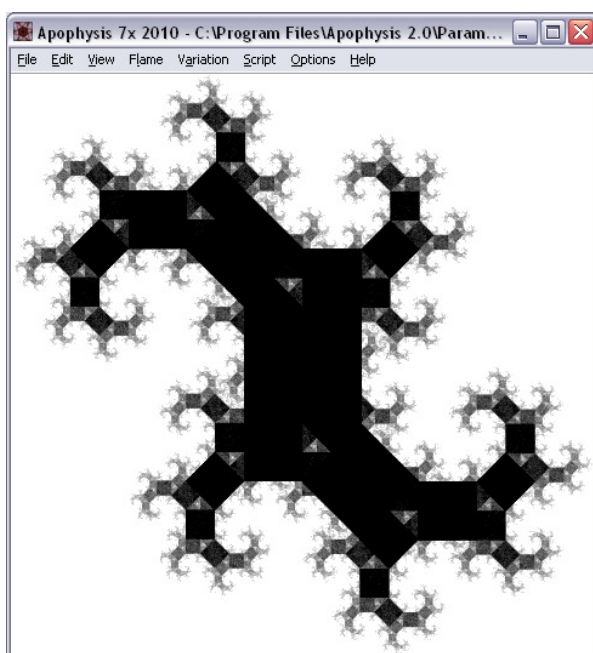
Still possible to make something though:

So, another group of frameworks to add to the growing list!