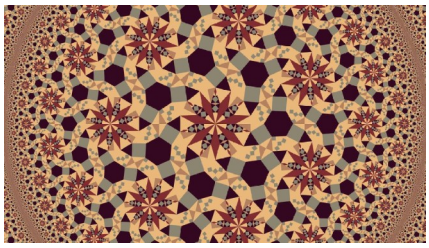
Hypertiling The Equilateral Triangle

An Apophysis 7X tutorial by teundenouden. *Level: intermediate.*

Examples





Used variations:

- starblur
- linear
- cpow
- hypertile2

Used software:

Apophysis 7X

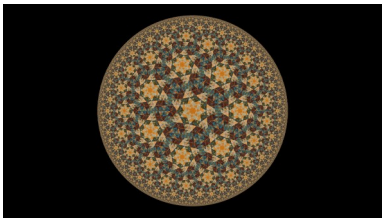
In case of missing variations, you'll find them within "The Aposhack Plugin Pack"

Introduction

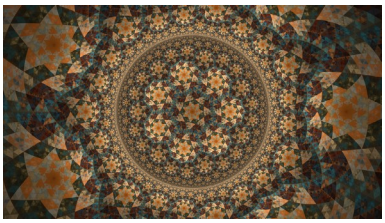
Pillemaster once made a tutorial on creating hypertiles with equilateral triangles.
His tutorial can be found using this link: Tiling Hypertile Chaotica Tutorial v.1.0
The unfortunate part is that it's written specifically for Chaotica due to use of so called "post-transform chains" in the camera transform. In Apophysis it's not possible to make post-transformation chains inside the final transform. However there is a better way that additionally is less hassle too.

The original tutorial needed an infinite amount of alternating mobiuses and hypertiles to completely fill the hypertile. Just after 8 copies you would barely see the gaps. This tutorial offers a better method because the hypertile is rotated 180 degrees and feeding back into itself every iteration, thus this infinite amount is automatically carried out without having to make all the copies manually.

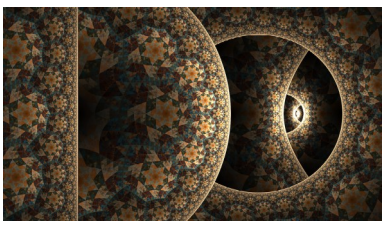
The biggest advantage of this technique is that it grants further use of the hypertile. For example, using it as input for other transformations and frameworks, instead of it being the 'final' transformation. Here are some possible examples:



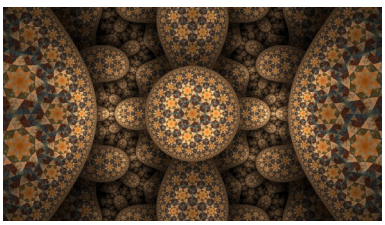
Hypertile created in this tutorial.



Hypertile surrounded by a Spherical transformation.



Hypertile into Flux-framework.



Hypertile into Julian-framework.

Part 1: Creating a base

An equilateral triangular input is required, but using a single shape will be quite dull.
Let's make a triangular rep-tile instead.

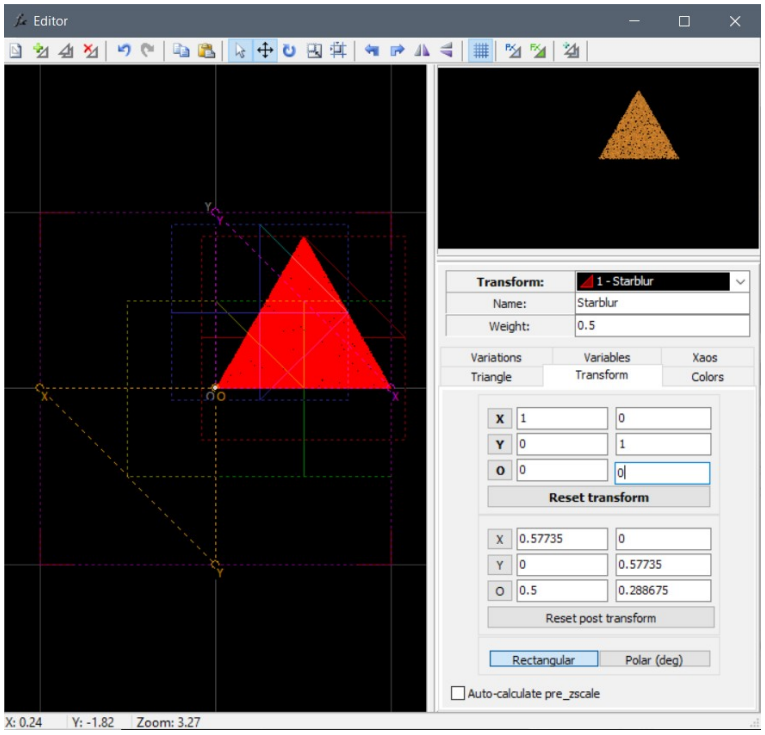
Open the editor window and click 'new flame'.
In the variations tab: set linear to 0 and starblur to 1.
In the variables tab: set power to 3 and range to 0.5.

Prior to making the triangle fit into the hypertile, it's necessary to change its scale and position.
Go to the transform tab and change its entries so it matches the following table:

X	1	0
Y	0	1
O	0	0
X	0.57735	0
Y	0	0.57735
O	0.5	0.288675

Explanation (you may skip this)
The starblur triangle's height =1.50000 and width ≈1.73205. In order to make the triangle fit in the hypertile it is necessary to make its height ≈0.866025 and width =1.000000.
In order to do so, a scaling factor of 0.57735 is needed.

Additionally the triangle has to be repositioned so that its left lower corner is at (x,y)=(0,0)
Originally the bottom of the triangle was at -0.5 on the y-axis which is now scaled by a factor of 0.57735 and therefore needs to be moved 0.288675 up.
After scaling the triangle has a width of 1 and has its center at 0 on the x-axis, therefore it needs to be moved 0,5 to the right.

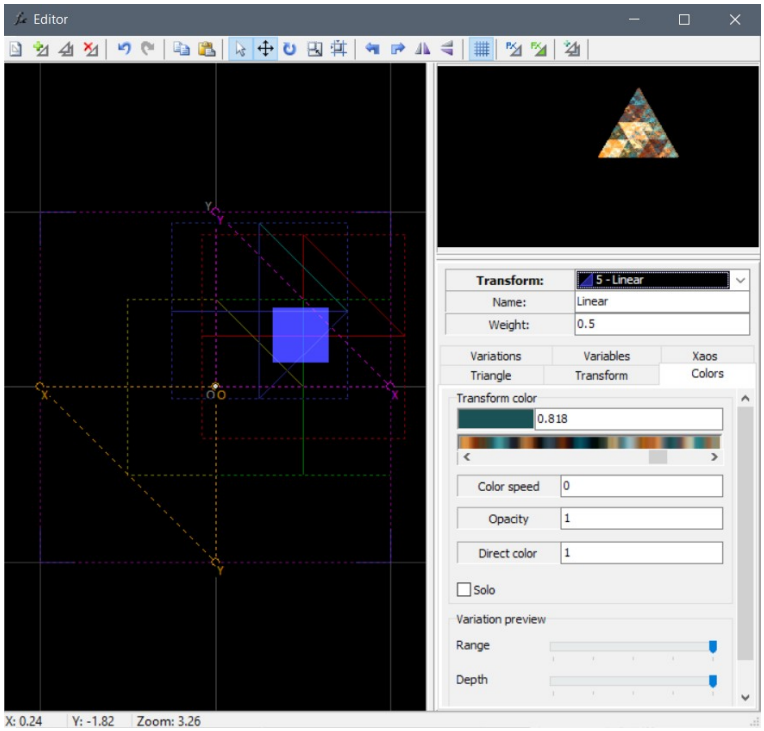


Add a new transform and in the variations tab leave linear set to 1.
Duplicate transform 2, three times.
Go through the transform tabs of transforms 2-5 and change their entries so they match the following tables:

	Transform 2			Transform 3			Transform 4			Transform 5	
X	1	0		1	0		1	0		1	0
Y	0	1		0	1		0	1		0	1
O	0	0		0	0		0	0		0	0
X	0.5	0		0.5	0		0.5	0		0.5	0
Y	0	0.5		0	0.5		0	0.5		0	-0.5
O	0	0		0.5	0		0.25	0.433013		0.25	0.433013

Explanation (you may skip this)
Transforms 2-5 are copies of the triangle (transform 1). Each copy is scaled with a factor 0.5. Transform 2 is a triangle bottom left, 3 bottom right, 4 top, 5 middle. Furthermore, these transforms are copies of themselfs and eachother, which results in a repetitive pattern that goes on infinitely into itself. Learn more about this in the 'linear tile tutorial'.

Select transform 1 and in the color tab set opacity to 0 and colorspeed to -1.
for transforms 2-5 in the color tab you can pick any number for transformcolor. Another way to do this is by pressing ctrl+alt+n (if using apophysis 7X), this will randomize the colors.



This colored triangle is the base that will be used as input for the hypertile.

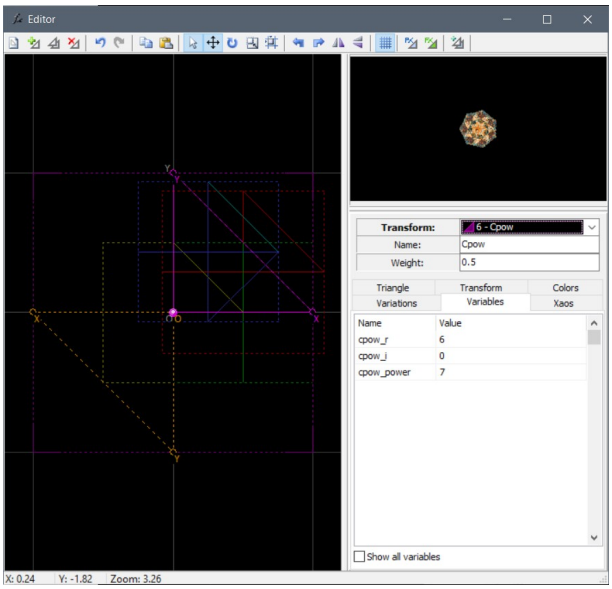
Part 2: Creating the hypertile

To make a hypertile out of an equilateral triangle it is helpful when the triangle is positioned at (0,0) and has a height of ≈0.866025 and width of =1.000000.
Luckily we already made a triangular pattern that meet those requirements.

In the color tab for transforms 2-5, set the opacity to 0.

Add a new transform and in the variations tab set linear to 0 and cpow to ≈ 0.300743.
In the variables tab set:
- cpow_r = 6
- cpow_i = 0
- cpow_power = 7

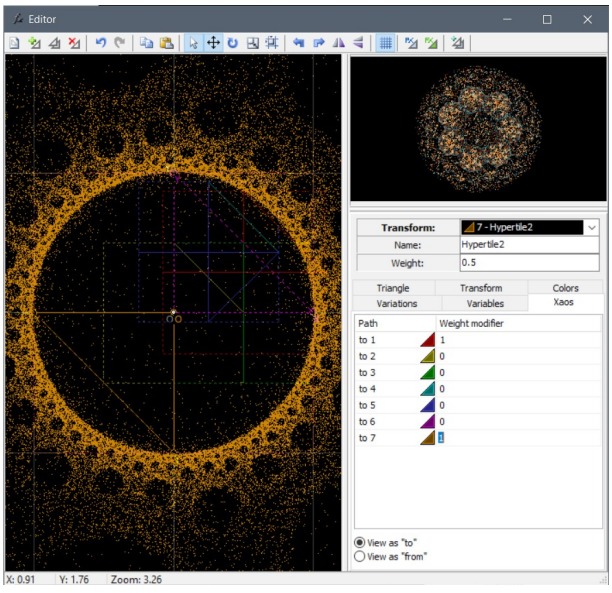
Enable the post transform and rotate it 180 degrees by clicking two times.
In the xaos tab set “to” transforms 2-6, to 0.
In the xaos tab set “from” transform 1, to 0.
In the color tab set the colorspeed to 1.



Add a new ‘linked’-transform and in the variations tab set linear to 0 and hypertile2 to 1.
In the variables tab set
- hypertile2_p = 7
- hypertile2_q = 3

Rotate the transform 180 degrees by clicking two times.
In the color tab make sure the colorspeed and the opacity are both set to 1.
In the xaos tab set “to” transforms 1 and 7, to 1.
Select transform 1 and in xaos tab set “from 7” to 1 and make sure the rest is 0.

Final Check
Only transform 7 has an opacity of 1. All other transforms should have opacity set to 0.



Select view as “to” and check for all transforms if their relationships are as shown:

Transform	1	2	3	4	5	6	7
To 1	0	0	0	0	0	0	1
To 2	1	1	1	1	1	0	0
To 3	1	1	1	1	1	0	0
To 4	1	1	1	1	1	0	0
To 5	1	1	1	1	1	0	0
To 6	0	1	1	1	1	0	0
To 7	0	0	0	0	0	1	1

Example Parameters

I strongly suggest to carefully follow through the tutorial. If that didn't work out please try it again. You learn most by trying yourself!
However if you really can't pull it off, here are my parameters:

```
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brightness="20" gamma="5" estimator_radius="9" estimator_minimum="0" estimator_curve="0.4"
enable_de="0" plugins="" new_linear="1" curves="0 0 1 0 0 1 1 1 1 1 1 1 0 0 1 0 0 1 1 1 1 1 1 1 0 0
1 0 0 1 1 1 1 1 1 1 0 0 1 0 0 1 1 1 1 1 1 1" >
   <xform weight="0.5" color="0.694598553236574" symmetry="-1" starblur="1" coefs="1 0 0 1 0 0"
post="0.57735 0 0 0.57735 0.5 -0.288675" starblur_power="3" starblur_range="0.5" chaos="0 1 1 1 1 0
0 " opacity="0" name="Starblur"/>
   <xform weight="0.5" color="0.721083033597097" linear="1" coefs="1 0 0 1 0 0" post="0.5 0 0 0.5 0
0" chaos="0 1 1 1 1 1 0 " opacity="0" name="Linear"/>
   <xform weight="0.5" color="0.0935550360009074" linear="1" coefs="1 0 0 1 0 0" post="0.5 0 0 0.5
0.5 0" chaos="0 1 1 1 1 1 0 " opacity="0" name="Linear"/>
   <xform weight="0.5" color="0.037266566650942" linear="1" coefs="1 0 0 1 0 0" post="0.5 0 0 0.5
0.25 -0.433013" chaos="0 1 1 1 1 1 0 " opacity="0" name="Linear"/>
   <xform weight="0.5" color="0.818099391181022" linear="1" coefs="1 0 0 1 0 0" post="0.5 0 0 -0.5
0.25 -0.433013" chaos="0 1 1 1 1 1 0 " opacity="0" name="Linear"/>
   <xform weight="0.5" color="0.561227260855958" symmetry="1" cpow="0.301" coefs="1 0 0 1 0 0"
post="-1 0 0 -1 0 0" cpow_r="6" cpow_i="0" cpow_power="7" chaos="0 0 0 0 0 0 " opacity="0"
name="Cpow"/>
   <xform weight="0.5" color="0.359624797478318" symmetry="1" hypertile2="1" coefs="-1 0 0 -1 0 0"
hypertile2_p="7" hypertile2_q="3" chaos="1 0 0 0 0 0 " opacity="1" name="Hypertile2"/>
   <palette count="256" format="RGB">
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      C97537C06A2DB76024A5521A93451186380E792B0C76290A
      7327095C300F57341452381A53351A55321A523219503219
      443F253F3F293B3F2D3441332E44392C48402A4C47225252
      1F5A61216E7829798132848B368C923B94993A94993A959A
      40888D3B8286377C7F3172772C696F2B62692B5B632B4D57
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      2D404E2D3C4A2E39462C36422A343F282E352C282C332522
      3F231949230E51250D5A270C5D260A602509611F07551903
      3913052F0F09250B0D20090E1B0810120D120B1219031C23
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      00131A0009130008100080E000908000A04000C03020D04
      0E180F1520171C29201F2B23222E26293627333D2B404331
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      A99B74A296709B916D847B656C6F615F6A664F6E754D797D
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      855B2B88531A975214A35611AA5B10AD5B12A65512A35115
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      C97030D07C3ECE844FC18857B0875FA58463967B627F7267
      6867684E5D6A3B586531525B264A511F454819424814464A
      174C4F1B5053215356275152C5058344D533C494E464548
      4C444B54484C6651518161539C7757AE8A65B49C79B6AA8E
      BDB29CC0B99FBFBD9BB2BD9D9EB69E88A9A16D969B53868E
      3A7F89297B7F237F811D7B812373792B6F77356B69466C61
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</flame>
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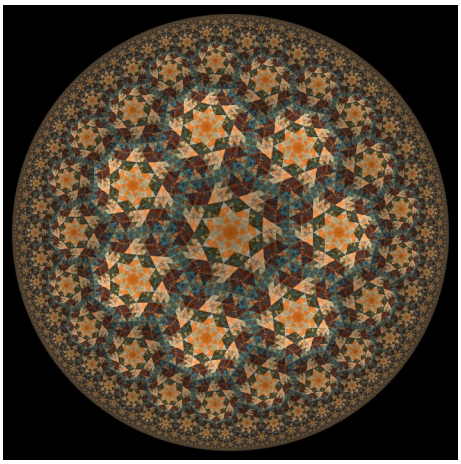

Sidenotes

1. This tutorial describes a method that will fit equilateral triangles into a hypertile. However, this is not a proper way to make hypertiles! For making proper hypertiles I like to refer to: Hypertile Uncovered & Hypertile Basics
2. Notice that I've used starblur instead of making a triangular rep-tile merely consisting of linears. I did this on purpose to prevent the use of the "hybrid method" and keep this tutorial more accessible to people. Starblur can be replaced with other transformations like ngon, but I chose starblur due to its esthetic appeal.
3. Any other form may serve as an input for the hypertile. However, it will be required to crop this input into a equilateral triangle in order to make it fit again.
4. It is possible to use (substitution)tiles with C_6 rotational symmetry as input. Knowing this, it might be interesting to look into 'IFStile'. This piece of software is able to find tiles and save them as .flame files.
5. The middle part is darker than the rest of the hypertile. Changing weights of the cpow and hypertile can result in a more evenly distributed structure. However using an additional "container transform" is probably the best way to reach a more equally distributed look. The container transform grants more possibilities to distributing weights.
6. Apophysis can hold up to six digits. Other software like Chaotica have higher precision. It is advisable to use more digits when rendering incredibly large or deeply zoomed fractals.
7. The numbers used in this tutorial in their exact form and approximation:
   - $\frac{\sqrt{3}}{2} \approx 1.73205$
   - $\frac{\sqrt{3}}{2} \approx 0.866025$
   - $\frac{\sqrt{3}}{3} \approx 0.577350$
   - $\frac{\sqrt{3}}{4} \approx 0.433013$
   - $\frac{\sqrt{3}}{6} \approx 0.288675$
8. For the size of the cpow I used the following calculation:
   $\frac{\sin\left(\frac{\pi}{2}\right) - \left(\frac{\pi}{3}\right) - \left(\frac{\pi}{7}\right)}{\sqrt{1 - \sin\left(\frac{\pi}{3}\right)^2 - \sin\left(\frac{\pi}{7}\right)^2}} \approx 0.300743.$