hdk
Zürcher Hochschule der Künste
Bachelor of Arts in Design

Bits & Atoms
Computer Aided Design

3rd Semester I 27th of September 2018

Florian Wille

Overview

Bits & Atoms: Computer Aided Design

27.09.2018

Rhino Basics

04.10.2018

Rhino to Grasshopper

11.10.2018

Parametric Design with Grasshopper

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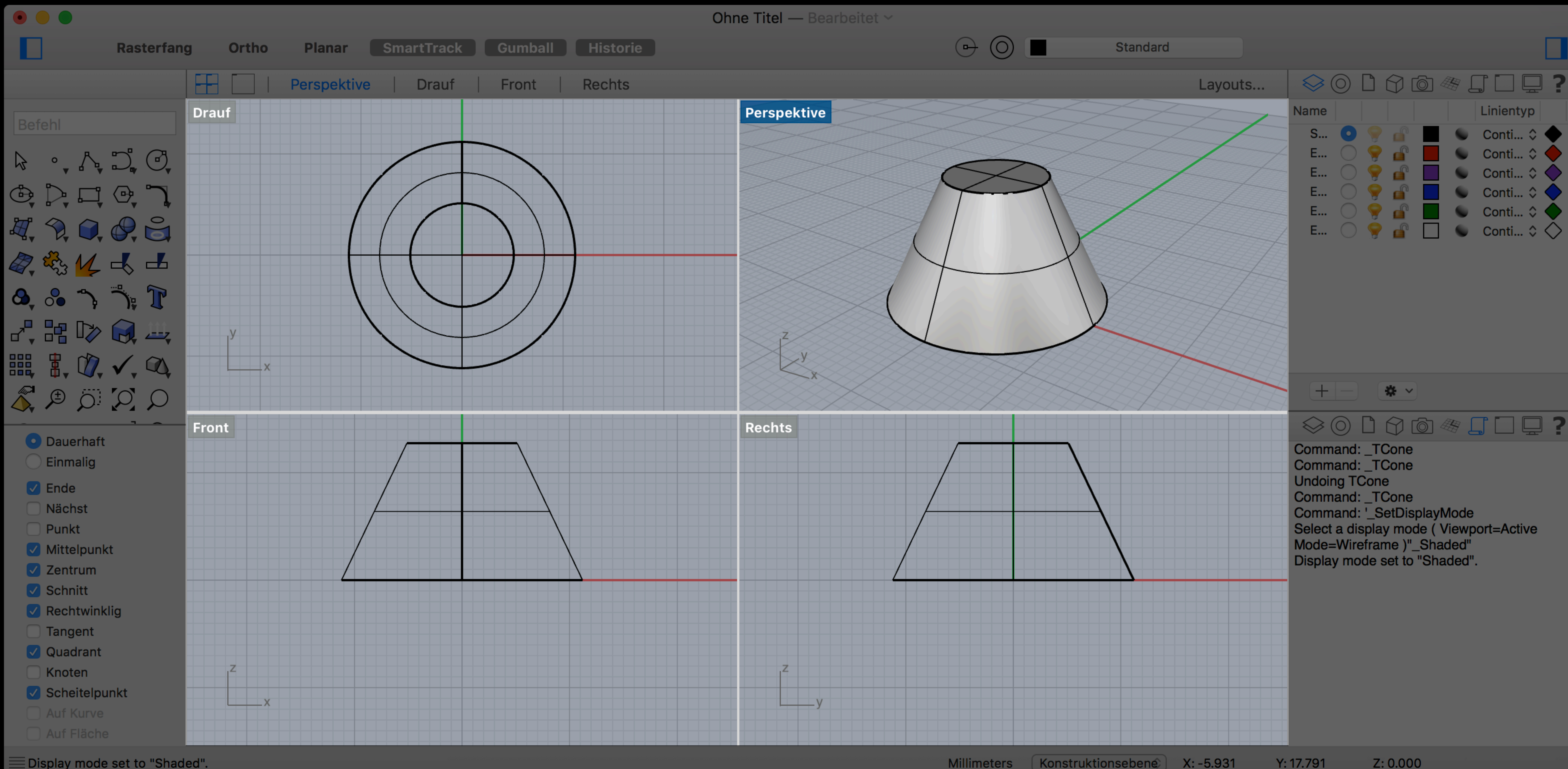
Install Rhino 3D

Rhino 3D

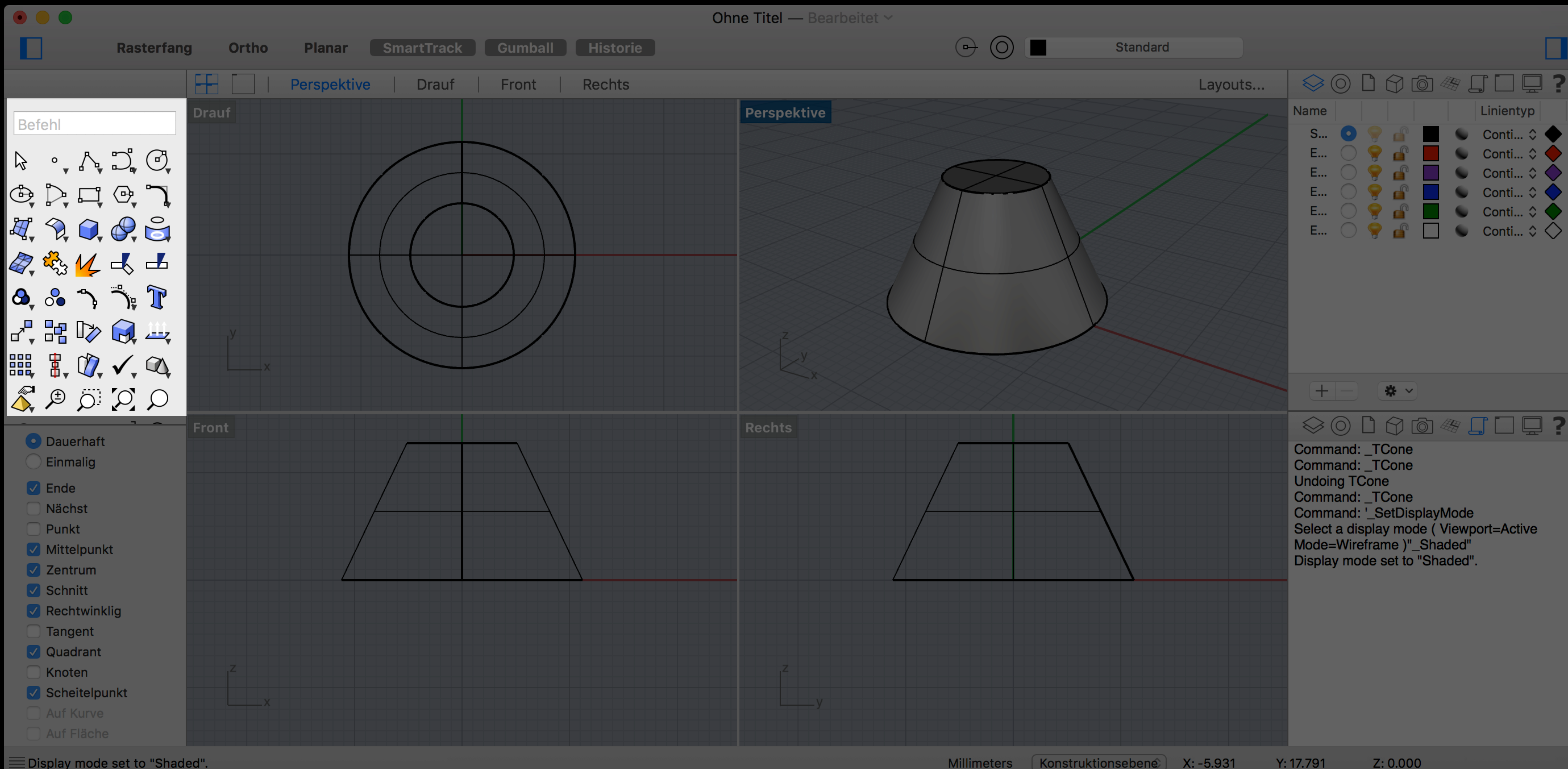
Rhino 3D

Interface - Editing



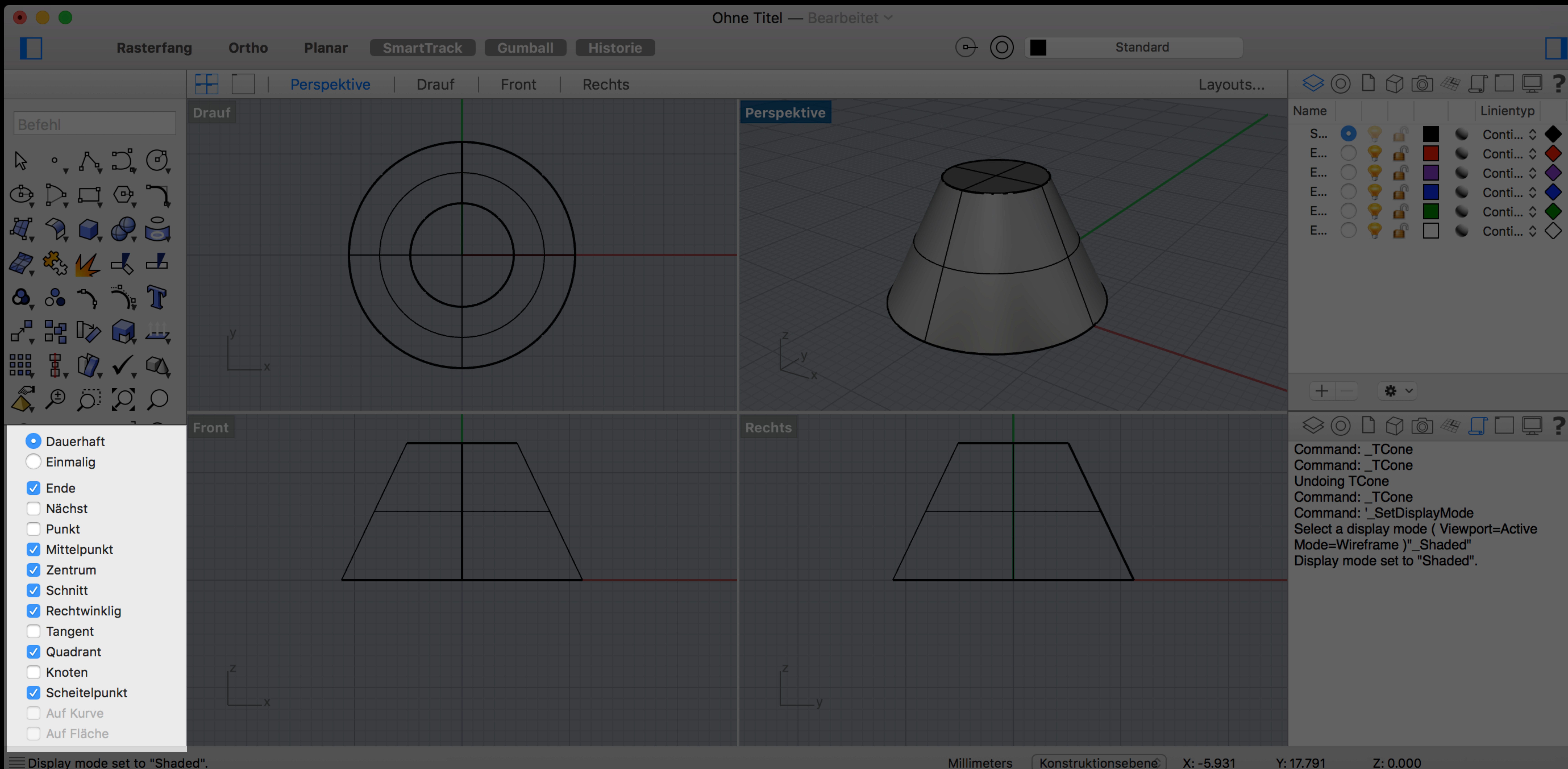
Rhino 3D

Interface - Editing



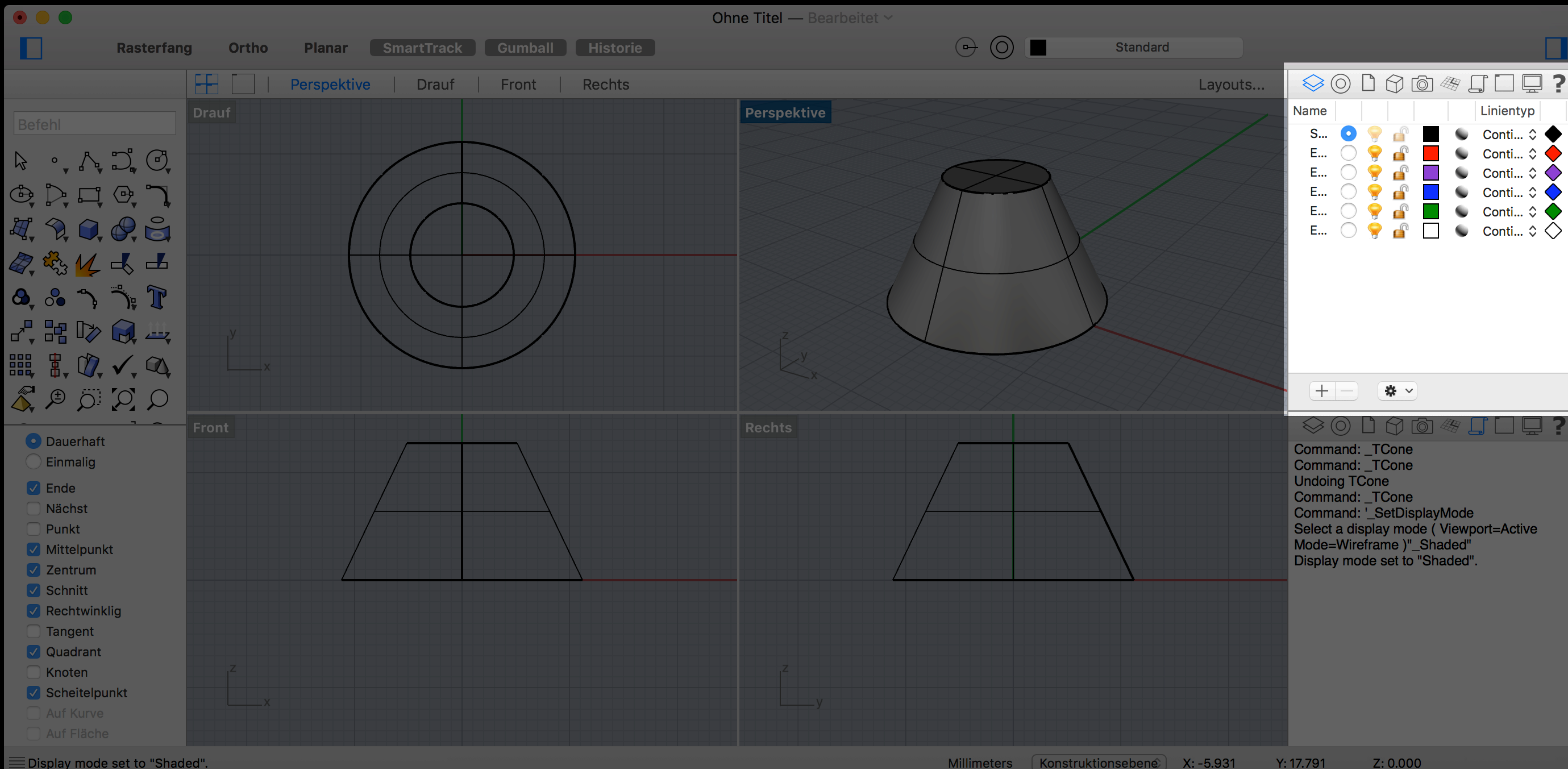
Rhino 3D

Interface - Editing



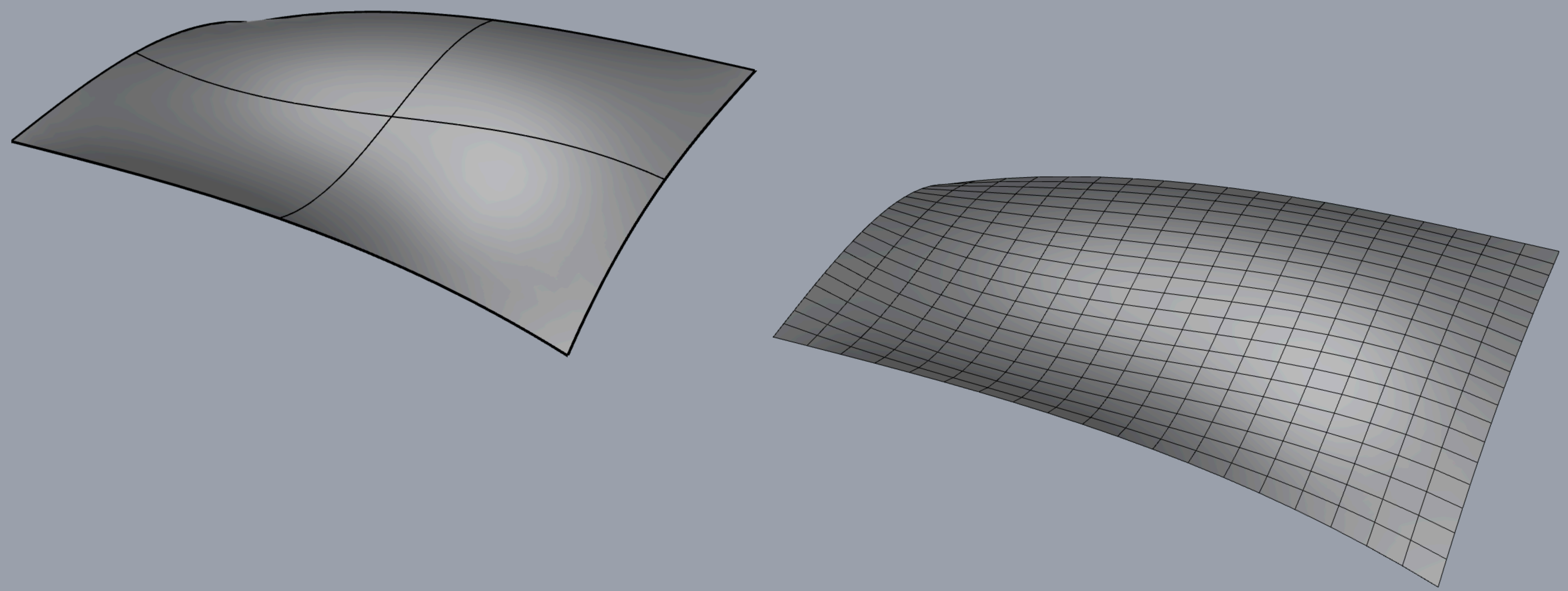
Rhino 3D

Interface - Layers



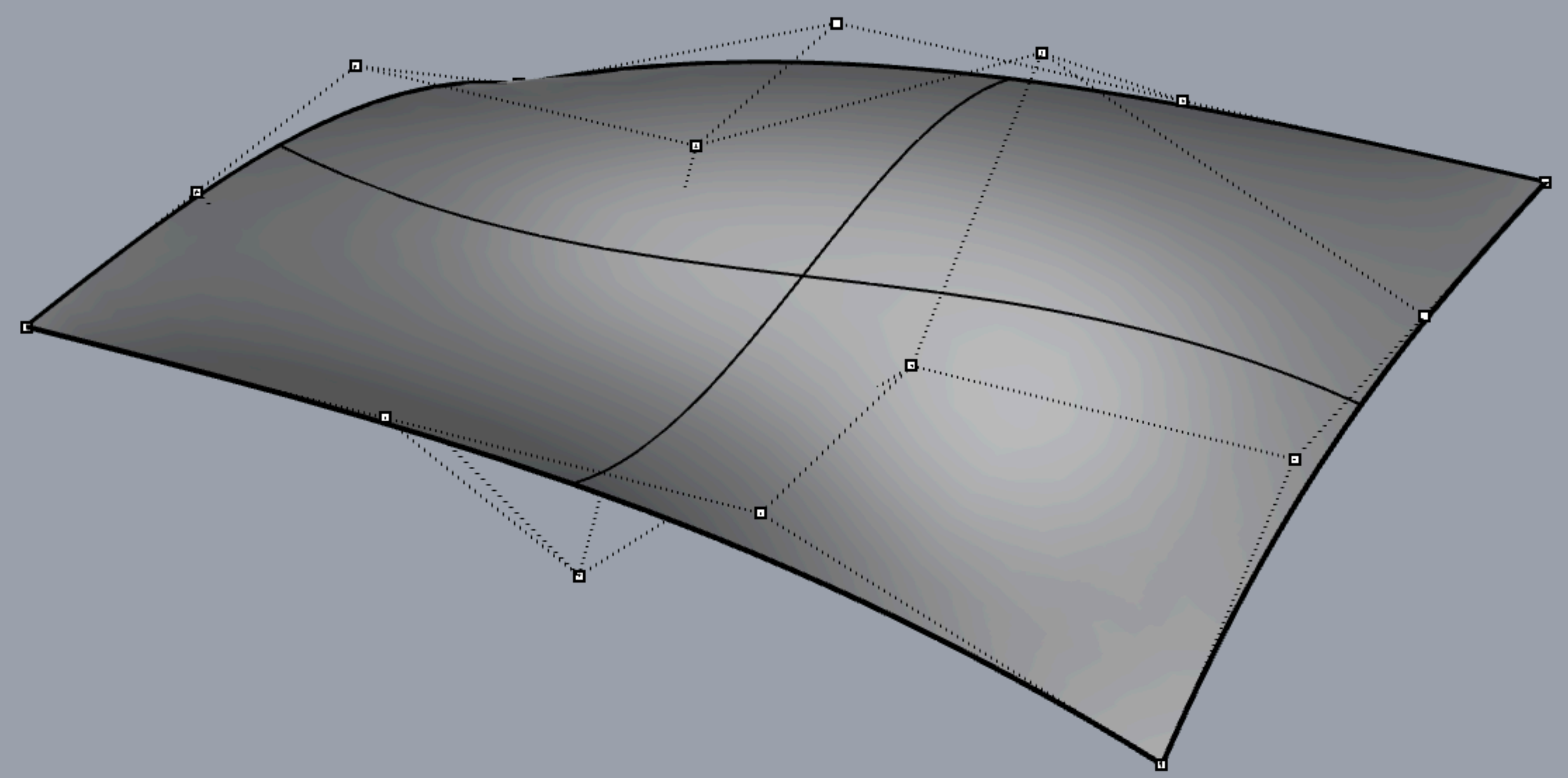
Creating and Editing Geometry

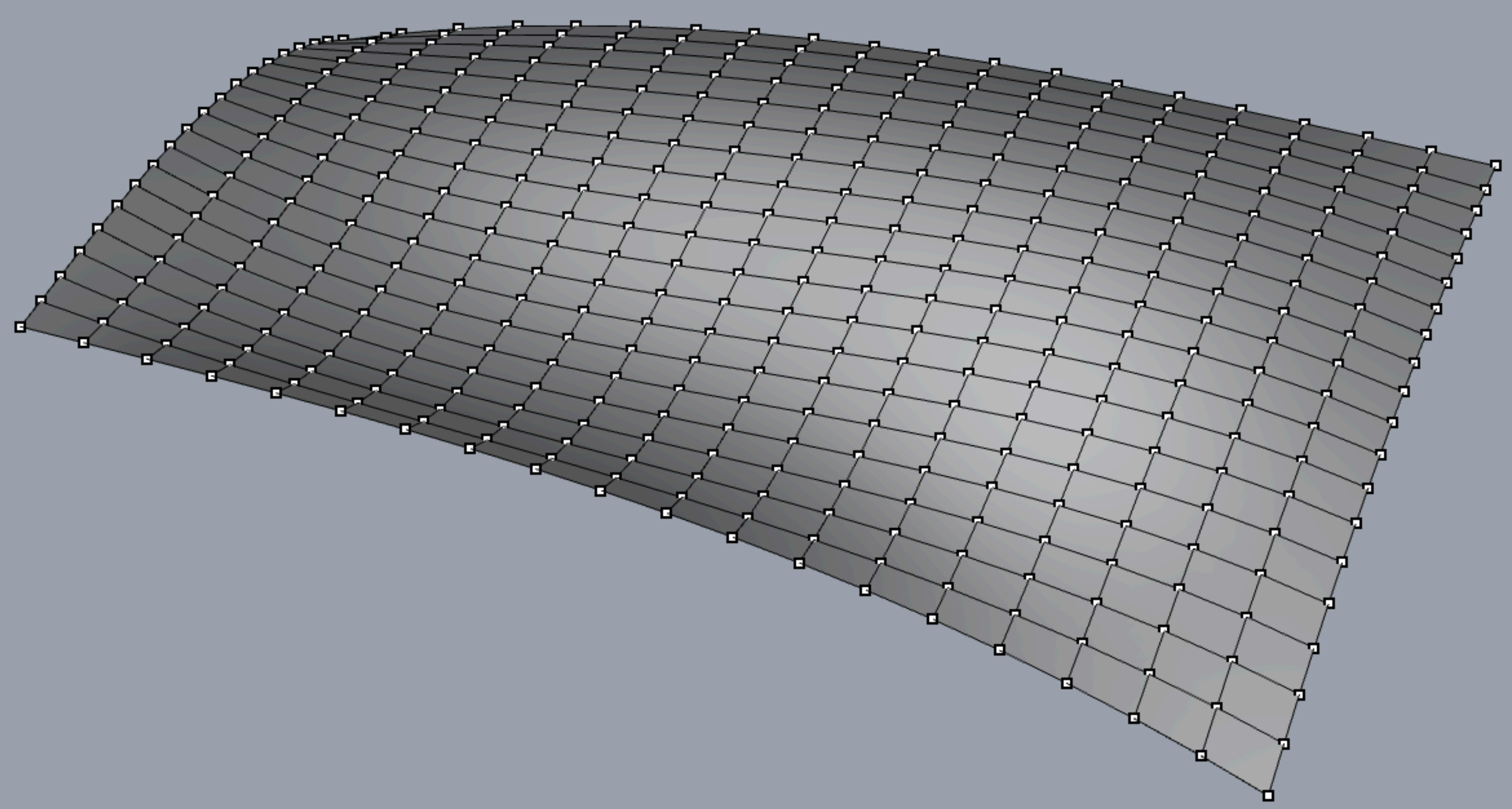
Nurbs vs. Polygons



Rhino 3D

Nurbs vs. Polygons



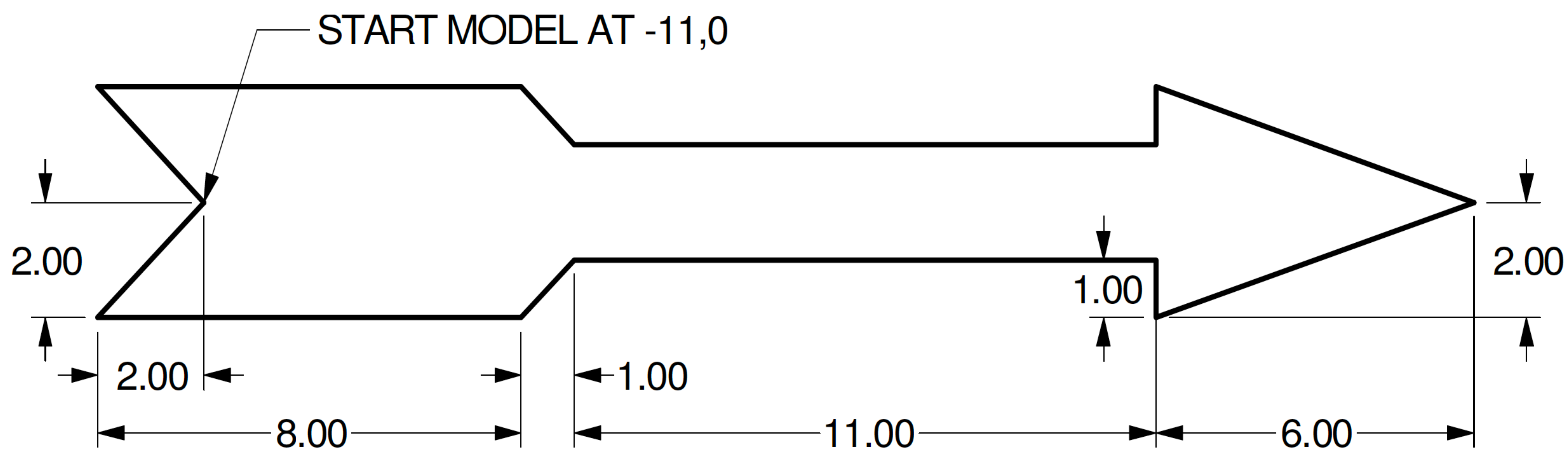


EXERCISE01

Create and Edit 2D Geometry

EXERCISE01

2D & 3D Creation and Editing



create & edit 2D:

_line, _circle, _curve, _arc

_move / _mirror / _trim / _extend

_EditPtOn

Use Osnap / Objektfang

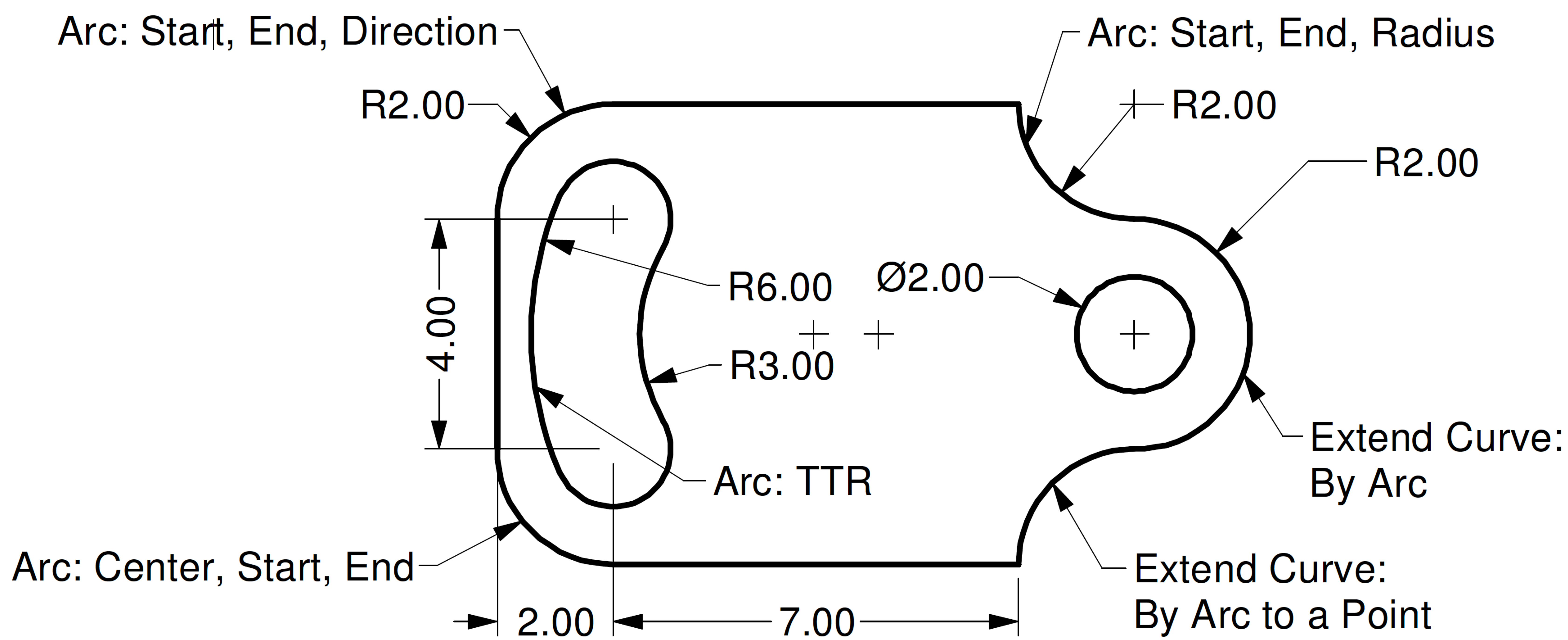
Use Gridsnap / Rasterfang

create & edit 3D:

_ExtrudeCrv

EXERCISE02

Circles and Arcs



create & edit 2D:

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Use Osnap / Objektfang

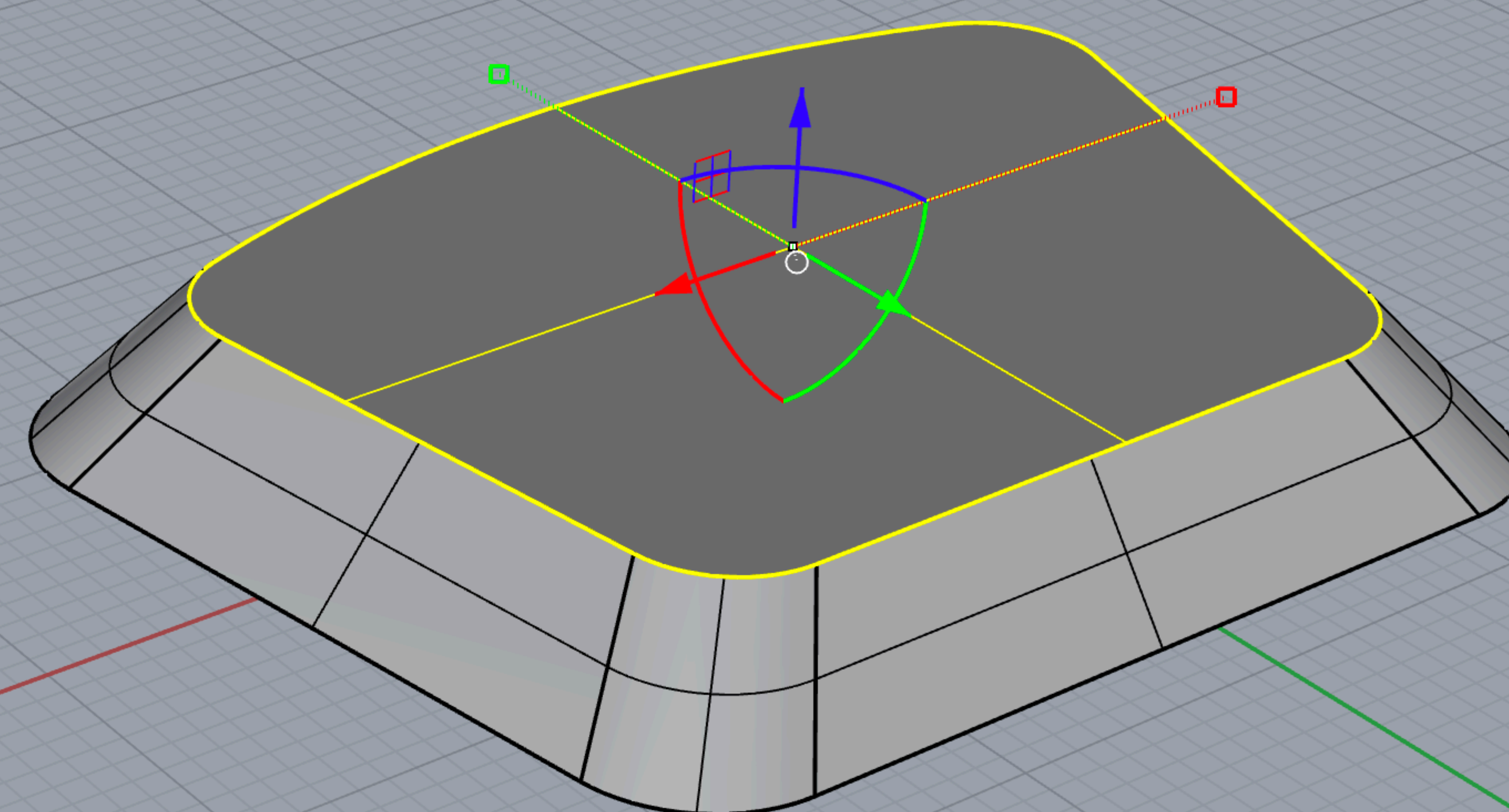
Use Gridsnap / Rasterfang

create & edit 3D:

_ExtrudeCrv

EXERCISE03

Modelling with Gumball



Gumball Commands:

move: arrow handles

scale: square handles

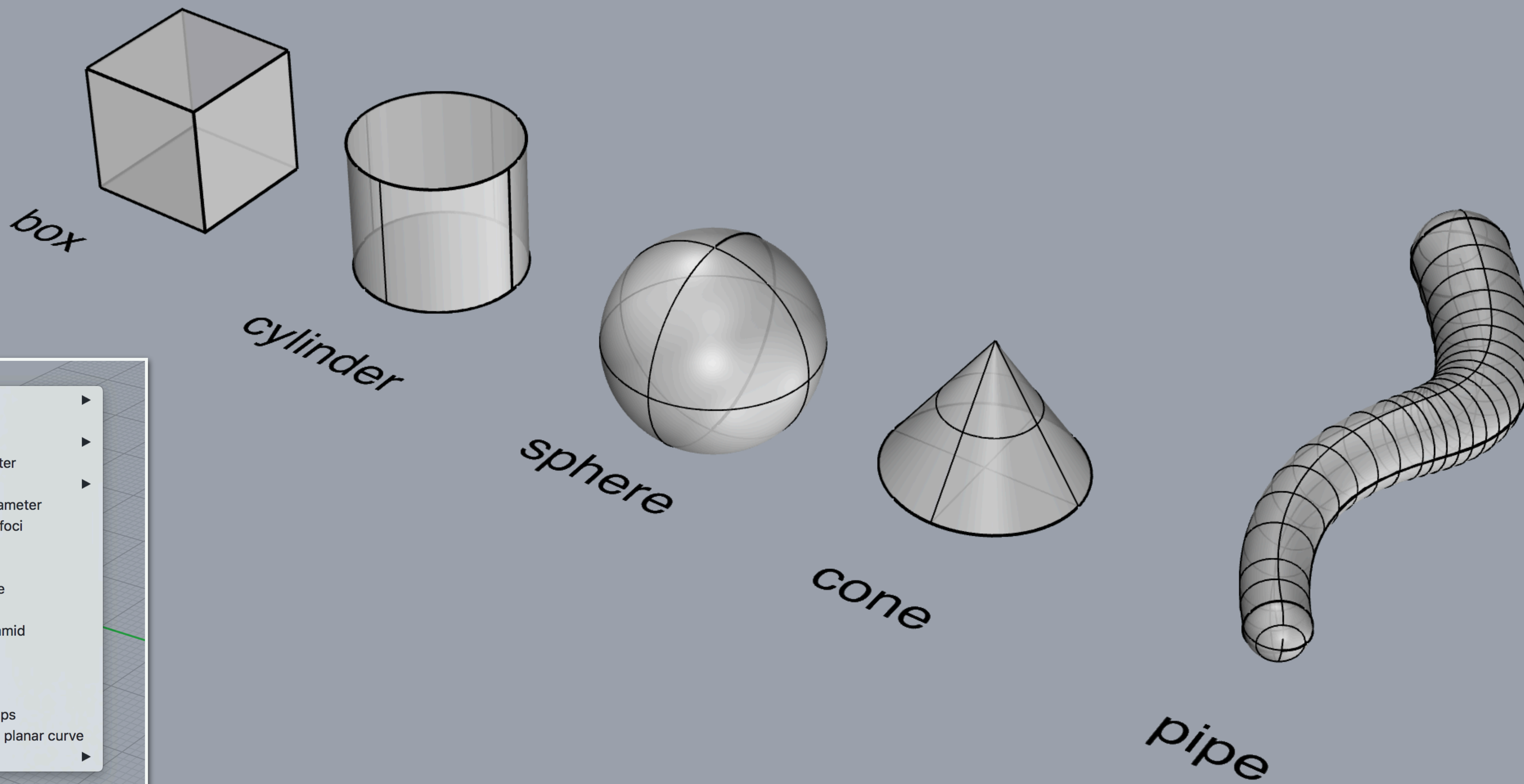
rotate: circle segment handles

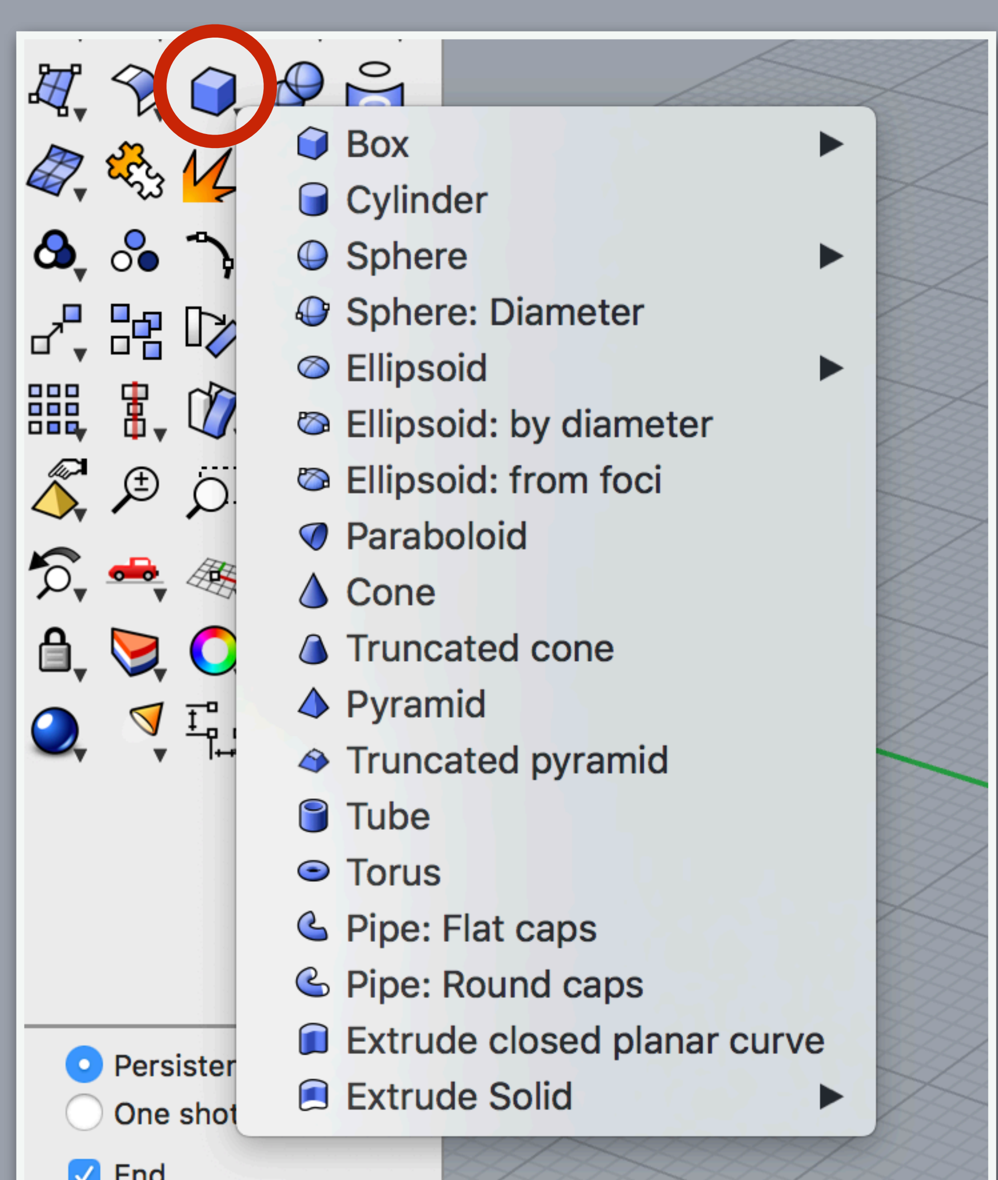
extrude: click arrow handle > drag > press command&shift

select subsurface: command&shift + selecting surface or edge

EXERCISE03

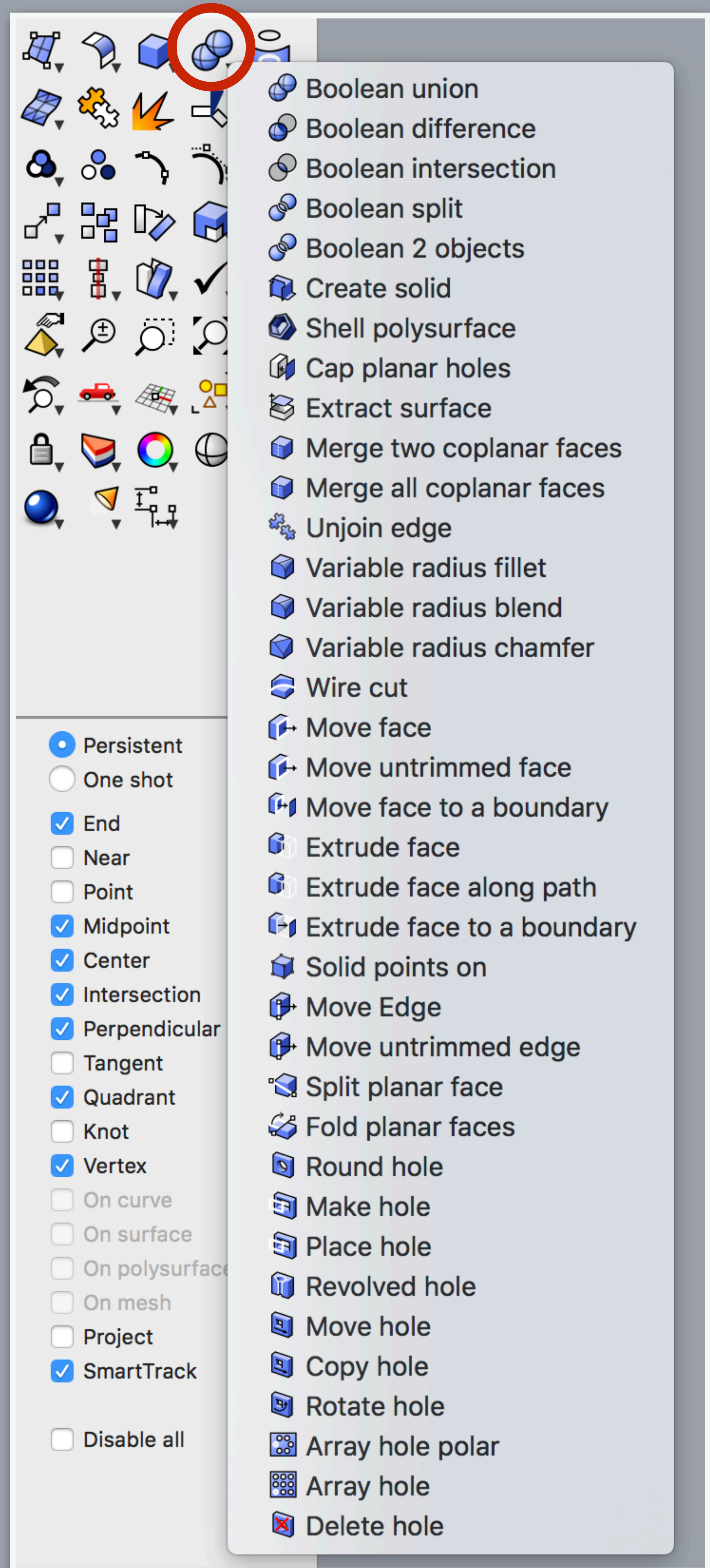
Create Solids

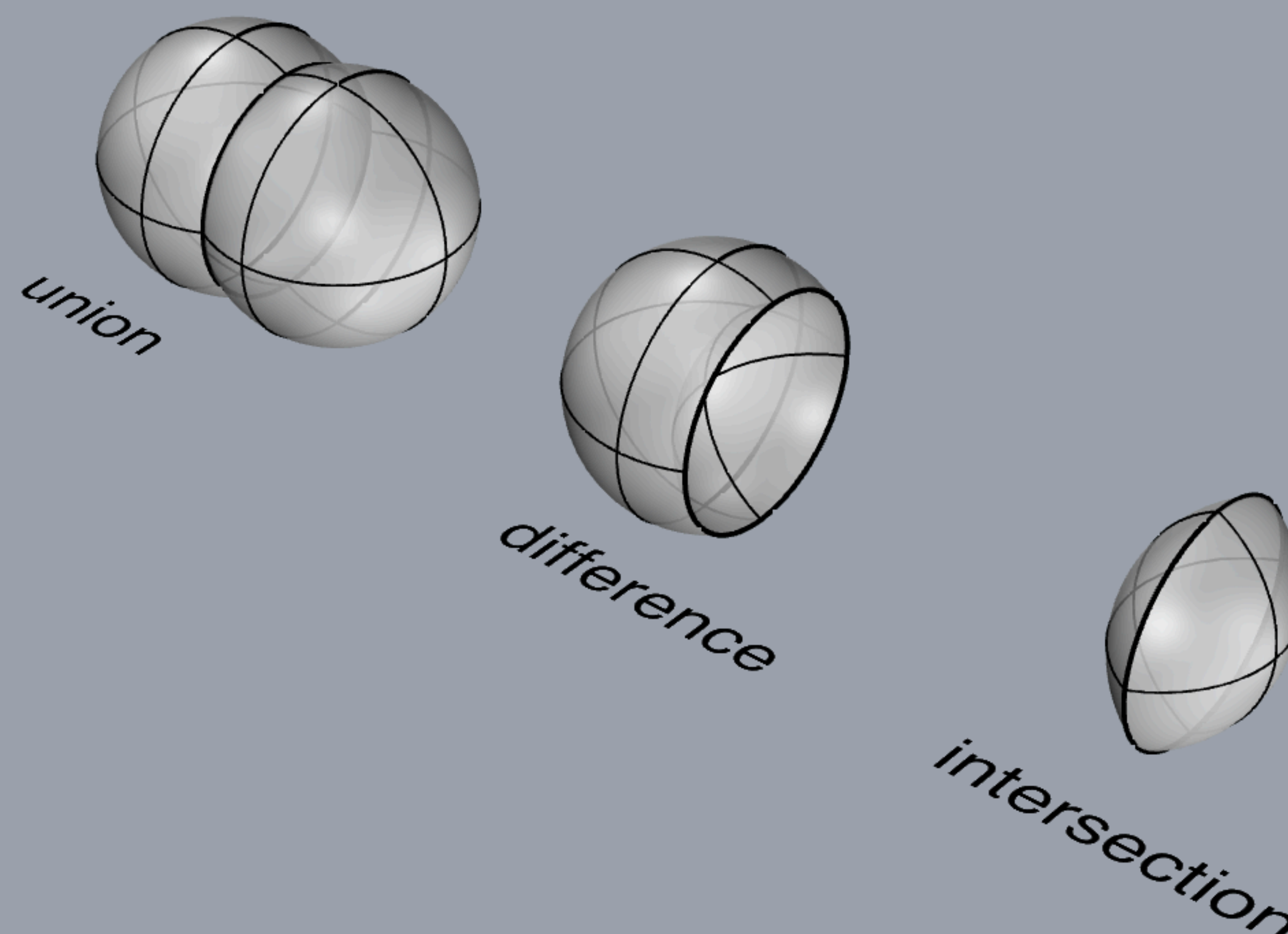




EXERCISE03

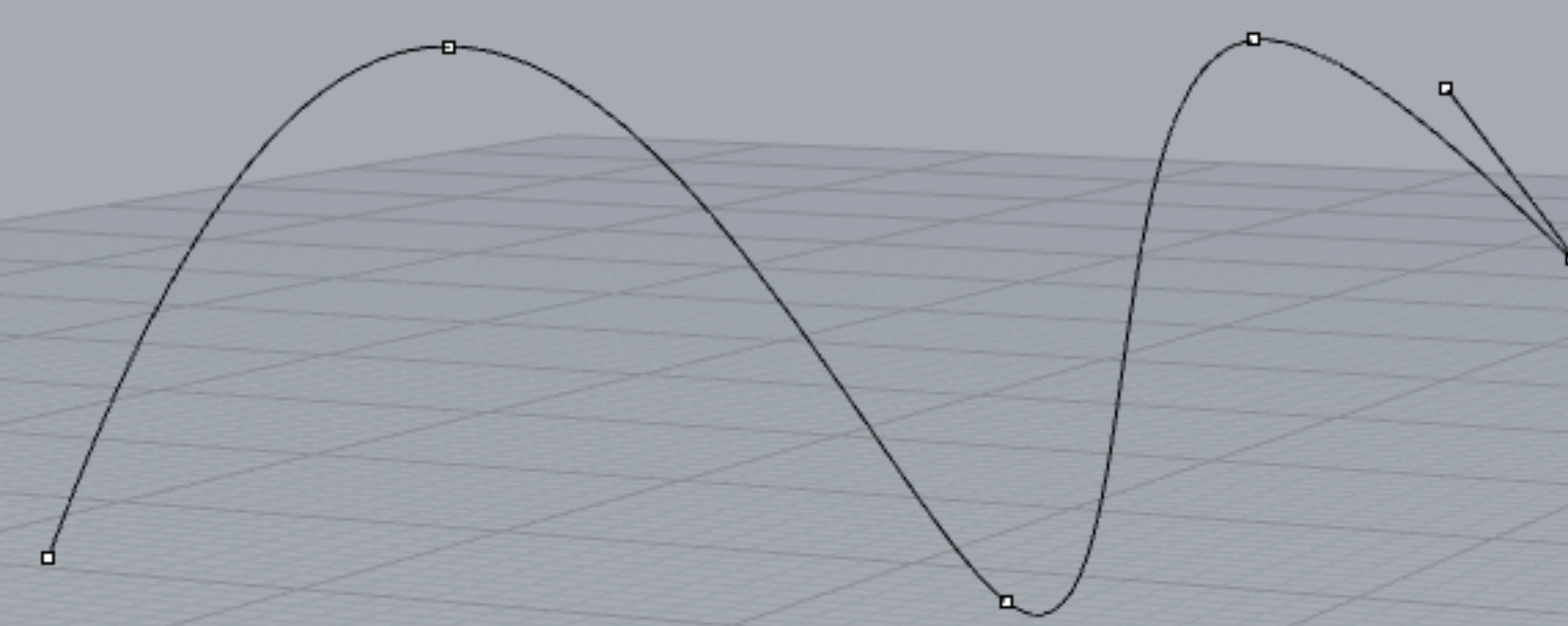
Edit Solids





EXERCISE04

CV Curve Creation and Editing



_curve

_move / _mirror / _trim / _extend

_EditPtOn

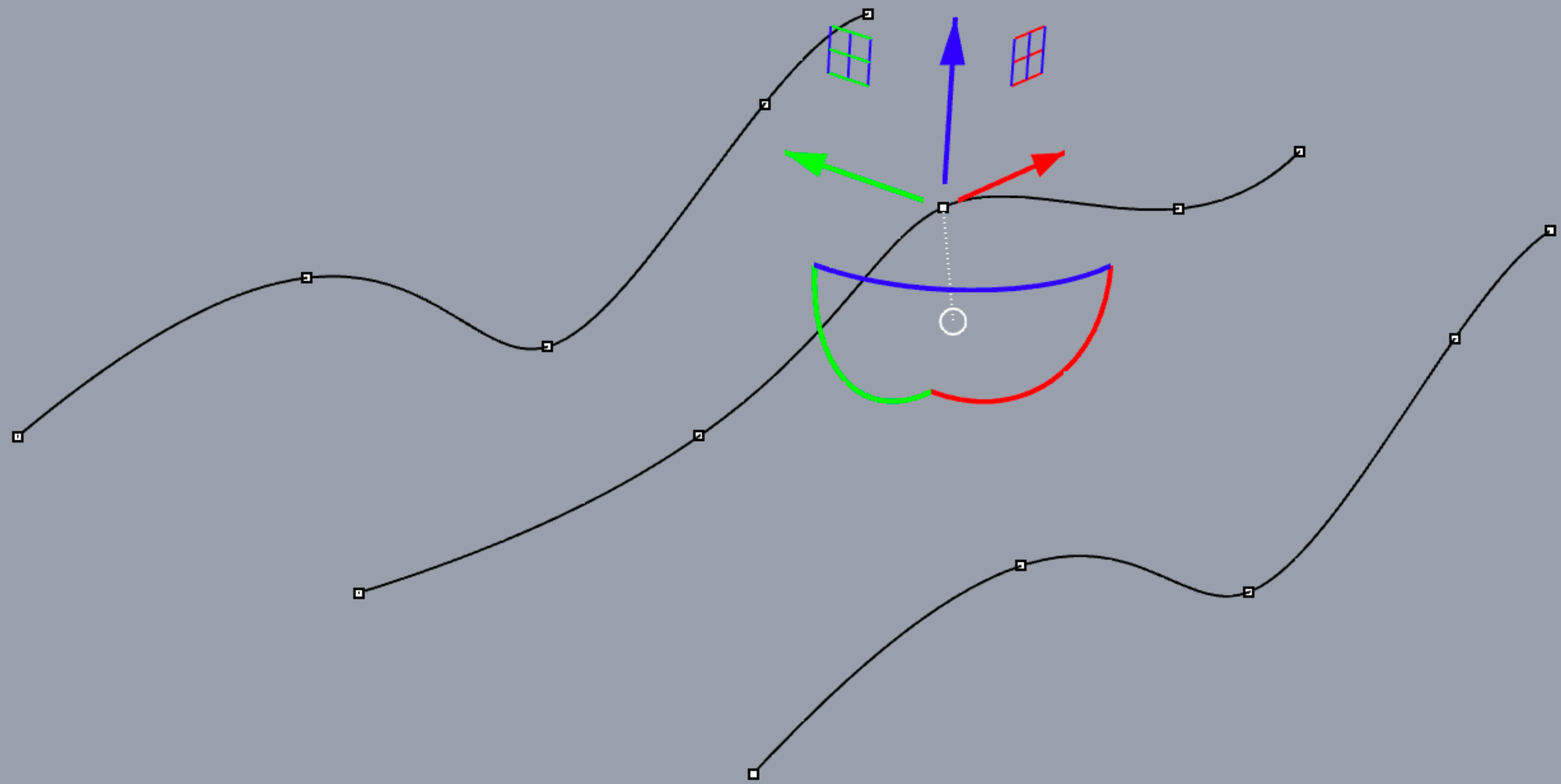
Use Osnap / Objektfang

Use Gridsnap / Rasterfang

Use gumball to to edit and move points

EXERCISE04

CV Curve Creation and Editing



_curve

_move / _mirror / _trim / _extend

_EditPtOn

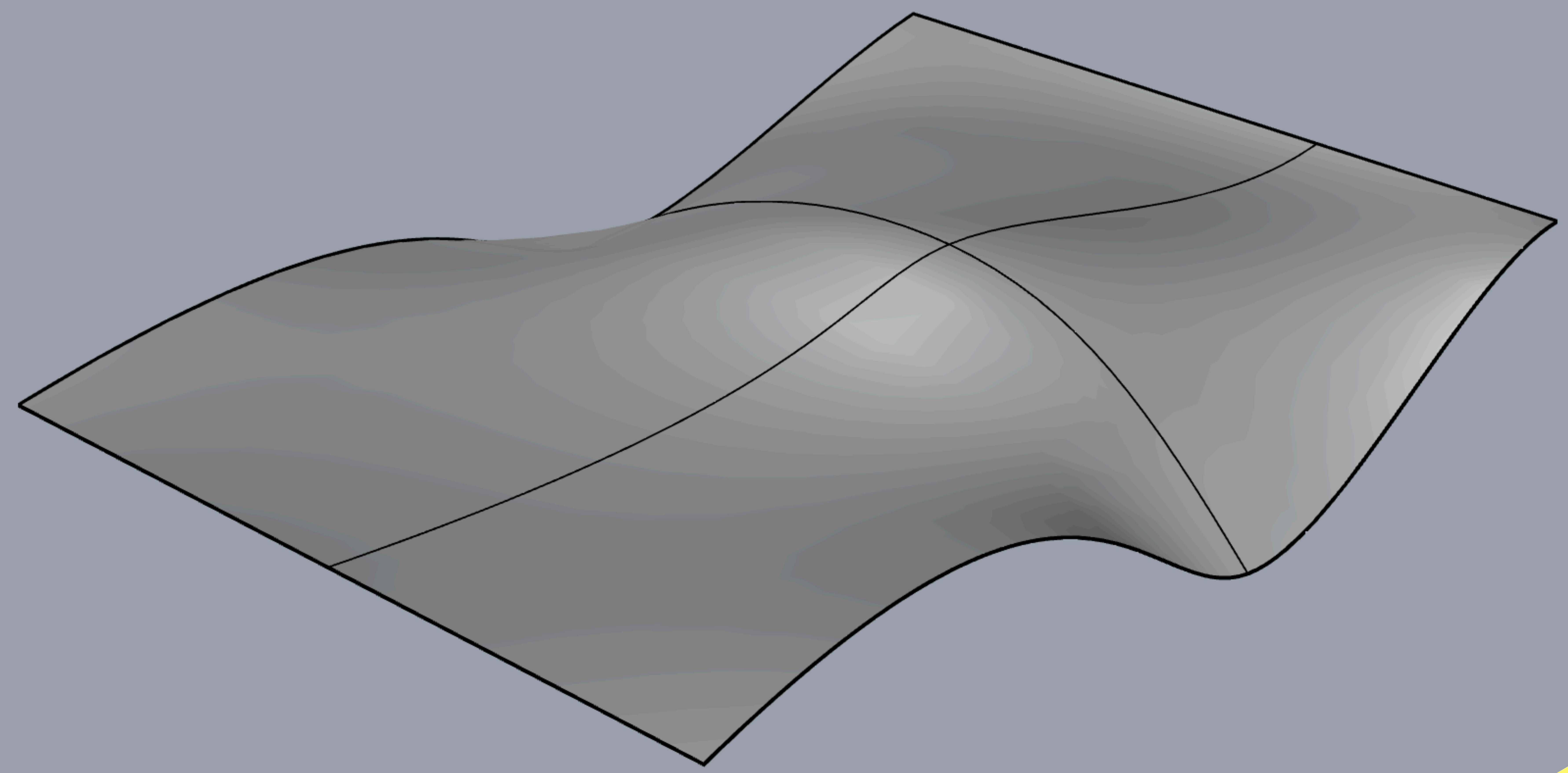
Use Osnap / Objektfang

Use Gridsnap / Rasterfang

Use gumball to to edit and move points

EXERCISE03

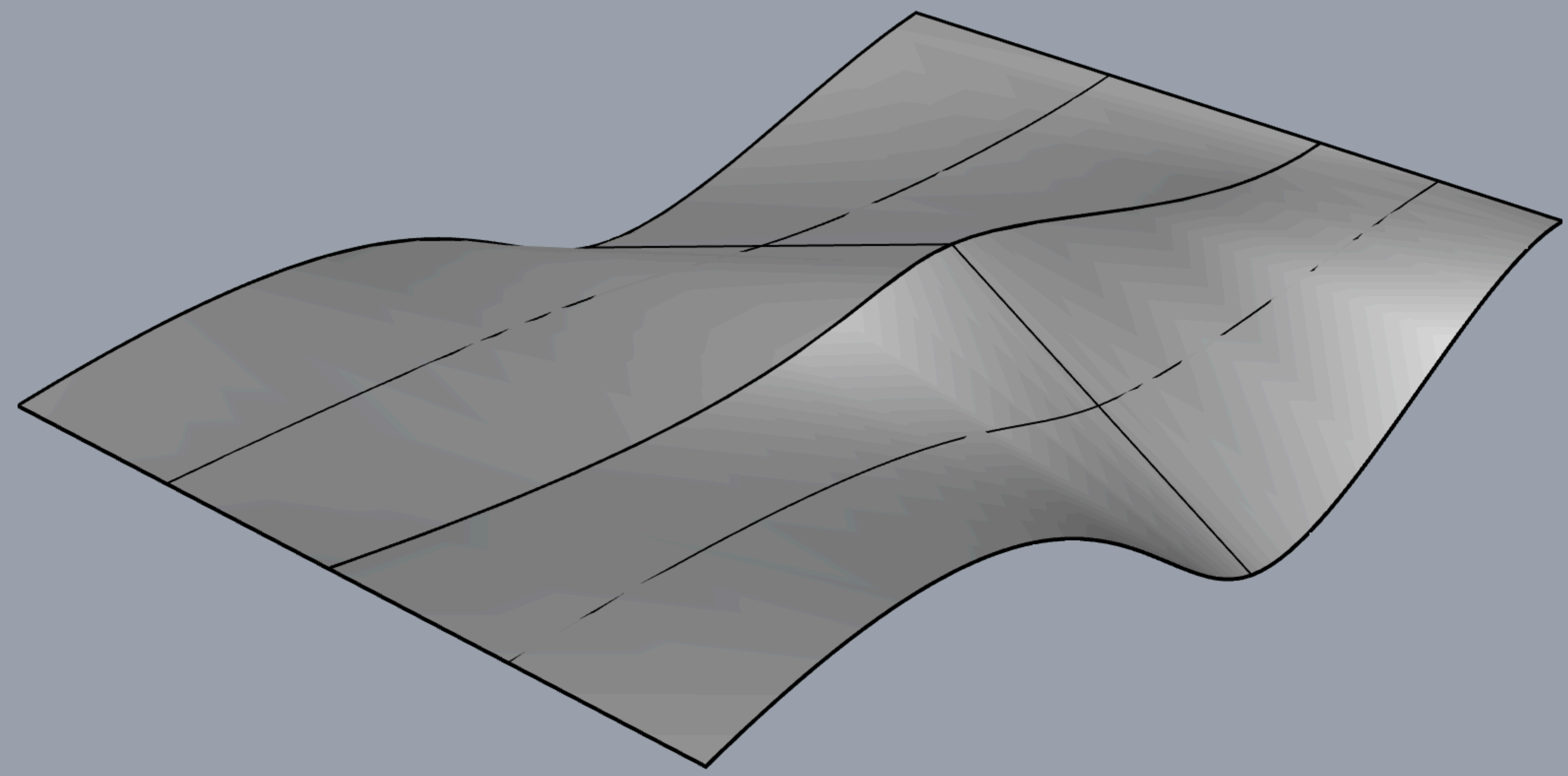
Create Surfaces - Loft



Loft > normal

EXERCISE03

Create Surfaces - Loft



Loft > straight sections

Overview

Bits & Atoms: Computer Aided Design

Overview

Grasshopper

Grasshopper is a visual programming language and environment developed by David Rutten at Robert McNeel & Associates, that runs within the Rhinoceros 3D computer-aided design (CAD) application. The first version of Grasshopper was released in September 2007, and titled Explicit History. Grasshopper has become part of the standard Rhino toolset in Rhino 6.0 and later.

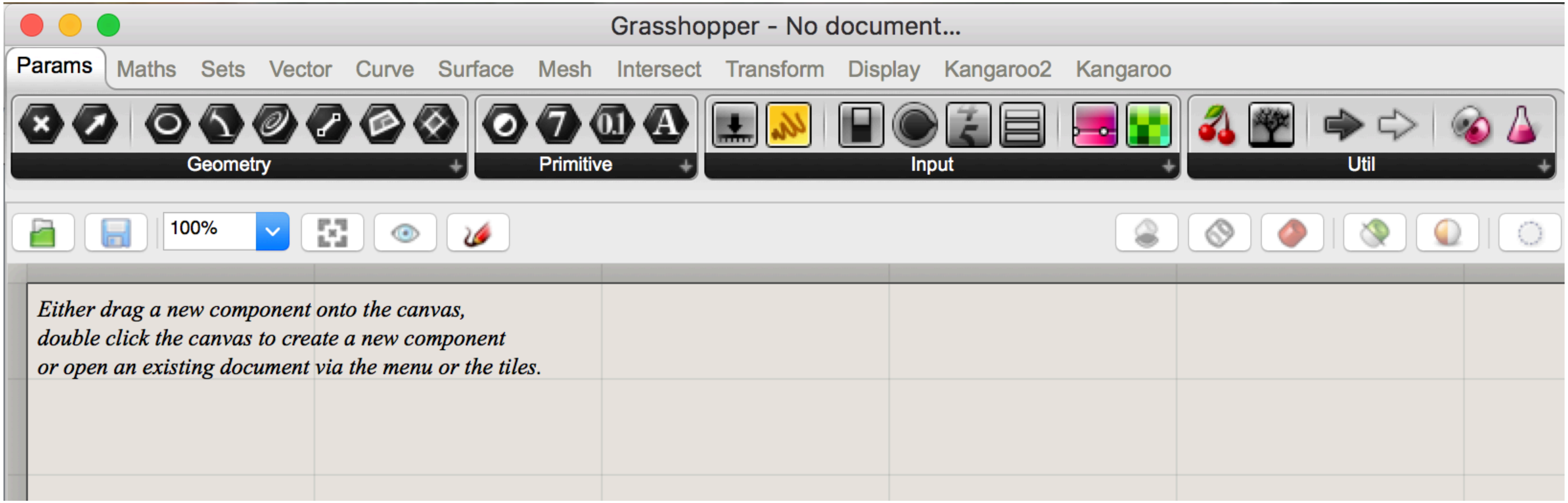
Overview

Grasshopper

- Grasshopper is primarily used to build generative algorithms, such as for generative art. Many of Grasshopper's components create 3D geometry.
- Advanced uses of Grasshopper include parametric modelling for structural engineering, parametric modelling for architecture and fabrication, lighting performance analysis for eco-friendly architecture and building energy consumption.

Overview

Component Panels (Container System)



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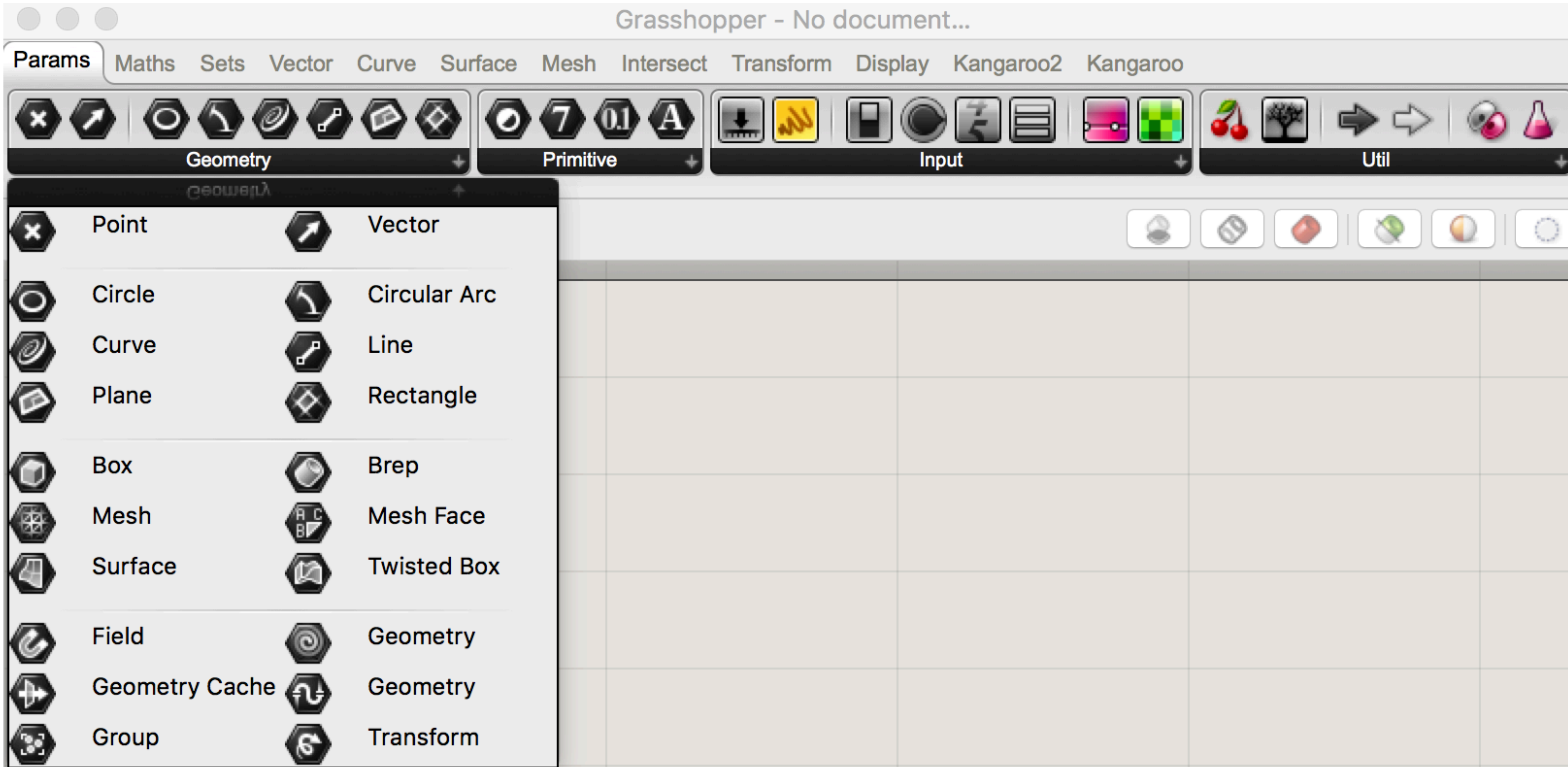

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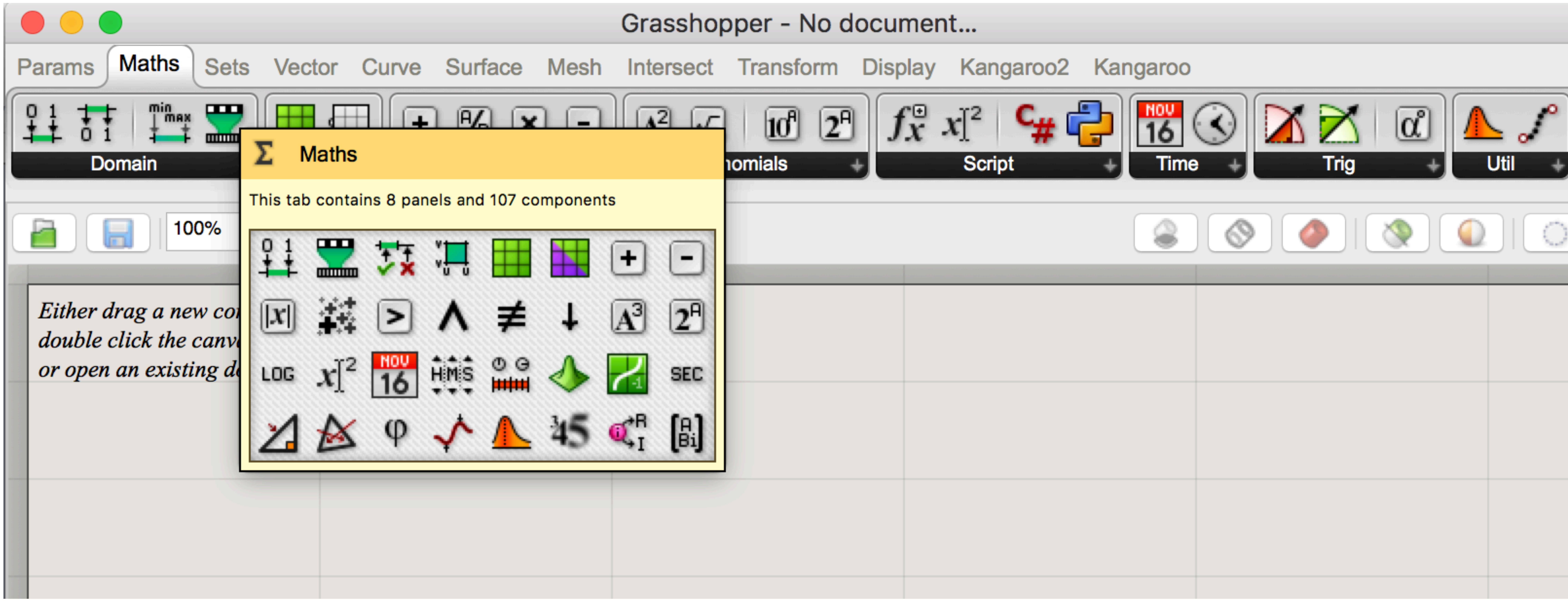

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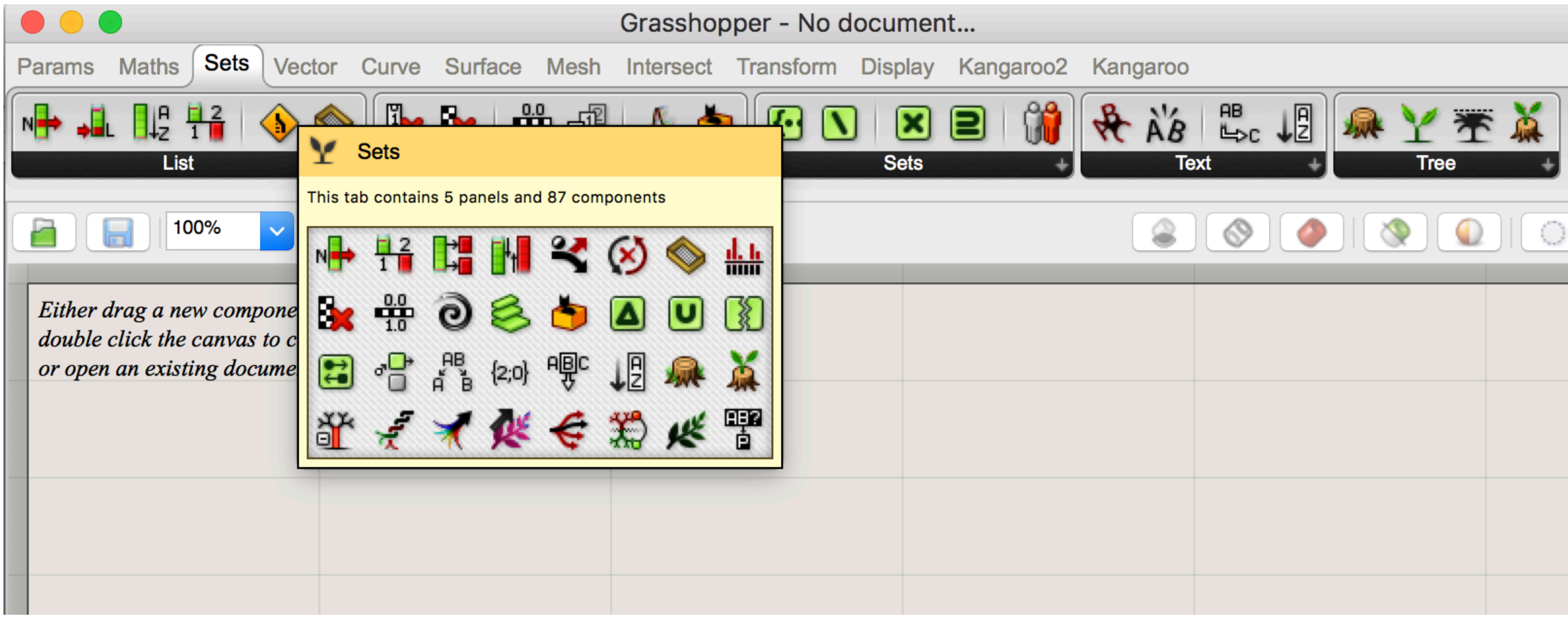

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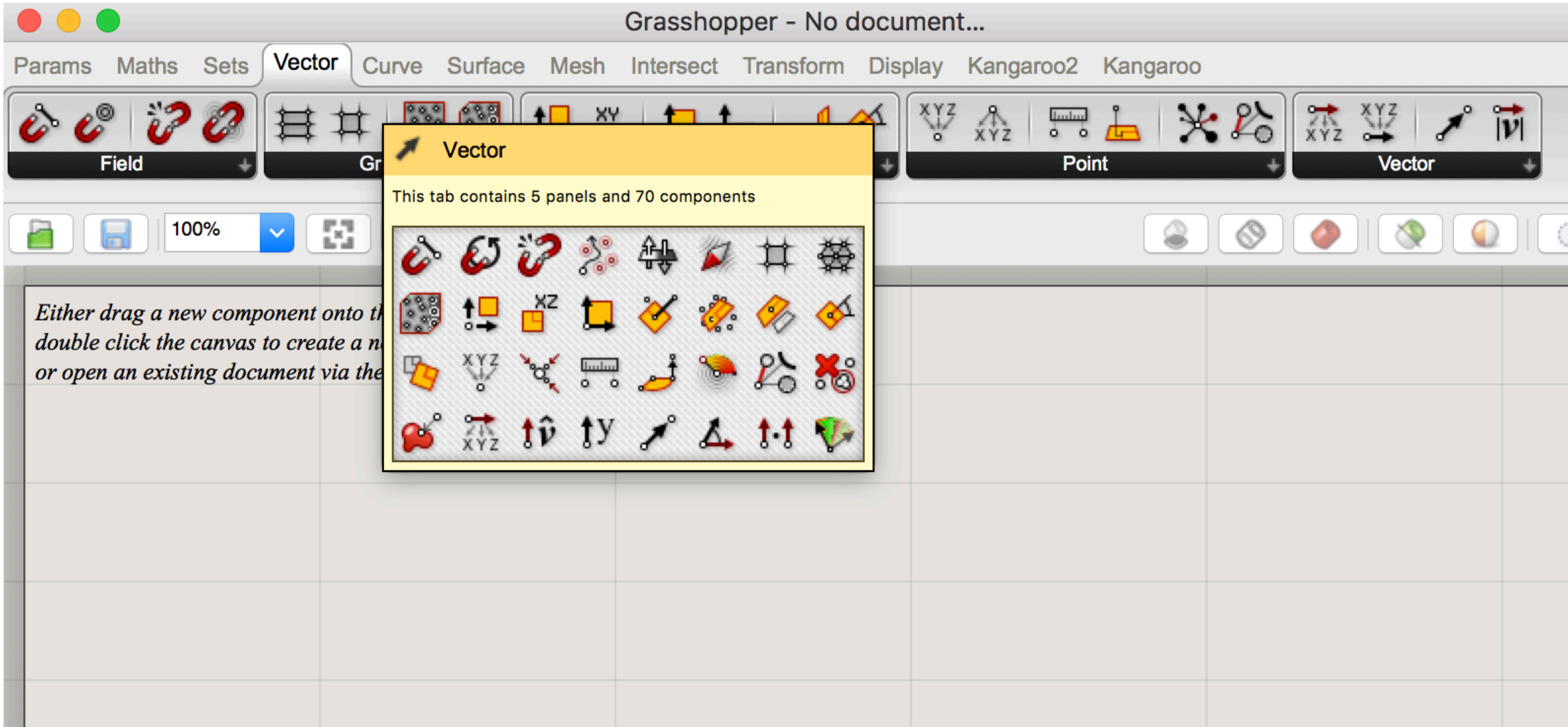

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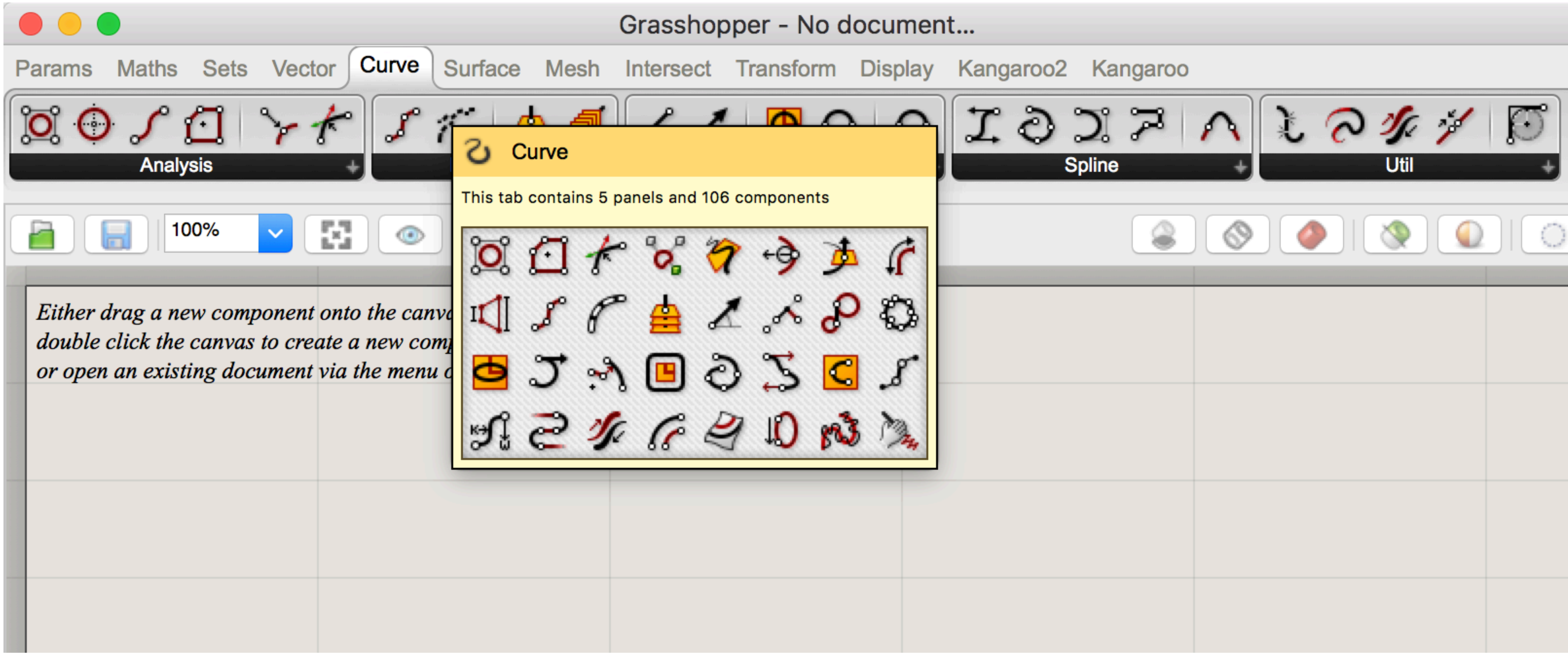

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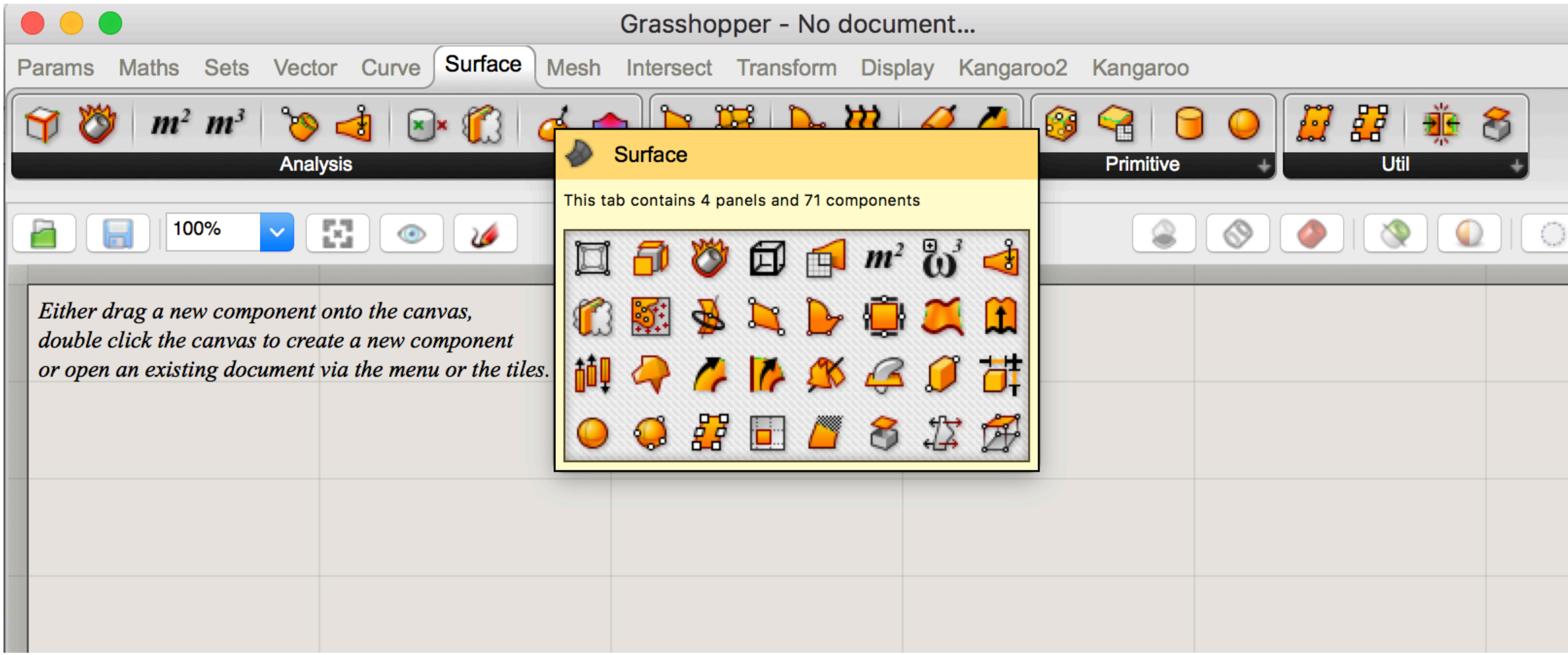

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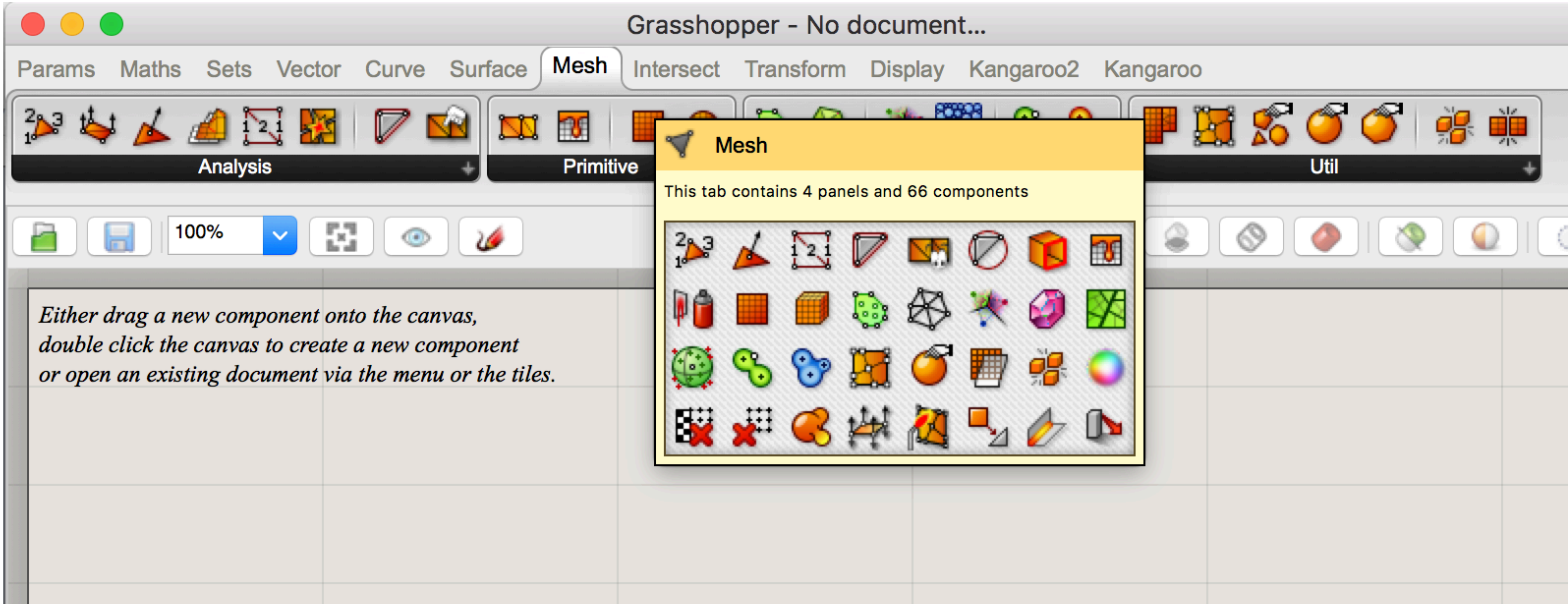

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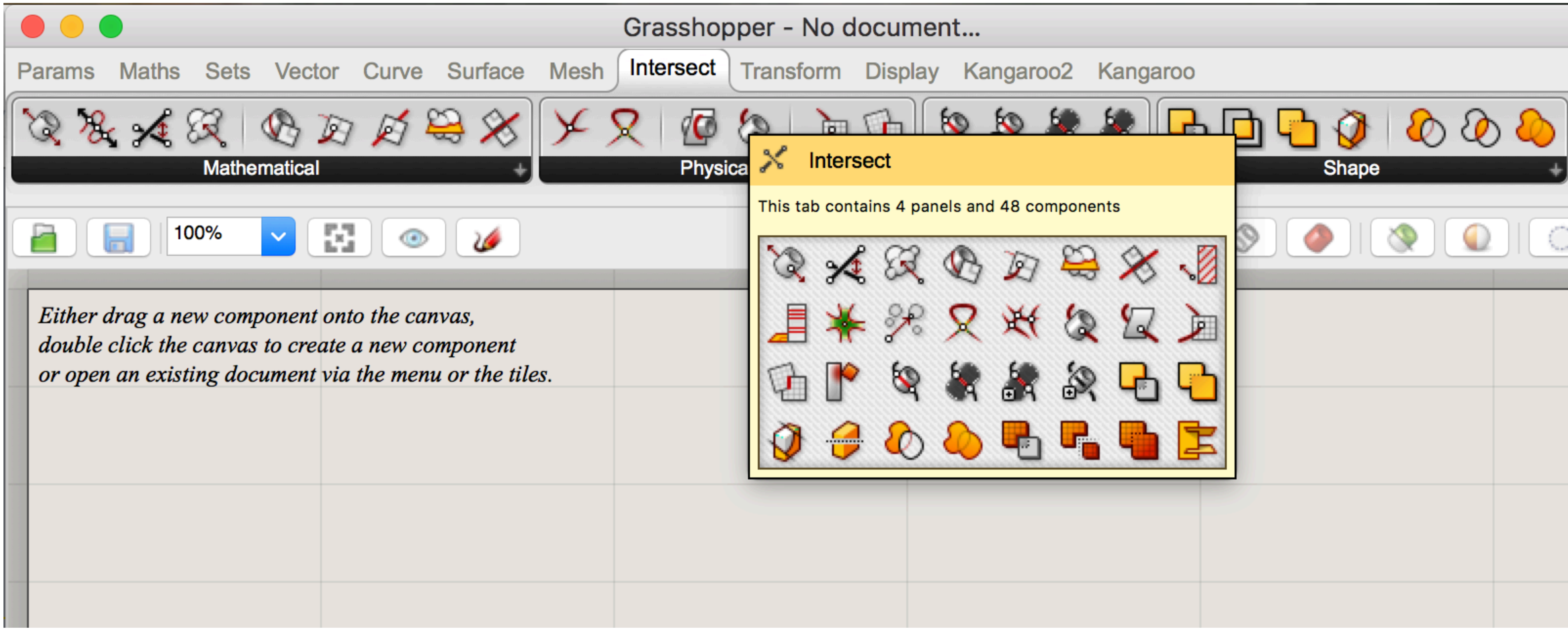

Overview

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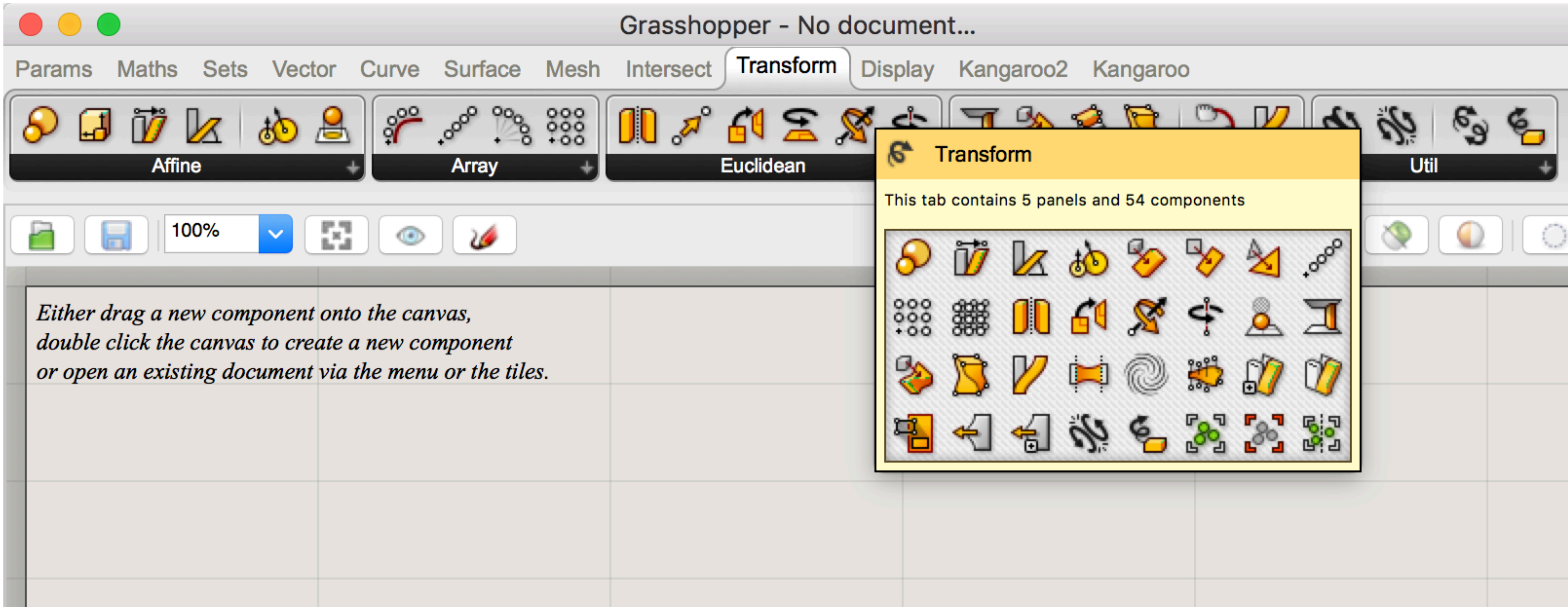

Overview

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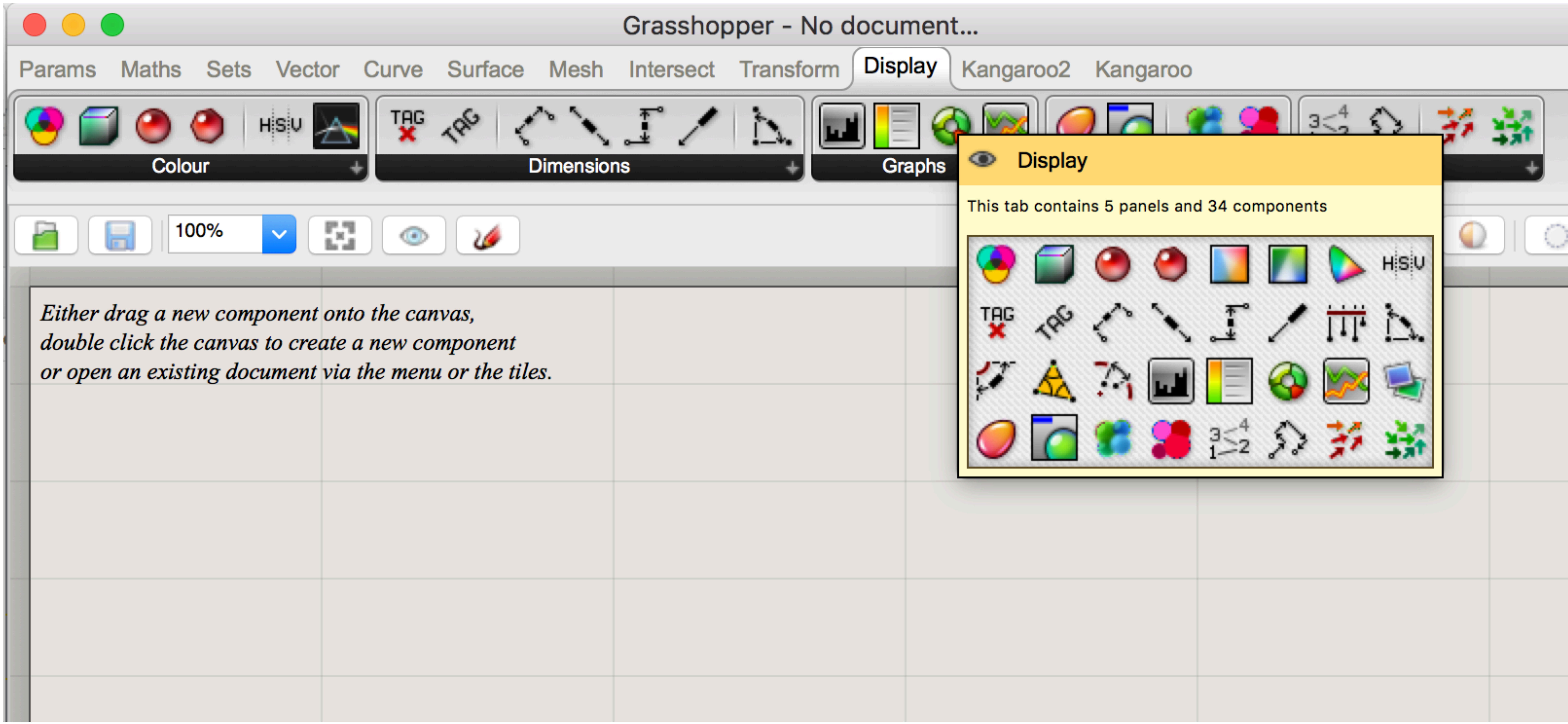
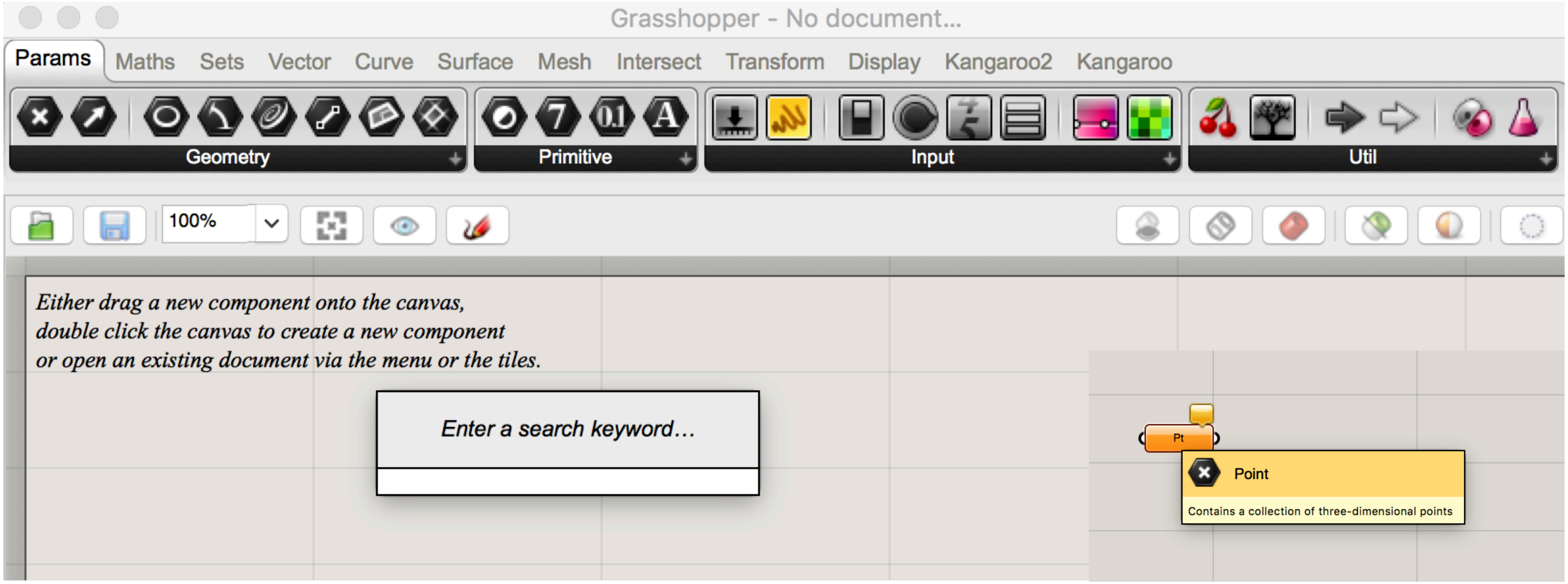


Component Panels (Container System)

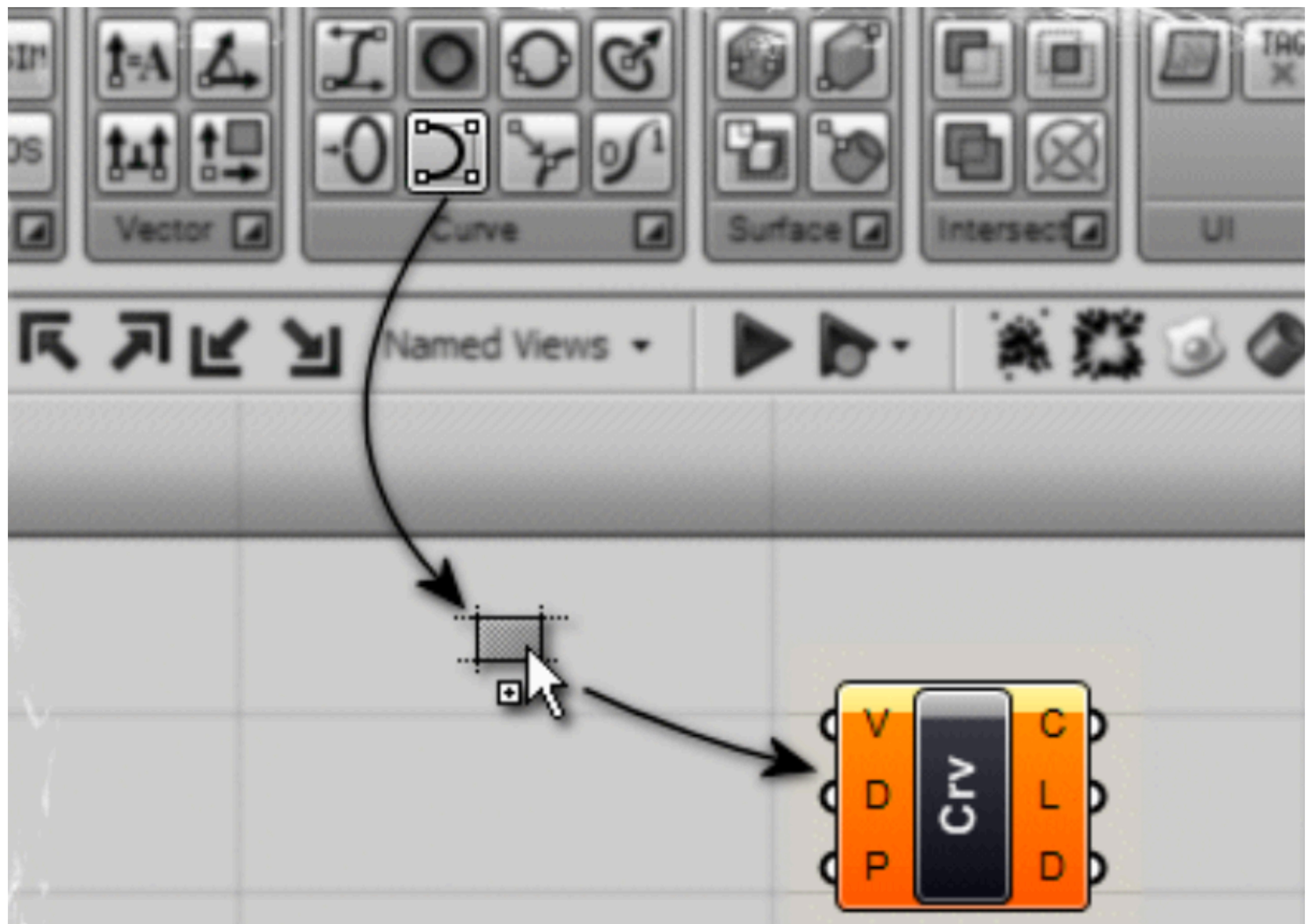
You can also find components by name, by double-clicking anywhere on the canvas; launching a pop-up search box. Type in the name of the component you are looking for and you will see a list of parameters or components that match your request.



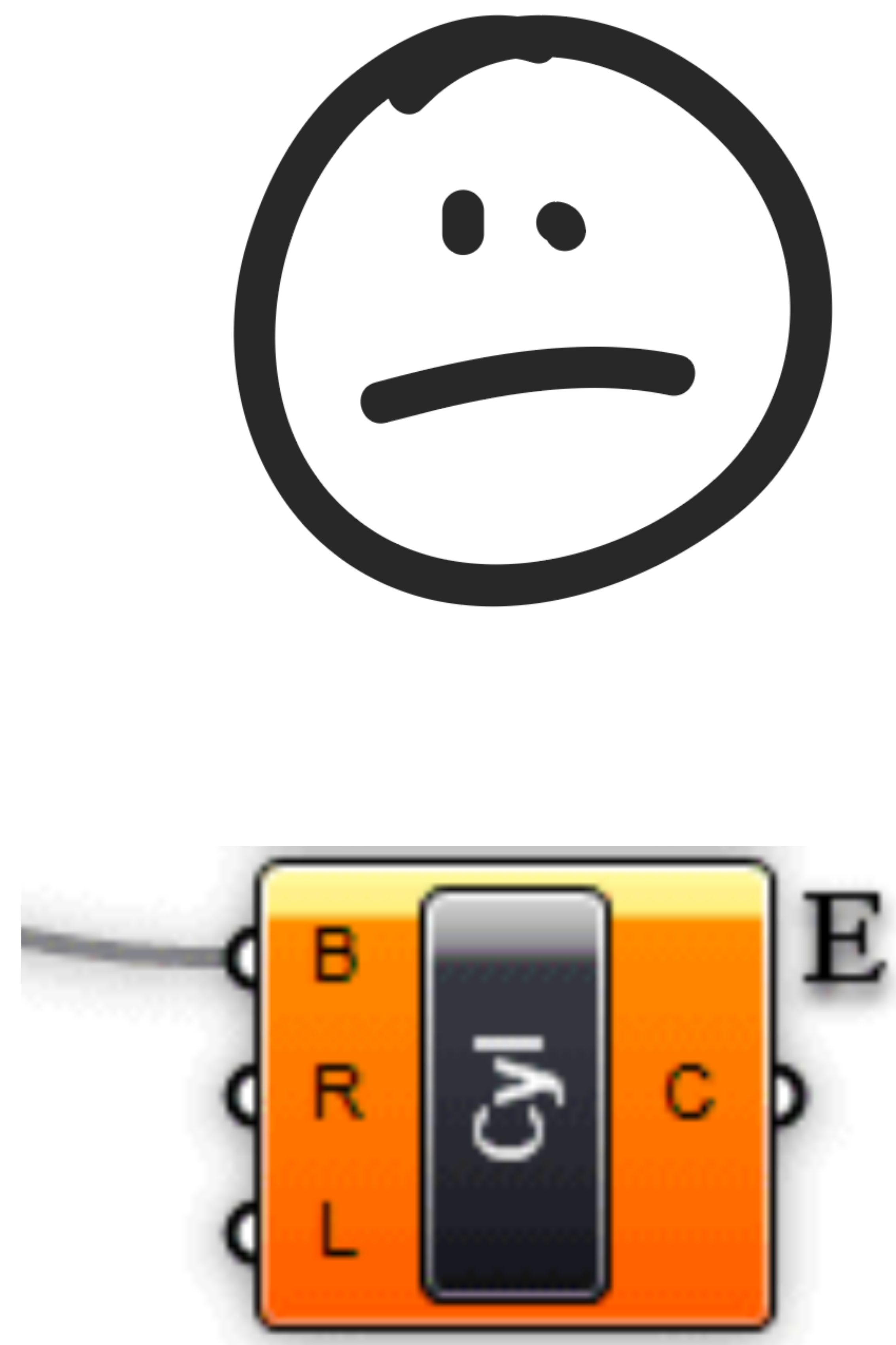
Overview

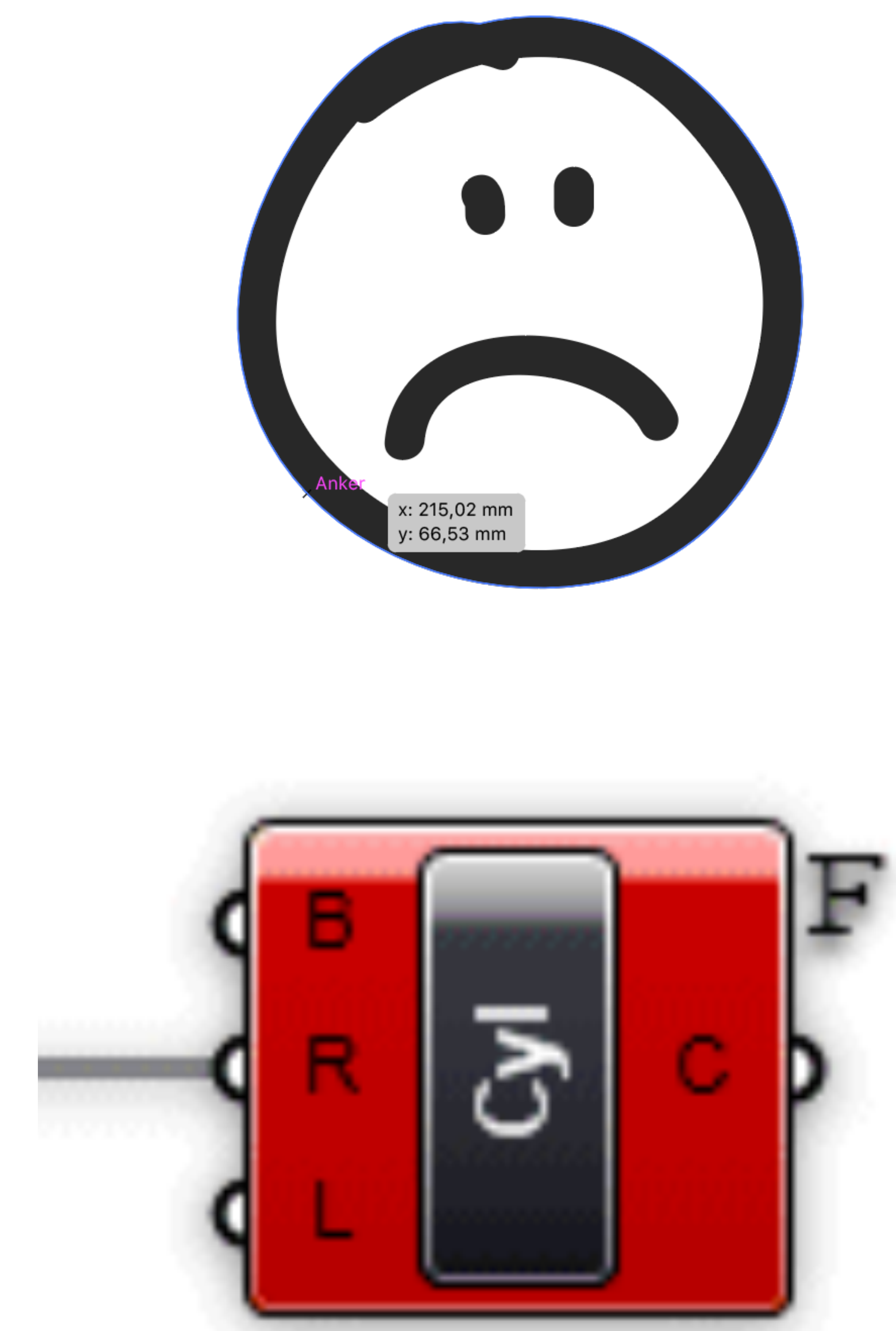
Component Panels (Container System)

- The program gets created by dragging components onto a canvas. The outputs to these components are then connected to the inputs of subsequent components.



Component Panels (Container System)



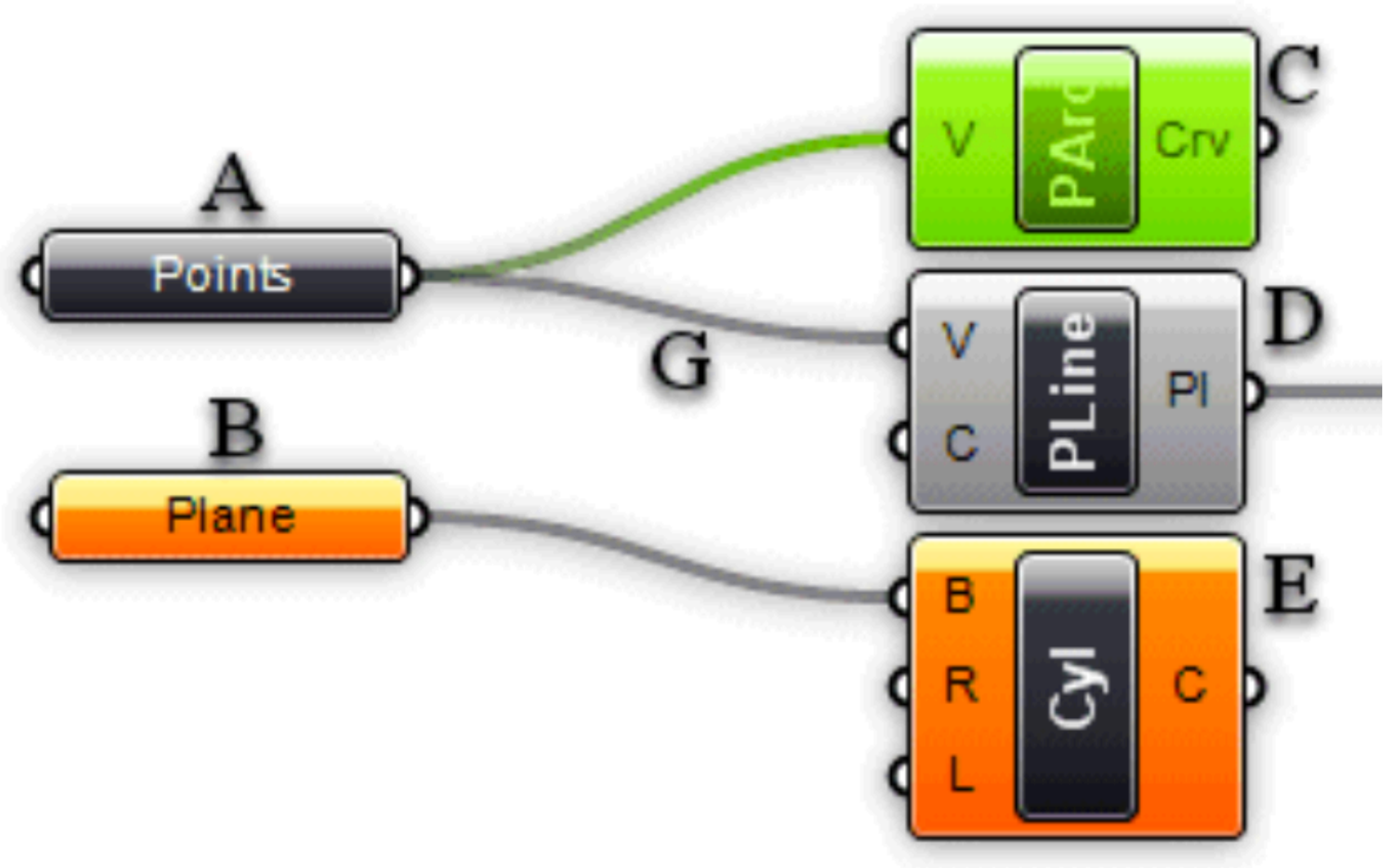


Overview

Component Panels (Container System)

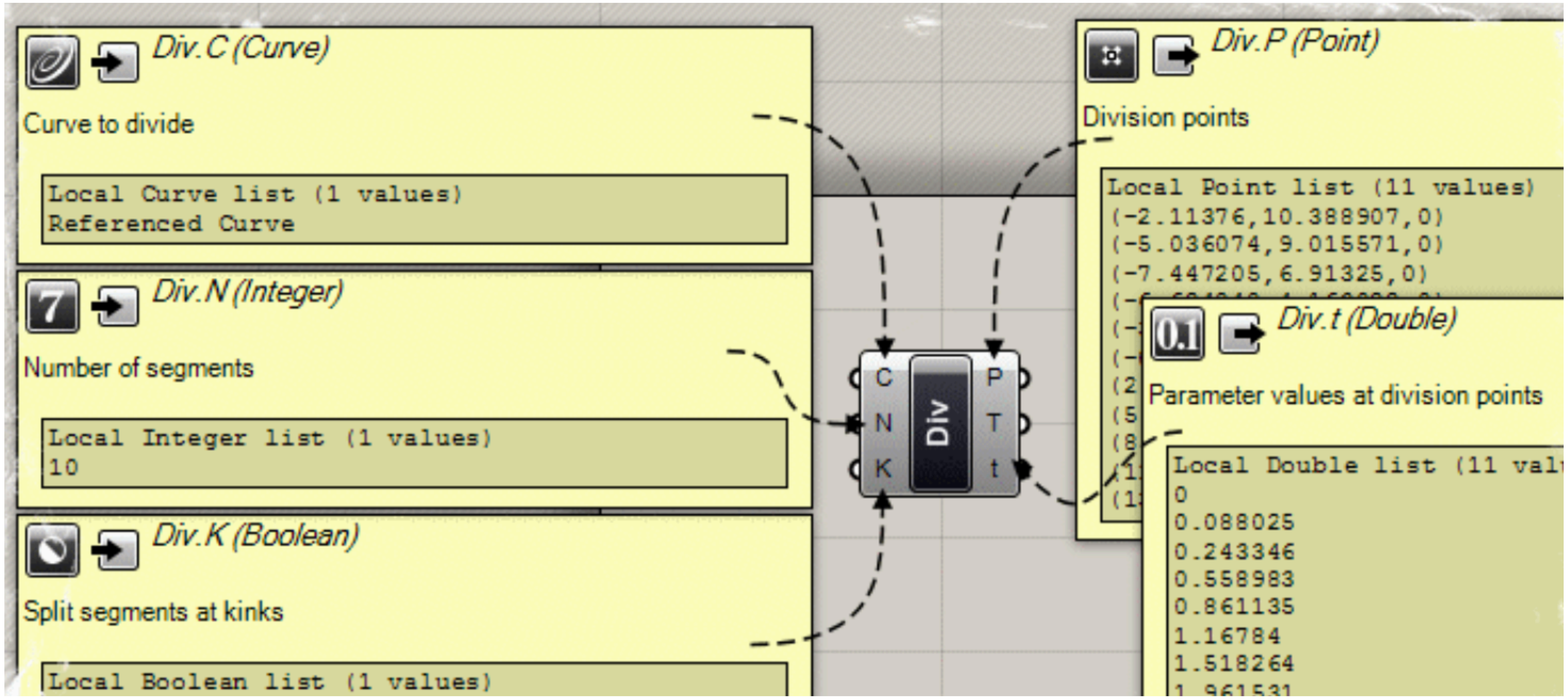
<u>Parameters</u> contain data, meaning that they <u>store</u> stuff.

<u>Components</u> contain actions, meaning that they <u>do</u> stuff.



Component Panels (Container System)

When you hover your mouse over the individual parts of a Component object, you'll see different tooltips that indicate the particular type of the (sub)object currently under the mouse. Tooltips are quite informative since they tell you both the type and the data of individual parameters:



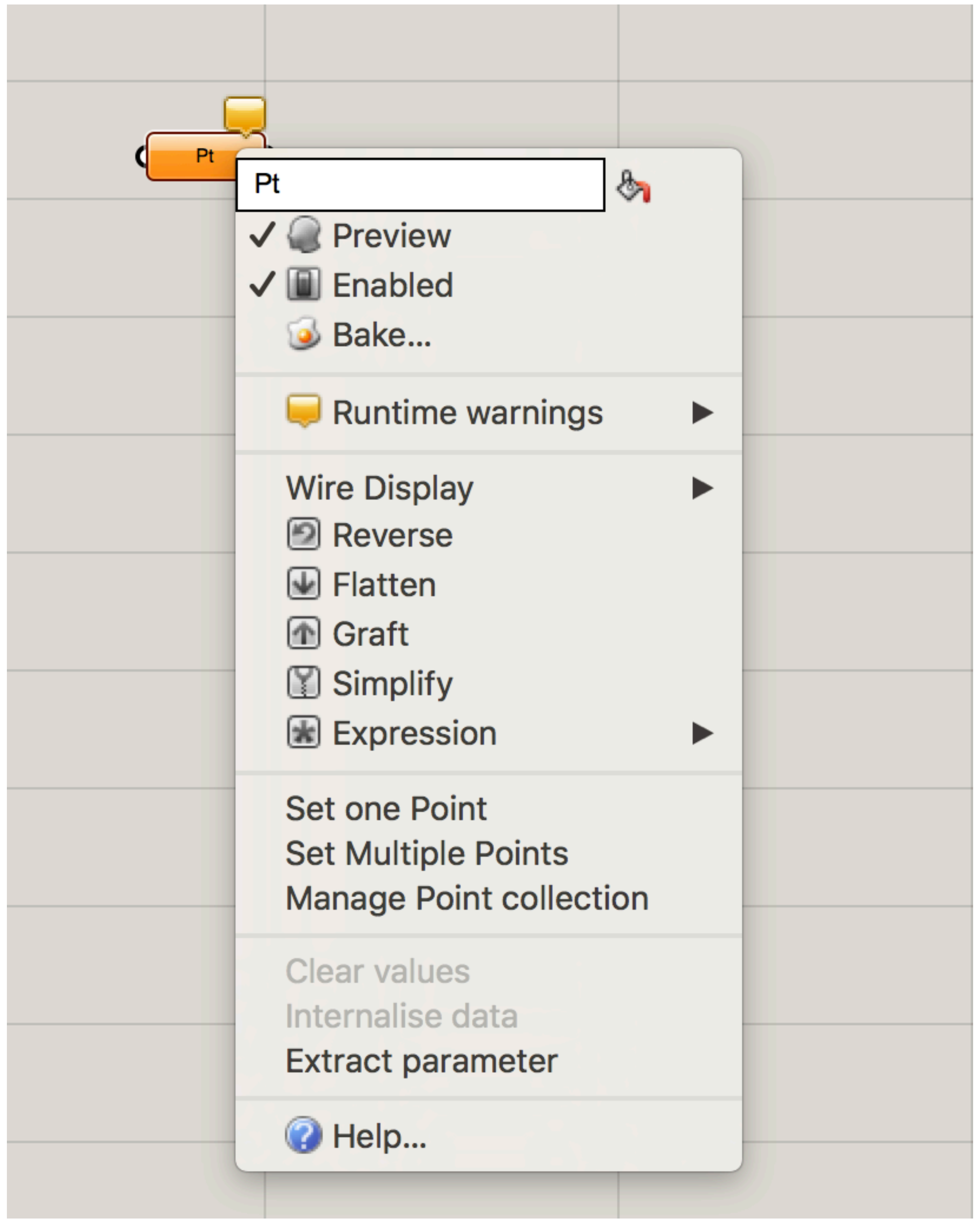
Overview

Component Panels (Container System)

All objects on the Canvas have their own context menus that expose most of the features for that particular component.

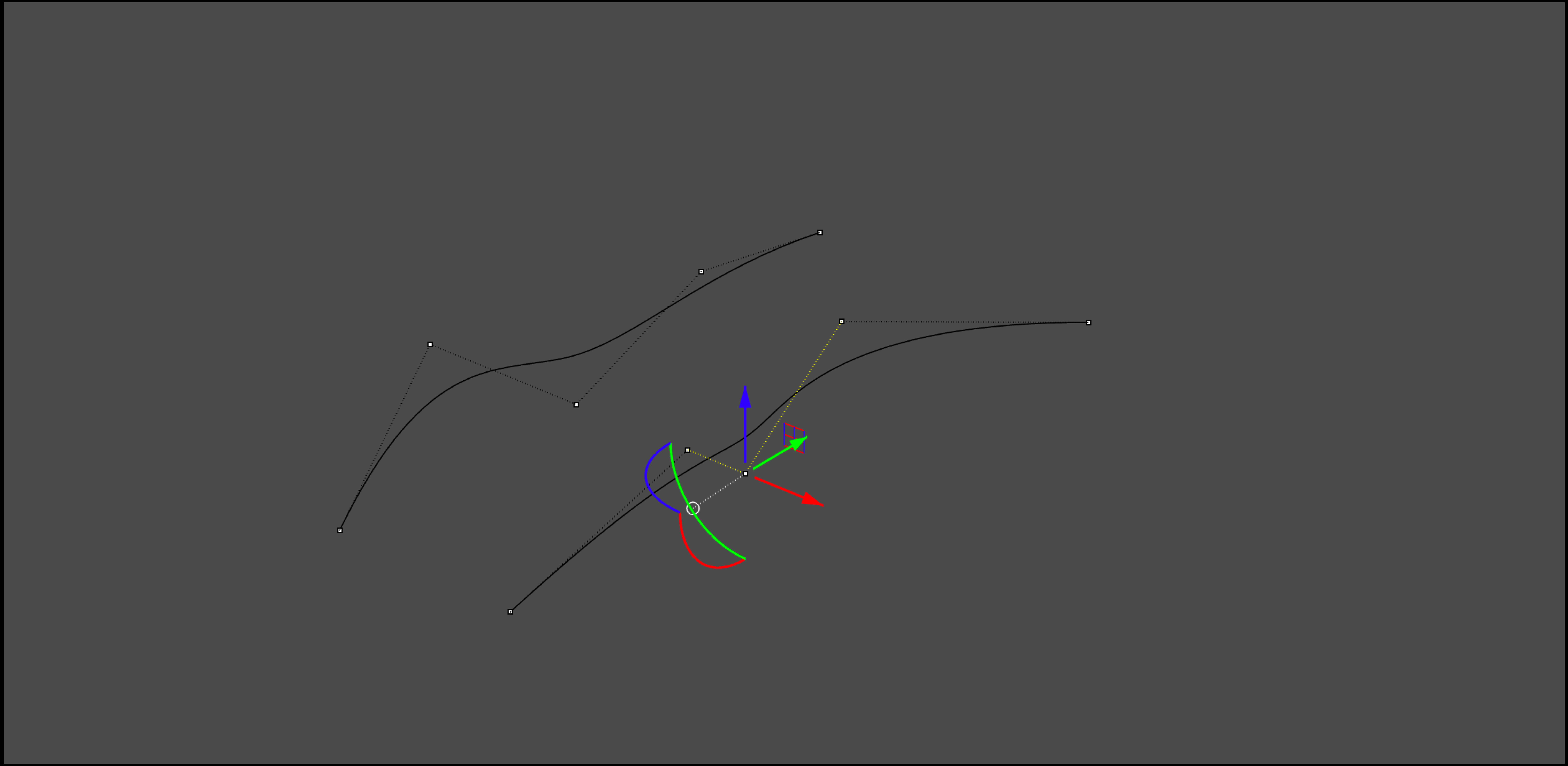
Right click on the Parameter or Component indicates those features:

The space button shows the same features in symbols:



Example

The Bridge



Example

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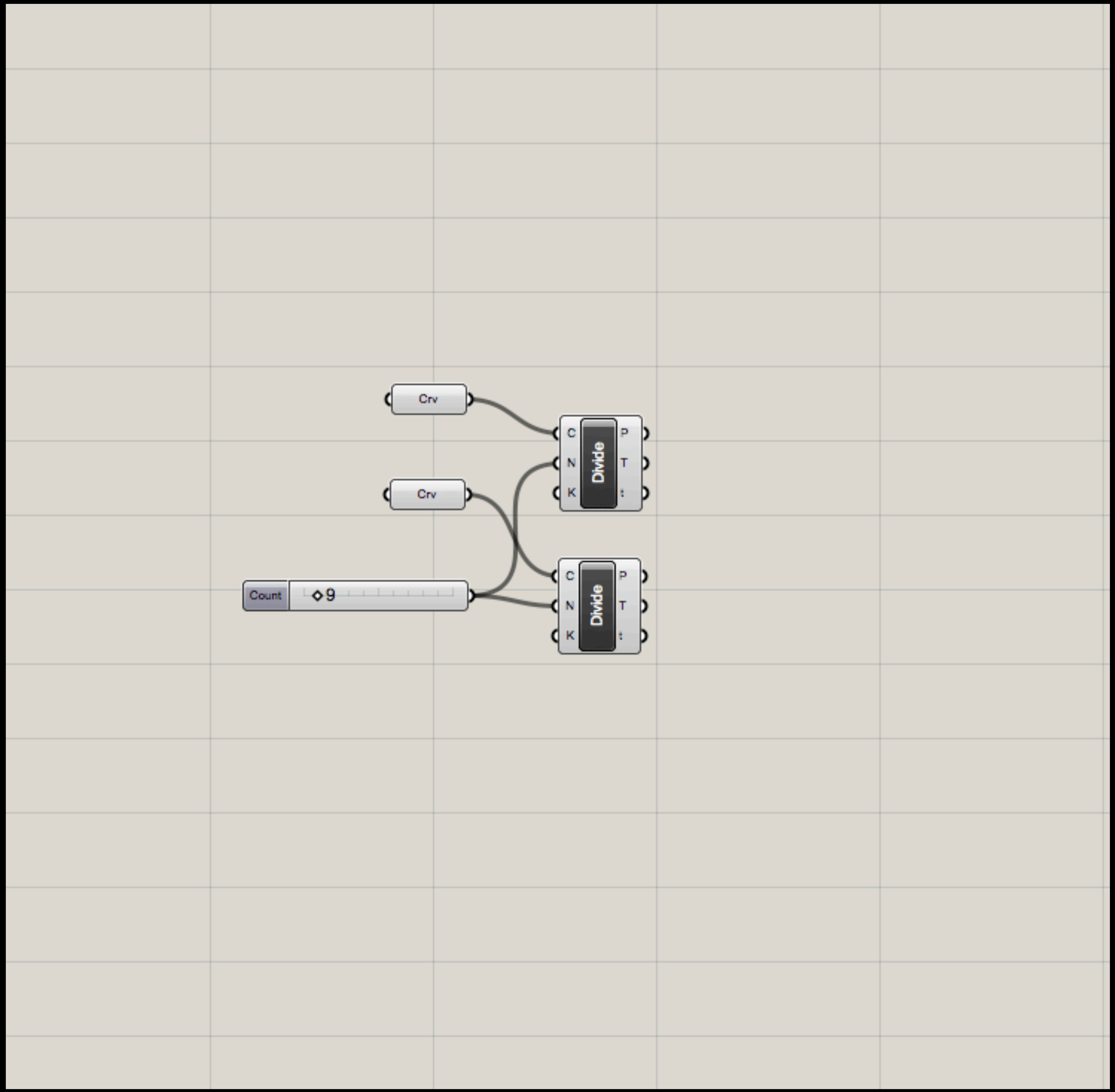

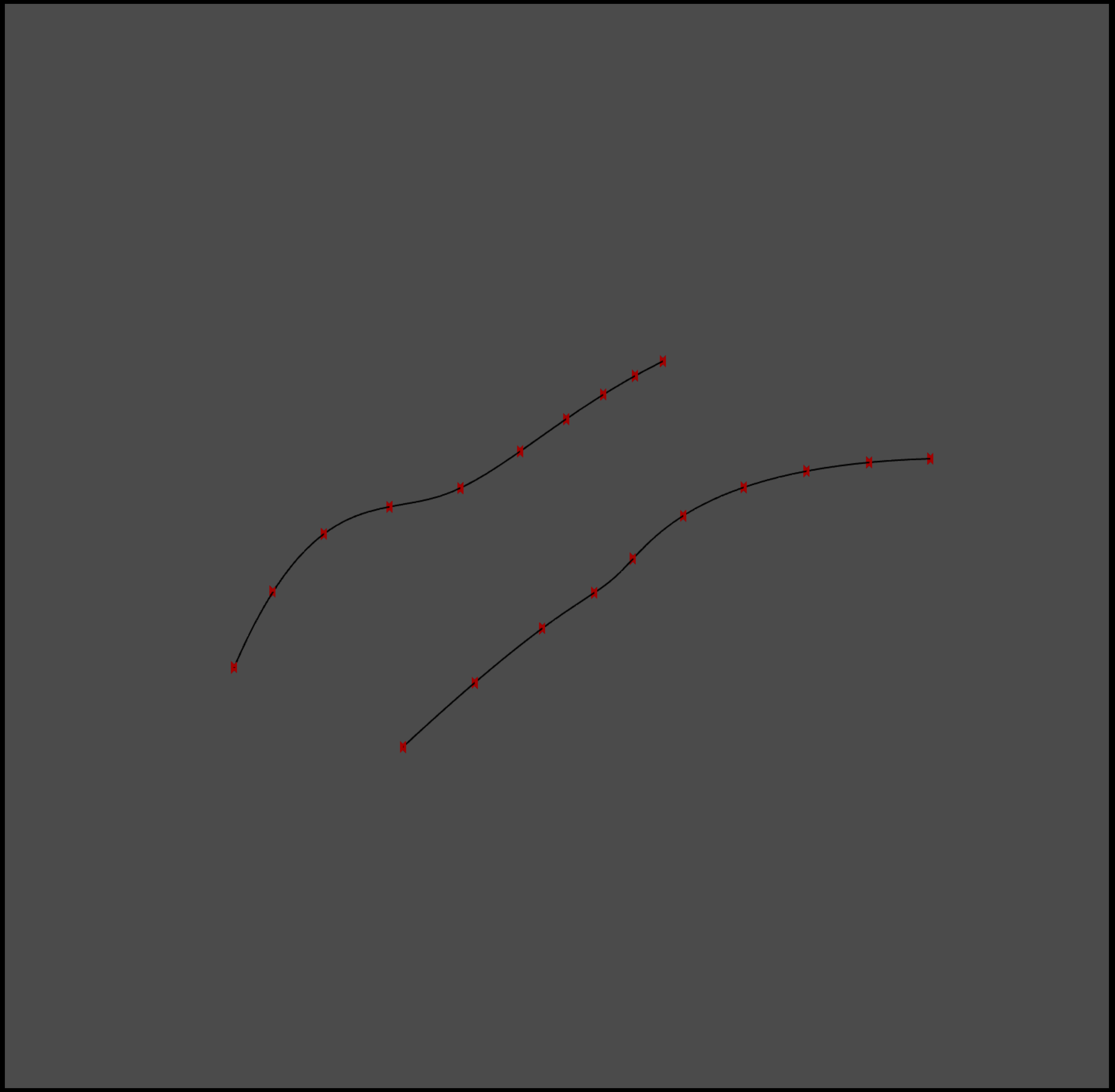

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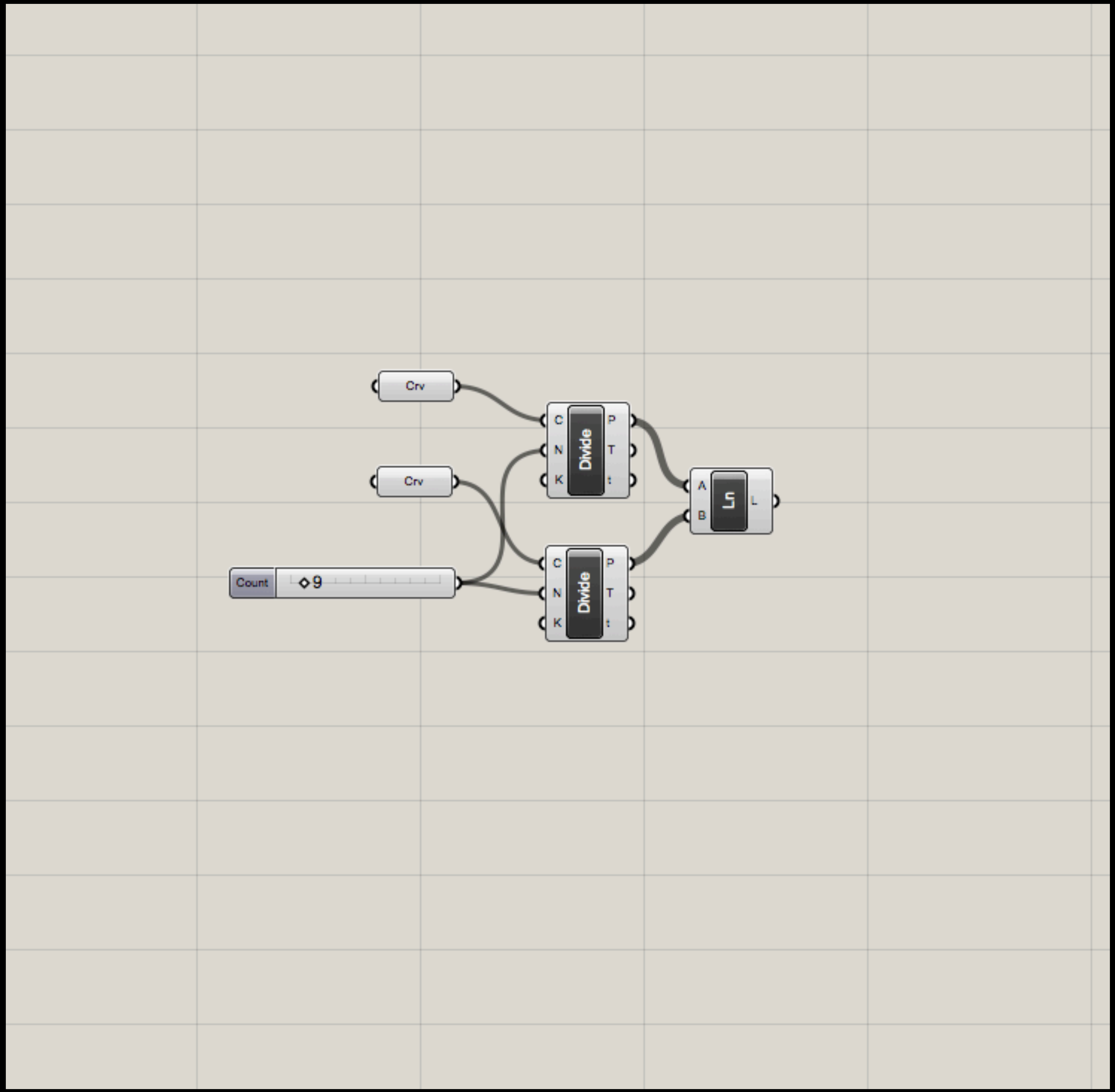

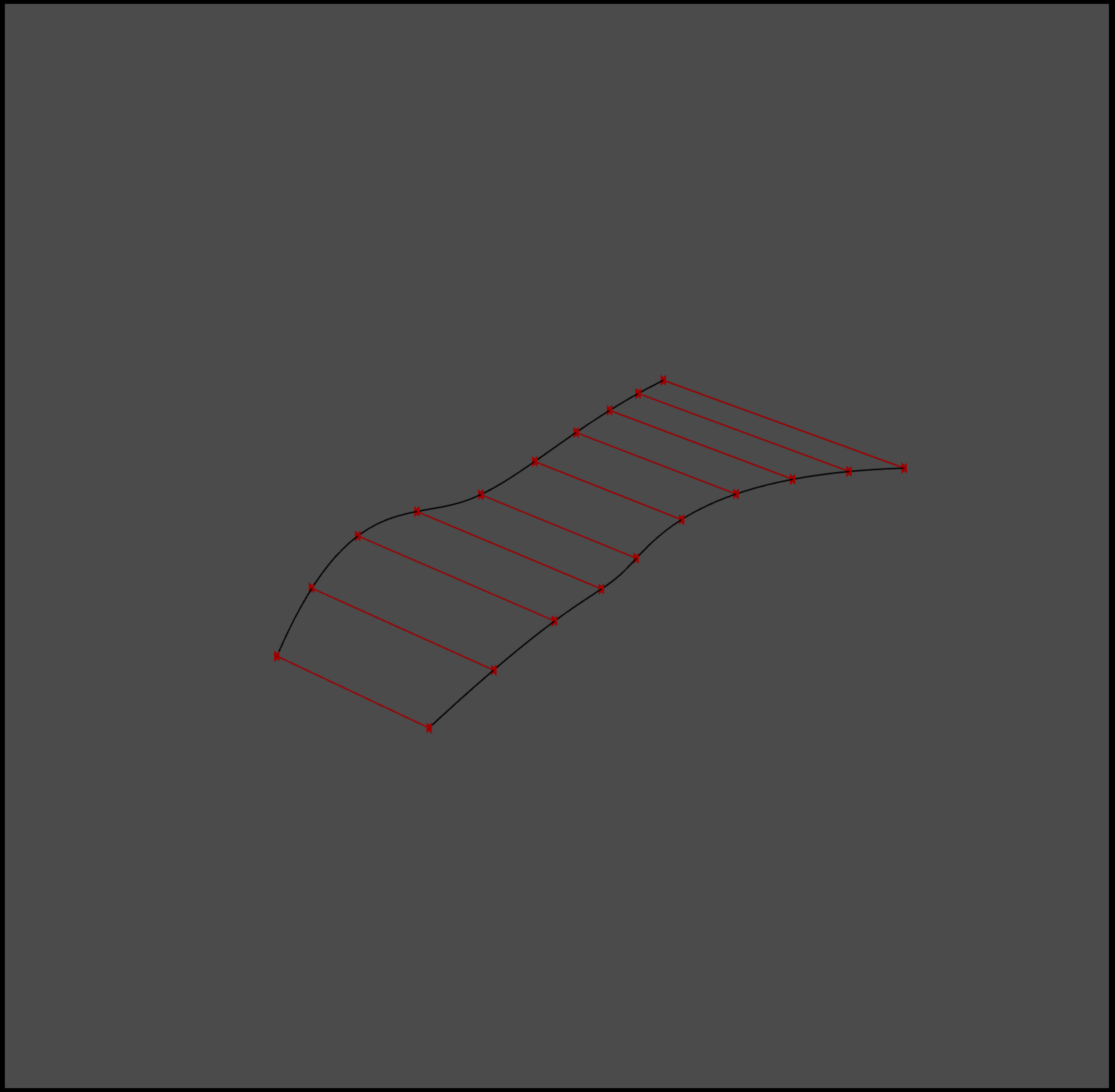

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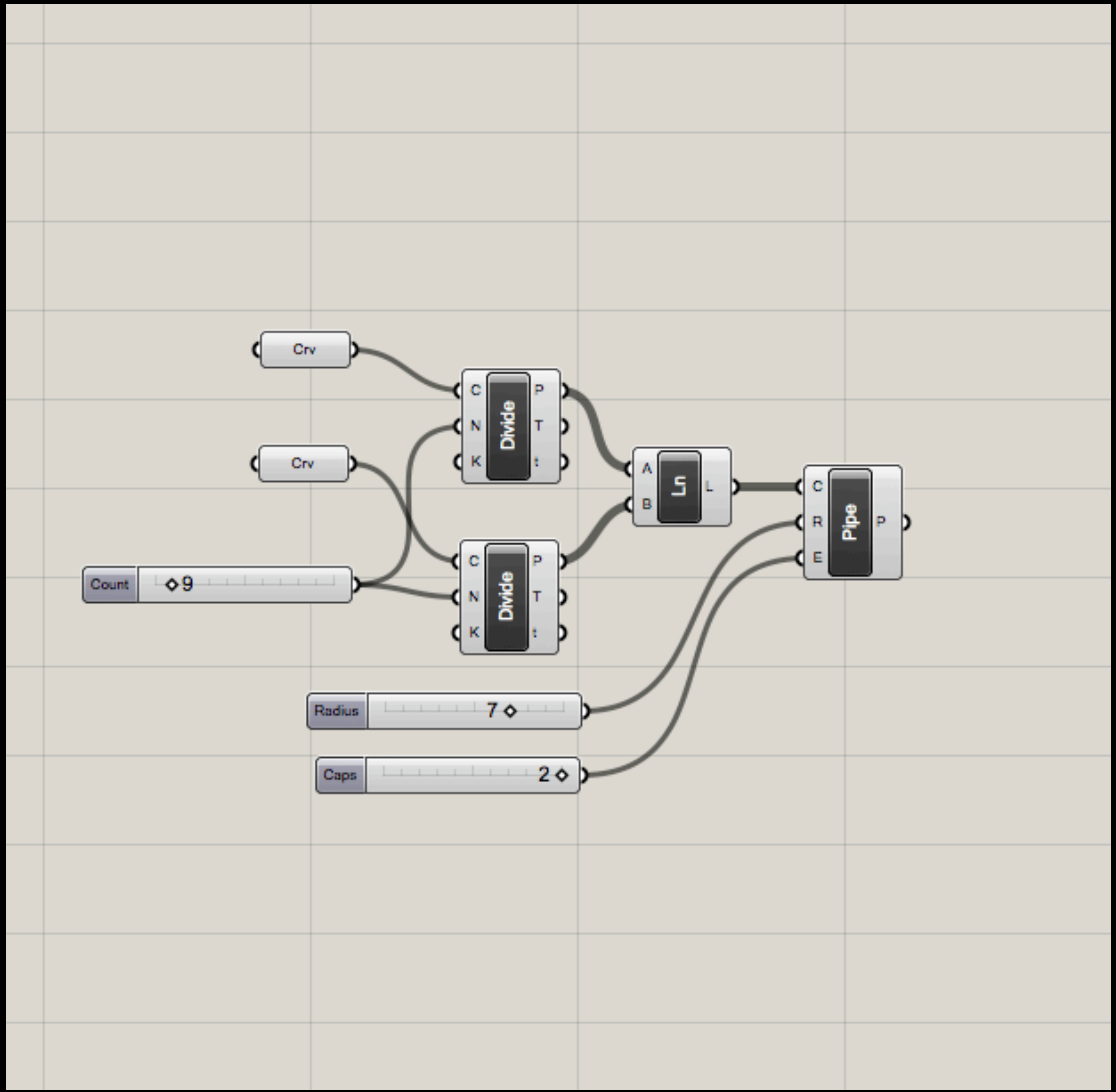
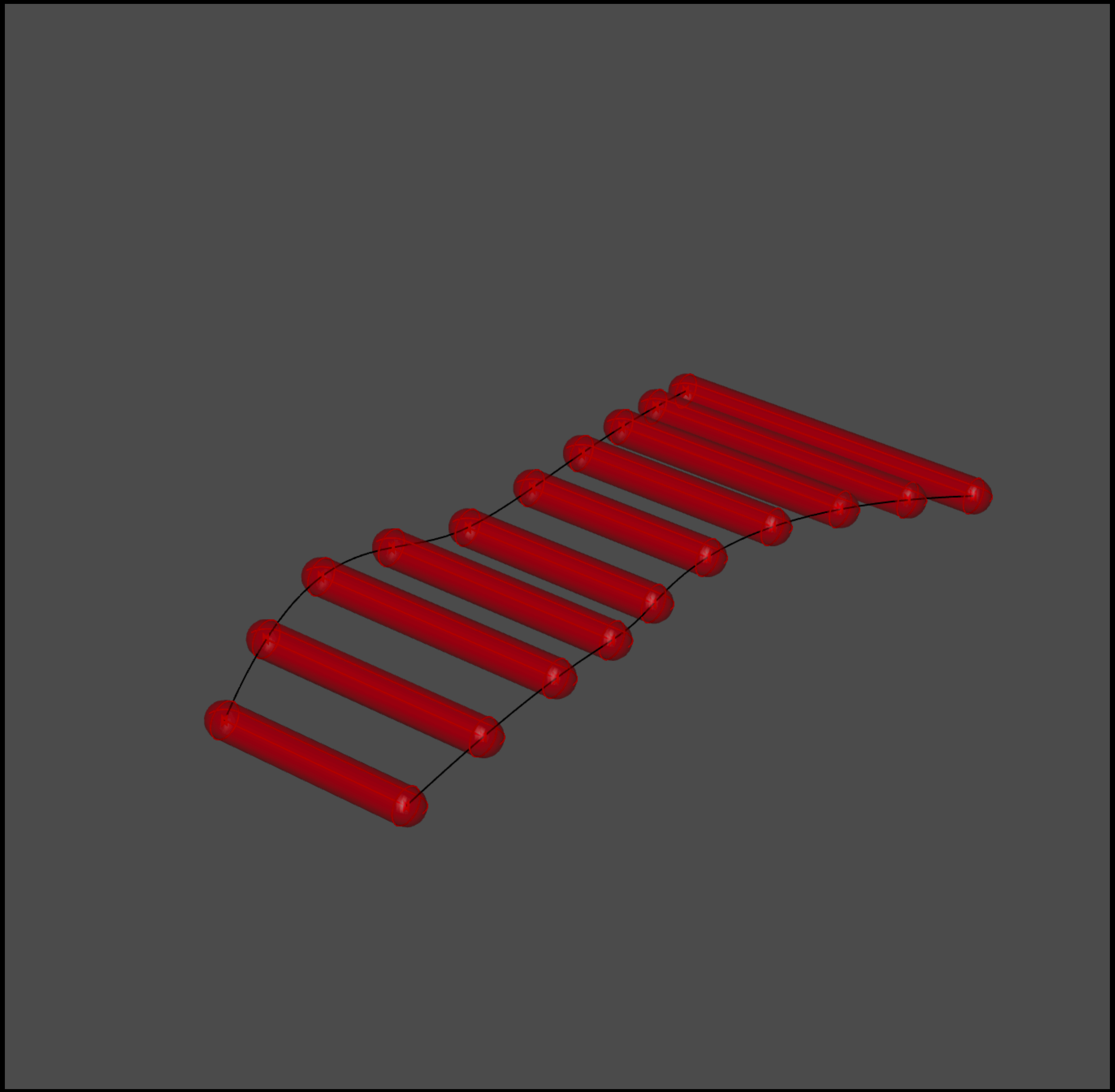
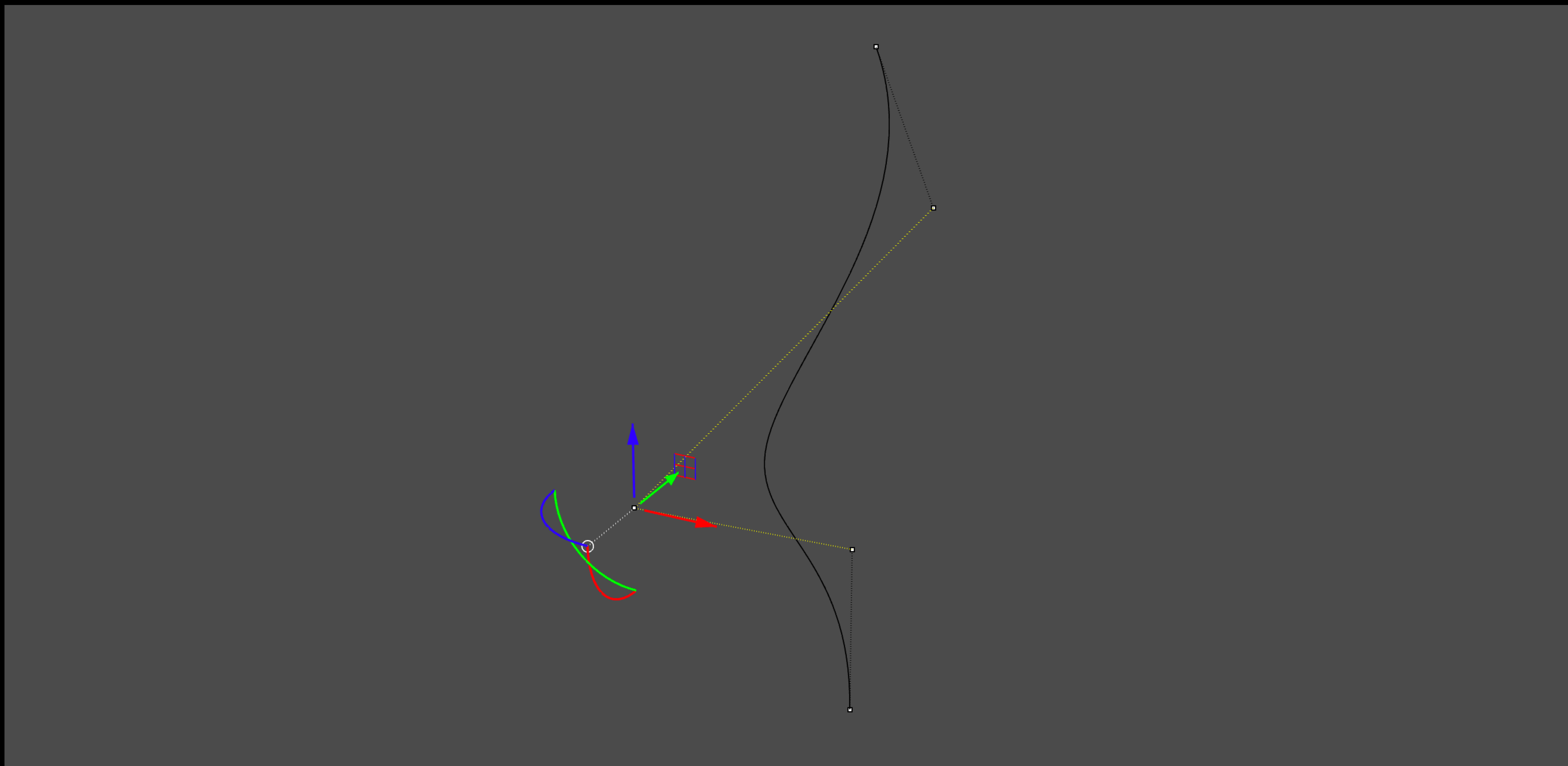




Example

Tower with variable diameter



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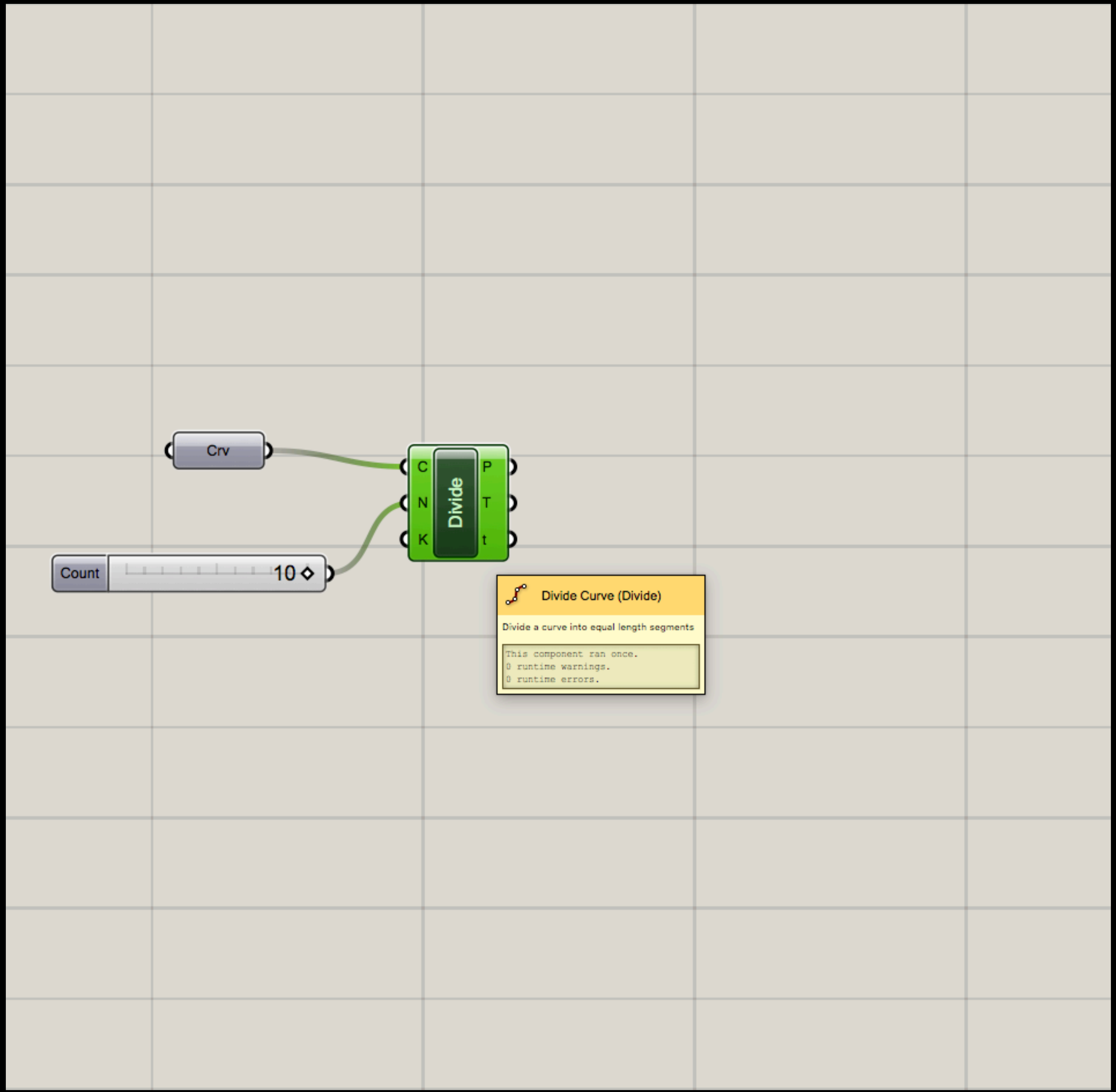

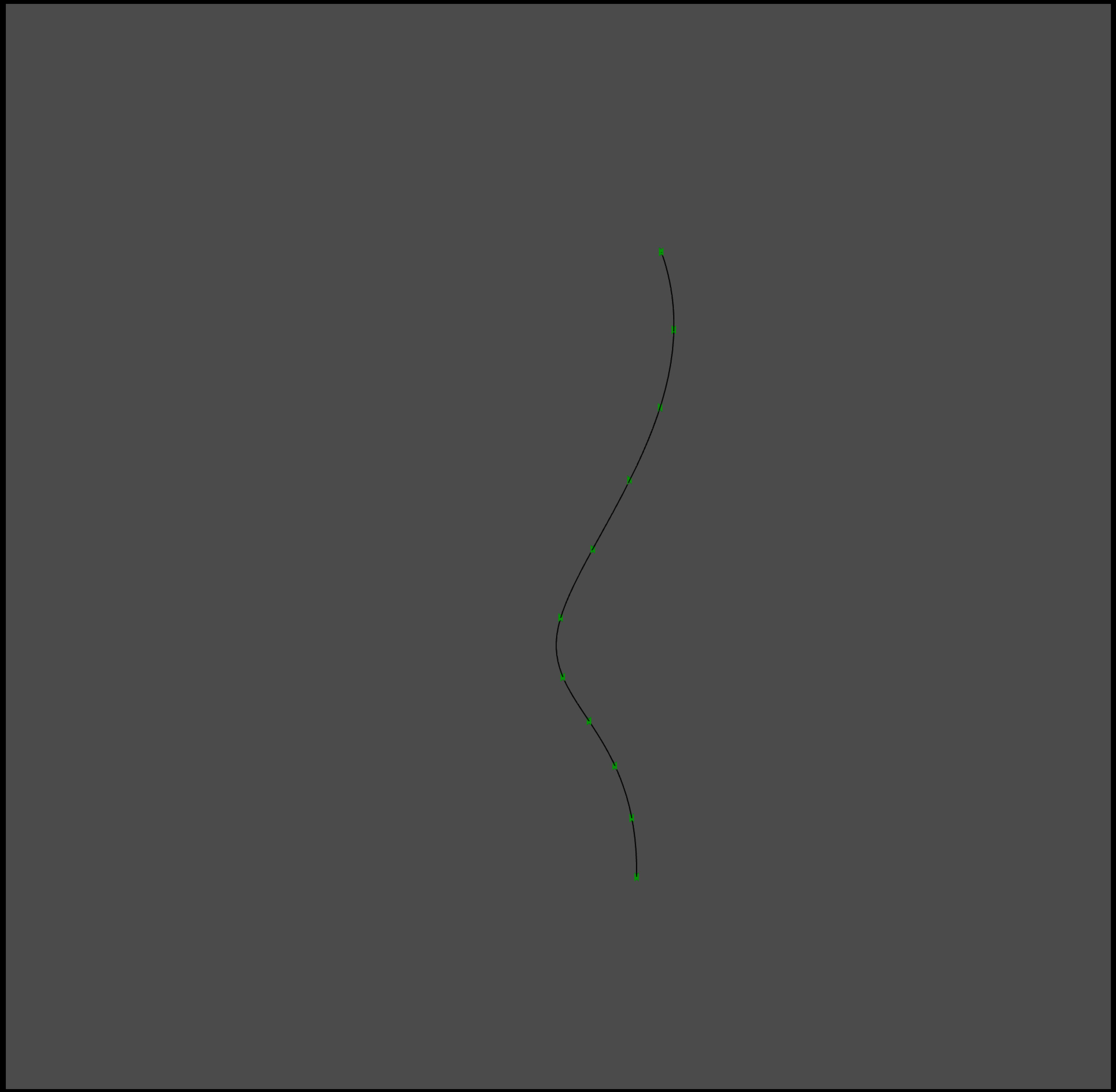

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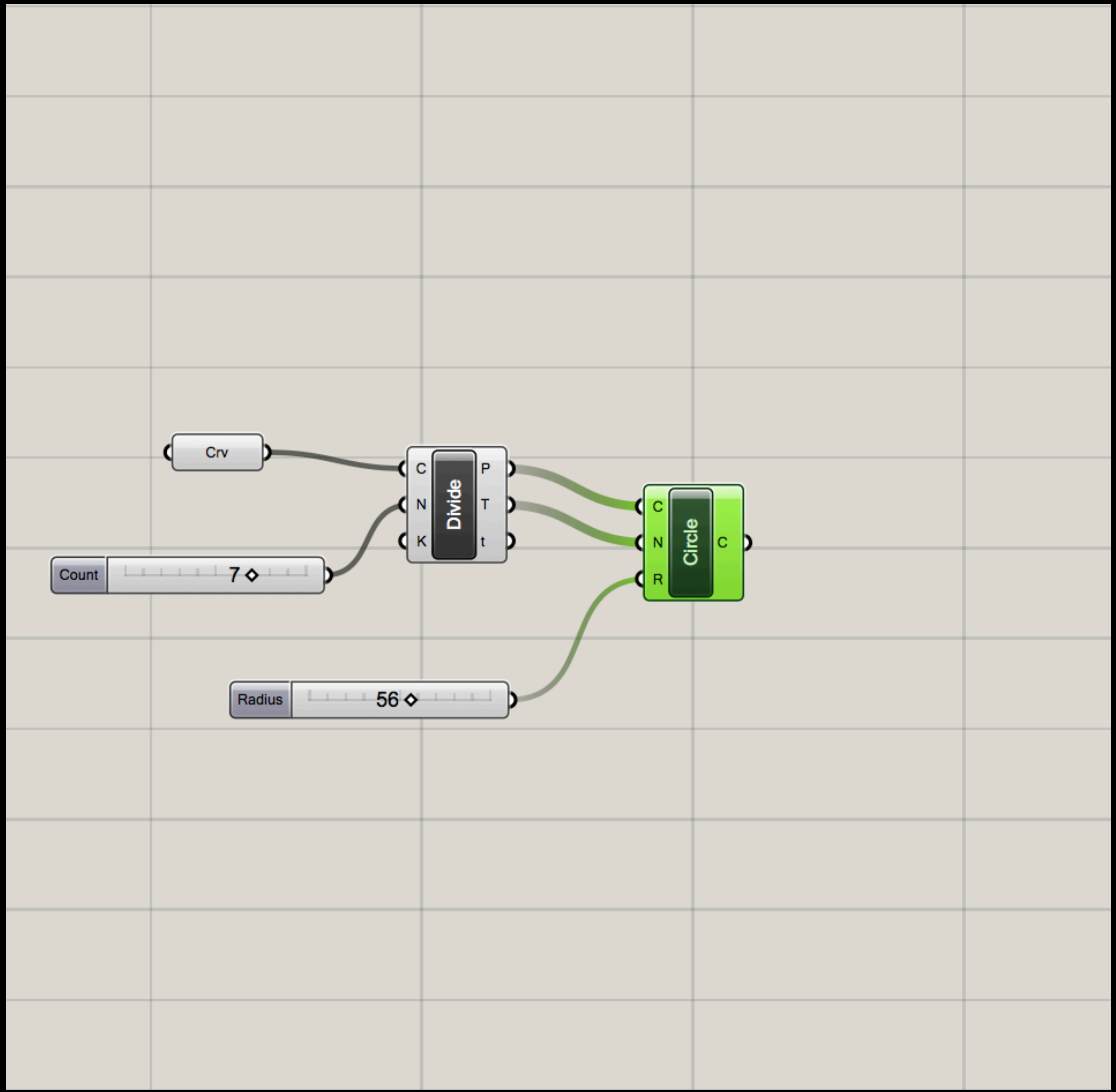

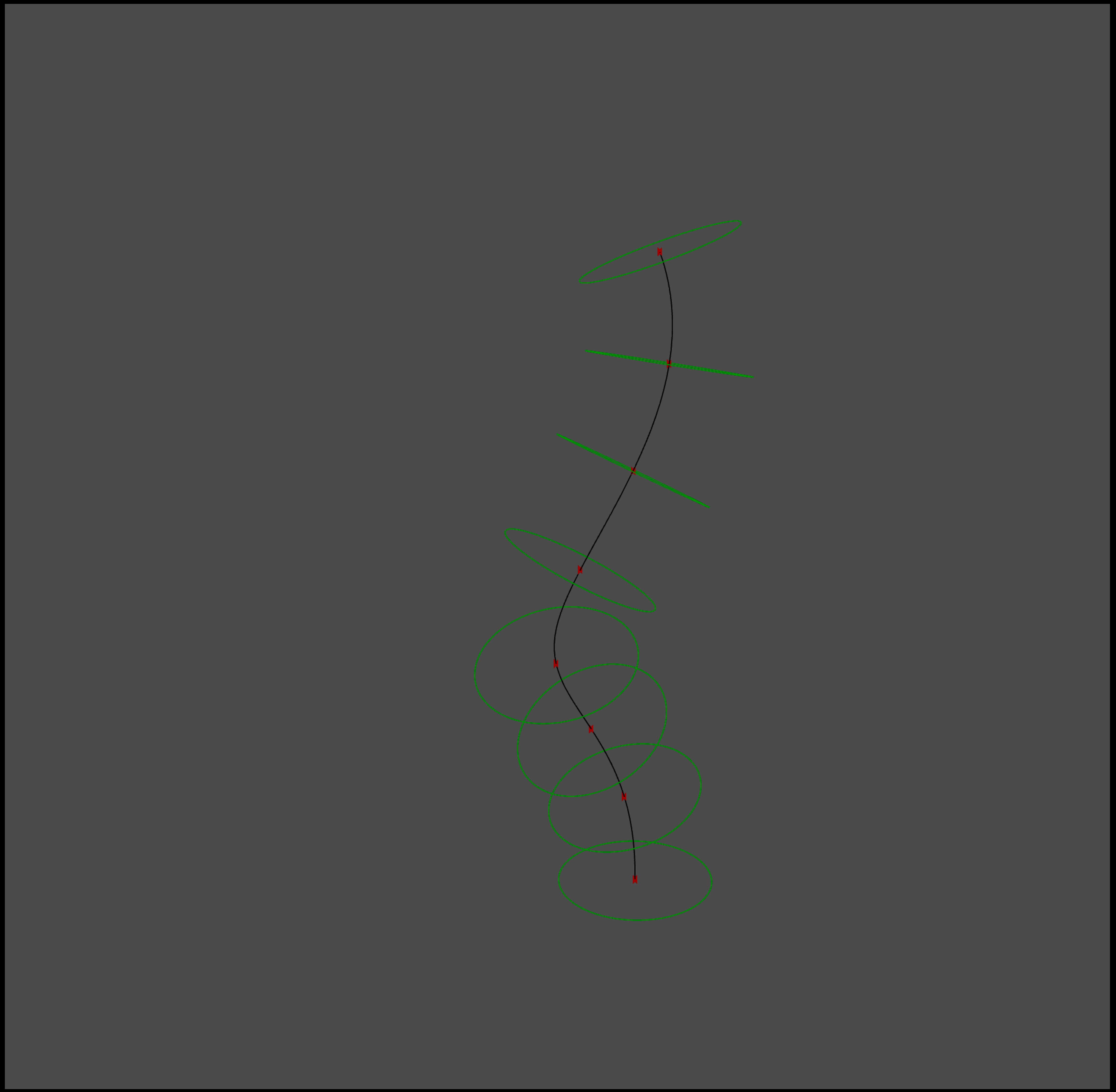

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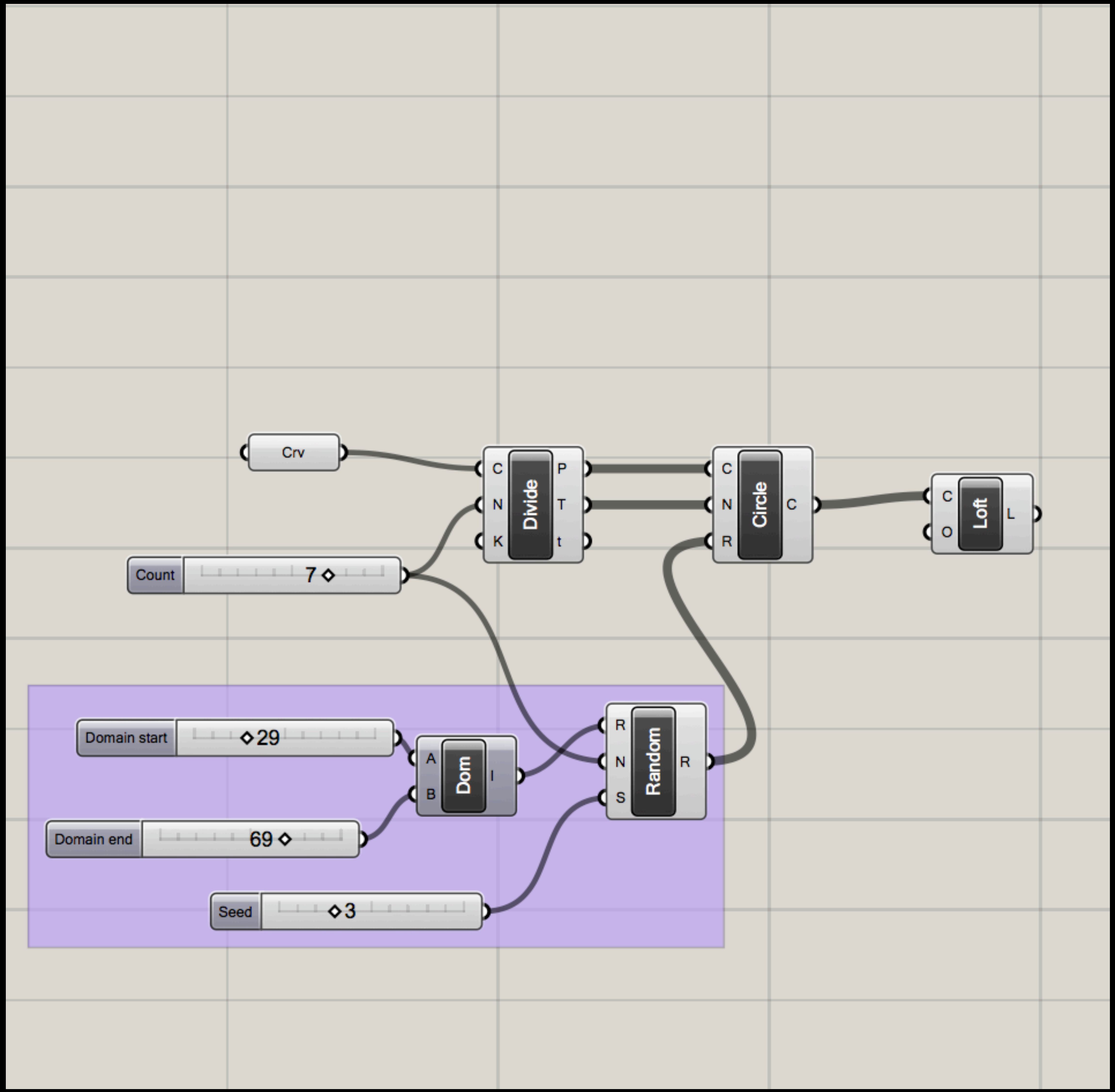

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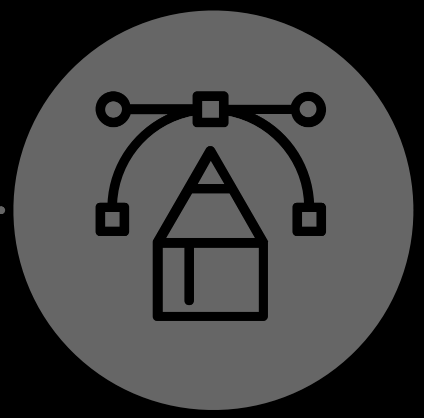
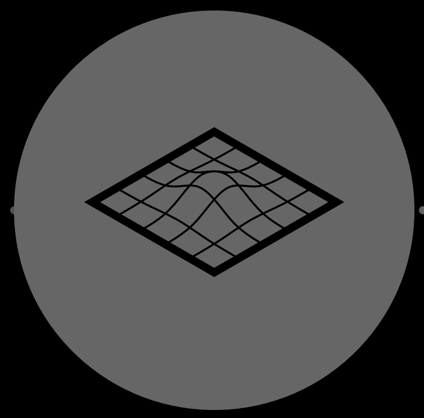


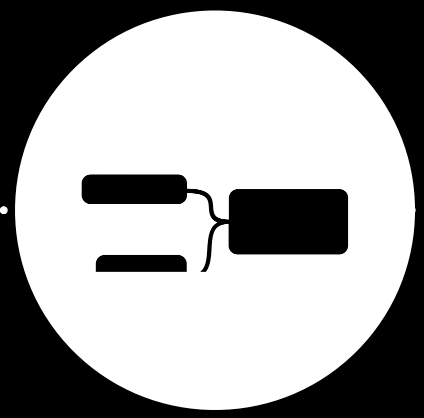
Rhino Basics

04.10.2018



Rhino to Grasshopper

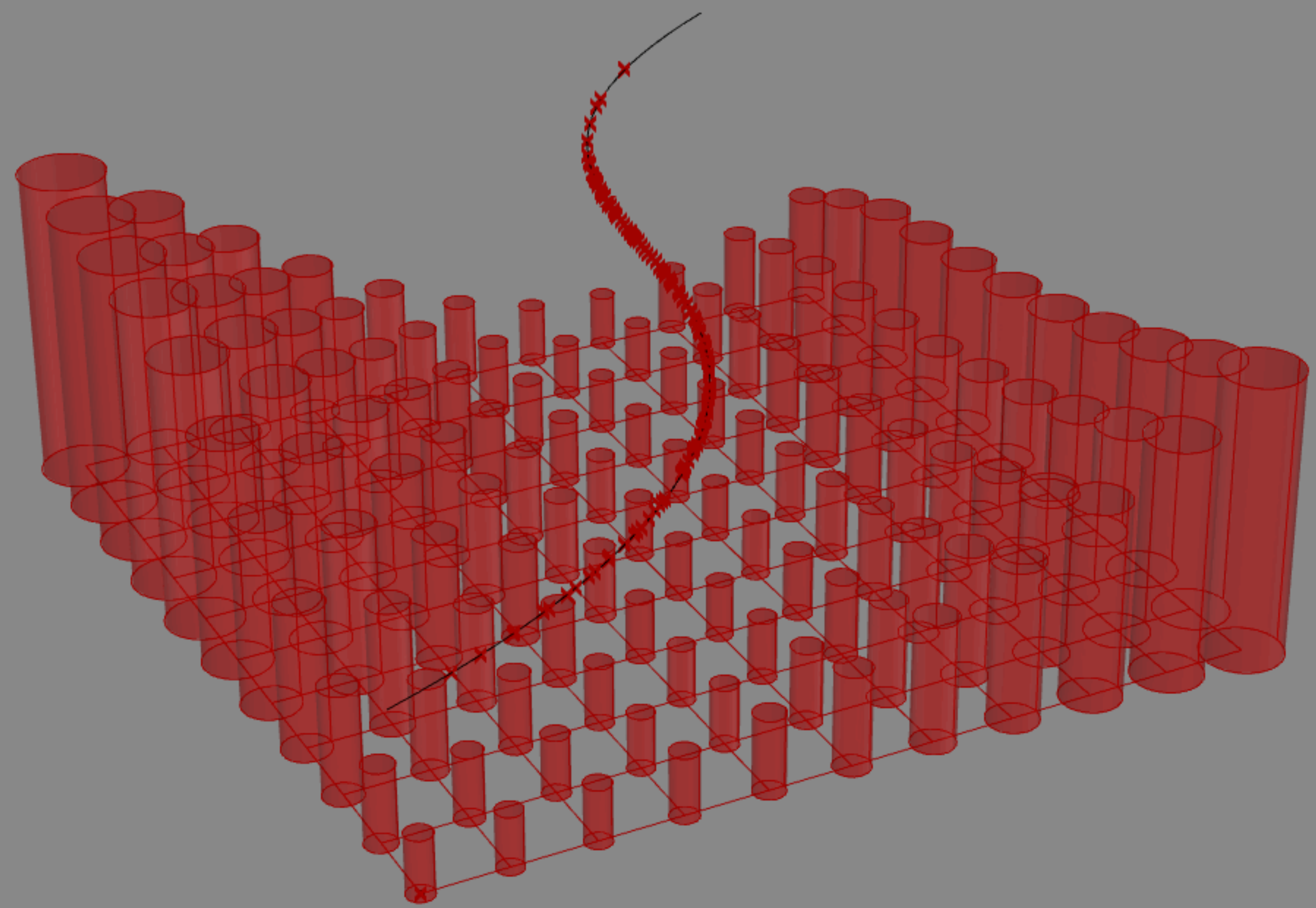
11.10.2018



Parametric Design with Grasshopper

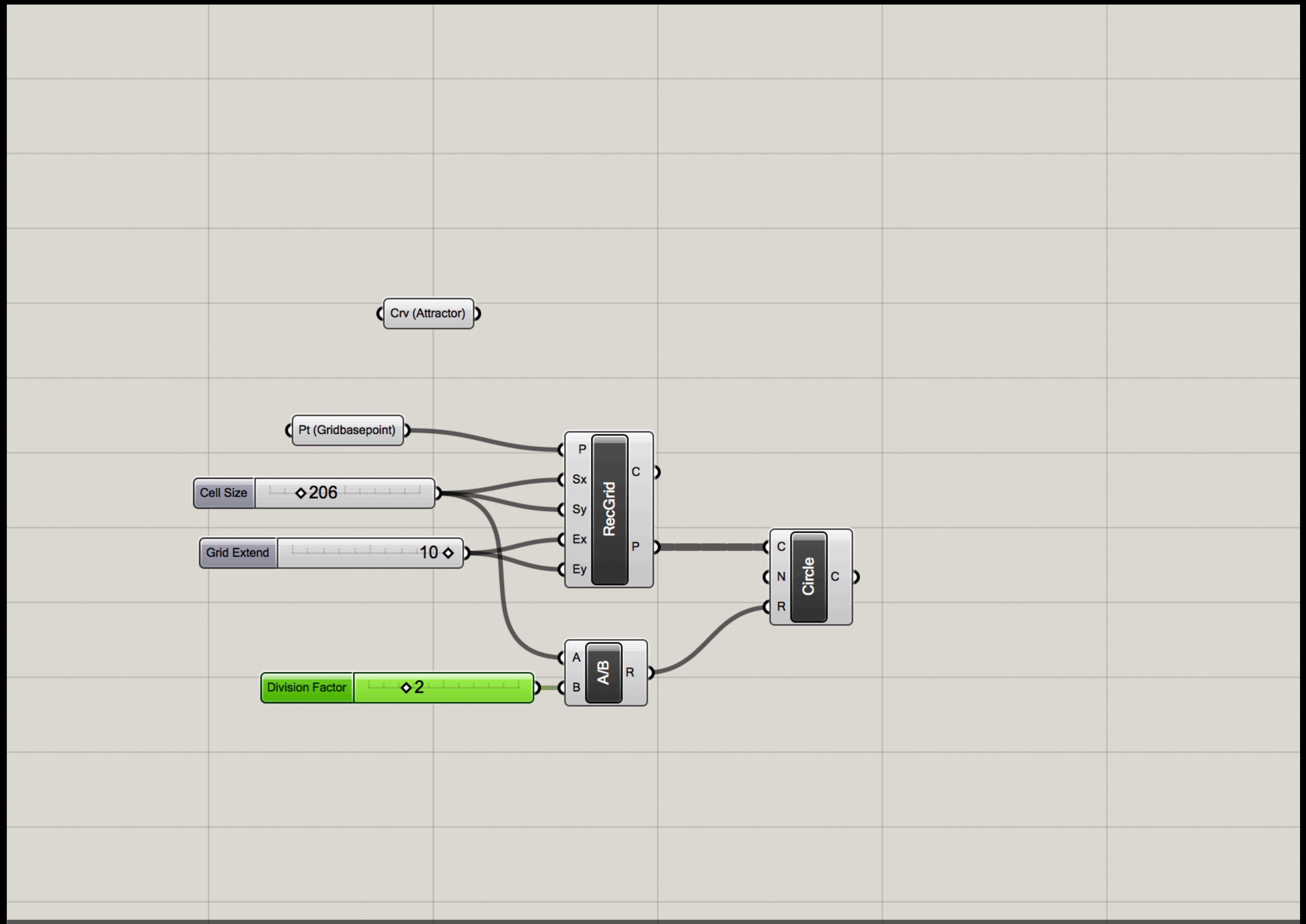
Example

Grids, Attractors & Remapping

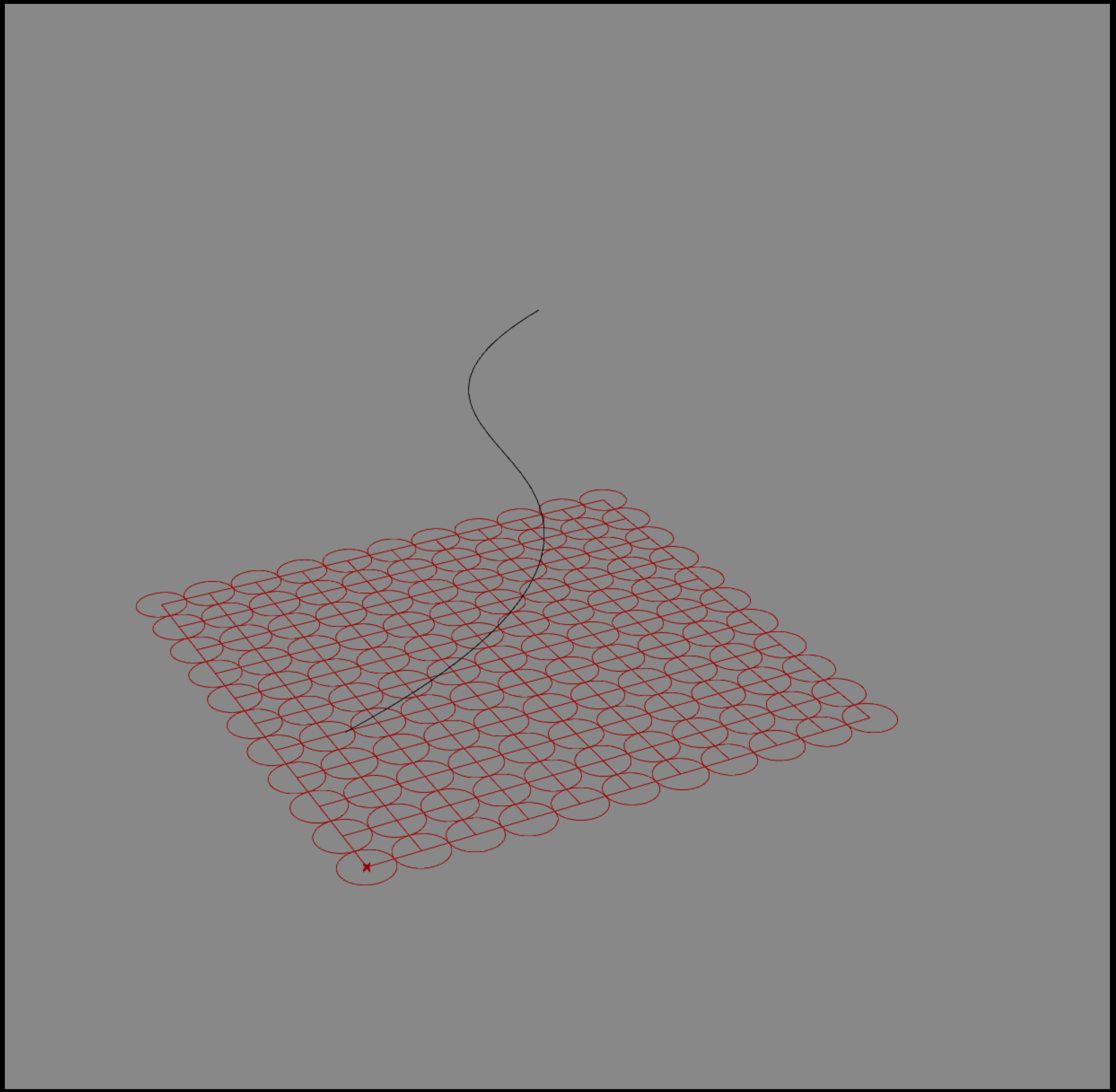


Example

Grids, Attractors & Remapping

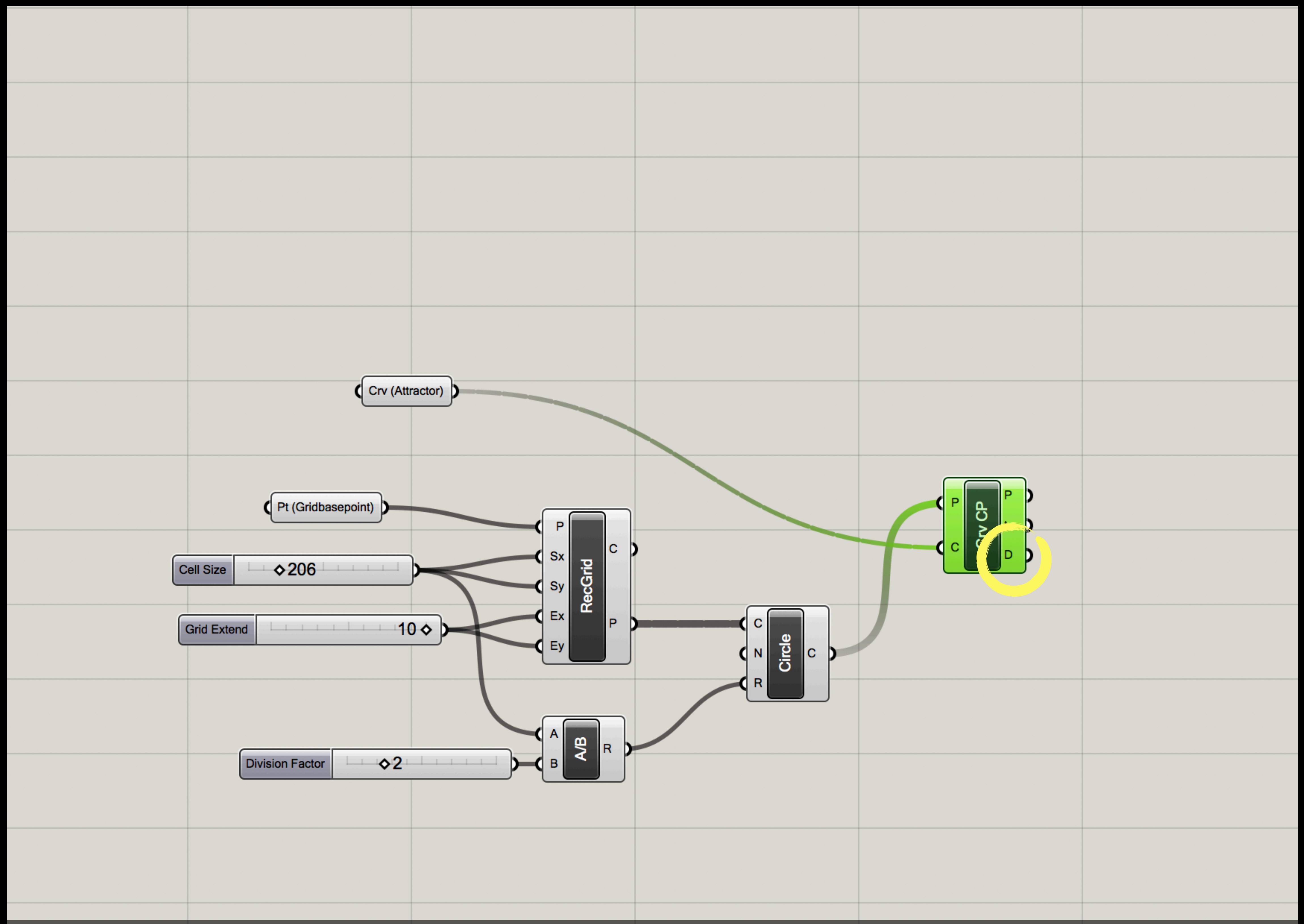


- In Rhino: create a **Point** and a **CV Curve** and connect them to Grasshopper
- In Grasshopper: create a grid „**RecGrid**“ using the Point as a Base point, Sliders to control the extend and size of the grid
- Create Circles using the Grids Points (P) as center an the a **division** of the Cell size as radius (R)

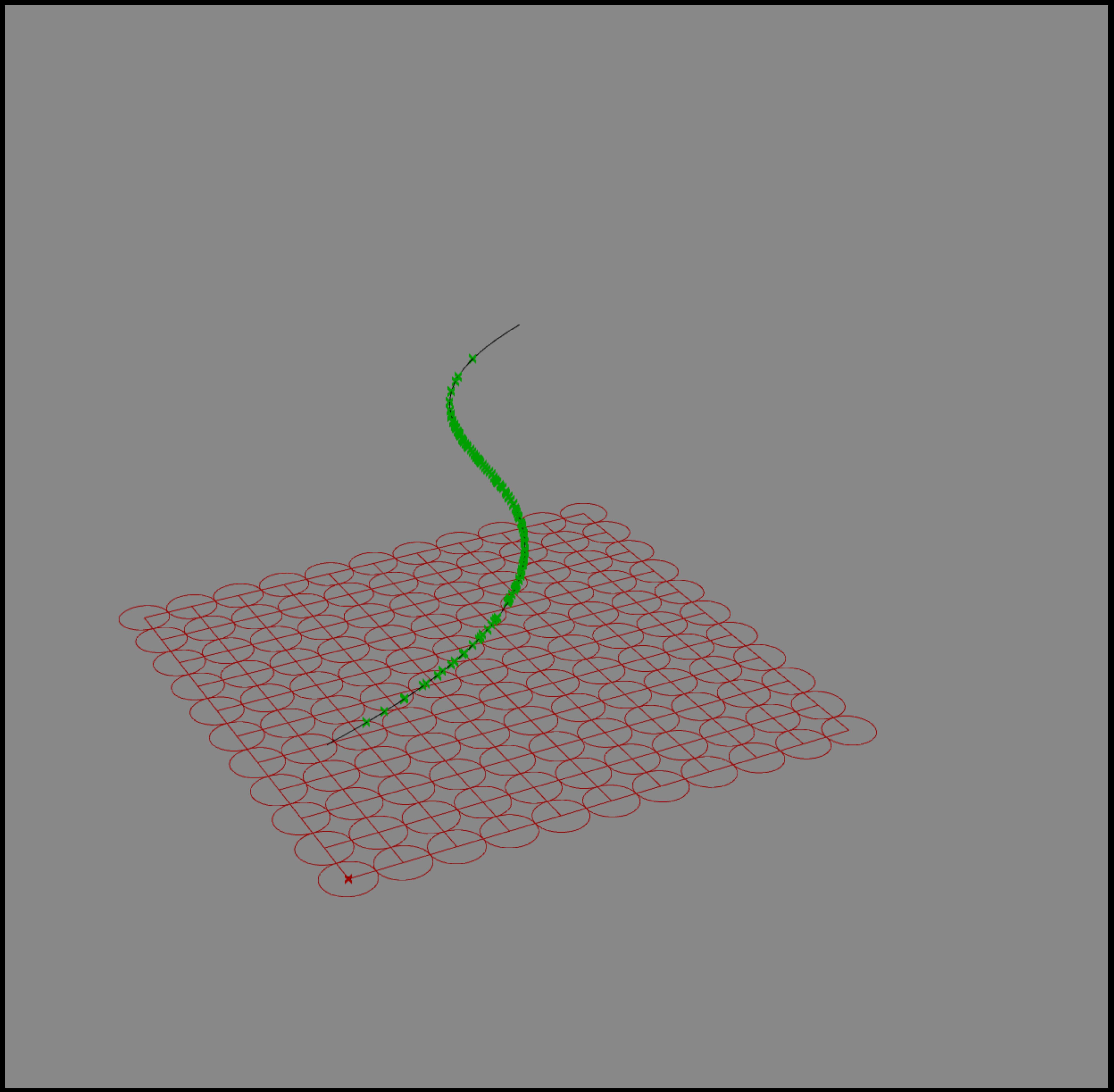


Example

Grids, Attractors & Remapping

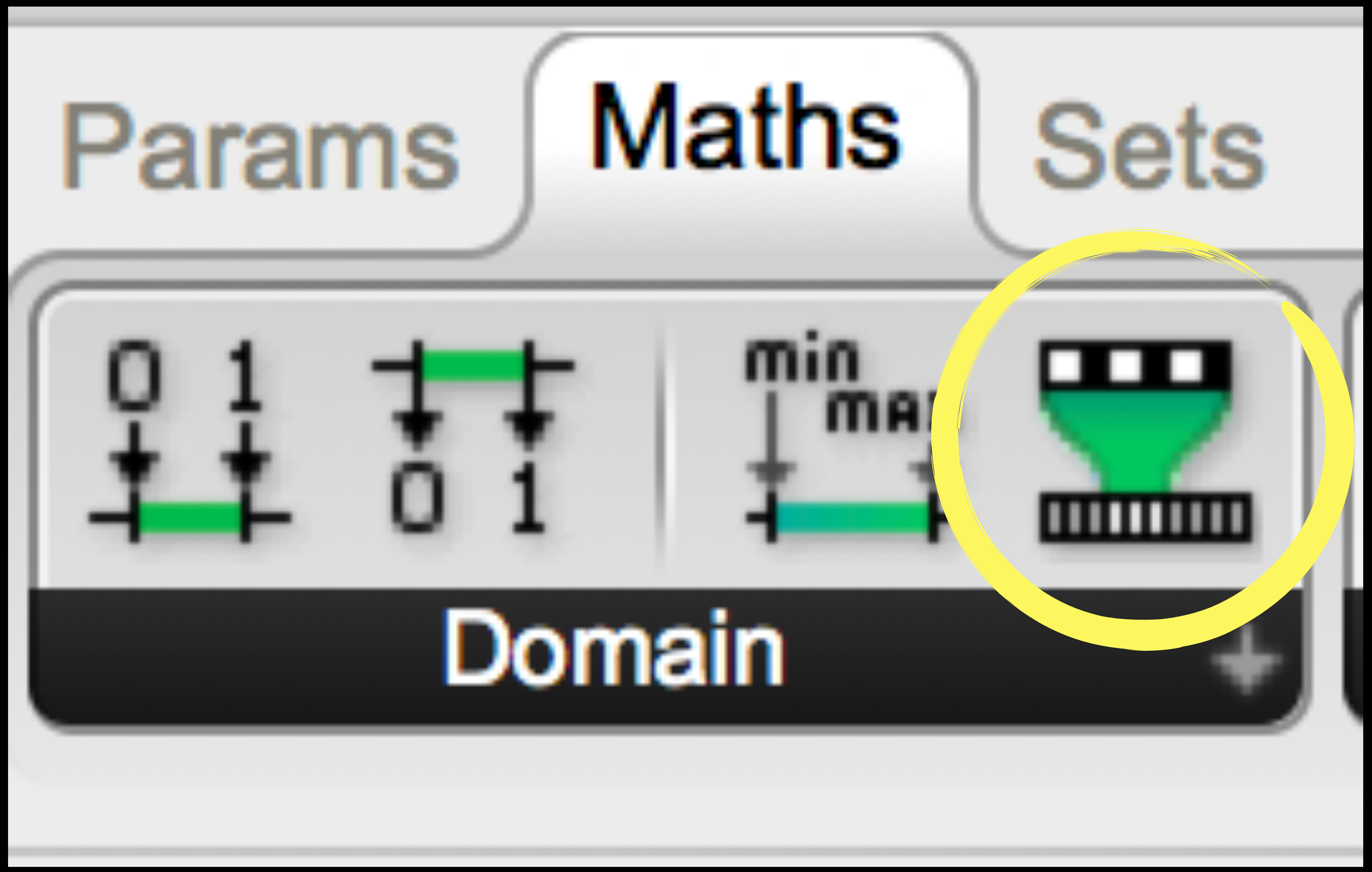


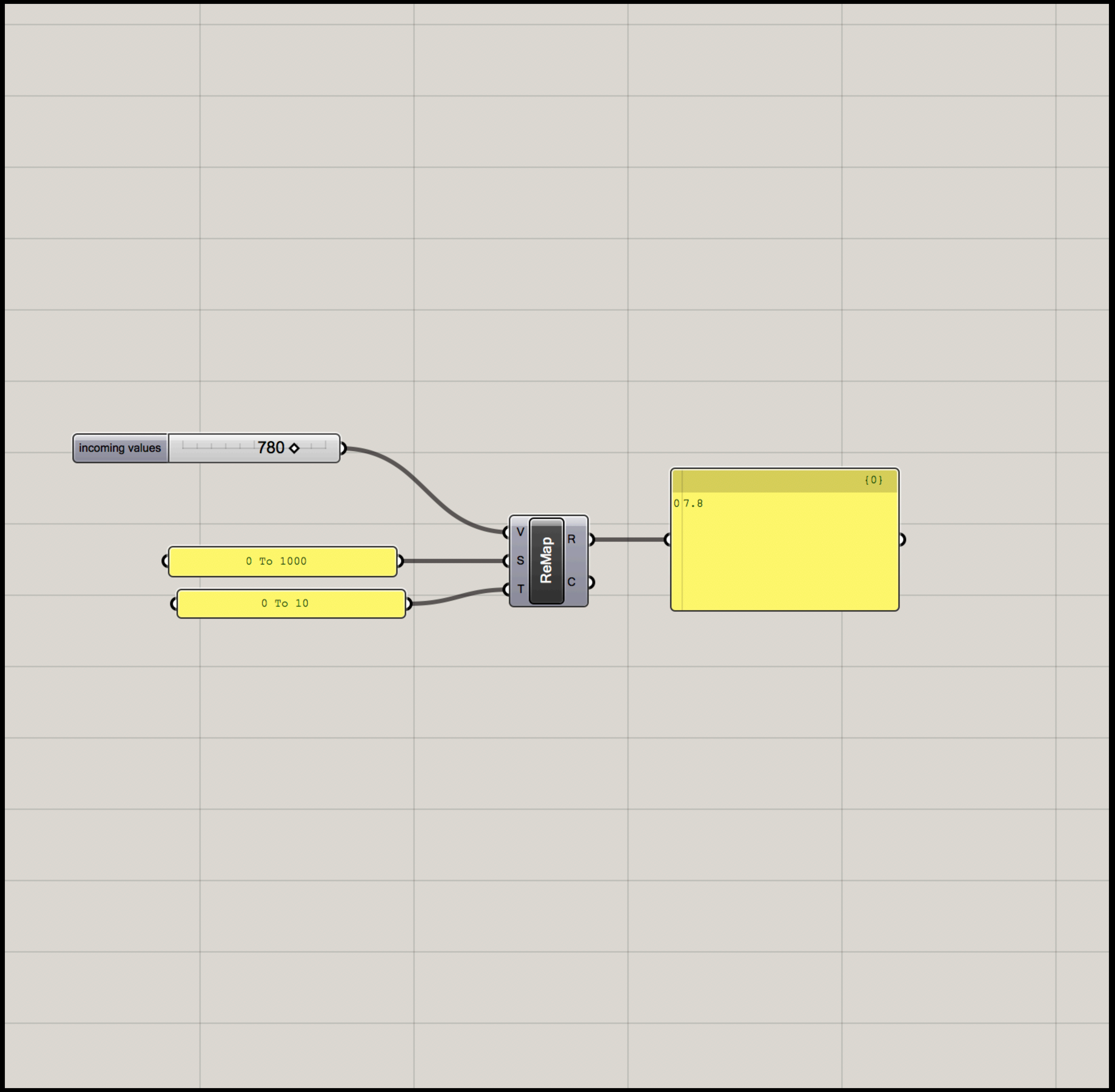
- We want to find out how the distance between each circle and the attractor curve is. We use the Curve Closest Point (**Crv CP**) to achieve that.
- We can then use the resulting Distance (D) to drive the scale and extrusion height of the circles



Example

Grids, Attractors & Remapping

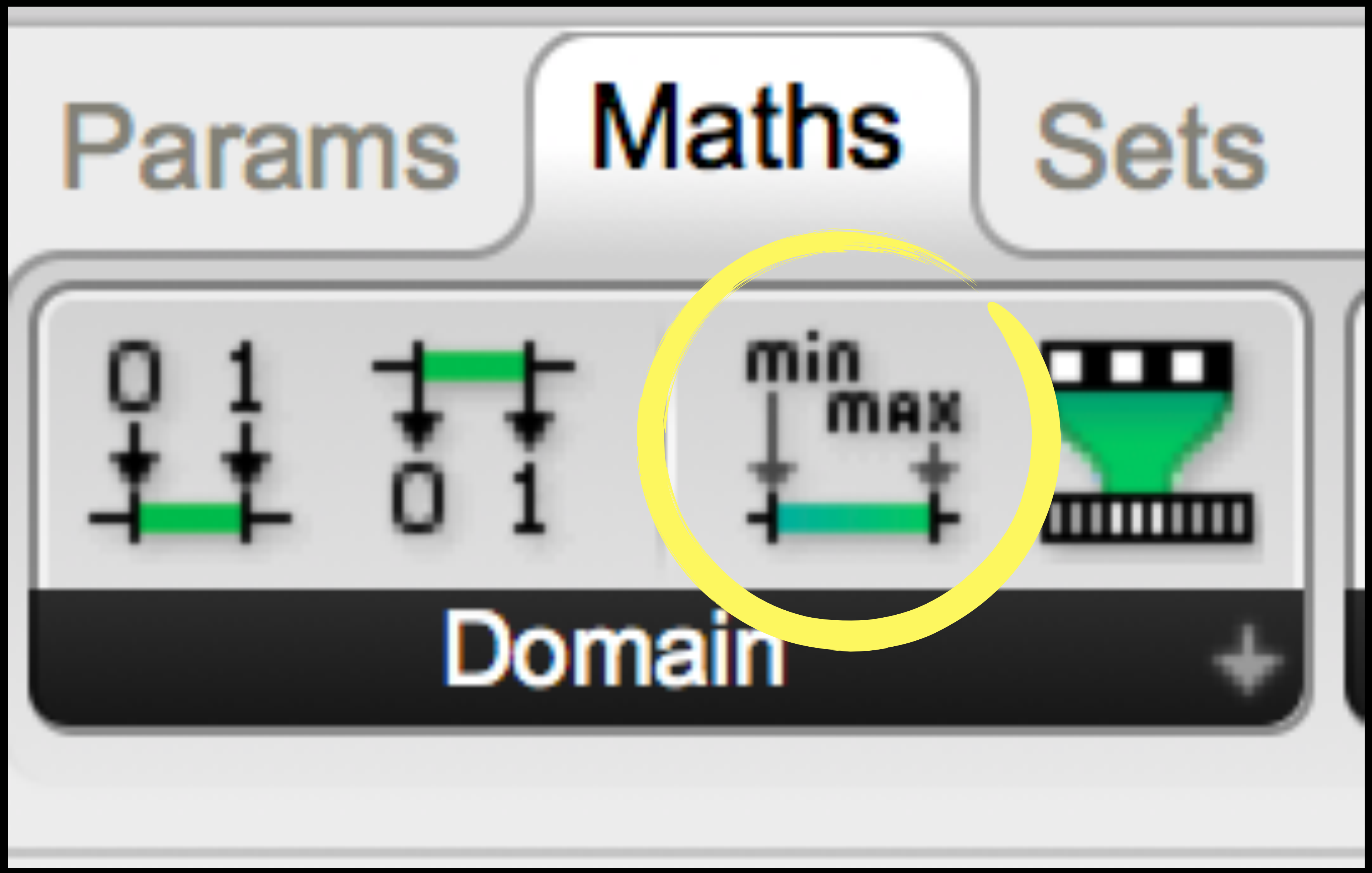


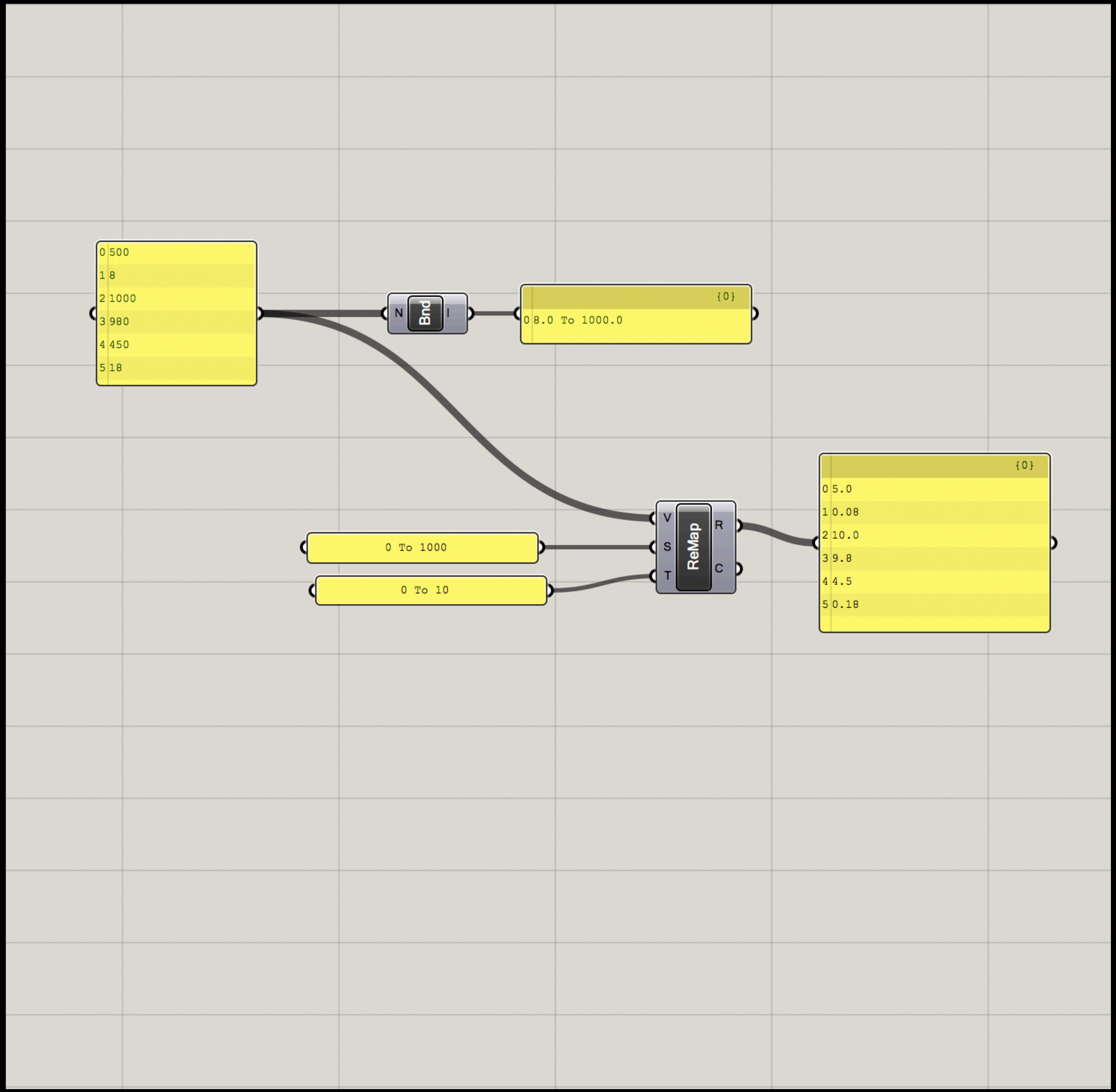


- Remap allows us to take a range of numeric values and remap them to a new range

Example

Grids, Attractors & Remapping

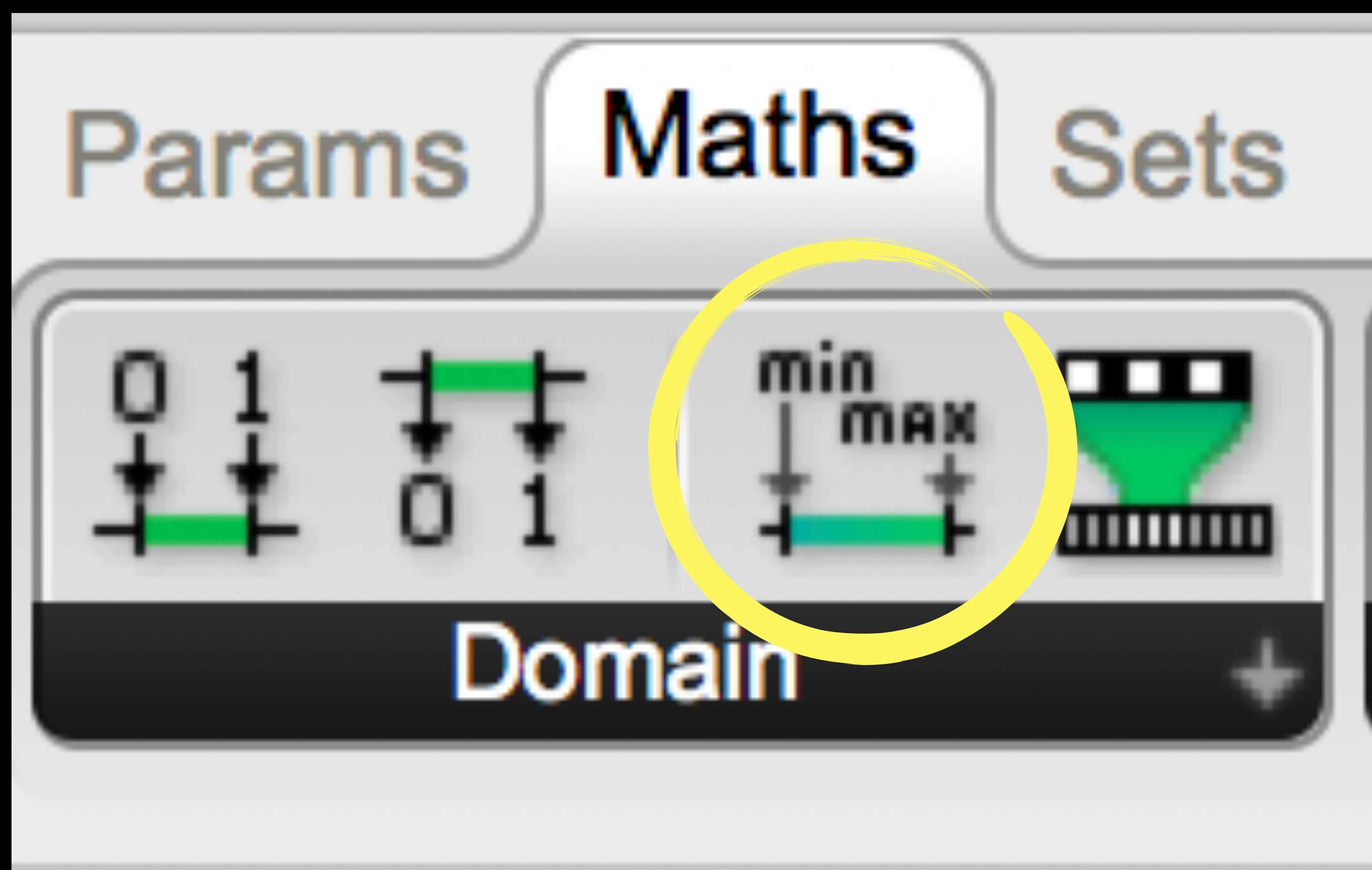


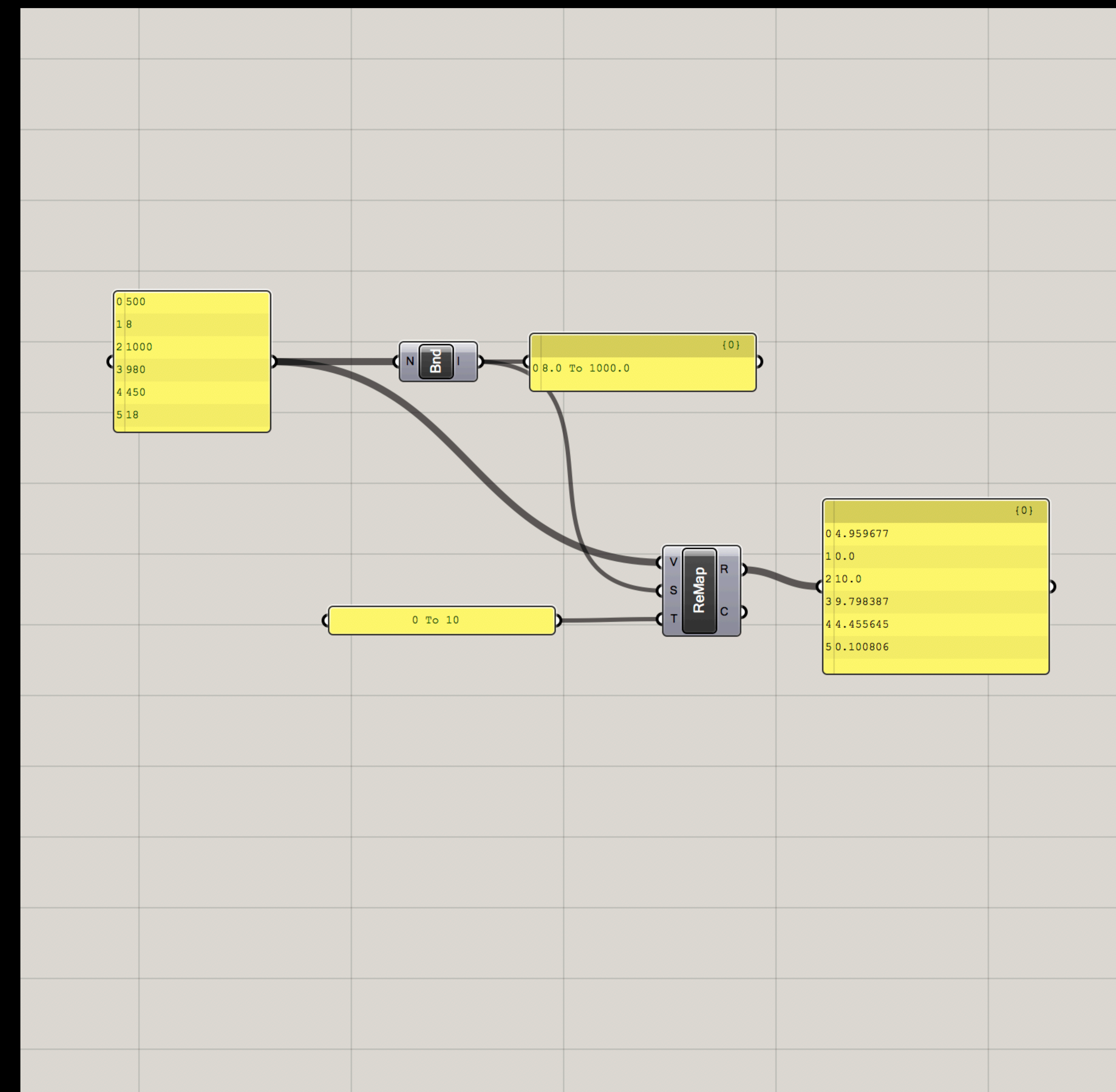


- Bounds allows us to find the minimum and maximum in a list of values

Example

Grids, Attractors & Remapping

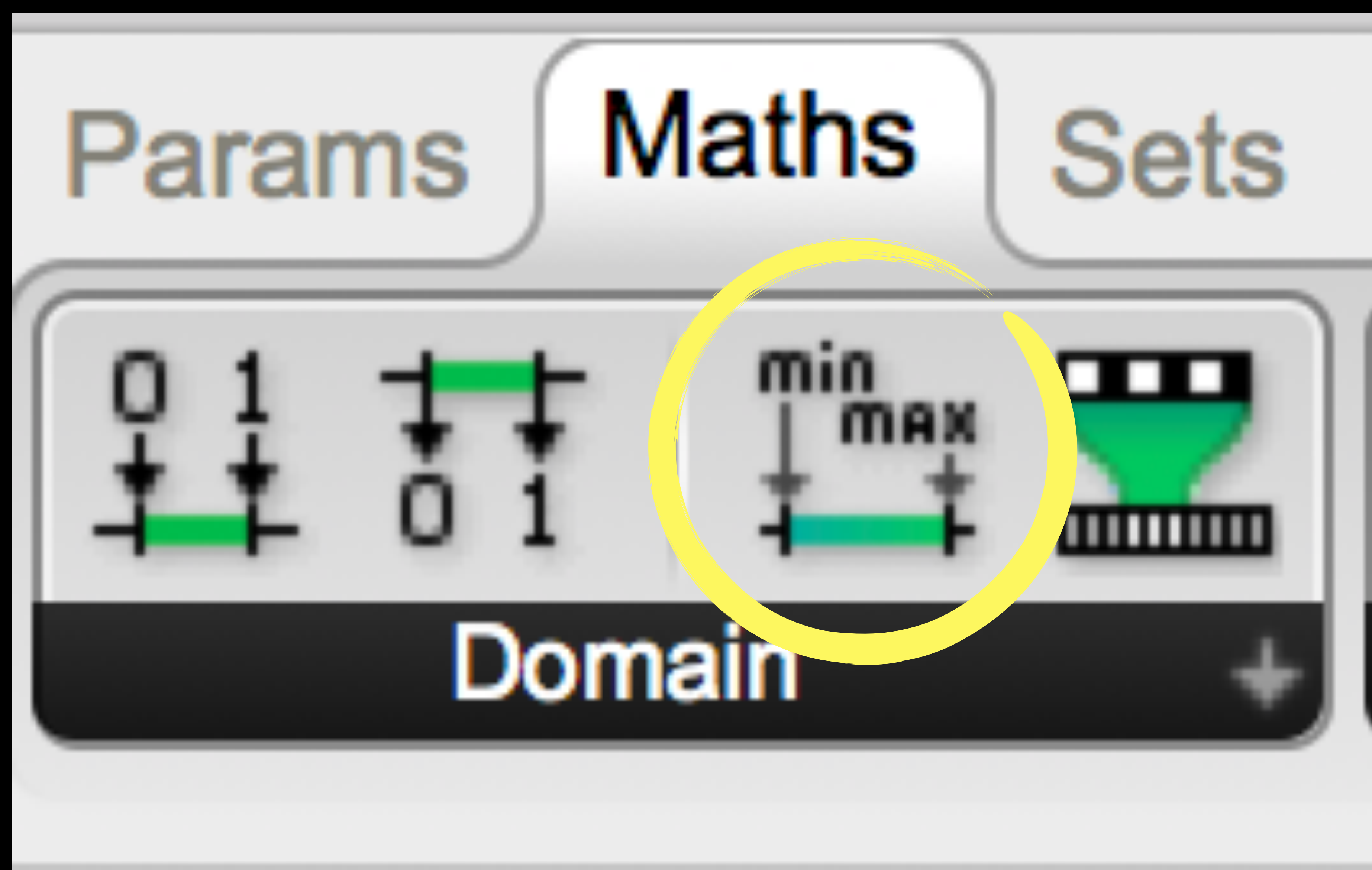




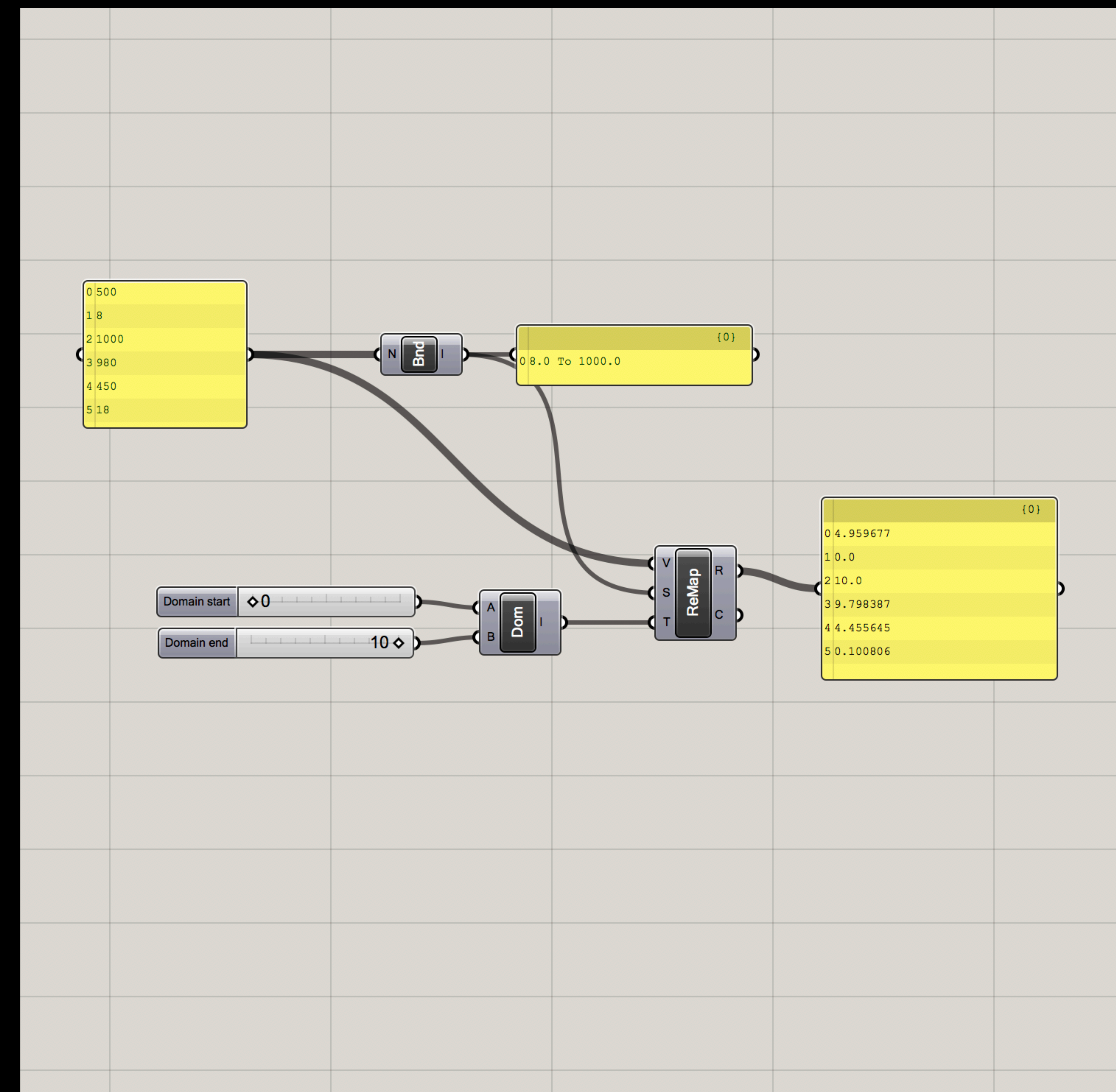
- Bounds allows us to find the minimum and maximum in a list of values. This range can be used to drive the source domain (S) for the remapping function

Example

Grids, Attractors & Remapping

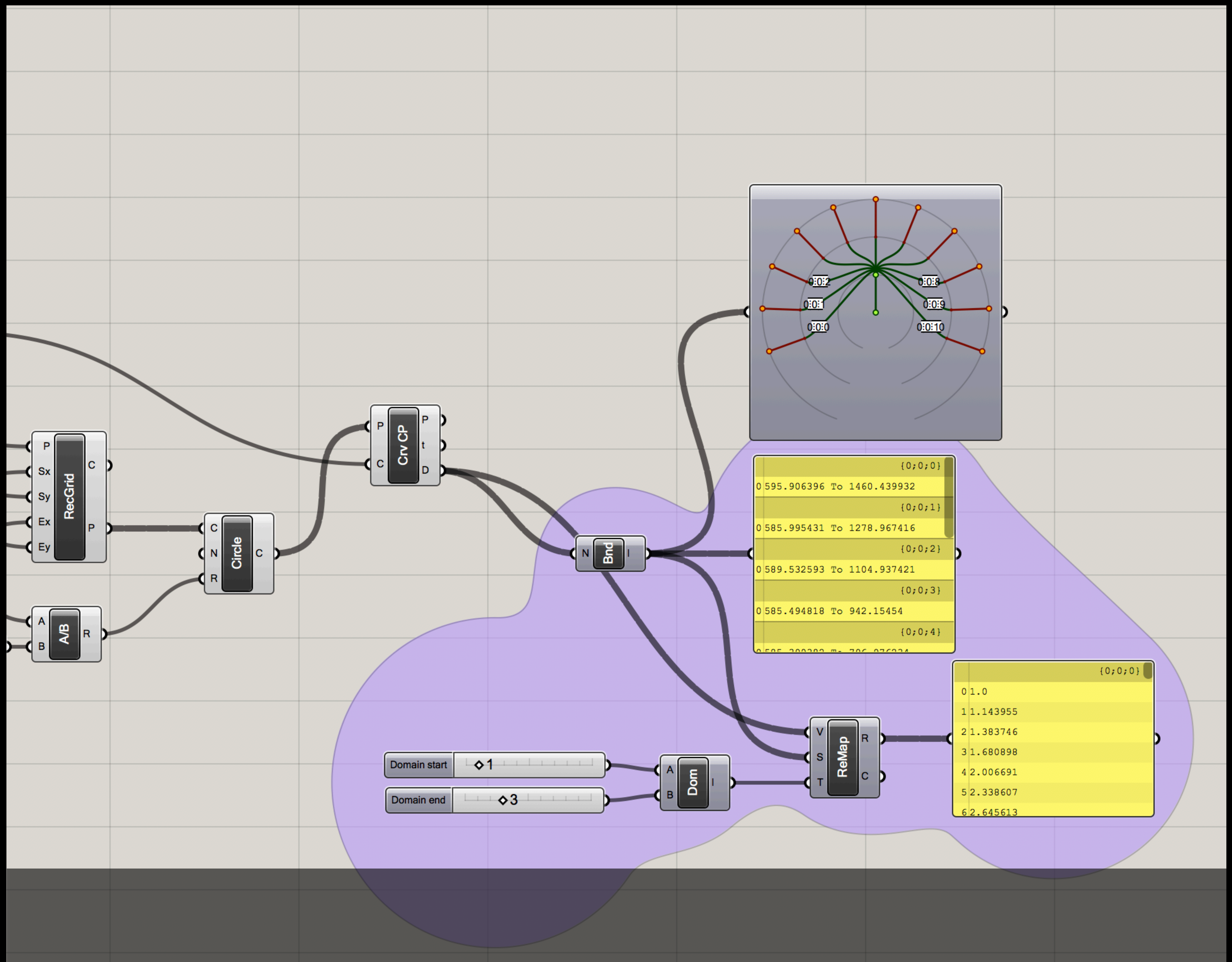


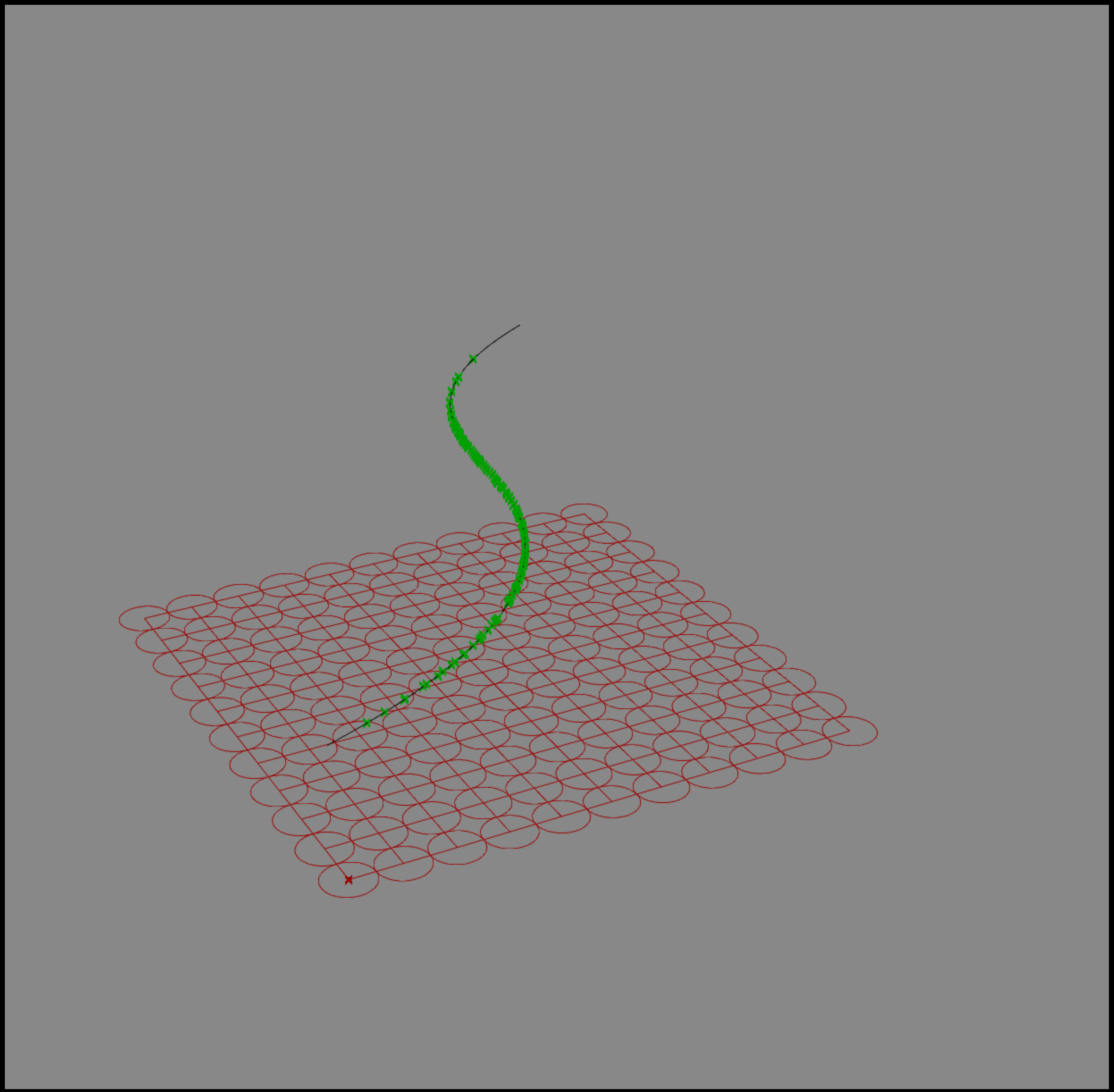
- The target domain can be constructed with number sliders to allow more control



Example

Grids, Attractors & Remapping

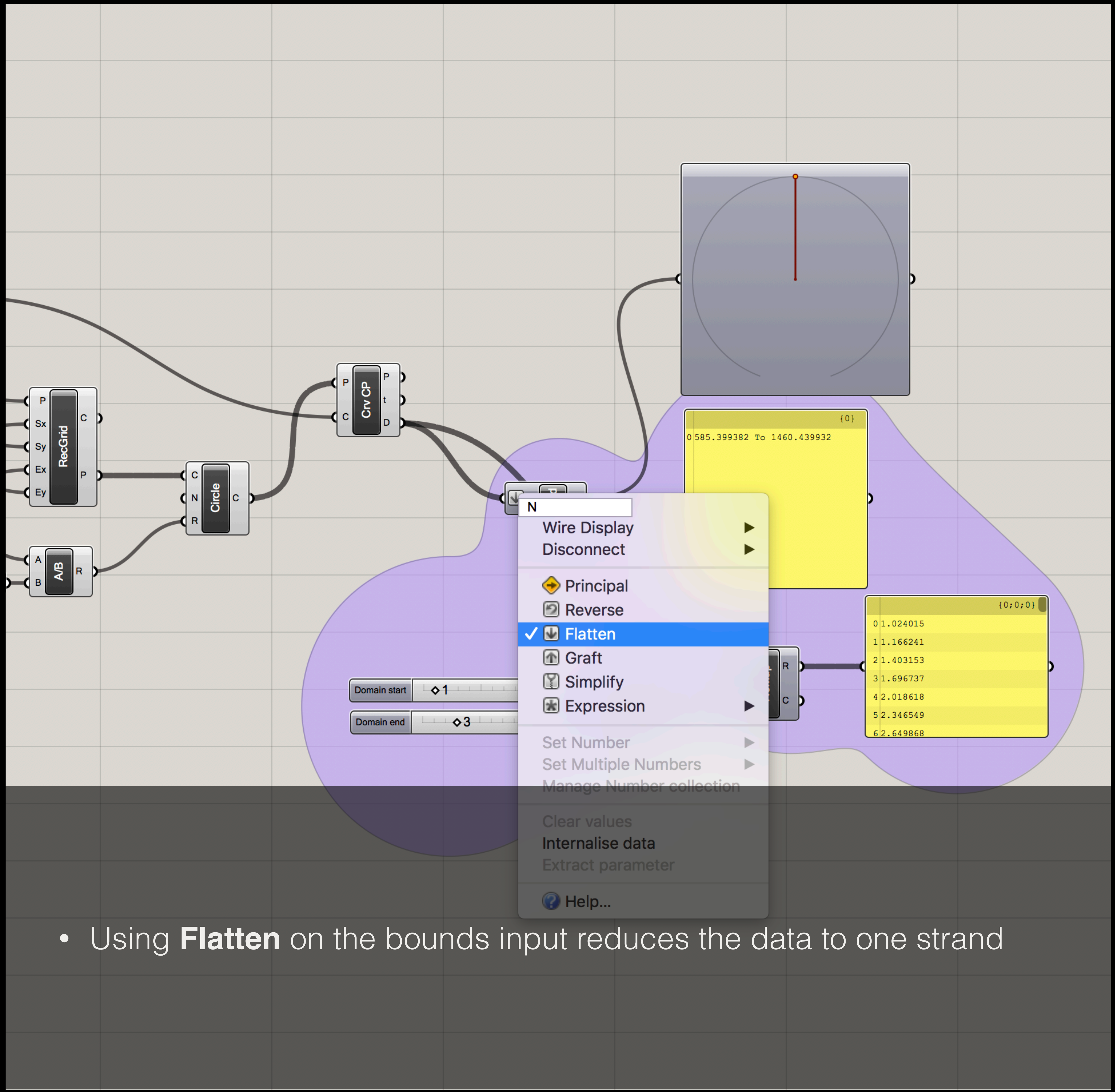


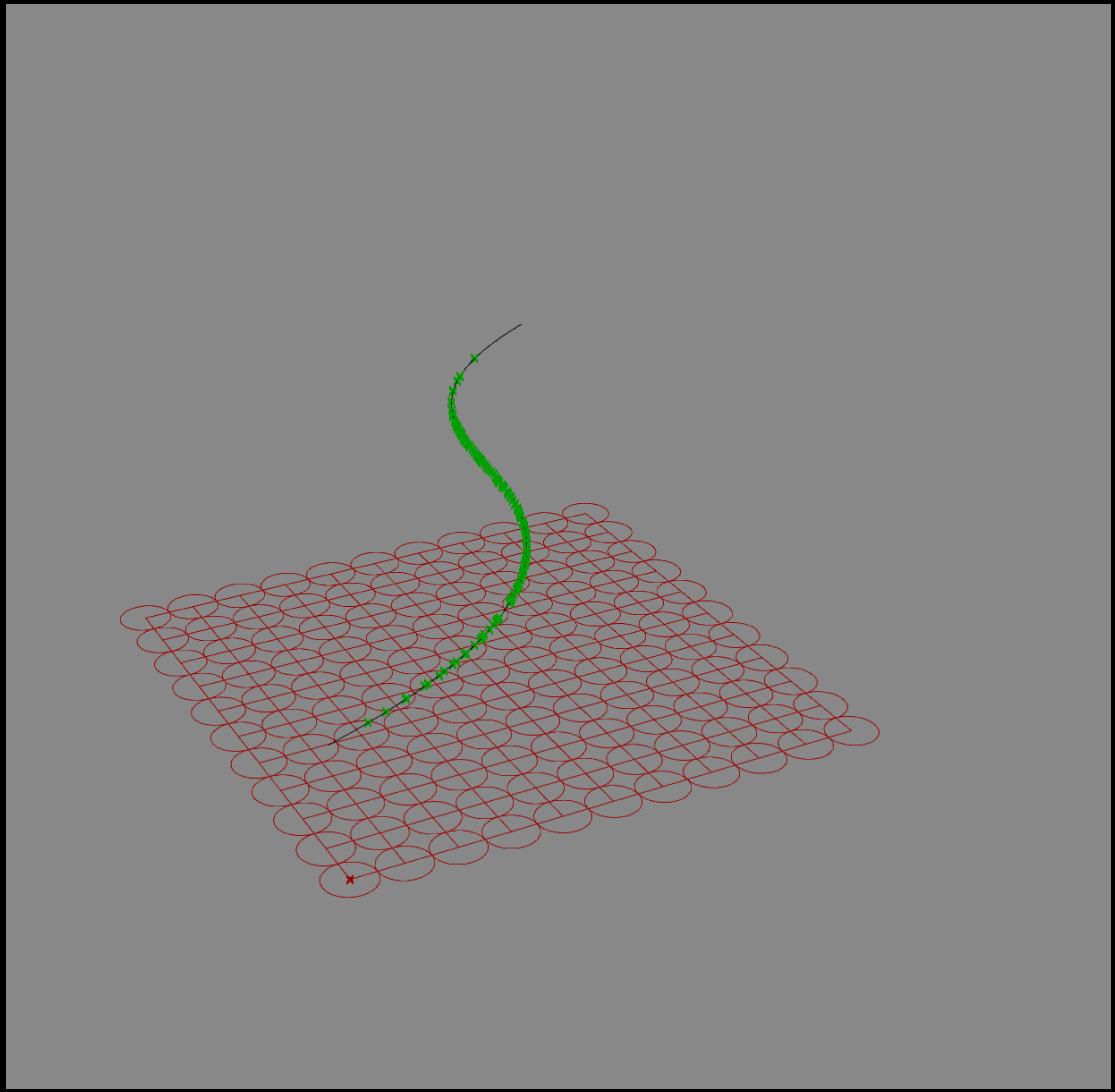


- Remapping does not work right away, as the distance values are „tree structured“

Example

Grids, Attractors & Remapping

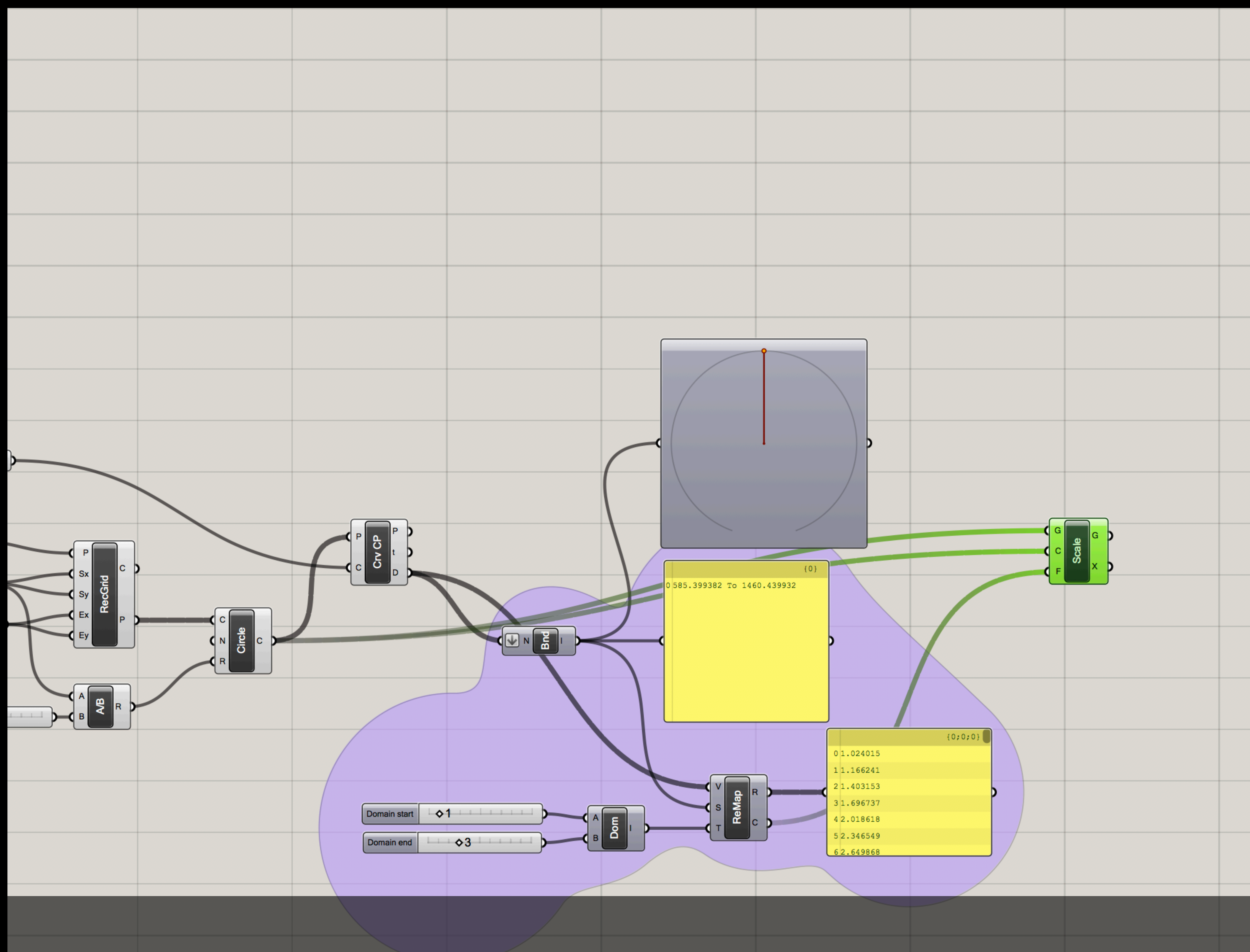


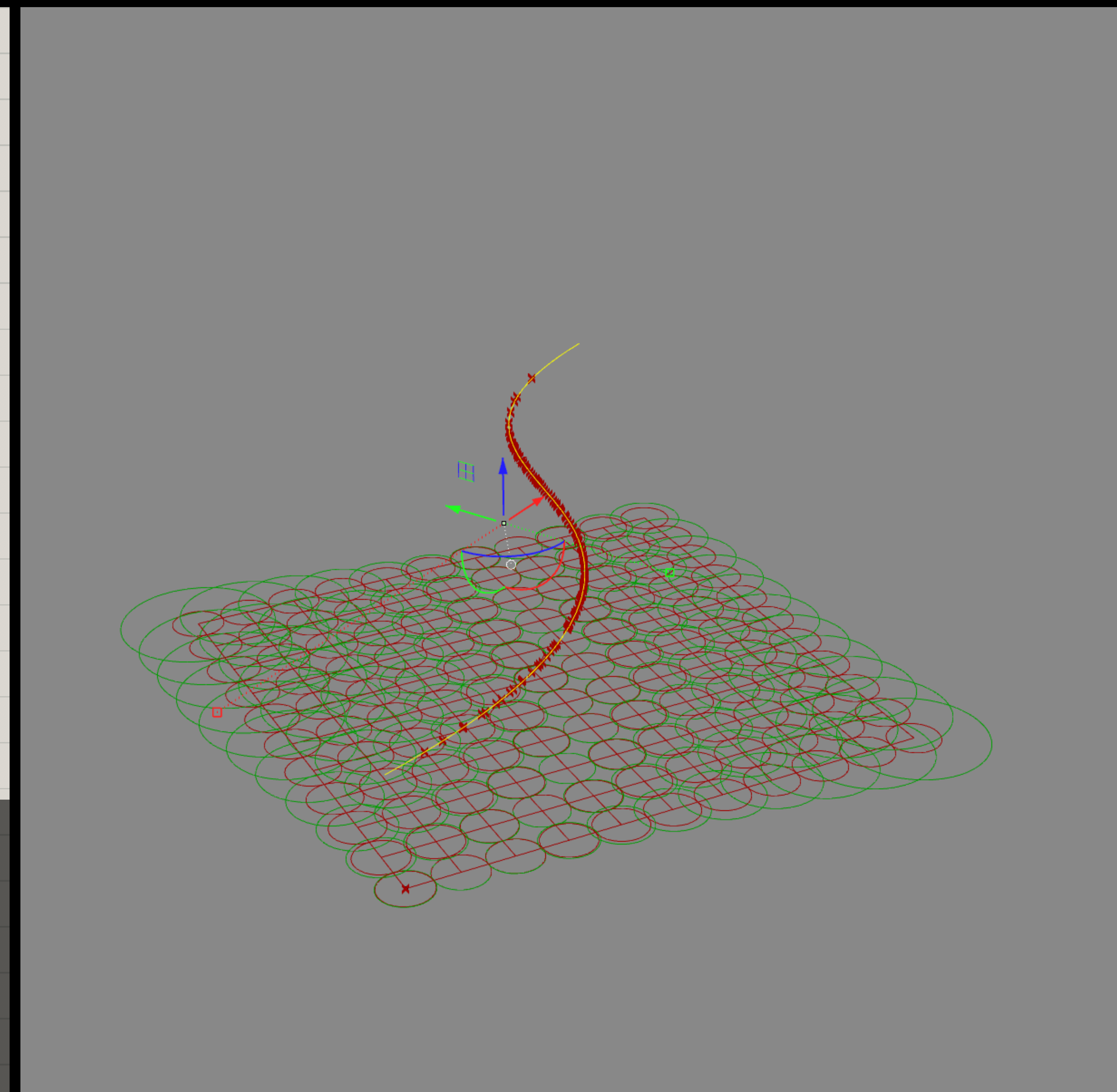


- Using **Flatten** on the bounds input reduces the data to one strand

Example

Grids, Attractors & Remapping

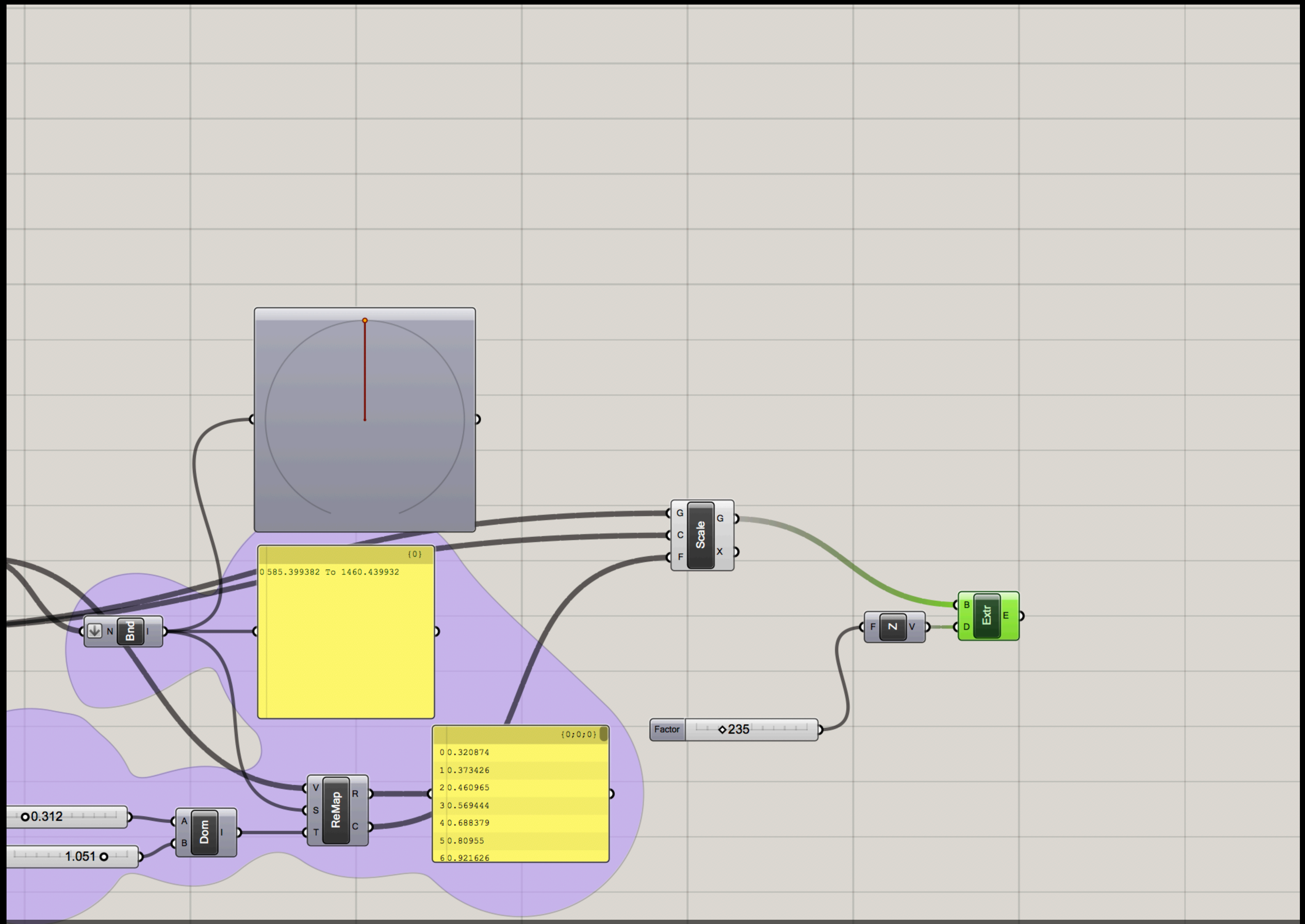


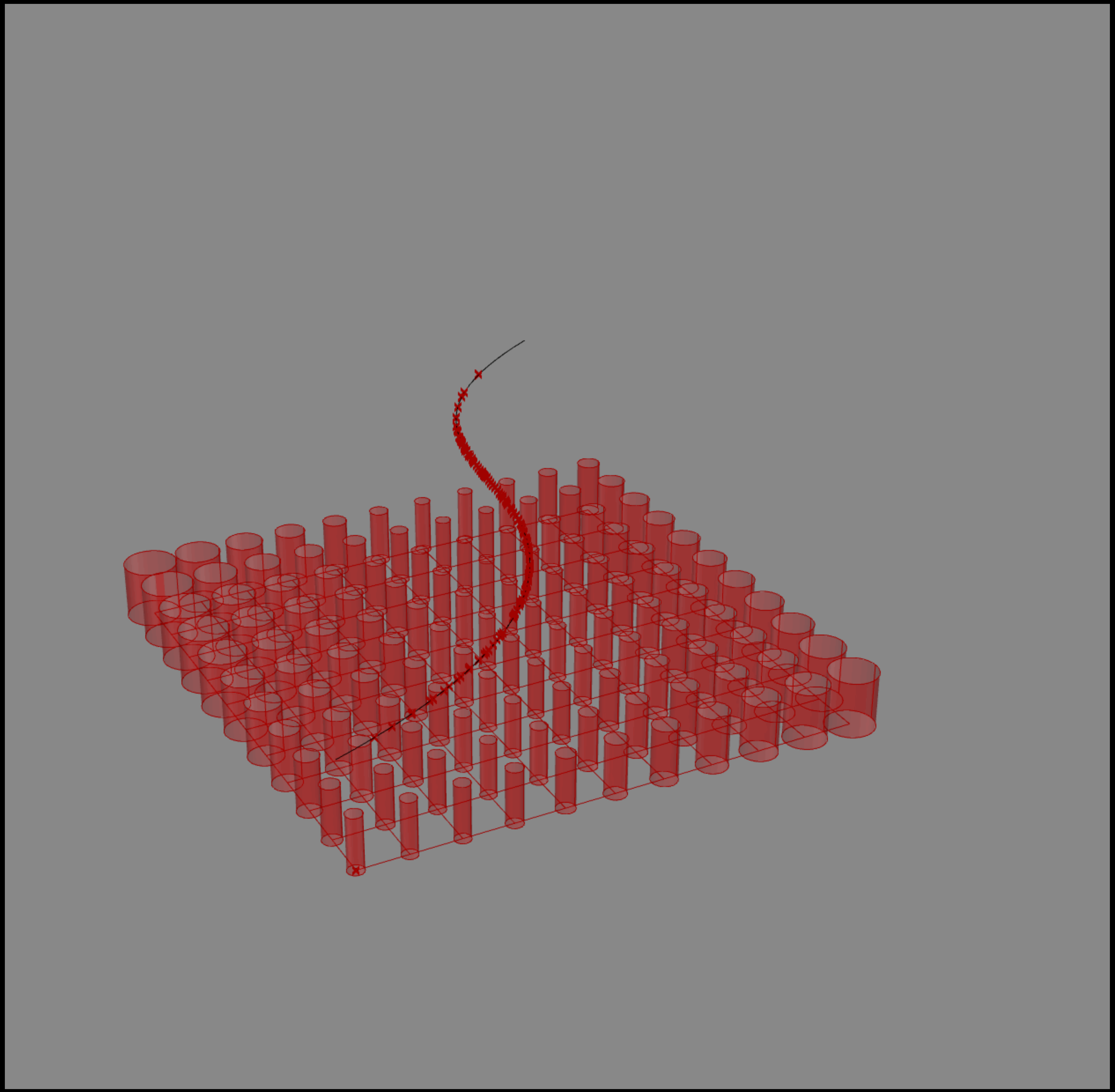


- Using the **scale** function, we can now scale each circle in accordance to its distance to the attractor line. Use the circle as geometry and center input for the scale function. Use the remapped distance values as a scale factor.

Example

Grids, Attractors & Remapping

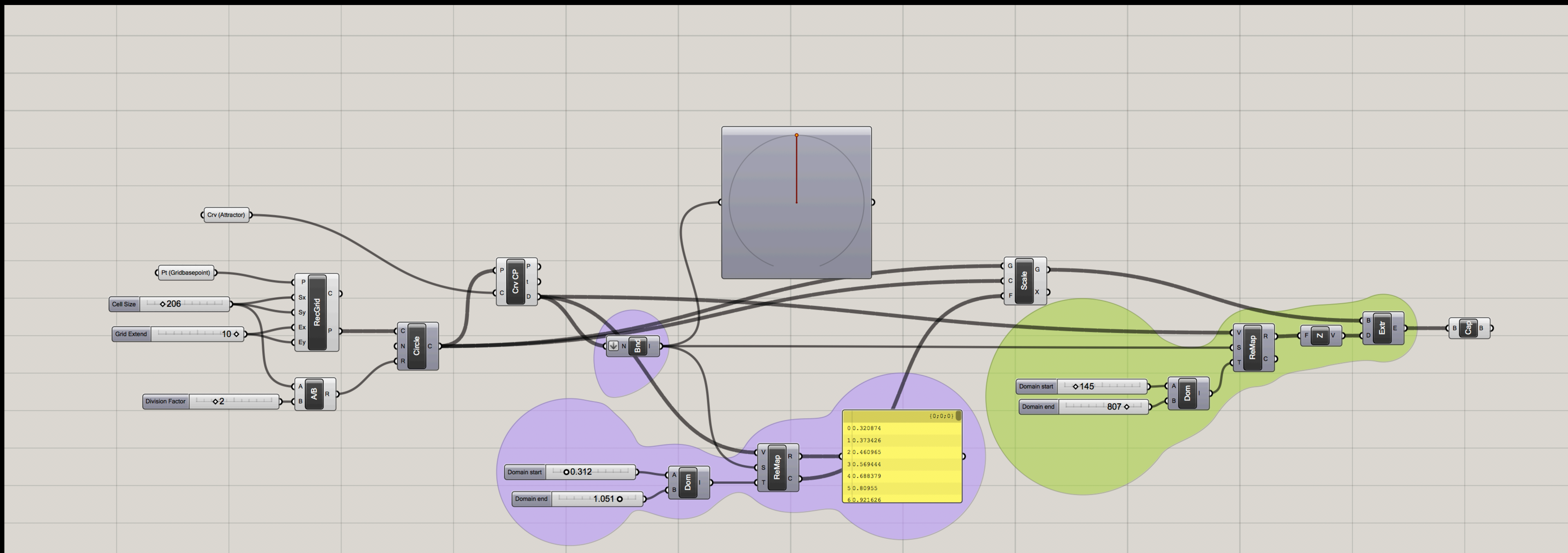




- Adjust the scale domain to achieve a satisfying result
- The scaled circles can now be extruded. You need to define a extrusion direction. To extrude upwards us a **z-vector** and feed that with a value to determine the extrusion height

Example

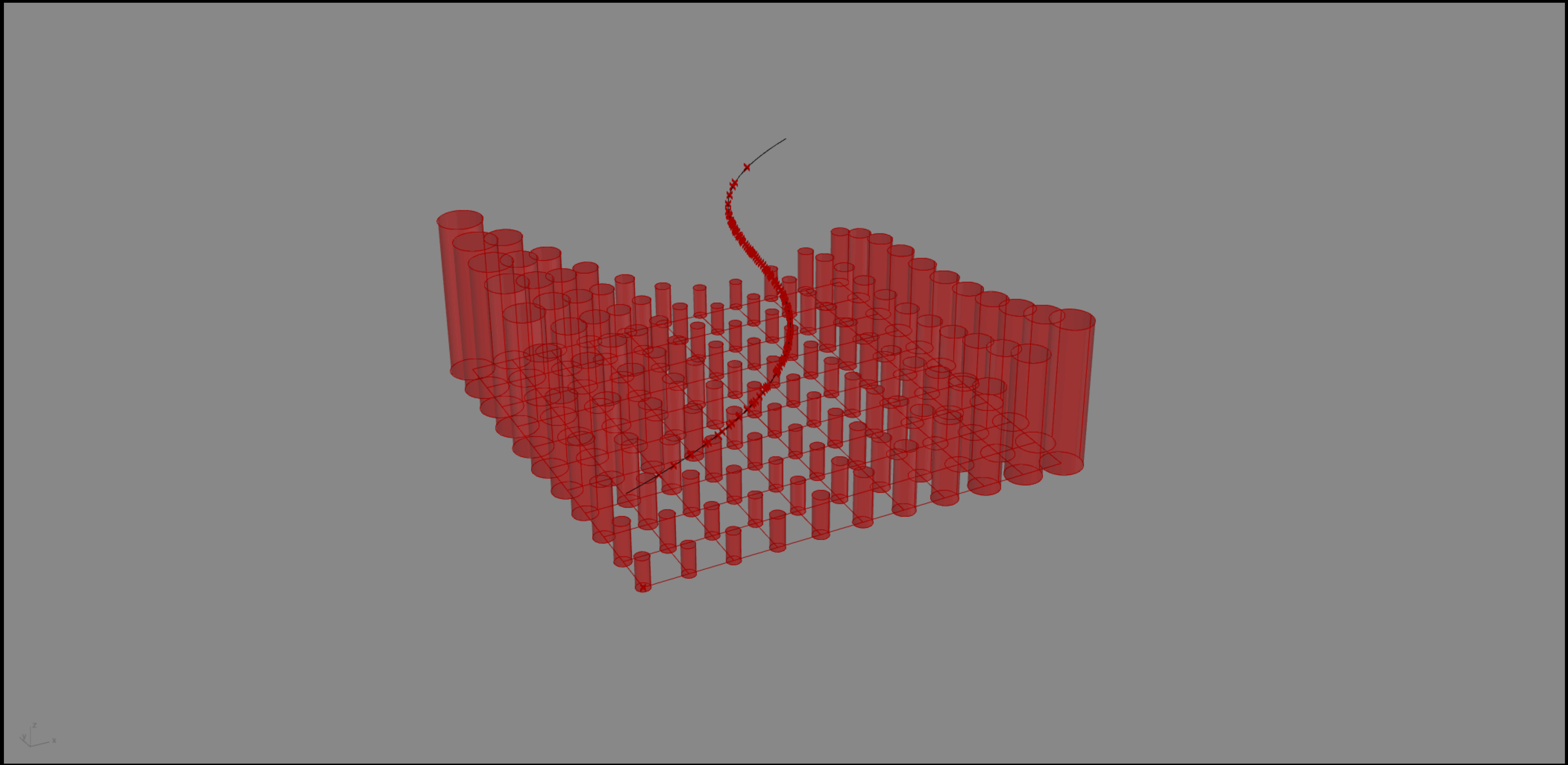
Grids, Attractors & Remapping



- The extrusion height can again be made dependent on the distance from the attractor line

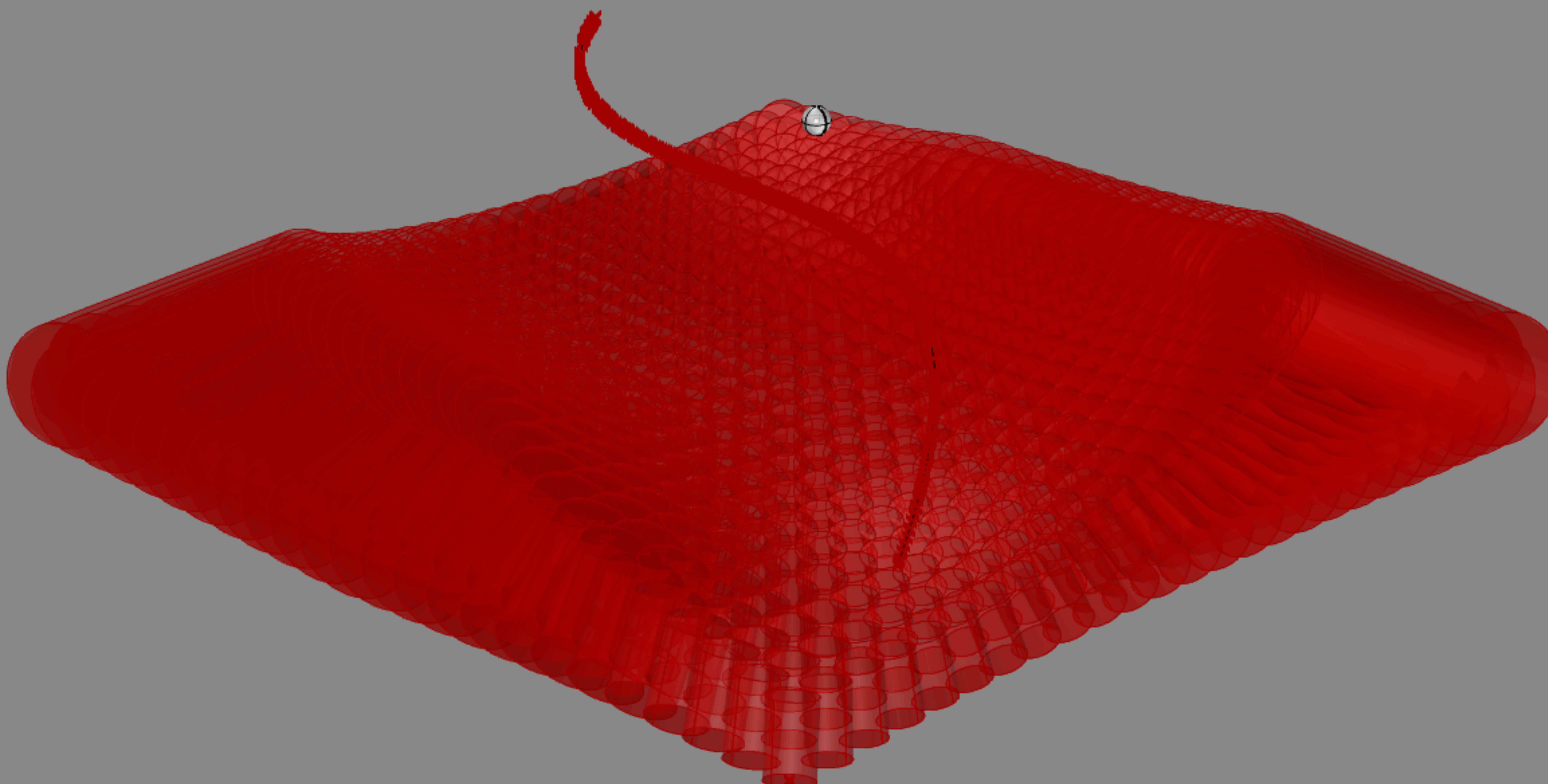
Example

Grids, Attractors & Remapping



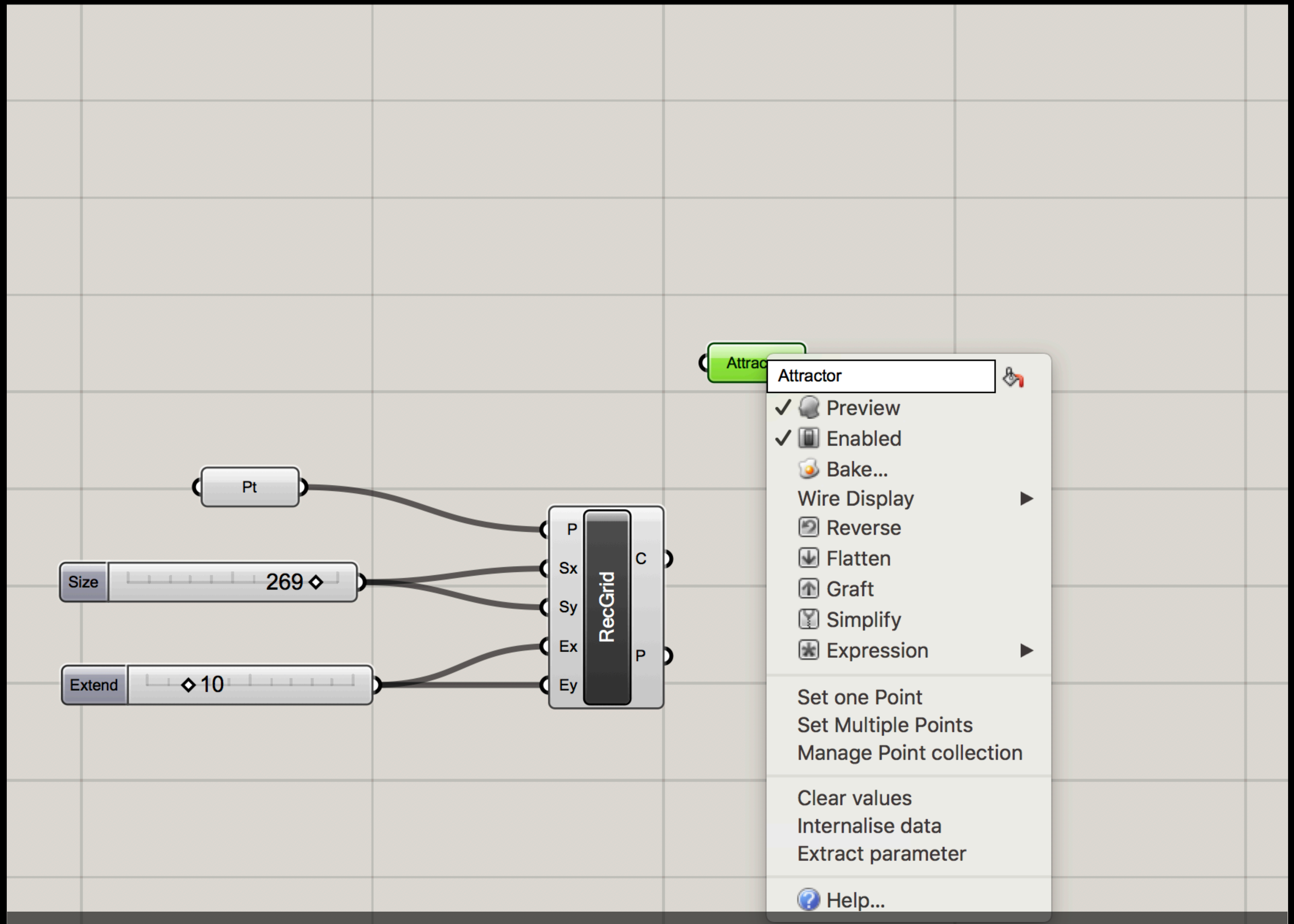
Example

Attractors to influence orientation



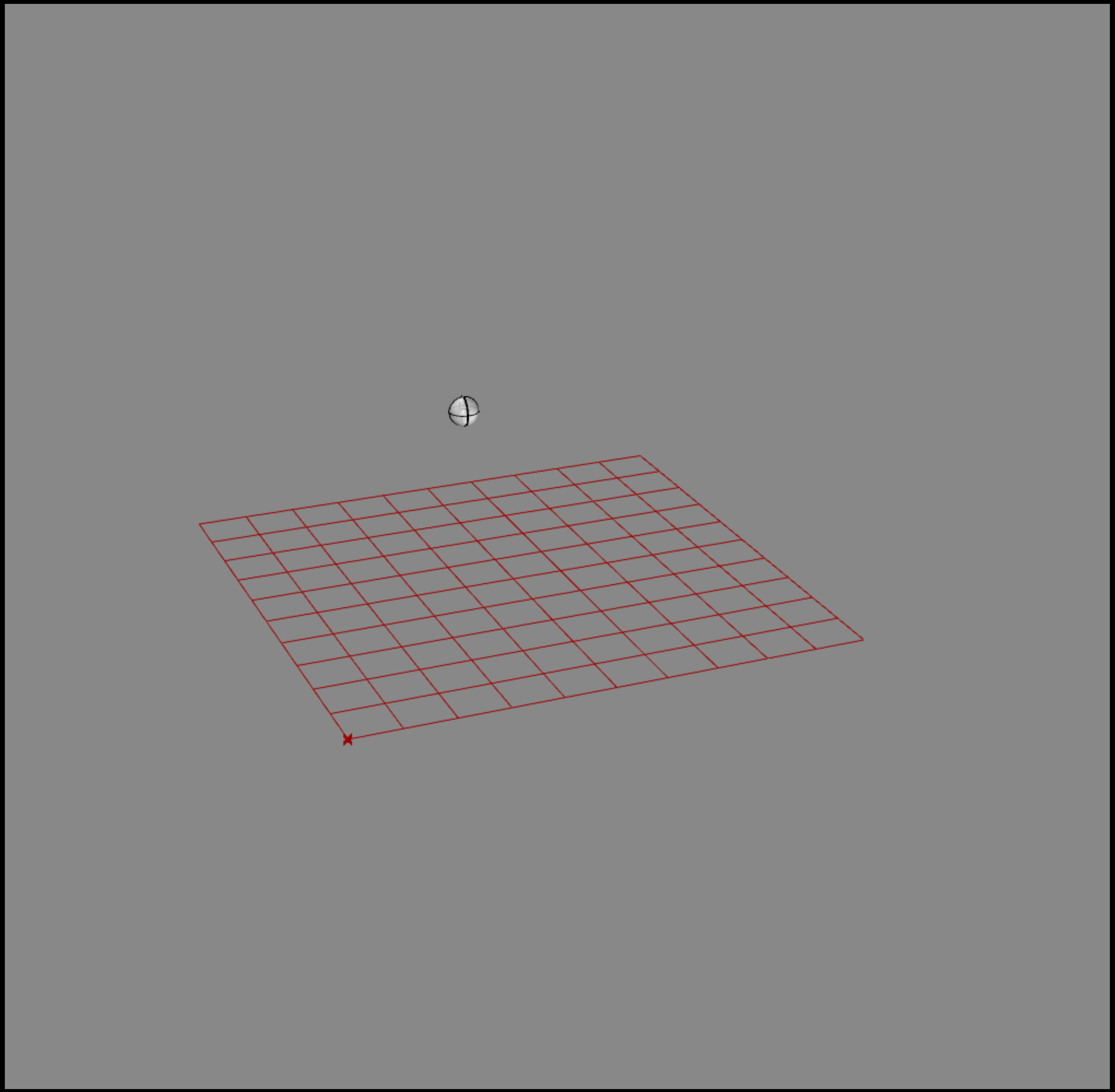
Example

Attractors to influence orientation



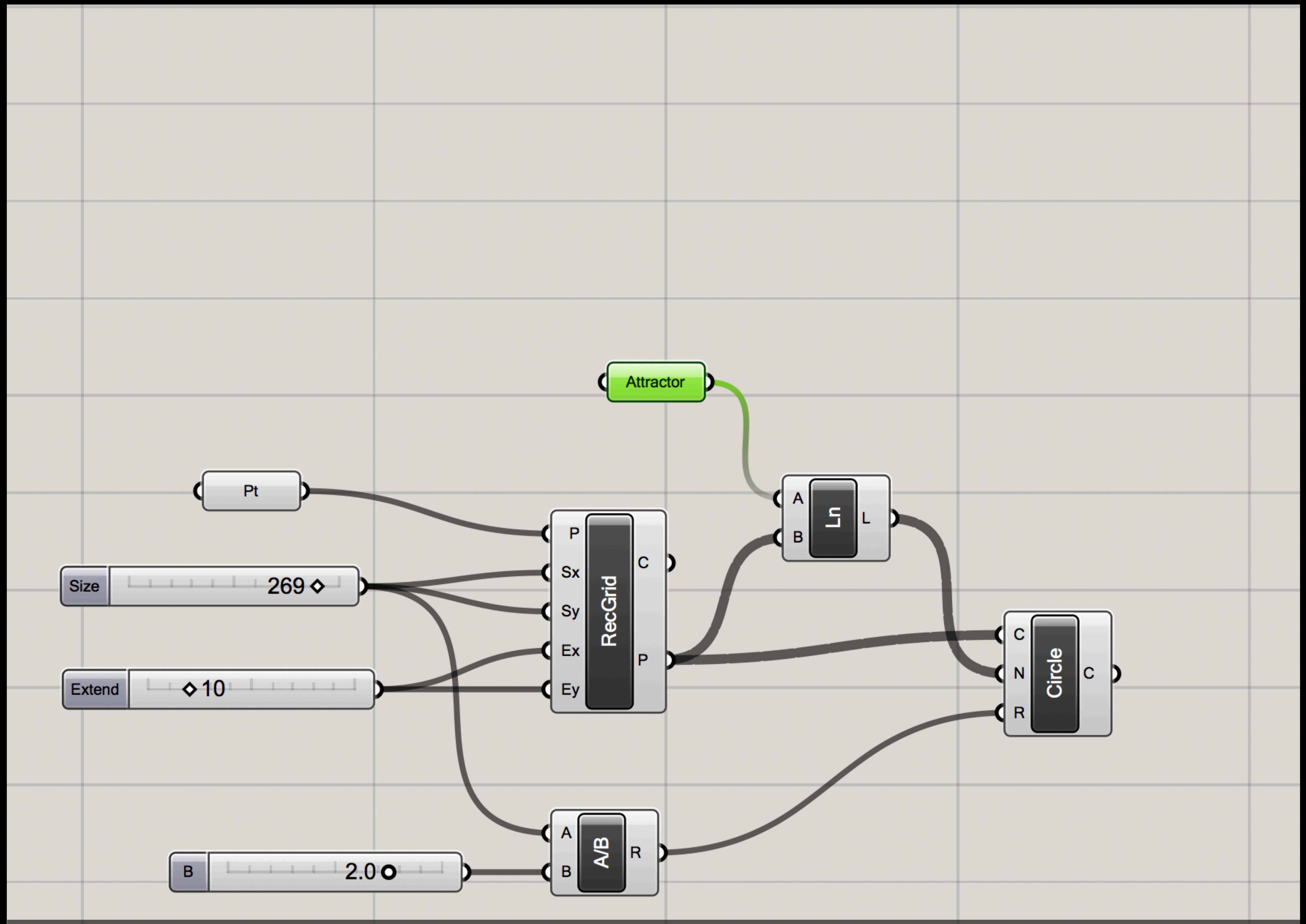
If we'd like to orient all cylinders to a attractor point we can do this with a couple of simple steps.

- Create an attractor (point) in Rhino and connect it to grasshopper.
  In this example I grouped the point with a sphere so it is easier to find and move around

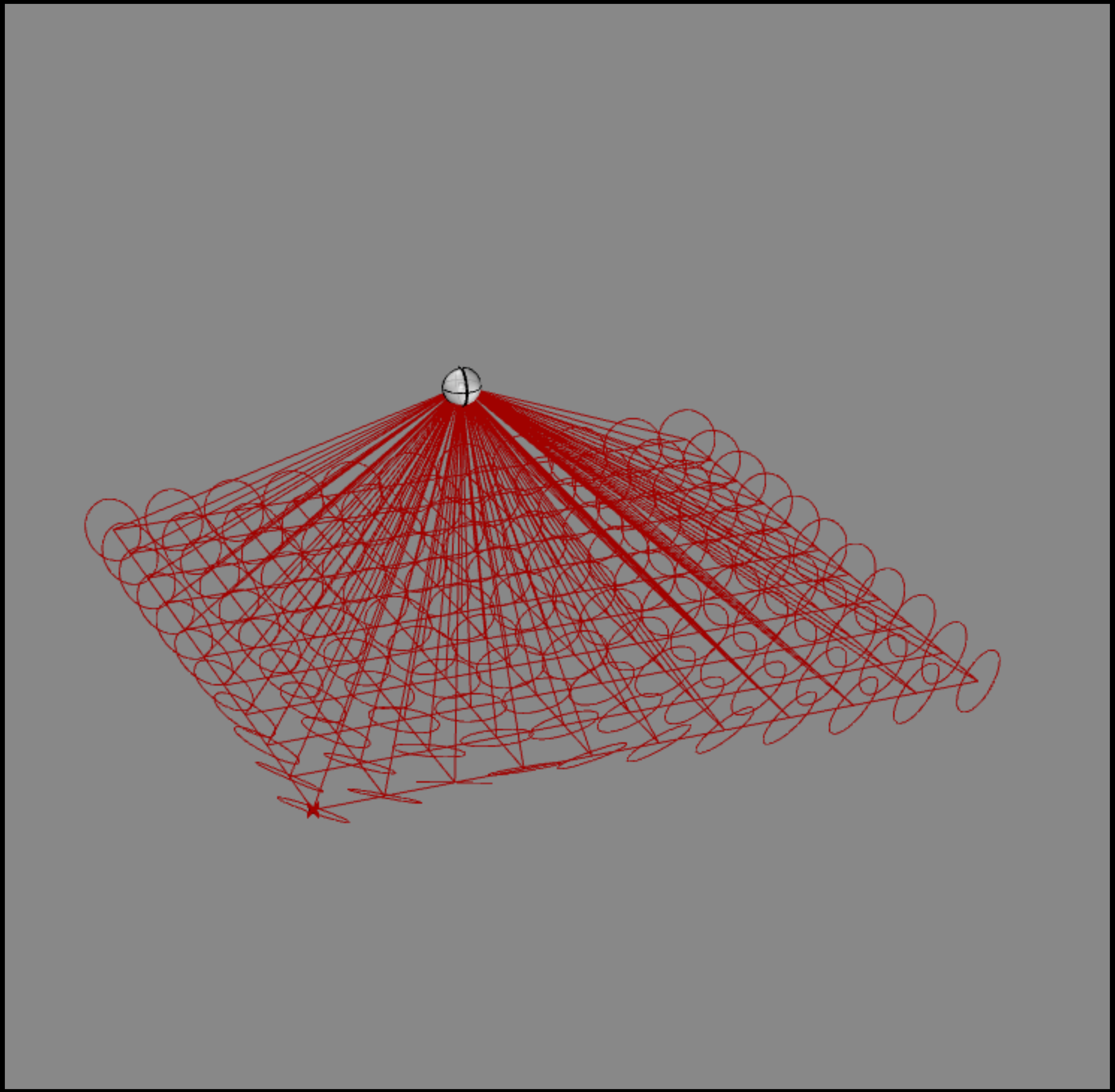


Example

Attractors to influence orientation

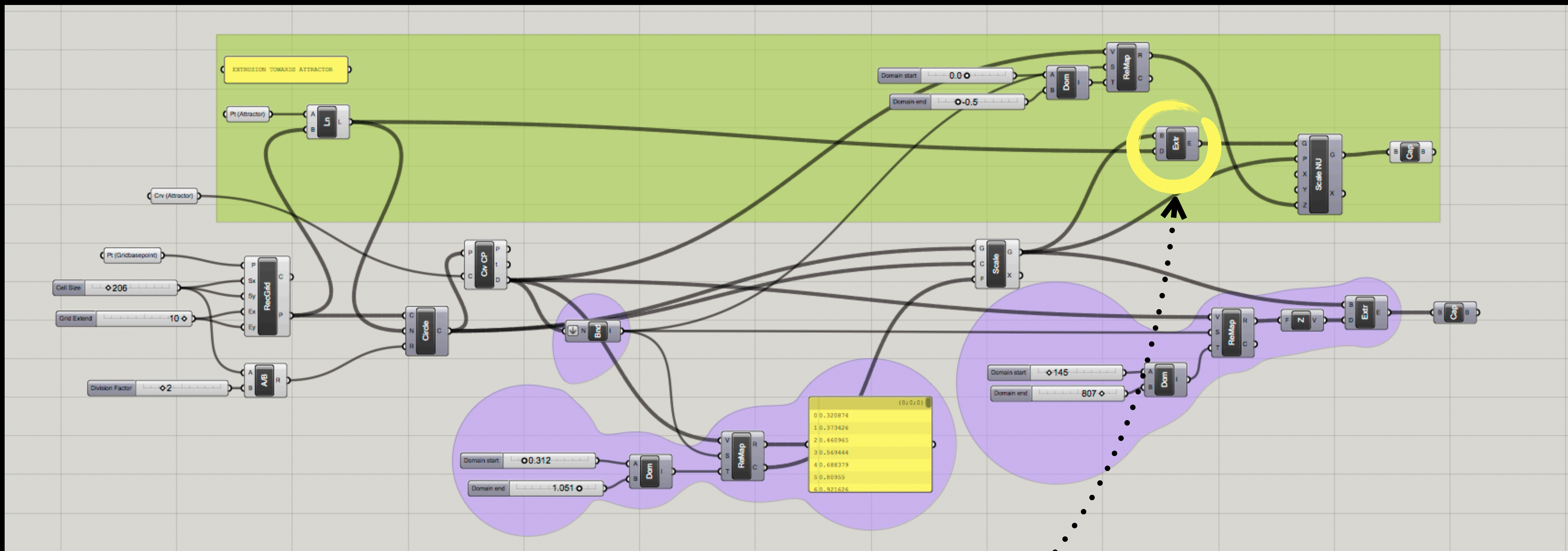


- Create circles (circle CNR) on the gridpoints
- Create lines from grid points to attractor
- Use the line as normal line for the Circles CNR
- Use a part (division) of the cell size (extend) to determine the size of the circle



Example

Attractors to influence orientation

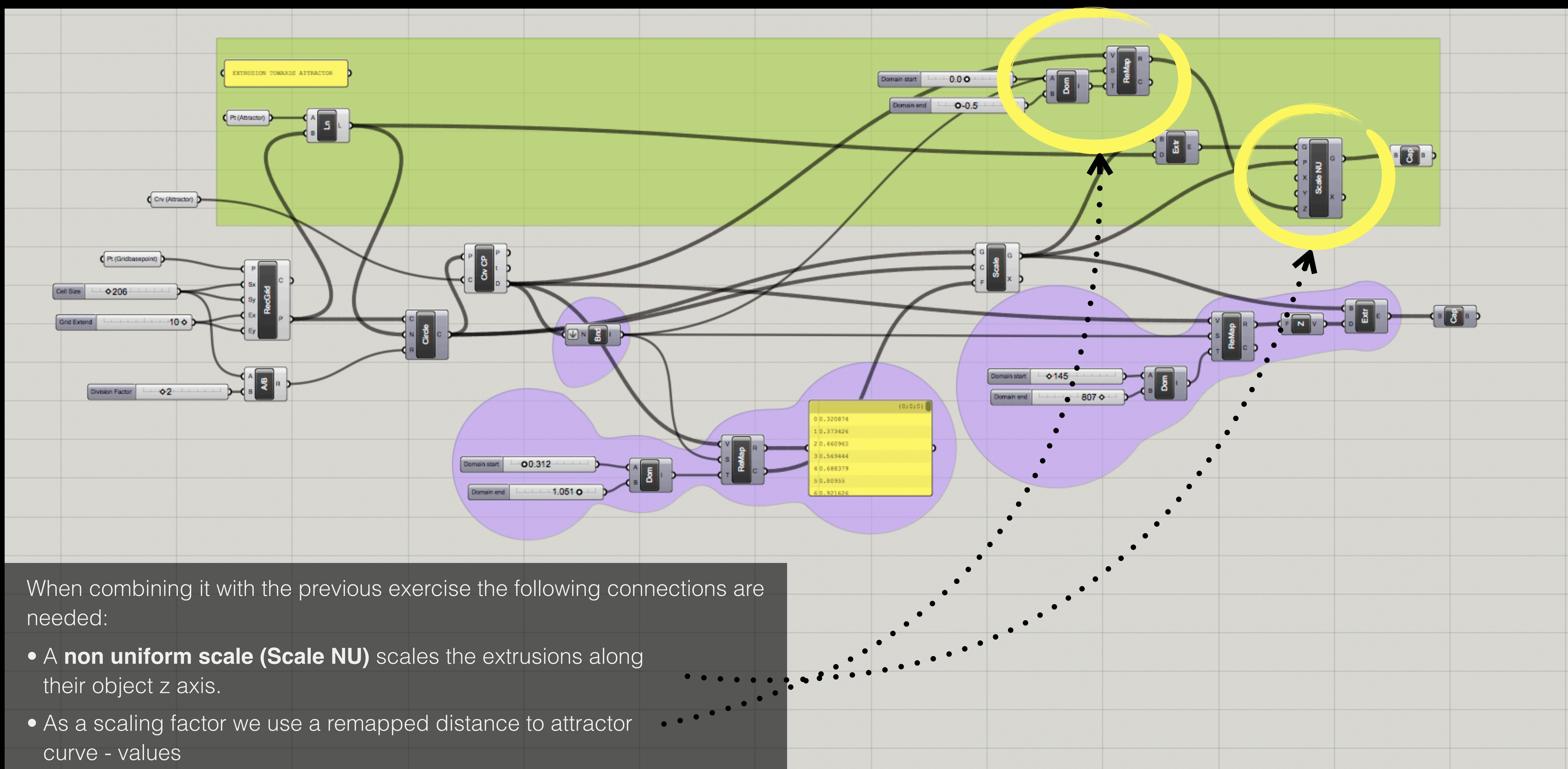


When combining it with the previous exercise the following connections are needed:

- The line from grid to attractor point drives the extrusion direction.

Example

Attractors to influence orientation



When combining it with the previous exercise the following connections are needed:

- A **non uniform scale (Scale NU)** scales the extrusions along their object z axis.
- As a scaling factor we use a remapped distance to attractor curve - values

Ressources

- **Digitaltoolbox.info**
- **Rhino 5 Level 1 Training Guide and Models**
- **Download Rhino 5 WIP**

Thank you!

Kontakt

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