Det Teknisk-Naturvidenskabelige Fakultet Første Studieår
AALBORG UNIVERSITET
Arkitektur Og Design

MATEMATIK OG FORM

27 April 2012 - Lecture 4 (in English)
Vector operations in Grasshopper

Group 1	8:15-9:15	Lecture at Auditorium 3
		Lecturer: Dario Parigi
	9:15-11:00	Task Check at group room
		Teachers: Martin Raussen, Poul Henning Kirkegaard, Dario Parigi
Group 2	9:15-10:15	Lecture at Auditorium 3
		Lecturer: Dario Parigi
	10:15-12:15	Task Check at group room
		Teachers: Martin Raussen, Poul Henning Kirkegaard, Dario Parigi

Before the lecture
-All students should come to the lecture with your laptop with Rhinoceros and Grasshopper installed.
Rhino 4.0 SR9 Evaluation Download: http://download.rhino3d.com/rhino/4.0/evaluation/download/
Grasshopper (requires at least Rhino4 SR8): http://www.grasshopper3d.com/page/download-1
- Al students should read the "Grasshopper Learning Material" document

Aims and contents:
The lecture goal is to perform the basic vector operations with Grasshopper, and to create an architectural component using vector data taking advantage of the potential of the parametric modelling environment.

Lecture schedule
-Getting started and introduction to Grasshopper
-Vector operations
-Architectural applications

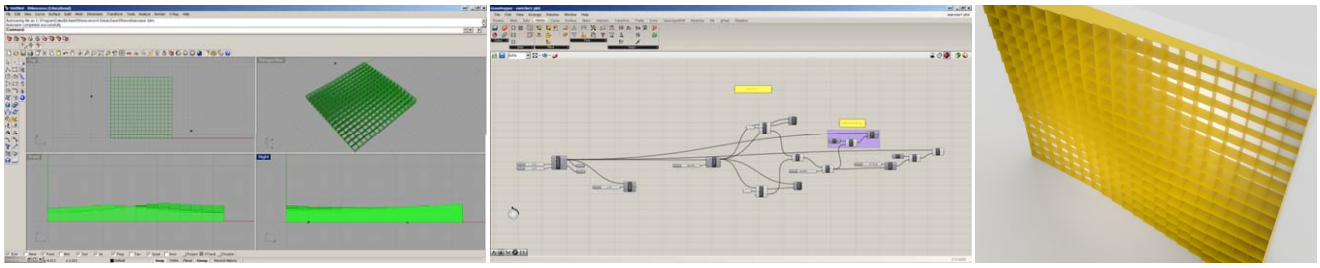
Tasks
group room task: see document
home assignment: taking inspiration from the group room exercise, create an architectural facade in Grasshopper using vectors components and/or vector operations.
You can use some time during the 'workshop slot' on Tuesday morning the 1st of May to develop your proposal

Literature
R. Issa, Essential Mathematics for computational design, 2nd ed. (pages 1-12)
Woojae Sung, Grasshopper Learning Material
Grasshopper Primer_Second Edition_090323 (pages 1-22)

MATEMATIK OG FORM

27 April 2012 - Lecture 4 Tasks

1) Group Room task



Steps 1 to 6
create and manage a large set of vectors and their components in the x y z direction.
Steps 7 to 13
extract values from the vectors set to create a first architectural component/facade.
Steps 13 to 15
additional examples how to use vector components and extracted data

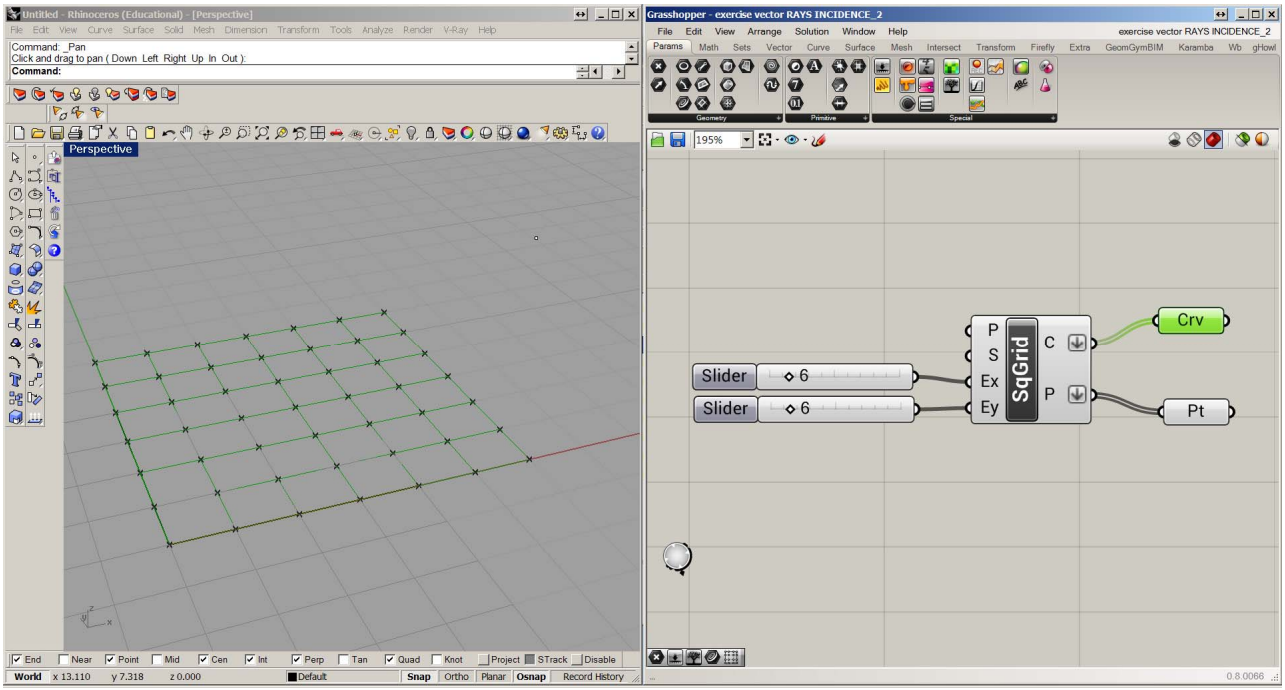
2) Home assignment
Taking inspiration from the group room exercise, create an architectural facade in Grasshopper using vectors components and/or vector operations, starting from SqGrid component (Vector>Grids)

Group Room Task

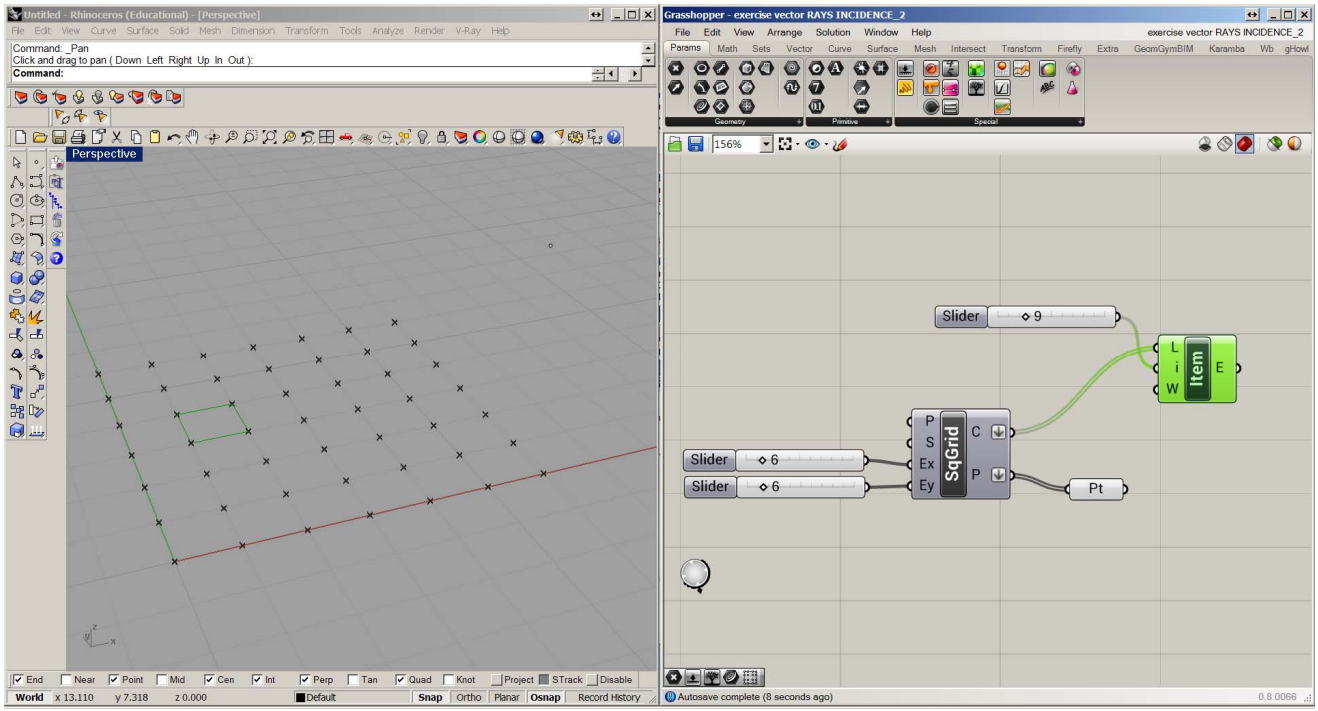
Teachers: Martin Raussen, Poul Henning Kirkegaard, Dario Parigi

Step 1

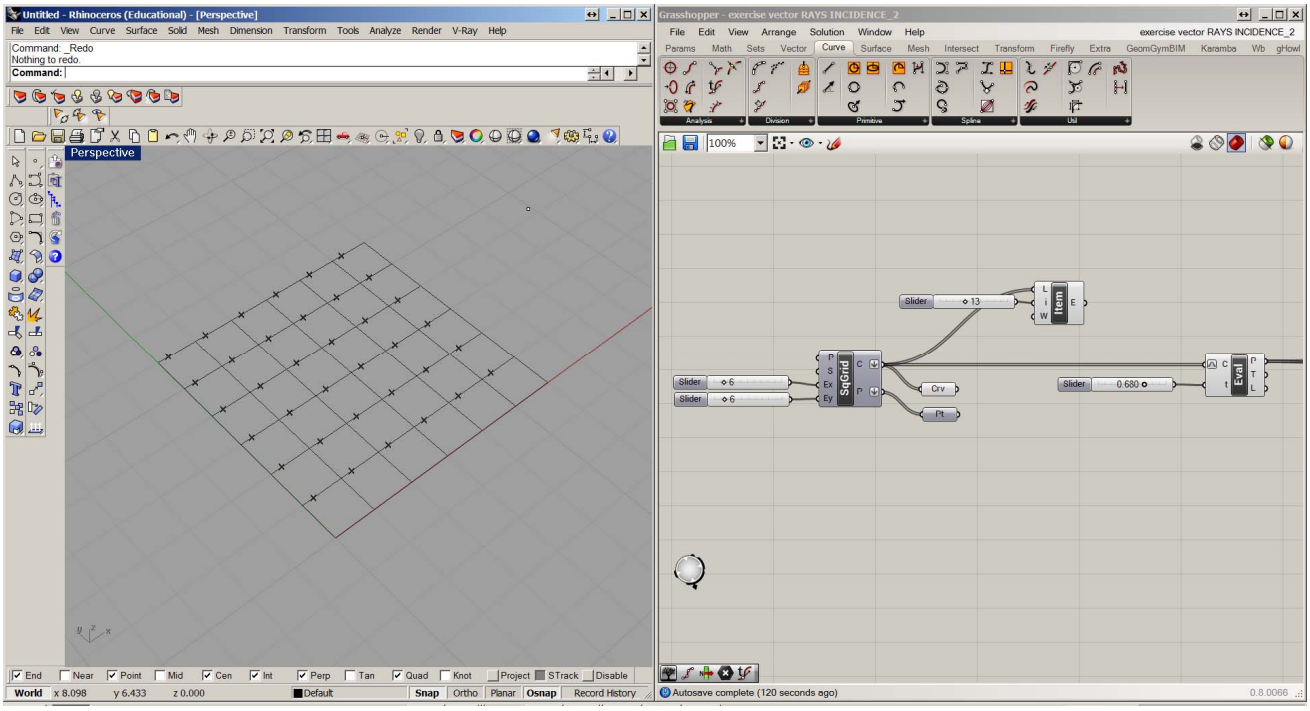
Create a square grid with **SqGrid** (Vector>Grids) and sliders of type "integer" as inputs. We will use the output curves. The component "Crv" is used at the sole scope of highlighting the object.



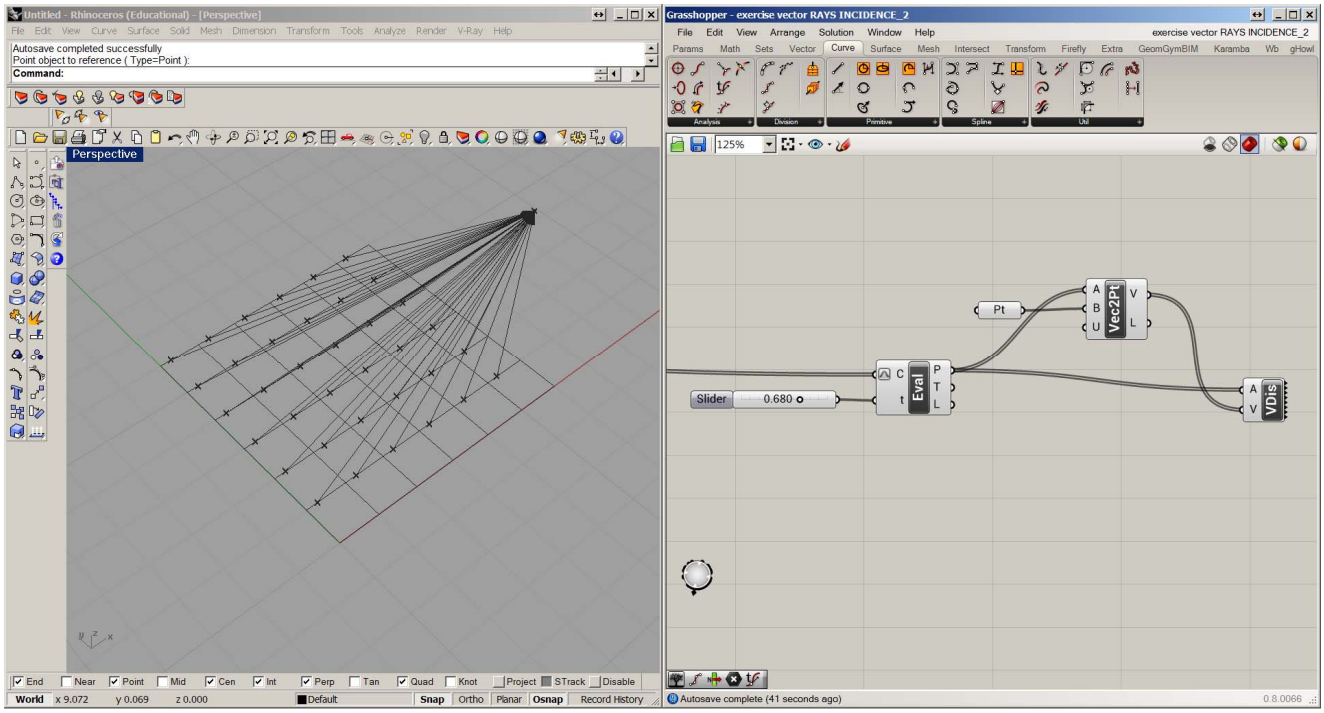
Step 2
Each square is defined by a curve. It is possible to select individual curves using the component **List Item,** from the tab **Sets>List**



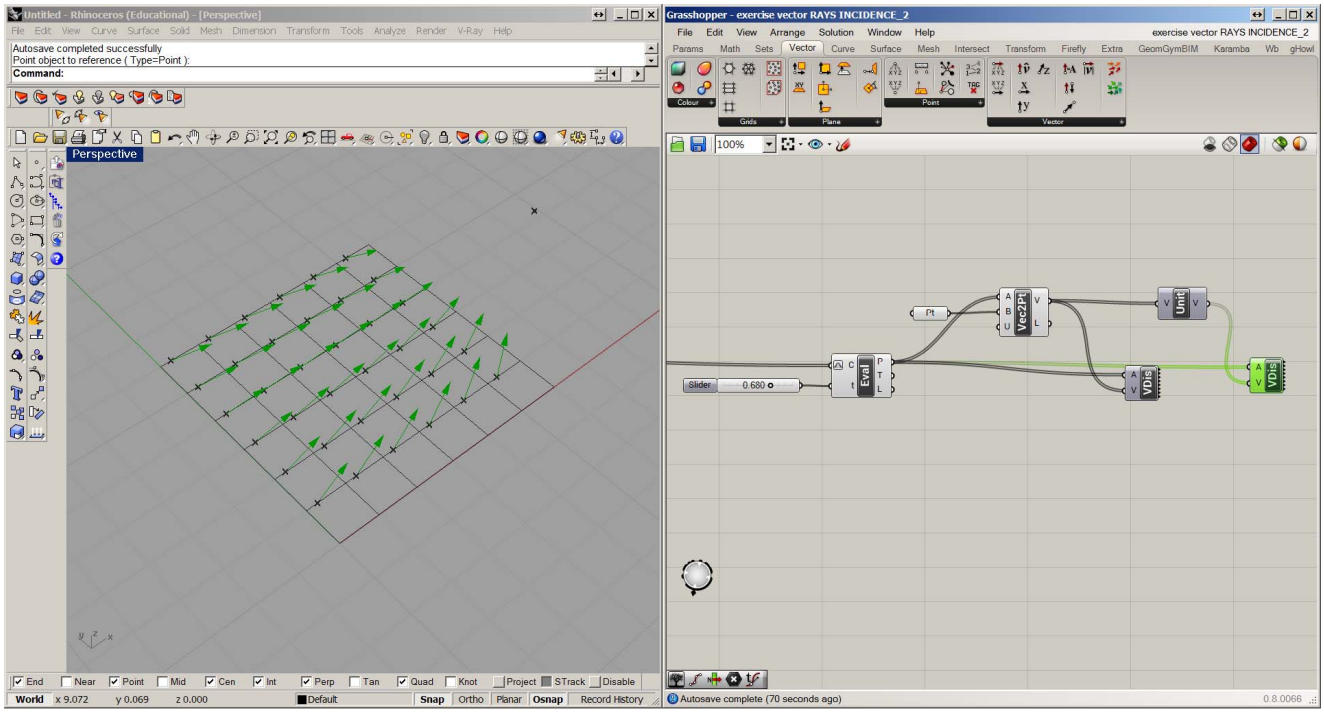
Step 3
Select one point for each square curve with the component **evaluate** curve (curve>analysis). The component evaluates different properties of a curve at a specified position, defined by a parameter **t** (use a slider with values from 0 to 1 in the **t** input). After selecting *reparametrize* (right click on the C input), the value 0 of the parameter t identifies the start of the curve, the value 1 the end of the curve, and the values from 0 to 1 intermediate position.
The output **P** identifies a point at the given **t** position



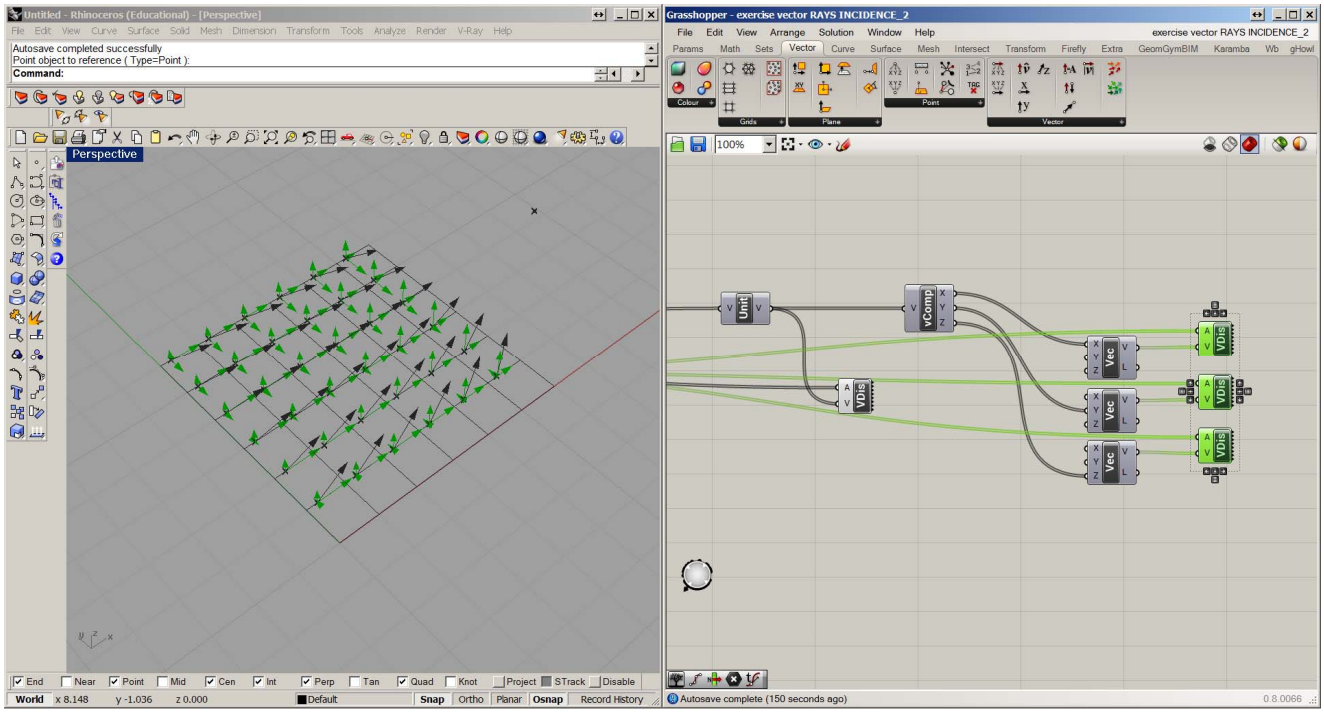
Step 4
Define an external point by drawing a point in Rhino canvas, and then creating a point component (**params>geometry**), with right click>set one point
Draw a vector between the external point and the points of the grid (Vector>Vector>Vector2Pt)
Visualize the vectors created (Vector>Vector>Vector Display)



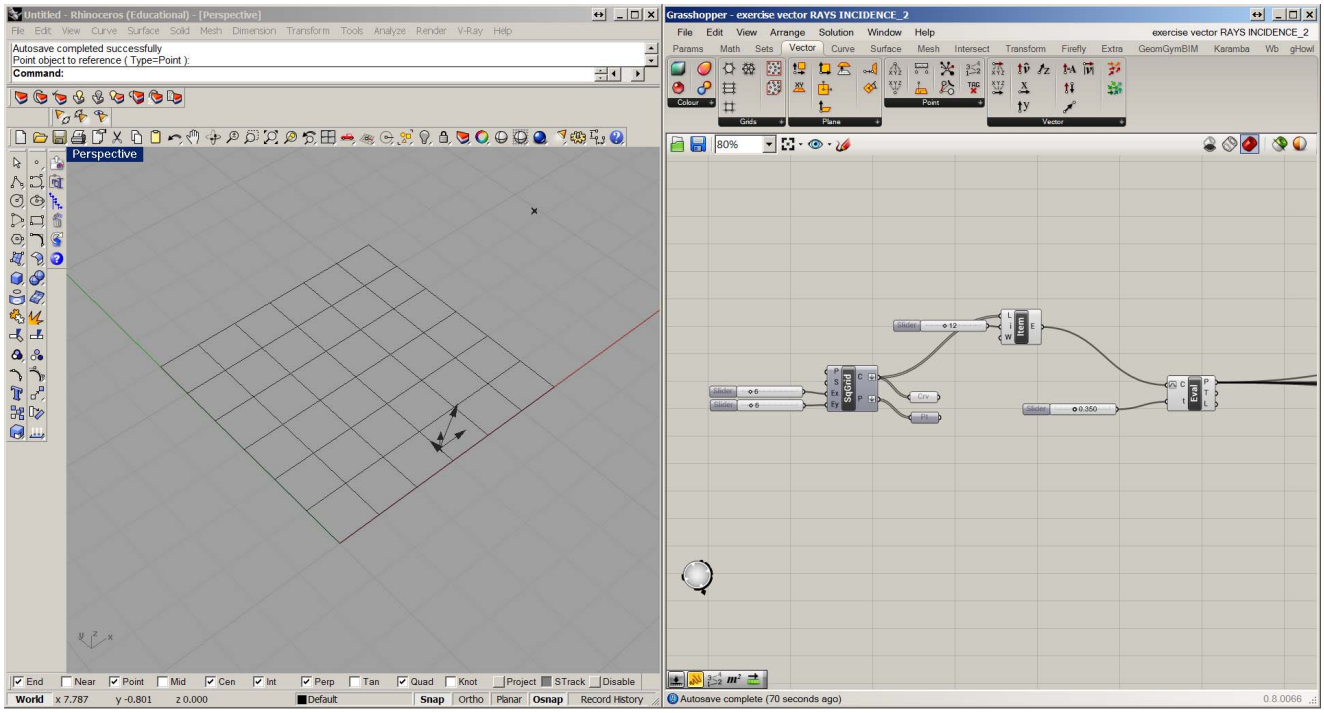
Step 5
Unitize the vectors (Vector>Vector>Unit Vector) to define a set of **UNIT VECTORS**



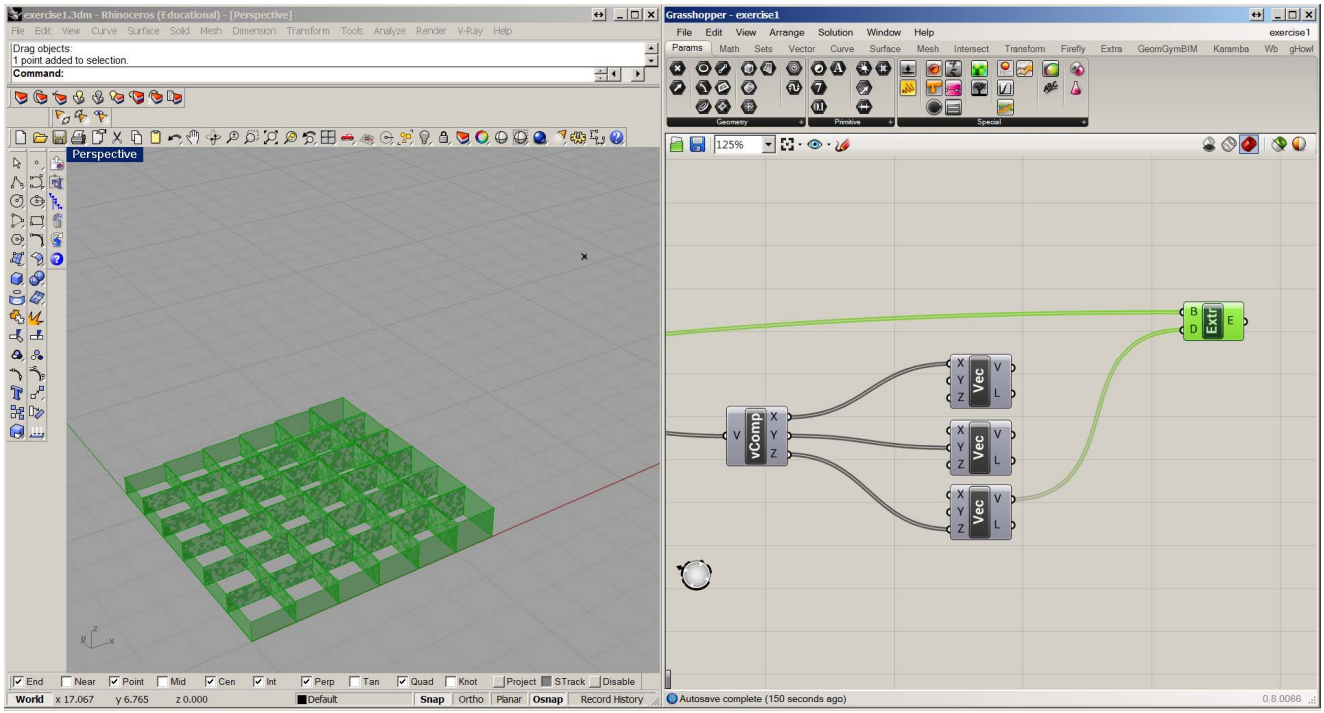
Step 6
-Decompose the vectors components in the x y z components (Vector>Vector>Decompose).
-Visualize the components in the x y z direction



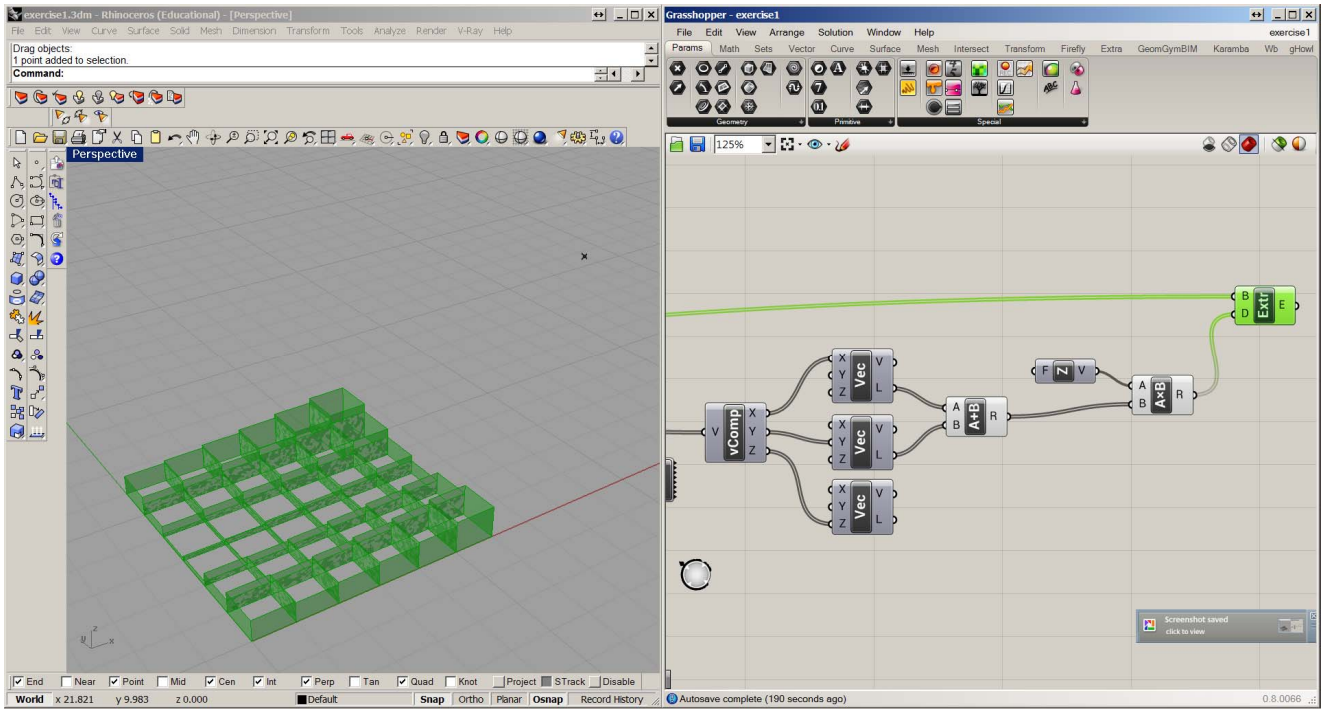
Step 7
-you can use a single vector or component connecting the "item" component created in step 2 to "eval" component



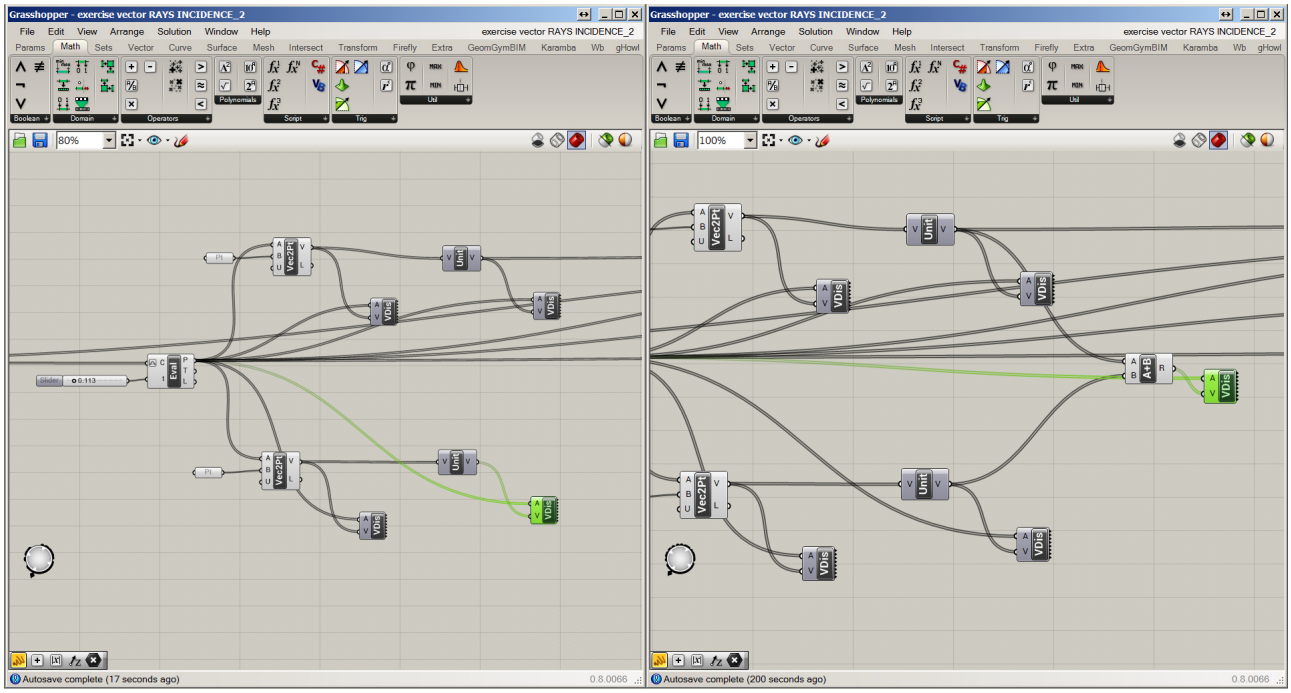
Step 8
-The extrude component (**surface>freeform>extrude**) accept as inputs the geometry, in our case the curves defining the square grid, (remember to link back the whole set of curves of step 2) and the extrusion direction.
-Use the z components of the unit vectors as extrusion direction



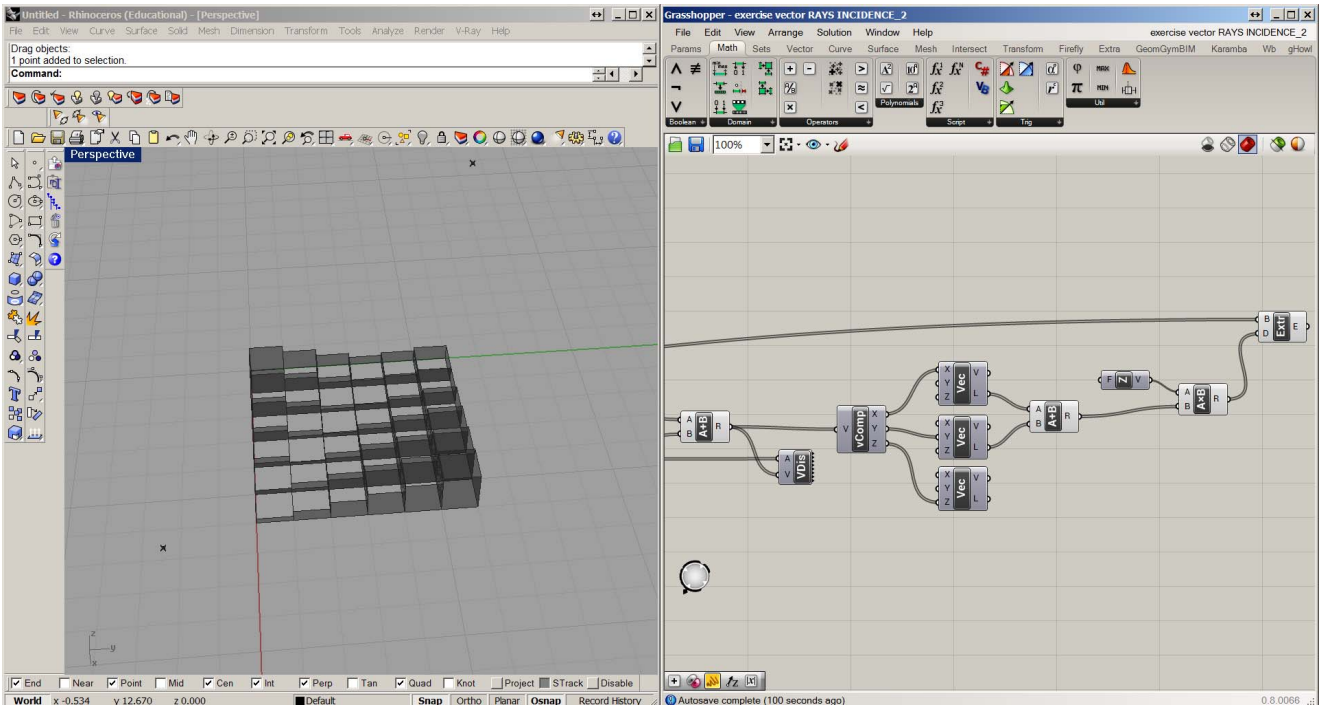
Step 9
It is possible to operate an extrusion in the z direction using values from other components by using a unit z component (**vector>vector**) and a multiplication parameter (**Math>operators**).
-The sum of the x and y unit vector component was used



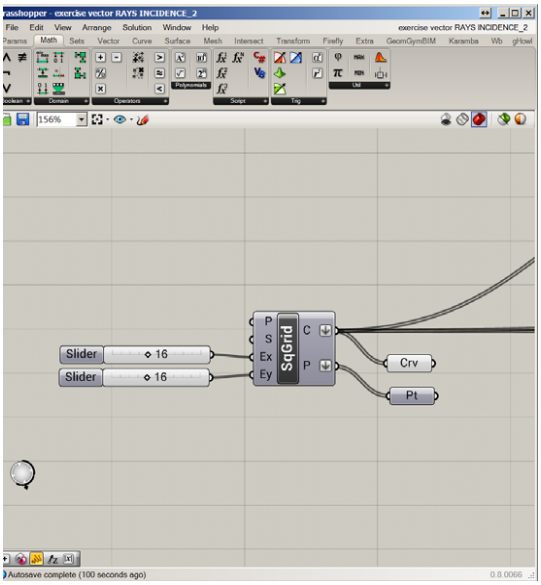
Step 10
- Define another external point (as in step 4) and the distance vectors with the points on the square cells as the previous point.
- Each point in the square cells should have two vectors, linking to the two external points. Add the two vectors (math>operators>addition)

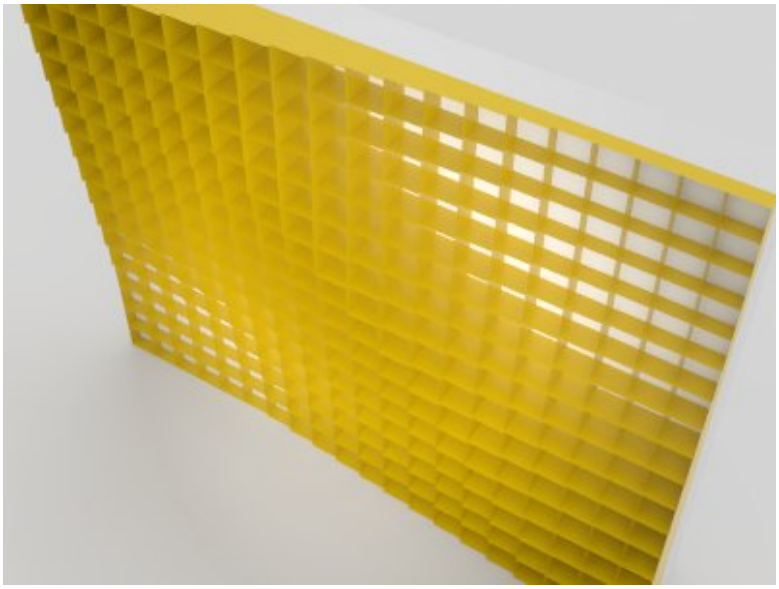


Step 11
- Use the resulting vector components as extrusion values for the square cells
- The sum of the x and the y component is used in this example

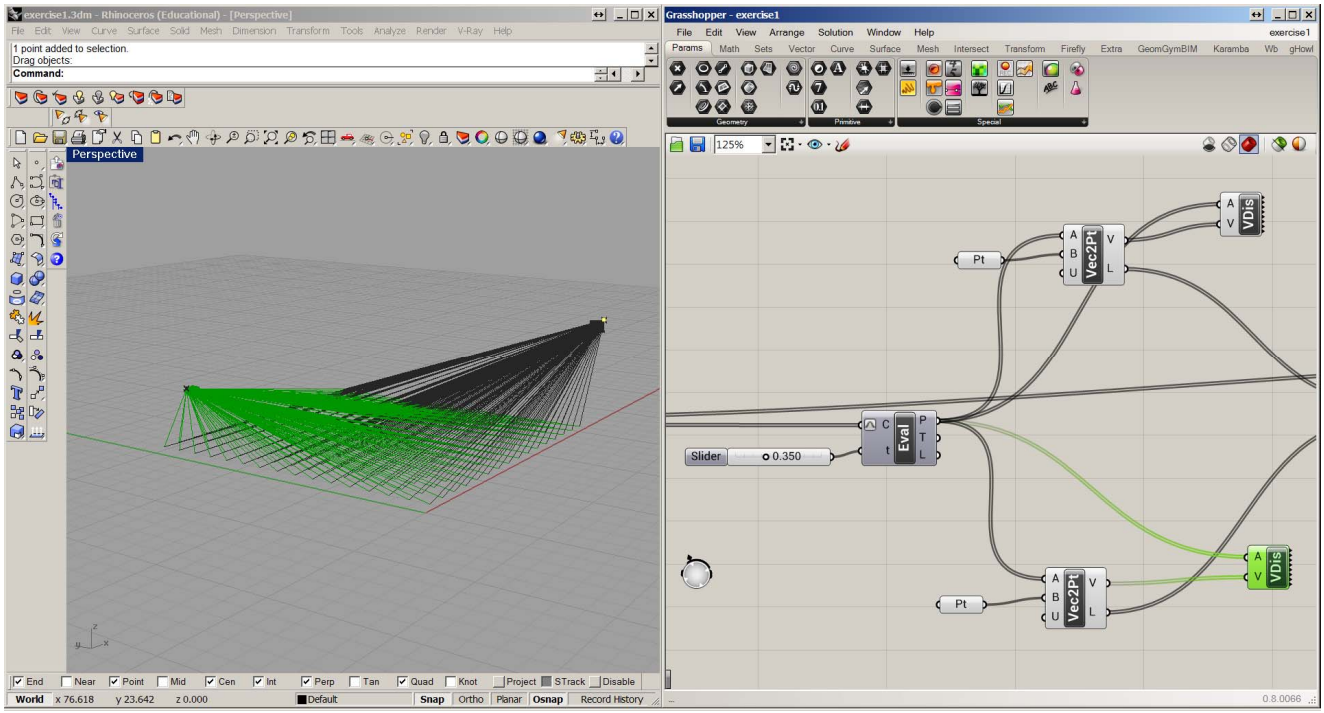


Step 12
-Increase the number of squares in the SqGrid component

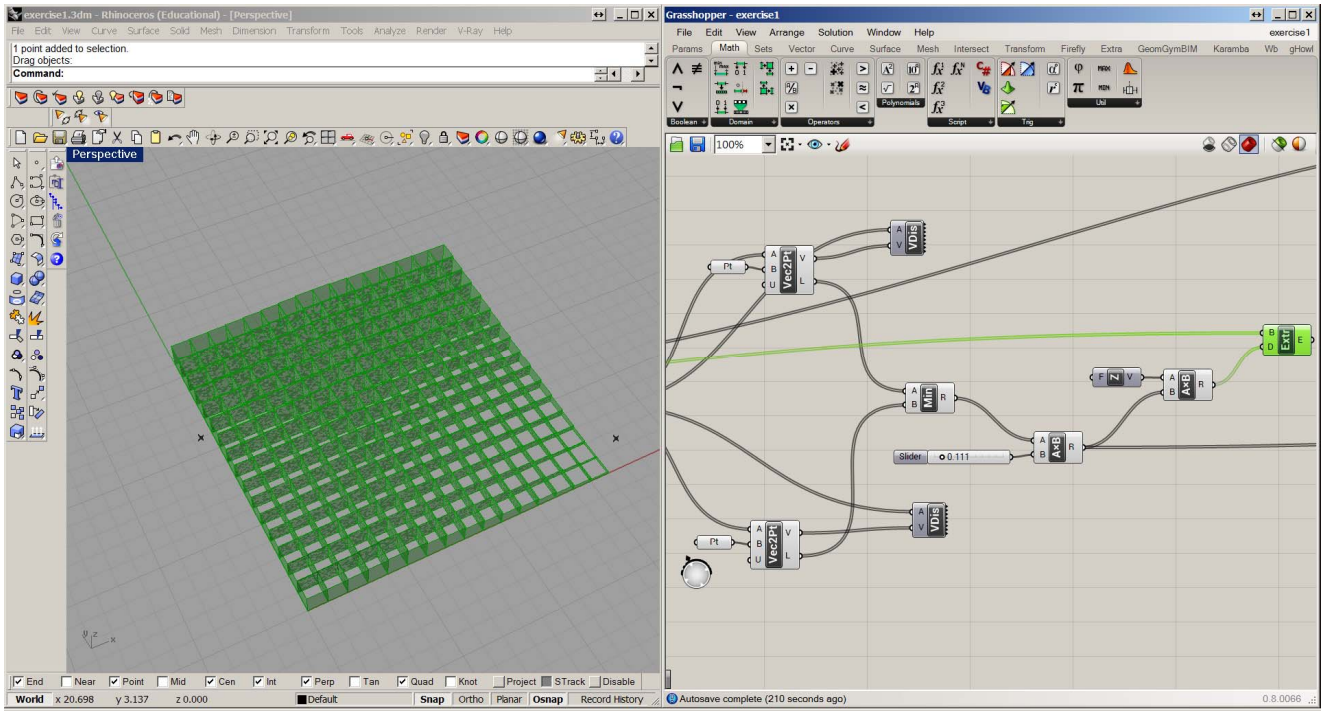




Step 13 - Add thresholds using min/max component
-Define two points and the vectors from the points to the points in the grid



Step 14
-For each point there exist a couple of vectors one going to point 1 and the other to point 2. We use a "Min" component (math>util) to select the one with minimum length between the two
- Scale the length of the vector by multiplying the value with a factor from 0 to 1, in order to have values we can use as extrusion value for the square grid



Step 15
Connect the values to a "max" component together with another value of your choice representing represent the threshold, under which the extrusion value would not go