

Modelação Geométrica e Generativa



FACULDADE DE ARQUITETURA
LISBON SCHOOL OF ARCHITECTURE
UNIVERSIDADE DE LISBOA

Mestrado Integrado em Arquitectura
Ano Lectivo 2025-2025 2º Semestre

20241236

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MGeG

Mestrado Integrado em Arquitectura
Ano Lectivo 2025-2025 2º Semestre
Docente - Nuno Alão 2º Ano

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1-12/02	2-19/02	3-26/02	4-05/03	5-12/03	6-20/03	7-26/03	8-09/04	9-16/04
Início 2º semestre: Apresentação	Iniciação do Rhino. Cubo truncado e Dual	Cont. Cubo truncado e dual; Cuboctaedro truncado e dual; Dodecaedro-iniciação.	Cont. Dodecaedro e Dual.	Layouts.	Abóbadas: -de berço; -cisterna; -ogival; -abatida. Lunetas: -cilíndrica -esférica -	Abóbadas cont.	Cont. abóbadas: -Abóbada de bolbo alveolada; Grasshopper .	Conchas: - Spirula; Abóbada de berço e ogival em grasshopper.

ÍNDICE

10-23/04 **11-30/04** **12-07/05** **13- 14/05** **14- 21/05**

Superfície
em
GrassHopper

Planorbis-
aula online

Caramujo do
mar: Rhino e
GrassHopper

Modelação de
terreno em
GrassHopper

1 - APRESENTAÇÃO DA DISCIPLINA DE MGG :

- Conteúdos Programáticos a desenvolver durante o semestre ;
- Programas de CAD - **Software a usar nos trabalhos: Rhino e Grasshopper;**
- Trabalhos a realizar e desenvolver durante as aulas ;
- Metodologia de avaliação.

2 - Operações Geométricas : Translação, Rotação, Reflexão e Homotetia.

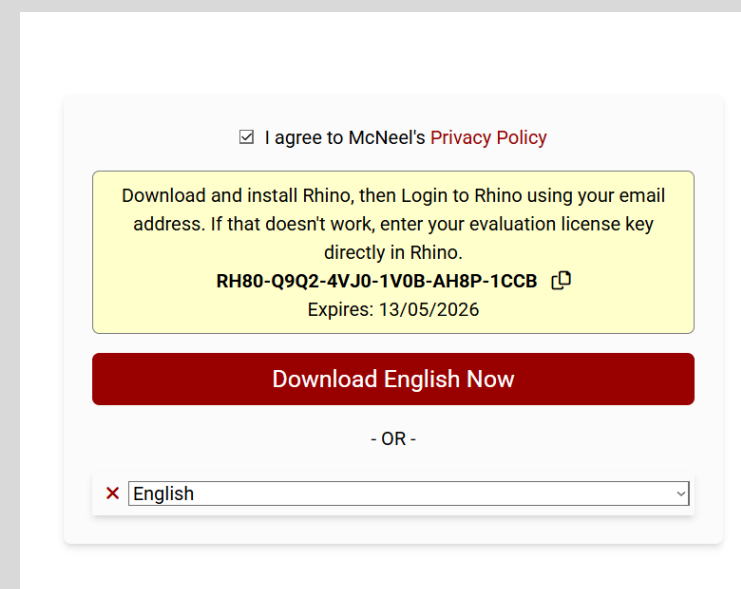
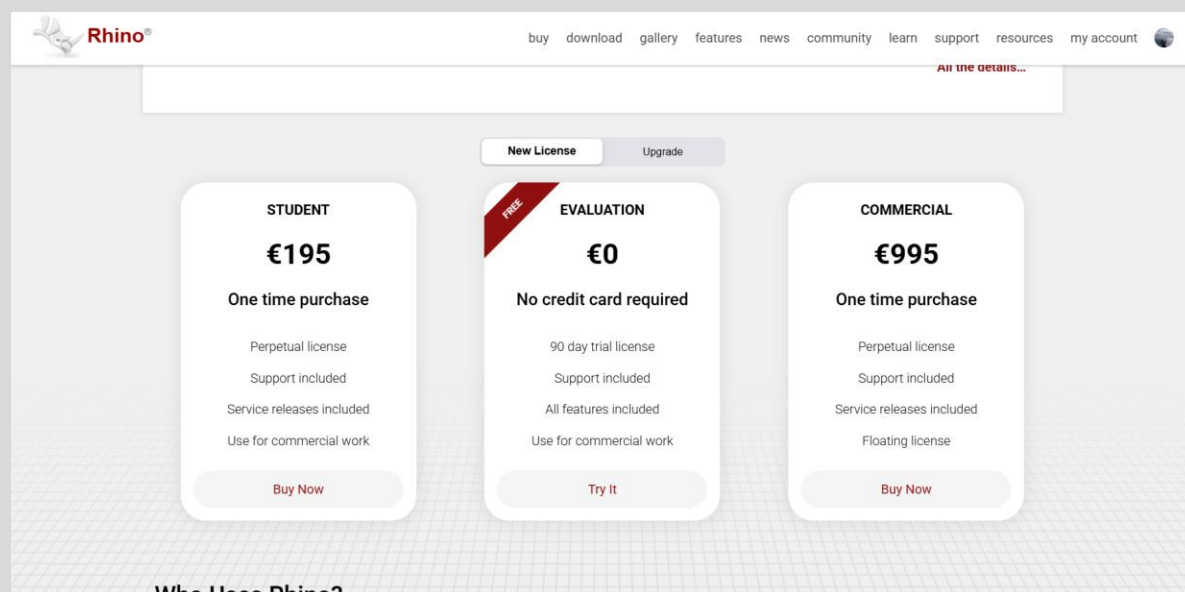
Aula. 1 - Apresentação

Apresentação:

Explicação da cadeira de Mgg e as suas implicações;

Isntalação de Rhinoceros 8

Explicação do programa em comparação com AutoCad aprendido no semestre anterior em Representação digital



Aula. 1 - Apresentação

Poly- polyline

4 vistas

Line-l

Command line

Point ou right click

A maioria dos comandos de AutoCAD funcionam em Rhino

Explicação sobre operações geométricas de movimento (alterando as suas coordenadas mantendo a sua identidade):

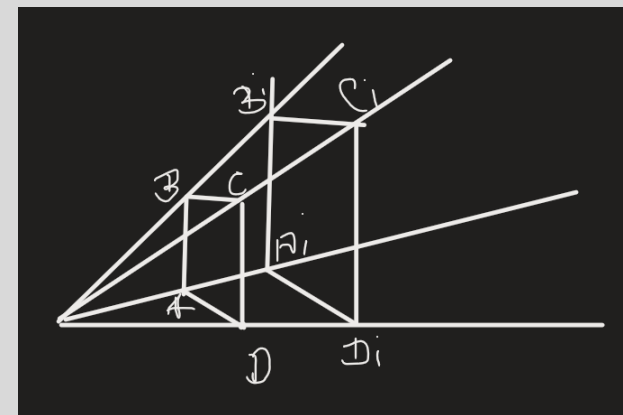
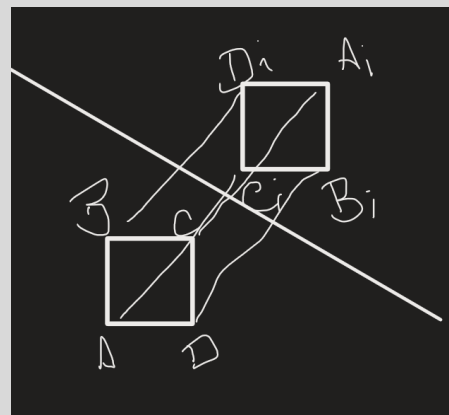
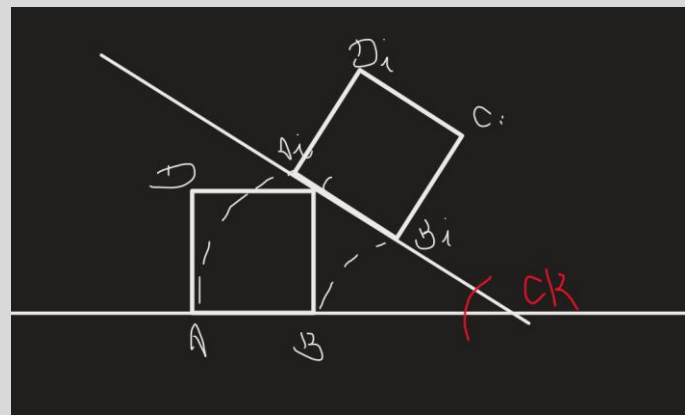
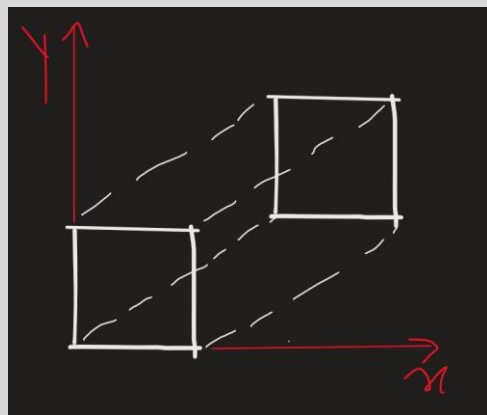
-translação

-rotação

-rebatimento

-reflexão

-homotetia



Aula. 1 - Apresentação

- 1 - Rhino: Apresentação do programa de CAD; análise do interface; comparação com programas usados anteriormente: diferenças e semelhanças.**
- 2 - Exercício 1 - para apreensão e prática dos comandos básicos de modelação: partindo dos sólidos platônicos, modelação dos sólidos de Arquimedes e seus Duais: Cubo Truncado a $\frac{1}{3}$ da aresta.**

Aula. 2 – Iniciação do Rhino

Rhino- Small objects- centimeters

Unidade: centímetro

Cubo de 9 cm

9cm rhino= 9mm irl

Rhino abre ficheiros de AutoCAD (dwg)

Ficheiros 3dm

Curves- linhas

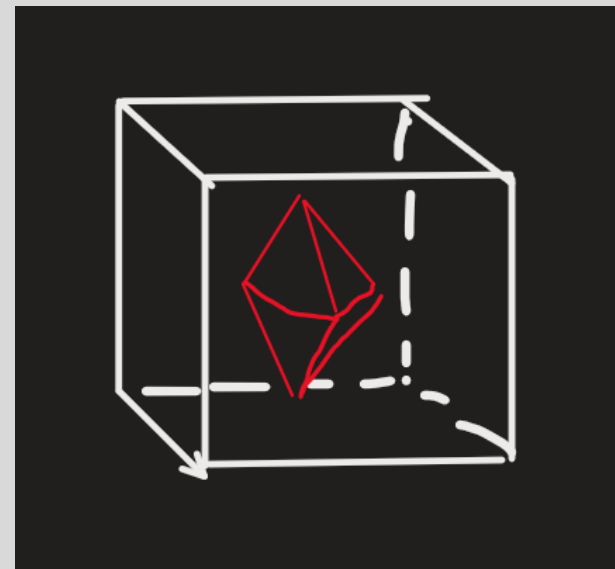
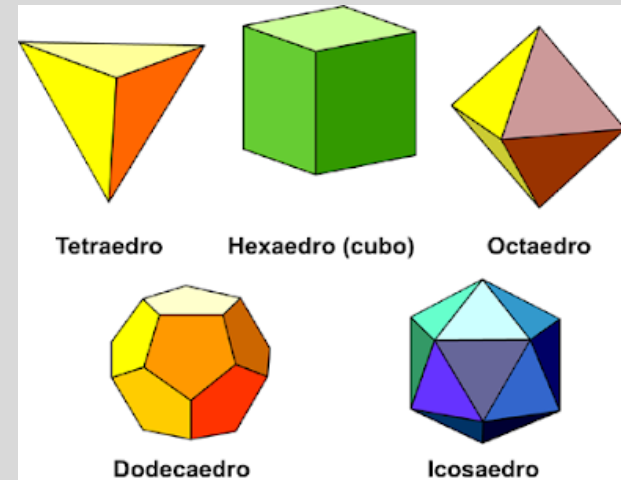
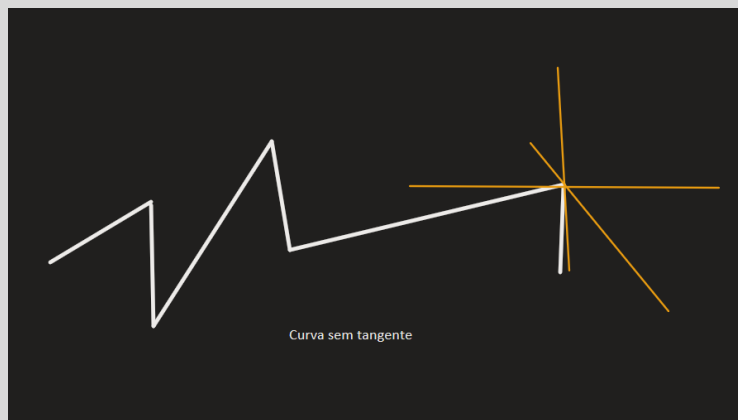
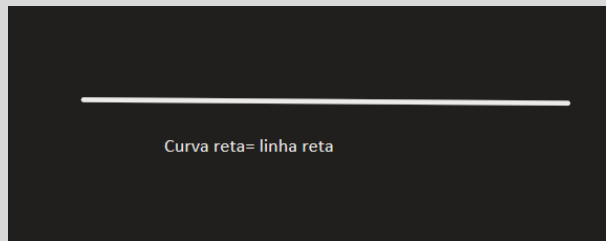
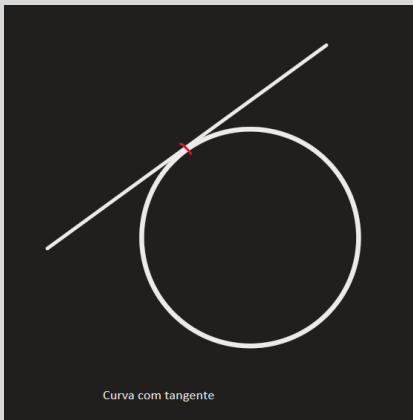
desligar todas as outras opções do osnap para evitar confusões com outras funções

Point no Rhino = node no AutoCAD

Criar faces com 3-4 pontos

União das faces

Split 3ds = break AutoCAD



Aula. 2 – Iniciação do Rhino

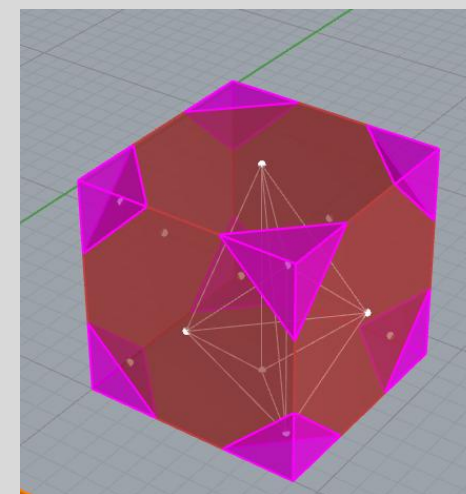
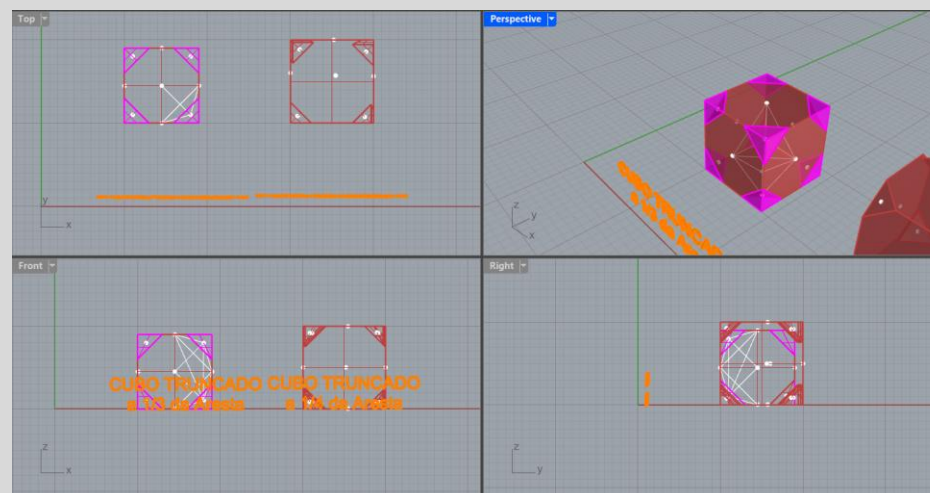
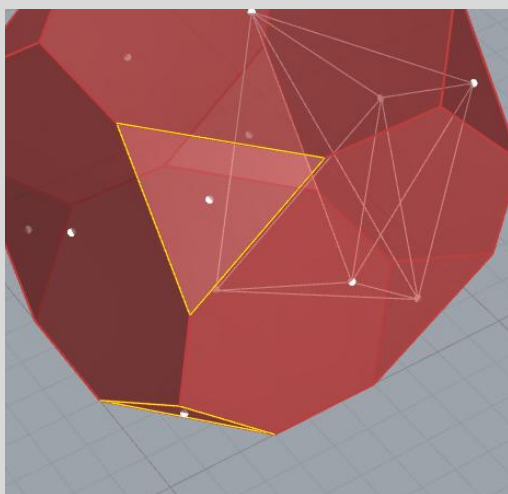
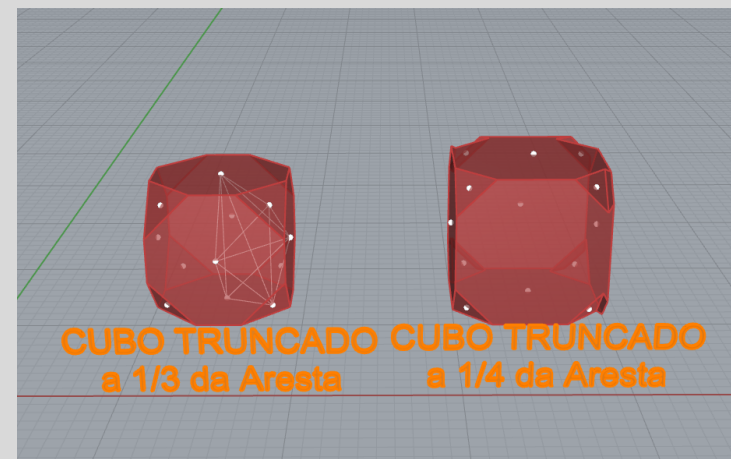
Criar um cubo e cortar os vértices
1/3 da aresta para intersecção do plano com o cubo
Array polar para repetir a intersecção

Criação cubo
Display modes
Change layers

Comandos:

- box
- extrude crv
- polyline
- mirror
- polar array
- redo
- undo
- wirecut
- select
- move

Layer			Materia
Default			
cubo 9c			
cubo 10c			
wires 9			
wires 10			
aux			
notas			
cubo 9 trun			
vértices			
texto			
texto 9			
centros			
arames			



Aula. 2 – Iniciação do Rhino

1 - Modelação dos poliedros regulares de base - Sólidos Platónicos - para os exercícios posteriores.

2 - Modelação de um cubo truncado a $\frac{1}{3}$ da aresta.

Aula. 3 –Cont.: Cubo Truncado e Dual

Polyline conectar os pontos

Array polar 4 vezes copiar o conjunto para n fazer todas as ligações

Layer Cubo T aux

Surface with 3 or 4 corner points

Layers:

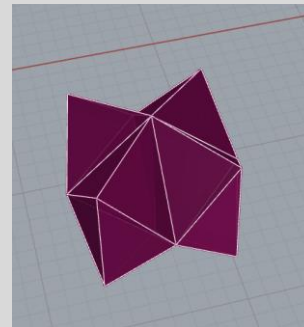
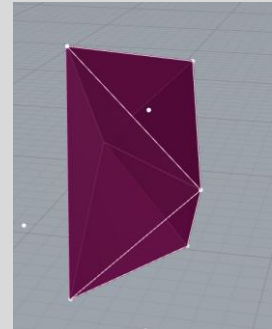
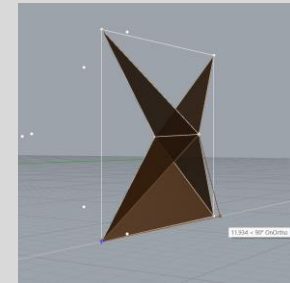
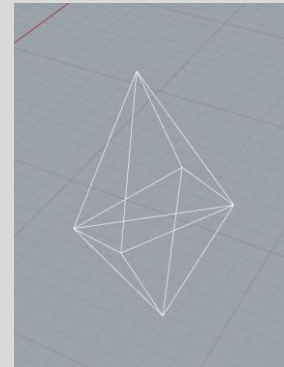
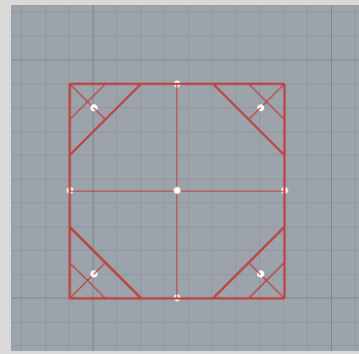
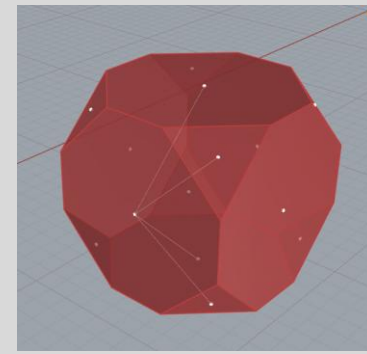
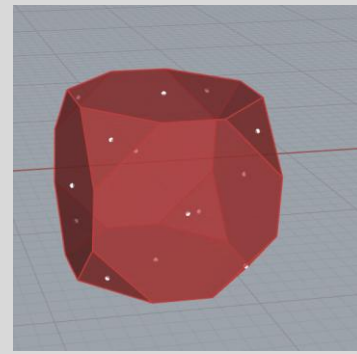
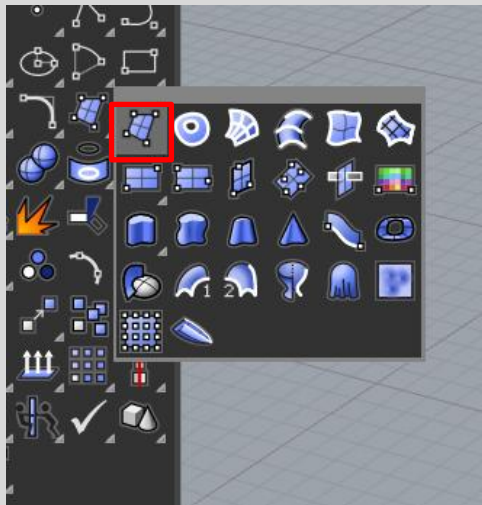
-dual faces

- Dual arames

- Pontos

Array polar 4x

«estrelinha»



Aula. 3 – Cuboctaedro Truncado e Dual

Novo ficheiro: cuboctaedro e dual

- box
- circle
- rotate
- polyline
- mirror
- arraypolar

Wirecut: polyline + cubo

Midpoints

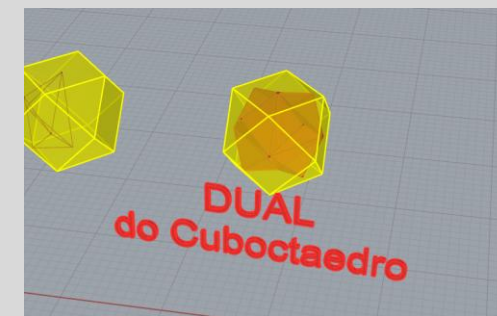
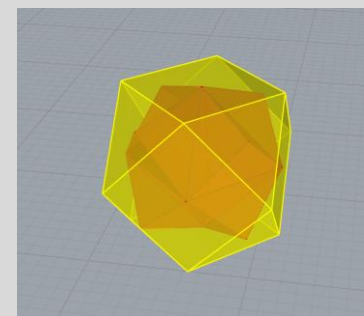
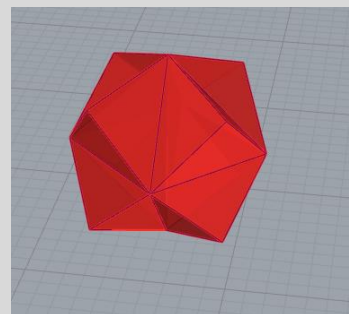
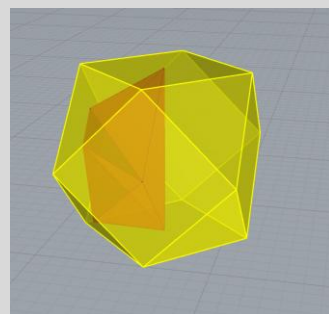
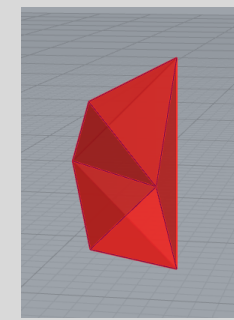
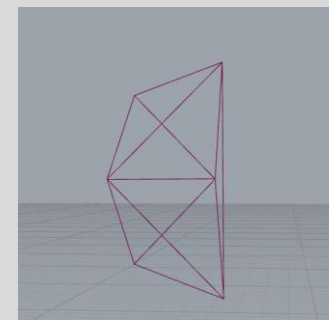
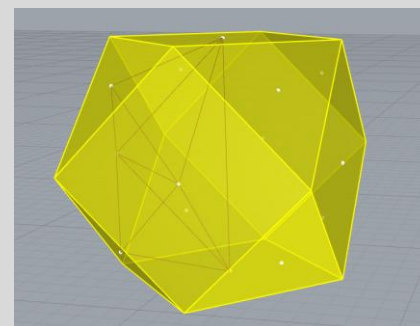
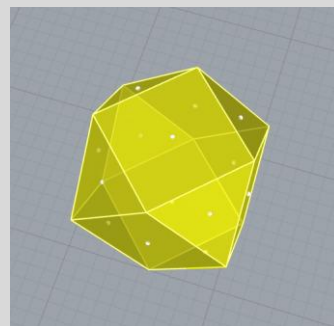
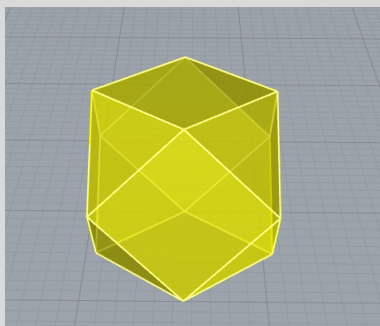
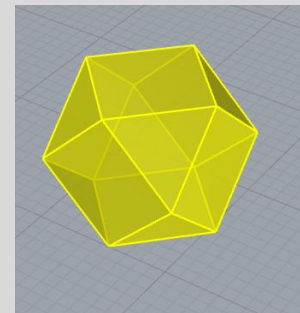
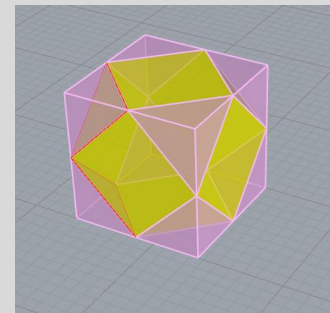
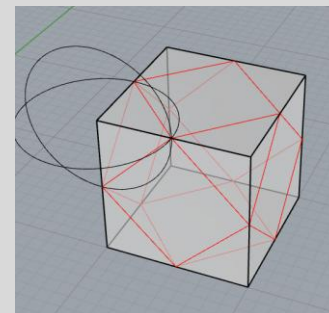
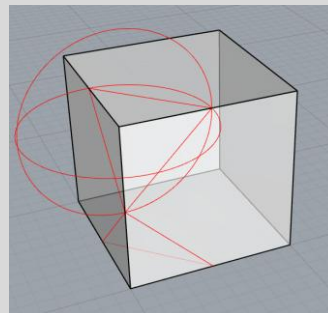
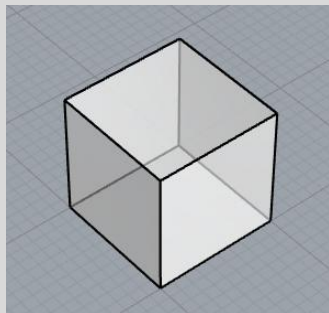
Polyline

Surface

Array polar- 4; 360°

Texto

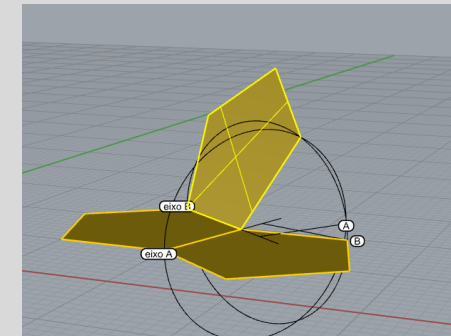
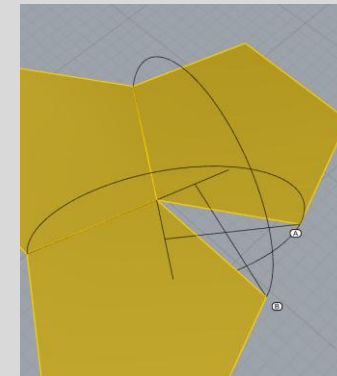
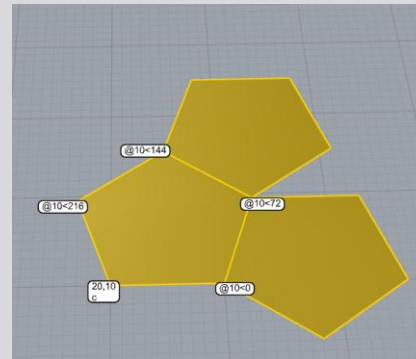
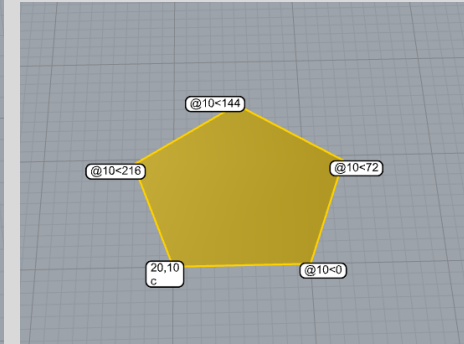
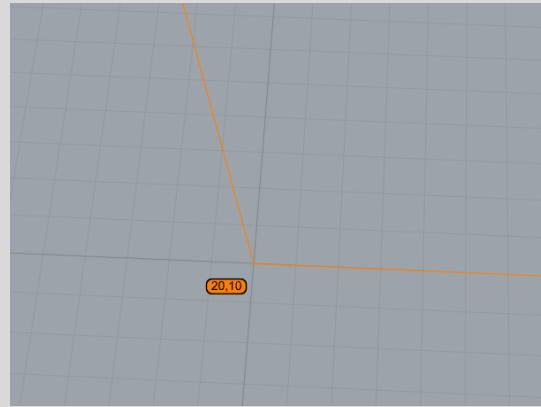
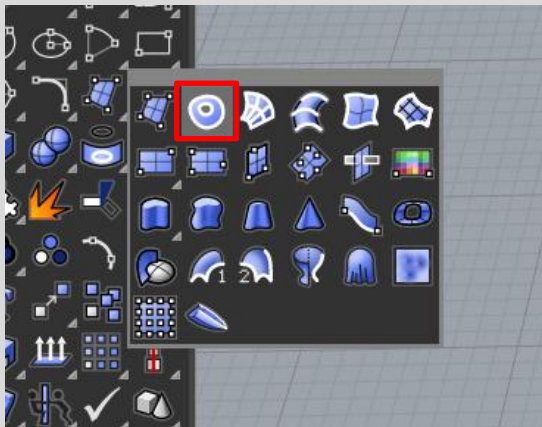
Layer				Materia
Default				
cuboctaedro				
wires				
vértices				
aux				
texto				
dual arame				
dual faces				
pontos				



Aula. 3 – Cuboctaedro Truncado e Dual

Novo ficheiro: Dodecaedro e dual:

- Layers
- Polyline 20,10
- Dot
- Coordenadas
- Surface planar curves
- Mirror
- Polyline
- Perpendiculares de A e B para polyline
- Circle vertical
- Rotate 3d
- Fim



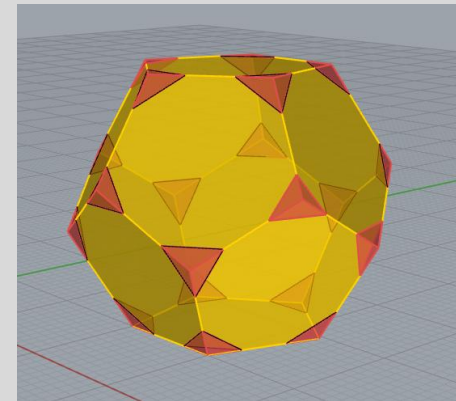
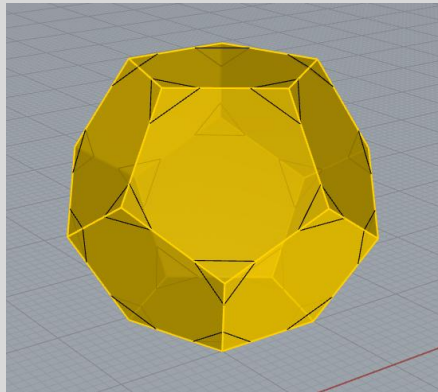
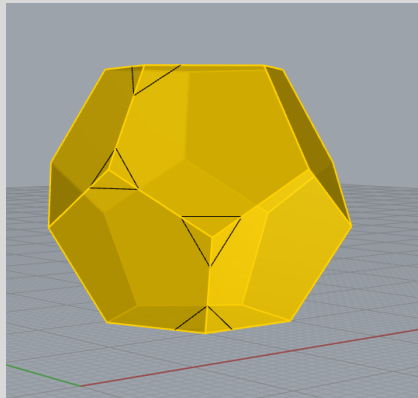
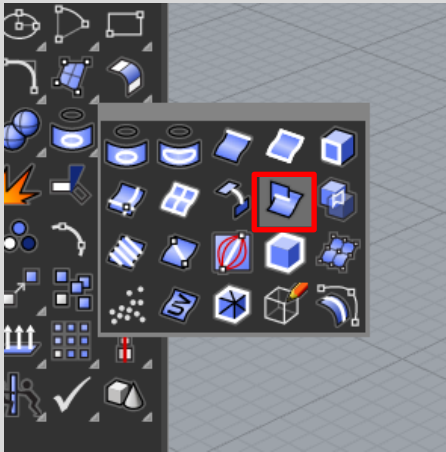
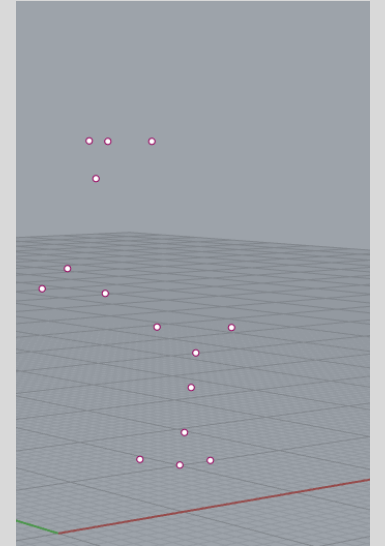
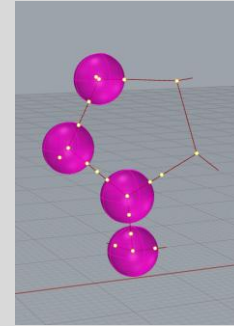
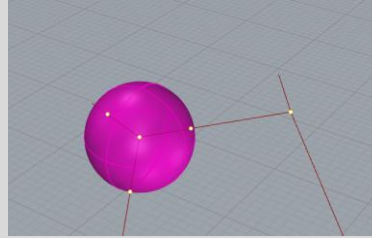
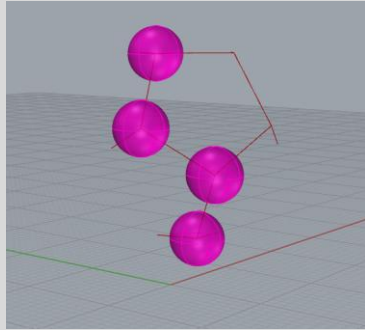
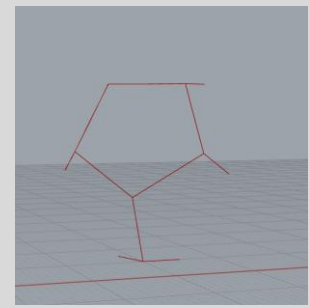
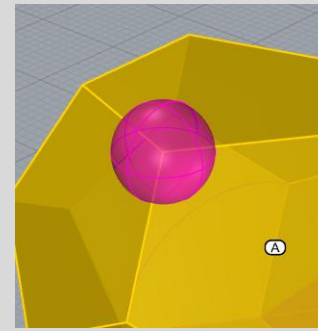
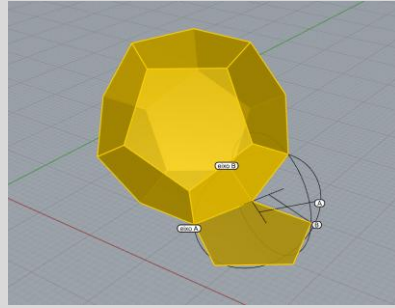
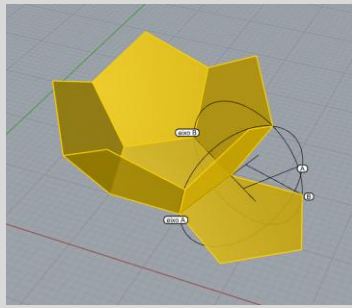
Aula. 3 – Dodecaedro- Início

1 - Continuação do exercício 1: DUAL DO CUBO TRUNCADO; CUBOCTAEDRO E SEU DUAL.

2 - Lançamento do trabalho 1 de avaliação: Desenvolvimento e representação de 6 sólidos arquimedianos.

Continuação: Dodecaedro e dual:

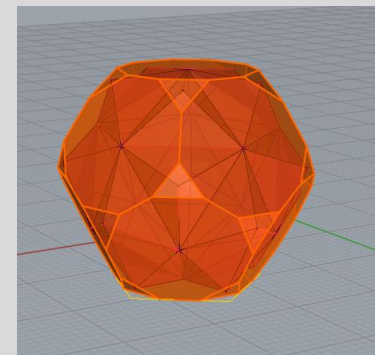
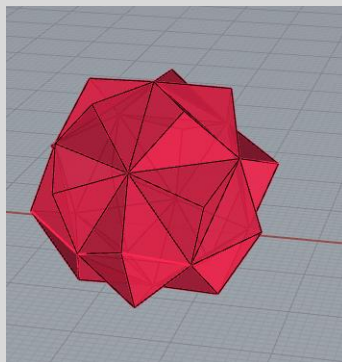
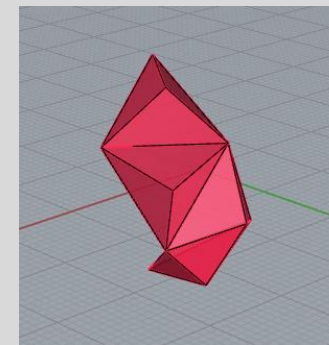
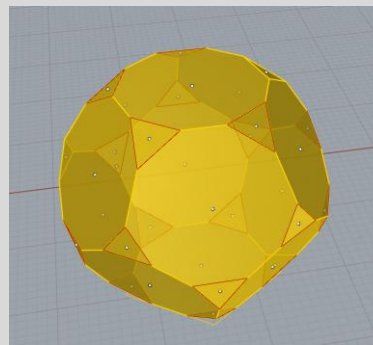
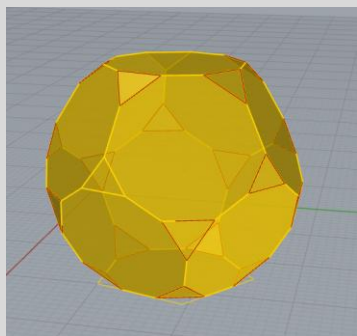
- Array polar
- Mirror
- Sphere
- polyline
- Object intersection
- Layer pontos
- Polyline
- Arraypolar
- Wirecut
- Layer vértices



Aula. 4 – Continuação do Dodecaedro e Dual

Continuação:

- Pontos em todos os centros de face
- Polyline
- Surface
- Array polar



1 - Conclusão do exercício dos poliedros semi-regulares de Arquimedes e seus duais.

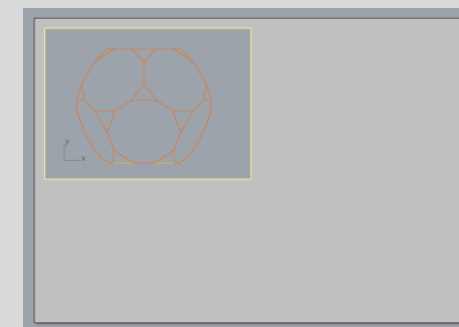
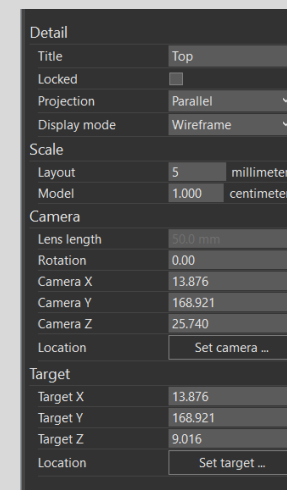
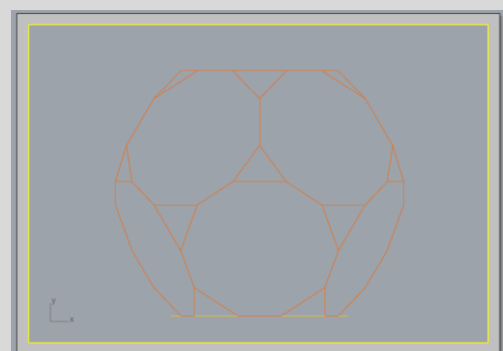
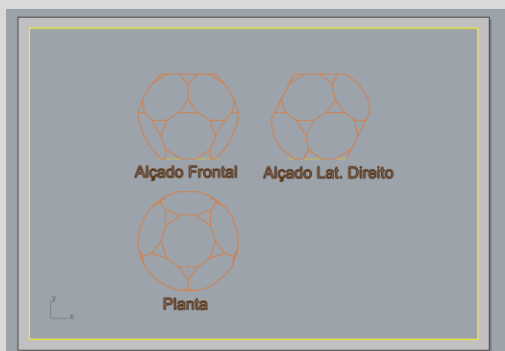
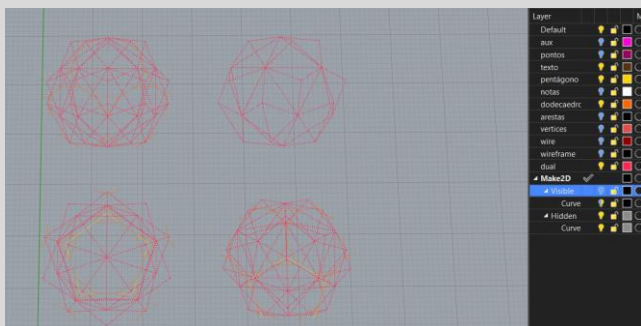
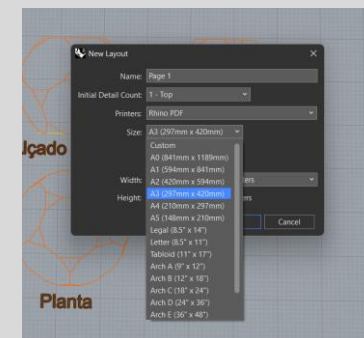
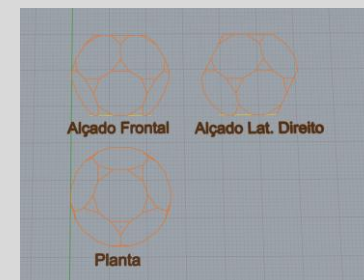
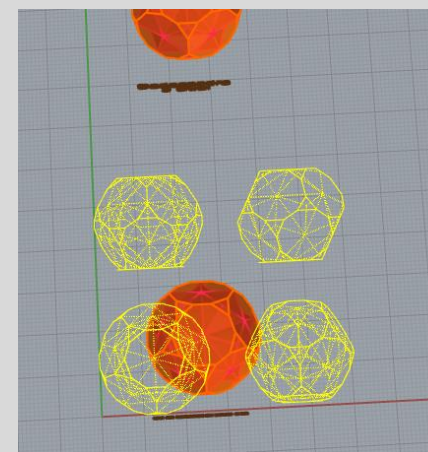
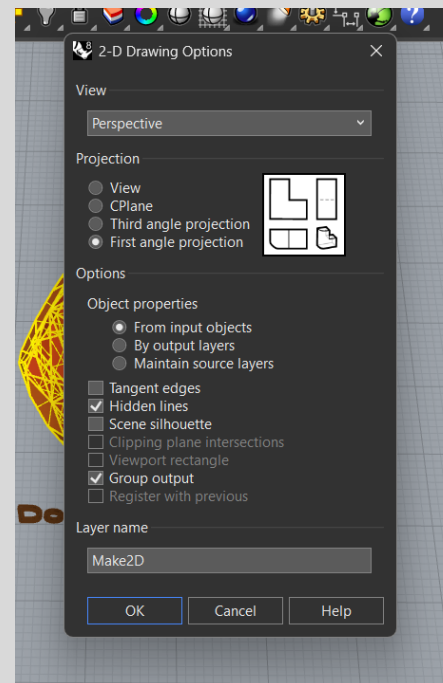
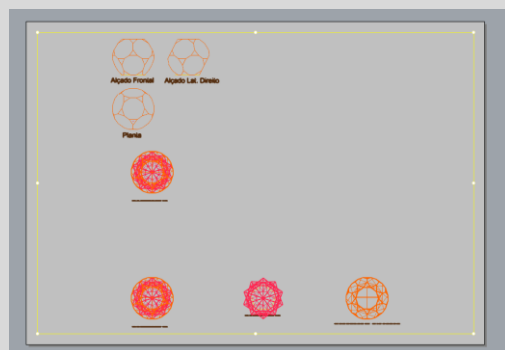
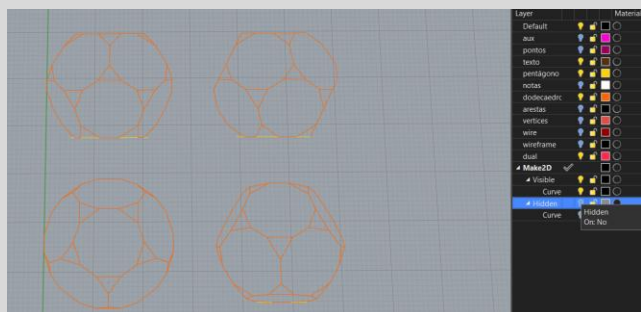
2 - Extração de vistas ortogonais dos modelos : comando - Make2D.

3 - Criação e gestão de Layouts para impressão; gestão de linhas e cores de impressão; modelação de cotas para cotação de desenhos.

Aula. 5 – Layouts

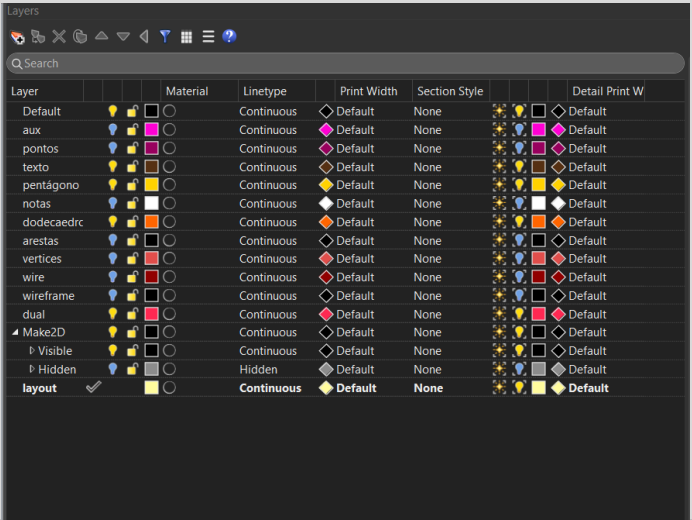
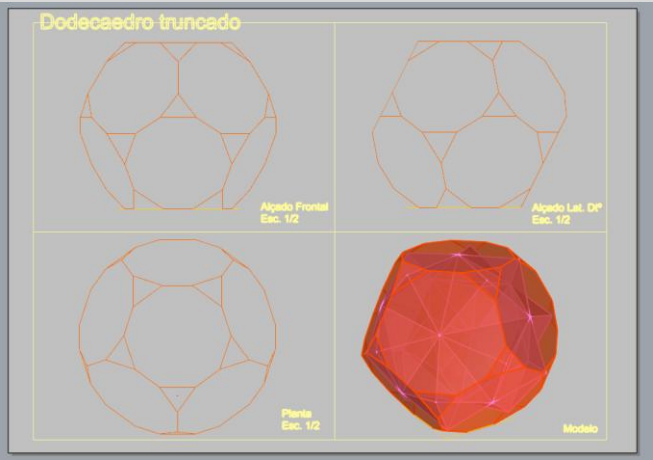
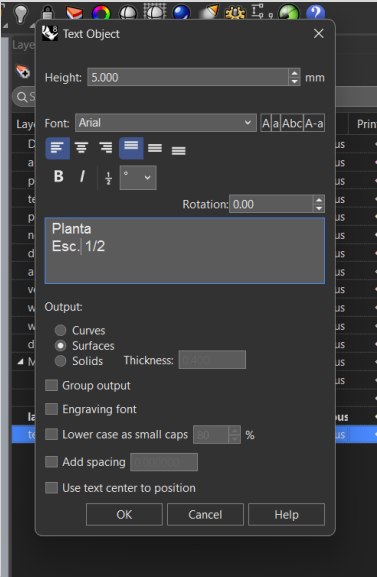
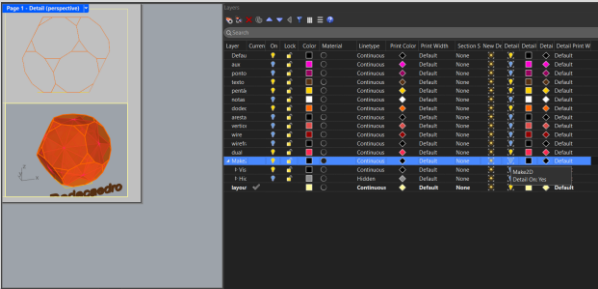
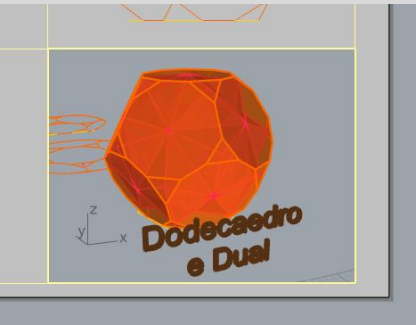
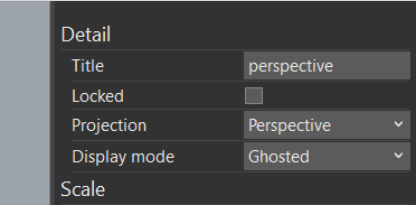
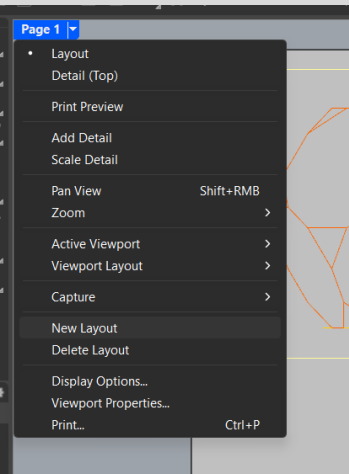
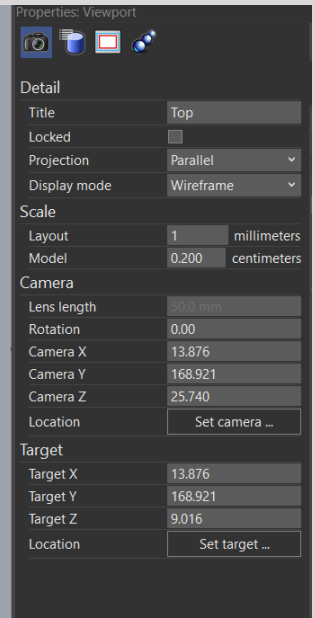
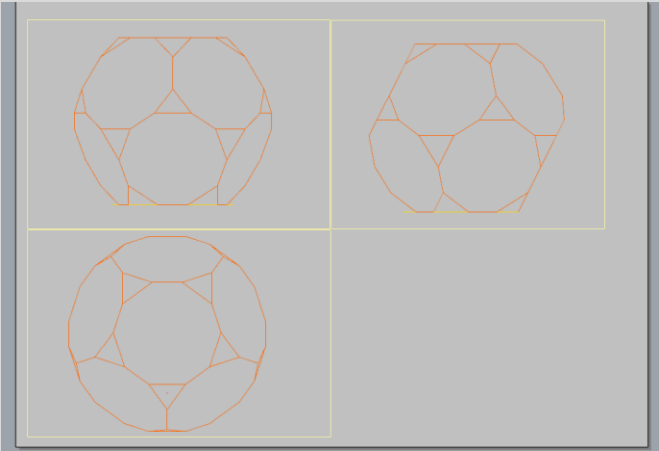
Resumo de aula:

- Layout:
- Make 2d- cria projeções ortogonais
- Perspetiva não é muito relevante pela regularidade do modelo
- Escala nas propriedades do layout
- Ficheiro em cm- layout em mm- 10m=1cm



Aula. 5 - Layouts

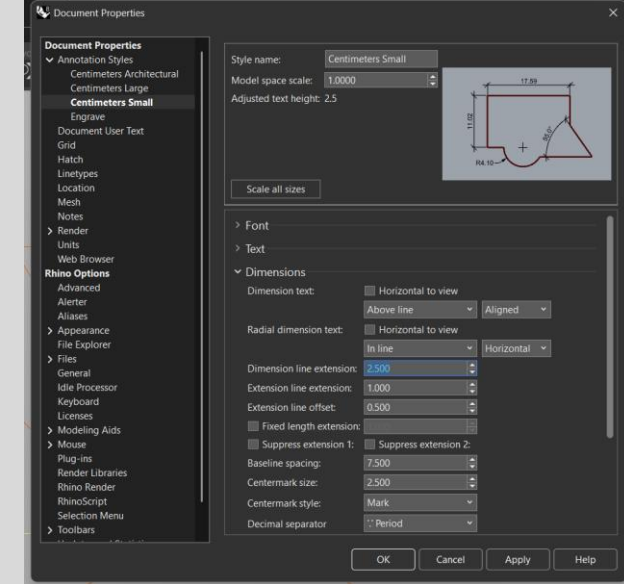
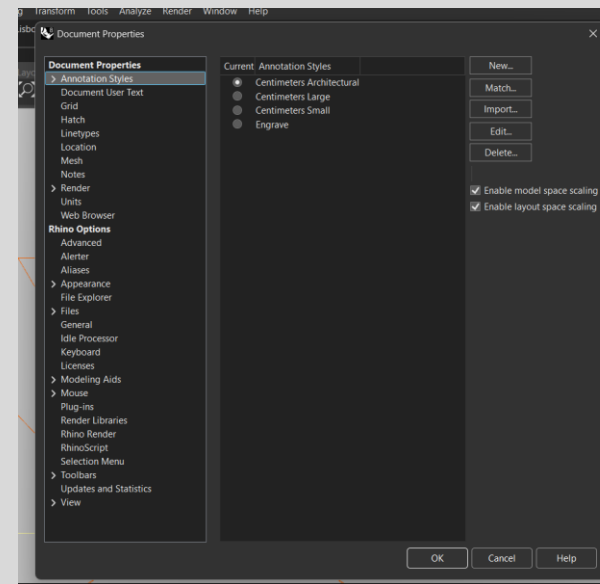
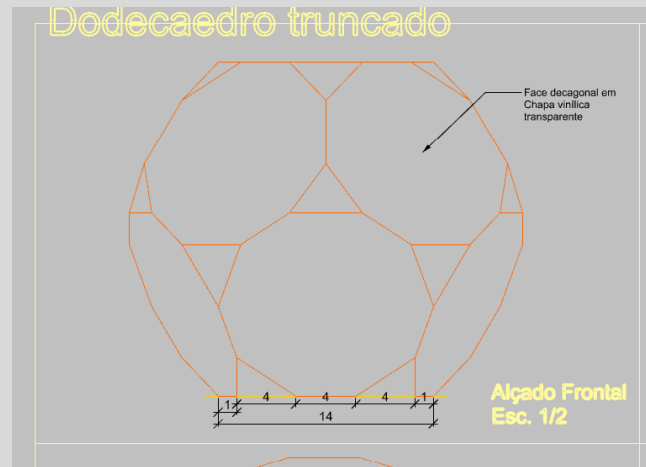
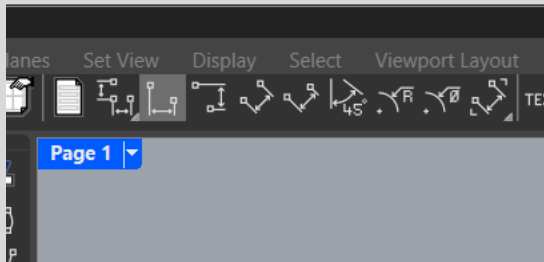
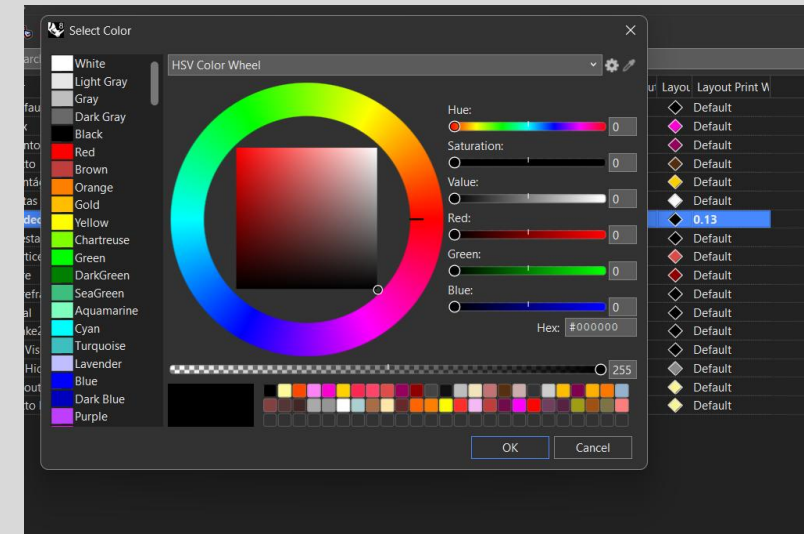
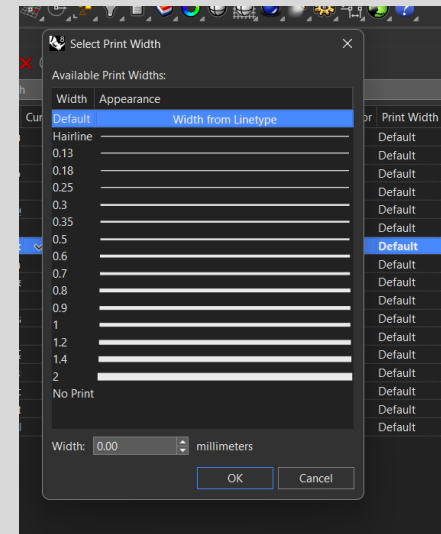
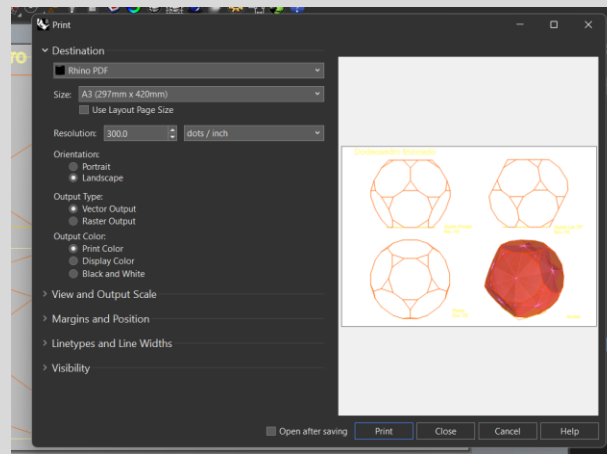
- Cont:
- Detail= viewport
 - New detail- nova janela
 - Alinhar as vistas
 - escala 1/2
 - Perspetiva do modelo



Aula. 5 – Layouts

Cont:

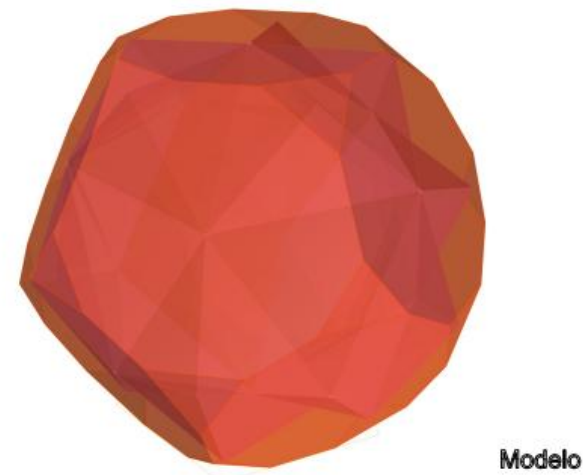
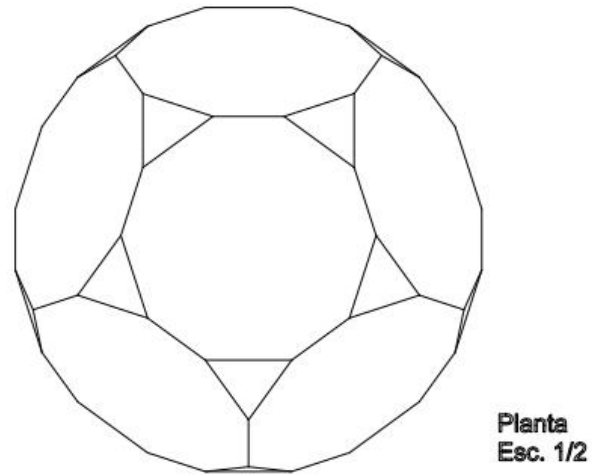
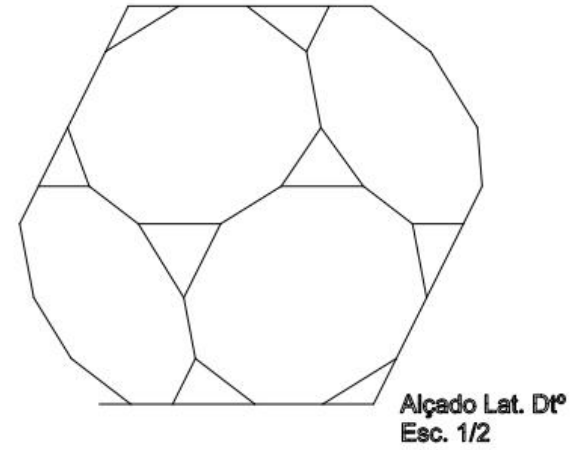
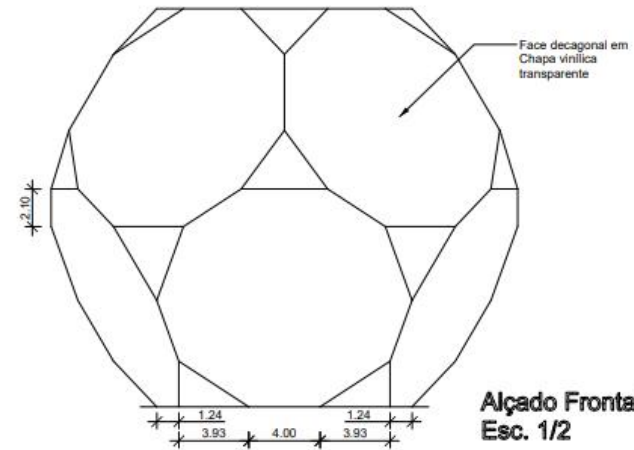
- Texto 5mm;
- Título 10mm
- File- print- preview
- Print color
- Cotagem: drafting- «linear dimension»
- Alteração de setas para Arquitetural ticks
- Aumento de casas decimais



Aula. 5 - Layouts

Layout:

Dodecaedro truncado



Aula. 5 – Layouts

1 - Modelação de superfícies de abóbada : Abóbada de Berço; Abóbada de Cisterna;

Abóbada Ogival; Abóbada Abatida.

2 - Abóbadas para entradas laterais de luz : Luneta Cilíndrica, Luneta Esférica e Luneta Cónica.

Aula. 6 - Abóbadas

Modelação de abóbadas derivadas de arcos:

- Abóbada de berço;
- Abóbada de cisterna;
- Abóbada ogival;
- Abóbada abatida.

Abóbada de berço :

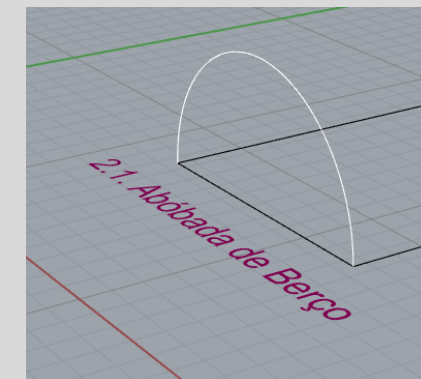
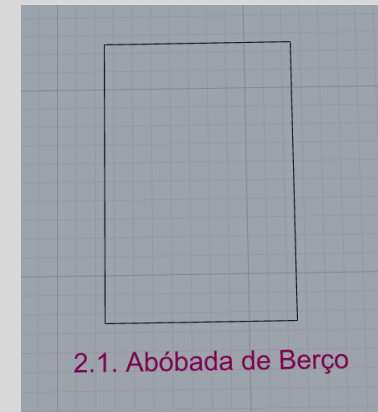
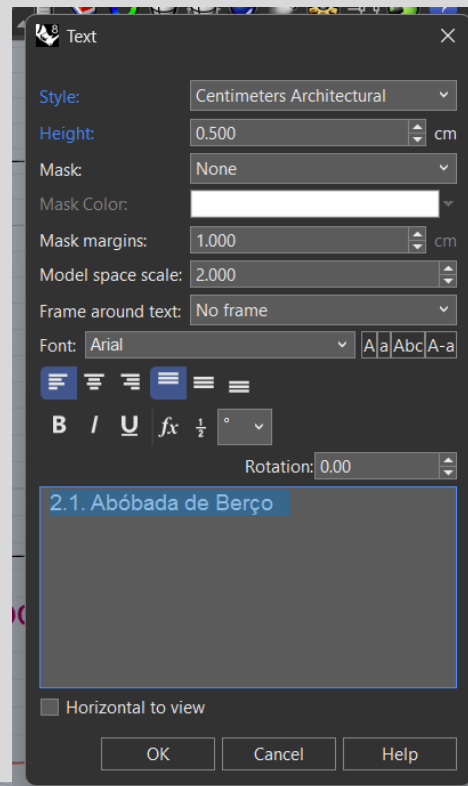
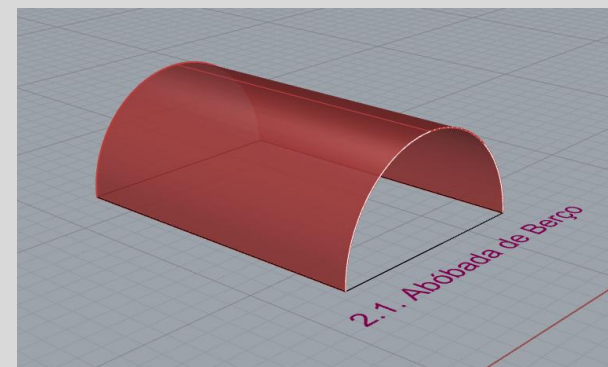
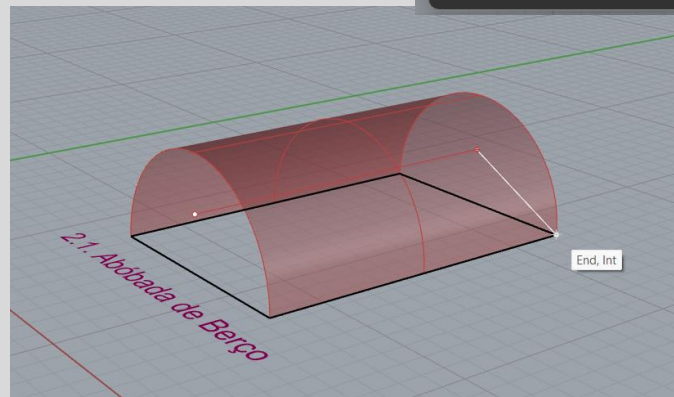
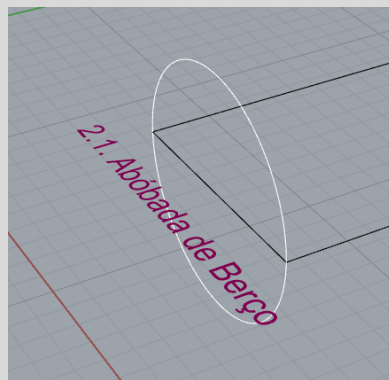
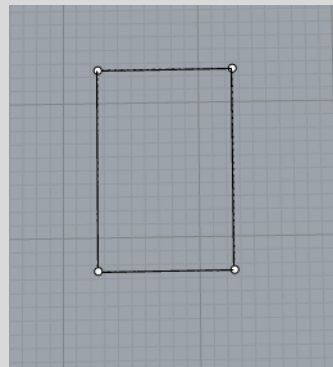
Começamos com um retângulo 10x15px;

Na layer texto aplicar- «text» a 0,5 cm;

Círculo- 2point nos vértices do retângulo

Trim na parte inferior do círculo

Extrude crv no meio círculo até ao vértice do retângulo

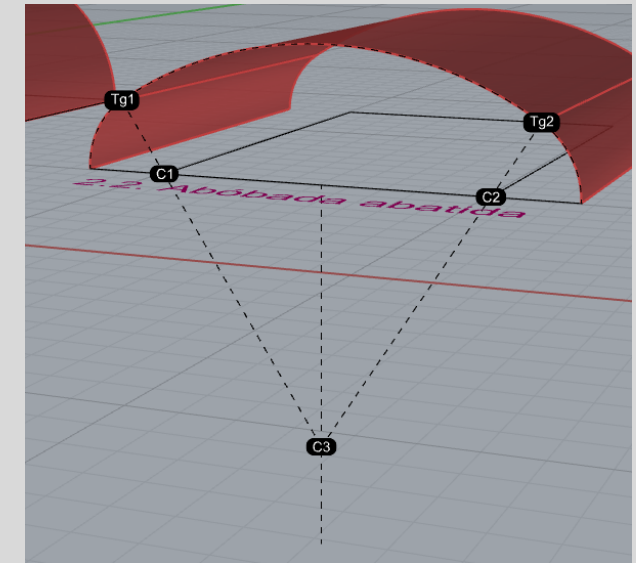
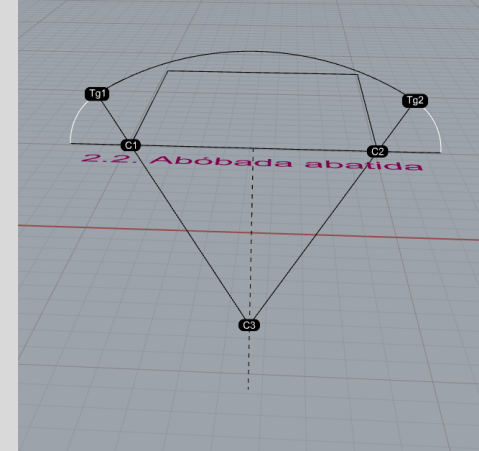
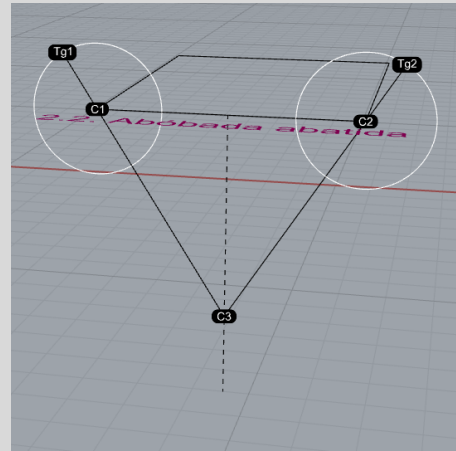
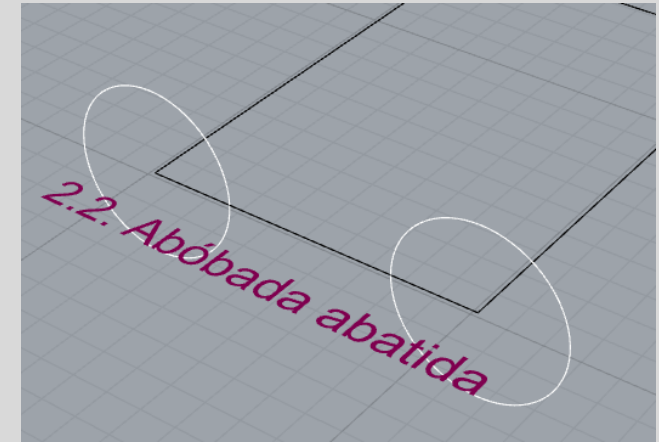
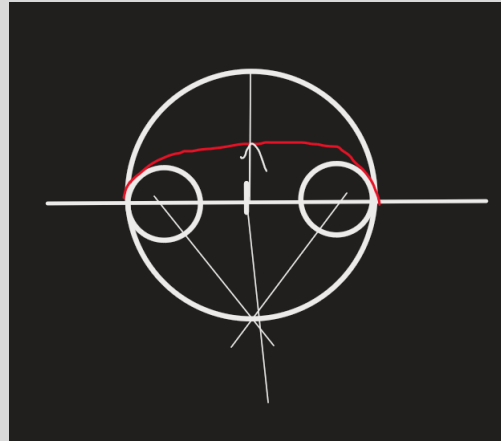


Modelação de abóbadas derivadas de arcos:

- Abóbada de berço;
- Abóbada de cisterna;
- Abóbada ogival;
- Abóbada abatida.

Abóbada abatida:

- Círculo;
- Círculos tangentes aos limites do 1º círculo;
- Reta vertical no centro do 1º círculo;
- Conectar os centros dos círculos à reta;
- Trim;
- Extrude crv.



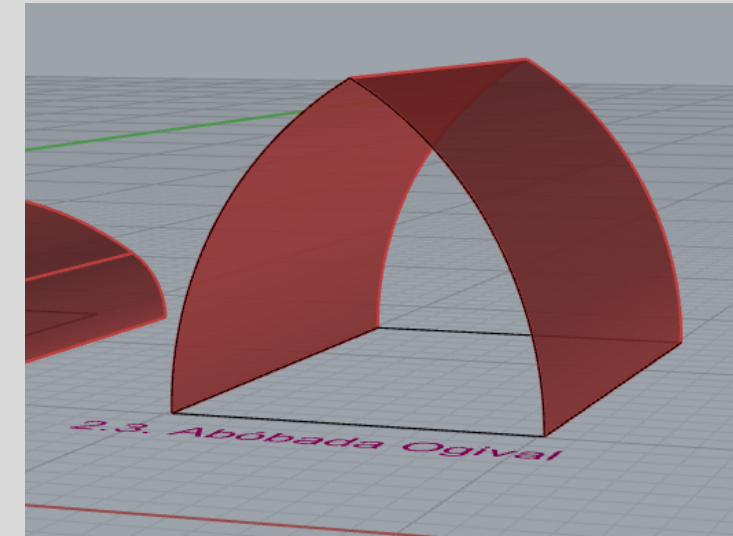
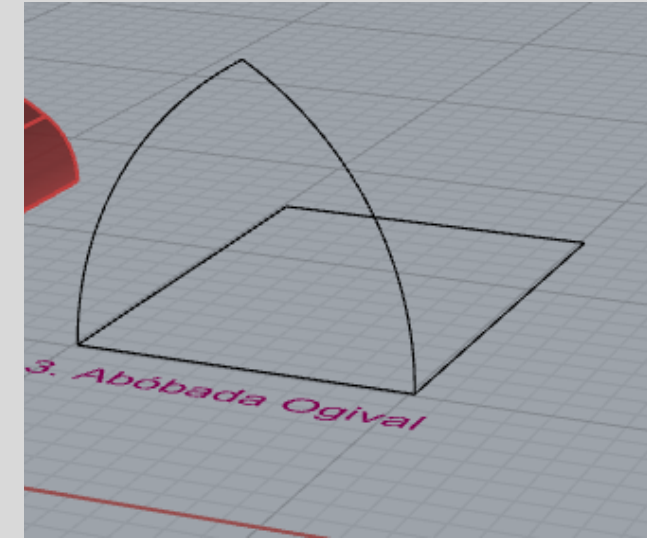
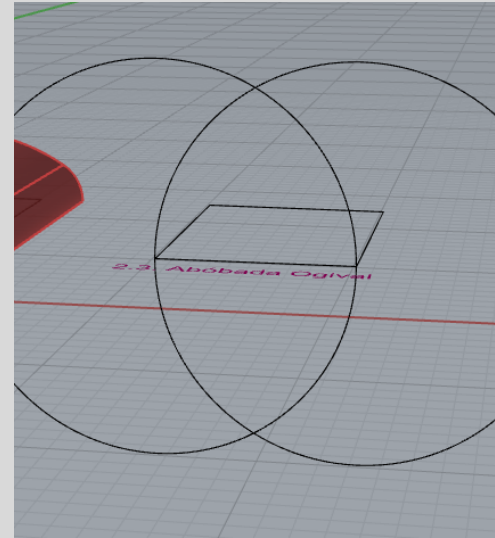
Aula. 6 – Abóbada abatida

Modelação de abóbadas derivadas de arcos:

- Abóbada de berço;
- Abóbada de cisterna;
- Abóbada ogival;
- Abóbada abatida.

Abóbada ogival:

- Círculo com raio igual à aresta mais pequena do retângulo;
- Trim para criar o arco;
- Extrude crv.



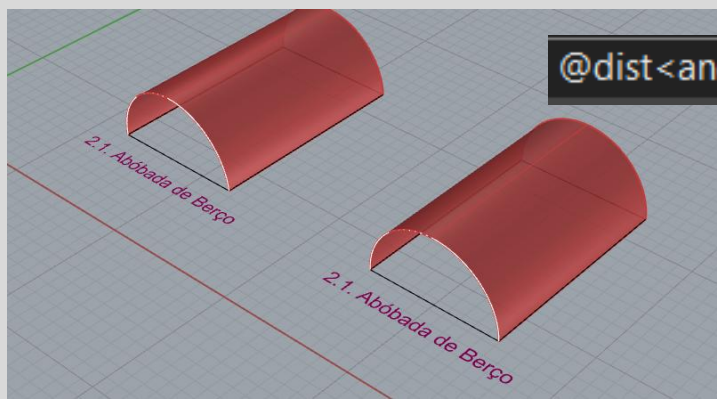
Aula. 6 – Abóbada ogival

Modelação de abóbadas derivadas de arcos:

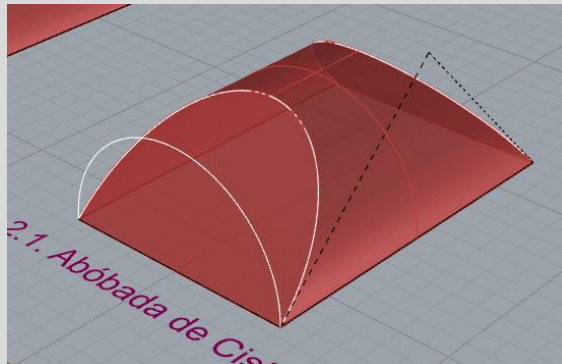
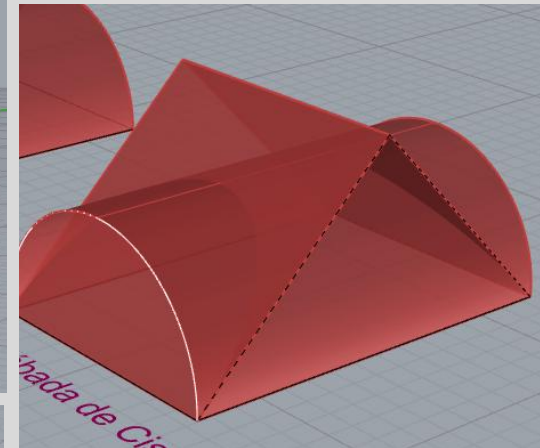
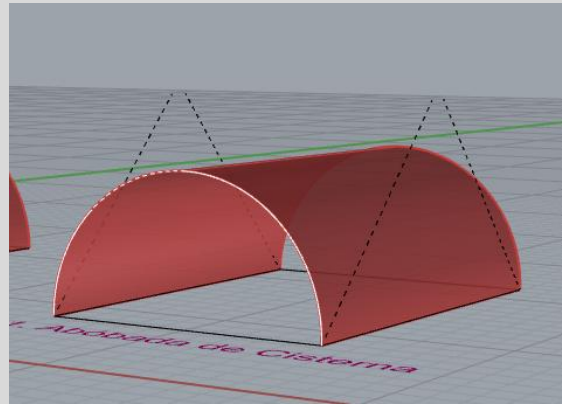
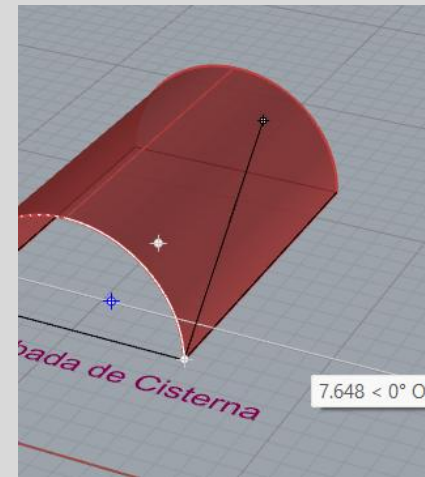
- Abóbada de berço;
- Abóbada de cisterna;
- Abóbada ogival;
- Abóbada abatida.

Abóbada de cisterna:

- Copy a abóbada de berço;
- Line @10<90<45
- Line @10<-90<45
- Extrudecrv na linha a picotado
- Object intersection
- Trim



@dist<ang.horizontal<ang.vert



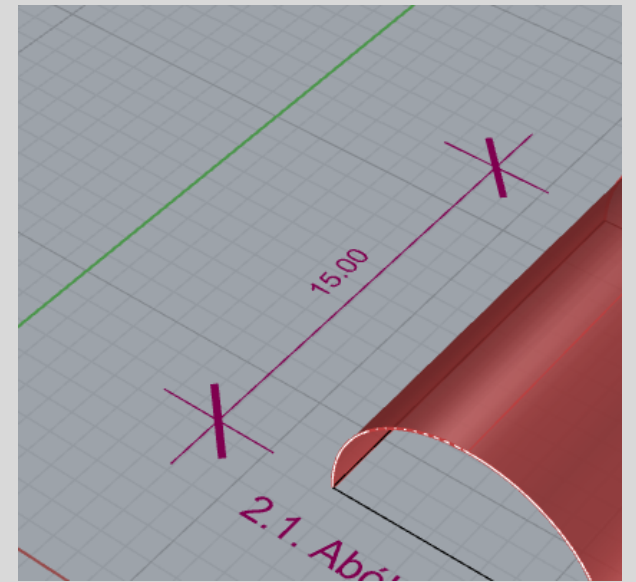
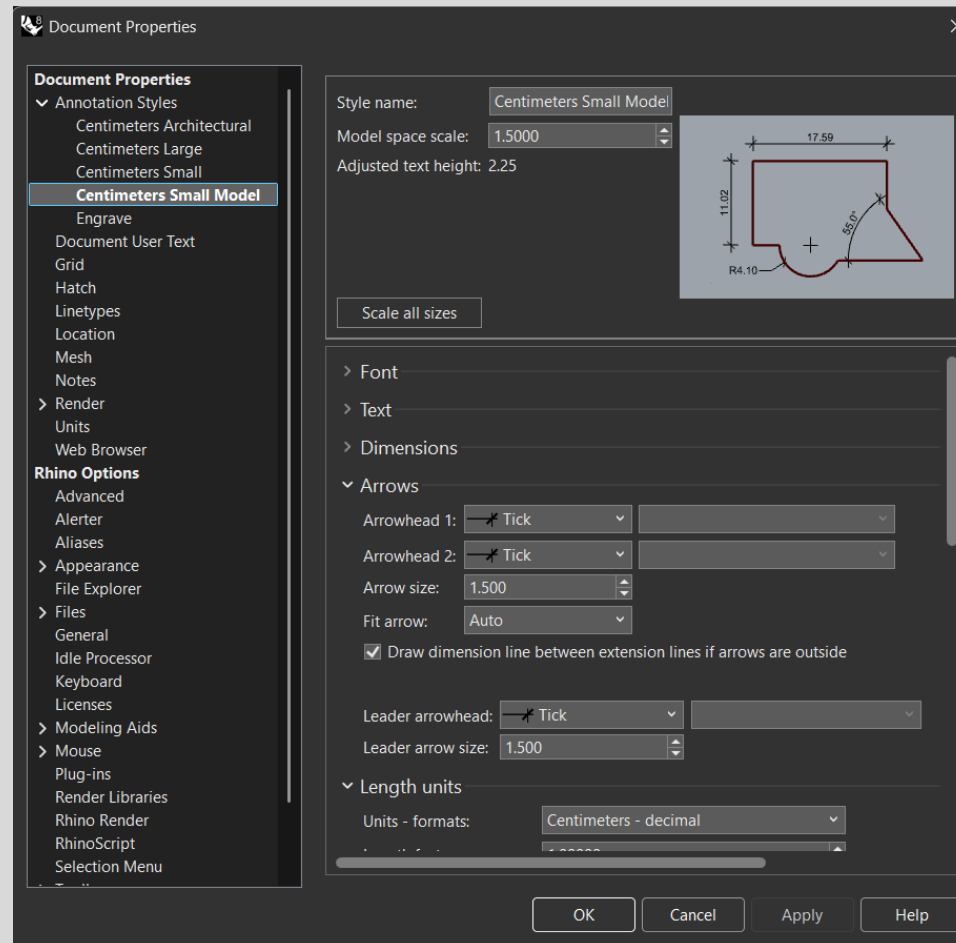
Aula. 6 – Abóbada de cisterna

Modelação de abóbadas derivadas de arcos:

- Abóbada de berço;
- Abóbada de cisterna;
- Abóbada ogival;
- Abóbada abatida.

Abóbada de cisterna:

- Copy a abóbada de berço;
- Line @10<90<45
- Line @10<-90<45
- Extrudecrv na linha a picotado
- Object intersection
- Trim



Aula. 6 – Abóbada de cisterna

Luneta cilíndrica:

-Abobada de berço

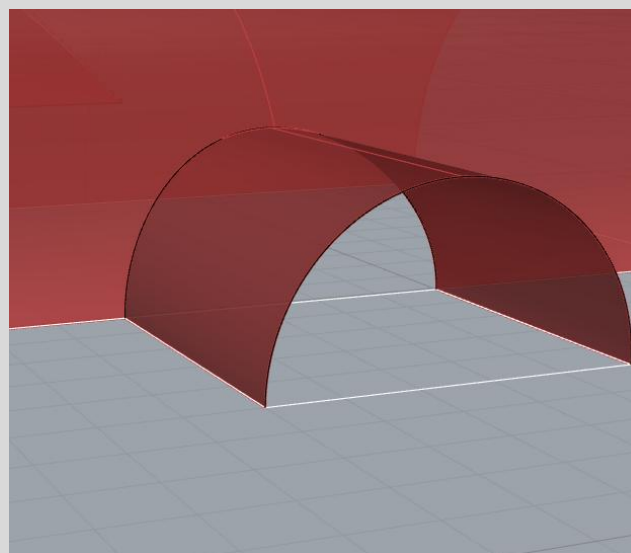
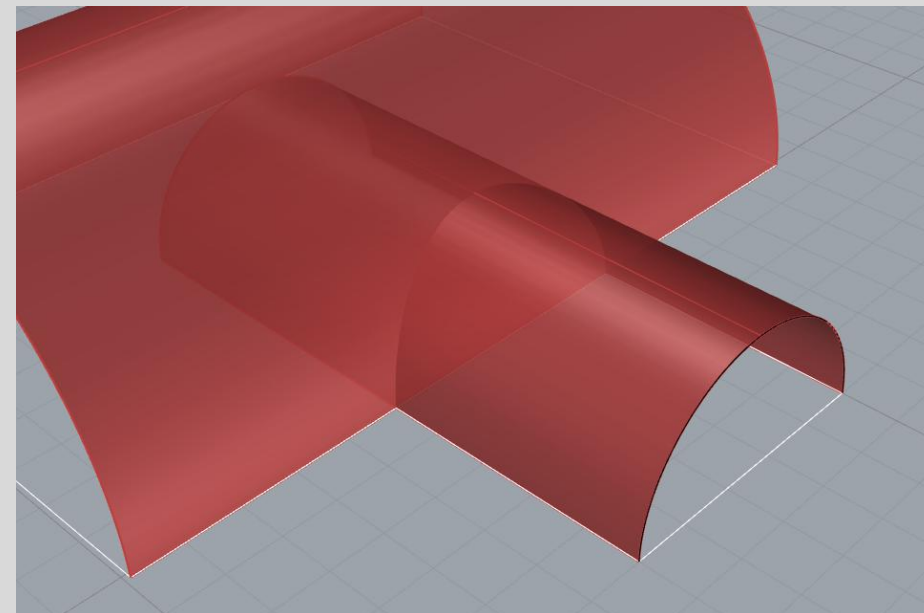
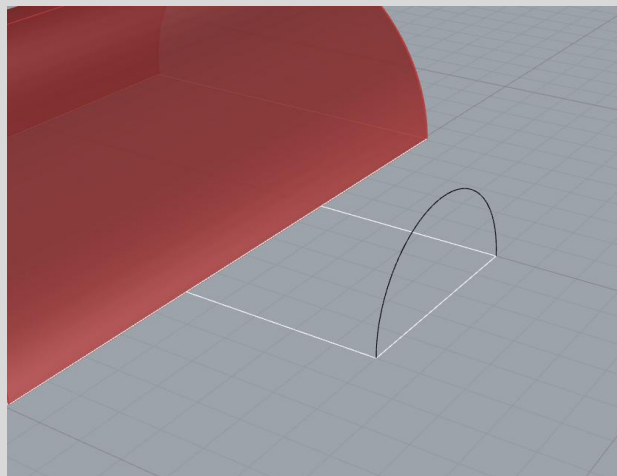
- Retângulo 5x5

- Círculo vertical na aresta (2 points)

- Extrude crv

- Objects intersect

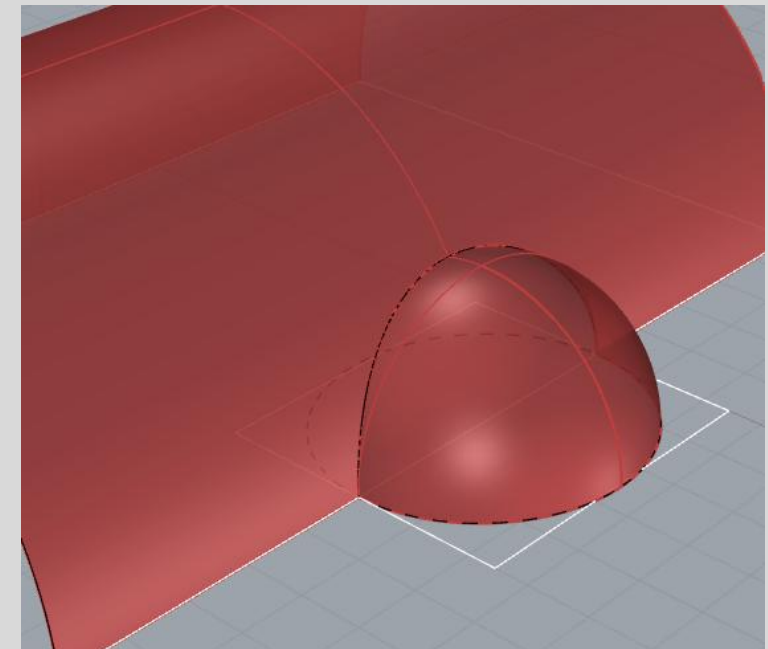
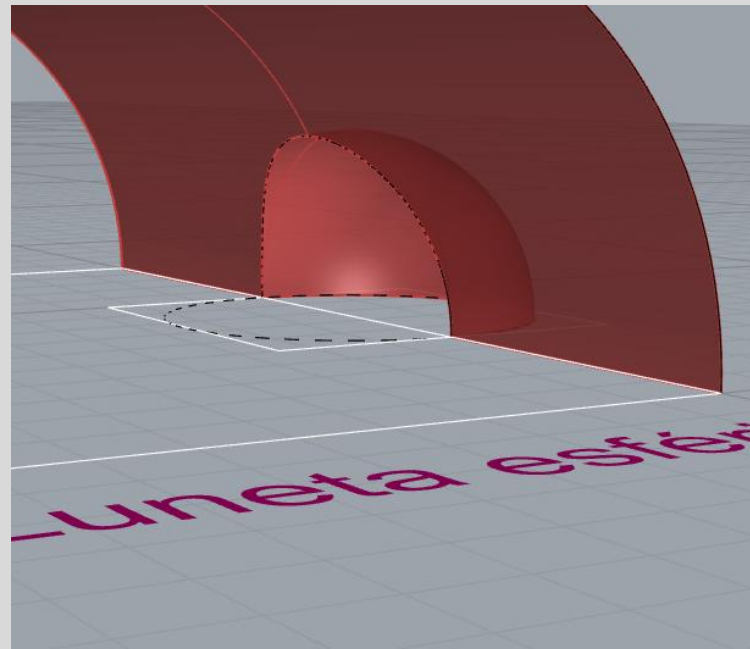
- Trim



Aula. 6 – Luneta cilíndrica

Luneta esférica:

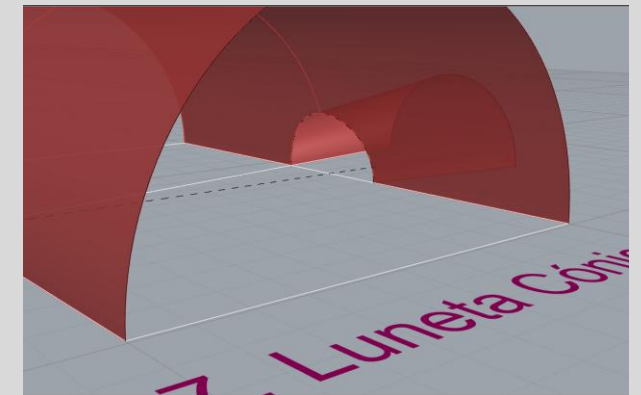
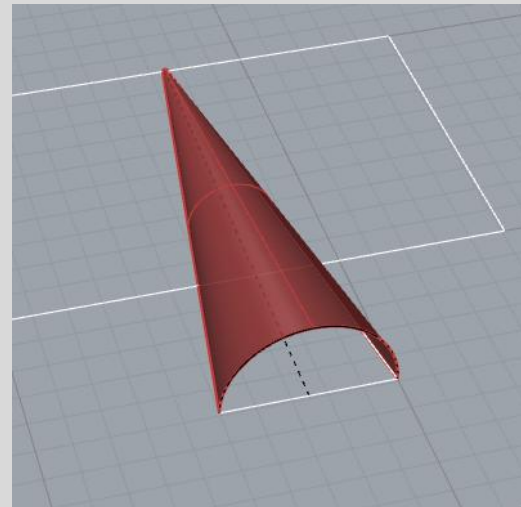
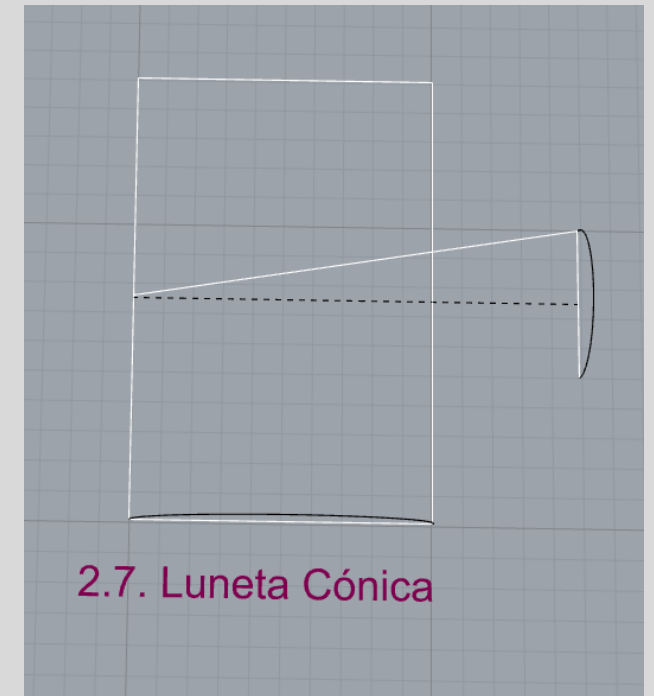
- retângulo e quadrado com centro no ponto médio da aresta do retângulo
- Arco com diâmetro igual à aresta mais pequena do retângulo
- Circulo com centro no centro do quadrado e raio 2,5cm
- Esfera com centro e raio igual ao circulo
- Extrude crv no arco para fazer a abobada
- trim no excesso da esfera
- Objects intersect entre a esfera e a abobada
- Trim na abóbada



Aula. 6 – Luneta esférica

Luneta cônica:

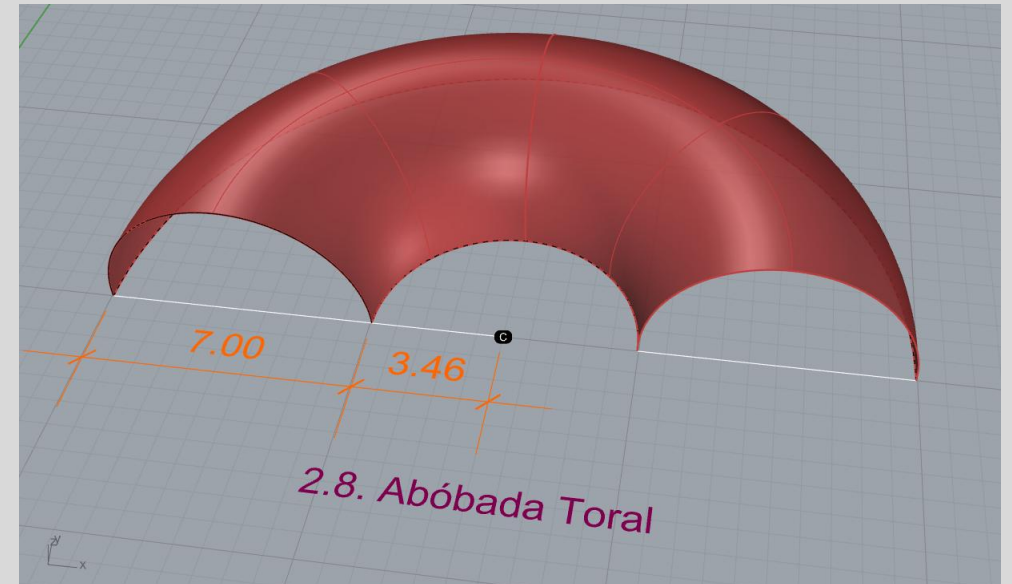
- copy do retângulo e arco da luneta anterior
- reta a 5cm do retângulo com o seu ponto médio no mesmo eixo do ponto médio do retângulo
- arco com 5cm de diâmetro na reta
- Geratriz do cone do vértice do arco até ao ponto médio da aresta oposta do retângulo



Aula. 6 – Luneta cônica

Abóbada Toral:

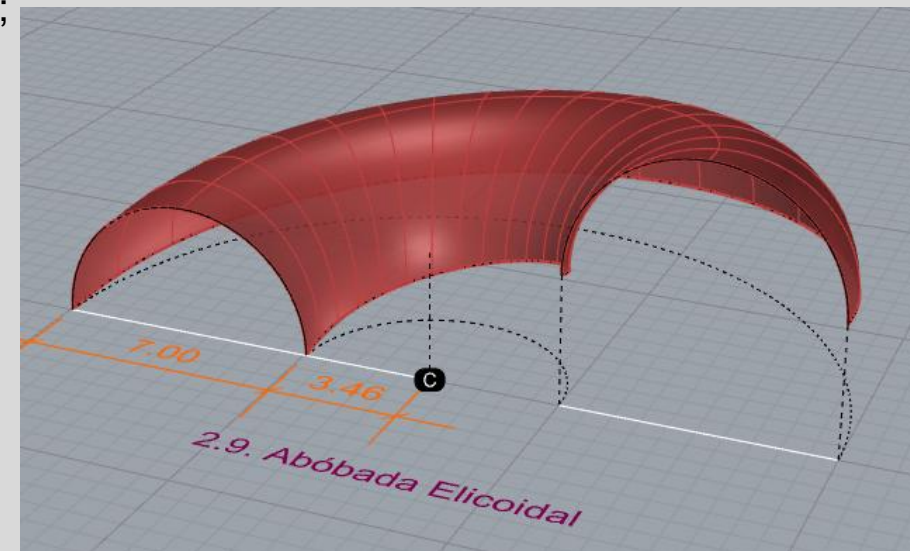
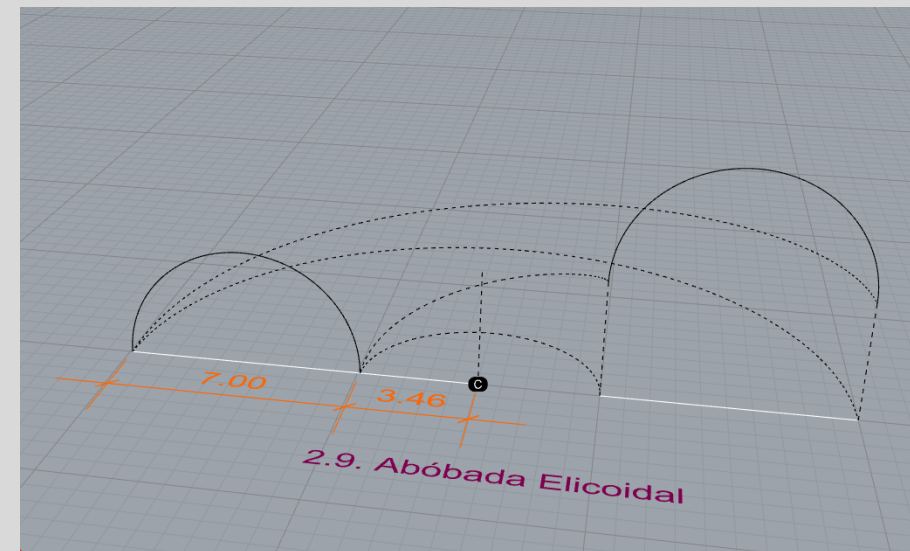
- Copy do arco da luneta anterior
- circunferência com centro C a 5cm dps do diâmetro do arco e raio 15cm
- Circunferência com 5cm de raio com centro em C
- Copy arco para a interseção do diâmetro maior com a circunferência menor
- Extrude crv nos arcos



Aula. 6 – abóbada toral

Abóbada Helicoidal:

- Copia-se o arco e o seu diâmetro da luneta anterior;
- Circunferência com centro a 5cm à direita do diâmetro do arco (C) e raio 5cm;
- Circunferência com centro no mesmo ponto que a anterior e raio 15cm;
- Reta vertical no ponto C e duas retas com 5cm de altura nos pontos em que as circunferências intersectam o diâmetro da maior;
- Copy arco para as retas verticais com 5cm
- Comando «Helix» com centro c, reversed e nos pontos do arco até ao outro arco;
- Extrude crv



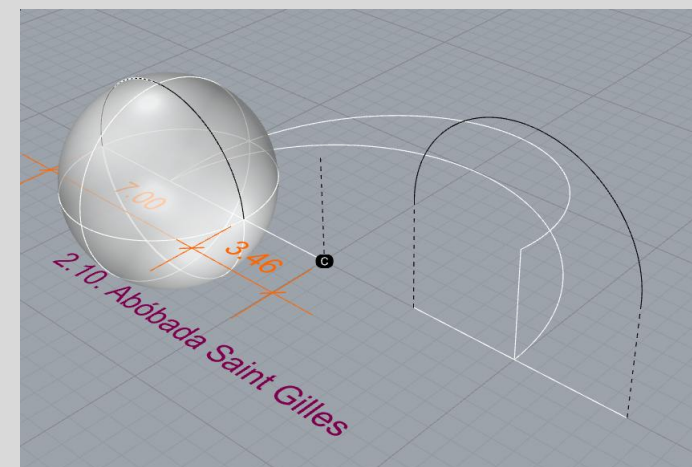
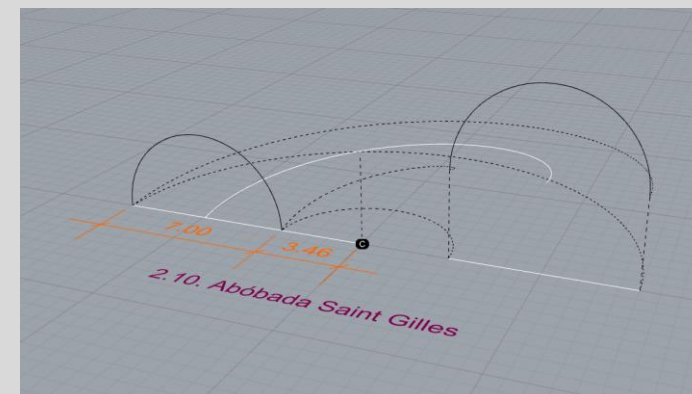
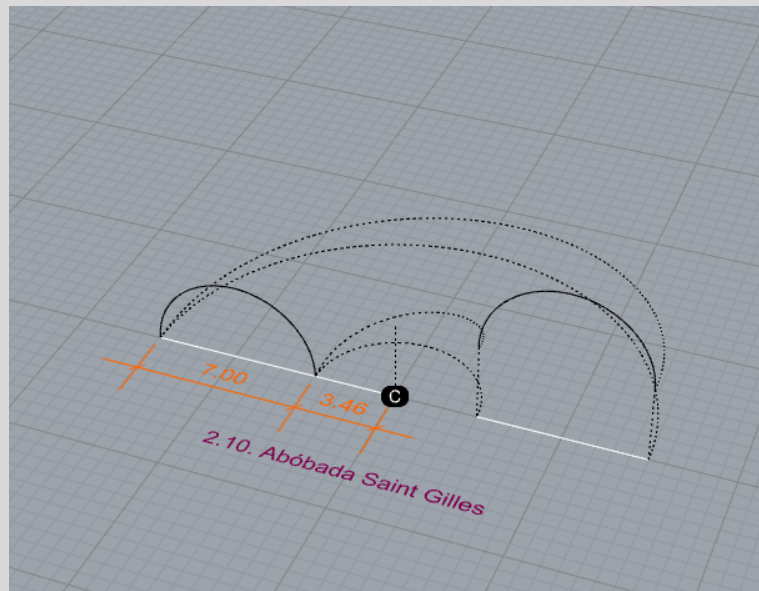
Aula. 6 – abóbada helicoidal

Continuação da modelação geométrica de superfícies de abóbadas : Abóbadas curvas: Abóbada Tórica ou Toral, Abóbada Helicoidal e Abóbada de Sain Gilles; Abóbadas esféricas: Abóbada Esférica, Abóbada de Vela, Abóbada de Vela Alongada e Abóbada Catalã; **Abóbadas alvoradas:** Abóbada Alvorada e Abóbada Alvorada de Bolbo.

Aula. 7 - Abóbadas

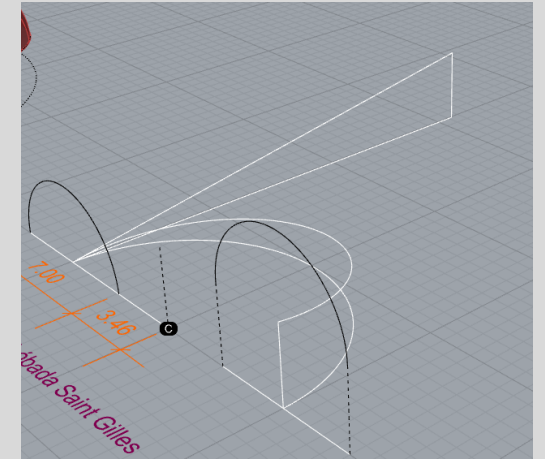
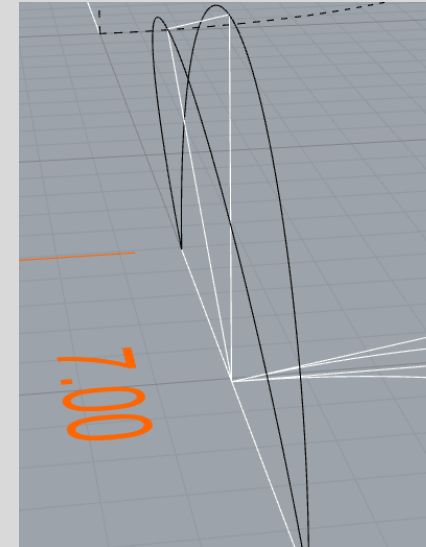
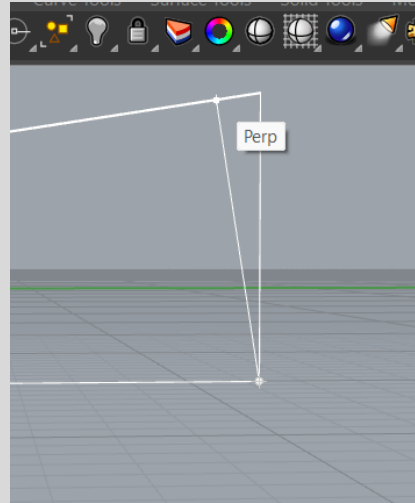
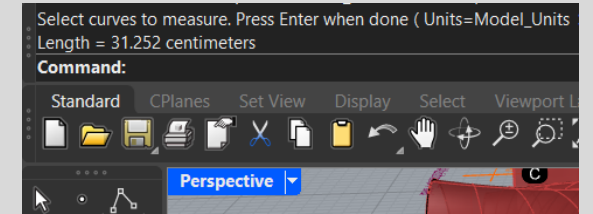
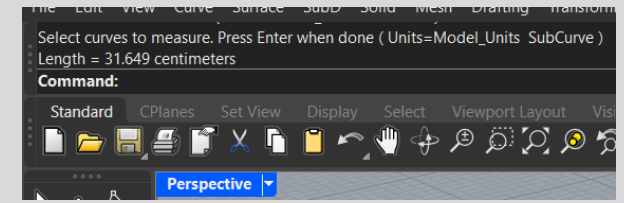
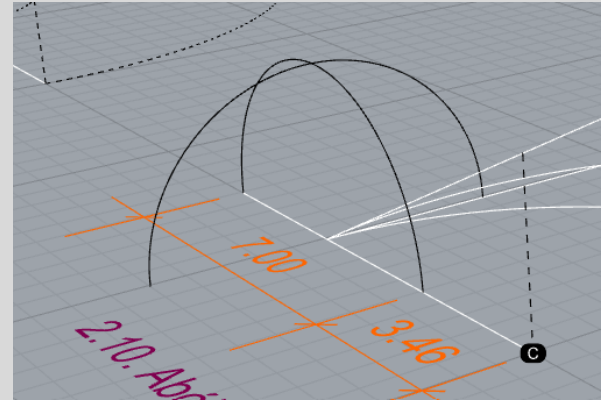
Helix- vertical, reverse twist radio até midpoint do arco

Esfera- raio midpoint até arco



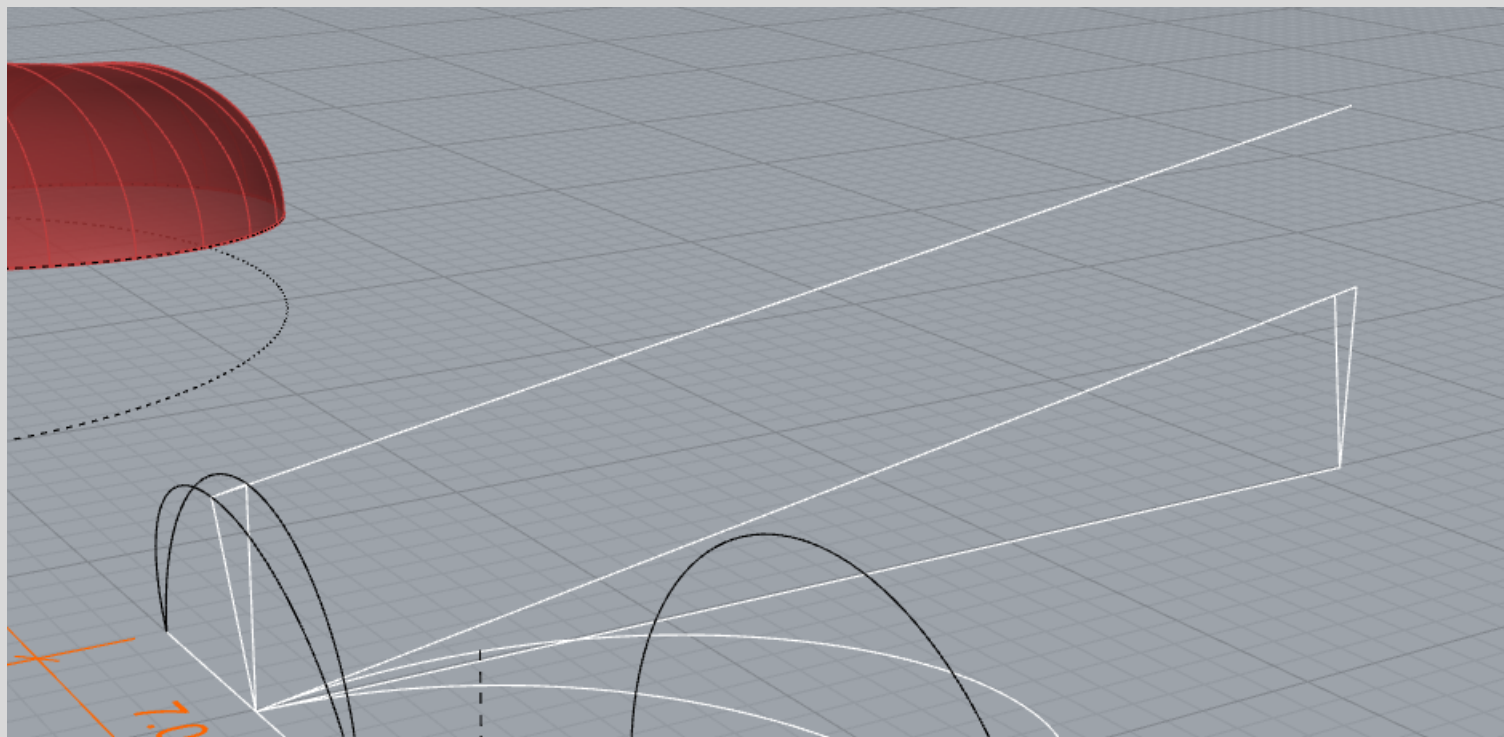
Aula. 7 – Abóbada Saint Gilles

Length da curva em hélice- 31,649cm
Length do arco horizontal- 31,252cm
Fazer lines a direito



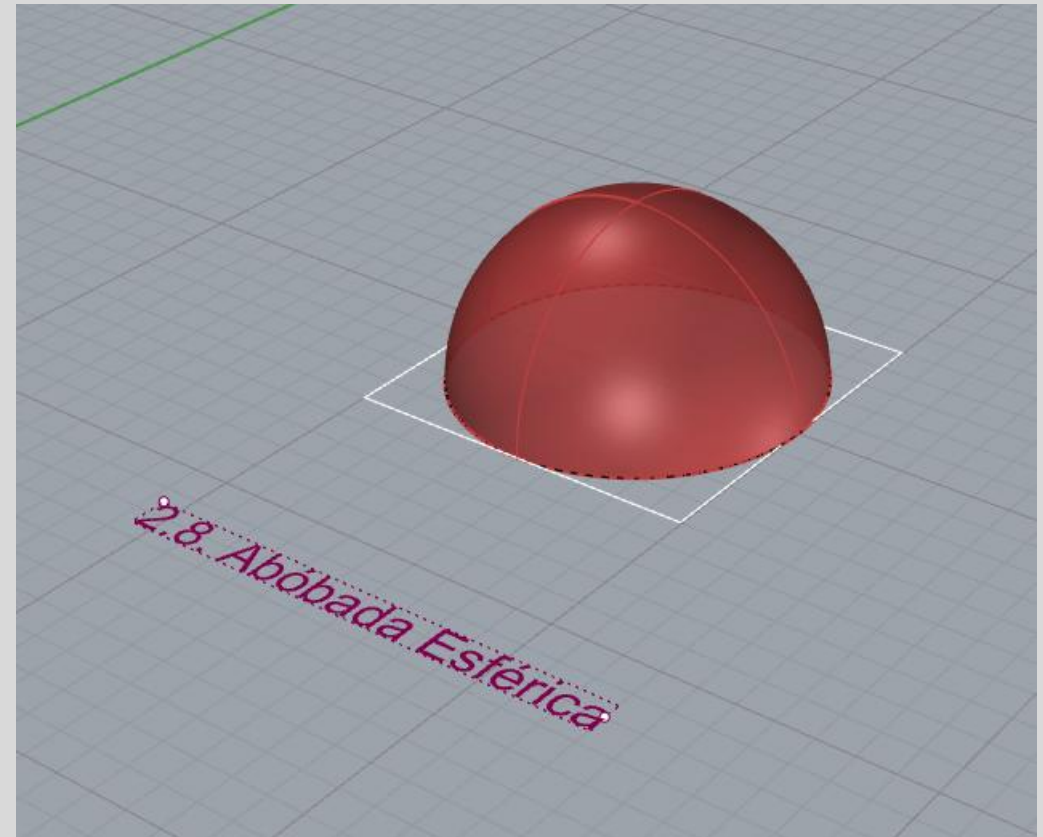
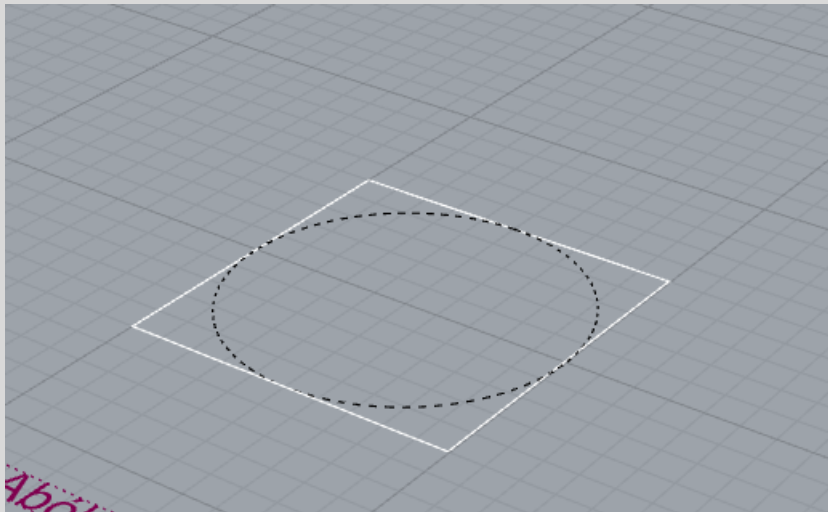
Aula. 7 – Abóbada Saint Gilles

Length da curva em hélice- 31,649cm
Length do arco horizontal- 31,252cm
Fazer lines a direito



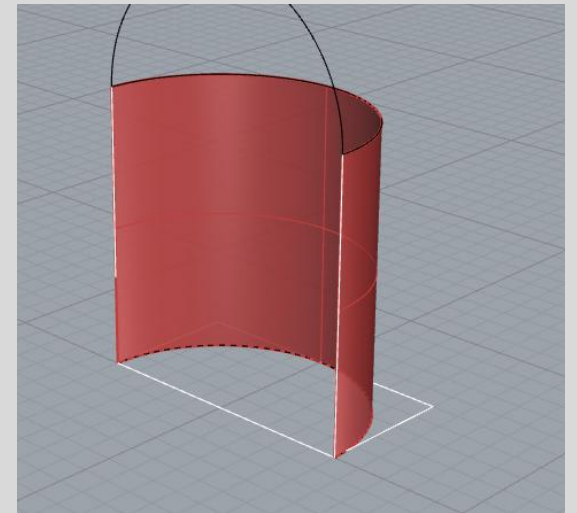
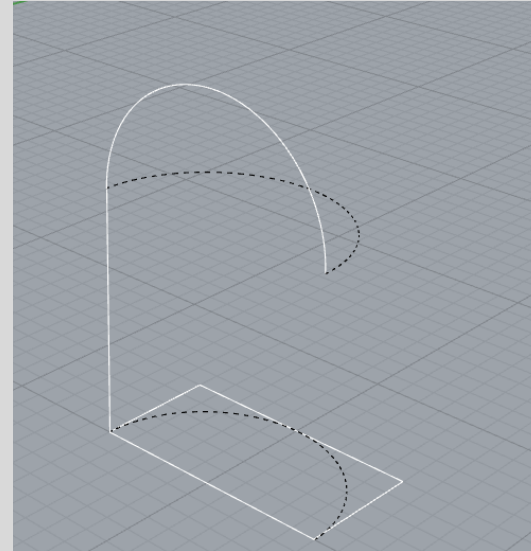
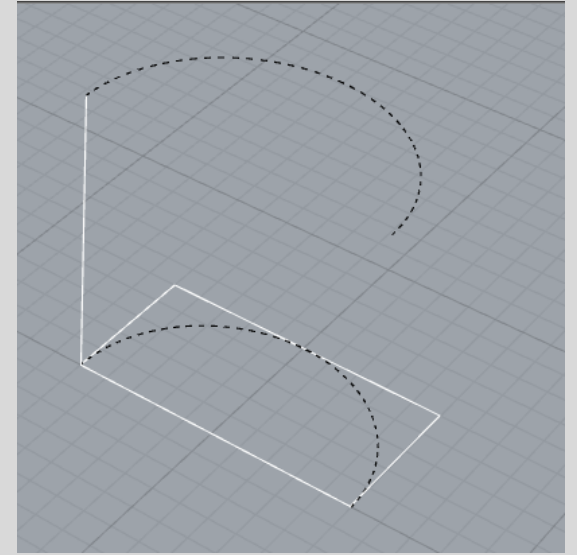
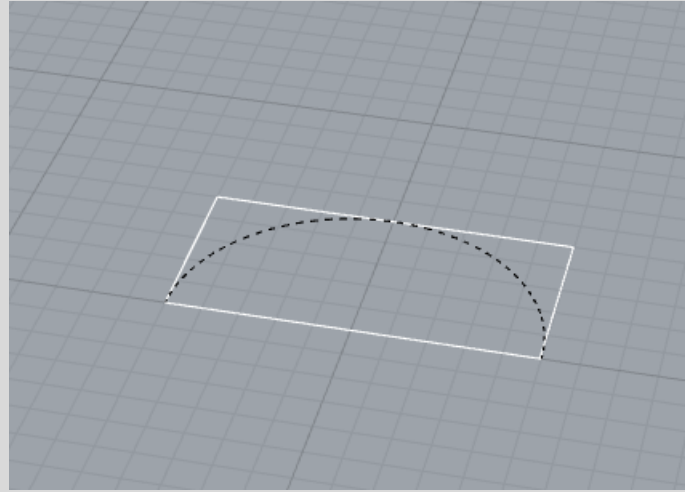
Aula. 7 – Abóbada Saint Gilles

Length da curva em hélice- 31,649cm
Length do arco horizontal- 31,252cm
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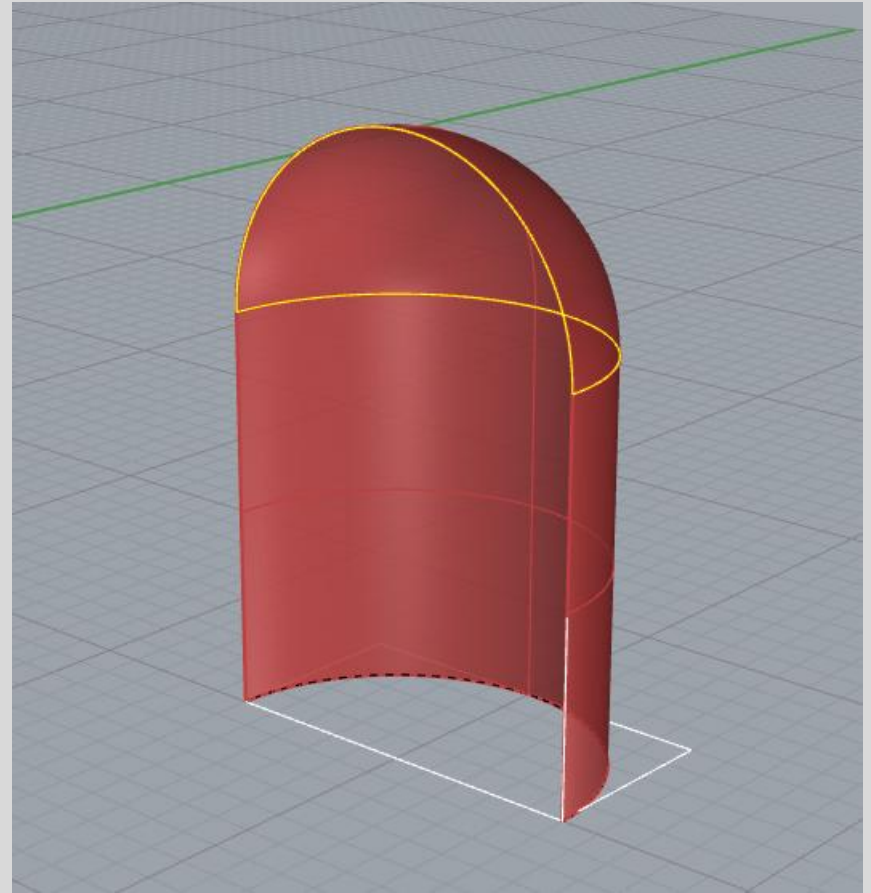
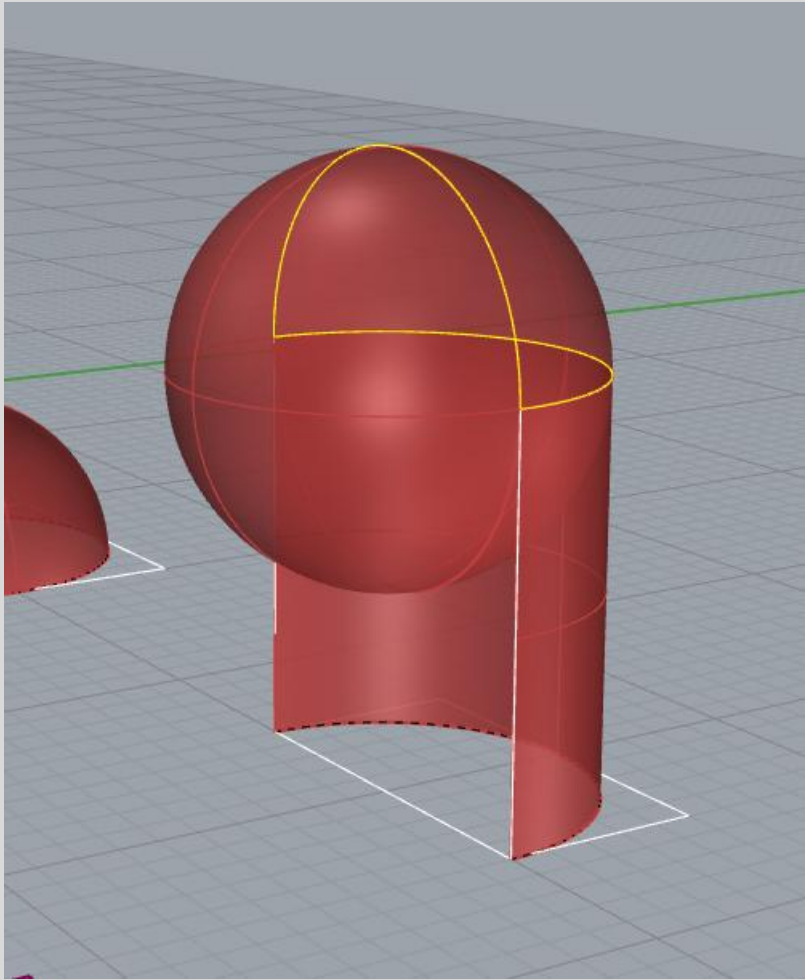
Aula. 7 – Abóbada Esférica

Loft



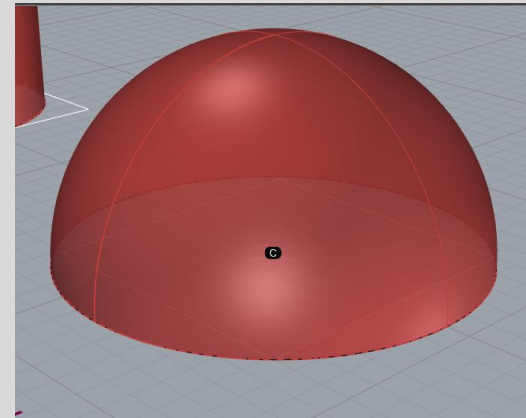
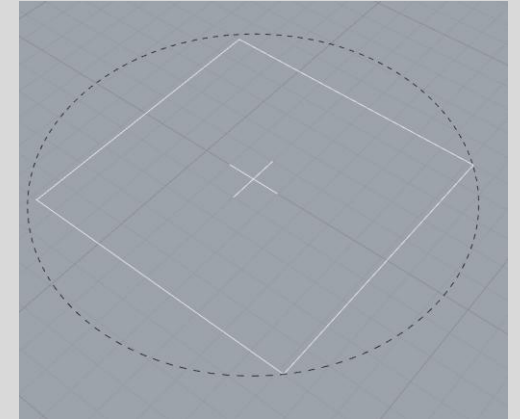
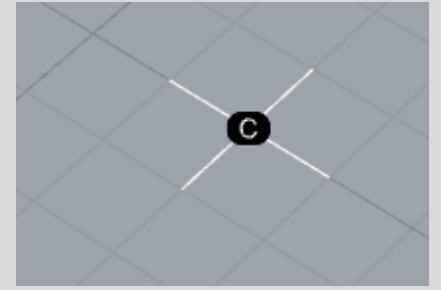
Aula. 7 – Abóbada de Forno

Sphere
trim



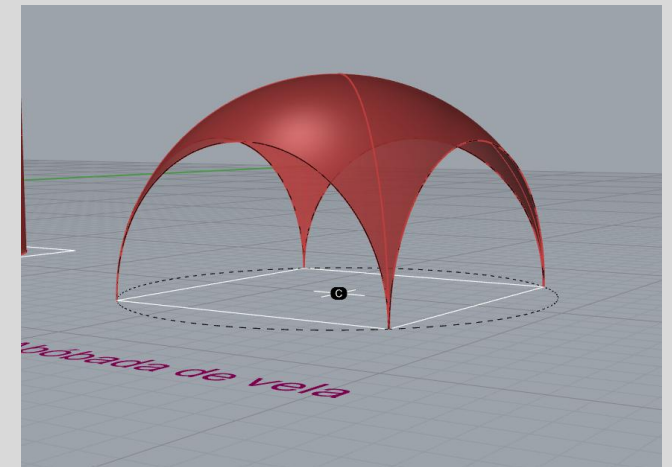
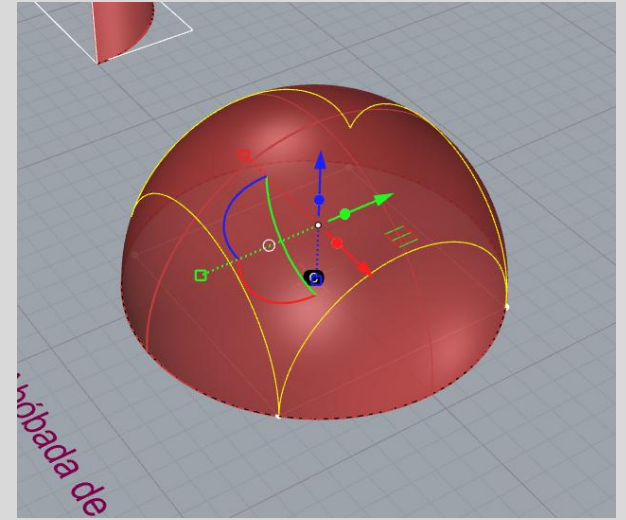
Aula. 7 – Abóbada de Forno

Bla



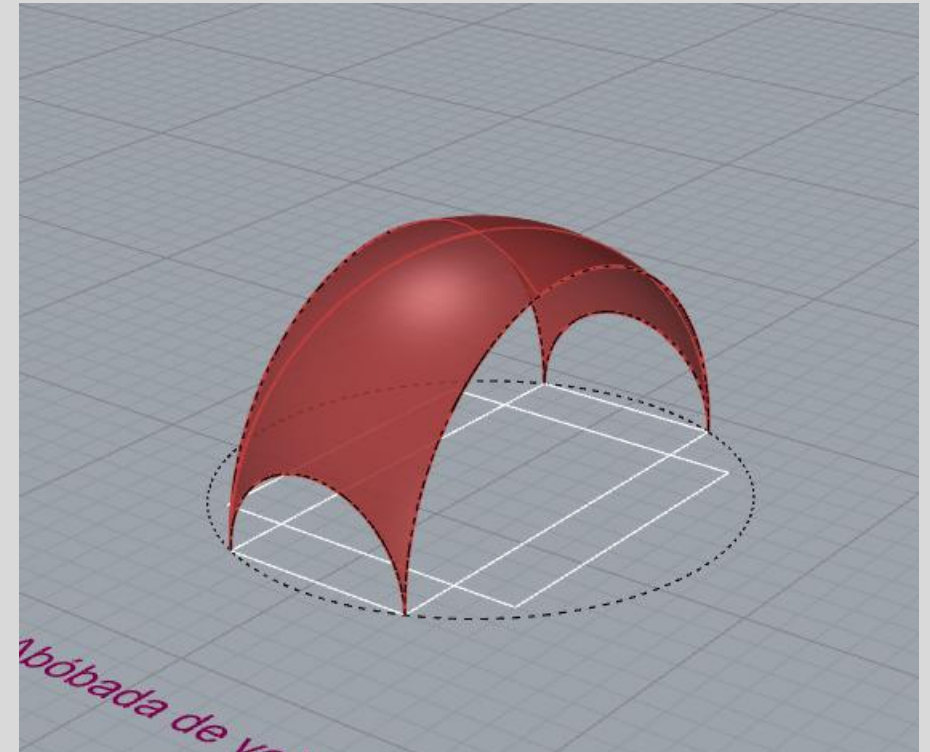
Aula. 7 – Abóbada de vela

Project
trim



Aula. 7 – Abóbada de vela

trim



Aula. 7 – Abóbada de Vela Alongada

Project

Aula. 7 – Abóbada Alveolada

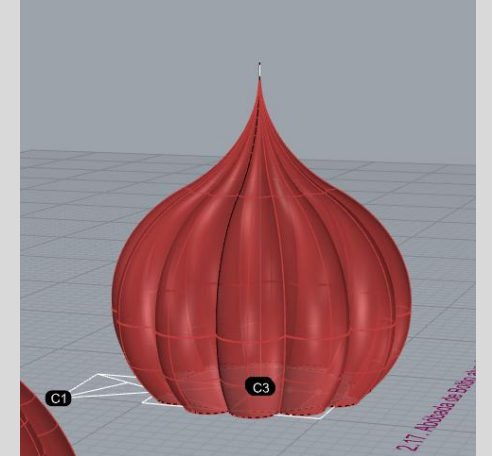
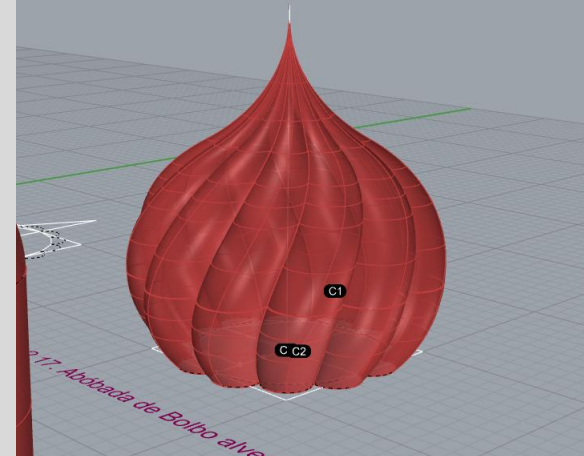
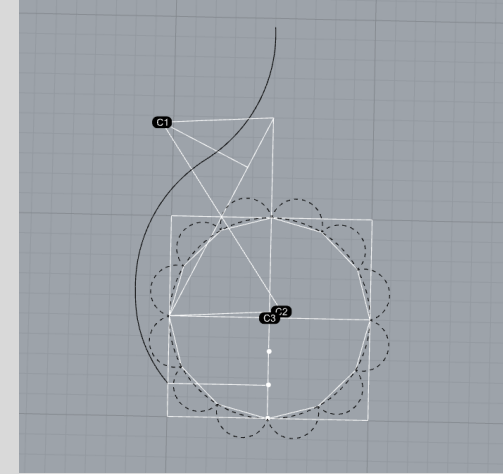
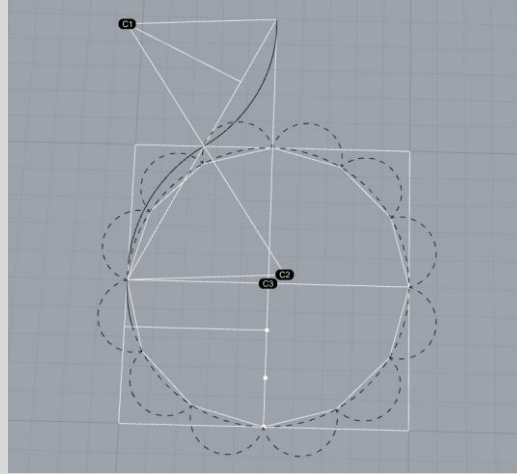
1 - Introdução ao Grasshopper - aplicação de programação visual do Rhino : análise do interface; programação por componentes aplicados sobre o plano da tela;

Ligação entre componentes por fios - wires; análise do automatismo entre a tela do Grasshopper e a pré-visualização no plano de trabalho do Rhino.

2 - Rhino : Modelação de superfícies curvas - Exercício dos Moluscos : Spirula, Planorbis, Nautilus e Caramujo do Mar.

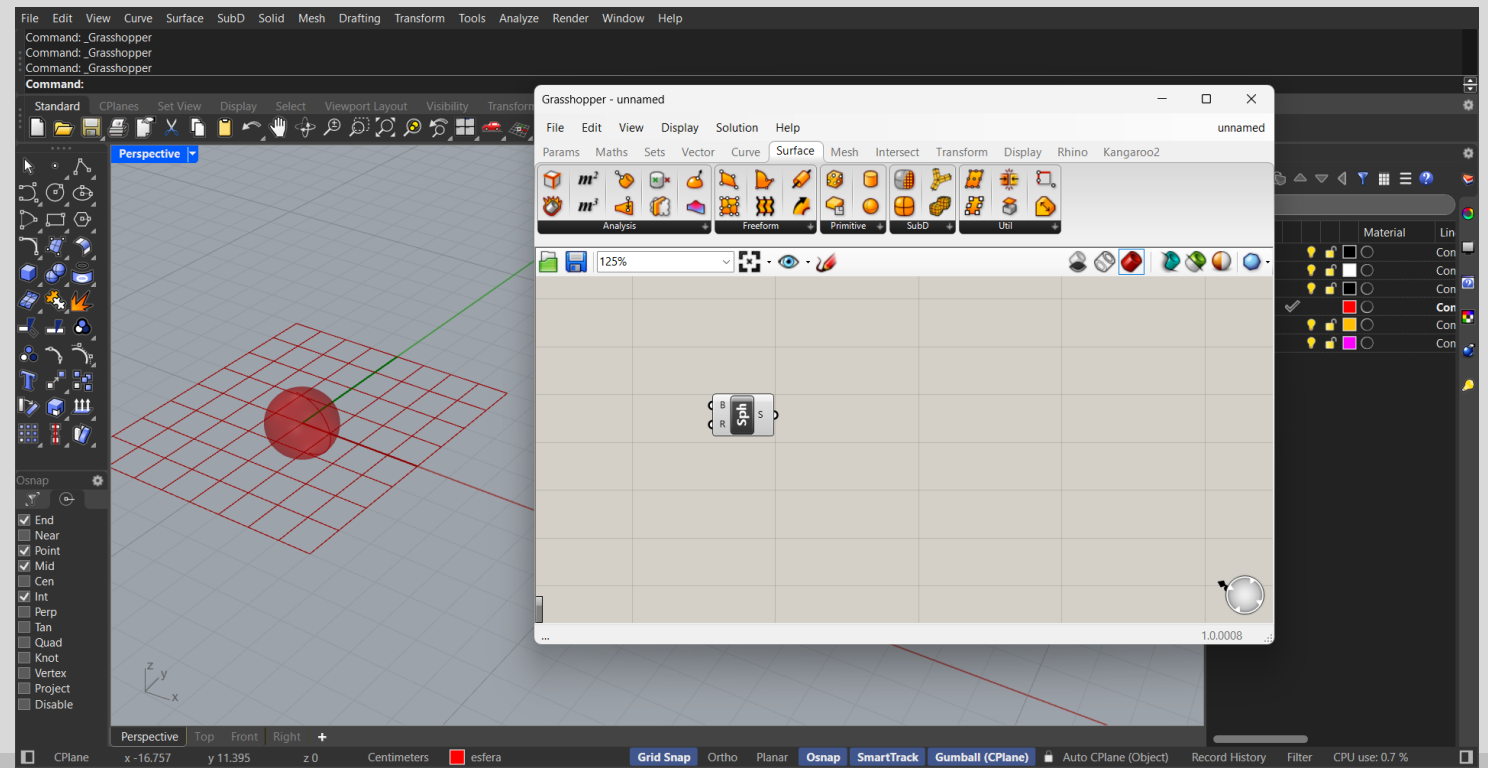
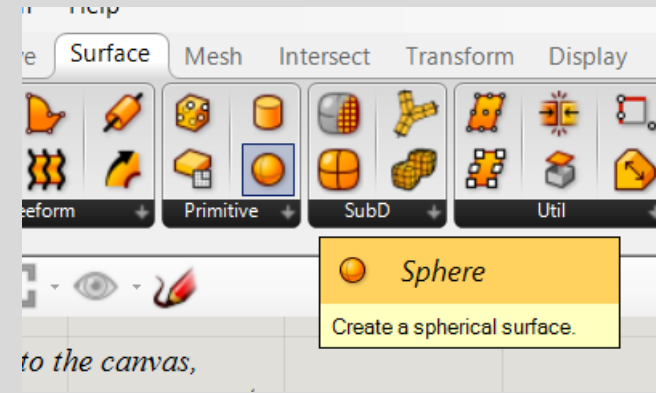
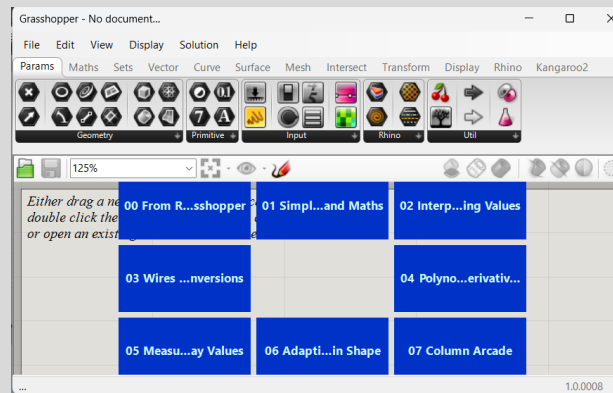
Aula. 8- Abóbadas

Twist
Railrevolve
Split



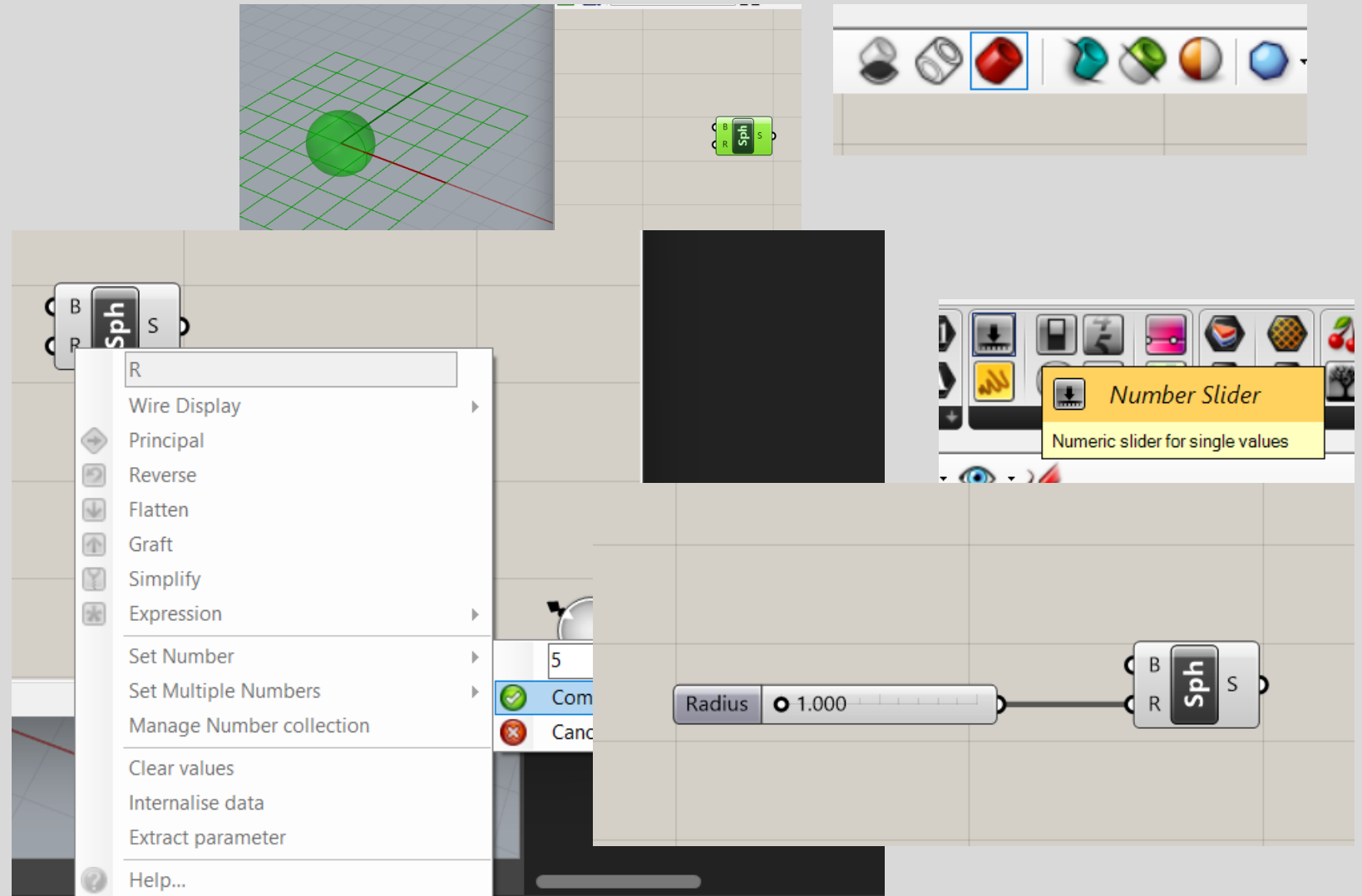
Aula. 8- Abóbada de Bolbo Alvéolada

Grasshopper



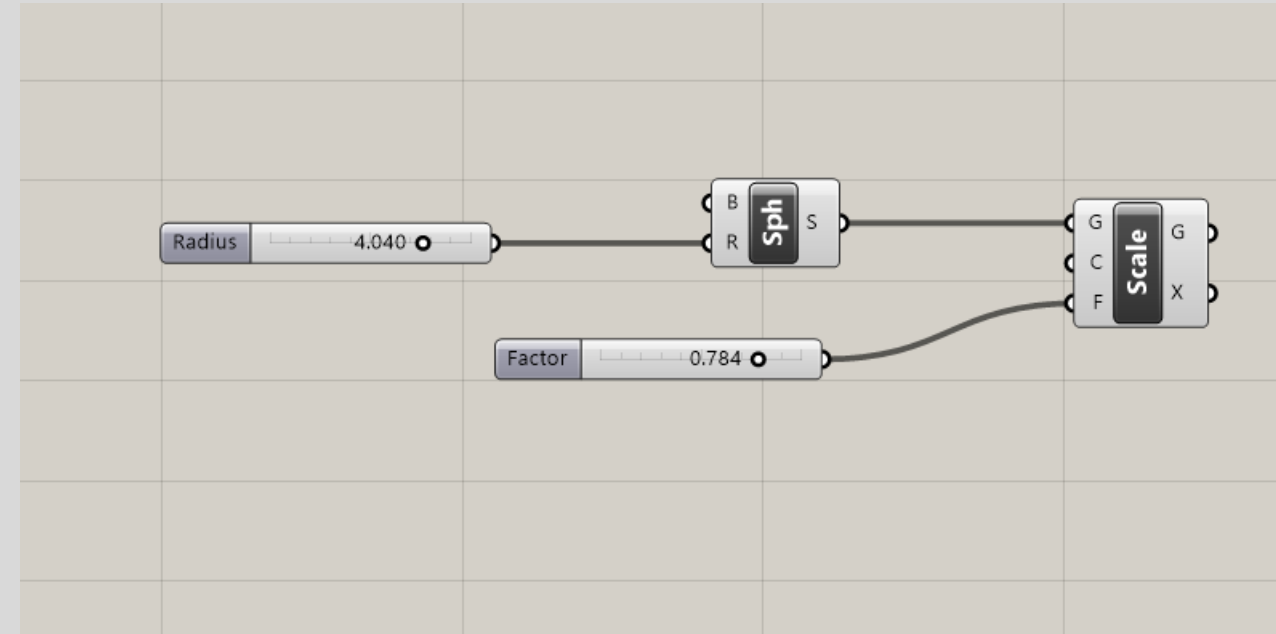
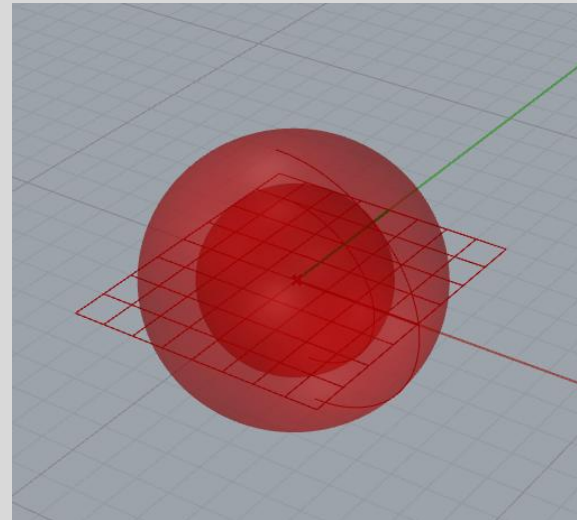
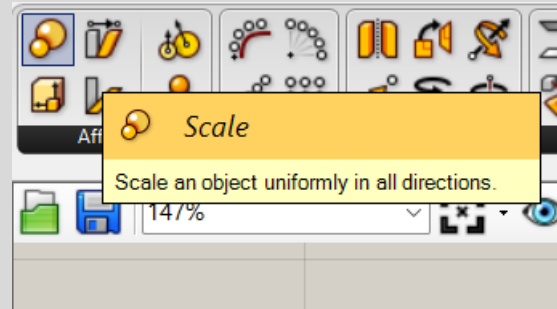
Aula. 8- Programação em Rhino

Grasshopper



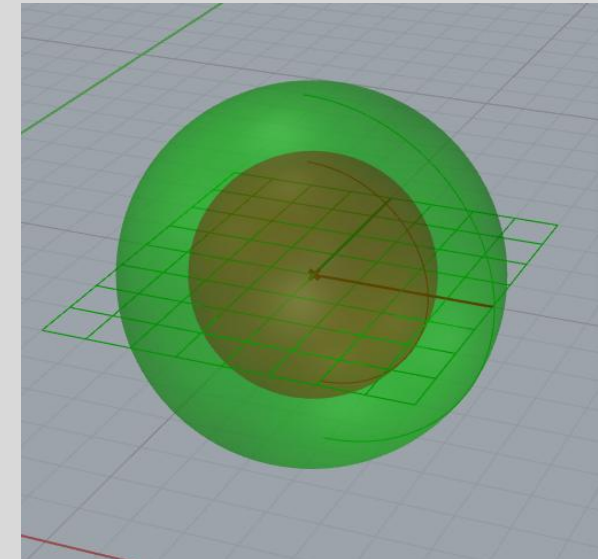
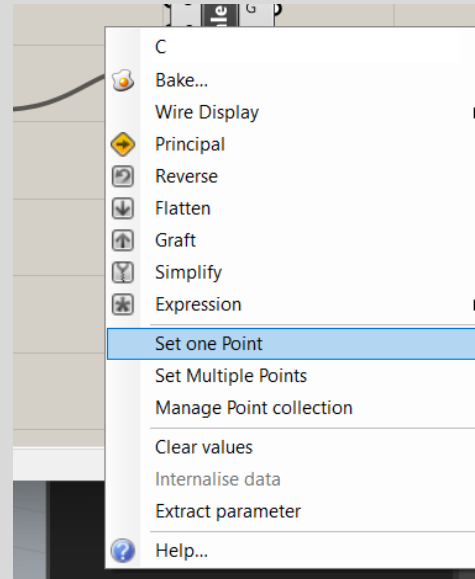
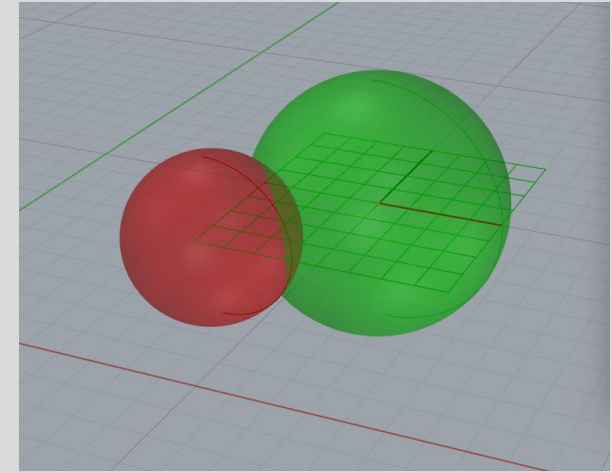
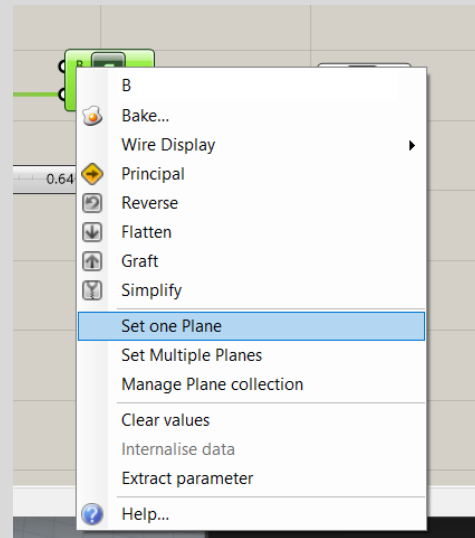
Aula. 8- Programação em Rhino

Grasshopper



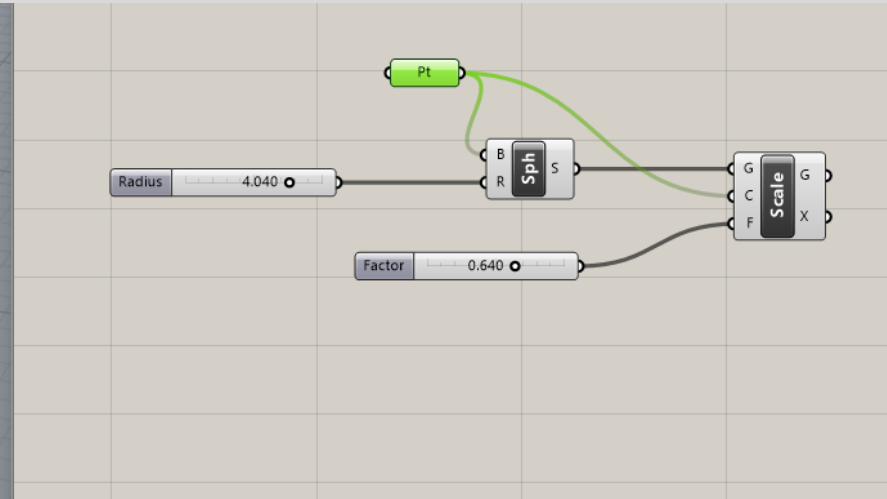
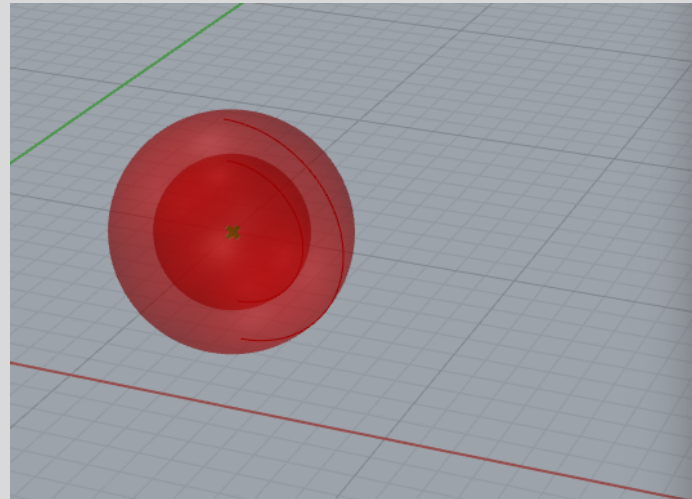
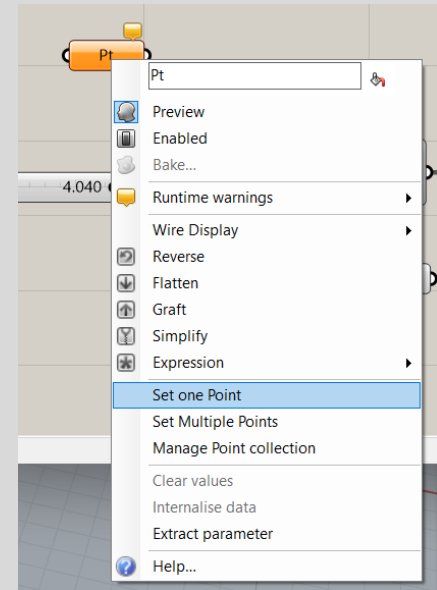
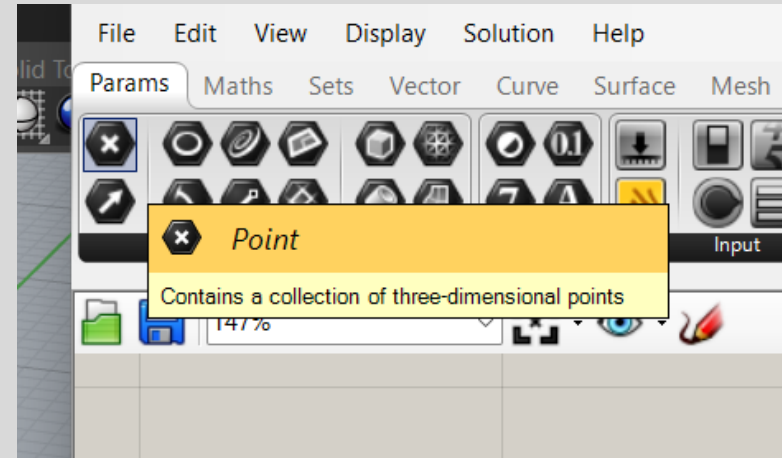
Aula. 8- Programação em Rhino

Grasshopper



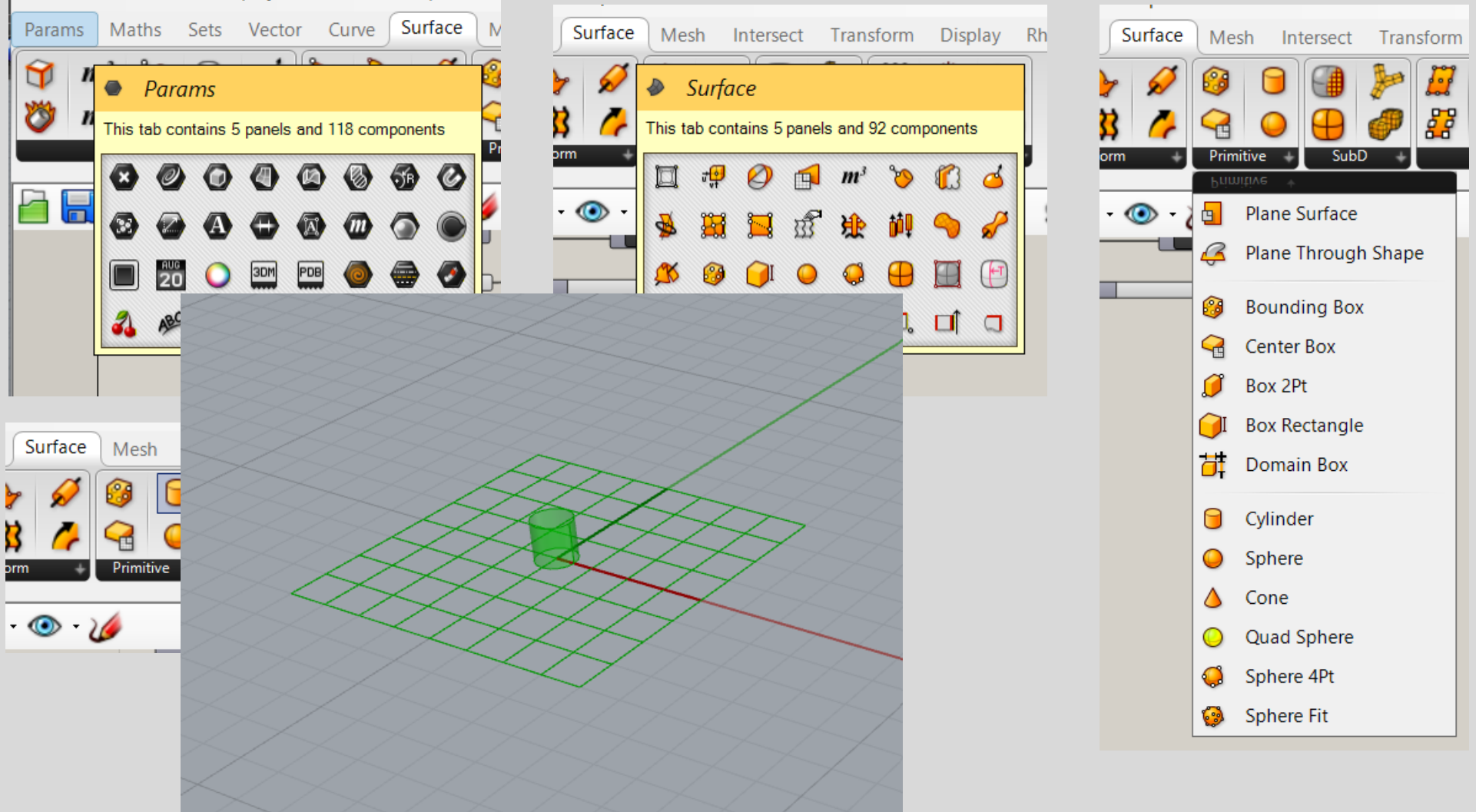
Aula. 8- Programação em Rhino

Grasshopper



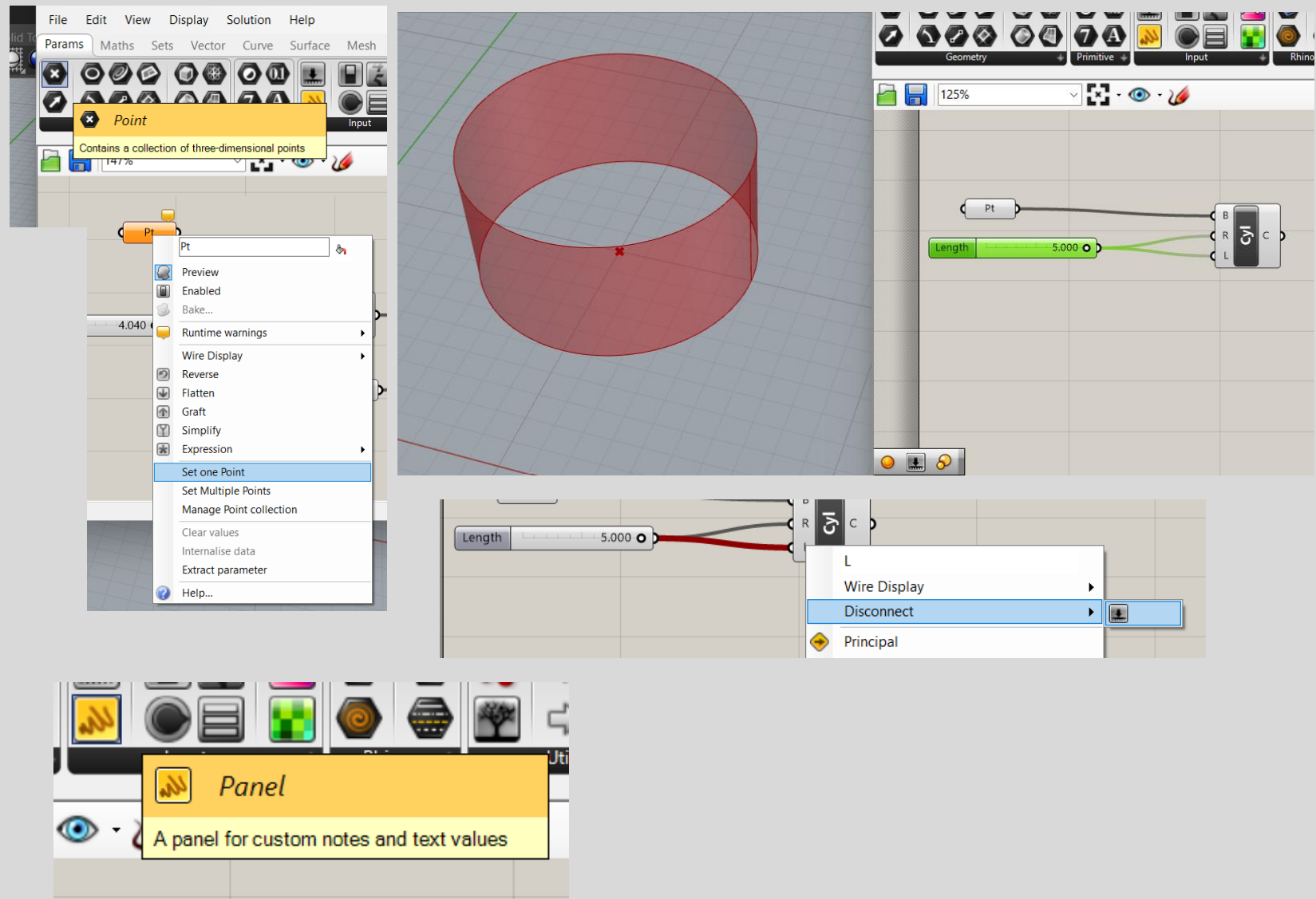
Aula. 8- Programação em Rhino

Grasshopper



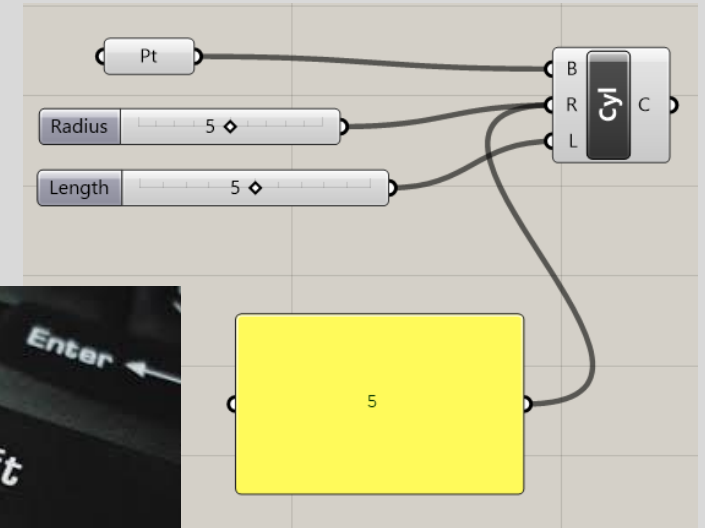
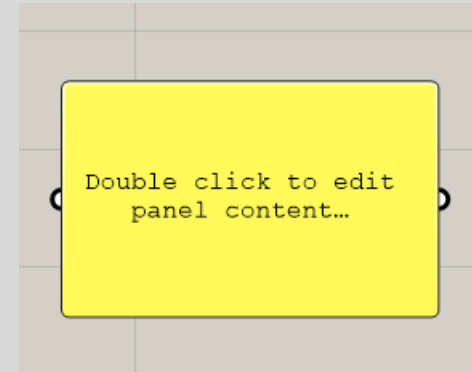
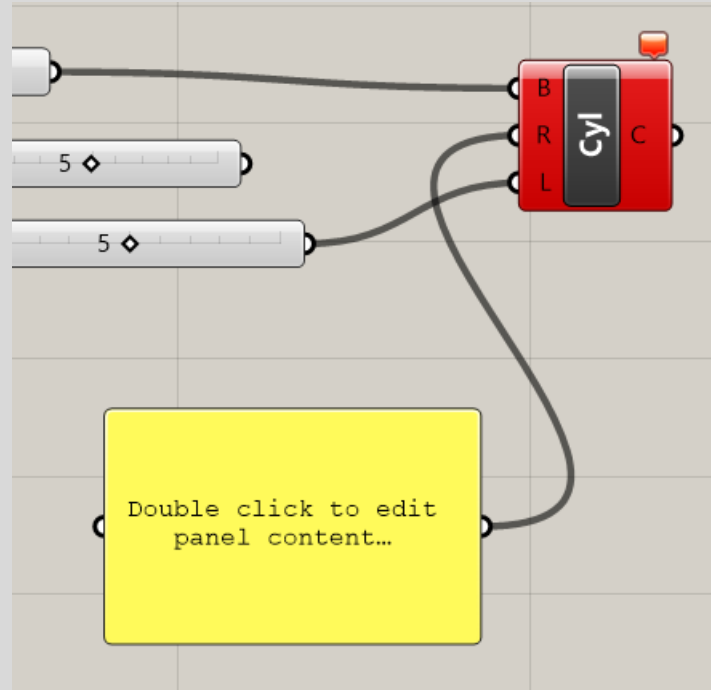
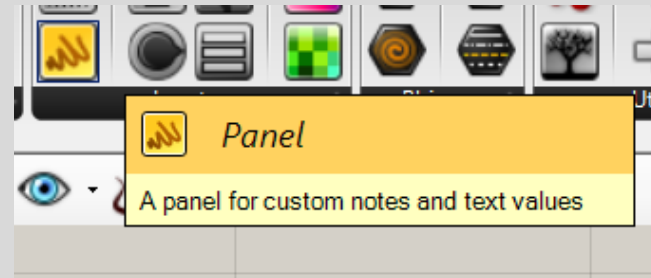
Aula. 8- Programação em Rhino

Grasshopper



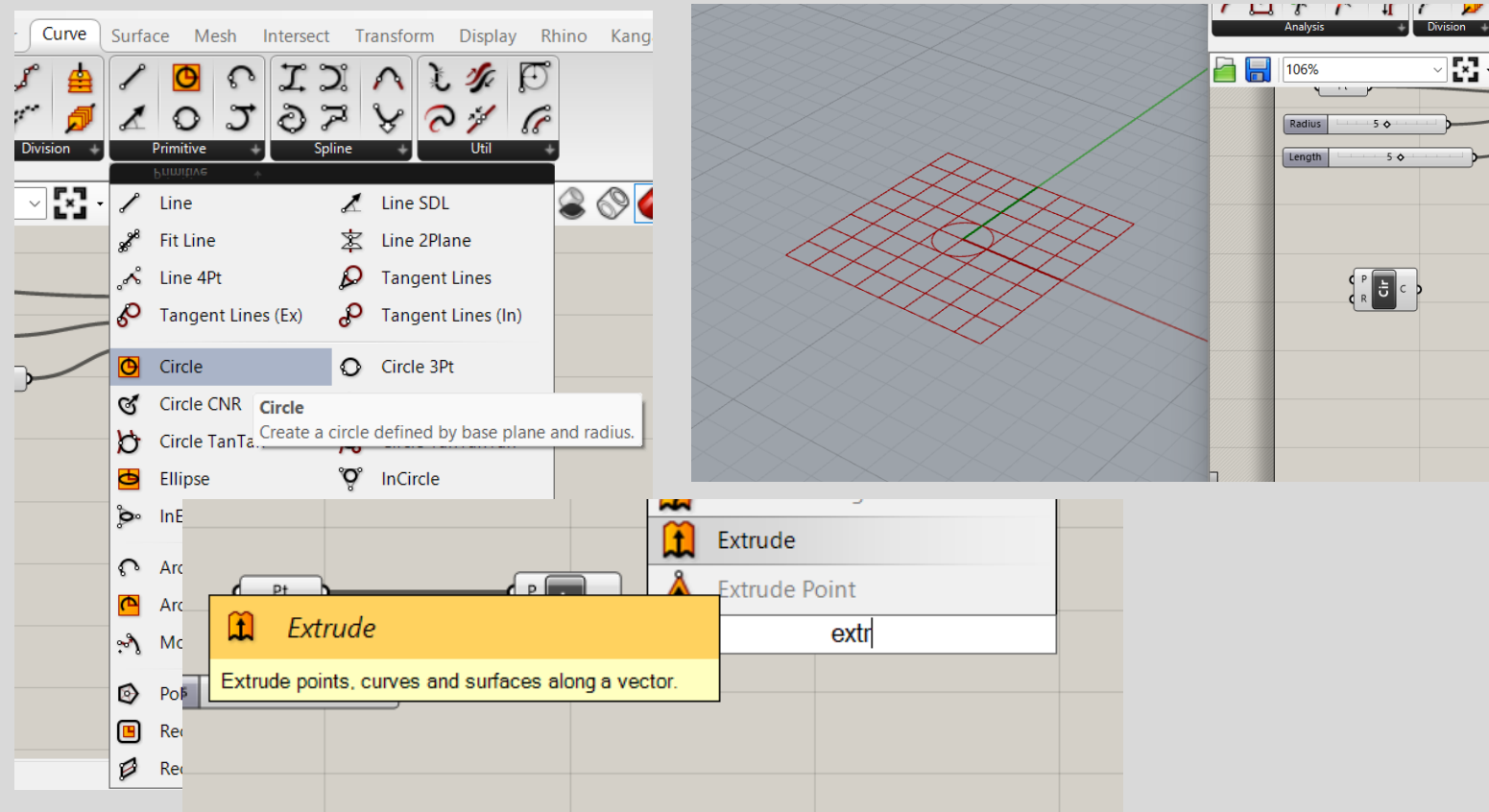
Aula. 8- Programação em Rhino

Grasshopper



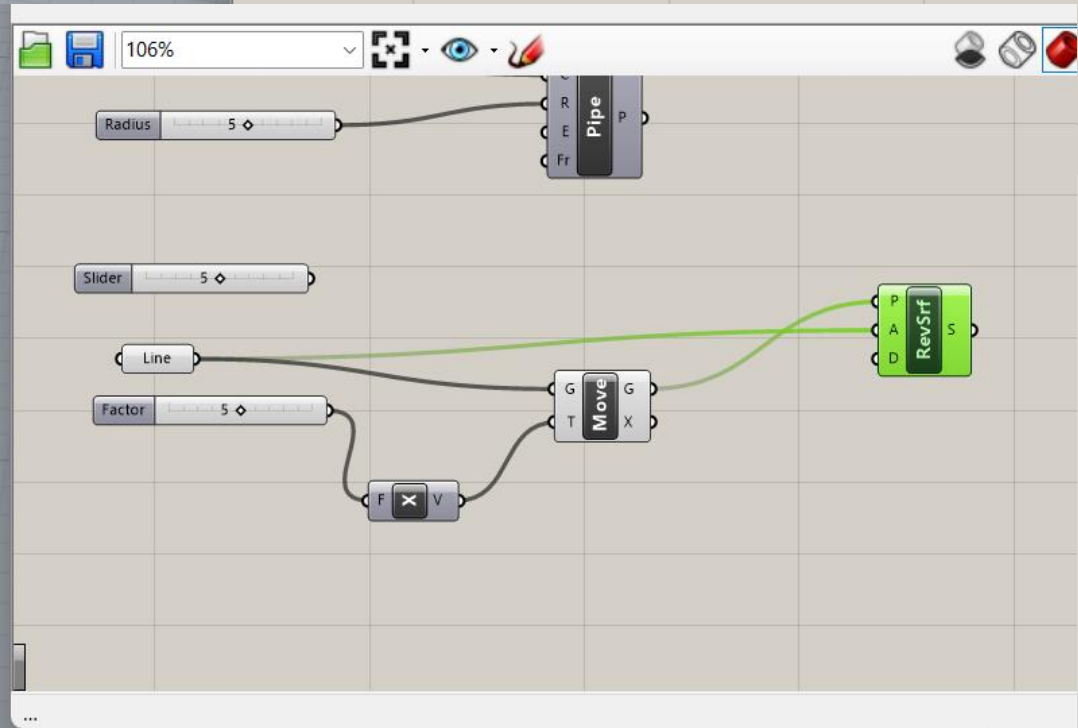
Aula. 8- Programação em Rhino

Grasshopper



Aula. 8- Programação em Rhino

The image shows a 3D software interface with a grid background. A green cylinder is positioned in the lower half of the frame. Above it, two red ellipses are drawn on the grid. A red 'x' marks a point on the grid, likely indicating a center or a specific location. The right sidebar contains several controls: a 'Radius' slider, a 'Slider' control set to 5, a 'Line' control, and a 'Factor' control set to 5. The top right corner shows a file icon, a save icon, and a zoom level of 106%.



1 - Grasshopper : listas e sua comunicação no Grasshopper; construção de uma superfície tórica e suas questões.

2 - Rhino : Modelação de superfícies curvas - Exercício dos Moluscos : Spirula, Planorbis, Nautilus e Caramujo do Mar. (continuação)

Aula. 9 - Conchas

Spirula

Planorbis

Nautilus

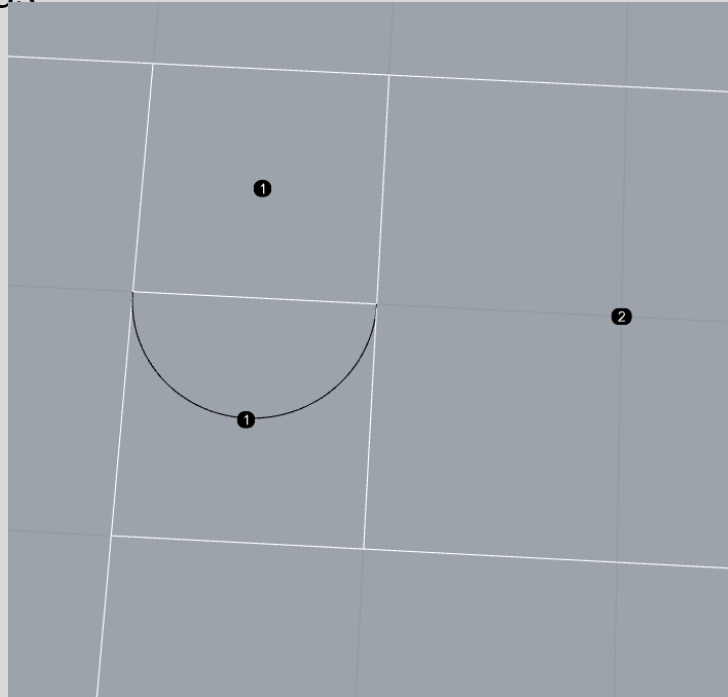
Caracol

Caramujo do mar

Seguir a sequência de fibonacchi: 1, 1, 2, 3, 5, 8, 13,...

-quadrados com arestas que definam a sequência

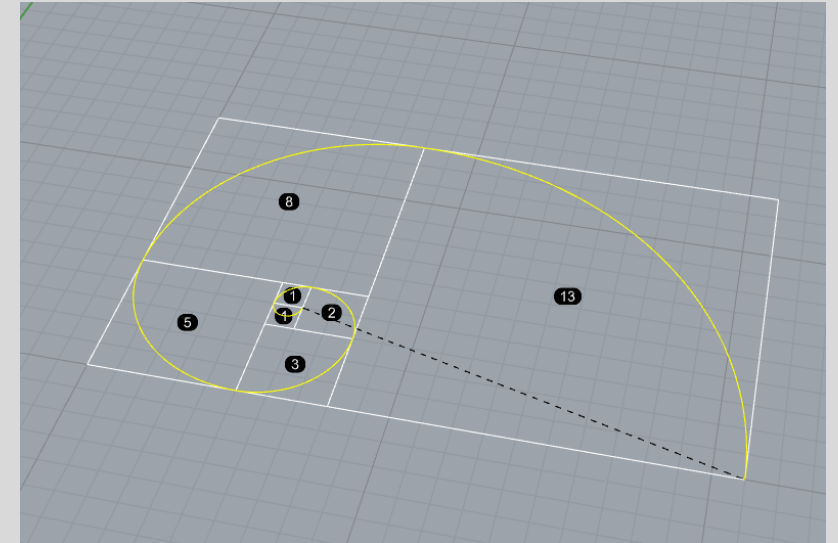
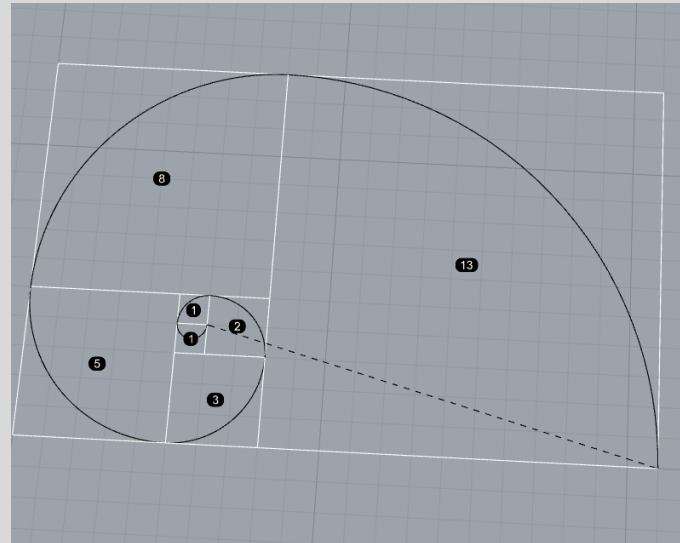
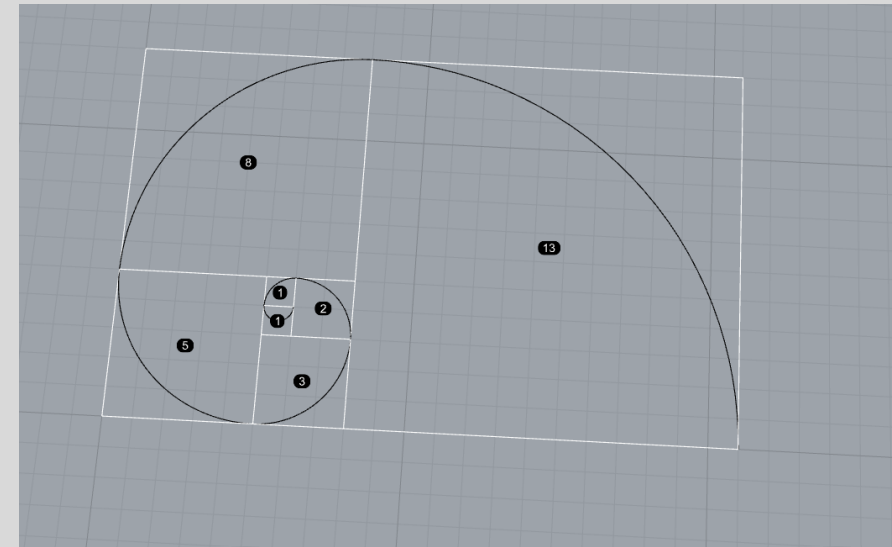
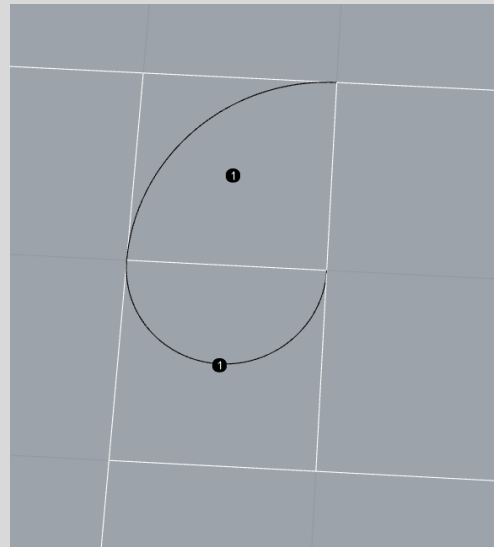
-circunferências “”



Aula. 9 - Conchas

Spirula
Planorbis
Nautilus
Caracol
Caramujo do mar

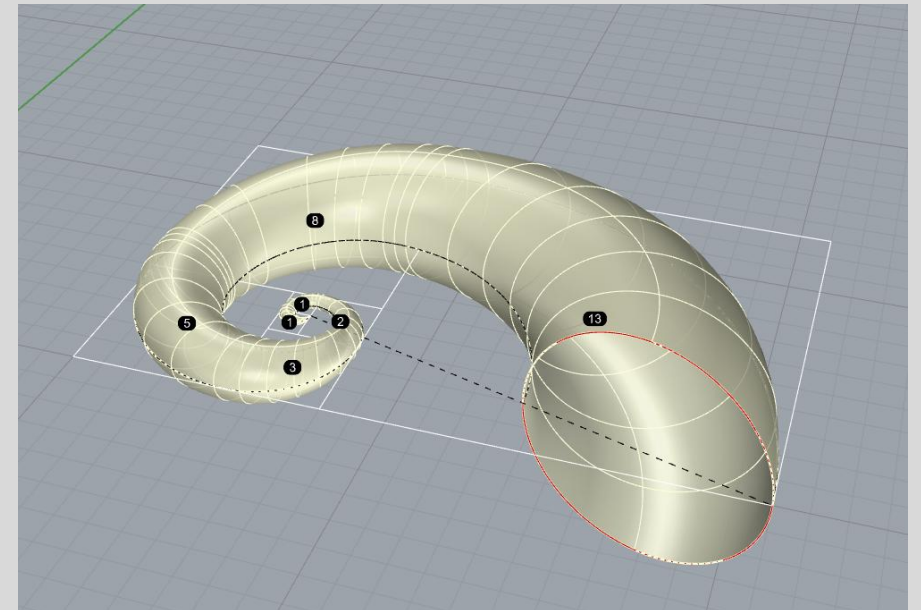
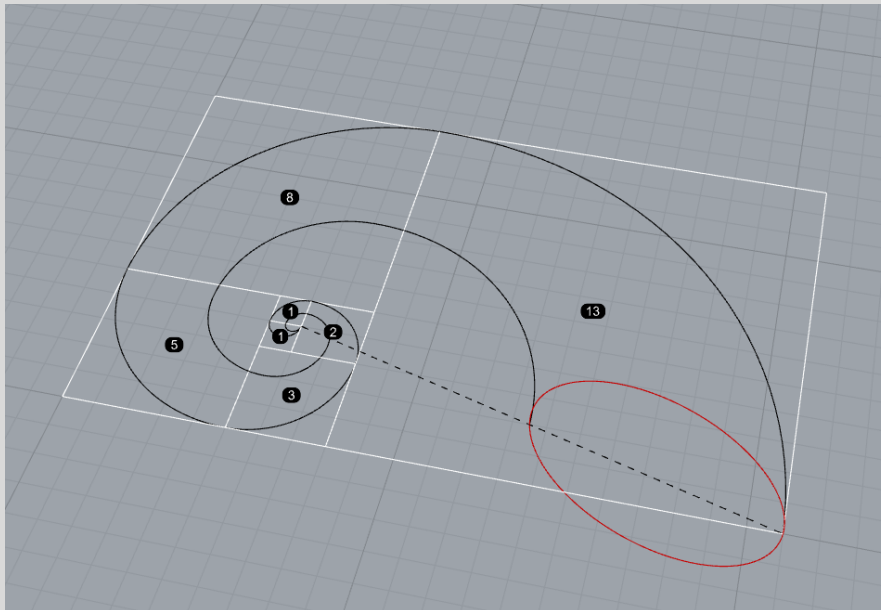
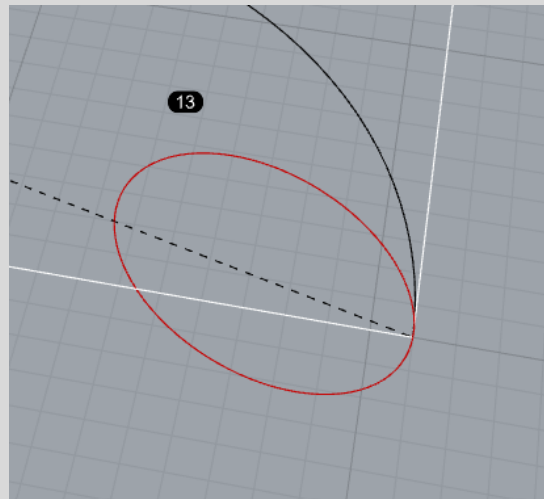
-centro no canto, arco até ao outro vértice
-linha q orienta o plano vertical que define a geratriz
join



Aula. 9 - Conchas

Spirula
Planorbis
Nautilus
Caracol
Caramujo do mar

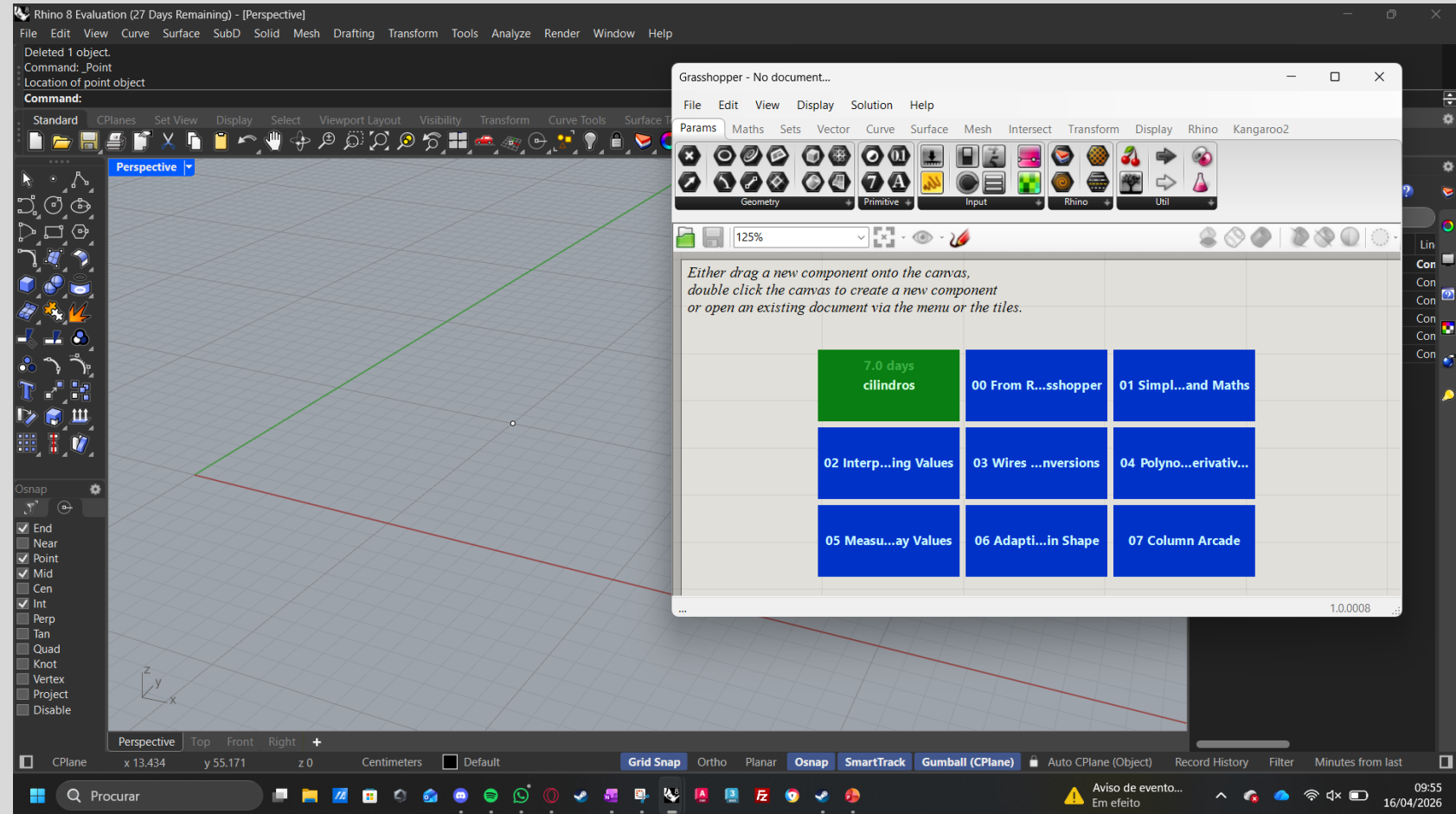
- Diretriz 1- circunferência vertical 2 point
- Geratriz 2- scale a copia da curva para o midpoint da reta
- sweep2



Aula. 9 - Conchas

Grasshopper:

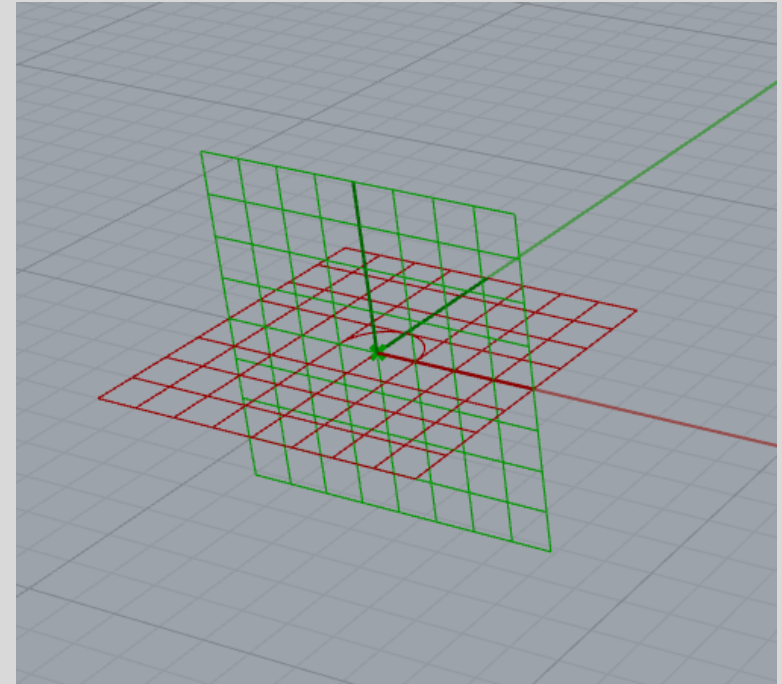
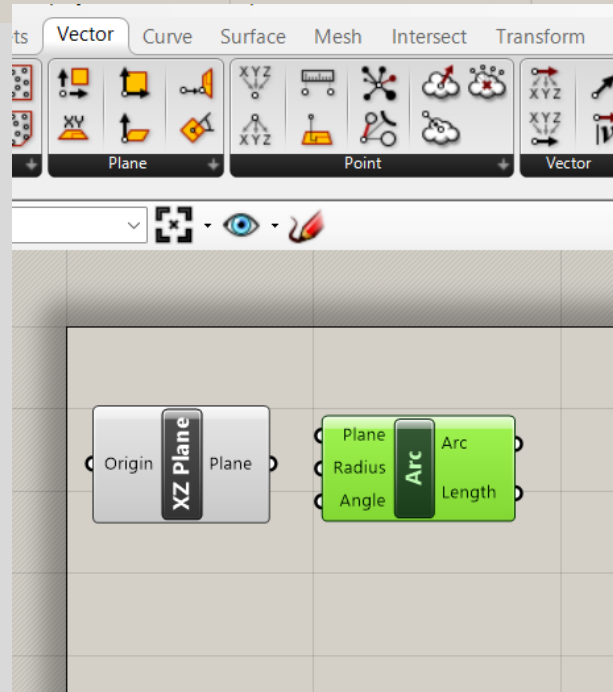
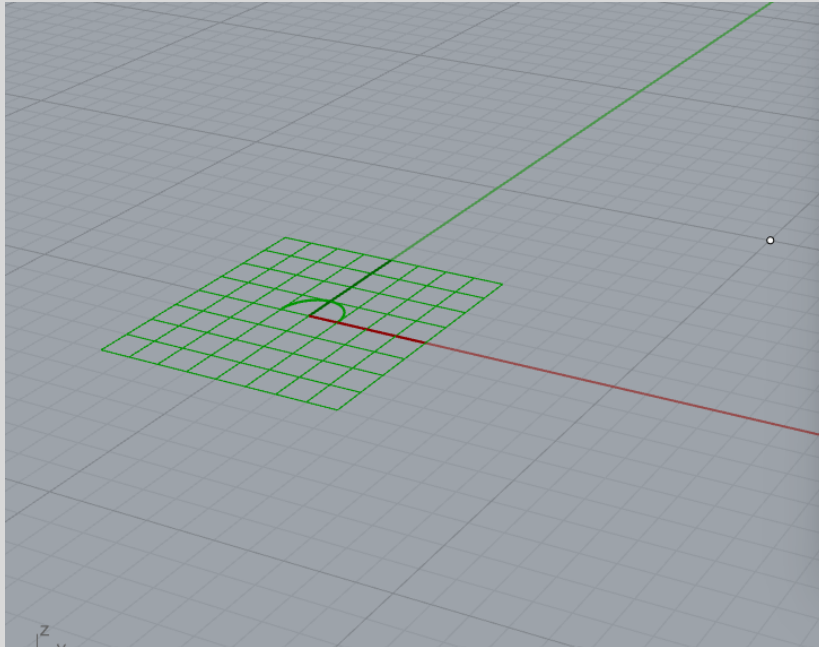
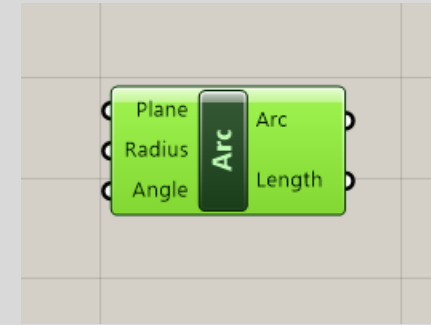
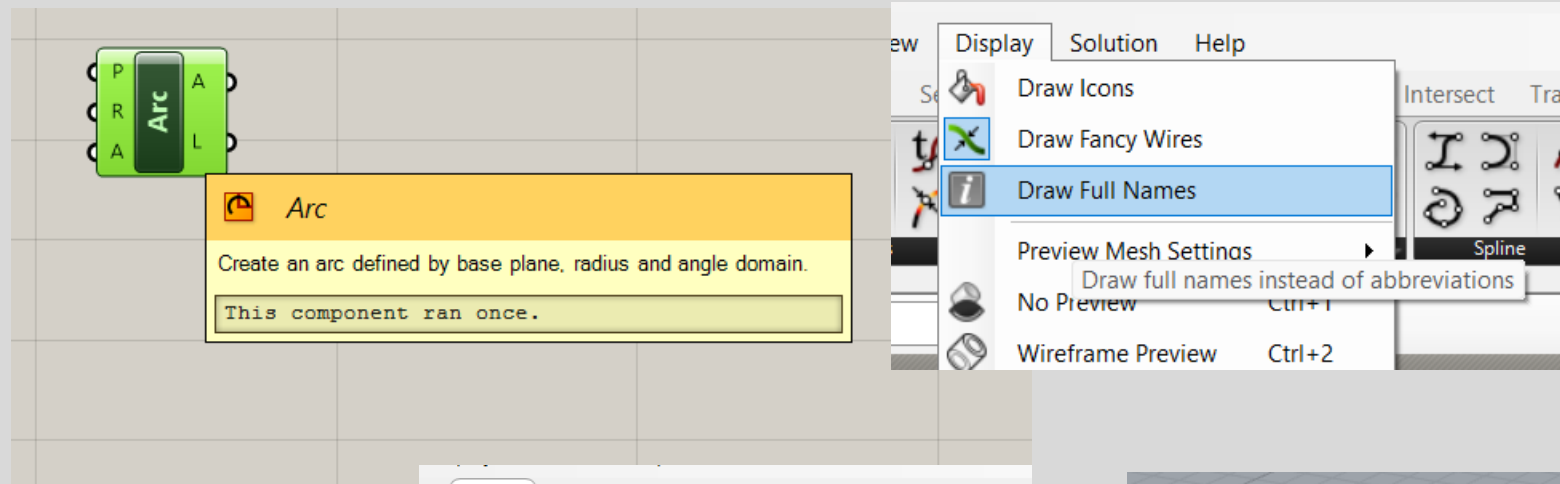
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

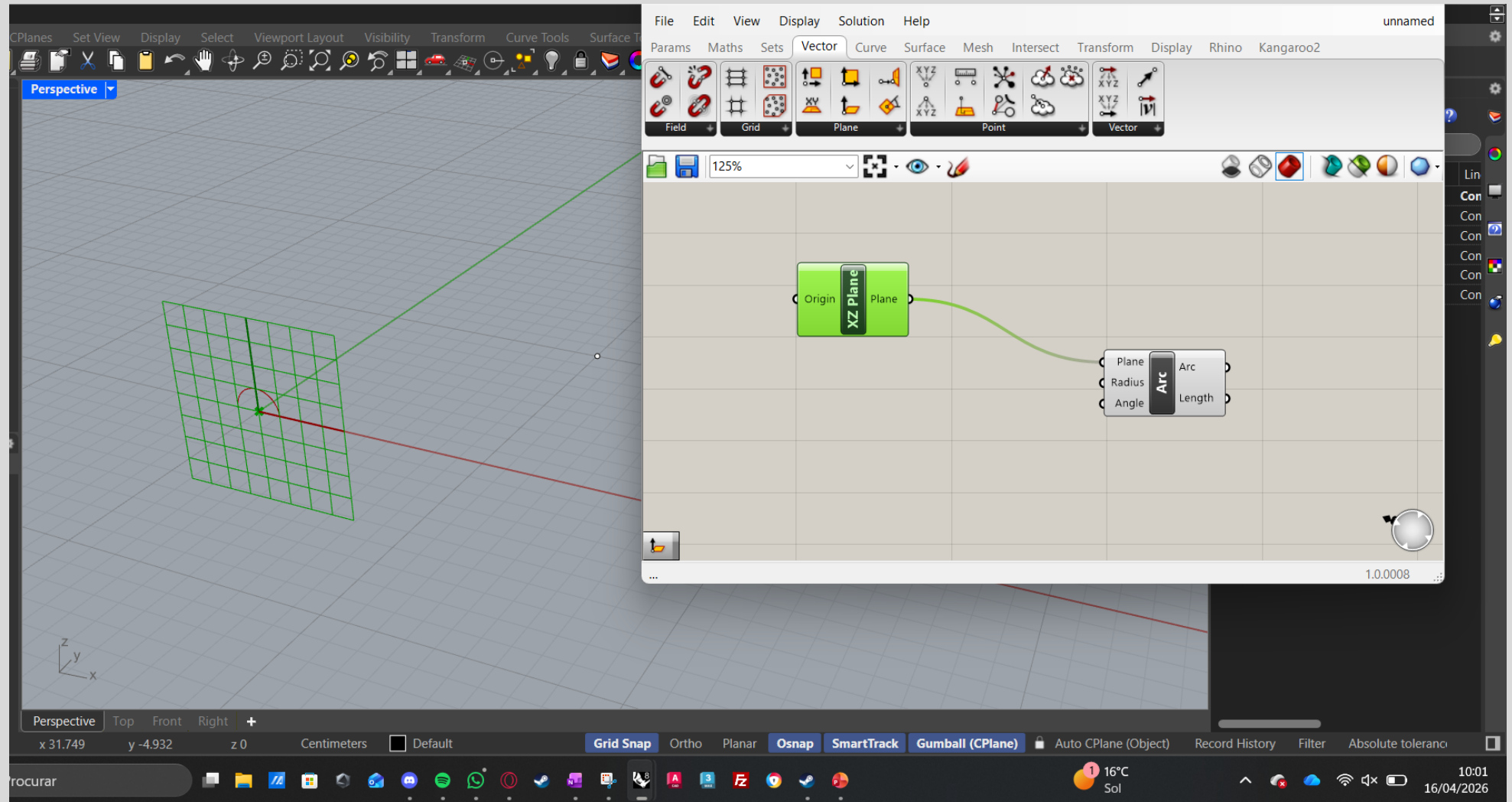
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

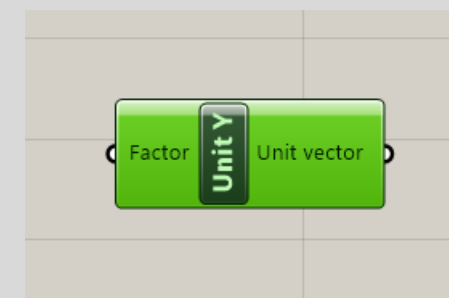
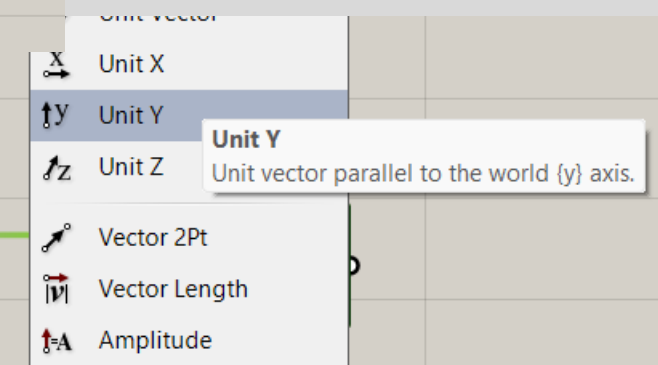
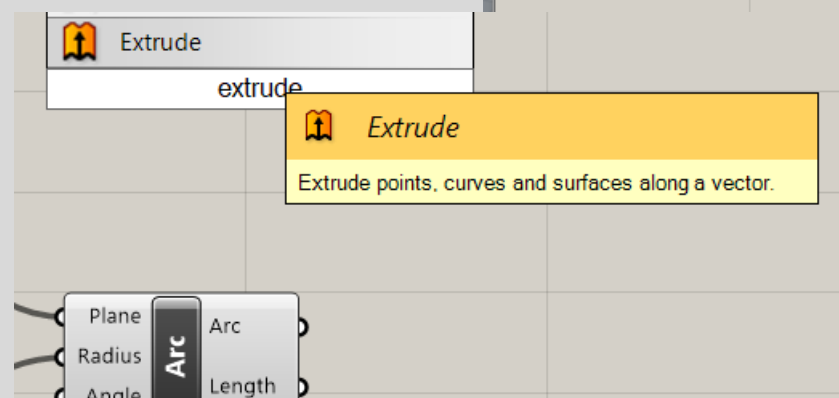
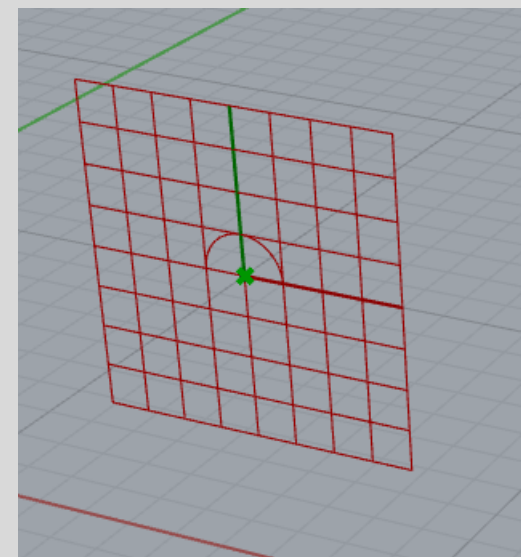
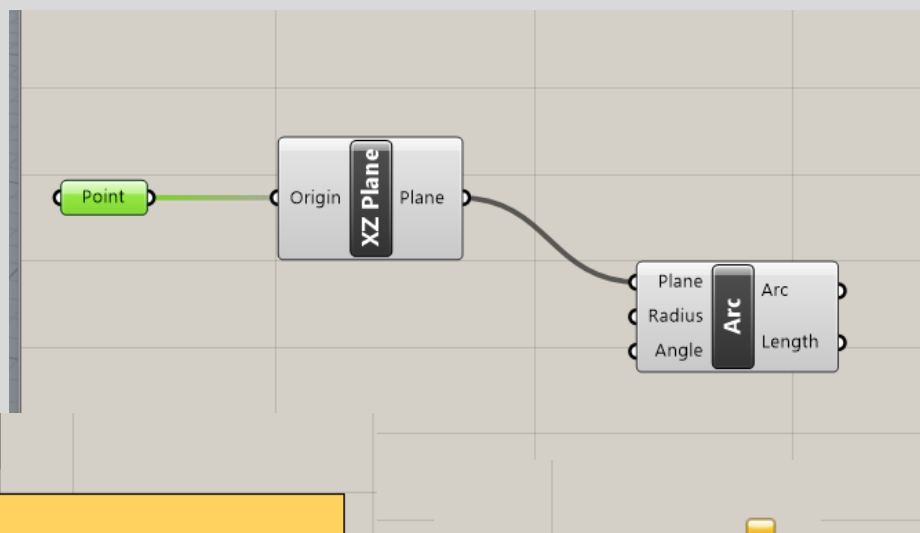
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

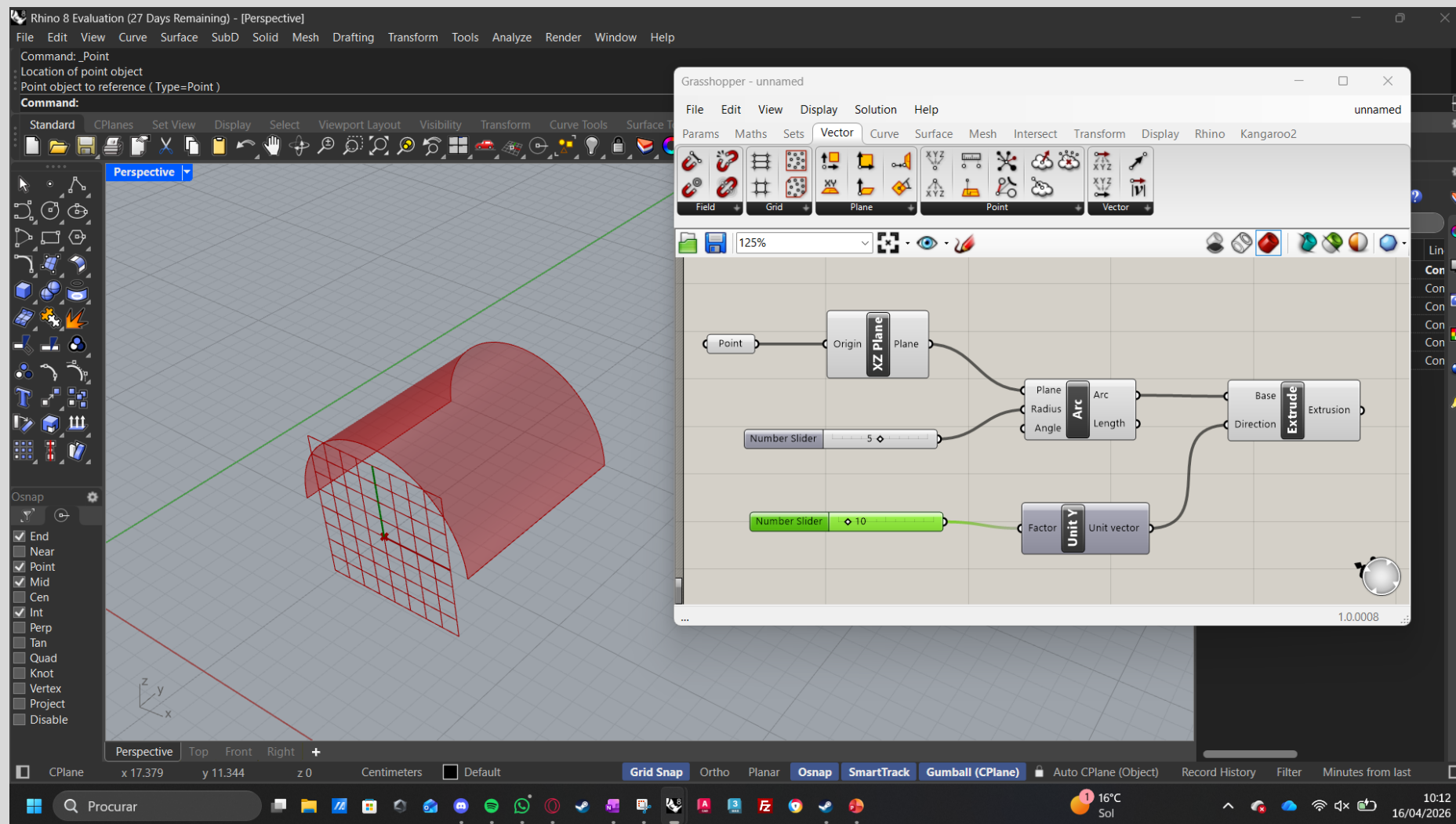
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

- **Abóbada de berço**
- Abóbada de bolbo

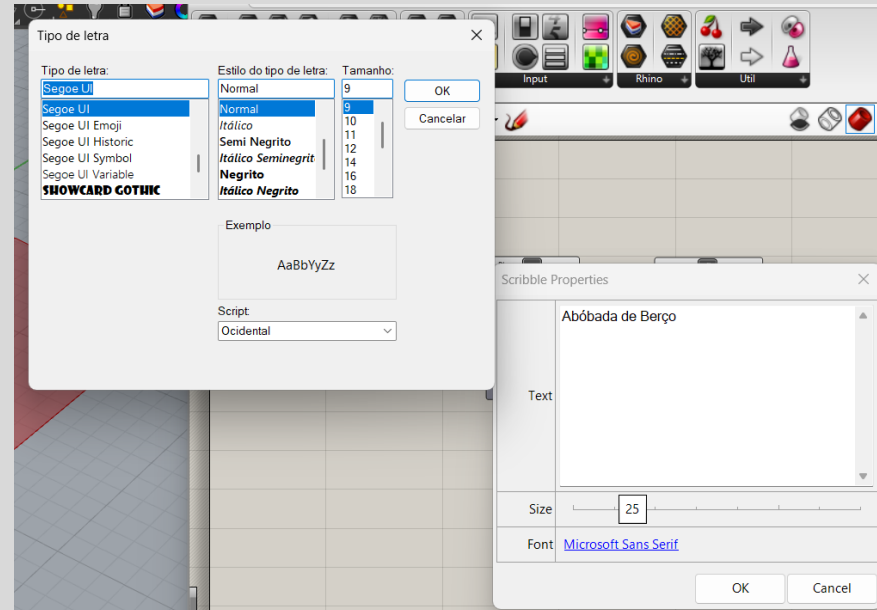
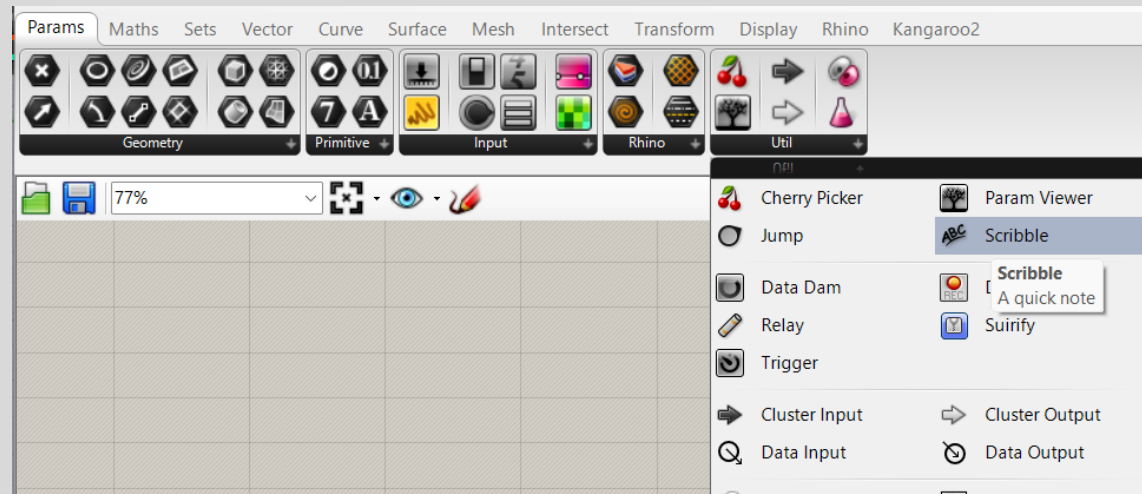
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

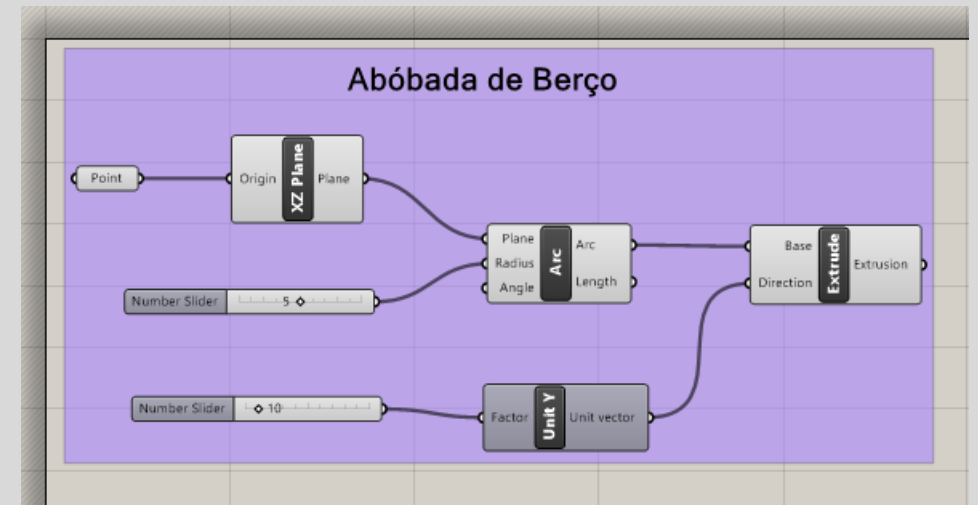
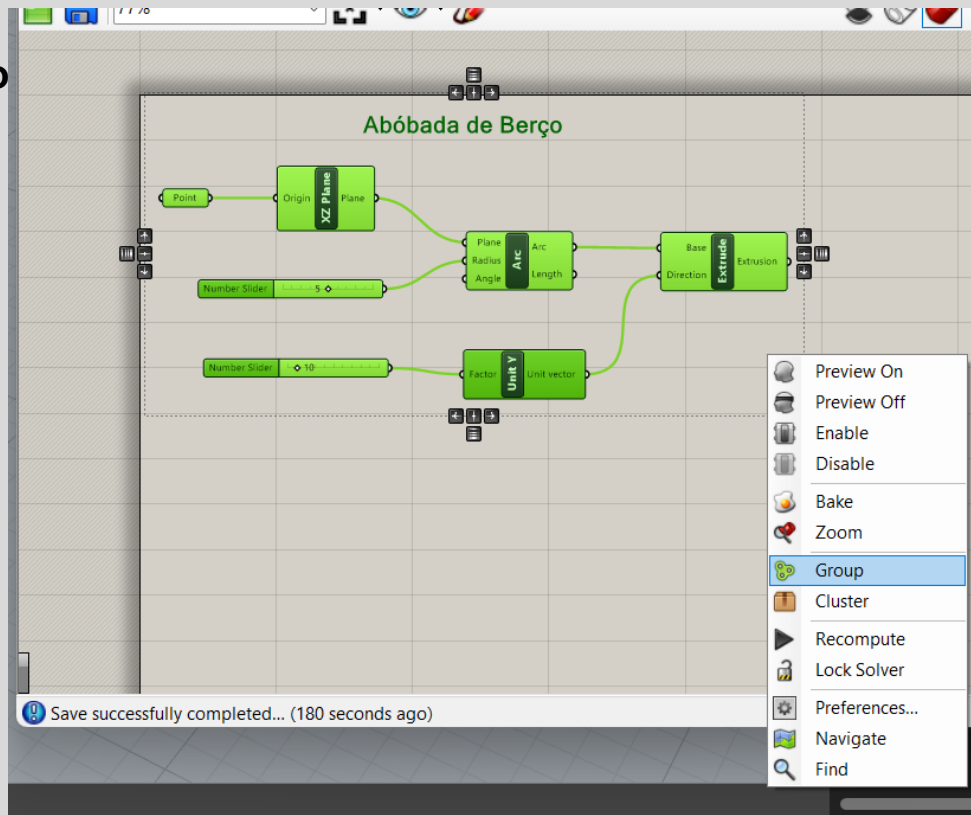
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

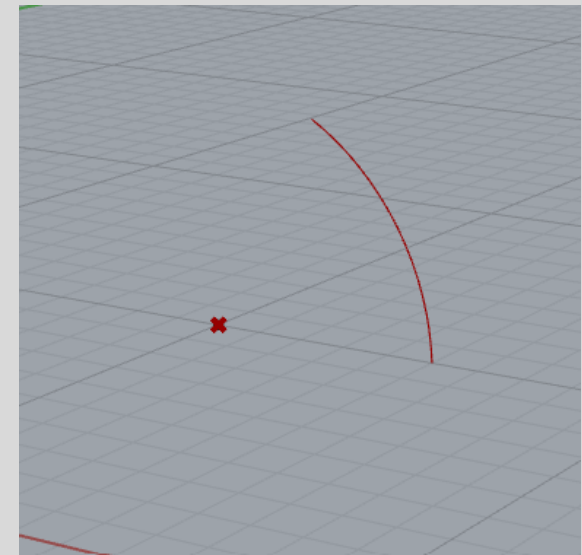
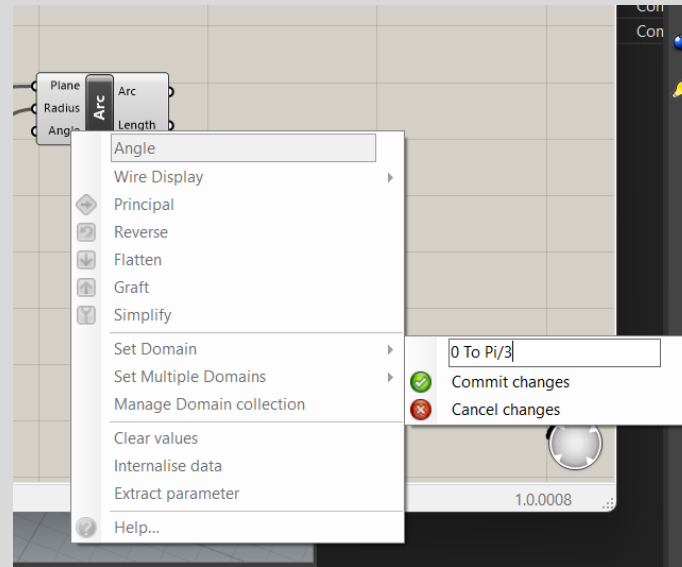
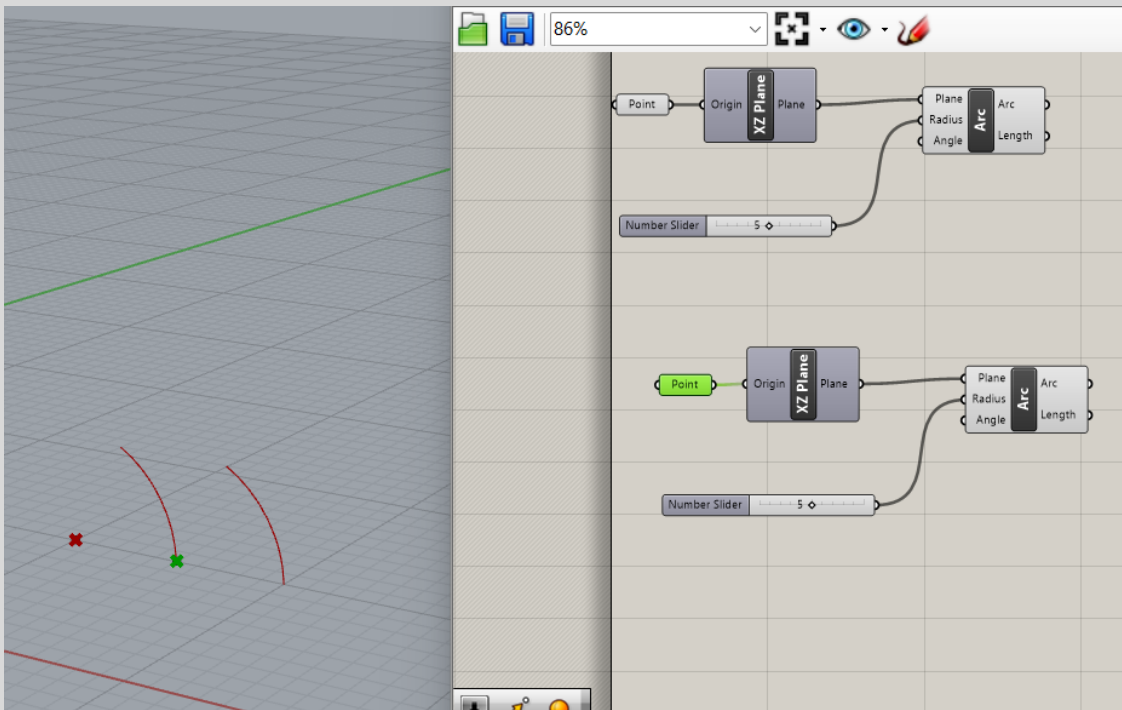
- **Abóbada de berço**
- Abóbada de bolbo



Aula. 9 - Grasshopper

Grasshopper:

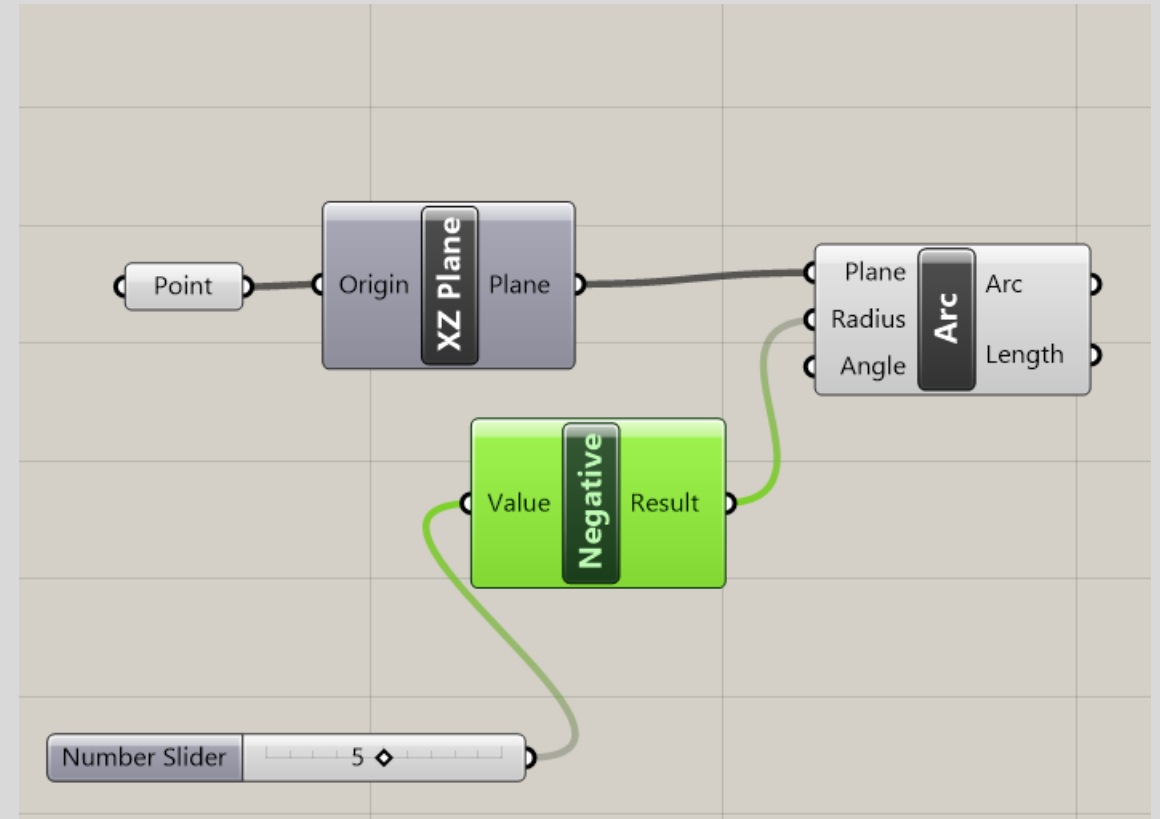
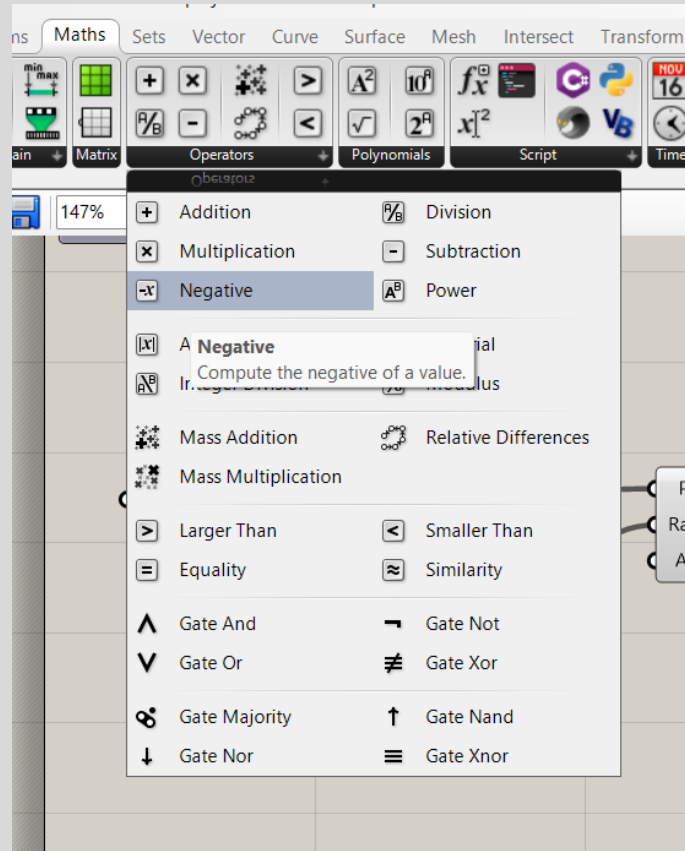
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

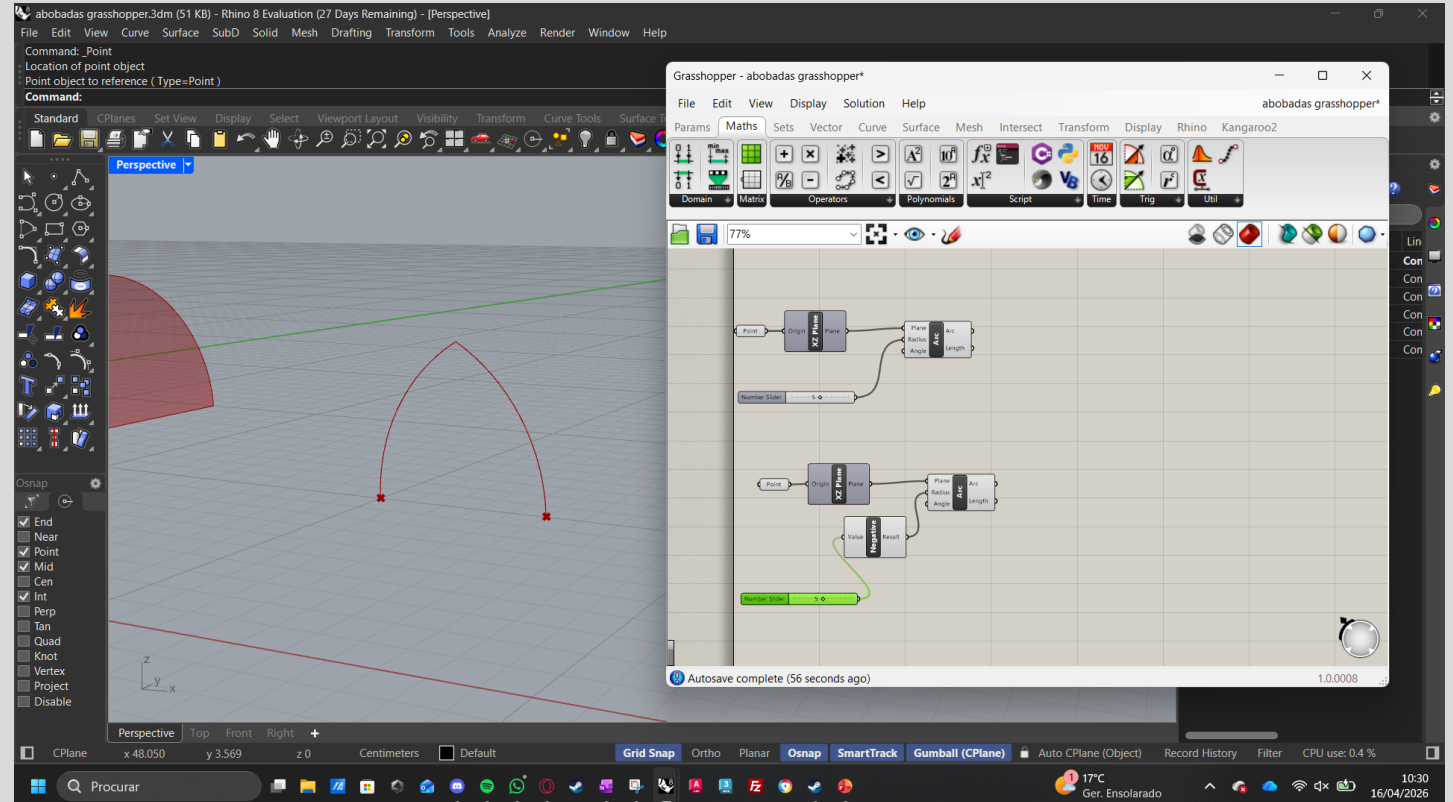
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

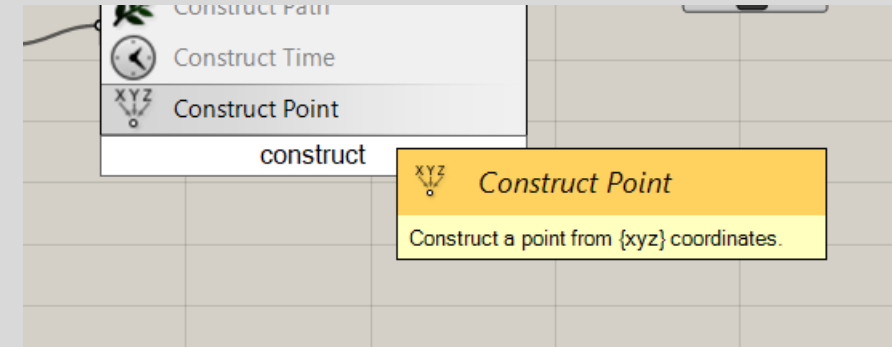
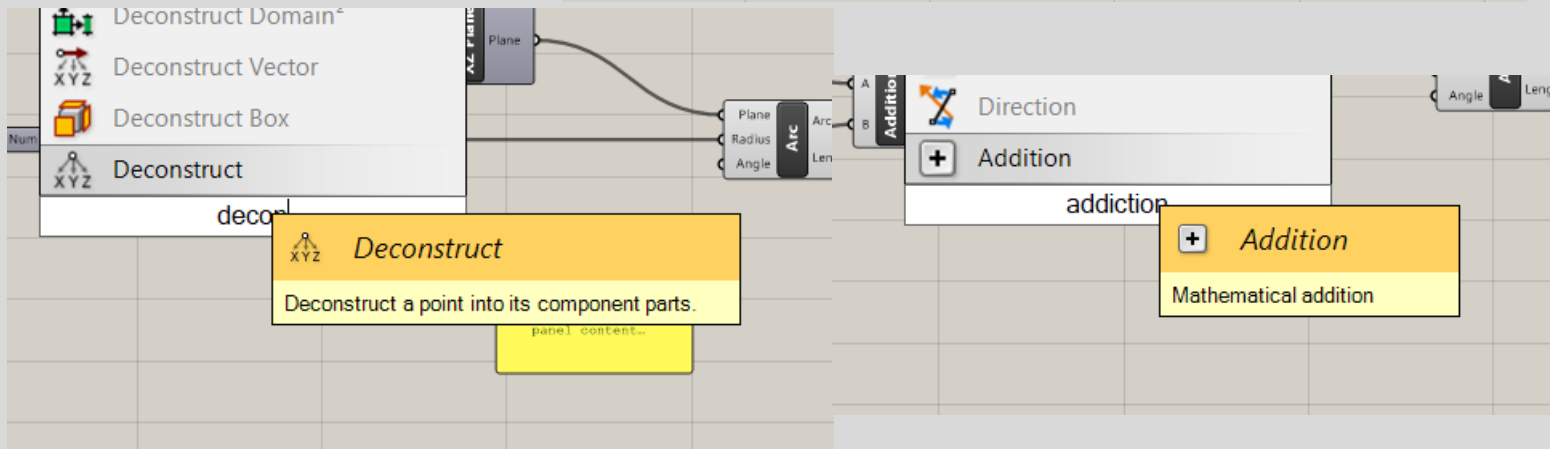
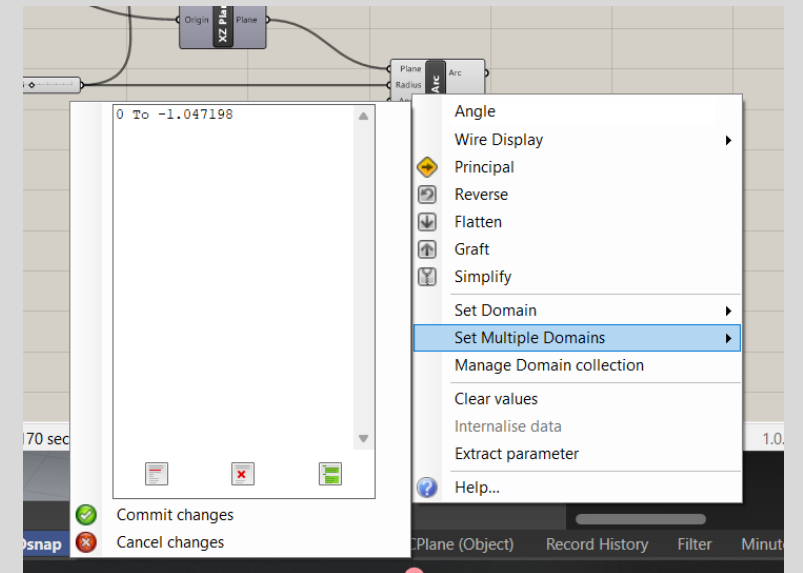
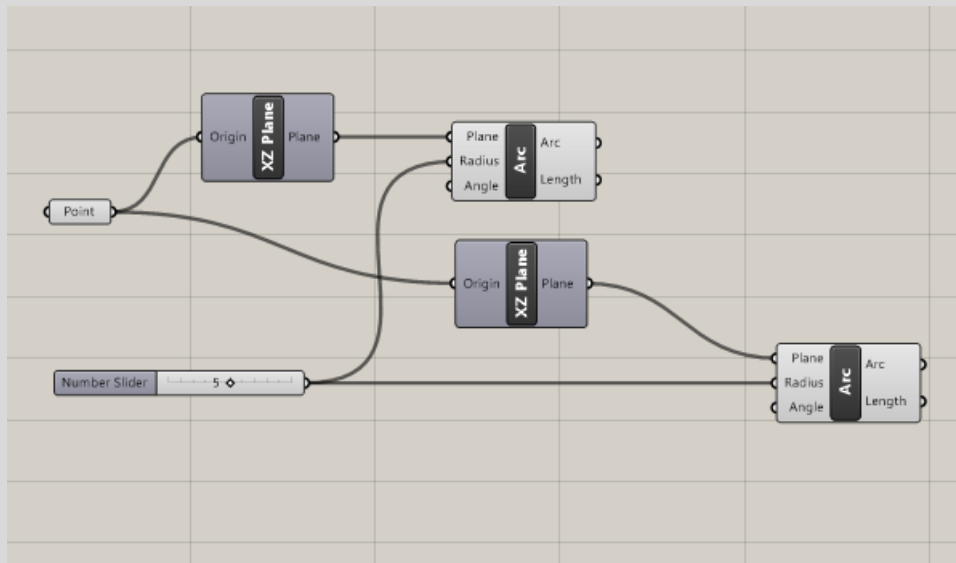
- Abóbada de berço
 - **Abóbada de bolbo**
-
- **Não é funcional pois não ajusta o tamanho dos arcos ao aumentar o raio**



Aula. 9 - Grasshopper

Grasshopper:

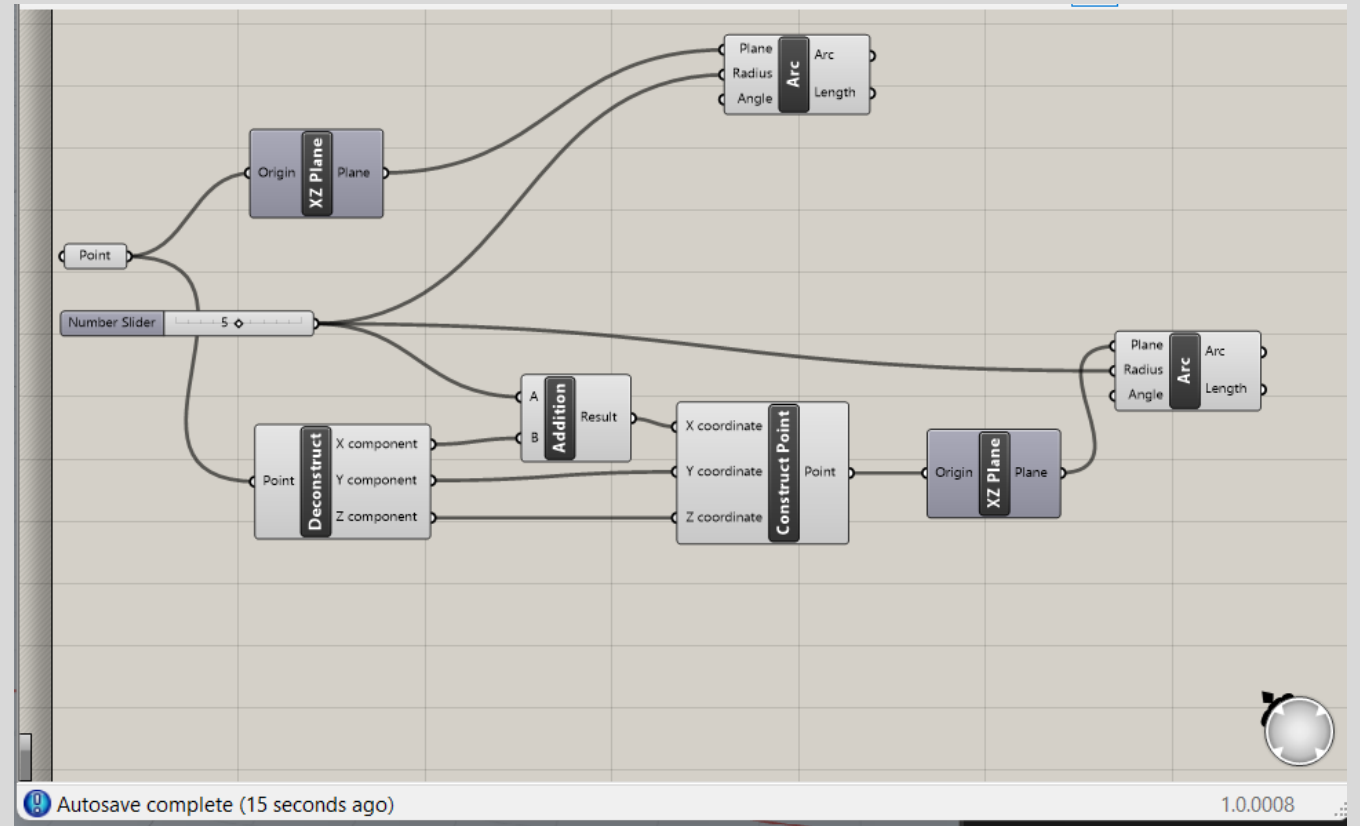
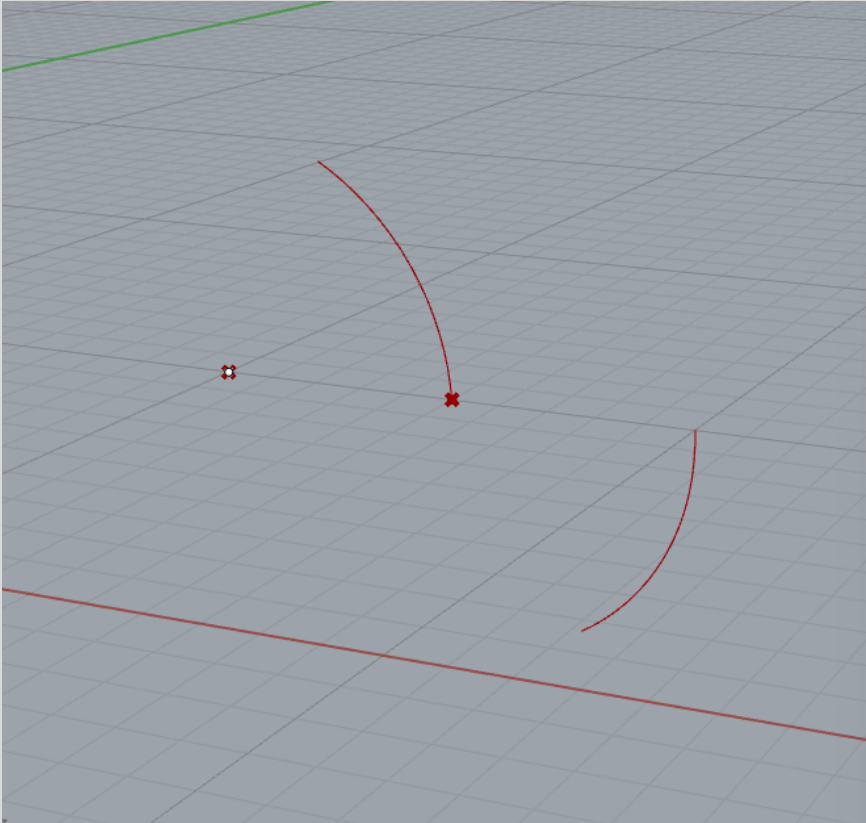
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

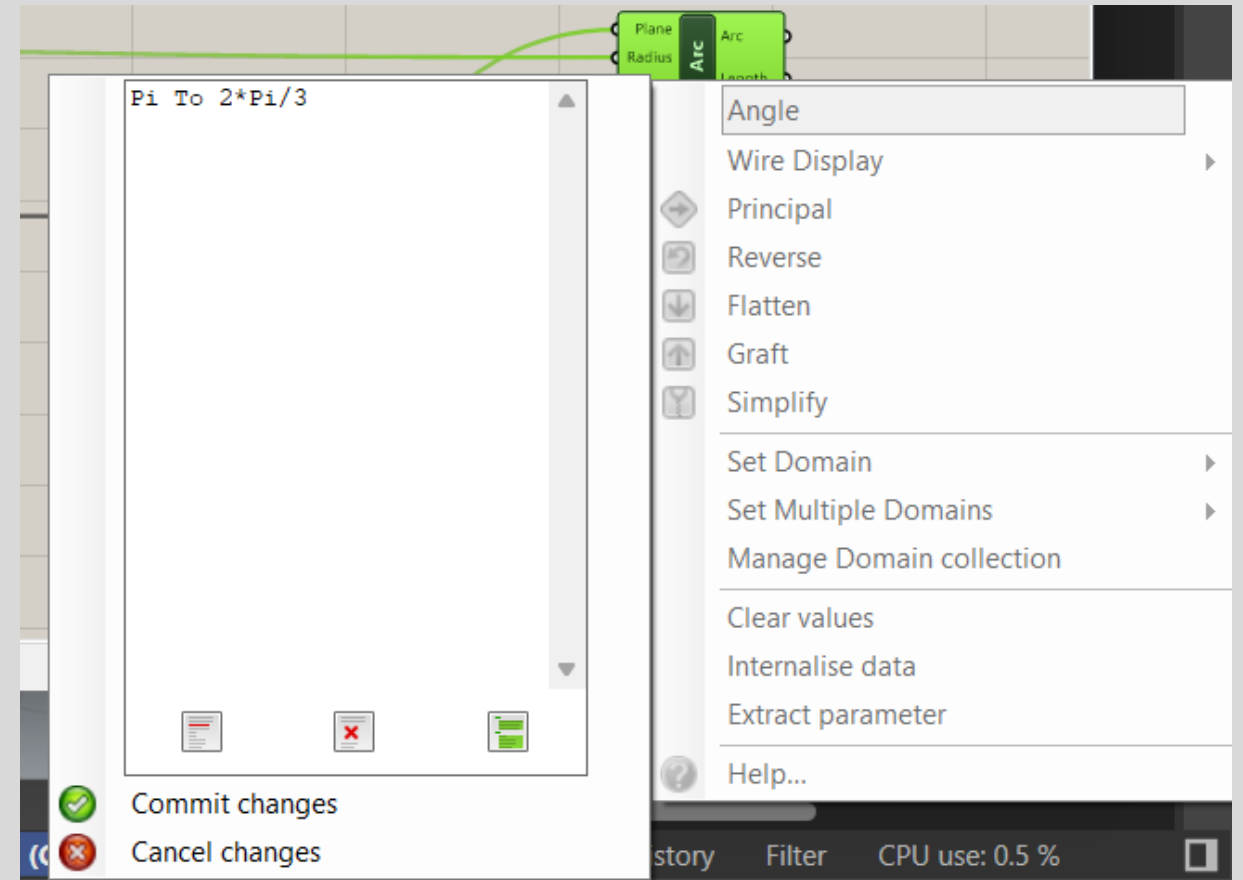
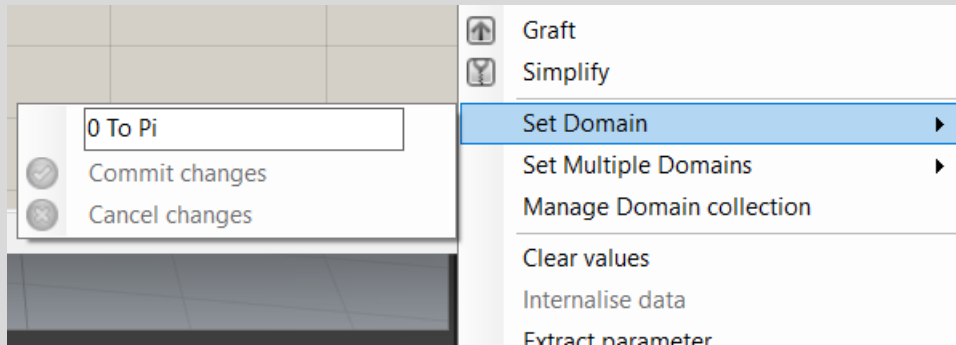
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

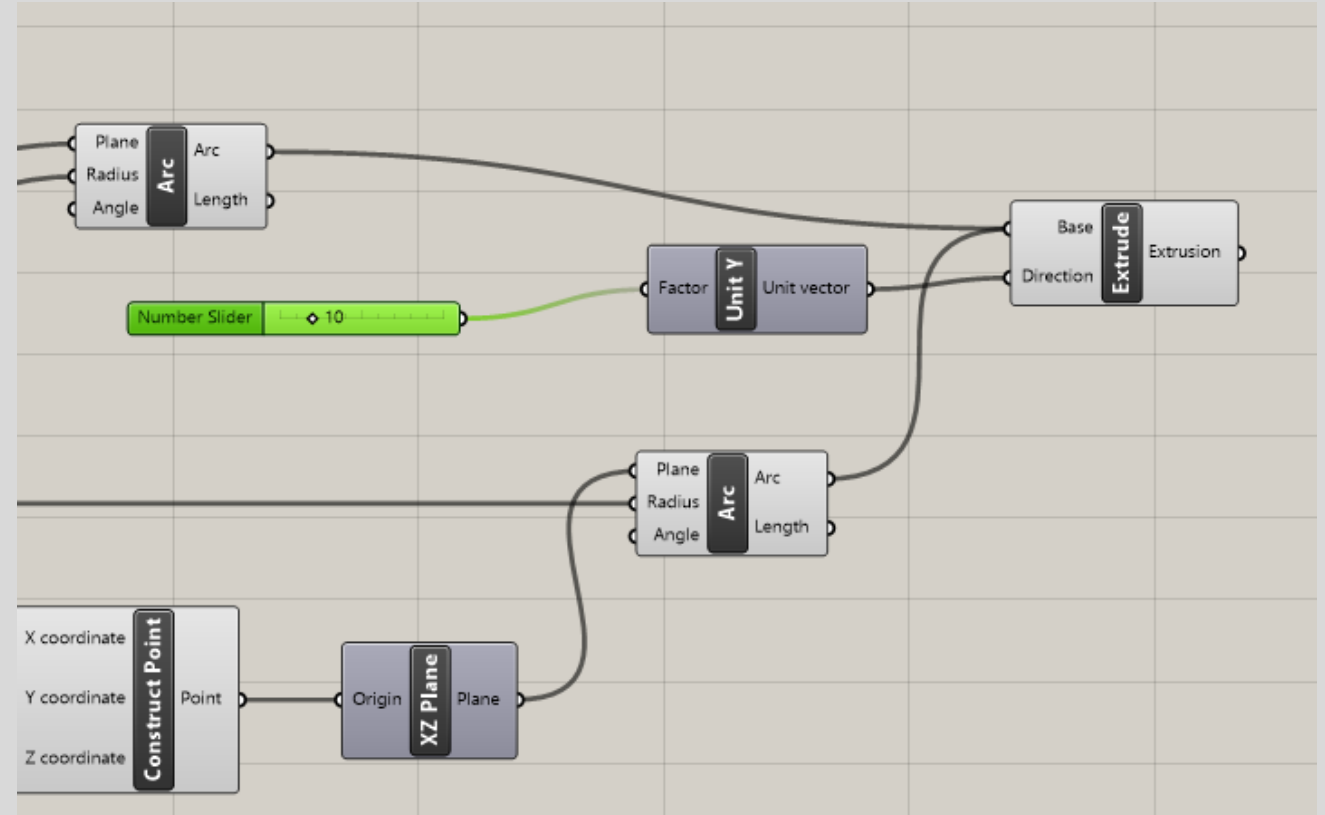
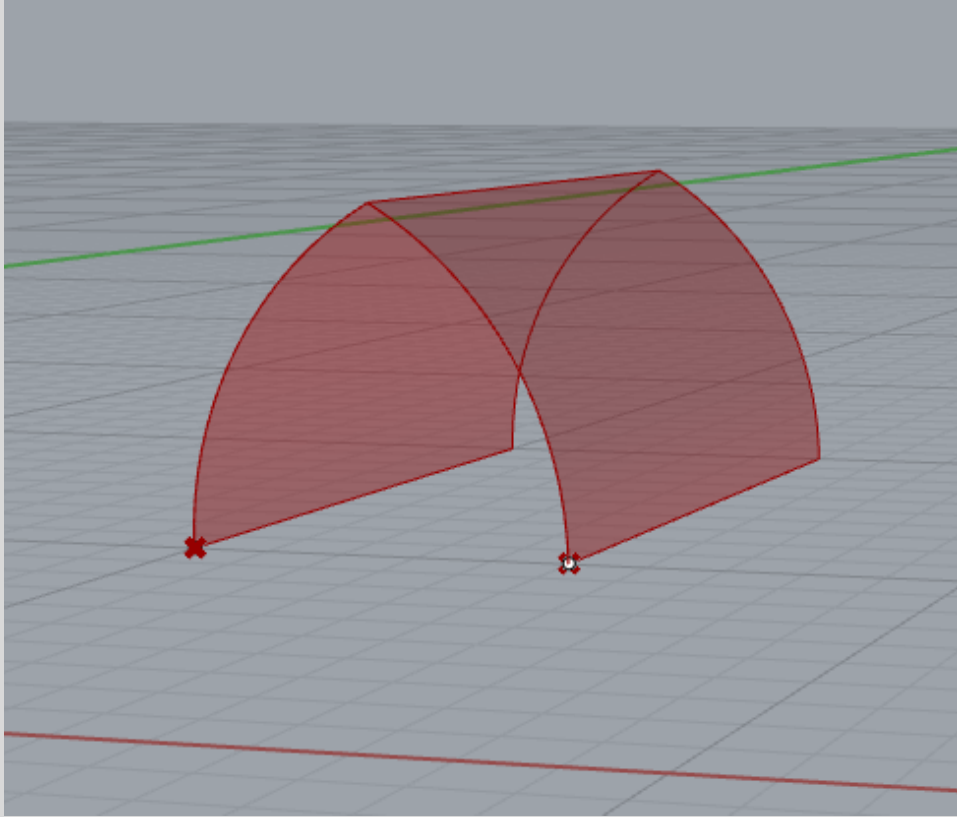
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

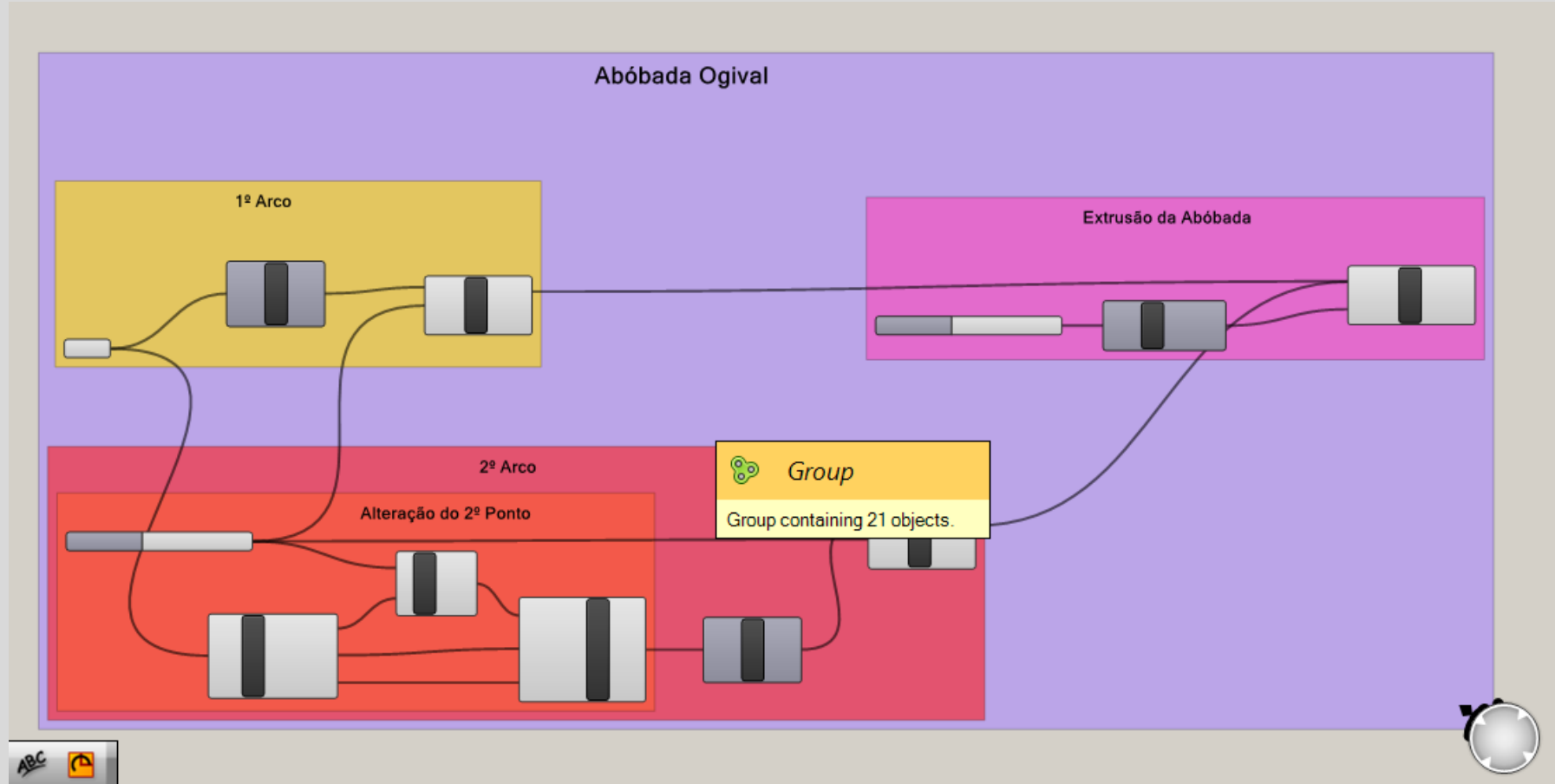
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

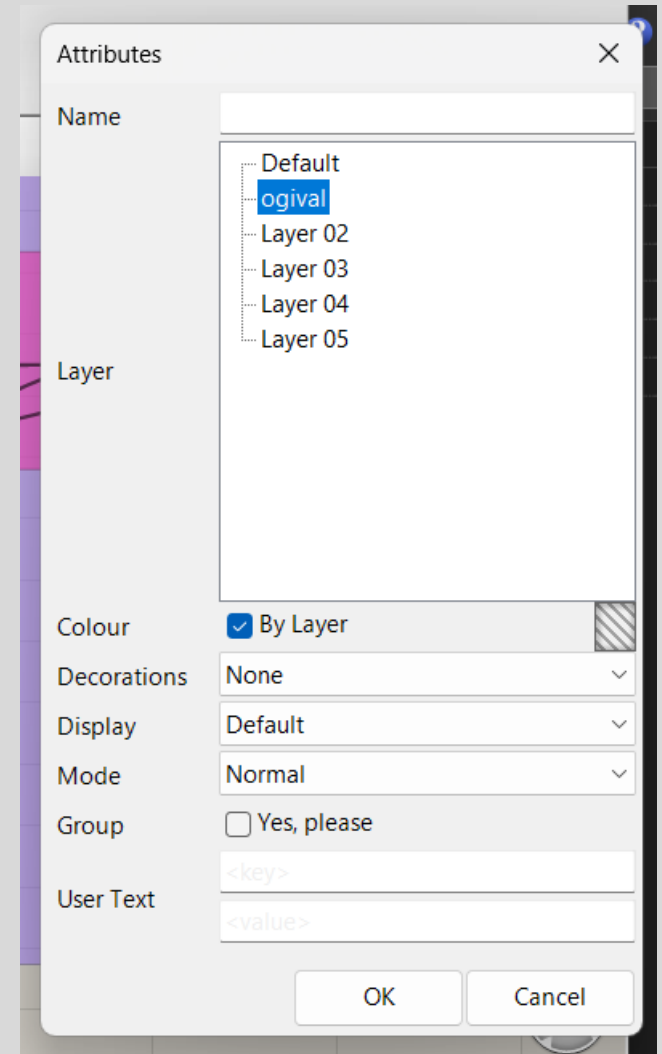
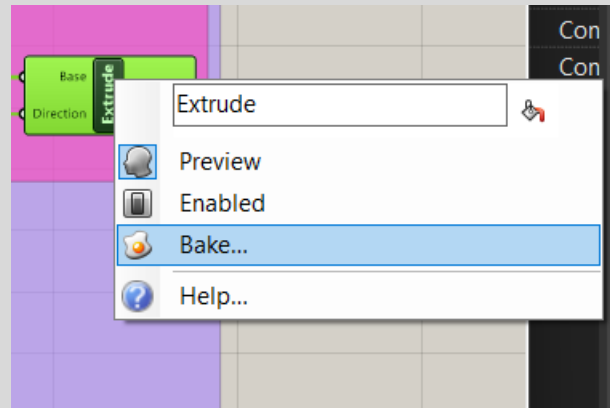
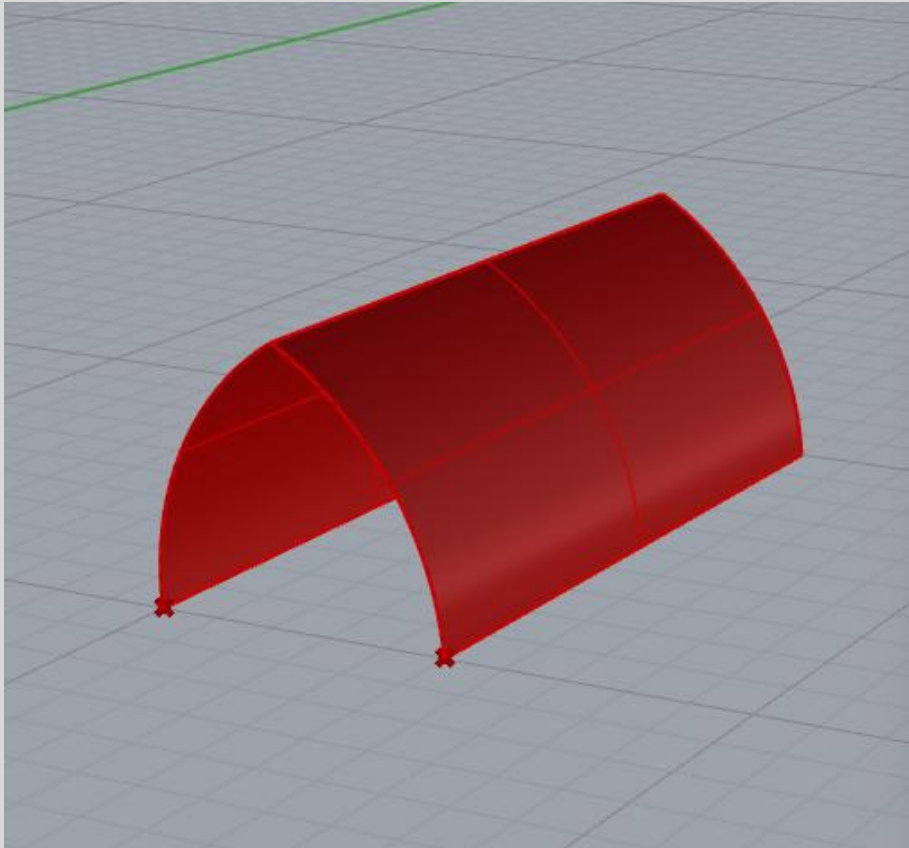
- Abóbada de berço
- **Abóbada de bolbo**



Aula. 9 - Grasshopper

Grasshopper:

- Abóbada de berço
- **Abóbada de bolbo**



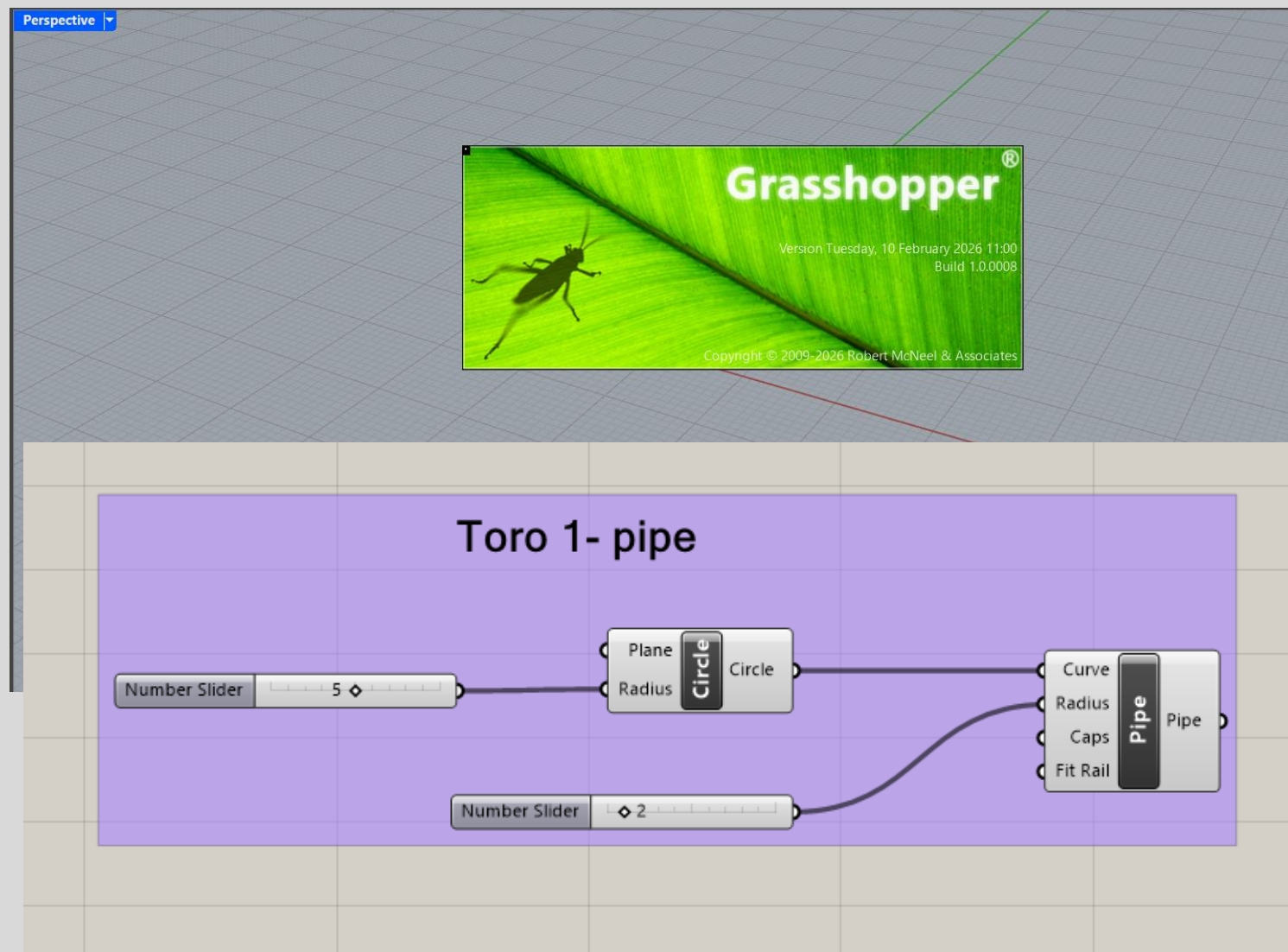
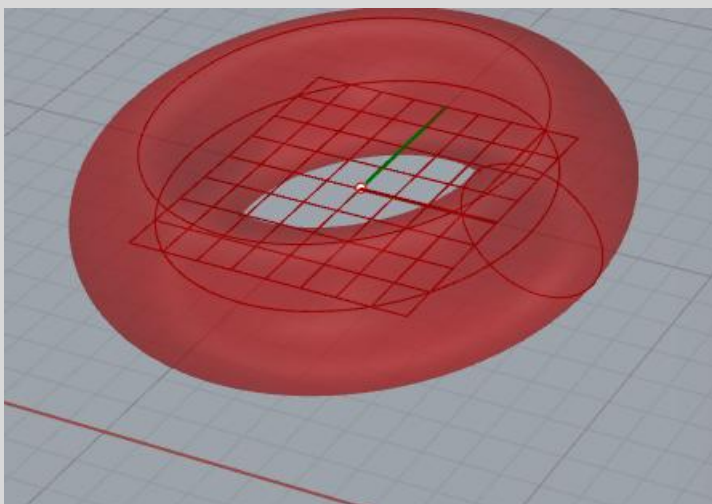
Aula. 9 - Grasshopper

1 - Grasshopper : listas e sua comunicação no Grasshopper; construção de uma superfície tórica e suas questões.

2 - Rhino : Modelação de superfícies curvas - **Exercício dos Moluscos** : Spirula, Planorbis, Nautilus e Caramujo do Mar. (continuação)

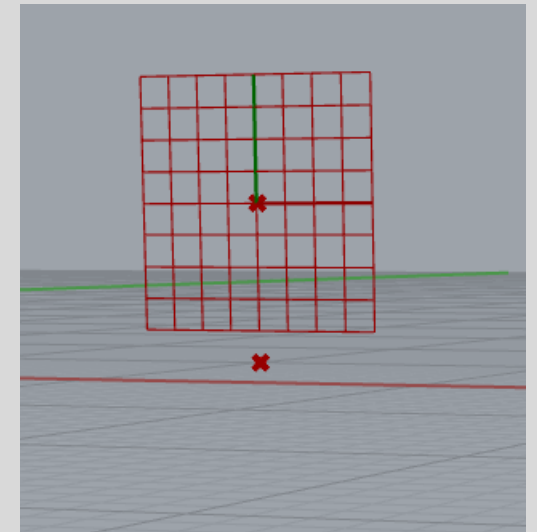
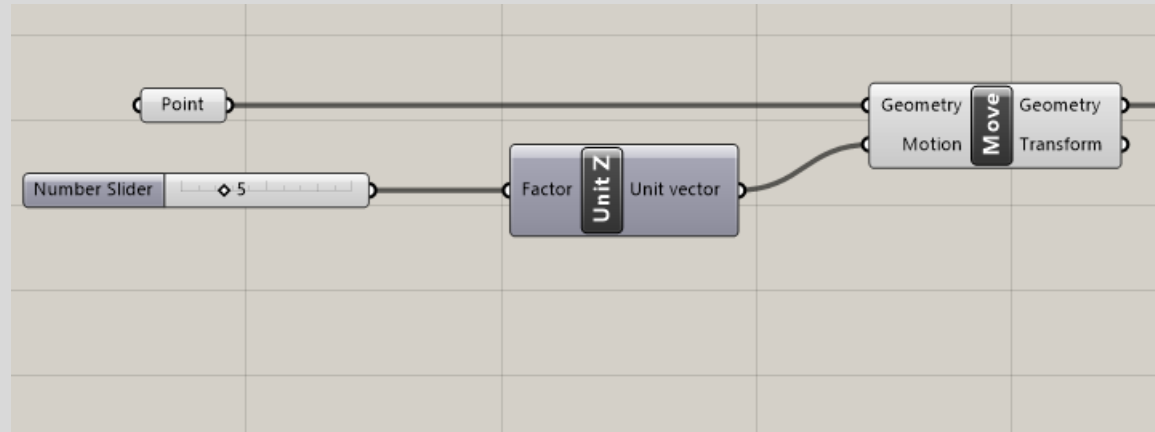
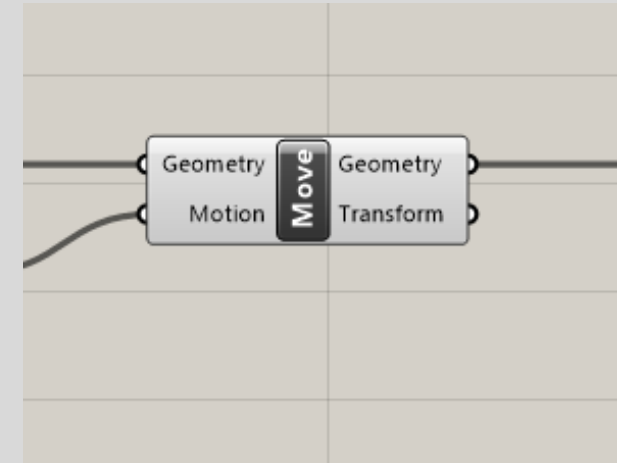
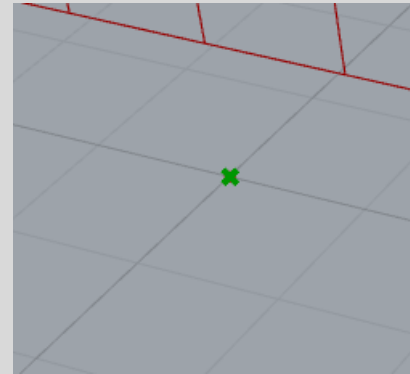
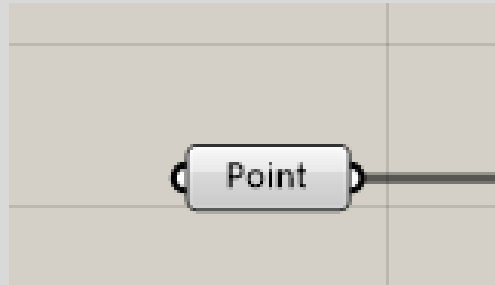
Aula. 10 – GrassHopper

Definir circulo;
Pipe
Toro

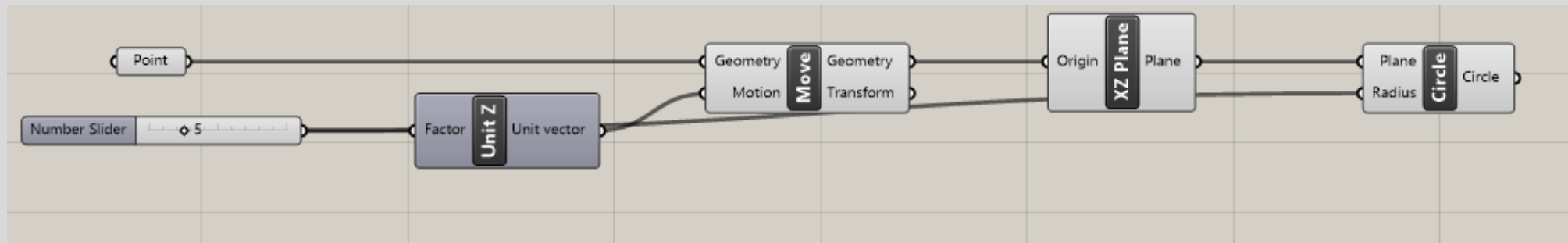


Aula. 10 – Toro em Grasshopper

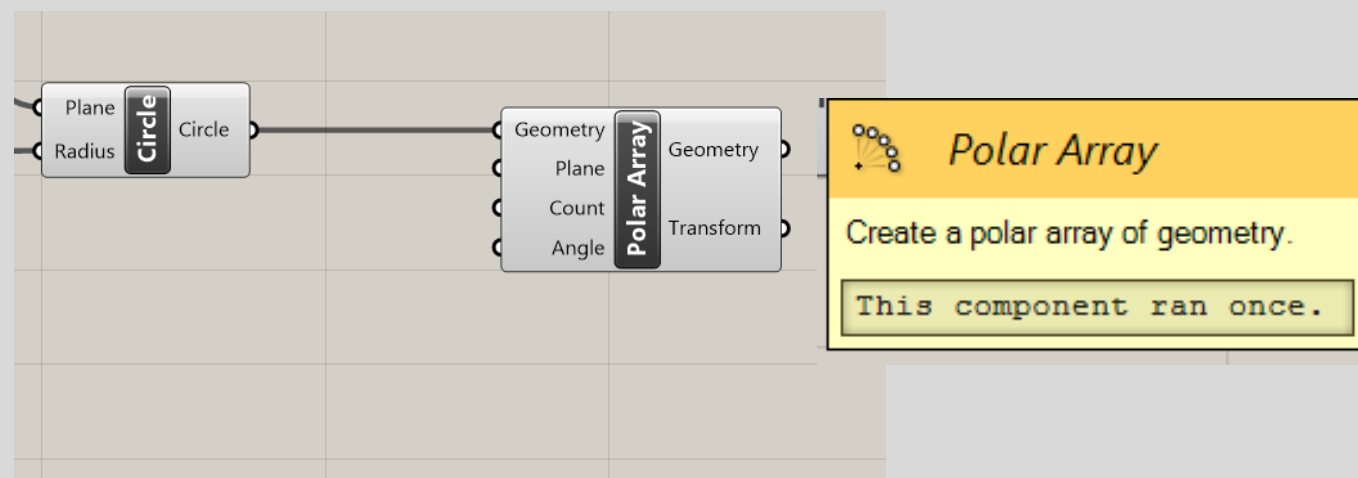
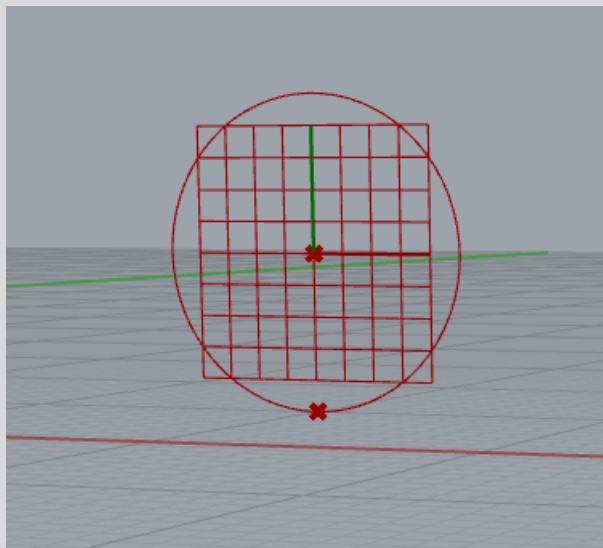
FUTURAMENTE



Aula. 10 – Toro em Grasshopper

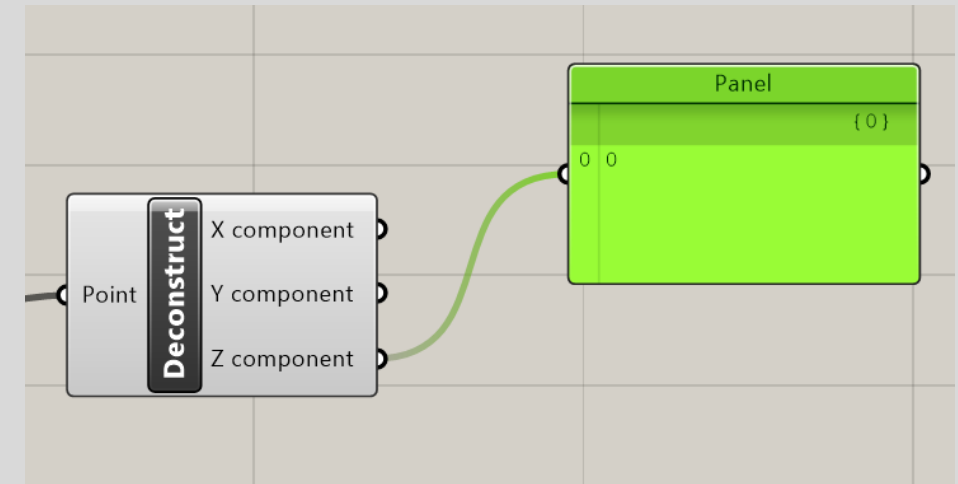
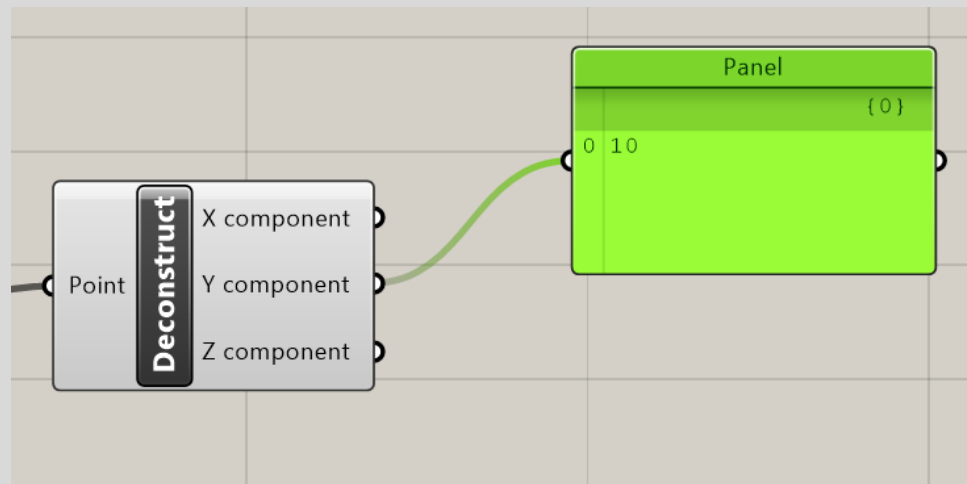
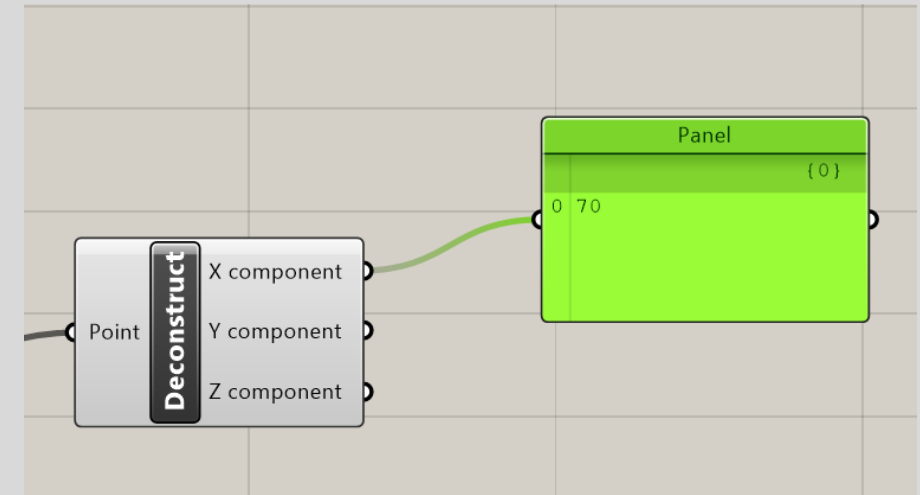
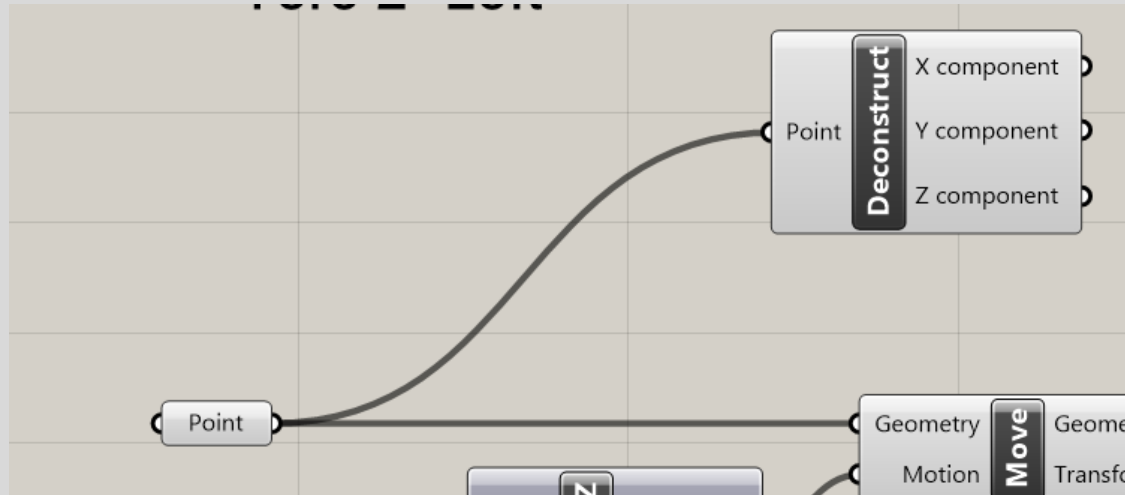


FUTURAMENTE



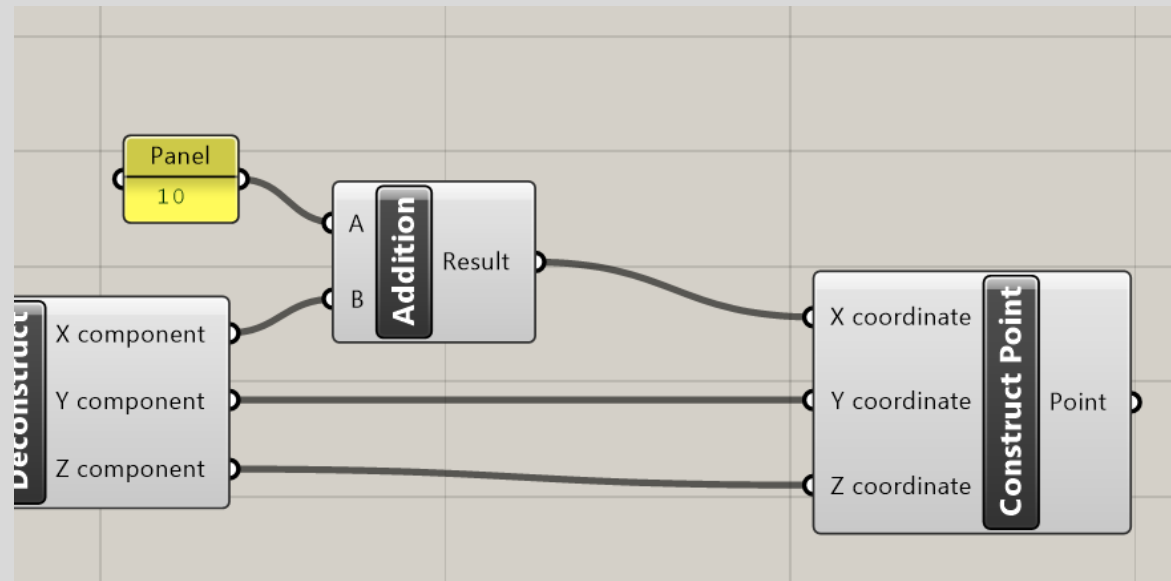
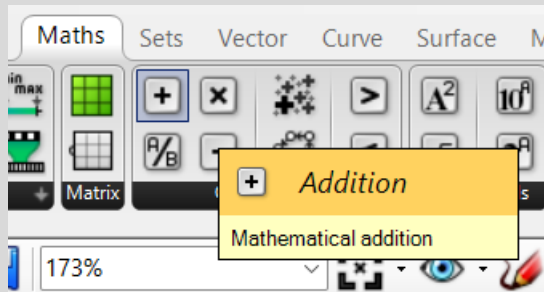
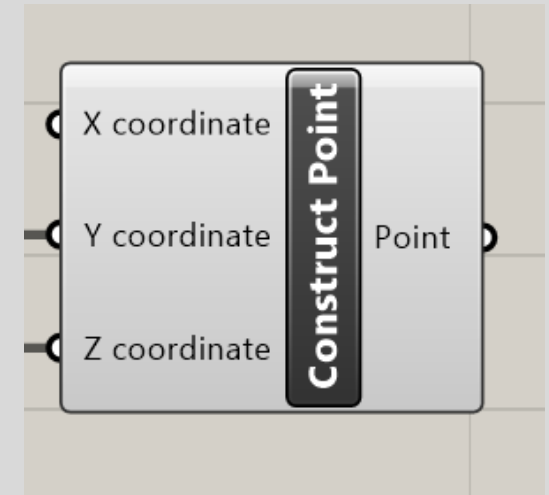
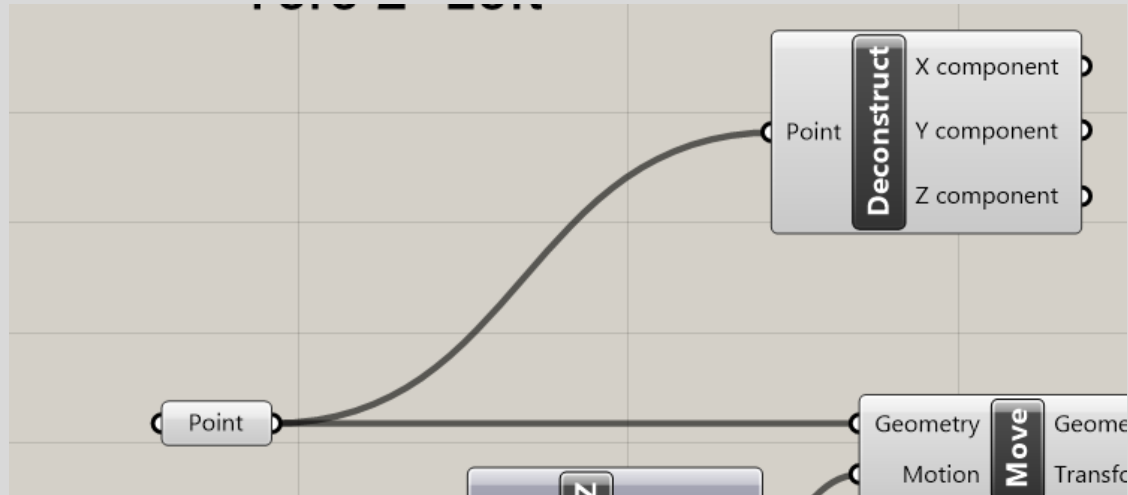
Aula. 10 – Toro em Grasshopper

FUTURAMENTE



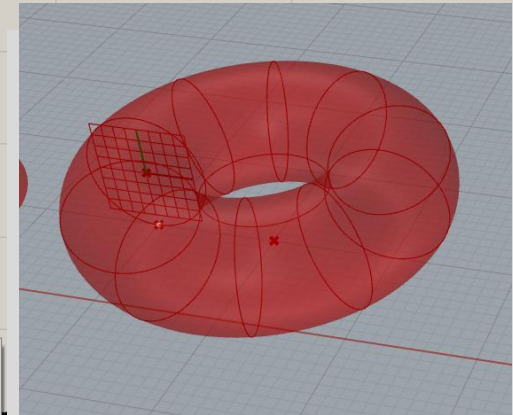
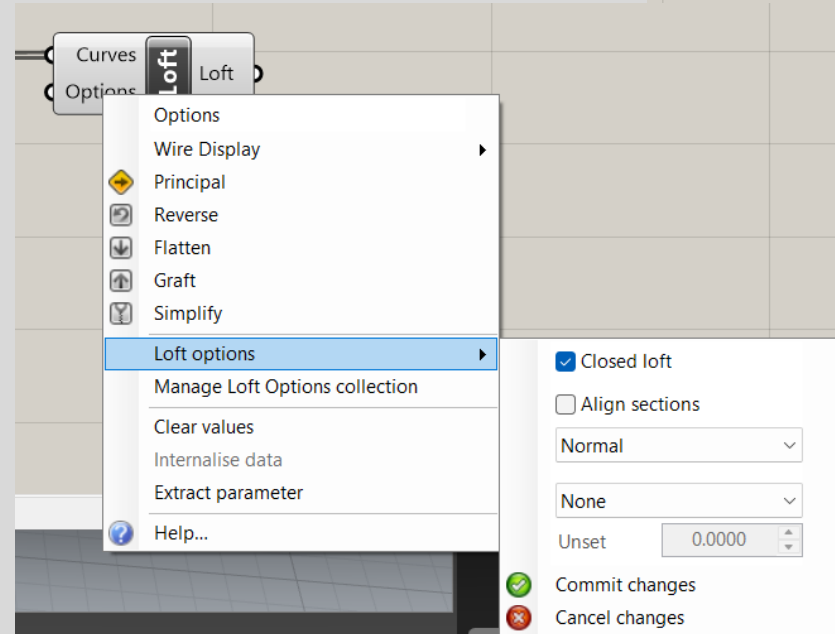
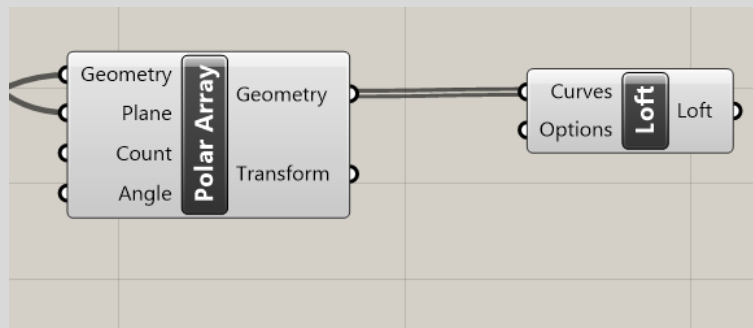
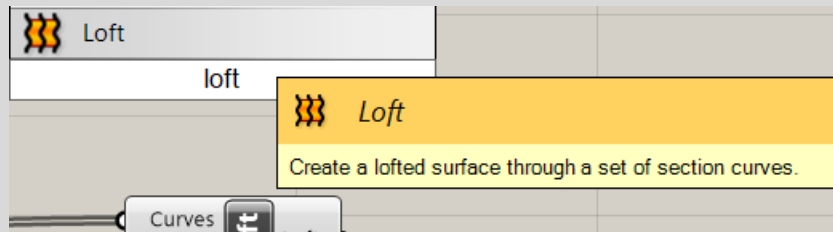
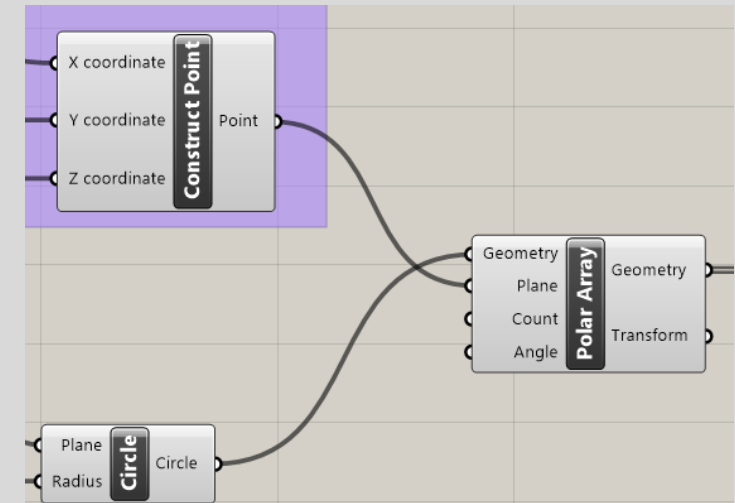
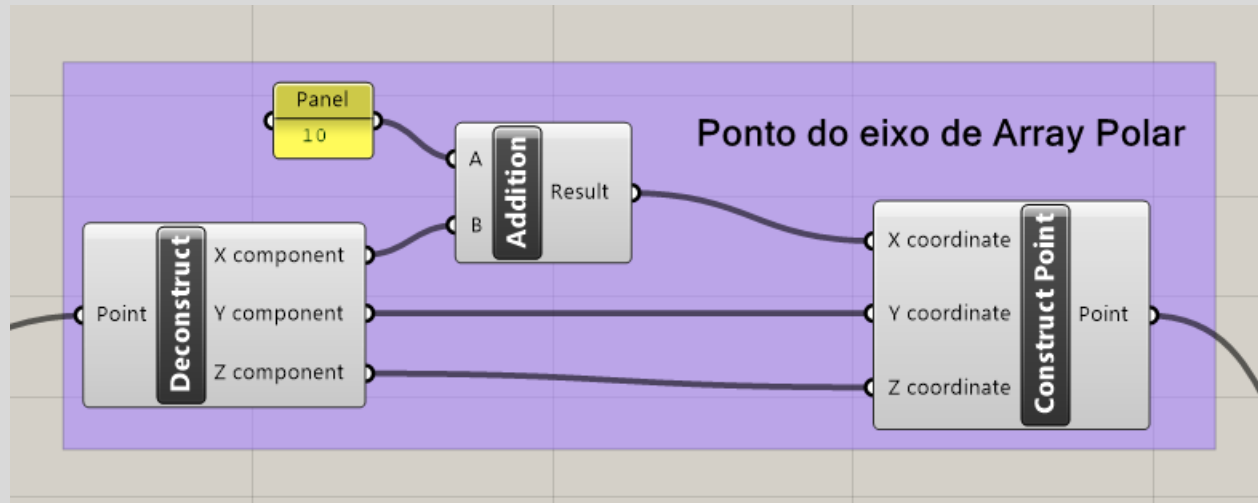
Aula. 10 – Toro em Grasshopper

FUTURAMENTE



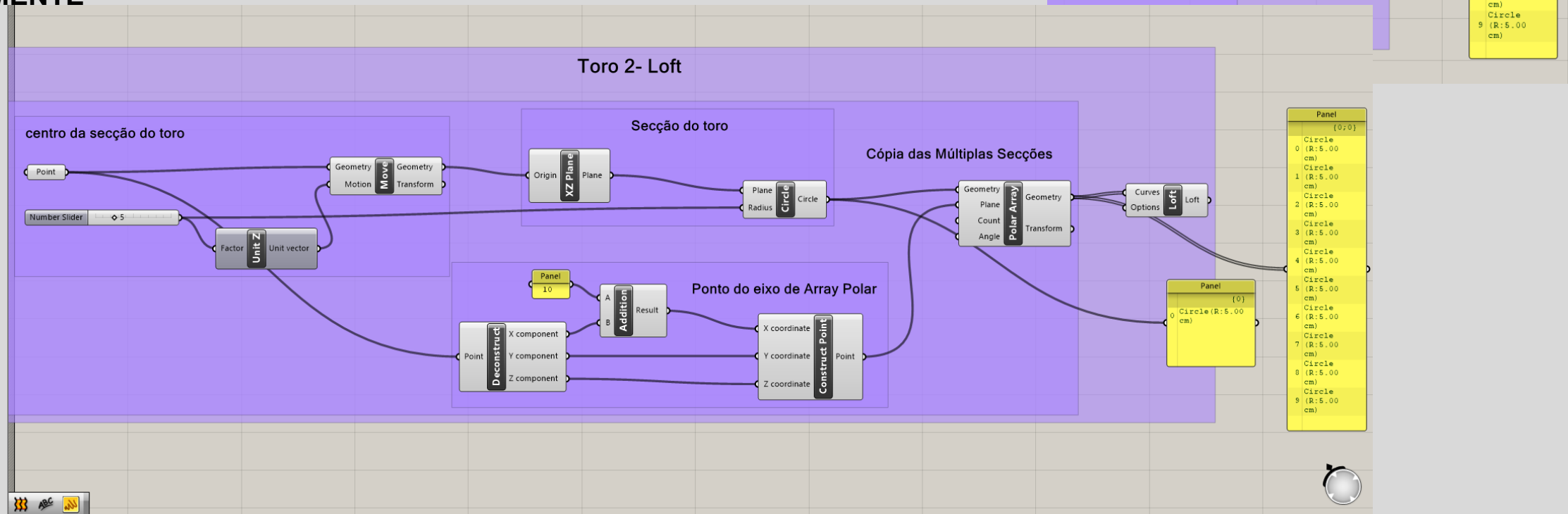
Aula. 10 – Toro em Grasshopper

FUTURAMENTE



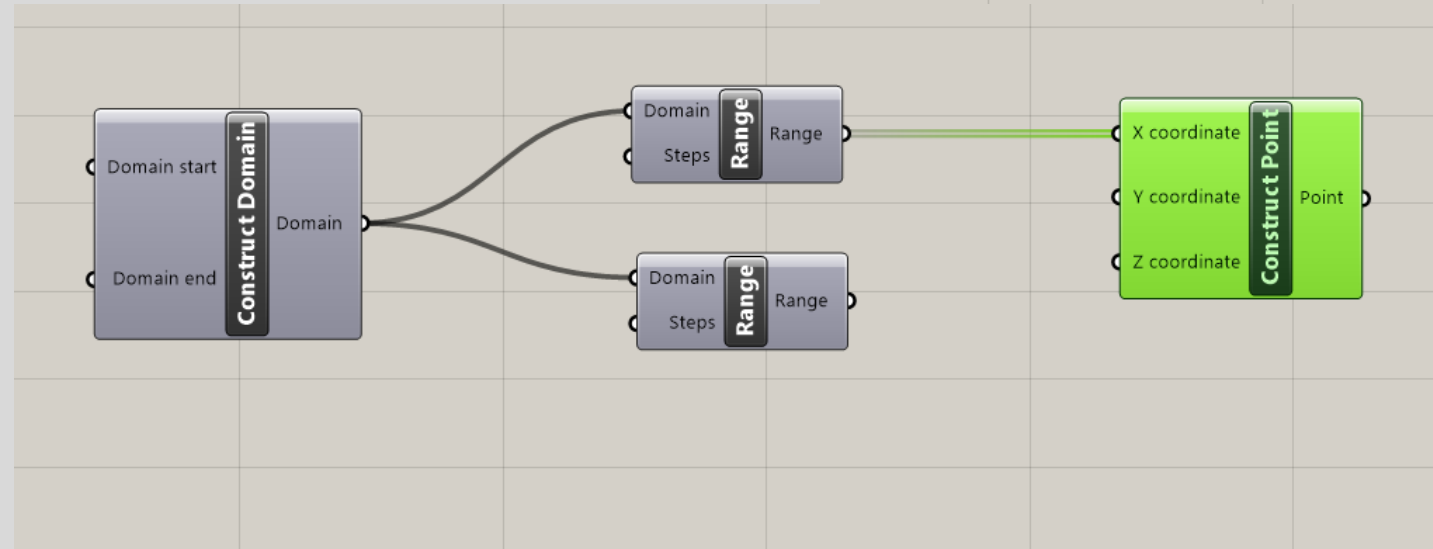
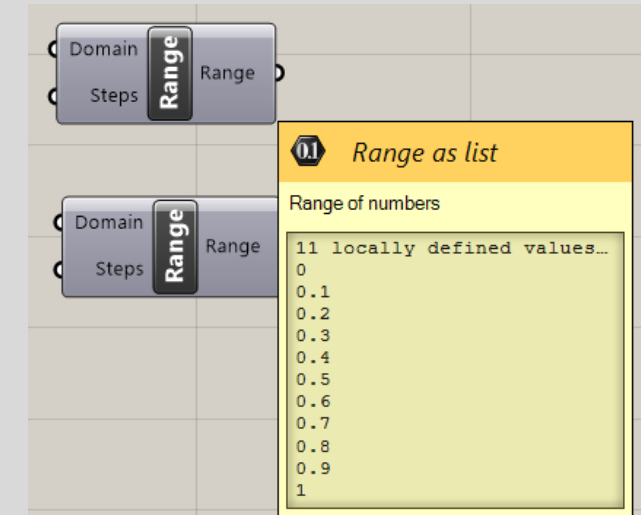
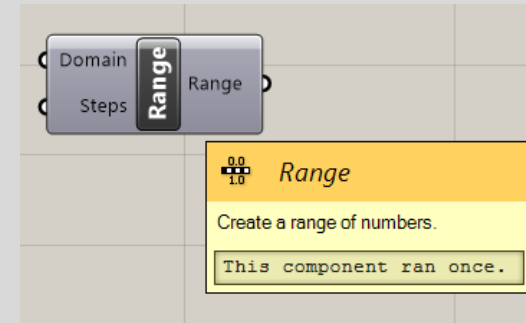
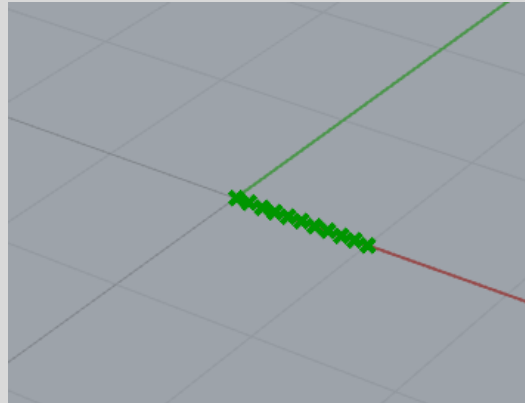
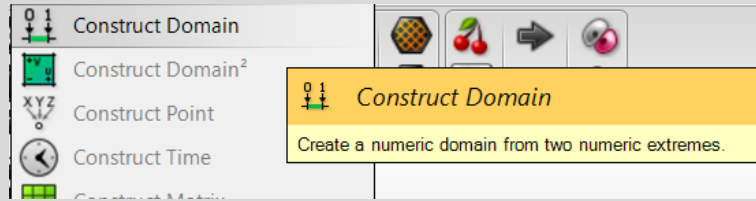
Aula. 10 – Toro em Grasshopper

FUTURAMENTE



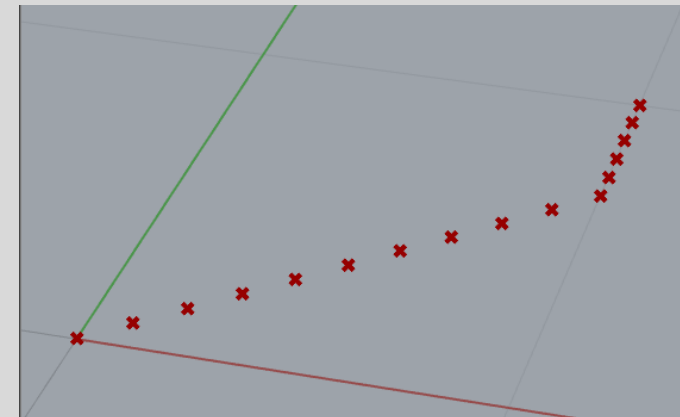
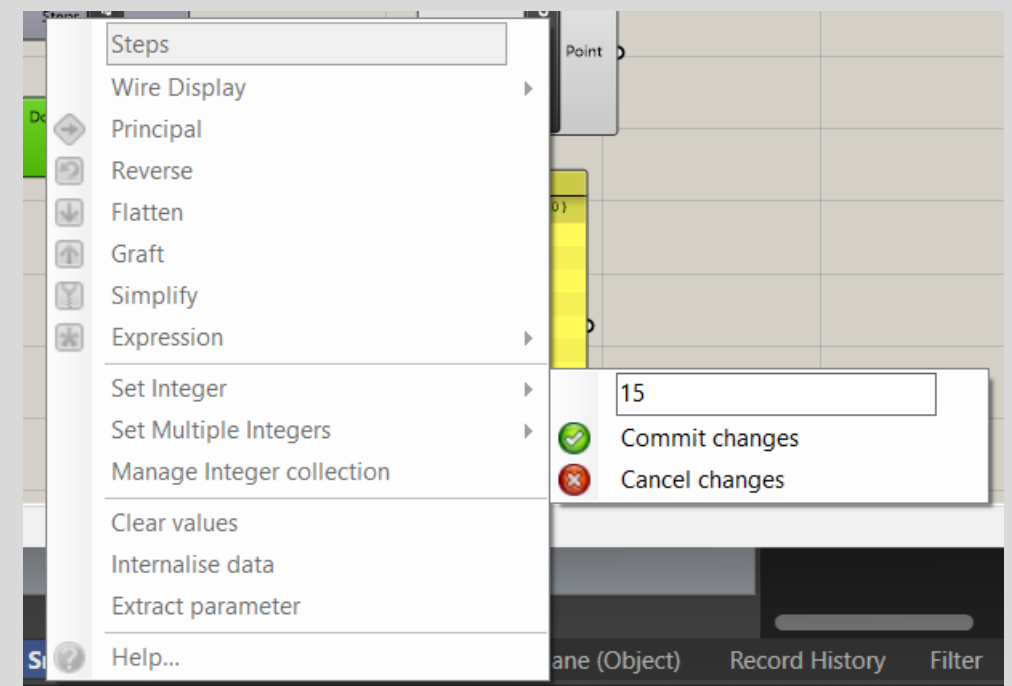
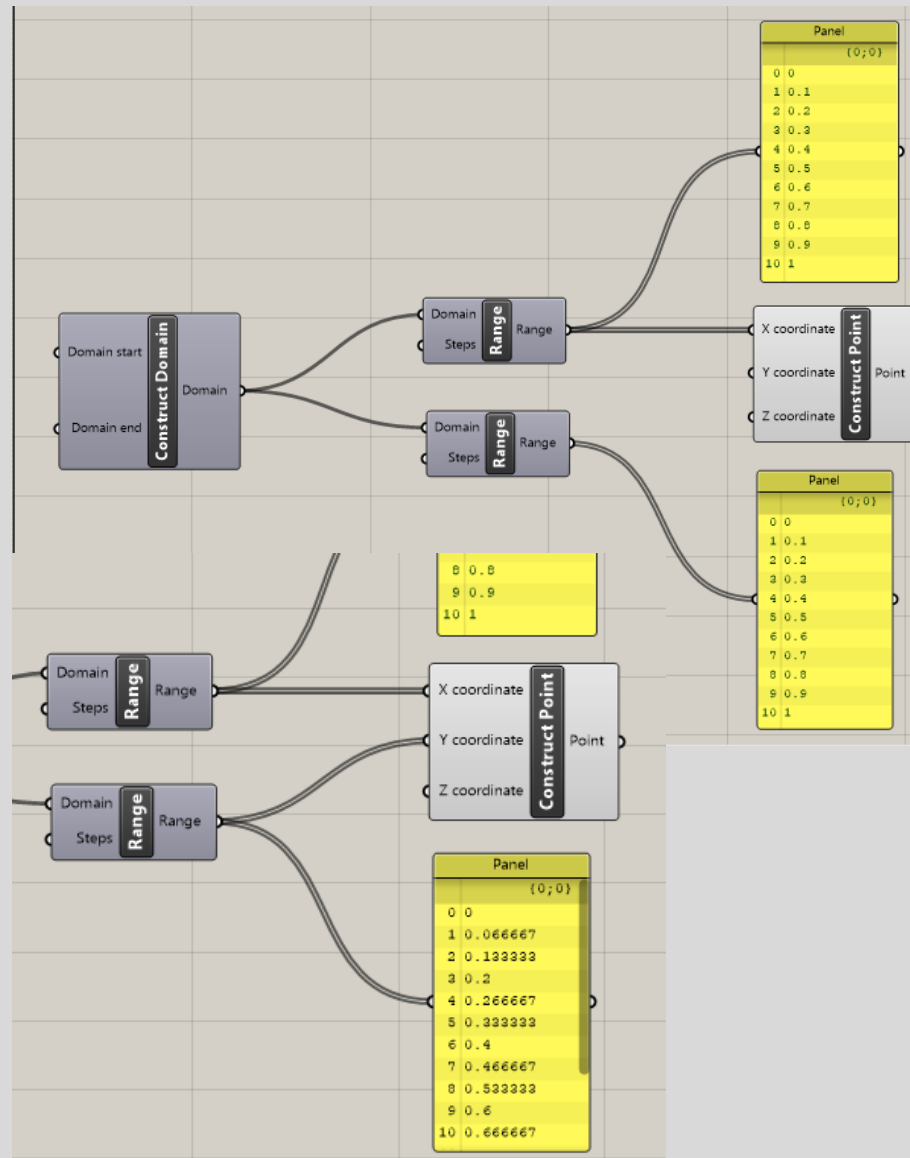
Aula. 10 – Toro em Grasshopper

Novo documento



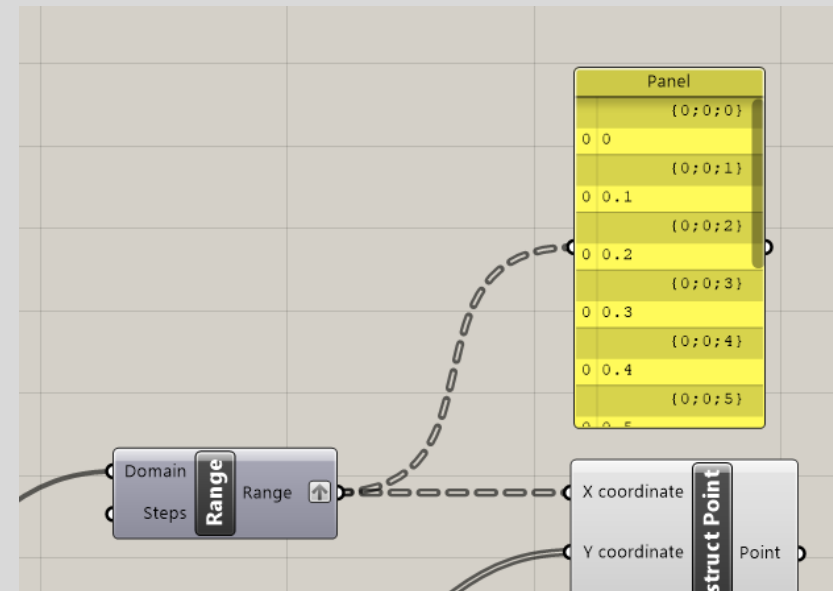
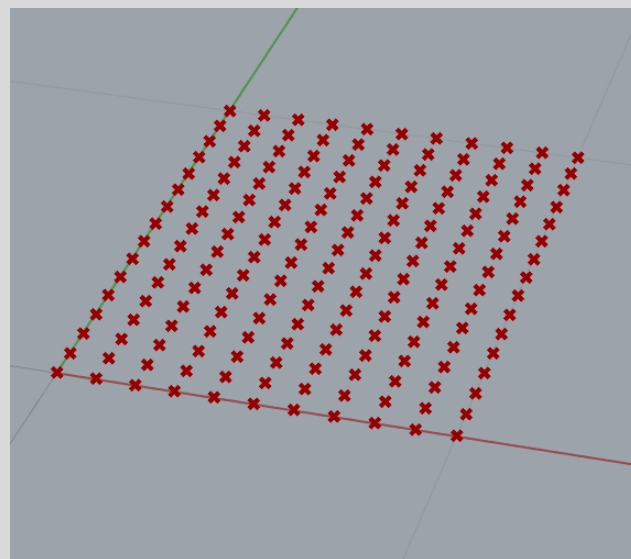
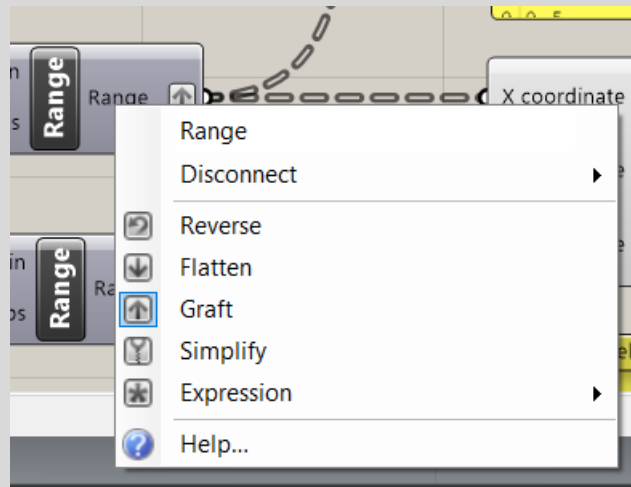
Aula. 10 – Grasshopper

Novo documento



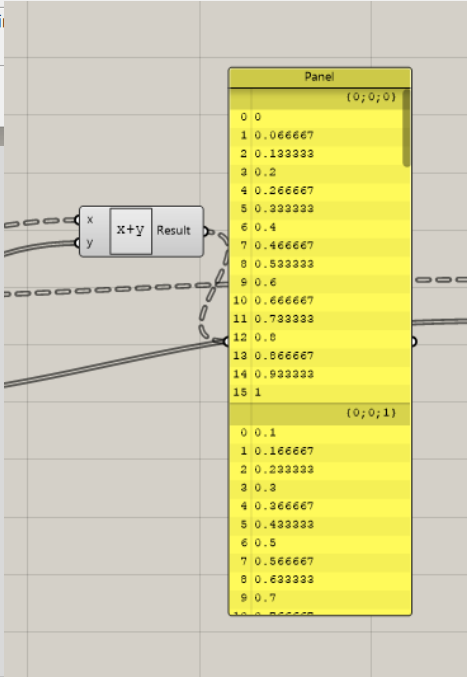
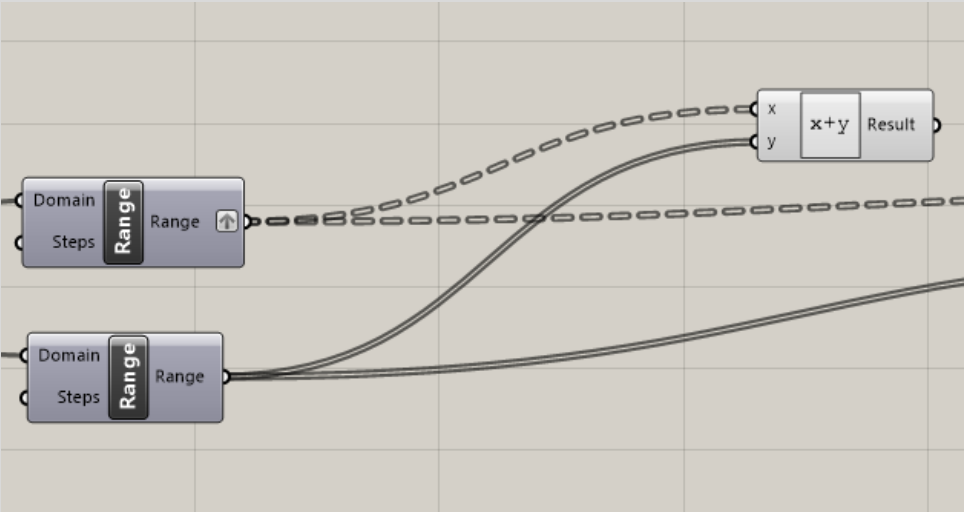
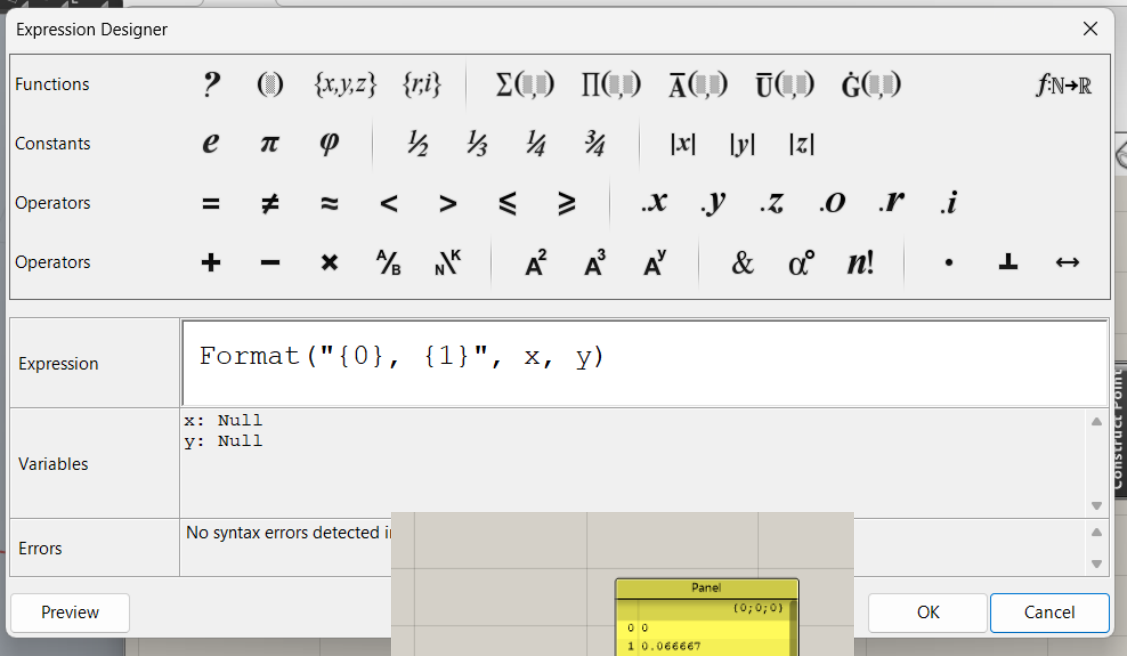
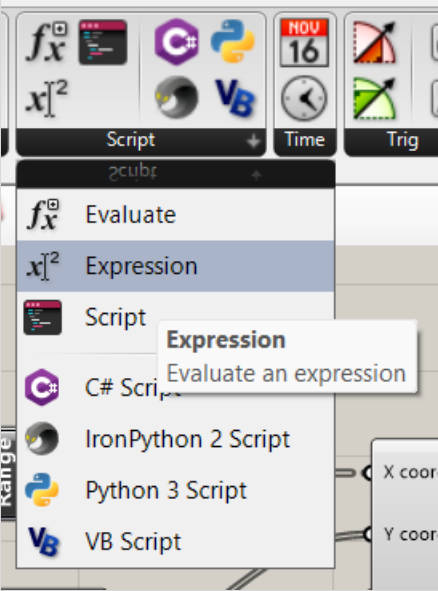
Aula. 10 – Grasshopper

Novo documento



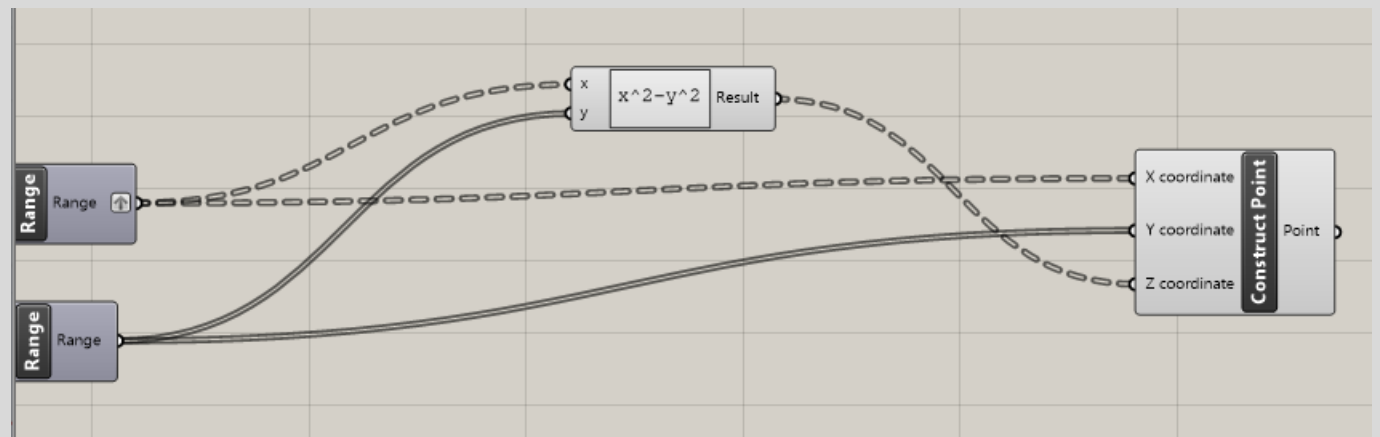
Aula. 10 – Grasshopper

Novo documento

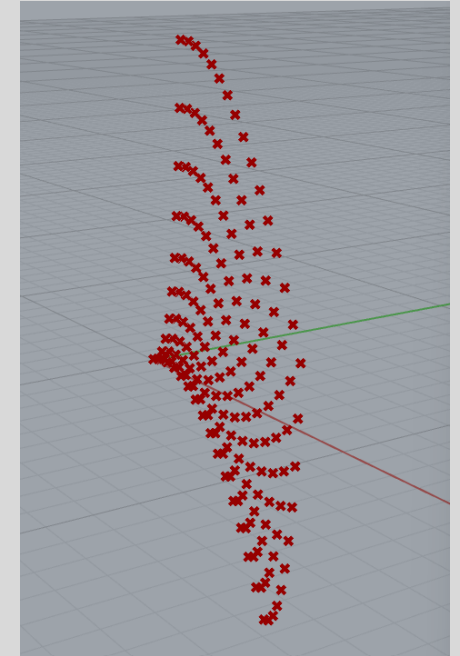
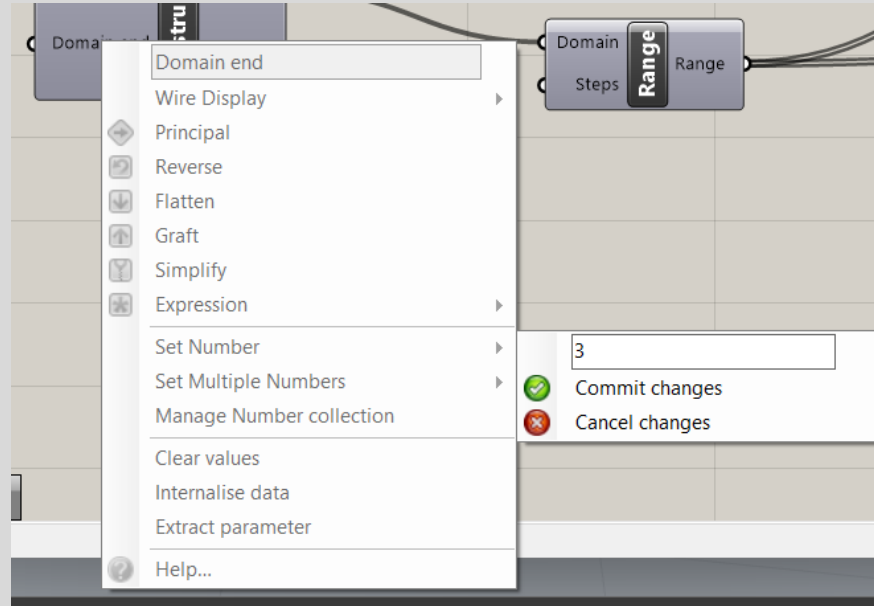
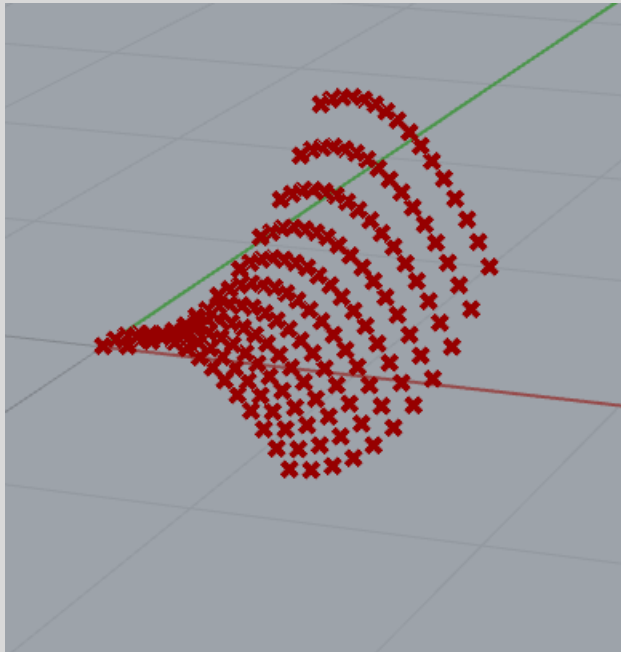


Aula. 10 – Grasshopper

Expression	$x^2 - y^2$
Variables	x: Number y: Number

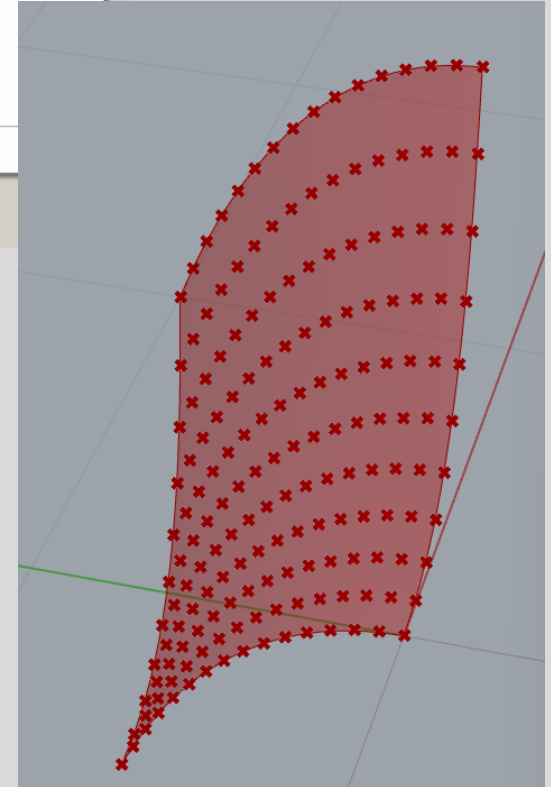
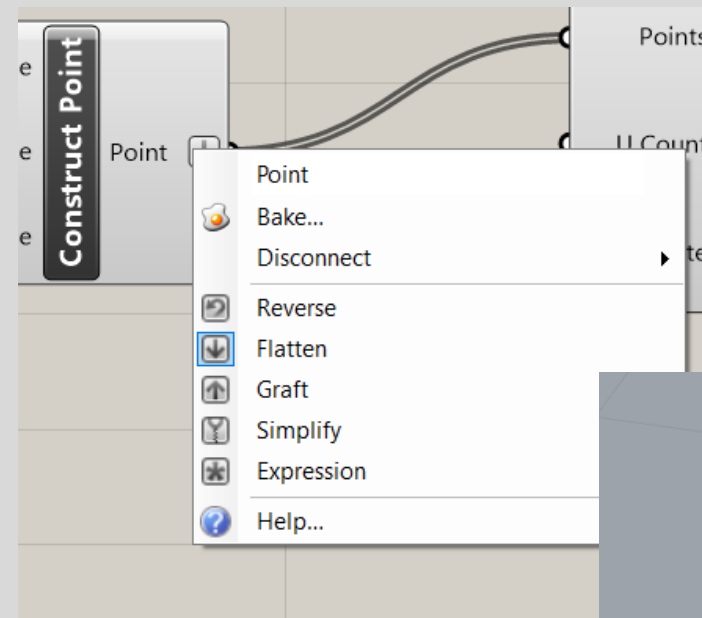
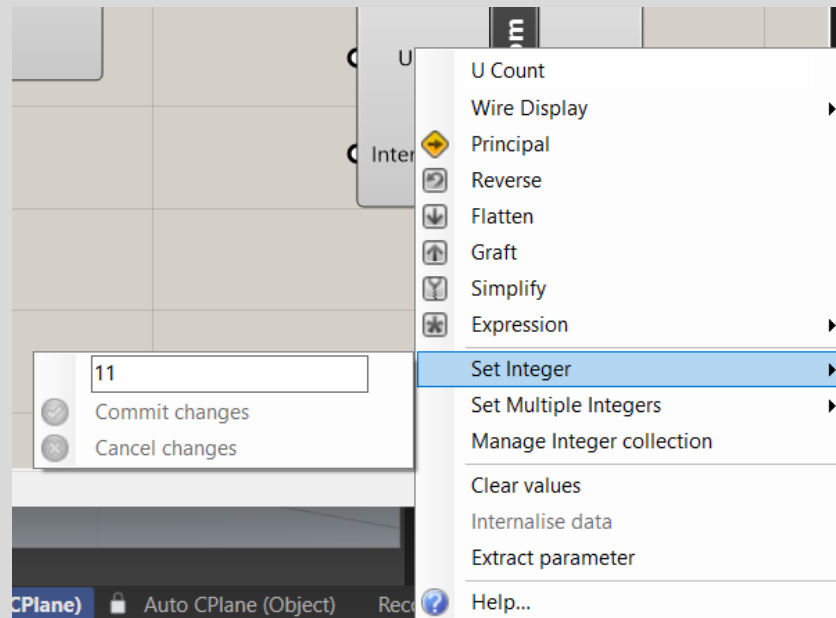


Novo documento



Aula. 10 – Grasshopper

Novo documento

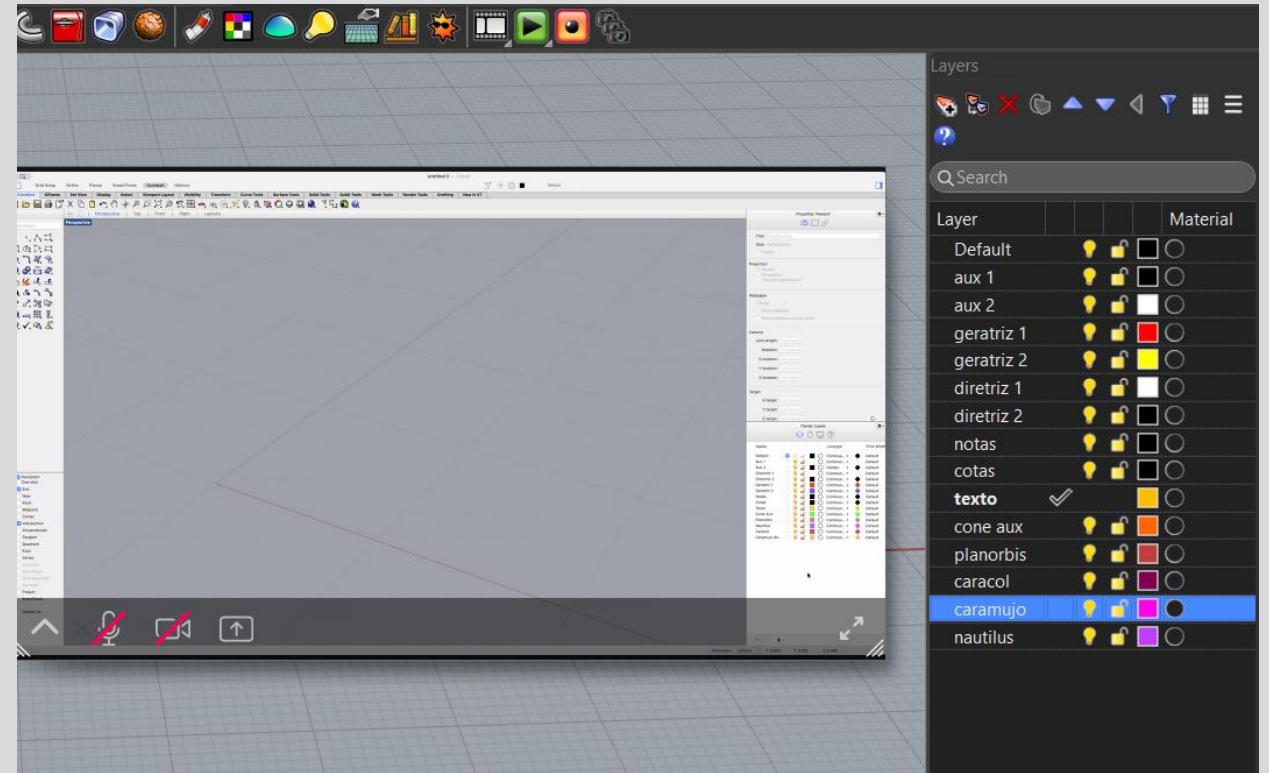


Aula. 10 – Grasshopper

FUTURAMENTE

Aula. 11 - Planorbis

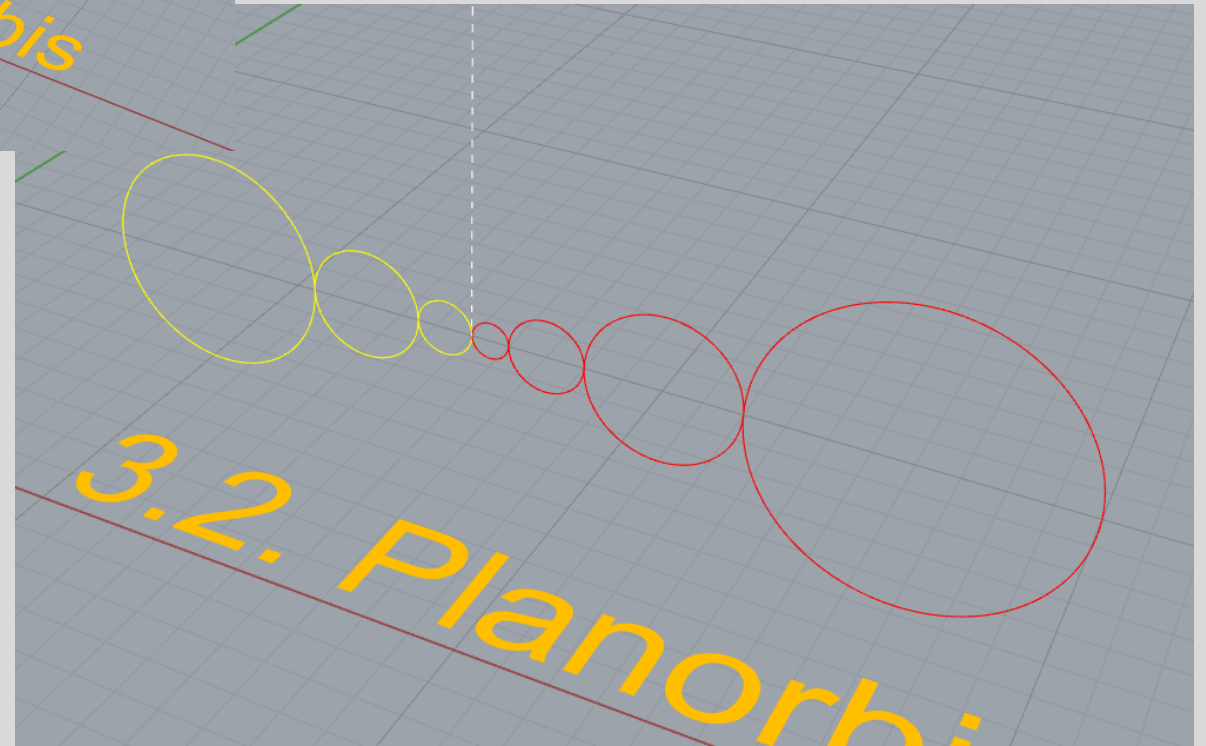
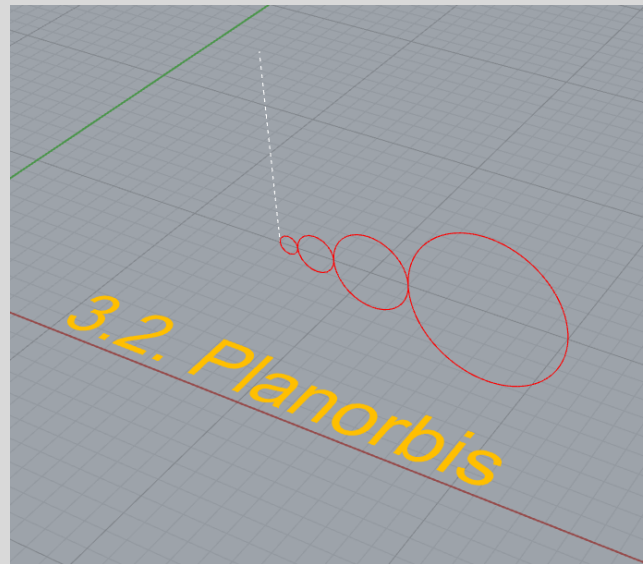
FUTURAMENTE



Aula. 11 - Planorbis

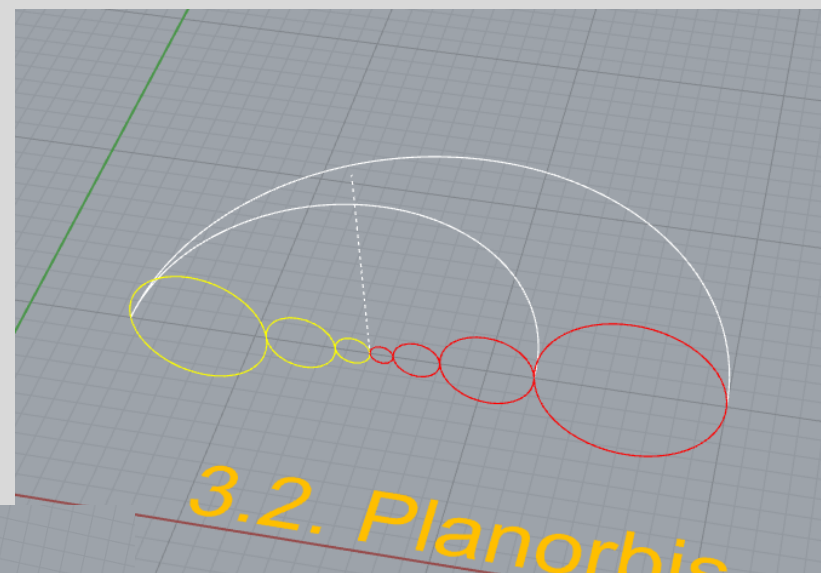
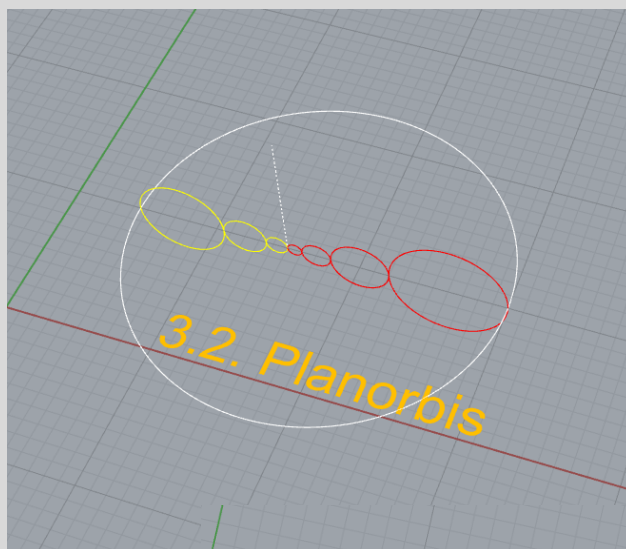
Circle com diâmetros 1,1.5, 2, 3, 4, 6, 8

Line vertical com 10



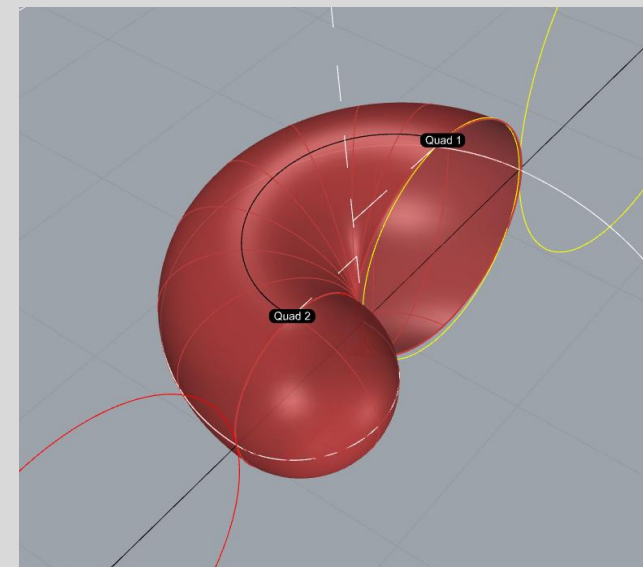
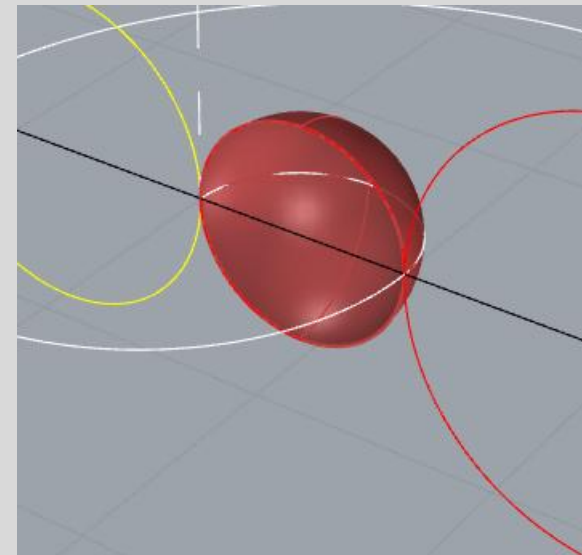
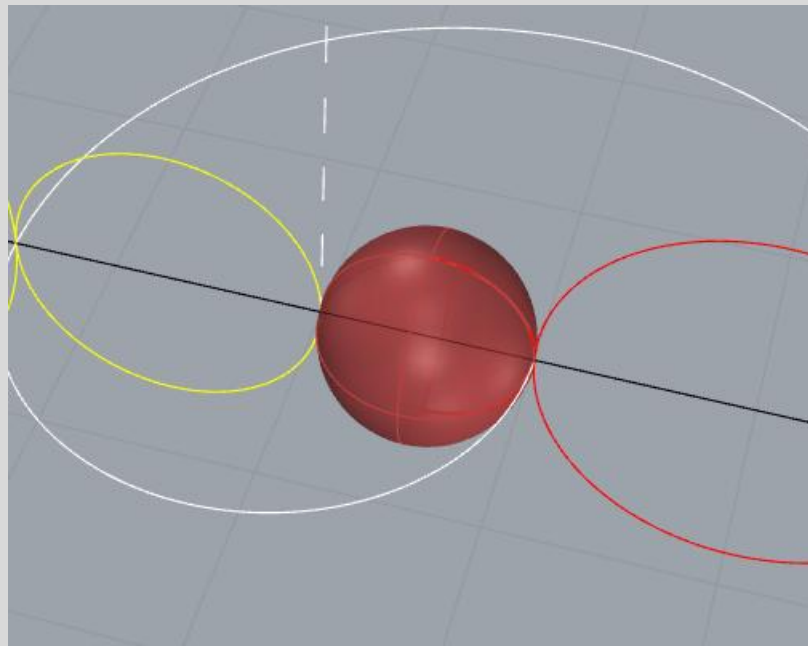
Aula. 11 - Planorbis

Circle
Trim



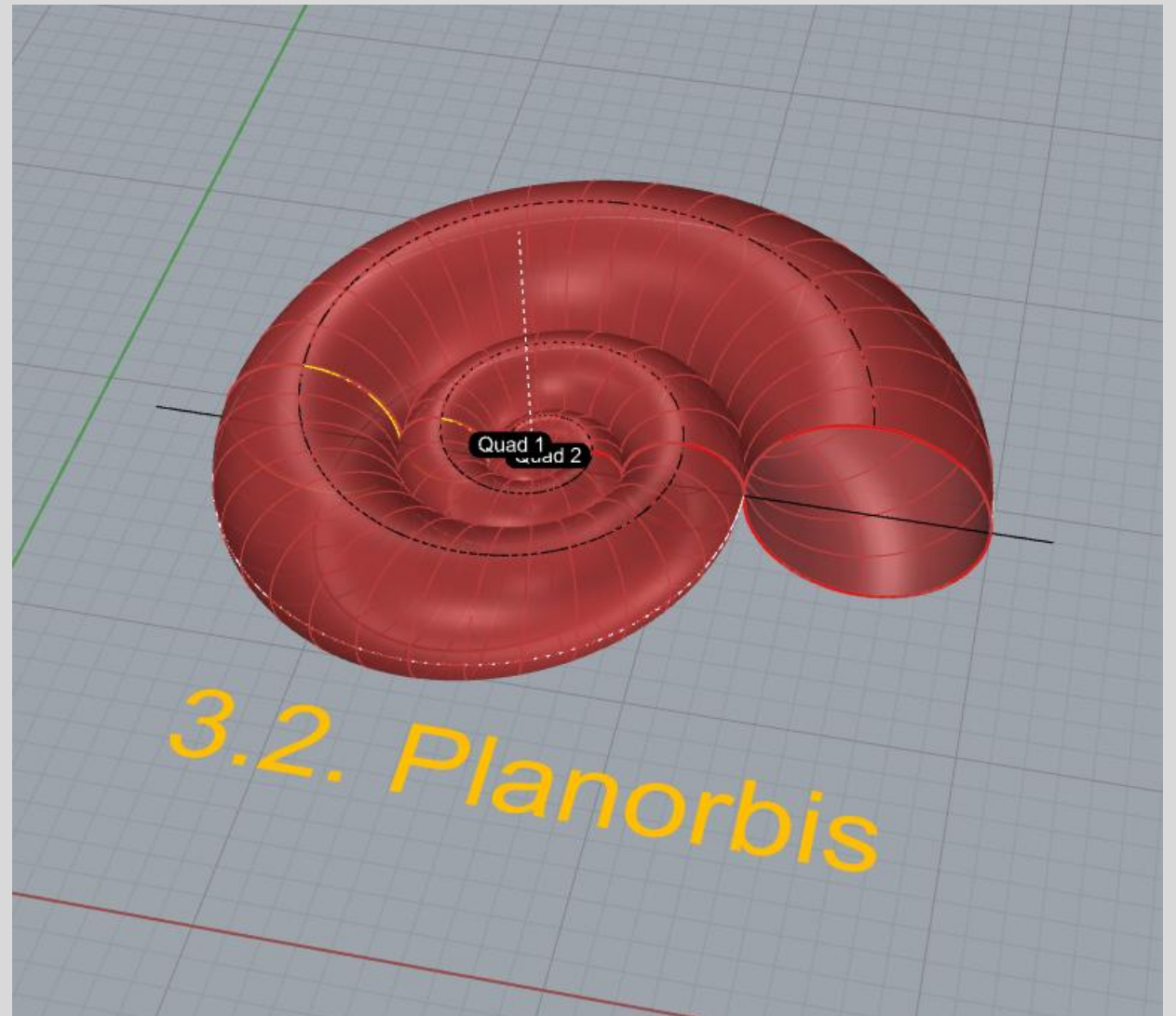
Aula. 11 - Planorbis

Trim na circunferência
Spiral
Sweep 2



Aula. 11 - Planorbis

Spiral
Sweep 2



Aula. 11 - Planorbis

nautilus

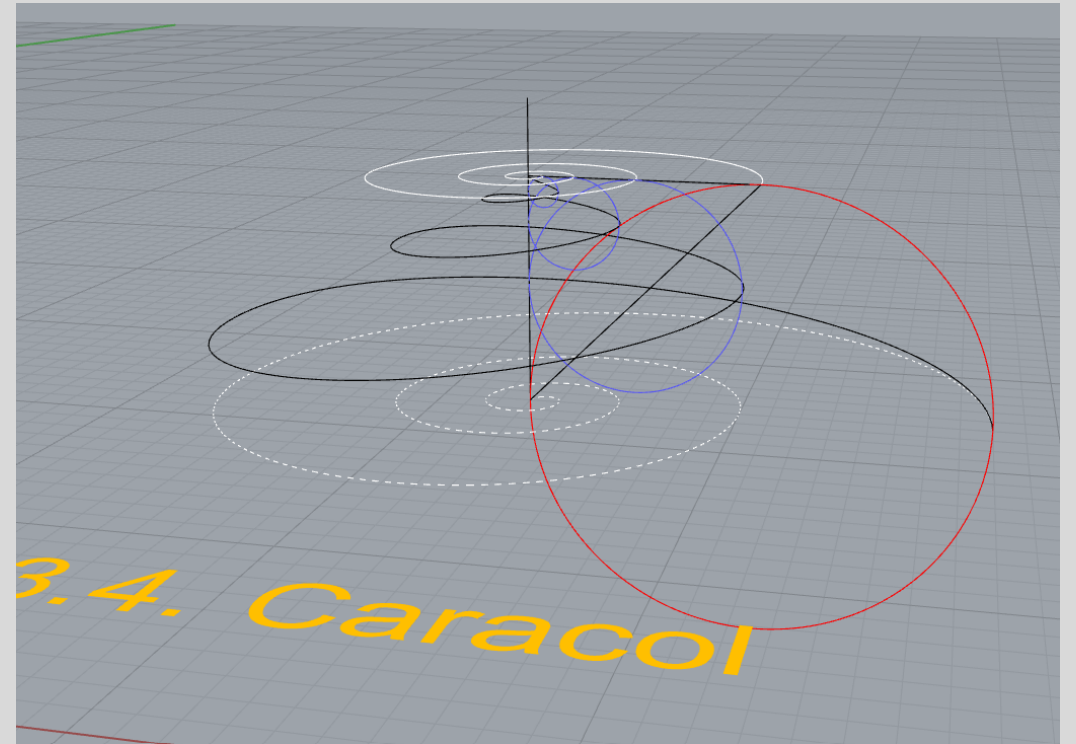
Aula. 11 - Planorbis

FUTURAMENTE

Aula. 12 - Caracol

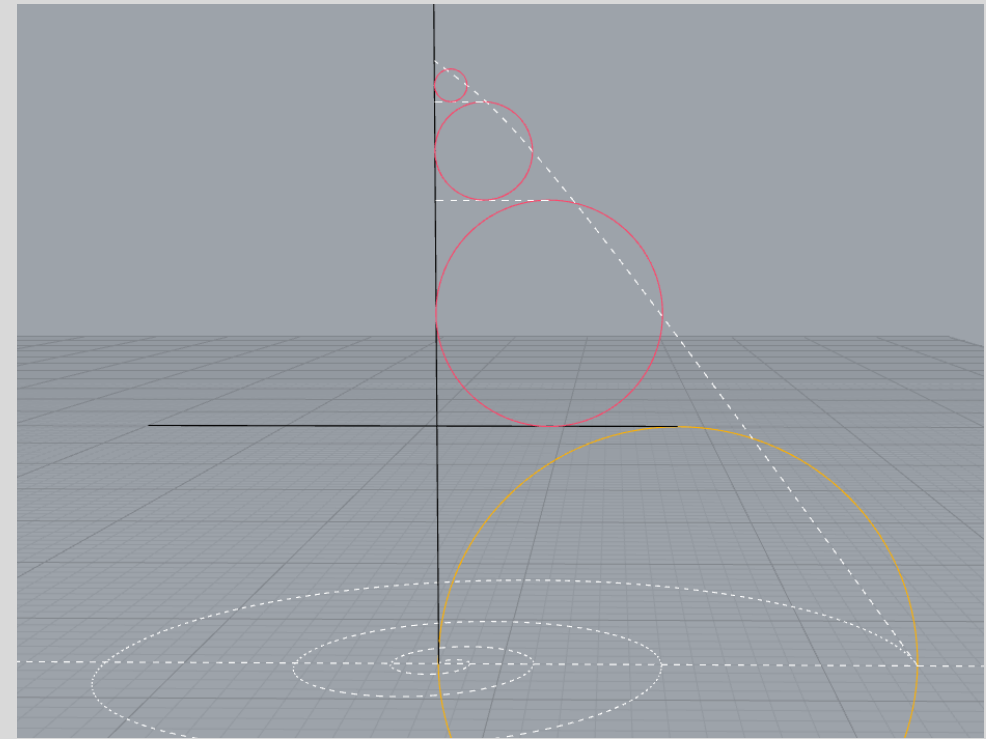
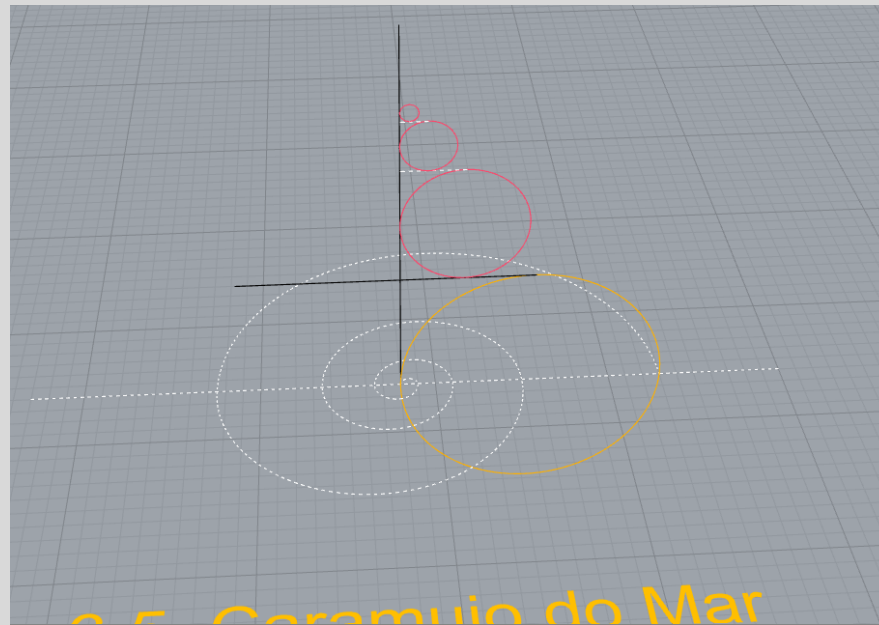
Caracol

Copiar a geometria da nautilus trocando as diretrizes e as auxiliares.



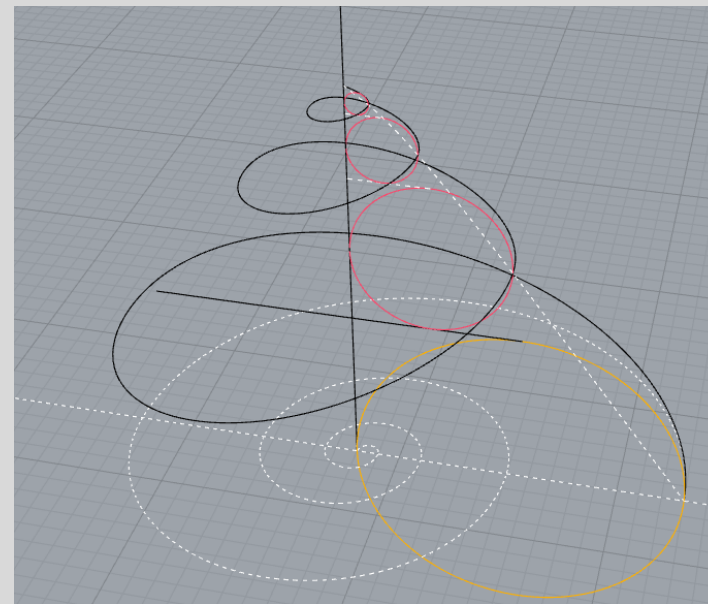
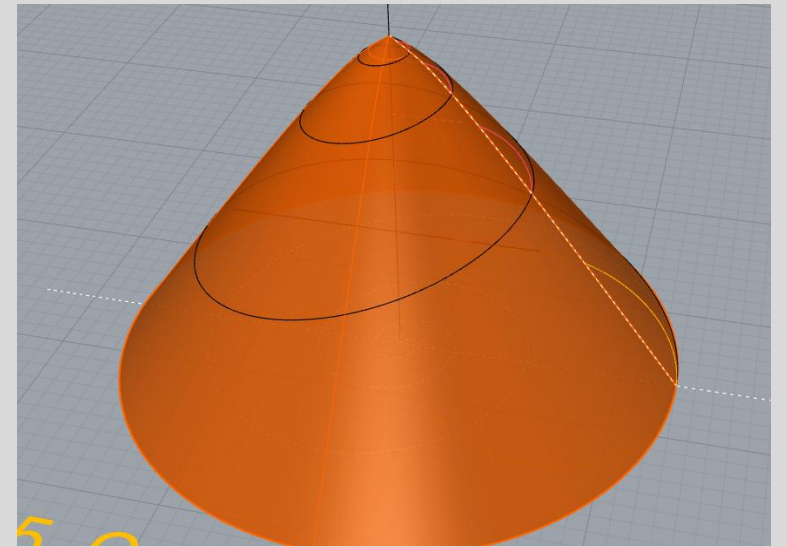
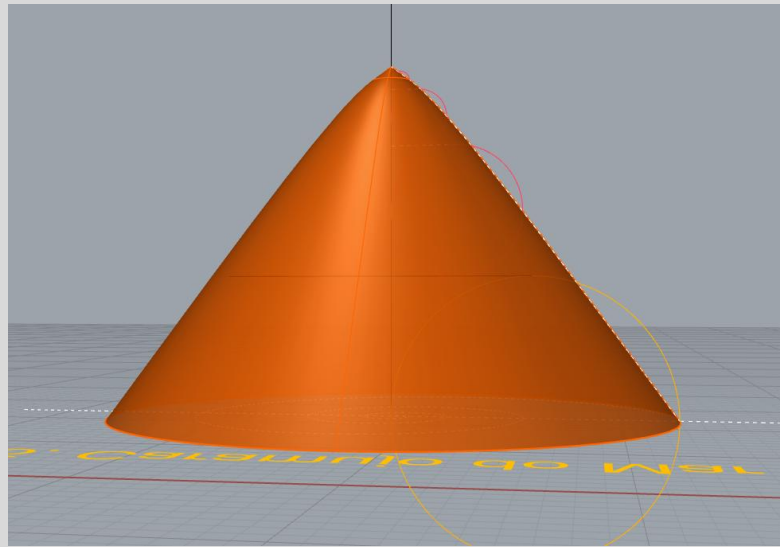
Aula. 12 - Caracol

Caramujo do mar
Copiar geometria
Move nos quadrantes
Spline- geratriz não reta



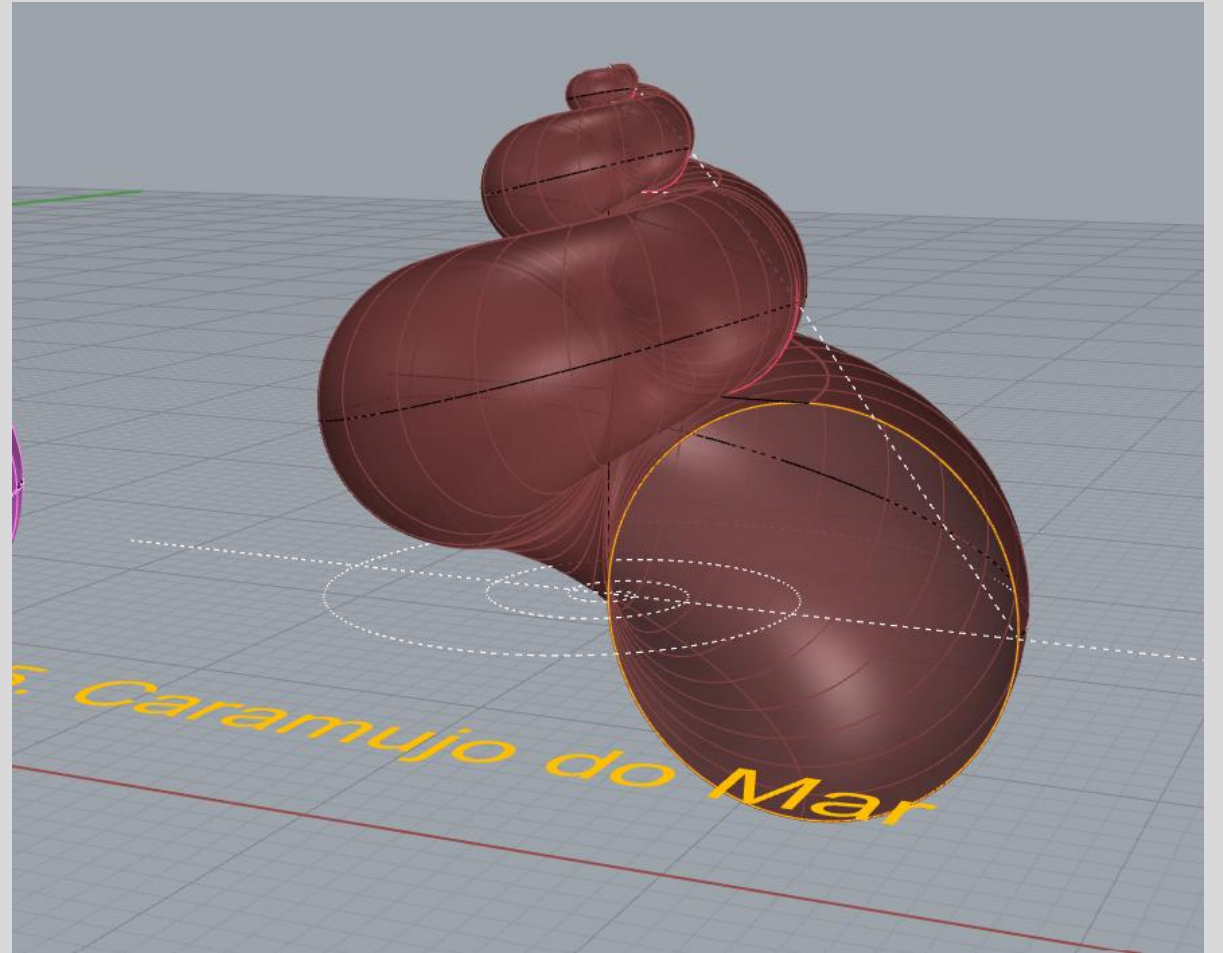
Aula. 12 – Caramujo do Mar

Caramujo do mar
Revolve
Project



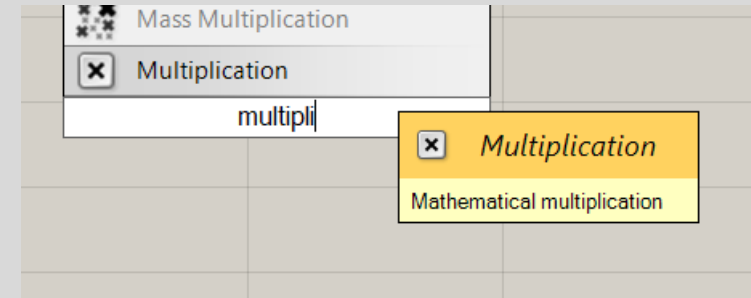
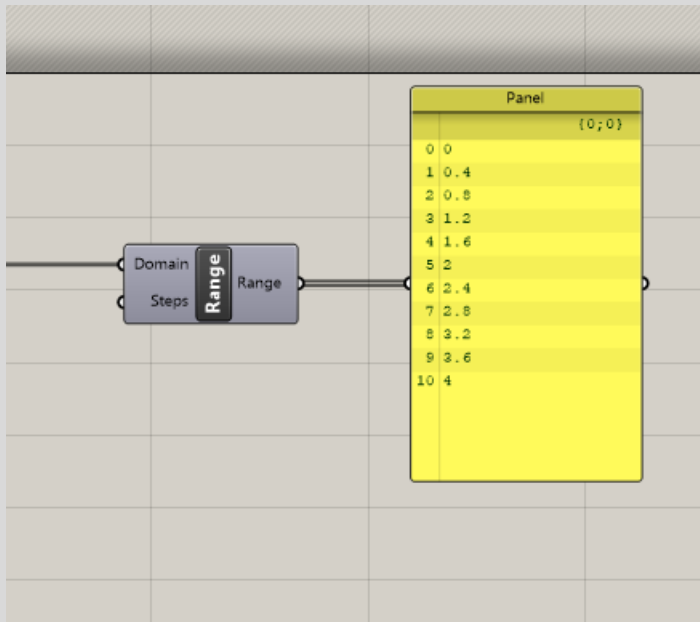
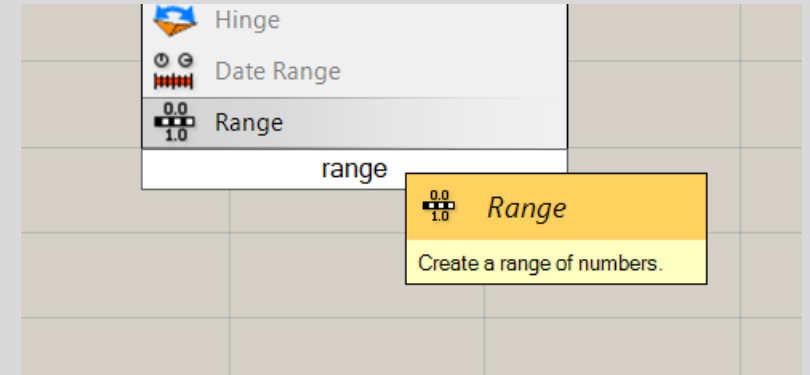
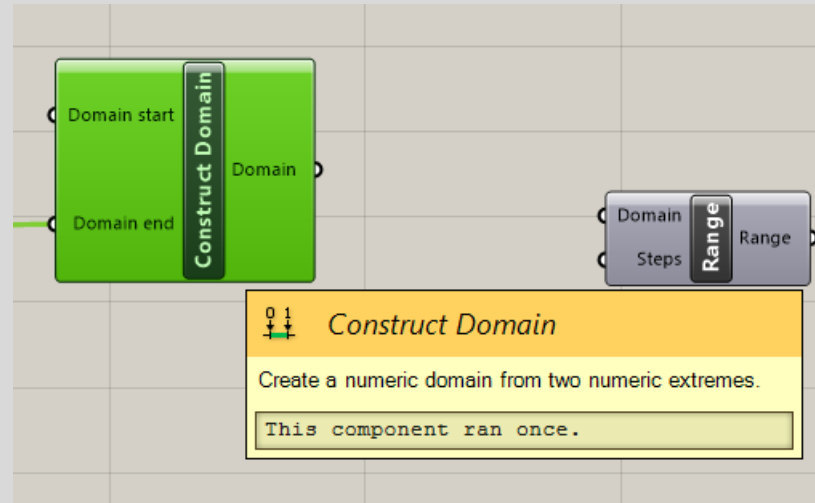
Aula. 12 – Caramujo do Mar

Caramujo do mar
Sweep 2

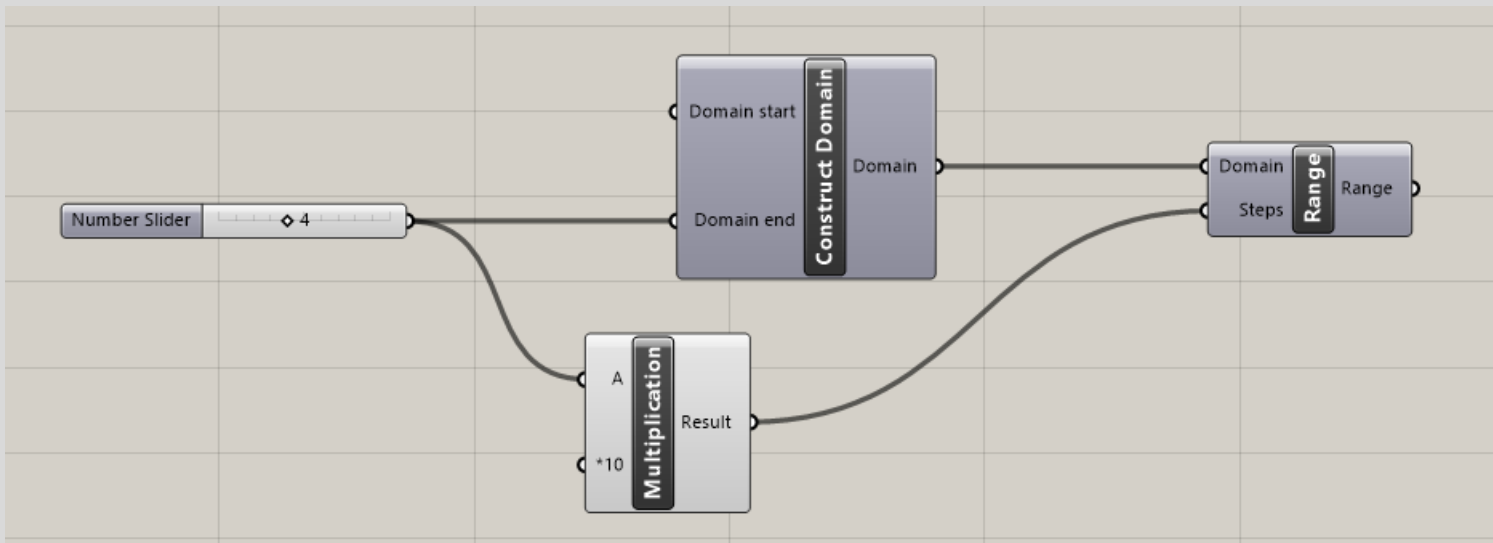
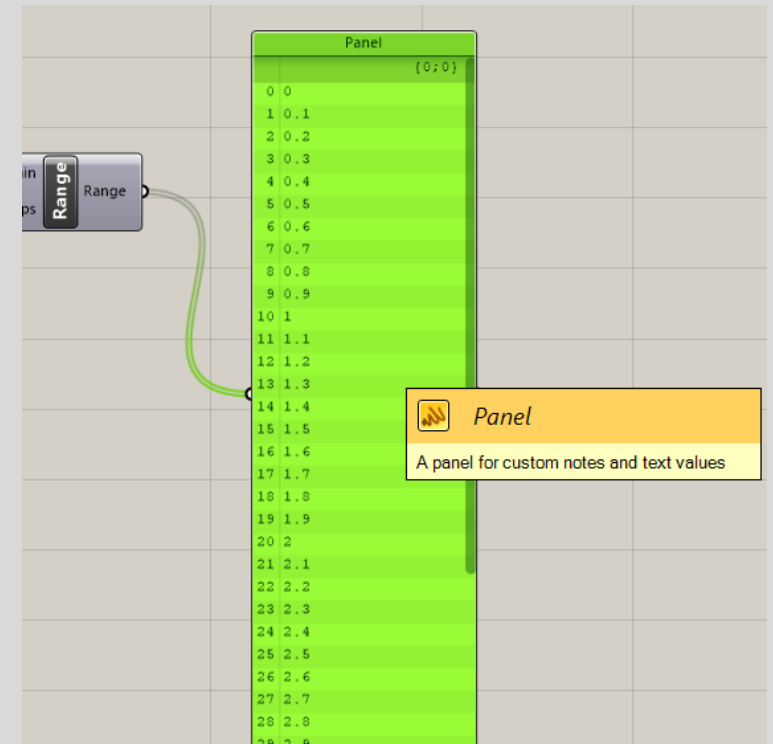
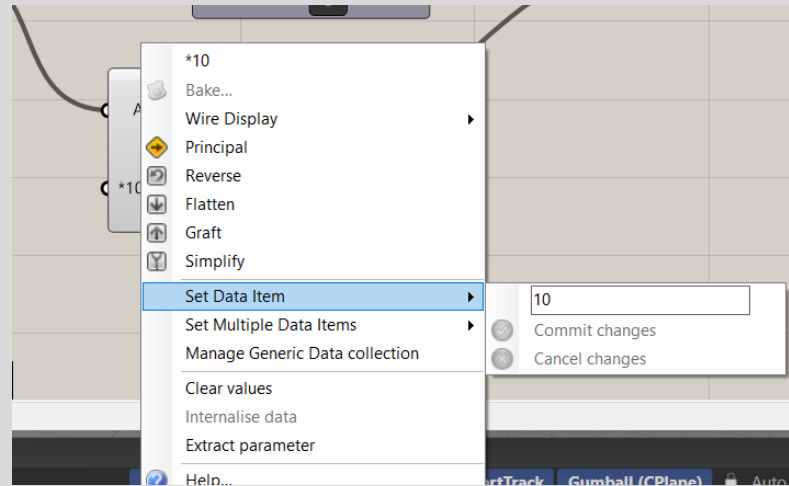


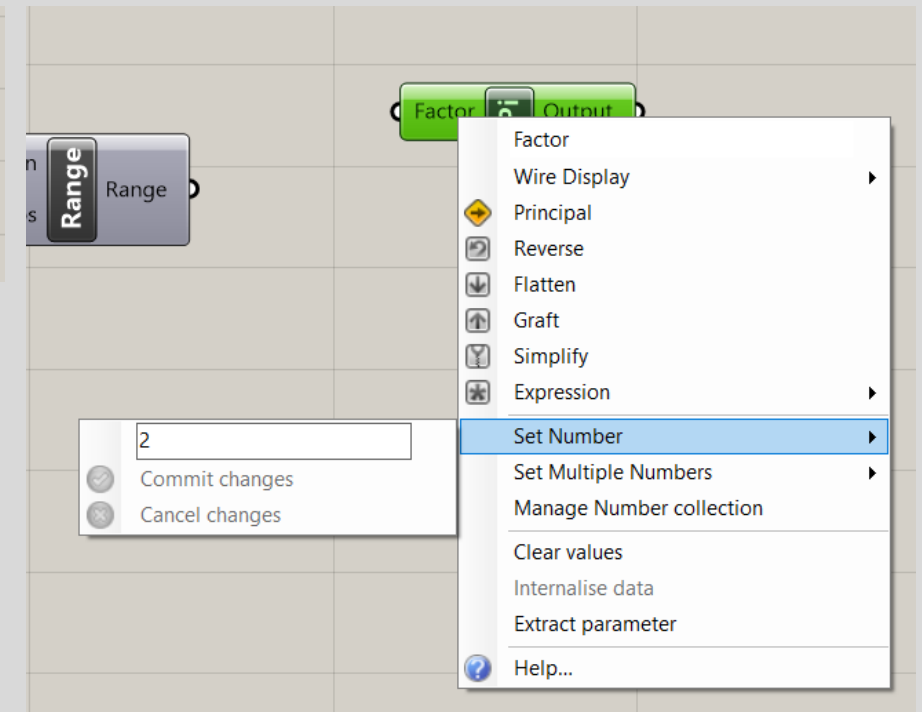
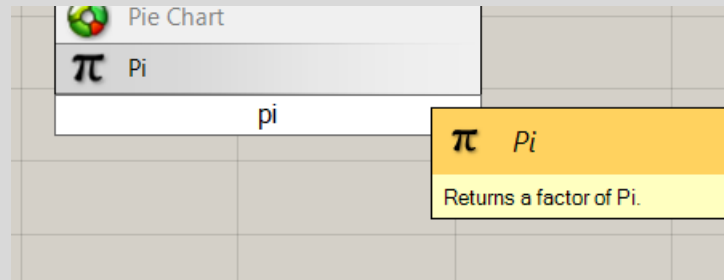
Aula. 12 – Caramujo do Mar

Caramujo do mar- Grasshopper Constrcut domain, range, number slider

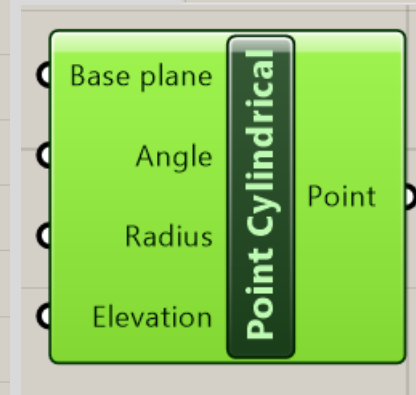
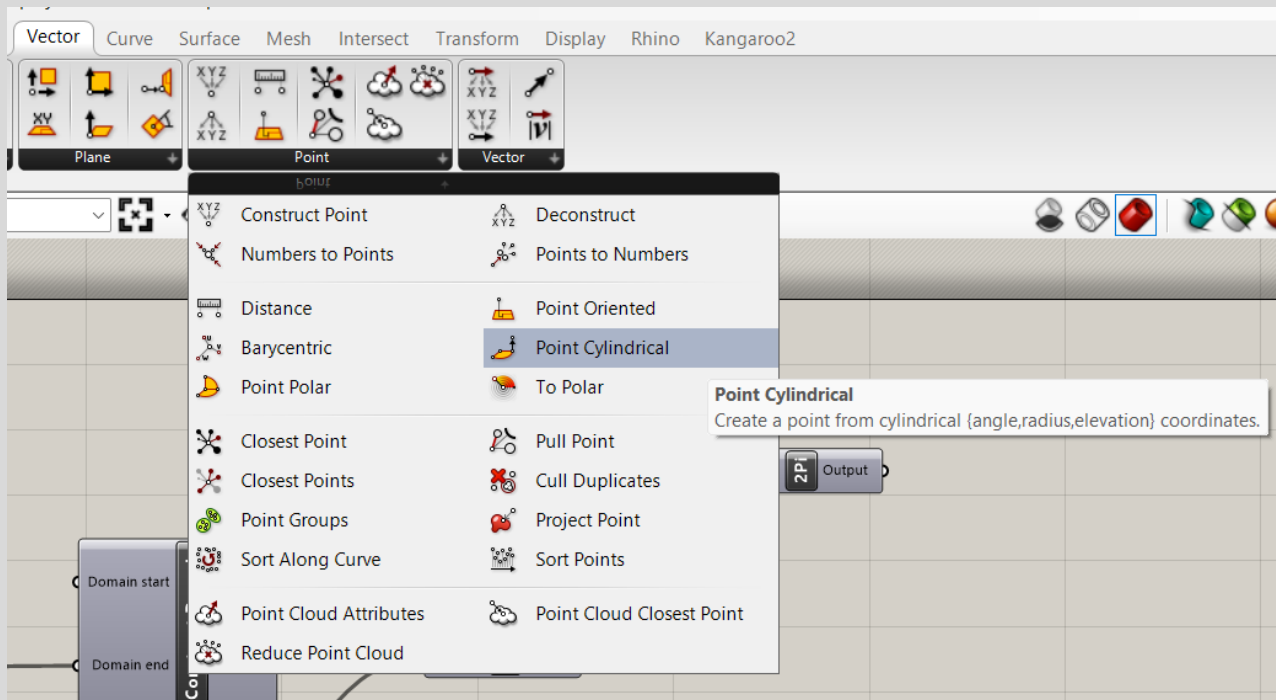


Caramujo do mar- Grasshopper Constrcut domain, range, number slider



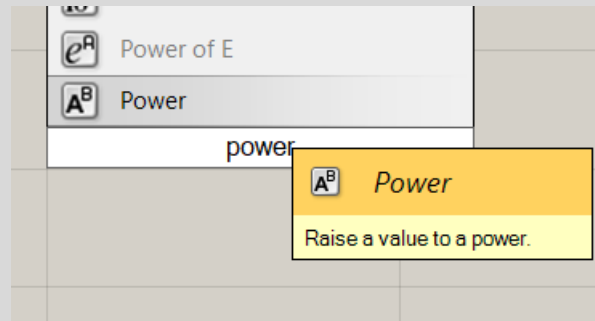
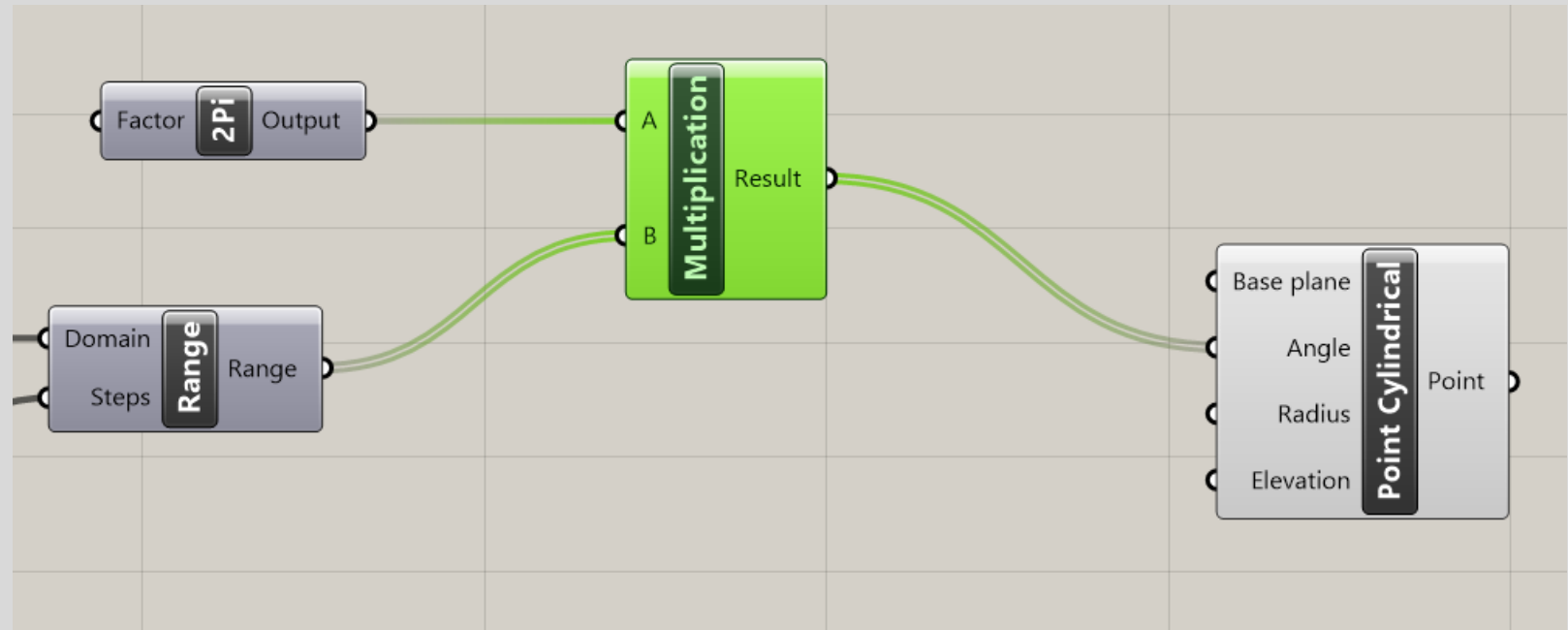
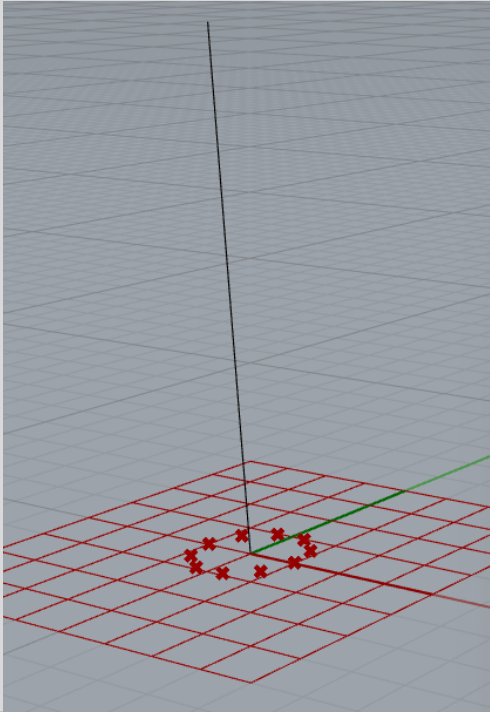


Caramujo do mar- Grasshopper
Construt domain, range, number slider



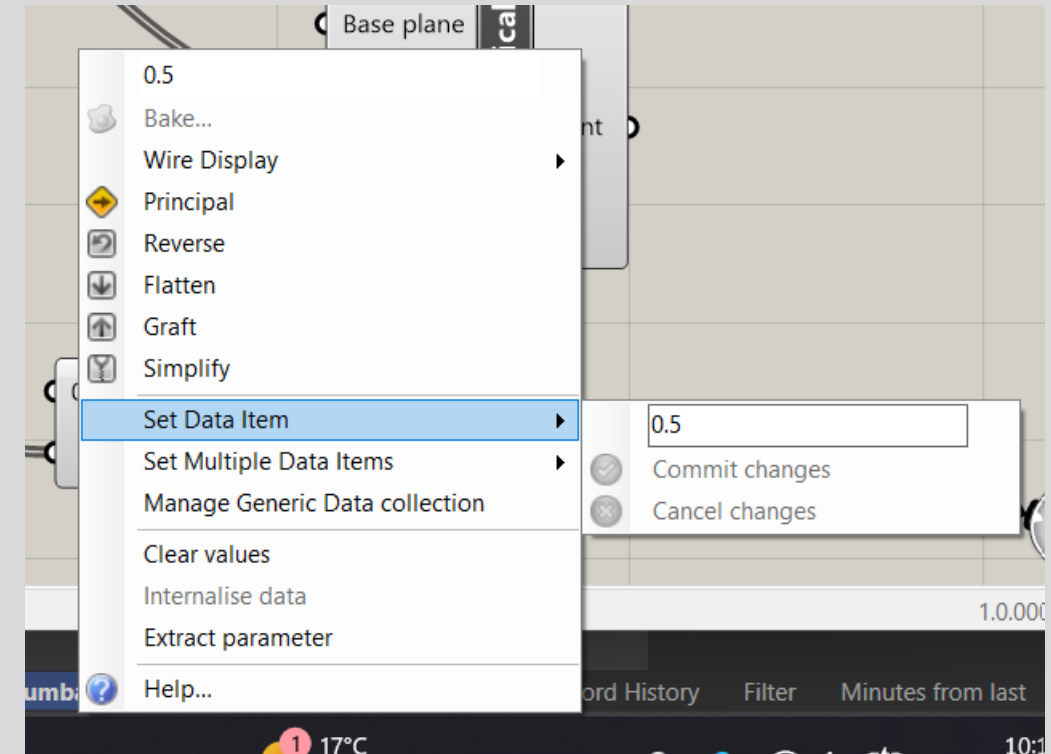
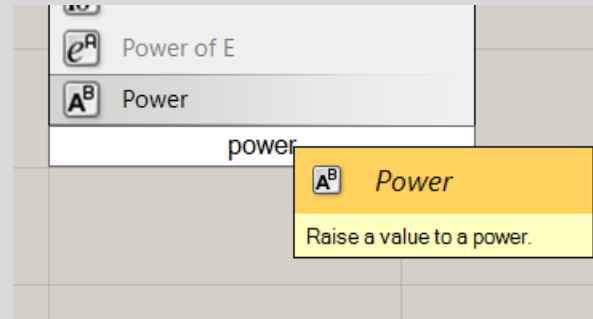
Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do mar- Grasshopper
Constrcut domain, range, number slider



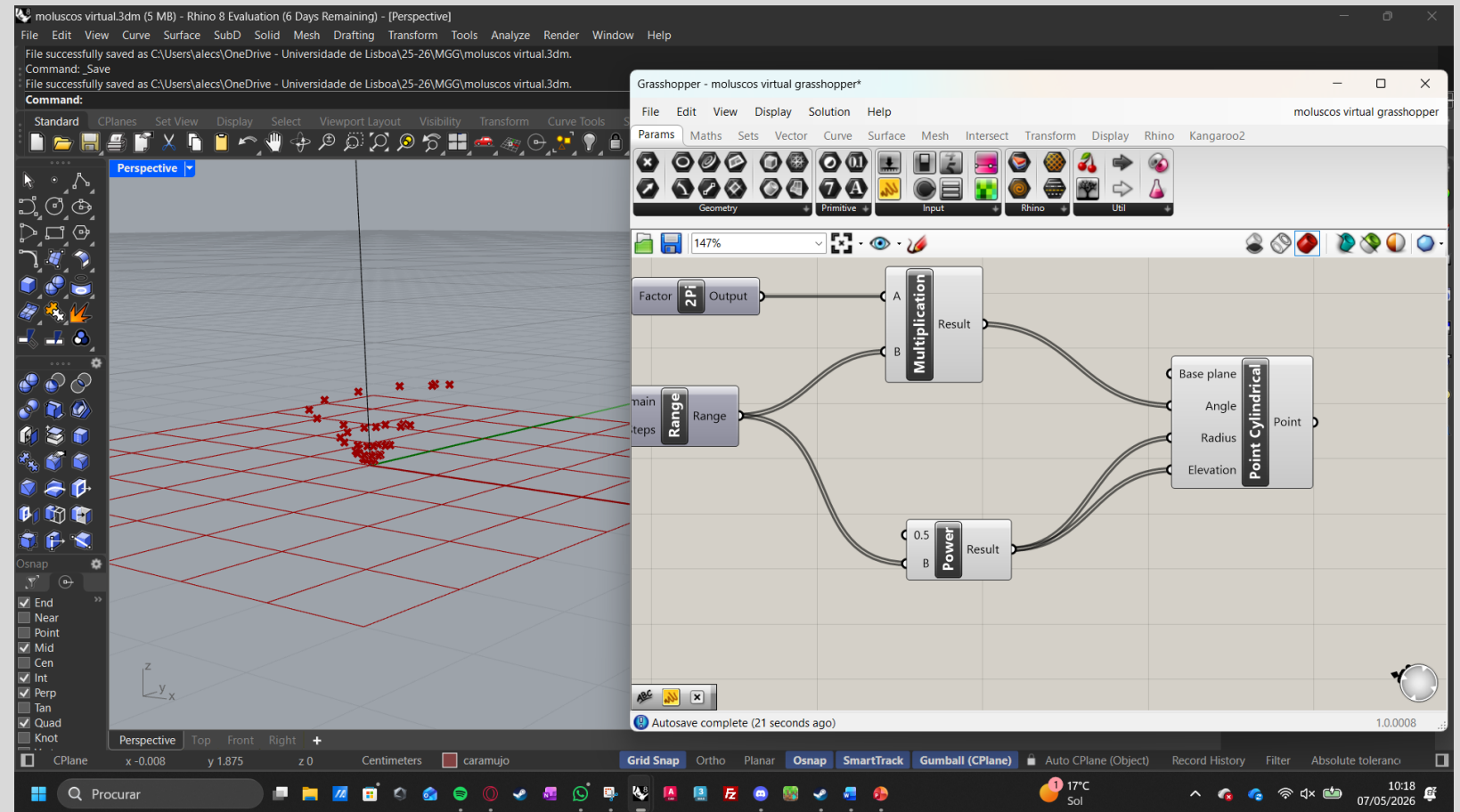
Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do mar- Grasshopper
Construct domain, range, number slider



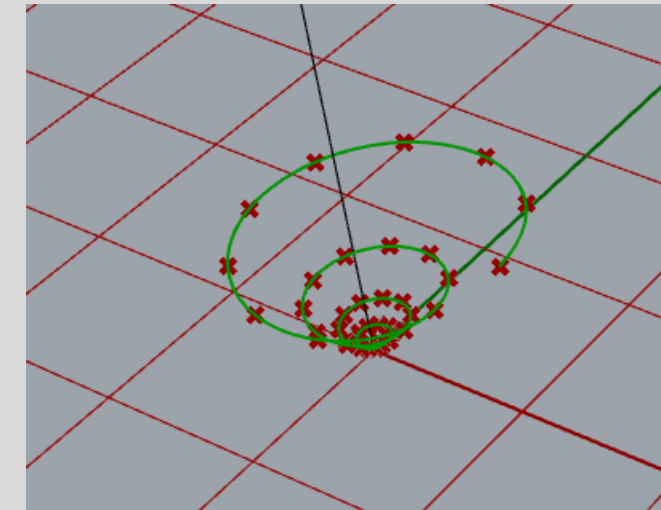
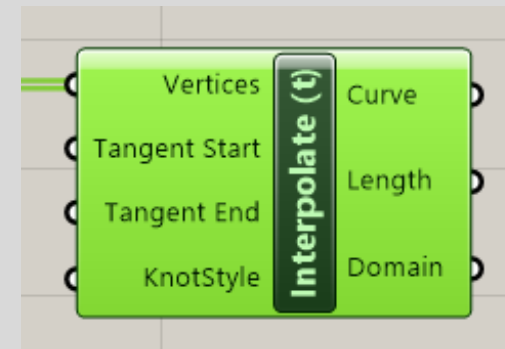
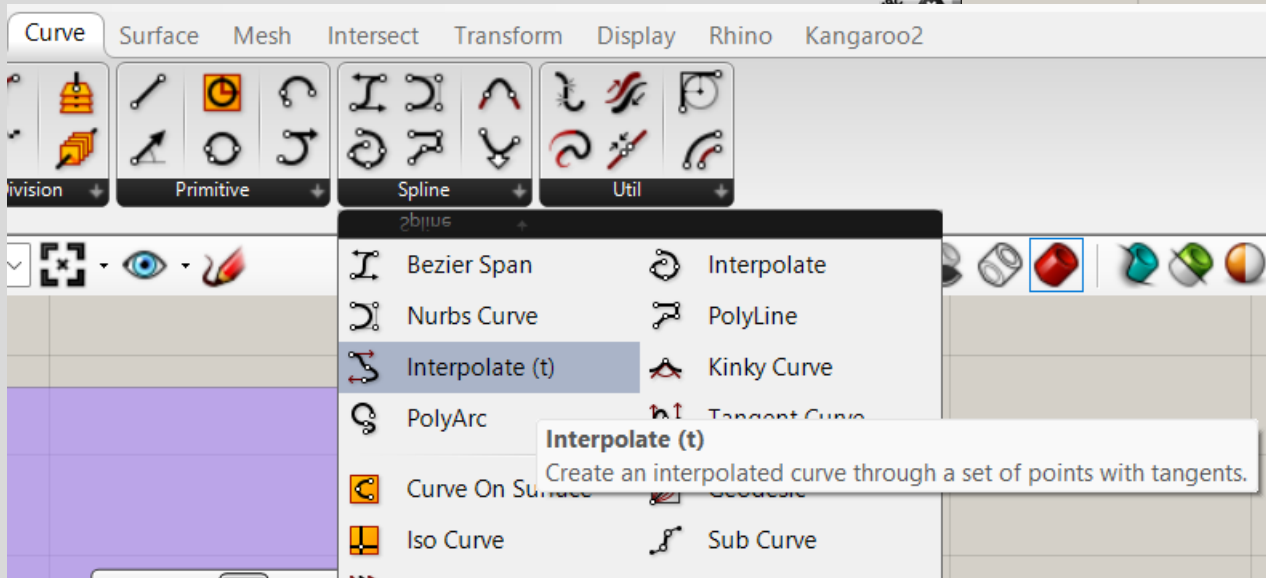
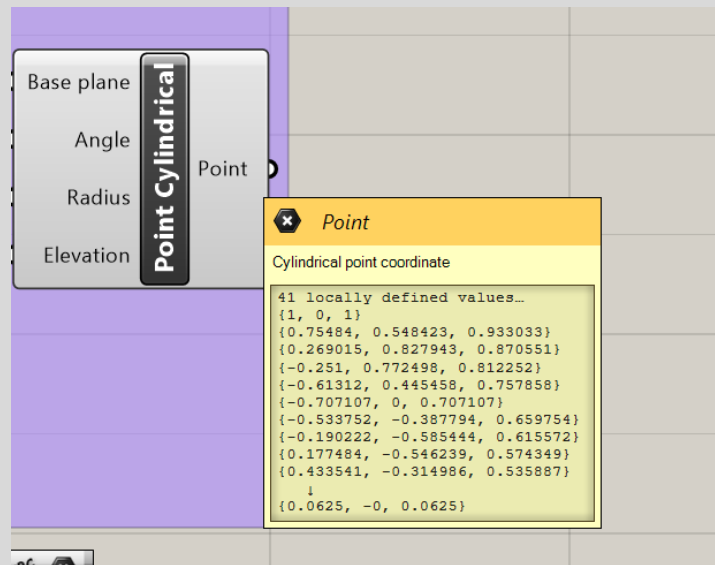
Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do mar- Grasshopper
Constrcut domain, range, number slider



Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do mar- Grasshopper Construt domain, range, number slider

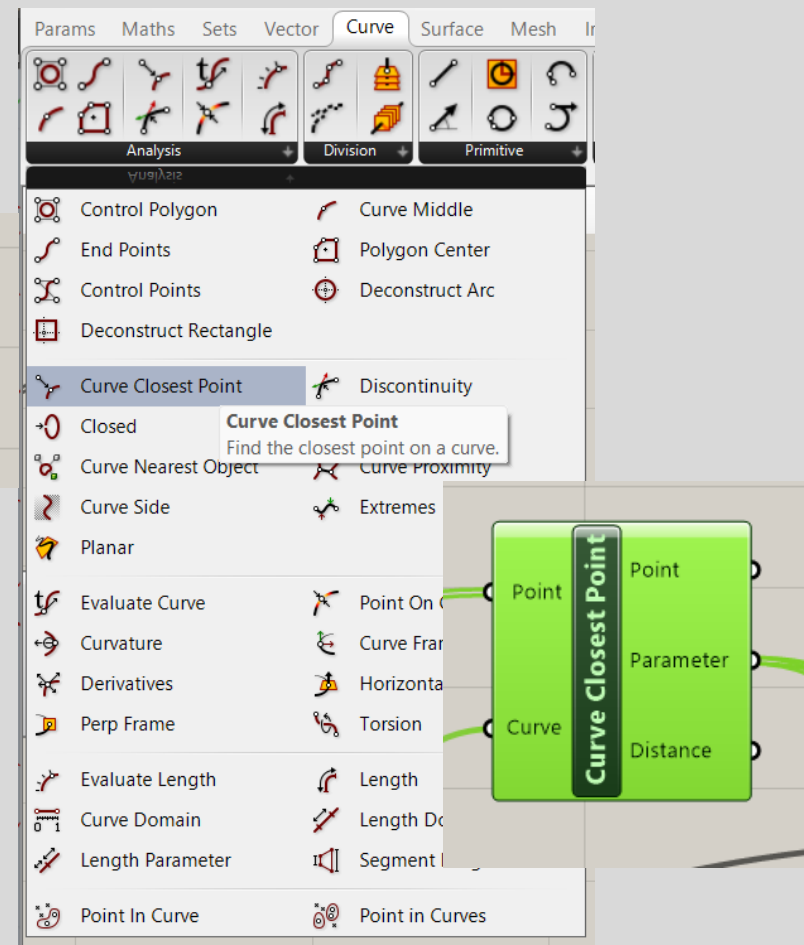
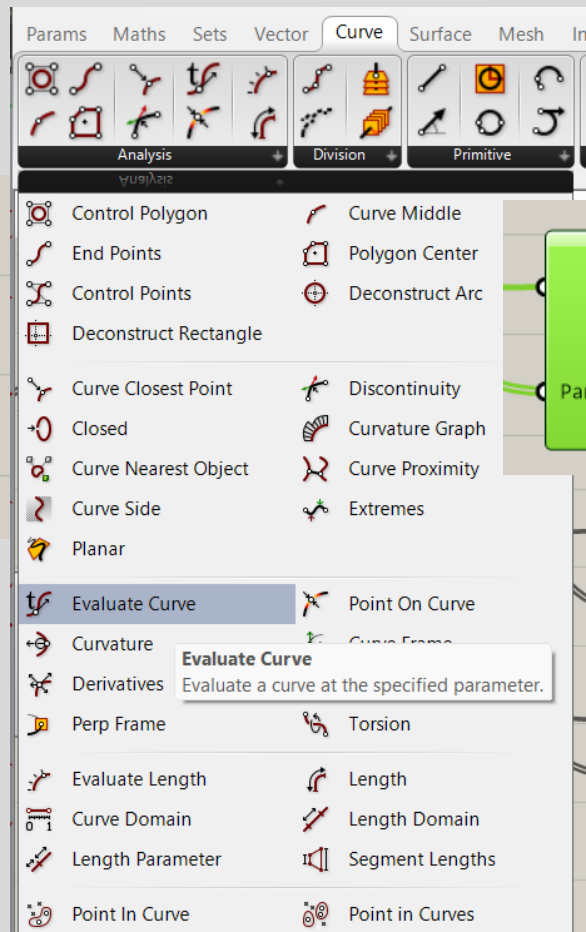
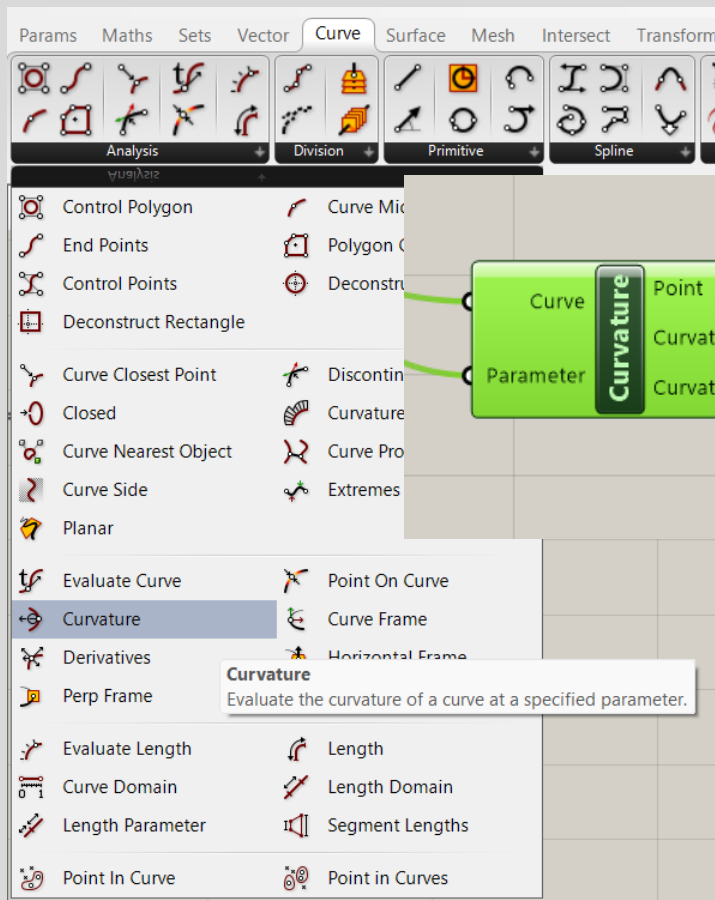


Aula. 12 – Caramujo do Mar- Grasshopper

Elementos calculados pelos pontos indicados no range- Curve closest point

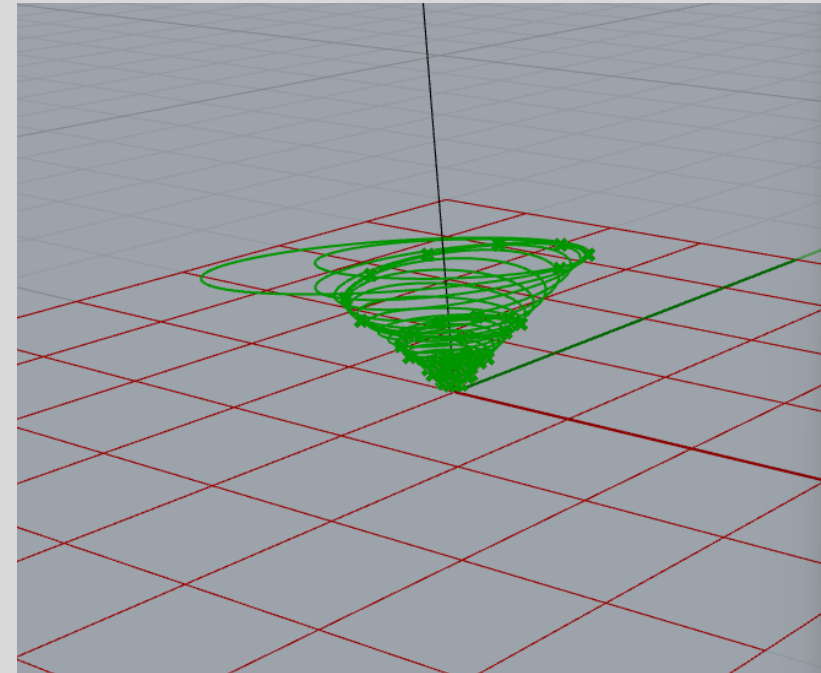
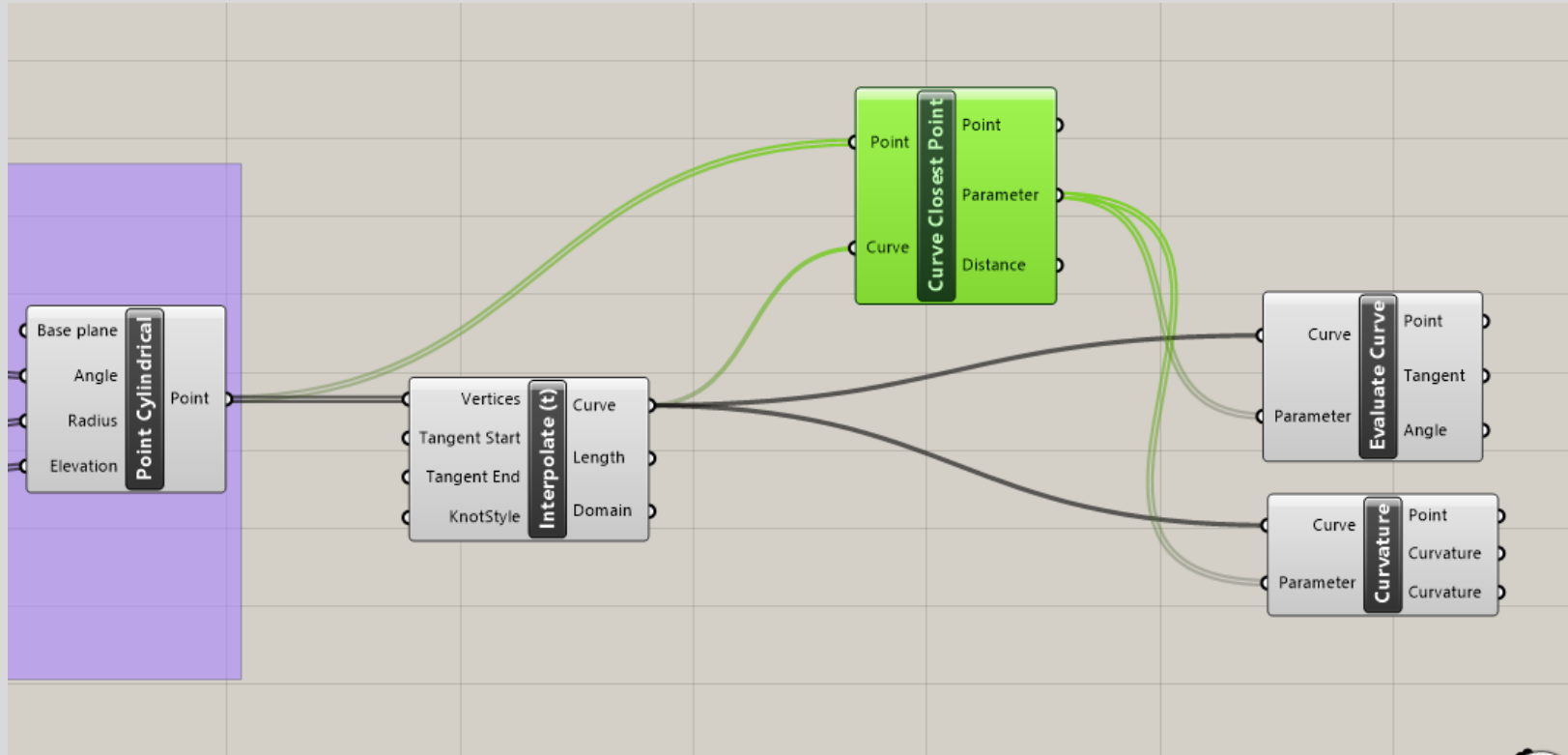
Curvature- dá a normal

Evaluate curve- Tangente (vetor perpendicular à curva)



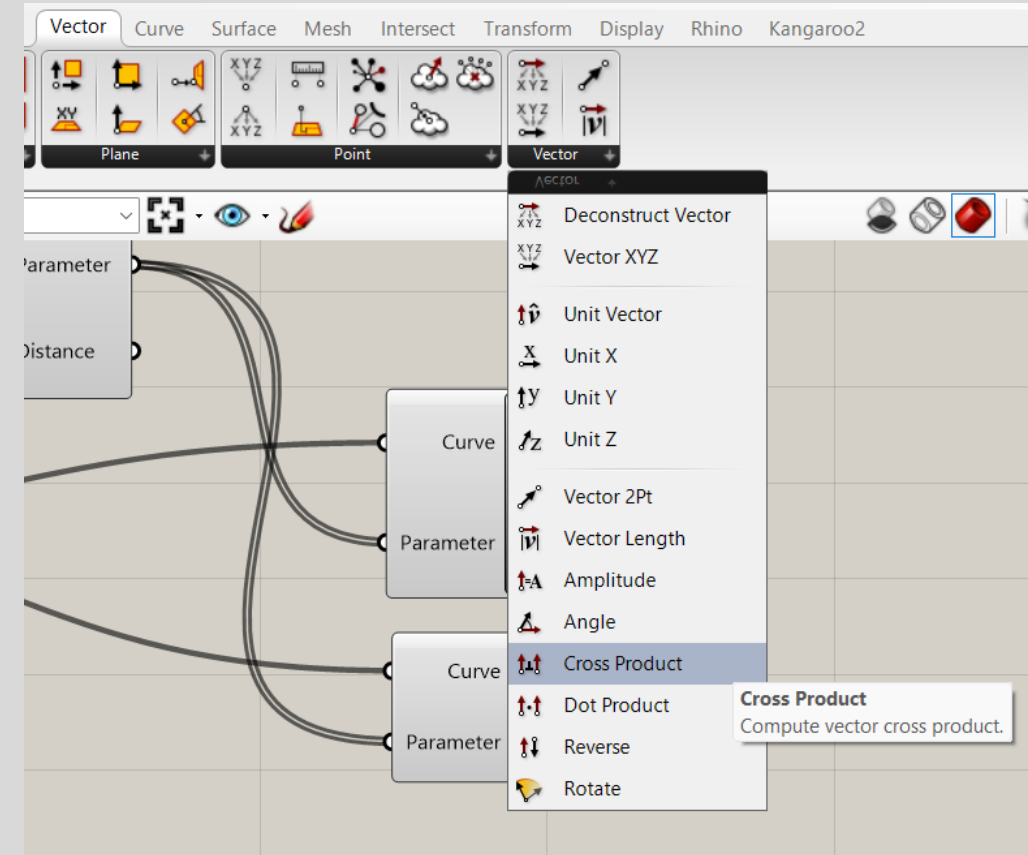
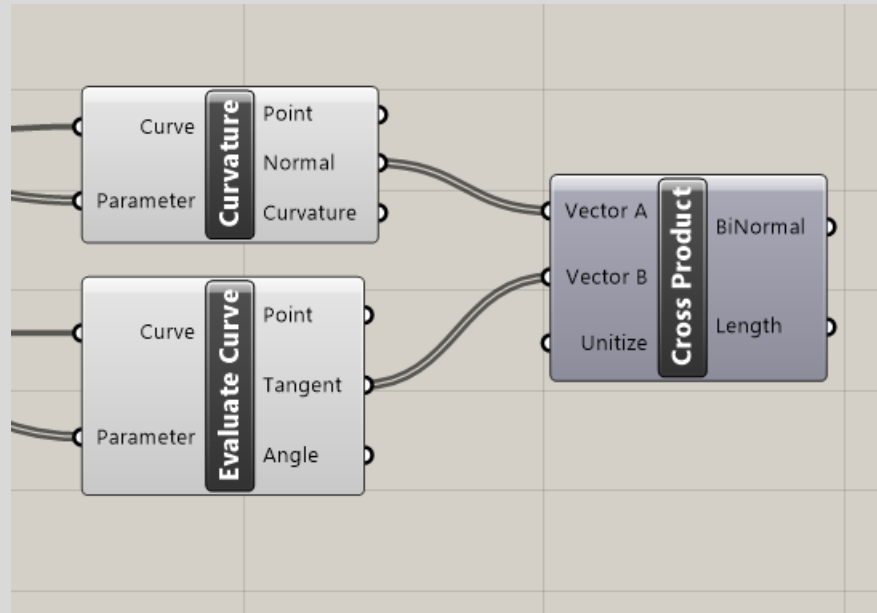
Aula. 12 – Caramujo do Mar- Grasshopper

Elementos calculados pelos pontos indicados no range- Curve closest point
Curvature- dá a normal
Evaluate curve- Tangente (vetor perpendicular à curva)

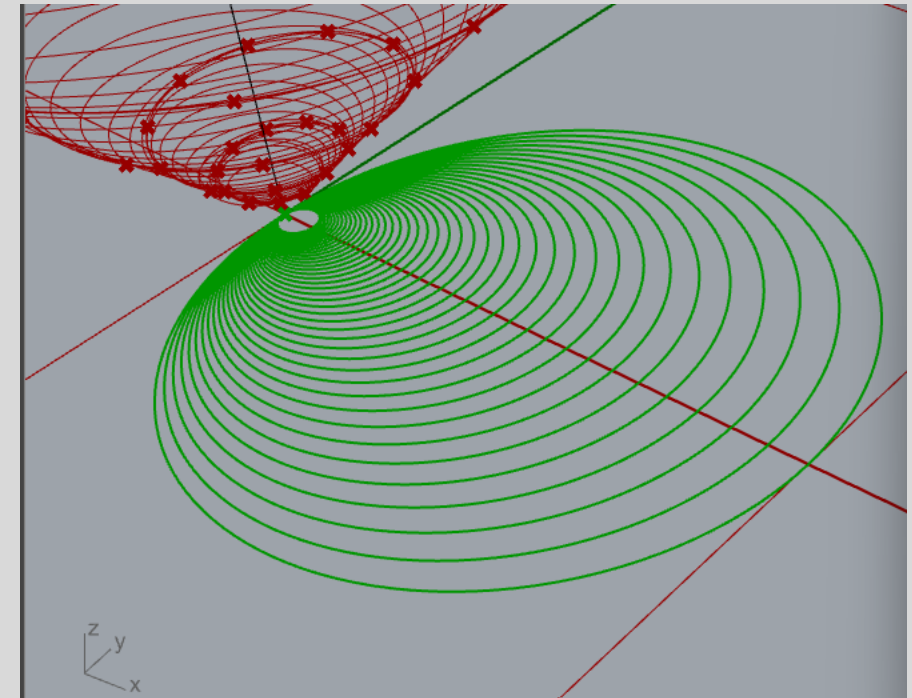
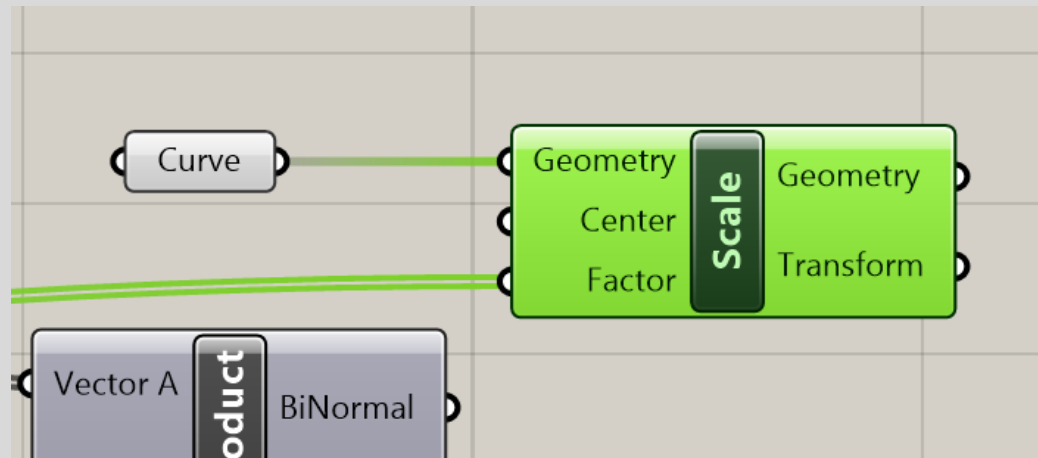
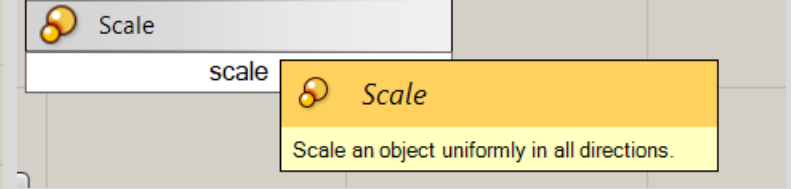
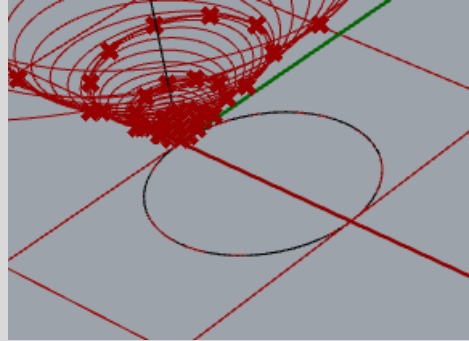


Aula. 12 – Caramujo do Mar- Grasshopper

Coordenadas UVW- como no 3dMax

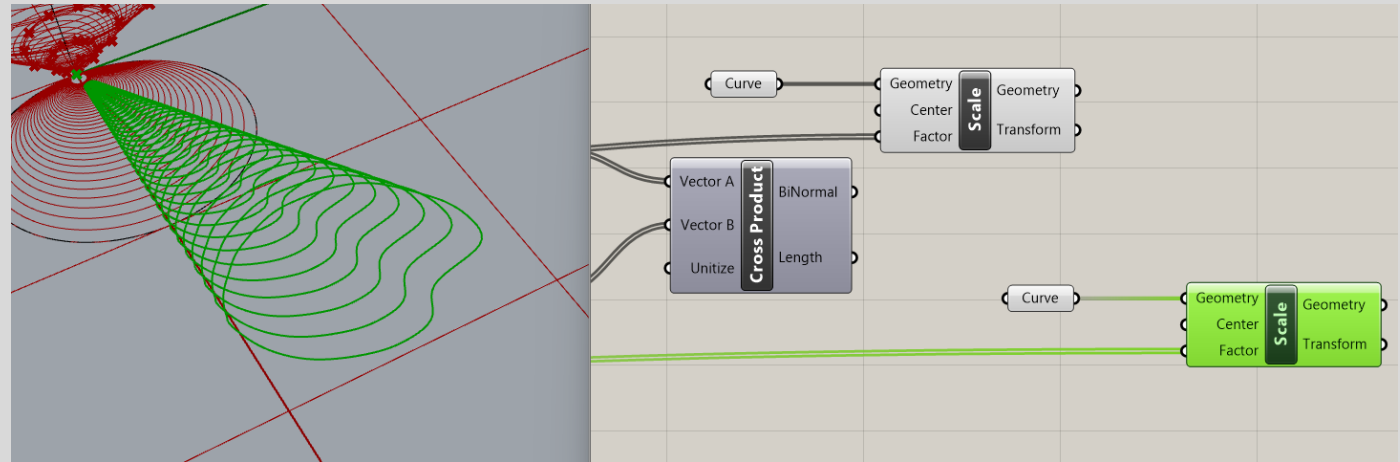
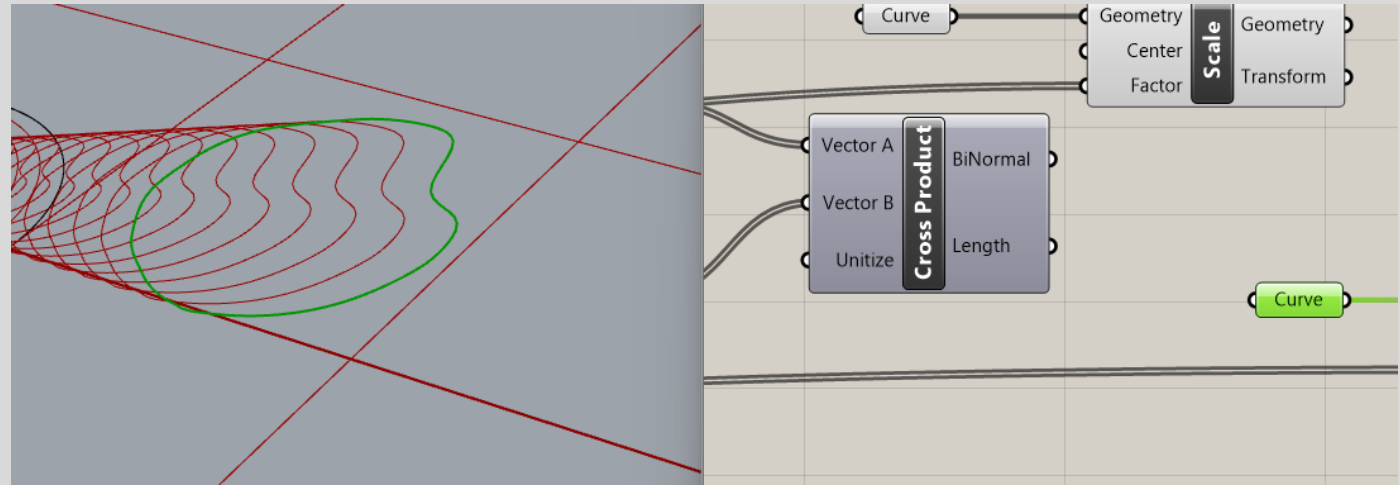
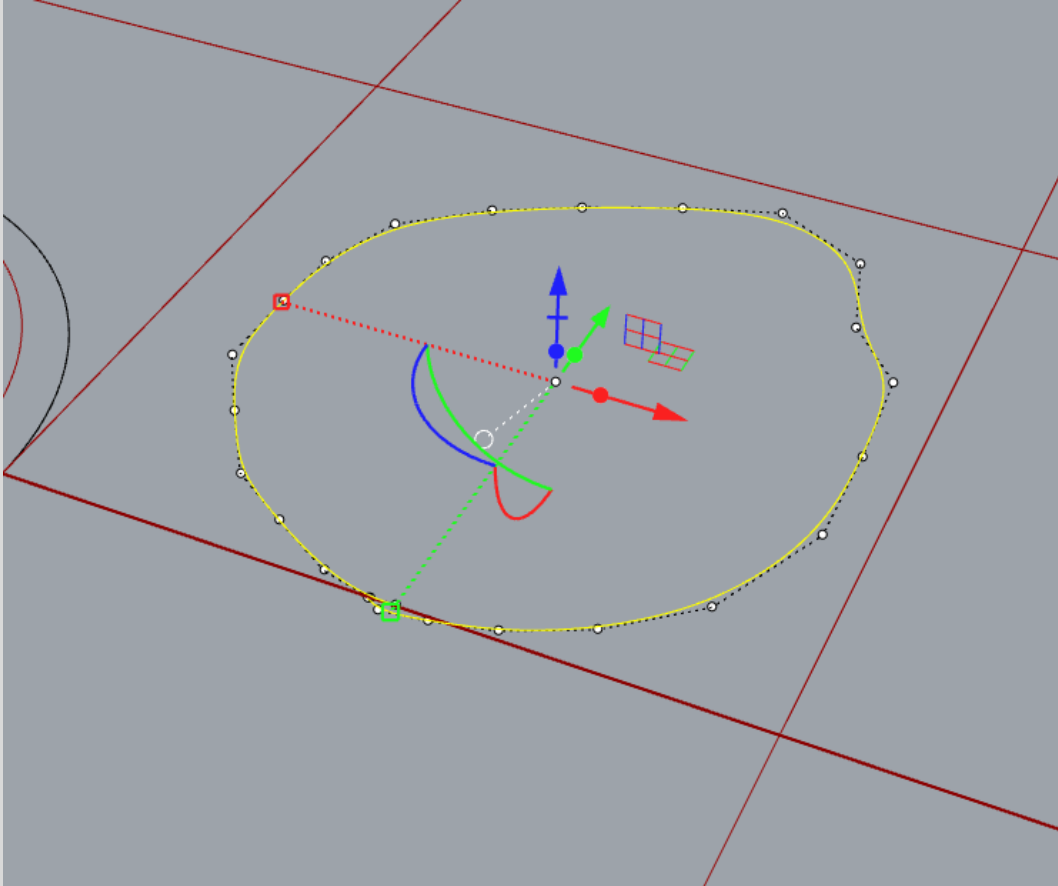


Coordenadas UVW- como no 3dMax



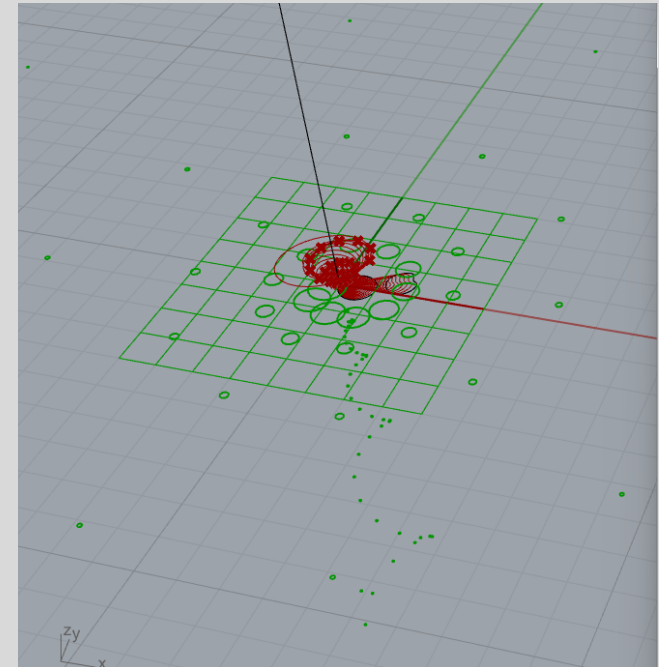
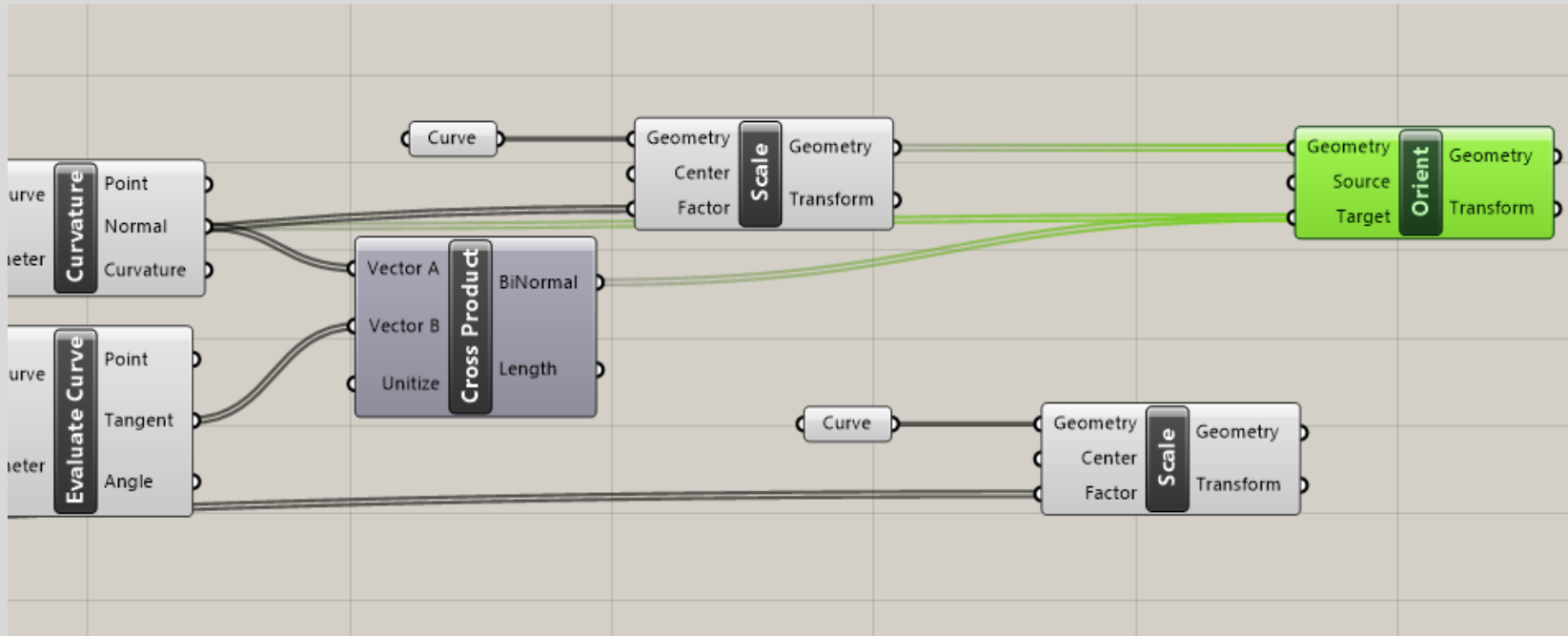
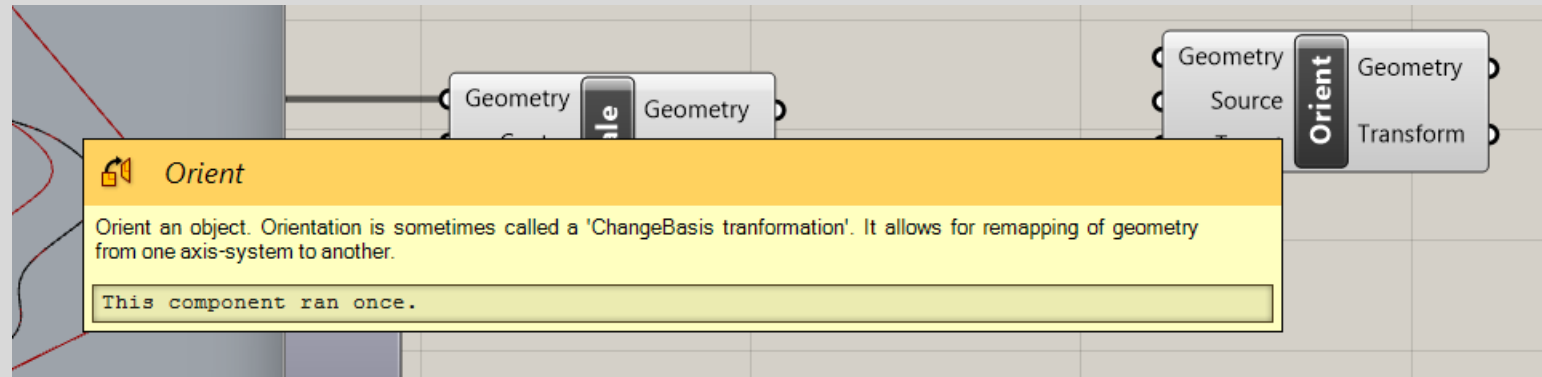
Aula. 12 – Caramujo do Mar- Grasshopper

No Rhino- Sketch



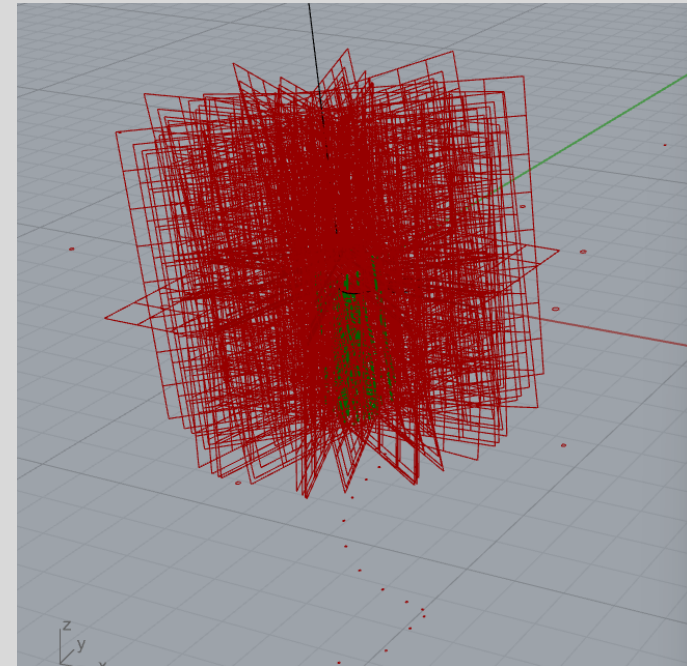
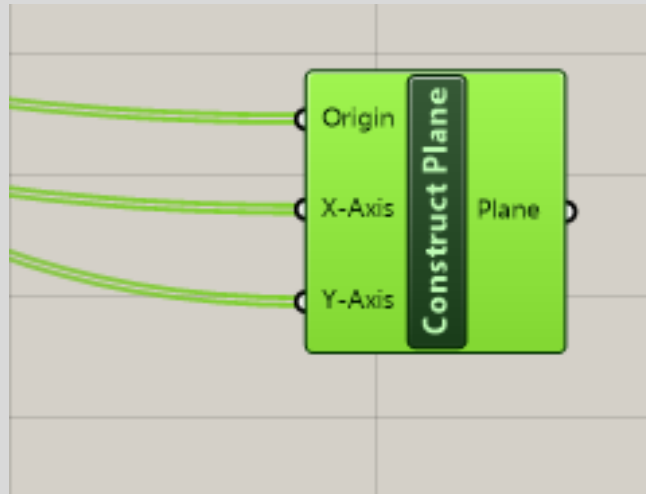
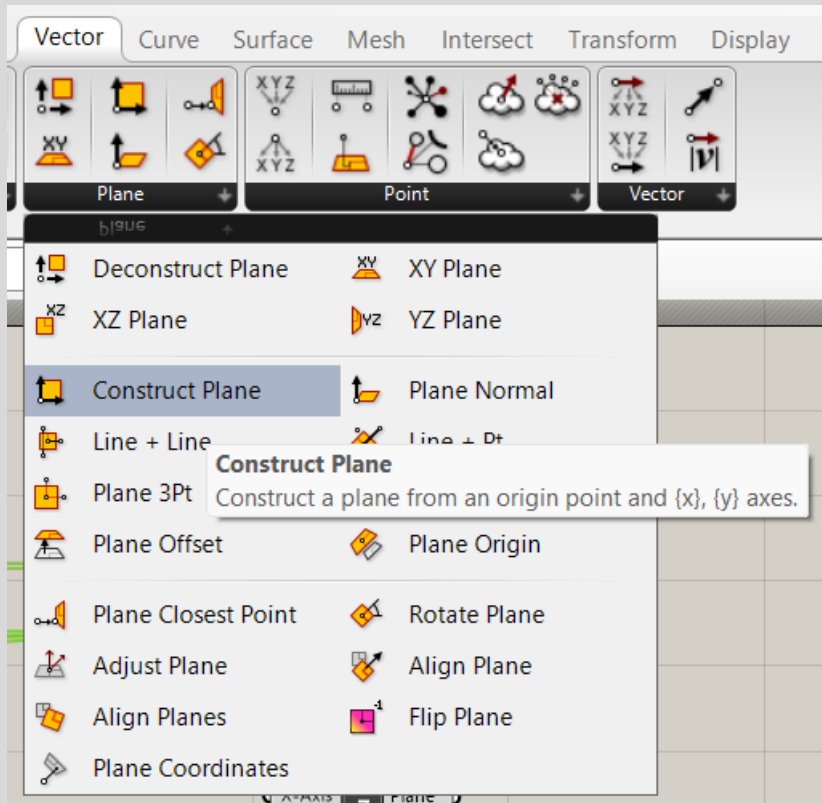
Aula. 12 – Caramujo do Mar- Grasshopper

Erro: Falta de plano



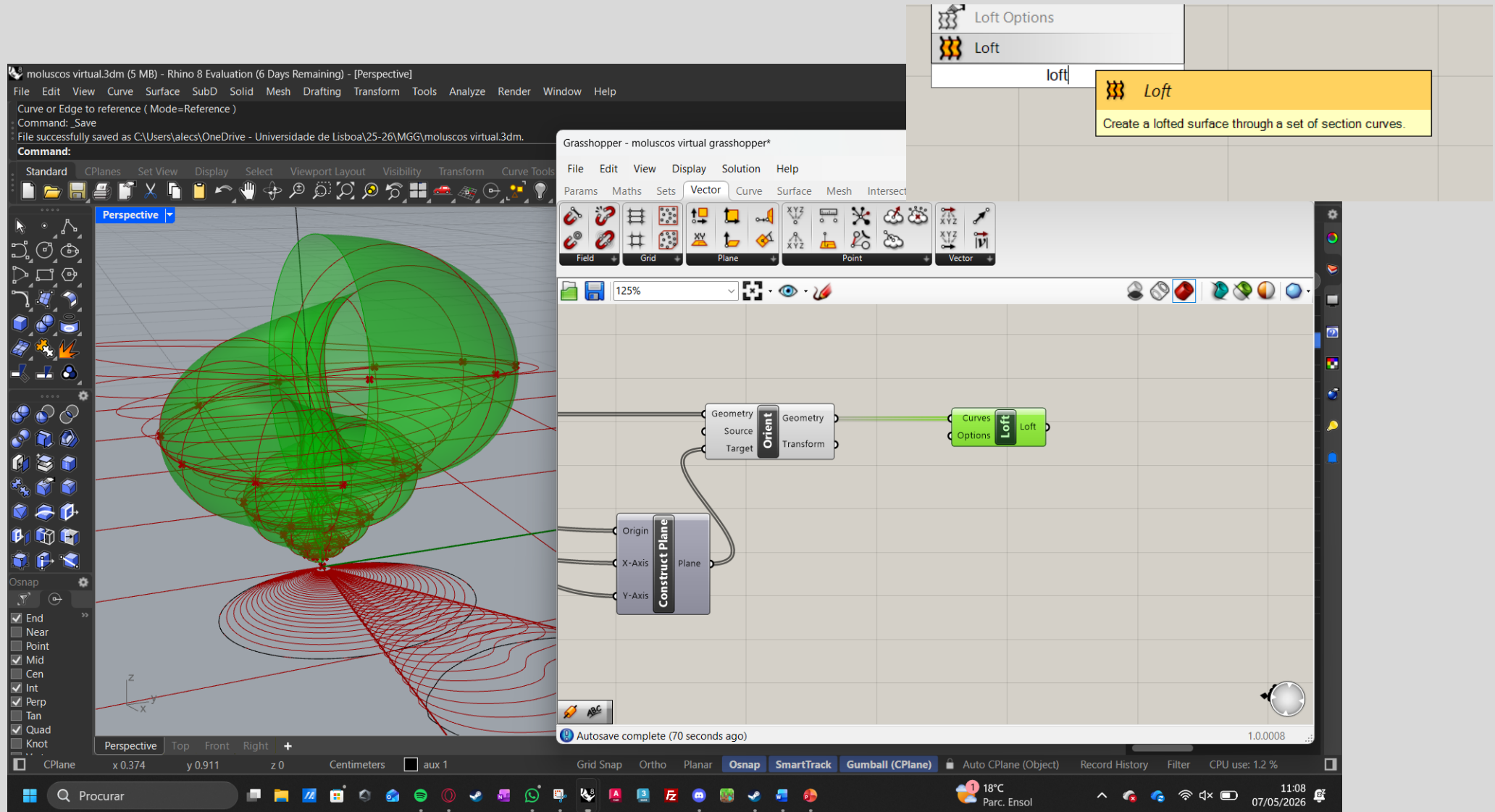
Aula. 12 – Caramujo do Mar- Grasshopper

Correção



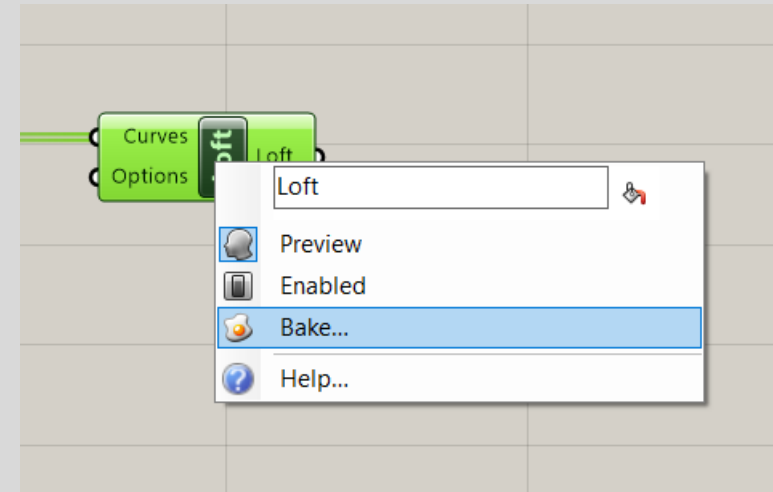
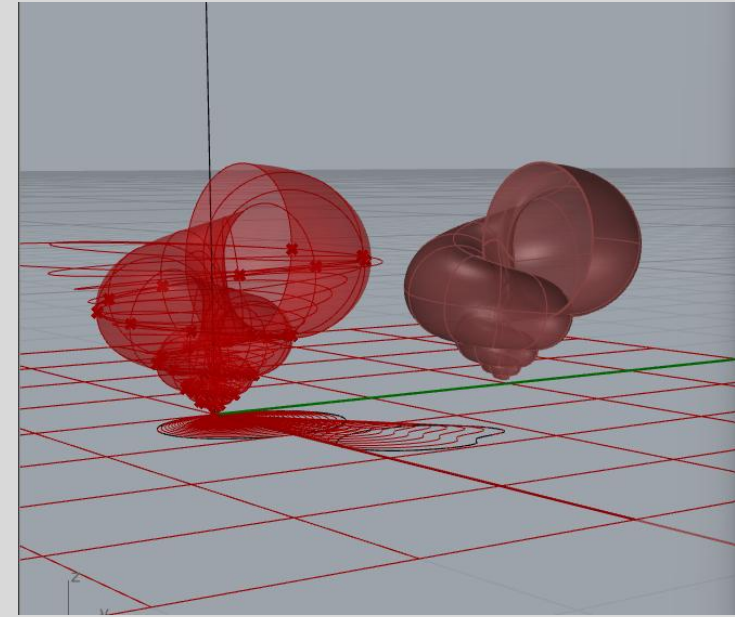
Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do Mar



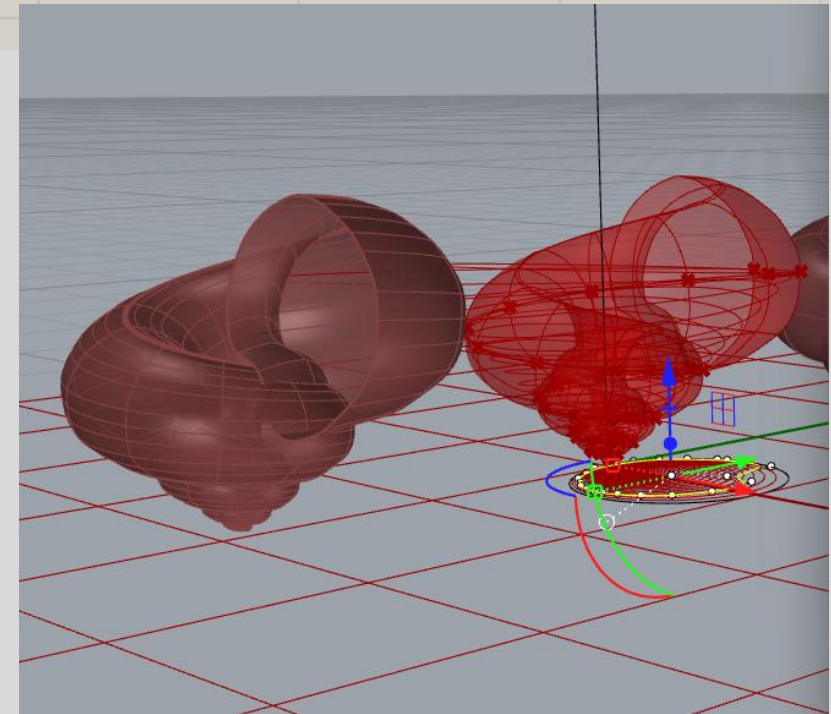
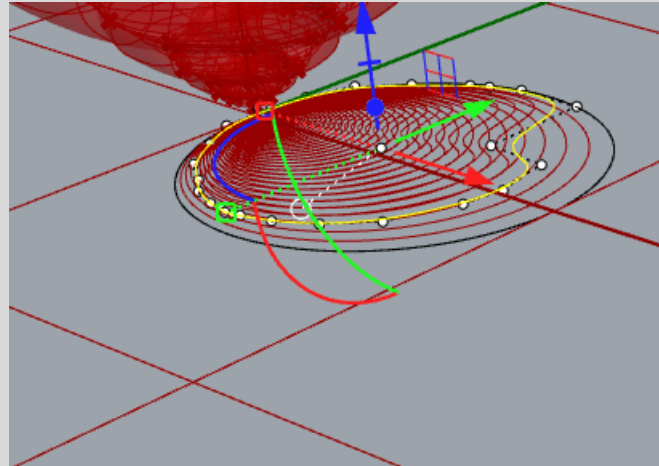
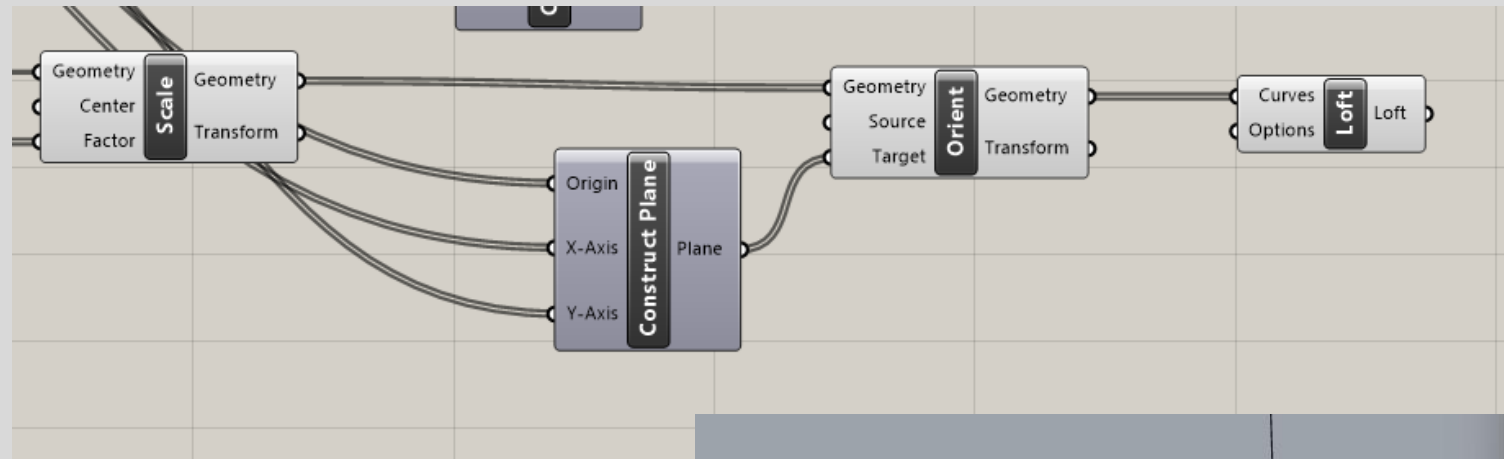
Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do Mar



Aula. 12 – Caramujo do Mar- Grasshopper

Caramujo do Mar

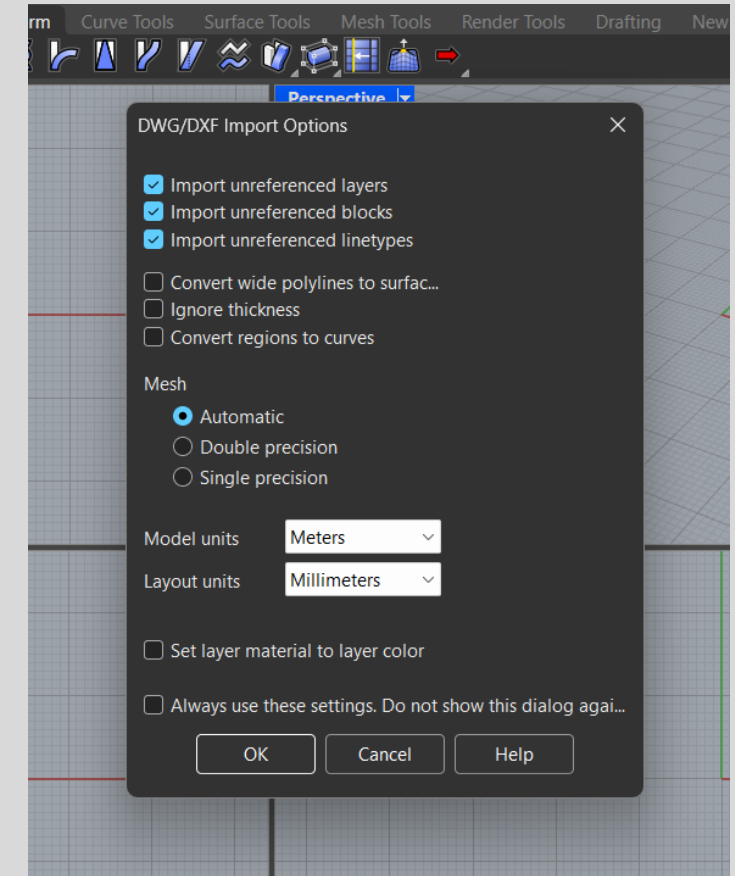
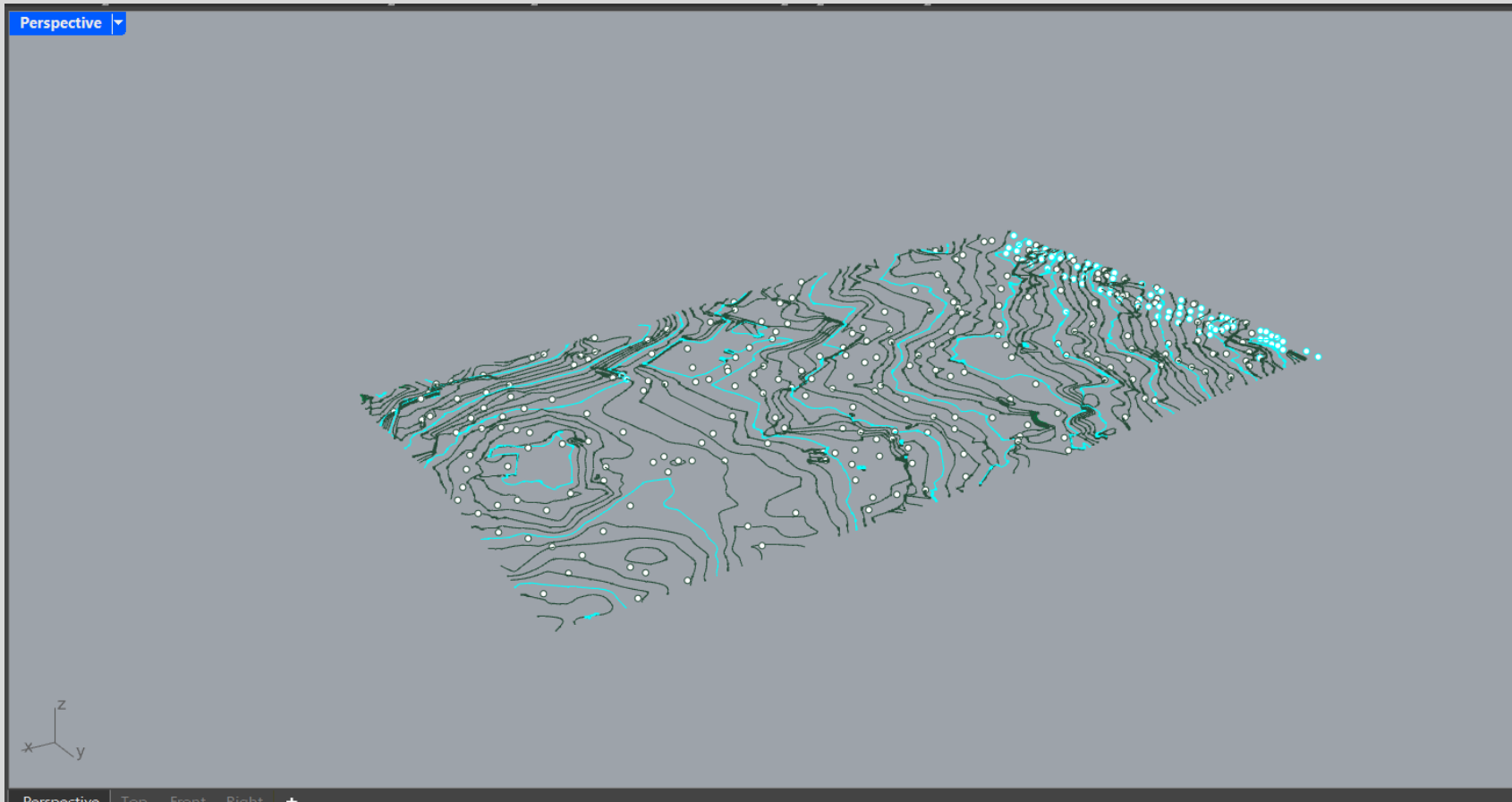


Aula. 12 – Caramujo do Mar- Grasshopper

FUTURAMENTE

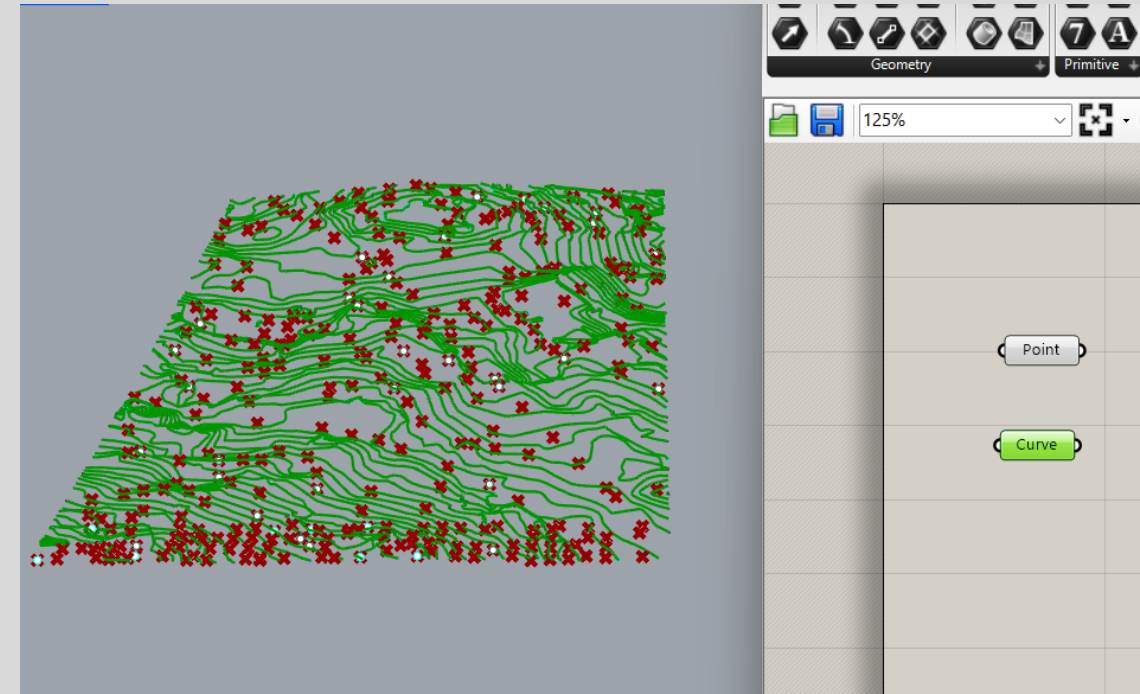
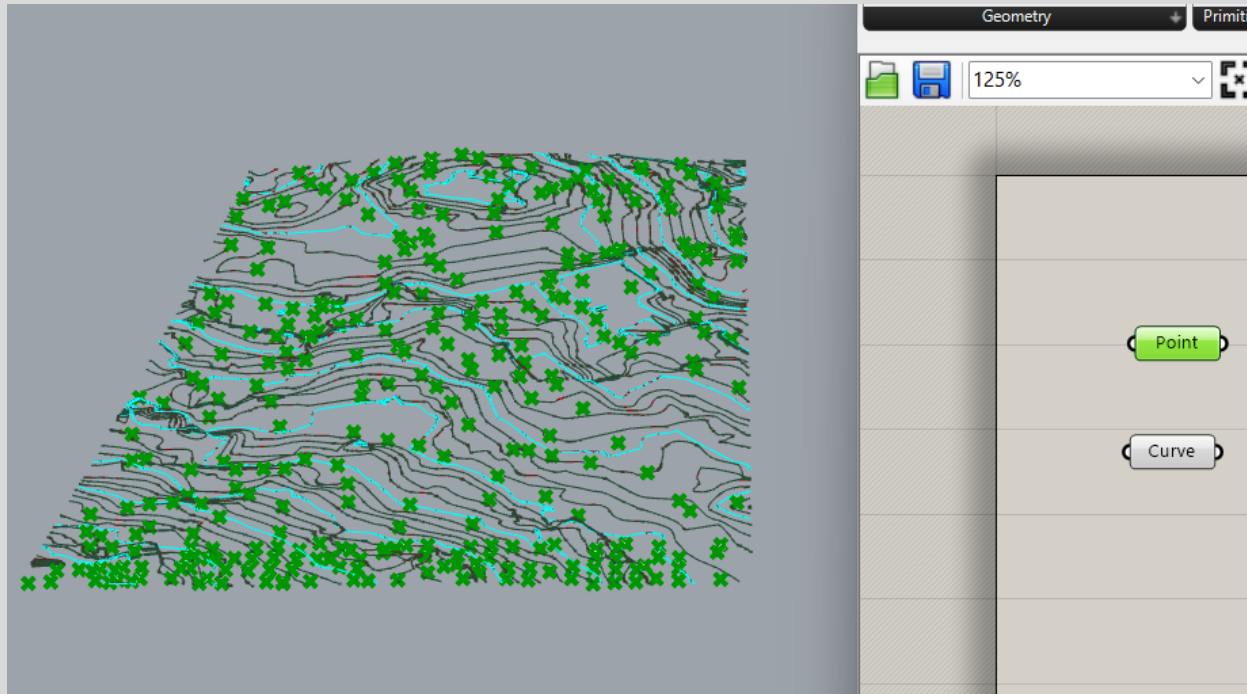
Aula. 13 – Modelação de terreno

Import carta altimetria
Informação altimétrica do terreno
Ficheiro CAD



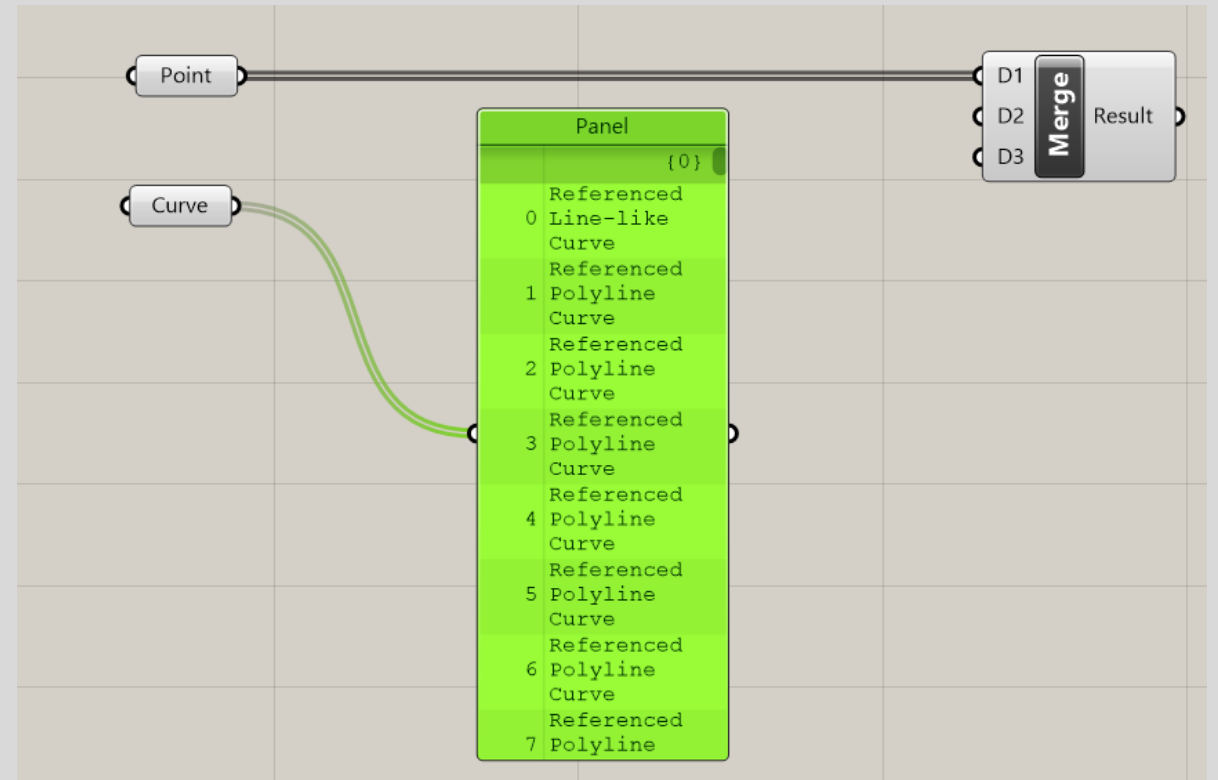
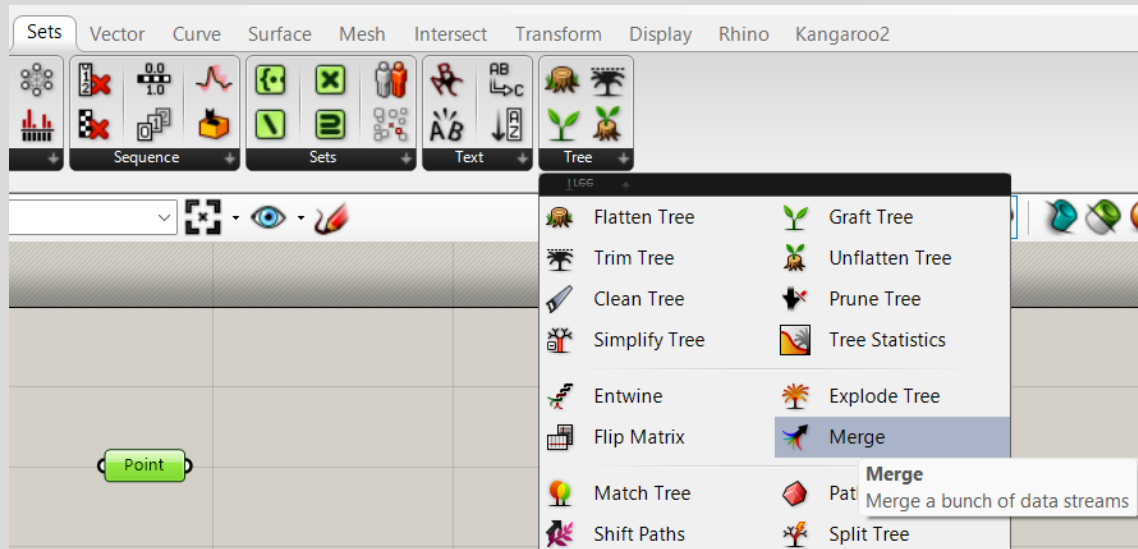
Aula. 13 – Modelação de terreno

Imagem vetorizada =\ - permite modelar
Imagem raster – n dá para fazer nada
Criar parâmetros de linhas e pontos em grasshopper



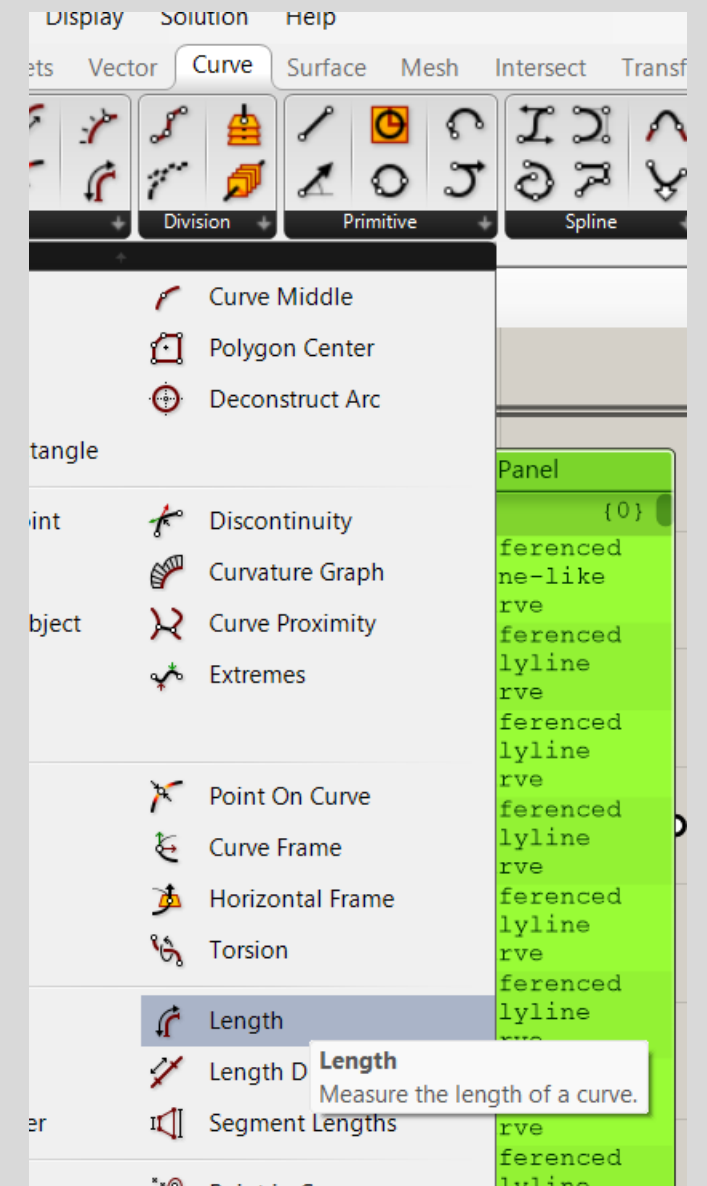
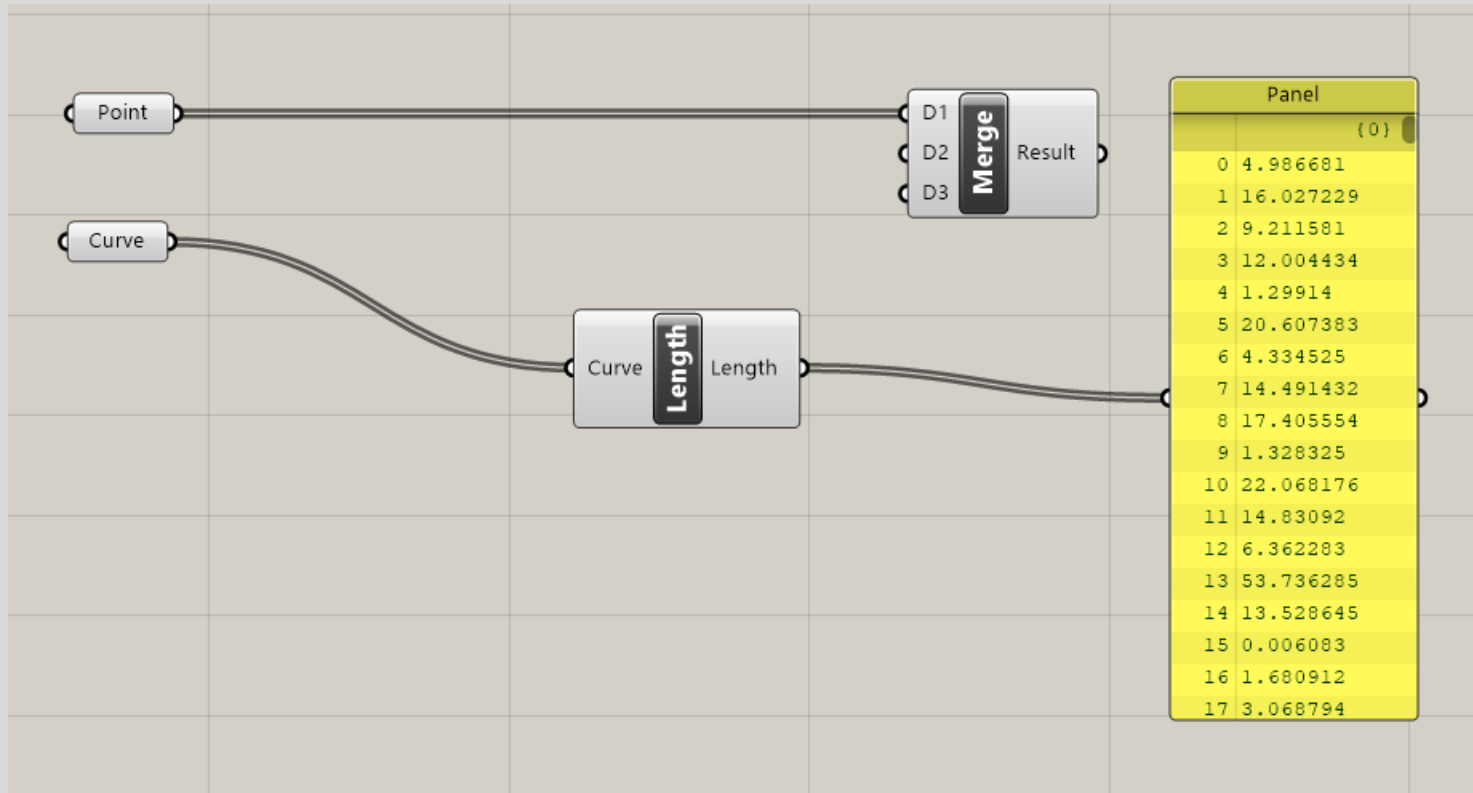
Aula. 13 – Modelação de terreno: GrassHopper

Criar malha Delaunay- a cada 3 pontos cria-se um triângulo com os pontos mais próximos

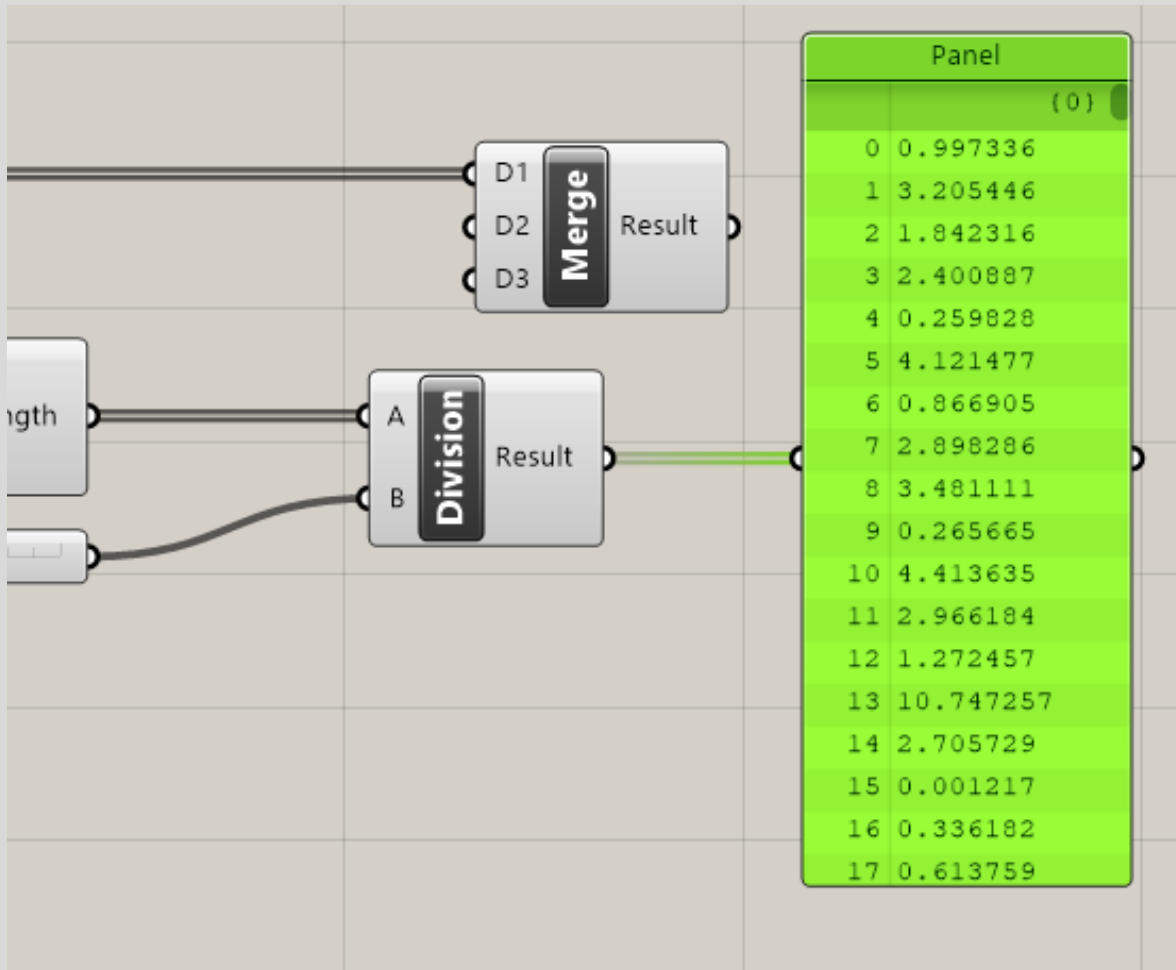


Aula. 13 – Modelação de terreno: GrassHopper

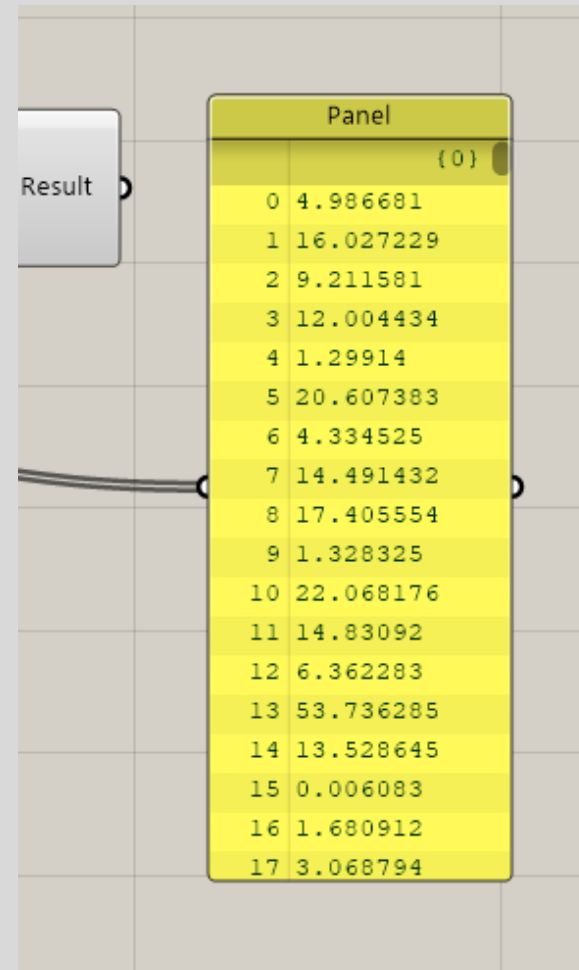
Comprimento das linhas



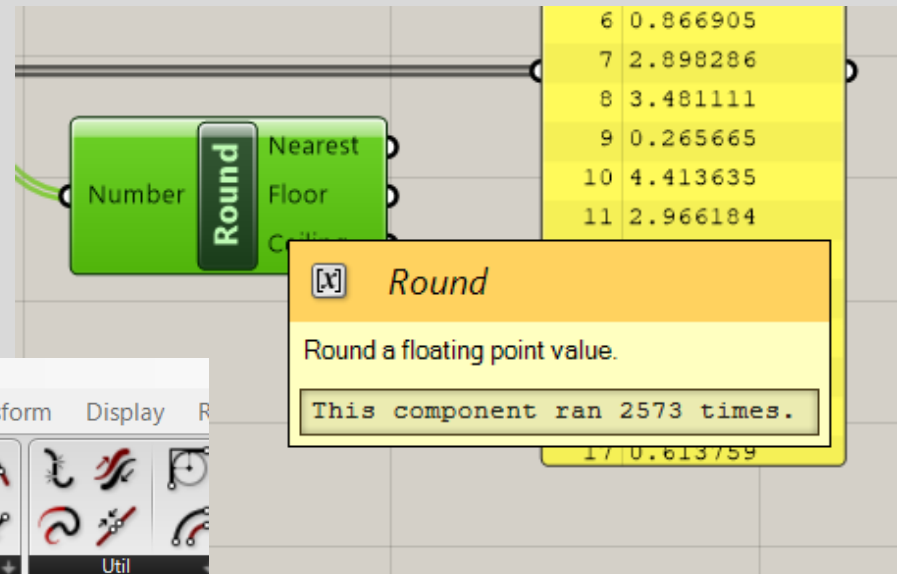
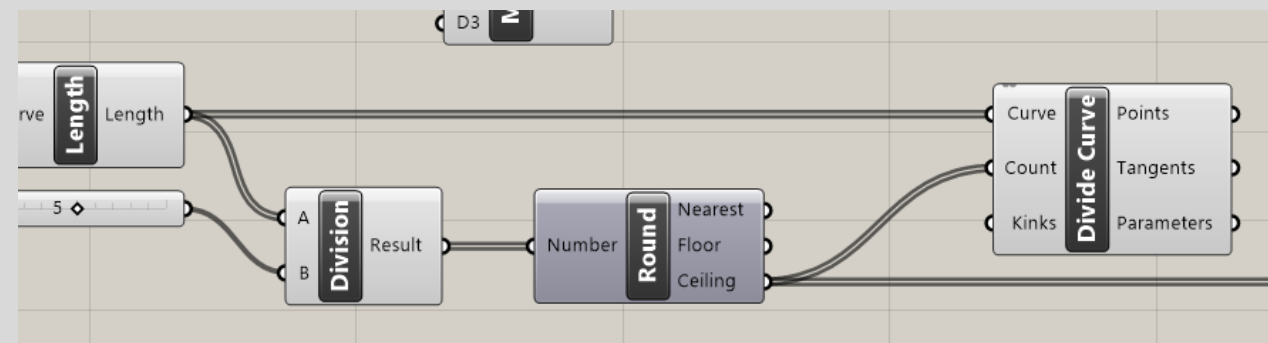
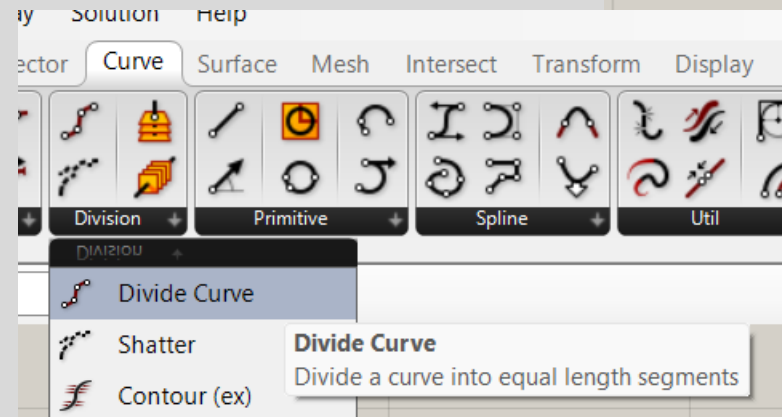
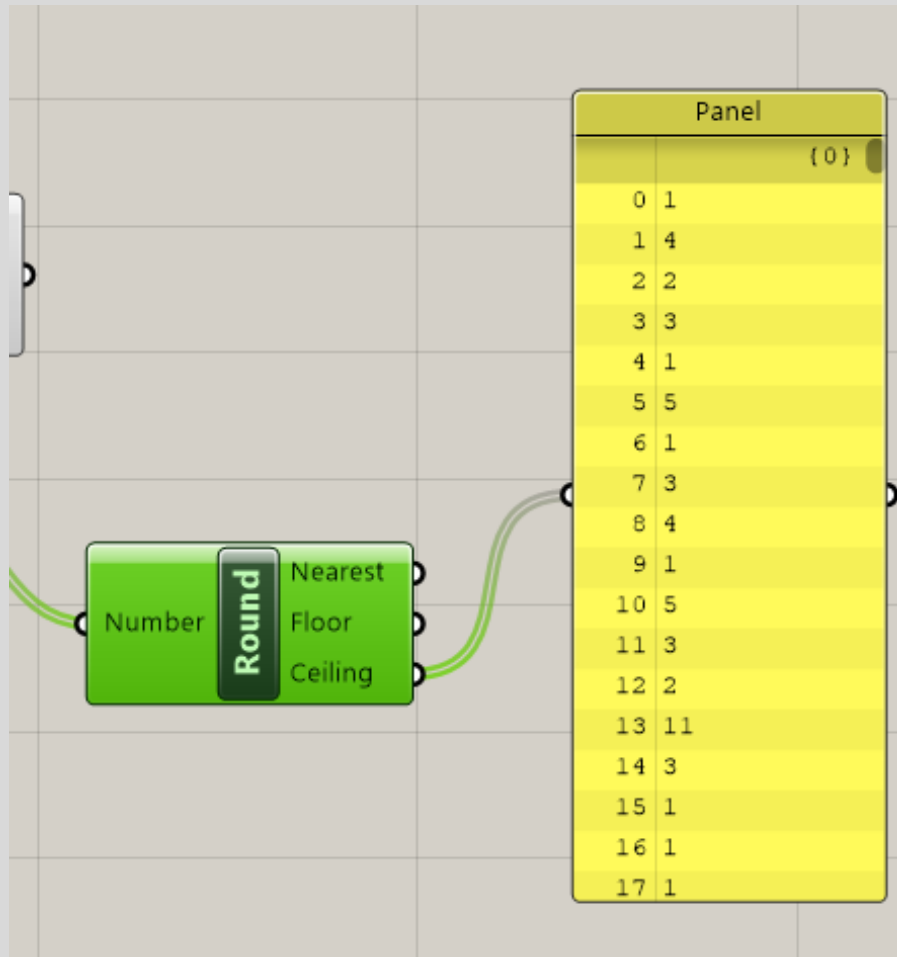
Dividir o espaço entre os pontos



anterior

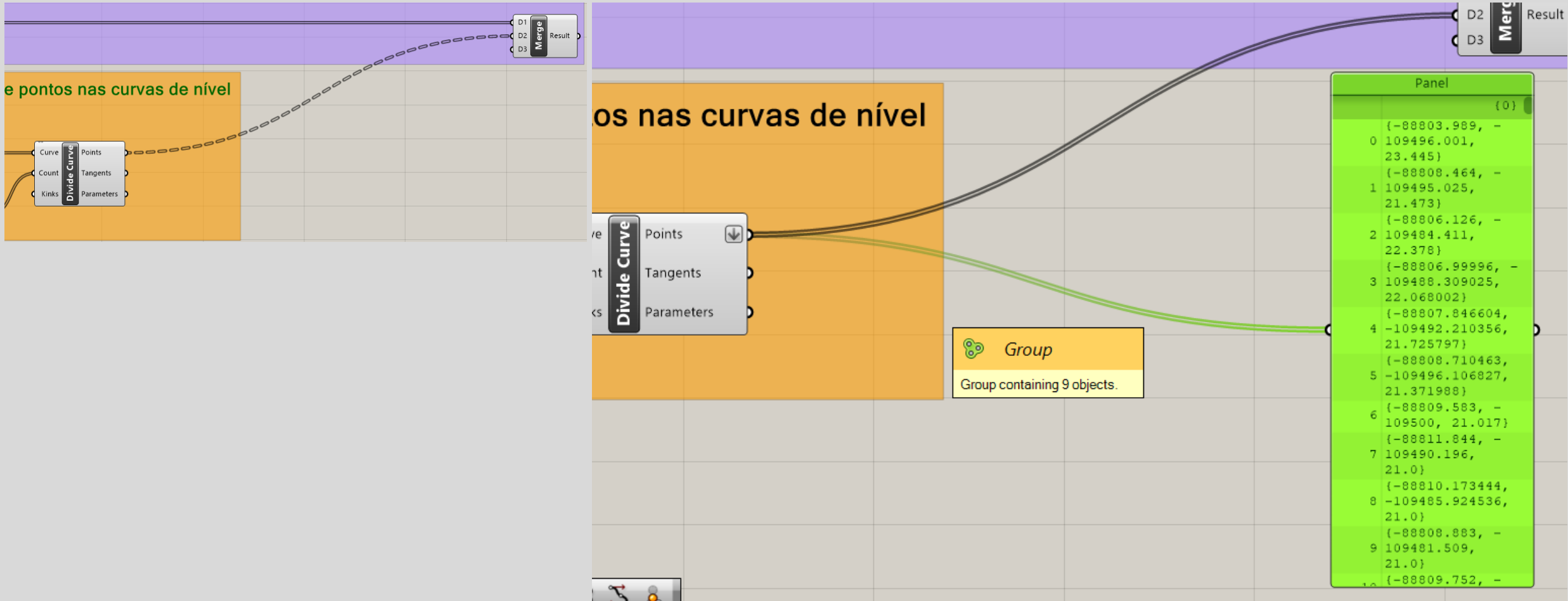


Arredondar os resultados por cima (ceiling) e dividir o valor arredondado por um valor inteiro

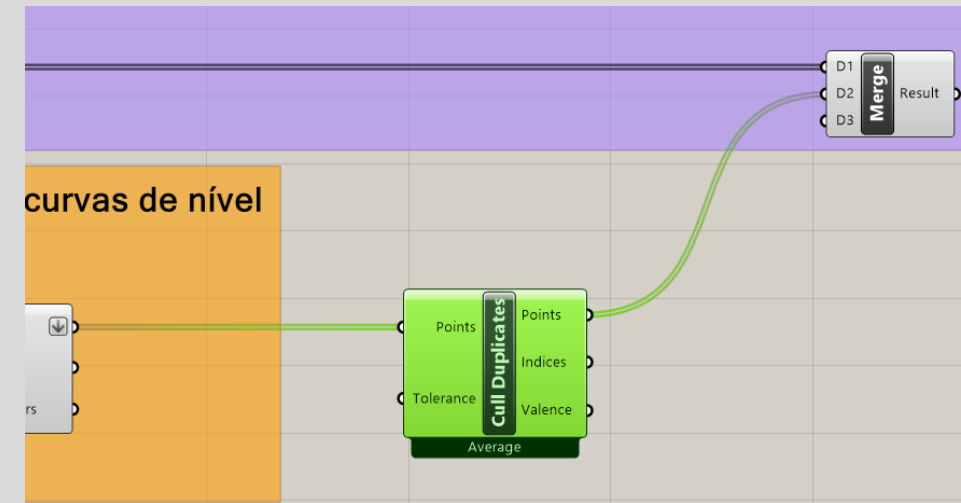
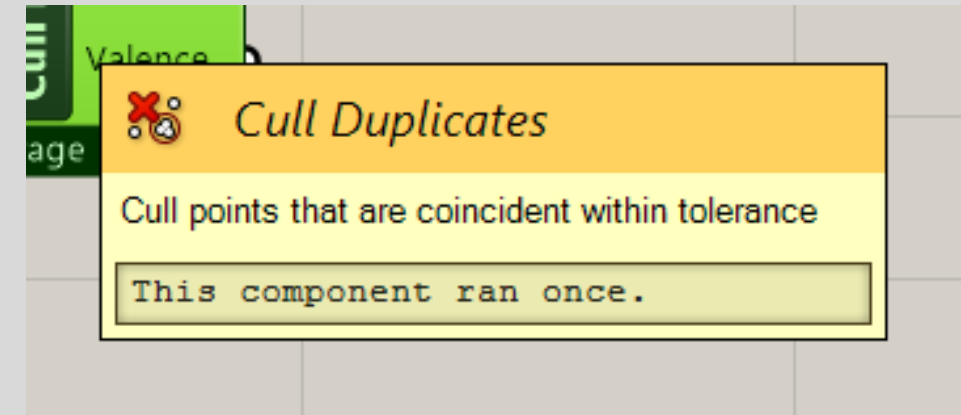
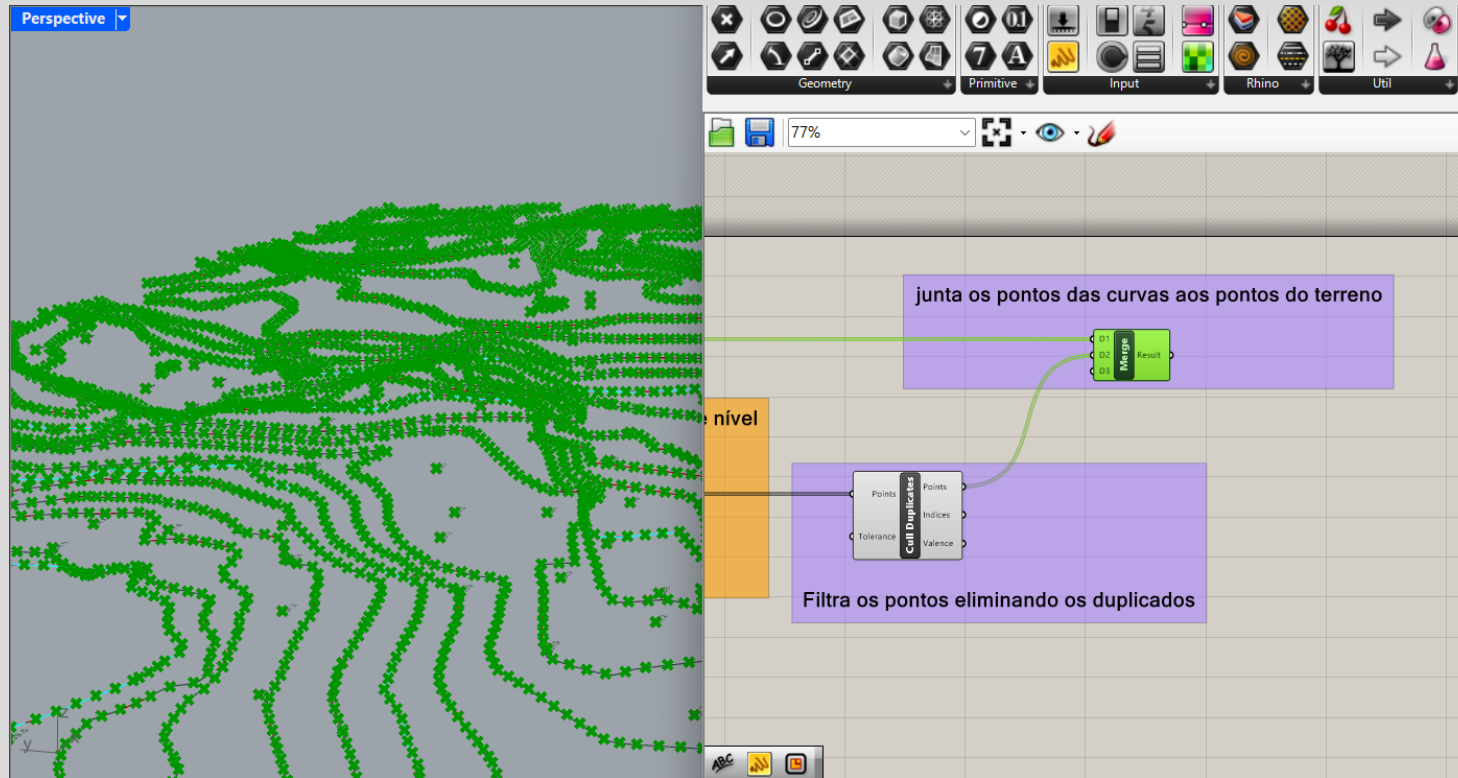


Aula. 13 – Modelação de terreno: GrassHopper

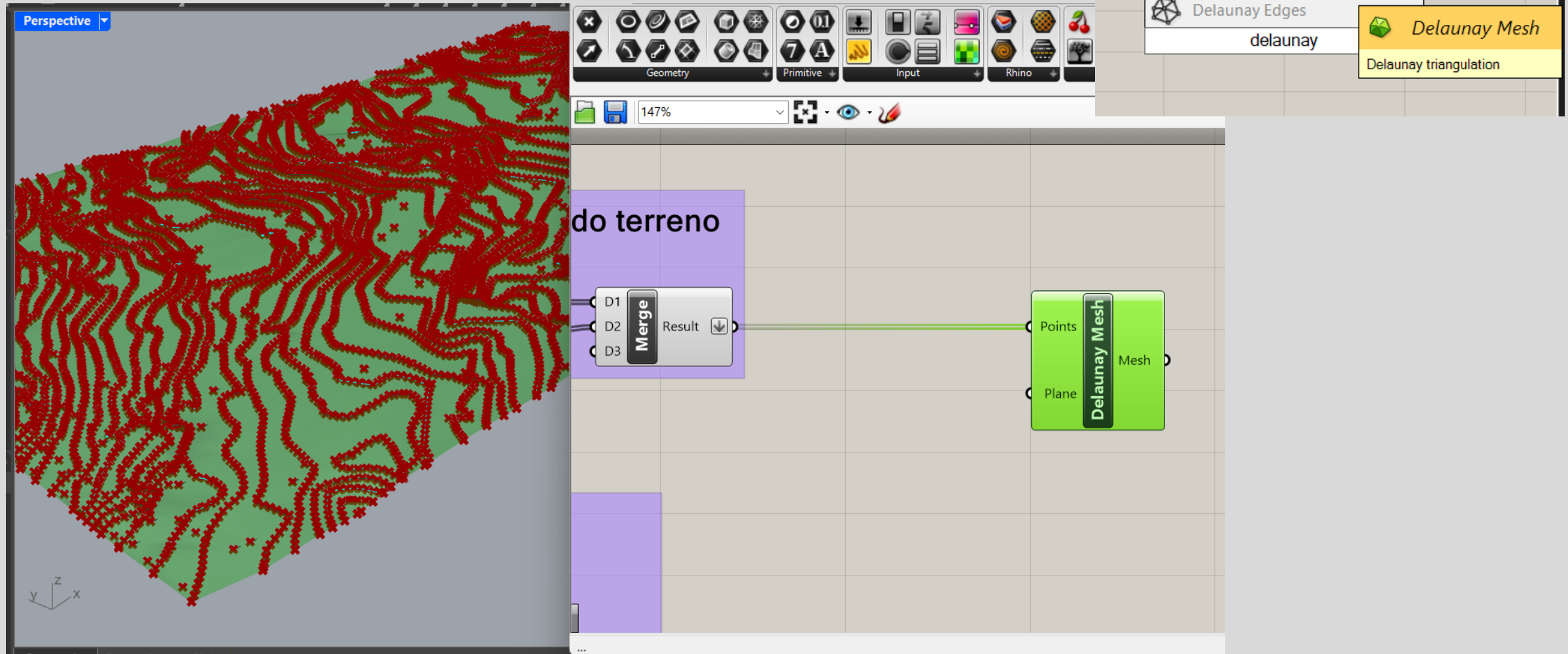
Lista de listas visível no painel



Eliminar os pontos duplicados

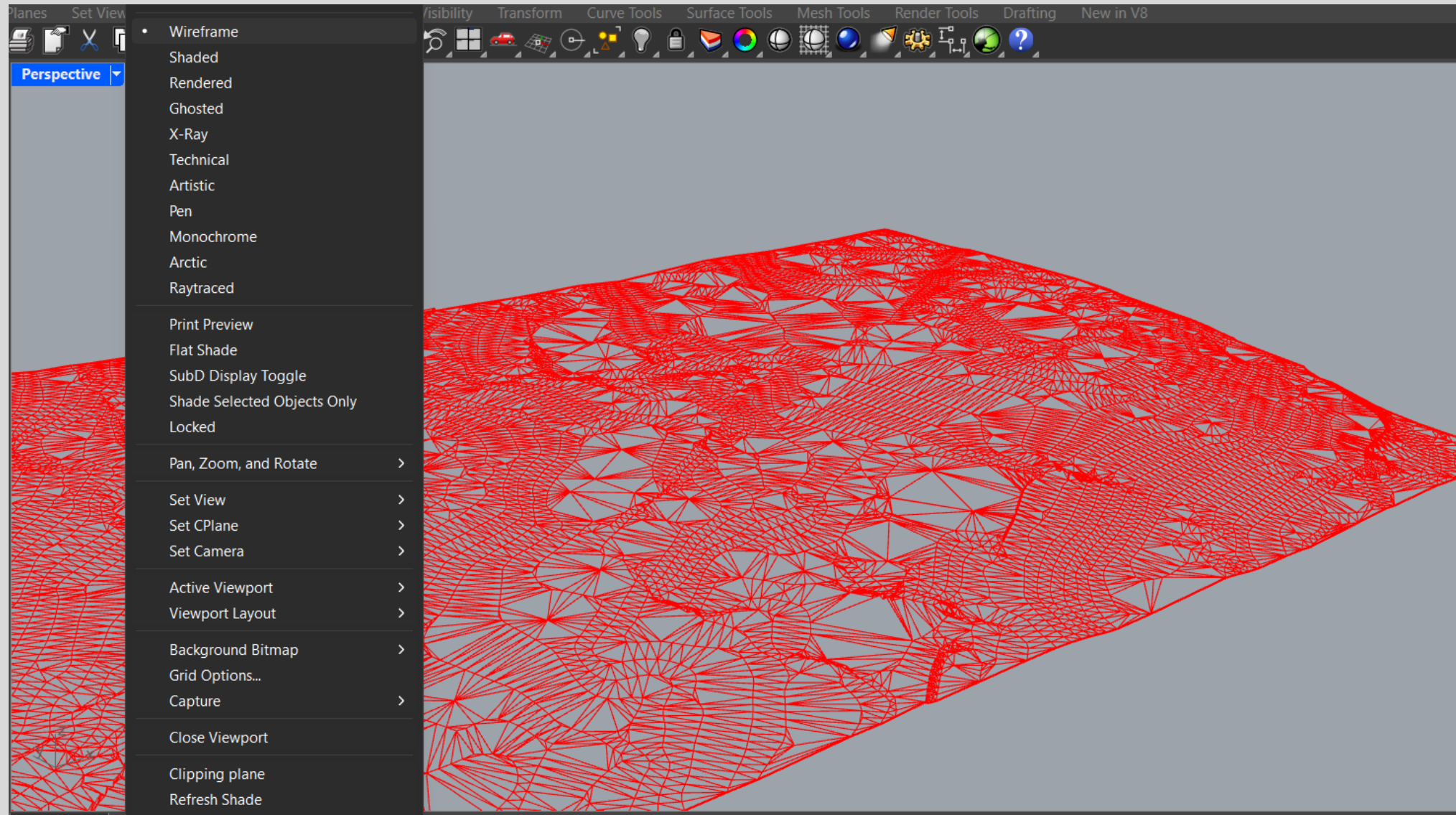


Delaunay mesh



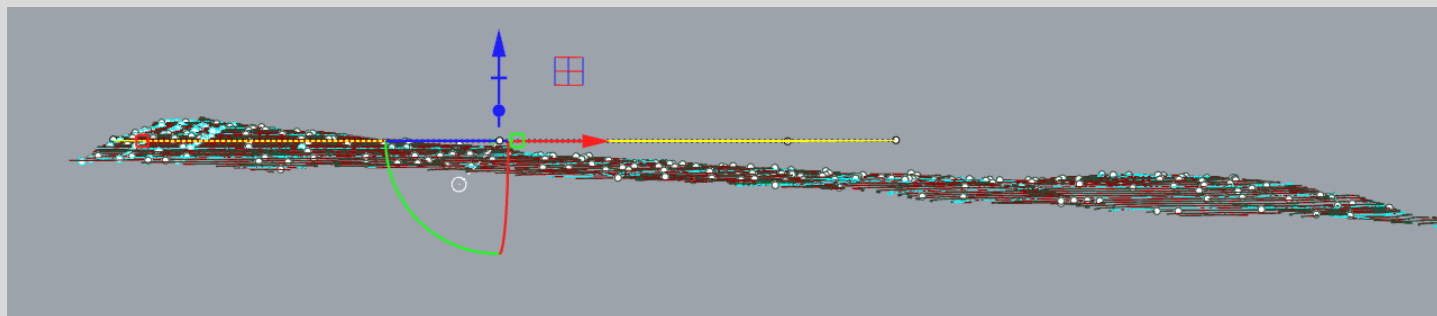
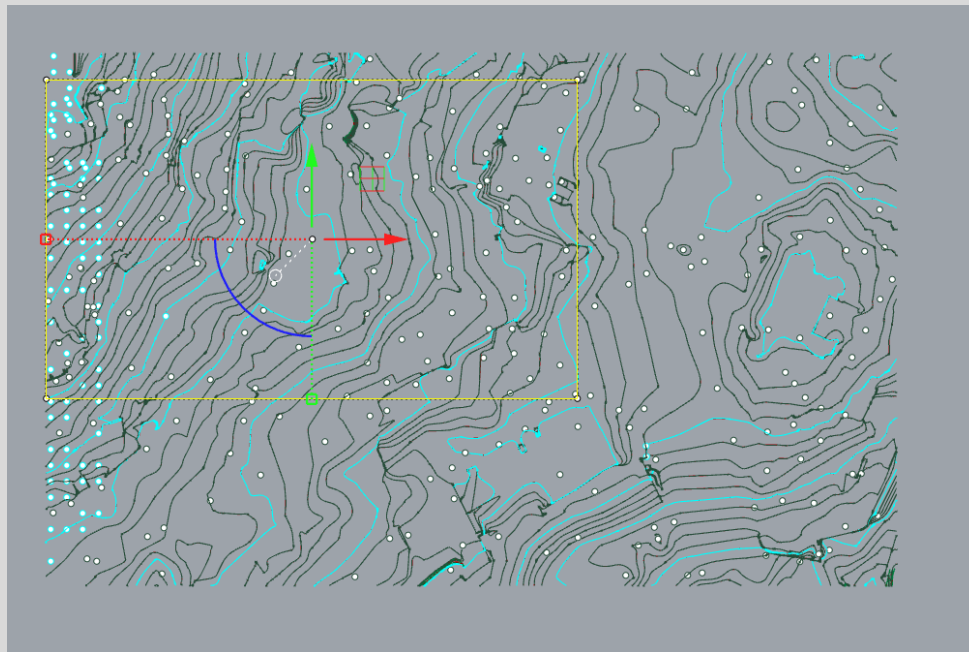
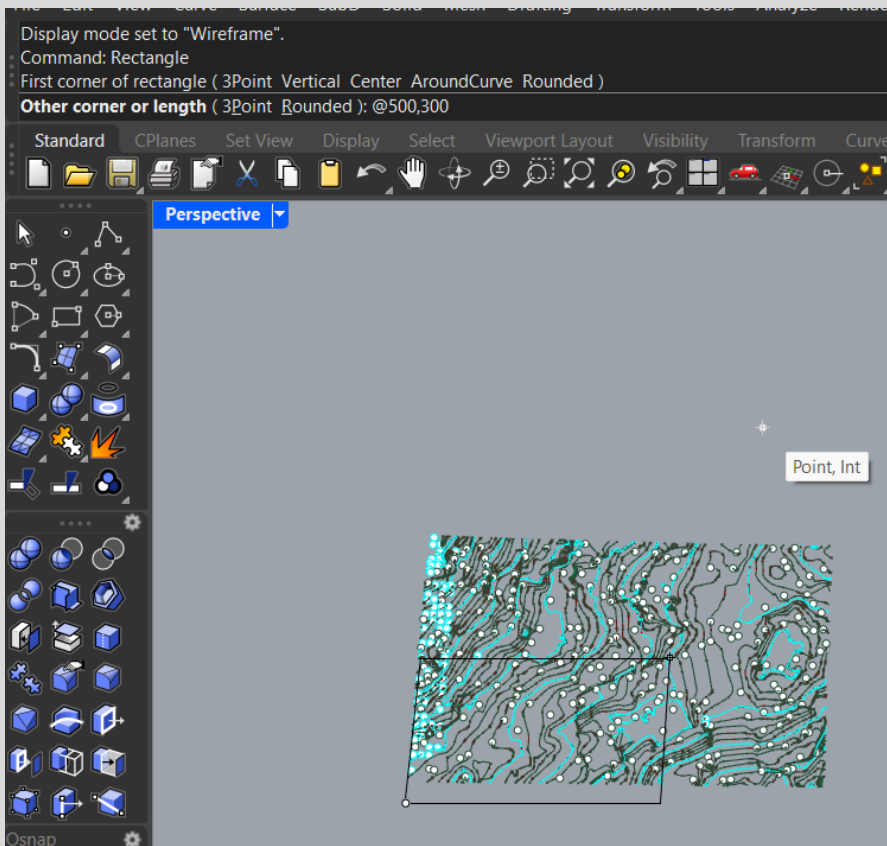
Aula. 13 – Modelação de terreno: GrassHopper

Delaunay mesh



Aula. 13 – Modelação de terreno: GrassHopper

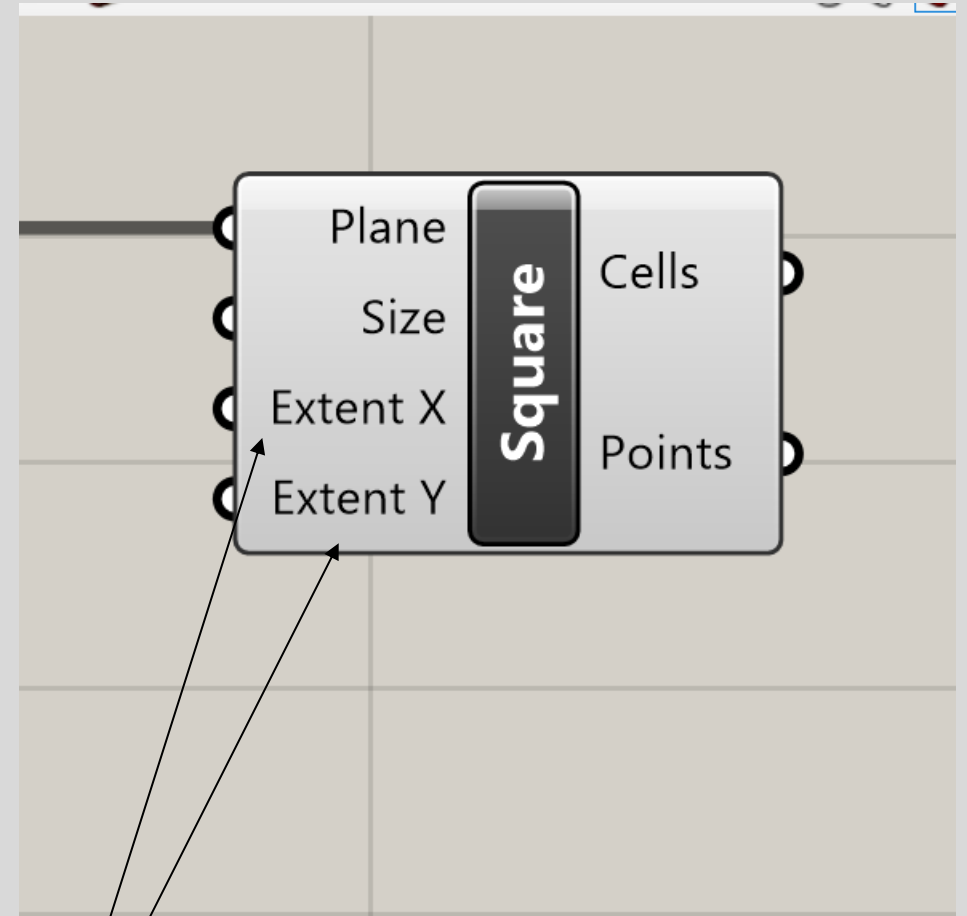
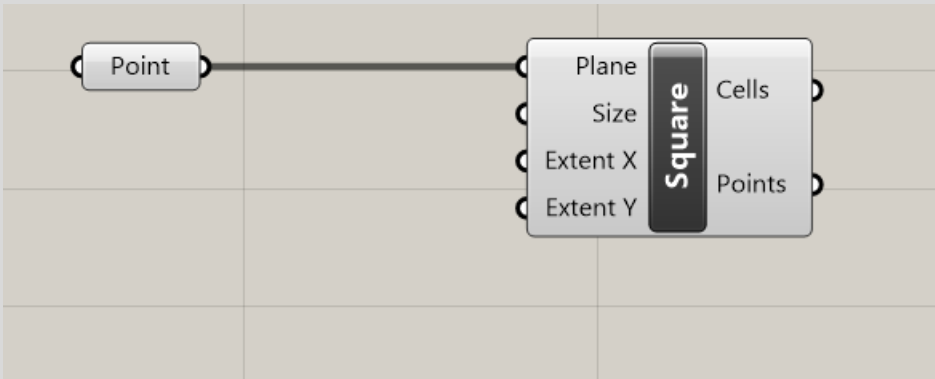
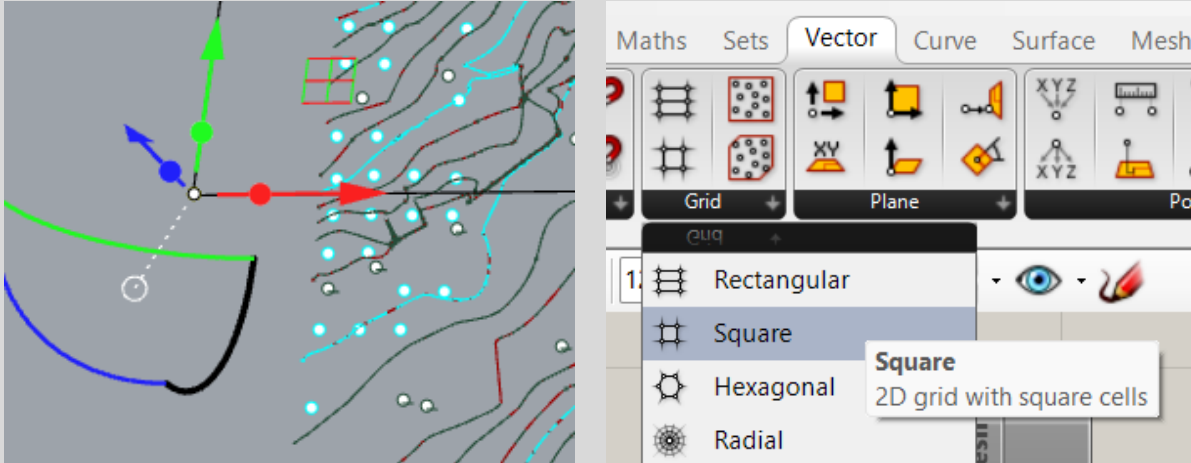
**Delaunay mesh- regularizar as dimensões dos triângulos da superfície para uma
parencia mais smooth**



Aula. 13 – Modelação de terreno: GrassHopper

Delaunay mesh- regularizar as dimensões dos triângulos da superfície para uma aparência mais smooth

Ponto de origem da grelha e define o plano da grelha

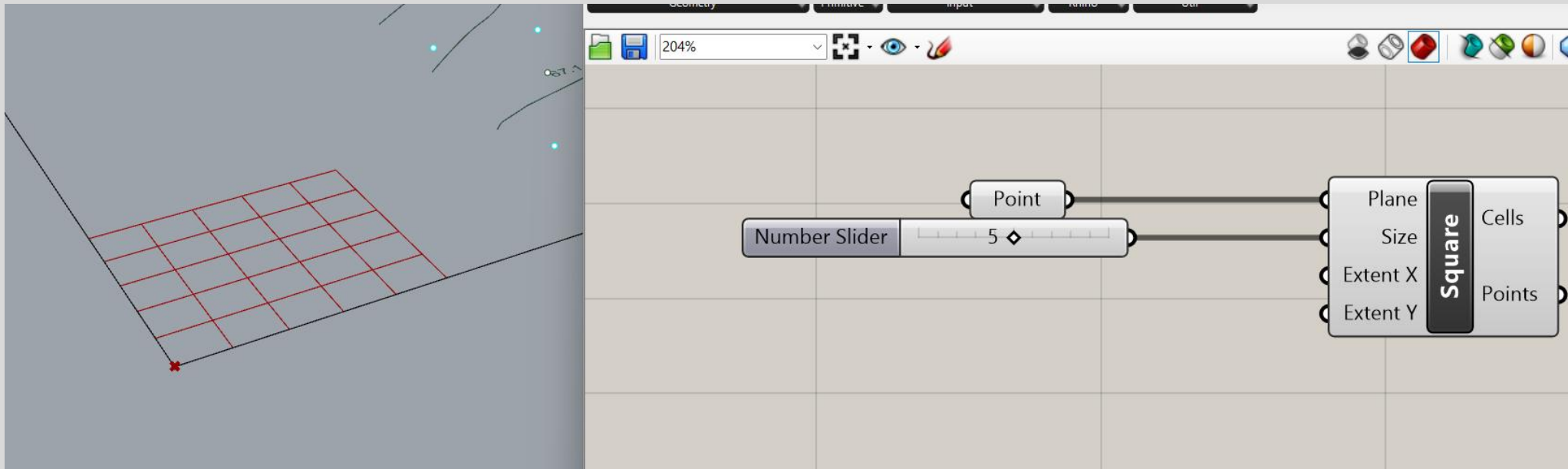


Equivalente as coordenadas UVW em AutoCAD e 3dsMAX

Aula. 13 – Modelação de terreno: GrassHopper

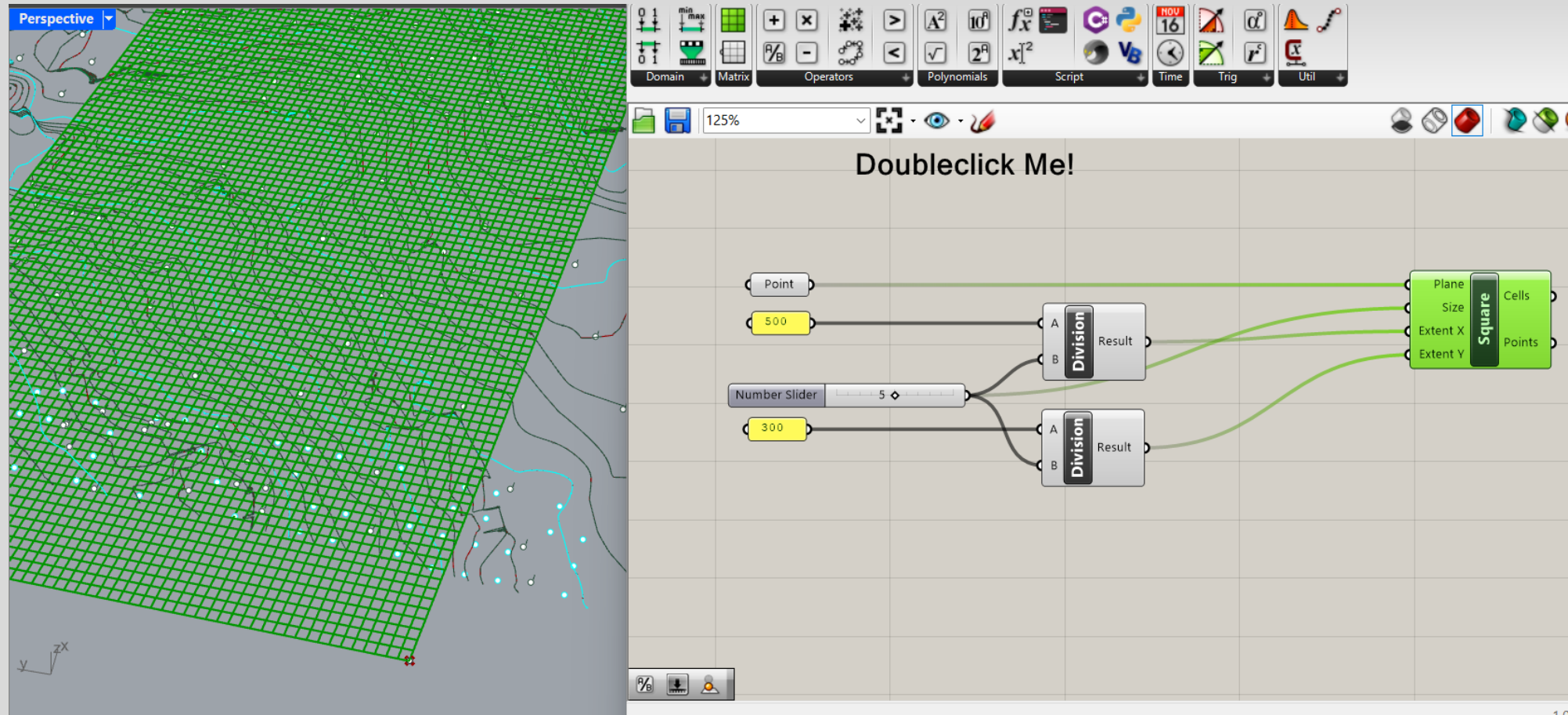
Delaunay mesh- regularizar as dimensões dos triângulos da superfície para uma aparência mais smooth

Valor submúltiplo da dimensão do retângulo (5 é submúltiplo de 300)



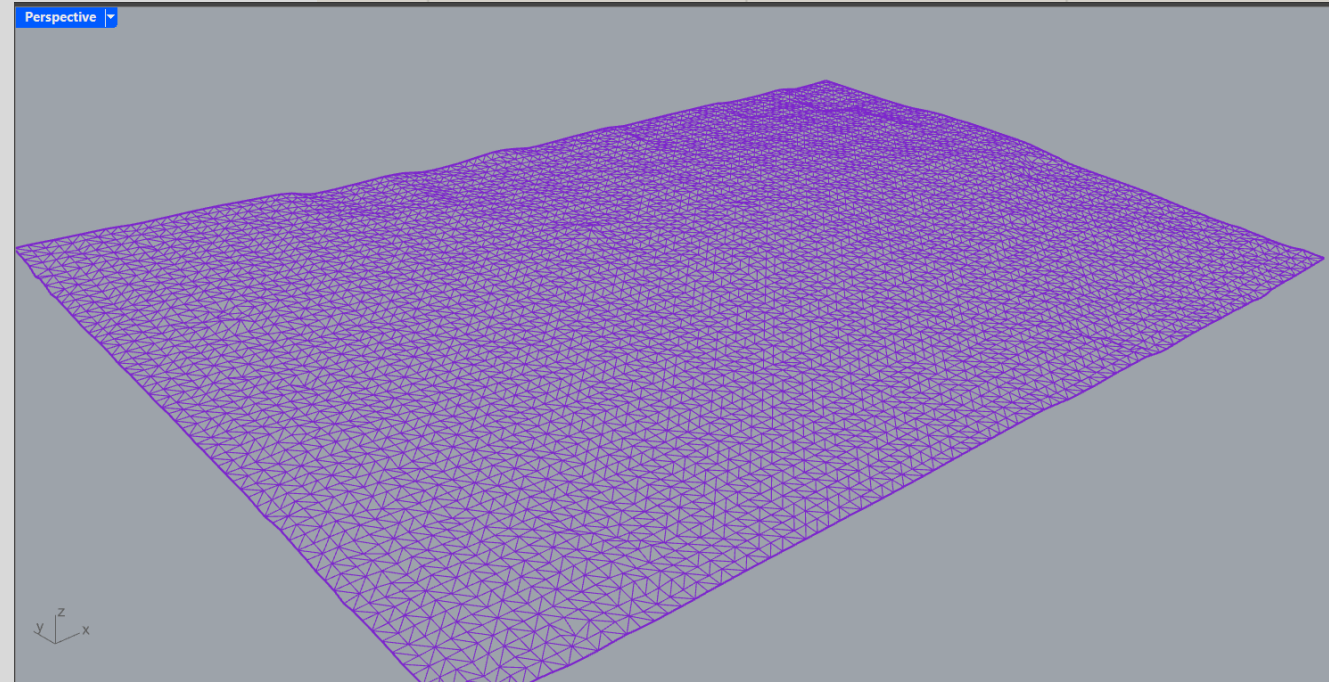
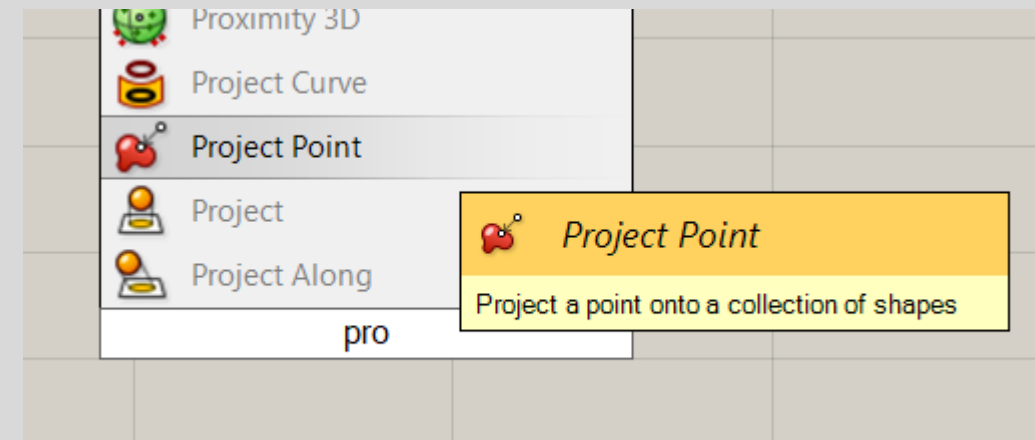
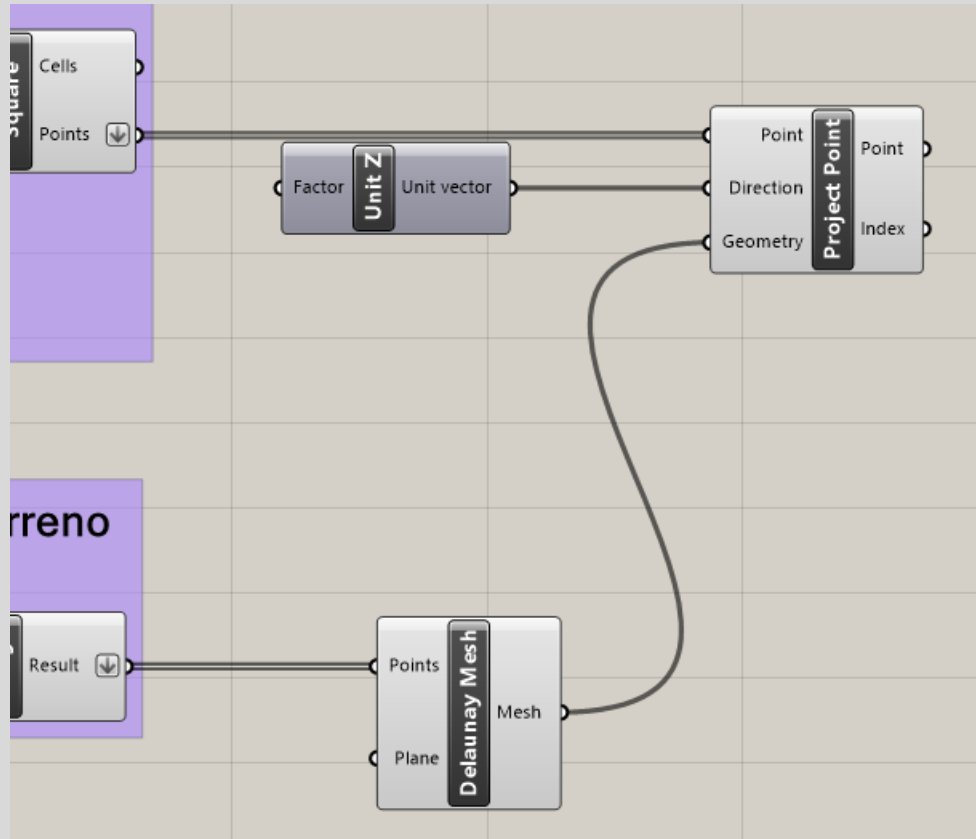
Delaunay mesh- regularizar as dimensões dos triângulos da superfície para uma aparência mais smooth

Valor submúltiplo da dimensão do retângulo (5 é submúltiplo de 300)



Aula. 13 – Modelação de terreno: GrassHopper

Projetar pontos na mesh



FIM DO CADERNO