

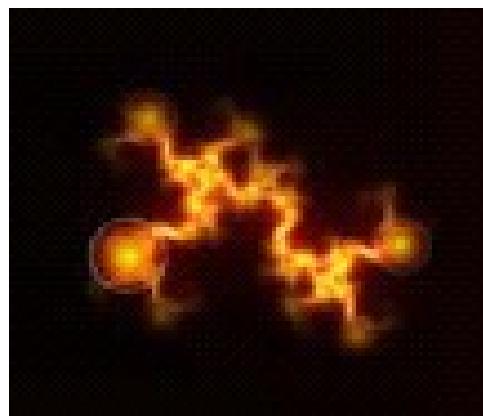
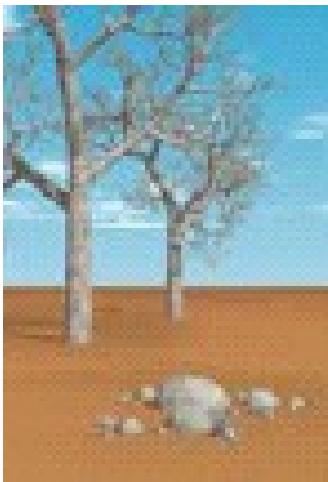
# Modelagem Geométrica

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Capítulo 7 do “Foley”  
Capítulo 4 de Azevedo e Conci  
Mortenson (Geometric Modeling)

# Objetos Naturais



# Introdução

- São os objetos mais difíceis de modelar porque são amorfos, contínuos e definidos por complexas interações física e/ou químicas
- Definidos
  - Plantas
    - Apresentam superfícies definidas mas tem processo de crescimento associado
- Indefinidos
  - Fogo, fumaça, explosões, nuvens, neblina, etc ...
    - Apresentam limites indefinidos e variáveis
  - Água, rios, córregos, mar, piscina, cachoeiras, fontes dágua, ondas etc ...
    - É uma superfície deformável ? Grande dificuldade de representar fielmente turbulências

# Fogo



# Fogo

(A&C, 2003: Cap 4.12)

- Mapas de texturas 2D animados são normalmente utilizados mas só são convenientes para câmeras estáticas (superposição em vários planos melhora mas não resolve)

# Nuvens



# Sistemas de Partículas



*Sistema de Partículas simulando água em colisão com as pedras.*

# Simulações

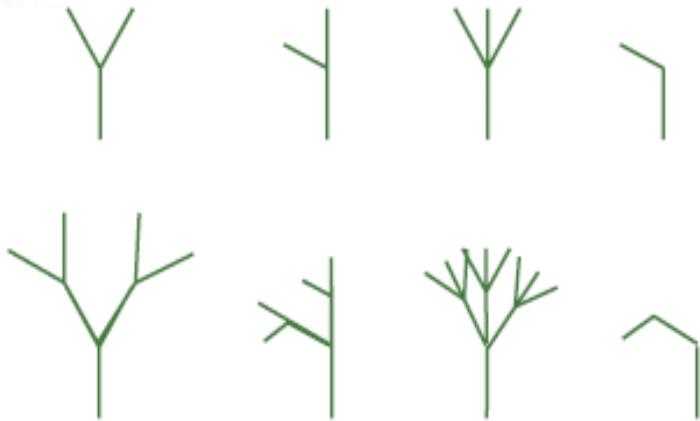
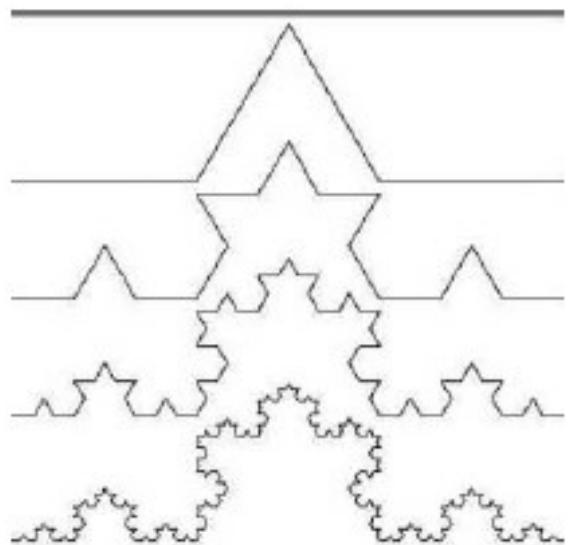
- Água
  - <http://physxinfo.com/news/11109/introduction-to-position-based-fluids/>
- Objetos Deformáveis
  - [http://www.youtube.com/watch?feature=player\\_embedded&v=KppTmsNFneg](http://www.youtube.com/watch?feature=player_embedded&v=KppTmsNFneg)

# **Modelagem Procedural**

# Plantas

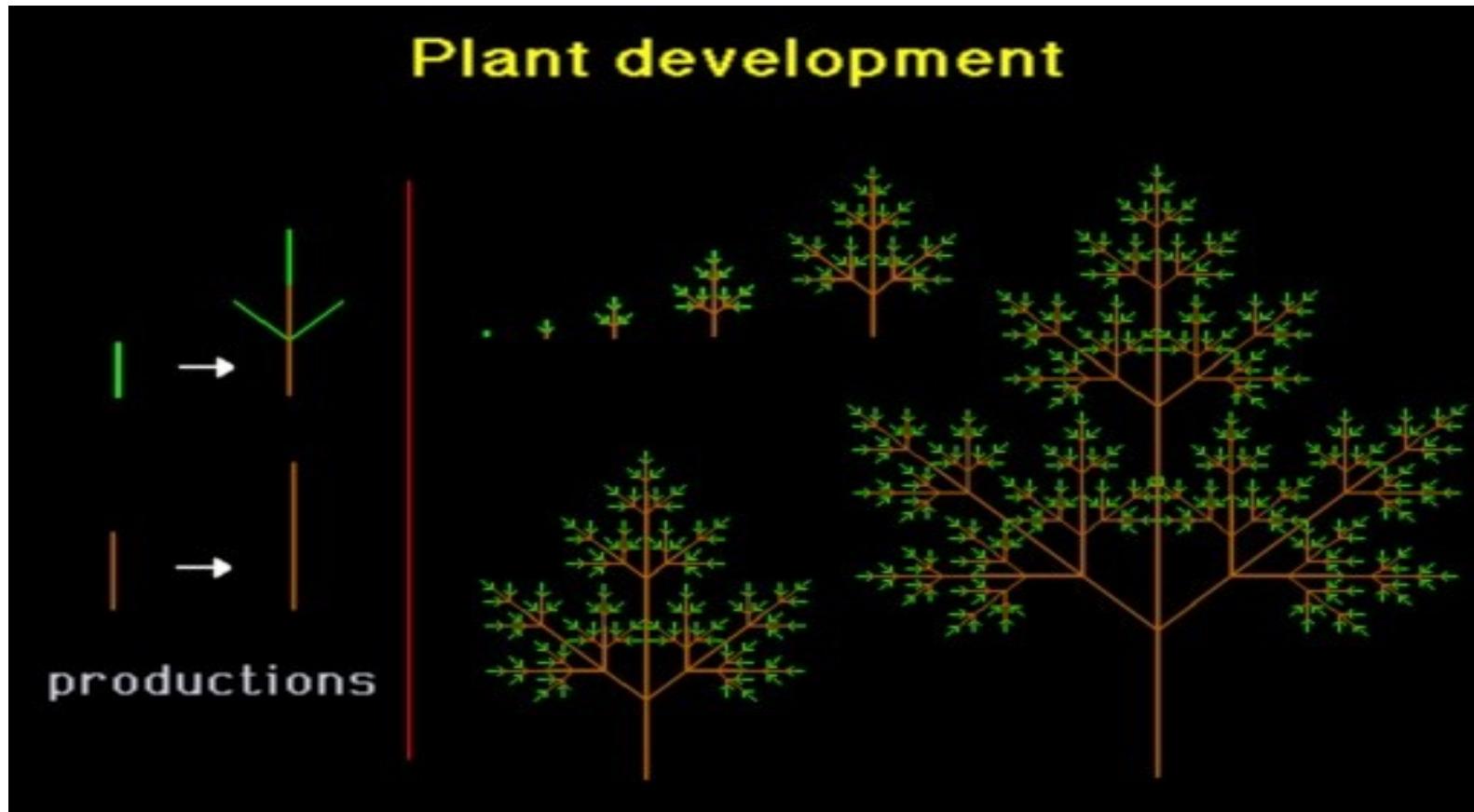
- Desenvolvem-se a partir de um único ponto obedecendo estrutura restrita e pré-definida
  - A topologia de uma planta é definida pela estrutura recursiva de galhos
  - Auto-similaridade em escala
- Vários esquemas de modelagem
  - Fractais
  - L-systems

# Plantas



*Os fractais têm sempre cópias aproximadas de si.*

# Plantas

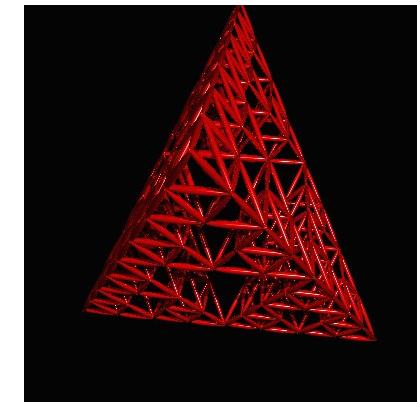


# Plantas





# Procedurais

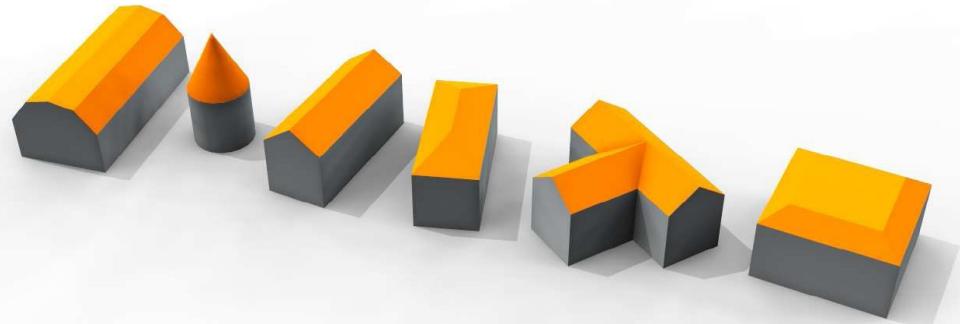


L-Systems (Przemyslaw Prusinkiewicz)

# **Modelagem Procedural**

# Procedural Modeling of Buildings

## Pascal Muller et al. Siggraph 2006.





# Mensagens

- Muitos dos Objetos Naturais **não** são efetivamente modelados
- Modelagem Geométrica tem muito a ver com sistemas CAD/CAE
- Modelagem Geométrica não é só objetos rígidos manufaturados



# Métodos de Modelagem de Objetos (Recursos de **Interface**)

Modificadores/Operadores

A&C, Cap 4.6

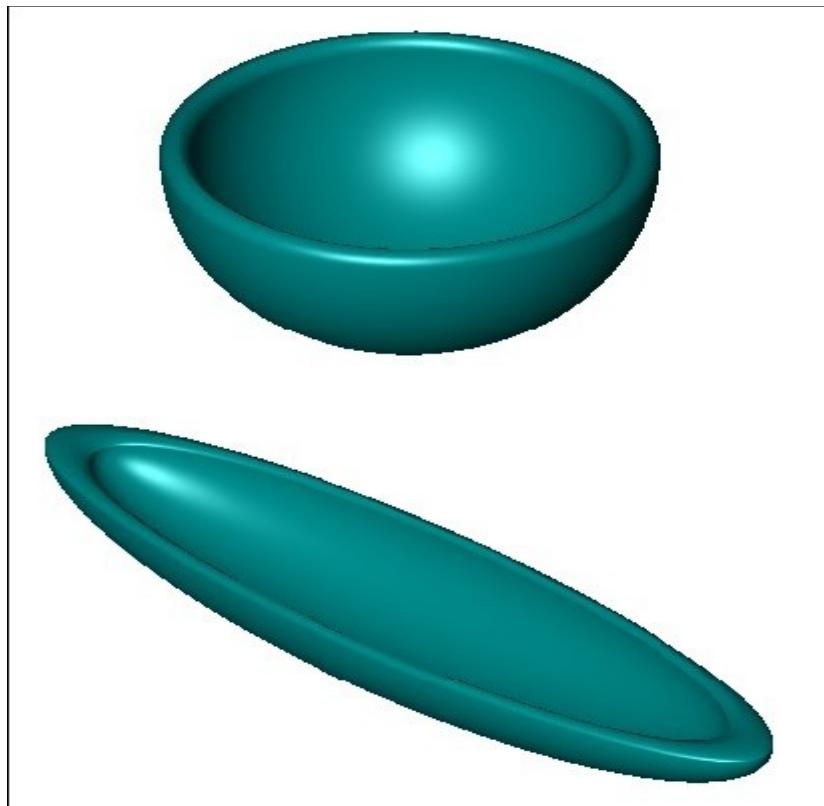
# Tipos de Métodos

- **Operações Globais**
  - Transformações/Deformações
  - Considera um **objeto como um todo**
    - Altera todo um objeto existente
    - Gera objeto(s) novo(s) com base em um existente
- **Operações Locais**
  - Detalhamentos
  - Altera **partes geométricas/topológicas** de objeto existente
    - Em nível de pontos/vértices
    - Em nível de faces/superfícies

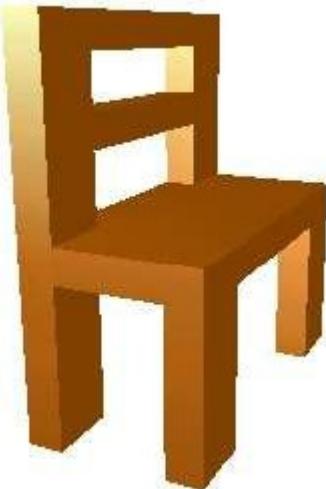
# Operações Globais

Refinamento da Malha, Inchaço, Torção,  
Dobra, Esticamento, Entortamento,  
Afunilamento, Escaleamento, Replicação,  
Leis

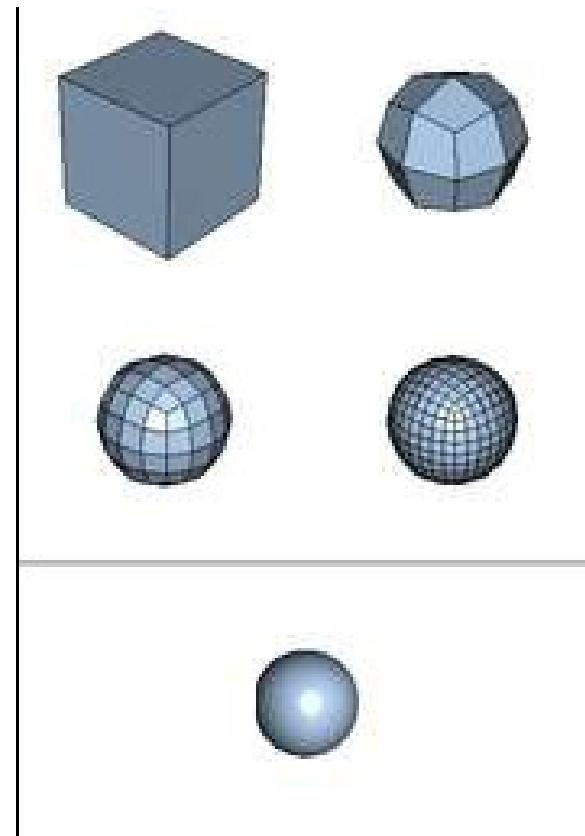
# Operação Global: Escala Não Uniforme



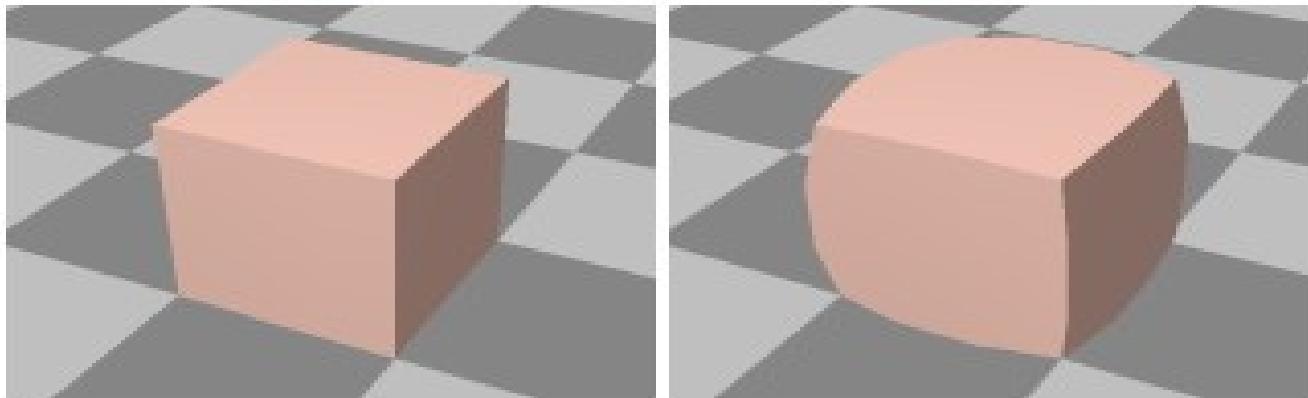
# Operação Global: Replicar/Array



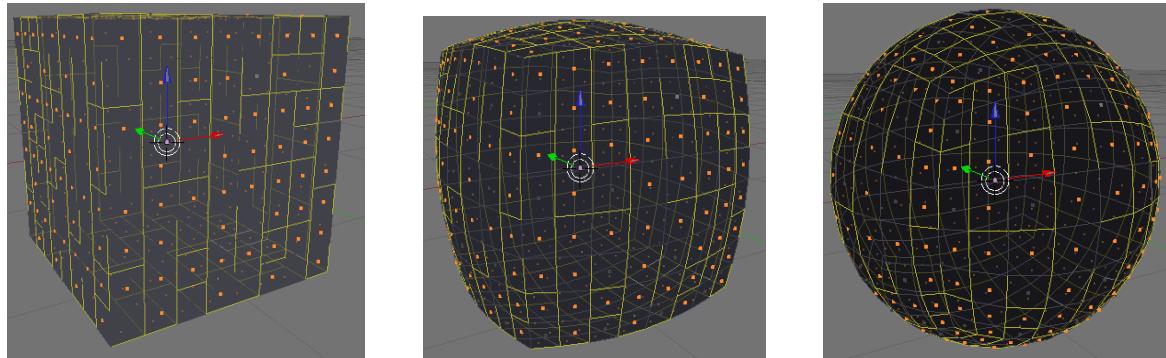
# Operação Global: Refinamento/Simplificação



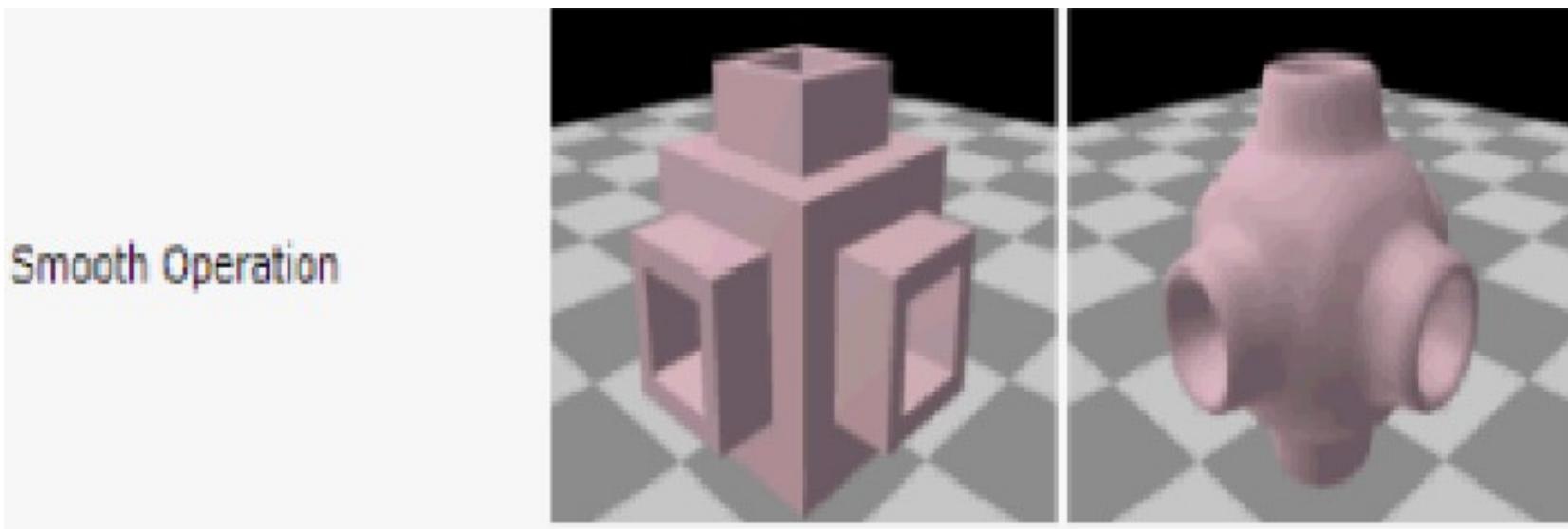
# Operação Global: *Bulge (3D Canvas)*



*To Sphere (Blender)*

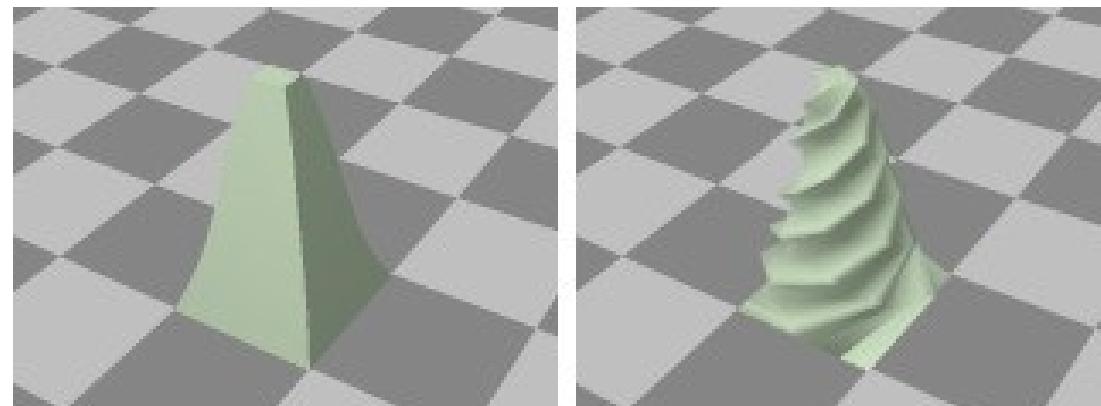
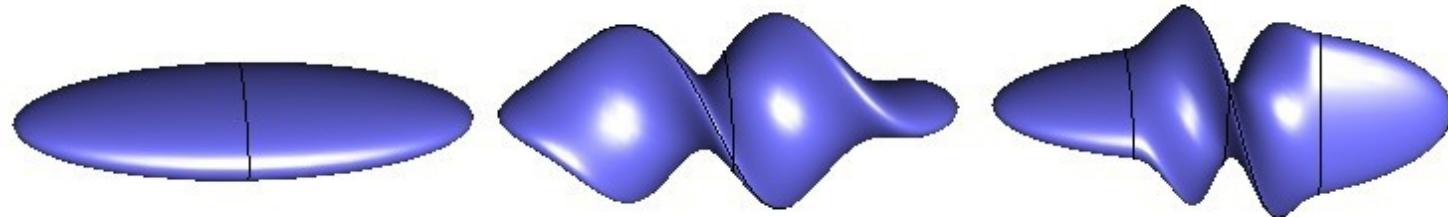


# Operação Global: *Smooth* (Canvas 3D)



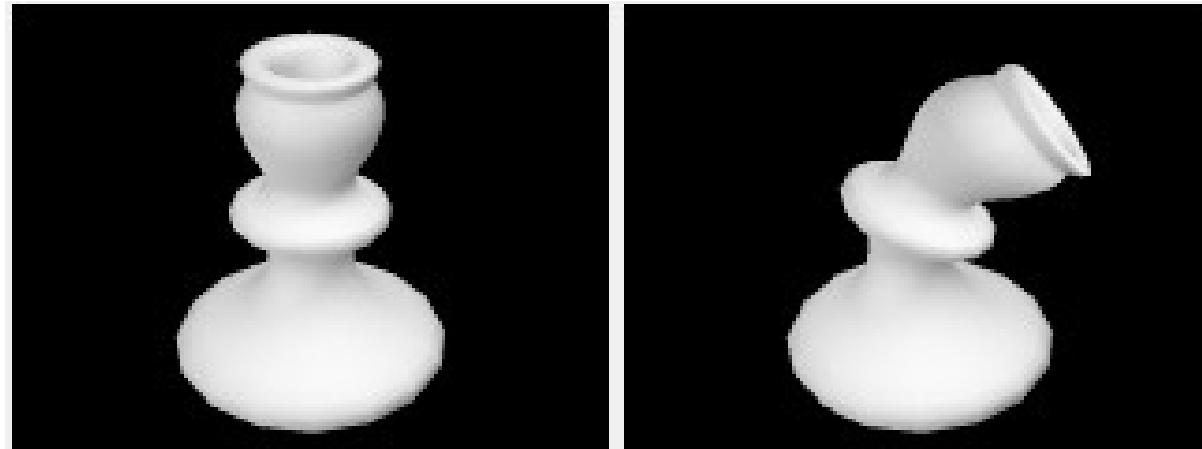
# Operação Global:

## *Warping: Twist*

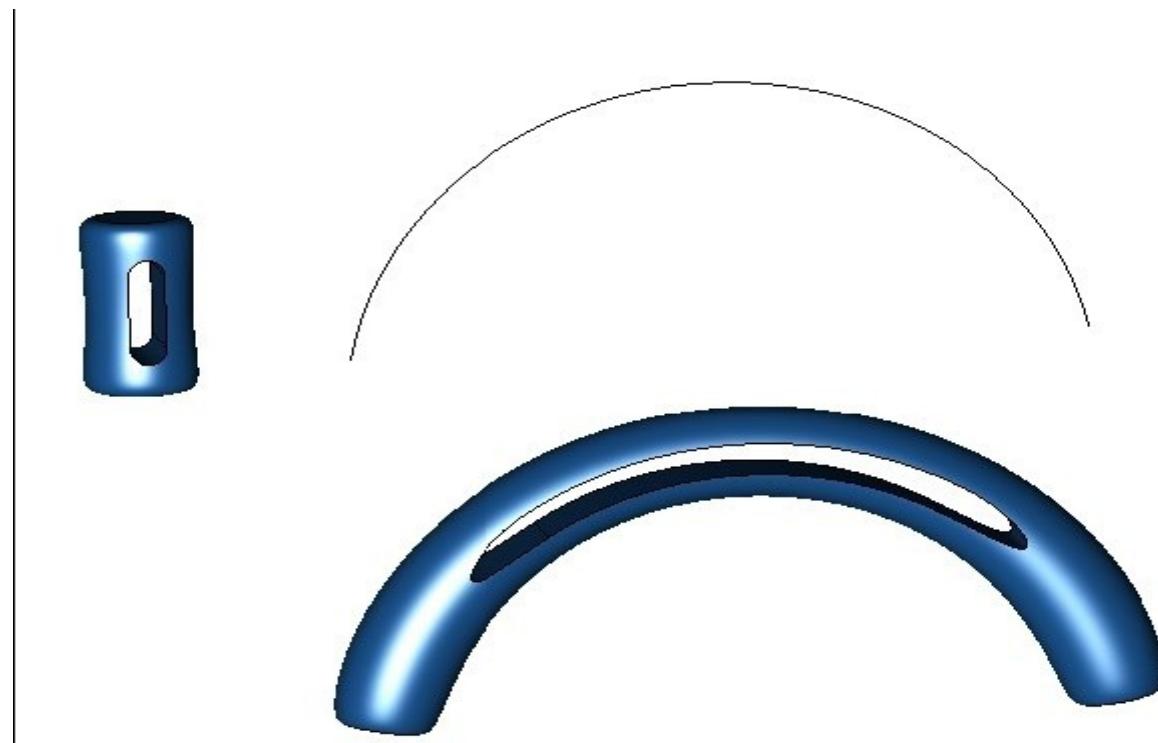


Canvas3D

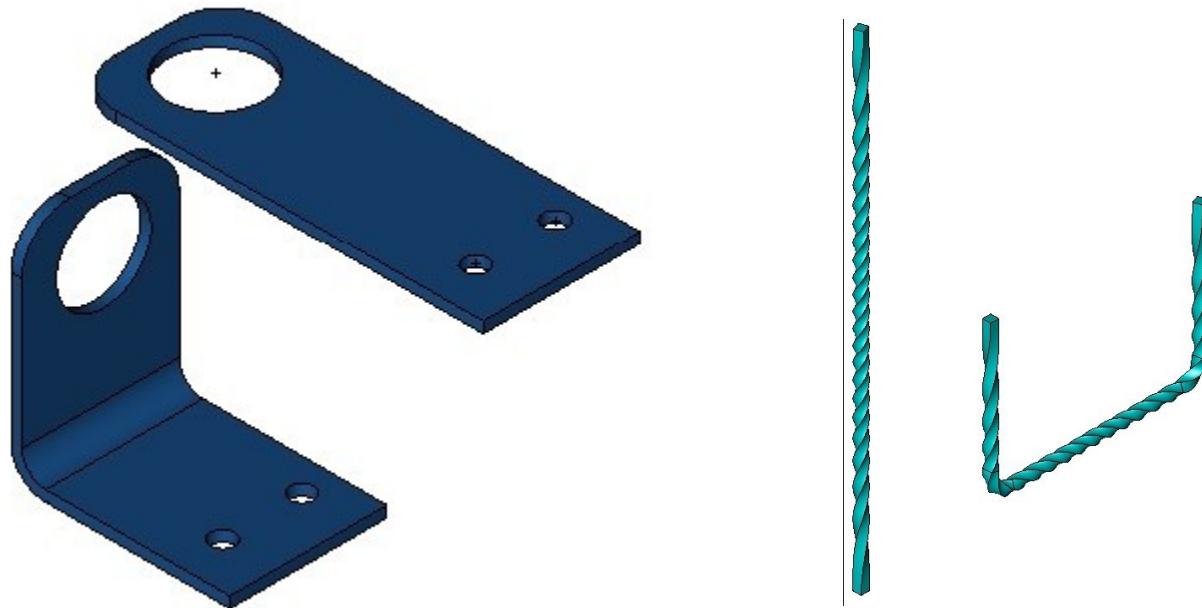
# Operação Global: *Bend or Shear* (3D Canvas)



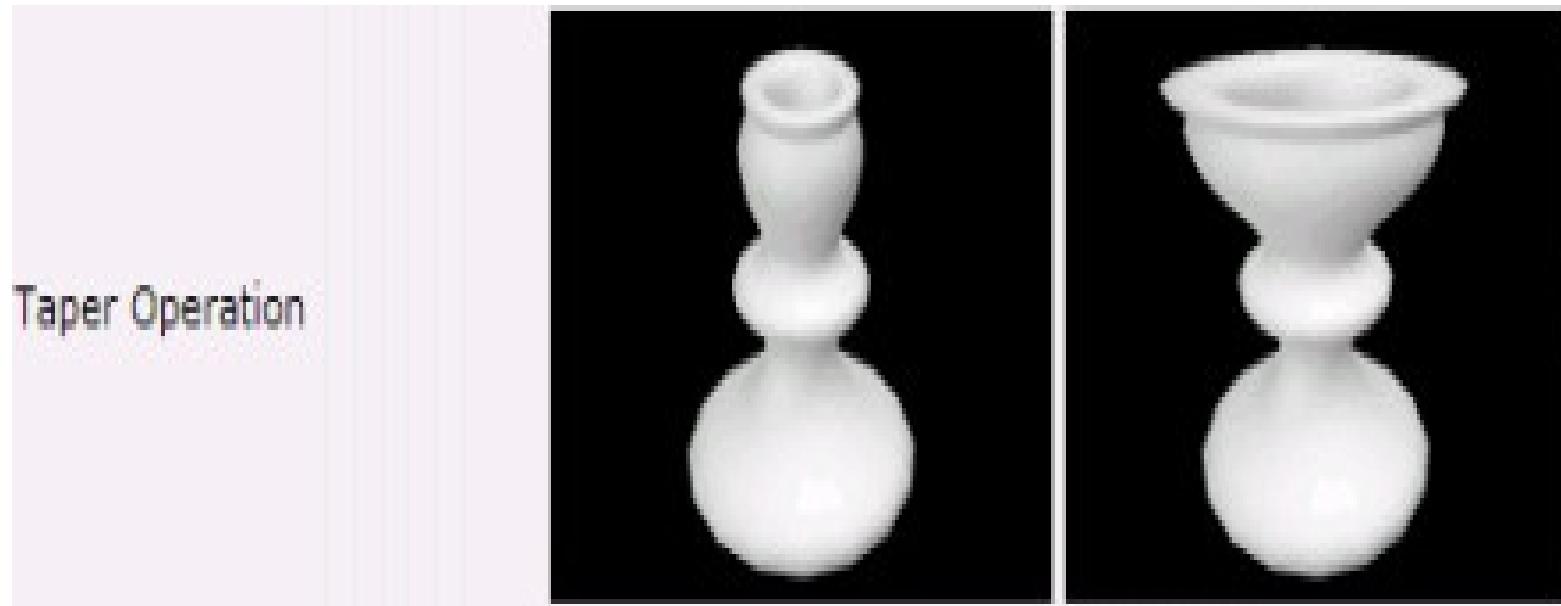
# Operação Global: *Warping: Bend Along Curve*



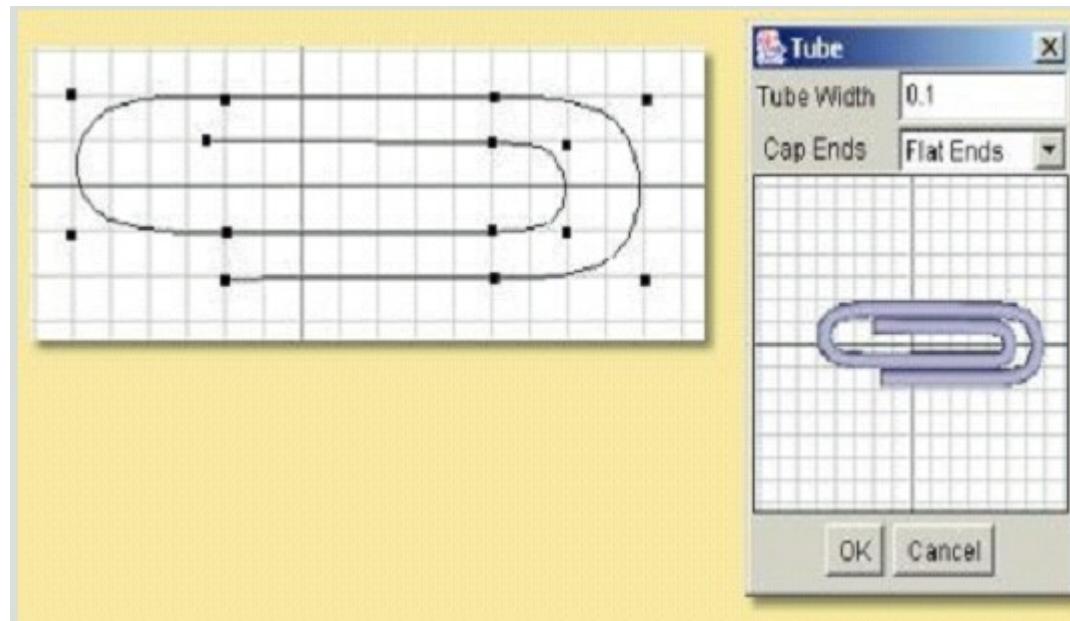
# Operação Global: *Warping: Bend Axis*



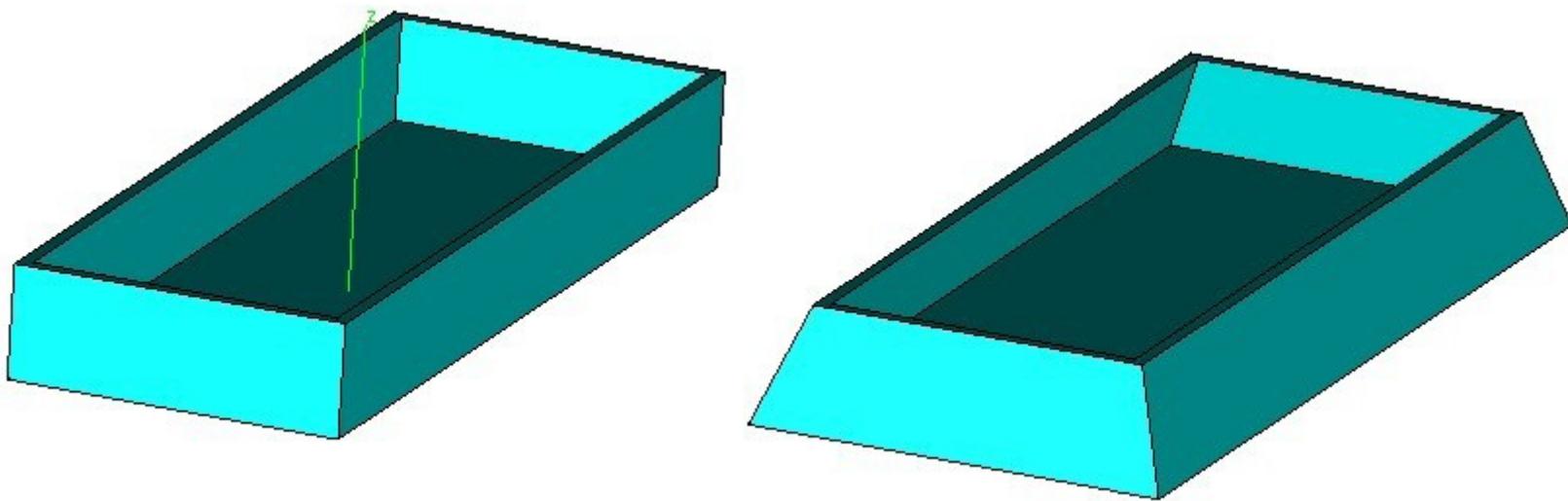
# Operação Global: *Taper* (Canvas 3D)



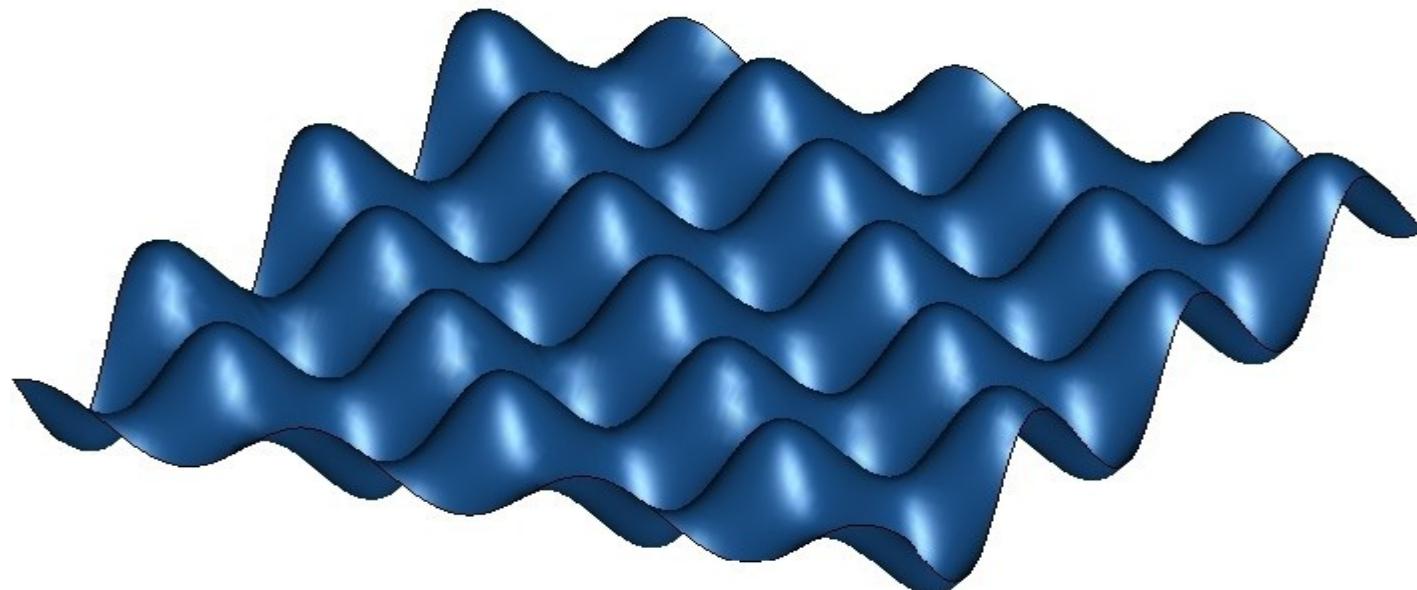
# Operação Global: *Tube* (Art of Illusion)



# Operação Global: *Taper*



# Operação Global: Warp Law

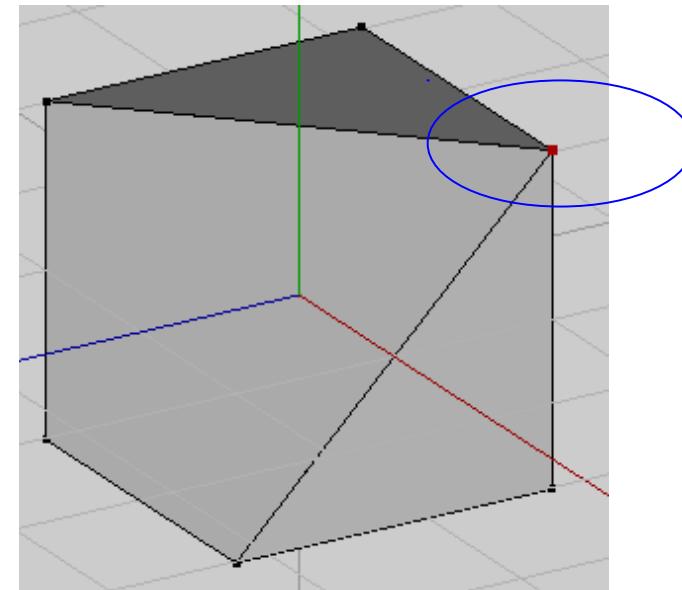
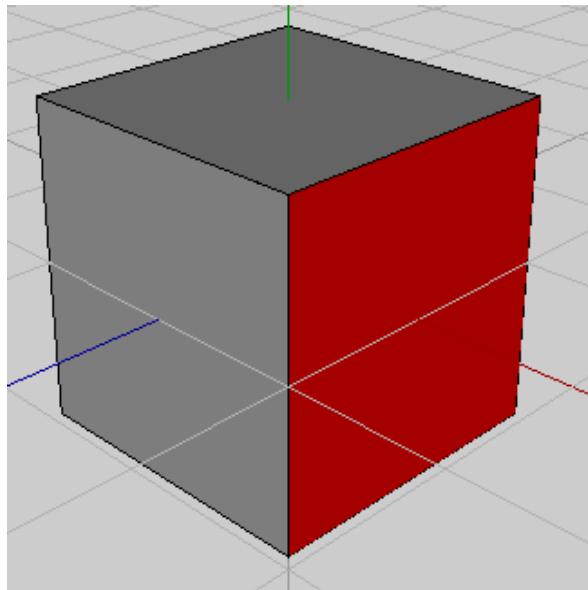
$$\text{vec}(u, -30 + v, 2\sin(u)*\cos(v))$$


# Operações Locais

## Nível de **Ponto/Vértice ou Aresta**

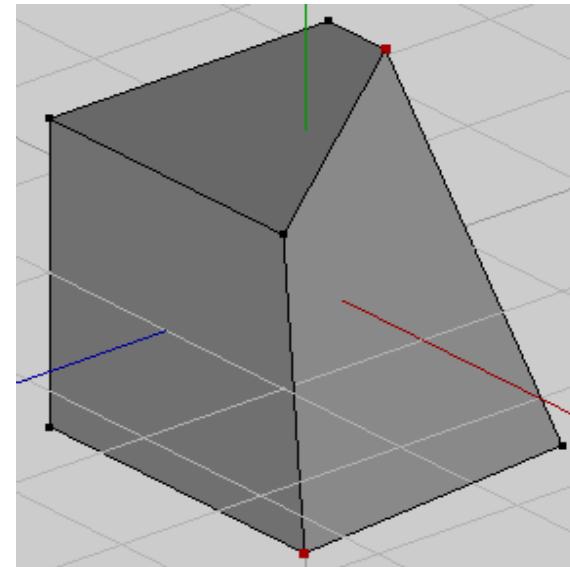
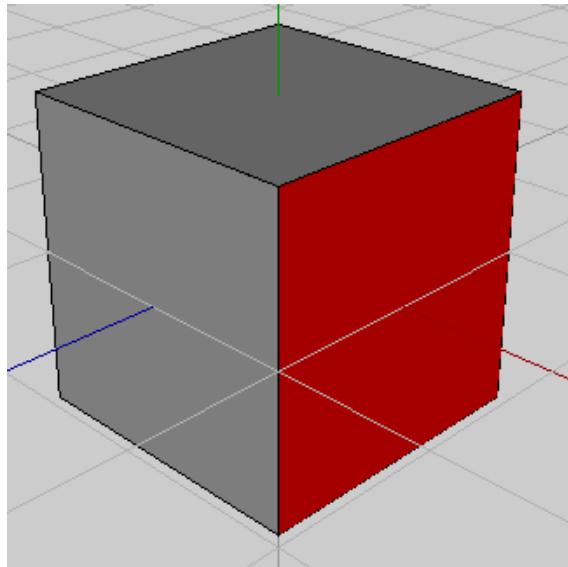
Une Ponto, Move Ponto, Arredonda/  
Corta Aresta

# Operação Local: *Weld* (Wings3D)

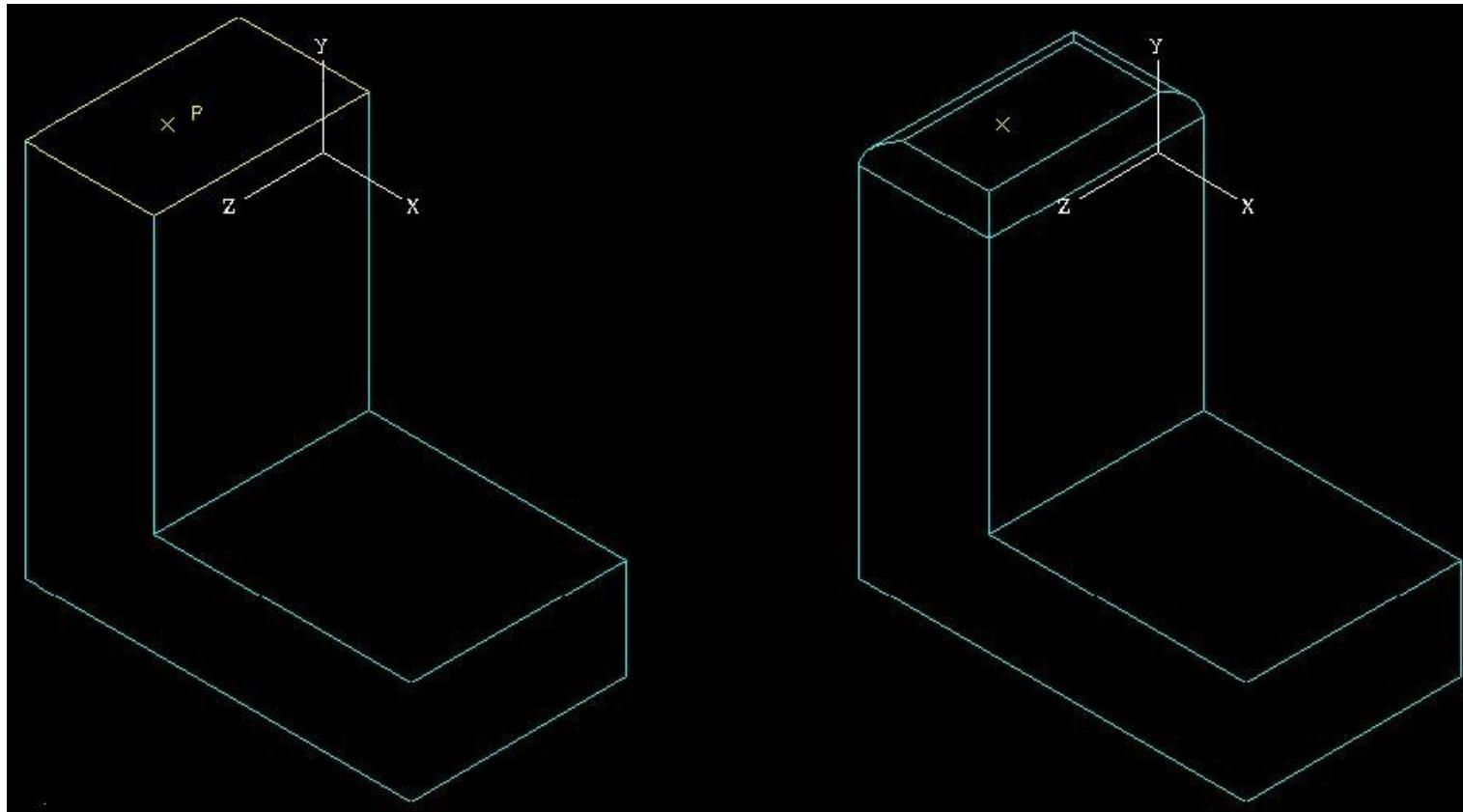


Wings 3D

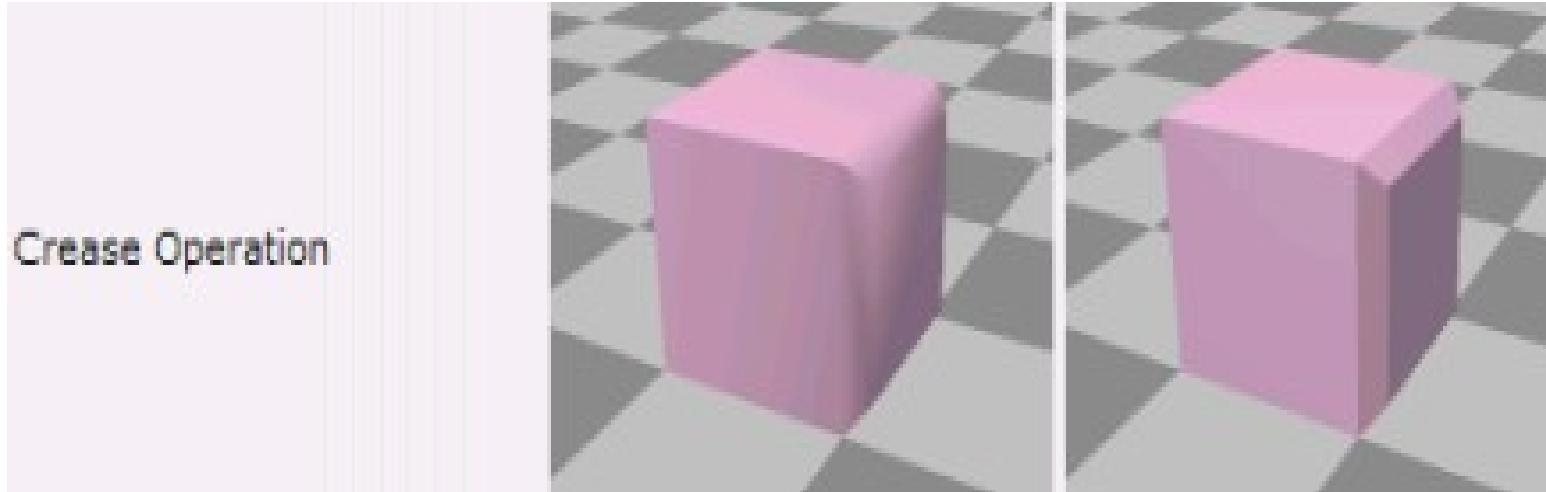
# Operação Local: *Deform Crumple (Wings 3D)*



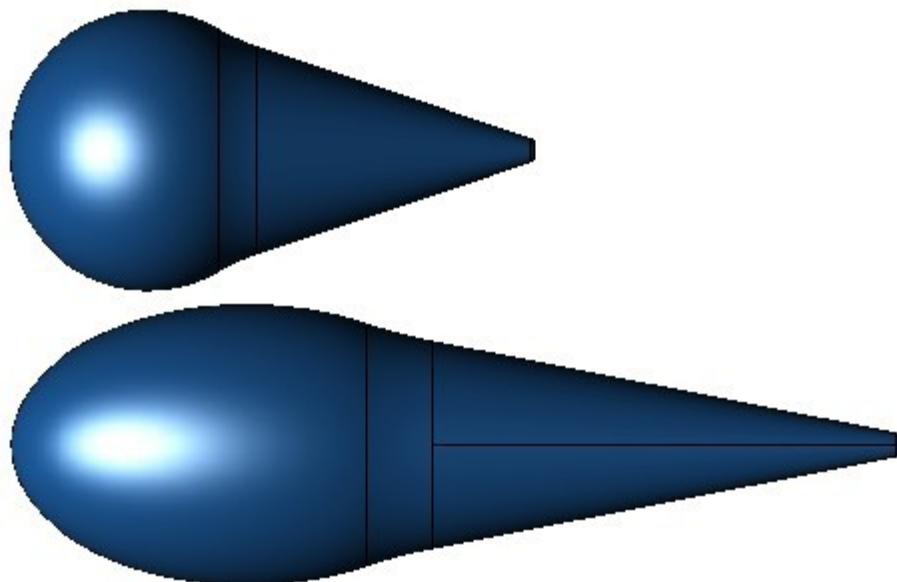
# Operação Local: *Fillet*



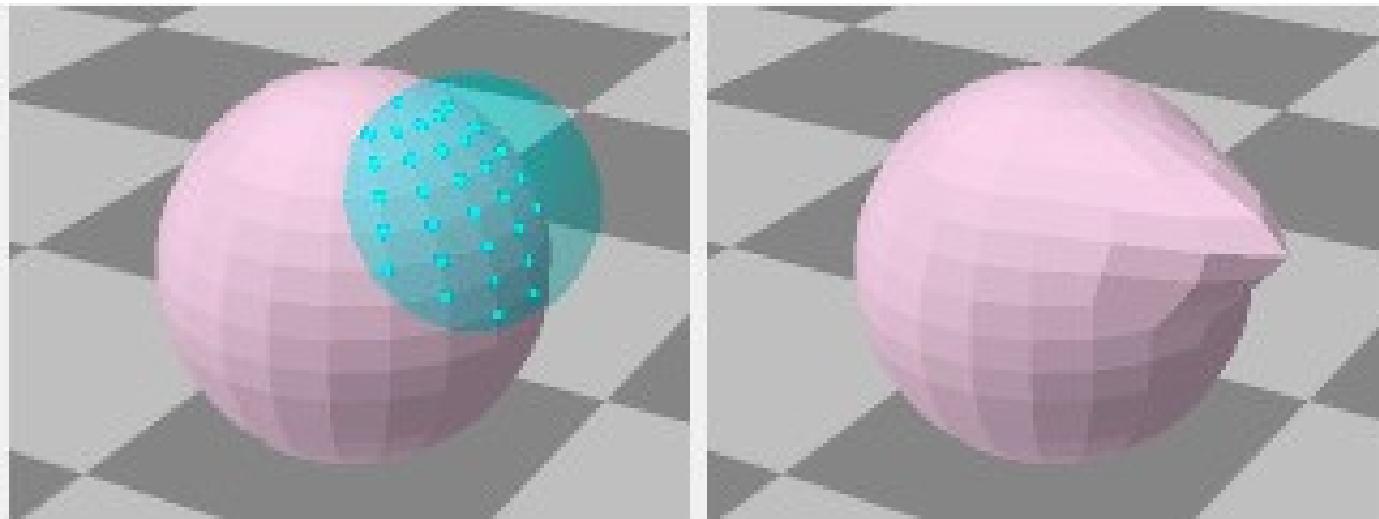
# Operação Local: *Crease* (Canvas 3D)



# Operação Local: *Warping: Stretch*



# Operação Local: Deformação (3D Canvas)



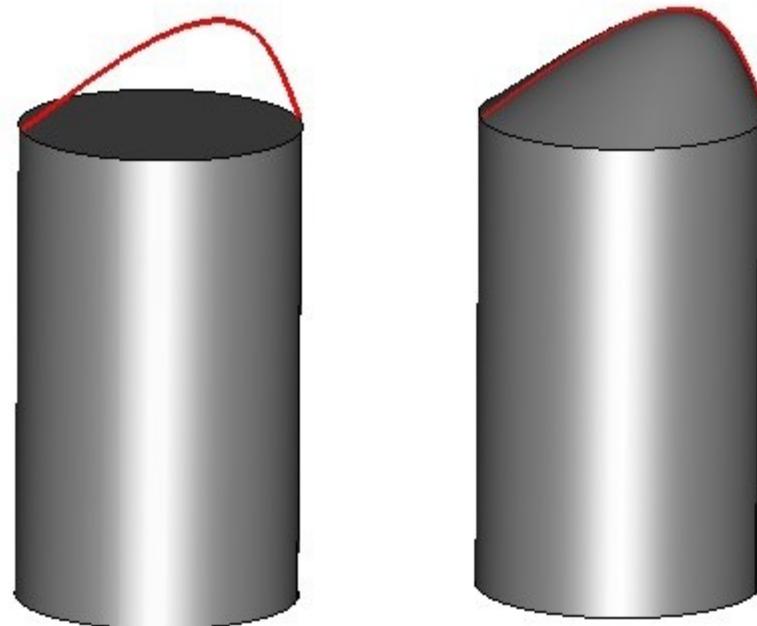
# Operações Locais

## Nível de Face/Superfície

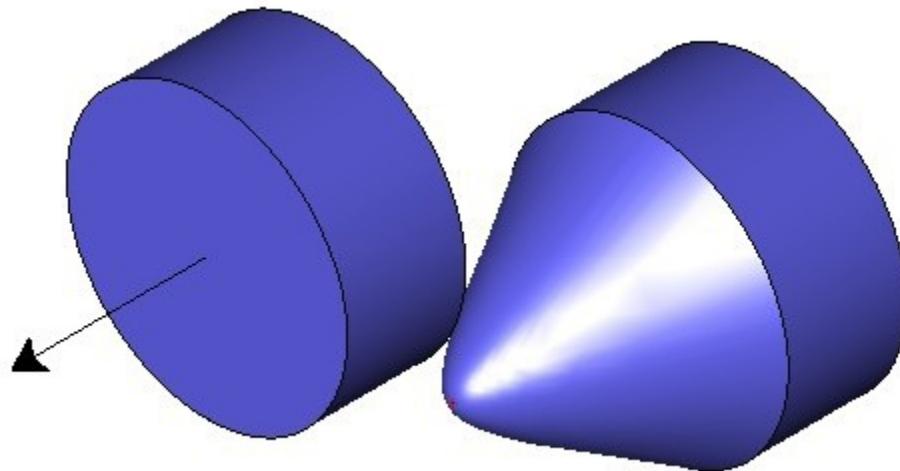
Deforma Face, Suaviza Face, Estica,  
Alinha Faces, Afunda por Pressão,  
Estende Face

*Deform by Point/Curve*

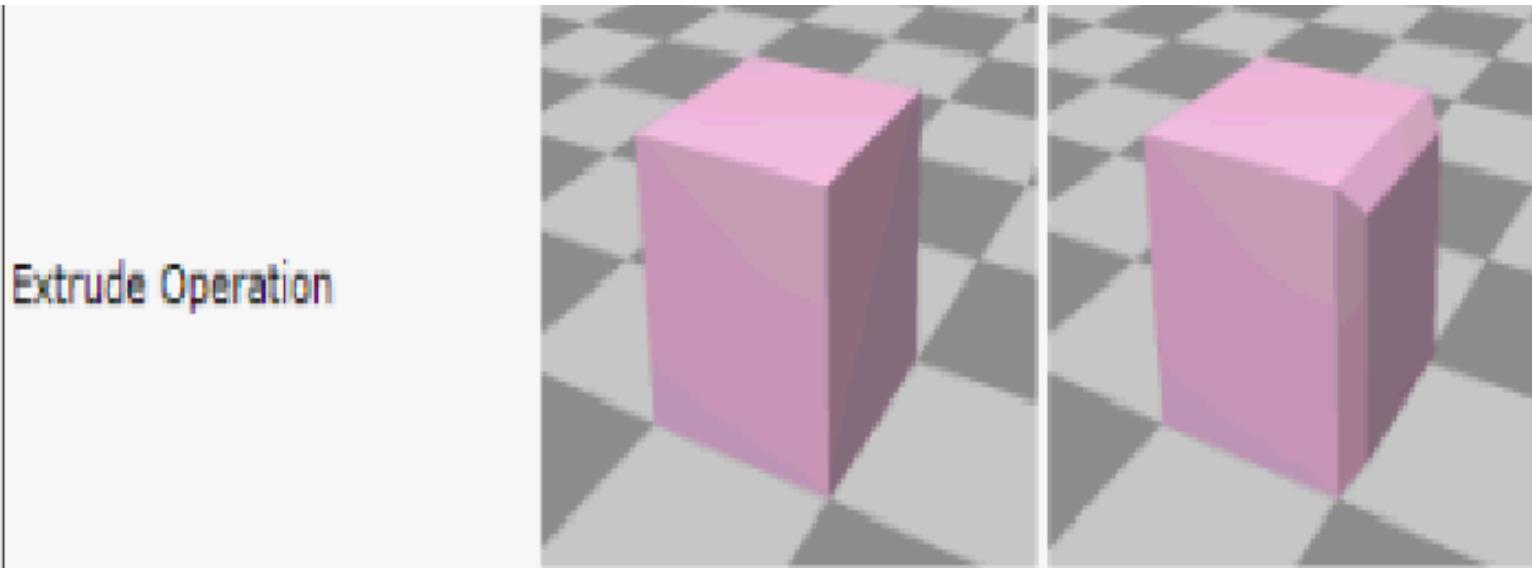
*Deforma Face*



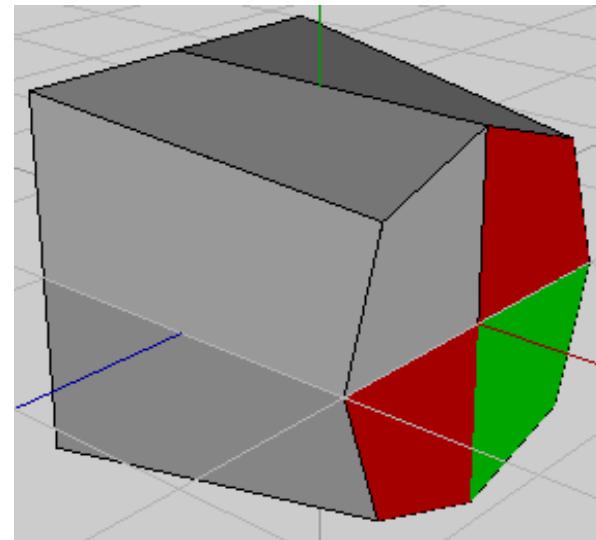
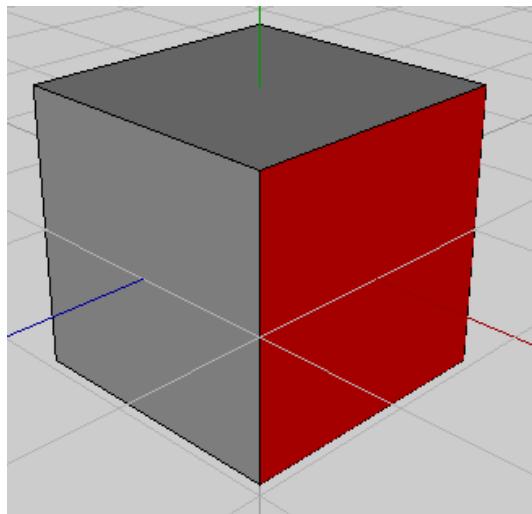
# Operação Local: *Deform by Location*



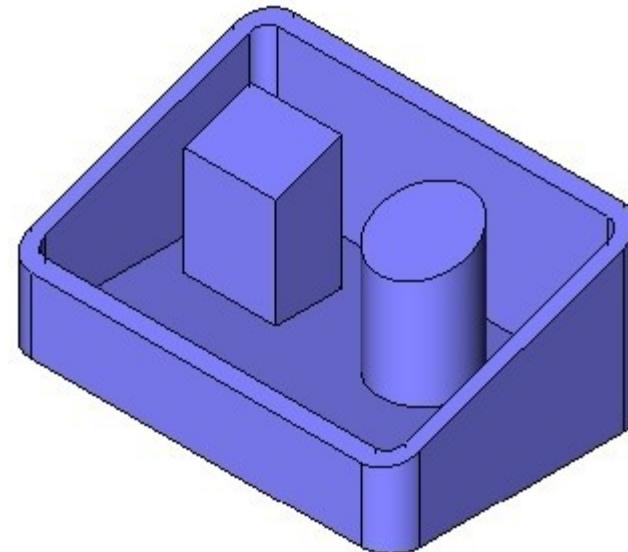
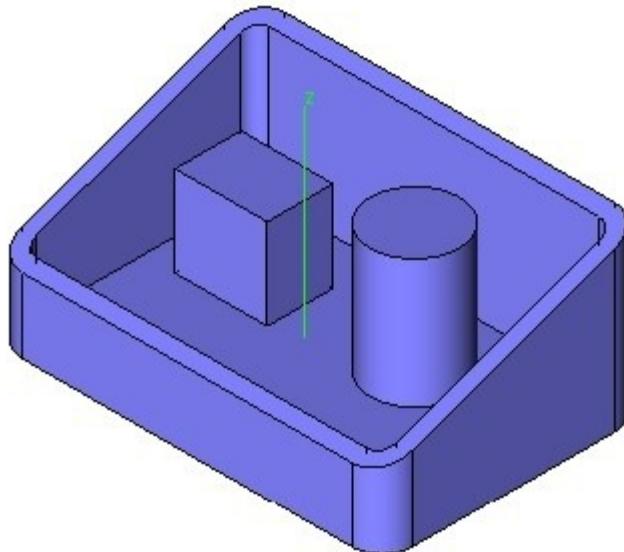
# Operação Local: *Extrude* (Canvas 3D)



# Operação Local: *Smooth* (Wings3D)

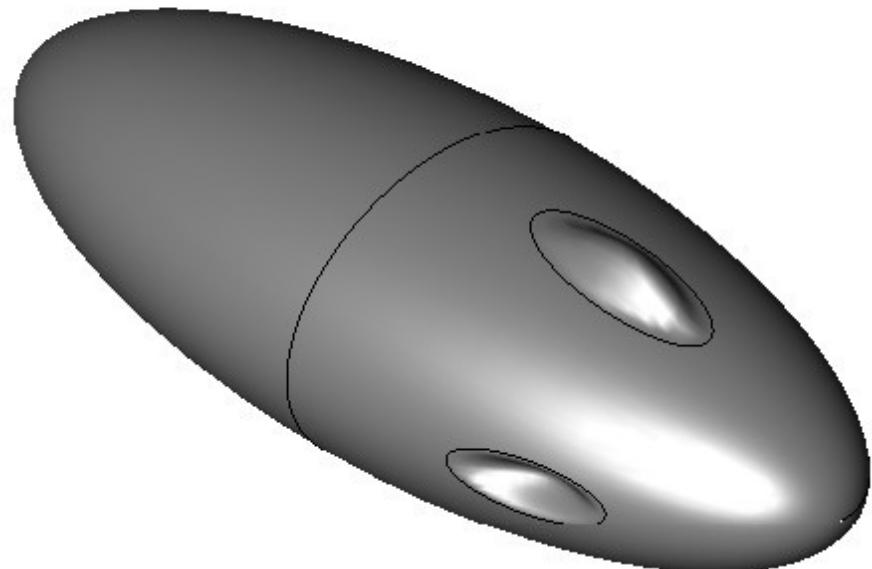
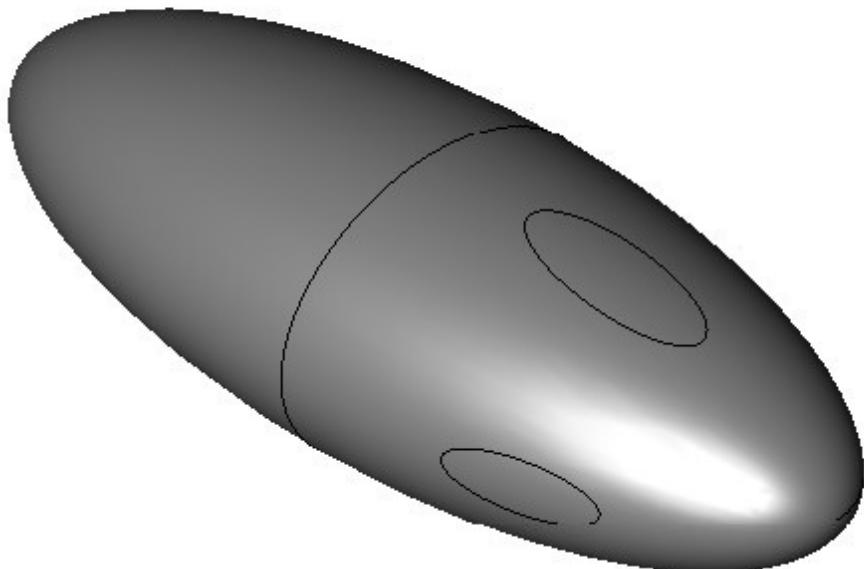


# Operação Local: *Match* (Local Operation)

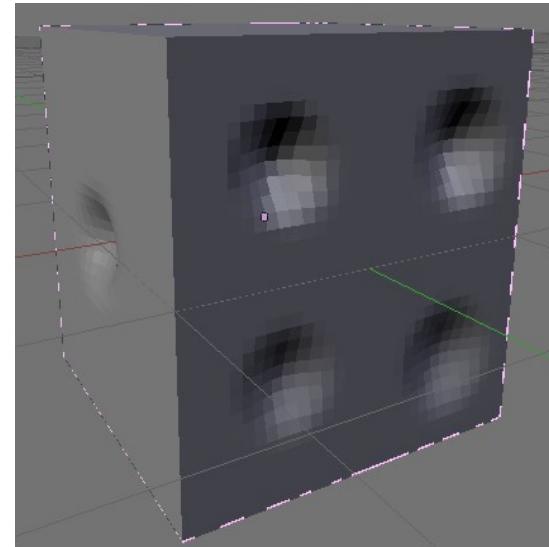
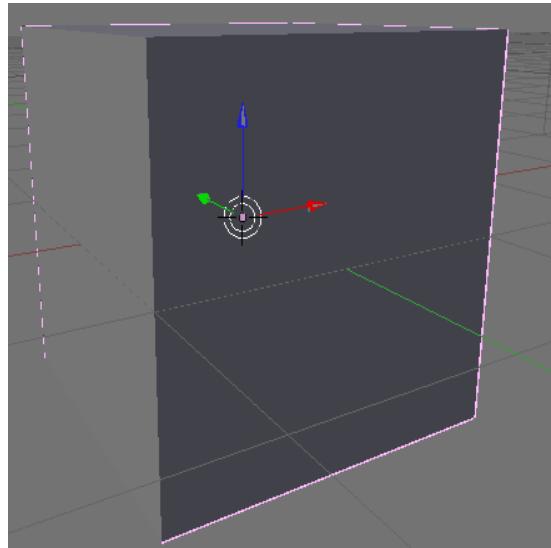


# Operação Local: *Deform by Pressure*

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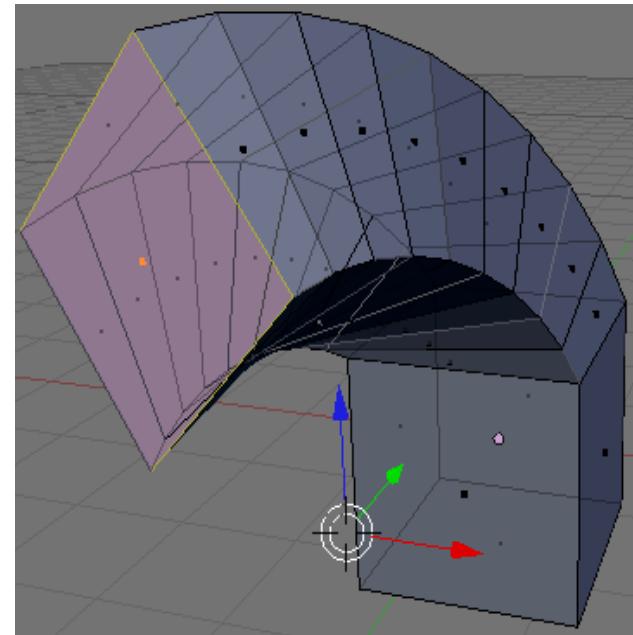
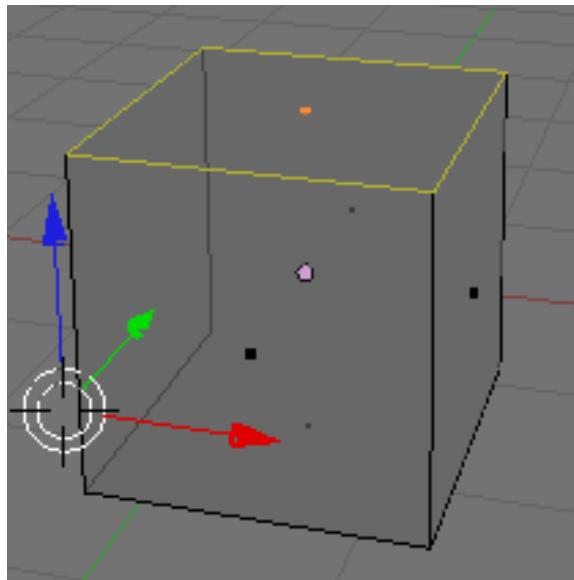


# Operação Local: *Sculpt*



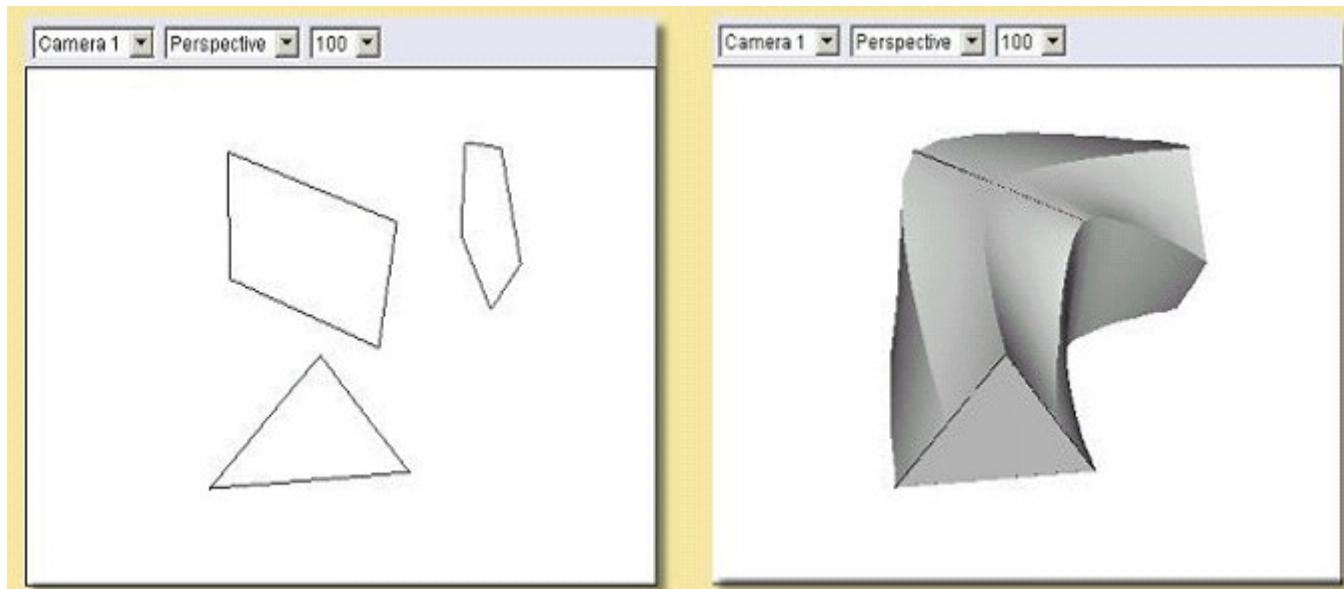
Blender

# Operação Local: *Spin* (Estende a Face)



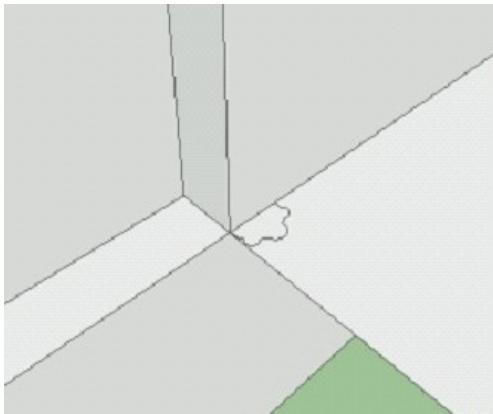
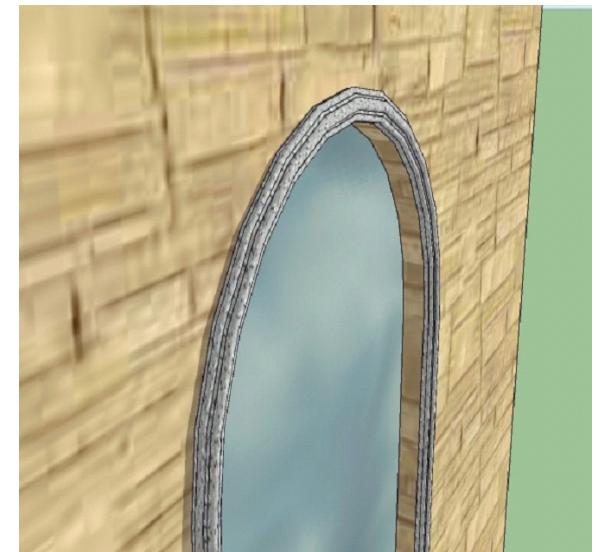
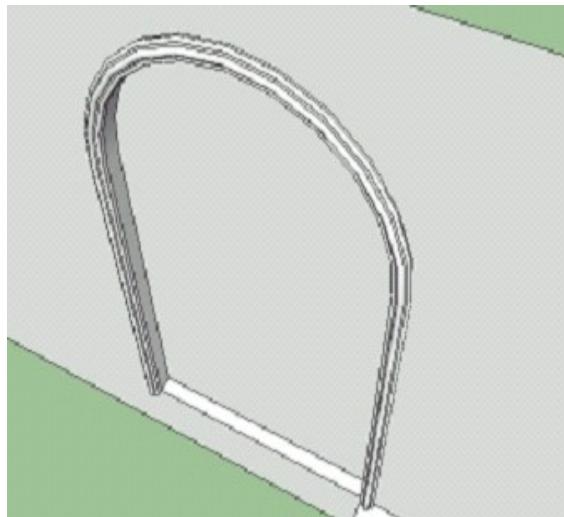
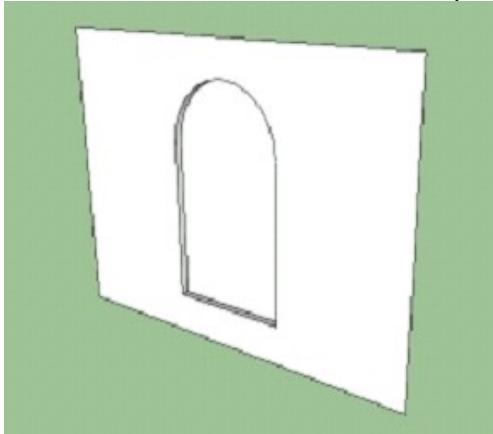
Blender

# Operação Local: *Skin* (Art of Illusion)



# *Follow Me (SketchUp)*

(Diretor é oriundo do modelo)



# Interface

- O objetivo destas metáforas é facilitar o trabalho de **criação** dos objetos
- Por traz de cada uma dessas metáforas de construção de objetos, existem operações de criação **convencionais** em separado ou combinadas.....