Boolean Operations
(on Polygons)

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Concepts

• Boolean operations produce new geometry from two models, A and B, by:
  • Adding A and B together to form one
    • This is also called Union
  • Subtracting B from A
    • Also sometimes called Difference
  • Intersecting A and B to find the volume shared by both

• (The name Boolean comes from a British logician, John Boole
  • who first developed the logic on which the operations are based)

• True Boolean operations work only on polygonal models
  • This is because the resulting model usually is topologically irregular
  • Therefore, the result may not be represented by a UV grid of points,
    • as is required by a NURBS patch
      • (See the Intro to NURBS Patches tutorial in this set)

• Maya offers a “NURBS Boolean” operation
  • This is actually a series of “trim” operations
    • (See the Trimmed Surfaces tutorial in this set)

• Here we examine true Booleans on polygons
Set Up

- >Create >Polygon Primitives >Cube
  - Scale it 4,4,4
- >Create >Polygon Primitives >Sphere
  - Scale it 2,2,2
- Make sure you use polygons for both objects

- Move the sphere so that it is centered on one corner of the cube
- To see the forms better, in Persp window:
  - >Shading >Smooth Shade All
  - >Shading >Shade Options >Wireframe on Shaded

- >Windows >Hypergraph: Hierarchy

- Go to the Polygons module

Union (Addition)

- Select the cube as object A
- Shift-select the sphere as object B
  - (For a Union operation, the order of selection doesn’t matter)

- >Mesh >Booleans >Union
  - Adds the two objects together

- In the Hypergraph window…
- The original objects automatically become hidden
  - A new object is created by the Boolean operation
    - called polySurface1

Difference (Subtraction)

- >Edit >Undo
  - to remove the Boolean operation

- Unselect all objects
- Select the cube as object A
- Shift-select the sphere as object B
  - CAREFUL: the order in which you select the objects is important for Difference
• >Mesh >Booleans >Difference
  • Subtracts B from A
  • Making a scoop in the corner of the cube

• Undo
• Redo the Difference operation,
  • But reverse the order of selection – sphere first, cube second

**Intersection**

• >Edit >Undo
  • to remove the Boolean operation
• Select the cube as object A
• Shift-select the sphere as object B
  • (Order of selection not important here)

• >Mesh >Booleans >Intersection
  • Gives the volume shared by both objects

**Construction History**

• As long as construction history remains active,
  • the Boolean operation can be recalculated in real time
    • you can change the operation
    • or move one of the original objects

• Select the new object created by your Boolean
  • It will be called _polySurface1_
  • In the Channel Box, click on the _Input_ node
    • It will be called something like _polyBoolOp1_
    • Next to _Operation_, change the Boolean operation
      • – e.g., from Intersection to Union or Difference

• Select either your original A or your original B object
  • You need to do this in either the Hypergraph or Outliner windows
    • because the two original forms are hidden
  • Transform the A or B object with Move, Rotate or Scale
    • The Boolean operation updates in real-time
• To make your Boolean operation permanent,
  • and independent of the original models,
    • you must delete the construction history
• Select the Boolean result
• >Delete >Delete by Type >History
  • Notice in the Outliner that the two original objects are deleted