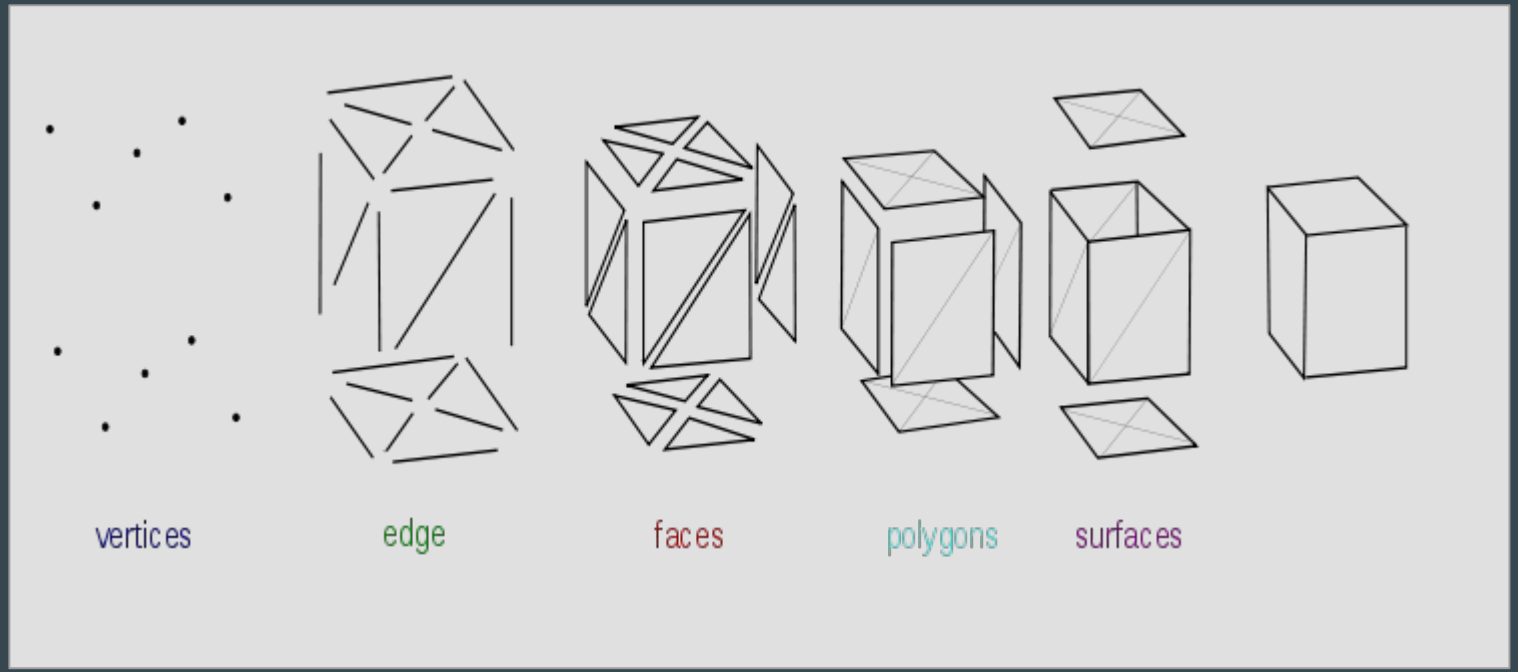
3D modeling

•••

Rhinoceros

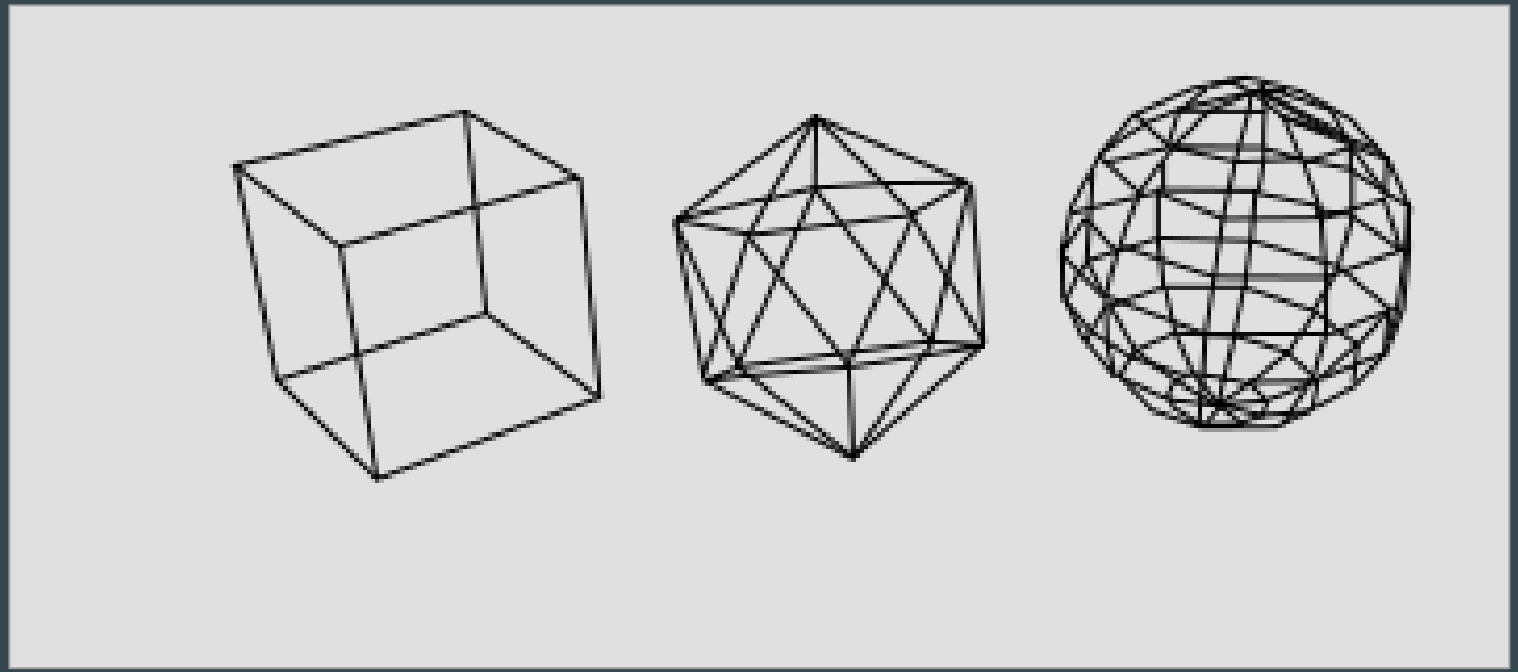
3D Modeling - Rhinoceros

Mesh



3D Modeling - Rhinoceros

Wireframe

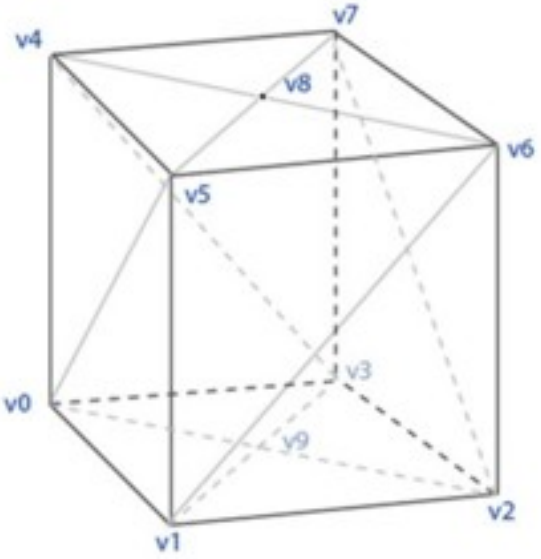


3D Modeling - Rhinoceros

Mesh

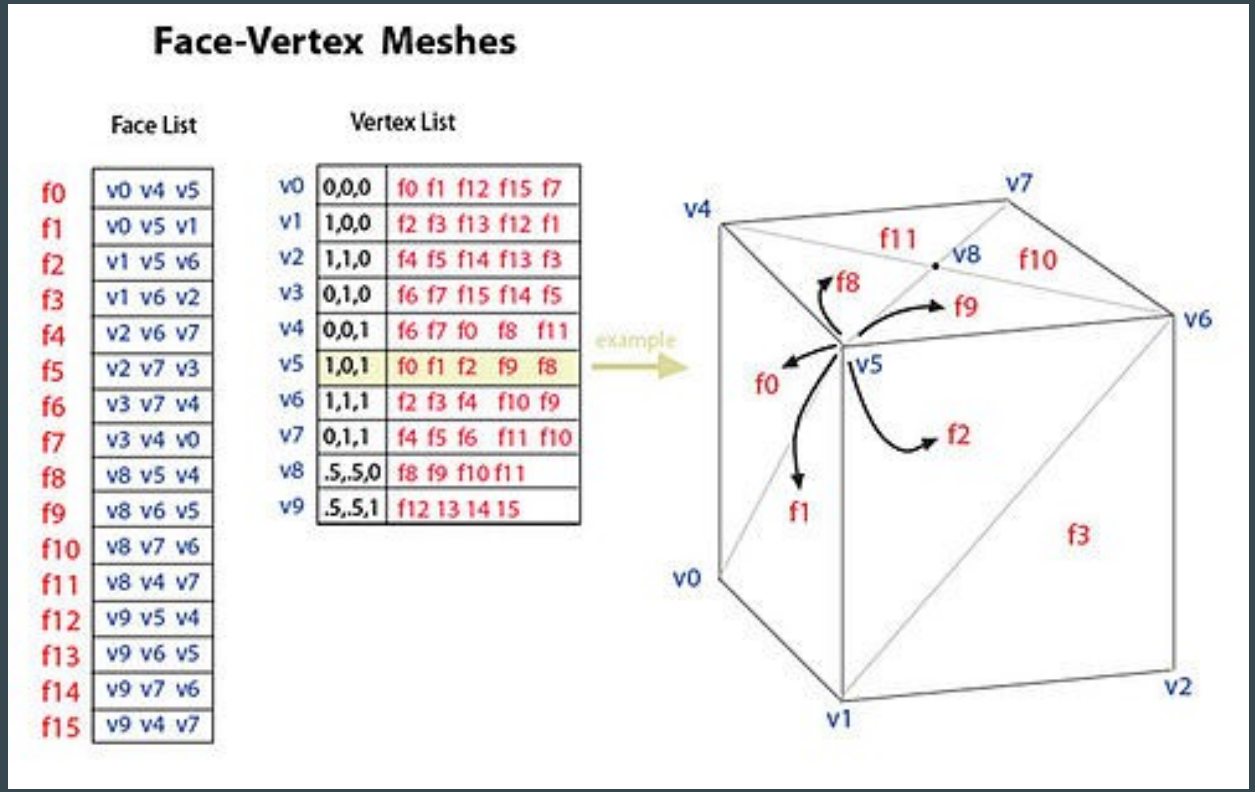
Vertex-Vertex Meshes (VV)

	Vertex List	
v0	0,0,0	v1 v5 v4 v3 v9
v1	1,0,0	v2 v6 v5 v0 v9
v2	1,1,0	v3 v7 v6 v1 v9
v3	0,1,0	v2 v6 v7 v4 v9
v4	0,0,1	v5 v0 v3 v7 v8
v5	1,0,1	v6 v1 v0 v4 v8
v6	1,1,1	v7 v2 v1 v5 v8
v7	0,1,1	v4 v3 v2 v6 v8
v8	.5,.5,1	v4 v5 v6 v7
v9	.5,.5,0	v0 v1 v2 v3



3D Modeling - Rhinoceros

Mesh

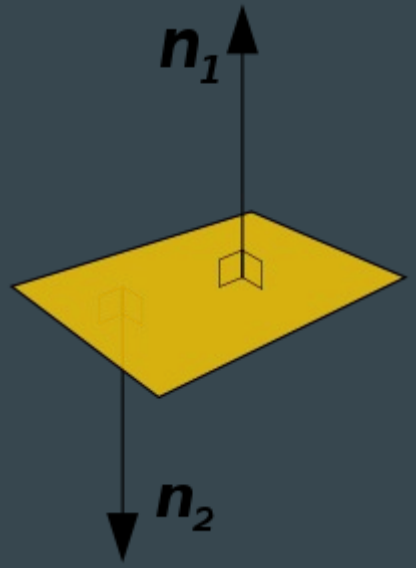


3D Modeling - Rhinoceros

Mesh

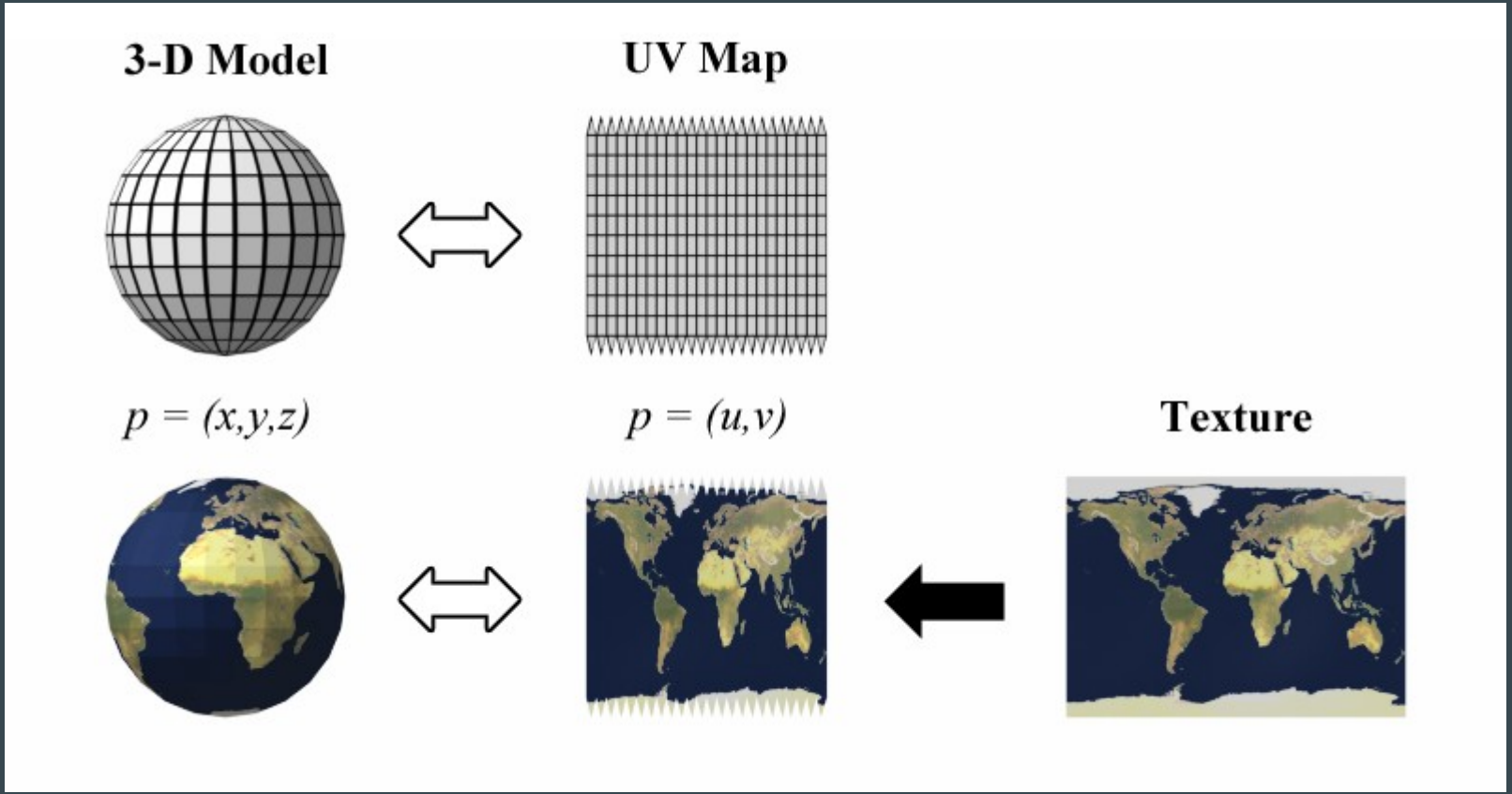
In 3D a surface normal, or simply normal, to a surface at a point P is a vector that is perpendicular to the tangent plane to that surface at P. The word "normal" is also used as an adjective: a line normal to a plane, the normal component of a force, the normal vector, etc. The concept of normality generalizes to orthogonality.

The normal is often used in computer graphics to determine a surface's orientation toward a light source for flat shading, or the orientation of each of the corners (vertices) to mimic a curved surface with Phong shading.The normal is often used in computer graphics to determine a surface's orientation toward a light source for flat shading, or the orientation of each of the corners (vertices) to mimic a curved surface with Phong shading.



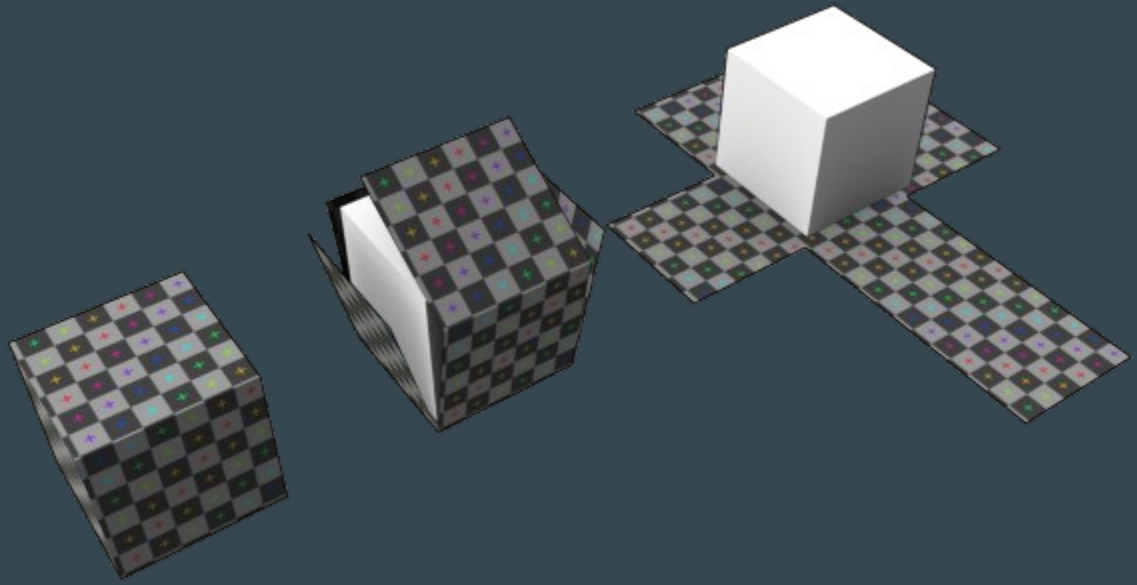
3D Modeling - Rhinoceros

Mesh

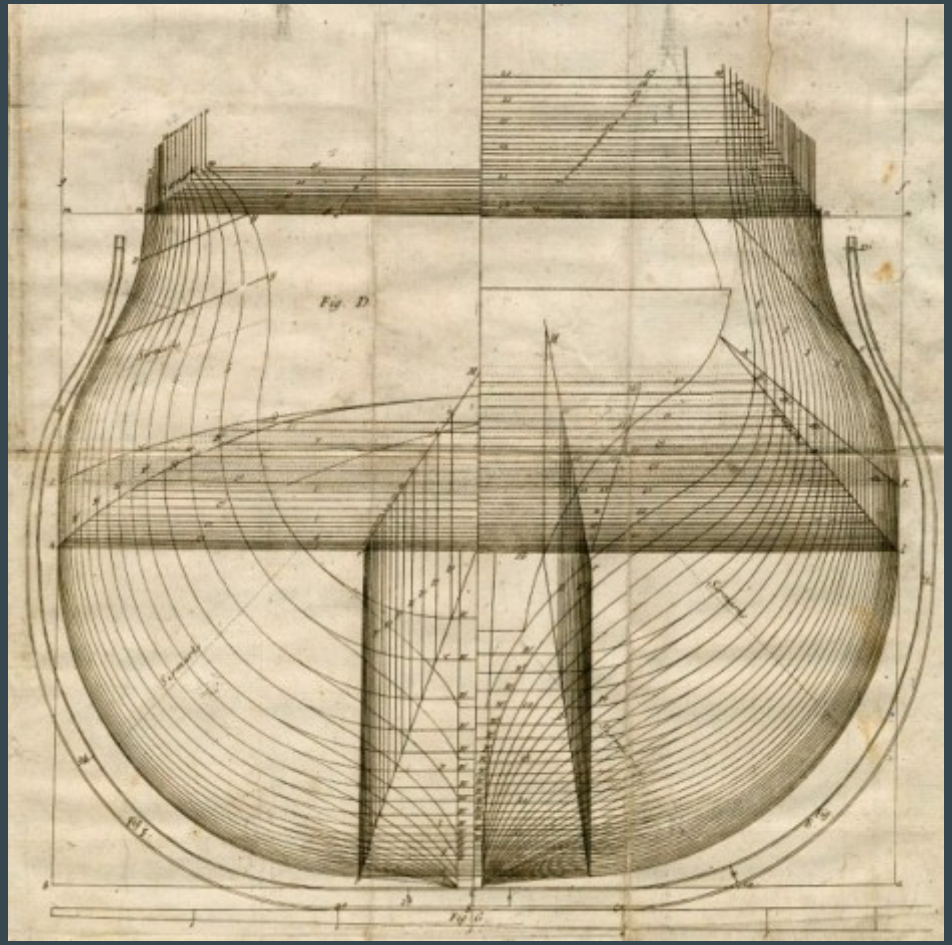


3D Modeling - Rhinoceros

Mesh

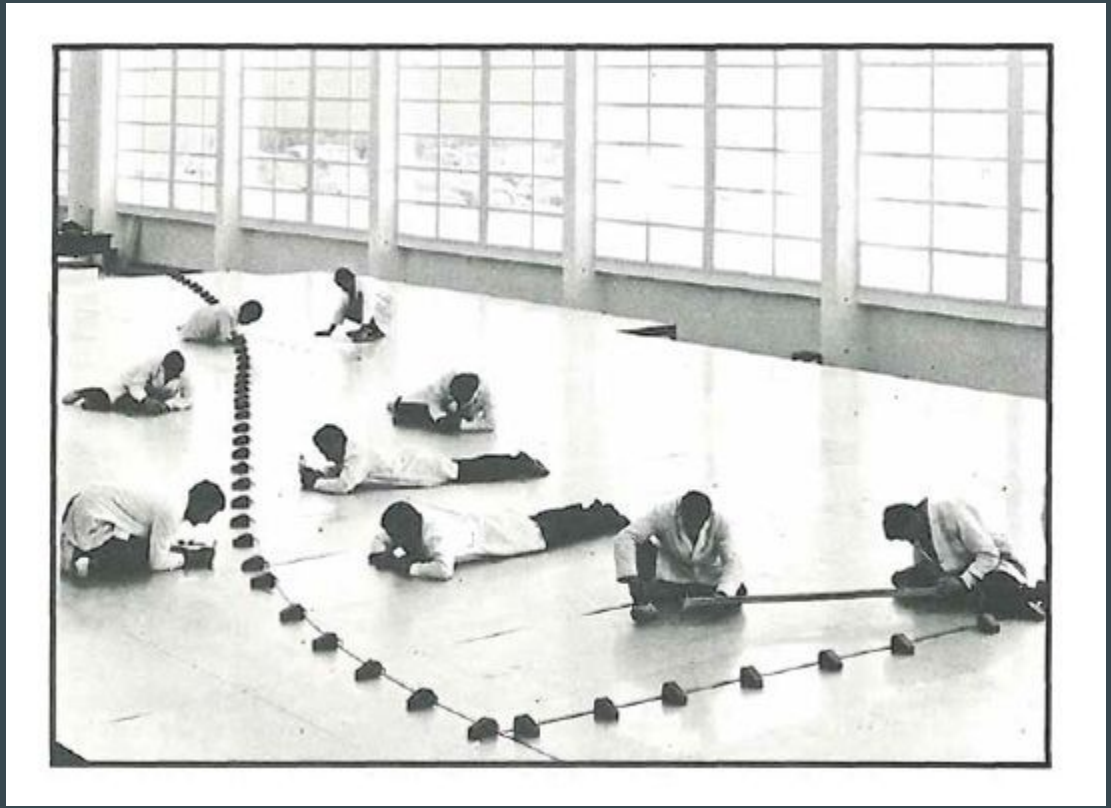


3D Modeling - Rhinoceros



Splines

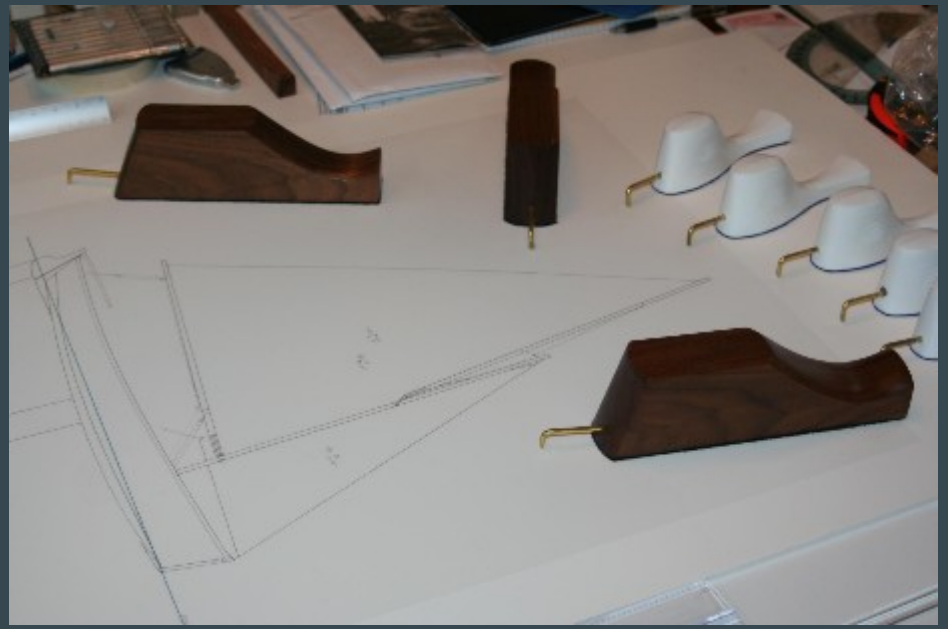
3D Modeling - Rhinoceros



Splines

3D Modeling - Rhinoceros

Splines



3D Modeling - Rhinoceros

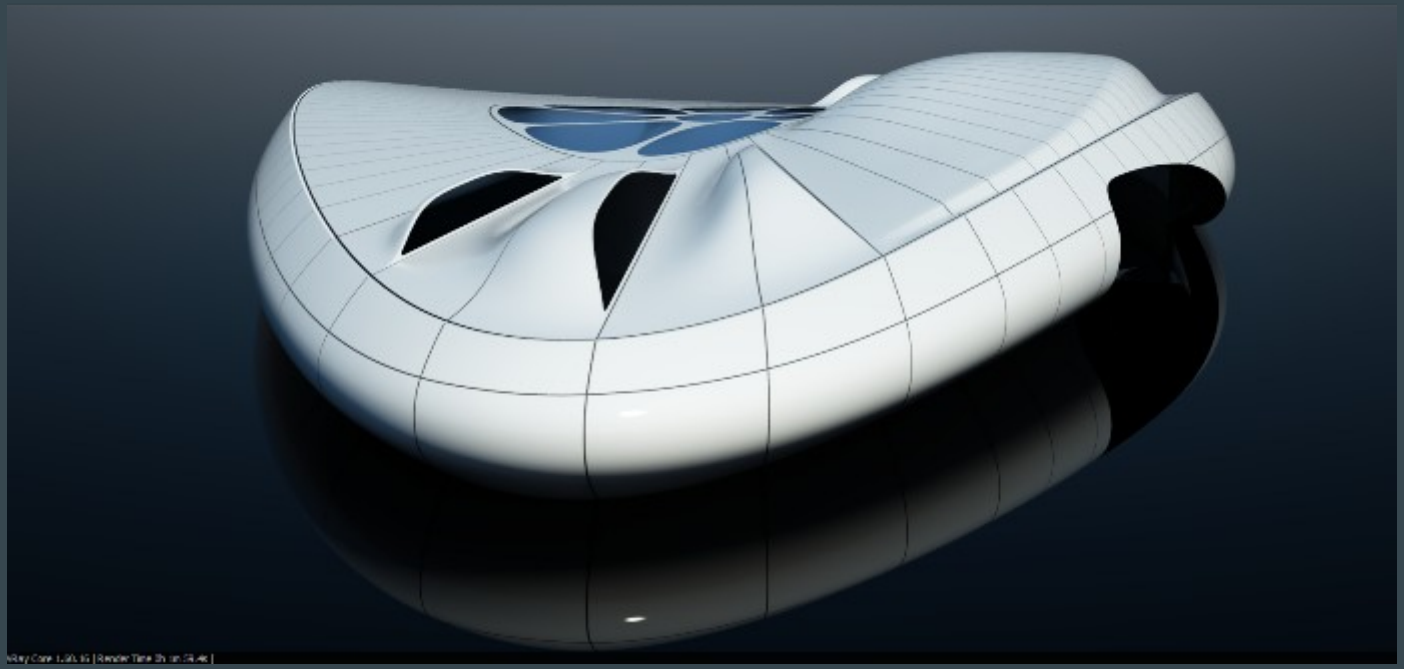
NURBS: Non-Uniform Rational B-Splines

“What makes NURBS curves and surfaces particularly appealing is their ability to easily control their shape by interactively manipulating the *control points*, *weights* and *knots*.

NURBS make the heterogeneous, yet coherent,forms of the digital architectures computationally possible and their construction attainable by means of computer numerically controlled (CNC) machinery.

3D Modeling - Rhinoceros

NURBS: Non-Uniform Rational B-Splines

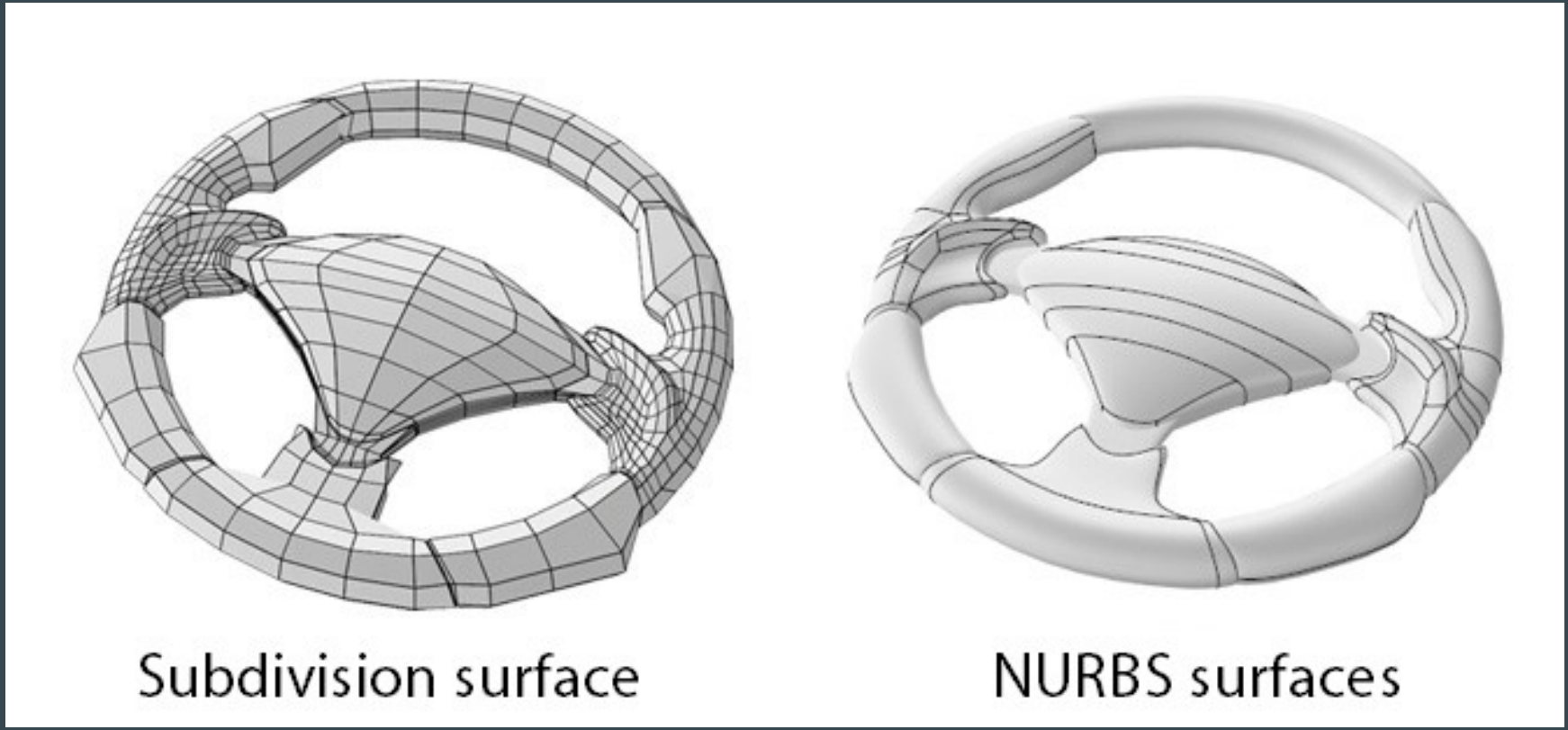


3D Modeling - Rhinoceros

NURBS: Non-Uniform Rational B-Splines

3D Modeling - Rhinoceros

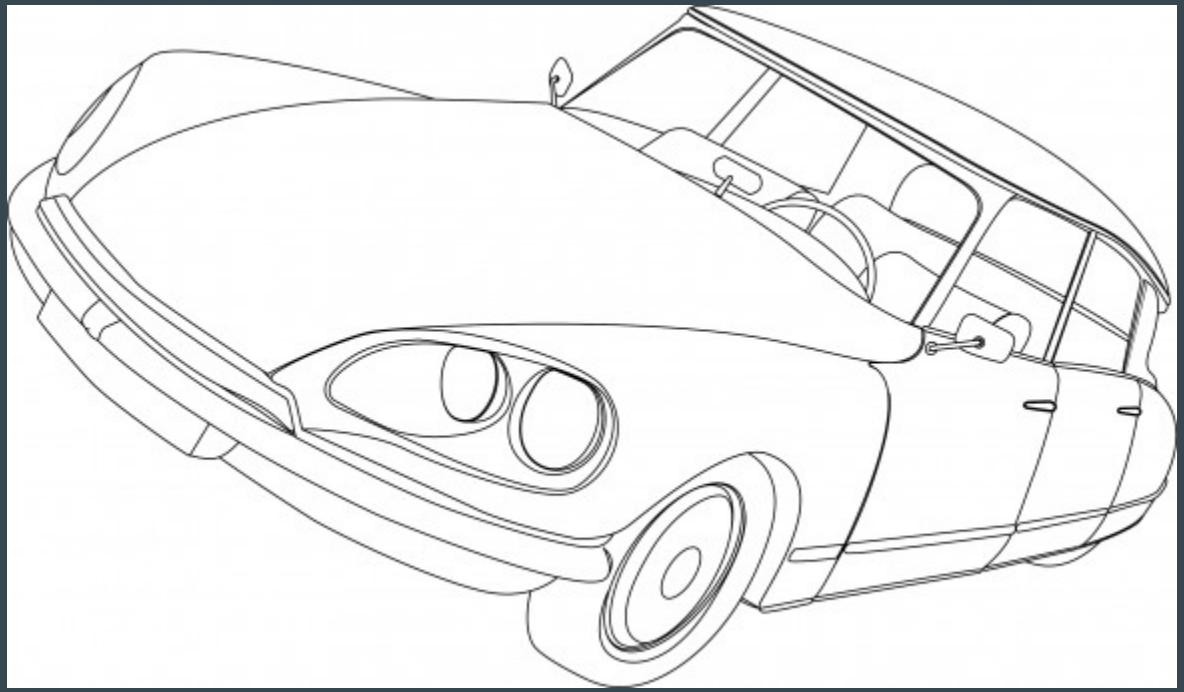
NURBS: Non-Uniform Rational B-Splines



3D Modeling - Rhinoceros

“From a computational point of view, NURBS provide for an efficient data representation of geometric forms, using a minimum amount of data and relatively few steps for shape computation, which is why most of today’s digital modeling programs rely on NURBS as a computational method for constructing complex surface models and, in some modelers, even solid models.

3D Modeling - Rhinoceros



3D Modeling - Rhinoceros

“By the late 1950′s, Citroën and its competitors had begun adopting – thanks to government support – early analog computers connected to machinery for milling the stamps and dies that repetitively press parts of the bodywork from sheet metal. These early CNC machines required coordinates be input in the form of holes punch along a paper tape to guide the tool’s path and direct the depth of travel as it excavated material.ix Lines, circles, parabolas, and other regular geometrical functions could be accurately inputted from the designer’s blueprints into the machinery, but a reliable method for freeform curves – much less surfaces – did not exist.”

http://www.alatown.com/spline/

3D Modeling - Rhinoceros

“In 1959 Citroën hired Paul de Faget de Casteljau, to find this missing link. Fresh from his PhD studies, the young mathematician was tasked with devising a system of equations, so that shapes could be reliably stored and communicated amongst the designers and engineers, as well as input into the primitive computers that drove the new milling machines. De Casteljau struggled with the problem at first. His epiphany occurred when he realized that, rather than defining a curve by points along its length, it could be accurately plotted and controlled by manipulating a few points around its vicinity. When these points of influence were moved, the curve would follow, similar to the intuitive response of moving the weights that anchored the boatbuilder’s spline..”

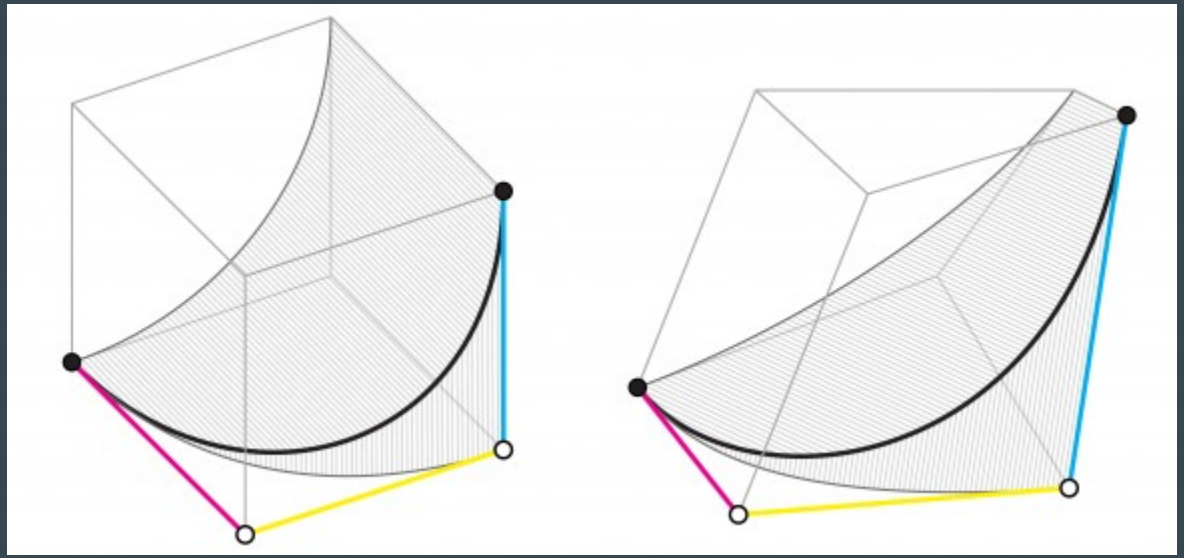
http://www.alatown.com/spline/

3D Modeling - Rhinoceros

“Citroën enforced strict secrecy surrounding de Casteljau’s breakthrough and his findings went unpublished for eight years. It was roughly fifteen years before he was personally credited with his discovery. However, confidentiality did not prevent his counterpart at Citroën’s direct competitor, Renault, from learning of his achievement, albeit not the secret algorithm itself. That man would go on to independently recreate de Casteljau’s achievement, and in doing so, make his own name synonymous with the curve in its computational form. Renault’s Head of Design at the time was an engineer named Pierre Bézier.”

http://www.alatown.com/spline/

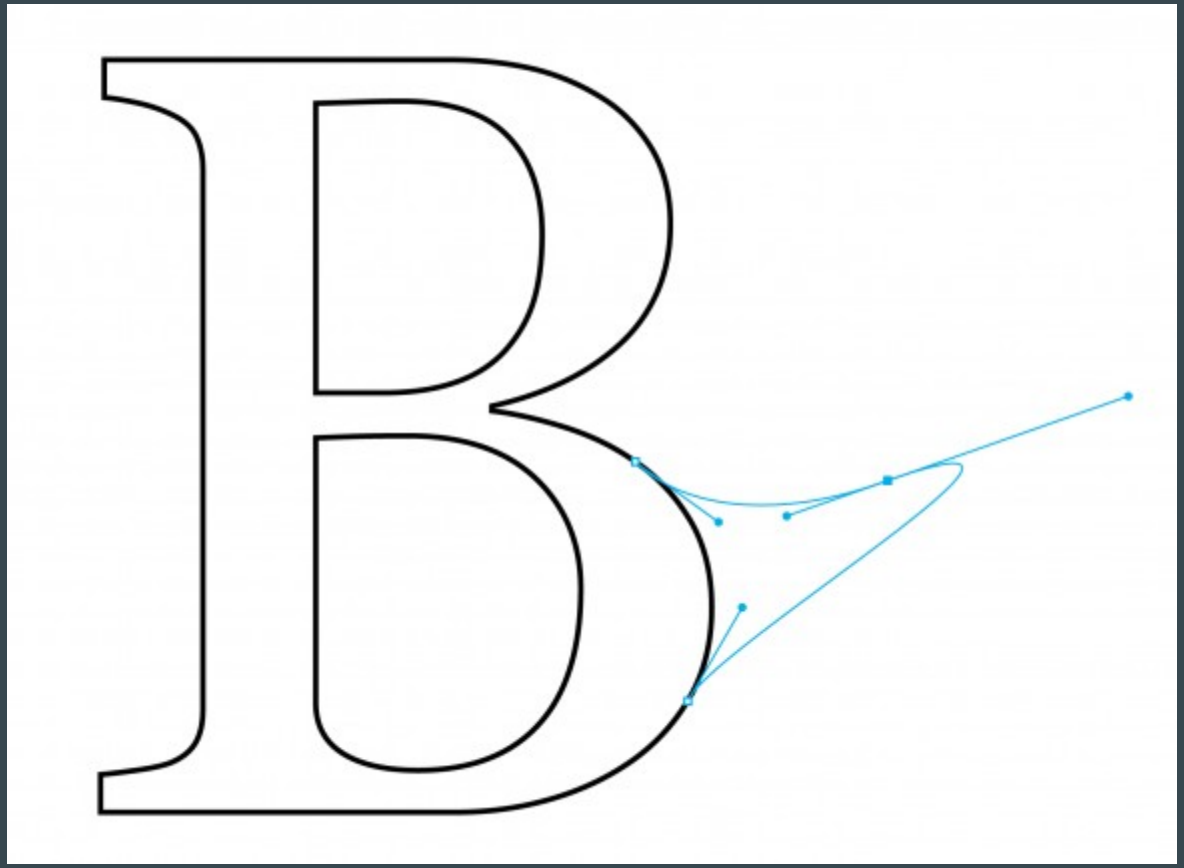
3D Modeling - Rhinoceros



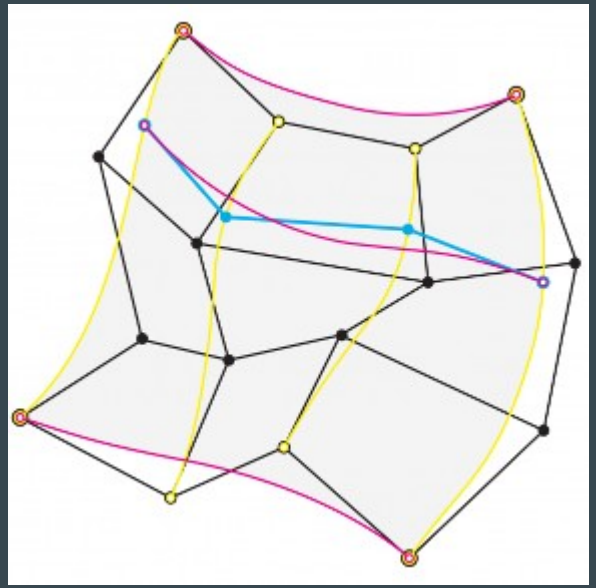
“Bézier’s technique conceived of the curve generated by two intersecting cylindrical surfaces (hatched areas. Parts of the cylinder outside the cube have omitted for clarity). These geometries could be mathematically defined by encompassing them within a cube (left). By mathematically transforming the cube, the curve inside is also reshaped (right). In practice, three vectors (pink, blue, yellow) between four vertices were only necessary for this construct.”

http://www.alatown.com/spline/

3D Modeling - Rhinoceros



3D Modeling - Rhinoceros



“Bézier combined polynomial curves to create fully three-dimensionally curved surfaces. Taking a grid of points (black), he established a set of curves in one direction (yellow). Points (blue) at equal proportions along these rails form curves traveling in the opposite direction (pink). Recursively sweeping across the rails at every proportional distance defines a surface. The underlying “net” of points can be easily and intuitively manipulated to shape the resultant surface.”

http://www.alatown.com/spline/

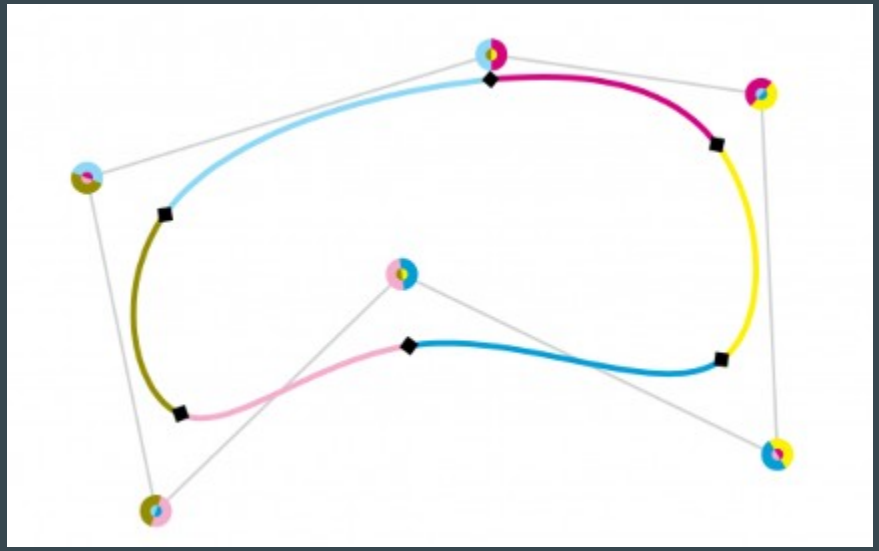
3D Modeling - Rhinoceros

B-SPlines

“GM’s predicament at the time was similar to that of the French automakers. By 1959 the company had acquired numerically controlled milling machines, but lacked a mathematical language to input the complex shapes of its streamlined cars, with all their space age tail fins and voluptuous styling. Carl de Boor, a researcher at GM, devised a recursive method for evaluating B-splines, a fairly obscure mathematical function, first conceived in the 1940s (although the mathematical development can be traced back to the nineteenth century), by I. Schoenberg for smoothly – albeit laboriously – plotting graphs of actuarial data.xv At GM, B-Splines’ powerful flexibility and superior control was truly unleashed through the recursive speed of computation.”

http://www.alatown.com/spline/

3D Modeling - Rhinoceros



“Closed cubic B-Spline. The six curve segments are each controlled by four points (the relative area of color in each control point represents to he amount of influence). The fact that each segment between the knots (black diamonds) shares points influenced by other segments blends them into one continuously smooth spline.”

http://www.alatown.com/spline/

3D Modeling - Rhinoceros

B-SPlines

“Like a Bezier curve, the B-spline is controlled by a group of linked control points. The B in B-spline stands for its multiple basis functions. Each defines an overlapping portion along the spline. The overlapping sub-curves are trimmed and tied together at uniform intervals, fittingly called “knots”.(...) Mathematically, the B-spline was later discovered to be a generalization of Casteljau’s algorithm, including it as well as a greater range of geometries. It also implicitly includes the Bezier Curve as a special case”

http://www.alatown.com/spline/

3D Modeling - Rhino

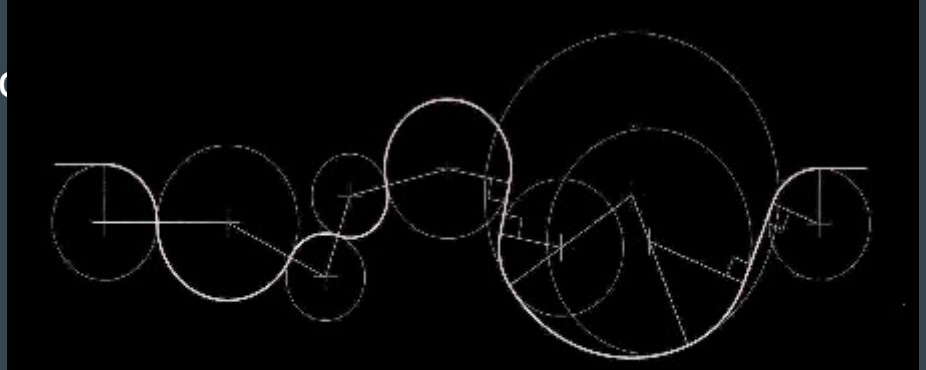


Figure 10:
An example of a composite curve using the same logic of regional definition and tangency as the ellipse described in Figure 5. Each section of the composite curve is defined by a fixed radius. The connection between radial curve segments occurs at points of tangency that are defined by a line connecting the radii. Perpendicular to theses lines, straight line segments can be inserted between the radial curves.

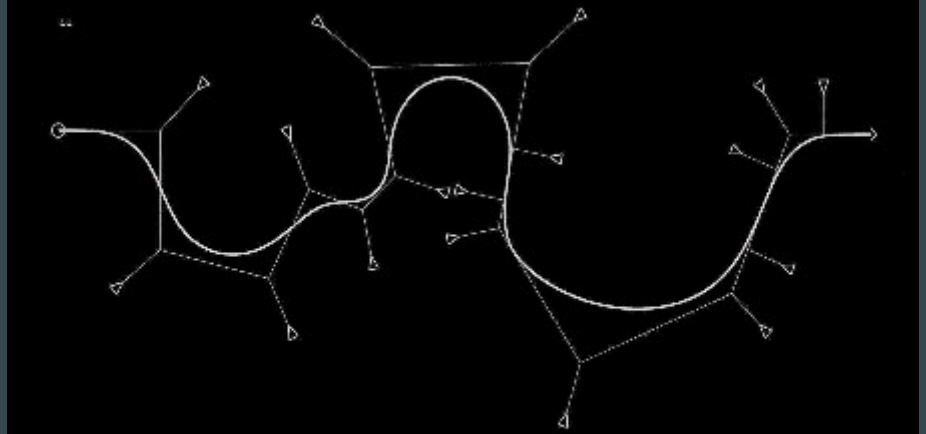
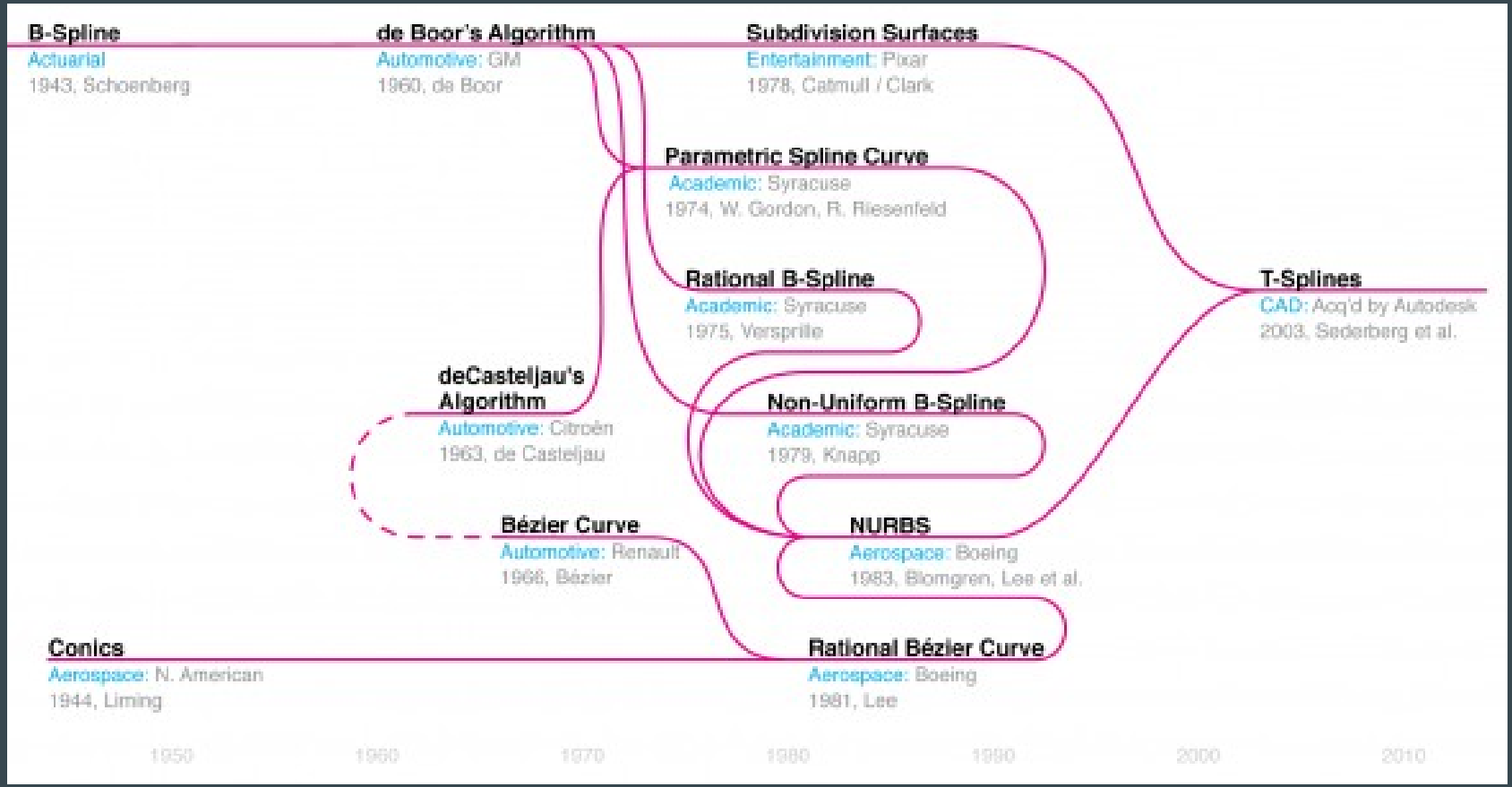


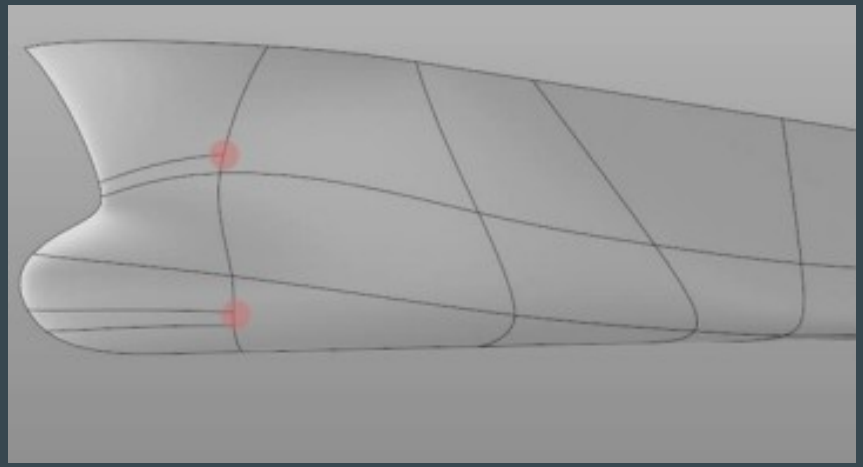
Figure 11:
A similar curve described using spline geometry, in which the radii are replaced by control vertices with weights and tangles through which the curved spline flows.

Greg Lynn

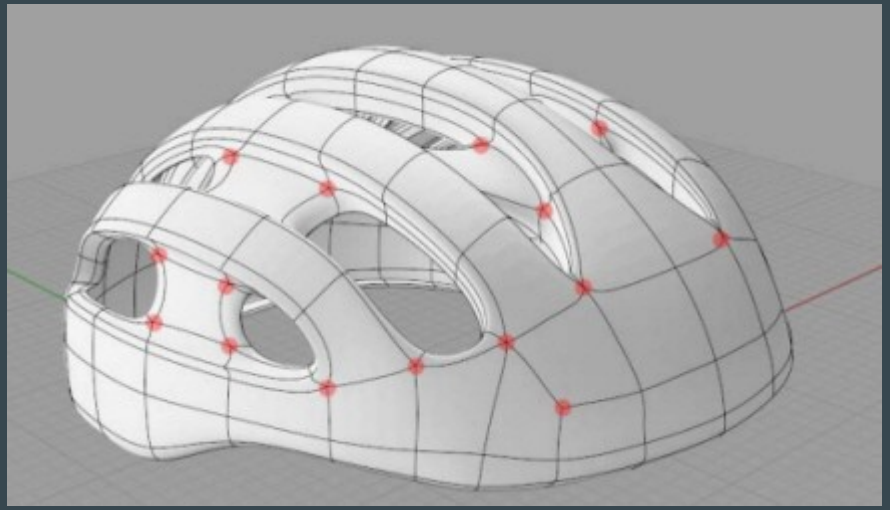
3D Modeling - Rhinoceros



3D Modeling - Rhinoceros

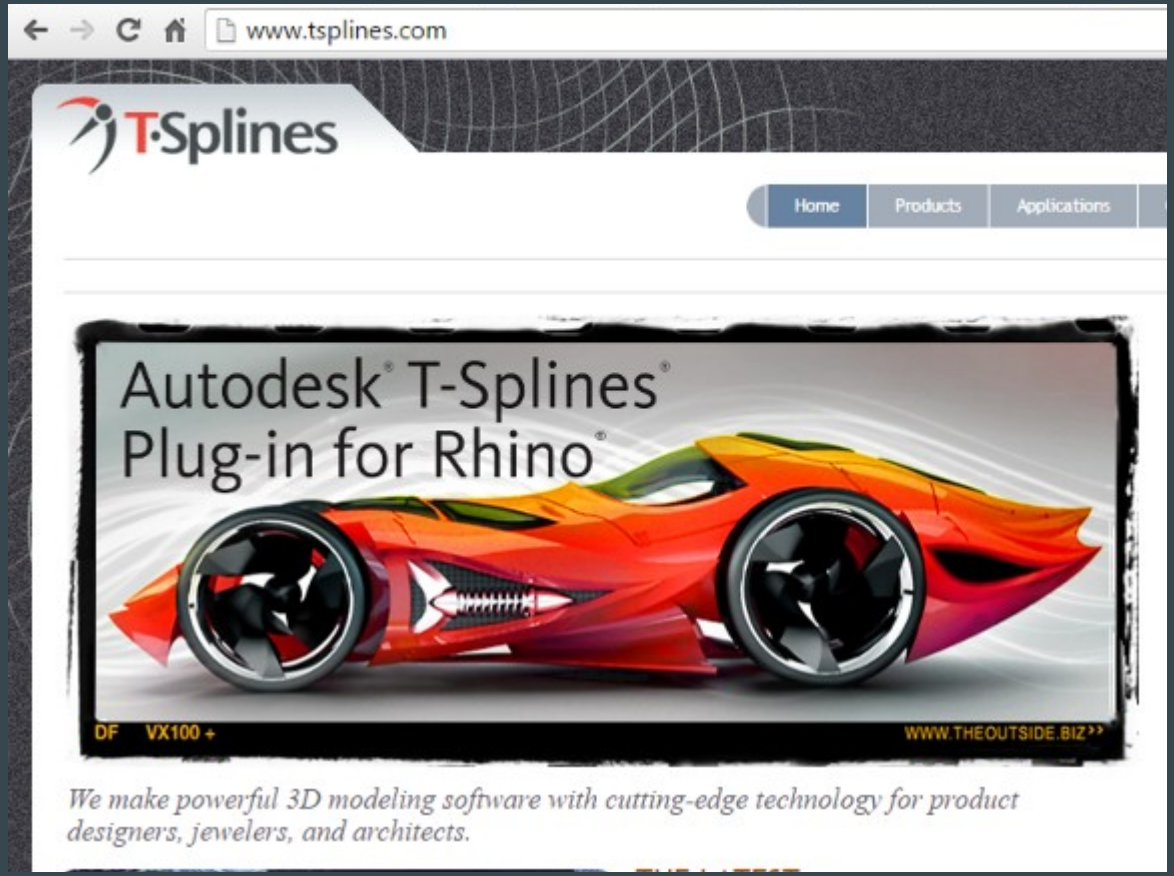


A main difference between T-Splines and NURBS is the existence of T-points. A T-point is a vertex where on one side, there is an isoparm, and on the other side, there isn't. This allows lines of detail to end elegantly. The surface is always smooth (C2) at a T-point. NURBS don't allow T-points

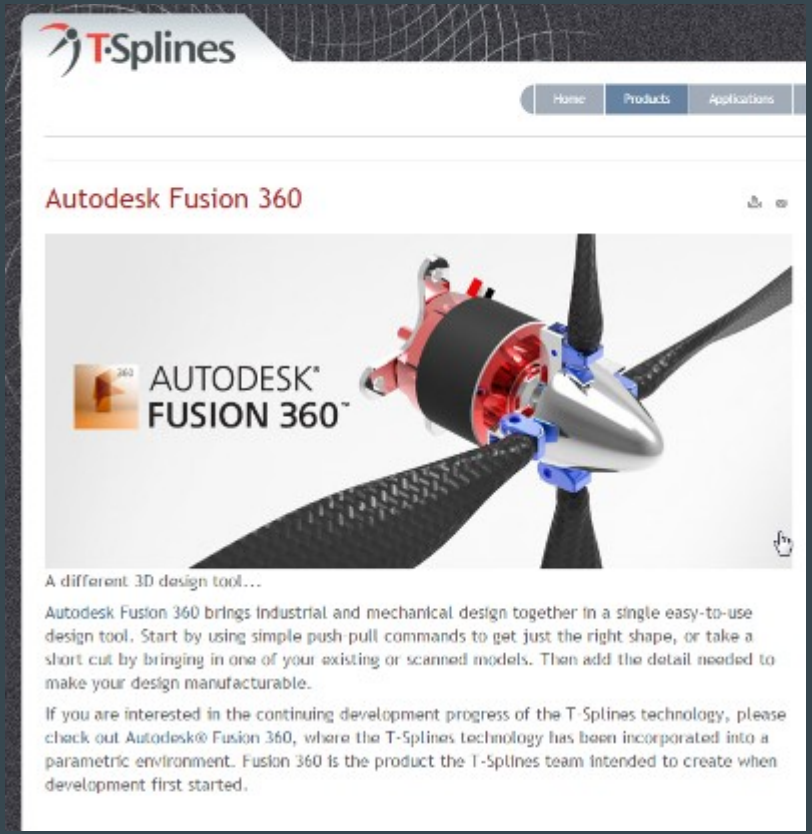


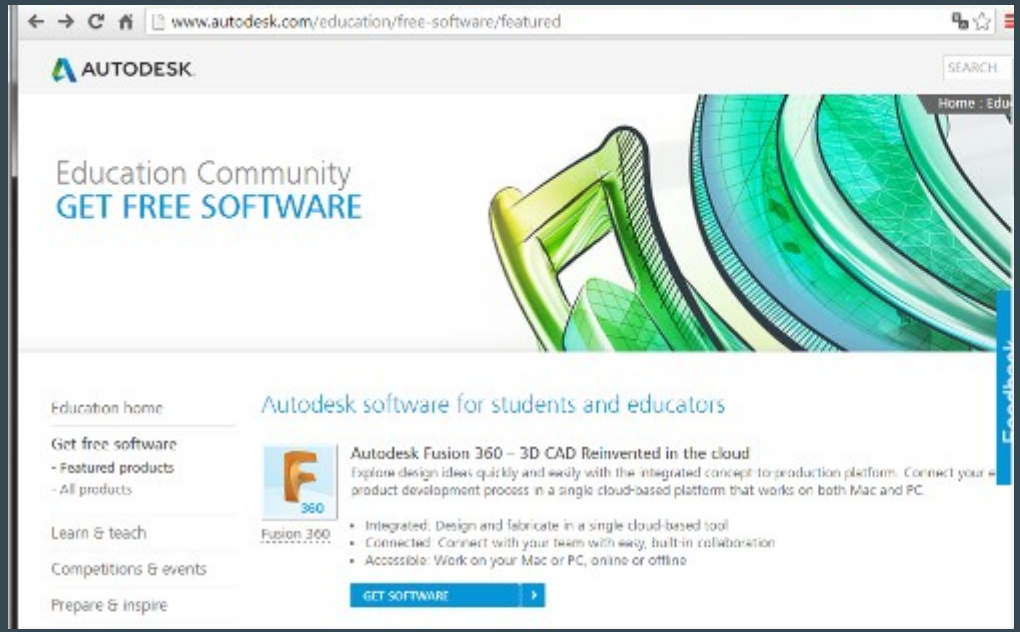
Extrusions, holes, and other unique features are easy to create in a T-Spline surface. This is a second difference between T-Splines and NURBS. NURBS require multiple surfaces, or a polysurface, for such objects. T-Splines can accommodate these features in a single surface, through using a special point called a star point.

3D Modeling - Rhinoceros

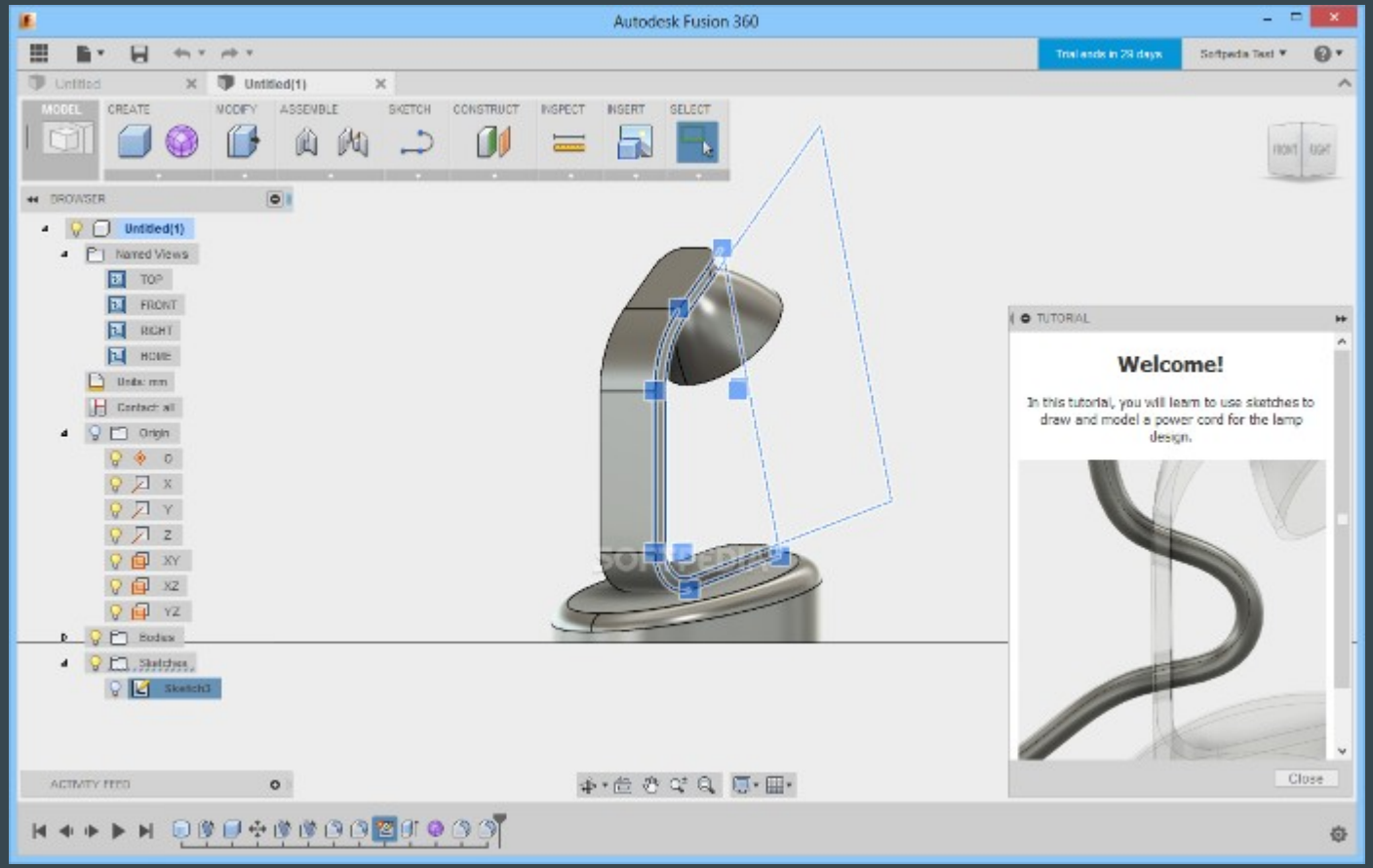


3D Modeling - Rhinoceros





3D Modeling - Rhinoceros

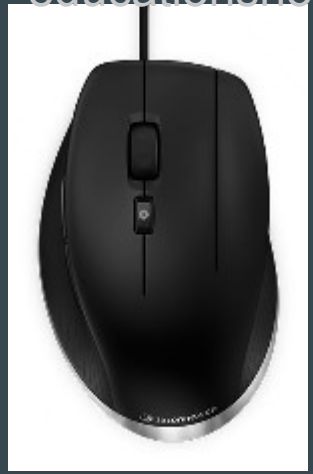


3D Modeling - Rhinoceros

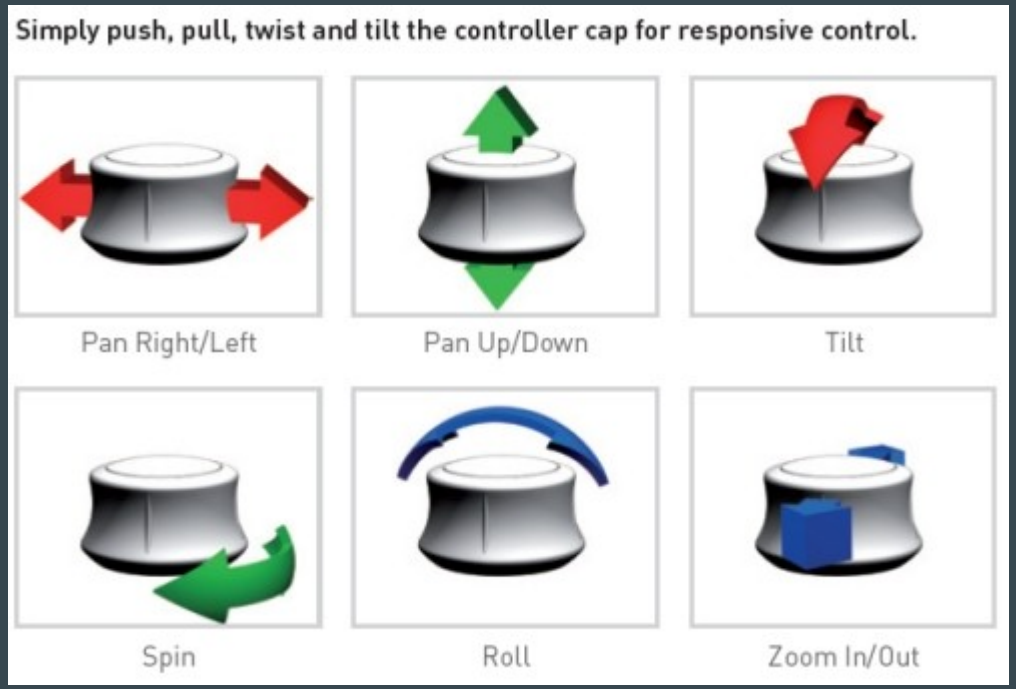
3DConnexion.com: 3D mouse, Cad Mouse (3 button+wheel)

Education shop site (special prices for students)

https://www.3dconnexion.es/buy/educationshop.html



3D Modeling - Rhinoceros



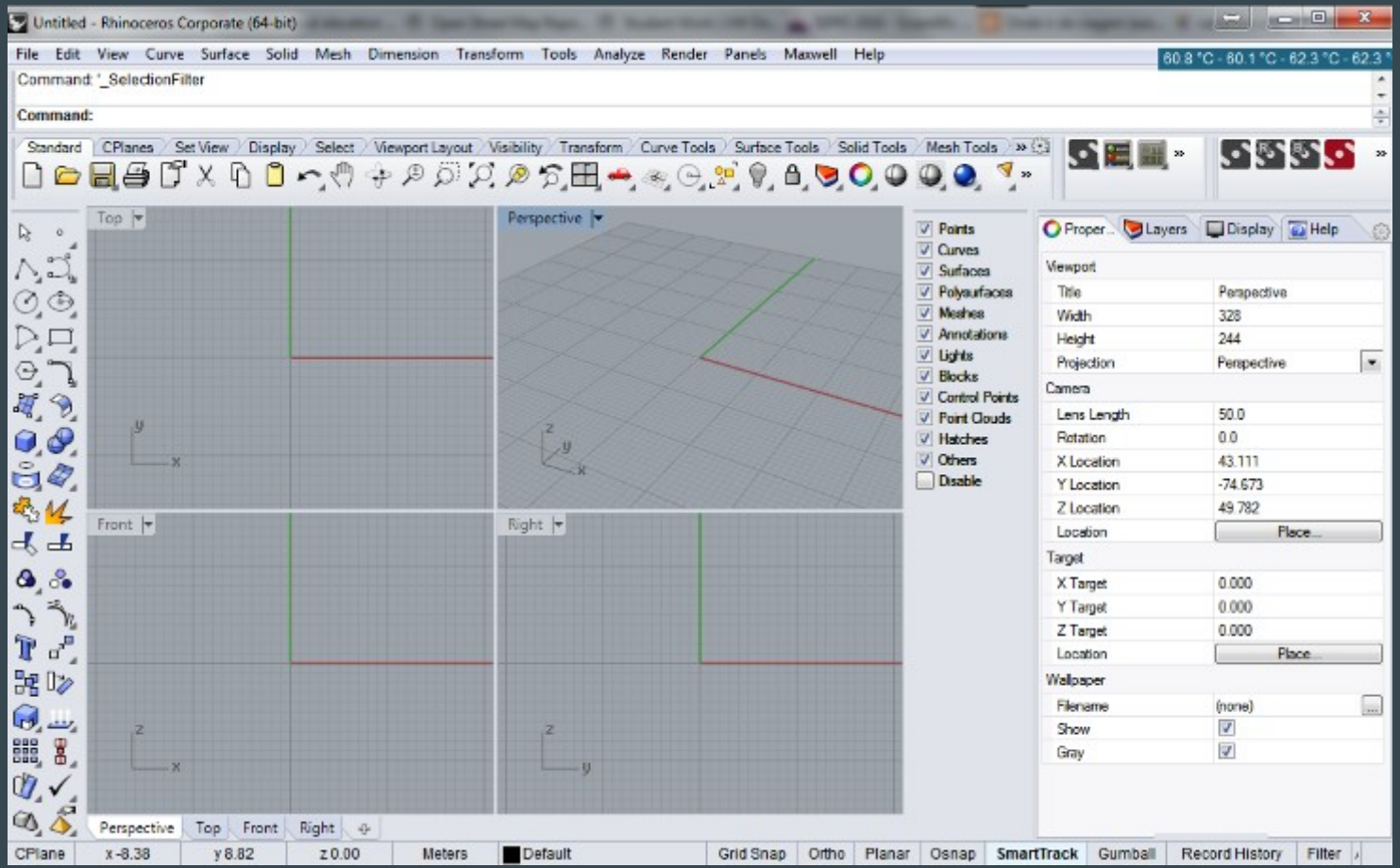
How the 3D mouse works (web page)

SpaceNavigator video

Space Mouse Demo video (see 1:33m)

3D Modeling - Rhinoceros

3D Modeling - Rhinoceros



3D Modeling - Rhinoceros

ALT - temporarily enable/disable Osnap (while selecting points)

Osnap / Smart track

Osnap>along line / along parallel /between: two points define line direction and then click to place point (press CTRL when passing with the mouse over osnap options)

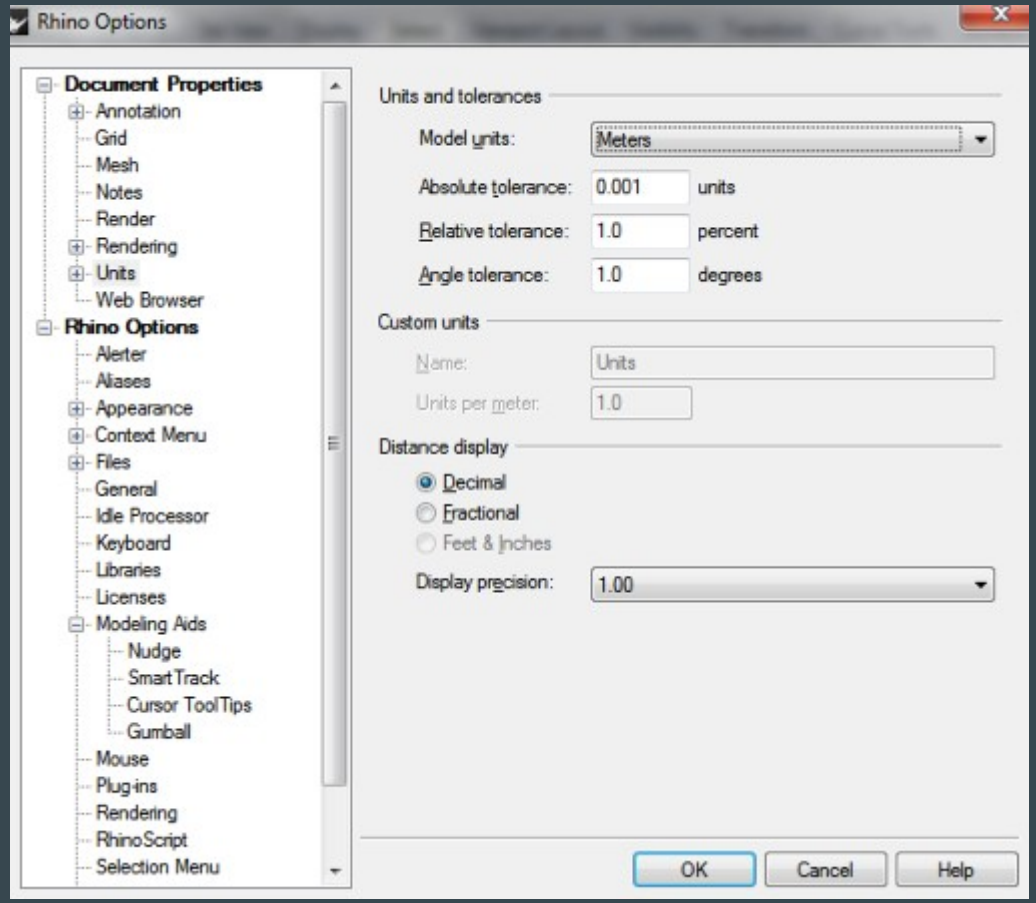
Select>Brush strokes (Selbrush) - selecting by painting

Selection filter: Edit>selection filter (choose the modes you want active)

Relative coordinates: Cartesian: @10,5,8 or r10,5,8 - Polar: @10<45 or r10<45

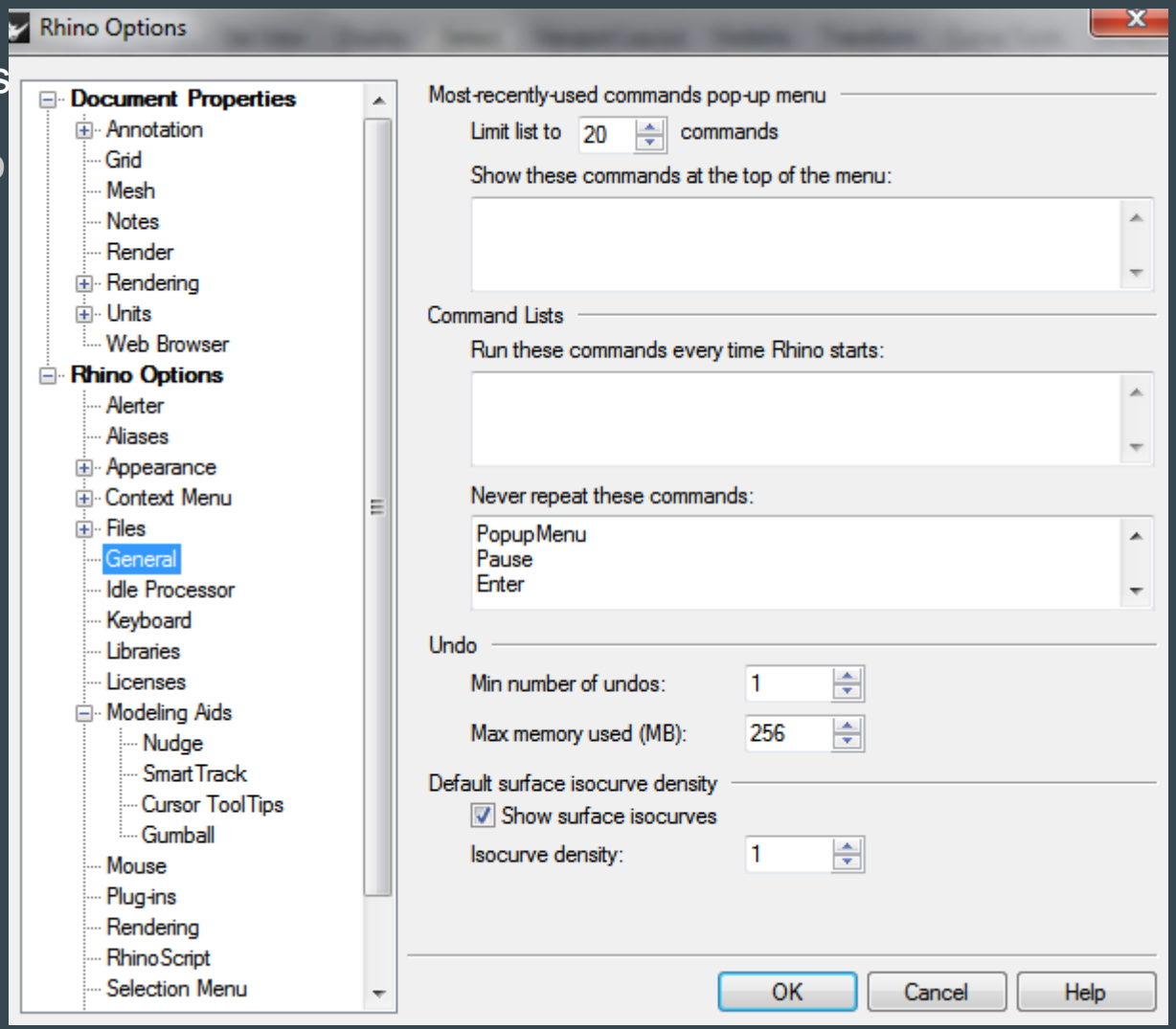
3D Modeling - Rhinoceros

>Options>Units



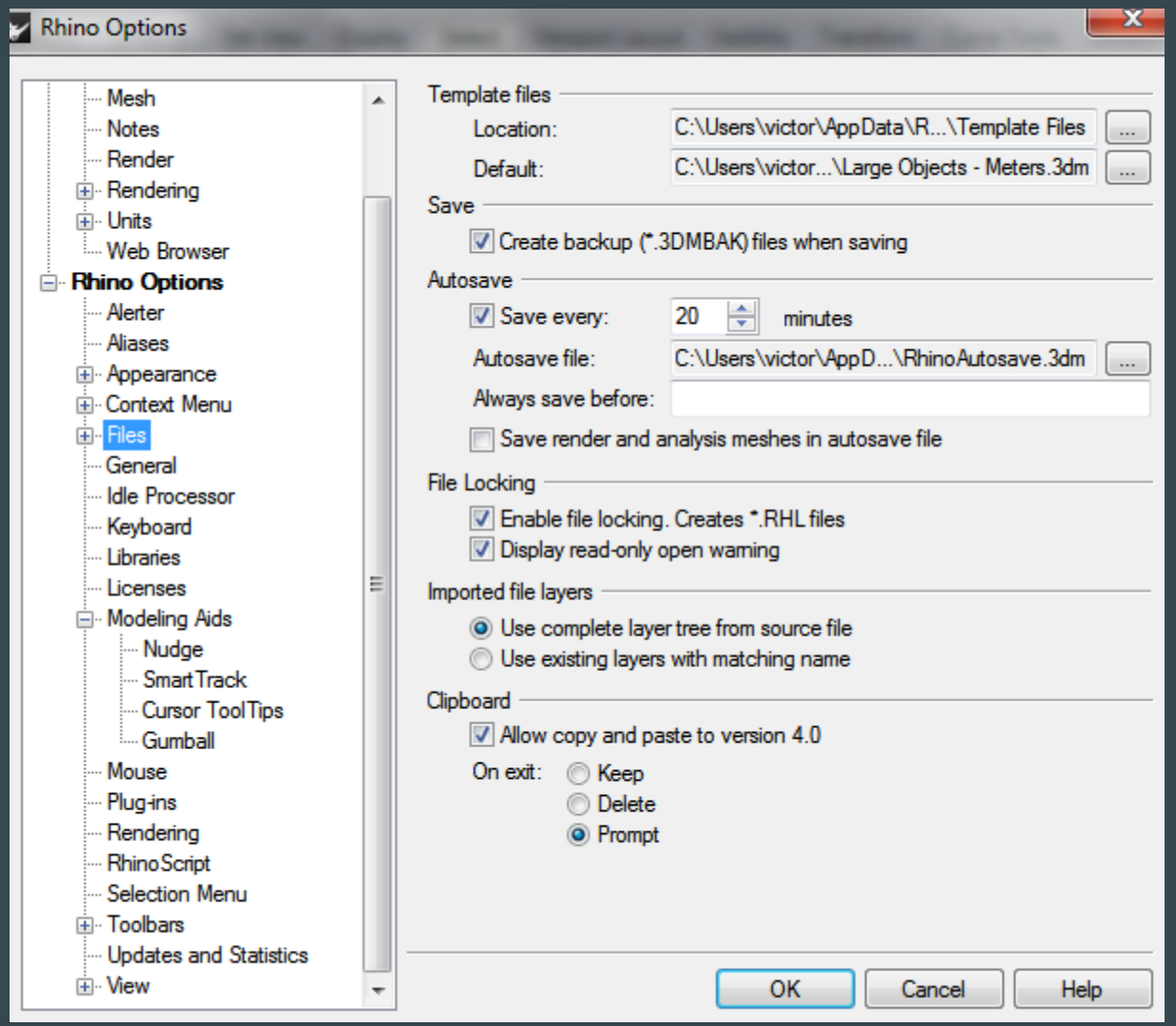
3D Modeling - Rhinoceros

>Options>General>Undo



3D Modeling - Rhinoceros

>Options>Files>



3D Modeling - Rhinoceros

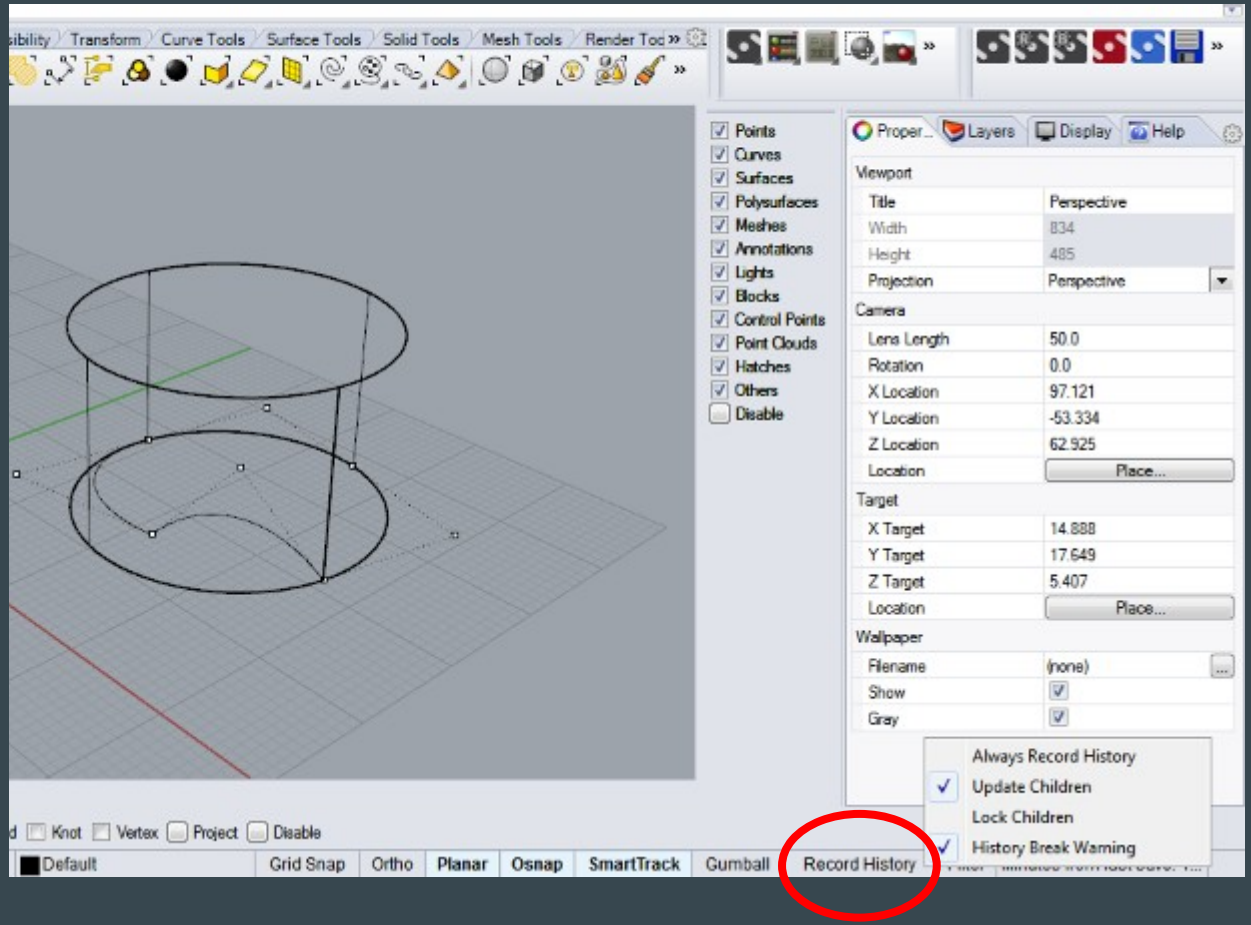
>Status bar>RecordHistory>

Always Record

Update Children

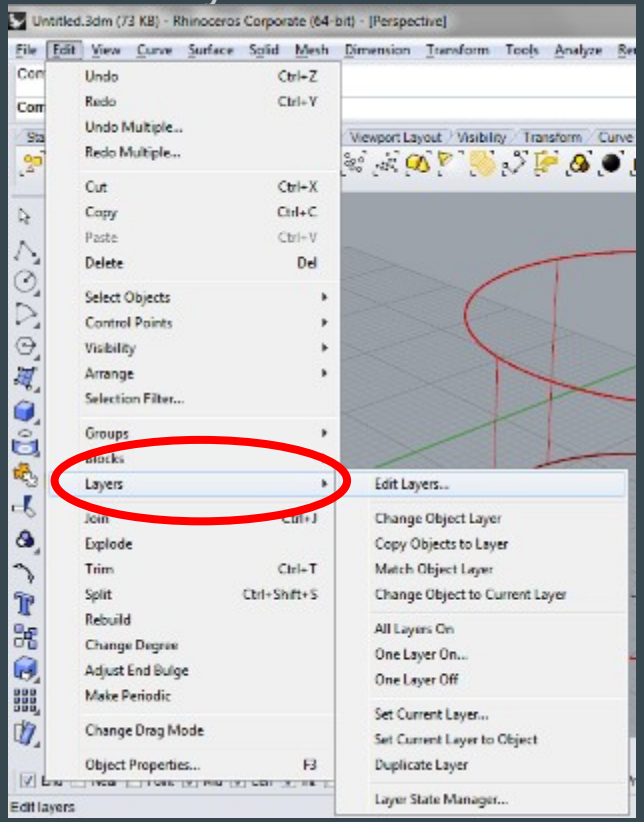
History Break Warning

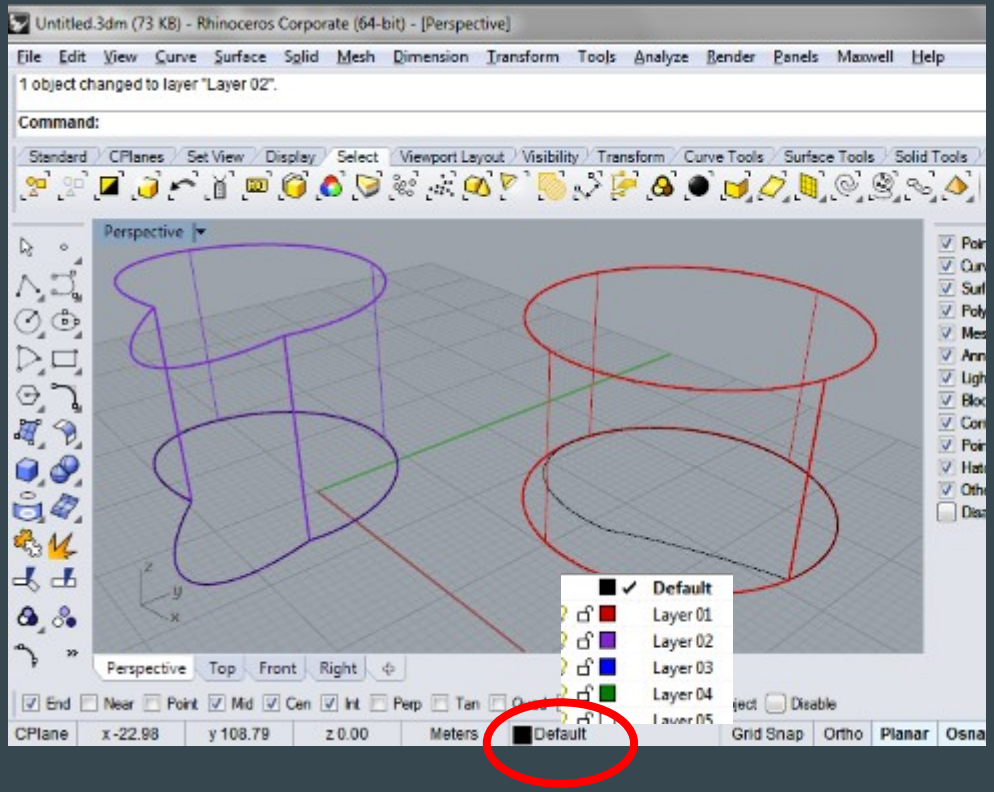
FIles will get bigger with history. You can use command “HistoryPurge” to clean history from file, if you no longer need it!



3D Modeling - Rhinoceros

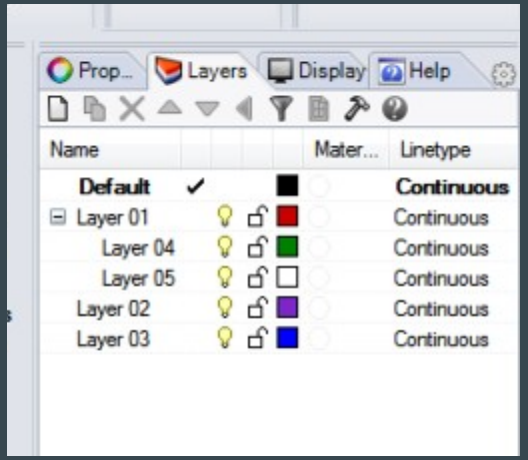
>Edit>Layers



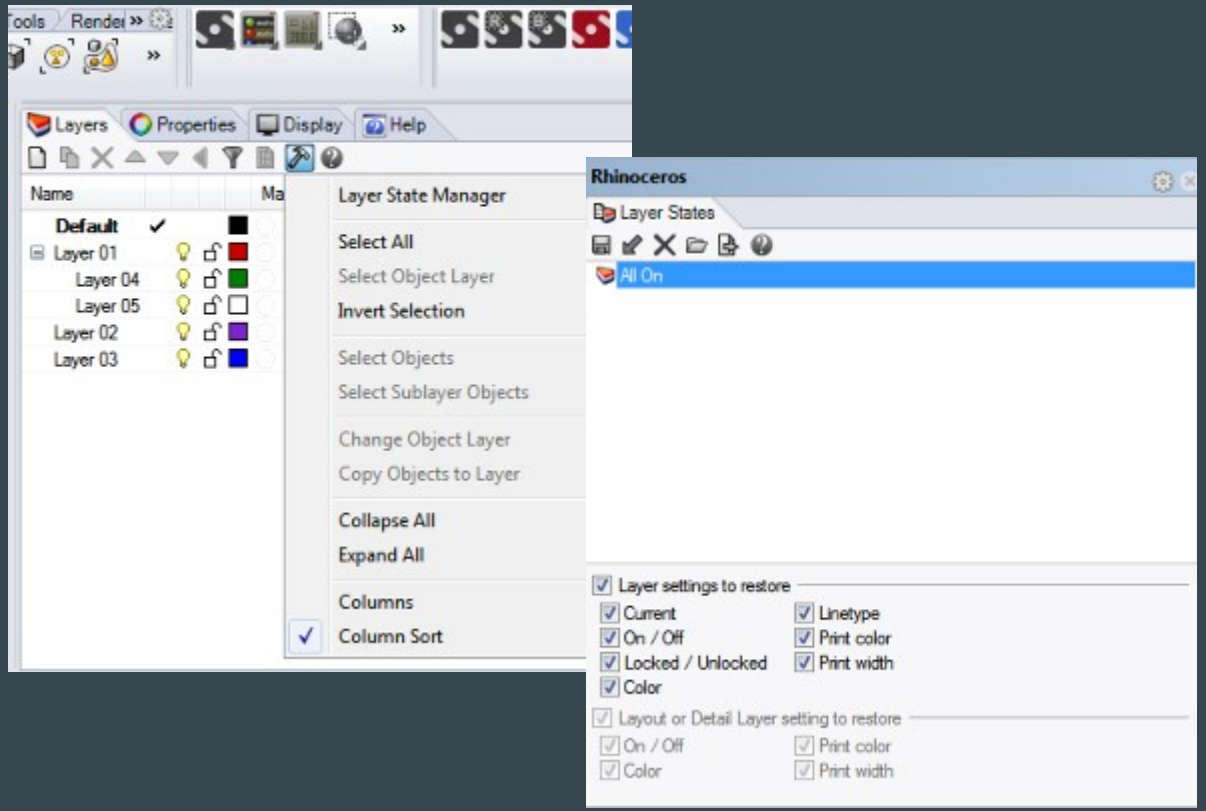


3D Modeling - Rhinoceros

Layers/SubLayers

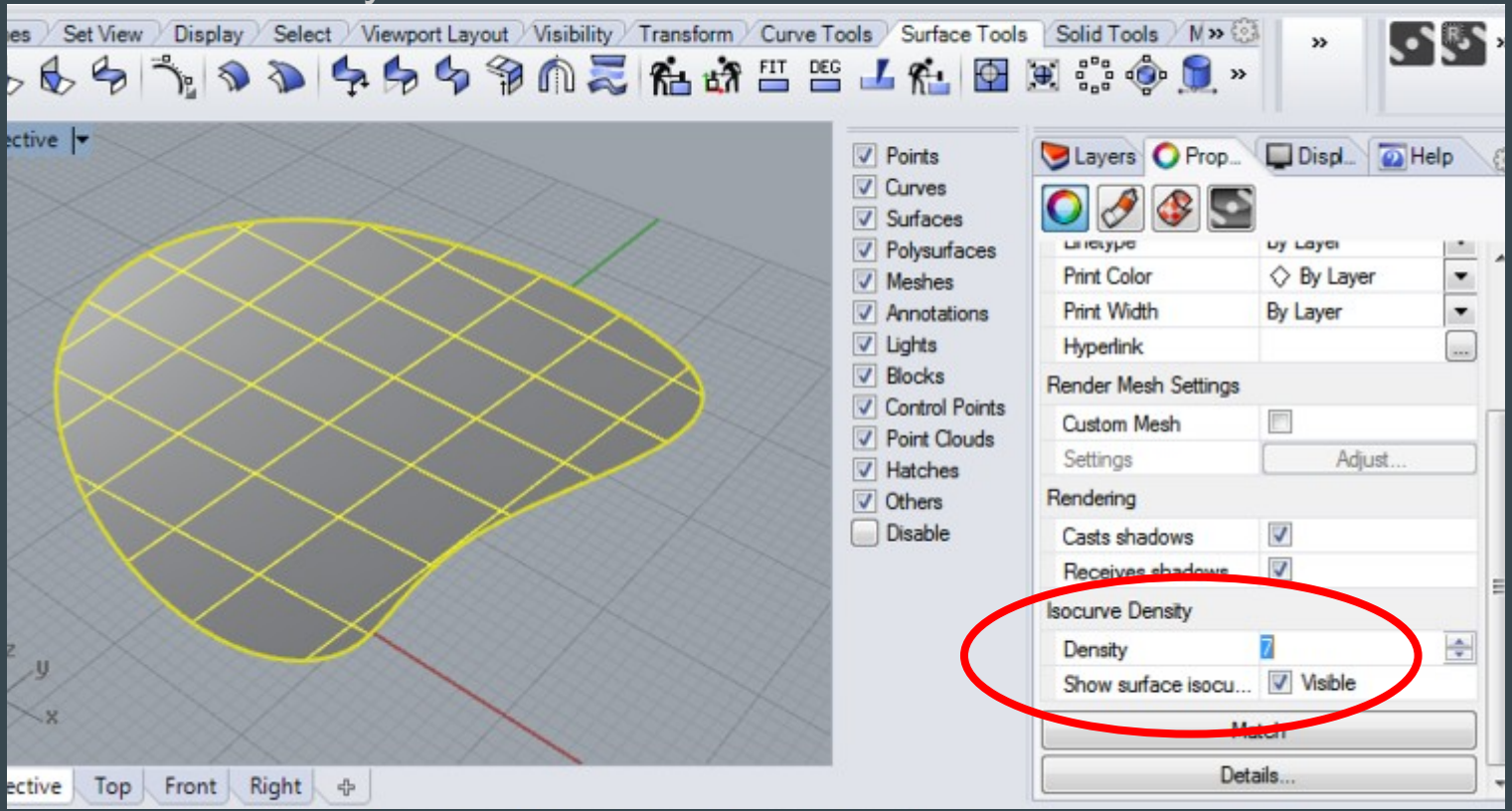


Layer State manager



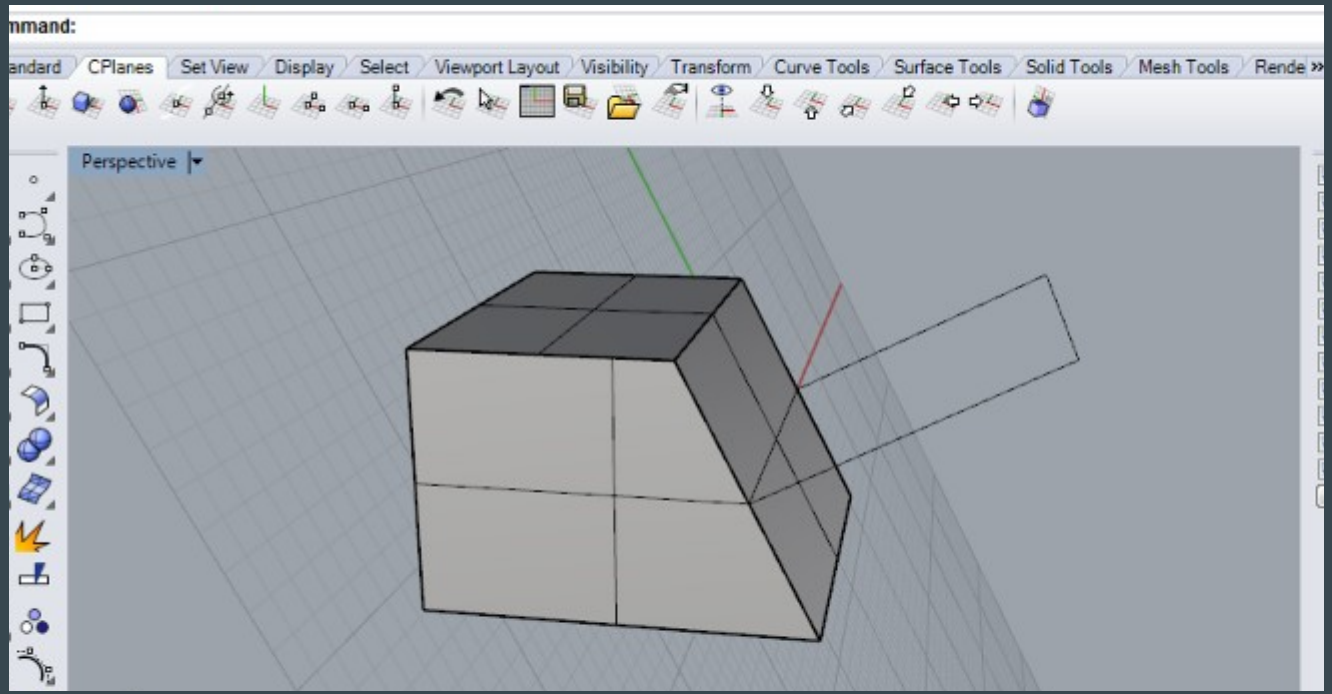
3D Modeling - Rhinoceros

>Isocurve Density



3D Modeling - Rhinoceros

>CPlanes>

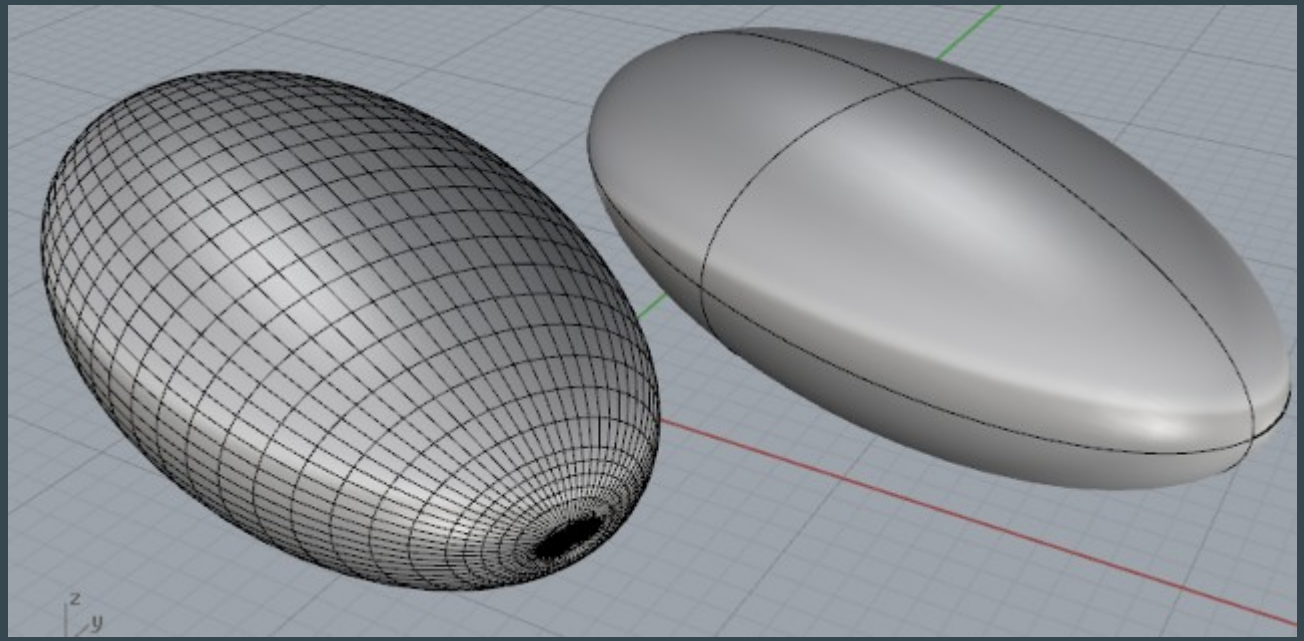


3D Modeling - Rhinoceros

TO BE CONTINUED….

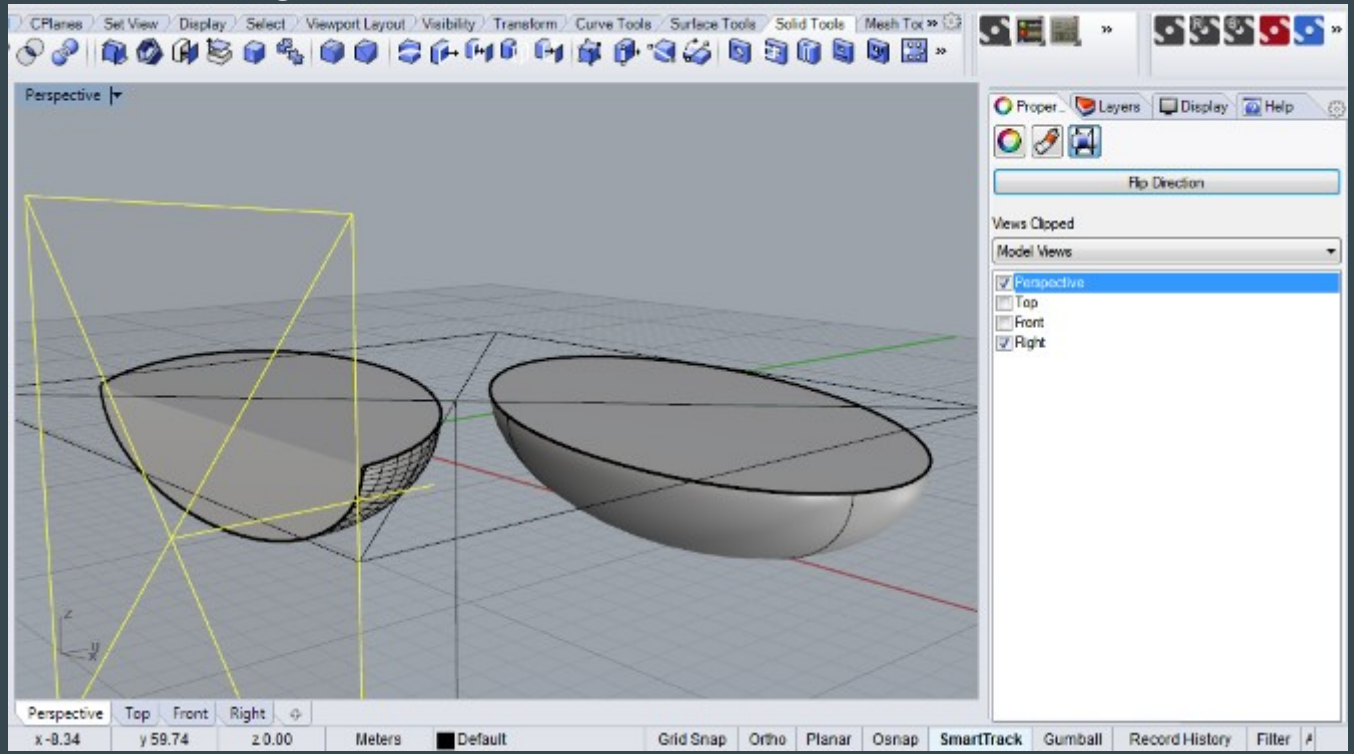
3D Modeling - Rhinoceros

3D Modeling - Rhinoceros



A NURBS surface is an accurate representation of a smooth surface and producing a rendered image of such surfaces requires the existence of a set of polygon meshes representing the surfaces.

3D Modeling - Rhinoceros



You can use one or more clipping planes to make interactive sections of the 3d model.

>ClippingPlane (Alternative: plugin http://wiki.mcneel.com/labs/sectiontools)