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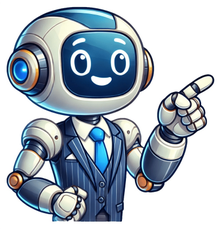

Creates a gizmo for a slice plane that can be positioned and rotated where you want to slice the edges. Also enables the Slice button. Performs the slice operation at the location of the slice plane. The Slice button is available only when the Slice Plane button is highlighted. This tool slices the mesh just like the Slice modifier in Operate On: Face mode. Note: At the Face, Poly, or Element level, Slice works only on a sub-object selection. Make the selection before activating Slice Plane. At the Vertex or Edge level, Slice works on the entire object. Lets you subdivide the mesh surface between pairs of edges by clicking, moving the mouse, and then clicking again, creating a new edge or edges between the two edges. You can continue to move and click repeatedly to cut further; to exit this mode, right-click the viewport. Note: The mouse cursor turns into a crosshairs where it's permissible to click while cutting. This includes visible edges as well as hidden ones. To view hidden edges, turn off Edges Only on the Display Properties rollout. Also, to avoid cutting edges that face away from you, turn on Ignore Backfacing on the Selection rollout. The first click sets the first vertex. A dashed line tracks the cursor movement until you click a second time. A new vertex is created at each point you click. Alternately, double-clicking an edge simply divides that edge at the point clicked, with invisible edges on either side. You can use Cut to cut across any number of faces, even across an entire object. Click one edge to start the cut, and a second edge to end the cut. Use Snaps with Cut for precision. Cut supports Midpoint, Endpoint, and Vertex snaps. You can also use the keyboard shortcut Alt+C to toggle Cut mode. Tip: While using Cut (between clicks), you can navigate the viewport interactively as follows: To pan the viewport, scroll the mouse wheel or drag with the middle mouse button. To orbit the viewport, hold down Alt while scrolling the mouse wheel or dragging the middle mouse button. To zoom the viewport, scroll the mouse wheel or hold down Alt+Ctrl and drag forward and back with the middle mouse button. When on, the Slice and Cut operations create double sets of vertices where the edges are divided. This lets you easily delete the new faces to create holes, or animate the new faces as separate elements. When on, adjacent faces at the ends of the cut are also divided by additional vertices, so that the surface stays contiguous. When Refine Ends is off, the surface will have a seam where the new vertex meets the adjacent face. For this reason, its a good idea to keep Refine Ends on unless youre sure you dont want the extra vertices created. Refine Ends affects only Cut. It does not affect Slice. Reddit and its partners use cookies and similar technologies to provide you with a better experience. By accepting all cookies, you agree to our use of cookies to deliver and maintain our services and site, improve the quality of Reddit, personalize Reddit content and advertising, and measure the effectiveness of advertising. By rejecting non-essential cookies, Reddit may still use certain cookies to ensure the proper functionality of our platform. For more information, please see our Cookie Notice and our Privacy Policy. Cutting models in 3ds Max is a fundamental skill for 3D designers and animators who want to create intricate shapes and detailed structures. This process allows users to modify geometry effectively, enabling creativity in character modeling, architectural design, and more. Here is a structured approach to help you cut objects in 3ds Max, complete with clear steps and detailed explanations.Preparing Your Object for CuttingBefore you begin the cutting process, its important to ensure that your object is ready. Start with the following steps:Select the Object: Click on the object you wish to cut in the viewport. Ensure that it is editable. If its not already an Editable Poly or Mesh, right-click on the object, navigate to Convert To, and select either Convert to Editable Poly or Convert to Editable Mesh.Switch to the Polygon Sub-Object Level: With the object selected, go to the Modify panel and change to the Polygon sub-object mode. This allows you to work directly on the faces of your model, making it easier to apply cuts precisely where needed.Making Cuts with the Edge Sub-Object ToolOne potent method to create cuts is by using the Edge tool. This method allows finer control:Select the Edge: While in the Polygon mode, switch to Edge sub-object level. Select the edges where you plan to make your cuts.Use the Cut Tool: Locate the Cut tool in the Graphite Modeling Tools tab, found under the Polygon Modeling section. Click on this tool; your mouse cursor will change, indicating that you are in cut mode.Perform the Cut: Click on one edge where the cut will start and then click on another edge where you want the cut to end. This action creates a new edge loop, thereby modifying the topography of your model. You can continue to click to create multi-segment cuts.Complete the Cut: Once youre satisfied with your cutting path, press the Enter key to finalize the cut.Using the Slice Plane ToolFor a more uniform cut across your object, the Slice Plane tool offers an effective alternative:Access the Slice Plane Tool: In the Modify panel, access the Slice Plane tool located within the Editable Poly dropdown.Position the Slice Plane: Adjust the slice planes position and angle according to your needs. This adjustment can be done by moving or rotating the plane in the viewport.Slice the Object: Click Slice from the menu to execute the cut. The object will then be divided according to the planes orientation.Finalizing the Cut: After slicing, you can choose to keep both halves of the object by selecting Keep Both Sides or work with one of the halves as needed.Touching Up After CutsAfter making your cuts, some clean-up might be necessary to maintain the models integrity:Check Your Geometry: Look for any n-gons or irregular polygons that may have formed due to the cutting process.Use Vertex or Edge Tools: Select the vertices or edges to tweak and refine your geometry. You can use the Target Weld tool to merge vertices or the Breech tool for dissolving edges as necessary.Apply Smoothing: To ensure seamless transitions and aesthetic appeal, apply smoothing groups or use the TurboSmooth modifier for a polished look.FAQsWhat file formats can I import into 3ds Max for cutting?You can import several file formats into 3ds Max, including .FBX, .OBJ, .3DS, and .MAX, among others. Ensure that the object is in a compatible format before attempting to cut.Can cuts be undone in 3ds Max?Yes, any cutting action can be undone in 3ds Max by using the Ctrl + Z shortcut, which allows you to revert to the previous state of your model.Is it possible to cut multiple objects at once?Yes, while you cannot directly cut multiple objects simultaneously, you can group them or use Array tools, and after individual cutting, regroup them for combined application or transformations. 3D computer graphics programAutodesk 3ds MaxDeveloper(s)AutodeskInitial releaseApril1996; 29years ago(1996-04)[1] (as 3D Studio MAX)Stable release2026[2] / March26, 2025; 2 months ago(2025-03-26)Written inC, C++, and PythonOperating systemWindowsPredecessor3D StudioAvailable inEnglish, German, French, Brazilian Portuguese, Japanese, Chinese, KoreanType3D computer graphicsLicenseSoftware as a service, TrialwareWebsitewww.autodesk.com/products/3ds-max/overviewAutodesk 3ds Max, formerly 3D Studio and 3D Studio Max, is a professional 3D computer graphics program for making 3D animations, models, games and images. It is developed and produced by Autodesk Media and Entertainment.[3] It has modeling capabilities and a flexible plugin architecture and must be used on the Microsoft Windows platform. It is frequently used by video game developers, many TV commercial studios, and architectural visualization studios. It is also used for movie effects and movie pre-visualization. 3ds Max features shaders (such as ambient occlusion and subsurface scattering), dynamic simulation, particle systems, radiosity, normal map creation and rendering, global illumination, a customizable user interface, and its own scripting language.[4]The original 3D Studio product was created for the DOS platform by the Yost Group, and published by Autodesk. The release of 3D Studio made Autodesk's previous 3D rendering package AutoShade obsolete. After 3D Studio DOS Release 4, the product was rewritten for the Windows NT platform, and renamed "3D Studio MAX." This version was also originally created by the Yost Group. It was released by Kinetix, which was at that time Autodesk's division of media and entertainment.Autodesk purchased the product at the second release update of the 3D Studio MAX version and internalized development entirely over the next two releases. Later, the product name was changed to "3ds max" (all lower case) to better comply with the naming conventions of Discreet, a Montreal-based software company which Autodesk had purchased.When it was re-released (release 7), the product was again branded with the Autodesk logo, and the short name was again changed to "3ds Max" (upper and lower case), while the formal product name became the current "Autodesk 3ds Max."[5]VersionCodenameYearOperating systemHardware platform3D Studio PrototypeTHUD1988MS-DOS16-bit x86 originally32-bit x86 using DOS extender3D Studio Release 1.0THUD19903D Studio Release 2.019923D Studio Release 3.019933D Studio Release 4.019943D Studio MAX 1.0Jaguar1996Windows NT 3.51, Windows NT 4.0IA-323D Studio MAX R2Athena1997[1]Windows 95 and Windows NT 4.03D Studio MAX R3Shiva1999Discreet 3dsmax 4Magma2000Windows 98, Windows ME, Windows 2000[6]Discreet 3dsmax 5Luna2002Windows 98, Windows 2000 and Windows XPDiscreet 3dsmax 6Granite2003Windows 2000 and Windows XPDiscreet 3dsmax 7Catalyst2004Autodesk 3ds Max 8Vesper2005Autodesk 3ds Max 9Makalu2006IA-32 and x64Autodesk 3ds Max 2008Gouda2007Windows XP and Windows VistaAutodesk 3ds Max 2009Johnson2008Autodesk 3ds Max 2010Renoir2009Autodesk 3ds Max 2011Zelda2010Windows XP, Windows Vista and Windows 7Autodesk 3ds Max 2012Excalibur / Rampage2011Autodesk 3ds Max 2013SimCity2012Windows XP and Windows 7Autodesk 3ds Max 2014Tekken2013Windows 7x64Autodesk 3ds Max 2015Elwood2014Windows 7 and Windows 8Autodesk 3ds Max 2016Phoenix2015Windows 7, Windows 8 and Windows 8.1Autodesk 3ds Max 2017Kirin2016Windows 7, Windows 8, Windows 8.1 and Windows 10Autodesk 3ds Max 2018Imoogi2017Autodesk 3ds Max 2019Neptune2018Autodesk 3ds Max 2020Athena2019Autodesk 3ds Max 2021Theseus2020Windows 10 and Windows 11[7]Autodesk 3ds Max 2022Heimdall2021Autodesk 3ds Max 2023Vesta2022Autodesk 3ds Max 2024Olympus2023Autodesk 3ds Max 2025Midgard2024Autodesk 3ds Max 2026Devi2025One core feature that stands 3ds Max apart from other 3D graphics software is its ability to edit geometry using non-destructive modifiers.[8] Modifiers allow users to make changes to the geometry of an object without permanently altering the original geometry. Instead, the modifications are applied as separate layers on top of the base geometry, which can be easily adjusted or removed without affecting the underlying structure.MAXScript is a built-in scripting language that can be used to automate repetitive tasks, combine existing functionality in new ways, develop new tools and user interfaces, and much more. Plugin modules can be created entirely within MAXScript.Character Studio was a plugin which since version 4 of Max is now integrated in 3ds Max; it helps users to animate virtual characters. The system works using a character rig or "Biped" skeleton which has stock settings that can be modified and customized to fit the character meshes and animation needs. This tool also includes robust editing tools for IK/FK switching, Pose manipulation, Layers and Keyframing workflows, and sharing of animation data across different Biped skeletons. These "Biped" objects have other useful features that help accelerate the production of walk cycles and movement paths, as well as secondary motion.Scene Explorer, a tool that provides a hierarchical view of scene data and analysis, facilitates working with more complex scenes. Scene Explorer has the ability to sort, filter, and search a scene by any object type or property (including metadata). Added in 3ds Max 2008, it was the first component to facilitate .NET managed code in 3ds Max outside of MAXScript.3ds Max supports both import and linking of .dwg files. Improved memory management in 3ds Max 2008 enables larger scenes to be imported with multiple objects.3ds Max offers operations for creative texture and planar mapping, including tiling, mirroring, decals, angle, rotate, blur, UV stretching, and relaxation; Remove Distortion; Preserve UV; and UV template image export. The texture workflow includes the ability to combine an unlimited number of textures, a material/map browser with support for drag-and-drop assignment, and hierarchies with thumbnails. UV workflow features include Pelt mapping, which defines custom seams and enables users to unfold UVs according to those seams; copy/paste materials, maps and colors; and access to quick mapping types (box, cylindrical, spherical).Two keying modes set key and auto key offer support for different keyframing workflows.Fast and intuitive controls for keyframing including cut, copy, and paste let the user create animations with ease. Animation trajectories may be viewed and edited directly in the viewport.Objects can be animated along curves with controls for alignment, banking, velocity, smoothness, and looping, and along surfaces with controls for alignment. Weight path-controlled animation between multiple curves, and animate the weight. Objects can be constrained to animate with other objects in many ways including look at, orientation in different coordinate spaces, and linking at different points in time. These constraints also support animated weighting between more than one target.All resulting constrained animation can be collapsed into standard keyframes for further editing.Either the Skin or Physique modifier may be used to achieve precise control of skeletal deformation, so the character deforms smoothly as joints are moved, even in the most challenging areas, such as shoulders. Skin deformation can be controlled using direct vertex weights, volumes of vertices defined by envelopes, or both. Capabilities such as weight tables, paintable weights, and saving and loading of weights offer easy editing and proximity-based transfer between models, providing the accuracy and flexibility needed for complicated characters.The rigid bind skinning option is useful for animating low-polygon models or as a diagnostic tool for regular skeleton animation.Additional modifiers, such as Skin Wrap and Skin Morph, can be used to drive meshes with other meshes and make targeted weighting adjustments in tricky areas.Characters can be rigged with custom skeletons using 3ds Max bones, IK solvers, and rigging tools powered by Motion Capture Data.All animation tools including expressions, scripts, list controllers, and wiring can be used along with a set of utilities specific to bones to build rigs of any structure and with custom controls, so animators see only the UI necessary to get their characters animated. Four plug-in IK solvers ship with 3ds Max: history-independent solver, history-dependent solver, limb solver, and spline IK solver. These powerful solvers reduce the time it takes to create high-quality character animation. The history-independent solver delivers smooth blending between IK and FK animation and uses preferred angles to give animators more control over the positioning of affected bones. The history-dependent solver can solve within joint limits and is used for machine-like animation. IK limb is a lightweight two-bone solver, optimized for real-time interactivity, ideal for working with a character arm or leg. Spline IK solver provides a flexible animation system with nodes that can be moved anywhere in 3D space. It allows for efficient animation of skeletal chains, such as a character's spine or tail, and includes easy-to-use twist and roll controls.In addition to reactor's cloth modifier, 3ds Max software has an integrated cloth-simulation engine that enables the user to turn almost any 3D object into clothing and even build garments from scratch. Collision solving is fast and accurate even in complex simulations. Local simulation lets artists drape cloth in real time to set up an initial clothing state before setting animation keys.Cloth simulations can be used in conjunction with other 3ds Max dynamic forces, such as Space Warps. Multiple independent cloth systems can be animated with their own objects and forces. Cloth deformation data can be cached to the hard drive to allow for nondestructive iterations and to improve playback performance.Autodesk Vault plug-in, which ships with 3ds Max, consolidates users' 3ds Max assets in a single location, enabling them to automatically track files and manage work in progress. Users can easily and safely find, share, and reuse 3ds Max (and design) assets in a large-scale production or visualization environment.Introduced with Max 2016, Max Creation Graph (MCG) enables users to create modifiers, geometry, and utility plug-ins using a visual node-based workflow.With MCG the user can create a new plug-in for 3ds Max in minutes by simply wiring together parameter nodes, computation nodes, and output nodes. The resulting graph can then be saved in an XML file (.maxtool) or be packaged with any compounds (.maxcompound) it depends on in a ZIP file (.mcg) which can be shared easily with 3ds Max users.Further information: List of films made with Autodesk 3ds MaxMany films have made use of 3ds Max, or previous versions of the program under previous names, in CGI animation, such as Avatar and 2012, which contain computer generated graphics from 3ds Max alongside live-action acting. Mudbox was also used in the final texturing of the set and characters in Avatar, with 3ds Max and Mudbox being closely related.3ds Max has been used in the development of 3D computer graphics for a number of video games.[1]Architectural and engineering design firms use 3ds Max for developing concept art and previsualization.Educational programs at secondary and tertiary level use 3ds Max in their courses on 3D computer graphics and computer animation. Students in the FIRST competition for 3d animation are known to use 3ds Max.Main article: Polygon modelingPolygon modeling is more common with game design than any other modeling technique as the very specific control over individual polygons allows for extreme optimization. Usually, the modeler begins with one of the 3ds max primitives, and using such tools as bevel and extrude, adds detail to and refines the model. Versions 4 and up feature the Editable Polygon object, which simplifies most mesh editing operations, and provides subdivision smoothing at customizable levels (see NURMS).Version 7 introduced the edit poly modifier, which allows the use of the tools available in the editable polygon object to be used higher in the modifier stack (i.e., on top of other modifications).NURBS in 3ds Max is a legacy feature. None of the features have been updated since version 4 and have been ignored by the development teams over the past decade. For example, the updated path deform and the updated normalize spline modifiers in version 2018 do not work on NURBS curves anymore as they did in previous versions.An alternative to polygons, it gives a smoothed out surface that eliminates the straight edges of a polygon model. NURBS is a mathematically exact representation of freeform surfaces like those used for car bodies and ship hulls, which can be exactly reproduced at any resolution whenever needed. With NURBS, a smooth sphere can be created with only one face.The non-uniform property of NURBS brings up an important point. Because they are generated mathematically, NURBS objects have a parameter space in addition to the 3D geometric space in which they are displayed. Specifically, an array of values called knots specifies the extent of influence of each control vertex (CV) on the curve or surface. Knots are invisible in 3D space and can't be manipulated directly, but occasionally their behavior affects the visible appearance of the NURBS object. Parameter space is one-dimensional for curves, which have only a single U dimension topologically, even though they exist geometrically in 3D space. Surfaces have two dimensions in parameter space, called U and V.[9]NURBS curves and surfaces have the important properties of not changing under the standard geometric affine transformations (Transforms), or under perspective projections. The CVs have local control of the object: moving a CV or changing its weight does not affect any part of the object beyond the neighboring CVs. (This property can be overridden by using the Soft Selection controls). Also, the control lattice that connects CVs surrounds the surface. This is known as the convex hull property.[10]Surface tool was originally a 3rd party plugin, but Kinetix acquired and included this feature since version 3.0.[citation needed] The surface tool is for creating common 3ds Max splines, and then applying a modifier called "surface." This modifier makes a surface from every three or four vertices in a grid. It is often seen as an alternative to "mesh" or "nurbs" modeling, as it enables a user to interpolate curved sections with straight geometry (for example a hole through a box shape). Although the surface tool is a useful way to generate parametrically accurate geometry, it lacks the "surface properties" found in the similar Edit Patch modifier, which enables a user to maintain the original parametric geometry whilst being able to adjust "smoothing groups" between faces.[citation needed]This is a basic method, in which one models something using only boxes, spheres, cones, cylinders and other predefined objects from the list of Predefined Standard Primitives or a list of Predefined Extended Primitives. One may also apply Boolean operations, including subtract, cut and connect. For example, one can make two spheres which will work as blobs that will connect with each other. These are called metaballs.[11]Some of the 3ds Max Primitives as they appear in the wireframe view of 3ds Max 93ds Max Standard Primitives: Box (top right), Cone (top center), Pyramid (top left), Sphere (bottom left), Tube (bottom center) and Geosphere (bottom right)3ds Max Extended Primitives: Torus Knot (top left), ChamferCyl (top center), Hose (top right), Capsule (bottom left), Gengon (bottom, second from left), OilTank (bottom, second from right) and Prism (bottom right)Box:Produces a rectangular prism. An alternative variation of box called Cub proportionally constrains the length, width, and height of the box.Cylinder:Produces a cylinder.Torus:Produces a torus or a ring with a circular cross section, sometimes referred to as a doughnut.Teapot:Produces a Utah teapot. Since the teapot is a parametric object, the user can choose which parts of the teapot to display after creation. These parts include the body, handle, spout and lid. Primarily used to test shaders (rendering settings).Cone:Produces upright or inverted cones.Sphere:Produces a full sphere, semi-sphere, or other portion of a sphere.Tube:Produces round or prismatic tubes. The tube is similar to the cylinder with a hole in it.Pyramid:Produces a pyramid with a square or rectangular base and triangular sides.Plane:Produces a special type of flat polygon mesh that can be enlarged by any amount at render time. The user can specify factors to magnify the size or number of segments or both. Modifiers such as displace can be added to a plane to simulate a hilly terrain.Geosphere:Produces spheres and hemispheres based on three classes of regular polyhedrons.Hedra:Produces objects from several families of polyhedra.ChamferBox:Produces a box with beveled or rounded edges.OilTank:Creates a cylinder with convex caps.Spindle:Creates a cylinder with conical caps.Gengon:Creates an extruded, regular-sided polygon with optionally filleted side edges.Prism:Creates a three-sided prism with independently segmented sides.Torus knot:Creates a complex or knotted torus by drawing 2D curves in the normal planes around a 3D curve. The 3D curve (called the Base Curve) can be either a circle or a torus knot. It can be converted from a torus knot object to a NURBS surface.ChamferCyl:Creates a cylinder with beveled or rounded cap edges.Capsule:Creates a cylinder with hemispherical caps.L-Ex:Creates an extruded L-shaped object.C-Ext:Creates an extruded C-shaped object.Hose:Creates a flexible object, similar to a spring.Scanline renderingThe default rendering method in 3ds Max is scanline rendering. Several advanced features have been added to the scanliner over the years, such as global illumination, radiosity, and ray tracing.ART RendererAutodesk Raytracer Renderer (ART) is a CPU-only, physically based renderer for architectural, product, and industrial design renderings and animations. It is integrated into 3ds Max as of version 2017.RedshiftA third-party GPU-accelerated, biased renderer with plugins for 3ds Max, Cinema 4D, Houdini, Katana and Maya.Mental RayMental ray is a third-party renderer using bucket rendering, a technique that allows distributing the rendering task for a single image between several computers. Since 3ds Max 2018, mental ray is no longer shipped with 3ds Max and needs to be obtained directly from NVIDIA.RenderManA third party connection tool to RenderMan pipelines is also available for those that need to integrate Max into Renderman render farms. Used by Pixar for rendering several of their CGI animated films.V-RayA third-party render engine plug-in for 3ds Max.Brazil R/SA third-party photorealistic rendering system. It is capable of fast ray tracing and global illumination.ArionA third party hybrid GPU+CPU interactive, unbiased ray tracer, based on Nvidia CUDA.Indigo RendererA third-party photorealistic renderer with plugins for 3ds Max.Maxwell RenderA third-party photorealistic rendering system providing materials and unbiased rendering.Octane RenderA third party unbiased GPU ray tracer with plugins for 3ds Max, based on Nvidia CUDA.LuxrenderAn open-source ray tracer supporting 3ds Max, Cinema 4D, Softimage, and Blender. Focuses on photorealism by simulating real light physics as much as possible.ArnoldArnold is an unbiased, physically based, unidirectional path-tracing renderer.Corona RendererAn third party high-performance (un)biased photorealistic renderer.Fstorm RendererEarlier versions (up to and including 3D Studio Max R3.1) required a special copy protection device (called a dongle) to be plugged into the parallel port while the program was run, but later versions incorporated software-based copy prevention methods instead. Current versions require online registration.Due to the high price of the commercial version of the program, Autodesk also offers a free student version, which explicitly states that it is to be used for "educational purposes only". The student version has identical features to the full version, but is only for single use and cannot be installed on a network. The student license expires after three years, at which time the user, if they are still a student, may download the latest version, thus renewing the license for another three years.In 2020, Autodesk had since reduced the free student version limit to one year only, as opposed to three years previously. In addition, all customers seeking free access to Autodesk educational products and services are required to provide proof of enrollment, employment, or contractor status at a qualified educational institution.Comparison of 3D computer graphics software.3dsAutodesk MayaBlenderCinema 4DElectric Image Animation SystemAdobe After EffectsLightWave 3DModoCyber Studio^ a b c "Toolbox". Next Generation. No.35. Imagine Media. November 1997. p.27.^ 3ds Max 2026 Help | 3ds Max 2026 Update Release Notes | Autodesk^ "Autodesk | 3D Design, Engineering & Entertainment Software"' November 21, 2013^ "Autodesk 3ds Max Detailed Features" Archived February 19, 2011, at the Wayback Machine, March 25, 2008^ "History of Autodesk 3ds Max". Archived from the original on October 24, 2015.^ "PC & Tech Authority". TechRadar.^ System requirements for Autodesk 3ds Max 2023 | 3ds Max 2023 | Autodesk Knowledge Network^ "3ds max 7 Review". Animation World Network. Retrieved July 17, 2024.^ "NURBS Curves and Surfaces", November 22, 2013^ "Why is the Convex Hull property so important". Stack Exchange. November 22, 2013.^ "Metaballs/Blobby Objects", November 22, 2013Wikimedia Commons has media related to 3DStudioMax.Wikibooks has a book on the topic of: Autodesk 3ds MaxOfficial website Retrieved from " 2Form of computer-aided engineeringThis article is about computer modeling within an artistic medium. For scientific usage, see Computer simulation.Three-dimensional (3D)computer graphicsFundamentalsModelingScanningRenderingPrintingPrimary uses3D modelsComputer-aided designGraphic designVideo gamesVisual effectsVisualizationVirtual engineeringVirtual realityVirtual cinematographyRelated topicsComputer-generated imagery (CGI)Animationcomputerskeletal3D displayWire-frame modelTexture mappingMotion captureCrowd simulationGlobal illuminationVolume renderingvteIn 3D computer graphics, 3D modeling is the process of developing a mathematical coordinate-based representation of a surface of an object (inanimate or living) in three dimensions via specialized software by manipulating edges, vertices, and polygons in a simulated 3D space.[1][2][3]Three-dimensional (3D) models represent a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc.[4] Being a collection of data (points and other information), 3D models can be created manually, algorithmically (procedural modeling), or by scanning.[5][6] Their surfaces may be further defined with texture mapping.See also: Environment artistThe product is called a 3D model, while someone who works with 3D models may be referred to as a 3D artist or a 3D modeler.A 3D model can also be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena.3D models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. The 3D model can be physically created using 3D printing devices that form 2D layers of the model with three-dimensional material, one layer at a time. Without a 3D model, a 3D print is not possible.3D modeling software is a class of 3D computer graphics software used to produce 3D models. Individual programs of this class are called modeling applications.[7]Three-dimensional model of a spectrograph[8] Rotating 3D video-game model3D selfie models are generated from 2D pictures taken at the Fantasitron 3D photo booth at Madurodam.3D models are now widely used anywhere in3D graphicsandCAD but their history predates the widespread use of 3D graphics onpersonal computers.[9]In the past, manycomputer gamesused pre-rendered images of 3D models asspritesbefore computers could render them in real-time. The designer can then see the model in various directions and views, this can help the designer see if the object is created as intended to compared to their original vision. Seeing the design this way can help the designer or company figure out changes or improvements needed to the product.[10]A modern render of the iconic Utah teapot model developed by Martin Newell (1975). The Utah teapot is one of the most common models used in 3D graphics education.Almost all 3D models can be divided into two categories:Solid These models define the volume of the object they represent (like a rock). Solid models are mostly used for engineering and medical simulations, and are usually built with constructive solid geometryShell or boundary These models represent the surface, i.e., the boundary of the object, not its volume (like an infinitesimally thin eggshell). Almost all visual models used in games and film are shell models.Solid and shell modeling can create functionally identical objects. Differences between them are mostly variations in the way they are created and edited and conventions of use in various fields and differences in types of approximations between the model and reality.Shell models must be manifold (having no holes or cracks in the shell) to be meaningful as a real object. In a shell model of a cube, the bottom and top surfaces of the cube must have a uniform thickness with no holes or cracks in the first and last layers printed. Polygonal meshes (and to a lesser extent, subdivision surfaces) are by far the most common representation. Level sets are a useful representation for deforming surfaces that undergo many topological changes, such as fluids.The process of transforming representations of objects, such as the middle point coordinate of a sphere and a point on its circumference, into a polygon representation of a sphere is called tessellation. This step is used in polygon-based rendering, where objects are broken down from abstract representations ("primitives") such as spheres, cones etc., to so-called meshes, which are nets of interconnected triangles. Meshes of triangles (instead of e.g., squares) are popular as they have proven to be easy to rasterize (the surface described by each triangle is planar, so the projection is always convex).[11] Polygon representations are not used in all rendering techniques, and in these cases the tessellation step is not included in the transition from abstract representation to rendered scene.There are three popular ways to represent a model:Polygonal modeling Points in 3D space, called vertices, are connected by line segments to form a polygon mesh. The vast majority of 3D models today are built as textured polygonal models because they are flexible and because computers can render them so quickly. However, polygons are planar and can only approximate curved surfaces using many polygons.Curve modeling Surfaces are defined by curves, which are influenced by weighted control points. The curve follows (but does not necessarily interpolate) the points. Increasing the weight for a point pulls the curve closer to that point. Curve types include nonuniform rational B-spline (NURBS), splines, patches, and geometric primitivesDigital sculpting There are three types of digital sculpting: Displacement, which is the most widely used among applications at this moment, uses a dense model (often generated by subdivision surfaces of a polygon control mesh) and stores new locations for the vertex positions through use of an image map that stores the adjusted locations. Volumetric, loosely based on voxels, has similar capabilities as displacement but does not suffer from polygon stretching when there are not enough polygons in a region to achieve a deformation. Dynamic tessellation, which is similar to voxel, divides the surface using triangulation to maintain a smooth surface and allow finer details. These methods allow for artistic exploration as the model has new topology created over it once the models form and possibly details have been sculpted. The new mesh usually has the original high-resolution mesh information transferred into displacement data or normal map data if it is for a game engine.A 3D fantasy fish composed of organic surfaces generated using LAI4D.The modeling stage consists of shaping individual objects that are later used in the scene. There are a number of modeling techniques, including:Constructive solid geometryImplicit surfacesSubdivision surfacesModeling can be performed by means of a dedicated program (e.g., 3D modeling software like Adobe Substance, Blender, Cinema 4D, LightWave, Maya, Modo, 3ds Max, SketchUp, Rhinoceros 3D, and others) or an application component (Shaper, Lofter in 3ds Max) or some scene description language (as in POV-Ray). In some cases, there is no strict distinction between these phases; in such cases, modeling is just part of the scene creation process (this is the case, for example, with Caligari trueSpace and Realsoft 3D).3D models can also be created using the technique of Photogrammetry with dedicated programs such as RealityCapture, Metashape and 3DF Zephyr. Cleanup and further processing can be performed with applications such as MeshLab, the GigaMesh Software Framework, netfabb or MeshMixer. Photogrammetry creates models using algorithms to interpret the shape and texture of real-world objects and environments based on photographs taken from many angles of the subject.Complex materials such as blowing sand, clouds, and liquid sprays are modeled with particle systems, and are a mass of 3D coordinates which have either points, polygons, texture splats or sprites assigned to them.Main article: List of 3D modeling softwareThere are a variety of 3D modeling programs that can be used in the industries of engineering, interior design, film and others. Each 3D modeling software has specific capabilities and can be utilized to fulfill demands for the industry.Many programs include export options to form a g-code, applicable to additive or subtractive manufacturing machinery. G-code (computer numerical control) works with automated technology to form a real-world rendition of 3D models. This code is a specific set of instructions to carry out steps of a product's manufacturing.[12]Main article: Virtual actorThe first widely available commercial application of human virtual models appeared in 1998 on the Lands' End web site. The human virtual models were created by the company My Virtual Mode Inc. and enabled users to create a model of themselves and try on 3D clothing. There are several modern programs that allow for the creation of virtual human models (Poser being one example).Dynamic 3D clothing model made in Marvelous DesignerThe development of cloth simulation software such as Marvelous Designer, CLO3D and Optitex, has enabled artists and fashion designers to model dynamic 3D clothing on the computer.[13]Dynamic 3D clothing is used for virtual fashion catalogs, as well as for dressing 3D characters for video games, 3D animation movies, for digital doubles in movies,[14] as a creation tool for digital fashion brands, as well as for making clothes for avatars in virtual worlds such as SecondLife.3D photorealistic effects are often achieved without wire-frame modeling and are sometimes indistinguishable in the final form. Some graphic art software includes filters that can be applied to 2D vector graphics or 2D raster graphics on transparent layers.Advantages of wireframe 3D modeling over exclusively 2D methods include:Flexibility, ability to change angles or animate images with quicker rendering of the changes;Ease of rendering, automatic calculation and rendering photorealistic effects rather than mentally visualizing or estimating;Accurate photorealism, less chance of human error in misplacing, overdoing, or forgetting to include a visual effect.Disadvantages compared to 2D photorealistic rendering may include a software learning curve and difficulty achieving certain photorealistic effects. Some photorealistic effects may be achieved with special rendering filters included in the 3D modeling software. For the best of both worlds, some artists use a combination of 3D modeling followed by editing the 2D computer-rendered images from the 3D model.A large market for 3D models (as well as 3D-related content, such as textures, scripts, etc.) existseither for individual models or large collections. Several online marketplaces for 3D content allow individual artists to sell content that they have created, including TurboSquid, MyMiniFactory, Sketchfab, CGTrader, and Cults. Often, the artists' goal is to get additional value out of assets they have previously created for projects. By doing so, artists can earn more money out of their old content, and companies can save money by buying pre-made models instead of paying an employee to create one from scratch. These marketplaces typically split the sale between themselves and the artist that created the asset, artists get 40% to 95% of the sales according to the marketplace. In most cases, the artist retains ownership of the 3d model while the customer only buys the right to use and present the model. Some artists sell their products directly in their own stores, offering their products at a lower price by not using intermediaries.The architecture, engineering and construction (AEC) industry is the biggest market for 3D modeling, with an estimated value of $12.13 billion by 2028.[15] This is due to the increasing adoption of 3D modeling in the AEC industry, which helps to improve design accuracy, reduce errors and omissions and facilitate collaboration among project stakeholders.[16][17]Over the last several years numerous marketplaces specializing in 3D rendering and printing models have emerged. Some of the 3D printing marketplaces are a combination of models sharing sites, with or without a built in e-com capability. Some of those platforms also offer 3D printing services on demand, software for model rendering and dynamic viewing of items.Main articles: 3D printing and Rapid prototypingThe term 3D printing or three-dimensional printing is a form of additive manufacturing technology where a three-dimensional object is created from successive layers of material.[18] Objects can be created without the need for complex expensive molds or assembly with multiple parts. 3D printing allows ideas to be prototyped and tested without having to go through a production process.[18][19]3D models can be purchased from online markets and printed by individuals or companies using commercially available 3D printers, enabling the home-production of objects such as spare parts and even medical equipment.[20][21]Steps of forensic facial reconstruction of a mummy made in Blender by the Brazilian 3D designer Ccero Moraes3D modeling is used in many industries.[22]The medical industry uses detailed models of organs created from multiple two-dimensional image slices from an MRI or CT scan. [23] Other scientific fields can use 3D models to visualize and communicate information such as models of chemical compounds.[24]The movie industry uses 3D models for computer-generated characters and objects in animated and real-life motion pictures. Similarly, the video game industry uses 3D models as assets for computer and video games. The source of the geometry for the shape of an object can be a designer, industrial engineer, or artist using a 3D CAD system; an existing object that has been reverse engineered or copied using a 3D shape digitizer or scanner; or mathematical data based on a numerical description or calculation of the object.[18]The architecture industry uses 3D models to demonstrate proposed buildings and landscapes in lieu of traditional, physical architectural models. Additionally, the use of Level of Detail (LOD) in 3D models is becoming increasingly important in architecture, engineering, and construction.[25][26]Archeologists create 3D models of cultural heritage items for research and visualization.[27][28] For example, the International Institute of MetaNumismatics (INIMEN) studies the applications of 3D modeling for the digitization and preservation of numismatic artifacts.[29]In recent decades, the earth science community has started to construct 3D geological models as a standard practice.3D models are also used in constructing digital representations of mechanical parts before they are manufactured. Using CAD- and CAM-related software, an engineer can test the functionality of assemblies of parts then use the same data to create toolpaths for CNC machining or 3D printing.3D modeling is used in industrial design, wherein products are 3D modeled[30] before representing them to the clients.In media and event industries, 3D modeling is used in stage and set design.[31]The OWL 2 translation of the vocabulary of X3D can be used to provide semantic descriptions for 3D models, which is suitable for indexing and retrieval of 3D models by features such as geometry, dimensions, material, texture, diffuse reflection, transmission spectra, transparency, reflectivity, opalescence, glazes, varnishes and enamels (as opposed to unstructured textual descriptions or 2.5D virtual museums and exhibitions using Google Street View on Google Arts & Culture, for example).[32] The RDF representation of 3D models can be used in reasoning, which enables intelligent 3D applications which, for example, can automatically compare two 3D models by volume.[33]List of 3D modeling softwareList of common 3D test modelsList of file formats#3D graphics3D city model3D computer graphics software3D figure3D printing3D scanner3D scanningAdditive manufacturing file formatBuilding information modelingCG artistCloth modelingComputer facial animationCornell boxDigital geometryEdge loopEnvironment artistGeological modelingHolographyIndustrial CT scanningMarching cubesOpen CASCADEPolygon meshPolygonal modelingRay tracing (graphics)Scaling (geometry)SIGGRAPHStanford bunnyTriangle meshUtah teapotVoxelB-rep^ "What is 3D Modeling & What's It Used For?". 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