



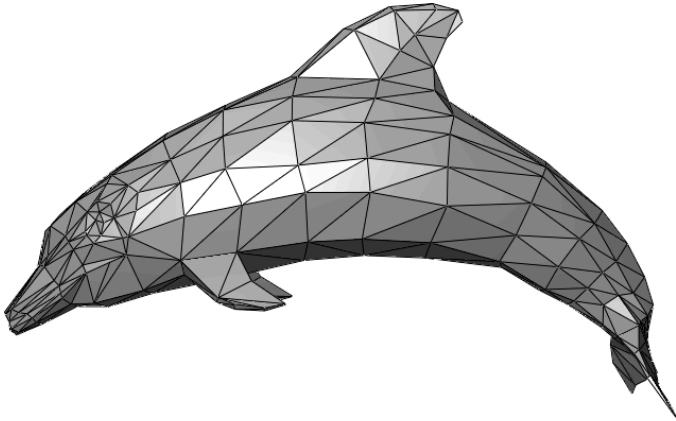
Introduction to 3D Modeling

Featuring *Tinkercad*, *123D Design*, *Meshmixer*, *123D Catch*, and *Blender*

This document provides a brief introduction to 3D modeling and a number of free 3D modeling programs that may be of use to individuals and teams in support of Challenge work.

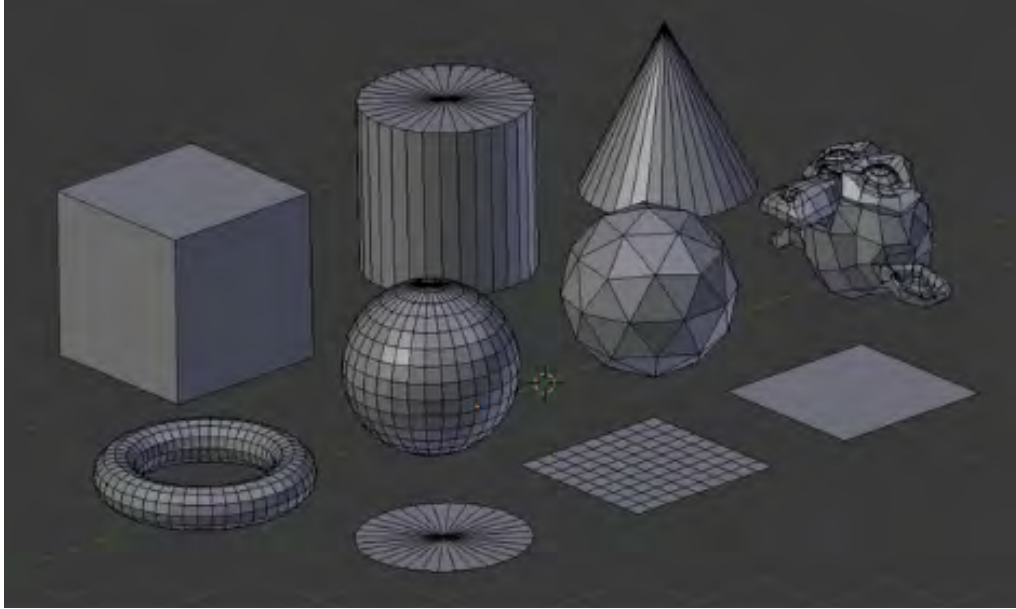
3d modeling overview

Generally speaking, 3D modeling is the process of forming a computer object into a desired shape and size. While there are several popular modeling techniques, the most common involves forming objects out of a three-dimensional polygon mesh (see image).



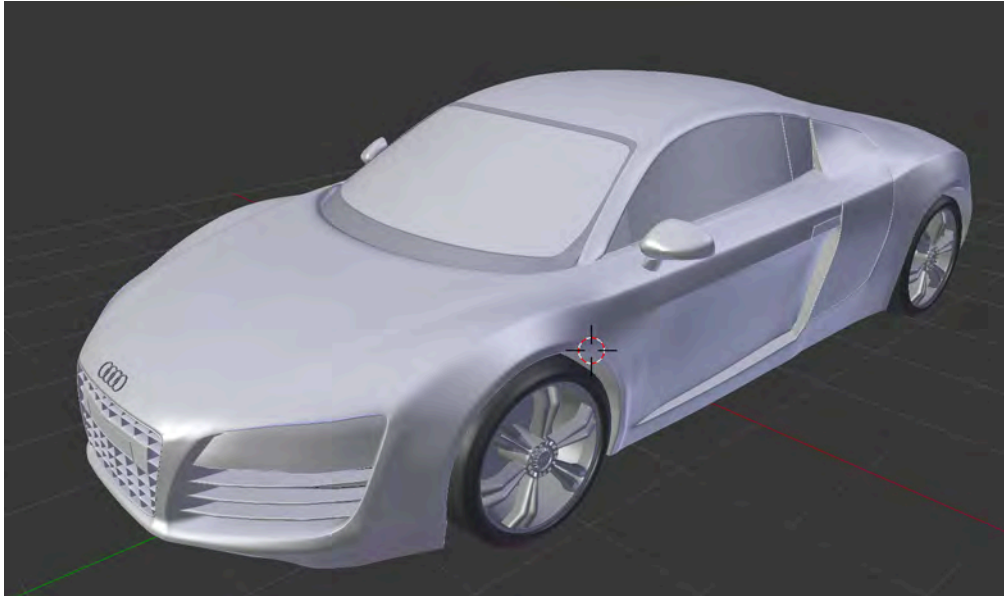
3D Mesh of a Dolphin

Rather than starting from scratch, the most widely used strategy for forming such objects is to begin with a simple mesh object, often called a *primitive*, and then reshape it into the desired form. Primitive shapes can be anything from a single point (*vertex*), to a two-dimensional line (*edge*) or curve (*spline*), to more complex 2D and 3D objects like circles, spheres, cones, toruses, and cubes.



Mesh Primitives in Blender

Additionally, it has become increasingly easy to find and download more complex mesh objects—like buildings, human avatars, or even classic cars—import them into your program of choice, and manipulate them as you see fit.



Free Audi R8 Model, from tf3dm.com

The tools you will have at your disposal to add and manipulate primitives and other objects will depend on your choice of program. Professional modeling programs like AutoCAD, Rhino, and Blender provide you with great tools and functionality, but can be expensive and/or time-consuming to learn. Thankfully, there is also an increasing number of free and easy-to-use programs that are

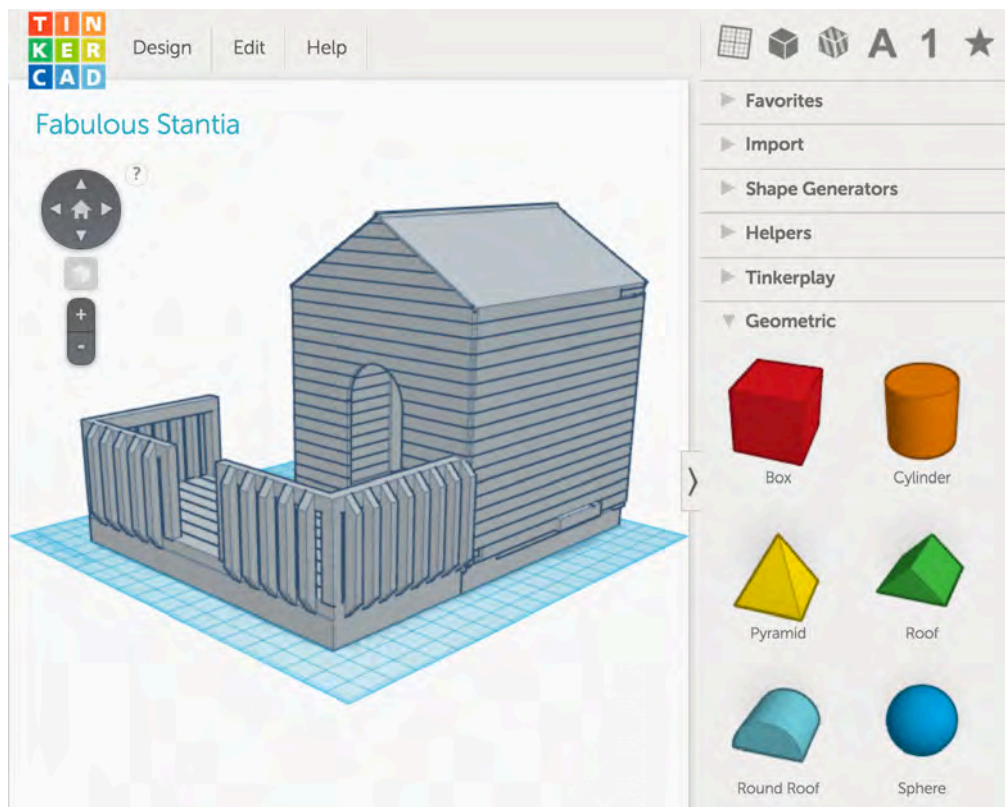
geared towards hobbyists and students. Several of these programs are detailed in the following sections of this guide, any of which will allow you to build, import, and manipulate mesh objects.

For more information about 3D modeling, including a more detailed description of common terminology, follow this link: <http://blog.digitaltutors.com/basic-3d-modeling-terminology/>

Recommended Programs

1. Tinkercad: www.tinkercad.com

Tinkercad is a relatively new 3D modeling program that has quickly become very popular with educators. It is completely free and web-based, so all you need is a computer, Internet connection, and a relatively up-to-date browser to start tinkering. Additionally, Tinkercad boasts what is arguably the most user-friendly and approachable interface of any 3D modeling program. While it has nowhere near the functionality of some of the more advanced programs, it is a very good choice for educators who want to get their students (or themselves) up and running quickly with basic modeling without needing to spend much time on training.



Tinkercad Interface

In addition to providing a generous number of primitive objects with which to begin building, Tinkercad also makes it easy for users to import 2D and 3D shapes from their computer or an external website. Users can also easily download their objects in several common 3D printing and 2D laser-cutting formats, or even as .schematic files, which [can be imported directly into Minecraft using a level editor like MCEdit](#).

For a quick Tinkercad tutorial, follow this link: <https://www.youtube.com/watch?v=MwjWT-EvKSU>

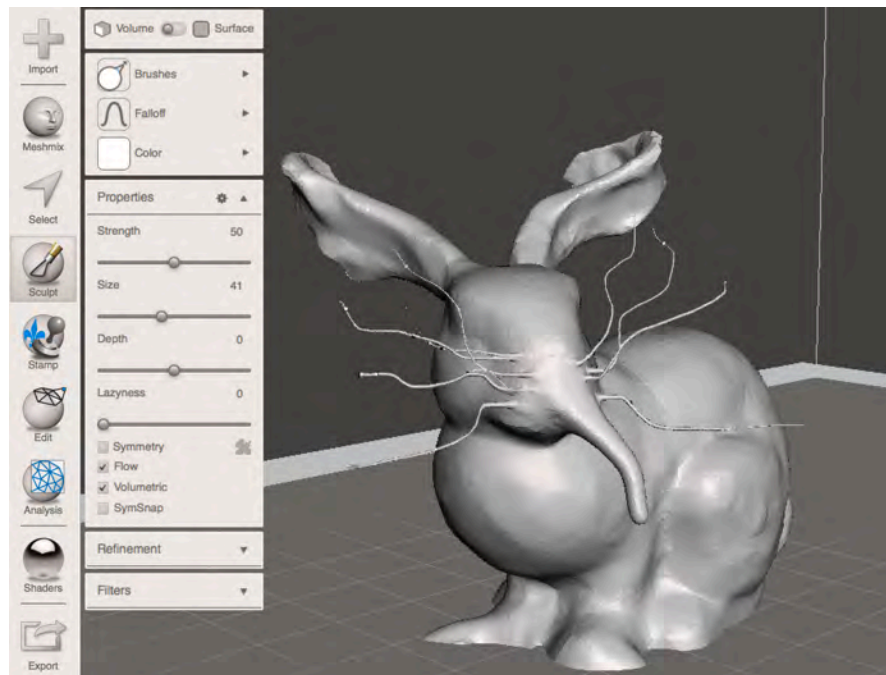
2. 123D Design: <http://www.123dapp.com/design>

123D design is another free and approachable modeling program that was developed by Autodesk, the same company that developed Tinkercad. Not surprisingly, 123D Design looks quite similar to Tinkercad. However, unlike Tinkercad, 123D Design is a standalone program that needs to be downloaded and installed on a Mac/PC computer or tablet. Additionally, 123D Design is more powerful and provides more functionality than Tinkercad, though this comes at the cost of a slightly steeper learning curve. 123D Design is a good choice for users who are interested in modeling fairly complex shapes, and can serve as a good steppingstone to the more advanced modeling programs.

For more information on 123D Design, follow this link: <http://www.123dapp.com/howto/design>

3. Meshmixer: <http://www.123dapp.com/meshmixer>

Meshmixer is another free program, also by Autodesk, that is designed to provide users with a set of easy-to-use tools to manipulate and remix existing 3D meshes to create new models. Like 123D Design, Meshmixer is a full program that needs to be downloaded and installed on a computer before it can be used. Unlike other programs, Meshmixer allows users to manipulate meshes like virtual clay—pushing, pulling, pinching, and combining objects in order to create more sophisticated, or just plain weird, shapes and creatures which can be exported for 3D printing or use in other programs. In addition to the enjoyment factor, this can also make Meshmixer more intuitive for many users, though it may not be the best choice if you want to model a more standard geometric object like a house.



MeshMixer Creature

MeshMixer is a dangerously enjoyable program, and an ideal application for beginners and those looking to create irregular and organic shapes or just have fun with the modeling process.

See also *Sculpt+* for tablets: <http://www.123dapp.com/sculptplus>

4. 123D Catch: <http://www.123dapp.com/catch>

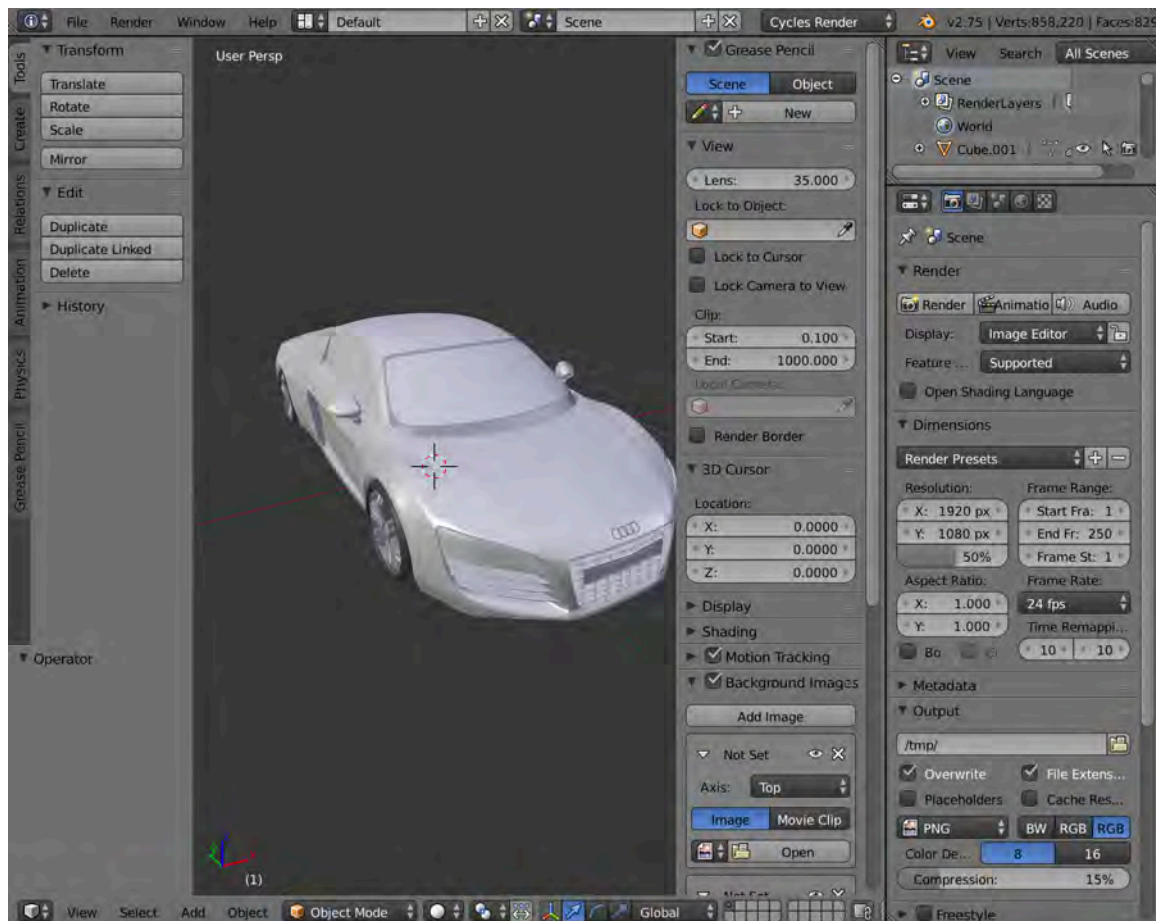
123D Catch is another cool program from Autodesk that turns a series of photographs into a 3D model. You can take pictures with the iPhone and iPad versions, or use a digital camera with any modern Internet browser. Autodesk also provides a standalone desktop version for Windows. There are also tools available in 123D Catch that can help you clean up your scans, select the most important parts, and export a file suitable for 3D printing or further modification in another modeling program.

Follow this link to learn more: <https://www.youtube.com/watch?v=OxsmnDKO7D0>

More advanced users may also want to consider Autodesk Memento, currently available in Beta:
<https://memento.autodesk.com/about>

5. Blender: <https://www.blender.org/>

Blender is a free, open-source, professional-grade 3D modeling and animation program that allows for extremely detailed modeling and photorealistic rendering. With a complicated interface (see image) and a lengthy list of keyboard shortcuts to memorize, Blender is not for the faint of heart. It has a steep learning curve and is a very daunting program for users who are new to 3D modeling. However, it can be a great choice for advanced and adventurous users. There are [many online tutorials available](#), but don't expect to be able master Blender in a day...or even a week.



Blender Interface