

# Computer Graphics & Animation

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Computer animation is the use of computers to create animations. There are a few different ways to make computer animations. One is 3D animation. One way to create computer animations is to create objects and then [render](#) them. This method produces perfect and three dimensional looking animations. Another way to create computer animation is to use standard computer painting tools and to paint single frames and composite them. These can later be either saved as a movie file or output to video. One last method of making computer animations is to use [transitions](#) and other special effects like [morphing](#) to modify existing images and video.

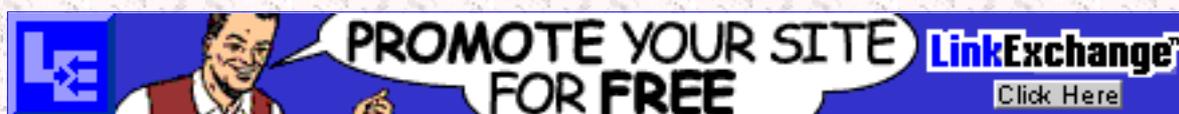
Computer graphics are any types of images created using any kind of computer. There is a vast amount of types of images a computer can create. Also, there are just as many ways of creating those images. Images created by computers can be very simple, such as lines and circles, or extremely complex such as [fractals](#) and complicated rendered animations.

If you want to create your own computer graphics, no matter how simple or complex, you have to know a few things about computers, computer graphics, and how they work.

The following information should help you get started in the field of computer graphics:

- [Anti-aliasing](#)
- [Binary system](#)
- [Bit depth](#)
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- [Transitions](#)
- [Vertex](#)



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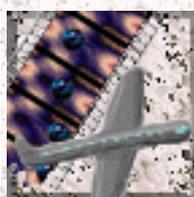
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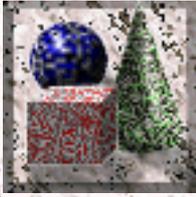
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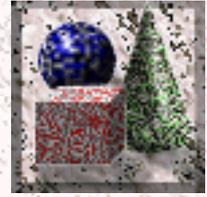
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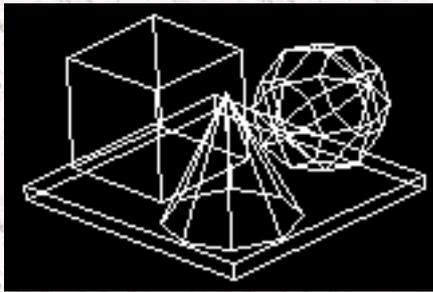
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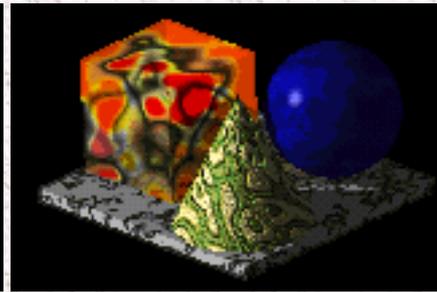
# Rendering



Rendering is the process a computer uses to create an image from a data file. Most 3D graphics programs are not capable of drawing the whole scene on the run with all the colors, textures, lights, and shading. Instead, the user handles a mesh which is a rough representation of an objects. When the user is satisfied with the mesh, he then renders the image.



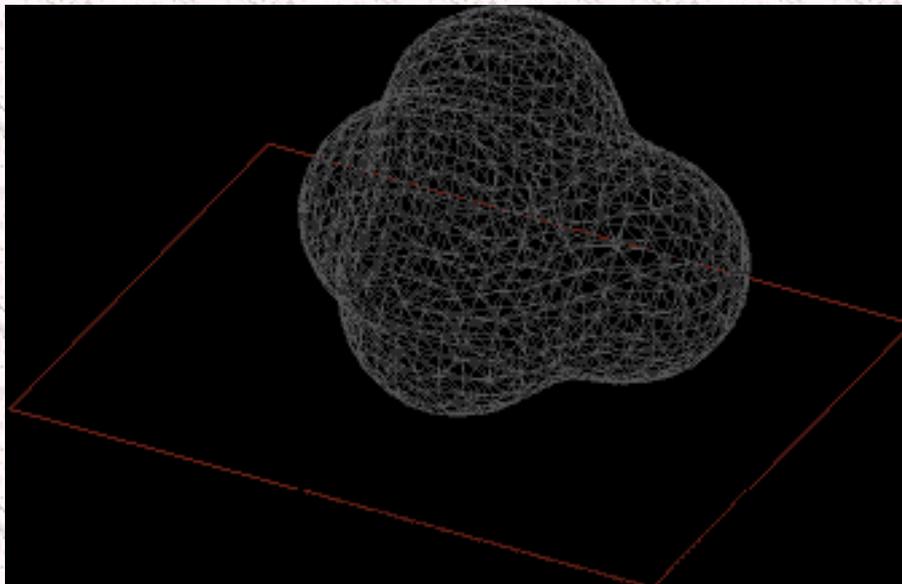
A Mesh



A Rendered Image

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## Wire Frame



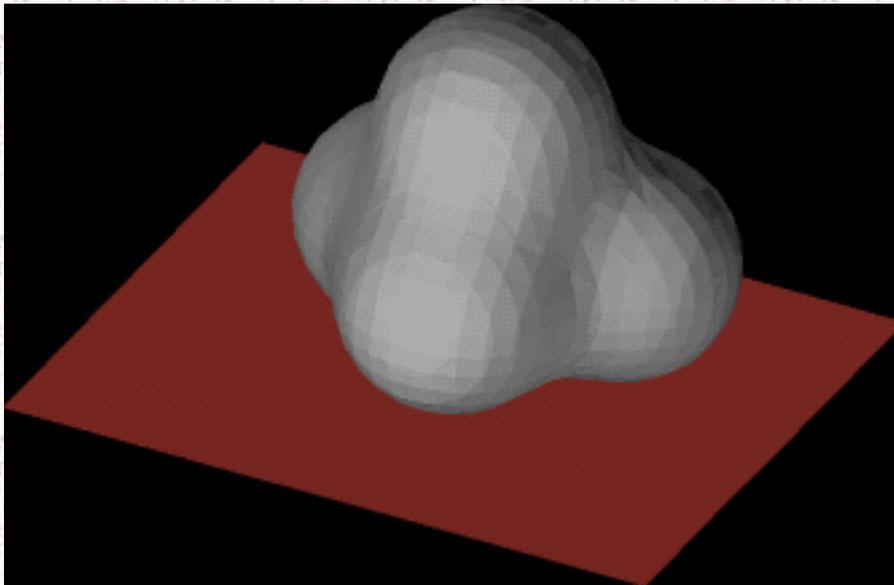
This isn't really a rendering method, by definition. Most 3D graphics programs represent objects as meshes. What happens in wire frame rendering is, every section of the mesh gets colored in with the average color of the texture. This comes in useful for special effects, and for quick previews. To take wire frame rendering one step further, some programs do a process called hidden line removal. It is just like normal wire frame rendering, except the parts of the mesh that would not be visible if the

mesh was a solid are not rendered.

Rendering usually takes a long time. The time it takes to render an image depends on the quality of rendering. There are a couple of different qualities of rendering.

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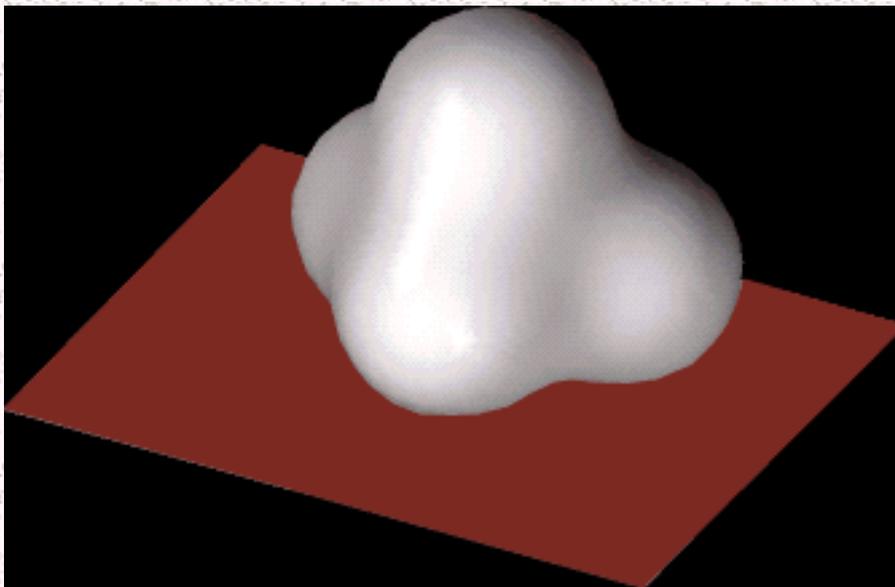
## Flat Shading



The quickest rendering method. Some programs are able to render flat shaded objects in [real time](#). When rendering using flat shading, the computer takes creates an average color for an object and then renders each face with different amounts of black or white added to simulate shading. Objects look flat and unrealistic. No textures are applied in this mode.

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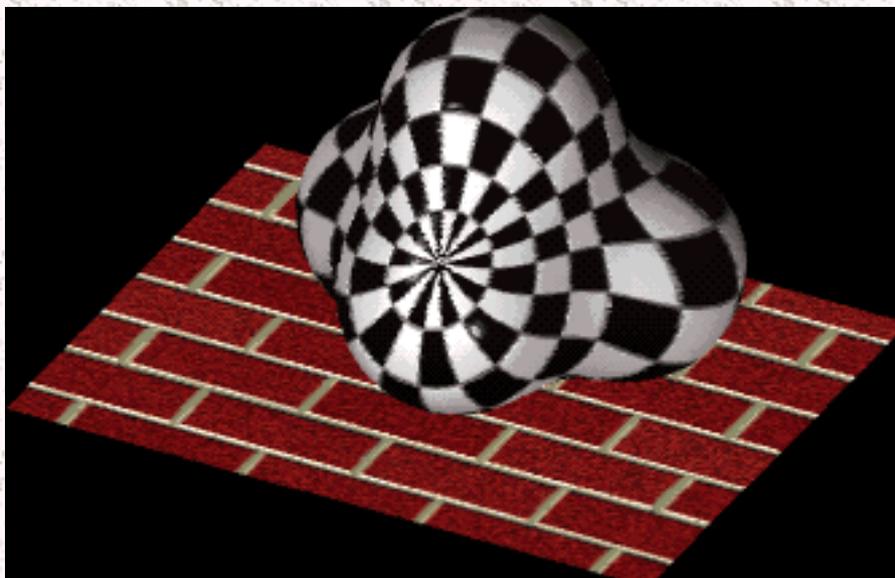
## Gourad



Gouraud rendering takes flat rendering one step further. The computer figures out values of a color on vertices of a face and then applies a gradient to the face to simulate shading. This mode is not much slower than flat shading and can also be rendered in [real time](#) on some of the more powerful computers.

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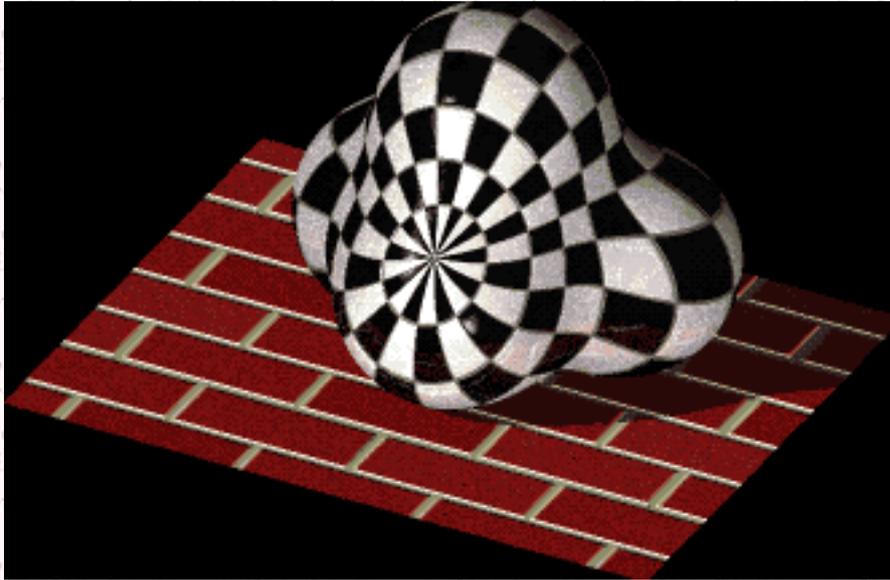
## Phong



Phong rendering takes rendering yet one more step further. It actually probes every pixel in the visible area and tries to determine a correct color for it. It takes into account all lights and textures. This is often as good as many low-end programs render. The results are pretty good, and the time that it takes to render is not **extremely** long.

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## Ray Tracing



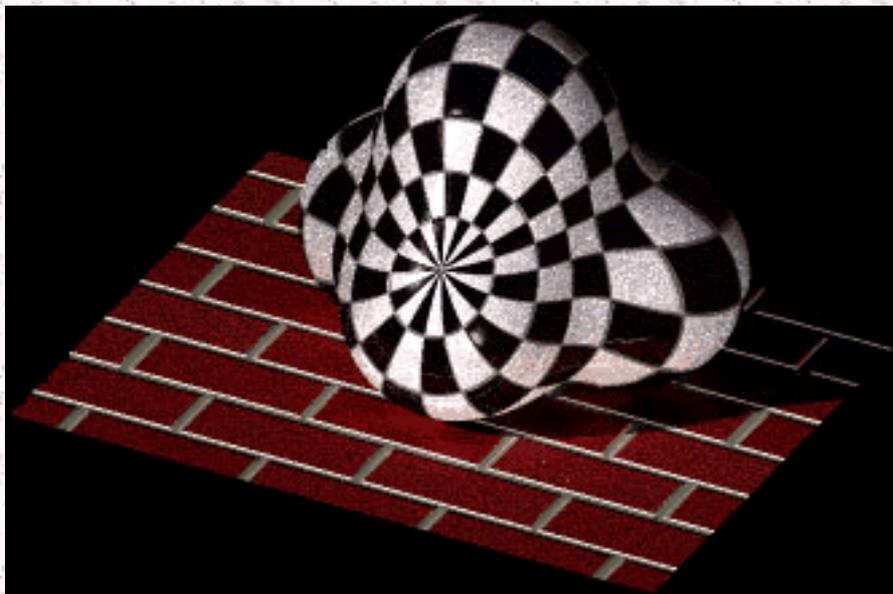
The best rendering quality. It also takes very long, but the results are awesome. Everything is rendered, including shadows, lighting, reflections, and transparencies. It also does another thing that other rendering options don't. It gives light a physical attribute. For example, a rendering of a pencil in a glass of water would give you the same diffraction effect that nature does: the pencil will appear broken. When a computer ray traces an image, it simulates a beam of light going out of every pixel on the screen. It reflects and deflects the beam of light in a similar fashion nature would. Finally it takes outcome of all this and puts it on the screen.

Here is a link to a more "in depth" definition of [ray tracing](#) at SIGGraph.

Look at this site dedicated to [ray tracing](#).

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## Radiosity



There is a new method of rendering that was recently developed. It is called radiosity. It does something all the other rendering methods don't do: it figures out the relationship in the scene of all the objects present. For example, in real life, if you take a bright colored ball and put it into a white room, the walls of the room are going to reflect a little bit of color from the ball, making them look a little reddish for example. This is not possible in raytracing, since it does not bounce rays off of matte objects, such as a wall.

You can compare the above picture to the one of the raytraced object. Although this is not a very good example, you can see that the checkerboard pattern of the "tri-ball" has a slight effect on the color of the bricks right underneath it. This adds the extra thing to rendered scenes and makes them look extremely realistic.

Radiosity produces extremely good results, but unfortunately, there is a tradeoff: rendering time. Before the computer even starts rendering, it has to solve a certain "radiosity model" which is the relationship of one object on all the other ones in a scene. Then it can start rendering.

For some more information on radiosity, try this [site](#) out at Cornell.

For some sample images of raytracing and radiosity try this [image sampler](#), again at Cornell.

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Here are some links to some extra informations as well as in depth explanations of terms that have to do with rendering:

[Color Theory](#)  
[Illumination](#)  
[Color and Light](#)  
[Diffuse Reflection](#)  
[Specular Reflection](#)

## Reflection & Transparency Shading Techniques

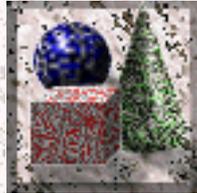
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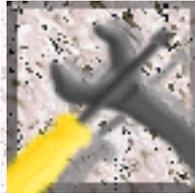
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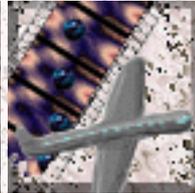
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# Transition



In computer animation, transitions are ways of moving from one picture to another. A simple transition might be a fade. In a fade, one image fades out while the other one fades in giving an animation a cool look. Other examples of transitions are wiping, [morphing](#), blending, etc.

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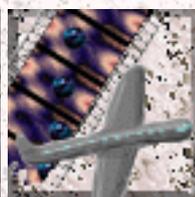
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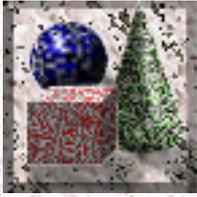


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# Morphing



Morphing is a very cool looking [transition](#). It is also one of the most complicated ones. A morph looks as if two images melt into each other with a very fluid motion. In technical terms what happens is, two images are distorted and a fade occurs between them. This is pretty complicated to understand, but believe me, it looks very cool. (You might have seen morphing in the Gillette© and Shell© gasoline commercials).

Warping is the same as morphing, except only one image is distorted and no fade occurs.



The original graphics    A warped version of this image

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If you have Netscape 2.0 or another browser that supports animated GIF's, wait for the below image to load to see a warping Mona Lisa.



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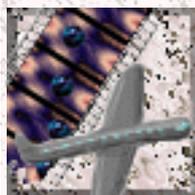
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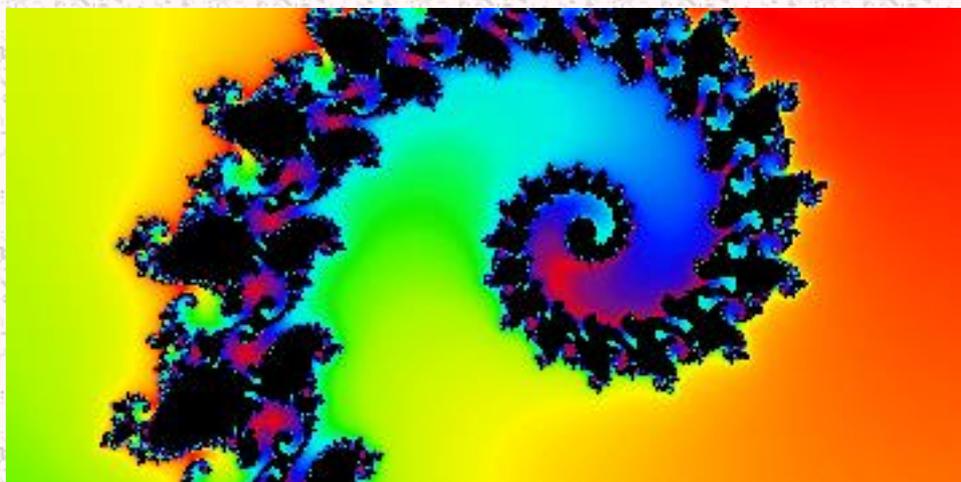
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# Fractals



Fractals are very complex pictures generated by a computer from a single formula. Very often they are very colorful and look beautiful. A fractal gets created by using iterations. This means that one formula is repeated with slightly different values over and over again, taking into account the results from the previous iteration. The results are then graphed. In fractals, the little parts of them look like the big picture, and when one zooms in more, one will find more and more repeating copies of the original.

For more information on fractals, try the fractal [FAQ](#).

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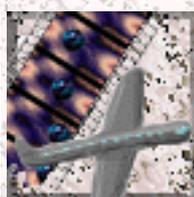
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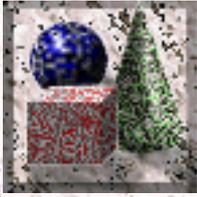


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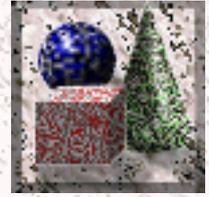
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# Anti-aliasing



Anti-aliasing is the process of blurring sharp edges in pictures to get rid of the jagged edges on lines. After an image is [rendered](#), some applications automatically anti-alias images. The program looks for edges in an image, and then blurs adjacent pixels to produce a smoother edge.

In order to anti-alias an image when [rendering](#), the computer has to take samples smaller than a pixel in order to figure out exactly where to blur and where not to. For example, if the computer finds that one pixel is on the edge of two objects, it then takes sub-pixel samples and checks about how many of them showed the front object, and how many showed the back one. Let's say that the computer took 8 sub-samples, and 4 of them were on object one and the other 4 on object two. The computer then takes the resulting color values from the subsamples and averages them into a resulting blurred pixel, when viewed from a distance gives a smoother edge effect.

In the below example, you can see an image without anti-aliasing and with anti-aliasing and enlargements of these two pictures.



Original image



Anti-aliased image



Original image (x6)



Anti-aliased image (x6)

A more detailed description of anti-aliasing as well as the explanation of different algorithms used is available by following this [link](#) at [SIGGraph](#).

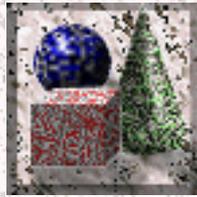
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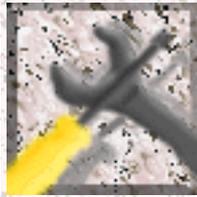
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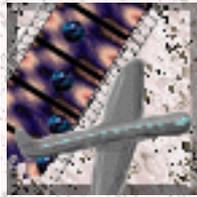
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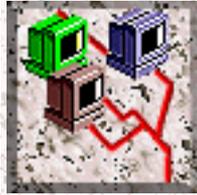
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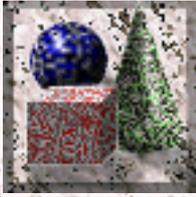


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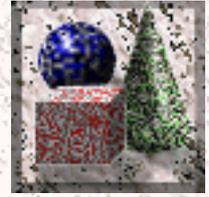
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# Binary System



Everything in the computer world, including graphics, is based on the binary system. The binary system is based on only 2 numbers, 0 and 1, unlike our decimal system which is based on numbers from 0 through 9. You can also think of the binary system being based on powers of 2 as the decimal system being based on powers of 10. This is because in the binary system you add another number place every time you reach another power of two (2,4,8,etc) and in the decimal you add another place every time you reach a power of 10 (10,100,1000).

The binary system is the simplest number system, since it only has two numbers. Computers use the binary system because binary information is extremely easy to store. A system of ON and OFF switches will do the job. Every 0 is marked by an OFF switch, and every 1 is marked by an ON switch. Binary digits are also very simple to work with mathematically, in fact, the computer can only do calculations on binary digits. Every time you calculate something on a computer using our standard decimal system, the computer converts it to binary, solves it, and converts it back to decimal and spits back out the answer.

One might think that the binary system is very complicated, but it is not. When you count in the decimal systems it goes like this: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and then you ran out of digits, so you make a two-digit number, 10. In the decimal system it is exactly the same: 0, 1, and you are already out of digits. Now you make the binary number 10, which is equivalent to the decimal 2. And then you go on: 10, 11, 100, 101, and so on.

Here is a table of the first 20 binary numbers and their decimal equivalents:

<u>Decimal</u>	<u>Binary</u>	<u>Decimal</u>	<u>Binary</u>	<u>Decimal</u>	<u>Binary</u>	<u>Decimal</u>	<u>Binary</u>
<b>0</b>	0	<b>5</b>	101	<b>10</b>	1010	<b>15</b>	1111
<b>1</b>	1	<b>6</b>	110	<b>11</b>	1011	<b>16</b>	10000
<b>2</b>	10	<b>7</b>	111	<b>12</b>	1100	<b>17</b>	10001
<b>3</b>	11	<b>8</b>	1000	<b>13</b>	1101	<b>18</b>	10010
<b>4</b>	100	<b>9</b>	1001	<b>14</b>	1110	<b>19</b>	10011

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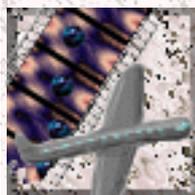
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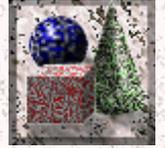
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# Bit Depth



Bit depth is the number of bits used to store information about each pixel. The higher the depth, the more colors are stored in an image. For example, the lowest bit-depth, 1 bit graphics are only capable of showing two colors, black & white. This is because there are only two combinations of numbers in one bit, 0 and 1. Four bit color is capable of displaying 16 colors because there are 16 different combinations of four bits:

0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111

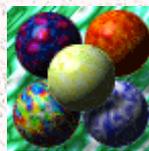
With 8 bit color, there is a total of 256 colors available. With 16 bit color, a total of 65536 is available. When you have 24 bit color, a total of 16777216 colors is available.

Bit depth might refer to the bit depth of an image, or the bit depth of a monitor. When it refers to the bit depth of a monitor, it means that your monitor is able to show a certain number of colors at one time. If it is meant as the bit depth of an image, it means that the image may contain the specified number of colors.

The following are examples of the same image of different bit-depths. You might not be able to appreciate all the quality of 16 bit images if your monitors do not support those bit-depths.



1-Bit image



8-Bit image



16-Bit image

(781 bytes) (5,362 bytes) (11,982 bytes)

You might wonder why not use the best bit depth for all images to make them look good. Well, as you might have noticed, the higher the bit depth, the more bits per pixel used in an image, and the more pixels used in an image, the larger the actual file is going to be. Sometimes you don't need very high image quality, so you won't use a high bit depth to preserve space.

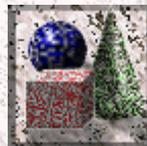
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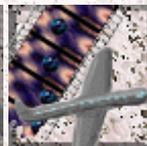
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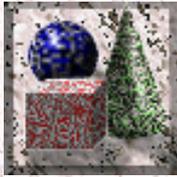


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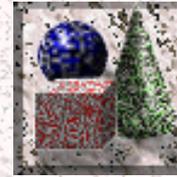
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# Bitmap



A bitmap is a collection of [pixels](#) that describes an image, in human terms, a complete picture. A bitmap can be of various [bit depth](#) and [resolution](#). Basically, a bitmap is an array of pixels.



A [bitmapped graphic](#) Enlarged to show detail and individual pixels.

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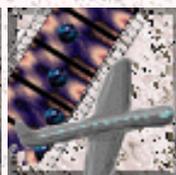
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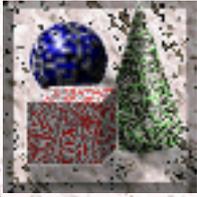


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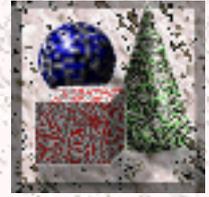
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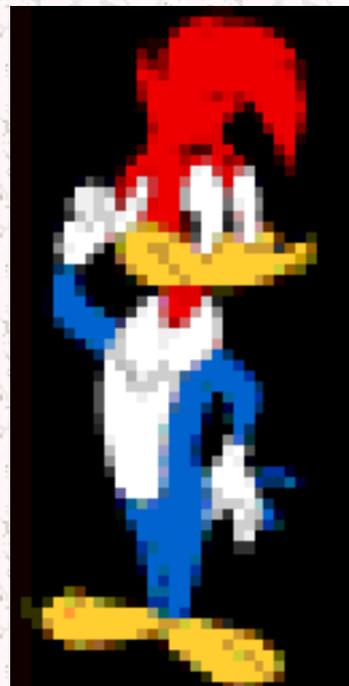
# Bitmapped Graphics



There are two kinds of computer graphics: Bit Mapped and Object Oriented. Bit mapped graphics are graphics that are stored in the form of a [bitmap](#). They are a sequence of bits that get drawn onto the screen. You create bit mapped graphics using a painting program. You can not edit the components of a bitmapped image once you drew them. For example, if you use your painting program to draw a line, you will not be able to edit that line as a separate object. It becomes part of the image. From now on, that line is a pattern of pixels.

When you enlarge a bit mapped image, you will get a pixelated look. If you are planning to print out an image that was originally 3 inches on 3 inches as 6 inches by 6 inches, you will get a very pixelated look.

One might use bit mapped graphics to edit [digitized](#) pictures. Bit mapped graphics are usually easier to work with. Bit mapped graphics tend to create larger files than object oriented graphics. There are some exceptions to that rule.



Original bitmapped graphic    Same image scaled up

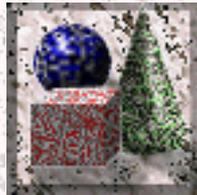
As you can see from these two pictures, when a bitmapped image gets scaled up, the detail is lost, as opposed to an [object oriented drawing](#) where no pixelation occurs.

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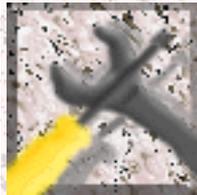
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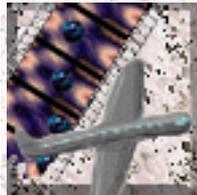
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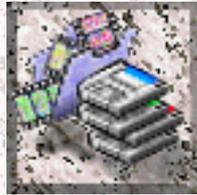
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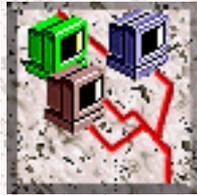
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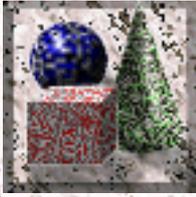
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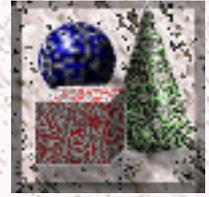
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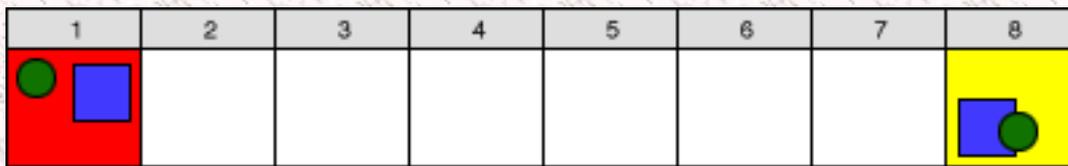
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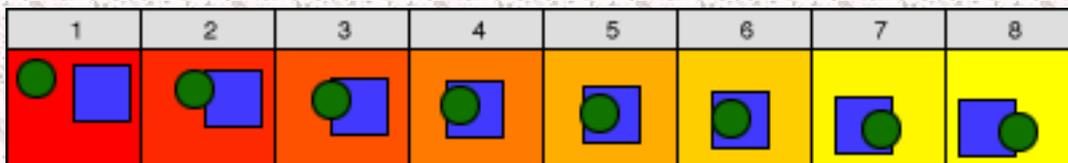
# Keyframe



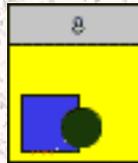
When someone creates a 3D animation on a computer, they usually don't specify the exact position of any given object on every single frame. They create keyframes. Keyframes are important frames during which an object changes its size, direction, shape or other properties. The computer then figures out all the in between frames and saves an extreme amount of time for the animator.



2 frames drawn by user



Inbetween frames generated by computer



Final Animation

(Note: Actual in between frames were drawn by me, not the computer, so the animation is not very smooth, but I hope it does demonstrate the concept.)

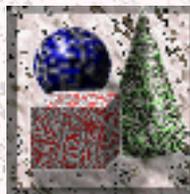
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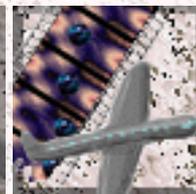
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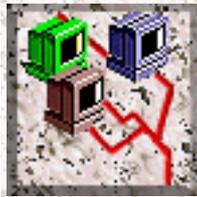
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# Modeling



There are many ways of creating [meshes](#) on a computer. In order to acquire a complex mesh, it can often be [digitized](#). More often however, one has to model the mesh.

Modeling is the process of creating 3D objects from simple 2D objects by [lofting](#), or from other simple 3D objects called [primitives](#). Primitives can be combined using a variety of [boolean](#) operations. They can also be distorted by dragging around their [vertices](#) or distorted in different ways.

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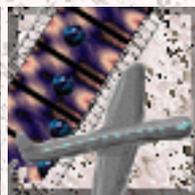
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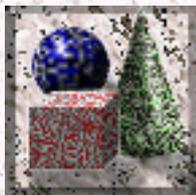


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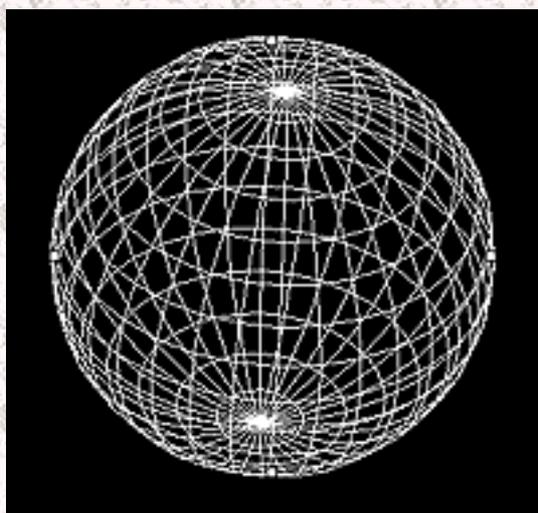
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# Mesh



A mesh is a collection of [faces](#) which describe an object. An object can be anything, a sphere, a pyramid, a car tire, or an elephant. The faces are arranged in such a way that they form the outside surface of that object. It could be thought of as the skin of the object. The mesh is usually depicted in [wireframe](#) mode, as this shows the faces and the outline and does not take very long to [render](#).



A very simple mesh of a sphere

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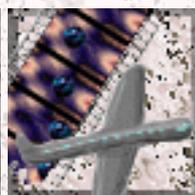
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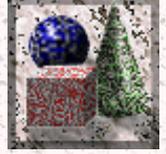
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# Object Oriented Graphics



There are two kinds of computer graphics: Bit Mapped and Object Oriented. You create object oriented graphics in a drawing program. When you create objects in a drawing program, you can still edit them after you have done something else. For example, if you draw a circle in one place, then draw a rectangle in another place, you can still select the circle and change its size and location. This is possible because object oriented graphics are stored as dimensions and formulas, unlike [bit mapped](#) graphics which are stored as individual pixels. When a drawing program opens a drawing file, it will look for objects, not pixels. A drawing file may be thought of as a series of instructions like the ones below, but in a computer language which most normal people can not understand.

Draw a circle at the point that is 100 pixels to the right and 140 pixels down from the top-left corner of the screen with the radius of 25 pixels.

There are advantages as well as disadvantages to object oriented graphics over bitmapped graphics. As already mentioned, object oriented graphics can still be modified as separate objects after being modified, unlike bitmapped which can't. Second, object oriented graphic files (drawing files) are usually much smaller in size than bitmapped graphics. Third, you can enlarge a object oriented graphic to any size, and it will not loose detail. That is because most object oriented graphics are [resolution](#)-independant. A disadvantage is that there are usually harder to create, and can not have many interesting special effects done to them, such as blurring for example.



Original object oriented image      Same image scaled up

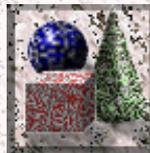
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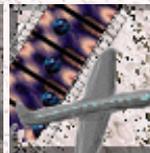
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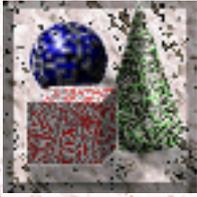


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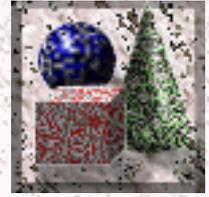
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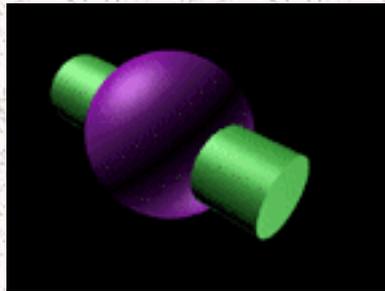


# Boolean Operations

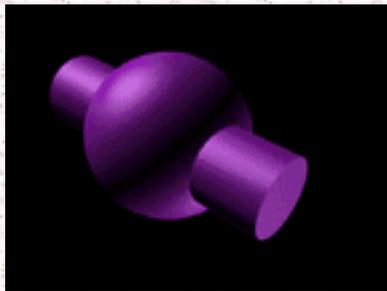


In regard to 3D [modeling](#), there are three primary operations: addition, subtraction, and intersection.

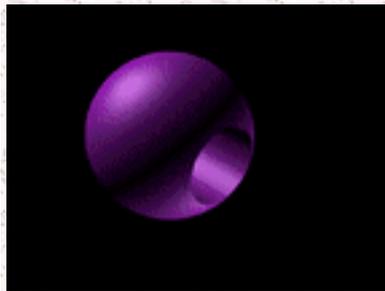
In order to create a boolean object, you first need two other objects. They can be [primitives](#) or other [meshes](#). They also need to intersect in 3D space. If you do addition, the resulting object will be the sum of the two initial objects. It will look as if the two were welded. If subtraction is what you are doing, the second object get subtracted from the first one. A hole in the shape of the second object is created in the first one. All the space that was occupied by both of the objects is taken away from the first one. Finally, in the intersection mode, the final object occupies the area in which both of the initial intersected.



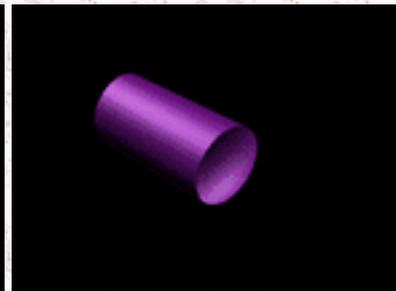
Two original objects



Addition



Subtraction

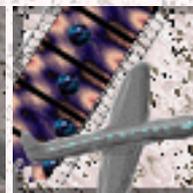
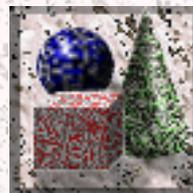


Intersection

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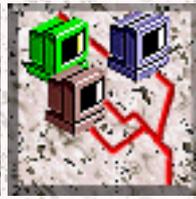


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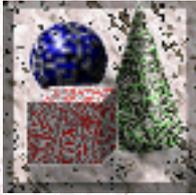
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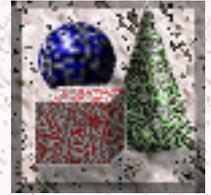
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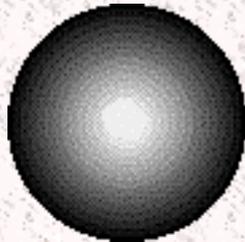
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# Contouring



Contouring is the loss of detail when converting a gradient image into a image with a smaller number of colors. An example is shown below.



Original sphere    The contouring effect

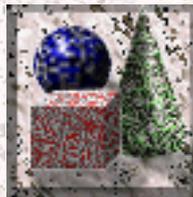
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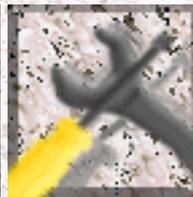
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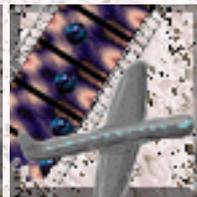
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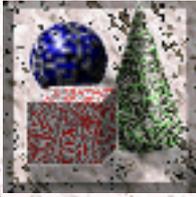


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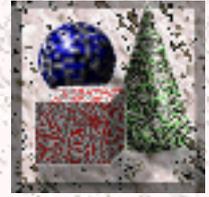
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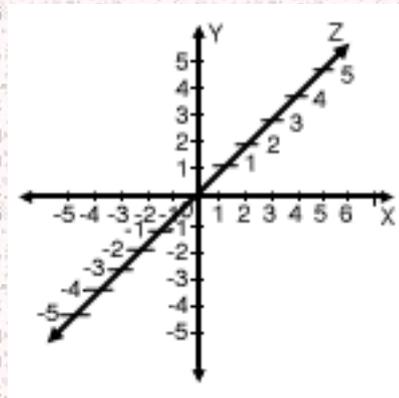
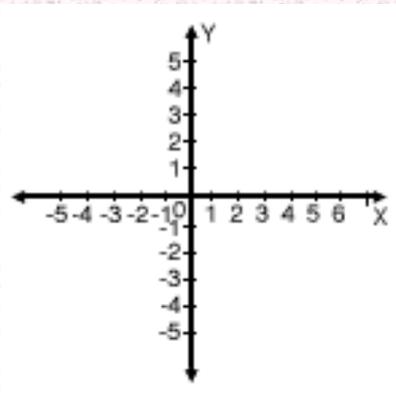


# Coordinate System



In real life, we can tell where objects are by measuring distance between them. As for placing them, moving them, and keeping track of where they are nature has developed a pretty good system. On the computer though, we have to somehow keep track of objects in a 3D scene. Mathematicians have developed the coordinate system. You have probably learned in geometry about the X and the Y axis. Well, these two axis define a coordinate plane, that is, a two dimensional world. However, to work in three dimintions, we need one more axis, the Z axis.

Each axis is like a number line. The three axis are perpendicular to each other. The point at which they intersect is called the point of origin. The point of origin is designated as 0,0,0, because it is located on the 0 point on all three axis. Now let's say that you want to define a point in space. You can do this by giving three numbers. The first one is the distance of the point from the origin in the X axis. The second one is the offset of the point from the point of origin along the Y axis, and the third on the points distance away from 0 along the Z axis.

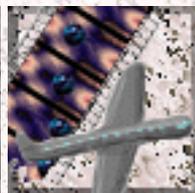


2D Coordinate Plane (Imagine the Z axis perpendicular to the XY plane)  
3D Coordinate System

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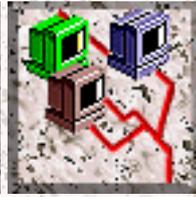


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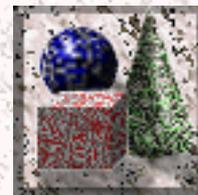
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# Digitizing



Digitizing is the process of converting a continuous signal (such as sound or video) into distinct units that the computer or other electronic equipment can process. There are many ways to digitize things. There is the microphone, which digitizes sound. The scanner can digitize photos and other images. A digital camera is able to bring video into the computer.

You can also digitize 3D objects. For that you use a 3D digitizer. These come in many different shapes and sizes. They usually use lasers to map out the 3D points and create a [mesh](#). Some other ones may use a pen as a probe which is attached to some sort of armature which can calculate points you touch on real objects into a computer model.

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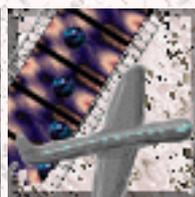
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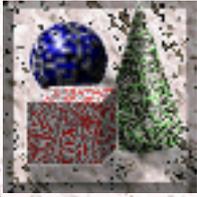


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# Dithering



Dithering is the process of converting an image with a certain bit depth to one with a lower bit depth. For example:



Original image

Dithered to 256 colors

When an application dithers an image, it converts colors that it can not display into patterns of two or more colors that closely resemble the original. You can see that in the B&W image. Patterns of different intensities of black and white pixels are converted represent different shades of gray. Below are some more exaples:



A gradient of grays



Same gradient converted to B&W

Dithering works because your mind is tricked by the pattern of colors into thinking that it is a different color.

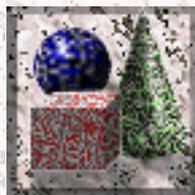
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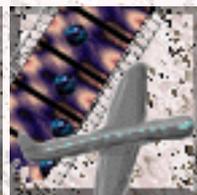
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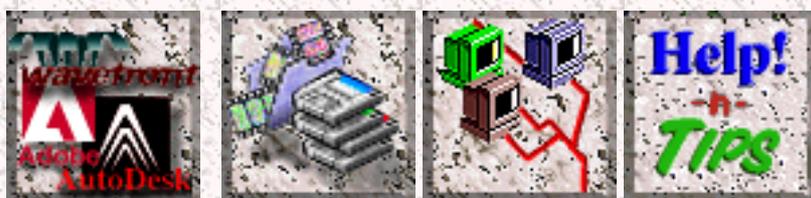
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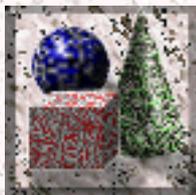
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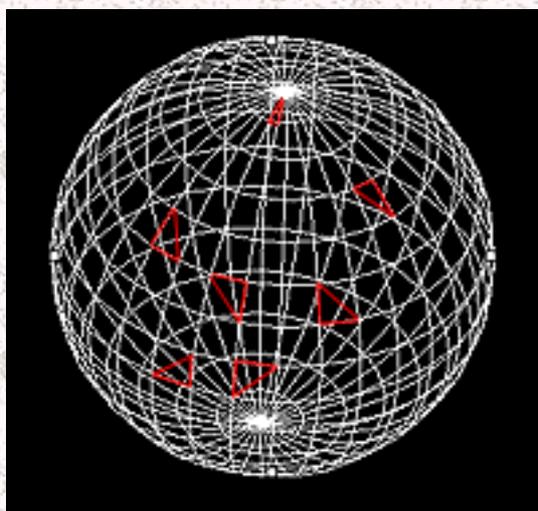


# Face



A face is a collection of 3 or more [verteces](#) tied together to form a small triangle surface. Most 3D programs use 3 sided faces, but some support 4 sided ones too. A collection of faces is refered to as a [mesh](#). Each face also has a special entity tied to it called a [normal](#). The normal defines which side of the face is considered to be the inside of an object, and which is the outside.

Faces are very often refered to as polygons.



Each red triangle is a face

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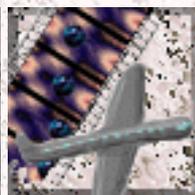
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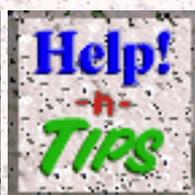
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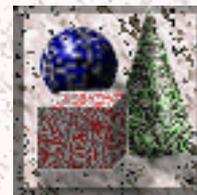
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# Title



There is a very large number of different file formats for images and movies/animations. There is no way to mention all of them. Different file types have their own qualities. Some file types store compressed images, others can only hold files of a specific bit depth and resolution. Finally, there are those files that contain information specific only to one application.

The following is a list of most common file types and their characteristics.

File Type	DOS or UNIX extension	Maximum Bit Depth	Description
Gif	.GIF	8	Universal graphic file
Targa	.TGA	32	Universal graphic file
JPEG	.JPG	24	Universal graphic file
Pict	none	32	Standard Macintosh graphics file
TIFF	.TIF	32	Universal graphic file
Flic	.FLI	8	Animation; Less than 640 by 480
Flic	.FLC	24	Animation; Larger or 640 by 480
Quicktime Movie	none	24	Mac or Windows Digitized Movie
SGI	.SGI	24	SGI image file
RGB	.RGB	24	SGI image file
BMP	.BMP	8	Standard Windows graphic file (Uncompressed)
RLE	.RLE	8	Standard Windows graphic file (Compressed)
PCX	.PCX	8	Paintbrush graphics file

Also check out the following lists of file types:

[Image File Types](#)  
[3D File Types](#)  
[Animation File Types](#)

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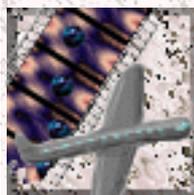
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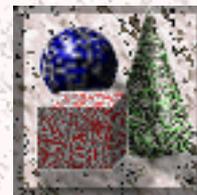
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# Hierarchy



When modeling a character, it is often useful to establish a hierarchy between all the objects making up the character. To explain what hierarchy is let us consider a model of a human. You have 5 fingers. Each of the fingers is connected to your hand. The hand is connected to your lower arm which in turn is connected to your upper arm. Finally the whole arm is connected to your torso. If you were to model a human arm, you would probably set up the same type of hierarchy. You would connect the fingers to the hand and the hand to the lower arm and the lower arm to the upper arm. You might ask yourself how does this help you. Well, consider animating this arm. If the objects were all disconnected, you would have to place each part of the whole arm in the appropriate position. With an established hierarchy, you start with the the object highest up in the hierarchy and position it in place. When you do this, all the objects further down follow. Then you continue going down the hierarchy until the whole arm and its components are in the position you want them to be in.

Some programs allow you to use [inverse kinematics](#) once a hierarchy is established to animate characters.

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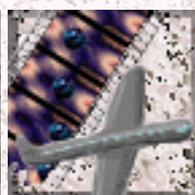
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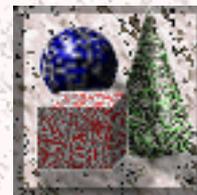
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# Inverse Kinematics



Before you try to understand what inverse kinematics is you have to know what [hierarchy](#) is.

If you have a hierarchy established, some programs allow you to take advantage of a process called inverse kinematics to position and animate characters. Unlike in a regular hierarchy, in inverse kinematics, all you have to do is pull on the object lowest in the hierarchy and the rest of them follow. This is possible because the computer calculates the position of the objects higher up in the hierarchy according to restraints and other parameters specified for a character.

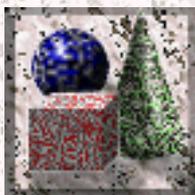
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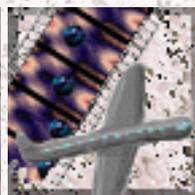
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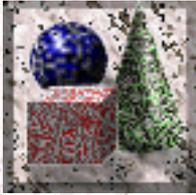


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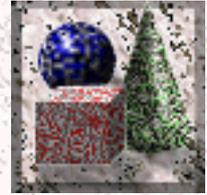
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# Onionskinning



Onionskinning is a term that commonly refers to a graphic process in which an image or an animation is composed of a couple of different layers. For example, if you have ever used Adobe Photoshop 3.0 or higher you are probably familiar with the layers window. That is exactly what onionskinning is all about. Imagine it as a series of totally transparent pieces of plastic with different drawings on them. When they are all stacked on top of another, a composite is formed. This is widely used in traditional animation when the background is a separate layer and each character is a separate layer. This way, only layers have to be redrawn or repositioned for a new frame. Onionskinning is also found in computer software where different effects can be placed on different layers and later composited into a final image or animation.

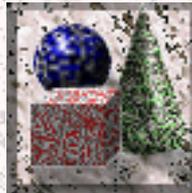
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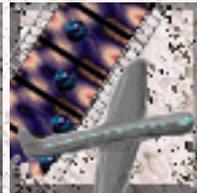
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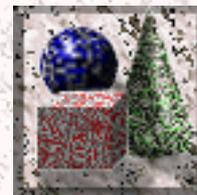
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# Pixel



A pixel is the most basic component of any computer graphic. Pixel stands for picture element. It corresponds to the smallest thing that can be drawn on a computer screen. Every computer graphic is made up of a grid of pixels. When these pixels are painted onto the screen, they form an image. This grid of pixels is called a [bitmap](#).



A black & white bitmapped image

Same image but magnified to show individual pixels

In black & white, each pixel can be represented by 1 bit, a 1 if the pixel is black, or a 0 if the pixel is white. The computer opens a black & white bitmapped image. then it starts looking for numbers that describe image information. Every time it comes to a 0 it draws a white pixel. When it comes to a 1 it draws a black pixel.

```

0000000000000000000011110000000000000000
0000000000000000000011000011000000000000
00000000000000000000100000000100000000000
0000000000000000000010000000000100000000000
0000000000000000000010001000100100000000000
000000000000000000001000111011100100000000000
000000000000000000001000010001000100000000000
000000000000000000001000000000000100000000000
00000000000000000000100000000000001000000000000
00000000000000000000100100000001001000000000000
00000000000000000000100100000100100000000000000
00000000000000000000100011110001000000000000000
00000000000000000000100000000010000000000000000
000000000000000000001100001100000000000000000000
00011110010000000000000000000000000000000000000000
0110001001000000000000000000000000000000000000000000
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00000100100001110001011000101100100100100
00111111110010010001101000110101100100100
    
```

```
00001001000100100111001011100101001000
00010010000101101010010101001011011010
00010010000110110111111011111101101100
00000000000000000100000010000000011000
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000000000000000001000000100000000100000
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Binary data describing the above image

Sometimes you need more than 1 bit per pixel. This depends on the bit depth of an image. Bit depth is described next.

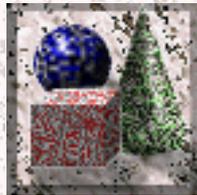
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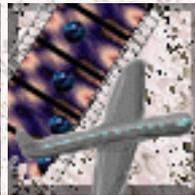
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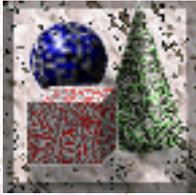


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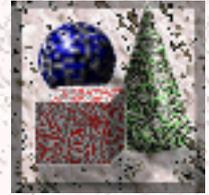
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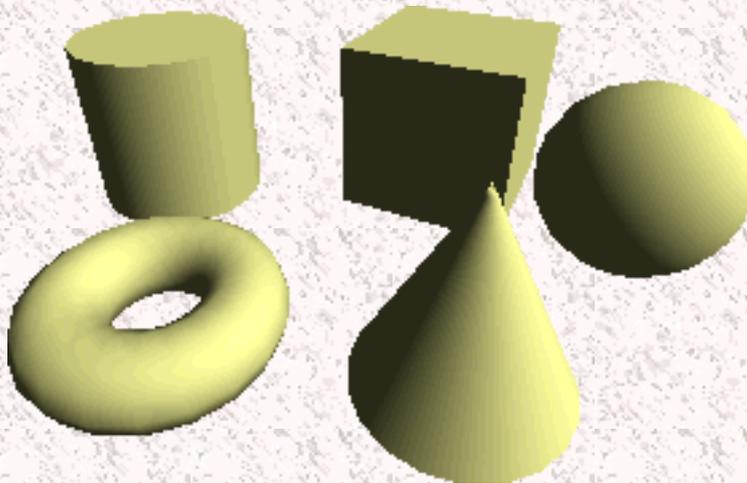
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# Primitives



If you really look around, you might realize that many objects around you are made up of very simple objects. Take a chair for example. It is created of a bunch of blocks. A table might be 2 cylinders, one really short and wide one for the top, and one long skinny one for the leg. Most 3D programs provide the user with a number of primitives from which they can model more complex objects. These primitives most often include a sphere, a box, a cylinder, a cone, and a torus. Some programs have more, like tube or hemisphere. In order to create other objects though, such as garden hose for example, you might need to use other [modeling](#) methods such as [extrusion](#) or [lathing](#).



The 5 primitives

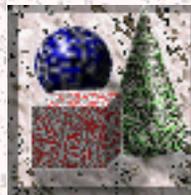
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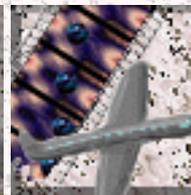
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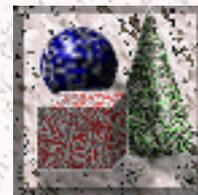
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# Real Time Rendering



Rendering in real time means that the computer updates the screen with an actual rendered image instead of a mesh on the fly. Real time rendering is most often done in flat rendering modes. This is because the more complicated rendering modes such as phong or gourad require more computer muscle, and hence can not render in real time. Real time rendering is what makes virtual reality possible.

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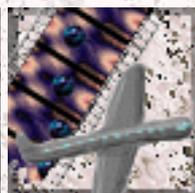
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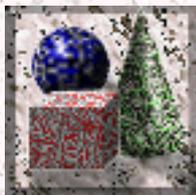


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# Resolution



Resolution in computer graphics either refers to the number of pixels per inch or other unit of measure (centimeter for example) on a monitor or printer. It is also sometimes used to describe the total number of pixels on a monitor. Resolution is usually measured in pixels per inch or dots per inch (dpi).

Most monitors can display at 72 dpi. Monitors come in a variety of resolutions. They can get as small as 320 pixels by 200 pixels or as large as 1280 by 1024.

Printers can also print at many different resolutions. The resolution can be as small as 128 dpi or less, to 300 dpi on inkjet printers, to 720 dpi on laser printer, and up to 2000 dpi on high quality type-setters.

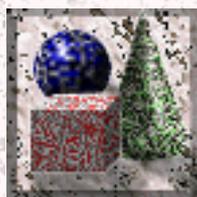
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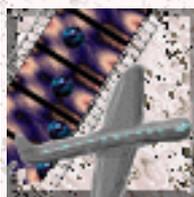
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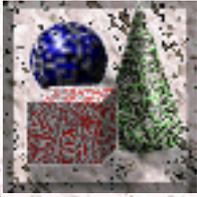


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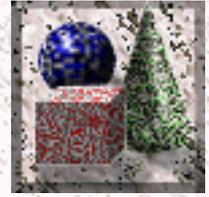
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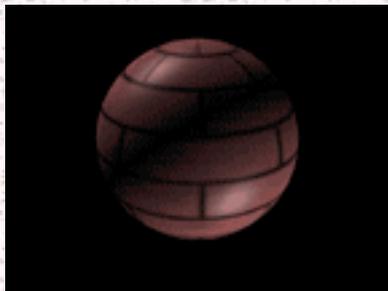
# Surface Mapping



Very often, when objects are to be [rendered](#), in order to achieve a more realistic look, a surface map is applied to an object or a part of an object. A surface map is really just a picture which is wrapped around an object in one or more fashion. A surface map can be a decal placed onto a bumper of a car or a brick texture put on a wall in order to make it look more realistic. Surface maps are sometimes referred to as textures.

Sometimes simple projection of a surface map will not do a trick. If actual texture needs to be seen, a bump map can be used. When rendering a bump map, the computer looks at the different black and white values of the image and makes the surface of the rendered object look as if it had such a texture. There are also other ways of applying surface maps. Some make parts of an object transparent and are referred to as opacity maps. Others can make an object shiny or dull. Depending on the software package, there may be a few other effects which can be created using surface maps.

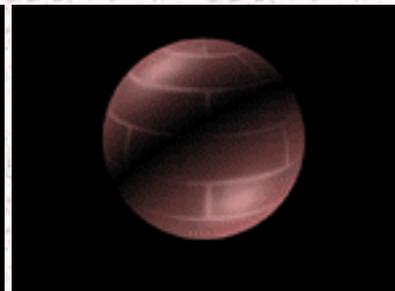
## Different types of mapping



Surface



Bump

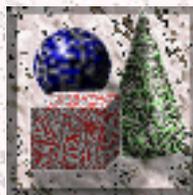
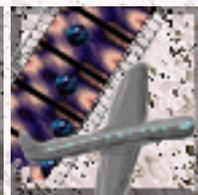


Reflection

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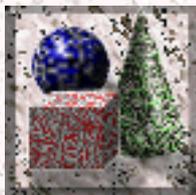
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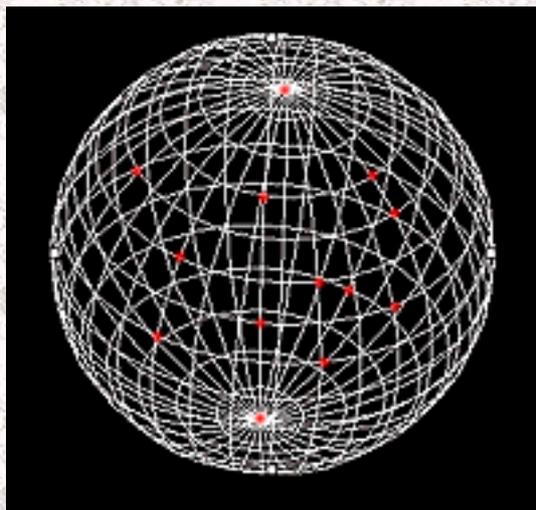
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# Vertex



A vertex is a collection of three numbers which define its position in the [coordinate system](#). Points are the building blocks of all 3D objects. From points one can build [faces](#), and ultimately [meshes](#).



Each red dot is a vertex

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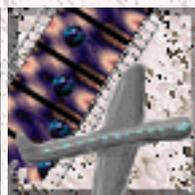
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# Evolution of Computer Animation

Computer Animation went through so much to get to where it is at today. It still continues to change rapidly today. As new, faster hardware and more sophisticated software becomes available at continually dropping prices, new standards are appearing almost every month.

## [Time Line](#)

## [Traditional Methods](#)

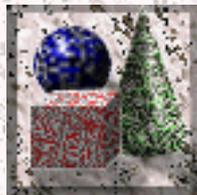
## Advent of Computers

## Animation Today and in the Future

- History of animation from the early 1800s to just before the advent of the personal computer.
- Information on how animations are traditionally made.
- Computer's influence on the field of animation
- What it is like and what awaits us.



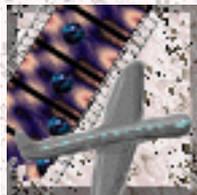
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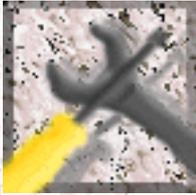
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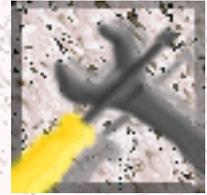
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# Tools



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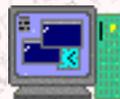
Computer animation can be done on a variety of computers. Simple cell animation requires nothing more than a computer system capable of simple graphics with proper animation software. Unfortunately, most of the computer animation that you see on television and in other [areas](#) is done on extremely sophisticated workstations. This page is broken into two sections, [software](#) and [hardware](#). In the hardware section, all the different computer platforms on which computer animation is done are explained. The software is explained in the software section. Only the most popular and most well known software is explained, since it would be practically impossible to name all computer animation programs because there are so many of them.

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## Hardware

Hardware comes in many shapes, sizes, and capabilities. Some hardware is specialized to do only certain tasks. Other kinds of hardware do a variety of things. The following is the most common hardware used in the field of computer animation.

### SGI



The SGI platform is one of the most widely used hardware platforms in professional or broadcast quality computer animation productions. SGI stands for **Silicon Graphics Inc.** SGI computers are extremely fast, produce excellent results, and operate using the wide spread UNIX operating system. SGI's are produced by [Silicon Graphics](#). They come in a variety of types, ranging from the general purpose Indy®, to the high power Indigo2 Extreme® used to produce animations, to the mule of the horde, the Onyx®, which is especially suited to do the complex calculations involved in rendering. Almost all major production studios use SGI's state of the art software like Wavefront, Alias, and SoftImage are ran on SGI's.

### PC's



PC's are very versatile machines. They have been around for years and are favorites of many computer users. Because of their combination of flexibility and power, PC's have proven to be very useful for small companies and other businesses as platforms to do computer animation. Applications such as [3DStudio](#) and [Animator Studio](#) are used on PC's to make animations. PC's are relatively cheap and provide pretty good quality for their price. Recently though, PC's have been getting a lot of attention from different production houses because of their relatively small price and the quality of the finished products.

## Macintosh



Mac's were originally designed to be graphic and desktop publishing machines. Macs did not become that widely known until recently, when newer faster models came out. Many people consider Mac's slow and inefficient, but that is not necessarily true. Right now with the advent of the Power Macintosh, the Mac is a pretty useful tool for small scale companies wishing to do nice looking applications. Many companies are producing computer graphics and animation software for the Macintosh. Some of these are [Adobe](#) with products such as [Photoshop](#) and [Premiere](#) and [Strata](#) with [Strata Studio Pro](#). There are also a few applications that were ported to the Macintosh from the SGI's such as Elastic Reality and Alias Sketch (a lower end version of Alias). Lately, a lot of production studios started using Macs because of their graphical abilities for smaller scale projects.

## Amiga

Originally owned by Commodore, Amiga computers have held a position in the computer animation industry for a number of years. There are two software packages that Amiga's are basically known for: Video Toaster and LightWave 3D. The Amiga is based on a Commodore, but it has been greatly customized to be a graphics machine. Many television shows use Amiga's for their special effects and animations.

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# Software

You might have the best hardware in the world, but without a good software package, your hardware can do nothing. There are literally hundreds of computer animation and graphics software packages out there, however, only a few are considered industry favorites. The software mentioned here is only the tip of the iceberg. These are some of the most popular software packages used by companies, schools, and individuals all around the globe.

## **3DStudio Max**

The successor to 3DStudio 3.0. 3DStudio Max runs under WindowsNT. It is entirely object oriented, featuring new improvements such as volumetric lighting, spacewarps, and an all new redesigned interface. Check out the official [3DStudio Max Homepage](#).

## **3DStudio**

3DStudio is a 3D computer graphics program. 3DStudio runs on [PC's](#). It is relatively easy to use. Many schools and small time production studios use 3DStudio to satisfy their needs. 3DStudio is created by [AutoDesk](#). 3DStudio consists of a 2D modeler in which shapes can be drawn, a 3D Loftter, in which 2D shapes can be extruded, twisted, or solidified to create 3D objects. Then there is a 3D modeler in which a scene is created. Finally there is an animator in which [key frames](#) are assigned to create an animation and a material editor in which a great variety of textures can be created. Overall this is a great program. Check out the official [3DStudio Homepage](#).

## **LightWave3D**

LightWave 3D is another high end PC 3D computer graphics software package. Originally developed for the Amiga platform, LightWave 3D is now also available on the PC. LightWave 3D is used in quite a few television productions such as Babylon 5 and SeaQuest. Many people debate that LightWave3D is the best 3D product for the PC. Check out the official [LightWave3D Homepage](#).

## **Adobe Photoshop**

Although Adobe Photoshop is not a computer animation application, it is one of the top of the line graphics programs. It is created by [Adobe](#). Photoshop runs both on [Mac's](#) and [PC](#) Windows, and even on SGI's. It can be used to touch up [digitized](#) images or to create graphics from scratch. Visit the [Adobe Photoshop Homepage](#).

## **Adobe Premiere**

Adobe Premier, just like the name says, is created by [Adobe](#). It is a tool used to composite digitized video, stills, and apply a variety of [transitions](#) and special effects. Adobe Premiere runs both on [Macintoshes](#) and [PC](#) Windows.

## **Alias|Wavefront**

Alias is one of the topmost computer animation packages out there. Alias was produced by the company that used to be Alias, but now it joined with Wavefront and is known as [Alias | Wavefront](#). It runs on SGI's. Alias is well known for its great modeler which is capable of modeling some of the most complicated objects. Also, this software package is very flexible, allowing for programmers to create software that will run hand in hand with Alias. Check out the great [Alias|Wavefront Homepage](#).

## Animator Studio

Animator Studio is a cell animation program from [AutoDesk](#). It's predecessor was Animator Pro for PC DOS. Animator Studio runs under Windows. It has a multitude of features that minimize the animation creation time. Visit the [Animator Studio Homepage](#).

## Elastic Reality

Elastic Reality is one of the top of the line [morphing](#) programs. Elastic Reality runs on [Mac's](#) and [SGI's](#). One of the great features of Elastic Reality as opposed to other programs is that it uses splines as opposed to points to define the morphing area. Elastic Reality allows to morph video as well as still images.

## SoftImage

One of the three top most computer animation software packages. SoftImage is used in many top production studios around the country and around the world.

## Strata Studio Pro

Strata Studio Pro is probably the most known 3D graphics application on the Mac. It is created by [Strata Inc.](#) Strata Studio Pro is mainly a still graphic rendering application, but it does have animation capabilities. Graphics for some games such as Myst were created in Strata Studio Pro.

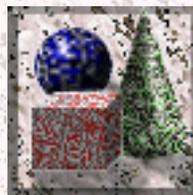


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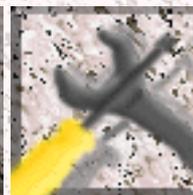
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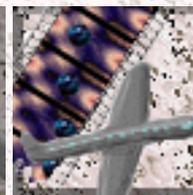
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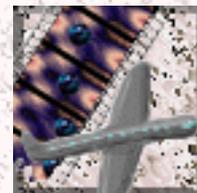
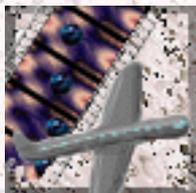


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# Applications for Computer Animation

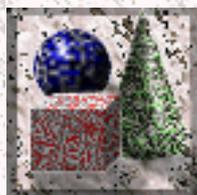
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There are a variety of uses for computer animation. They can range from fun to practical and educational ones. As you will find out in the following links, computer animation has found its way into fields which you might have not thought that there were any uses for. Here is a list of some of the places where computer animation is used:

- [Advertising](#)
  - [Archeology](#)
  - [Architecture](#)
  - [Art](#)
  - [Chemistry](#)
  - [Education](#)
  - [Engineering](#)
  - [Entertainment](#)
  - [Film](#)
  - [Flight Simulation](#)
  - [Forensics](#)
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  - [Simulation](#)
  - [Space Exploration](#)
  - [Television](#)
  - [Video](#)
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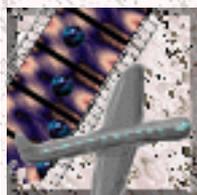
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# Companies & Associations

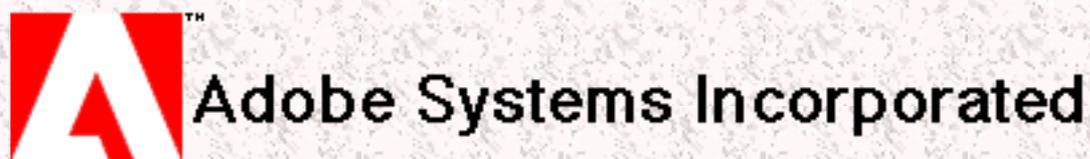


There is now a great industry in computer animation. There is a great need for more stunning animations for television to keep the watchers glued to the screen. There is also demand for computer animation in many fields. Because of this demand, there is also a growing number of computer animation companies. It would be probably impossible to list all of them, but here is a list of what we thought were the largest and most popular of them. You might have heard some of these names before.

Many of these companies already are present on the World Wide Web.

- [Adobe Systems Inc.](#)
- [Alias | Wavefront](#)
- [AutoDesk](#)
- [Bentley](#)
- [Caligari](#)
- [Computational Logic Inc.](#)
- [ComputerVision](#)
- [ElectricImage](#)
- [ElectroGIG](#)
- [Fractal Design](#)

- [InterGraph](#)
  - [Lateiner Dataspace](#)
  - [MacroMedia](#)
  - [National Association of Broadcasters](#)
  - [NewTek](#)
  - [ReZ.n8](#)
  - [SigGraph](#)
  - [Silicon Graphics](#)
  - [Strata Inc.](#)
  - [ViewPoint Datalabs](#)
- 



Adobe Systems Incorporated, founded in 1982, is headquartered in Mountain View, California.

Adobe develops, markets and supports computer software products and technologies that enable users to create, display, print and communicate electronic documents. The company licenses its

technology to major computer, printing, and publishing suppliers, and markets a line of applications software and type products for authoring visually rich documents. Additionally, the company markets a line of powerful, but easy to use, products for home and small business users. Adobe has subsidiaries in Europe and the Pacific Rim serving a worldwide network of dealers and distributors.

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On June 15, 1995, Alias Research Inc. and Wavefront Technologies, Inc. merged with Silicon Graphics, Inc. to form Alias/Wavefront, a wholly owned, independent software subsidiary that will focus on developing the world's most advanced tools for the creation of digital content. The new organization bolsters Silicon Graphics' commitment to the entertainment and creative design markets, and allows the company to architect the foundation necessary for customers and software partners to build the digital studio of the 21st Century using the industry's most advanced three-dimensional graphics workstations.



# AutoDesk

AutoDesk is one of the leading and most prestigious computer graphic design and animation companies. It makes the popular AutoCad software which is one of the best CAD programs on the market. It also owns 3DStudio, a 3D modeling and rendering package, and AnimatorPro which is a program for frame by frame animation.

---



Bentley Systems, Inc. is the leader in professional computer-aided design (CAD) products and services to engineers, architects, drafters, and organizations whose overall success relies on CAD. The company's range of MicroStation® products, with over 170,000 fully licensed users worldwide, is an established standard and award-winner throughout the worldwide architecture/engineering/construction (AEC) and geographic information systems (GIS) markets and is gaining rapid acceptance in the mechanical design market.

---



Caligari Corporation was founded in 1986 with the mission to operate and develop tools for on-line 3D worlds where people can learn, play and work. Our main assets are our proven expertise in immersive 3D interface design and our ownership of 3D core technologies, which have been developed and continuously improved over the last nine years.



Computational Logic Inc. (CLI) performs advanced research and development in mathematical modeling of digital hardware and software systems. This technology is intended to enable the production of higher quality systems with reduced time and cost. In addition to research and development, CLInc provides education and consulting services in applying mathematical modeling of hardware and software systems to industrial problems.

---



Computervision Corporation, headquartered in Bedford, Massachusetts is the leading international supplier of engineering data and lifecycle management software and services. More than 10,000 engineers rely on this production -proven technology everyday to design

and develop new products. The company develops, markets and support mechanical, electronic, architectural engineering and construction applications and has an installed base of more than 180,000 seats worldwide.

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Electric Image, Inc. pioneered high-end 3D imagery and animation on the desktop platform, and in the process created the undisputed "world's fastest software renderer" without sacrificing quality for speed. The company's animation package, ElectricImage, represents a milestone in PC-based animation - having been the first desktop 3D package used for motion picture (Terminator 2: Judgment Day) and television (Space Rangers) special effects, a film-quality motion simulator ride (Space Shuttle America at Six Flags, Illinois) and a 3D outdoor display (Fremont Street, Las Vegas). There are numerous features and interface considerations which, after having been successfully introduced in ElectricImage, were immediately adopted by

competing products and are now considered industry standards.

---



ElectroGIG develops, markets and supports the GIG family of software products and services for design professionals in the broadcast, film and video, CAD and publishing industries. With its mission to provide superior digital media tools, ElectroGIG is at the forefront of today's burgeoning field of interactive communications. The company's products are designed for users looking forward to real-time, remote creative collaboration and production delivery. GIG tools are currently used by visual-communication and image-production experts in over 800 institutions and corporations and 40 countries worldwide. ElectroGIG's products are available through an international channel of resellers and systems integrators.

---



Fractal Design Corporation was founded in 1991 by Mark Zimmer and Tom Hedges. That same year, Fractal Design introduced its first Natural-Media software, Fractal Design Paintertm. This paint and image-editing program has become an industry standard, winning numerous awards and recognition for its technical achievements. In 1995, Fractal Design filed for a successful initial public offering and is now publicly traded on the NASDAQ National Market under the symbol: FRAC. In May 1996, Fractal Design completed its acquisition of Ray Dream, Inc., the leader in 3D illustration and animation technology. Ray Dream pioneered the use of 3D technology in the graphic arts market when it introduced Ray Dream Designertm in 1991. The product has become one of the most popular 3D software products on the desktop today.

---

**INTERGRAPH**

Intergraph Corporation develops, manufactures, sells, and supports computer systems for the Technical Desktop -- the combination of compatible technical applications and personal productivity tools in a single desktop computer. Hardware products include workstations, servers, scanners, and plotters. The company's integrated software applications are used for computer-aided engineering, design, analysis, manufacturing, publishing, and earth sciences such as mapping/geographical information systems. A member of the Fortune 500, Intergraph is the world's largest company dedicated to supplying interactive computer graphics systems.

---



Lateiner Dataspace is a company that is doing research on high-speed volume visualization and discrete physical simulation techniques. This would include works dealing with the rendering of voxel data, manipulation and simulation of voxel models, and distributed computing algorithms.

# **M** MACROMEDIA

Macromedia has developed with the multimedia industry from Day 1. Begun as MacroMind in 1984, we teamed up with Paracomp in 1991 to form MacroMind-Paracomp. One year later, we joined hands with Authorware and took the name Macromedia. Most recently in 1994, Macromedia tied the knot with Altsys and added two award-winning products to our family of software, FreeHand and Fontographer.

---



The National Association of Broadcasters is the industry's largest, most inclusive organization, offering a wide variety of member services in addition to providing legislative, regulatory, and judicial representation in Washington, D.C. For more than 70 years, NAB has sought to ensure the

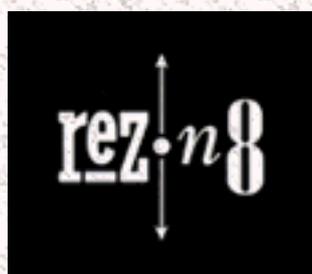
viability and strength of America's free, over-the-air broadcasters and serve as a practical, technical and educational resource for the entire industry. NAB believes the American public is best served by a broadcasting system that provides programming free of government intervention and reflecting local interests and audience choice.

---



NewTek, the desktop video company, founded in 1985 is a privately-held business located in Topeka, Kansas. It has developed products such as the Video Toaster, and the award winning 3D software package LightWave3D.

---



Since 1987 ReZ.n8 Productions has been creating comprehensive image branding packages for television networks, programs, stations and syndicators, motion pictures and advertising agencies. The company recently designed the look

for the 1994 Winter Olympics for CBS Sports and the NFL for Fox Sports. Employing programmers, illustrators and producers, ReZ.n8 has been honored with numerous awards for conceptualizing, designing and producing state-of-the-art developmental computer graphics, animation and special effects for the entertainment and advertising industries.

---



## **SigGraph**

SigGraph is the ACM Special Interest Group on Computer Graphics. It sponsors many special events concerning computer graphics. They also hold an annual technical conference in different cities every year. these conferences bring forward new graphic technologies. In addition to this, SigGraph also sponsors a multitude of shows, workshops, and conferences.

---



Silicon Graphics® systems deliver the power to visualize, the power to see the new path, to storm ahead, and to lead your industry. Through an innovative combination of visualization, compute power, and data manipulation, Silicon Graphics systems reduce the time between a great idea and a great product. For ten years, Silicon Graphics systems have been used in industrial design, database analysis, visual simulation, energy exploration, and entertainment.

---



Strata, Inc. is a leading developer of powerful yet easy-to-use computer-assisted visualization and illustration software tools for Macintosh, Power Macintosh and IBM computers. The company's charter is to provide professional state-of-the-art software for designers and illustrators working in business, science, education, and government.



As the first company of its kind focused solely on creating and marketing technically accurate 3D data, Viewpoint DataLabs remains the leader in a dynamic market niche within the computer animation industry. Viewpoint's product Datasets are custom and off-the-shelf 3D data representations of physical objects for use in 3D modeling, animation, simulation, visualization, and virtual reality packages. Viewpoint Datasets have gained a great deal of popularity in many feature films, broadcast television spots, games, and multimedia titles. In addition, Viewpoint Datasets are frequently used for a wide variety of medical visualization and architectural applications.



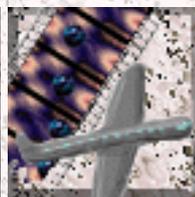
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[Help-n-Tips](#)

# Main Menu

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# Files




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Here at the Academy, many students have worked on a great variety of graphics. Here we have gathered some of them for your use and enjoyment.

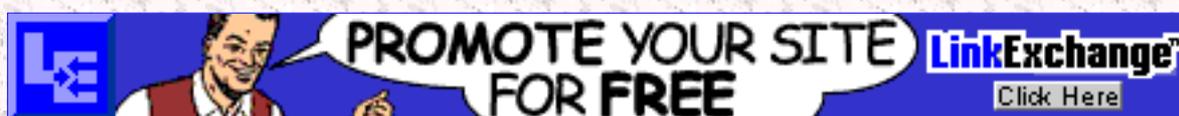
The files are organized into a couple categories. There are mesh objects, full scenes, graphic files, and miscellaneous. You may download these files freely, but if you use them we would like to hear from you. These files are property of their creators and the Academy.



Most of the files in this section have been compressed in one way or another. Compression tools can be found in the [Utilities](#) section. All PC files have are in the ZIP file format. The tool of choice for uncompressing these files is PKUNZIP. The Mac files have been compressed using either StuffIt or CompactPro. These can be uncompressed using StuffIt Expander or CompactPro. In order to store these files on a Unix system, they have also been encoded into the MacBinary or HQX file format. These can be decoded using StuffIt Expander, DeHQX, or MacBinary. All the Unix files have been TARed and compressed using the compress Unix command. To uncompress these files simply type "uncompress ."

If you want to contribute to this archive, here are the uploading [instructions](#).

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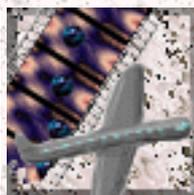
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# Main Menu

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# Other Sites



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There is a vast amount of information and resources about computer graphics and animation available on the InterNET, but it is often pretty hard to find exactly what you are looking for. This page is designed to help you to find information that you are looking for. It consists of a couple of links to other places where information about computer animation can be found. It also contains links to newsgroups and popular search engines.

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[Member of the Internet Link Exchange](#)

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## Submit a Site

Do you have a site that has something to do with computer graphics or animation? Maybe a company, or a new graphics department at some educational institution. Even if you have a homepage and feature some of your graphics work. Please use this form to submit the necessary information and your site will be added to this page.

**Site Name**

**Site URL**

**Your Name**

**E-Mail  
Address**

---

# WWW Resources:

## Companies

(Note: Click [here](#) to see a list of all the big companies)

- [AD FX Animations](#)
- [Adobe Systems Incorporated](#)
- [AEGIS Forensic Animations](#)
- [Algorithm Inc.](#)
- [Alias | Wavefront](#)
- [Animatek](#)
- [AutoDesk](#)
- [Bentley Systems, Inc.](#)
- [Caligari inc.](#)
- [Commercial Video Services, Inc.](#)
- [Computational Logic Inc.](#)
- [Computervision](#)
- [CTHUGHA Home Page](#)
- [Digital Concepts](#)
- [Echupalante Productions](#)
- [EClips Computer Graphics](#)
- [Electric Image](#)
- [ElectroGIG](#)
- [Engineering Animation, Inc.](#)
- [Fasttrack Productions](#)
- [Flying Leap](#)
- [Fractal Design Corp.](#)
- [Hash, Inc.](#)
- [Infinite Digital Imaging](#)
- [Intergraph](#)
- [Kleiser-Walczak Construction Co.](#)
- [Lateiner Dataspace](#)
- [Macromedia](#)

- [Marqueting and Advertising by Creativa](#)
- [Metatron Ltd.](#)
- [MovingMedia](#)
- [Neo-Visuals Inc.](#)
- [NewTek Inc.](#)
- [Paradigm Productions](#)
- [Pixel Light Communications, Inc.](#)
- [ProActive Productions](#)
- [Red Leaf Animations](#)
- [Rem Inforgraphica](#)
- [ReZ.n8](#)
- [Screen Team - the screen saver superstore](#)
- [2nd Nature Industries](#)
- [Silicon Graphics](#)
- [SoftImage](#)
- [Strata Inc.](#)
- [Trattoria di Frame](#)
- [Vegas FX Cyber Voodoo Web graphics tools](#)
- [Vibrant Graphics](#)
- [Viewpoint DataLabs](#)
- [ZOE Pproductions](#)



**EYEBENDERZ**  
computer animation on the web

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## Other Informative Sites

- [3D Artists](#)
- [3DWeb](#)
- [3D Launchpad](#)
- [Computer graphics Site Index at UCSC](#)
- [The Animation Master Hobbyist](#)
- [Top Design Site of the Week](#)
- [JKafer's List o' Computer Graphics Sites](#)

- [Webmaster University](#)

## Galleries and such

- [Art Gallery List](#)
- [ArtNetwork](#)

## Educational Facilities

- [University of Aizu, Japan: Computer Graphics Lab](#)
- [University of Aizu, Japan: F-rep](#)
- [University of Aizu, Japan: Shape Modeling Lab](#)
- [Bath University: Geometric Modeling](#)
- [Berkley University: Computer Graphics](#)
- [University of Bremen, Germany: CeVis](#)
- [University of British Columbia: Imager Computer Graphics Lab](#)
- [Brown University: Computer Graphics Group](#)
- [University of California: Perpetual Science Laboratory](#)
- [Caltech: Computer Graphics Group](#)
- [University of Chicago: Electronic Visualization Laboratory](#)
- [Cornell University: Computer Graphics Program](#)
- [Cornell University: Cornell Theory Center, Computer Visualization](#)
- [University of Geneva: MIRALab](#)
- [George Washington University: Computer Graphics Group](#)
- [Georgia Tech: Graphics, Visualization & Usability](#)
- [Georgia Tech: Scientific Visualization Lab](#)
- [ICASE Visualization and Graphic research](#)
- [Indiana University: Center for Innovative Computer Applications](#)
- [University of Manchester: Computer Graphics Unit](#)
- [University of Minnesota: Center for the Computation and Visualization of Geometric Structures](#)
- [MIT: Computer Graphics Society](#)
- [The Advanced Computing Center for the Arts and Design at The Ohio State University](#)
- [University of Pennsylvania: Center for Human Modeling and Simulation](#)
- [Princeton University: Graphic Group](#)

- [Stanford University: Computer Graphics Program](#)
- [University of Toronto, Canada: Computer Graphics](#)
- [Virginia Tech: Laboratory for Scientific Visual Analysis](#)
- [University of Waterloo: Computer Graphics Lab](#)
- [WSU Computer Animations](#)

## Organizations

- [ACM](#)
- [Computer Visualization at Army Research Laboratory](#)
- [The National Association of Broadcasters \(NAB\)](#)
- [SigGraph](#)
- [The Scientific Applications and Visualization Branch at NASA](#)
- [Scientific Visualization and Digital Media Group](#)
- [Eurographics](#)
- [Scientific Visualization at ZIB](#)

## Personal Homepages

- [Brian Keffer's Homepage](#)
- [Animations and Graphics For Your Website](#)
- [Christian Laroque's Cartoons](#)
- [Craig's Homepage](#)
- [Do-It-Yourself Homepage](#)
- [Eric's Animation Page](#)
- [Harmer's Graphics Homepage](#)
- [Jason's "Check-it" Homepage](#)
- [Mask's Computer Graphics and Animation Home Page](#)
- ["Planet Earth" Animations](#)
- [Rhapsody](#)
- [StAnK-e Homepage](#)
- [Rudolph's GIF animation](#)
- [Bruno e Vania Home Sweet Home Page](#)
- [Chip Jones Homepage](#)
- [Ronald L. Breitenbach](#)

# Newsgroups

[alt.graphics](#)

[comp.graphics.animation](#)

[comp.graphics.misc](#)

[comp.graphics.algorithms](#)

[comp.sys.amiga.graphics](#)

[comp.sys.mac.graphics](#)

[comp.sys.sgi.graphics](#)

[comp.graphics.rendering.misc](#)

[comp.graphics.rendering.raytracing](#)

[comp.graphics.rendering.renderman](#)

[comp.graphics.visualization](#)

[alt.design.graphics](#)

[comp.graphics.apps.alias](#)

[comp.graphics.apps.lightwave](#)

[comp.graphics.apps.photoshop](#)

[comp.graphics.apps.softimage](#)

[comp.graphics.apps.wavefront](#)

[comp.graphics.packages.3dstudio](#)

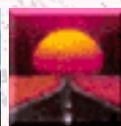
- general computer graphics discussion
- general computer animation discussion
- miscellaneous computer graphics discussion
- rendering and graphics processing algorithm discussion
- discussion about computer graphics on the Amiga platform
- discussion about computer graphics on the Macintosh platform
- discussion about computer graphics on the Silicon Graphics platform
- miscellaneous rendering discussion
- raytracing discussion
- rendering using renderman software discussion
- computer visualization discussion
- design graphics discussion
- Alias|Wavefront discussion group
- Lightwave 3D discussion group
- Photoshop discussion group
- Softimage discussion group
- Alias|Wavefront discussion group
- 3D Studio discussion group

---

# Search Engines

In order to find out the most and the best pages related to this topic, use the following keywords or phrases:

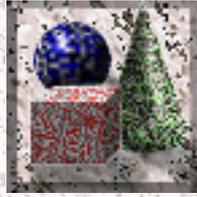
"computer animation" "graphics" "computer visualization"  
"computer graphics" "animation" "rendering"  
"3D graphics" "virtual reality" "imaging"



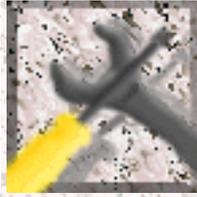
[Webcrawler](#) [Yahoo](#) [Infoseek](#) [Lycos](#) [Internet Yellow Pages](#) [Alta Vista](#) [Starting Point](#)



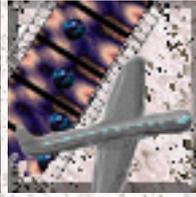
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[Help-n-Tips](#)

# Main Menu

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# Help 'n Tips



---

This page will soon include many informative tools.

---



## FAQ's



Many FAQ's (Frequently Asked Questions) on a variety of topics that have to do with computer graphics and animation. This is a great place to start if you are looking for specific information which you don't know how to find.

---



## Message Boards



You have probably heard of Newsgroups. They are like bulletin boards where one can ask questions and have them asked by many other people. Well, soon, a collection of message boards not much unlike the newsgroups will be opened right here. Users will be able to post questions, answer questions of others, post tips, and engage in general conversation on a variety of topics.

---



## Photoshop How To's



Adobe Photoshop: the grand tool in the computer graphics industry. Developed by [Adobe Inc.](#), it is probably the most wide-most and well known tool in the industry. It is an extremely versatile program which is simple enough to use by a beginner, and yet has enough nooks and crannies to keep the most advanced user occupied. The trouble with Photoshop is that in order to create stunning graphics without buying additional software, you have to go through a couple (many) steps. These steps are often ambiguous and something that might seem simple to do in a different program may take several steps in Photoshop. This page will demonstrate how to do a lot of cool things in Photoshop. It will also allow users with tips of their own to post them for everyone to share.

---

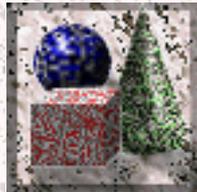
# Tests

If you are an teacher or an instructor and are using this site in your course several tests will be made available for your use. These will test general knowledge aquired throughout these and other pages in different areas of computer graphics and animation.

---



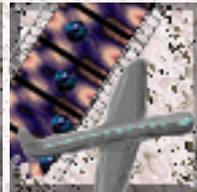
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## Main Menu

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# Welcome to the Computer Animation Pages at AAST

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The Computer Animation Homepage is a project done by [Krys Cybulski](#) and [David Valentine](#) in their third trimester of their sophomore year at [AAST](#). This site is still an ongoing process, and is being worked on almost constantly. The purpose of these pages is to teach people about computer graphics and animation. These pages can be used by the "newbie" as well as the experienced user.

A person can find a lot of reference material throughout these pages. This site is organized into sections for easy access to information. All of the sections are hyper-linked for maximum coverage of a topic. Links to other sites on the internet where more information can be found on a particular topic can also be found throughout this site.

## !!! NOTICE !!!

Due to other distractions (school, work, etc) I am unable to continue to update this web site as much as I would like. As a matter of fact, I am sorry to say that the content on this web page has not been touched for over a year. I still hope you can make the best of the material that is represented here.

The good news is that in the little time I do find for this project, I am currently building another web site which will feature many improvements, updates, and even correct spelling.

I do not have a time line for the completion of this new site, but I know it will be done someday, so please stay tuned for now.

---

We are sorry, but due to unprofessional conduct, the WWWBoard has been taken offline for the moment.

---

This page has been accessed

00553091

times since October 1, 1995.

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[Member of the Internet Link Exchange](#)

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These pages  
are  
[Netscape 1.1N](#)  
Enhanced.

---

## [Evolution of Computer Animation](#)

The progress of animation through the past 200 years. (Under Construction)

## [Computer Graphics](#)

Definitions of terms used in computer graphics and animation as well as other information.

## [Computer Animation Tools](#)

Different software and hardware used in computer animation.

## [Applications for Computer Animation](#)

Where all this computer animation is used.

## [Companies & Associations](#)

Companies and Associations heavily involved in computer graphics and animation.

## [Files](#)

Our own little graphic, animation, mesh, and software library.

## [Other Sites](#)

An extensive list of other sources of information on computer graphics and animation.

## [Help -n- Tips](#)

Help, Tips, and Tricks: How do I .... (Under construction)



Have a question? Need help? Like the pages? Hate the pages? Found a spelling mistake? A link doesn't work? Want to add a link? Please write to:



[graphix@bergen.org](mailto:graphix@bergen.org)

Due to large amounts of email and an inversly small amount of free time, I am unable to respond to most email. I will try to make an effort to reorganize my time and when the new page is up, I will dedicate more time to answering your questions. I want to make sure you understand this and not get frustrated when you get no response from me. I really appreciate all the nice emails and comments I have received so far. They make the whole thing worthwhile.

## Other Cool Pages:

[AAST Homepage](#)   [SIGKids Homepage](#)

The school were this project took place and where Krys and Dave go to school.

Another page that has a lot to do with computer graphics and animation. Krys and Dave also helped out with this one.

[Dave's Homepage](#)   [Krys's Homepage](#)

Dave's really cool homepage.

Krys's spiffy homepage. Make sure you visit.

## [BergenNET Homepage](#)

BergenNET's main server's homepage. All these pages are located on it.



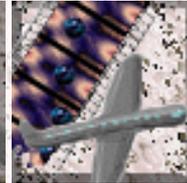
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*Created by [Krys Cybulski](#) & [David Valentine](#)*



# Graphic Files



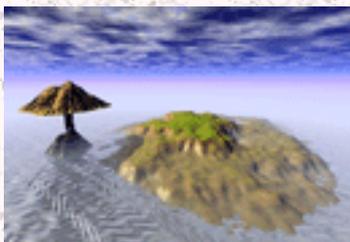

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The files featured in this sections are rendered, drawn, or painted graphics that were created by the people at the Academy. All of these files are original works and are property of their respective owners. You may download and use these files. If you do use any of these files in your own works, we would like to hear from you.

The graphics in this section have been created using a variety of programs running on PC, Macintoshes, and UNIX machines. For the maximum quality and conservation of space, most of these images are in JPEG format, but you will also see other [formats](#).

To download a file, click on its preview.

---



**Title:** Column Island

**Author:** [Krys Cybulski](#)

**Filename:** ColumnIsland.JPEG

**Size:** 158K

Look in the scenes directory to find the KPT Bryce file. One of my first attempts at the program.



**Title:** A Peek Into a Cloud Chamber

**Author:** [Krys Cybulski](#)

**Filename:** PeekIntoCloudChamber.JPEG

**Size:** 32K

What does it really look like? Hey, I don't know... This is in now way realistic but it does look pretty cool.



**Title:** Lake of Fire

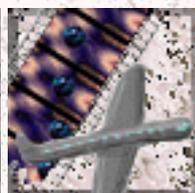
**Author:** [Krys Cybulski](#)

**Filename:** LakeFire.JPEG

**Size:** 197K

Just like the song... A hi-rez image, really big. Check out the fire...

---



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