I Glossary

Look here to find the meanings of abstruse words.

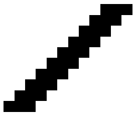
I GLOSSARY

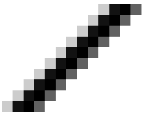
Abstruse
Not easy to understand.

Algorithm
A logical or mathematical procedure for solving a problem.

Aliasing | Anti-aliasing
When representing an image with discrete pixels, an original image cannot be accurately displayed due to the limited number of pixels of a digital device. This results in a “jaggy” look (called *aliasing*) in the displayed image; moiré effects, and strobe-light-like flickering in animations.

To reduce the effect of aliasing, many programs offer an option to anti-alias a graphic. This process calculates the mean color between two adjacent pixels, and inserts pixels of this color at the abrupt edges in the image to give a smoother appearance to the display.


An Aliased Line


An Anti-Aliased Line

Alpha-Numeric
Using only the letters A-Z and the digits 0-9.

Alias
A user defined short-form of a longer keyboard command. Both the Houdini textport, and *csh* offer aliases. For example, it is faster to type the alias *md* than to type-out the complete UNIX command: *mkdir* (make directory).

Alpha
The amount of transparency of an image or a portion of an image. An alpha value of 0 yields a transparent portion of an image; an alpha value of 1 is completely opaque.

Ambient Color
A material’s response to ambient light. The ambient light will be scaled by this color to result in the final ambient shading of a surface. See also: *color, diffuse, specular, transmit, emit*.

Ambient Light

Illumination from directionless light sources. This illumination lights all objects from all directions equally.

Aperture

Specifies the field of view looking through a Houdini camera. Combined with the focal length, this determines the perspective of a camera. A wide angle lens will have a larger aperture, while a telephoto lens will have a smaller aperture.

Arena

When a process runs, it allocates portions of RAM. The arena is the total amount of memory that has ever been allocated by the process. Even if the process gives back portions of the RAM, the arena size will remain constant. In other words, the arena will grow as new memory gets allocated, but it will never shrink.

ASCII

ASCII is an acronym for: American Standard Code for Information Interchange. It is a seven-bit code in which each of the 128 possible combinations represent a discrete character or control.

For example, the codes 65 - 90 represent uppercase letters from A - Z; the codes 97 - 122 represent lowercase characters from a - z, and the codes 0 - 31 represent controls for such things as Backspace, Carriage Return, Tab, and Line Feed. Most modern implementations use an entire byte (eight bits) to represent each character, allowing 256 possible combinations. The extra characters are used to represent symbols such as: é, ©, and ¶. For a complete listing, type: *man ascii* into a UNIX shell.

Typically, a file stored as ASCII contains readable text. An ASCII file requires more disk space than a binary file.

Aspect ratio

The ratio between the vertical and horizontal components of an object. Most monitors have an aspect ratio of three vertical units to four horizontal units (a 3:4 ratio works out to: 1:1.33). 35mm movies use an aspect ratio of 1:1.85.

Attitude

The orientation of a piece of geometry. Usually in relation to the origin of the XYZ axis

Attributes

Factors which affect the appearance of a rendered object, including position, rotation, scale, color and shininess. *See also: channel.*

Bézier Curve

A spline that interpolates some points of a control hull but not others.

Bi-cubic patch

A curved surface which uses cubic equations of two parameters to generate the coordinates of any point on the patch. Examples of bi-cubic patches include Bézier, B-splines and Coon's patches – all of which are supported by Houdini. Also called a patch.

Binary
A data representation that stores information as a sequence of 0's and 1's. A binary file requires less disk space than an ASCII file.

Bit
A bit is the smallest unit of information a digital computer can handle. A single bit is basically an on/off switch – it can be either on (1) or off (0). Bits can be combined to represent myriad types of data. For example, a bit can represent the status (on or off) of a pixel in a black & white picture, or multiple bits can be combined to represent numbers and letters. See also: Byte.

Bitmap
An array of values representing an image, with a direct mapping of positions in the array to positions in the image.

Bits per Pixel
See *Pixel depth*.

Blinn lighting model
A model developed by James Blinn for applying shading to 3D geometry which involves: diffusion, specular reflection, eccentricity, a refractive Index, and implements the fresnel effect. See also: Lighting model.

Bounding box
A bounding box is a box whose dimensions delimit the extreme edges of the specified object. For example, the bounding box of a person with outstretched hands and feet would just enclose them and touch their fingers, toes, and head.

Box Select
Selecting items with a marquee. This is done by positioning the cursor so it is not on anything currently selectable, and dragging the mouse to create a dotted box (a marquee). Items of the type currently selectable contained or partially contained within the marquee when the mouse button is released become selected.

Box Zoom
Creating a box in a view which fills the view with what was in the box. In Houdini, this is done by Ctrl 🖱 dragging a box, the area outlined will be zoomed in upon. Dragging the mouse from left to right zooms in. If the mouse motion is right to left, Houdini will zoom out.

bpoly
A binary polygon file, a UNIX file containing points, polygons and vertices, in the *PRISMS* format.

bgeo
A binary geometry file. It can contain all geometry types.

Bump mapping
A rendering technique that alters the normals of a surface so that the surface appears bumpy without adding any new points to the surface.

Button

A button is a rectangular area which performs an action when you click in it. When you click on a button and it changes color, it is called highlighting. When a button is highlighted, it is *On*. The three main kinds of buttons are: Push Buttons, Check Boxes, and Radio Buttons. See also: *Push Buttons*, *Check Boxes*, and *Radio Buttons*.

Byte

A byte is made of eight bits. When arranged in this fashion, the bits can be used to represent any number from 0 (the bits would look like this: 00000000), to 255 (the bits would look like this: 11111111). The position of the bit in the byte is significant, just as the position of the digits is important in a number such as: 347,586. Moving the number 5 within this number would change the value of the number. Each bit represents an increasing power of 2. i.e. the first bit = $2^1 = 2$, the second $2^2 = 4$, the third $2^3 = 8$, and so on. Bytes are useful, because they can represent many types of data, from the brightness of a pixel in an image, to a letter of the alphabet. See also: ASCII, Bit, Pixel.

Camera

One of several object types. A camera defines a view which can be used to define the view in a Viewport and render an image. (Lights can also be used to view or render a scene in the Object Editor).

Case Sensitive

Distinguishes between upper-case and lower-case letters.

Color

The color of geometry depends on five factors: ambient, diffuse, specular, transmit and emit. An apple sitting on a desk under a bright light would have an ambient of dark red (the color in shade); diffuse of bright red (the color in light); specular of white (color of highlight); no emit and no transmit. See also: *ambient*, *diffuse*, *specular*, *transmit*, *emit*.

Control Vertices

Points used to define the hull of a spline. They do not necessarily coincide with points on the curve or surface.

Coons patch

A surface patch defined by four boundary curves. In Houdini, one way of creating it is with a Skin SOP.

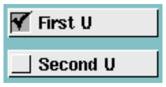
Channel

A channel contains the changes in value to a parameter over time. You can edit channels with the *channel editor.*

Channel array

A set of numbers containing one number for each frame of the animation.

Check boxes



These are often grouped into a list, allowing you to quickly check-off which options you want active. Click once to make active, click again to disable the option. A small X or check-mark will appear indicating it is on or off. See also: *Button*, *Push buttons*, and *Radio buttons*.

Clipboard

A temporary holding area to which you can store and retrieve information via Cut, Copy, and Paste operations. It is also sometimes referred to as the “copy buffer”.

Color Channel

Typically 32 bit images (images containing 32 bits of color per pixel) are split into several channels. This produces 8 bits (256 levels) of color for each of the three primary colors red, green, and blue, with 8 bits left over for a pixels’ alpha (transparency). When the varying shades of red, green and blue are combined, any possible color an image requires can be produced. Such an image is said to have “eight bits per color channel”.

Compositing

To superimpose one or more 2D images upon another to create a single combined image. The *Houdini image compositor* performs compositing.

Composite Operation (COP)

A way of creating or modifying a two-dimensional raster image.

Confirmation dialog

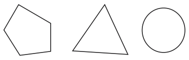
Some action has been specified and this dialog box, usually *yellow*, requests confirmation of the task. See also: *Dialog Box*, and *Error Dialog*.

Construction Plane

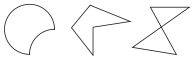
A plane used in the Model Editor which you construct geometry relative to.

Concave Polygon

A concave polygon is a polygon that is reentrant (turns in on itself). In other words, if an elastic band were streched around the polygon, it would not necessarily touch all the sides of the polygon. Triangles are always convex. See also: polygon, convex polygon.



Convex Polygons



Concave Polygons

Control Vertices (CVs)

Points which contain 3D position (XYZ), tension (W) and other spline attributes. Used with curves and patches.

Convex Polygon

A polygon that is not re-entrant. See also: concave polygon.

Cook

Refers to the process of an OP taking all the parameters and data it has been given and processing them to make the actual 3D geometry (or other data it is supposed to generate), or to evaluate a channel expression at a given frame. See also: Surface Operation, Channel Expression.

Co-planar

All the points, if connected together, will make a flat surface. If several points are co-planar, you should be able to place a stiff piece of cardboard in space, and orient the cardboard so that all the points are lying on the surface of that cardboard.

Coverage

The alpha plane of an image. Indicates which areas of the image are solid and which are transparent. Also known as: matte, mask or alpha.

Cross Product

The cross product between two vectors (u_1, u_2, u_3) x (v_1, v_2, v_3) is a third vector $(u_2v_3 - u_3v_2, u_3v_1 - u_1v_3, u_1v_2 - u_2v_1)$. The cross product of any two vectors produces a third vector orthogonal to both.

csh

A csh is a command shell that interprets commands, and allows you to interact with the UNIX file system. The command syntax is reminiscent of the C language. See also: *Shell*.

Cubic

A cubic is an equation containing a sequence of terms, in which no terms have a power (a polynomial) greater than three. An example of a cubic polynomial equation in x is: $y = ax^3 + bx^2 + cx + d$.

Current frame

The frame that is being displayed. See also: *frame*.

Current

The one object whose parameters are being edited. For example, the current OP is outlined in yellow, and it's parameters are displayed in the Parameter editing area. See also: *Selected*.

Curve

A line connecting multiple points. Some curves will interpolate (pass through) the points defining the curve (i.e. polygon). Other curves will use the defining points to create a smooth path (i.e. NURBS).

Cusp

To make a visible edge in a surface where adjacent polygons meet. See also: *normal*.

Default

The initial value.

Degenerate polygon

Polygons which render incorrectly may be degenerate. A polygon with only one or two points, multiple points at the same position in space, or polygons that crossover themselves may not render as expected and can be considered degenerate. See also: *polygon*, *concave polygon*, *convex polygon*.

Degenerate primitive

A primitive which cannot possibly exist. Examples of these are a closed polygon with fewer than 3 vertices (no surface is defined), a cubic Bézier curve with fewer than 4 vertices, a sphere with a radius of zero.

Dialog box

Similar to a Window, does not allow other action outside of it until it is closed. Instead of having the typical border and title of a Window, it will have a button labelled “Done” or “Ok”. This button is usually in the lower right corner. See also: *Error Dialog*, *Confirmation Dialog*, *Window.*

Diffuse

The color of the object where direct light is shining on it. Essentially, this is the color of the object, such the red in a red apple. See also: *color*, *ambient*, *specular*, *transmit*, *emit*.

Dithering

The process of simulating a greater number of colors with a fewer number of colors by displaying tightly grouped patterns of alternating shades to approximate the needed color. These patterns are known as *dither patterns*. At a distance these patterns appear to simulate a greater number of colors than is actually possible with the given number of colors.

Dither patterns help add noise to an image and thereby help break-up undesirable artifacts like mach banding. Too much dithering is undesirable because it appears much coarser, and detracts from image quality.

Display mode

Controls the type of image displayed in a viewport. Display modes include: wireframe, hidden lines removed, and Gouraud mode (shaded geometry).

Double buffering

Double buffering improves the quality of moving images on a 24 bit display. How does it improve the quality? When double buffering is not used, changes to the screen display are written directly to the buffer that is displayed on the screen, and you end up seeing the rapid changes as a flickering of the screen.

Turning double buffering on employs two display buffers. These two buffers are constantly swapped so that while one buffer is being displayed, the other buffer receives the changes. Because you never see the changes being made directly to the screen, there is no flicker, and the display quality is improved.

On eight bit displays, colors are dithered. Therefore, using double buffering on such a display results in poor quality for stationary images.

Drag

Click the mouse on the specified object, hold down the mouse button, and without letting go, move the mouse. When the desired drag action is complete (e.g. move an icon or a SOP on the screen, change a value in a slider, move the thumb of the scroll bar to the desired position), then release the mouse button.

Edit field

A rectangular box for typing in a single line of numbers or letters.

Emit

The color that an object glows. No light is actually cast form the object, but the overall object will become brighter, and appear to emit light. See also: *color*, *ambient*, *diffuse*, *specular*, *transmit*.

Error dialog

Something is about to happen and the program is uncertain which course of action to take. This dialog box is usually a *Red* with a brief message, and two or three buttons which determine the course of action. See also: *Dialog Box*, and *Confirmation Dialog*.

Expression

A text string which specifies some mathematical function.

Faceted shading

A shading technique that renders flat polygons with each having its own constant color. See also: *gouraud shading, smooth shading*, *wireframe*.

Field

A video frame is typically composed of two fields. The first field displays the odd numbered lines of an image, and the second field displays the evenly numbered lines of an image. The reason frames are split up this way is so that less flicker is perceived during the transitions between frames. For NTSC, a new field is displayed every 60th of a second, while for PAL and SECAM it is every 50th of a second. These rates correspond to the frequency of the electrical current used in those countries. i.e. Countries with 120 volt, 60 hz AC power typically use NTSC video, while countries with 240 volt, 50 hz AC power typically use PAL or SECAM video.

Field guide

A standard reference grid for 2D images. See also: *safe action, safe title*.

Filename

The name of a file. May include directory path information.

A filename:	*myHoudini_file23.hip*
A filename with a path:	*/n/pisa/staff/john/jobs/myHoudini_file23.hip*

Flat Shading

Same as faceted shading.

Focal length

The distance from the lens to the focal point of the lens. Perspective is flattened or exaggerated depending on the ratio of focal length and aperture. A wide angle lens has a smaller focal length – it will increase the apparent depth in an image. A telephoto lens will have a larger focal length – it will decrease the apparent depth by visually squashing the objects together.

Focal Point

The point at which rays of light from a mirror or lens converge.

Font

Font or Fount describes a complete set of typefaces. For example, the *Times* font contains four typefaces: *Times Roman*, *Times Italic*, *Times Bold*, and *Times Bold Italic*. See also: Typeface.

Foo | Bar

Programmers sometimes use these two words in examples as generic place holders, or as nonsense words.

FPS

An acronym for “Frames Per Second”.

Frame

An instant in time, designated with a frame number starting from frame 1 at time 0. A frame can also be an interval of time, typically 1/30 or 1/60 of a second. See also: *current frame*. The purpose of animation is to display a slightly different image at each frame, giving the illusion of motion or change over time. If a frame is interlaced, it is composed of two fields per frame. See also: *field*.

Frame rate

The number of images (frames) displayed each second. Typical frame rates are 24 (for film), and 25 and 30 frames (for video) per second. See also: NTSC, PAL, SECAM, Frame, Field.

Frame range

The *from* and *to* range of frames to play during playback.

f-Stop

In photography, f-stop is controlled by the lens aperture setting. It determines the blurriness of depth-of field effects.

Gadget

See Interface Elements.

Geometry

The visible surfaces that are rendered. The surfaces may be created with SOPs, model mode, or other 3D data read in. These surfaces are defined by the different Houdini primitives. See also: *Objects, polygon, point*.

Geometry Detail

An organized structure of points, primitives, and attributes thereof as well as groups of points and primitives.

Generator SOP

A SOP which creates geometry (as opposed to modifying existing geometry). In the SOP Editor, these are the SOPs available at the top of the layout area with individual icons. See also *Modifier SOP*.

Gouraud Shading

A technique that makes surfaces made of flat connected polygons appear to be smooth. The colors at the corners of polygons are computed using shared normals. These colors are then interpolated across the interior of the polygon. This technique misses specular highlights on the interior of polygons. See also: *Phong Shading*.

Graph

Displays a channel's values over time, keys, and segments visually.

Grid

A series of interconnecting rows and columns defining a surface.

Gutter

That part of a scroll bar or slider bar along which you move the thumb to change a windows view, or a parameter's value. See also: *Scroll Bar*, *Slider Bar*.

Highlight (shading)

A reflection of a light source which creates the appearance of a bright spot on the shaded surface.

Hue

That attribute of a color which describes its place within the spectrum.

Hull

A shape created by connecting the control vertices of a spline.

HSL

Referring to a color system that uses Hue, Saturation and Luminance to define a color, where hue is the specific color tone; saturation is the amount of white mixed in with the color; and luminance is the overall brightness.

HSV

Referring to a color system that uses Hue, Saturation and Value to define a color, where hue is the specific color tone; saturation is the amount of white mixed in with the color; and value is the lightness or darkness of the color.

IFD

See *Instantaneous Frame Description*.

Icon

An icon is a small picture (typically less than 1" x 1") which can be clicked to cause an action – similar in operation to a button.

Image

In computer animation, an image is a picture composed of a two-dimensional array of pixels resembling a mosaic. The greater the number of pixels per square inch that are displayed (its resolution), the more detailed the image can be. Typically images are represented by pixel arrays of 640x486 (NTSC) and 720x576 (PAL). See also: *Pixel*.

Image Toolkit

A set of UNIX programs used to manipulate images through compositing, blurring, cutting etc. The names of all Image Toolkit programs start with the letter *i*. The *i* stands for *image*.

Input Connector (on a tile)

The portion of an OP tile to which connectors from other OP tiles may be connected. This area is usually marked with an arrow pointing into the OP tile.

Instantaneous Frame Description

A complete description of a scene at a moment in time. Usually represented as an ASCII text file containing all rendering attributes that Houdini sends to the renderer *(mantra)*.

Interface

See *User Interface*.

Interface elements

These are controls through which you tell a program what to do. They include buttons, pop-up and pull-down menus, slider-bars, edit fields, text and viewports. Sometimes also referred to as “gadgets”. See also: *Button, Icon, Pop-up Menu, Pull-down menu, Scroll Bar, Textport, Viewport, Window.*

Interpolation

To place between two items another item whose value is computed from the mean of the items surrounding it.

Key

Keys (also known as ‘keyframes’ and ‘timemarks’) associate specific values with a specific time. Between keys, the value of a channel will be interpolated.

Light

An object which provides illumination of the scene. They can be point lights or ambient lights. Lights can be used as a point from which to view in a viewport. See also: *camera, object types*.

Light Mask

A text pattern which indicates which lights illuminate a specific object. Each object has a light mask indicating the lights which will illuminate it. For example:

*	Object will be lit by all lights
light1	Object will be lit solely by the light named *light1*

See also: *Reflection Mask, Shadow Mask*.

Lighting Model

The algorithm used to compute the color of an object at a particular point. Takes all lighting and surface characteristics into account. The result of a shader may give a wide range of appearances to geometry, including: wood grain, stucco, and plastic.

Marquee

A rectangular selection area. So named, because marquees are sometimes animated, making them reminiscent of the lights moving around large broadway-type signs of the same name. See also: *Box Select*.

Mask

See *Matte*.

Material

See: *Lighting model*.

Matte

Relating to Images:
The alpha plane of an image. Indicates which areas of the image are solid and which are transparent. Also known as *coverage*, *mask* or *alpha*.

Relating to Lighting Models:
A matte shaded object will occlude objects behind it when rendered. However, no alpha will be filled in to the resulting image. That is, it will be rendered totally black and opaque, but with zero alpha. The matte object can be used to create cut-outs or holes in the render, which can be filled during compositing.

Matrix

A group of values ordered into a grid. The grid may be any size and have any number of dimensions. Typically, for computer graphics, matrices are used for computing things like transformations, and are limited in size to 3x3 or 4x4 entries.

Mean

The result obtained by adding a set of numbers together, and dividing the total by the number of elements in the set.

Menu

A list of items from which you choose the command you want to perform. There are two kinds of menus in general use: pop-up and pull-down menus. To use a menu, click and hold the mouse button on the desired menu's name – the menu appears. Without letting go of the mouse button, move the mouse pointer to the desired item in the menu, and release the mouse button when the item becomes highlighted. See also: *pop-up* and *pull-down menus*.

Mesh

A special kind of surface whose points are ordered in a set of rows and columns.

Metaball

A metaball can be thought of as a force field. It is strongest at the center of the field, and weakest at the perimeter of the field. When two metaballs are close to each other, their fields add together.

Meta Surface

A meta surface is generated by evaluating the field of a single or multiple metaballs. Where the field strength of the metaballs is equal to 1, the meta surface exists.

Model

To create geometry, or referring to geometry that has been created.

Modifier OP

A SOP, COP or TOP which modifies existing data rather than creating new data. These operators are generally available by selecting from the *More* menu to the right of the Generator OPs.

Moiré

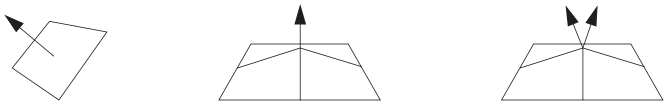
Wave-like interference created by repetitive patterns.

Multiplicity

The multiplicity of a point refers to the number of times the point is referenced consecutively in a primitive.

Normal

A vector perpendicular to a surface which indicates the direction a surface faces. Among other things, normals are used to determine the shading of a surface. An object will be smooth shaded when all polygons at one point use an averaged normal of all adjacent polygons, and will appear faceted (cusped) when a different normal is used for each polygon.



You can display the normals of a piece of geometry by selecting the option in the *Viewport Settings* dialog of any Viewport.

NTSC

The standard used for video transmission in North America and Japan. NTSC is an acronym for: National Television Systems Committee. It has a frame rate of 30 frames per second.

NURBS

Non-Uniform Rational B-Splines. Generates a smooth curve from a series of control points that may or may not touch the end points.

Objects

All of the physical elements that make up the scene, such as lights, geometry and cameras. Each object has a name, channels for animation, and settings (such as its wireframe color and whether it is turned on for display). See also: *camera, light, geometry.*

Orthographic

Projection system in which all rays run parallel from the viewer. This simulates the effect of viewing the object from an infinite distance.

Output Connector (on a tile)

The portion of an OP tile to which connectors to other OP tiles may be connected. This area is usually marked with an arrow pointing out of the OP tile.

PAL

The standard used for video transmission in the United Kingdom, Europe, and Australia. PAL is an acronym for: Phase Alternation Line. It has a frame rate of 25 frames per second.

Parameter

A value which may be changed to alter the operation being performed.

Parenting

A method of grouping objects so that transformations to the parent affect the child. For example, if an arm is parented to a shoulder, when the shoulder is moved, the arm moves too.

Particles

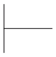
Particles have a direction and a velocity which are acted upon in such that they simulate phenomena such as smoke, rain, or dust. They can be rendered as a primitive type in Houdini which uses the points in the primitive as tiny spheres or tubes or polygons.

Patch

A surface containing vertices, spline types and subdivisions. Patches can be modelled and converted to polygons.

Penumbra

The area of partial eclipse. If you were standing in the area of penumbra, you would see a portion of the light source obscured by some other object. See also: *Umbra*.



Perpendicular

At right angles with respect to each other, like the two lines to the left.

Phantom

A phantom object is seen only in reflections and shadows. It is not rendered directly in the scene.

Phong Shading

A technique created by Bui Tuong Phong in his 1973 doctoral thesis *Illumination for Computer Generated Images* that makes surfaces made of flat connected polygons appear to be smooth. This is done by interpolating the normals across the interior of the polygon. This technique is more accurate than Gouraud shading. See also: *Gouraud Shading*.

Pixel

A PIcture ELement. It is the smallest piece of information that can be displayed on a screen. Each pixel is seen as a small square dot on a screen. The number of pixels per inch determine the resolution of an image. See also: *Pixel depth*, and *Resolution*.

Pixel Depth

The number of number of colors that a given pixel can display, usually measured in *bits*. The pixel depth can be determined by computing the result of 2 to the power of the number of bits per pixel. e.g. 2 bits per pixel yields 4 colors ($2^2 = 4$), 8 bits yields 256 colors ($2^8 = 256$), and 24 bits yields 16,777,216 colors. See also *Bits*, *Color Channels*.

Plane
A flat, infinitely large, infinitely thin, surface.

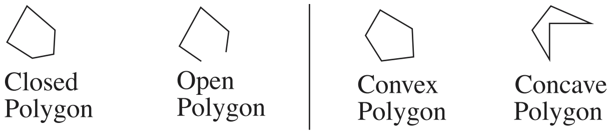
Plane Normal
A vector perpendicular to a plane. This is vector is used for shading purposes in order to determine the reflection of light.

Playbar
The slider indicating the current frame. In Houdini, the Playbar is located at the bottom right of the Houdini window.

Point
A three dimensional (XYZ) position in space, with optional color, texture coordinates, weight, and point normal attributes.

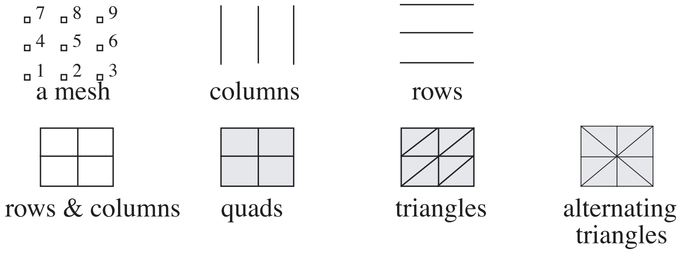
poly
An ASCII polygon file, a UNIX file containing a description of points, polygons and vertices.

Polygon
A figure with one or more sides composed of straight lines. See also: *Concave Polygon, Vertices*



Polygon file
A UNIX file containing descriptions of points, polygons and vertices.

Polygon mesh
A polygonal surface with its points arranged as an array of points and columns. This mesh can be connected together in a variety of ways: as a renderable surface when output as rows & columns, quads or triangles; or as lines (open polygons) when output as rows or columns.



Polynomial
A polynomial is a mathematical equation containing a sequence of terms raised to a power. An example of a polynomial equation in x is: $ax^2 + bx + c$.

Pop-up menu

As opposed to a pull-down menu, a pop-up menu can be located anywhere within a window, just like a button, but when clicked, a menu of choices appears. See also: *Menu*, *Pull-down Menu*.

Primitive

A geometric entity containing one or more points, and defined by a given topology represented as one object in a geometry detail. e.g. ellipse, polygon, particles system, NURBS surface, etc. See also *Geometry Detail*.

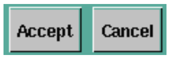
Primitive Closure

When you select geometry, the selection turns yellow, and another portion turns green. The green portion is called the primitive closure (except in the case of selecting primitives, in which the closure and selection will be identical, because the selection color supsedes the closure color, and thus you see only yellow).

A primitive closure can be of two types: point closures and primitive closures. A primitive closure of a selection will be the set of all the primitives that reference at least one item of that selection. A point closure contains the set of points referenced by the entities in the selection.

Pull-down menu

Same as a Pop-up Menu, except it is always located in a menu-bar (several Pull-down menus side by side at the top of a window). See also: *Menu, Pop-up Menu*.

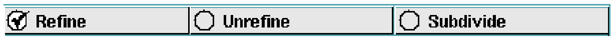


Push buttons

The most common type of button. It behaves in one of two ways. i) Regular Push Button: Performs an action when it is clicked. e.g.: Opening a file, Deleting a selected item, changing the camera position. ii) Toggle Push Button: Click once to turn it on (it becomes highlighted, and stays that way). Click again to turn it off. This second type is not as common. See also: *Button*, *Check boxes*, and *Radio buttons*.

Radio buttons

A series of buttons in which only one can be active at a time, much like the buttons for selecting the station on an old-fashioned car radio. These buttons are usually round. See also: *Button, Push buttons, and Check boxes*.



Raytracing

A rendering technique that achieves photorealistic images by following light rays as they travel through the scene bouncing off objects and hitting light sources.

Real time

Fluid display of moving images requires that a certain number of frames (pictures) per second be displayed (for NTSC: 30, for PAL: 25, for film: 24). Because it takes a great deal of processing power to generate complex animations, computers are sometimes unable to display every frame necessary to produce the effect of continuous motion without pre-computing the sequence of images. Enabling the *realtime* option forces an animation to play at the actual speed specified, even if some frames must be skipped in order to maintain the right speed. For example, given a frame rate of 30 fps, it ensures that you will see the 300th frame after exactly 10 seconds of play. See also: *frame, frame rate*.

Reflection Mask
A text pattern which specifies which objects will appear in reflections from a specific object. For example:

*	Object will reflect all other objects in the scene
geo2	Object will reflect only the object named *geo2*

See also: *Light Mask, Shadow Mask*.

Refraction
When light passes from one medium to another of a different density (e.g. air to water), it undergoes a speed change, and consequentially the direction it travels is altered. The *Index of Refraction* corresponds to this angular change.

Render
To create a high-quality 2D image of a 3D scene.

RenderMan
A specification for renderers developed by Pixar. The RenderMan specification defines geometry, shading and transforms. The most common renderer which implements the RenderMan specification is *prman*, which is distributed by Pixar. A public domain renderer: BMRT (Blue Moon Rendering Tools) also implements the RenderMan standard more completely than *prman*, but is slower.

RLE
A system whereby pixels are stored in compressed form. In this system, the color value of a pixel is stored together with a value representing how many subsequent pixels of the same color follow the initial pixel. A new pair of values occurs wherever the pixels change color. RLE is an acronym for: Run Length Encoding.

This method is very efficient in storing computer generated graphics where large areas of solid color are used, but is inefficient where live-action video, which contains noise and static, is involved.

RGB
An acronym for Red-Green-Blue; referring to the system by which varying amounts of red green and blue are mixed to display any possible color. Red, green, and blue are necessary, because they are the primary additive colors.

Resolution
The level of information contained. In images, this usually refers to the number of horizontal and vertical pixels contained in the image (e.g. 1024 x 768).

Safe area
The portion of a video image which will be visible on most monitors. Approximately 90% of the full video frame.

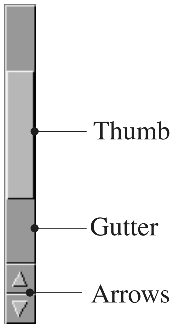
Safe title area
The portion of a video image which will be visible without distortion on all mon-

itors. Approximately 80% of the full video frame. Animators need to know this because it is undesirable to display faces and text outside the safe title area.

Scene
The complete setup of objects, including geometry, lights, and cameras.

Script
A file containing a list of commands. A script may contain shell or Houdini commands.

Scroll bar
When a window, edit field, or textport aren't big enough to display all the information they contain, a scroll bar allows you to scroll through the information. This is done in one of three ways:



i) Clicking the arrows on either end of a scroll bar, brings just a bit more information (e.g. one line of text) into view. The arrows indicate the direction in which the scrolling will go.

ii) Dragging the rectangular "thumb" within the scroll bar's "gutter" allows you to jump directly to any given place in a document. Moving it to the top of the scroll bar gets you to the top of the information; moving it to the bottom gets you to the end.

iii) Clicking within the gutter itself scrolls the information a full screen forwards or backwards.

See also: *Gutter, Slider bar, Thumb.*

SECAM
The standard used for video transmission in France, the former USSR, and many other countries. SECAM is an acronym for: Séquence à Mémoire (Sequential Color with Memory). It has a frame rate of 25 frames per second.

Seed
A seed is an integer that tells the random number generator where, in its large ($16*2^{32}-1$) sequence of random numbers, to start giving out values required for an operation. What this, in effect, produces is a predictability in the sets of different "random" numbers generated by a particular seed value. This is valuable in that the effects, like random noise, for example, will be consistent from render to render.

Segment
Defines the behaviour of a channel in the frame range between two keys. See also: *key.*

Selected OP (vs Current OP)
Yellow borders indicate that an OP has been selected. Once selected, the OP may be moved, deleted, cut or copied. The selected OP is not necessarily the current OP. Selecting an OP does not allow you to modify its parameters. Selected OPs are outlined in yellow.

Selecting

To select something is to tell the computer what you want to apply an action to. This is done by clicking on it; Shift-clicking to select more than one element, or in the case of text within an edit field, dragging the mouse over the text. See also: *Selection*.

Selection

High-lighted areas or items indicating what objects will be affected by user commands. You must select something before performing an action, otherwise the computer will be unable to determine what you want to affect with your command. If nothing is selected, a command will affect all objects to which the command is applicable. A selection in Houdini is ussually green. See also: *Current*.

Shade

i) The darkness of a given colour's hue.
ii) The area in which a light-source is obscured.

Shader

The RenderMan equivalent to a Material.

Shading

The change in lighting across the surface of an object due to it's position relative to a light source. See: *Lighting model*.

Shadow

The darkened area formed on a surface by the interference of some object between a light source, and the object on which the light is falling.

Shadow Mask

A text pattern which specifies which objects will cast shadows from a specific light source. For example:

*	All objects cast shadows from the light
geo2	Only object *geo2* will cast shadows from the light

See also: *Light Mask*, *Reflection Mask*.

Shell

A UNIX program which takes text commands on a line, executes them, displays the results on the screen and then waits for another command.

Shell script

A list of shell commands in a UNIX file. Typically the script contains Houdini compositing or recording commands. See also: *shell*.

Slider bar

Similar to a scroll bar, but lets you change a numeric value by dragging the thumb along a track. Adjusting the value of a number in this way is often faster than typing it on a keyboard. See also: *Scroll Bar*, *Thumb*.

Smooth shading

A technique that makes surfaces made of flat connected polygons appear smoothly curved by interpolating surface normals across the face of each polygon. See also: *Gouraud shading, Phong shading*.

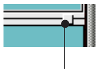
SOP
See: *Surface Operations*.

Spectrum
If you shine white light through a prism, the resulting rainbow of colors is called a spectrum. The spectrum contains one shade of all possible colors.

Specular
The light an object reflects which results in a shiny spots on the object.

Specular reflection
The reflection of a light source as seen by an observer on a reflective surface.

Spline
A polynomial curve formed by a series of control points.



Split-bar
When a window is divided into two or more panes, the panes are divided by a "split-bar". Dragging the split-bar handle allows you to adjust the size of the window panes. See also: *Window pane*.

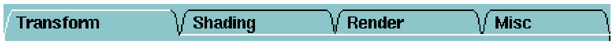
spy
A fast text-based interface included with Houdini that allows you to: view, copy, move, and delete UNIX files and directories, and execute UNIX commands.

Stochastic
To do with random processes.

Surface
The polygons, vertices and points of a geometry object that can be rendered.

Surface OPerations (SOPs)
A way of creating and modifying geometry. A procedure for creating objects by joining a series of Surface OPerations in which each step may be modified and any parameter animated. See also: *Generator SOP, Modifier OP.*

Tabbed page
When many buttons and edit fields must be grouped in a limited space, Tabbed Pages allow you to quickly switch back and forth between related groups of buttons and edit-fields.



Tangent
A vector parallel to a surface/curve at a point, which only touches the curve at that point.

Temporal
To do with time.

Template object
An object in the SOP or Model Editor which is viewed but cannot be modified.

Texture mapping
The process whereby a 2D image (e.g. wood grain, marble, wall-paper) is applied to a 3D geometric surface. This gives a more realistic appearance to the geometry.

Textport
This is an area within a window in which you type commands from the keyboard into the program. The program's responses to these commands are then displayed. The textport is scrollable, meaning you can scroll back to see previous typing. See *Scroll Bars*.

Thumb
That part of a scroll bar or slider bar that you move back and forth to change the windows view, or the slider's value. See also: *Scroll Bar, Slider Bar.*

Tile (OP)
The graphical representation of an OP in the Layout Area.

Time
In computer animation, time is measured in seconds, or frames. Time starts at zero. At 30 frames per second, frame 60 = 2 seconds. See also: *frame, current frame*.

Timemark
See 'Key'.

Timemark Interpolation
To automatically fill in the frames between timemarks with new values. There are several interpolation methods including ease-in, ease-out and spline. See also: *timemark.*

Transforms
The translation, rotation and scaling of an object, geometry, material, etc.

Transformation order
The order in which translating, scaling and rotating occur. Since these transformations are not commutative the order is important. For example rotating and the moving forward 5 units will not get you to the same place as moving forward 5 units and then rotating.

Transform jack
Allows you to do a variety of transformations to geometry in the Model Editor. See the *Editing Geometry* section of the Reference Manual for details.

Translate
To move from one place in space to another.

Transmit
The colour of light that passes through a transparent object. If an object is transparent, objects behind it will be tinted based on the transmit colour of the object. See also: *color, ambient, diffuse, specular, emit.*

Tropism

Tropism is when a plant bends or curves in response to an external stimulus such as gravity or wind. The bending is characterised by the fact that the thicker or shorter parts bend less than the longer or thinner parts. L-systems employ a *tropism vector* to simulate this behaviour.

Typeface

A single style of letters within a Font. For example, *Times Bold* is a single typeface belonging to the *Times* font. Changing the typeface changes the appearance of the individual letters and characters. See also: *font*.

Umbra

The area of total eclipse. If you were standing in the area of umbra, you would be standing in the shade – the light source being completely obscured by some other object. See also: *penumbra*.

UNIX

The operating system used by computers manufactured by SGI, under which Houdini runs.

Up Vector

A vector whose orientation is used to specify which direction is up relative to the Construction Plane. See also *Construction Plane*.

User interface

A user interface consists of the various graphics you see on the screen that allow you to interact with programs. See also: *Interface elements*.

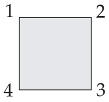
Variable

A variable is a text string with a name. The string may be a filename, a number, or a math expression. For example, the variable *MyHome* might contain the string: */usr/staff/john* , the number *35* , or the expression *sin($F*10)+5* . You can substitute the variable in place of actually typing the string. If you change the contents of a variable, the places where you used the variable automatically use the updated contents.

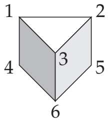
When variables are referenced in Houdini, they are preceded by a “$”.
For example, the variable for the current frame is: *F*, so you would use: *$F* .

Vertices

A polygon is made of vertices which are indexes into a list of points. Vertices do not contain XYZ information, but are used to specify how to connect points together into polygons. The following illustrates a rectangle and a prism.



POINTS	POLYGONS	VERTEX #s
1: -1, 1, 0	1: 1 2 3 4 <	1 2 3 4 <
2: 1, 1, 0		
3: 1, -1, 0		
4: -1, -1, 0		



POINTS	POLYGONS	VERTEX #s
1: -1, 1, 0	1: 1 2 3 <	1: 1 2 3 <
2: 1, 1, 0	2: 4 5 6 <	2: 1 2 3 <
3: 0, 1, 1	3: 1 3 6 4 <	3: 1 2 3 4 <
4: -1,-1, 0	4: 2 3 6 5 <	4: 1 2 3 4 <
5: 1, -1, 0	5: 1 2 5 4 <	5: 1 2 3 4 <
6: 0, -1, 1		

Polygons

Vertices

The rectangle has 4 points, 1 polygon and 4 vertices. The prism has 6 points, 5 polygons and 18 vertices. The point list contains the list of points and XYZ information. The polygon list contains a list of polygons; each polygon contains a set of numbers which defines how to connect the points together into polygons – these are the vertices. The vertex #s list on the right renumbers the vertices starting at 1 for each polygon.

Viewport

An area where a 3D view of geometry is displayed, in which you are able to manipulate the vantage-point. See also *Camera port*.

Window

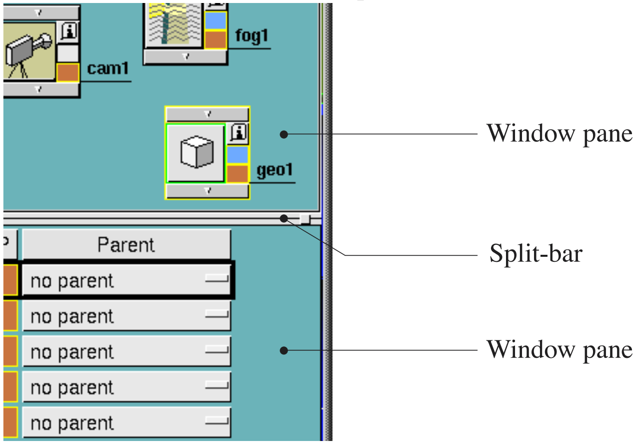
A rectangular area on the screen used to display and manipulate information. A window may contain many interface elements, or nothing more than a textport. Windows can usually be resized and moved anywhere on the screen.

Close windows by double-clicking on the small square in the top-left corner. Stow (temporarily make the window into an icon) windows by clicking on the second-last square in the top-right corner. To enlarge or reduce the size of the window, click and drag the corners or edges.

In some rare circumstances, some windows may not be rectangular; other shapes are also possible. See also: *Dialog box, Split-bar, Window-pane*.

Window pane

Sometimes a window is split into two or more areas by a split-bar. Each of these areas is referred to as a "window pane". See also: *Split-bar*.



Wireframe

A line drawing of an object. Polygons are represented by their edges only. See also: *Smooth shading, Faceted shading*.

Wombat

A furry, heavily-built, plant-eating Australian marsupial.

wsh

A Window SHell. See: *Shell*.

Z-Buffer

When pixels are written to the viewport for display, some pixels should be displayed in front of others so that the parts of the 3D object that should be obscured from view are actually obscured.

The Z-Buffer is a place where pixels are stored with a depth attribute. This allows a pixel that is supposed to remain in the foreground to remain there.

Zoom

The magnification of an image. This often involves a change in perspective to simulate the effect of zooming with a real camera lens.