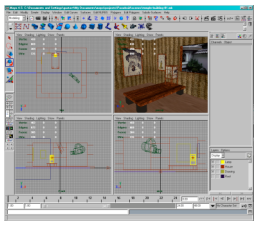
DH2640 Grafik och interaktionsprogrammering
DH2323 Datorgrafik och interaktion
NA8740 Datorgrafik och användargränssnitt



An Introduction to Maya

original slides by Gustav Taxén

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Maya

- Used in industrial design, CAD, computer games and motion picture effects
- Special focus on motion pictures and games
- The ambition is ”what you see is what you get”
- Being able to manipulate things directly in a perspective view was quite new at the time
- Alias/Wavefront → Alias → Autodesk

Main competitors

- **3D Studio Max**, http://www.discreet.com/
- **Cinema 4D**, http://www.maxon.net/
- **Houdini**, http://www.sidefx.com/
- **LightWave**, http://www.newtek.com/
- **SoftImage XSI**, http://www.softimage.com/
- **ZBrush**, http://pixologic.com/
- **Blender** (free), http/www.blender.org/
- **Alias, AutoCAD**

Graphical Editors used at CSC/Nada earlier

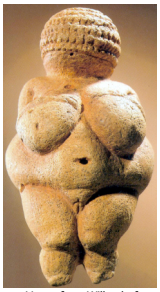
- **Constraint based editor, SCED, free**
- **Rhino, free**
- **SunGV/SunVision**
- **Alias**

An evaluation was done a few years ago between 3D Studio Max and Maya - we decided to go for Maya.

What is Maya?

- **Tool for creating virtual 3D- or 2D models**
- Rendering
- Animation
- Special effects
- Different kinds of surface representations

- **Think sculpting: creating form / shape!**



Venus from Willendorf
22000-24000 B.C.
http://witcombe.sbc.edu/willendorf/

What is Maya?

- Concepts in Maya are (more or less) common to all 3D tools (workflow, tool set, and GUI differs)
- The same operation can be performed in many different ways in Maya
- Steep learning curve
- Very efficient workflow for experienced users
- We have used different versions, currently Maya2008 (things here may include earlier versions which is also the case for webb info)

Assignment examples

Pär Bäckström

Assignment examples

Pär Bäckström

Assignment examples

Gustav Taxén

Maya tool sets

- Modeling
- Shading
- Lighting
- Rendering
- Animation

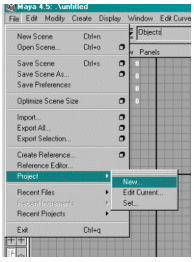
The assignment

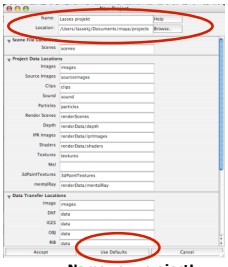
- Dynamics, particles
- Character rigging and skinning

Project management

- Maya proposes a work organization scheme (but does not enforce it)
- A Maya **project** contains one or several **scenes**
- All scenes in a project share input resources (such as texture images)
- The rendered output images for the scenes in the project are stored in the same folder

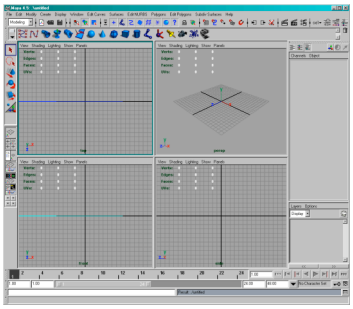
Project management

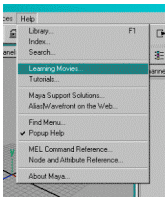




Name your project!
PRESS "Use Defaults" BEFORE "Accept"!
(Creates a very useful directory/folder structure.)

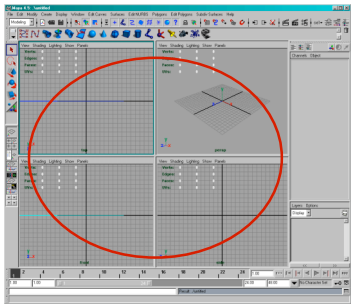
The user interface



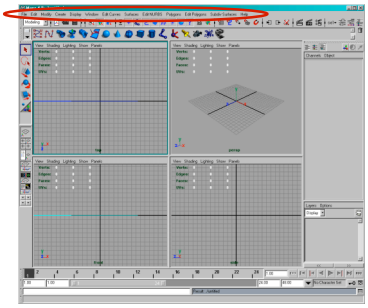


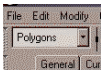
Watch the Learning Movies!
Browse the Tutorials!
Use the Help System!

The Workspace



The menu bar

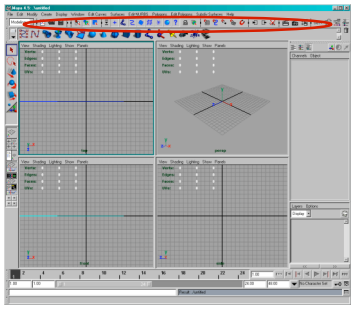




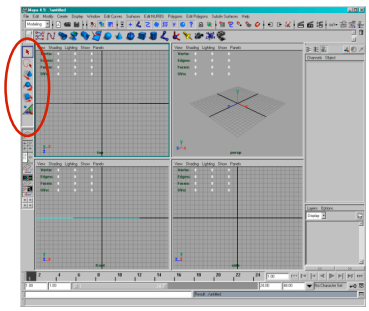
Toolset-specific menus

"Polygons" should usually be active (except e.g. when you associate light sources with objects, more later)

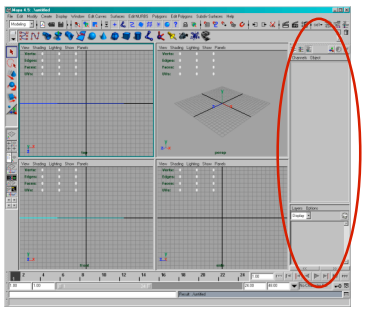
Selection masks, snap, rendering



Tool box

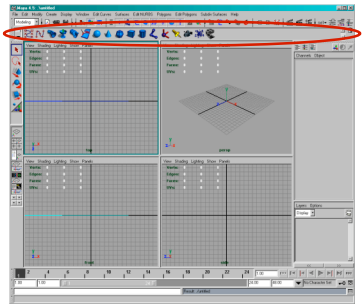


Channel box, layers

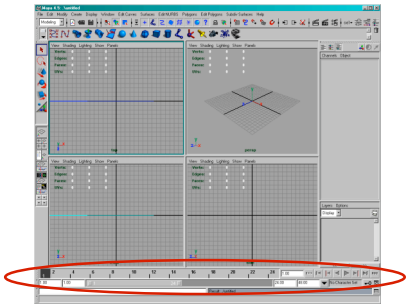


Display / hide channel box & layers.

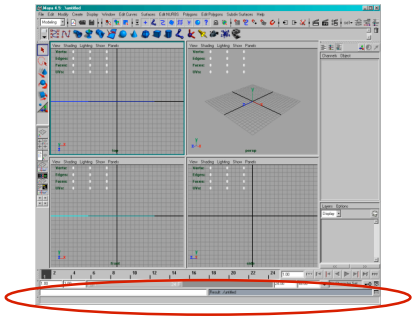
Shelf



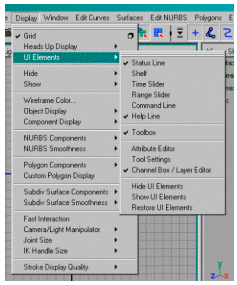
Animation, timeline



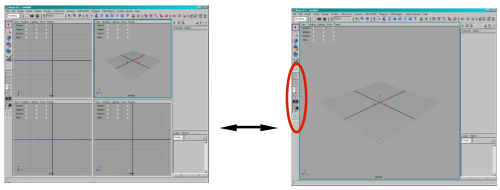
Status/command line, help line



Show / hide UI elements

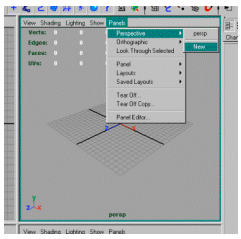


Workspace layouts

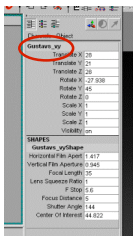


Pressing <SPACE> quickly toggles between 4-view and active view.
Choose different workspace layouts by
clicking on the icons beneath the tool box.

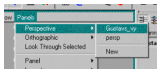
Views



Create new view
(perspective or orthographic)

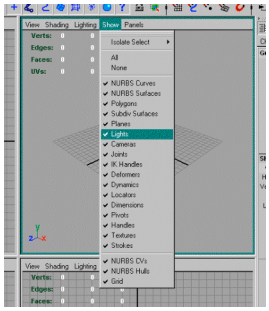


Name your view!
(Click once in the
entry field)



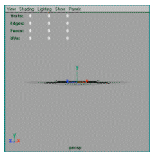
Choosing your new view

Views

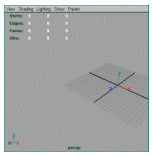


Show / hide different entity types (per view)

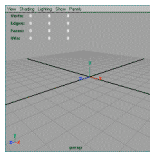
Views



Rotate view (perspective only): Alt + left mouse button.



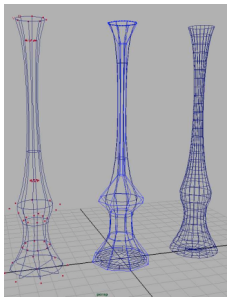
Translate: Alt + middle mouse button.



Dolly in/ut: Alt + right mouse button.

Modeling

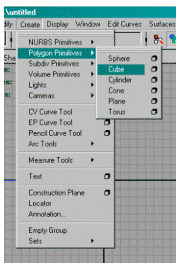
- NURBS
- Subdivision (Catmull-Clark)
- Polygons

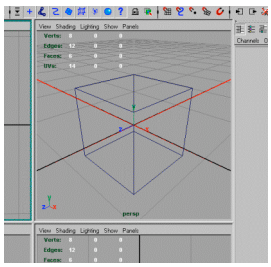


Polygon modeling

- **We use polygon modeling in the assignment**
- Two main ways of working:
  - Create a primitive object and manipulate it
  - Create polygons one at time and manipulate those (possibly join together into an object)
- The first way is simpler and more efficient for the assignment
- **Modeling requires imagination** – both with respect to form/shape and with respect to the tools you use!

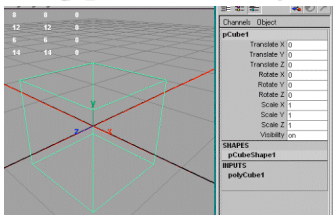
Creating primitive objects





Position pointer in a view and press <F> to center the camera on the objects.

Creating primitive objects



The channel box shows the most important attributes of the object.

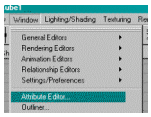
Click on the object with the left mouse button to select it.

Press <Delete> to delete something you have selected.
Maya has an Undo facility (Ctrl-Z), but **save often**!
Use "Save As..." so you can return to a previous stage in your work if you need to.

Nodes and attributes

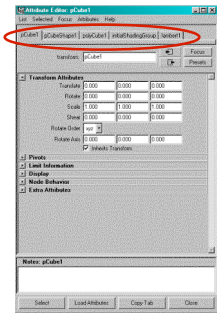
- Objects in Maya are built from **nodes**:
  - **Creation node** - records the options that created the object
  - **Transform node** - records how the object is moved, rotated, and scaled
  - **Shape node** - stores the positions of the control points or vertices of the object
  - **Rendering nodes** – stores information about the appearance of the object
- Each node has **attributes** associated with it

Nodes and attributes



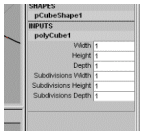
The attribute editor shows all attributes for a selected object.

Choose a node using the tabs and an attribute group in the window beneath.

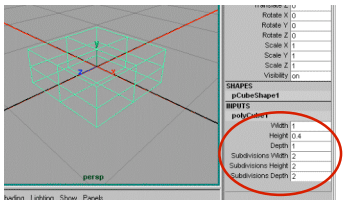


Nodes

Nodes and attributes

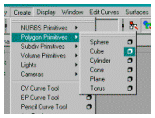


In the channel box, creation node attributes are shown under "INPUTS".



Change these to modify the initial attributes of the object.

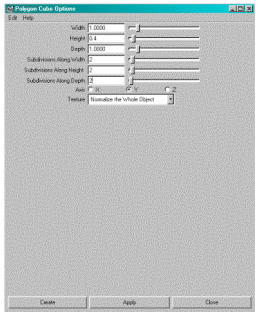
Nodes and attributes



The creation node parameters can also be accessed by clicking the ❐ button in the menu (this button is called "**Tool options**").

Changes made here changes the default creation node parameters.

"Apply" creates a new object and leaves the window open. "Create" creates a new object and closes the window.



Transformations

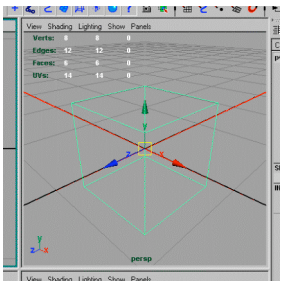
Translation (along coordinate axes)

Rotation

Scaling (along coordinate axes)

Keyboard shortcuts for tool box:
<Q>, <W>, <E>, <R> and <T>

Translation

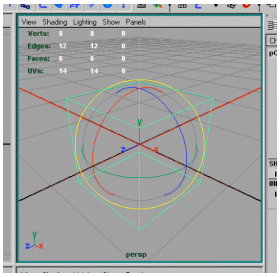


Move freely:
left-drag in the yellow square

Constrain to an axis:
left-drag one of the axis arrows

Constrain to principal plane:
<Ctrl> + left drag one of the axis arrows

Rotation

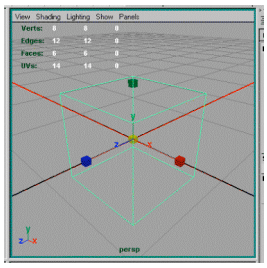


Free rotate:
left-drag on object

Constrain to camera plane:
left-drag yellow ring

Constrain to principal plane:
left-drag one of the other three rings (red, green, blue)

Scaling

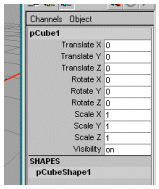


Scale freely:
left-drag the yellow cube

Constrain to axis:
left-drag the red, green, or blue cube

Constrain to principal plane:
<Ctrl> + left drag the red, green, or blue cube.

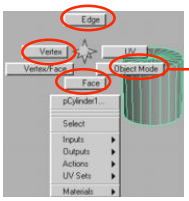
Transformations



You can also enter values directly into the transformation node using the channel box (or the attribute editor).

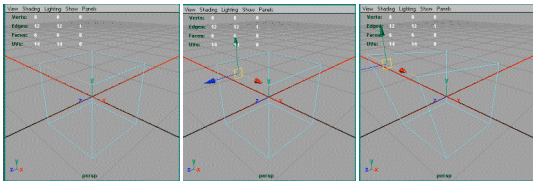
Components

Components are the entities that make up the shape of an object:



Press and hold the right mouse button over an object to display the menu (called a **marking menu**).
Then drag onto a button to select which component type you wish to work with.

Manipulating edges

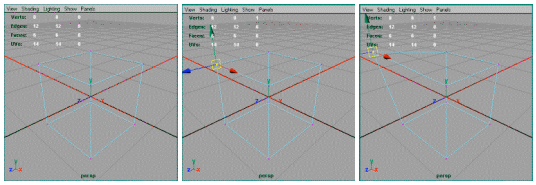


Choose edge components. Select one or more edges.

Choose a transformation tool.

Transform!

Manipulating vertices

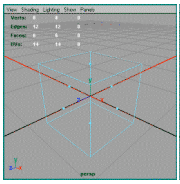


Choose vertex components. Select one or more vertices.

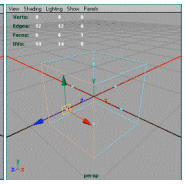
Choose a transformation tool.

Transform!

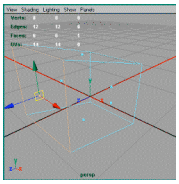
Manipulating faces



Choose face components. Select one or more faces (use the blue center dot).

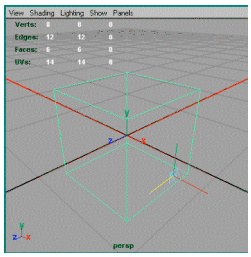


Choose a transformation tool.



Transform!

Pivot points



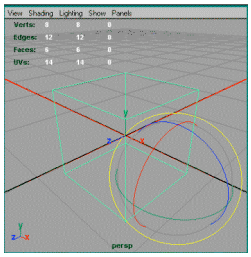
<↖> or <Insert> toggles between transformation of the object and transformation of the pivot point.

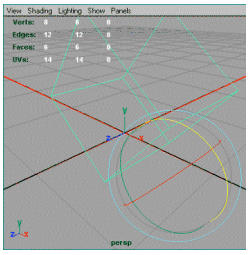
Transformations are applied at the **pivot point**.

There is one pivot point per object.

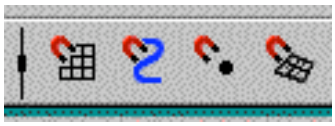
You often need to move the pivot point.

Pivot points





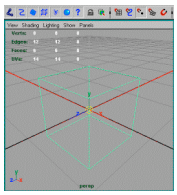
Snapping



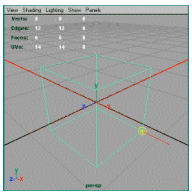
Snap to grids | Snap to curves | Snap to Points (vertexes) | Snap to view planes

When transforming, the pivot point is snapped.

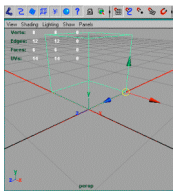
Snapping - example



Moving the pivot point to a corner: choose snap to points.

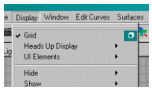


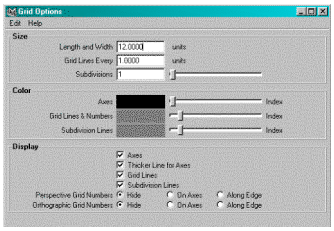
Translate the pivot point to the corner.



To move the cube "onto" the X/Z plane: choose snap to grids and translate.

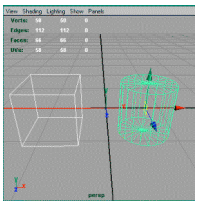
The grid



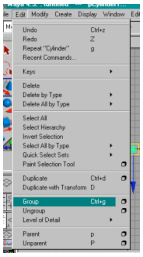


Change the grid parameters when needed.
Choose size and the number of lines ber unit.
Subdivisions = additional lines between each unit line.

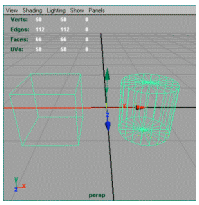
Groups



Select two or more objects:
<Shift> + left click



Choose Edit→Group
(or Ctrl+G) to
create a group.



The pivot point **for the group** is placed at the center of one of the objects (**not** between the objects as above, previous version)

Groups

Manipulate or select groups

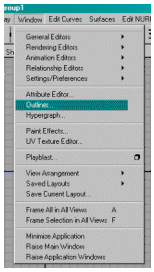
Manipulate or select individual objects (inside or outside groups)

Manipulate or select object components (inside or outside groups)

The component type to be manipulated or selected

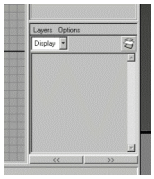
Vertices, edges, and faces.

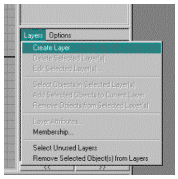
Groups

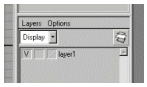


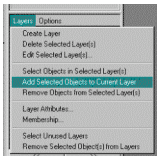
The outliner window shows all group hierarchies.
It also shows other entities that are part of the project.
You can select groups and objects by choosing them in the outliner window.

Layers



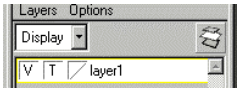






Layers are used to hide or "lock" objects so that they don't get in the way or are modified by accident.
Window → General Editors → Display Layer Editor to display layer editor
(some changes menues in new version)
Always name your layers!

Layers



Visible / invisible

Lock / unlock

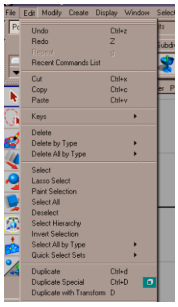
T = lock + template (display objects in low level of detail)

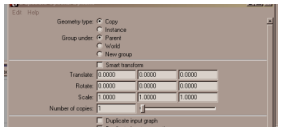
R = lock + reference (display objects in high level of detail)

Layer color (double click to modify)

Name your layer! (double left-click the name)

Duplicating objects

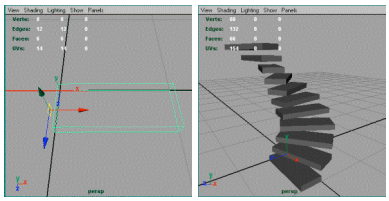




Choose the number of copies and the transformation Maya should perform before each copy is made.
The new copy is automatically selected when it has been created.

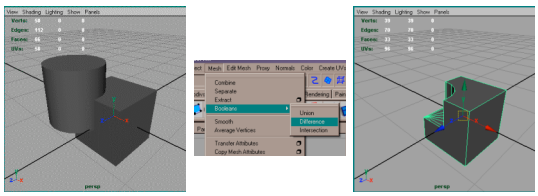
The "Instance" option associates the copies with the original so that changes made to the original is automatically made to the copies.

Duplicating objects - example



Create a stairway step.
Move the pivot point to the side.
Translate up and rotate around y axis as duplication options.

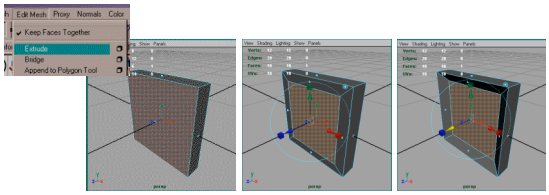
Boolean operations



Select two objects (MUST be closed).

Choose an operation.

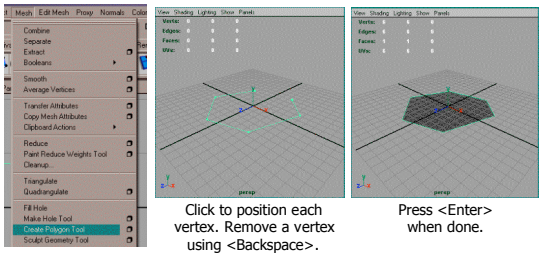
Extruding faces



Select a face.
Select "Extrude Face" in the menu.
This creates a new face in the same plane as the original face.

Manipulate the size and position of the new face

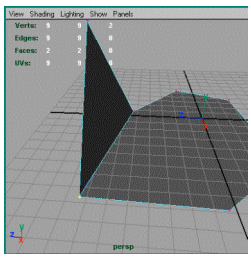
Creating individual polygons



Click to position each vertex. Remove a vertex using <Backspace>.

Press <Enter> when done.

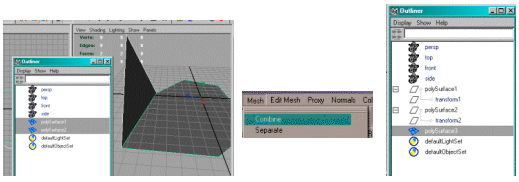
Merging vertices



The tolerance level can be modified using the tool options (❒).

Objects may have to be combined first (Mesh→Combine), see next slide

Combining polygons into an object

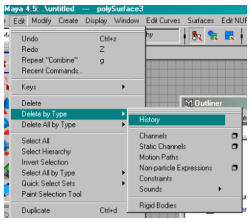


Select the polygons.
Merging vertices and edges before combining is recommended!

Choose "Combine".

The result is a new object with creation history...

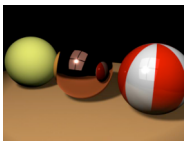
Combining polygons into objects



If you delete the creation history...

...the polygon surface is all that remains – the new object is equivalent to the other primitive objects (sphere, cube, ...).

Shaders and textures

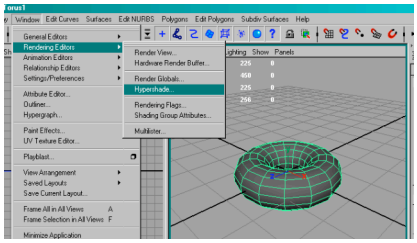


Surface appearance in Maya is specified using **shaders**. A shader consists of a **render node network**.

There are three types of render nodes: **material nodes, texture nodes** and **positioning nodes**.

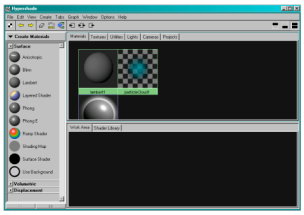
Each shader must have a material node.

Shaders and textures



The "Hypershade" window is the "work area" where shaders are created.

Hypershade



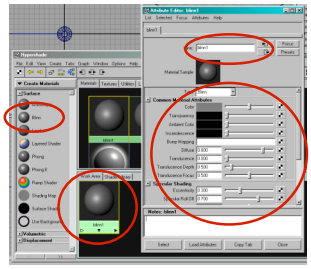
All shaders in the current scene.

Work area where new shaders are created and modified.

Material nodes. (Some correspond to reflection models.)

Creating a shader

1. Choose a material node to create a new shader.

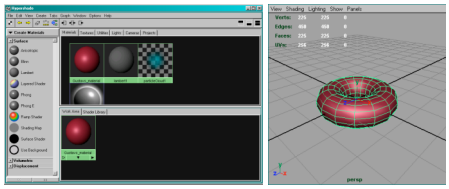


Name your shader!

2. Double click the new shader in the work area.

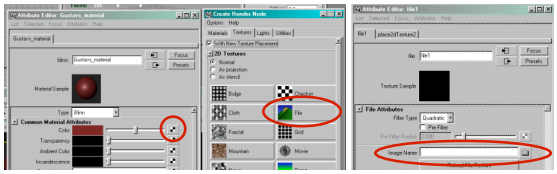
3. Modify the attributes for the material node.

Assigning shaders to objects



Assigning a shader to objects:
1) Select the object(s). Click-hold the right mouse button over the shader in Hypershade and choose "Assign Material To Selection".
2) Click-hold the right mouse button on an object and choose "Materials→Assign Existing Material". (Only works for a single object at a time.)

Textures



Click the checkerboard button for the color attribute.

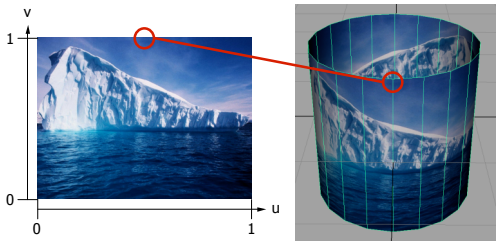
This will create a new texture node and connect it to the material node.

Choose "File".

Select an image file.

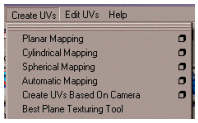
Put your texture files in the "sourceImages" folder for your project!

Texture positioning



UV points are assigned to each vertex.
The values are then interpolated across the surface.

Texture positioning

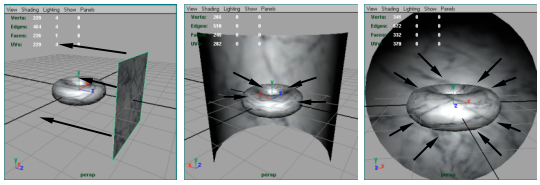


Maya assigns UV points automatically to polygons (using a **positioning node** in the shader), but the result is often haphazard.
So we need to set the UV points ourselves!

Select the object(s) and choose a **mapping**.
Use the tool options (❐) to set the mapping parameters first!

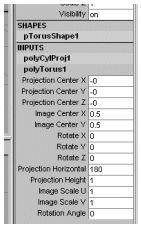
The mapping is stored in a separate **projection node** (outside the shader network, since it belongs to the object(s) and not the shader).

Texture positioning

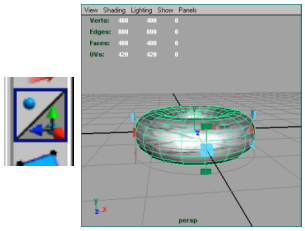


Planar | Cylindrical | Spherical

Texture positioning

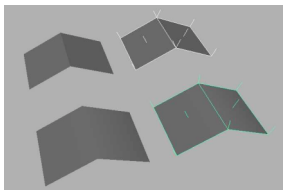


You can choose the mapping in the channel box (under INPUTS) if you want to change the projection attributes.



You can also press the "Show Manipulators Tool" button in the tool box to manipulate the projection interactively.

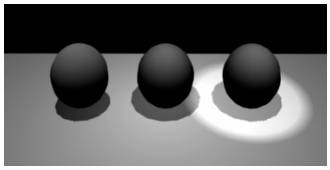
Surface normals



Normals are assigned to vertices and interpolated across the surface.

Vertex normals can be set to the surface normal ("Harden Edge") or be averaged across surfaces ("Soften Edge").

Lights



Directional Point Spotlight

Ambient

Lighting

- Lighting is an art form!
- ”Simulating reality” seldom leads to interesting images!
- Professionals often use ”negative” light sources to remove light from the scene
- As in illustration, the key role of the light is to **bring out form/shape**!
- Think ”painting with light”!
- Think about the color scheme and the general feel of your image!

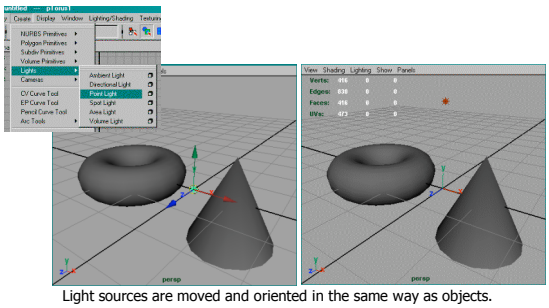
Three point lighting

- Classic imaging technique
- **Key light**: most important, brings out the main shape
- **Fill light**: takes the edge off shadow regions, brings out shape in shadow regions
- **Back light**: accentuates the silhouette

http://www.andrew-whitehurst.net/3point.html

http://www.3drender.com/light/3point.html

Creating light sources

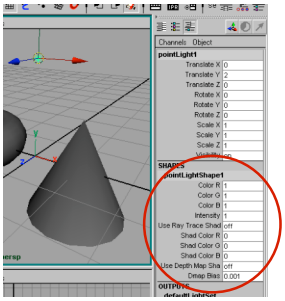


Light sources are moved and oriented in the same way as objects.

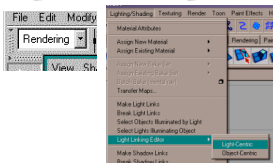
Light source attributes

Select the light source. The most important attributes are shown in the channel box.

The other attributes can be modified using the attribute editor.



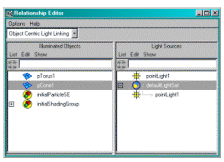
Light linking



Sometimes, you don’t want an object to be lit by a light source.

Disconnect light sources from objects in the ”Light Linking” window. (Need to choose ”Rendering” to see the menu.)

Grey line on the right = light is ”on” for the selected (grey) objects on the left.



Rendering

- Two types:
  - Ray tracing
  - Ray casting
- Ray tracing allows for reflection, refraction, and high-quality shadows, but is slow
- Ray casting is faster, but uses textures for shadows and reflections (which may lead to aliasing)

Rendering

Render image (of the currently selected view)

Render image that allows for interactive updates (more later)

Open the general rendering attributes window: "Render Globals"

Render globals

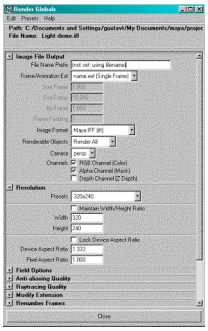
Important fields:

Image Format (use JPEG)

Resolution (of the output image)

Anti-aliasing quality

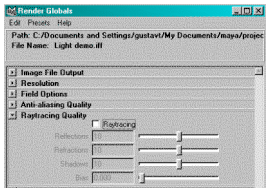
Raytracing quality



Render globals

To use ray tracing (rather than ray casting), check the "Raytracing" box under "Raytracing Quality").

Choose the recursion depth for reflections and refractions: 1-2 is usually enough.

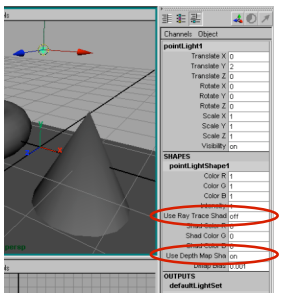


Shadows

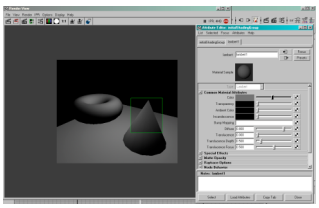
A light source does NOT cast shadows unless shadow casting has been activated!

Select the light and activate"Ray Trace Shad" (if you want to use ray tracing) or "Depth Map Sha" (if you want to use ray casting).

The objects also need to receive/cast shadows (which is the default, but can be changed in the attribute editor).



Interactive rendering



Turn off ray tracing. Click the IPR-button. When the rendering is complete, select a region. It is now possible to update light sources (position and other attributes) and shaders. The region is updated automatically.

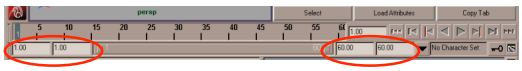
IPR creates large files in the renderData/iprImages folder!

Animation

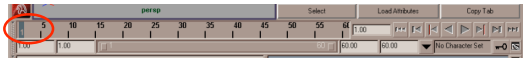
- Maya supports **keyframing**, **dynamics**, and **inverse kinematics**
- More on dynamics and inverse kinematics in animation lecture...
- Keyframing:
  - Set object attributes at specific **key frames**
  - Computer **interpolates** the attribute values (**in-betweening** or "**tweening**")

Animation

Choose "Animation" to display animation-specific menus.



Choose total number of frames for the animation.
Assume 24 frames per second.



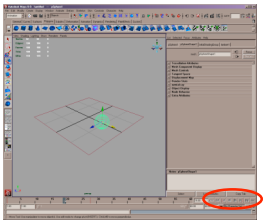
Select a frame in the time slider.

Setting key frames

Select the objects you wish to set a keyframe for, then do "Animate→Set Key".

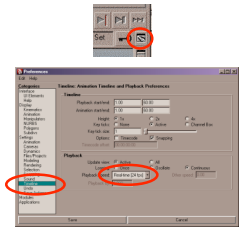
Red lines in the time slider indicates where keyframes have been set.

Keyframing



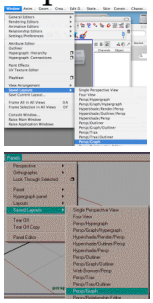
Choose a new frame, manipulate the object(s), and set a new key frame.

Play animation using the animation controls.

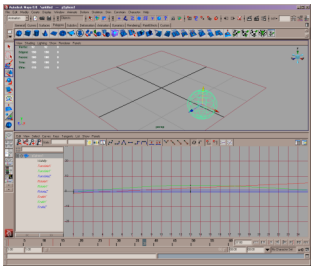


To set the animation speed to 24 fps, open animation prefs, select "Timeline" and choose "Real-time (24 fps).

Interpolation curves



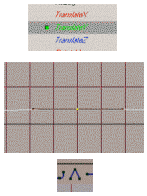
Select a layout with a graph to show the interpolation curves.



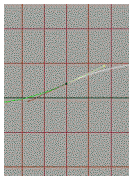
These curves illustrate how the object attributes change over time.

By default, the changes are smoothed.

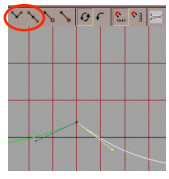
Interpolation curves



To create a "sharp" interpolation, select the attribute, choose a key frame and press the "sharp" icon.



To change the tangent interactively, selecting it, press 'w' to activate the move tool, and drag with the **middle** mouse button.



Break the tangent by clicking the "break tangent" icon.

Join tangents together by clicking the "unify tangents" icon.