

Maya Introduction (Studio Prof. Greg Lynn)

This brief handout gives a short introduction to MAYA. Only the most important and basic commands are listed here. For further information and special knowledge to all the commands you can temporarily lend a MAYA manual at the Lynn studio. For any other questions contact us.

In this intro several abbreviations are used:

LMB – Left mouse button
RMB – Right mouse button
MMB – middle mouse button

Maya file types :

mb – default: MAYA binary
ma – MAYA ascii (for exchange with other MAYA version –manipulate header)
iges – Iges File for data exchange with Surfcam, Rhino, FromZ....etc. supports nurbs geometries. (Hint: to import in SurfCam modify file extension to .igs)
Dxf (not recommended) polygon format for AutoCAD etc.

The viewport

- Different viewport configurations are available on the sidebar.
- To change between default viewport configurations press the spacebar.
- Defaults are the [perspective window](#) & the [4-tiled persp/orthogonal views](#)

Orientation in the viewport:

Alt+LMB+drag: rotate view

Alt+MMB+drag: pan view

Ctrl+Alt+drag: zoom window

Display properties:

Select viewport and hit

4 for wireframe display
6 for shaded view with default lighting
7 for shaded view with scene lighting

Select object and hit

1 for rough display
2 for medium display
3 for fine display

note: this only effects the display not the object.

Problems with the viewport:

Lost in Space: Center view on selected object:

[viewport menu>view>frame selection](#)

Default view (center of grid): viewport-menu view-default home - If the viewport navigation is behaving strange, probably the world up vector is the wrong direction.

Make sure that the z-direction is the world up axis. (Orientation of the mill)

Change it with [window>settings/preferences>preferences>settings](#)

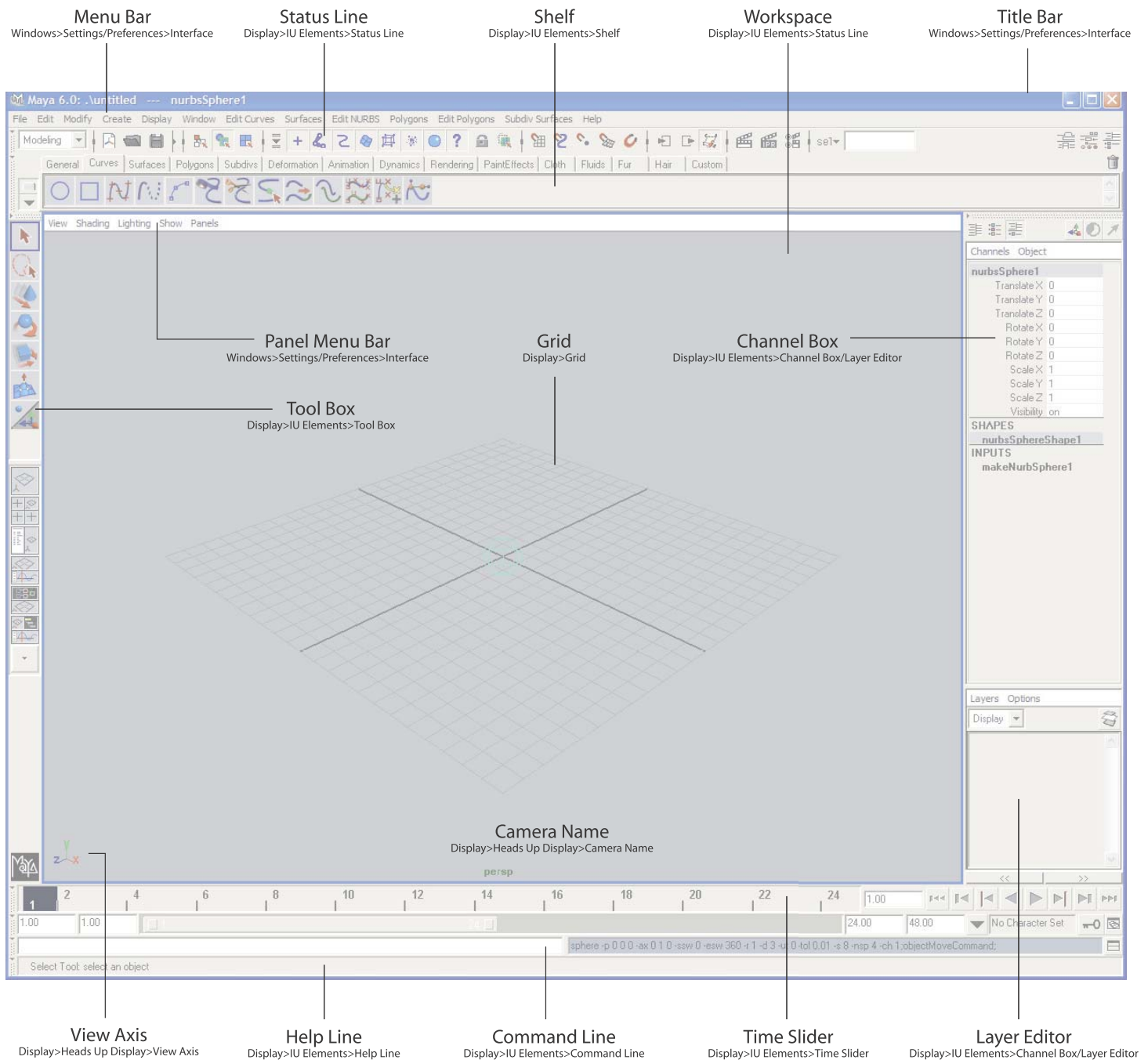
Changing the view setup:

Tiling of viewports to fullscreen and back: spacebar

Customization of single viewports: viewport menu panel;

Changing the viewport object display from rough (fast) to fine (slower): number keys 1(rough)-3(fine)

Display mapping: [viewport menu>shading>enable hardware texturing](#)



Organization of working objects and entities:

The Outliner: Open Outliner: [Window >Outliner](#)

The outliner is a list of all of the entities, and object that make up the scene (model). The Outliner works similar to windows explorer but drag and drop works with MMB

Group objects by selecting them and **Cntrl-G** or [Edit>group](#), move o
Move objects within the list or between groups by click and dragging them with the MMB.

Rename objects by double-clicking on name, typing name **and confirming with enter**.

HINT: Most scenes consist of hundreds of objects. A good hierarchical structure is necessary for effective working. Delete objects that are not necessary.

Layers: A scene can also be organized with layers.

The layer menu should be under the channel box on the right. If not, activate it through [Display>UI elements>Channel Box / Layers](#)

Display layer properties by double-clicking on layer.

Tools:

Maya is a very robust and complex modeling and animation program. It has hundreds of different tools, and each tool often has multiple settings and parameters to fine tune its usage.

Work Mode

There are 6 different work modes in Maya Complete. They are Animation, Modeling, Dynamics, Rendering, Live, and Cloth. The work mode, sets the GUI (Graphical User Interface) – the menus and icon bars that are available on the screen for doing different work. **The work mode is set** by choosing the appropriate mode in the dialogue box in the upper left menu bar (immediately below “File”).

We will mostly be working in the **Modeling work mode**. Make sure that in the popup menu in the left upper corner is on [modeling](#) mode!

Tool - Options window:

All menu items with a small square on the right side offer an options menu for the tool. It is accessed by clicking the box beside the tool, rather than the tool name.

Polygon modeling:

Polygon objects are made up of connected faces which are determined by straight connections between points rather than mathematically calculated curves. You can work with polygon objects directly or work with NURBS surfaces and then convert them to polygons later.

Polygon Primitives:

One way to create polygons is the manipulation of preset primitives:

[Create>Polygon primitives>Sphere \(Cube, Cylinder, Cone, Plane, Taurus\)](#)

Polygons are made up of Vertices, Lines, Faces and Edges and each of these can be manipulated just like NURBs components (move, scale, rotate.)

Creating Polygons from scratch:

You can also draw polygons by specifying their vertices.

Polygons>Create Polygon tool (as independent objects)

Polygons>Append to Polygon tool (as new faces of existing polygons)

Building with polygons generally involves working with faces – splitting, merging and extruding (to create new faces) them to create changes in shape or pattern. All of these tools are found under *Edit Polygons>*

NURBS modeling:

NURBS stands for Non Uniform Rational B-Spline, and is a mathematical way for defining a complex curve or surface based on a set of points and a set of vectorial forces applied to those points. NURBS allows for complex surfaces to be defined using a smaller data structure, and as a result they are more efficient computationally and in terms of data size.

Make sure that in the popup menu in the left upper corner is on *modeling mode!*

There are two major ways to create NURBS surfaces: Generating a surface with a preset primitive, or generating a surface from lines.

NURBS Primitives:

The first (more simple but also more restricted) way is the manipulation of preset primitives:

Create>NURBS primitives>Sphere (Cube, Cylinder, Cone, Plane, Taurus, Circle, Square)

Each of these primitives have parameters that can be independently defined by clicking on the options box in the drop down menu.

NURBS lines and generating surfaces:

First you must understand the issues of the DEGREE of a line.

Degree of curvature:

- 1 (polygon – straight segments between points)
- 3 cubic (curved line interpolation 3 Control Points)
- 5 (curved line interpolation 5 Control Points smoother)
- 7 (curved line interpolation 5 Control Points smoother)

The spline (or NURBS curve) degree is the average curvature between the degree number of points. A 7 degree spline will pass through the 1st, 4th and 7th point, and will be averaged over three points on either side of any given point (above a 7 point line). This is why a 7 degree spline will be “smoother” than a 5 degree spline (2 points on either side of a central point above 5 points).

Creating Curves:

Maya has two different ways of creating splines:

EP curves – Edit Points Curve – the curve always passes through the points, and the inflection of the curve between points is determined by the degree of the curve. *Create>EP Curve Tool*

CV curves – Control Vertex Curve – the curve is averaged between points based on the degree of the curve. *Create>CV Curve Tool*

Creating a surface with lines:

For creating surfaces through lines it is advantageous to have lines with the same amount of control points. The simplest way is to be always conscious about this during creating lines and afterwards use the rebuild curves command in *Edit Curves*. Here you can either rebuild uniform with a certain number of subdivisions or simply activate multiple curves and click match knots.

Loft: [Surfaces>Loft](#) this command interpolates a surface between any number of splines. It is necessary to activate the lines in the right order

Birail: [Surfaces>Birail](#) > 1- 3+ The birail tool creates a surface along two rail-paths with any number of different section curves in between. Precise curve modeling is indispensable here.

Surface Properties: NURBS surfaces are defined by the internal mesh of U&V lines, and the mathematical interpolation of the space between them. Too low or too high surface subdivision can be a problem.

Use the [Edit NURBS>rebuild surface](#) command for rebuilding the surface or change surface degree (1-7)

Object transformation and manipulation tools:

All objects can be manipulated at the component and sub-component level. Manual transformation of the object can be achieved by manipulating the “control handles”, by using the [Transformation Tools](#). The transformation tools are in the toolbox on the left side. If not activate in the menu:

[Window>Settings/preferences>Interface>UI elements>Tool Box](#)

Manipulators

Selection tool: used to select objects or components ([SHORTCUT Q](#))

Move tool: perpendicular to the viewport or axis wise ([SHORTCUT W](#))

Rotate tool: axis based ([SHORTCUT E](#))

Scale tool: uniform or axis wise ([SHORTCUT R](#))

The options for the manipulators are available by double clicking their icons in the Tool Box.

By selecting an object and clicking a manipulator tool, the pivot handle (x,y,z) appears.

The manipulator handle appears at the center of the object (or at 0,0,0 if set to default).

You can either manipulate the object (default) or the handle origin (pivot). The handle can be repositioned in the scene by pressing *INSERT*. Deactivate change pivot mode with insert key a second time.

For changing the pivot in the center of an object: [Modify>center pivot](#)

Modifications with the channel box (default right side): type into white fields

Editors: Object can be manipulated at the unit level by using the [Edit](#) menu

Delete: Delete and Delete by type

Select: Select all, Select inverse, Select by Type

Duplicate: Duplicate, Duplicate with Transform

Group: Create a a single group from selected objects

Parent: link and manipulate multiple items based on a single item

Component transformation and manipulation tools:

Components of a NURBS-surface: Isoparms, Control Vertex's, Hulls

Selecting components: mouse over object – right button component menu
Choose isoparm, CV, or Hull

Isoparms: linear demarcations defined by the surface, and the internal U&V logic of the surface geometry. Isoparms are used for detaching and attaching surfaces.

Control Vertex's: free shaping of surfaces

Same with **hulls:** hull-transformation is a linear group transformation of CV's

Getting out of the component selection-mode:

click and hold RMB in open space – select all – deselect all

NURBs tools:

NURBS modeling is normally a process moving back and forth between lines and surfaces, manipulating both and then cleaning up their geometry and rebuilding. Most of these tools apply to both curves (Edit Curves menu) and surfaces (Edit NURBS menu.)

Lofting, birailing, extruding and revolving create surfaces from curves.

Create 3 3-degree curves that will be lofted.

Project curve, intersect surfaces, and extract isoparm create curves from surfaces.

Insert a knot on one curve.

Manipulating Geometry:

You will often have to rebuild or clean up your geometry (the organization of CVs and isoparms) before you can add to it or use it to continue modeling.

Rebuild all three curves with equal numbers of CVs.

Insert Knot/Isoparm:

Add additional edit points or isoparms at a specific location. Useful for *snapping to curves and surfaces*.

Verify that all three curves have the same direction and reverse if necessary.

Rebuild:

Recalculates CVs and isoparms on a curve or surface which is often necessary before *lofting, offsetting*, etc.

Loft the curves, draw a fourth curve and project on the surface.

Reverse Curve/Surface direction:

Curves and surfaces have a direction (shown by the box at the start of the curve.) Curves must be aligned before *lofting*.

Project Curve on Surface:

Adds a 'curve on surface' to surface geometry. This is not an isoparm but can be extracted with 'duplicate surface curve.'

Project a curve on surface and use it to trim the surface.

Intersect Curves/Surfaces:

Adds a point or isoparm to lines and surfaces at points of intersection

Splitting & Merging:

Attach Curves / Surfaces:

Must be Snapped together at end points / edges.

Detach Curves / Surfaces:

Split at an Edit point (not a CV) or Isoparm.

Cut curve:

Cut at an intersection with another curve or surface.

Multiplying & Morphing:

Duplicate Surface Curves:

Extracts isoparms or 'curves on surface' from a surface and changes them into autonomous curves.

Offset.

Extend.

Fillet:

Curves must be coplanar, surfaces can not be filleted depending on orientation.

Trimming:

All surfaces in Maya are gridded – made up of isoparm which run their entire length in both directions. The program cannot calculate surfaces with holes or irregular edges. Trimming a surface changes its appearance but not its underlying geometry maya retains the original surface but renders it with the trimmed portion missing. This allows you to untrim – revert back to the original surface, but maya has an extremely difficult time calculating multiple trimmed surfaces and outputting them to other programs. Therefore:
USE THE TRIM TOOL ONLY WHEN ABSOLUTELY NECESSARY. You are almost always better off making the same object from multiple surfaces instead.

Dynamics and Parametrics:

Maya includes many tools meant to create complex and emergent movement and change with simple controls. Many are more geared toward animation, but can be extremely useful in architecture for developing complex organizations and parametric systems.

History:

Move the three curves that were used to build the surface off to the side - these will be the controls used to deform the surface. Move CVs and whole curves to affect the surface.

History:

Maya organizes objects into generational hierarchies, relating each body to its parents. Any changes made to the parents will have the same effect on the children – moving a CV on the curve used to loft a surface will move the corresponding CV on the surface.

History allows multiple and interweaving surfaces to be manipulated by a 'control panel' of points and curves located somewhere else.

If you don't want a surface to move when you move its parents, you can delete the history of that object by selecting the object and then going to:

[Edit>Delete by Type>History](#)

Or you can turn off construction history for the entire model by clicking on the construction history button to the left of the rendering buttons.

Instancing:

Instancing creates history-like effects through the duplicate command. Select an object and open the Duplicate options dialog box.

[Edit>Duplicate](#)

Click the instance box and duplicate the object. The copy is a child of the original object meaning it will change with its parent. You can create a field of instanced objects that you can control with one or several parents.

Deformer Lattice:

The lattice tool allows global deformations on a complex object or set of objects. Set the work mode to dynamics and select the objects to deform.

[Deform>Create Lattice](#)

Set the number of divisions depending on the scale of the deformations you need. Local Mode determines whether each lattice point can influence only the deformable object's points that are nearby (local), or can influence all the deformable object's points.

Local Divisions specify the extent of each lattice point's local influence in terms of the lattice's local STU space. The default settings are: S has 2 divisions, T has 2 divisions, and U has 2 divisions. With the default setting, each lattice point can only influence the deformable object's points that are at most two divisions away (in S, T, or U) from the lattice point.

Move the lattice to another layer and set the deformable object to reference or template mode under layers so you cannot select it. Deform the object by moving, scaling and rotating the points of the lattice.

Blend Shape:

Blend shape morphs one object into the shape of one or several other objects. This is useful for creating a gradation of shapes over a field of objects or making a set of similar but differentiated objects. When creating a blend shape deformer, you identify one or more objects whose shapes you want to use to deform the shape of some other object. Objects whose shapes you want to use to deform the shape of another object are called target objects, and the object being deformed is called the base object.

First, Open the Blend Shape Editor:

[Window>Animation Editors>Blend Shape](#)

Select the target object(s) first, then the base object and create the blend shape.

[Deform>Create Blend Shape](#)

Select the options box and name the blend shape. Click create and the object should appear in the Blend Shape Editor with a slider for each target object. Move the slider to morph from the base shape to the target shape. If nothing

Instancing:

Create three identical objects (spheres, planes...) duplicate all three with instance several times (until you have 20 or 40 objects) and arrange in a grid or field. Keep the three originals off to the side. Move, scale, and rotate each of the originals to affect the field.

Latticing:

Take a single original object and duplicate with transform but without instancing into a new field. Select the entire field and create a lattice. Change the number of divisions to change the scale of deformation.

Blend Shape:

Create two new identical objects and deform one. Select the target and then the base object and create blend shape. Move slider in the Blend Shape Editor.

happens when you move the slider, make sure you don't have any historical relationships between target and base objects.

IK Handles:

This tool creates a skeleton under or inside a second surface that controls the movement or deformation of that surface. IK (Inverse Kinematics) control a series of joints in a linear chain with a single control (IK solver) and are most often used in animations for replicating human and animal movement.

IK Handles can be useful for developing a series of interdependent movements or deformations within a set of objects. See the Maya tutorial on line for more information.

Particles, rigid and soft bodies:

Maya can recreate the movement and deformation of objects in the real world, as they are affected by gravity or wind. Particles and soft bodies are objects that can be moved or deformed by fields (objects that generate forces that act like gravity and turbulence) or by the presence of other objects. This allows you to roll objects down a hill, shoot particles into the wind and track their flow, or replicate disturbances on a single object. The possibilities are nearly endless, but the effects of these tools are extremely hard to control precisely and take a lot of practice to master.

Fields:

Rigid and Soft Bodies are put in motion by fields, forces that affect other objects in different ways.

A **drag field** exerts a friction or braking force on an object that's animated with dynamic motion.

A **gravity field** simulates the Earth's gravitational force. It accelerates objects in a fixed direction.

A **radial field** pushes objects away or pulls them toward itself, like a magnet.

A **uniform field** pushes objects in a uniform direction.

A **turbulence field** causes irregularities in the motion of affected objects. These irregularities are also called noise or jitter. You can combine turbulence with other fields to mimic the random motion in fluid or gaseous mediums such as water and air.

A **vortex field** pulls objects in a circular or spiraling direction. You can use this field with particles to create effects such as whirlpools or tornados.

An **air field** simulates the effects of moving air. The objects you connect to the air field accelerate or decelerate so their velocities match that of the air as the animation plays.

A **newton field** pulls objects towards it. This lets you create effects such as orbiting planets or tethered, colliding balls. This field is based on the principle that a mutual attractive force exists between any two objects in the universe, proportional to the product of their masses. As the distance between the objects increases, the force of the pull decreases.

Rigid Bodies:

are displaced and not deformed by field forces (soft bodies are deformed and displaced.) Rigid bodies are created automatically when they are linked to a field. To create still iterations of the moving objects and remove them from the effects of the field, duplicate it and delete it's rigid body properties:

[Edit>Delete by Type>Rigid Bodies](#)

*Creating Rigid Bodies:
Create 1 or more objects.
Select the objects, go to the Field pull-down menu (in Dynamics Workmode) and select the desired type of field. This creates a new field which affects the selected objects. Move objects and field as necessary and then press play on the time slider.*

Soft Bodies:

are objects that are deformed and displaced by field forces. Nurbs and Polygonal objects as well as lattices, IK splines and motion paths can be soft bodies. Select a single object and turn it into a soft body:

[Soft/Rigid Bodies>Create Soft Body](#)

To create still iterations of the deformed objects and remove them from the effects of the field, duplicate them. In the duplicate options window, turn off Duplicate Upstream Graph and turn off Duplicate Input Connections. If either box is checked, the duplicate will still be affected by the field.

Particles:

are objects that are deformed and displaced by field forces. There are two ways to create particles, by placing them in the model with the *particle tool* (either one-by-one or in 2d or 3d grids) or through an *emitter* which generates moving or stationary particles as an animation plays. Particles can then be programmed as groups or individuals, or subjected to fields such as gravity (to link particles to a field, use the same processes as rigid bodies.)

You can also make particle objects collide with geometry. Either or both objects can be moving at the moment of impact. You can also make particles split, emit new particles or die. To do this, select the particles, then shift select the object they will collide with. Like them:

[Particles>Make Collide](#)

Run the animation.

Animation:

Keyframe animation lets you transform objects or skeletons over time by setting keyframes. Object move from their position in the first keyframe to their position in the next.

Driven key animation lets you link and drive the attributes of one object with those of another object by setting driven keys. For example, you can key a character's X and Z translations as *driver* attributes and a door model's Y rotation as the *driven* attribute to create an animation of a character and a swinging door.

Nonlinear animation lets you split, duplicate, and blend animation clips to achieve the motion effects that you want. For example, you can use nonlinear animation to create a looping walk cycle for a person.

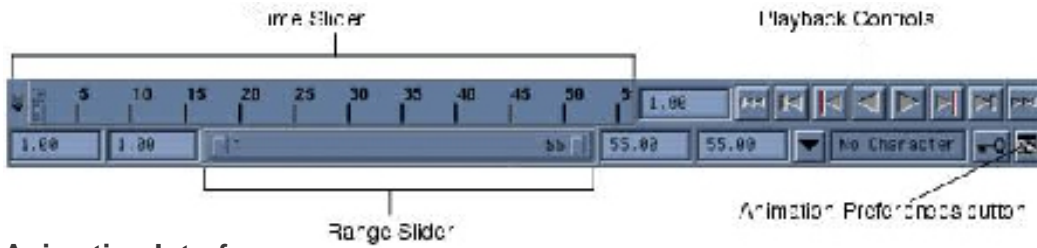
Path animation lets you set a curve as an animation path for an object. When you attach an object to a motion path, it follows the curve during its animation. You can also attach a camera to a motion path so that the point of view in the scene moves through it.

Motion capture animation lets you use imported motion capture data to apply realistic motion to the characters in your scene. For example, you can use the captured motion of a horse to animate the skeleton of a quadruped model.

Dynamic animation lets you create realistic motion by using the rules of physics to simulate natural forces.

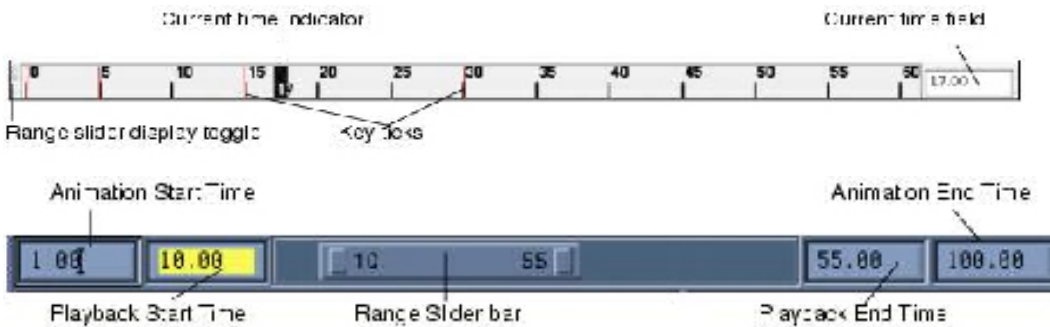
Creating Soft Bodies:
Create 1 or more objects. Select the objects, and create soft body. With the soft bodies selected, create a deformation field under the Field pull-down menu (in Dynamics Workmode) and select the desired type of field. This creates a new field which affects the selected objects. Move objects and field as necessary and then press play on the time slider.

Expressions are instructions that you can type to animate attributes. For example, you can write an expression formula that animates the flapping of a bird's wings.



Animation Interface:

The time slider displays temporal position of current view and any key frames. (Key frames are only visible when exactly the same set of objects or components are selected that were selected when you originally set the key.) The Range slider controls how much of the time slider is visible.



Playback speed:

When you play a scene, you see a rough approximation of the animation. The playback speed and quality is imprecise as compared to rendering each frame and playing the frames in sequence with a playback utility specifically designed for this purpose. The reason for this is that Maya processes the animation of each frame before display, while a playback utility simply plays previously processed and rendered images. The more detail that Maya needs to process, the slower the playback.

To see the animation with a more accurate timing, use playblast to create **and view a video clip**.

[Window>Playblast](#)

It is also possible to simply add more frames to the animation to slow down dynamics temporarily.

Key Frame Animation:

This is the easiest and most common type of animation. The modeler sets a series of keys or still frames that contain the position, scale and rotation of each object in the frame. Maya then interpolates between frames, moving, scaling and rotating objects between frames. After selecting the objects you want to animate, create a keyframe.

[Animate>Set key](#)

Copy or delete keys by selecting the animated objects, selecting frame which contains the key and right-clicking on the key

To change the length of the animation, type the new length in the Animation End Time Window.