
CHARACTER ANIMATION

This tutorial shows you how to add animation controls to an existing character, animate the character, and edit vertex weights to adjust movement and clean up the animation.

In this tutorial:

- Creating a skeleton... *page 2*
- Applying Smooth Skin to bind a model to a skeleton... *page 6*
- Adding IK to the character... *page 7*
- Setting keys in the Set Driven Key window... *page 9*
- Animating the character... *page 12*
- Using 2 bone IK... *page 13*
- Editing vertex weights using the Paint Skin Weights tool... *page 16*
- Pruning vertex weights... *page 19*



Clothes by Maya Cloth. Scenery created with Maya's Paint Effects.

Before you start:

This tutorial requires Maya scene files. To download the tutorial files, please visit the Taste of Maya web site at www.aliaswavefront.com/tasteofmaya.

Starting Maya:

Double-click the **Maya 3.0 Evaluation** icon on the desktop, or from **Start > Programs > Maya 3.0 Evaluation > Maya**.

In Maya:

Once the tutorial files have been installed, you have to set the current project to access the Maya scene files. To set the current project from within Maya:

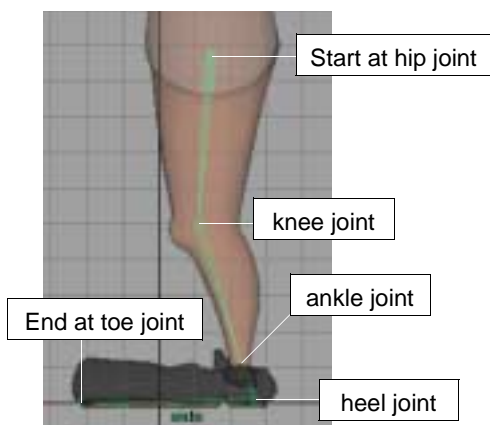
- Select **File > Project > Set** and navigate to the directory where you installed the Maya scene files.
- Select the **Maya_tutorial_data** directory and press **OK**.

Creating a skeleton

The following steps show you how to place joints and connect them to build part of a skeleton. Select **File > Open Scene** to open **characterModel1.ma**. This scene helps you visualize how the skeleton is put together under the character.

Build the skeleton

- 1 Press **F2** to access the **Animation** menu set, then click in the **side** view to make it the current view.
- 2 Select **Skeleton > Joint Tool**.
- 3 Hold the **x** key to snap to the grid, then click to place the first joint at the hip, then at the knee and ankle of the leg, and at the heel, ball, and toe of the foot.



- 4 Press **Enter** to complete the leg.

Tips

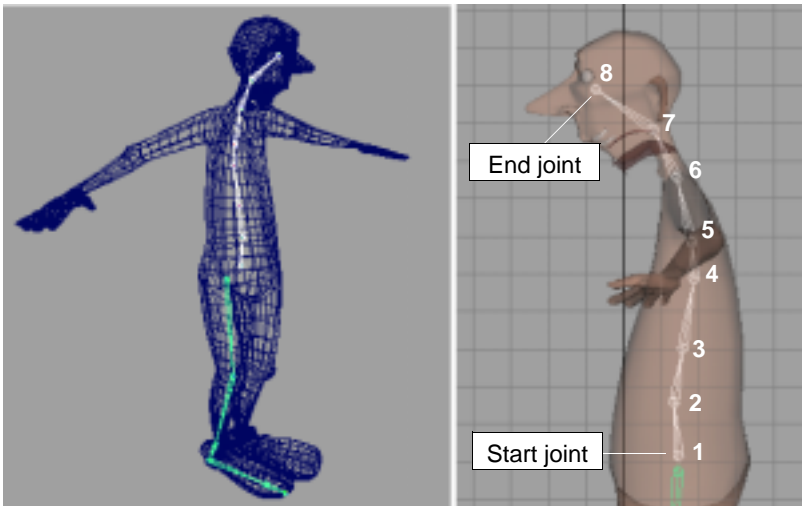
- To see the display as shown, press **6** to enter shaded mode and select **Shading > Shade Options > X-Ray** from the current view.
 - To change the joint display size, select **Display > Joint Size** and choose a different size.
-

Match the right leg geometry

- 1 Click in the **front** view to make it current.
- 2 Press **w** and click the right arrow on the Move Tool's manipulator to constrain movement to the *x-axis*.
- 3 **MMB-drag** and move the leg to fit the geometry of the right leg.

Build the skeleton back

- 1 Click in the **side** view to make it current and select **Skeleton > Joint Tool**.
- 2 Place the first joint slightly above the hip joint, then continue placing joints until there are eight.
- 3 Press **Enter** to complete the skeleton back.



Joints placed for the back

Tip

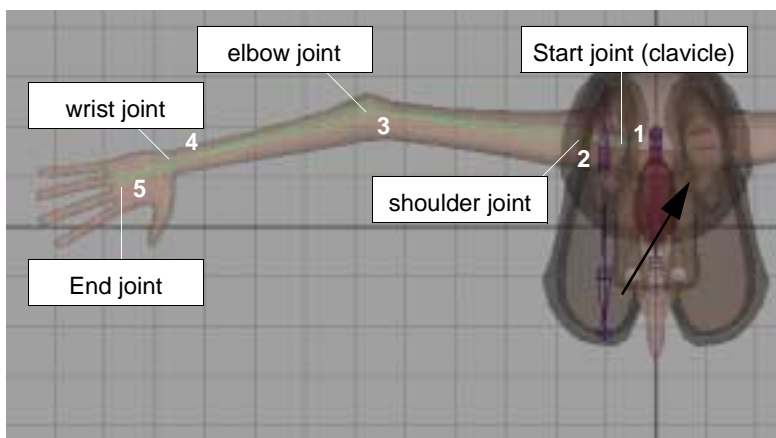
Press the **Insert** key to move the placement of a single joint. Press Insert again to out of this mode.

Build the right arm joints

- 1 Click in the **top** view and select **Skeleton > Joint Tool**.
- 2 Starting at the clavicle, click to place five joints as shown in the following.

Note

The clavicle is the joint above the shoulder closest to the spine.



Joints placed for the right arm

- 3 Press **Enter** to complete the skeleton.

Match the arm geometry

- 1 Press **w** and click the right arrow on the manipulator to constrain movement to the *x-axis*.
- 2 Select the shoulder joint.

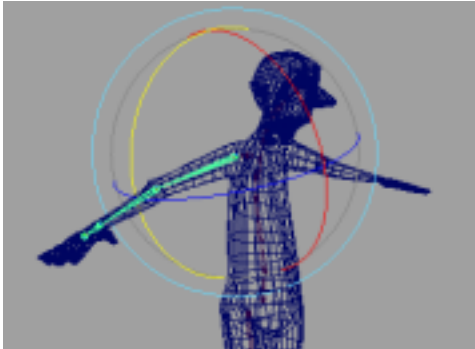
Tip

To select a joint, **LMB** directly on the joint or **LMB-drag** across the bone below it. For example, to select the elbow joint, **LMB-drag** across the forearm bone.

- 3 Rotate and scale the shoulder joint to orient the bones correctly with the arm.

Tip

Use the up and down arrow keys to move up and down a joint chain.



Adjust the arm bones to match the arm geometry

- 4 Select the right clavicle joint.
- 5 **Shift-select** the joint at the base of the neck and select **Edit > Parent**.

Create the left arm

- 1 Select the right clavicle.
- 2 Select **Skeleton > Mirror Joint** to open the options window.
- 3 Set the **Mirror Across** attribute to **YZ**.
- 4 Press **Mirror** to create the left arm.



Mirror the arm

Parent the right leg to the back skeleton

- 1 **Shift-select** the right hip joint then the joint at the base of the back.
- 2 Select **Edit > Parent**.
- 3 Select the right hip and **Skeleton > Mirror Joint** to create the left leg.

Applying Smooth Skin to bind a model to a skeleton

Open the **characterModel2.ma** file or continue from the last step.

Skin the character's body

- 1 Select the character's body. (*Do not* select the feet surfaces yet. They will be bound to the skeleton later on.)
- 2 **Shift-select** the root joint of the skeleton. The *root joint* is the joint at the base of the back from which all the other joints branch off. When you move it, all the other joints in the hierarchy also move.
- 3 Select **Skin > Bind Skin > Smooth Bind**.
- 4 To test the bind, rotate the joints in the skeleton. Press **z** to undo any joint rotations you make to return the character to its previous pose, or use **Skin > Go to Bind Pose**.

Skin the feet

- 1 Select the joints of the right leg from the knee to the toe. Select the toe joint first, then **Shift-select** the ball joint, heel joint, ankle joint, and knee joint.

Tip

Open the **Hypergraph** or the **Outliner** to help make these selections (**Window** menu).

- 2 **Shift-select** the right foot geometry.
- 3 Select **Skin > Bind Skin > Smooth Bind** , and set **Bind to: Selected Joints**. Because the feet are so big, this helps to keep them from being skinned to the wrong joints.
- 4 Press **Bind Skin**.



Hypergraph view

Binding the shoe to the skeleton


- 5 Repeat these steps for the left foot.

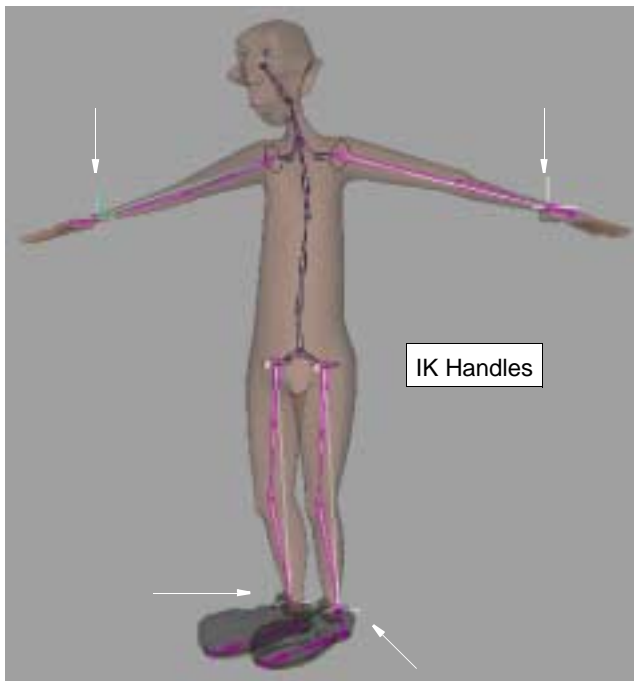
Adding IK to the character

Open the **characterModel3.ma** file, or continue from the last step.

IK Handles let you control the motion for several joints at once. You can move one object (the IK Handle), and several other objects (joints) change position by rotating. Since you only need to control one or two IK handles to create a lot of motion, you can quickly animate a skeleton.

Add IK to the legs and arms

- 1 Select **Skeleton > IK Handle Tool** , and set **Current Solver: ikRPsolver**.
- 2 Click the right hip joint, then the right ankle joint to add an IK chain to the right leg.
- 3 Press the **y** key to repeat for the left leg. Pressing **y** returns Maya to the last used tool. In this case, pressing **y** is the same as selecting **Skeleton > IK Handle Tool**.
- 4 Repeat for the arms by pressing the **y** key and clicking on a shoulder, followed by the corresponding wrist.



IK chain added to the arms and legs

Tip

It is a good idea to rename the IK handles to keep the scene organized. Select an IK handle, click on its heading at the top of the Channel Box, and type a new name.

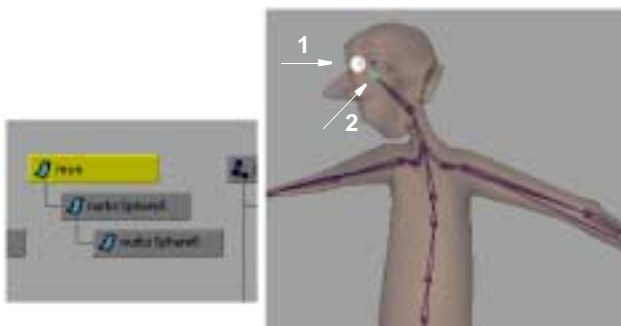
- 5 Test the IK chains by selecting an IK handle and moving it. After you stop testing, press **z** to undo any transformations you make.

Adding IK spline to the back

Open the **characterModel4.ma** file or continue from the last step.

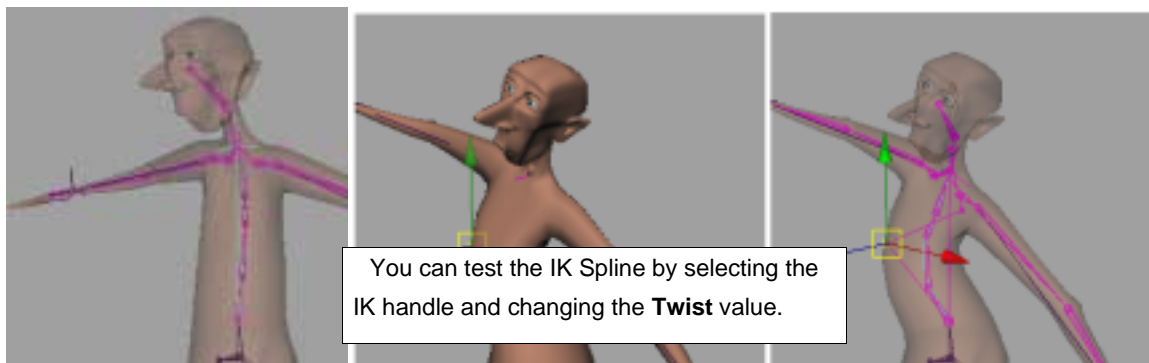
Add IK spline

- 1 Select the right eye, then the joint at the top of the head, and **Edit > Parent**.



Parenting the eye to the skeleton

- 2 Select the left eye, then the joint at the top of the head, and **Edit > Parent**.
- 3 Select **Skeleton > IK Spline Handle Tool**, and click the stomach joint followed by the joint at the base of the neck.



IK Spline added to the back

Tip

The IK Spline is controlled by a curve. When you create the IK Spline, the curve is parented to the skeleton. If you select the curve and press **F8** to enter component mode, you can move the curve's CVs to provide more control for the back.

Remember to press **F8** when done testing to return to object mode.

Add an attribute to control the head

Open the **characterModel5.ma** file, or continue from the last step.

- 1 Select the root joint, then **Display > Component Display > Selection Handles**.



Selection handle added to the root joint

Tip

Selection Handles take the highest priority when selecting geometry. This makes it easier to select the root joint.

- 2 While the root joint is active, select **Modify > Add Attribute**.

- 3 Enter **headTurn** as the attribute's name and press **OK**.

Maya adds an extra attribute to the root joint and displays it in the Channel Box.

Setting keys in the Set Driven Key window

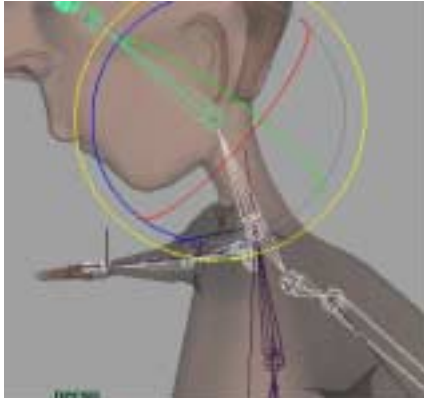
The **Set Driven Key** lets you connect an attribute from one object to an attribute of another object. For example, a sphere's *translate Y* could drive the *scale Y* of a cone. When you move the sphere in a defined range of values in the Y axis, the *scale Y* of the cone changes accordingly.

These next few steps show you how to combine custom attributes and Set Driven Key to automate character controls.

Load Driver and Driven

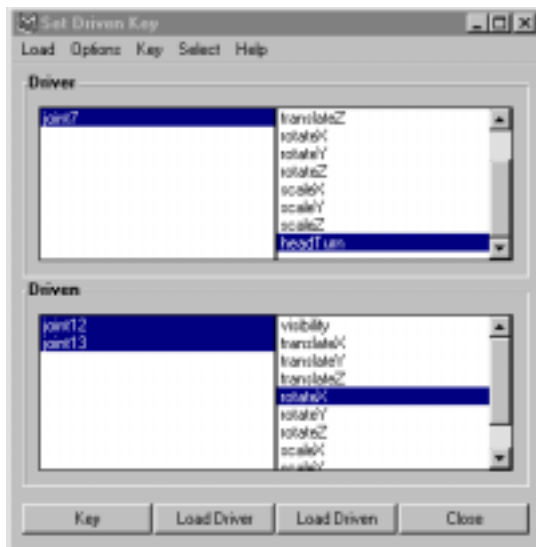
To use the **Set Driven Key** window, you have to load a *driver* object and a *driven* object. Once loaded, you modify attributes on both driver and driven and key them using the **key button**.

- 1 Open the **Set Driven Key** window (**Animate > Set Driven Key > Set**).
- 2 With the root joint still selected, press **Load Driver**.
- 3 Select the joint at the base of the neck, then the joint at the base of the head, and press **Load Driven**.



Set initial key for Set Driven Key

- 1 Click to highlight **headTurn** in the Driver panel.
- 2 **Shift-select** the two Driven joints and **rotateX**, then press **Key**.



Set Driven Key window

In the Set Driven Key window:

If you click the name of a listed object (either Driver or Driven), it becomes the selected object and its attributes display in the Channel Box.

- 1 Click the **Driver** joint, and set **Head Turn** to **10** in the **Channel Box**.
- 2 **Shift-select** the two driven joints then rotate them about **30** degrees in **X**.

You can use the Rotate tool interactively and constrain the rotation to the x-axis using the rotate manipulator, or you can type the value into the Channel Box.

- 3 Press the **Key** button.

- 4 Click the **Driver** joint and set **Head Turn** to **-10** in the **Channel Box**.
- 5 **Shift-select** the two **Driven** joints and rotate them about **-30** degrees in **X**.
- 6 Press the **Key** button.

Now when you change the value of the **headTurn** attribute on the root joint, the **rotateX** changes on the other two joints.



Twisting the neck with Set Driven Key and a custom attribute

If you select the root joint of the character, you can click the **Head Turn** attribute *heading* in the Channel Box (not the value), and using **MMB** in the perspective view, click-drag left or right to change the values interactively.

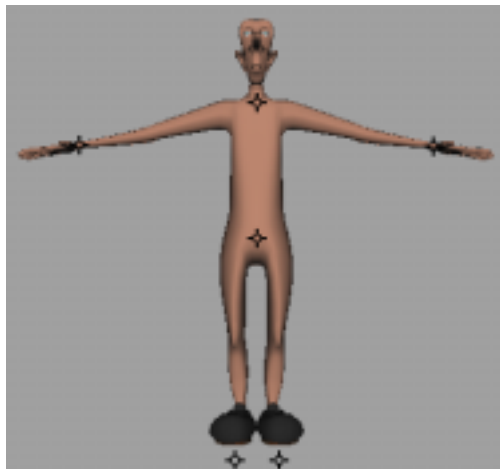
Tips

- To test the setup, adjust the Head Turn value between **-10** and **10**.
 - To stop the arms from moving, keyframe the IK handles (press **s** to set keyframes), or turn **Stickiness** ON in the IK Handle Attributes section of the Attribute Editor.
-

Animating the character

The final version of this file is called **characterModel6.ma**. Open this file if you want to try to animate the character.

The difference between this file and the others is that the foot is set up mostly for walking. Also, the IK handles have selection handles for easier selection.

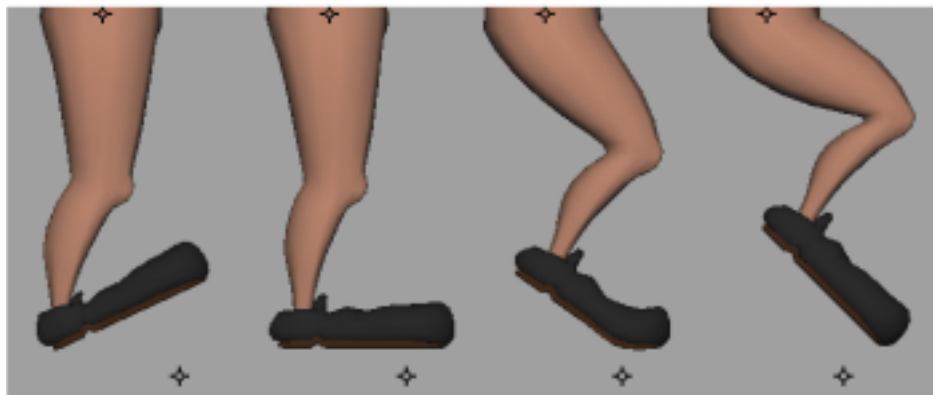


The character ready for animating

The feet nodes have an added attribute called **Roll**. When you adjust this attribute, the foot rolls from heel to toe making a realistic-looking walking motion.

Note

This foot setup comes from the *Character Animation in Maya* class.



The foot set to Roll when walking

Set the foot for walking

- 1 Select one of the foot selection handles. Notice the extra **Roll** attribute for the foot in the Channel Box.
- 2 Click the word **Roll** in the Channel Box.
- 3 **MMB-drag** left or right in a view. A new mouse icon resembling arrows pointing left and right displays.



Selection handles

USING 2 BONE IK

2 Bone IK is a lightweight version of Maya's **Rotate Plane IK solver** that you used in the previous lesson. The source code for the 2 Bone solver ships with Maya so it can be easily incorporated into a game or real-time application.

To use the 2 Bone solver, you have to create the node first.

Enter the following MEL command in the Command Line or Script Editor.

```
createNode ik2Bsolver;
```

If you open the IK Handle's Tool Settings window (**Skeleton > IK Handle Tool**), the 2 Bone solver is now available to use.

PAINTING VERTEX WEIGHTS

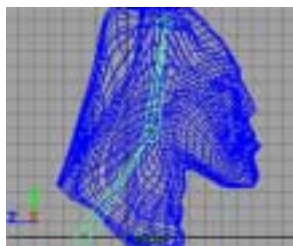
This lesson focuses on the Smooth Skin functionality of the Bind Skin operation in conjunction with Artisan to **Paint Vertex Weights** on a pre-built character head model. The two processes work together effectively to achieve control over the resulting deformation of a head model.

Open the scene file and layers

- 1 Open **Skinning_Start.ma**.
- 2 Select **Options > Layer Bar**.
- 3 **RMB** over **HeadExt** and **Lights** and select **Visibility** from the list to hide the objects pre-assigned to these layers from view.

Create a three joint (two boned) skeleton

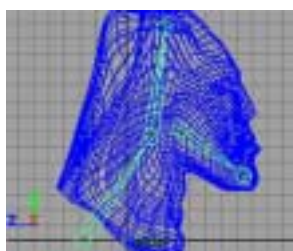
- 1 Click to focus in the side view panel.
- 2 Select **Skeleton -> Joint Tool**.
- 3 Draw a three joint (two boned) skeleton from the bottom up through to the top of the head, as shown in the following.



- 4 Rename the lowest joint **base**, the middle joint **neck**, and the top joint **top**.

Create a two joint (one bone) skeleton

- 1 As a separate skeleton, create a two joint (one bone) skeleton that runs the length of the jaw.
- 2 Rename the joint near the middle of the head **jaw** and name the other joint **chin**.

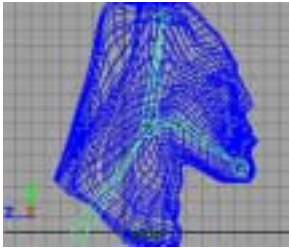


Parent joints in the Hypergraph

You will now parent the jaw joint to the neck joint.

- 1 Open the Hypergraph (**Window -> Hypergraph**).
- 2 **MMB-select jaw** and drag-drop it onto **neck**.

Notice the new hierarchy structure in the Hypergraph. Maya also automatically generates a new bone between the neck and jaw joint.



Tip

You could also use **Edit -> Parent** to perform this operation.

Bind the head to the skeleton

At this point you are ready to bind the **minionHead** to the skeleton.

In this lesson, *Smooth Skinning* is used instead of *Rigid Skinning*. The major difference between the two is that when Smooth Skinning, vertices can be affected by more than one joint—when Rigid Skinning, vertex weighting cannot be shared.

Noteworthy

Although a vertex can be affected by more than one joint, the total range of influence allowed for that vertex must always equal a value of one. In other words, a vertex weighting always totals to a value of one regardless of how many joints it is shared by. It is the specific distribution of vertex weighting amongst the joints that allows for different results.

- 1 Select the base joint (the root joint of the skeleton chain) and Shift-select the minionHead geometry.
- 2 Choose **Skin > Bind Skin > Smooth Bind** and set the following options:
 - **Bind to Complete Skeleton** (uses the entire skeleton for the bind procedure).
 - **Bind Method to Closest Distance** (uses relative proximity of vertices to skeleton joints for the bind procedure).
 - **Max Influence to 5** (the number of joints allowed to influence given vertices).
 - **Drop off Rate to 5** (the rate at which the influence of joints on vertices lessens over distance).
- 3 Press **Bind**.

- 4 Click to focus in the perspective view. Press **5** to view the display in shaded mode.
- 5 Select the neck joint and **Rotate** it to test the initial results of the Bind operation.
- 6 Reset the rotation values of this joint back to zero when done.

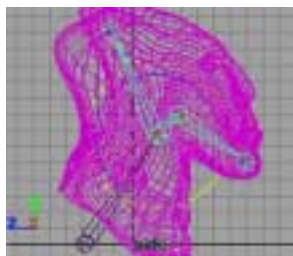
Editing vertex weights using the Paint Skin Weights tool

You are now ready to begin editing vertex weights on the bound geometry using Artisan's Paint Skin Weights tool. There are two ways to achieve this—interactively, as in the steps that follow, or using MEL (Maya's Embedded Language).

You can do this interactively, as shown in the following steps, or you can run a script in MEL (Maya's Embedded Language).

Edit weight skin weighting interactively using the Paint Skin Weights tool

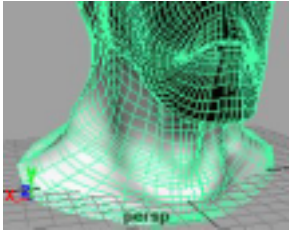
- 1 Select the neck joint and **Rotate** about 30 degrees on the Z-axis, then repeat for the jaw joint. These rotations help show how the changes in vertex weighting affect the object.



- 2 Select the **minionHead** surface and choose **Skin > Edit Smooth Skin > Paint Skin Weights Tool** .
- 3 In the Tool Settings window, adjust the brush size accordingly in **Radius[U]** and **Radius[L]**, then ensure the **Value** is set to **1**.
- 4 **Operation mode** should be set to **Replace**. This replaces all vertices painted with weighting values to the set **Value** number.
- 5 Select the base joint from the list displayed to create a relationship between any subsequently painted vertices with this base joint.
- 6 Paint the lower portion of the neck surface on **minionHead**.

The goal is to make sure this region of the head “sticks” to the position of the neck joint only. The value of 1 means that any painted vertices adopt a value of one (maximum) in relation to the base joint which eliminates the potential of any other joint effecting these vertices.

Notice how the model's color changes as it is painted. The affected areas become white.



When using the Paint Skin Weights Tool, the surface color is a visual cue indicating the weighting values assigned to vertices across the surface. The color displays in gray scale and works along a tonal range where white equals a value of 1 and black a value of 0.

- 7 Change the **Operation mode** from Replace to **Smooth** in the Paint Skin Weights Tool options window.

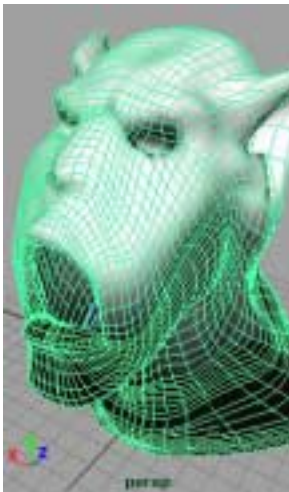
The Smooth operation mode helps to avoid creating hard edges between the areas with vertices that have a value of 1 and those with lesser values. Paint along these areas on the lower neck where the value difference is noticeable so it begins to look similar to the image above.

Edit the vertices weights at the top of the head

- 1 From the Paint Skin Weights Tool options window, select the neck joint.

Since this joint will be used to control most of the head's general movements, it requires the most paint work to create a relationship between the majority of vertices.

- 2 Reset the **Operation mode** back to **Replace** and paint the top of the head down to the upper lip (but not the jaw area).



The mouth should begin to open when painting the upper portion since the vertices inherit the rotation applied earlier to the associated joint.

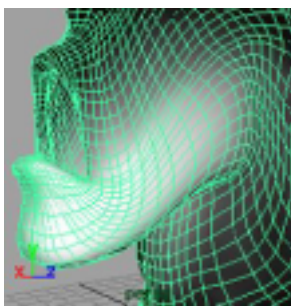
Tips

- Increase the brush size when working with larger more general areas, such as the top of the head, and smaller for areas that require more focused selections, such as around the mouth.
 - Remember to use the Smooth Operation as well as Replace when refining your weighting.
-

Edit the jaw vertex weights

You can now edit the vertex weighting on the jaw of minionHead.

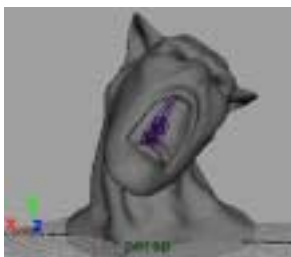
- 1 Select the jaw joint and paint around the lower lip and mouth area associating those vertices to the jaw joint's movements.



- 2 When finished painting the skin weights for this joint, choose the **Select** tool and select the jaw joint.

Rotate the jaw joint to see the effects of the painting process. Notice how the throat area moves too drastically when this joint is rotated.

- 3 To fix the throat area, select the minionHead surface and return to the Paint Skin Weights Tool options window.
- 4 Select the base joint from the list, and in Smooth operation mode, paint around the Adam's apple area.



Tips

- It may be useful to rotate the jaw and neck joints a bit more to better gage the results across the surface.
 - If other problem areas become noticeable, such as hard breaks along the cheek bone area or back of the neck, use Smooth and Replace where necessary with the appropriate selected joint.
-

Pruning vertex weights

You may find that you have a lot of joints affecting each vertex. This happens often in a game or real-time application. To correct this, you can prune the membership (remove influence objects).

Edit weight skin weighting using MEL

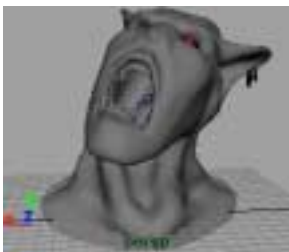
- 1 For a NURBS object, select the CVs for which you want to prune weights. For a polygonal object, select vertices.
- 2 In the Channel Box, search for the **skinCluster** heading.
- 3 In the Command Line, type:

```
skinPercent -prw <weight> <skinCluster>;
```

The <weight> value is considered and all influence objects with a weight value lower than this value are removed from the selected vertices.

Finish and test the results

- 1 Once finished weighting the vertices, return all joint rotational values to zero, *or...*
Select the base joint (root joint) and choose **Skin > Go To Bind Pose** returning all joints to the position at which they were set during the Bind Skin operation.
- 2 From the Layer Bar, **RMB** over the **HeadExt** and **Lights** layer, and select **Visibility** from the list to see the objects pre-assigned to these layers.
- 3 Select **Window > Hypergraph** and then **MMB-drag-drop** **minionBottomTeeth** onto the jaw joint.
- 4 Repeat the same procedure to place **minionTopTeeth**, **minionEyes**, and **minionEarRings** onto the neck joint.
- 5 Select the neck joint and jaw joint to rotate and test results.



HELPFUL HINTS

The following points should help when animating the character:

- Only the following nodes need to be animated: **root**, **back**, **right_wrist**, **left_wrist**, **right_foot** and **left_foot**.
- Set keyframes by pressing **s** or select **Animate > Set Key**.
- Animation curves can be adjusted in the **Graph Editor (Window > Animation Editors > Graph Editor)**.
- When setting keys, start with the **root** and **feet nodes** to block out the animation.
- Finer animation of the **arms**, **back** and **feet** rolling should be secondary.
- You can get real-time playback using **Window > Playblast**.

Tip

Other animation procedures are also covered in the *Part 1—Comic Book Setup*, *Part 2—Blended Comic Book*, and *Jellyfish* tutorials.

CONCLUSION

You have now experienced how easy it is to prepare a character for animation in Maya. To recap, this tutorial showed you how to:

- Create joints and build skeletons.
- Add IK chains.
- Use IK Spline for smooth and organic control.
- Create custom attributes for finer control.
- Use Set Driven Key to create relationships between nodes which simplifies character control.

Tip

Character setup and animation can be very complex. Alias | Wavefront offers a Character Animation course that explores these topics in depth. For more information go to www.aliaswavefront.com (Express Link to Training).
