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Maya® Visual Effects The Innovator's Guide

Second Edition

Eric Keller
with Max Dayan



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Maya[®] Visual Effects The Innovator's Guide

Second Edition

Eric Keller



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For all my students and all my teachers. Let's make something cool today!



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Naturally, all the programmers and designers at Autodesk who work so hard to develop this software deserve special recognition for their hard work. They are the true artists who allow the rest of us to create such fantastic things.

Extra special thanks go my wife, Zoe, for tolerating my nonstop talk of polygons, nParticles, and Paint Effects strokes, as well as my pals Daisy and Joe, who force me to go outside. And as always, special thanks to little Blue, whose hungry ghost still haunts the kitchen.

About the Author

Eric Keller is a freelance visual effects artist working in Hollywood. He divides his time between the entertainment industry and scientific visualization. He teaches the Introduction to Maya and Introducing Digital Sculpting classes at the Gnomon School of Visual Effects in Hollywood, and has authored numerous animation and visualization tutorials for the Harvard Medical School course Maya for Molecular Biologists, taught by Gael McGill.

Eric started out as an animator at the Howard Hughes Medical Institute in Maryland, where he created animations for science education for seven years. In 2005, he and his wife moved to Los Angeles, where he could study and learn from the masters of visual effects. His goal is to bring the artistry and technology of Hollywood computer graphics to the field of scientific visualizations in the hope that it can inspire and inform the scientific community and the general public.

Eric has worked at some of the best design studios in Los Angeles, including Prologue Films, Imaginary Forces, Yu and Company, BLT and Associates, and The Syndicate. Projects include feature-film title animations for *The Invasion*, *Enchanted*, *Sympathy for Lady Vengeance*, and *Dragon Wars*. He has also contributed to numerous commercials, television shows, and design projects. Currently Eric is the visual effects supervisor for E. O. Wilson's *Life on Earth* iBook project for the Apple iPad.

Other books by Eric Keller include *Maya Visual Effects: The Innovator's Guide (first edition)*, *Introducing ZBrush (first, second, and third editions)*, *Mastering Maya 2009*, and *Mastering Maya 2011*, all published by Sybex. He was a contributing author to *Mastering Maya 7* and *Mastering Maya 2012*. He authored the *Hyper Real Insect Design* DVD for the Gnomon Workshop, the *Maya for Artists* series at the Phoenix Atelier, and the video series *Essential ZBrush 3.1* and *Rendering with Mental Ray for Maya 2011* for Lynda.com, as well as numerous tutorials and articles for Highend 3D magazine and 3D World magazine. Many of his tutorials are available online at www.bloopatone.com and www.molecularmovies.org.

About the Contributor

Max Dayan is a passionate visual effects artist with a thirst for knowledge. He is constantly learning new techniques and tools, always seeking to stay on top of the current trends in the industry. Originally a graphic designer, Max moved to Hollywood to attend the Gnomon School of Visual Effects. He has since worked for such companies as Gentle Giant Studios, Technicolor, and Free Range 3D, with a focus on digital sculpting, hard surface modeling, texturing, and on-set photography.

He has worked on countless projects for the film, television, and games industries, most notably *Toy Story 3*, *Land of the Lost*, 2012, *Watchmen*, *Night at the Museum: Battle of the Smithsonian*, *A Christmas Carol*, *High School Musical 3*, *Bedtime Stories*, multiple UFC and WWE games, Mass Animation's *Live Music* short film, and *Fast & Furious (Fast 4)*. Max recently joined Gnomon as the associate director of education, working on curriculum development, teaching, and helping students develop their skills and portfolios.

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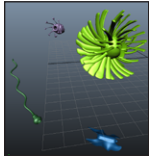


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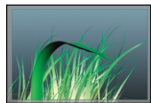
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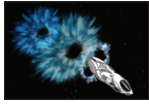
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Introduction

Be creative is the one instruction I find in many CG books that always makes me laugh out loud. Why is the author telling me to be creative? If I wasn't a creative person, I wouldn't be interested in computer graphics in the first place.

It always seems to me that authors of tutorials use the phrase *be creative* when they are not exactly sure what to say. But upon reflection, it's not really a bad piece of advice if you stop to think about what drives the creative process. Creativity is the ability to make connections between two or more seemingly unrelated things. For example, when chemicals were exposed to light in a particular way, the art of photography was born. Sound vibrations used to carve grooves into a wax tube gave birth to recorded music. The aha! moment occurs when an artist suddenly realizes that what makes art more than the sum of its parts is the way in which those parts are connected. When successful, this realization is shared by the audience in the form of an experience that feels new and reveals something about the universe that may not have been immediately apparent before. It sounds like lofty stuff, but this is the whole point of creativity; it is an exploration of what new things can be made with the existing tools we have before us. *Innovation* is the word used to describe the process of making these types of connections. Innovation is the engine of creativity.

Autodesk® Maya® is all about connections. It's a virtual world made of nodes . . . individual packets of data. A Maya scene is just a bunch of nodes connected together. This is clearly illustrated in any number of Maya interface panels such as the Node Editor, Hypergraph, Outliner, Hypershade, and many others. When you first learn Maya, you generally go through the tutorials that are meant to show you how to connect these nodes in their intended arrangements in order to create the types of animations you commonly see. Most tutorials will take you through the process of how to use joints to make a character walk, how to create snow using particles, or how to make a ball bounce using the Graph Editor. These are all important, even crucial, skills to learn. Unfortunately, most tutorials stop there, leaving you to wonder what's next. There is a gap in Maya training between the beginner tutorials and the advanced tutorials. This book is meant to bridge that gap. I wanted to create a series of fun tutorials specifically for the student who has completed the basic training but is not yet ready for the advanced techniques. The goal of this book is to help you understand that the true power of Maya lies in its ability to make connections in interesting ways; in other words, how to be creative in Maya.

The techniques in this book are just ideas meant to inspire you. They are culled from my own experience working as a professional in the industry. The audience is expecting to be surprised, your art director is looking for something that hasn't been

done, and the client wants to set themselves apart from their competition. In these situations, simply being a master of tried-and-true techniques is not going to keep you employed. These situations call for innovation and creativity. You need to think on your feet and be fearless about taking risks. How you solve problems, how you connect the various nodes within Maya, is what is going to set you apart from the CG artists who are content to simply repeat the same techniques everyone else has been using for the past 20 years.

My hope is that by going through these tutorials you'll acquire a deeper understanding of how Maya works and this will help you to develop your own Maya innovations when confronted with a challenge on a job or with one of your own projects. I sincerely doubt that I should see one of my techniques used verbatim in a movie or a commercial. That's really not the point of this book. The point of this book is to help you discover ways in which you can use Maya to *be creative*.

Who Should Buy This Book

This is not a beginner Maya book, nor is it a comprehensive guide to every tool in Maya. If you are new to Maya, I recommend you first familiarize yourself with the basics, the interface, and the tools. I recommend a book such as *Introducing Autodesk Maya 2014* by Dariush Derakhshani (Sybex, 2013) as well as the Maya documentation. The Innovator's Guide is comprised of 24 tutorials loosely categorized by Maya features. It is meant for students who are looking to take their Maya skills to the next level. It's also for the professional who is looking to deepen their skills perhaps in an area of Maya they are not familiar with. I've had some wonderful feedback on the first edition of this book, which was written in 2006. Many professionals have told me that the tutorials were a great source of inspiration when they were stumped by a tricky problem that lacked an obvious solution. Bottom line, if you have not used Maya before or if you're an expert in another piece of CG software such as 3ds Max, buy this book, but then set it aside; spend some time learning Maya and then pick this book up when you're ready to improve your skills.

This book was written using a prerelease version of Maya 2014, but many of the techniques can be used in older versions of Maya, at least as far back as version 2011. There are a few exceptions, including the Maya Hair tutorials, which use features introduced in Maya 2013, but with some thought and creativity even these techniques can be applied to older versions of Maya. So, if you don't have the very latest version, not to worry, you should still be able to get a lot out of this book.

What's Inside

The lessons in this book are loosely grouped by Maya tools, but that's not to say you won't find nParticle techniques demonstrated in the chapter on textures or nCloth techniques in the chapter on nParticles. Each chapter consists of three tutorials demonstrating some neat ideas of how the Maya tools can be connected in interesting ways to achieve a particular effect. Each tutorial presents a problem you might

encounter as a Maya artist working in a small studio. These scenarios are based on my experience working as a freelance artist in Hollywood. I tried to make the tutorials fun and engaging as well as short. At the end of each tutorial is a short section called “Further Study” that has suggestions of how you can build on the techniques you’ve just learned.

Many of the tutorials are accompanied by a mini-lesson on Maya Embedded Language (MEL) scripting. MEL is a scripting language used to automate repetitive tasks in Maya as well as add additional functionality. My good friend Max Dayan, himself an accomplished professional Maya artist and an instructor at the Gnomon School of Visual Effects, has written these scripts along with a short description of the logic he used to write them.

These scripts are “learning scripts;” in other words, they were created to help you understand the techniques of the lessons as well as how to write better scripts. In a professional setting, Max’s scripts would be more efficient but more difficult for a student to understand, so in some cases he has sacrificed a small amount of efficiency to maximize clarity. If you are not interested or you’re intimidated by MEL scripting (and many artists including myself are not necessarily master programmers), you can feel free to skip these sections and return to them later when you feel like you want to dive in to the world of MEL scripting.

If you’ve never written an MEL script before, you should spend a little time familiarizing yourself with Maya’s Script Editor. I recommend reading through the Scripting section of the Maya documentation so that you understand how scripts are entered into the Script Editor or written in an external text editor, what it means to source a script, and how to create a shelf button from a script.

The tutorials in each section have accompanying scene files that you can use to follow along. There is no DVD with this book; instead, we have decided it’s more efficient to provide a link to the Sybex website where the project files can be downloaded. Each chapter of this book has its own project file that contains everything you need to follow along. To retrieve the file, simply use your web browser to go to this address: www.sybex.com/go/mayavisualeffects2e. Here, you’ll find the projects in zipped archives as well as instructions on how to use them. As you start each chapter, make sure you use the File menu to set the current Maya project to the appropriate chapter project. This way, textures, caches, and other externally linked files will behave predictably.

The chapters do not need to be read in order; each lesson is self-contained, so feel free to skip around between the chapters and their tutorials as you like. The difficulty of each tutorial ranges from easy to intermediate with a few extra advanced challenges thrown in for fun. Here’s a description of what you’ll find in each chapter:

Chapter 1: Texture Effects This chapter contains three tutorials designed to approach texturing with some interesting twists. Learn to create an interactive animation control for lighting up a demonic neon sign using a ramp texture, create holographic effects using the ambient occlusion texture node, and create scrolling text for a blimp sign.

Chapter 2: Particle Effects One of the most powerful animation tools in Maya is the humble particle. These tutorials give you a small taste of the kinds of things you can do with some clever tricks. You'll create a dynamically blossoming cherry tree, grow a beard of bees for a character, and create an animation control panel that can choreograph a school of swimming fish.

Chapter 3: Joint Rigging for Effects Joints can be used for a lot more than character animation. This chapter has three challenges designed to inspire you with ideas for how you can exploit the power of Maya's skeleton tools. Joints are used to create a creepy undulating mass of tentacles, unroll a magic brick path through a forest, and create a growing mass of bacteria by combining joints and particles.

Chapter 4: Creative Blend Shape Techniques Blend shape deformers are easy to set up and animate. Because of this, they can easily be combined with deformers to create some unique effects. In this chapter, you'll create an interactive rig that can be used to coax abstract designs and motion from a field of bocks, you'll build a small population of swimming plankton by layering simple deformers, and finally you'll learn how to write an MEL script that automates the setup of complex blend shape sequences.

Chapter 5: Paint Effects Paint Effects is Maya's own procedural modeling tool commonly used for creating plantlife. In this chapter, you'll learn some cool tricks for using Paint Effects as a solution to some interesting problems. You'll learn how to instance animated lightning bolts to particles, animate an eye suffering from an alien infection, and use Paint Effects as a way to deform geometry.

Chapter 6: nCloth Techniques Maya's nCloth is an easy-to-use system for creating soft body-style dynamic effects. Beyond its obvious application for adding dynamic motion to a character's cloth, it also has a myriad possibilities as a solution for problems posed by unconventional animation. In this chapter, you'll use nCloth as a way to melt the metal of a complex gun model, you'll create an animated spider web by combining nCloth and Paint Effects, and you'll animate a drop of water rolling off a blade of grass.

Chapter 7: Fluid Effects Maya's Fluid Effects can be intimidating to a new user, but they're actually quite easy to use and, when combined with other dynamics, very powerful effects tools. In this chapter, you'll use 2D fluid containers to create a 3D shock wave, propel a rocket with nParticles and fluids, and construct the head of an android from floating goeey blobs.

Chapter 8: nHair and Fur Effects Maya's nHair system and its fur tools aren't just for characters and creatures; they can also be used as animation tools. In this chapter, you'll build an undulating jellyfish by lofting geometry from dynamic hair curves, create a rig for Medusa's head of snakes, and animate an alien design in a crop field.

How to Contact the Author

I enjoy hearing from the readers of my books. Feedback helps me continually improve my skills as an author. You can contact me through my website, www.bloopatone.com, as well as see examples of my own artwork there.

Sybex strives to keep you supplied with the latest tools and information you need for your work. Please check the book's website at www.sybex.com/go/mayavisualeffects2e, where Sybex will post additional content and updates that supplement this book should the need arise.



Texture Effects

1

All too often textures are overlooked as a solution for creating effects. The tendency is to think of textures as simply a means for coloring objects. The tutorials in this first chapter demonstrate some ways in which engaging visual effects can be created quickly and easily simply by taking advantage of the power that textures have to offer.

Chapter Contents

- Create Animated Lighting Effects with a Ramp Texture
- Use Ambient Occlusion for Holographic Effects
- Use Creative Text Effects

Create Animated Effects with a Ramp Texture

This first challenge involves adding an effect to the opening shot of an animated short. Figure 1.1 shows part of the storyboard for the opening. The camera moves down and out to reveal a dilapidated hotel sign with some broken lights. The gag is that the lighted parts of the sign spell “Hell.” The neon vacancy sign is just barely hanging on. The director would like to suggest that the hotel is possessed by demons, so as the camera stops, the Vacancy sign lights up, one of the bolts gives away, and the sign swivels so that the arrow points downward. Subtle, no?



Figure 1.1 The storyboard shows a neon sign magically coming to life.

Rather than have the sign blink on like a real neon sign would, the director would like the light of the neon Vacancy sign to start at the letter V and travel to the end over the course of about a second. A particle effect should be added to the leading end of the light.

The sign has already been modeled, and the basic camera move, along with the animation of the broken sign, is established. For the Vacancy sign, there is a NURBS curve but no neon geometry as of yet.

This effect should be fairly easy to create by extruding geometry along the length of the curve. A shader can be applied to the geometry, and then an animated ramp attached to the incandescence of the shader will provide the lighted effect. Whenever you’re confronted with an effect, it’s a good idea to design a rig with a few simple controls that can be easily animated. Whenever possible, the rig should be set up to anticipate changes as easily as possible because art directors are fussy and tend to

change their minds a lot. This tutorial will take you through the steps of setting up a rig so that one control can be used to animate the light traveling along the length of the word *Vacancy* as well as the position emitter for the particle effect.

This exercise demonstrates one way of creating the rig and introduces you to several methods for navigating the node hierarchy in Autodesk® Maya®. Every Maya artist has their own style of working, but once in a while it's a good idea to explore alternative methods of navigating the Maya interface. Doing so will open possible workflows that you may not be aware of, which can increase your efficiency as well as your understanding of how Maya works.

Create the Sign Geometry

The geometry for the Vacancy sign can be extruded along the existing curve in the scene. Before you start extruding geometry using NURBS geometry, I suggest you consider applying a Paint Effects stroke to the curve and then convert the stroke into polygons. The reason for this is that it's easier to control the twisting and pinching that may occur as the geometry follows the curve. In addition, the UV texture coordinates created by the Paint Effects geometry will be easily adapted so that the ramp that creates the neon light can be animated without too much work.

1. The project files for this chapter can be downloaded from from the book's support site. Use your web browser to navigate to www.sybex.com/go/mayavisualeffects2e and download the Chapter01_project. Once the files have been downloaded, unzip them to your local drive. Open Maya and use the File menu to set the Project to Chapter01_project. Then open the signStart.ma file located in the Scenes directory of the Chapter01_project file directory. Once the scene is open, switch to the Persp camera using the View menu in the main viewport.
2. In the Outliner, expand the vacancy_sign group, and select the curve node named vacancyNeonCurve (see Figure 1.2).

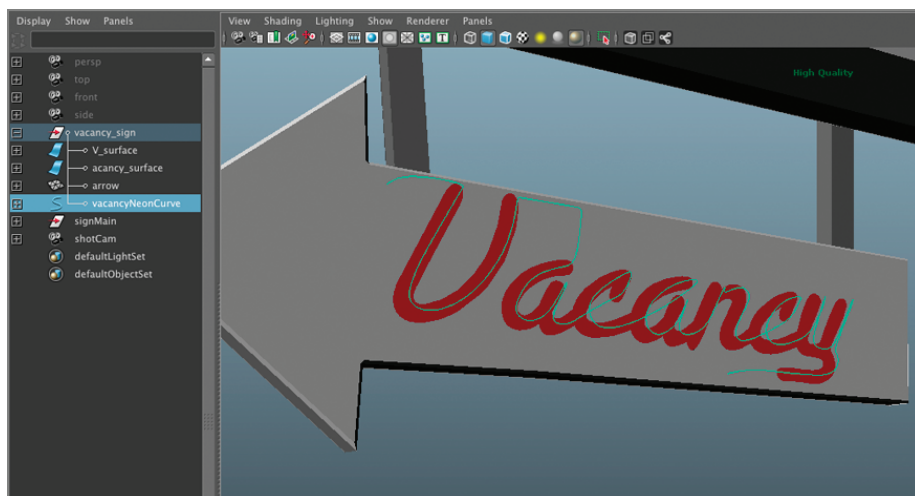


Figure 1.2 Select the vacancyNeonCurve node in the Outliner.

3. Switch to the Rendering menu set, and choose Paint Effects > Curve Utilities > Attach Brush To Curves (see Figure 1.3). The default stroke, which is a thick black line, is applied to the curve.

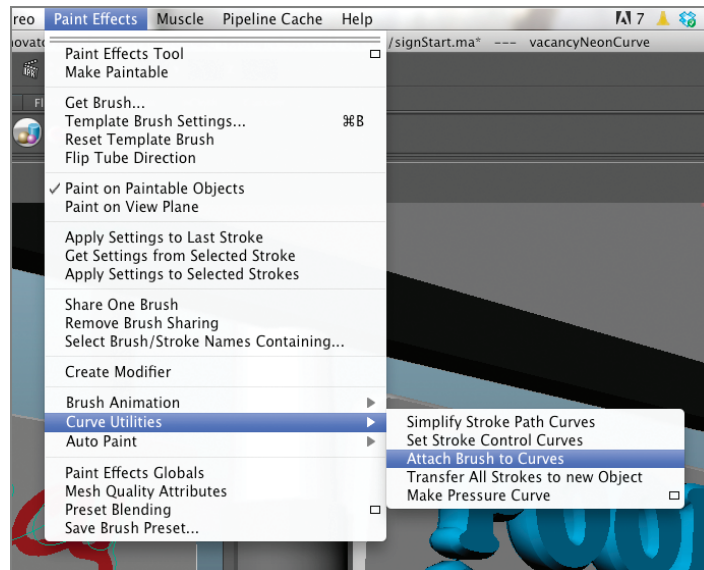


Figure 1.3 Use the Paint Effects menu to attach the default brush stroke to the curve.

4. Select the Stroke1 node in the Outliner, and open the Attribute Editor.
5. To convert the stroke into geometry, choose Modify > Convert > Paint Effects To Polygons > Options; in the options, turn on Quad Output and Hide Strokes.
6. Maya creates a new node for the converted geometry and places it in a group called brush2MeshGroup. Expand this group, and select the brush2Main node. Press Shift+P to unparent the mesh, which moves it out of the group brush2MeshGroup.
7. Double-click the brush2Main node in the Outliner so it becomes highlighted, and rename the brush2Main node to vacancyNeonGeo. You can select and delete the brush2MeshGroup node (see Figure 1.4).

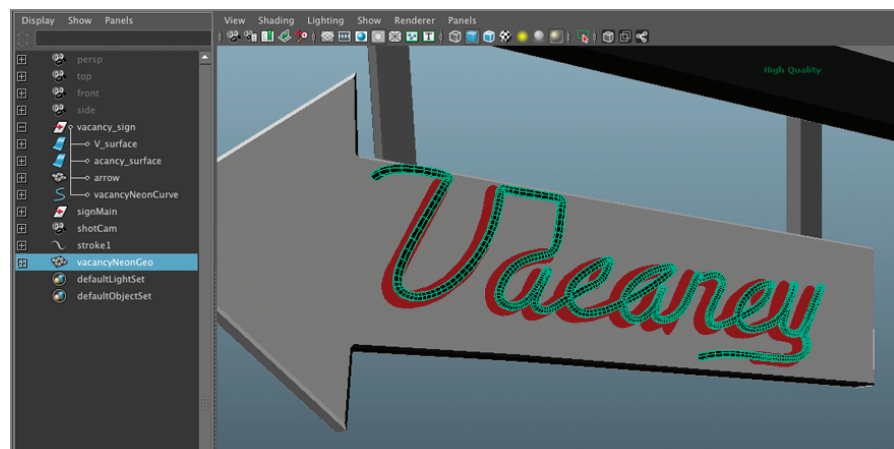



Figure 1.4 Convert the Paint Effects stroke into polygons. Ungroup the node, and name it vacancyNeonGeo.

Make sure you do not delete the Stroke1 node and don't delete the history on the vacancyNeonGeo node. Since the stroke is applied to the curve that is contained inside the vacancy_sign group, which is keyframed, the vacancyNeonGeo node will inherit the animation (see the sidebar “Construction History” for information on how this works). The advantage of keeping the history on the vacancyNeonGeo node is that you can change the width and other attributes of the vacancy geometry by tweaking the settings on the stroke1 node. This is helpful if a picky art director decides changes need to be made to the sign at some point in the future.

Construction History

Maya keeps a record of all the changes that go into the nodes that you create when you model an object as well as how different nodes may be connected. This is known as *construction history*. When you create a model such as the neon sign, Maya remembers that the surface of the neon tube was created when you attached a Paint Effects stroke to the tube and that you then converted the tube into polygons. So, if you make changes to the original curve or the Paint Effects stroke, the changes propagate all the way to the polygon surface of the tube; thus, the polygon tube “inherits” any changes you make to the original curve or any of the other nodes that went into the construction process. You can take advantage of construction history when you animate the nodes that are connected through construction history. You can toggle construction history on or off by clicking the history script icon  located on the status bar.

Set Up the Neon Shader

Here's where the fun begins. To create the effect of the light traveling along the length of the neon tube, you'll attach a ramp to the incandescence channel of a Blinn shader.

1. Open the Hypershade to find the shader named neonGlassBlinn. This is a simple shader that has already been set up to create the look of the neon glass. Select the shader, and MMB drag it on top of the vacancyNeonGeo in the Perspective view.
2. In the Hypershade, select the neonGlassBlinn shader, and open its settings in the Attribute Editor. Click the checkered box to the right of the Incandescence channel to open the Create Texture Node panel.
3. Select the 2D Textures category on the left side of the panel, and click Ramp to create a ramp node (see Figure 1.5). Hold the mouse pointer over the Perspective view, and press the 6 hotkey to switch to textured view. Make sure that the Renderer panel in the viewport window is set to High Quality Rendering; otherwise, you won't see the ramp texture update properly as it's applied to the geometry.

In Perspective view, the rainbow pattern of the ramp appears on the neon tube, but it is a repeating pattern that looks more festive than demonic. To fix this, you can adjust the UVs of the vacancyNeonGeo node.

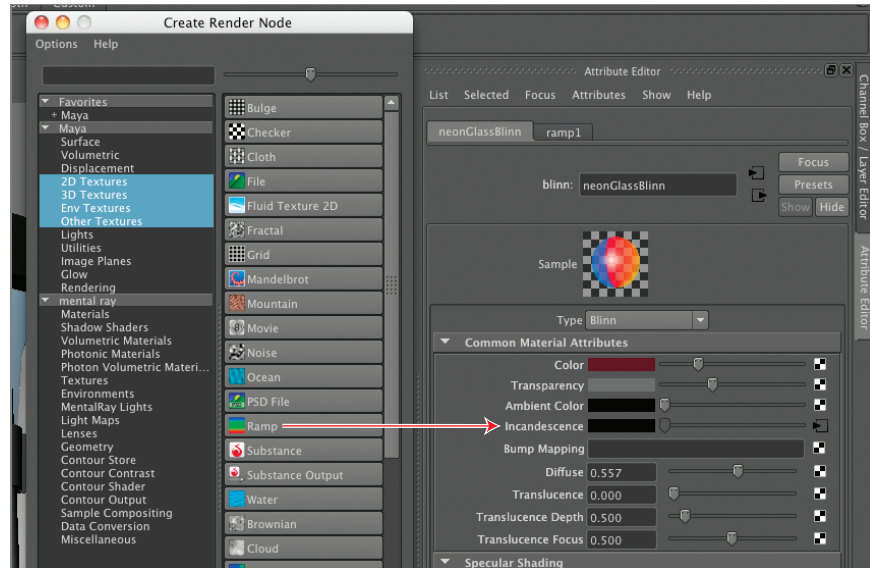


Figure 1.5 Use the Create Render node panel to attach a ramp texture to the Incandescence channel of the neon-GlassBlinn material.

4. Select the vacancyNeonGeo node, and choose Window > UV Texture Editor. If you zoom out (waaaaay out), you'll see that the UVs are a long vertical strip. In the UV Texture Editor's menu panel, expand the Textures menu, and select vacancyNeonGeoblinn2SGlramp1 so that the ramp appears in the UV Texture Editor.

As you can see, the rainbow colors of the ramp appear in the upper quadrant of the UV Texture Editor. What you don't see is that outside of this area, the ramp texture repeats over and over to infinity, which is what the colors on the neon tube continually repeat; the UVs for the tube continue well outside of that upper quadrant (see Figure 1.6).

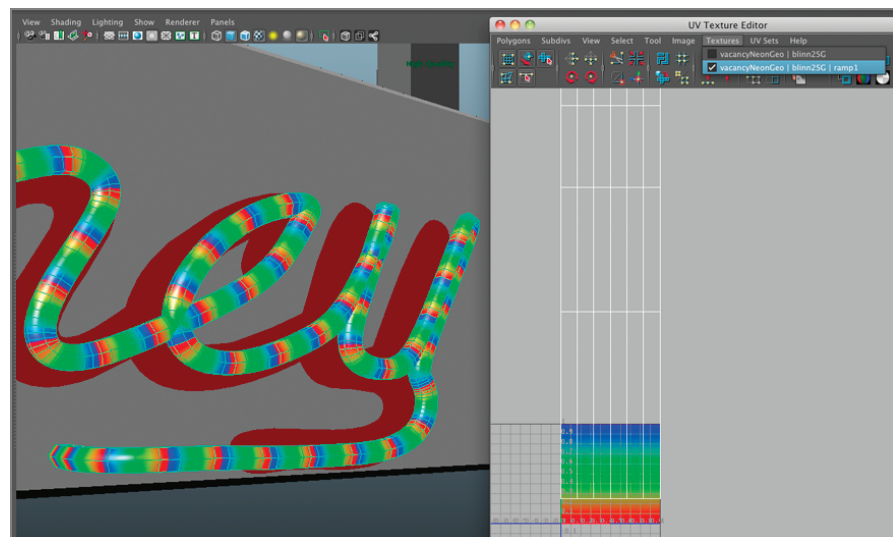


Figure 1.6 The UV Texture Editor shows that the UV texture coordinates of the neon sign geometry go well beyond the upper quadrant of the texture space. The result is that the ramp texture repeats along the length of the glass tube.

5. Right-click the UVs, and select UV from the marking menu. Select some of the UV coordinates in the editor (the selected coordinates will be highlighted in green). Hold the Ctrl key, right-click again above the selected UVs, and choose To Shell from the marking menu. This selects all of the connected UVs of the glass tube geometry.
6. From within the UV Texture Editor, choose Polygons > Normalize. This forces the UVs to fit within the upper-right quadrant of the UV texture space. Now the ramp is no longer repeating. The UV coordinates will look fairly dense in the UV Texture Editor, but in Perspective view, you'll see that the ramp goes from red to green to blue across the length of the sign.
7. Select the ramp1 node on the Textures tab of Hypershade, and open its settings in the Attribute Editor.
8. Click the x at the top of the ramp to delete the blue color at the top of the ramp. Set the middle color to black; then set Interpolation to None.
9. Set the bottom color to a devilish shade of red.
10. Try dragging the circle for the black color up and down; you'll see the light move along the neon tube (see Figure 1.7). Name the ramp node neonLight.



Figure 1.7 Move the black color of the ramp up and down; the color updates on the tube geometry in Perspective view.

To make the sign easier to read, you can apply a separate dark shader to the parts of the tube that connect the letters. This replicates the way actual neon signs are constructed in the real world, adding an extra touch of realism.

11. Right-click the vacancyNeonGeo geometry in Perspective view, and choose Face. Carefully select the individual faces connecting the V and the A. Once they are selected, switch to the Rendering menu set, and choose Lighting/Shading > Assign Favorite Material > Lambert. This creates a new Lambert shader and applies it to the selected faces. Do the same for the other parts of the sign. Assign the same Lambert shader to these selected faces (you can use Lighting/Shading > Assign Existing Material to do this easily). Figure 1.8 shows the result.

12. Edit the Lambert shader that has been applied to these faces so that the Diffuse color is a very dark gray.

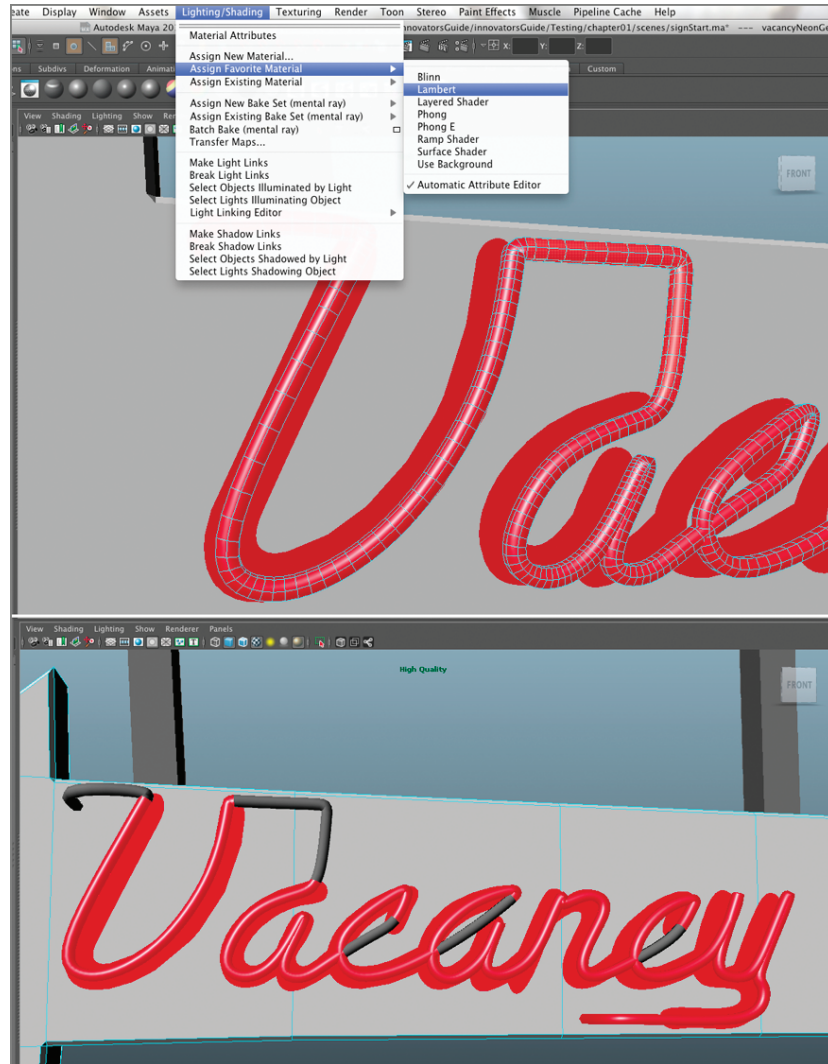


Figure 1.8 To make the sign easier to read, select the faces between some of the letters, and apply a dark gray Lambert shader.

Create an Animation Control for the Sign

At this point, you could consider yourself done, but before you declare “mission accomplished,” you should take some time to set up an animation control. Taking the time to do this now can save you trouble later when the director starts asking for tweaks on the animation. In addition, any animators you share the project with will appreciate not having to hunt around to find the keyframed attributes within the many panels Maya has to offer.

You can create custom controls in lots of ways. In this example, you’ll create an arrow-shaped control using a NURBS curve. When the control is connected to the

ramp, dragging it back and forth will control the progress of the light along the sign. This way, the animation can be controlled directly in Perspective view, eliminating the need to hunt around for the animated settings in the Attribute Editor.

1. Switch to a front view, and zoom in on the sign. Turn on the grid using the View menu in the upper left of the viewport.
2. Choose Create > EP Curve Tool > Options. In the Options, set Cure Degree to Linear. This option means that the curves will be straight lines.
3. Activate Snap To Grids by clicking the icon that looks like a magnet over a grid on the top menu bar of Maya. Create a straight line by clicking two different points below the sign, as shown in Figure 1.9.



Figure 1.9 Create a line below the Vacancy sign using the EP Curve tool (top image). Create a triangle below the line (bottom image).

4. Double-click the curve in the Outliner, and name it lightControl. This line will provide a visual indication for the length of the control.

5. Using the EP Curve tool again, click three times to create a triangle just below the line. Name the triangle `lightControlHandle`. This triangle will be the actual control that is used to animate the light of the sign (see the bottom image in Figure 1.9).
6. Select `lightControlHandle`; then Shift+select the light control. Press the P hotkey to parent the `lightControlHandle` to the lightControl. Turn off the grid so you can easily see the control curves.
7. Select `lightControlHandle`, and choose Modify > Center Pivot. Open the Attribute Editor for the `lightControlHandle`. Make sure the tab in the Attribute Editor is set to `lightControlHandle` and not `lightControlHandleShape`. You're going to set translation limits on the handle, so you want to make sure you're working on the transform node of the curve and not the shape node.
8. Expand the Limit Information rollout; then expand the Translate rollout within this section. Move the `lightControlHandle` to the left end of the line, and click the arrow to the left of the Current setting, as shown in Figure 1.10. Click the check box next to Trans Limit X to set the minimum value.

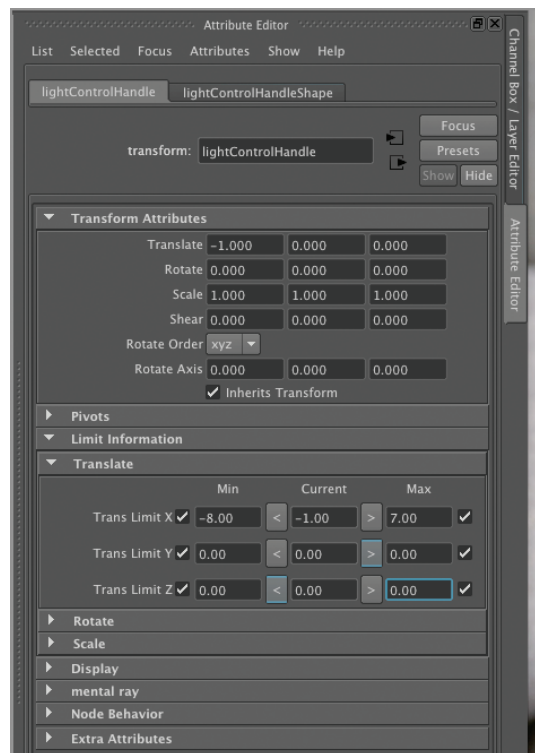


Figure 1.10 Set the minimum and maximum Translate values for the handle so that it does not go beyond the length of the lightControl curve.

9. Move the `lightControlHandle` all the way to the right, and use the same techniques to set the Max setting. Once this is set, the `lightControlHandle` is restricted on the X axis so that it can't move beyond the length of the line.
10. Set the Min and Max values for Trans Limit Y and Trans Limit Z to 0 so that the `lightControlHandle` can't be moved along these axes by mistake (see Figure 1.10).