
AUTODESK
Official Press
Todd Palamar
Mastering Autodesk®
Maya® 2016
SYBEX
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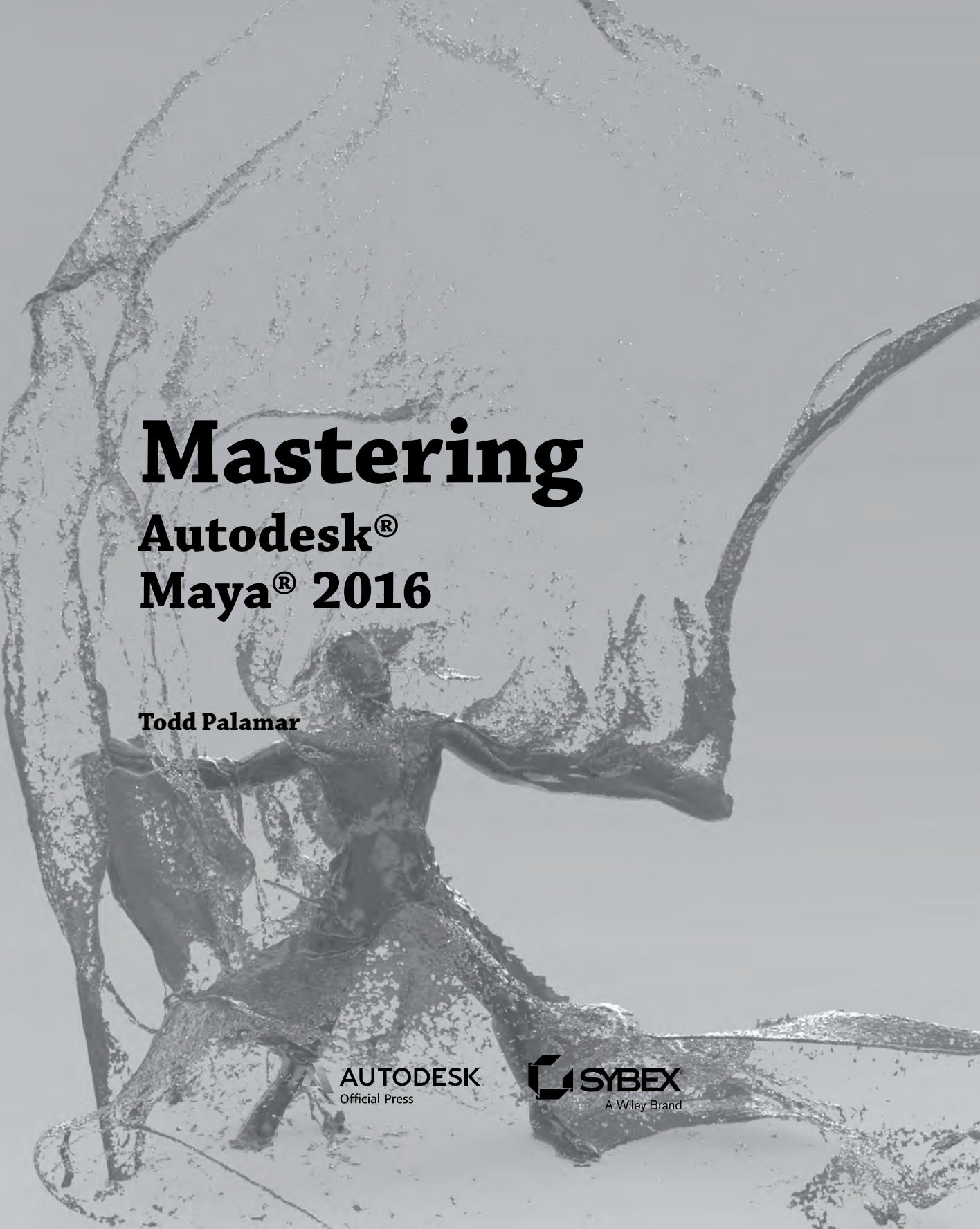

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Autodesk® Maya® 2016

Todd Palamar

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I would also like to thank our development editor, Gary Schwartz. Gary is a pleasure to work with, and he always put the content of the book first.

About the Author

Todd Palamar is a 23-year veteran of the computer animation industry. After transitioning early in his career from traditional special effects to computer-generated imagery, Todd did effects work for several direct-to-video movies. He later went on to work on numerous video games, including Sega of Japan's coin-operated title *Behind Enemy Lines*, as well as *Dukes of Hazzard* and *Trophy Buck 2* for the Sony PlayStation console.

For six years, Todd taught at Full Sail University in Winter Park, Florida. During this time, he received numerous accolades as an outstanding educator. Todd currently runs his own company, Surrealistic Producing Effects, making and distributing movies. Todd has written several books, among them *Maya Cloth for Characters* (Surrealistic Producing Effects, 2008), *Maya Studio Projects: Dynamics* (Sybex, 2009), and *Maya Studio Projects: Photorealistic Characters* (Sybex, 2011). The breadth of his experience has allowed him to work on location-based entertainment, military simulations, television commercials, and corporate spots. You can see more of Todd's work on his company's website, `www.speffects.com`.

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Introduction

The Autodesk® Maya® program is big. It is really, really huge. The book you hold in your hands, and all the exercises within it, represents a mere sliver of what can be created in Maya. Mastering Maya takes years of study and practice. I have been using Maya almost every day since 1999, and I'm still constantly facing new challenges and making new discoveries.

This book is meant to be a guide to help you not only understand Maya but also learn about Maya. The title *Mastering Autodesk Maya 2016* implies an active engagement with the software. This book is packed with hands-on tutorials. If you're looking for a quick-reference guide that simply describes each and every button, control, and tool in the Maya interface, turn to the Maya documentation that comes with the software. This book is not a description of Maya; it is an explanation illustrated with practical examples.

The skills you acquire through the examples in this book should prepare you for using Maya in a professional environment. To that end, some features, such as lighting and rendering with mental ray®, nDynamics, Fluids, and Maya Muscle, have received more emphasis and attention than others. Features that have not changed significantly over the past few versions of the software, such as Maya Software rendering, standard Maya shaders, and older rigging techniques, receive less attention since they have been thoroughly covered elsewhere.

When you read this book and work through the exercises, do not hesitate to use the Maya help files. I won't be insulted! The Maya documentation has a very useful search function that allows you to find complete descriptions of each control in the software. To use the help files, click the Help menu in the Maya menu interface. The documentation consists of a large library of Maya resources, which will appear in your default web browser when you access the help files. Experienced Maya artists never hesitate to use the help files to find more information about the software; there is no shame in asking questions! In addition, hovering over a tool or setting will give you a brief description. Features new to Maya, highlighted in green throughout the interface, have links to larger descriptions as well as movies.

Who Should Buy This Book

This book is written for intermediate Maya users and users who are advanced in some aspects of Maya and want to learn more about other facets of the program. The book is intended for artists who are familiar with Maya and the Maya interface or those who have significant experience using similar 3D packages. If you have used older versions of Maya, this book will help you catch up on the features in Maya 2016.

If you have never used Maya or any other 3D software on a computer before, this book will be too challenging and you will quickly become frustrated. You are encouraged to read

Introducing Autodesk Maya 2016 by Dariush Derakhshani (Sybex, 2015) or to read through the tutorials in the Maya documentation before diving into this book.

You should be familiar with the following before reading this book:

- The Maya interface.
- Computer image basics such as color channels, masking, resolution, and image compression.
- Computer animation basics, such as keyframes, squash and stretch, and 3D coordinate systems.
- Standard Maya shaders, such as the Blinn, Phong, Lambert, Layered, and Anisotropic materials, as well as standard textures, such as Fractal, Ramp, Noise, and Checker.
- Lighting and rendering with standard Maya lights and the Maya software renderer.
- The basics of working with NURBS curves, polygon surfaces, and NURBS surfaces.
- Your operating system. You need to be familiar with opening and saving files and the like. Basic computer networking skills are helpful as well.

What's Inside

The topics in this book move in a progressive order from introductory to complex. They also loosely follow a typical production pipeline for starting and completing assets. The following are brief explanations of the contents of each chapter.

There is also a companion website, which is home to all of the project files and samples referenced in the book. Go to `www.sybex.com/go/masteringmaya2016`, and click the Downloads tab to access the files.

- **Chapter 1: Working in Autodesk Maya** This chapter discusses how to work with the various nodes and the node structure that make up a scene. Using the Hypergraph, Outliner, Hypershade, Attribute Editor, and Connection Editor to build relationships between nodes is demonstrated through a series of exercises.
- **Chapter 2: Introduction to Animation** This chapter demonstrates basic rigging with inverse kinematics as well as animating with keyframes, expressions, and constraints. Animation layers are explained.
- **Chapter 3: Hard-Surface Modeling** This chapter introduces the various types of surfaces you can use to model. It walks you through numerous approaches for modeling parts of a bicycle.
- **Chapter 4: Organic Modeling** This chapter focuses on building a humanoid mesh, using polygon and subdivision surface techniques. Smooth mesh polygons, creasing, and soft selection are demonstrated on various parts of the model.
- **Chapter 5: Rigging and Muscle Systems** This chapter explains joints, expands on inverse kinematics, and covers smooth binding and proper rigging techniques. Maya Muscle is introduced and demonstrated on a character's leg.
- **Chapter 6: Animation Techniques** This chapter takes you through the numerous deformation tools available in Maya. Creating a facial-animation rig using blend shapes

is demonstrated, along with texture deformers, nonlinear deformers, and the geometry cache. We also take a look at importing motion capture.

- **Chapter 7: Lighting with mental ray** This chapter demonstrates a variety of lighting tools and techniques that can be used when rendering scenes with mental ray. Indirect lighting using global illumination, Final Gathering, and the Physical Sun and Sky network are all demonstrated.
- **Chapter 8: mental ray Shading Techniques** This chapter describes commonly used mental ray shaders and how they can be employed to add material qualities that mimic real-world surfaces. Tips on how to use the shaders together as well as how to light and render them using mental ray are offered.
- **Chapter 9: Texture Mapping** This chapter demonstrates how to create UV texture coordinates for a giraffe. Applying textures painted in other software packages, such as Adobe Photoshop, is discussed, as are displacement and normal maps and subsurface scattering shaders.
- **Chapter 10: Paint Effects** This chapter provides a step-by-step demonstration of how to create a custom Paint Effects brush as well as how to animate and render with Paint Effects.
- **Chapter 11: Rendering for Compositing** This chapter introduces render layers and render passes, which can be used to split the various elements of a render into separate files that are then recombined in compositing software.
- **Chapter 12: Introducing nParticles** This chapter provides numerous examples of how to use nParticles. You'll use fluid behavior, particle meshes, internal force fields, and other techniques to create amazing effects.
- **Chapter 13: Dynamic Effects** This chapter demonstrates a variety of techniques that can be used with nCloth to create effects. Traditional rigid body dynamics are compared with nCloth, and combining nCloth and nParticles is illustrated.
- **Chapter 14: Hair and Clothing** This chapter discusses how to augment your Maya creatures and characters using XGen, Maya nHair, and nCloth. Using dynamic curves to create a rig for a dragon's tail is also demonstrated.
- **Chapter 15: Maya Fluids** This chapter explains how 2D and 3D fluids can be used to create smoke, cloud, and flame effects, and it provides a demonstration of how to render using the Ocean shader. Bifrost is introduced as a way of creating liquid simulation.
- **Chapter 16: Scene Management and Virtual Filmmaking** This chapter provides an in-depth discussion of the Maya virtual camera and its attributes. A number of exercises provide examples of standard and custom camera rigs. Stereo 3D cameras are also introduced. References and the Asset Editor are also introduced. These features aid with large Maya projects that are divided between teams of artists.
- **Appendix A: The Bottom Line** This appendix contains all of the solutions from the Master It section at the end of each chapter.
- **Appendix B: Autodesk Maya 2016 Certification** This appendix contains the Autodesk Maya 2016 Certified Professional Objectives table that lists the topic, exam objective, and chapter where the information can be found.

NOTE Go to www.autodesk.com/certification to find information about the Maya 2016 Certified Professional exam covered in this book, as well as other Maya certification exams.

Conventions

Navigating in Maya is slightly different in the Windows and Mac operating systems. You can navigate the Hypergraph by using the same hot-key combination that you use in the viewport: Alt+MMB-drag/Option+MMB-drag pans through the Hypergraph workspace, and Alt+RMB-drag/Option+RMB-drag zooms in and out. (MMB refers to the middle mouse button, and RMB refers to the right mouse button.)

It is also important to note that Maya uses three digits for values listed within its tools and editors. The book may show only one or two digits when the last one or two digits are 0.

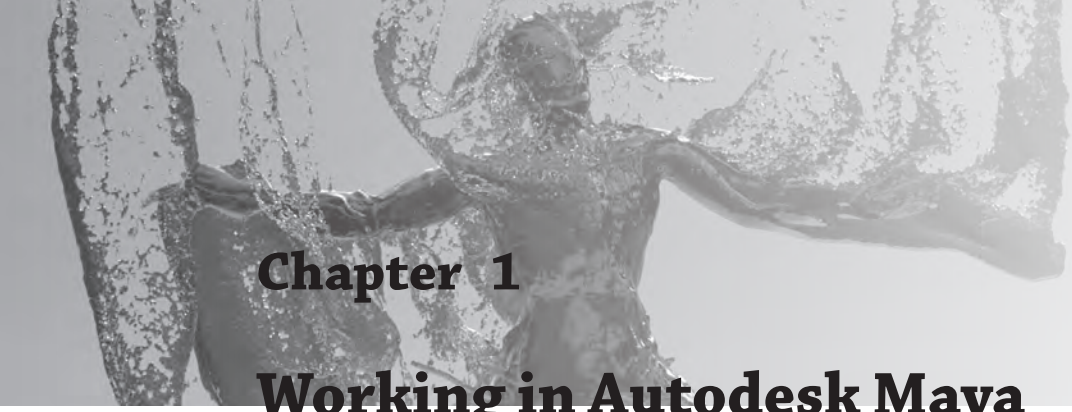
Free Autodesk Software for Students and Educators

The Autodesk Education Community is an online resource with more than five million members that enables educators and students to download—for free (see website for terms and conditions)—the same software as used by professionals worldwide. You can also access additional tools and materials to help you design, visualize, and simulate ideas. Connect with other learners to stay current with the latest industry trends and get the most out of your designs. Get started today at www.autodesk.com/joinedu.

How to Contact the Author

You can contact me with questions, comments, or concerns through his website at www.speffects.com, where you can see other books and productions on which he has worked.

Sybex strives to keep you supplied with the latest tools and information that you need for your work. Please check this book's website at www.sybex.com/go/masteringmaya2016, where we'll post additional content and updates that supplement this book should the need arise.



Chapter 1

Working in Autodesk Maya

The Autodesk® Maya® working environment has evolved to accommodate the individual artist as well as a team of artists working in a production pipeline. The interface presents tools, controls, and data in an organized fashion to allow you to bring your fantastic creations to life easily.

Autodesk Maya 2016 introduces a new, flattened GUI. The 3D beveled look of the interface's icons has been removed in favor of a simpler 2D look. Many of the colors have been modified as well. As a result, the GUI is now more modern and streamlined.

Understanding the way Maya organizes data about the objects, animations, textures, lights, dynamics, and all of the other elements contained within the 3D environment of a scene is essential to understanding how the interface is organized. Maya uses what's known as the *Dependency Graph* to keep track of the various packets of data, called nodes, and how they affect each other. Any single element of a Maya scene consists of multiple nodes connected in a web, and each one of these nodes is dependent on another. The Maya interface consists of editing windows that allow you to connect these nodes in an intuitive way and edit the information contained within each node.

There is usually more than one way to accomplish a task in Maya. As you grow comfortable with the interface, you'll discover which editing windows best suit your working style.

This chapter is a brief overview of what professionals need to understand when working in Maya. You'll learn about the types of nodes with which you'll be working and how they can be created and edited in Maya. You'll also learn how to work with projects and scene data as well as the various windows, panels, and controls that make up the interface. This will help you, whether you are working alone or as part of a team of artists.

This chapter is about working with nodes, but it is not meant to be a comprehensive guide to each and every control in Maya. You will find that information in the Maya documentation. If you've never used Maya, I strongly encourage you to read the Maya documentation as well as *Introducing Autodesk Maya 2016* by Dariush Derakhshani (Sybex, 2016).

In this chapter, you will learn to

- Work with Color Management
- Understand transform and shape nodes
- Create a project

Color Management

New!

Autodesk Maya 2016 implements a new management system for controlling the way colors are displayed in the viewport and in Render View. The Color Management system is based

on Autodesk Color Management, or SynColor, which is shared across several Autodesk applications. Color Management lets you switch between sRGB and linear color space. You can also switch to many other common color space environments. The Color Management system makes it easy to render your images to be color-corrected within your favorite compositing package.

The Color Management controls are visible in the Viewport 2.0 viewport, in the render view, and also within your preferences. Figure 1.1 shows the Color Management controls from the viewport. The viewport controls are the same controls that are located in the render view. Figure 1.2 shows the Color Management settings in the Preferences window.

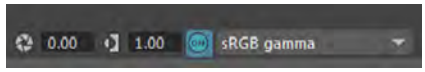


FIGURE 1.1
The Color Management controls within the viewport

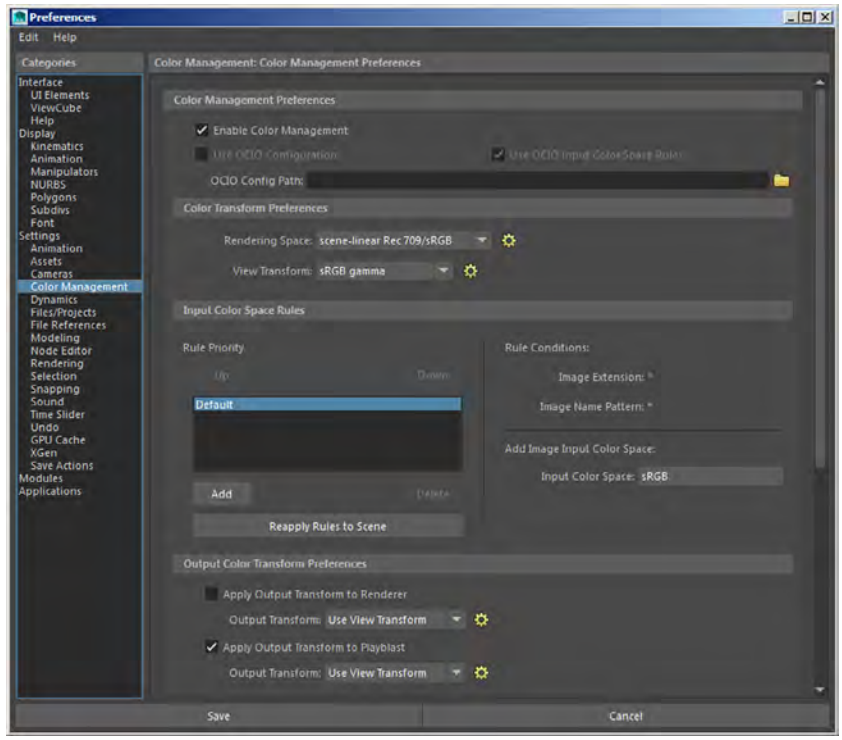


FIGURE 1.2
The Preferences for Color Management

Color Management affects all aspects of a production. In Maya 2016, you should establish your color space at the beginning of any project. To see more features and uses of Maya's Color Management system, you can watch `Color_Management.mov` in the `chapter1\movies` folder at the book's web page.

Creating and Editing Nodes

A Maya *scene* is a system of interconnected nodes that are packets of data. The data within a node tells the software what exists within the world of a Maya scene. The nodes are the building blocks that you, as the artist, put together to create the 3D scene and animation that will finally be rendered for the world to see. So if you can think of the objects in your scene, their motion, and their appearance as nodes, think of the Maya interface as the tools and controls that you use to connect those nodes. The relationship between these nodes is organized by the Dependency Graph (DG), which describes the hierarchical relationship between connected nodes. The interface provides many ways to view the graph, and these methods are described in this chapter.

Any given workflow in Maya is much like a route on a city map. You usually have many ways to get to your destination, and some of them make more sense than others, depending on where you're going. In Maya, the best workflow depends on what you're trying to achieve, and there is typically more than one possible ideal workflow.

Maya has many types of nodes that serve any number of different functions. All of the nodes in Maya are considered DG nodes. Let's say that you have a simple cube and you subdivide it once, thus quadrupling the number of faces that make up the cube. The information concerning how the cube has been subdivided is contained within a DG node that is connected to the cube node.

A special type of DG node is the *directed acyclic graph (DAG)* node. These nodes are made up of two specific types of connected nodes: transform and shape. The arrangement of DAG nodes consists of a hierarchy in which the shape node is a child of the transform node. Most of the objects with which you work in the Maya viewport, such as surface geometry (cubes, spheres, planes, and so on), are DAG nodes.

To understand the difference between the transform and shape node types, think of a transform node as describing where an object is located and a shape node as describing what an object is.

The simple polygon cube in Figure 1.3 consists of six flat squares attached at the edges to form a box. Each side of the cube is subdivided twice, creating four polygons per side. That basically describes what the object is, and the description of the object would be contained in the shape node. This simple polygon cube may be 4.174018 centimeters above the grid, rotated 35 degrees on the x-axis, and scaled four times its original size based on the cube's local x- and y-axes and six times its original size in the cube's local z-axis. That description would be in the transform node.

Maya has a number of workspaces that enable you to visualize and work with the nodes and their connections. The following sections describe how these workspaces work together when building a node network in a Maya scene.

Using the Hypergraph

The *Hypergraph* is a visual representation of the nodes and their connections in Maya. A complex scene can look like an intricate web of these connections. When you need to know how a network of nodes is connected, the Hypergraph gives you the most detailed view. There are two ways to view the Hypergraph:

- The *hierarchy view* shows the relationships between nodes as a tree structure.
- The *connections view* shows how the nodes are connected as a web.

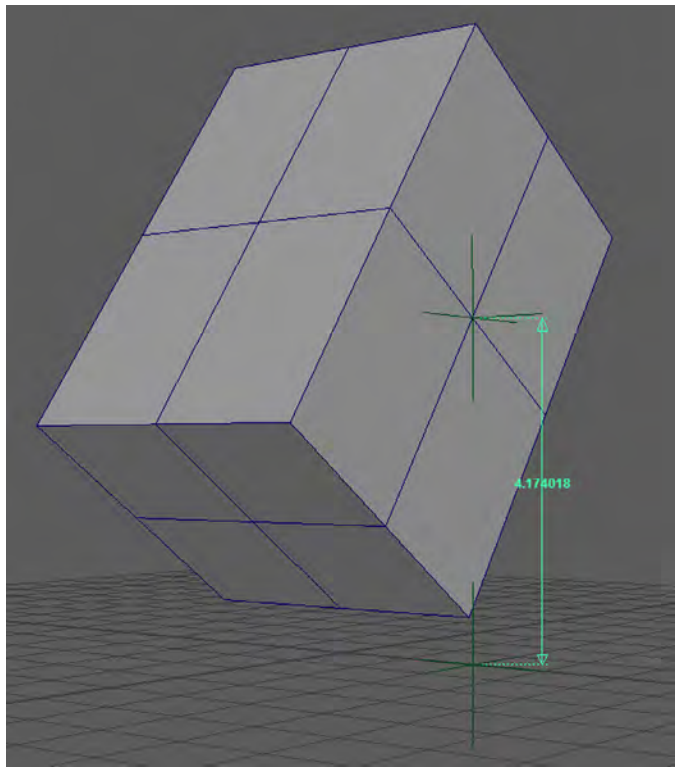


FIGURE 1.3
A shape node describes the shape of an object and how it has been constructed; a transform node describes where the object is located in the scene.

You can have more than one Hypergraph window open at the same time, but you are still looking at the same scene with the same nodes and connections.

This short exercise gives you a sense of how you would typically use the Hypergraph:

1. Create a new Maya scene.
2. Create a polygon cube by choosing Create ➢ Polygon Primitives ➢ Cube.
3. Select the cube in the viewport, and choose Windows ➢ Hypergraph: Hierarchy to open the Hypergraph in Hierarchy mode.
4. Press **f** to frame your selection. You'll see a yellow rectangle on a black field labeled pCube1. The rectangle turns gray when deselected.
5. Move the mouse over the rectangle labeled pCube1 and then right-click. Choose Rename from the pop-up window. Rename the cube **myCube** (see Figure 1.4).
6. Select myCube and, from the Hypergraph menu, choose Graph ➢ Input And Output Connections. This switches the view to the connections view just as if you had originally opened the Hypergraph by choosing Windows ➢ Hypergraph: Connections. It's the same Hypergraph, but the view mode has changed, allowing you to see more of the scene.

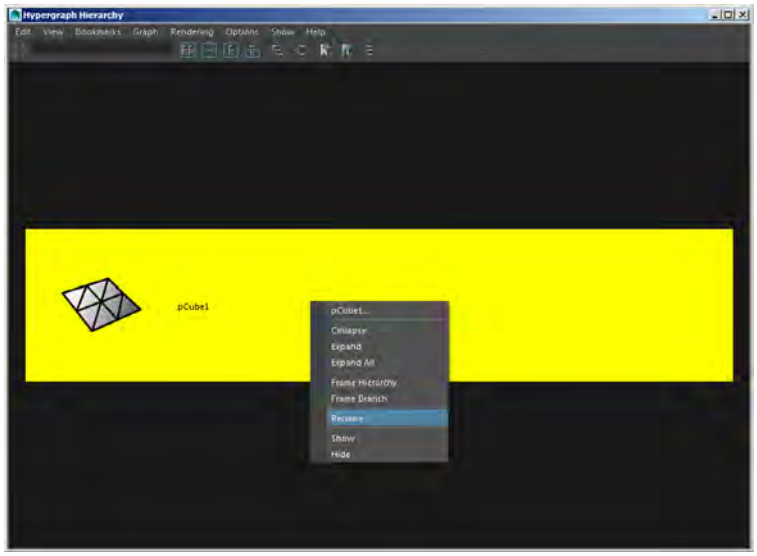


Figure 1.4
You can rename nodes in the Hypergraph through the context menu when you RMB-click.

When you graph the input and output connections, you see the connected nodes that make up an object and how the object appears in the scene. In the current view, you should see the myCube node next to a stack of connected nodes labeled polyCube1, myCubeShape, and initialShadingGroup, as shown in Figure 1.5. (The nodes may also be arranged in a line; the actual position of the nodes in the Hypergraph does not affect the nodes themselves.)

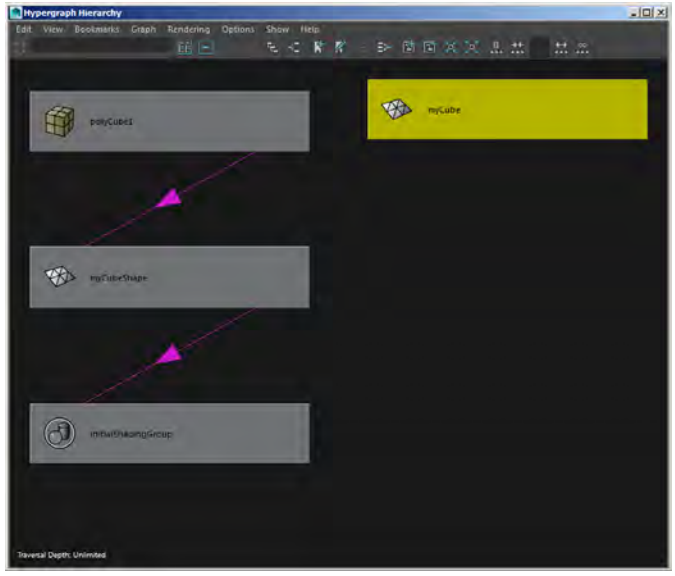


Figure 1.5
The node network appears in the Hypergraph. This shape node (myCubeShape) is connected to two other nodes, whereas the transform node (myCube) appears off to the side.

Navigating the Hypergraph

You can navigate the Hypergraph by using the same hot-key combination that you use in the viewport: Alt+MMB-drag/Option+MMB-drag pans through the Hypergraph workspace, and Alt+RMB-drag/Option+RMB-drag zooms in and out. (MMB means clicking with the middle mouse button, and RMB means clicking with the right mouse button.) Selecting a node and pressing the **f** hot key focuses the view on the currently selected node. It is also possible to zoom in using the scroll wheel on your mouse.

The myCube node is the transform node. The myCubeShape node is the shape node. In the Hypergraph, the shape and transform nodes are depicted as unconnected; however, there is an implied connection, as you'll see later. This is demonstrated when you rename the myCube node; the shape node is renamed as well.

In Maya, the construction history feature stores a record of the changes used to create a particular node. The polyCube1 node is the construction history node for the myCubeShape node. When you first create a piece of geometry, you can set options to the number of subdivisions, spans, width, height, depth, and many other features that are stored as a record in this history node. Additional history nodes are added as you make changes to the node. You can go back and change these settings as long as the history node still exists. Deleting a history node makes all of the previous changes to the node permanent (however, deleting history is undoable). Use the following steps to guide you through the process of modifying history nodes:

1. Keep the Hypergraph open, but select the cube in the viewport.
2. Change the menu set in the upper left of the main interface to Modeling.
3. Press the **5** key on the keyboard to switch to Shaded mode. Choose Mesh ➢ Smooth. The cube will be subdivided and smoothed in the viewport.

In the Hypergraph, you'll see a new polySmoothFace1 node between the polyCube1 node and the myCubeShape node (see Figure 1.6). This new node is part of the history of the cube.

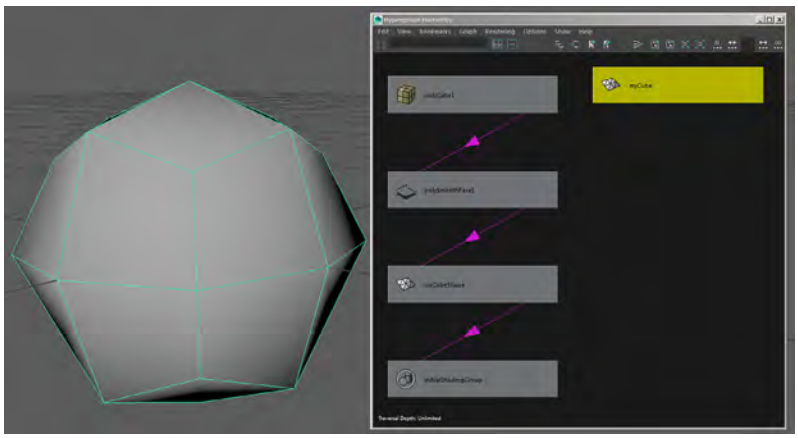


Figure 1.6
Performing a smooth operation on the cube when construction history is activated causes a new polySmoothFace1 node to be inserted into the node network.