



AUTODESK
Official Press

Todd Palamar



Mastering Autodesk
Maya 2014



SYBEX
A Wiley Brand

Table of Contents

[Cover](#)

[Introduction](#)

[Who Should Buy This Book](#)

[What's Inside](#)

[Conventions](#)

[How to Contact the Author](#)

[Chapter 1: Working in Autodesk Maya](#)

[Creating and Editing Nodes](#)

[Creating Maya Projects](#)

[Organizing Complex Node Structures with Assets](#)

[File References](#)

[The Bottom Line](#)

[Chapter 2: Virtual Filmmaking](#)

[Determining the Image Size and Film Speed of the Camera](#)

[Creating and Animating Cameras](#)

[Creating Custom Camera Rigs](#)

[Applying Depth of Field and Motion Blur](#)

[Using Orthographic and Stereo Cameras](#)

[Using the Camera Sequencer](#)

[The Bottom Line](#)

[Chapter 3: Modeling I](#)

[Understanding Polygon Geometry](#)

[Using Subdivision Surfaces](#)

[Understanding NURBS](#)

[Employing Image Planes](#)

[Modeling NURBS Surfaces](#)

[NURBS Tessellation](#)

[Modeling with Polygons](#)

[The Bottom Line](#)

[Chapter 4: Modeling II](#)

[Modeling with Deformers](#)

[Combining Meshes](#)

[Using Bevel Plus](#)

[Using Curves](#)

[Converting NURBS Surfaces to Polygons](#)

[Boolean Operations](#)

[Sculpting Polygons Using Artisan](#)

[Advanced Polygon-Editing Tools](#)

[The Bottom Line](#)

[Chapter 5: Animation Techniques](#)

[Using Joints and Constraints](#)

[Inverse Kinematics](#)

[Keyframe Animation](#)

[The Graph Editor](#)

[Playblast and FCheck](#)

[Driven Keys](#)

[Motion-Path Animation](#)

[Motion Trails](#)

[Animating Constraints](#)

[Animation Layers](#)

[Grease Pencil](#)

[The Bottom Line](#)

[Chapter 6: Animating with Deformers](#)

[Animating Facial Expressions Using Blend Shapes](#)

[Animating Blend Shapes Sequentially](#)

[Animating with Lattices](#)

[Animating Object Components with Clusters](#)

[Animating a Scene Using Nonlinear Deformers](#)

[Creating a Jiggle Effect](#)

[Optimizing Animations with the Geometry Cache](#)

[The Bottom Line](#)

[Chapter 7: Rigging and Muscle Systems](#)

[Understanding Rigging](#)

[Creating and Organizing Joint Hierarchies](#)

[Rigging the Giraffe](#)

[Human Inverse Kinematics](#)

[Skinning Geometry](#)

[The Maya Muscle System](#)

[The Bottom Line](#)

[Chapter 8: Paint Effects](#)

[Using the Paint Effects Canvas](#)

[Painting on 3D Objects](#)

[Understanding Strokes](#)

[Designing Brushes](#)

[Create Complexity by Adding Strokes to a Curve](#)

[Shaping Strokes with Behavior Controls](#)

[Animating Strokes](#)

[Rendering Paint Effects](#)

[The Bottom Line](#)

[Chapter 9: Lighting with mental ray](#)

[Shadow-Casting Lights](#)

[Indirect Lighting: Global Illumination](#)

[Indirect Illumination: Final Gathering](#)

[Image-Based Lighting](#)

[Physical Sun and Sky](#)

[mental ray Area Lights](#)

[Light Shaders](#)

[The Bottom Line](#)

[Chapter 10: mental ray Shading Techniques](#)

[Shading Concepts](#)

[Creating Blurred Reflections and Refractions Using Standard Maya Shaders](#)

[Basic mental ray Shaders](#)

[Car Paint Materials](#)

[The mia Material](#)

[Controlling Exposure with Tone Mapping](#)

[Rendering Contours](#)

[The Bottom Line](#)

[Chapter 11: Texture Mapping](#)

[UV Texture Layout](#)

[Bump and Normal Mapping](#)

[Displacement Mapping](#)

[Subsurface Scattering](#)

[Viewport 2.0](#)

[The Bottom Line](#)

[Chapter 12: Rendering for Compositing](#)

[Render Layers](#)

[Render Passes](#)

[Render Pass Contribution Maps](#)

[Setting Up a Render with mental ray](#)

[mental ray Quality Settings](#)

[The Bottom Line](#)

[Chapter 13: Introducing nParticles](#)

[Creating nParticles](#)

[Making nParticles Collide with nRigids](#)

[Using nParticles to Simulate Liquids](#)

[Emit nParticles Using a Texture](#)

[Using Wind](#)

[Shading nParticles and Using Hardware Rendering to Create Flame Effects](#)

[nParticles and Fields](#)

[Rendering Particles with mental ray](#)

[The Bottom Line](#)

[Chapter 14: Dynamic Effects](#)

[Creating nCloth Objects](#)

[Creating nCloth and nParticle Interactions](#)

[Rigid Body Dynamics](#)

[Soft Body Dynamics](#)

[Creating Flying Debris Using nParticle Instancing](#)

[Animating Instances Using nParticle Expressions](#)

[The Bottom Line](#)

[Chapter 15: Fur, Hair, and Clothing](#)

[Adding Fur to Characters](#)

[Rendering Fur Using mental ray](#)

[Animating Using Dynamic Curves](#)

[Adding Hair to a Character](#)

[Styling Hair](#)

[Rendering Hair](#)

[Creating Clothing for Characters](#)

[Painting nCloth Properties](#)

[The Bottom Line](#)

[Chapter 16: Maya Fluids](#)

[Using Fluid Containers](#)

[Fluid Interactions](#)

[Rendering Fluid Containers](#)

[Create Fluids and nParticle Interactions](#)

[Creating Water Effects](#)

[The Bottom Line](#)

[Appendix A: The Bottom Line](#)

[Chapter 1](#)

[Chapter 2](#)

[Chapter 3](#)

[Chapter 4](#)

[Chapter 5](#)

[Chapter 6](#)

[Chapter 7](#)

[Chapter 8](#)

[Chapter 9](#)

[Chapter 10](#)

[Chapter 11](#)

[Chapter 12](#)

[Chapter 13](#)

[Chapter 14](#)

[Chapter 15](#)

[Chapter 16](#)

[Appendix B: Autodesk Maya 2014 Certification](#)



Mastering Autodesk® Maya® 2014

Todd Palamar

 **AUTODESK.**
Official Press

 **SYBEX**
A Wiley Brand

Acquisitions Editor: Mariann Barsolo

Development Editor: Candace Cunningham

Technical Editor: Chip Weatherman

Production Editor: Elizabeth Campbell

Copy Editor: Liz Welch

Editorial Manager: Pete Gaughan

Production Manager: Tim Tate

Vice President and Executive Group Publisher: Richard Swadley

Vice President and Publisher: Neil Edde

Book Designers: Maureen Forys, Happenstance Type-O-Rama with Judy Fung

Compositor: Maureen Forys, Happenstance Type-O-Rama

Proofreader: Sara Eddleman-Clute, Word One, New York

Indexer: Ted Laux

Project Coordinator, Cover: Katherine Crocker

Cover Designer: Ryan Sneed

Cover Image: Todd Palamar

Published simultaneously in Canada

ISBN: 978-1-118-57496-6

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Limit of Liability/Disclaimer of Warranty: The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation warranties of fitness for a particular purpose. No warranty may be created or extended by sales or promotional materials. The advice and strategies contained herein may not be suitable for every situation. This work is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional services. If professional assistance is required, the services of a competent professional person should be sought. Neither the publisher nor the author shall be liable for damages arising herefrom. The fact that an organization or Web site is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Web site may provide or recommendations it may make. Further, readers should be aware that Internet Web sites listed in this work may have changed or disappeared between when this work was written and when it is read.

For general information on our other products and services or to obtain technical support, please contact our Customer Care Department within the U.S. at (877) 762-2974, outside the U.S. at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Control Number: 2013936840

TRADEMARKS: Wiley, the Wiley logo, and the Sybex logo are trademarks or registered trademarks of John Wiley & Sons, Inc. and/or its affiliates, in the United States and other countries, and may not be used without written permission. Autodesk and Maya are registered trademarks of Autodesk, Inc. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc. is not associated with any product or vendor mentioned in this book.

10 9 8 7 6 5 4 3 2 1

Dear Reader,

Thank you for choosing *Mastering Autodesk Maya 2014*. This book is part of a family of premium

quality Sybex books, all of which are written by outstanding authors who combine practical experience with a gift for teaching.

Sybex was founded in 1976. More than 30 years later, we're still committed to producing consistent, exceptional books. With each of our titles, we're working hard to set a new standard for the industry. From the paper we print on, to the authors we work with, our goal is to bring you the best book available.

I hope you see all that reflected in these pages. I'd be very interested to hear your comments and give your feedback on how we're doing. Feel free to let me know what you think about this or any other Sybex book by sending me an email at nedde@wiley.com. If you think you've found a technical error in this book, please visit <http://sybex.custhelp.com>. Customer feedback is critical to our efforts at Sybex.

Best regards,



Neil Edde
Vice President and Publisher
Sybex, an Imprint of Wiley

Acknowledgments

I would like to Eric Keller and Lee Lanier, whose work on previous editions has built a foundation for this edition; Anthony Honn, who built the vehicle models used in many of the example scenes; Travis Keller, who designed the kitchen and pergola models used in the lighting chapters; and Chris Sanchez, who provided the fantastic spacesuit design used in the modeling chapters. Thanks, also, to Chip Weatherman, our technical editor. Chip's fresh perspective was much appreciated.

I would also like to thank all the people from Wiley, and a special thanks to Mariann Barsol, Candace Cunningham, and Elizabeth Campbell for having such great attitudes. Their management and editing skills are superior.

About the Author

Todd Palamar is a 22-year veteran in 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's 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 is currently an instructor at the Digital Animation & Visual Effects (DAVE) School at Universal Studios in Orlando, Florida. Todd has written several books, among them *Maya Cloth for Characters* (Surrealist Productions, 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.

About the Contributing Authors

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 Introducing Digital Sculpting class 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 has worked at some of the best design studios in Los Angeles, including Prologue Film, Imaginary Forces, Yu and Company, BLT and Associates, and The Syndicate. Books by Eric Keller include *Maya Visual Effects: The Innovator’s Guide*, *Introducing ZBrush* (three editions), *Mastering Maya 2009*, and *Mastering Maya 2011*, all published by Sybex. He was a contributing author on *Mastering Maya 7* and *Mastering Maya 2012*. Many of his tutorials are available online at www.bloopatone.com.

Lee Lanier is a visual effects/animation veteran of over 20 years. Formerly a senior animator at PDI/DreamWorks for *Antz* and *Shrek*, his credits include a dozen features and numerous short films. In addition, he has taught at several schools, including the Academy of Art University and the Gnomon School of Visual Effects, and has written several books for Sybex, including *Maya Studio Projects: Texturing and Lighting* (2011). You can view his work at <http://beezlebugbit.com/>.

Anthony Honn created the vehicle models used in the example scenes throughout this book. Anthony is originally trained in industrial design and architecture, but a series of fateful events resulted in his career in the film and design industries. His clients have included recording artists such as Janis Joplin and Jackson, as well as lifestyle brands such as Nike. Arguably, the industrial designer still lurks beneath the surface with his continued passion for robotics, automobiles, and furniture.

Contents at a Glance

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 represent 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 how to learn about Maya. The title *Mastering Autodesk Maya 2014* 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. We 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 out 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 to be used by artists who are familiar with Maya and the Maya interface or 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 2014.

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 2014*, by Dariush Derakhshani (Sybex, 2013) 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 rendering engine.
- 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 the project files and samples referenced in the book, as well as bonus chapters on MEL scripting and toon shading. Go to www.sybex.com/go/masteringmaya2014 and click the Downloads tab to access the files.

Note

Some of the scene files provided with Mastering Autodesk Maya 2014 may *not* work with previous versions of Maya, even if the 'Ignore Versions' option is checked when you open the file. You may be able to download the previous book's scene files and use them if you are using a previous version of Maya, however be warned that the scene files from previous editions of the book may not be completely updated to address exercises in the 2014 edition of the book.

- **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. References and the Asset Editor are also introduced. These features have been created to aid with large Maya projects that are divided between teams of artists.
- **Chapter 2: 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.
- **Chapter 3: Modeling I** This chapter introduces the various types of surfaces with which you can model. It walks you through numerous approaches for modeling parts of a helmet for a spacesuit based on a concept drawing created by a professional artist.
- **Chapter 4: Modeling II** This chapter continues to build on the model started in Chapter 3, using polygon and subdivision surface techniques. Smooth mesh polygons, creasing, and soft selection are demonstrated on various parts of the model.
- **Chapter 5: Animation Techniques** This chapter demonstrates basic rigging with inverse kinematics as well as animating with keyframes, expressions, and constraints. Animation layers are explained.
- **Chapter 6: Animating with Deformers** This chapter takes you through the numerous deformation tools available in Maya. Creating a facial-animation rig using blend shapes is demonstrated, along with using lattices, nonlinear deformers, and the geometry cache.
- **Chapter 7: 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 arm.

- **Chapter 8: 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 9: 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 10: mental ray Shading Techniques** This chapter describes commonly used mental ray shaders and how they can be employed to add material qualities to the space helmet created in Chapter 3. Tips on how to use the shaders together as well as how to light and render them using mental ray are offered.
- **Chapter 11: 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 12: 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 13: 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 14: 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 15: Fur, Hair, and Clothing** This chapter discusses how to augment your Maya creatures and characters using Maya Fur, Maya nHair, and nCloth. Using dynamic curves to create a rig for a dragon's tail is also demonstrated.
- **Chapter 16: Maya Fluids** This chapter explains how 2D and 3D fluids can be used to create smoke, cloud, and flame effects, and a demonstration of how to render using the Ocean shader is given. Using nParticles as a Fluid emitter is introduced, as is using Fluids for liquid simulation.
- **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 2014 Certification** This appendix contains the Autodesk Maya 2014 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 2014 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 you use in the viewport: Alt+MMF

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.)

It is also important to note that Maya uses three digits for values listed within its tools and editors. The book may only show 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 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 author Todd Palamar 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 you need for your work. Please check this book's website at www.sybex.com/go/masteringmaya2014, where we'll post additional content and updates that supplement this book should the need arise.

Working in Autodesk Maya

The Autodesk® Maya® working environment has evolved to accommodate both 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.

Understanding the way Maya organizes data about the objects, animations, textures, lights, dynamics, and all 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, known as 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 what types of nodes you'll be working with 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 window 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 every node and every control in Maya. You will find that information in the Maya documentation. If you've never used Maya before, I strongly encourage you to read the Maya documentation as well as *Introducing Autodesk Maya 2013*, by Dariush Derakhshani (Sybex, 2012).

In this chapter, you will learn to:

- Understand transform and shape nodes
- Create a project
- Use assets
- Create file references

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 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. There are usually 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.

There are many types of nodes in Maya that serve any number of different functions. All the nodes in Maya are considered DG nodes. Let's say 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.

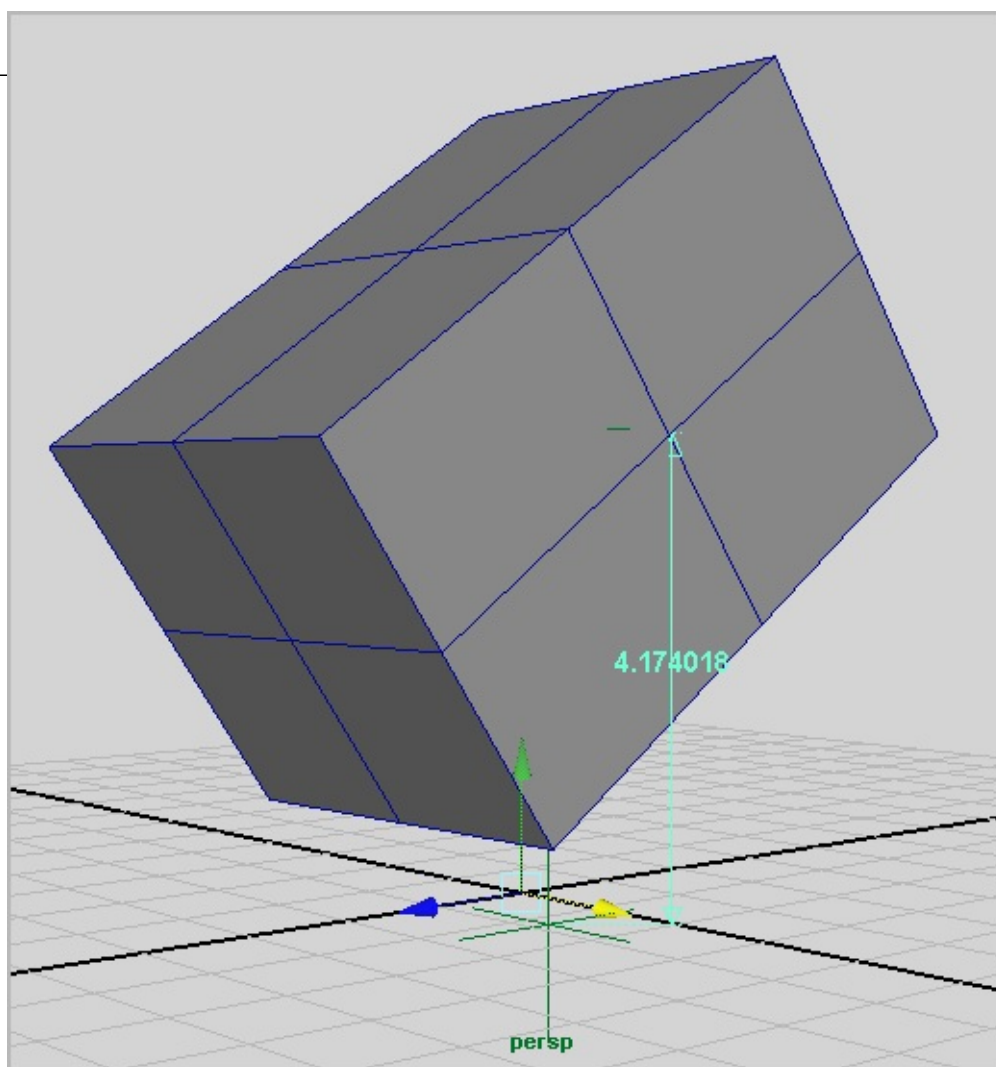
A special type of DG node is the **directed acyclic graph (DAG)** node. These nodes are made of two specific types of connected nodes: transform and shape. The arrangement of DAG nodes consists of a hierarchy in which the shape node is a child of the transform node. Most of the objects you work with 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 1-1](#) consists of six flat squares attached at the edges to form a cube. Each side of the cube is subdivided twice, creating four polygons per side. That basic description 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.

Figure 1-1 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.



Using the Hypergraph

The **Hypergraph** is a picture 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 are connected, the Hypergraph gives you the most detailed view. There are two ways to view the Hypergraph:

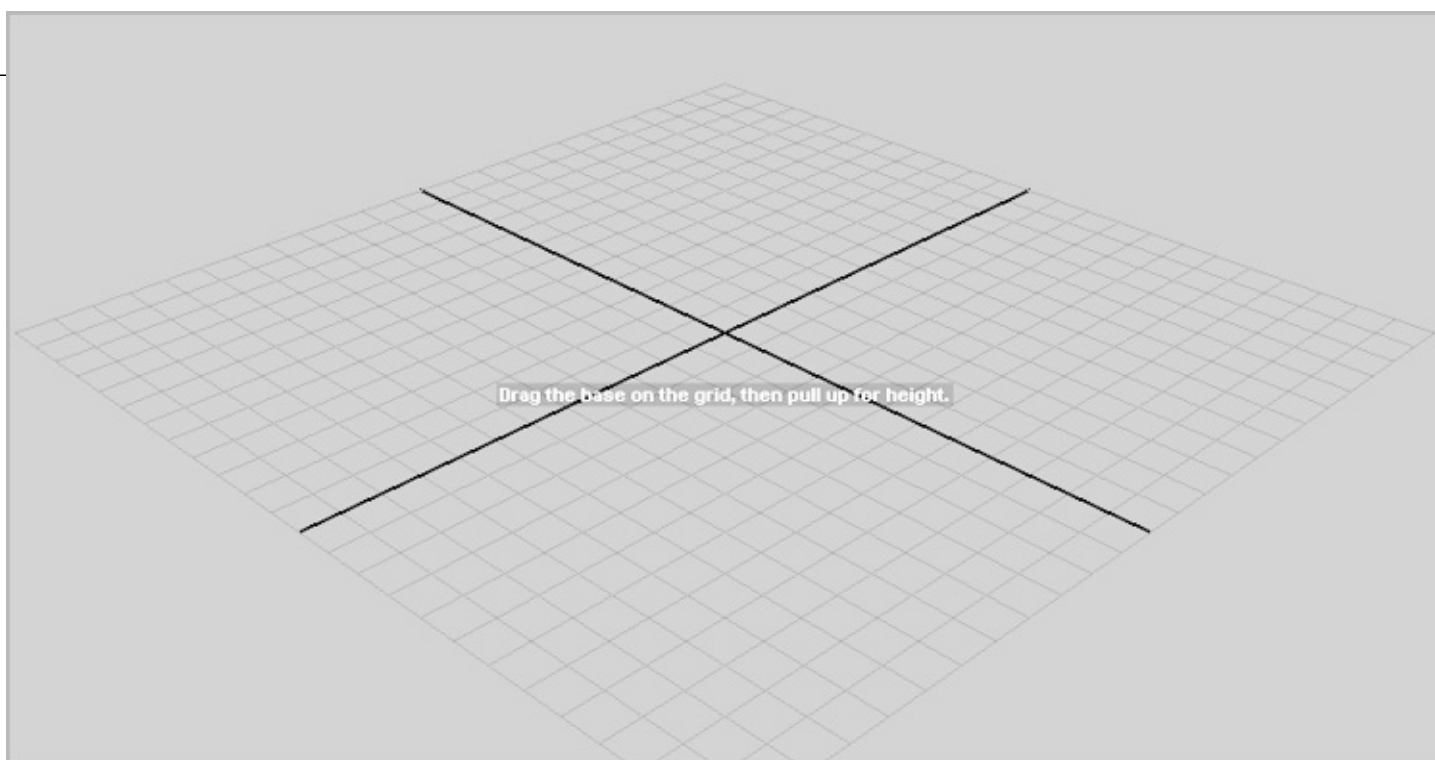
- The **hierarchy view** shows the relationships between nodes as a tree structure.
- The **connections view** shows how the nodes are connected as a web.

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. You will be prompted to draw a polygon on the grid by dragging on the grid (see [Figure 1-2](#)). Drag a square on the grid, release the cursor, and then drag upward on the square to turn it into a three-dimensional cube. Release the mouse button to complete the cube. At this point, feel free to make your own decisions about the size and position of the cube on the grid.

Figure 1-2 Maya prompts you to draw the base of the cube on the grid in the scene.



4. Select the cube in the viewport, and choose Window ⇒ Hypergraph: Hierarchy to open the Hypergraph in hierarchy mode. You'll see a yellow rectangle on a black field labeled pCube1. The rectangle turns gray when deselected.

Interactive Creation

By default Maya creates objects using the **Interactive Creation method**, which allows you to draw on the canvas as you create your geometry. To turn this feature off, choose the Create ⇒ Polygon Primitives menu, and deselect the Interactive Creation option at the bottom of the menu. This feature is turned off for all the projects in this book to ensure precise placement of primitive objects.

While the Interactive Creation mode is on, you can deselect the Exit On Completion method; this means that each time you draw on the grid, you will continue to create cubes until you switch to another tool.

5. Move the mouse over the rectangle labeled pCube and then right-click. Choose Rename from the pop-up window. Rename the cube **myCube**.

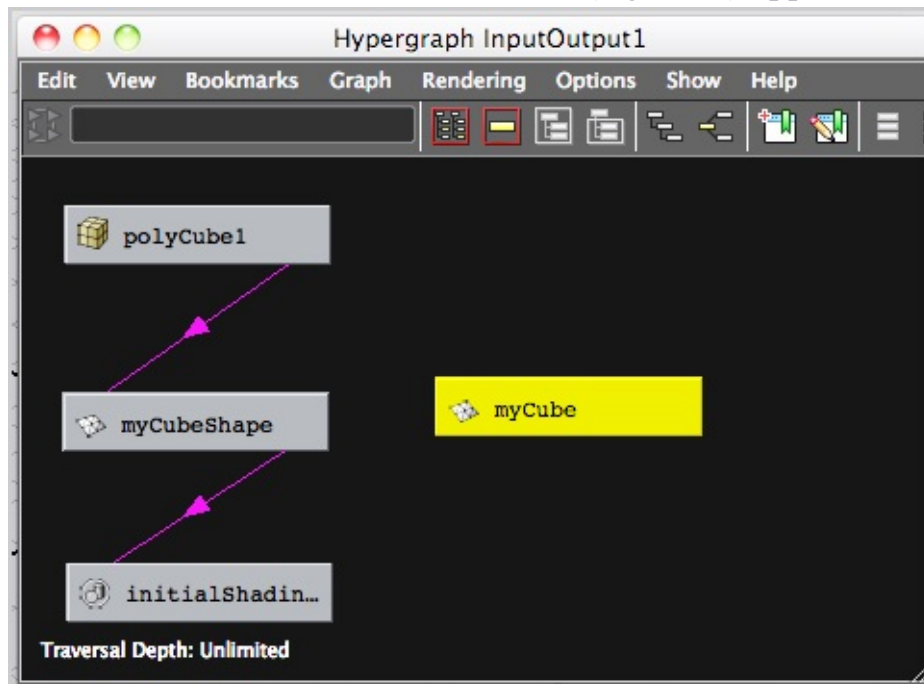
6. Select myCube and, from the Hypergraph menu, choose Graph ⇒ Input And Output Connections. This switches the view to the connections view just as if you had originally opened the Hypergraph by choosing Window ⇒ Hypergraph: Connections. It's the same Hypergraph, but the view mode has changed, allowing you to see more of the scene.

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 1-3](#). (The nodes may also be arranged in a line; the actual position of the nodes in the Hypergraph does not affect the nodes themselves.)

Navigating the Hypergraph

You can navigate the Hypergraph by using the same hot-key combination 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.

Figure 1-3 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.



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 implicit 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 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 Polygons.
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 1-4](#)). This new node is part of the history of the cube.

- [Mad Mitch's Tribal Law: Aden and the End of the Empire pdf](#)
- [download Pinterest For Dummies pdf](#)
- [Doctor Goebbels: His Life and Death for free](#)
- [download How to Be Happy: A Memoir of Love, Sex and Teenage Confusion](#)
- [click Prinzessin Enjas Traumwelt \(Comic, Band 7\) online](#)

- <http://rodrigocaporal.com/library/Top-10-Rio-de-Janeiro--DK-Eyewitness-Top-10-Travel-Guides-.pdf>
- <http://betsy.wesleychapelcomputerrepair.com/library/Pinterest-For-Dummies.pdf>
- <http://patrickvincitore.com/?ebooks/Doctor-Goebbels--His-Life-and-Death.pdf>
- <http://damianfoster.com/books/The-Legalized-Crime-of-Banking-and-a-Constitutional-Remedy.pdf>
- <http://www.1973vision.com/?library/Prinzessin-Enjas-Traumwelt--Comic--Band-7-.pdf>