Autodesk®
Official Training Guide

Autodesk Certification Preparation

Todd Palamar
Eric Keller
with Anthony Honn,
Lee Lanier, and Beau Janzen

Mastering Autodesk® Maya® 2012

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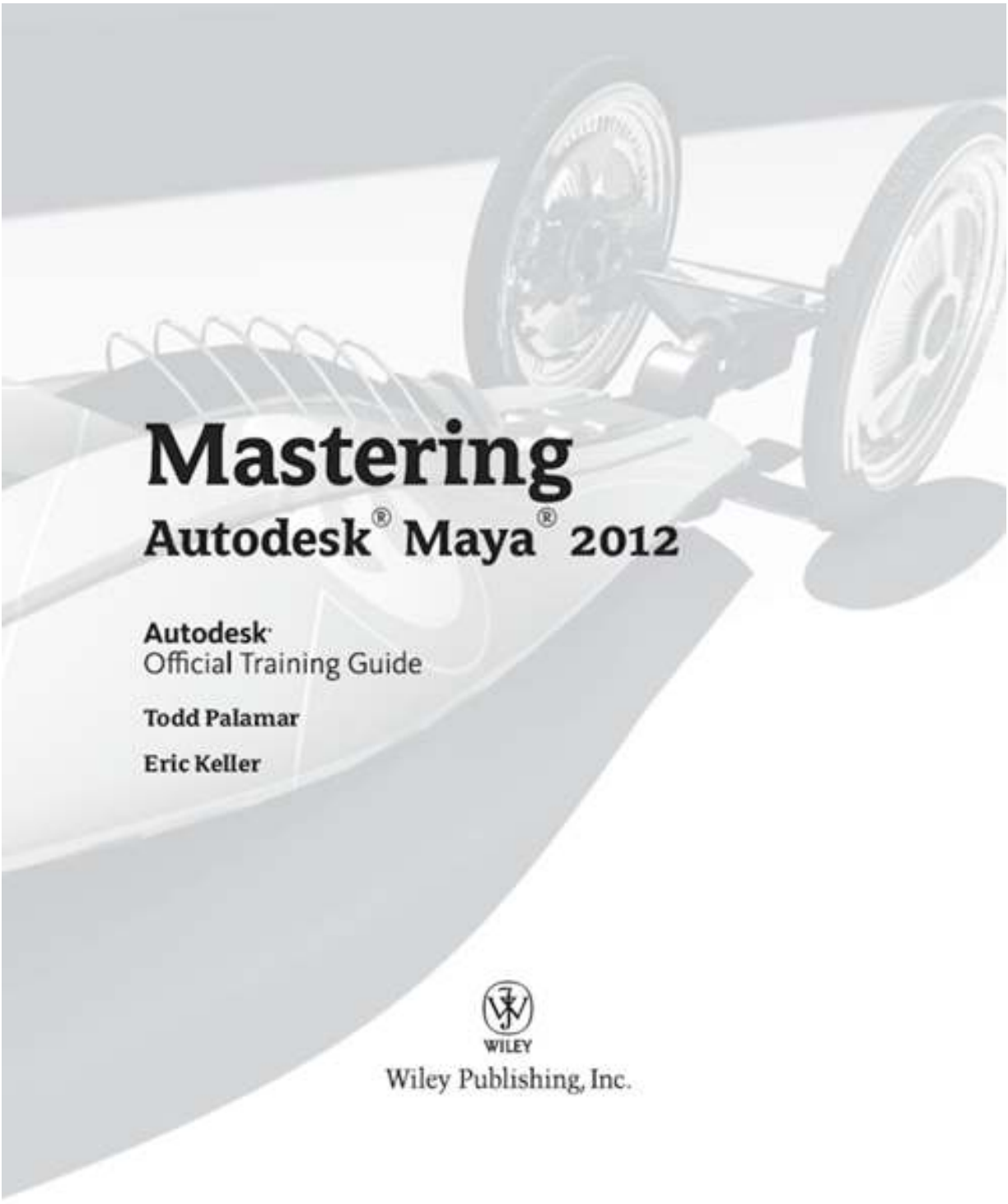

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Todd Palamar

Eric Keller

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Best regards,

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

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Anthony Honn built the vehicle models used in many of the example scenes; Eric Keller’s brother, Travis Keller, designed the kitchen and pergola models used in the lighting chapters; and Chris Sanchez provided the fantastic space suit design used in the modeling chapters.

I would like to thank all the people from Wiley. A special thanks to Mariann Barsolo, Heather O’Connor, and Christine O’Connor. Their management and editing skills are superior.

—*Todd Palamar*

About the Authors

Todd Palamar is a 21-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 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. Additionally, Todd was a trainer at the Digital Animation & Visual Effects (DAVE) School at Universal Studios Florida, bringing postgraduate students up to speed in Maya. 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). His breadth of experience has allowed him to work in location-based entertainment, military simulation, television commercials, and corporate spots. Todd is currently Technical Art Director at Vcom3D, creating real-time characters capable of lip syncing to multiple languages and sign language. You can see more of Todd's work on his company's website, www.speffects.com.

Eric Keller is a freelance visual effects artist working in Hollywood. He divides his time between the entertainment industry and scientific visualization. He teaches an introductory ZBrush class at the Gnomon School of Visual Effects 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 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.

Other books by Eric Keller include *Introducing ZBrush 4* (Sybex, 2011), *Maya Visual Effects: The Innovator's Guide* (Sybex, 2007), and *Introducing ZBrush* (Sybex, 2008). He was a contributing author to *Mastering Maya 7* (Sybex, 2006). He authored the video series *Essential ZBrush 3.1* for Lynda.com as well as numerous tutorials and articles for industry magazines. Many of his tutorials are available online at www.highend3d.com and www.molecularmovies.org.

About the Contributing Authors

Lee Lanier is a 3D animator, digital compositor, and director. His films have played in more than 200 museums, galleries, and film festivals worldwide. Before directing the shorts *Millennium Bug*, *Mirror*, *Day Off the Dead*, *Weapons of Mass Destruction*, *13 Ways to Die at Home*, and *Blood Roulette*, he served as a senior animator in the lighting and modeling departments at PDI/DreamWorks on *Antz* and *Shrek*. He created digital visual effects for such films as *Mortal Kombat* while at Buena Vista Visual Effects at Walt Disney Studios. He is the author of *Advanced Maya Texturing and Lighting* (Sybex, 2006) and *Professional Digital Compositing* (Sybex, 2009). You can view his work at www.BeezleBugBit.com.

Beau Janzen is a faculty member at the Art Institute of California, Los Angeles, where he teaches digital animation and mathematics. His production credits include *X-Men*, *X-Men: The Last Stand*, and *Speed Racer*. He has worked with

Autodesk Maya since its inception, serving as a beta tester on the first pre-release of the software. Beau has written and produced award-winning instructional films for such clients as NASA, General Motors, WGBH Boston, and Annenberg/Corporation for Public Broadcasting (CPB) in addition to creating work for his own company, Zipheron Design Labs (www.zipheron.com).

Anthony Honn created the vehicle models used in the example scenes throughout this book. Anthony originally trained in industrial design and architecture. After graduating from the Art Center College of Design, a series of fateful events resulted in a career in the film and design industries. His clients have included multiple recording artists such as Janet Jackson, as well as lifestyle brands such as Nike. Arguably, the industrial designer still lurks beneath, with his continued passion for robotics, automobiles, and furniture. For more of Anthony's work, visit www.anthonyhonn.com.

Introduction

Autodesk Maya 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 Autodesk Maya. Mastering Autodesk Maya takes years of study and practice. I have been using Autodesk Maya almost every day since 1999, and I'm still constantly faced with new challenges and making new discoveries.

This book is meant to be a guide to help you not only understand Autodesk Maya but also understand how to learn about Autodesk Maya. The title *Mastering Maya* 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 Autodesk Maya interface, use the Autodesk Maya documentation that comes with the software instead. This book is not a description of Autodesk Maya; it is an explanation illustrated with practical examples.

The skills you acquire through the examples in this book should prepare you for using Autodesk 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. 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 Autodesk Maya help files. The authors of this book will not be insulted! The Autodesk 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 Autodesk Maya menu interface. The documentation consists of a large library of Autodesk Maya resources, which will appear in your default web browser when you access the help files. Experienced Autodesk Maya artists never hesitate to use the help files to find out more information about the software; there is no shame in asking questions!

Who Should Buy This Book

This book is written for intermediate Autodesk Maya users and users who are advanced in some aspects of Autodesk Maya and want to learn more about other aspects. The book is intended to be used by artists who are familiar with Autodesk Maya and the Autodesk Maya interface or who have significant experience using similar 3D packages. If you have used older versions of Autodesk Maya, this book will help you catch up on the newer features in Autodesk Maya 2012.

If you have never used Autodesk 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 2012* by Dariush Derakhshani (Sybex, 2011) or to read through the tutorials in the Maya documentation before attempting this book.

You should be familiar with these principles before reading this book:

- The Autodesk 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 Autodesk 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 Autodesk Maya lights and the Autodesk 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

Here is a description of the chapters in this book. The lessons in each chapter are accompanied by example scenes from the companion DVD.

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. This chapter was written by Eric Keller, author of *Introducing ZBrush 4* (Sybex, 2011).

Chapter 2: Virtual Filmmaking with Autodesk Maya Cameras This chapter provides an in-depth discussion of the Autodesk Maya virtual camera and its attributes. A number of exercises provide examples of standard and custom camera rigs. Stereo 3D cameras are also introduced. This chapter was also written by Eric Keller.

Chapter 3: Modeling I This chapter introduces the various types of surfaces you can model with. It walks you through numerous approaches for modeling parts of a helmet for a space suit 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 Autodesk 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, inverse kinematics, smooth binding, and proper rigging techniques. Autodesk 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 shader are all demonstrated. This chapter was written by Lee Lanier.

Chapter 10: mental ray Shading Techniques This chapter describes commonly used mental ray shaders and how they can be used 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 discussed. This chapter was also written by Lee Lanier.

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 well as 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. This chapter was written by Beau Janzen.

Chapter 13: Introducing nParticles This chapter provides numerous examples of how to use nParticles. In this chapter, 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 Hair, and nCloth. Using dynamic curves to create a rig for an armored tail is also demonstrated.

Chapter 16: Autodesk 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.

Appendix A: The Bottom Line This appendix contains all of the solutions from the Master It suggestions at the end of each chapter.

Appendix B: Autodesk Maya 2012 Certification This appendix contains the certification objectives to obtain an Autodesk certification in Maya.

Appendix C: About Companion DVD This appendix lists the contents of the DVD.

Companion DVD

The companion DVD is home to all the demo files, samples, two bonus chapters on MEL scripting and toon shading, as well as the bonus resources mentioned in the book. See Appendix C for more details on the contents of the DVD and how to access them.

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 he has worked on.

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/masteringmaya2012, where we'll post additional content and updates that supplement this book should the need arise.

Chapter 1

Working in Autodesk Maya

Maya's 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 easily allow you to bring your fantastic creations to life. Maya's interface is made up of four views: the perspective, front, side, and top. Each camera can be customized. Additional cameras can also be created. In each camera view or viewport is a viewing cube located in the upper right corner. The cube allows you to quickly set the current camera to a specific view by clicking on a highlighted area of the cube.

Understanding the way Maya organizes data about the objects, animation, 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. Maya's 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 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.

If you've never used Maya before, we strongly encourage you to read the Maya documentation as well as *Introducing Maya 2012* by Dariush Derakhshani (Sybex, 2011). This chapter is about working with nodes, but it is not meant to be a comprehensive guide to each and every control within Maya. That information is contained within the Maya documentation.

In this chapter, you will learn to:

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

Creating and Editing Maya Nodes

A Maya *scene* is a system of interconnected nodes that are packets of data. The data within a node tells the software about what exists within the world of a Maya scene. The nodes are the building blocks 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 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, 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 Dependency Graph (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.

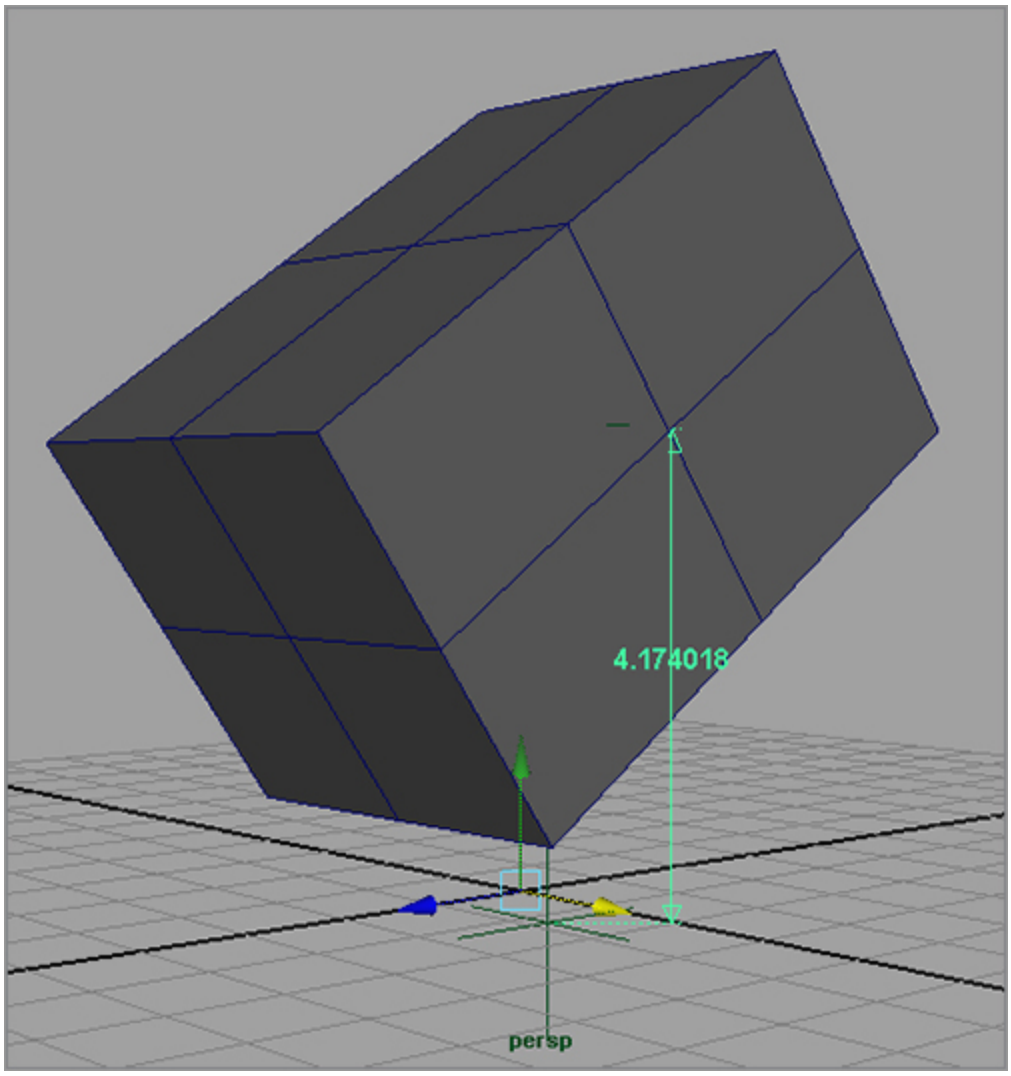
A special type of DG node is the directed acyclic graph (DAG) node. These nodes are made of two specific types of connected nodes: transform and shape. The arrangement of DAG nodes consists of a hierarchy in which the shape node is a child of the transform node. Most of the objects you work with in the 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*. Transform nodes retain translation, rotation, and scale information. Often it is necessary to freeze a node's transforms. Freezing transformations sets the translation and rotation values to zero and scale values to 1.0 without altering the position of the node. Doing this allows you to add animation and mathematical expressions

to zeroed values instead of complex numbers. In addition, freezing the transforms on a node that is a child of another node, forces the child to adopt the transforms of the parent.

The simple polygon cube in Figure 1-1 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 (see Figure 1-1).

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.



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 picture of the nodes and their connections in Maya. A complex scene can look like a very 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.

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.

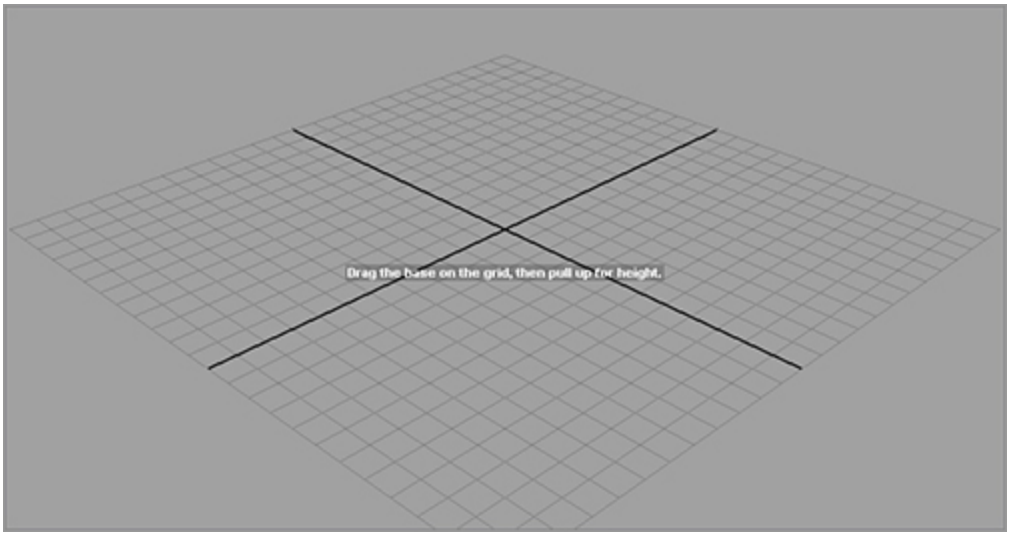
This short exercise gives you a sense of how you would typically use the Hypergraph:

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