digital
MODELING

WILLIAM VAUGHAN
Praise for [digital] Modeling

“This book does a great job of covering the many aspects of digital modeling. William explains everything in detail with full-color references and pictures. What I found most useful was his explanations for why he performed specific modeling tasks. This is the first book that I have read on 3D modeling that isn’t just a rehash of what I can find in a software manual. I’d highly recommend this book to not only modelers, but also anyone looking to improve their understanding of production pipelines.”
—Brian Arndt, BioWare

“William’s skill as a 3d modeler is legendary. His passion for teaching and abilities are just as well known. The combination of his knowledge of the art of modeling, and his clear and patient style of teaching make this book a “must have” for anyone, regardless of their current skill level.”
—Jack “Deuce” Bennett II, owner, Creative Imagineering, Inc.

“William is an amazing teacher and one of the best designer/modelers I have ever met. His digital modeling book is just another in a long list of gifts from the master.”
—Nicholas Boughen, owner, CG-Masters.com

“In his trademark natural writing style, William concisely explains not only how to model but also how to think and solve problems like a professional. This book is an absolute must-have for those who wish to get a solid understanding of the digital modeling process.”
—Alan Chan, Digital Domain

“You’d be hard pressed to find a more talented or prolific artist in the industry today. William is one of a truly rare breed: someone who can both do the work and teach it to others. His methods have shaped my own practices in countless ways. I’ve learned a great deal from William, and so will you!”
—Jarrod Davis, Emmy Award–winning VFX artist

“Think of this book as THE BIBLE—not just for digital modeling but for applying a fun, professional attitude towards a career in the digital arts. I don’t think you can get a clearer picture of what is expected of a digital artist in a production environment than what is shared in this glorious tome. But don’t just take my word for it... really, you should stop reading my quote and get to page one already.”
—David A. Maldonado, Deluxe Digital
“With his industry insights, thorough explanations and relevant examples, William’s new book, *digital* Modeling, is required reading not only for those new to the industry but veterans who’ve come to rely on just a small subset of available tools and techniques as well.”
—Chris O’Riley, V | 4 Digital

“William Vaughan is not teaching techniques as much as he is teaching the necessary mindset one must have for success as a digital modeler. Having been a student of William’s, in my opinion this book is the best learning experience possible aside from sitting in on one of his classes. From the very first page it is clear that his experience and passion for his craft are the driving forces behind this amazing book.”
—Kurt Smith, Pixomondo

“William Vaughan has the rare ability to share his in-depth knowledge of 3D modeling and the CG industry with others in an easy to digest way. He has trained hundreds of artists working in the industry and has influenced the way I approach modeling. This book is a must-read for anyone interested in creating digital models.”
—Ron Thornton, award-winning VFX/CG Leader and recognized industry pioneer

“I’ve had the privilege of working with William for over a decade at many training events. His ability to explain difficult concepts in a simple, precise manner regarding the concepts of 3D modeling and animation is rare and exceptional. His insight and explanation of methodology to me over the years has been invaluable, and this modeling guide pulls it all into one amazing resource.”
—Graham Toms, 3D educational specialist, NewTek

“Truly William Vaughan has a passion for teaching and shares that passion within the pages of this book. He is one of the best teachers I have had and I’m excited that he’s able to share his modeling knowledge outside the boundaries of a single classroom.”
—April Warren, Digital Domain
Image Credits

Figure 1.1a used courtesy of Chris Patchell. All rights reserved.
Figures 1.2a, 9.6, and 15.11 used courtesy of Joe Zeff Design at Splashlight. All rights reserved.
Figures 1.2b, 1.2d, 2.9, and Chapter 5 opening spread image used courtesy of Worldwide Biggies. All rights reserved.
Figures 1.3 and 15.5a–b used courtesy of Bruce Branit. All rights reserved.
Figures 2.1 and 2.21 used courtesy of Inhance Digital. Photo by Johan Lefkowitz. All rights reserved.
Figure 2.4a used courtesy of Alan Chan. Photo by Dan Katzenberger. All rights reserved.
Figures 2.4b–c used courtesy of Alan Chan. All rights reserved.
Figure 2.6b used courtesy of Rocco Tartamella. All rights reserved.
Figures 2.7 and 2.8 used courtesy of Kory Heinzen. All rights reserved.
Figures 2.13 and 2.23a–c used courtesy of Sound-o-Rama. All rights reserved.
Figure 2.24 used courtesy of Jay Schneider. All rights reserved.
Figures 2.25a–b used courtesy of Rob Powers. All rights reserved.
Figures 3.1, 3.2, 3.3a, 3.5, 3.6, 3.7, 3.10, 3.12, 3.15a–b, Chapter 4 opening spread image, 7.1, and Chapter 11 opening spread image used courtesy of Chris O'Riley. All rights reserved.
Figure 3.11 used courtesy of Graham Toms. All rights reserved.
Figures 4.16, 4.17, 5.15, 5.16, 5.18, 7.31, 15.7 used courtesy of FunGoPlay. All rights reserved.
Figures 5.4 and 5.11 used courtesy of Deuce Bennett. All rights reserved.
Figures 5.5, 10.1a–f, 15.3a–b used courtesy of Pixar. All rights reserved.
Figures 5.7, 5.9, Chapter 12 and 13 images used courtesy of Glen Southern. All rights reserved.
Figure 5.8 used courtesy of Lewis. All rights reserved.
Figure 5.10 used courtesy of Jon-Troy Nickel. All rights reserved.
Figures 5.12a–b used courtesy of Steve Varner. All rights reserved.
Figure 5.13 used courtesy of Elmar Moelzer. All rights reserved.
Figure 9.2 used courtesy of April Warren. All rights reserved.
Figure 15.1 used courtesy of Erik Gamache. All rights reserved.
Figures 15.2a–b used courtesy of Blind Spot Pictures and Energia Productions. All rights reserved.
Figures 15.4a–b used courtesy of The Foundation TV Productions Limited/Decode/Blue Entertainment. All rights reserved.
Figure 15.6 used courtesy of Baj Singh. All rights reserved.
Figures 15.8a–b used courtesy of Marv Riley. All rights reserved.
Figures 15.9a–b used courtesy of Sylvain Saintpère. All rights reserved.
Many people have come in and out of my life over the years, and have helped to shape me into the artist I am today, but one stands out over the rest. Von Kwallek, one of my high school art instructors, instilled in me the importance of problem solving, which has carried me through my entire career. My teaching style can be directly attributed to Kwallek’s passion for education and his unbelievable ability to share his knowledge.

Thank you, Thank you, Thank you.
Author Acknowledgments

I need to start by thanking my long-time, good friend, Deuce Bennett. Deuce recommended to Peachpit that I write this book and then graciously came on board to handle the technical editing. He also made himself available for countless conversations during the creation of the book, offering his vast knowledge of 3D. Deuce has always been quick to offer assistance in anything I’ve reached out to him for and has been a great friend for many years. I can’t think of a better person to have had on board for the production of this book.

Along with Deuce’s help, many other industry professionals and friends played a role in the development of this book, offering insights and sharing their expertise in the field. I’d like to thank all of them for their contributions. Some of the artists that played a role include:


I’d like to thank Karyn Johnson and the entire team at New Riders for the opportunity to create this book and for their support in its creation. Special thanks to Corbin Collins for his attention to detail, guidance, and countless hours devoted to this project. I’m without a doubt a better writer thanks to Corbin’s shared expertise.
Images play a major role in this book, and I’d like to thank the following for either contributing images they created or worked on, and/or images they allowed me to use that I produced for/with them:


Although they’ve been thanked already, I’d like to give David Maldonado special recognition for his pep talks, unwavering support, and advice during the creation of this book—and Glen Southern for his guidance and contributions to the digital sculpting sections of the book.

I’d also like to thank my business partners at Applehead Factory, Joe DiDomenico and Phil Nannay, for supporting this book and for their friendship over the years.

I’d like to thank my wife Addie and dog Jack for waiting patiently over the two months it took to write the book and for understanding my absence and allowing me to work.

And last but certainly not least, I’d like to thank you, the reader, for your interest in this book. I hope it aids you in the creation of countless digital models.
About the Author

Originally from Texas, now happily residing in Philadelphia with his wife Addie and dog Jack, William Vaughan’s CG work can be seen in all forms of media over the past 20 years. He’s worked on projects ranging from children’s books to toys, video games, broadcast, and film, and for clients like Rolling Stone magazine, Hasbro Toys, and Pixar Animation Studios.

William has always had a passion for creating as well as teaching. For over six years, he played a major role in the evolution of the industry-leading software, LightWave 3D. While working for NewTek as its LightWave Evangelist, he helped write the manual and provided the training for CGI artists all over the world, authoring more than 300 tutorials and instructional videos. His online tutorials are required reading for anyone interested in learning 3D. William has been published by every major CGI magazine and has contributed to 17 books. However, his writing is not limited to tutorials and case studies. He has also written and directed several award-winning animated short films, such as Batman: New Times, X-Men: Dark Tide, and the Tofu the Vegan Zombie animated short, Zombie Dearest.

For several years, William was the Director of Industry Relations and Head of Curriculum at the Digital Animation and Visual Effects School at Universal Studios in Orlando, Florida. He has personally trained hundreds of students to become professional animators at major studios, such as Rhythm and Hues, Digital Domain, Weta Digital, Monolith, and EA Sports. Among his prized pupils are the art department at NASA’s Johnson Space Center and actor Dick Van Dyke.

After spending two years in New York creating content for Nickelodeon, SyFy, Spike TV, and others, William recently moved to focus on his Philly-based toy company, Applehead Factory. As co-owner and Creative Director, he works with his business partners Joe DiDomenico and Phil Nannay on building brands and creating memorable characters.
About the Technical Reviewer

Jack “Deuce” Bennett II is a freelance CGI artist whose background is in physical special effects for motion pictures and television. Deuce has been working in the film industry his entire life and has such movies as *Robocop*, *Lonesome Dove*, and *Jimmy Neutron: Boy Genius* to his credit, as well as TV shows such as *Walker, Texas Ranger*. Deuce has been using computers since he was nine, and he started off writing his own graphic programs. He is a unique combination of physical knowledge and virtual know-how.
Table of Contents

Foreword xx

Chapter One   Introduction  2
   What Is Digital Modeling?  4
   Who Can Become a Professional Digital Modeler?  5
   Who Should Read This Book?  7
   What Can You Expect from This Book?  8
   What You Should Know  9
   What You Will Need  10
      RAM  10
      CPU Speed and Number of Cores  10
      Graphics Card and GPU  11
      Two Monitors  11
   About This Book’s Approach to Software  13
   Software Requirements  14
      3D Software  14
      2D software  15
   What’s on the Disc  15
   A Final Word: Change Your Thinking  16

Chapter Two   Understanding a Modeler’s Role  20
   Production Pipelines: Stages of Production  22
   Stage 1: Pre-production  25
      Story  25
      Visual Design  28
      Storyboard  33
   Audio: Scratch Voice Recording  35
   Animatics  37
   Audio: Voice Recording  39
Stage 2: Production 40
   Modeling 40
   Rigging 43
   Scene Setup 45
   Texturing 48
   Animation 50
   Effects 53
   Lighting 56
   Rendering 59
Stage 3: Post-production 61
   Compositing 61
   Audio 64
   Final Edit and Delivery 67
Evolution of Production Pipelines 68
   Virtual Art Department (VAD) 69
   Stereo Department 72

Chapter Three  Preparing for Modeling 76
   Tools of a Digital Modeler 78
      Reference 78
      Observation 81
      Problem Solving 82
   Gathering Reference Material 84
      Physical Reference 84
      Digital Camera 85
      Tape Measure 86
      Sketchbook 87
      Digital Reference 89
      Printed Reference 89
      Movie Reference 90
   Note on Copyrighted Material 91
   References to Avoid 91
Preparing Reference Material 96
- Scan or Transfer 96
- Adjust Color and Levels 96
- Rotate, Size, and Crop 97
- Composite 98
- Rename and Organize 99

**Chapter Four**  **Fundamentals of a Digital Model**  100
- A Model’s Anatomy 102
  - Points 102
  - Vertex Maps 103
  - Edges 107
  - Polygonal Models 108
  - NURBS 109
  - Subdivision Surfaces 112
- Model Classification: Hard Surface and Organic 113
  - Production Driven 113
  - Attribute Driven 114
  - Construction Driven 114
  - Model Classification Evaluation 114
- Model Styles 117
  - Photo-real 118
  - Stylized 118
  - Choosing a Style 118

**Chapter Five**  **Digital Modeling Methods**  120
- Build Out 122
  - Point by Point 123
  - Edge Extend 123
- Primitive Modeling 124
- Box Modeling 126
- Patch Modeling 127
- Digital Sculpting 128
- 3D Scanning 131
<table>
<thead>
<tr>
<th>Chapter Six</th>
<th>Professional Modeling Practices</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naming Conventions and Directory Structure</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Content Directory</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Naming Conventions</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>Don’t Agonize, Organize</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>Clean Modeling</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>Polygon-count</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>Topology</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>Preparing a Model for Production</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>General Production Preparation</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>Texturing Preparation</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Rigging Preparation</td>
<td>162</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter Seven</th>
<th>Polygonal Modeling</th>
<th>166</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling 3D Polygonal Text</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>Vector and Raster Images</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>Getting Started</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Creating the 2D Base Mesh</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>From 2D to 3D</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Micro-bevels, Chamfers, and Fillets</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Clean Up</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>Modeling a 3D Polygonal Object with Seams</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Getting Started</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>House Cleaning</td>
<td>185</td>
<td></td>
</tr>
<tr>
<td>Layout Foundations</td>
<td>186</td>
<td></td>
</tr>
<tr>
<td>Final Stages</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>Gooool!!!</td>
<td>195</td>
<td></td>
</tr>
</tbody>
</table>
Chapter Eight  Subdivision Surface Modeling  196
  Modeling 3D Text with SubDs  198
    Getting Started  198
    Adding Support Edges  199
    Patching in Polygons  201
    Adding Depth  203
    Adding Detail  204
  Modeling a SubD Object  205
    Reference  205
    Getting Started  206
    Creating the Metal Spring  209

Chapter Nine  Modeling a Realistic Head  212
  Choosing a Method: Edge Extend vs. Box Modeling  214
  Using Reference  216
    Preparing the Background Templates  217
    Taking Advantage of Symmetry  218
  Modeling the Head’s Components  219
    Eyes  219
    Nose  225
    Laugh Line  228
    Mouth  228
    Jawline  231
    Ears  232
    Finishing Off the Head  234

Chapter Ten  Modeling a Stylized Character  238
  Box Modeling a Character Mesh  240
  Getting Started  242
  Detailing the Face  247
  Building the Body  253
  Give ’em a Hand  256
  Final Character Review  262
## Chapter Eleven  Product Modeling for Print Graphics  264

- Building a Better Product  266
- Reference: CAD Geometry, Photos, and Blueprints  268
- Getting Started: Creating Splines  270
- Spline Patching  272
- Final Details  278

## Chapter Twelve  Digital Sculpting  280

- Digital Sculpting with Glen Southern  282
- Creating a Digital Creature Maquette  284
  - Sculpting Legs  286
  - Sculpting Arms  288
  - Sculpting the Head  289
- Second Pass over the Sculpt  292
- Detailing  294

## Chapter Thirteen  Game Modeling  298

- Next-Gen Game Modeling with Glen Southern  300
- Creating the Creature Sculpt  300
- Performing Retopology to Create the Game Model  305
- Creating UVs for the Low-Poly Model  314
- Generating Maps for the Low-Poly Model  315
  - Color Map  315
  - Bump Map  317
  - Normal Map  318

## Chapter Fourteen  3D Printing of Digital Models  320

- 3D Printing Overview  322
- 3D Printing Applications  328
- Preparing a Digital Model for 3D Printing  329
  - Using Closed Meshes  329
  - Avoiding Texture or Displacement Maps  330
- Getting the Right File Format  331
- Guidelines for 3D Printing  332
- From 3D Printing to Manufactured Toy  334
Chapter Fifteen  Getting a Job in Digital Modeling  342

Overview of the Industry and Markets  344
  Film  344
  Television  350
  Games  353
  Visualization  356
  Print Graphics  360
Demo Reels  361
  Demo Reel Case and Sleeve  361
  Demo Reel Content  365
  Demo Reel Length  368
  Demo Reel Audio  368
  Demo Reel DVD Burning and Labeling  369
Personal Site  370
The Seven Deadly Job Search Sins  374
  Sin #1: Homesickness  374
  Sin #2: Greed  375
  Sin #3: Inflexibility  376
  Sin #4: Putting All Your Eggs in One Basket  377
  Sin #5: Sloppiness  378
  Sin #6: Playing Hard to Get  378
  Sin #7: Sloth  379
  Get a Job!  380
Staying Current  380
  Skill Set  380
  Software  381
Networking: Online Communities  382
  Staying on Top of Industry Trends and News  384
  Reel and Resume  385
Health  386
Advancing in Your Career  387

Final Thoughts  390

Index  395
Foreword

Several years ago, while I was trying to finish my first book, exhausted, demoralized, and with a deadline looming, my publisher told me I needed some sort of CG expert—some well-known public figure—to read a draft and write a foreword for my book. I told him I didn’t know anyone who matched the description, because back in those days I was just a struggling artist and had met only a handful of others who pursued computer animation as a career. You have to remember, there just weren’t that many of us in those days. “I have just the person,” he said. “Proton.”

“What’s a Proton, other than a positively charged subatomic particle?” I asked.

“Exactly,” he replied.

I was pretty puzzled at the time, but I soon came to learn exactly what he meant.

“Positively charged.” That’s the key. William Vaughan is one of those people who is able to discover the amazing in anything that possesses it and who has no compunction about sharing those discoveries with the world. If something is awesome, he lets everyone know about it. So when I received his feedback from the first draft, it was so positive and filled with such excitement that it gave me the energy I needed to finish the book and get it out there. That was very early in my career, and the success of that book is reflected in nearly everything I do professionally today.

Now here we are many years later, and I am faced with the privilege and problem of writing this foreword for William. My immediate urge is to write, without regard for the contents of the book, a glowing review so that I can repay William for his enthusiasm and advice over the years. But I don’t need to do that because the book stands on its own, without my platitudes. William is an artist of immense integrity, which means that he puts the best of himself into everything he does.
Over the years, I have seen so many artists, hundreds certainly, perhaps thou-
sands, benefit from the influence of this man’s work, and I know this book is
simply another expression of William’s love for the art—just another way he
can share his passion with the world, just another in a long list of gifts to us.

So why should you read this book? Because passion drives excellence and
because William is one of the most passionate artists I have ever known, so
I know with certainty that he brings all his excellence to it. Why on earth
would anyone not want to read that?

Nicholas Boughen
VFX Supervisor
Owner CG-Masters.com
Before we go too far down the rabbit hole, I want to introduce some of the elements of digital models and the terms you'll encounter throughout the book. If you have some experience already, you may be inclined to skip this section, but I recommend you at least skim through it just to make sure we're on the same page. You can think of this chapter as a refresher course of 3D models 101.
Fundamentals of a Digital Model

Before we go too far down the rabbit hole, I want to introduce some of the elements of digital models and the terms you’ll encounter throughout the book. If you have some experience already, you may be inclined to skip this section, but I recommend you at least skim through it just to make sure we’re on the same page. You can think of this chapter as a refresher course of 3D models 101.
A Model’s Anatomy

Digital models can be broken down into three types:

- Polygonal models are made up of a collection of points, edges, and polygons.
- NURBS surfaces consist of a network of curves with smooth surfaces between them.
- Subdivision surfaces are similar to polygonal models because they are made up of points, edges, and polygons but also share some of the benefits of NURBS surfaces, placing them into their own category.

In this section I explain some of the terminology used in the creation of all three types of digital models.

Points

A point, also called a vertex (plural: vertices), is the lowest-level component that makes up a 3D model. Each point exists in 3D space with a specific X, Y, and Z coordinate. Because points alone do not have height, width, or depth, they cannot be rendered.

When two points are connected, a line is drawn. When three points are connected, they can become corners of surfaces on a model called a polygon. Without points, there would be no polygons. A triangle, for example, consists of three points and one polygon, as shown in Figure 4.1.

[Figure 4.1] The three points (shown here in pink) define the shape of the triangle and its placement in 3D space.
Multiple polygons can share the same points when used on a contiguous (seamless) mesh. The tessellated sphere in Figure 4.2 shows individual points being used to define the multiple polygons that make up the object.

**Vertex Maps**

Every point in an object stores information about its position and rotation, although you normally don’t access the rotational values of an individual point. Points also have the ability to store a variety of additional information using vertex maps. Simply put, a vertex map is information saved to a point.

The most common types of vertex maps include:

- Texture (UV)
- Weight
- Morph
- Color
- Selection
Texture (UV)

Texture, or UV, maps store texture placement information and are the most common vertex map. UV mapping adds two extra coordinates to the points in your object; those on the U (horizontal) and V (vertical) axes, running horizontally and vertically through the flat plane of the texture map, on which you can paint your texture. UV coordinates are a 2D representation of 3D space. They set up a relationship between a two-dimensional image and the three-dimensional surface the image will be applied to.

Points can have as many UV maps assigned to them as you’d like. Figure 4.3 shows three UV maps that were created for the Spiderbait character that you can download from my site at www.pushingpoints.com/2011/07/spiderbait-rig.
Weight

*Weight maps* store a single value, usually between -100 and 100 (although in some instances lower and higher values are possible). The most common use of a weight map is for defining a bone’s influence on a point when *rigging* (placing bones and controls to allow a model to be deformed for animation). *Figure 4.4* shows positive weight values applied to the points that make up the character’s jaw. When the weight map is assigned to the jaw bone, the points will move when the bone moves. This allows for seamless organic meshes to deform in localized areas.

*Figure 4.4*  Weight values assigned to points in the mesh (top) can be assigned to a specific bone (bottom) during the rigging process.
There are far more uses for weight maps than rigging. For example, you can use weights to mask a surface when texturing, influence dynamic simulations over an object, aid during the modeling process, and do much more.

**Morph**

*Morph maps* store offset information (alternate XYZ values) for a point’s position and are commonly used for creating morph targets for animation. **Figure 4.5** shows several morphs applied to the base mesh. Each morph relies on multiple points being moved to new coordinates, and that information is saved to each vertex.

![Figure 4.5](image1.png)

Morph maps are commonly used to create facial poses for animation.

Similar to weight maps, morph maps have a variety of uses during the modeling and texturing processes.

**Color**

*Color maps* hold values for Red, Green, Blue, and Alpha (RGBA) color information. I often use color maps on my character models to add color variation to the object’s surfaces, like adding blush to a character’s face. **Figure 4.6** shows an example of using a color map to add a five o’clock shadow and some color to a character’s face.

![Figure 4.6](image2.png)

A color map was applied to the character’s face (right) to give the appearance of a five o’clock shadow.
Selection

A selection map, also referred to as a selection set, stores a single state of a point—either selected or unselected. Selection maps allow a modeler to recall a selected group of points quickly and can be extremely useful for defining which points will be affected by dynamic simulations.

Edges

An edge is a one-dimensional line that connects two points in a polygon. Another way to describe edges would be to say that they are the line segments that border a polygon. A triangle, for example, has three edges, three points, and one polygon, as shown in Figure 4.7.

Similar to points, multiple polygons can share the same edges when used on a contiguous mesh. The tessellated sphere in Figure 4.8 shows individual edges bordering the multiple polygons.

[Figure 4.7] The polygon in this image consists of three edges, shown here in pink.

[Figure 4.8] Each polygon shares common edges in this mesh.

Edge weights

Edge weighting increases or decreases the sharpness of an edge between two subdivision surface (SubDs) polygons, allowing for harder or softer corners without additional geometry being added (Figure 4.9). The main issue with edge weights is that there is no universal, widely supported format that allows you to transfer edge weights from one 3D application to another. In today's
mixed software pipeline, this can be a showstopper. Most modelers I know avoid edge weighting and opt for additional geometry to accomplish the same end goal.

[Figure 4.9] Edge weighting has been increased to 100 percent to the four edges on the top of the SubD object on the left to produce harder edges.

Polygonal Models

Polygons, often shortened to polys and commonly referred to as faces, are geometric shapes consisting of a number of points that define the surface of a 3D object. A polygon is what you actually see in a render, and a typical 3D model will consist of hundreds or thousands of polygons (Figure 4.10).

[Figure 4.10] This head mesh consists of over 6000 polygons.
Although some 3D applications allow the creation of one- and two-point polygons, it’s more common that a polygon be made up of at least three points. Three-point polygons are commonly called triangles or tris. Polygons made up of four points are called quads, and a polygon that has more than four points is usually referred to as an n-gon. The term n-gon means a polygon with n sides, where n is the number of the polygon’s sides. For example, a polygon with six sides is a 6-gon. Examples of a triangle, a quad, and an n-gon are shown in Figure 4.11.

![Figure 4.11] Polygons come in all shapes and sizes. The triangle (left) consists of three points, the quad (middle) is made up of four points, and the n-gon (right) is made up of 24 points.

**NURBS**

A *Non-Uniform Rational B-Splines (NURBS)* surface is a smooth mesh defined by a series of connected splines, which are polynomial curves. This smooth surface is converted to polygons at render time, so NURBS surfaces can contain an arbitrary number of polygons. NURBS can be converted to polygons or subdivision surfaces and are useful for constructing many types of organic 3D forms because of the minimal nature of their curves. NURBS geometry is smooth by default and doesn’t need to be subdivided to “become” smooth like polygon geometry does.

*Non-Uniform* refers to the parameterization (defining the parameters) of the curve. Non-Uniform curves allow, among other things, the presence of multi-knots (a sequence of values that determines how much and where the control points influence the shape), which are needed to represent Bézier curves.
Rational refers to the underlying mathematical representation. This property allows NURBS to represent exact conics (such as parabolic curves, circles, and ellipses) in addition to free-form curves.

B-splines are piecewise (a function that changes) polynomial curves (splines) that have a parametric representation. Simply put, a B-spline is based on four local functions or control points that lie outside the curve itself.

The best way to understand NURBS is to see them in action. Figure 4.12 shows multiple examples of the splines that define the NURBS surfaces.

[Figure 4.12] Each of these three NURBS surfaces are defined by a series of splines, shown to the left of each object.
NURBS are most commonly used in computer-aided design (CAD), manufacturing, and engineering. Although they were once used heavily for organic objects (see the forthcoming section “Model Classification: Hard Surface and Organic”) in the film and broadcast markets, subdivision surfaces have since replaced them in almost all instances in movies and television.

**Splines**

A *spline* is a curve in 3D space defined by at least two points. The most common spline used in digital modeling is the Bézier curve. Bézier curves are used to model smooth curves using far fewer points than a polygonal model would require. *Control points* make up the curve and can be used to dramatically manipulate the curve with little effort. Also, splines are resolution independent, unlike a polygonal mesh, which can appear faceted when you zoom in close enough to a curved surface.

Splines in 3D applications can be likened to vector curves in software such as Illustrator, Flash, and Photoshop. Splines are similar to NURBS in that they can create a “patch” of polygons that extends between multiple splines, forming a 3D skin around the shape ([Figure 4.13](#)), a feature which is extremely useful when modeling. Unlike NURBS, the splines must be converted to polygons before rendering.

Splines are also useful in many other modeling techniques, including but not limited to, *extrusion* (adding depth to a flat surface) and *cloning* (duplicating) along a spline and deforming a mesh based on the curves of a spline.

![Figure 4.13](#) The four splines on the left were used to patch the polygonal mesh on the right.
Subdivision Surfaces

*Subdivision surface (SubD)* is a refinement algorithm that creates a smooth curved surface from a coarse *polygonal mesh* (also called a *base mesh*). This process takes the base mesh and creates a smooth surface using the original vertices as control points, also referred to as the control cage. Figure 4.14 shows the polygonal mesh (left), the control cage (middle), and the resulting SubD mesh (right).

![Figure 4.14](image1.png)

Subdivision surfaces allow you to work with a very light and simple polygonal mesh to create smooth organic shapes.

The number of polygons, or subdivisions, generated from SubDs can be adjusted to a varying level of density, and complex smooth objects can be created in a fast and predictable way from simple base meshes, as shown in the character model in Figure 4.15. This makes SubDs a popular option for most digital modelers.

![Figure 4.15](image2.png)

[Figure 4.15] This character was created with a very simple polygonal mesh (left). But with SubDs applied (middle), a smooth, high-poly mesh was generated (right).
Model Classification: Hard Surface and Organic

When 3D was still in its infancy, digital modelers were usually put into one of two distinct groups based on the type of meshes they constructed. Although the lines have become blurred, these groups still exist today and play a role in how modelers define themselves in the industry. Also, the distinction of the types of meshes a modeler creates makes it easier for studios looking for talent to find the right digital modeler for their specific modeling needs.

Every 3D mesh can be grouped or classified as either a hard surface or organic. What’s the difference? What defines an object as hard surface? What defines an object as organic? So many objects nowadays seem to blur the lines between the two. How would you make a distinction between these classifications?

What may come as a surprise is that if you ask 20 professional digital modelers what the difference between these two classifications is, you’ll receive 20 different responses. I did just that before writing this section of the book and was quite surprised at some of what I heard.

How can something so seemingly clear-cut bring about so many different ways to classify a 3D model? Before coming to a conclusion, let’s explore the most common responses.

Production Driven

Many artists felt that a model would be classified by how it would be used in a production. A static object, such as a stone statue, gas pump, or street sign, would be considered a hard surface object, whereas objects that would deform or animate, such as an animated human character, flag, or animal would fall into the organic category.

The same item could be classified two different ways depending on what the object is called to do for the shot/project. A statue is made of stone and doesn’t usually deform; therefore, it is a hard surface object. But if it becomes a moving statue, as in the world of Harry Potter, it is organic.

Although a gun has moving parts that can be animated, it is still a rigid object, which makes it a hard surface object, unless of course, someone with
super human strength comes along and bends (deforms) the barrel—then it becomes organic.

If the mesh is going to deform in some way, it needs to be modeled differently and it should then be classified as an organic object.

**Attribute Driven**

Some believed that it was a model’s attributes, or what an object looks like, that defined whether it was hard surface or organic. So if the mesh had flowing “organic” curves where any shape could smoothly transform into any other, like a character, ornate piece of furniture, or a sleek sports car, it was an organic mesh.

Hard surface objects would be defined as meshes typically involving tight edges or simpler shapes joining together with distinct edges, even if the shapes were soft or sleek, like guns, power tools, and retro robots.

Also, if the object’s surface attributes were that of stone, metal, or glass, it would fall into the hard surface category, whereas objects made up of living tissue, like animals, plants, and people, would be considered organic.

**Construction Driven**

One artist defined the two by focusing solely on the modeling aspect. Objects that require a more “organized” topology could be classified as an organic mesh and easily created using “organic” modeling tools and techniques. He believed that organic meshes tend to have more polygons and could benefit from SubDs more than hard surface objects. Hard surface objects don’t require an organized, semi-regular topology and could be created with fewer polygons with less concern about the object’s underlying mesh.

**Model Classification Evaluation**

Although each of these schools of thought has valid arguments and may work for a particular artist, we simply can’t classify an object based on how it is constructed, will be used in production, or by its appearance. To do that would cause confusion, because every object could find its way into each category.
Take, for example, my dog Jack. He’s a chocolate lab, which is classified as being part of the *Canidae* family. For the most part, Jack acts like your average dog, wanting to eat, play, and sleep most of the time. He does, however, show attributes of a cat at times, and every now and then he will scratch at the ground after he urinates, like a cat pawing at its litter box. Although this is common in cats, it doesn’t make Jack part of the *Felidae* family.

Organic modeling goes beyond the fact that the shape of the model is rounded. Many hard surface objects have organic shapes, like cars, cell phones, and robots, whereas organic objects can have rigid shapes like rocks, insects, and crustaceans. Industrial design has moved more towards organic shapes over the years, and the entertainment industry is taking things that were traditionally hard surface, static objects and deforming them in animation—having gas pumps dance in commercials, for example.

Also, modeling something to perform well when animated is just good modeling technique and shouldn’t determine whether something is hard surface or organic. For example, look at a mesh sculpted in ZBrush, or modeling with metaballs or voxels. You can create something very organic, but these modeling techniques will make the model nonconducive to animating. Would that then be considered hard surface modeling? Of course not.

Most modelers don’t limit their tool and technique use based on whether a model is organic or hard surface. Generally, they use good modeling techniques, which include building a model that’ll hold up if deformed, even if it’s not intended to, and apply those same techniques regardless of whether the model is hard surface or organic.

You hear the terms *hard surface* and *organic modeling* all the time in the 3D modeling community, and artists are often defined as one or the other. If you make mostly characters meshes, you are an organic modeler. If you make more architectural or mechanical objects, you are a hard surface modeler. I usually describe myself as an organic character modeler, but it is simply not that straightforward, because I create products and vehicles that are defined as hard surface too.
So back to the point: What’s the difference between hard surface and organic models, and how do we define the two? I suppose, essentially, there is no difference at all, and it is a question of semantics. For the purposes of this book (and based on my personal philosophy), I use the following distinction: Characters, creatures, plant life, and more naturalistic environments are organic models, and architectural environments, vehicles, and mechanical products are hard surface. This is very loose as a definition, and as I’ve tried to emphasize, the lines between the two are indeed very blurred.

**Hard surface**

*Hard surface* objects are anything man-made or constructed. Architectural structures, vehicles, robots, and anything machined or manufactured could fall into this category. The robots from FunGoPlay’s *Grid Iron Gladiators* (www.fungoplay.com), shown in Figure 4.16, would fall into the hard surface category.

*Figure 4.16* Although these robots have smooth organic shapes, they still fall into the hard surface category.
Organic

Organic models are subjects that naturally exist in nature. This would include humans, animals, plants, trees, rocks, boulders, terrains, clouds, and even lightning bolts. The nonplayer characters that roam the world of FunGoPlay (Figure 4.17) would be considered organic models.

Model Styles

As with a model’s classification, a mesh usually has a specific style associated with it. A style refers to a specific philosophy, goal, or look. Realism, impressionism, abstract expressionism, and surrealism are common styles found in traditional art. Although a digital model could easily fall into any of the traditional art styles, the 3D industry usually places them into one of two different model styles: photo-real and stylized.
Photo-real
When a model depicts an object with realistic accuracy, the term *photo-real* is applied. Digital artists use photographic reference and their observation skills to transfer the realistic properties to the details that make up their models.

It’s important to understand that the subject matter is not required to be a real-world object, like a car, human, or architectural structure. Models of robots, dragons, and other fictional subjects can also be modeled in a photo-realistic style using real-world reference as a guide.

Stylized
When a digital model consists of artistic forms and conventions in a non-realistic style, it is referred to as a *stylized* model. Simply put, a stylized model is one that is not photo-real. Cartoon characters and environments are classic examples of stylized models.

The best stylized modelers I know still gather and use just as much real-world reference material as a photo-real modeler. The only difference is how they interpret it and apply that information to the model.

Choosing a Style
Although many artists would argue otherwise, I don’t find either style of modeling to be more difficult than the other. Both styles require the same attention to detail, and the same care needs to be put into the poly-count and topology of the mesh. At the end of the day, the only real difference between the two styles is where the points are arranged on the model, as shown in the head models in Figure 4.18.
Most artists gravitate towards a particular style. I prefer creating stylized models and creating meshes that have otherworldly proportions and attributes, but I also tackle photo-real models on a regular basis. My modeling toolset and techniques don’t change depending on the style of the mesh I’m tasked with. Digital modelers’ goals should be to hone their observational skills and to have the ability to work across styles.

Learning to work in both styles will only enhance your ability in the style of your choice and will open up more opportunities to you as a professional modeler.
Index

2D animatics, 37
2D base mesh, 170–174
2D paint programs, 9, 14, 15
2D software, 15
2D to 3D conversions, 72–73, 74, 174
3D animatics, 37
3D Artist, 385
3D Art to Part, 327
3D characters, 239–263
   and box modeling method, 240–241
   building body for, 253–256
   and clean geometry, 239
   creating head for, 242–246
   detailing face for, 247–253
   reviewing/changing, 262–263
3D-Coat, 282, 300
3D films, 344
3D gaming, 299–300. See also game modeling
3D graphics, 5
3D graphics programs, 9
3D illustration, 321
3D meshes, 4. See also 3D models; meshes
3D modeling. See also digital modeling
   applications, 9, 10
   hardware required for, 10–12
3D models. See also digital models
   for computer games, 299 (See also game modeling)
   creating, 4
   examples of, 6
   of human head, 213–237 (See also head model)
   reference materials for, 78–81
   sources of, 4
   of stylized character, 239–263 (See also 3D characters)
3D polygonal objects, 180–195
3D printers, 322–327, 338
3D printing, 321–341
   cost considerations, 327
   defined, 321
   file format considerations, 331
   guidelines, 332–334
   how it works, 322–327
   preparing digital model for, 329–334
   producing toys via, 334–341
   sealing considerations, 326–327
   service bureaus, 327, 331
   ways of using, 328–329
3D product visualization, 358–359
3D scanning, 131–133
3D.sk, 91
3ds Max, 14
3D software, 14
3D space, 72
3D text, 168–179, 198–204
3DTotal, 11, 383, 385
3D visualization, 356–359
3D World, 385
3-point polygons, 109, 156–157, 270, 278
4-point polygons, 156–157, 262

A
active scanners, 132
Adair, Dustin, 355
additive manufacturing, 322
ADG (Art Directors Guild), 69, 70
Adobe Photoshop
- and 2D paint/image manipulation, 15
- adjusting color/levels with, 96
- alternatives to, 15
- applying skin details with, 48
- mirroring images with, 218
- scaling/rotating images with, 217
- template tools, 371
- and texturing, 48

*Adventures of Tintin, The*, 70
Agency typeface, 198
alpha maps, 317
alphas, 283
anatomy, digital model, 102–112, 286, 302
anatomy reference, 85, 89
Android devices, 355
animated shorts
- production pipeline for, 24
- recording scratch track for, 36
- as testing ground for new artists, 348–349
- voice recording for, 39
animatics, 37–38
animation
- common departments for, 23
- importance of audio in, 64–67
- post-production stage, 61–75
- pre-production stage, 25–39
- production stage, 40–61
- and rigging process, 45, 53
animation director, 50
Animation Factory, 80
animation tools, 134–137
animators, 50, 52
API (Application Programming Interface), 11
Applehead Factory
- content directories, 143
- creating logo for, 168–179
reference collection, 89
storyboarding at, 34–35
toy manufacturing experience, 338, 341
Application Programming Interface (API), 11
architectural visualization, 357–358
armatures, 282–283
art department, virtual, 69–72
art directors, 28, 40
Art Directors Guild (ADG), 69, 70
attribute-driven models, 114
audio engineers, 64
audio recording
- scratch voice, 35–36
- voice, 39
Autodesk, 383
*Avatar*, 69, 70

B
Baker, Rick, 39
Barker, Clive, 39
base mesh, 112, 170–174
base pose, 45, 162–164
bases, model support, 333
*Battle for Terra*, 72, 74
*Battlestar Galactica*, 59, 63
beveled edges, 199, 222
Bézier curves, 109, 111, 172
binding agents, 322, 325, 326
Blair, Linda, 39
Blender, 14
blocking, 52
Blogger, 371
blueprints, 25, 33, 268–270
blurry images, 92–93
boat images, 92
bones, 135–136
bookstores, 89
bottle caps, 275–276
bottles, 266, 268–279
Boughen, Nicholas, 58
box modeling
  creating character models with, 126–127, 240–241
  creating head models with, 214–215
  first step in process, 126
  as Holy Grail of modeling, 122
  vs. edge extend method, 214–215
Branit, Bruce, 350
Branit|FX, 350, 352
Breaking Bad, 350
brushes, sculpting, 283–284. See also ZBrush
B-splines, 110
Bubble Guppies, 350
build out method, 122–124
bump maps, 180, 317
business cards, 87

C
CAD (computer-aided design), 111, 128, 268
cameras, 85–86, 96
Cameron, James, 69, 70
Canon PowerShot, 85
Captain America, 74
career advancement, 387–388
careers, digital modeling, 5, 344–361
Carnivores Cityscape, 381
cartoon characters, 118, 127. See also character models
CBeebies, 350
CG (computer graphics)
careers in, 7
  online communities, 11, 383, 385
  production pipeline, 41
  software, 13–14
CG Arena, 385
CG_Content folder, 143–144
CG Society, 11, 383, 385
chamfers, 175
Chan, Alan, 26–27, 81
caracter designers, 31
cart models, 239–263
  box modeling, 240–241
  building body for, 253–256
  for console games, 299
  creating hands for, 256–262
  creating heads for, 242–246
  detailing face for, 247–253
  gathering reference material for, 84–85
  prepping for production, 40–41
  questions to ask about, 82
  reviewing final mesh for, 262–263
character technical directors, 43
Christmas Carol, A, 70
Cinefx, 385
Clarke, Jamie, 89
Clay Buildup brush, ZBrush, 302
Clay Polish brush, ZBrush, 304
clay sculptures, 29, 321
clean modeling, 147–159
cloning, 111, 318
closed meshes, 329–330
cloth effects, 55
clothespin model, 205–211
color correction, 61, 63
color maps, 106, 315–316
color stylists, 29
color texture maps, 315–316
color theory, 61
commercials, 352
compositing, 61–64, 98
compositing programs, 64
compositors, 61
compound curves, 268
computer-aided design (CAD), 111, 128, 268
computer games, 353
computer graphics
careers in, 7
online communities, 11, 383, 385
production pipeline, 41
software, 13–14
Computer Graphics World, 385
computer processor speed, 10
concept artists, 29
conferences, industry, 382
console games, 353
construction-driven models, 114
contact information, 373
contact scanners, 131–132
content directory structure, 142–147
contests, 380
contiguous mesh, 103, 107
control cage, 112
copyrighted material, 91
cores, 10
CPU speed, 10
creature models, 284–319
adding surface detail to, 294–297
creating creature sculpt for, 300–305
creating UVs for, 314–315
doing second pass for, 292–293
generating maps for, 315–319
performing retopology for, 305–313
producing 3D sketch for, 284–285
sculpting arms for, 288–289
sculpting head for, 289–292
sculpting legs for, 286–288
cropping images, 98
CSI: Crime Scene Investigators, 133, 350
CT scans, 132–133
curves, 109, 110, 111, 172, 268
cutaways, 35
cut-ins, 35
cutscenes, 356
Cyberware, 131

D
Davis, Jarrod, 55–56
death mask region, 231
Deep Exploration, 331
deformations, 158
Demo Reel Breakdowns (DRBs), 366–367
demo reels, 361–369
burning, 369
case/sleeve for, 361–364
essential content for, 365–367
importance of, 361
labeling, 369, 378
offering online versions of, 371, 373
recommended length for, 368
sending out, 377
sound track for, 368
updating, 385–386
depth artists, 74
depth effect, 203
diamond polygons, 157
DiDomenico, Joe, 34–35
digital cameras, 85–86, 96, 99
digital creature maquettes, 284–297
adding surface detail to, 294–297
doing second pass for, 292–293
producing 3D sketch for, 284–285
sculpting arms for, 288–289
sculpting head for, 289–292
sculpting legs for, 286–288
Digital Domain, 345
digital modelers. See also digital modeling
hard surface vs. organic, 113–117
job market for, 5, 343–361
networking with other, 382–384
as problem solvers, 17
role of, in production pipeline, 40–42
skills required for, 7, 141, 147
tools used by, 78–84, 134–137, 381
digital modeling
defined, 128, 281
Glen Southern’s approach to, 282–283
of heads, 289–292
of legs, 286–288
for next-gen game model, 300–305
programs/tools, 122, 132, 282–284, 300
second pass, 292–297
ways of using, 128–130, 281
directories, content, 142–147
directors, 26, 28, 67–68
Directory of Illustration, The, 370
directory structure, 142–145, 147
displacement maps, 330
Documents folder, 144
“Do My Job” button, 17, 78
Drag Rectangle option, ZBrush, 294
Draw mode, ZBrush, 290
dual monitor setups, 11–12
DVDs, burning/labeling, 369
DVD training videos, 15
dynamics, 136–137
edgers, 232–234, 251–252
Ebay, 89
digitally extending modeling, 123–124, 214–215
digitally extending loops, 154–155, 199, 202
digits, 107–108
digitally extending weights, 107–108
digitally extending editors, 37, 67–68
digitally extending effects artists, 53–56
Einstein, Albert, 153
digitally extending elemental effects, 53
digitally extending EPS files, 169, 198
digitally extending Etter, Ryan, 372
events, industry, 382
exercise, 386
extrusion, 111, 203
eye masks, 225
eyes, 219–225, 247, 330

F

fabric dynamics, 53
Facebook, 382
faces, 108, 213, 247–253. See also head model
facial animation, 53, 106
facial expressions, 216
Falling Skies, 350
feather effect, 55
feature films, 345
FGP virtual world, 181
fillets, 175
film industry, 344–349
film terminology, 35
final edit, 67
final pass, 160
fingers, 256–262
fire effect, 53, 55
Flash, 111, 372
focal shift, 292
Foundation 3D, 11, 383
Foundry, 64
four-point polygons, 156–157, 262
four-point triangles, 157
Freeform, 132, 359
Frima, 355
FunGoPlay, 116, 117, 134, 181, 355
fur effect, 55

G

Gamache, Erik, 345
game industry, 353–356, 381
game modeling, 299–319
creating creature sculpt, 300–305
creating UVs for low-poly model, 314–315
generating maps for low-poly model, 315–319
Glen Southern’s approach to, 300
growth of, 299
next-gen, 299, 300
performing retopology, 305–313
GIF files, 373
GIMP, 15
Google, 89
Google Groups, 382
Gordon, Johnny, 52–53
GPU-based rendering, 11
graphics cards, 11
graphics tablets, 282
grayscale images, 283, 317
greed, 375
Grid Iron Gladiators, 116

H

hair fibers, 53
handheld devices, 355
hands, 152, 256–262
hard surface modeling, 113–117
hard surface objects, 116
Harryhausen, Ray, 90
head model, 213–237
build out approach to, 122
challenge to creating, 213
choosing modeling method for, 214–215
choosing style for, 118–119
for creature maquette, 289–292
defining surface of, 108
modeling components of, 219–237
reference photos for, 97, 216–218
ways of using, 213

health considerations, 386
Heinzen, Kory, 29–32, 372
Hellhound creature, 300–319
creating creature sculpt for, 300–305
creating UVs for, 314–315
generating maps for, 315–319
performing retopology for, 305–313

hinge joints, 45
hi-res textures, 11
homesickness, 374–375
horse illustration, 93
How to Train Your Dragon, 72

human head. See head model

Illustration, The Directory of, 370
illustrations, 93–94
Illustrator, 111, 169, 198
image-based meshing, 132
image manipulation software, 14, 15, 96
images
adjusting color/levels for, 96–97
compositing multiple, 98
cropping, 98
naming, 99
overprocessing, 97
rotating, 97
scanning, 96
sizing, 97–98
Images folder, 145
indie films, 346–347
industry conferences/events, 382
industry insights (by contributor)
  Boughen, Nicholas, 58
  Chan, Alan, 26–27
  Davis, Jarrod, 55–56
  DiDomenico, Joe, 34–35
  Gordon, Johnny, 52–53
  Heinzen, Kory, 29–32
  Ladnier, K. C., 65–67
  Maldonado, David, 74
  McDonough, 46–47
  Nieves, Angel, 49–50
  Powers, Rob, 70–72
  Smith, Kurt, 44–45
  Southern, Glen, 41–42
  Stringer, Lee, 63–64
  Tsirbas, Aristomenis, 38
  Welch, Farrah L., 59–61

industry insights (by topic)
animatics, 38
animation, 52–53
compositing, 63–64
effects artists, 55–56
lighting, 58
render artists, 59–61
rigging, 44–45
role of 3D modelers, 41–42
set decoration, 46–47
sound design, 65–67
stereoscopic 3D, 74
storyboarding, 34–35
story development process, 26–27
texturing, 49–50
virtual art departments, 70–72
visual design, 29–32

industry news/trends, 384–385
Inflate brush, ZBrush, 292
inflexibility, 376–377
Inhance Digital, 22, 59
ink jet 3D printers, 322–324
Inside the Living Baby, 133
Internet
  forums, 11
  as source of reference images, 89
  as tool for self-promotion, 370
internships, 375
interviews, job, 378
iPad, 355
iPhone, 355
Iron Sky, 346

J
Jack the Giant Killer, 70
jawlines, 231–232
Jimmy Neutron, 350
job interviews, 378
job opportunities, digital modeling, 5,
  344–361
job search sins, 374–380
Joe Zeff Design, 360
joints, 338
JPEG files, 373

K
keys, 79
Kraftwurx, 327

L
Ladnier, K. C., 64–67
laugh lines, 228
layout artists, 37, 45, 46, 52
layout foundations, 186–190
Lee, Jason, 372
legs, 286–288
“less is more” rule, 153
letterforms. See text
level design, 381
libraries, 89
light, color of, 63
lighting artists, 56–58
lighting conditions, photos with extreme,
  92–93
lighting technical directors, 56
LightWave 3D, 14, 15, 71, 157, 367
lines, 102, 107
LinkedIn, 382
lip sync, 53
Littlest Pet Shop, 341
localized detail, 151–152
logos, 168–169
loops, edge, 154–155, 199, 202
low-poly models
  creating UVs for, 314–315
  generating maps for, 315–319
  poly-count considerations, 306
Lucasfilm, 63
Luxology, 383

M
magazines, trade, 385
Makerbot, 327
Maldonado, David, 74
maps
  alpha, 317
  bump, 180, 317
  color, 106, 315–316
  displacement, 330
  morph, 106
  normal, 300, 318–319
selection, 107
texture, 15, 48, 104, 315–316, 330
UV, 40, 48, 104
vertex, 103–107
weight, 40, 105–106
maquettes, 284–297
  adding surface detail to, 294–297
defined, 29
digital sculpting of, 129
doing second pass for, 292–293
producing 3D sketch for, 284–285
sculpting arms for, 288–289
sculpting head for, 289–292
sculpting legs for, 286–288
Mars Needs Moms, 70
mattes, 63
Maya, 14
McDonough, Ed, 46–47
measuring, 86–87
medical illustrations, 132–133
memory, 10
MenitThings, 38
Merton, Robert K., 16
meshes
  closed, 329–330
  contiguous, 103, 107
  controlling poly-count for, 148
  delivering production-ready, 40
  hard surface vs. organic, 113–117
  hiding portions of, 292–293
  image-based, 132
  polygonal, 112
  position/rotation of, 160
  tools for generating, 13–14
metal printing, 327
metal spring model, 209–211
Method Studios, 58
micro-bevels, 174–177
microphone model, 136–137
MicroScribe G2 scanner, 131
Minolta Vivid Laser scanner, 132
mirroring, 218, 224, 278
M&Ms, 219, 360
mobile apps, 355
model classification, 113–117
modelers, 5–7, 40, 141. See also digital modelers
modeling. See also digital modeling
  3D polygonal object with seams, 180–195
  3D polygonal text, 168–179
  3D text with SubDs, 198–204
  clean, 147–159
departments, 40
game extend, 123–124, 214–215
  game, 299–319 (See also game modeling)
methods (See modeling methods)
pilates, 83
practices (See modeling practices)
preparing for career in, 77–78
product, 265–279
realistic head, 213–237
to scale, 159–160
software/tools, 13–15, 42, 78–84, 134–137, 381
  stylized character, 239–263
  SubD object, 205–211
  supervisors, 40
modeling methods, 121–139
  3D scanning, 131–133
  build out, 122–124
  digital sculpting, 128–130, 291–297
  mixing, 138–139
  patch, 127–128
  primitive, 124–125
modeling practices, 141–165
  clean modeling, 147–159
  directory structure, 142–145
  naming conventions, 142, 145–147
  preparing model for production, 159–165
models
  creating multiple versions of, 165
  positioning, 160
  preparing for production, 159–165
  as reference material, 94
  terminology, 102–112
  types of, 102
model sheets, 29, 40
model styles, 117–119
Modo, 14, 282
monitors, 11–12
morph maps, 106
mouths, 228–230, 246
Move brush, ZBrush, 286
movie industry, 344–349
movie reference, 90
MTM, 49
Mudbox, 42, 122, 282, 300
multi-core CPUs, 10
multi-knots, 109

N
naming conventions, 99, 142–147
National Geographic Channel, 133
networking, 382–384
news, industry, 384–385
NewTek, 15, 71, 383
NextEngine 3D Scanner, 131
NextFab, 327
next-generation models, 299, 300
n-gons, 49, 109, 149, 157, 201
Nickel, Jon-Troy, 129
Nickelodeon, 350
Nieves, Angel, 49–50
noncontact scanners, 132–133
Non-Uniform curves, 109
normal mapping, 300, 318–319
noses, 225–227, 245
notebooks, 87–88
Nuke, 64
NURBS surfaces, 102, 109–112, 127
nurnies, 60
NVIDIA graphics cards, 11

O
objects, naming, 146–147
Objects folder, 145
OBJ files, 312, 315
observational skills, 81–82
offline rendering, 148–149
online communities, 382–384
online forums, 11, 382, 383
online reference material, 89
OpenGL, 11
open source software, 14
organic modeling, 113–117
organic models, 117
organization skills, 147
origin, centering model at, 160
O’Riley, Chris, 80, 94, 372

P
Paint.net, 15
Paint Shop Pro, 15, 96
Partly Cloudy, 126, 240, 241, 348–349
patching, spline, 272–277
Patchkey Kidz, 4
polygons
  and 3D printing, 332
  controlling flow of, 156
  counting, 149–151
  deciding on number of, 151–153
  defined, 102, 108
  patching in, 201–202, 272–273
  and rule of three, 158–159
  sharing of edges by, 107
  sharing of points by, 103
  and texturing, 49
  types of, 109
  and visual effects, 55
  Polypaint feature, ZBrush, 316
  PolyTrans, 331
  Ponoko, 327
  portfolios, 361, 370, 373, 377. See also demo reels
  poses, 45, 162–164
  Postcards from the Future, 26, 81
  post-production stage, 61–68
    audio, 64–67
    compositing, 61–64
    final edit/delivery, 67–68
  powder prints, 326
  Powerhouse Punter, 355
  PowerPoint, 198
  Powers, Rob, 69, 70–72
  Praying Mantis, 80
  pre-production stage, 25–39
    animatics, 37–38
    purpose of, 25
    scratch voice recording, 35–36
    storyboarding, 33–35
    story development, 25–28
    visual design, 28–32
    voice recording, 39
  primitive modeling, 121, 124–125
  printed reference material, 89–90
digital modeling
professional digital modelers, 5–7, 141. See also digital modelers
project folders, 143–145
protrusions, 332
proxy models, 37
pushingpoints.com, 392
pyramids, 184–185

Q
quads, 109, 156
queue managers, 59
Quick Forge, 327

R
RAM (random access memory), 10
raster images, 169
Ratatouille, 36
real-time 3D gaming, 299–300
real-time rendering, 149
reels. See demo reels
Reference folder, 144
reference material, 84–99
copyright considerations, 91
as digital modeling tool, 78
gathering, 84–95
for head models, 97, 216–218
importance of, 78–81
naming/organizing, 99
preparing, 96–99
for product modeling, 268–270
reference photos, 97, 216–218, 268
reflections, 265
relaxed pose, 164
rendering
GPU-based, 11
offline, 148–149
print graphics
product modeling for, 265–279
role of digital artists in, 360–361
printing, 3D. See 3D printing
printing service bureaus, 327, 331
problem solving, 82–84
production
illustrators, 29
pipelines (See production pipelines)
preparing model for, 159–165
stage (See production stage)
production-driven models, 113–114
production pipelines, 22–75
defined, 22
evolution of, 68–75
graphical representation of, 24
post-production stage, 61–68
pre-production stage, 25–39
production stage, 40–61
production stage, 40–61
animation, 50–53
effects, 53–56
lighting, 56–58
modeling, 40–42
purpose of, 40
rendering, 59–61
rigging, 43–45
scene setup, 45–47
texturing, 48–50
product modeling, 265–279
advantages over photography, 265
creating splines for, 270–271
details to avoid in, 266–267
final details for, 278–279
goals for, 267
reference types for, 268–270
spline patching in, 272–277
product visualization, 358–359
real-time, 149
render nodes, 59
render wranglers, 59–61
resin, 326, 327
resolution, 96
resumes, 371, 385–386
retopology, 122–123, 305–313
RGBA color information, 106
Rhythm + Hues Commercials, 46
rigged characters, 43
rigging, 43–45, 53, 105, 162–165
rigging artists, 43
Riley, Marv, 356
Romano, Lou, 36
rotating images, 97
rule of three, 45, 158–159
Runners, 33–34, 36

S
Saintpère, Sylvain, 357–358
scale, 159–160
scanners, 131–133
scanning, 96, 131–133
scenes, animating, 52–53
scene setup, 45–47
Scenes folder, 145
Schneider, Joseph, 67–68
scratch tracks, 35–36
scratch voices, 35–36
screenplays, 25, 26
scripts, 25
Sculpeo, 327
sculpting. See also digital sculpting
   brushes, 283–284
   programs, 122, 132, 282, 359
Sculptris, 300
seams
   avoiding, in product shots, 266–267
in manufactured toys, 338
modeling 3D object with, 180–195
UV, 161
selection maps, 107
selection sets, 40, 107
self-fulfilling prophecies, 16
self-promotion, 370, 374
Serious Sam, 381
service bureaus, 3D printing, 327
set decorators, 45–47
shaders, 48
shadows, 94–95
shapes, 171
ShapeWays, 327
Shoemaker, Dave, 39
short films, 348–349. See also animated shorts
Sifaka World, 33
Silo, 14, 282
simplicity, 153, 159, 373
simulations, physics-based, 136
Singh, Baj, 353–354
Sister Act logo, 168
sizing images, 97–98
skeleton rigs, 135
sketch artists, 29
sketchbooks, 87–88
skin details, 48
sloppiness, 378
sloth, 379–380
smartphones, 87
Smith, Kurt, 44–45
smoke effect, 53, 55
soccer ball, 180–195
social networking sites, 382
software
   animation, 134–137
digital sculpting, 122, 132, 282–284, 300
modeling, 13–15, 42, 78–84, 134–137, 381
open source, 14
staying up to date on, 381
this book’s approach to, 13–14
wars, 13
Sohn, Peter, 36
sound designers, 64
sound effects, 64. See also audio
Sound “O” Rama, 64
source books, 370
Southern, Glen, 41–42, 128, 282–283, 300, 372
SouthernGFX Limited, 41, 372
Spiderbait character, 104
Splashlight, 360
spline patching, 272–277
splines
creating, 270–271
defined, 111
and NURBS surfaces, 110
as shape-creation technique, 172
ways of using, 111
Spoonman, 53–54
spring model, 209–211
sprite sheets, 355
stages of production, 22–75
overview, 22–25
stage 1: pre-production, 25–39
stage 2: production, 40–61
stage 3: post-production, 61–68
stars, 44
Star Wars, 63, 90
static objects, 153–154
Steinbichler Comet 5 White Light scanner, 132
stereo artists, 72
Stereo D, 74
Stereo Lighography file format, 331
stereoscopic 3D, 72–75
sticky notes, 25
STL files, 331
stop-motion animators, 90
story
artists, 33
constructing timeline for, 25
developing, 27–28
fleshing out, 33
importance of, 25
reels, 37
Storyboard folder, 144
storyboards, 33–35, 144
strawberry model, 94
Stringer, Lee, 63–64, 90, 142
stunt doubles, 350
styles, model, 117–119
stylized characters, 239–263
and box modeling, 240–241
building body for, 253–256
creating hands for, 256–262
creating head for, 242–246
detailing face for, 247–253
reviewing final mesh for, 262–263
stylized models, 118. See also stylized characters
subdivision surfaces, 102, 112. See also SubDs
SubDs, 197–211
edge weighting, 107–108
modeling 3D text with, 198–204
modeling clothespin with, 205–211
purpose of, 112, 197
vs. NURBS surfaces, 197
subtractive manufacturing, 322
support edges, 199–200
surface names, 161–162
symmetry, 218, 224, 242, 285
tape measures, 86–87
teapot images, 95
technical directors (TDs), 40, 58
Teddy Scares, 28, 39, 56
television market, 350–352
terminology, digital model, 102–112
Terra Nova, 350
tests, studio, 379
tetrahedrons, 184–185
text
  modeling 3D, with SubDs, 198–204
  modeling 3D polygonal, 168–179
texture artists, 48, 49, 160
texture displacement, 134–135
texture maps, 15, 48, 104, 315–316, 330
texturing, 48–50, 160–162
Thor, 74
three, rule of, 45
three-dimensional models. See 3D models
three-point polygons, 109, 156–157, 270, 278
Titanic, 74
title cards, demo reel, 365–366
Tofu the Vegan Zombie, 15, 25, 335–341, 359. See also Zombie Dearest
Toms, Graham, 93
topology, 44–45, 49, 153–159, 244, 282. See also retopology
toys, 334–341
T-pose, 45, 163
trade magazines, 385
training videos, 15
Tralfazz, 4
Transpose feature, ZBrush, 290–291, 294
trends, industry, 384–385
triangles, 109, 149, 157
Tsirbas, Aristomenis, 38
TV commercials, 352

United States Mint, 359
Unity 3 game development tool, 300, 319
Up, 72
UV layout, 161
UV maps, 40, 48, 104
UV options, 162
UV seams, 161
UV unwrapping, 49–50, 312

VAD (virtual art department/direction), 69–72
Varner, Steve, 132, 338
Varner Studios, 132, 338, 341
vector curves, 111
vector graphics, 169
vertex maps, 103–107
vertices, 102
video games, 353–356
video slot machines, 356
Viewsonic monitors, 11
virtual art department/direction (VAD), 69–72
visual design, 28–32
visual development artists, 29
visual effects artists, 53–56
visualization, 82–83, 356–359
viz-dev artists, 29
voice recording, 35–36, 39
Volumedic, 132–133

Wacom graphics tablets, 282
Walt Disney Studios, 33, 65
Warren, April, 215
water effect, 53, 55
Waybuloo, 350, 351
Web addresses, 373
Web sites, personal, 370–374
weight maps, 40, 105–106
Welch, Farrah L., 59–61
Whole Body Color 3D Scanner, 131
wide-screen monitors, 12
Wii, 353
Will Vinton Studios, 376
WordPress, 371, 372
workstations, 11–12

X
Xbox, 353
XSI, 14

Y
Young, Greg, 36
YouTube, 90

Z
ZBrush
alternatives to, 282, 300
built-in brushes, 284–285
Clay Buildup brush, 302
Clay Polish brush, 304
creating Hellhound creature with, 300–305
creators of, 282
Drag Rectangle option, 294
Draw mode, 290
Dynamesh feature, 284–285, 289, 304
Inflate brush, 292
Move brush, 286
and noncontact scanners, 132
performing retopology with, 122
Polypaint feature, 316
posing figures in, 295
and product visualization, 359
training videos, 15
Transpose feature, 290–291, 294
Web site, 14
ZSphere tool, 306–308
Z Corporation, 327
Z-depth information, 72–73
Zoic, 89, 133
Zombie Dearest
animated sequence of Addie in, 50–51
audio engineer for, 65
character models for, 40–41, 335
compositing for, 61–62
model sheet/maquette for, 29
proxy models for, 37
script for, 25–26
set decoration for, 46
skin details for, 48
stereo 3D conversion for, 72–73
viewing, 15
Zorro masks, 225
ZPrinter, 327
ZSphere tool, ZBrush, 306–308
This page intentionally left blank
Unlimited online access to all Peachpit, Adobe Press, Apple Training and New Riders videos and books, as well as content from other leading publishers including: O’Reilly Media, Focal Press, Sams, Que, Total Training, John Wiley & Sons, Course Technology PTR, Class on Demand, VTC and more.

No time commitment or contract required! Sign up for one month or a year. All for $19.99 a month

SIGN UP TODAY
peachpit.com/creativeedge