# Contents

*Introduction* ........................................... xxvii

**Chapter 1 • Getting Started** ........................................... 1

  Understanding Parametric Design ............................... 1
  Creating a Base Sketch ........................................ 1
  Creating a Base Feature ...................................... 2
  Adding More Features ......................................... 3
  Using the Part in an Assembly ................................ 3
  Making Changes .............................................. 4
  Understanding History-Based Modeling and Dependencies ... 4
  Taking a Closer Look at Sketch Dimensions .................. 5
  Following Part Modeling Best Practices ...................... 7
  Following Assembly Modeling Best Practices ................ 8

  Understanding the “Feel” of Inventor ........................ 10
    Understanding the Intuitive Interface ....................... 10
    Using General Tools vs. Specific Commands ............... 12
    When in Doubt, Right-Click ................................ 12

  Using the Graphical Interface ................................ 13
    Inventor Title Bar .......................................... 14
    Graphics Window Tools ..................................... 15
    The Ribbon Menu .......................................... 17
    The Browser Pane/Model Browser ............................ 19
    Dialog Boxes and the In-Canvas Mini-Toolbars .......... 19
    Task-Based Tools .......................................... 20

  Learning the File Types in Inventor .......................... 20
  What Is an Inventor Project? .................................. 22
    Project Files and Search Paths ............................. 22
    Library Folders and Library Editor IPJ Files .............. 25
    Content Center Files ...................................... 26
    How Search Paths and Project Files Are Used ............. 26

  Exploring Project File Types .................................. 27
  Creating a Project File ....................................... 29
    Creating Single-User Projects .............................. 29
    Creating Multiuser Projects ................................ 38

  Understanding Inventor Templates ............................ 39
  Working with Styles, Style Libraries, and Company Standards .................................................. 40

  The Bottom Line .............................................. 40

**Chapter 2 • A Hands-on Test-Drive of the Workflow** .......... 43

  Creating a Part Model ....................................... 43
  Starting with a Part Template ................................ 45
<table>
<thead>
<tr>
<th>Chapter 3</th>
<th>Sketch Techniques</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploring the Options and Settings for Sketches</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Application Options</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Document Settings</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Sketching Basics</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Creating a Sketch on an Existing Sketch</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Projecting Geometry into Your Sketch</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Breaking Links to Projected Geometry</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Deleting a Sketch</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Creating Another New Sketch</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Creating Dimensions</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Creating a Sketch in a New Part</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Creating a New Part File from a Template</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Creating Lines Using the Line Tool</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Understanding Sketch Constraints</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Using Degrees of Freedom to View Underconstrained Sketch Elements</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Using Dimensions to Fully Constrain a Sketch</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Understanding the Save Options</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Making a Sketch Active for Edits</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>Using Construction Geometry</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>Using the Polygon Tool and Creating an Aligned Dimension</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Using Offset and Creating a Three-Point Rectangle</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>Creating Driven Dimensions</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>Taking a Closer Look at Sketch Constraints</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>The Tangent Constraint</td>
<td>103</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4 • Basic Modeling Techniques .......................... 135

Exploring Application Options and Settings for Part Modeling .................. 135
  Specifying Global Settings ........................................... 135
  Specifying Document-Specific Settings .................................. 137

Key Concepts for Creating Basic Part Features ...................................... 144
  Simplifying Your Sketches .................................................. 147

Exploring the Extrude Tool ...................................................... 148
  Extruding Basic Features ...................................................... 149
  Editing an Extrusion Feature ............................................... 152
  Extruding with Cut and Taper .............................................. 152
  Extruding with Intersect .................................................... 153
  Extruding Surfaces from Open Profiles .................................... 155
  Extruding Solids from Open Profiles ....................................... 156
  Extruding with To ............................................................ 158
  Extruding with the Minimum Solution Option ................................ 160
  Extruding with To Next ....................................................... 160
  Extruding Between ............................................................ 161
  Extruding Multi-body Solids .................................................. 162
Patterns Along Curves ................................................................. 236
The Coil Tool and Spiral Patterns .............................................. 238
Pattern Solids ............................................................................. 240
Dynamic Patterns ...................................................................... 243
Setting iProperties and Parameters .......................................... 244
iProperties .................................................................................. 244
Part Parameters ......................................................................... 245
Assembly Parameters ................................................................ 250
Adding Part Tolerances ............................................................. 250
Tolerances in Sketches ............................................................... 251
Setting Global File Tolerances ................................................ 252
Working with Limits and Fits .................................................... 254
Working with Free-Form Modeling and Direct Editing Tools ..... 257
Free-Form Modeling .................................................................. 257
Using the Direct Edit Tool ......................................................... 264
Troubleshooting Failures with the End-of-Part Marker ............ 265
Step 1: Editing the First Feature ................................................ 266
Step 2: Moving the EOP Marker Down One Feature at a Time .... 267
The Bottom Line ......................................................................... 268

Chapter 6 • Sheet Metal .......................................................... 269
Understanding Sheet-Metal Parts ............................................. 269
Getting to Know the Features ..................................................... 270
Starting with a Base Feature ....................................................... 270
Creating Secondary Flange Features ......................................... 276
Adding, Removing, or Deforming Material ............................... 285
Using Sheet-Metal Templates and Rules ................................. 302
What Are Sheet-Metal Rules? ................................................... 302
Working with Styles and Templates .......................................... 310
Working with the Flat Pattern .................................................... 311
Exploring the Flat Pattern Edit Features ................................. 311
Adding Manufacturing Information to the Flat Pattern .......... 311
Using the Flat Pattern Definition Dialog Box ......................... 313
Manufacturing Your Flat Pattern ............................................. 314
Using Sheet-Metal iPart Factories ............................................ 315
iParts for Configurations ............................................................ 316
iParts for Fold Progression ........................................................ 316
Modeling with Non-Sheet-Metal Features ............................... 317
Selecting Problematic Features ................................................ 317
Using Surface-Based Workflows .............................................. 317
Working with Imported Parts .................................................... 318
Setting Yourself Up for Success ................................................ 318
Converting Components ............................................................ 318
Annotating Your Sheet-Metal Design ....................................... 319
Creating a View of Your Sheet-Metal Design .......................... 319
Chapter 7 • Reusing Parts and Features ........................................ 325
Working with iParts .......................................................... 325
  Creating and Modifying iParts ......................................... 326
  Using iParts in Designs ................................................. 338
Working with iFeatures .................................................... 340
  Creating iFeatures ....................................................... 341
  Creating Punch Features .............................................. 345
Reusing Existing Geometry ............................................... 349
  Copying Features ........................................................ 349
  Cloning ................................................................. 351
  Linking Parameters Between Two Files ............................. 352
  Copying Sketches ...................................................... 353
Introducing Content Center .............................................. 355
  Configuring Content Center ....................................... 356
  Using Content Center ............................................... 358
  Publishing Parts to Content Center ................................. 366
The Bottom Line ............................................................ 369

Chapter 8 • Assembly Design Workflows .................................. 371
Assembly Relationships .................................................... 372
  Degrees of Freedom .................................................... 372
  Grounded Components ............................................... 374
  How the Constrain Tool Works .................................... 375
  How the Joint Tool Works ........................................... 376
  Working with Constraints ............................................. 377
  Additional Constrain Tools and Options ......................... 391
  Working with Joint Relationships ................................. 397
Understanding Subassemblies ............................................ 408
Top-Down Design .......................................................... 410
  Developing an Efficient Assembly Workflow .................... 410
  Layout Sketches ....................................................... 414
  Flexibility .............................................................. 417
Adaptivity ....................................................................... 417
  Creating Adaptivity .................................................... 418
  Removing Adaptivity from Parts .................................... 420
Assembly Features .......................................................... 421
Managing the Bill of Materials .......................................... 423
  Parts-Level BOM Control ............................................ 424
  Assembly-Level BOM Control ...................................... 424
Assembly Reuse and Configurations .................................. 431
  Copying Designs ........................................................ 431
  Using Representations ............................................... 433
  Using iAssemblies ..................................................... 443
Use Assembly Design Accelerators .......................... 447
Functional Design vs. Geometric Modeling ................. 447
Working with Design Accelerators ......................... 448
The Bottom Line ............................................. 455

Chapter 9 • Large Assembly Strategies ..................... 457
Selecting a Workstation ....................................... 457
Physical Memory vs. Virtual Memory ....................... 458
Hardware .................................................. 458
Working with Performance Settings ....................... 461
Express Mode .............................................. 461
Working with Drawing Settings ........................... 461
Working with Model Display Settings .................... 465
Working with General Settings ............................ 466
Using the Memory Probe .................................. 468
Working with System Settings ............................. 469
Large Assembly Best Practices ............................ 470
Working with the Model .................................... 470
Improving File Open Time .................................. 471
Reducing Assembly Constraints ............................ 471
Adaptivity .................................................. 474
Selection Tools ............................................. 475
View Representations ...................................... 477
Find ....................................................... 477
Opening the Model ........................................ 478
Working with Large Assembly Drawings ................... 479
Managing Assembly Detail .................................. 483
LOD Strategies ............................................. 483
Substitute LODs ........................................... 485
Subassembly LODs ........................................ 487
Simplifying Parts ............................................ 489
Removing or Suppressing Unneeded Features ............ 489
The Bottom Line ............................................. 491

Chapter 10 • Weldment Design ............................... 493
Exploring Weldment Design Methodologies .................. 493
Part Files and Part Features .................................. 494
Weldment Assembly and Derived Technology ................ 494
Weldment Assembly ........................................ 495
Multi-body Part Files ....................................... 496
Modeling Preparations ....................................... 497
Exploring Cosmetic Welds ................................... 499
Creating a Simple Cosmetic Weld ........................... 501
Using Split Faces to Place Cosmetic Welds .................. 502
Placing Cosmetic Welds with Extents ....................... 502
Creating Weld Beads ...................................... 503
Creating Fillet Welds ................................................................. 504
Modeling a Fillet Weld .............................................................. 505
Fillet Welds and Gaps ............................................................... 507
Creating Intermittent Fillet Welds ............................................. 508
Creating Groove Welds ............................................................. 509
Performing Machining Operations ........................................... 512
Exploring Weld Properties and Combinations .............................. 513
Weld Properties ................................................................... 513
Replication ........................................................................... 514
Groove and Fillet Weld Combinations ........................................ 514
Split Technique ................................................................... 515
Using the Weld Symbol ............................................................ 517
Understanding Bead Property Report and Mass Properties .............. 518
Creating Drawing Documentation ............................................. 519
Weldment Design Stages ............................................................ 521
End Fill ............................................................................... 523
Drawing Weld Symbols ............................................................. 524
Caterpillar ............................................................................ 525
Generating a Bill of Materials and Parts List ................................. 526
The Bottom Line ................................................................. 527

Chapter 11 • Presentations and Exploded Views ......................... 529
Getting Started ................................................................... 530
Working in the Presentation Environment .................................... 530
Creating an Automatically Exploded Presentation ......................... 532
Creating Tweaks Individually .................................................... 535
Preparing the Exploded Presentation to Be Used in an Animation .... 538
Hiding Components from View During Animations ....................... 544
Rounding Up Presentation Preparation ....................................... 546
Creating and Publishing Animations .......................................... 546
Animation File Types and Compression Codecs ............................. 547
The Bottom Line ................................................................. 549

Chapter 12 • Documentation ........................................................ 551
Creating Drawing Views ............................................................ 551
Creating a Base View ................................................................ 552
Moving and Copying Views ....................................................... 556
Creating Section Views ............................................................. 557
Slice Views ........................................................................... 561
Using Breakout Views ............................................................ 562
Using Detail Views .................................................................. 566
Creating Break Views ............................................................. 567
Cropping Views ..................................................................... 570
Using Draft Views .................................................................. 570
Creating Overlay Views ........................................................... 570
Annotating Part Drawings ......................................................... 571
Using Centerline and Center Marks ............................................ 571
Chapter 14 • Exchanging Data with Other Systems ......................... 687
Importing and Exporting Geometry ............................................. 687
Importing vs. Referencing Geometry ........................................... 688
Translating DWG and DXF Files .................................................. 695
Mechanical Desktop DWG .......................................................... 703
STEP and IGES ........................................................................ 704
SAT .......................................................................................... 706
CATIA Import Options .............................................................. 706
Pro/ENGINEER Import Options .................................................... 707
Unigraphics and Parasolids Import Options .................................... 707
SolidWorks Import Options ....................................................... 708
Rhino Import Options ................................................................. 708
SMT Import Options ................................................................. 708
JT Import Options ................................................................... 708
STL Import Options ................................................................. 709
IDF Board Files ...................................................................... 709
Working with Imported Data .................................................. 711
Repair Tools ........................................................................... 711
Edit Solid Tools ...................................................................... 711
Viewing DWF Markup ............................................................. 714
Publishing a DWF or DWFx File .............................................. 715
Reviewing and Marking Up DWF and DWFx Files .................. 716
Accessing DWF or DWFx Markups in Inventor ......................... 717
The Bottom Line ..................................................................... 718

Chapter 15 • Frame Generator ................................................. 719
Accessing Frame Generator Tools ........................................... 719
Exploring the Frame Generator File Structure ......................... 720
Exploring the Anatomy of a Frame Member ............................... 722
Inserting Frame Members ........................................................ 723
  Specifying a Structural Shape .............................................. 723
  Changing the Orientation ..................................................... 724
Selecting Placement Geometry ................................................ 725
Creating a Basic Frame ............................................................ 726
Aligning Frame Members ........................................................ 730
Using the Change Tool ............................................................. 731
Adding End Treatments ............................................................ 732
Miter ....................................................................................... 733
Trim/Extend to Face ................................................................. 736
Trim to Frame Member ............................................................. 737
Notch Frame Members ............................................................ 738
Lengthen/Shorten Frame Member ........................................... 739
Reuse Frame Members ............................................................ 739
Maintaining Frames ................................................................. 741
Remove End Treatments .......................................................... 741
Frame Member Information ..................................................... 741
Refresh ................................................................................... 741
Performing Calculations and Analysis ...................................... 742
The Beam and Column Calculator .......................................... 742
Publishing Frame Members ..................................................... 751
Authoring a Part ..................................................................... 751
Publishing a Part ................................................................. 754
Frame Assemblies and BOMs .................................................... 755
The Bottom Line ................................................................. 756

Chapter 16 • Inventor Studio ..................................................... 757
How to Make Your Models Look Great, Live Onscreen ............ 758
  Materials and Appearances .................................................... 758
Chapter 18 • Routed Systems ........................................... 841
  Tube and Pipe ......................................................... 841
    Understanding Routes, Runs, and Assembly Structure .......... 841
  Tube and Pipe Settings ............................................. 843
  Exploring the Tube and Pipe Styles ............................... 844
  Placing Fittings ..................................................... 849
  Creating Routes ..................................................... 850
  Exporting ISOGEN Files ............................................. 859
  Cable and Harness .................................................. 859
    Creating and Placing Electrical Parts ........................... 860
    Creating a Harness ................................................ 863
    Placing Wires ...................................................... 865
    Using the Cable & Harness Library ................................ 866
    Placing Cables ..................................................... 867
    Placing and Editing Segments .................................... 868
    Copying Cable and Harness Designs ............................... 871
    Creating Nailboard Drawings ..................................... 873
  The Bottom Line ..................................................... 875

Chapter 19 • Plastics Design Features ............................... 877
  Creating Thicken/Offset Features .................................. 878
  Creating Shell Features .............................................. 879
  Creating Split Features ............................................. 881
  Creating Grill Features ............................................. 882
  Creating Rule Fillet Features ...................................... 884
  Creating Rest Features .............................................. 886
  Creating Boss Features ............................................. 888
  Creating Lip and Groove Features .................................. 891
  Creating Snap-Fit Features ........................................ 892
  Creating Rib and Web Features ..................................... 894
  Creating Draft Features ............................................ 896
  Mold Design Overview ................................................ 898
    Inventor Tooling .................................................. 898
    Importing a Plastic Part ......................................... 899
    Creating Runners and Gates ...................................... 902
    Analyzing and Creating Cores and Cavities ...................... 904
    Working with Mold Bases ......................................... 907
    Working with Ejectors and Sprue Bushings ...................... 909
  The Bottom Line ..................................................... 912

Chapter 20 • iLogic ..................................................... 915
  What Is iLogic? ....................................................... 915
    Understanding iLogic Rules ....................................... 916
  What Are Functions? ................................................. 916
    Conditional Statements ............................................ 919
  Understanding the iLogic Elements and Interface ................ 921
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Getting Started</td>
<td>961</td>
</tr>
<tr>
<td>2</td>
<td>A Hands-on Test-Drive of the Workflow</td>
<td>963</td>
</tr>
<tr>
<td>3</td>
<td>Sketch Techniques</td>
<td>964</td>
</tr>
<tr>
<td>4</td>
<td>Basic Modeling Techniques</td>
<td>966</td>
</tr>
<tr>
<td>5</td>
<td>Advanced Modeling Techniques</td>
<td>968</td>
</tr>
<tr>
<td>6</td>
<td>Sheet Metal</td>
<td>970</td>
</tr>
<tr>
<td>7</td>
<td>Reusing Parts and Features</td>
<td>973</td>
</tr>
<tr>
<td>8</td>
<td>Assembly Design Workflows</td>
<td>974</td>
</tr>
<tr>
<td>9</td>
<td>Large Assembly Strategies</td>
<td>977</td>
</tr>
<tr>
<td>10</td>
<td>Weldment Design</td>
<td>978</td>
</tr>
<tr>
<td>11</td>
<td>Presentations and Exploded Views</td>
<td>980</td>
</tr>
<tr>
<td>12</td>
<td>Documentation</td>
<td>981</td>
</tr>
<tr>
<td>13</td>
<td>Tools Overview</td>
<td>984</td>
</tr>
<tr>
<td>14</td>
<td>Exchanging Data with Other Systems</td>
<td>986</td>
</tr>
<tr>
<td>15</td>
<td>Frame Generator</td>
<td>987</td>
</tr>
<tr>
<td>16</td>
<td>Inventor Studio</td>
<td>988</td>
</tr>
<tr>
<td>17</td>
<td>Stress Analysis and Dynamic Simulation</td>
<td>991</td>
</tr>
<tr>
<td>18</td>
<td>Routed Systems</td>
<td>991</td>
</tr>
<tr>
<td>19</td>
<td>Plastics Design Features</td>
<td>992</td>
</tr>
<tr>
<td>20</td>
<td>iLogic</td>
<td>995</td>
</tr>
</tbody>
</table>

**Appendix B • Autodesk Inventor 2016 Certification**

Index | 1009