

# Contents

<b>About the Author .....</b>	<b>ix</b>
<b>About the Technical Reviewer .....</b>	<b>xi</b>
<b>■Part I: Introducing Entity Framework Core 2.....</b>	<b>1</b>
<b>■Chapter 1: Entity Framework Core in Context .....</b>	<b>3</b>
Understanding Entity Framework Core .....	3
About This Book .....	4
What Do You Need to Know? .....	4
What Software Do You Need? .....	4
What If You Don't Want to Use Windows? .....	4
What Is the Structure of This Book? .....	4
Part 1: Introducing Entity Framework Core 2.....	5
Part 2: Entity Framework Core 2 in Detail.....	5
Part 3: Advanced Entity Framework Core 2 .....	5
Where Can You Get the Example Code?.....	5
Where Can You Get Corrections for This Book? .....	5
How Can You Contact Me?.....	5
Summary.....	5
<b>■Chapter 2: Your First Entity Framework Core Application.....</b>	<b>7</b>
Getting Ready .....	7
Installing .NET Core .....	8
Installing Visual Studio 2017 .....	8
Creating the Project.....	10
Setting the Scene .....	10
Creating the Project.....	11

■ CONTENTS

Creating the Data Model and Context Classes .....	14
Creating the Controller and Views .....	15
Configuring Entity Framework Core .....	19
Configuring the Connection String.....	20
Configuring the Startup Class .....	21
Preparing the Database.....	22
Testing the Application .....	22
Summary.....	24
<b>■ Chapter 3: Working with Databases .....</b>	<b>25</b>
Preparing for This Chapter .....	26
Exploring the Database .....	27
Examining the Database Tables.....	29
Examining the Database Content .....	31
Understanding SQL.....	33
Querying Data.....	33
Storing and Updating Data.....	42
Deleting Data .....	44
Joining Data .....	45
Preparing the Database .....	45
Performing a Join .....	47
Summary.....	47
<b>■ Chapter 4: SportsStore: A Real (Data) Application .....</b>	<b>49</b>
Creating the Project.....	49
Configuring the MVC Framework.....	51
Adding the Model.....	52
Adding a Repository .....	52
Adding a Controller and View .....	54
Adding the Finishing Touches .....	56
Running the Example Application.....	58
Summary.....	59

<b>■ Chapter 5: SportsStore: Storing Data .....</b>	<b>61</b>
Preparing for this Chapter .....	61
Configuring Entity Framework Core .....	62
Configuring Entity Framework Core Logging Messages.....	62
Preparing the Data Model.....	63
Defining a Primary Key Property .....	63
Creating the Database Context Class .....	63
Updating the Repository Implementation .....	64
Preparing the Database.....	65
Configuring the Connection String.....	65
Configuring the Database Provider and Context Class .....	66
Creating the Database .....	68
Running the Application .....	69
Avoiding the Query Pitfalls .....	70
Understanding the <code>IEnumerable&lt;T&gt;</code> Pitfall .....	71
Understanding the Duplicate Query Pitfall.....	73
Common Problems and Solutions .....	78
Problems Creating or Accessing the Database.....	78
Problems Querying Data.....	80
Problems Storing Data.....	81
Summary .....	82
<b>■ Chapter 6: SportsStore: Modifying and Deleting Data .....</b>	<b>83</b>
Preparing for This Chapter .....	83
Modifying Objects.....	85
Updating the Repository .....	85
Updating the Controller and Creating a View.....	86
Updating Only Changed Properties.....	91
Performing Bulk Updates.....	92
Deleting Data.....	99

<b>Common Problems and Solutions .....</b>	<b>103</b>
Objects Are Not Updated or Deleted .....	103
The “Reference Not Set to an Instance of an Object” Exception .....	103
The “Instance of Entity Type Cannot be Tracked” Exception.....	104
The “Property Has a Temporary Value” Exception .....	104
Updates Result in Zero Values .....	104
Summary .....	104
<b>■ Chapter 7: SportsStore: Expanding the Model.....</b>	<b>105</b>
Preparing for This Chapter .....	105
Creating a Data Model Relationship .....	107
Adding a Data Model Class.....	108
Creating the Relationship .....	108
Updating the Context and Creating the Repository.....	109
Creating and Applying a Migration .....	111
Creating a Controller and View .....	111
Populating the Database with Categories.....	115
Using a Data Relationship .....	116
Working with Related Data .....	116
Selecting a Category for a Product.....	118
Creating and Editing Products with Categories .....	120
Adding Support for Orders.....	122
Creating the Data Model Classes.....	122
Creating the Repository and Preparing the Database.....	123
Creating Controllers and Views.....	125
Storing Order Data.....	131
Common Problems and Solutions .....	133
The “ALTER TABLE conflicted with the FOREIGN KEY” Exception.....	133
The “UPDATE Conflicted with the FOREIGN KEY” Exception .....	134
The “The Property Expression ‘x => x.<name>’ is Not Valid” Exception .....	134
The “Type of Navigation Property <name> Does Not Implement ICollection<OrderLine>” Exception .....	134

The “The Property <name> is Not a Navigation Property of Entity Type <name>” Exception.....	134
The “Invalid Object Name <name>” Exception.....	134
Objects Are Deleted Instead of Being Updated.....	135
The Class Name for Related Data Is Displayed in a View .....	135
Summary.....	135
<b>Chapter 8: SportsStore: Scaling Up .....</b>	<b>137</b>
Preparing for This Chapter .....	137
Creating a Seed Data Controller and View.....	137
Scaling Up Data Presentation.....	142
Adding Support for Pagination.....	142
Adding Search and Ordering Support.....	148
Applying the Data Presentation Features to Categories .....	152
Indexing the Database.....	155
Creating and Applying Indexes .....	157
Common Problems and Solutions .....	159
Queries for Pages Are Too Slow.....	159
Applying the Index Migration Times Out.....	159
Creating an Index Does Not Improve Performance.....	160
Summary.....	160
<b>Chapter 9: SportsStore: Customer Features .....</b>	<b>161</b>
Preparing for This Chapter .....	161
Removing the Timing Statements.....	161
Adding a View Import.....	162
Modifying the Data Model.....	162
Adding Product Seed Data.....	163
Preparing the Database .....	166
Displaying Products to the Customer .....	167
Preparing the Data Model.....	167
Creating the Store Controller, Views, and Layout.....	169
Testing the Store Display.....	173

<b>Adding the Shopping Cart .....</b>	<b>174</b>
Enabling Persistent Session Data.....	174
Creating the Cart Model Class .....	177
Creating the Controller and Views .....	178
Testing the Ordering Process.....	183
<b>Common Problems and Solutions .....</b>	<b>183</b>
Clicking a Page Button Manages the Wrong Data Type .....	183
Clicking a Page Button Has No Effect.....	184
The “Cannot Insert Explicit Value for Identity Column” Exception .....	184
Session Objects Are Null.....	184
Session Objects Are Lost or Inconsistently Available.....	184
Summary.....	184
<b>■ Chapter 10: SportsStore: Creating a RESTful Web Service .....</b>	<b>185</b>
Preparing for This Chapter .....	185
Creating a Web Service .....	186
Creating the Repository .....	186
Creating the API Controller .....	188
Testing the Web Service .....	190
Projecting a Result to Exclude Null Navigation Properties .....	190
Including Related Data in a Web Service Response .....	192
Querying for Multiple Objects .....	195
Completing the Web Service .....	198
Updating the Controller.....	200
Common Problems and Solutions .....	202
Null Property Values When Storing or Updating Objects.....	202
Slow Web Service Requests .....	202
The “Cannot Insert Explicit Value for Identity Column” Exception .....	202
Summary.....	202

<b>■ Part II: Entity Framework Core 2 in Detail .....</b>	<b>203</b>
<b>■ Chapter 11: Working with Entity Framework Core .....</b>	<b>205</b>
Creating the ASP.NET Core MVC Project .....	206
Creating the Data Model Class .....	207
Configuring Services and Middleware.....	208
Adding a Controller and View .....	209
Adding the Bootstrap CSS Framework .....	210
Configuring the HTTP Port .....	211
Running the Example Application .....	212
Adding and Configuring Entity Framework Core .....	213
Adding the NuGet Package .....	213
Creating the Database Context Class .....	214
Preparing the Entity Class .....	214
Updating the Controller.....	215
Configuring the Database Provider.....	216
Configuring Entity Framework Core Logging.....	219
Implementing the Repository Pattern.....	223
Defining the Repository Interface and Implementation Class .....	224
Avoiding the IEnumerable vs IQueryable Pitfall .....	226
Hiding the Data Operations.....	230
Completing the Example MVC Application .....	232
Completing the Repository .....	233
Adding the Action Methods.....	234
Updating and Adding Views .....	235
Summary .....	237
<b>■ Chapter 12: Performing Data Operations.....</b>	<b>239</b>
Preparing for This Chapter .....	240
Starting the Example Application .....	241
Reading Data .....	242
Reading an Object by Key .....	242

## CONTENTS

Querying All Objects .....	246
Querying for Specific Objects .....	247
Storing New Data .....	252
Understanding Key Assignment.....	253
Updating Data.....	254
Updating a Complete Object.....	254
Querying the Existing Data Before Updating .....	256
Updating in a Single Database Operation .....	258
Deleting Data.....	262
Summary.....	264
<b>■ Chapter 13: Understanding Migrations .....</b>	<b>265</b>
Preparing for This Chapter .....	266
Understanding Migrations .....	267
Working with the Initial Migration .....	267
Examining the Migration SQL .....	271
Applying the Migration .....	272
Seeding the Database and Running the Application.....	273
Creating Additional Migrations .....	274
Adding Another Property to the Data Model .....	276
Managing Migrations .....	277
Listing Migrations.....	278
Applying All Migrations .....	278
Updating to a Specific Migration .....	279
Removing a Migration.....	280
Resetting the Database .....	281
Working with Multiple Databases.....	281
Extending the Data Model.....	282
Configuring the Application .....	283
Creating and Applying Migrations .....	285

<b>Managing Migrations Programmatically .....</b>	<b>286</b>
Creating the Migration Manager Class .....	286
Creating the Migrations Controller and View .....	289
Configuring the Application .....	291
Running the Migrations Manager .....	291
<b>Seeding Databases Programmatically .....</b>	<b>292</b>
Creating a Seeding Tool .....	294
Seeding During Startup .....	296
Summary.....	298
<b>■Chapter 14: Creating Data Relationships.....</b>	<b>299</b>
Preparing for This Chapter .....	300
Creating a Relationship .....	300
Adding a Navigation Property .....	301
Creating the Migration.....	302
Querying and Displaying the Related Data .....	304
Updating the View to Display Related Data .....	308
Preparing the Database .....	310
Creating and Updating Related Data .....	312
Creating a New Supplier When Creating a New Product .....	314
Updating a Supplier when Updating a Product.....	316
Deleting Related Data.....	318
Creating a Required Relationship .....	321
Creating a Foreign Key Property.....	321
Dropping the Database and Preparing the Seed Data .....	323
Updating and Seeding the Database .....	324
Understanding the Required Relationship Delete Operation .....	325
Querying for Multiple Relationships .....	327
Updating and Seeding the Database .....	328
Querying the Chain of Navigation Properties.....	329
Summary.....	331

<b>■ Chapter 15: Working with Relationships Part 1 .....</b>	<b>333</b>
Preparing for This Chapter .....	333
Directly Accessing Related Data.....	334
Promoting Related Data.....	335
Accessing Related Data Using a Type Parameter .....	338
Completing a Data Relationship .....	343
Querying Related Data in a One-to-Many Relationship .....	344
Working with Related Data in a One-to-Many Relationship .....	353
Updating Related Objects .....	355
Creating New Related Objects.....	358
Changing Relationships .....	362
Summary.....	369
<b>■ Chapter 16: Working with Relationship Part 2 .....</b>	<b>371</b>
Preparing for This Chapter .....	371
Completing a One-to-One Relationship .....	372
Defining the Navigation Property.....	372
Selecting the Dependent Entity Class.....	373
Creating and Applying the Migration .....	374
Working with One-to-One Relationships .....	375
Querying Related Data in a One-to-One Relationship.....	375
Creating and Updating Related Objects .....	377
Changing One-to-One Relationships .....	380
Defining Many-to-Many Relationships .....	389
Creating the Junction Class .....	390
Completing the Many-to-Many Relationship .....	391
Preparing the Application .....	392
Querying for Many-to-Many Data .....	394
Managing Many-to-Many Relationships.....	397
Summary.....	402

<b>■ Chapter 17: Scaffolding an Existing Database .....</b>	<b>403</b>
Preparing for This Chapter .....	404
Understanding the Example Existing Database .....	404
Connecting to the Database Server .....	405
Creating the Database .....	405
Creating the ASP.NET Core MVC Project .....	411
Testing the Example Application .....	415
Scaffolding an Existing Database .....	416
Performing the Scaffold Process .....	416
Using a Scaffolded Data Model in the ASP.NET Core MVC .....	419
Responding to Database Changes .....	423
Modifying the Database .....	424
Updating the Data Model .....	425
Updating the Context Class .....	426
Updating the Controllers and Views .....	426
Adding Persistent Data Model Features .....	428
Summary .....	430
<b>■ Chapter 18: Manually Modeling a Database .....</b>	<b>431</b>
Preparing for This Chapter .....	432
Creating a Manual Data Model .....	432
Creating the Context and Entity Classes .....	433
Creating the Controller and View .....	434
Understanding the Basic Data Model Conventions .....	436
Overriding the Data Model Conventions .....	437
Modeling Relationships .....	443
Completing the Data Model .....	449
Using the Manually Created Data Model .....	451
Querying Data in a Manually Created Data Model .....	452
Updating Data in a Manually Created Data Model .....	455
Summary .....	461

<b>■ Part III: Advanced Entity Framework Core 2 .....</b>	<b>463</b>
<b>■ Chapter 19: Working with Keys .....</b>	<b>465</b>
Preparing for This Chapter .....	466
Creating the Data Model.....	467
Creating the Controller and Views .....	468
Configuring the Application .....	471
Creating the Database and Testing the Application .....	474
Managing Key Generation .....	475
Understanding the Identity Strategy.....	475
Understanding the Hi-Lo Key Strategy .....	476
Working with Natural Keys .....	479
Ensuring Unique Values for Natural Keys .....	480
Creating an Alternate Key.....	482
Using Natural Keys as Primary Keys .....	487
Creating Composite Keys .....	490
Summary .....	495
<b>■ Chapter 20: Queries .....</b>	<b>497</b>
Preparing for This Chapter .....	498
Managing Change Tracking for Query Results .....	500
Removing Individual Objects from Change Tracking .....	502
Changing the Default Change Tracking Behavior.....	503
Using a Query Filter .....	505
Overriding a Query Filter.....	509
Querying Using Search Patterns .....	512
Making Asynchronous Queries .....	515
Explicitly Compiling Queries .....	518
Avoiding the Client Evaluation Pitfall.....	520
Throwing a Client Evaluation Exception .....	523
Summary .....	525

<b>■ Chapter 21: Storing Data .....</b>	<b>527</b>
Preparing for This Chapter .....	528
Specifying SQL Data Types .....	531
Specifying a Maximum Length .....	533
Updating the Database .....	534
Validating or Formatting Data Values .....	536
Avoiding the Backing Field Selective Update Pitfall .....	539
Hiding Data Values from the MVC Application .....	543
Accessing Shadow Property Values.....	544
Including Shadow Properties in Queries.....	545
Setting Default Values .....	546
Displaying the Default Value .....	548
Detecting Concurrent Updates .....	551
Using Concurrency Tokens.....	552
Using a Row Version to Detect Concurrent Updates.....	557
Summary.....	562
<b>■ Chapter 22: Deleting Data.....</b>	<b>563</b>
Preparing for This Chapter .....	563
Understanding Delete Constraints.....	568
Configuring the Delete Behavior.....	570
Using the Cascade Delete Behavior .....	571
Setting Foreign Keys to Null .....	573
Relying on the Database Server to Change Foreign Keys .....	574
Relying on Entity Framework Core to Update Foreign Keys .....	576
Taking Control of the Delete Operation.....	581
Re-creating the Cascade Behavior .....	581
Re-creating the Set Null Behavior .....	582
Reinstating the Soft-Delete Feature .....	583
Summary .....	587

<b>■ Chapter 23: Using Database Server Features .....</b>	<b>589</b>
Preparing for This Chapter .....	590
Using SQL Directly .....	594
Querying Using SQL.....	594
Calling Stored Procedures or Other Operations .....	607
Using Server-Generated Values.....	611
Using Database Server–Generated Default Values.....	611
Incorporating Sequential Values.....	616
Computing Values in the Database .....	619
Modeling Automatically Generated Values .....	623
Summary.....	628
<b>■ Chapter 24: Using Transactions.....</b>	<b>629</b>
Preparing for This Chapter .....	630
Understanding the Default Behavior .....	633
Performing Independent Changes .....	634
Disabling Automatic Transactions.....	636
Using Explicit Transactions.....	638
Including Other Operations in a Transaction.....	640
Changing the Transaction Isolation Level .....	642
Summary.....	645
<b>Index.....</b>	<b>647</b>