O'REILLY®

Fourth Edition

Head First C#

A Learner's Guide to Real-World Programming with C# and .NET Core

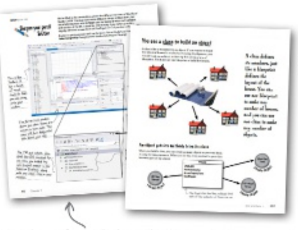
Andrew Stellman
& Jennifer Greene

A Brain-Friendly Guide

Head First C#

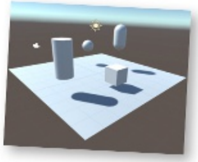
What will you learn from this book?

Dive into C# and create apps, user interfaces, games, and more using this fun and highly visual introduction to C#, .NET Core, and Visual Studio. With this completely updated guide, which covers C# 8.0 and Visual Studio 2019, beginning programmers like you will build a fully functional game in the opening chapter. Then you'll learn how to use classes and object-oriented programming, create 3D games in Unity, and query data with LINQ. And you'll do it all by solving puzzles, doing hands-on exercises, and building real-world applications. By the time you're done, you'll be a solid C# programmer—and you'll have a great time along the way!



Understand the difference between classes and objects.

Learn how to get the IDE to do your grunt work for you.



Exercise your C# skills by building 3D games in Unity...

Build satisfying and fun projects from the very first chapter.

...and by creating more serious apps.

Inheritance

Encapsulation

Abstraction

Polymorphism

Master the principles of object-oriented programming.

What's so special about this book?

Based on the latest research in cognitive science and learning theory, *Head First C#* uses a visually rich format to engage your mind rather than a text-heavy approach that puts you to sleep. Why waste your time struggling with new concepts? This multisensory learning experience is designed for the way your brain really works.

> "Thank you so much! Your books have helped me to launch my career."
>
> —***Ryan White***
> Game Developer

> "Andrew and Jennifer have written a concise, authoritative, and most of all, fun introduction to C# development."
>
> —***Jon Galloway***
> Senior Program Manager on the .NET Community Team at Microsoft

> "If you want to learn C# in depth and have fun doing it, this is THE book for you."
>
> —***Andy Parker***
> Fledgling C# programmer

.NET

US $64.99 **CAN $85.99**
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Praise for *Head First C#*

"Thank you so much! Your books have helped me to launch my career."

—Ryan White, Game Developer

"If you're a new C# developer (welcome to the party!), I highly recommend *Head First C#*. Andrew and Jennifer have written a concise, authoritative, and most of all, fun introduction to C# development. I wish I'd had this book when I was first learning C#!"

—Jon Galloway, Senior Program Manager on the .NET Community Team, Microsoft

"Not only does *Head First C#* cover all the nuances it took me a long time to understand, it has that Head First magic going on where it is just a super fun read."

—Jeff Counts, Senior C# Developer

"*Head First C#* is a great book with fun examples that keep learning interesting."

—Lindsey Bieda, Lead Software Engineer

"*Head First C#* is a great book, both for brand-new developers and developers like myself coming from a Java background. No assumptions are made as to the reader's proficiency, yet the material builds up quickly enough for those who are not complete newbies—a hard balance to strike. This book got me up to speed in no time for my first large-scale C# development project at work—I highly recommend it."

—Shalewa Odusanya, Principal

"*Head First C#* is an excellent, simple, and fun way of learning C#. It's the best piece for C# beginners I've ever seen—the samples are clear, the topics are concise and well written. The mini-games that guide you through the different programming challenges will definitely stick the knowledge to your brain. A great learn-by-doing book!"

—Johnny Halife, Partner

"*Head First C#* is a comprehensive guide to learning C# that reads like a conversation with a friend. The many coding challenges keep it fun, even when the concepts are tough."

—Rebeca Dunn-Krahn, founding Partner, Sempahore Solutions

"I've never read a computer book cover to cover, but this one held my interest from the first page to the last. If you want to learn C# in depth and have fun doing it, this is THE book for you."

—Andy Parker, fledgling C# Programmer

More Praise for *Head First C#*

"It's hard to really learn a programming language without good, engaging examples, and this book is full of them! *Head First C#* will guide beginners of all sorts to a long and productive relationship with C# and the .NET Framework."

—Chris Burrows, Software Engineer

"With *Head First C#*, Andrew and Jenny have presented an excellent tutorial on learning C#. It is very approachable while covering a great amount of detail in a unique style. If you've been turned off by more conventional books on C#, you'll love this one."

—Jay Hilyard, Director and Software Security Architect, and author of *C# 6.0 Cookbook*

"I'd recommend this book to anyone looking for a great introduction into the world of programming and C#. From the first page onwards, the authors walk the reader through some of the more challenging concepts of C# in a simple, easy-to-follow way. At the end of some of the larger projects/labs, the reader can look back at their programs and stand in awe of what they've accomplished."

—David Sterling, Principal Software Developer

"*Head First C#* is a highly enjoyable tutorial, full of memorable examples and entertaining exercises. Its lively style is sure to captivate readers—from the humorously annotated examples to the Fireside Chats, where the abstract class and interface butt heads in a heated argument! For anyone new to programming, there's no better way to dive in."

—Joseph Albahari, inventor of LINQPad, and coauthor of *C# 8.0 in a Nutshell* and *C# 8.0 Pocket Reference*

"[*Head First C#*] was an easy book to read and understand. I will recommend this book to any developer wanting to jump into the C# waters. I will recommend it to the advanced developer that wants to understand better what is happening with their code. [I will recommend it to developers who] want to find a better way to explain how C# works to their less-seasoned developer friends."

—Giuseppe Turitto, Director of Engineering

"Andrew and Jenny have crafted another stimulating Head First learning experience. Grab a pencil, a computer, and enjoy the ride as you engage your left brain, right brain, and funny bone."

—Bill Mietelski, Advanced Systems Analyst

"Going through this *Head First C#* book was a great experience. I have not come across a book series which actually teaches you so well.…This is a book I would definitely recommend to people wanting to learn C#."

—Krishna Pala, MCP

Praise for other *Head First* books

"I received the book yesterday and started to read it…and I couldn't stop. This is definitely très 'cool.' It is fun, but they cover a lot of ground and they are right to the point. I'm really impressed."

—Erich Gamma, IBM Distinguished Engineer, and coauthor of *Design Patterns*

"One of the funniest and smartest books on software design I've ever read."

— Aaron LaBerge, SVP Technology & Product Development, ESPN

"What used to be a long trial and error learning process has now been reduced neatly into an engaging paperback."

— Mike Davidson, former VP of Design, Twitter, and founder of Newsvine

"Elegant design is at the core of every chapter here, each concept conveyed with equal doses of pragmatism and wit."

— Ken Goldstein, Executive VP & Managing Director, Disney Online

"Usually when reading through a book or article on design patterns, I'd have to occasionally stick myself in the eye with something just to make sure I was paying attention. Not with this book. Odd as it may sound, this book makes learning about design patterns fun.

"While other books on design patterns are saying 'Bueller… Bueller… Bueller…' this book is on the float belting out 'Shake it up, baby!'"

— Eric Wuehler

"I literally love this book. In fact, I kissed this book in front of my wife."

— Satish Kumar

Related books from O’Reilly

C# 8.0 in a Nutshell

C# 8.0 Pocket Reference

C# Database Basics

C# Essentials, 2nd Edition

Concurrency in C# Cookbook, 2nd Edition

Mobile Development with C#

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Head First Software Development

Head First SQL

Head First Statistics

Head First Web Design

Head First WordPress

Head First C#

Fourth Edition

WOULDN'T IT BE DREAMY IF THERE WAS A C# BOOK THAT WAS MORE FUN THAN MEMORIZING A DICTIONARY? IT'S PROBABLY NOTHING BUT A FANTASY...

Andrew Stellman
Jennifer Greene

Beijing • Boston • Farnham • Sebastopol • Tokyo
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Fourth Edition

by Andrew Stellman and Jennifer Greene

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While every precaution has been taken in the preparation of this book, the publisher and the authors assume no responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.

No bees, space aliens, or comic book heroes were harmed in the making of this book.

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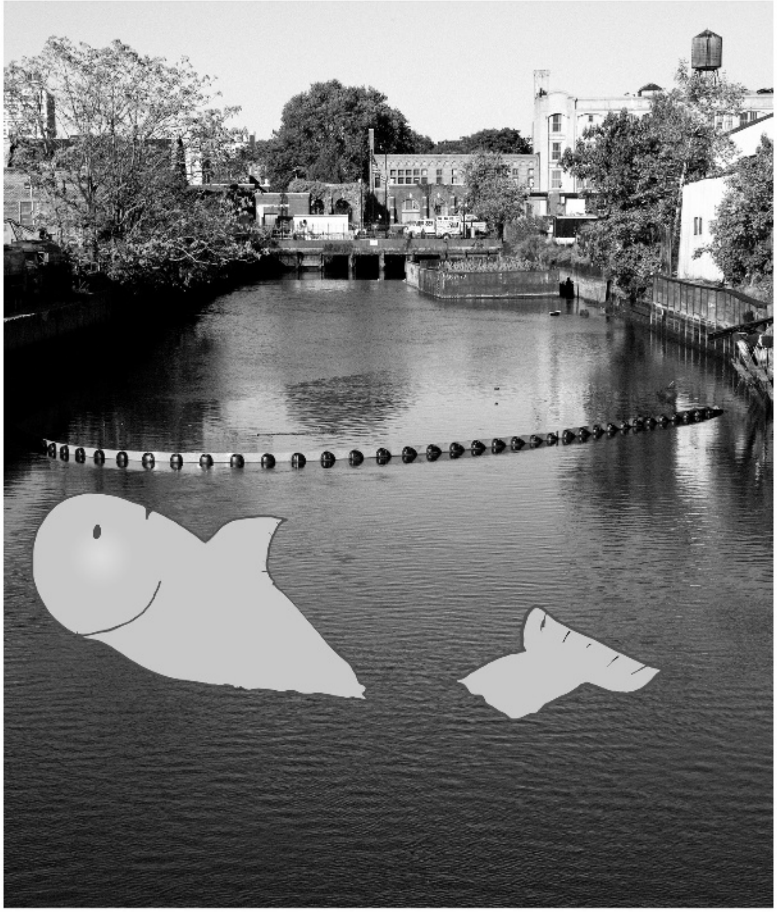
[LSI] [2020-12-18]

*This book is dedicated to the loving memory of Sludgie the Whale,
who swam to Brooklyn on April 17, 2007.*



*You were only in our canal for a day,
but you'll be in our hearts forever.*

THANKS FOR READING OUR BOOK! WE REALLY LOVE WRITING ABOUT THIS STUFF, AND WE HOPE YOU GET A LOT OUT OF IT...
...BECAUSE WE KNOW YOU'RE GOING TO HAVE A GREAT TIME LEARNING C#.

Andrew

This photo (and the photo of the Gowanus Canal) by Nisha Sondhe

Jenny

Andrew Stellman, despite being raised a New Yorker, has lived in Minneapolis, Geneva, and Pittsburgh... *twice*, first when he graduated from Carnegie Mellon's School of Computer Science, and then again when he and Jenny were starting their consulting business and writing their first book for O'Reilly.

Andrew's first job after college was building software at a record company, EMI-Capitol Records—which actually made sense, as he went to LaGuardia High School of Music & Art and the Performing Arts to study cello and jazz bass guitar. He and Jenny first worked together at a company on Wall Street that built financial software, where he was managing a team of programmers. Over the years he's been a vice president at a major investment bank, architected large-scale real-time backend systems, managed large international software teams, and consulted for companies, schools, and organizations, including Microsoft, the National Bureau of Economic Research, and MIT. He's had the privilege of working with some pretty amazing programmers during that time, and likes to think that he's learned a few things from them.

When he's not writing books, Andrew keeps himself busy writing useless (but fun) software, playing (and making) both music and video games, practicing krav maga, tai chi, and aikido, and owning a crazy Pomeranian.

Jennifer Greene studied philosophy in college but, like everyone else in the field, couldn't find a job doing it. Luckily, she's a great software engineer, so she started out working at an online service, and that's the first time she really got a good sense of what good software development looked like.

She moved to New York in 1998 to work on software quality at a financial software company. She's managed teams of developers, testers, and PMs on software projects in media and finance since then.

Jenny has traveled all over the world to work with different software teams and build all kinds of cool projects.

She loves traveling, watching Bollywood movies, reading the occasional comic book, playing video games, and hanging out with her huge Siberian cat, Sascha, and her miniature bull terrier, Greta.

Jenny and Andrew have been building software and writing about software engineering together since they first met in 1998. Their first book, **Applied Software Project Management**, was published by O'Reilly in 2005. Other Stellman and Greene books for O'Reilly include **Beautiful Teams** (2009), **Learning Agile** (2014), and their first book in the Head First series, **Head First PMP** (2007), now in its fourth edition.

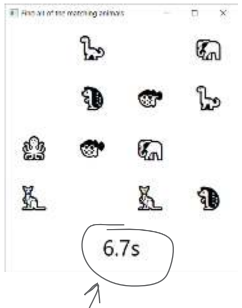
They founded Stellman & Greene Consulting in 2003 to build a really neat software project for scientists studying herbicide exposure in Vietnam vets. In addition to building software and writing books, they've consulted for companies and spoken at conferences and meetings of software engineers, architects, and project managers.

Learn more about them on their website, **Building Better Software**: https://www.stellman-greene.com.

Follow **@AndrewStellman** and **@JennyGreene** on Twitter

☮❤👾 Jenny and Andrew

Table of Contents (the summary)



Let's add some excitement to the game! The time elapsed since the game started will appear at the bottom of the window, constantly going up, and only stopping after the last animal is matched.

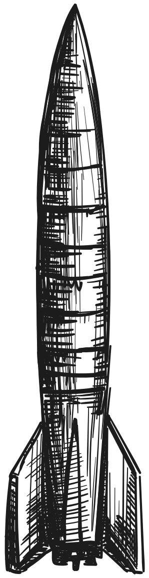
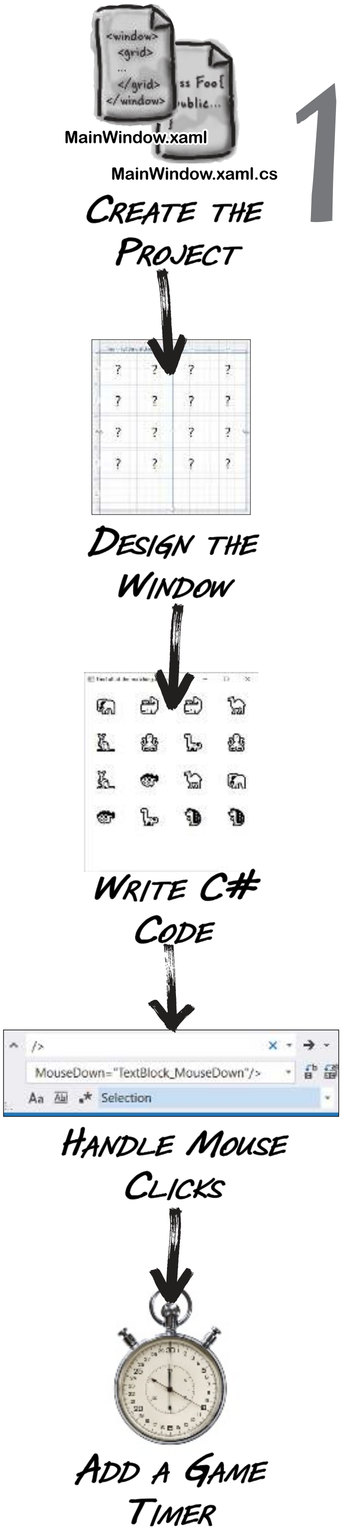


Table of Contents (the real thing)

Intro

Your brain on C#. You're sitting around trying to *learn* something, but your *brain* keeps telling you all that learning *isn't important*. Your brain's saying, "Better leave room for more important things, like which wild animals to avoid and whether nude archery is a bad idea." So how *do* you trick your brain into thinking that your life really depends on learning C#?



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1

start building with C#

Build something great...fast!

Want to build great apps…right now?

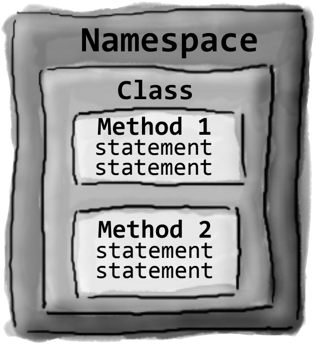
With C#, you’ve got a **modern programming language** and a **valuable tool** at your fingertips. And with **Visual Studio**, you’ve got an **amazing development environment** with highly intuitive features that make coding as easy as possible. Not only is Visual Studio a great tool for writing code, it’s also a **really valuable learning tool** for exploring C#. Sound appealing? Turn the page, and let’s get coding.

2 dive into C#

Statements, classes, and code

You're not just an IDE user. You're a developer.

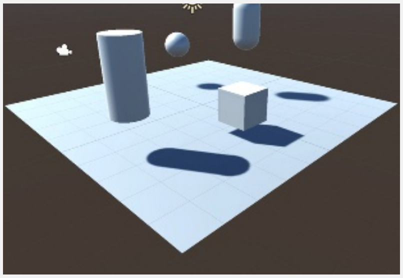
You can get a lot of work done using the IDE, but there's only so far it can take you. Visual Studio is one of the most advanced software development tools ever made, but a **powerful IDE** is only the beginning. It's time to **dig in to C# code**: how it's structured, how it works, and how you can take control of it…because there's no limit to what you can get your apps to do.

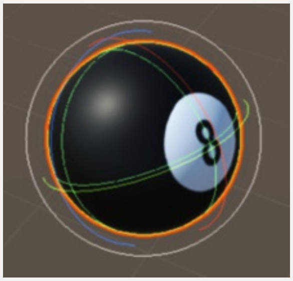


Unity Lab 1

Explore C# with Unity

Welcome to your first **Head First C# Unity Lab**. Writing code is a skill, and like any other skill, getting better at it takes **practice and experimentation**. Unity will be a really valuable tool for that. In this lab, you can begin practicing what you've learned about C# in Chapters 1 and 2.



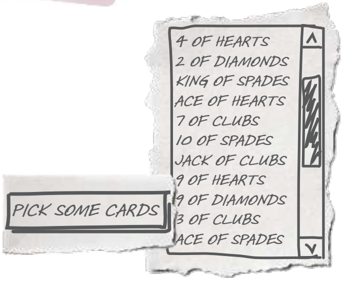


3 objects...get oriented!

Making code make sense

Every program you write solves a problem.

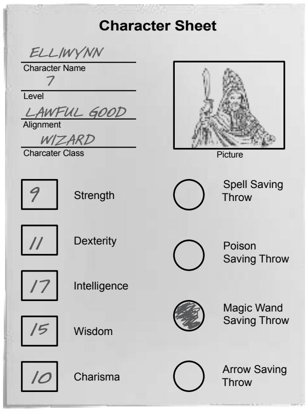
When you're building a program, it's always a good idea to start by thinking about what *problem* your program's supposed to solve. That's why **objects** are really useful. They let you structure your code based on the problem it's solving so that you can spend your time *thinking about the problem* you need to work on rather than getting bogged down in the mechanics of writing code. When you use objects right—and really put some thought into how you design them—you end up with code that's *intuitive* to write, and easy to read and change.



types and references

4 Getting the reference

What would your apps be without data? Think about it for a minute. Without data, your programs are…well, it's actually hard to imagine writing code without data. You need **information** from your users, and you use that to look up or produce new information to give back to them. In fact, almost everything you do in programming involves **working with data** in one way or another. In this chapter, you'll learn the ins and outs of C#'s **data types** and **references**, see how to work with data in your program, and even learn a few more things about **objects** (*guess what…objects are data, too!*).



Character Sheet

ELLIWYNN
Character Name

7
Level

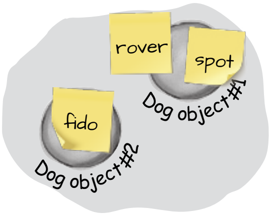
LAWFUL GOOD
Alignment

WIZARD
Charcater Class

Picture

9	Strength	○	Spell Saving Throw
11	Dexterity	○	Poison Saving Throw
17	Intelligence	●	Magic Wand Saving Throw
15	Wisdom		
10	Charisma	○	Arrow Saving Throw

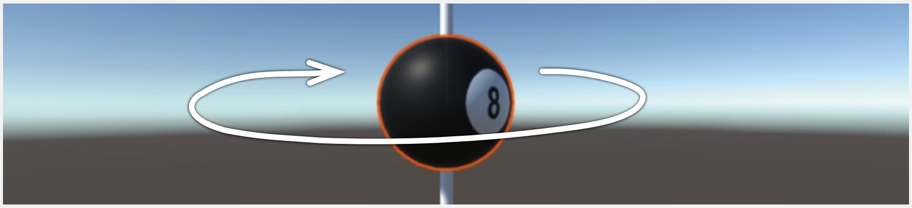
Creating a reference is like writing a name on a sticky note and sticking it to the object. You're using it to label an object so you can refer to it later.



Unity Lab 2

Write C# Code for Unity

Unity isn't *just* a powerful, cross-platform engine and editor for building 2D and 3D games and simulations. It's also a **great way to get practice writing C# code**. In this lab, you'll get more practice writing C# code for a project in Unity.



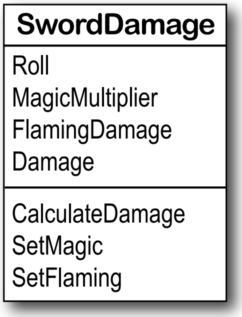
5

encapsulation

Keep your privates...private

Ever wished for a little more privacy?

Sometimes your objects feel the same way. Just like you don't want anybody you don't trust reading your journal or paging through your bank statements, good objects don't let ***other*** objects go poking around their fields. In this chapter, you're going to learn about the power of **encapsulation**, a way of programming that helps you make code that's flexible, easy to use, and difficult to misuse. You'll **make your objects' data private**, and add **properties** to protect how that data is accessed.



```
RealName: "Herb Jones"

Alias: "Dash Martin"

Password: "the crow flies at midnight"
```

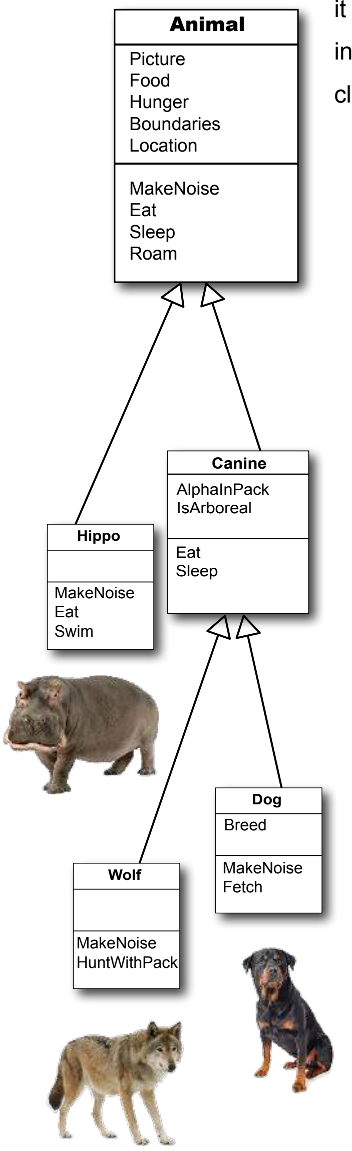
6

inheritance

Your object's family tree

Sometimes you *DO* want to be just like your parents.

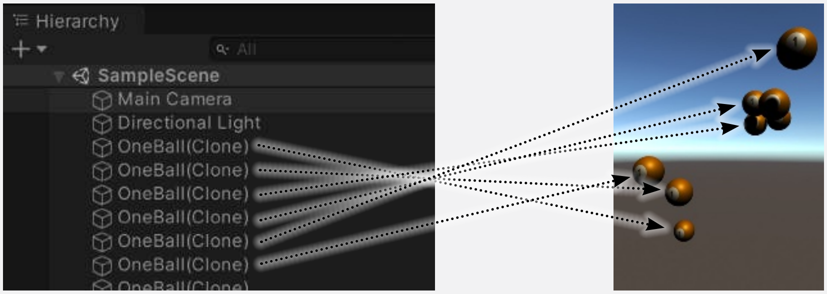
Ever run across a class that ***almost*** does exactly what you want ***your*** class to do? Found yourself thinking that if you could just ***change a few things***, that class would be perfect? With **inheritance**, you can **extend** an existing class so your new class gets all of its behavior—with the **flexibility** to make changes to that behavior so you can tailor it however you want. Inheritance is one of the most powerful concepts and techniques in the C# language: with it you'll **avoid duplicate code**, **model the real world** more closely, and end up with apps that are **easier to maintain** and **less prone to bugs**.



Unity Lab 3

GameObject Instances

C# is an object-oriented language, and since these Head First C# Unity Labs are all **about getting practice writing C# code**, it makes sense that these labs will focus on creating objects.


Hierarchy
All
SampleScene
Main Camera
Directional Light
OneBall(Clone)
OneBall(Clone)
OneBall(Clone)
OneBall(Clone)
OneBall(Clone)
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