To our brains, for always being there

(despite shaky evidence)

Creators of the Head First series

Kathy Sierra

Bert Bates

Kathy has been interested in learning theory since her days as a game designer (she wrote games for Virgin, MGM, and Amblin'). She developed much of the Head First format while teaching New Media Authoring for UCLA Extension's Entertainment Studies program. More recently, she's been a master trainer for Sun Microsystems, teaching Sun's Java instructors how to teach the latest Java technologies, and a lead developer of several of Sun's Java programmer and developer certification exams. Together with Bert Bates, she has been actively using the concepts in Head First Java to teach hundreds of trainers, developers and even non-programmers. She is also the founder of one of the largest Java community websites in the world, javaranch.com, and the Creating Passionate Users blog.

Along with this book, Kathy co-authored Head First Servlets, Head First EJB, and Head First Design Patterns.

In her spare time she enjoys her new Icelandic horse, skiing, running, and the speed of light.

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Bert is a software developer and architect, but a decade-long stint in artificial intelligence drove his interest in learning theory and technology-based training. He's been teaching programming to clients ever since. Recently, he's been a member of the development team for several of Sun's Java Certification exams.

He spent the first decade of his software career travelling the world to help broadcast clients like Radio New Zealand, the Weather Channel, and the Arts & Entertainment Network (A & E). One of his all-time favorite projects was building a full rail system simulation for Union Pacific Railroad.

Bert is a hopelessly addicted Go player, and has been working on a Go program for way too long. He's a fair guitar player, now trying his hand at banjo, and likes to spend time skiing, running, and trying to train (or learn from) his Icelandic horse Andi.

Bert co-authored the same books as Kathy, and is hard at work on the next batch of books (check the blog for updates).

You can sometimes catch him on the IGS Go server (under the login *jackStraw*).

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Although Kathy and Bert try to answer as much email as they can, the volume of mail and their travel schedule makes that difficult. The best (quickest) way to get technical help with the book is at the *very* active Java beginners forum at javaranch.com.

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Table of Contents (the full version)

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Your brain on Java. Here *you* are trying to *learn* something, while here your *brain* is doing you a favor by making sure the learning doesn't *stick*. Your brain's thinking, "Better leave room for more important things, like which wild animals to avoid and whether naked snowboarding is a bad idea." So how *do* you trick your brain into thinking that your life depends on knowing Java?

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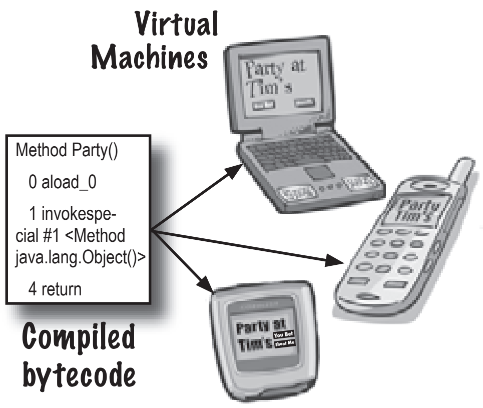
1 Breaking the Surface

Java takes you to new places. From its humble release to the public as the (wimpy) version 1.02, Java seduced programmers with its friendly syntax, object-oriented features, memory management, and best of all—the promise of portability. We'll take a quick dip and write some code, compile it, and run it. We're talking syntax, loops, branching, and what makes Java so cool. Dive in.



```
Method Party()
  0 aload_0
  1 invokespe-
cial #1 <Method
java.lang.Object()>
  4 return
```

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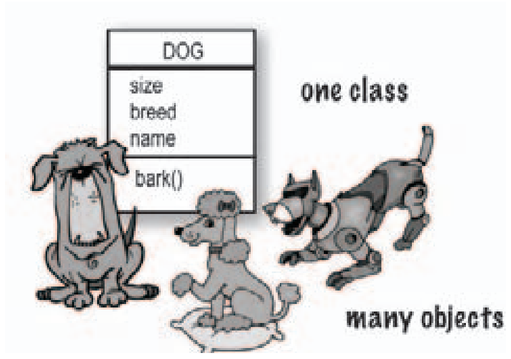
2 A Trip to Objectville

I was told there would be objects. In Chapter 1, we put all of our code in the main() method. That's not exactly object-oriented. So now we've got to leave that procedural world behind and start making some objects of our own. We'll look at what makes object-oriented (OO) development in Java so much fun. We'll look at the difference between a class and an object. We'll look at how objects can improve your life.



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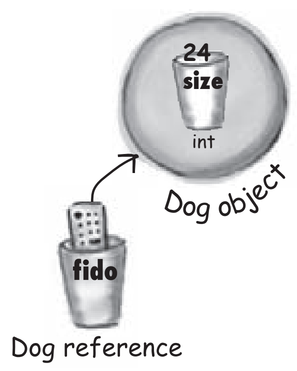
3 Know Your Variables

Variables come in two flavors: primitive and reference. There's gotta be more to life than integers, Strings, and arrays. What if you have a PetOwner object with a Dog instance variable? Or a Car with an Engine? In this chapter we'll unwrap the mysteries of Java types and look at what you can *declare* as a variable, what you can *put* in a variable, and what you can *do* with a variable. And we'll finally see what life is truly like on the garbage-collectible heap.



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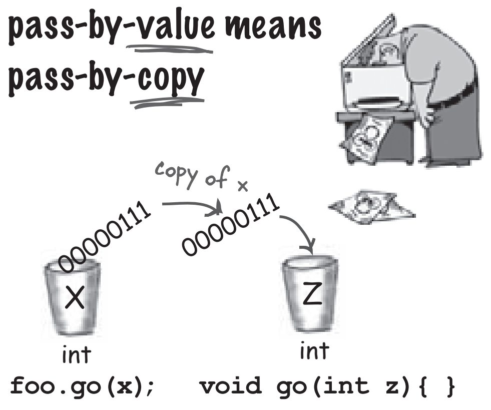
4 How Objects Behave

State affects behavior, behavior affects state. We know that objects have **state** and **behavior**, represented by **instance variables** and **methods**. Now we'll look at how state and behavior are *related*. An object's behavior uses an object's unique state. In other words, ***methods use instance variable values***. Like, "if dog weight is less than 14 pounds, make yippy sound, else..." ***Let's go change some state!***



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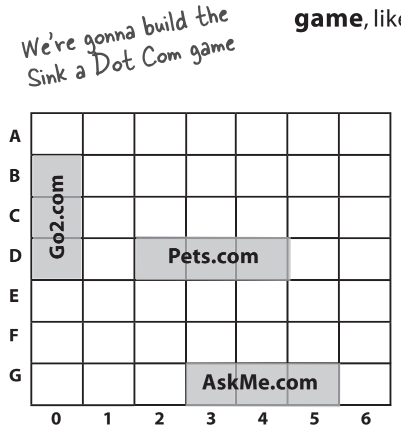
5 **Extra-Strength Methods**

Let's put some muscle in our methods. You dabbled with variables, played with a few objects, and wrote a little code. But you need more tools. Like **operators**. And **loops**. Might be useful to **generate random numbers**. And **turn a String into an int**, yeah, that would be cool. And why don't we learn it all by *building* something real, to see what it's like to write (and test) a program from scratch. **Maybe a game**, like Sink a Dot Com (similar to Battleship).



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6 **Using the Java Library**

Java ships with hundreds of pre-built classes. You don't have to reinvent the wheel if you know how to find what you need from the Java library, commonly known as the **Java API**. *You've got better things to do.* If you're going to write code, you might as well write *only* the parts that are custom for your application. The core Java library is a giant pile of classes just waiting for you to use like building blocks.

*"Good to know there's an ArrayList in the java.util package. But by myself, how would **I** have figured that out?"*

- Julia, 31, hand model

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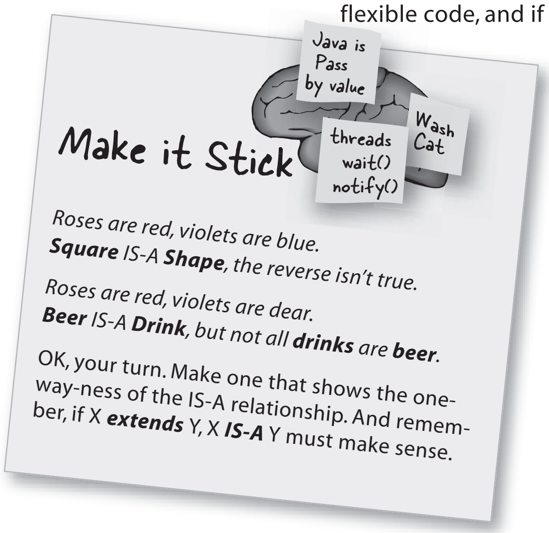
7 Better Living in Objectville

Plan your programs with the future in mind. What if you could write code that someone *else* could extend, **easily**? What if you could write code that was flexible, for those pesky last-minute spec changes? When you get on the Polymorphism Plan, you'll learn the 5 steps to better class design, the 3 tricks to polymorphism, the 8 ways to make flexible code, and if you act now—a bonus lesson on the 4 tips for exploiting inheritance.



Roses are red, violets are blue.
Square IS-A **Shape**, the reverse isn't true.

Roses are red, violets are dear.
Beer IS-A **Drink**, but not all **drinks** are **beer**.

OK, your turn. Make one that shows the one-way-ness of the IS-A relationship. And remember, if X ***extends*** Y, X ***IS-A*** Y must make sense.

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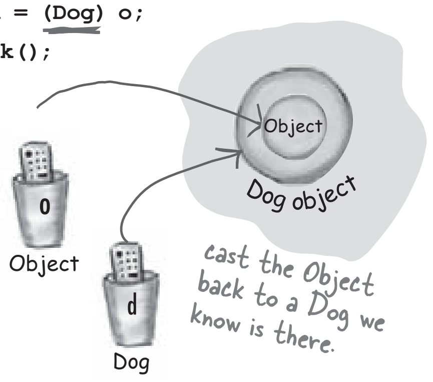
8 Serious Polymorphism

Inheritance is just the beginning. To exploit polymorphism, we need interfaces. We need to go beyond simple inheritance to flexibility you can get only by designing and coding to interfaces. What's an interface? A 100% abstract class. What's an abstract class? A class that can't be instantiated. What's that good for? Read the chapter...

```
Object o = al.get(id);
Dog d = (Dog) o;
d.bark();
```



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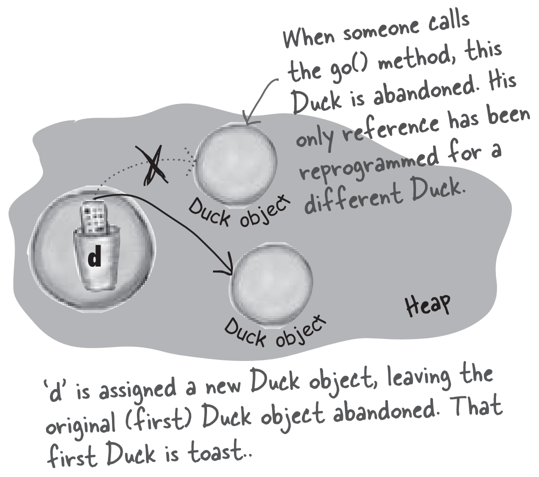
9 Life and Death of an Object

Objects are born and objects die. You're in charge. You decide when and how to *construct* them. You decide when to *abandon* them. The **Garbage Collector (gc)** reclaims the memory. We'll look at how objects are created, where they live, and how to keep or abandon them efficiently. That means we'll talk about the heap, the stack, scope, constructors, super constructors, null references, and gc eligibility.



When someone calls the go() method, this Duck is abandoned. His only reference has been reprogrammed for a different Duck.
Duck object
d
Duck object
Heap
'd' is assigned a new Duck object, leaving the original (first) Duck object abandoned. That first Duck is toast..

The stack and the heap, where objects and variables live 236
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10 Numbers Matter

Do the Math. The Java API has methods for absolute value, rounding, min/max, etc. But what about formatting? You might want numbers to print exactly two decimal points, or with commas in all the right places. And you might want to print and manipulate dates, too. And what about parsing a String into a number? Or turning a number into a String? We'll start by learning what it means for a variable or method to be *static*.

Static variables are shared by all instances of a class.

static variable: iceCream
kid instance one
kid instance two
instance variables: one per instance
static variables: one per class

Math class (do you really need an instance of it?) 274
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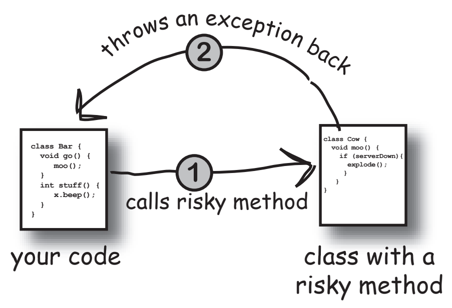
11 Risky Behavior

Stuff happens. The file isn't there. The server is down. No matter how good a programmer you are, you can't control *everything*. When you write a risky method, you need code to handle the bad things that might happen. But how do you *know* when a method is risky? Where do you put the code to *handle* the ***exceptional*** situation? In *this* chapter, we're going to build a MIDI Music Player, that uses the risky JavaSound API, so we better find out.



```
class Bar {
  void go() {
     moo();
  }
  int stuff() {
     x.beep();
  }
}
```

```
class Cow {
  void moo() {
    if (serverDown){
      explode();
    }
  }
}
```

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12 A Very Graphic Story

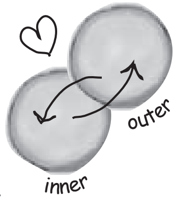
Face it, you need to make GUIs. Even if you believe that for the rest of your life you'll write only server-side code, sooner or later you'll need to write tools, and you'll want a graphical interface. We'll spend two chapters on GUIs, and learn more language features including **Event Handling** and **Inner Classes**. We'll put a button on the screen, we'll paint on the screen, we'll display a jpeg image, and we'll even do some animation.

```
class MyOuter  {

   class MyInner {
      void go() {
        }
    }

}
```

The outer and inner objects are now intimately linked.



These two objects on the heap have a special bond. The inner can use the outer's variables (and vice-versa).

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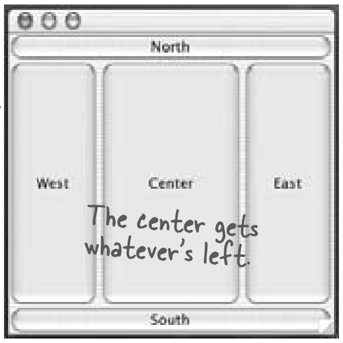
13 Work on your Swing

Swing is easy. Unless you actually *care* where everything goes. Swing code *looks* easy, but then compile it, run it, look at it and think, "hey, *that's* not supposed to go *there*." The thing that makes it *easy* to *code* is the thing that makes it *hard* to *control*—the **Layout Manager**. But with a little work, you can get layout managers to submit to your will. In this chapter, we'll work on our Swing and learn more about widgets.

Components in the east and west get their preferred width.

Things in the north and south get their preferred height.



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14 Saving Objects

Objects can be flattened and inflated. Objects have state and behavior. Behavior lives in the class, but *state* lives within each individual *object*. If your program needs to save state, *you can do it the hard way*, interrogating each object, painstakingly writing the value of each instance variable. Or, **you can do it the easy OO way**—you simply freeze-dry the object (serialize it) and reconstitute (deserialize) it to get it back.

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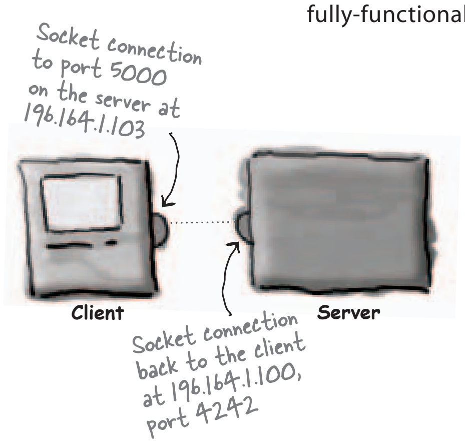
15 Make a Connection

Connect with the outside world. It's easy. All the low-level networking details are taken care of by classes in the java.net library. One of Java's best features is that sending and receiving data over a network is really just I/O with a slightly different connection stream at the end of the chain. In this chapter we'll make client sockets. We'll make server sockets. We'll make clients and servers. Before the chapter's done, you'll have a fully-functional, multithreaded chat client. Did we just say *multithreaded*?


Socket connection to port 5000 on the server at 196.164.1.103
Client
Server
Socket connection back to the client at 196.164.1.100, port 4242

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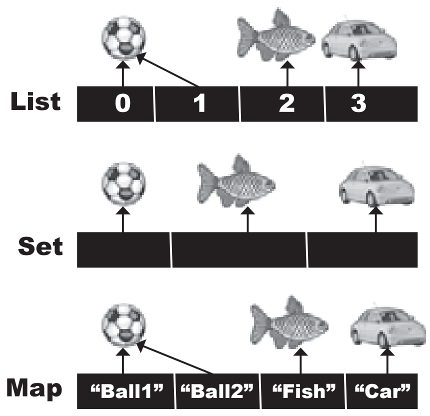
16 Data Structures

Sorting is a snap in Java. You have all the tools for collecting and manipulating your data without having to write your own sort algorithms The Java Collections Framework has a data structure that should work for virtually anything you'll ever need to do. Want to keep a list that you can easily keep adding to? Want to find something by name? Want to create a list that automatically takes out all the duplicates? Sort your co-workers by the number of times they've stabbed you in the back?



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Avoiding duplicates with HashSet 559

Overriding hashCode() and equals() 560

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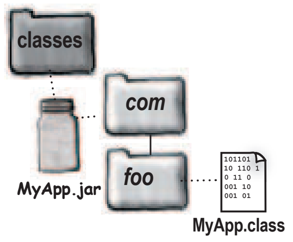
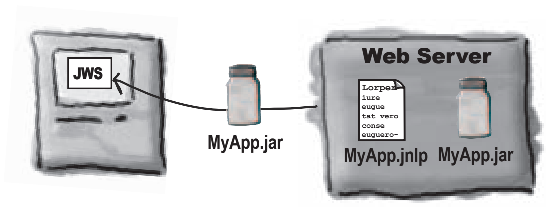
17 Release Your Code

It's time to let go. You wrote your code. You tested your code. You refined your code. You told everyone you know that if you never saw a line of code again, that'd be fine. But in the end, you've created a work of art. The thing actually runs! But now what? In these final two chapters, we'll explore how to organize, package, and deploy your Java code. We'll look at local, semi-local, and remote deployment options including executable jars, Java Web Start, RMI, and Servlets. Relax. Some of the coolest things in Java are easier than you think.





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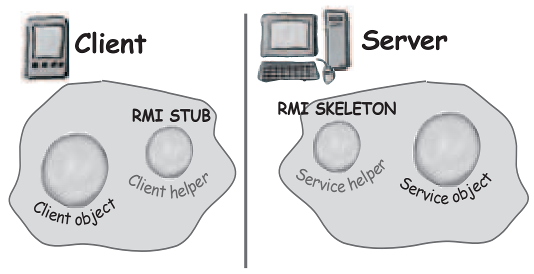
18 **Distributed Computing**

Being remote doesn't have to be a bad thing. Sure, things *are* easier when all the parts of your application are in one place, in one heap, with one JVM to rule them all. But that's not always possible. Or desirable. What if your application handles powerful computations? What if your app needs data from a secure database? In this chapter, we'll learn to use Java's amazingly simple Remote Method Invocation (RMI). We'll also take a quick peek at Servlets, Enterprise Java Beans (EJB) , and Jini.



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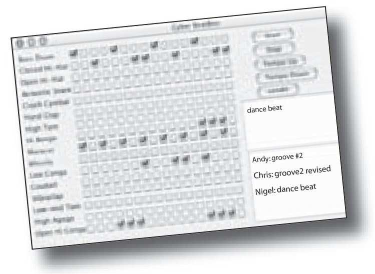
A **Appendix A**

The final Code Kitchen project. All the code for the full client-server chat beat box. Your chance to be a rock star.



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MusicServer (server code)	657

B **Appendix B**

The Top Ten Things that didn't make it into the book. We can't send you out into the world just yet. We have a few more things for you, but this *is* the end of the book. And this time we really mean it.

Top Ten List	660

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