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Building an Application: Introduction

by Dana Nourie, *October 2001*

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Overview

Many Java™ Application Programming Interfaces (APIs) are used in application programming. As you learn how to create buttons or write text to files, figuring out how to fit the technologies together into a single application can be difficult and confusing. Seeing an application built from the ground up can be more useful than just reading how to make a menu bar or read a file into a Graphical User Interface (GUI).

This six-part tutorial details application development, using a single fully-featured application as an example. You'll learn how to:

- Use predefined objects and creating new objects.
- Call predefined methods and writing new methods.
- Create GUI components, such as tabbed panes, buttons, menus, text fields, and text areas.
- Use AWT layout managers and event handlers.
- Print text and images to the screen.
- Read from and writing to files.
- Open an HTML page in the application and activating the links.

You'll also learn about packages and packaging an application for distribution, and the Java technologies referred to as Java I/O, Project Swing, and AWT.

The application created for this series tutorial is a simple dive log, such as one a scuba diver might use to record dive depth, water temperature and conditions, and air consumed.

Though to a certified scuba diver, this application falls short of being a robust, detailed dive log, it serves as an example application, demonstrating features commonly used in application programming.

The tutorial begins with simple concepts and leads to more complex programming techniques, introducing new concepts and repeating programming techniques throughout.

- The first half of each series part explains how to create the GUI for that particular pane.
- The second half details the functionality of any buttons, menus, text fields, and so forth.

This tutorial is aimed at beginning programmers, or developers new to Java technology. Though programming concepts are introduced and many given great detail, this is not intended to be a comprehensive tutorial to all Java programming syntax.

What You Need

You don't need to be a certified scuba diver to follow this tutorial (though diving is a lot of fun and you might consider trying it). You also don't need a lot of experience with the Java programming language.

Familiarity with programming is helpful, and it's recommended that you at least understand what the Java platform is and how to set it up on your computer.

If Java technology is new to you, read the following articles before starting the tutorial:

- [About Java Technology](#)
- [Introducing the Java Platform](#)
- [Setting Up and Getting Started](#)

The following software is required to compile the code in this tutorial:

- [Java 2 Platform, Standard Edition \(J2SE™\)](#)
This dive log was created using J2SE version 1.3. J2SE includes the compiler and API needed for creating the Java technology dive log.
- A text editor for writing classes. Use a simple text editor. If you use a full-fledged word processor, save class files as text and create a `.java` extension. Examples are shown in the tutorial.

Optional

[Forte™ for Java](#)

This is an Integrated Development Environment (IDE) that enables you to write, compile, and run code within one application. In addition, it has short cut features to use for creating buttons, toolbars, and many other widgets or components. Learning an IDE can be time-consuming, so many programmers opt for a simple text editor and use the command line for compiling.

Start the Tutorial

If a dive log is not to your liking, feel free to change the text and code to better suit your needs. Perhaps you'd rather design a diet or exercise log, or some other kind of application. You can learn a lot by taking prewritten code and changing it. In fact, that is the theme of object oriented programming: Reuse, don't start from scratch.

As each part of the tutorial is completed, the titles below will be linked. With that in mind, start the tutorial:

[Part 1: Application Objects, Classes, Constructors, and Methods](#)  (October 2001)

[Part 2: Inheritance, Images, Text, and Layouts](#) (December 2001)

Part 3: Receiving User Input Through Text Fields and Check Boxes, and the Basics Event Handling

Part 4: Scroll Bars, Pop-up Option Boxes, Reading From and Writing to Files

Part 5: Converting Data, Operations and Expressions, Displaying Results

Part 6: Displaying HTML and Activating Links



[Click to enlarge](#)

Application Objects

The Java™ programming language has a lot in common with every day life. Each day you use objects, such as the car you drive, the meals you eat, and Internet pages you read.

Java applications are also built of objects, such as buttons, scroll bars, menus, and text areas.

In addition, objects do something. Your car gets you from one place to another. To do that, it has to have function, or many functions. Software objects also have function.

For action to take place in Java objects, blocks of code called methods are used. Methods tell an application what to do when buttons are clicked, menus are opened, and text is typed. Methods are either predefined or are created from scratch to manipulate objects, or the data within those objects.

The Dive Log application you're going to create consists of many objects. These objects are based on classes that detail how the object is defined and how it behaves.

This lesson covers the basics of using predefined classes and creating, or designing, new objects with your own classes. In addition, you'll learn how to work with objects by calling predefined methods and writing new methods to get the application to do what you want it to do.

Preparation

Before learning about the code for the Dive Log, you need to create a special directory for the files and images that build this application.

Saving Files

The Dive Log is designed from many classes, therefore many files. Keep them organized and in place.



Follow these steps...

1. Create a directory called `diveLog`.
2. Under the `diveLog` directory, create another directory called `images`.

The directory structure:

For the Windows platform:

```
C:\diveLog\images
```

For the Solaris™ environment:

```
%home/usr/diveLog/images
```

[Setting up the Java 2 Platform](#)

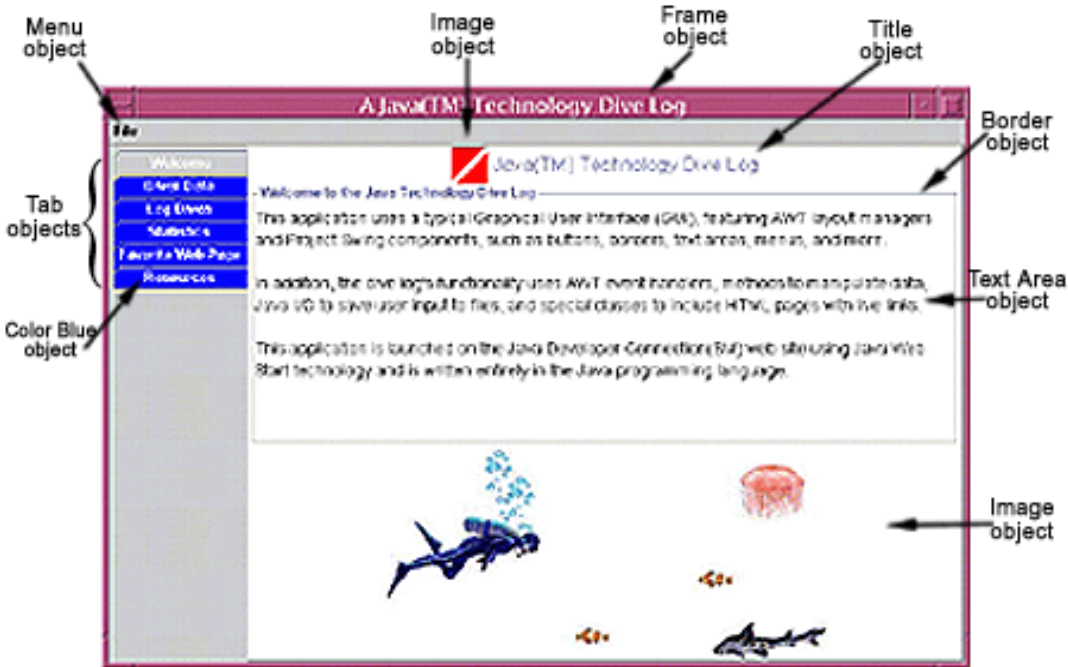
[Java 2 Platform, Standard Edition
version 1.3.1](#)

[Setting Up and Getting Started](#)

[Lesson: Solving Common Compiler and
Interpreter Problems](#)

Dive Log Objects

The concept of software objects is easier to understand with a real world example. Everything you're going to create for the Dive Log application is an object, including the application itself. The Dive Log application main screen lists some of the visible objects.



Visible objects in the completed Dive Log

Each object has its own characteristics, or state. The Title object is different from the Tab objects, and the Image objects are different from the Text Area objects. But before an object comes into existence, the design must be written.

Before cars and houses are built, someone designs a blueprint. Before a batch of cookies is baked, a recipe is written. Software objects are also created with a specific design.

The design for a software object is called a class. Classes detail, or specify, exactly how an object should appear and how it is to behave. Instructions for creating software objects are carefully written into the class using variables for data and information, and methods for manipulation of that data and information.

Do you think there is a limit to how many objects make up an application?	
Yes	No

Do you think there is a limit to how many objects make up an application?

There are no limits on how many objects you can create for an application.

The number of objects an application instantiates, or puts into memory, depends entirely on the requirements of the application.

The point to keep in mind about classes and objects is that the class is the plan, the object is the plan with all the details filled in and put into memory. In other words, the object is the actual button a user clicks rather than the

instructions or class that specifies button size or function.

About Classes

The classes that are a part of the Java™ J2SE™ download are complete, predefined classes you can use in your applications. These predefined classes provide features frequently used in creating applications, such as writing to and reading from files, creating graphical components like buttons and menus, and making web pages interactive.

To create an application, though, you need to define your own classes as well as using predefined classes from the Java library.

When you define a class, you are planning how the object created from that class is going to appear and behave. A class contains:

- **Fields**
Fields, or variables, store data and are frequently called data members. These variables often differentiate one object from another and define attributes such as amounts, names, titles, and so forth.
- **Methods**
Methods manipulate variables or objects, such as doing math operations, inputting characters or strings, printing text to the screen, adding a button to a menu bar, or simply instantiating an object.

What are Keywords?

Keywords are reserved words that cannot be used as variable, method, or class names because they are used in Java™ programming syntax.

`for`, `while`, `public`, `if`, and `class` are some keywords.

More on fields and methods later. For now, look at some kinds of classes you'll write to create objects for the Dive Log.

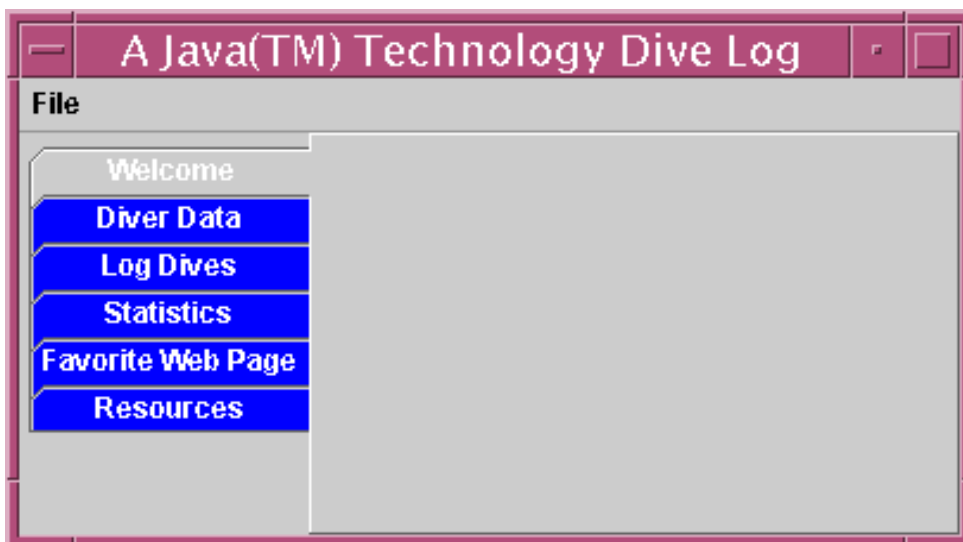
You'll need a frame for the application. Other components of the application are organized into tabbed panes. Each of those tab objects has white text and the background color blue. Later, you'll learn what goes on each pane and how to develop those objects. For now, you'll learn about frame and tab objects.

More About Objects

[Classes, Objects, and Constructors: What's the Difference?](#)

[Object-Oriented Programming Defined](#)

[What Is an Object?](#)



Result of creating frame and tab objects

Designing the classes for these objects makes more sense as code is covered in detail.

You will start with designing a few objects (the frame and tabs), then build on those classes as you progress through the lessons.



Follow these steps...

1. Take a look at the first class you are going to create: [DiveLog.java](#).
2. Note the syntax of how the names are written, paying special attention to which words start with uppercase letters and which do not.
3. Look at positions where the curly braces are placed.
4. Open your text editor to start your first class.
5. Copy and paste this line of code into your text editor:

```
package divelog;
```

6. Save the file, naming it `DiveLog.java`

Every class in the Dive Log starts with:

```
package divelog;
```

What is the purpose of the keyword `package`?

- A. Group and store related classes in a container.
- B. Make the classes in a package accessible to the compiler.
- C. All of the above.

The purpose of using the `package` keyword is to group **and** store related classes in a container, and to make the classes in a package accessible to the compiler.

Packages

The Java™ programming language has many predefined classes that can be used in applications. There are so many that the classes have been organized into groups called packages.

For instance, classes that support I/O (input and output) are contained within the `java.io` package, and classes for creating applets are in the `java.applet` package. Putting classes into packages organizes them conveniently for the compiler and for you.

More About Objects

[Naming Conventions](#)

[Code Conventions for the Java Programming Language](#)

[It's All in the Packaging](#)

[Creating a Package](#)

When you create applications, put the classes for your particular application into a package. The Dive Log application stores its files in a package called `diveLog`. This tells anyone looking at the code that the classes for the Dive Log application are in a directory called `diveLog`, just as `java.applet` classes are in a directory called `applet`, which is in a directory under `java`. In other words, package names correspond with directory names.

package `java.applet` has the directory structure:

```
/java/  
|  
 /applet
```

This `diveLog` package has the directory structure:

```
C:\diveLog
```

or

```
~/usr/home/diveLog
```

Naming Your Class Files

As you create class files, save them in the `diveLog` directory:

1. Copy or type the code as explained in the tutorial into a file.
2. Save the file with the same name as the class you are creating.
3. Name each file with the `.java` extension. A file with the class `DiveLog` defined should be called `DiveLog.java`.

When you use predefined Java API classes, the compiler needs to locate those classes. The package keyword is only going to map out classes for your particular application, not the Java API classes you may be using. Tell the compiler which and where the Java classes are in two ways:

- Writing out the entire package name and the class name:
`java.applet.Applet`
- Using an import statement at the top of your class:
`import java.applet.*;`

The second way, using import statements, tells the compiler your class includes classes from the `java.applet` package. This way, after the import

statement, you need only name the class rather than having to write out the fully qualified name as in the first example.

Getting Ready for the Graphical User Interface (GUI)

The Dive Log is an application with a graphical user interface (GUI). In fact, most of the application is the interface itself. In creating graphical features such as menus, tabs, text, images, and so forth, you will become familiar with Project Swing, the Java APIs that provide many predefined classes for GUI applications. In addition, you will learn about AWT, another large set of Java APIs that provides classes for designing the layout of the graphical objects, and functionality called event handling.

Importing Packages

To make it easy to use the Swing and AWT classes, include import statements in your class.



Follow these steps...

1. Copy and paste, or type the following lines of code into your `DiveLog.java` class file:

```
import javax.swing.*;

import java.awt.*;

import java.awt.event.*;
```

2. Save the file

These import statements allow easy access of the predefined classes in those packages. In this case, the packages with classes for GUI components have been imported, so now you needn't type out the fully qualified name, but instead can directly name the class you need to use. In other words, import statements give you a shortcut to class names in other packages. You'll see examples of this throughout the tutorial.

Class Definition

After package names and import statements, you are ready to define the class. The first class to define is the framework for the application itself, the `DiveLog` class:

```
public class DiveLog
{
```

This line tells the compiler:

- The class is `public`, meaning it's accessible from any other class in any package.
- That it is a class, hence the keyword `class`.
- That the class' name is `DiveLog`.

Notice this class name begins with an uppercase letter. Naming convention calls for the first letter of a class name to be in uppercase, and the first letter of method names to be in lowercase. Using this naming scheme makes it easier to read code because class names differ from method and variable names.

The `{` begins the class definition. At the end of the class you must have a closing `}`. Curly braces signify the beginning and ending of classes and method bodies and statements.

Missing or extra curly braces are one of the most common causes of compilation errors. It's a good idea to create curly braces in pairs, then insert your code between them, such as in this method:

Commenting Code

Commenting code is important to provide insight for others, and also to provide reminders for you. Comments may be inserted into source in the following formats, which tell the compiler to ignore the text:

```
// This is a single line comment.  
/* This format is often used for  
multiline comments. */
```

First:

```
public void actionPerformed(ActionEvent e)  
{  
  
}
```

Second:

```
public void actionPerformed(ActionEvent e)  
{  
  
    System.exit(0);  
  
}
```



Follow these steps...

1. Open the `DiveLog.java` file in your text editor.
2. Type or copy and paste the class header and curly braces into your file after a few lines down from the import statements:

```
public class DiveLog  
{
```

```
}
```

3. Save the file.

Declaring Variables

Objects contain data, and variables are holders of that data, or rather references to the data. The idea behind using a variable, a reference to the data, rather than the data itself is so you can manipulate the data.

For instance, in the example below `birthYear` and `currentYear` are given values, while `age` represents `birthYear` subtracted from `currentYear`:

```
birthYear = 1981;
```

```
currentYear = 2001;
```

```
age = currentYear - birthYear;
```

In this example, the variable `age` has a value of 20. Change the value of either `birthYear` or `currentYear` and the value of `age` changes accordingly.

Variables don't have to be hardcoded. The variable `birthYear` can instead be assigned to a text field for a user to enter a number. Then the `currentYear` variable could be hardcoded, declared with the current year, such as 2001. This kind of variable use is what makes applications dynamic. While one user types in 1962 as the value of the `birthYear`, another user types in 1982 as the `birthYear`, a different value for the `age` is calculated according to the user input.

Using variables in this way to represent data, a programmer doesn't have to know what the value is going to be in advance. Bank applications are likely to have variables representing customers names, addresses, account numbers, checking account amounts, and so forth, along with hardcoded variable values such as interest rates and bank fees.

In the Java programming language, variable **types** must be declared with the variable name. In other words, the compiler has to know if the variable is going to represent a `String`, an `int`, or some other type. For the example above to compile, the code must be rewritten:

```
int birthYear = 1981;
```

```
int currentYear = 2001;
```

```
int age = currentYear - birthYear;
```

Look closely at the code above, then see if you can answer the question below:

Which variable declaration is written incorrectly?

```
A. String lang = "Java Programming";  
B. double amount = 80.11  
C. int size = 8;
```

Which variable declaration is written incorrectly?

The statement `double amount = 80.11` is incorrect because it is missing a semicolon at the end of the declaration. All statements, including declarations, must end in a semicolon. The statement should appear as:

```
double amount = 80.11;
```

[More about Variables and Java Documentation](#)

[Variable Definition and Assignment](#)

[Variables](#)

[Java 2 Platform Documentation](#)

Variable Types

The Java™ programming language is sometimes called a strongly typed language because you must declare variables as a specific type before using them. A variable can be one of two basic types:

- Primitive type
- Reference type

Primitive Type

Primitive, or simple, types are the only types that are not objects.

The following are primitives:

- Integers, such as `byte`, `short`, `int`, and `long`
- Floating-point numbers, such as `double` and `float`
- Characters representing letters and numbers called `char`
- Boolean, which is a type that represents `true` or `false` values

In other words, primitives are what you commonly call numbers, single characters, or true or false. Numbers can also be represented as a `String`, but if you declare a number as a `String`, you cannot do mathematic operations on it, and it becomes an object of type `String`.

Also, whenever numbers are entered at the command line or in a GUI, the entry is accepted as a `String` object and must be converted to do calculations. Special classes called wrappers make this conversion and are covered later in this tutorial.

Because primitive types are not objects, declaring them is a one-step process:

```
int month; //declaration without a value
```

```
int month = 10; //declaration with an assigned value of 10
```

Reference Type

Reference types frequently refer to predefined objects, such as classes that are a part of the J2SE library. Reference types may also refer to classes specifically designed by the programmer to go with an application. The term *class type* is often used synonymously with *reference type*.

As an example:

```
Font monoFont = new Font("Courier", Font.PLAIN, 12);
```

What are Parameters?

Parameters appear between () following a method or class name, specifying the type of value that can be passed in:

```
methodName(type variableName, type variableName2)
```

The parameter is the information you pass to a new class to build an object, or to a method to use.

The reference variable name `monoFont` refers to the `Font` class, a predefined class in the Java library. To declare and instantiate, or create a `Font` object, the keyword `new` is used. In this case, information is also included, such as the font face, style type, and point size. The included information is called parameters. In other words, a `Font` object with specific details is created and put into memory.

Many of the predefined classes provided in the Java library are created this way. If you want to instantiate a predefined class in your

application, use the [Java API documentation](#) to find out exactly how to call the class from within your application. The documentation makes more sense when you understand constructors and methods, which is discussed in detail later in this tutorial.

In [DiveLog.java](#), two variables are declared right after the opening curly brace.



Follow these steps...

1. Open the `DiveLog.java` file in your text editor.
2. After the opening curly brace, type or copy and paste these two declarations:

```
private JFrame dlframe; //Not assigned yet.  
  
private JTabbedPane tabbedPane; //Not assigned yet.
```

3. Save the file

`JFrame` and `JTabbedPane` are reference types. In this case, the variables `dlframe` and `tabbedPane` refer to classes in the `javax.swing` package. In the declarations above, no object has been created yet. For now, this code just tells the compiler to reserve some memory for these two variables. Later in the code, objects of the `JFrame` and `JTabbedPane` classes are instantiated, or created, to build a frame for the Dive Log application, with a tabbed pane included.

Access Attributes

In the snippet of code above, notice the words `private`. This is an access attribute that tells the compiler if other packages or classes have access to this variable. In this case, the variables `dIframe` and `tabbedPane` have been declared `private`, which makes them accessible only from within this class and not accessible at all from other classes or packages.

Access attributes are also used with classes, as in this `DiveLog` class, which has been declared `public`, making it accessible to any class or package, and access attributes are used with methods.

The following table lists the access attributes and the access privileges they allow:

Attribute	Access
If none is provided	Default or package, meaning from any class in the same package
<code>public</code>	Any class or package
<code>private</code>	Only from within that particular class
<code>protected</code>	Any class in that package only

You'll see more about variables and access attributes as you create classes for the Dive Log. The important point to keep in mind is that the variables declared so far can be accessed only from the `DiveLog.java` class, and as yet they have not been assigned a value. They've only been declared as a reference type, specific to the `JFrame` and `JTabbedPane` classes. Until the key word `new` is used to instantiate them, these are not yet objects in memory.

Instantiating the `JFrame` and `JTabbedPane` objects occurs within a method. As mentioned earlier, methods make something happen. Methods instantiate objects, perform math calculations, and more.

Constructing Objects

One important type of method to understand is a special method called a constructor. The main purpose of a constructor is to set the initial state of an object when the object is created, or instantiated. A class details the data an object contains and can work with, methods it uses to work with that data, and a constructor tells how the object is to be built.

Constructors look like other methods with a few differences, which are described in the next section.

Use the `DiveLog` constructor as a guide to answer the following question:

```
public DiveLog()  
{  
    . . . // These dots mean that code has been  
        // omitted for brevity.  
}
```

Which constructor is written incorrectly?

- A. `public Button() {}`
- B. `public Button(String mode) {}`
- C. A and B are both correct.

Which constructor is written incorrectly?

Both `public Button() {}` and `public Button(String mode) {}` are correct. Constructors can be written with empty `()`, or a constructor can require parameters in the `()`, such as B, a `Button` constructor that takes a `String` parameter. In fact, a class can have several constructors. This is called constructor overloading.

Constructor Details

Many classes in the Java™ library have a constructor. To create an object of that class in one of your own classes, for most classes, you call the class's constructor.

For instance, if you want to create a button for your application, the Java library has a predefined `Button` class you can use. A look at the documentation for `Button` shows that this class has two possible constructors you can call:

- `Button()`
Creates a button without a label
- `Button(String label)`
Creates a button with a text label

Having more than one constructor is called constructor overloading. Each constructor must have the same name as the class that defines it, but it can have as many constructors as might be necessary. The difference is in the parameter list that is defined in the `()`. The compiler knows which constructor is being called simply by the type of information being provided.

In this case, if you provide a `String` as a parameter when calling the constructor as in `Button("Edit")`, the compiler knows you are calling the second constructor.

A constructor can require different types in the parameter list, but you should put them in the order you want them added.

For instance:

```
Customer(String name, String address, int age)
```

Instantiate a `Customer` object by calling the `Customer` class constructor with the `new` keyword:

```
Customer cust1 = new Customer(  
    "Jane Smith", "555 Street", 30);
```

More about Constructors

[Classes, Objects, and Constructors: What's the Difference?](#)

[Providing Constructors for Your Classes](#)

Customer defines the reference variable, and the variable is called `cust1`. A `Customer` object is built by calling the `Customer` class constructor with the keyword `new`.

In other words, the constructor builds an object exactly the way you want. In this case, it creates a `Customer` object with personal information.

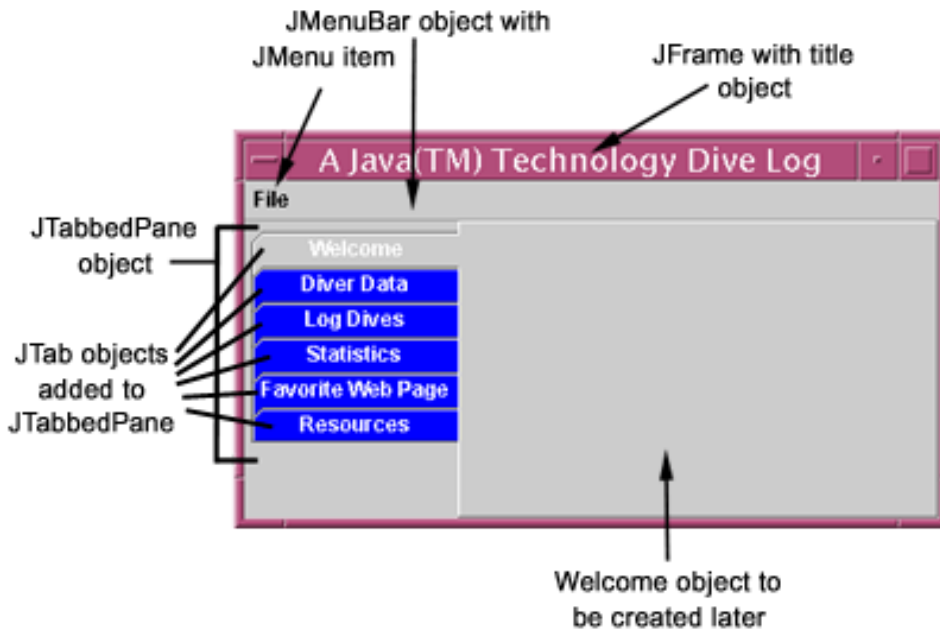
Upon starting an application, certain GUI components must appear for the user to use the application. This concept may make it seem like everything for the entire application must be written into the constructor, but it doesn't.

The `DiveLog` constructor defines just a few GUI components, and it can have some of those class definitions call other classes. Otherwise, the main class would get big and unwieldy. Also, in object oriented programming, the objective is to build objects that work with other objects to make it easy to add or remove components without having to change a lot of code.

When writing constructors, include only the elements an object must have on initialization.

You'll see these concepts at work as you build this Dive Log application.

The image below points out the objects that are created within the `DiveLog` constructor:



Object created from the `DiveLog` constructor

The `DiveLog` class constructor begins as follows:

```
public DiveLog()  
{ // Opens constructor  
  
    // Creates a frame object to add to  
  
    // the application GUI components.
```

```
dlframe = new JFrame(  
    "A Java(TM) Technology Dive Log");
```

Notice this class constructor has the same name as the class itself and does not require any parameters, which () shows. The opening { begins the body of the constructor.

Recall at the beginning of DiveLog.java, the variable dlframe was declared, but not yet assigned a value. Now, within the constructor, the JFrame constructor is assigned to the variable dlframe. A JFrame is simply a predefined Java class that builds a frame with a border, a minimize and maximize button, and a close box. A JFrame is a Swing container that can hold other containers and components. DiveLog initializes a JFrame as follows:

```
dlframe = new JFrame(  
    "A Java(TM) Technology Dive Log");
```

If you read the [JFrame class documentation](#) under the heading Constructor Summary, you'll discover several constructors available for building a JFrame object:

- The first is the default constructor, which creates a JFrame that's invisible and doesn't have any other features.
- The second constructor creates a JFrame in the specified GraphicsConfiguration of a screen device and a blank title.
- The third constructor accepts a String as an argument, and creates a JFrame with the title provided. This is the constructor called in the DiveLog constructor.
- The last constructor creates a JFrame with the specified title and the specified GraphicsConfiguration of a screen device.

Though a JFrame object is initialized with the title for the frame and assigned to the variable dlframe, it still needs a bit more work.

The following snippet of code has some advanced concepts involved, so it will be explained fully at a later time. This method insures that the Dive Log application can shut down fully and properly.

```
// Closes from title bar  
  
// and from menu  
  
dlframe.addWindowListener(new WindowAdapter()  
  
    {  
  
        public void windowClosing(WindowEvent e)  
  
        {  
  
            System.exit(0);
```

```
}  
});
```



Follow these steps...

1. Open the DiveLog.java class file.
2. Type, or cut and paste the following lines of code:

```
public DiveLog()  
{  
  
    // Create a frame object to add the  
    // application GUI components to.  
  
    dlframe = new JFrame(  
        "A Java(TM) Technology Dive Log");  
  
    // Closes from title bar  
    //and from menu  
    dlframe.addWindowListener(new WindowAdapter()  
    {  
        public void windowClosing(WindowEvent e)  
        {  
            System.exit(0);  
        }  
    });
```

```
}// Ends constructor
```

3. Save the file.

Next, the `JTabbedPane` is instantiated. At the top of the `DiveLog` class, the variable `tabbedPane` was declared as type `JTabbedPane`, but not assigned. Here, in the constructor, the keyword `new` is used to create the `JTabbedPane` object, passing in the necessary parameters to position the tabs on the left side of the window pane, and the variable is assigned to the `JTabbedPane` object:

```
// Tabbed pane with panels for components
```

```
tabbedPane =
```

```
    new JTabbedPane(SwingConstants.LEFT);
```

`JTabbedPane` is another handy Java class that creates tabs in an application and has two available constructors to call. The `DiveLog` constructor calls the [JTabbedPane class](#) constructor that makes it possible to create tabs at the `TOP`, `BOTTOM`, `LEFT`, or `RIGHT`. Simply type in your preference when calling the constructor. In the `DiveLog` case, the tabs are set to the left of the screen. You can place them wherever you like.

Calling Predefined Methods

`JFrame` inherits the predefined methods from the classes `Frame`, `Window`, `Container`, `Component`, and `Object`. You'll read about inheritance later.

Recall that methods provide action in applications. A class has at least one method, but generally many more. You can see what methods are available for use in the `JFrame` class by reading the [JFrame class documentation](#) and scanning the methods listed in the inherited classes. Click on the method names to find out what information you need to provide when calling the methods.

Methods, like constructors, often need information passed into them through the parameter list.

Call these predefined methods simply by using the dot operator with the object variable name as follows:

```
tabbedPane.setBackground(Color.blue);
```

```
tabbedPane.setForeground(Color.white);
```

The methods `setBackground` and `setForeground` are called and used on the `tabbedPane` object, setting the background and foreground colors. You can use these methods on any GUI component to change background and foreground colors, simply by naming the object through its variable, then passing in the `Color` class as a parameter, along with the color you want to use.



Follow these steps...

1. Open the `DiveLog.java` class file
2. Type, or cut and paste the following lines of code into the file just after the last section you added:

```
// Tabbed pane with panels for Jcomponents  
  
// Instantiate JTabbedPane with keyword new  
tabbedPane =  
  
    new JTabbedPane(SwingConstants.LEFT);  
  
// Calls method to set color  
tabbedPane.setBackground(Color.blue);  
  
tabbedPane.setForeground(Color.white);
```

3. Save the file.

Predefined methods are easy to use. When you decide you want to create an object of a certain class, then look that class up in the documentation and see what methods are available. Create an instance of that class using the `new` operator and assign a variable, then call the method by using the dot operator as demonstrated above. You'll see many more examples of this as you progress through the Dive Log.

At this point, the `JTabbedPane` class constructor has been called and the object instantiated, but the individual tabs have not been added.

How are the individual tabs added to the `JTabbedPane`?

- A. Assign a variable and using the keyword `new`.
- B. Call a special method of the `JTabbedPane` class.
- C. None of the above.

How are the individual tabs are added to the `JTabbedPane`?

The answer is B. The clue in this question was the word *added*. The `TabbedPane` class has an `addTab` method that takes parameters. By calling the `addTab` method and providing the necessary information, you can add as many tabs to the `TabbedPane` object as you need.

Calling Methods

You could call the `addTab` method within the constructor for each tab you want to add to the `JTabbedPane` object, but that clutters the constructor body. Constructing the tabs contained within a method designed for that purpose is a

cleaner way of doing it.

So far you have begun writing a constructor and calling predefined methods from the Java™ library, using the object variable name and the dot operator.

To call a method of your design from within the constructor, simply type the method's name and any required parameters:

```
populateTabbedPane ( ) ;
```

Note the method name

- Begins with a lowercase letter
- Uses uppercase letters
- Gives an indication of its function to make reading the code easier

Since the `populateTabbedPane` method is called in the `DiveLog` constructor, you must define a `populateTabbedPane` method outside the constructor, which is covered in the next section.



Follow these steps...

1. Open `DiveLog.java` in a text editor
2. Type or paste the following line of code:

```
populateTabbedPane ( ) ;
```

By now your `DiveLog.java` class file should look like [this example](#).

More about Methods

[Details of a Method Declaration](#)

[Passing Information into a Method](#)

[The Method Body](#)

[Methods](#)

Defining Methods

A method is a group of programming statements that is given a name. The statements can contain other method calls, simple print statements, or complex operations. When a method is called, the flow of control transfers to that method. Each statement in the method body is executed, one at a time, then control returns to the location where the call was made.

A method's header gives the compiler important information:

- access modifier (optional)
Tells the compiler whether other classes or packages have access to this method
- return type (required)
If the method returns an object or primitive data, the type must be listed here. If the method doesn't return a value, then it is type `void`.
- method name (required)
Like classes, methods need a name. Generally methods begin with a lowercase letter.
- parameter list or `()` (required)

Return Types

Some methods require a return type. For instance, if you create an `addNumbers` method to add numbers, then return the sum, the return type might be an `int`, `double`, or `float`. For example:

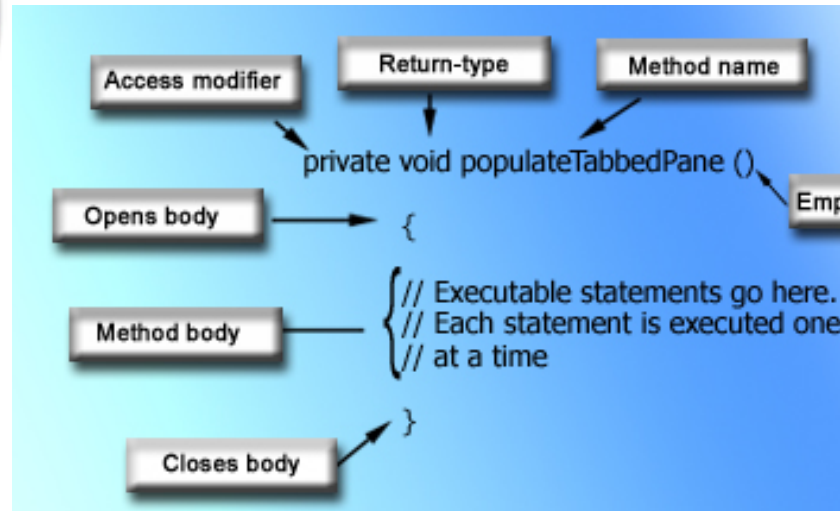
```
public int addNum(int a, int b, int c)
{
    int sum;
    sum = a + b + c;
    return sum;
}
```

The return type is `int`.

If no parameters are passed into the method, then empty `()` are shown. Otherwise the type of information must be detailed in the parameter list.

The `tabbedPane` method is declared `private` because no other class in the `diveLog` package, or any other package, needs to or should have access to this method. This method is used only to add the individual tabs to the `JTabbedPane` object called `tabbedPane`.

The return type of the `tabbedPane` method is `void` because it doesn't return a value. This method simply provides a function for building a part of the GUI.



Method header and body

In the `DiveLog` class, the method created to populate the `tabbedPane` object is called `populateTabbedPane` because it is descriptive, making it easy to guess what the method does.

Calling Methods within Methods

As mentioned earlier, tabs are added to the `tabbedPane` object by calling a predefined method from the `JTabbedPane` class. So in this `populateTabbedPane` method, to add tabs, or rather populate the `tabbedPane` object with tabs, you need only call the `addTab` method and provide parameters for each tab.

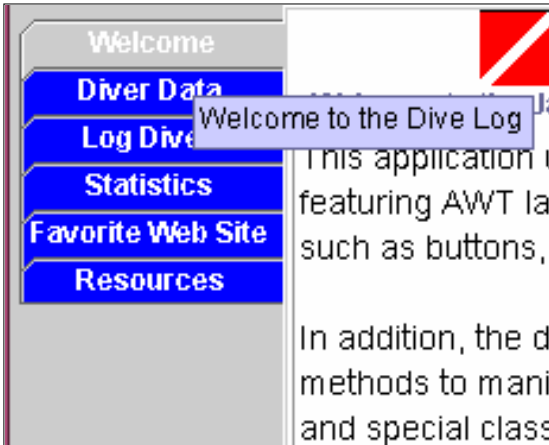
There are three versions of the `addTab` method:

- Tab with title and a component
- Tab with title, icon, and a component
- Tab with title, icon, component, and a string tip

For the `DiveLog`, use the last:

```
tabbedPane.addTab(
    "Welcome ",
    null,
```

```
new Welcome(),
    "Welcome to the Dive Log");
```



Tab with string tip displayed

The last `addTab` method signature creates a tab with a title, a component, and a string tip. Include the title by typing text enclosed in quote marks. Since an icon is not provided on the tabs, `null` takes place of an icon image name.

Next, a component, or more specifically, a new class called `Welcome` is instantiated. The `Welcome` class displays the content for this tab, and is covered fully in the next part of this Dive Log tutorial. Lastly, text for a string tip is provided. This text appears when a user mouses over the tab.

Each tab initializes a new class that contains the code for that particular tabbed page:



Follow these steps...

1. Open `DiveLog.java` in a text editor
2. Type or paste the following line of code after the `} //Ends Constructor`:

```
private void populateTabbedPane()
{
    // Create tabs with titles

    tabbedPane.addTab(
        "Welcome",
        null,
        new Welcome(),
        "Welcome to the Dive Log");
```

```
tabbedPane.addTab(  
    "Diver Data",  
    null,  
    new Diver(),  
    "Click here to enter diver data");
```

```
tabbedPane.addTab(  
    "Log Dives",  
    null,  
    new Dives(),  
    "Click here to enter dives");
```

```
tabbedPane.addTab(  
    "Statistics",  
    null,  
    new Statistics(),  
    "Click here to calculate" +  
        " dive statistics");
```

```
tabbedPane.addTab(  
    "Favorite Web Site",  
    null,  
    new WebSite(),  
    "Click here to see a web site");
```

```
tabbedPane.addTab(  
    "Favorite Web Site",  
    null,  
    new WebSite(),  
    "Click here to see a web site");
```

```
        "Resources" ,  
        null ,  
        new Resources() ,  
        "Click here to see a list " +  
            "of resources" );  
    } //Ends populateTabbedPane method
```

3. Save the file.

Tabs that initialize other classes provide organization for the application and prevent classes from becoming overly long and confusing.

What happens if you do not create classes called `Welcome.java`, `Diver.java`, `Dives.java`, and so forth?

- A. Nothing since there isn't a class to put into memory yet.
- B. A compilation error because the compiler can't find the named classes.
- C. None of the above.

What will happen if you do not create classes yet called `Welcome`, `Diver`, `Dives`, and so forth?

You get a compilation error if the compiler cannot locate every class that is called in the code. To prevent this type of error, create classes that can be instantiated. For now, they don't need to do anything other than exist in memory.

Creating Placeholder Classes

The individual classes initialized with each tab are covered in the next installments of the Dive Log tutorial. The `Welcome` class is the next class to be covered in detail.

In the meantime, though, so you can compile the `DiveLog` class, create empty classes that do nothing but initialize placeholders. For now, these classes consist only of package and import statements, the class header, and the closing and opening curly braces. Each class is saved in its own file.

More on Creating Objects

[Creating Objects](#)

[Learn How To Store Data in Objects](#)

[Beginning Java Objects](#)

[Creating Class Instances](#)



Follow these steps...

1. Open your text editor.
2. Copy and paste, or type the following class, in a new file:

```
package divelog;

/**
 * This class creates the content on the
 * Welcome tabbed pane in the Dive Log
 * application.
 * @version 1.0
 */

//import for buttons, labels, and images
import javax.swing.*;

//import for layout manager
import java.awt.*;

public class Welcome extends JPanel
{ //Opens class

    //Closes class
}
```

3. Save this file as [Welcome.java](#) in the divelog directory.
4. Create classes like this Welcome class with the titles [Diver.java](#), [Dives.java](#), [Statistics.java](#), [WebSite.java](#), and [Resources.java](#).

As you work through the tutorial, you'll be instructed to open these files later and fill them in as each class is covered.

Creating Additional GUI Objects

After the `DiveLog` constructor calls `populateTabbedPane`, program flow returns to the constructor. Next, a menu object needs to be created. Like the tabs, creating and pulling the objects together to create a menu is best done within a method. Using the [typical naming conventions](#), this method is called `buildMenu`.

This method is `private` to prevent other packages and classes from accessing it, and it is `void` because its only purpose is to build a menu with a menu item called `Exit`, and to exit cleanly when `Exit` is selected. The name suggests what the method does, and the parentheses are empty because no parameters are required.

Step 3 below shows you how to create application menus using the `JMenuBar`, `JMenu`, and `JMenuItem` classes. You instantiate a new `JMenuBar` and assign it to `mb`. Next, you instantiate a `JMenu` object with the variable `menu`, and pass in the `String` `"File"` to name a new menu. Lastly, instantiate a menu item object, including the parameter `"Exit"` and assigning it to `item`.



Follow these steps...

1. Open your text editor
2. Open the `DiveLog.java` file
3. Copy and paste, or type the following code in after the closing constructor curly brace:

```
// Method header
private void buildMenu()
{
    // Instantiates JMenuBar, JMenu,
    // and JMenuItem.

    JMenuBar mb = new JMenuBar();

    JMenu menu = new JMenu("File");

    JMenuItem item = new JMenuItem("Exit");
```

Note: To make the menu functional, an `addActionListener` is assigned to the `JMenuItem`. `ActionListener` concepts are a bit advanced and are discussed in detail in another part of the Dive Log tutorial.

After the `buildMenu` is called in the `DiveLog` constructor, the code completes the construction of the `DiveLog` object. Next the code needs to get the content pane and adds the `tabbedPane` object. The frame you have created for the application is a container, and in this case is the top-level container. All Swing containers have another container within, which is the content pane, where you place all child containers and components.



Follow these steps...

1. Type or cut and paste the code:

```
//Closes the application from the Exit
//menu item.
item.addActionListener(new ActionListener()
    {
        public void actionPerformed(ActionEvent e)
        {
            System.exit(0);
        }
    }); // Ends buildMenu method
```

Pull the menu objects together, using the predefined add method, passing in the variable reference.

2. Add the following:

```
//Adds the item to the menu object
menu.add(item);

//Adds the menu object with item
//onto the menu bar
mb.add(menu);

//Sets the menu bar in the frame
dlframe.setJMenuBar(mb);
```

3. Save the file.

Though it may seem as though the objects created so far have been added to the frame object, they haven't. Instead

objects must be added to a frame's container, the content pane.

Adding Objects to the Frame

The content pane manages the interior of a Swing frame, and components are added to the frame's content pane rather than directly to the frame. To do this, simply send a message to the `dlframe` object with the dot operator, calling the `getContentPane` method and call the `add` method to add the `tabbedPane` object to the content pane. You won't need to add anything else to the content pane, since the tabs instantiate classes, so those are added with the creation of the tabs, which in turn have already been added to the `tabbedPane` object.

The `pack` method causes the Window to be sized to fit the preferred size and layouts of its subcomponents, and the `setSize` method sets a size for the frame. Even with size and color established, you still

won't see the application without setting the initialized `JFrame` component to visible. It might seem odd to do this, but frequently you need to hide components. For instance, once a user has entered information to a text area, you hide the text area component, which is no longer needed, then display the text to the screen, or provide a different component.

This `JFrame` for the Dive Log should be visible all the time. This done by calling `setVisible` to `true` with the following:

```
dlframe.setVisible(true);
```

To hide a component, change the `true` to `false`.



Follow these steps...

1. Open the `DiveLog.java` file in your text editor.
2. Copy and paste, or type this code before the closing `}` of the constructor:

```
dlframe.getContentPane().add(tabbedPane);  
  
dlframe.pack();  
  
dlframe.setSize(765, 690);  
  
dlframe.setBackground(Color.white);  
  
dlframe.setVisible(true);
```

Your code should look like [this](#).

More on Project Swing

[Fundamentals of JFC/Swing: Part I](#)

[Fundamentals of JFC/Swing: Part II](#)

[Trail: Creating a GUI with JFC/Swing](#)

[Project Swing and Java™ 2D Graphics](#)

The DiveLog constructor is finished and defines how the DiveLog object looks and behaves when it is initialized:

- The frame that has a set size, background color, and is visible.
- The content pane contains a tabbedPane object.
- The tabbedPane object contains tabs with titles, string tips, and initializes separate classes that contain the details of those pages. (For now those classes are empty.)

With the instructions about how the DiveLog object is written out within the constructor, only one method remains:

```
public static void main(String[] args)
{
    DiveLog dl = new DiveLog();
}
```

What purpose does a main method serve?
A. Serves as an entry point for any application. B. Calls the other methods required to run the application. C. All of the above.

```
package divelog;

import javax.swing.*;
import java.awt.*;
import java.awt.event.*;

public class DiveLog
{ //Opens DiveLog class

    private JTabbedPane tabbedPane;
    private JFrame dlframe;

    public DiveLog()
    { //Opens DiveLog constructor

        //Create a frame object to add the application
        //GUI components to.

        dlframe = new JFrame("A Java(TM) Technology Dive Log");

        // Closes from title bar
        //and from menu
        dlframe.addWindowListener(new WindowAdapter()
        { // Opens addWindowListener method
            public void windowClosing(WindowEvent e)
            { // Opens windowClosing method
                System.exit(0);
            } // Closes windowClosing method
        }); // Closes addWindowListener method

        // Tabbed pane with panels for Jcomponents

        tabbedPane = new JTabbedPane(SwingConstants.LEFT);
        tabbedPane.setBackground(Color.blue);
        tabbedPane.setForeground(Color.white);

        // Calls a method that adds individual tabs to the
        //tabbedPane object.
        populateTabbedPane();

        //Calls the method that builds the menu
        buildMenu();

        dlframe.getContentPane().add(tabbedPane);

        dlframe.pack();
        dlframe.setSize(765, 690);
        dlframe.setBackground(Color.white);
        dlframe.setVisible(true);
    } // Ends class constructor

    private void populateTabbedPane()
    { // Opens populateTabbedPane method definition
        // Create tabs with titles

        tabbedPane.addTab("Welcome",
```

```
        null,
        new Welcome(),
        "Welcome to the Dive Log");

    tabbedPane.addTab("Diver Data",
        null,
        new Diver(),
        "Click here to enter diver data");

    tabbedPane.addTab("Log Dives",
        null,
        new Dives(),
        "Click here to enter dives");

    tabbedPane.addTab("Statistics",
        null,
        new Statistics(),
        "Click here to calculate dive statistics");

    tabbedPane.addTab("Favorite Web Site",
        null,
        new WebSite(),
        "Click here to see a web site");
    tabbedPane.addTab("Resources",
        null,
        new Resources(),
        "Click here to see a list of resources");
    } //Ends populateTabbedPane method

private void buildMenu()
{ // Opens buildMenu method definition
    JMenuBar mb = new JMenuBar();
    JMenu menu = new JMenu("File");
    JMenuItem item = new JMenuItem("Exit");

    //Closes the application from the Exit
    //menu item.
    item.addActionListener(new ActionListener()
    { // Opens addActionListener method
        public void actionPerformed(ActionEvent e)
        { // Opens actionPerformed method
            System.exit(0);
        } // Closes actionPerformed method

    }); // Closes addActionListener method

    menu.add(item);
    mb.add(menu);
    dlframe.setJMenuBar(mb);
} // Closes buildMenu method

// main method and entry point for app
public static void main(String[] args)
{ // Opens main method

    DiveLog dl = new DiveLog();
```

```
    } // Closes main method
```

```
} //Ends class DiveLog
```

```
package divelog;

import javax.swing.*;
import java.awt.*;
import java.awt.event.*;

public class DiveLog
{ // Opens class

    private JTabbedPane tabbedPane;
    private JFrame dlframe;

    public DiveLog()
    { // Opens constructor

        //Create a frame object to add the application
        //GUI components to.

        dlframe = new JFrame("A Java(TM) Technology Dive Log");

        // Closes from title bar
        //and from menu
        dlframe.addWindowListener(new WindowAdapter()
        { // Opens addWindowListener method
            public void windowClosing(WindowEvent e)
            { // Opens windowClosing method
                System.exit(0);
            } // Closes windowClosing method
        }); // Closes addWindowListener method

        // Tabbed pane with panels for Jcomponents

        tabbedPane = new JTabbedPane(SwingConstants.LEFT);
        tabbedPane.setBackground(Color.blue);
        tabbedPane.setForeground(Color.white);

        //A method that adds individual tabs to the
        //tabbedPane object.
        populateTabbedPane();

    } // Ends constructor

} //Ends class
```

```
package divelog;

import javax.swing.*;
import java.awt.*;
import java.awt.event.*;

public class DiveLog
{ // Opens class

    private JTabbedPane tabbedPane;
    private JFrame dlframe;

    public DiveLog()
    { // Opens constructor

        //Create a frame object to add the application
        //GUI components to.

        dlframe = new JFrame("A Java(TM) Technology Dive Log");

        // Closes from title bar
        //and from menu
        dlframe.addWindowListener(new WindowAdapter()
        { // Opens addWindowListener method
            public void windowClosing(WindowEvent e)
            { // Opens windowClosing method
                System.exit(0);
            } // Closes windowClosing method
        }); // Closes addWindowListener method

        // Tabbed pane with panels for Jcomponents

        tabbedPane = new JTabbedPane(SwingConstants.LEFT);
        tabbedPane.setBackground(Color.blue);
        tabbedPane.setForeground(Color.white);

        //A method that adds individual tabs to the
        //tabbedPane object.
        populateTabbedPane();

        //Calls the method that builds the menu
        buildMenu();

        dlframe.getContentPane().add(tabbedPane);

        dlframe.pack();
        dlframe.setSize(765, 690);
        dlframe.setBackground(Color.white);
        dlframe.setVisible(true);

    } //Ends the constructor

    private void populateTabbedPane()
    { // Opens populateTabbedPane method
        // Create tabs with titles
```

```
        tabbedPane.addTab("Welcome",
                           null,
                           new Welcome(),
                           "Welcome to the Dive Log");

        tabbedPane.addTab("Diver Data",
                           null,
                           new Diver(),
                           "Click here to enter diver data");

        tabbedPane.addTab("Log Dives",
                           null,
                           new Dives(),
                           "Click here to enter dives");

        tabbedPane.addTab("Statistics",
                           null,
                           new Statistics(),
                           "Click here to calculate dive statistics");

        tabbedPane.addTab("Favorite Web Site",
                           null,
                           new WebSite(),
                           "Click here to see a web site");
        tabbedPane.addTab("Resources",
                           null,
                           new Resources(),
                           "Click here to see a list of resources");

    } //Ends populateTabbedPane method

private void buildMenu()
{ // Opens buildMenu method
    JMenuBar mb = new JMenuBar();
    JMenu menu = new JMenu("File");
    JMenuItem item = new JMenuItem("Exit");

    //Closes the application from the Exit
    //menu item.
    item.addActionListener(new ActionListener()
    { // Opens addActionListener method
      public void actionPerformed(ActionEvent e)
      { // Opens actionPerformed method
        System.exit(0);
      } // Closes actionPerformed method
    }); // Closes addActionListener method

    menu.add(item);
    mb.add(menu);
    dlframe.setJMenuBar(mb);

} //Ends the buildMenu method
```

```
} //Ends class
```