

11.7 Stack Unwinding and Obtaining Information from an Exception

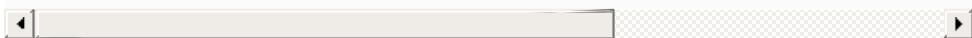
When an exception is thrown but *not caught* in a particular method, the method-call stack is “unwound,” and an attempt is made to **catch** the exception in the next outer **try** block.

This process is called **stack unwinding**. Unwinding the method-call stack means that the method in which the exception was not caught *terminates*, all local variables in that method *go out of scope* and control returns to the statement that originally invoked that method. If a **try** block encloses that statement, an attempt is made to **catch** the exception. If a **try** block does not enclose that statement or if the exception is not caught, stack unwinding occurs again. [Figure 11.6](#) demonstrates stack unwinding, and the exception handler in **main** shows how to access the data in an exception object.

```
1 // Fig. 11.6: UsingExceptions.java
2 // Stack unwinding and obtaining data from an ex
3
4 public class UsingExceptions {
5     public static void main(String[] args) {
6         try {
7             method1();
8         }
9     catch (Exception exception) { // catch exc
10        System.err.printf("%s%n%n", exception.ge
```

```

11         exception.printStackTrace();
12
13     // obtain the stack-trace information
14     StackTraceElement[] traceElements = exc
15
16     System.out.printf("%nStack trace from g
17     System.out.println("Class\t\tFile\t\t
18
19     // loop through traceElements to get ex
20     for (StackTraceElement element : traceE
21         System.out.printf("%s\t", element.ge
22         System.out.printf("%s\t", element.ge
23         System.out.printf("%s\t", element.ge
24         System.out.printf("%s%n", element.ge
25             }
26         }
27     }
28
29 // call method2; throw exceptions back to mai
30 public static void method1() throws Exception
31     method2();
32 }
33
34 // call method3; throw exceptions back to met
35 public static void method2() throws Exception
36     method3();
37 }
38
39 // throw Exception back to method2
40 public static void method3() throws Exception
41     throw new Exception("Exception thrown in m
42 }
43 }
```



Exception thrown in method3

java.lang.Exception: Exception thrown in method3
 at UsingExceptions.method3(UsingExceptions.ja

```
at UsingExceptions.method2(UsingExceptions.java:41)
at UsingExceptions.method1(UsingExceptions.java:36)
at UsingExceptions.main(UsingExceptions.java:7)

        Stack trace from getStackTrace:
Class           File           Line Method
UsingExceptions UsingExceptions.java 41   method3
UsingExceptions UsingExceptions.java 36   method2
UsingExceptions UsingExceptions.java 31   method1
UsingExceptions UsingExceptions.java 7    main
```

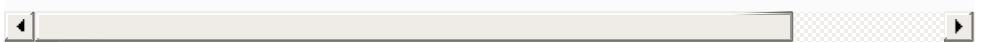
A screenshot of a Java IDE interface. At the top, there's a status bar with some icons. Below it is a code editor window showing Java code. In the center of the screen is a large text block displaying a stack trace and method signatures. At the bottom of the screen, there's a horizontal scroll bar.

Fig. 11.6

Stack unwinding and obtaining data from an exception object.

Stack Unwinding

In `main`, the `try` block (lines 6–8) calls `method1` (declared at lines 30–32), which in turn calls `method2` (declared at lines 35–37), which in turn calls `method3` (declared at lines 40–42). Line 41 in `method3` throws an `Exception` object—this is the *throw point*. Because the `throw` statement is *not* enclosed in a `try` block, *stack unwinding* occurs—`method3` terminates at line 41, then returns control to the statement in `method2` that invoked `method3`(i.e., line 36). Because *no try block encloses line 36*, *stack unwinding* occurs again—`method2` terminates at line 36 and returns control to the statement in `method1` that invoked `method2` (i.e., line 31). Because *no try block encloses line 31*, *stack unwinding*

occurs one more time—`method1` terminates at line 31 and returns control to the statement in `main` that invoked `method1` (i.e., line 7). The `try` block at lines 6–8 encloses this statement. The exception has not been handled, so the `try` block terminates and the first matching `catch` block (lines 9–26) catches and processes the exception. If there were no matching `catch` blocks, and the exception is *not declared* in each method that throws it, a compilation error would occur—`main` does not have a `throws` clause because `main` catches the exception. Remember that this is not always the case—for *unchecked* exceptions, the application will compile, but it will run with unexpected results.

Obtaining Data from an Exception Object

All exceptions derive from class `Throwable`, which has a `printStackTrace` method that outputs to the standard error stream the *stack trace* (discussed in [Section 11.2](#)). Often this is helpful in testing and debugging. Class `Throwable` also provides a `getStackTrace` method that retrieves the stack-trace information that might be printed by `printStackTrace`. Class `Throwable`'s `getMessage` method (inherited by all `Throwable` subclasses) returns the descriptive string stored in an exception. `Throwable` method `toString` (also inherited by all `Throwable` subclasses) returns a `String` containing the name of the exception's class and a descriptive message.

An exception that's not caught in an application causes Java's *default exception handler* to run. This displays the name of the exception, a descriptive message that indicates the problem that occurred and a complete execution stack trace. In an application with a single thread of execution, the application terminates. In an application with multiple threads, the thread that caused the exception terminates. We discuss multithreading in [Chapter 23](#).

The `catch` handler in [Fig. 11.6](#) (lines 9–26) demonstrates `getMessage`, `printStackTrace` and `getStackTrace`. If we wanted to output the stack-trace information to streams other than the standard error stream, we could use the information returned from `getStackTrace` and output it to another stream or use one of the overloaded versions of method `printStackTrace`. Sending data to other streams is discussed in [Chapter 15](#).

Line 10 invokes the exception's `getMessage` method to get the *exception description*. Line 11 invokes the exception's `printStackTrace` method to output the *stack trace* that indicates where the exception occurred. Line 14 invokes the exception's `getStackTrace` method to obtain the stack-trace information as an array of `StackTraceElement` objects. Lines 20–25 get each `StackTraceElement` in the array and invoke its methods `getClassName`, `getFileName`, `getLineNumber` and `getMethodName` to get the class name, filename, line number and method name, respectively, for that `StackTraceElement`. Each `StackTraceElement` represents *one* method call on the

method-call stack.

The program's output shows that the output of `printStackTrace` follows the pattern:

`className.methodName(fileName:lineNumber)`, where `className`, `methodName` and `fileName` indicate the names of the class, method and file in which the exception occurred, respectively, and the `lineNumber` indicates where in the file the exception occurred. You saw this in the output for Fig. 11.2. Method `getStackTrace` enables custom processing of the exception information. Compare the output of `printStackTrace` with the output created from the `StackTraceElements` to see that both contain the same stack-trace information.



Software Engineering Observation 11.14

Occasionally, you might want to ignore an exception by writing a `catch` handler with an empty body. Before doing so, ensure that the exception doesn't indicate a condition that code higher up the stack might want to know about or recover from.

Java SE 9: Stack-Walking

API

Throwable methods `printStackTrace` and `getStackTrace` each process the entire method-call stack. When debugging, this can be inefficient—for example, you may be interested only in stack frames corresponding to methods of a specific class. Java SE 9 introduces the **Stack-Walking API** (class `StackWalker` in package `java.lang`), which uses lambdas and streams (introduced in [Chapter 17](#)) to access method-call-stack information in a more efficient manner. You can learn more about this API at:

<http://openjdk.java.net/jeps/259>

