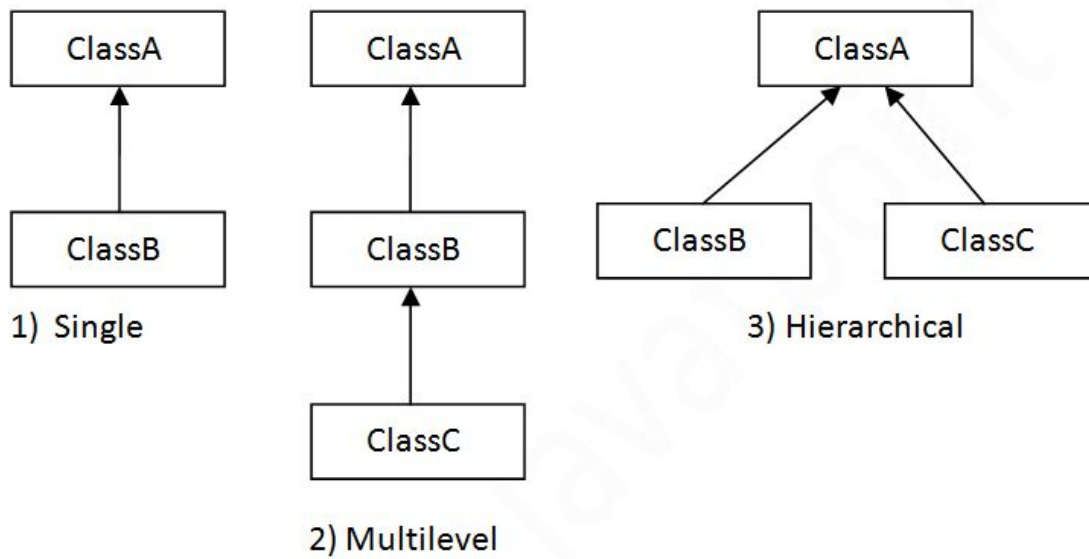


Inheritance

Types of inheritance in java



Single Inheritance Example

File: *TestInheritance.java*

```
1. class Animal{
2. void eat(){System.out.println("eating...");}
3. }
4. class Dog extends Animal{
5. void bark(){System.out.println("barking...");}
6. }
7. class TestInheritance{
8. public static void main(String args[]){
9. Dog d=new Dog();
10. d.bark();
11. d.eat();
12. }}
```

Output:
barking...
eating...

Multilevel Inheritance Example

File: *TestInheritance2.java*

```
1. class Animal{
2. void eat(){System.out.println("eating...");}
3. }
4. class Dog extends Animal{
5. void bark(){System.out.println("barking...");}
6. }
7. class BabyDog extends Dog{
8. void weep(){System.out.println("weeping...");}
9. }
10. class TestInheritance2{
11. public static void main(String args[]){
12. BabyDog d=new BabyDog();
13. d.weep();
14. d.bark();
15. d.eat();
16. }}
```

Output:

```
weeping...
barking...
eating...
```

Hierarchical Inheritance Example

File: *TestInheritance3.java*

```
1. class Animal{
2. void eat(){System.out.println("eating...");}
3. }
4. class Dog extends Animal{
5. void bark(){System.out.println("barking...");}
6. }
7. class Cat extends Animal{
8. void meow(){System.out.println("meowing...");}
9. }
10. class TestInheritance3{
11. public static void main(String args[]){
12. Cat c=new Cat();
```

```
13. c.meow();
14. c.eat();
15. //c.bark();//C.T.Error
16. }}
```

Output:

meowing...

eating...

Why multiple inheritance is not supported in java?

To reduce the complexity and simplify the language, multiple inheritance is not supported in java.

Consider a scenario where A, B, and C are three classes. The C class inherits A and B classes. If A and B classes have the same method and you call it from child class object, there will be ambiguity to call the method of A or B class. Since compile-time errors are better than runtime errors, Java renders compile-time error if you inherit 2 classes. So whether you have same method or different, there will be compile time error.

Inheritance Basics

To inherit a class, you simply incorporate the definition of one class into another by using the **extends** keyword.

General Syntax

```
class subclass-name extends superclass-name
{
    // body of class
}
```

The following program creates a superclass called A and a subclass called B. Notice how the keyword **extends** is used to create a subclass of A.

```
// A simple example of inheritance.
```

```
// Create a superclass.
```

```

// A simple example of inheritance.

// Create a superclass.
class A {
    int i, j;

    void showij() {
        System.out.println("i and j: " + i + " " + j);
    }
}

// Create a subclass by extending class A.
class B extends A {
    int k;

    void showk() {
        System.out.println("k: " + k);
    }

    void sum() {
        System.out.println("i+j+k: " + (i+j+k));
    }
}

class SimpleInheritance {
    public static void main(String args []) {
        A superOb = new A();
        B subOb = new B();

        // The superclass may be used by itself.
        superOb.i = 10;
        superOb.j = 20;
        System.out.println("Contents of superOb: ");
        superOb.showij();
        System.out.println();

        /* The subclass has access to all public members of
           its superclass. */
        subOb.i = 7;
        subOb.j = 8;
        subOb.k = 9;
        System.out.println("Contents of subOb: ");
        subOb.showij();
        subOb.showk();
        System.out.println();

        System.out.println("Sum of i, j and k in subOb:");
        subOb.sum();
    }
}

```

OUTPUT

```

Contents of superOb:
i and j: 10 20

Contents of subOb:
i and j: 7 8
k: 9

Sum of i, j and k in subOb:
i+j+k: 24

```

Member Access and Inheritance

Although a subclass includes all of the members of its superclass, it cannot access those members of the superclass that have been declared as private.

A More Practical Example

```
// This program uses inheritance to extend Box.
class Box {
    double width;
    double height;
    double depth;

    // construct clone of an object
    Box(Box ob) { // pass object to constructor
        width = ob.width;
        height = ob.height;
        depth = ob.depth;
    }

    // constructor used when all dimensions specified
    Box(double w, double h, double d) {
        width = w;
        height = h;
        depth = d;
    }

    // constructor used when no dimensions specified
    Box() {
        width = -1; // use -1 to indicate
        height = -1; // an uninitialized
        depth = -1; // box
    }

    // constructor used when cube is created
    Box(double len) {
        width = height = depth = len;
    }

    // compute and return volume
    double volume() {
        return width * height * depth;
    }
}

// Here, Box is extended to include weight.
class BoxWeight extends Box {
```

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```
    double weight; // weight of box

    // constructor for BoxWeight
    BoxWeight(double w, double h, double d, double m) {
        width = w;
        height = h;
        depth = d;
        weight = m;
    }
}
```

```

class DemoBoxWeight {
    public static void main(String args[]) {
        BoxWeight mybox1 = new BoxWeight(10, 20, 15, 34.3);
        BoxWeight mybox2 = new BoxWeight(2, 3, 4, 0.076);
        double vol;

        vol = mybox1.volume();
        System.out.println("Volume of mybox1 is " + vol);
        System.out.println("Weight of mybox1 is " + mybox1.weight);
        System.out.println();

        vol = mybox2.volume();
        System.out.println("Volume of mybox2 is " + vol);
        System.out.println("Weight of mybox2 is " + mybox2.weight);
    }
}

```

The output from this program is shown here:

```

Volume of mybox1 is 3000.0
Weight of mybox1 is 34.3

Volume of mybox2 is 24.0
Weight of mybox2 is 0.076

```

once you have created a superclass that defines the general aspects of an object, that superclass can be inherited to form specialized classes. Each subclass simply adds its own unique attributes. This is the essence of inheritance.

A Superclass Variable Can Reference a Subclass Object

A reference variable of a superclass can be assigned a reference to any subclass derived from that superclass.

```

class RefDemo {
    public static void main(String args[]) {
        BoxWeight weightbox = new BoxWeight(3, 5, 7, 8.37);
        Box plainbox = new Box();
        double vol;

        vol = weightbox.volume();
        System.out.println("Volume of weightbox is " + vol);
        System.out.println("Weight of weightbox is " +
            weightbox.weight);
        System.out.println();

        // assign BoxWeight reference to Box reference
        plainbox = weightbox;

        vol = plainbox.volume(); // OK, volume() defined in Box
        System.out.println("Volume of plainbox is " + vol);

        /* The following statement is invalid because plainbox
           does not define a weight member. */
        // System.out.println("Weight of plainbox is " + plainbox.weight);
    }
}

```

Here, weightbox is a reference to BoxWeight objects, and plainbox is a reference to Box objects. Since BoxWeight is a subclass of Box, it is permissible to assign plainbox a reference to the weightbox object.

Using super

Whenever a subclass needs to refer to its immediate superclass, it can do so by use of the keyword super.
super has two general forms.

The first calls the superclass' constructor.

The second is used to access a member of the superclass that has been hidden by a member of a subclass.

Using super to Call Superclass Constructors

A subclass can call a constructor defined by its superclass by use of the following form of super:

super(arg-list);

Here, arg-list specifies any arguments needed by the constructor in the superclass. super() must always be the first statement executed inside a subclass' constructor.

To see how super() is used, consider this improved version of the BoxWeight class:

```
// BoxWeight now uses super to initialize its Box attributes.
class BoxWeight extends Box {
    double weight; // weight of box

    // initialize width, height, and depth using super()
    BoxWeight(double w, double h, double d, double m) {
        super(w, h, d); // call superclass constructor
        weight = m;
    }
}
```

Here, BoxWeight() calls super() with the arguments w, h, and d. This causes the Box constructor to be called, which initializes width, height, and depth using these values. BoxWeight no longer initializes these values itself. It only needs to initialize the value unique to it: weight. This leaves Box free to make these values private if desired.

A Second Use for super

The second form of super acts somewhat like this, except that it always refers to the superclass of the subclass in which it is used. This usage has the following general form:

Super.member

Here, member can be either a method or an instance variable.

```
// Using super to overcome name hiding.
class A {
    int i;
}

// Create a subclass by extending class A.
```

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```
class B extends A {
    int i; // this i hides the i in A

    B(int a, int b) {
        super.i = a; // i in A
        i = b; // i in B
    }

    void show() {
        System.out.println("i in superclass: " + super.i);
        System.out.println("i in subclass: " + i);
    }
}

class UseSuper {
    public static void main(String args[]) {
        B subOb = new B(1, 2);

        subOb.show();
    }
}
```

This program displays the following:

```
i in superclass: 1
i in subclass: 2
```



```
// Using super to overcome name hiding.
class A {
    int i;
}

// Create a subclass by extending class A.
```

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```
class B extends A {
    int i; // this i hides the i in A

    B(int a, int b) {
        super.i = a; // i in A
        i = b; // i in B
    }

    void show() {
        System.out.println("i in superclass: " + super.i);
        System.out.println("i in subclass: " + i);
    }
}

class UseSuper {
    public static void main(String args[]) {
        B subOb = new B(1, 2);

        subOb.show();
    }
}
```

This program displays the following:

```
i in superclass: 1
i in subclass: 2
```

Method Overriding

In a class hierarchy, when a method in a subclass has the same name and type signature as a method in its superclass, then the method in the subclass is said to override the method in the superclass. When an overridden method is called from within its subclass, it will always refer to the version of that method defined by the subclass. The version of the method defined by the superclass will be hidden.

```

// Method overriding.
class A {
    int i, j;
    A(int a, int b) {
        i = a;
        j = b;
    }

    // display i and j
    void show() {
        System.out.println("i and j: " + i + " " + j);
    }
}

class B extends A {
    int k;

    B(int a, int b, int c) {
        super(a, b);
        k = c;
    }

    // display k - this overrides show() in A
    void show() {
        System.out.println("k: " + k);
    }
}

class Override {
    public static void main(String args[]) {
        B subOb = new B(1, 2, 3);

        subOb.show(); // this calls show() in B
    }
}

```

The output produced by this program is shown here:

```
k: 3
```

If you wish to access the superclass version of an overridden method, you can do so by using `super`. For example, in this version of `B`, the superclass version of `show()` is invoked within the subclass' version. This allows all instance variables to be displayed.

```

class B extends A {
    int k;

    B(int a, int b, int c) {
        super(a, b);
        k = c;
    }

    void show() {
        super.show(); // this calls A's show()
        System.out.println("k: " + k);
    }
}

```

If you substitute this version of `A` into the previous program, you will see the following output:

```
i and j: 1 2
k: 3
```

Method overriding occurs only when the names and the type signatures of the two methods are identical. If they are not, then the two methods are simply overloaded.

Using Abstract Classes

certain methods be overridden by subclasses by specifying the abstract type modifier. These methods are sometimes referred to as subclasser responsibility because they have no implementation specified in the superclass. Thus, a subclass must override them—it cannot simply use the version defined in the superclass. To declare an abstract method, use this general form:

abstract type name(*parameter-list*);

no method body is present.

Any class that contains one or more abstract methods must also be declared abstract. To declare a class abstract, you simply use the abstract keyword in front of the class keyword at the beginning of the class declaration. There can be no objects of an abstract class. That is, an abstract class cannot be directly instantiated with the **new** operator.

Here is a simple example of a class with an abstract method, followed by a class which implements that method:

```
// A Simple demonstration of abstract.
abstract class A {
    abstract void callme();

    // concrete methods are still allowed in abstract classes
    void callmetoo() {
        System.out.println("This is a concrete method.");
    }
}

class B extends A {
    void callme() {
        System.out.println("B's implementation of callme.");
    }
}

class AbstractDemo {
    public static void main(String args[]) {
        B b = new B();

        b.callme();
        b.callmetoo();
    }
}
```

class A implements a concrete method called callmetoo(). This is perfectly acceptable.

Abstract classes can include as much implementation as they see fit.

Although abstract classes cannot be used to instantiate objects, they can be used to create object references, because Java's approach to run-time polymorphism is implemented through the use of superclass references.

```

// Using abstract methods and classes.
abstract class Figure {
    double dim1;
    double dim2;

    Figure(double a, double b) {
        dim1 = a;
        dim2 = b;
    }

    // area is now an abstract method
    abstract double area();
}

class Rectangle extends Figure {
    Rectangle(double a, double b) {
        super(a, b);
    }

    // override area for rectangle
    double area() {
        System.out.println("Inside Area for Rectangle.");
        return dim1 * dim2;
    }
}

class Triangle extends Figure {
    Triangle(double a, double b) {
        super(a, b);
    }

    // override area for right triangle
    double area() {
        System.out.println("Inside Area for Triangle.");
        return dim1 * dim2 / 2;
    }
}

class AbstractAreas {
    public static void main(String args[]) {
        // Figure f = new Figure(10, 10); // illegal now
        Rectangle r = new Rectangle(9, 5);
        Triangle t = new Triangle(10, 8);
        Figure figref; // this is OK, no object is created

        figref = r;
        System.out.println("Area is " + figref.area());

        figref = t;

        System.out.println("Area is " + figref.area());
    }
}

```

Although it is not possible to create an object of type Figure, you can create a reference variable of type Figure. The variable figref is declared as a reference to Figure, which means that it can be used to refer to an object of any class derived from Figure.

Using final with Inheritance

1. Using final to Prevent Overriding

To disallow a method from being overridden, specify final as a modifier at the start of its declaration. Methods declared as final cannot be overridden. The following fragment illustrates final:

```

class A {
    final void meth() {
        System.out.println("This is a final method.");
    }
}

class B extends A {
    void meth() { // ERROR! Can't override.
        System.out.println("Illegal!");
    }
}

```

Because meth() is declared as final, it cannot be overridden in B. If you attempt to do so, a compile-time error will result.

2. Using final to Prevent Inheritance

Declaring a class as **final** implicitly declares all of its methods as final,.

Here is an example of a final class:

```

final class A {
    //...
}

// The following class is illegal.
class B extends A { // ERROR! Can't subclass A
    //...
}

```

Packages

Java provides a mechanism for partitioning the class name space into more manageable chunks. This mechanism is the package. The package is both a naming and a visibility control mechanism.

Defining a Package

To create a package is quite easy: simply include a package command as the first statement in a Java source file. Any classes declared within that file will belong to the specified package. The package statement defines a name space in which classes are stored.

This is the general form of the package statement:

```
package pkg;
```

Here, pkg is the name of the package.

For example, the following statement creates a package called MyPackage:

```
package MyPackage;
```

You can create a hierarchy of packages. To do so, simply separate each package name from the one above it by use of a period. The general form of a multileveled package statement is shown here:

```
package pkg1[.pkg2[.pkg3]];
```

A Short Package Example

```

// A simple package
package MyPack;

class Balance {
    String name;
    double bal;

    Balance(String n, double b) {
        name = n;
        bal = b;
    }

    void show() {
        if(bal<0)
            System.out.print("--> ");
        System.out.println(name + ": $" + bal);
    }
}

class AccountBalance {
    public static void main(String args[]) {
        Balance current[] = new Balance[3];

        current[0] = new Balance("K. J. Fielding", 123.23);
        current[1] = new Balance("Will Tell", 157.02);
        current[2] = new Balance("Tom Jackson", -12.33);

        for(int i=0; i<3; i++) current[i].show();
    }
}

```

Call this file **AccountBalance.java** and put it in a directory called **MyPack**.

Next, compile the file. Make sure that the resulting **.class** file is also in the **MyPack** directory. Then, try executing the **AccountBalance** class, using the following command line:

java MyPack.AccountBalance

As explained, **AccountBalance** is now part of the package **MyPack**. This means that it cannot be executed by itself. That is, you cannot use this command line: `java AccountBalance AccountBalance` must be qualified with its package name.

Access Protection

	Private	No Modifier	Protected	Public
Same class	Yes	Yes	Yes	Yes
Same package subclass	No	Yes	Yes	Yes
Same package non-subclass	No	Yes	Yes	Yes
Different package subclass	No	No	Yes	Yes
Different package non-subclass	No	No	No	Yes

Table 9-1 Class Member Access

Importing Packages

This is the general form of the import statement:

import *pkg1* [*.pkg2*].(*classname* | *);

pkg1 is the name of a top-level package, and *pkg2* is the name of a subordinate package inside the outer package separated by a dot (.).

Finally, you specify either an explicit classname or a star (*), which indicates that the Java compiler should import the entire package. This code fragment shows both forms in use:

```
import java.util.Date;
import java.io.*;
```

Interfaces

Using the keyword `interface`, you can fully abstract a class' interface from its implementation. That is, using `interface`, you can specify what a class must do, but not how it does it.

Interfaces are syntactically similar to classes, but they lack instance variables, and their methods are declared without any body.

Defining an Interface An interface is defined much like a class. This is a simplified general form of an interface:

```
access interface name {
    return-type method-name1(parameter-list);
    return-type method-name2(parameter-list);

    type final-varname1 = value;
    type final-varname2 = value;
    // ...

    return-type method-nameN(parameter-list);
    type final-varnameN = value;
}
```

When no access modifier is included, then default access results, and the interface is only available to other members of the package in which it is declared. When it is declared as `public`, the interface can be used by any other code.

Here is an example of an interface definition. It declares a simple interface that contains one method called `callback()` that takes a single integer parameter.

```
interface Callback {
    void callback(int param);
}
```

Implementing Interfaces

Once an interface has been defined, one or more classes can implement that interface. To implement an interface, include the `implements` clause in a class definition, and then create the methods defined by the interface. The general form of a class that includes the `implements` clause looks like this:

```

class classname [extends superclass] [implements interface [,interface...]] {
    // class-body
}

```

If a class implements more than one interface, the interfaces are separated with a comma. Here is a small example class that implements the Callback interface shown earlier:

```

class Client implements Callback {
    // Implement Callback's interface
    public void callback(int p) {

        System.out.println("callback called with " + p);
    }
}

```

It is both permissible and common for classes that implement interfaces to define additional members of their own. For example, the following version of Client implements callback() and adds the method nonInterfaceMeth():

```

class Client implements Callback {
    // Implement Callback's interface
    public void callback(int p) {
        System.out.println("callback called with " + p);
    }

    void nonInterfaceMeth() {
        System.out.println("Classes that implement interfaces " +
            "may also define other members, too.");
    }
}

```

Interfaces Can Be Extended

One interface can inherit another by use of the keyword **extends**.

```

// One interface can extend another.
interface A {
    void meth1();
    void meth2();
}

// B now includes meth1() and meth2() -- it adds meth3().
interface B extends A {
    void meth3();
}

// This class must implement all of A and B
class MyClass implements B {
    public void meth1() {
        System.out.println("Implement meth1().");
    }

    public void meth2() {
        System.out.println("Implement meth2().");
    }

    public void meth3() {
        System.out.println("Implement meth3().");
    }
}

class IFExtend {
    public static void main(String arg[]) {
        MyClass ob = new MyClass();

        ob.meth1();
        ob.meth2();
        ob.meth3();
    }
}

```


any class that implements an interface must implement all methods defined by that interface, including any that are inherited from other interfaces.

Exception Handling

An exception is an abnormal condition that arises in a code sequence at run time. In other words, an exception is a runtime error.

Java exception handling is managed via five keywords: **try, catch, throw, throws, and finally.**

This is the general form of an exception-handling block:

```
try {
    // block of code to monitor for errors
}

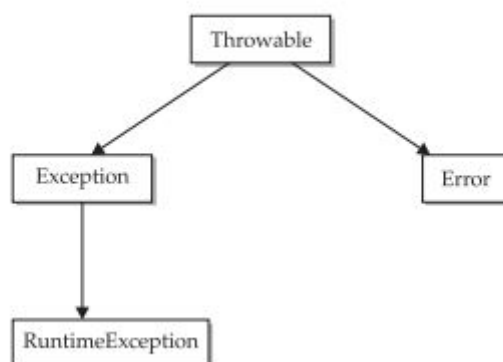
catch (ExceptionType1 exOb) {
    // exception handler for ExceptionType1
}

catch (ExceptionType2 exOb) {
    // exception handler for ExceptionType2
}
// ...
finally {
    // block of code to be executed after try block ends
}
```

Here, ExceptionType is the type of exception that has occurred

Exception Types

Chapter 10 Exception



All exception types are subclasses of the built-in class Throwable. Thus, Throwable is at the top of the exception class hierarchy. Immediately below Throwable are two subclasses that partition exceptions into two distinct branches. One branch is headed by Exception. This class is used for exceptional conditions that user programs should catch. This is also the class that you will subclass to create your own custom exception types. There is an important subclass of Exception, called RuntimeException. Exceptions of this type are automatically defined for the programs that you write and include things such as division by zero and invalid array indexing..

The other branch is topped by Error, which defines exceptions that are not expected to be caught under normal circumstances by your program.

Using try and catch

To guard against and handle a run-time error, simply enclose the code that you want to monitor inside a try block. Immediately following the try block, include a catch clause that specifies the exception type that you wish to catch.

```
class Exc2 {
    public static void main(String args[]) {
        int d, a;

        try { // monitor a block of code.
            d = 0;
            a = 42 / d;
            System.out.println("This will not be printed.");
        } catch (ArithmeticException e) { // catch divide-by-zero error
            System.out.println("Division by zero.");
        }

        System.out.println("After catch statement.");
    }
}
```

This program generates the following output:

```
Division by zero.
After catch statement.
```

Multiple catch Clauses

In some cases, more than one exception could be raised by a single piece of code. To handle this type of situation, you can specify two or more catch clauses, each catching a different type of exception. When an exception is thrown, each catch statement is inspected in order, and the first one whose type matches that of the exception is executed. After one catch statement executes, the others are bypassed, and execution continues after the try / catch block.

```
// Demonstrate multiple catch statements.
class MultipleCatches {
    public static void main(String args[]) {
        try {
            int a = args.length;
            System.out.println("a = " + a);
            int b = 42 / a;
            int c[] = { 1 };
            c[42] = 99;
        } catch (ArithmeticException e) {
            System.out.println("Divide by 0: " + e);
        } catch (ArrayIndexOutOfBoundsException e) {
            System.out.println("Array index oob: " + e);
        }
        System.out.println("After try/catch blocks.");
    }
}
```

Here is the output generated by running it both ways:

```
C:\>java MultipleCatches
a = 0
Divide by 0: java.lang.ArithmeticException: / by zero
After try/catch blocks.

C:\>java MultipleCatches TestArg
a = 1
Array index oob: java.lang.ArrayIndexOutOfBoundsException:42
After try/catch blocks.
```

When you use multiple catch statements, it is important to remember that exception subclasses must come before any of their superclasses. This is because a catch statement that uses a superclass will catch exceptions of that type plus any of its subclasses.

Nested try Statements

a try statement can be inside the block of another try. Each time a try statement is entered, the context of that exception is pushed on the stack. If an inner try statement does not have a catch handler for a particular exception, the stack is unwound and the next try statement's catch handlers are inspected for a match. This continues until one of the catch statements succeeds, or until all of the nested try statements are exhausted. If no catch statement matches, then the Java run-time system will handle the exception.

```
// An example of nested try statements.
class NestTry {
    public static void main(String args[]) {
        try {
            int a = args.length;

            /* If no command-line args are present,
             the following statement will generate
             a divide-by-zero exception. */
            int b = 42 / a;

            System.out.println("a = " + a);

            try { // nested try block
                /* If one command-line arg is used,
                 then a divide-by-zero exception
                 will be generated by the following code. */
                if(a==1) a = a/(a-a); // division by zero

                /* If two command-line args are used,
                 then generate an out-of-bounds exception. */
                if(a==2) {
                    int c[] = { 1 };
                    c[42] = 99; // generate an out-of-bounds exception
                }
            } catch(ArrayIndexOutOfBoundsException e) {
                System.out.println("Array index out-of-bounds: " + e);
            }

            } catch(ArithmeticException e) {
                System.out.println("Divide by 0: " + e);
            }
        }
    }
}
```

OUTPUT

```
C:\>java NestTry
Divide by 0: java.lang.ArithmeticException: / by zero

C:\>java NestTry One
a = 1
Divide by 0: java.lang.ArithmeticException: / by zero

C:\>java NestTry One Two
a = 2
Array index out-of-bounds:
java.lang.ArrayIndexOutOfBoundsException:42
```

throw

it is possible for your program to throw an exception explicitly, using the throw statement. The general form of throw is shown here:

```
throw ThrowableInstance;
```

Here, *ThrowableInstance* must be an object of type *Throwable* or a subclass of *Throwable*.

```

// Demonstrate throw.
class ThrowDemo {
    static void demoproc() {
        try {
            throw new NullPointerException("demo");
        } catch(NullPointerException e) {
            System.out.println("Caught inside demoproc.");
            throw e; // rethrow the exception
        }
    }

    public static void main(String args[]) {
        try {
            demoproc();
        } catch(NullPointerException e) {
            System.out.println("Recaught: " + e);
        }
    }
}

```

OUTPUT

```

Caught inside demoproc.
Recaught: java.lang.NullPointerException: demo

```

Throws

A throws clause lists the types of exceptions that a method might throw. This is necessary for all exceptions, except those of type `Error` or `RuntimeException`, or any of their subclasses. All other exceptions that a method can throw must be declared in the throws clause. If they are not, a compile-time error will result.

This is the general form of a method declaration that includes a throws clause:

```

type method-name(parameter-list) throws exception-list
{
    // body of method
}

```

exception-list is a comma-separated list of the exceptions that a method can throw.

Following is an example of an incorrect program that tries to throw an exception that it does not catch. Because the program does not specify a throws clause to declare this fact, the program will not compile.

```

// This program contains an error and will not compile.
class ThrowsDemo {
    static void throwOne() {
        System.out.println("Inside throwOne.");
        throw new IllegalAccessException("demo");
    }
    public static void main(String args[]) {
        throwOne();
    }
}

```

To make this example compile, you need to make two changes. First, you need to declare that `throwOne()` throws `IllegalAccessException`. Second, `main()` must define a try / catch statement that catches this exception.

```
// This is now correct.
class ThrowsDemo {
    static void throwOne() throws IllegalAccessException {
        System.out.println("Inside throwOne.");
        throw new IllegalAccessException("demo");
    }
    public static void main(String args[]) {
        try {
            throwOne();
        } catch (IllegalAccessException e) {
            System.out.println("Caught " + e);
        }
    }
}

```

Here is the output generated by running this example program:

```
inside throwOne
caught java.lang.IllegalAccessException: demo

```

Finally

finally creates a block of code that will be executed after a try /catch block has completed and before the code following the try/catch block. The finally block will execute whether or not an exception is thrown. If an exception is thrown, the finally block will execute even if no catch statement matches the exception.

```
// Demonstrate finally.
class FinallyDemo {
    // Throw an exception out of the method.
    static void procA() {
        try {
            System.out.println("inside procA");
            throw new RuntimeException("demo");
        } finally {
            System.out.println("procA's finally");
        }
    }

    // Return from within a try block.
    static void procB() {
        try {
            System.out.println("inside procB");
            return;
        } finally {
            System.out.println("procB's finally");
        }
    }

    // Execute a try block normally.
    static void procC() {
        try {
            System.out.println("inside procC");
        } finally {
            System.out.println("procC's finally");
        }
    }

    public static void main(String args[]) {
        try {
            procA();
        } catch (Exception e) {
            System.out.println("Exception caught");
        }

        procB();
        procC();
    }
}

```

Here is the output generated by the preceding program:

```
inside procA
procA's finally
Exception caught
inside procB
procB's finally
inside procC
procC's finally
```

Java's Built-in Exceptions

Exception	Meaning
ArithmeticException	Arithmetic error, such as divide-by-zero.
ArrayIndexOutOfBoundsException	Array index is out-of-bounds.
ArrayStoreException	Assignment to an array element of an incompatible type.
ClassCastException	Invalid cast.
EnumConstantNotPresentException	An attempt is made to use an undefined enumeration value.
IllegalArgumentException	Illegal argument used to invoke a method.
IllegalMonitorStateException	Illegal monitor operation, such as waiting on an unlocked thread.
IllegalStateException	Environment or application is in incorrect state.
IllegalThreadStateException	Requested operation not compatible with current thread state.
IndexOutOfBoundsException	Some type of index is out-of-bounds.
NegativeArraySizeException	Array created with a negative size.
NullPointerException	Invalid use of a null reference.
NumberFormatException	Invalid conversion of a string to a numeric format.
SecurityException	Attempt to violate security.
StringIndexOutOfBoundsException	Attempt to index outside the bounds of a string.
TypeNotPresentException	Type not found.
UnsupportedOperationException	An unsupported operation was encountered.

Table 10.1 Java's Unchecked Runtime Exception Subclasses Defined in java.lang

Exception	Meaning
ClassNotFoundException	Class not found.
CloneNotSupportedException	Attempt to clone an object that does not implement the Cloneable interface.
IllegalAccessException	Access to a class is denied.
InstantiationException	Attempt to create an object of an abstract class or interface.
InterruptedException	One thread has been interrupted by another thread.
NoSuchFieldException	A requested field does not exist.
NoSuchMethodException	A requested method does not exist.
ReflectiveOperationException	Superclass of reflection-related exceptions. (Added by JDK 7.)