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To use a class such as ArrayList from the Java API you have three choices:

1. import the class using its full name:
   
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   import java.util.ArrayList;
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   (This statement must go at the top of your .java file, outside the class)
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2. import the whole package:
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   import java.util.*;
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2. import the whole package:
   ```java
   import java.util.*;
   ```

3. Utilize the full class name everywhere.
The following code illustrates `import`, the container class `ArrayList`, and one of the primitive wrapper classes, `Integer` (it also introduces `generics`, Java’s equivalent of templates!):

```java
import java.util.ArrayList;
// ALT: import java.util.*;

public class Import {
    public static void main(String[] args) {
        ArrayList<Integer> list =
            new ArrayList<Integer>();
    //
```
The following code illustrates **import**, the container class **ArrayList**, and one of the primitive wrapper classes, **Integer** (it also introduces **generics**, Java's equivalent of templates!):

```java
import java.util.ArrayList;
// ALT: import java.util.*;

public class Import {
    public static void main(String[] args) {
        ArrayList<Integer> list =
            new ArrayList<Integer>();
            //
        list.add(new Integer(10));
    }
}
```
The following code illustrates `import`, the container class `ArrayList`, and one of the primitive wrapper classes, `Integer` (it also introduces `generics`, Java’s equivalent of templates!):

```java
import java.util.ArrayList;
// ALT: import java.util.*;

public class Import {
    public static void main(String[] args) {
        ArrayList<Integer> list =
            new ArrayList<Integer>();
        // list.add(new Integer(10)); // Shortcut to above form
        list.add(20);
    }
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The following code illustrates \texttt{import}, the container class \texttt{ArrayList}, and one of the primitive wrapper classes, \texttt{Integer} (it also introduces \texttt{generics}, Java’s equivalent of templates!):

\begin{verbatim}
import java.util.ArrayList;
// ALT: import java.util.*;

public class Import {
    public static void main(String[] args) {
        ArrayList<Integer> list =
                new ArrayList<Integer>();

        list.add(new Integer(10)); // list.add(10);
        list.add(20); // Shortcut to above form
        list.add(30);
    }
}
\end{verbatim}
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import java.util.ArrayList;
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public class Import {
    public static void main(String[] args) {
        ArrayList<Integer> list =
            new ArrayList<Integer>();
            //
        list.add(new Integer(10));
        list.add(20); // Shortcut to above form
        list.add(30);
            //
        for (Integer i : list)
            System.out.println(i);
    }
}
```
A package is a set of related classes.
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All files belonging to the package must be placed in a corresponding directory
\[\text{e.g. files in package } \text{avardy.package1 must go in avardy/package1 (relative to the CLASSPATH directory)}\]
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A class, member data item, or member method is either private, public, protected, or has package access, meaning that it is public within the package:
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E.g., files in package `avardy.package1` must go in `avardy/package1` (relative to the `CLASSPATH` directory).

A class, member data item, or member method is either private, public, protected, or has package access, meaning that it is public within the package:

```java
package mypackage;
public class X {
    private int i;
    int j;
}
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```java
package mypackage;
public class X {
    private int i;
    int j;
}
```

j is accessible from other classes within the package, but not i
package avardy.package1;
class A {
    int value = 42;
}

package avardy.package1;
class B {
    private int value;
    public B(A refA) {
        // This is OK because A's value has package access
        value = refA.value;
    }
}

package avardy.package1;
public class Front {
    public static void main(String[] args) {
        A refA = new A();
        B refB = new B(refA);
    }
}
package avardy.package1;
class A {
    int value = 42;
}

package avardy.package1;
class B {
    private int value;
    public B(A refA) {
        // This is OK because A’s
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    }
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- Utilize super keyword to call the base class constructor or base class methods
class Animal {
    protected int legs;

    public Animal(int legs) {
        this.legs = legs;
    }

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class Animal {
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    public Animal(int legs) {
        this.legs = legs;
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    //

    public void makeSound() {
        System.out.println("???");
    }

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    protected int legs;

    public Animal(int legs) {
        this.legs = legs;
    }

    public void makeSound() {
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    }

    public String getClassification() {
        if (legs == 2)
            return "biped";
        else if (legs == 4)
            return "quadroped";
        else
            return "unclassified";
    }
}
public class Dog extends Animal {
    private String name, owner;
    //
    public Dog(String name, String owner) {
        super();
        this.name = name;
        this.owner = owner;
    }
    @Override public void makeSound() {
        System.out.println("Woof!");
    }
    public static void main(String[] args) {
        Dog dog = new Dog("Bruno", "Andrew");
        System.out.println("Classification: " + dog.getClassification());
        dog.makeSound();
    }
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Abstract Methods and Classes

- In C++ we have the notion of pure virtual methods:
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- In Java, these methods are declared as **abstract**

- A class defined with any abstract methods must be declared as **abstract**

- You cannot instantiate an abstract class! Only a sub-class.

- An abstract class may have implementations for non-abstract methods
abstract class Instrument {
    public abstract void play();
    public String getName() {
        return "Instrument, but you'll "
            + "never see this!";
    }
}

class Drum extends Instrument {
    public void play() {
        System.out.println("Bang!");
    }
    public String getName() {
        return "Drum";
    }
}
abstract class Instrument {
    public abstract void play();
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    }
}

class Drum extends Instrument {
    public void play() {
        System.out.println("Bang!");
    }

    public String getName() {
        return "Drum";
    }
}
After adding a Guitar class, we can see that Instrument serves to standardize the interface to sub-classes:

```java
public class TestInstruments {
    public static void main(String[] args) {
        Instrument[] trio = new Instrument[3];
        trio[0] = new Drum();
        trio[1] = new Guitar();
        trio[2] = new Guitar();

        // Usage code is independent of
        // the creation code above.
        for (Instrument inst : trio)
            inst.play();
    }
}
```
Java goes further than abstract classes. An abstract class might contain some implementation:

```java
abstract class Instrument {
    public abstract void play();
    public String getName() {
        return "Instrument, but you'll never see this!";
    }
}
```

But often what we really want is to define the methods that a set of classes must have, and nothing more. For this purpose, we have interfaces which have no implementation and public access:

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interface Instrument {
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    String getName();
}
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```java
interface Instrument {
    void play();
    String getName();
}
```
Classes can **implement** an interface.

class Drum implements Instrument {
    public void play() {
        System.out.println("Bang!");
    }

    public String getName() {
        return "Drum";
    }
}
Some entities can be interacted with in several different ways. For example, if you have a vehicle you should be able to drive it and check how much gas is left. Some entities may be capable of being repaired.
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interface Vehicle {
    void drive(double km);
    double gasLeft();
}

interface Repairable {
    boolean canRepair();
    void repair();
}
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- A toaster is repairable but is not a vehicle.
- A car is both a vehicle and repairable...
class Car implements Vehicle, Repairable {
    double mileage = 0;
    double gas = 100.0;
}

class Car implements Vehicle, Repairable {
    double mileage = 0;
    double gas = 100.0;

    @Override public void drive(double km) {
        mileage += km;
        gas -= km / 10.0;
        // Not handling running out of gas!
    }
}
```java
class Car implements Vehicle, Repairable {
    double mileage = 0;
    double gas = 100.0;

    //
    @Override public void drive(double km) {
        mileage += km;
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    }
    //
    public double gasLeft() {
        return gas;
    }
    //
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    public double gasLeft() {
        return gas;
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    public boolean canRepair() {
        return (mileage < 200000);
    }
}
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    public double getMileage() {
        return mileage;
    }
}
Features Not Covered

- Tools outside the Java language itself:

  - Annotations (e.g., `@Override` or `@Test` placed in front of a method)
  - Javadoc: Generate API documentation for your code
  - Collections of .class files (and data files)
  - The final keyword

Various other uses

- Inner classes
- Exception handling

We saw only a tiny fraction of the Java API!

See links page for more information on these topics
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