INHERITANCE

Asmaliza Ahzan
IVERSON ASSOCIATES SDN BHD [Company address]

Inheritance

Inheritance Basics

- Using inheritance, you can create a general class that defines traits common to a set of related items.
- This class can then be inherited by other, more specific classes, each adding those things that are unique to it.
- In the terminology of Java, a class that is inherited is called a superclass.
- The class that does the inheriting is called a subclass.
- Therefore, a subclass is a specialized version of a superclass.
- It inherits all of the members defined by the superclass and adds its own, unique elements.

```
// 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));
	}
}.
```

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.

```
/* In a class hierarchy, private members remain
private to their class.
This program contains an error and will not
compile.
*/
// Create a superclass.
class A {
	int i; // public by default
	private int j; // private to A

	void setij(int x, int y) {
		i = x;
		j = y;
	}
}

// A's j is not accessible here.
class B extends A {
	int total;

	void sum() {
		total = i + j; // ERROR, j is not accessible here
	}
}

class Access {
	public static void main(String args[]) {
		B subOb = new B();
		subOb.setij(10, 12);
		subOb.sum();
		System.out.println("Total is " + subOb.total);
	}
}
```

This program will not compile because the use of j inside the sum( ) method of B causes an access violation. Since j is declared as private, it is only accessible by other members of its own class. Subclasses have no access to it.

Constructors and Inheritance

- Although a subclass inherits all of the methods and variables from superclass, it does not inherit constructors.
- Subclasses need to create its own constructor and add a call to the superclass's constructor.

```
public class Manager extends Employee {

	private String department;

	public Manager(String name, double salary, String department) {
		super(name, salary);
		this.department = department;
	}

	public Manager(String name, String department) {
		super(name);
		this.department = department;
	}
}
```

Using super to Call Superclass Constructors

- A superclass's constructor is always called in addition to the a subclass's constructor.
- The call super() can take any number of arguments appropriate to the various constructors available in the parent class, but it must be the first statement in the constructor.
- Example as above.

Using super to Access Superclass Members

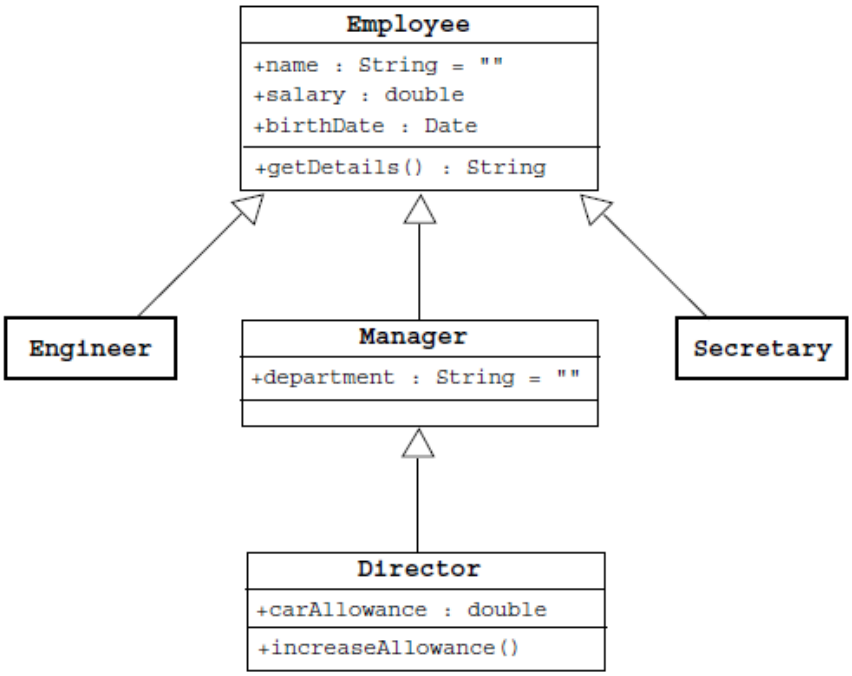
- The second form of super acts somewhat like this, except that it always refers to the superclass of the subclass in which it is used.
- This usage has the following general form **super.*member***
- Here, member can be either a method or an instance variable.

```
// toString method in Employee class
@Override
public String toString() {
	return "Name: " + this.name +
			"\nSalary: " + this.salary +
			"\nBirthdate: " + this.birthDate;
}


// toString method in Manager class
@Override
public String toString() {
	return super.toString() + "\nDepartment: " + this.department;
}
```

Creating a Multilevel Hierarchy

- Up to this point, we have been using simple class hierarchies that consist of only a superclass and a subclass.
- However, you can build hierarchies that contain as many layers of inheritance as you like.
- As mentioned, it is perfectly acceptable to use a subclass as a superclass of another.



- The Employee class contains three attributes (name, salary, and birthdate), as well as one method (getDetails).
- The Manager class inherits all of these members and specifies an additional attribute, department, as well as the getDetails method.
- The Director class inherits all of the member of Employee and Manager and specifies a carAllowance attribute and a new method, increaseAllowance.
- Similarly, the Engineer and Secretary classes inherit the members of the Employee class and might specify additional members (not shown).

When Are Constructors Executed?

- When a class hierarchy is created, in what order are the constructors for the classes that make up the hierarchy executed?
- For example, given a subclass called B and a superclass called A, is A's constructor executed before B's, or vice versa?
- The answer is that in a class hierarchy, constructors complete their execution in order of derivation, from superclass to subclass.
- Further, since super( ) must be the first statement executed in a subclass' constructor, this order is the same whether or not super( ) is used.
- If super( ) is not used, then the default or parameterless constructor of each superclass will be executed.

```
// Demonstrate when constructors are executed.
// Create a super class.
class A {
	A() {
		System.out.println("Inside A's constructor.");
	}
}// Create a subclass by extending class A.

class B extends A {
	B() {
		System.out.println("Inside B's constructor.");
	}
}

// Create another subclass by extending B.
class C extends B {
	C() {
		System.out.println("Inside C's constructor.");
	}
}

class CallingCons {
	public static void main(String args[]) {
		C c = new C();
	}
}
```

Method Overriding

- In addition to producing a new class based on an old one by additional features, you can modify existing behaviour of the parent class.
- If a method is defined in a subclass so that the name, return type, and argument list match exactly those of a method in the parent class, then the new method is said to override the old one.

```
// getDetails method in Employee class
public String getDetails() {
	return "Name: " + this.name +
			"\nSalary: " + this.salary +
			"\nBirthdate: " + this.birthDate;
}


// getDetails method in Manager class
public String getDetails() {
	return super.toString() + "\nDepartment: " + this.department;
}
```

The Manager class has a getDetails method by definition because it inherits one from the Employee class. However, the original method has been replaced, or overridden, by the child class's version.

Overridden Methods Support Polymorphism

- While the examples in the preceding section demonstrate the mechanics of method overriding, they do not show its power.
- Indeed, if there were nothing more to method overriding than a name space convention, then it would be, at best, an interesting curiosity, but of little real value. However, this is not the case.
- Method overriding forms the basis for one of Java's most powerful concepts: dynamic method dispatch.
- Dynamic method dispatch is the mechanism by which a call to an overridden method is resolved at run time, rather than compile time.
- Dynamic method dispatch is important because this is how Java implements run-time polymorphism.

Polymorphism

- An object has only one form (the one that is given to it when constructed).
- However, a variable is polymorphic because it can refer to objects of different forms.
- Java permits you to refer to an object with a variable that is one of the parent class type.

```
Employee e = new Manager("John", "IT");// legal
e.getDetails();
```

Which getDetails method will be invoked here? From Employee or Manager class?

This is the aspect of polymorphism, which is an important feature of object-oriented languages. The behaviour is not determined by the compile time type of the variable, instead it refers to during runtime.

In the above codes, the getDetails method executed is from the object's real type, the Manager class.

Why Override Methods?

- As stated earlier, overridden methods allow Java to support run-time polymorphism.
- Polymorphism is essential to object-oriented programming for one reason: it allows a general class to specify methods that will be common to all of its derivatives, while allowing subclasses to define the specific implementation of some or all of those methods.
- Overridden methods are another way that Java implements the "one interface, multiple methods" aspect of polymorphism.

Using Abstract Methods

- Abstract methods are those defined with abstract keyword at its method signature.

  abstract *type name*(*parameter-list*);

- Abstract methods mean there is no implementation provided, that is not method body.

  ```
  abstract void callme();
  ```

There are situations in which you will want to define a superclass that declares the structure of a given abstraction without providing a complete implementation of every method. That is, sometimes you will want to create a superclass that only defines a generalized form that will be shared by all of its subclasses, leaving it to each subclass to fill in the details.

Using Abstract Classes

- 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.
- Any subclass of an abstract class must either implement all of the abstract methods in the superclass, or be declared abstract itself.

```
//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.");
	}
}
```

Using final with inheritance

The keyword final has three uses. First, it can be used to create the equivalent of a named constant. This use was described in the preceding chapter. The other two uses of final apply to inheritance.

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.

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

Using final to Prevent Inheritance

- Sometimes you will want to prevent a class from being inherited. To do this, precede the class declaration with final.
- Declaring a class as final implicitly declares all of its methods as final, too.

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

The Object Class

- There is one special class, Object, defined by Java.
- All other classes are subclasses of Object.
- That is, Object is a superclass of all other classes.
- This means that a reference variable of type Object can refer to an object of any other class.
- Object defines the following methods, which means that they are available in every object.

Method	Purpose
Object clone( )	Creates a new object that is the same as the object being cloned.
boolean equals(Object object)	Determines whether one object is equal to another.
Class<?> getClass( )	Obtains the class of an object at run time.
int hashCode( )	Returns the hash code associated with the invoking object.
String toString( )	Returns a string that describes the object.