**CLASSES :**

A class is a template for an object, and an object is an instance of a class.

A class creates a new data type that can be used to create objects.

When you declare an object of a class, you are creating an instance of that class.

Thus, a class is a logical construct. An object has physical reality. (That is, an object occupies space in memory.)

Objects are characterized by three essential properties: state, identity, and behavior.

The state of an object is a value from its data type. The identity of an object distinguishes one object from another.

It is useful to think of an object’s identity as the place where its value is stored in memory.

The behavior of an object is the effect of data-type operations.

The dot operator links the name of the object with the name of an instance variable.

Although commonly referred to as the dot operator, the formal specification for Java categorizes the . as a separator.

The 'new' keyword dynamically allocates(that is, allocates at run time)memory for an object & returns a reference to it.

This reference is, more or less, the address in memory of the object allocated by new.

This reference is then stored in the variable.

Thus, in Java, all class objects must be dynamically allocated.

Box mybox; // declare reference to object

mybox = new Box(); // allocate a Box object

The first line declares mybox as a reference to an object of type Box. At this point, mybox does not yet refer to an

actual object. The next line allocates an object and assigns a reference to it to mybox. After the second line executes,

you can use mybox as if it were a Box object. But in reality, mybox simply holds, in essence, the memory address of the actual Box object.

The key to Java’s safety is that you cannot manipulate references as you can actual pointers.

Thus, you cannot cause an object reference to point to an arbitrary memory location or manipulate it like an integer.

A Closer Look at new:

classname class-var = new classname ( );

Here, class-var is a variable of the class type being created. The classname is the name of the class that is being

instantiated. The class name followed by parentheses specifies the constructor for the class. A constructor defines

what occurs when an object of a class is created.

You might be wondering why you do not need to use new for such things as integers or characters.

The answer is that Java’s primitive types are not implemented as objects.

Rather, they are implemented as “normal” variables.

This is done in the interest of efficiency.

It is important to understand that new allocates memory for an object during run time.

Box b1 = new Box();

Box b2 = b1;

b1 and b2 will both refer to the same object. The assignment of b1 to b2 did not allocate any memory or copy any part of the original object. It simply makes b2 refer to the same object as does b1. Thus, any changes made to the object through b2 will affect the object to which b1 is referring, since they are the same object.

When you assign one object reference variable to another object reference variable, you are not creating a copy of the object, you are only making a copy of the reference.

int square(int i){

return i \* i;

}

A parameter is a variable defined by a method that receives a value when the method is called. For example,

in square( int i), i is a parameter. An argument is a value that is passed to a method when it is invoked.

For example, square(100) passes 100 as an argument. Inside square( ), the parameter i receives that value.

NOTE:

Bus bus = new Bus();

lhs(reference i.e. bus) is looked by compiler & rhs (object i.e. new Bus()) is looked by jvm

**PACKAGES:**

Packages are containers for classes. They are used to keep the class name space compartmentalized.

For example, a package allows you to create a class named List, which you can store in your own package without

concern that it will collide with some other class named List stored elsewhere. Packages are stored in a hierarchical

manner and are explicitly imported into new class definitions.

The package is both a naming and a visibility control mechanism.

The following statement creates a package called MyPackage: package MyPackage;

Java uses file system directories to store packages. For example, the .class files for any classes you declare to be

part of MyPackage must be stored in a directory called MyPackage. Remember that case is significant, and the directory name must match the package name exactly.

A package hierarchy must be reflected in the file system of your Java development system.

For example, a package declared as

package java.awt.image;

needs to be stored in java\awt\image in a Windows environment. Be sure to choose your package names carefully.

You cannot rename a package without renaming the directory in which the classes are stored.

How does the Java run-time system know where to look for packages that you create? The answer has three parts.

- First, by default, the Java run-time system uses the current working directory as its starting point.

Thus, if your package is in a subdirectory of the current directory, it will be found.

- Second, you can specify a directory path or paths by setting the CLASSPATH environmental variable.

- Third, you can use the -classpath option with java and javac to specify the path to your classes.

When a package is imported, only those items within the package declared as public will be available to non-subclasses in the importing code.

**OVERLOADING METHODS :**

In Java, it is possible to define two or more methods within the same class that share the same name,

as long as their parameter declarations are different.

While overloaded methods may have different return types, the return type alone is insufficient to distinguish two

versions of a method. When Java encounters a call to an overloaded method, it simply executes the version of the method

whose parameters match the arguments used in the call.

In some cases, Java’s automatic type conversions can play a role in overload resolution.

class OverloadDemo {

void test(double a){

System.out.println("Inside test(double) a: " + a);

}

}

class Overload {

public static void main(String args[]) {

OverloadDemo ob = new OverloadDemo();

int i = 88;

ob.test(i); // this will invoke test(double)

ob.test(123.2); // this will invoke test(double)

}

}

As you can see, this version of OverloadDemo does not define test(int). Therefore, when test( ) is called with an

integer argument inside Overload, no matching method is found. However, Java can automatically convert an integer into a double, and this conversion can be used to resolve the call. Therefore, after test(int) is not found,

Java elevates i to double and then calls test(double).

Of course, if test(int) had been defined, it would have been called instead.

Java will employ its automatic type conversions only if no exact match is found.

Returning Objects:

// Returning an object.

class Test {

int a;

Test(int i) {

a = i;

}

Test incrByTen() {

Test temp = new Test(a+10);

return temp;

}

}

class RetOb {

public static void main(String args[]) {

Test ob1 = new Test(2);

Test ob2;

ob2 = ob1.incrByTen();

System.out.println("ob1.a: " + ob1.a);

System.out.println("ob2.a: " + ob2.a);

}

}

Output:

ob1.a: 2

ob2.a: 12

As you can see, each time incrByTen( ) is invoked, a new object is created, and a reference to it is returned to the

calling routine. Since all objects are dynamically allocated using new, you don’t need to worry about an object going

out-of-scope because the method in which it was created terminates. The object will continue to exist as long as there is a reference to it somewhere in your program. When there are no references to it, the object will be reclaimed the next time garbage collection takes place.

**OVERRIDING METHODS :**

In a class hierarchy, when a method in a subclass has the same name and type signature as a method in its super class, 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 super class will be hidden.

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.

(Check display functions in box classes)

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.

Let’s begin by restating an important principle: a superclass reference variable can refer to a subclass object.

When an overridden method is called through a superclass reference, Java determines which version of that method to execute based upon the type of the object being referred to at the time the call occurs. Thus, this determination is

made at run time.

In other words, it is the type of the object being referred to (not the type of the reference variable)

that determines which version of an overridden method will be executed.

If B extends A then you can override a method in A through B with changing the return type of method to B.

**STATIC :**

When a member is declared static, it can be accessed before any objects of its class are created,and without reference to any object. You can declare both methods and variables to be static.

The most common example of a static member is main( ).

main( ) is declared as static because it must be called before any objects exist.

Static method in Java is a method which belongs to the class and not to the object.

A static method can access only static data. It cannot access non-static data (instance variables)

A non-static member belongs to an instance. It's meaningless without somehow resolving which instance of a class you are talking about. In a static context, you don't have an instance, that's why you can't access a non-static member without explicitly mentioning an object reference.

In fact, you can access a non-static member in a static context by specifying the object reference explicitly :

public class Human {

String message = "Hello World";

public static void display(Human human){

System.out.println(human.message);

}

public static void main(String[] args) {

Human kunal = new Human();

kunal.message = "Kunal's message";

Human.display(kunal);

} }

A static method can call only other static methods and cannot call a non-static method from it.

A static method can be accessed directly by the class name and doesn’t need any object

A static method cannot refer to "this" or "super" keywords in anyway

If you need to do computation in order to initialize your static variables,

you can declare a static block that gets executed exactly once, when the class is first loaded.

// Demonstrate static variables, methods, and blocks.

class UseStatic {

static int a = 3;

static int b;

static void meth(int x) {

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

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

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

}

static {

System.out.println("Static block initialized.");

b = a \* 4;

}

public static void main(String args[]) {

meth(42);

}

}

As soon as the UseStatic class is loaded, all of the static statements are run. First, a is set to 3,

then the static block executes, which prints a message and then initializes b to a\*4 or 12. Then main( ) is called,

which calls meth( ), passing 42 to x. The three println( ) statements refer to the two static variables a and b,

as well as to the local variable x.

Here is the output of the program:

Static block initialized. x = 42

a = 3

b = 12

Note: main method is static, since it must be accessible for an application to run, before any instantiation takes place.

NOTE: Only nested classes can be static.

NOTE: Static inner classes can have static variables

You cant override the inherited static methods, as in java overriding takes place by resolving the type of object at

run-time and not compile time, and then calling the respective method.

Static methods are class level methods, so it is always resolved during compile time.

Static INTERFACE METHODS are not inherited by either an implementing class or a sub-interface.

NOTE:

public class Static {

// class Test // ERROR

static class Test{

String name;

public Test(String name) {

this.name = name;

}

}

public static void main(String[] args) {

Test a = new Test("Kunal");

Test b = new Test("Rahul");

System.out.println(a.name); // Kunal

System.out.println(b.name); // Rahul

}

}

Because :

The static keyword may modify the declaration of a member type C within the body of a non-inner class or interface T.

Its effect is to declare that C is not an inner class. Just as a static method of T has no current instance of T in its

body, C also has no current instance of T, nor does it have any lexically enclosing instances.

Here, test does not have any instance of it's outer class Static. Neither does main.

But main & Test can have instances of each other.

An enumeration is a list of named constants.

In Java, an enumeration defines a class type.

By making enumerations into classes, the capabilities of the enumeration are greatly expanded.

An enumeration is created using the enum keyword.

Enum declaration can be done outside a Class or inside a Class but not inside a Method

We can declare main() method inside enum. Hence we can invoke enum directly from the Command Prompt.

/\* internally above enum Color is converted to (Check Example.java)

class Color

{

public static final Color Red = new Color();

public static final Color Blue = new Color();

public static final Color Green = new Color();

}\*/

**Access Control:**

How a member can be accessed is determined by the access modifier attached to its declaration.

Usually, you will want to restrict access to the data members of a class—allowing access only through methods.

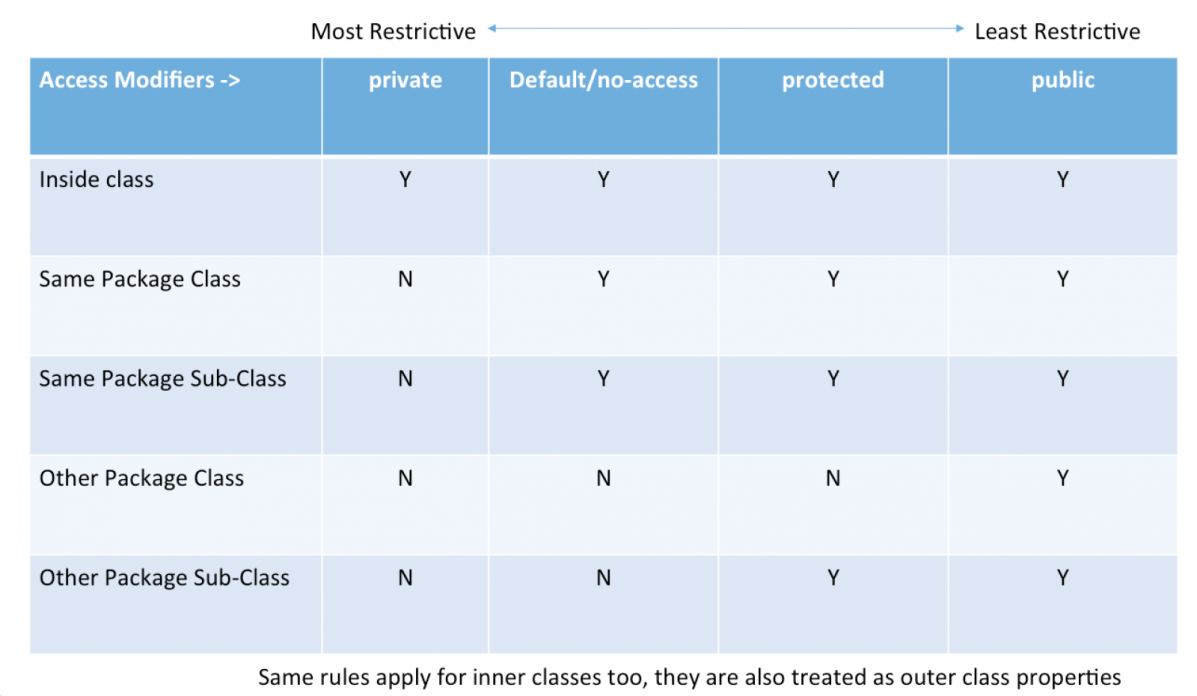
Also, there will be times when you will want to define methods that are private to a class.

Java’s access modifiers are public, private, and protected. Java also defines a default access level.

protected applies only when inheritance is involved.

When no access modifier is used, then by default the member of a class is public within its own package,

but cannot be accessed outside of its package.

 package packageOne;

public class Base

{

protected void display(){

System.out.println("in Base");

}

}

package packageTwo;

public class Derived extends packageOne.Base{

public void show(){

new Base().display(); // this is not working

new Derived().display(); // is working

display();//is working

}

}

protected allows access from subclasses and from other classes in the same package.

We can use child class to use protected member outside the package but only child class object can access it.

That's why any Derived class instance can access the protected method in Base.

The other line creates a Base instance (not a Derived instance!!).

And access to protected methods of that instance is only allowed from objects of the same package.

display();

-> allowed, because the caller, an instance of Derived has access to protected members and fields of its subclasses,

even if they're in different packages

new Derived().display();

-> allowed, because you call the method on an instance of Derived and that instance has access to the protected methods

of its subclasses

new Base().display();

-> not allowed because the caller's (the this instance) class is not defined in the same package like the Base class,

so this can't access the protected method. And it doesn't matter - as we see - that the current subclasses a class from

that package. That backdoor is closed ;)

Remember that any time talks about a subclass having an access to a superclass member, we could be talking about the subclass inheriting the member, not simple accessing the member through a reference to an instance of the superclass.

class C

protected member;

// in a different package

class S extends C

obj.member; // only allowed if type of obj is S or subclass of S

The motivation is probably as following. If obj is an S, class S has sufficient knowledge of its internals,

it has the right to manipulate its members, and it can do this safely.

If obj is not an S, it's probably another subclass S2 of C, which S has no idea of.

S2 may have not even been born when S is written. For S to manipulate S2's protected internals is quite dangerous.

If this is allowed, from S2's point of view, it doesn't know who will tamper with its protected internals and how,

this makes S2 job very hard to reason about its own state.

Now if obj is D, and D extends S, is it dangerous for S to access obj.member? Not really.

How S uses member is a shared knowledge of S and all its subclasses, including D. S as the superclass has the right to

define behaviours, and D as the subclass has the obligation to accept and conform.

For easier understanding, the rule should really be simplified to require obj's (static) type to be exactly S.

After all, it's very unusual and inappropriate for subclass D to appear in S. And even if it happens,

that the static type of obj is D, our simplified rule can deal with it easily by upcasting: ((S)obj).member

**INTERFACE :**

Multiple inheritance is not available in java.

(Same functions in 2 classes it will skip that hence no multiple inheritance)

Instead we have java interfaces. they have abstract functions (no body of functions)

Interface is like class but not completely. it is like an abstract class.

By default functions are public and abstract in interface.

variables are final and static by default in interface.

Interfaces specify only what the class is doing, not how it is doing it.

The problem with MULTIPLE INHERITANCE is that two classes may define different ways of doing the same thing,

and the subclass can't choose which one to pick.

Key difference between a class and an interface: a class can maintain state information(especially through the use of instance variables), but an interface cannot.

Using interface, you can specify a set of methods that can be implemented by one or more classes.

Although they are similar to abstract classes, interfaces have an additional capability:

A class can implement more than one interface. By contrast, a class can only inherit a single superclass

(abstract or otherwise).

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, as a general rule,

their methods are declared without any body.

By providing the interface keyword, Java allows you to fully utilize the “one interface, multiple methods”

aspect of polymorphism.

NOTE: Interfaces are designed to support dynamic method resolution at run time.

Normally, in order for a method to be called from one class to another, both classes need to be present at compile time so the Java compiler can check to ensure that the method signatures are compatible. This requirement by itself makes for a static and nonextensible classing environment. Inevitably in a system like this, functionality gets pushed up higher and higher in the class hierarchy so that the mechanisms will be available to more and more subclasses. Interfaces are designed to avoid this problem. They disconnect the definition of a method or set of methods from the inheritance hierarchy. Since interfaces are in a different hierarchy from classes, it is possible for classes that are unrelated in terms of the class hierarchy to implement the same interface. This is where the real power of interfaces is realized.

Beginning with JDK 8, it is possible to add a default implementation to an interface method.

Thus, it is now possible for interface to specify some behavior.However, default methods constitute what is, in essence,a special-use feature, and the original intent behind interface still remains.

Variables can be declared inside of interface declarations.

NOTE: They are implicitly final and static, meaning they cannot be changed by the implementing class.

They must also be initialized. All methods and variables are implicitly public.

NOTE: The methods that implement an interface must be declared public. Also, the type signature of the implementing method must match exactly the type signature specified in the interface definition.

It is both permissible and common for classes that implement interfaces to define additional members of their own.

NOTE: You can declare variables as object references that use an interface rather than a class type.

This process is similar to using a superclass reference to access a subclass object.

Any instance of any class that implements the declared interface can be referred to by such a variable.

When you call a method through one of these references, the correct version will be called based on the actual instance of the interface being referred to. Called at run time by the type of object it refers to.

The method to be executed is looked up dynamically at run time, allowing classes to be created later than the code which calls methods on them.

The calling code can dispatch through an interface without having to know anything about the “callee.”

CAUTION: Because dynamic lookup of a method at run time incurs a significant overhead when compared with the normal method invocation in Java, you should be careful not to use interfaces casually in performance-critical code.

**Nested Interfaces**:

An interface can be declared a member of a class or another interface. Such an interface is called a member interface or a nested interface. A nested interface can be declared as public, private, or protected.

This differs from a top-level interface, which must either be declared as public or use the default access level.

// This class contains a member interface.

class A {

// this is a nested interface

public interface NestedIF {

boolean isNotNegative(int x);

}

}

// B implements the nested interface.

class B implements A.NestedIF {

public boolean isNotNegative(int x) {

return x < 0 ? false: true;

}

}

class NestedIFDemo {

public static void main(String args[]) {

// use a nested interface reference

A.NestedIF nif = new B();

if(nif.isNotNegative(10))

System.out.println("10 is not negative");

if(nif.isNotNegative(-12))

System.out.println("this won't be displayed");

}

}

Interfaces Can Be Extended:

One interface can inherit another by use of the keyword extends. The syntax is the same as for inheriting classes.

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

Default Interface Methods (aka extension method) :

A primary motivation for the default method was to provide a means by which interfaces could be expanded without breaking existing code.

i.e. suppose you add another method without body in an interface. Then you will have to provide the body of that method in all the classes that implement that interface.

Ex: default String getString() {

return "Default String";

}

For example, you might have a class that implements two interfaces.

If each of these interfaces provides default methods, then some behavior is inherited from both.

# In all cases, a class implementation takes priority over an interface default implementation.

# In cases in which a class implements two interfaces that both have the same default method, but the class does not override that method, then an error will result.

# In cases in which one interface inherits another, with both defining a common default method, the inheriting

interface’s version of the method takes precedence.

NOTE: static interface methods are not inherited by either an implementing class or a subinterface.

i.e. static interface methods should have a body! They cannot be abstract.

NOTE : when overriding methods, the access modifier should be same or better i.e. if in Parent Class it was protected, then then overridden should be either protected or public.

**Enum and Inheritance :**

-All enums implicitly extend java.lang.Enum class. As a class can only extend one parent in Java,

so an enum cannot extend anything else.

-An enum cannot be a superclass.

-toString() method is overridden in java.lang.Enum class, which returns enum constant name.

-enum can implement many interfaces.

Two enumeration constants can be compared for equality by using the == relational operator.

values(), ordinal() and valueOf() methods :

These methods are present inside **java.lang.Enum**.

-values() method can be used to return all values present inside enum.

-Order is important in enums.By using ordinal() method, each enum constant index can be found,

just like array index.

-valueOf() method returns the enum constant of the specified string value, if exists.

**enum and constructor :**

-enum can contain constructor and it is executed separately for each enum constant at the time

of enum class loading.

-We can’t create enum objects explicitly and hence we can’t invoke enum constructor directly.

-And the constructor cannot be the public or protected it must have private or default modifiers.

-Why? if we create public or protected, it will allow initializing more than one objects.

-This is totally against enum concept.

**enum and methods** :

enum can contain concrete methods only i.e. no any abstract method.

You can compare for equality an enumeration constant with any other object by using equals( ),

which overrides the equals( ) method defined by Object.

Although equals( ) can compare an enumeration constant to any other object, those two objects

will be equal only if they both refer to the same constant,within the same enumeration.

Simply having ordinal values in common will not cause equals( ) to return true if the two constants

are from different enumerations. Remember, you can compare two enumeration references for equality by using ==.