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Classes and Objects in Java

SYNTAX:
```
Class <name> {
        <field declarations>
        <method definitions>
}
```

```
Class Body {
  public long idNum;
  public String nameFor;
  public Body orbits;
  public static long nextID = 0;

  public long getID( )  {
    return idNum;
  }

  public String getName( )  {
     return nameFor;
  }
}
```

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Instance Creation with New

```
Body sun  =  new  Body( );
sun.idNum = Body.nextID++;
sun.NameFor = "Sol ";
sun.orbits = null;

Body earth = new Body( );
earth.idNum = Body.nextID++;
earth.nameFor = "Earth";
earth.orbits = sun;
```

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Access to Fields and Methods

public: accessible anywhere the class is and inherited by subclasses

private: accessible ONLY in the class itself

protected: accessible to subclasses and code in the same package and inherited by subclasses

package: accessible only to code and inherited only by subclasses in the same package

How does this compare to C++ ?

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Defining Constructors

```
Class Body  {
  public long idNum;
  public String name = "unnamed";
  public Body orbits = null;

  private static long nextID = 0;

  Body( )  {
    idNum = nextID++;
  }

  Body(String bodyName,
         Body  orbitsAround)  {
*   this();
    name = bodyName;
    orbits = orbitsAround;
  }
}
```

NOTE: a constructor can invoke another constructor from the same class using this.

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Use of Constructors

constructor with 2 arguments

```
Body  sun  =  new Body("Sol", null);
Body earth = new Body("Earth", sun);
```

constructor with no arguments

```
Body  mars = new  Body( );
mars.name = "Mars";
mars.orbits = sun;
```

Overloading: 2 methods with the same name, but different signatures (different number or type of parameters).

When are zero-argument constructors useful?

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The Method toString( )

```
Public  String  toString( )  {

  String   desc  =  idNum  +  " ("
                    +  name  +  ")";

  if  (orbits  !=  null)
            desc  +=  " orbits "  +
                       orbits.toString( );
```

NOTE: the toString method is special.

If you provide a toString( ) method for an object, then it will be used whenever the object is used in a string concatenation.

```
System.out.println("Body  "  +  earth);
```

What is the output ?

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PARAMETER PASSAGE

In Java, parameters are passed by value.

- Variables containing primitive types cannot be changed by a method.

```
Class PassByValue{
  public static void main(String[]  args)  {
    double one = 1.0;

    System.out.println("before:  one = " +  one);
    halveIt(one);
    System.out.println("after:  one = " + one);
}

  public static void halveIt(double  arg)  {
    arg  /=  2.0;
    System.out.println("halved:  arg = " + arg);
  }
}
```

What will the output be ?

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- If a variable contains an object reference, the fields of that object can be changed.

```
Class PassRefByValue  {
  public static void main(String[] args)  {
    Body sirius = new Body("Sirius", null);

    System.out.println("before: " +  sirius);
    commonName(sirius);
    System.out.println("after: " +  sirius);
  }

  public static void commonName(Body bodyRef) {
    bodyRef.name = "Dog Star";
    bodyRef  = null;
  }
}
```

What does this do?
Does the name field of sirius change ?
Does the value of sirius change to null?

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STATIC MEMBERS

A member is a field or a method.

A static member is a member that belongs to the class, not to instances of the class.

A static field is just a class variable, such as nextID in class Body. It is assigned its initial value before any instances of the class are created.

A static initialization block can be used to initialize static structures.

static { <initialization statements> }

A static method (also called a class method) can be used to modify static fields.

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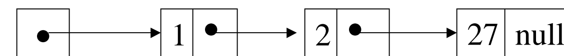
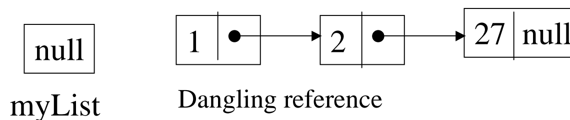
GARBAGE COLLECTION

- Java has new, but it doesn't have free.
- The garbage collector is a system method that finds objects that are no longer referenced and reclaims their memory.
- Garbage collection is especially useful in applications that require linked structures, such as linked lists.

myList



myList = null;



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EXAMPLE:
Using Java to Implement Linked Lists

```
Public class ListNode
{
  int  Element;
  ListNode  Next;

  ListNode(int  NewElement,  ListNode  Node) {
    Element  =  NewElement;
    Next  = Node;
  } }

public class IntList  {
  ListNode Head;

  IntList( ) {
    Head  =  new  ListNode(0, null);  }

  void  InsertEnd(int  NewElement)  {
    ListNode Marker;
    for (Marker  =  Head;  Marker.Next  !=  null;
         Marker  =  Marker.Next);
    Marker.Next  =  new  ListNode(NewElement,
                                  null);  }
}
```

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```
Void Delete(int DelElement)  throws ListException  {

  ListNode Marker;
  for (Marker = Head; Marker.Next != null &&
         Marker.Next.Element  !=  DelElement;
      Marker = Marker.Next);

  if (Marker.Next != null &&
      Marker.Next.Element == DelElement)
    Marker.Next = Marker.Next.Next;
  else
    throw new ListException("Cannot delete:
        element not in list.");
}
```

What does this do when
Delete(17)
is invoked for the list myList?

What about when
Delete(1)
is invoked for the list myList?
What’s wrong with myList ?