Interface

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❖Interface implementation by classes
❖Benefits of interfaces
❖Implementation of multiple interface

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❖Sorting with Comparable<T> and Comparator<T>

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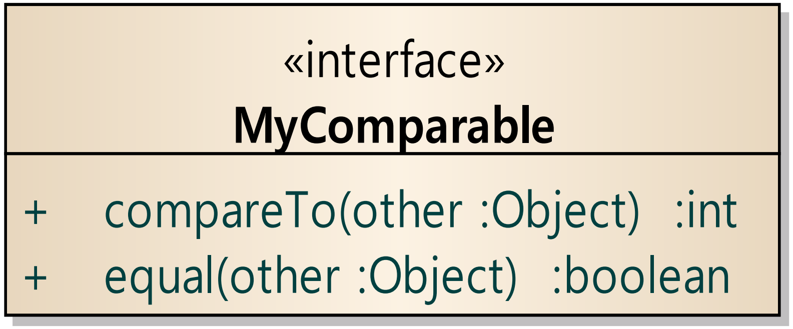
Interfaces

- Interfaces is a way of describing what classes should do, without specifying how they should do it.

- An interface defines a set of methods.
- An interface declaration contains signatures, but no implementations

```
public interface MyComparable {
     public int compareTo(Object other) ;
     public boolean equal(Object other) ;
}
```



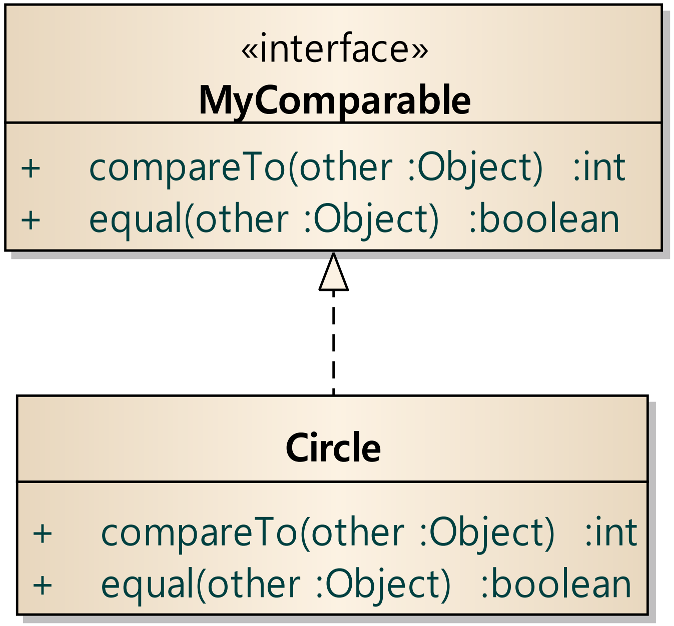
«interface»
MyComparable

+ compareTo(other :Object) :int
+ equal(other :Object) :boolean

Interfaces

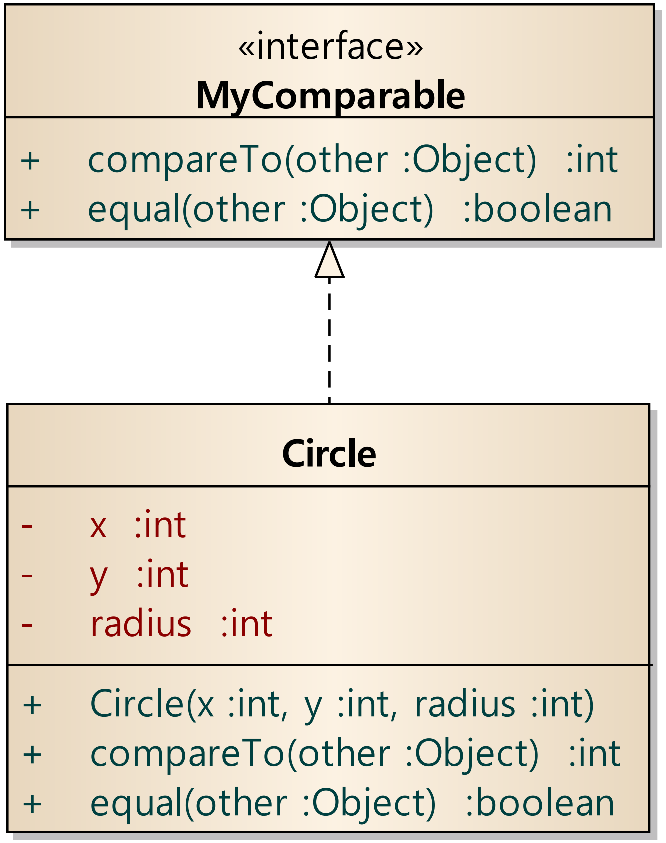
- A class can implement an interface. The class must implement all the methods declared in the interface

```
public class Circle implements MyComparable {
   …
   public int compareTo(Object other) {
       …
   }
   public boolean equal(Object other) {
       …
   }
}
```


«interface»
MyComparable
+ compareTo(other :Object) :int
+ equal(other :Object) :boolean
Circle
+ compareTo(other :Object) :int
+ equal(other :Object) :boolean

Interfaces

```
public class Circle implements MyComparable {
   private int x, y, radius ;

   public Circle(int x, int y, int radius) {
       this.x = x ; this.y = y ; this.radius = radius ;
   }
   public int compareTo(Object other) {
       if ( ! other instanceof Circle ) return -2 ;
       Circle otherCircle = (Circle) other ;
       int returnValue = 0 ;
       if ( radius < otherCircle.radius ) returnValue = -1 ;
       if ( radius == otherCircle.radius ) returnValue = 0 ;
       if ( radius > otherCircle.radius ) returnValue = 1 ;
       return returnValue ;
   }
   public boolean equal(Object other) {
       if ( ! other instanceof Circle ) return false ;
       Circle otherCircle = (Circle) other ;
       return x == otherCircle.x && y == otherCircle.y
              && radius == otherCircle.radius ;
   }
}
```



«interface»
MyComparable

+ compareTo(other :Object) :int
+ equal(other :Object) :boolean

Circle

- x :int
- y :int
- radius :int

+ Circle(x :int, y :int, radius :int)
+ compareTo(other :Object) :int
+ equal(other :Object) :boolean

Interface based programming

- Interface variable can point to objects of a class that implements the interface

```
Circle c1 = new Circle(0, 0, 10) ;
Circle c2 = new Circle(10, 10, 10) ;
Circle c3 = new Circle(0, 0, 10) ;

MyComparable[] list = new MyComparable[10] ;
list[0] = c1 ;
list[1] = c2 ;
list[2] = c3 ;
```

List can point to Circle object.

Interface based programming

- Objects of a class can be accessed through its interface.

```
public class CircleTest {
   public static void main(String[] args) {
       Circle c1 = new Circle(0, 0, 10) ;
       Circle c2 = new Circle(10, 10, 10) ;
       Circle c3 = new Circle(0, 0, 10) ;

        MyComparable[] list = {c1, c2, c3} ;

       for ( int i = 0 ; i < list.length ; i ++ ) {
           if ( list[0].compareTo(list[i]) < 0 )
                     System.out.println(list[0] + " has smaller size than " + list[i]) ;
           if ( list[0].compareTo(list[i]) == 0 )
                     System.out.println(list[0] + " has the same size as " + list[i]) ;
           if ( list[0].compareTo(list[i]) == 0 )
                     System.out.println(list[0] + " has the larger size than " + list[i]) ;
       } // actually, Circle is a subclass of Object. So, toString() can be invoked.
   }
}
```

Each Circle object is accessed through MyComparable interface

Benefits of Interfaces

- Interfaces support generalized functions for different classes.
- Therefore, MySort can be used with any class which implements MyComparable interface

```
public class MySort {
    public static void sort(MyComparable[] elements) {
        for ( int i = 0 ; i < elements.length - 1; i ++ ) {
            for ( int j = i + 1 ; j < elements.length ; j ++ ) {
                if ( elements[i].compareTo(elements[j]) > 0 ) {
                    MyComparable temp = elements[j] ;
                    elements[j] = elements[i] ;
                    elements[i] = temp ;
                }
            }
        }
    }
}
```

Benefits of Interfaces

- MySort with Circle

```
public class CircleSortTest {
    public static void main(String[] args) {
        Circle c1 = new Circle(0, 0, 15) ;
        Circle c2 = new Circle(10, 10, 10) ;
        Circle c3 = new Circle(0, 0, 20) ;

        MyComparable[] list = {c1, c2, c3} ;
        MySort.sort(list) ;

        for ( Object o : list ) // for (Circle o : list) is allowed?
            System.out.println(o) ;
    }
}
```

```
Center: [   10,    10], Radius:    10
Center: [    0,     0], Radius:    15
Center: [    0,     0], Radius:    20
```

Benefits of Interfaces

MySort with Student

```
public class StudentSortTest {
    public static void main(String[] args) {
        Student s1  =  new Student(1, "공부잘하는학생", 4.5F) ;
        Student s2  =  new Student(2, "공부잘못하는학생", 2.5F) ;

        MyComparable[] list = {s1, s2} ;
        MySort.sort(list) ;

        for ( Object o : list ) System.out.println(o) ;
    }
}
```

```
ID:     2, Name:        공부잘못하는학생, GPA:  2.50
ID:     1, Name:         공부잘하는학생, GPA:  4.50
```

Student class

```
public class Student implements MyComparable {
    private int studentID ;
    private String name ;
    private float gpa ;
    public Student(int id, String name, float gpa) {
        studentID = id ; this.name = name ; this.gpa = gpa ;
    }
    public int compareTo(Object other) {
        Student otherStudent = (Student) other ;
        int returnValue = 0 ;
        if ( gpa < otherStudent.gpa ) returnValue = -1 ;
        if ( gpa == otherStudent.gpa ) returnValue = 0 ;
        if ( gpa > otherStudent.gpa ) returnValue = 1 ;
        return returnValue ;
    }
    public boolean equal(Object other) { return studentID==((Student) other).studentID; }
    public String toString() {
        return String.format("ID: %5d, Name: %15s, GPA: %5.2f", studentID, name, gpa) ;
    }
}
```

Implementation of Multi-interfaces

- A class can implement two or more interfaces.

```
public interface AreaComputable {
    public float getArea() ;
}
```

```
public class Circle2 implements MyComparable, AreaComputable {
    private int x, y ;
    private int radius ;

    public Circle2(int x, int y, int radius) {
        this.x = x ; this.y = y ; this.radius = radius ;
    }
    public float getArea() { return (float) Math.PI * radius * radius ; }
    public int compareTo(Object other) { … }
    public boolean equal(Object other) { … }
    public String toString() { … }
}
```

Triangle class

```
public class Triangle implements AreaComputable {
    private int width, height ;
    public Triangle(int width, int height) {
        this.width = width ; this.height = height ;
    }
    public float getArea() { return (float) 0.5 * width * height ; }
    public String toString() {
        return String.format("Width: %5d, Height: %5d", width, height) ;
    }
}
```

Implementation of Multi-interfaces

```
public class AreaComputableTest {
  public static void main(String[] args) {
     Circle2 c1 = new Circle2(0, 0, 15) ;
     Circle2 c2 = new Circle2(10, 10, 10) ;

     Triangle t1 = new Triangle(10, 20) ;
     Triangle t2 = new Triangle(20, 20) ;

     AreaComputable[] list = {c1, c2, t1, t2} ;

     float totalArea = 0 ;
     for ( AreaComputable elem: list) {
        final float area = elem.getArea() ;
        System.out.printf("%-40s Area: %10.2f%n", elem, area) ;
        totalArea += area ;
     }
     System.out.printf("Total Area%n%10.2f%n", totalArea) ;
  }
}
```

```
Center: [    0,     0], Radius:    15     Area:     706.86
Center: [   10,    10], Radius:    10     Area:     314.16
Width:     10, Height:    20              Area:     100.00
Width:     20, Height:    20              Area:     200.00
Total Area
   1321.02
```

SCORE PROCESSNG

ScoreProcessing

```
enum Kind { General, Java };
public class ScoreProcessing {
  private int min, max ;
  private Kind kind;

  public ScoreProcessing(Kind kind) { setKind(kind); }
  private void setKind(Kind kind) { this.kind = kind; }

  public void analyze(int[] data) {
    switch ( kind ) {
    case General:
       min = getGeneralMin(data);
       max = getGeneralMax(data);
       break;
    case Java:
       min = getJavaMin(data);
       max = getJavaMax(data);
       break;
    default: break;
    }
  }
```

- It is harder to maintain, especially if they support multiple algorithms.
- Different algorithms will be appropriate at different times.

```
  private int getGeneralMax(int[] data) {
    int max = data[0] ;
    for ( int i = 1 ; i < data.length ; i ++ )
       if ( max < data[i] ) max = data[i] ;
    return max ;
  }
  private int getGeneralMin(int[] data) {
    int min = data[0] ;
    for ( int i = 1 ; i < data.length ; i ++ )
       if ( min > data[i] ) min = data[i] ;
    return min ;
  }
  private int getJavaMax(int[] data) {
    int[] copied = Arrays.copyOf(data, data.length) ;
    Arrays.sort(copied) ;
    int max = copied[copied.length-1] ;
    return max ;
  }
  private int getJavaMin(int[] data) {
    int[] copied = Arrays.copyOf(data, data.length) ;
    Arrays.sort(copied) ;
    int min = copied[0] ;
    return min ;
  }
}
```

MinMaxStrategy

```
public interface MinMaxStrategy {
  public int getMin(int[] data);
  public int getMax(int[] data);
}
```

```
public class GeneralMinMax
  implements MinMaxStrategy {
 public int getMin(int[] data) {
  int min = data[0] ;
  for ( int i = 1; i < data.length; i ++ )
   if ( min > data[i] ) min = data[i] ;
  return min ;
 }
 public int getMax(int[] data) {
  int max = data[0] ;
  for ( int i = 1; i < data.length; i ++ )
   if ( max < data[i] ) max = data[i] ;
  return max ;
 }
}
```

```
public class JavaMinMax
  implements MinMaxStrategy {
 public int getMin(int[] data) {
  int[] copied = Arrays.copyOf(data, data.length);
  Arrays.sort(copied) ;
  int min = copied[0] ;
  return min ;
 }
 public int getMax(int[] data) {
  int[] copied = Arrays.copyOf(data, data.length);
  Arrays.sort(copied) ;
  int max = copied[copied.length-1] ;
  return max ;
 }
}
```

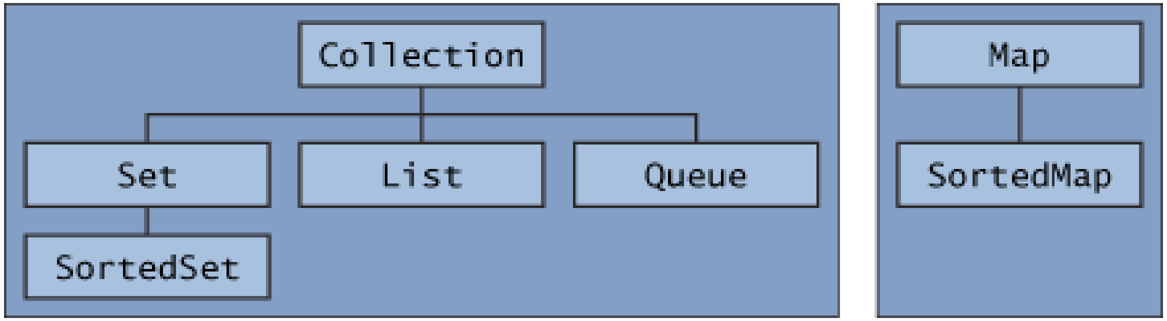
ScoreProcessing by Interface

```
public class ScoreProcessing {
  private int min, max ;
  private MinMaxStrategy strategy;

  public ScoreProcessing(MinMaxStrategy strategy) { setStrategy(strategy); }
  public void setStrategy(MinMaxStrategy strategy) { this.strategy = strategy; }
  public void analyze(int[] data) {
    min = strategy.getMin(data);
    max = strategy.getMax(data);
  }

  public static void main(String[] args) {
    int[] data = {0, 50, 10, 30, 70} ;
    ScoreProcessing proc = new ScoreProcessing(new GeneralMinMax()) ;
    proc.analyze(data) ;

    proc.setStrategy(new JavaMinMax()) ;
    proc.analyze(data) ;
  }
}
```

COLLECTION FRAMEWORK

Java Collection Framework

- Standard Library for Collection
- Need to import java.util.*
- Interfaces



- General implementations

Interfaces	Implementations				
	Hash table	Resizable array	Tree	Linked list	Hash table + Linked list
Set	**HashSet**		TreeSet		LinkedHashSet
List		**ArrayList**		LinkedList	
Queue				**LinkedList**	
Map	**HashMap**		TreeMap		LinkedHashMap

- Refer to http://docs.oracle.com/javase/tutorial/collections/index.html
- Refer to http://www.tutorialspoint.com/java/java_collections.htm

Collection : List

```
import java.util.*;
public class ListExample {
  public static void main(String[] args) {
    List<String> names = new ArrayList<>() ; // or LinkedList<>()

    // add, allAll
    names.add("Park") ;
    names.add("Kim") ;

    // toString
    System.out.println(names.toString()) ; // [Park, Kim]

    // add
    names.add(1, "Lee") ;

    // size, get
    for ( int i = 0 ; i < names.size() ; i ++ ) System.out.println(names.get(i)) ;
    // Park
    // Lee
    // Kim
    // remove
    names.remove("Kim") ; // remove(int index), removeAll
    // indexOf
    int foundIndex = names.indexOf("Kim") ; // lastIndexOf also supported
    if (  foundIndex == -1 ) // ! names.contains(“Kim”), containsAll()
        System.out.println("Kim not Found") ; // Kim not Found
    else {
        System.out.println("Kim Found") ;
        names.remove(foundIndex)
    }

    // subList, clear
    names.subList(0, 1).clear(); // Remove Park

    // Iterator
    Iterator<String> it = names.iterator() ;
    while ( it.hasNext() ) System.out.println(it.next()) ;
    // Lee

    // clear, isEmpty
    names.clear();
    assert ( names.isEmpty() == true );
  }
}
```

Collection : Set

```
import java.util.*;
public class FindDups {
    public static void main(String[] args) {
        Set<String> s = new HashSet<>(); // or TreeSet<String>()
        for ( final String a : args )
            if ( !s.add(a) ) System.out.println("Duplicate detected: " + a);

        System.out.println(s.size() + " distinct words: " + s);
    }
}
```

Now run the program.

```
    % java FindDups i came i saw i left
```

The following output is produced.

```
    Duplicate detected: I
    Duplicate detected: I
    4 distinct words: [i, left, saw, came]
```

Modifier and Type	Method and Description
boolean	add(E e)Adds the specified element to this set if it is not already present (optional operation).
boolean	addAll(Collection<? extends E> c)Adds all of the elements in the specified collection to this set if they're not already present (optional operation).
void	clear()Removes all of the elements from this set (optional operation).
boolean	contains(Object o)Returns true if this set contains the specified element.
boolean	containsAll(Collection<?> c)Returns true if this set contains all of the elements of the specified collection.
boolean	equals(Object o)Compares the specified object with this set for equality.
int	hashCode()Returns the hash code value for this set.
boolean	isEmpty()Returns true if this set contains no elements.
Iterator<E>	iterator()Returns an iterator over the elements in this set.
boolean	remove(Object o)Removes the specified element from this set if it is present (optional operation).
boolean	removeAll(Collection<?> c)Removes from this set all of its elements that are contained in the specified collection (optional operation).
boolean	retainAll(Collection<?> c)Retains only the elements in this set that are contained in the specified collection (optional operation).
int	size()Returns the number of elements in this set (its cardinality).
Object[]	toArray()Returns an array containing all of the elements in this set.
<T> T[]	toArray(T[] a)Returns an array containing all of the elements in this set; the runtime type of the returned array is that of the specified array.

Collection : Map

```
import java.util.*;
public class MapExample {
  public static void main(String[] args) {
    Map<String, Integer> cityPopulation = new HashMap<>() ;

    cityPopulation.put("Busan", 350) ; // putAll
    cityPopulation.put("Seoul", 1000) ;
    cityPopulation.put("Daejon", 150) ;

    System.out.println(cityPopulation) ; // {Busan=350, Seoul=1000, Daejon=150}

    if ( cityPopulation.containsKey("Daejon") )
       System.out.println(cityPopulation.get("Daejon")) ; // 150

    cityPopulation.remove("Daejon") ;

    Set<String> cities = cityPopulation.keySet() ;
    System.out.println(cities) ; // [Busan, Seoul]

    Collection<Integer> population = cityPopulation.values() ;
    System.out.println(population) ; // [350, 1000]
  }
}
```

```
        cityPopulation.replace("Busan", 300);
        for ( final String key : cityPopulation.keySet() ) {
            System.out.println( String.format("키 : %s, 값 : %s", key, cityPopulation.get(key)) );
        }

        Iterator<String> keys = cityPopulation.keySet().iterator();
        while ( keys.hasNext() ) {
            String key = keys.next();
            System.out.println( String.format("키 : %s, 값 : %s", key, cityPopulation.get(key)) );
        }

        for ( final Map.Entry<String, Integer> elem : cityPopulation.entrySet() ) {
            System.out.println( String.format("키 : %s, 값 : %s", elem.getKey(), elem.getValue()) );
        }

    }
}
```

```
키 : Busan, 값 : 300
키 : Seoul, 값 : 1000
키 : Busan, 값 : 300
키 : Seoul, 값 : 1000
키 : Busan, 값 : 300
키 : Seoul, 값 : 1000
```

Sorting with Comparable<T> and Comparator<T>

Sorting Array of Basic Types

```
public class BasicSortingMain {
  public static void main(String[] args) {
       int[] intArr = {5,9,1,10};
       Arrays.sort(intArr);
       System.out.println(Arrays.toString(intArr));

       String[] strArr = {"A", "C", "B", "Z", "E"};
       Arrays.sort(strArr);
       System.out.println(Arrays.toString(strArr));

       List<String> strList = new ArrayList<>();
       strList.add("A");
       strList.add("C");
       strList.add("B");
       strList.add("Z");
       strList.add("E");
       Collections.sort(strList);
       for ( String str: strList ) System.out.print(" "+str);
  }
}
```

```
[1, 5, 9, 10]
[A, B, C, E, Z]
 A B C E Z
```

Sorting With Comparable<T> Interface

- To sort an Object by its property, you have to make the Object implement the **Comparable** interface and override the **compareTo**() method

```
public class SortingObjectMain {
  public static void main(String[] args) {
    //sorting object array
    Employee[] empArr = new Employee[4];
    empArr[0] = new Employee(10, "Mikey", 25, 10000);
    empArr[1] = new Employee(20, "Arun", 29, 20000);
    empArr[2] = new Employee(5, "Lisa", 35, 5000);
    empArr[3] = new Employee(1, "Pankaj", 32, 50000);

    //sorting employees array using Comparable interface implementation
    Arrays.sort(empArr);

    System.out.println("Default Sorting of Employees list:₩n
        +Arrays.toString(empArr));
  }
}
```

```
Default Sorting of Employees list:
[[id=1, name=Pankaj, age=32,
salary=50000], [id=5, name=Lisa,
age=35, salary=5000], [id=10,
name=Mikey, age=25,
salary=10000], [id=20, name=Arun,
age=29, salary=20000]]
```

Employee should implement Comparable<Employee> interface

Class Employee implementing Comparable

```
public class Employee implements Comparable<Employee> {
  private int id;
  private String name;
  private int age;
  private long salary;

  public Employee(int id, String name, int age, int salary) {
    this.id = id;
    this.name = name;
    this.age = age;
    this.salary = salary;
  }
  @Override
  public String toString() {
    return "[id=" + this.id + ", name=" + this.name + ", age=" +
        this.age + ", salary=" + this.salary + "]";
  }
  @Override
  public int compareTo(Employee emp) { return (this.id - emp.id); }
}
```

Sorting With Comparator<T> Interface

- The Comparable interface is only allow to sort a single property. To sort with multiple properties, you need **Comparator<T>**.

```
public class SortingObjectMain {
  public static void main(String[] args) {
    //sorting object array
    Employee[] empArr = new Employee[4];
    …

    //sort employees array using Comparator by Salary
    Arrays.sort(empArr, Employee.SalaryComparator);
    System.out.println("Employees list sorted by Salary:₩n"
        +Arrays.toString(empArr));

    //sort employees array using Comparator by Age
    Arrays.sort(empArr, Employee.AgeComparator);
    System.out.println("Employees list sorted by Age:₩n"
        +Arrays.toString(empArr));

    //sort employees array using Comparator by Name
    Arrays.sort(empArr, Employee.NameComparator);
    System.out.println("Employees list sorted by Name:₩n"
        +Arrays.toString(empArr));
  }
}
```

```
Employees list sorted by Salary:
[[id=5, name=Lisa, age=35,
salary=5000], [id=10, name=Mikey,
age=25, salary=10000], [id=20,
name=Arun, age=29, salary=20000],
[id=1, name=Pankaj, age=32,
salary=50000]]
Employees list sorted by Age:
[[id=10, name=Mikey, age=25,
salary=10000], [id=20, name=Arun,
age=29, salary=20000], [id=1,
name=Pankaj, age=32, salary=50000],
[id=5, name=Lisa, age=35, salary=5000]]
Employees list sorted by Name:
[[id=20, name=Arun, age=29,
salary=20000], [id=5, name=Lisa,
age=35, salary=5000], [id=10,
name=Mikey, age=25, salary=10000],
[id=1, name=Pankaj, age=32,
salary=50000]]
```

Class Employee having Comparators

```
public class Employee ~~implements Comparable<Employee>~~ {
  ...
~~  public int compareTo(Employee emp) { return (this.id - emp.id); }~~
  public static Comparator<Employee> SalaryComparator
    = new Comparator<Employee>() {
        public int compare(Employee e1, Employee e2) {
            return (int) (e1.getSalary() - e2.getSalary());
        }
    };
  public static Comparator<Employee> AgeComparator
    = new Comparator<Employee>() {
        public int compare(Employee e1, Employee e2) {
            return e1.getAge() - e2.getAge();
        }
    };
  public static Comparator<Employee> NameComparator
    = new Comparator<Employee>() {
        public int compare(Employee e1, Employee e2) {
            return e1.getName().compareTo(e2.getName());
        }
    };
}
```

DEFAULT INTERFACE METHOD
STATIC INTERFACE METHOD

Default Interface Method Since Java 8(March 2014)

- Default interface methods
  - They are declared with the **default** keyword at the beginning of the method signature, and they provide an implementation

```
public interface MyInterface {

    // regular interface methods

    public default void defaultMethod() {
        // default method implementation
    }
}
```

- They allow us to add new methods to an interface that are automatically available in the implementations.
- Thus, there's no need to modify the implementing classes

Default Interface Method

```
public interface Vehicle {
    public String getBrand();
    public String speedUp();
    public String slowDown();
    public default String turnAlarmOn() {
        return "Turning the vehicle alarm on.";
    }
    public default String turnAlarmOff() {
        return "Turning the vehicle alarm off.";
    }
}
```

Default Interface Method

```
public class Car implements Vehicle {
    private String brand;

    public Car(String brand) {
        this.brand = brand;
    }
    @Override
    public String getBrand() {
        return brand;
    }
    @Override
    public String speedUp() {
        return "The car is speeding up.";
    }
    @Override
    public String slowDown() {
        return "The car is slowing down.";
    }
}
```

```
public static void main(String[] args) {

    Vehicle car = new Car("BMW");

    System.out.println(car.getBrand());

    System.out.println(car.speedUp());

    System.out.println(car.slowDown());

    System.out.println(car.turnAlarmOn());

    System.out.println(car.turnAlarmOff());

}
```

Static Interface Method

- Java 8 allows us to define and implement static methods in interfaces

```
public interface Vehicle {

    // regular / default interface methods

    public static int getHorsePower(int rpm, int torque) {
        return (rpm * torque) / 5252;
    }
}
```

```
Vehicle.getHorsePower(2500, 480));
```

- A static method can be invoked within other static and default methods

- Static methods in interfaces make possible to group related utility methods, without having to create artificial utility classes

Static Interface Method

- Up to now, it has been common to place static methods in companion classes; you find pairs of interfaces and utility classes such as Collection/Collections, Array/Arrays, or Path/Paths
- Paths class only has a couple of factory methods. You can construct a path to a file or directory from a sequence of strings, such as **Paths**.get("jdk1.8.0", "jre", "bin").
- In Java SE 8, one could have added this method to the Path interface:

```
public interface Path {
   public static Path get(String first, String... more) {
      return FileSystems.getDefault().getPath(first, more);
   }
   . . .
}
```

- It is unlikely that the Java library will be refactored in this way, but when you implement your own interfaces, there is no longer a reason to provide a separate companion class for utility methods

Interface TimeClient

```java
import java.time.DateTimeException;
import java.time.LocalDateTime;
import java.time.ZoneId;
import java.time.ZonedDateTime;
public interface TimeClient {
  public void setTime(int hour, int minute, int second);
  public void setDate(int day, int month, int year);
  public void setDateAndTime(int day, int month, int year, int hour, int min, int sec);
  public LocalDateTime getLocalDateTime();

  public static ZoneId getZoneId (String zoneString) {
    try {
       return ZoneId.of(zoneString);
    } catch (DateTimeException e) {
       System.err.println("Invalid time zone: " + zoneString + "; using default time zone");
       return ZoneId.systemDefault();
    }
  }
  public default ZonedDateTime getZonedDateTime(String zoneString) {
    return ZonedDateTime.of(getLocalDateTime(), getZoneId(zoneString));
  } // similar to template method
}
```

Class SimpleTimeClient

```
import java.time.LocalDate;
import java.time.LocalDateTime;
import java.time.LocalTime;

public class SimpleTimeClient implements TimeClient {
  private LocalDateTime dateAndTime;
  public SimpleTimeClient() {
    dateAndTime = LocalDateTime.now();
  }
  public void setTime(int hour, int minute, int second) {
    LocalDate currentDate = LocalDate.from(dateAndTime);
    LocalTime timeToSet = LocalTime.of(hour, minute, second);
    dateAndTime = LocalDateTime.of(currentDate, timeToSet);
  }
  public void setDate(int day, int month, int year) {
    LocalDate dateToSet = LocalDate.of(day, month, year);
    LocalTime currentTime = LocalTime.from(dateAndTime);
    dateAndTime = LocalDateTime.of(dateToSet, currentTime);
  }
```

Class SimpleTimeClient

```
  public void setDateAndTime(int day, int month, int year, int hour, int min, int sec) {
    LocalDate dateToSet = LocalDate.of(day, month, year);
    LocalTime timeToSet = LocalTime.of(hour, minute, second);
    dateAndTime = LocalDateTime.of(dateToSet, timeToSet);
  }
  public LocalDateTime getLocalDateTime() {
    return dateAndTime;
  }
  public String toString() {
    return dateAndTime.toString();
  }

  public static void main(String... args) {
    TimeClient myTimeClient = new SimpleTimeClient();
    System.out.println(myTimeClient.toString());
  }
}
```

Class SimpleTimeClientTest

```
public class SimpleTimeClientTest {
  public static void main(String... args) {
    TimeClient myTimeClient = new SimpleTimeClient();

    System.out.println("Current time: " + myTimeClient.toString());
    System.out.println("Time in Seoul: " +
          myTimeClient.getZonedDateTime("Asia/Seoul").toString());
  }
}
```

Extending Interfaces That Contain Default Methods

- When you extend an interface that contains a default method, you can do the following:
  - 1) Not mention the default method at all, which lets your extended interface inherit the default method.

```
public interface AnotherTimeClient extends TimeClient { }
```

  - 2) Redeclare the default method, which makes it abstract.

```
public interface AbstractZoneTimeClient extends TimeClient {
    public ZonedDateTime getZonedDateTime(String zoneString);
}
```

Extending Interfaces That Contain Default Methods

- 3) Redefine the default method, which overrides it.

```
public interface HandleInvalidTimeZoneClient extends TimeClient {
  public default ZonedDateTime getZonedDateTime(String zoneString) {
    try {
      return ZonedDateTime.of(getLocalDateTime(), ZoneId.of(zoneString));
    } catch (DateTimeException e) {
      System.err.println("Invalid zone ID: " + zoneString +
        "; using the default time zone instead.");
      return ZonedDateTime.of(getLocalDateTime(), ZoneId.systemDefault());
    }
  }
}
```

Q&A