Generics 2

- Recap from Generics 1
- Bounded type parameters
- Wildcards
- Generic Methods

Generics 2

- Recap from Generics 1
  - It ensures that all the members of the collection are objects related by inheritance
  - It allows the data type to be determined later by the client of the class
  - Allows Java compiler to apply strong type checking
  - Improves flexibility and maintainability

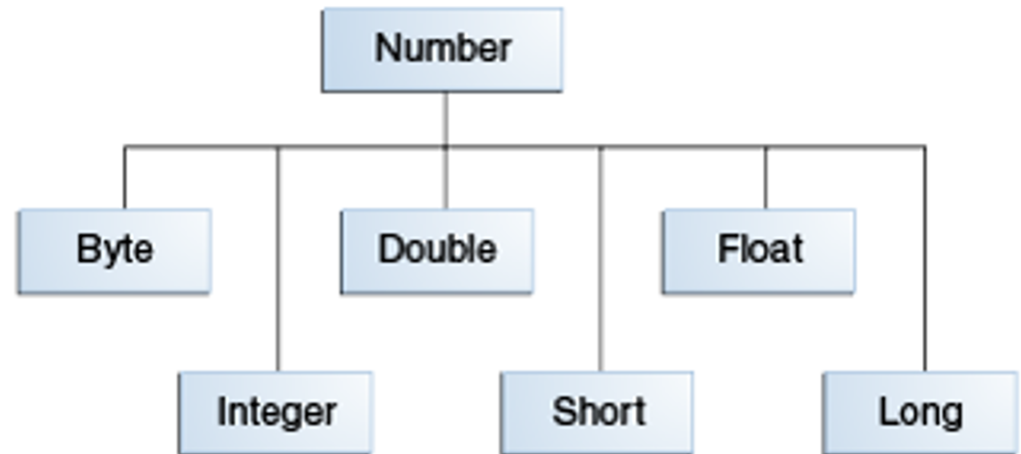


Image source:
Oracle. "The Numbers Classes." The Java™ Tutorials, Oracle, docs.oracle.com/javase/tutorial/java/data/numberclasses.html. Accessed 10 July 2020

Bounded Type Parameters

- Generics offer flexibility, but what about when you want to enforce restrictions on types?

```
public static                                   void add(T first, T second) {

    System.out.println("Sum = " + first.doubleValue() + second.doubleValue());

}
```

Declaring Bounded Type Parameters

< typeParameterName extends UpperBound >

Bounded Type Parameters

```
public static <T extends Number> void add(T first, T second) {

    System.out.println("Sum = " + first.doubleValue() + second.doubleValue());

 }
```

Generic Methods

method/access modifiers <genericParams> returnType methodName (methodParams)

Example Generic method declaration

```
public static <T extends Number> void add ( T first, T second )
```

Wildcards

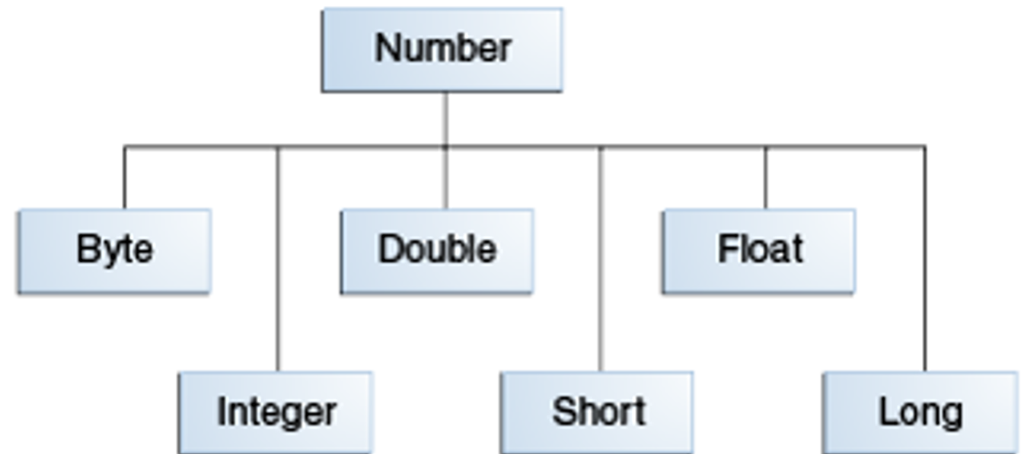
- The question mark (?)
  - The ? can be used as a placeholder to represent any class
- When should you use ?
  - parameter, field, local variable, or even as a return type
- Do not use
  - type argument

Bounded Wildcards

- Recall that ? Is a placeholder representing any class
- Therefore
  - <? super MyClass>
    - ? represents any superclass of MyClass, so MyClass is the lower bound
  - <? extends MyClass>
    - ? represents any subclass of MyClass, so MyClass is the upper bound

Upper Bounded Wildcard

- Consider the effect of the following:
  - ? extends Number

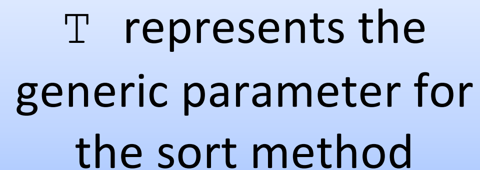


Source:
https://docs.oracle.com/javase/tutorial/java/data/numberclasses.html

Declaring a Generic Method

Sample declarations:

```
public static <T> void sort(T[] items, Comparator<? super T> comp)
```



Declaring a Generic Method (cont.)

Sample declarations:

```
public static <T> void sort(T[] items, Comparator<? super T> comp)
```

`T` should also appear in the method parameter list

Declaring a Generic Method (cont.)

Sample declarations:

```
public static <T> void sort(T[] items, Comparator<? super T> comp)
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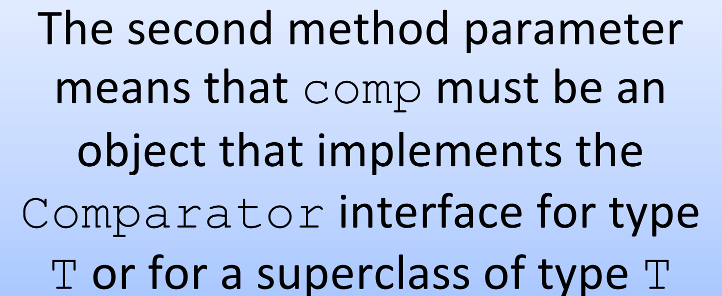

Declaring a Generic Method (cont.)

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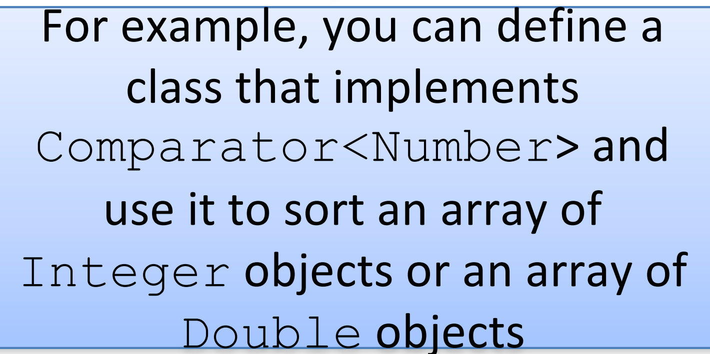
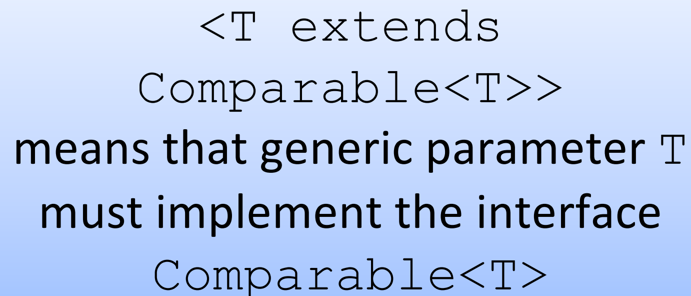


Declaring a Generic Method (cont.)

Sample declarations:

```
public static <T extends Comparable<T>> void sort(List<T> list)
```



Declaring a Generic Method (cont.)

Sample declarations:

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public static <T extends Comparable<T>> void sort(List<T> list)
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