3 scenarios to get handle on Java generics

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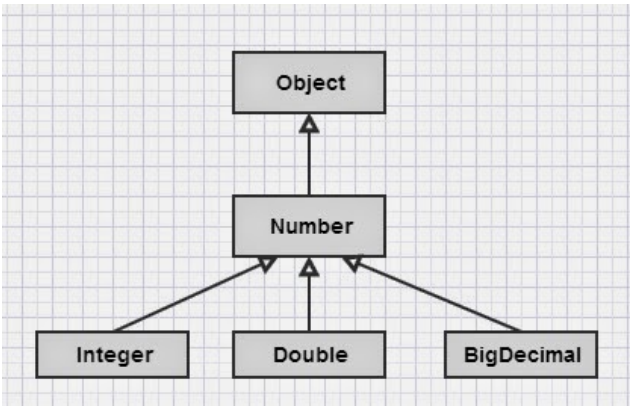
Q1. If java.lang.*Object* is the super type for java.lang.*Number* and, *Number* is the super type for java.lang.*Integer*, am I correct in saying that *List<Object>* is the super type for *List<number>* and, *List<Number>* is the super type for *List<Integer>*.



A1. **No**. *List<Object>* is not the the super type of *List<Number>*. If that were the case, then you could add objects of any type, and it defeats the purpose of Generics.

```
1  /* Compile Error: Type mismatch. Cannot convert
2  List<Number> numbers2 = new ArrayList<Integer>()
3
4
5  //Compiles
6  List<Integer> numbers3 = new ArrayList<Integer>(
7
8
9  /*Compile Error: Cannot instantiate the type Arr
10 List<? super Integer> numbers6 = new ArrayList<?
11
12
13 //Compiles
14 List<? super Integer> numbers7 = new ArrayList<I
15 numbers7.add(Integer.valueOf(5)); //ok
16
17
18 //Compiles
19 List<? extends Number> numbers5 = new ArrayList<
20 //Compile error:  Read only.Can't add
21 numbers5.add(Integer.valueOf(5));
22
23
```

In Generics, wildcards (i.e. ?), makes it possible to work with **super classes** and **sub classes**.

Q2. How will you go about deciding which of the following to use?

- *<Number>*
- <? extends Number>
- <? super Number>

A2. Here is the guide:

1. Use the **? extends wildcard** if you need to retrieve object from a data structure. That is read only. You can't add elements to the collection.
2. Use the **? super wildcard** if you need to put objects in a data structure.
3. If you need to do both things (read and add elements), don't use any wildcard.

Let's take 3 scenarios to explain this.

Scenario 1: A custom generic class ***GenericSingleTypeScenario*** class that handles only Integer types.

```
1  import java.util.List;
2
3  public class GenericSingleTypeScenario<Integer>
4
5   public void readOnly(List<? extends Number> num
6    for (Number number : numbers) {
7     System.out.println("readOnly: " + number);
8    }
9   }
10
11  public void writeOnly(List<? super Integer> num
12   numbers.add(aNumber);
13  }
14
15  public void writeAndRead(List<Integer> numbers,
16   numbers.add(aNumber);
17   for (Integer integer : numbers) {
18    System.out.println("readAndWrite: " + integer
19   }
20
21  }
22 }
23
```

Add a test class with a main method to test the above class

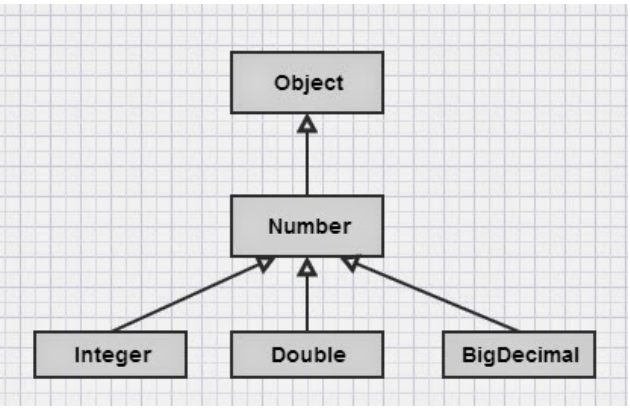
```
1  import java.util.ArrayList;
2  import java.util.List;
3
4  public class GenericSingleTypeScenarioTest {
5
6   public static void main(String[] args) {
7    GenericSingleTypeScenario<Integer> singleType
8    List<Integer> numbers = new ArrayList<Integer>
9    numbers.add(1); //autoboxes 1 to type Integer
```

```
10
11    singleType.readOnly(numbers);
12    singleType.writeOnly(numbers, 6);  //autoboxes
13    singleType.writeAndRead(numbers, Integer.value
14
15   }
16 }
17
```

Output:

```
1 readOnly: 1
2 readAndWrite: 1
3 readAndWrite: 6
4 readAndWrite: 9
5
```

Scenario 2: A custom generic class ***GenericMultipleTypesScenario*** class that handles *Integer* and *Double* types.




```
1  import java.util.List;
2
3  public class GenericMultipleTypesScenario<Number
4
5   public void readOnly(List<? extends Number> num
6     for (Number number : numbers) {
7     System.out.println("readOnly: " + number);
8    }
9   }
10
11  public void writeOnly(List<? super Number> numb
12   numbers.add(aNumber);
13  }
14
15  public void writeAndRead(List<Number> numbers,
16   numbers.add(aNumber);
17   for (Number number : numbers) {
18    System.out.println("readAndWrite: " + number)
```

```
19    }
20
21   }
22 }
23
```

The test class

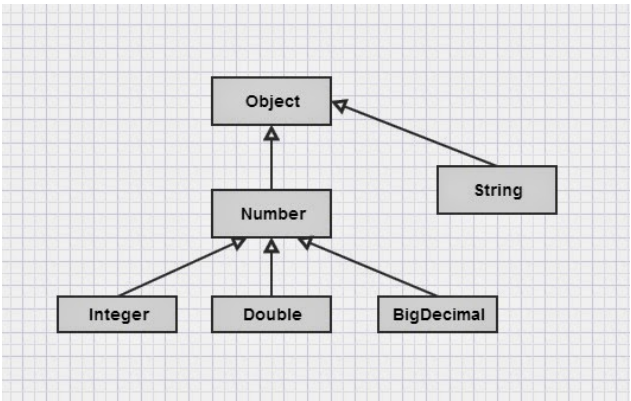
```
1  import java.util.ArrayList;
2  import java.util.List;
3
4  public class GenericMultipleTypesScenarioTest {
5
6   public static void main(String[] args) {
7       //Integer
8    GenericMultipleTypesScenario<Integer> integerT
9    List<Integer> numbers = new ArrayList<Integer>
10   numbers.add(1); //autoboxes 1 to type Integer
11
12   integerType.readOnly(numbers);
13   integerType.writeOnly(numbers, 6);  //autoboxe
14   integerType.writeAndRead(numbers, Integer.valu
15
16   //Double
17   GenericMultipleTypesScenario<Double> doubleTyp
18   List<Double> numbersDouble = new ArrayList<Dou
19   numbersDouble.add(1.5); //autoboxes 1.5 to typ
20
21   doubleType.readOnly(numbersDouble);
22   doubleType.writeOnly(numbersDouble, 6.5);  //a
23   doubleType.writeAndRead(numbersDouble, Double.
24
25  }
26 }
27
28
```

Output:

```
1 readOnly: 1
2 readAndWrite: 1
3 readAndWrite: 6
4 readAndWrite: 9
5 readOnly: 1.5
6 readAndWrite: 1.5
7 readAndWrite: 6.5
8 readAndWrite: 9.5
9
```

Scenario 3: A custom generic class ***GenericAnyTypesScenario*** class that handles any

type like *Integer, Double, String, etc*. The any type is defined in this example as letter ***T***. It can be any letter.




```
1  import java.util.List;
2
3  public class GenericAnyTypesScenario<T> {
4
5   public void readOnly(List<? extends T> values)
6     for (T value : values) {
7     System.out.println("readOnly: " + value);
8    }
9   }
10
11  public void writeOnly(List<? super T> values, T
12   values.add(aValue);
13  }
14
15  public void writeAndRead(List<T> values, T aVal
16   values.add(aValue);
17   for (T value : values) {
18    System.out.println("readAndWrite: " + value);
19   }
20
21  }
22 }
23
24
```

Test class

```
1  import java.util.ArrayList;
2  import java.util.List;
3
4  public class GenericAnyTypesScenarioTest {
5
6   public static void main(String[] args) {
```

```
7    //integer type
8    GenericAnyTypesScenario<Integer> integerType =
9    List<Integer> valuesIntegers = new ArrayList<I
10   valuesIntegers.add(1); //autoboxes 1 to type I
11
12   integerType.readOnly(valuesIntegers);
13   integerType.writeOnly(valuesIntegers, 6);  //a
14   integerType.writeAndRead(valuesIntegers, Integ
15
16
17   //double type
18   GenericAnyTypesScenario<Double> doubleType = n
19   List<Double> valuesDouble = new ArrayList<Doub
20   valuesDouble.add(1.5); //autoboxes 1.5 to type
21
22   doubleType.readOnly(valuesDouble);
23   doubleType.writeOnly(valuesDouble, 6.5);  //au
24   doubleType.writeAndRead(valuesDouble, Double.v
25
26
27   //string type
28   GenericAnyTypesScenario<String> stringType = n
29   List<String> valuesString = new ArrayList<Stri
30   valuesString.add("apple");
31
32   stringType.readOnly(valuesString);
33   stringType.writeOnly(valuesString, "orange");
34   stringType.writeAndRead(valuesString, "mango")
35
36  }
37 }
38
39
```

Output:

```
1   readOnly: 1
2  readAndWrite: 1
3  readAndWrite: 6
4  readAndWrite: 9
5  readOnly: 1.5
6  readAndWrite: 1.5
7  readAndWrite: 6.5
8  readAndWrite: 9.5
9  readOnly: apple
10 readAndWrite: apple
11 readAndWrite: orange
12 readAndWrite: mango
13
```

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