Overview of the Java Programming Language

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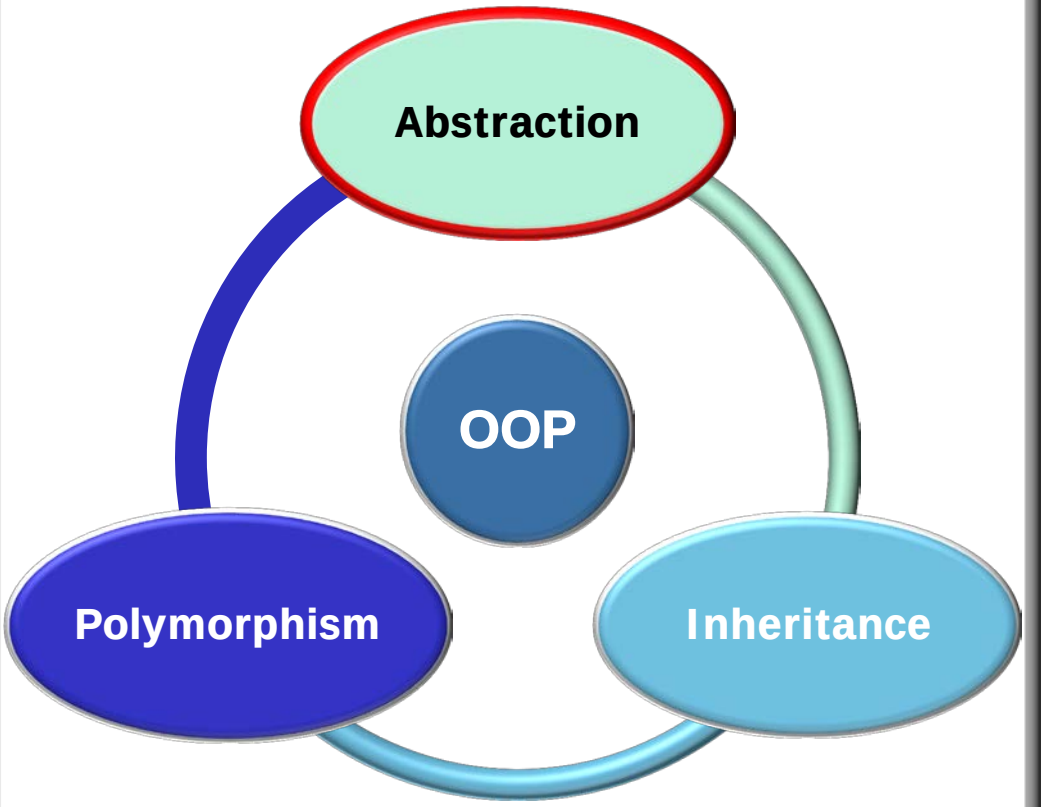

See www.stroustrup.com/whatis.pdf

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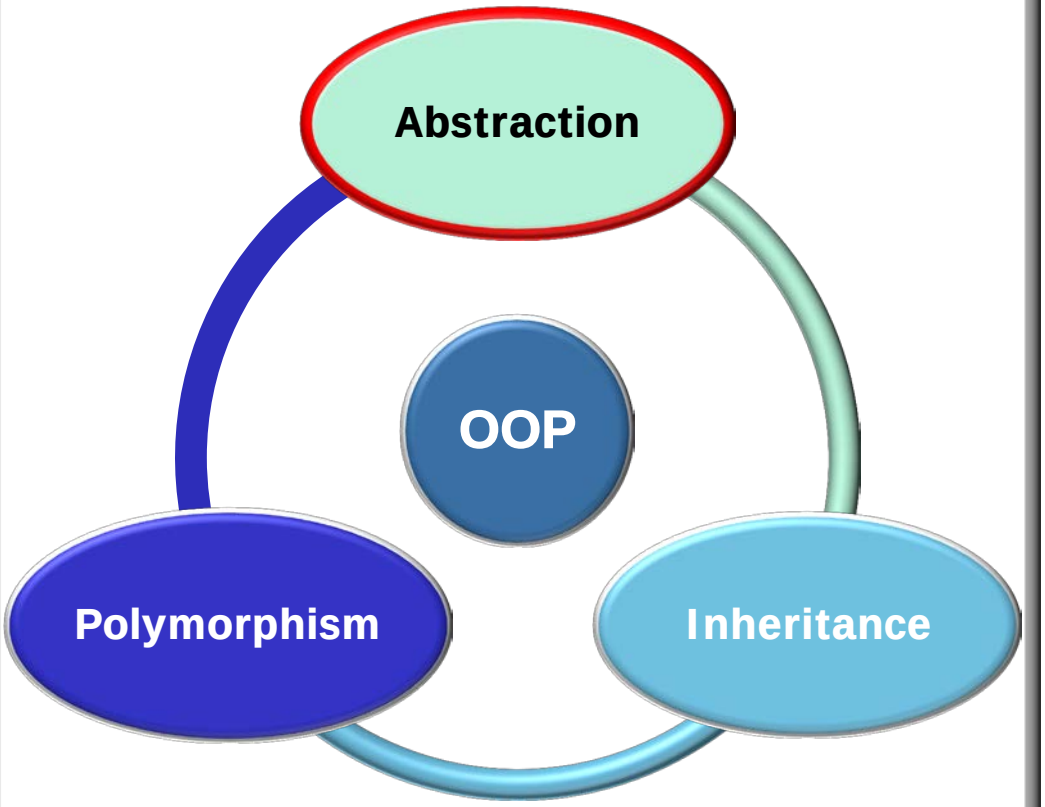

Abstraction makes it easier to develop robust apps that can evolve flexibly

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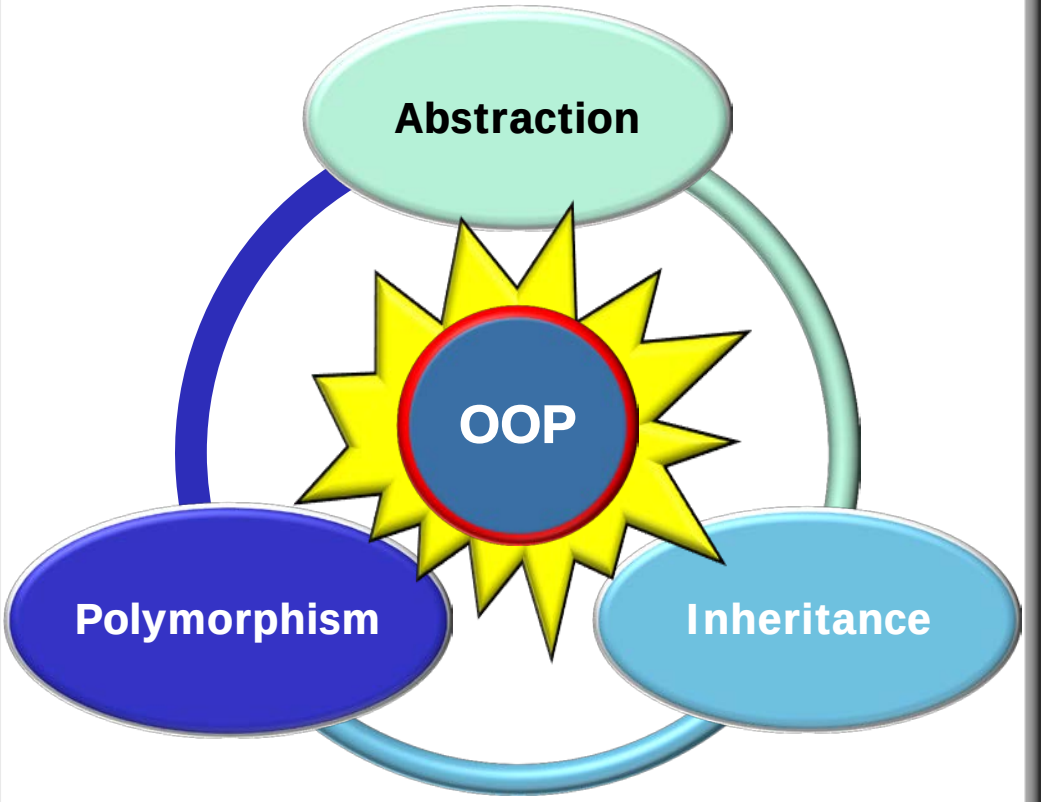

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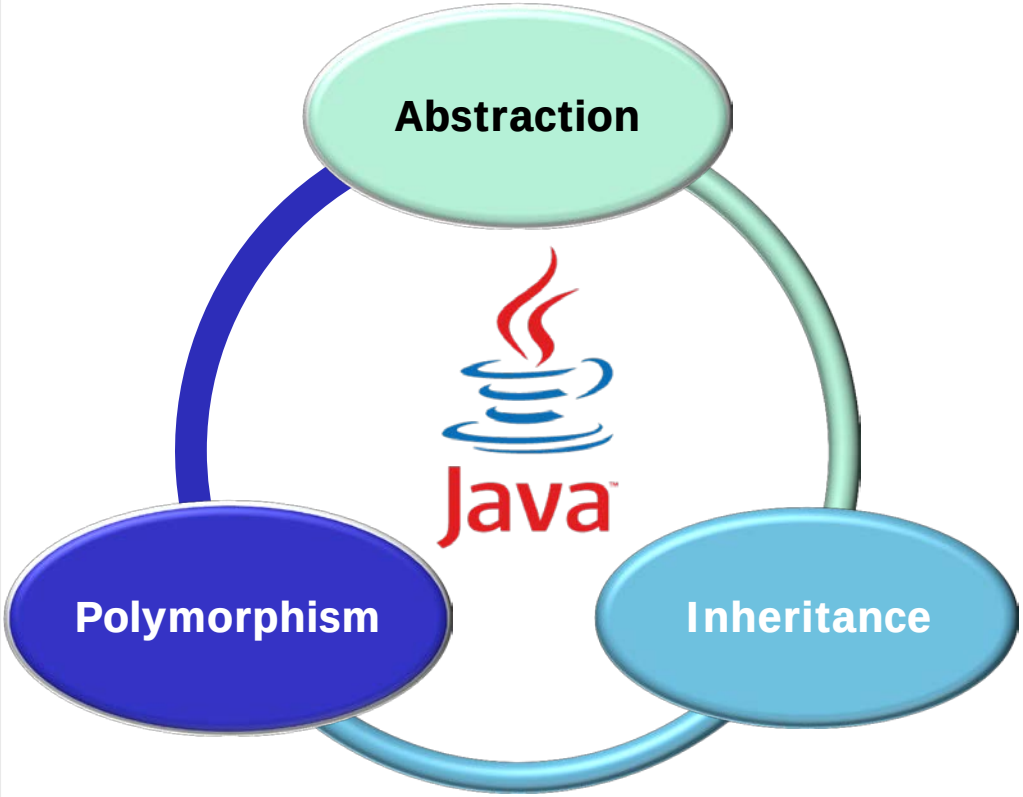

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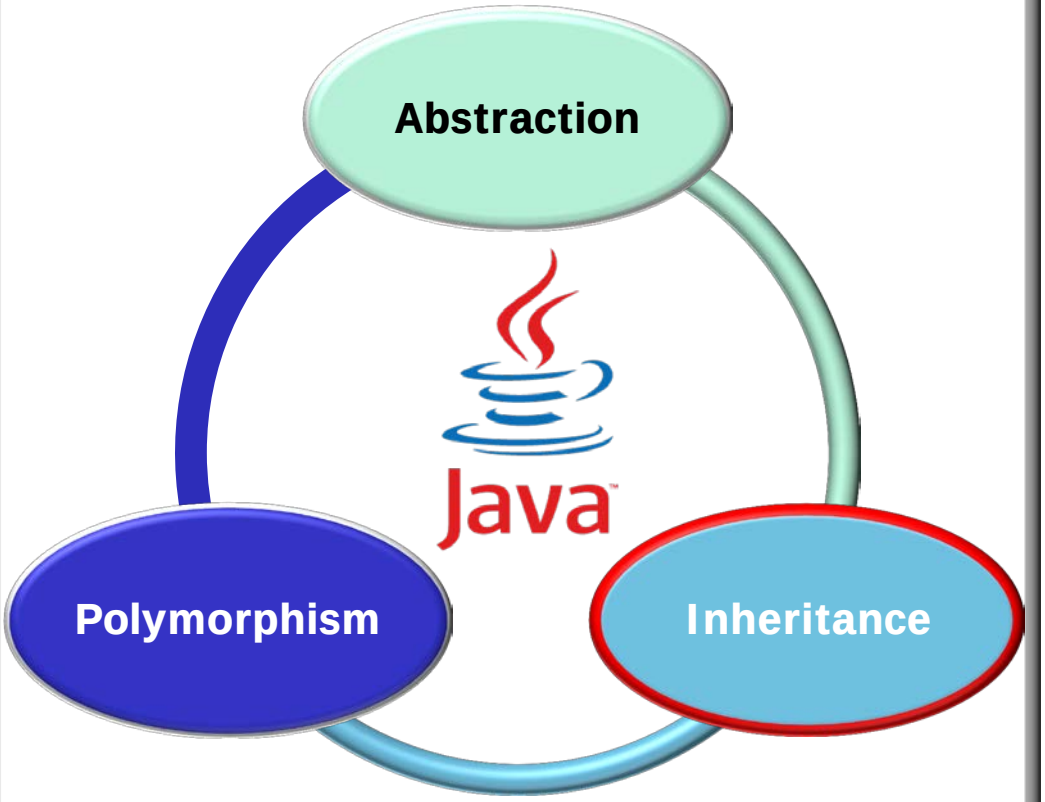

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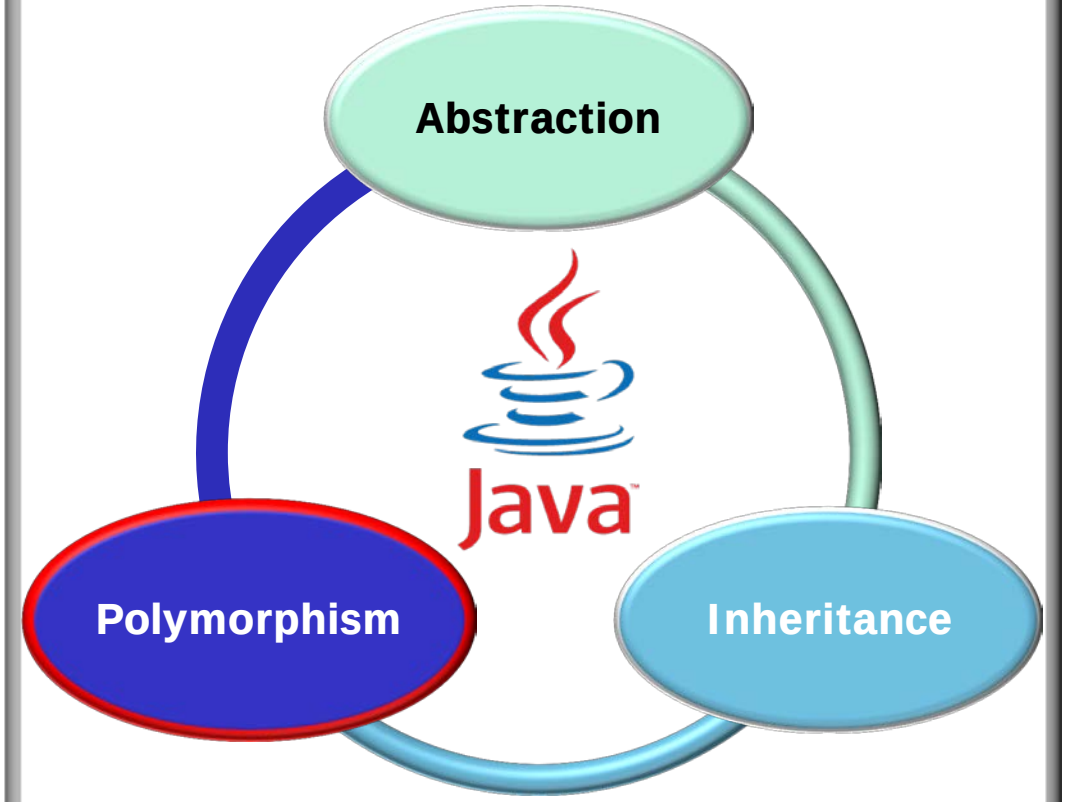

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Overview of the Java Programming Language

Learning Objectives

- Understand what these advanced object-oriented (OO) concepts mean
- Know the benefits they provide developers of Java apps in Android
- Identify Java features that implement these OO concepts

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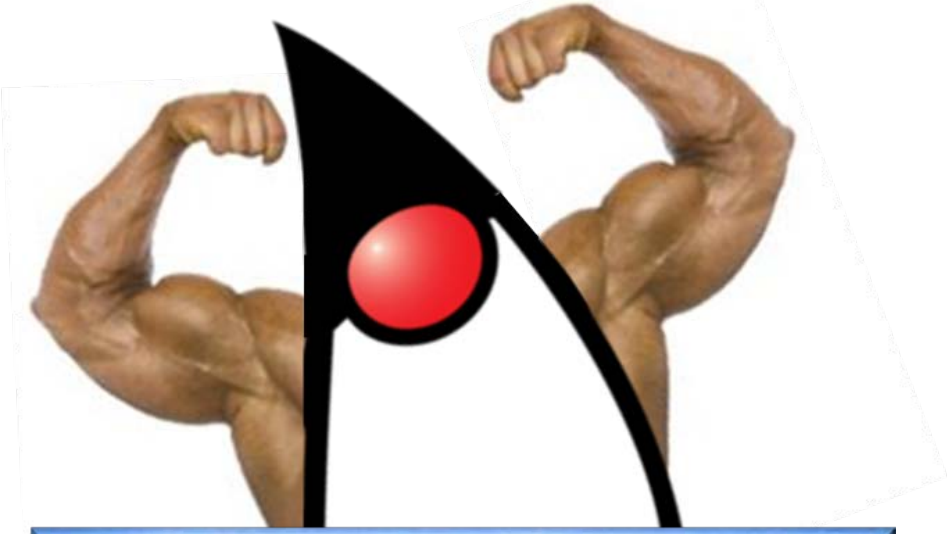

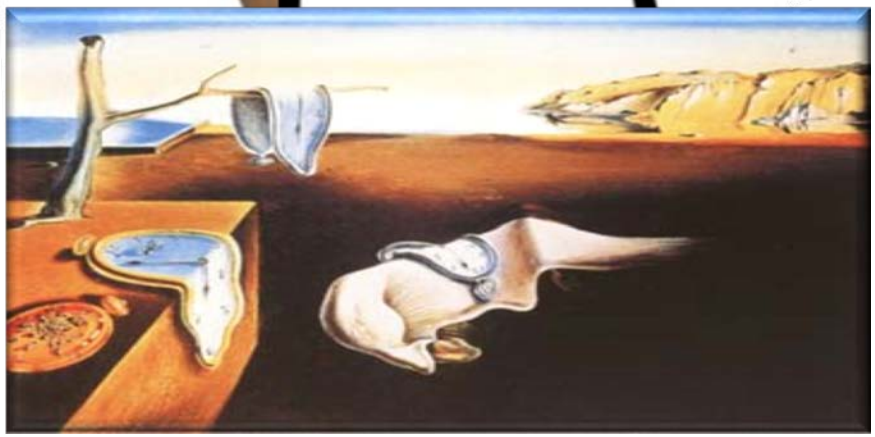

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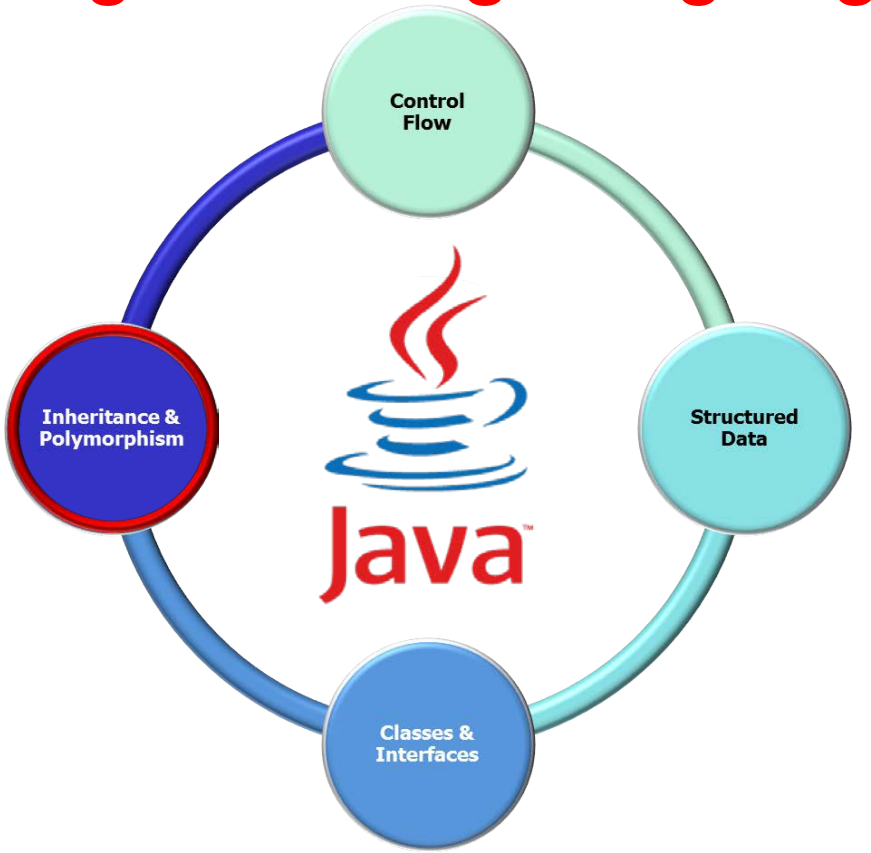
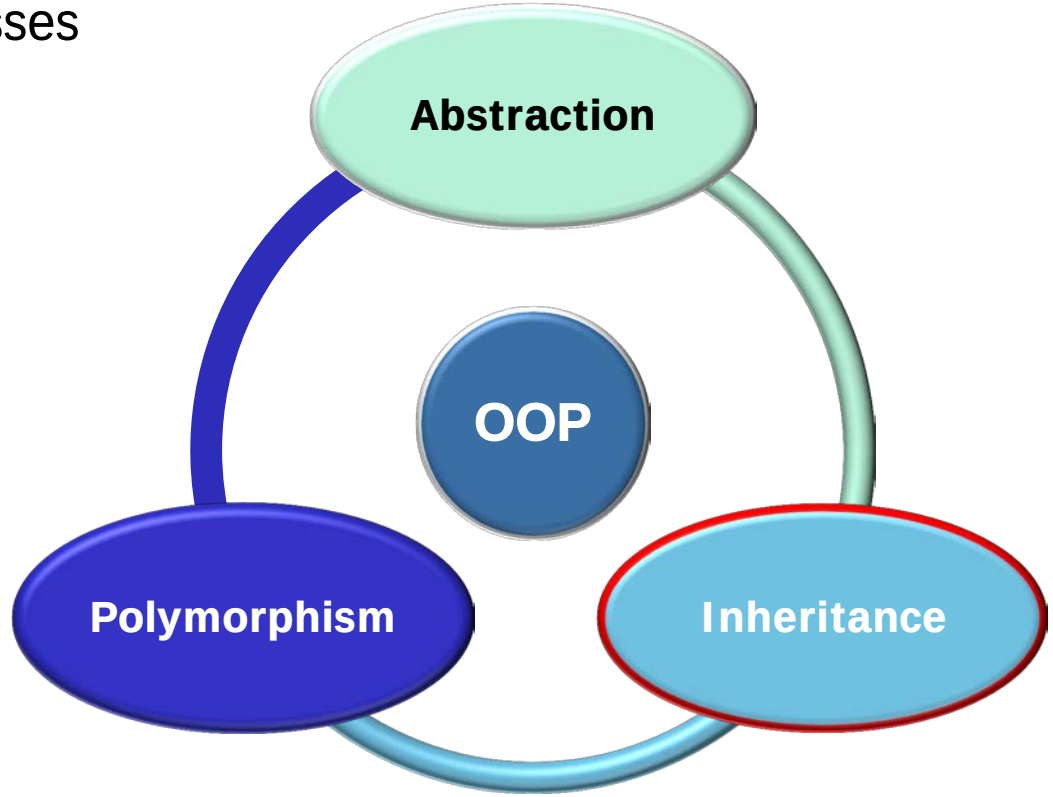


Other lessons examine Java inheritance & polymorphism in detail

Overview of Java's Support for Inheritance (Part 1)

Overview of Java's Support for Inheritance

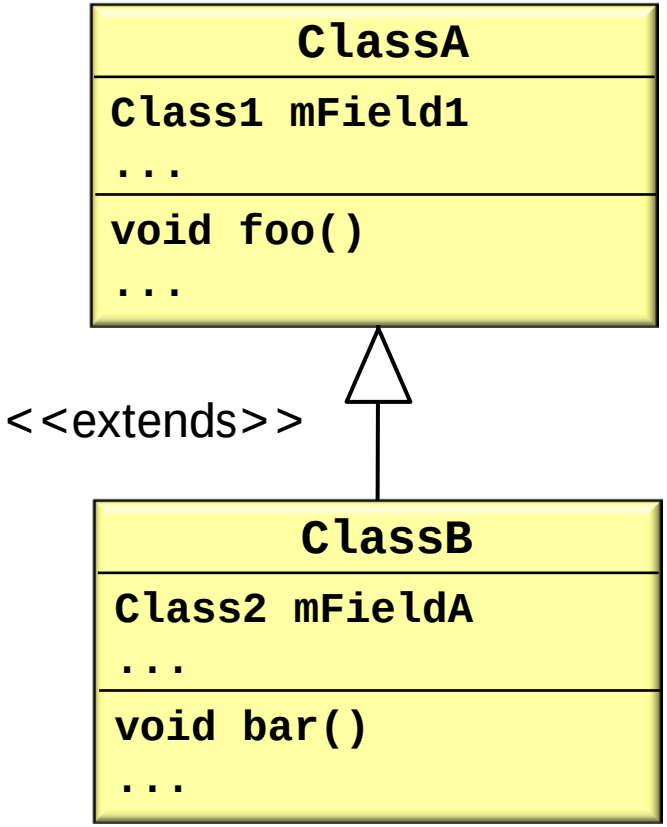
- OO languages enhance reuse by allowing classes to inherit commonly used state & behavior from other classes



See en.wikipedia.org/wiki/Inheritance_(object-oriented_programming)

Overview of Java's Support for Inheritance

- Inheritance in Java is specified via its **`extends`** keyword



See docs.oracle.com/javase/tutorial/java/IandI/subclasses.html

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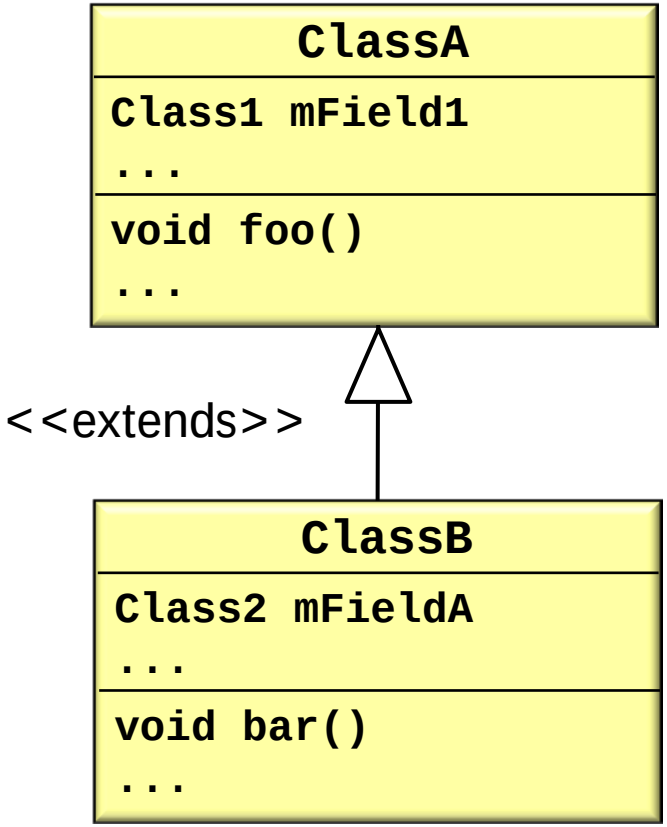

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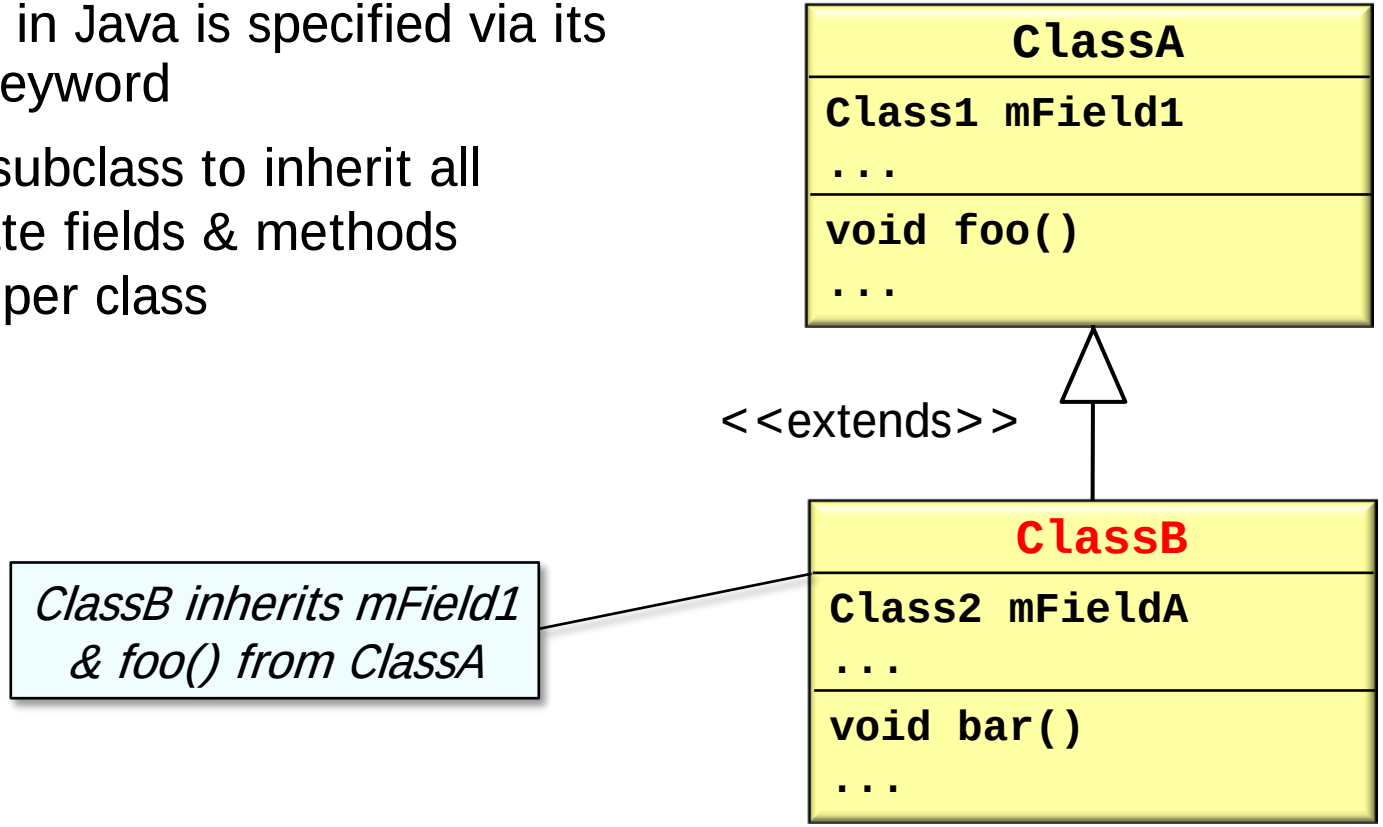

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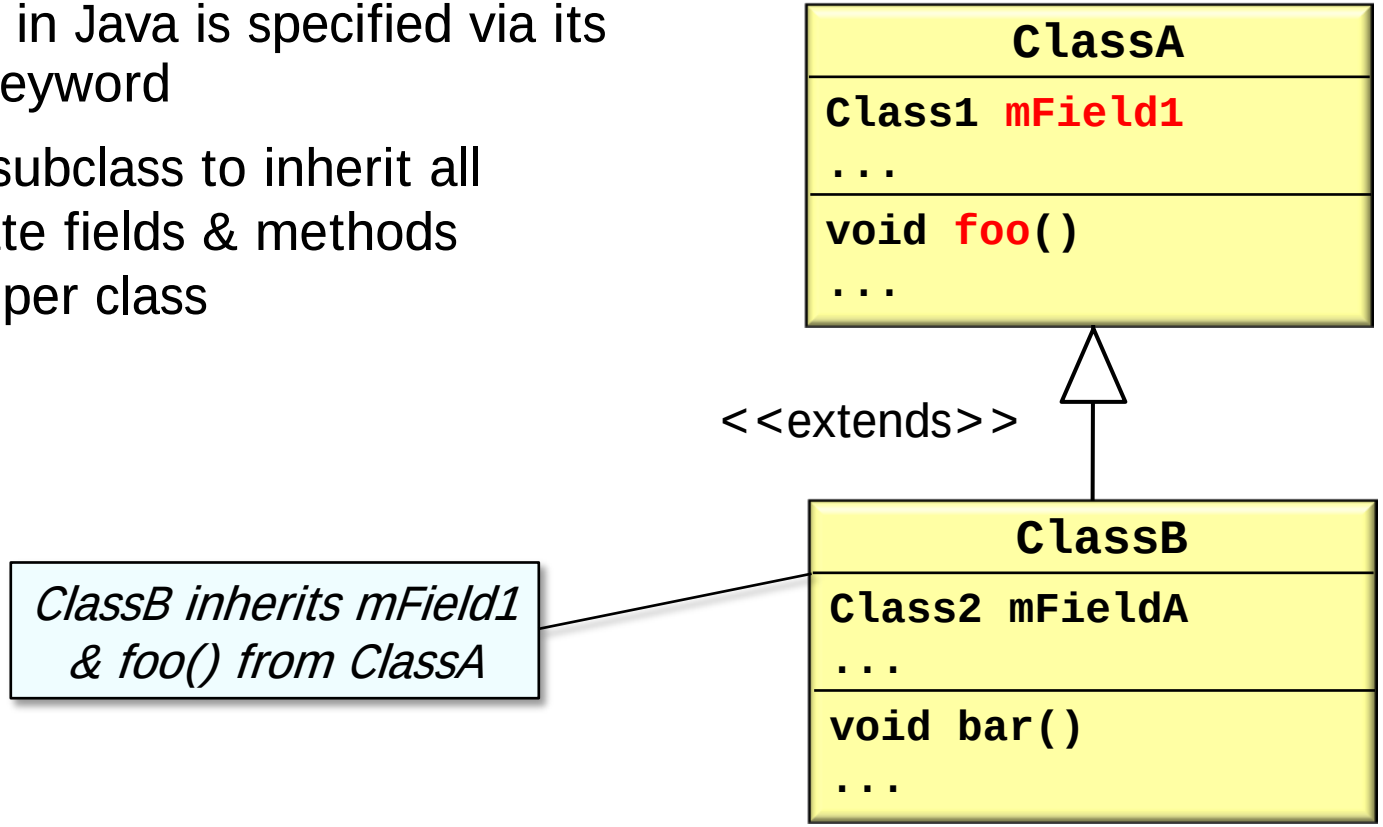

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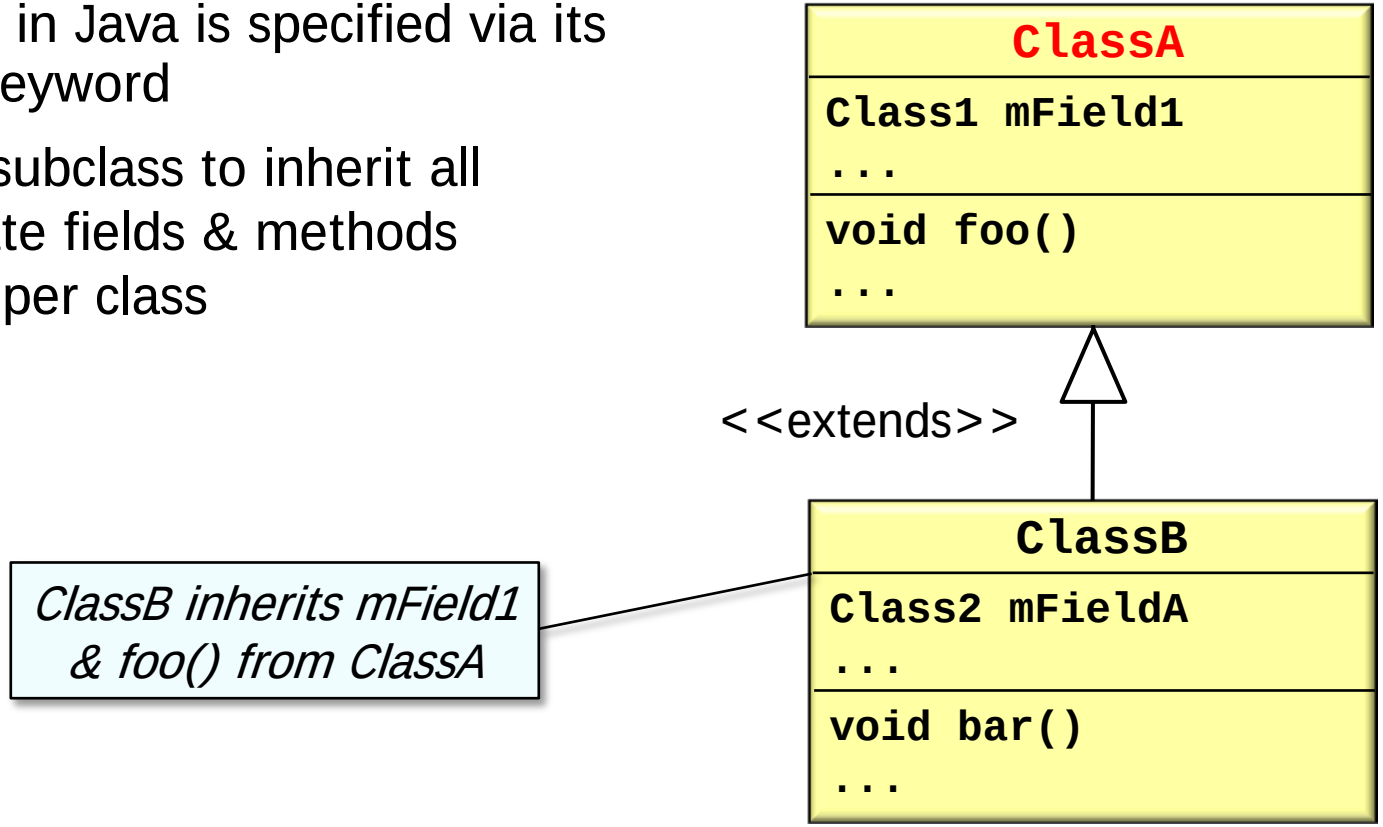

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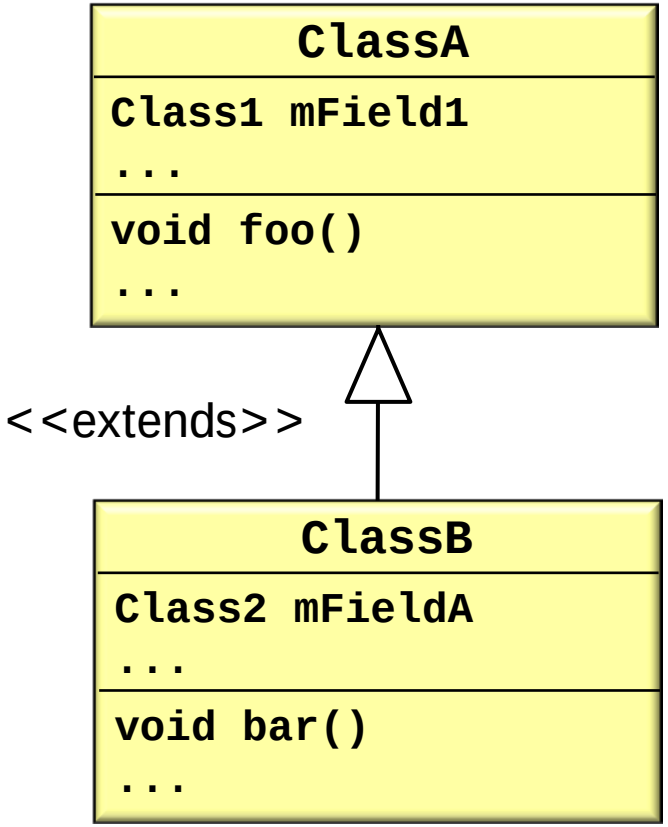
Class B b = new ClassB();
b.foo();
b.bar();
```



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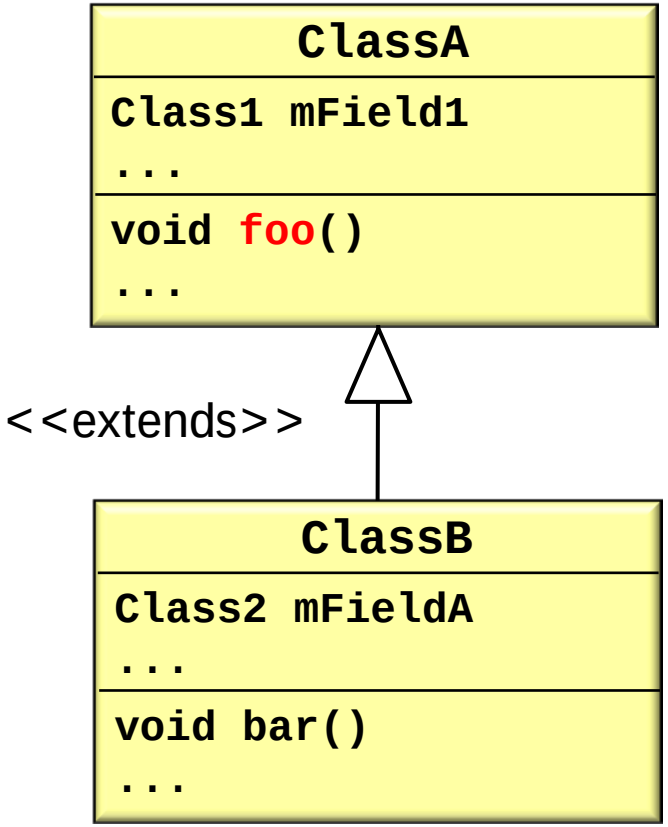

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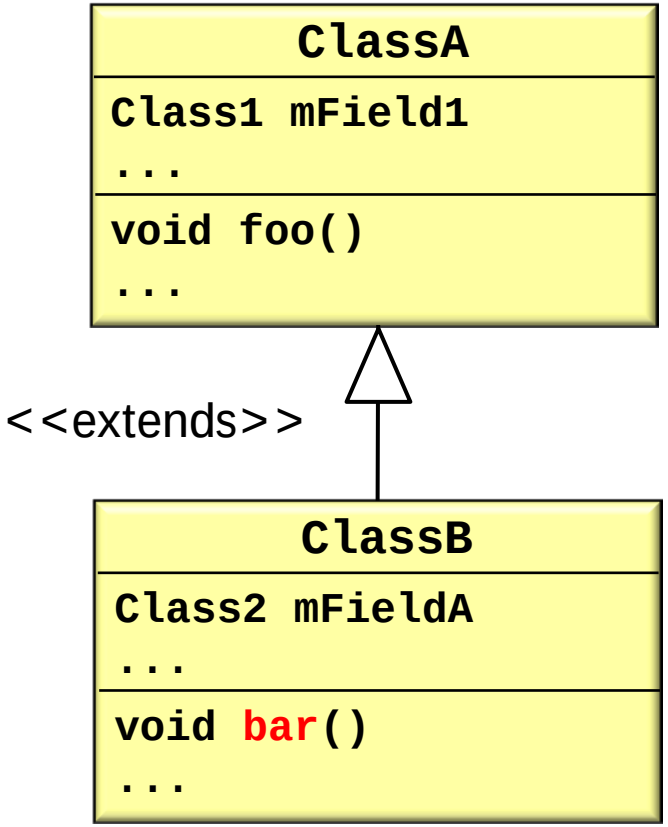
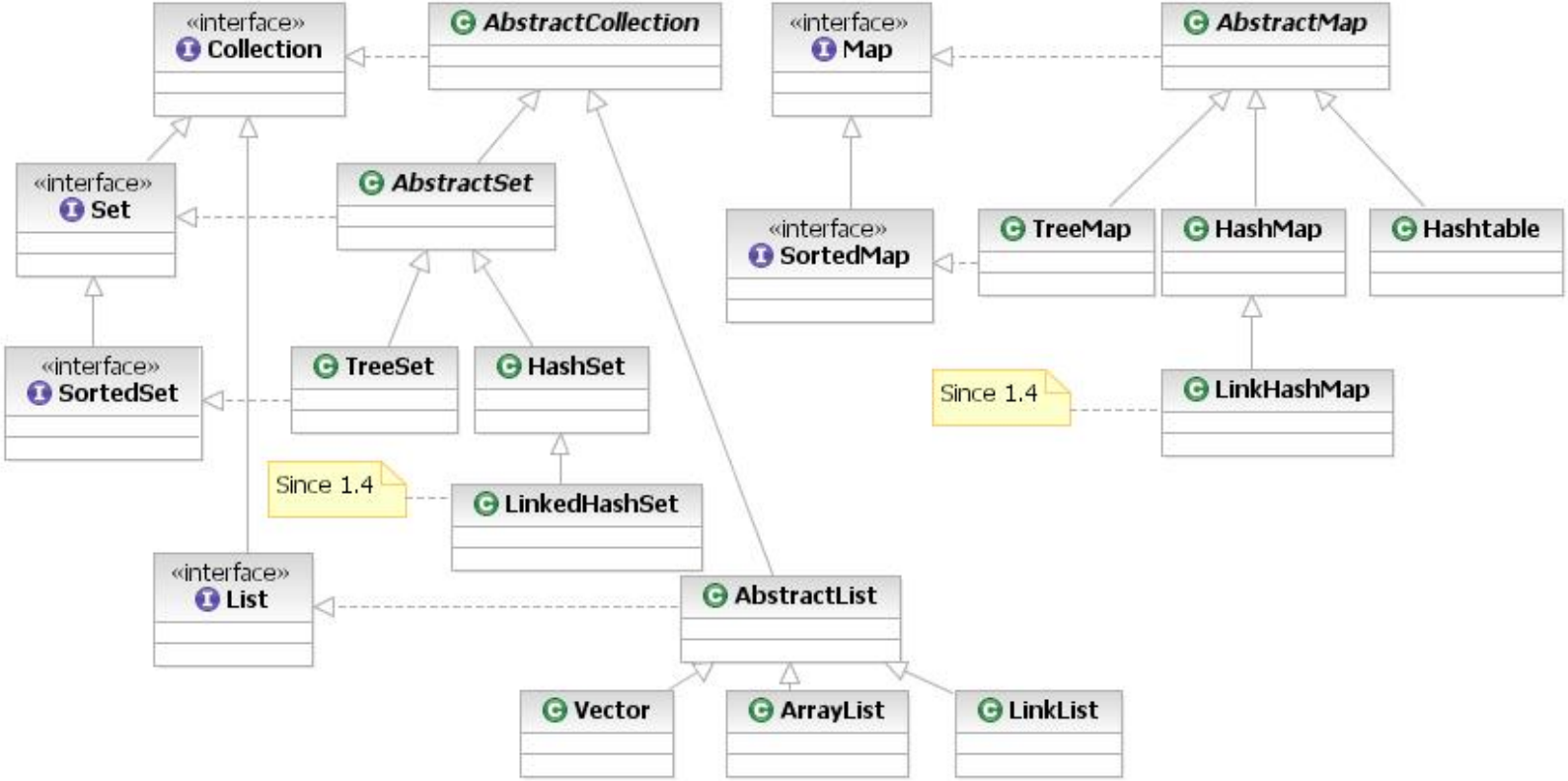


Overview of Java's Support for Inheritance

- Java Collections Framework demonstrates capabilities & benefits of inheritance



See docs.oracle.com/javase/8/docs/technotes/guides/collections

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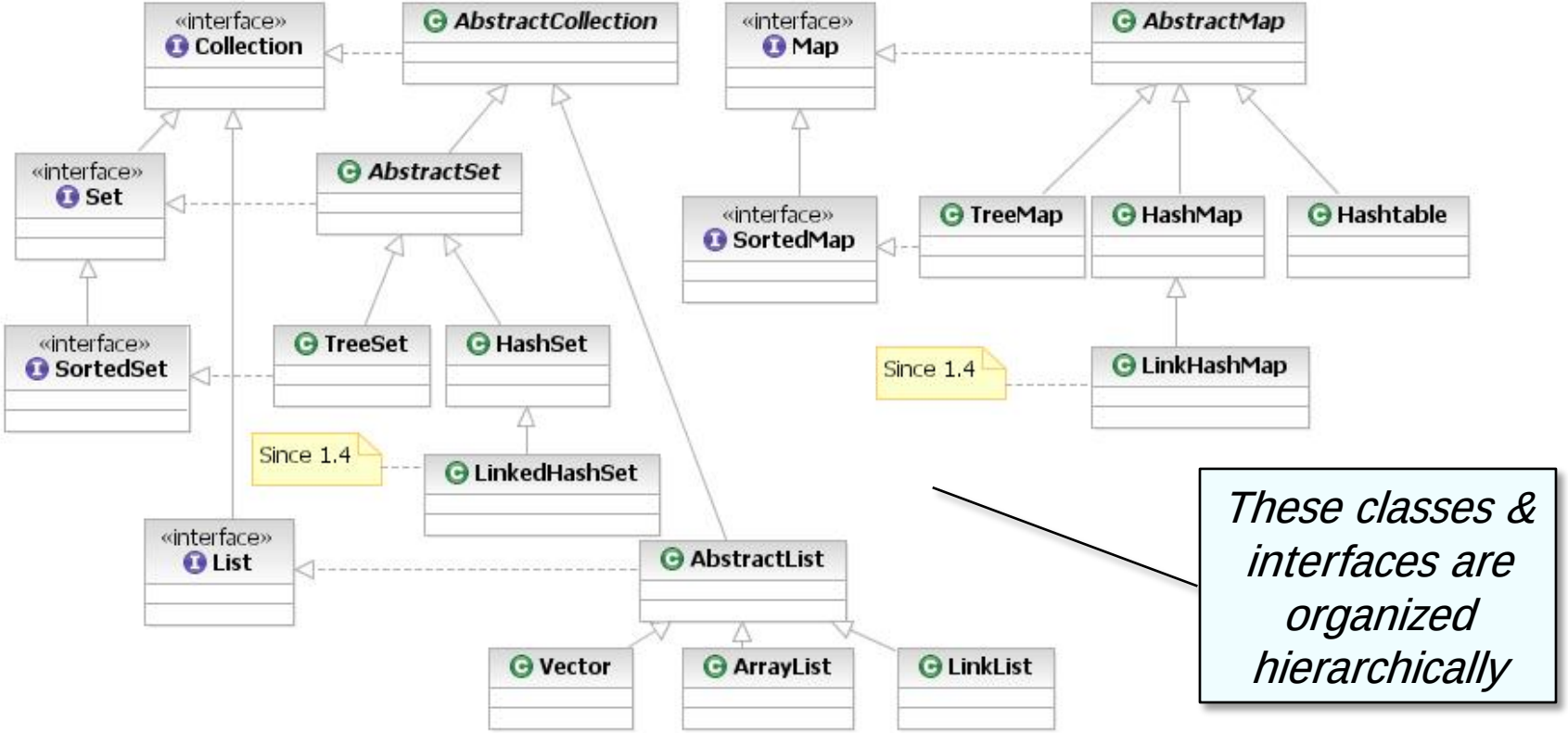

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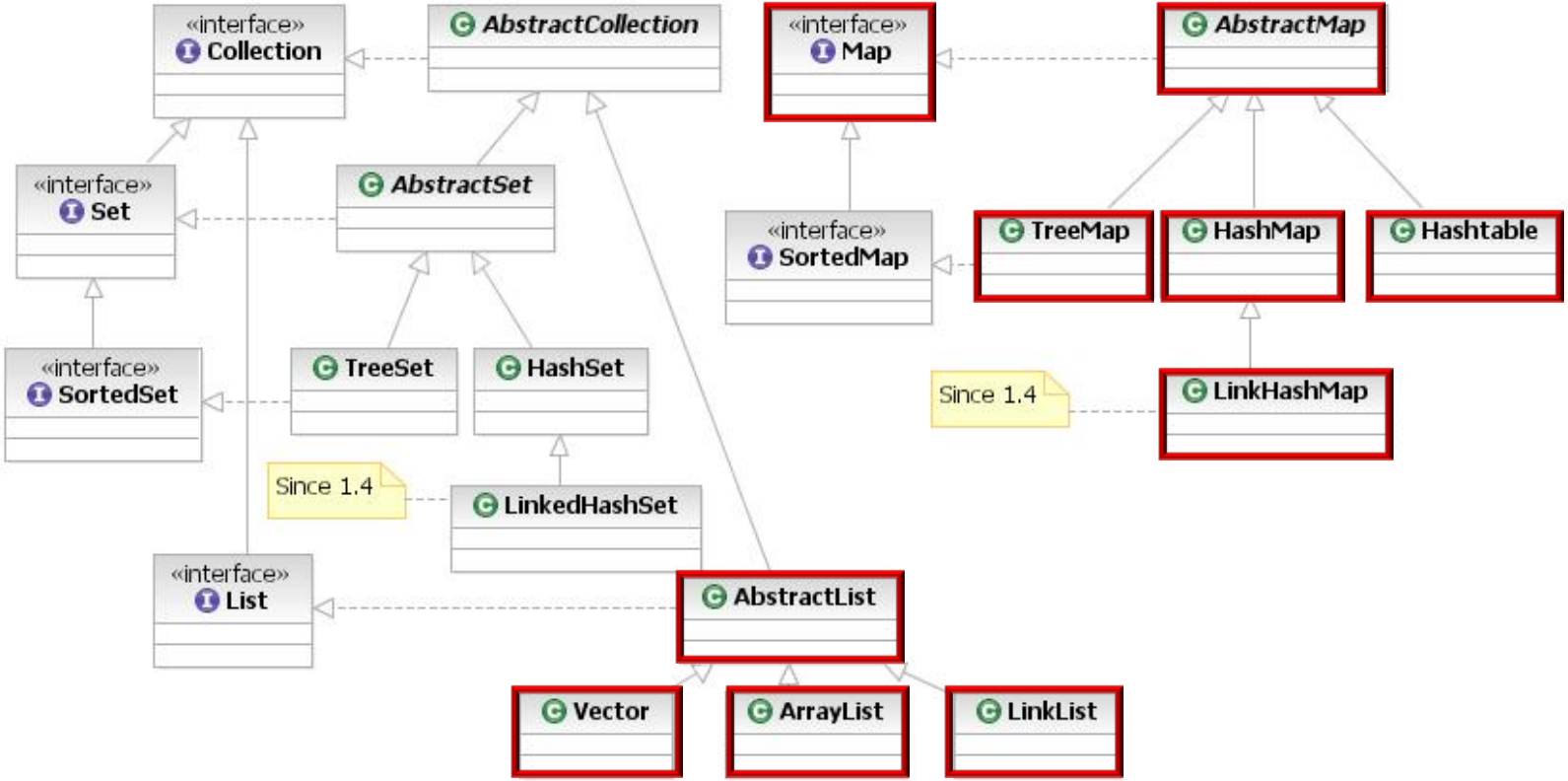
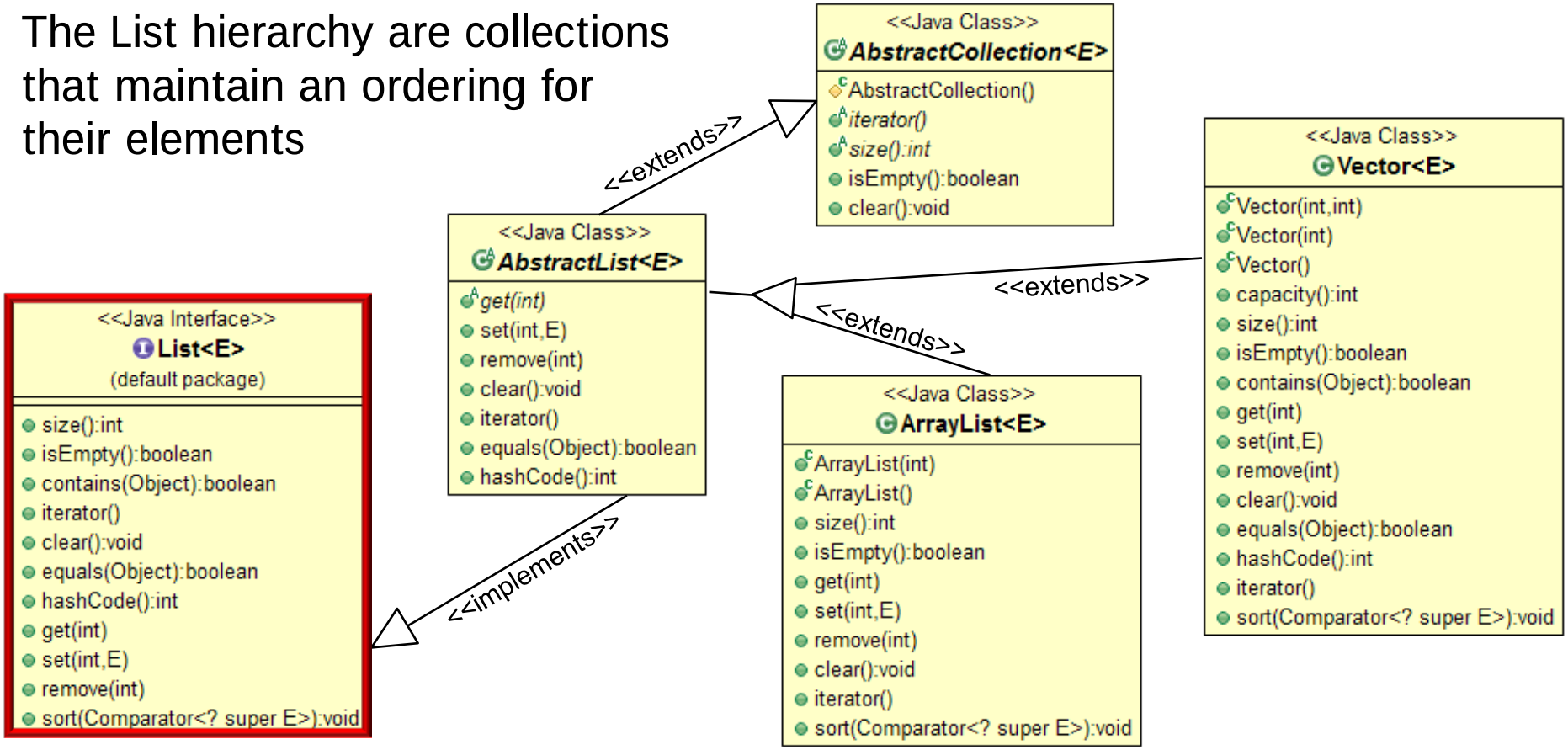


See the module on "Structured Data" for more on the Java Collections Framework

Overview of Java's Support for Inheritance

- The List hierarchy are collections that maintain an ordering for their elements



See developer.android.com/reference/java/util/List.html

Overview of Java's Support for Inheritance

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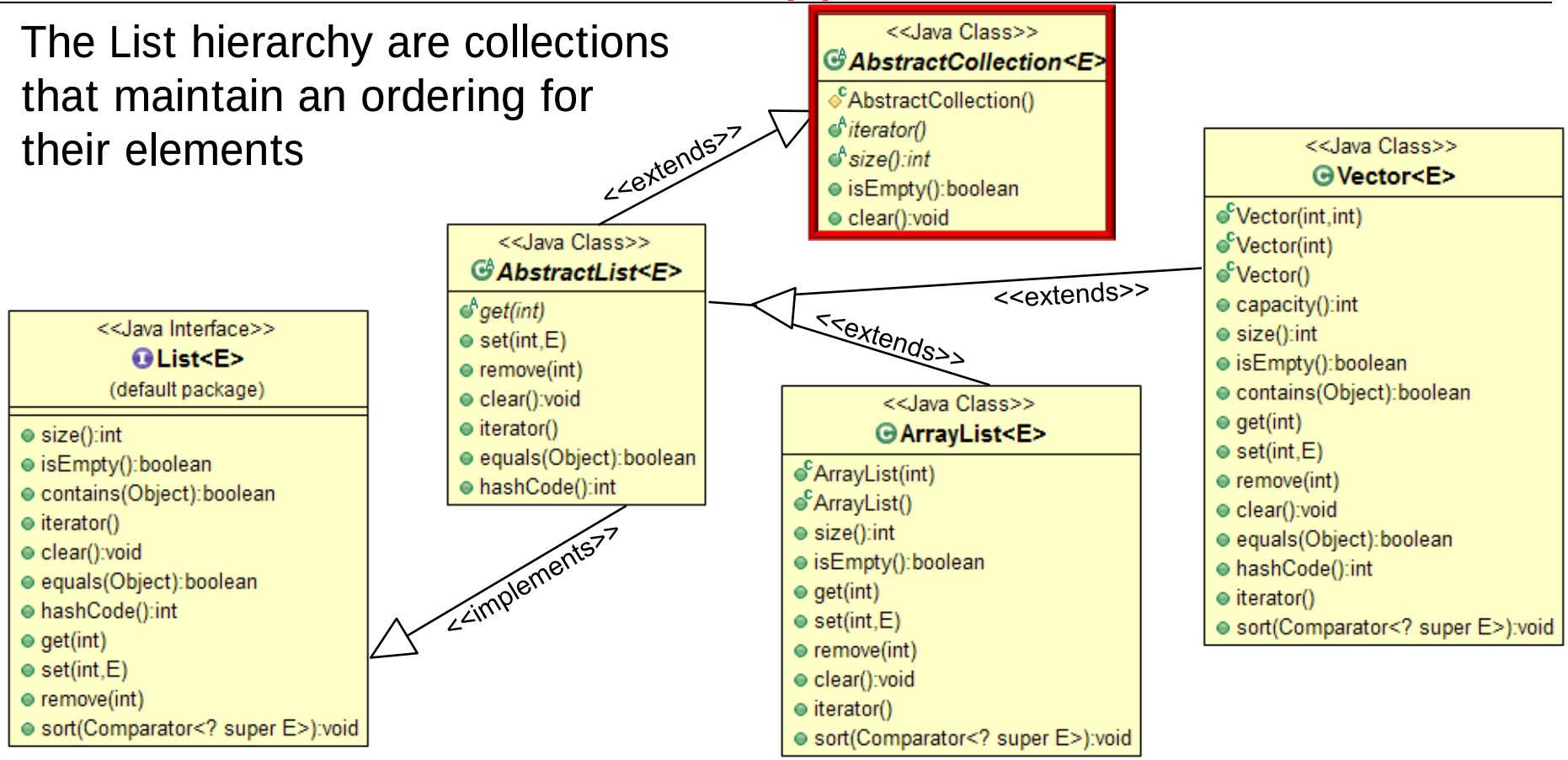

See developer.android.com/reference/java/util/AbstractCollection.html

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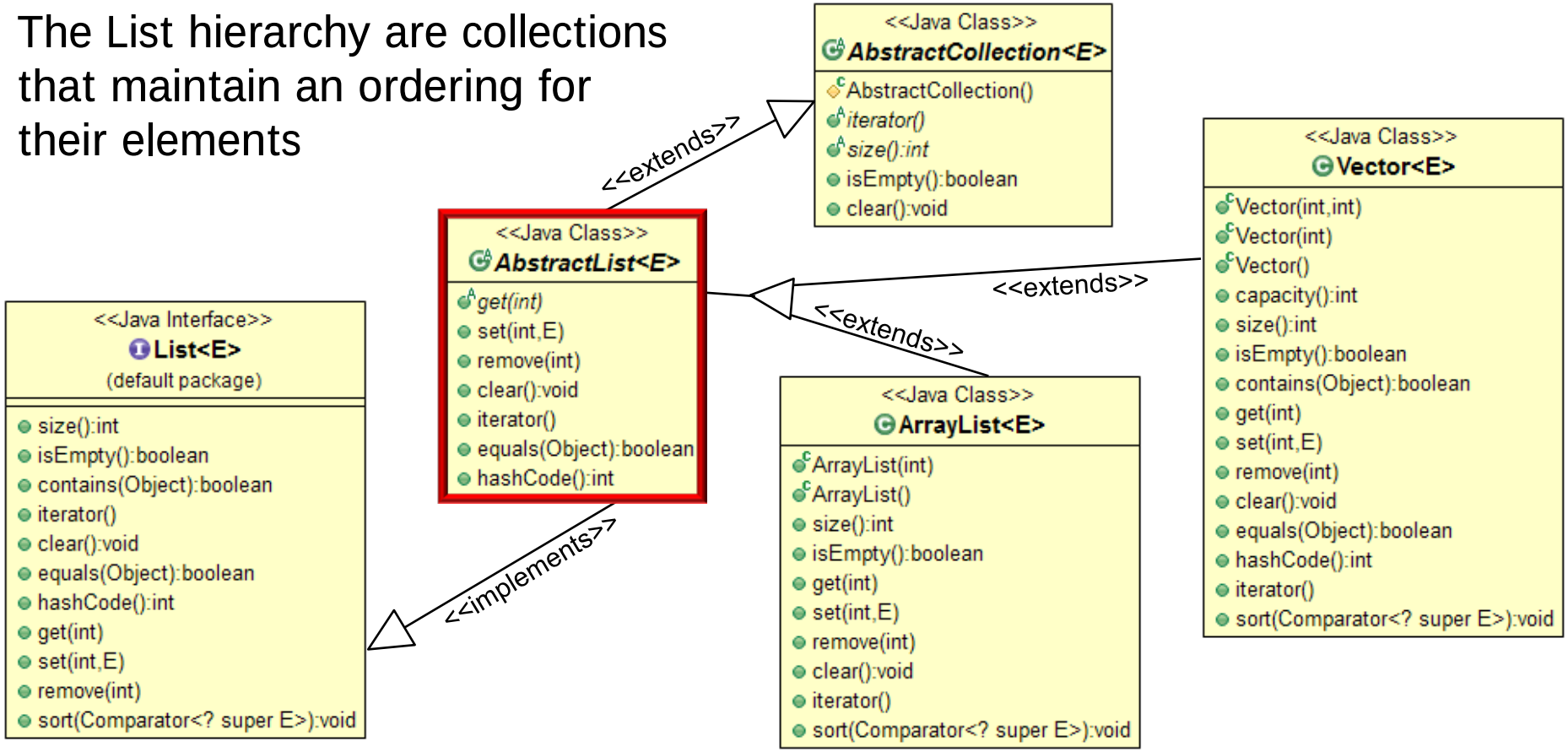

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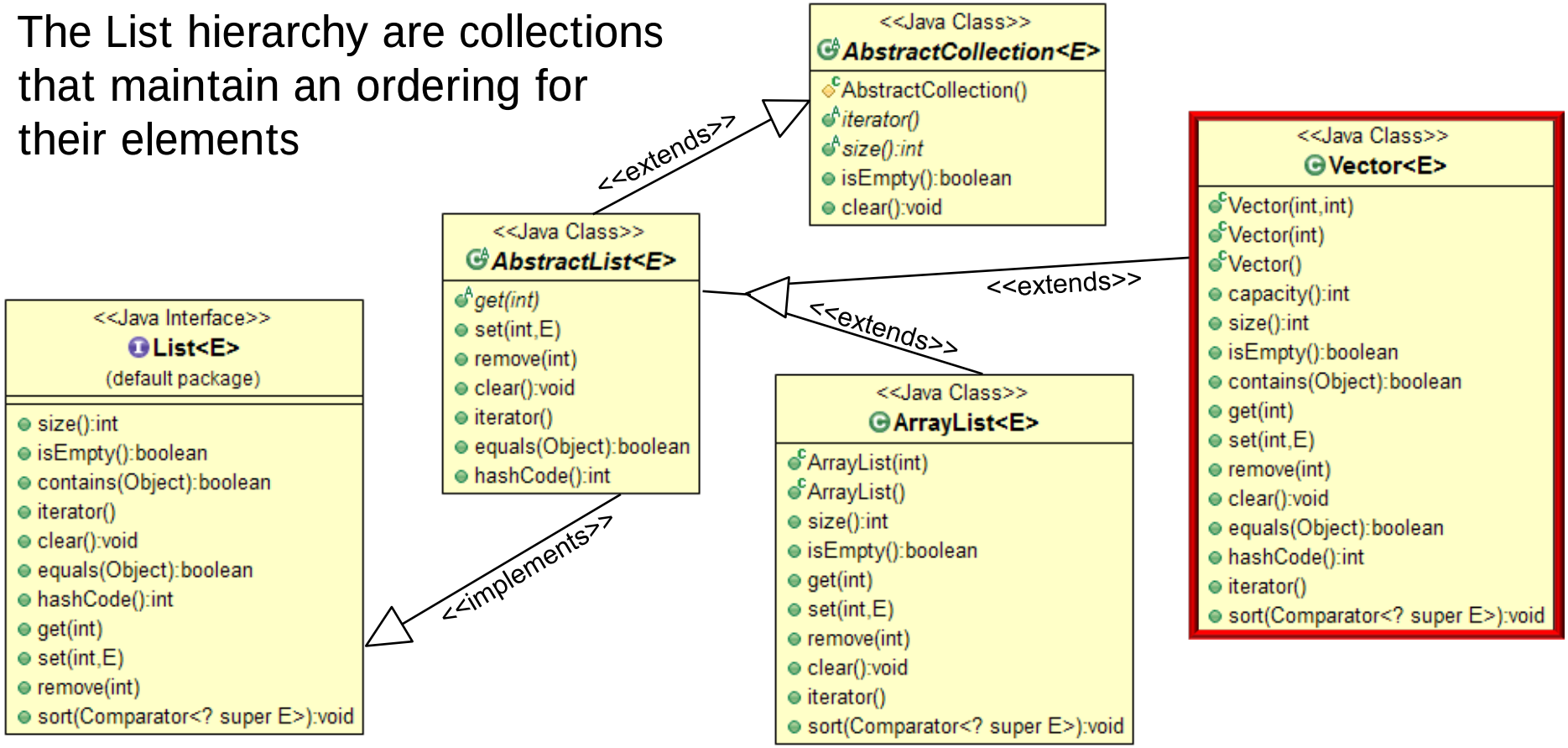

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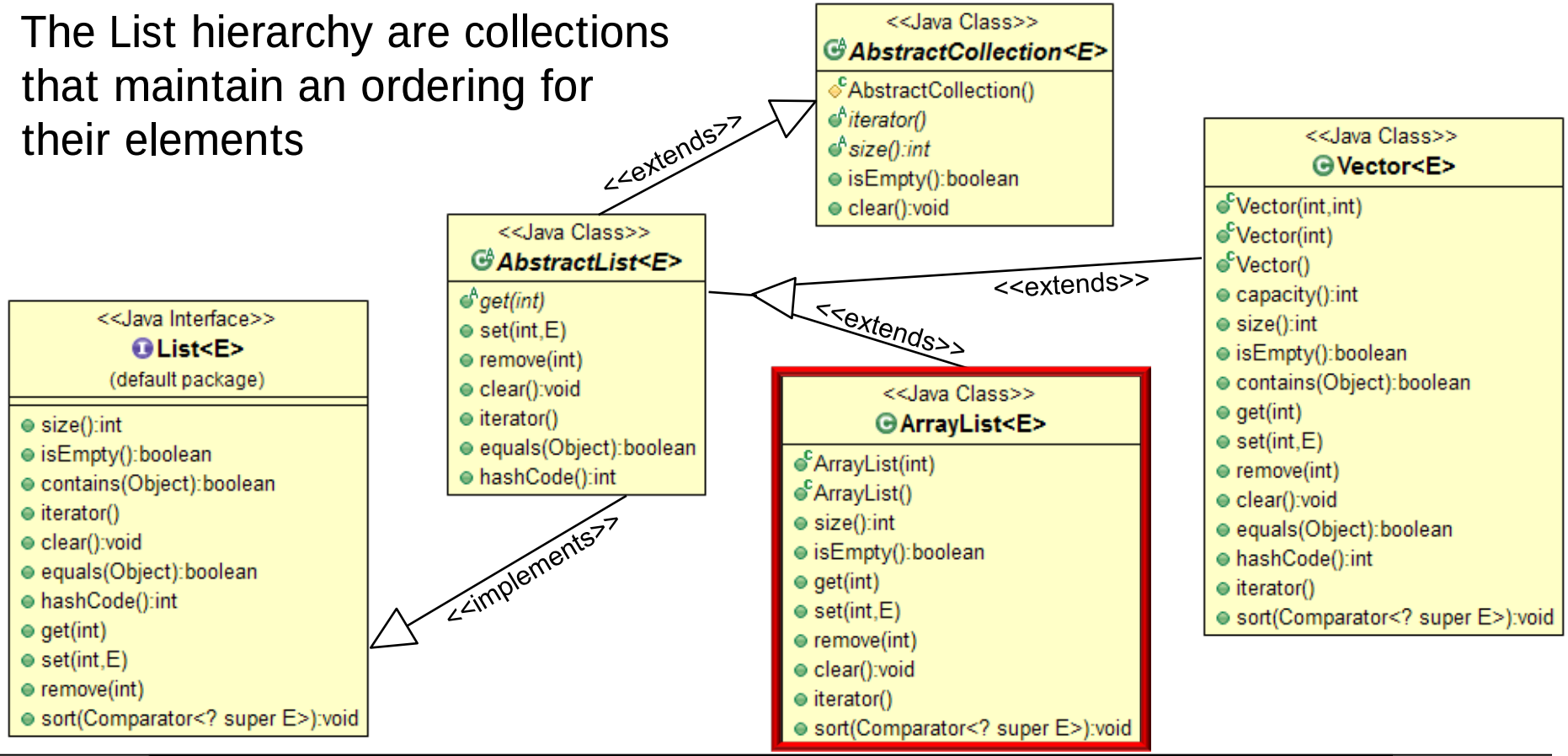

See developer.android.com/reference/java/util/ArrayList.html

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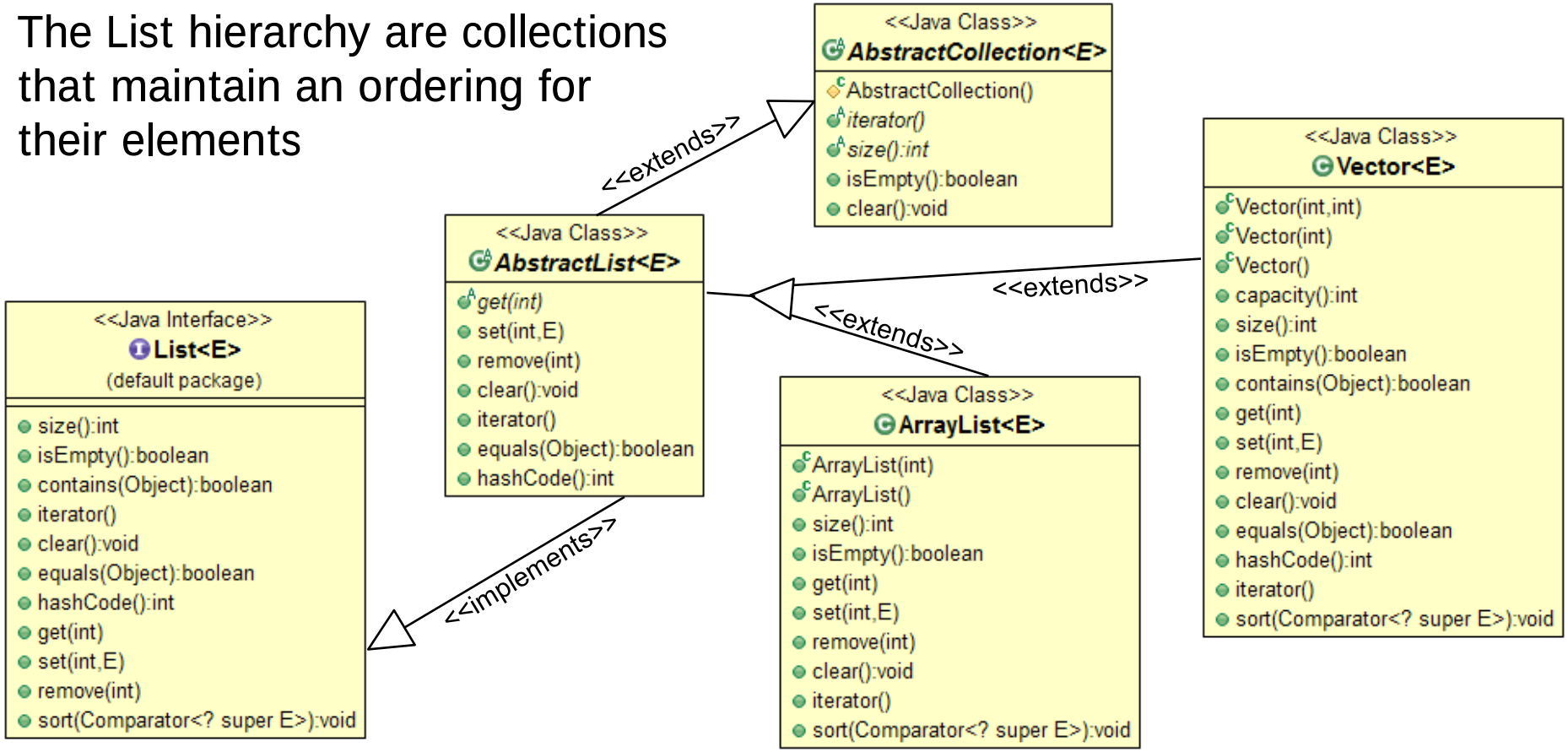

This inheritance hierarchy enhances systematic reuse of data fields & methods

Overview of Java's Support for Inheritance (Part 2)

Overview of Java's Support for Inheritance

- All Java classes inherit from the java.lang.Object super class

```
package java.lang;

public class Object {
   ...
   public int hashCode();
   public boolean equals
                  (Object o);
   ...
   public final void wait();
   public final void notify();
   public final void notifyAll();
   ...
```

See developer.android.com/reference/java/lang/Object.html

Overview of Java's Support for Inheritance

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See developer.android.com/reference/java/lang/Object.html#hashCode()

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See developer.android.com/reference/java/lang/Object.html#equals(java.lang.Object)

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See docs.oracle.com/javase/tutorial/essential/concurrency/guardmeth.html

Overview of Java's Support for Inheritance

- Subclasses that don't explicitly extend a super class implicitly inherit from java.lang.Object

```
package java.lang;

public abstract class Process {
  ...
  public abstract int waitFor()
    ...;
  ...
```

Overview of Java's Support for Inheritance

- Subclasses that don't explicitly extend a super class implicitly inherit from java.lang.Object, e.g.
  - java.lang.Process implicitly extends java.lang.Object

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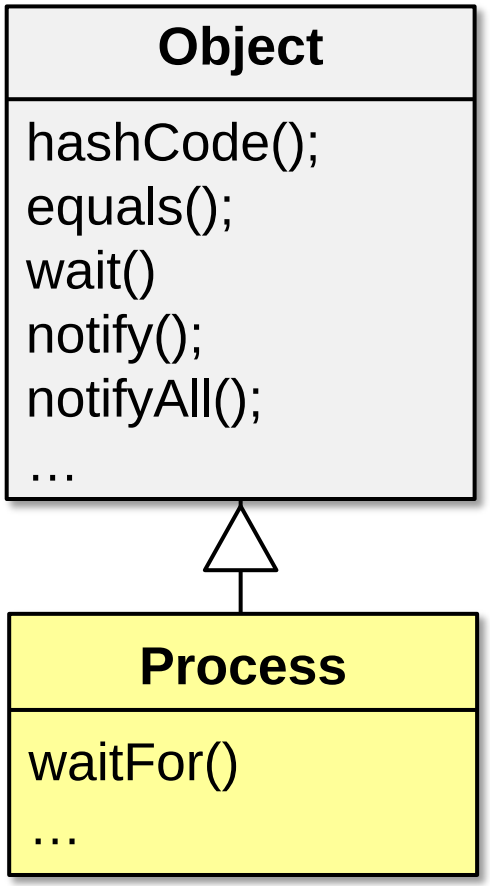
See developer.android.com/reference/java/lang/Process.html

Overview of Java's Support for Inheritance

- Subclasses that don't explicitly extend a super class implicitly inherit from java.lang.Object, e.g.
  - java.lang.Process implicitly extends java.lang.Object
  - All instances of java.lang.Process therefore also provide clients access to inherited java.lang.Object methods

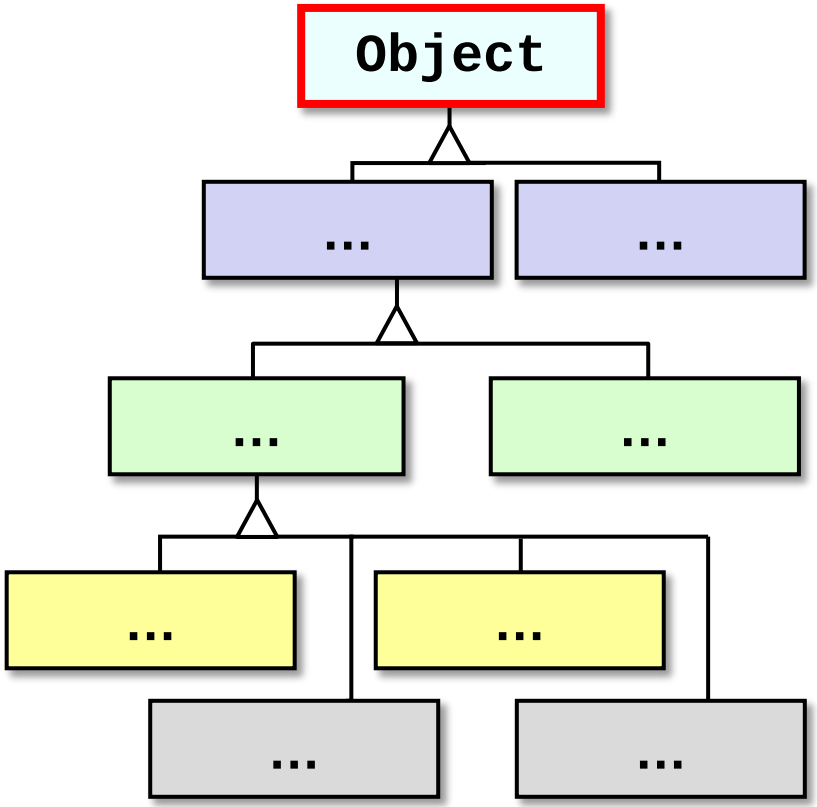


Overview of Java's Support for Inheritance

- java.lang.Object is the most general of all classes

Overview of Java's Support for Inheritance

- java.lang.Object is the most general of all classes
  - It serves as the root of a hierarchy of classes available to Java apps



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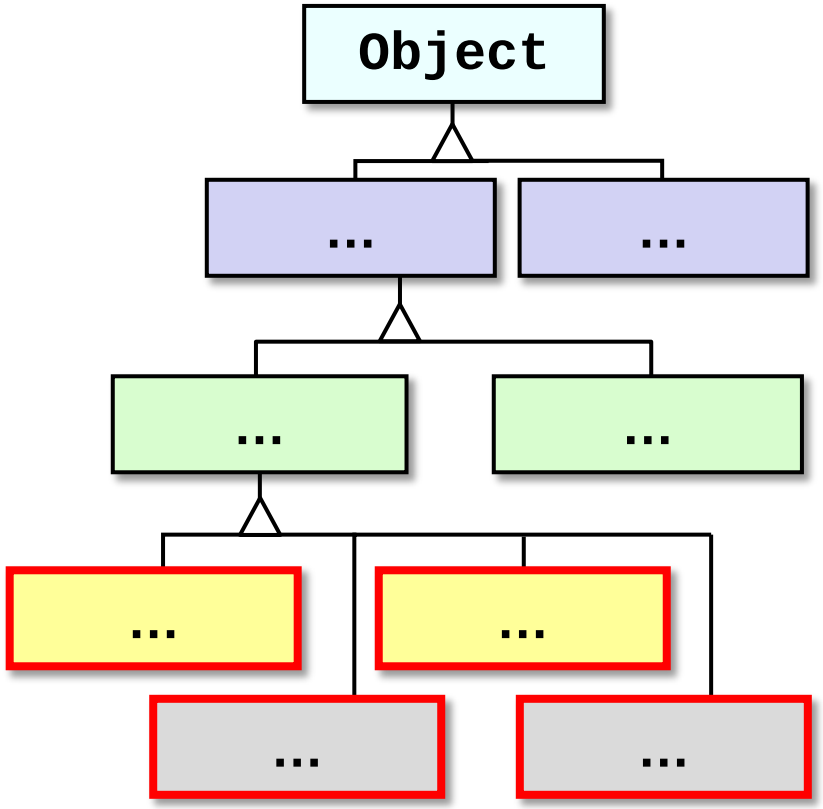
  - Classes towards the bottom of the inheritance hierarchy are more specialized



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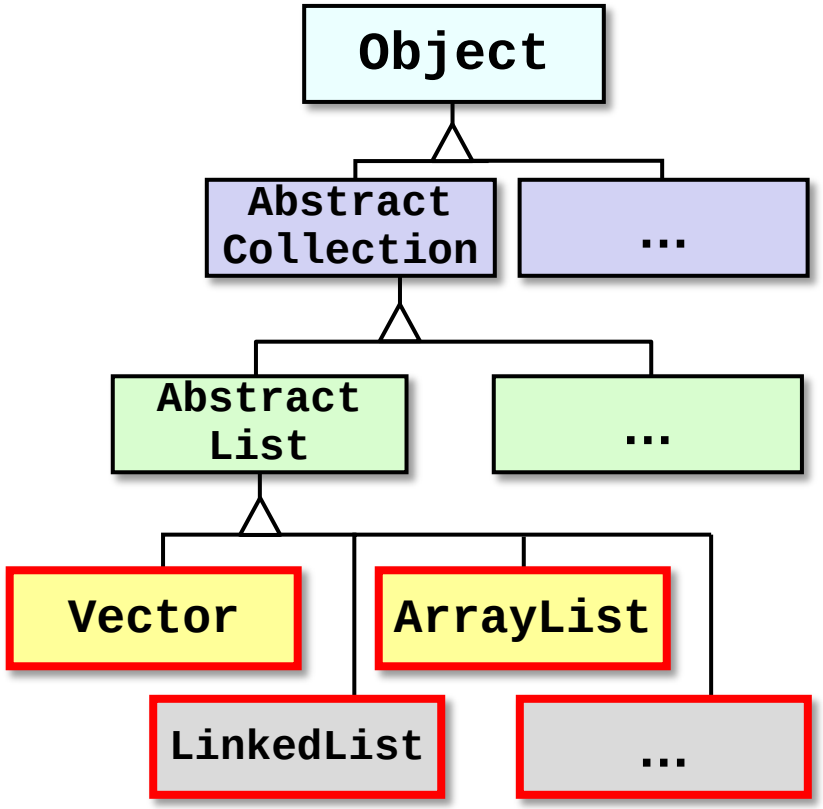
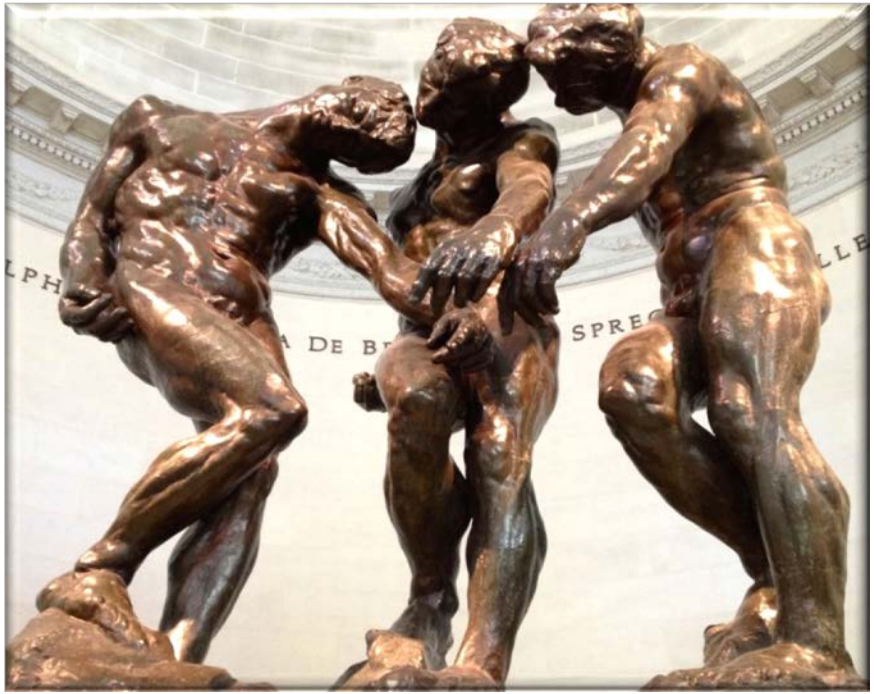
    - e.g., List-related subclasses override methods inherited from super classes



Overview of Java's Support for Inheritance

- Subclass methods inherited from a super class are used for 3 purposes

```
public class Stack<E> {
        extends Vector<E> {
```



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public class Stack<E> {
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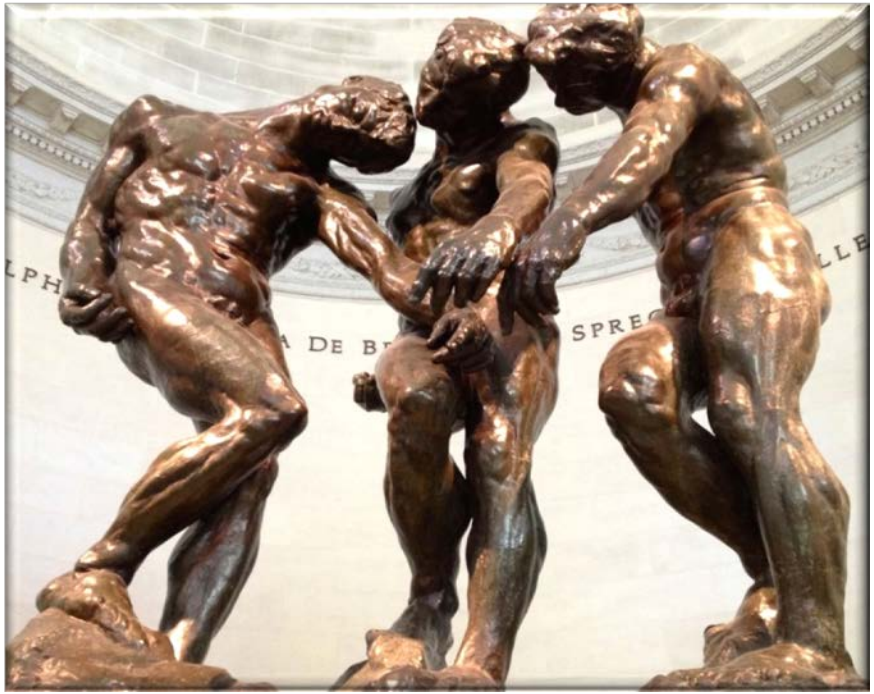
Extends Vector to define a last-in/first-out data structure that enables apps to pop & push items to/from a stack



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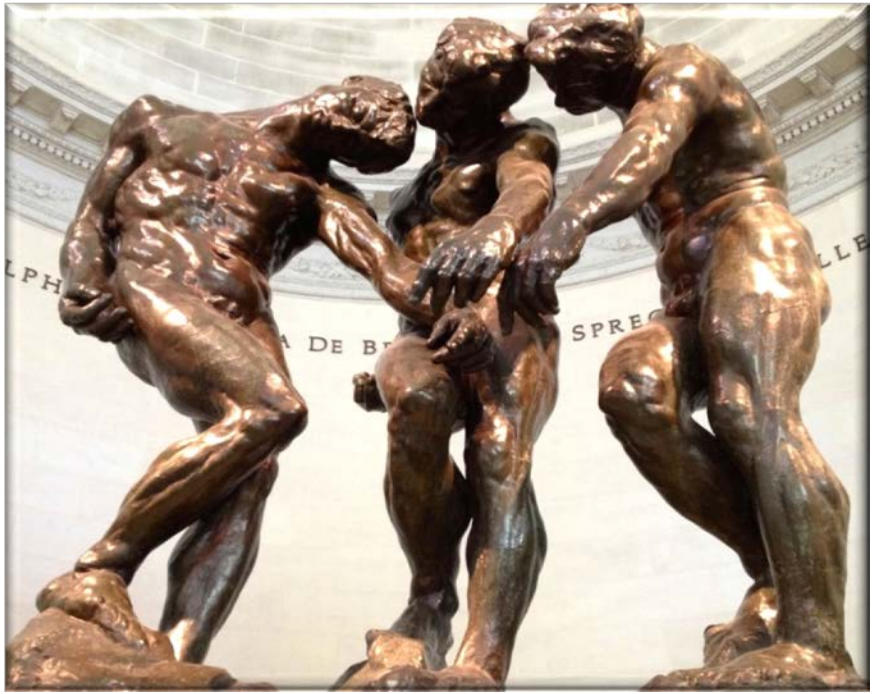

See developer.android.com/reference/java/util/Vector.html

Overview of Java's Support for Inheritance

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  1. To augment the subclass API

```
public class Stack<E> {
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Overview of Java's Support for Inheritance

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     - e.g., Stack subclass inherits fields & methods from Vector super class

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     - e.g., Stack subclass inherits fields & methods from Vector super class

```
public class Stack<E> {
        extends Vector<E> {
```

e.g.,

```
Stack<Integer> s =
  new Stack<>();
...

if(!s.isEmpty())
   s.pop();
```

isEmpty() method inherited from Vector can be invoked on a Stack instance

Overview of Java's Support for Inheritance

- Subclass methods inherited from a super class are used for 3 purposes
  1. To augment the subclass API
  2. To implement subclass methods

```
public class Stack<E> {
        extends Vector<E> {
  ...
  public Object push(E e){
    addElement(e);
    return e;
  }
  ...
```

Overview of Java's Support for Inheritance

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Overview of Java's Support for Inheritance

- Subclass methods inherited from a super class are used for 3 purposes
  1. To augment the subclass API
  2. To implement subclass methods
  3. To override super class methods in subclass with same signatures

```
public abstract class
        AbstractMap<K,V> ...
  public abstract
    Set<Entry<K,V>> entrySet();
  public V put(K key, V value)
  { ... }
  ...

public HashMap<K,V> extends
     AbstractMap<K,V> ...
  public Set<Entry<K,V>>
    entrySet() { ... }
  public V put(K key, V value)
  { ... }
  ...
```

See en.wikipedia.org/wiki/Type_signature#Java_2

Overview of Java's Support for Inheritance

- Subclass methods inherited from a super class are used for 3 purposes
  1. To augment the subclass API
  2. To implement subclass methods
  3. To override super class methods in subclass with same signatures
     - e.g., the HashMap subclass overrides AbstractMap super class methods

```
public abstract class
        AbstractMap<K,V> ...
  public abstract
    Set<Entry<K,V>> entrySet();
  public V put(K key, V value)
  { ... }
  ...

public HashMap<K,V> extends
     AbstractMap<K,V> ...
  public Set<Entry<K,V>>
    entrySet() { ... }
  public V put(K key, V value)
  { ... }
  ...
```

See docs.oracle.com/javase/tutorial/java/IandI/override.html

Overview of Java's Support for Inheritance

- Subclass methods inherited from a super class are used for 3 purposes
  1. To augment the subclass API
  2. To implement subclass methods
  3. To override super class methods in subclass with same signatures
     - e.g., the HashMap subclass overrides AbstractMap super class methods

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public abstract class
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  { ... }
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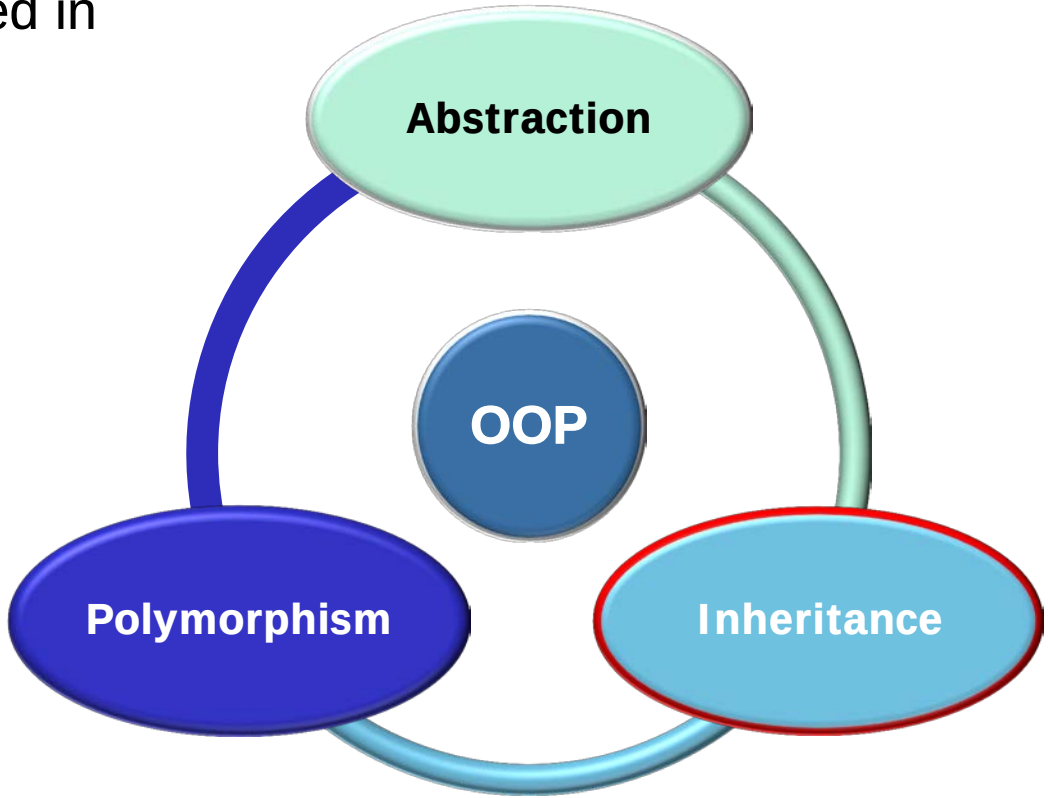
Method overriding is covered next in our discussion of Java Polymorphism

Overview of Java's Support for Polymorphism (Part 1)

Overview of Java's Support for Polymorphism

- Inheritance is nearly always used in conjunction with polymorphism



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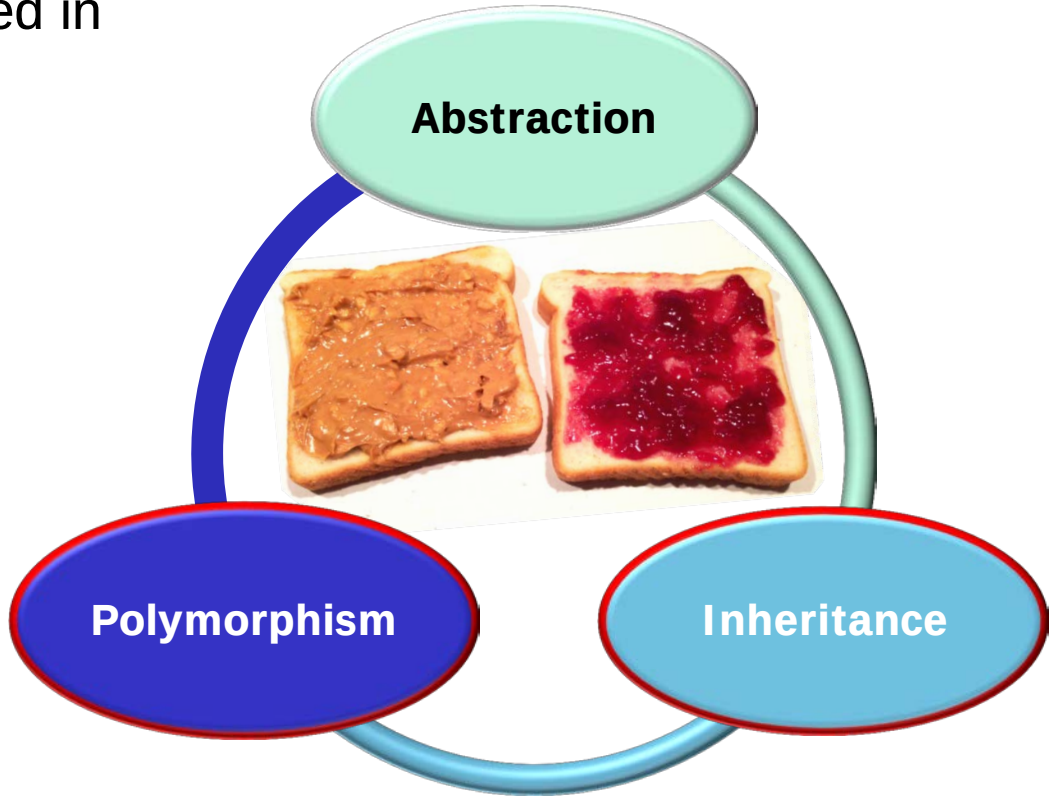
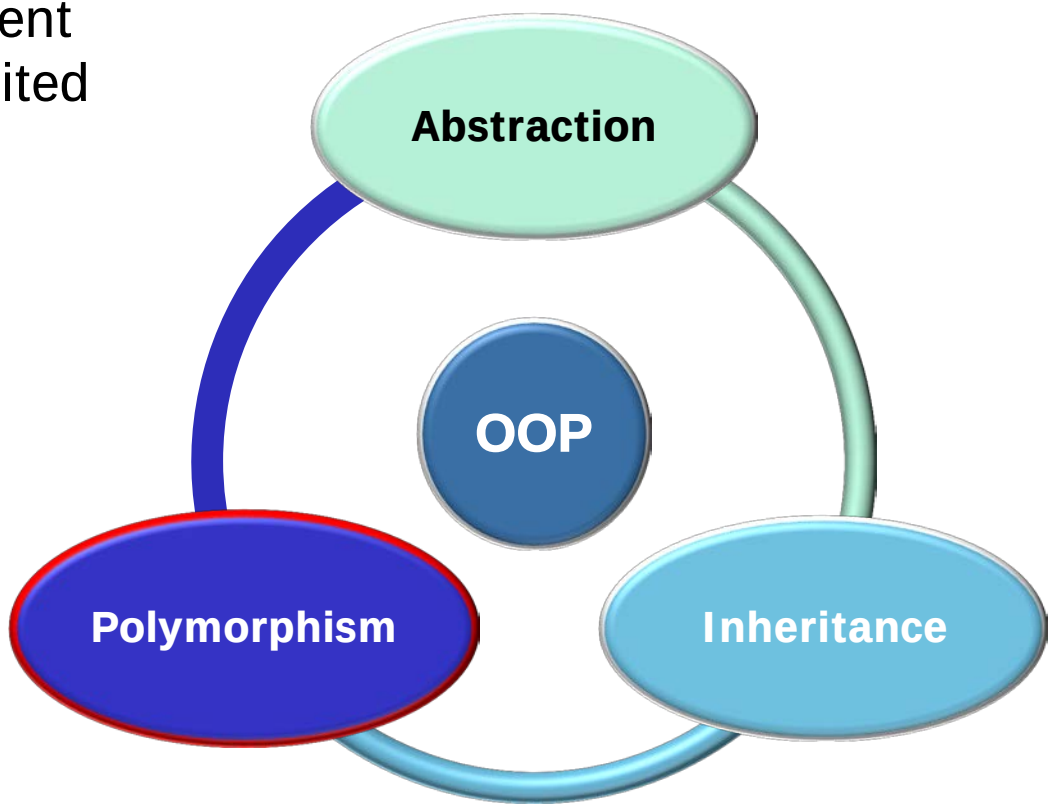


Overview of Java's Support for Polymorphism

- Polymorphism enables transparent customization of methods inherited from a super class



See en.wikipedia.org/wiki/Polymorphism_(computer_science)

Overview of Java's Support for Polymorphism

- Polymorphism & inheritance are essential to the "open/closed principle"

See en.wikipedia.org/wiki/Open/closed_principle

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  - "A class should be open for extension, but closed for modification"

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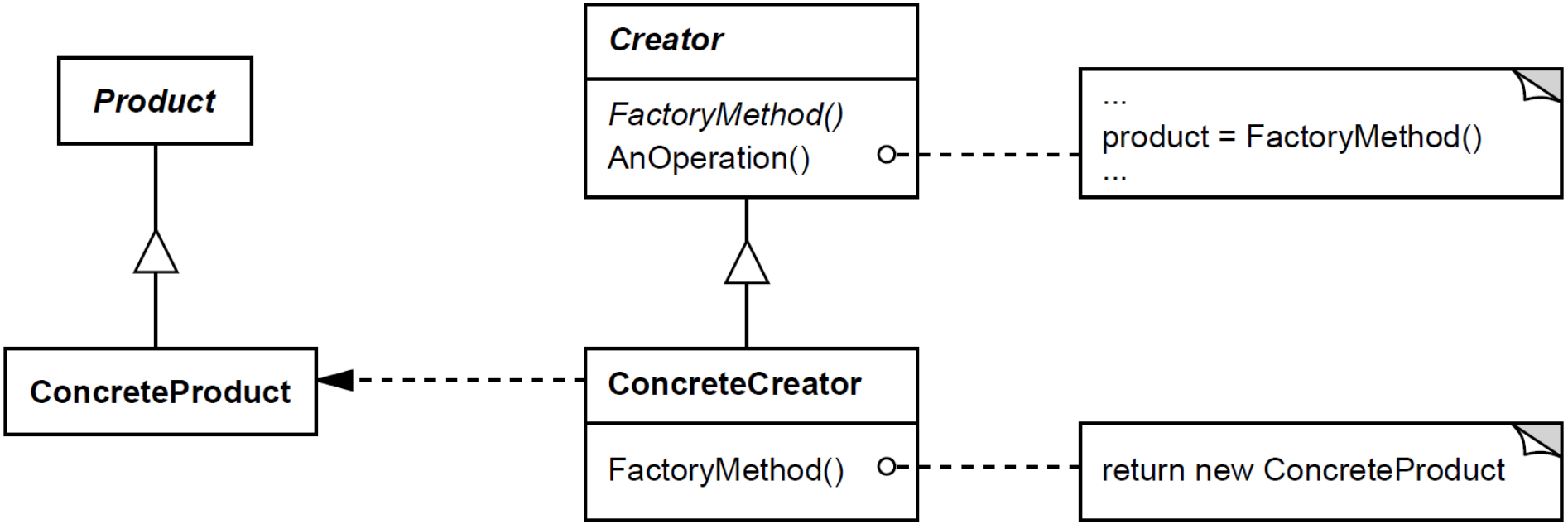
Overview of Java's Support for Polymorphism

- Polymorphism & inheritance are essential to the "open/closed principle"
  - "A class should be open for extension, but closed for modification"
  - Insulating a class from modifications helps make the class more robust, flexible, & reusable

See www.dre.vanderbilt.edu/~schmidt/OCP.pdf

Overview of Java's Support for Polymorphism

- The "open/closed principle" can be applied in conjunction with patterns to enable extensions *without* modifying existing classes or apps



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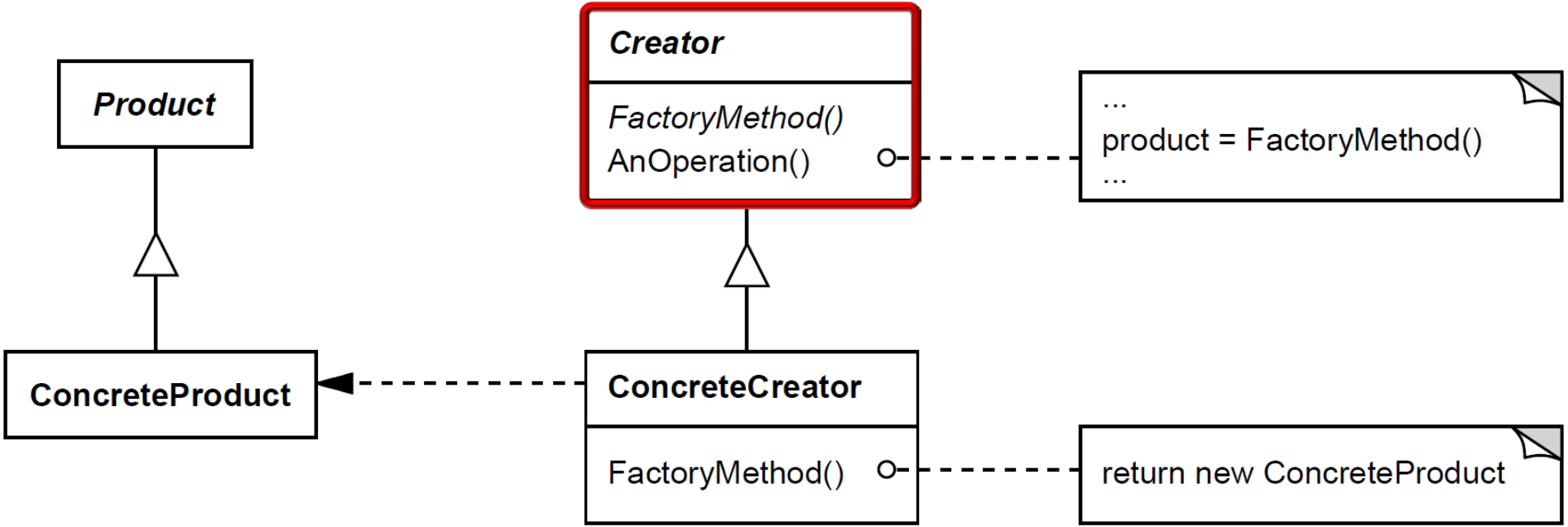

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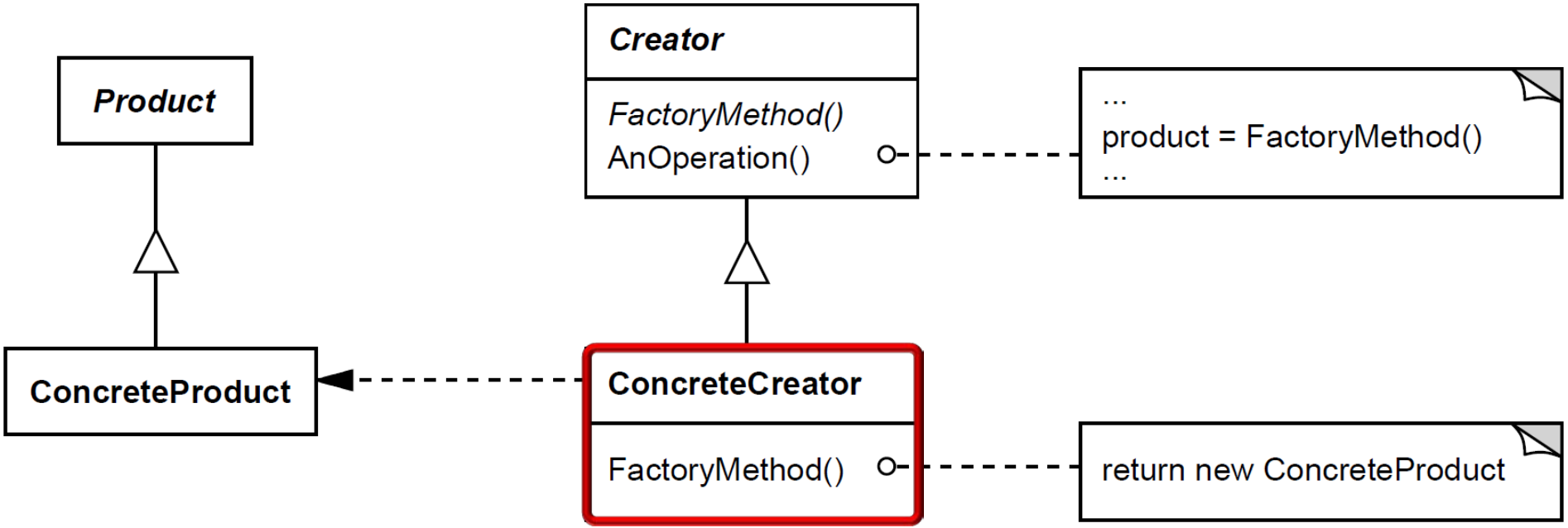

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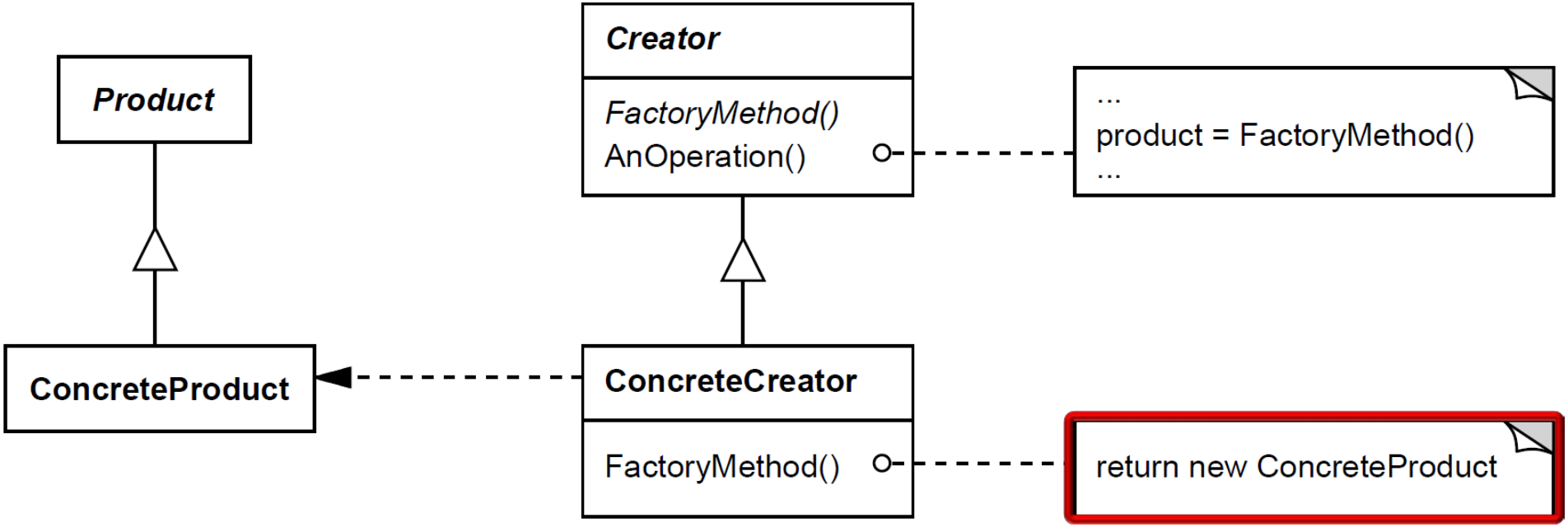

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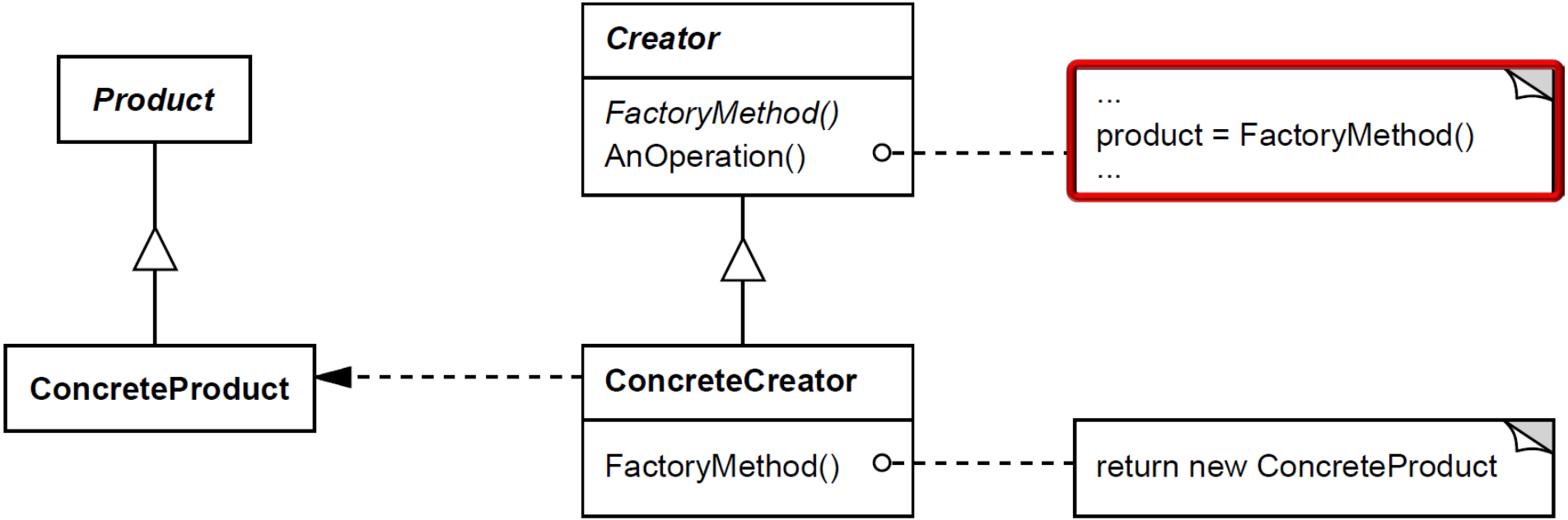

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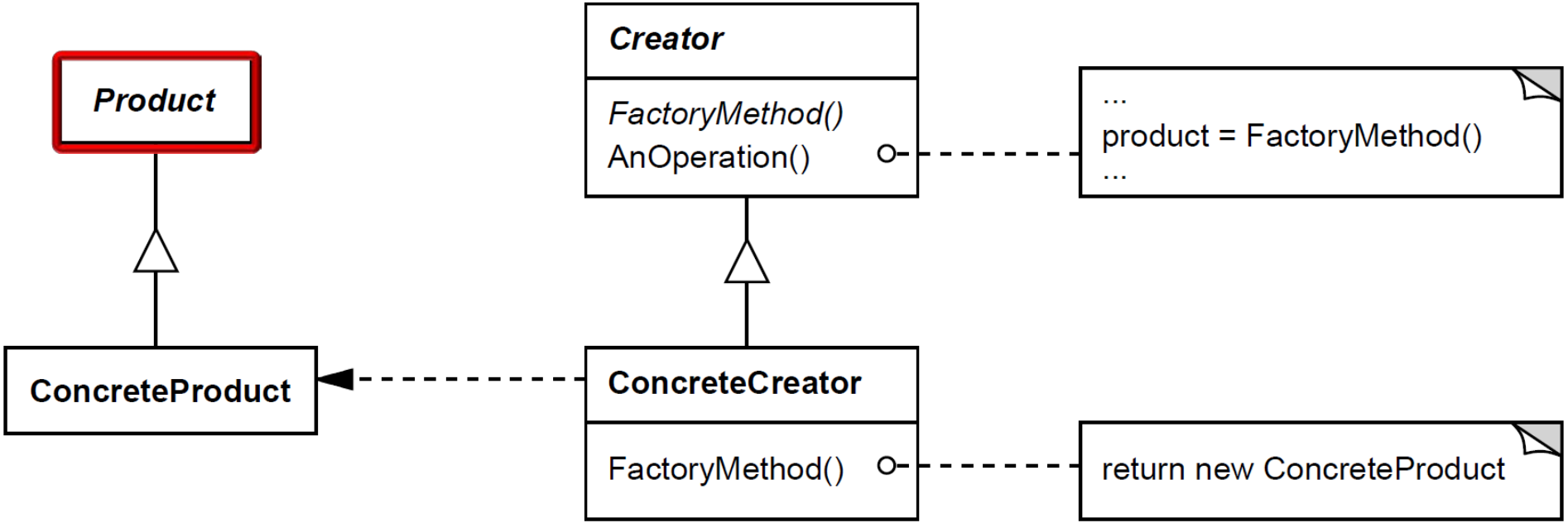

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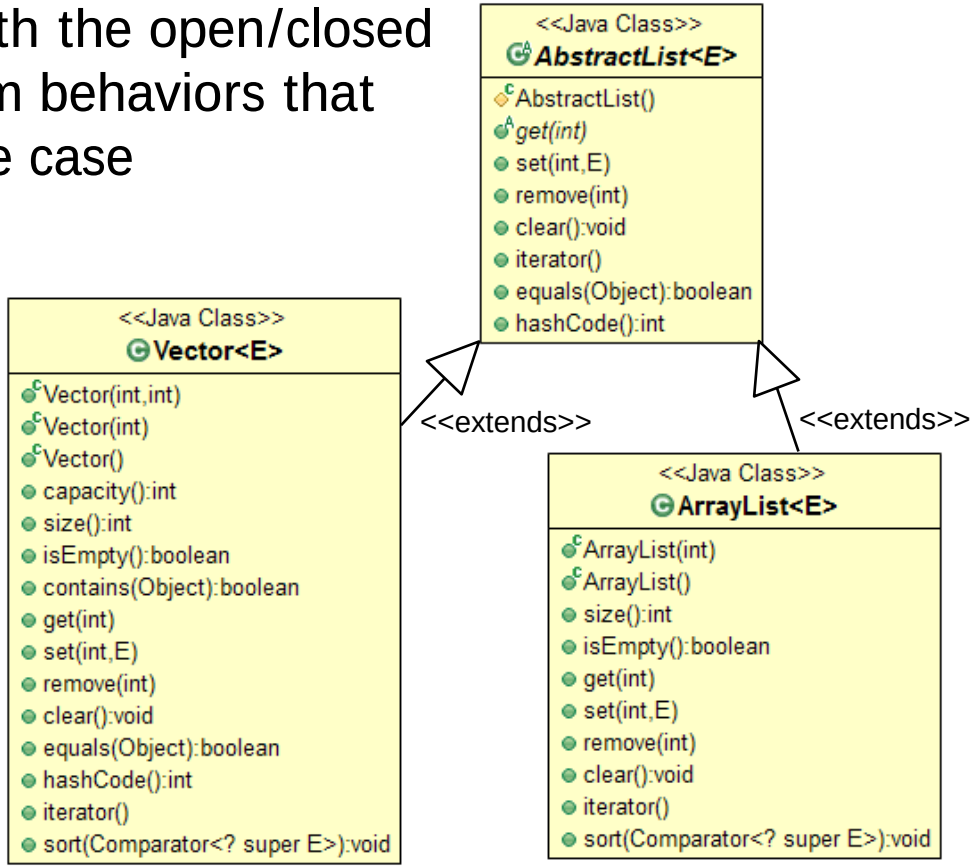
- Subclasses defined in accordance with the open/closed principle can define their own custom behaviors that are more suitable for a particular use case



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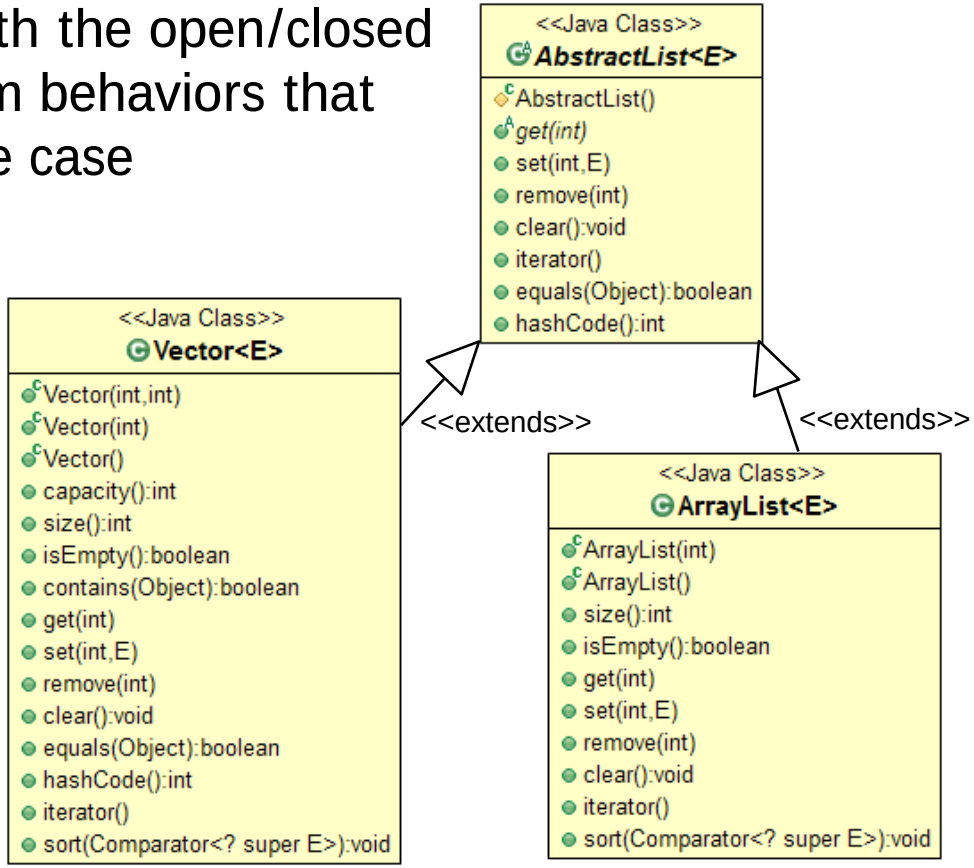

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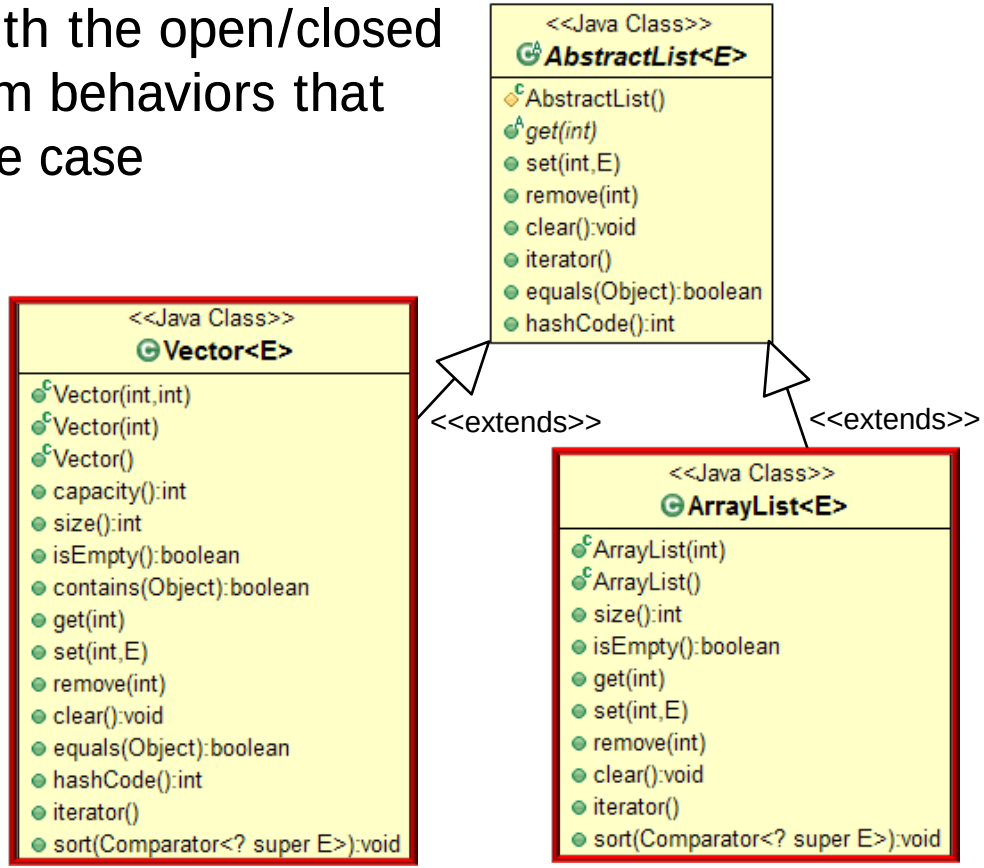

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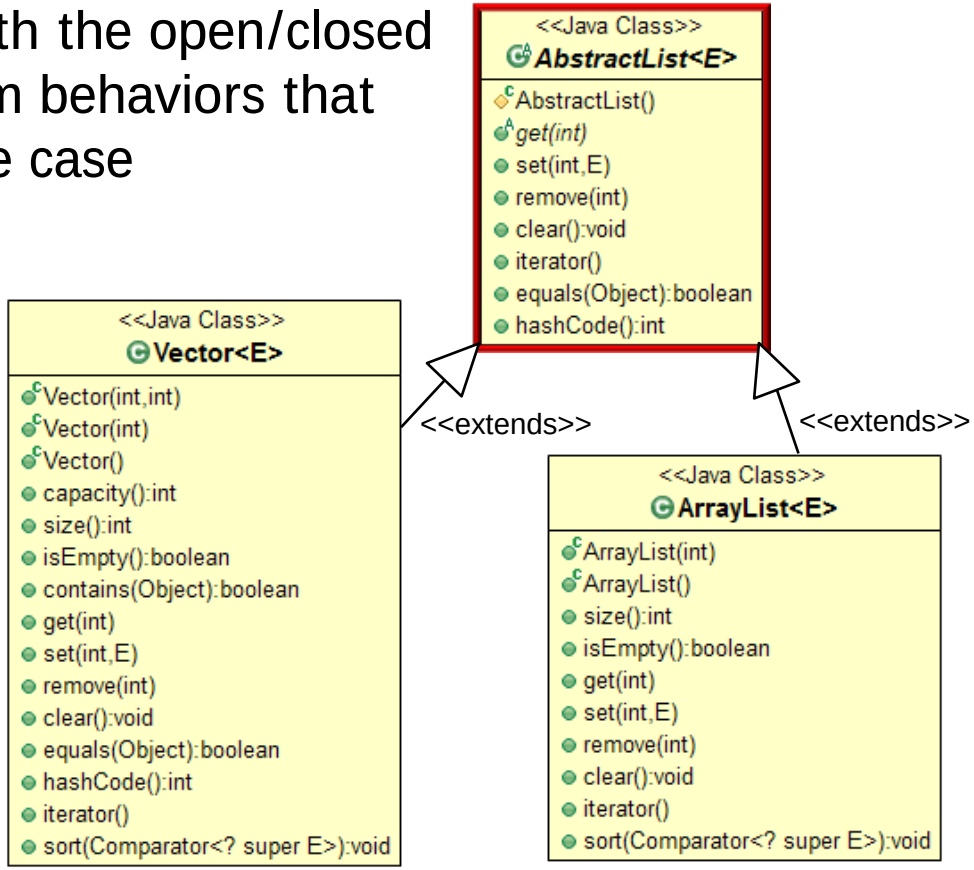

Overview of Java's Support for Polymorphism (Part 2)

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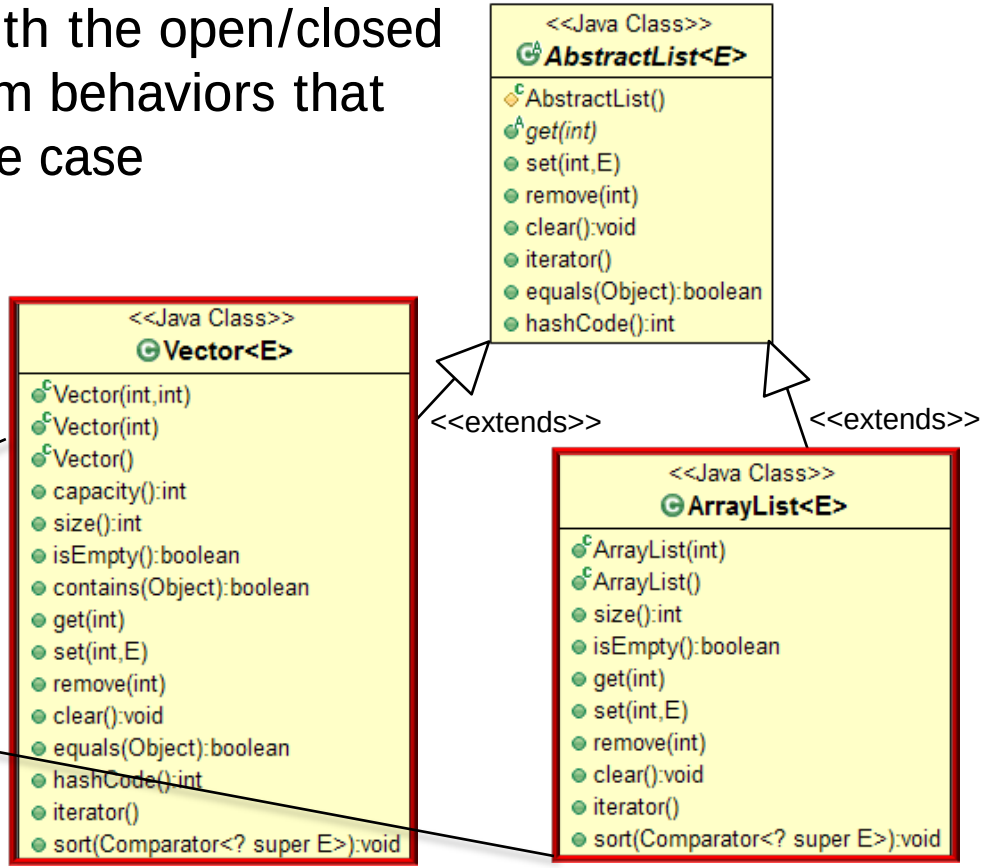
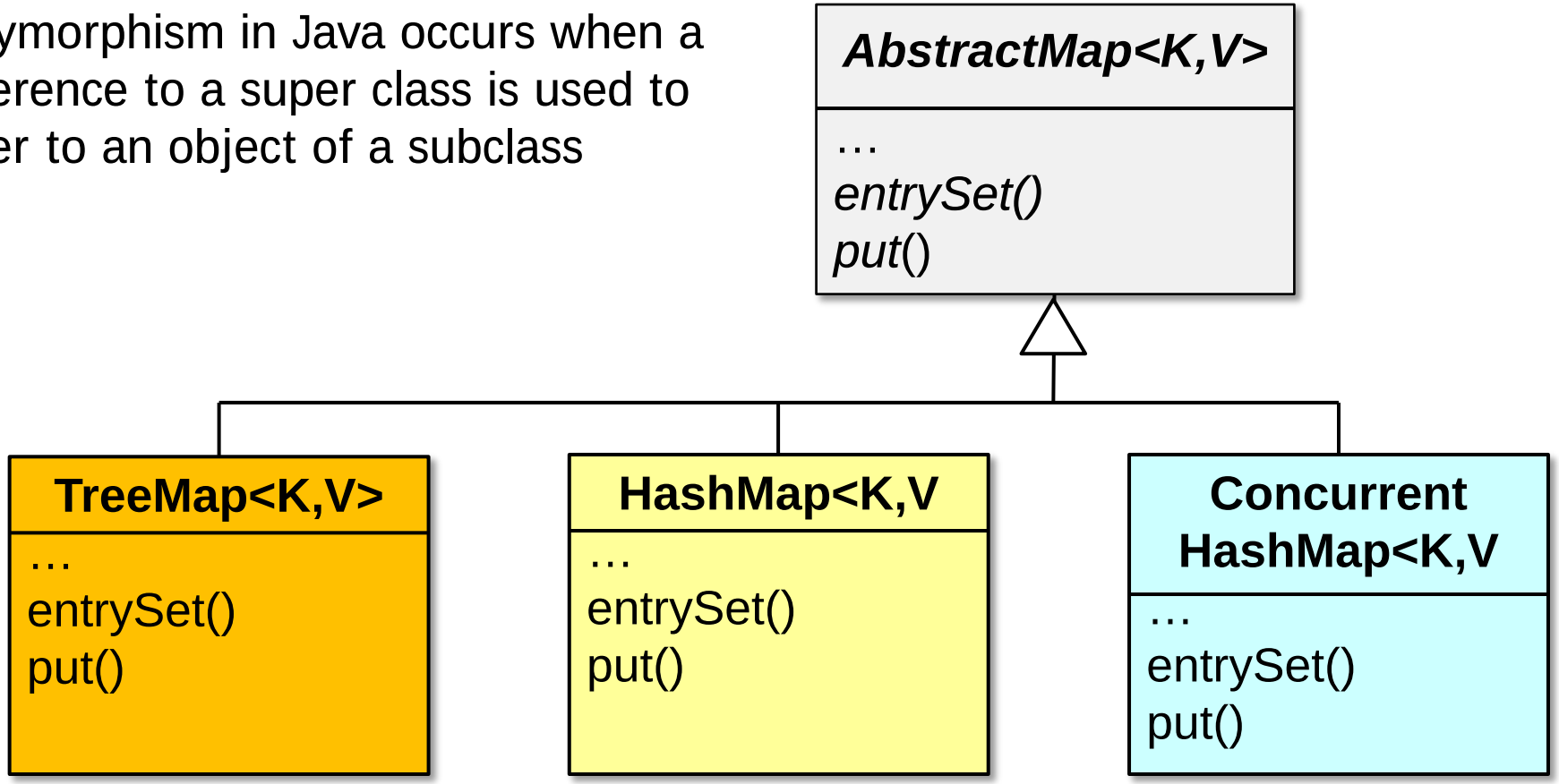


Methods in each subclass emphasize different List properties

See beginnersbook.com/2013/12/difference-between-arraylist-and-vector-in-java

Overview of Java's Support for Polymorphism

- Polymorphism in Java occurs when a reference to a super class is used to refer to an object of a subclass



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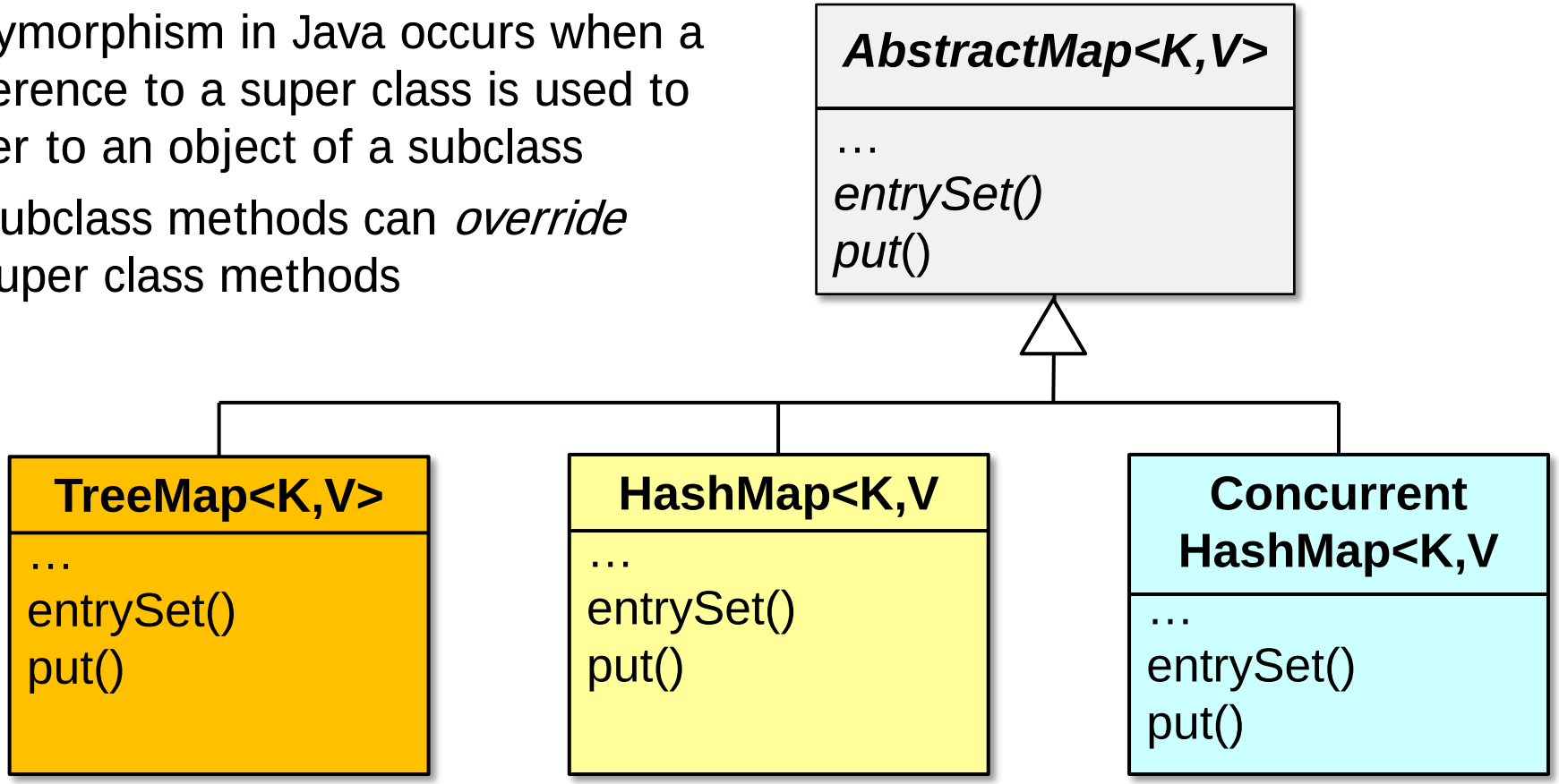

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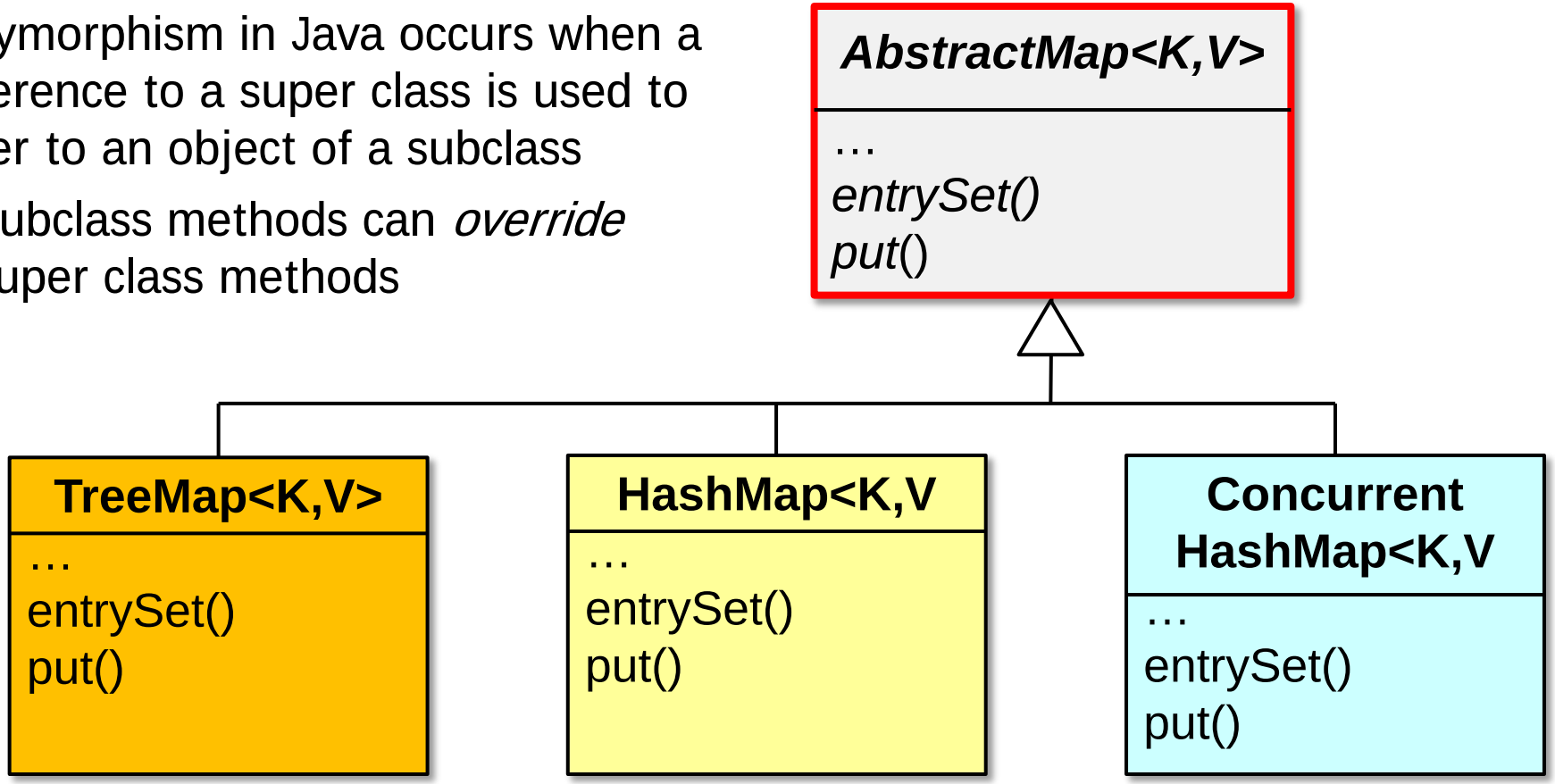

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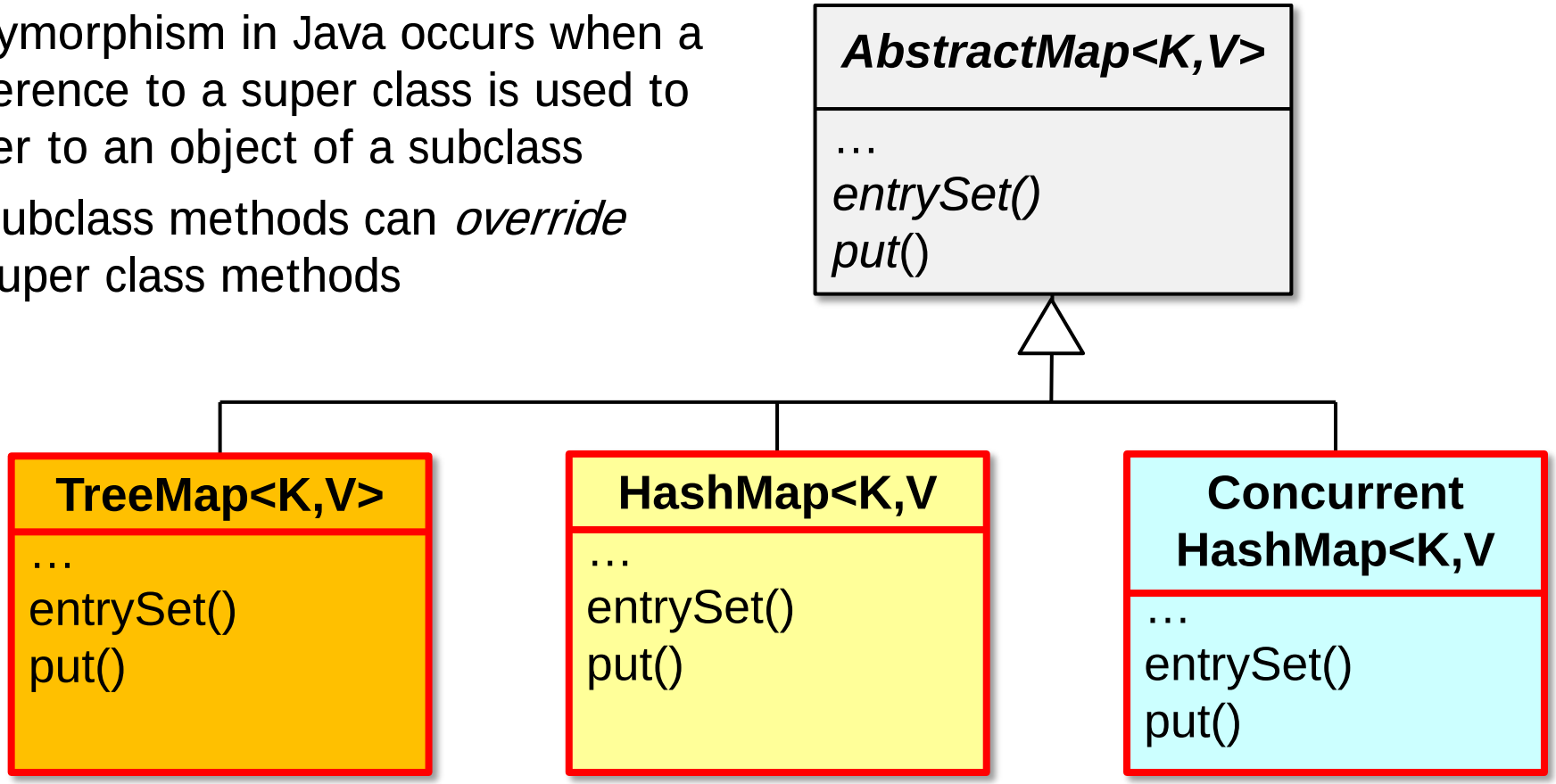

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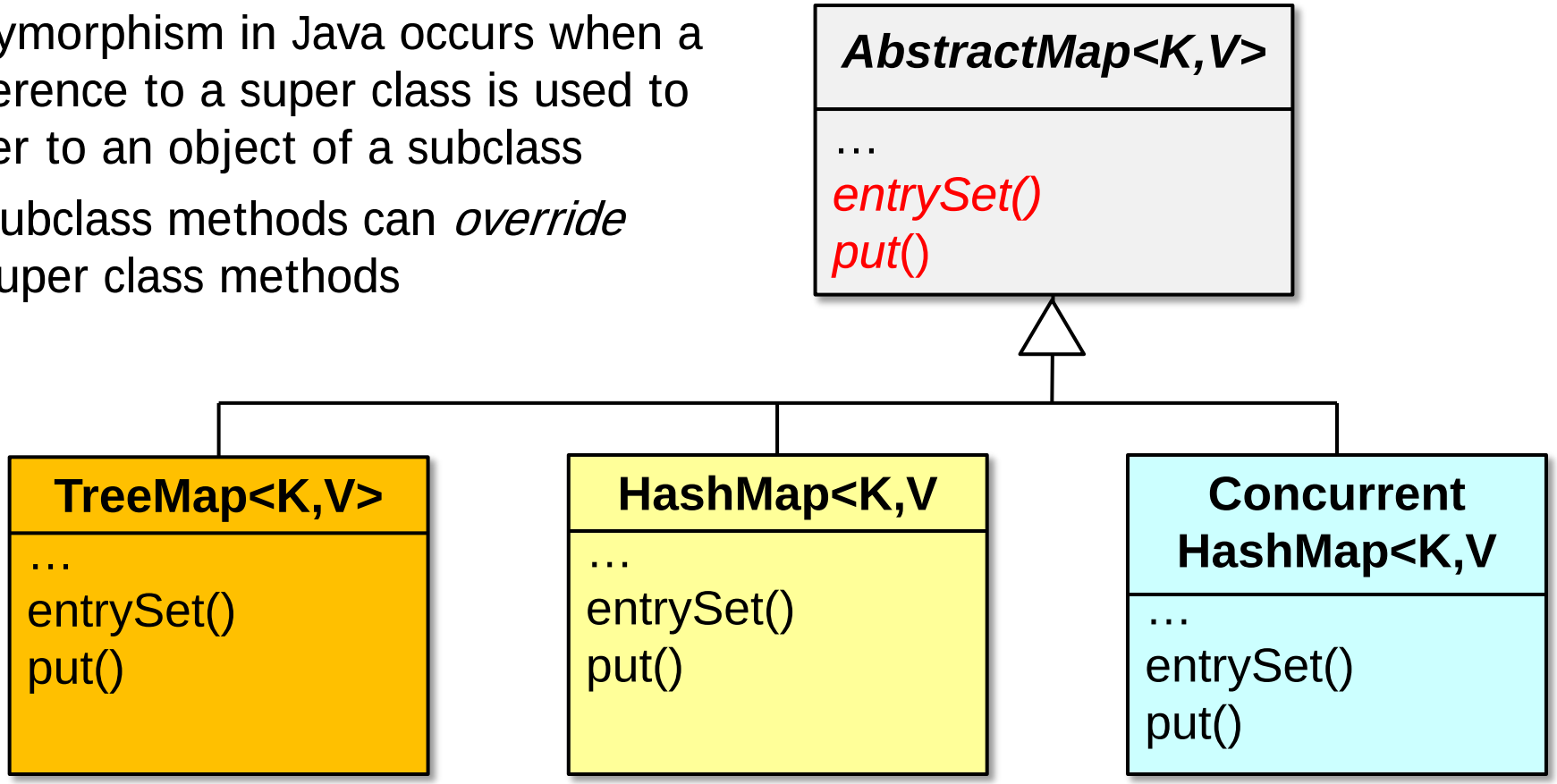

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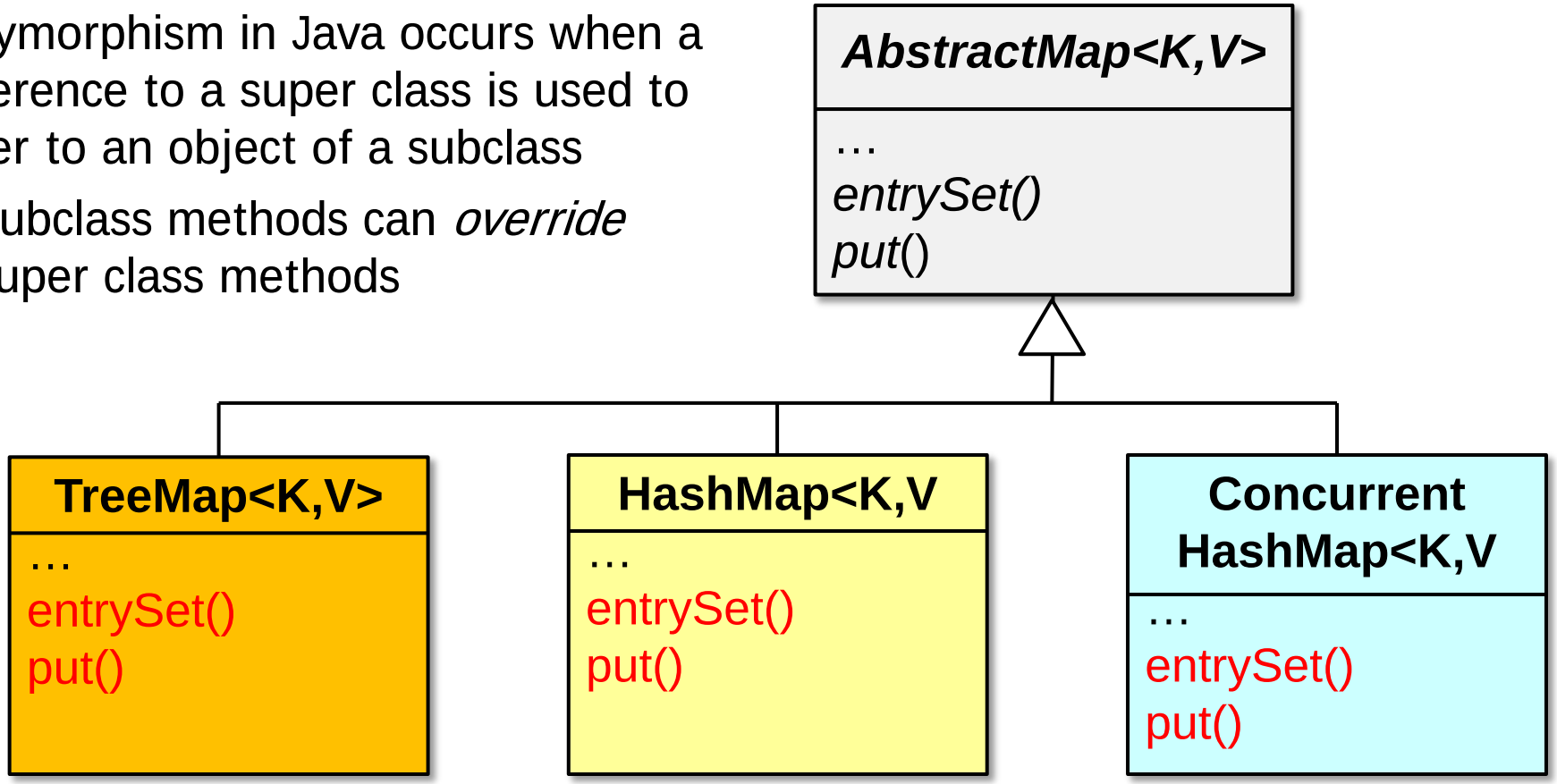

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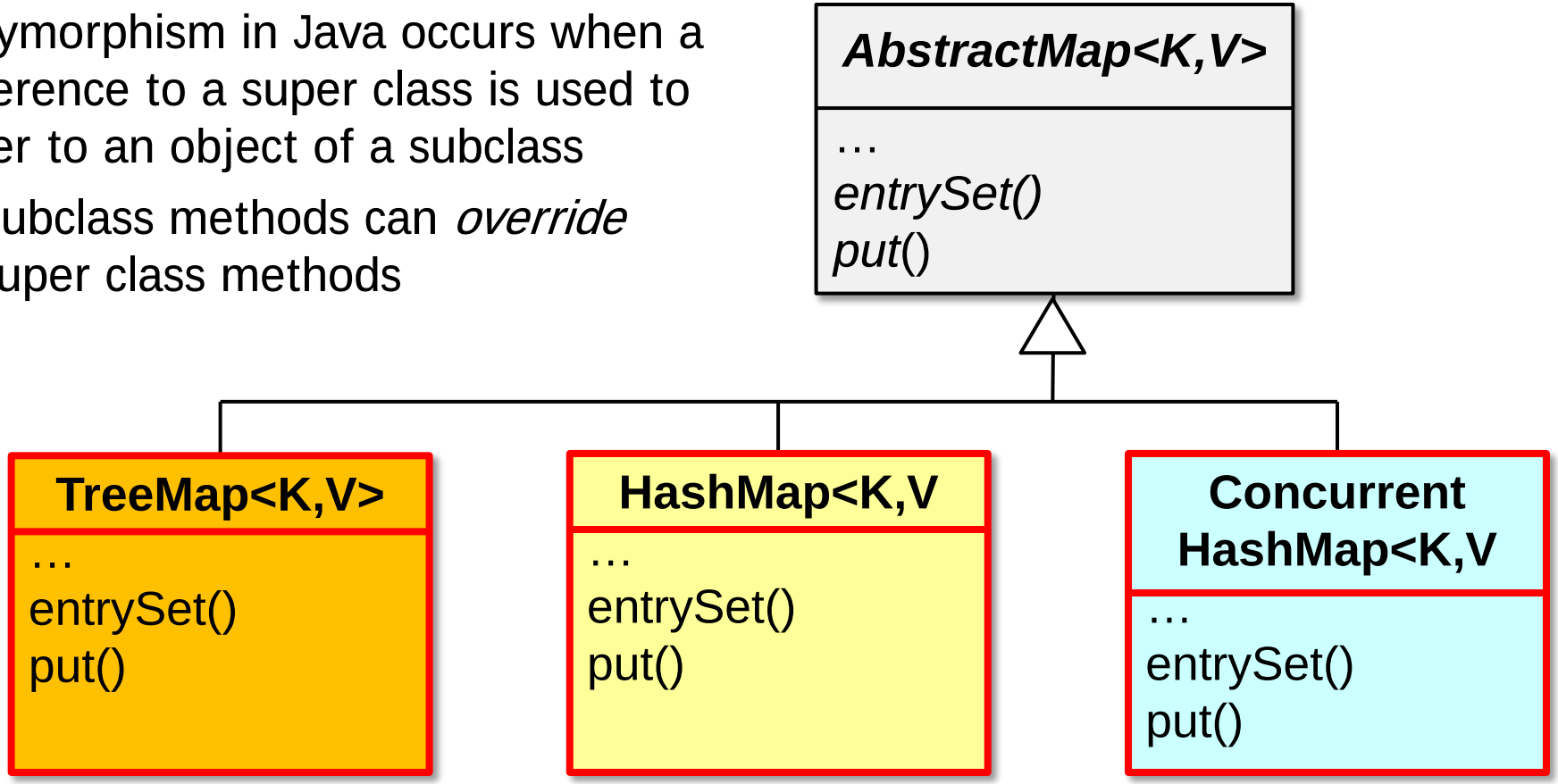

Subclasses of AbstractMap have different time & space tradeoffs

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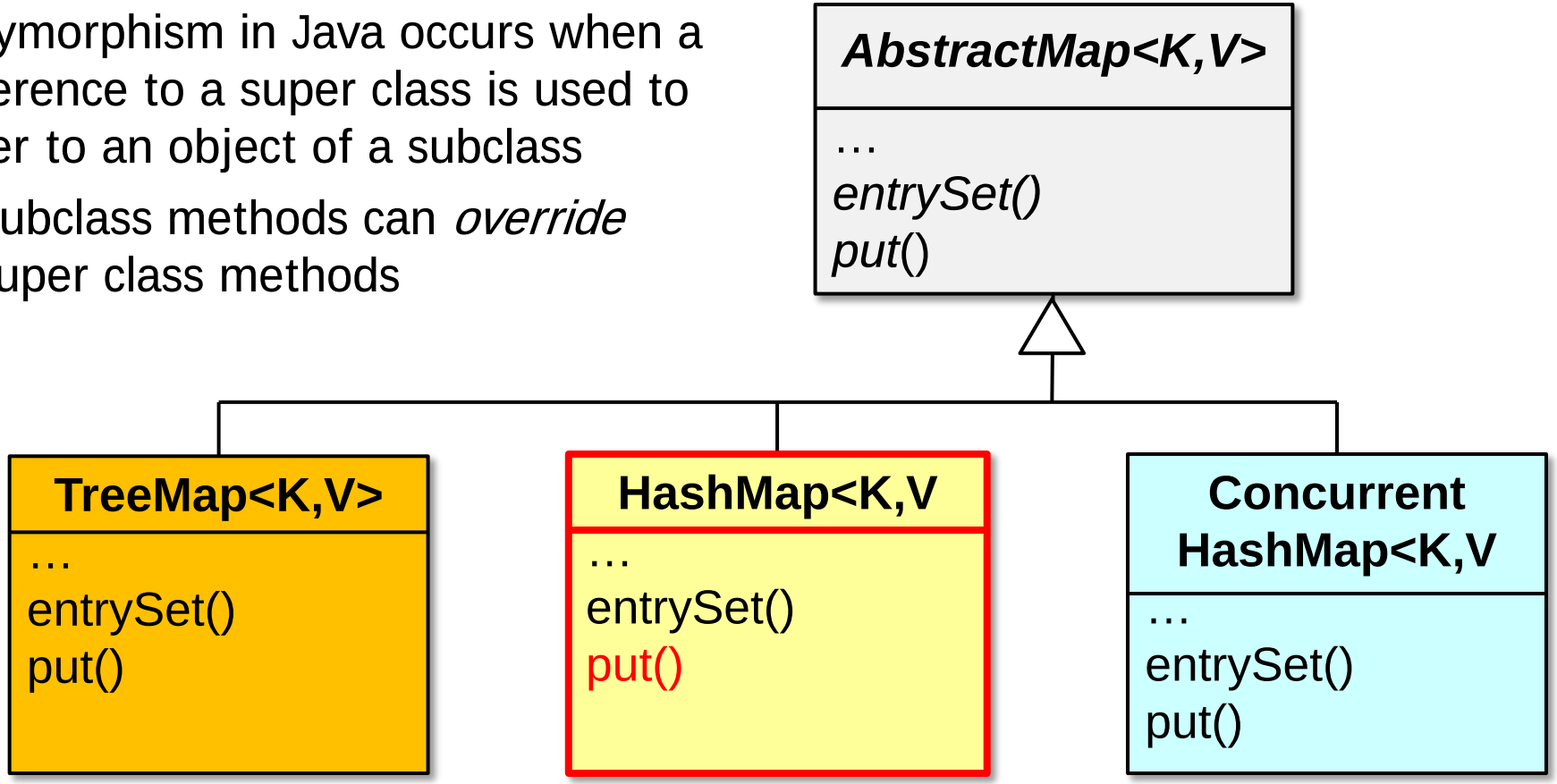

See developer.android.com/reference/java/util/HashMap.html

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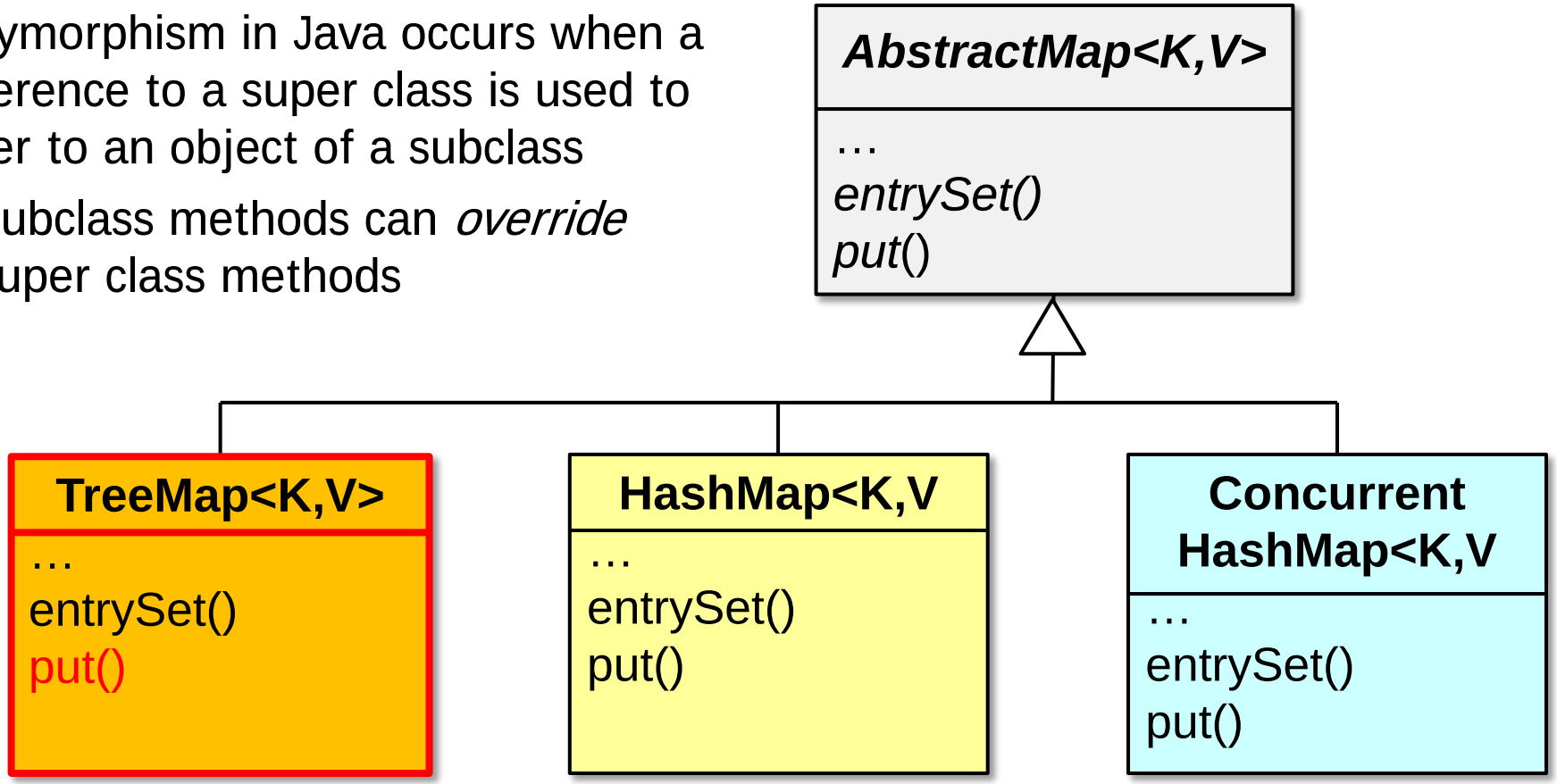
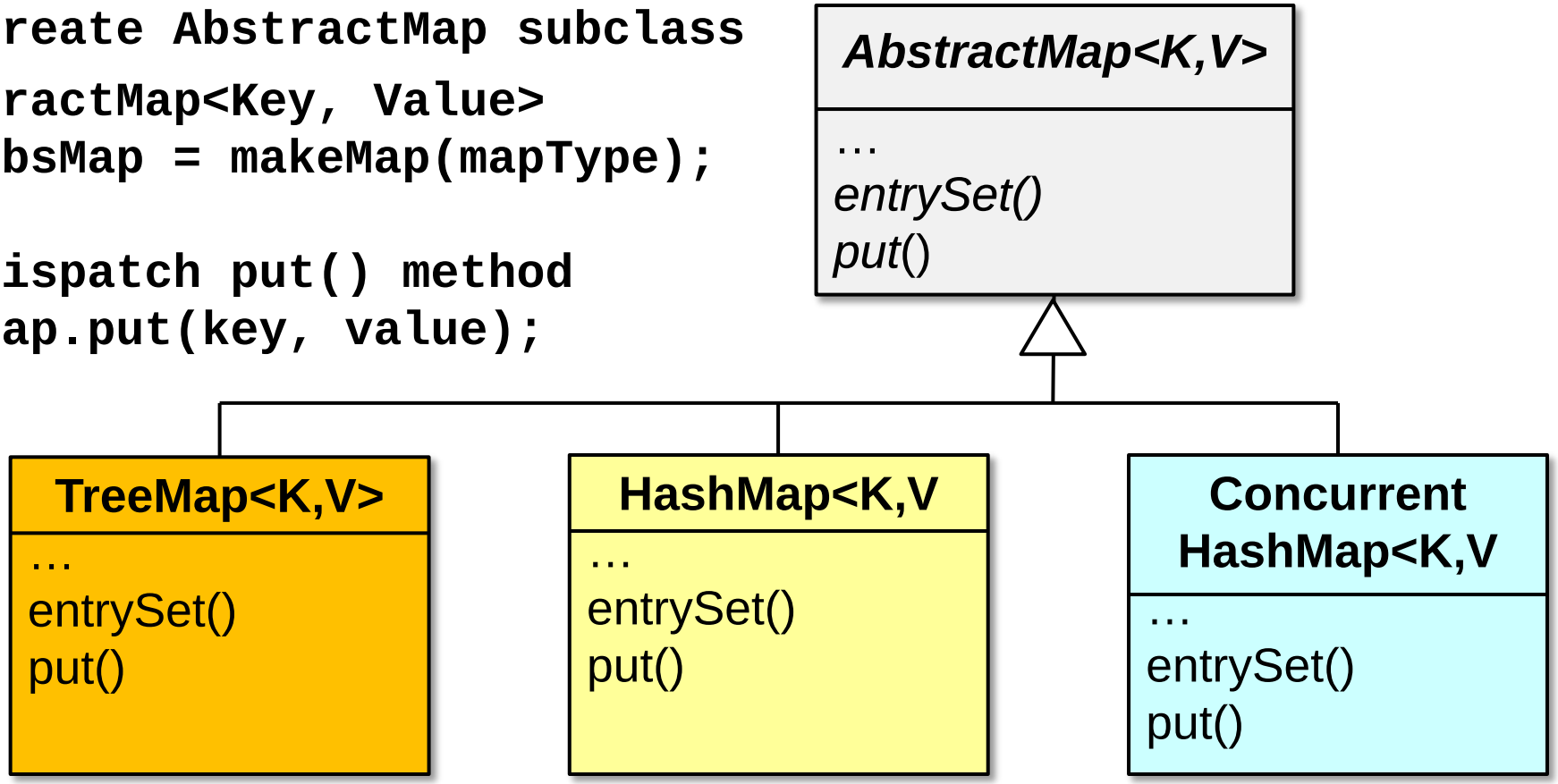


See developer.android.com/reference/java/util/TreeMap.html

Overview of Java's Support for Polymorphism

```
// Create AbstractMap subclass
AbstractMap<Key, Value>
   absMap = makeMap(mapType);
...
// Dispatch put() method
absMap.put(key, value);
```



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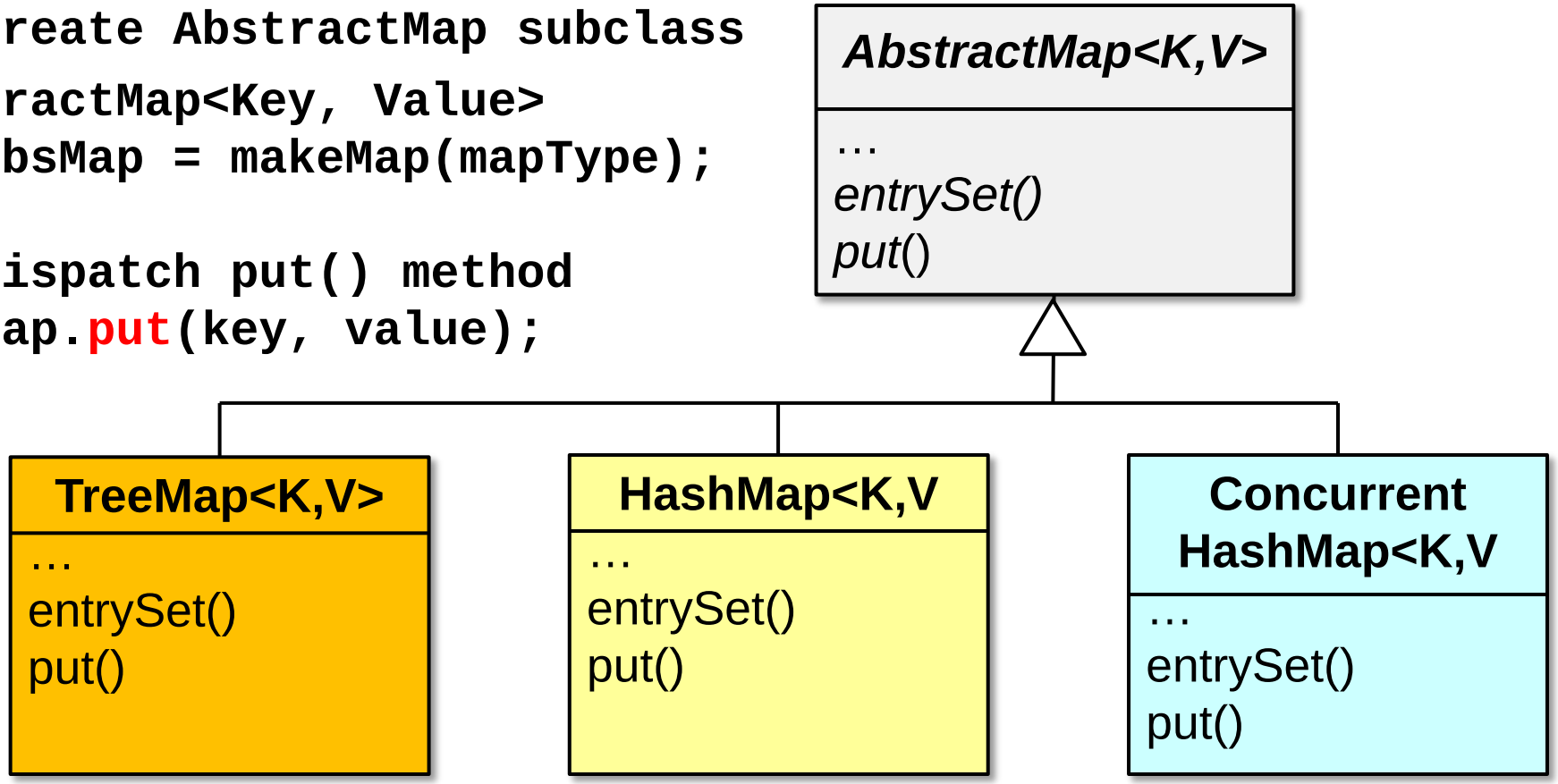

The appropriate method is dispatched at runtime based on the subclass object

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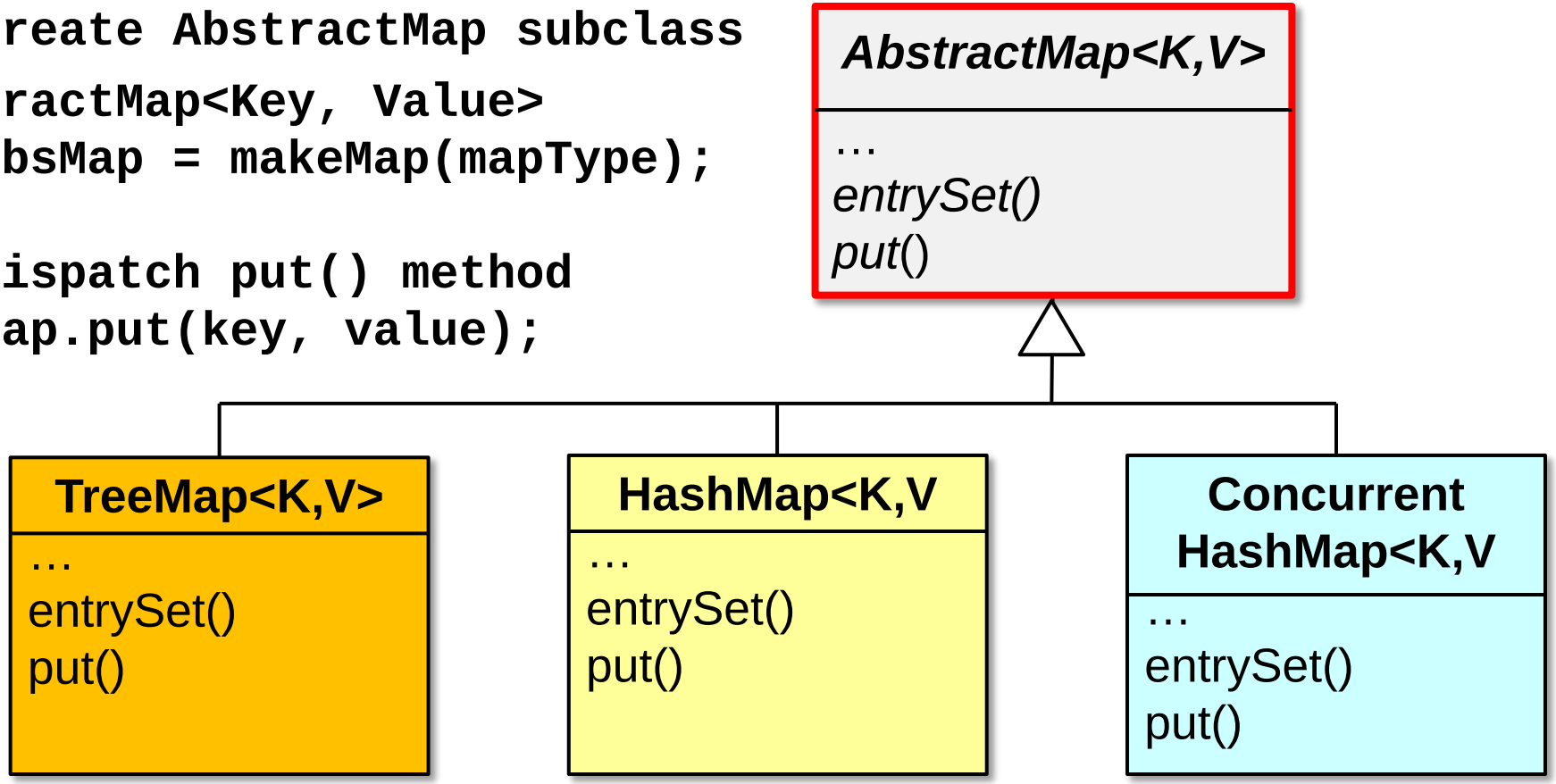

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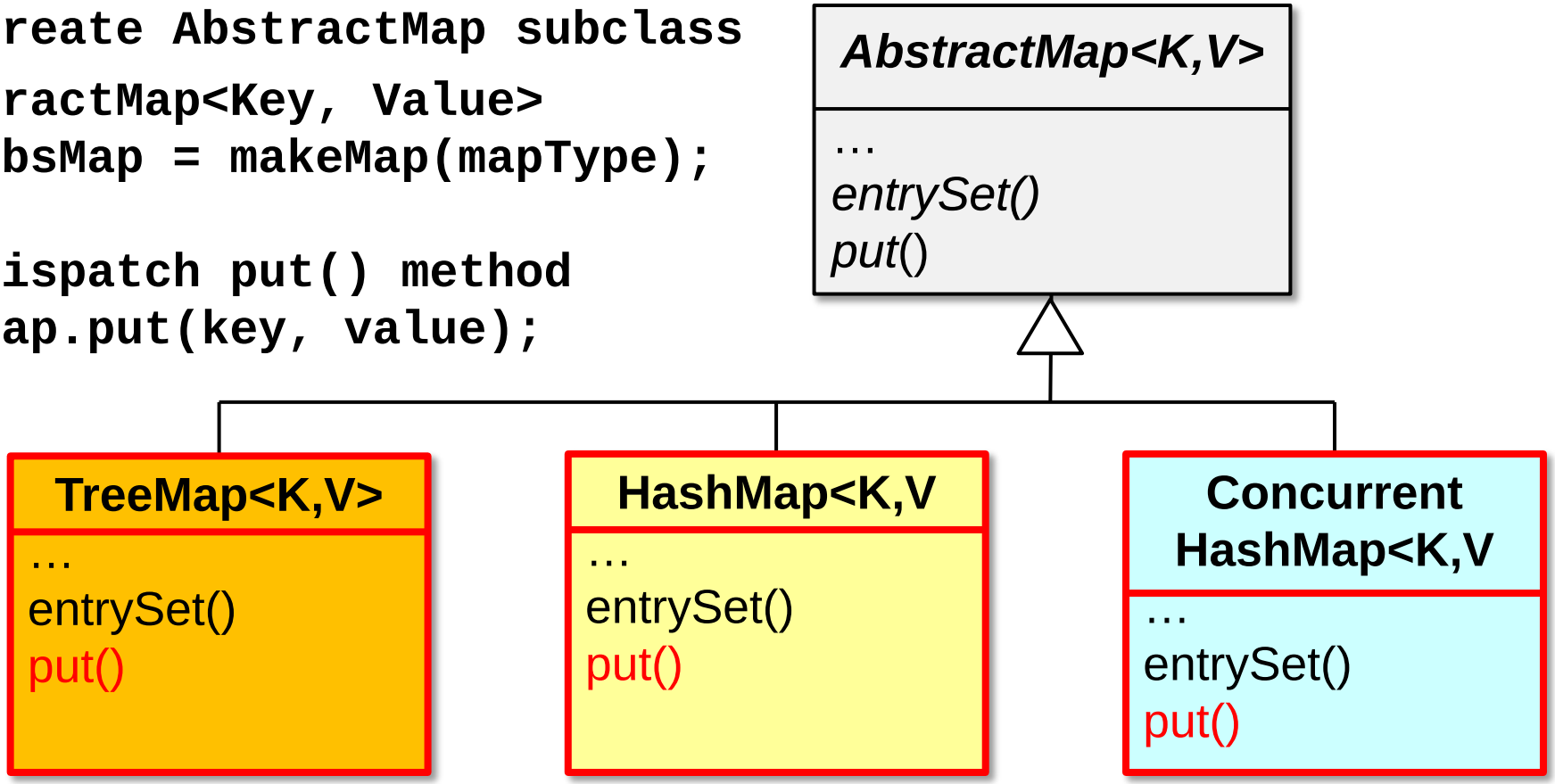

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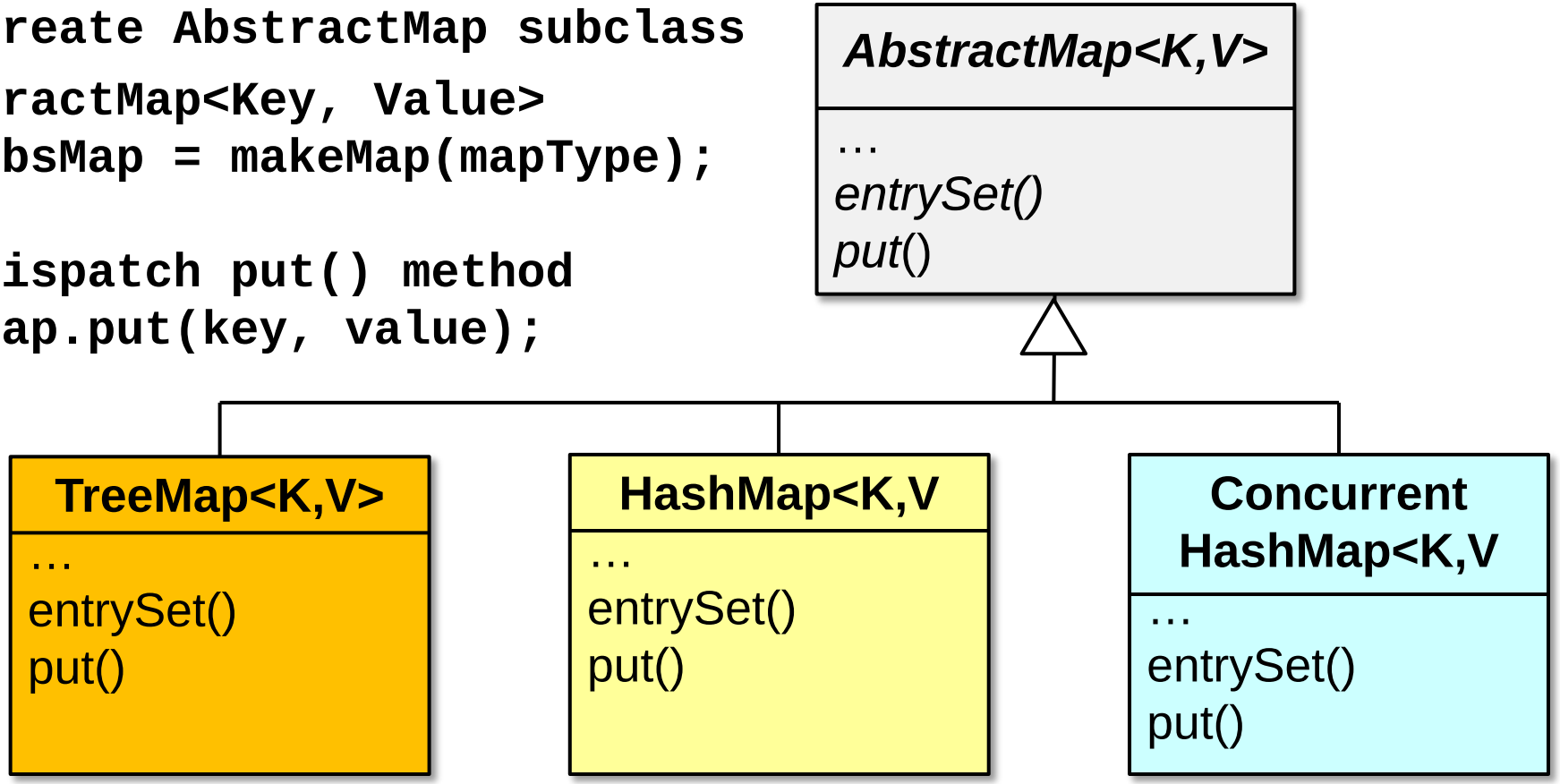

See en.wikipedia.org/wiki/Factory_method_pattern & en.wikipedia.org/wiki/Open/closed_principle

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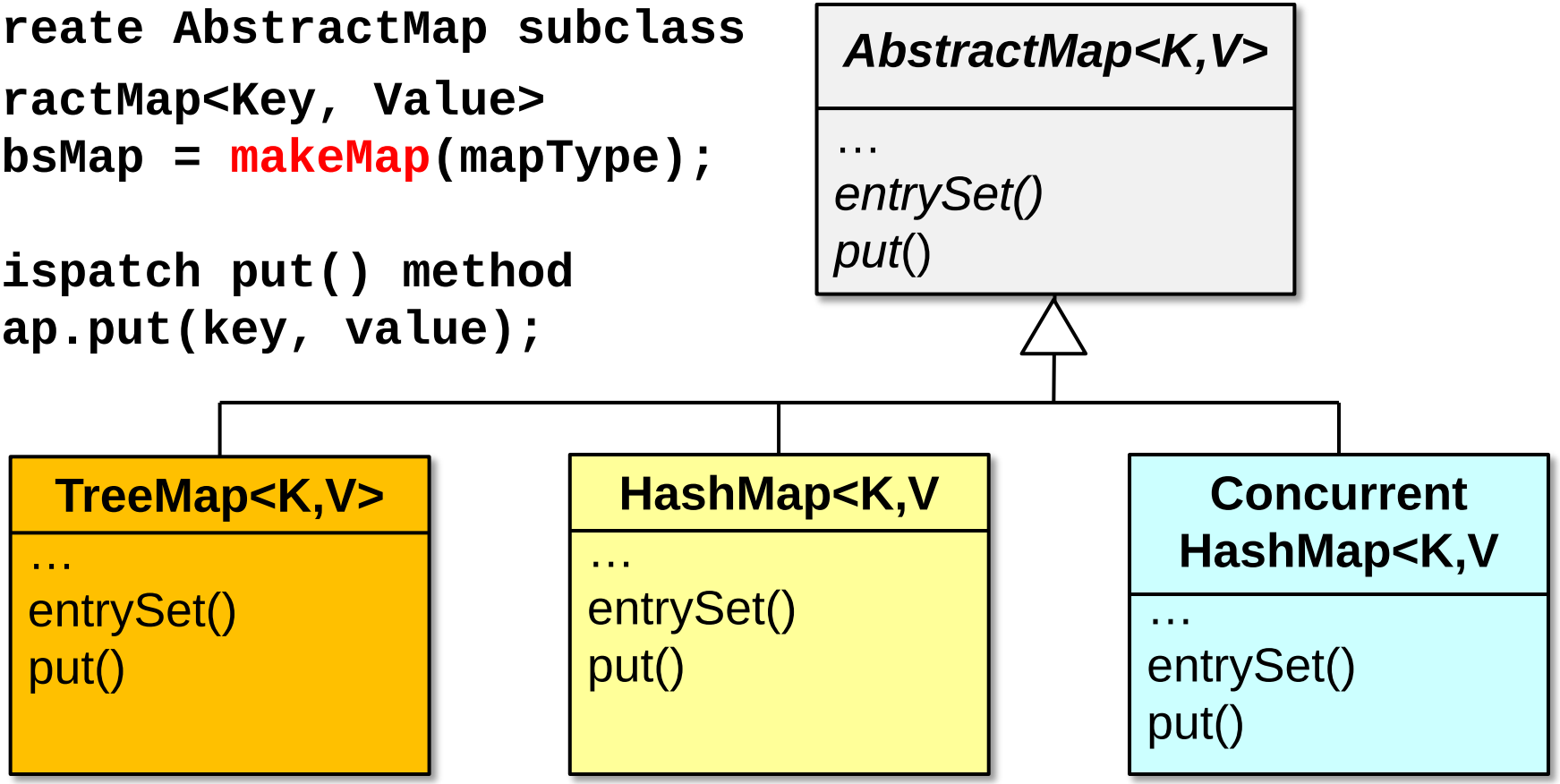

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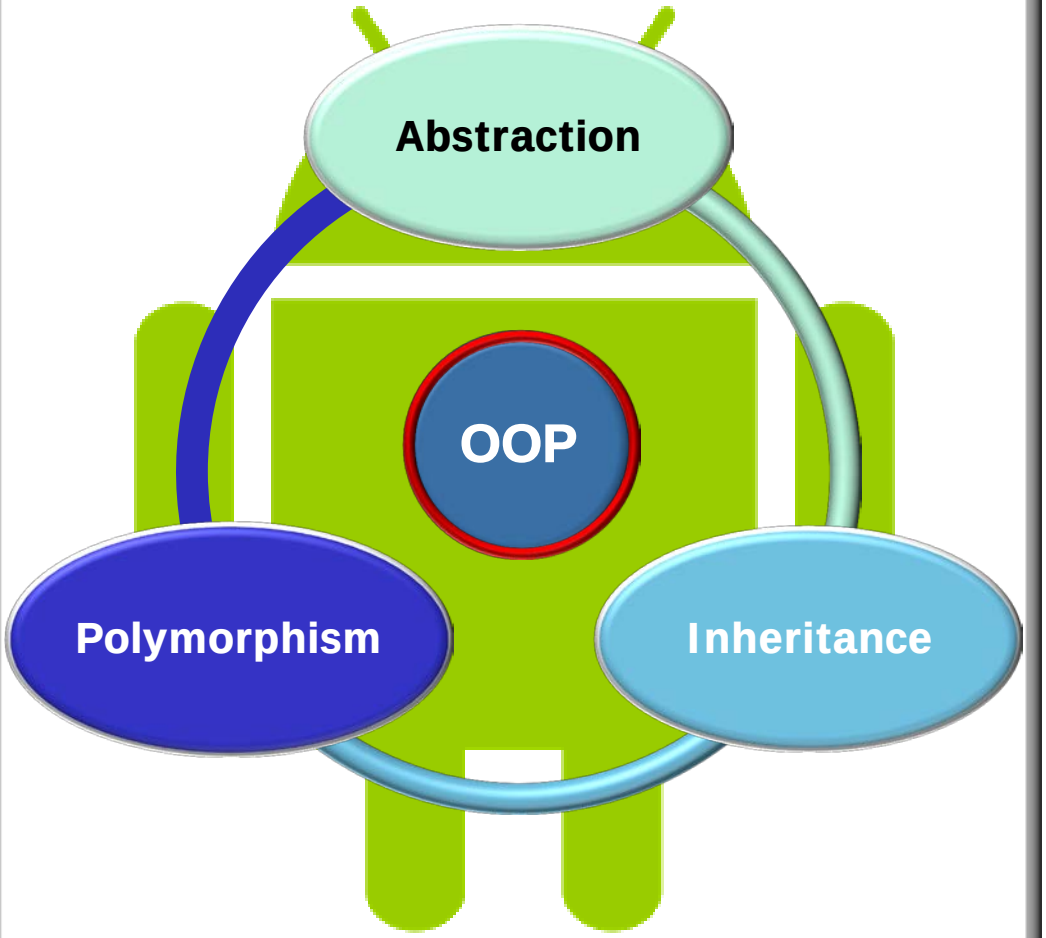

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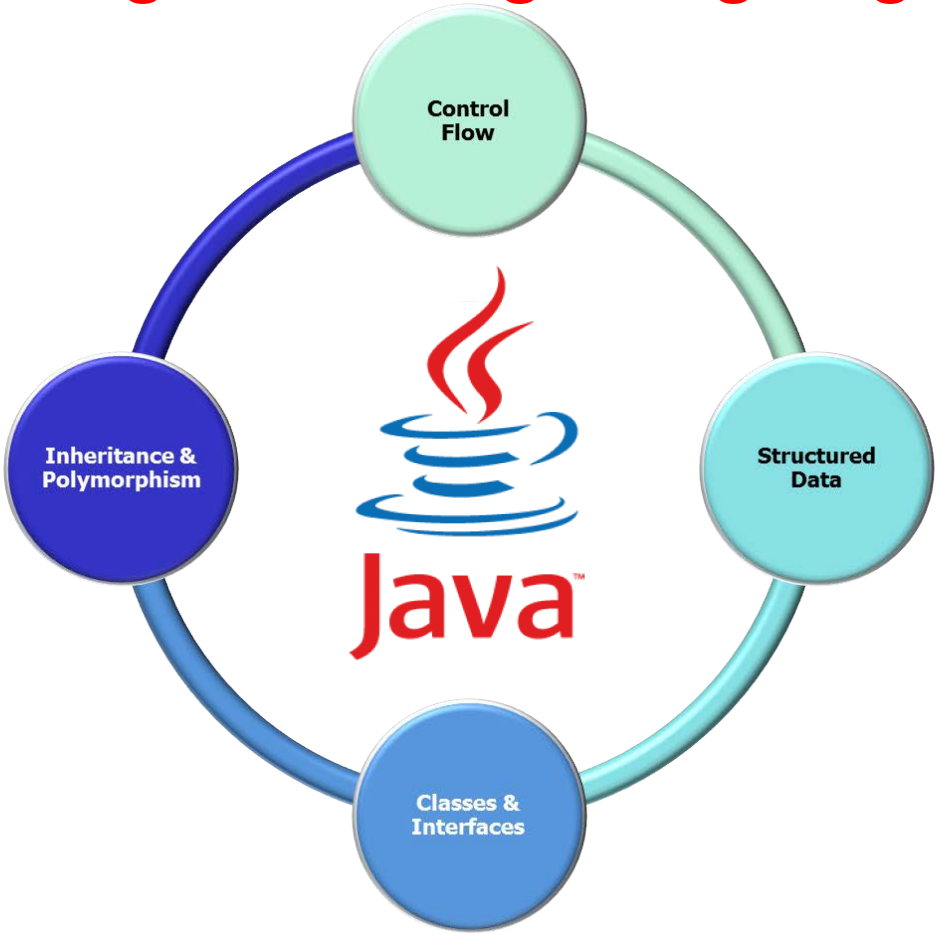

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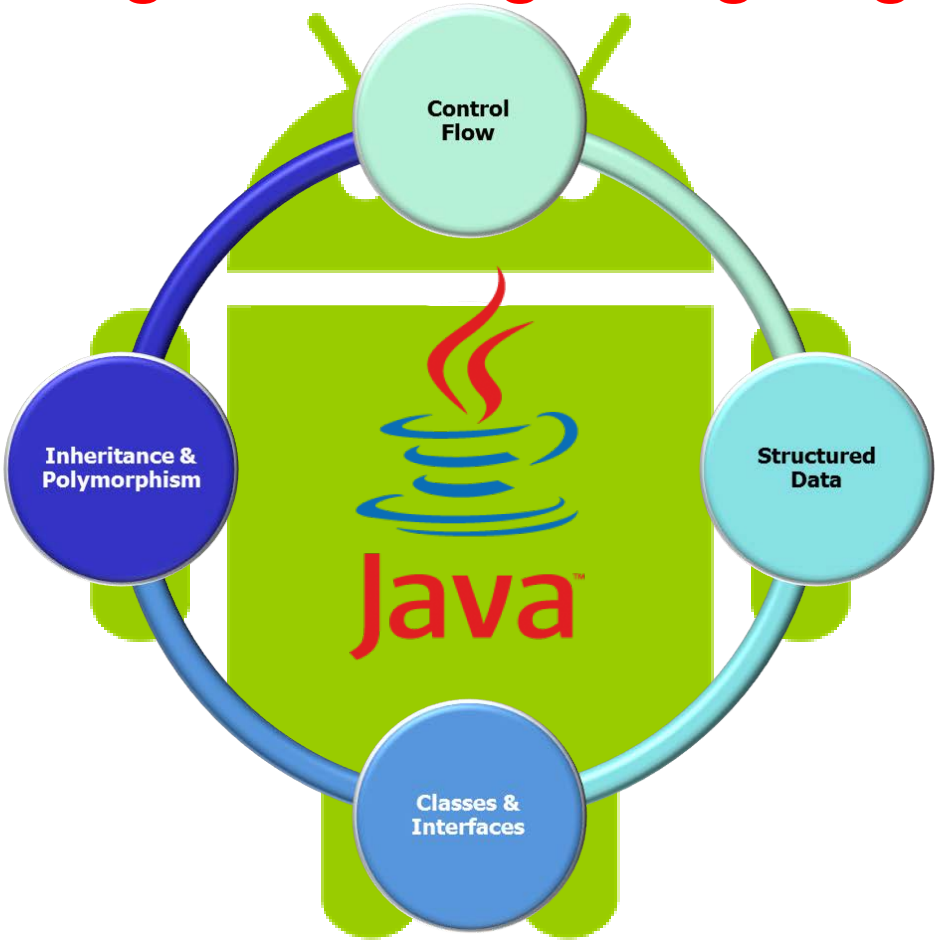

Overview of the Java Programming Language

Learning Objectives

- Understand the key object-oriented (OO) concepts supported by Java
- Know the benefits that OO concepts provide developers of Java apps in Android
- Identify Java features that implement these OO concepts

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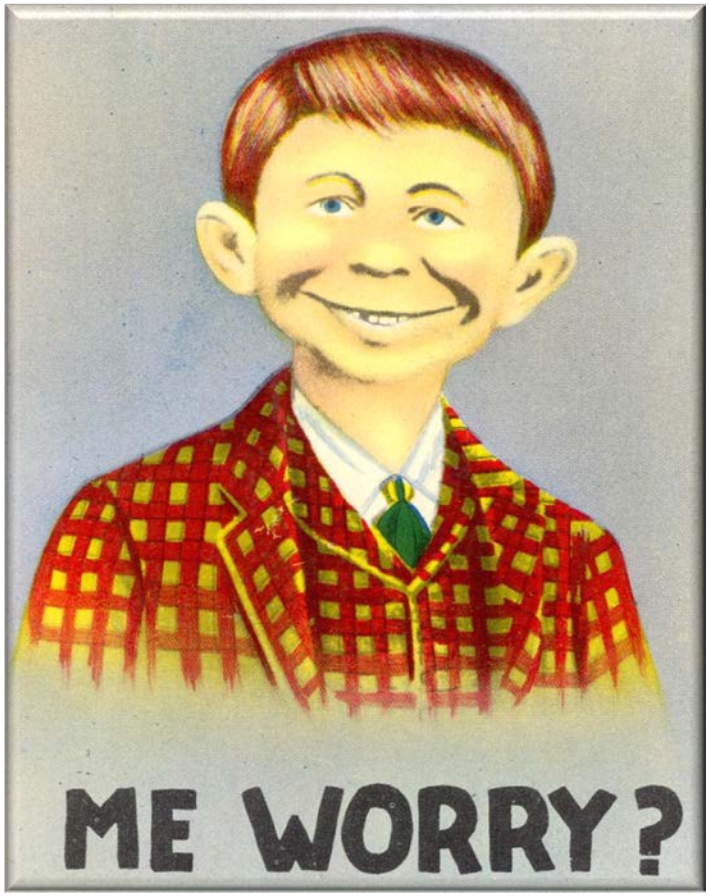

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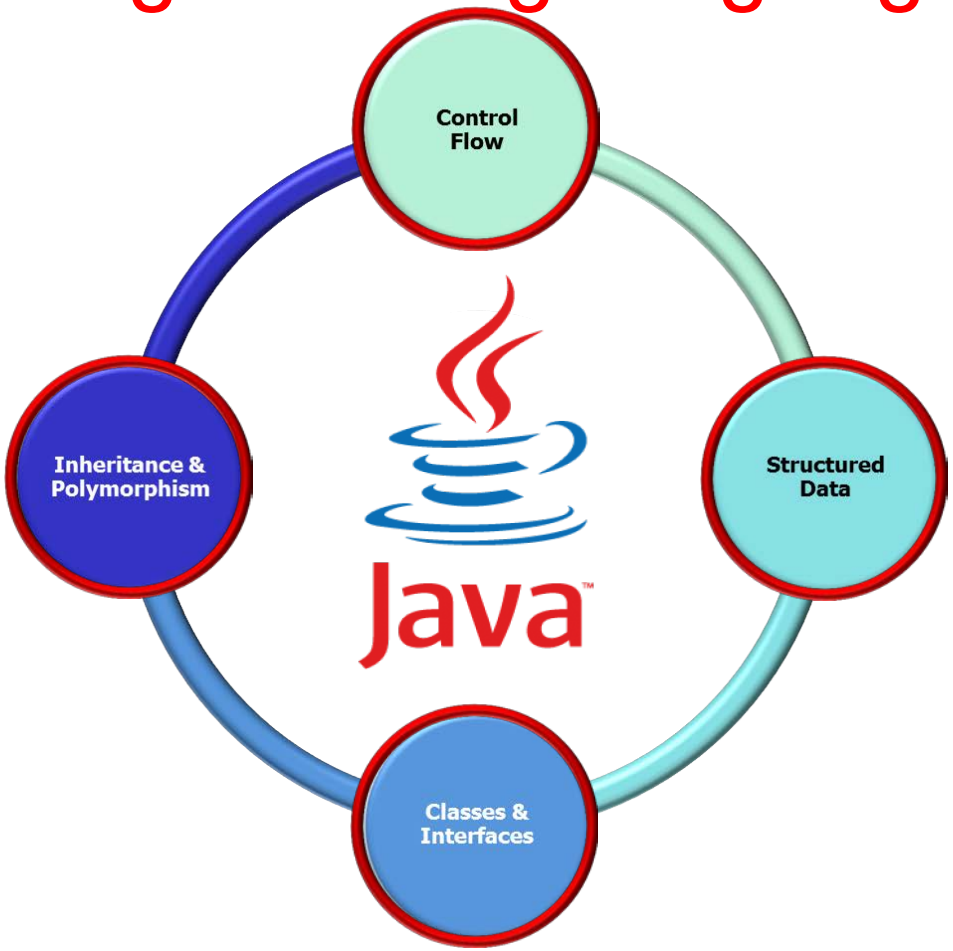
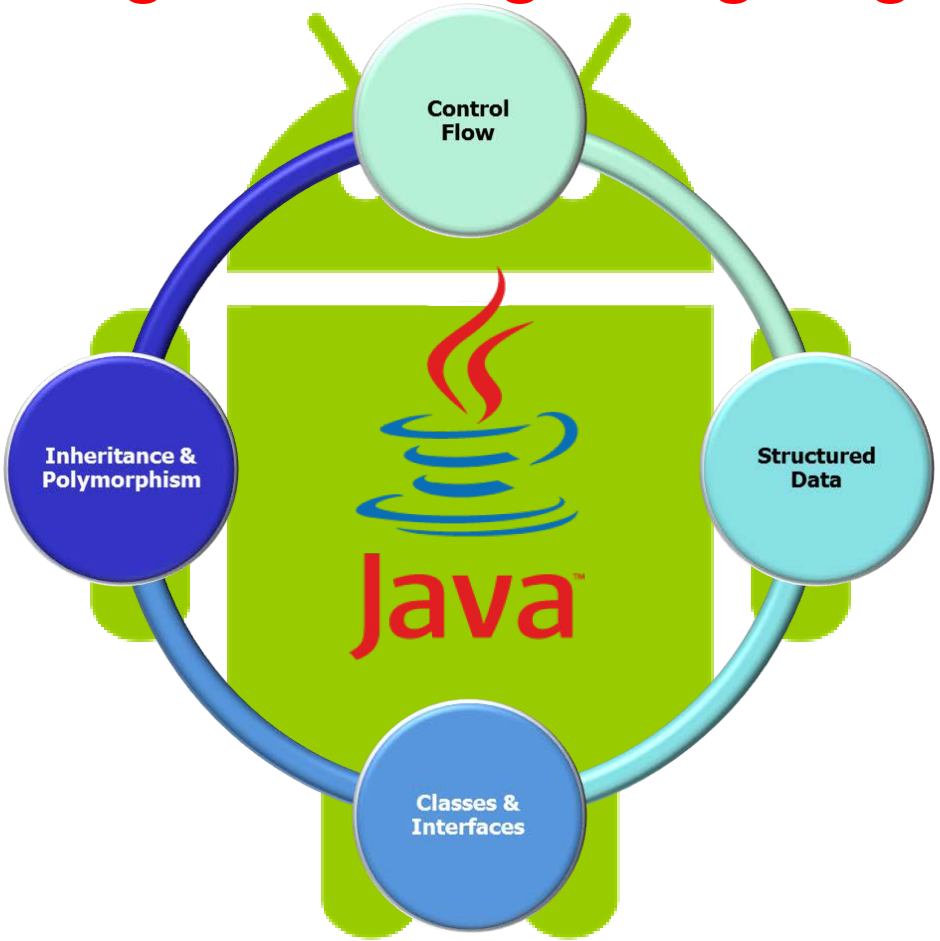


Other lessons examine Java in detail…

Overview of the Java Programming Language



...to learn to program Java for Android

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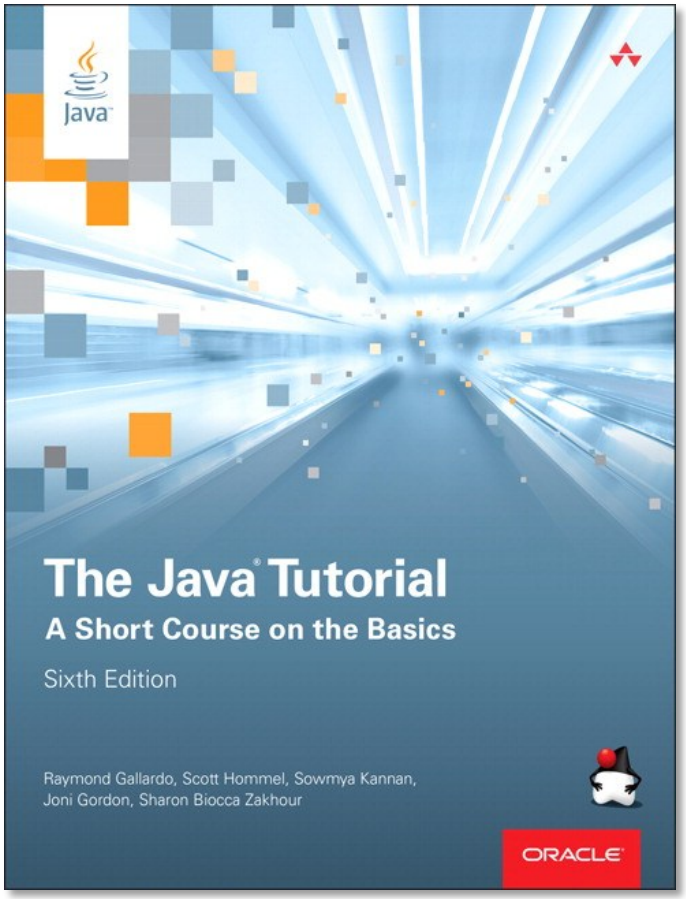

See download.oracle.com/javase/tutorial

Overview of the Java Programming Language

Package Index

These are the Android APIs. See all API classes.

java.util.concurrent	Utility classes commonly useful in concurrent programming.
java.util.concurrent.atomic	A small toolkit of classes that support lock-free thread-safe programming on single variables.
java.util.concurrent.locks	Interfaces and classes providing a framework for locking and waiting for conditions that is distinct from built-in synchronization and monitors.
java.util.jar	
java.util.logging	
java.util.prefs	
java.util.regex	
java.util.zip	
javax.crypto	This package provides the classes and interfaces for cryptographic applications implementing algorithms for encryption, decryption, or key agreement.
javax.crypto.interfaces	This package provides the interfaces needed to implement the Diffie-Hellman (DH) key agreement's algorithm as specified by PKCS#3.
javax.crypto.spec	This package provides the classes and interfaces needed to specify keys and parameter for encryption.
javax.microedition.khronos.egl	
javax.microedition.khronos.opengles	Provides a standard OpenGL interface.

See developer.android.com/reference/packages.html

Overview of the Java Programming Language