
SHARCNET™

Programming Best Practices

Tips For Defensive Programming

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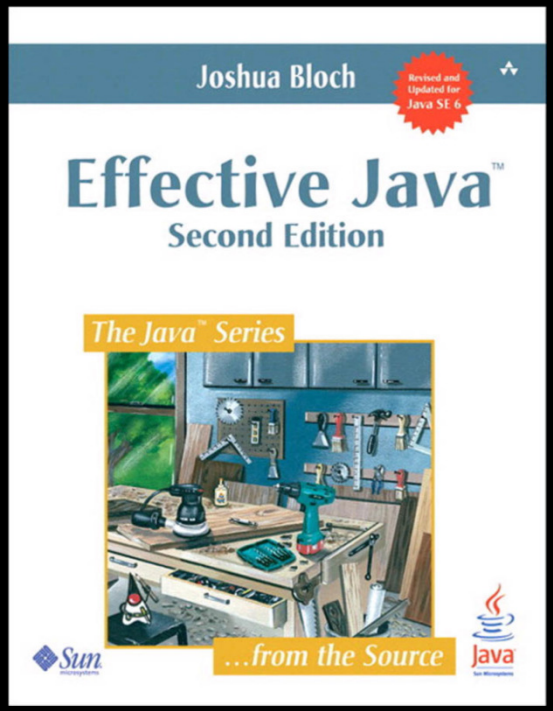
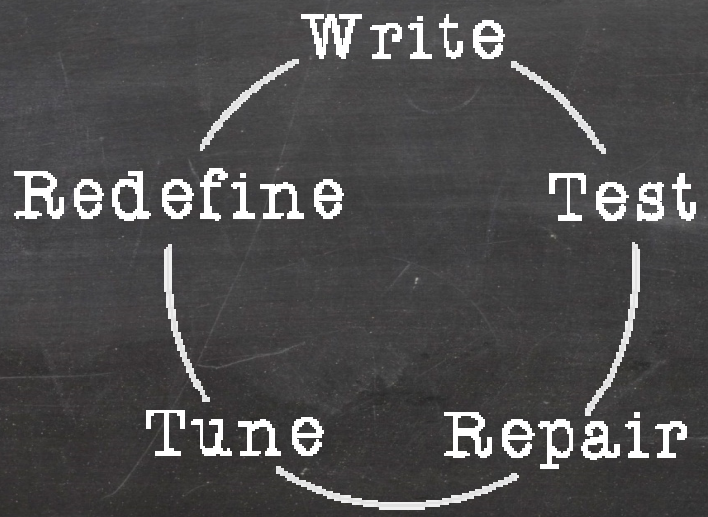
"Effective Java, Second Edition" by Joshua Block.

Chapters and page references are indicated on the slides on which they occur.



Your Own Worst Enemy



Background

- Correctness, clarity, & conciseness of code.
- Abstraction, encapsulation, & information hiding.
- Cohesion & coupling.
- OOP : Object Oriented Programming

OOP Language Support

Abstraction – Interfaces

Inheritance – Method “extension”

Encapsulation – Access level (private, protected, public)

Modularity – Classes

Part 1 : Style

- avoid long code blocks
- use naming conventions
- prefer collections over arrays
- order class variables by scope
- wrap all variables
- declare variables when needed

```
public void process (int i){
 /* long detailed commend on what
   * this it statement is doing */
 if (i == 0){
   blah...
   blah...
   blah...
  }
 /* long detailed commend on what
   * this it statement is doing */
  else if (i == 1){
   blah...
   blah...
   blah...
  }
 /* long detailed commend on what
   * this it statement is doing */
  else if (i == 2){
   blah...
   blah...
   blah...
  }
  ... more else if statements ad nauseam
```

```
public void process (int i){
  if (i == 0) this.addAll();
  else if (i == 1) this.addSome();
  else if (i == 2) this.addNone();
  else this.addRandom();
}

public void addAdd() ...
public void addSome() ...
public void addNone() ...
public void addRandom() ...
```

```
package fruit;

import java.awt.Shape;

public class Fruit implements IFood{
   static final int DISPLAY_RESOLUTION = 640;
   private Flavour flavour;
   private Colour colour;
   private Shape shape;

   public Fruit(){ ... }
   public void ripen(){ ... }
   public void addToBasket(Basket basket){ ... }
}
```

```
package fruit;

import java.awt.Shape;

public class Fruit implements IFood{
   static final int DISPLAY_RESOLUTION = 640;
   private Flavour flavour;
   private Colour colour;
   private Shape shape;

   public Fruit(){ ... }
   public void ripen(){ ... }
   public void addToBasket(Basket basket){ ... }
}
```

Package

Package Tree

Class/Interface

"Global"

Variable

Method

Multi-word Names

```
public class Apple extends Fruit{
   /* private variables */
   private Colour colour;
   private int size;

   /* package private */
   Type type;
   Flavour flavour;

   /* protected */
   Boolean seeded;

   /* public */
   public final int universalIdentifier;
}
```

```
package fruit;

import java.awt.Shape;

public class Fruit implements IFood{
   static final int DISPLAY_RESOLUTION = 640;
   private Flavour flavour;
   private Colour colour;
   private final Shape shape;

   public Flavour getFlavour() { ... }
   public void setFlavour(Flavour flavour) { ... }

   public Flavour getColour() { ... }
   public void setColour() { ... }

   public Shape getShape() {...}
}
```

note: final variable

```
int i, j, k;

for (i = 0; i < 10; i++){
}

for (k = 0; k < 10; k++){
}

for (j = 0; j < 10; j++){
}
```

```
for (int i = 0; i < 10; i++){
}

for (int i = 0; i < 10; i++){
}

for (int i = 0; i < 10; i++){
}
```

```
Iterator <Fruit> i = collection.iterator();

while (i.hasNext()){
 Fruit f = i.next();
 f.eat();
}
```

```
for (Fruit f : collection){
 f.eat();
}
```

```
// Can you spot the bug?

enum Suit { CLUB, DIAMOND, HEART, SPADE }
enum Rank { ACE, DEUCE, THREE, FOUR, FIVE, SIX, SEVEN, EIGHT,
NINE, TEN, JACK, QUEEN, KING }
...
Collection<Suit> suits = Arrays.asList(Suit.values());
Collection<Rank> ranks = Arrays.asList(Rank.values());

List<Card> deck = new ArrayList<Card>();

for (Iterator<Suit> i = suits.iterator(); i.hasNext(); )
        for (Iterator<Rank> j = ranks.iterator(); j.hasNext();
                deck.add(new Card(i.next(), j.next()));
```

Code snippet from “Essential Java 2nd Edition”

```
// Can you spot the bug?

enum Suit { CLUB, DIAMOND, HEART, SPADE }
enum Rank { ACE, DEUCE, THREE, FOUR, FIVE, SIX, SEVEN, EIGHT,
NINE, TEN, JACK, QUEEN, KING }
...
Collection<Suit> suits = Arrays.asList(Suit.values());
Collection<Rank> ranks = Arrays.asList(Rank.values());

List<Card> deck = new ArrayList<Card>();

for (Iterator<Suit> i = suits.iterator(); i.hasNext(); )
        for (Iterator<Rank> j = ranks.iterator(); j.hasNext();
                deck.add(new Card(i.next(), j.next()));
```

Code snippet from “Essential Java 2nd Edition”

```
enum Suit { CLUB, DIAMOND, HEART, SPADE }
enum Rank { ACE, DEUCE, THREE, FOUR, FIVE, SIX, SEVEN, EIGHT,
NINE, TEN, JACK, QUEEN, KING }
...
Collection<Suit> suits = Arrays.asList(Suit.values());
Collection<Rank> ranks = Arrays.asList(Rank.values());

for (Suit suit : suits){
   for (Rand rank : ranks){
      deck.add(new Card(suit, rank));
   }
}
```

Code snippet from “Essential Java 2nd Edition”

Part 2 : Patterns & Practices

- exceptional circumstances
- null values
- over-riding equals
- interfaces

Exceptional Circumstances

Assert : Things that should never occur; to protect against programming errors (private methods).

RtuntimeException : To ensure that a class is used correctly (public methods).

Exception : (!RuntimeException) Things out of the programmer's control, that the end user wants to know about.

Assert

java -jar -enableassertions Examples.jar

```
public class AssertExample {
   static public void printString(String string){
      assert string != null;
      System.out.println(string);
   }
}
```

Exception

```
public class AssertExample  throws Exception {
   static public void printString(String string){
      if (string == null) throw new Exception();
      System.out.println(string);
   }
}
```

Runtime exception

```
public class AssertExample {
   static public void printString(String string){
      if (string == null) throw new RuntimeException();
      System.out.println(string);
   }
}
```

Avoid External NULLs

I call it my billion-dollar mistake ...the invention of the null reference in 1965. At that time, I was designing [ALGOL] ... I couldn't resist the temptation to put in a null reference, simply because it was so easy to implement. This has led to innumerable errors, vulnerabilities, and system crashes, which have probably caused a billion dollars of pain and damage in the last forty years.

- Richard Hoare, the inventor of the NULL reference.

Guidelines to using NULL

Only use null privately in a class.
Don't return NULLs.
Throw an exception when null is passed in.
Return empty collections.
Return NULL representative objects.

Return Empty Collections

in class

```
public Fruit[] getFruit(){
  if (collection.size() == 0) return null;
  …
}
```

in class

```
public Fruit[] getFruit(){
  if (collection.size() == 0) new Fruit[0];
  …
}
```

Return Empty Collections

in class
```
public Fruit[] getFruit(){
  if (collection.size() == 0) return null;
  …
}
```

in main
```
Fruit f = getFruit();
if (f != null){
   for (Fruit f : getFruit()) {
      [do something]
   }
}
```

in class
```
public Fruit[] getFruit(){
  if (collection.size() == 0) new Fruit[0];
  …
}
```

in main
```
for (Fruit f : getFruit()) {
   [do something]
}
```

Single Instance

```
class Basket{
   private ArrayList <Fruit> fruits;
   public Fruit getFruit(){
      if (fruits.size() == 0) return null;
      else return fruits.remove(0);
   }
}
```

Single Instance Fixed

```
class Basket{
   private ArrayList <Fruit> fruits;

   public boolean hasFruit(){
      return fruits.size() > 0;
   }

   public Fruit getFruit(){
      if (fruits.size() == 0) throw new NullPointerException();
      else return fruits.remove(0);
   }
}
```

NULL misrepresenting errors

```
Fruit aPieceOfFruit = fruitBasket.getFruit();

[do some stuff]

aPieceOfFruit.eat(); /* throws NullPointerException */
```

NULL misrepresenting errors

```
Fruit fruit = basket.getFruit(); /* throws NullPointerException */

[do some stuff]

aPieceOfFruit.eat();
```

Overriding Equals

Reflexive if a=a
Symmetric if a=b then b=a
Transitive if x=y and y=z then x=z
Consistent if x=y now, x=y always
Non-Empty Object x != NULL

Immutable Objects

"Classes should be immutable unless there's a very good reason to make them mutable....If a class cannot be made immutable, limit its mutability as much as possible."

– Joshua Block, Effective Java

- Simple to use and implement.
- Doesn't need a copy, or synchronization.
- Make good keys.
- Never indeterminate.

- Make the class final.
- Make all fields final & private.
- Provide no accessor methods.
- Set all values in constructor (or factory).

Interfaces

```
interface IFood {
    Flavour getFlavour();
    Size getSize();
    void setPortions(int i);
    int getPortions();

    default void bite(){
        this.setPortions(this.getPortions() - 1);
    }

}
```

Interfaces

```
interface IFood {
    Flavour getFlavour();
    Size getSize();
    void setPortions(int i);
    int getPortions();

    default void bite(){
        this.setPortions(this.getPortions() - 1);
    }
}
```

default = public

default

Code to the interface

```
Class Bucket{
  private ArrayList myList= new
ArrayList();
}
```

```
Class Bucket{
  private List myList = new ArrayList();
}
```

--- REFACTOR ---

```
Class Bucket{
  private List myList = new TreeList();
}
```

Immutable Interface

```
public interface ImmutableFruit {
   Flavour getFlavour();
   Colour getColour();
   Shape getShape();
}
```

```
public class Fruit
implements ImmutableFruit{

   private Flavour flavour;
   private Colour colour;
   private final Shape shape;

   public Flavour getFlavour() {...}
   public Colour getColour() {...}
   public Shape getShape() {...}

   public Fruit(){ ... }

   public void ripen(){ ... }
}
```

Citations

Collected Java Practices, [online], http://www.javapractices.com (accessed 2015)

Bloch, J. "Effective Java, 2nd edn. The Java Series." (2008).