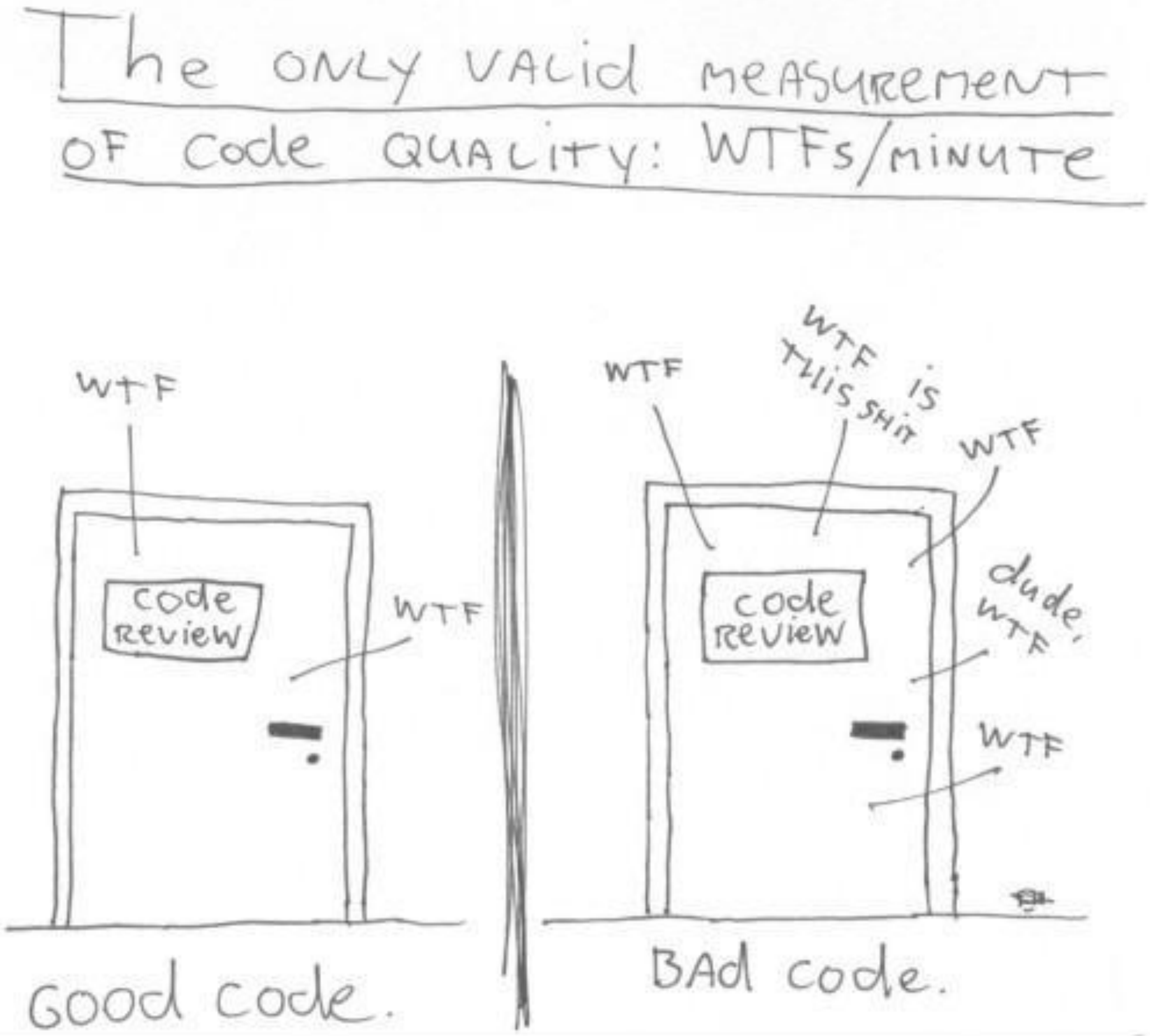
FACULTAD DE INGENIERIA
Universidad de Buenos Aires

Refactoring

FI.UBA

75.10 - Técnicas de Diseño


The only valid measurement of code quality: WTFs/minute
WTF
code review
WTF
Good code.
WTF
WTF is this shit
WTF
code review
dude, WTF
WTF
Bad code.

What is Refactoring?

A **technique** for **restructuring** an existing body of **code**, **altering** its **internal structure** **without changing** its **external behavior**

How to achieve it?

- Unit tests to guarantee the external behavior has not been changed

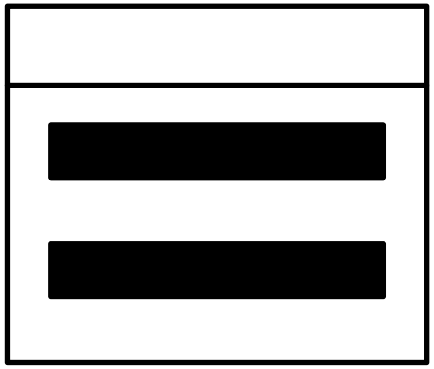
- Applying the proposed refactorings

Refactoring Flow

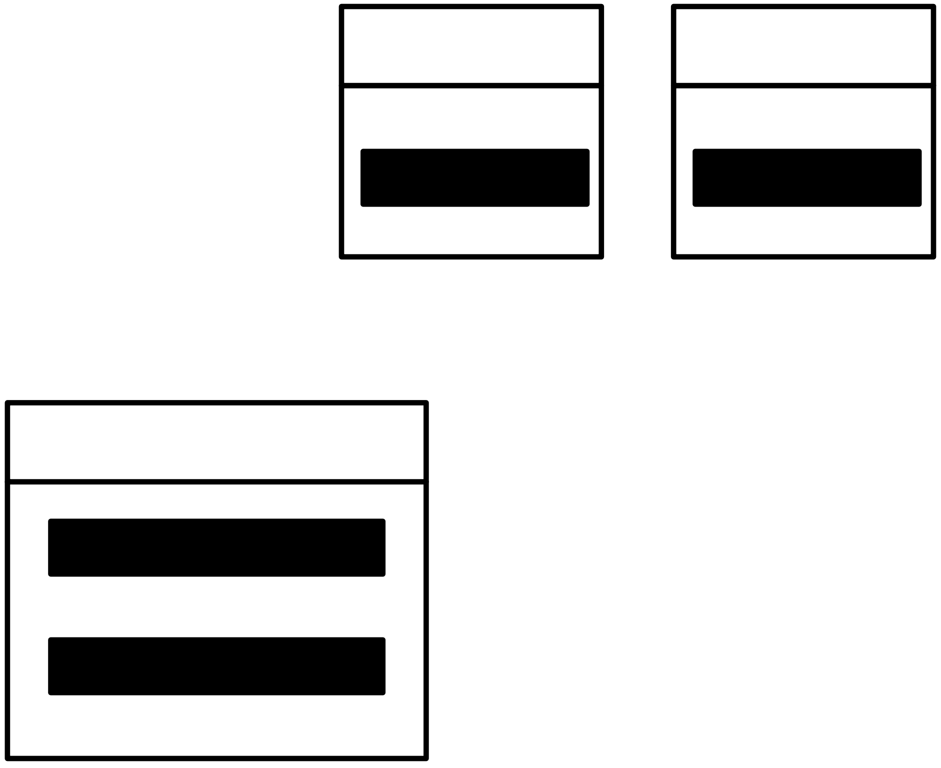
- Ensure all tests pass
- Find code that smells
- Find refactoring
- Apply refactoring

Code Smells

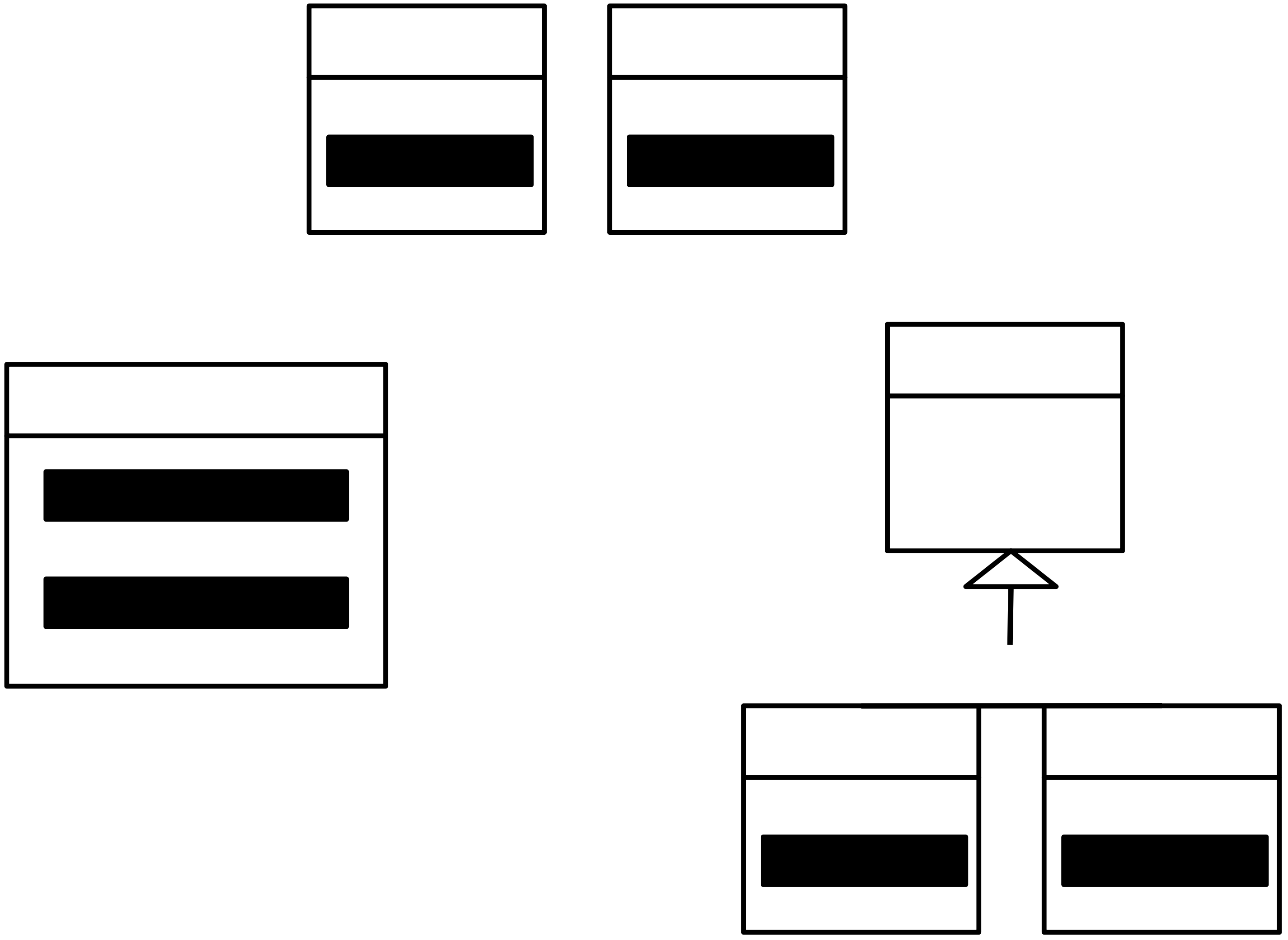
Duplicated Code



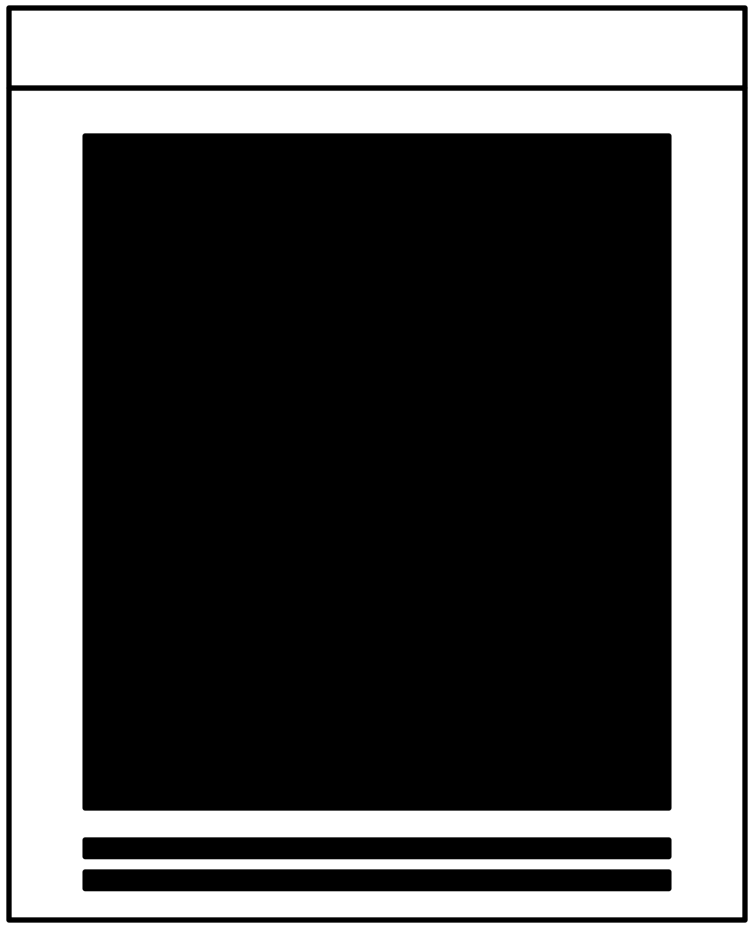
Duplicated Code



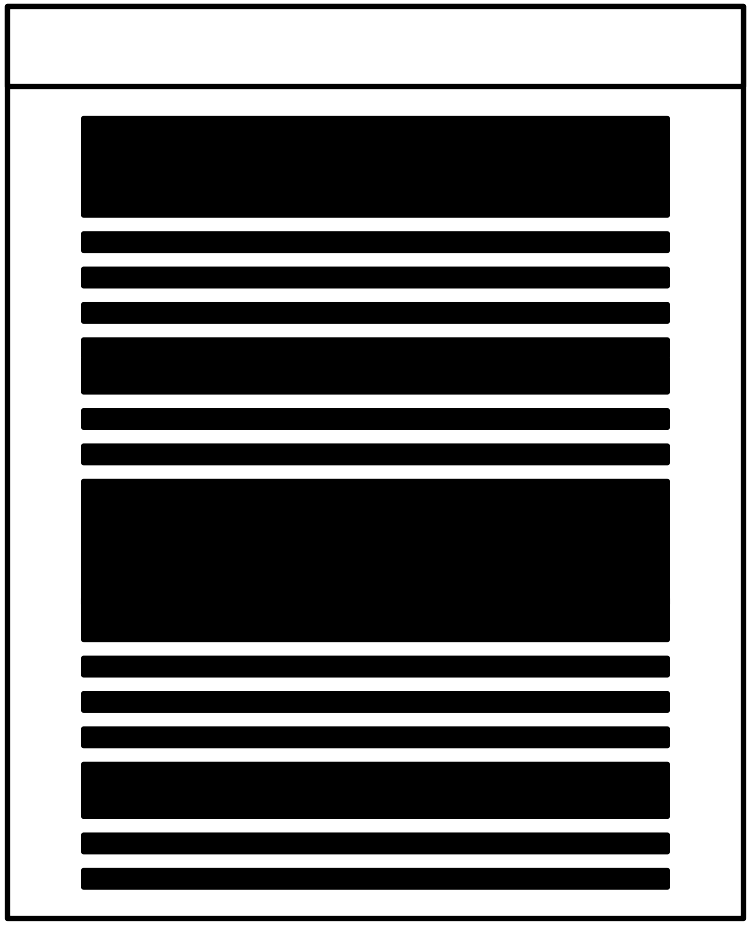
Duplicated Code



Long Method



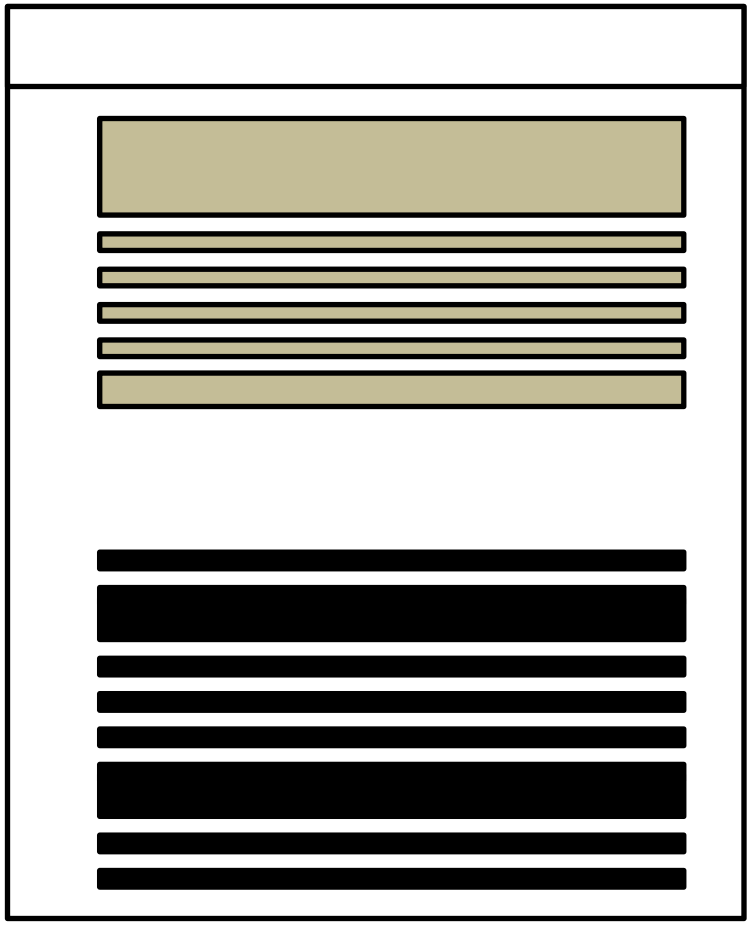
Large Class



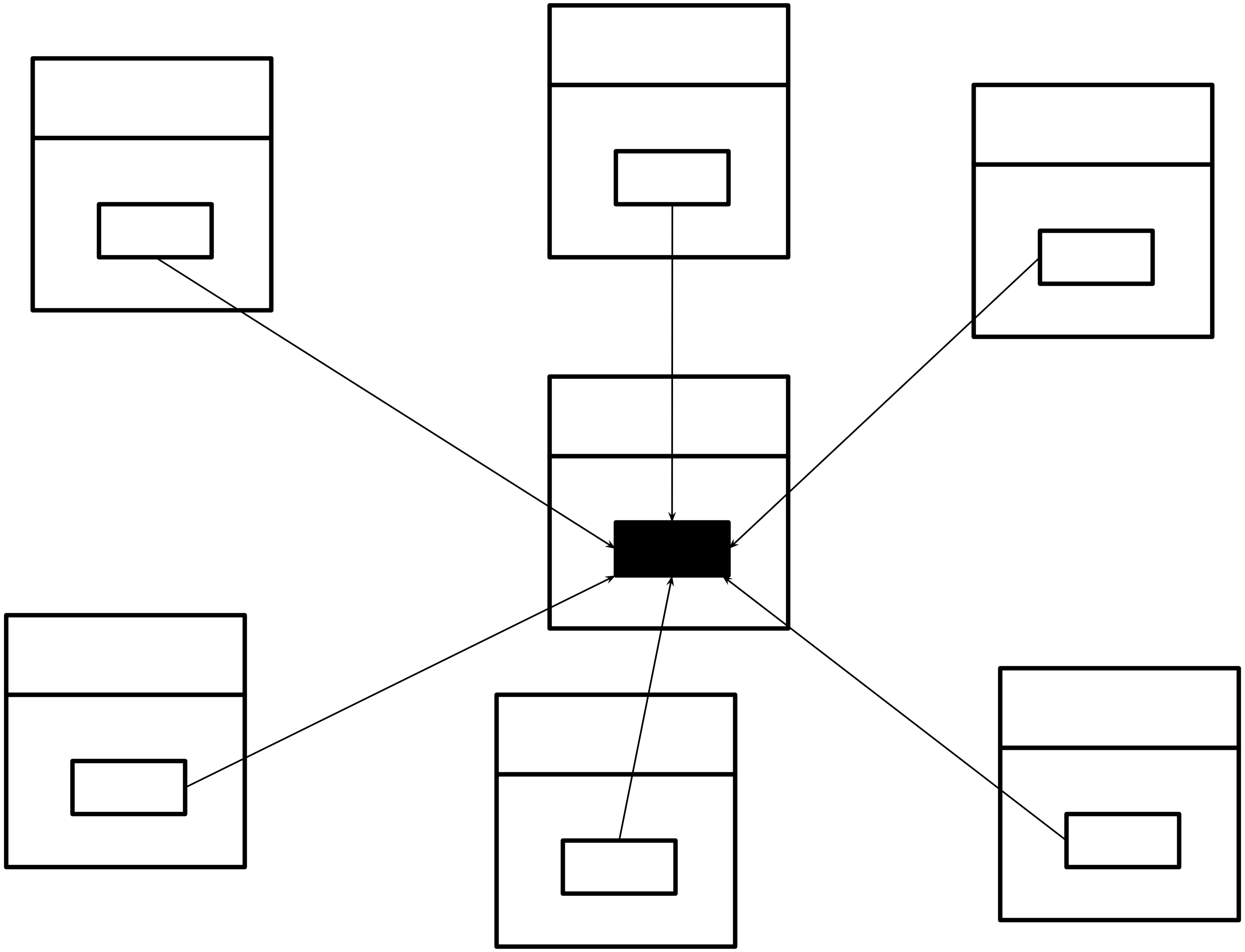
Long parameter list

xxxxxxx(■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■)

Divergent Change



Shotgun Surgery



feature envy

```
class CapitalCalculator {
 ...

 public double capital(Loan loan) {
  if (loan.getExpiry() == null && loan.getMaturity() != null)
   return loan.getCommitment()*loan.duration()*loan.riskFactor();

  if (loan.getExpiry() != null && loan.getMaturity() == null) {
    if (loan.getUnusedPercentage() != 1.0)
       return loan.getCommitment() * loan.getUnusedPercentage() *
                loan.duration() * loan.riskFactor();
    else
       return (loan.outstandingRiskAmount()*loan.duration()
                  * loan.riskFactor())
      + (loan.unusedRiskAmount() * loan.duration()
                  * loan.unusedRiskFactor());
   }

   return 0.0;
 }
 ...
}
```

```
class CapitalCalculator {
 ...

 public double capital(Loan loan) {
  if (loan.getExpiry() == null && loan.getMaturity() != null)
   return loan.getCommitment()*loan.duration()*loan.riskFactor();

  if (loan.getExpiry() != null && loan.getMaturity() == null) {
    if (loan.getUnusedPercentage() != 1.0)
       return loan.getCommitment() * loan.getUnusedPercentage() *
                 loan.duration() * loan.riskFactor();
    else
       return (loan.outstandingRiskAmount()*loan.duration()
                  * loan.riskFactor())
      + (loan.unusedRiskAmount() * loan.duration()
                  * loan.unusedRiskFactor());
   }

   return 0.0;
 }
 ...
}
```

Data Clumps

method1(■ ▲ ◆ ⬬)

method2(■ ▲ ◆ ⬬)

method3(■ ▲ ◆ ⬬)

method4(■ ▲ ◆ ⬬)

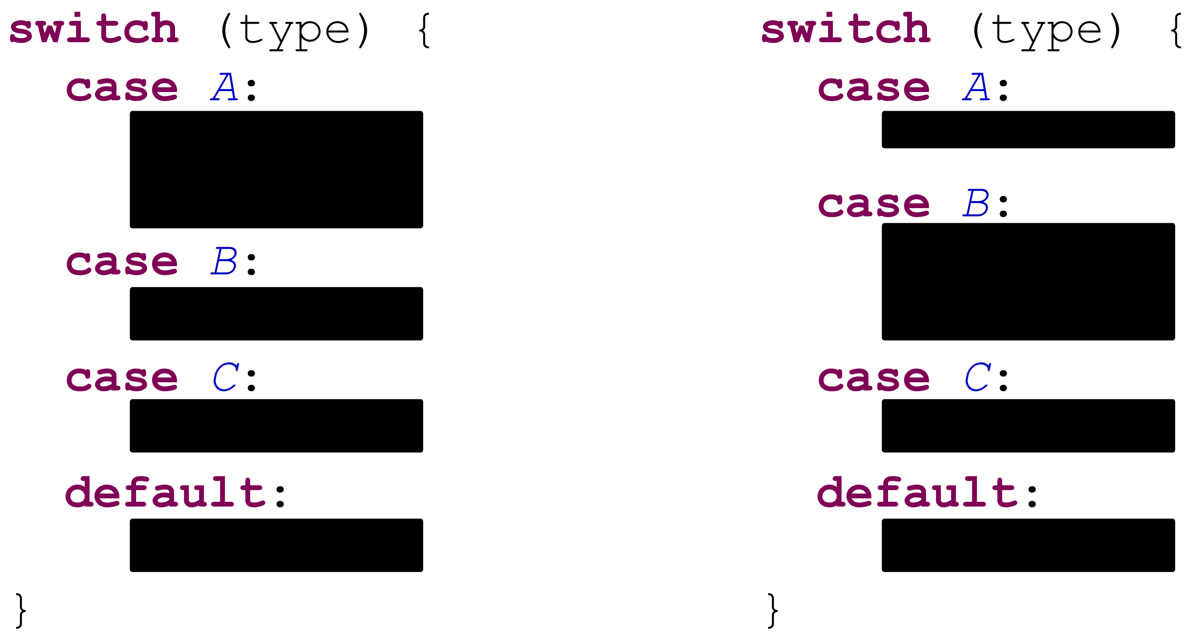
Primitive Obsession

```
double money;
String phone;
String zipCode;
String password;
```

Switch Statements

```
switch (type) {
  case A:
    [redacted]
  case B:
    [redacted]
  case C:
    [redacted]
  default:
    [redacted]
}
```

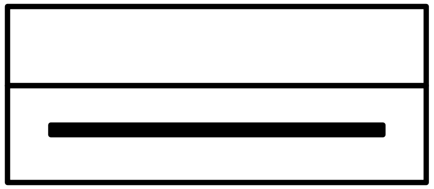
Switch Statements



```
switch (type) {
  case A:

  case B:

  case C:

  default:

}
```

```
switch (type) {
  case A:

  case B:

  case C:

  default:

}
```

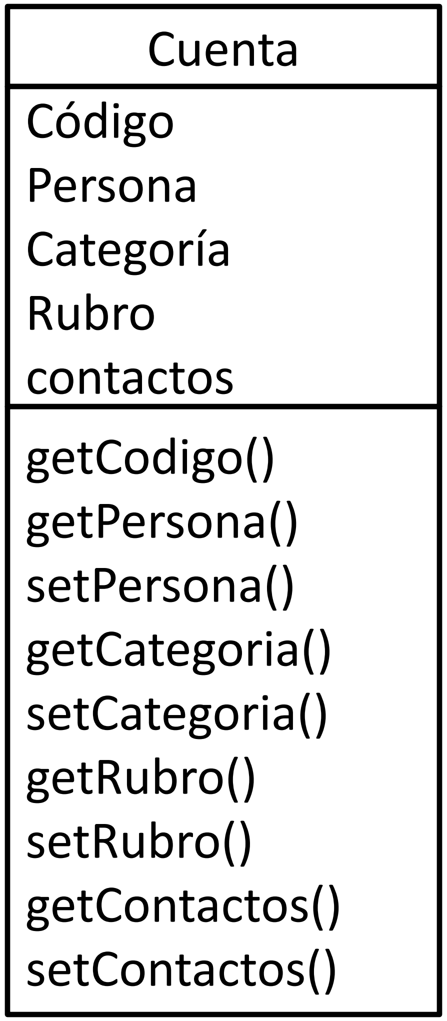
Lazy Class



Message Chains

```
■.■().■().■().■()
```

Data Class


Cuenta
Código
Persona
Categoría
Rubro
contactos
getCodigo()
getPersona()
setPersona()
getCategoria()
setCategoria()
getRubro()
setRubro()
getContactos()
setContactos()

Refactorings

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```
if ((platform.toUpperCase().indexOf("MAC") > -1)
   && (platform.toUpperCase().indexOf("IE") > -1)
   && wasInitialized()
   && resize > 0) {

  someCode();

}

otherCode();
```

Introduce Explaining Method

```
if (isMacOs()
    && isIEBrowser()
    && wasInitialized()
    && wasResized()) {

      someCode();
}

otherCode();
```

```
if (isMacOs()
    && isIEBrowser()
    && wasInitialized()
    && wasResized()) {

      someCode();
}

otherCode();


if (isPlatformSupported()
    && wasInitialized()
    && wasResized()) {

    someCode();
}

otherCode();
```

```java
boolean wasResized() {
   return resize > 0;
}

boolean isIEBrowser() {
   return platform.toUpperCase().indexOf("IE") > -1;
}

boolean isMacOs() {
   return platform.toUpperCase().indexOf("MAC") > -1;
}

boolean isPlatformSupported() {
   return isMacOs() && isIEBrowser();
}
```

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```java
double getDistanceTravelled (int time) {
    double result;

    double acc = primaryForce / mass;
    int primaryTime = Math.min(time, delay);
    result = 0.5 * acc * primaryTime * primaryTime;
    int secondaryTime = time - delay;

    if (secondaryTime > 0) {
        double primaryVel = acc * delay;
        acc = (primaryForce + secondaryForce) / mass;
        result += primaryVel * secondaryTime + 0.5 * acc *
secondaryTime * secondaryTime;
    }

    return result;
}
```

```
double getDistanceTravelled (int time) {
    double result;
    double acc = primaryForce / mass;
    int primaryTime = Math.min(time, delay);
    result = 0.5 * acc * primaryTime * primaryTime;
    int secondaryTime = time - delay;

    if (secondaryTime > 0) {
        double primaryVel = acc * delay;
        acc = (primaryForce + secondaryForce) / mass;
        result += primaryVel * secondaryTime + 0.5 * acc *
secondaryTime * secondaryTime;
    }

    return result;
}
```

Split Temporary Variable

```java
double getDistanceTravelled(int time) {
    double result;

    double primaryAcc = primaryForce / mass;
    int primaryTime = Math.min(time, delay);
    result = 0.5 * primaryAcc * primaryTime * primaryTime;
    int secondaryTime = time - delay;

    if (secondaryTime > 0) {
        double primaryVel = primaryAcc * delay;
        double secondaryAcc = (primaryForce + secondaryForce) / mass;
        result += primaryVel * secondaryTime + 0.5
         * secondaryAcc * secondaryTime * secondaryTime;
    }

    return result;
}
```

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```java
class Page {
      private String[] lines;

      private double widthNumber;
      private String widthUnits;

      private double heightNumber;
      private String heightUnits;

      /**
       * return the page area in inches.
       */
      public double area() {
         double widthInches;
         double heightInches;
         widthInches = widthNumber *
              ((widthUnits.equals("mm")) ? 25.4 : 1.0);
         heightInches = heightNumber *
              ((heightUnits.equals("mm")) ? 25.4 : 1.0);
         return widthInches * heightInches;
      }

      ...
   }
```

Extract Class

```
class Page {
      private String[] lines;

      private Length width;
      private Length height;

      public Length area() {
         return width.multipliedBy(height);
      }
}
```

```java
class Length {

      private final double magnitude;
      private final Unit unit;

      public Length(Unit unit, double magnitude) {
         this.unit = unit;
         this.magnitude = magnitude;
      }

      private static Length newInInches(double magnitudeInInches) {
         return new Length(Unit.inches, magnitudeInInches);
      }

      public Length multipliedBy(Length aLength) {
         return Length.newInInches(this.magnitudeInInches()
            + aLength.magnitudeInInches());
      }

      private double magnitudeInInches() {
         return magnitude;
      }

      private double magnitudeInMM() {
         return magnitude * Unit.mmFactor();
      }
}
```

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```
double chargeFor(Date date, int quantity) {
      double totalCharge = 0;
      if (date.after(WINTER_START) && date.before(WINTER_END)) {
         totalCharge = quantity * WINTER_RATE
             + WINTER_SERVICE_CHARGE;
      } else {
         totalCharge = quantity * NORMAL_RATE;
      }
      return totalCharge;
}
```

Decompose Conditional

```
double chargeFor(Date date, int quantity) {
      if (isAWinter(date)) {
         return winterCharge(quantity);
      }
      return normalCharge(quantity);
}
```

```
double chargeFor(Date date, int quantity) {
      return isAWinter(date) ?
      winterCharge(quantity) : normalCharge(quantity);
}
```

```java
private boolean isAWinter(Date date) {
    return date.after(WINTER_START) && date.before(WINTER_END);
}

private double normalCharge(int quantity) {
    return quantity * NORMAL_RATE;
}

private double winterCharge(int quantity) {
    return quantity * WINTER_RATE + WINTER_SERVICE_CHARGE;
}
```

```java
class YXZPaginator {
   ...

   public List<Element> nextFrom(int offset, int size) {
      if (((offset + size) > (cacheOffset + cacheSize))
        || (offset < cacheOffset)) {

         repopulateCache(offset, size);
      }

      return nextFromCache(offset, size);
    }

    ...
}
```

```java
public List<Element> nextFrom( int offset,  int size) {
  if (cacheNeedsRePopulation(offset, size)) {
     repopulateCache(offset, size);
  }

  return nextFromCache(offset, size);
}
```

```
public List<Element> nextFrom( int offset,  int size) {
  if (cacheNeedsRePopulation(offset, size)) {
     repopulateCache(offset, size);
  }

  return nextFromCache(offset, size);
}



boolean cacheNeedsRePopulation(int offset,  int size) {
  return requestIsUnderCacheWindow(offset, size)
            || requestIsOverCacheWindow(offset);
}
```

```java
public List<Element> nextFrom( int offset,  int size) {
  if (cacheNeedsRePopulation(offset, size)) {
     repopulateCache(offset, size);
  }

  return nextFromCache(offset, size);
}



boolean cacheNeedsRePopulation(int offset,  int size) {
  return requestIsUnderCacheWindow(offset, size)
            || requestIsOverCacheWindow(offset);
}

boolean requestIsOverCacheWindow(int offset) {
  return offset < cacheOffset;
}

boolean requestIsUnderCacheWindow(int offset,int size) {
  return (offset + size) > (cacheOffset + cacheSize);
}
```

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```
class TicTacToeGame {

    boolean isGameOver() {
            if (allPositionsAreFilled()) {
                return true;
            }
            if (oneRowIsFilledByOnePlayer()) {
                return true;
            }
            if (oneColumnIsFilledByOnePlayer()) {
                return true;
            }
            if (oneDiagonalIsFilledByOnePlayer()) {
                return true;
            }
            return false;
        }

}
```

Consolidate conditional expression

```
boolean isGameOver() {
    if (allPositionsAreFilled()
            || oneRowIsFilledByOnePlayer()
            || oneColumnIsFilledByOnePlayer()
            || oneDiagonalIsFilledByOnePlayer()) {
        return true;
    }
    return false;
}
```

```
boolean isGameOver() {
    if (allPositionsAreFilled()
            || oneRowIsFilledByOnePlayer()
            || oneColumnIsFilledByOnePlayer()
            || oneDiagonalIsFilledByOnePlayer()) {
        return true;
    }
    return false;
}
```

```
boolean isGameOver() {
    return allPositionsAreFilled()
            || oneRowIsFilledByOnePlayer()
            || oneColumnIsFilledByOnePlayer()
            || oneDiagonalIsFilledByOnePlayer();
}
```

```
public double getRate() {
        if (onVacation()) {
            if (lengthOfService() > 10) {
                return 1;
            }
        }
        return 0.5;
    }
```

```
public double getRate() {
    if (onVacation() && lengthOfService() > 10) {
        return 1;
    }
    return 0.5;
}

public double getRate() {
    return (onVacation() && lengthOfService() > 10) ? 1 : 0.5;
}
```

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```java
public double finalPrice(double price) {
      double total = 0;
      if (isSpecialDeal()) {
         total = price * 0.95;
         changed();
      } else {
         total = price;
         changed();
      }
      return total;
}
```

```
public double finalPrice(double price) {
      double total = 0;
      if (isSpecialDeal()) {
         total = price * 0.95;
         changed();
      } else {
         total = price;
         changed();
      }
      return total;
}
```

Consolidate duplicate conditional fragments

```java
public double finalPrice(double price) {
      double total = 0;
      if (isSpecialDeal()) {
         total = price * 0.95;
      } else {
         total = price;
      }
      changed();
      return total;
}
```

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```java
public boolean exist(String nameToFind) {
      boolean found = false;
      for (String name : names) {
         if (name.equals(nameToFind)) {
            found = true;
         }
      }
      return found;
}
```

Remove control flag

```java
public boolean exist(String nameToFind) {
      for (String name : names) {
         if (name.equals(nameToFind)) {
            return true;
         }
      }
      return false;
}
```

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```java
double getPayAmount() {
    double result;
    if (isDead) {
        result = deadAmount();
    } else {
        if (isSeparated) {
            result = separatedAmount();
        } else {
            if (isRetired) {
                result = retiredAmount();
            } else {
                result = normalAmount();
            }
        }
    }
    return result;
}
```

Replace nested conditionals with guard clauses

```
double getPayAmount() {
      if (isDead) {
         return deadAmount();
      }
      if (isSeparated) {
         return separatedAmount();
      }
      if (isRetired) {
         return retiredAmount();
      }
      return normalAmount();
}
```

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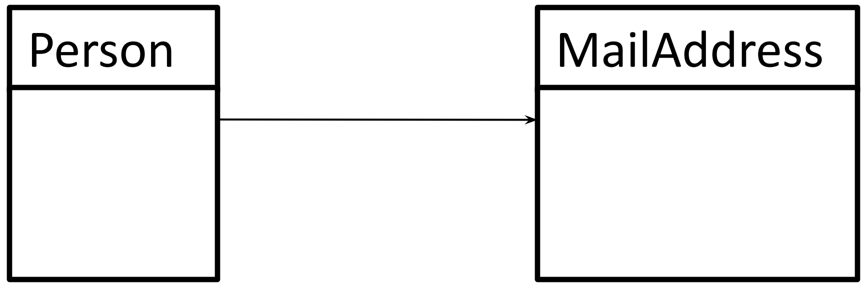
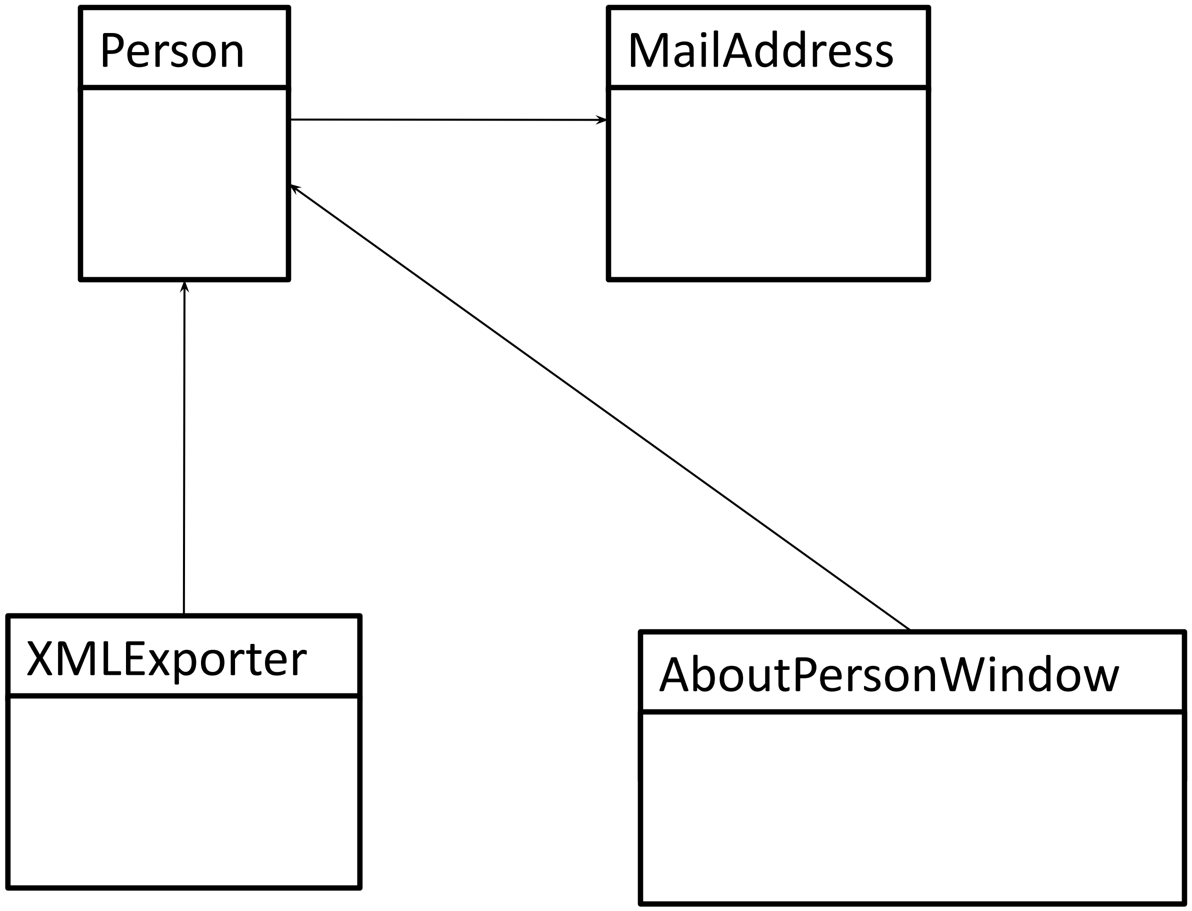

Person
MailAddress


Person
MailAddress
XMLExporter
AboutPersonWindow

```java
class Person {
      private String name;
      private MailAddress mailAddress;

      public MailAddress getMailAddress() {
         return mailAddress;
      }
      public void setMail(MailAddress mailAddress) {
         this.mailAddress = mailAddress;
      }
      // ..
   }
```

```java
class AboutPersonWindow {
      private JTextField mailAddressTextField;
      private JTextField nameTextField;

      private Person person;

      public void render() {
          // ...
          nameTextField.setText(person.name);
          if (person.getMailAddress() != null) {
             mailAddressTextField.setText(
           person.getMailAddress().toString());
          } else {
         mailAddressTextField.setText("-");
      }
          // ...
       }
}
```

```java
class AboutPersonWindow {
      private JTextField mailAddressTextField;
      private JTextField nameTextField;

      private Person person;

      public void render() {
         // ...
         nameTextField.setText(person.name);
         if (person.getMailAddress() != null) {
            mailAddressTextField.setText(
          person.getMailAddress().toString());
         } else {
        mailAddressTextField.setText("-");
     }
         // ...
      }
}
```

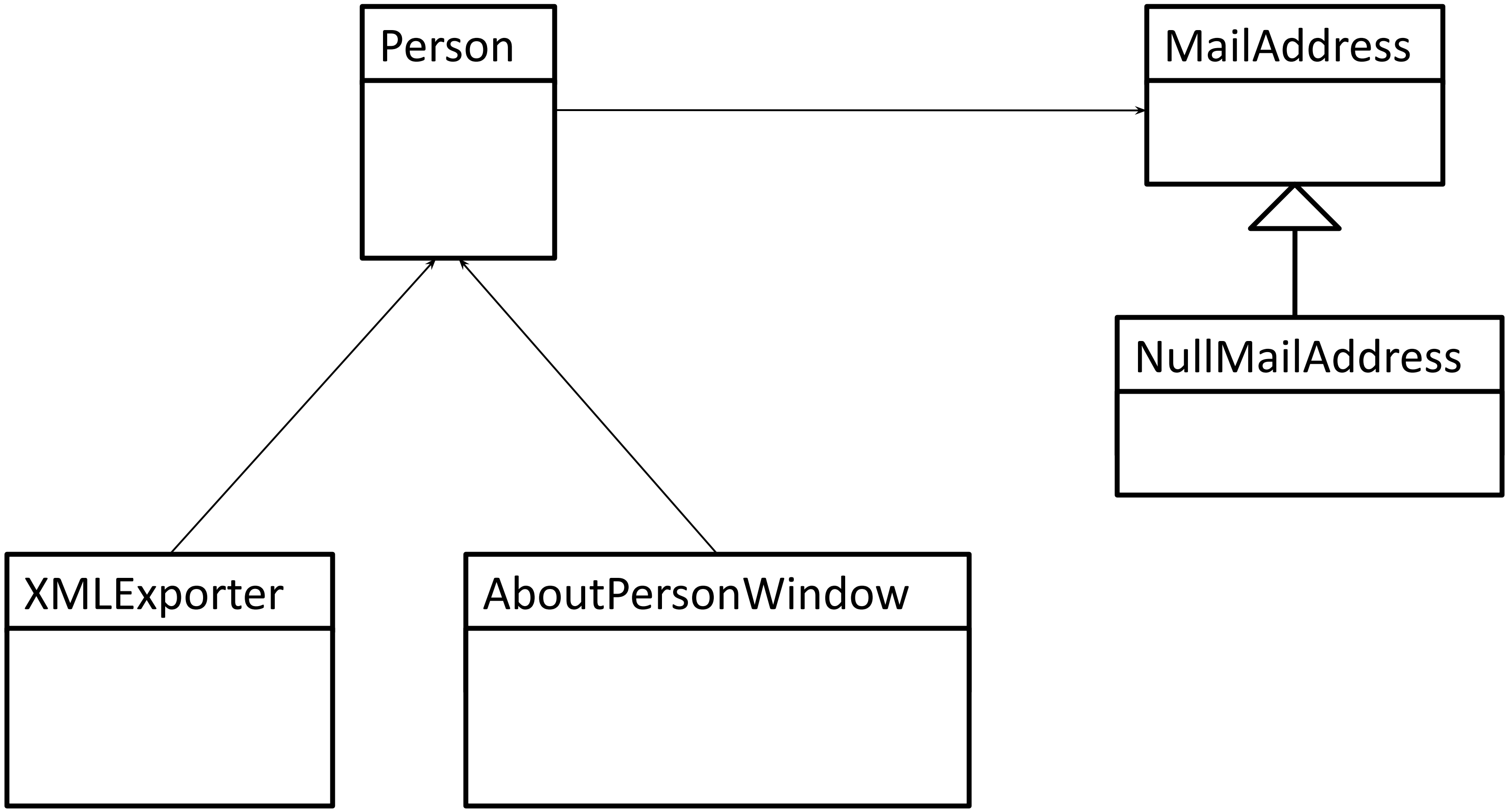
```java
class XMLExporter {
      private List<Person> persons;

      public void export() {
            // ...
            for (Person person : persons) {
                  print("<person>");
                  // ..
                  print("<mailAddress>");
                  if (person.getMailAddress() != null) {
                        print(person.getMailAddress().toString());
                  } else {
                        print("-");
                  }
                  print("</mailAddress>");
                  // ..
                  print("</person>");
            }
            // ...
      }
}
```

```
class XMLExporter {
      private List<Person> persons;

      public void export() {
         // ...
         for (Person person : persons) {
            print("<person>");
            // ..
            print("<mailAddress>");
            if (person.getMailAddress() != null) {
               print(person.getMailAddress().toString());
            } else {
               print("-");
            }
            print("</mailAddress>");
            // ..
            print("</person>");
         }
         // ...
      }
}
```

Introduce NullObject


Person
MailAddress
NullMailAddress
XMLExporter
AboutPersonWindow

```
class Person {
      // ..
      private MailAddress mailAddress = new NullMailAddress();
      // ..
}

class NullMailAddress extends MailAddress {

      public String toString() {
         return "-";
      }

}
```

```java
class AboutPersonWindow {

      private JTextField mailAddressTextField;
      private JTextField nameTextField;

      private Person person;

      public void render() {
         // ...
         nameTextField.setText(person.name);
         mailAddressTextField.setText(
                person.getMailAddress().toString());
         // ...
      }
}
```

```java
class XMLExporter {
      private List<Person> persons;

      public void export() {
         // ...
         for (Person person : persons) {
            print("<person>");
            // ..
            print("<mailAddress>");
            print(person.getMailAddress().toString());
            print("</mailAddress>");
            // ..
            print("</person>");
         }
         // ...
      }
```

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```
calculateWeeklyPay(true);

calculateWeeklyPay(false);
```

```java
calculateWeeklyPay(true);

calculateWeeklyPay(false);
```

```java
public int calculateWeeklyPay(final boolean overtime) {
   int straightTime = Math.min(400, getHoursWorked());
   int straightPay = straightTime * getHoursRate();
   int overTime = Math.max(0, getHoursWorked() - straightTime);
   double overtimeRate = overtime ? 1.5 : 1.0 * getHoursRate();
   int overtimePay = (int) Math.round(overTime * overtimeRate);
   return straightPay + overtimePay;
}
```

```
public int straightPay() {
    ...
    ...
}

public int overtimePay() {
    ...
    ...
}
```

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```java
double getPrice(int quantity, double itemPrice) {
   double basePrice = quantity * itemPrice;
   int discountLevel = getDiscountLevel();
   return discountedPrice(basePrice, discountLevel);
}


double discountedPrice(double basePrice, int discountLevel) {
   if (discountLevel == 2) {
      return basePrice * 0.1;
   }
   return basePrice * 0.05;
}
```

Replace parameter with method

```java
double getPrice(int quantity, double itemPrice) {
    double basePrice = quantity * itemPrice;
    return discountedPrice(basePrice);
}

double discountedPrice(double basePrice) {
    if (getDiscountLevel() == 2) {
        return basePrice * 0.1;
    }
    return basePrice * 0.05;
}
```

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```java
interface ClaimsRepository {

      List<Claim> claimsReceivedIn(Date start, Date end);

      List<Claim> claimsApprovedIn(Date start, Date end);

      List<Claim> claimsRejectedIn(Date start, Date end);

}
```

Introduce parameter object

```
interface ClaimsRepository {

      List<Claim> claimsReceivedIn(Range<Date> range);

      List<Claim> claimsApprovedIn(Range<Date> range);

      List<Claim> claimsRejectedIn(Range<Date> range);

}
```

```java
class RepositorioDeClientes {

      public void agregar(long id, String doc, String cuit,
       String nombre, String apellido, String telefono,
             String mail, String direccion, String localidad,
       String piso, String provincia) {

       // Agrega un nuevo cliente a la DB
      }

      public void modificar(long id, String doc, String cuit,
       String nombre, String apellido, String telefono,
             String mail, String direccion, String localidad,
       String piso, String provincia) {

       // Agrega un nuevo cliente a la DB
      }

}
```

```
class RepositorioDeClientes {

      public void agregar(Cliente cliente) {
         // Agrega un nuevo cliente a la DB
      }

      public void modificar(Cliente cliente) {
         // modifica un cliente de la DB
      }

}
```

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```java
int withdraw(double amount) {
    if (amount > balance) {
        return -1;
    }

    balance -= amount;
    return 0;
}


void usoEnCodigoCliente () {
    if (withdraw(200) < 0) {
        handleError();
    }
    moreCode();
}
```

Replace error code with exception

```java
void withdraw(double amount) {
   if (amount > balance) {
      throw new BalanceException(balance, amount);
   }
   balance -= amount;
}


public void usoEnCodigoCliente() {
   try {
      withdraw(200);
   } catch (BalanceException e) {
      handleError();
   }
   moreCode();
}
```

```java
public ErrorCode xxxxxxxxx(String inputFileName, Status status) {
  ErrorCode errorCode = ErrorCode.NONE;
  File file = openFile(inputFileName, status);
  if (status == Status.ERROR) {
    errorCode = ErrorCode.FileOpenError;
  } else {
    FileData data = readFile(file, status);
    if (status == Status.SUCCESS) {
       FileData summary = summarizeFileData(data, status);
       if (status == Status.ERROR) {
         errorCode = ErrorCode.DataSummaryError;
       } else {
      printSummary(summary);
         saveSummary(summary, status);
         if (status == Status.ERROR) {
        errorCode = ErrorCode.SummarySaveError;
      } else {
        updateAllAccounts();
        eraseUndoFile();
      }
       }
     } else {
        errorCode = ErrorCode.FileReadError;
     }
   }
   return errorCode;
}
```

```
public ErrorCode xxxx(inputFileName, Status status) {
   ErrorCode errorCode = ErrorCode.NONE;
   File file = openFile(inputFileName, status);
   if (status == Status.SUCCESS) {
      FileData data = readFile(file, status);
      if (status == Status.SUCCESS) {
        FileData summary = summarizeFileData(data, status);
        if (status == Status.SUCCESS) {
           printSummary(summary);
           saveSummary(summary, status);
           if (status == Status.SUCCESS) {
              updateAllAccounts();
              eraseUndoFile();
           } else {
           errorCode = ErrorCode.SummarySaveError;
           }
        } else {
         errorCode = ErrorCode.DataSummaryError;
        }
      } else {
         errorCode = ErrorCode.FileReadError;
      }
   } else {
      errorCode = ErrorCode.FileOpenError;
   }
   return errorCode;
}
```

```java
public ErrorCode xxxx(String inputFileName, Status status) {
   File file = openFile(inputFileName, status);
   if (status == Status.SUCCESS) {
      return ErrorCode.NONE;
   }
   FileData data = readFile(file, status);
   if (status == Status.ERROR) {
      return ErrorCode.FileReadError;
   }
   FileData summary = summarizeFileData(data, status);
   if (status == Status.ERROR) {
      return ErrorCode.DataSummaryError;
   }
   printSummary(summary);
   saveSummary(summary, status);
   if (status == Status.ERROR) {
      return ErrorCode.SummarySaveError;
   }
   updateAllAccounts();
   eraseUndoFile();
   return ErrorCode.NONE;
}
```

```java
void xxxx(String inputFileName) {
    File file = openFile(inputFileName);
    FileData data = readFile(file);
    FileData summary = summarizeFileData(data);
    printSummary(summary);
    saveSummary(summary);
    updateAllAccounts();
    eraseUndoFile();
}
```

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```java
class Loan {

      private  double minAmount = 100;
      private  double maxAmount = 5000;

      private final Client client;
      private final double amountToLoan;

      public Loan(Client aClient, double amount) {
         client = aClient;
         checkAmountToLoan(amount);
         amountToLoan = amount;
      }
      private void checkAmountToLoan(double amount) {
         if (amount < minAmount || maxAmount < amount) {
            throw new RuntimeException("the loan can not be ...");
         }
      }
      // ...
}
```

```java
// Montana rusa
class RollerCoaster {

   private  int minAge = 13;
   private  int maxAge = 40;

   public void admit(Person person) {
      if (person.age < minAge || maxAge < person.age) {
         throw new RuntimeException("no esta en el rango...");
      }
   }
   // ...
}
```

Replace primitive with object

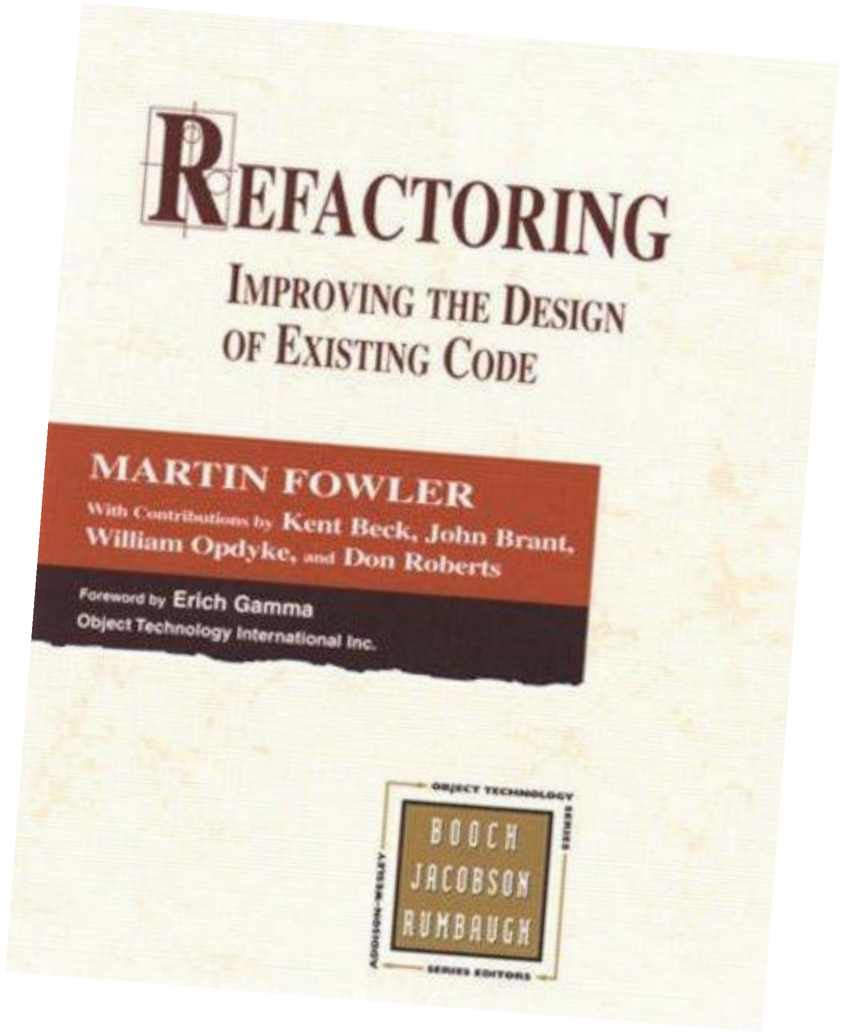
```java
class Loan {
      private Range<Double> rangeOfAllowedAmount
              = new Range<Double>(100.0, 5000.0);

      private final Client client;
      private final double amountToLoan;

      public Loan(Client aClient, double amount) {
         client = aClient;
         checkAmountToLoan(amount);
         amountToLoan = amount;
      }

      private void checkAmountToLoan(double amount) {
         if (rangeOfAllowedAmount.notIncludes(amount)) {
            throw new RuntimeException("the loan can not be ..");
         }
      }
      // ...
   }
```

```java
 class RollerCoaster {
   private  Range<Integer> rangeOfAllowedAge
                                     = new Range<Integer>(13, 40);
   public void admit(Person person) {
      if (rangeOfAllowedAge.notIncludes(person.age)) {
         throw new RuntimeException("no esta en el rango de ..");
      }
   }
   // ...
}
```

```java
public class Range<T extends Comparable<? super T>> {

    private final T start;
    private final T end;

    public Range(T start, T end) {
        this.start = start;
        this.end = end;
    }

    public boolean notIncludes(T value) {
        return !includes(value);
    }
    public boolean includes(T value) {
        return startIsLowerOrEqualThan(value)
                 && endIsGreaterOrEqualThan(value);
    }
    private boolean startIsLowerOrEqualThan(T value) {
        return start.compareTo(value) <= 0;
    }
    private boolean endIsGreaterOrEqualThan(T value) {
        return end.compareTo(value) >= 0;
    }
}
```

```
class Loan {

   private Range<Money> rangeOfAllowedAmount
      = new Range<Money>(Money.dollars(100), Money.dollars(5000));

   private final Client client;
   private final Money amountToLoan;

   public Loan(Client aClient, Money amount) {
      client = aClient;
      checkAmountToLoan(amount);
      amountToLoan = amount;
   }

   private void checkAmountToLoan(Money amount) {
      if (rangeOfAllowedAmount.notIncludes(amount)) {
         throw new RuntimeException("the loan can not be ... etc")
      }
   }
   // ...
}


class Money implements Comparable<Money> { ... }
```

Bibliografía



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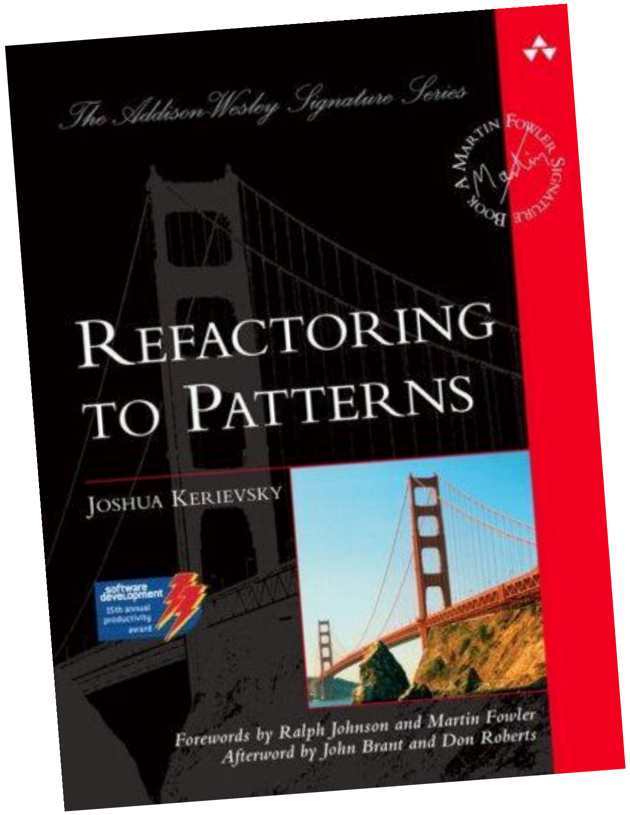
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