Code Smells

What is thta smell? Did you write that code?

Agenda

- day 1
- clean comments
- clean Functions
- clean tests
- clean class

- day 2
- oo programming
- functional programming
- reactive programming
- ddd

- Clean Code
- Implementation Patterns
- Refactoring
- Refactoring to Patterns
- Beautiful Code
- Xunit Patterns
- 97 things very programmer should know
- Solid Code
- 50 rules for High Scalability
- Inside C++ object model
- Modern C++ design
- inside JVM

Code Smell

CODE SMELLS ARE SYMPTOMS OF POOR DESIGN OR IMPLEMENTATION CHOISES

[Martin Fowler]

```
0 references
public int  GetTotalPrice_Dirty()
{
    List<int> p = new List<int>() { 10, 20, 30, 40, 50 };
    int t = 0;
    foreach (var i in p)
    {
        t += i;
    }
    return t;
}
```

Solution to the spaghetti code problem

Tip:
Any fool can write code that a computer can understand.
Good programmers write code that humans can understand.

- Refactoring

```
0 references
public int GetTotalPrice_CodeReview()
{
    List<int> priceList = new List<int>() { 10, 20, 30, 40, 50 };
    int totalPrice = 0;
    foreach (var price in priceList)
    {
        totalPrice += price;
    }
    return totalPrice;
}
```

```
public class SetScorer
{
    private int[] games = {0, 0};

    public void gameWon(int i) {
        games[i-1]++;
    }

    public String getSetScore() {
        if (games[0] < 6 && games[1] < 6) {
            if (games[0] > games[1]) {
                return "Player1 leads " + games[0] + " - " + games[1];
            } else if (games[1] > games[0]) {
                return "Player2 leads " + games[1] + " - " + games[0];
            } else {
                return "Set is tied at " + games[1];
            }
        }
        if (game[0] == 6 && game[1] < 5) {
            return "Player1 wins the set " + game[0] + "   " +
                  games[1];
        }
        if (games[1] == 6 && games[0] < 5) {
            return "Player2 wins the set " + games[1] + " - " +
                  games[0];
        }
        if (games[0] == 6 && games[1] == 5) {
            return "Player1 leads 6 - 5";
        }
        if (games[1] == 6 && games[0] == 5) {
            return "Player2 leads 6 - 5";
        }
        if (game[0] == 6 && game[1] == 6) {
            return "Set is tied at 6 games";
        }
        if (games[0] == 7) {
            return "Player1 wins the set 7 - " + games[1];
        }
        return "Player2 wins the set 7 - " + games[0];
    }
}
```

Boy Scout Rule

Leave your code better than you found it.

```
public class SetScorer {
      private int[] gamesWon = {0, 0};

      public void gameWon(int player) {
            gamesWon[player-1]++;
      }

      public String getSetScore() {
            int leader = gamesWon[0] > gamesWon[1] ? 1 : 2;
            int leadersGames = gamesWon[leader -  1];
            int opponentsGames = gamesWon[leader == 1 ? 1 : 0];
            String setScoreMessage = null;
            if ((gamesWon[0] < 6 && gamesWon[1] < 6)
                  || (leadersGames == 6 && opponentsGames == 5)) {
                      setScoreMessage = "Player" + leader + " leads " +
                        leadersGames + " - " + opponentsGames;
            } else if (gamesWon[0] == gamesWon[1]) {
                      setScoreMessage = "Set is tied at " +
                              leadersGames;
            } else if ((leadersGames - opponentsGames >= 2)
                  || (leadersGames == 7)) {
                  setScoreMessage = "Player" + leader +
                        " wins the set " + leadersGames + " - " +
                        opponentsGames;
            }
            return setScoreMessage;
      }
}
```

Problem Accumulation

Area was pristine clean for many days, one fine day a lazy guy threw garbage at the place just one bag, next one week place was filled with garbage, reason other people saw garbage and instead of picking it up they threw their own.

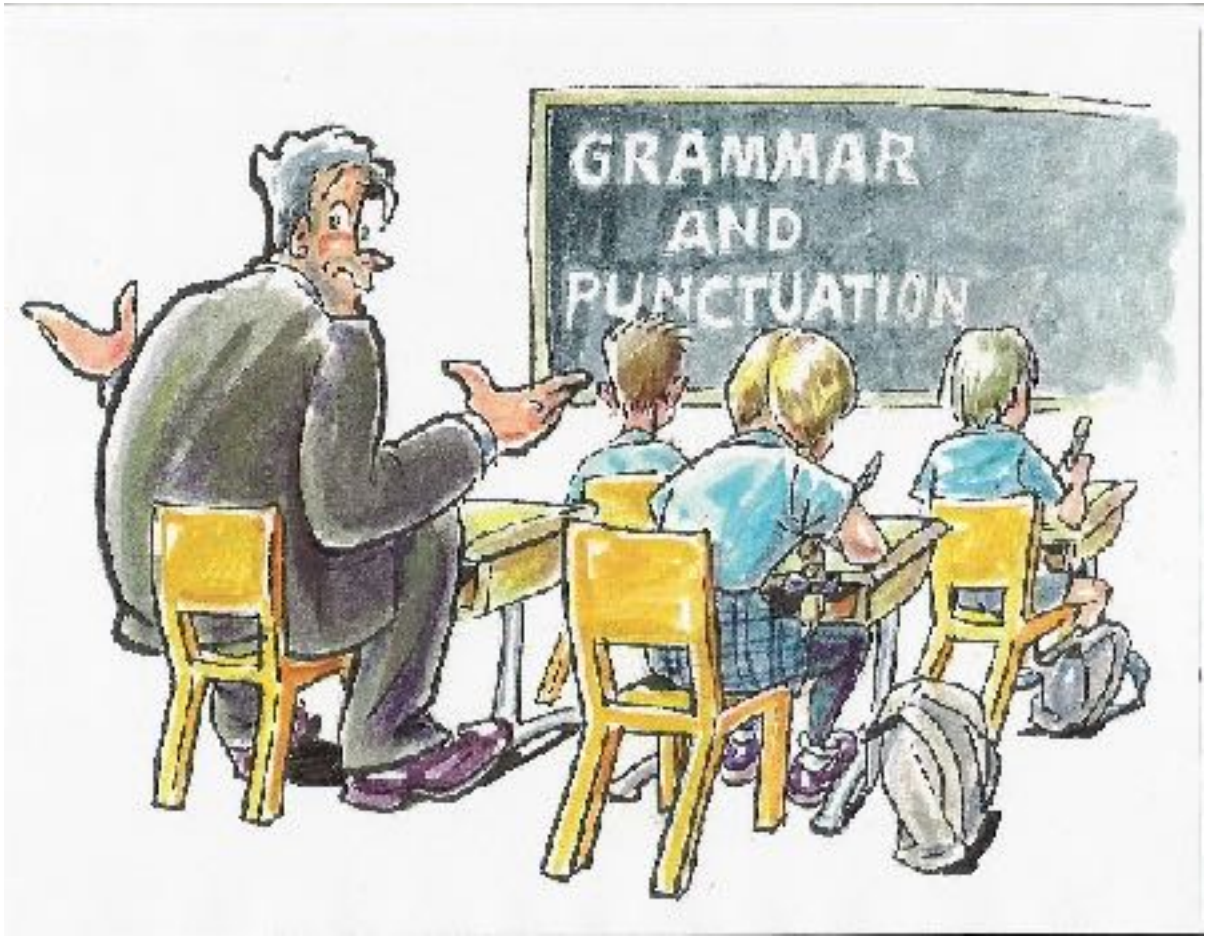
Comments

```
//Add Books associated with the Category

public void add(Category category)
{
        bookMap.put(category.getCategoryId(),
                        category.getBooks());
}
```

Explain Yourself in Code

```
public void addBooksFromCategory(Category category)
{
  bookMap.put(category.getCategoryId(), category.getBooks());
}
```

```
patientCount++; // add patient hospital visiting
```



A comment worth writing is worth writing well.

```
i++; // increment I
```

Comments are Failures

they compensate for our inability to express in code

```
InputStreamResponse response = new InputStreamResponse();
response.setBody(formatter.getResultStream(), formatter.getByteCount());
// InputStream resultsStream = formatter.getResultStream();
// StreamReader reader = new StreamReader(resultsStream);
// response.setContent(reader.read(formatter.getByteCount()));
```

```
/*

public void registerItem(Item item) {
      if (item != null) {
            ItemRegistry registry = peristentStore.getItemRegistry();
            if (registry != null) {
                  Item existing = registry.getItem(item.getID());
                  if (existing.getBillingPeriod().hasRetailOwner()) {
                        existing.register(item);
                  }
            }
      }
}

….

*/
```

It is inappropriate for a comment to hold information better held in a as source code control system, issue tracking system, or any other record-keeping system.

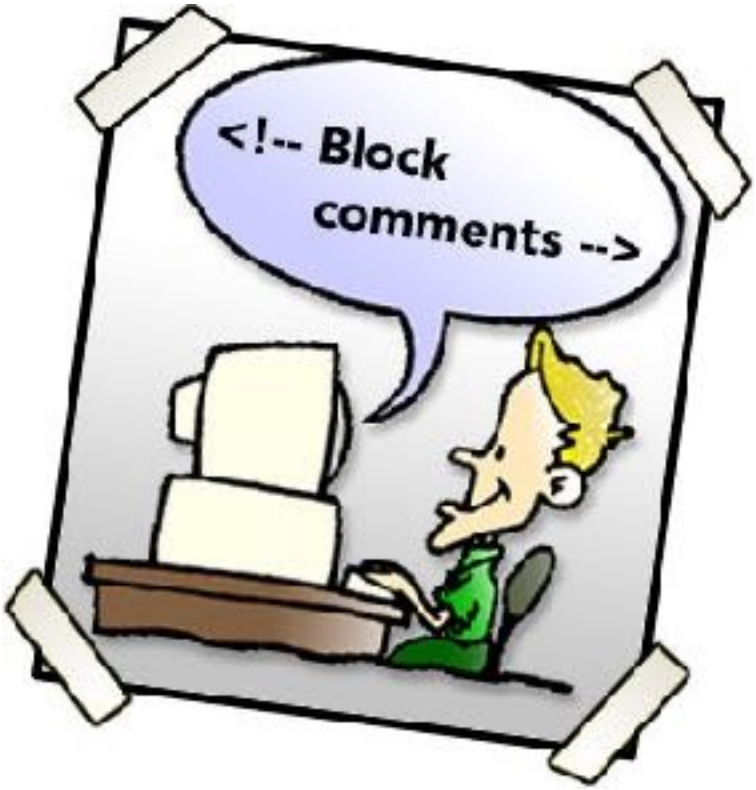
```
/**
* @dateModified 12/12/1947
* @modifiedBy RamgopalVerma
* @modifiedReason because sky is so high
* /
public class Patient
{
}
```

Avoid *Obsolete Comment*

It is best not to write a comment that will become obsolete.

They become floating islands of irrelevance and misdirection in the code.

```
/**
* Returns the day of the month.
*
* @return the day of the month.
*/
public int getDayOfMonth() {
   return dayOfMonth;
}
```



Comments should say things that the code cannot say for itself.

```
// Check to see if the employee is eligible for full benefits
if ((employee.flags && HOURLY_FLAG) && (employee.age > 65))
```

Explain Yourself in Code

```
if (employee.isEligibleForFullBenefits())
```

```
double getExpenseLimit() {
  // should have either expense limit or a primary project
  return (_expenseLimit != NULL_EXPENSE) ?
    _expenseLimit:
    _primaryProject.getMemberExpenseLimit();
}
```

Introduce Assertion

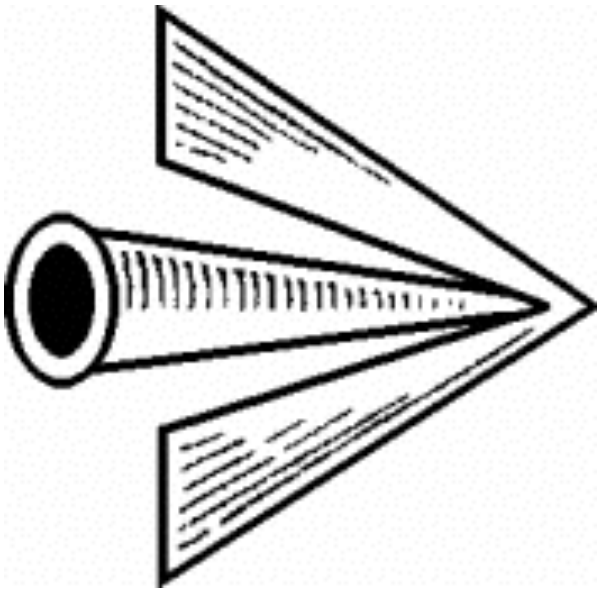
```
double getExpenseLimit() {
  Assert.isTrue (_expenseLimit != NULL_EXPENSE || _primaryProject != null);
  return (_expenseLimit != NULL_EXPENSE) ?
    _expenseLimit:
    _primaryProject.getMemberExpenseLimit();
}
```

Error

```
public class DeviceController {
      ...
      public void sendShutDown() {
            DeviceHandle handle = getHandle(DEV1);
            // Check the state of the device
            if (handle != DeviceHandle.INVALID) {
                  // Save the device status to the record field
                  retrieveDeviceRecord(handle);
                  // If not suspended, shut down
                  if (record.getStatus() != DEVICE_SUSPENDED) {
                        pauseDevice(handle);
                        clearDeviceWorkQueue(handle);
                        closeDevice(handle);
                  } else {
                        logger.log("Device suspended. Unable to shut down");
                  }
            } else {
                  logger.log("Invalid handle for: " + DEV1.toString());
            }
      }
```

```
void DoJob()
{
        Domain domain = new Domain();
        bool res = domain.fun();
        if(res == true){
                res = domain.fun2(100);
                if(res == true){
                        Repostory rep = new Repository();
                        Emp emp = rep.get(1);
                        if(emp != null){
                                ...
                        }else{
                                …
                        }
                }else{
                        …
                }
        }else{
                …
        }
}
```

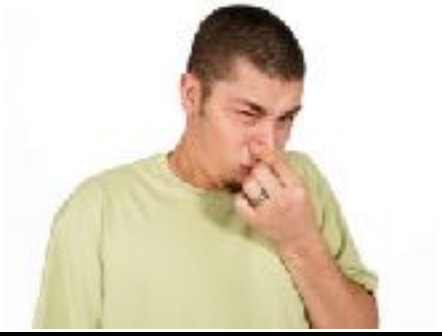
Arrow Code



```
if
  if
    if
      if
        do something
      endif
    endif
  endif
endif
```

Use Exceptions Rather Than Return Codes

```
public class DeviceController {
      ...
      public void sendShutDown() {
            try {
                  tryToShutDown();
            } catch (DeviceShutDownError e) {
                  logger.log(e);
            }
      }
      private void tryToShutDown() throws DeviceShutDownError {
            DeviceHandle handle = getHandle(DEV1);
            DeviceRecord record = retrieveDeviceRecord(handle);
            pauseDevice(handle);
            clearDeviceWorkQueue(handle);
            closeDevice(handle);
      }
      private DeviceHandle getHandle(DeviceID id) {
            ...
            throw new DeviceShutDownError("Invalid handle for: " + id.toString());
            ...
      }
      ...
}
```



```
void DoJob()
{
        Domain domain = new Domain();
        domain.fun();
        domain.fun2(100);
        Repostory rep = new Repository();
        Emp emp = rep.get(1);
        ...
}


        try{
                DoJob();
        }catch(…){
                ….
        }
```

```
int withdraw(int amount) {
  if (amount > _balance)
    return -1;
  else {
    _balance -= amount;
    return 0;
  }
}
```

Replace Error Code with Exception

```
void withdraw(int amount) throws BalanceException
{
  if (amount > _balance)
        throw new BalanceException();

  _balance -= amount;
}
```

```
double getValueForPeriod (int periodNumber) {
  try {
        return _values[periodNumber];
  } catch (ArrayIndexOutOfBoundsException e) {
        return 0;
  }
}
```

Replace Exception with Test

```
double getValueForPeriod (int periodNumber) {
        if (periodNumber >= _values.length)
                return 0;

        return _values[periodNumber];
}
```

```
private static List readLines(String fileName)
{
    String line;
    ArrayList list= new ArrayList();

    try
   {
      BufferedReader in = new BufferedReader(new FileReader(fileName));
      while ((line = in.readLine()) != null)
        list.add(line);
      in.close();
    }
    catch (Exception e)
    {
      System.out.println(e);
      return null;
    }
    return list;
}
```

Always know why you are catching an exception

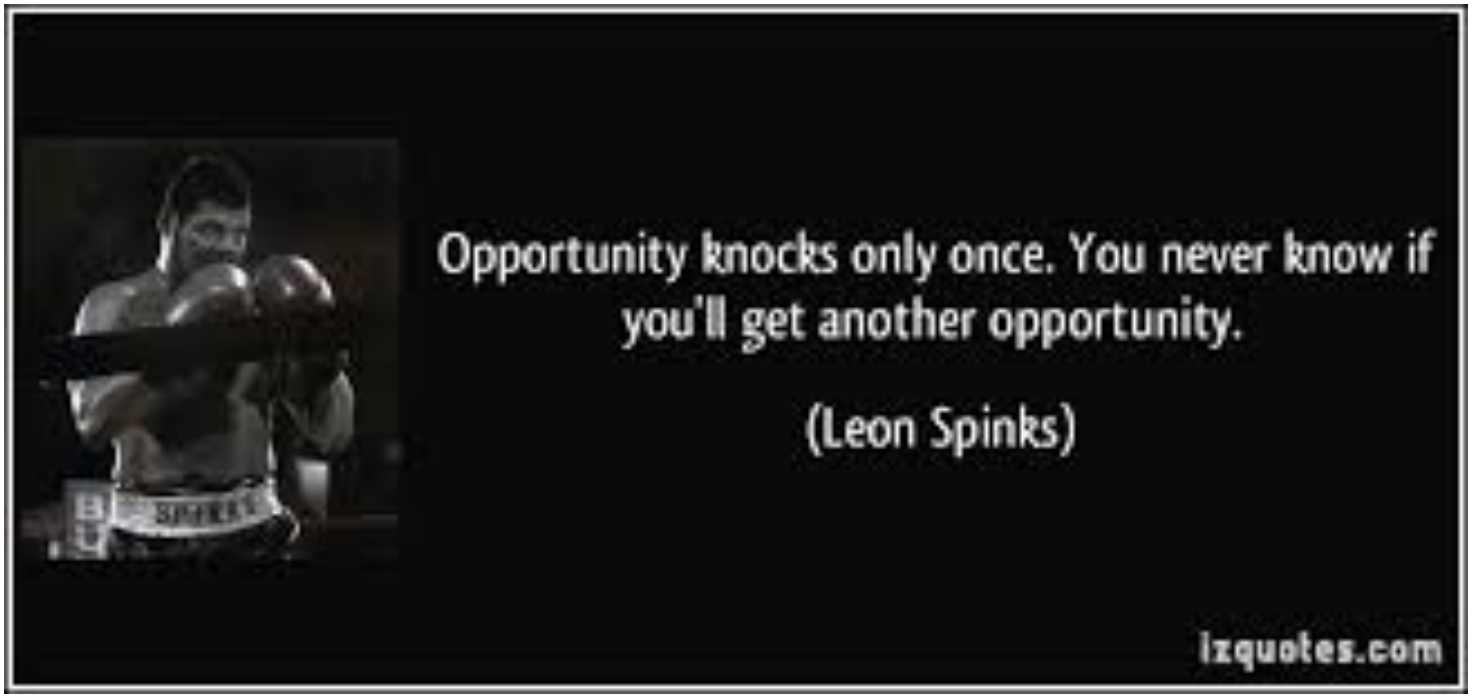
If you don't catch the exception, you get a traceback.

```
public void create(Map<String,Object> results) throws Exception
{
   //validate condition
   if(condition) {
        results.set("ERROR_CODE","CONDITION VIOLATED");
   }
}

Map<String,Object> results = new HashMap<>();
create(results);
if(results.containsKey("ERROR_CODE")) {
   ...
}
```

```
String line;
ArrayList file = new ArrayList();

try
{
  BufferedReader in = new BufferedReader(new FileReader(fileName));
  while ((line = in.readLine()) != null)
  {
    file.add(line);
  }
  in.close();
}
catch (Exception e)
{
}
```

```
//method 1
catch(SQLException exp) {
  log.fatal("Exception occurred:", exp);
  throw exp;
}

//method 2
try {
  //call method 1
}
catch(Exception exp) {
  log.fatal("Exception occurred:", exp);
}
```

Log exception stack trace only once



```
catch(InterruptedException e) {
   AppException exp = new AppException();
   exp.addError(Constants.ERROR_CODE, "EXP005");
   exp.addError(Constants.ERROR_MESG, e.getMessage());
   throw exp;
}
catch(SQLException e) {
   AppException exp = new AppException();
   exp.addError(Constants.ERROR_CODE, "EXP011");
   exp.addError(Constants.ERROR_MESG, e.getMessage());
   throw exp;
}
catch(Exception e) {
   AppException exp = new AppException();
   exp.addError(Constants.ERROR_CODE, "EXP003");
   exp.addError(Constants.ERROR_MESG, e.getMessage());
   throw exp;
}
```

remove duplicate code

```
private AppException createAppException(String errorCode,e) {
   AppException exp = new AppException();
   exp.addError(Constants.ERROR_CODE, errorCode);
   exp.addError(Constants.ERROR_MESG, e.getMessage());
   return exp;
}

//code
catch(InterruptedException exp) {
   throw createAppException("EXP005",exp);
}
catch(SQLException exp) {
   throw createAppException("EXP011",exp);
}
catch(Exception exp) {
   throw createAppException("EXP003",exp);
}
```

```
logger.error("Exception occurred:" + e.getMessage());
```

the exception stacktrace is lost

```
void fun()
{
	try
	{
		…logic 1

		if(cond)
			throw new Exception(…);

		…logic 2

	}
	catch(Exception e)
	{
		…logic 3
	}
}
```

Farmers in India use Pepsi as pesticides, because it's cheaper than pesticides and gets the job done just as well.

```
try {
      …

} catch (Exception e) {
        LOGGER.error("Exception :", e);
        LOGGER.debug("Exception :" + e.getMessage());
        try {
                con.rollback();
        } catch (SQLException e1) {
                LOGGER.error("Exception :", e1);
                LOGGER.debug("Exception :" + e1.getMessage());
        }
} finally {
        try {
                con.close();
        } catch (SQLException e1) {
                LOGGER.error("Exception :", e1);
                LOGGER.debug("Exception :" + e1.getMessage());
        }
}
```

- Unchecked Exceptions
  - No more `try`/`throws`/empty `catch`(); no return status codes
  - Runtime Exceptions don't annoy the caller
    - Can be handled uniformly in a transparent layer at the entry points
    - Can hold enum error codes for (i18n) user messages
    - Define custom exception sub-types for recoverable errors (selective catch)

functions

Dead Function

Methods that are never called.

Ruthlessly delete code that isn't being used.

```
double potentialEnergy(double mass, double height) {
  return mass * height * 9.81;
}
```

Magic Numbers and Strings

Explicit is better than implicit. - Tim Peters, The Zen of Python

Replace Magic Number with Symbolic Constant

```
double potentialEnergy(double mass, double height) {
  return mass * GRAVITATIONAL_CONSTANT * height;
}
static final double GRAVITATIONAL_CONSTANT = 9.81;
```

```
class Constants
{
    // Prevents instanciation of myself and my subclasses
    private SomeConstants() {}

    public final static String TOTO = "toto";
    public final static Integer TEN = 10;
    public static final String NAME=“name1”;
      public static final int MAX_VAL=25;
    //...
}
```

- DO NOT create a dreadful 4000-lines Constants class !

0 references

```
public void CompareString_Dirty()
{
    Employee employee = new Employee();
    if (employee.EmployeeType == "Contractor")
    {
        // do some action
    }
}
```

```
0 references
public void CompareString_CodeReview()
{
    Employee employee = new Employee();
    if (employee.TypeOfEmployee ==  EmployeeType.Contractor)
    {
        // do some action
    }
}
```

leverage an Enum to make a strongly typed check

0 references

```
public decimal TernaryElegant_Dirty()
{
    int age = 65;
    decimal incomeTax ;

    if (age >= 65)
    {
        incomeTax = 0.1M;
    }
    else
    {
        incomeTax = 0.3M;
    }

    return incomeTax;
}
```

```
0 references
public decimal TernaryElegant_CodeReview()
{
    int age = 65;
    decimal incomeTax = age >= 65 ? 0.1M : 0.3M;
    return incomeTax;
}
```

```
while ((!found) && (pos < (fileContent.Length - 6)))
{
    byteData = new byte[6];
    Array.Copy(fileContent, pos, byteData, 0, 6);
    pos = pos + 6;
    str_byteData = enc.GetString(byteData);
    if (str_byteData.Contains("s"))
    {
        posE_byteData = str_byteData.IndexOf("s");
        pos = pos + (posE_byteData - 6);
        Array.Copy(fileContent, pos, byteData, 0, 6);
        pos = pos + 6;
        if (byteData[0] == 0x73)    // 's'
        {
            if (byteData[1] == 0x74)    // 't'
            {
                if (byteData[2] == 0x72)    // 'r'
                {
                    if (byteData[3] == 0x65)    // 'e'
                    {
                        if (byteData[4] == 0x61)    // 'a'
                        {
                            if (byteData[5] == 0x6D)    //
                            {
                                found = true;
                                break;
                            }
                            else
                            {
                                if (byteData[5] == 0x73)
                                {
                                    pos = pos - 1;
```

Nesting Levels

{if < 4 , switch,while,do, for <3}

```
private boolean isValidRequest(HttpServletRequest req) {

    if (req.getPathInfo() == null) return false;

    switch (req.getMethod()) {
        case "GET":
            return Configuration.validGetPaths().stream().anyMatch(req.getPathInfo()::startsWith);
        case "POST":
            return Configuration.validPostPaths().stream().anyMatch(req.getPathInfo()::startsWith);
        default:
            return false;
    }

}
```

DON'T REPEAT YOURSELF

Repetition is the root of all software evil

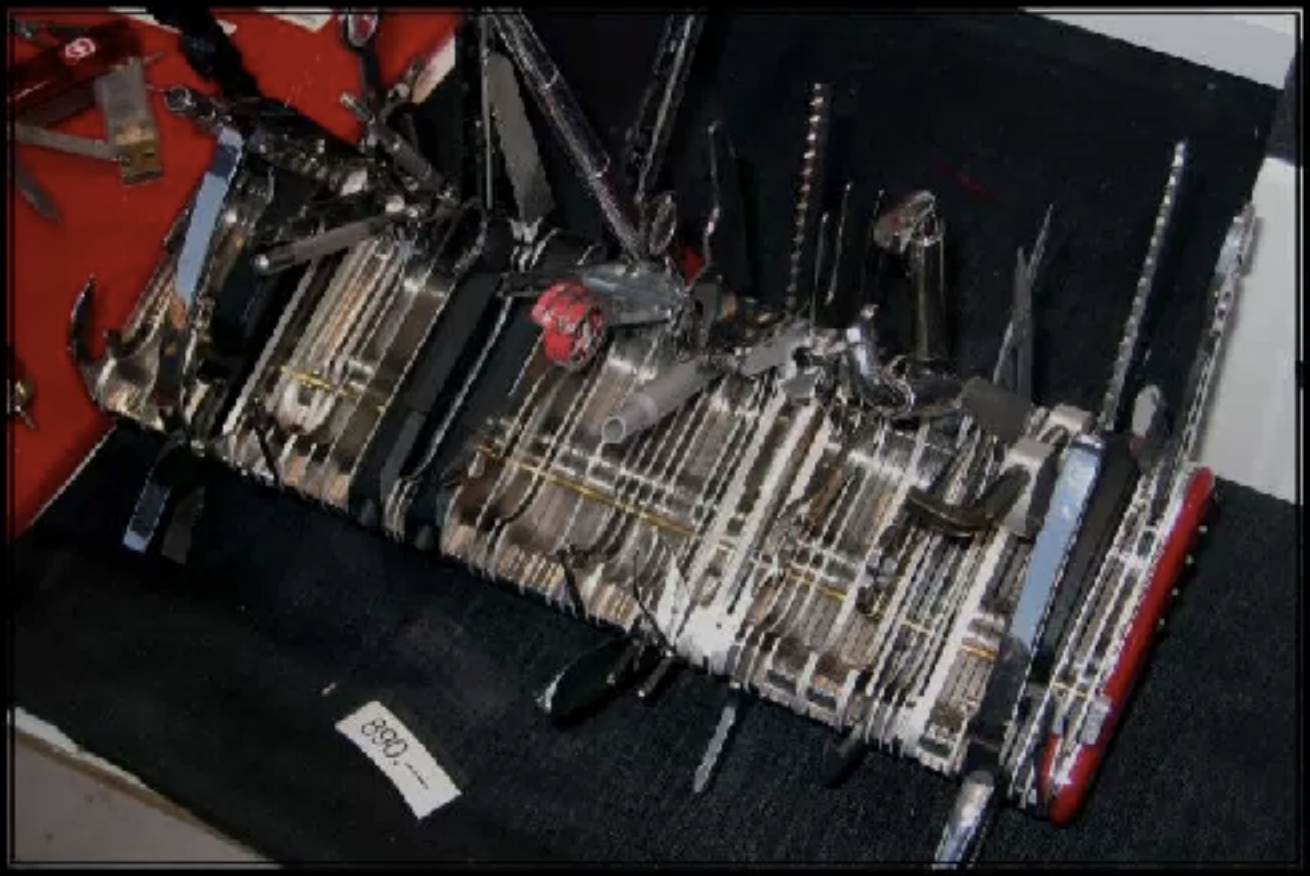
Disable the paste function on every developer machine

“Perfection (in enterprise development) is achieved not when there is nothing more to add, but rather when there is nothing more to take away.”

--Antoine de Saint-Exupéry

```
        FormView1.FindControl("noteRow").Visible = true;
        FormView1.FindControl("RequiredFieldValidator4").Visible = false;
        // TODO: Fix this - What if Action is 2nd parameter in URL
        if (Request.Path.Contains(@"clientProfile.aspx?Action=Add"))
        {
            FormView1.FindControl("thLoginID").Visible = true;
            FormView1.FindControl("tdLoginID").Visible = true;
            FormView1.FindControl("txtLoginID").Visible = true;
        }

    }
    else
    {
        FormView1.FindControl("noteRow").Visible = false;
    }


if (HttpContext.Current.User.IsInRole("Administrator"))
{

    if (!Request.Path.Contains(@"/administratorProfile.aspx"))
    {
        if (!Request.Path.Contains(@"/Profile.aspx"))
        {
            FormView1.FindControl("txtLoginID").Visible = false;
            FormView1.FindControl("lblLoginID").Visible = false;
            -- Snip snip snip - more controls are hidden or shown -- --

            if (Request.Path.Contains(@"/UserProfile.aspx") && HttpContext.Current.User.IsInRole("User") && (Request.QueryString["Action"] == null ||
            {

                FormView1.FindControl("thLoginID").Visible = true;
                FormView1.FindControl("lblLoginID").Visible = true;
                -- Snip snip snip - more controls are hidden or shown -- --

            }
            else
            {
                FormView1.FindControl("thLoginID").Visible = false;
                FormView1.FindControl("lblLoginID").Visible = false;
                -- Snip snip snip - more controls are hidden or shown -- --


            }

        }
        else
        {
            FormView1.FindControl("thDateRegistered").Visible = false;
            FormView1.FindControl("tdDateRegistered").Visible = false;
            -- Snip snip snip - more controls are hidden or shown -- --

        }
    }
    else if (Request.Path.Contains(@"/ReaderProfile.aspx"))
    {
        FormView1.FindControl("tdAdviser").Visible = false;
        FormView1.FindControl("thAdviser").Visible = false;
        -- Snip snip snip - more controls are hidden or shown -- --

    }
}
else if (HttpContext.Current.User.IsInRole("Administrator"))
```

Long Method



Single Responsibility Principle

Yes, it's all there. No, it's not a good idea.

Functions Should be Small !!

- How small ?
  - **4 *lines*** is best; 5 is ok; 6 is already too much
  - By any means, keep your functions smaller than a page of your IDE!

- Why so small ?!

➔To be sure that they do only 1 THING

  - ➔In a few lines, you can't do much
  - ➔Its name can then tell you everything

```
public class UglyMoneyTransferService
{
public void transferFunds(Account source, Account target, BigDecimal amount, boolean allowDuplicateTxn){
        Account sourceAccount = null;
        if(rs.next()) {
            sourceAccount = new Account();
            //populate account
        }
        Account targetAccount = null;
        if(!sourceAccount.isOverdraftAllowed()) {
            if((sourceAccount.getBalance() - amount) < 0) {
                throw new RuntimeException("Insufficient Balance");
            }
        }
        else {
            if(((sourceAccount.getBalance()+sourceAccount.getOverdraftLimit()) - amount) < 0) {
                throw new RuntimeException("Insufficient Balance, Exceeding Overdraft Limit");
            }
        }
        AccountTransaction lastTxn = .. ; //JDBC code to obtain last transaction of sourceAccount
        if(lastTxn != null) {
            if(lastTxn.getTargetAcno().equals(targetAccount.getAcno()) && lastTxn.getAmount() == amount && !allowDuplicateTxn) {
                throw new RuntimeException("Duplicate transaction exception");
            }
        }
            sourceAccount.debit(amount);
            targetAccount.credit(amount);
        }

}
```

```
Public void doTheDomesticThings()
{
        takeOutTheTrash();
        walkTheDog();
        for(Dish dish : dirtyDishStack)
        {
                sink.washDish(dish);
                teaTowel.dryDish(dish);
        }
}
```

Don’t mix levels of abstraction

```
Public void doTheDomesticThings()
{
        takeOutTheTrash();
        walkTheDog();
        doTheDishes();
}
```

```
private Account validateAndGetAccount(String acno){
    Account account = AccountDAO.getAccount(acno);
    if(account == null){
    throw new InvalidAccountException("Invalid ACNO :"+acno);
    }
}
private void checkForOverdraft(Account account, BigDecimal amount){
    if(!account.isOverdraftAllowed()){
        if((account.getBalance() - amount) < 0){
            throw new InsufficientBalanceException("Insufficient Balance");
        }
    }
    else{
        if(((account.getBalance()+account.getOverdraftLimit()) - amount) < 0){
            throw new ExceedingOverdraftLimitException("Insufficient Balance, Exceeding Overdraft Limit");
        }
    }
}
private void checkForDuplicateTransaction(FundTransferTxn txn){
    AccountTransaction lastTxn = TransactionDAO.getLastTransaction(txn.getSourceAccount().getAcno());
        if(lastTxn != null){
            if(lastTxn.getTargetAcno().equals(txn.getTargetAccount().getAcno())
            && lastTxn.getAmount() == txn.getAmount()
            && !txn.isAllowDuplicateTxn()){
                throw new DuplicateTransactionException("Duplicate transaction exception");
        }
    }
}
private void makeTransfer(Account source, Account target, BigDecimal amount){
    sourceAccount.debit(amount);
    targetAccount.credit(amount);
    TransactionService.saveTransaction(source, target,  amount);
}
```

```
class FundTransferTxn
{
private Account sourceAccount;
private Account targetAccount;
private BigDecimal amount;
private boolean allowDuplicateTxn;
//setters & getters
}



public class CleanMoneyTransferService
{
    public void transferFunds(FundTransferTxn txn) {
        Account sourceAccount = validateAndGetAccount(txn.getSourceAccount().getAcno());
        Account targetAccount = validateAndGetAccount(txn.getTargetAccount().getAcno());
        checkForOverdraft(sourceAccount, txn.getAmount());
        checkForDuplicateTransaction(txn);
        makeTransfer(sourceAccount, targetAccount, txn.getAmount());
    }

    ....
}
```

```
double getPrice()
{
        int basePrice = _quantity * _itemPrice;

        double discountFactor;
        if(basePrice > 1000)
                discountFactor = 0.95;
        else
                discountFactor = 0.98;

        return basePrice * discountFactor;
}
```

Replace Temp with Query

```
double getPrice()
{
        return basePrice() * discountFactor();
}
private double discountFactor()
{
        if(basePrice > 1000)
                return 0.95;
        else
                return  0.98;
}
private int basePrice()
{
        return _quantity * _itemPrice;
}
```

```
File CreateFile(string name, boolean isTemp)
{
   //implementation
}


myfile = CreateFile("foo.txt", true);
```

SINGLE RESPONSIBILITY PRINCIPLE

Every object should have a single responsibility, and all its services should be narrowly aligned with that responsibility.

Flag Arguments are Ugly

```
customer.setLoggedIn(true);
```

```
removeOrders(customer, false, true);
```

- It shouts that the function does more than one thing !

Reveal Intend

```
File CreatePermenantFile(String name);
File CreateTempFile(String name);
```

Reveal Intend

```
myFile = CreateFile("foo.txt", FileType.Temp);
```

Reveal Intend

```
isTemp = true;
CreateFile("foo.bar", isTemp);
```

If you have to call an existing API that uses this style,
you should introduce a local variable for clarity.

```
void getPositiveNumbers(List<Integer> l1, List<Integer> l2) {

    for (Integer el1: l1)
        if (el1 > 0)
            l2.add(el1);

}
```

Avoid output parameters

```
List<Integer> getPositiveNumbers(List<Integer> numbers) {
    return numbers.stream()
        .filter(num -> num > 0)
        .collect(toList());
}
```

- The caller may be surprised that an argument changed.

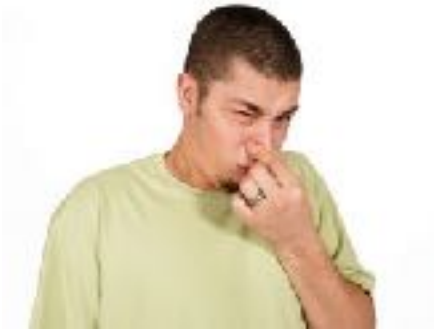
Did you expect that the second parameter will be changed when you call that method?

principle of least astonishment

the name of a function should reflect what it does

result of performing some operation should be obvious, consistent, and predictable, based upon the name of the operation

Embrace Immutability



```
myBadMethod("John","Michael",
      "Paris","St. Albergue");
```

Max 2 parameters

```
params.setStreet(“Paris");
…
myBadMethod(params);
```

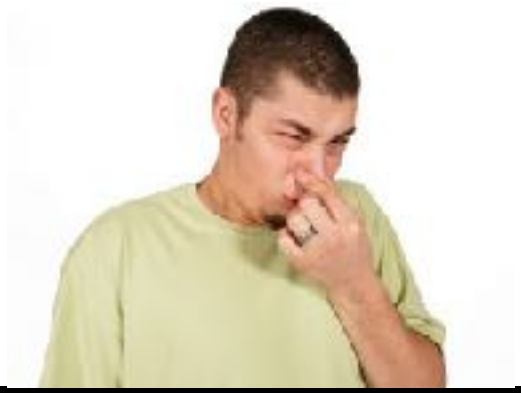
- For ≥ 3 parameters, it's hard to read: their order becomes a problem

➔ group them in a **Parameter Object**/**DTO**

```
void bad_handle_data(char *data, size_t length)
{
        if (check_CRC(data, length) == OK)
        {
                /* * 30 * lines * of * data * handling */
        }
        else
        {
                printf("Error: CRC check failed\n");
        }
}
```

Test Exception instead of normal code

```
void good_handle_data(char *data, size_t length)
{
        if (check_CRC(data, length) != OK)
        {
                printf("Error: CRC check failed\n");
                return;
        }

        /* * 30 * lines * of * data * handling */

}
```



```
List<Employee> employees = getEmployees();
if (employees != null) {
    for(Employee e : employees) {
        totalPay += e.getPay();
    }
}

….
```

```
public void registerItem(Item item) {
      if (item != null) {
            ItemRegistry registry = peristentStore.getItemRegistry();
            if (registry != null && registry.Count > 0) {
                  Item existing = registry.getItem(item.getID());
                  if (existing !=null && existing.getBillingPeriod().hasRetailOwner()) {
                        existing.register(item);
                  }
                  if (existing !=null && !existing.getBillingPeriod().hasRetailOwner()) {
                        existing.unregister(item);
                  }
                  if (existing !=null) {
                        existing.remove(item);
                  }
            }
      }
}
```

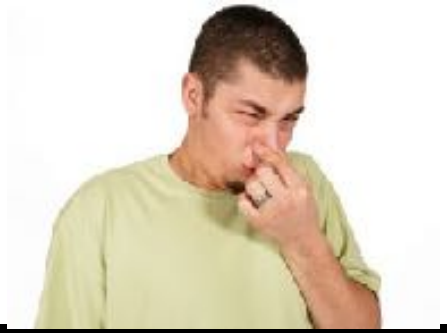
Don’t Return Null

If we change getEmployee so that it returns an empty list

```
List<Employee> employees = getEmployees();
for(Employee e : employees) {
        totalPay += e.getPay();
}
```

Fortunately, Java has Collections.emptyList(), and it returns a predefined immutable

```
public List<Employee> getEmployees() {
if( .. there are no employees .. )
        return Collections.emptyList();
}
```



```
public void registerItem(Item item) {
    if (item != null) {
        ItemRegistry registry =
        peristentStore.getItemRegistry();
        Item existing = registry.getItem(item.getID());
        if (existing.getBillingPeriod().hasRetailOwner()) {
                existing.register(item);
        }
    }
}
```

No nullable parameters

```
public void registerItem(Item item) {
    ItemRegistry registry = peristentStore.getItemRegistry();
    Item existing = registry.getItem(item.getID());
    if (existing.getBillingPeriod().hasRetailOwner()) {
                existing.register(item);
    }
}
```

- It's like a **`boolean`** ⇨ split that function in 2: one for null, one for not-null
- Thoroughly check parameters at boundaries (=**defensive programming**)

```
void myMethod(Optional<String>
optionalArgument) {
```

It Causes Conditional Logic Inside Methods

```
public void myMethod(Optional<String>
optionalArgument) {
    // some code
    if (optionalArgument.isPresent()) {
        doSomething(optionalArgument.get());
    } else {
        doSomethingElse();
    }
    // some code
}
```

```
Outer outer = getObj();

if (outer != null && outer.nested != null && outer.nested.inner != null) {
    System.out.println(outer.nested.inner.foo);
}
```

Removing null check

```
Integer value1 = null;
Optional<Integer> a = Optional.ofNullable(value1);
Integer value2 = a.orElse(new Integer(0));
```

```
int? length = customers?.Length; // null if customers is null
Customer first = customers?[0];  // null if customers is null
int? count = customers?[0]?.Orders?.Count();  // null if customers, the first customer, or Orders is null
```

Removing null check

```
// let's assume you will get this from your model in the future; in the meantime…
Optional<Project> optionalProject = Optional.ofNullable(project);


// safe, java 8, but still ugly and omission-prone
if (optionalProject.isPresent()) {

   ApplicationType applicationType = optionalProject.get().getApplicationType();
   Optional<ApplicationType> optionalApplicationType = Optional.ofNullable(app licationType);
   if (optionalApplicationType.isPresent()) {
      String typeDirName = optionalApplicationType.get().getTypeDirName();
      Optional<String> optionalTypeDirName = Optional.ofNullable(typeDirName);
      if (optionalTypeDirName.isPresent()) {
         System.out.println(optionalTypeDirName);
      }
}
```

Removing null check

```
// let's assume you will get this from your model in the future; in the meantime…
Optional<Project> optionalProject = Optional.ofNullable(project);


// safe, java 8, but still ugly and omission-prone
if (optionalProject.isPresent()) {

   ApplicationType applicationType = optionalProject.get().getApplicationType();
   Optional<ApplicationType> optionalApplicationType = Optional.ofNullable(app licationType);
   if (optionalApplicationType.isPresent()) {
      String typeDirName = optionalApplicationType.get().getTypeDirName();
      Optional<String> optionalTypeDirName = Optional.ofNullable(typeDirName);
      if (optionalTypeDirName.isPresent()) {
         System.out.println(optionalTypeDirName);
      }
}
```

Removing null check

```
// safe, yet prettier

optionalProject

        .flatMap(Project::getApplicationTypeOptional)

        .flatMap(ApplicationType::getTypeDirNameOptional)

        .ifPresent(System.out::println);
```

```
public WebUser getCurrentUser(){
        if (_currentUser == null) {
            Object obj  = HttpContext.Current.Session["__currentUser"];
            if (obj != null) {
                _currentUser = (WebUser)obj;
                return _currentUser;
            }
            SecurityHelper secHelper = new SecurityHelper();
            WebUserRepository rep = new WebUserRepository();
            if (secHelper.TrackingGuid != Guid.Empty){
                _currentUser = rep.GetWebUserByTrackingGuid(secHelper.TrackingGuid);
                if (_currentUser != null)
               return _currentUser;
            }
            WebUserFactory factory = new WebUserFactory();
            _currentUser = factory.CreateWebUser();
        }
        return _currentUser;
}
```

Avoid multiple returns

```
private WebUser _currentUser;
 public WebUser getCurrentUser()
{
  if (_currentUser == null) _currentUser = GetWebUserFromSession();
     if (_currentUser == null) _currentUser = GetWebUserFromTrackingCookie();
     if (_currentUser == null) _currentUser = CreateNewWebUser();
     return _currentUser;
}
private WebUser GetWebUserFromSession()
{
     Object obj = HttpContext.Current.Session["__currentUser"];
     return obj == null ? null : (WebUser)obj;
}
private WebUser GetWebUserFromTrackingCookie()
{
     SecurityHelper secHelper = new SecurityHelper();
     WebUserRepository rep = new WebUserRepository();
     if (secHelper.TrackingGuid == Guid.Empty)
          return null;
     else
          return rep.GetWebUserByTrackingGuid(secHelper.TrackingGuid);
}
private WebUser CreateNewWebUser()
{
     WebUserFactory factory = new WebUserFactory();
     return factory.CreateWebUser();
}
```

```
double getPayAmount() {
  double result;
  if (_isDead) result = deadAmount();
  else {
   //logic
    if (_isSeparated) result = separatedAmount();
    else {
      //logic
      if (_isRetired) result = retiredAmount();
      else result = normalPayAmount();
    };
  }
  return result;
```

Replace Nested Conditional with Guard Clauses

```
double getPayAmount() {
  if (_isDead) return deadAmount();
  if (_isSeparated) return separatedAmount();
  if (_isRetired) return retiredAmount();
  return normalPayAmount();
};
```

```
public List<Integer> stringsToInts(
                    List<String> strings) {
    if (strings != null) {
        List<Integer> integers = new ArrayList<>();
        for (String s : strings) {
            integers.add(Integer.parseInt(s));
        }
        return integers;
    } else {
        return null;
    }
}
```

use Early returns

```
public List<Integer> stringsToInts2(
                    List<String> strings) {
   if (strings == null) {
      return null;
   }
   List<Integer> integers = new ArrayList<>();
   for (String s : strings) {
      integers.add(Integer.parseInt(s));
   }
   return integers;
}
```

- Reduces the number of indentations

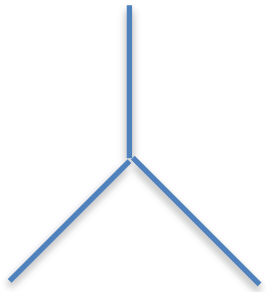
```
if (rowCount > rowIdx) {
      if(drc[rowIdx].Table.Columns.Contains("avalId")) {
      do {
            if (Attributes[attrVal.AttributeClassId] == null) {
            // do stuff
            }
            else {
                  if (!(Attributes[attrVal.AttributeClassId] is ArrayList)) {
                   // do stuff
            }
            else {
                  if (!isChecking) {
                  // do stuff
                  } else
                  {
                  // do stuff
                  } }
                  }
            rowIdx++;
      } while(rowIdx < rowCount && GetIdAsInt32(drc[rowIdx]) == Id);
}
else rowIdx++;
}
return rowIdx;
```

Cyclometic Complexity

```
public void ProcessPages()
{
 while(nextPage !=true)
 {
  if((lineCount<=linesPerPage) && (status != Status.Cancelled)
&& (morePages == true))
  {
   //....
  }
 }
}
```

Cyclometic Complexity

```
public int getValue(int param1)
{
 int value = 0;
 if (param1 == 0)
 {
  value = 4;
 }
 else
 {
  value = 0;
 }
 return value;
}
```



Cyclometic Complexity

CC Value	**Risk**
1-10	Low risk program
11-20	Moderate risk
21-50	High risk
>50	Most complex and highly unstable method

```
private int x;
public int increment_and_return_x()
{
  x = x + 1;
  return x;
}
```

Command / Query Separation

1. A **Query** doesn't have side effects and returns a result

e.g. `getState():State`, `isLoggedIn():boolean`, `findCustomer():Customer`

2. A **Command** changes the system state and returns `void`

e.g. `processOrder(Order)`, `consumeMessage(Message)`, `setName(String)`

- Avoid doing both in the same method

e.g. `processOrder(Order):boolean` (that returns `false` if it failed)

(It forces the caller to check the result right away. Prefer exceptions instead!)

```
private int x;
public int value()
{
  return x;
}
void increment()
{
  x = x + 1;
}
```

```
string result = _storeService.PurchaseItem(buyer, item);
```

Data Structure

```
Map sensors = new HashMap();

…

Sensor s = (Sensor)sensors.get(sensorId );
```

```
Map<int, Sensor> sensors = new HashMap<int, Sensor>();

...

Sensor s = sensors.get(sensorId );
```

Hide boundary (Map)

```
public class Sensors
 {
    private Map sensors = new HashMap();

    public Sensor getById(String id)
    {
        return (Sensor) sensors.get(id);
    }
    //snip
}
```

Code at the boundaries needs clear separation

Encapsulate Collection

```
private ArrayList fieldDetails = new ArrayList();
private HashMap linkedFields = new HashMap();


private void setTransactionParams(Hashtable params) {
    ...
}
```

Use collection framework interfaces, use generics

```
private List<Field> fieldDetails = new ArrayList<>();
private Map<String,FieldProperties> linkedFields = new
   HashMap<>();


private void setTransactionParams(Map<String,Object> params) {
   ...
}
```

```
private void setParameters(HashMap<String,String> parameters) {

}
```

Use interfaces instead of classes

```
private void setParameters(Map<String,String> parameters) {

}
```

basics

```
private List getTableColumns(Map tableFieldListMap) {
    Set tables = tableFieldListMap.keySet();
    Iterator iterator = tables.iterator();
    while(iterator.hasNext()) {
        String tableName = (String)iterator.next();
        ...
    }
}
```

Use generics, for..each loop

```
private List<String> getTableColumns(Map<String,Field>
   tableFieldListMap) {
   for(String tableName : tableFieldListMap.keySet()) {
        ...
   }
   ...
}
```

```
private static final String _ALPHABETS = "ALPHABETS";
private static final int _ALPHABETS_NO = 1;

private int getSwitchId(String value) {
        if(value.equals(_ALPHABETS)) {
                return _ALPHABETS_NO;
        }
        ...
}

int switchId = getSwitchId(data);
switch(switchId) {
   case _ALPHABETS_NO:
        ...
}
```

Use enum

```
private enum DataType {
   ALPHABETS,ALPHA_NUMERIC,NUMERIC,SWIFT,ALL,DATE,TIME
}

switch(DataType.valueOf(data)) {
   case ALPHABETS:
        ...
}
```

```
public String getUpdateQuery() {
   StringBuffer updateQuery = new StringBuffer();
   ...
   return updateQuery.toString();
}
```

Use StringBuilder for local variables

```
public String getUpdateQuery() {
   StringBuilder updateQuery = new StringBuilder();
   ...
   return updateQuery.toString();
}
```

```
strName = TextBox1.Text;
iAge = int.parse(TextBox2.Text);
```

Avoid Type Embedded in Name

```
name = TextBox1.Text;
age = int.pasre(TextBox2.Text);
```

Avoid placing types in method names; it's not only redundant, but it forces you to change the name if the type changes.

```
void Clean(int id)
{
        Person object = myCollection.get(id);
        boolean present = myCollection.remove(object);
}
```

Don't preserve return values you don't use

```
void Clean(int id)
{
        Person object = myCollection.get(id);
        myCollection.remove(object);
}
```

```
public class ServiceLocator {
   Map<String,Object> cache;

   public ServiceLocator() {
        cache = Collections.synchronizedMap(
                        new HashMap<String, Object>());
   }
}
```

ConcurrentHashMap has better performance than Collections.synchronizedMap

```
public class ServiceLocator {
   ConcurrentMap<String,Object> cache;

   public ServiceLocator() {
        cache = new ConcurrentHashMap<String, Object>());
   }
}
```

```
Map<String,String> parameters = new Hashtable<>();
```

ConcurrentHashMap has better performance than Hashtable

```
Map<String,String> parameters = new ConcurrentHashMap<>();
```

```
if(condition)
  do something
else
  do something else
```

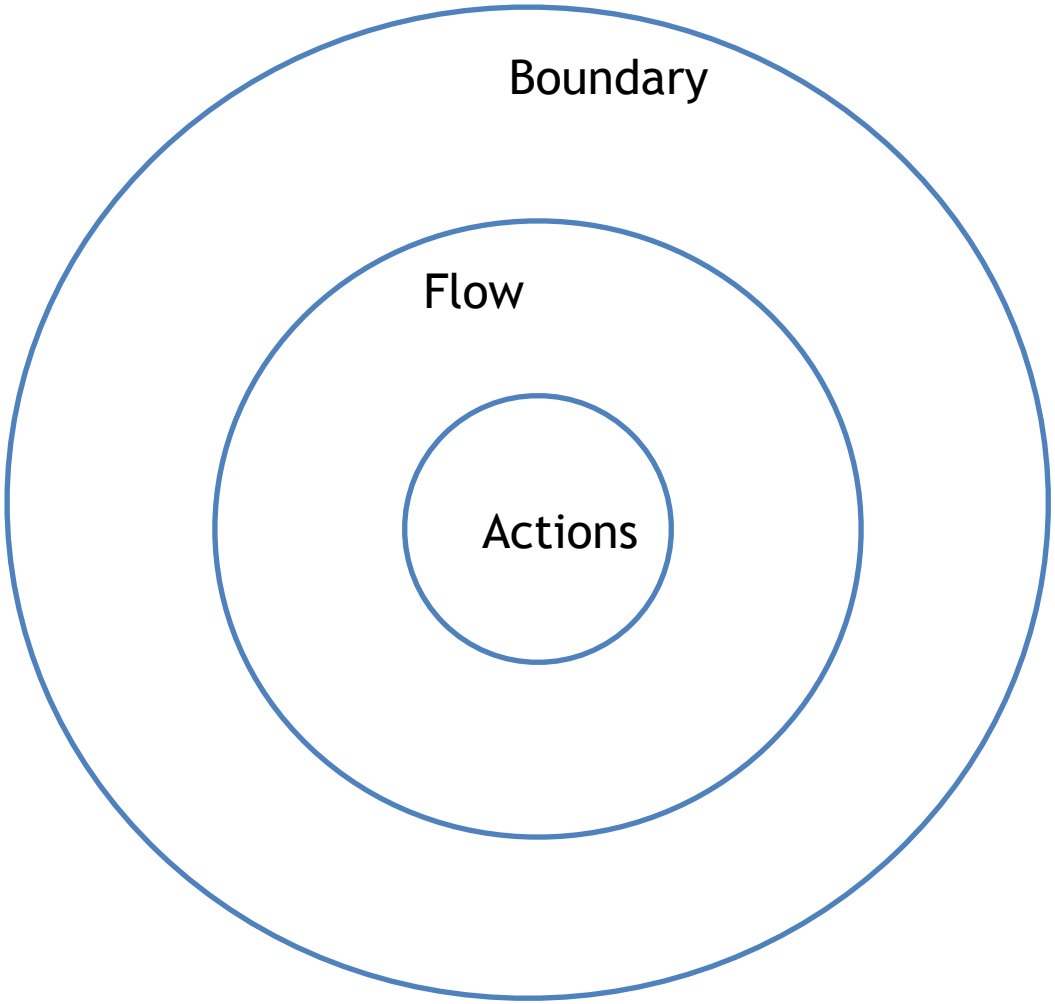
Use curly braces for if..else blocks

```
if(condition) {
  //do something
}
else {
  //do something else
}
```

```
public String getColumns(List<Field> fields) {
  String column = "";
  StringBuilder columns = new StringBuilder();
  for(Field field : fields) {
     column = field.getColumn();
     columns.append(column);
     columns.append(",");
  }
  return columns.toString();
}
```

Declare variable only where required

```
public String getColumns(List<Field> fields) {
  StringBuilder columns = new StringBuilder();
  for(Field field : fields) {
     String column = field.getColumn();
     columns.append(column);
     columns.append(",");
  }
  return columns.toString();
}
```


Boundary
Flow
Actions