Qualité des développements

De l'hypothèse à la proposition de solution !

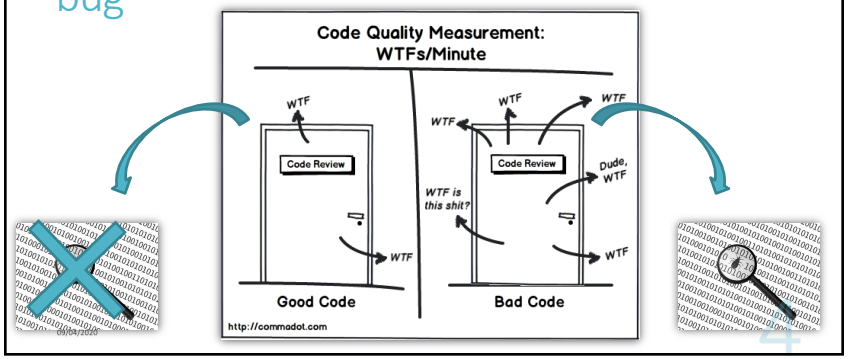
Xavier Blanc – IUF – Univ. Bordeaux

Pas (ou peu) de bug

Hypothèse

Comment expliquer les bugs?

Hypothèse : Clean Code => moins de bug



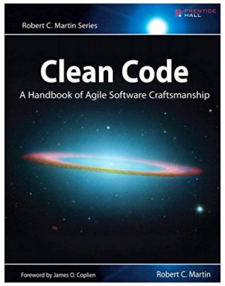
Coder Bien

Bon ou mauvais code ?

Pour la plupart,

- Un bon code est **lisible**
- Un mauvais code est *difficile à lire*, à comprendre

La qualité d'une application est décuplée quant le code est lisible et compréhensible



Nommage des variables

Un nom = une intention

Le nom doit porter l'intention et rien d'autre

Prononçables

Les noms vont être communiqués lorsqu'on parlera du code

Cherchable

On va chercher les noms (ctrl+f),


```
46  public class ConnectionFactory implements Cloneable {
47
48      /** Default user name */
49      public static final String DEFAULT_USER = "guest";
50      /** Default password */
51      public static final String DEFAULT_PASS = "guest";
52      /** Default virtual host */
53      public static final String DEFAULT_VHOST = "/";
54      /** Default maximum channel number;
55       *  zero for unlimited */
56      public static final int    DEFAULT_CHANNEL_MAX = 0;
57      /** Default maximum frame size;
58       *  zero means no limit */
59      public static final int    DEFAULT_FRAME_MAX = 0;
60      /** Default heart-beat interval;
61       *  60 seconds */
62      public static final int    DEFAULT_HEARTBEAT = 60;
```



```
92
93      private static final Version clientVersion =
94          new Version(AMQP.PROTOCOL.MAJOR, AMQP.PROTOCOL.MINOR);
95
96      /** The special channel 0 (<i>work</i> managed by the <code><b>_channelManager</b></code>) */
97      private final AMQChannel _channel0;
98
99      protected ConsumerWorkService _workService = null;
100
101     /** Frame source/sink */
102     private final FrameHandler _frameHandler;
103
104     /** Flag controlling the main driver loop's termination */
105     private volatile boolean _running = false;
106
107     /** Handler for (uncaught) exceptions that crop up in the {@link MainLoop}. */
108     private final ExceptionHandler _exceptionHandler;
109
110     /** Object used for blocking main application thread when doing all the necessary
```

```
if (frame.channel == 0) { // the special channel
    _channel0.handleFrame(frame);
} else {
```

```
String host = uri.getHost();
if (host != null) {
    setHost(host);
}

int port = uri.getPort();
if (port != -1) {
    setPort(port);
}

String userInfo = uri.getRawUserInfo();
if (userInfo != null) {
    String userPass[] = userInfo.split(":");
    if (userPass.length > 2) {
        throw new IllegalArgumentException("Bad user info in AMQP " +
                                           "URI: " + userInfo);
    }
```


Simplicité des fonctions

Une seule intention par fonction
- L'idéal est quand le corps de la fonction est une séquence

Un niveau d'abstraction
- Sinon la fonction fait trop de choses

Paramètres
- Un ou deux en lecture seule


```
/**
 * Convenience method for setting the fields in an AMQP URI: host,
 * port, username, password and virtual host.  If any part of the
 * URI is ommited, the ConnectionFactory's corre
 * is left unchanged.
 * @param uri is the AMQP URI containing the dat
 */
public void setUri(URI uri)
    throws URISyntaxException, NoSuchAlgorithmException, KeyManagementException
{
    if ("amqp".equals(uri.getScheme().toLowerCase())) {
        // nothing special to do
    } else if ("amqps".equals(uri.getScheme().toLowerCase())) {
        setPort(DEFAULT_AMQP_OVER_SSL_PORT);
        // SSL context factory not set yet, we use the default one
        if (this.sslContextFactory == null) {
            useSslProtocol();
        }
    } else {
        throw new IllegalArgumentException("Wrong
                                           uri.get
    }

    String host = uri.getHost();
    if (host != null) {
        setHost(host);
```

On s'attend à ce que la fonction écrive l'URI de l'objet (un setter)

Des tests sont effectués (check & set?)

Une configuration est opérée

En fait, elle set pleins d'information à partir d'une URI !!!


```
public Connection newConnection(Address[] addrs) throws IOException, TimeoutException {
    return newConnection(this.sharedExecutor, Arrays.asList(addrs), null);
}

public Connection newConnection(AddressResolver addressResolver) throws IOException, TimeoutException {
    return newConnection(this.sharedExecutor, addressResolver, null);
}

public Connection newConnection(Address[] addrs, String clientProvidedName) throws IOException, TimeoutException {
    return newConnection(this.sharedExecutor, Arrays.asList(addrs), clientProvidedName);
}

public Connection newConnection(List<Address> addrs) throws IOException, TimeoutExceptio
    return newConnection(this.sharedExecutor, addrs, null);
}

public Connection newConnection(List<Address> addrs, String clientProvidedName) throws IOE
    return newConnection(this.sharedExecutor, addrs, clientProvidedName);
}

public Connection newConnection(ExecutorService executor, Address[] addrs) throws IOExcept
    return newConnection(executor, Arrays.asList(addrs), null);
}

public Connection newConnection(ExecutorService executor, Address[] addrs, String clientProvidedName) throws IOException, TimeoutException
    return newConnection(executor, Arrays.asList(addrs), clientProvidedName);
}

public Connection newConnection(ExecutorService executor, List<Address> addrs) throws IOException, TimeoutException {
    return newConnection(executor, addrs, null);
}

public Connection newConnection(ExecutorService executor, List<Address> addrs, String clientProvidedName)
```

Trop de paramètres, les combinaisons sont trop nombreuses.

En fait on passe des options de connexion !

```
public Connection newConnection(ExecutorService executor, AddressResolver addressResolver, String clientProvidedName)
    throws IOException, TimeoutException {
    if(this.metricsCollector == null) {
        this.metricsCollector = new NoOpMetricsCollector();
    }
    // make sure we respect the provided thread factory
    FrameHandlerFactory fhFactory = createFrameHandlerFactory();
    ConnectionParams params = params(executor);
    // set client-provided via a client property
    if (clientProvidedName != null) {
        Map<String, Object> properties = new HashMap<String, Object>(params.getClientProperties());
        properties.put("connection_name", clientProvidedName);
        params.setClientProperties(properties);
    }

    if (isAutomaticRecoveryEnabled()) {
        // see com.rabbitmq.client.impl.recovery.RecoveryAwareAMQConnectionFactory#newConnection
        AutorecoveringConnection conn = new AutorecoveringConnection(params, fhFactory, addressResolver, metricsCollector);

        conn.init();
        return conn;
    } else {
        List<Address> addrs = addressResolver.getAddresses();
        Exception lastException = null;
        for (Address addr : addrs) {
            try {
                FrameHandler handler = fhFactory.create(addr, clientProvidedName);
                AMQConnection conn = createConnection(params, handler, metricsCollector);
                conn.start();
                this.metricsCollector.newConnection(conn);
```

Le choix de la surcharge rend la fonction bien complexe !

Commenter ou Coder

Un commentaire n'améliore pas un mauvais code

- On écrit souvent un commentaire sur un module mal codé.
- Cela ne changera pas le problème.
- Il faut recoder le module et le rendre plus clair.

Le code s'explique lui-même

- Mettre des commentaires dans le code ne sert à rien, le code doit se lire et être intelligible


```
     * garbage collected when the connection object is no longer referenced.
     */
    public void start()
            throws IOException, TimeoutException {
        initializeConsumerWorkService();
        initializeHeartbeatSender();
        this._running = true;
        // Make sure that the first thing we do is to send the header,
        // which should cause any socket errors to show up for us, rather
        // than risking them pop out in the MainLoop
        AMQChannel.SimpleBlockingRpcContinuation connStartBlocker =
            new AMQChannel.SimpleBlockingRpcContinuation();
        // We enqueue an RPC continuation here without sending an RPC
        // request, since the protocol specifies that after sending
        // the version negotiation header, the client (connection
        // initiator) is to wait for a connection.start method to
        // arrive.
        _channel0.enqueueRpc(connStartBlocker);
        try {
            // The following two lines are akin to AMQChannel's
            // transmit() method for this pseudo-RPC.
            _frameHandler.setTimeout(handshakeTimeout);
            _frameHandler.sendHeader();
        } catch (IOException ioe) {
            _frameHandler.close();
            throw ioe;
        }

        this._frameHandler.initialize(this);
```



```
        // We can now respond to errors having finished tailoring the connection
        this._inConnectionNegotiation = false;
    }
```

```
    /**
     * Protected API - set the heartbeat timeout. Should only be called
     * during tuning.
     */
    public void setHeartbeat(int heartbeat) {
        try {
            _heartbeatSender.setHeartbeat(heartbeat);
            _heartbeat = heartbeat;

            // Divide by four to make the maximum unwanted delay in
            // sending a timeout be less than a quarter of the
            // timeout setting.
            _frameHandler.setTimeout(heartbeat * 1000 / 4);
        } catch (SocketException se) {
            // should do more here?
        }
    }
```

```
223     /**
224      * Convenience method for setting the fields in an AMQP URI: host,
225      * port, username, password and virtual host.  If any part of the
226      * URI is ommited, the ConnectionFactory's corresponding variable
227      * is left unchanged.
228      * @param uri is the AMQP URI containing the data
229      */
230     public void setUri(URI uri)
231         throws URISyntaxException, NoSuchAlgorithmException, KeyManagementException
232     {
233         if ("amqp".equals(uri.getScheme().toLowerCase())) {
234             // nothing special to do
235         } else if ("amqps".equals(uri.getScheme().toLowerCase())) {
236             setPort(DEFAULT_AMQP_OVER_SSL_PORT);
237             // SSL context factory not set yet, we use the default one
238             if (this.sslContextFactory == null) {
239                 useSslProtocol();
240             }
241         } else {
242             throw new IllegalArgumentException("Wrong scheme in AMQP URI: " +
243                                                uri.getScheme());
244         }
245
246         String host = uri.getHost();
247         if (host != null) {
248             setHost(host);
```


Validation de l'hypothèse

La qualité du code est-elle liée au nombre de bug ?

Défaut vs Bug

Un défaut rend le code moins lisible

Le code sera donc plus difficile à maintenir, à optimiser, à améliorer, à corriger, etc.

Un défaut n'est pas forcément la source d'un bug

Un bug dans le code est la cause d'une erreur dans l'application

Les conséquences d'un bug sont donc mesurables

La sévérité du bug est calculée en fonction de l'impact qu'il cause

=> plus il y a de défauts, plus il y a de bugs

Bad Smell : identifier les défauts

Les Bad Smells sont des indices pour identifier des défauts potentiels

Calculables automatiquement, les Bad Smells pointent les éléments du code à surveiller

L'objectif des Bad Smells est d'offrir une estimation quantitative du nombre de défauts

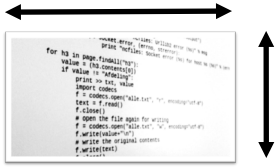
Attention, l'absence de Bad Smell ne veut pas dire qu'il n'y a pas de défaut

Taille

La taille du code est un très bon indicateur des défauts

Le code propre doit être petit, donc un grand code contient probablement des défauts

Les Bad Smell de taille
- LOC (Ligne de Code)
- Largeur des lignes
- Nombre de classes,
- Nombre de fonctions,
- etc.

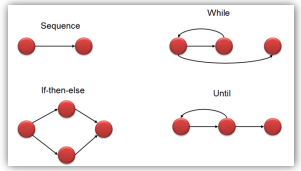


Complexité

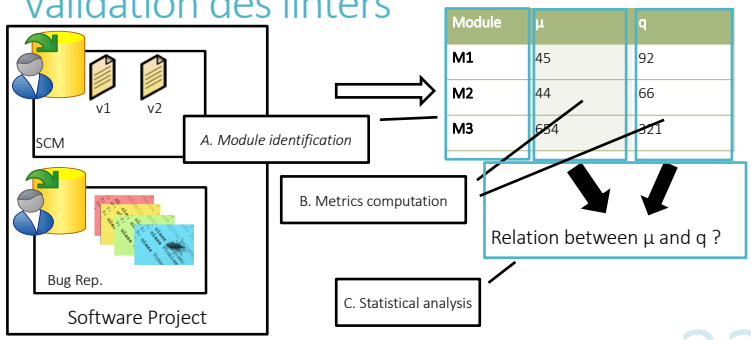
La complexité peut être mesurée en comptant le nombre de chemins dans le code

Plus un code est complexe moins il est lisible

Les Bad Smell de complexité
- McCabe complexity
- Nombre de paramètres
- Nombre de switch case
- Nombre de return



Validation des linters



Nagappan Ball Zeller 06

Corrélation Métriques / Bug pour identifier les composants critiques

L'objectif étant de focaliser la maintenance sur ces composants

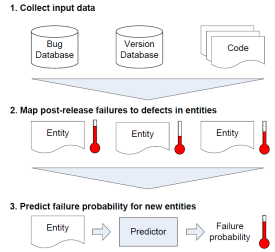


Figure 1. After mapping historical failures to entities, we can use their complexity metrics to predict failures of new entities.

Corrélation

Metric	Description		Correlation with post-release defects of M				
			A	B	C	D	E
Module metrics — correlation with metric in a module M							
Classes	# Classes in M		**0.531**	**0.612**	**0.713**	0.066	0.438
Functions	# Functions in M		0.131	**0.699**	**0.761**	0.104	**0.531**
GlobalVariables	# global variables in M		0.023	**0.664**	**0.695**	0.108	0.460
Per-function metrics — correlation with maximum and sum of metric across all functions $f()$ in a module M							
Lines	# executable lines in $f()$	Max	-0.236	**0.514**	**0.585**	**0.496**	**0.509**
		Total	0.131	**0.709**	**0.797**	0.187	**0.506**
Parameters	# parameters in $f()$	Max	-0.344	0.372	**0.547**	0.015	0.346
		Total	0.116	**0.689**	**0.790**	0.152	0.478
Arcs	# arcs in $f()$'s control flow graph	Max	-0.209	0.376	**0.587**	0.527	0.444
		Total	0.127	**0.679**	**0.803**	0.158	**0.484**
Blocks	# basic blocks in $f()$'s control flow graph	Max	-0.245	0.347	**0.585**	0.546	0.462
		Total	0.128	**0.707**	**0.787**	0.158	0.472
ReadCoupling	# global variables read in $f()$	Max	-0.005	**0.582**	**0.633**	0.362	0.229
		Total	-0.172	**0.676**	**0.756**	0.277	0.445
WriteCoupling	# global variables written in $f()$	Max	0.043	**0.618**	**0.392**	0.011	0.450
		Total	-0.128	**0.629**	**0.629**	0.230	0.406
AddrTakenCoupling	# global variables whose address is taken in $f()$	Max	0.237	**0.491**	**0.412**	0.016	0.263
		Total	0.182	**0.593**	**0.667**	0.175	0.145
ProcCoupling	# functions that access a global variable written in $f()$	Max	-0.063	**0.614**	**0.496**	0.024	0.357
		Total	0.043	**0.562**	**0.579**	0.000	0.443
FanIn	# functions calling $f()$	Max	0.034	**0.578**	**0.846**	0.037	**0.530**
		Total	0.066	**0.676**	**0.814**	0.074	**0.537**

Dépend des métriques mais aussi du logiciel

Combiner les métriques

Table 5. Regression models and their explanative power

Project	Number of principal components	% cumulative variance explained	R^2	Adjusted R^2	F - test
A	9	95.33	**0.741**	0.612	5.731, $p < 0.001$
B	6	96.13	**0.779**	0.684	8.215, $p < 0.001$
C	7	95.34	**0.579**	0.416	3.541, $p < 0.005$
D	7	96.44	**0.684**	0.440	2.794, $p < 0.077$
E	5	96.33	**0.919**	0.882	24.823, $p < 0.0005$

Mais …

Table 6. Predictive power of the regression models in random split experiments

Project	Correlation type	Random split 1	Random split 2	Random split 3	Random split 4	Random split 5
A	Pearson	**0.480**	**0.327**	**0.725**	-0.381	**0.637**
	Spearman	**0.238**	**0.185**	**0.693**	-0.602	**0.422**
B	Pearson	-0.173	**0.410**	**0.181**	**0.939**	**0.227**
	Spearman	-0.055	**0.054**	**0.318**	**0.906**	**0.218**
C	Pearson	**0.559**	-0.539	-0.190	**0.495**	-0.060
	Spearman	**0.445**	-0.165	**0.050**	**0.190**	**0.082**
D	Pearson	**0.572**	**0.845**	**0.522**	**0.266**	**0.419**
	Spearman	**0.617**	**0.828**	**0.494**	**0.494**	**0.494**
E	Pearson	-0.711	**0.976**	-0.818	**0.418**	**0.007**
	Spearman	-0.759	**0.577**	-0.883	**0.120**	**0.152**

Predictors are accurate only when obtained from the same or similar projects.

Approche

Constat => Manque d'engagement !

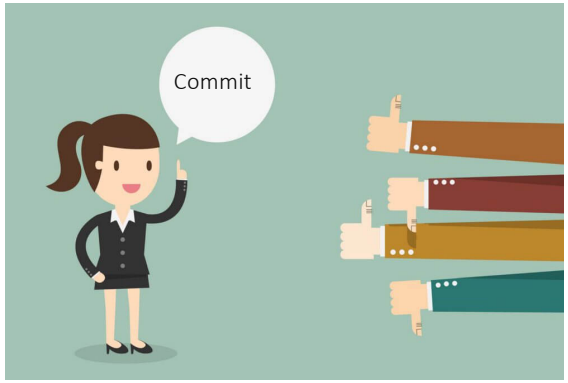
09/04/2020

29

Partenariat Industriel CNRS – ESN

09/04/2020

30



Concept 1 - Retour Personnalisé

09/04/2020

31

Concept 2 - Gamification

09/04/2020

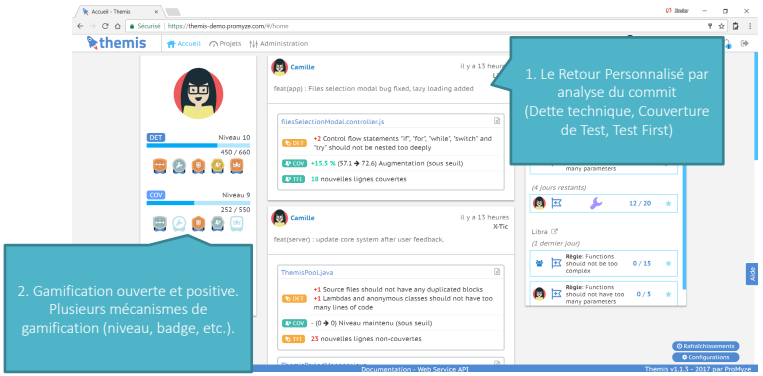
32

Etude de Concepts

Focus Group
- Grande ESN
- Développeurs (env. 30)
- Plusieurs projets
- Plusieurs mois

09/04/2020

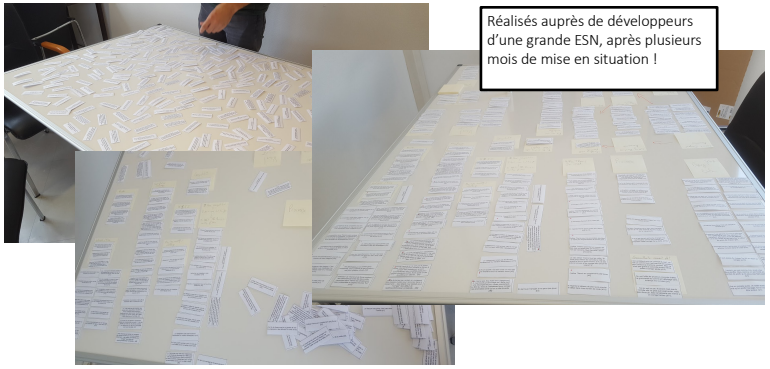
33



Un outil qui supporte les 2 concepts

09/04/2020

34

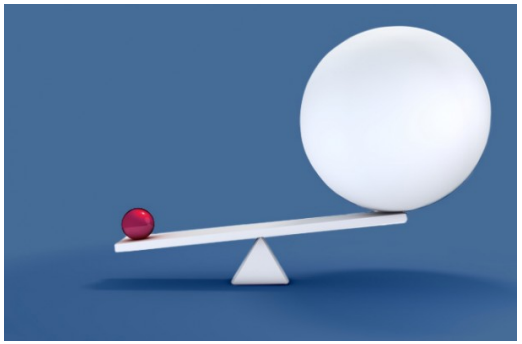


Réalisés auprès de développeurs d'une grande ESN, après plusieurs mois de mise en situation !

Analyse Qualitative : Interviews

09/04/2020

35



Less is More

09/04/2020

36

Prise de Conscience
Vs. Connaissance

09/04/2020

37

09/04/2020

38

Compétition

09/04/2020

39

Evaluation Personnelle

09/04/2020

40

La Gamification n'est pas un jeu !

Conclusion