

Further Steps in Enterprise Application Development

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Java 8 – 21 Features



Cycles Simplification

How to do make simpler?

```
List<LocalDate> myReports = new ArrayList<>();  
for (Report r : reports) {  
    if (r.isActive()) {  
        if (r.getAuthor().equals(me)) {  
            myReports.add(r.getDueTo());  
        }  
    }  
}  
Collections.sort(myReports);
```

Nothing wrong, business as usual. Can we do it better?



Cycles Simplification

Is this better/more readable?

```
List<LocalDate> myReports = reports.stream()  
    .filter((Report r) -> r.isActive())  
    .filter((Report r) -> r.getAuthor().equals(me))  
    .map((Report r) -> r.getDueTo())  
    .sorted()  
    .toList();
```

...and we can continue...



Cycles Simplification

We can remove types...

```
List<LocalDate> myReports = reports.stream()  
    .filter(r -> r.isActive())  
    .filter(r -> r.getAuthor().equals(me))  
    .map(r -> r.getDueTo())  
    .sorted()  
    .toList();
```

...and we can continue...



Cycles Simplification

We can use method reference...

```
public static boolean isMyReport (Report r) {  
    return r.equals (me);  
}
```

```
List<LocalDate> myReports = reports.stream()  
    .filter (Report::isActive)  
    .filter (TestFunctional::isMyReport)  
    .map (Report::getDueTo)  
    .sorted()  
    .toList();
```

...Let's compare it on the next slide!



Cycles Simplification

Before

```
List<LocalDate> myReports = new ArrayList<>();  
for (Report r : reports) {  
    if (r.isActive()) {  
        if (r.getAuthor().equals(me)) {  
            myReports.add(r.getDueTo());  
        }  
    }  
}  
Collections.sort(myReports);
```

After

```
List<LocalDate> myReports = reports.stream()  
    .filter(Report::isActive)  
    .filter(TestFunctional::isMyReport)  
    .map(Report::getDueTo)  
    .sorted()  
    .toList();
```


Stream

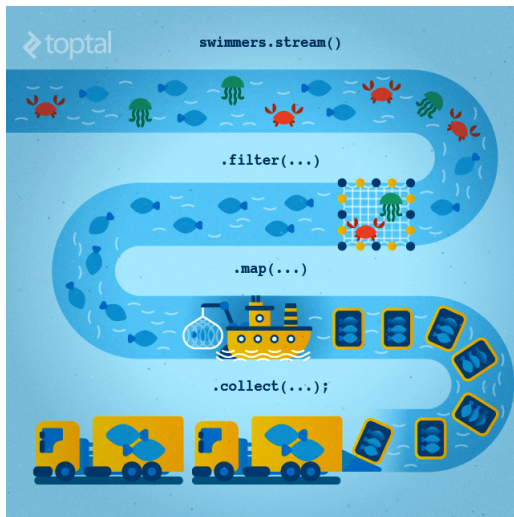


Figure: Stream processing visualization. Source: <https://www.toptal.com/java/why-you-need-to-upgrade-to-java-8-already>

Lambda for Multithreaded Application

So far it was just a syntax sugar. BUT! How easily can you write multithreaded apps?

```
List<LocalDate> myReports = reports.stream()  
    .parallel() // run on multiple threads!  
    .filter(RemoteVerification::isValid) // calls outside service  
    .toList();
```



Optional

Before

```
title = reports.get(0).getTitle(); // I want this!

Report r = reports.get(0);
Band header = r.getHeaderBand();
if(header!=null) {
    title = header.getTitle();
    if(title==null) {
        title = "Default Title";
    }
}
```

After

```
String title = Optional.of(reports)
    .map(reports -> reports.get(0))
    .map(Report::getHeaderBand)
    .map(Band::getTitle)
    .orElse("Default Title");
```

Log4j

Before – annoying

```
if(log.isDebugEnabled()) {  
    log.debug(prepareDataForLog());  
}
```

Simple – useless overhead if not used

```
log.debug(prepareDataForLog());
```

Functional – simple and effective

```
log.debug(() -> prepareDataForLog());
```



Couple of Usefulness

Switch Expression

```
int value = switch (day) {  
    case MONDAY, FRIDAY, SUNDAY -> 6;  
    case TUESDAY -> 7;  
    case THURSDAY, SATURDAY -> 8;  
    case WEDNESDAY -> 9;  
    default -> throw new IllegalStateException("Invalid day: " + day);  
}
```

Records aka Lombok

```
record Point(int x, int y) {}
```



Couple of Usefulness

Text Blocks

```
public static final String SAMPLE_ENTRY
    = """
      R 6 (#70c710)
      D 5 (#0dc571)
      L 2 (#5713f0)
      """;
```

Virtual Threads

```
Thread.startVirtualThread(() -> {
    // do async job
});
```



...and Many Others

- `Collectors.teeing`,
- `String.repeat(n)` or `Stream<String> lines()`
- `if(abj instanceof String str) {}`
- JMH
- `NullPointerException: a.b.c()`
- shebang
- Vector API (Incubator)
- Foreign Function and Memory API (Incubator)



Agile World



Waterfall, Model V

- What's wrong with waterfall, model V (e.g. detailed planning before programming)? Everything!
 - Detailed analysis becomes useless immediately after programming starts – many assumptions are wrong.
 - Detailed long-time planning is crazy – can you say, what you will do on October 21st next year in the morning? And afternoon?
 - Users tend to change their minds when they see the first version.
 - Programming takes long time and situation changes.
 - Studies have shown that in over 80 % of the investigated and failed software projects, the usage of the Waterfall methodology was one of the key factors of failure. https://www.scrum-institute.org/What_Makes_Waterfall_Fail_in_Many_Ways.php



Agile Style of Work

- Principles (see agilemanifesto.org)
 - Individuals and interactions over processes and tools
 - Working software over comprehensive documentation
 - Customer collaboration over contract negotiation
 - Responding to change over following a plan
- Pair programming
- SCRUM or Canban
- Cooperation is much more important than individual success.
- **Frequent and regular increments!** Often are shared with customers.
- ... e.g. you have a release several times a day – you need CI.



Continuous Integration

- After every commit, build is verified – including unit tests
- At least once a day, the whole product is deployed – including functional tests
- UI tests are done frequently (can take hours)
- ...all automated.
- Quick detection of errors, cheaper fixes, fewer integration issues.



CI Tools

Version Control

- **Git**, others: CSV, Subversion, Bazaar, Mercurial, Bitkeeper, RTC...
- Pro GIT (Chapter 1 Introduction, Chapter 2 Basics, Chapter 3 Branches)

CI Servers

- **Jenkins**
 - Open-source, easy to setup,
 - Highly configurable, lots of plugins.
- **TeamCity**
 - Free for 3 agents and 20 build configurations,
 - Developed by JetBrains,
 - More suitable for enterprises – beast.
- **Github/Gitlab CI**
- Today's servers concentrate on whole process including deployment to cloud.

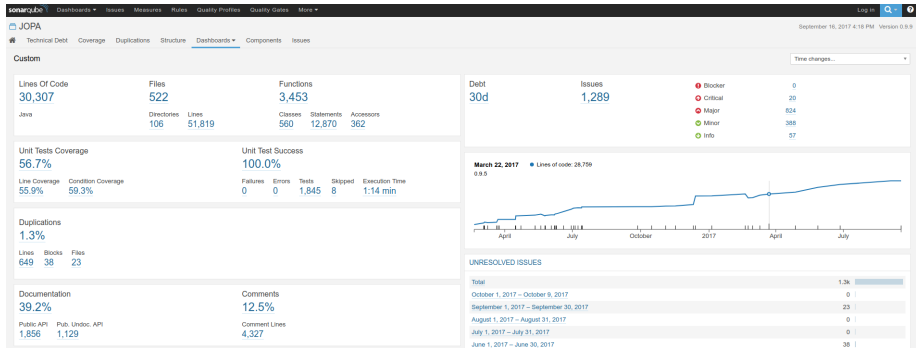
Static Code Analysis

- Analyze code structure or flows, don't run it.
- Full-featured IDEs contain some sort of SCA.
- **Checkstyle** – checks just formatting.
- **SpotBugs¹(FindBugs)** – simple and pretty fast check, can find adding to String inside cycle, impossible equals, bad null handling. . .
- **Sonarqube** – server-side analysis, long, discovers data flow from database to servlet (e.g. finds XSS)

¹<https://jenkins.payara.fish/view/All/job/Spotbugs-Payara6-Build/>



Sonarqube



JOPA JOPA - Implementation src/main/java/cz/cvut/kbsa/jopa/model/EntityManagerImpl.java

Do not override the Object.finalize() method.

Critical Open Not assigned Not planned 20min debt

2 years ago L516

cert, unpredictable

JOPA JOPA - Implementation src/main/java/cz/cvut/kbsa/jopa/model/metamodel/ManagedClassProcessor.java

Either log or rethrow this exception.

Critical Open Martin Ledvinka Not planned 10min debt

10 months ago L87

error-handling, security



12 Factor App 1/2

- <https://12factor.net/>
- I. Codebase
 - One codebase tracked in revision control, many deploys
- II. Dependencies
 - Explicitly declare and isolate dependencies
- III. Config
 - Store config in the environment
- IV. Backing services
 - Treat backing services² as attached resources
- V. Build, release, run
 - Strictly separate build and run stages
- VI. Processes
 - Execute the app as one or more stateless processes

²db, messaging server



12 Factor App 2/2

- VII. Port binding
 - Export services via port binding
- VIII. Concurrency
 - Scale out via the process model
- IX. Disposability
 - Maximize robustness with fast startup and graceful shutdown
- X. Dev/prod parity
 - Keep development, staging, and production as similar as possible
- XI. Logs
 - Treat logs as event streams
- XII. Admin processes
 - Run admin/management tasks as one-off processes



Application Monitoring and Administration



Java Management Extensions (JMX)

- Allow management of resources in an application,
- Standard part of the Java platform,
- Resources represented by *Managed Beans* (*MBeans*), registered in an *MBean* server,
- Accessible via JMX connectors.

Managed Beans

- Operations (MBean methods), through which the application can be managed,
- Attributes (getters/setters) for information/configuration.



Application Management via JMX

- Connect to application with *JConsole*,
- Locate the desired MBean,
 - Invoke managed operations,
 - View/configure attributes,
- MBean server set up in Spring – `@EnableMBeanExport`.

The screenshot shows the JConsole interface with the 'MBeans' tab selected. The left pane displays a tree of MBeans, with 'ch.qos.logback.classic.jmx.JMXConfigurator' selected. The right pane shows the details for this MBean.

MBeanInfo	
Name	Value
Info:	
ObjectName	ch.qos.logback.classic.Name=default;Type=ch.qos.logback.classic.jmx.JMXConfigurator
ClassName	ch.qos.logback.classic.jmx.JMXConfigurator
Description	Information on the management interface of the MBean
Constructor-0:	
Name	ch.qos.logback.classic.jmx.JMXConfigurator
Description	Public constructor of the MBean
Parameter-0-0:	
Name	p1
Description	
Type	ch.qos.logback.classic.LoggerContext
Parameter-0-1:	
Name	p2
Description	
Type	javax.management.MBeanServer
Parameter-0-2:	
Name	p3
Description	
Type	javax.management.ObjectName
Descriptor	
Name	Value
Info:	
immutableInfo	true
interfaceClassName	ch.qos.logback.classic.jmx.JMXConfiguratorMBean
mbean	false



More Tools

JDK

- **jmap** – memory-related statistics about a VM, obsolete,
 - **jcmd** – send diagnostic commands to JVM, internally used by the GUI tools,
 - **jstat** – monitors JVM statistics, lots of options.
-
- **Eclipse MAT** – advanced memory analyzer,
 - **Java Mission Control** and **Java Flight Recorder** – commercial JVM monitoring tools by Oracle,
 - **StageMonitor**, **MoSKito** etc. – open source alternatives.
 - **CA Wily** – very famous and very detailed monitoring of JavaEE



Database Versioning



Database Versioning

- JPA provides a possibility to create missing tables
- ... useless when table is changed
- Libraries: **Liquibase** and **Flyway**
- A list of changes is recorded, keeps current database version
- Application keeps steps to upgrade from one version to the next
- The most reliable way
- Alternatives: direct upgrades from older version (leads to multiple ways – hard testing), creating SQL scripts (customers tend to make mistakes during deployment, problematic error handling)
- Example of bad database upgrade:
`https://docs.gitlab.com/ee/update/#upgrade-paths`
- Martin Fowler: Evolutionary Database Design



Production



Production Environments

- As usual – supported servers inside client's network (Payara, Glassfish, TomEE, WildFly, WebSphere)
- Hosted – our servers in server houses
- Clouds, Docker
 - Problem with acceptance in banks
 - Cloud requires multitenancy application, e.g. there is a big risk of information leak, very rare
 - Docker seem a good choice, pack of all required software, needs just CPU, memory, disk space, TCP/IP ports.



What We Actually Use

- Versioning: git, github, gitlab
- CI: Jenkins, investigating Gitlab CI
- Code analysis: Spotbugs
- IDE: NetBeans :-), Idea (In fact, this doesn't matter.)
- Servers: Payara, TomEE, less Glassfish, WebSphere, WildFly
- Databases: PostgreSQL, MSSQL, Oracle
- Monitoring: JavaMelody
- OS: our systems – Linux, clients often Windows, recently Docker



The End

Thank You

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Resources

- R. Urma, M. Fusco and A. Mycroft: *Java 8 in Action*
- <http://www.oracle.com/technetwork/articles/java/ma14-java-se-8-streams-2177646.html>
- <https://martinfowler.com/articles/continuousIntegration.html>
- <https://www.martinfowler.com/articles/evodb.html>
- <http://docs.oracle.com/javase/tutorial/jmx/mbeans/index.html>
- <http://docs.oracle.com/javase/7/docs/technotes/guides/management/jconsole.html>
- <https://github.com/javamelody/javamelody/wiki>

