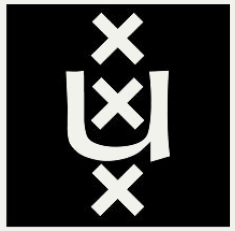


UNIVERSITEIT VAN AMSTERDAM

Code Quality

Software Construction 2018

Dr. Vadim Zaytsev aka @grammarware

raincode

LABS

compiler experts

Test

- Link in today's email
- Next week: last lecture!
- Prepare a screencast (~30min)

Screencast

- Technically any platform
- Identification (accounts + photos?)
- Language + frameworks
- Parsing (syntactic analysis)
- AST (design)
- Static analysis (type check)
- Interpretation (rendering)
- Styling (QLS)

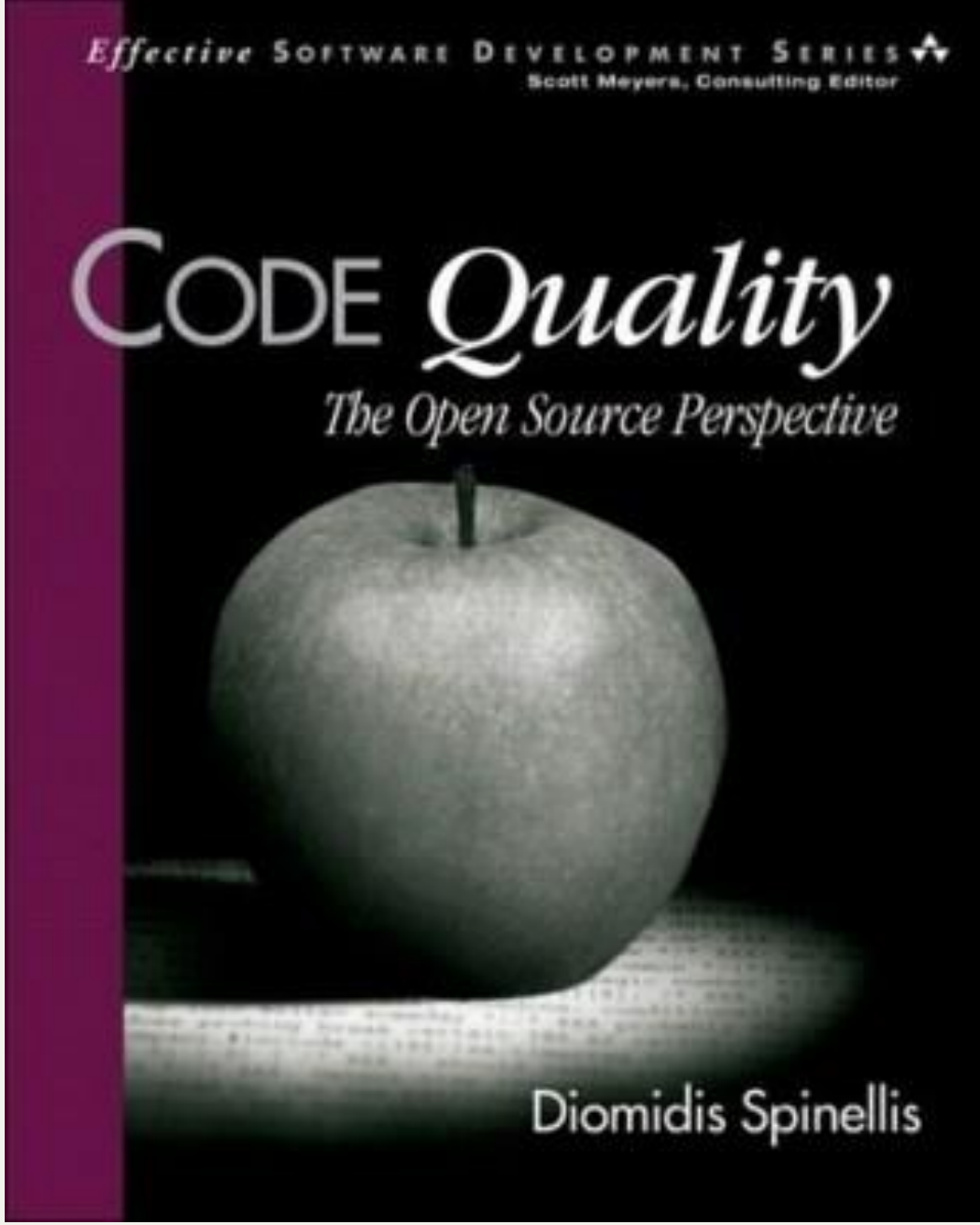
Code Quality

- Robustness of code
- Amount of flaws / defects
- Lack of errors / less bugs
- Maintanability / readability
- Requirements satisfaction / meeting standards
- Meeting functional req / nonfunction req
- How well software is designed / complies to design
- All sorts of things

(your test results)

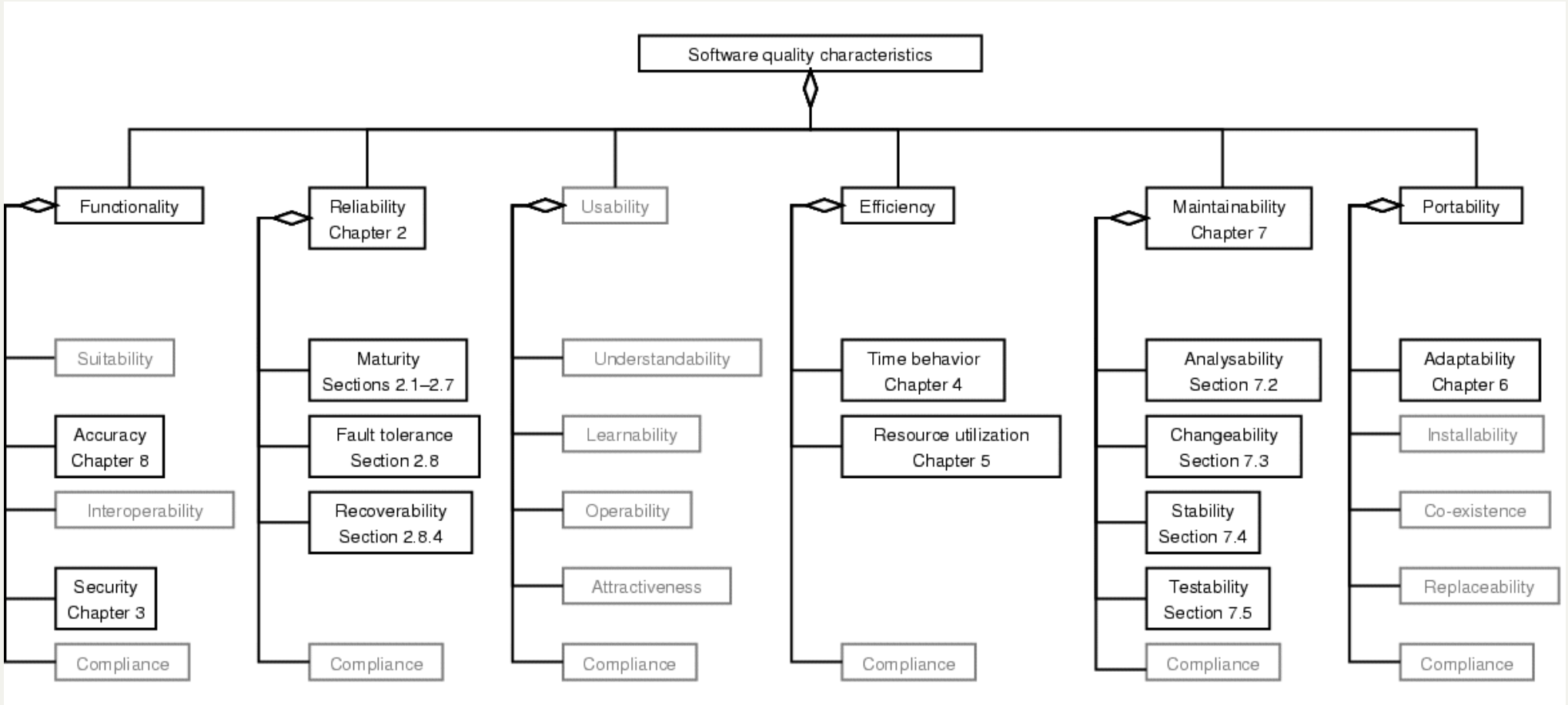
Code Quality

- Quality in use
  - bugs that manifest
- External quality
  - benchmarked
- Internal quality
  - examine, not run
- Process quality
  - accident?



Diomidis Spinellis. *Code Quality: The Open Source Perspective*. Addison Wesley, 2006

Software quality characteristics



Diomidis Spinellis. *Code Quality: Introduction*, CC-BY-SA, 2006.

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ISO 25010

Functional suitability

- Obvious
- Completeness
  - cover all tasks & objectives
- Correctness
  - accuracy of results
- Appropriateness
  - suitability

ISO/IEC 25010:2011, cited via http://iso25000.com

Correctness example: floating point

- Inherently imprecise?
- ANSI/IEEE 754-1985 aka IEC 60559:1989
- Integers from $[-2^{53}, 2^{53}]$ are exact
  - represented by bit sequences
- $0.5 = 2^{-1}$ is exact; $0.0126953125 = 2^{-7} + 2^{-8} + 2^{-10}$ is exact
- $0.2 \simeq 2^{-3} + 2^{-4} + 2^{-7} + 2^{-8} + 2^{-11} + 2^{-12} + \ldots + 2^{-54}$
  $= 0.19999999999999955591079014993738383054733276367187 5$
- Error is measured in ULP
- Rounding? Memory format? Implied 1? Overflow? Cancellation? Absorption?

ISO 25010

Performance & Efficiency

- Time behaviour
  - latency (response time), processing time
- Resource utilisation
  - humans included
- Capacity
  - bandwidth, throughput, database size

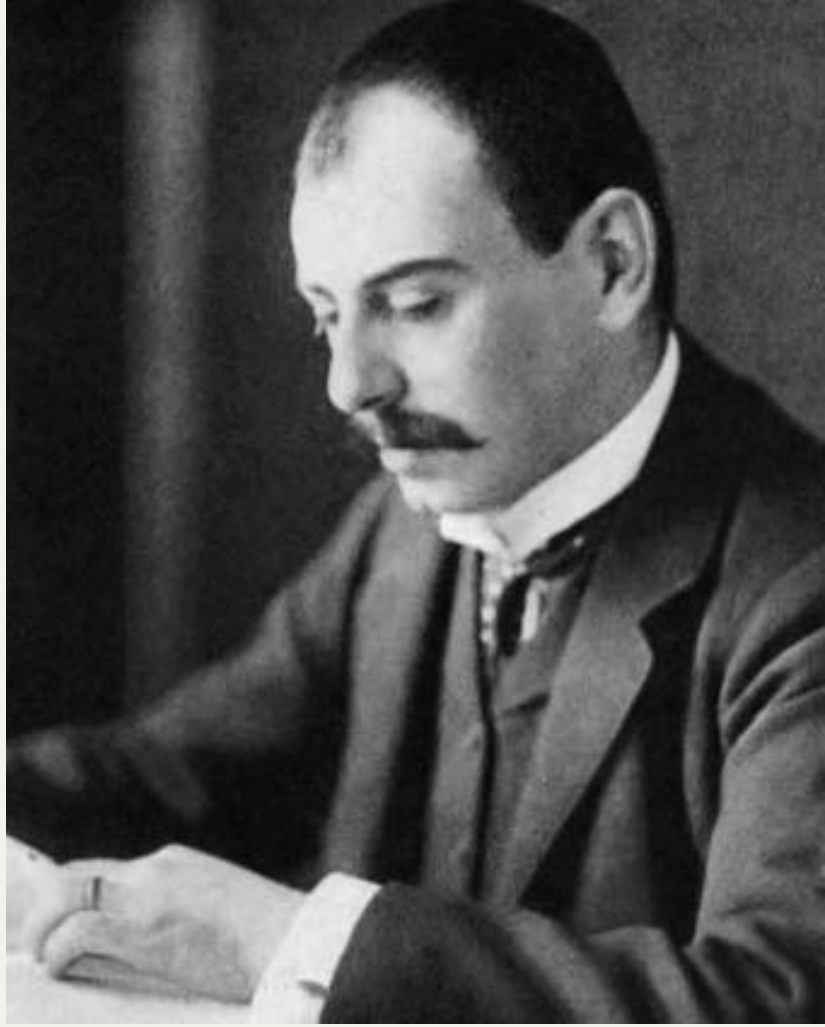
ISO/IEC 25010:2011, cited via http://iso25000.com

Quotes about efficiency

- *Do not strive to write fast programs—strive to write good ones.* (Joshua Bloch)
- *Premature optimization is the root of all evil (or at least most of it) in programming.* (Donald Knuth)
- *A fast program is just as important as a correct one—false!* (Steve McConnell)
- *Optimizations always bust things, because all optimizations are, in the long haul, a form of cheating, and cheaters eventually get caught.* (Larry Wall)
- *The key to performance is elegance, not battalions of special cases. The terrible temptation to tweak should be resisted unless the payoff is really noticeable.* (Jon L. Bentley & M. Douglas McIlroy)

Perf analysis

- Workload
  - user time; kernel time; idle time
- Profiles
  - running time ~ user time?
  - kernel time > user time?
  - running time >> user time + kernel time
- Algorithm complexity
  - const < log < linear < loglinear < quadratic < cubic < exp < fac
- Average complexity vs worst-case complexity



ISO 25010

Compatibility

- Co-existence
  - reach goals without bad impact on others
- Interoperability
  - systems can collaborate to reach goals
  - seamlessness?
- When the concern was raised?
  - early: common central design
  - mid: mappings to/from common schema
  - late: megamodelling & synchronisation

ISO/IEC 25010:2011, cited via http://iso25000.com

J.C.Wileden, A.Kaplan, *Software Interoperability: Principles and Practice*, ICSE 1999.

ISO 25010

Usability

- Appropriateness recognisability
- Learnability
- Operability
- User error protection
- UI aesthetics
- Accessibility

- Questionnaires!

ISO/IEC 25010:2011, cited via http://iso25000.com

N. Shedroff, C. Nossel, *Make It So*, 2012.
J. Kosinski, *Oblivion*, 2013.

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ISO 25010

Reliability

- Maturity
  - reliable in normal circumstances
- Availability
  - is up
- Fault tolerance
  - reliable despite faults
- Recoverability
  - reestablish program state
- *Investment in reliability will increase until it exceeds the probable cost of errors, or until someone insists on getting some useful work done.*

(Gilb's Fourth Law of Unreliability)

ISO/IEC 25010:2011, cited via http://iso25000.com

Maturity up close

- Input
  - lexer/parser, XML lib, validating widgets; shotgun parsing
- Output
  - incompleteness or wrong format
- Logic
  - off-by-one, neglected extremes, forgotten cases, missing methods
- Computation & data handling
  - algorithm, operand, operators, uninitialised, null, type cheating
- Timing
  - race conditions
- Interfacing

ISO 25010

Security

- Confidentiality
  - only authorised data access
- Integrity
- Non-repudiation
  - actions can be proven to have taken place
- Authenticity
  - provable identity
- Accountability
  - actions traced back to the entity

ISO/IEC 25010:2011, cited via http://iso25000.com

Some security advice

- Ignore vulnerable code
- Most common vulnerability?
- Race conditions are insecure
  - TOC2TOU
- Some API are more secure than others
  - strcpy vs strlcpy, gets vs fgets
- Shell
  - metachars, .com vs .exe
- Temporary files and other forms of leakage

ISO 25010

Maintainability

- Modularity
  - changes do not propagate, coupling & dependencies, separation
- Reusability
  - can be reprofiled
- Analysability
  - consistency, conventions, indentation, size
- Modifiability
  - changeability, stability, identification, patterns, encapsulation
- Testability
  - unit, integration, system, incidental, logging,

ISO/IEC 25010:2011, cited via http://iso25000.com
Diomidis Spinellis. *Code Quality: Introduction*, CC-BY-SA, 2006.

ISO 25010

Portability

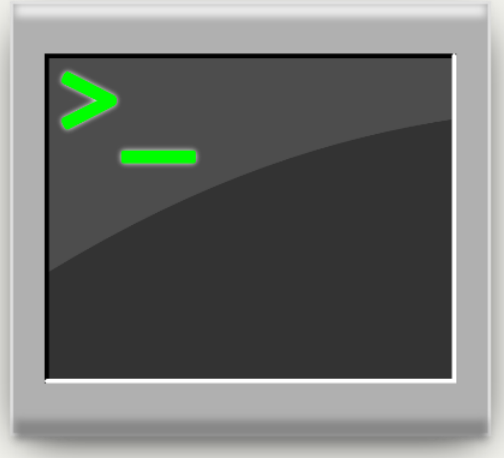
- Adaptability
  - can it coevolve with the environment?
- Installability
  - how to fit in an environment?
- Replaceability
  - can it replace an alternative product?

ISO/IEC 25010:2011, cited via http://iso25000.com

GUI portability strategies

- Unportable
  - application uses OS directly
- Portability layers
  - app is built on top of interchangeable PLs
- Emulation layer
  - native calls + foreign OS emulation
- Portable platform
  - JVM, .NET Core, JS, Tcl/Tk
- Internationalisation!

Conclusion



- ISO 9126 or 25010 is useful
- Software product quality has many aspects
  - functionality, performance, reliability, …
  - each requires its own approach
- Analysing with metrics is OK, but…

- Start wrapping up at the lab
- Refactor!
- Prepare to share