SE4831 : Software Quality Assurance

Software Quality Standards

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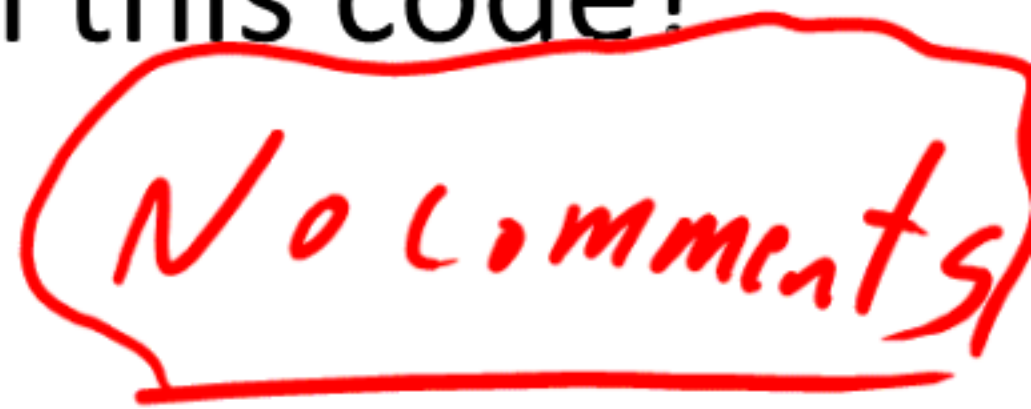
Instructor

Objectives

- Explain the difference between certification and licensure.
- Explain the goals for the IEEE CSDP program.
- Explain the goals and ramifications of professional engineering licensure.
- Explain the concept of the order of the engineer
- Explain the goals of ASQ Certification program
- Justify the need for standards in software engineering
- List organizations involves in standards development

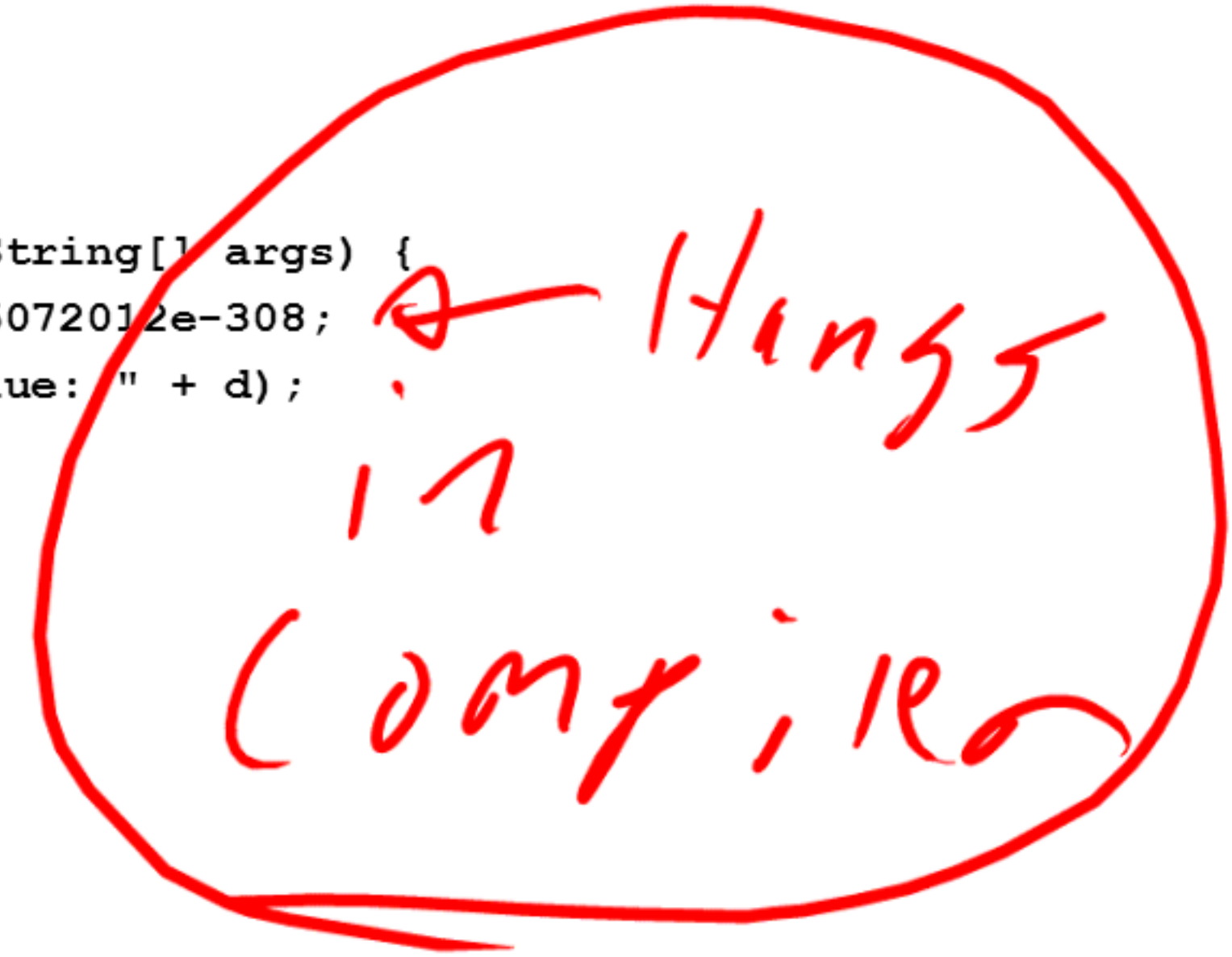
What is wrong with this code?




```
public class DoubleBug {
    public static void main(String args[])
    {
            Scanner kbd = new Scanner(System.in);
            Double d1 = Double.parseDouble("1.0");
            Double d2 = Double.parseDouble("2.0");

            Double d3 = d2 + d1;

            System.out.println("The sum of " +d1+ " + "+ d2 + " is "+ d3);

            System.out.println("Enter return to continue.");

            kbd.nextLine();
            Double d4 = Double.parseDouble("2.2250738585072012e-308");

            Double d5 = d2 + d1+d4;

            System.out.println("The sum of " +d3+ " + "+ d4 + " is "+ d5);

    }
}
```

Another example

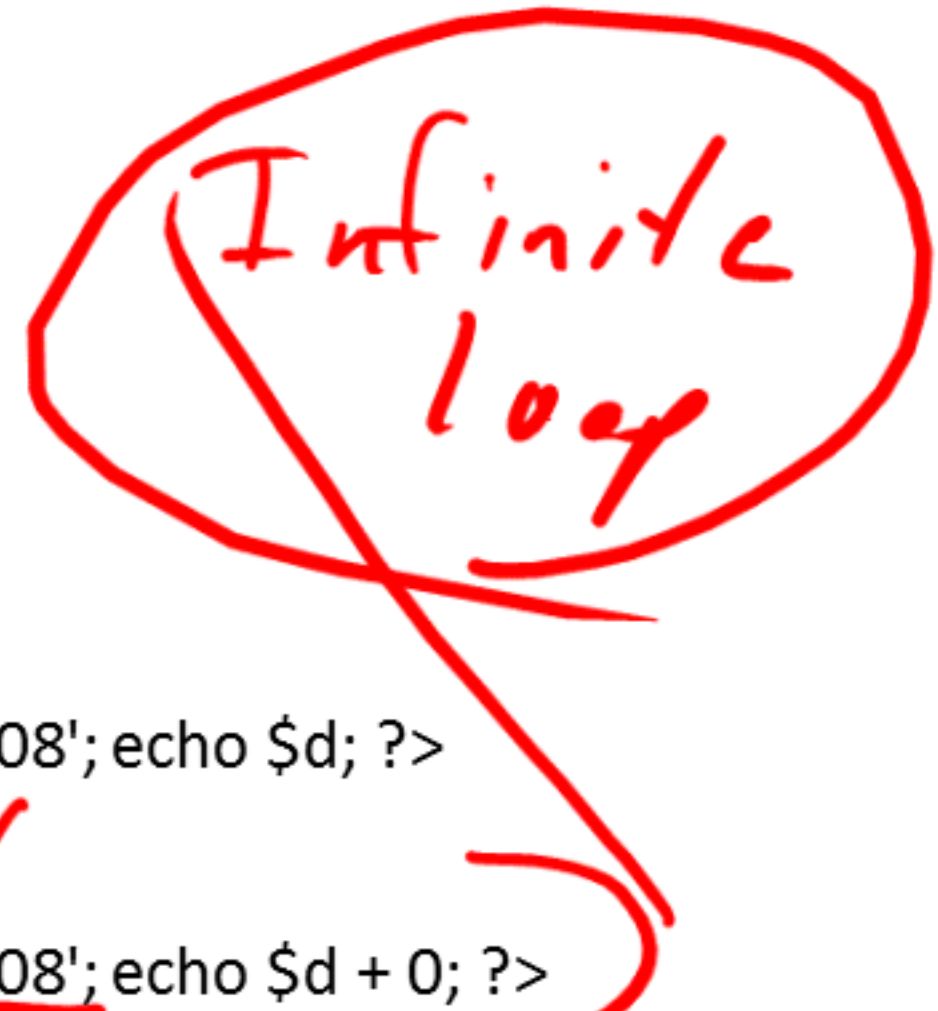
```
class compilehang {

public static void main(String[] args) {
   double d = 2.2250738585072012e-308;
   System.out.println("Value: " + d);
  }
}
```



The problem

- Java — both its runtime and compiler — go into an infinite loop when converting the decimal number 2.2250738585072012e-308 to double-precision binary floating-point.
  - Number is supposed to convert to 0x1p-1022
  - DBL_MIN;
  - Java gets stuck, oscillating between 0x1p-1022 and 0x0.fffffffffffffp-1022

Impacts



- PHP
  - This works:
    - <?php $d = '2.2250738585072011e-308'; echo $d; ?>
  - but this doesn't:
    - <?php $d = '2.2250738585072011e-308'; echo $d + 0; ?>
  - Double.parseDouble(request.getParameter("d"))
- Tomcat
  - Uses ParseDouble
  - <code>request.getLocale()
    - Uses Local, you are at risk

Why do we use standards?

Cross communication
⇒ Makes sure we
are speaking
the same language.

- The ability to apply methodologies and procedures of the highest professional level.
- Better mutual understanding and coordination among development teams but especially between development and maintenance teams.
- Greater cooperation between the software developer and external participants in the project.
- Better understanding and cooperation between suppliers and customers, based on the adoption of standards as part of the contract.

Certification versus licensure

Licensing – Service of a government agency
⇒ Force of law behind it driven by health safety or welfare issues.

Certification versus licensure

Certification

⇒ Have passed a series of tests that ensure a specific common base of knowledge or skills

⇒ Private entity

IEEE CS Certifications

- IEEE CSDA
  - Intended for **entry-level** software development and software engineering professionals.

- IEEE CSDP
  - Available for experienced software development and software engineering professionals

  - Requires B.S. degree and 9,000 hours of experience
    - First offered in 2001

Test Specifications

- 180 Multiple Choice Questions
- 4 Hours Available
- 15 Knowledge Areas

I. Software Requirements	7%
II. Software Design	8%
III. Software Construction	10%
IV. Software Testing	7%
V. Software Maintenance	7%
VI. Software Configuration Management	3%
VII. Software Engineering Management	3%
VIII. Software Engineering Process	4%
IX. Software Engineering Methods	5%
X. Software Quality	6%
XI. Software Engineering Professional Practice	7%
XII. Software Engineering Economics	3%
XIII. Computing Foundations	10%
XIV. Mathematical Foundations	10%
XV. Engineering Foundations	10%

Sample Question

During a software development project two similar defects were detected. One was detected in the requirements phase, and the other during the implementation phase. Which of the following statements is mostly likely to be true?

[a] The most expensive defect to correct is the one detected during the requirements phase.
[b] The most expensive defect to correct is the one detected during the implementation phase.
[c] The cost of fixing either defect will usually be similar.
[d] There is no relationship between the phase in which a defect is discovered and its repair cost.

PE License for Software Engineers (New 2013)

CD0031: Software PE Exam - Sample Questions and Solutions

Licensing Software Engineers Is in the Works

IEEE is helping develop the first-ever licensure exam

By KATHY KOWALENKO 3 February 2012

Photo: iStockphoto

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2 Exams ⇒ 8 hours each

1. Fundimentals of Engineering
   ⇒ General Exam taken by all engineers in AM. Discipline specific PM.

2nd Exam

Professional Engineering Exam

⇒ Discipline specific taken after ≥ 4 years of practice

8 hour exam

ASQ QE Program

- ASQ
  - American Society for Quality
  - International organization dedicated to the development of quality products
  - Interdisciplinary in nature
  - Largest organization solely dedicated to quality
    - 100,000 international members

Headquarted in Milwaukee

Software Division

- Develops the software quality engineer certification programs
- Sponsors international conference on software quality
- Maintains relationships with ANSI and ISO
- Interacts with IEEE and ACM professional societies
- Reviews software quality tools and techniques

CSQE

- Certified Software Quality Engineer
  - An individual who "understands software quality development and implementation, software inspection, testing, verification, and validation; and implements software development and maintenance processes and methods."

Content of the exam

- General knowledge (10%)
  - Benefits of quality, ethics, prevention versus detection, ISO 9000, IEEE Software Standards, SEI CMMI, etc.
- Software Quality Management (20%)
  - Goals and objectives, managing outsourced projects, planning, SQM documentation, methodologies (change management, cost of quality, quality data tracking, PRCA, QIP), audits
- Software Engineering Processes (15%)
  - Lifecycles, system architecture, requirements management, requirements engineering (types, elicitation), tools and methodologies (design, resuse, clean-room and formal methods, development tools)

Content of the exam

- Program and Project Management (15%)
  - Planning, Tracking and controlling, risk management)
- Metrics, measurement, and Analytical Methods (15%)
  - Definitions, measurement theory, psychology of measurements, data integrity, quality tools (pareto charts, cause effect diagrams, histograms, root cause analysis, sampling theory)
- Software Verification and Validation (15%)
  - V and V program, reviews and inspections, test planning and design, tools, strategies, test implementation, coverage, anomaly tracking and severity ranking
- Software Configuration Management (10%)
  - Infrastructure, Configuration identification, configuration control, status accounting, configuration audits, release and distribution issues, packaging

Example questions

- The primary task of a change control board (CCB) is to
  - Define change procedures
  - Approve and / or disapprove changes to software products
  - Evaluate cost and schedule impacts of changes
  - Authorize personnel to implement change

- A module includes a control flow loop that can be executed 0 or more times. The test most likely to reveal loop initialization defects executes the loop body
  - 0 times
  - 1 times
  - 2 times
  - 3 times

Example questions

- The primary task of a change control board (CCB) is to
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  - **1 times**
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  - 3 times

Order of the Engineer

- Initiated in the United States to foster a spirit of pride and responsibility in the engineering profession
- To bridge the gap between training and experience,
- To present to the public a visible symbol identifying the engineer.

Classes of SQA Standards - Comparison

Characteristics	Quality Management Standards	Project Process Standards
The target unit	**Management** of software development and/or maintenance and the specific **SQA units**	A software development and/or maintenance project **team**
The main focus	Organization of SQA systems, infrastructure and requirements	Methodologies for carrying out software development and maintenance projects
Standard's objective	"What" to achieve	"How" to perform
Standard's goal	Assuring supplier's software quality and assessing its software process capability	Assuring the quality of a specific software project's products

Who develops standards?

ISO

Standard Bodies

∋ NISA

IEEE ACM

Who develops standards?

- IEEE (Institute of Electric and Electronic Engineers) Computer Society
- ISO (International Standards Organization)
- DOD (US Department of Defense)
- ANSI (American National Standards Institute)
- IEC (International Electrotechnical Commission)
- EIA (Electronic Industries Association)
- SAE (Society of Automotive Engineers)

IEEE Standards

- Conceptual standards
  - IEEE 1061 – Software Quality Metrics Methodology
  - IEEE/EIA 12207.0 — Information Technology Software Life Cycle Processes
- Prescriptive standards of conformance
  - IEEE 829 — Software Test Documentation
  - IEEE 1012 – Software Verification And Validation
  - IEEE 1028 – Software Reviews
- Guidance standards.
  - IEEE 1233 – Guide for Developing System Requirement Specifications
  - IEEE/EIA 12207.1 – Guide, Information technology – Software Life Cycle Processes – Life Cycle Data

Process Techniques

- Define the process

Say what you are going to do.

- Follow the defined process

Do what you say you will do.

- Demonstrate that the process has been followed

Show me in audit

Assessment Standards

- Serve organizations as a tool for self-assessment of their ability to carry out software development projects.
- Serve for improvement of development and maintenance processes by application of the standard directions
- Help purchasing organizations determine the capabilities of potential suppliers.
- Guide training of assessor by delineating qualifications and training program curricula.

ISO 9000-3

- **Quality management standard for computer software and related services. It replaces the old ISO 9000-3 1997 software standard.**
- **Explains how ISO 9001 2000 can be applied to software and related services.**

ISO 9000-3 principles

- Customer focus
- Leadership
- Involvement of people
- Process approach
- System approach to management
- Continual improvement
- Factual approach to decision making
- Mutually supportive supplier relationships

ISO 9000-3 - Requirements classification

Requirement Subjects	Requirement Subjects
4. Quality management system	4.1 General requirements 4.2 Documentation requirements
5. Management responsibilities	5.1 Management commitments 5.2 Customer focus 5.3 Quality policy 5.4 Planning 5.5 Responsibility, authority and communication 5.6 Management review
6. Resource management	6.1 Provision of resources 6.2 Human resources 6.3 Infrastructure 6.4 Work environment
7. Product realization	7.1 Planning of product realization 7.2 Customer-related processes 7.3 Design and development 7.4 Purchasing 7.5 Production and service provision 7.6 Control of monitoring and measuring devices
8. Measurement, analysis and improvement	8.1 General 8.2 Monitoring and measurement 8.3 Control of nonconforming product 8.4 Analysis of data 8.5 Improvement

CMM/ CMMI

- Quantitative management methods increases the organization's capability to control the quality and improve the productivity.
- Application of the five-level capability maturity model that enables to evaluate the achievements and determine the efforts needed to reach the next capability.
- Generic process areas that define the “what” — not “how” enables the model's applicability to a wide range of implementation organizations:
  - It allows use of any life cycle model.
  - It allows use of any design methodology, development tool and programming language.
  - It does not specify any particular documentation standard.

Project resources distribution by CMM capability level

The case of Raytheon

	Percentage of project resources		
CMM capability level	Original work	Reworking	Testing and quality assurance
1	34	41	25
2	55	18	27
3	67	11	22
4	76	7	17