Software Quality and Sustainability Guidelines

CLARIAH

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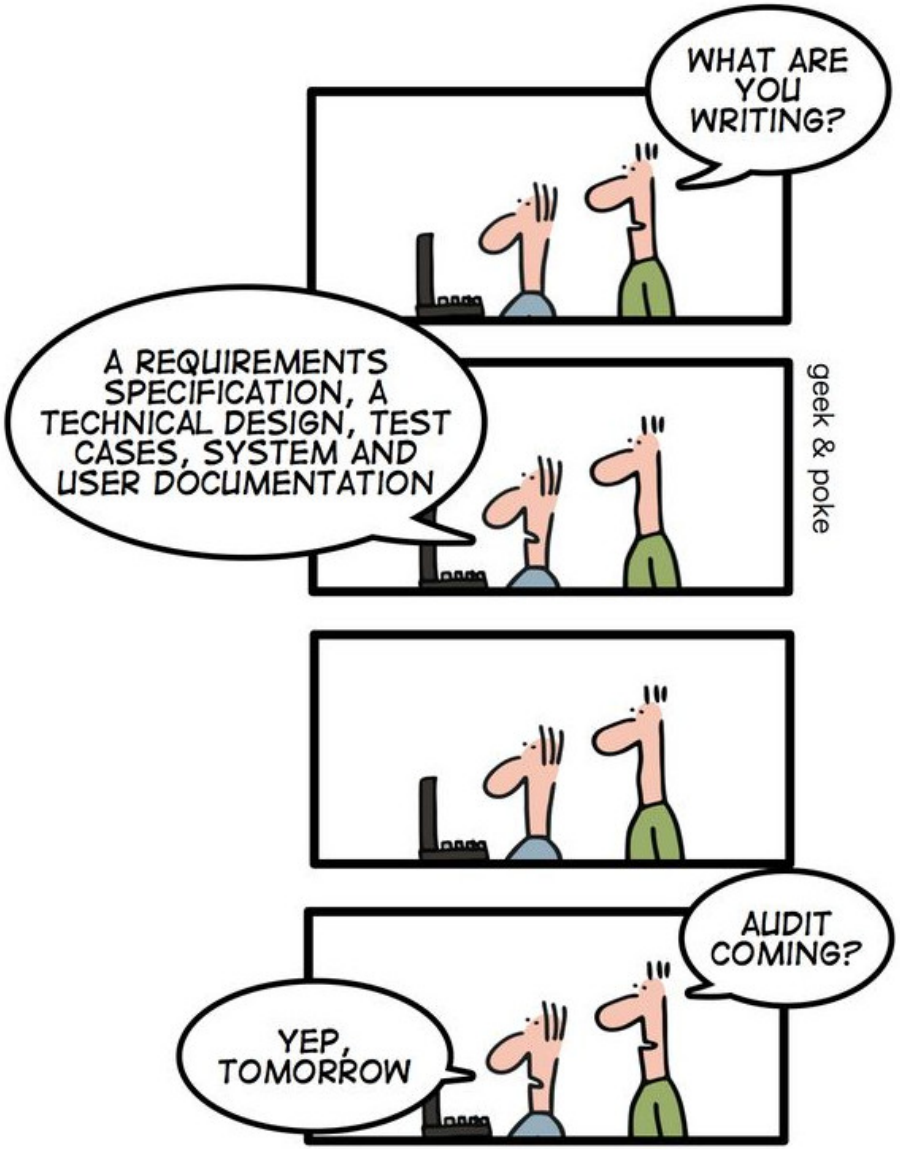
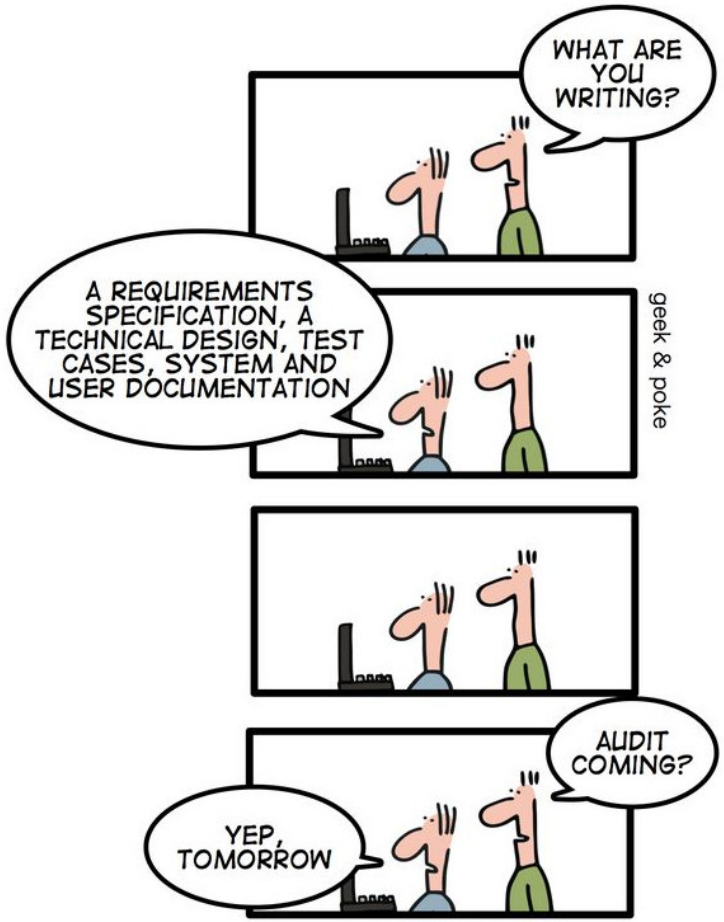
Introduction



Introduction



Software quality and sustainability should be an **essential component** of the development process rather than an afterthought.

Introduction

Software plays an essential role

- Development of advanced sofware is a core activity within CLARIAH.
- The CLARIAH infrastructure consists of numerous interconnected software components.
- The success of the whole depends on the success of its parts

Questions addressed

- How do we ensure software is of good quality?
- ... How to measure this?
- ... What quality standards do we aim for?
- How do we ensure software is sustainable towards the future?

Introduction

Context

- DANS & eScience-NL report (Doorn et al., 2016):
  - Research software is a **fundamental component** of modern research.
  - Software in academia **lags behind** commercial software.
  - Pressure is on publication of new results: software is fragile and not sustainable or usable beyond project lifetime.
- Research Software Sustainability: Report on Knowledge Exchange workshop
  - Software is not data: software **must adapt** to the constant changes in its environment or will decay.
- Software Sustainability Institute (UK): `http://software.ac.uk`

Goals

1. **Improve** software quality & sustainability
2. **Emphasise** the importance of good software development in academia
3. **Provide practical guidelines** that allow developers and adopters to assess software on their own.

Form

- A **set of specific assessment criteria** grouped into various **dimensions**
- A web-based survey anybody can use to assess software: `http://softwarequality.clariah.nl`
- A list of minimal requirements for developers that offers a different perspective on the criteria.

Usage of the guidelines

How to use the guidelines?

For developers..

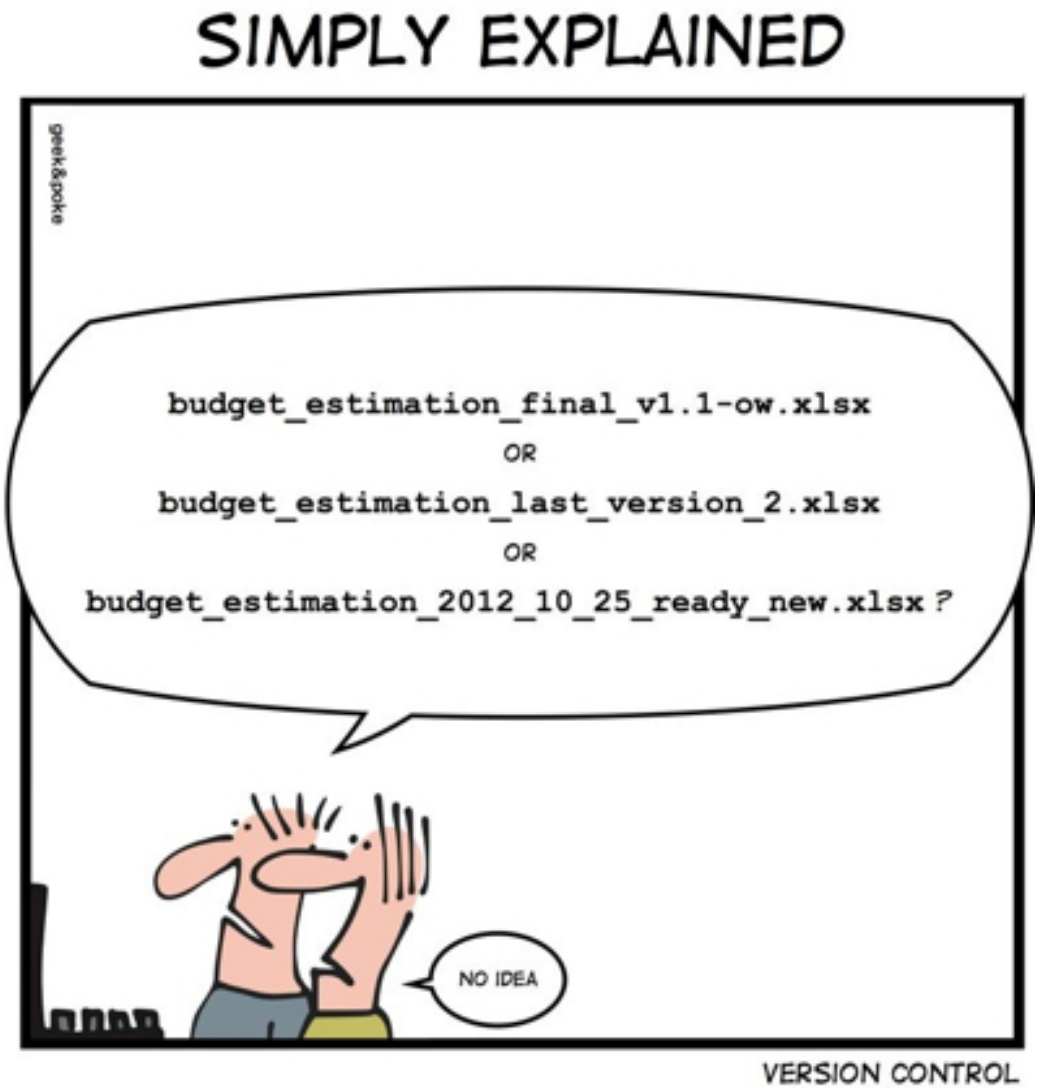
- self-assessment using the web-survey (`http://softwarequality.clariah.nl`)
- add the survey results to your VC repository so others can see it
- provide us with feedback through our issue tracker! (`https://github.com/CLARIAH/software-quality-guidelines/issues`)

Future

- Revision of guidelines based on feedback after usage
- Incorporation of CLARIAH-specific interoperability criteria
- A software seal of approval?

Highlights

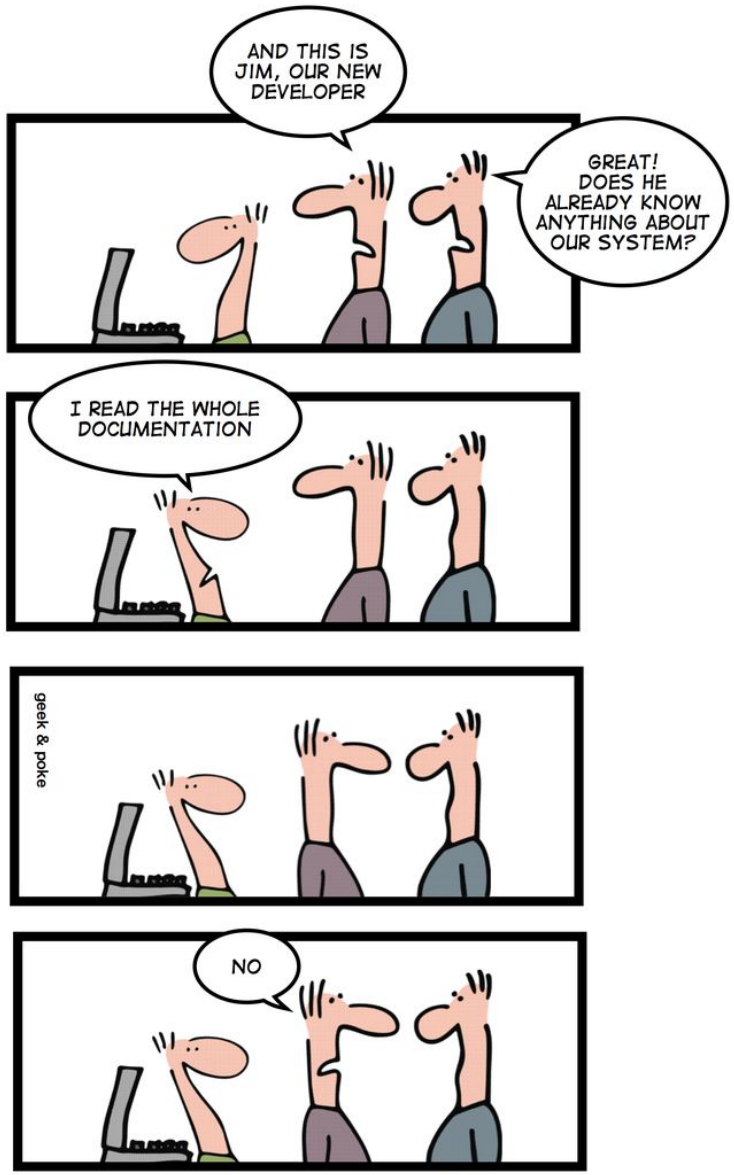
Accessibility: Version Control



Accessibility: Version Control

- Always use **version control** for any software project
- Use **public** version control (e.g. Github) whenever possible
  - increases project visibility/findability
  - encourages contribution and interaction.
  - provides infrastructure with issue trackers (bug reports), release management facilities
  - transparency: allows users to assess the project's activity
  - `https://github.com/CLARIAH`
- Periodically publish releases of your software, using a sane version numbering scheme, accompanied with release notes or a changelog.

Documentation



Documentation

- Have a good and comprehensive **README** (plain-text) in your VC repository.
  - **Tip:** Use Markdown or ReStructureText for mark-up
- Document how to **build and install** the software
- Address **all the intended audiences** at the **appropriate levels**.
- Documentation should **live alongside the code** in the VC repository
- API documentation should be **automatically generated** from documentation comments in the source code *(Doxygen, sphinx, javadoc)*
- Documentation should be up to date with the latest version.
- **Tip:** Have documentation auto-regenerate on every commit to your VC repo, using services like https://readthedocs.io

Buildability & Installability

INSTALL.SH

```
#!/bin/bash

pip install "$1" &
easy_install "$1" &
brew install "$1" &
npm install "$1" &
yum install "$1" & dnf install "$1" &
docker run "$1" &
pkg install "$1" &
apt-get install "$1" &
sudo apt-get install "$1" &
steamcmd +app_update "$1" validate &
git clone https://github.com/"$1"/"$1" &
cd "$1";./configure;make;make install &
curl "$1" | bash &
```

Buildability & Installability

- There should be an automated build and install procedure for the software *and all dependencies* on the target platform(s). Preferably through **one command**.
- Use established build tools (GNU Autotools, CMake, Maven, Ant)
- Package and upload to the programming language's infrastructure to facilitate installation:
  - Python - Python Package Index (http://pypi.org)
  - Java - Maven (http://maven.org)
  - Ruby - Gems (http://rubygems.org)
  - Perl - CPAN (http://cpan.net)
  - Javascript - npm
- or ...

Buildability & Installability

- Package and upload to the platform's repository to facilitate installation:
  - Build packages for Linux distributions (DEB packages for Debian/Ubuntu packages, Arch User Repository (AUR), RPM for Fedora/CentOS/RHeL, etc)
  - Consider Homebrew or macports for Mac, or the Mac App store.
  - Apple's App store (iOS) Google's Play (Android) store for mobile apps.
- Last resort only: statically linked download archive from a project website
- Additionally, consider container or VM solutions (e.g, Docker, Vagrant, Ansible) for complex setups.

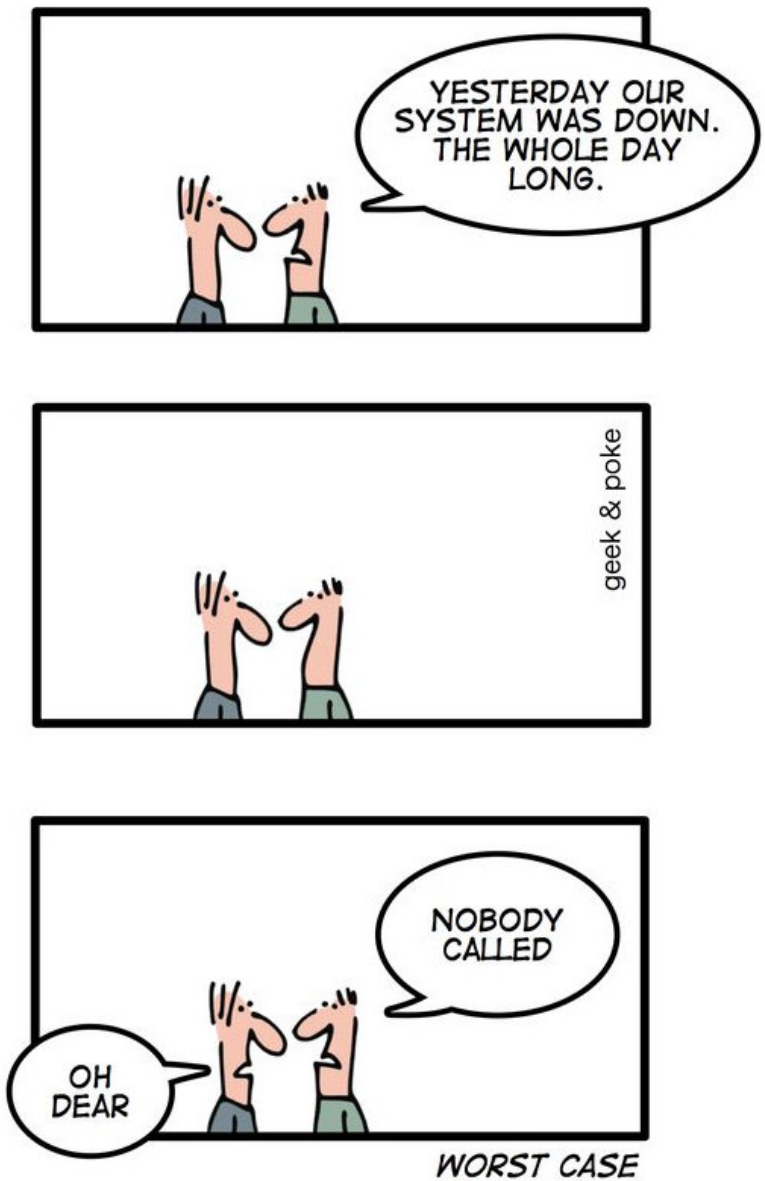
Testability

Testability

Testability

- If you didn't test it, it most likely doesn't work.
- Write automated tests (unit & integration tests) for your software.
- Ensure automated tests cover all enough of your software.
- Use continuous integration platforms such as Travis-CI (https://travis-ci.org), Jenkins (http://jenkins.io) or others.
  - These automatically run tests each time you commit code to your VC repo.

Community, Changeability & Supportability



Community, Changeability & Supportability

Community

- Is the software used? Do you have usage statistics?

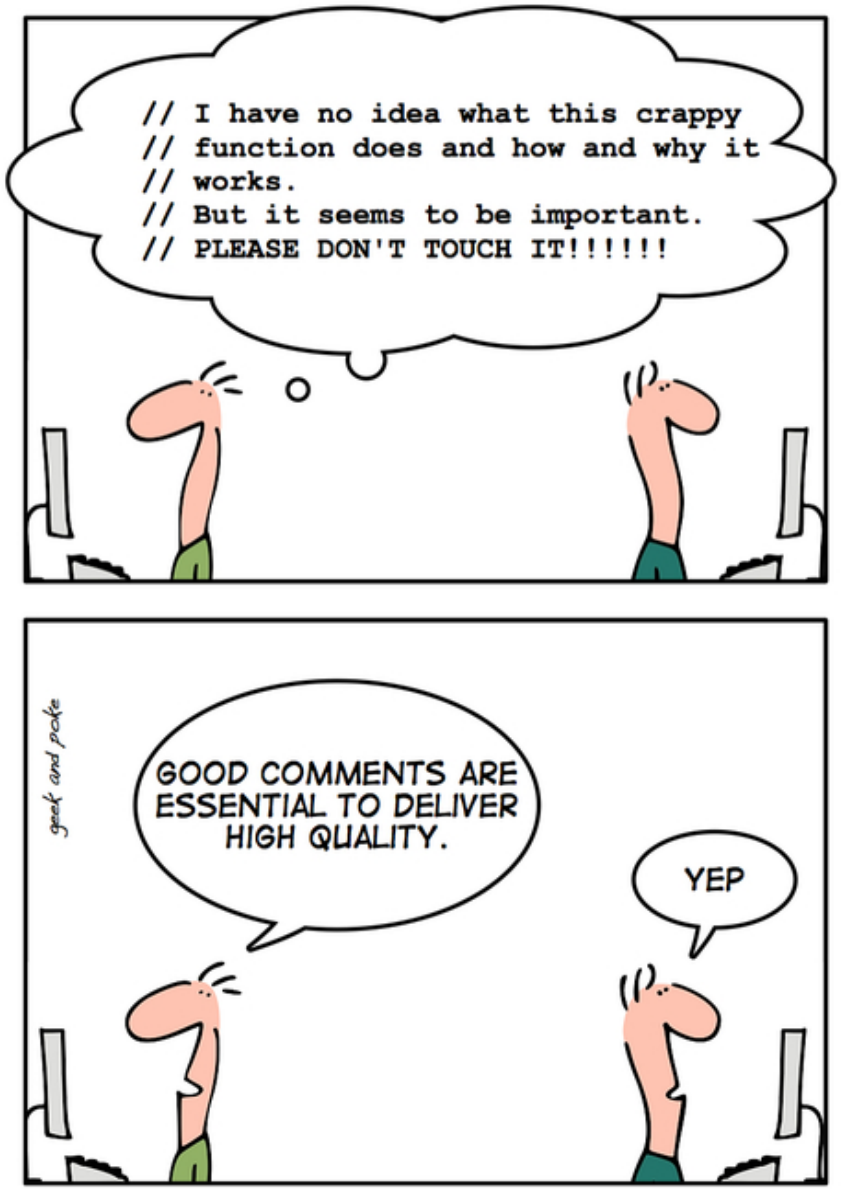
Changeability

- Be open to outside contributors
- Code changes and authorships should be publicly visible through versioning control, with sane commit messages
- Is the software sufficiently backwards compatible?

Supportability

- Be in touch with the users your software.
- Have a **public issue tracker** for tracking bugs and feature requests. Alternatively, have a mailing list (publically archived).
  - Platforms like github provide an issue tracker automatically.

Analysability & Reusability



Analysability & Reusability

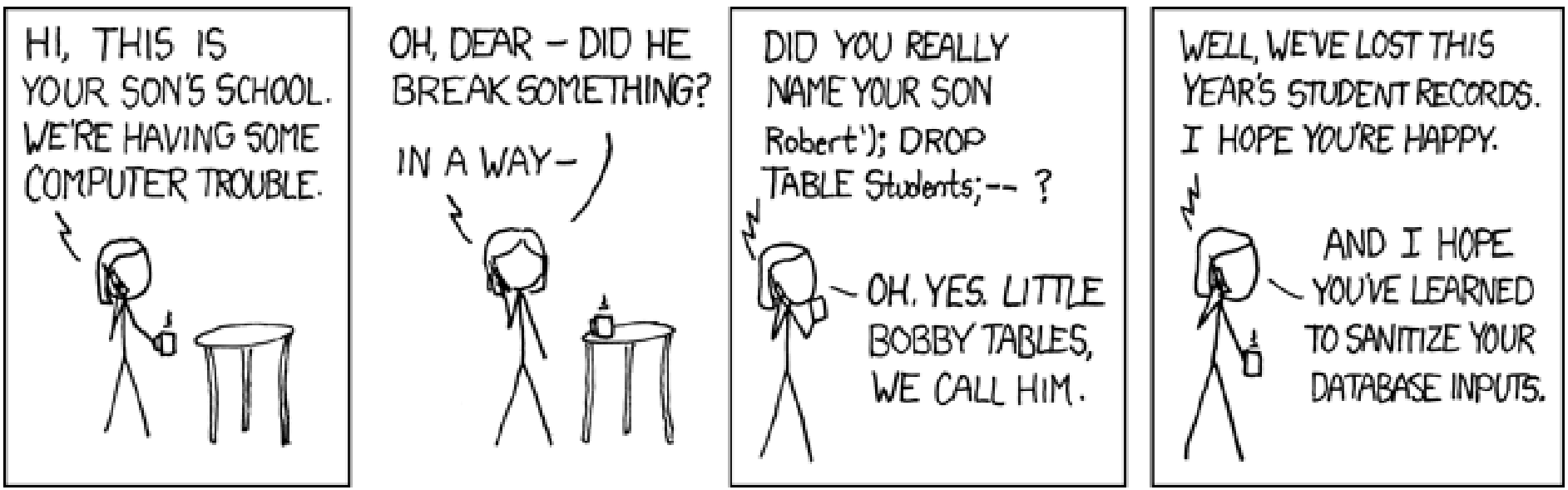
Analysability

- Is the source code commented adequately?
- Is the source code cleanly laid out? (e.g. proper indentation)
- Are sensible named used?
- Follow established conventions for the programming language

Reusability

- Does the software offer the **appropriate interfaces** for the respective audiiences? (command-line, web, GUI, API, web-api..)
- Is the software set up in a **modular** fashion?
  - on **code level**: functions, classes
  - abstraction of core logic from interfaces (front-end/back-end separation)
  - architectural: modules for different functionality

Security & Privacy



Security & Privacy

Security

- Validate user input
- Be aware of possible attack vectors:
  - DB injection in e.g. SQL queries
  - shell injection (when invoking system calls)
  - cross-site request forgery
  - denial of service
- Do not rely on outdated platforms or libraries
- Never run anything as root

Privacy

- Never store unhashed passwords
- Require authentication to access sensitive user data

Questions?

Comics by: Geek & Poke and XKCD

Doorn, P., Aerts, P., and Luscher, S. (2016). Research software at the heart of discovery. Technical report, DANS, NLeSC.

Extra: Dimensions (1/2)

Usability Dimensions

- **Understandability** - Is the software easily understood?
- **Documentation** – Comprehensive well-structured documentation?
- **Buildability** – Straightforward to build from source on a supported system?
- **Installability** – Straightforward to install and deploy on a supported system?
- **Learnability** – Easy/intuitive to learn how to use its functions?

Sustainability & Manageability Dimensions

- **Identity** – Project/software identity is clear and unique?
- **Copyright** – Licencing and ownership Adoption of appropriate open-source license
- ...

Extra: Dimensions (2/2)

Sustainability & Manageability Dimensions

- **Community** – Evidence of current/future community
- **Accessibility** – Good facilities to obtain versions of the software?
- **Testability** – Easy to verify if the software functions correctly?
- **Portability** – Usable on multiple platforms?
- **Supportability** – Evidence of current/future developer support?
- **Analysability** – Easy to understand at the source-code level?
- **Changeability** – Easy to modify and contribute changes?
- **Performance** – Resource demands/consumption
- **Interoperability**
- **Security & Privacy**