

L00 Preliminary Talk

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Preliminaries

- 1 Preliminaries
- 2 Motivation
- 3 Content Overview
- 4 Organisation
 - Preliminaries
 - Grades
 - Assignments

BigBlueButton

- used for weekly virtual meetings
- set status (e.g. raise the hand) immediately on any issues
- use “Real Name @GitHubName” as your name
- on technical problems say it in the chat and try another browser, e.g., recent Firefox or Chromium
- you can connect several times, e.g., phone and laptop

Language

Materials are in English:

- Slides are in English
- Papers are in English
- Videos are in English
- Book is in English

Language of the Talk?

Task

- A English
- B Slightly Prefer English
- C Both are fine
- D Slightly Prefer German
- E German
- F Don't care

Video

I am keeping meetings short with many breaks.

You are allowed to:

- stretch
- move
- eat
- look somewhere else
- leave your place

Task

But please turn video on.

Task

Break.

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Motivation

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Misconfiguration

- *misconfigurations* [1, 8, 10, 11] are a major cause of system failures [4, 5, 9]
- 2022 Cloud Security Report: “Misconfiguration was the number one cause of cloud-security incidents in 2021”¹
- much time is needed to fix misconfigurations [3, 4, 7, 11]

¹[https://cloudcomputing-news.net/news/2022/mar/04/](https://cloudcomputing-news.net/news/2022/mar/04/misconfiguration-was-the-number-one-cause-of-cloud-security-incidents-in-2021/)

[misconfiguration-was-the-number-one-cause-of-cloud-security-incidents-in-2021/](https://cloudcomputing-news.net/news/2022/mar/04/misconfiguration-was-the-number-one-cause-of-cloud-security-incidents-in-2021/)

No-Futz

- Holland et al. [2] defined *futzing* to denote *“tinkering or fiddling experimentally”*
- with ***no-futz computing*** Holland et al. [2] mean *“that futzing should be allowed, but should never be required”*
- currently configuration is error-prone and under-specified, *futzing* is often required

Examples

Not every misconfiguration involves big companies and huge amounts of money:

- No internet access because resolv.conf symlink broken.
- KDE crash because of ulimit setting.
- Out-of-service of computers during exam.

First Assignment

- Have you already experienced misconfiguration?
- Did you read about misconfiguration in the news?

Task

Discuss in breakout room and tell your partner's story.

Task

Break.

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Content Overview

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learning outcome:

- remember the topics of configuration management

L01: *Configuration Settings*

- definitions
- metalevels
- data structures

Terminology

Definition

A ***configuration setting***, or ***setting*** in short, fulfills these properties:

- ① It is provided by the execution environment.
- ② It is *consumed* by an application.
- ③ It consists of a key, a configuration value, and potentially *metadata*. The ***configuration value***, or ***value*** in short, influences the application's behavior.
- ④ It can be *produced* by the maintainer, user, or system administrator of the software.

Example

```
1      slapd/threads/listener=4
```

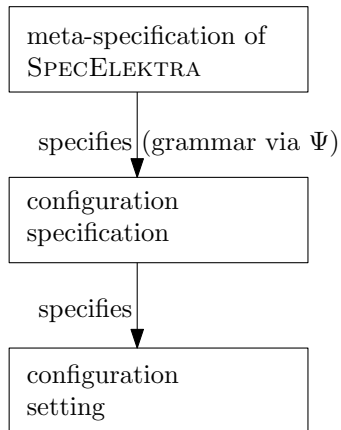
Configuration Settings

Task

Discuss about configuration settings you already changed.

L02: *Configuration Specification Languages*

- theory & practice
- specify possible configuration specifications



L03: *Configuration Integration*

art and technical challenges of sharing configurations between applications

L04: *Sources of Configuration*

- configuration file formats
- command-line arguments
- environment variables
- abstractions

L05: *Configuration Management Tools*

- infrastructure as code
- desirable properties of configuration
 - self-description
 - changeability
 - idempotence
 - round-tripping
- examples: Puppet, Chef, Ansible, CfEngine, Nix, ...

Task

Break.

L06: *Strategies for Validation and Modularization*

- validation
- modularity
- plugins

L07: *Strategies for Reduction of Misconfiguration*

- configuration-less systems (auto-detection)
- pitfalls
- finding (un)used settings

L08: *Early Detection of Misconfiguration*

points in time for

- configuration access
- validation
- configuration management (push vs. pull)
- misconfiguration

L09: *Configuration as a User Interface*

- Which user interfaces exist.
- How to avoid errors.
- How to design error messages.
- How system administrators work.

L10: *Design of Configuration*

- documentation
- introspection vs. code generation
- context awareness

Map



CCO
RAAB

In which topics are you interested?

Task (1)

Discuss topics with your partner. Can be new topics not mentioned before.

Task (2)

Write down the most interesting in the shared notes.

Elektra

- Elektra is one implementation of what we discuss in this lecture.
- Configuration management tools use Elektra.
- Elektra is developed at TU Wien (<https://libelektra.org>).



Use Cases of Elektra

- Embedded systems (L04 Sources of Configuration)
 - OpenWRT (distribution)
 - Broadcom (blue-ray devices)
 - Kapsch (cameras)
 - Toshiba (TVs)
- Desktop (L03 Configuration Integration)
 - Oyranos
 - Redshift
 - LCDproc
 - KDE
 - GNOME
- Server (L05 Configuration Management Tools)
 - Allianz (insurance)
 - TU Wien and other universities

Possible Benefits of CM

Task

What are the goals of Configuration Management?

- Documentation, Customization, Reproducibility
- Declarative description of the system
- Less configuration drift
- Better error handling
- Reusability
- (Resource) Abstractions

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Organisation

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Communication

- TUWEL
<https://tuwel.tuwien.ac.at/course/view.php?idnumber=194030-2021S>
- TISS (exam) <https://tiss.tuwien.ac.at/course/courseDetails.xhtml?courseNr=194030&semester=2019S>
- GitHub (private and public repository)
public: <https://git.libelektra.org>
- Email markus.raab@complang.tuwien.ac.at
- Meetings Wednesday 9:00 c.t.–11:00
- Consulting Hour with Klemens Böswirth Wednesday 13:00-14:00

Inverted Classroom

Meeting is every week Wednesday 09:00 c.t.–11:00 (max.)

- always read/watch the material in advance
- within meetings we'll do a recapitulation
- and you ask questions
- we start off with many materials, going slower after L05

Previous Knowledge

- Obviously *no* prior knowledge about Configuration (Management) is necessary.
- If you already have experience, you can use it in your presentation and assignments.
- You should have some understanding of FLOSS.
- Programming skills is a must.

Programming Languages

Elektra supports following programming languages:

- C
- C++
- Java
- Python
- (Rust)
- (Go)
- (Lua)
- (Ruby)

You can use either of these languages.

You will get a grade once you did H0.

To get a positive grade:

- All parts must be done.
- All parts must be positive.

Grade is calculated from:

30 %: homework

30 %: teamwork

30 %: project

10 %: presentation

+: extrapoints in meetings

Assignments

- Are described in detail in a separate document.
- The document contains everything you'll need to do besides the meeting (preparation).
- Very transparent but might look shocking to you at first.

Deadlines

- if you make submissions earlier, you get feedback earlier
- dates are both in “schedule.pdf” and calender of TUWEL

There are often two deadlines for each homework/teamwork/project:

- regular deadline: the submission as described in the document (definition of done)
- deadline for correction: based on the feedback from CI and from review you get after the deadline

Task

Talk with someone about a potential collaboration in the teamwork/project.

- Forum
- “schedule.pdf”
- “assignments.pdf”
- L01 section

Questions?

Task

Please register for the course by doing H0.

Task

Any questions?

- [1] Mona Attariyan and Jason Flinn. Automating configuration troubleshooting with dynamic information flow analysis. In *Proceedings of the 9th USENIX Conference on Operating Systems Design and Implementation*, OSDI'10, pages 1–11, Berkeley, CA, USA, 2010. USENIX Association.
- [2] David A. Holland, William Josephson, Kostas Magoutis, Margo I. Seltzer, Christopher A. Stein, and Ada Lim. Research issues in no-futz computing. In *Hot Topics in Operating Systems, 2001. Proceedings of the Eighth Workshop on*, pages 106–110. IEEE, May 2001. doi: 10.1109/HOTOS.2001.990069.
- [3] Ratul Mahajan, David Wetherall, and Tom Anderson. Understanding BGP misconfiguration. In *Proceedings of the 2002 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communications*, SIGCOMM '02, pages 3–16, New York, NY, USA, 2002. ACM. ISBN 1-58113-570-X.
- [4] David Oppenheimer, Archana Ganapathi, and David A. Patterson. Why do Internet services fail, and what can be done about it? In *USENIX Symposium on Internet Technologies and Systems*, volume 67. Seattle, WA, 2003.

- [5] Soila Pertet and Priya Narasimhan. Causes of failure in web applications (cmu-pdl-05-109). *Parallel Data Laboratory*, page 48, 2005.
- [6] Markus Raab and Gergö Barany. Introducing context awareness in unmodified, context-unaware software. In *Proceedings of the 12th International Conference on Evaluation of Novel Approaches to Software Engineering - Volume 1: ENASE*,, pages 218–225. INSTICC, ScitePress, 2017. ISBN 978-989-758-250-9. doi: 10.5220/0006326602180225.
- [7] Ariel Rabkin and Randy Katz. Static extraction of program configuration options. In *Software Engineering (ICSE), 2011 33rd International Conference on*, pages 131–140. IEEE, 2011.
- [8] Ya-Yunn Su, Mona Attariyan, and Jason Flinn. Autobash: Improving configuration management with operating system causality analysis. pages 237–250, 2007. doi: 10.1145/1294261.1294284. URL <http://dx.doi.org/10.1145/1294261.1294284>.
- [9] Avishai Wool. A quantitative study of firewall configuration errors. *Computer*, 37 (6):62–67, 2004.

- [10] Tianyin Xu and Yuanyuan Zhou. Systems approaches to tackling configuration errors: A survey. *ACM Comput. Surv.*, 47(4):70:1–70:41, July 2015. ISSN 0360-0300. doi: 10.1145/2791577. URL <http://dx.doi.org/10.1145/2791577>.
- [11] Zuoning Yin, Xiao Ma, Jing Zheng, Yuanyuan Zhou, Lakshmi N. Bairavasundaram, and Shankar Pasupathy. An empirical study on configuration errors in commercial and open source systems. In *Proceedings of the Twenty-Third ACM Symposium on Operating Systems Principles, SOSP '11*, pages 159–172, New York, NY, USA, 2011. ACM. ISBN 978-1-4503-0977-6. doi: 10.1145/2043556.2043572.