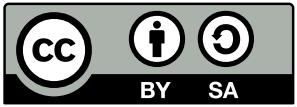
L04 Continuous Integration

Markus Raab

Institute of Information Systems Engineering, TU Wien



Use

Learning Outcomes

After successful completion of L04
students will be able to

- use continuous integration
- remember basics of reproducibility
- improve continuous integration

Workload

- maintainers of FLOSS usually have high workload
- review focus on difficult aspects
- use CI to answer trivial questions

Check If

- the code compiles without warnings (with different compilers)
- all test suites run successfully (on different systems)
- release notes are written
- code is correctly formatted
- consistency rules are fulfilled
- ABI/API is compatible
- all content has a license

Artifacts

The build server gives us:

- documentation
- executables
- reports of
  - test runs
  - memory leaks
  - code coverage
- website, ...

Trigger Build

In Elektra:

- Build server runs on every push in every branch
- nightly/monthly/... builds
- Jenkins is the main CI
- Sometimes CI problems need to be reported and fixed
- Maintenance reports in issues.libelektra.org/160

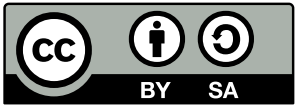
Conclusion

- Start of build server automatically
- Reading of build server results manually
- Set label “ready to merge” iff build server passes
- Make sure that new test cases are executed
- CI handled like other code

L04 Continuous Integration

Markus Raab

Institute of Information Systems Engineering, TU Wien



Reproducibility

Goals

1. get identical behavior from tools, e.g.:
   same error messages or reformatting of source code
2. get same failures when running tests
3. (re)create identical binaries

Goal 1: Compilation

For identical results installation of exactly the same tools is needed.

Problem

Different distributions offer different tool chains, compiled differently.

Solution (Possible Solution)

Install tools with identical version manually.

Goal 2: Tests

Problem

For identical results the whole execution environment need to be replicated.

Solution (Possible Solution)

Virtualization but even then with limitations.

Dockerfile

- allows to define an image to be used for the build server
- FROM defines a base image
- RUN are commands to be executed that modify the image

Alternatives: NixOS, Guix

Example

scripts/docker/debian/bullseye/Dockerfile:

```
1  FROM␣debian:bullseye
2
3  ENV␣LC_ALL␣C.UTF-8
4
5  RUN␣apt-get␣update␣&&␣apt-get␣-y␣install␣\
6  ␣␣␣␣build-essential
7  RUN␣ldconfig
8
9  RUN␣useradd␣jenkins
10 USER␣${JENKINS_USERID}
11 RUN␣git␣config␣--global␣user.email␣'Jenkins␣<autobuilder@libel
12 ␣␣␣␣&&␣git␣config␣--global␣user.name␣'Jenkins'␣
```

Goal 3: Binaries

Problem

- *Different distributions offer different tool chains.*
- *Tool chained can be compiled or configured differently.*
- *Any current dates or build paths influence binaries.*
- *Any input from outside the source code (e.g. Internet) is volatile.*

Solutions

- Virtualization of build environment
- Recording of build environment (e.g. buildinfo files)
- Let build process ignore the environment
  $\rightarrow$ reduce problem to Goal 1

Reproducible Builds

- verifiable path from source to binary
- reproducible by default (without virtualization)
- reduces influence of build environment
- make build system deterministic

Limitations

Build system and macros enable/disable code depending on:

- compiler
- operating system
- installed dependencies

E.g. in Elektra plugins get disabled depending on missing dependencies.

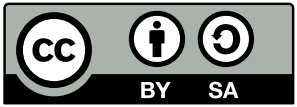
Solution

In practice a combination of recording and ignoring the environment is used.

L04 Continuous Integration

Markus Raab

Institute of Information Systems Engineering, TU Wien



Improve

Jenkins

- cron on steroids
- many plugins
- implemented in Java
- Jenkinsfiles directly in source code

Jenkinsfile

for Elektra in scripts/jenkins/Jenkinsfile

- either declarativ or in Groovy
- enables review of CI
- different CI for different PRs

Jenkinsfile Example

Run one script:

```
1 ␣␣def␣tasks␣=␣[:]
2 ␣␣tasks.failFast␣=␣false
3 ␣␣tasks␣<<␣buildIcheck()
```

```
1 def␣buildIcheck()␣{
2 ␣␣def␣stageName␣=␣"icheck"
3 ␣␣return␣[(stageName):␣{
4 ␣␣␣␣stage(stageName)␣{
5 ␣␣␣␣␣␣withDockerEnv(DOCKER_IMAGES.bullseye)␣{
6 ␣␣␣␣␣␣␣␣sh␣"scripts/build/run_icheck"
7 ␣␣␣␣␣␣␣␣deleteDir()
8 ␣␣␣␣␣␣}
9 ␣␣␣␣}
10 ␣␣}]
11 }
```

Useful Tests

Problem

CI must be fast enough.

- Verify a fact everyone agreed on is actually the case.
- Unit or integration tests run with different compilers and operating systems.
- Verify that a bug is fixed (regression).
- ABI/API tests: that behavior for customers is unchanged.

Order is Important

- first check locally
- them implement automatic check
- then add automatic check to CI

Definition of Done

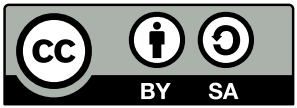
Continuous improvements:

- underlying issue for discussion
- updated documentation
- added tests
- improved code comments
- review done
- QA (valgrind, ASAN, ...)

L04 Continuous Integration

Markus Raab

Institute of Information Systems Engineering, TU Wien



Meeting

Recapitulation.

Feedback

- Feedback Talk

L05 Documentation