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Automating the Build Pipeline for Docker Container

Nikolai Reed, **Jürgen Walter**, and
Samuel Kounev

University of Würzburg

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Reproducibility Problem

- The lack of reproducibility of scientific experiments is a huge problem in research [5]
- Scientific papers often lack a detailed description on how to apply the research software [5, 2]
- Many software projects in public repositories cannot be built or installed within a hour [2]

Solutions

- Problem: Traditional deployment of software can be cumbersome due to compilation, required adaptations, dependency resolution, and lack of developer knowledge [2, 3, 4]

- Problem: Classical virtualization using virtual machines leads to heavy weight containers [1]

- Novel container technologies like Docker
  - provide a reproducible environment to run software
  - run on every machine the same
  - allow for a fast deployments
  - provide smaller containers compared to VM images

In a Nutshell

- This talk motivates and explains the integration of Docker into an automated build and delivery pipeline
- The SSP community provides more containerized services
- The SSP community solves the reproducibility problem through containerization

Introduction to Docker

Creation of Docker Containers

- Docker containers include dependencies required to run the software
- Required software packages are integrated into the Docker image during its build process
- Required information is contained in the so called *DockerFile* [3]

Creation of Docker Containers

- *DockerFile* example for the apache webserver

```
# A basic apache server. To use either add or bind mount content under /var/www
FROM ubuntu:12.04

RUN apt-get update &&
          apt-get install -y apache2 &&
          apt-get clean &&
          rm -rf /var/lib/apt/lists/*

ENV APACHE_RUN_USER www-data
ENV APACHE_RUN_GROUP www-data
ENV APACHE_LOG_DIR /var/log/apache2

EXPOSE 80

CMD ["/usr/sbin/apache2", "-D", "FOREGROUND"]
```

Creation of Docker Containers

- *DockerFile* for our performance model extraction software

```
# Pull base image
FROM openjdk:8u111-jre

# Expose port of the Docker container
EXPOSE 8080

# Define working directory
WORKDIR /opt

# Add Software and server
ADD pmxConsole.jar /opt/data/
ADD target/pmxserver-0.0.1-SNAPSHOT.jar /opt/

# Create directories during build process
RUN \
            mkdir /opt/input && \
            mkdir /opt/zip && \
            mkdir /opt/download && \
            mkdir /opt/output && \
            mkdir /opt/uploaded

# Start command to run wenn container is started
ENTRYPOINT ["java", "-jar", "/opt/pmxserver-0.0.1-SNAPSHOT.jar"]
```

Docker Commands

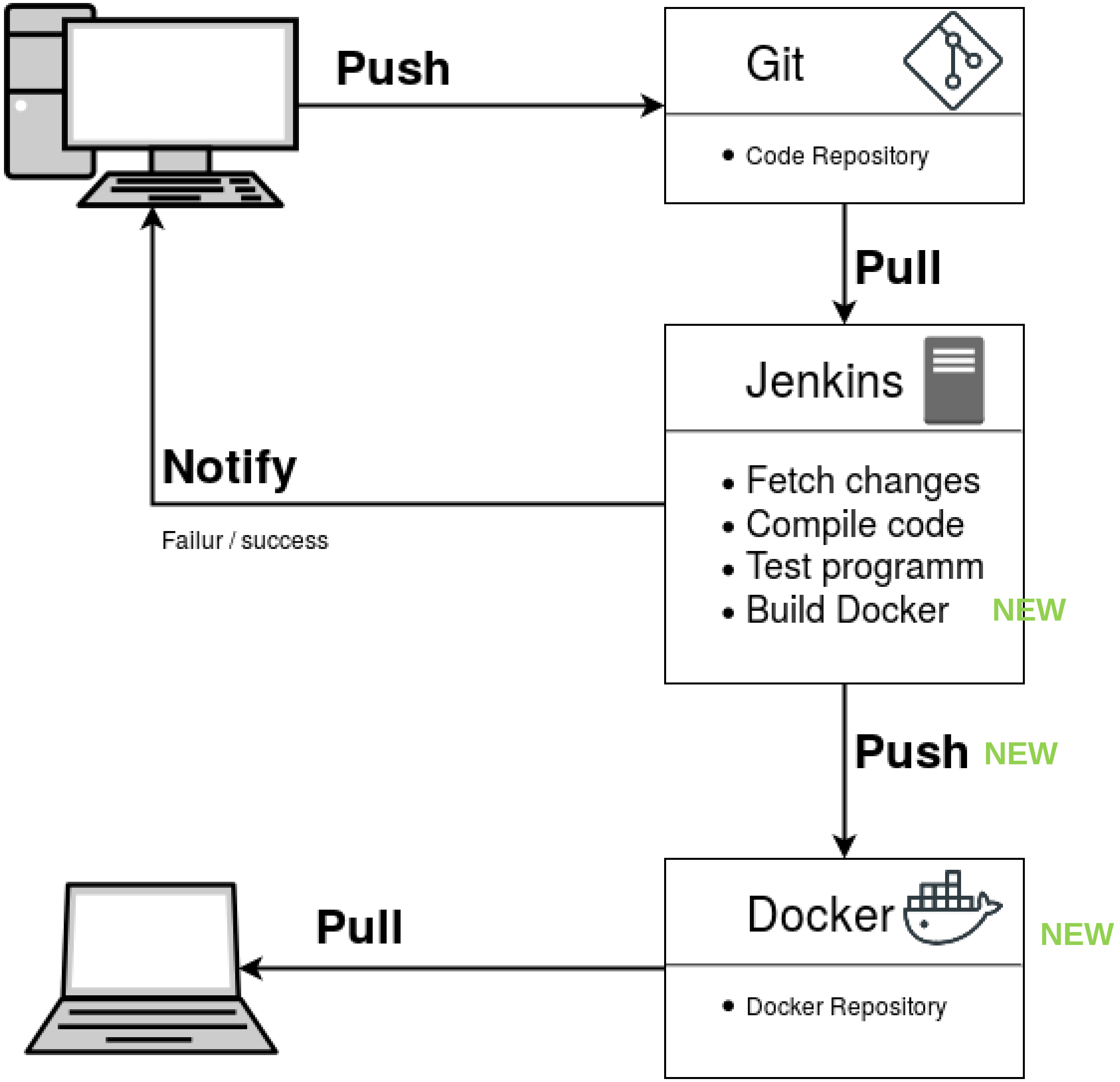
- Creation of Docker container
  - **docker build -t descartesresearch/pmx-dml-server .**
- Running a Docker container
  - **docker run -d -p 8080:8080 descartesresearch/pmx-dml-server**
- Pulling a Docker container
  - **docker pull descartesresearch/pmx-dml-server**

Integrating Docker into CI

- The combination of Docker and CI allows to join their benefits

- Benefits of a automated Docker build Pipeline
  - fast time to production
  - low overhead for developers and operators
  - fast distribution and deployments

Automated Pipeline Process



NEW compared to non-dockerized CI

Required Artifacts

- We already had a running Jenkins CI-server setup available that we could expand upon.

Component Type	Component Instance
Version Control Server	GitLab (Git repository hosting service)
Docker Engine	standard (running on a Linux 64-bit system with Jenkins)
CI Server	Jenkins (an open source automation CI-server)
Docker build software	GitLab plugin (interaction with GitLab) CloudBees plugin (build and publish of docker images)

Alternatives for Automated Pipeline Setup

- Plugin
  - Travis: native Docker integration
  - Team Foundation Server (Windows): Docker plugin available
  - …
- Command line scripts
  - Writing your own scripts based on the Docker file structure
- External service
  - GitLab already offers a CI service that is capable of building Docker images
  - DockerHub can be configured to build images from repositories of BitBucket and GitHub

What we Dockerized so far …

- We apply the presented build pipeline for
  - The performance model extraction tool Performance Model eXtractor (PMX) [6]
  - The Pet Supply Store, a micro-service reference test application for model extraction, cloud management, energy efficiency, power prediction, multi-tier auto-scaling
- Further ideas
  - Simulation as a Service
  - Performance evaluation as a Service
  - …

PMX-PCM Webserver

The manual creation of architectural performance models is very complex, time intense and error prone. The Performance Model eXtractor (PMX) tool automates the extraction of architectural performance models form measurement data. Currently, PMX supports logs of the Kieker Monitoring Framework as input data format

For more information please visit our website

ZIP-File to upload: Durchsuchen... Keine Datei ausgewählt.

Analyze

By uploading files to this web service you herby grant us the right to use, process, share and distribute the data you have provided with the general public for research purposes.

Download some examples here:	
Bookstore	download
Calculator	download

For code and documentation of this service please visit our GitHub instance

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Software Engineering

[illegible]

Conclusion

- Docker can be applied to solve the reproducibility problem
- The combination of Docker and CI allows to join their benefits.
- Their combination enables fast time to production with low overhead for operators and developers.

Thank You!

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References

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[3] C. Boettiger. "An Introduction to Docker for Repropucible Research". In: SIGOPS Operating Systems Review 49.1 (Jan. 2015), pp. 71-79.

[4] R. Nagler et al. "Sustainability and Reproducibility via Containerized Computing". In: CoRRabs/1509.08789 (2015).

[5] J. Cito and H. C. Gall. "Using Docker Containers to Improve Reproducibility in Software Engineering Research". In: Proceedings of the 38th International Conference on Software Engineering (ICSE 2016). Austin, Texas: ACM, 2016, pp. 906-907.

[6] J. Walter et al. "An Expandable Extraction Framework for Architectural Performance Models“. In: Proceedings of the 3rd International Workshop on Quality-Aware DevOps (QUDOS'17). ACM, 2017,pp. 165-170.