



Application Deployment

Software Engineering II
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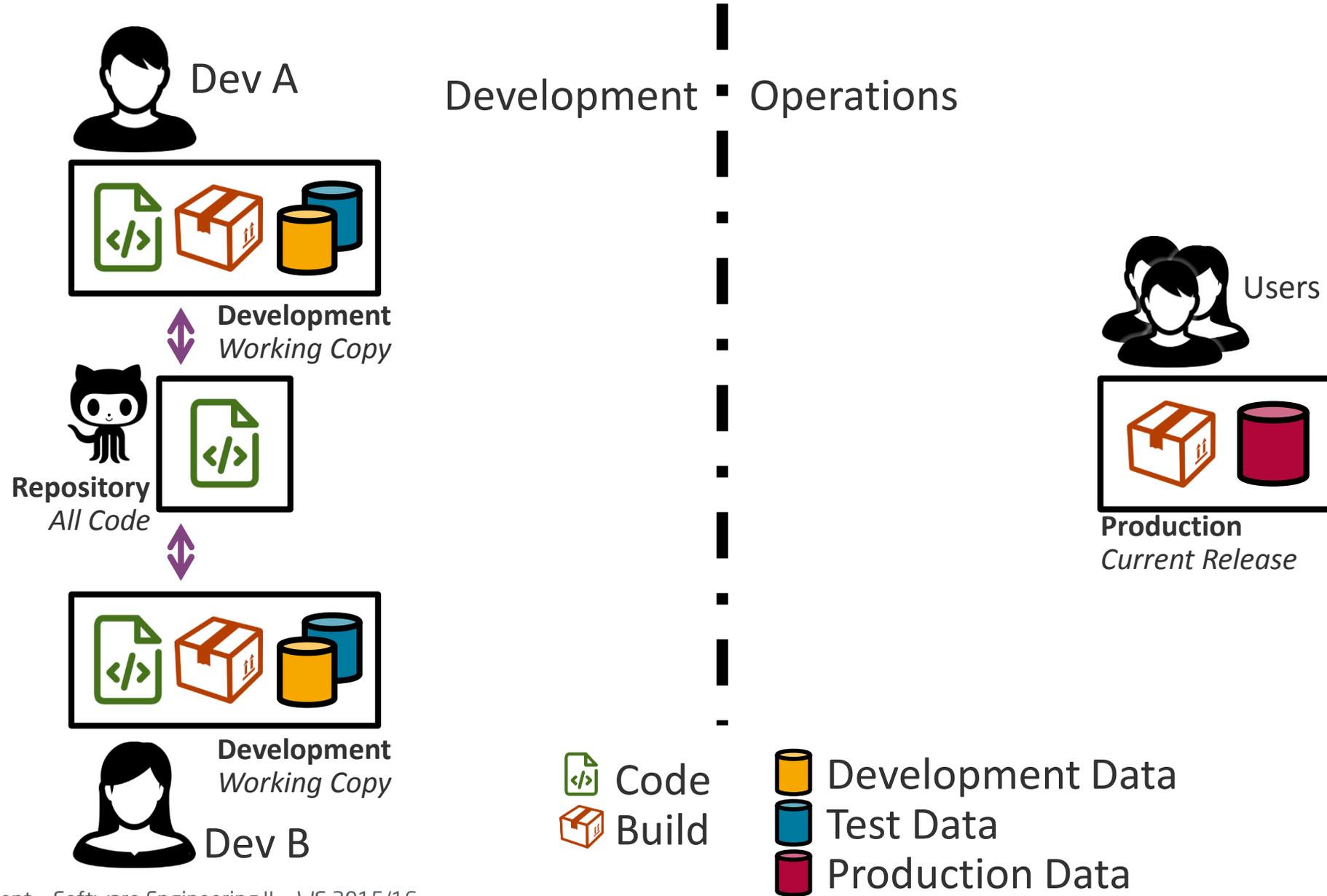
Prof. Plattner, Dr. Uflacker
Enterprise Platform and Integration Concepts

Agenda



1. DevOps
2. Application Hosting Options
3. Automating Environment Setup
4. Deployment Scripting
5. Application Monitoring
6. Continuous Deployment and Scrum

Development vs. Operations



Development & Operations

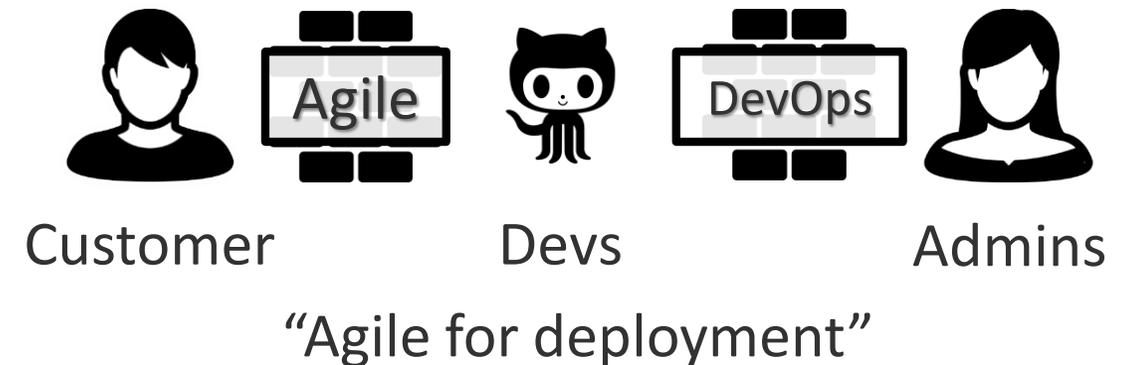


Problems

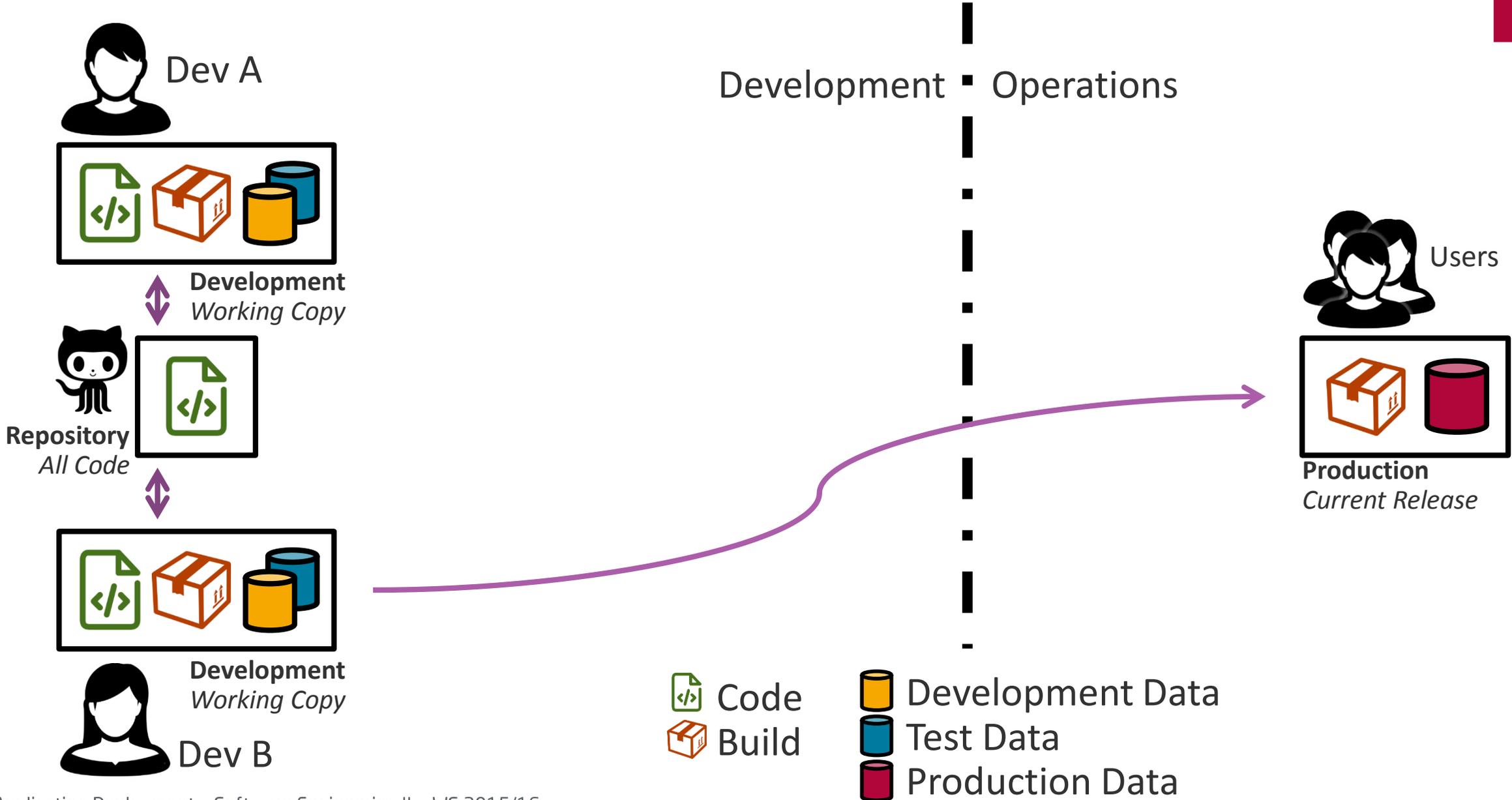
- Software needs to be operated
 - Developers vs. Admins
- **Short** deployment cycles
- Maintain quality **standards**

DevOps

- **Formalized** process for deployment
- Focus on communication, **collaboration**, and integration between Dev and Ops



Not DevOps



Terminology

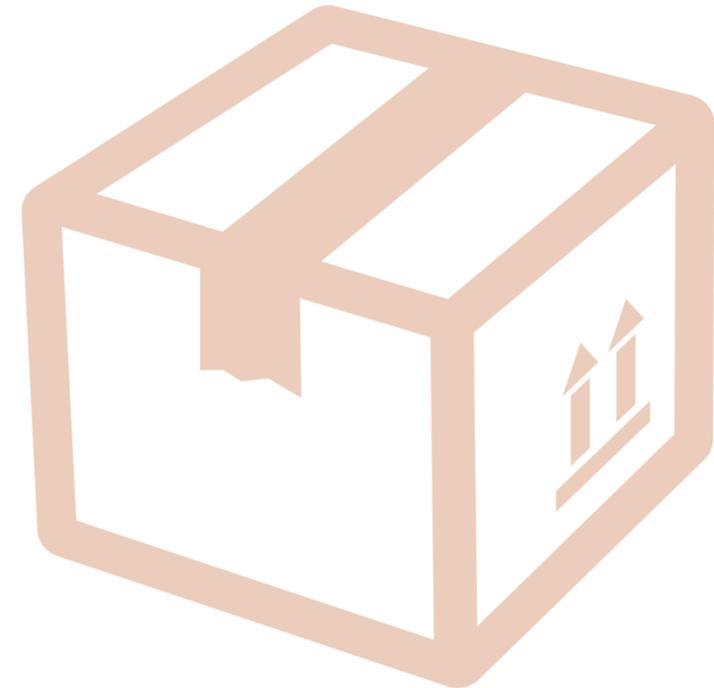


Release

- **Planned state** of the application
- Set of requirements
- Examples
 - Next big version with new shiny features
 - Urgent hotfix
 - Anything in-between

Version

- Could be anything
 - Let's avoid this term
- A release has a **version number**

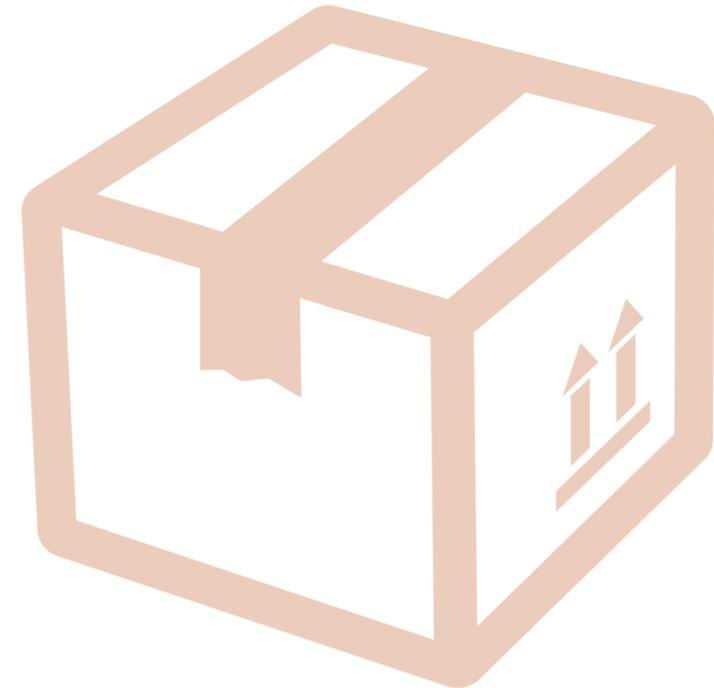


Terminology



Build

- Attempt to implement a release
 - **Snapshot** of application
- Often the output of the build tool
 - Not: the build script/tool/process
- Version number is
“<Release Number>.<Build Number>”



Terminology



Environment

- A system on which the application can be deployed and used

To promote

- To deploy a build on the **next** environment

To release

- To promote a build to **production**
- Thereby closing the release



Which Environments Do We Need?



Development

managed by developers

Development

- Where the developers work
- One per developer (if possible)

Integration

- Runs all tests
- A try-out version

Quality Assurance

- Professional manual testing

Operations

managed by admins

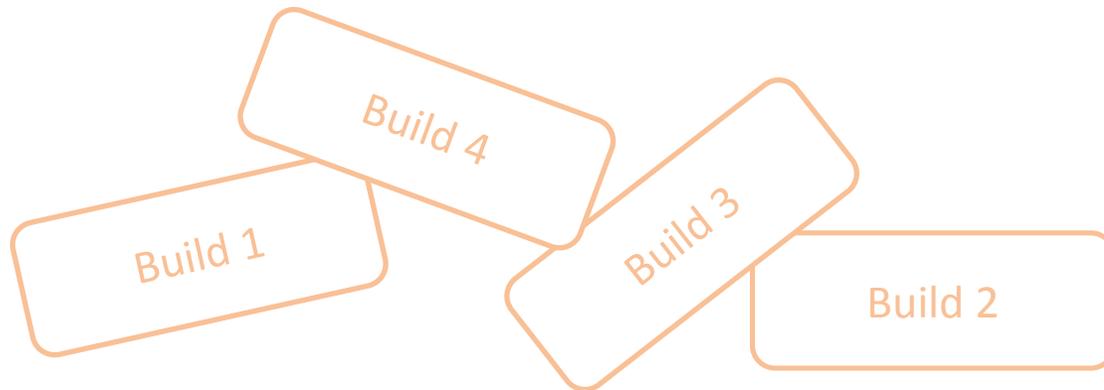
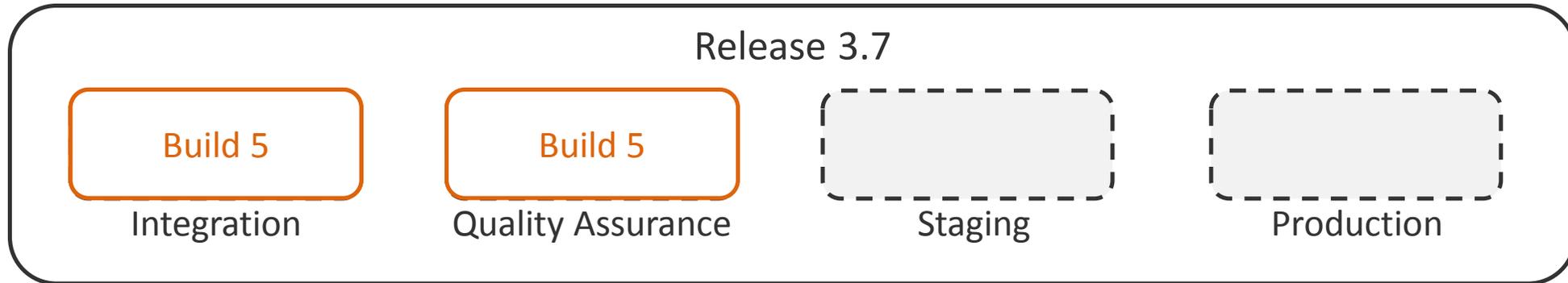
Staging

- Clone of production system
- Final rehearsal

Production

- The live system
- Failures are expensive here

Example



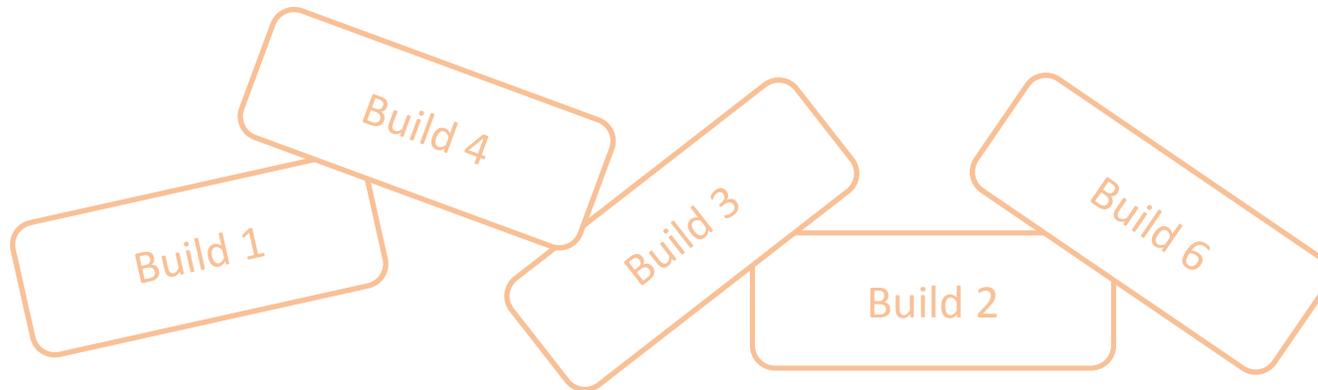
Example



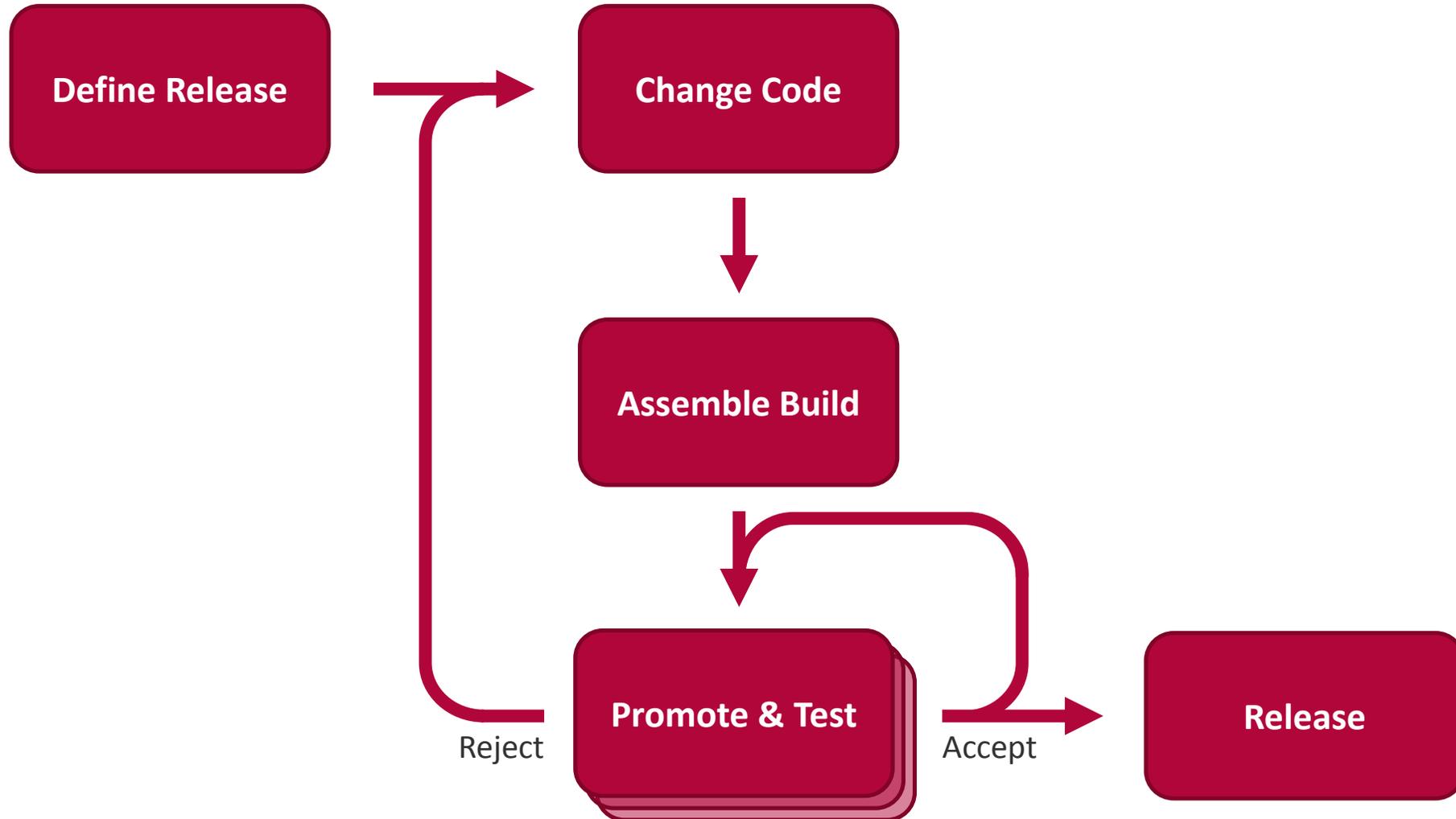
Build 8



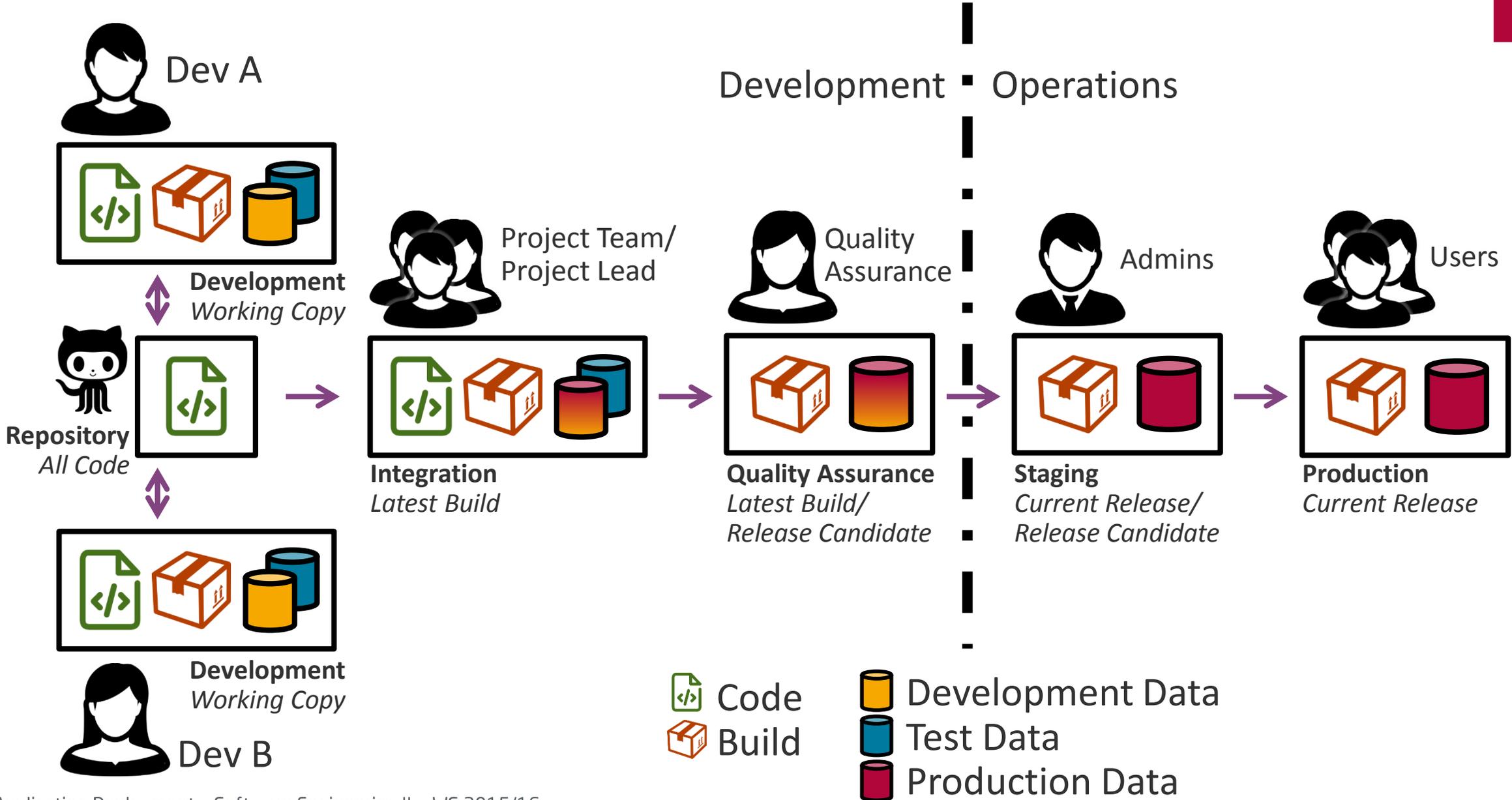
Developers
changing Code



Workflow



DevOps



Implications



Builds are immutable

- If changed, previous testing was pointless
- ➔ Even the smallest change has to go through all environments

Many systems required

- Each environment has to be maintained
- Automation?

Deployment overhead

- Manual steps are potential for human failure
- Automation?

} Remainder of this lecture

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Application Hosting Options

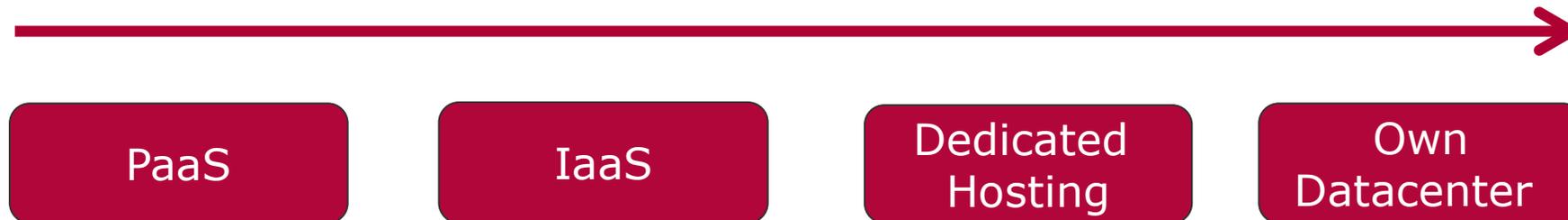


Choice of hosting options is driven by a variety of parameters

- Initial setup effort, cost, and required expertise
- Operational costs and effort
- Targeted service level agreements (SLAs)
- Legal considerations (data privacy, liability, etc.)

Low Effort
Little Control

High Effort
High Control



Platform as a Service (Paas)



Providers deliver OS, execution environment, database, web server, monitoring, etc.

Advantages

- Minimal effort and knowledge required for setup
- Only platform development knowledge (e.g. Python, Ruby) needed, no need for hardware / OS maintenance
- Possibility to scale up quickly and easily

Disadvantages

- Usually fixed environment with little variation points
- Provider SLA targets might differ from yours, e.g. downtime, response times
- Limited technical support

Examples: Heroku, Azure Compute, Google App Engine

Infrastructure as a Service (IaaS)



Providers deliver virtual private servers (VPS) with requested configuration
Setup of execution environment, database servers, etc. is up to customers

Advantages

- Flexibility regarding execution environment
- Avoid management of underlying hardware
- Dynamic on-demand scaling of resources

Disadvantages

- Server administration know-how and efforts required
- It's still a VM: Potential performance drops, Disk I/O, etc.

Examples: Amazon EC2, Google Compute Engine, Rackspace Cloud, DigitalOcean

Dedicated Hosting



Providers allocate *dedicated* hardware, classical approach

Advantages

- Complete control over server, down to bare metal, full power always available
- No virtualization-related performance issues
- More control over network configuration
- Dedicated SLAs

Disadvantages (compared to IaaS)

- No easy scaling of resources
- Administration efforts for servers, e.g. monitor disk failures

Examples: Hetzner, OVH, Rackspace, Host Europe

Own datacenter



You host your own servers

Advantages

- Complete control over data, security, operations, network etc.
- Custom designed servers possible
- Add cabinets in available space with low cost

Disadvantages

- Huge upfront costs, e.g. space, cooling, fiber, hardware
- Expanding the space of the datacenter is expensive
- Provide around the clock support, monitoring, personnel, etc.
- Not feasible for small companies

Examples: Google, Facebook

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 - Virtualization
 - Provisioning
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Setting up an Environment



Main challenges in preparing infrastructure:

- Minimize the effort required to repeatedly setup identical execution environments
- Without relying on “administration gurus”

Solutions:

- *DevOps*, i.e. a strong collaboration between the development and the operations team
- A strong bias towards automation

Where to start with "deploying"?



- Hosted solutions aren't always feasible for initial experiments
- Maintaining local installs of server stacks in different versions can get cumbersome (*e.g. XAMPP, WAMP, LAMP*)
- Development vs. production environment differences result in *"it works on my machine"* problems
- Don't want to force all developers to use the same development environment (e.g. choice of OS)

Possible solution: VirtualBox + Vagrant (<https://www.vagrantup.com/>)

- "Deploy" to a virtual machine on your local OS for development

Vagrant



- Provides reproducible, portable work environments (*VMs*)
- VMs can be created with VirtualBox or others (*e.g. VMware or AWS*)
- Provisioning tools (*e.g. shell scripts, Chef, Puppet*)
automatically install and configure software on the VM
- DSL for describing the basic parameters of a virtual machine (*Vagrantfiles*)
- Predefined and custom packaged boxes

Advantages:

- Reduced file size compared to sharing suspended VMs
- Provisioning ensures same development environment
- Developers can use local tools to develop on the VM
(shared folders, port forwarding)
- Can deploy multiple machines (e.g. database servers)

Vagrant in a nutshell



```
$ vagrant init hashicorp/precise32 # Get a VM image
$ vagrant up # Start the VM
$ vagrant ssh # make desired changes to the VM
# Work on the project
$ vagrant suspend # or halt or destroy
```

Vagrantfiles automate this process:

```
Vagrant::Config.run do |config|
  config.vm.customize ["modifyvm", :id, "--name", "app", "--memory", "512"]
  config.vm.box = "lucid64_with_ruby193"
  config.vm.host_name = "app"
  config.vm.forward_port 22, 2222, :auto => true
  config.vm.forward_port 80, 4567
  config.vm.network :hostonly, "33.33.13.37"
  config.vm.share_folder "hosttmp", "/hosttmp", "/tmp"
end
```

The Vagrantfile from your project: <https://github.com/hpi-sw2/swt2-vagrant/blob/master/Vagrantfile>

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Next Step: Automate VM Configuration



Virtualization software provides a VM.

Provisioning tools configure it, e.g. install required software.

Why not provision manually?

- Error prone, repetitive tasks
- Documentation has to be kept up-to-date
- Explicit knowledge transfer required if Admin changes

One provisioning tool example: Chef (<http://chef.io>, <https://github.com/chef/chef>)

- Formalize software install and configuration state into *recipes*
- Recipes (e.g. for rails4) are shared (<https://supermarket.chef.io/cookbooks>)
- Ensure software is installed based on dependencies
- Ensure that files, packages, and services are in the prescribed state

Common alternative: Puppet (<https://puppetlabs.com/>)

Example: nginx cookbook



```
include_recipe "apt"

package 'nginx' do
  action :install
end

service 'nginx' do
  action [ :enable, :start ]
end

cookbook_file "/usr/share/nginx/www/index.html" do
  source "index.html"
  mode "0644"
end
```

<http://gettingstartedwithchef.com/first-steps-with-chef.html>

Provisioning Summary



Create your VM, e.g. describe it with Vagrant.

Using provisioning tools, you can:

- Define the required packages for all required servers
- Install and configure necessary services
- Create the directory structure for your application
- Create custom configuration files (e.g., database.yml)

Not touched here but also possible:

- Use templates to create different files based on variables
- Control flow features (if-else and switch)
- Environments (staging vs. production)
- Central management of configuration files that are automatically transferred to clients

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Environment is set - How to deploy?



Necessary steps after the server is configured:

- Checkout code changes
- Update your dependencies (i.e. gems)
- Run database migrations, restart application servers
- Optional: Restart index servers, setup new Cron jobs, etc.

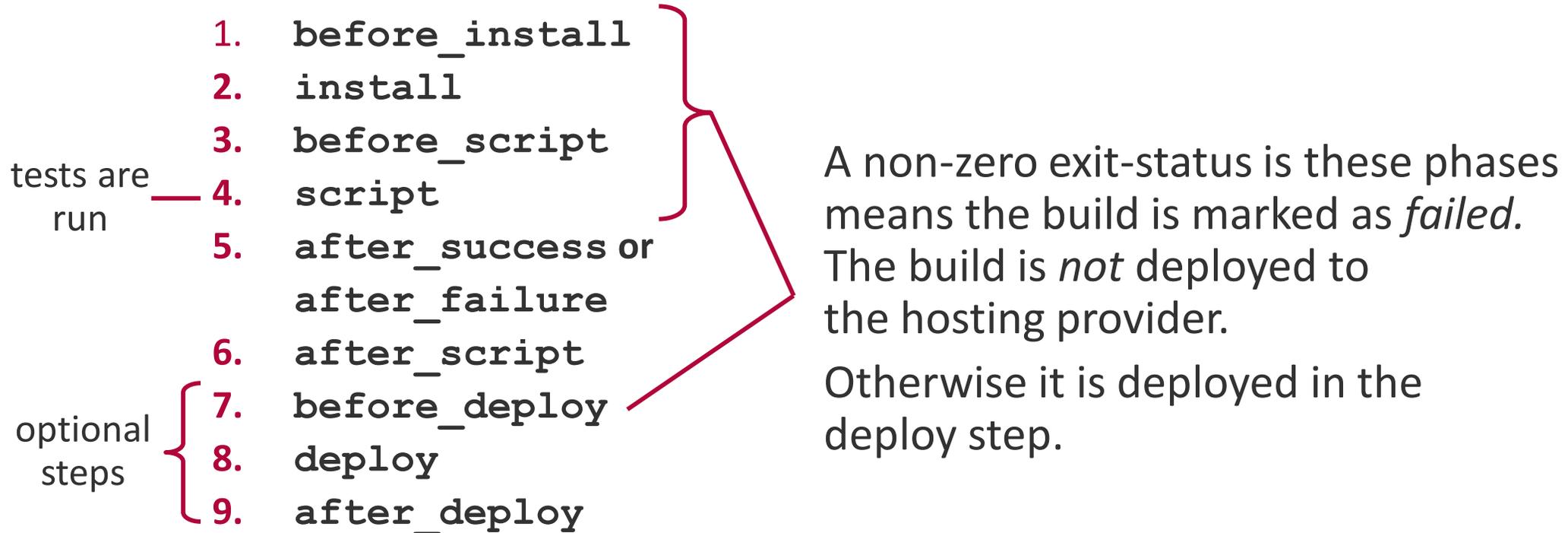
Remember: Automation!

- Easiest: **Travis CI** supports deploying to many hosting providers (<http://docs.travis-ci.com/user/deployment/>)
 - Deploy after all the tests pass
- Alternative: Capistrano (<https://github.com/capistrano/capistrano>)
 - Prepares the server for deployment (possibly using provisioning tools)
 - Deploy the application as updates are made

Deployment with Travis CI



Travis Continuous Integration and Deployment Workflow:



- A custom `after_success` step can be used to deploy to own servers (<http://docs.travis-ci.com/user/deployment/custom/>)

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Monitoring your servers and application



Keep an eye on server health and applications:

- Get alerts when components fail or exceed predefined thresholds
- Examples:
 - Uptime Robot—HTTP GET / ping every 5 mins (<https://uptimerobot.com/>)
 - Nagios—Monitor infrastructure, down to switches and services (<http://nagios.org>)

Monitor application errors and performance bottlenecks:

- Monitor errors that happen at runtime, discovered by users
- Notifications upon application errors, slow downs
- Good idea: Protocols for error fixing!
- Examples:
 - Errbit—Collect and organize errors (<https://github.com/errbit/errbit>)
 - New Relic—Performance monitoring, response times, SQL (<http://newrelic.com/>)

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Deploying 50 times a day? Continuous Delivery

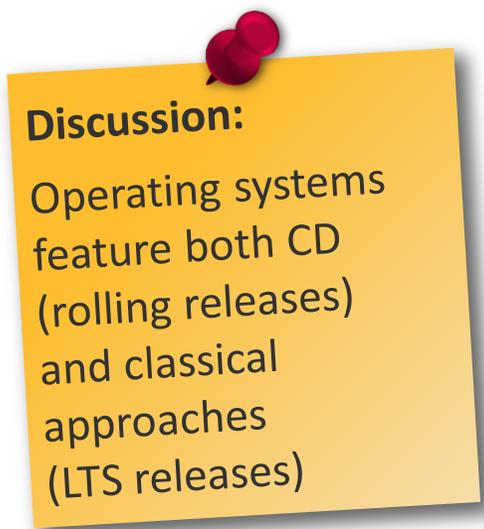


Advantages:

- Users get a sense of “something happening” frequently, shorter feedback loop
- Business value of features immediately present
- Deploy scripts used often, less likely to contain errors
- Reduced amount of code changes per release → faster fixes, less downtime

Prerequisites/Disadvantages:

- Only feasible with extensive set of *good* tests
- Tests / deployment need to run fast (*Continuous Integration*)
- Additional training for developers (*DevOps*) required
- May not be feasible for applications that require planning or long-term support (e.g. operating systems)



Discussion:

Operating systems feature both CD (rolling releases) and classical approaches (LTS releases)

Continuous Deployment vs. Scrum



How do 50 deployments a day fit into Scrums notion of Sprints?

Some ideas (let's discuss):

- Intermediate Reviews for individual stories by the PO
 - At sprint review, each finished story is already running in production
 - Review meetings become shorter, more of a high level overview
- Get faster feedback from stakeholders for next Scrum meeting
- Deploying to staging or testing systems becomes part of the definition of done
- Acceptance of features not only based on PO approval but stakeholder approval?
 - A/B testing?
- "Working software is the primary measure of progress" —*Agile Manifesto*
 - Is software that is not deployed *working*? (*DevOps*)
- ...

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Conclusion: **Automate** everything!

<https://github.com/narkoz/hacker-scripts> ;-)

Image Credits



- thenounproject.com
 - Box designed by Mourad Mokrane
 - Bricks designed by Trammie Anderson