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

Dev A

Dev B

Development Working Copy

Repository
All Code

Development Working Copy

Operations

Users

Production
Current Release

Code
Build

Development Data
Test Data
Production Data
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

“Agile for deployment”
Not DevOps

Dev A

Dev B

Development
Working Copy

Repository
All Code

Development
Working Copy

Development
Operations

Users

Production
Current Release

Code
Build

Development Data
Test Data
Production Data
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
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

- 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

Release 3.7

Build 5
Integration

Build 5
Quality Assurance

Staging

Production

Build 1

Build 2

Build 3

Build 4

Build 2

Build 3

Build 4

Build 1
Example

Release 3.7

Build 8
Developers changing Code

Build 7
Integration

Build 5
Quality Assurance

Build 5
Staging

Production

Build 4
Build 3
Build 6
Build 1
Build 2
Workflow

Define Release → Change Code → Assemble Build → Promote & Test

Rejected by: Reject

Accepted by: Accept

Release
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
1. DevOps
2. Application Hosting Options
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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

PaaS
IaaS
Dedicated Hosting
Own Datacenter
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
1. DevOps
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3. Automating Environment Setup
   - Virtualization
   - Provisioning
4. Deployment Scripting
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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.run do |config|
  config.vm.customize ["modifyvm", :id, "--name", "app", "--memory", "512"]
  config.vm.box = "lucid64_with_ruby193"
  config.vm.hostname = "app"
  config.vm.forward_port 22, 2222, :auto => true
  config.vm.forward_port 80, 4567
  config.vm.network :hostonly, "33.33.33.37"
  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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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

```ruby
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

```
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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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:

1. before_install
2. install
3. before_script
4. script
5. after_success or after_failure
6. after_script
7. before_deploy
8. deploy
9. after_deploy

A non-zero exit-status is these phases means the build is marked as failed. The build is not deployed to the hosting provider. Otherwise it is deployed in the deploy step.

A custom after_success step can be used to deploy to own servers

(http://docs.travis-ci.com/user/deployment/custom/)

http://docs.travis-ci.com/user/build-lifecycle/
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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/](https://uptimerobot.com/))
  - Nagios—Monitor infrastructure, down to switches and services ([http://nagios.org](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](https://github.com/errbit/errbit))
  - New Relic—Performance monitoring, response times, SQL ([http://newrelic.com](http://newrelic.com))
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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 Scrum’s 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)
■ ...

— Agile Manifesto
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Conclusion: Automate everything!

https://github.com/narkoz/hacker-scripts ;}
Image Credits

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