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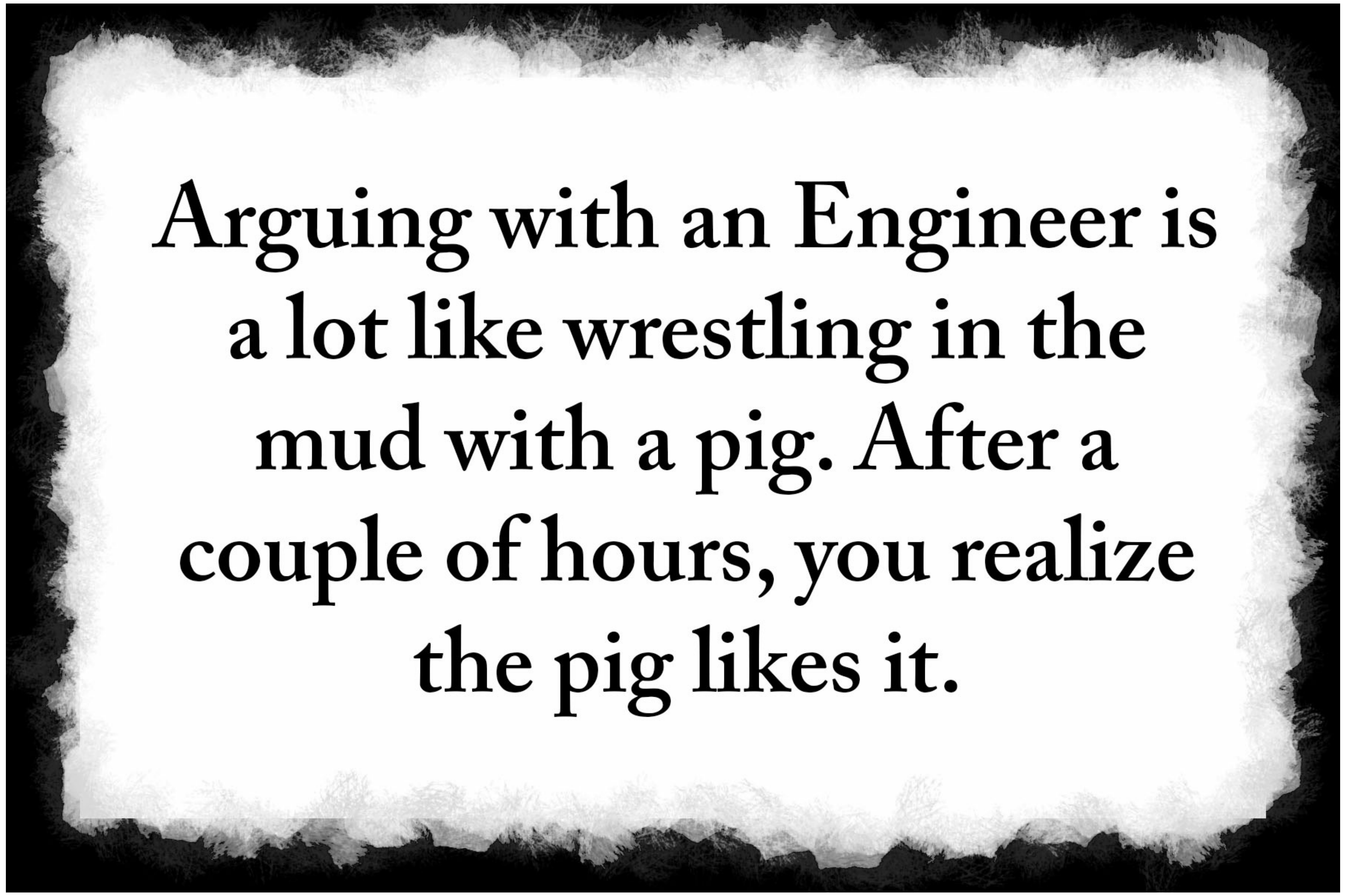
DEVFEST LILLE 2017

JENKINS, BLUEOCEAN AND DECLARATIVE PIPELINES

TOC

MOTIVATIONS OF THIS TALK

MOTIVATIONS



Arguing with an Engineer is a lot like wrestling in the mud with a pig. After a couple of hours, you realize the pig likes it.

JENKINS PROJECT

MEET JENKINS

Jenkins is an open source automation server which enables developers around the world to reliably build, test, and deploy their software.

WHAT IS JENKINS ?

- #1 Continuous Integration and Delivery server
- Created by Kohsuke Kawaguchi in 2006
  - Original project: "Hudson", renamed "Jenkins" in 2011
- An independent and active community (jenkins.io)
  - 500+ releases to date
  - 150,000+ active installations
  - 300,000+ Jenkins servers
  - 1,200+ plugins

JENKINS POPULARITY: THROUGH THE ROOF

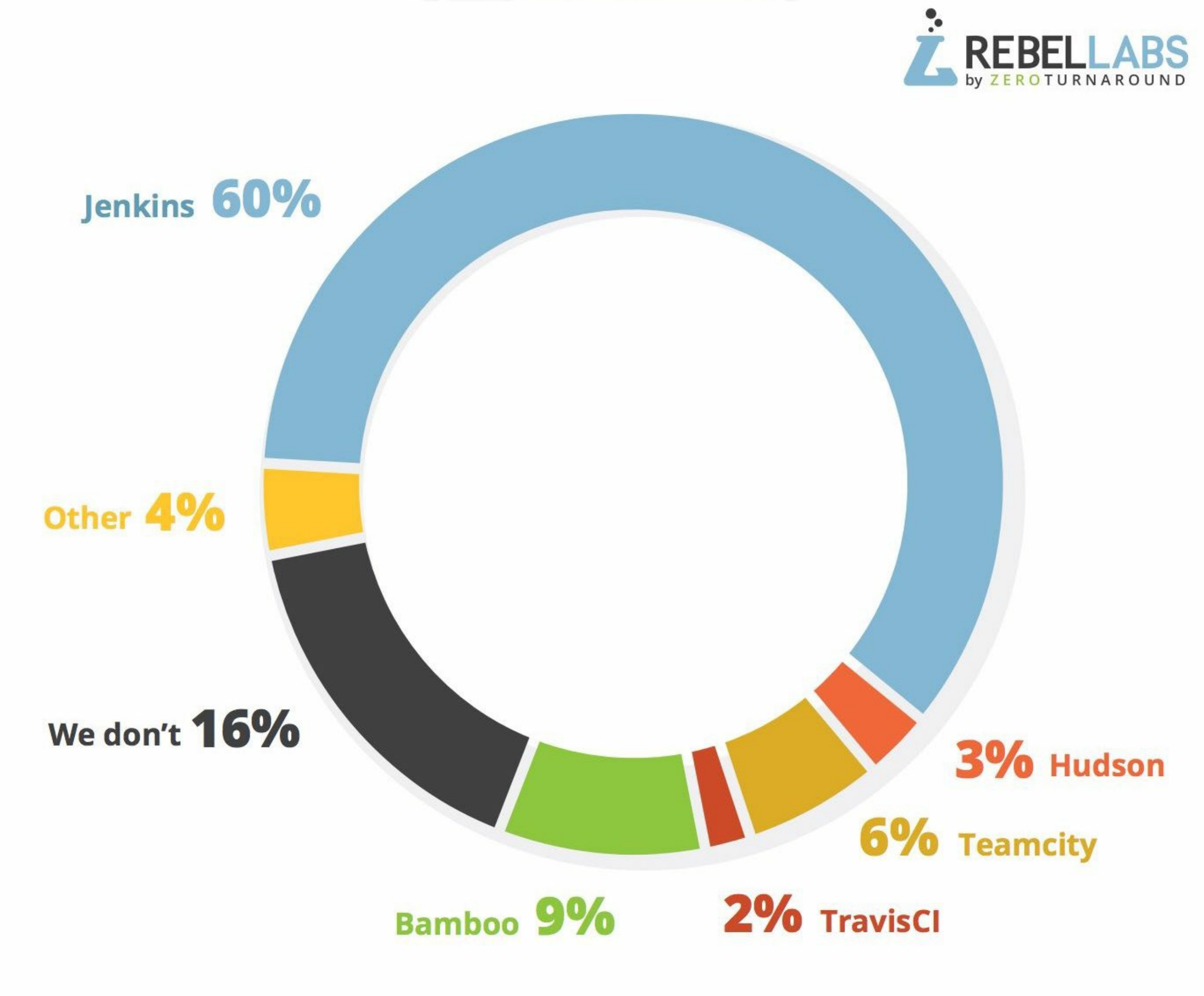
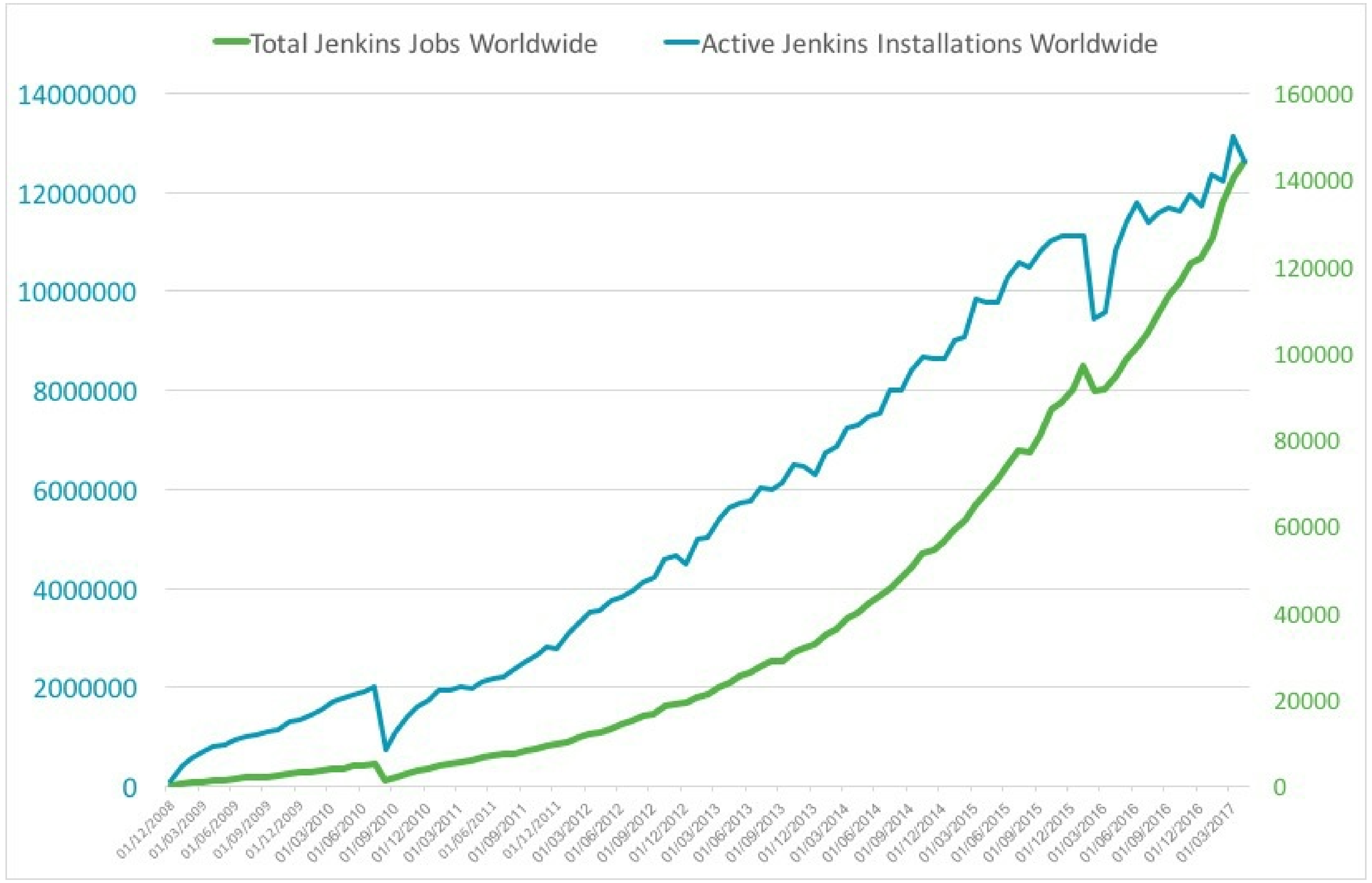


Figure 1.17 Continuous Integration Server Usage

Source: RebelLabs Tools and Technologies Leaderboard 2016

WORLDWIDE ADOPTION



Source: stats.jenkins.io

JENKINS IN 2016

2016 was the year of Jenkins 2

WHY JENKINS 2 ?

- Jenkins 1 is more than 12 years old
- Because Continuous Integration have changed...
  - jenkins-ci.org !?
- slave ➞ agent
- "Fire and forget"
- "Modern Web":
  - jenkins.io
  - jenkins.io/docs
  - plugins.jenkins.io

JENKINS 2 GOALS

- Target: CI → CD
- No breaking changes from Jenkins 1
  - Smooth upgrade
  - Plugins compatibility
- First time experience improvement
  - Brand new Wizard
- Pipeline-as-Code:
  - **Jenkinsfile** stored in SCM
  - Groovy DSL: "Code your Pipeline"

JENKINS IN 2017 ?

JENKINS IN 2017

- Declarative Pipeline
  - Still **Jenkinsfile**
  - Easier
  - Compatible with Scripted Pipeline
- BlueOcean
  - Brand new GUI
  - Written in ReactJS
  - Opinionated

HELLO

WHOAMI: JEAN-MARC MEESSEN

- Customer Success Manager @ CloudBees
  - Explorer of the great things out there
  - Loves to share his discoveries
  - Not too old for great adventures
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iglo
CAPTAIN IGLO
10 Fish Sticks
NATUURLIJKE BRON VAN
SOURCE NATURELLE DE
SELENIUM
15min
8min
Forever Food
300g℮

WHOAMI: DAMIEN DUPORTAL

- Training Engineer @ CloudBees
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  - Rock climber
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  - Github: dduportal
  - Google: damien.duportal@gmail.com

CLOUDBEES

<sales_pitch>

- Software at the "Speed of Ideas", Hub of "Enterprise Jenkins and DevOps", providing:
  - Jenkins "Enterprise" Distribution
  - Services around Jenkins
- Jenkins World 2017: THE Event for Everything Jenkins and DevOps
  - August 28-31 2017, San Francisco, CA, USA
  - Register at Jenkins World 2017 Website with the code JWJMEESSEN for 20% discount

</sales_pitch>

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WHO ARE YOU ?

PREPARE LAB ENVIRONMENT: LOCAL VM BASED

- Requires VirtualBox >= 5.1.22
  - Virtualbox website
- Requires Vagrant >= 1.9.4
  - Vagrant website
- From a Terminal, download the VM (1 time, ~1Gb):

```
vagrant box add devfest-2017-jenkins \
  https://github.com/oufti-playground/lab-vm/releases/download/devfest-2017/jenkins-lab-
```

- From the same Terminal, initialize the VM project:

```
mkdir devfest-2017-jenkins
cd devfest-2017-jenkins
vagrant init -m -f devfest-2017-jenkins
```

LET'S GET STARTED: LOCAL VM BASED

- Start the VM from the devfest-2017-jenkins folder:

```
$ ls
  Vagrantfile
$ pwd
  .../devfest-2017-jenkins
$ vagrant up
```

- Access your instance homepage: http://localhost:10000

THAT'S ALL FOR THIS CHAPTER

DEMO APPLICATION

DEMO APPLICATION: WHY ?

- Goal: Illustrate a Software Supply Chain with a demo application
- Challenge: So many languages/framework/toolchains
- Solution:
  - Opinionated demo application (language, tooling, etc.)
  - Put everyone on same page with initial exercise

DEMO APPLICATION: WHAT ?

- Web application
- This is the Spring Boot Starter
- Language: Java (OpenJDK 8)
- Toolchain: Maven (Maven >= 3.3)
- Source code stored inside a local Git repository

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DEMO APPLICATION: HOW ?

DEMO APPLICATION: ACCESS IT

- Open the local GitServer:
  - http://localhost:10000/gitserver
- Sign In using the top-right button
  - User is **butler**, same for the password
- Browse to the repository. Either:
  - Click on Explore → butler/demoapp
  - or Direct URL: http://localhost:10000/gitserver/butler/demoapp

DEMO APPLICATION: CHECK IT

- Maven configuration: `pom.xml`
- Application Source code: `src/main/java/`
- Application Templates/HTML: `src/main/resources/`
- Application Test code: `src/test/java`

DEMO APPLICATION: GET IT

- Open the DevBox, the Web based command line:
  - http://localhost:10000/devbox
  - WebSockets must be authorized
- Copy the demoapp repository URL from GitServer
- Run the following commands:

```
# Get the git repository
git clone http://localhost:10000/gitserver/butler/demoapp.git
# Browse to the local repository
cd ./demoapp
# Check source code
ls -l
cat pom.xml
```

DEMO APPLICATION: DEVBOX TRICKS

- Clean the window: **clear**
- Show command history: **history**
- **CTRL + R**: search the command history interactively
- **CTRL + C**: cancel current command and clean line buffer
- **CTRL + A**: jump to beginning of line
- **CTRL + E**: jump to end of line

DEMO APPLICATION: MAVEN

- Maven TL;DR:
  - Provide a standardized workflow
  - **pom.xml** describe the application
- Maven Command line : **mvn**, expects goals (workflow steps)

```
mvn dependency:list
```

- Can have flags (configuration on the fly)

```
mvn dependency:list -fn
```

DEMO APPLICATION: COMPILE IT

- Maven goal is **compile**
  - Resolve build dependencies
  - Process source code
  - Generate classes
- Content put in the **./target** folder:

```
mvn compile
ls -l ./target
```

DEMO APPLICATION: UNIT-TEST IT

- Maven goal is **test**
  - Execute **compile** goal
  - Compile Unit Test classes
  - Run Unit Test
- Tests Reports put in the **./target/surefire-reports** folder:

```
mvn test
ls -l ./target/surefire-reports
```

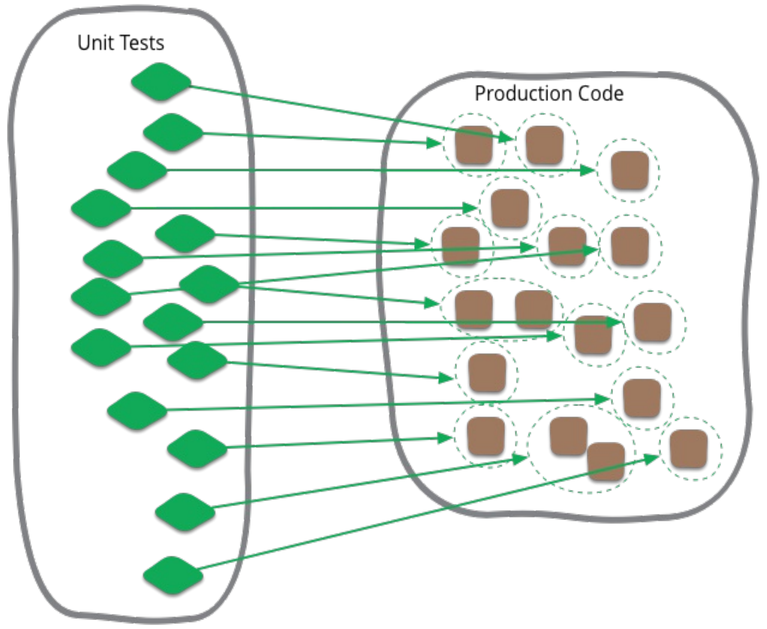
DEMO APPLICATION: BUILD IT

- Maven goal is **package**
  - Execute **compile** and **test** goals
  - Package the application as specified in **pom.xml**
- The new artifact (generated packages) is stored in **./target**

```
mvn package
ls -ltrh ./target/
```

DEMO APPLICATION: A NOTE ABOUT TESTS

- Unit / Integration Test ?
  - Bedtime reading: https://martinfowler.com/tags/testing.html



DEMO APPLICATION: INTEGRATION TESTING

- Maven goal is **verify**
  - Execute **compile**, **test** and **package** goals
  - Resolve integration test dependencies
  - Run Tests against the packaged application
- Tests Reports stored in the **./target/failsafe-reports** folder:

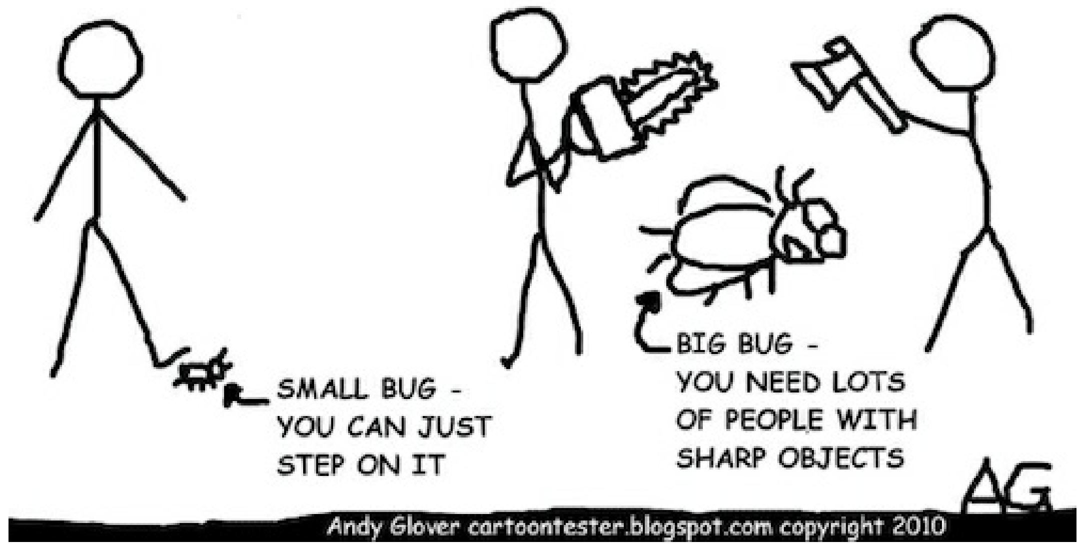
```
mvn verify
ls -l ./target/failsafe-reports
```

THAT’S ALL FOR THIS CHAPTER

CONTINUOUS INTEGRATION WITH JENKINS

aka "CI"

CI: WHY ?


SMALL BUG - YOU CAN JUST STEP ON IT
BIG BUG - YOU NEED LOTS OF PEOPLE WITH SHARP OBJECTS
AG
Andy Glover cartoontester.blogspot.com copyright 2010

Continuous Integration doesn’t get rid of bugs, but it does make them dramatically easier to find and remove.

— Martin Fowler

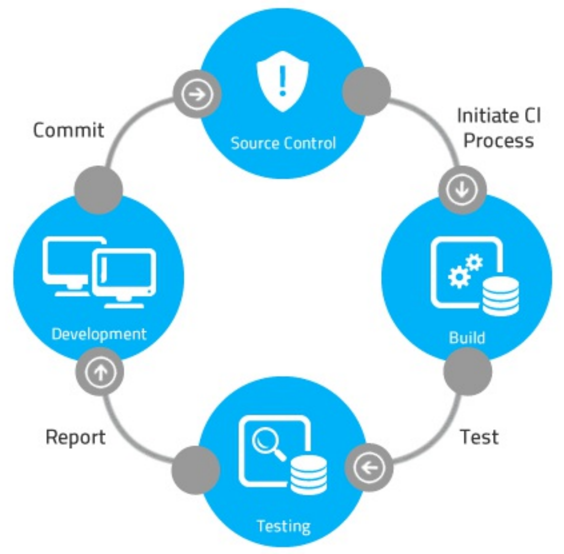
CI: WHAT ?

Continuous Integration is a software development practice where members of a team integrate their work frequently, usually each person integrates at least daily, leading to multiple integrations per day.

— Martin Fowler - Continuous Integration

CI: HOW ?

- Each integration is verified by an automated build (including test)
- Integrate code often, at least daily, to make integration a non-event
- Continuously build and integrate, with a feedback loop



CONTINUOUS INTEGRATION WITH JENKINS

CI: ACCESSING JENKINS

- Access your Jenkins instance:
  - http://localhost:10000/jenkins
  - Log in as the user **butler** (password is the same)
  - This is the "Jenkins Classic GUI"

CI: JENKINS BLUEOCEAN

- Switch to BlueOcean, the new UI
  - Direct link to BlueOcean GUI
  - *Or* click on the top button "Open Blue Ocean"

CI: OUR FIRST PIPELINE PROJECT

- Create your 1st Pipeline:
  - Stored in Git
  - Fetch URL from the Gitserver
    - Direct link to Git repository
  - Add a User/password credential (**butler** / **butler**)
  - Pipeline is empty (for now): no **Jenkinsfile**

CI: FAST FEEDBACK WITH WEBHOOKS

- We want Fast feedback !
  - Pushed code to repository ? Tell Jenkins to build it now
- Let’s use Webhook to the repository
  - HTTP request Gitserver → Jenkins

CI: ADD A GOGS WEBHOOKS

- From repo. in Gitserver → Settings → Webhooks
  - Direct link to Repository Webhook Settings
- Add a new webhook:
  - Type: Gogs (not Slack)
  - Payload URL: http://localhost:10000/jenkins/job/demoapp/build?delay=0
  - When should this webhook be triggered?: I need everything

CI: STARTING WITH PIPELINES

- Pipeline-as-code: We need a **Jenkinsfile**
- Where to start ?
  - Getting Started with Pipeline
  - Pipeline "Handbook"
  - Pipeline Syntax Reference
  - Pipeline Steps Reference

CI: DECLARATIVE OR SCRIPTED PIPELINES ?

- Declarative
  - Easy syntax
  - Default syntax
  - Start with this one
- Scripted
  - Original syntax (~3 years)
  - "Great Power == Great Responsibility"
  - Use it when Declarative starts to be weird

CI: BLUEOCEAN PIPELINE EDITOR

- Provides the full round trip with SCM
- No Pipeline ? Follow the wizard (not Gandalf, fool !)
- Already have a Pipeline ? Edit, commit, run it
- Needs a compliant SCM
  - Only Github with BO 1.0.1
  - Interested ? Open-Source: Contribute !

CI: USE THE PIPELINE EDITOR

- Git is not supported (yet): let’s hack
  - Open the hidden BlueOcean Pipeline Editor: Direct URL
  - Use **CTRL + S** (On Mac: **CMD +S**) to switch to/from textual version
- The "Pipeline Snippet Generator" is useful:
  - Dynamic generation based on the installed plugins
  - A pipeline job is required: check the left menu icon on http://localhost:10000/jenkins/job/demoapp
  - http://localhost:10000/jenkins/job/demoapp/pipeline-syntax/

CI: EXERCISE - YOUR FIRST PIPELINE

- Use the BlueOcean Pipeline Editor and Gitserver
- Create a Pipeline that have a single stage "Hello"
- This stage have 1 step that prints the message "Hello World"
- Copy/Paste this Pipeline in a new file **Jenkinsfile** on the repository root
  - Direct link to Git repository
- A build will kick off immediately:
  - demoapp Activity Dashboard

CI: SOLUTION - YOUR FIRST PIPELINE

```
pipeline {
  agent any
  stages {
    stage('Hello') {
      steps {
        echo 'Hello World !'
      }
    }
  }
}
```

CI: EXERCISE - SIMPLE BUILD PIPELINE

- Exercise: Implement a simple build pipeline for demoapp
- We want 4 stages, for the 4 Maven goals:
  - **compile**, **test**, **package**, **verify**
- We need to build on the **maven** agent

CI: SOLUTION - SIMPLE BUILD PIPELINE

```
pipeline {
  agent {
    node {
      label 'maven'
    }
  }
  stages {
    stage('Compile') {
      steps {
        sh 'mvn compile'
      }
    }
    stage('Unit Tests') {
      steps {
        sh 'mvn test'
      }
    }
    stage('Build') {
      steps {
        sh 'mvn package'
      }
    }
    stage('Integration Tests') {
      steps {
        sh 'mvn verify'
      }
    }
  }
}
```

CI: EXERCISE - ARTIFACTS

- We want to simplify to 2 stages, based on Unit Tests definition:
  - **Build**: compile, unit test and package the application
  - **Verify**: Run Integration Tests
- We also want to archive the generated **jar** file
  - Only if the build is successful
- *Clues*: Keywords **post** + **success** (not in Editor), and **archiveArtifacts**
  - Pipeline Syntax Reference
  - Snippet Generator

CI: SOLUTION - ARTIFACTS

```
pipeline {
  agent {
    node {
      label 'maven'
    }
  }
  stages {
    stage('Build') {
      steps {
        sh 'mvn package'
      }
    }
    stage('Verify') {
      steps {
        sh 'mvn verify'
      }
    }
  }
  post {
    success {
      archiveArtifacts 'target/demoapp.jar'
    }
  }
}
```

CI: EXERCISE - INTEGRATION TESTS REPORTS

- We want the integration test reports to be published to Jenkins
  - Better feedback loop
- If Integration Tests are failing, do NOT fail the build
  - Make it UNSTABLE instead
- *Clues*:
  - Maven flag **-fn** ("Fails Never")
  - keyword **junit** (Pipeline keyword)

CI: SOLUTION - INTEGRATION TESTS REPORTS

```
pipeline {
  agent {
    node {
      label 'maven'
    }
  }
  stages {
    stage('Build') {
      steps {
        sh 'mvn clean compile test package'
      }
    }
    stage('Verify') {
      steps {
        sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml'
      }
    }
  }
  post {
    success {
      archiveArtifacts 'target/demoapp.jar'
    }
  }
}
```

CI: EXERCISE - ALL TESTS REPORTS

- We now want all test reports published
  - Problem: how to handle Unit test failure ?
- We also want to archive artifacts if build is unstable only due to the **Verify** stage
- *Clues*: **post** can be used per stage

CI: SOLUTION - ALL TESTS REPORTS

```
pipeline {
  agent {
    node {
      label 'maven'
    }
  }
  stages {
    stage('Build') {
      steps {
        sh 'mvn clean compile test package'
      }
      post {
        always {
          junit '**/target/surefire-reports/*.xml'
        }
      }
    }
    stage('Verify') {
      steps {
        sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml'
      }
      post {
        unstable {
          archiveArtifacts 'target/demoapp.jar'
        }
      }
    }
  }
  post {
    success {
      archiveArtifacts 'target/demoapp.jar'
```

CI: FAILING TESTS

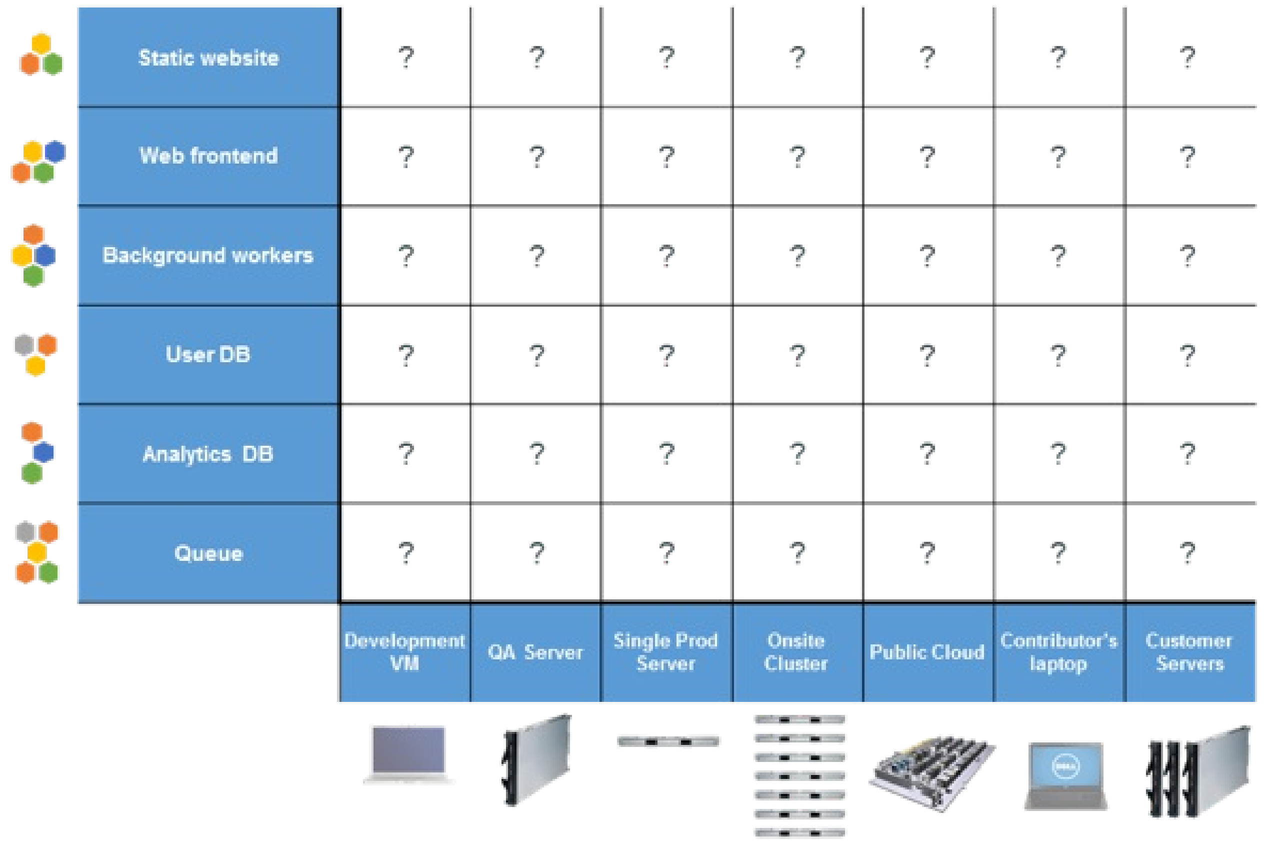
- Validate your changes by making your tests fails.
- Edit each one and uncomment the failing block:
  - Integration: `src/master/src/test/java/hello/ApplicationIT.java`
  - Unit Tests: `src/master/src/test/java/hello/ApplicationTest.java`
- Browse the top-level items "Changes", "Tests" and "Artifacts"
- Do NOT forget to correct your tests at the end

THAT'S ALL FOR THIS CHAPTER

DOCKER

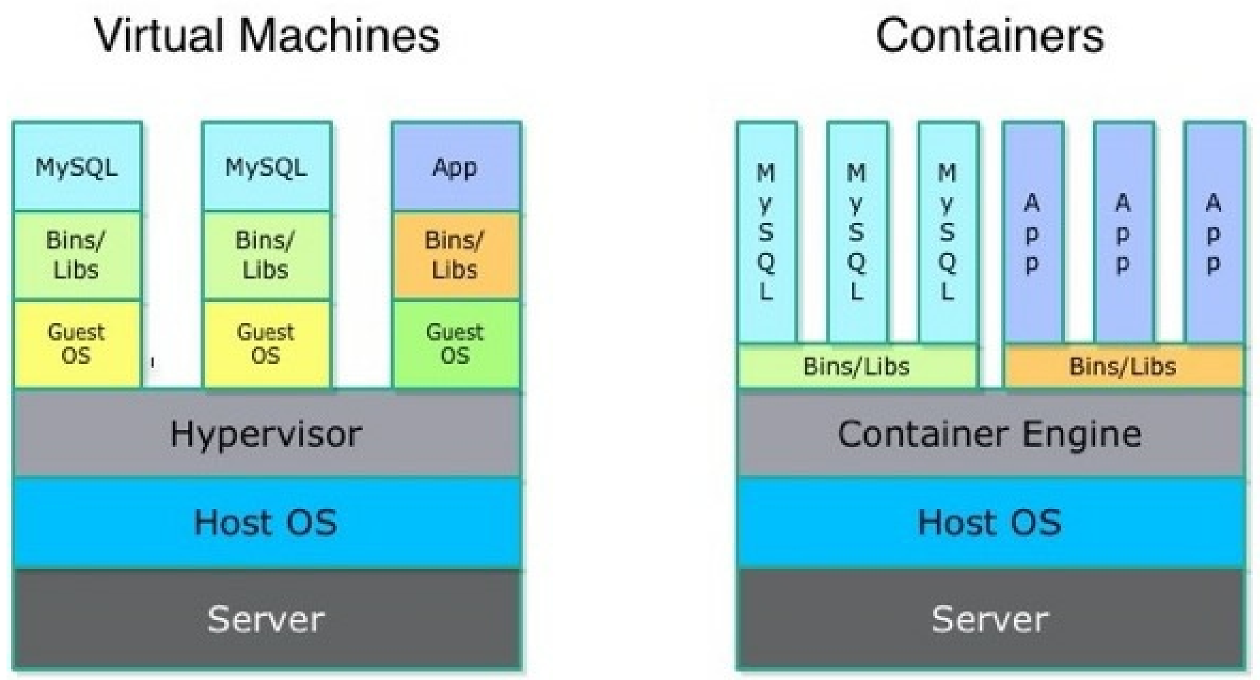
to the Rescue

DOCKER: WHY ?

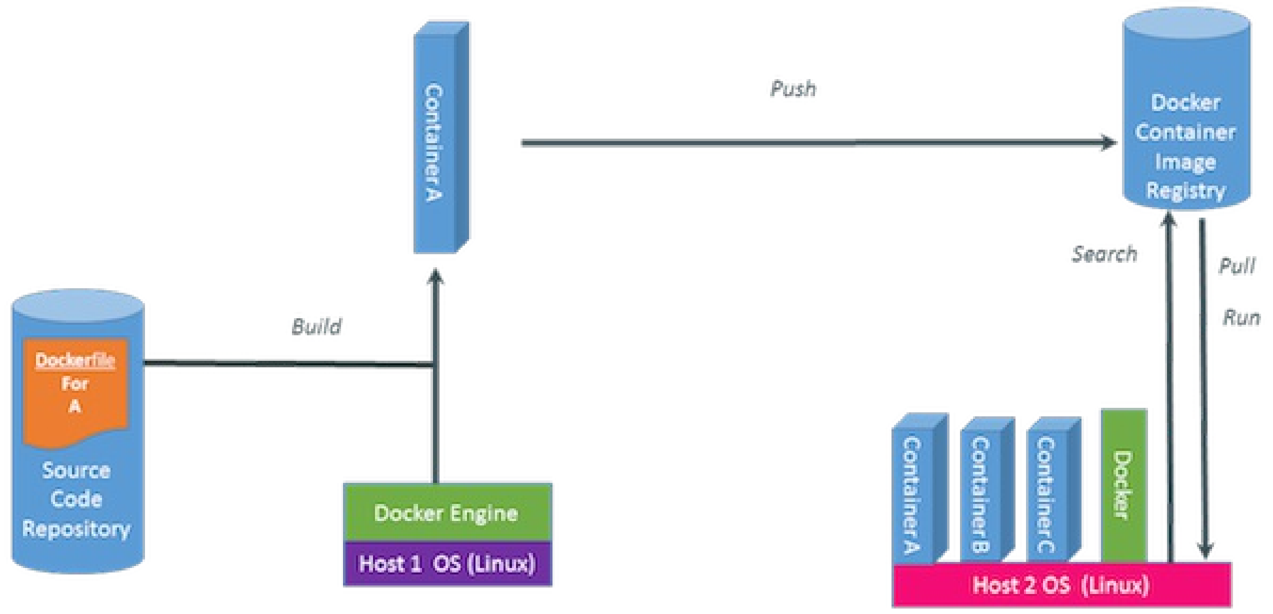


	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor's laptop	Customer Servers
Static website	?	?	?	?	?	?	?
Web frontend	?	?	?	?	?	?	?
Background workers	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?

DOCKER: WHAT ?


Virtual Machines
MySQL
MySQL
App
Bins/ Libs
Bins/ Libs
Bins/ Libs
Guest OS
Guest OS
Guest OS
Hypervisor
Host OS
Server
Containers
MySQL
MySQL
MySQL
App
App
App
Bins/Libs
Bins/Libs
Container Engine
Host OS
Server

DOCKER HOW ?


Dockerfile For A
Source Code Repository
Build
Container A
Docker Engine
Host 1 OS (Linux)
Push
Docker Container Image Registry
Search
Pull
Run
Container A
Container B
Container C
Docker
Host 2 OS (Linux)

DOCKER: DEMO APPLICATION’S DOCKERFILE

- Using GitServer, from the repository root
  - Check the **Dockerfile** content
  - Direct URL to Dockerfile

DOCKER: BUILDING DEMO APPLICATION

- Using Devbox, from the demoapp work directory’s root
  - Checking images with **docker images | grep registry_user**
- Build an image named **registry_user/demoapp:latest** from the repository root:

```
docker build -t registry_user/demoapp:latest ./
```

- Check again the images

DOCKER: BUILD AND SMOKE TEST

- It is a lot of commands !
- What about testing the Docker Image ?
- The demoapp contains a testing system:
  - It’s using Bats
  - Link to file: src/test/bats/docker.bats
  - Command:

```
/usr/local/bin/bats ./src/test/bats/docker.bats
```

THAT’S ALL FOR THIS CHAPTER

CONTINUOUS DELIVERY WITH JENKINS

aka "CD"

CD: WHY ?

How long would it take your organization to deploy a change that involves just one single line of code?

- Reduce deployment risks
- Allow more frequent user feedback
- Make progress believable by everyone

CD: WHAT ?

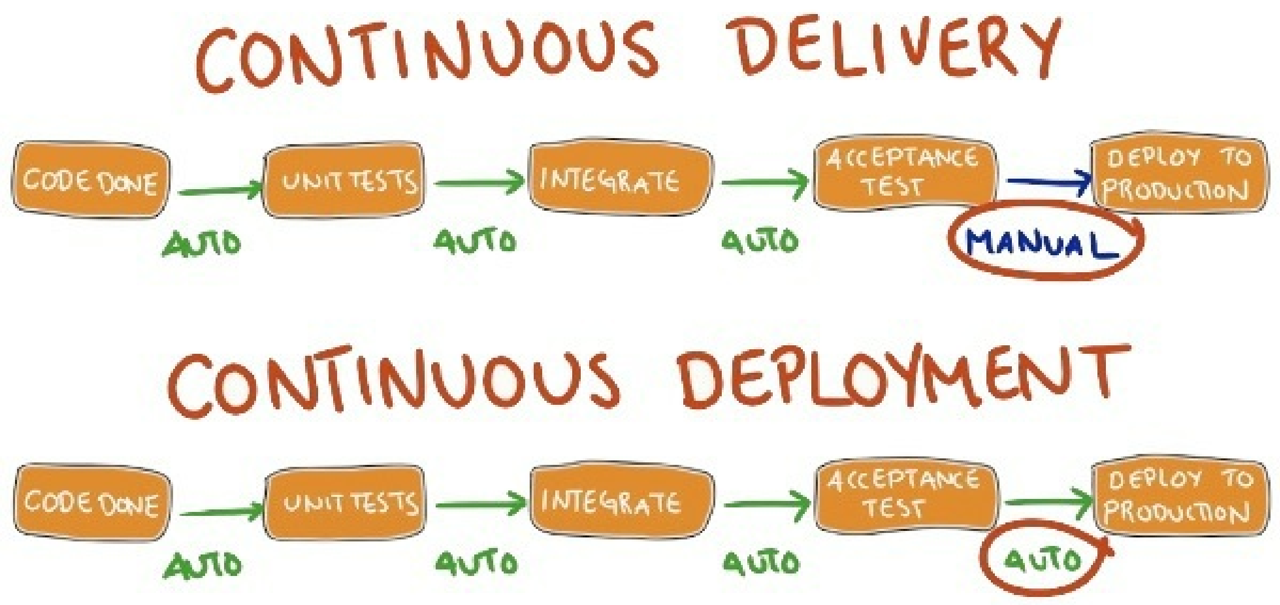
Continuous Delivery is the next step after Continuous Integration:

- Every change to the system can be released for production
- Delivery can be done at any time, on any environment

> *Your team prioritizes keeping the software deployable over working on new features*
>
> — Martin Fowler

CD IS NOT CONTINUOUS DEPLOYMENT

Both are always confused:



CD: HOW ?

- Having a collaborating working relationship with everyone involved
- Using Deployment Pipelines, which are automated implementations of your application's build lifecycle process

CD: DELIVERY TARGET

- Production runs on Docker
- Your Ops team use a Docker Registry
- Expected Artifact:
  - Not a `jar` file
  - But a Docker image

CD: EXERCISE - DOCKER TEST SUITE

- Goal: Run the Docker Test Suite
  - Using a single stage named "Docker", before Integration Tests
  - Using the agent labelled **docker**
  - Challenge: we need the **jar** file at "Docker time"
  - We do not need to archive artifact at the end, unless Integration Test is unstable
- *Clues:* Keywords **stash** and **unstash**

CD: SOLUTION - DOCKER TEST SUITE

```
pipeline {
  agent { node { label 'maven' }}
  stages {
    stage('Build') {
      steps {
        sh 'mvn package'
        stash(name: 'app', includes: 'target/demoapp.jar')
      }
      post { always { junit '**/target/surefire-reports/*.xml' }}
    }
    stage('Docker') {
      agent {
        label 'docker'
      }
      steps {
        unstash 'app'
        sh '/usr/local/bin/bats ./src/test/bats/docker.bats'
      }
    }
    stage('Verify') {
      steps {
        sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml'
      }
      post { unstable { archiveArtifacts 'target/demoapp.jar' }}
    }
  }
}
```

CD: EXERCISE - APPROVAL AND DEPLOY

- Goal: We want a Human Approval before Deploy
- Add 2 stages named **Approval** and **Deploy**:
  - **Approval** will ask for a manual validation, after Integration Tests
  - **Deploy** will tag and push the Docker Image to the Docker registry at the URL **localhost:5000**:
- *Clues:* Keyword **input**
- Here is the Deploy shell code:

```
docker tag demoapp localhost:5000/registry_user/demoapp:latest
docker push localhost:5000/registry_user/demoapp:latest
```

CD: SOLUTION - APPROVAL AND DEPLOY

```
pipeline {
  agent { node { label 'maven' }}
  stages {
    stage('Build') {
      steps { sh 'mvn package'
        stash(name: 'app', includes: 'target/demoapp.jar') }
      post { always { junit '**/target/surefire-reports/*.xml' }}
    }
    stage('Docker') {
      agent { label 'docker' }
      steps { unstash 'app'
        sh '/usr/local/bin/bats ./src/test/bats/docker.bats' }
    }
    stage('Verify') {
      steps { sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml' }
      post { unstable { archiveArtifacts 'target/demoapp.jar' }}
    }
    stage('Approval') {
      agent none
      steps { input 'Is it OK to deploy demoapp ?' }
    }
    stage('Deploy') {
      agent { label 'docker' }
      steps {
        sh 'docker tag demoapp localhost:5000/registry_user/demoapp:latest'
        sh 'docker push localhost:5000/registry_user/demoapp:latest'
      }
    }
  }
}
```

CD: EXERCISE - BUILDING WITH DOCKER

- Goal: Use Docker to provide the build environment
  - Use the agent allocation to build and run builds within a Docker container
  - Use the **Dockerfile.build** from the repository
- *Clues:* Keywords **agent none**, **agent { dockerfile … label …}**

CD: SOLUTION - BUILDING WITH DOCKER

```
pipeline { agent none
  stages {
    stage('Build') {
      agent { dockerfile { filename 'Dockerfile.build'
        label 'docker'}}
      steps { sh 'mvn package'
        stash(name: 'app', includes: 'target/demoapp.jar') }
      post { always { junit '**/target/surefire-reports/*.xml' }}
    }
    stage('Docker') {
      agent { label 'docker' }
      steps { unstash 'app'
        sh '/usr/local/bin/bats ./src/test/bats/docker.bats' }
    }
    stage('Verify') {
      agent { dockerfile { filename 'Dockerfile.build'
        label 'docker'}}
      steps { sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml' }
      post { unstable { archiveArtifacts 'target/demoapp.jar' }}
    }
    stage('Approval') {
      agent none
      steps { input 'Is it OK to deploy demoapp ?' }
    }
    stage('Deploy') {
      agent { label 'docker' }
      steps { sh 'docker tag demoapp localhost:5000/registry_user/demoapp:latest'
        sh 'docker push localhost:5000/registry_user/demoapp:latest' }
    }
  }
}
```

CD: EXERCISE - SCALING PIPELINE

- Goal: Share Pipeline across your teams
- We want to use Shared Libraries
- There is one autoconfigured named **deploy**
- Use the annotation to load the Library, on master branch
- Check the library here
- *Clues:* Keywords **@Library**, **script**

CD: SOLUTION - SCALING PIPELINE

```
@Library('deploy@master') _
pipeline { agent none
  stages {
    stage('Build') {
      agent { dockerfile { filename 'Dockerfile.build'
        label 'docker'}}
      steps { sh 'mvn package'
        stash(name: 'app', includes: 'target/demoapp.jar') }
      post { always { junit '**/target/surefire-reports/*.xml' }}
    }
    stage('Docker') {
      agent { label 'docker' }
      steps { unstash 'app'
        sh '/usr/local/bin/bats ./src/test/bats/docker.bats' }
    }
    stage('Verify') {
      agent { dockerfile { filename 'Dockerfile.build'
        label 'docker'}}
      steps { sh 'mvn verify -fn'
        junit '**/target/failsafe-reports/*.xml' }
      post { unstable { archiveArtifacts 'target/demoapp.jar' }}
    }
    stage('Deploy') {
      agent none
      steps {
        script {
          deploy('demoapp','localhost:5000/registry_user')
        }
      }
    }
  }
}
```

CD: EXERCISE - PARALLEL STAGES

- Goal: Run Stages in parallels to gain time
  - We can safely run Docker Smoke and Integration Tests in parallel
  - To specify a specific agent, use Scripted Pipeline Block and the node allocation
- *Clues:* Keywords **parallel**, **script**, **node**
- WARNING: https://issues.jenkins-ci.org/browse/JENKINS-41334

CD: SOLUTION - PARALLEL STAGES

```
@Library('deploy@master') _
pipeline { agent none
  stages {
    stage('Build') {
      agent { dockerfile { filename 'Dockerfile.build'
          label 'docker' }}
      steps {
        sh 'mvn package'
        stash(name: 'app', includes: 'target/demoapp.jar')
      }
      post { always { junit '**/target/surefire-reports/*.xml' }}
    }
    stage('Tests') {
      steps {
        parallel ( "Integration Tests": { script {
          node('maven') { checkout scm
            sh 'mvn verify -fn'
            junit '**/target/failsafe-reports/*.xml'
        }}}, "Docker": { script {
          node('docker') {
            unstash 'app'
            withEnv(['DOCKER_HOST=tcp://docker-service:2375']) {
              sh '/usr/local/bin/bats ./src/test/bats/docker.bats'
        }}}})
      }
      post { unstable { archiveArtifacts 'target/demoapp.jar' }}
    }
    stage('Deploy') { agent none
      steps { script { deploy('demoapp','localhost:5000/registry_user') } }
    }
  }
}
```

"That's all Folks!"
lsberg©