Jenkins Pipelines

Continuous Delivery

Agile Development

- Sprints of ~1-4 weeks duration
- Result: Product that can be shown/given to customer
- Return: Feedback

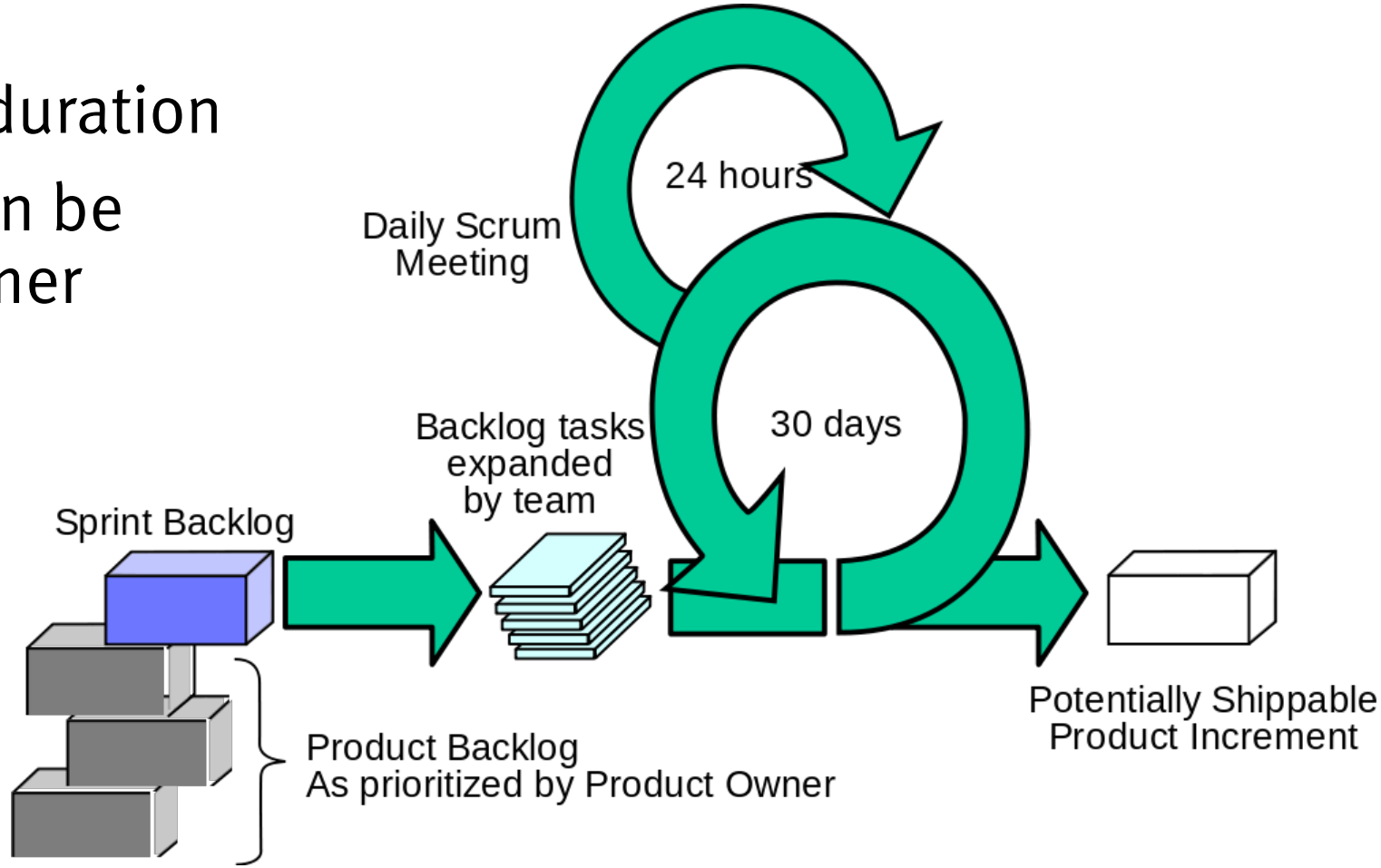
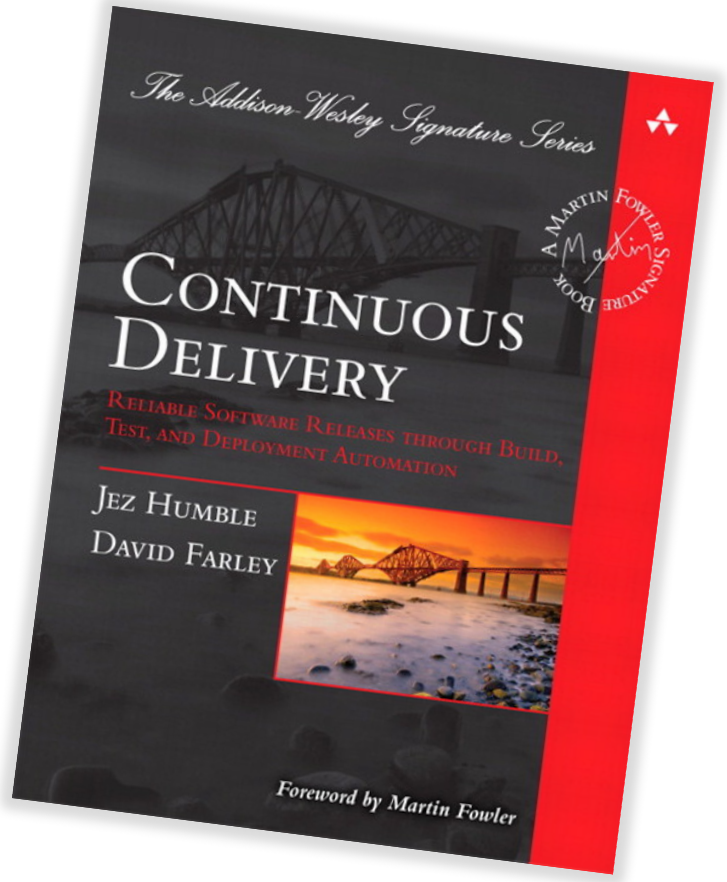


Image credits: Marekventur, Wikimedia, CC-BY-SA-3.0

Continuous Delivery

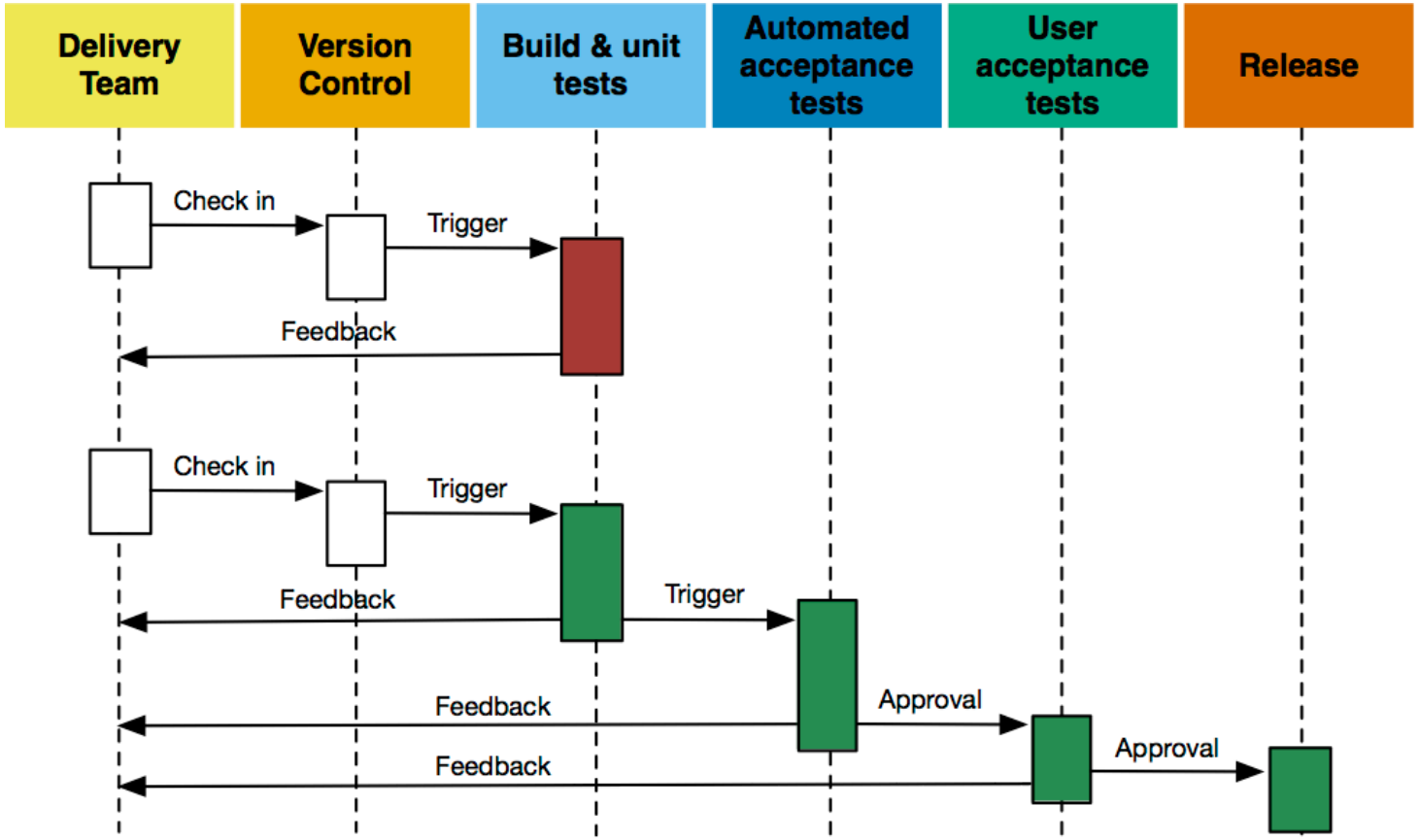
- Reduce cycle times (even more)
  - *“How long does it take to release a one-line change?”*

- Potentially deliverable code with every commit
  - Automated tests decide about acceptance
  - You don’t *have to* release/deploy it, but you *could*
    → Continuous Deployment: Deploy every successfully tested commit automatically



Pipelines

- Every check-in triggers pipeline execution
- Feedback to the team in every stage
  - *“Bring the pain forward”*
  - *“Fail fast, fail often”*
- Minimize execution time
- Always aware of latest *stable* release



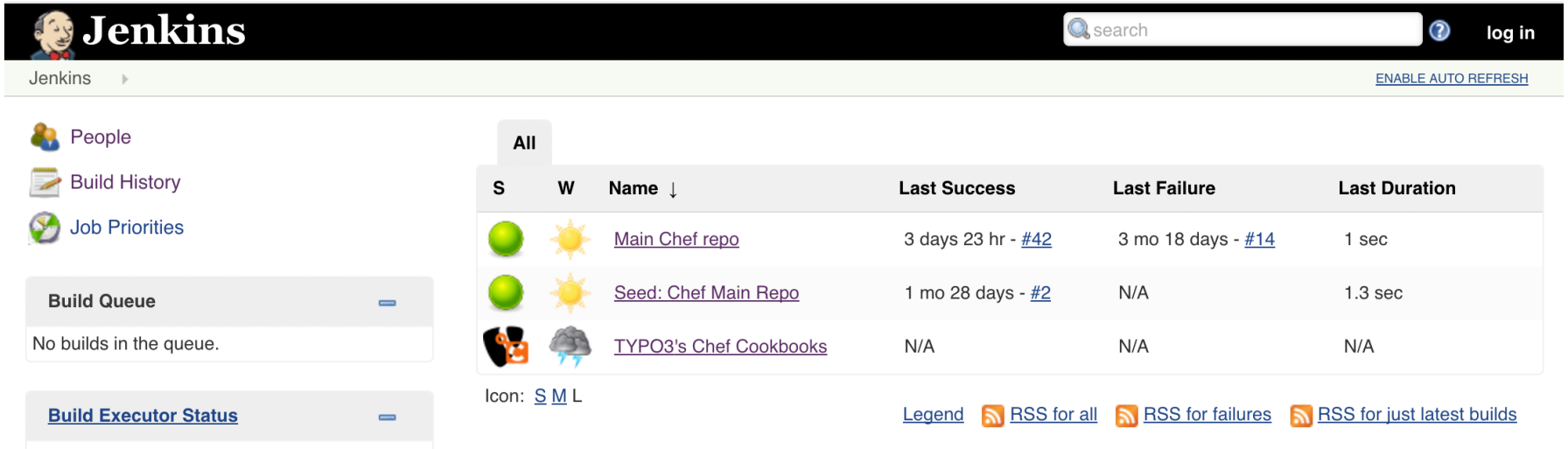
CI & CD Tools

CI/CD Tools

- On-premise
  - *Jenkins*
  - Thoughtworks Go
  - Gitlab CI
  - Pivotal Concourse
  - Jetbrains TeamCity
- SaaS
  - TravisCI
  - CircleCI
  - AppVeyor
  - Codeship
  - Visual Studio Team Services

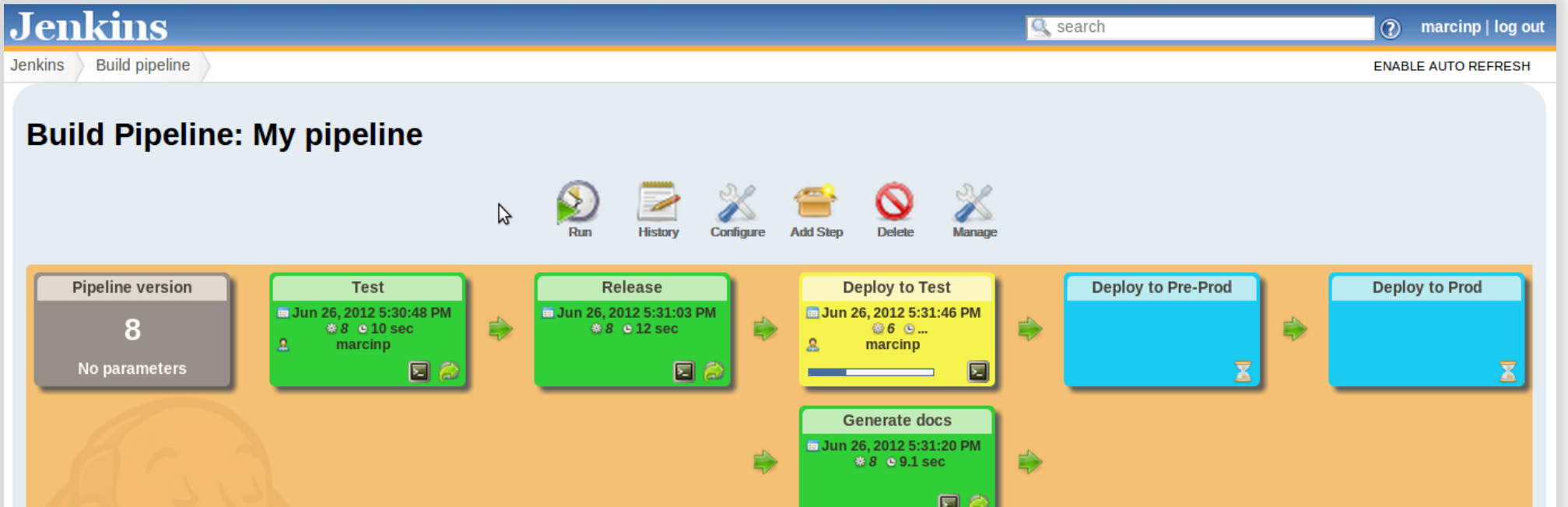
Why (I like) Jenkins

- Established open source project
- On premise installation
- Thousands of plugins
- Integrates with many tools/services
- Tailored to CI/CD



History of CI/CD with Jenkins

- Downstream Jobs
  - Job A triggers job B triggers job C triggers job D trig...
  - If one job fails, fail all
- *Build Pipeline* View



… and what I want instead

But that’s awkward

Configuration as Code

- Define jobs/pipelines as code
  - Avoid point & click
  - **In version control**
  - Can live with the application
  - **Scales better**
- Example: `.travis.yml` (from TravisCI)
- Similar to GitlabCI

```
language: php

services:
- redis-server

before_script:
- composer install

script:
- ./bin/phpunit -c …

notifications:
  slack:
…
```

Code-driven Approaches in Jenkins

- Jenkins Job Builder
  - Python / YAML based, from the OpenStack project

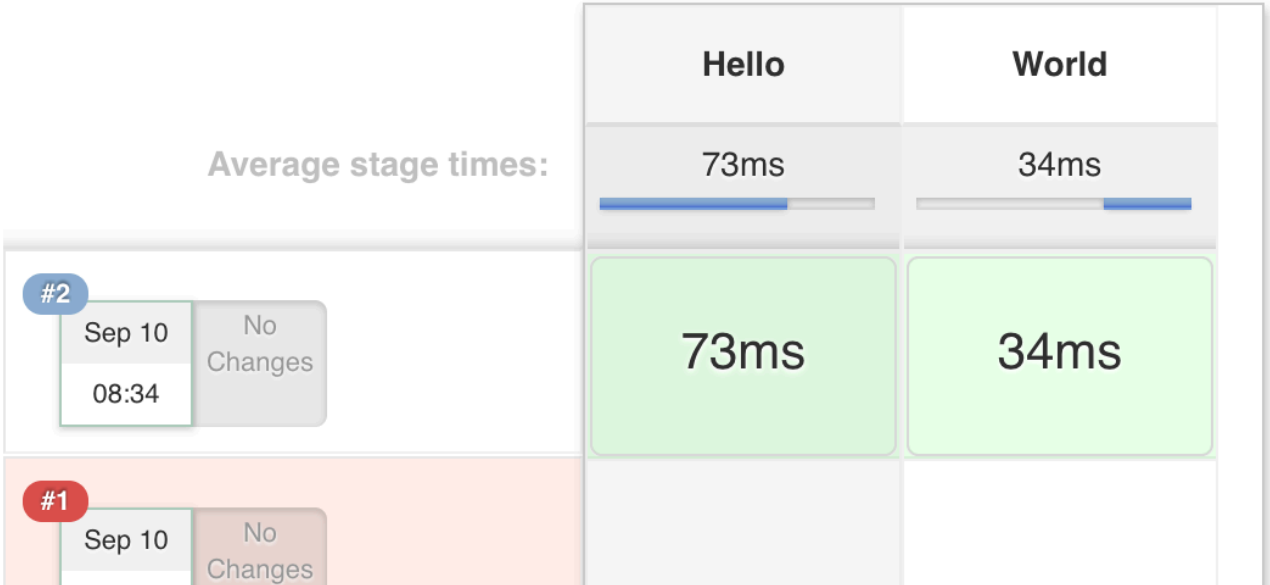
- Job DSL plugin
  - Groovy DSL!
    (e.g. query Github API and create jobs for all branches)
  - Great thing!
  - But creates single jobs

```
job('my-project-main') {
  scm {
    git('https://github.com/...')
  }
  triggers {
    scm('H/15 * * * *')
  }
  publishers {
    downstream('my-project-unit')
  }
}
```

Jenkins Pipeline Plugins

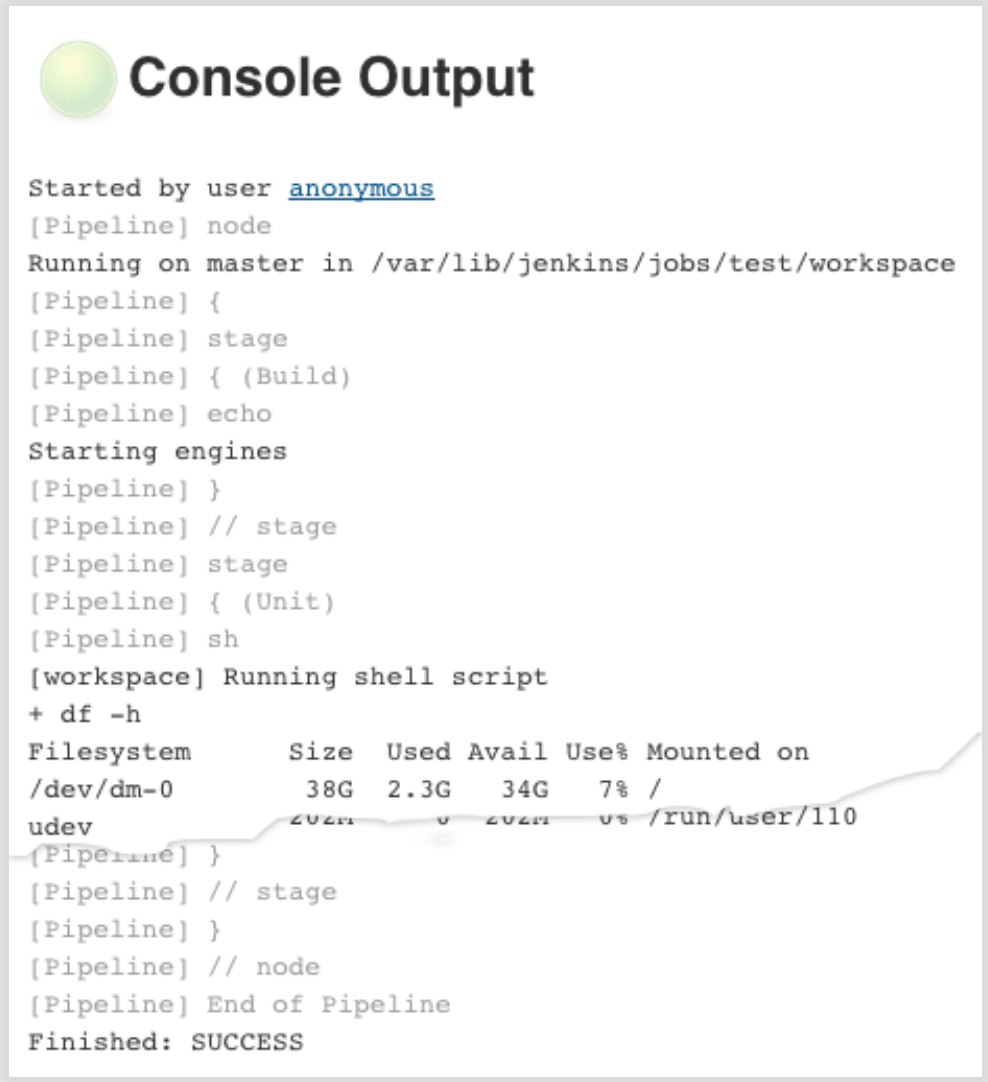
Jenkins Pipeline Plugins

- Whole suite of plugins (20+), open-sourced a year ago
- Shipped with Jenkins 2.0
- Formerly commercially available by CloudBees, called *Workflow*
- Define pipeline as code (again Groovy DSL)




```
stage("Hello") {
   ...
}
stage("World") {
   ...
}
```

Pipeline Example




```
pipeline {
  stages {
    stage("Build") {
      steps {
        echo "Starting engines"
      }
    }
    stage("Unit") {
      steps {
        sh "df -h"
      }
    }
  }
  agent any
}
```

Pipeline DSL Steps

- Shellout
  - *nix systems: `sh`

```
sh('make'), sh('rm -rf /')
```

  - Windows systems: `bat`

```
bat('C:\Program Files\..')
```

- SCM

```
git('https://github.com/..')
```

- File handling

```
readFile('my.config')
writeFile(file: 'README.md', text: 'Hello World')
fileExists('filename.txt')
```

Pipeline DSL Steps (2)

- Copy workspace to next agent (aka executor/node)

```
stage('build') {
  agent 'build-tool'
  steps {
    step {
      sh('make')
      stash('my-workspace')
    }
  }
}
// continue - - >
```

```
stage('release') {
  agent 'release-machine'
  steps {
    step {
      unstash('my-workspace')
      sh('release')
    }
  }
}
```

Pipeline DSL Steps (3)

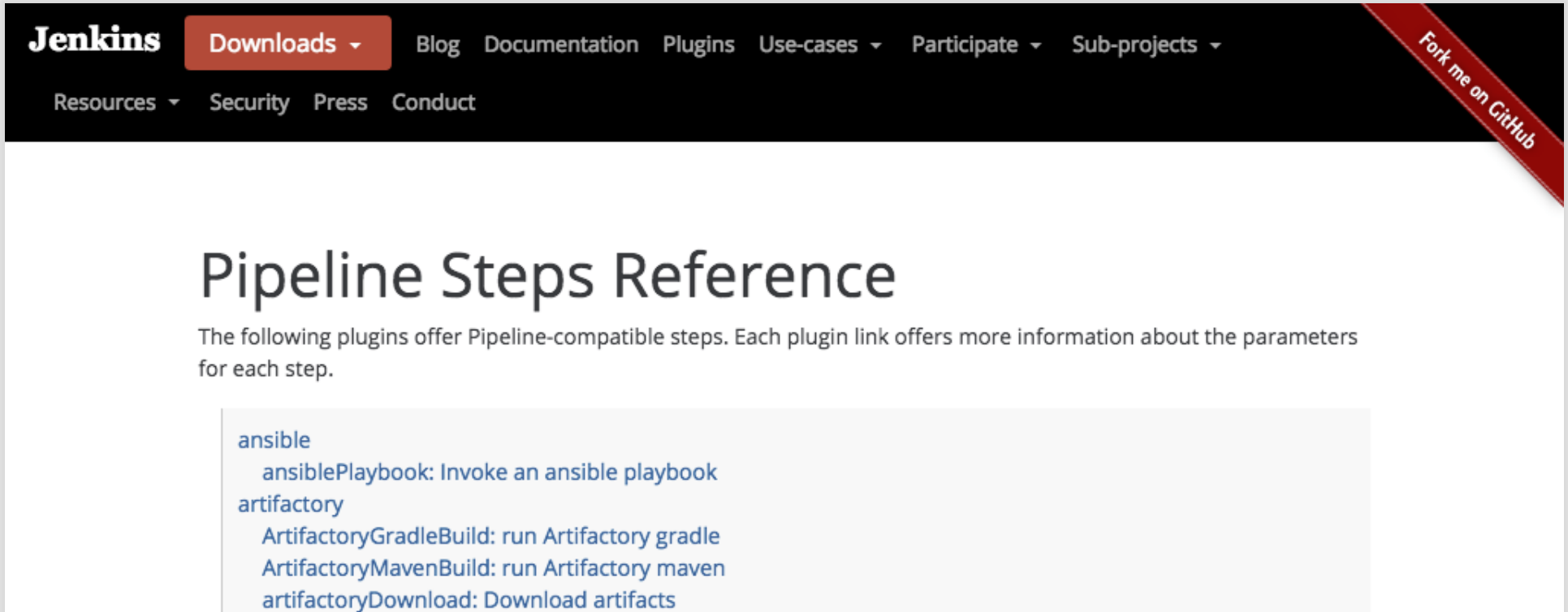
- Build another job:

```
build("jobname")
build("jobname", wait: false, propagate: false)
build(job: 'jobname', parameters: [
    [$class: 'StringParameterValue', name: 'target', value: target]
    [$class: 'ListSubversionTagsParameterValue', name: 'release', tag: release],
    [$class: 'BooleanParameterValue', name: 'update_composer', value:
    update_composer.to_boolean()])
```

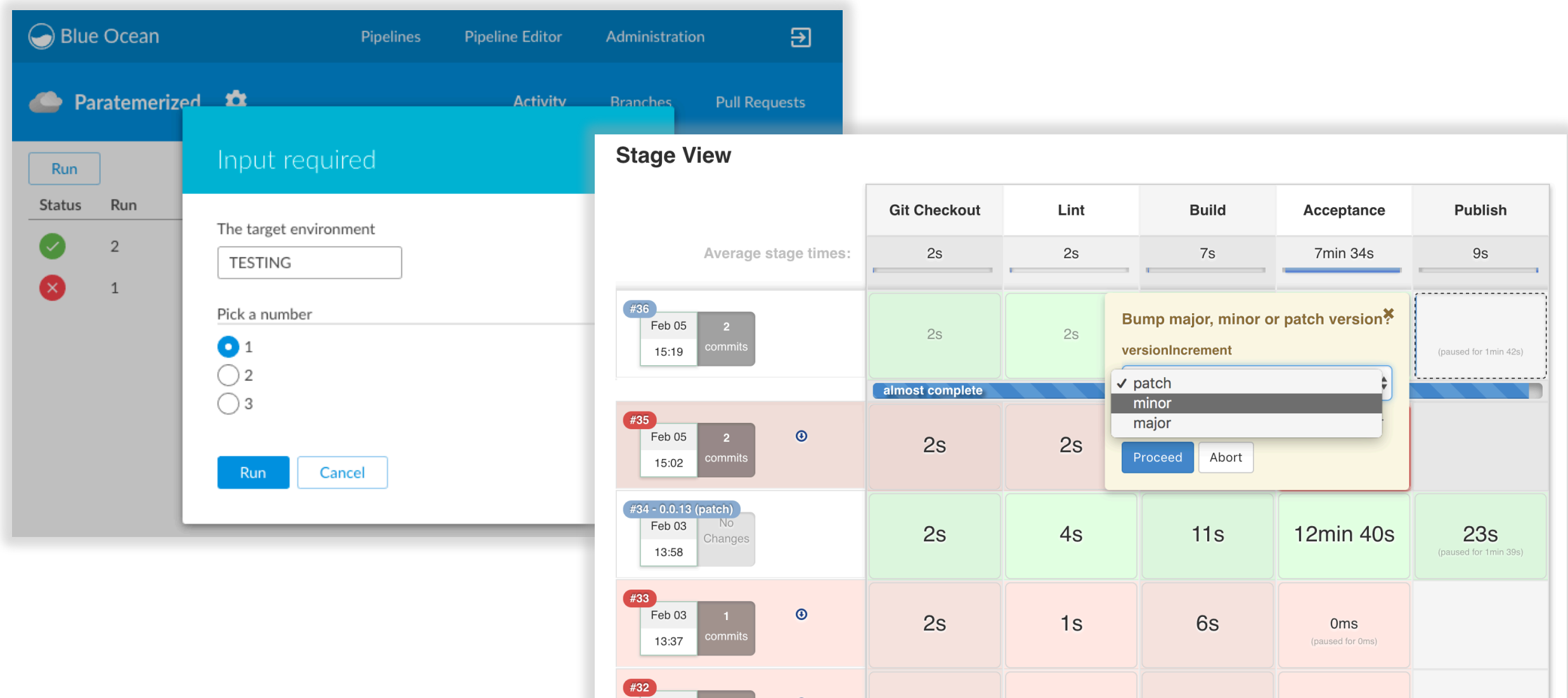
- Will not go further into detail ☺

Even More Pipeline Steps

- Plugins contribute additional steps
  - Steps available in this Jenkins instance via Pipeline Syntax
  - Online reference: https://jenkins.io/doc/pipeline/steps/



User Input?


Blue Ocean
Pipelines
Pipeline Editor
Administration
Paratemerized
Activity
Branches
Pull Requests
Run
Status
Run
2
1
Input required
The target environment
TESTING
Pick a number
1
2
3
Run
Cancel
Stage View
Git Checkout
Lint
Build
Acceptance
Publish
Average stage times:
2s
2s
7s
7min 34s
9s
#36
Feb 05
15:19
2 commits
2s
2s
(paused for 1min 42s)
Bump major, minor or patch version?
versionIncrement
patch
minor
major
Proceed
Abort
almost complete
#35
Feb 05
15:02
2 commits
2s
2s
#34 - 0.0.13 (patch)
Feb 03
13:58
No Changes
2s
4s
11s
12min 40s
23s
(paused for 1min 39s)
#33
Feb 03
13:37
1 commits
2s
1s
6s
0ms
(paused for 0ms)
#32

Parameters and Input

- Parametrized build (before build starts) [1]

```
pipeline {
  // agent, steps. etc.
  parameters {
      string(name: 'DEPLOY_ENV', defaultValue: 'TESTING',
        description: 'The target environment')
```

- Input step (during pipeline execution) [2]

```
input(message: 'Heyho', parameters: [string(..), ..])
```

bonus points for `lock`, `milestone`, `timeout`..

1) see https://st-g.de/2016/12/parametrized-jenkins-pipelines
2) see http://stackoverflow.com/questions/42501553/jenkins-declarative-pipeline-how-to-read-choice-from-input-step

Pipeline DSL

- Specify custom environment variables (and access credentials)

```
environment {
  AWS_ACCESS_KEY_ID = credentials('my-aws-key')
}

sh "echo $AWS_ACCESS_KEY_ID"
```

- Variables provided by Jenkins

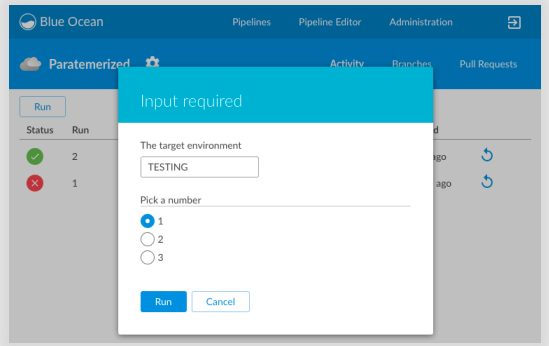
```
sh 'echo $BUILD_NUMBER'
echo env.BUILD_NUMBER
```

- Control flow (a tiny bit..)

```
when { branch 'production' { sh 'rm -rf /' } }
```

SKIP

Full Example Parameterized Build




```
pipeline {
    agent any

    parameters {
        string(name: 'DEPLOY_ENV', defaultValue: 'TESTING', description: 'Target environment')
        choice(name: 'FRUIT', choices: 'apple\nbanana\npizza', description: 'Pick a fruit')
    }

    stages {
        stage('Something') {
            steps {
                echo "Will deploy to ${params.DEPLOY_ENV}"
                writeFile(file: 'fruit.txt', text: params.FRUIT)
                echo readFile('fruit.txt')
            }
        }
    }
}
```

Docker

- Run build jobs within Docker containers
  - No need to install software on Jenkins master/slave
  - Use multiple versions of the same tool

- Containers can be existing ones or based on `Dockerfile`
- .. and Kubernetes

```
agent {
  docker {
    image 'maven:3-alpine'
  }
  stages { .. }
}
```

Demo Time!

Picture by annca/ pixabay:
https://pixabay.com/en/popcorn-cinema-ticket-film-1433327/

SKIP

```
pipeline {
    agent any
    tools {
        maven 'maven-3'
    }
    // or alternatively:
    // agent { docker 'maven:3-alpine' }
    stages {
        stage('Checkout') {
            steps {
                git "https://github.com/StephenKing/MAJUG17-jenkins-mvn"
                sh 'mvn clean'
            }
        }
        stage('Build') {
            steps {
                sh 'mvn package -DskipTests'
            }
        }
        stage('Tests') {
            steps {
                sh 'mvn test'
            }
            post {
                always {
                    junit 'target/surefire-reports/**/*.xml'
                }
            }
        }
    }
    post {
        always {
            archiveArtifacts artifacts: '**/target/*.jar', fingerprint: true
        }
        success {
            emailext (
                    subject: "SUCCESSFUL: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]'",
                    body: """SUCCESSFUL: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]': Check console output at ${env.BUILD_URL}""",
                    to: 'mail@example.org'
            )
        }
        failure {
            emailext (
                    subject: "FAILED: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]'",
                    body: """FAILED: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]': Check console output at ${env.BUILD_URL}""",
                    to: 'mail@example.org'
            )
        }
    }
}
```

Declarative What?

- What you've seen now is the brand new stuff (pipeline-model-* v1.1)
- Formerly, there were "scripted pipelines"
  - Groovy-based DSL
  - Real code → real power
  - Sometimes: real pain*
- Both approaches officially supported

* includes debugging, failure handling, script security / sandbox, CPS, …

Scripted Pipeline Example

```
node {
    stage("Foo") {
        def data = new groovy.json.JsonSlurper().parseText(readFile('somefile.txt'))
        sh "make ${data.options}"
    }
    stage("Bar") {
        try {
            sh "make"
        } catch (err) {
            slackSend message: "Oh dude, didn't workout. ${err}"
            error "Things went wrong"
        }
    }
    if (env.BRANCH_NAME == 'master') {
        stage("Bar") {
            echo "Deploy!!"
        }
    }
}
```

Scripted Pipeline Execution

- node step allocates executor slot (“heavyweight executor”)
  - As other Jenkins jobs
  - Filter node by labels (i.e. `node('php7'), node('master')`)
  - Required for heavy lifting
  - Avoid many sequential allocations (slows down pipeline progress)
- Code outside of node
  - Flyweight executor
  - Running on master, "for free”
- Pipeline execution survives Jenkins restarts (CPS)

Pipeline Syntax: Declarative vs. Scripted

- Beginning

```
pipeline { .. }
```

```
// everything else
```

- Executor allocation

```
agent(docker:'image')
steps { .. }
```

```
node('label') { sh .. } // or
docker.image('..').inside{ .. }
```

(node can be used for declarative as well)

- Post-build steps, failure handling

```
post { failure {} always {} }
```

```
try { sh .. } catch { cry }
```

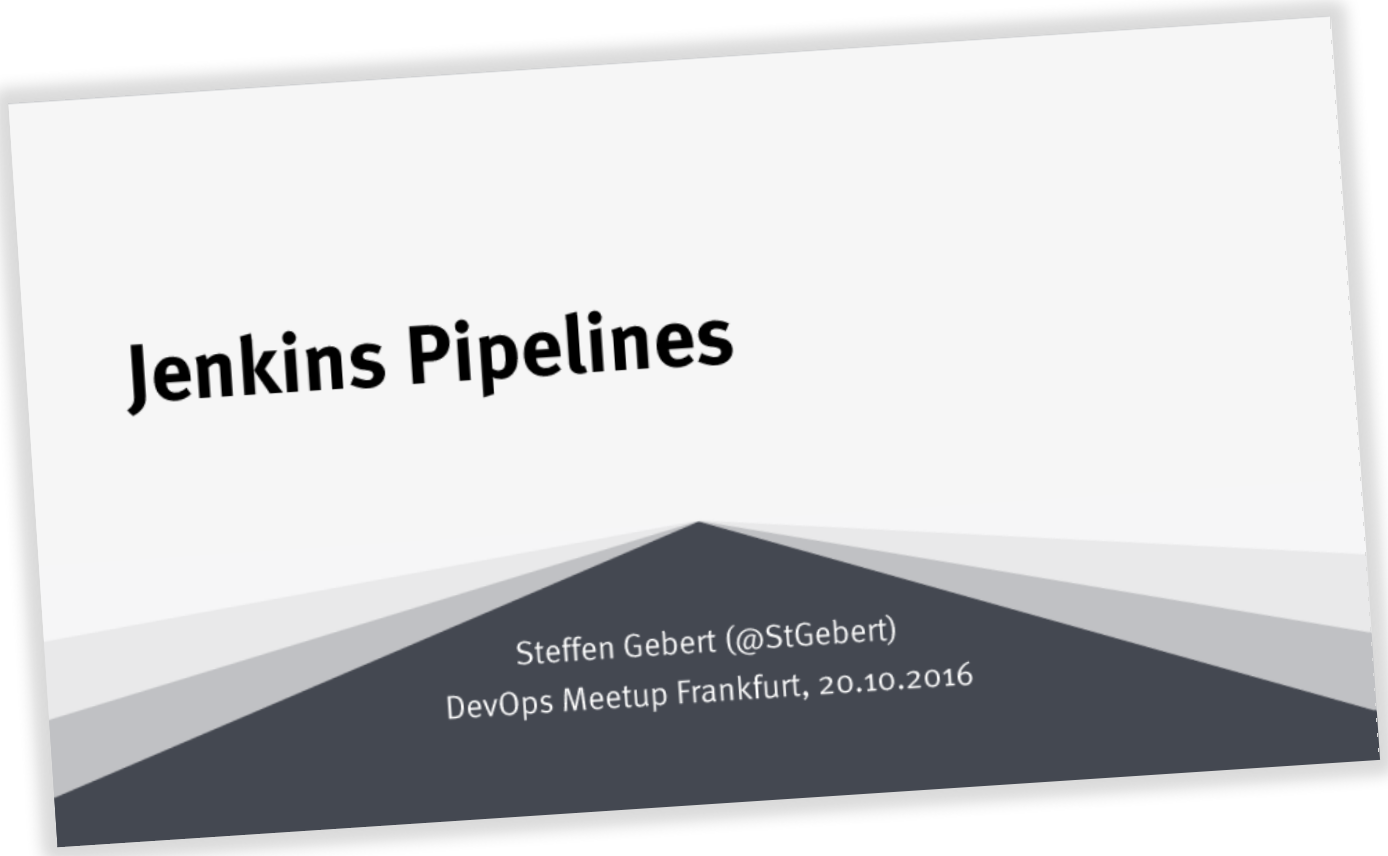
- Flow control

```
when { .. }
script { // groovy script }
```

```
// any groovy statement
```

see https://jenkins.io/doc/book/pipeline/syntax/

More on Scripted Pipelines



..in older versions of this talk
https://st-g.de/speaking

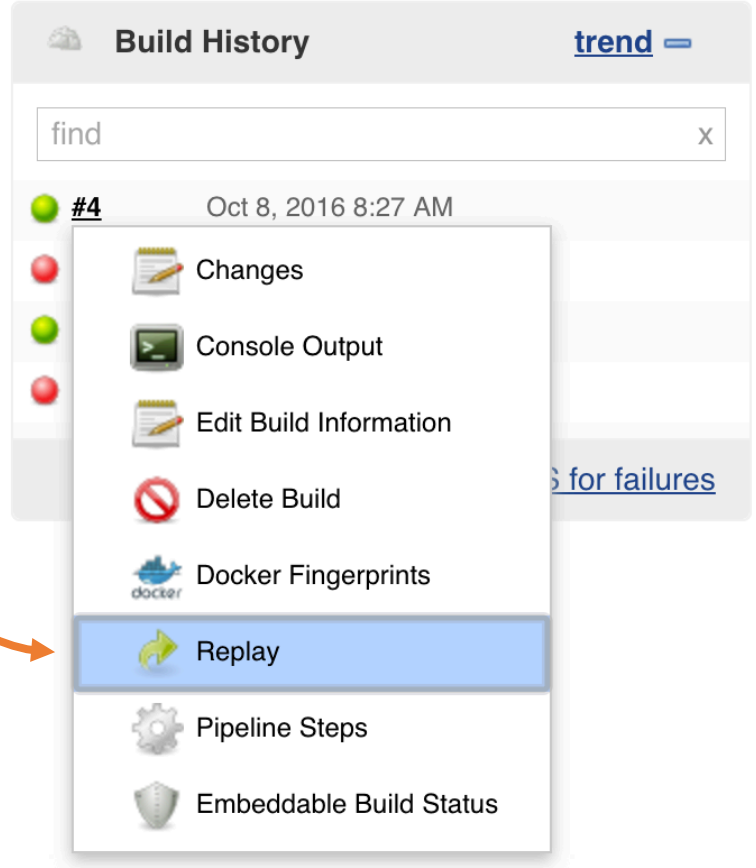
Where to put that config?

Pipeline Configuration

- Paste code into job config (fine for testing)
  (job type: Pipeline)

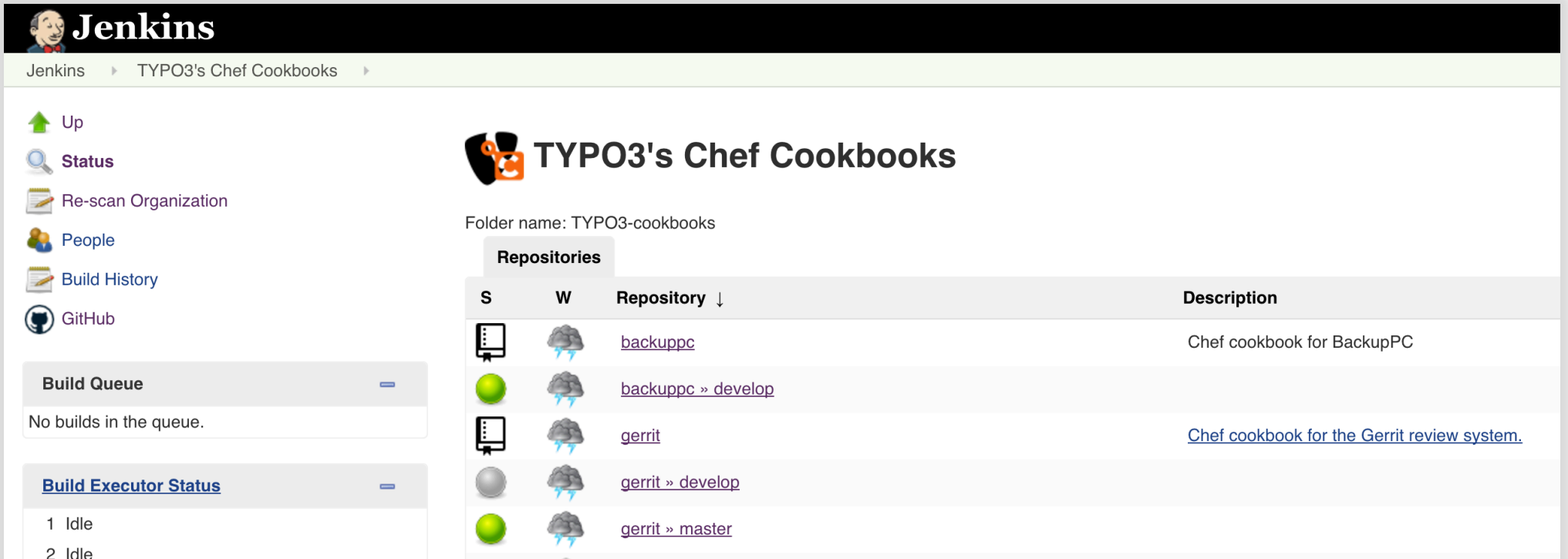
- Create pipelines via JobDSL

- Commit it to your repo (job type: Multibranch)
  - File called `Jenkinsfile`
  - It evolves with the application
  - It is versioned
  - Everybody can read (and modify) it
  - You can throw away your Jenkins master at any time



Multibranch & Organization Folder Plugins

- Scans a complete GitHub/Bitbucket organization for `Jenkinsfile`
- Triggered by Webhook and/or runs periodically
- Automatically adds pipeline jobs per repo/branch/PR



DRY: Jenkins Global Library

- Provides shared functionality available for all jobs
- Loaded from remote Git repos

  - Specified in global configuration or on folder-level

```
node { deployToProd() }
```

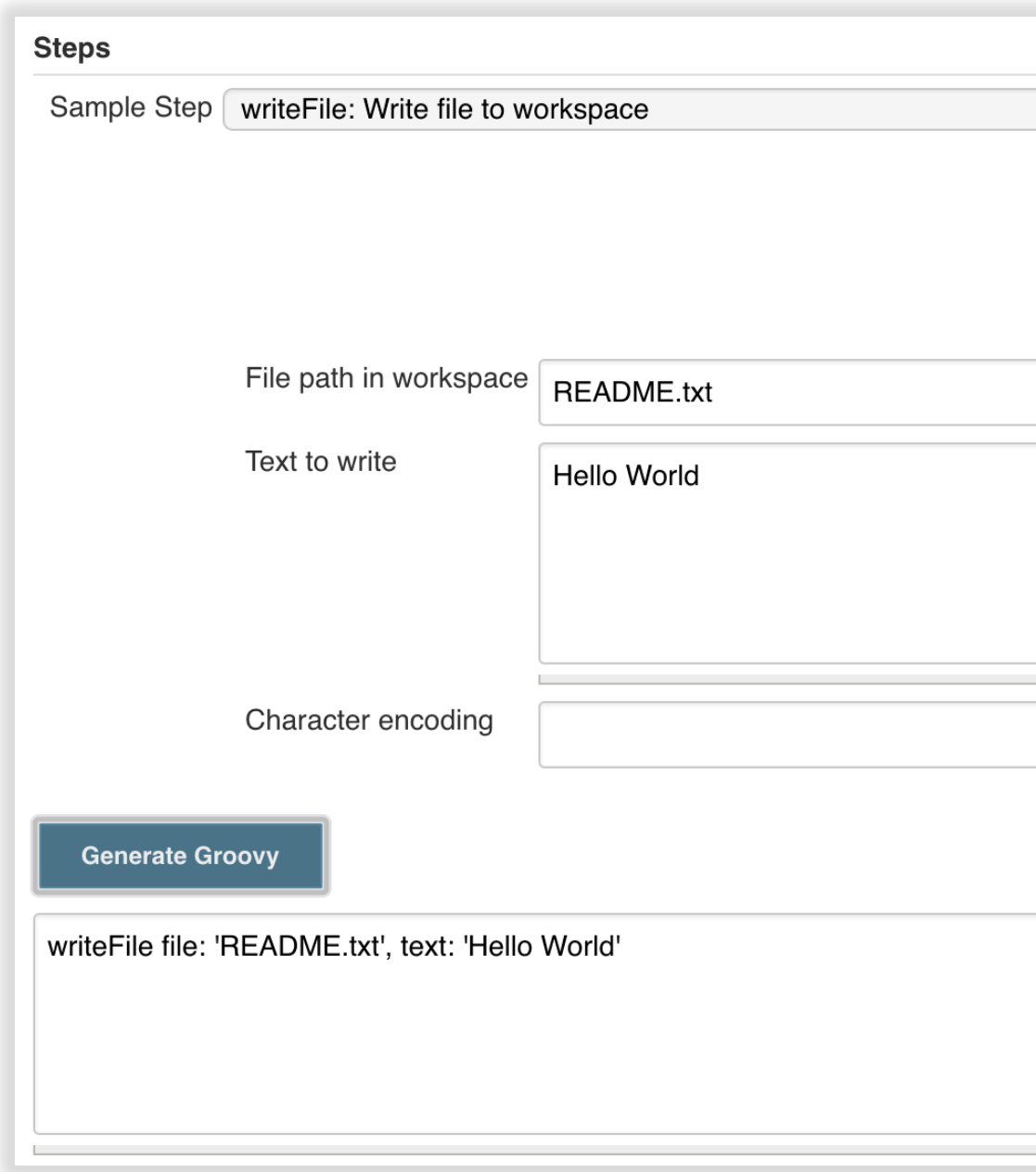
```
@Library("mylib@v1.2")
node { deployToProd() }
```

  - Specified in `Jenkinsfile`

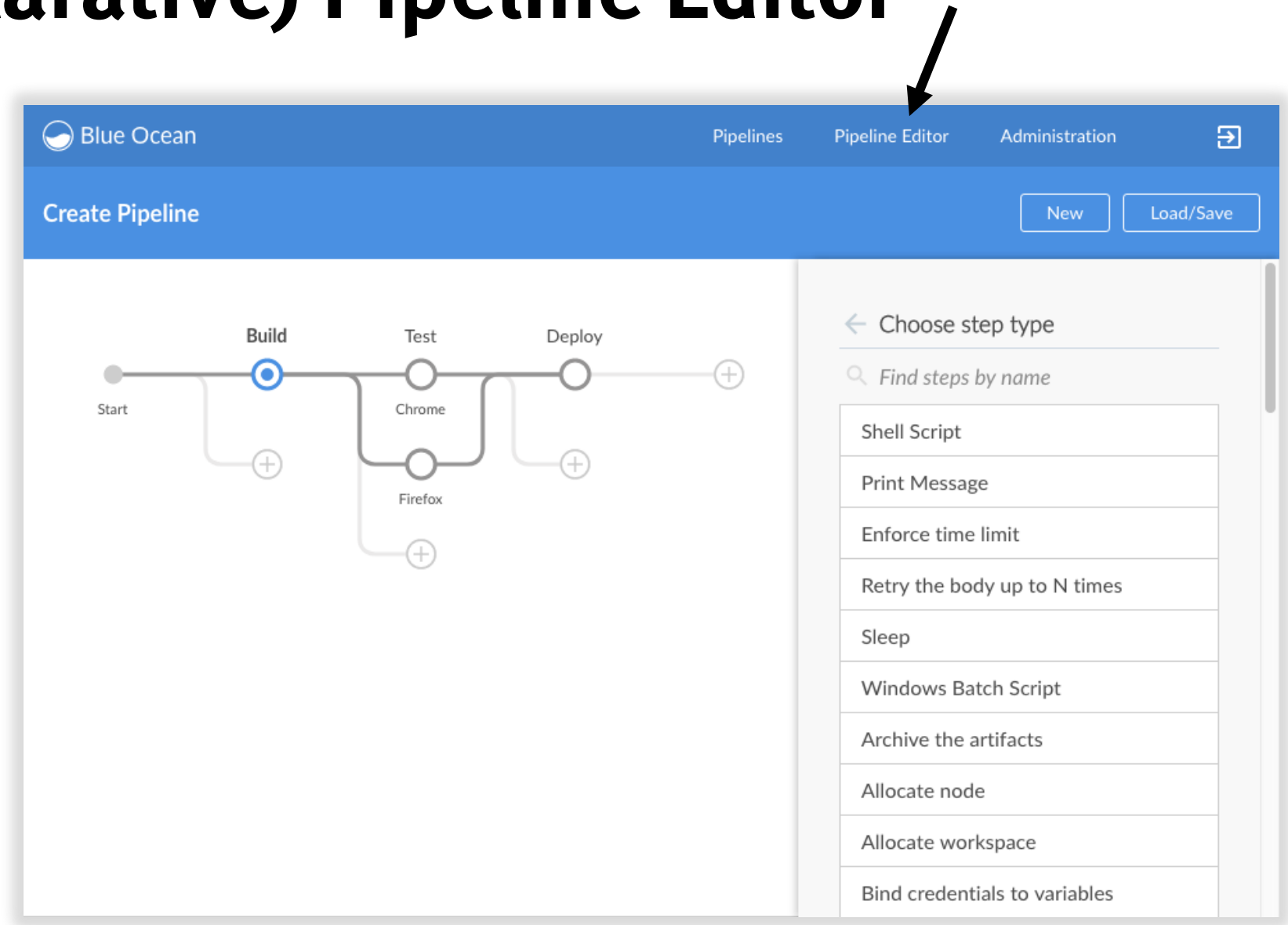
```
@Library("https://github.com/..")
node { deployToProd() }
```

Snipped Editor & Docs

- Because first steps are hard..
- For scripted and declarative pipelines
- Auto-generated DSL documentation (*Pipeline Syntax → Step Reference*)



(Declarative) Pipeline Editor



Real-World Example

Jenkins Pipelines for Chef Cookbooks

Chef CI/CD at TYPO3.org

- Code that runs the *.typo3.org infrastructure, chef-ci.typo3.org
- Objective: Chef cookbooks
  - Server provisioning (installs packages, configures services)
  - Code: github.com/TYPO3-cookbooks

	lint	resolve dependencies	test-kitchen	archive artifacts	upload
Average stage times:	1s	15s	8min 19s	4s	26s
#2 Aug 28 16:18 — 3 commits	1s	30s	8min 19s	4s	22s
#1 Aug 28 10:08 — No Changes	1s	1s	8min 19s	4s	31s

Many Cookbooks, Many Pipelines

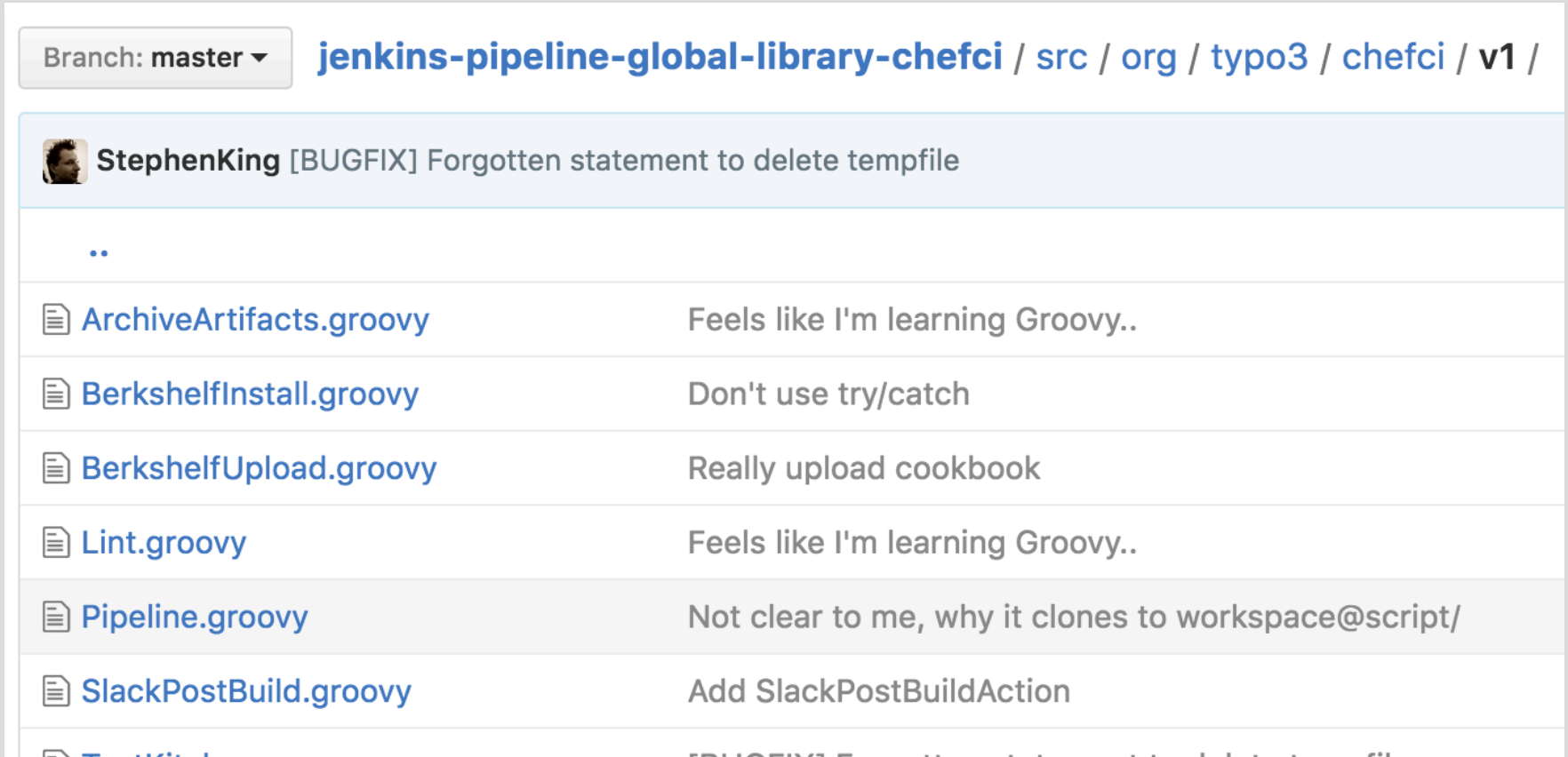
- Scans our GitHub organization *TYPO3-cookbooks*
  - Automatically adds/removes pipelines for branches and pull requests*
  - Triggered via Webhooks
  - Contents of `Jenkinsfile`:

```
def pipe = new org.typo3.chefci.v1.Pipeline()
pipe.execute()
```

* Currently suspicious to arbitrary code execution

Jenkins Global Library

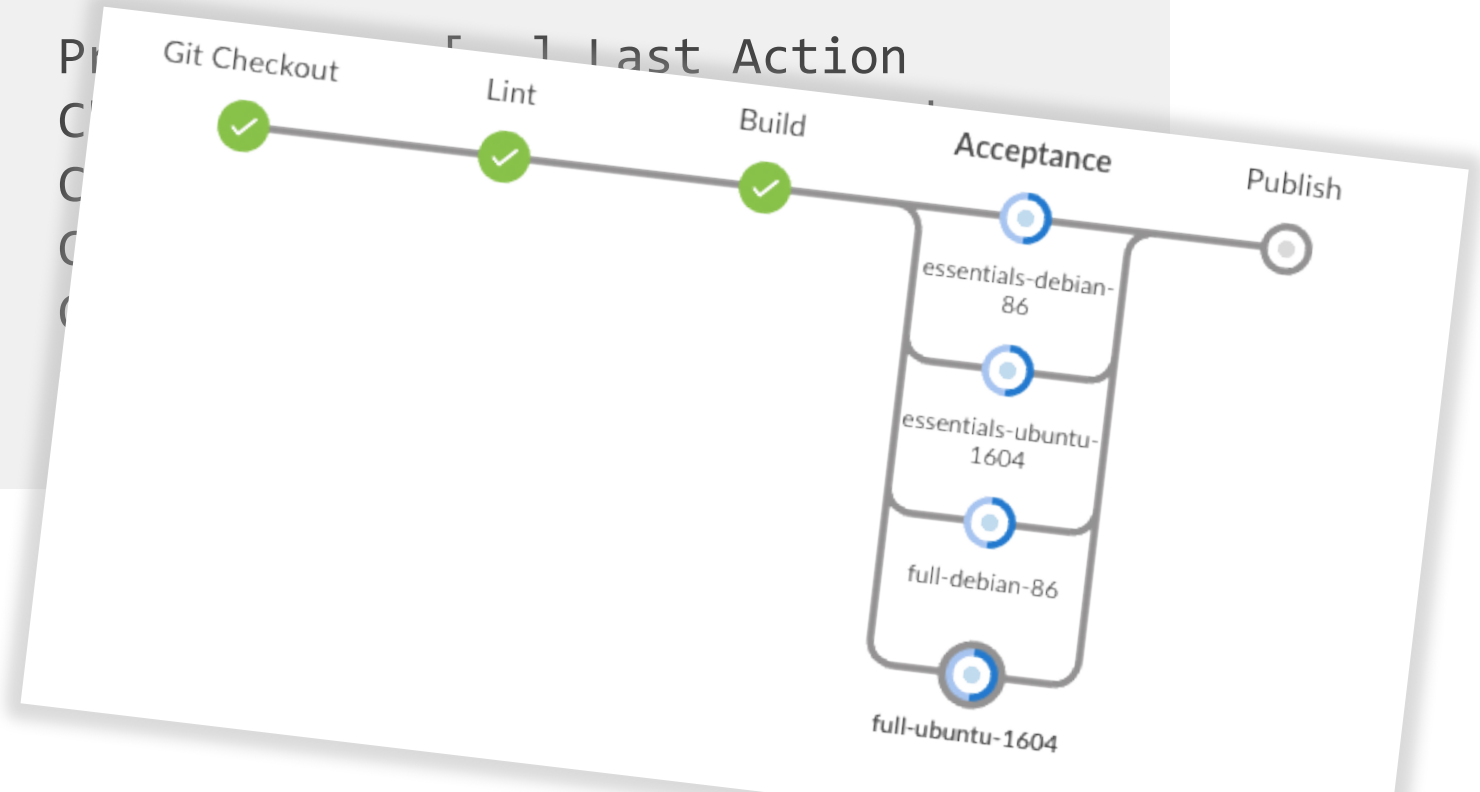
- Pipelines implemented in Global Library
  [TYPO3-infrastructure/jenkins-pipeline-global-library-chefci]



Parallelize Integration Tests

- Run *Test-Kitchen* (integration test for Chef cookbooks)
- Run all instances in parallel (by Jenkins)

```
$ kitchen list
Instance                  Driver   Pr                  ] Last Action
default-debian-78         Docker   C
default-debian-82         Docker   C
physical-debian-78        Docker   C
physical-debian-82        Docker   C
production-debian-78      Docker
production-debian-82      Docker
```



Parallelize Integration Tests (2)

- Goal: Extract instance list, run `kitchen` commands in parallel
- Expected result:

```
parallel(
  'default-debian-82': {
    node {
      unstash('cookbook-tk')
      sh('kitchen test --destroy always default-debian-82')
    }
  },
  'physical-debian-82': {
    node {
      unstash('cookbook-tk')
      sh('kitchen test --destroy always physical-debian-82')
    }...
```

Parallelize Integration Tests (3)

- Grab list of instance names

```
def ArrayList<String> getInstanceNames(){
  def instanceNames = []
  node {
    def lines = sh(script: 'kitchen list', returnStdout: true).split('\n')
    for (int i = 1; i < lines.size(); i++) {
      instanceNames << lines[i].tokenize(' ')[0]
    }
  }
  return instanceNames
}
```

* Closures don’t always work well within pipeline code (cf. @NonCPS)

Parallelize Integration Tests (4)

```
def Closure getNodeForInstance(String instanceName) {
  return {
    // this node (one per instance) is later executed in parallel
    node {
      // restore workspace
     unstash('cookbook-tk')
     sh('kitchen test --destroy always ' + instanceName)
}}}
```

```
for (int i = 0; i < instanceNames.size(); i++) {
  def instanceName = instanceNames.get(i)
  plNodes[instanceName] = this.getNodeForInstance(instanceName)
}
parallel plNodes
```

Failure Notification

- Pipeline stops, when any step fails
- But.. I want that info in Slack!

```
def execute() {
  this.prepare()
  this.run(new Lint())
  this.run(new BerkshelfInstall())
  this.run(new TestKitchen())
  this.run(new ArchiveArtifacts())

  if (env.BRANCH_NAME == "master") {
    this.run(new BerkshelfUpload())
  }
}
```

```
def run(Object step){
  try {
    step.execute()
  } catch (err) {
    this.postBuildNotify
    failTheBuild("Build failed")
  }
}
```

#infrastructure-status

★ | 12 | 0 | *Add a topic*

github BOT 19:55

[jenkins-chefci:master] 1 new commit by Steffen Gebert:

> `9cc9c8a` [TESTS] Can't test docker in docker - Steffen Gebert

Chef CI BOT 19:55

> TYPO3-cookbooks/jenkins-chefci/master build #24 **started**:
> [Branch indexing]
> https://chef-ci.typo3.org/job/TYPO3-cookbooks/job/jenkins-chefci/job/master/24/

Chef CI BOT 20:05

> TYPO3-cookbooks/jenkins-chefci/master build #24 **waiting for input**:
> https://chef-ci.typo3.org/job/TYPO3-cookbooks/job/jenkins-chefci/job/master/24/

github BOT 20:15

> [jenkins-chefci] New tag 0.0.10 was pushed by chefcitypo3org

Chef CI BOT 20:15

> TYPO3-cookbooks/jenkins-chefci/master build #24 **finished**:
> https://chef-ci.typo3.org/job/TYPO3-cookbooks/job/jenkins-chefci/job/master/24/

Summary

- Finally nice pipelines!
  - The way to go with Jenkins
  - Many Jenkins plugins already compatible
- Pipeline as code!
  - Versioned
  - Doesn't mess up Jenkins jobs
  - Code sharing
- New UI stuff still freaking broken
- Endless possibilities - can be complex and painful*
- Chained pipelines? Yes, but..

*IMHO still better than YAML

Further Reading

- Pipeline Documentation:
  https://jenkins.io/doc/book/pipeline/
- Step documentation:
  https://jenkins.io/doc/pipeline/steps/
- Pipeline shared libraries:
  https://jenkins.io/doc/book/pipeline/shared-libraries/
- Parallel execution:
  https://jenkins.io/blog/2016/06/16/parallel-test-executor-plugin/
- Extending pipeline DSL:
  https://jenkins.io/blog/2016/04/21/dsl-plugins/
- Controlling the Flow with Stage, Lock, and Milestone:
  https://jenkins.io/blog/2016/10/16/stage-lock-milestone/
- TYPO3's Chef CI:
  https://chef-ci.typo3.org

Slides will be available at st-g.de/speaking