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CONTINUOUS DELIVERY WITH THE CLOUDBEES JENKINS PLATFORM

USER TRAINING

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TOC

- CI & CD, Jenkins Overview and CloudBees Introduction
- Jenkins Jobs/Projects and Setting up Freestyle Projects
- Monitoring and Organizing your jobs
- Plugins Management
- Working with Version Control
- Code Quality and Coverage Metrics
- Parameterized Builds
- Automated Deployment
- Folders & Folders Plus plugins and Security + RBAC plugins
- Playing with Git: Validated Merge Plugin and Pull-Request Builder for GitHub
- Pipeline (formerly known as Workflow)
- Template Plugin
- CloudBees Support
- Introduction to CloudBees Jenkins Operation Center

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CI / CD FUNDAMENTALS

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WHAT IS CONTINUOUS INTEGRATION (CI)?

- Original answer by Martin Fowler:
  - Integrate code often, at least daily, to make integration a non-event
  - Developers follow repository tip closely
- Modern Answer
  - Automate build and test executions of components
    - Build very often (e.g., per commit) to detect regressions quickly
    - Test often (unit and integration tests)
  - Automate regular code quality analysis executions

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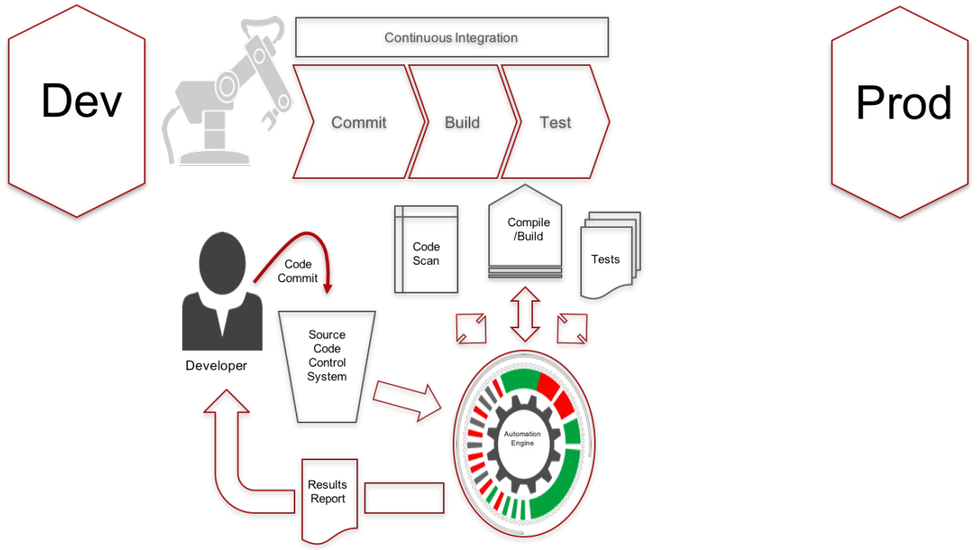
CONTINUOUS INTEGRATION (CI)

- Automate Build & Test phases
- Continually build and integrate



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WHAT IS CONTINUOUS DELIVERY (CD) ?

- While CI lets you automate the software build, scan and test process, CD automates the full application delivery pipeline taking new features and code from development to staging to production
- With automated building, testing, environment provisioning, and deployment, CD becomes the foundation of your DevOps transformation

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WHAT IS CONTINUOUS DELIVERY (CD) ?

The ability to get:

- Features
- Configuration changes
- Bug fixes
- Experiments

into production or into the hands of users safely & quickly in a sustainable way.

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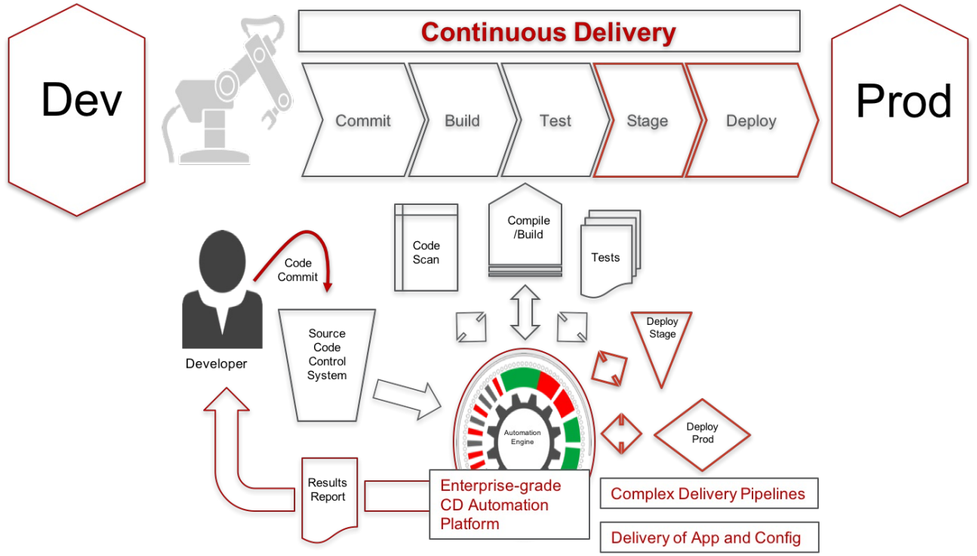
CONTINUOUS DELIVERY (CD)

- CD starts with CI
- It then extends automation across the entire application lifecycle



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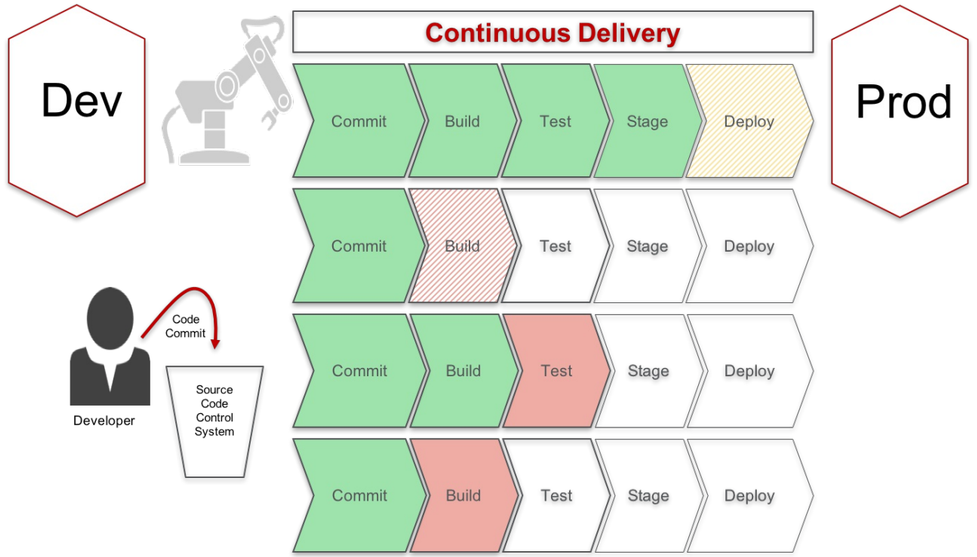
CONTINUOUS DELIVERY (CD)

- Enables continuous execution and monitoring of the entire software development pipeline



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CONTINUOUS DELIVERY (CD), WHY DO IT ?

- Make releases painless, low risk events
- Reduce time to market
- Increase software quality & stability
- Reduce cost of ongoing software development
- Increase customer & employee satisfaction
- Speed up the feedback loop

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RELEASE CADENCE

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

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JENKINS OVERVIEW

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MEET JENKINS…

- #1 Continuous Integration and Delivery server
- Created by Kohsuke Kawaguchi
- An independent and active community (jenkins-ci.org)
- 10 years old
- 500+ releases to date
- 100,000 active installations
- 300,000 Jenkins servers
- 1,200+ plugins

Source: 2014 Java Tools and Technologies Landscape – Rebel Labs

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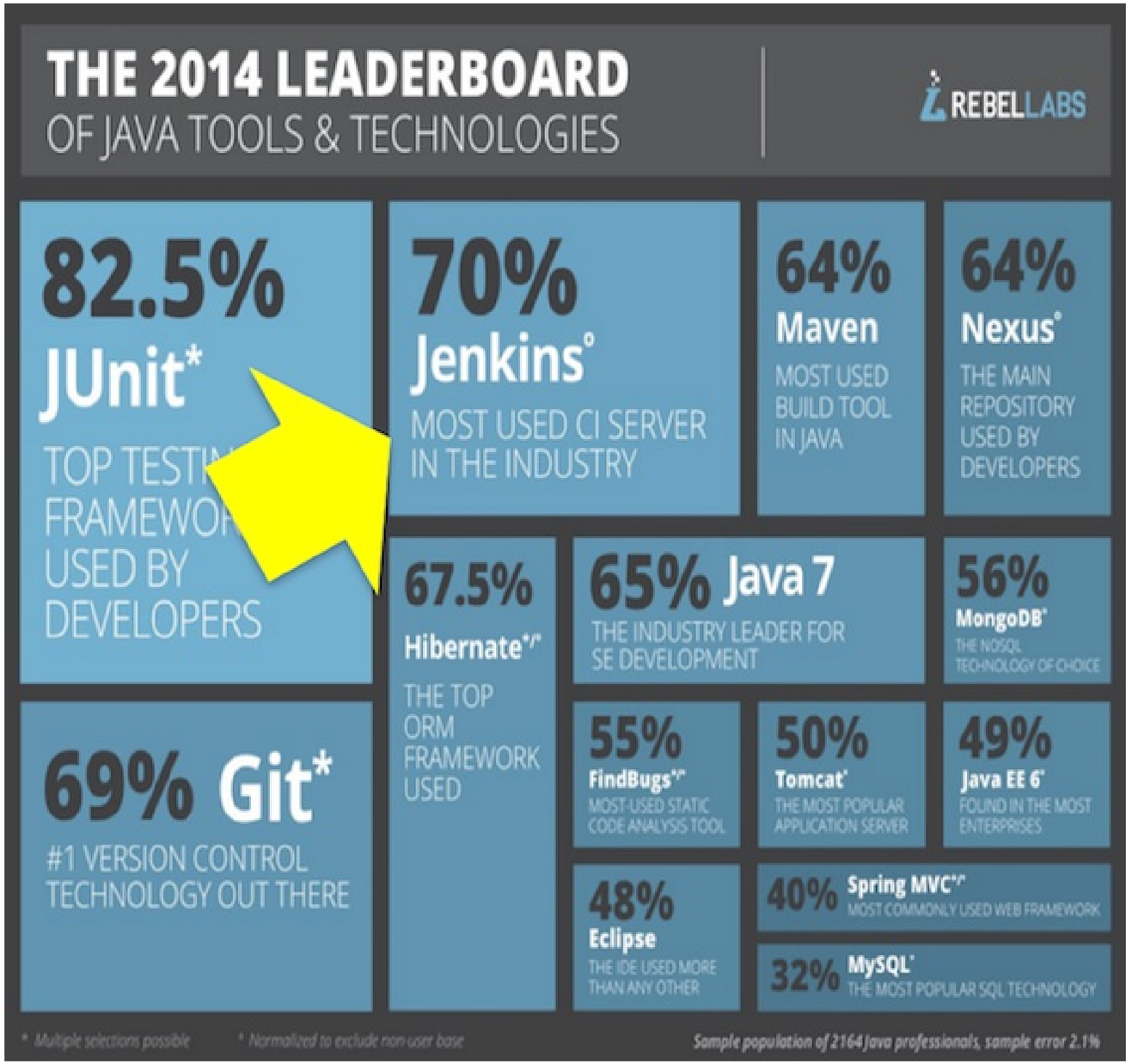

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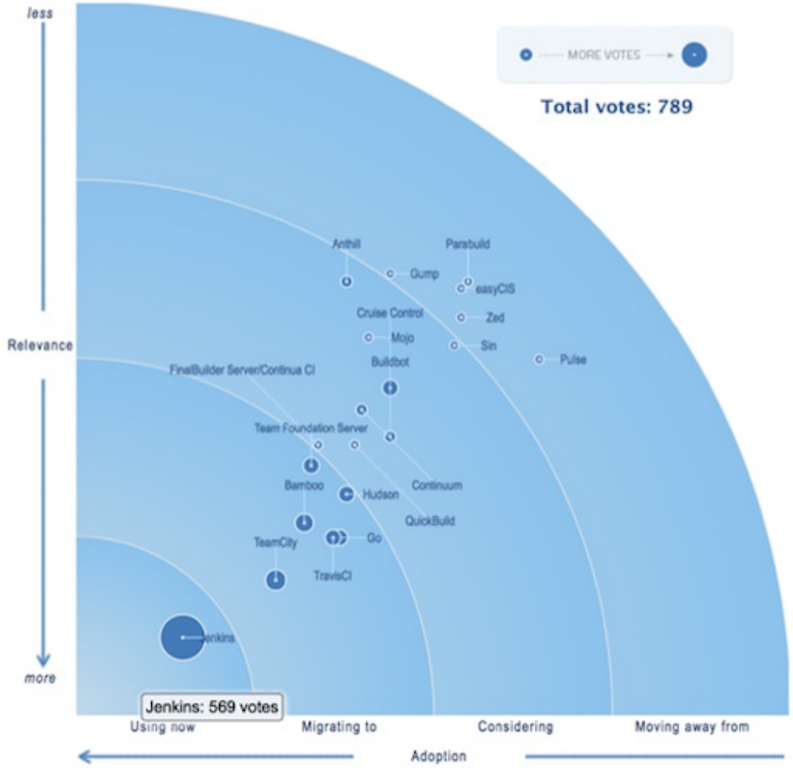
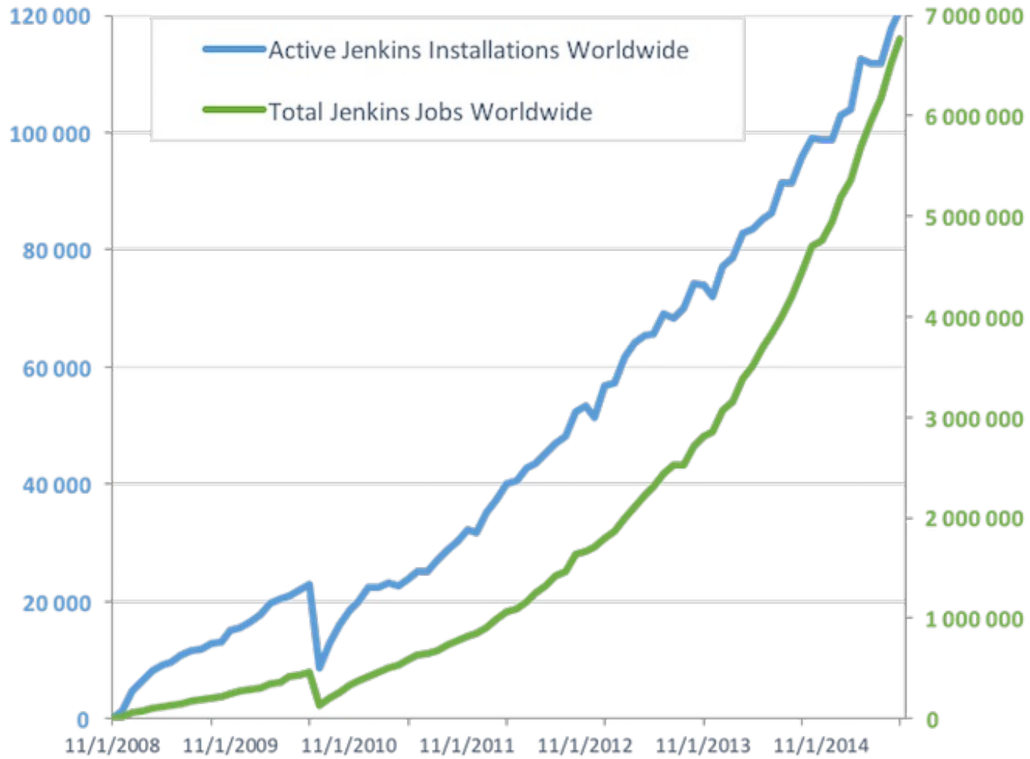
JENKINS POPULARITY: THROUGH THE ROOF



http://stats.jenkins-ci.org/jenkins-stats

http://www.infoq.com/research/ci-server



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WORLDWIDE ADOPTION

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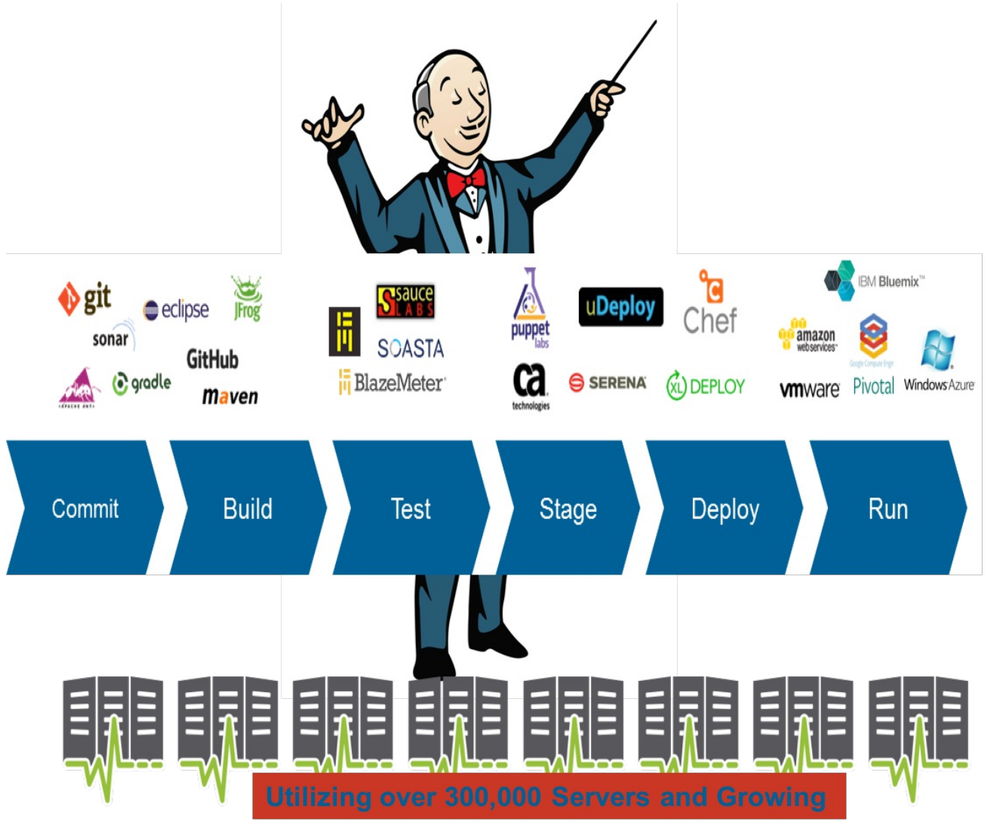
JENKINS IS THE CD ORCHESTRATOR



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CLOUDBEES INTRODUCTION

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CLOUDBEES AND THE JENKINS COMMUNITY

- Kohsuke Kawaguchi
  - Community leader and CloudBees' CTO
- Code and Releases
  - CloudBees partners with the community on development
  - CloudBees engineers contribute a majority of Jenkins OSS code
  - CloudBees partners with the community on releases
  - CloudBees contributes fixes back to the community
- Produces Jenkins Quarterly Newsletter
- Conducts Jenkins User Conferences

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CLOUDBEES INC.

- Incorporated in April 2010
- ~ 200 people as of July 2016
- Headcount and revenue tripled between January 2015 and July 2016
- Presence in 14 countries
- Offices:
  - USA:
  - Raleigh, Richmond, San Jose
- Europe:
  - Sevilla (Spain), Reading (UK), Neuchatel (Switzerland)

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FOLLOW-THE-SUN 24/7 SUPPORT LOCATIONS

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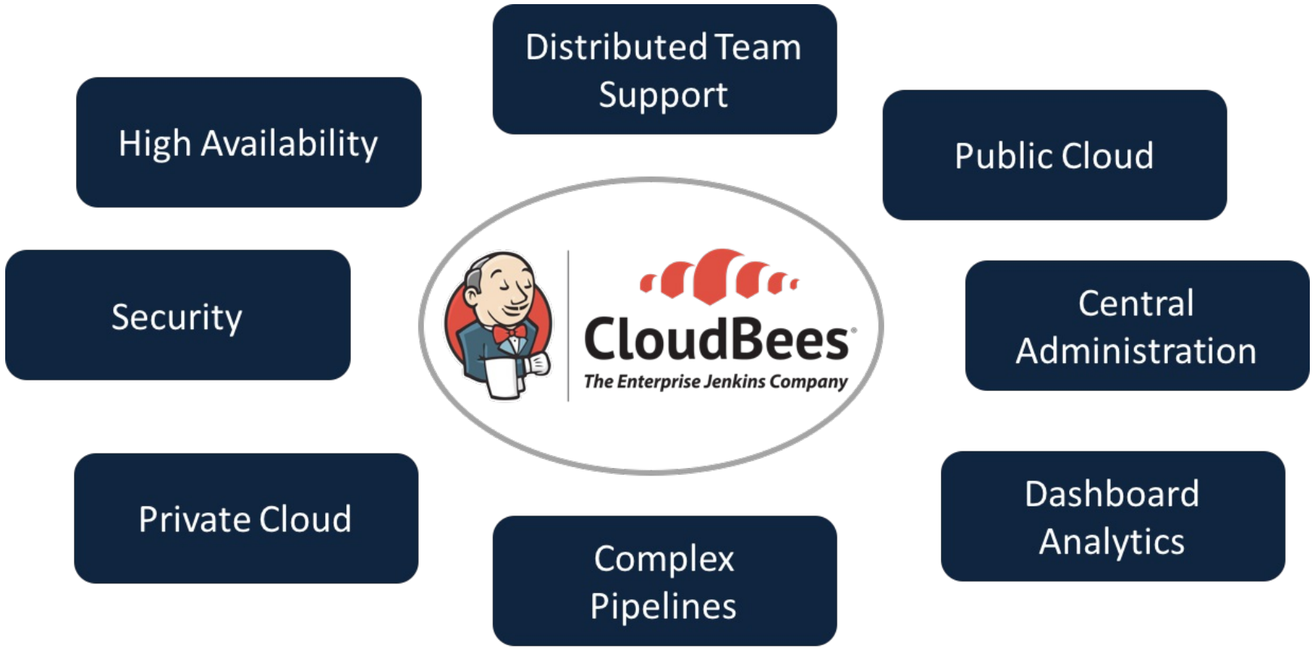
WE DELIVER JENKINS @ ENTERPRISE SCALE



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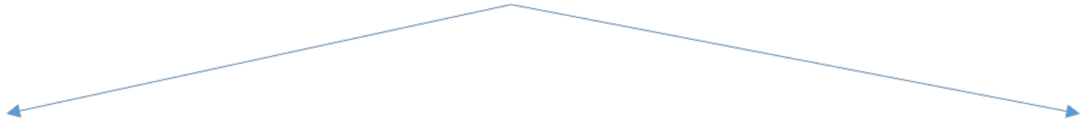
CLOUDBEES JENKINS PLATFORM



Enterprise Edition
Scalable, Secure and Manageable

- High Availability
- Cluster Operations – multi-master environment control
- Shared Build Nodes
- Role Based Access Control and single sign-on
- Pipeline management
- Templates to automate best practices
- Analytics and actionable information

Private SaaS Edition
Continuous Delivery as a Service

- Deploy on your private cloud or VPC
- Federated, shared services across projects
- Deploy new Jenkins services in seconds
- Resilient cloud-based HA/DR
- Automated storage backups
- Optimize infrastructure cost & usage
- Operational visibility & analysis
- Oversight of total workflow & complex pipelines

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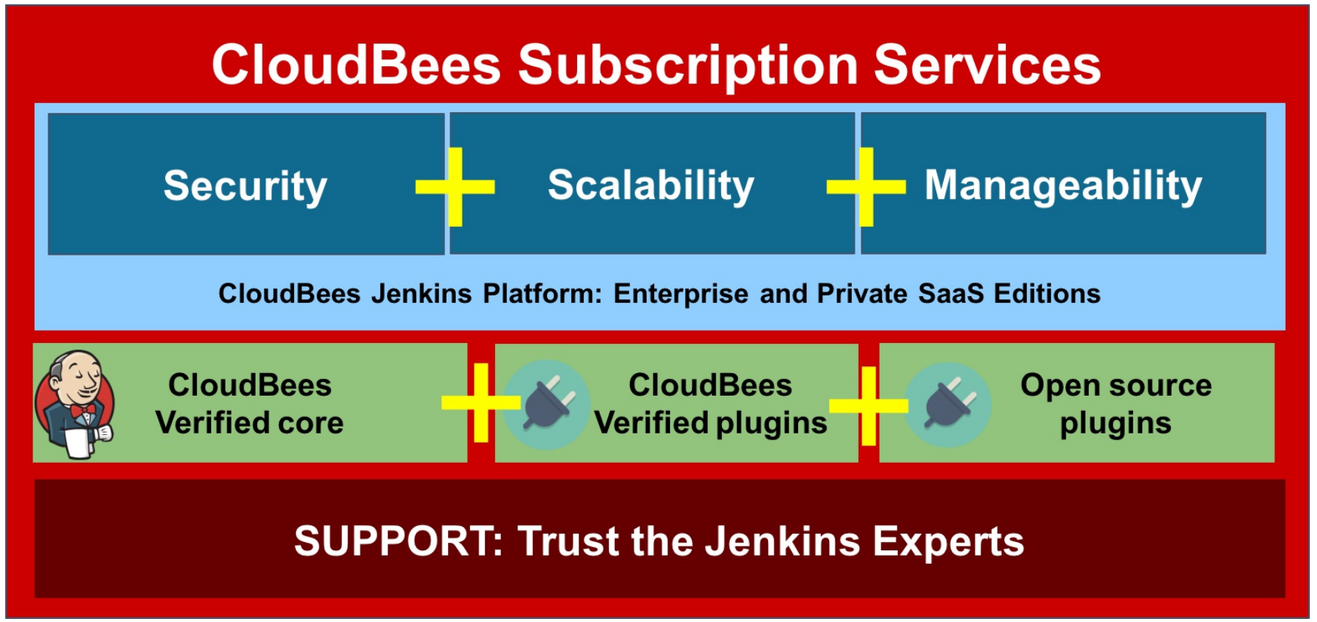
CLOUDBEES JENKINS PLATFORM: ENTERPRISE EDITION



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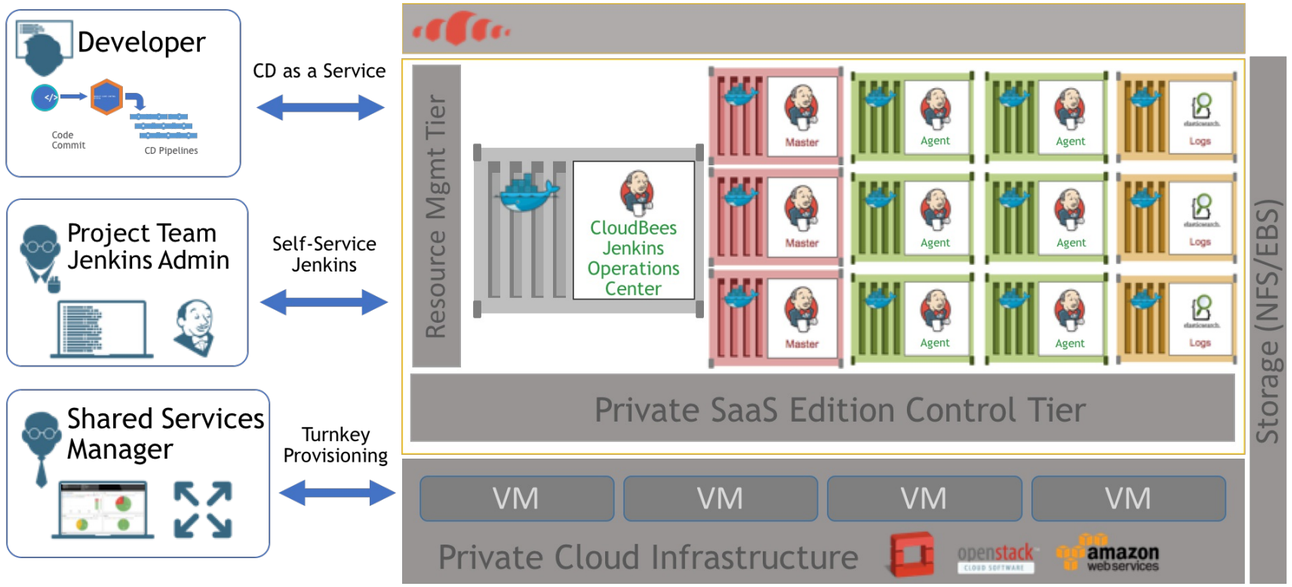
CLOUDBEES JENKINS PLATFORM: PRIVATE SAAS EDITION



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JENKINS SERVICES FROM CLOUDBEES

Jenkins Certified Training

Jenkins Certification

Jenkins Consulting

Jenkins Newsletter

Jenkins User Conferences

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CLOUDBEES SUBSCRIPTION MODEL

- CloudBees sells subscriptions that entitle you to receive support for:
  - CloudBees Jenkins Platform
  - OSS Jenkins including 1,200+ Open Source Plugins
- Customers are charged an annual subscription fee per installation
  - Multi-year subscriptions are available
- A typical service subscription includes:
  - Software updates, bug fixes, and upgrades
  - Technical support
  - stable versions, stable APIs, and more

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CLOUDBEES RESOURCES

- Customer Engagement
  - Support
  - Knowledge Base
  - Diagnostics
- Professional Services
  - Architecture Assessment & CD Guidance
  - Bootstrap Implementation Services
  - Migration Assistance
- Certified Partners
  - Training
  - DevOps transformation
  - DevOps integration
  - Custom Development

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JENKINS JOBS/PROJECTS

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WHAT IS A JENKINS JOB/PROJECT

- Jobs are at the heart of the Jenkins build process.
- A Jenkins job is most of the time a particular task or step in your build process.
- An application may require several jobs
- A single job may have multiple build steps

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KEY JENKINS PROJECT (JOB) TYPES

- Pipeline Project (Brand New!)
- Freestyle Project
- Maven Project
- Monitor External Job
- Several more types supported

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FREESTYLE PROJECTS

- Most flexible
- Build any type of projects (Ant, Maven, Makefile, Shell script…)
- Supports most reporting plugins

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MAVEN PROJECTS

- Optimized for Maven 2/3 projects
- Jenkins reads the pom.xml file to make setting up the project easier.
- Build projects in the correct order based on the Maven dependencies
- Understands multi-module projects
- Default reporting of tests and code analysis tools

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SETTING UP FREESTYLE PROJECTS

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NEW FREESTYLE PROJECT: GENERAL INFO

- Discard old build data
  - Useful to cap the disk consumption
  - You can mark some to be kept forever
- Configure specific tools for the build to run with
  - Specify JDK
  - Specify Maven/Ant versions

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NEW FREESTYLE PROJECT: BUILD STEPS

- Build steps do the actual work
- Out of the box, many types available:
  - Unix shell or Windows batch script
  - Invoke an Ant script
  - Invoke a Maven script
- You can have several build steps
  - A shell script followed by an Ant or Maven build
  - An Ant build followed by a Maven build
- Can be reordered via Drag & Drop
- Plugins can add new build steps

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ENVIRONMENT VARIABLES

- Jenkins also sets environment variables, eg.
  - BUILD_NUMBER (eg “123”)
  - JOB_NAME (eg. “tax-api-unit-tests”)
  - BUILD_TAG (eg. “Jenkins-tax-api-unit-tests-123”)
  - SVN_REVISION or CVS_BRANCH
- You can use these in your build script

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POST-BUILD ACTIONS

- Collect the results of builds
  - Archiving
  - Reporting
  - Trigger other builds
  - Notifications

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POST-BUILD ACTION: ARCHIVING

- Store build artifacts for future reference
- Use Ant-style paths build/**/*.jar to determine what files to archive Stored artifacts are displayed on a build's page

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POST-BUILD ACTION: JUNIT REPORTS

- The build needs to run the tests and generate an XML JUnit report
- Use Ant-style path expressions
- Results appear on the project home page

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POST-BUILD ACTION: JAVADOC API

- The build needs to generate Javadoc
- Jenkins will capture javadoc
- Javadoc link appears on the build home page

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POST-BUILD ACTION: E-MAIL NOTIFICATION

- Email notification strategies
  - Sent when a build fails or is deemed “unstable”
  - And on the first successful build after a series of failures
- To fine-tune the behaviour, use “email-ext”

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POST-BUILD ACTION: TRIGGER OTHER BUILDS

- Specify other builds to be started when this build succeeds
- Useful for cascading builds
- Different view of the same data as “build trigger”

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LAB EXERCISES:

- Lab 1: Creating A Freestyle build Job
- Lab 2: Creating A Maven build Job

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MONITORING BUILD JOBS

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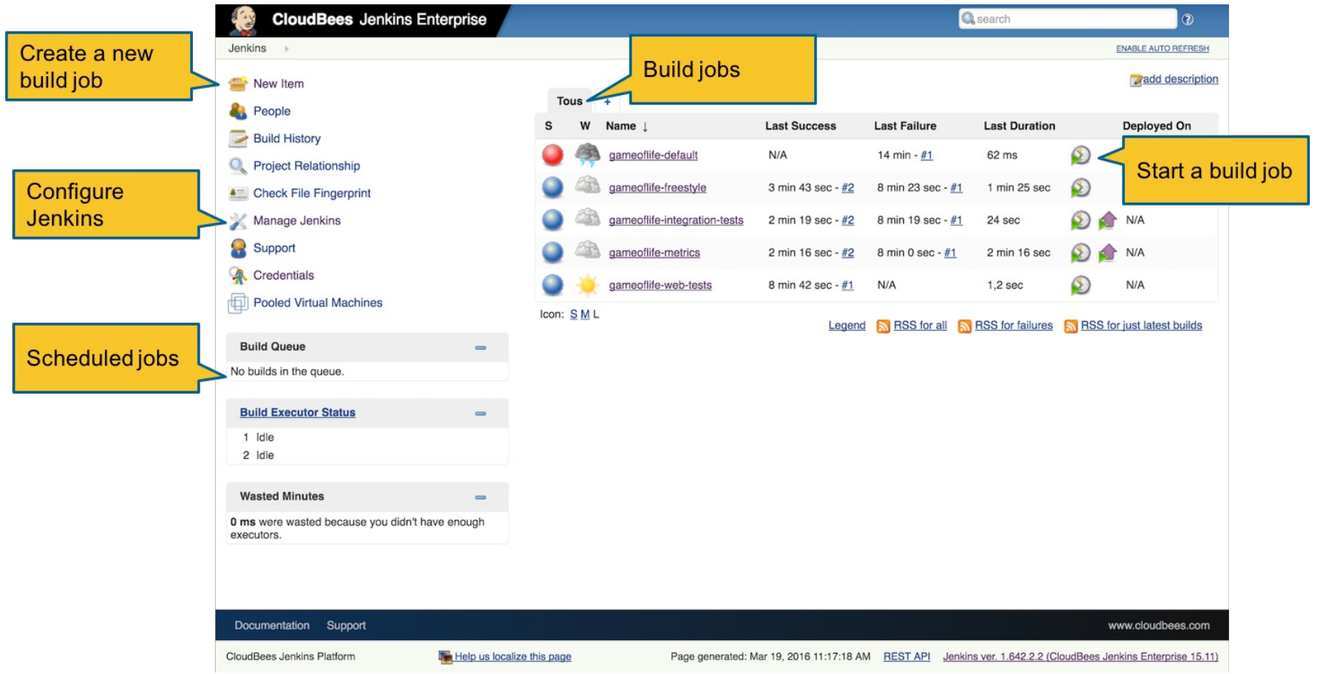
THE JENKINS DASHBOARD



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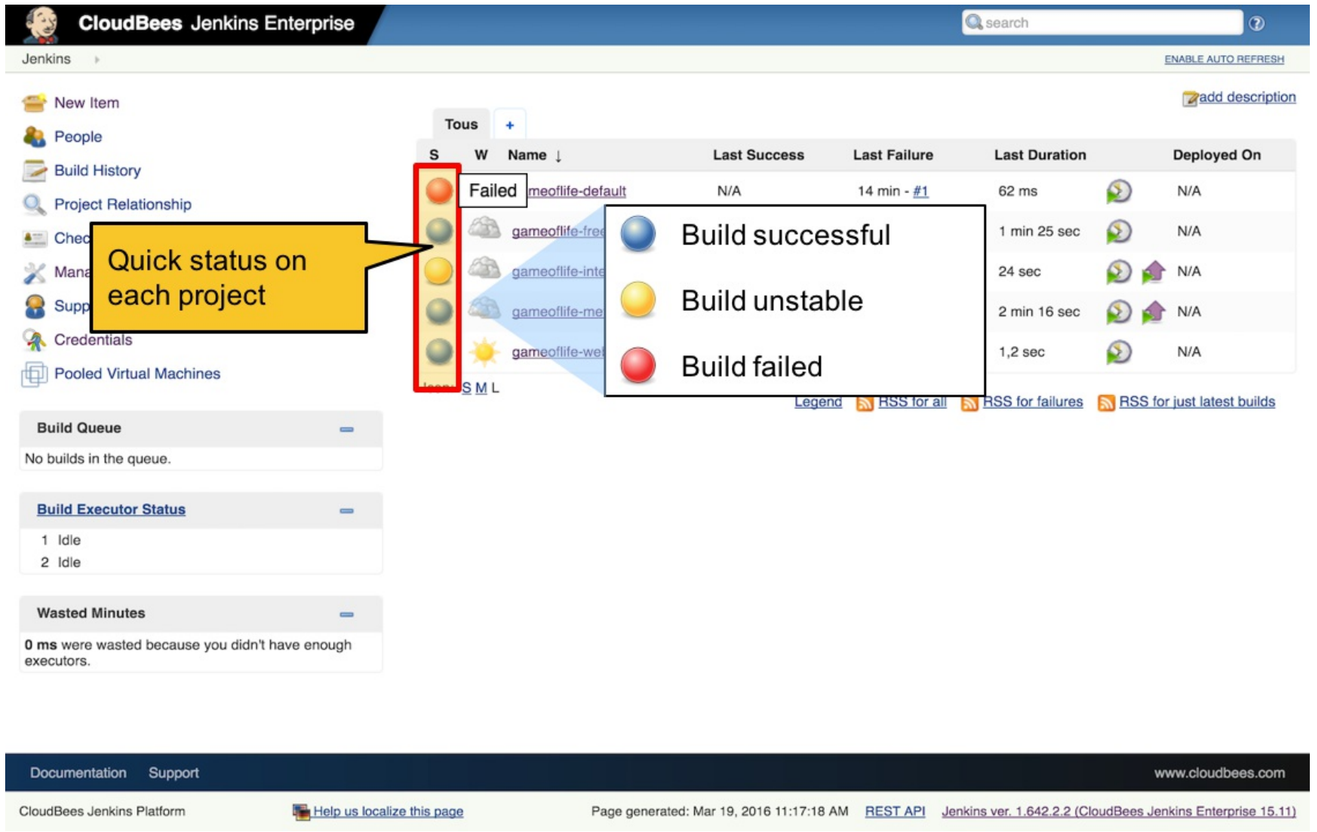
MONITORING BUILD JOBS

- What is the last build result?



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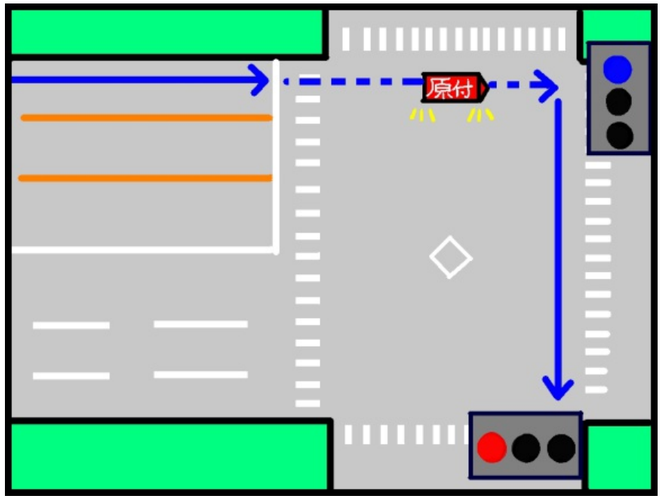
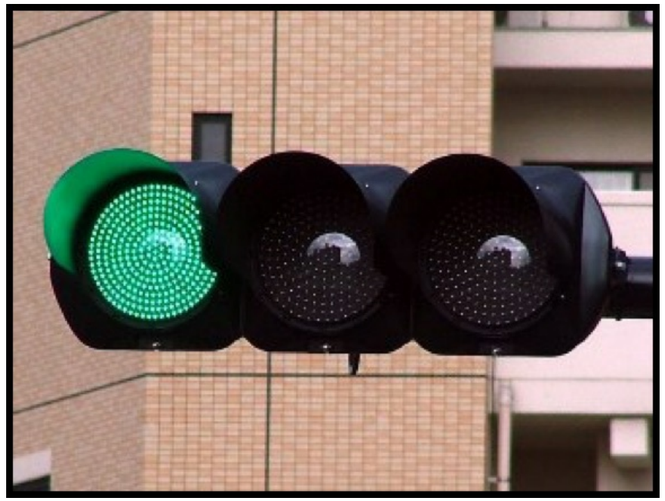
WHY BLUE?

- In Japan, it is really called "blue light"
  - So people draw them as such
  - Even though the actual color is green!





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BENEFITS: QUICK OVERVIEW

- KISS principle:
  - Color for last build status
  - Weather for the build status trend
- One screen to see them all

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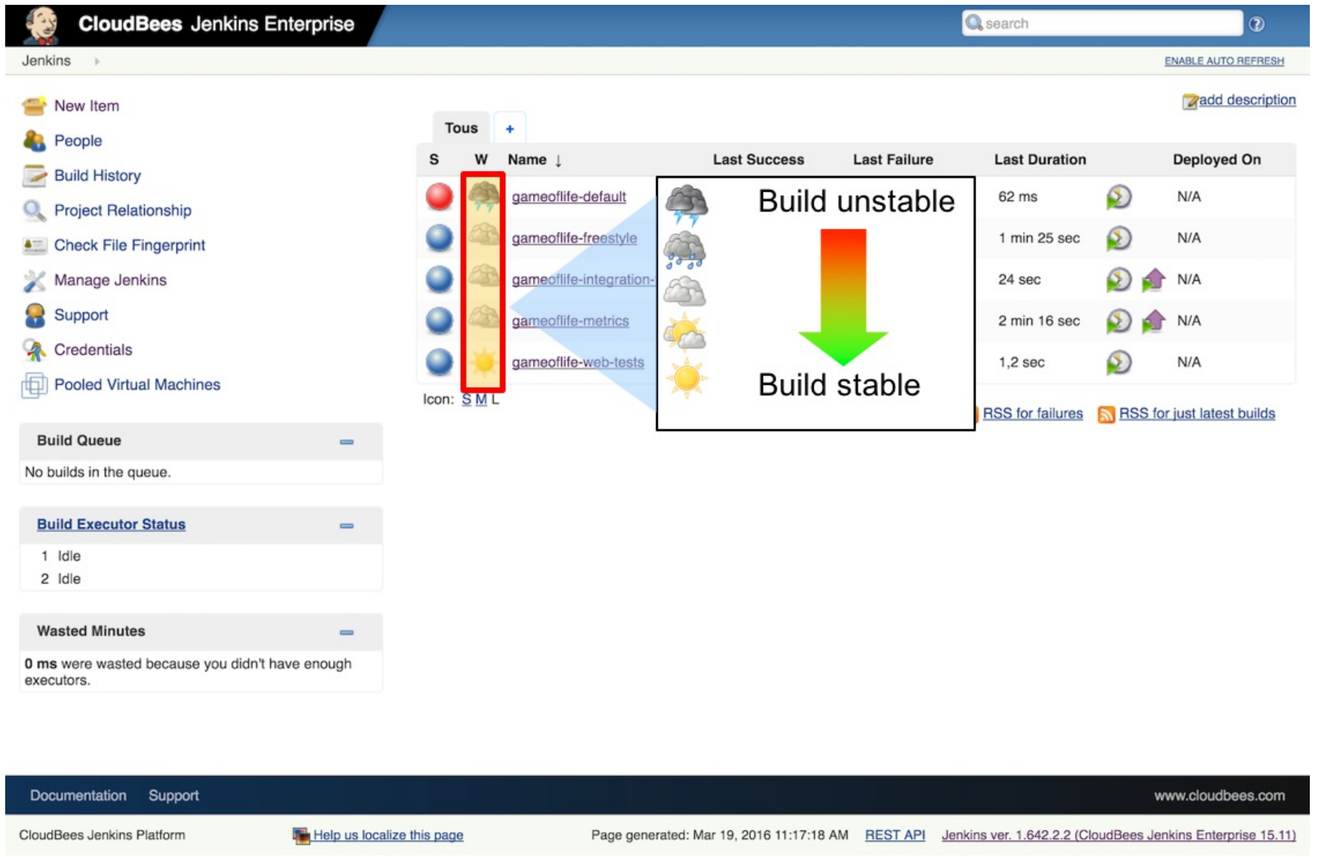
MONITORING BUILD JOBS

- How my jobs are behaving for the last 5 builds?



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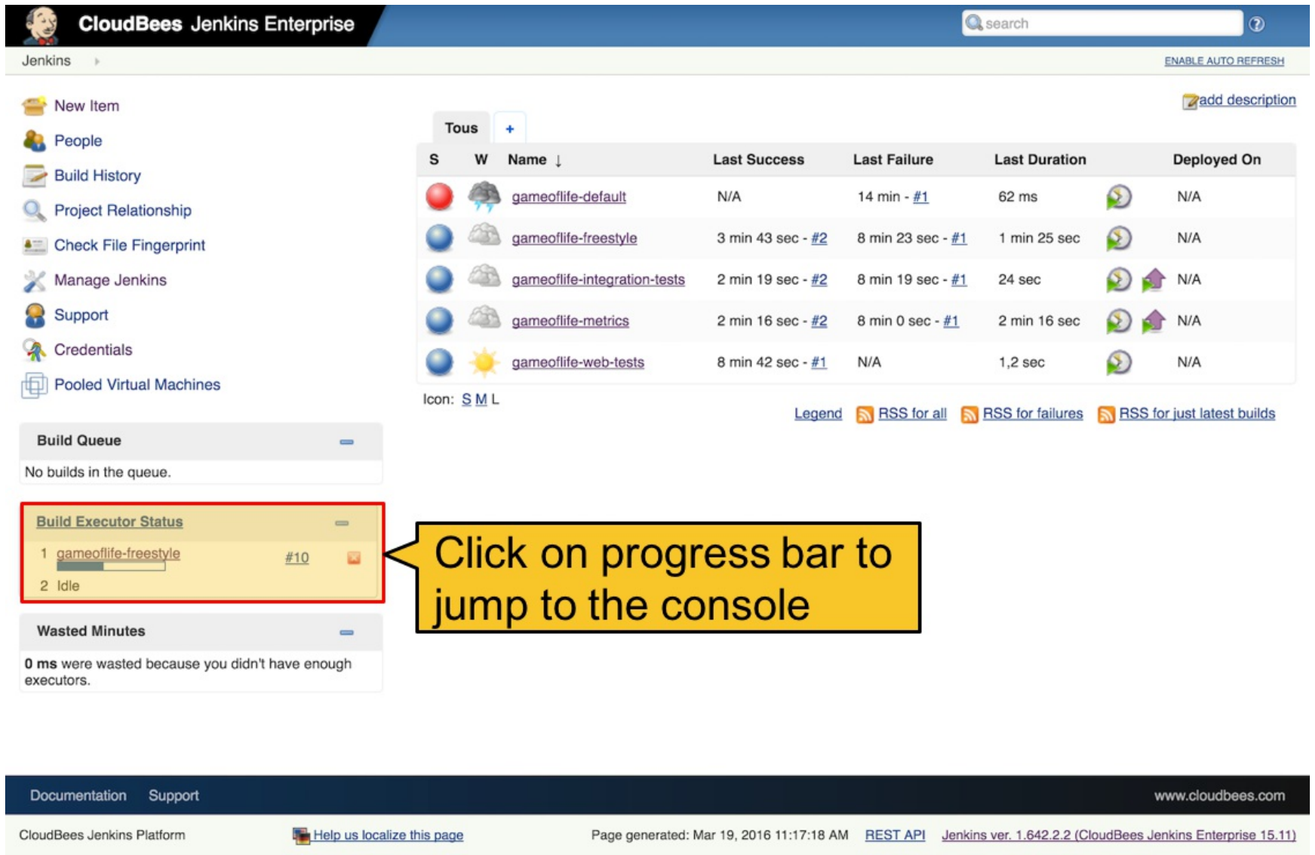
MONITORING BUILD JOBS

- What jobs are currently executed?



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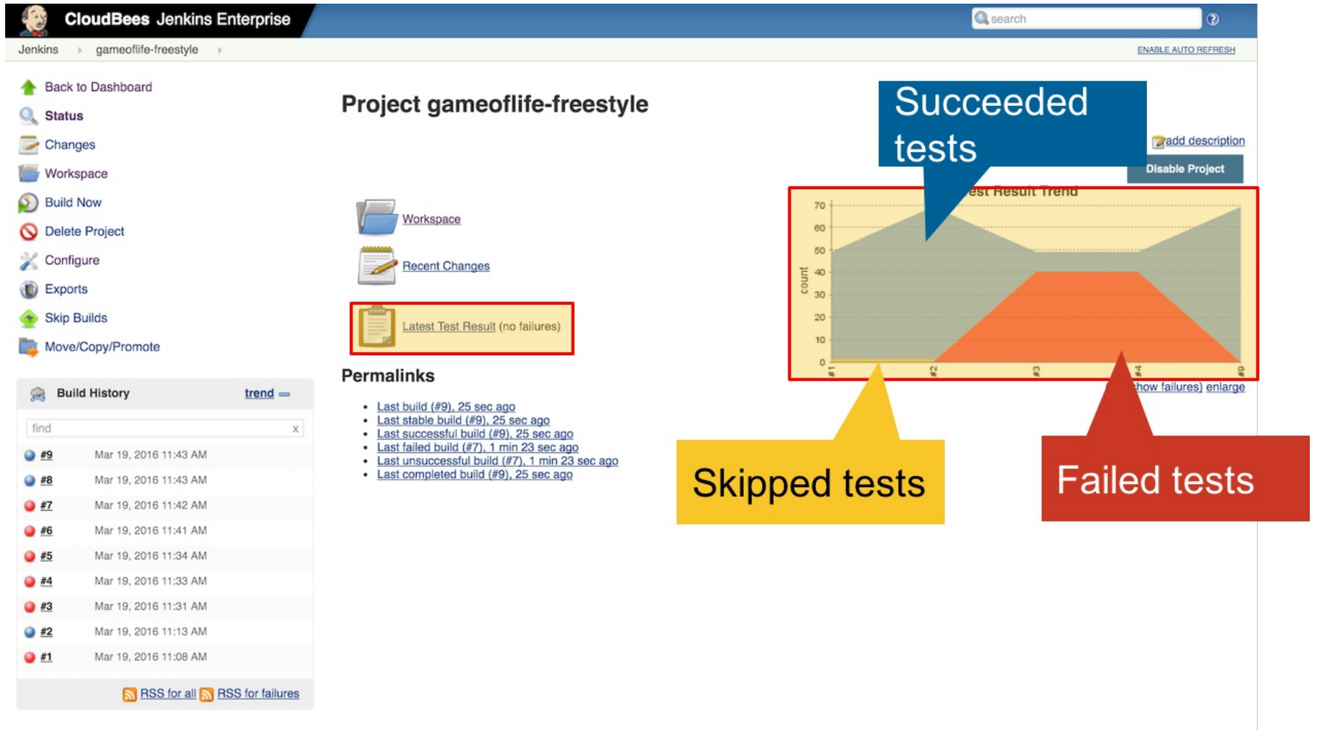
BUILD DETAILS

- See the tests results:



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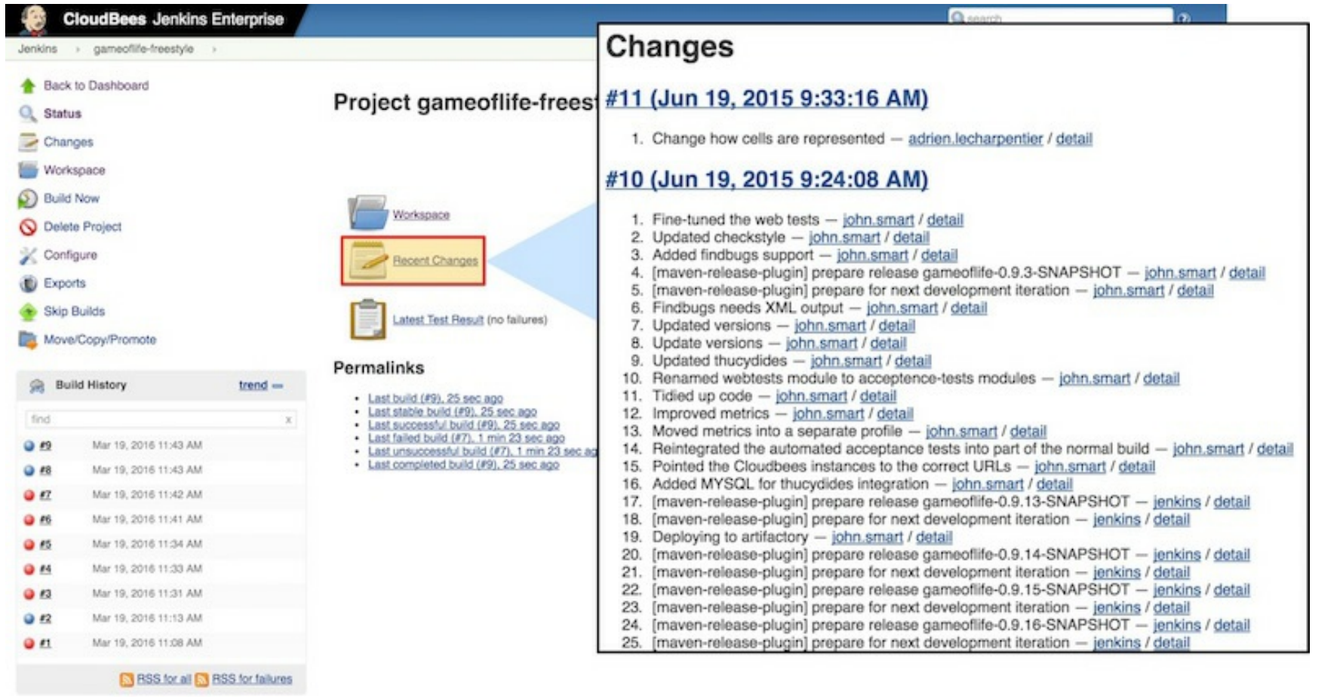
BUILD DETAILS

- See what has changed:



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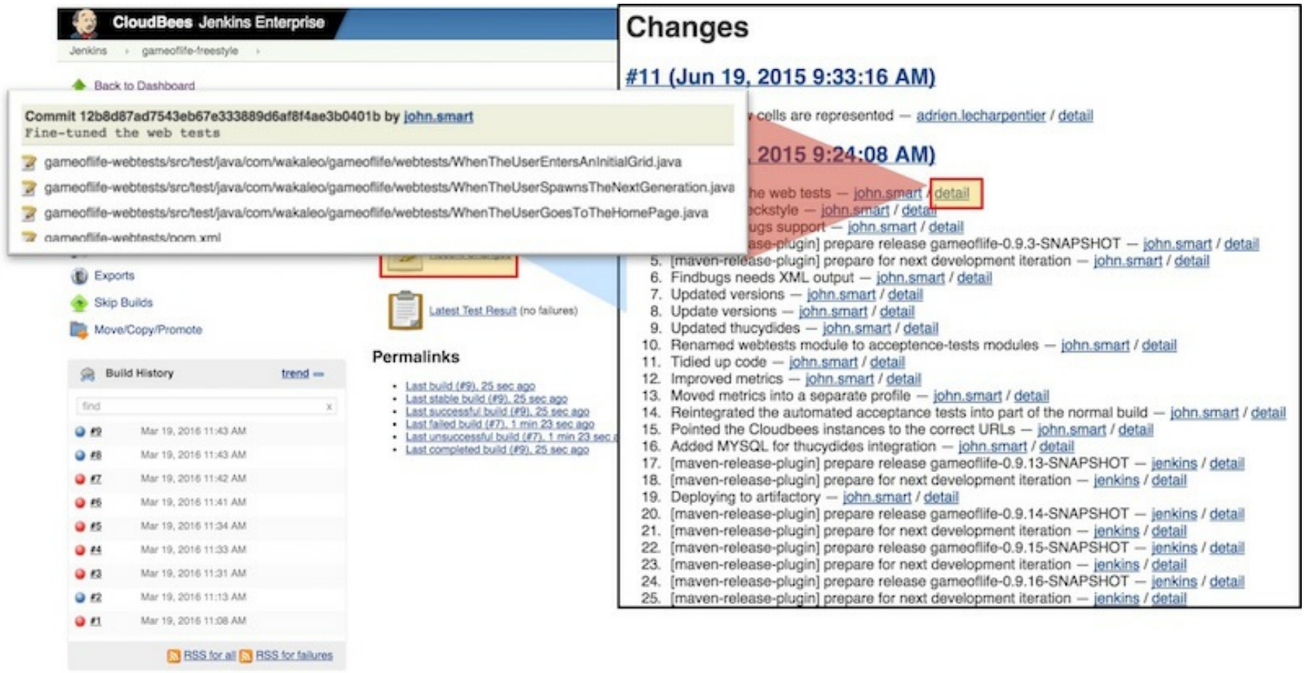
BUILD DETAILS

- See what has changed:



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BUILD DETAILS

- Download latest archived artifact:

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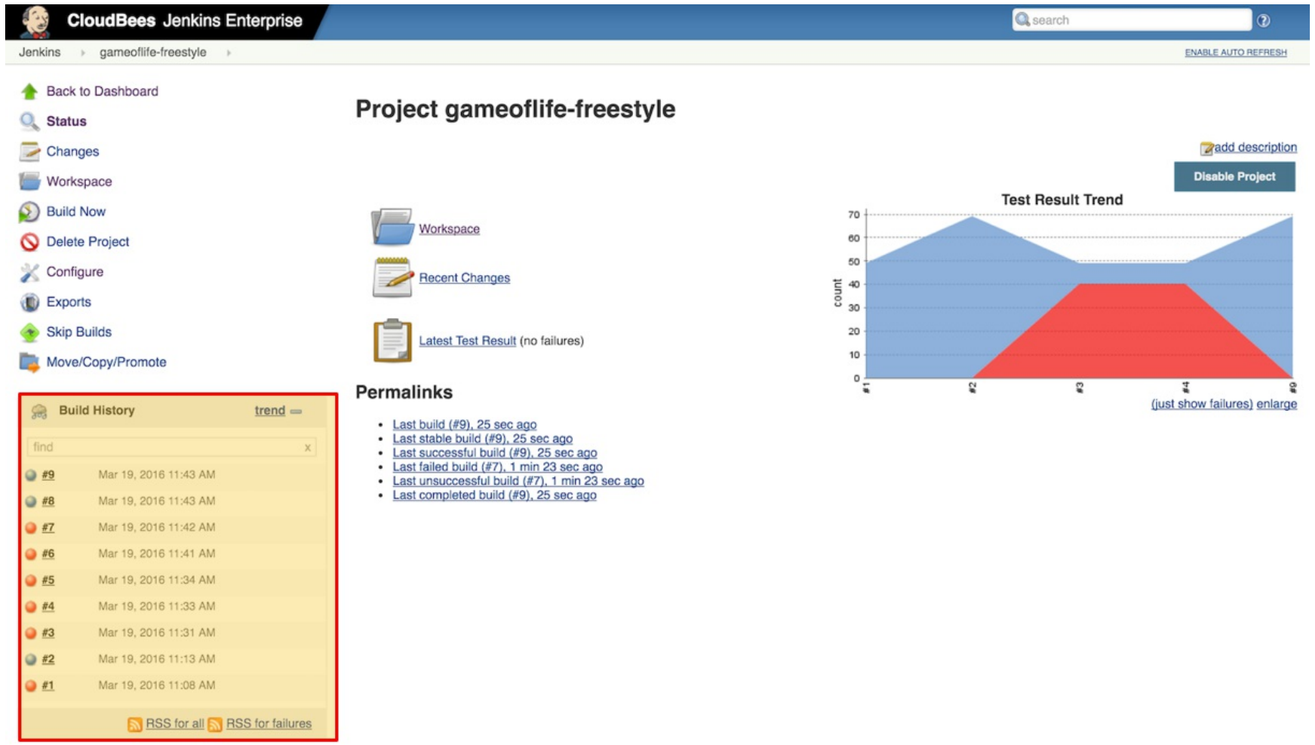
BUILD DETAILS

- Build history:



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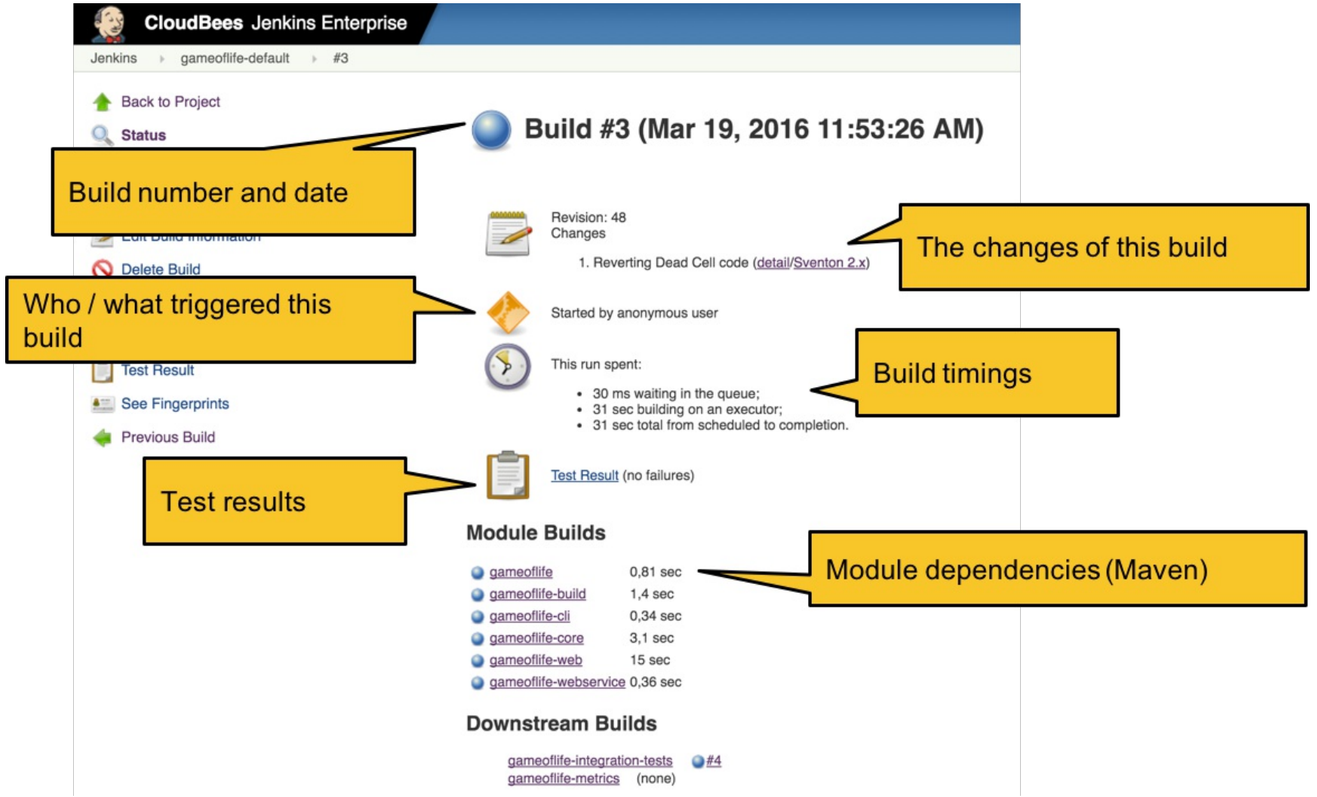
BUILD DETAILS

- View the details of any particular build:



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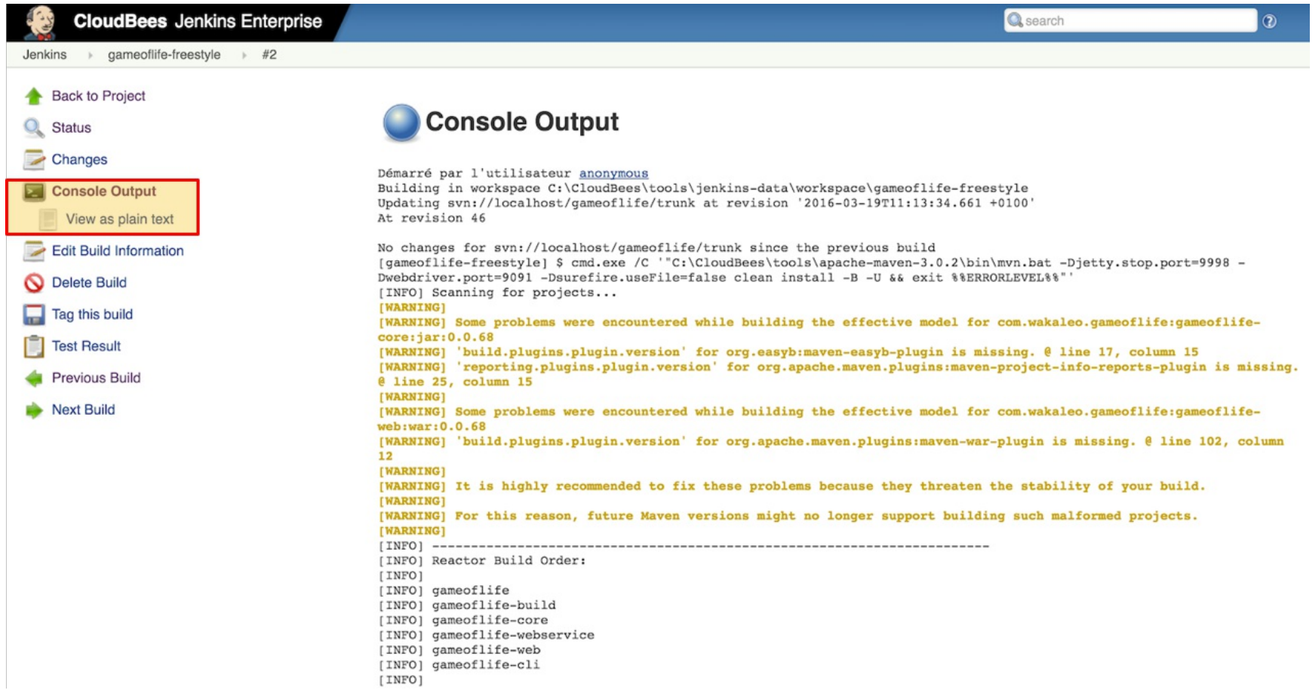
BUILD DETAILS

- View the output of the build:



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ORGANIZING BUILD JOBS

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ORGANIZING YOUR BUILD JOBS

- Don’t do everything in one job:
  - Create many job and divide things up
- Progressive refinement:
  - Do cheap things first and get fast feedback:
    - Compilation, unit tests
  - Do expensive things later:
    - Only after cheap things run successfully
    - Integration tests, cross-platform tests

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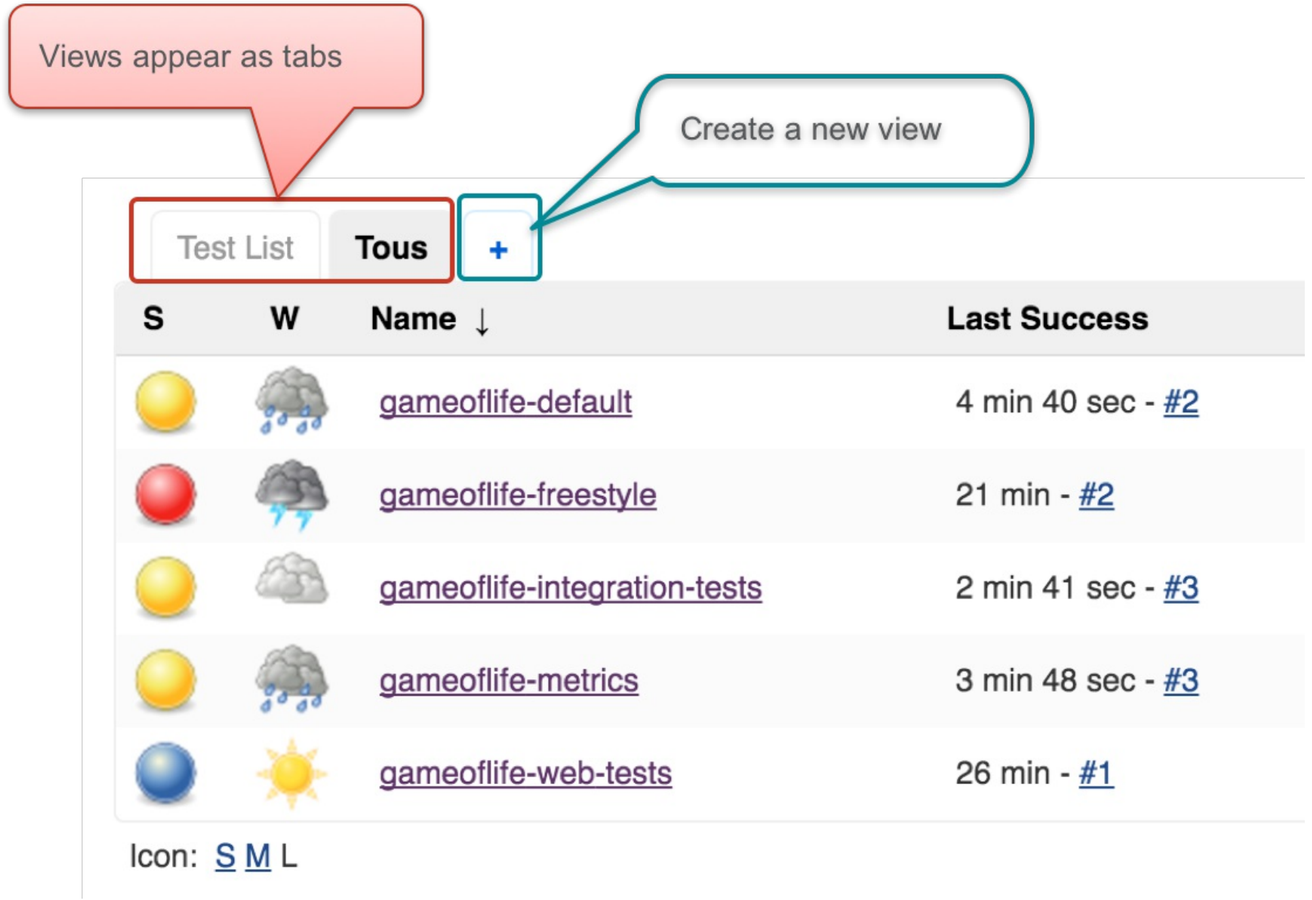
USING VIEWS



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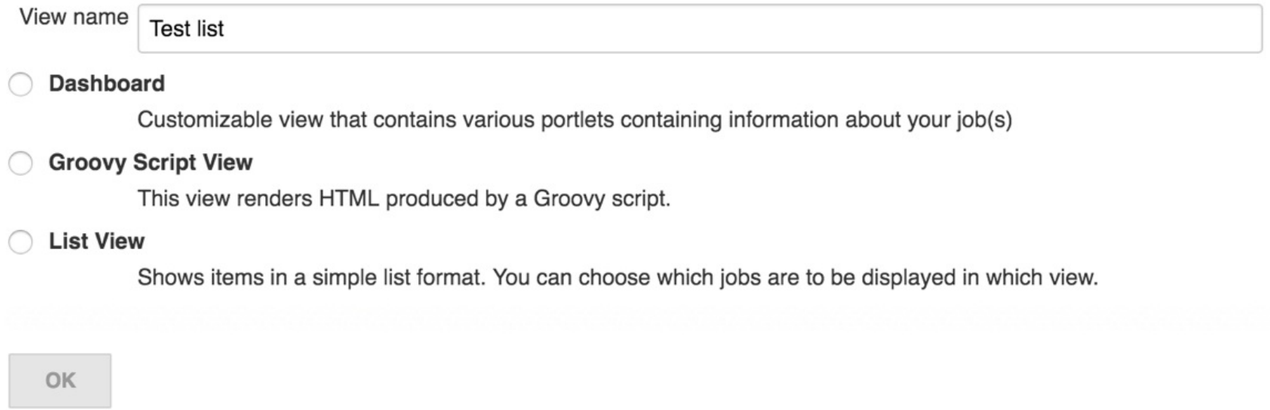
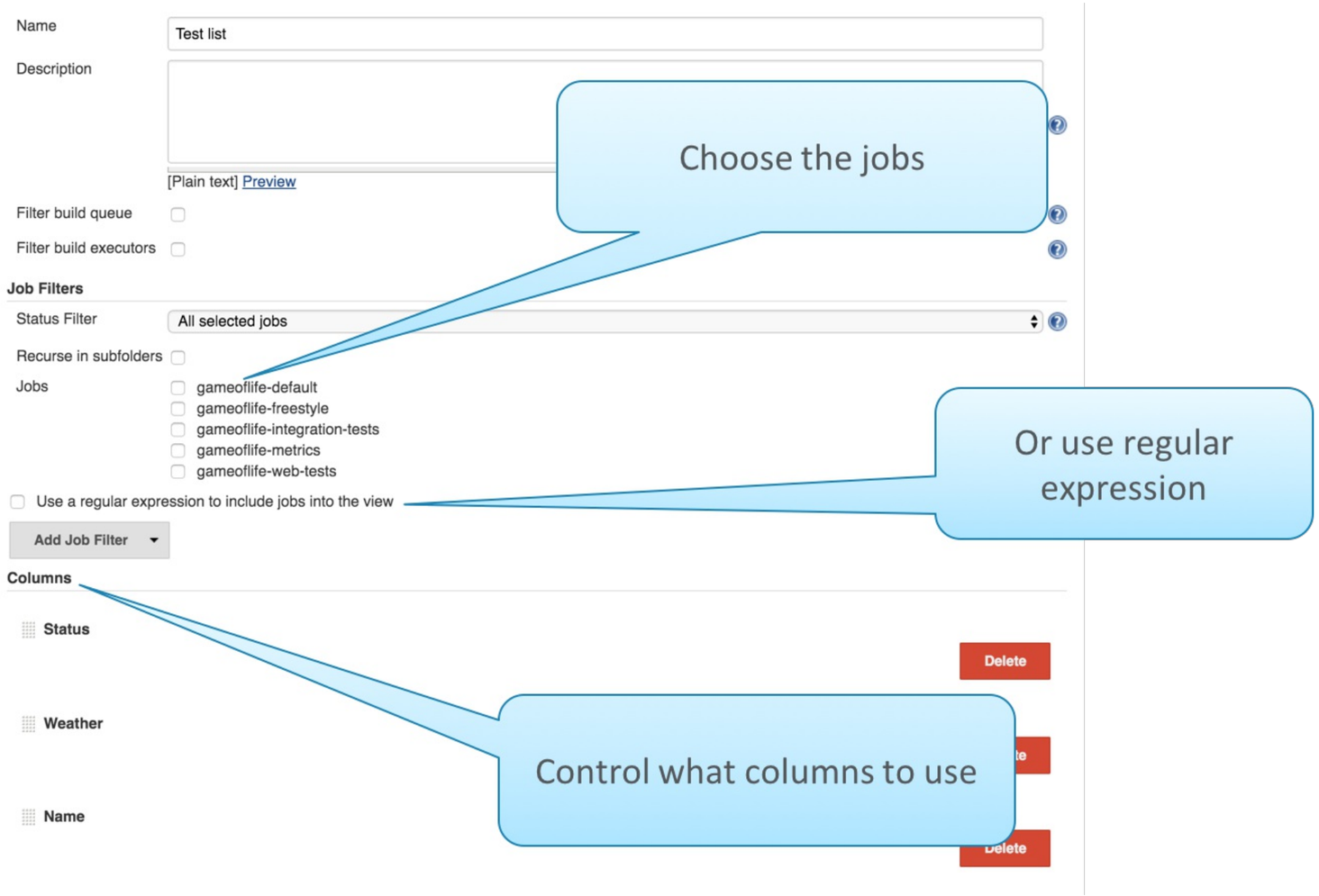
LIST VIEW

- Contains a list of projects:



CREATING A LIST VIEW



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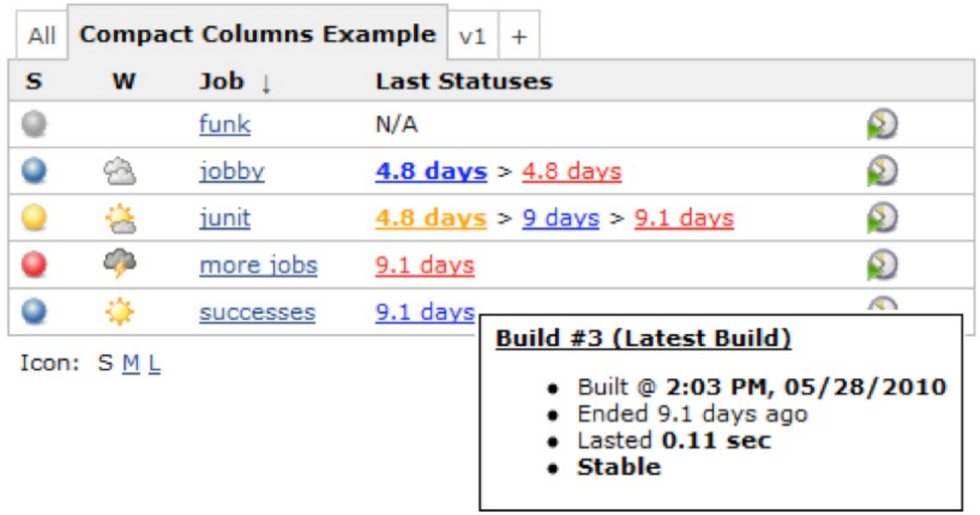
CUSTOMIZE LIST VIEW

- "View Job Filters" plugin
- Columns:
  - "Favorite" mark
  - Compact status column



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OTHER VIEW TYPES

Radiator View Plugin:

- Highly-visible display of build status
  - Visible from a distance
  - May show all builds
  - Or only broken ones

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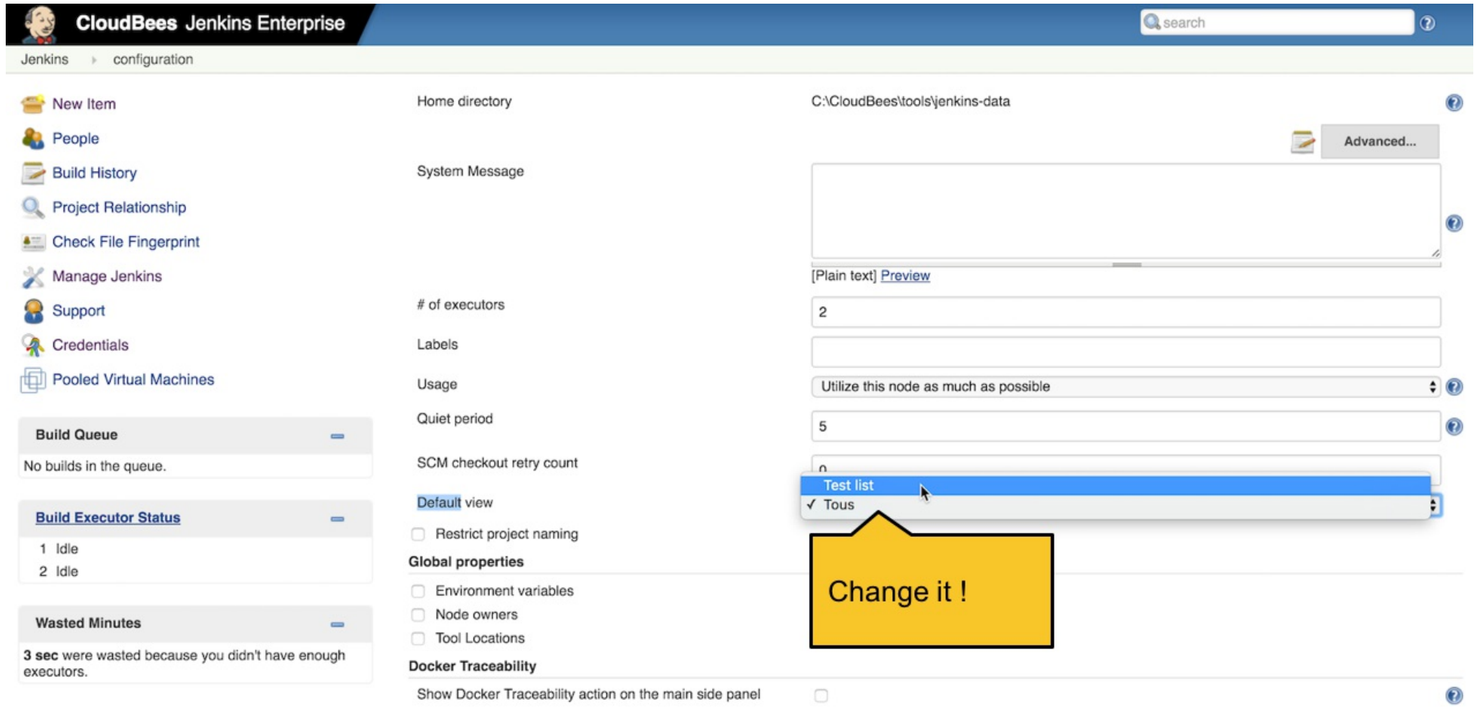
DEFAULT VIEW

- All view is the default, but if more views exist, this can be changed in $JENKINS_URL/configure:



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LAB EXERCISES:

- Lab 3: Displaying Test Results
- Lab 4: Creating an Integration Tests Build

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PLUGIN MANAGEMENT

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JENKINS PLUGINS

- Jenkins can be extended by writing plugins
- They are mainly used to integrate with 3rd-party tools
- Many already available
- Check out the Jenkins website

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PLUGIN EXAMPLES

- Source code management tools
- Build Tools
- Reporting tools
  - Code coverage, static code analysis
- Online source code browsers
- Issue tracker
- Notification tools
- Views and UI customizations
- Distributed builds

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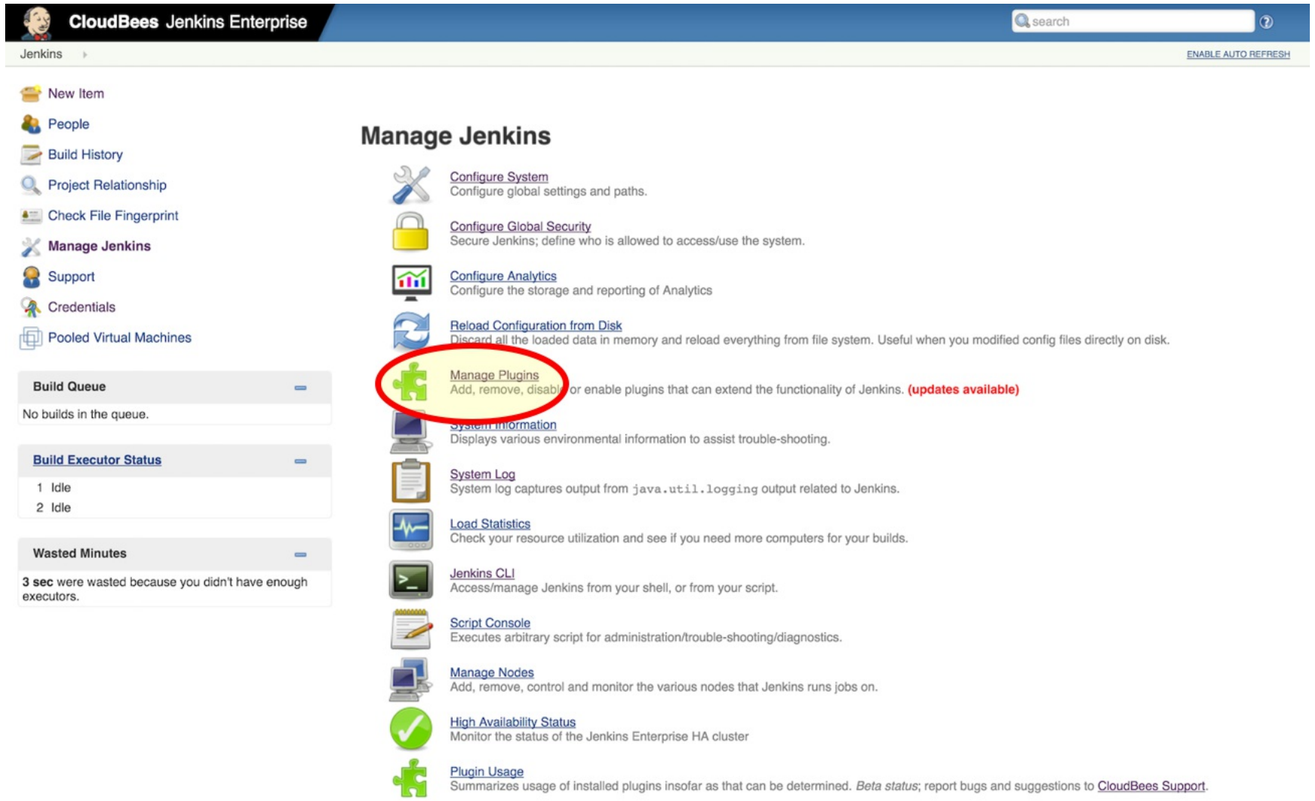
INSTALLING PLUGINS



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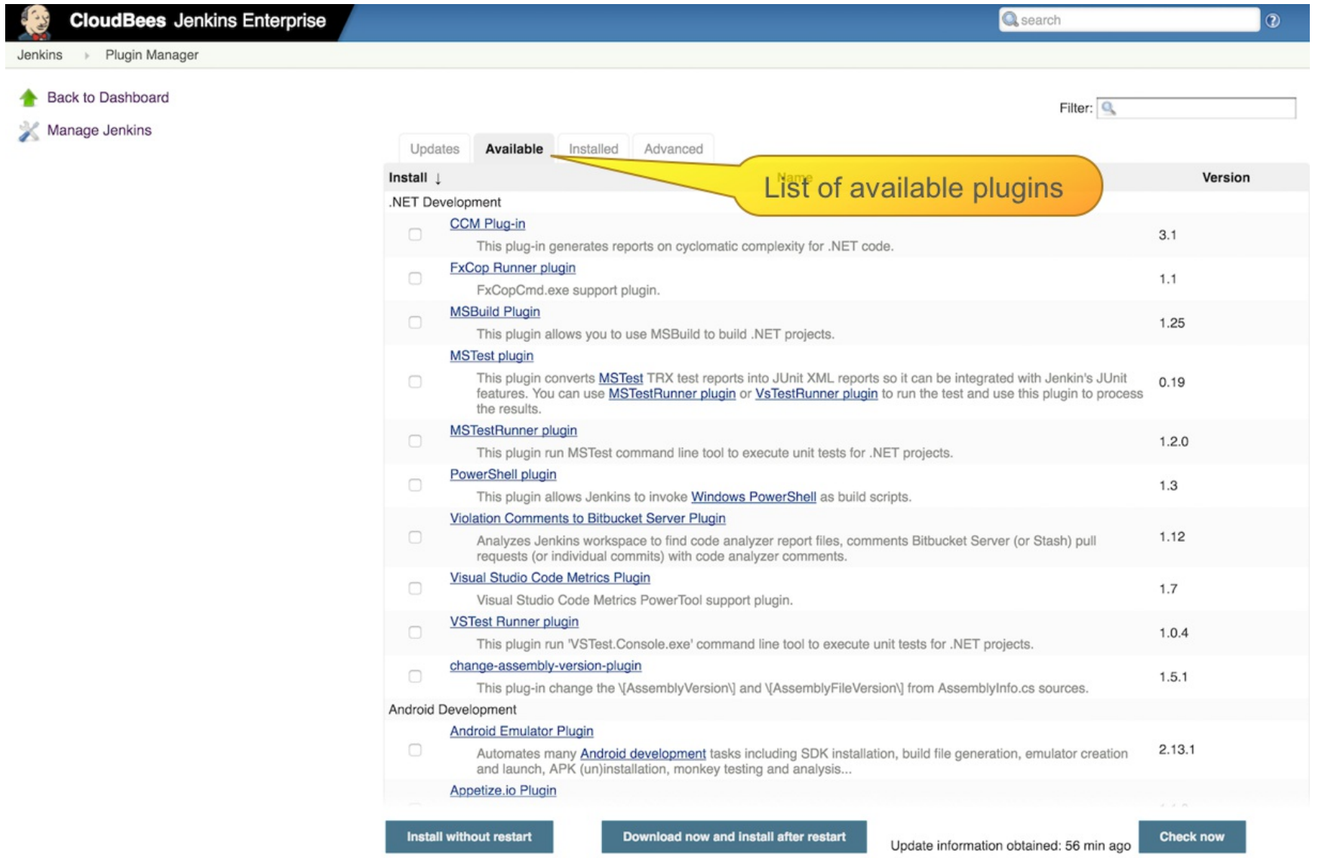
WHAT PLUGINS ARE AVAILABLE?



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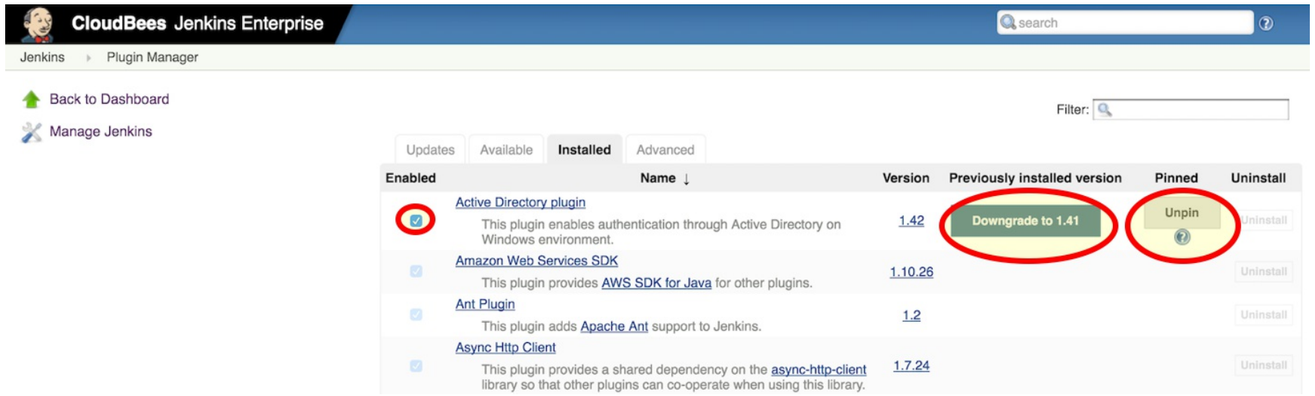
INSTALLED PLUGINS

- You can downgrade, pin/unpin or disable plugins:



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PINNING PLUGINS:

- When you update bundled plugin, they get pinned
- Pinned plugins don't get overwritten automatically
- On disk, you'll see a file named foo.hpi.pinned

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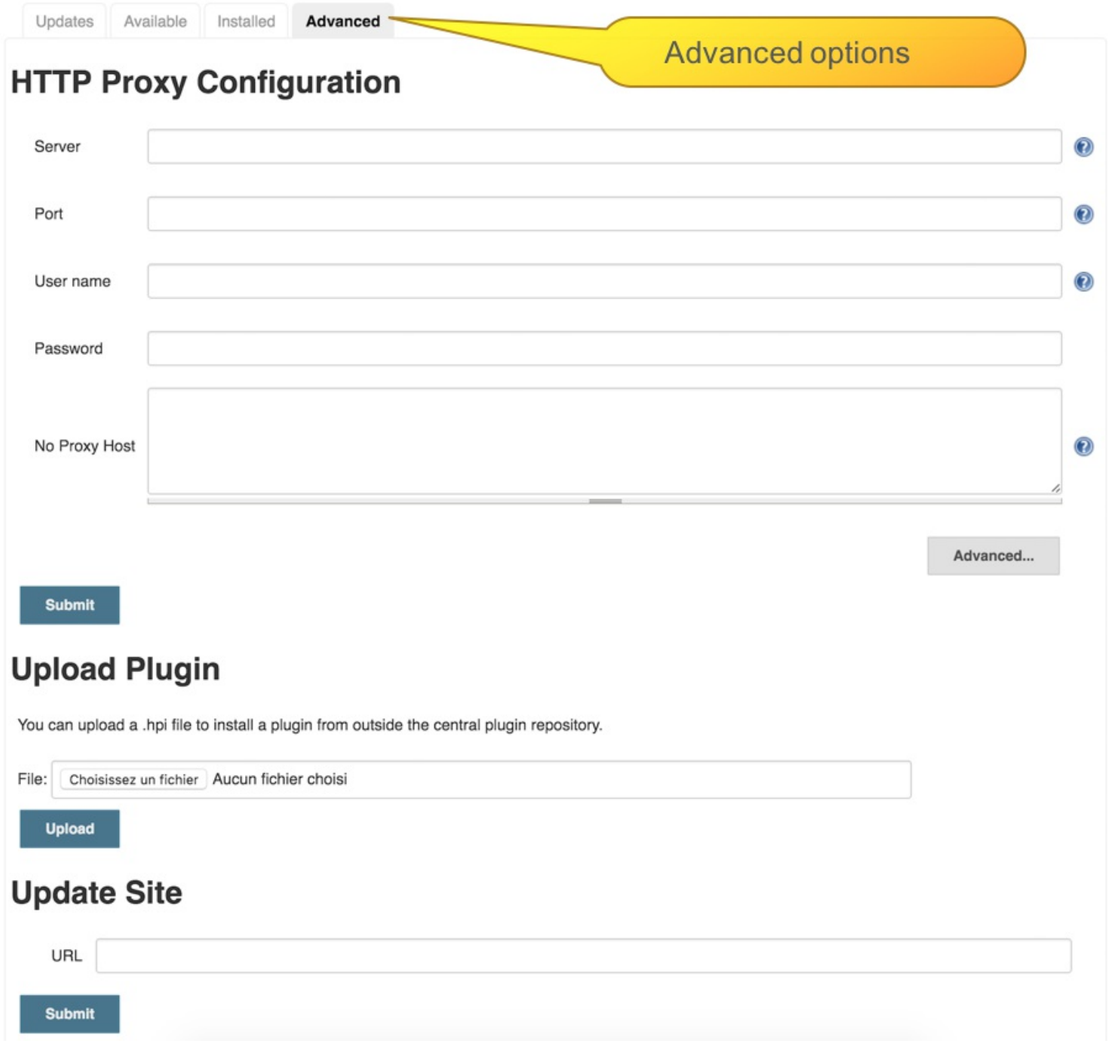
MANUALLY INSTALLING PLUGINS



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EXAMPLE: VIOLATIONS PLUGIN

- Reports on code quality metrics:
- Checkstyle, CPD, FindBugs, PMD, and also FxCop and pylint
- Your build script needs to generate the raw XML data

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WORKING WITH VERSION CONTROL

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WORKING WITH VERSION CONTROL

- Integrating with your SCM
  - Build triggers
  - Integrating with a SCM browser
  - Integrate with SCM users

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SCM BROWSER INTEGRATION

- Why?
  - See details of what changes went to builds
  - You can share the pointer with colleagues
- Jenkins Integrates with browsers for many modern SCMs
  - Subversion: Trac, ViewSVN, WebSVN, Sventon, Fisheye, Collabnet,…
  - Git: gitweb, github,…
  - Mercurial: bitbucket, googlecode, hgweb,…

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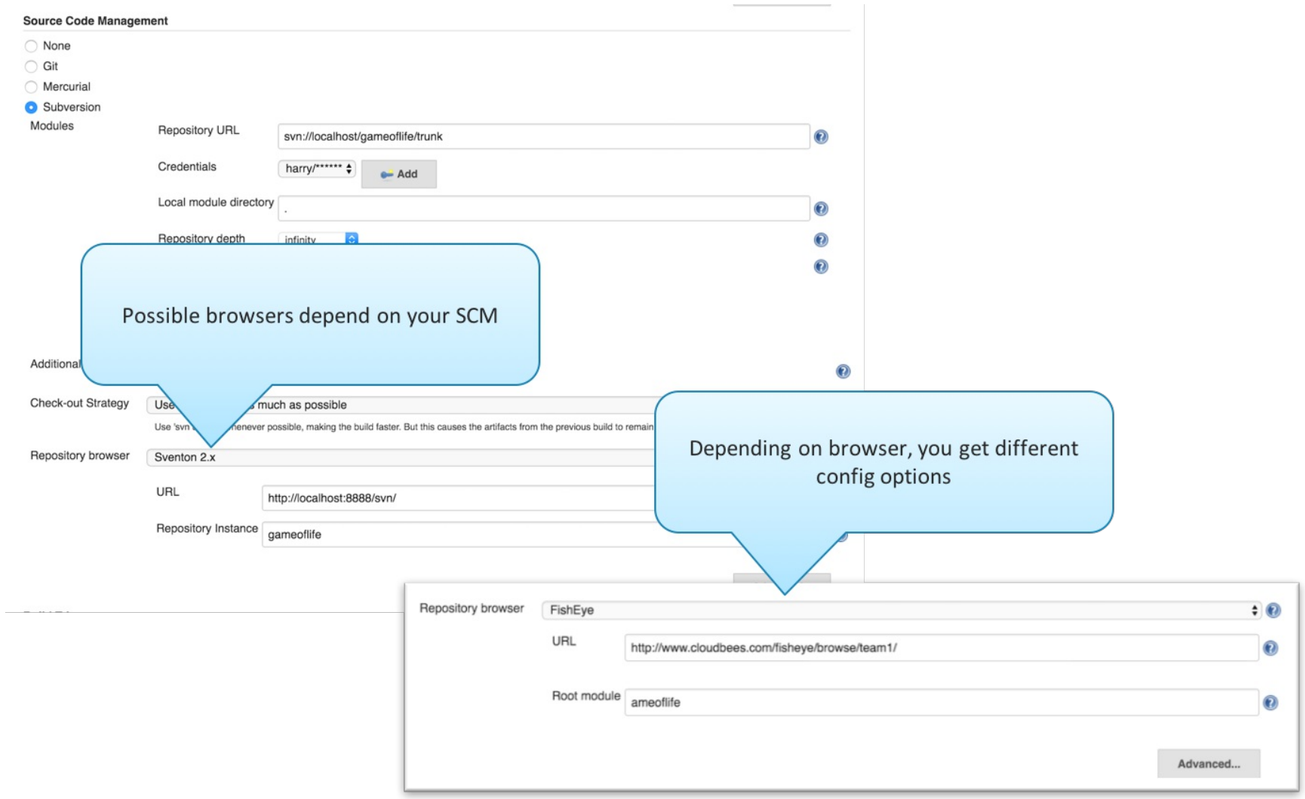
EXAMPLE USING SVENTON



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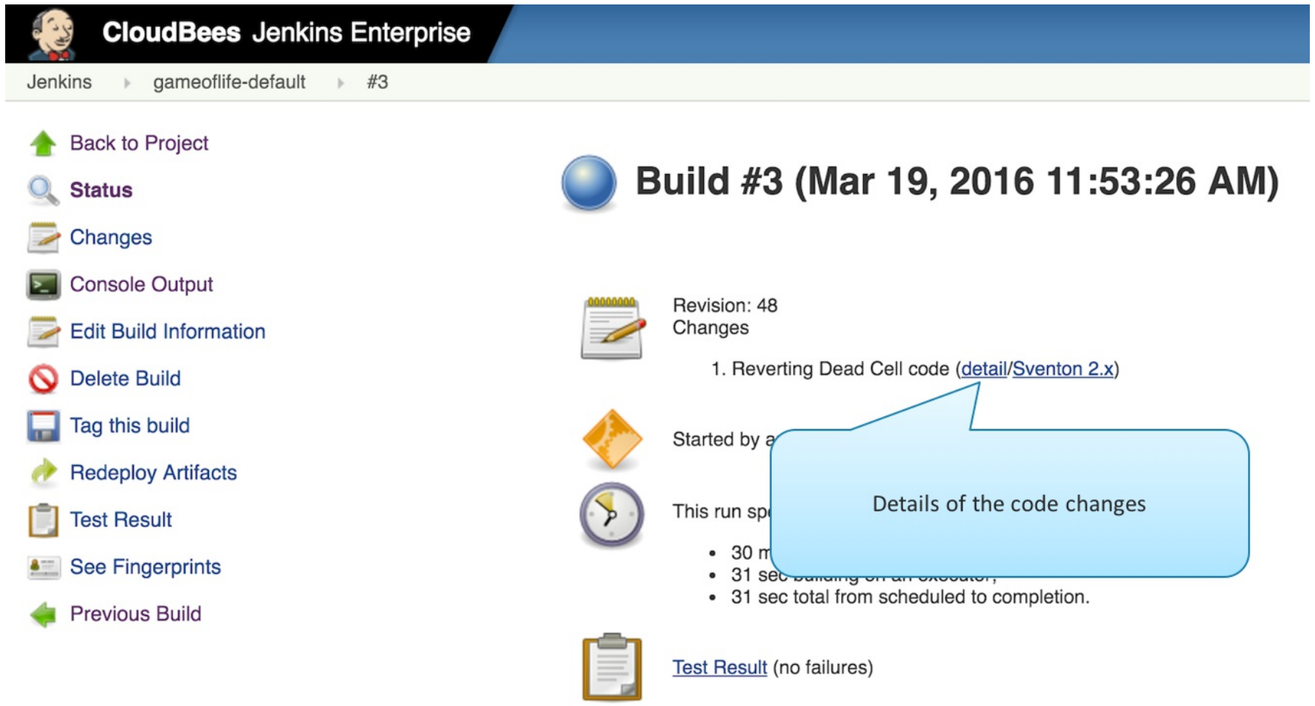
EXAMPLE USING SVENTON



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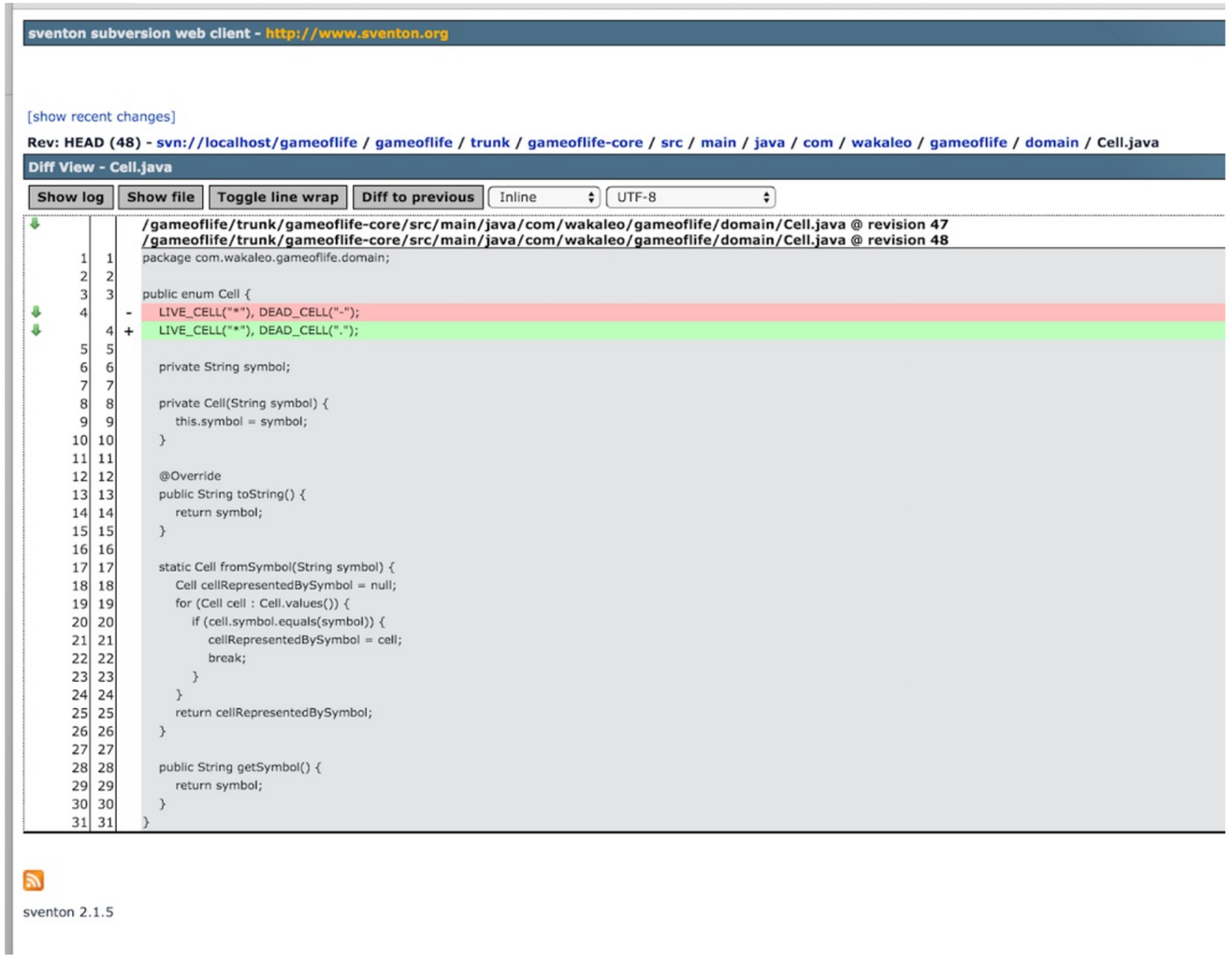
EXAMPLE USING SVENTON



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LAB EXERCISE:

Lab 5: Integrating with a SCM Browser

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CODE QUALITY METRICS

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CODE QUALITY METRICS

- Jenkins is very good at reporting on code quality metrics:
  - Static analysis (Checkstyle, FindBugs,…)
  - Code Coverage (Cobertura, Clover,…)
  - Code quality data mining(SonarQube)

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STATIC ANALYSIS

- Analyze code without running it
- Find potential bugs
- Examples:
  - Checkstyle
  - PMD
  - Findbugs
- Use the Jenkins 'Violations' plugin

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INTEGRATING CHECKSTYLE REPORTS

- Works on source code:
  - Enforce coding standards, javadoc, etc.
- Customizable rules
- Supports Ant, Maven, etc.

```
<project>
 <reporting>
    ...
    <plugin>
      <artifactId>maven-checkstyle-plugin</artifactId>
      <configuration>
        <configLocation>${basedir}/src/main/config/my-checkstyle-rules.xml</configLocation>
      </configuration>
    </plugin>
    ...
  </plugins>
 </reporting>
</project>
```

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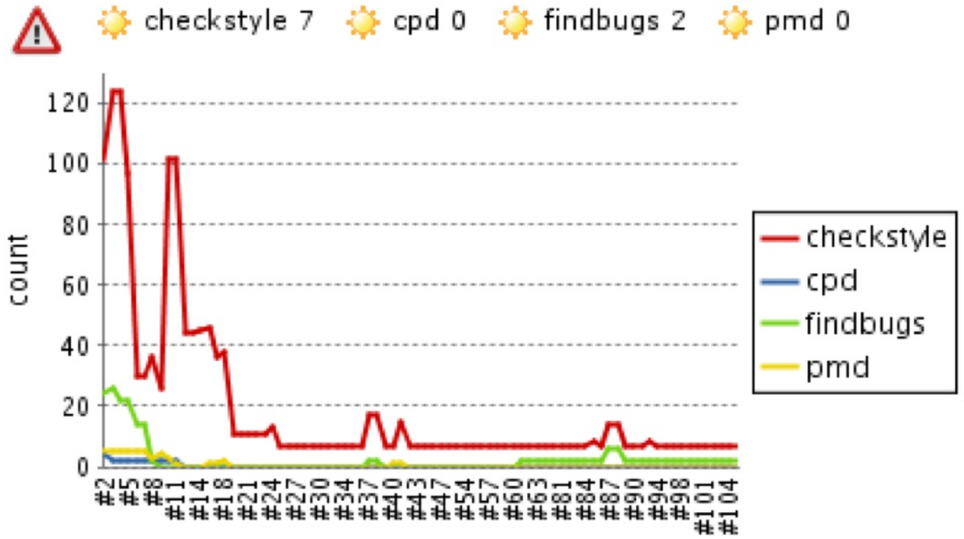
INTEGRATING CHECKSTYLE REPORTS

- Checkstyle statistics are included in the Violations graph



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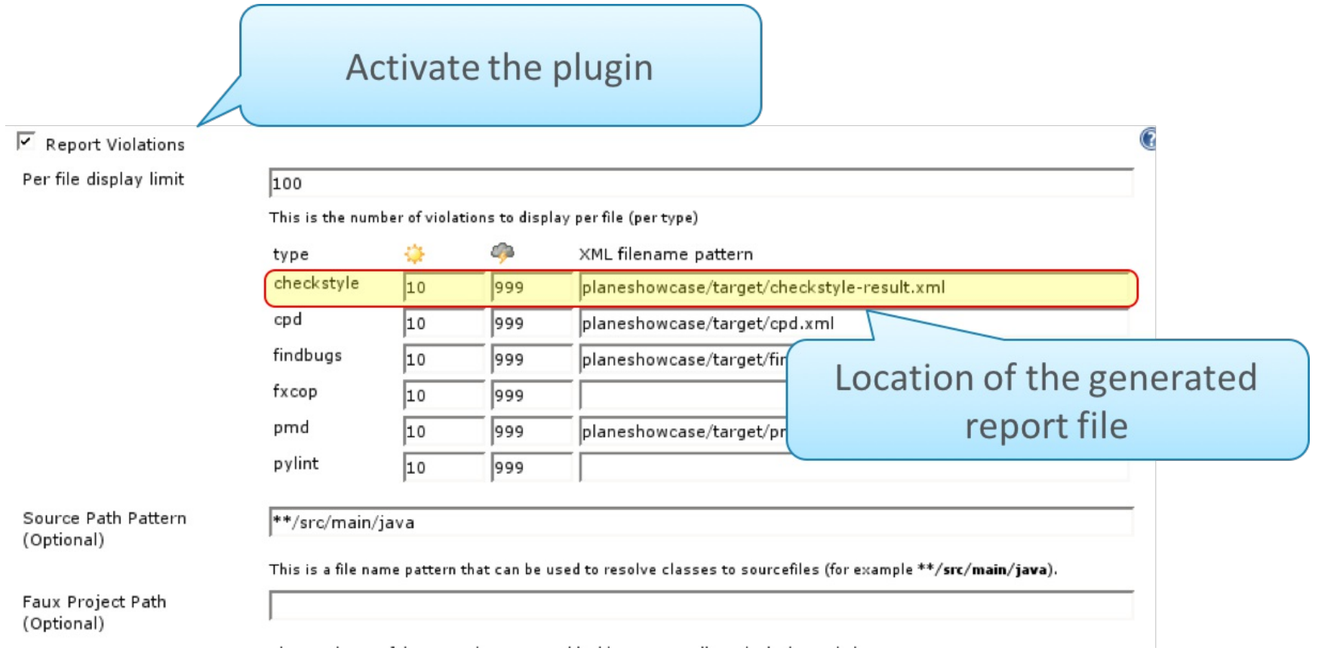
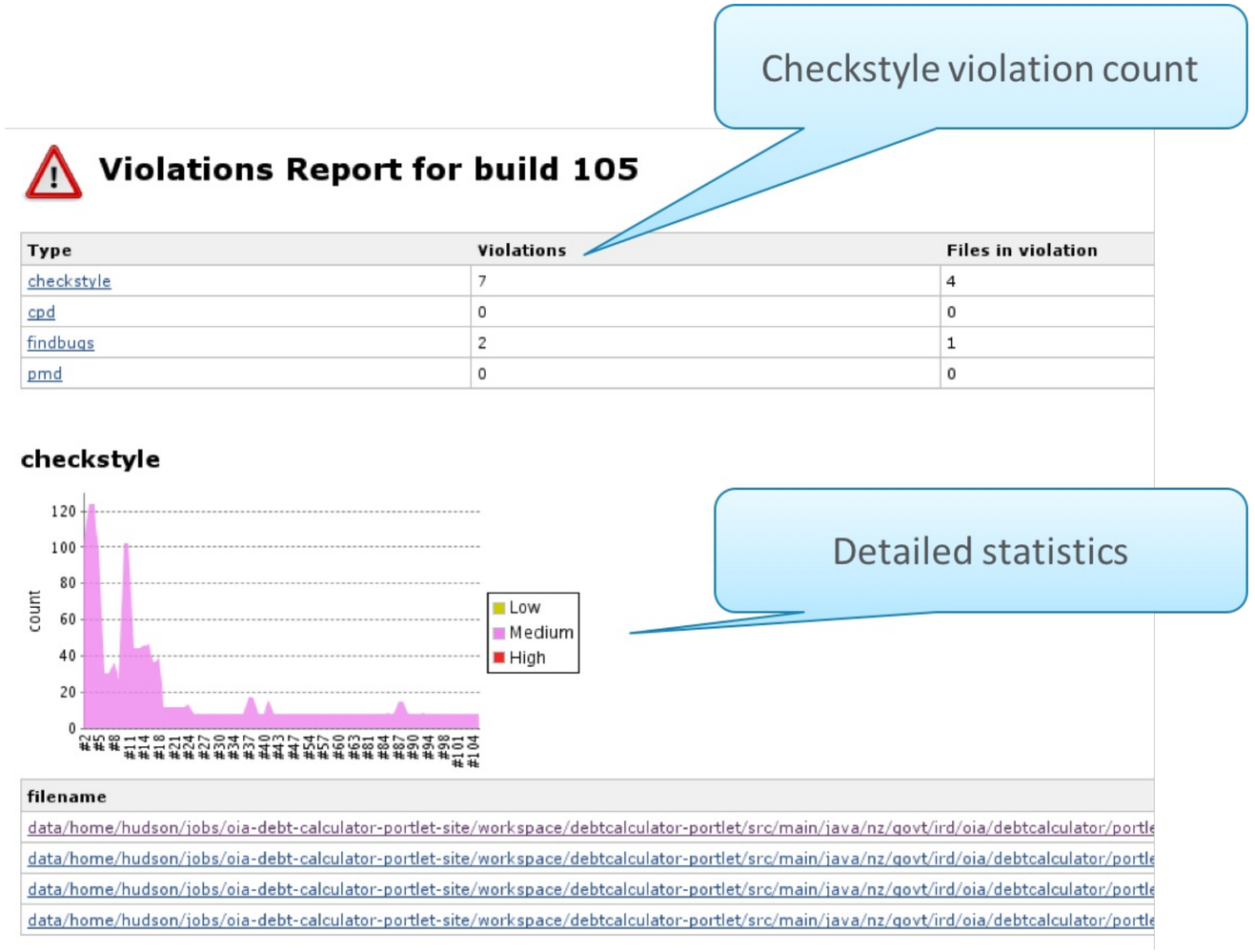
CONFIGURING CHECKSTYLE PLUGIN

- Configured as a post-build plugin



CHECKSTYLE DETAILS



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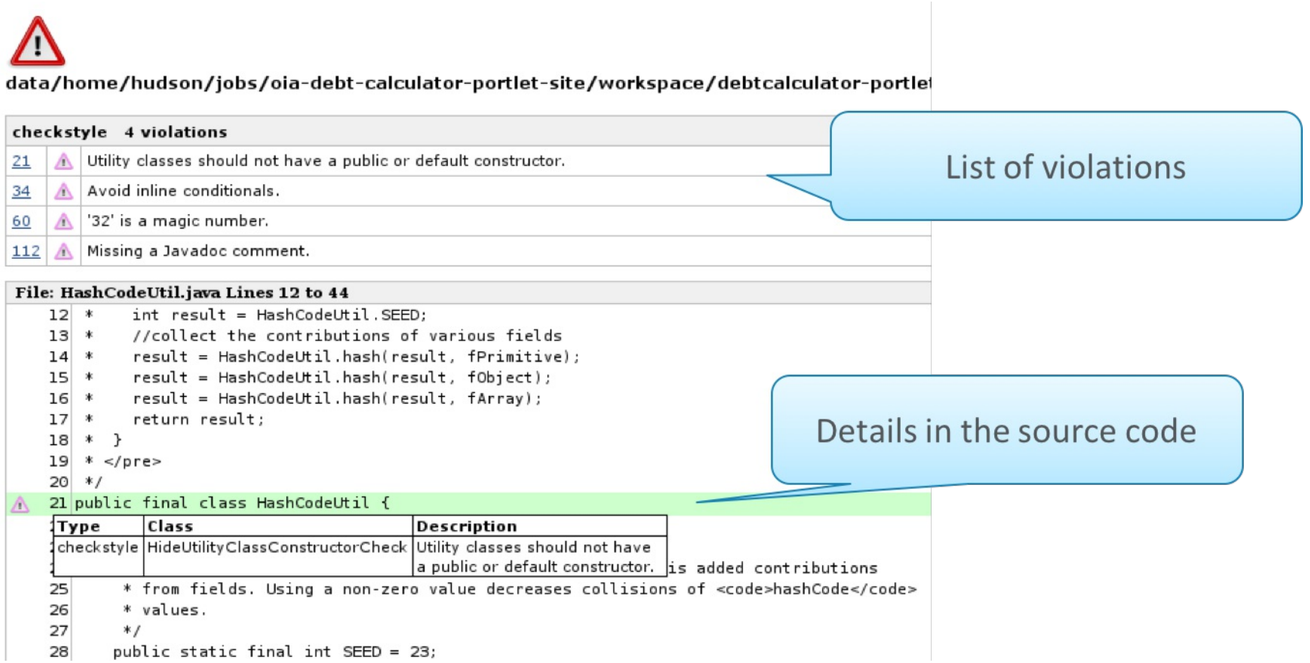
CHECKSTYLE SOURCE CODE OVERLAY

- View details for a particular class:



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VIOLATIONS PLUGIN SUPPORTS MORE

- PMD
  - Works on source code
    - Based on xpath matches from source tree.
  - Find coding problems
- CPD
  - Works on source code
  - Detects copy/paste in code
- FindBugs
  - Works on bytecode
  - Good at finding errors involving types

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LAB EXERCISE:

Lab 6: Code Quality Metrics

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CODE COVERAGE METRICS:

Dynamic Analysis

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DYNAMIC ANALYSIS

- Most commonly used code coverage
  - But there are others, like deadlock analysis
- Code coverage measures how much code is executed by your tests
- Useful in guiding unit test effort
- Jenkins integrates with several Code Coverage tools:
  - JaCoCo, Clover, Cobertura, Emma, Crap4j

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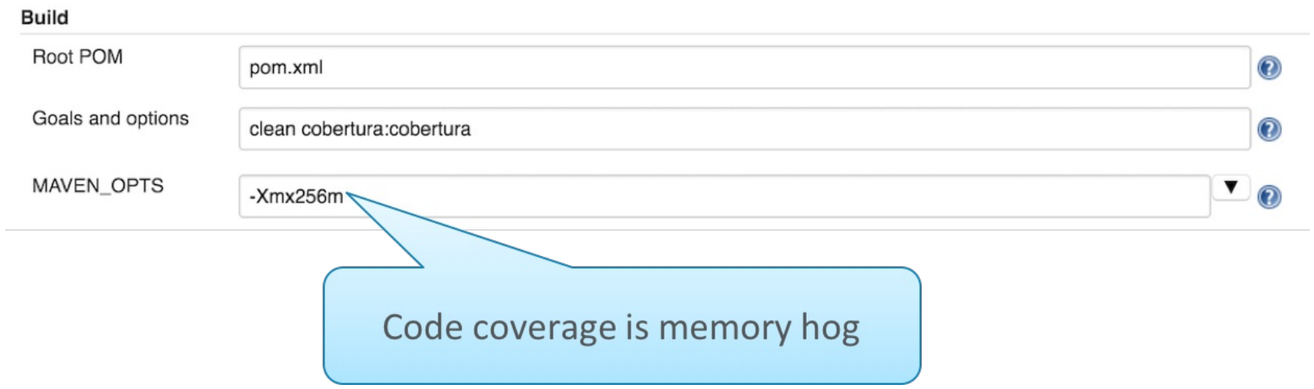
INTEGRATING WITH COBERTURA

- Configuring projects to work with Cobertura:



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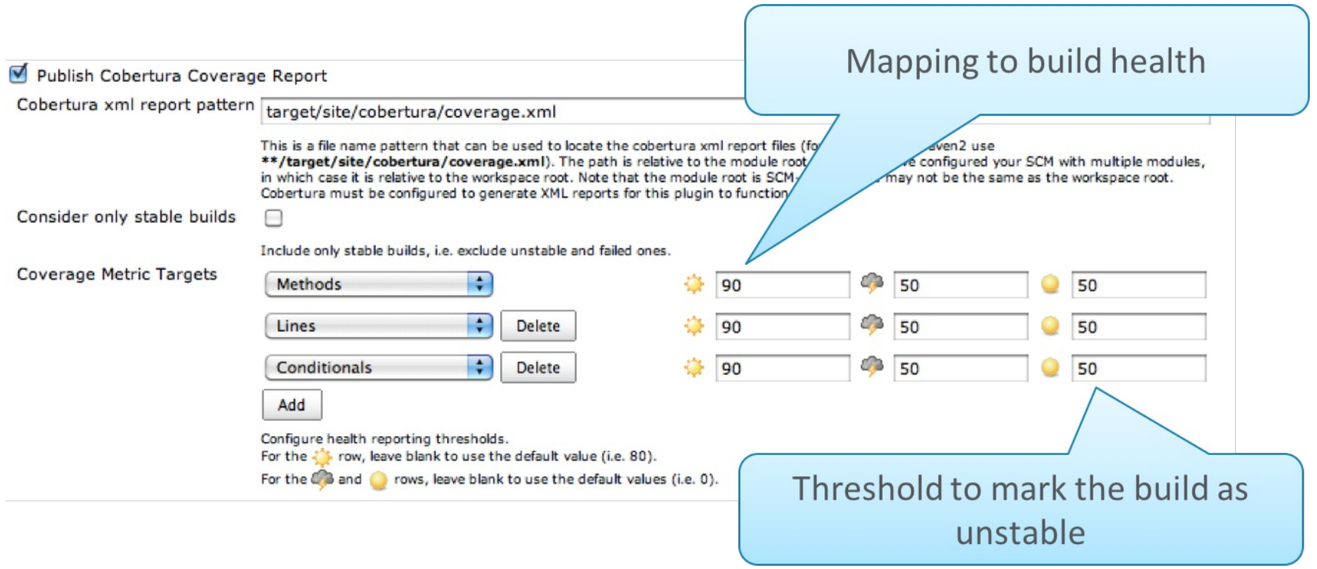
INTEGRATING WITH COBERTURA

- Configure Cobertura in the Post-build Actions:



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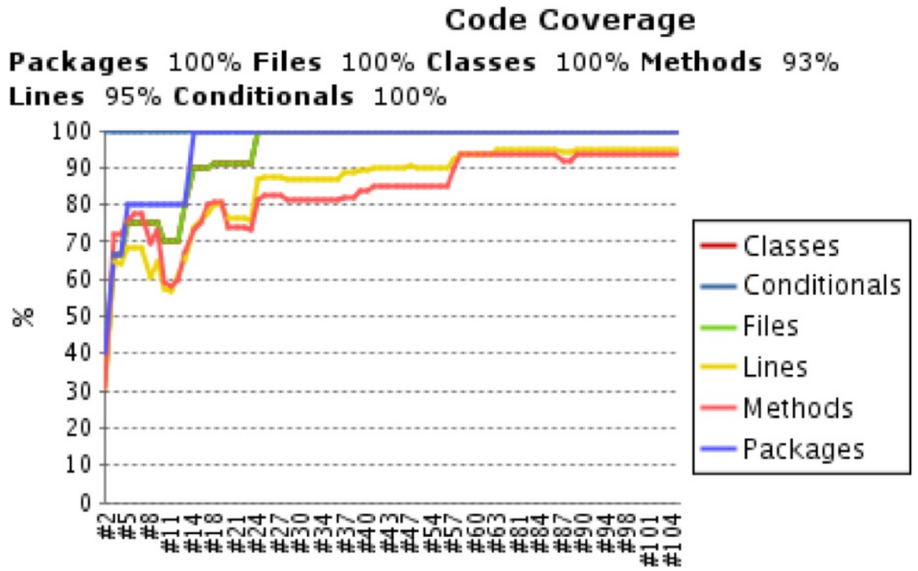
CODE COVERAGE REPORTS

- Code coverage statistics are displayed on the build results page



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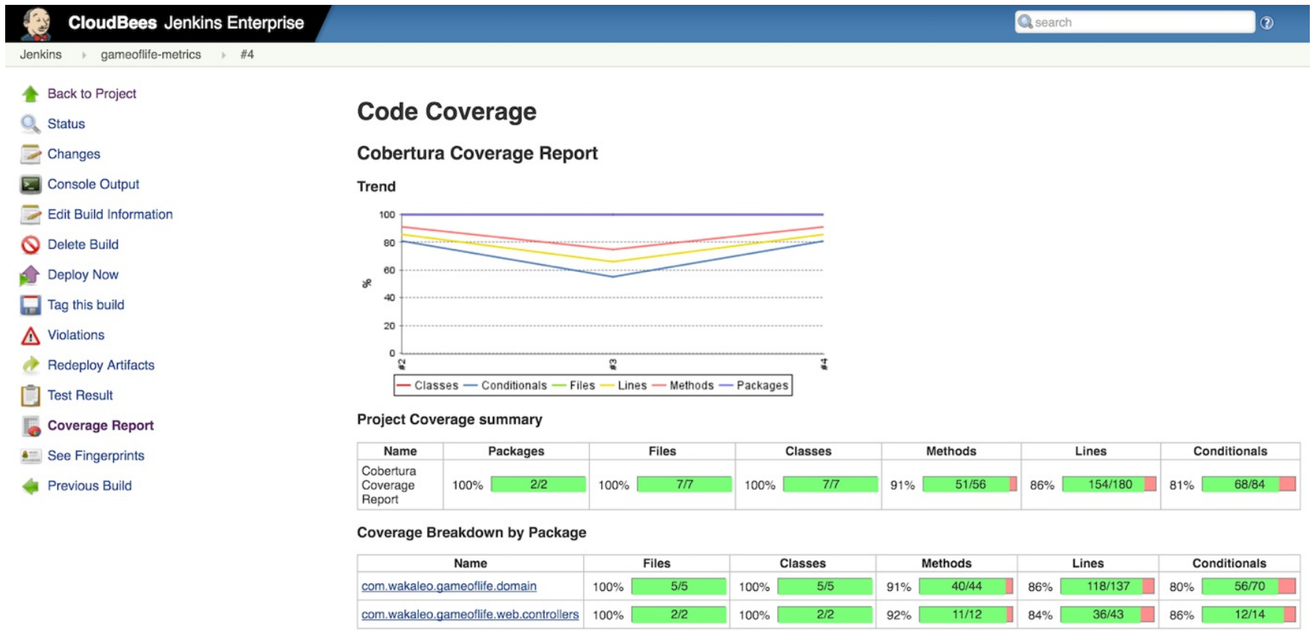
CODE COVERAGE REPORT DRILL-DOWN



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CODE COVERAGE LINE-BY-LINE REPORT

```
43      */
44     public Manifest getManifest() {
45  3      if (manifest == null) {
46  0          loadMetaInf();
47         }
48  3      return manifest;
49     }
50
51     public void setManifest(Manifest manifest) {
52  0      this.manifest = manifest;
53  0  }
54
55     public ServletContext getContext() {
56  0      return context;
57     }
58
59     public void setContext(ServletContext context) {
60  3      this.context = context;
61  3  }
62
63     /**
64      * Load the META-INF file.
65      */
66     public void loadMetaInf() {
67  3      String appServerHome = context.getRealPath("/");
68  3      File manifestFile = new File(appServerHome, "META-INF/MANIFEST.MF");
```

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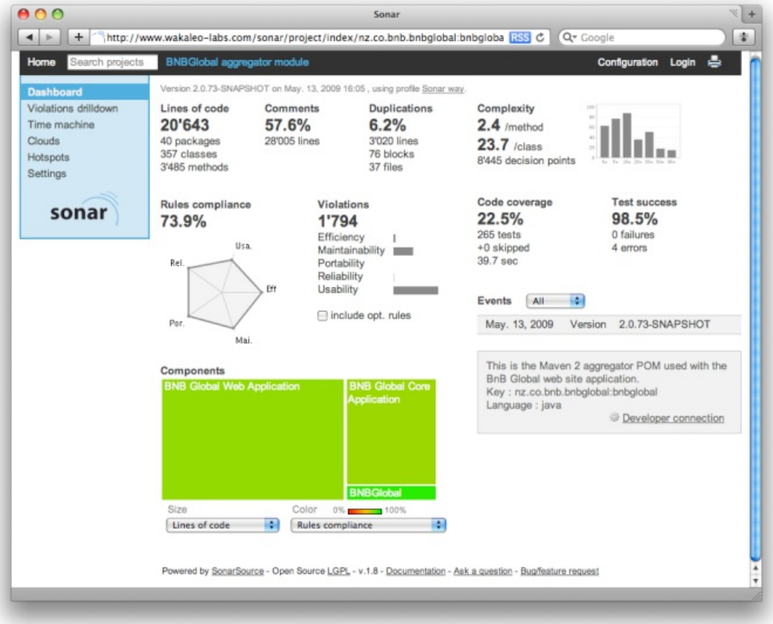
COMBINED METRICS: SONARQUBE

- SonarQube gives overview of project metrics
- Projects publish metrics data to the SonarQube database
- Jenkins is obviousplace to run them



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PUBLISHING METRICS TO SONARQUBE

Step 1

Configure the Jenkins SonarQube plugin:

Step 2

Configure SonarQube:

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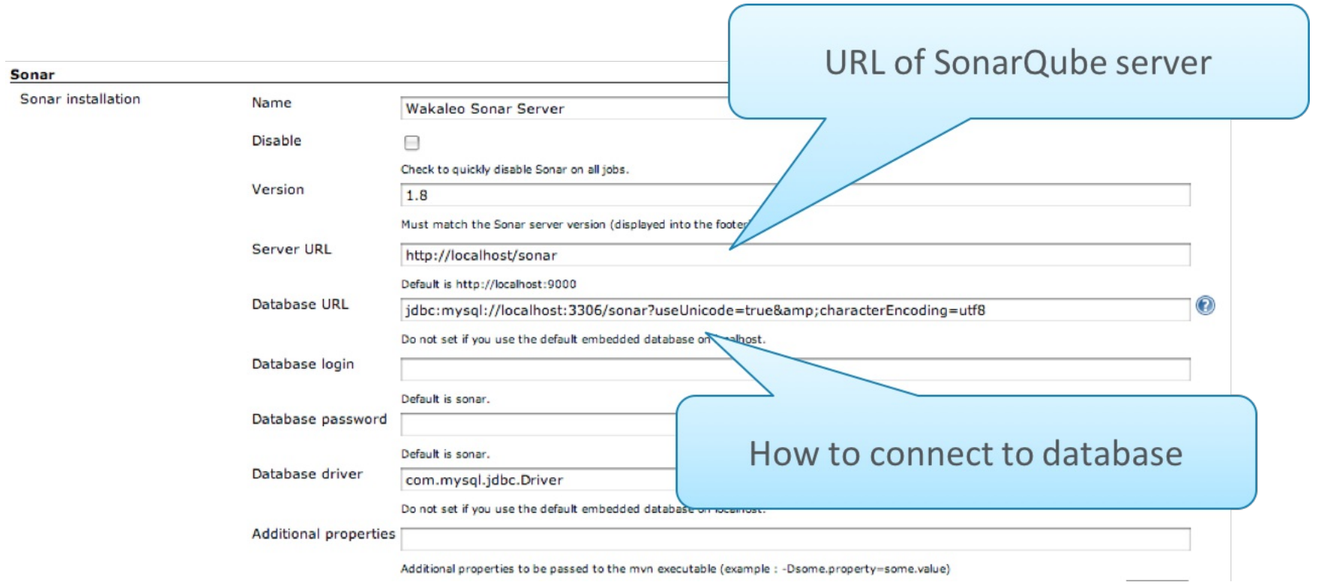
CONFIGURING SONARQUBE PLUGIN



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LAB EXERCISE:

Lab 7: Code Coverage metrics

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PARAMETERIZED BUILDS

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WHAT ARE PARAMETERIZED BUILDS?

- For the moment, jobs were no-arguments methods call

```
void doCIOfProjectGameOfLife() {...}
```

- but it is possible to add parameter to this method

```
void doCIOfProjectGameOfLife(testPlatform) {...}
```

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BENEFITS: GENERIC JOBS

- You don’t need to create a job for every platform you want to test / use
  - DRY : Do not Repeat Yourself
  - Maintenance is easier

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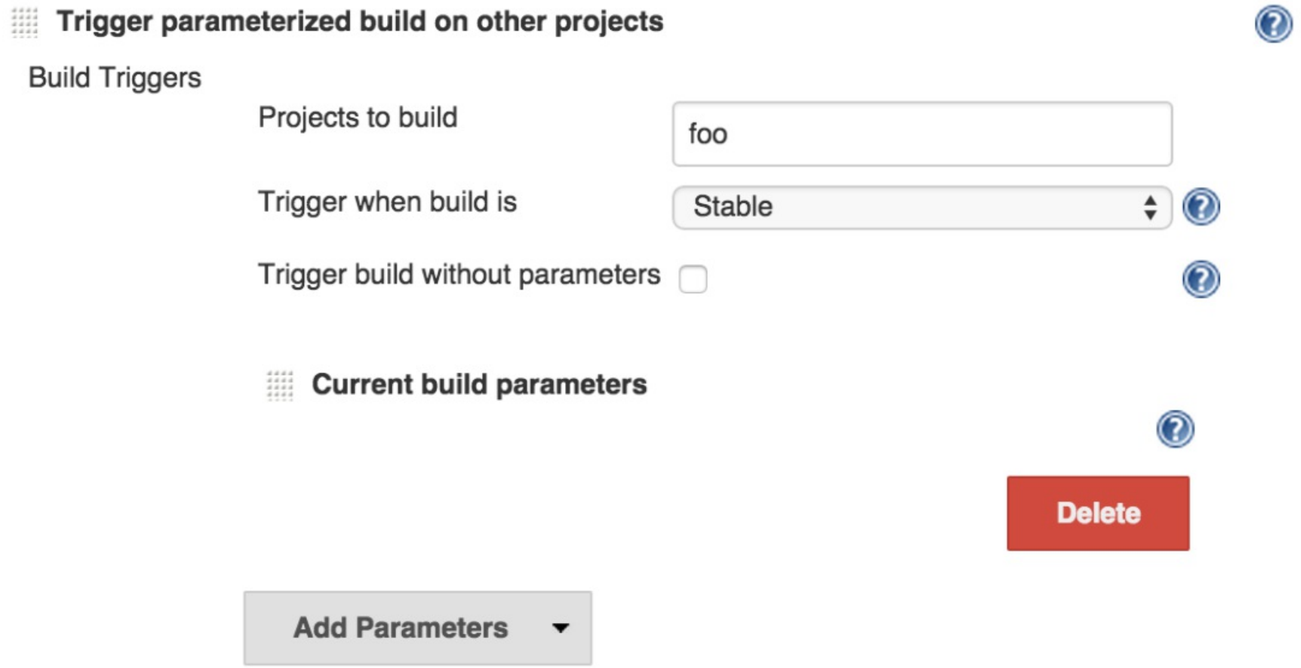
BENEFITS: CREATE A « PIPELINE »

- Using Parameterized Trigger Plugin, you can start another job with the current parameters:



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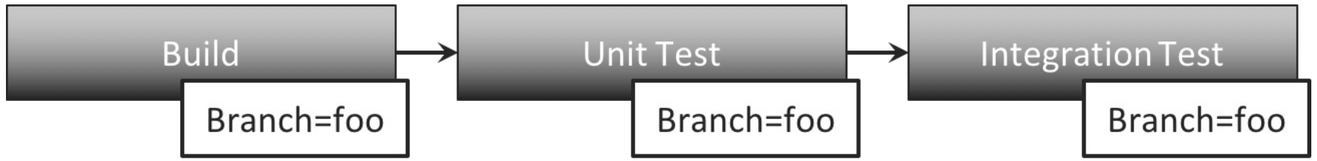
BENEFITS: CREATE A "PIPELINE"



- Pass current parameters:
- Pass SCM revision/branch/tags
  - This makes downstream builds check out the exact same revision
  - E.g., Ensure unit tests and builds are synced
- Similar feature available for all SCMs

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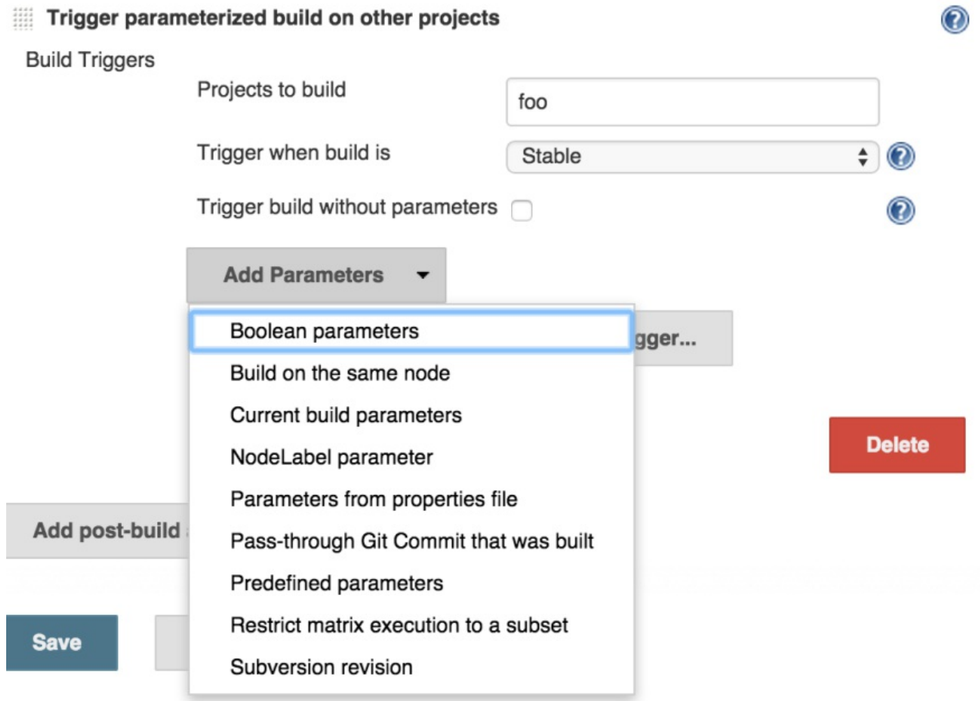
BENEFITS: CREATE A « PIPELINE »

- It's also possible to provide more or different parameters to the next job:



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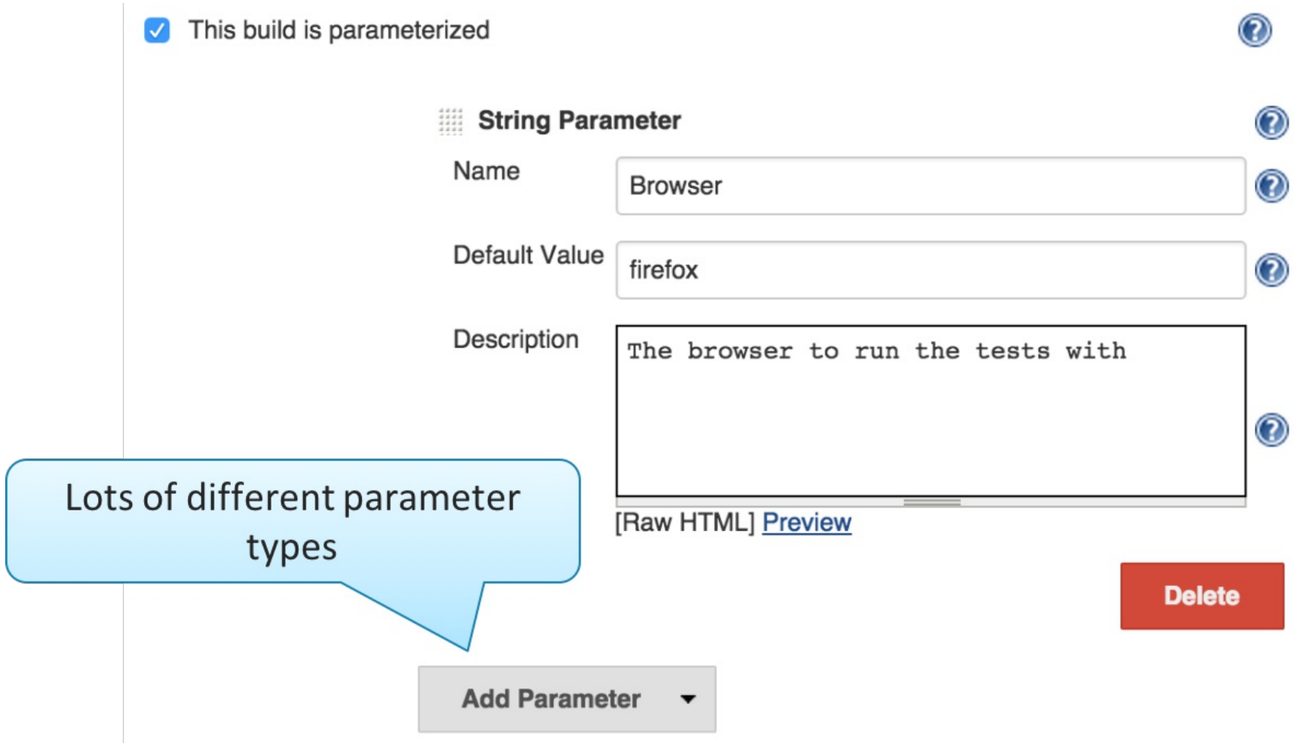
WHERE DO WE START? #1

- Define parameters



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WHERE DO WE START? #2

- Refer to parameter values
  - As variable expansions: ${Browser}
  - As environment variables from your builds
    - Watch out for cases!
  - Some parameter types expose data in different ways
    - File parameter

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WHERE DO WE START? #3

- Specify actual values when you launch a build:

- From curl/wget, use query parameter:

```
/job/foo/buildWithParameters?Browser=firefox
```

- From CLI:

```
-p Browser=firefox”
```

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LAB EXERCISE:

Lab 8: Parameterized Builds

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AUTOMATED DEPLOYMENT

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WHAT IS AUTOMATED DEPLOYMENT

- A way to deploy your application to a container:
  - Continuous Deployment
  - Manual Deployment to test servers

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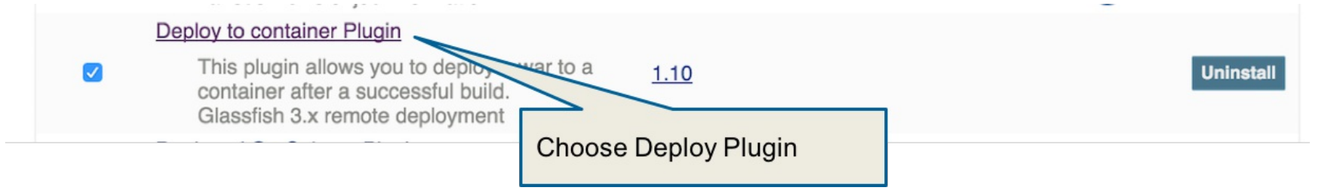
WHERE DO WE START?

- Install Deploy Plugin
  - supports several application servers (Tomcat, JBoss, GlassFish)



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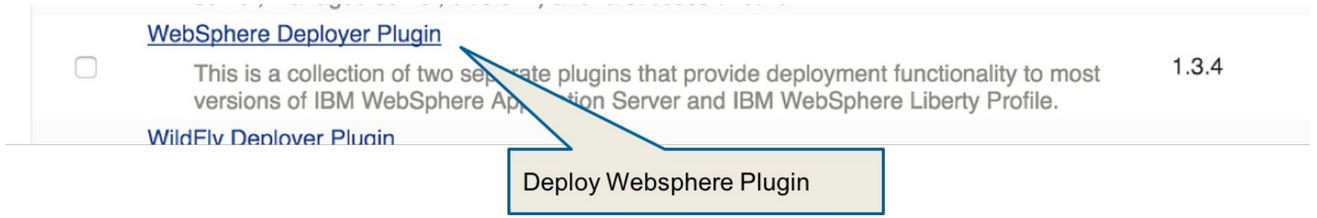
WHERE DO WE START?

- Install Deploy Plugin Additions:
  - Some additional containers available as separate plugins



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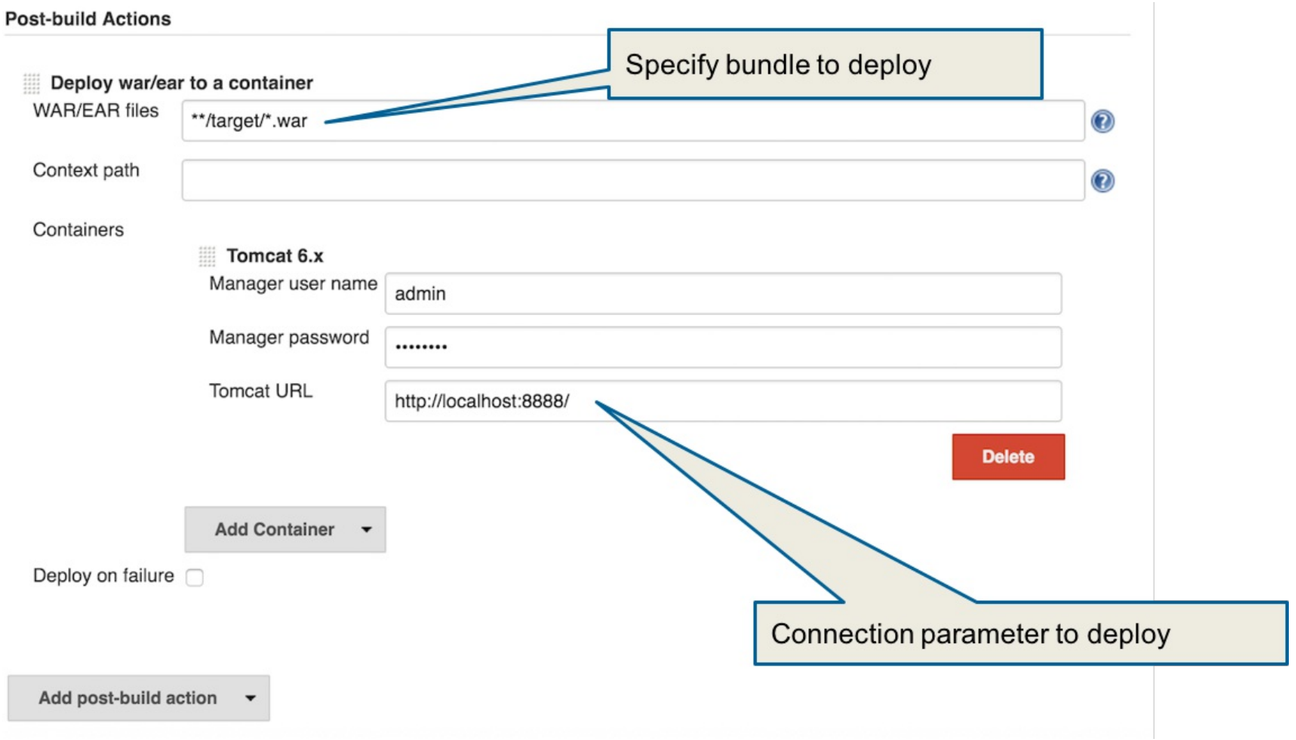
WHERE DO WE START?

- Configure the WAR or EAR to be deployed



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LAB EXERCISE:

Lab 9: Automated Deployment to Tomcat

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FOLDERS AND FOLDERS PLUS PLUGINS

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WHAT IS FOLDERS/FOLDERS PLUS?

- Just like operating system folders, unlimited nesting
  - Folder 1→Folder 2→Folder 3→…→Folder n
  - Help you model custom taxonomies
- Creates namespace
  - "build" job in Folder A is different than "build" job in Folder B
- Folders have their own views.

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BENEFITS: ISOLATION AND INHERITANCE

- When combined with the Role-Based Access Control (RBAC) plugin, Folders can have their own groups and permissions, effectively allowing teams to have their own “world” without needing their own Jenkins master
- Nested folders can inherit permissions from their parent folder, as well as templates in the parent folder.

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BENEFIT: GRANULAR CONTROL #1

- Each folder supports groups and roles configured on a particular folder.
- Permissions from root be inherited (default), but can also be excluded by filtering out all filterable root-level groups.
- Folders can limit what types of objects can be created in the folder.

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BENEFIT: GRANULAR CONTROL #2

- Folders allow for arbitrary key-value pairs to be set as environment variables.
  - Can be referenced from builds within folder
  - E.g.: $BRANCH_NAME or $DEPLOY_URL
- "Folders Plus" supports linking agents to specific folders, such that agents will only run that folders' builds.

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BENEFITS: EASY BRANCHING

- When a branch of an existing project needs its own pipeline, the folder with the parent project's pipeline can simply be copied
  - Local references within the branch are kept intact
- Folders can also have environment variables for arbitrary key-value pairs, which jobs can reference
  - E.g.: $BRANCH_NAME or $DEPLOY_URL

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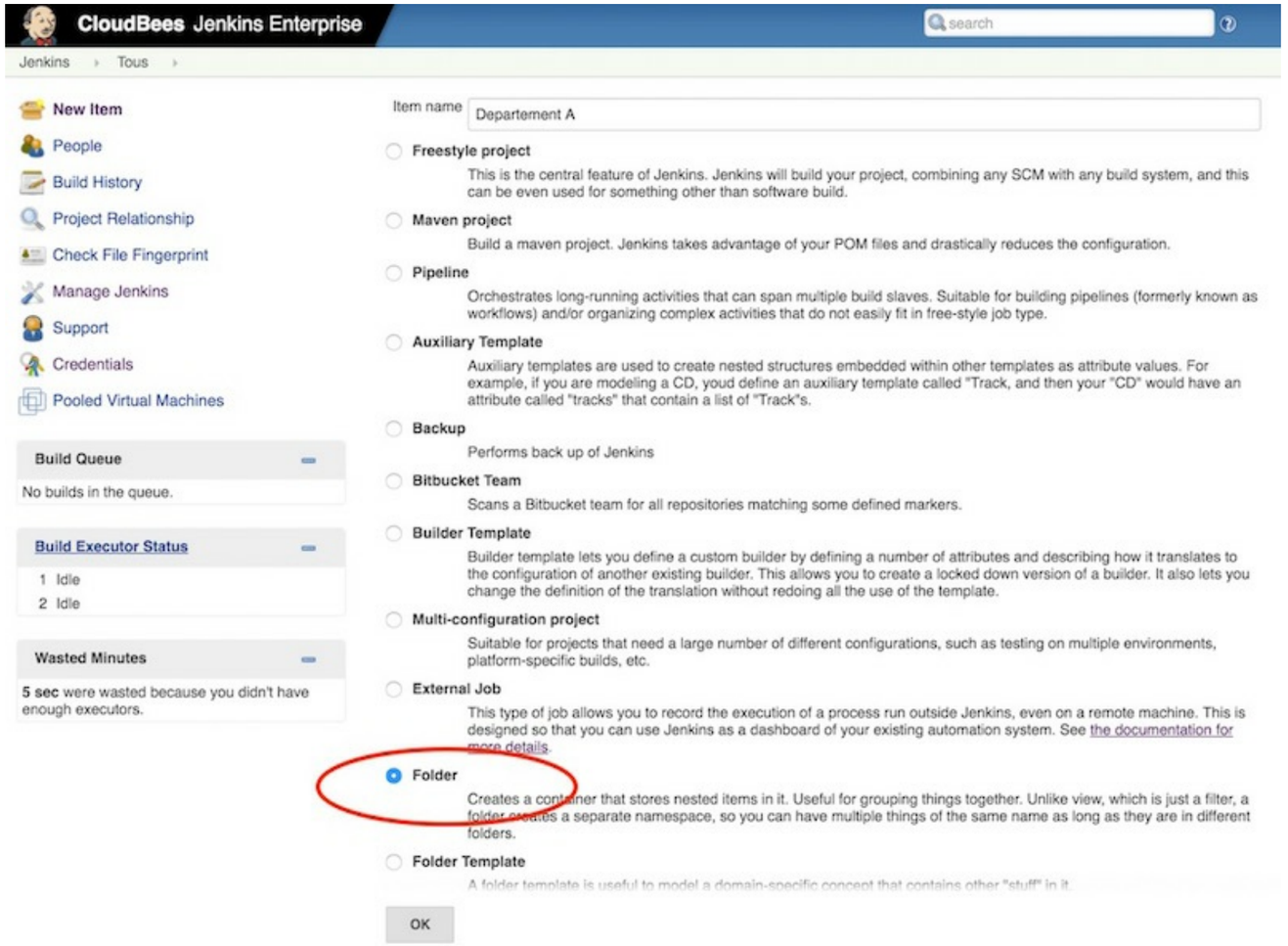
WHERE DO WE START? #1



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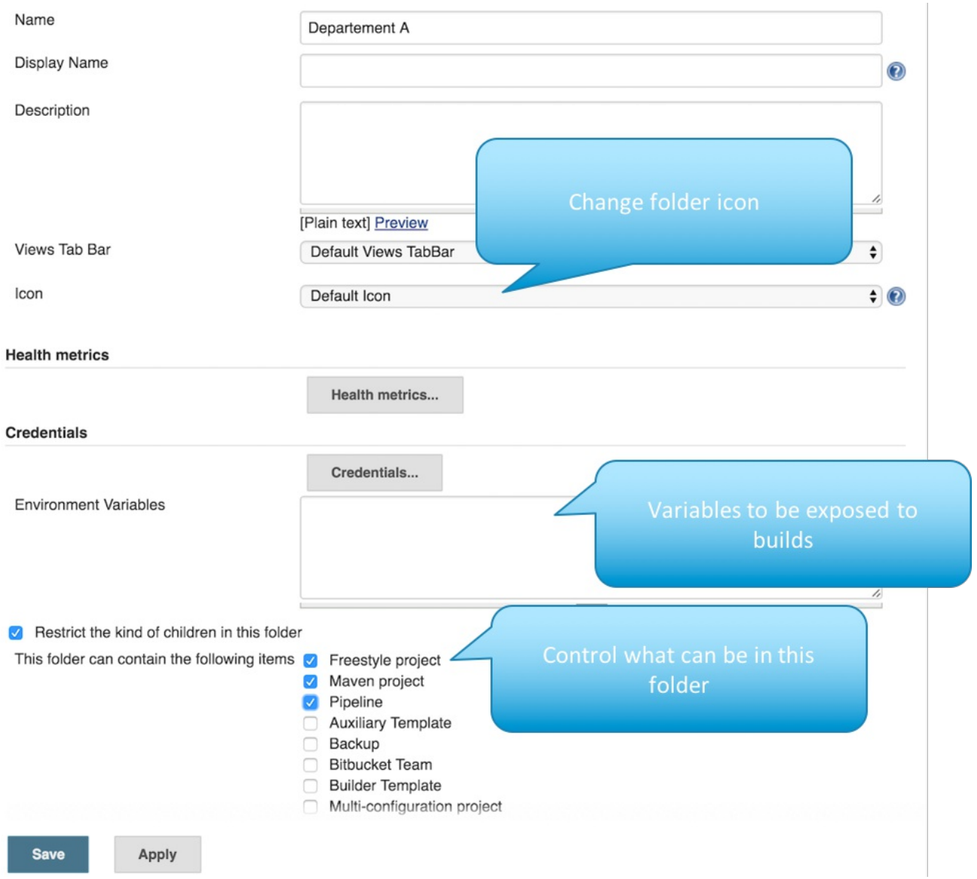
WHERE DO WE START? #2



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SECURITY & ROLES BASE ACCESS CONTROL (RBAC)

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ENABLING SECURITY

Jenkins can integrate its security to a lot of existing assets:

- Active Directory
- Delegate to servlet container
- Google Apps SSO (with OpenID)
- Jenkins' own user database
- LDAP
- OpenID SSO
- Operations Center Single Sign On
- Unix user/group database

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PER-PROJECT ACCESS CONTROL

- If your Jenkins installation hosts sensitive projects that must be visible to a restricted set of people, define permissions at the individual project level so that different people have access to different sets of projects.
- Or if you just want to have a single set of access rights across all your projects, Jenkins can be configured that way, too.

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WHAT IS RBAC?

- Role-based access control can be configured as an authorization policy.
- RBAC comes as a CJE plugin.
- RBAC allows:
  - Creation of re-usable global and object-only roles.
  - Role define very granular permissions on all Jenkins objects (projects, view, folders, etc.)

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HOW DO I USE RBAC?

- Roles that are created must be mapped to groups defined in Jenkins:
  - These groups can be "shadow" groups for external groups in LDAP/AD
- Groups/roles can be defined on different objects in Jenkins:
  - Jobs
  - Maven modules
  - Agents
  - Views
  - Folders

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BENEFITS: GRANULARITY

- CJE RBAC supports very granular permissions for roles.
  - E.g. "Browse" role only has overall read permissions while "QA" role supports read/write/execute permissions on jobs only in a given folder.
- Roles and groups can be combined with folders and other Jenkins objects to limit users' permissions within those objects.
  - E.g. A team-only project folder containing all jobs in a pipeline, along with a job that is hidden from anyone not in the "QA Team" group.

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WHERE DO WE START?

- Ensure security is turned on and a valid security realm has been selected.
- Opt to use "role-based matrix authorization strategy" to enable CloudBees RBAC plugin to your authorization policy.
- Create groups and roles on jour CJE master configuration:
  - Assign roles to these groups
  - Add users to groups

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LAB EXERCISE:

Lab 10: Job Organization and Security with Folders

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VALIDATED MERGE PLUGIN

aka the “Unbreakable Build”

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WHAT IS THE VALIDATED MERGE PLUGIN?

- How can you delegate more to Jenkins?
- Does your CI server shift work from laptops to servers?
  - Not if you have to share the changes to test: You end up testing locally before committing => FAIL
- OK, let's test it before sharing changes
  - By taking advantages of Git

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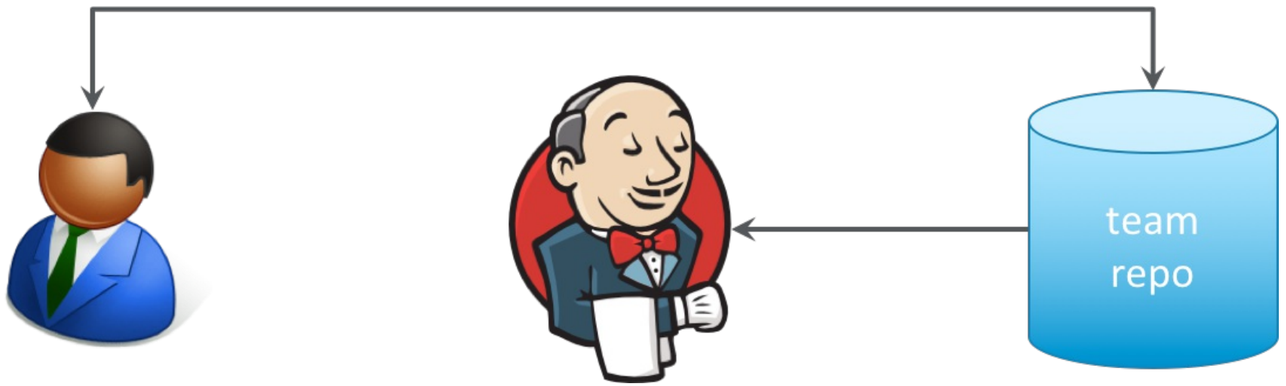
WHAT IS THE VALIDATED MERGE PLUGIN?

- Model before validated merge:
  - You push to team repo, then test



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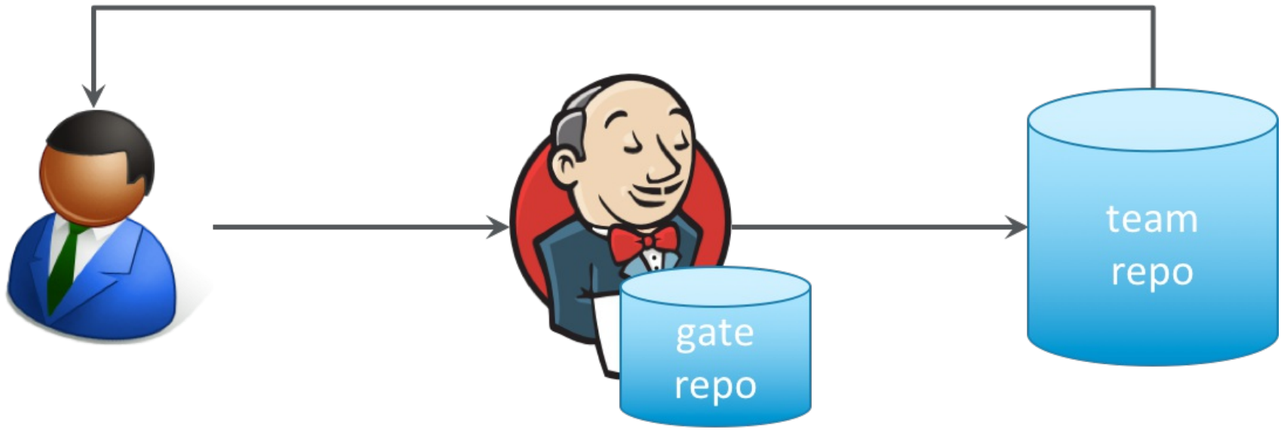
WHAT IS THE VALIDATED MERGE PLUGIN?

- Model with Validated Merge:
  - Jenkins becomes git repo
  - You push to Jenkins
  - Jenkins tests, then push to team repo



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BENEFITS: NO BROKEN BUILDS

- A mistake will not block others
- Only push after changes are validated
- It is the Unbreakable Build pattern

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BENEFITS: TESTS ASYNCHRONOUSLY

Make

change and move on

Let

Jenkins follow through

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BENEFITS: TESTS ON THE SERVER

Your laptop has more important things to do Highly concurrent, environment-dependent test executions

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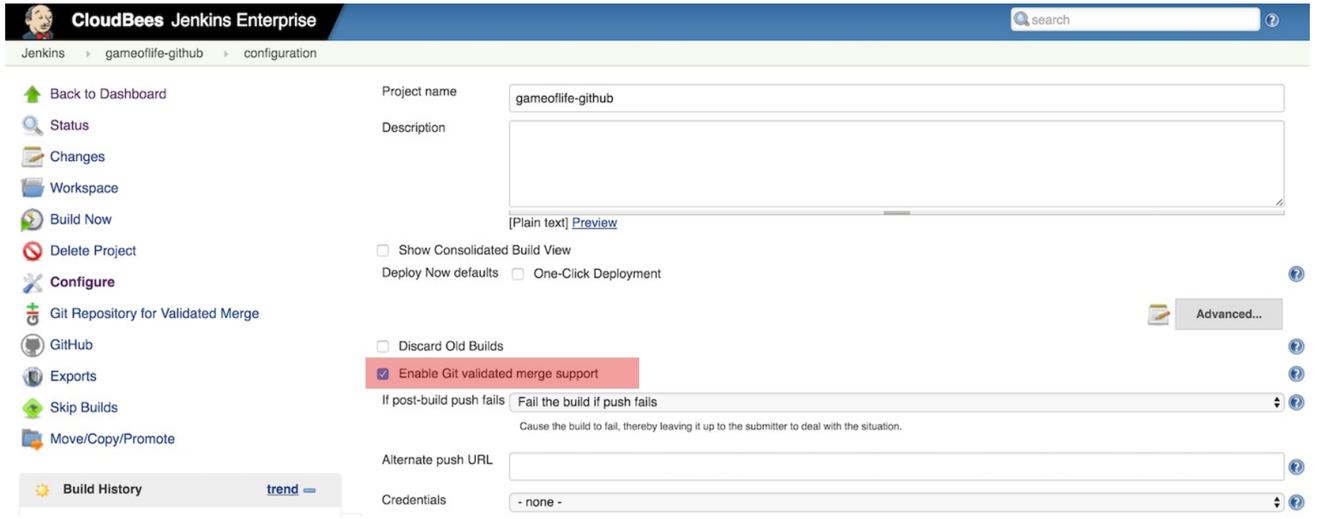
WHERE DO WE START?

- To enable, just one checkbox:



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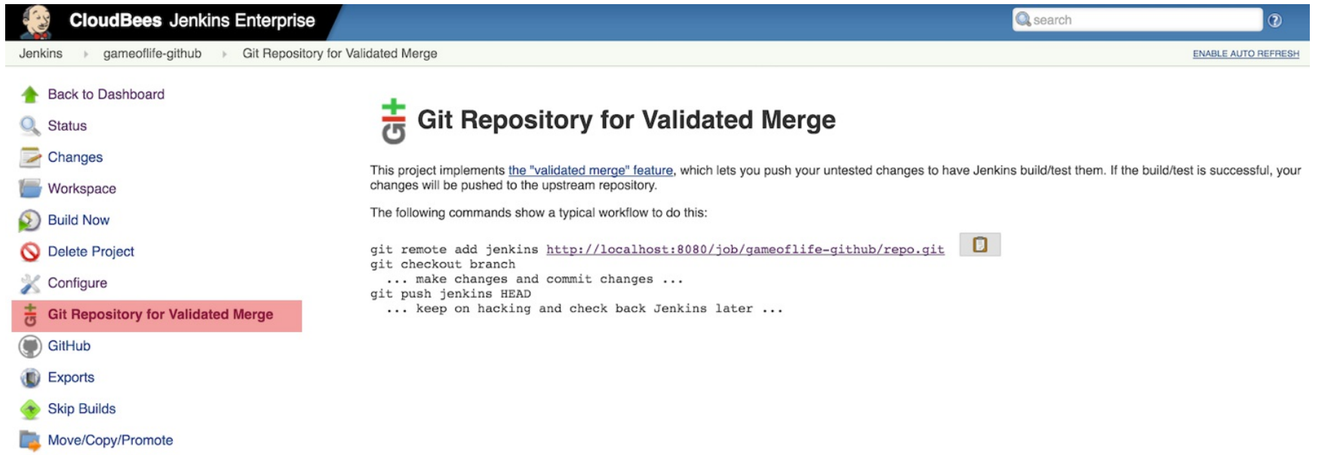
WHERE DO WE START?

- Git access coordinate from project page:



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WHERE DO WE START?

- Two protocols supported:
  - SSH
    - See system config to fix the port number for production use
  - HTTP
    - The same URL as the “Git repository” page in Jenkins Awkward to handle authentication

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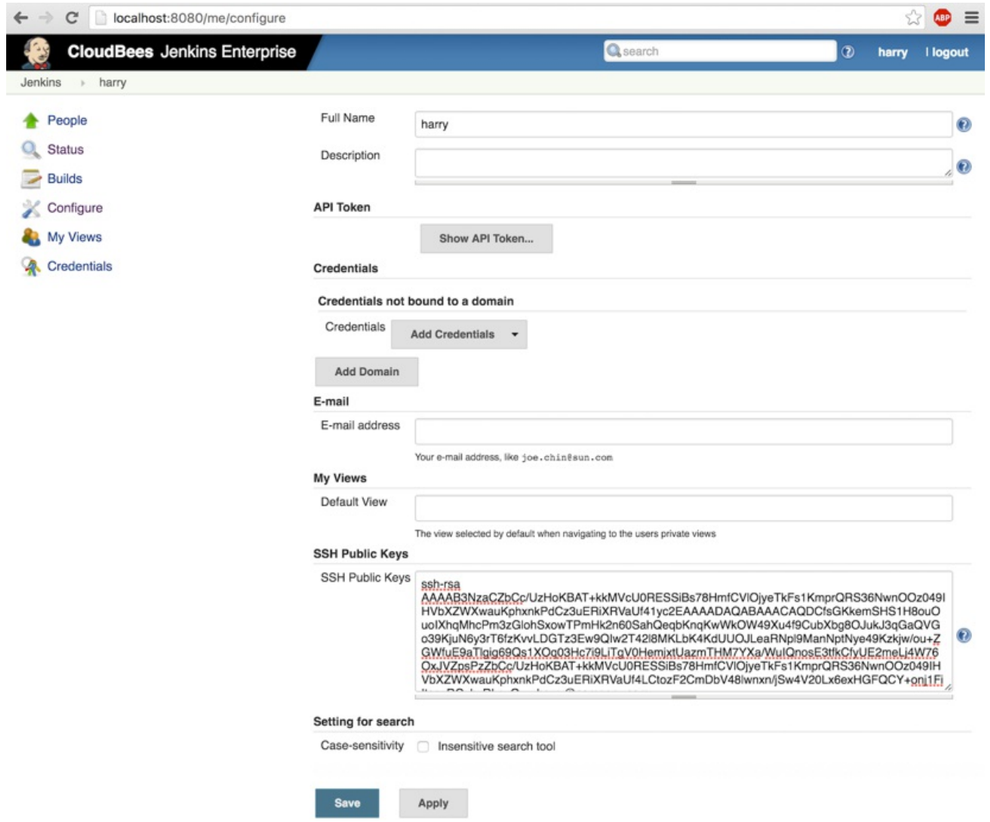
WHERE DO WE START?

Developer Workflow

Register SSH public key : http://<JENKINS_URL>/me/configure



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WHERE DO WE START?

Developer Workflow

- Adds Jenkins as a new git remote repository

```
$ git remote add jenkins ssh://server:port/JOBNAME/
```

- Get changes from team repo

```
$ git pull origin mybranch
```

- Hack

```
$ vi .
$ git commit
```

- Push to the « Jenkins » remote instead of team one

```
$ git push jenkins mybranch
```

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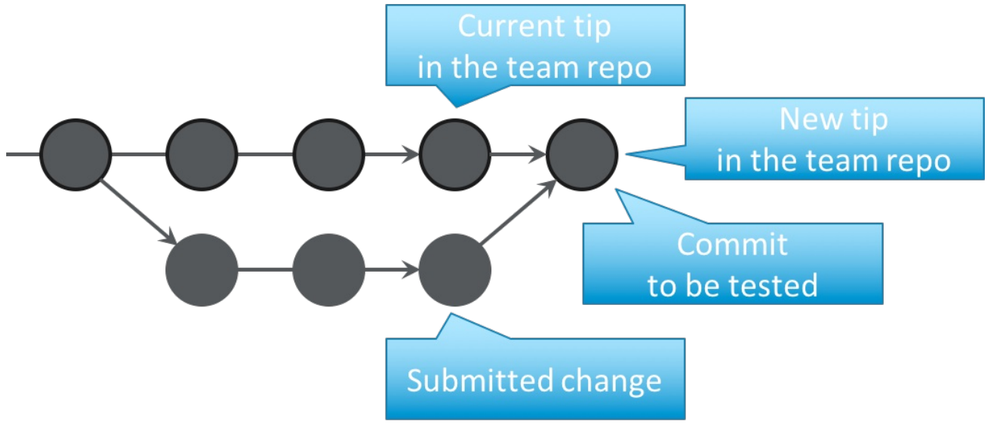
WHERE DO WE START?

- Pre-build merge behavior
  - Jenkins needs to test what becomes the new tip:



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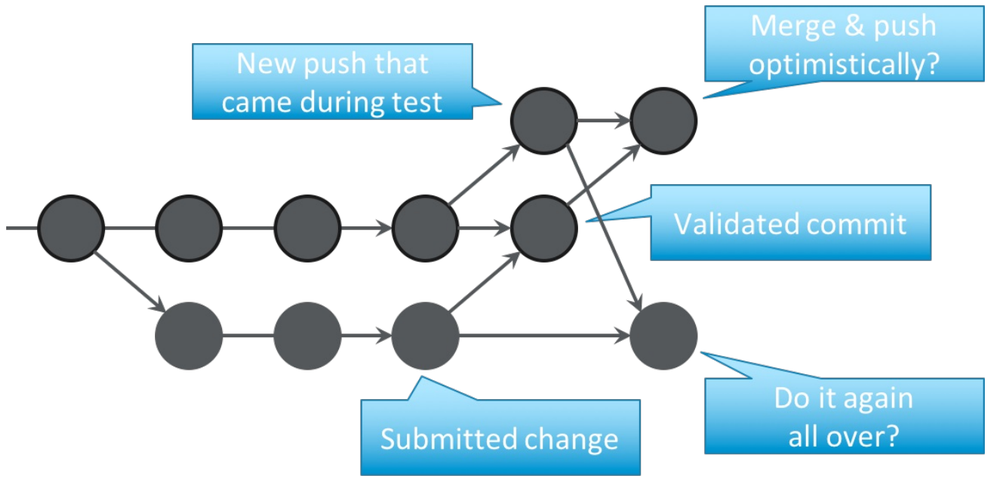
WHERE DO WE START?

- Post-build merge behavior
  - What if new push is made to the team repo?



Or fail and leave it to the developer to resolve

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ALTERNATIVES: GERRIT

- Gerrit is a code review tool
- Gerrit trigger plugin for Jenkins:
  - Jenkins acts as a code reviewer (review===test)
- Works great if you want code review
- Problems:
  - Gerrit needs to own the repository
  - More client side changes required

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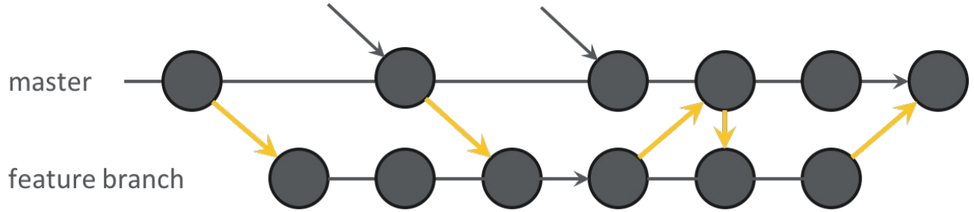
ALTERNATIVES: SUBVERSION?

- Yes! Svnmerge plugin to the rescue
  - It's not Git, but Subversion has improved
- You commit to branches
- Jenkins will merge and commit to upstream



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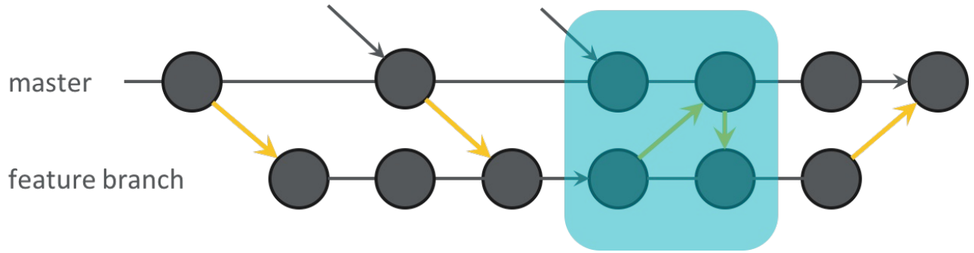
CAVEAT

- Push and rebase need to happen in one go:



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LAB EXERCISE:

Lab 11: Validated Merge

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PULL-REQUEST BUILDER FOR GITHUB

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WHAT IS PULL-REQUEST BUILDER FOR GITHUB

The Pull-Request Builder for GitHub plugin let you configure Jenkins to verify pull-request on a GitHub project and check the proposed changes validates Continuous Integration criteria set on your Jenkins instance.

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BENEFITS: EFFICIENCY

The GitHub Pull Requester Plugin can:

- automatically run unit/integration tests.
- merge the pull request upstream if it passes the unit/integration tests

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WHERE DO WE START?

- Download and install the GitHub Pull Request Builder Plugin.
- Configure the Plugin, add users to the Admin, and White List

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PIPELINE

Formerly known as Workflow

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WHAT IS A « JENKINS WORKFLOW »

CD is about setting a “pipeline”, from SCM commit to deployed application

Jenkins can chain jobs this way, but …

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JENKINS CD PIPELINE

a real world CD pipeline is way more complex !

- requires (complex) conditional logic
- requires resources allocation and cleanup
- involves human interaction for manual approval
- should be resumable at some point on failure

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JENKINS CD PIPELINE

- many related plugins
  - conditional build steps
  - parameterized trigger
  - promotions
  - …
- Major issue : pipeline configuration is scattered in various jobs

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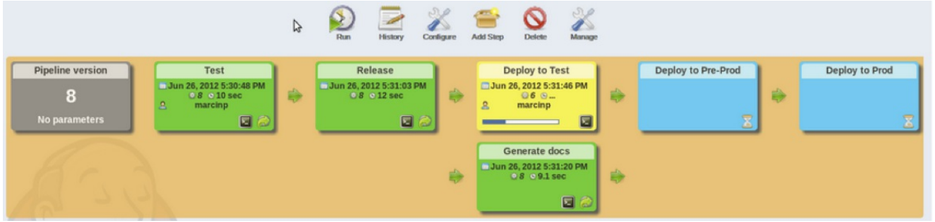
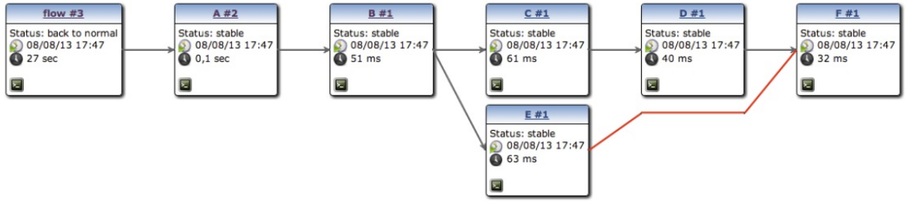
CD PIPELINE VISUALIZATION

- pipeline plugin to render “linear” pipeline



- build-graph-view to render complex ones



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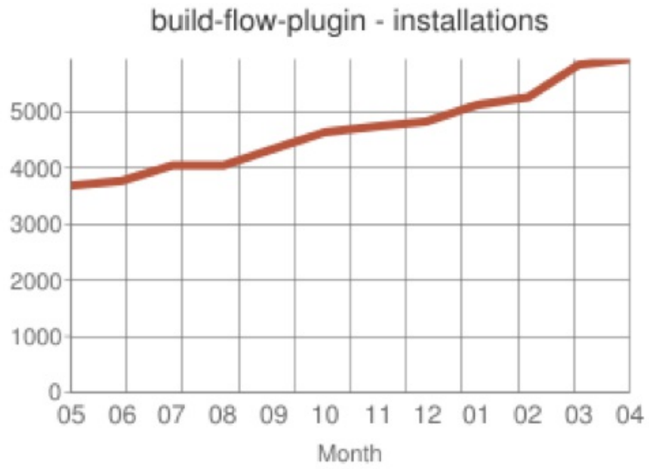
BUILD-FLOW PLUGIN

- OSS, considered a proof of concept



- define CD pipeline as (possibly complex) job orchestration written with a Groovy DSL
- largely adopted
  - demonstrates direction is correct
- But major technical limitations

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CLOUDBEES PIPELINE PLUGIN

- inspired by build-flow
- Groovy DSL to orchestrate build steps (optionally jobs)
- extensible DSL syntax
- do supports savepoints
- advanced visualization
- plain text : Can be stored in SCM

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GROOVY DSL ?

Groovy based “Domain Specific Language” to manage build step orchestration

- Groovy is widely used in Jenkins ecosystem. You can leverage on Groovy experience
- If you don’t like/care about Groovy, just consider the DSL as a dedicated simple syntax

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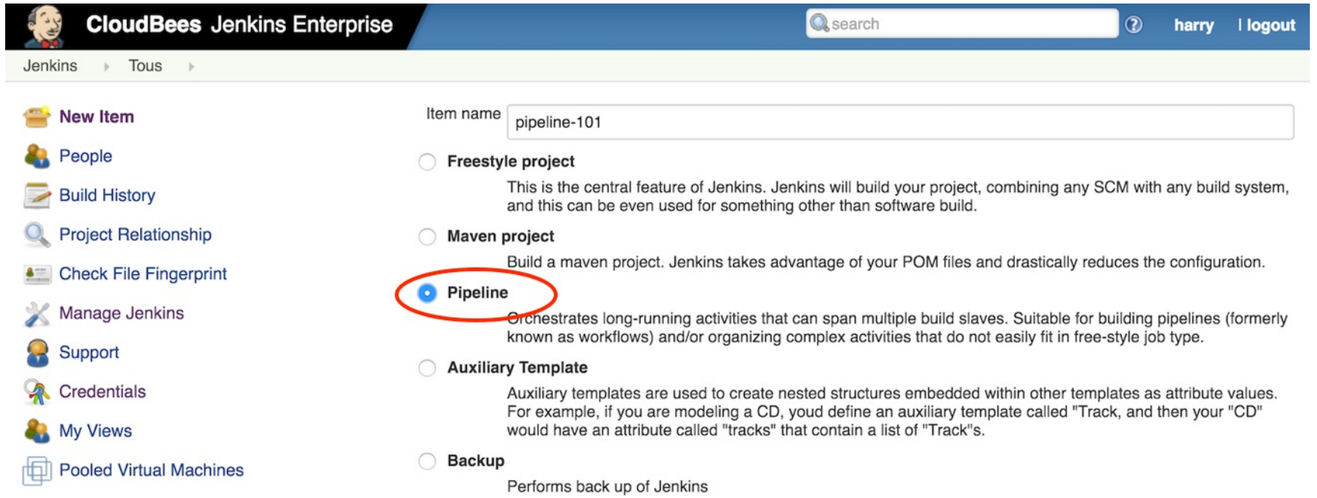
PIPELINE 101

- A Pipeline is a new type of job:



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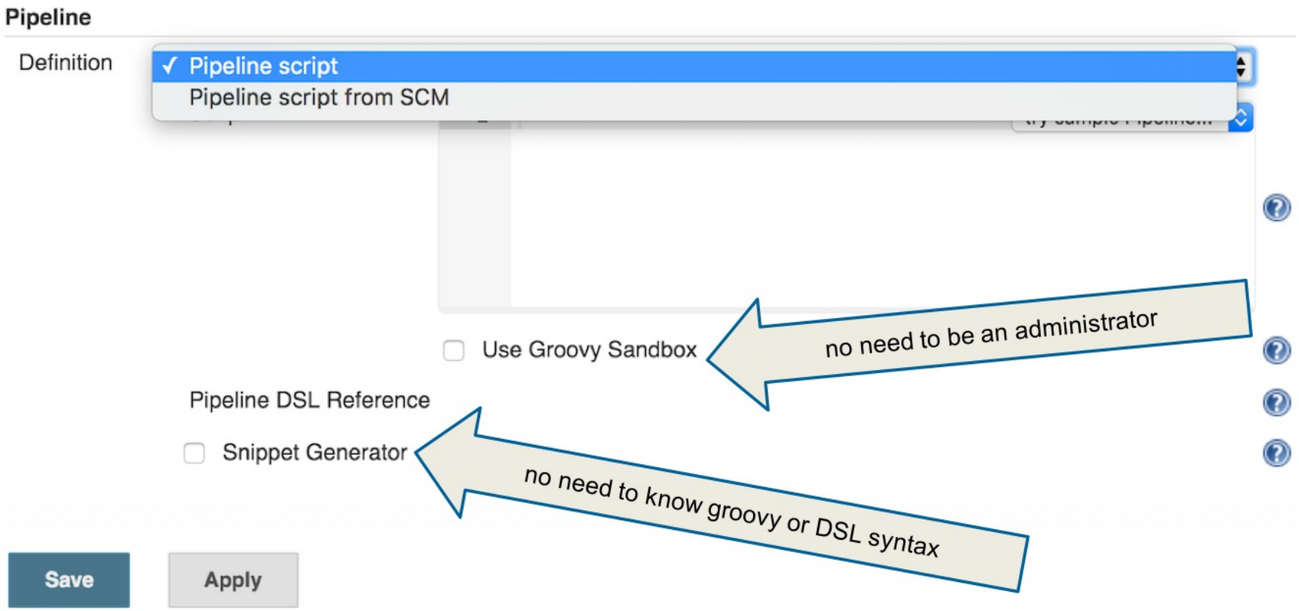
PIPELINE 101

Can define DSL in Jenkins, or store in SCM
= > possibly distinct pipeline per branch



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PIPELINE 101 - BASIC DSL SYNTAX

- DSL is used to define when/how to run build steps
- Those (most of them) will run on a node, i.e. a build executor
- Example with sh:

```
node('linux') { // run on node that are labelled as "linux"
  sh 'echo hello world' // a DSL keyword to run a shell script build step:
}
```

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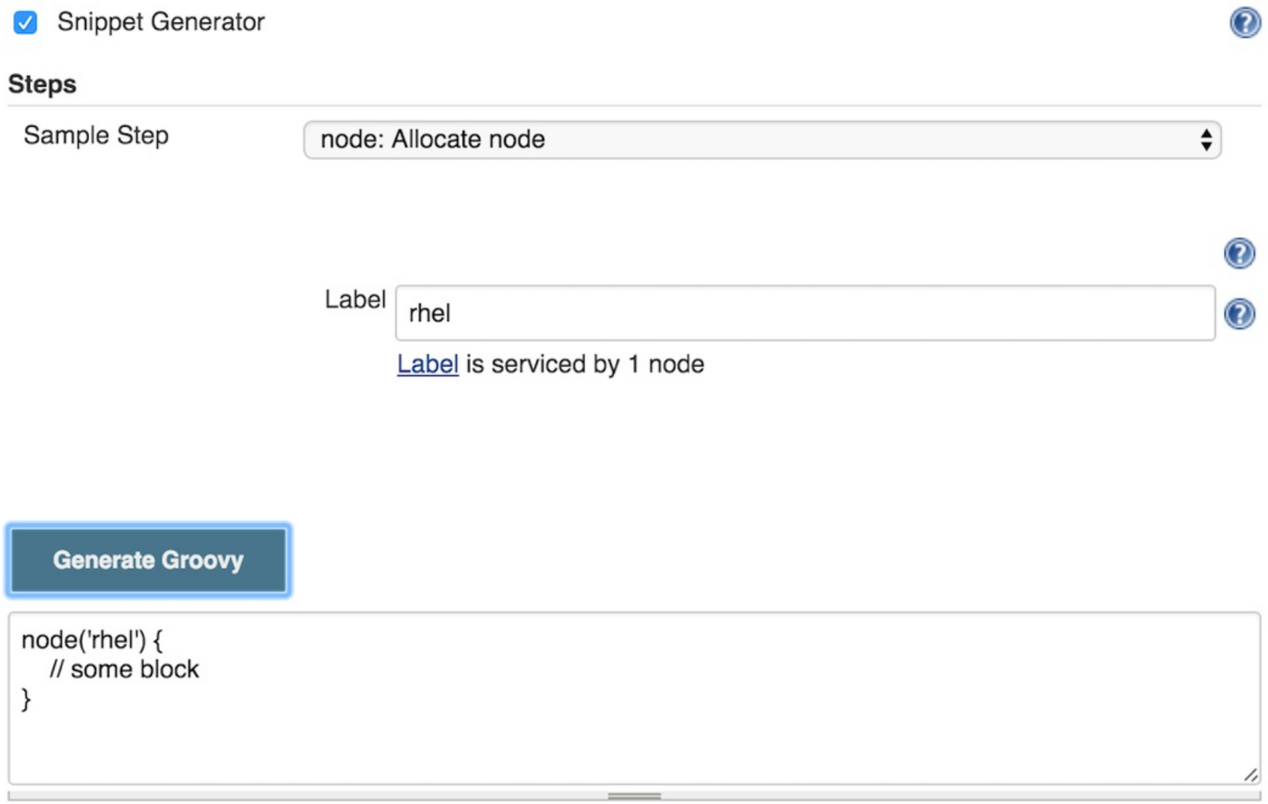
PIPELINE SNIPPET GENERATOR

- No need to learn DSL syntax !



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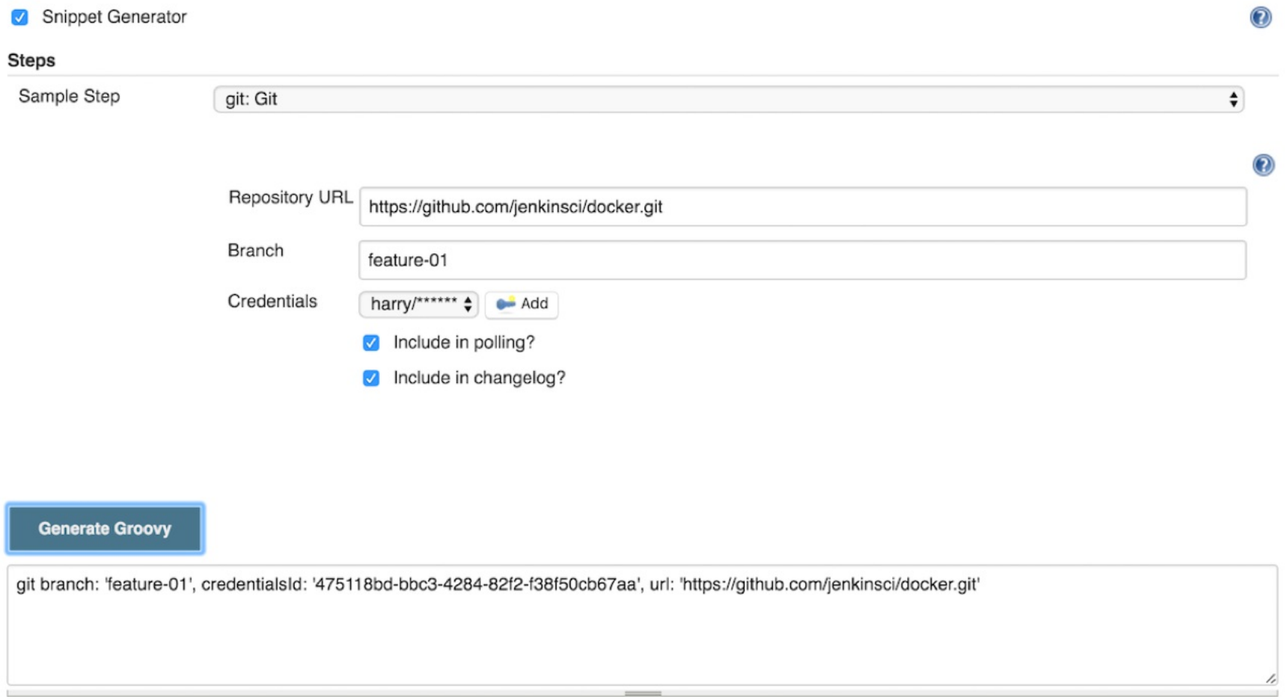
PIPELINE 101 - BUILD STEPS

- Some have native DSL support



PIPELINE 101 - BUILD STEPS

Some don't (yet) have native DSL support and require some hack-ish invocation syntax - but still work:

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INVOCATION SYNTAX

- Most build steps can be used this way today, they may evolve to offer native pipeline support:

```
step( // DSL keyword to invoke arbitrary step
  [ // groovy map
      $class: 'build_step_class_name', // Same as in job's config.xml on disk
      constructor_argument: 'value',
      constructor_argument_2: 'value'
  ]
)
```

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HUMAN INTERACTION

A real world CD pipeline involves human interaction:

- manual validation steps
- approval

Jenkins users used to rely on Promoted Builds Plugin
but then lost the “pipeline execution flow” view

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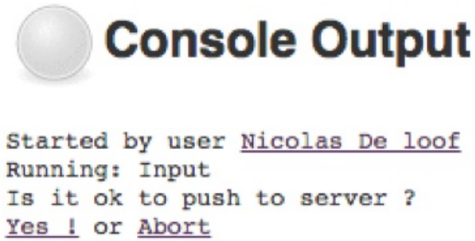
HUMAN INTERACTION

```
input // DSL keyword for interactive step
  message: 'Is it ok to deploy ?',
  ok: 'Yes!', // Button caption
  submitter: 'boss' // Role restriction
```

- Will give this "output":



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EXECUTION CONTROL

- Try up to N times:

```
retry(10) {
  // some block
}
```

- Pause the flow:

```
sleep time: 10,
  unit: 'MINUTES'
```

- Wait for event:

```
waitUntil {
    // some block
}
```

- Timeout an operation:

```
timeout(time: 100,
   unit: 'SECONDS') {
    // some block
}
```

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EXECUTION CONTROL

You can also rely on Groovy control flow syntax:

```
while(something) {
   // do something
   if (something_else) {
      // do something else
   }
}
```

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CONCURRENCY

Pipeline can execute tasks in parallel :

```
parallel
  firstBranch: {
    // do something
  },
  secondBranch: {
    // do something else
  }
```

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FILE SYSTEM

- read file:

```
readFile file: 'some/file', encoding: 'UTF-8'
```

- write file:

```
writeFile file: 'some/file', text: 'hello'
```

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BUILD-FLOW COMPATIBILITY

- build-flow might be deprecated at some time
- Pipeline can trigger a job too:

```
build job: 'foo', wait: false
```

so could run a build flow script with some minor changes

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PIPELINE STAGE VIEW

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WHAT IS PIPELINE STAGE VIEW?

- When you have complex builds pipelines,
  it is useful to be able to see the progress of each stage.
- To that end, CJE includes an extended visualization
  of pipeline build history on the index page of a flow project.

Tip : (You can also click on Full Stage View to get a full-screen view.)

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DEFINING STAGES

- The stage keyword let you label parts of the pipeline :

```
stage 'build'
  // Steps to build your application

stage 'test'
  // Steps to run tests against application

stage 'package'
  // Steps to packaging

stage 'deploy'
  // GO in production
```

This will be rendered by visualization

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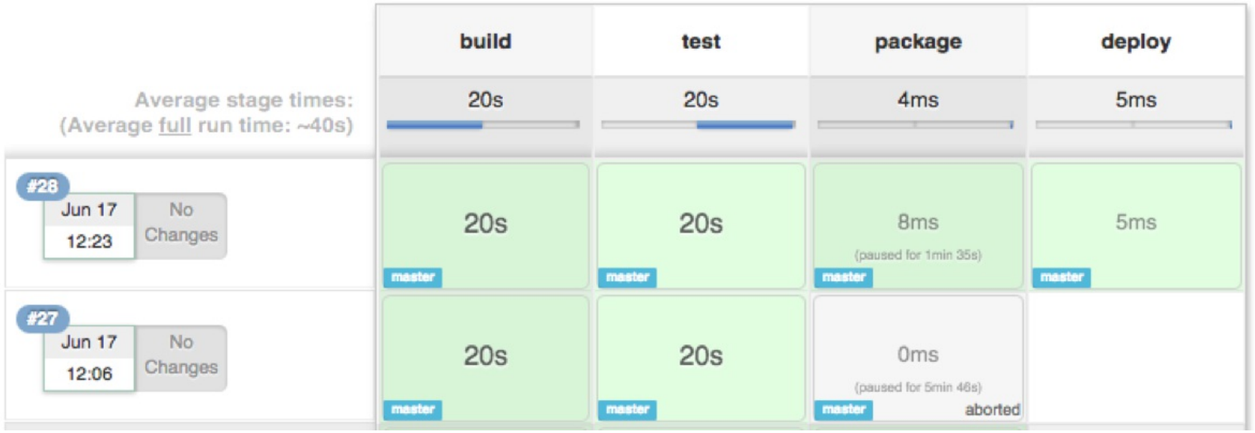
VISUALIZING STAGES

After the first build, you can see your stages (and their states, logs, etc.) :



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CONCURENT STAGES

Stages also let you control concurrency:

```
stage name: 'load-tests',
    concurrency: 4 // spread across 4 nodes
```

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BENEFITS: SIMPLICITY

By adding Stage View to your Pipeline jobs it allows users to easily identify the progress of each stage within the job.

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CHECKPOINTS

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WHAT ARE CHECKPOINTS?

- The checkpoints plugin, offered through CloudBees Jenkins enterprise package, allows for Pipelines to be resumed at specified points.
- By adding a simple line of code to a pipeline script, a failed Pipeline build can be started at that specific checkpoint.
- Data is always preserved with restarted Pipelines and it is easy to pick up where the build left off.

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BENEFITS: RESTART PIPELINE WHERE THEY FAILED

- Without Checkpoints, failed long running Pipebuilds will need to be re-run from the start.
- With Checkpoints, you can simply place a checkpoint before a high risk operations. And if the build fails, Checkpoint will allow the build to be resumed from the checkpoint just before the failure.
- Caution: Checkpoints take additional disk space. You can delete a specific checkpoint to save space

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WHERE DO WE START?

- Create or modify an existing Pipeline to include a Checkpoint. Where is there a high risk operation? A task that depends on network communications or a large amount of disk space?
- Add a checkpoint before the high risk operation. For example:

```
checkpoint 'Built & Tested'
```

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WHERE DO WE START?

A note about Checkpoints:

- As started earlier, data is always preserved with Checkpoint'ed Pipelines and it is easy to pick up where the build left off
- This is accomplished by serializing the entire workspace and the pipeline script itself (hence the impact on disk usage)
- So updating a pipeline script and resuming it after a checkpoint will not run the new version of the pipeline
- This feature is really intended to resume the exact same pipeline from the checkpoint after an external issue has been fixed or resolved
- For example, compile, test, build stages pass, but deploy stage may fail due to connection issue to the deployment environment. You could resume from a checkpoint placed after the test stage to re-deploy once the connectivity issue is resolved

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LAB EXERCISE:

Lab 12: Pipelines

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TEMPLATE PLUGIN

Template Plugin Overview

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WHAT ARE TEMPLATES?

- A template is a reusable piece of job configuration that only exposes a minimal and pre-defined set of parameters to users
- A template is internally translated to a “standard” Jenkins job configuration.
- A template can extend another template
- Changes to a template immediately apply to everywhere the template is used.

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WHAT ARE TEMPLATES?

attribute

named & typed variable

model

collection of attributes (& super model)

instance

particular values for all attributes in a model

transformer

translates model instance into real item

template

model + transform**er**

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WHAT ARE TEMPLATES?

- 5 different kinds of templates
  - Builder
  - Publisher
  - Job
  - Folder
  - Auxiliary (model only)

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BENEFITS: MAINTAINABILITY

- Manage a large set of jobs without duplicating configuration:
  - Configuration update is easily done in one place instead of doing a dangerous mass update using the groovy console for example
  - Easier onboarding of new teams/applications
- Manage a large set of jobs without unexpected subtle differences
  - You are explicitly controlling what may be different/customized

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BENEFITS: DELEGATION

- Delegate jobs creation without allowing users to do anything:
  - They can create jobs but they can customize only what the administrator allows
  - Enforce common enterprise standard across all applications (for example, Static Code Analysis to be done all projects)
- Delegate jobs creation without exposing to users all advanced options and switches that Jenkins may provide
  - Configuration settings are limited by the administrator who can specialize them to his targeted audience

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TEMPLATE PLUGIN

Builder templates

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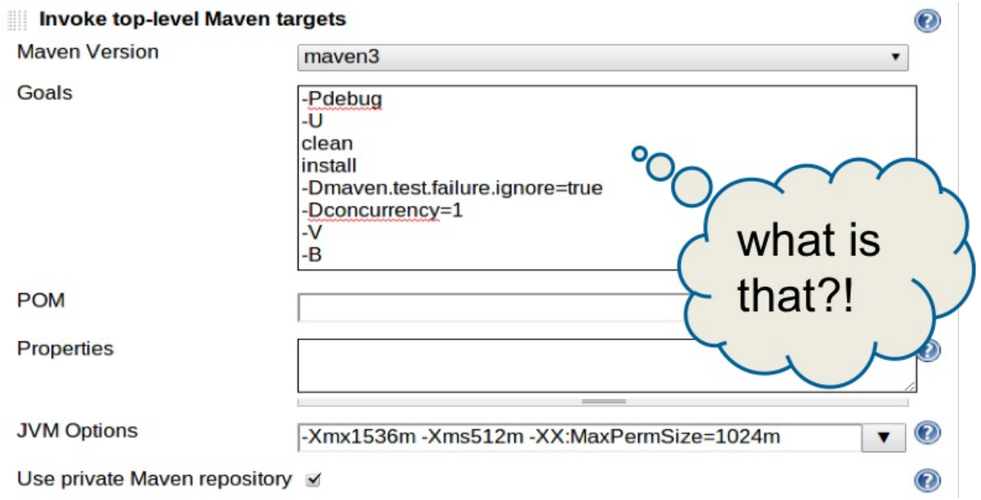
WHAT ARE BUILDER TEMPLATES?

- A builder template allows to create your own simplified and reusable build step



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WHAT ARE BUILDER TEMPLATES?

- How does it work?
  - transformer produces a Jenkins build step
  - often a shell/batch script but need not be
  - transformation run during build, so can access live data
  - new builder immediately run

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BENEFITS: SIMPLICITY

- By using builder templates you avoid
  - copying & modifying too complex build steps
  - writing heavyweight Jenkins plugins (learning curve)

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WHERE DO WE START?

- Using general transformers in a builder
  - awkward to do simple things
  - but can generate any builder: Gradle, wsadmin, &c.
  - useful if builder's plugin does tricky things
  - copy XML from a prototype job, then templatize
    - RFE in progress to load sample XML for you

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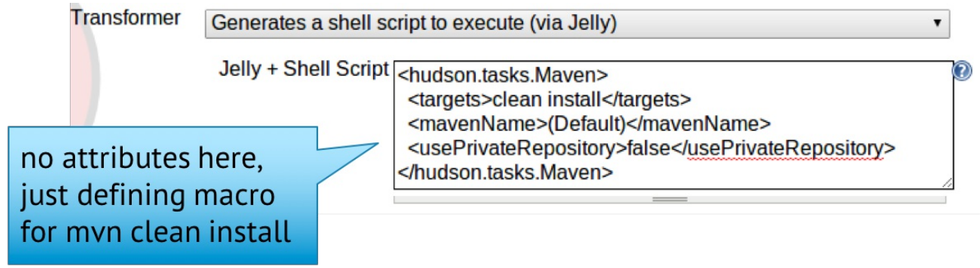
WHERE DO WE START?

- Using general transformers in a builder
  - Groovy for scripting power;
  - Jelly for XML hygiene (deprecated)



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WHERE DO WE START?

- Generate shell scripts and run
  - easier if you would normally use a shell script anyway
  - write a template of a shell script (usually in Groovy)
  - do not confuse Groovy variables with shell variables

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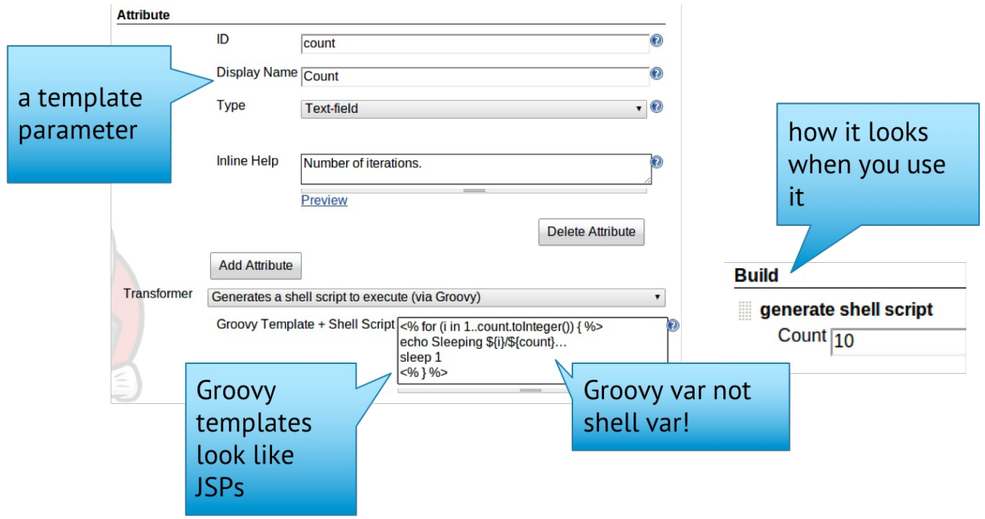
WHERE DO WE START?

- Generate shell scripts and run



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WHERE DO WE START?

- Predefine variables then run script
  - alternative keeping Groovy and shell syntax separated
  - supports Windows batch scripts as well
  - special characters (spaces, quotes, …) preserved
  - all control flow must be done by shell

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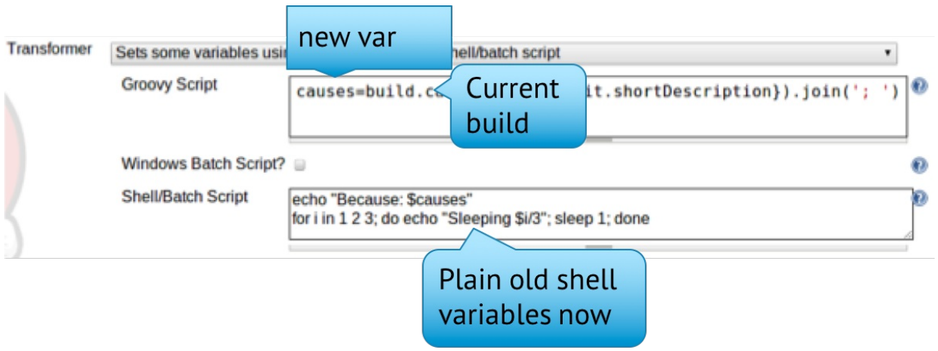
WHERE DO WE START?

- Predefine variables then run script
  - Definition:



  - Output:

```
[workspace] $ /bin/sh -e /tmp/hudson6506427550849825755.sh
Because: Started by user anonymous
Sleeping 1/3
Sleeping 2/3
Sleeping 3/3
```

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TEMPLATE PLUGIN

Publisher templates

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WHAT ARE PUBLISHER TEMPLATES?

- much like builders, except for post-build actions
- publish HTML or test results, send email, …
- only general transformers (Groovy/Jelly) supported

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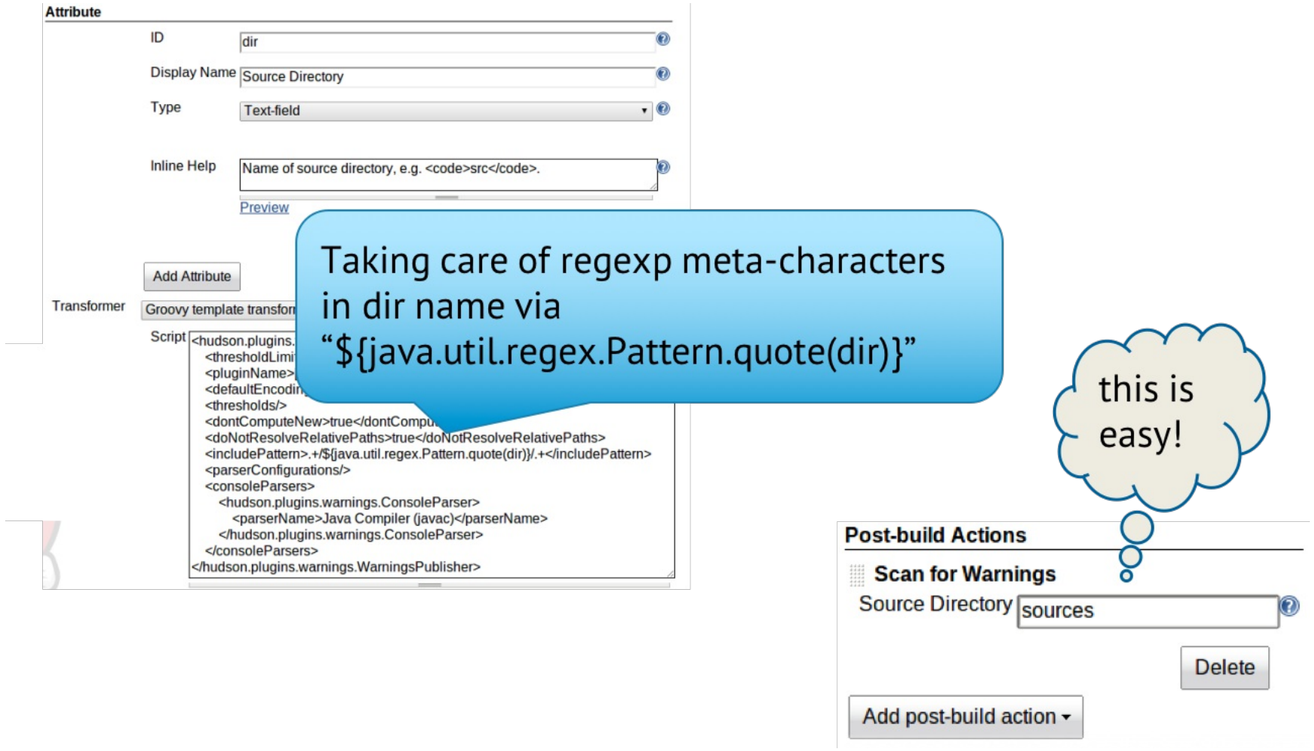
WHERE DO WE START?



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TEMPLATE PLUGIN

Job templates

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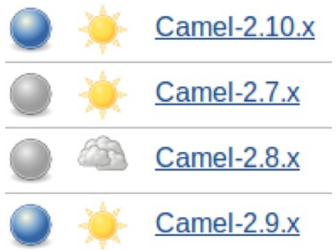
WHAT ARE JOB TEMPLATES?

- A maze of twisty little projects, all alike
  - many Jenkins jobs are very similar
    - want to capture the common parts
  - not everyone creating a job is a Jenkins expert
  - managers want to know what varies and what does not
  - security setup may prohibitarbitrary job configs
  - job templates to the rescue!



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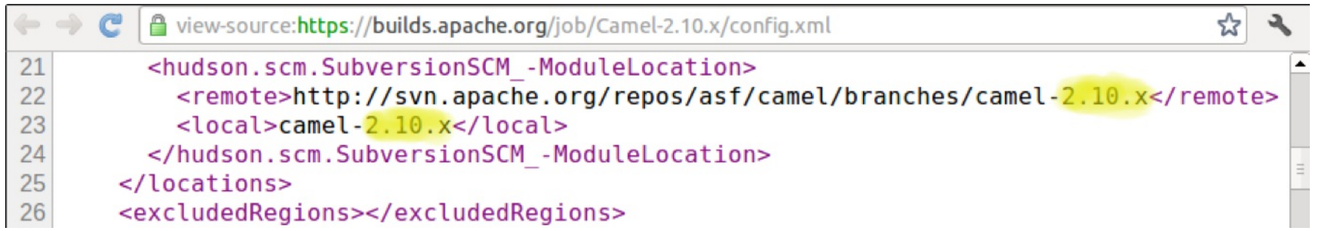
WHERE DO WE START?

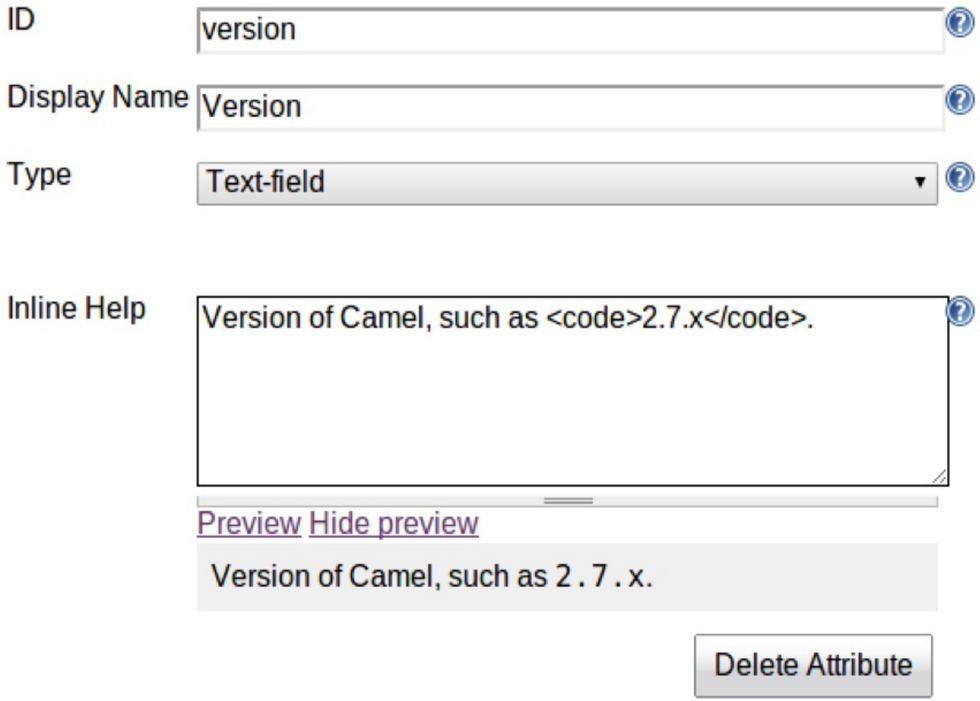
- Defining a job template
  - start with config.xml from a working job
  - decide which parts should be customizable



CLOUDBEES UNIVERSITY

WHERE DO WE START?

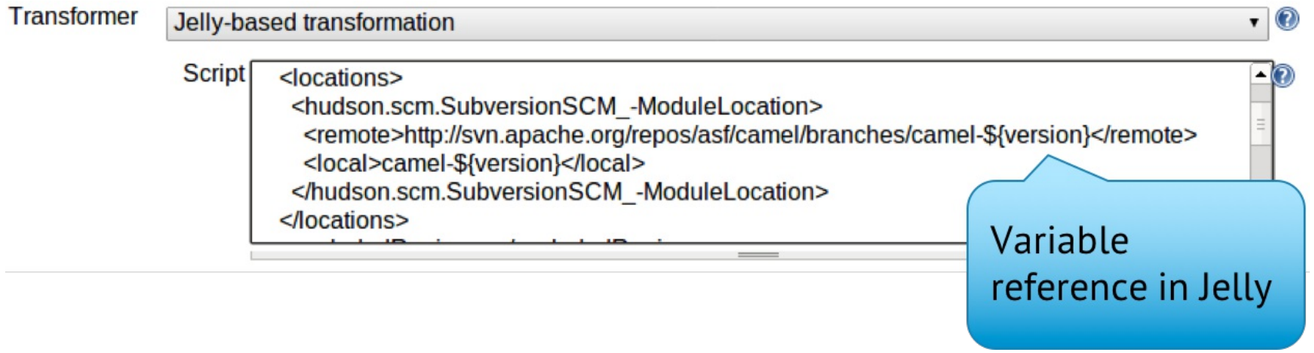
- Defining a job template
  - define and document attributes



CLOUDBEES UNIVERSITY

WHERE DO WE START?

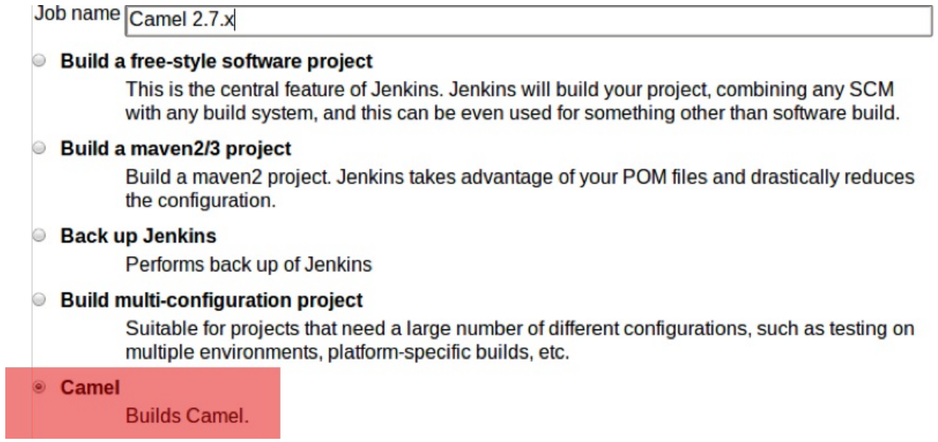
- Defining a job template
  - pick a transformation language (Groovy, Jelly)
  - make config.xml into a template



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Instantiating a job template
  - "New Job" page:



  - Configuration screen:

CLOUDBEES UNIVERSITY

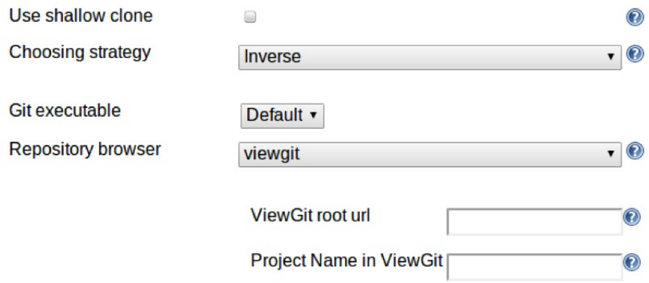
TEMPLATE PLUGIN

Auxiliary models and fancier template attributes

CLOUDBEES UNIVERSITY

WHAT ARE ATTRIBUTES?

- Attribute types
  - so far all attributes have been simple text fields
  - complex templates demand more!
  - after all, plain Jenkins jobs have a rich config UI…



CLOUDBEES UNIVERSITY

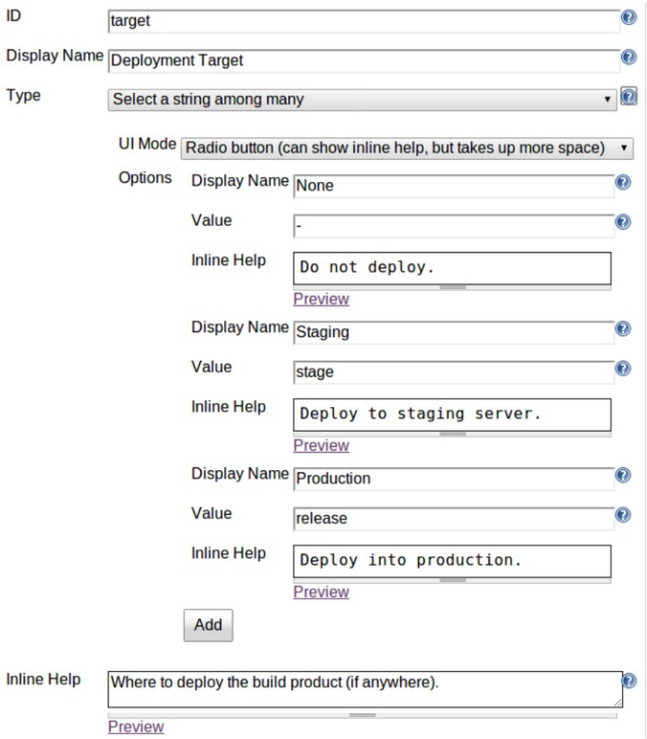
WHAT ARE ATTRIBUTES?

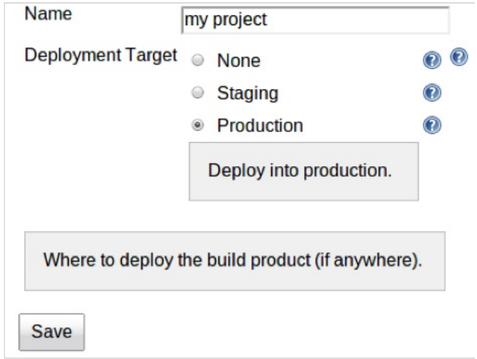
- Some basic attribute types:
  - text field ~ String (what we have seen)
  - text area ~ String (same but multiline)
  - checkbox ~ boolean

CLOUDBEES UNIVERSITY

WHAT ARE ATTRIBUTES?

- Select from enumerated items:





CLOUDBEES UNIVERSITY

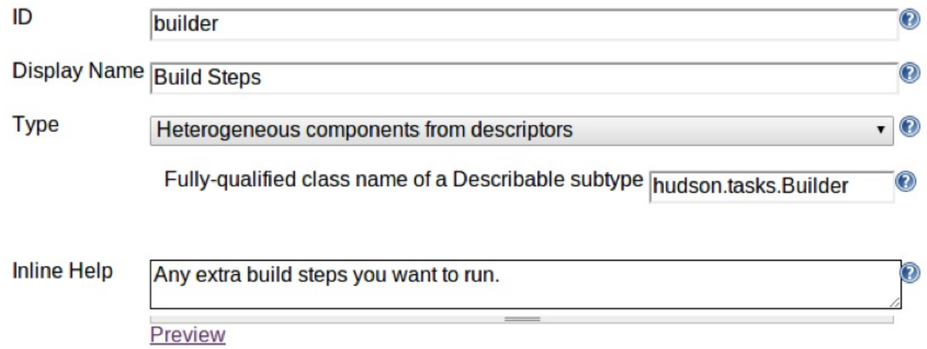
WHAT ARE ATTRIBUTES?

- Jenkins-specific attribute types
  - “item” (~ job/project)
  - installation of some type of tool (e.g. JDK)
  - “component” of some type, such as builder

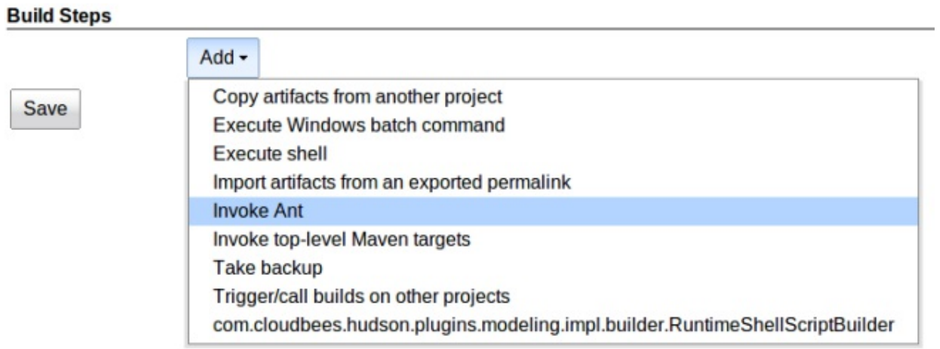
CLOUDBEES UNIVERSITY

WHAT ARE ATTRIBUTES?

- Jenkins-specific attribute types:
  - Definition:



  - What users see:



CLOUDBEES UNIVERSITY

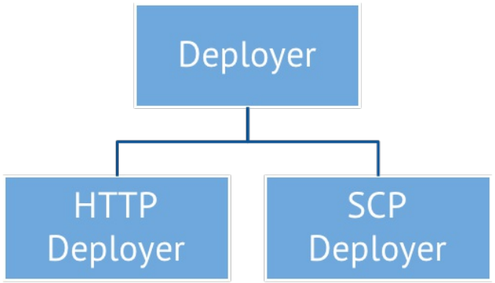
WHAT ARE AUXILIARY MODELS?

- Auxiliary models and inheritance:
  - like defining your own struct/class (with config GUI)
  - model only used inside other models
  - object-oriented style
    - “abstract” models
    - subtypes
    - polymorphic attributes
    - virtual attributes
  - used for complex, structured configuration

CLOUDBEES UNIVERSITY

WHERE DO WE START?

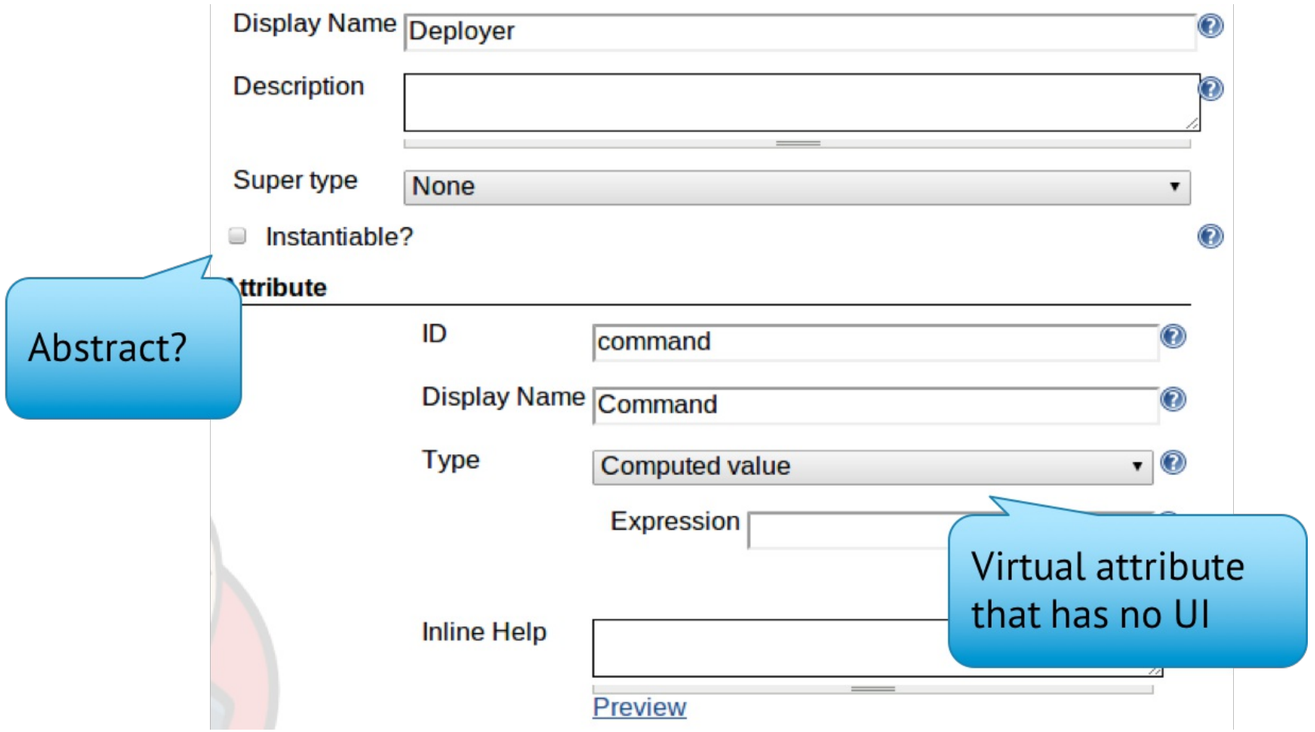
- Auxiliary model example:
  - Scenario
    - We build webapp
    - Team decides where to deploy
    - Two types of deployment (via HTTP or SCP)
  - How we model this
    - Via 3 models
    - With inheritance



CLOUDBEES UNIVERSITY

WHERE DO WE START?

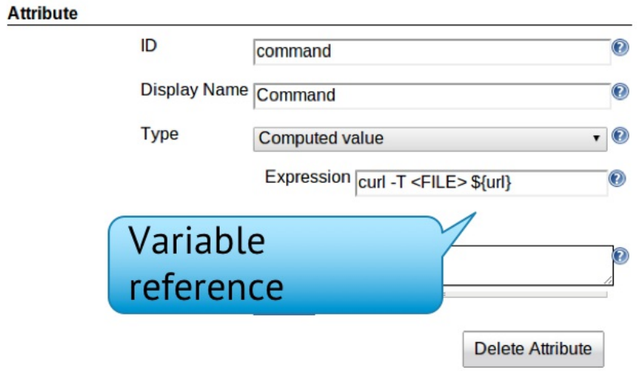
- Defining an abstract auxiliary model:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

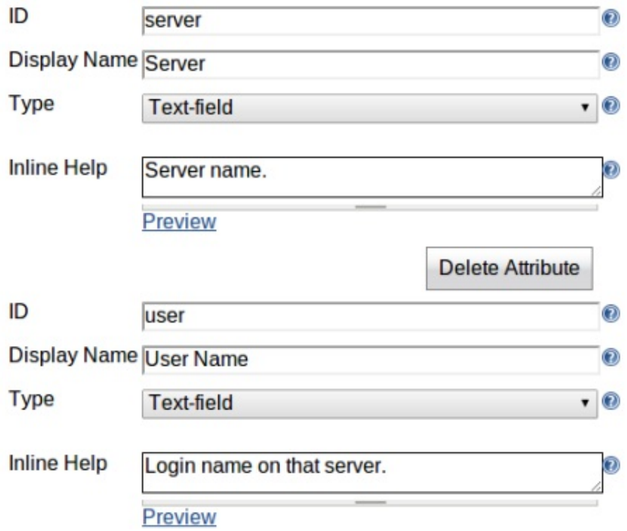
- Defining auxiliary model subtypes
  - Marked as “instantiable”
  - Extends from “Deployer”
  - “command” attribute concretely defined



CLOUDBEES UNIVERSITY

WHERE DO WE START?

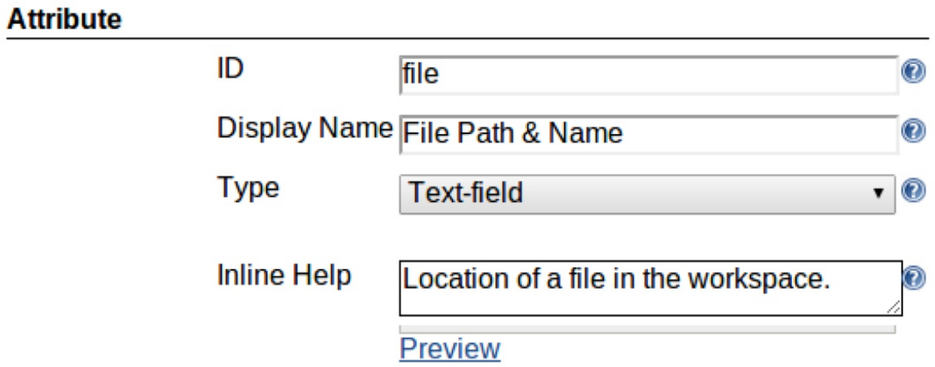
- Defining auxiliary model subtypes
  - Another subtype defined similarly



CLOUDBEES UNIVERSITY

WHERE DO WE START?

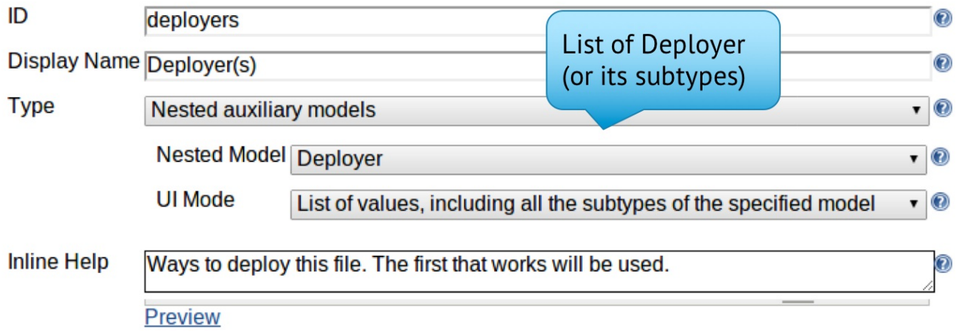
- Use deployer from builder template
  - First, define the file attribute:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Then let users specify deployers



CLOUDBEES UNIVERSITY

WHERE DO WE START?

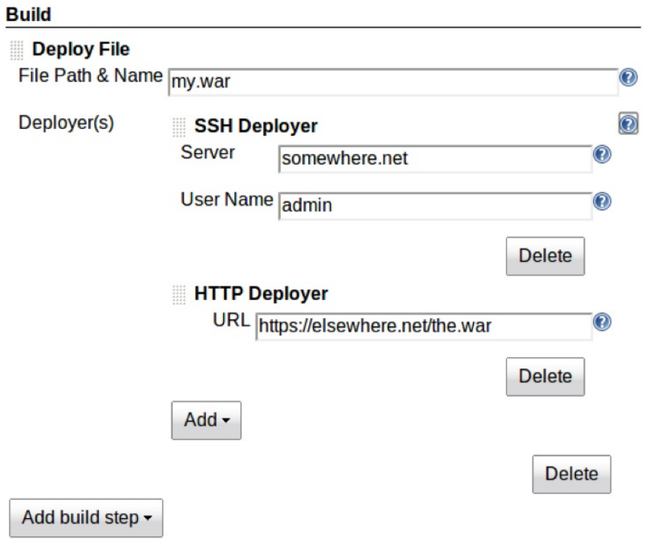
- Produce command that runs
  - Bit of Groovy to generate the command to run

```
cmd = deployers.
    toList()*.
    command*.
    toString()*.
    replace('<FILE>',file).
    join('\n')
```

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- And the user experience …




```
[workspace] $ /bin/sh -e /tmp/hudson8063706505027028169.sh
+ scp my.war admin@somewhere.net:~ || curl -T my.war https://elsewhere.net/the.war
Finished: SUCCESS
```

CLOUDBEES UNIVERSITY

TEMPLATE PLUGIN

Folder templates

CLOUDBEES UNIVERSITY

WHAT IS A FOLDER TEMPLATE?

- like a job template, but produces a whole folder
- may predefine:
  - job type restrictions
  - icon
  - columns
  - variables passed to jobs
- template produces config.xml as for a job
- can also define initial list of jobs
- admins can control what happens inside!

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Folder template example
- Scenario:
  - Team uses one branch for one sprint
  - Each branch requires build & test jobs
- How we model this:
  - Let's map one branch to one folder
  - Create a folder template so that build & test jobs are there from get-go

CLOUDBEES UNIVERSITY

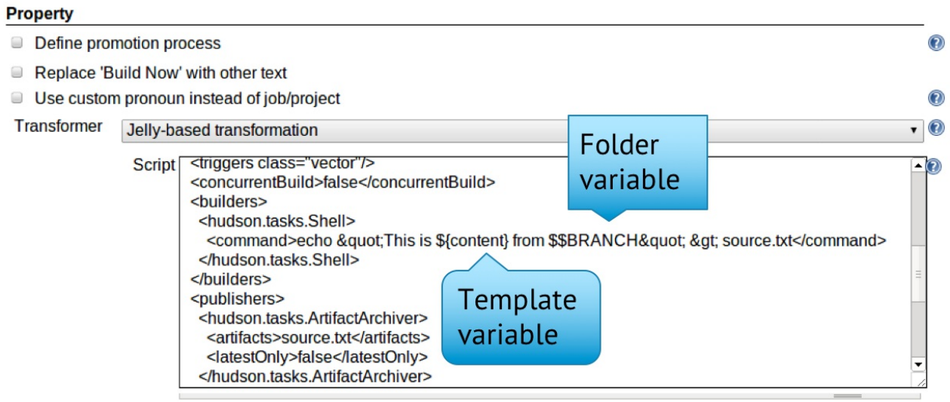
WHERE DO WE START?

- How to create them ?
- The same as before… by example!
  - Manually create a folder
  - Manually create two jobs in them
  - Take their config.xml and create templates

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Setup: job template build
  - Define “content” attribute



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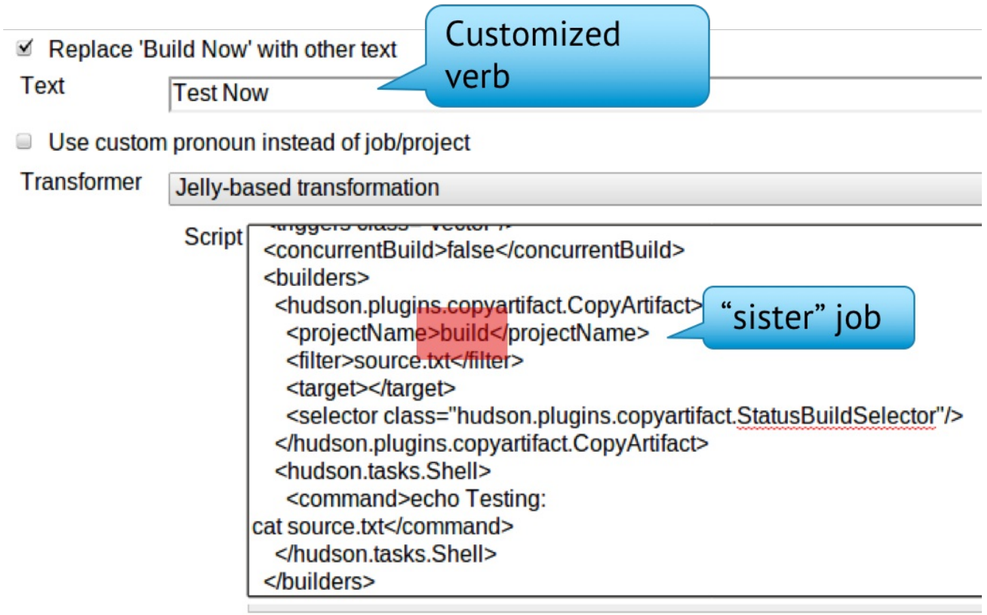
WHERE DO WE START?

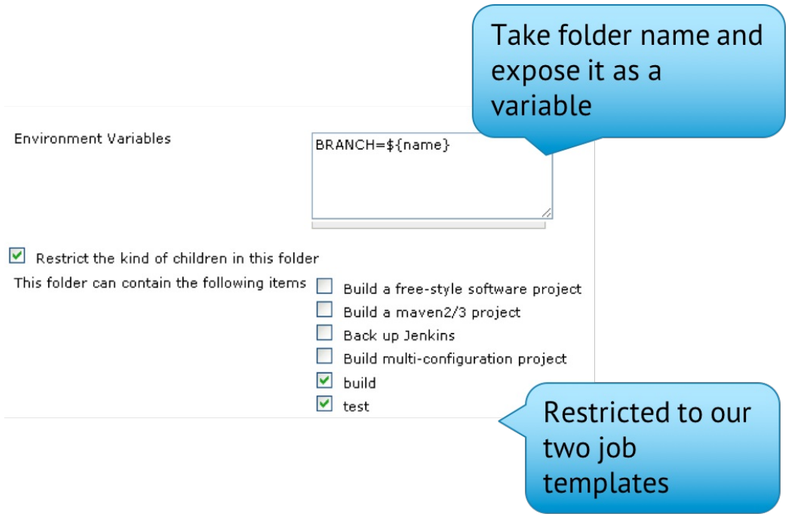
- Setup: job template test



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Create a folder that becomes a template
  - Create a folder by any name
  - Configure it the way we like

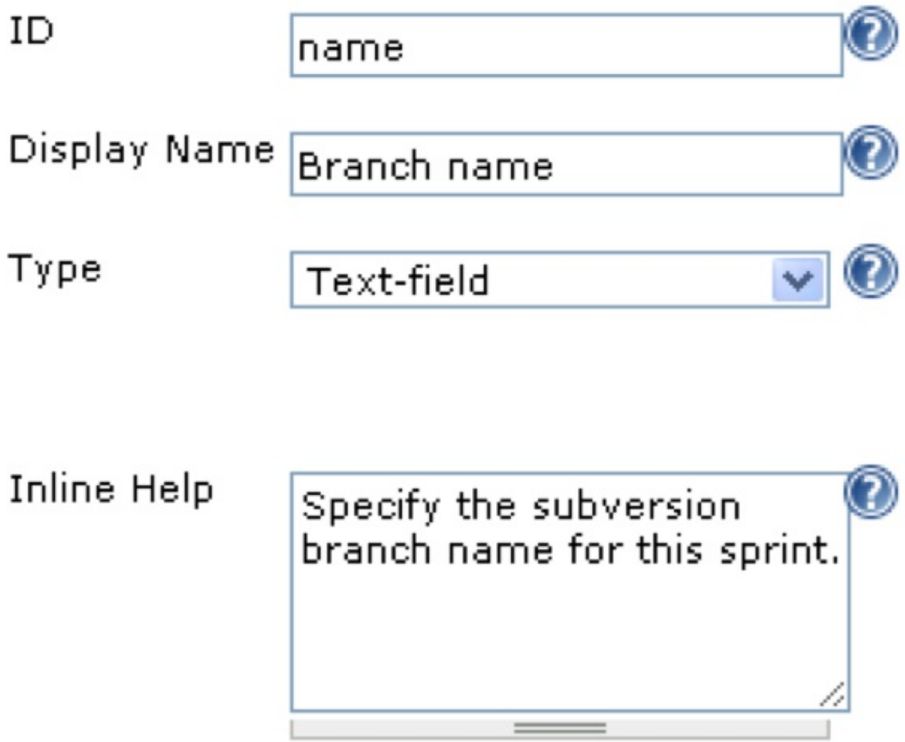


  - Copy config.xml into clipboard

CLOUDBEES UNIVERSITY

WHERE DO WE START?

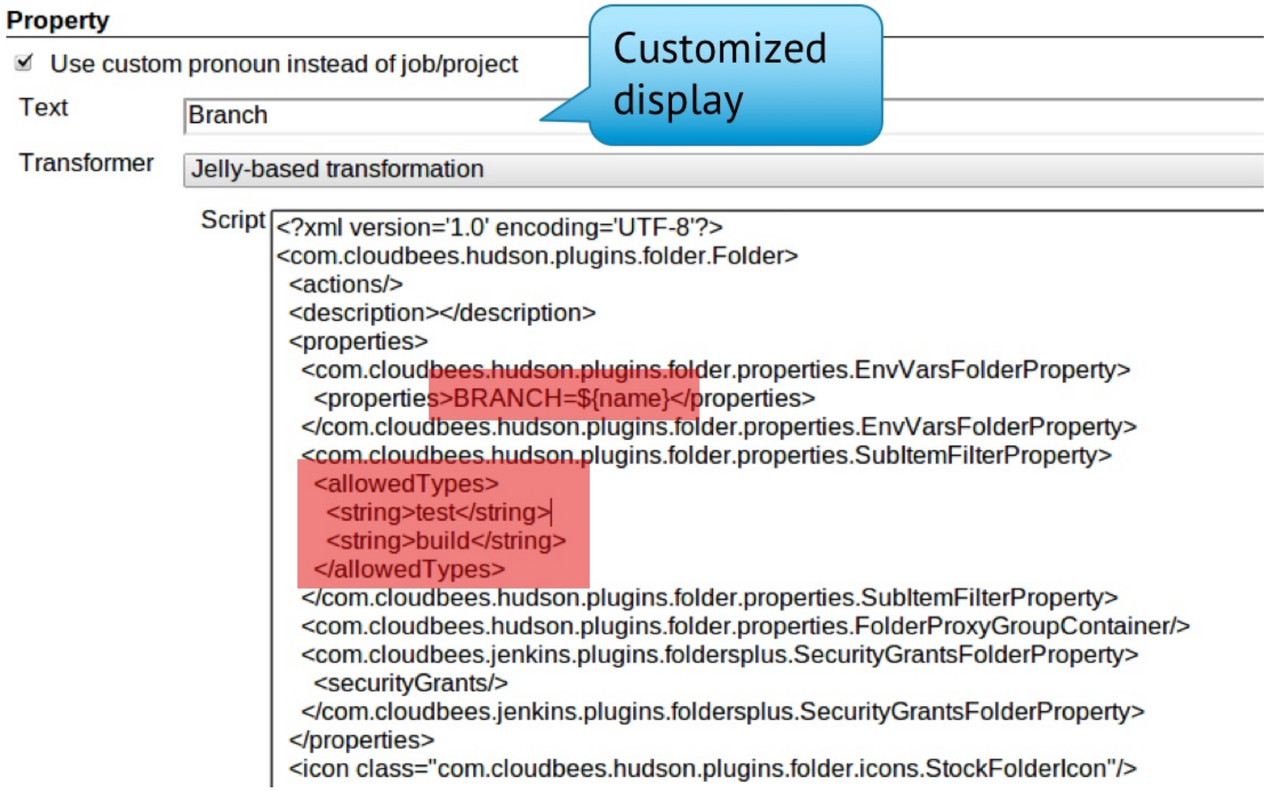
- Folder template branch
  - Define the branch name attribute:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

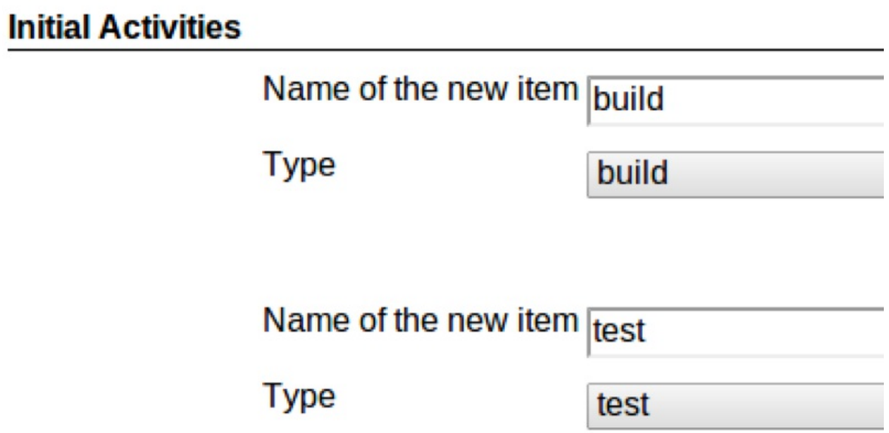
- Folder template branch:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Folder template branch
  - Create build & test jobs when a folder is created:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Going one more level!
  - Scenario:
    - Many teams work on different products in your org
  - Let's define "product":
    - As a collection of branches

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Create a folder that becomes a template
  - Create a folder by any name
  - Configure it the way we like
    - Restrict children to “branch”
    - Custom folder icon

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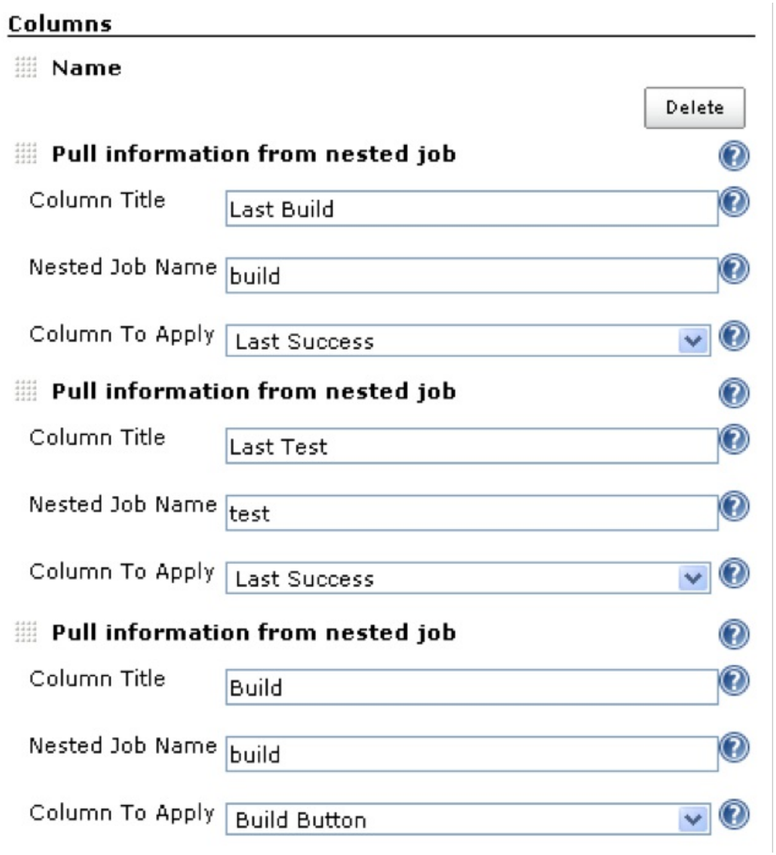
WHERE DO WE START?

- Configure it the way we like (cont'd)
  - Column configuration:



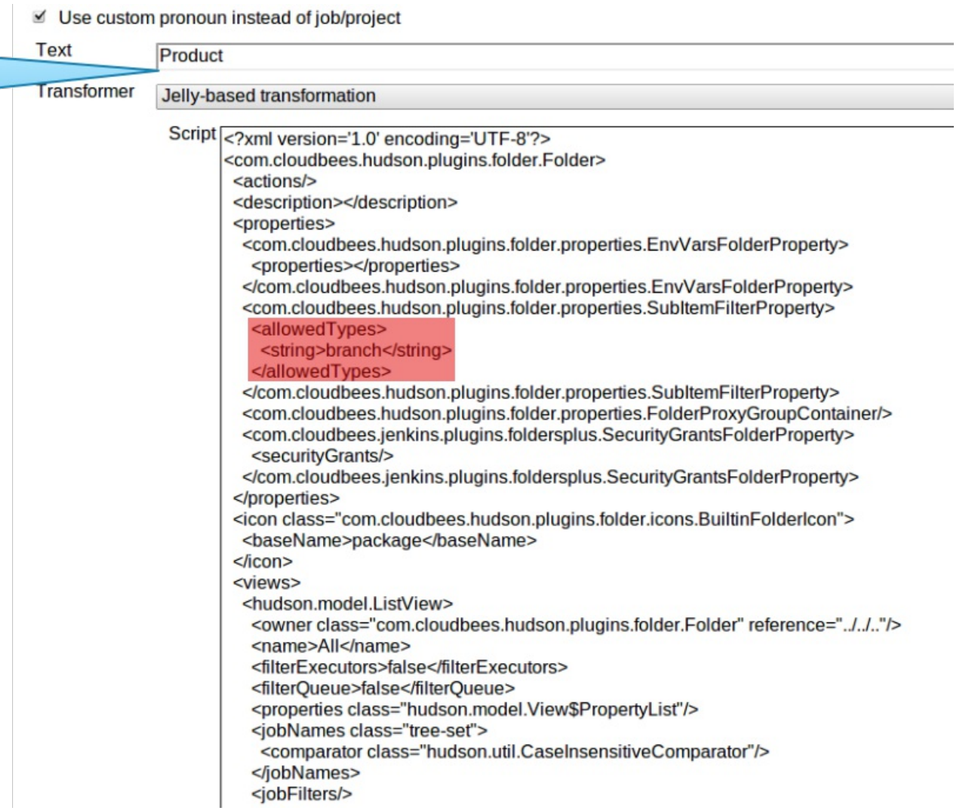
Show information about job inside the folder

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Take config.xml and paste that as XML:

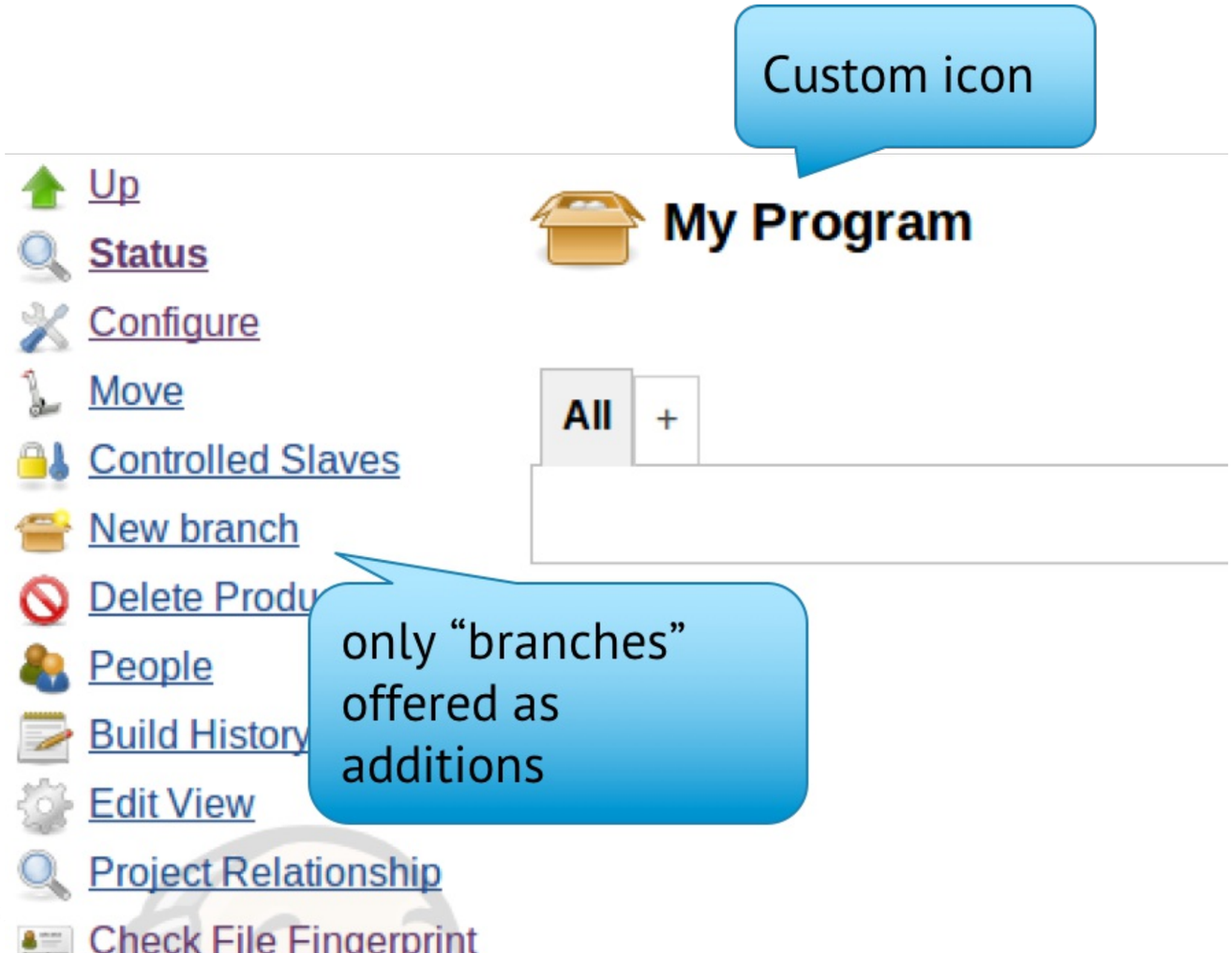
more custom display



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Making a “product” and “branches”
  - initially empty…



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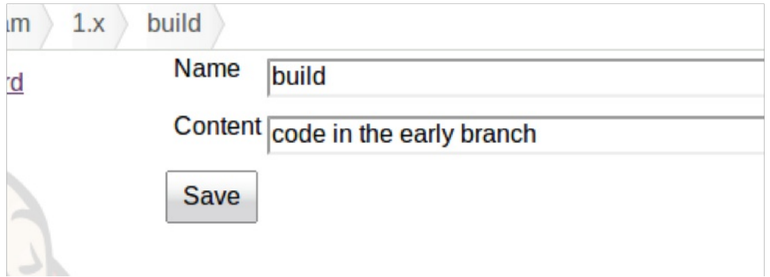
WHERE DO WE START?

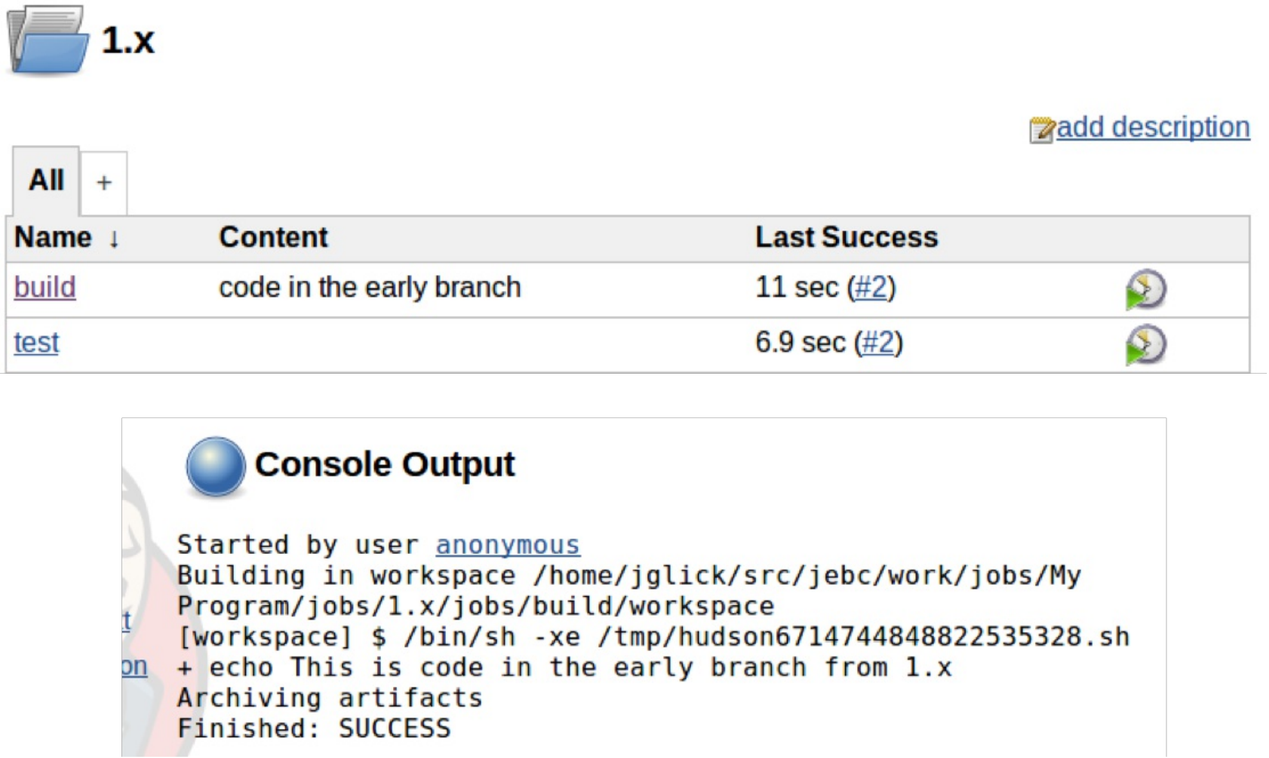
- Adding a branch and customizing its build job:



CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Running build and test jobs inside a branch:



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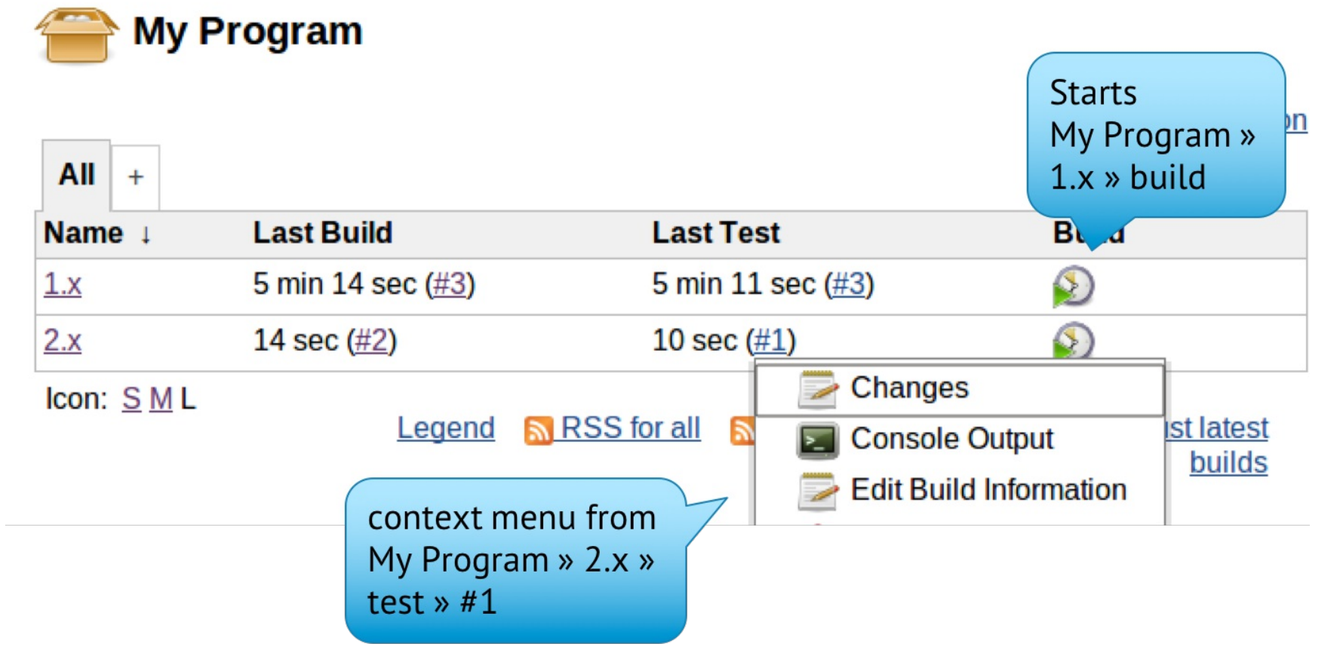
WHERE DO WE START?

- Product folder now shows overview of branches:



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LAB EXERCISE:

Lab 13: Templates

CLOUDBEES UNIVERSITY

CLOUDBEES SUPPORT PLUGIN

Accelerate diagnosis with CloudBees Support

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WHAT IS CLOUDBEES SUPPORT

- CloudBees customers have access to a whole set of services including Professional Support by Jenkins experts who are themselves developers and Jenkins maintainers.
- The Support plugin provides the ability to generate a bundle of all the commonly requested information used by CloudBees when resolving support issues.
  - Those bundles will be used within the CloudBees Support Portal

CLOUDBEES UNIVERSITY

WHERE DO WE START?

- Simply go to the plugin's release notes, pick the latest version, and click the link in the Download section, such as to http://jenkins-updates.cloudbees.com/download/plugins/cloudbees-support/latest/cloudbees-support.hpi). You can install the downloaded plugin using Manage Jenkins » Manage Plugins » Advanced » Upload Plugin
- To generate a bundle, simply go to the CloudBees Support link on the Jenkins instance.

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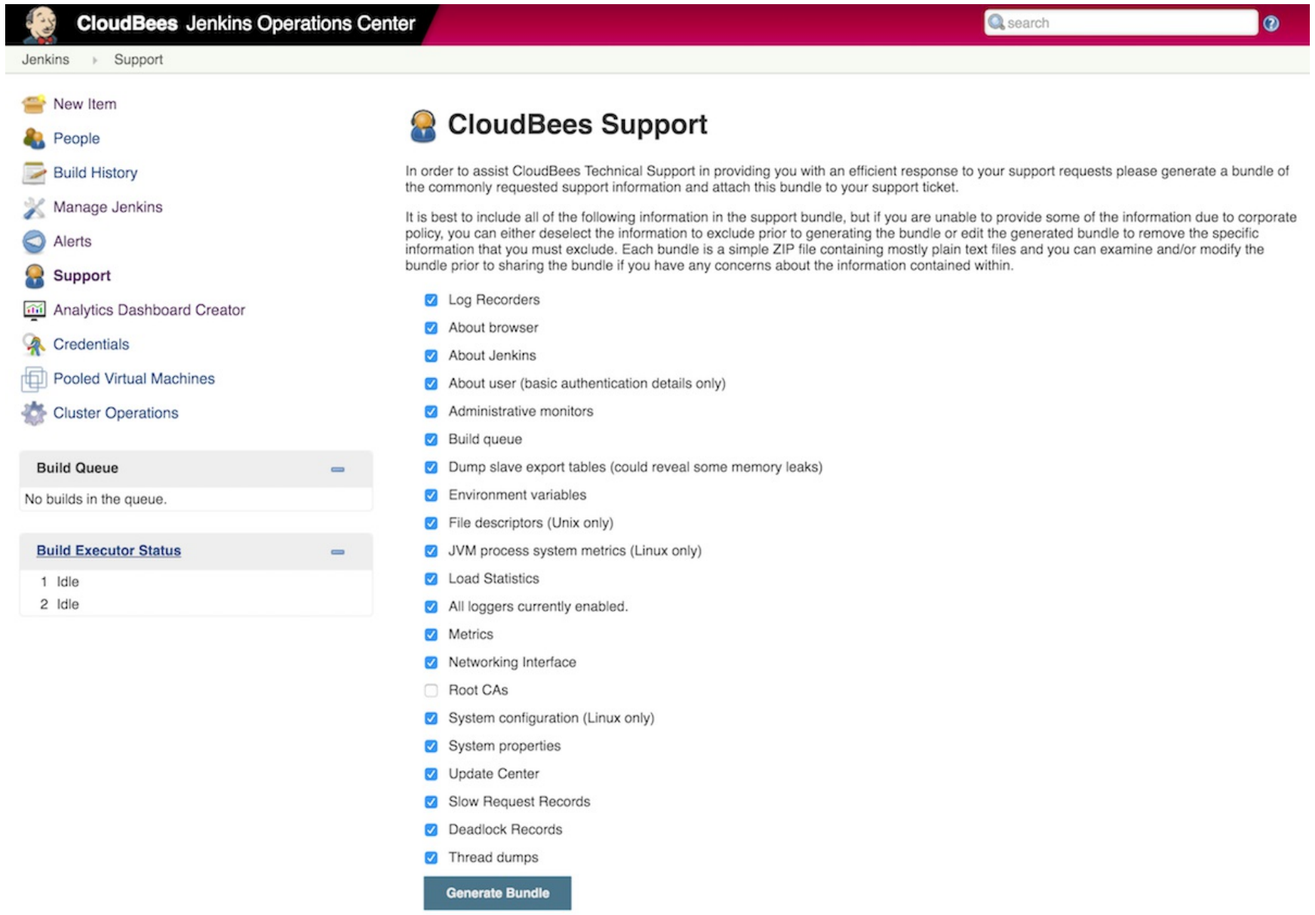
WHERE DO WE START?(CONT.)



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LAB EXERCISE

Lab 14: CloudBees Support

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INTRODUCTION TO CJOC

CloudBees Jenkins Operations Center

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JENKINS @ SCALE

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HOW JENKINS GROWS IN AN ORGANIZATION ?

~~Horizontally...~~ virally

Vertically

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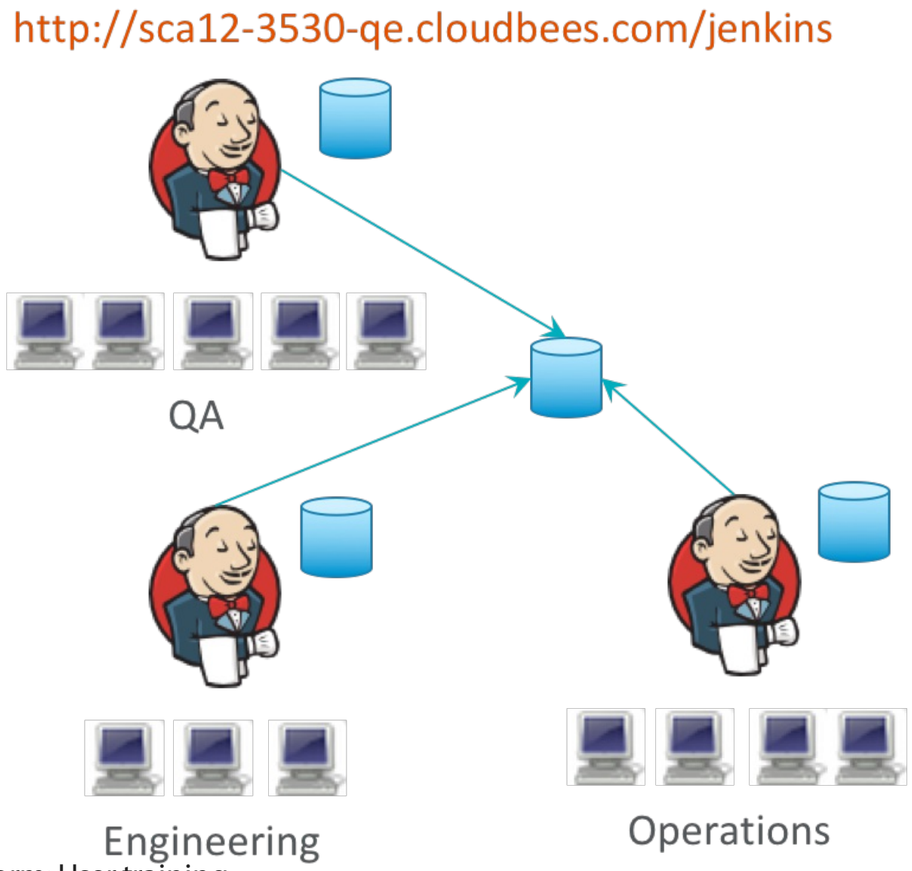
VERTICAL SCALING ISSUES

- How long can I keep scaling Jenkins?
- Single point of failure:

HORIZONTAL SCALING ISSUES

- I would like to…
  - Share security information: Security Realm and roles
  - Easily navigate between masters



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INTRODUCING CLOUDBEES JENKINS OPERATIONS CENTER

aka "CJOC"

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WHAT IS CLOUDBEES JENKINS OPERATIONS CENTER?

- Operations console for Jenkins
  - Consolidated navigation
  - Shared agents
  - Centralized authentication and authorization
  - License management
  - Security enforcement
  - Analytics
  - Cluster Operations

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WHAT IS CLOUDBEES JENKINS OPERATIONS CENTER?

- Without CJOC, scaling with Jenkins can be painful.
  - Two ways to scale today:
    - Vertical
    - Horizontal
- CJOC provides alternative scaling model to avoid the pitfalls of a single point of failure and master sprawl.

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WHAT IS CLOUDBEES JENKINS OPERATIONS CENTER?

- CJOC treats agents and Jenkins masters like Jenkins jobs.
- Maintenance tasks, like plugin updates, can also be run as Jenkins jobs using a CJOC-only job type called “Cluster Operations”.
- CJOC tracks agent and master usages in a report format.

CLOUDBEES JENKINS OPERATIONS CENTER OVERVIEW

Scale

- Easily configured client masters
- Shared build resources
- Shared clouds

Secure

- Role-based Access Control (RBAC)
- Integration with LDAP and ActiveDirectory
- Single-Sign On
- Setting enforcement
- Plugin version enforcement

Manage

- License management
- CloudBees Jenkins Analytics
- Cluster Operations
- Test instance management

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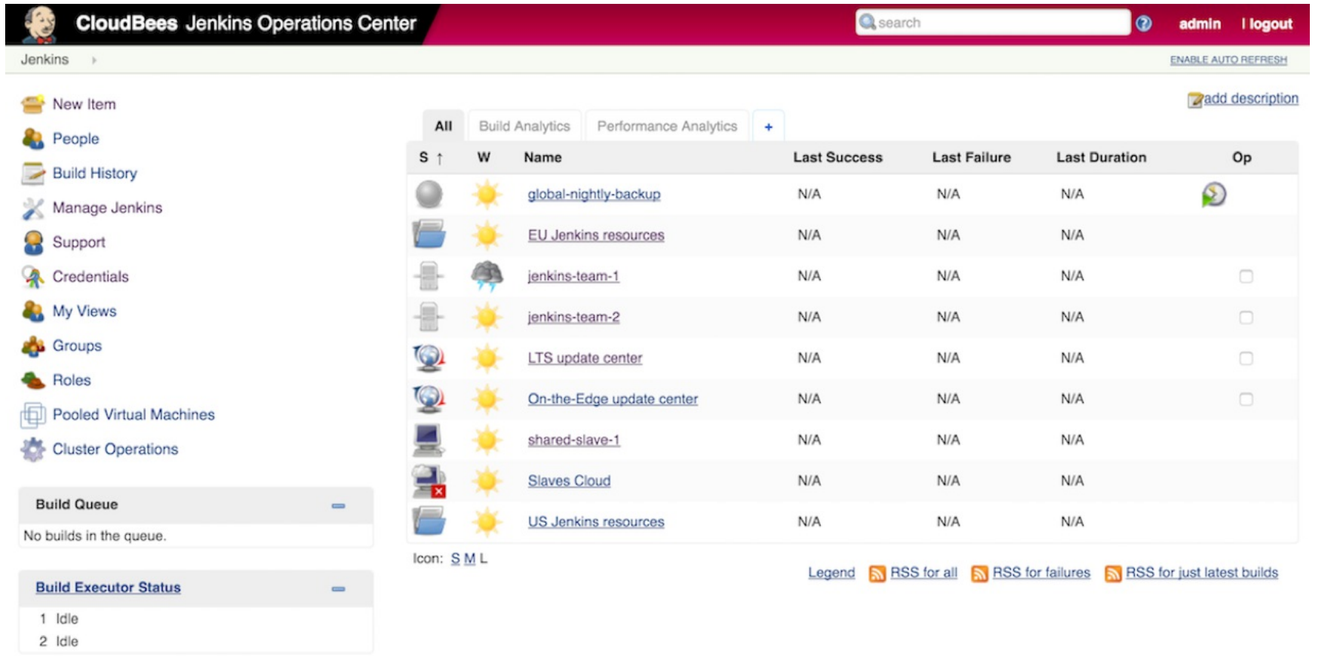
CONCEPTS

- Operations Center server:



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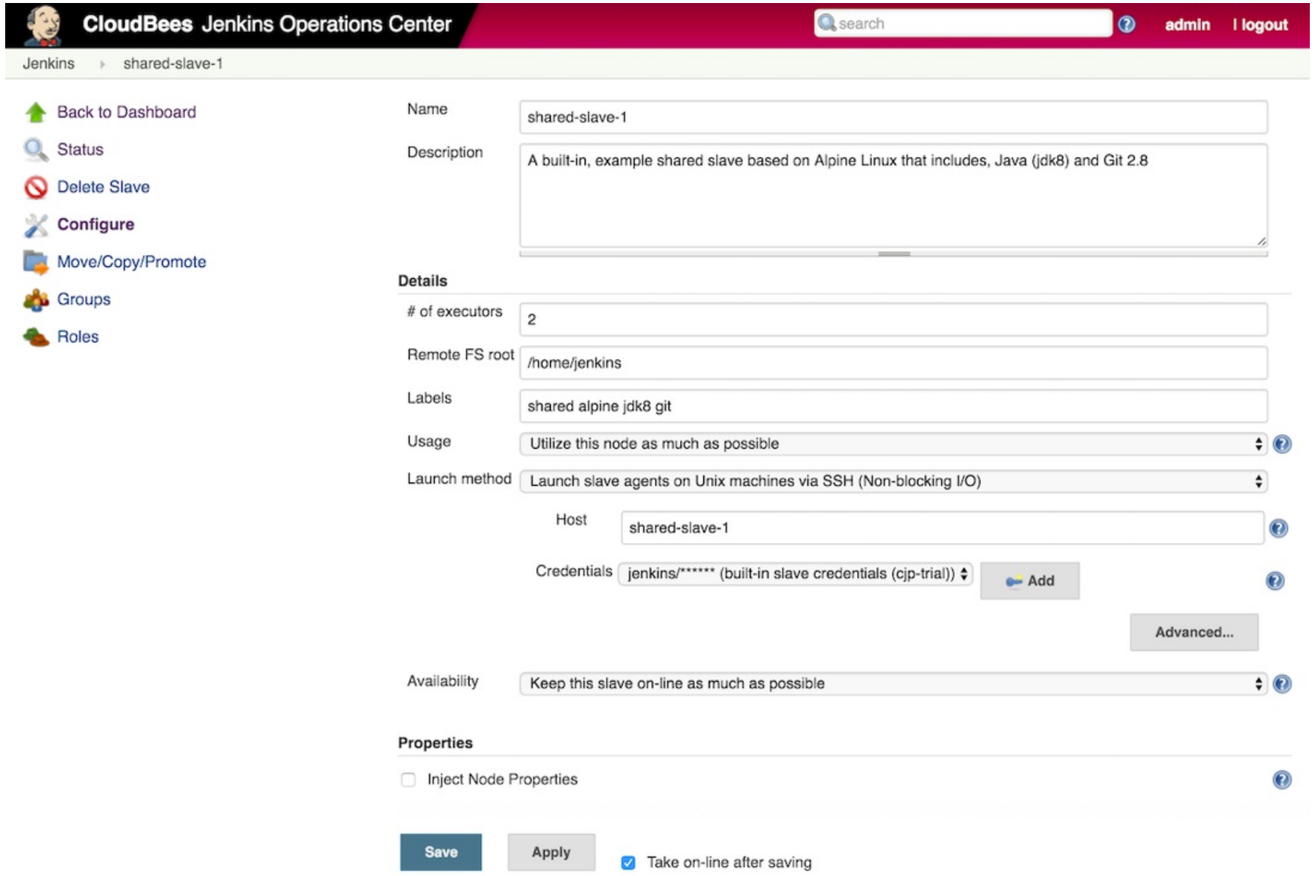
CONCEPTS

- Client master:

CLOUDBEES UNIVERSITY

CONCEPTS

- Shared agent:



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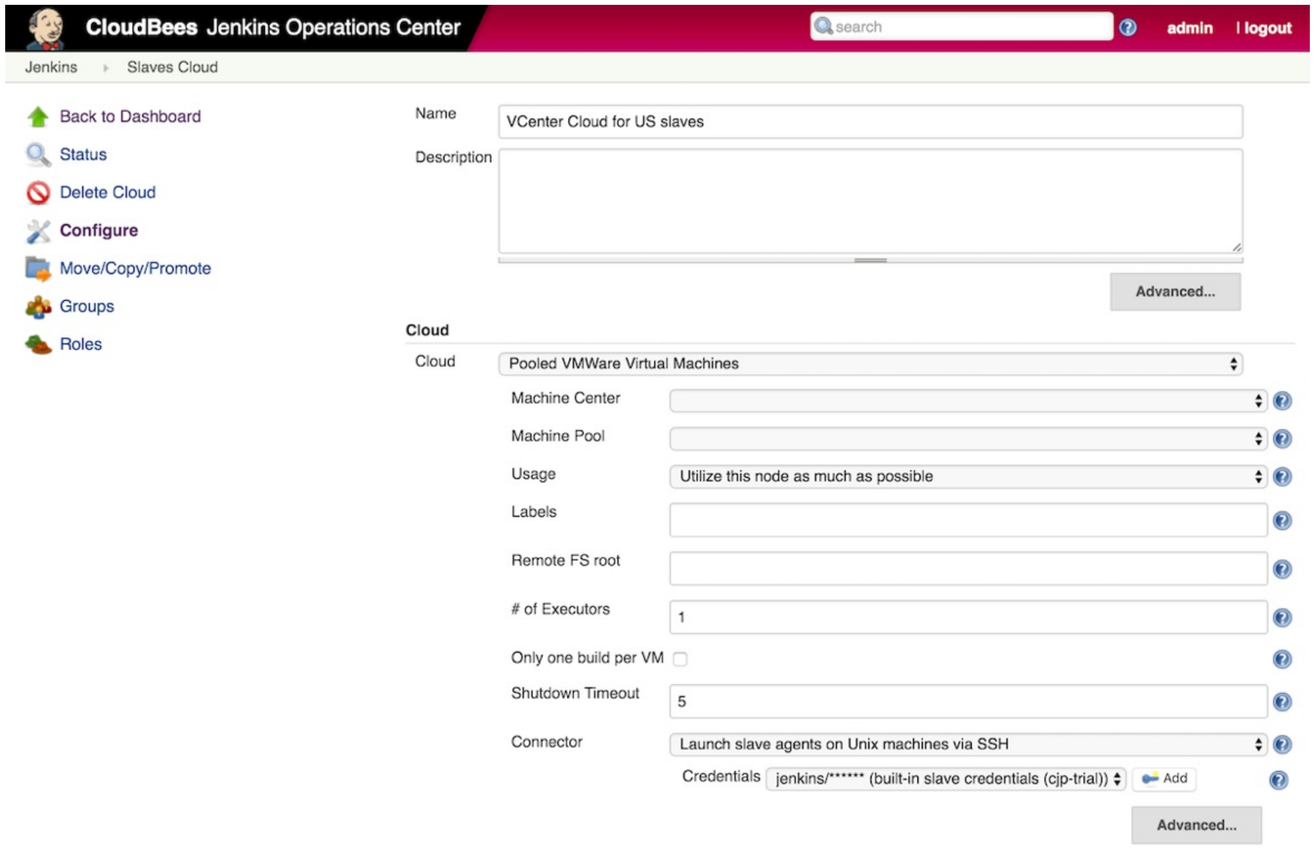
CONCEPTS

- Shared cloud:



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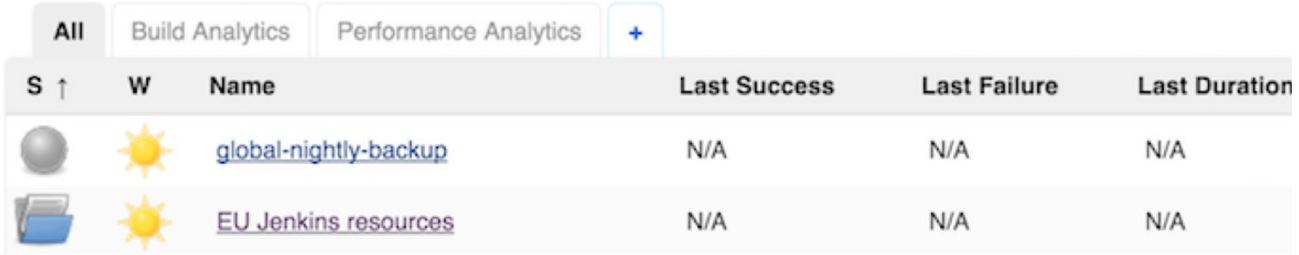
CONCEPTS

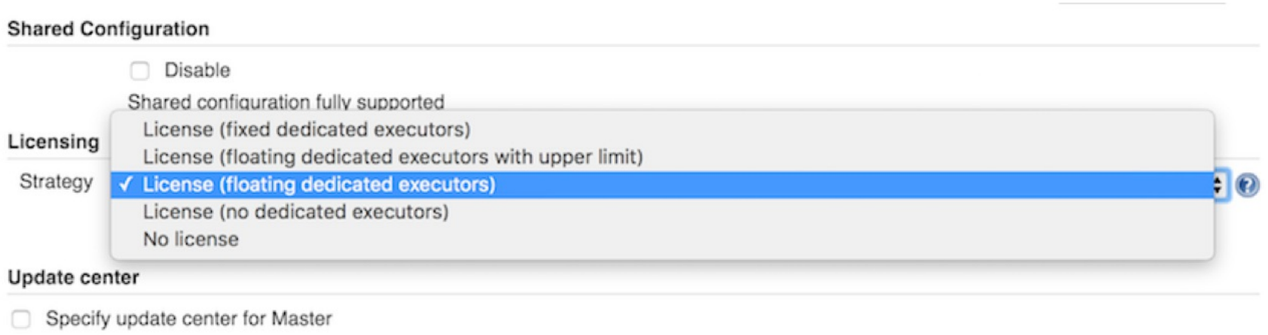
- Folders:



CLOUDBEES UNIVERSITY

CONCEPTS

- Sub-licensing:



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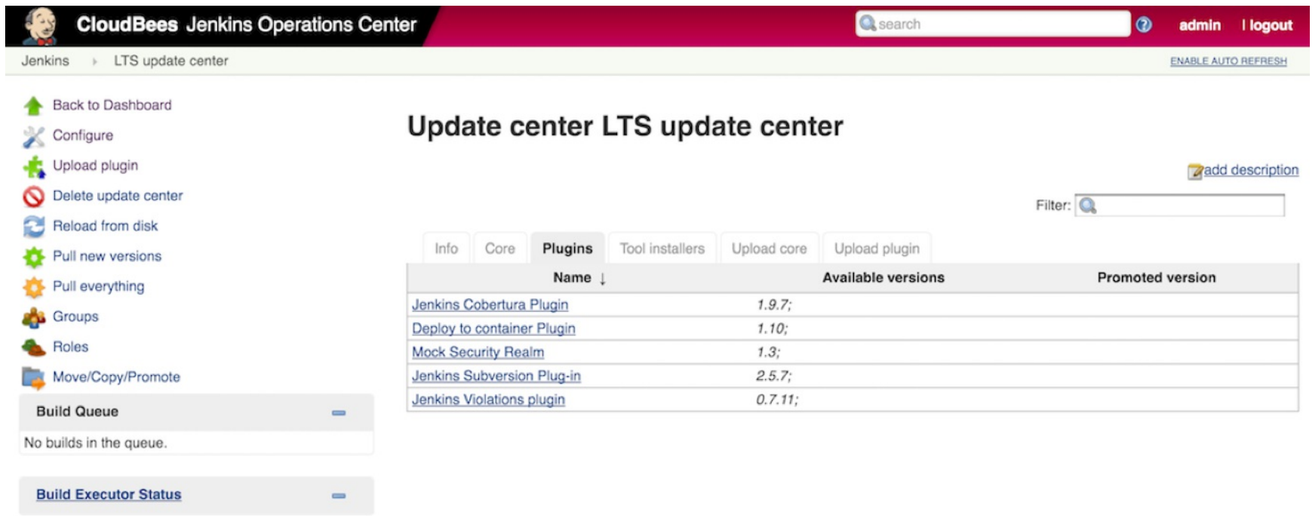
CONCEPTS

- Update Center:



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BENEFIT: MAINTAINABILITY

- While some organizations seek to ease the pain of maintenance by offloading Jenkins to a managed service like CloudBees' DEV@cloud or PSE, CJOC offers an alternative solution.
- CJOC's Cluster Operations can automate maintenance tasks, like plugin and core updates, rollbacks, and master back ups.
  - Cluster Operations can be scheduled, triggered, etc. like regular Jenkins jobs.

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BENEFIT: AUDIT TRAIL

- Track:
  - who performed an update or plugin install,
  - which master or update center was affected,
  - and what the outcome was.
- CJOC's Analytics allows metrics on master/agent usage to be tracked and stored in an Elasticsearch instance.

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BENEFIT: SCALABILITY

- CJOC allows masters to be onboarded quickly, with new masters receiving pre-configured security authorization and authentication settings as well as the ability to “lease” agents from a shared pool.
- Shared agents allow build resources to be used more efficiently between Jenkins masters.

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BENEFIT: STABILITY

- Test masters for production instances can be set up and managed used CJOC.
  - Test instances are the best way to test for plugin/core conflicts before running updates on production masters
- CJOC and client masters are compatible with CloudBees' High Availability plugin.

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WHERE DO WE START?

- CJOC will need to be installed on a server
  - Run as .war, RPM, etc
  - At least 1 GB for CJOC's JVM