Setup

When not using the preinstalled Web IDE provided by your Trainer, it’s also possible to use your local computer.

Local Environment Requirements

In this Training its required to have the following tools locally installed on your computer:

- git
- git bash on Windows
- Argo CD CLI
- oc Tool (OpenShift Client) *Only when on OpenShift*
- kubectl

Argo CD Command line tool

Follow the instructions on this page to install the ArgoCD tool on your local computer.

oc tool

Follow the instructions on this page to install the oc tool on your local computer.

kubectl

Follow the instructions on this page to install the kubectl on your local computer.

Labs

Argo CD is a part of the Argo Project and affiliated under the Cloud Native Computing Foundation (CNCF) . The project is just under three years old, completely open source, and primarily implemented in Go.

As the name suggests, Argo CD takes care of the continuous delivery aspect of CI/CD. Continuous integration is handled by a CI tool such as GitLab CI/CD, Jenkins, Tekton or GitHub Actions. The core of Argo CD consists of a Kubernetes controller, which continuously compares the live-state with the desired-state. The live-state is tapped from the Kubernetes API, and the desired-state is persisted in the form of manifests in YAML or JSON in a Git repository. Argo CD helps to point out deviations of the states, to display the deviations or to autonomously restore the desired state.

Argo CD is deployed and operated on a Kubernetes-based container platform. It is possible to connect multiple Kubernetes and OpenShift clusters to one Argo CD instance.

Argo CD is a declarative, GitOps continuous delivery tool for Kubernetes.

GitOps is a way to do Kubernetes cluster management and application delivery. It works by using Git as a single source of truth for declarative infrastructure and applications. With GitOps, the use of software agents can alert on any divergence between Git with what's running in a cluster, and if there's a difference, Kubernetes reconcilers automatically update or rollback the cluster depending on the case. With Git at the center of your delivery pipelines, developers use familiar tools to make pull requests to accelerate and simplify both application deployments and operations tasks to Kubernetes.

Managing Kubernetes resources using a GitOps approach brings the following benefits:

- The definition of the manifests is done in a declarative way and a tool ensures the comparison between the desired and live manifests. The differences between the desired configurations and the actually applied manifests can be easily seen at any time.
- Rollbacks to older versions are easily possible with git revert or via the used GitOps tool (provided that the application also supports this).
- Manual adjustments directly on the container platform are immediately visible and can be automatically overwritten (self-healing).
- The git commit history is also a detailed audit log
- The developers describe the infrastructure in already known formats and tools like yaml and git.

Argo CD follows the GitOps pattern of using Git repositories as the source of truth for defining the desired application state.

Warning

Argo CD provides a mechanism to override the parameters of Argo CD applications. The Argo CD parameter overrides feature is provided mainly as a convenience to developers and is intended to be used in dev/test environments, vs. production environments.

Many consider this feature as anti-pattern to GitOps. So only use this feature when no other option is available!

Kubernetes manifests can be specified in several ways:

- kustomize applications
- helm charts
- ksonnet applications (deprecated)
- jsonnet files
- Plain directory of YAML/json manifests
- Any custom config management tool configured as a config management plugin

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Argo CD automates the deployment of the desired application states in the specified target environments. Application deployments can track updates to branches, tags, or pinned to a specific version of manifests at a Git commit. See tracking strategies for additional details about the different tracking strategies available.

For a quick 10 minute overview of Argo CD, check out the demo presented to the Sig Apps community meeting:

Argo CD Architecture

Argo CDs core components are the API Server, the Repository Server and the Application Controller

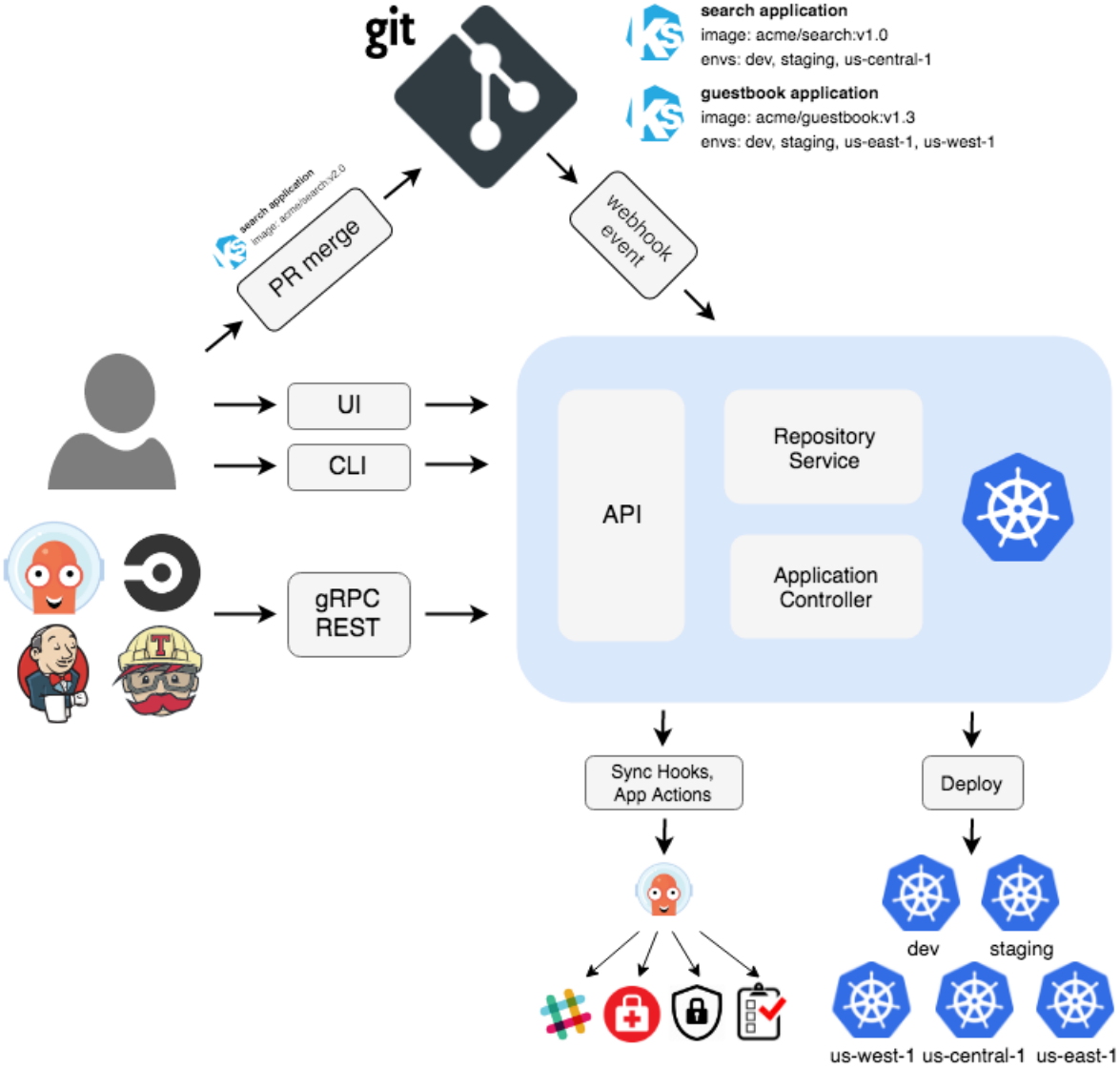

Image and component description source: https://argoproj.github.io/argo-cd/

API Server

The API server is a gRPC/REST server which exposes the API consumed by the Web UI, CLI, and CI/CD systems. It has the following responsibilities:

- application management and status reporting
- invoking of application operations (e.g. sync, rollback, user-defined actions)
- repository and cluster credential management (stored as K8s secrets)
- authentication and auth delegation to external identity providers
- RBAC enforcement
- listener/forwarder for Git webhook events

Repository Server

The repository server is an internal service which maintains a local cache of the Git repository holding the application manifests. It is responsible for generating and returning the Kubernetes manifests when provided the following inputs:

- repository URL
- revision (commit, tag, branch)
- application path
- template specific settings: parameters, ksonnet environments, helm values.yaml

Application Controller

The application controller is a Kubernetes controller which continuously monitors running applications and compares the current, live state against the desired target state (as specified in the repo). It detects OutOfSync application state and optionally takes corrective action. It is responsible for invoking any user-defined hooks for lifecycle events (PreSync, Sync, PostSync)

Argo CD Core Concepts

Those core Concepts exist in Argo CD:

- Clusters: pre configured Kubernetes Clusters (including OpenShift)
- Repositories : pre configured git repositories, including repository credentials (ssh, username-password).
- Applications : A group of Kubernetes resources, represented in a git repository. Usually the Kubernetes resources which will be applied in a Kubernetes namespace. Represented as CRD .
- Projects : A logical grouping of Argo CD applications. Various restrictions can be defined on project level. Useful when multiple Teams work with the same Argo CD instance

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1. Getting started

Task 1.1: Web IDE

The first thing we're going to do is to explore our lab environment and get in touch with the different components.

The namespace with the name corresponding to your username is going to be used for all the hands-on labs. And you will be using the `argocd tool` or the ArgoCD webconsole, to verify what resources and objects Argo CD created for you.

> **Note**
> You can also use your local installation of the cli tools. Make sure you completed the setup before you continue with this lab.

> **Note**
> The URL and Credentials to the Web IDE will provided by the teacher. Use Chrome for the best experience.

Once you're successfully logged into the web IDE open a new Terminal by hitting `CTRL + SHIFT + ¨` or clicking the Menu button –> Terminal –> new Terminal and check the installed kubectlversion by executing the following command:

```
kubectl version
```

The Web IDE Pod consists of the following tools:

- oc
- kubectl
- kustomize
- helm
- kubectx
- kubens
- tekton cli
- odo
- argocd

The files in the home directory under `/home/project` are stored in a persistence volume, so please make sure to store all your persistence data in this directory.

Task 1.1.1: Local Workspace Directory

During the lab, you'll be using local files (eg. YAML resources) which will be applied in your lab project.

Create a new folder for your `<workspace>` in your Web IDE (for example `argocd-training` under `/home/project/argocd-training`). Either you can create it with `right-mouse-click -> New Folder` or in the Web IDE terminal

```
mkdir argocd-training && cd argocd-training
```

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Task 1.1.2: Login on ArgoCD using argocd CLI

You can access Argo CD via Web UI (Credentials are provided by your teacher) or using the CLI. The Argo CD CLI Tool is already installed on the web IDE.

```
argocd login argocd-training.cluster.acend.ch --grpc-web --username NAME
```

Task 1.2: Argo CD CLI

The Argo CD CLI is a powerful tool to manage Argo CD and different applications. It's a self contained binary written in Go and available for Linux, Mac OS and Windows. Thanks to the fact that the CLI is implemented in Go, it can be easily integrated into scripts and build servers for automation purposes.

Task 1.2: Getting familiar with the CLI

Print out the help of the CLI by typing

```
argocd --help
```

You will see a list with the available commands and flags. If you prefer to browse the manual in the browser you'll find it in the online documentation .

```
argocd controls a argo CD server

Usage:
  argocd [flags]
  argocd [command]

Available Commands:
  admin       Contains a set of commands useful for argo CD administrators and requires direct Kubernetes access
  app         Manage applications
  cert        Manage repository certificates and SSH known hosts entries
  cluster     Manage cluster credentials
  completion  Output shell completion code for the specified shell (bash or zsh)
  gpg         Manage GPG keys used for signature verification
  help        Help about any command
  login       Log in to argo CD
  logout      Log out from argo CD
  proj        Manage projects
  relogin     Refresh an expired authentication token
  repo        Manage repository connection parameters
  repocreds   Manage repository connection parameters
  version     Print client and server version information

Flags:
      --auth-token string               Authentication token
      --client-crt string               Client certificate file
      --client-crt-key string           Client certificate key file
      --config string                   Path to Argo CD config (default "/home/NAME/.argocd/config")
      --controller-name string          Name of the argo CD application controller in Kubernetes (overrides ARGOCD_CONTROLLER_NAME)
      --grpc-web                        Enables gRPC-web protocol. Useful if Argo CD server is behind proxy which does not support HTTP2.
      --grpc-web-root-path string       Enables gRPC-web protocol. Useful if Argo CD server is behind proxy which does not support HTTP2 or HTTP1.1 and web rule.
  -H, --header strings                  Sets additional header to all requests made by Argo CD CLI. (Can be repeated multiple times to add multiple headers, also supports comma separated headers)
  -h, --help                            help for argocd
      --http-retry-max int              Maximum number of retries to establish http connection to Argo CD server
      --insecure                        Skip server certificate and domain verification
      --logformat string                Set the logging format. One of: text|json (default "text")
      --loglevel string                 Set the logging level. One of: debug|info|warn|error (default "info")
      --plaintext                       Disable TLS
      --port-forward                    Connect to a random argocd-server port using port forwarding
      --port-forward-namespace string   Namespace name which should be used for port forwarding
      --server string                   Argo CD server address
      --server-crt string               Server certificate file
```

The `--help` flag is available for every command and subcommand of the CLI. Beside the documentation for every flag and subcommand in the current context, it prints out example command lines for the most common use cases.

Now get the help of the `app create` subcommand and find the examples and documentation of the flags.

```
argocd app create --help
```

Task 1.2: Autocompletion

> **Note**
> This step is only needed, when you're not working with the Web IDE we've provided. The autocompletion is already installed in the Web IDE

A productivity booster when working with the CLI is the autocompletion feature. It can be used for `bash` and `zsh` shells. You can enable the autocompletion for the current `bash` with the following command:

```
source <(argocd completion bash)
```

After typing `argocd` you can autocomplete the subcommands with a double tap the tabulator key. This works even for deployed artifacts on the cluster: A double tab after `argocd app get` lists all defined Argo CD applications.

To install autocompletion permanently you can add the following command in the `~/.bashrc` file.

```
echo "source <(argocd completion bash)" >> ~/.bashrc
source ~/.bashrc
```

Find further information in the official documentation

2. Simple Example

In this lab you will learn how to deploy a simple application using Argo CD.

Our lab setup consists of the following components:

- Git Server (Gitea): https://gitea.training.cluster.acend.ch
- Argo CD Server: https://argocd.training.cluster.acend.ch
- Kubernetes Cluster

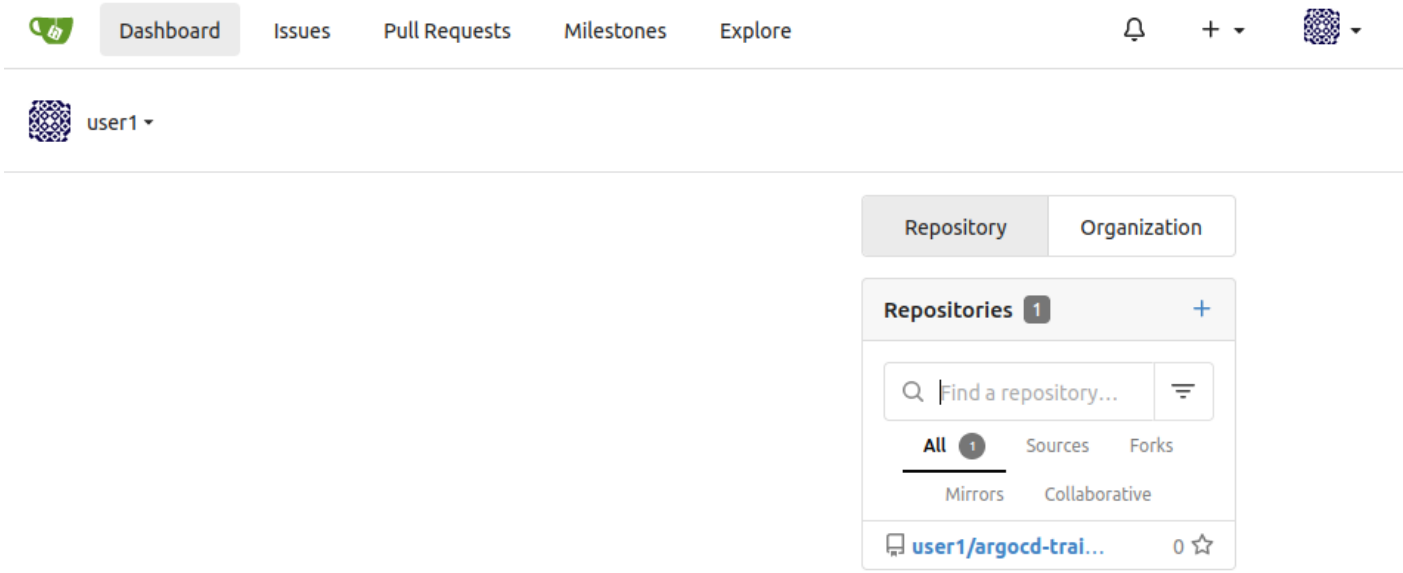
Task 2.1: Login to the Gitea and Clone the Repo

For this Training we've installed a Git Server under https://gitea.training.cluster.acend.ch . We also forked the Argo CD Example Repo for your `<username>` .

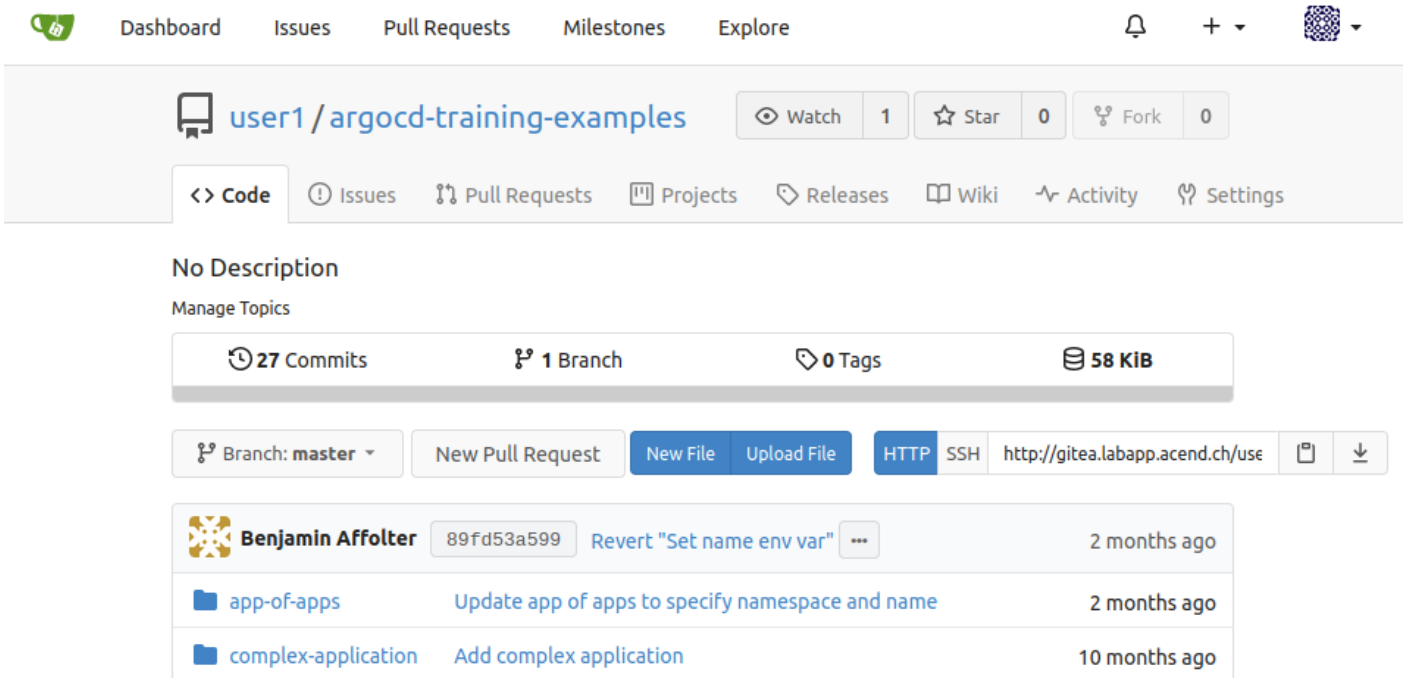
Open your Webbrowser and navigate to https://gitea.training.cluster.acend.ch . Login with the training credentials provided by the trainer (Login Button is in the upper right corner).

> **Note**
> Users which have a personal Github account can just fork the Repository argocd-training-examples to their personal account. To fork the repository click on the top right of the Github on *Fork*.

The Git Repository is available under your Repositories



By clicking on the repository link in the repository list you get to the detail page.



The **URL** of the Git repository, we'll be working with, will look like `https://gitea.training.cluster.acend.ch/<username>/argocd-training-examples.git` .

Within the Web IDE we set the `USER` environment variable to your personal `<username>` .

Verify that with the following command:

```
```

The `USER` variable will be used as part of the commands to make the lab experience more comfortable for you.

Note

If you're **not** using our lab webshell to execute the labs, make sure to set the `USER` environment variable accordingly with the following command `export USER=<username>`

Clone the forked repository to your local workspace:

```
```

... or the corresponding URL if you have choosen to use your own Git Server.

Change the working directory to the cloned git repository:

```
```

When using the Web IDE: Configure the Git Client and verify the output

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```
git config user.name "<USER>"
git config user.email "<USER>@training.cluster.acend.ch"
```

And we also want git to store our Password for the whole day so that we don’t need to login every single time we push something.

```
git config credential.helper 'cache --timeout=<USER>'
```

Then use the following command to verify whether the git config for username and email were correctly added:

```
git config --local --list
```

Task 2.2: Deploying the resources with Argo CD

Now we want to deploy the resource manifests contained in the cloned repository with Argo CD to demonstrate the basic features of Argo CD.

To deploy the resources using the Argo CD CLI use the following command:

```
argocd app create argo-<USER> --repo https://gitea.training.cluster.acend.ch/<USER>/argocd-training-examples.git --path 'example-app' --dest-server https://kubernetes.default.svc --dest-namespace <USER>
```

Expected output: `application 'argo-<username>' created`

Note

We don’t need to provide Git credentials because the repository is readable for non-authenticated users as well

Note

If you want to deploy it in a different namespace, make sure the namespaces exists before synching the app

Once the application is created, you can view its status:

```
argocd app get argo-<USER>
```

```
Project:        default
Server:         https://kubernetes.default.svc
Namespace:      <USER>
URL:            https://argocd.training.cluster.acend.ch/applications/argo-<username>
Repo:           https://gitea.training.cluster.acend.ch/<username>/argocd-training-examples.git
Target:
Path:           example-app
SyncWindow:     Sync Allowed
Sync Policy:    <none>
Sync Status:    OutOfSync from  (5a61d32)
Health Status:  Missing

GROUP  KIND        NAMESPACE  NAME        STATUS     HEALTH   HOOK  MESSAGE
       Service     <username>  simple-example  OutOfSync  Missing
apps   Deployment  <username>  simple-example  OutOfSync  Missing
```

The application status is initially in OutOfSync state. To sync (deploy) the resource manifests, run:

```
argocd app sync argo-<USER>
```

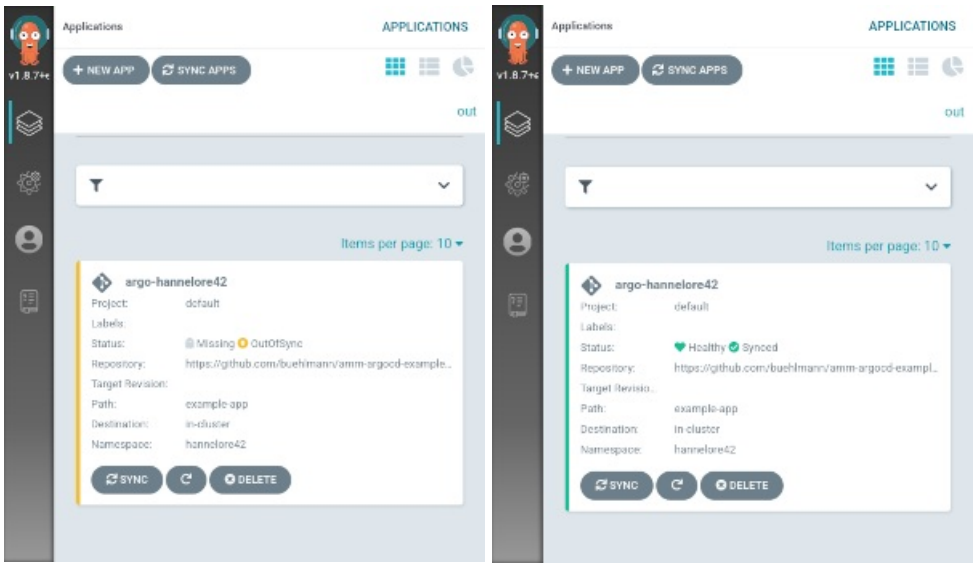
This command retrieves the manifests from the git repository and performs a `kubectl apply` on them. Because all our manifests has been deployed manually before, no new rollout of them will be triggered on Kubernetes. But form now on, all resources are managed by Argo CD. Congrats, the first step in direction GitOps! :)

You should see an output similar to the following lines:

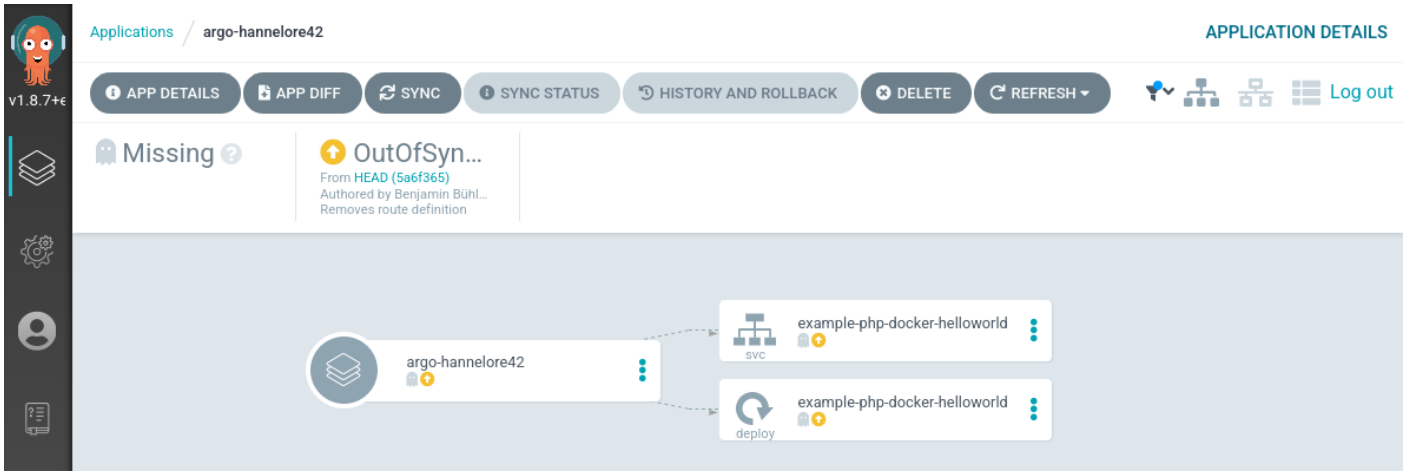
```
[redacted]
```

Check the Argo CD UI to browse the application and their components. The URL of the Argo CD webinterface will be provided by the teacher.

Application overview in unsynced and synced state



Detailed view of a application in unsynced and synced state



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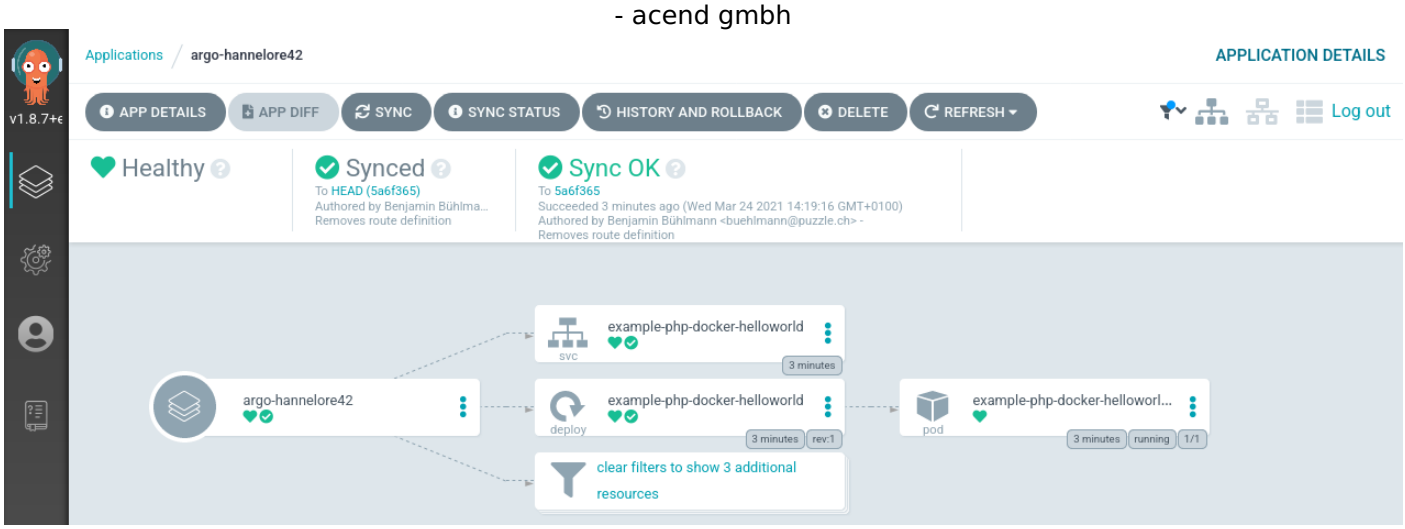
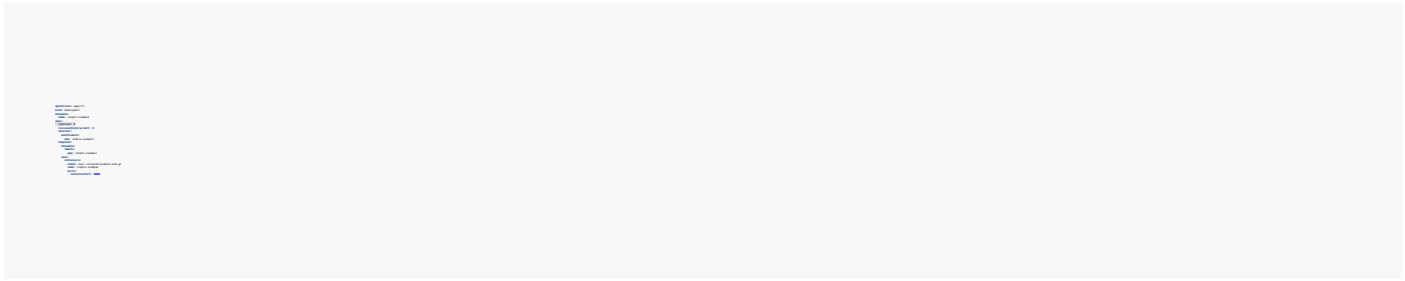


Task 2.3: Automated Sync Policy and Diff

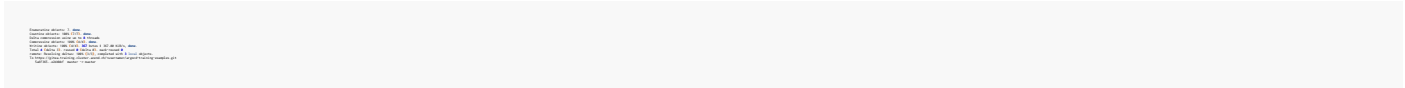
When there is a new commit in your Git repository, the Argo CD application becomes OutOfSync. Let's assume we want to scale up our `Deployment` of the example application from 1 to 2 replicas. We will change this in the Deployment manifest.

Increase the number of replicas in your file `<workspace>/example-app/deployment.yaml` to 2.



Commit the changes and push them to your personal remote Git repository. After the Git push command a **password** input field will appear at the top of the Web IDE.

After a successful push you should see the following output



Check the state of the resources by cli:

The parameter `--refresh` triggers an update against the Git repository. Out of the box Git will be polled by Argo CD in a predefined interval (defaults to 3 minutes). To use a synchronous workflow you can use webhooks in Git. These will trigger a synchronization in Argo CD on every push to the repository.

You will see that the Deployment is now OutOfSync:

```
Name:               argo-<username>
Project:            default
Server:             https://kubernetes.default.svc
Namespace:          <username>
URL:                https://argocd.training.cluster.acend.ch/applications/argo-<username>
Repo:               https://gitea.training.cluster.acend.ch/<username>/argocd-training-examples.git
Target:
Path:               example-app
SyncWindow:         Sync Allowed
Sync Policy:        <none>
Sync Status:        OutOfSync from  (e2d4bbf)
Health Status:      Healthy

GROUP  KIND        NAMESPACE   NAME            STATUS     HEALTH   HOOK  MESSAGE
       Service     <username>  simple-example  Synced     Healthy        service/simple-example created
apps   Deployment  <username>  simple-example  OutOfSync  Healthy        deployment.apps/simple-example created
```

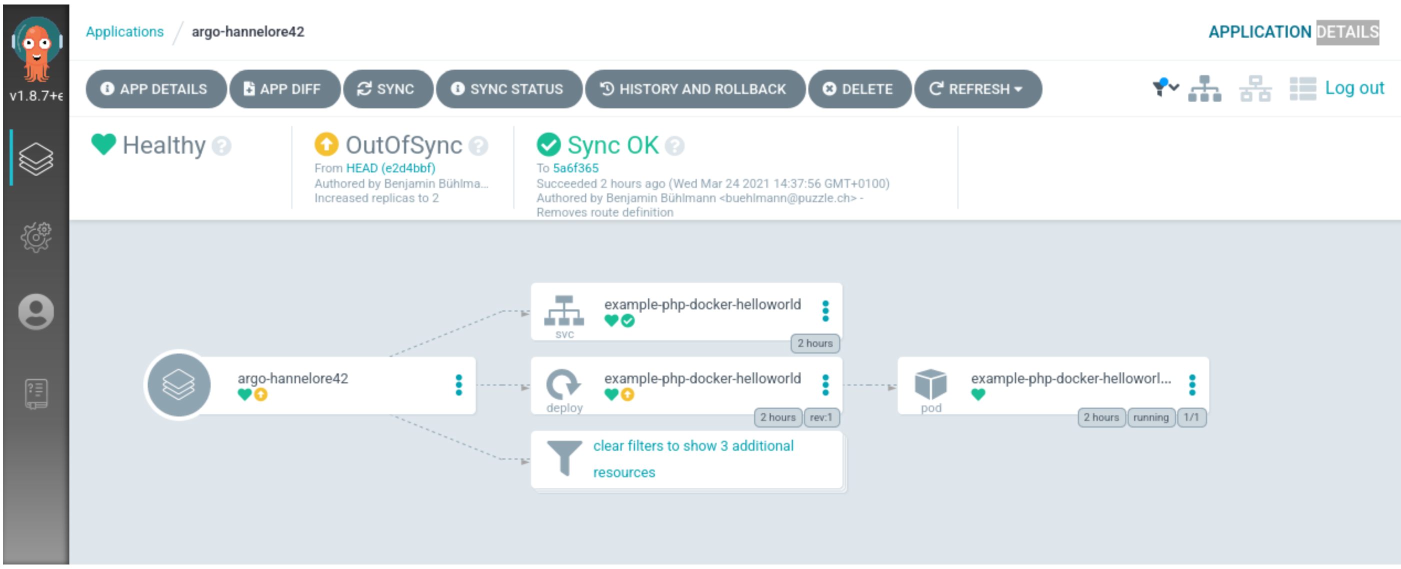
When an application is OutOfSync then your deployed 'live state' is no longer the same as the 'target state' which is represented by the resource manifests in the Git repository. You can inspect the differences between live and target state by cli:

```
argocd app diff argo-$USER
```

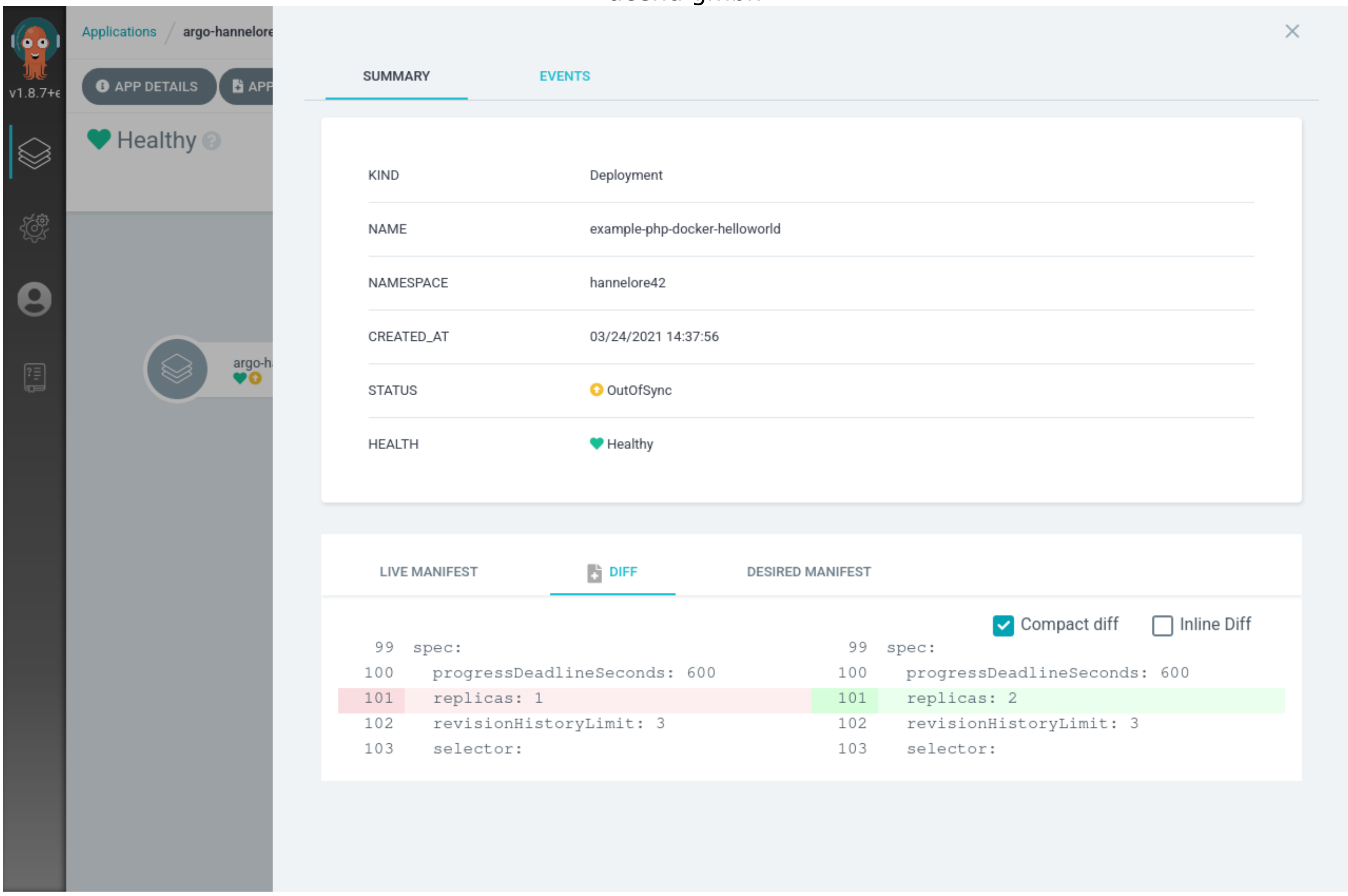
which should give you an output similar to:

```
===== apps/Deployment <username>/simple-example ======
101c102
<   replicas: 1
---
>   replicas: 2
```

Now open the web console of Argo CD and go to your application. The deployment `simple-example` is marked as 'OutOfSync':



With a click on Deployment > Diff you will see the differences:



Now click `Sync` on the top left and let the magic happens ;) The application will be scaled up to 2 replicas and the resources are in Sync again.

Double-check the status by cli

```
argocd app get argo-$USER
```

```
Name:               argo-<username>
Project:            default
Server:             https://kubernetes.default.svc
Namespace:          <username>
URL:                https://argocd.training.cluster.acend.ch/applications/argo-<username>
Repo:               https://gitea.training.cluster.acend.ch/<username>/argocd-training-examples.git
Target:
Path:               example-app
SyncWindow:         Sync Allowed
Sync Policy:        <none>
Sync Status:        Synced to  (e2d4bbf)
Health Status:      Healthy

GROUP  KIND        NAMESPACE    NAME            STATUS  HEALTH   HOOK  MESSAGE
       Service     <username>   simple-example  Synced  Healthy        service/simple-example unchanged
apps   Deployment  <username>   simple-example  Synced  Healthy        deployment.apps/simple-example configured
```

Argo CD can automatically sync an application when it detects differences between the desired manifests in Git, and the live state in the cluster. A benefit of automatic sync is that CI/CD pipelines no longer need direct access to the Argo CD API server to perform the deployment. Instead, the pipeline makes a commit and push to the Git repository with the changes to the manifests in the tracking Git repo.

To configure automatic sync run (or use the UI):

```
argocd app set argo-$USER --sync-policy automated
```

From now on Argo CD will automatically apply all resources to Kubernetes every time you commit to the Git repository.

Decrease the replicas count to 1 and push the updated manifest to remote. Wait for a few moments and see check that ArgoCD will scale the deployment of the example app down to 1 replica. The default polling interval is 3 minutes. If you don’t want to wait you can force a refresh by clicking `Refresh` in the UI or by cli:

```
argocd app get argo-XXXX --refresh
```

Task 2.4: Automatic Self-Healing

By default, changes made to the live cluster will not trigger automatic sync. To enable automatic sync when the live cluster’s state deviates from the state defined in Git, run:

```
argocd app set argo-XXXX --self-heal
```

Watch the deployment `simple-example` in a separate terminal

```
kubectl get deployment simple-example --watch --namespace=XXXX
```

Let’s scale our `simple-example` Deployment and observe whats happening:

```
kubectl scale deployment simple-example --replicas=3 --namespace=XXXX
```

Argo CD will immediately scale back the `simple-example` Deployment to `1` replicas. You will see the desired replicas count in the watched Deployment.

```
NAME             READY   UP-TO-DATE   AVAILABLE   AGE
simple-example   1/3     3            1           174m
simple-example   1/3     3            1           174m
simple-example   1/3     3            1           174m
simple-example   1/3     3            1           174m
simple-example   1/3     3            1           174m
simple-example   1/3     3            1           174m
simple-example   2/3     3            2           174m
simple-example   3/3     3            3           174m
```

This is a great way to enforce a strict GitOps principle. Changes which are manually made on deployed resource manifests are reverted immediately back to the desired state by the ArgoCD controller.

Task 2.5: Expose Application

This is an optional task.

To expose an application we need to specify a so called `ingress` resource. Create an `ingress.yaml` file next to the `deployment.yaml` in the example-app directory with the following content.

```
---
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: simple-example
spec:
  rules:
  - host: simple-example-<username-training-cluster.acend.ch
    http:
      paths:
      - path: /
        pathType: Prefix
        backend:
          service:
            name: simple-example
            port:
              number: 5000
...
  - hosts:
    - simple-example-<username-training-cluster.acend.ch
```

Commit and Push the changes again, like you did before:

```
git add .
git commit -m "Expose application"
git push
```

After ArgoCD syncs the changes, you can access the example applications url: `https://simple-example-<username>.training.cluster.acend.ch`

Verify using the following command:

```
curl https://simple-example-$USER.training.cluster.acend.ch
```

The result should look similar to this:

```
<h1 style=color:#e81198>Hello golang</h1><h2>ID: e81198</h2>
```

Task 2.6: Pruning

You probably asked yourself how can I delete deployed resources on the container platform? Argo CD can be configured to delete resources that no longer exist in the Git repository.

First delete the files `service.yaml` and `ingress.yaml` from Git repository and push the changes

```
git add .
git add --all && git commit -m 'Removes service and ingress' && git push
```

Check the status of the application with

```
argocd app get argo-$USER --refresh
```

You will see that even with auto-sync and self-healing enabled the status is still OutOfSync

```
GROUP              KIND        NAMESPACE  NAME            STATUS     HEALTH   HOOK  MESSAGE
networking.k8s.io  Ingress     <username> simple-example  OutOfSync  Healthy        ingress.networking.k8s.io/simple-example created
                   Service     <username> simple-example  OutOfSync  Healthy
apps               Deployment  <username> simple-example  Synced     Healthy
```

Now enable the auto pruning explicitly:

```
argocd app set argo-$USER --auto-prune
```

Recheck the status again

```
argocd app get argo-$USER --refresh
```

```
GROUP       KIND        NAMESPACE  NAME            STATUS     HEALTH   HOOK  MESSAGE
extensions  Ingress     <username> simple-example  Succeeded  Pruned         pruned
            Service     <username> simple-example  Succeeded  Pruned         pruned
apps        Deployment  <username> simple-example  Synced     Healthy        deployment.apps/simple-example unchanged
```

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The Service was successfully deleted by Argo CD because the manifest was removed from git. See the HEALTH and MESSAGE of the previous console output.

Task 2.7: State of ArgoCD

Argo CD is largely built stateless. The configuration is persisted as native Kubernetes objects. And those are stored in Kubernetes *etcd*. There is no additional storage layer needed to run ArgoCD. The Redis storage under the hood acts just as a throw-away cache and can be evicted anytime without any data loss.

The configuration changes made on ArgoCD objects through the UI or by cli tool `argocd` are reflected in updates of the ArgoCD Kubernetes objects `Application` and `AppProject` in the `argocd` namespace.

Let's list all Kubernetes objects of type `Application` (short form: `app`)

```
kubectl get applications -n<namespace>argocd
```

```
NAME                SYNC STATUS   HEALTH STATUS
argo-<username>     Synced        Healthy
```

You will see the application which we created some chapters ago by cli command `argocd app create...` . To see the complete configuration of the `Application` as *yaml* use:

```
kubectl get applications.argoproj.io argo-k8s -o yaml -n<namespace>argocd
```

You even can edit the `Application` resource by using:

```
kubectl edit applications.argoproj.io argo-k8s -n<namespace>argocd
```

This allows us to manage the ArgoCD application definitions in a declarative way as well. It is a common pattern to have one ArgoCD application which references n child Applications which allows us a fast bootstrapping of a whole environment or a new cluster. This pattern is well known as the *App of apps* pattern.

Task 2.8: Accessing a private Git repository

The Git repository we have imported to Gitea is public available for the whole world. When accessing a private repository we have to provide credentials in form of a username/password pair or a ssh private key. In this task you will learn how to access a protected repo from Argo CD.

First make the Git repository in Gitea private by checking the option `Visibility: Make Repository Private` under `Settings -> Repository` . Now sync the app again.

```
argocd app sync argo-k8s
```

You will see the following error

```
FATA[0000] rpc error: code = FailedPrecondition desc = authentication required
```

Argo CD can’t any longer access the protected repository without providing credentials for authentication. Next assign credentials to used Git repository. You have to provide the Gitea password interactively.

```
argocd repo add https://gitea.training.cluster.acend.ch:8080/argocd-training/examples.git --username test01
```

> **Note**
> You can provide the password through the cli by using the flag `--password`.

Now the sync should work. Argo CD use the configured credentials to authenticate against your repository in Gitea.

```
argocd app sync argo-test01
```

You can define credential templates when using the same credential for multiple Git repositories. The configured credentials are used for each Git repository beginning with the configured URL. The following command will create a credential which matches all git repositories for your username (e.g. https://<username>@gitea.training.cluster.acend.ch/<username>)

```
argocd repocreds add https://gitea.training.cluster.acend.ch:8080 --username test01
```

Finally make your personal Git repository public again for the following labs. Uncheck the option `Visibility: Make Repository Private` under `Settings -> Repository` in the Gitea UI.

> **Note**
> TLS certificates and SSH private keys are supported alternative authentication methods by Argo CD. Proxy support can be configured as well in the repository settings.

Have a look in the documentation for detailed information about accessing private repositories.

Task 2.9: Delete the Application

You can cascading delete the ArgoCD Application with the following command:

```
argocd app delete argo-test01
```

Hit `y` to confirm the deletion and this will delete the `Application` manifests of ArgoCD and all created resources by this application. In our case the `Application`, `Deployment` and `Service` will be deleted. With the flag `--cascade=false` only the ArgoCD `Application` will be deleted and the created resources `Deployment` and `Service` remain untouched.

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3. Resource Hooks

In this Lab you are going to learn about Resource Hooks .

Resource Hooks

Hooks allow to run scripts before, during and after the Argo CD **sync** operation is running. They give you more control over the sync process. They can also run when the sync operation fails for example. The concept is very similar to the concept of Helm Hooks . Argo CD supports many Helm hooks by mapping the Helm annotations onto Argo CD's own hook annotations. You can see the full mapping of the Helm hooks in the ArgoCD documentation

Some examples when hooks can be useful:

- `PreSync` hook. Upgrading a Database, Performing a migration before deploying a new version of the application.
- `PostSync` hook. Run integration, smoke and other tests after the deployment to verify its status.
- `Sync` hook. Allows to run more complex deployment strategies. e.g.: Blue-Green or Canary Deployments
- `SyncFail` hook. Clean up a failed deployment.

Hooks are annotated `argocd.argoproj.io/hook: <hook>` Kubernetes resources in the source repository, which Argo CD will apply during the sync operation.

A `PreSync` Hook to run a database migration might therefore look like this:

It's basically a Kubernetes Job which starts a Pod that executes some sort of code.

> **Note**
> Named hooks (i.e. ones with `/metadata/name`) will only be created once. If you want a hook to be re-created each time either use BeforeHookCreation policy or `/metadata/generateName`.

> **Note**
> Hooks are not run during a selective sync

Hook Deletion Policies

The hook deletion policy defines when a hook should be deleted. It's also configured with an annotation `argocd.argoproj.io/hook-delete-policy` on the hook resource.

- `HookSucceeded` : will be deleted after the hook succeeded
- `HookFailed` : will be deleted after a hook failed
- `BeforeHookCreation` : Any hook resource will be deleted before the new one is created.

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Task 3.1: Hook Example

In this task we're going to deploy an example which has `pre` and `post` hooks.

Create the new application `argo-hook-$USER` with the following command. It will create a service, a deployment and two hooks as soon as the application is synced.

- PreSync: before Job
- Sync: Deployment with name `pre-post-sync-hook`
- PostSync: after Job

```
argocd app create argo-hook-$USER --repo https://github.com/acend/kubernetes-training.git --path pre-post-sync-hook --dest-server https://kubernetes.default.svc --dest-namespace $USER
```

Sync the application

```
argocd app sync argo-hook-$USER
```

And verify the deployment:

```
kubectl get pod --namespace $USER --watch
```

Or in the web UI.

Task 3.2: Post-hook Curl (Optional)

Alter the post sync hook command from `sleep` to `curl https://acend.ch` (Could be used to send a notification to a Chat channel) The curl command is not available in the minimal `quay.io/acend/example-web-go` image. You can use `quay.io/acend/example-web-python` or different image.

Edit the hook under `pre-post-sync-hook/post-sync-job.yaml` accordingly, commit and push the changes and trigger the sync operation.

```
apiVersion: batch/v1
kind: Job
metadata:
  name: post-job
  annotations:
    argocd.argoproj.io/hook: PostSync
    argocd.argoproj.io/hook-delete-policy: HookSucceeded
spec:
  template:
    spec:
      containers:
        - name: post
          image: quay.io/acend/example-web-python
          command: ["curl", "https://acend.ch"]
      restartPolicy: Never
```

Task 3.3: Delete the Application

Delete the application after you've explored the Argo CD Resources and the managed Kubernetes resources.

```
argocd app delete argo-hook-$USER
```

4. Sync Phases and Waves

In this Lab you are going to learn about Sync Phases and Waves .

Sync Phases and Waves

At a high-level, Argo CD executes the sync operation in the three phases pre-sync, sync and post-sync.

Within each phase you can have one or more waves, that allows you to ensure certain resources are healthy before subsequent resources are synced.

When Argo CD starts a sync, it orders the resources in the following precedence:

- The phase
- The wave they are in (lower values first)
- By kind (e.g. namespaces first)
- By name

It then determines the number of the next wave to apply. This is the first number where any resource is out-of-sync or unhealthy.

It applies resources in that wave.

It repeats this process until all phases and waves are in-sync and healthy.

How to specify waves and phases

Pre-sync and post-sync can only contain hooks defined on annotations `argocd.argoproj.io/hook: PreSync` .

You can specify the wave in the sync phase by setting an annotation `argocd.argoproj.io/sync-wave` . Hooks and resources are assigned to wave zero by default. The wave can be negative, so you can create a wave that runs before all other resources.

Task 4.1: Sync Wave Example

Let’s now get our hands on a sync wave example.

Create the new application `argo-wave-$USER` with the following command. The Application consist of the following resources, phases and waves:

- PreSync
  - Job: upgrade-sql-schema
- Sync Wave 0
  - Deployment: backend
  - Service: backend
- Sync Wave 1
  - Job: maintenance-page-up
- Sync Wave 2
  - Deployment: frontend
  - Service: frontend
- Sync Wave 3
  - Job: maintenance-page-down

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```
argocd app create argo-user-9d0f --repo https://gitea.training.cluster.acend.ch/9d0f/argocd-training-example.git --path ./ --dest-server https://kubernetes.default.svc --dest-namespace 9d0f
```

Sync the application:

```
argocd app sync argo-user-9d0f
```

And verify the deployment:

```
kubectl get pod --namespace 9d0f --watch
```

Task 4.2: Delete the Application

Delete the application after you've explored the Argo CD Resources and the managed Kubernetes resources.

```
argocd app delete argo-user-9d0f
```

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5. Tools

In this Lab you are going to learn about different application source tools .

Tools

As mentioned in the introduction Argo CD supports many different formats in which the Kubernetes manifests can be defined:

- kustomize applications
- helm charts
- ksonnet applications (deprecated)
- jsonnet files
- Plain directory of YAML/json manifests
- Any custom config management tool configured as a config management plugin

So far you have been using **plain YAML** manifest in the previous labs.

> **Warning**
> Argo CD provides a mechanism to override the parameters of Argo CD applications. The Argo CD parameter overrides feature is provided mainly as a convenience to developers and is intended to be used in dev/test environments, vs. production environments.
>
> Many consider this feature as anti-pattern to GitOps. So only use this feature when no other option is available!

Tool Detection

When the build tool is not specified explicitly in the Argo CD Application CRD it will be detected:

- `Helm` if there's a file matching `Chart.yaml` .
- `Kustomize` if there's a `kustomization.yaml` , `kustomization.yml` , or `Kustomization`
- `jsonnet` if there's a `*.jsonnet` file.

You are now going to deploy an application in the different formats.

You can also find additional examples here .

5.1 Helm

This lab explains how to use Helm as manifest format together with Argo CD.

Helm Introduction

Helm is a Cloud Native Foundation project to define, install and manage applications in Kubernetes.

It can be used to package multiple Kubernetes resources into a single logical deployment unit.

Helm Charts are configured using `values.yaml` files. (e.g. images, image tags, hostnames, ...).

When using `helm` charts together with Argo CD we can specify the `values.yaml` like this:

```
argocd app set argocd-lab05 --values values-production.yaml
```

The `--values` flag can be repeated to support multiple values files.

> **Info**
> Values files must be in the same git repository as the Helm chart. The files can be in a different location in which case it can be accessed using a relative path relative to the root directory of the Helm chart.

Helm Parameters

Similar to when using `helm` directly (`helm install <release> --set replicaCount=2 ./mychart --namespace <namespace>`), you are able to overwrite values from the values.yaml, by setting parameters.

```
argocd app set argocd-lab05 --parameter replicaCount=2
```

> **Warning**
> Argo CD provides a mechanism to override the parameters of Argo CD applications. The Argo CD parameter overrides feature is provided mainly as a convenience to developers and is intended to be used in dev/test environments, vs. production environments.
>
> Many consider this feature as anti-pattern to GitOps. So only use this feature when no other option is available!

Helm Release Name

By default, the Helm release name is equal to the Application name to which it belongs. Sometimes, especially on a centralised ArgoCD, you may want to override that name, and it is possible with the `release-name` flag on the cli:

```
argocd app set argocd-lab05 --release-name myRelease
```

> **Warning**
> Please note that overriding the Helm release name might cause problems when the chart you are deploying is using the app.kubernetes.io/instance label. ArgoCD injects this label with the value of the Application name for tracking purposes.

Helm Hooks

Helm hooks are similar to the Argo CD Hooks from lab 4 .

Further Docs

Read more about the helm integration in the official documentation

Task 5.1.1: Deploy the simple-example as Helm Chart

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Let’s deploy the simple-example from lab 1 using a helm chart .

First you’ll have to create a new Argo CD application.

```
argocd app create argo-tute-6609 --repo https://gitea.training.cluster.acend.ch/6609/argocd-training-examples.git --path 'helm/simple-example' --dest-server https://kubernetes.default.svc --dest-namespace 6609 --values values.yaml
```

Sync the application

To sync (deploy) the resources you can simply click sync in the web UI or execute the following command:

```
argocd app sync argo-tute-6609
```

And verify the deployment:

```
kubectl get pod --namespace 6609 --watch
```

Tell the application to sync automatically, to enable self-healing and auto-prune

```
argocd app set argo-tute-6609 --sync-policy automated
argocd app set argo-tute-6609 --self-heal
argocd app set argo-tute-6609 --auto-prune
```

Task 5.1.2: Scale the deployment to 2 replicas

We can set the `helm` parameter with the following command:

```
argocd app set argo-tute-6609 --parameter replicaCount=2
```

> **Warning**
> Only use this way of setting params in dev and test stages. Not for Production!

Since the `sync-policy` is set to `automated` the second pod will be deployed immediately.

Task 5.1.3: Ingress

The proper and production ready way of overwriting values is by doing it in git.

Change the `helm/simple-example/values.yaml` file in your git repository

```
ingress:
  enabled: true
  hosts:
    - host: tute-<username>.training.cluster.acend.ch
      paths:
        - /
  tls:
    - hosts:
        - tute-<username>.training.cluster.acend.ch
      secretName: acend-wildcard
```

Commit and push the changes to your repository.

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```
git add helm/simple-example/values.yaml
git commit -m "Update ingress"
git push
```

Open your Browser and verify whether you can access the application.

Task 5.1.4: Create a second application representing the production stage

Let’s now also deploy an application for the production stage.

Create a new values.yaml file for the production stage: `helm/simple-example/values-production.yaml` And copy the content from the default `helm/simple-example/values.yaml` file.

Change the host in the `helm/simple-example/values-production.yaml` to the production url

```
ingress:
  enabled: true
  hosts:
    - host: helloteilnehmer-prod-training.cluster.acend.ch
      paths:
        - /
  tls:
    - hosts:
        - helloteilnehmer-prod-training.cluster.acend.ch
      secretName: acend-schweiz
```

Commit and push the changes to your repository.

```
git add helm/simple-example/values-production.yaml
git commit -m "Add prod stage"
git push
```

Let’s create the production stage Argo CD application with the name `argo-helm-prod-$USER` and enable automated sync, self-healing and pruning.

```
argocd app create argo-helm-prod-$USER --repo https://github.com/acend/argocd-training-examples.git --path 'helm/simple-example' --dest-server https://kubernetes.default.svc --dest-namespace $USER
argocd app set argo-helm-prod-$USER --sync-policy automated
argocd app set argo-helm-prod-$USER --auto-heal
argocd app set argo-helm-prod-$USER --self-heal
```

And verify the deployment:

```
kubectl get pod --namespace $USER --watch
```

Tell the Argo CD app to use the `values-production.yaml` values file

```
argocd app set argo-helm-prod-$USER --values values-production.yaml
```

Change for example the ingress hostname to something different in the `values-production.yaml` and verify whether you can access the new hostname.

Task 5.1.4: Delete the Applications

Delete the applications after you’ve explored the Argo CD Resources and the managed Kubernetes resources.

```
argocd app delete argo-helm-$USER
argocd app delete argo-helm-prod-$USER
```

5.2 Kustomize

This lab explains how to use kustomize as manifest format together with Argo CD.

Kustomize Introduction

Kustomize introduces a template-free way to customize application configuration that simplifies the use of off-the-shelf applications. It is built into `kubectl` and `oc` with the command `kubectl apply -k` or `oc apply -k` .

It uses a concept called overlays, which allows to reduce redundant configuration for multiple stages (e.g. dev, prod, test) without a use of a template language.

Argo CD supports kustomize manifests out of the box.

Kustomize Overlays

When you want to use Kustomize with an overlay, you have to point the Argo Application to the Overlay

Kustomize Configuration

The following configuration options are available for Kustomize:

- `namePrefix` is a prefix appended to resources for Kustomize apps
- `nameSuffix` is a suffix appended to resources for Kustomize apps
- `images` is a list of Kustomize image overrides
- `commonLabels` is a string map of an additional labels
- `commonAnnotations` is a string map of an additional annotations

Use the following command to set those parameters:

```
argocd app set argo-kustomize-$USER --nameprefix=<namePrefix>
```

Further Docs

Read more about the kustomize integration in the official documentation

Task 5.2.1: Deploy the simple-example with kustomize

Let’s deploy the simple-example from lab 1 using kustomize .

First you’ll have to create a new Argo CD application.

```
argocd app create argo-kustomize-$USER --repo https://gitea.training.cluster.acend.ch/$USER/argocd-training-examples.git --path 'kustomize/simple-example' --dest-server https://kubernetes.default.svc --dest-namespace $USER
```

Sync the application

To sync (deploy) the resources you can simply click sync in the web UI or execute the following command:

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```
argocd app sync argo-kustomize-$USER
```

And verify the deployment:

```
kubectl get pod --namespace $USER --watch
```

Tell the application to sync automatically, to enable self-healing and auto-prune

```
argocd app set argo-kustomize-$USER --sync-policy automated
argocd app set argo-kustomize-$USER --self-heal
argocd app set argo-kustomize-$USER --auto-prune
```

Task 5.2.2: Set a configuration parameter

We can set the `kustomize` configuration parameter with the following command:

```
argocd app set argo-kustomize-$USER --kustomize-image
```

And take a look at the application in the web UI or using the command line tool

```
argocd app get argo-kustomize-$USER
```

> **Warning**
> Only use this way of setting params in dev and test stages. Not for Production!

Task 5.2.3: Create a second application representing the production stage

Let’s now also deploy an application for the production stage.

This does mean we deploy an overlay which specifically configures the production stage.

Let’s create the production stage Argo CD application (path: `kustomize/overlays-example/overlays/production`) with the name `argo-kustomize-prod-$USER` and enable automated sync, self-healing and pruning.

```
argocd app create argo-kustomize-prod-$USER --repo https://github.com/acend/antidote-general-training-examples.git --path kustomize/overlays-example/overlays/production --dest-server https://kubernetes.default.svc --dest-namespace $USER
argocd app set argo-kustomize-prod-$USER --kustomize-image
argocd app set argo-kustomize-prod-$USER --self-heal
argocd app set argo-kustomize-prod-$USER --auto-prune
```

And verify the deployment:

```
kubectl get pod --namespace $USER --watch
```

Task 5.2.4: Delete the Applications

Delete the applications after you've explored the Argo CD Resources and the managed Kubernetes resources.

```
argocd app delete argo-kuard-dev -y
argocd app delete argo-kuard-prod -y
```

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5.3 Jsonnet (Optional)

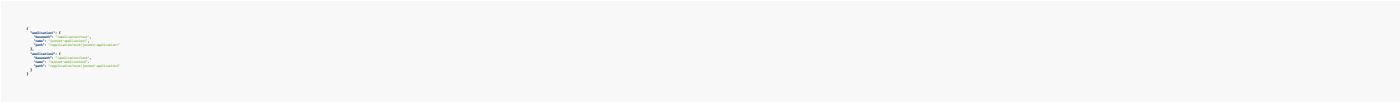
This lab explains how to use jsonnet as manifest format together with Argo CD.

Jsonnet

Jsonnet is a templating language which adds the possibility to programmatically work with the underlying data. It basically is a simple extension of JSON .

Let’s have a look at an example first. The following jsonnet file

will render into:



Among many other features, Jsonnet can help to reduce duplications.

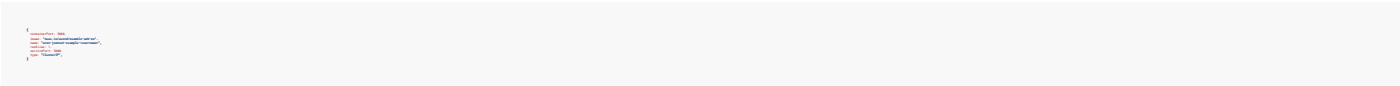
Further Docs

Read more about the jsonnet integration in the official documentation

Task 5.3.1: Deploy the simple-example with jsonnet

Let’s first explore the files in your local repository under `jsonnet` .

Similar to `helm` , `jsonnet` allows us to extract parameters into a separate file. In our example we extracted all values to the `params.libsonnet` file:



And the actual template file, containing the kubernetes service and deployment definitions, `simple-application.jsonnet` file:

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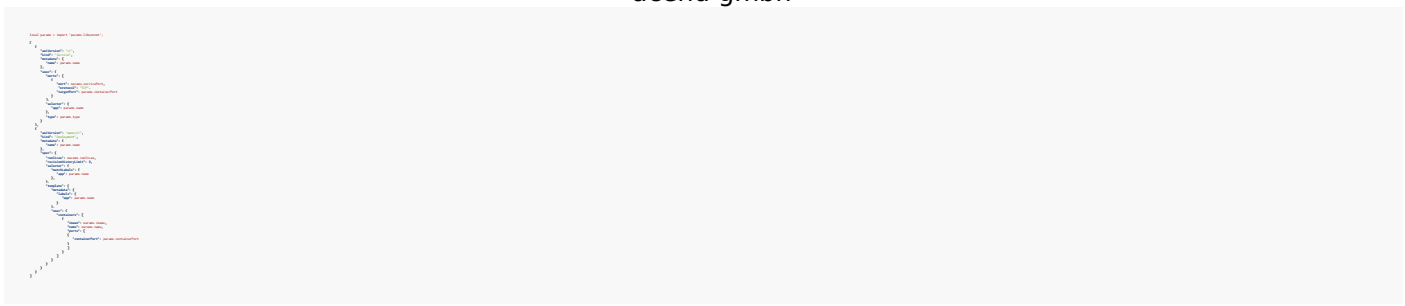

Note the first line, where we tell jsonnet where to get params from.

Ok now replace the `<username>` placeholder in the `params.libsonnet` file with your username.

Commit and push the changes to your repository.

Create the new Argo CD application.

Sync the application

To sync (deploy) the resources you can simply click sync in the web UI or execute the following command:

And verify whether your jsonnet Application definition has be successfully synced.

Task 5.3.2: Autosync and scale up

Tell the application to sync automatically, to enable self-healing and auto-prune

Now let’s change the replicacount of the deployment and scale to `2` pods.

Change the replica param in your `params.libsonnet` to 2

Commit and push the changes to your repository.

```
git add jsonnet/params.libsonnet
git commit -m "Scale Jsonnet to two"
git push
```

And verify the result in the ArgoCD Ui or by using the following command, this might take a little while to happen, depending on how many trainees are currently working on the labs. Hint: hit refresh to speed up the process.

```
kubectl get pod --namespace $USER --watch
```

Task 5.3.4: Delete the Applications

Delete the applications after you’ve explored the Argo CD Resources and the managed Kubernetes resources.

```
argocd app delete argo-jsonnet-$USER
```