Lab 4: Secure and Optimize Workflows

When you think about deploying to remote server, SSH is first network protocol which comes to your mind. Adding on top GitLab CI/CD will let you take advantage of automation. To use GitLab CI/CD pipeline together with SSH connections it is necessary to firstly configure GitLab and I would like to show you how to configure it and run simple script.

Prerequisite

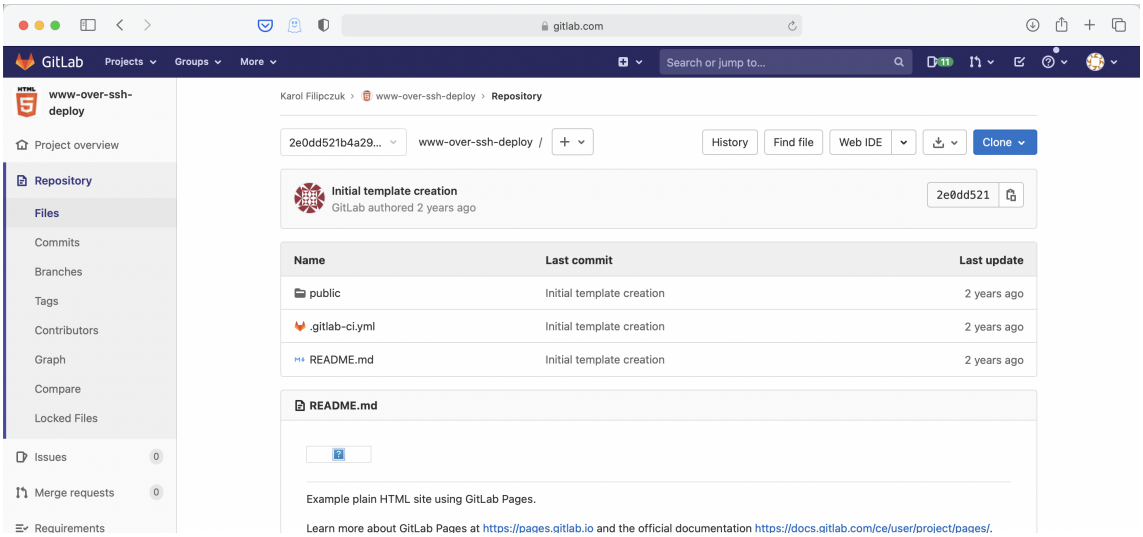
- GitLab account
- Remote server

Agenda

1. Create new GitLab project
2. Create and add SSH keys
3. Create and run GitLab CI/CD pipeline

Create new GitLab project

As a first step we will create GitLab project. Login into GitLab and navigate to `New project -> Create from template -> Pages/Plain HTML -> Use template`. Give it a project name and hit `Create project`. This will create a simple plain html project.



Pages/Plain HTML project

The template cretaed README.md file, initial `.gitlab-ci.yml` and public directory with `index.html` and `style.css` files.

Important!

1. Disable instance runners for the project that you created. Otherwise, gitlab will fail your pipeline and ask for account verification.

2. Make sure that default branch name is `main` for the newly created project. Otherwise, use correct default branch name in `.gitlab-ci.yml` .

Create and add SSH keys

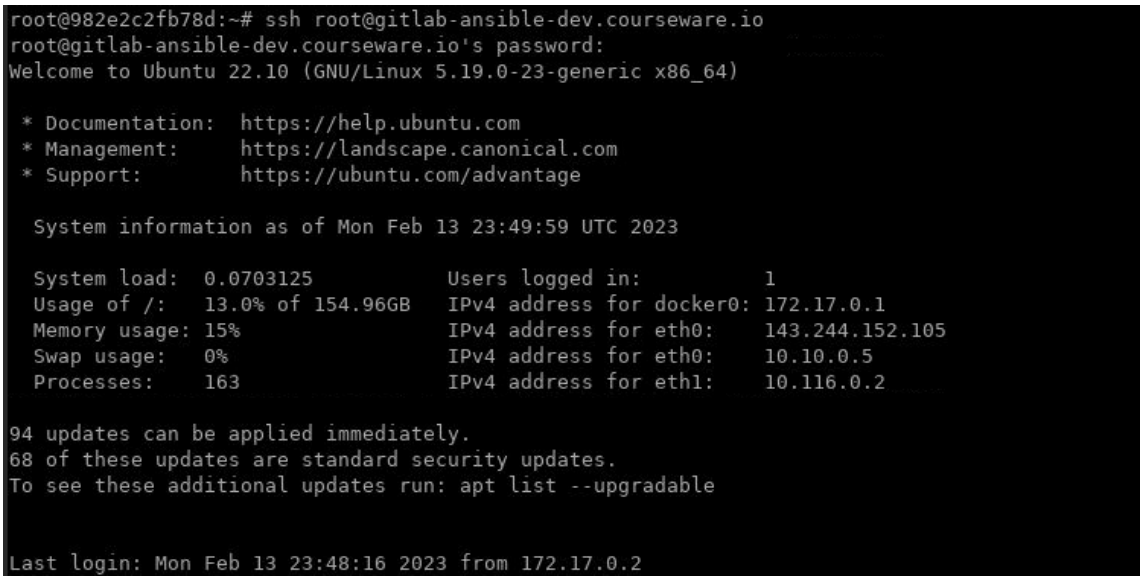
We already have an example project, now we need to create SSH keys. They will be used to connect to our remote server. Each time GitLab CI/CD pipeline is running, it is using GitLab Runner.

You can create new SSH key in any environment, even your local environment. When you create new SSH key, you will receive two keys: private and public. It is important that GitLab have private key and your remote server has public key. That is why it doesn't matter where you create keys, it only matters to share them accordingly with GitLab and remote server.

GitLab recommendation is to create SSH key type ED25519, which is more secure than RSA.

NOTE: Make sure to open new terminal and connect with your remote VM as shown below before creating SSH keys:

`ssh ubuntu@YOUR_VM_DNS_NAME`



Password: Will be provided by Instructor.

1. To create new key run `ssh-keygen -t ed25519 -C "GitLab SSH key"` in the same **terminal**. Text after `-C` option is a comment and you can change it.

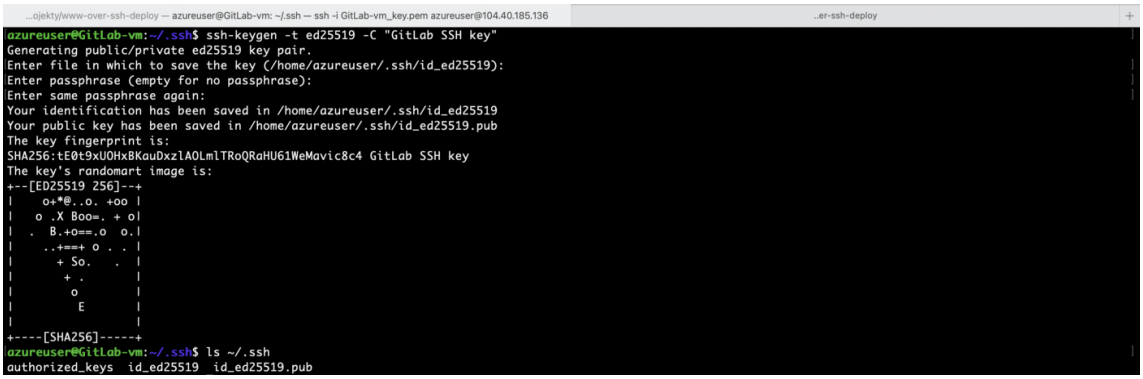
2. Press `Enter` . Output similar to the following is displayed:

```
Generating public/private ed25519 key pair.
Enter file in which to save the key (~/.ssh/id_ed25519):
```

3. Accept the suggested filename and directory.

4. Do not specify a passphrase:

```
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
```



The key will be created in default directory which for linux is `~/.ssh` . Do not specify passphrase, otherwise it will be cumbersome for GitLab CI/CD pipeline. You should have two new files in `.ssh` directory:

- `id_ed25519` --- private key
- `id_ed25519.pub` --- public key

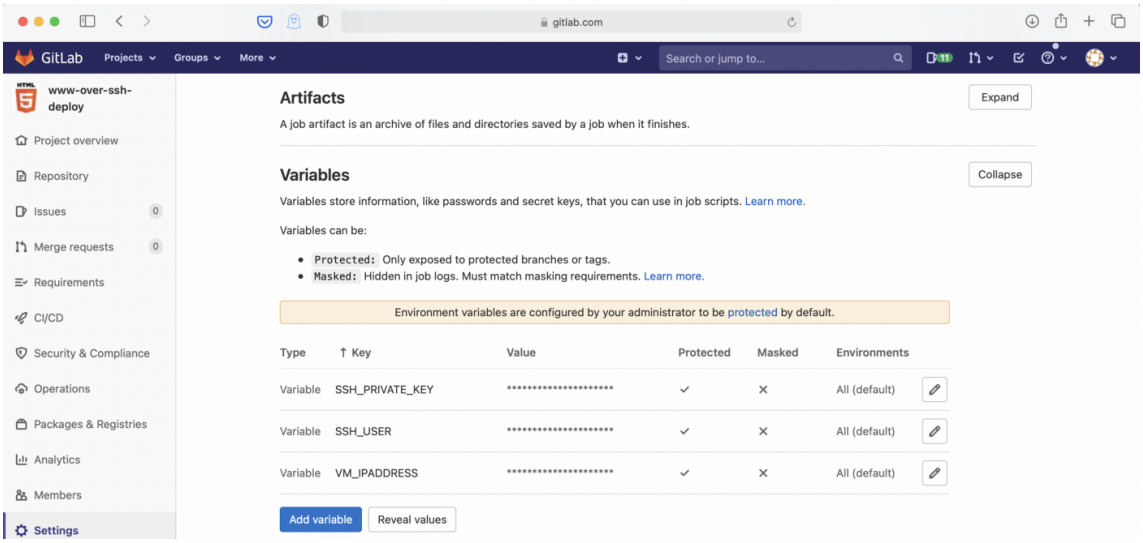
Add private key as GitLab Variable

Copy content of private key and go back to GitLab project. Navigate to `Settings -> CI/CD -> Variables -> Expand -> Add Variable` . GitLab's variable is a key-value pair. Name key `SSH_PRIVATE_KEY` and paste private key in value field. Click `Add Variable` .

Add two more variables:

- `SSH_USER` --- name of the user on the remote server: **ubuntu**
- `VM_IPADDRESS` --- IP address of remote server i-e: **YOUR_VM_DNS_NAME**

Note: Don't add http/https etc in `VM_IPADDRESS` . Use your lab environment DNS name.



Add public key to remote server

Copy content of public key and go back to remote server. Login as the same user which you have specified in `SSH_USER` GitLab's variable. If you don't have yet this user, it is time to create it.

Navigate to `~/.ssh`. If directory `.ssh` doesn't exist, then create it. Paste the public key into `authorized_keys` file. If you don't have `authorized_keys` file, create it. Here is screenshot from the VM.

```
root@gitlab-ansible-dev:~# cd ~/.ssh/
root@gitlab-ansible-dev:~/.ssh#
root@gitlab-ansible-dev:~/.ssh# ls -ltr
total 12
-rw-r--r-- 1 root root  96 Feb 13 09:16 id_ed25519.pub
-rw------- 1 root root 411 Feb 13 09:16 id_ed25519
-rw------- 1 root root  96 Feb 13 09:28 authorized_keys
root@gitlab-ansible-dev:~/.ssh# cat authorized_keys
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAICnZ6KuaC5lerLC3IeuibCtyat+FlUkOsjiW5sFURP4J GitLab SSH key
root@gitlab-ansible-dev:~/.ssh#
```

Create and run GitLab CI/CD pipeline

It's time to create GitLab CI/CD pipeline. We want to achieve two goals using SSH: log remote server's hostname and create an example file in user's home directory.

The pipeline is defined in `.gitlab-ci.yml` and we have two option to create/edit:

1. Directly in GitLab project in web browser, we can edit `.gitlab-ci.yml` and commit changes
2. Clone repository, edit `.gitlab-ci.yml` in your favorite code editor, commit changes and push it to GitLab

Let's go with option number 2, it's more proper way to handle `.gitlab-ci.yml`.

You can clone repository using command `git clone <repo_address>` and repo address you can find in GitLab repository by clicking `Clone` button. After cloning open already existing `.gitlab-ci.yml` which was created as part of the Pages/Plain HTML template.

```
image: alpine:latest

pages:
  stage: deploy
  script:
  - echo 'Nothing to do...'
  artifacts:
    paths:
    - public
  only:
  - main
```

We need to add `before_script` section and update `script` section.

```
image: alpine:latest

pages:
  stage: deploy
  before_script:
  - 'command -v ssh-agent >/dev/null || ( apk add --update openssh )'
```

```
  - eval $(ssh-agent -s)
  - echo "$SSH_PRIVATE_KEY" | tr -d '\r' | ssh-add -
  - mkdir -p ~/.ssh
  - chmod 700 ~/.ssh
  - ssh-keyscan $VM_IPADDRESS >> ~/.ssh/known_hosts
  - chmod 644 ~/.ssh/known_hosts
  script:
  - ssh $SSH_USER@$VM_IPADDRESS "hostname && echo 'Welcome!!!' > welcome.txt"
  artifacts:
    paths:
    - public
  only:
  - main
```

Note: Make sure that default branch name is `main` for the newly created project. Otherwise, use correct default branch name in `.gitlab-ci.yml` .

`.gitlab-ci.yml` defines pipeline. It uses docker image `alpine:latest` to run jobs defined in pipeline. We only have one job `pages` .

The job run in `stage: deploy` . We didn't define any stages, but we have 5 default stages to use: `.pre, build, test, deploy, .post` . It doesn't matter in our case, since our pipeline at the moment is simple and doesn't require setting up stages.

Then we have `before_script` which is pretty self-explanatory and will run before `script` command. Let's explain script line by line:

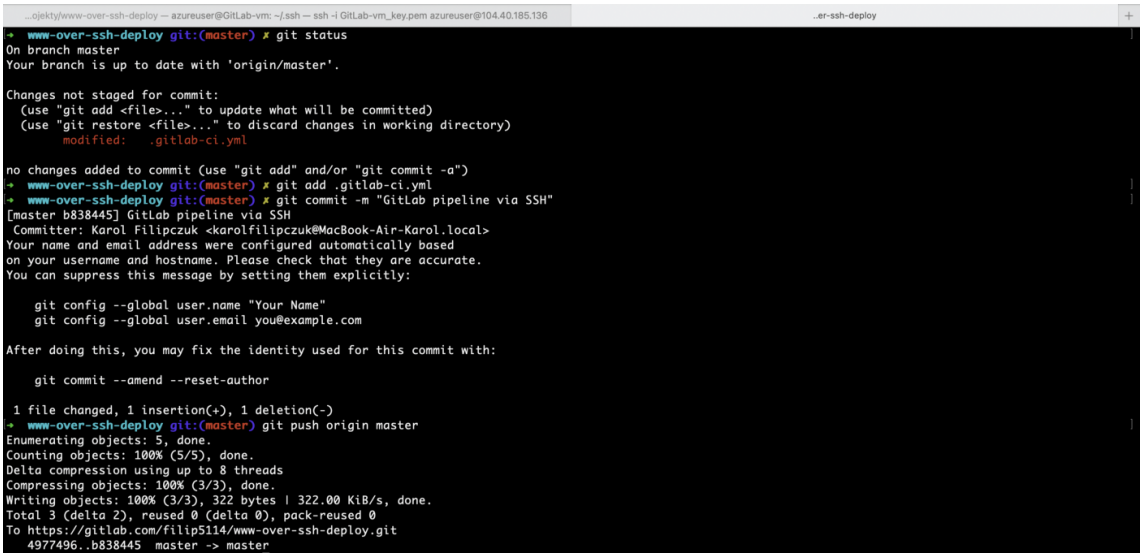
- `command -v ssh-agent > /dev/null || (apk add --update openssh)` --- checks if ssh-agent is already installed and if not, then install it
- `eval $(ssh-agent -v)` --- starts ssh-agent
- `echo "$SSH_PRIVATE_KEY" | tr -d '\r' | ssh-add —` --- adds ssh private key stored in variable `SSH_PRIAVTE_KEY` to agent store
- `mkdir -p ~/.ssh` and `chmod 700 ~/.ssh` --- creates `.ssh` directory and assign correct permissions
- `ssh-keyscan $VM_IPADDRESS >> ~/.ssh/known_hosts` --- checks public key on remotes server using IP address stored in `VM_IPADDRESS` variable and add it to known hosts. It is protecting from men-in-the-middle attack and is necessary to work, otherwise the job will fail.
- `chmod 644 ~/.ssh/known_hosts` --- assign correct permissions

`script` is where our actual code to execute is defined. We simply want to print hostname to job log and then create an example file on remote host. `ssh $SSH_USER@$IP_ADDRESS "hostname && echo 'Welcome!!!' > welcome.txt"` will connect over SSH as user specified in `SSH_USER` variable to remote server, then run command `hostname` which will print hostname and echo `Welcome!!!` to file `welcome.txt` which will be created on remote server in `SSH_USER` home directory.

`artifacts` specify which artifacts to use in deployment. We are not using it in our example.

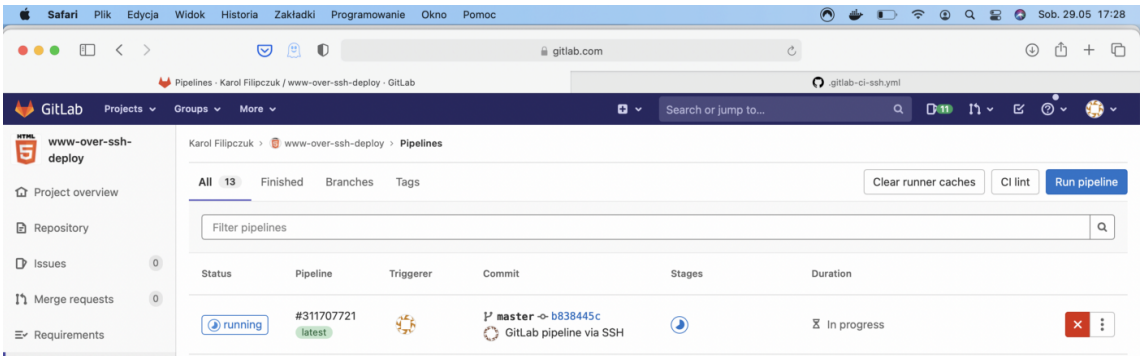
`only` specify that the job should be only run if any change is pushed into `main` branch in repository.

After making changes, we need to commit them and push to repository.



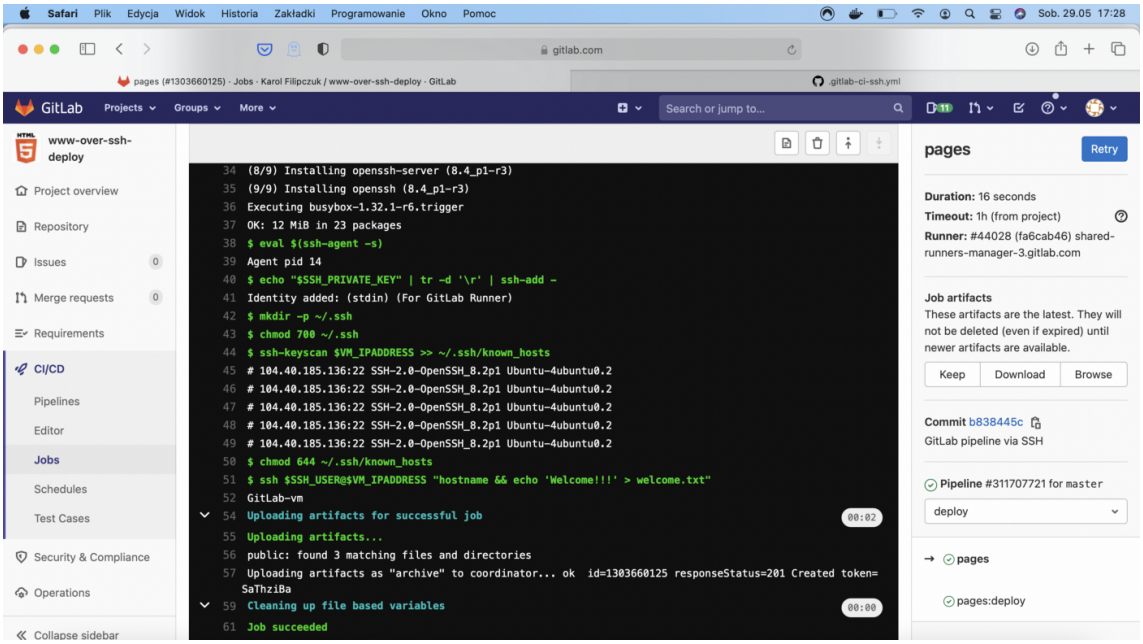
Add, commit and push changes to repository

Once the change is pushed into main branch the GitLab CI/CD will be trigged. Navigate to `CI/CD -> Pipelines` and you should see pipeline in status running.



Running pipeline

Click on it and the click on job `pages` to see logs.



Pipeline's job logs

Job should finish quickly, in my case it took 16 seconds. The last line shows that job was run successfully. Line 51 shows `script` part from `.gitlab-ci.yml` and in line 52 we can see remote server hostname which is exactly what we wanted to achieve. Check your remote server, you will find `welcome.txt` there.

NOTE: Make sure to run following command in terminal where you have connected with remote server using SSH.

```
root@982e2c2fb78d:~# ssh root@gitlab-ansible-dev.courseware.io
Warning: Permanently added 'gitlab-ansible-dev.courseware.io' (ECDSA) to the list of known hosts.
root@gitlab-ansible-dev.courseware.io's password:
Welcome to Ubuntu 22.10 (GNU/Linux 5.19.0-23-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Mon Feb 13 23:48:15 UTC 2023

  System load:  0.0791015625        Users logged in:          1
  Usage of /:   13.0% of 154.96GB   IPv4 address for docker0: 172.17.0.1
  Memory usage: 15%                 IPv4 address for eth0:    143.244.152.105
  Swap usage:   0%                  IPv4 address for eth0:    10.10.0.5
  Processes:    161                 IPv4 address for eth1:    10.116.0.2

94 updates can be applied immediately.
68 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable


Last login: Mon Feb 13 09:15:42 2023 from 172.17.0.2
root@gitlab-ansible-dev:~# cat ~/welcome.txt
Welcome!!!
root@gitlab-ansible-dev:~# exit
logout
Connection to gitlab-ansible-dev.courseware.io closed.
root@982e2c2fb78d:~#
```

That's it! We have successfully created new GitLab project, setup SSH connection to remote server and created simple GitLab CI/CD pipeline to run script via SSH to the remote server.