Working with GitLab and Terraform

TABLE OF CONTENTS

1. Git and GitLab Introduction

Introducing GitLab

In this lesson, we'll explore the following topics:

- An overview of version control
- The main features of GitLab
- Self-managed versus SaaS
- Free versus paid
- A brief history of GitLab

Version control systems and Git

- Let's say you write code, or work on a course, or even just want to collect and update a set of text-based documents.

- You need some method of keeping track of changes, of being able to revert mistakes in the work, or branch in new directions; and you'll probably want some way of remotely backing up your work in case of fire, theft, or acts of a misbehaving computer.

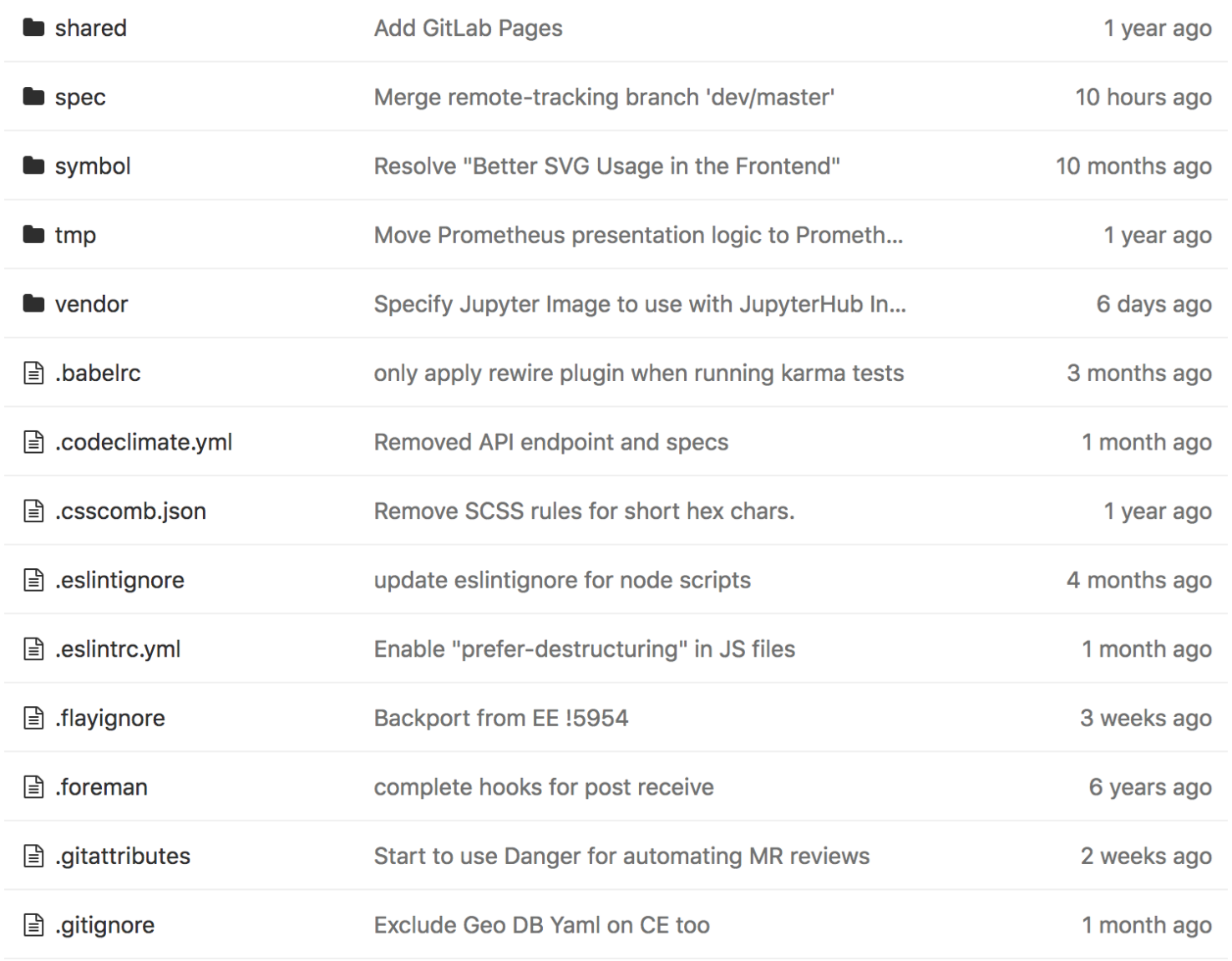
GitLab and Git

- GitLab is built on top of git so that users who are contributing work (editing code, writing lessons, and so on) to a project will have a copy of the project downloaded/checked out/cloned on their local computer.

- It provides a web interface for handling many of git's more advanced workflows, and recommends a workflow for interacting with git for the best in productivity, efficiency, and ease of use.

Features

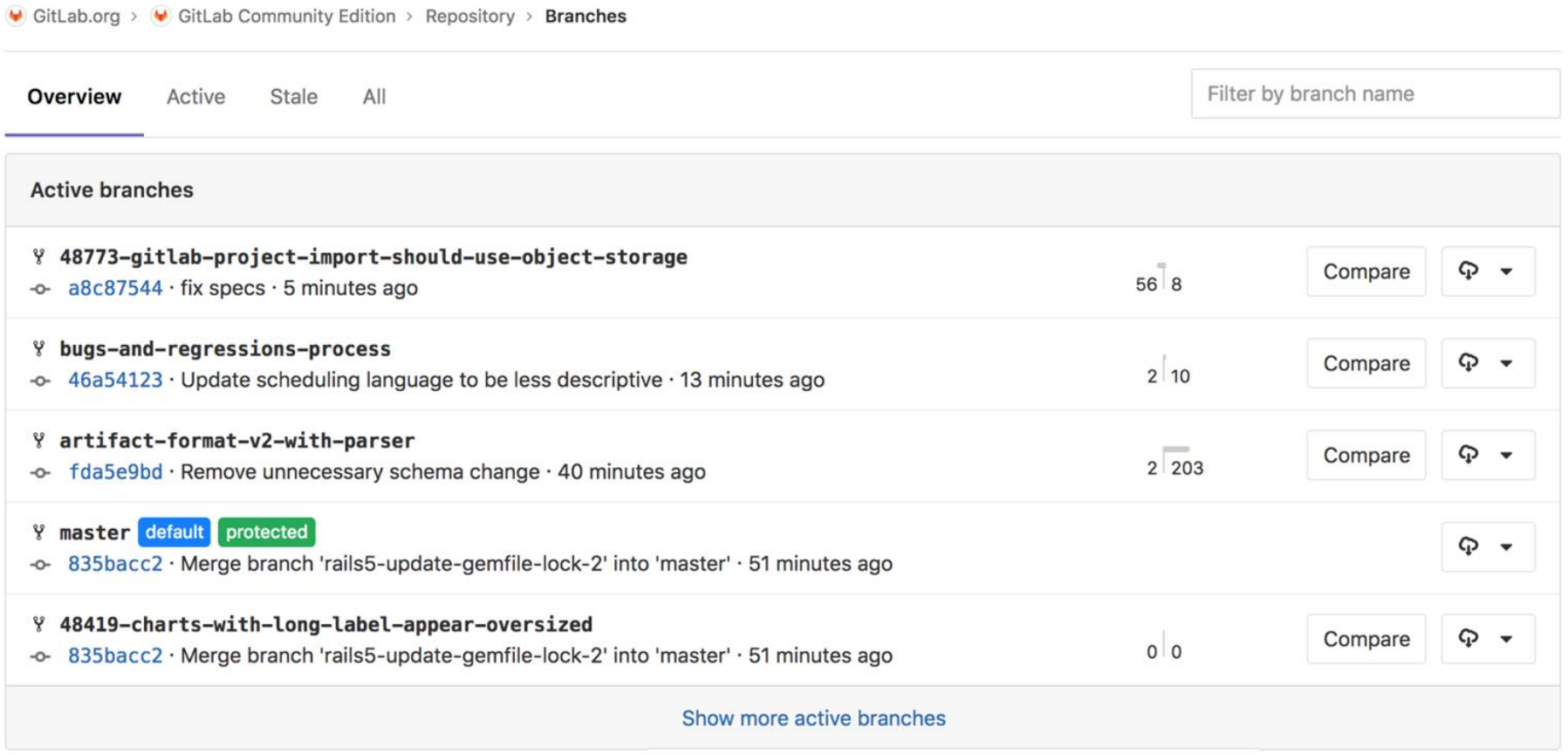
- There is the classic file browser that lets you explore the files in your repository:



shared	Add GitLab Pages	1 year ago
spec	Merge remote-tracking branch 'dev/master'	10 hours ago
symbol	Resolve "Better SVG Usage in the Frontend"	10 months ago
tmp	Move Prometheus presentation logic to Prometh...	1 year ago
vendor	Specify Jupyter Image to use with JupyterHub In...	6 days ago
.babelrc	only apply rewire plugin when running karma tests	3 months ago
.codeclimate.yml	Removed API endpoint and specs	1 month ago
.csscomb.json	Remove SCSS rules for short hex chars.	1 year ago
.eslintignore	update eslintignore for node scripts	4 months ago
.eslintrc.yml	Enable "prefer-destructuring" in JS files	1 month ago
.flayignore	Backport from EE !5954	3 weeks ago
.foreman	complete hooks for post receive	6 years ago
.gitattributes	Start to use Danger for automating MR reviews	2 weeks ago
.gitignore	Exclude Geo DB Yaml on CE too	1 month ago

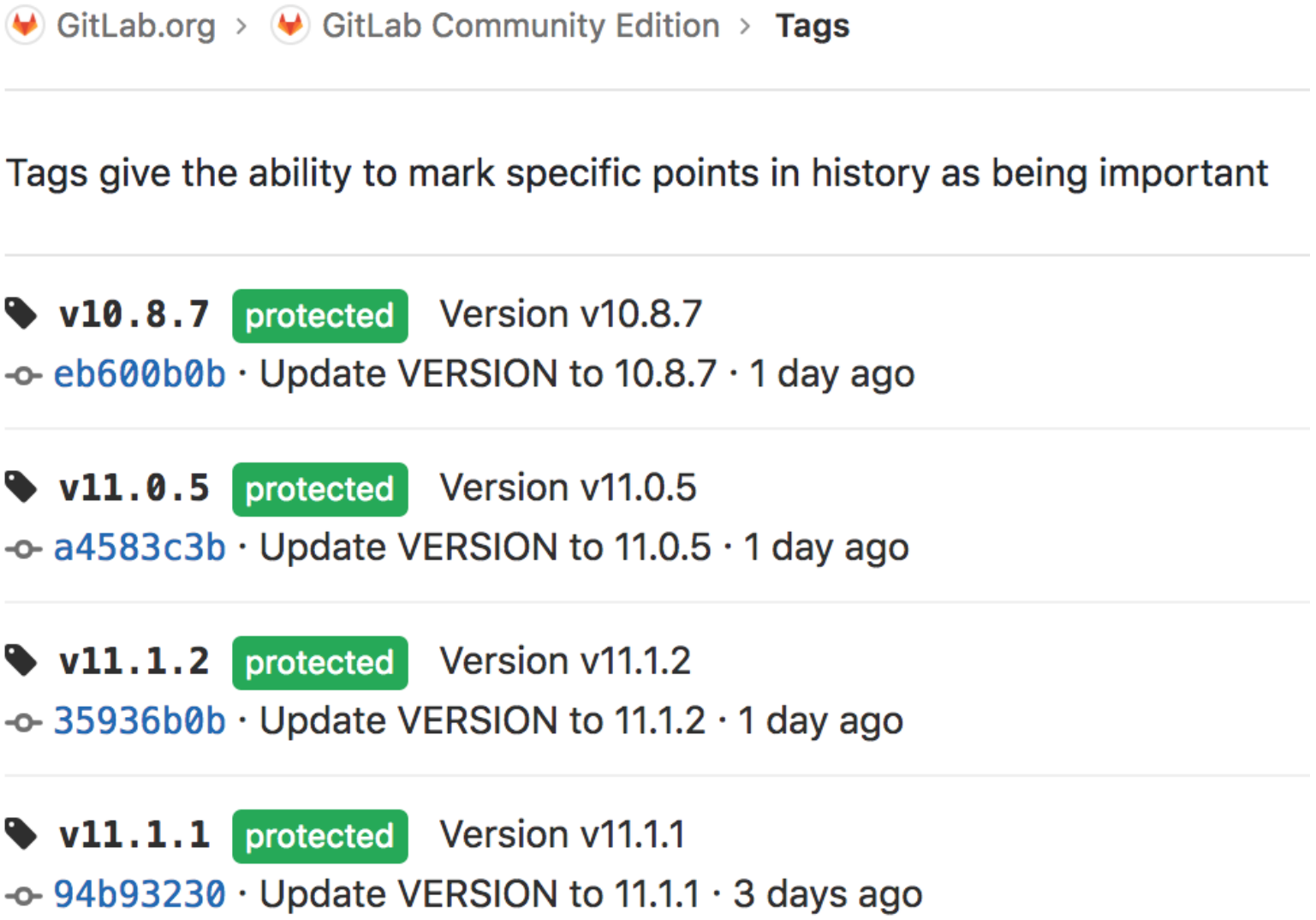
Features

- There's also a branch viewer, which lets you see variations of your work under active development, as well as branches that are considered stale and no longer developed:



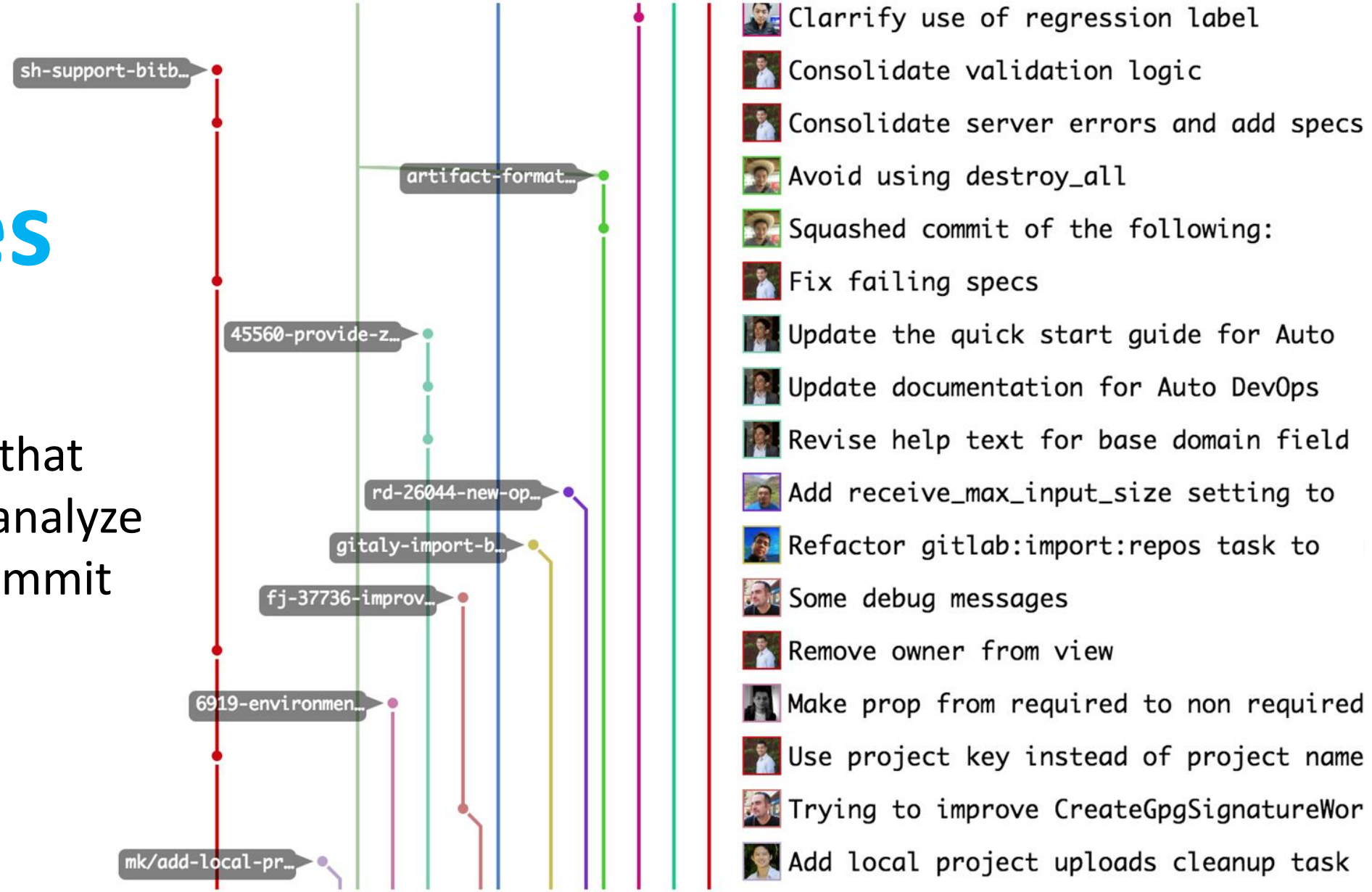
Features

- Alongside this is a tag viewer that lets you explore specific releases of your work:



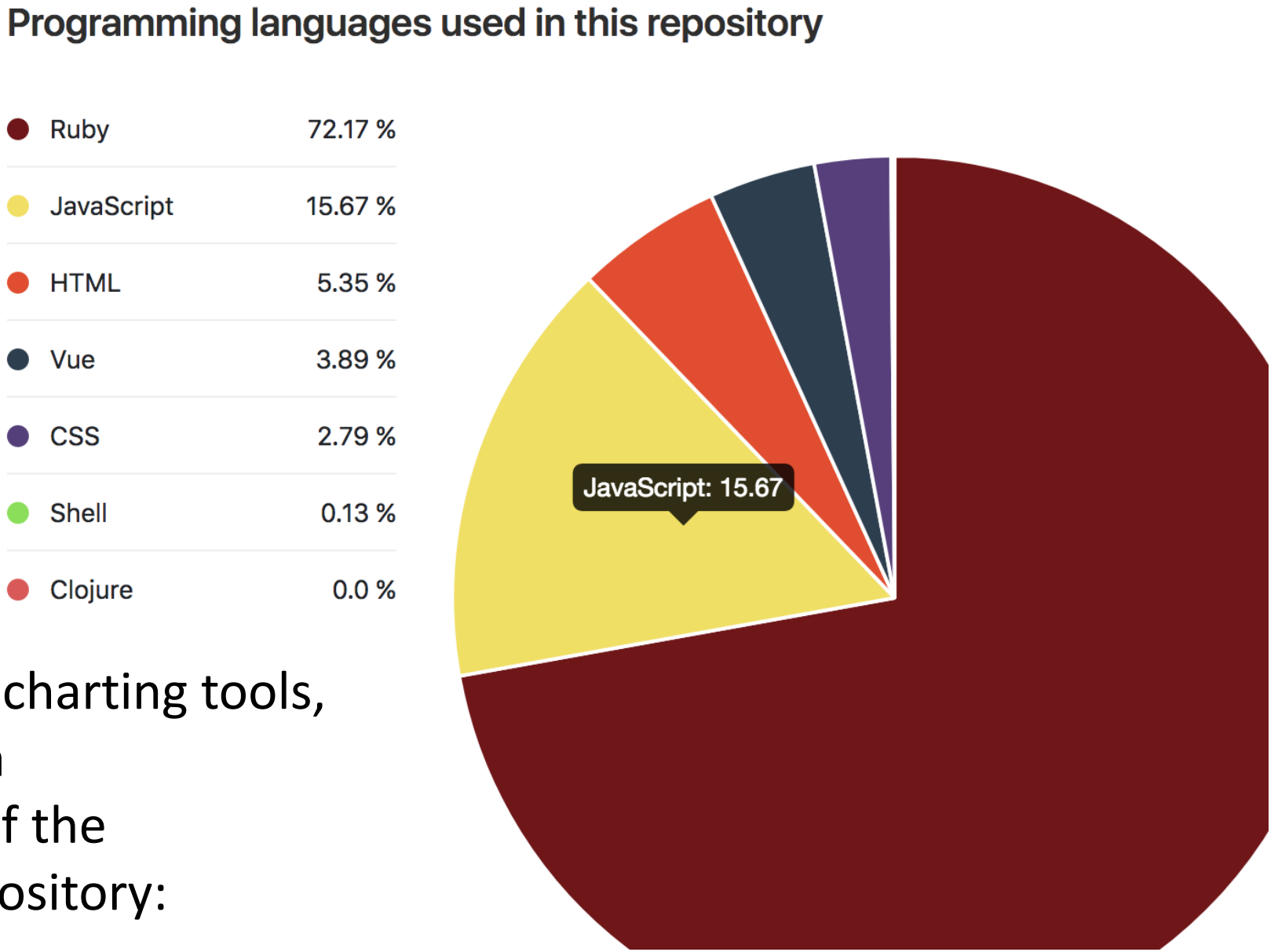
Features

- There are tools that can be used to analyze and view the commit graph:



Features

- Among these tools are charting tools, which are used to get a better understanding of the composition of the repository:



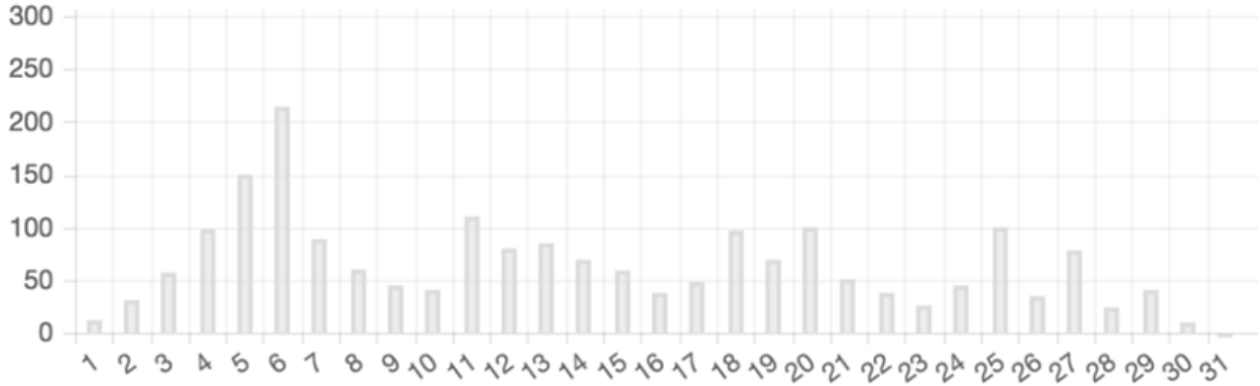
Commit statistics for master Jun 01 - Jul 26

- Total: **2000 commits**
- Average per day: **35 commits**
- Authors: **204**

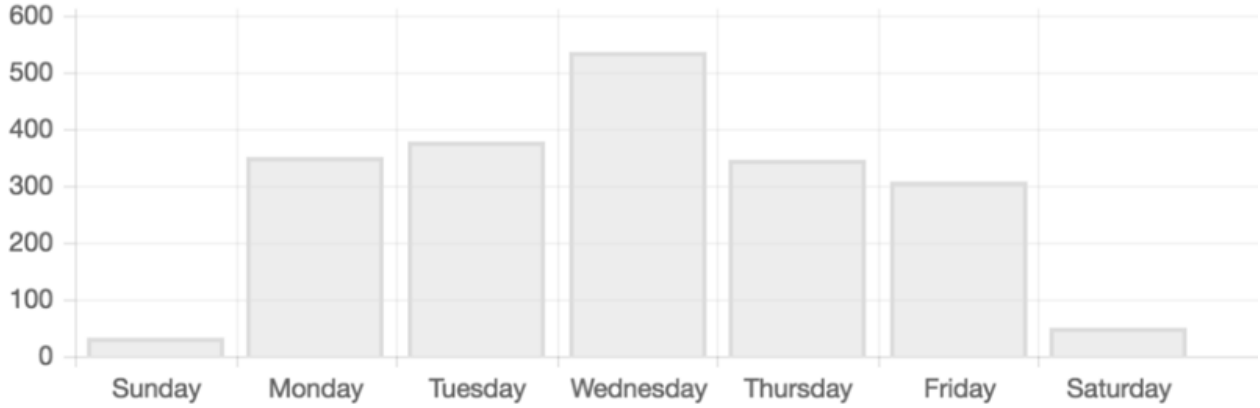
master

gitlab-ce

Commits per day of month



Commits per weekday

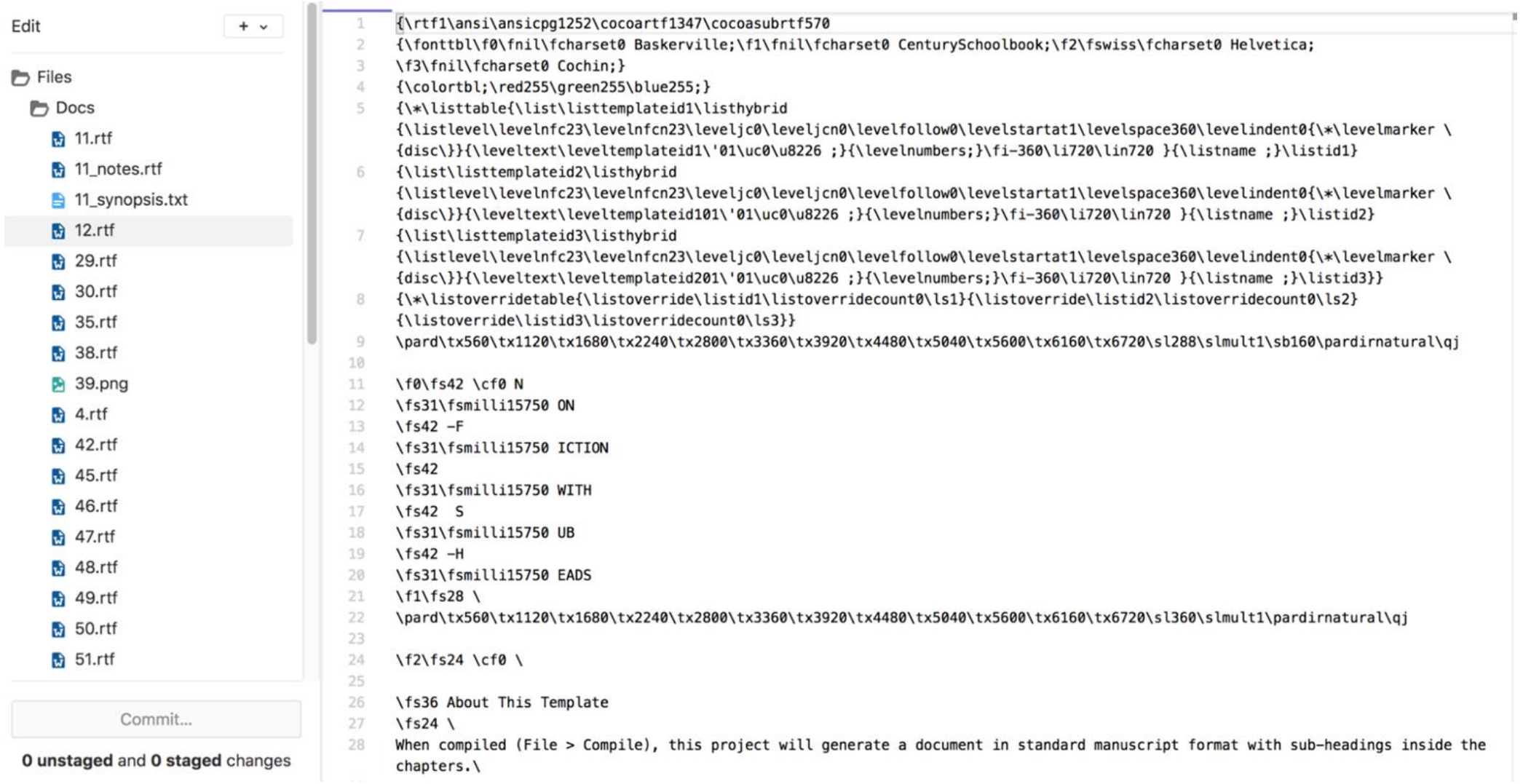


Features

- Alongside this is a breakdown of the frequencies of commits and activity:

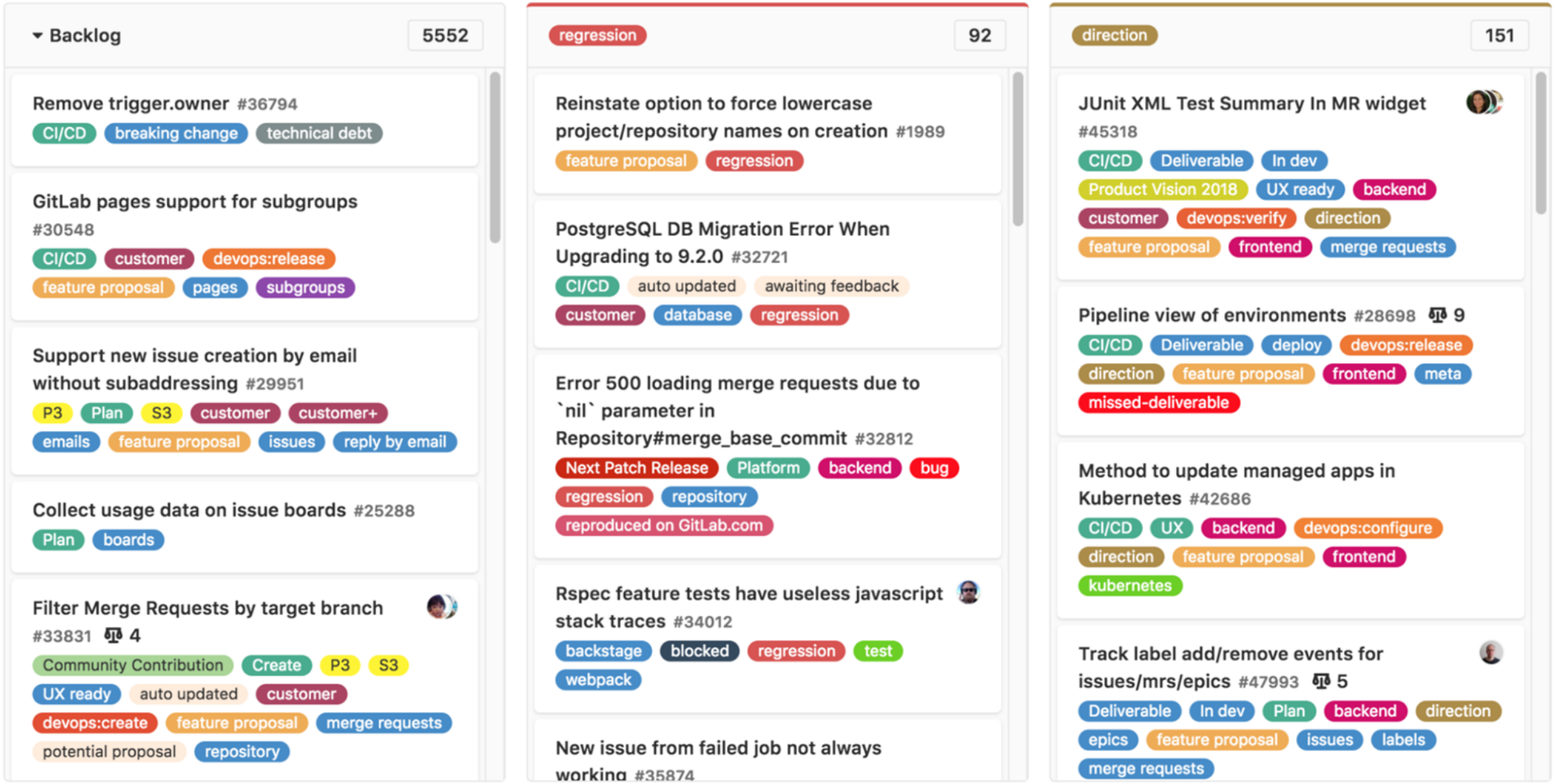
Features

- GitLab also provides a web interface where you can make changes to code and commit it straight from the browser:



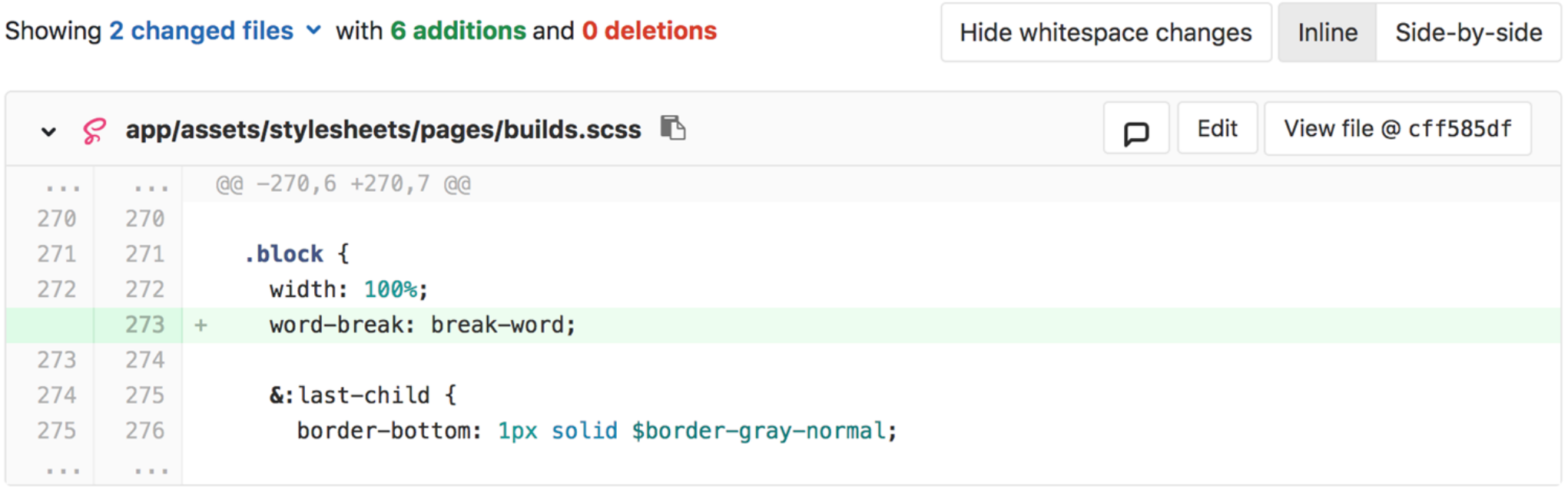
Features

- With things like epics, milestones, and cycle analytics, GitLab can help measure the effectiveness of your development process.



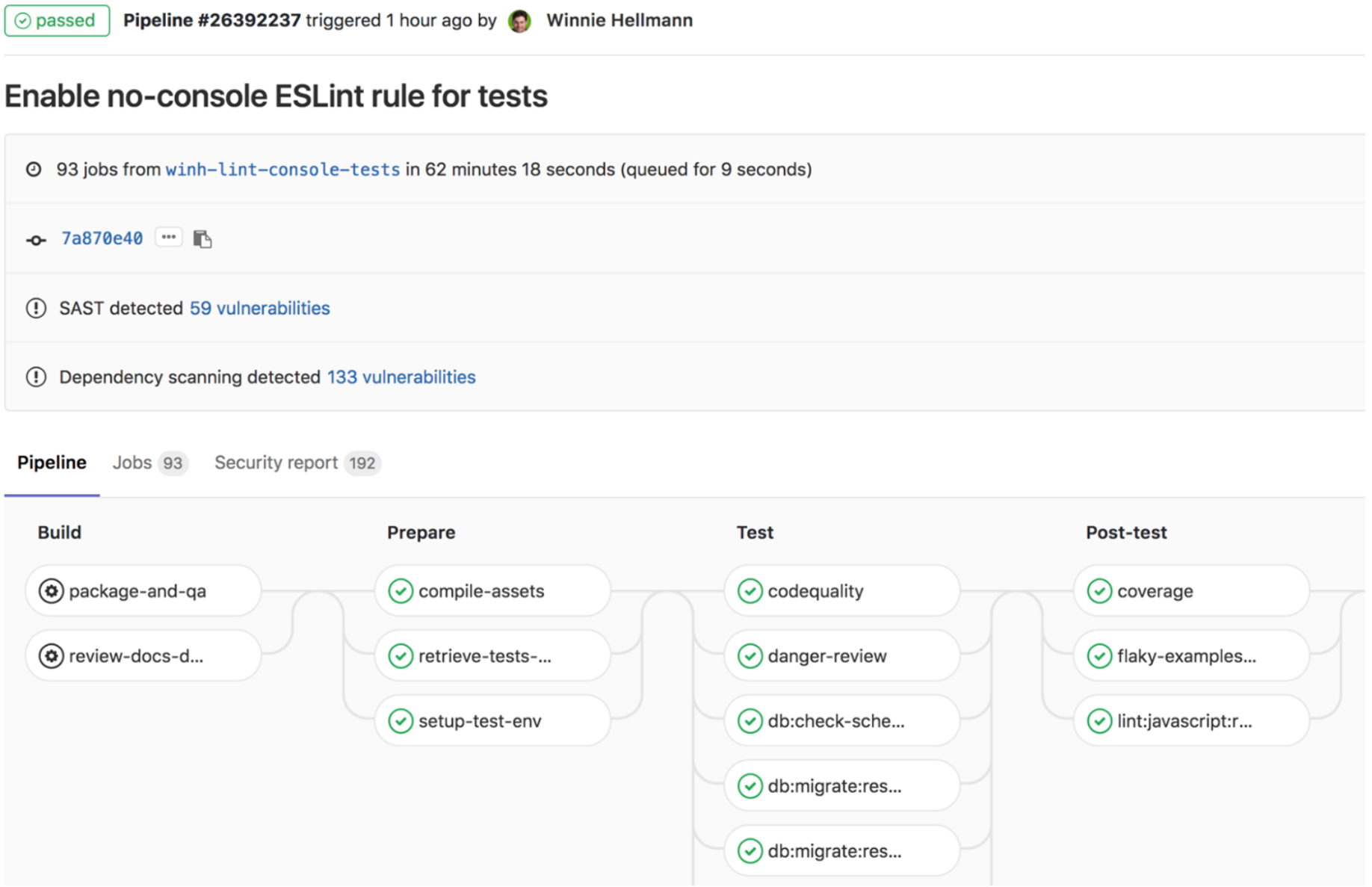
Features

- It also includes the necessary tools for code review prior to merging branches to ensure that all work is up to scratch:



Features

- Automated testing tools and pipelines are also included to help make sure that code is working perfectly before it's merged back in or released:



Self-managed versus Software as a Service (SaaS)

- GitLab can be used in one of two ways: either self-managed, where you host your own instance of GitLab Community Edition/Enterprise Edition

- Using the online platform GitLab.com, which comes as a paid or free Software as a Service (SaaS) model.

Free versus paid

- Lastly, there are multiple tiers of GitLab for both the self-managed and SaaS versions.
- Please note that both versions can be used for free and provide all of the main features that you'd expect (git hosting, code review, issue management, testing, and deployment).
- The added tiers provide extra features that are available at different levels of pricing on a per-user, per-month basis.

Summary

- So far, we've discovered what version control is: a method of tracking revisions of work, of creating alternate test branches, and working collaboratively.

- We know that git is a form of version control system that specializes in working in a distributed network and that GitLab is a platform that is based on git but with a lot of powerful features.

2. GitLab Flow

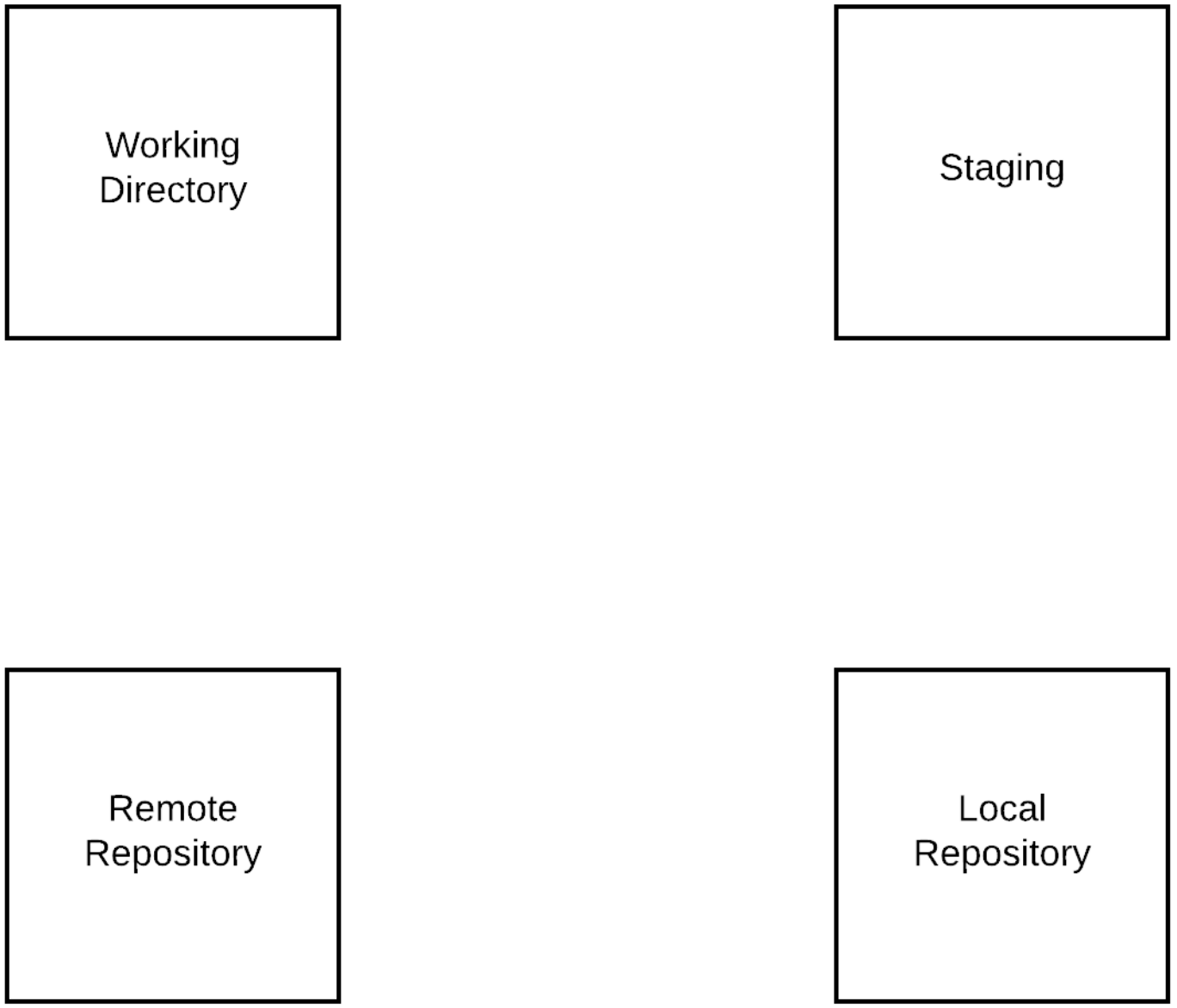
GitLab Flow

In this lesson, we'll explore the following topics:

- How to use Git
- The GitFlow for branching and merging
- The GitLab flow (recommended by GitLab)
- The GitLab flow in comparison to the GitHub flow

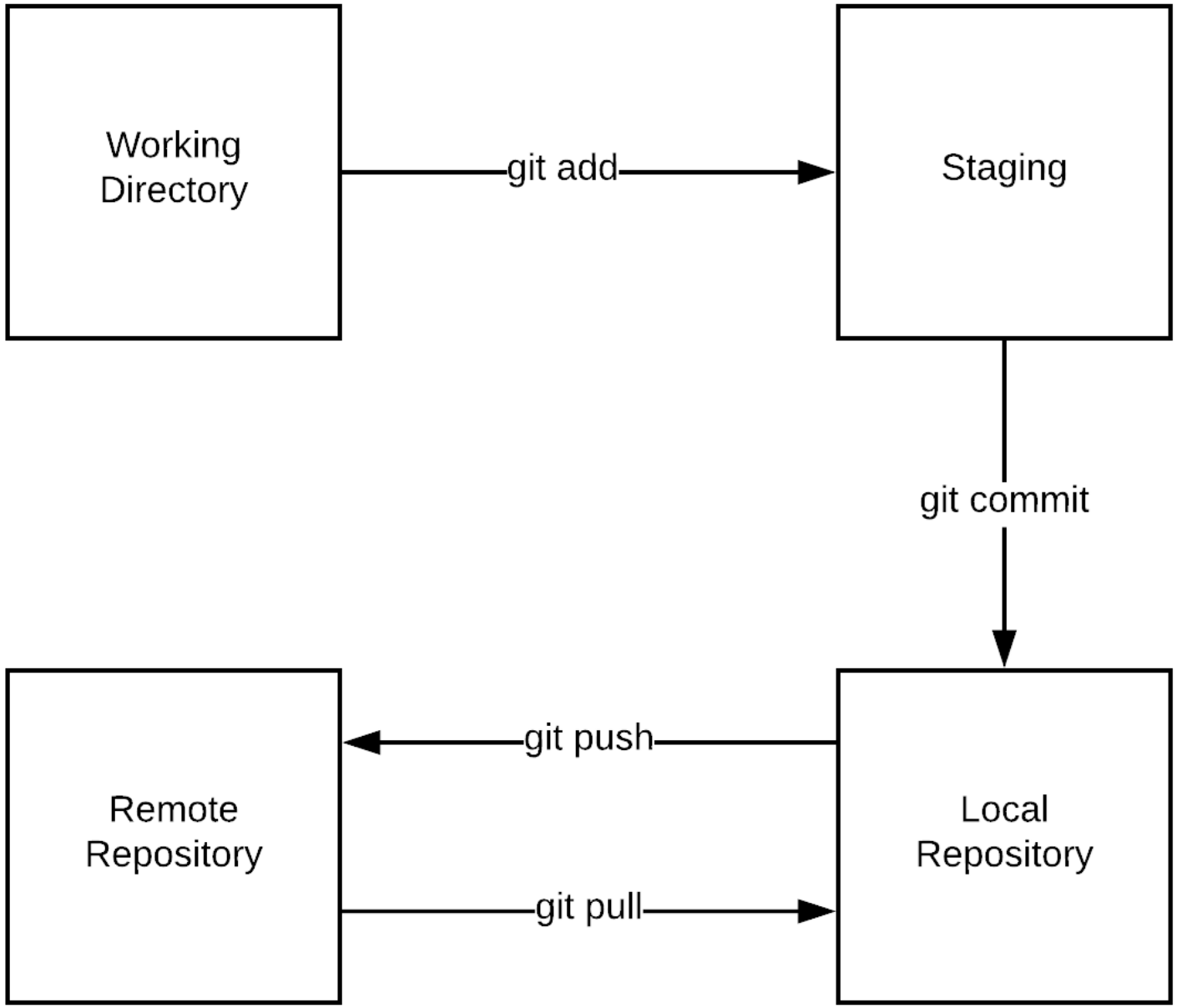
Using Git

- One thing to recognize is the life cycle of Git work and the stages it can go through.
- There are four separate parts: your working directory, the index or staging area, committing to the local repository, and pushing to remote repositories:



Using Git

- Overall, it seems like a pretty complicated workflow, which is why I've created this handy graph to illustrate the basic operations that you can perform and how they relate to these stages:



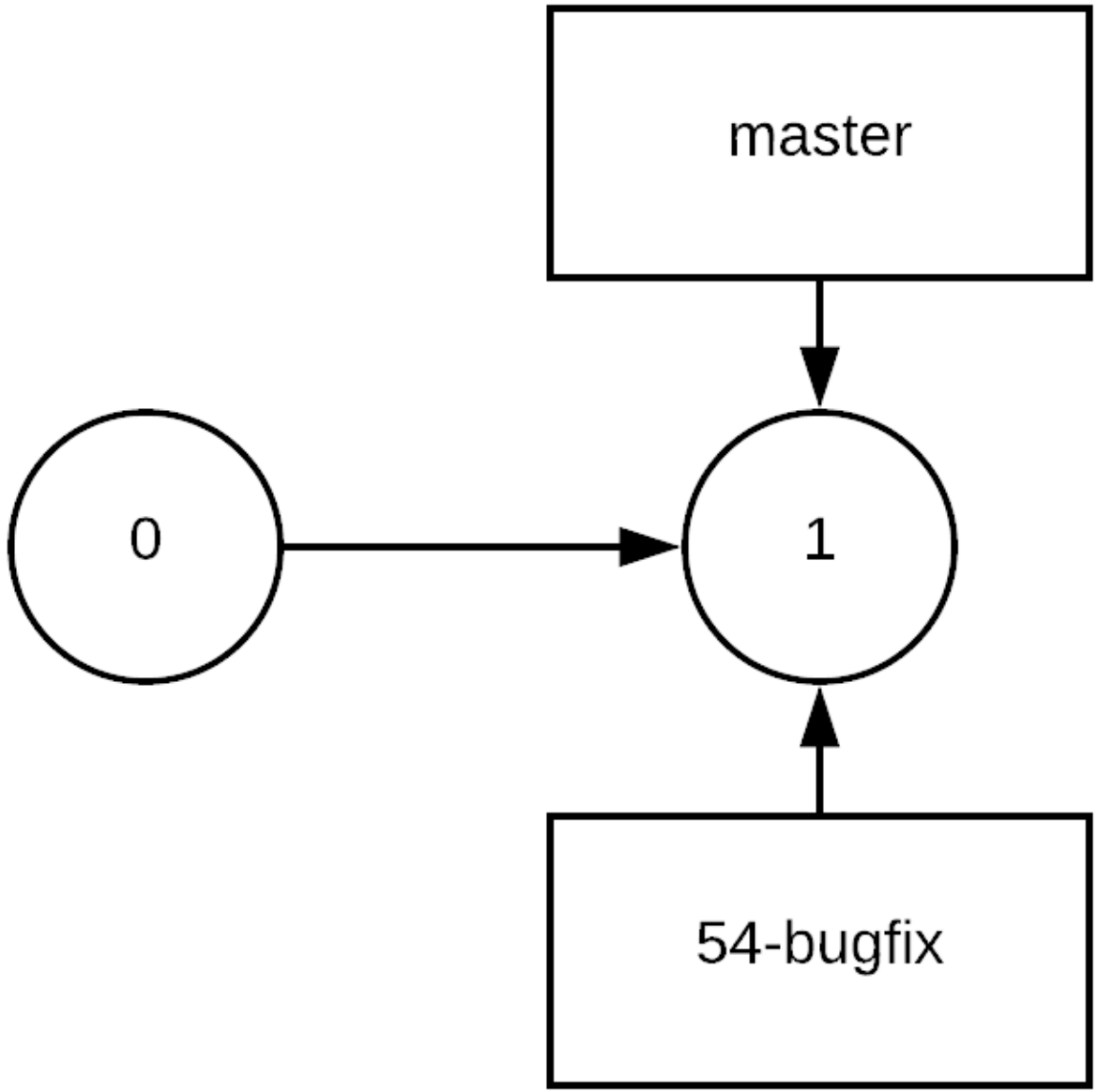
Git commands

- I've introduced a few Git commands while discussing how Gitworks, but haven't actually explained properly how to use them, so let's do a very brief introduction to the basic usage of Git.

- The first command you'll need when starting a new project is git init, This initializes a new Gitrepository, and you'll notice that it creates a .git folder so that you can start your project (this is hidden by default on Unix-based and Windows operating systems).

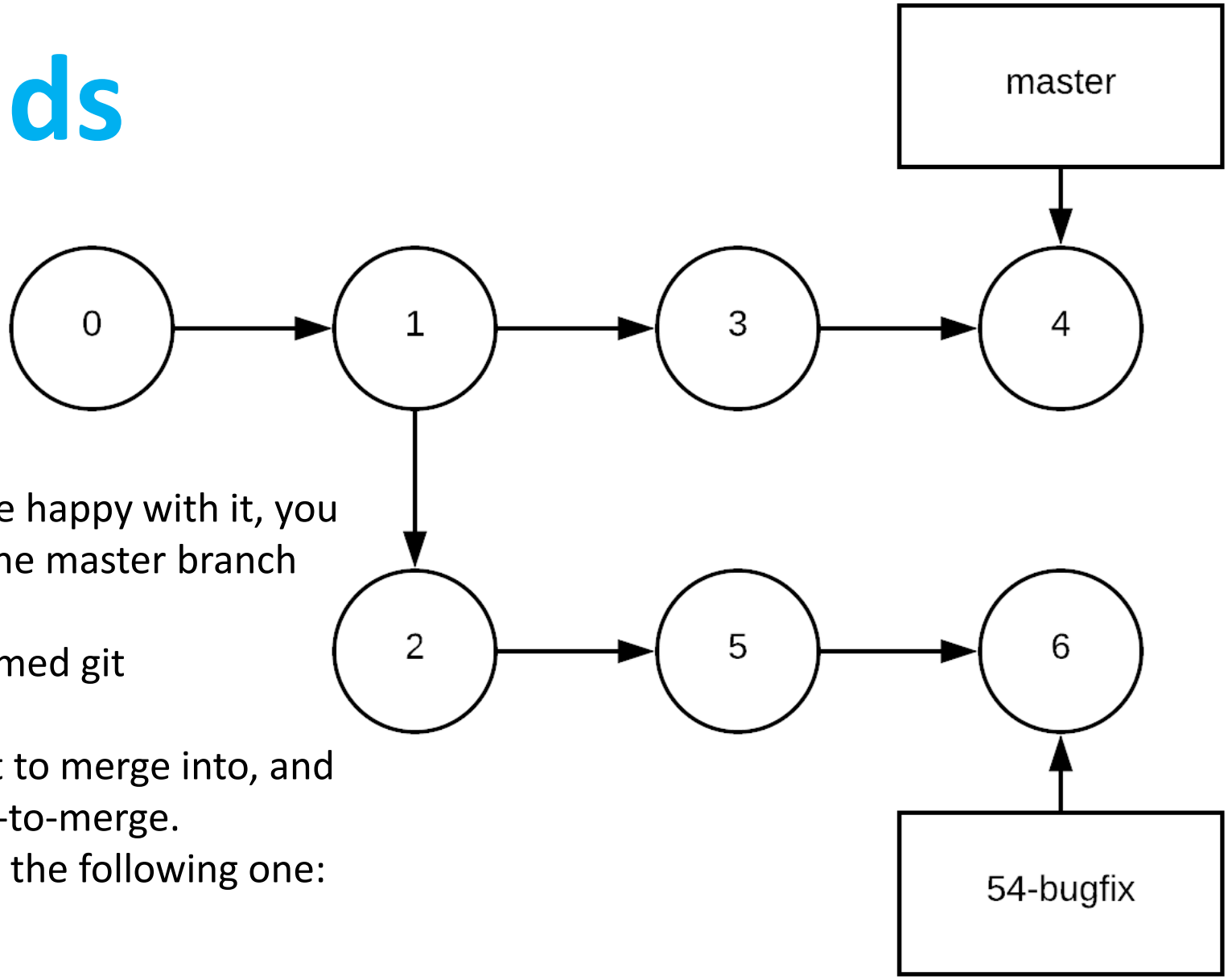
Git commands

- Behind the scenes, a Git branch is a reference to a particular commit, and adding new commits moves the branch pointer forward, but forks off from the main (master) branch.
- In this way, they are lightweight and still connected to the entire history of the local repository:



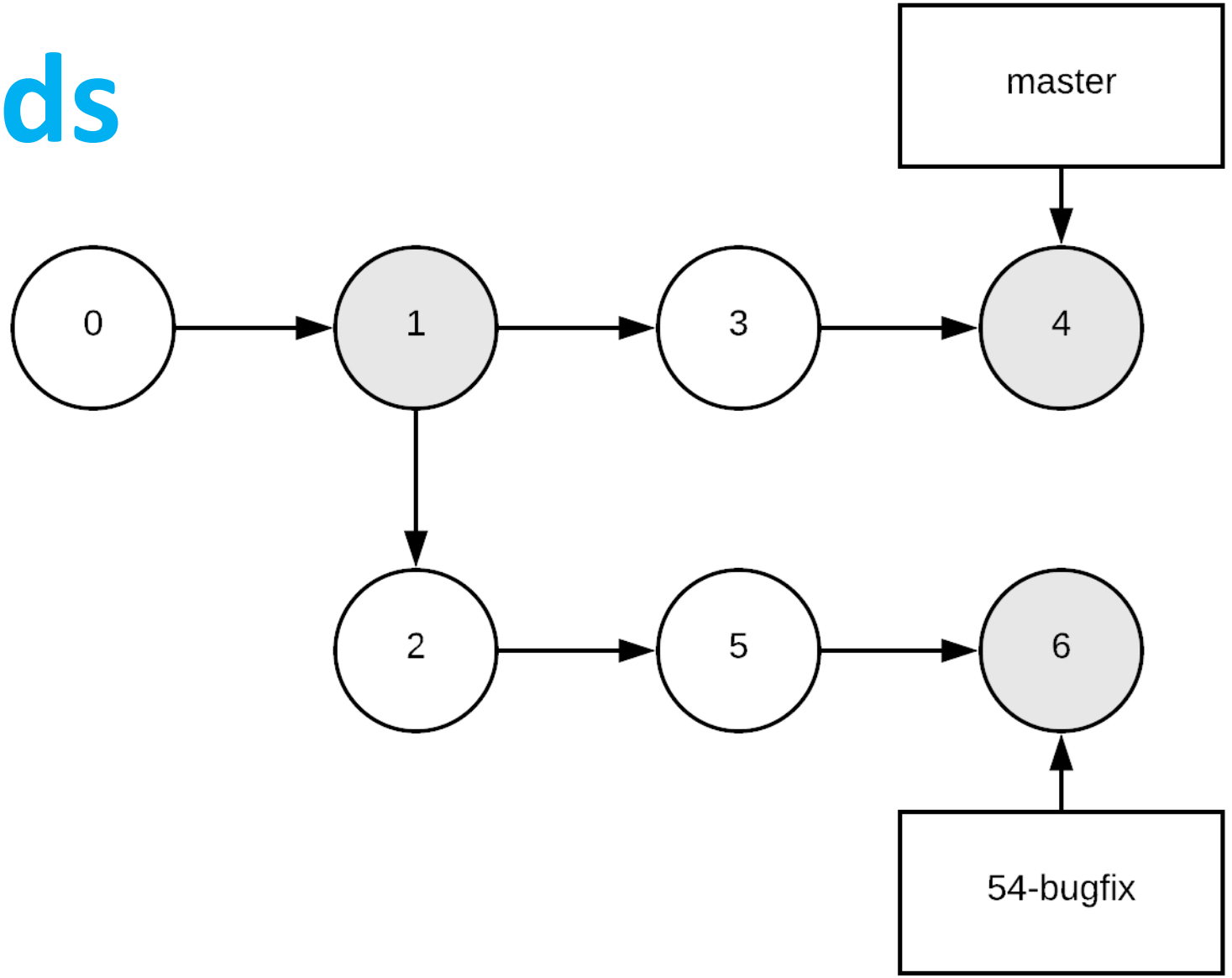
Git commands

- If you've done some work and are happy with it, you may want to merge it back into the master branch of the code.
- You can do this with the aptly named git merge command.
- You swap to the branch you want to merge into, and then run git merge branch-name-to-merge.
- Let's say you have a situation like the following one:



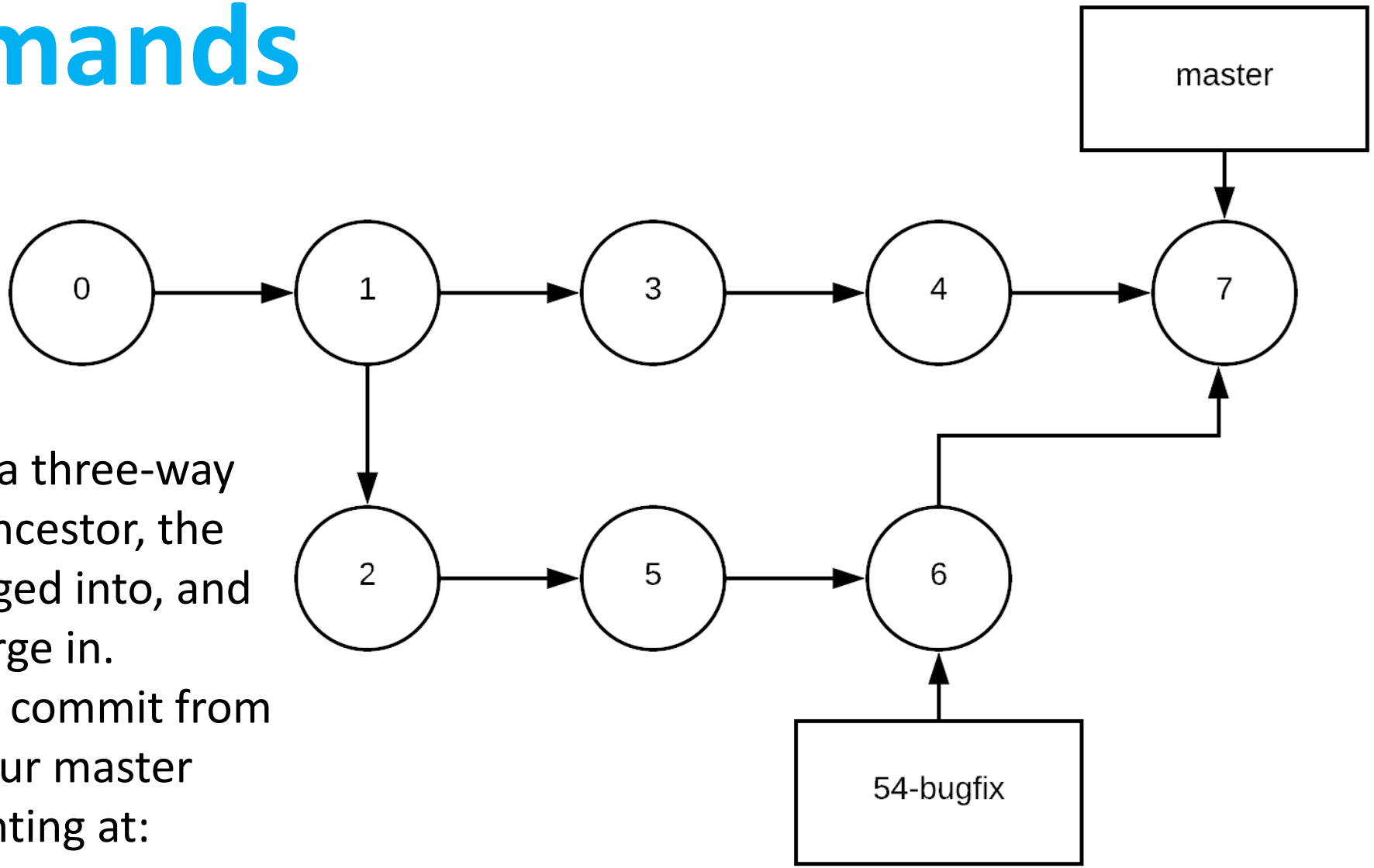
Git commands

- When you're on the master branch and run git merge 54-bugfix, behind the scenes, Git grabs those two commits and then finds their closest common ancestor:



Git commands

- Git then attempts a three-way merge using the ancestor, the commit to be merged into, and the commit to merge in.
- This creates a new commit from all three, which your master branch is now pointing at:

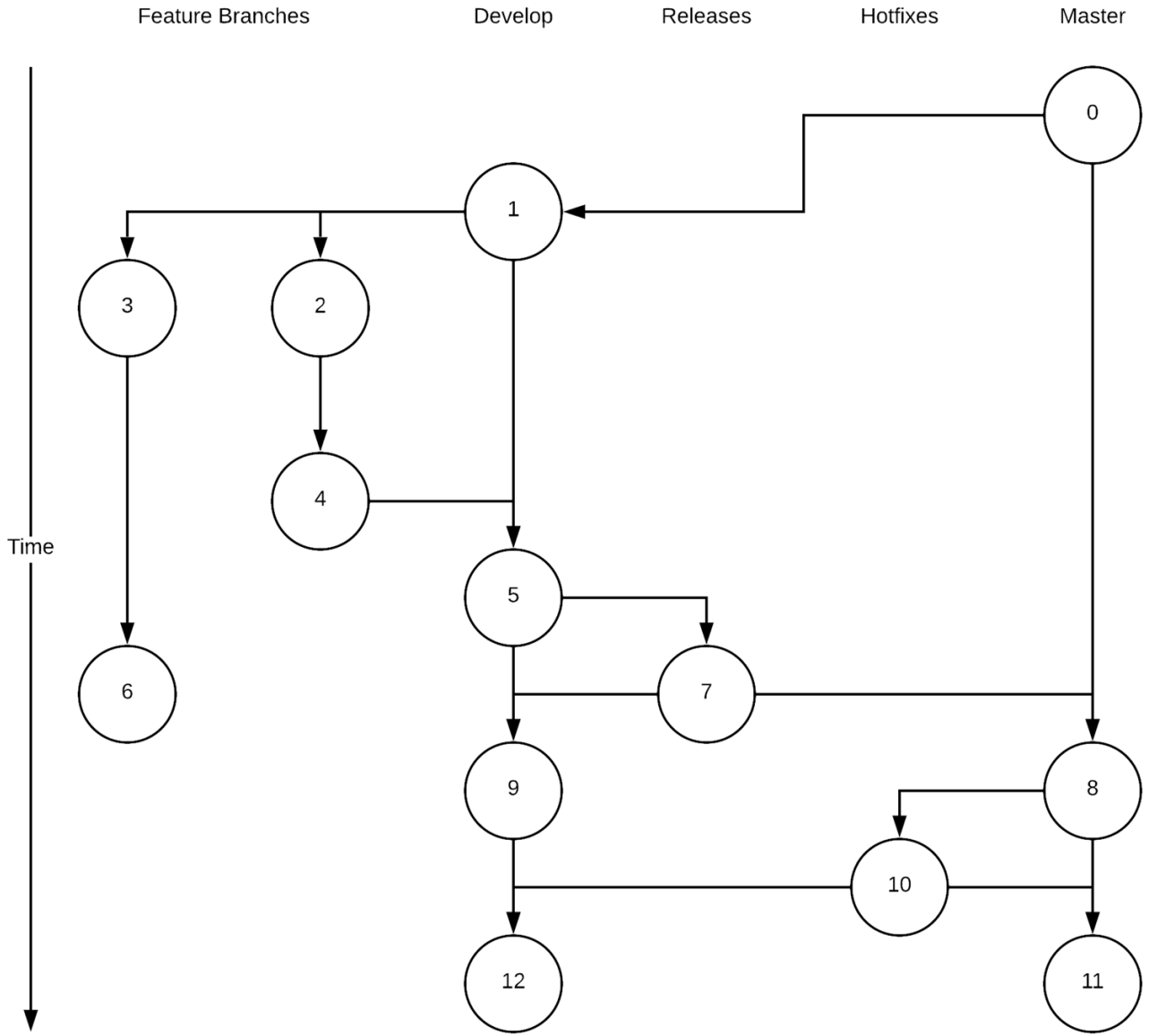


GitFlow

- Git flow is a semi-standardized workflow for dealing with projects in Git.

- It can be daunting, but the rules involve creating a stringent practice for when branches should be committed to or merged in order to prevent deploying buggy code or releases.

A diagram of it is as follows:



Master

The master branch is the original branch where all code is branched from.

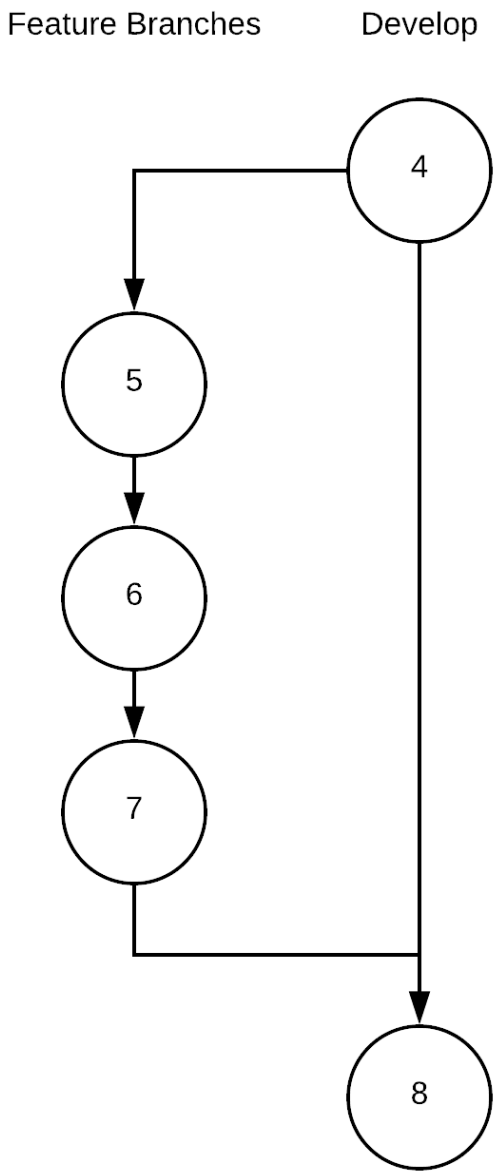
- However, it is never committed to directly; it is only ever merged into.
- The master branch is then used as the deployed branch, or the released branch if you have a product that is shipped, You can tag each merge with a version number to help identify these releases or deployed versions.

Develop

- The develop branch is the other continuously existing branch in the Git flow model, along with the master branch.
- All other branches are considered temporary and can be deleted after work is finished on them and they've been merged.

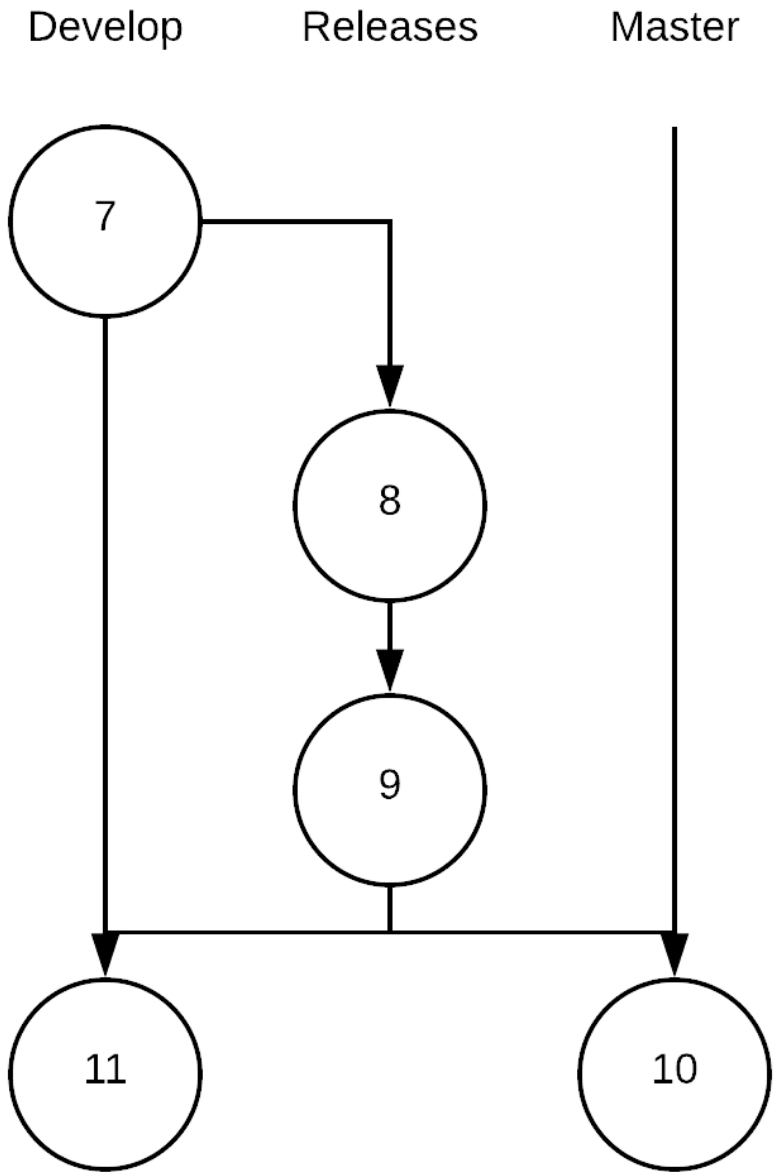
Features

- Unlike the develop or master branches, feature branches only need to last until the feature is complete and merged into develop, after which you can delete the branch since it should no longer be needed:



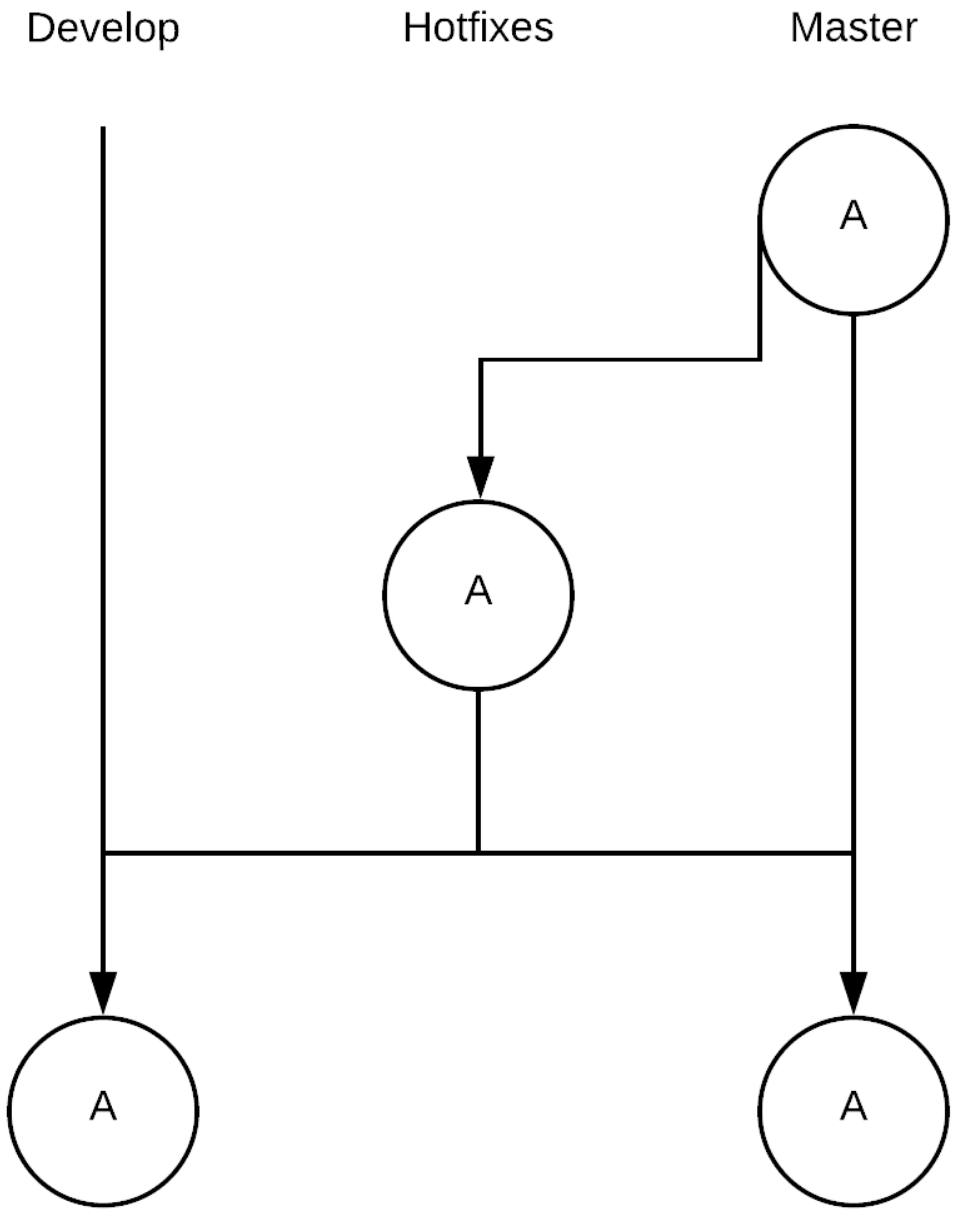
Releases

- If everything is ready, the branch can be merged directly into the master and tagged appropriately as a new release (with either a major or minor version number, depending on your scheme).
- Once this is done, the branch should be re-merged into develop once more to ensure that all of the changes are back into the main development stream.
- You can then safely delete this branch since it is no longer required:



Hotfixes

- After you've merged into master, you also need to merge this into develop so that develop has the latest patches and fixes and you don't conflict in future releases.
- The hotfix can then be safely deleted as it is no longer required:

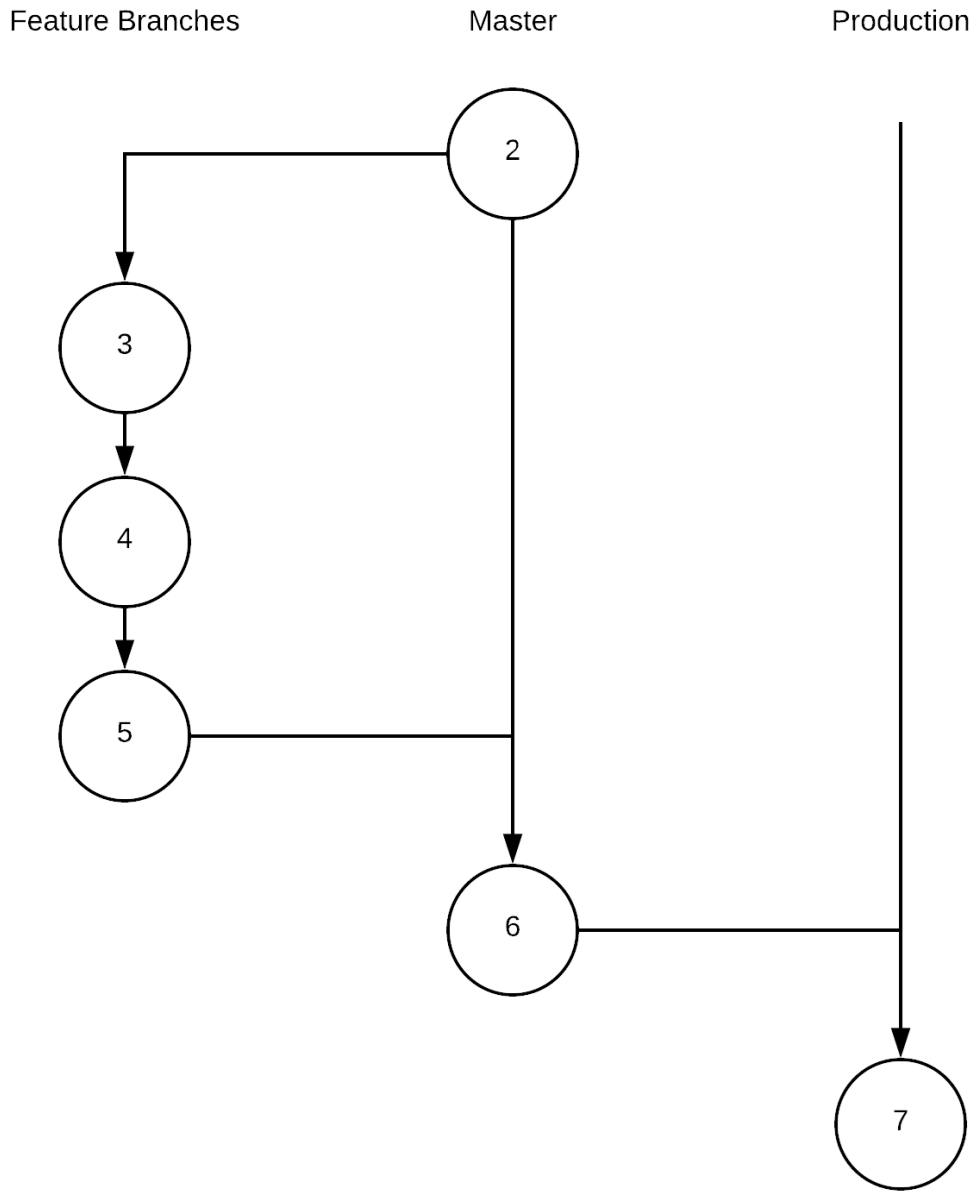


GitLab Flow

- So far, we've explored GitFlow for collaborative project management, but it can be a complex one that doesn't suit all needs.
- There are alternatives, though, and one of these is posited by GitLab and thus known as GitLab Flow.
- GitLab Flow is actually a collection of different branching strategies that can be used depending on your environments and needs.

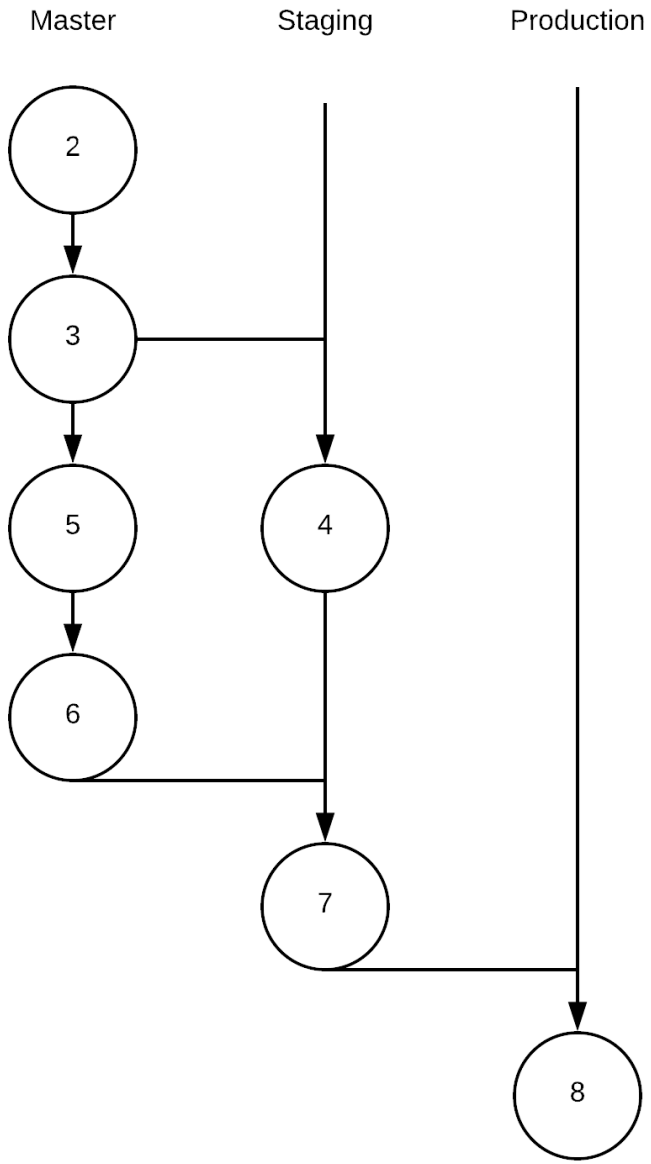
Production branch

- While some development environments can be deployed as soon as commits are merged in, some projects aren't set up like that.
- A good example is apps that need to be approved by the app store and thus aren't on the same agile, continuous release schedule as the code in the master branch, or platforms that can only be deployed during certain late night/early morning windows so as not to affect the users of the systems:



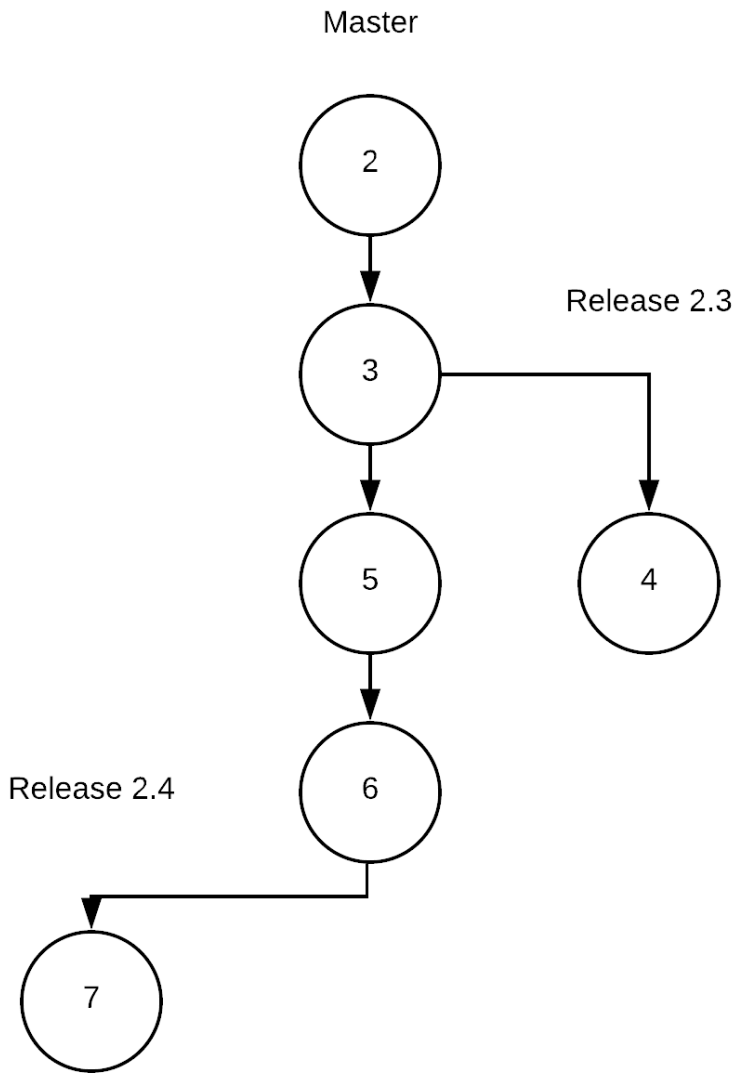
Staging branch

- The production branch workflow is good, but sometimes you have multiple environments and your QA team might want to test stuff a bit further before it gets released.
- For example, you might have a staging or pre-production environment that you want to deploy to and ensure that everything is working before you deploy to production.
- In that case, you can use a workflow like the following:

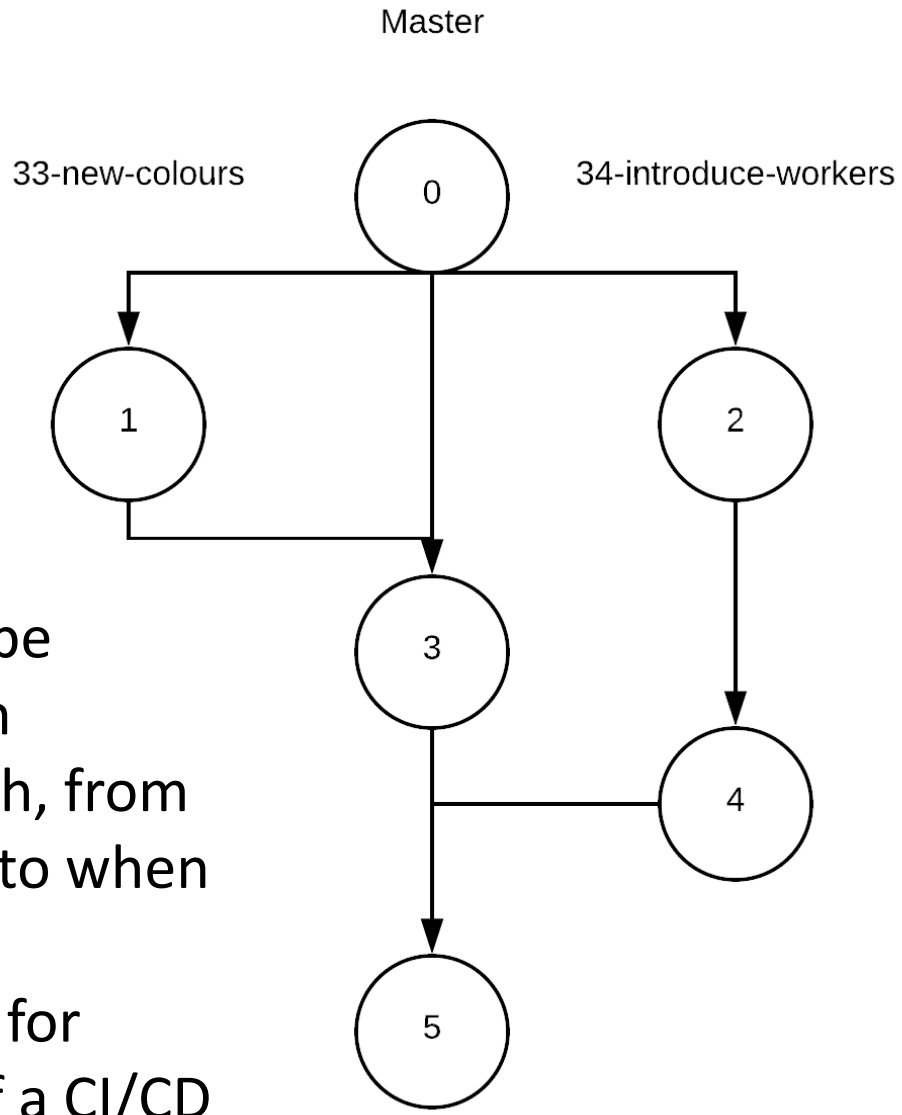


Release branch

- The last flow suggested by the GitLab team is the release branch flow.
- A handy diagram of it is included as follows:



Differences from GitHub flow



- If you've previously worked with GitHub, you might be familiar with the GitHub flow, a rigid workflow which recommends only having a continuous master branch, from which features are branched off and then merged into when created.
- Any code in the master branch is theoretically ready for deployment and continuous release with the help of a CI/CD platform:

Summary

- In this lesson, we've looked at how to apply Git to your software development process and we've covered most of the basic commands, including add, commit, push, pull, branch, and merge.
- We also looked at GitFlow, a recommended workflow for Git software projects, and how to handle branching and merging correctly.

Introducing the GitLab Architecture

In this lesson, we will be covering the following topics:

- The origins of GitLab
- GitLab CE or EE
- The core components of GitLab
- GitLab CI
- GitLab Runners
- Cloud native

The origins of GitLab

- The story began in 2011, when Dimitri Zaporozhets, a web programmer from Ukraine, was faced with a common problem.
- He wanted to switch to Git for version management and GitHub to collaborate, but that was not allowed in his company.
- He needed a tool that did not hinder him in developing code and was easy to use.

The origins of GitLab

- After this initiative, the project grew enormously:

Date	Fact
2011	Sytze Sybrandij, the future CEO of GitLab, is impressed by the GitLab project and code, and offers Zaporozhets the opportunity to try to commercialize it via https://about.gitlab.com/.
2012	GitLab was announced to a broader audience via Hacker News (https://news.ycombinator.com/item?id=4428278).
2013	Dimitri Zaporozhets decides to work full-time on GitLab and joins the company.
2015	GitLab becomes part of the Y Combinator class and received VC funding that year.
2018	GitLab receives another $100 million of VC funding and is valued at $1 billion.
2019	The GitLab company employs over 600 employees.

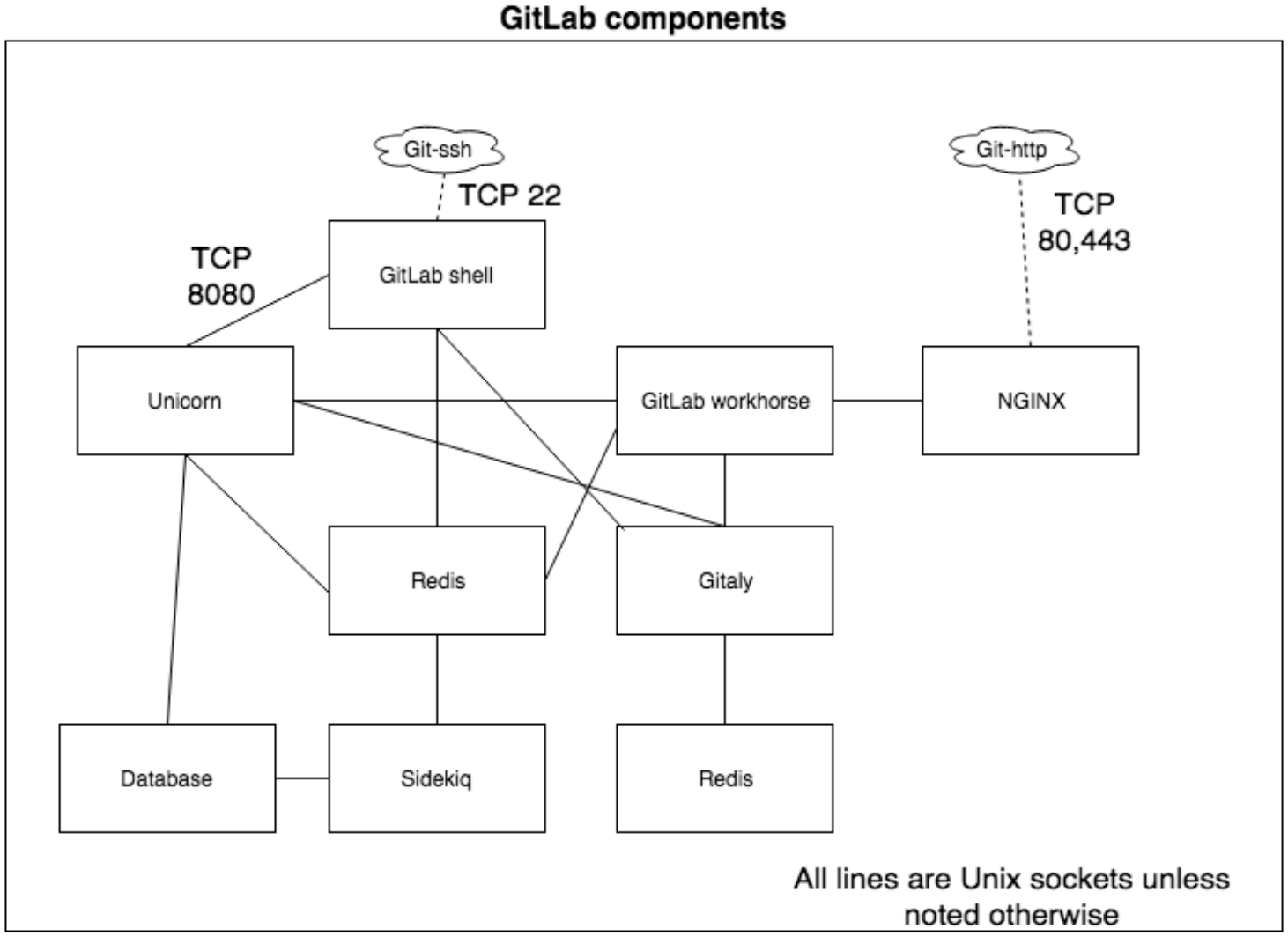
Exploring GitLab editions – CE and EE

- The core of the GitLab software is called the CE.
- It is distributed under the MIT license, which is a permissive free software license created at the Massachusetts Institute of Technology.
- You are allowed to modify the software and use it in your creations.

Exploring GitLab editions – CE and EE

ersion	Features (short list)
Starter	Everything on core GitLab CE: •CI/CD •Project Issue Board •Mattermost integrations •Time tracking •GitLab pages
Premium	More enterprise features such as the following: •Maven and NPM repository functionality •Protected environments •Burndown charts •Multiple LDAP servers and Active Directory support
Ultimate	All options, including the following: •All security scanning tools •Epics •Free guest users •Web terminal for the web IDE

The core system components of GitLab



Summary

- In this lesson, we have learned about the people and the organization behind GitLab.
- Starting from the beginning, we have shown you how the project has developed over the years.
- We went through the core components of GitLab.

"Complete Lab 1&2"

Configuring GitLab Using the Web UI

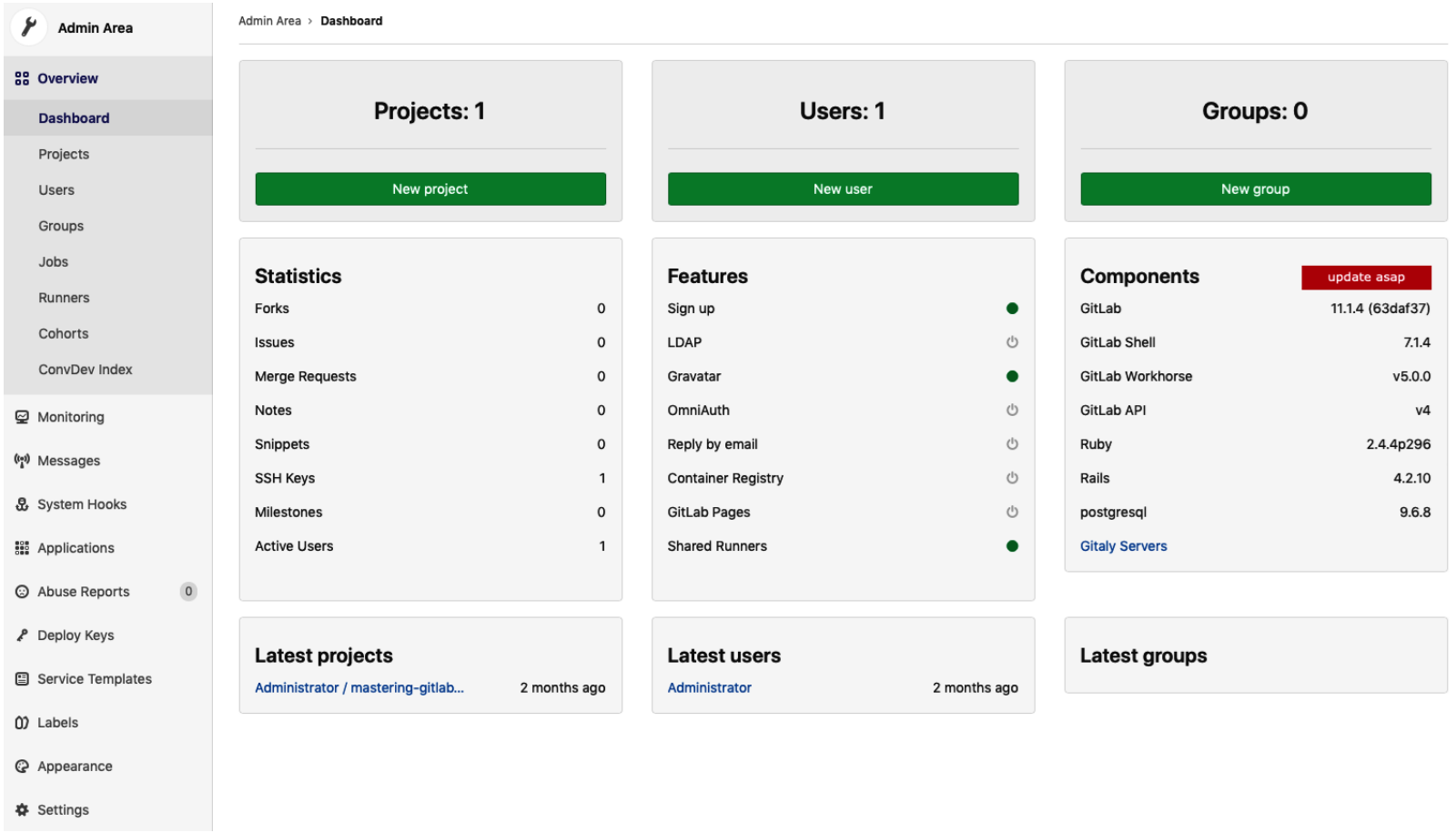
The following topics will be covered in this lesson:

- Configuring GitLab settings at the instance level
- Configuring GitLab settings at the group level
- Configuring GitLab settings at the project level

Configuring GitLab settings at the instance level

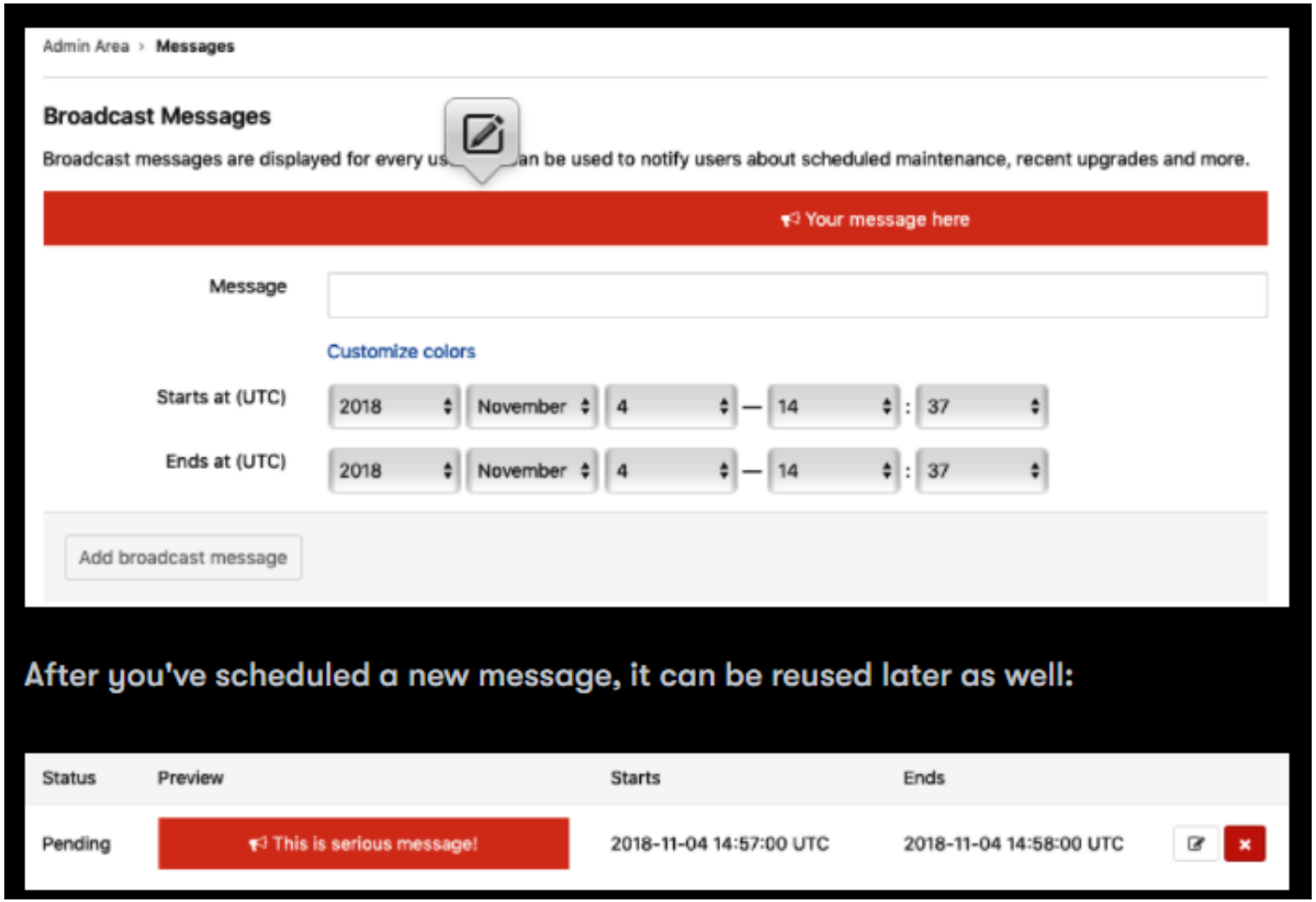
- When you log on to GitLab as an administrator, you will notice a tool icon in the top right of the menu:

Configuring GitLab settings at the instance level



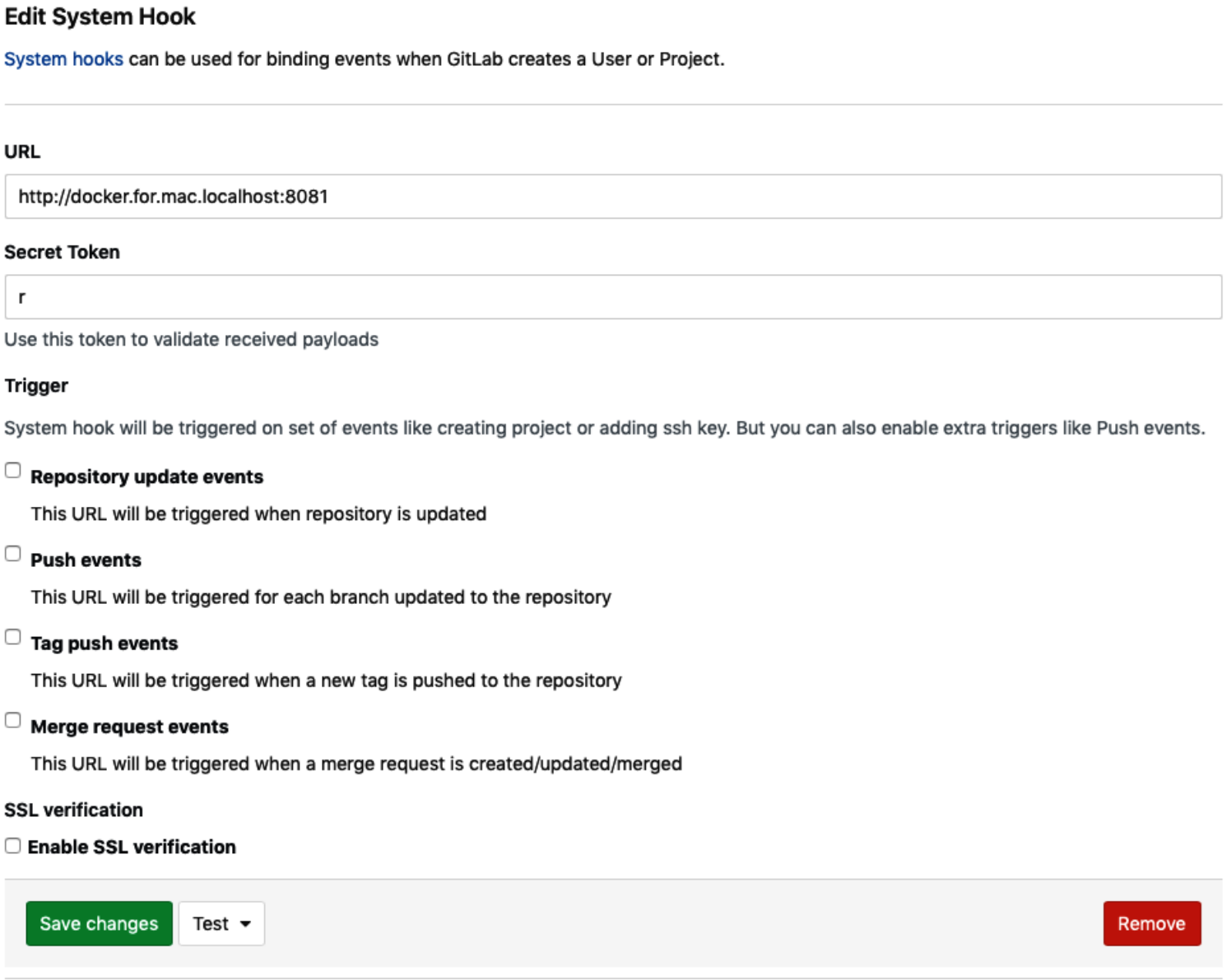
Messages

- Your GitLab instance has a facility where you can send messages to all of your users.
- These broadcasts can come in handy if you want to inform your users about system-wide events, such as upgrades and scheduled downtime.
- The following is the Admin page, which you can find in the side menu:



System hooks

- A standard event is raised when you're creating a new project or user.
- Additionally, it can send other types of events as well. Just add a destination URL and (optionally) a secret token:



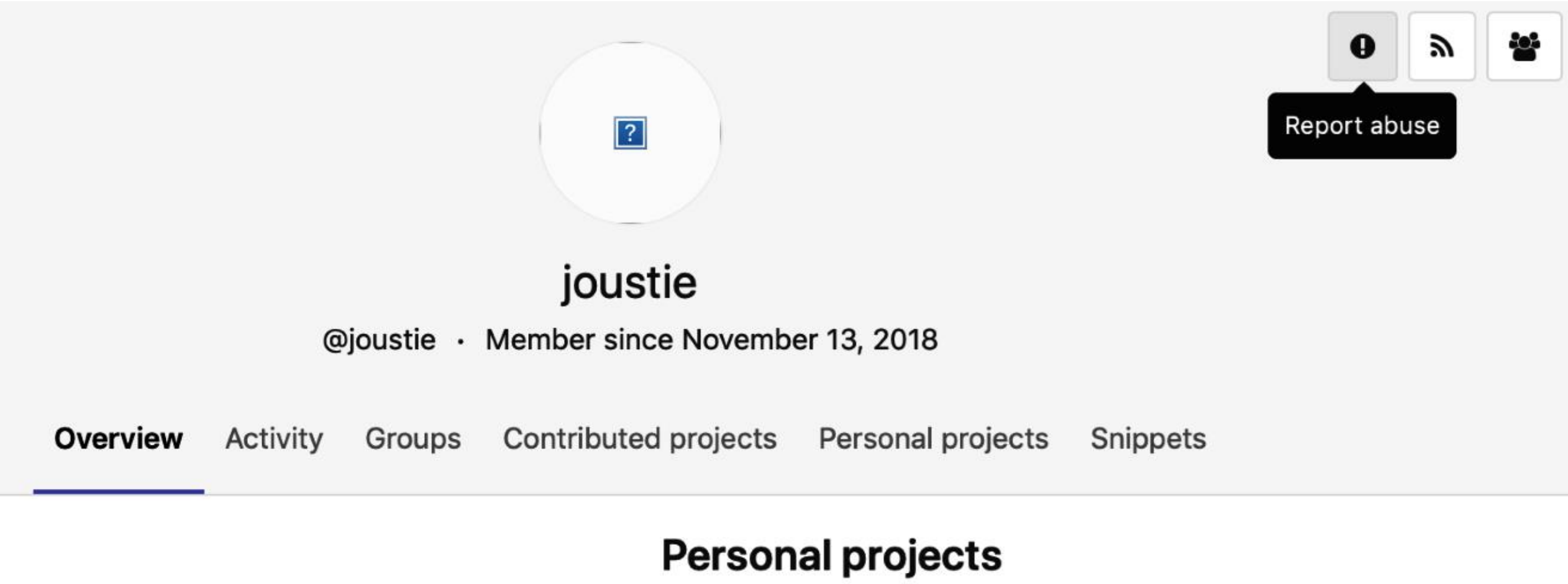
Plugins

- On this page, you also have the option to configure installed plugins.
- This basically fires a locally installed program instead of calling a URL with parameters.
- It requires you to place the plugin code in /opt/gitlab/embedded/service/gitlab-rails/plugins, and it has to be written in a certain way.

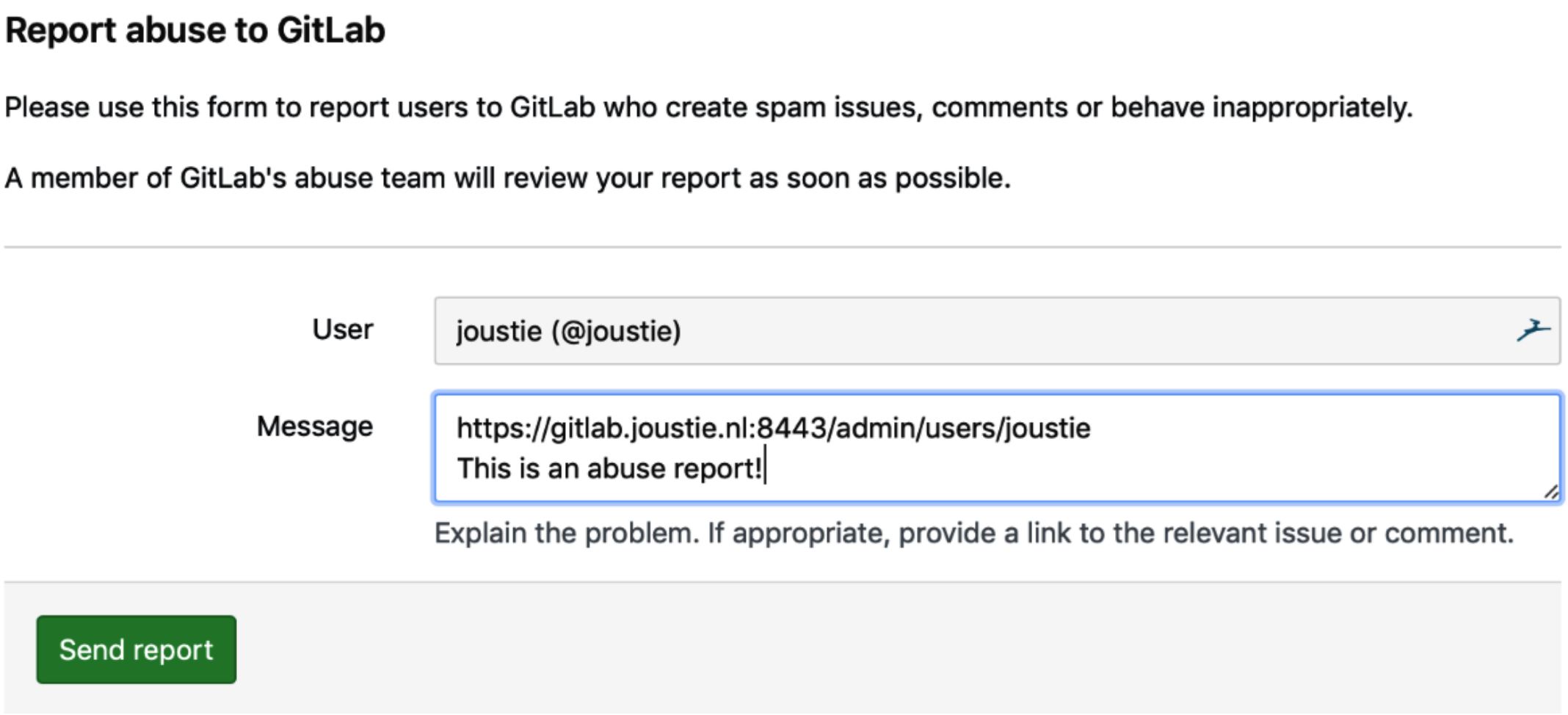
Applications

- In this section of the administration page, you have the option to register third-party applications in order to use GitLab as an OAuth authorization provider.
- Open Authorization (OAuth) is an open standard for authorization.
- Users can give a program or website access to their private data that's kept on another website without revealing their username and password.

Abuse reports



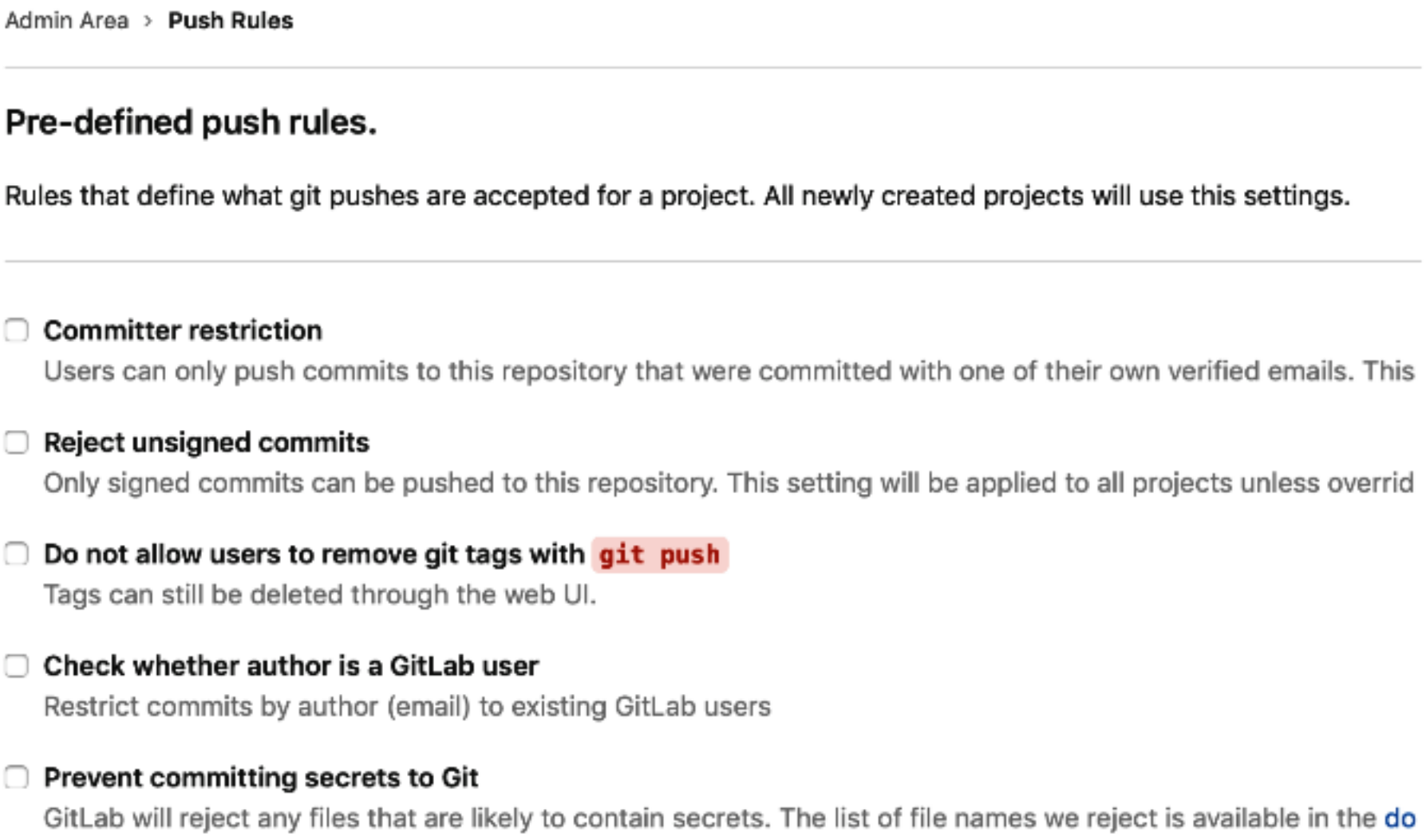
Abuse reports



Abuse reports

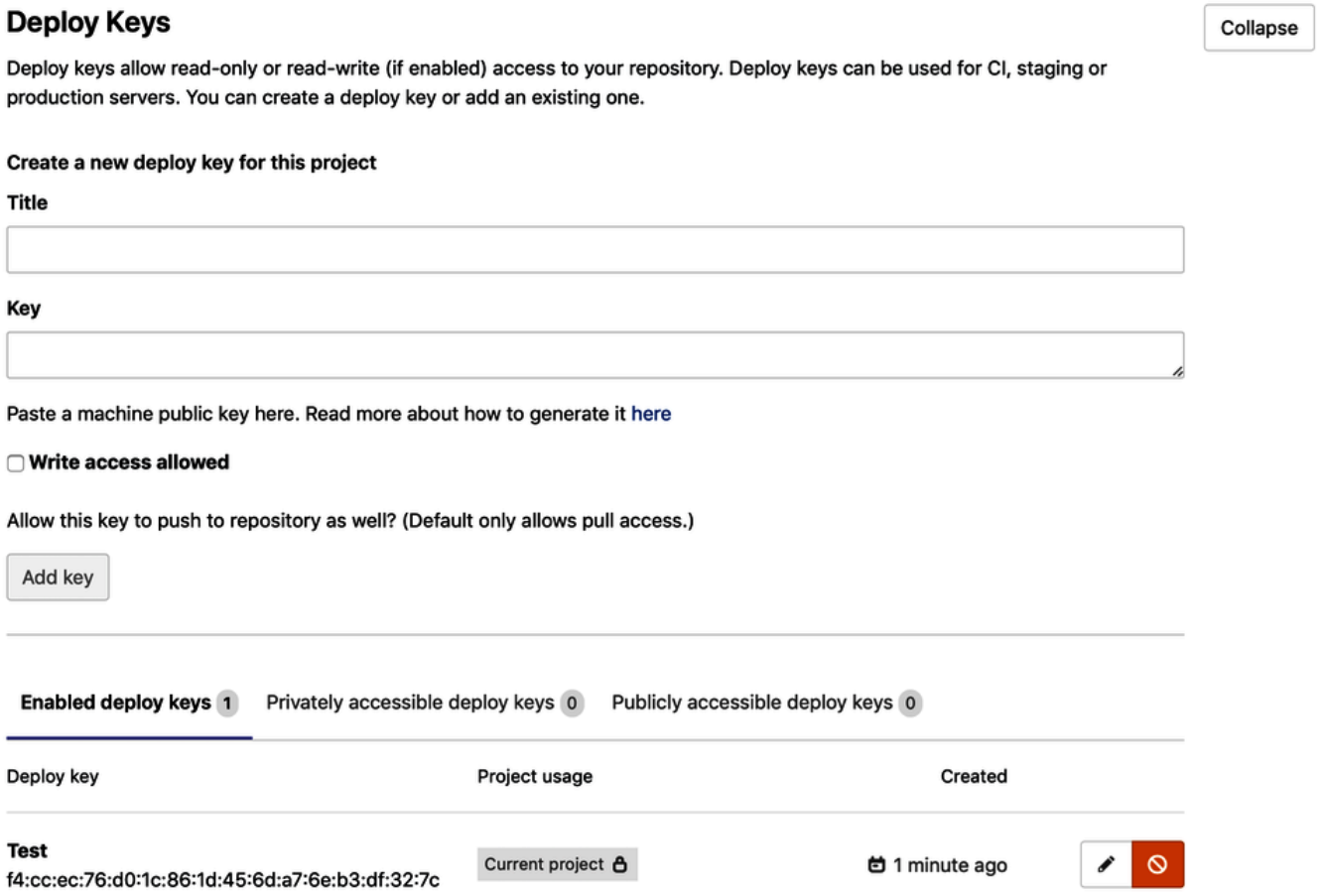
Push rules

- In this section, you can define all kinds of rules that will allow or disallow Git pushes:



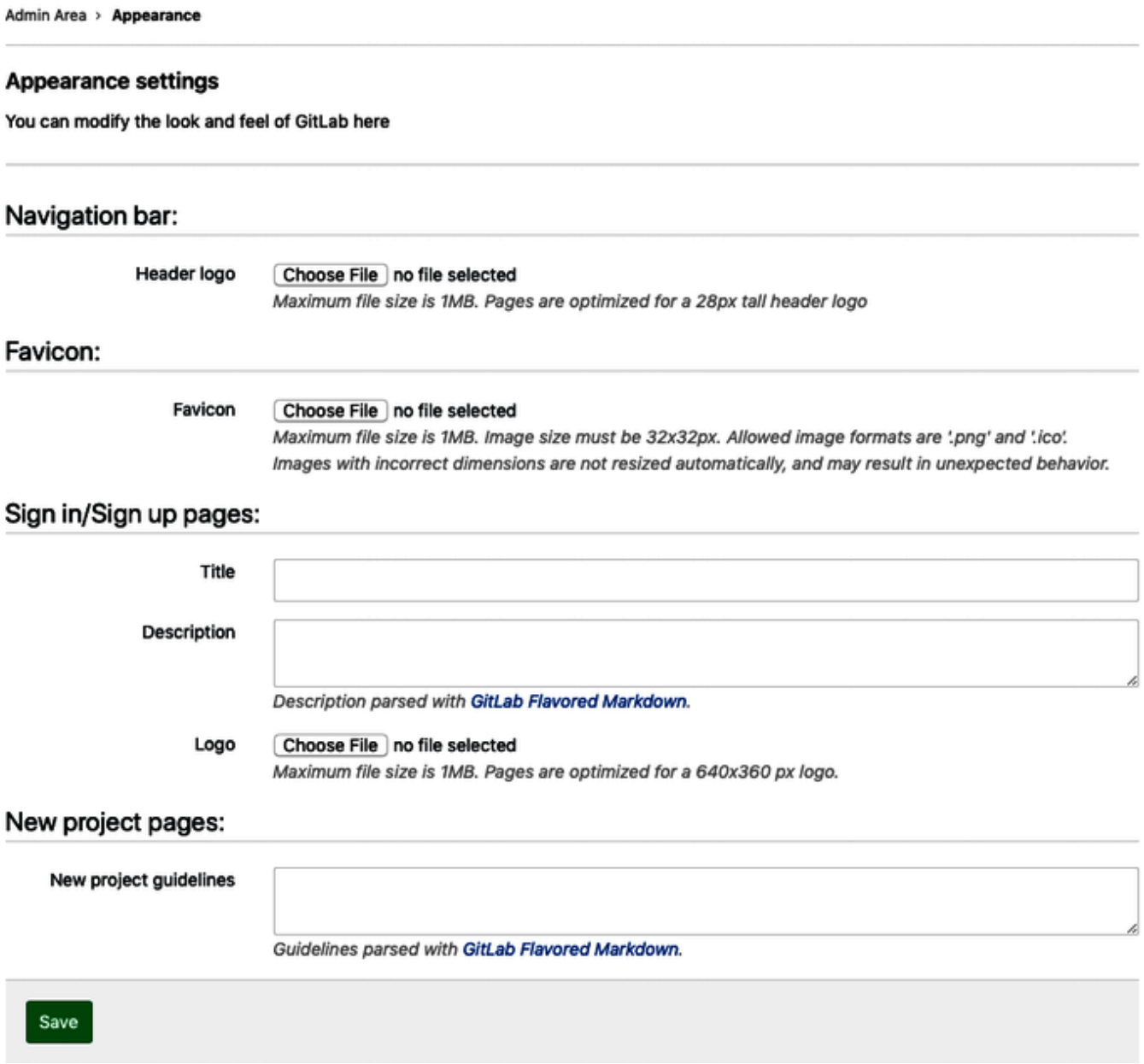
Deploy Keys

- In this section, you can register SSH keys, which are known as Global Shared Deploy keys.
- They allow read-only or read-write (if enabled) access to be configured on any repository in the entire GitLab installation.
- When the administrator has registered them here, you can assign them in your project, as shown in the following screenshot:



Appearance

- You can define some cosmetic aspects of your GitLab instance on the Appearance settings page:



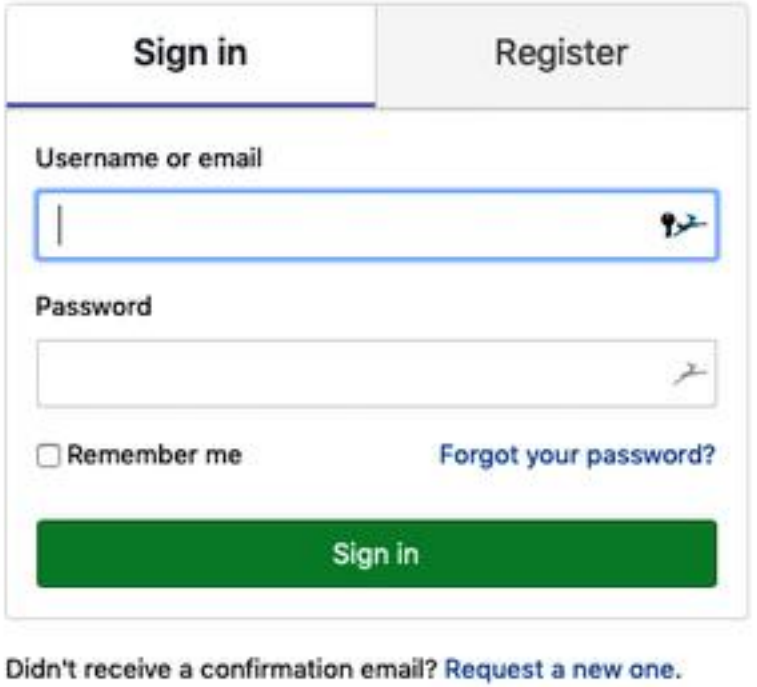
Appearance

- After you have done this, log out. You will be redirected to the front page:

GitLab Community Edition

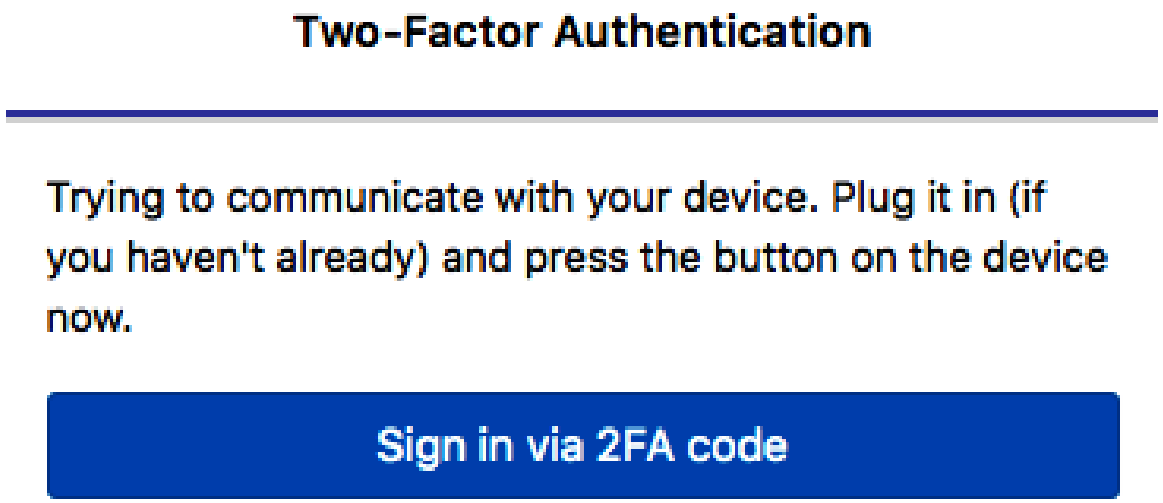
Open source software to collaborate on code

Manage Git repositories with fine-grained access controls that keep your code secure. Perform code reviews and enhance collaboration with merge requests. Each project can also have an issue tracker and a wiki.



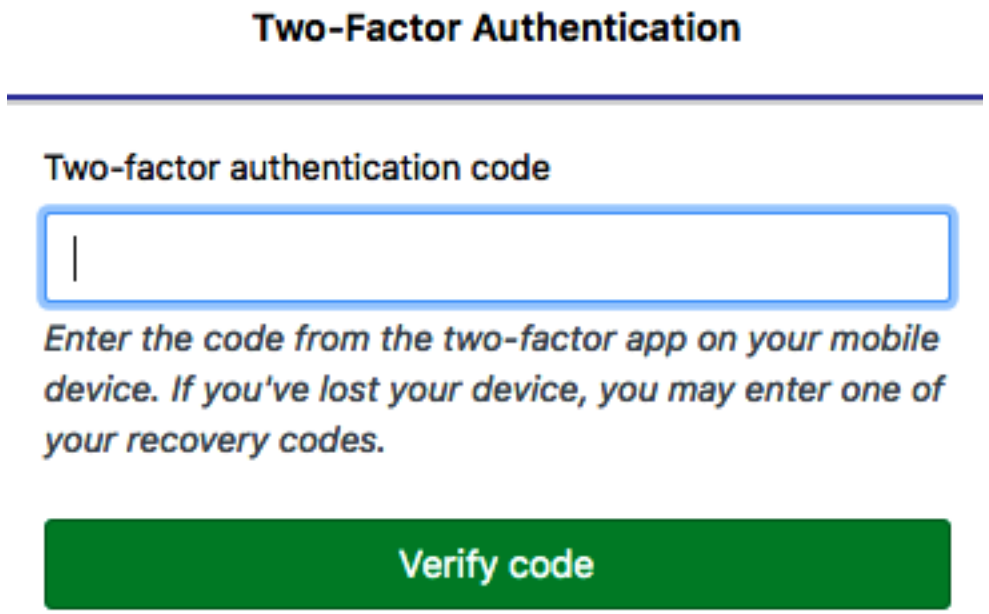
Sign-in restrictions

- It is possible to use a hardware token device as a second factor, as you can see in the following screenshot (this only works in Chrome):

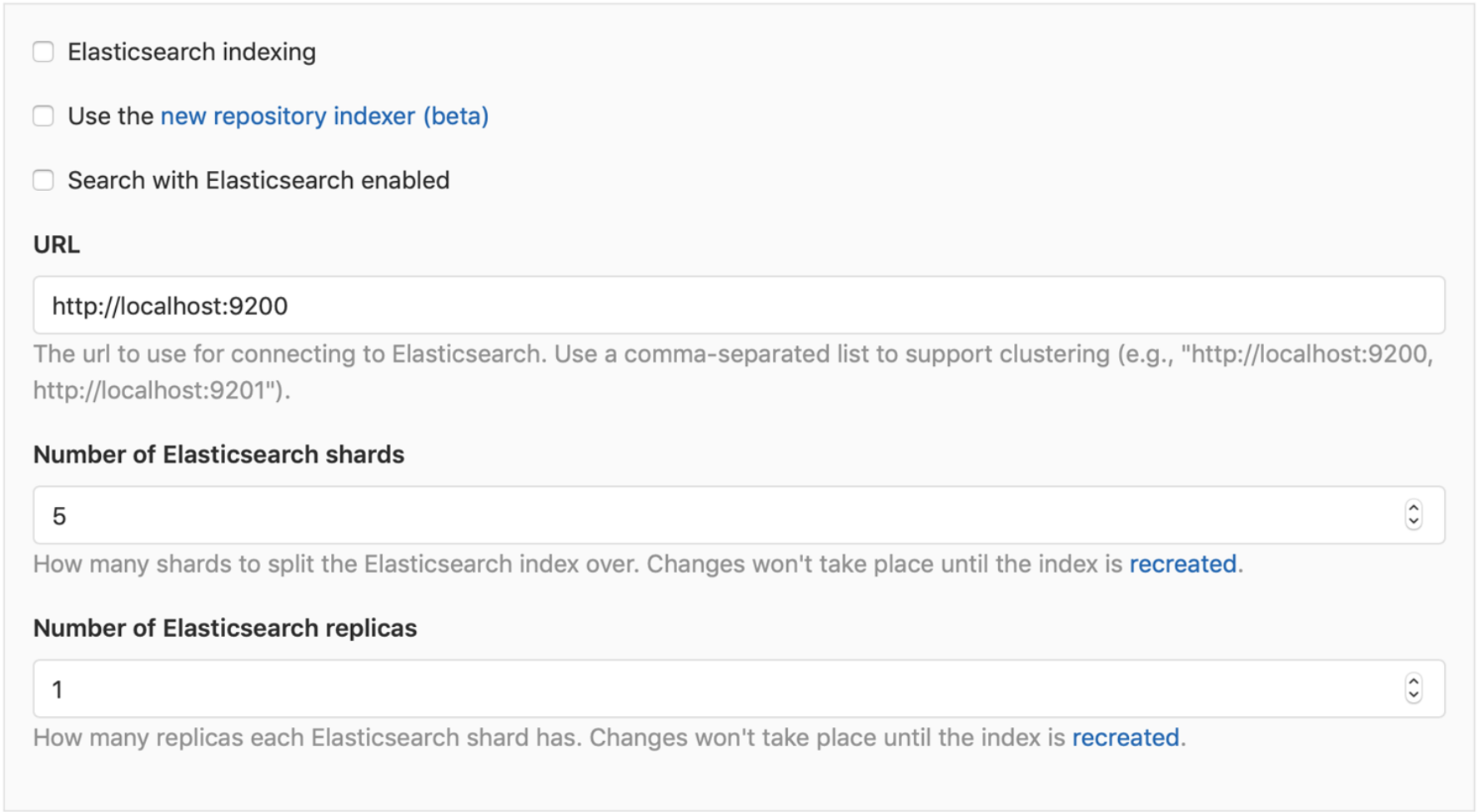


Sign-in restrictions

- You can also choose to use a code generator app such as Google Authentication:

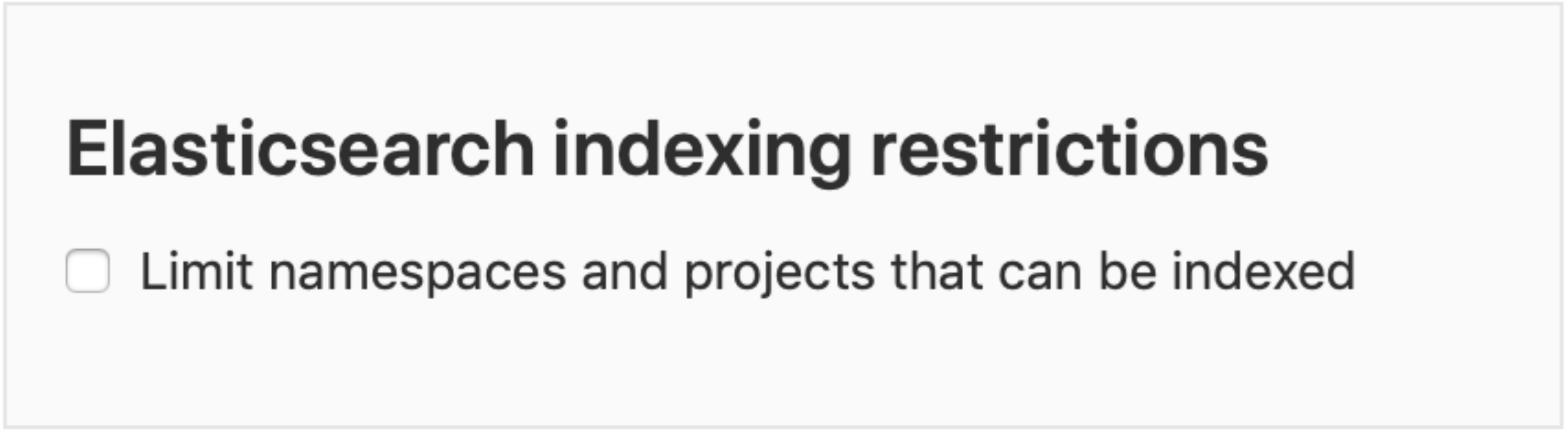


Elasticsearch



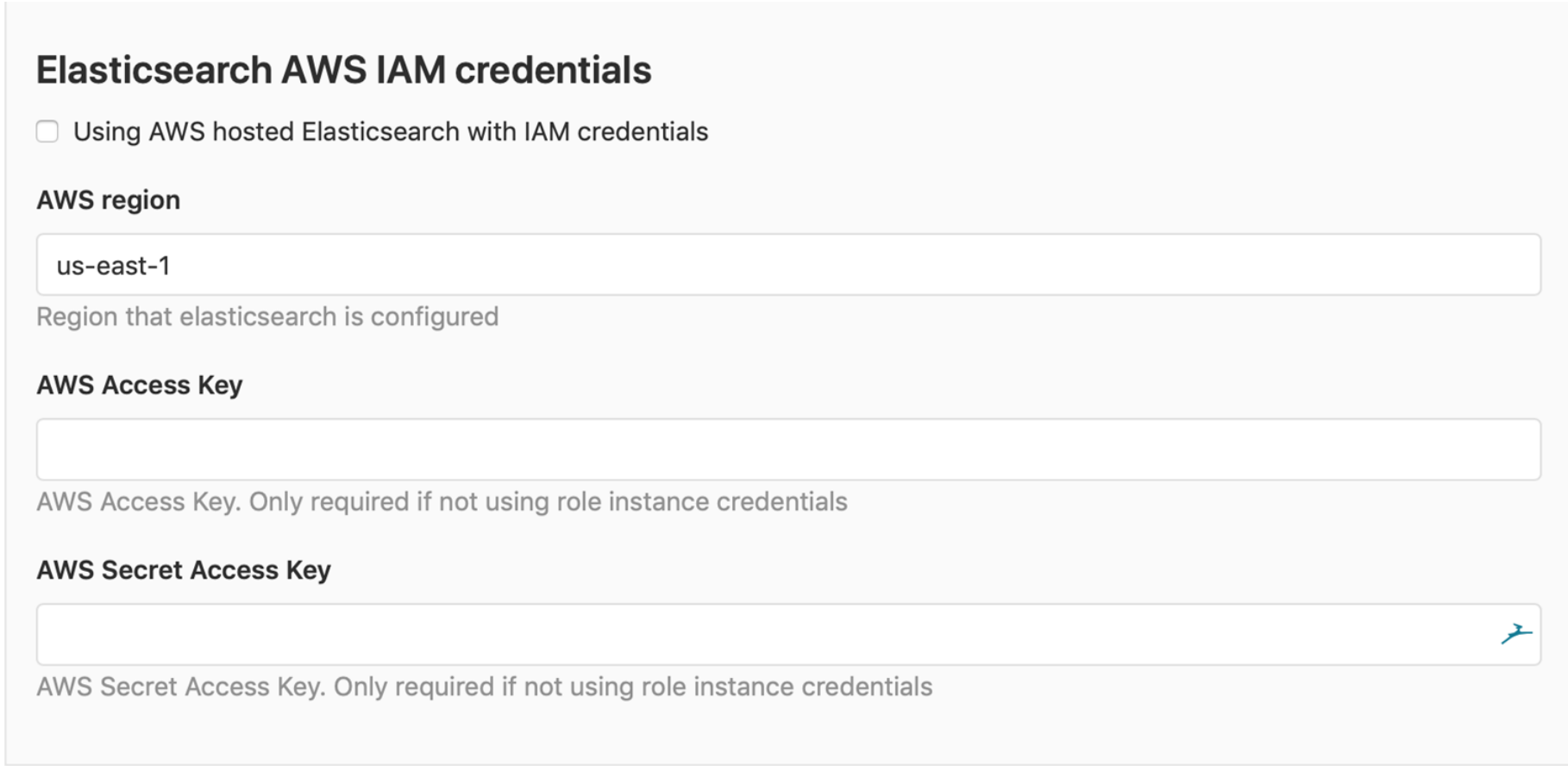
Elasticsearch

- You can also limit what will be indexed:

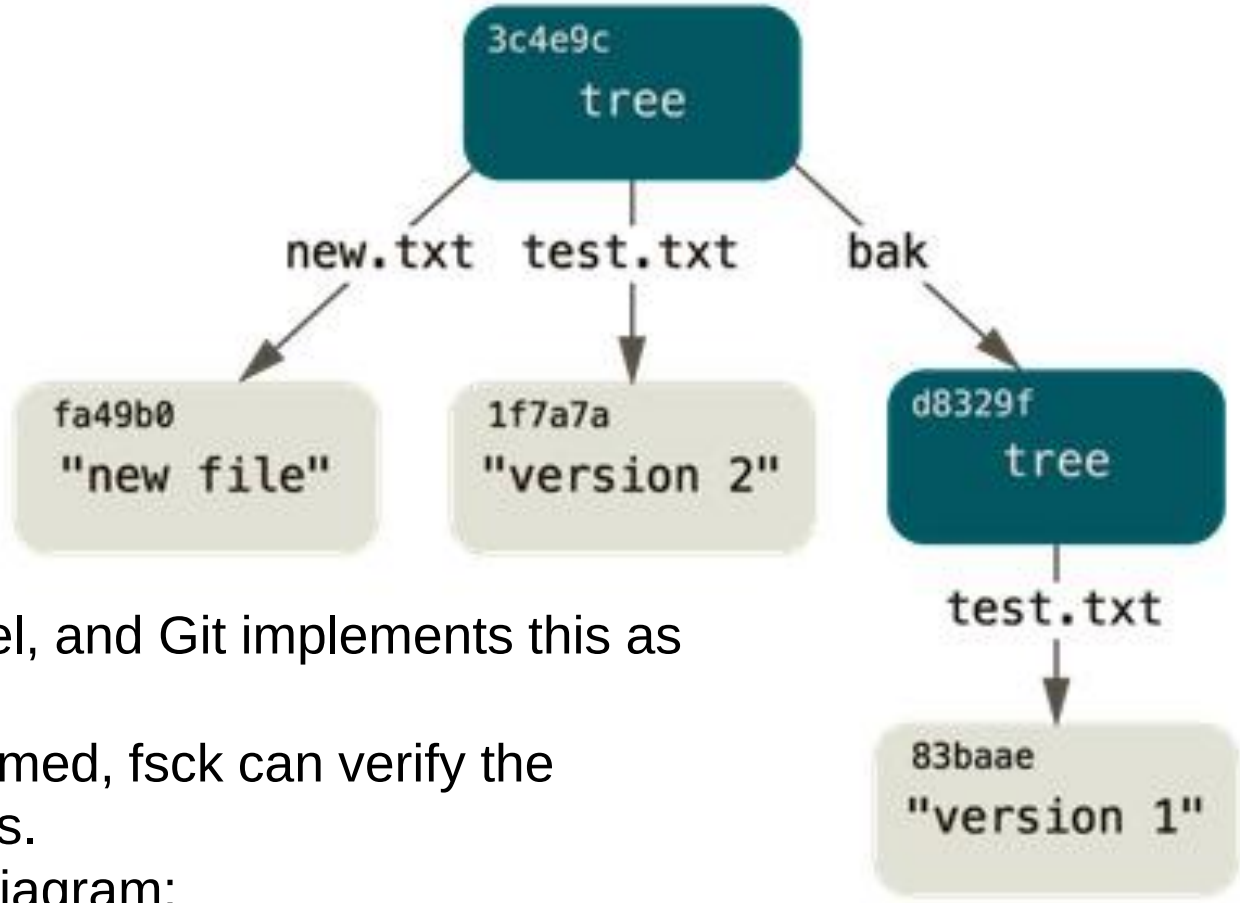


Elasticsearch

- Another option is to connect to an Elasticsearch instance that you are running in the Amazon cloud.
- You can specify connection settings here as well if you have this set up:



Repository maintenance



- A filesystem is classed as a graph model, and Git implements this as tree and blob objects.
- Because all of the items are check-summed, fsck can verify the integrity of the objects and their relations.
- This graph is depicted in the following diagram:

Auto DevOps settings

Continuous Integration and Deployment

Auto DevOps, runners and job artifacts

- [x] Default to Auto DevOps pipeline for all projects

  The Auto DevOps pipeline will run if no alternative CI configuration file is found. More information

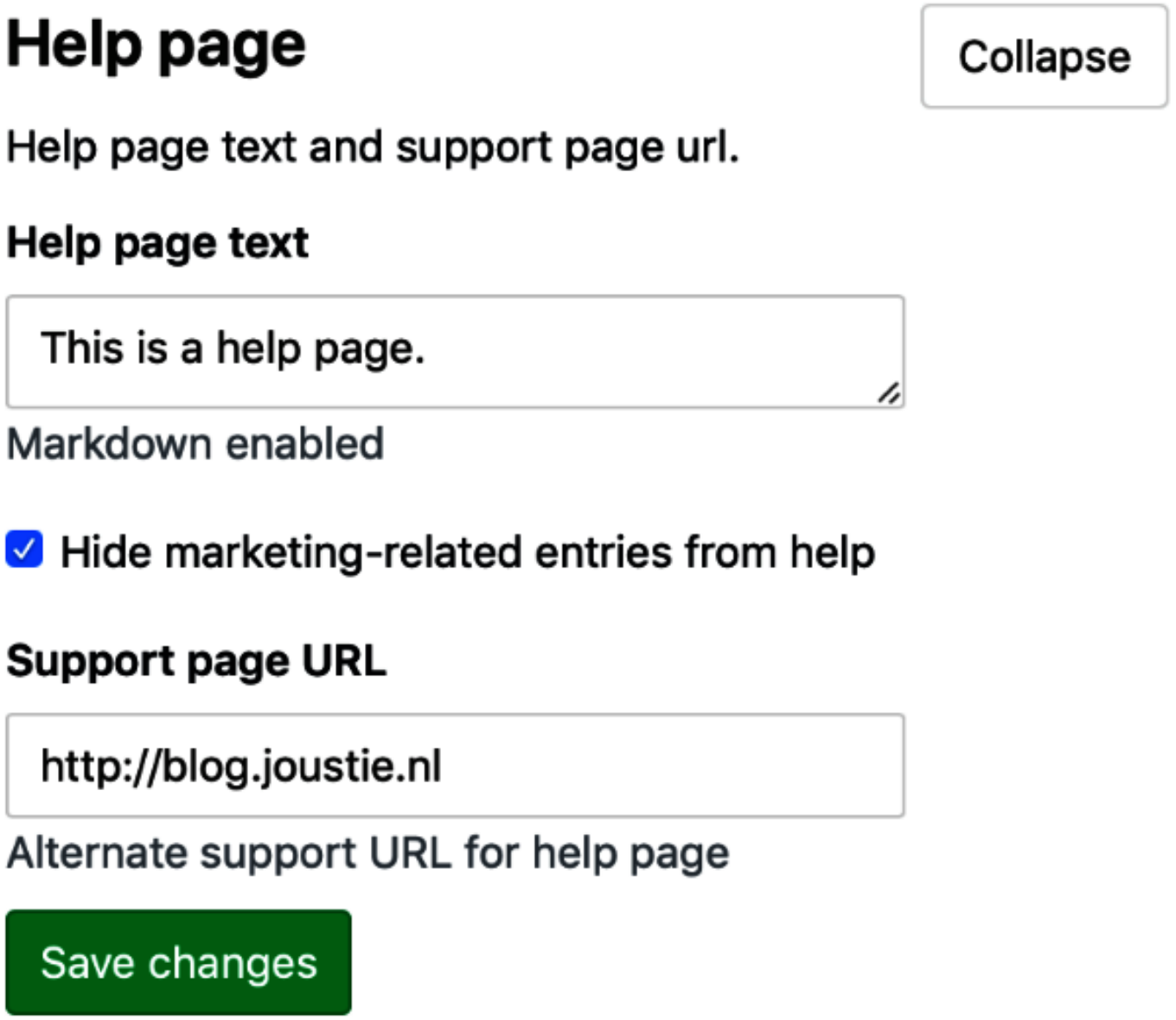
Auto devops domain

domain.com

Specify a domain to use by default for every project's Auto Review Apps and Auto Deploy stages.

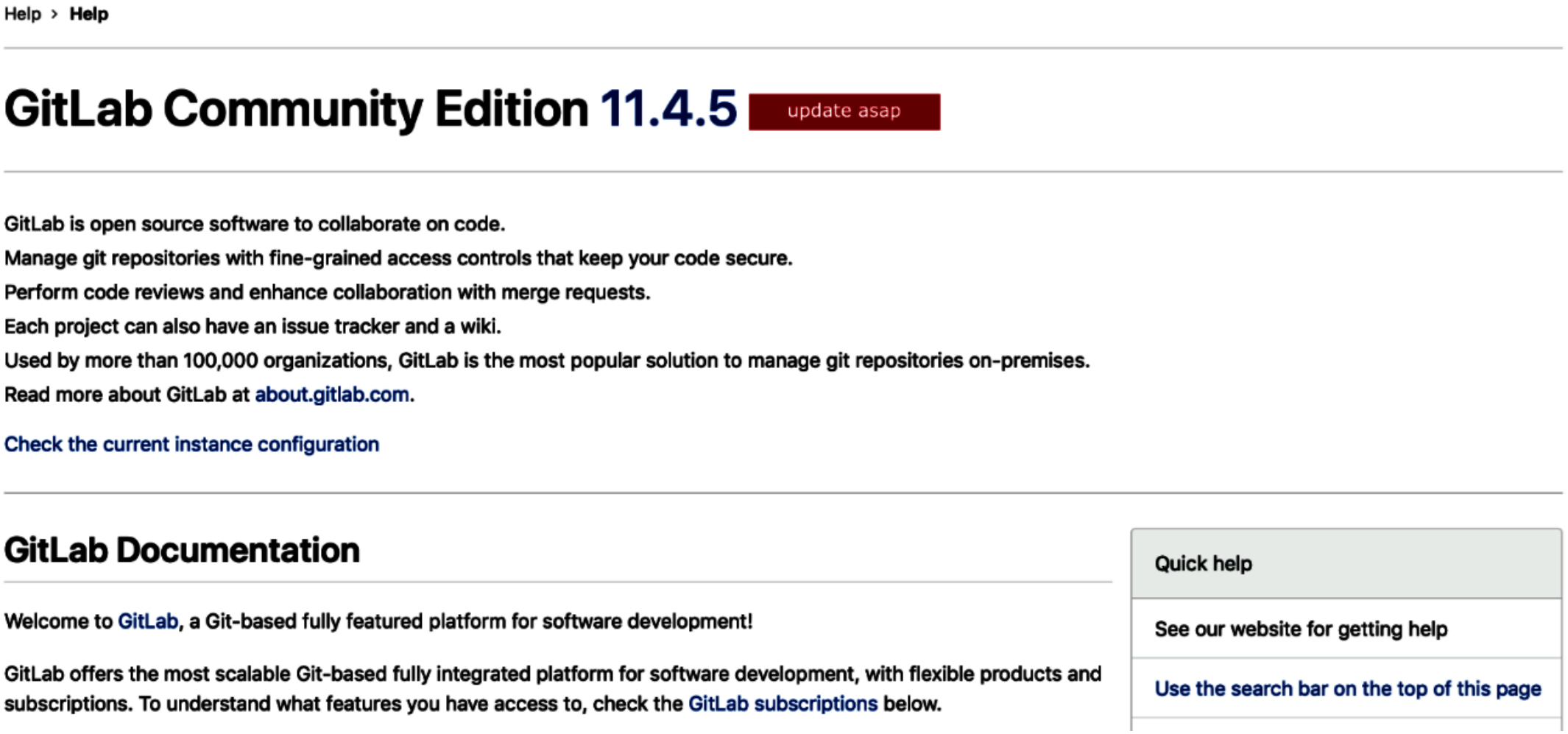
Help page

- You can also customize the way the Help page for GitLab is presented.
- There's the option to provide some custom text, which will be displayed on top of the Help page:

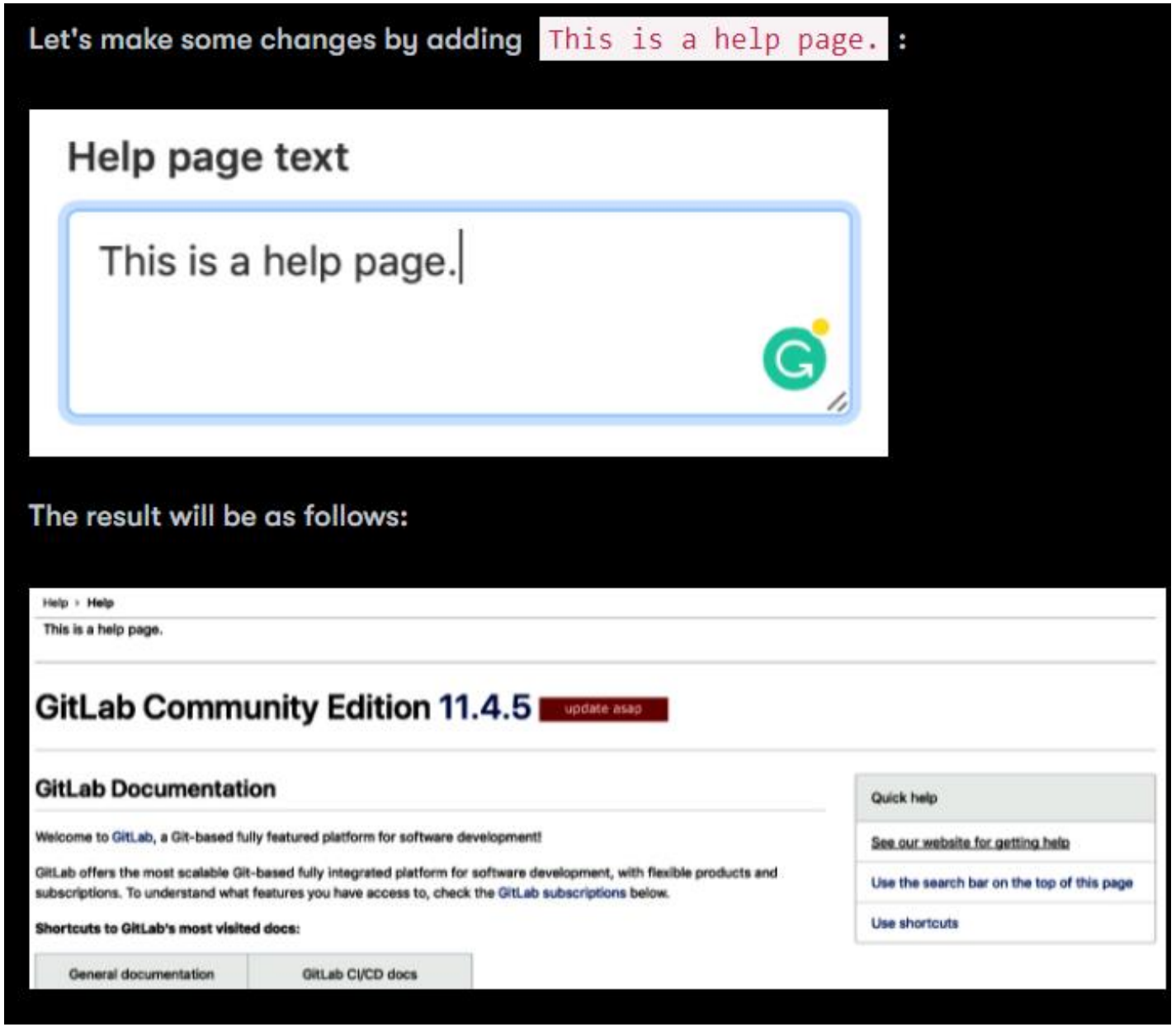


Help page

- The following is a screenshot of the standard Help page:



Help page

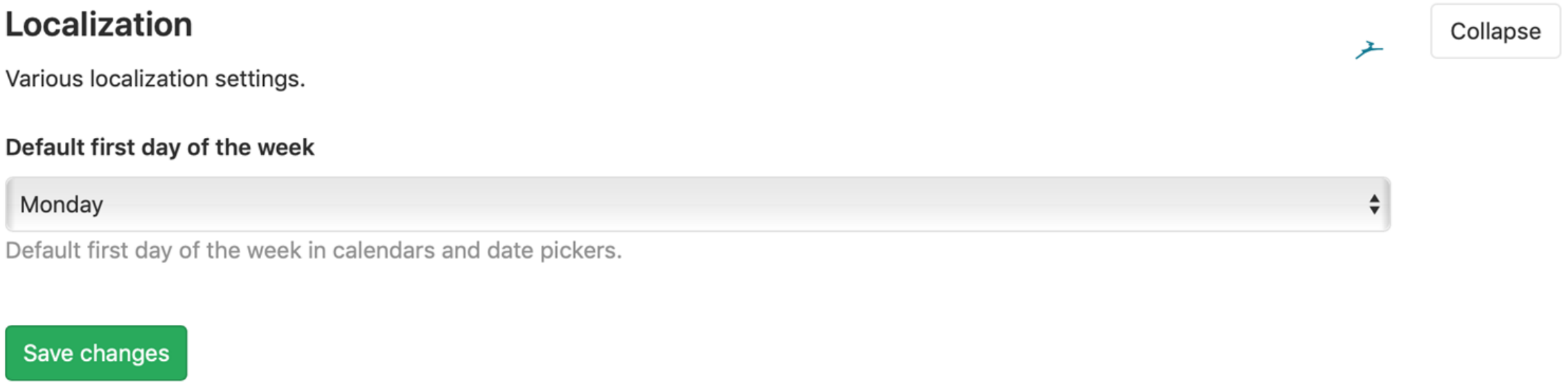

Let's make some changes by adding This is a help page. :
Help page text
This is a help page.
The result will be as follows:
Help › Help
This is a help page.
GitLab Community Edition 11.4.5
update asap
GitLab Documentation
Welcome to GitLab, a Git-based fully featured platform for software development!
GitLab offers the most scalable Git-based fully integrated platform for software development, with flexible products and subscriptions. To understand what features you have access to, check the GitLab subscriptions below.
Shortcuts to GitLab's most visited docs:
General documentation
GitLab CI/CD docs
Quick help
See our website for getting help
Use the search bar on the top of this page
Use shortcuts

Pages

- If you use the GitLab Pages feature, you can specify the maximum size of pages.
- You can set it to zero if you want the size to be unlimited.
- You can also allow users to prove that they own a domain before you serve a page for it:

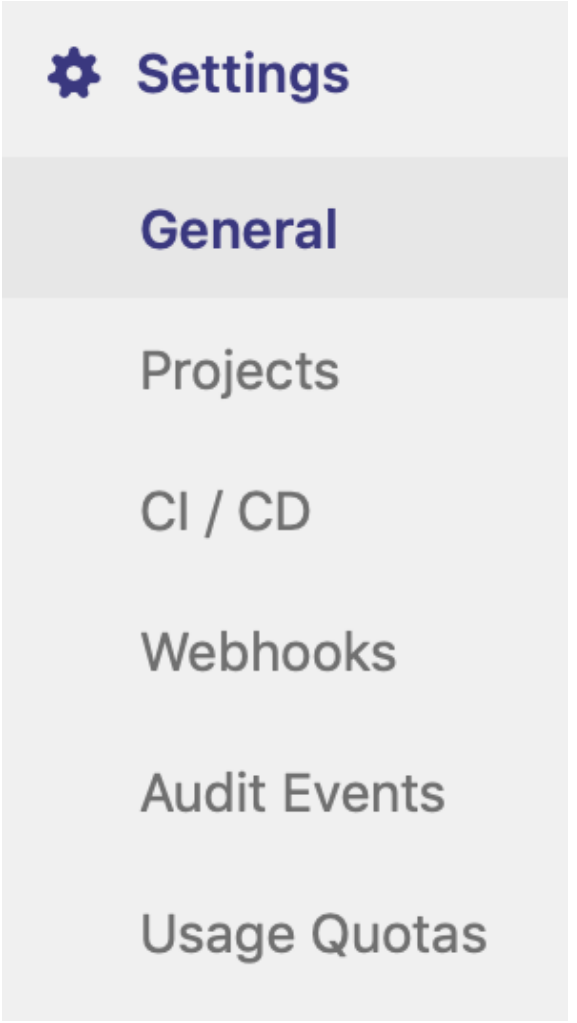
Localization

- This is a big section of the settings since there are many localization settings for software products.
- The only one that is exposed in this screen is Default first day of the week:

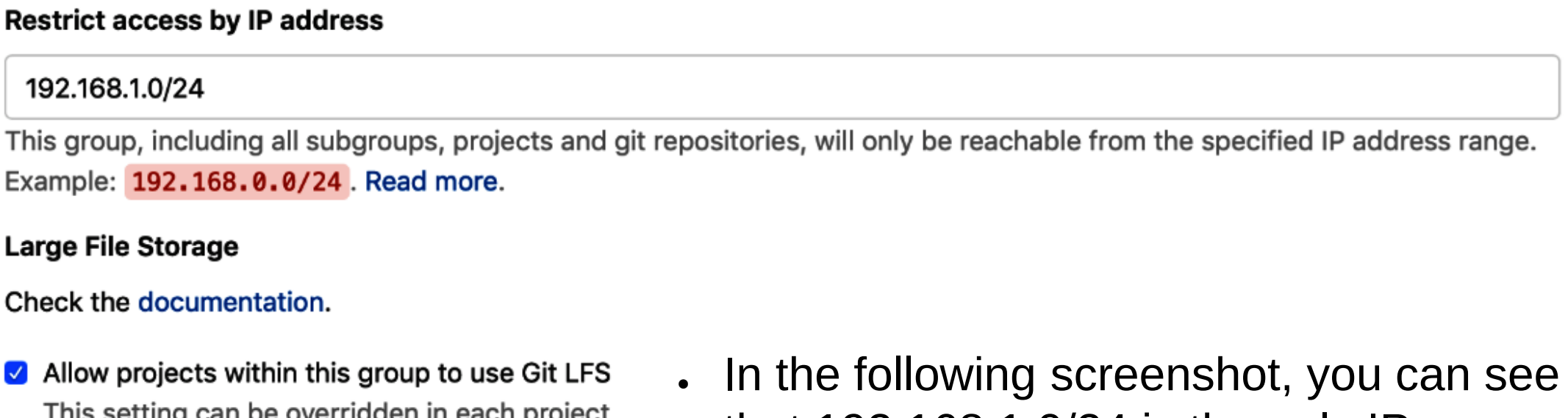


Configuring GitLab settings at the group level

- You will see a submenu with the items that you can configure.
- It looks a lot like the UI in the admin area but is, of course, scoped to the group:



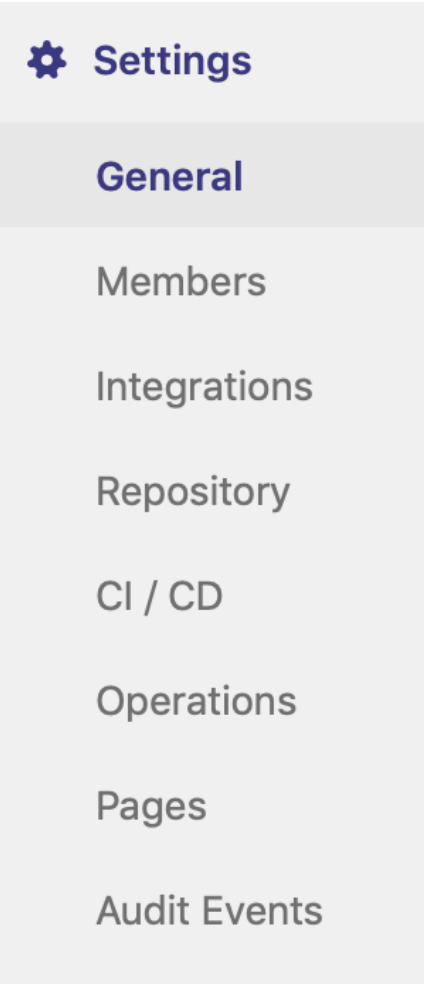
Configuring GitLab settings at the group level



- In the following screenshot, you can see that 192.168.1.0/24 is the only IP range that's allowed to see the group content:

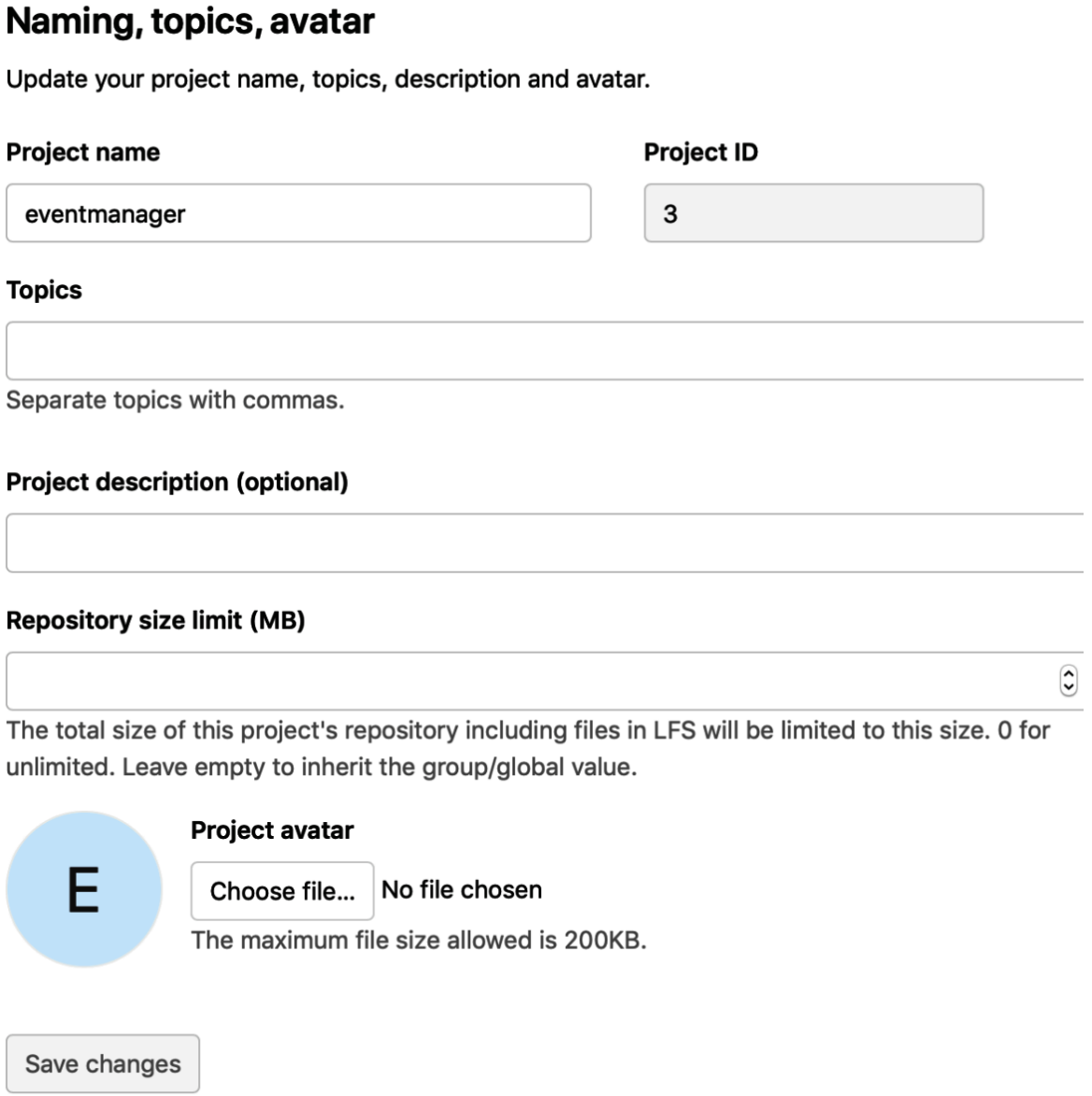
Configuring GitLab settings at the project level

- There are also options for setting an individual project.
- If you browse to one of your projects, you will see a Settings menu on the left:

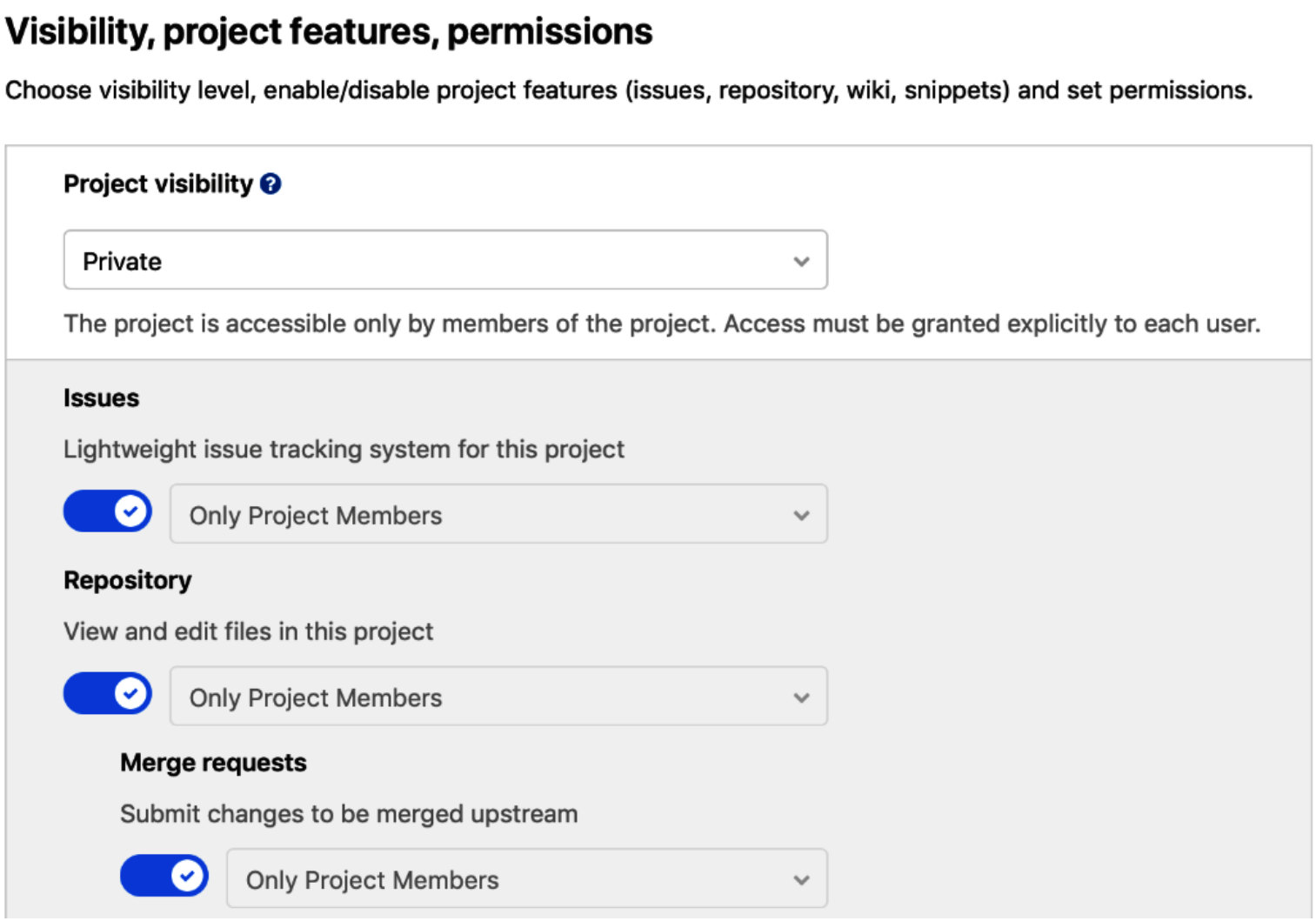


Naming, topics, avatar

- Under the General settings, you can find the fields:

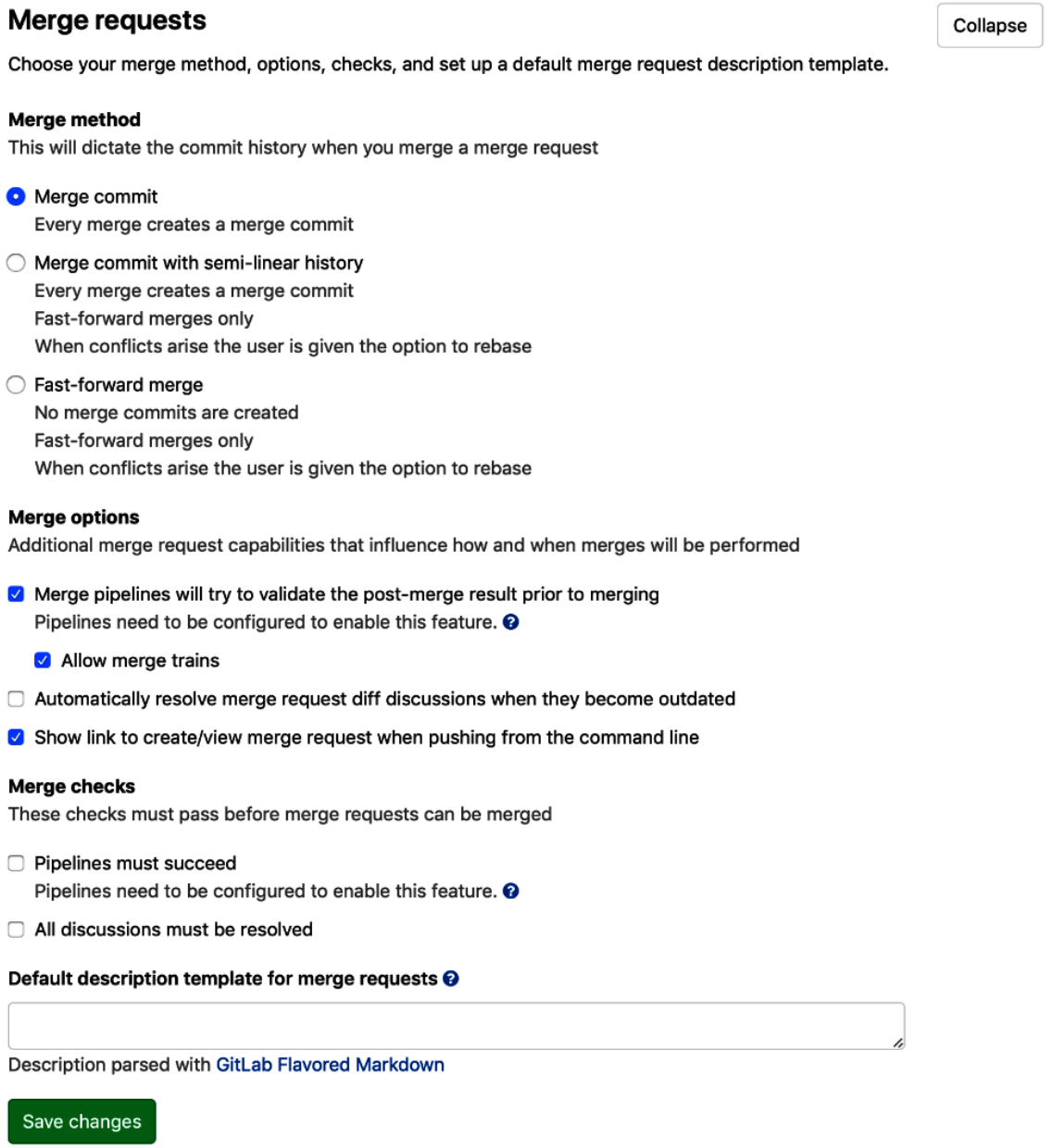


Visibility, project features, permissions



Merge requests

- For every executed merge request, there is a Git session on the server running the same Git binary that you have on your workstation.
- For instance, you can specify that the server side never does a merge commit:



Summary

- In this lesson, we discussed how to configure an existing GitLab application instance via the web interface.
- The administration pages of GitLab give you a lot of control over your instance.
- After going through those pages, we explained the various items that can be managed.

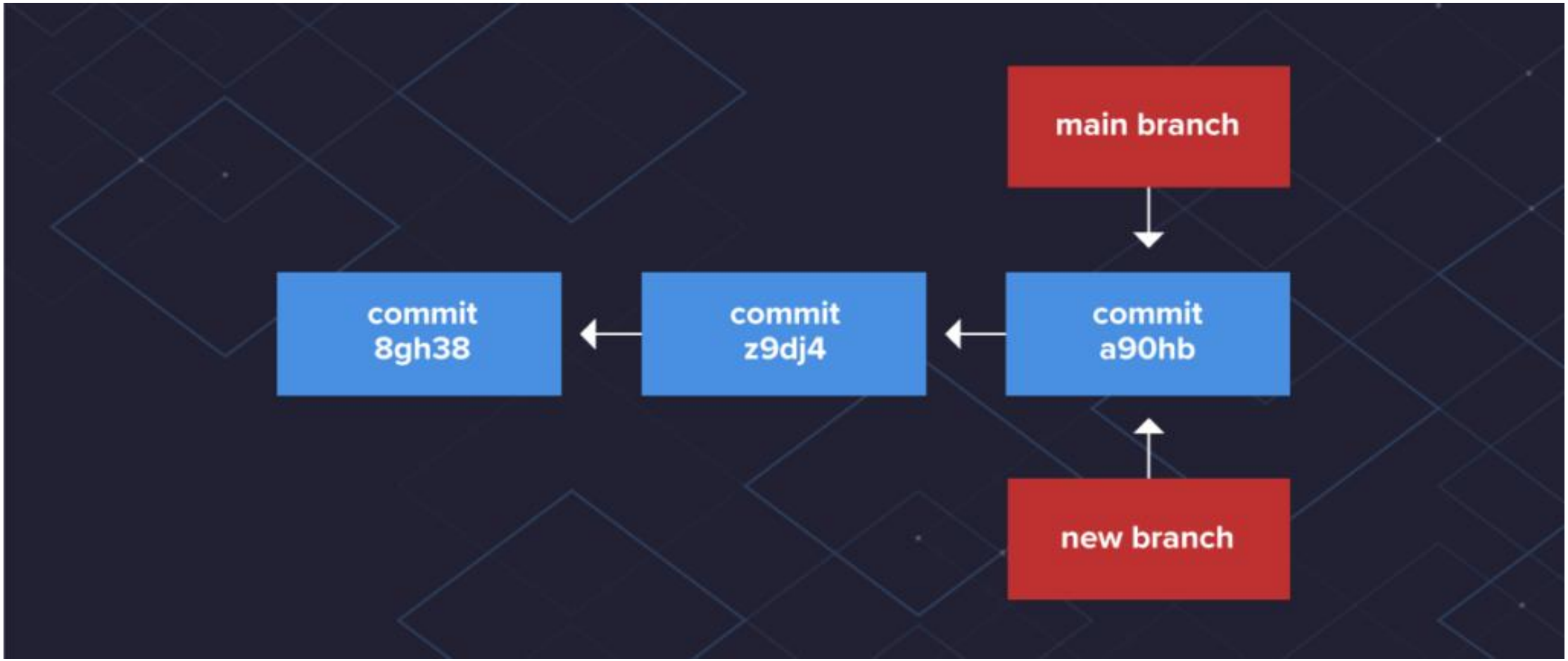
"Complete Lab 3"

3. Branching

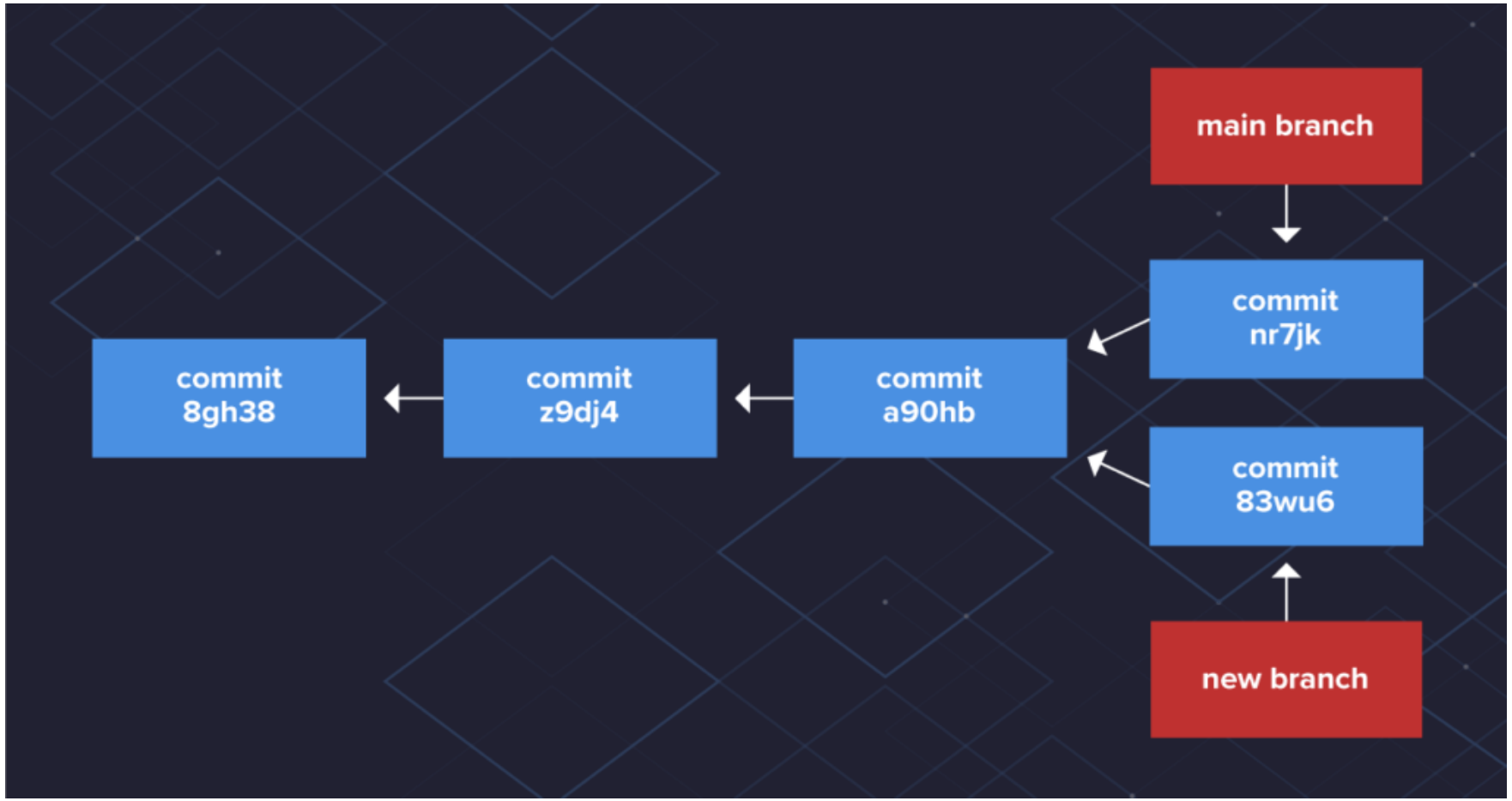
Git branching

- Branches are not just exclusive to Git. However, in this course we focus on Git due to the many advantages this model of branching offers.
- Consequently, before we delve into the various branching strategies out there, including Git branching strategies.
- Put simply, Git and other version control tools allow developers to track, manage and organize their code.

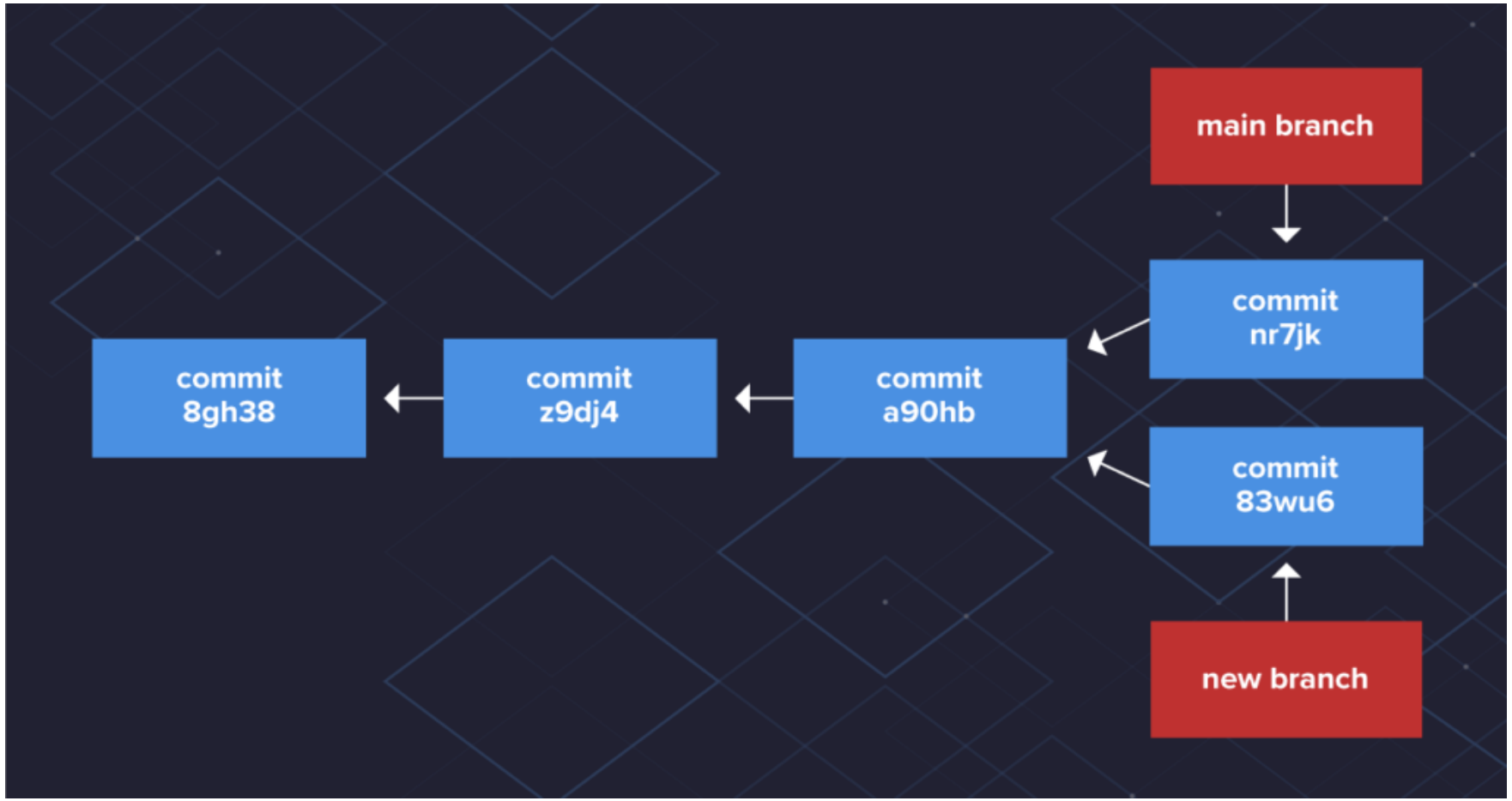
Git Branching



Git Branching



Git Branching



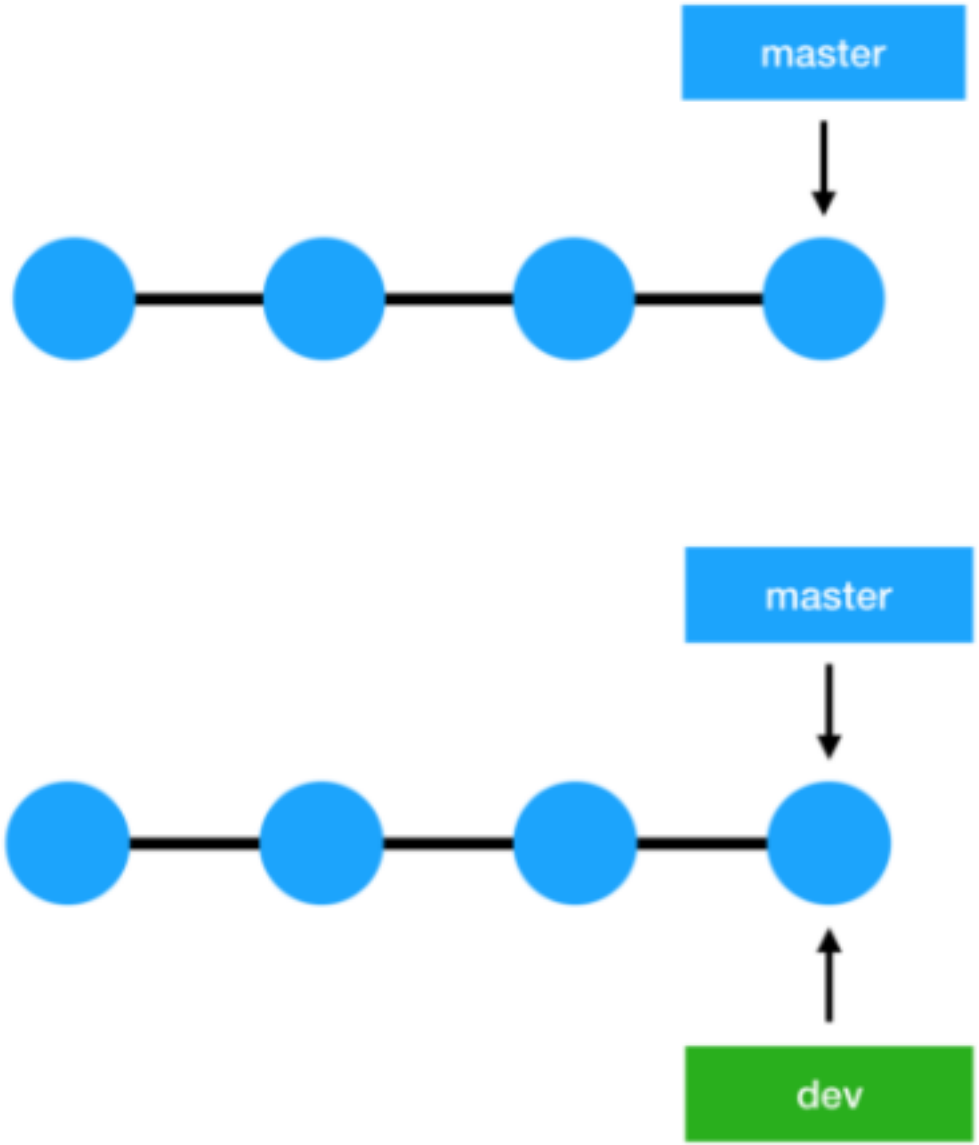
Branch Naming Strategies

- Branch names can be anything you'd like.
- Your organization or project may have standards outlined for branch naming.
- For example, naming the branch based on the person responsible for working on the branch and a description or work item:
  - username/description
  - username/workitem

Branch Naming Strategies

- You can name a branch to indicate the branch's function, like a feature, bug fix, or hotfix:
  - bugfix/description
  - feature/feature-name
  - hotfix/description

Introduction



Introduction

- If you are developing a small application in a big corporation as a developer.
- Or you are trying to wrap your head around an open source project from GitHub, you have already been using branches with Git.

Managing your local branches

- Suppose you are just having your local Git repository, and you have no intentions at the moment to share the code with others.

- However, you can easily share this knowledge while working with a repository with one or more remotes.

Getting ready

- Use the following command to clone the jgit repository to match:

```
$ git clone https://git.eclipse.org/r/jgit/jgit
$ cd jgit
```

How to do it…

- Whenever you start working on a bug fix or a new feature in your project, you should create a branch.

- You can do so using the following code:

```
$ git branch newBugFix
$ git branch
* master
  newBugFix
```

How to do it...

- The newBugFix branch points to the current HEAD I was on at the time of the creation.
- You can see the HEAD with git log -1:

```
$ git log -1 newBugFix --format=format:%H
25fe20b2dbb20cac8aa43c5ad64494ef8ea64ffc
```

- If you want to add a description to the branch, you can do it with the --edit-description option for the git branch command:

```
$ git branch --edit-description newBugFix
```

How to do it...

- The previous command will open an editor where you can type in a description:

Refactoring the Hydro controller
The hydro controller code is currently horrible needs to be refactored.

- Close the editor and the message will be saved.

How it works…

- Git stores the information in the local git config file; this also means that you cannot push this information to a remote repository.
- To retrieve the description for the branch, you can use the --get flag for the git config command:

```
$ git config --get branch.newBugFix.description
Refactoring the Hydro controller
The hydro controller code is currently horrible needs to be refactored.
```

How it works…

- The branch information is stored as a file in .git/refs/heads/newBugFix:

```
$ cat .git/refs/heads/newBugFix
25fe20b2dbb20cac8aa43c5ad64494ef8ea64ffc
```

- Note that it is the same commit hash we retrieved with the git log command

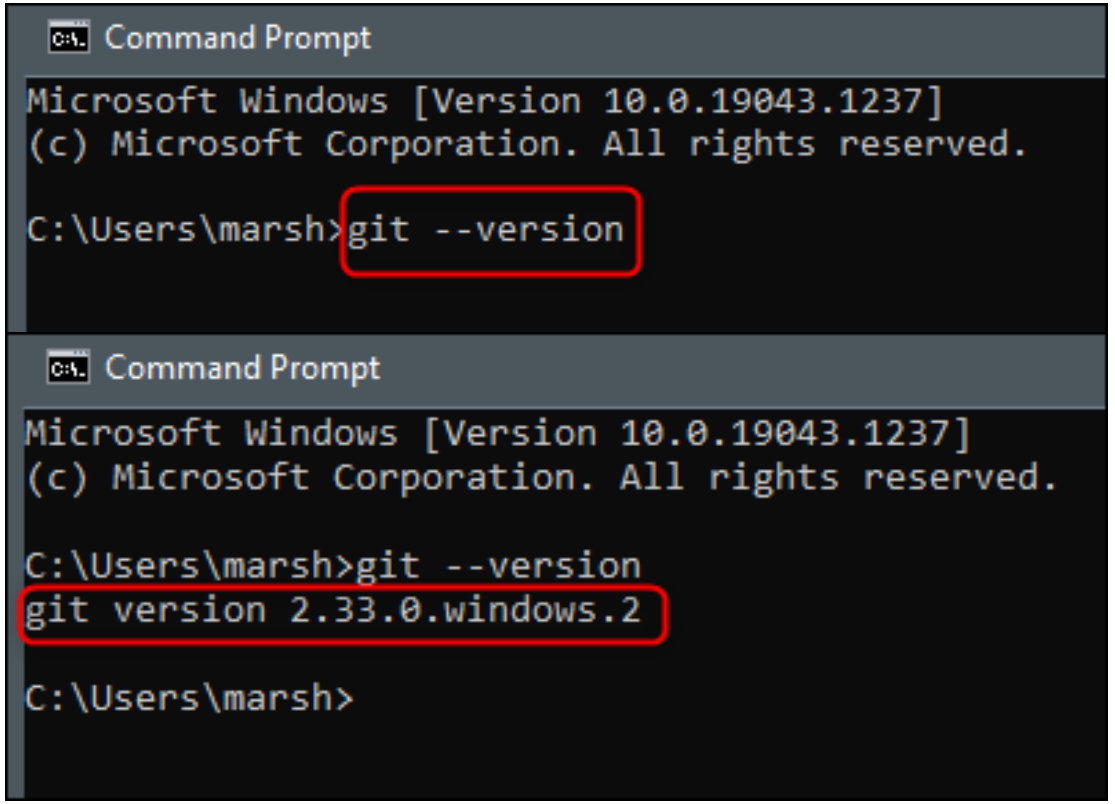
"Complete Lab 4"

4. Configuring Git

Checking your Git version

- Once open, run this command:

git --version



Git Configuration Levels

- In Git different layers that can be configured. The layers are:

SYSTEM: This layer is system-wide and found in /etc/gitconfig
GLOBAL: This layer is global for the user and found in ~/.gitconfig
LOCAL: This layer is local to the current repository and found in .git/config

Viewing your configurations

- You can use:

git config –list

- or look at your ~/.gitconfig file. The local configuration will be in your repository's .git/config file.

Use:

git config --list --show-origin

to see where that setting is defined (global, user, repo, etc...)

Configuring your username and email

# Create a project specific config, you have to execute this under the project's directory.
$ git config user.name "John Doe"

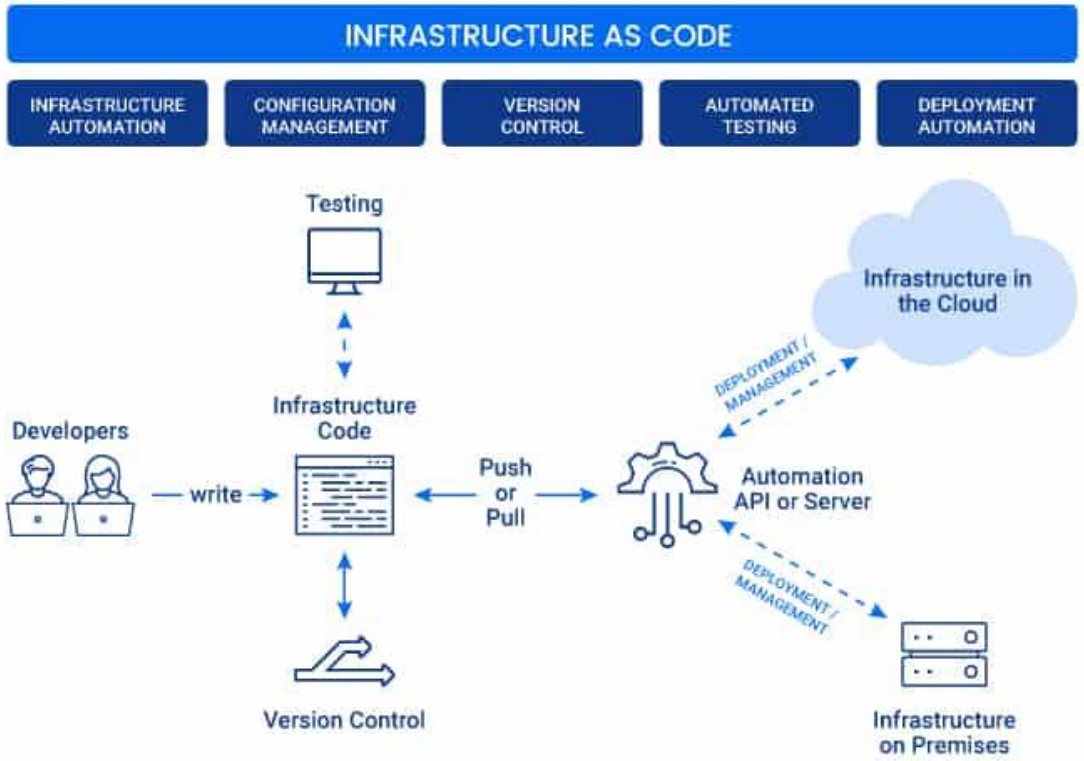
$ git config --global user.name "John Doe"
$ git config --global user.email johndoe@example.com

5. Terraform Basics

Terraform Beginner’s Guide: Everything You Should Know

What Is Infrastructure as Code (IaC)?

- Infrastructure as Code (IaC) is a widespread terminology among DevOps professionals and a key DevOps practice in the industry. It is the process of managing and provisioning the complete IT infrastructure (comprises both physical and virtual machines) using machine-readable definition files.
- It helps in automating the complete data center by using programming scripts.



Popular IaC Tools:

- Terraform An open-source declarative tool that offers pre-written modules to build and manage an infrastructure.
- Chef: A configuration management tool that uses cookbooks and recipes to deploy the desired environment. Best used for Deploying and configuring applications using a pull-based approach.
- Puppet: Popular tool for configuration management that follows a Client-Server Model. Puppet needs agents to be deployed on the target machines before the puppet can start managing them.
- Ansible: Ansible is used for building infrastructure as well as deploying and configuring applications on top of them. Best used for Ad hoc analysis.
- Packer: Unique tool that generates VM images (not running VMs) based on steps you provide. Best used for Baking compute images.
- Vagrant: Builds VMs using a workflow. Best used for Creating pre-configured developer VMs within VirtualBox.

What Is Terraform?

Terraform is one of the most popular Infrastructure-as-code (IaC) tool, used by DevOps teams to automate infrastructure tasks.

It is used to automate the provisioning of your cloud resources.

Terraform is an open-source, cloud-agnostic provisioning tool developed by HashiCorp and written in GO language.

Benefits of using Terraform:

Does orchestration, not just configuration management

Supports multiple providers such as AWS, Azure, Oracle, GCP, and many more

Provide immutable infrastructure where configuration changes smoothly

Uses easy to understand language, HCL (HashiCorp configuration language)

Easily portable to any other provider

Terraform Lifecycle

Terraform lifecycle consists of – init, plan, apply, and destroy.

- Terraform init initializes the (local) Terraform environment. Usually executed only once per session.
- Terraform plan compares the Terraform state with the as-is state in the cloud, build and display an
- execution plan. This does not change the deployment (read-only).
- Terraform apply executes the plan. This potentially changes the deployment.
- Terraform destroy deletes all resources that are governed by this specific terraform environment.

Terraform Core Concepts

- **Variables:** Terraform has input and output variables, it is a key-value pair. Input variables are used as parameters to input values at run time to customize our deployments. Output variables are return values of a terraform module that can be used by other configurations.

- **Provider:** Terraform users provision their infrastructure on the major cloud providers such as AWS, Azure, OCI, and others. A provider is a plugin that interacts with the various APIs required to create, update, and delete various resources.

- **Module:** Any set of Terraform configuration files in a folder is a module. Every Terraform configuration has at least one module, known as its root module.

- **State:** Terraform records information about what infrastructure is created in a Terraform state file. With the state file, Terraform is able to find the resources it created previously, supposed to manage and update them accordingly.

- **Resources:** Cloud Providers provides various services in their offerings, they are referenced as Resources in Terraform. Terraform resources can be anything from compute instances, virtual networks to higher-level components such as DNS records. Each resource has its own attributes to define that resource.

- **Data Source:** Data source performs a read-only operation. It allows data to be fetched or computed from resources/entities that are not defined or managed by Terraform or the current Terraform configuration.

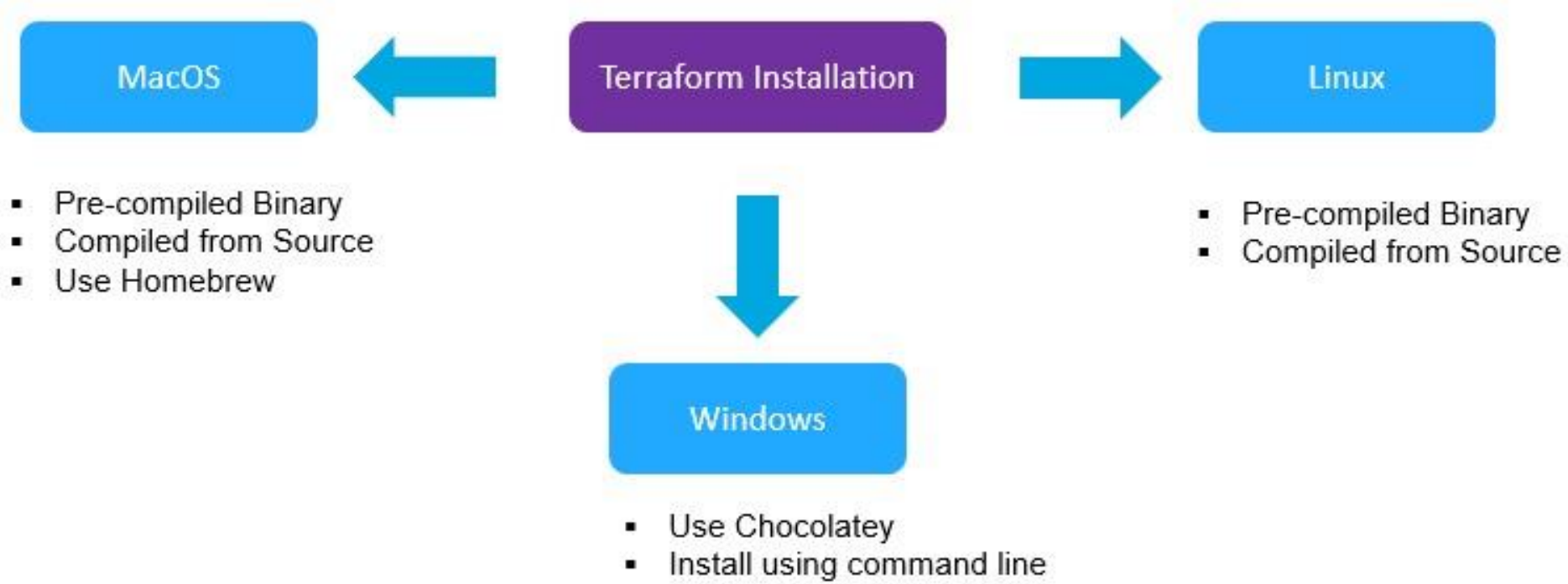
- **Plan:** It is one of the stages in the Terraform lifecycle where it determines what needs to be created, updated, or destroyed to move from the real/current state of the infrastructure to the desired state.

- **Apply:** It is one of the stages in the Terraform lifecycle where it applies the changes real/current state of the infrastructure in order to achieve the desired state.

Terraform Installation

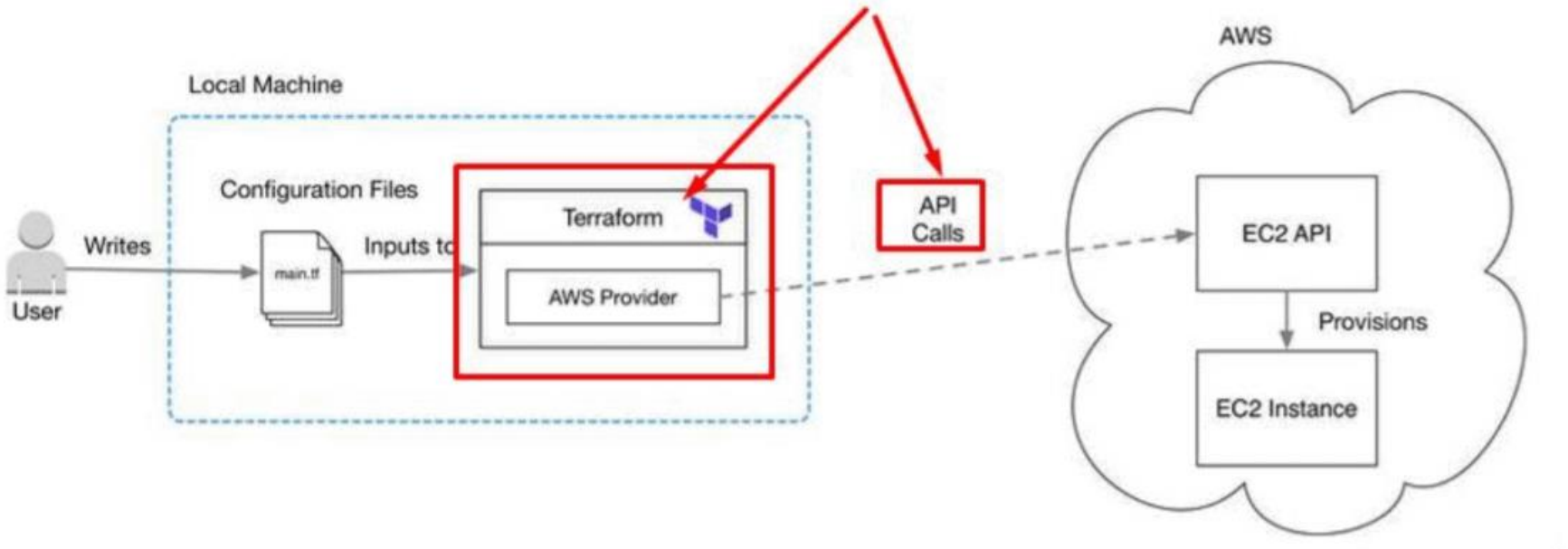
Before you start working, make sure you have Terraform installed on your machine, it can be installed on any OS, say Windows, macOS, Linux, or others.
Terraform installation is an easy process and can be done in a few minutes.

Read our blog to know how to install Terraform in Linux, Mac, Windows



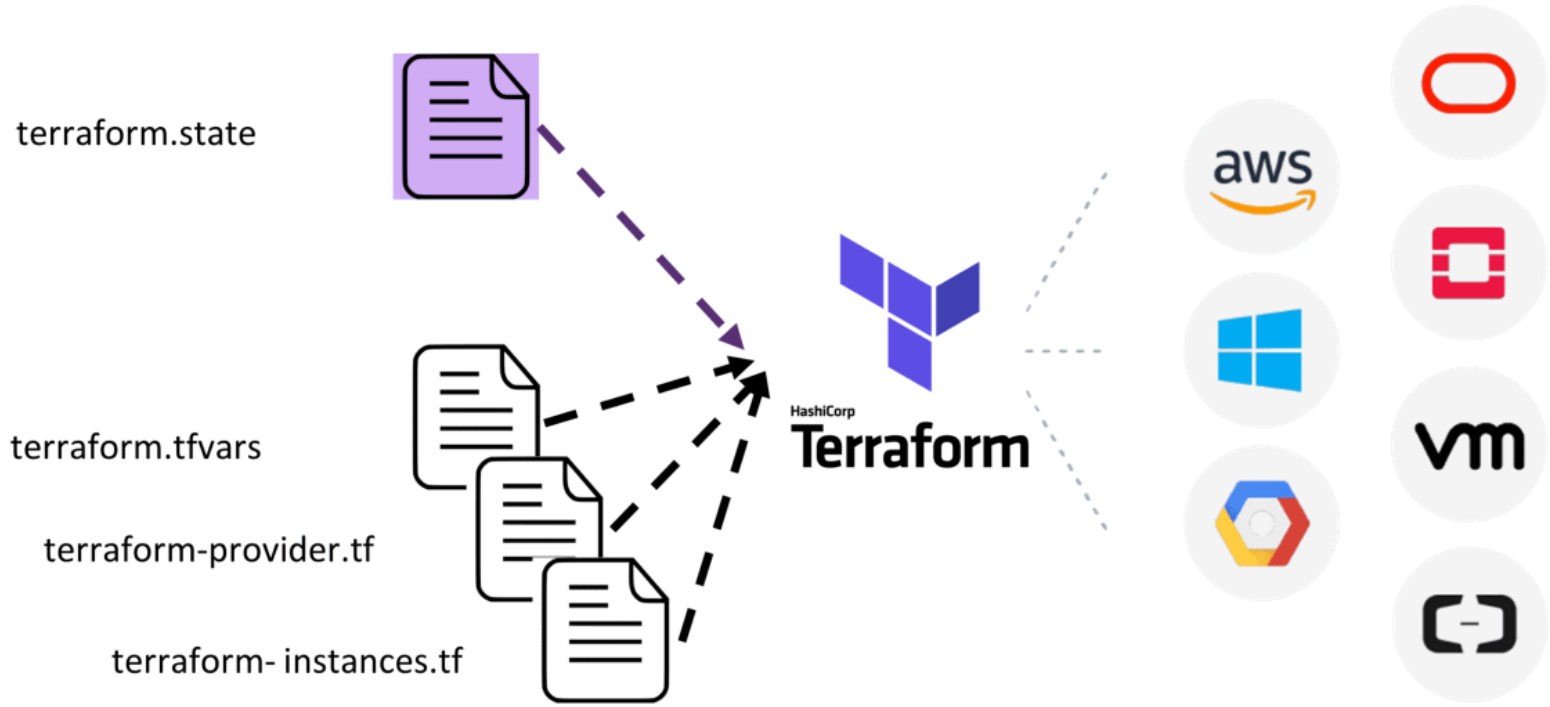
Terraform Providers

A provider is responsible for understanding API interactions and exposing resources.
It is an executable plug-in that contains code necessary to interact with the API of the service.
Terraform configurations must declare which providers they require so that Terraform can install and use them.



Terraform Configuration Files

Configuration files are a set of files used to describe infrastructure in Terraform and have the file extensions .tf and .tf.json. Terraform uses a declarative model for defining infrastructure. Configuration files let you write a configuration that declares your desired state. Configuration files are made up of resources with settings and values representing the desired state of your infrastructure.



Getting started using Terraform

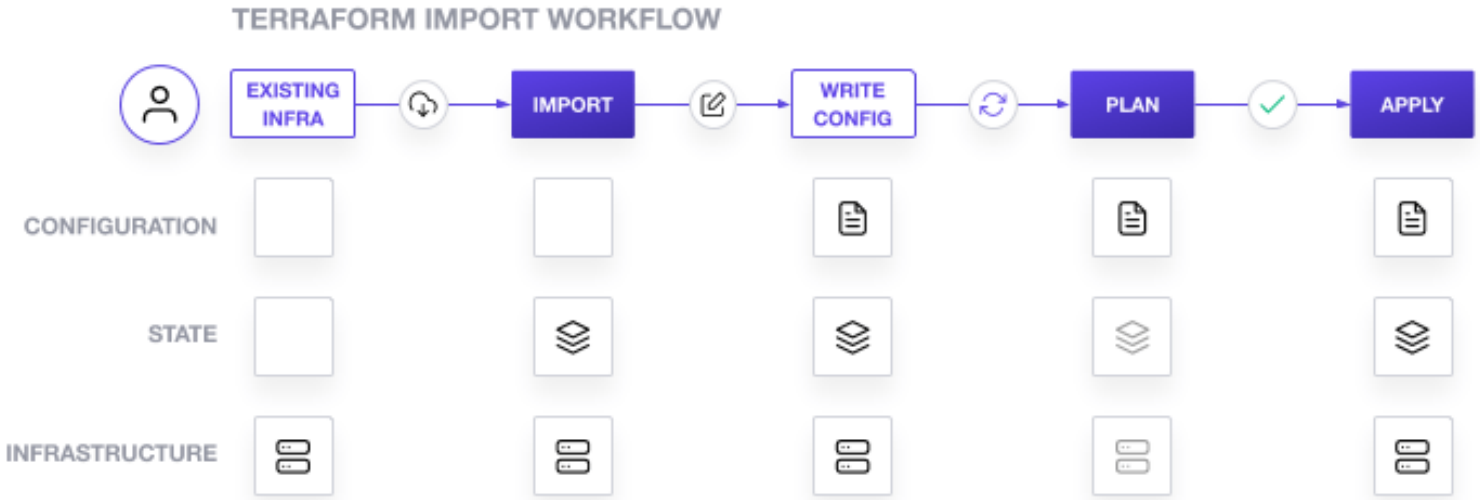
To get started building infrastructure resources using Terraform, there are few things that you should take care of. The general steps to deploy a resource(s) in the cloud are:

- Set up a Cloud Account on any cloud provider (AWS, Azure, OCI)
- Install Terraform
- Add a provider – AWS, Azure, OCI, GCP, or others
- Write configuration files
- Initialize Terraform Providers
- PLAN (DRY RUN) using terraform plan
- APPLY (Create a Resource) using terraform apply
- DESTROY (Delete a Resource) using terraform destroy

Import Existing Infrastructure

- Terraform is one of the great IaC tools with which, you can deploy all your infrastructure's resources.
- In addition to that, you can manage infrastructures from different cloud providers, such as AWS, Google Cloud, etc. But what if you have already created your infrastructure manually?

- Terraform has a really nice feature for importing existing resources, which makes the migration of existing infrastructure into Terraform a lot easier.



AWS Virtual Machine Using AWS Console | Terraform AWS Deployment Overview

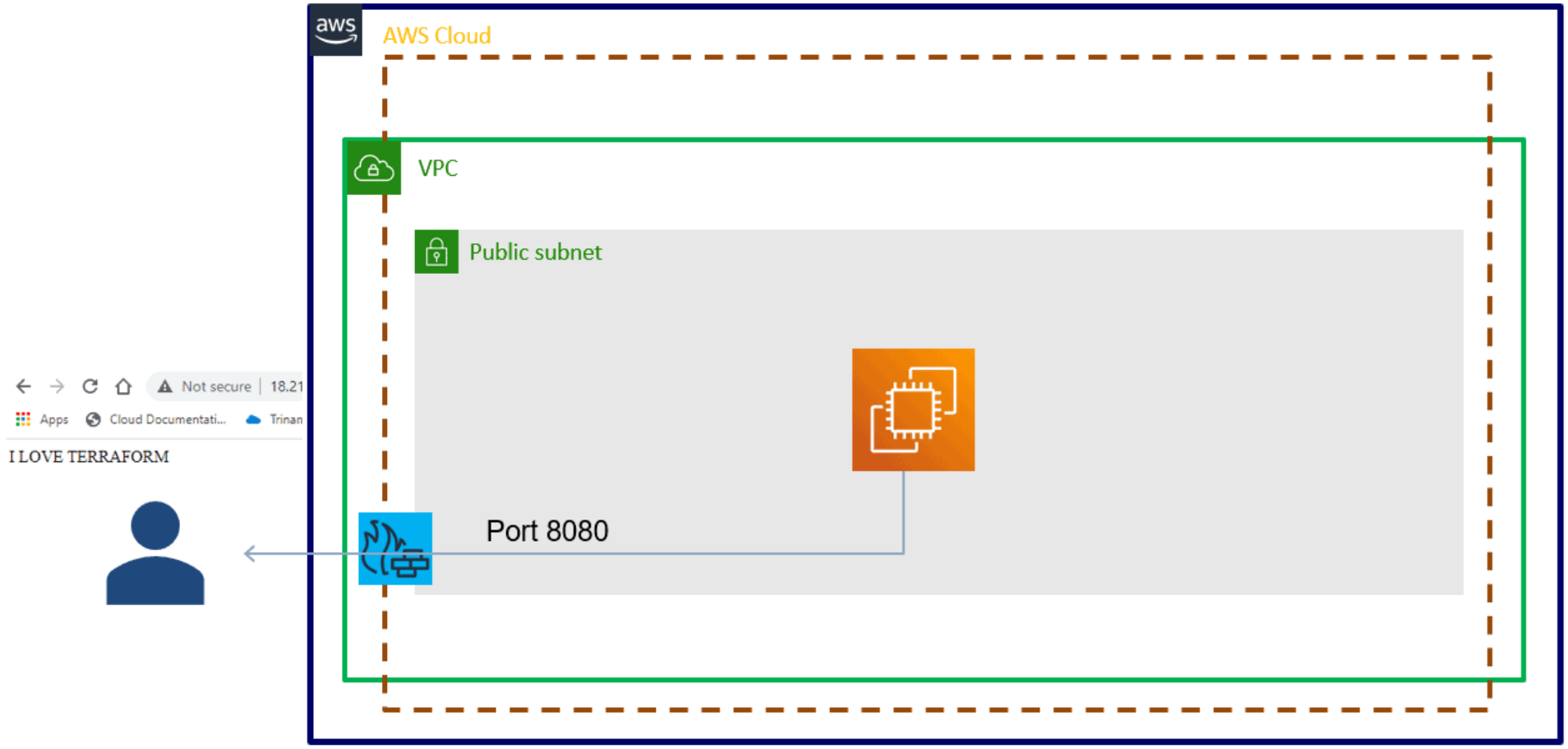
In this blog, we will see how to create an AWS Virtual machine in two different ways, one using the AWS console and the other using terraform.

Pre-requisites:

- AWS Free Tier or Paid account. Check how to create an AWS free tier account
- Terraform should be installed. Check how to install terraform

Architecture

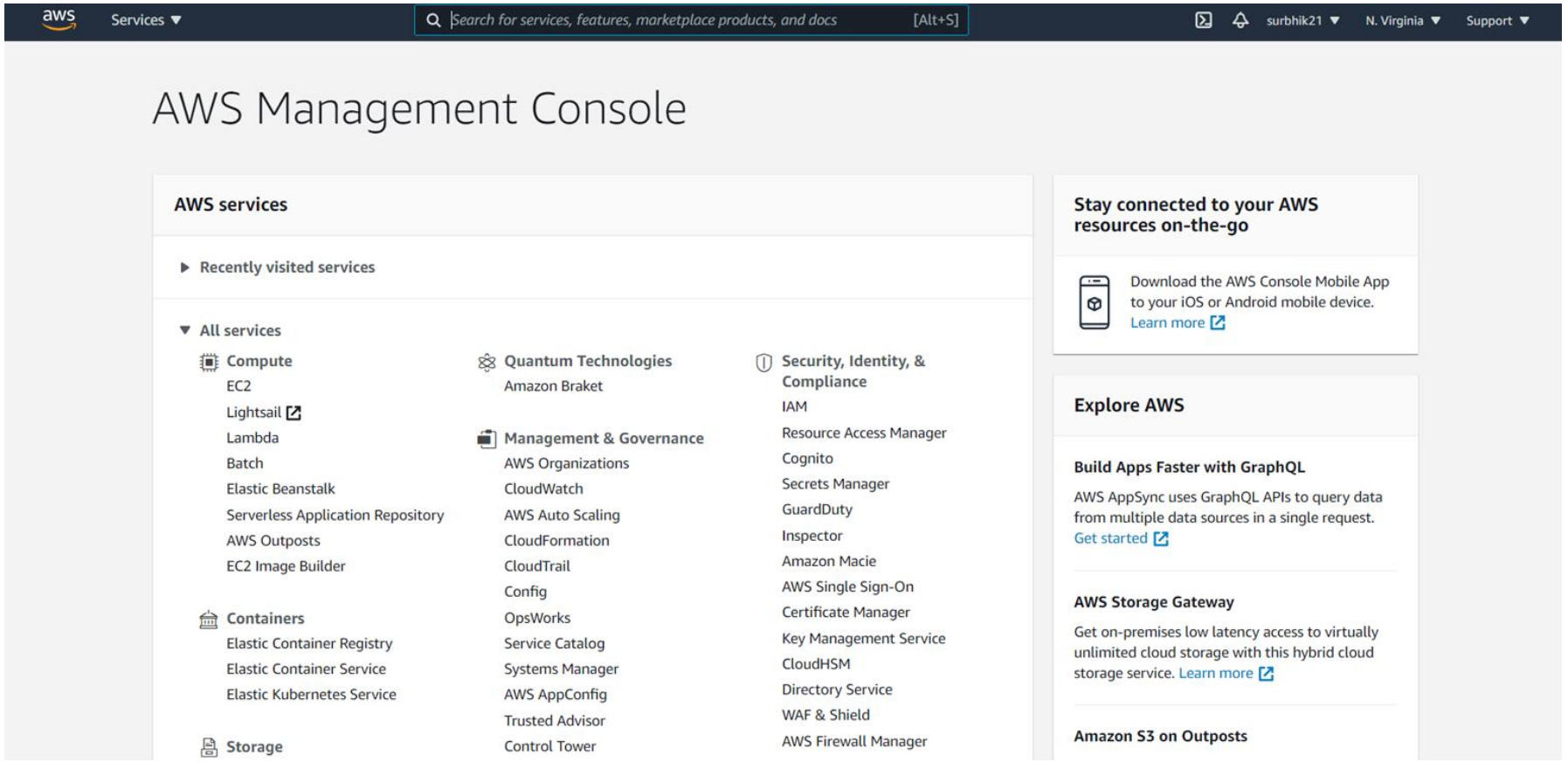
To give a brief about what demo we will be performing, please refer to the below Architecture



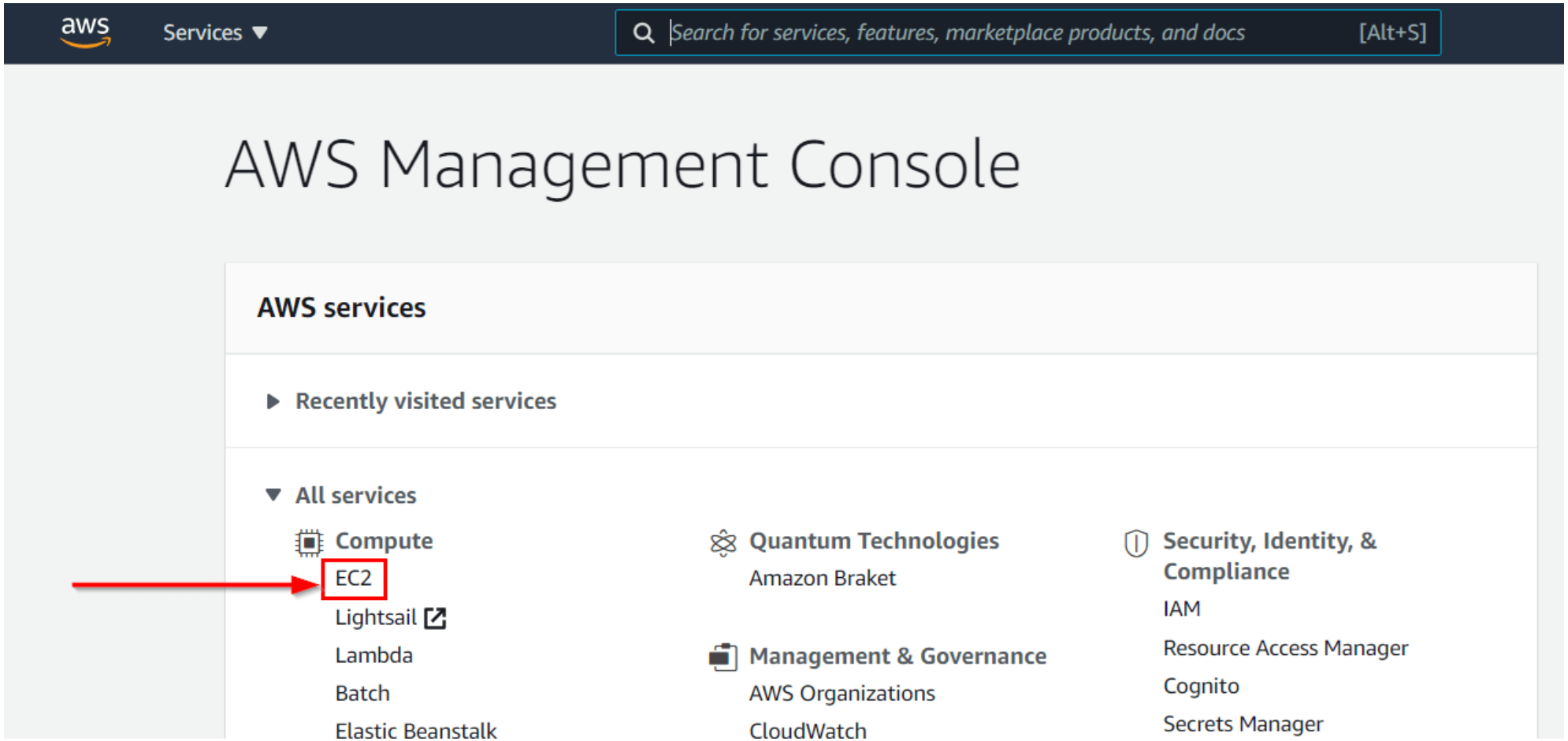
Create VM in AWS Using Terraform

There are a series of steps that you need to follow to create an AWS Virtual Machine and deploy a webpage on top of it.
Now, below are the steps that you can follow to create the above-shown architecture:

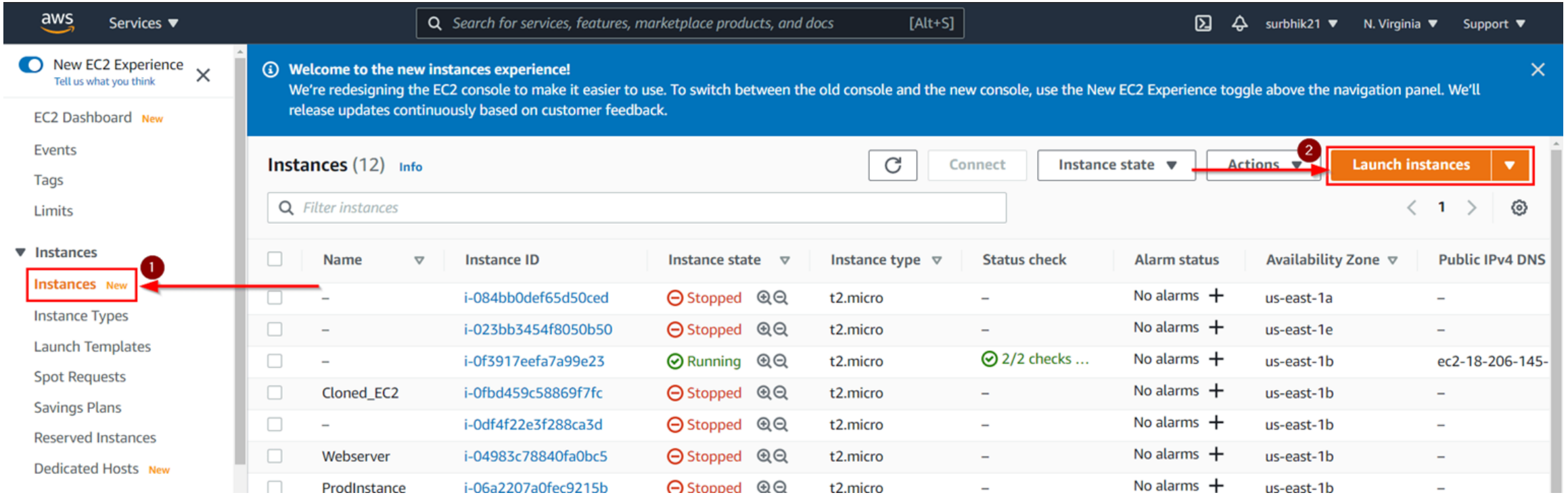
- Log in to your AWS account.



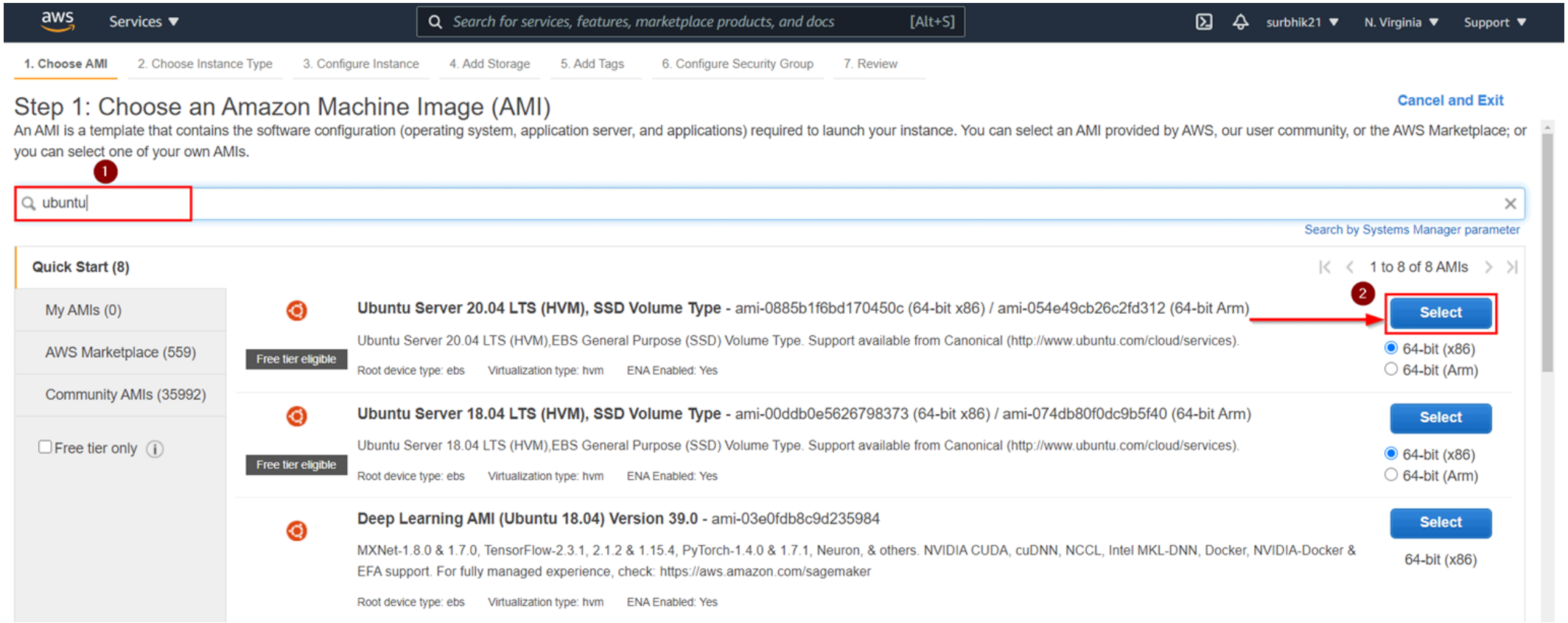
- Go to EC2 from the navigation menu present under Compute service.



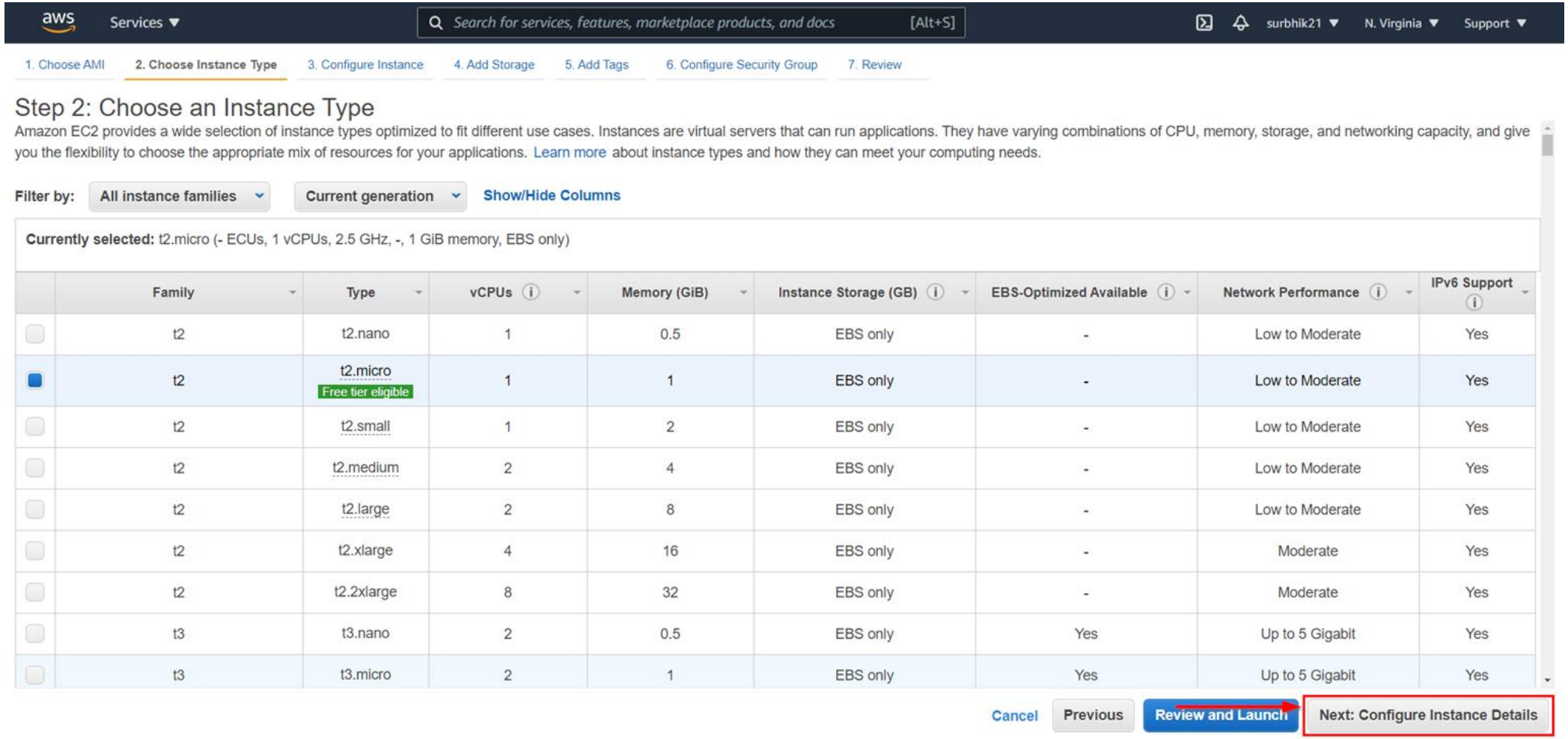
- Go to Instances from the navigation menu on the left and click on Launch instances.



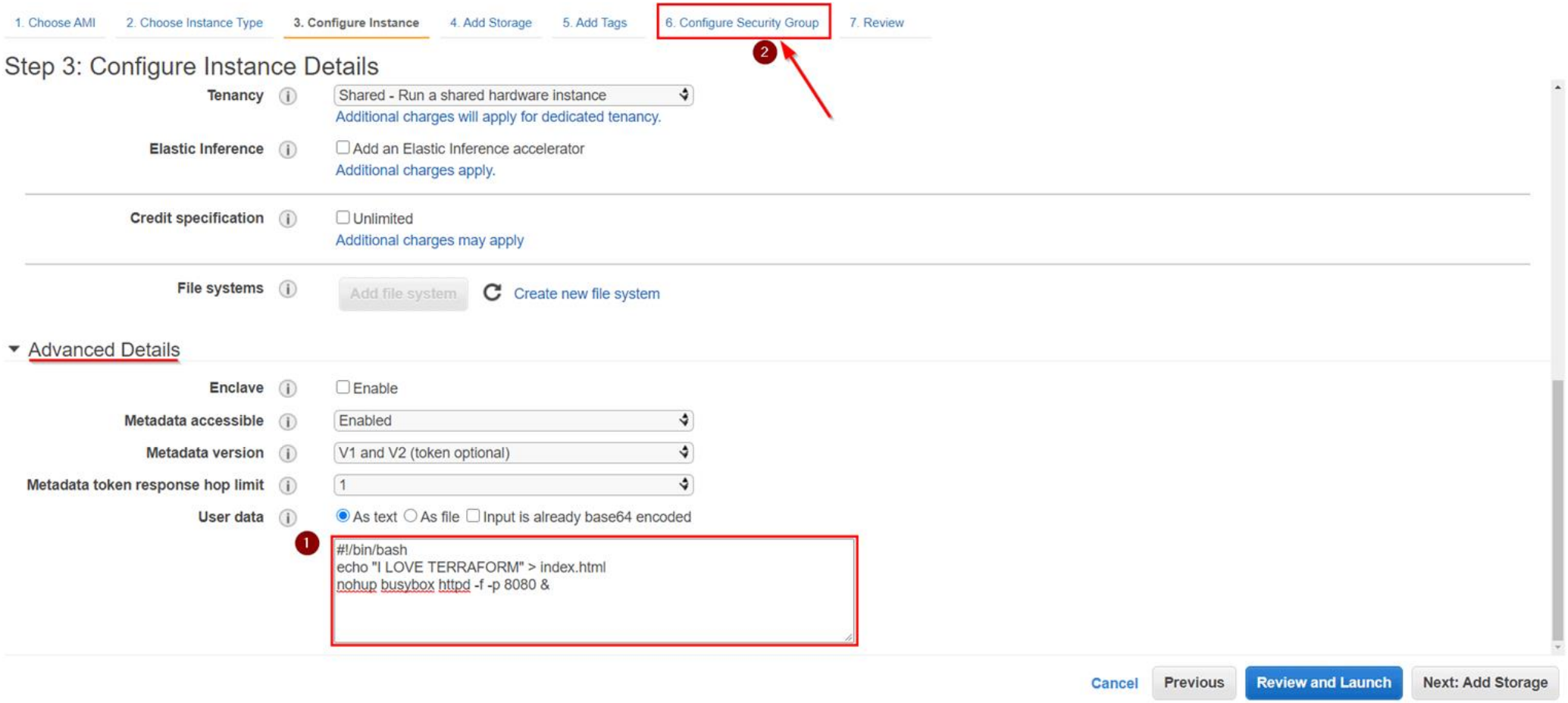
- Search for Ubuntu and select Ubuntu Server 20.04 LTS (HTM).



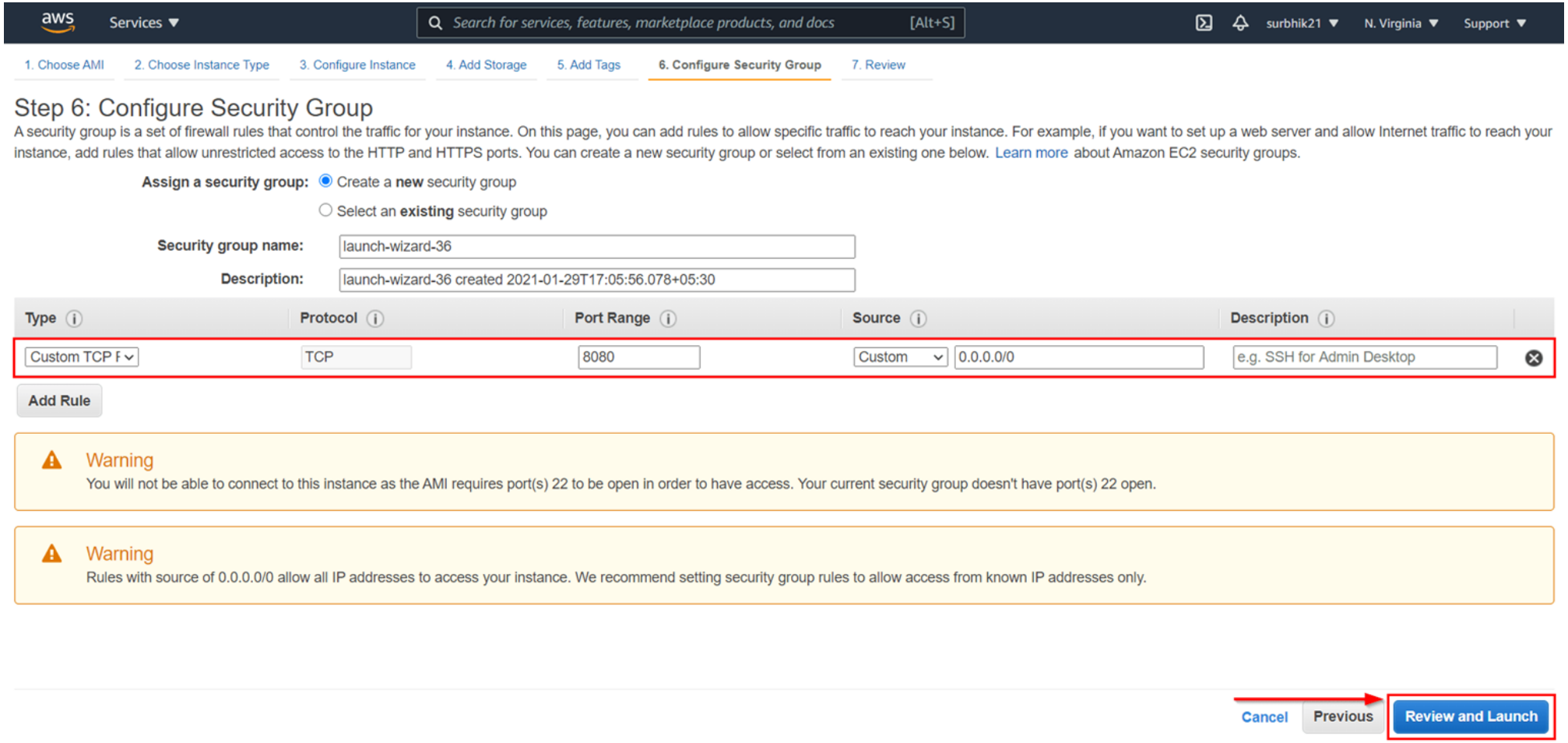
- Select Instance type as t2.micro and click on Next: Configure Instance Details.



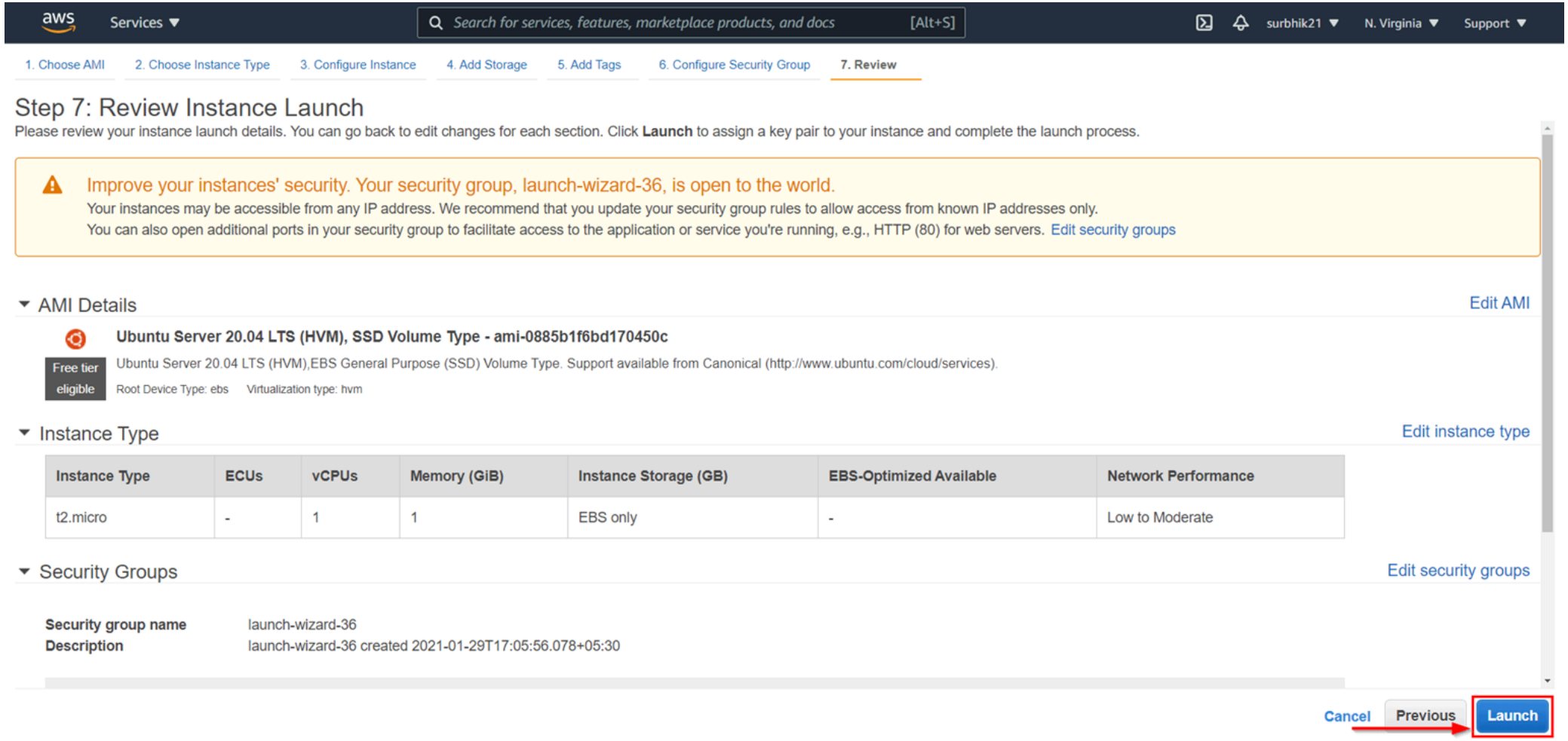
- On Configure Instance Details page, scroll down and add the following code in User data to provision the web page after the instance is provisioned. Click on 6. Configure Security Group to skip Storage and Tags.



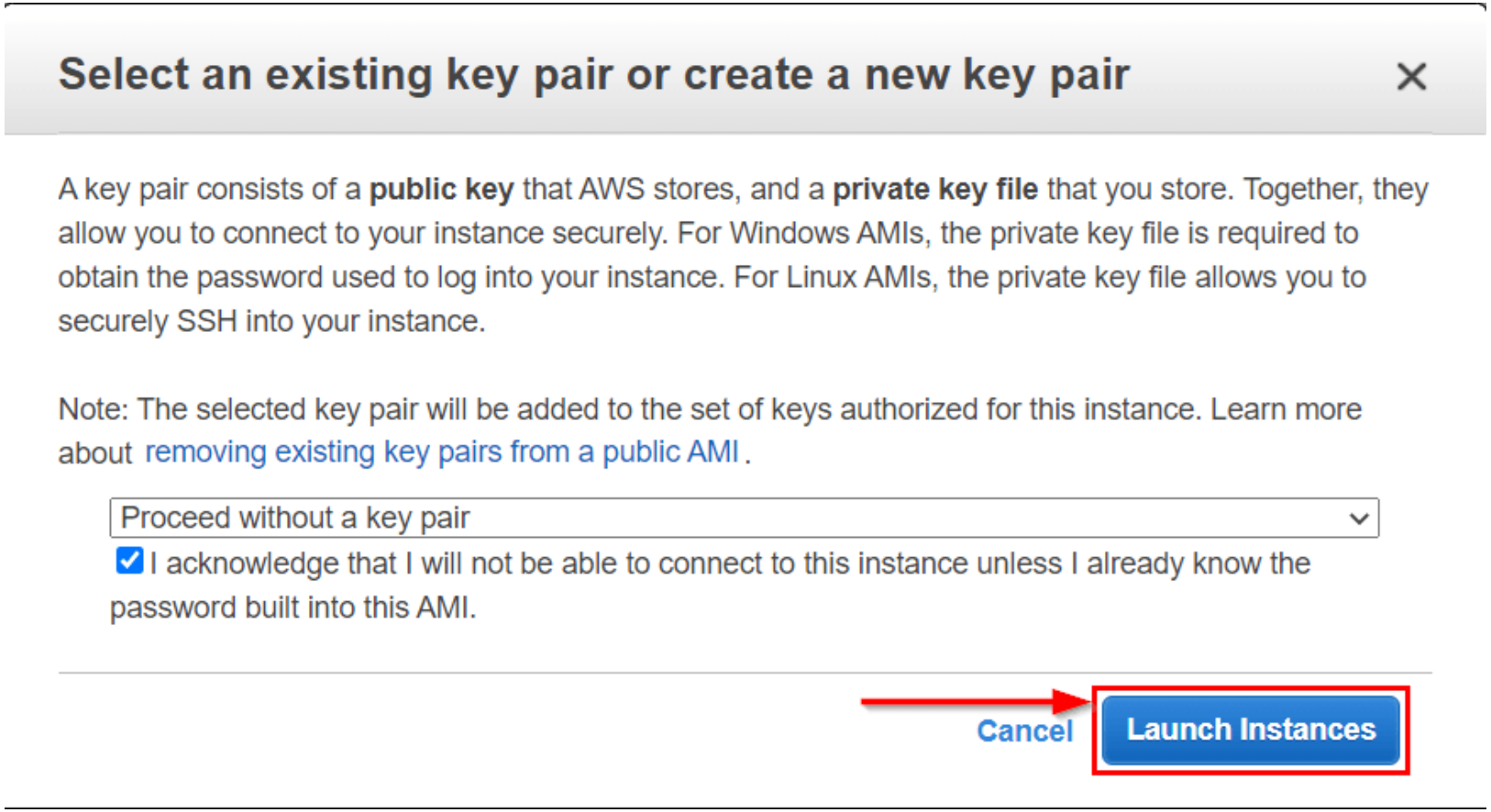
- Add Custom TCP protocol to open 8080 port accessible from the internet and click on Review and Launch.



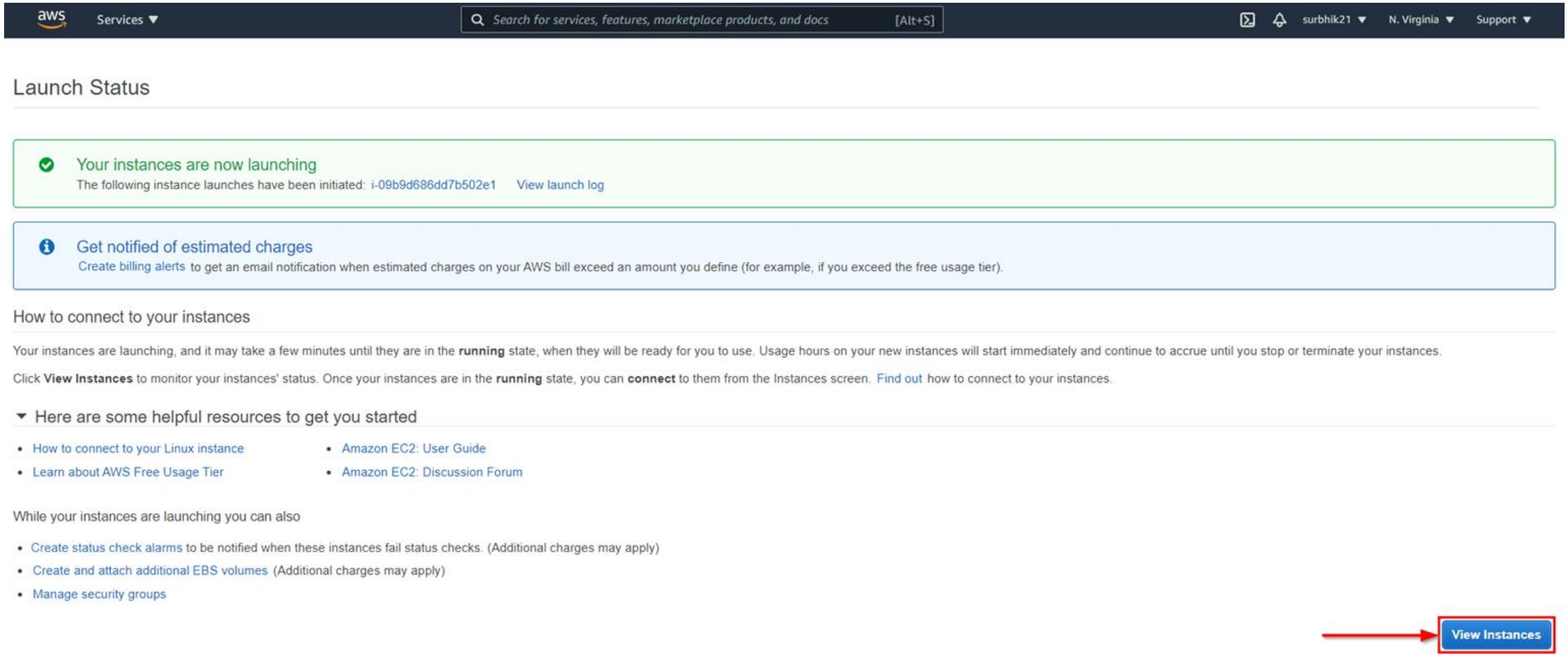
- Review all the information and click on Launch.



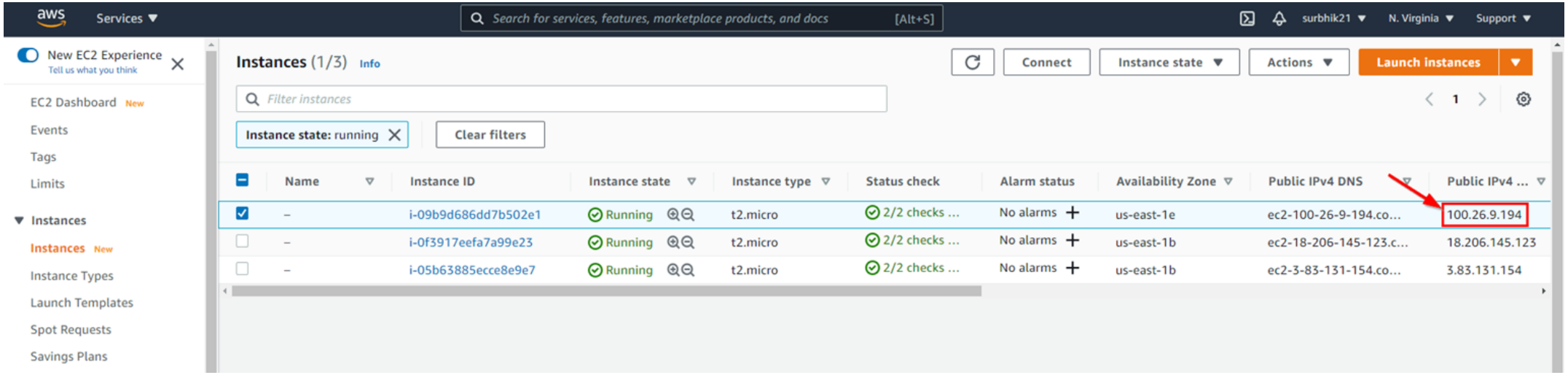
- When asked to select a key pair, select Proceed without a key pair and click on Launch Instances.



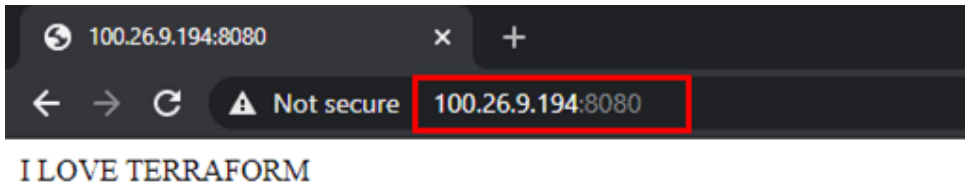
- Click on View Instance to check the status of the Instance.



- Once the instance is up and running, copy the Public IP.



- Paste the IP in your browser followed by port 8080 to access the created webpage.



Terraform AWS Deployment

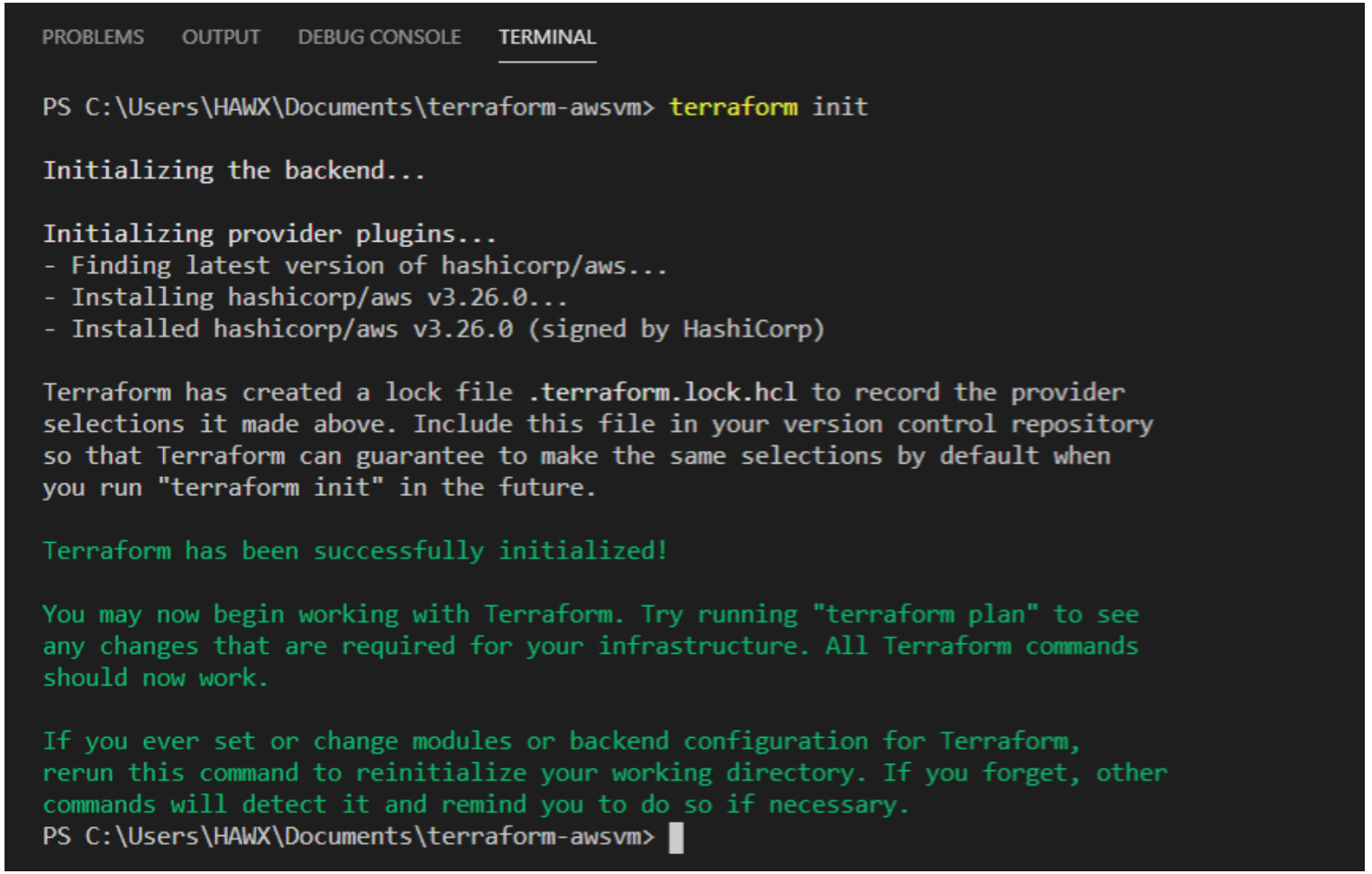
We will use the below code to provision AWS Virtual Machine in our account. You can download the code by clicking here.

```
provider "aws" {
  region = "us-east-1"
  access_key = "<YOUR ACCESS KEY HERE>"
  secret_key = "<YOUR SECRET KEY HERE>"
}
resource "aws_instance" "tfvm" {
  ami = "ami-0885b1f6bd170450c"
  instance_type = "t2.micro"
  vpc_security_group_ids = [ aws_security_group.websg.id ]
  user_data = <<-EOF
 #!/bin/bash
              echo "I LOVE TERRAFORM" > index.html
              nohup busybox httpd -f -p 8080 &
              EOF
```

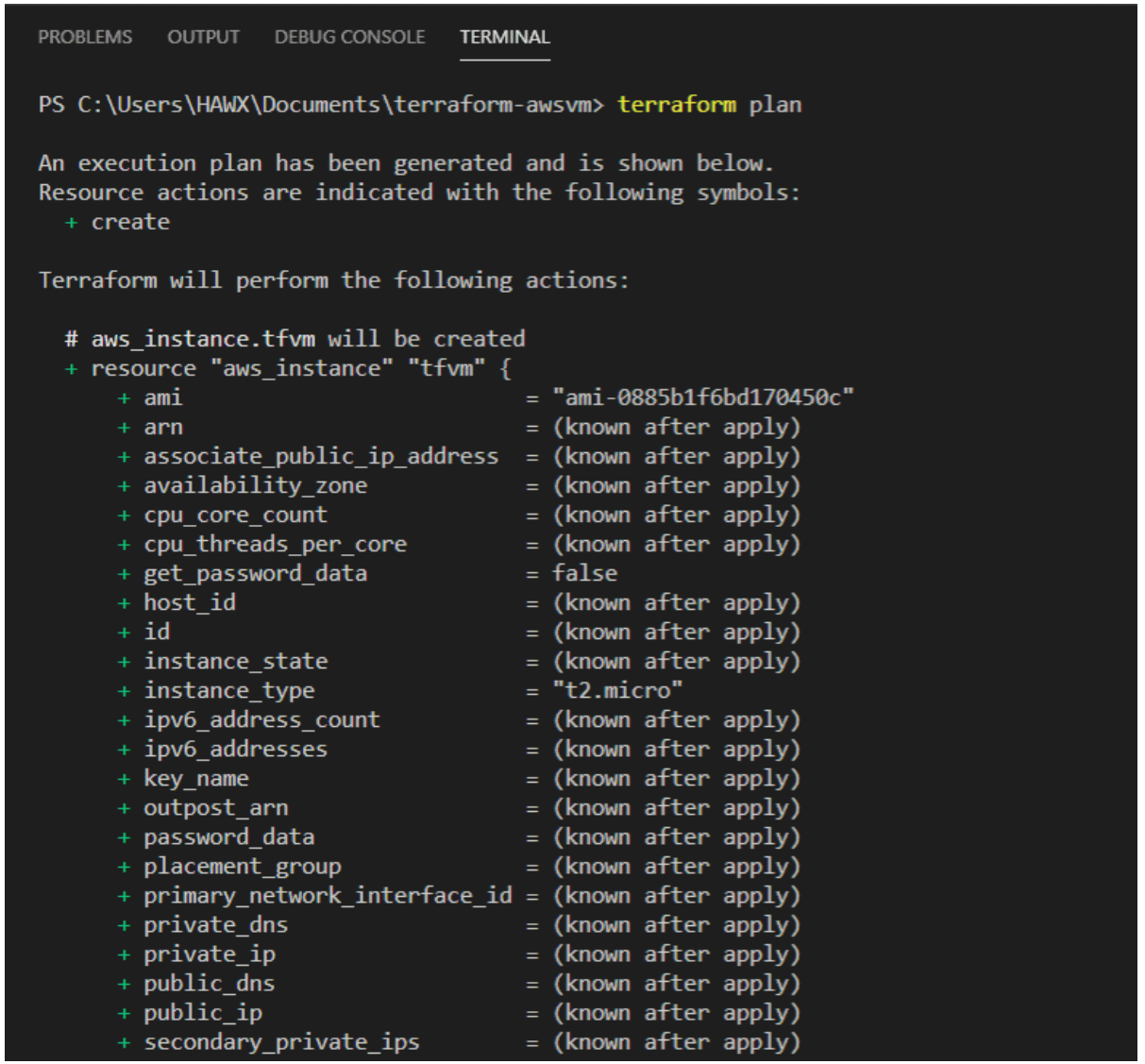
```
tags = {
      Name = "WEB-demo"
    }
}
resource "aws_security_group" "websg" {
  name = "web-sg01"
  ingress {
    protocol = "tcp"
    from_port = 8080
    to_port = 8080
    cidr_blocks = [ "0.0.0.0/0" ]
  }
}
output "instance_ips" {
  value = aws_instance.tfvm.public_ip
}
```

Steps to create the VM from the code:

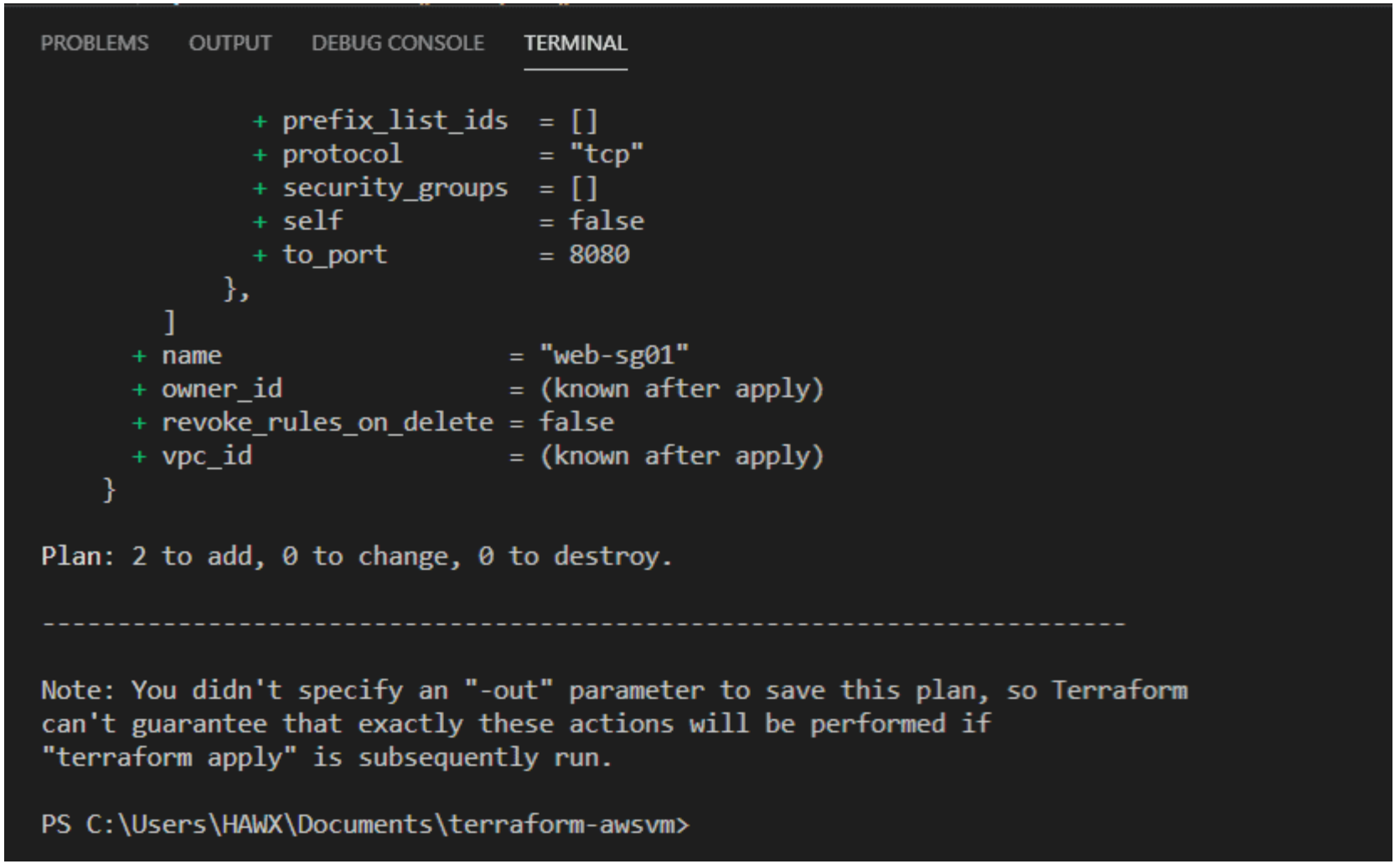
- Use terraform init command in terminal to initialize terraform and download the configuration files



- Now let’s check for any human error in our script by using terraform plan command.



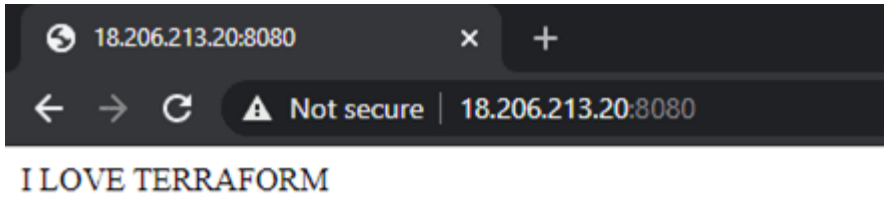
In the end, it will also show us the number of resources that will be added to our AWS account.



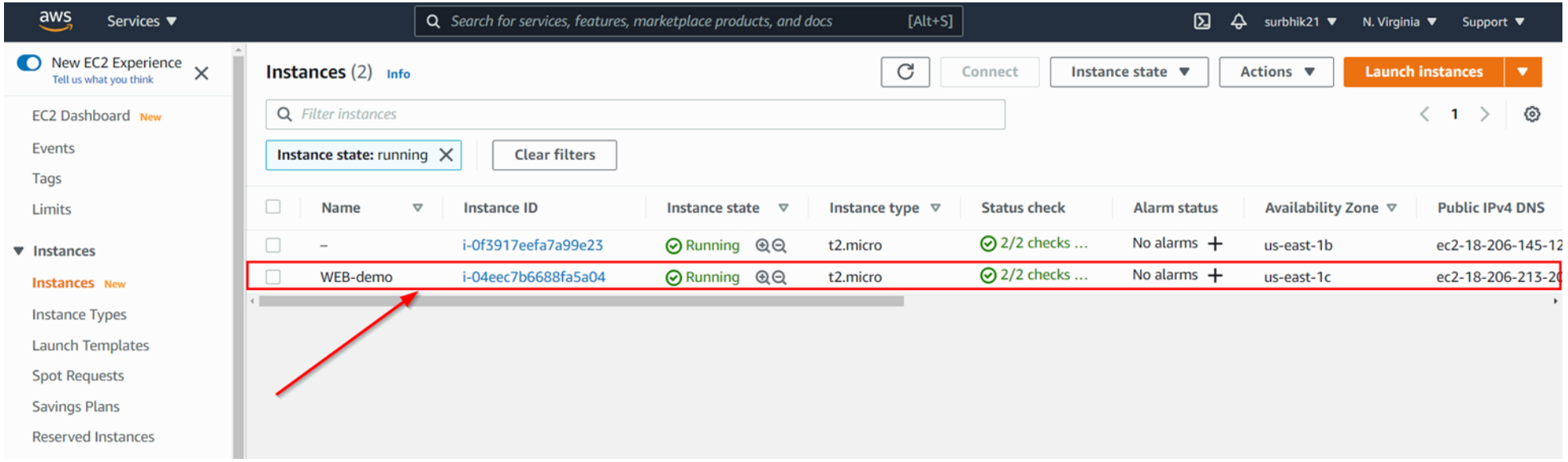
- Now we will apply our code using terraform apply -auto-approve command. It will provide us the IP of our created VM.

```
PS C:\Users\HAWX\Documents\terraform-awsvm> terraform apply -auto-approve
aws_security_group.websg: Creating...
aws_security_group.websg: Creation complete after 8s [id=sg-019465038b95617b1]
aws_instance.tfvm: Creating...
aws_instance.tfvm: Still creating... [10s elapsed]
aws_instance.tfvm: Still creating... [20s elapsed]
aws_instance.tfvm: Still creating... [30s elapsed]
aws_instance.tfvm: Still creating... [40s elapsed]
aws_instance.tfvm: Creation complete after 42s [id=i-04eec7b6688fa5a04]

Apply complete! Resources: 2 added, 0 changed, 0 destroyed.

Outputs:

instance_ips = "18.206.213.20"
```

Now, we can check if the Webpage has been created or not. Just copy the IP and check on 8080 port regarding the same.



You can also check if the EC2 instance is created in the AWS by going to the EC2 dashboard.



"Complete Lab 5"

6. Infrastructure Deployment using Terraform

Provision a CockroachDB Cloud Cluster with Terraform

- Terraform is an infrastructure-as-code provisioning tool that uses configuration files to define application and network resources.
- You can provision CockroachDB Cloud clusters and cluster resources by using the CockroachDB Cloud Terraform provider in your Terraform configuration files.
- This shows you how to provision a CockroachDB Cloud cluster using the CockroachDB Cloud Terraform provider.

CockroachDB Serverless

Before you begin

Before you start this tutorial, you must

- Install Terraform.
- Install the wget command line utility.
- Create a service account and API key in the CockroachDB Cloud Console, and assign admin privilege or Cluster Creator / Cluster Admin role at the organization scope. Refer to: Service Accounts

Create the Terraform configuration files

- In a terminal create a new directory and use wget to download the CockroachDB Serverless main.tf example file:

wget https://raw.githubusercontent.com/cockroachdb/terraform-provider-cockroach/main/examples/workflows/cockroach_serverless_cluster/main.tf

- In a text editor create a new file terraform.tfvars with the following settings:

cluster_name = "{cluster name}"
sql_user_name = "{SQL user name}"
sql_user_password = "{SQL user password}“

- Create an environment variable named COCKROACH_API_KEY. Copy the API key from the CockroachDB Cloud console and create the COCKROACH_API_KEY environment variable:

export COCKROACH_API_KEY={API key}

Provision the cluster

- Initialize the provider:

terraform init –upgrade

- Create the Terraform plan. This shows the actions the provider will take, but won't perform them:

terraform plan

- Create the cluster:

terraform apply

Delete the cluster

- If you want to delete the cluster, run the following command:

terraform destroy

- Enter yes when prompted to delete the cluster.

Provision a CockroachDB Cloud Cluster with Terraform

- Terraform is an infrastructure-as-code provisioning tool that uses configuration files to define application and network resources.
- You can provision CockroachDB Cloud clusters and cluster resources by using the CockroachDB Cloud Terraform provider in your Terraform configuration files.
- This tutorial shows you how to provision a CockroachDB Cloud cluster using the CockroachDB Cloud Terraform provider.

CockroachDB Dedicated

Before you begin

Before you start this tutorial, you must

- Install Terraform.
- Install the wget command line utility.
- Create a service account and API key in the CockroachDB Cloud Console, and assign admin privilege or Cluster Creator / Cluster Admin role at the organization scope. Refer to: Service Accounts

Create the Terraform configuration files

- In a terminal create a new directory and use wget to download the CockroachDB Serverless main.tf example file:

wget https://raw.githubusercontent.com/cockroachdb/terraform-provider-cockroach/main/examples/workflows/cockroach_dedicated_cluster/main.tf

- In a text editor create a new file terraform.tfvars with the following settings:

```
cluster_name = "{cluster name}"
sql_user_name = "{SQL user name}"
sql_user_password = "{SQL user password}"
cloud_provider = "{cloud provider}"
cloud_provider_regions = ["{cloud provider region}"]
cluster_node_count = {number of nodes}
storage_gib = {storage in GiB}
machine_type = "{cloud provider machine type}"
allow_list_name = "{allow list name}"
cidr_ip = "{allow list CIDR IP}"
cidr_mask = {allow list CIDR mask}
```

- Create an environment variable named COCKROACH_API_KEY.

- Copy the API key from the CockroachDB Cloud console and create the COCKROACH_API_KEY environment variable:

```
export COCKROACH_API_KEY={API key}
```

Provision the cluster

- **Initialize the provider:**

terraform init -upgrade
This reads the main.tf configuration file and uses the terraform.tfvars file for settings specific to your cluster.
The -upgrade flag ensures you are using the latest version of the provider.

- **Create the Terraform plan. This shows the actions the provider will take, but won't perform them**:

terraform plan

- **Create the cluster:**

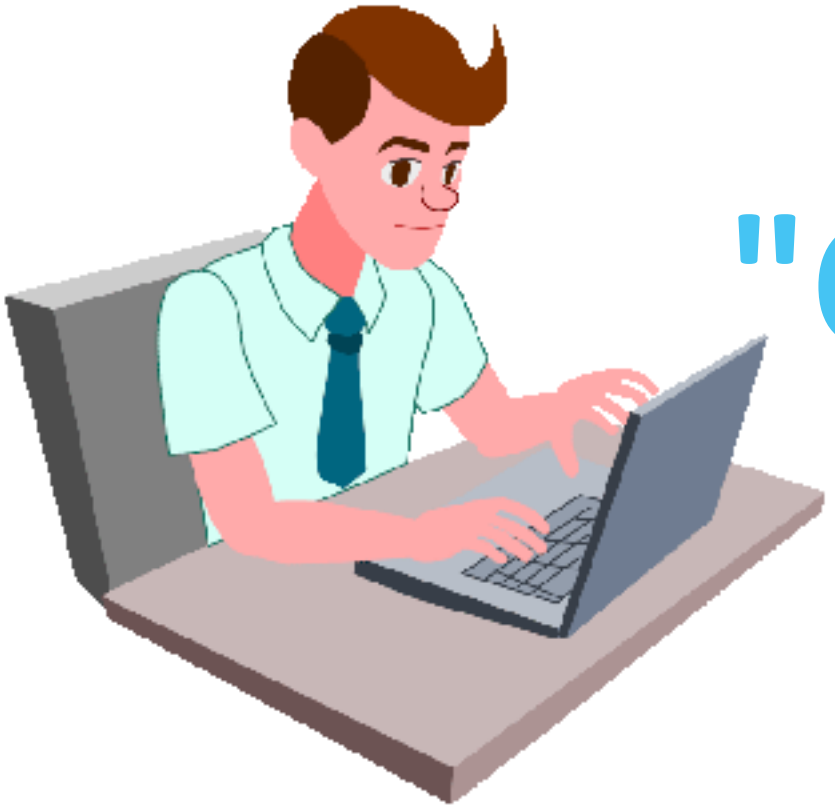
terraform apply
Enter yes when prompted to apply the plan and create the cluster.

Get information about your cluster

- The terraform show command shows detailed information of your cluster resources.
- terraform show

Delete the cluster

- If you want to delete the cluster, run the following command:
- terraform destroy



"Complete Lab 6"

7. Merging

Merging branches

In Git, merging two (or more!) branches is the act of making their personal history meet each other. When they meet, two things can happen:

- Files in their tip commit are different, so some conflict will rise
- Files do not conflict
- Commits of the target branch are directly behind commits of the branch we are merging, so a fast-forward will happen

Merging branches

- Let's give it a try.
- We can try to merge the melons branch into the master one; to do so, you have to check out the target branch, master in this case, and then fire a git merge <branch name> command; as I'm already on the master branch, I go straight with the merge command:

```
[1] ~/grocery (master)
$ git merge melons
Auto-merging shoppingList.txt
CONFLICT (content): Merge conflict in shoppingList.txt
Automatic merge failed; fix conflicts and then commit the result.
```

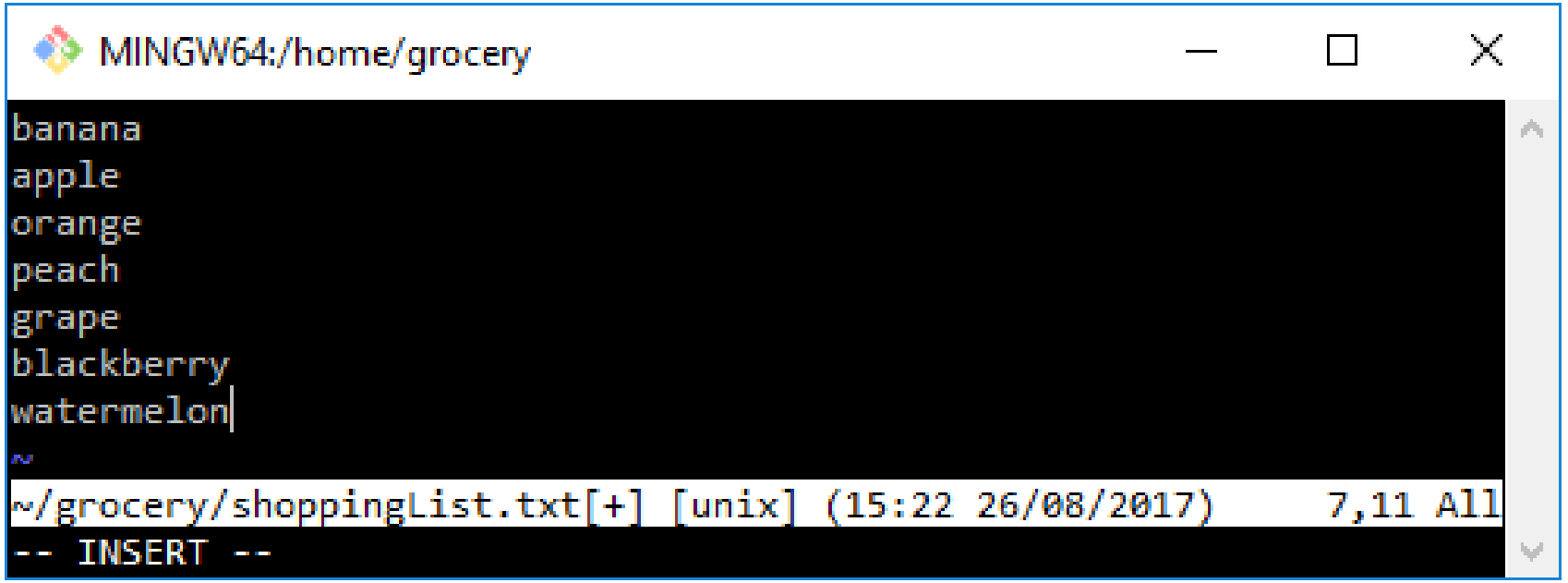
Merging branches

- See the conflict with git diff:

```
[2] ~/grocery (master|MERGING)
$ git diff
diff --cc shoppingList.txt
index 862debc,7786024..0000000
--- a/shoppingList.txt
+++ b/shoppingList.txt
@@@ -1,5 -1,5 +1,10 @@@
  banana
  apple
  orange
++<<<<<<< HEAD
 +peach
- grape

++grape
++=======
+ blackberry
+ watermelon
++>>>>>>> melons
```

Merging branches

- I will edit the file enqueuing blackberry and watermelon after peach and grape, as per the following screenshot:



Merging branches

- After saving the file, add it to the staging area and then commit:

```
[3] ~/grocery (master|MERGING)
$ git add shoppingList.txt

[4] ~/grocery (master|MERGING)
$ git commit -m "Merged melons branch into master"
[master e18a921] Merged melons branch into master
```

Merging branches

- Now take a look at the log:

```
[5] ~/grocery (master)
$ git log --oneline --graph --decorate --all
*   e18a921 (HEAD -> master) Merged melons branch into master
|\
| * a8c6219 (melons) Add a watermelon
| * ef6c382 (berries) Add a blackberry
* | 6409527 Add a grape
* | 603b9d1 Add a peach
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Merging branches

- Suggestion: look at the merge commit with git cat-file -p:

```
[6] ~/grocery (master)
$ git cat-file -p HEAD
tree 2916dd995ee356351c9b49a5071051575c070e5f
parent 6409527a1f06d0bbe680d461666ef8b137ac7135
parent a8c62190fb1c54d1034db78a87562733a6e3629c
author Ferdinando Santacroce <ferdinando.santacroce@gmail.com> 1503754221 +0200
committer Ferdinando Santacroce <ferdinando.santacroce@gmail.com> 1503754221 +0200

Merged melons branch into master
```

Merging branches

Fast forwarding

- A merge not always generates a new commit; to test this case, try to merge the melons branch into a berries one:

```
[7] ~/grocery (master)
$ git checkout berries
Switched to branch 'berries'

[8] ~/grocery (berries)
$ git merge melons
Updating ef6c382..a8c6219
Fast-forward
 shoppingList.txt | 1 +
 1 file changed, 1 insertion(+)

[9] ~/grocery (berries)
$ git log --oneline --graph --decorate --all
*   e18a921 (master) Merged melons branch into master
|\
| * a8c6219 (HEAD -> berries, melons) Add a watermelon
| * ef6c382 Add a blackberry
* | 6409527 Add a grape
* | 603b9d1 Add a peach
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Merging branches

- Move back the berries branch where it was using git reset:

```
[10] ~/grocery (berries)
$ git reset --hard HEAD^
HEAD is now at ef6c382 Add a blackberry

[11] ~/grocery (berries)
$ git log --oneline --graph --decorate --all
*   e18a921 (master) Merged melons branch into master
|\
| * a8c6219 (melons) Add a watermelon
| * ef6c382 (HEAD -> berries) Add a blackberry
* | 6409527 Add a grape
* | 603b9d1 Add a peach
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

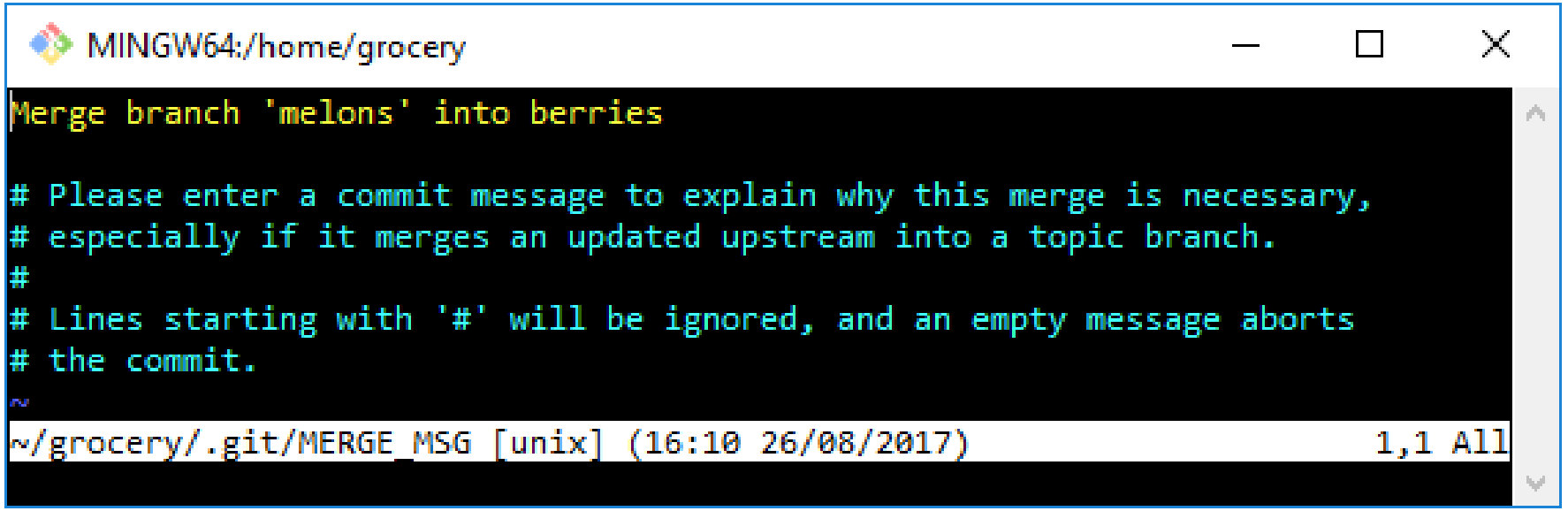
Merging branches

- We have just undone a merge, did you realize it?
- Okay, now do the merge again with the --no-ff option:

```
[12] ~/grocery (berries)
$ git merge --no-ff melons
```

Merging branches

- Git will now open your default editor to allow you to specify a commit message, as shown in the following screenshot:



Merging branches

- Accept the default message, save and exit:

```
[13] ~/grocery (berries)
Merge made by the 'recursive' strategy.--all
 shoppingList.txt | 1 +
 1 file changed, 1 insertion(+)
```

Merging branches

- Now a git log:

```
[14] ~/grocery (berries)
$ git log --oneline --graph --decorate --all
*   cb912b2 (HEAD -> berries) Merge branch 'melons' into berries
|\
| | *   e18a921 (master) Merged melons branch into master
| | |\
| | |/
| |/|
| * | a8c6219 (melons) Add a watermelon
|/ /
* | ef6c382 Add a blackberry
| * 6409527 Add a grape
| * 603b9d1 Add a peach
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Merging branches

- We are done with these experiments; anyway, I want to undo this merge, because I want to keep the repository as simple as possible to allow you to better understand the exercise we do together; go with a git reset --hard HEAD^:

```
[15] ~/grocery (berries)
$ git reset --hard HEAD^
HEAD is now at ef6c382 Add a blackberry


[16] ~/grocery (berries)
$ git log --oneline --graph --decorate --all
*   e18a921 (master) Merged melons branch into master
|\
| * a8c6219 (melons) Add a watermelon
| * ef6c382 (HEAD -> berries) Add a blackberry
* | 6409527 Add a grape
* | 603b9d1 Add a peach
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Merging branches

Okay, now undo even the past merge we did on the master branch:

```
[17] ~/grocery (master)
$ git reset --hard HEAD^
HEAD is now at 6409527 Add a grape

[18] ~/grocery (master)
$ git log --oneline --graph --decorate --all
* 6409527 (HEAD -> master) Add a grape
* 603b9d1 Add a peach
| * a8c6219 (melons) Add a watermelon
| * ef6c382 (berries) Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Cherry picking

- Let's play with it a little bit.
- Assume you want to pick the blackberry from the berries branch, and then apply it into the master branch; this is the way:

```
[1] ~/grocery (master)
$ git cherry-pick ef6c382
error: could not apply ef6c382... Add a blackberry
hint: after resolving the conflicts, mark the corrected paths
hint: with 'git add <paths>' or 'git rm <paths>'
hint: and commit the result with 'git commit'
```

Cherry picking

- Okay, the cherry pick raised a conflict, of course:

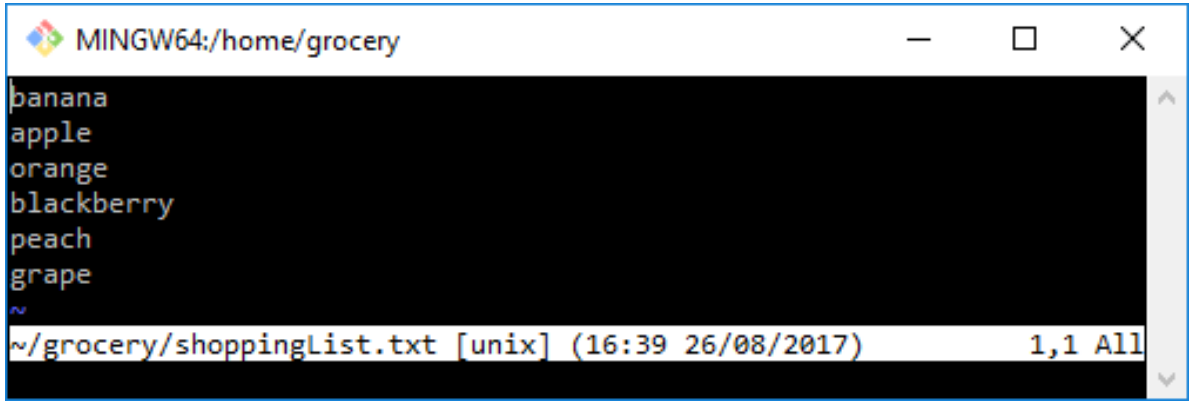
```
[2] ~/grocery (master|CHERRY-PICKING)
$ git diff
diff --cc shoppingList.txt
index 862debc,b05b25f..0000000
--- a/shoppingList.txt
+++ b/shoppingList.txt
@@@ -1,5 -1,4 +1,9 @@@
  banana
  apple
  orange
++<<<<<<< HEAD
 +peach
- grape
++grape
++=======
+ blackberry
++>>>>>>> ef6c382... Add a blackberry
```

Cherry picking

- The fourth line of both the shoppingList.txt file versions has been modified with different fruits.
- Resolve the conflict and then add a commit:

```
[3] ~/grocery (master|CHERRY-PICKING)
$ vi shoppingList.txt
```

- The following is a screenshot of my Vim console, and the files are arranged as I like:



Cherry picking

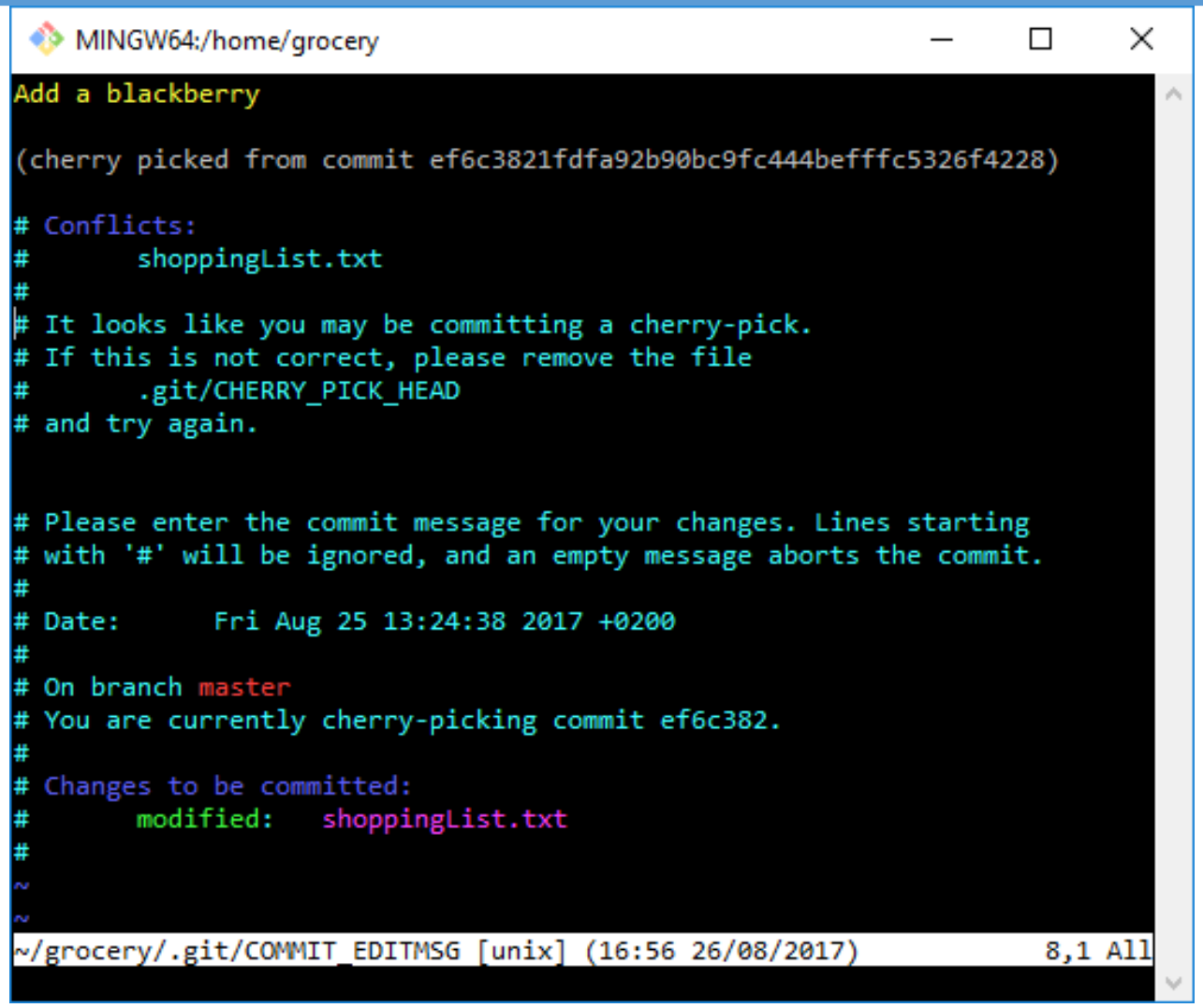
```
[4] ~/grocery (master|CHERRY-PICKING)
$ git add shoppingList.txt

[5] ~/grocery (master|CHERRY-PICKING)
$ git status
On branch master
You are currently cherry-picking commit ef6c382.
  (all conflicts fixed: run "git cherry-pick --continue")
  (use "git cherry-pick --abort" to cancel the cherry-pick operation)

Changes to be committed:

modified:   shoppingList.txt
```

Cherry picking

- Now go on and commit:

```
[6] ~/grocery (master)
$ git commit -m "Add a cherry-picked blackberry"
On branch master
nothing to commit, working tree clean

[7] ~/grocery (master)
$ git log --oneline --graph --decorate --all
* 99dd471 (HEAD -> master) Add a cherry-picked blackberry
* 6409527 Add a grape
* 603b9d1 Add a peach
| * a8c6219 (melons) Add a watermelon
| * ef6c382 (berries) Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Cherry picking



Summary

- This has been a very long lesson, I know.
- But now I think you know all you need to work proficiently with Git, at least in your own local repository.
- You know about working tree, staging area, and HEAD commit; you know about references as branches and HEAD.
- You know how to merge rebase, and cherry pick; and finally, you know how Git works under the hood, and this will help you from here on out.

"Complete Lab 7"

7. Resolving Merge Conflicts

Local Merge Conflicts

- Merge conflicts occur when competing changes are made to the same line of a file, or when one person edits a file and another person deletes the same file.

- To resolve a merge conflict caused by competing line changes, you must choose which changes to incorporate from the different branches in a new commit.

Local Merge Conflicts

- Open Git Bash.
- Navigate into the local Git repository that has the merge conflict.

```
cd REPOSITORY-NAME
```

Local Merge Conflicts

```
$ git status
> # On branch branch-b
> # You have unmerged paths.
> #   (fix conflicts and run "git commit")
> #
> # Unmerged paths:
> #   (use "git add ..." to mark resolution)
> #
> # both modified:      styleguide.md
> #
> no changes added to commit (use "git add" and/or "git commit -a")
```

Local Merge Conflicts

- In this example, one person wrote "open an issue" in the base or HEAD branch and another person wrote "ask your question in IRC" in the compare branch or branch-a.
- If you have questions, please

```
<<<<<<< HEAD
open an issue
=======
ask your question in IRC.
>>>>>>> branch-a
```

Local Merge Conflicts

- Add or stage your changes.

```
$ git add .
```

- Commit your changes with a comment.

```
$ git commit -m "Resolved merge conflict by incorporating both suggestions."
```

"Complete Lab 7"

8. Remote Repositories

Git Fundamentals - Working Remotely

In this lesson, we finally start to work in a distributed manner, using remote servers as a contact point for different developers. These are the main topics we will focus on:

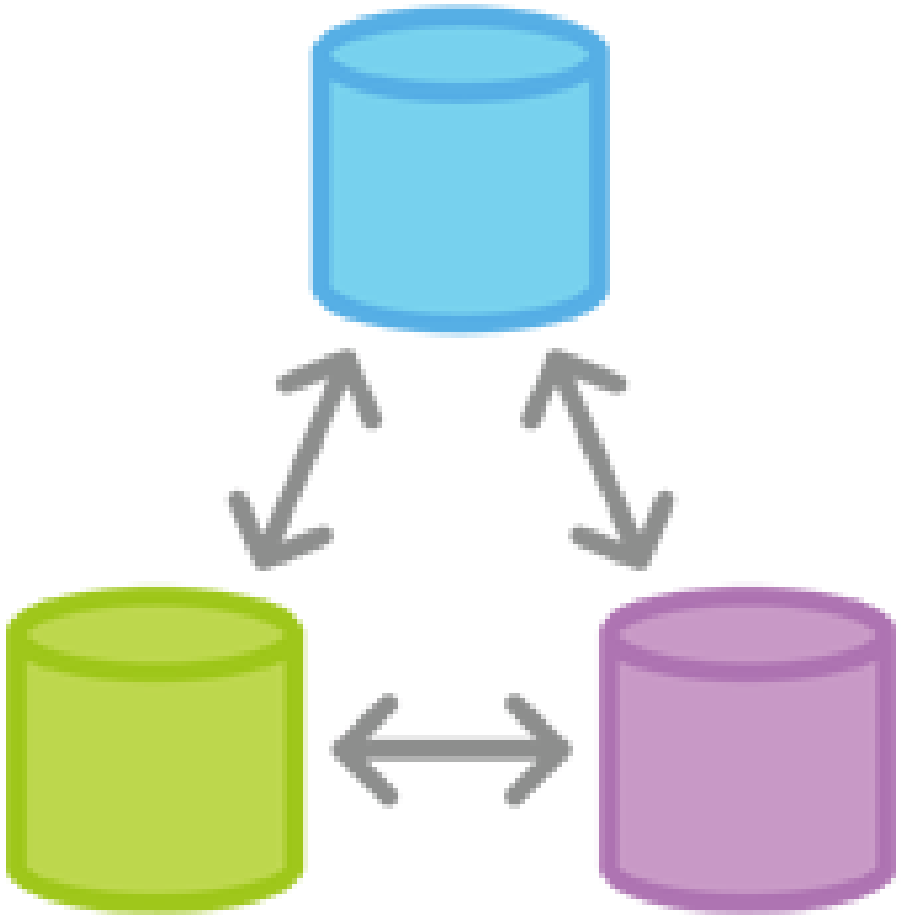
- Dealing with remotes
- Cloning a remote repository
- Working with online hosting services, such as GitHub

Working with remotes

- Git is a tool for versioning files, as you know, but it has been built with collaboration in mind.

- In 2005, Linus Torvalds had the need for a light and efficient tool to share the Linux kernel code, allowing him and hundreds of other people to work on it without going crazy.

Working with remotes



Working with remotes

Clone a local repository

- Create a new folder on your disk to clone our grocery repository:

[1] ~
$ mkdir grocery-cloned

- Then clone the grocery repository using the git clone command:

```
[2] ~ $ cd grocery-cloned [3] ~/grocery-cloned $ git clone ~/grocery . Cloning into '.'...
```

Working with remotes

- Now, go directly to the point with a git log command:

```
[4] ~/grocery-cloned (master)
$ git log --oneline --graph --decorate --all
* 6409527 (HEAD -> master, origin/master, origin/HEAD) Add a grape
* 603b9d1 Add a peach
| * a8c6219 (origin/melons) Add a watermelon
| * ef6c382 (origin/berries) Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Working with remotes

- But don't worry: a local branch in which to work locally can be created by simply checking it out:

```
[5] ~/grocery-cloned (master)
$ git checkout berries
Branch berries set up to track remote branch berries from origin.
Switched to a new branch 'berries'
```

Working with remotes

- Now, look at the log again:

```
[6] ~/grocery-cloned (berries)
$ git log --oneline --graph --decorate --all
* 6409527 (origin/master, origin/HEAD, master) Add a grape
* 603b9d1 Add a peach
| * a8c6219 (origin/melons) Add a watermelon
| * ef6c382 (HEAD -> berries, origin/berries) Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Working with remotes

- Let's try:

```
[7] ~/grocery-cloned (berries)
$ echo "blueberry" >> shoppingList.txt

[8] ~/grocery-cloned (berries)
$ git commit -am "Add a blueberry"
[berries ab9f231] Add a blueberry
Committer: Santacroce Ferdinando <san@intre.it>
```

Working with remotes

- You can suppress this message by setting them explicitly:

```
git config --global user.name "Your Name"
git config --global user.email you@example.com
```

- After doing this, you may fix the identity used for this commit with the following code:

```
git commit --amend --reset-author
```

```
1 file changed, 1 insertion(+)
```

Working with remotes

OK, let's see what happened:

```
[9] ~/grocery-cloned (berries)
$ git log --oneline --graph --decorate --all
* ab9f231 (HEAD -> berries) Add a blueberry
| * 6409527 (origin/master, origin/HEAD, master) Add a grape
| * 603b9d1 Add a peach
| | * a8c6219 (origin/melons) Add a watermelon
| |/
|/|
* | ef6c382 (origin/berries) Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Working with remotes

- Now, we will try to push the modifications in the berries branch to the origin; the command is git push, followed by the name of the remote and the target branch:

```
[10] ~/grocery-cloned (berries)
$ git push origin berries
Counting objects: 3, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 323 bytes | 0 bytes/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To C:/Users/san/Google Drive/Packt/PortableGit/home/grocery
   ef6c382..ab9f231  berries -> berries
```

Working with remotes

- Now, we obviously want to see if, in the remote repository, there is a new commit in the berries branch; so, open the grocery folder in a new console and do git log:

```
[11] ~
$ cd grocery

[12] ~/grocery (master)
$ git log --oneline --graph --decorate --all
* ab9f231 (berries) Add a blueberry
| * 6409527 (HEAD -> master) Add a grape
| * 603b9d1 Add a peach
| | * a8c6219 (melons) Add a watermelon
| |/
|/|
* | ef6c382 Add a blackberry
|/
* 0e8b5cf Add an orange
* e4a5e7b Add an apple
* a57d783 Add a banana to the shopping list
```

Working with remotes

Getting remote commits with git pull

- Now, it's time to experiment the inverse: retrieving updates from the remote repository and applying them to our local copy.

- So, make a new commit in the grocery repository, and then, we will download it into the grocery-cloned one:

```
[13] ~/grocery (master)
$ printf "\r\n" >> shoppingList.txt
```

Working with remotes

- I firstly need to create a new line, because due to the previous grape rebase, we ended having the shoppinList.txt file with no new line at the end, as echo "" >> <file> usually does:

```
[14] ~/grocery (master)
$ echo "apricot" >> shoppingList.txt

[15] ~/grocery (master)
$ git commit -am "Add an apricot"
[master 741ed56] Add an apricot
 1 file changed, 2 insertions(+), 1 deletion(-)
```

Working with remotes

- Let's try git pull for now, then we will try to use git fetch and git merge separately.
- Go back to the grocery-cloned repository, switch to the master branch, and do a git pull:

```
[16] ~/grocery-cloned (berries)
$ git checkout master
Your branch is up-to-date with 'origin/master'.
Switched to branch 'master'
```

Working with remotes

- For now, go with git pull: the command wants you to specify the name of the remote you want to pull from, which is origin in this case, and then the branch you want to merge into your local one, which is master, of course:

```
[17] ~/grocery-cloned (master)
$ git pull origin master
remote: Counting objects: 3, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From C:/Users/san/Google Drive/Packt/PortableGit/home/grocery
 * branch    master     -> FETCH_HEAD
   6409527..741ed56  master     -> origin/master
Updating 6409527..741ed56
Fast-forward
 shoppingList.txt | 3 ++-
 1 file changed, 2 insertions(+), 1 deletion(-)
```

Working with remotes

- OK, now I want you to try doing these steps in a separate manner; create the umpteenth new commit in the grocery repository, the master branch:

```
[18] ~/grocery (master)
$ echo "plum" >> shoppingList.txt

[19] ~/grocery (master)
$ git commit -am "Add a plum"
[master 50851d2] Add a plum
1 file changed, 1 insertion(+)
```

Working with remotes

- Now perform a git fetch on grocery-cloned repository:

```
[20] ~/grocery-cloned (master)
$ git fetch
remote: Counting objects: 3, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From C:/Users/san/Google Drive/Packt/PortableGit/home/grocery
   741ed56..50851d2  master     -> origin/master
```

Working with remotes

- Do a git status now:

```
[21] ~/grocery-cloned (master)
$ git status
On branch master
Your branch is behind 'origin/master' by 1 commit, and can be fast-forwarded.
  (use "git pull" to update your local branch)
nothing to commit, working tree clean
```

Working with remotes

- Now, let's sync with a git merge; to merge a remote branch, we have to specify, other than the branch name, even the remote one, as we did in the git pull command previously:

```
[22] ~/grocery-cloned (master)
$ git merge origin master
Updating 741ed56..50851d2
Fast-forward
 shoppingList.txt | 1 +
 1 file changed, 1 insertion(+)
```

Working with remotes

How Git keeps track of remotes

- Git stores remote branch labels in a similar way to how it stores the local branches ones; it uses a subfolder in refs for the scope, with the symbolic name we used for the remote, in this case origin, the default one:

```
[23] ~/grocery-cloned (master)
$ ll .git/refs/remotes/origin/
total 3
drwxr-xr-x 1 san 1049089  0 Aug 27 11:25 ./
drwxr-xr-x 1 san 1049089  0 Aug 26 18:19 ../
-rw-r--r-- 1 san 1049089 41 Aug 26 18:56 berries
-rw-r--r-- 1 san 1049089 32 Aug 26 18:19 HEAD
-rw-r--r-- 1 san 1049089 41 Aug 27 11:25 master
```

"Complete Lab 9"

9. Reviewing the Commit History

Using Git Log

- In modern Git, you can trace the evolution of the line range within the file using git log -L, which is currently limited to walk starting from a single revision (zero or one positive revision arguments) and a single file.

- The range is given either by denoting the start and end of the range with -L <start>,<end>:<file> (where either <start> or <end> can be the line number or /regexp/), or a function to track with -L :<funcname regexp>:<file>.

Selecting and formatting the git log output

- Now that you know how to select revisions to examine and to limit which revisions are shown (selecting those that are interesting).

- There is a huge number and variety of options of the git log command available for this.

Predefined and user defined output formats

```
$ git log --pretty="%h - %an, %ar : %s"
50f84e3 - Junio C Hamano, 7 days ago : Update draft release notes
0953113 - Junio C Hamano, 10 days ago : Second batch for 2.1
afa53fe - Nick Alcock, 2 weeks ago : t5538: move http push tests out
```

Using Git Log

Placeholder	Description of output
%H	Commit hash (full SHA-1 identifier of revision)
%h	Abbreviated commit hash
%an	Author name
%ae	Author e-mail
%ar	Author date, relative
%cn	Committer name
%ce	Committer email
%cr	Committer date, relative
%s	Subject (first line of a commit message, describing revision)
%%	A raw %

Using Git Log

```
$ git log --graph --decorate --oneline origin/maint
*   bce14aa (origin/maint) Sync with 1.9.4
|\
| * 34d5217 (tag: v1.9.4) Git 1.9.4
| *   12188a8 Merge branch 'rh/prompt' into maint
| |\
| * \   64d8c31 Merge branch 'mw/symlinks' into maint
| |\ \
* | | | d717282 t5537: re-drop http tests
* | | | e156455 (tag: v2.0.0) Git 2.0
```

11. Continuous Integration / Continuous Delivery (CI/CD)

CI/CD explained

- CI/CD falls under DevOps (the joining of development and operations teams) and combines the practices of continuous integration and continuous delivery.

- CI/CD automates much or all of the manual human intervention traditionally needed to get new code from a commit into production, encompassing the build, test (including integration tests, unit tests, and regression tests), and deploy phases, as well as infrastructure provisioning.

What is continuous integration (CI)?

- Continuous integration is the practice of integrating all your code changes into the main branch of a shared source code repository early and often, automatically testing each change when you commit or merge them, and automatically kicking off a build.
- With continuous integration, errors and security issues can be identified and fixed more easily, and much earlier in the development process.
- By merging changes frequently and triggering automatic testing and validation processes, you minimize the possibility of code conflict, even with multiple developers working on the same application..

What is continuous delivery (CD)?

- Continuous delivery is a software development practice that works in conjunction with CI to automate the infrastructure provisioning and application release process.
- Once code has been tested and built as part of the CI process, CD takes over during the final stages to ensure it’s packaged with everything it needs to deploy to any environment at any time.
- CD can cover everything from provisioning the infrastructure to deploying the application to the testing or production environment.

What is continuous deployment?

- Continuous deployment enables organizations to deploy their applications automatically, eliminating the need for human intervention.
- With continuous deployment, DevOps teams set the criteria for code releases ahead of time and when those criteria are met and validated, the code is deployed into the production environment.
- This allows organizations to be more nimble and get new features into the hands of users faster.

What is continuous testing?

In continuous testing, various types of tests are performed within the CI/CD pipeline. These can include:

- Unit testing, which checks that individual units of code work as expected
- Integration testing, which verifies how different modules or services within an application work together
- Regression testing, which is performed after a bug is fixed to ensure that specific bug won't occur again

There are eight fundamental elements of CI/CD that help ensure maximum efficiency for your development lifecycle. They span development and deployment. Include these fundamentals in your pipeline to improve your DevOps workflow and software delivery:

- A single source repository
- Frequent check-ins to main branch
- Automated builds
- Self-testing builds
- Frequent iterations
- Stable testing environments
- Maximum visibility
- Predictable deployments anytime

CI/CD fundamentals

The benefits of CI/CD implementation

Companies and organizations that adopt CI/CD tend to notice a lot of positive changes. Here are some of the benefits you can look forward to as you implement CI/CD:

- Happier users and customers
- Accelerated time-to-value
- Less fire fighting
- Free up developers' time
- Less context switching
- Reduce burnout
- Recover faster

Why GitLab CI/CD?

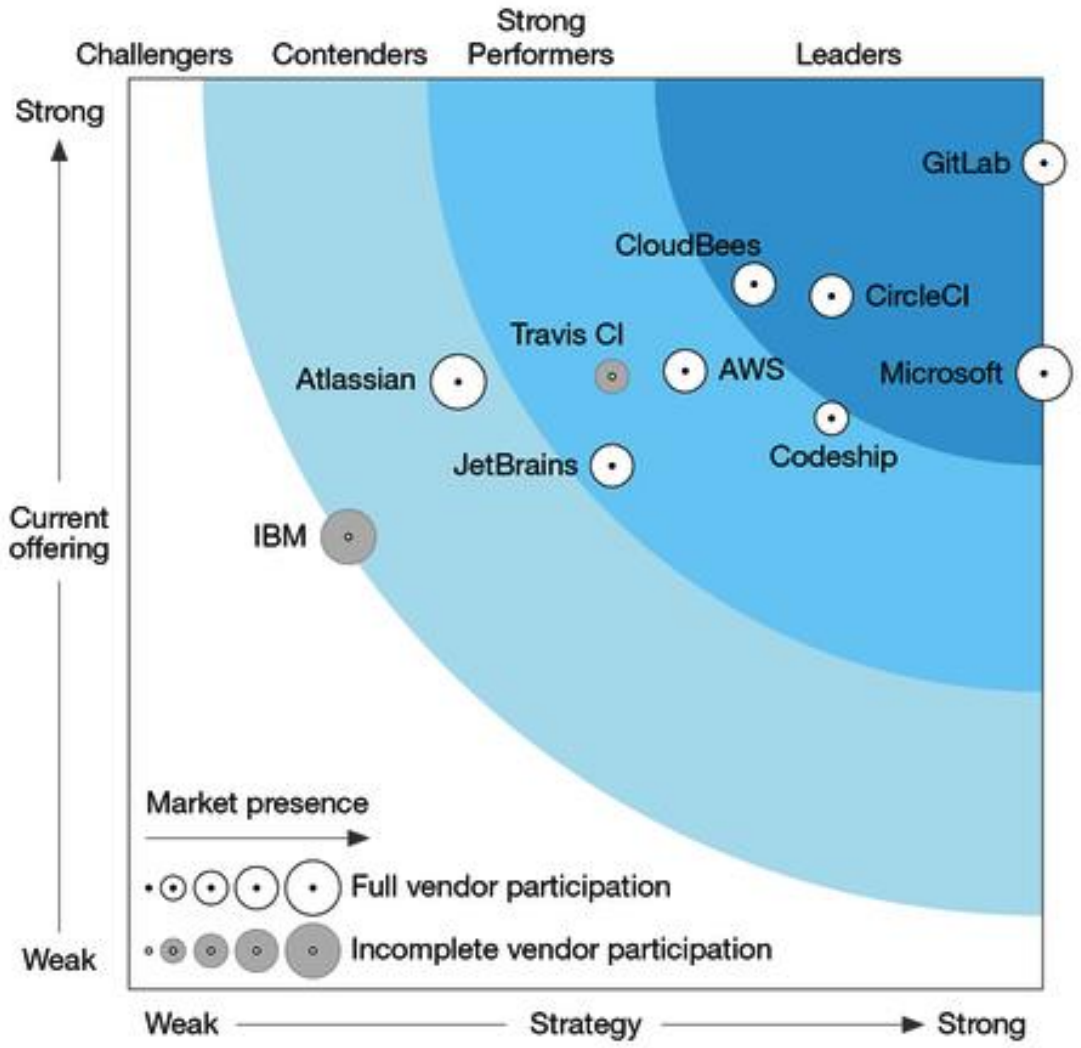
- In order to complete all the required fundamentals of full CI/CD, many CI platforms rely on integrations with other tools to fulfill those needs.
- Many organizations have to maintain costly and complicated toolchains in order to have full CI/CD capabilities.
- This often means maintaining a separate SCM like Bitbucket or GitHub, and connecting to a separate testing tool that connects to their CI tool, that connects to a deployment tool like Chef or Puppet, that also connects to various security and monitoring tools.

GitLab CI

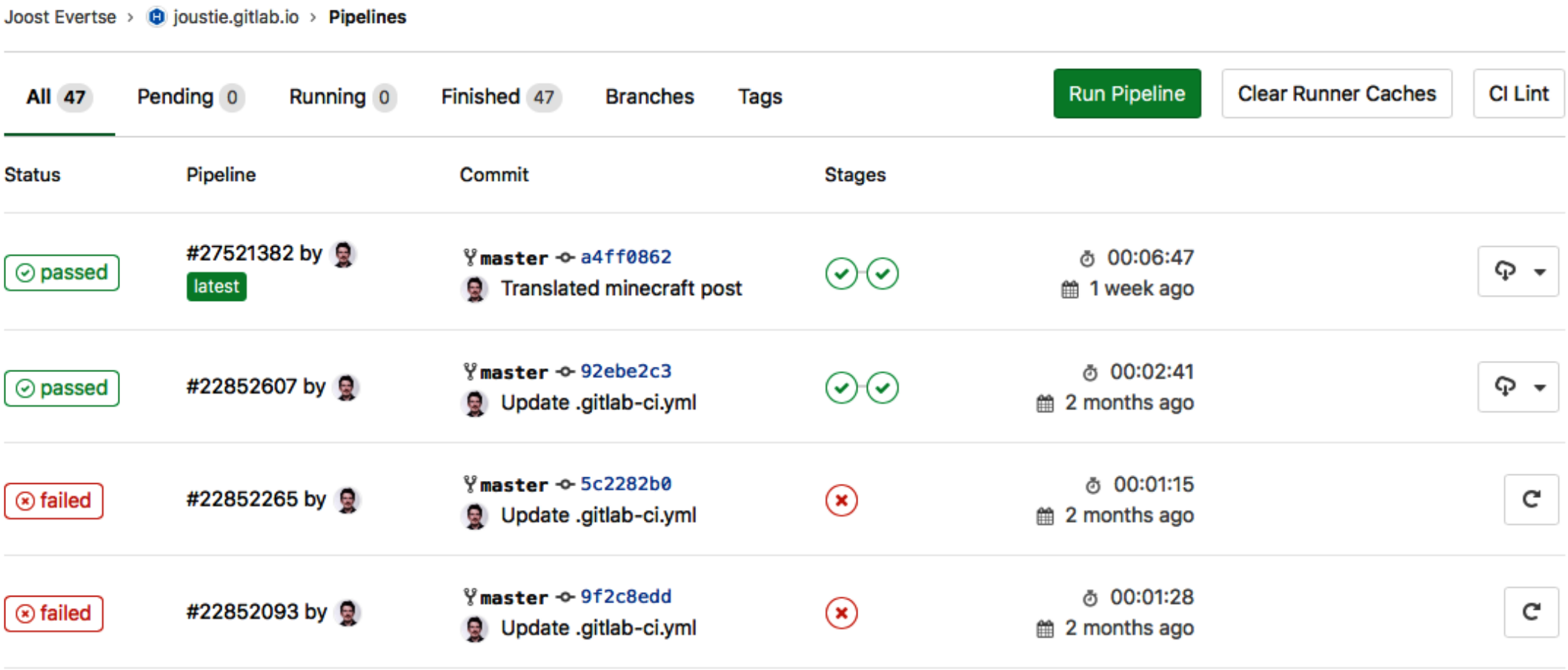
- GitLab CI is a feature that helps perform the Continuous Integration (CI) of software components.
- When several developers work together using a versioning system, problems can arise when changes made by one developer break the product as a whole.
- The best way to make sure this happens less often, or at least early in the process, is to use integration tests more frequently, hence the name continuous.

GitLab CI

- Forrester classified GitLab as a leader in CI in The Forrester Wave: Continuous Integration Tools, Q3 2017.
- This is shown in the following diagram:

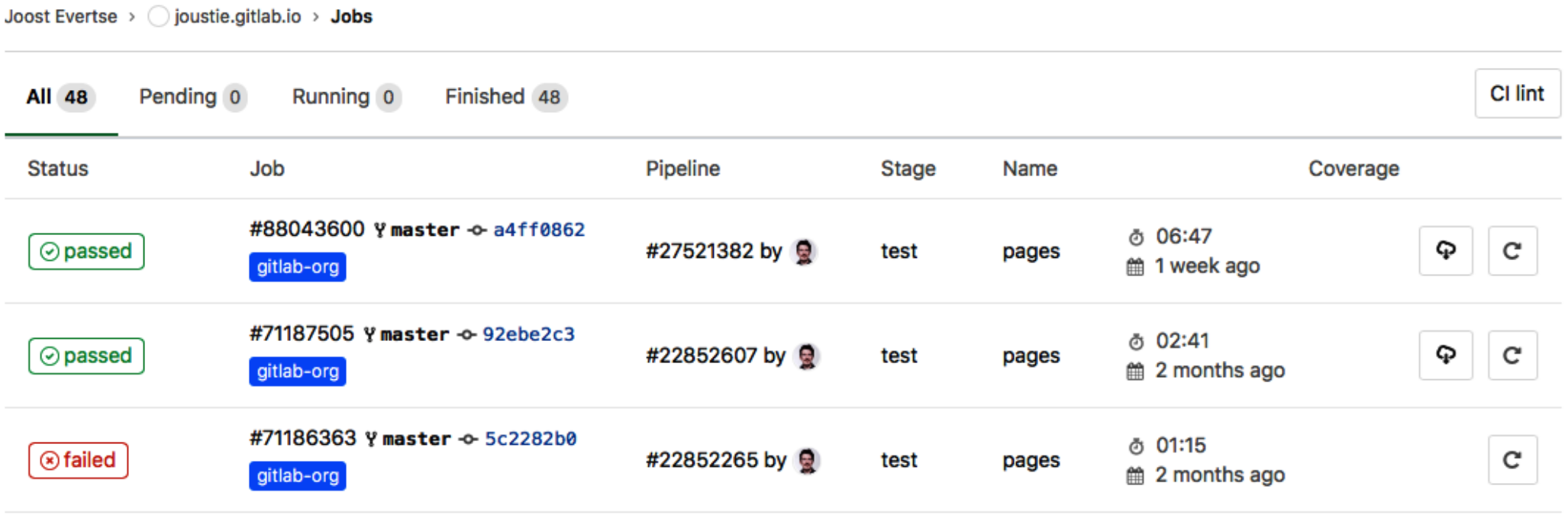


Pipelines and jobs



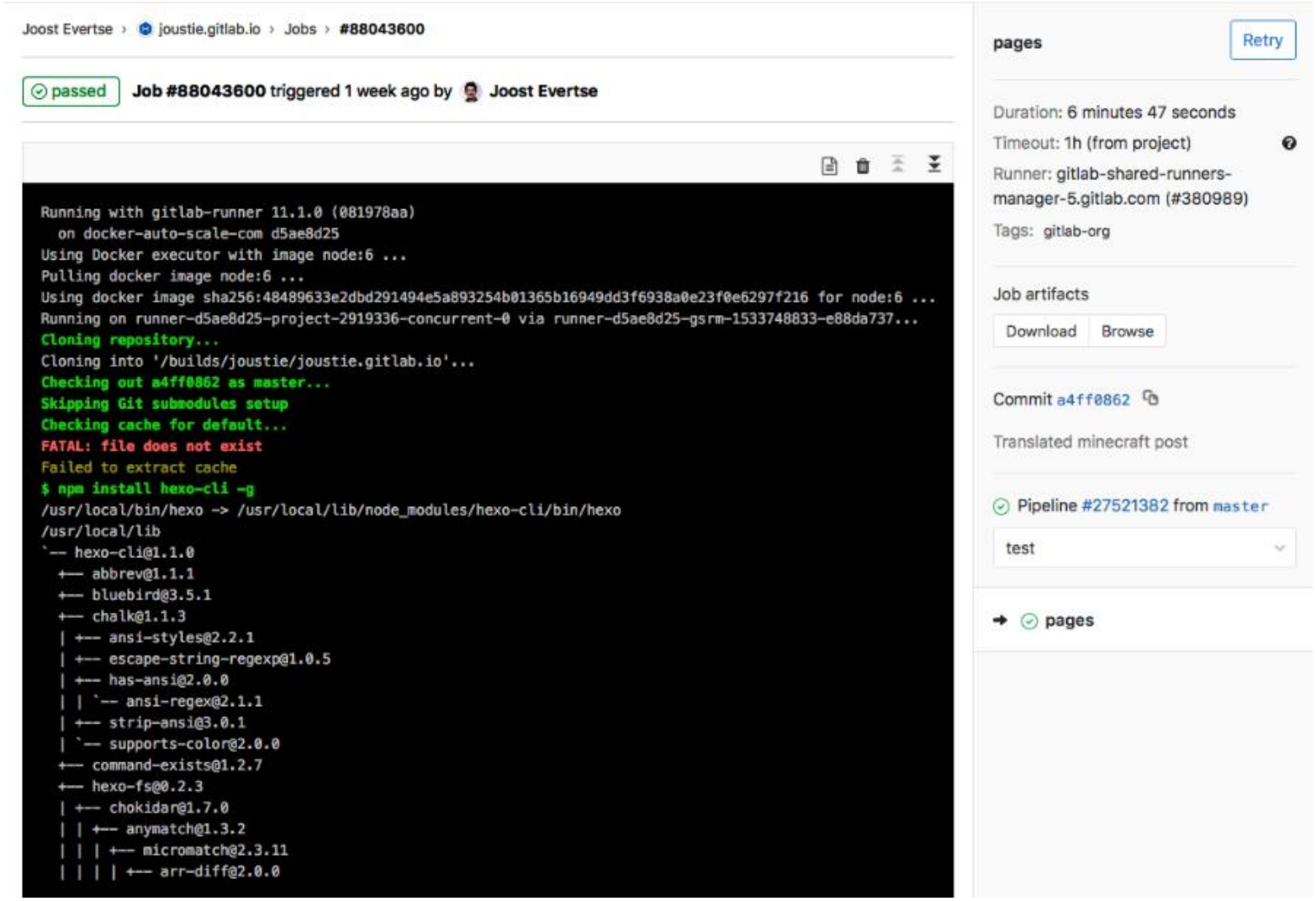
Pipelines and jobs

- Alternatively, you can view all jobs, by going to the Pipelines' Jobs page, as shown in the following screenshot:



Pipelines and jobs

- You can check the log of a job by clicking on the status of the job (for example, failed or passed). You can debug why some jobs fail and see exactly what happened:



Issues with the old runner

- The main problem with the old runner is that it could only run one concurrent job at a time.
- If you wanted to run more, you could either set up a new server or create an additional user to build jobs.
- Secondly, it always ran projects on the server shell, This made it really hard to test projects using different versions of Ruby or any other dependencies.

Switching to Go

- Go (or Golang) is a new language (less than 10 years old).
- It is already widely used by some impressive parties, such as Docker (https://docker.com), Google, Kubernetes (https://kubernetes.io), and Prometheus (https://prometheus.io).
- Go is a versatile tool that can help you to program at a low level, close to the operating system or at a high level in a language such as Java.
- It is perfectly suited to creating systems software.

Switching to Go

- The project can be found at https://gitlab.com/gitlab-org/gitlab-runner:

Build, test, deploy, and monitor your code from a single application

- We believe a single application that offers visibility across the entire
- SDLC is the best way to ensure that every development stage is included
- and optimized. When everything is under one roof, it's as easy to pinpoint
- workflow bottlenecks and evaluate the impact each element has on
- deployment speed. GitLab has CI/CD built right in, no plugins required.

Breaking down .gitlab-ci.yml

- A basic .gitlab-ci.yml file might look something like this:

```
before_script:
  - apt-get update -qq && DEBIAN_FRONTEND=noninteractive apt-get install -y -
qq ca-certificates git php php-xml
  - php -r "copy('https://getcomposer.org/installer', 'composer-setup.php');"
  - php composer-setup.php
  - php composer.phar install

phpunit:
  script:
    - vendor/bin/phpunit tests/ROT13FormatterTest
```

The script parameter

- The most common parameter to a job, script is used to define any commands that should be run in the job. In our preceding example, we have the following:

```
phpunit:
  script:
    - vendor/bin/phpunit tests/ROT13FormatterTest
```

The stage parameter

- Stages are defined at the top level of the YAML file and are used to define separate blocks of jobs, which can be executed in parallel.
- They also define the order in which stages are run. In each job, the stage parameter can be used to define which build stage a job is in, thus grouping together similar jobs and allowing for jobs to depend on other jobs having finished.
- The following is an example of defining and using stages:

```
stages:
  - build
  - test
  - deploy

job 1:
  stage: build
  script: npm run build dependencies

job 2:
  stage: build
  script: npm run build artifacts

job 3:
  stage: test
  script: npm run test

job 4:
  stage: deploy
  script: npm run deploy
```

The only and except parameters

- Please note that only and except don't have to be mutually exclusive either; you can use a combination of them to have more fine-grained control over when a job will be executed.
- An example of this is as follows:

```
job:
  only:
    - /^iss-.*$/
  except:
    - tags
```

The tags parameter

- You can specify a tag or tags in this parameter, which will limit this job to only being executed on Runners that also have the same tag.

- Please note that the tags are additive, so if you specify multiple tags, the job will only be executed on a Runner that has all of those tags present:

```
job:
  tags:
    - php
    - postgres
```

The tags parameter

- One example use case of when is as follows:

```
stages:
  - build
  - cleanup_build

build_job:
  stage: build
  script:
    - webpack

cleanup_build_job:
  stage: cleanup_build
  script:
    - rm /dist/*
  when: on_failure
```

cache – paths

- This is an array of paths to files and/or directories that should be cached.
- You can also use the asterisk wildcard character (*). This is demonstrated in the following code snippet:

```
build:
  cache:
  paths:
    - binaries/*.apk
    - .config
```

cache – key

- This takes a string that can be used to create separate caches for different jobs or branches, like so:

```
test:
  cache:
    key: "$CI_COMMIT_REF_SLUG"
    paths:
      - binaries/
```

cache – key

- In this example, we use an inbuilt default variable provided by GitLab CI – CI_COMMIT_REF_SLUG – that is equal to the branch/tag name of the commit.
- In this case, GitLab CI will maintain a separate cache for each branch. Next up, let's look at jobs with different paths cached:

```
stages:
  - build
  - test

build_job:
  stage: build
  script: npm run build
  cache:
    key: build-key
    paths:
      - public/

test_job:
  stage: test
  script: npm run test
  cache:
    key: test-key
    paths:
     - vendor/
```

Breaking down .gitlab-ci.yml

- This lesson is a rapid and very high-level overview of Python; the following lessons provide more detail.
- You may find it valuable to return to this lesson and work through the appropriate examples as a review after you read about the features covered in subsequent lessons.
- If this lesson was mostly a review for you, or if you'd like to learn more about only a few features, feel free to jump around, using the index or table of contents.

artifacts – paths

- Much like with caching, you specify an array of paths, which can include wildcards like so:

```
package:
  artifacts:
    paths:
      - public/
      - tests/*.html
```

artifacts – name

- By default, any uploaded files will be stored in a .zip archive titled artifacts.zip.

- You can use the name parameter to change the default filename (it will still end with .zip), as demonstrated in the following code:

```
package:
  artifacts:
    name: cool_project_name
```

The variables parameter

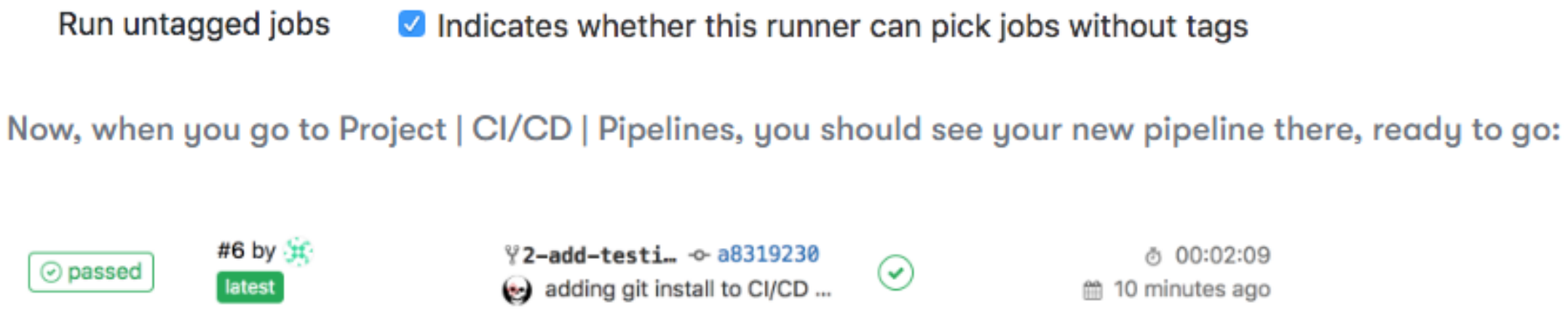
- You can store variables per job or globally using the variables keyword.
- The value for variables should be an array of key/value pairs that can be represented by strings or integers (for both key and value), although typically the key will be an all-capitalized string for ease of recognition.
- Any variables used should be of a non-sensitive nature; they are not considered an appropriate method for storing secrets.
- Locally defined variables will override their globally defined counterparts, but to have a job run with no access to globally defined variables, you should redeclare it with an empty array like so:

```
cool_job_name:
  variables: {}
```

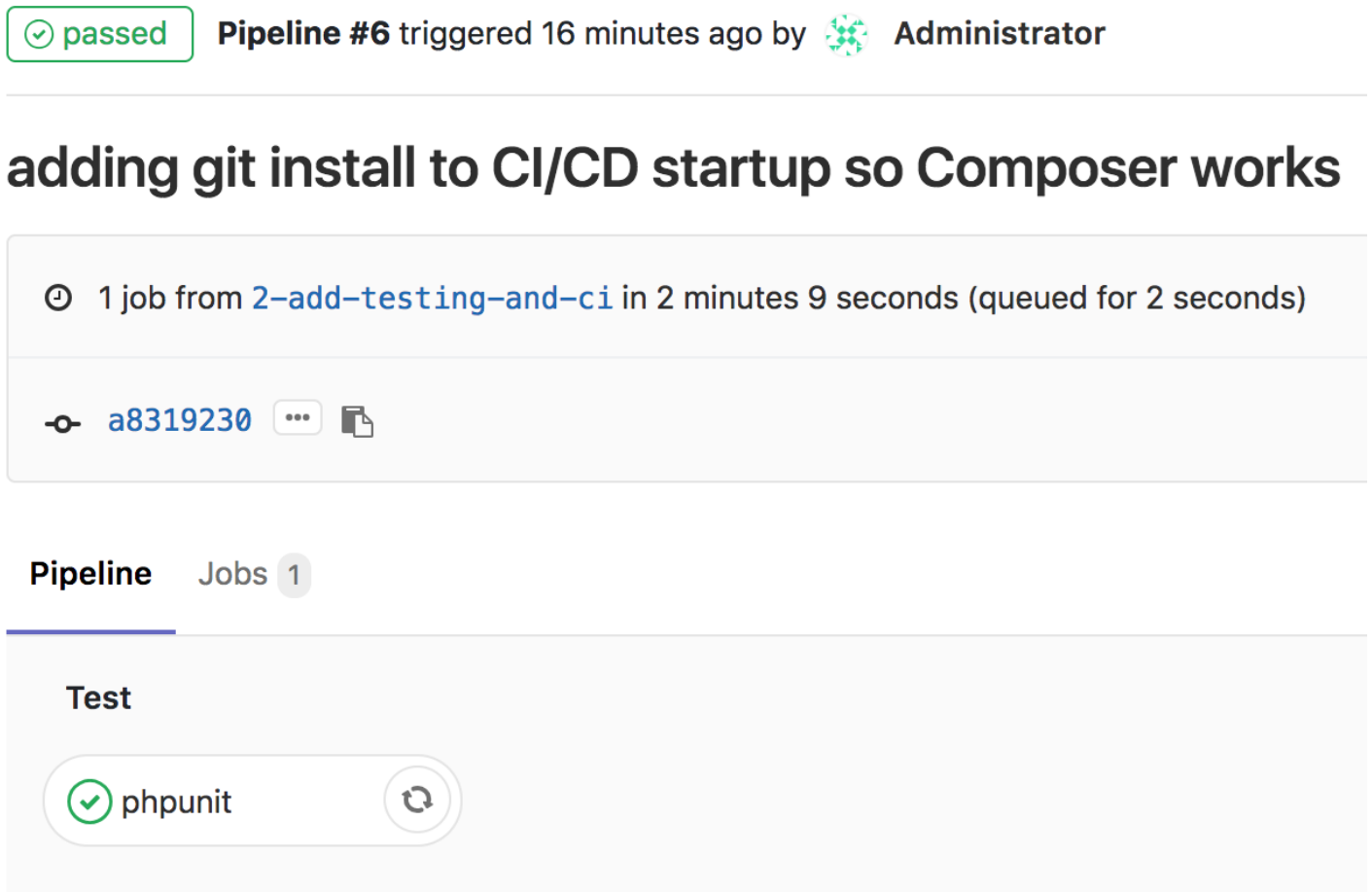
Adding .gitlab-ci.yml to our example project

```
before_script:
  - apt-get update -qq && DEBIAN_FRONTEND=noninteractive apt-get install -y -
qq ca-certificates git php php-xml
  - php -r "copy('https://getcomposer.org/installer', 'composer-setup.php');"
  - php composer-setup.php
  - php composer.phar install

phpunit:
  script:
    - vendor/bin/phpunit tests/ROT13FormatterTest
```

Adding .gitlab-ci.yml to our example project

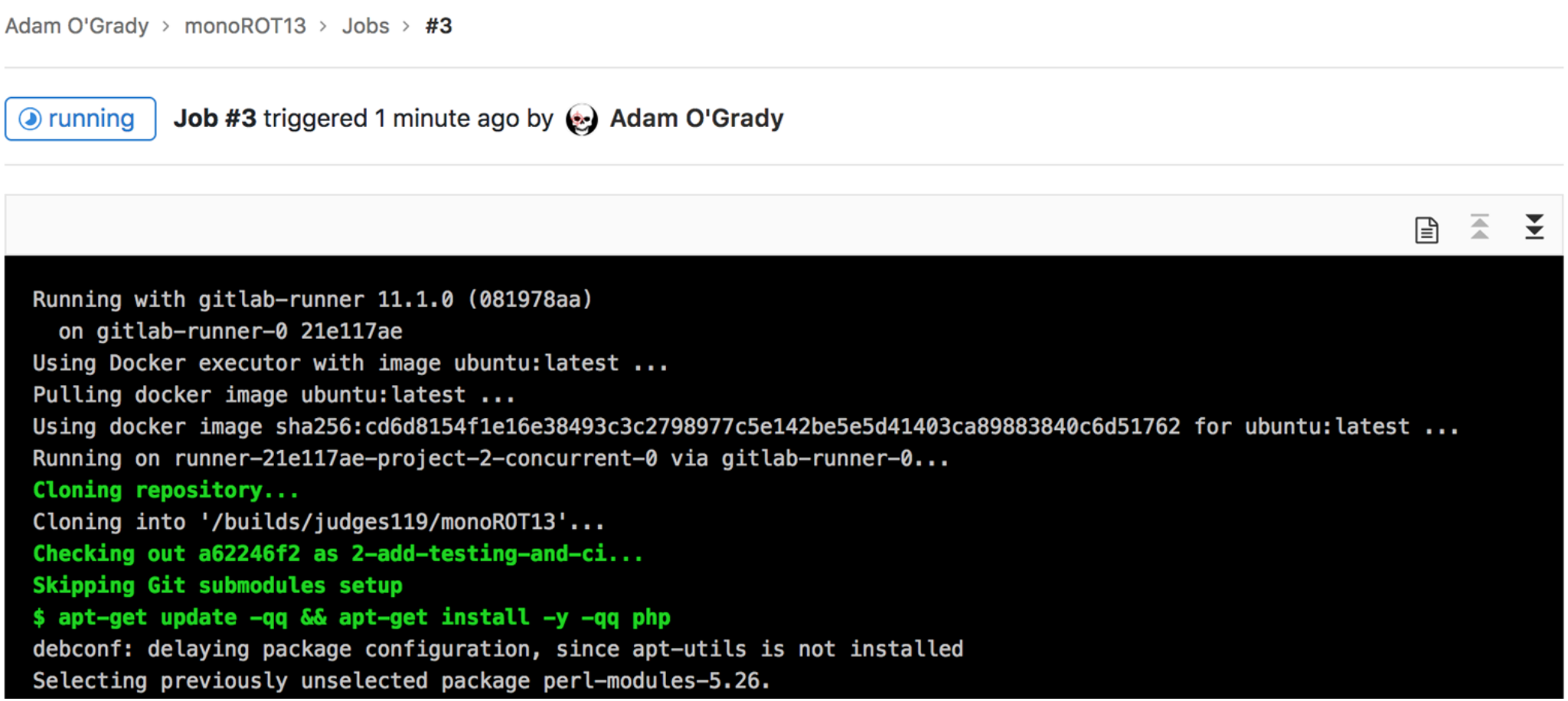


Adding .gitlab-ci.yml to our example project



- You can click the status (passed, in the preceding screenshot) to receive a breakdown of the pipeline. Yours should look similar to this:

Adding .gitlab-ci.yml to our example project



Deconstructing an advanced .gitlab-ci.yml file

- The header of the .gitlab-ci.yml file defines an image to use from the Docker Registry (image: bitnami/laravel:latest), as well as defining a service (in this case, the postgres:9.6 image, also from the Docker registry).
- This service container will be attached directly to our Laravel image to provide a database without needing to set up a database as part of a before_script each time a job is run:

```
image: bitnami/laravel:latest

services:
  - postgres:9.6
```

Deconstructing an advanced .gitlab-ci.yml file

- The variables that are declared all relate to our database and will be used in the jobs so that we can connect to our database service image.
- Of particular note is the DB_HOST parameter, which simply specifies postgres as the hostname.
- This is because with GitLab CI, any services that are connected are referred to by their image name, in this case, postgres:

```
variables:
  POSTGRES_DATABASE: postgres
  POSTGRES_PASSWORD: password
  DB_HOST: postgres
  DB_USERNAME: root
```

Deconstructing an advanced .gitlab-ci.yml file

- Next, we define three stages that we want: test, package, and deploy.
- These stages will be run sequentially (and any errors in an earlier stage will cause the whole pipeline to be canceled):

```
stages:
  - test
  - package
  - deploy
```

Deconstructing an advanced .gitlab-ci.yml file

- The big difference between the two is that php_unit_test also contains a cache section, which means that after the job is finished, the entire vendor/ directory will be zipped up and stored under the composer key for reuse in future jobs and pipelines.
- This helps reduce the time taken to build and execute subsequent runs of this job and any other jobs that use the same cache.
- Once both jobs are finished (and both are successful), the next stage can begin:

```
php_unit_test:
  stage: test
  script:
    - cp .env.example .env
    - composer install
    - php artisan key:generate
    - php artisan migrate
    - vendor/bin/phpunit
  cache:
    key: composer
    paths:
      - vendor/

js_unit_test:
  stage: test
  script:
    - npm install
    - npm run test
```

Deconstructing an advanced .gitlab-ci.yml file

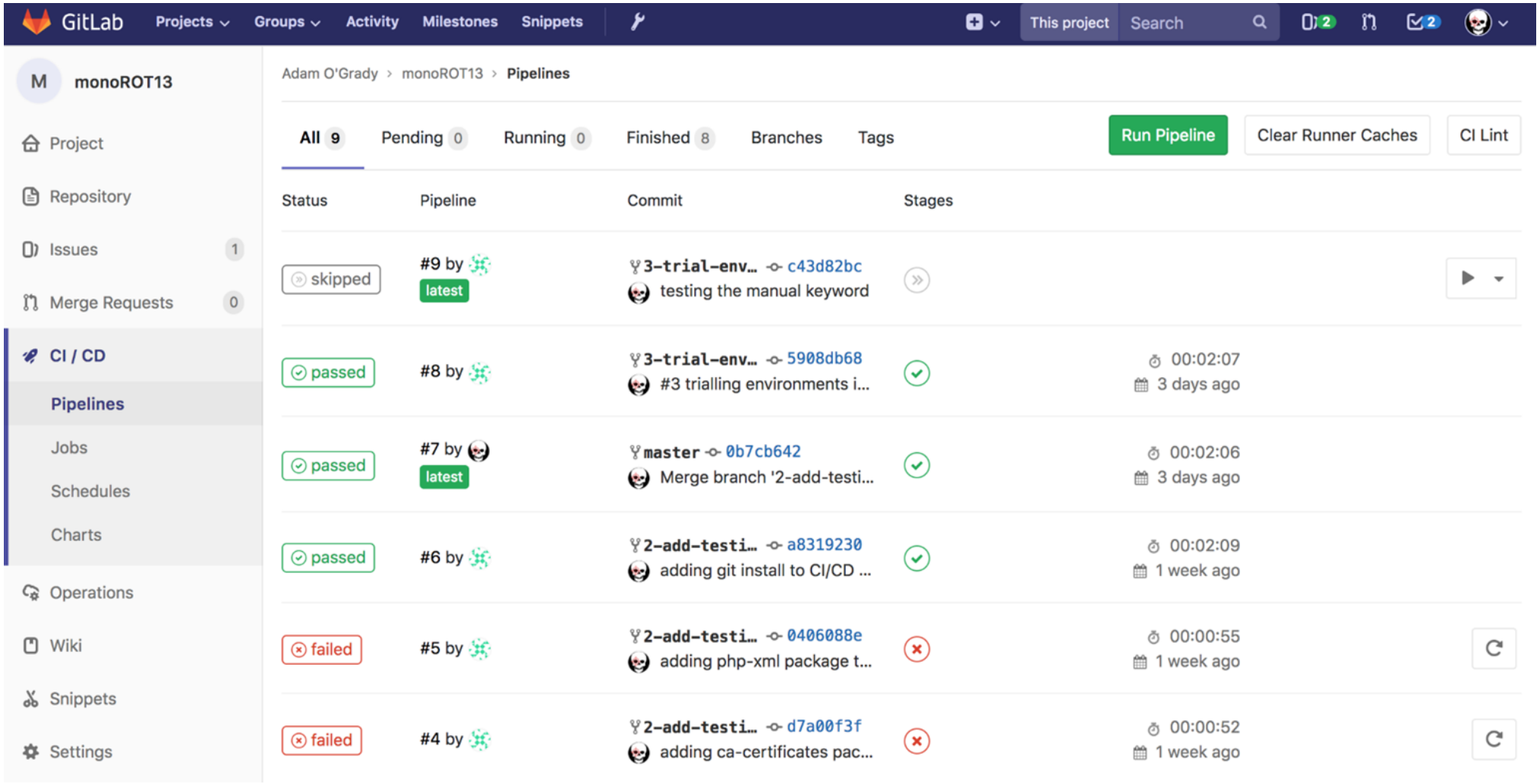
- For this example, we've also set the policy to pull to demonstrate it.
- This means that while it will download any available cache stored under the composer key, it will not re-upload any files once the job has finished.
- This task will also only operate on tagged commits, which is handy if you're doing versioned releases of software.
- Once all of the scripts have been executed, all of the files in the public/ directory will be packaged and uploaded as artifacts and stored for up to a week:

```
package_upload:
  stage: package
  script:
    - composer install
    - npm install
    - webpack
  cache:
    key: composer
    paths:
      -vendor/
    policy: pull
  artifacts:
    paths:
      - public/
    expire_in: 1 week
    only:
      - tags
```

Deconstructing an advanced .gitlab-ci.yml file

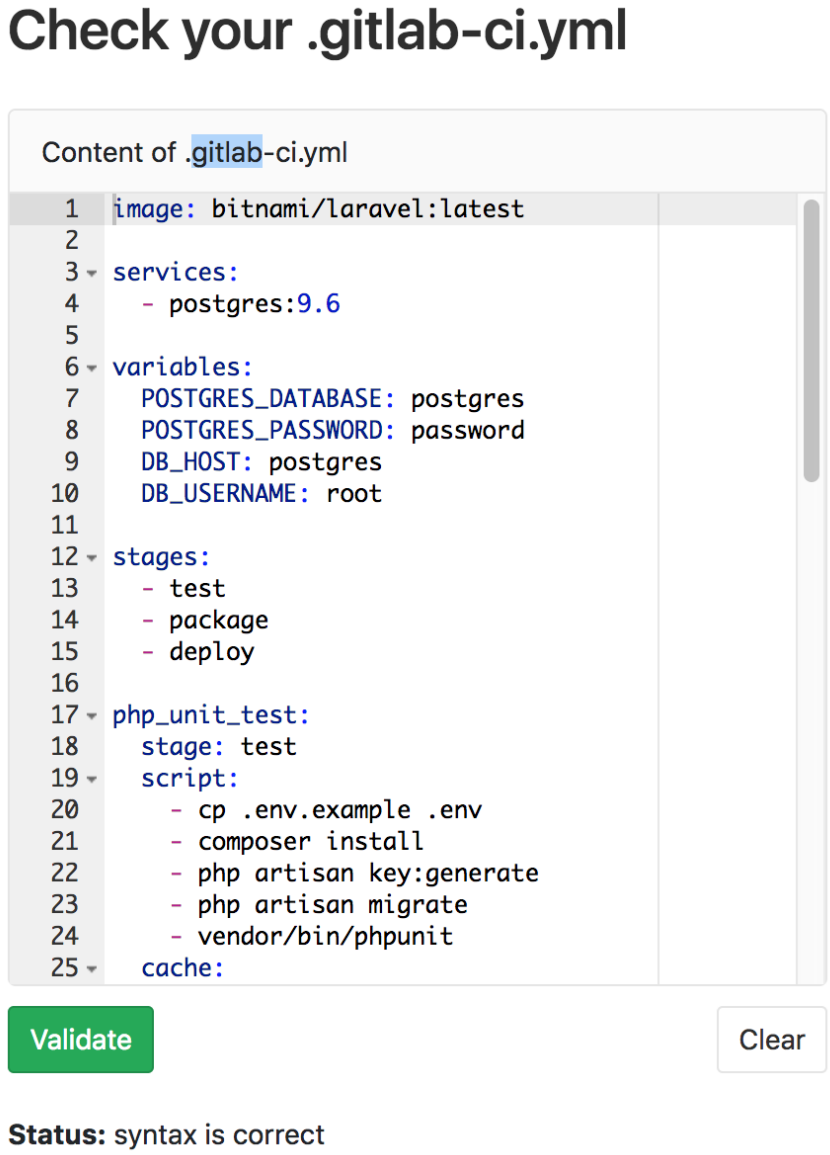
```
deploy_production:
  stage: deploy
  script:
    - composer install
    - npm install
    - webpack
    - .composer/vendor/bin/envoy run deploy
  environment:
    name: production
    url: http://192.168.0.1
  when: manual
  only:
    - master
```

GitLab CI/CD web UI



GitLab CI/CD web UI

- The output of a linted .gitlab-ci.yml file looks like this:



GitLab CI/CD web UI

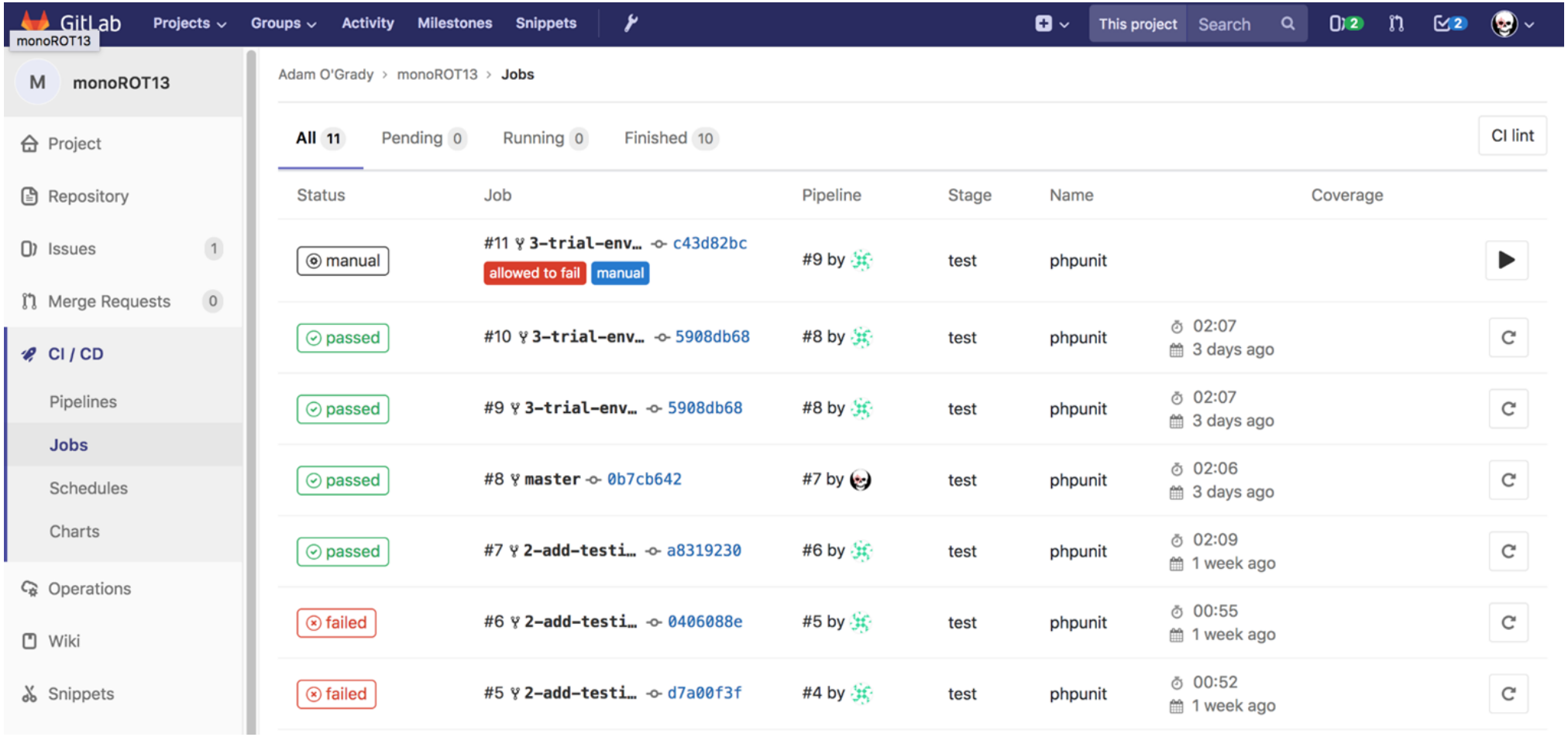
- If the syntax passes its validation, you'll be shown the preceding message, as well as a table (visible in the following screenshot) that breaks down the keys and values provided in the script. You can use these to sanity check your work:

Parameter	Value

Test Job - php_unit_test	`cp .env.example .env`
	`composer install`
	`php artisan key:generate`
	`php artisan migrate`
	`vendor/bin/phpunit`
	
	Tag list:
	Only policy:
	Except policy:
	Environment:
	When: on_success

Test Job - js_unit_test	`npm install`
	`npm run test`
	
	Tag list:
	Only policy:
	Except policy:
	Environment:
	When: on_success

GitLab CI/CD web UI



GitLab CI/CD web UI

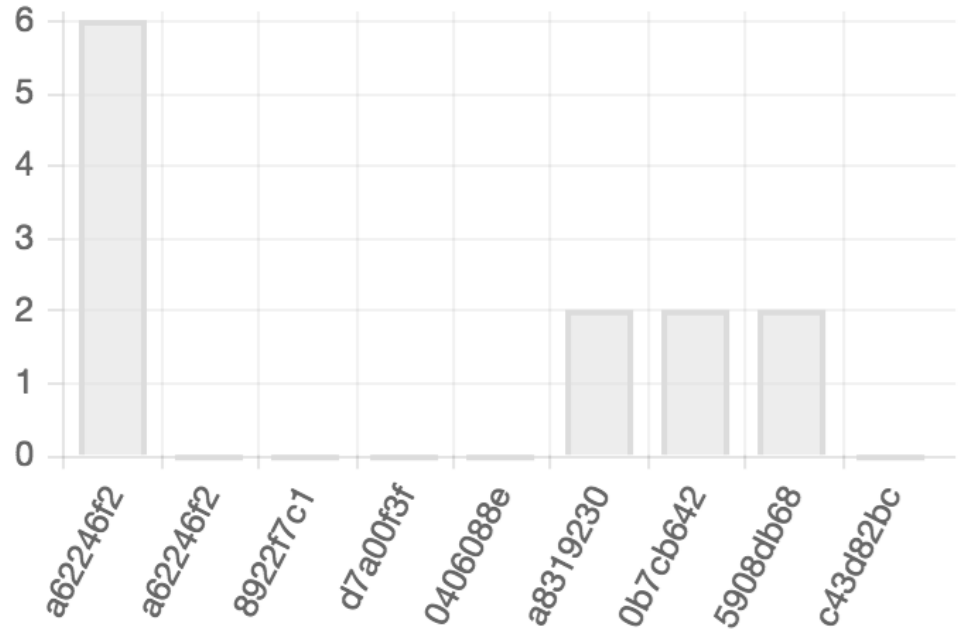
- From the menu on the left, under CI/CD, you can click Charts to get some graphical information about the CI/CD process attached to this project:

A collection of graphs regarding Continuous Integration

Overall statistics

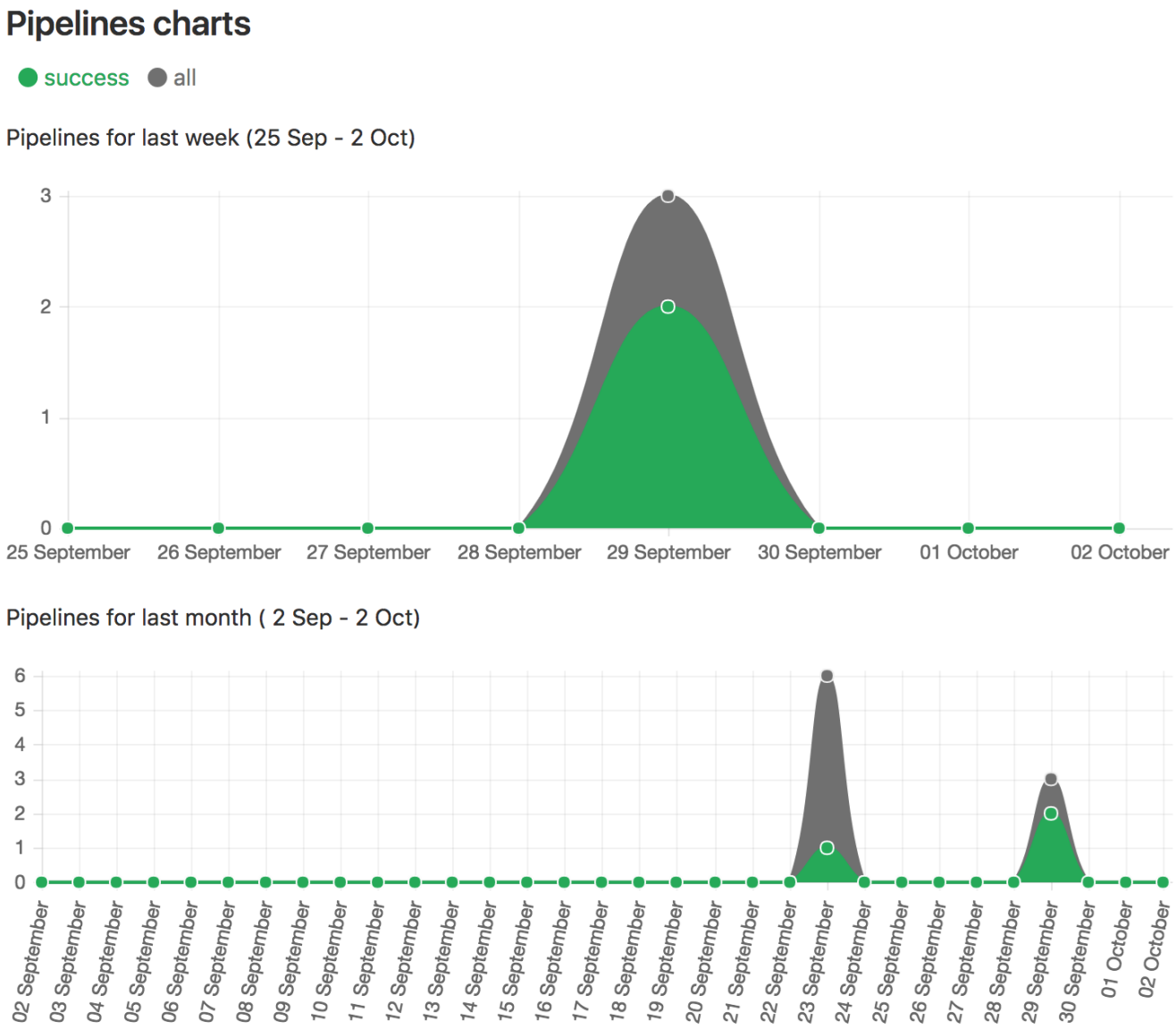
- Total: **9 pipelines**
- Successful: **3 pipelines**
- Failed: **4 pipelines**
- Success ratio: **42%**

Commit duration in minutes for last 30 commits

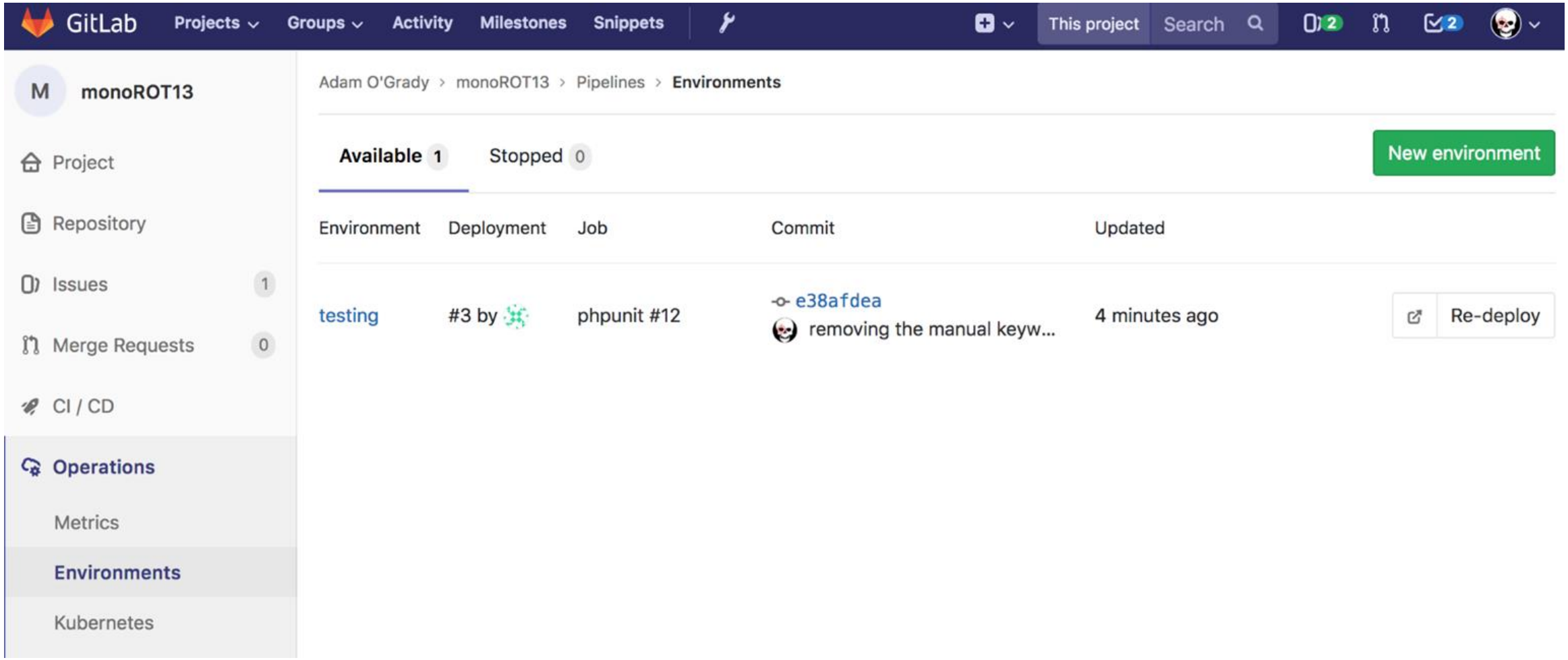


GitLab CI/CD web UI

- Next up, we have charts showing the breakdown of pipelines over the past week, month, and year:



GitLab CI/CD web UI



Summary

- By now, you should have a firm grip on the basics of continuous integration and continuous delivery, as done by GitLab.
- We started out in this lesson by exploring the concept of CI/CD and giving you a crash course in it.
- Next up, we ran through the process of installing a GitLab Runner, Don't forget that the Runner is the platform where your CI/CD stages are actually executed; you can have many of them per project or per GitLab installation to help parallelize the work.
- We looked at their installation on Ubuntu and CentOS, and manually installing one via a binary.

"Complete Lab 10 & 11"

The scope of runners ALL TIERS

Runners are available based on who you want to have access:

- Shared runners are available to all groups and projects in a GitLab instance.
- Group runners are available to all projects and subgroups in a group.
- Project runners are associated with specific projects. Typically, project runners are used by one project at a time.

Shared runners

- Shared runners are available to every project in a GitLab instance.
- Use shared runners when you have multiple jobs with similar requirements. Rather than having multiple runners idling for many projects, you can have a few runners that handle multiple projects.

If you are using a self-managed instance of GitLab:

- Your administrator can install and register shared runners by going to your project's Settings > CI/CD, expanding Runners, and selecting Show runner installation instructions, These instructions are also available in the documentation.

Enable shared runners for a project

For existing projects, an administrator must install and register them.

To enable shared runners for a project:

- On the top bar, select Main menu > Projects and find your project.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- Turn on the Enable shared runners for this project toggle.

Enable shared runners for a group

To enable shared runners for a group:

- On the top bar, select Main menu > Groups and find your group.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- Turn on the Enable shared runners for this group toggle.

Disable shared runners for a project

To disable shared runners for a project:

- On the top bar, select Main menu > Projects and find your project.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- In the Shared runners area, turn off the Enable shared runners for this project toggle.

Shared runners are automatically disabled for a project:

- If the shared runners setting for the parent group is disabled, and
- If overriding this setting is not permitted at the project level.

Disable shared runners for a group

To disable shared runners for a group:

- On the top bar, select Main menu > Groups and find your group.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- Turn off the Enable shared runners for this group toggle.
- Optional. To allow shared runners to be enabled for individual projects or subgroups, select Allow projects and subgroups to override the group setting.

How shared runners pick jobs

- Shared runners process jobs by using a fair usage queue. This queue prevents projects from creating hundreds of jobs and using all available shared runner resources.
- The fair usage queue algorithm assigns jobs based on the projects that have the fewest number of jobs already running on shared runners.
- For example, if these jobs are in the queue:

Job 1 for Project 1
Job 2 for Project 1
Job 3 for Project 1
Job 4 for Project 2
Job 5 for Project 2
Job 6 for Project 3

Group runners

- Use group runners when you want all projects in a group to have access to a set of runners.
- Group runners process jobs by using a first in, first out (FIFO) queue.

Create a group runner

- You can create a group runner for your self-managed GitLab instance or for GitLab.com. You must have the Owner role for the group.

To create a group runner:

- Install GitLab Runner.
- On the top bar, select Main menu > Groups and find your group.
- On the left sidebar, select CI/CD > Runners.
- In the upper-right corner, select Register a group runner.
- Select Show runner installation and registration instructions. These instructions include the token, URL, and a command to register a runner.

Project runners

Use project runners when you want to use runners for specific projects. For example, when you have:

- Jobs with specific requirements, like a deploy job that requires credentials.
- Projects with a lot of CI activity that can benefit from being separate from other runners.

You can set up a project runner to be used by multiple projects. Project runners must be enabled for each project explicitly.

- Project runners process jobs by using a first in, first out (FIFO) queue.

Create a project runner

To create a project runner:

- Install GitLab Runner.
- On the top bar, select Main menu > Projects and find the project where you want to use the runner.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- In the Project runners section, note the URL and token.
- Register the runner.
- The runner is now enabled for the project

Enable a project runner for a different project

After a project runner is created, you can enable it for other projects.

- Prerequisites: You must have at least the Maintainer role for:

- The project where the runner is already enabled.
- The project where you want to enable the runner.
- The project runner must not be locked

Prevent a project runner from being enabled for other projects

To lock or unlock a project runner:

- On the top bar, select Main menu > Projects and find the project where you want to enable the runner.
- On the left sidebar, select Settings > CI/CD.
- Expand Runners.
- Find the project runner you want to lock or unlock. Make sure it’s enabled. You cannot lock shared or group runners.
- Select Edit ().
- Select the Lock to current projects checkbox.
- Select Save changes.

Executors ALL TIERS

To jump into the specific documentation for each executor, visit:

- SSH
- Shell
- Parallels
- VirtualBox
- Docker
- Docker Machine (auto-scaling)
- Kubernetes
- Custom

Prerequisites for non-Docker executors

- Executors that do not rely on a helper image require a Git installation on the target machine and in the PATH.
- Always use the latest available version of Git.
- GitLab Runner uses the git lfs command if Git LFS is installed on the target machine.
- Ensure Git LFS is up to date on any systems where GitLab Runner uses these executors.

Selecting the executor

Executor	SSH	Shell	VirtualBox	Parallels	Docker	Kubernetes	Custom
Clean build environment for every build	×	×	✓	✓	✓	✓	conditional (4)
Reuse previous clone if it exists	✓	✓	×	×	✓	×	conditional (4)
Runner file system access protected (5)	✓	×	✓	✓	✓	✓	conditional
Migrate runner machine	×	×	partial	partial	✓	✓	✓
Zero-configuration support for concurrent builds	×	× (1)	✓	✓	✓	✓	conditional (4)
Complicated build environments	×	× (2)	✓ (3)	✓ (3)	✓	✓	✓
Debugging build problems	easy	easy	hard	hard	medium	medium	medium

Compatibility chart

- Supported features by different executors:

Executor	SSH	Shell	VirtualBox	Parallels	Docker	Kubernetes	Custom
Secure Variables	✓	✓	✓	✓	✓	✓	✓
GitLab Runner Exec command	×	✓	×	×	✓	✓	✓
`.gitlab-ci.yml`: image	×	×	✓ (1)	✓ (1)	✓	✓	✓ (via `$CUSTOM_ENV_CI_JOB_IMAGE`)
`.gitlab-ci.yml`: services	×	×	×	×	✓	✓	✓
`.gitlab-ci.yml`: cache	✓	✓	✓	✓	✓	✓	✓
`.gitlab-ci.yml`: artifacts	✓	✓	✓	✓	✓	✓	✓
Passing artifacts between stages	✓	✓	✓	✓	✓	✓	✓
Use GitLab Container Registry private images	n/a	n/a	n/a	n/a	✓	✓	n/a
Interactive Web terminal	×	✓ (UNIX)	×	×	✓	✓	×

Compatibility chart

- Supported systems by different shells:

Shells	Bash	PowerShell Desktop	PowerShell Core	Windows Batch (deprecated)
Windows	× (4)	✓ (3)	✓	✓ (2)
Linux	✓ (1)	×	✓	×
macOS	✓ (1)	×	✓	×
FreeBSD	✓ (1)	×	×	×

Compatibility chart

- Supported systems for interactive web terminals by different shells:

Shells	Bash	PowerShell Desktop	PowerShell Core	Windows Batch (deprecated)
Windows	×	×	×	×
Linux	✓	×	×	×
macOS	✓	×	×	×
FreeBSD	✓	×	×	×

Plan and operate a fleet of shared runners

When you host a fleet of shared runners, you need a well-planned infrastructure that takes into consideration your:

- Computing capacity.
- Storage capacity.
- Network bandwidth and throughput.
- Type of jobs (including programming language, OS platform, and dependent libraries).
- Use this guide to develop a GitLab Runner deployment strategy based on your organization’s requirements.

Consider your workload and environment

Before you deploy runners, consider your workload and environment requirements.

- Create a list of the teams that you plan to onboard to GitLab.
- Catalog the programming languages, web frameworks, and libraries in use at your organization. For example, GoLang, C++, PHP, Java, Python, JavaScript, React, Node.js.
- Estimate the number of CI/CD jobs each team may execute per hour, per day.
- Validate if any team has build environment requirements that cannot be addressed by using containers.

Workers, executors, and autoscaling capabilities

- The gitlab-runner executable runs your CI/CD jobs.
- Each runner is an isolated process that picks up requests for job executions and deals with them according to pre-defined configurations.
- As an isolated process, each runner can create “sub-processes” (also called “workers”) to run jobs.

Basic configuration: one runner, one worker

- After the installation is complete, you execute the runner registration command just once and you select the shell executor.
- Then you edit the runner config.toml file to set concurrency to 1.

```
concurrent = 1

[[runners]]
  name = "instance-level-runner-001"
  url = ""
  token = ""
  executor = "shell"
```

Intermediate configuration: one runner, multiple workers

- You can also register multiple runner workers on the same machine.
- When you do this, the runner's config.toml file has multiple [[runners]] sections in it.
- If all of the additional runner workers are registered to use the shell executor, and you update the value of the global configuration option, concurrent, to 3, the upper limit of jobs that can run concurrently on this host is equal to three.

```
concurrent = 3

[[runners]]
  name = "instance_level_shell_001"
  url = ""
  token = ""
  executor = "shell"

[[runners]]
  name = "instance_level_shell_002"
  url = ""
  token = ""
  executor = "shell"

[[runners]]
  name = "instance_level_shell_003"
  url = ""
  token = ""
  executor = "shell"
```

"Complete Lab 12 & 13"

12. Advanced Infrastructure Management with Terraform

How to manage CockroachDB as Code with Terraform

How to deploy CockroachDB Dedicated with Terraform

List of required prerequisites:

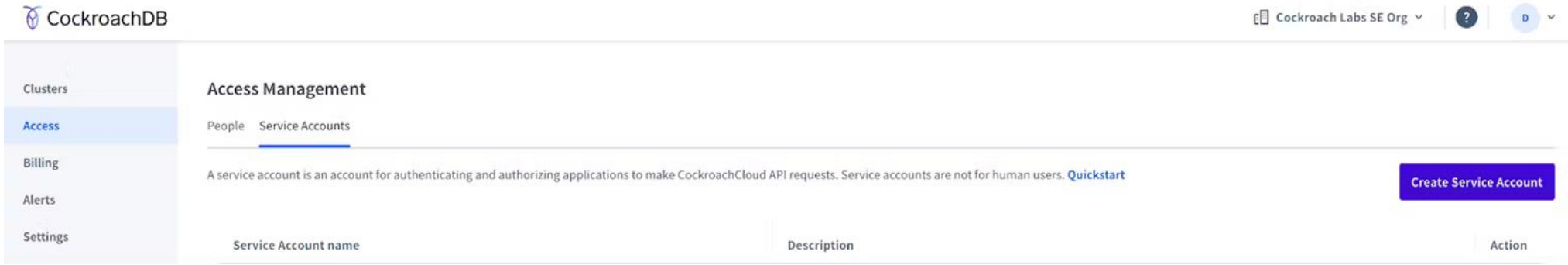
- **Git CLI**
- **Terraform (=>1.3.1)**
- **Cockroach Cloud API Key**

Step 1: Clone the git repository

- git clone https://github.com/cockroachlabs-field/cockroachdb-terraform-dedicated-july2023-example.git

Step 2: Grab your API key

Before we get into the Terraform code, and the resources it creates, we need to add the Cockroach API key as a local environment variable. You can create one of these in the Cockroach Cloud UI by adding a service account, which then allows you to generate a key associated with it.



Once a service account is created and an API key is generated we export that into our environment for Terraform to use.

- **export COCKROACH_API_KEY=<YOUR_API_KEY>**

Step 3: Prepare your variables

- The new CockroachDB Cloud Terraform provider requires the presence of the environment variable to be able to create the required resources within the cloud platform. Now let’s take a closer look at the Terraform code itself.

```
cluster_name = "dsmbcrdbtftexample2"
sql_user_name = "mbds"
sql_user_password ="ThisIsASuperSafePassword"
cloud_provider = "AWS"
cloud_provider_region = ["eu-west-2"]
cluster_nodes = "3"
storage_gib = "150"
machine_type = "m6i.xlarge"
region = "eu-west-2"
datadog_site = "US1"
datadog_api_key = "redacted"
```

Step 4: Connection String and Certificate

- This is followed by the location of the certificate required to communicate with the cluster. There is an example below.

'postgresql://<user>@<cluster-name>-<short-id>.<region>.<host>:26257/<database>?sslmode=verify-full&sslrootcert='$HOME'/Library/CockroachCloud/certs/<cluster-name>-ca.crt'

- To retrieve this information with Terraform you need to create a data resource in your terraform code to retrieve it. Below is an example on how to do this.

```
data "cockroach_connection_string" "cockroach" {
  id       = cockroach_cluster.cockroach.id
  sql_user = cockroach_sql_user.cockroach.name
  database = cockroach_cluster.cockroach.id
}
```

- With this, you can then create an output in your output.tf file to display the connection string when the terraform runs, or output to a variable to use elsewhere. Below is an example of outputting the connection string

```
output "connection_string" {
    value = module.cockroach-dedicated.connection_string
}
```

- Alongside the connection string, in order to connect to your cluster, you'll also need to output the cluster certificate, you can output this as a file within the terraform with the code snippet below.

```
resource "local_file" "cluster_cert" {
  filename = "${path.root}/cert.pem"
  content = data.cockroach_cluster_cert.cockroach.cert
}
```

- If required you can also output this as a variable or text output using the output snippet below:

```
output "cert" {
  value = data.cockroach_cluster_cert.cockroach.cert
}
```

Step 5: Customer Managed Encryption Keys (CMEK)

Customer-Managed Encryption Keys (CMEK) allow you to protect data at rest in a CockroachDB Dedicated advanced private cluster using a cryptographic key that is entirely within your control, hosted in a supported cloud provider key-management system (KMS). This key is called the CMEK key.

You can manage your CMEK keys using one or more of the following services:

- Amazon Web Services (AWS) KMS
- Google Cloud Platform (GCP) KMS

Step 6: Maintenance Windows

- Within Cockroach Cloud you can view and manage the patch upgrade window for your cluster.
- To help keep your clusters updated while minimizing disruption and downtime, set a window of time when your cluster is experiencing the lowest traffic.
- You are also able to configure this using Terraform.

```
resource "cockroach_maintenance_window" "example" {
  id              = cockroach_cluster.cockroach.id
  offset_duration = var.offset_duration
  window_duration = var.window_duration
}
```

Step 7: Operations with Datadog

- Cockroach Cloud allows for the export of metrics to external monitoring tools like Datadog.
- By doing this you can collate metrics for other sources to give you an end to end view of the service you are trying to deliver.
- This is critical in maintaining your prescribed SLA to your customers, whoever that may be.
- This could be external users of the platform or an internal system where the customers are internal members of staff. To configure and manage metrics export for your CockroachDB Dedicated cluster, use the metricexport endpoint for Datadog.
- Access to the metricexport endpoints requires a valid CockroachDB Cloud service account with the appropriate permissions (admin privilege or Cluster Admin role). To configure this using Terraform use the following code example to help.

```
resource "cockroach_metric_export_datadog_config" "example" {
  id      = cockroach_cluster.cockroach.id
  site    = var.datadog_site
  api_key = var.datadog_api_key
}
```

Step 8: Initialize your Terraform

- To prepare our directory containing the terraform code we have just cloned from the GitHub repository we must run terraform init.
- By running this command it prepares our directory with all the required components that are defined in our code.
- For example downloading any Terraform providers or modules that are externally hosted. In this blog that will be the CockroachDB Cloud provider.

terraform init

Step 9: Check your planned outcome

Now we are able to move to the next stage which is to run a terraform plan. The terraform plan command creates an execution plan, which lets you preview the changes that Terraform plans to make to your infrastructure. When Terraform creates a plan it:

- Reads the current state of any already-existing remote objects to make sure that the Terraform state is up-to-date.
- Compares the current configuration to the prior state and notes any differences.
- Proposes a set of change actions that should, if applied, make the remote objects match the configuration.

terraform plan

Step 10: Deploy your infrastructure

- To build our cluster there is one final step to complete. Once we are happy with our terraform plan and the resources that it is going to create, then terraform apply can be executed.

- terraform apply -auto-approve

- This will create all the resources that are defined in the terraform code in the repository. It will now take a number of minutes as Terraform instructs the APIs of AWS and Cockroach Cloud.