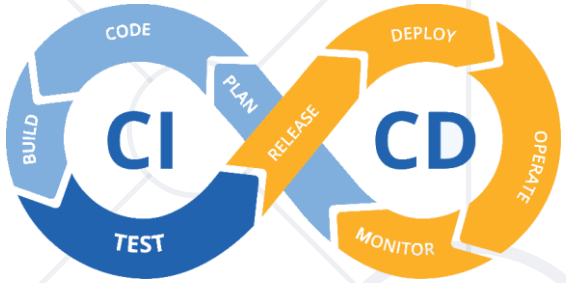
Continuous Integration, CI / CD Pipelines

Continuous Integration, Continuous Delivery, Continuous Deployment, GitHub Actions, YAML



SoftUni Team

Technical Trainers

Software University

SoftUni

Software University

https://softuni.bg

Have a Question?

Software University

sli.do

#Dev-Ops

Table of Contents

The CI/CD Pipelines

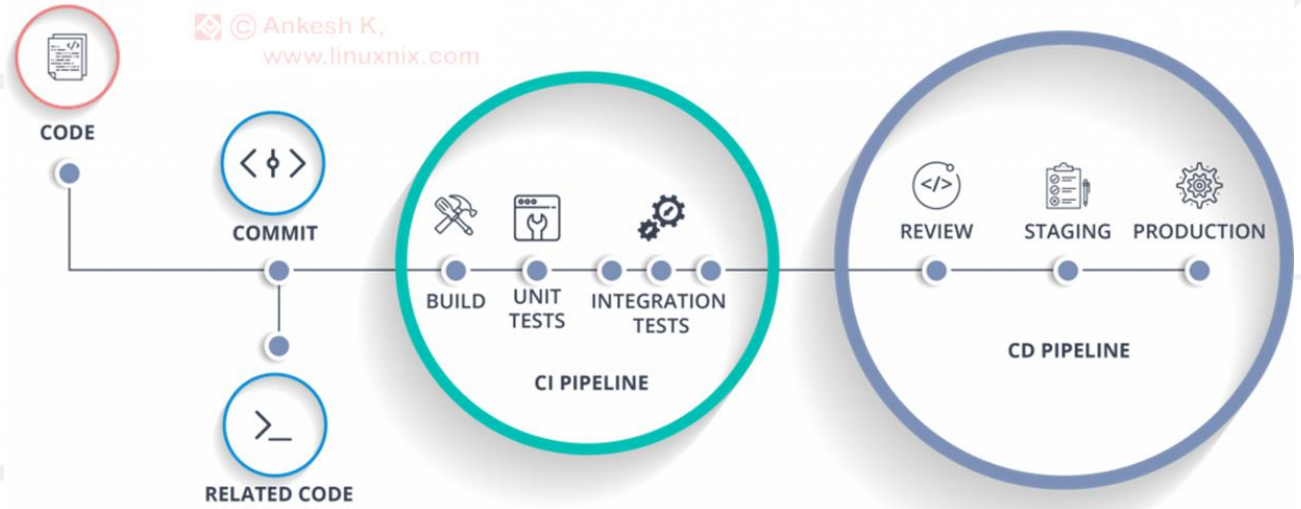
What is CI/CD?

- **CI/CD** = **Continuous Integration** + **Continuous Delivery**
  (+ **Continuous Deployment**)

- **Automates** much of the process to get new code from a **commit** into **production**
  - Developers **regularly** merge their code changes into a **central** repository, which is then **automatically tested** and **deployed** to **production** to ensure frequent and reliable software updates

CI/CD Overview

- **CI/CD pipeline**
  - Continuously **integrate** and **release** new features
- **Continuous integration** (**CI**)
  - Write code, test it and **integrate** it in the product
- **Continuous delivery** (**CD**)
  - Continuously **release** new features
- **QAs** monitor and sometimes maintain the CI/CD pipeline



Continuous Integration (CI)

- Integrating the code from different developers frequently (at least once a day)
- **Automated building** and **testing** the code
  - Typically, at **Git push** in certain branch
- **Finding integration problems** and bugs early
  - Continuously maintain software quality
- CI is implemented by a **CI system** (like Jenkins, GitHub Actions, TeamCity, Azure Pipelines)

Continuous Testing (CT)

- Regularly execute **automated tests** as part of the software delivery pipeline
  - Ensures consistent software quality
- Implemented with a **CI system**
  - **Unit tests** executed at each commit / push
  - **Integration tests** executed at each major commit / push
  - **End-to-end tests** executed every night (execution takes hours)

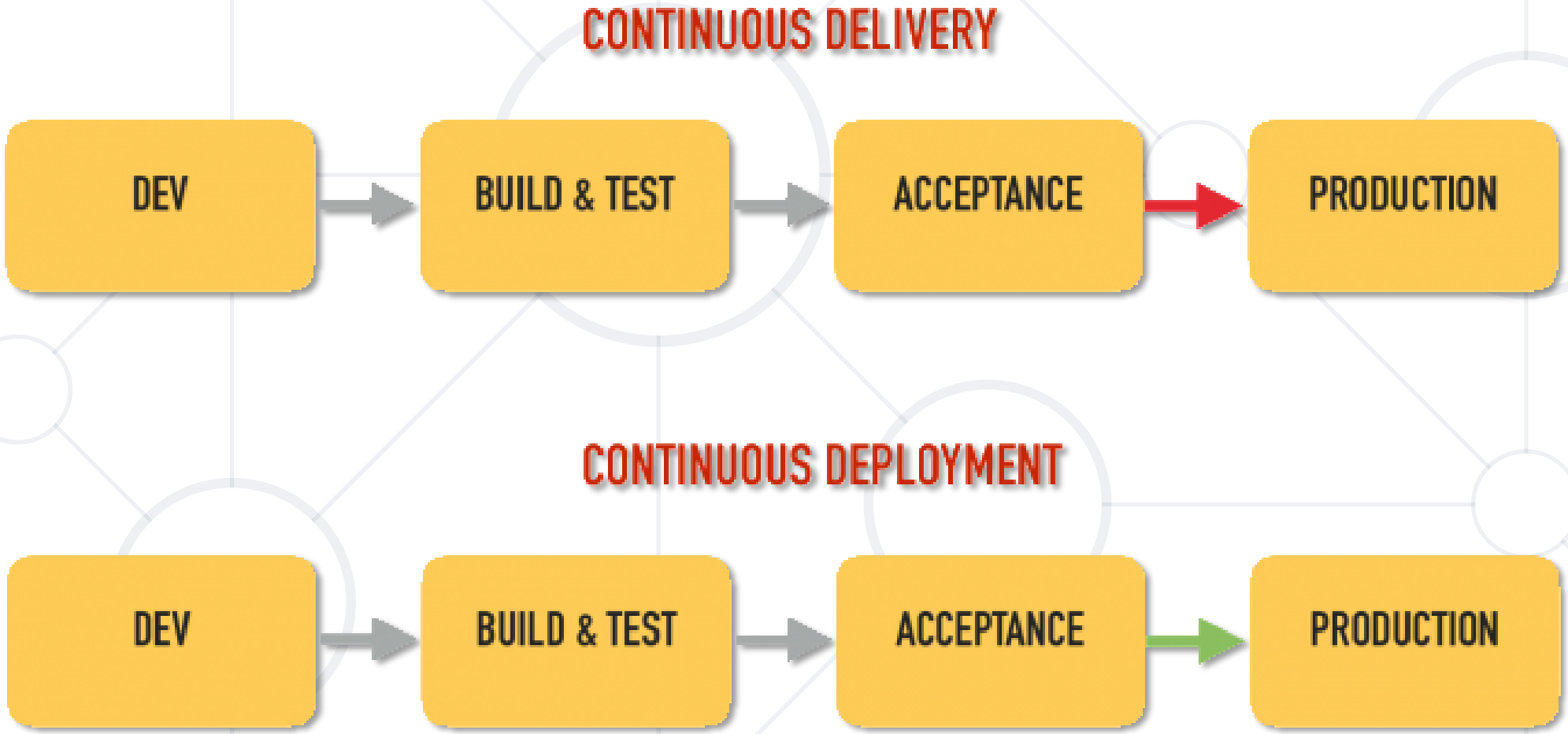
Continuous Delivery (CD)

- Keeping your codebase **deployable at any point**
- **CD** continuously verifies that
  - Software **builds** correctly
  - Passes the **automated tests**
  - Has all the necessary **configuration** and assets for **deployment in production**
- E.g., build an **.apk** package for Android apps

Continuous Deployment (CD)

- Continuous **automated deployment**
- E.g., after each **git push** in certain branch
  - The software is **built**, the **tests** are executed, and binaries are **deployed** and configured correctly
- Automated deployment typically uses a **testing environment**
  - Sometimes directly to the **production** servers
- Deployment should be done by script (not by hand)

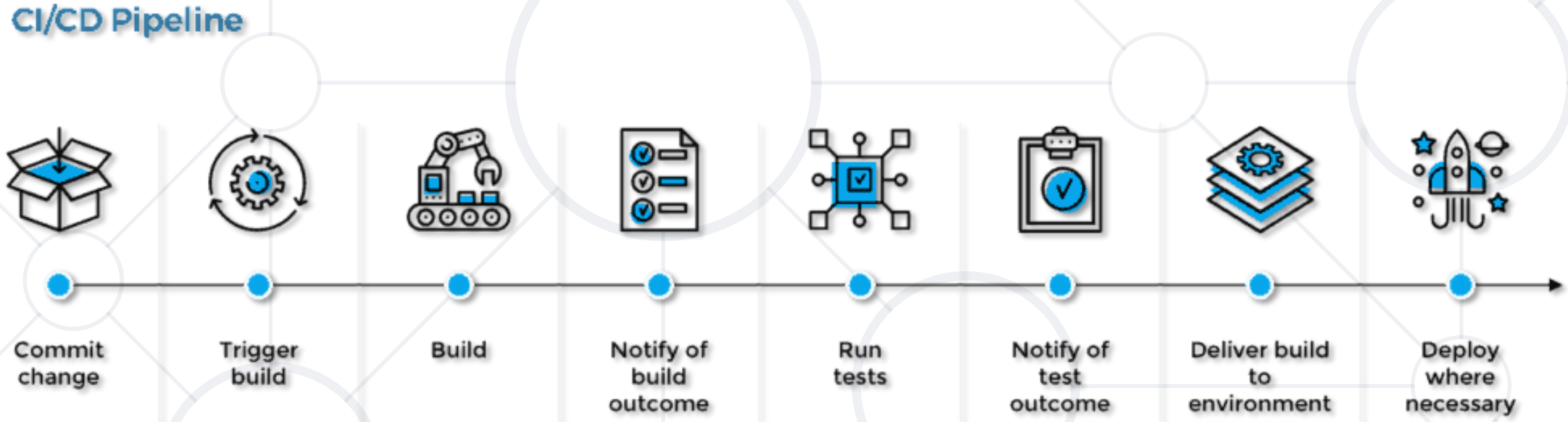
Continuous Delivery vs. Continuous Deployment



CI/CD Pipelines

- **CI/CD pipeline** == **CI** + **CD**
  - Continuously integrate, test and release new features
- On **git push**, the CI/CD pipeline does automatically
  - **Build** the software (compile, package, sign, etc.)
  - Run the **automated tests** (unit & integration)
  - **Deploy** in the testing environment & run E2E tests
    - Or only prepare for deployment
    - Or deploy directly on production

CI/CD Pipeline View



CI/CD & Software Development Environments

- **Development** environment
  - Code commit
- **Testing** environment
  - Continuous integration, automated testing
- **Staging** environment
  - Continuous delivery, user acceptance test
- **Production** environment
  - Continuous deployment, monitoring

CI/CD Principles

- A **single source repository**, which contains everything needed for the build
  - Source code, database structure, libraries, scripts, etc.
- **Frequent iterations and check-ins** to the main branch
  - Use small segments of code and merge them into the branch often
- **Automated** and **self-testing builds**

CI/CD Benefits

- Higher efficiency of web deployment
- Reduced risk of defects
- Faster product delivery
- Exclusive log generation
- Easier rollback of code changes
- More test liability
- Customer satisfaction

CI/CD Systems

Software University

CI → CI → CD → CD

Source Code Control

Automatically trigger CI/CD pipeline based on code check-in.

git

GitLab

GitHub

Build & Test Automation

Start automated build and test, including functional, security and performance tests.

Jenkins

GitLab

Selenium

docker

Maven

Release Automation

Update artifact repository with latest successful code artifacts or containers for record-keeping and accessibility.

JFrog Artifactory

docker

Nexus

Deploy to Staging & Production

Deploy applications to staging and migrate to production using either a blue/green or canary process.

Microsoft Azure

Amazon AWS

Google Cloud Platform

Physical

Virtual

openstack

CI/CD Tools

GitHub Actions

- GitHub Actions == powerful **CI/CD platform**
  - Integrated directly into GitHub repos
- Enables developers to **automate** workflows, build, test and code deployment
- Large **library** of pre-built actions and custom workflows
- Free for public repos + 2000 mins per month for private repos with the **free plan**

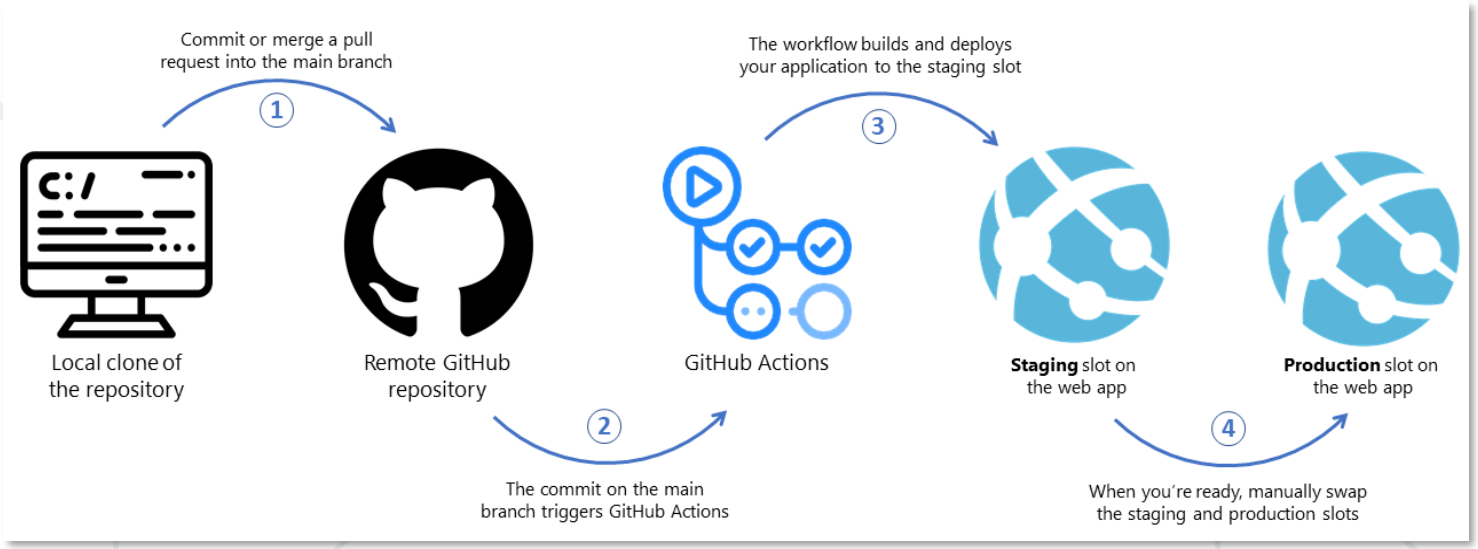
GitHub Actions

Software University

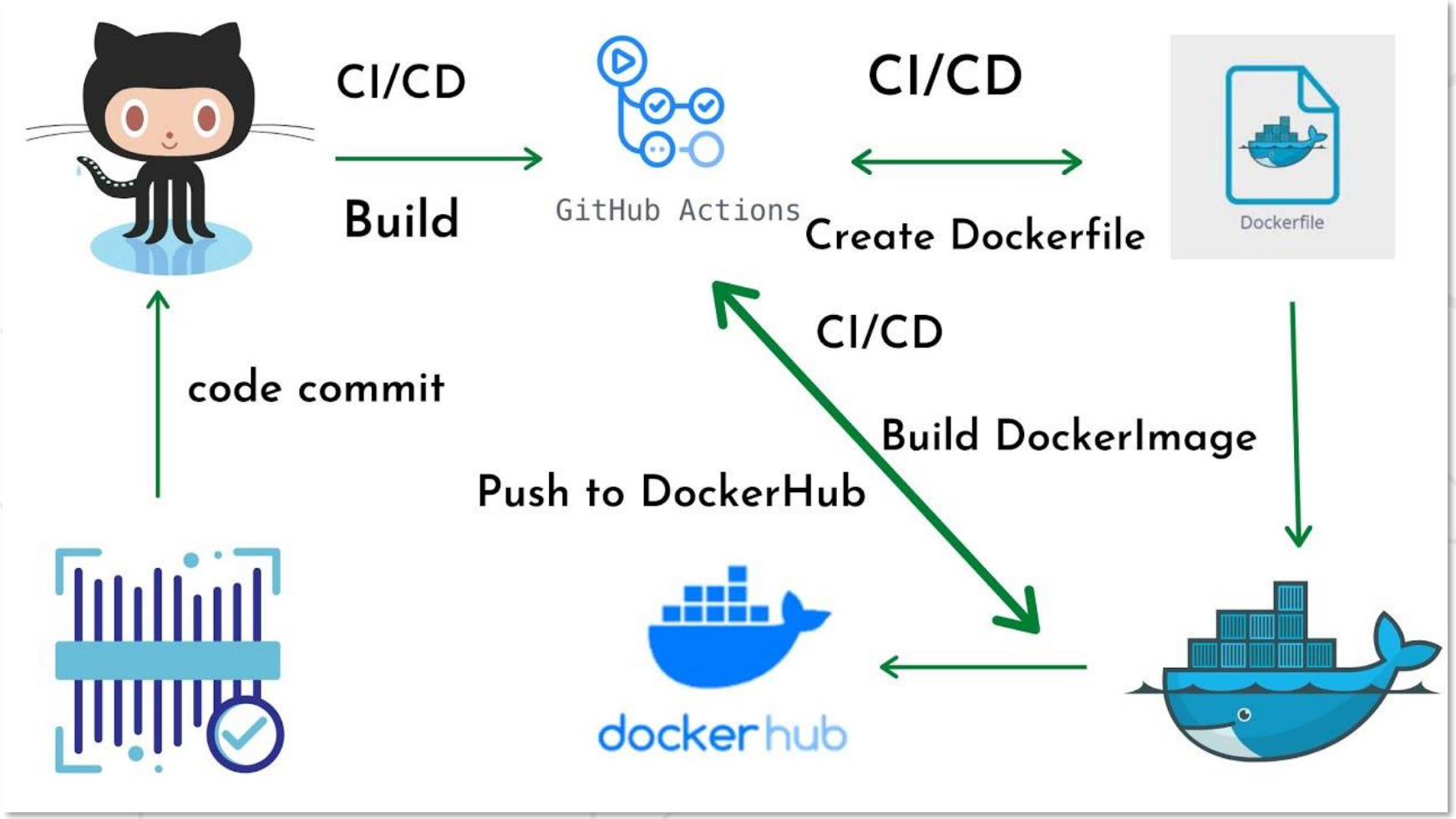
- Flexible environment
  - Supports **various** programming languages
- Allows developers to **trigger workflows**
  - Based on events like code commits, pull requests, issue updates
- Allows defining **custom** workflows
- YAML syntax

GitHub Actions and Other Platforms

- You can use it to integrate and deploy code changes to a **cloud application platform** and test, track, and manage these changes
- With **GitHub Actions for Azure**, you can deploy to Azure
- GitHub Actions also supports other **CI/CD tools**, **Docker**, and **automation platforms**



GitHub Actions and Other Platforms



CircleCI

Software University

- CircleCI == **CI/CD platform**
- Supports a wide range of programming languages
- Integrates with **version control systems**
  - e.g., GitHub and Bitbucket
- User-friendly configuration file
  - Allows custom workflows

Azure DevOps

- Azure DevOps == set of deployment tools that enables
  - Planning
  - Developing
  - Testing
  - Deployment
- Facilitates creation of CI/CD pipelines

Azure DevOps

Software University

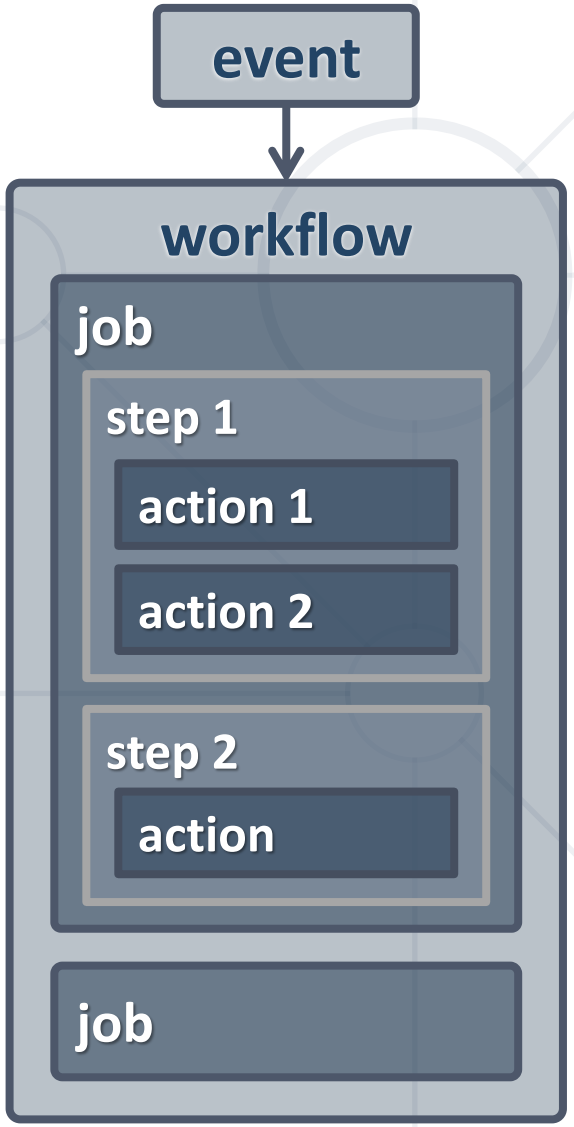
- Offers **services** for
  - Version control
  - Agile project management
  - CI/CD
  - Application monitoring
  - and many more…
- Supports **integration** with **version control systems**, e.g., Git
- Provides **code repository** for managing source code

GitHub Actions

Introduction

Concepts

- **Events** execute **workflows**
  (one or several jobs, running in parallel)
- **Workflows** hold **jobs**
  (e.g., build, check security, deploy)
- **Jobs** hold **steps** (e.g.. "checkout the code", "install .NET", "run tests", …)
- **Steps** hold **actions**
  (commands like `` `dotnet test` ``)



Events

- Specific **triggers** that can activate workflows in a repository
- Allow **automation** of various **tasks** and **actions** based on different types of events that occur in the within the repository
- Each event can be used to **start a workflow** that performs **specific action**, e.g.,
  - Running tests
  - Deploy code
  - Sending notifications

Events Types

- **Repository**
  - Specific to the repository and are triggered by actions like code pushes, pull requests, etc.
- **Workflow**
  - Related to the workflows themselves and are triggered by workflow-specific events
- **Webhook**
  - Triggered by external services integrated with GitHub using webhooks
- **External**
  - Specific to actions taken by external services
- **Internal**
  - Related to actions within the GitHub repository or organization

Workflow

- **GitHub Actions workflow** is a configurable automated procedure
- Made of one or many **jobs**
- Defined by a **YAML file** in **.github/workflows** folder in your repo
- Can be triggered by **events** in the repo, on **schedule** or **manually**

.github > workflows > my-workflow.yaml

```yaml
name: learn-github-actions
on: [push]
jobs:
  check-bats-version:
    runs-on: ubuntu-latest
    steps:
      - name: Check out repository ···
      - name: Install Node.js ···
      - name: Install bats ···
      - name: Run bats ···
```

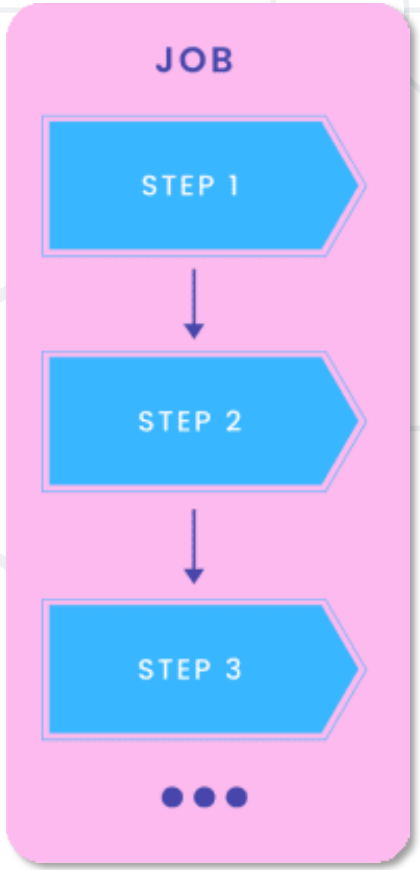
- A **GitHub repository** can have **multiple workflows**

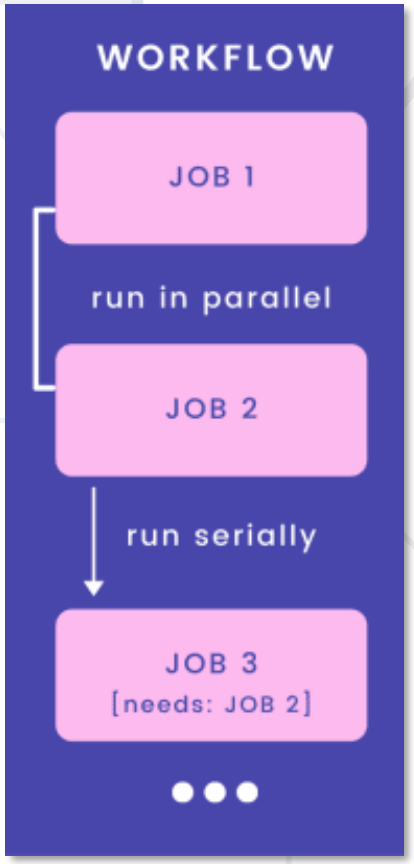
Jobs

- **Job** == a **set of steps** that will be executed on **the same runner**
- All **jobs in the workflow** normally run in **parallel**
- When you have **jobs that depend on each other**, they run **serially**

.github > workflows > my-workflow.yaml

```yaml
name: learn-github-actions
on: [push]
jobs:
  check-bats-version:
    runs-on: ubuntu-latest
    steps:
      - name: Check out repository ···
      - name: Install Node.js ···
      - name: Install bats ···
      - name: Run bats ···
```

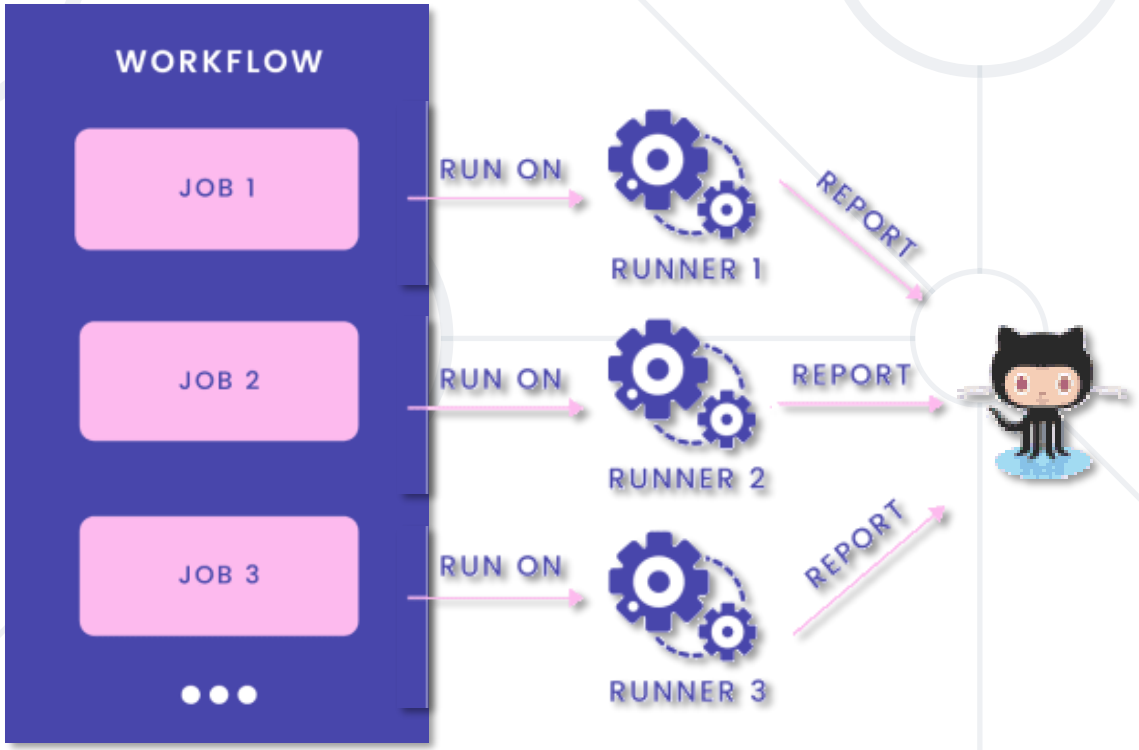




Runners

- To **run jobs**, we must specify a **runner** for each of them
- A **runner** is a **server that runs jobs**
- Runs only **1 job at a time**
- Reports **job progress**, **logs**, and **results** back to GitHub
  - We can look at them in the UI of the repository
- Two types: **GitHub hosted** or **self-hosted**

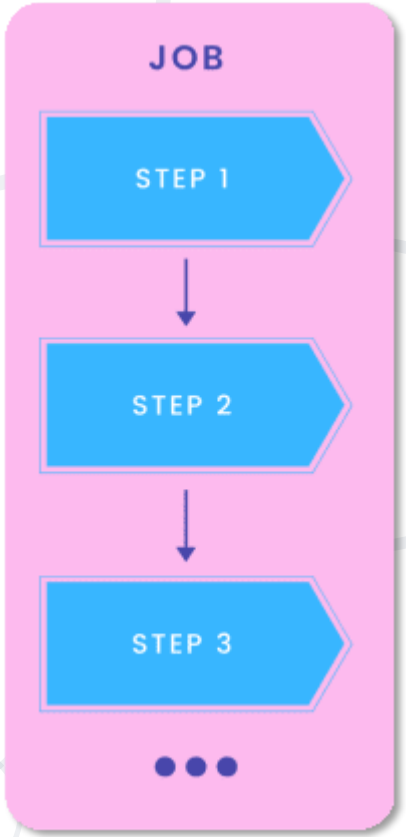
```
3   jobs:
4     check-bats-version:
5       runs-on: ubuntu-latest
```

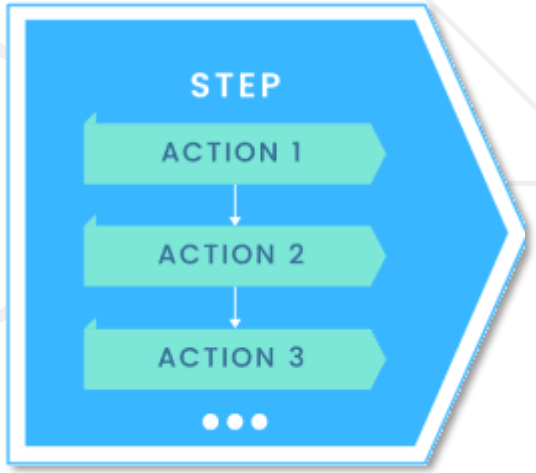


Steps and Actions

- **Steps** are **individual tasks** within a **job**
- They run serially, one after another
- Each **step** is either a **shell script** that will be executed, or an **action** that will be run
- An **action** is basically a **standalone command**
- **Actions** run serially within a step
- **Actions** can be reused

```
3   jobs:
4     check-bats-version:
5       runs-on: ubuntu-latest
6       steps:
7         - name: Check out repository
8           uses: actions/checkout@v3
9 >       - name: Install Node.js ···
13 >      - name: Install bats ···
15 >      - name: Run bats ···
```





Workflow Syntax Keywords

- **name**
  - For **names** of workflows, steps, which GitHub Action displays
- **on**
  - Used to define which events can cause the workflow to run (**triggers**)
- **jobs**
  - Used to **list jobs**
- **runs-on**
  - Specify **runner environment**

.github > workflows > my-workflow.yaml

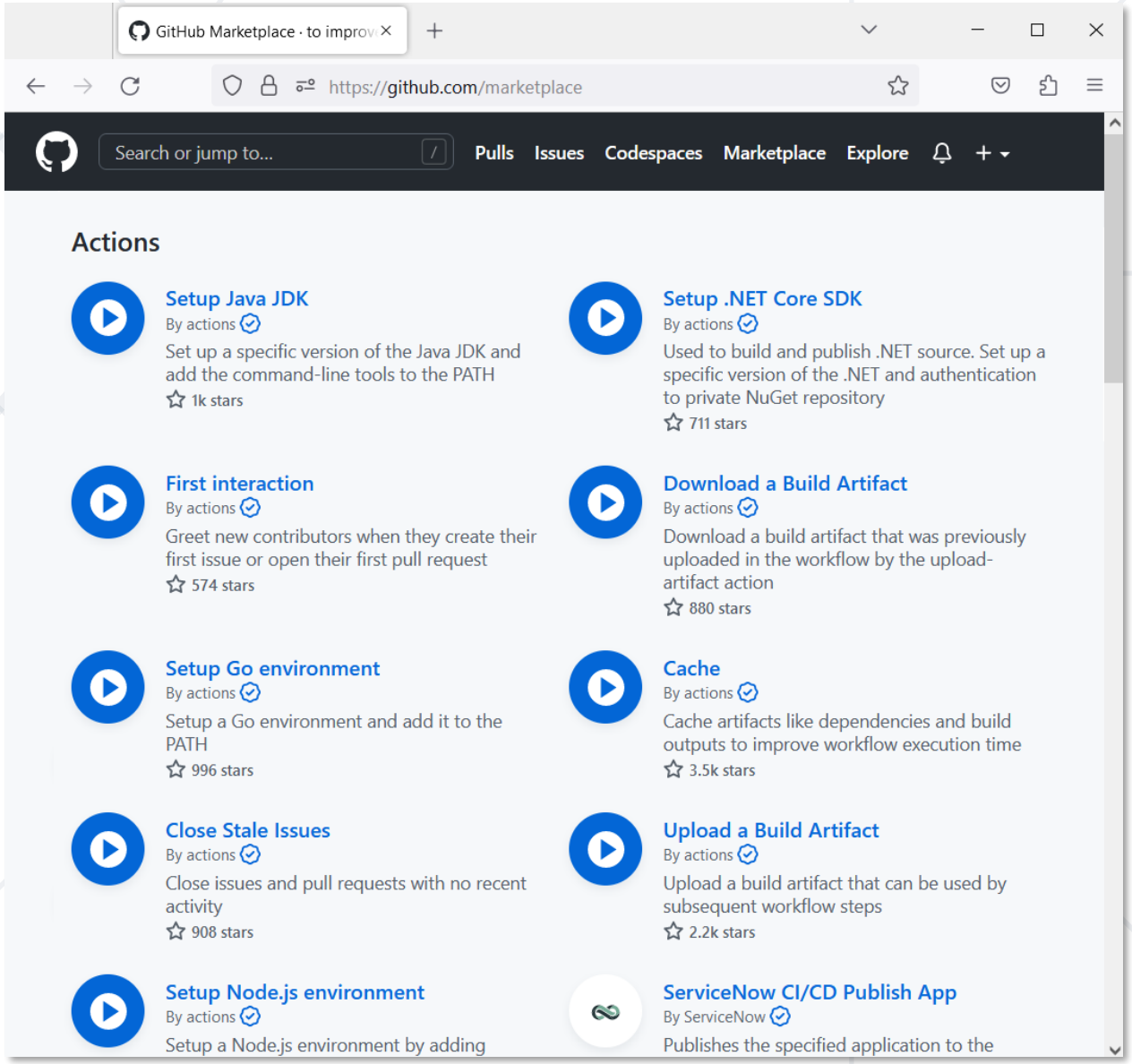
```yaml
name: learn-github-actions
on: [push]
jobs:
  check-bats-version:
    runs-on: ubuntu-latest
    steps:
      - name: Check out repository
        uses: actions/checkout@v3
      - name: Install Node.js
        uses: actions/setup-node@v3
        with:
          node-version: '14'
      - name: Install bats
        run: npm install -g bats
      - name: Run bats
        run: bats -v
```

Workflow Syntax Keywords

- `steps`
  - Used to **list steps** to run in the job
- `uses`
  - **Use an action** which is already defined with its version (v3)
- `with`
  - **Input parameters** required by some actions
- `run`
  - Tells the job to **execute a Shell command** on the runner

GitHub Marketplace

- GitHub Marketplace contains tools that add functionality and improve your workflow
- You can discover, browse, and install tools, including **GitHub Actions**
- GitHub uses it to suggest you **workflow templates** based on code in your repo



YAML

Definition and Syntax

YAML

- YAML (**Y**AML **A**in't **M**arkup **L**anguage)
  - Originally – **Y**et **A**nother **M**arkup **L**anguage
  - Human-readable data serialization **standard**
  - Focused on clear **data serialization**
- Widespread adoption
  - Common in configuration and system management
  - Favored in DevOps for complex systems
  - Principal format for deployment and setup

YAML Syntax

- **Indentation**
  - **Spaces** are used to denote structure
  - **Tabs** are not allowed
- **Key-Value Pairs**
  - The basic structure of YAML is **map** of **key-value** pairs
  - Separated by colons (**:**)
- **Lists**
  - Represented by a **dash**, followed by a **space** (**-**)
- **Comments** (**#**)
  - Used to add comments within YAML files

Advanced Structures

- **Nested Structures**
  - Consist of maps and lists

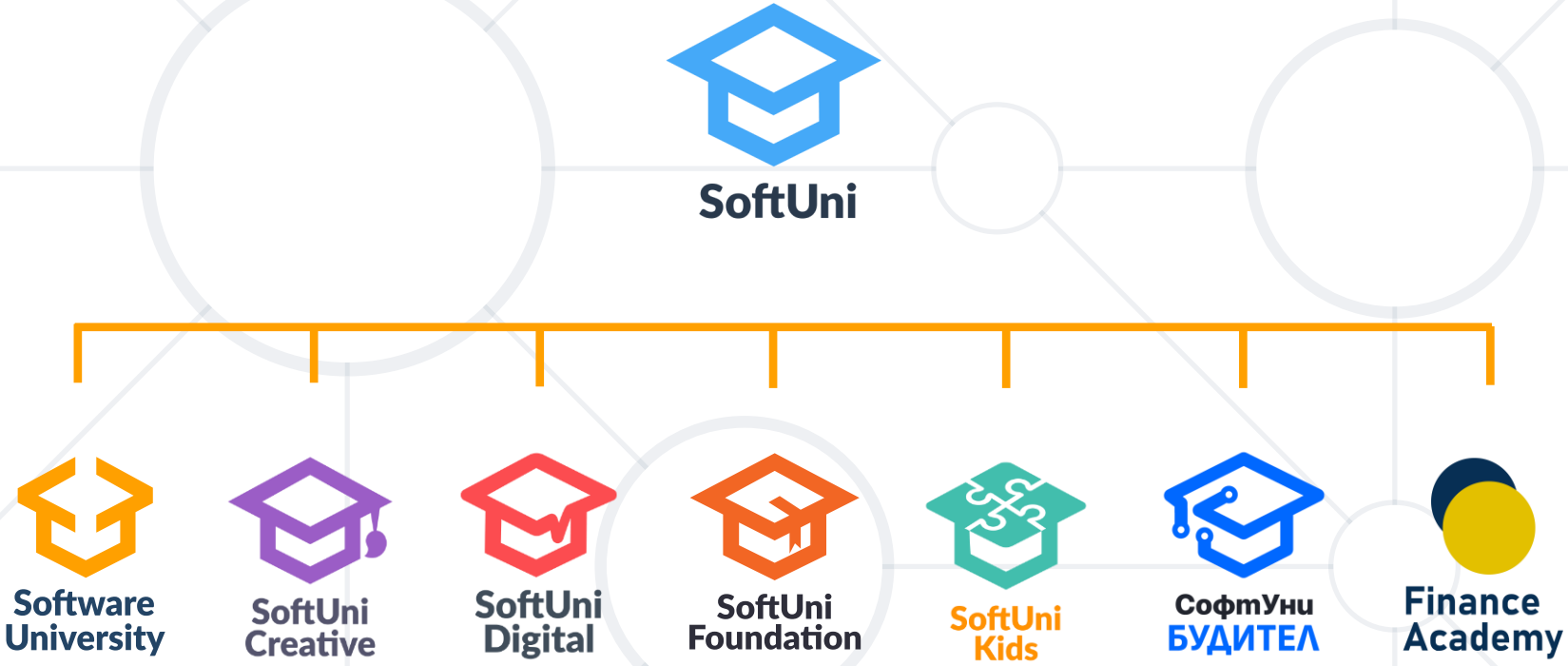
```
parentKey:
  childKey: value
  childList:
    - Item 1
    - Item 2
```

- **Scalars**
  - Strings, numbers and Booleans
    - No need of **quotes around strings** unless the string contains special characters

Summary

- **CI/CD** == a method to **frequently deliver apps** by introducing **automation** into **continuous delivery** and **continuous deployment**
- There are a lot of **CI/CD platforms**
  - **GitHub Actions,** in which you can create **workflows** to **automate** your **build**, **test** and **deployment pipeline,** using **YAML**

Questions?



SoftUni Diamond Partners

Software University

SmartIT

Coca-Cola HBC Bulgaria

SUPER HOSTING .BG

createX

Postbank

top EMPLOYER България Bulgaria 2024 FOR A BETTER WORLD OF WORK

DRAFT KINGS

THE CROWN IS YOURS

VIVACOM

INDEAVR

Serving the high achievers

AMBITIONED

PHAR VISION

Trainings @ Software University (SoftUni)

- Software University – High-Quality Education, Profession and Job for Software Developers
  - softuni.bg, about.softuni.bg
- Software University Foundation
  - softuni.foundation
- Software University @ Facebook
  - facebook.com/SoftwareUniversity

License

- This course (slides, examples, demos, exercises, homework, documents, videos and other assets) is **copyrighted content**
- Unauthorized copy, reproduction or use is illegal
- © SoftUni – https://about.softuni.bg/
- © Software University – https://softuni.bg