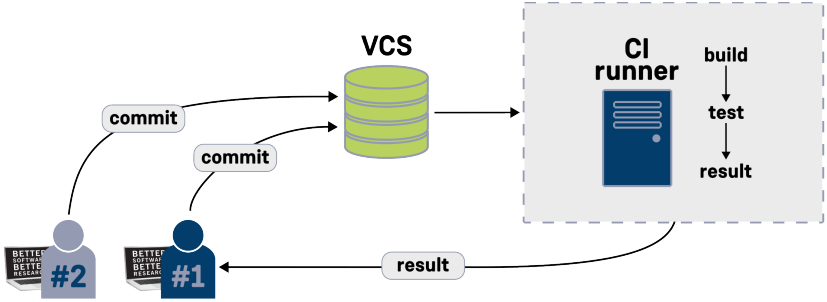


CONTINUOUS INTEGRATION

Hello World

RSE Summer School, September 25, 2024 | Jakob Fritz, Maria Lupe Barrios Sazo, Dirk Brömmel, Robert Speck | Jülich Supercomputing Center, Forschungszentrum Jülich

Overview

Structure of the day

- Laying the foundations
- Give examples using GitLab and/or GitHub

  Break
- Test and code quality automation

  Lunch
- Monitor performance

  Break
- Various applications

Incorporate what you find interesting. Want to chat about ideas? Talk to us!

YAML

What is it and how to write it

```yaml
Key: Value
FirstKey: String
SecondKey: “String with spaces“
ThirdKey: String # followed by a comment
FourthKey: 1234 # Integer
FithKey: 1234.5 # Float
SixthKey: true # Boolean
AList:
  - firstEntry
  - secondEntry
AnotherList: [firstEntry, 2, 3.0]
NewList:
  - NewDict: 1
    AnotherEntry:
    - NestingDictsAndLists
```

GitHub & GitLab

GitHub-Actions

- Add a YAML-file to `.github/workflows/`
- GitHub detects files there and starts Actions
- Multiple YAML-files create multiple pipelines
- Pipelines are independent of each other
- Specify docker-image with keyword „container“

```yaml
name: REUSE Compliance Check
on: [push, pull_request]
jobs:
  reuse_compliance:
    runs-on: ubuntu-latest
    container: alpine:3.17
    steps:
    - uses: actions/checkout@v3
    - name: REUSE Compliance Check
      uses: fsfe/reuse-action@v1
```

GitHub & GitLab

GitLab-CI

- Add a YAML-file `.gitlab-ci.yml` to top level
- GitLab detects the file and starts pipeline
- Only a single file, only a single pipeline
- Multiple stages to order execution of jobs
- Specify docker-image with keyword „image“

```yaml
reuse:
  stage: test
  image:
    name: fsfe/reuse:latest
    entrypoint: [""]
  script:
    - reuse lint
test_python:
  stage: test
  image: python:3.11-alpine
  before_script:
    - pip install .
  script:
    - coverage run -m pytest .
```

GitHub & GitLab

Where the CI-files differ

GitHub-Actions

- Add a YAML-file to `.github/workflows/`
- GitHub detects files there and starts Actions
- Multiple YAML-files create multiple pipelines
- Pipelines are independent of each other
- Specify docker-image with keyword „container“
- **Need to check out code explicitly**

GitLab-CI

- Add a YAML-file `.gitlab-ci.yml` to top level
- GitLab detects the file and starts pipeline
- Only a single file, only a single pipeline
- Multiple stages to order execution of jobs
- Specify docker-image with keyword „image“
- Code is checked out automatically

Artifacts

What they are

- Artifacts can be used to expose files to other jobs and the UI
- Specified per job
- Specify paths and/or filenames or extensions
- Exhibit artifacts only on error, on success or always
- Artifacts are available to jobs at later stages

```yaml
test_python:
  stage: test
  image: mambaorg/micromamba:bullseye-slim
  artifacts:
    when: on_success
    paths:
      - htmlcov/*
    expire_in: "30 days"
  script:
    - coverage run -m pytest .
    - coverage report --show-missing
    - coverage html
```

Containers

A brief introduction

- *Similar to VMs, keywords are: images, containers, Docker*
- CI pipelines are executed on ‘a system’, containers define this system, i.e. set up the OS environment the pipelines run in. There may be a default.
- Large ‘hub’ of available images, one for every use-case, library, programming language, …
- Clearly defined starting point, always identical
- Extend by toolchains/libraries you need

A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another. A Docker container image is a lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings.

Container images become containers at runtime and in the case of Docker containers – images become containers when they run on Docker Engine.

source: docker.com

Benefits

- Reproducible, extensible, shareable
- Under your control
- Reuse outside of CI and have identical environment

Containers

Quickstart

- Large ‘hub’ of available images, one for every use-case, library, programming language, …
  - Pick one close to your needs or pick one from the actual project (if available)
  - Default registry often DockerHub
  - CI pipeline will download the same, fresh image and start new container every time
  - Perhaps have different images for compiling, testing, deploying code
- Extend by toolchains and libraries you need
  - Depending on chosen image/OS, install additional software (every time during the pipeline)
  - Or: extend image in first step of pipeline, use in steps that follow
- Define your own image for most control (and speed)
- Ship your images, perhaps even your code within an image

Containers

Quickstart

- Large ‘hub’ of a
  - Pick one cl
  - Default regi
  - CI pipeline
  - Perhaps ha
- Extend by to
  - Depending
  - Or: extend
- Define your ow
- Ship your imag

gitlab

```
image:
  name: "debian:stretch-slim"
```

github

```
runs:
  using: 'docker'
  image: 'docker://debian:stretch-slim'
```

ning language, …

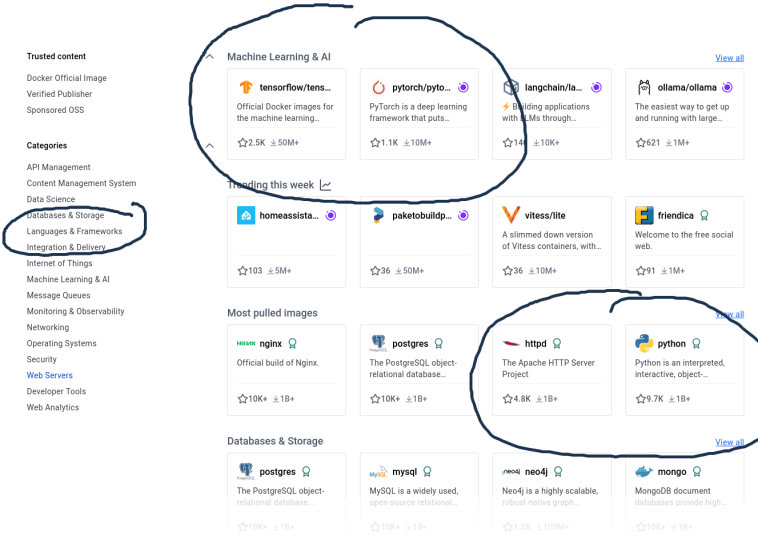
ry time

g the pipeline)

Conta

Quickstart

- Large
  - F
  - D
  - C
  - P
- Exter
  - D
  - C
- Defin
- Ship



source: hub.docker.com

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Containers

Quickstart

- Large ‘hub’ of available images, one for every use-case, library, programming language, …
  - Pick one close to your needs or pick one from the actual project (if available)
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  - CI pipeli ime
  - Perhaps
- Extend by to
  - Depend he pipeline)
  - Or: exte
- Define you
- Ship your images, perhaps even your code within an image

```
dry_run_micromamba:
  stage: test
  image: mambaorg/micromamba:1
  before_script:
    - micromamba create -n cla_bot
    - micromamba install -y -f env.yml
    - micromamba clean --all --yes
    - eval "$(micromamba shell hook --shell bash)"
    - micromamba activate cla_bot
  script:
```

Containers

Quickstart

- Large ‘hub’ of available images, one for every use-case, library, programming language, …
  - Pick one close to your needs or pick one from the actual project (if available)
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- Define your own image for most control (and speed)
- Ship your images, perhaps even your code within an image

Containers

Quickstart

- Large ‘hub’ of available images, one for every use-case, library, programming language, …
- Extensible
- Define
- Ship your images, perhaps even your code within an image

```
ARG CODE_VERSION=latest
FROM ubuntu:${CODE_VERSION}
COPY ./examplefile.txt /examplefile.txt
ENV MY_ENV_VARIABLE="example_value"
RUN apt-get update

# Mount a directory from the Docker volume
# Note: This is usually specified in the 'docker run' command.
VOLUME ["/myvolume"]

# Expose a port (22 for SSH)
EXPOSE 22
```

source: wikipedia.org

Containers

Quickstart

- Large ‘hub’ of available images, one for every use-case, library, programming language, …
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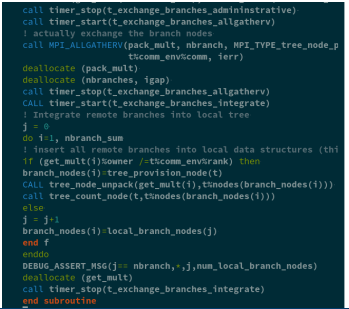
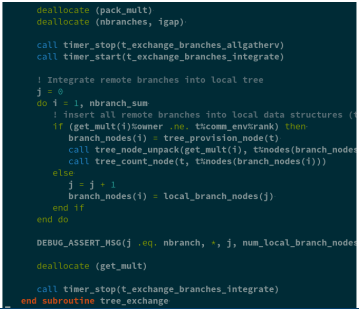
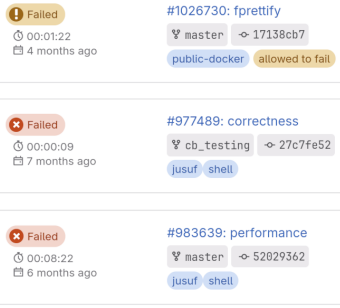
  - Or: extend image in first step of pipeline, use in steps that follow
- Define your own image for most control (and speed)
- Ship your images, perhaps even your code within an image

Getting things done

Now, enough talking.
You can use the time until the break to get your first CI-Pipeline running.







CONTINUOUS INTEGRATION
Essentials

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Overview

Upcoming topics in context

- Important elements to include
- Checks on your source code
- Run tests
- What to execute when?
- Default environment variables

Linting

What it is and why it is useful

> *A linter is a small program that checks code for stylistic or programming errors. Linters are available for most syntaxes, from Python to HTML.*

The idea is to check the code fast and automatically.
Linters analyze the static code (they do not execute it).
Linters are specific for the language to check but not for the code to check.
It checks for syntactic correctness, not for semantic one.

Pros:

- Fast to execute
- No (or little) need to adapt to your code
- Finds e.g. unused variables, …
- Check the whole code (not only paths)

Definition from SublimeLinter

Cons:

- Do not find flaws in your logic
- Do not check if your results are correct

Running tests

Running tests in CI has a few advantages:

- Tests are run in a reproducible way, as no manual interaction is needed.
- Tests are run frequently with every push to the git-server (GitHub or GitLab)

How to run tests in CI

1. Add job in your CI-file (`.gitlab-ci.yml` or `.github/workflows/WHATEVER.yml`)
2. Select a suitable (docker-)image for your code
3. For GitHub: checkout your code
4. For compiled languages: compile your code
5. Run tests with a framework of your choice (see talk on testing)

Running tests

Running tests in CI has a few advantages:

- Tests are run in a reproducible way, as no manual interaction is needed.
- Tests are run frequently with every push to the git-server (GitHub or GitLab)

How to run tests in CI

1. Add job in your CI-file (`.gitlab-ci.yml` or `.github/workflows/WHATEVER.yml`)
2. Select a suitable (docker-)image for your code
3. For GitHub: checkout your code
4. For compiled languages: compile your code
5. Run tests with a framework of your choice (see talk on testing)

Running tests

GitLab:
Entries in `script` are used in shell directly

```yaml
Run_tests:
  image: alpine:3.17
  before_script:
    - PACKAGE MANAGER COMMAND
    - TO INSTALL DEPENDENCIES
  script:
    - YOUR TESTING COMMAND HERE
```

GitHub:
Use `run` in `steps`

```yaml
name: Run tests
jobs:
  tests:
    runs-on: ubuntu-latest
    container: alpine:3.17
    steps:
    - uses: actions/checkout@v3
    - name: Install everything needed
      run: PACKAGE MANAGER COMMAND HERE
    - name: Acutal testing
      run: YOUR TESTING COMMAND HERE
```

Triggering & Conditionals

It is possible to run a workflow/pipeline after different events: after push, PR/MR, scheduled

- On GitHub, a large number of ready-to-use options exist
  - When issue and/or PR is opened, edited, reopened, closed …etc
  - Keywords: **on, types, branches, paths**
  - Use **workflow_dispatch** to manually run
  - Possible to use multiple events and filter combinations
- Distinct sections can be executed under various circumstances
  - Use of expressions can be helpful

```yaml
on:
  pull_request:
    types:
      - opened
    branches:
      - 'releases/**'
    paths:
      - '**.js'
```

```yaml
    steps:
    - name: if_issue
      if: github.event.issue
      run: |
```

- On GitLab, keyword: **rules**
  - Can be run manually
  - Possible to use different conditions per job
  - Many rules and combinations: **if, when, changes, exist, needs, allow_failure** …

```yaml
docker build:
  script: docker build -t my-image:$CI_COMMIT_REF_SLUG .
  rules:
    - if: $CI_PIPELINE_SOURCE == "merge_request_event"
      changes:
        - Dockerfile
      when: manual
      allow_failure: true
```

- You are able to configure entire pipeline with **workflow** keyword
- Worthwhile to take a look at predefined CI/CD variables

```yaml
workflow:
  rules:
    - if: $CI_PIPELINE_SOURCE == 'merge_request_event'
    - if: $CI_COMMIT_TAG
    - if: $CI_COMMIT_BRANCH == $CI_DEFAULT_BRANCH
```

Environment variables

GitLab

- Can be available when pipeline is created or when runner runs the job
- Depending on which event starts the pipeline **CI_PIPELINE_SOURCE** gets value, e.g. **merge_request_event, push, web**

Variable	Defined for	GitLab	Runner	Description
`CI_BUILDS_DIR`	Jobs only	all	11.10	The top-level directory where builds are executed.
`CI_COMMIT_AUTHOR`	Pipeline	13.11	all	The author of the commit in `Name <email>` format.
`CI_COMMIT_BEFORE_SHA`	Pipeline	11.2	all	The previous latest commit present on a branch or tag. Is always `0000000000000000000000000000000000000000` for merge request pipelines, the first commit in pipelines for branches or tags, or when manually running a pipeline.
`CI_COMMIT_BRANCH`	Pipeline	12.6	0.5	The commit branch name. Available in branch pipelines, including pipelines for the default branch. Not available in merge request pipelines or tag pipelines.
`CI_COMMIT_DESCRIPTION`	Pipeline	10.8	all	The description of the commit. If the title is shorter than 100 characters, the message without the first line.
`CI_COMMIT_MESSAGE`	Pipeline	10.8	all	The full commit message.

Environment variables

GitHub

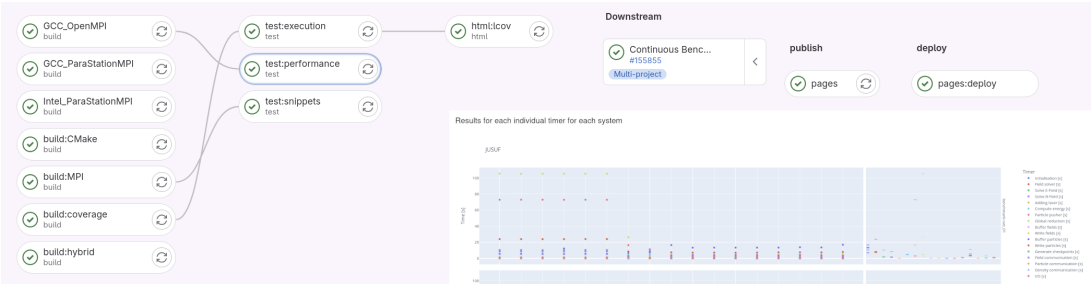
- Default environment variables exist only when runner runs the job
- Contexts available for workflow configuration before job is directed to runner
  - Contexts are objects at hand to access information about runs, variables, jobs, environment
  - To mention a few: GitHub, job, runner
  - Can use with expressions syntax, and functions, e.g. contains, toJSON
- Most default variables have an analogous context property

Property name	Type	Description
`github`	`object`	The top-level context available during any job or step in a workflow. This object contains all the properties listed below.
`github.action`	`string`	The name of the action currently running, or the `id` of a step. GitHub removes special characters, and uses the name `__run` when the current step runs a script without an `id`. If you use the same action more than once in the same job, the name will include a suffix with the sequence number with underscore before it. For example, the first script you run will have the name `__run`, and the second script will be named `__run_2`. Similarly, the second invocation of `actions/checkout` will be `actionscheckout2`.
`github.action_path`	`string`	The path where an action is located. This property is only supported in composite actions.

```yaml
jobs:
  prod-check:
    if: ${{ github.ref == 'refs/heads/main' }}
    runs-on: ubuntu-latest
    steps:
      - run: echo "Deploying to production server on branch $GITHUB_REF"
```

Getting things done

Now, enough talking.
You can use the time until the break to add tests to your pipeline.



CONTINUOUS INTEGRATION

Next Steps

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Overview

Upcoming topics in context

- Other possible components
- Set up customized containers for your needs
- Keep track of performance
- More on variables and handling sensitive info
- Deploy websites and release code versions

Containers

Building & storing them

- Heard earlier: interesting to run pipelines with dedicated containers

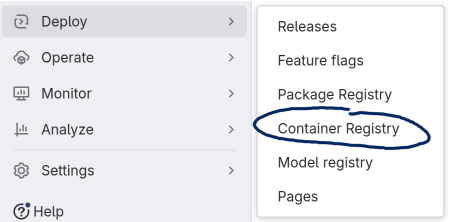
⟶ Next step is building your own, custom containers

Will not discuss Dockerfiles, instead focus on how to integrate with CI

GitHub offers an easy start: using a Dockerfile instead of an image

```yaml
# action.yml
name: 'Hello World'
description: 'Greet someone and record the time'
inputs:
  who-to-greet:  # id of input
outputs:
  time: # id of output
    description: 'The time we greeted you'
runs:
  using: 'docker'
  image: 'Dockerfile'
  args:
    - ${{ inputs.who-to-greet }}
```

GitLab offers per project container registry that is easily accessible



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Containers

Building & storing them

Running Docker (building an image) inside Docker (in CI) is difficult, may require additional permissions. One suggested, easy way round: do not use Docker directly, us `kaniko`:

```yaml
# Create new image from a changed Dockerfile
docker_image:
  stage: docker
  image:
    name: gcr.io/kaniko-project/executor:debug
    entrypoint: [""]
  script:
    - mkdir -p /kaniko/.docker
    - |
      echo "{\"auths\":{\"$CI_REGISTRY\":{\"username\":\"$CI_REGISTRY_USER\",\"password\":\"$CI_REGISTRY_PASSWORD\"}}}" \
      > /kaniko/.docker/config.json
    - |
      /kaniko/executor --context $CI_PROJECT_DIR \
      --dockerfile $CI_PROJECT_DIR/Dockerfile \
      --destination $CI_REGISTRY_IMAGE/$CI_COMMIT_REF_SLUG:$CI_COMMIT_SHORT_SHA \
      --destination $CI_REGISTRY_IMAGE/$CI_COMMIT_REF_SLUG:latest
  rules:
    # Run when variable is set
    - if: $FORCE_DOCKER_IMAGE == "true"
      when: always
    # Run when committing to a branch or merging and changing Dockerfile
    - if: $CI_COMMIT_BRANCH || $CI_PIPELINE_SOURCE == "merge_request_event"
      changes:
        - Dockerfile
      when: always
```

Continuous Benchmarking

What is it?

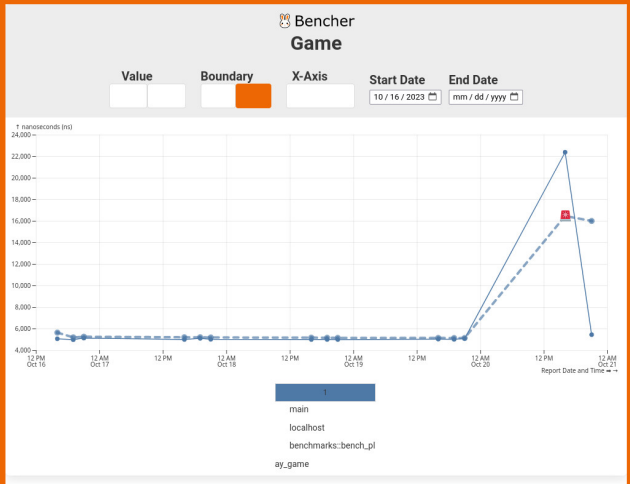
The title gives it away: **continuous monitoring of your code's performance**

⟶ Running automatic benchmarks from the CI pipeline

This does not need to be a benchmark for simulation software, any application is speed 'critical'

Continuous Benchmarking

What is it?



How It Works

Run your benchmarks

Run your benchmarks locally or in CI using your favorite benchmarking tools. The `bencher` CLI simply wraps your existing benchmark harness and stores its results.

Track your benchmarks

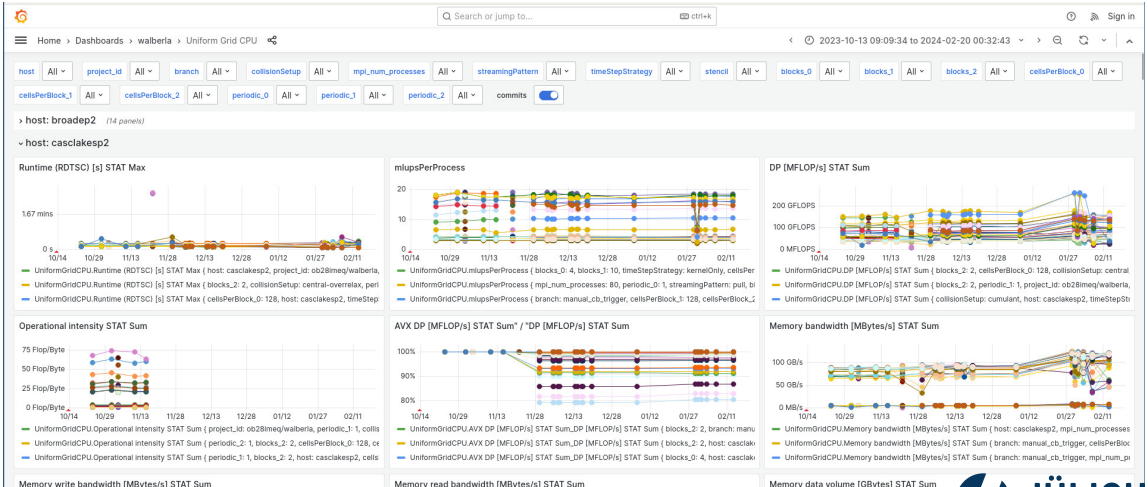
Track the results of your benchmarks over time. Monitor, query, and graph the results using the Bencher web console based on the source branch and testbed.

Catch performance regressions

Catch performance regressions in CI. Bencher uses state of the art, customizable analytics to detect performance regressions before they make it to production.

Continuous Benchmarking

What is it?



Continuous Benchmarking

Why should I use it?

- Track evolution of performance due to code changes
- Track evolution of performance due to system changes

⟶ Act before users complain about slowdowns
If you don't know you have a problem, you cannot take action to fix it

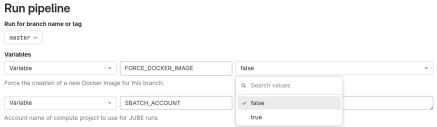
- Show users what performance to expect (and how)
- Test automatically on different platforms
- Reduce burden on developers by separating concerns

Environment variables

Ease their usage, make them available

Sooner or later: too many variables to remember, though some may control your pipeline behaviour
$\longrightarrow$ describe them and make them show up with pull-down option list for manual triggers

To get



Include in `.gitlab-ci.yml`

```
variables:
  FORCE_DOCKER_IMAGE:
    value: "false"
    options:
      - "false"
      - "true"
    description: "Force the creation of a new Docker image for this branch."
  SBATCH_ACCOUNT:
    # use this variable for SBATCH/JUBE to define accounting (or hard code within JUBE file)
    value: ommea
    description: "Account name of compute project to use for JUBE runs"
```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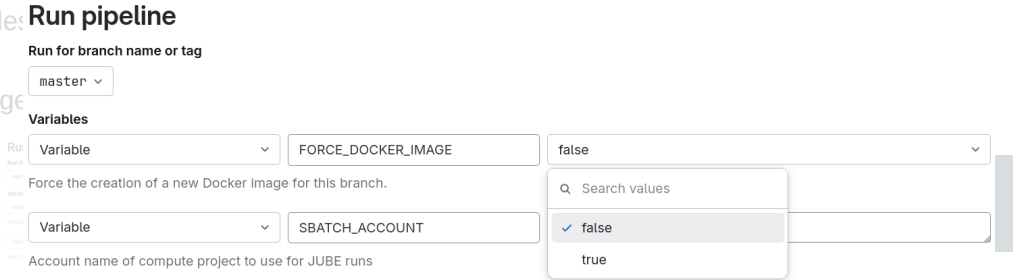
Environment variables

Ease their usage, make them available

Soon[illegible] → des[illegible]

To ge[illegible]



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Environment variables

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To ge

```yaml
variables:
  FORCE_DOCKER_IMAGE:
    value: "false"
    options:
      - "false"
      - "true"
    description: "Force the creation of a new Docker image for this branch."
  SBATCH_ACCOUNT:
    # use this variable for SBATCH/JUBE to define accounting (or hard code within JUBE file)
    value: [redacted]
    description: "Account name of compute project to use for JUBE runs"
```

Secrets

Variables you don’t want to tell everyone

A secret is anything that you want to tightly control access to, such as API keys, passwords, certificates, and more.

- Any variable defined for a CI pipeline is accessible, can be echoed
- GitHub knows ‘variables’ and ‘secrets’, GitLab defines a ‘visibility’
  $\longrightarrow$ omitted from log files or the output of your pipelines
- **Secrets may still be leaked by changes to the CI pipeline $\longrightarrow$ check any changes**
- Services and tools promise to help with secrets management, e.g. Hashicorp Vault, Infiscal, `git-secret`
  - Manage secrets centrally, also for a team
  - Control access to secrets

A private repository will not ensure secrets are kept safe.

🔗`blog.gitguardian.com/secrets-api-management`

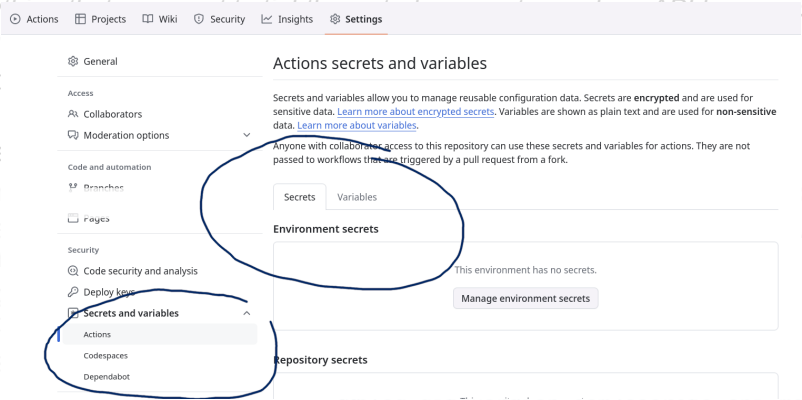
Secrets

Variables you don't want to tell everyone

A secret is a

- Any va
- GitHub kn
  ⟶ om
- Secret
- Service
  git-sec
  - Ma
  - Co

A private repos



words, certificates, an

anges

ult, Infiscal,

@blog.gitguardian.com/secrets-api-management

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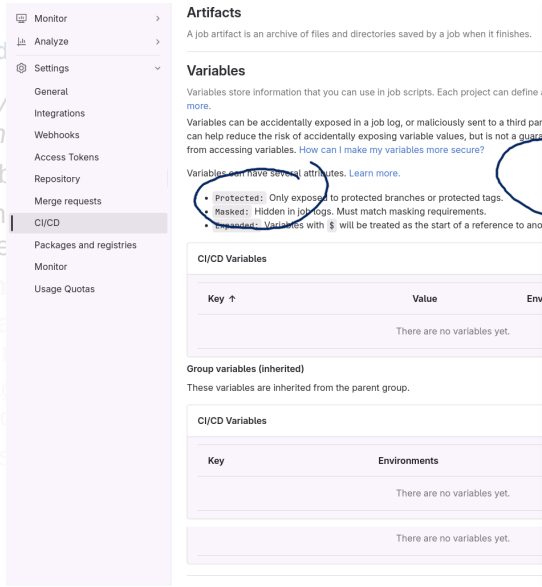
Secrets

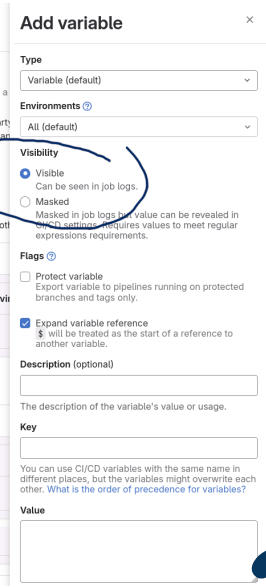
Variables you d

*A secret is a*ny *certificates, an*

- Any vari
- GitHub kn
  ⟶ omitte
- Secrets n
- Service a
  git-sec
  - Mana
  - Contr

A private repos





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Secrets

Variables you don’t want to tell everyone

A secret is anything that you want to tightly control access to, such as API keys, passwords, certificates, and more.

- Any variable defined for a CI pipeline is accessible, can be echoed
- GitHub knows ‘variables’ and ‘secrets’, GitLab defines a ‘visibility’
  $\longrightarrow$ omitted from log files or the output of your pipelines
- **Secrets may still be leaked by changes to the CI pipeline $\longrightarrow$ check any changes**
- Services and tools promise to help with secrets management, e.g. Hashicorp Vault, Infiscal, `git-secret`
  - Manage secrets centrally, also for a team
  - Control access to secrets

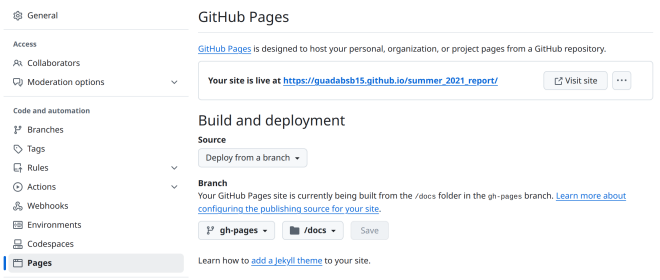
A private repository will not ensure secrets are kept safe.

`blog.gitguardian.com/secrets-api-management`

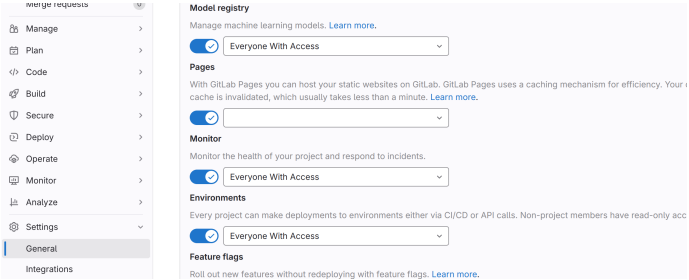
Deployment

How to deploy websites (pages)

- You can use GitHub pages to build and host project, user, and organization websites
- Site can be published by changes pushed to specific branch which holds static generated website, or with a workflow that holds the site content as an artifact
- In the repository settings one should specify further details in Pages options
- In the branch case, when push is done in a development branch one can automatically build the site and push content on the gh-pages branch, actions-gh-pages can help
- In GitLab, Pages option enabled in Settings, General, Visibility, project, features, permissions.
- Use specific **pages** job in `.gitlab-ci.yml`, artifact with content in folder named **public**


General
Access
Collaborators
Moderation options
Code and automation
Branches
Tags
Rules
Actions
Webhooks
Environments
Codespaces
Pages
GitHub Pages
GitHub Pages is designed to host your personal, organization, or project pages from a GitHub repository.
Your site is live at https://guadabsb15.github.io/summer_2021_report/
Visit site
Build and deployment
Source
Deploy from a branch
Branch
Your GitHub Pages site is currently being built from the /docs folder in the gh-pages branch. Learn more about configuring the publishing source for your site.
gh-pages
/docs
Save
Learn how to add a Jekyll theme to your site.

Deployments 500+
github-pages 5 days ago
+ more deployments


Merge requests
Manage
Plan
Code
Build
Secure
Deploy
Operate
Monitor
Analyze
Settings
General
Integrations
Model registry
Manage machine learning models. Learn more.
Everyone With Access
Pages
With GitLab Pages you can host your static websites on GitLab. GitLab Pages uses a caching mechanism for efficiency. Your
cache is invalidated, which usually takes less than a minute. Learn more.
Monitor
Monitor the health of your project and respond to incidents.
Everyone With Access
Environments
Every project can make deployments to environments either via CI/CD or API calls. Non-project members have read-only acc
Everyone With Access
Feature flags
Roll out new features without redeploying with feature flags. Learn more.

README
CI/CD configuration
GitLab Pages

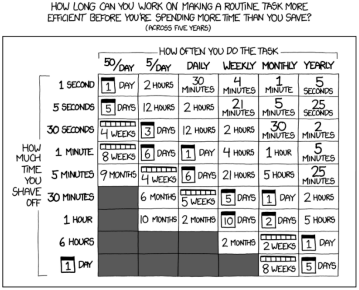
Deployment

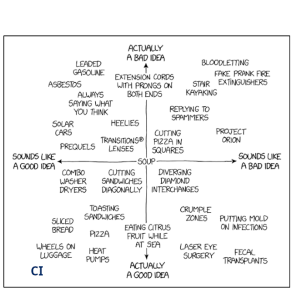
Release code versions

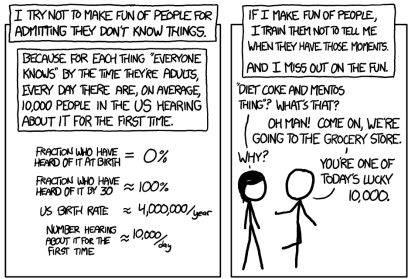
- Some of this points will be cover later in the software publication session
- It is possible to use workflows and pipelines to do code releases
- An option is to trigger workflow/pipeline when a tag is created
- Release can include comments with changes and links to binaries
- During code releases some of the options to explore include
  - Create or update (Digital Object Identifier) DOI in data archiving tool like Zenodo, with GitHub integration, Hermes
  - Save artifacts and upload, link to assets
  - Automate packaging
  - Publish python code to package repo e.g. TestPyPI, PyPI

Getting things done

Now, enough talking.
You can use the time until the break to extend your CI.







source: xkcd.com

CONTINUOUS INTEGRATION
Outlook

RSE Summer School, September 25, 2024 | Jakob Fritz, Maria Lupe Barrios Sazo, Dirk Brömmel, Robert Speck | Jülich Supercomputing Center, Forschungszentrum Jülich

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Overview

Upcoming topics in context

- Miscellaneous ideas
- Couple pipelines
- Need more freedom and control of runners?
- Verify commit author
- Automate potential agreement by contributors
- Host websites
- Create LaTeX documents
- Include features/tools from other projects
- Combine with team chat apps
- Syncing repositories

Coupling pipelines

In GitLab

Multiple pipelines can be coupled using the `trigger` keyword.

The triggered pipelines can be in the same repository or in another repository. This is then called parent-child or multi-project pipeline

Parent-child pipelines help to structure jobs and to run multiple similar pipelines from a single file.

Multi-project pipelines can help if multiple repositories need to work together (e.g. in microservices).

Coupling pipelines

In GitLab

.gitlab-ci.yml

```yaml
...
echo_downstream:
  trigger:
    include:
      - local: downstream.yml
...
```

downstream.yml

```yaml
stages:
  - build
  - test
mimic_build:
  stage: build
  image: alpine:latest
  script:
    - echo "This mimics a build job"
```

Coupling pipelines

In GitLab

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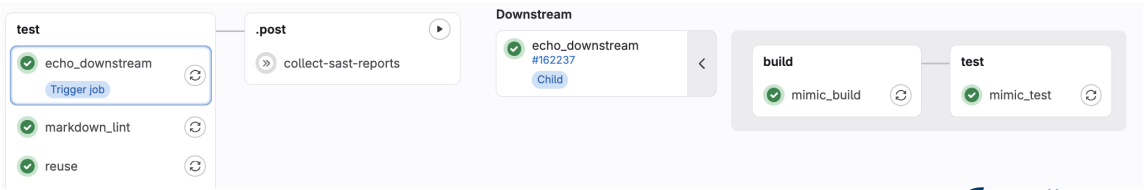


Coupling pipelines

In GitLab & GitHub

- Triggering pipelines via the API is possible.
- Checking status and downloading artifacts can also be done via API.

This makes it possible to couple pipelines/workflows. E.g. waiting in GitHub for another workflow to finish in order to combine results from both workflows.

Coupling pipelines

Syncing GitHub and GitLab

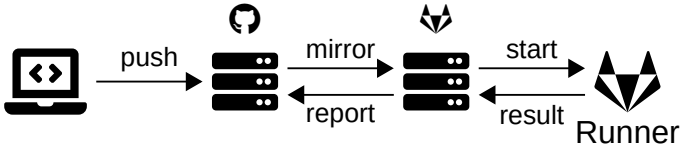
Combine the benefits of GitHub (large community and visibility) with the benefits of GitLab (possibility of self-hosted instances and long history of self-hosted runners)

https://github.com/jakob-fritz/github2lab_action

Coupling pipelines

Syncing GitHub and GitLab

Combine the benefits of GitHub (large community and visibility) with the benefits of GitLab (possibility of self-hosted instances and long history of self-hosted runners)



https://github.com/jakob-fritz/github2lab_action

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Using your own runners

For special usecases

GitHub and GitLab offer runners to projects. On self-hosted GitLab-Instances, the admins can provide runners to all projects of that instance.
Furthermore, own runners can be set up and registered at the platform (GitHub or GitLab).

Pros:

- ➕ Known what hardware is used for the runners and if/when they change
- ➕ Can be decided, if multiple jobs can run in parallel on the hardware

Cons:

- ➖ Additional work for set-up and maintenance
- ➖ Often, hardware architecture is not relevant in containers

Bottom line:

- It is possible to have runners, that are only available to a group or a single project
- May be helpful when doing performance analysis or when needing resources not provided by other runners
- If not needed: save yourself the effort of creating and maintaining

What CI can also be used for

Automizing repetitive tasks

Also for repetitive tasks, the benefits of CI hold true. These include repeatability and explicit documentation of how processes are done.

CI can therefore also be used for (small) jobs that occur in a specific frequency. This can include updates to a Database, updates of a website, …

The downside of this approach is, that the environment needs to be created new every time, as you use a new container each run.

Also be aware, that you use external services/computers, so be nice with the usage (regarding duration and frequency of execution).

An example is a database and website, I update every month.

What CI can also be used for

Hosting websites

In Addition to hosting a website with the documentation of your code, GitHub and GitLab can also be used to host websites, that are not documentation.

This approach offers a few advantages:

- Version controlled website (You can track and roll-back changes made)
- Collaborative creation/updates with multiple people and even PRs/MRs
- No need to take care of hosting yourself
- Known system (you already know how to use git and GH, GL)

However, when using GitLab, the admins of the instance need to have that feature enabled (called pages). The Helmholtz Codebase has this feature enabled.

An example is the HiRSE_PS Website that is maintained in a GitHub repository.

What CI can also be used for

Compiling LaTeX

Versioning LaTeX in git can be a good idea to know when something changed and keep the previous versions.

Also, CI of the platforms (GitHub & GitLab) can compile the document. This helps, as you know when some change broke your document. Also, the document is build the same way regardless, who made changes. The compiled document can be made available as artifact.

This presentation is an example for this approach.

Furthermore, linting the document is possible.

Usage of Git(Hub|Lab)

Signing commits

Commit authors are defined in a project's (or global) `git` settings and can be chosen at will

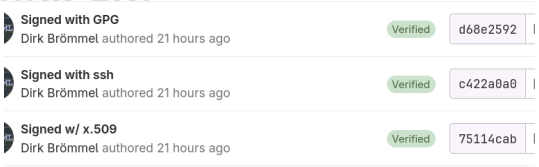
⟶ Thus no reliable information
⟶ Do not use to judge security implications by this

Signing commits will verify who committed what, a CI pipeline can be used to check that.

- `git` supports signing either via `GPG`, `x.509`, or `ssh`
- Requires settings for `git` (set up of format and key, allowed keys, trust)
- Requires providing matching information to Git(Hub|Lab) (upload keys)

Usage of Git(Hub|Lab)

Signing commi



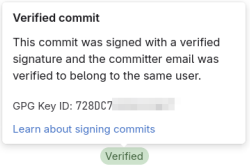
Commit auth… …en at will

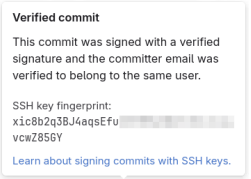
⟶ Thus no re…

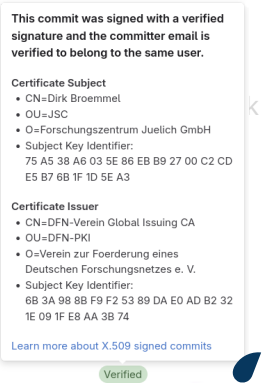
⟶ Do not use…

Signing commi… …k that.

- `git` supp…
- Require…
- Require…







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Usage of Git(Hub|Lab)

Signing commits

Commit aut… …en at will

⟶ Thus no …

⟶ Do not us…

Signing com… …hat.

- `git` sup…
- Require…
- Require…

```
commit d68e25923d9ead286ce71dffb66bb8245bbf8363
gpg: keyserver option 'honor-http-proxy' is unknown
gpg: Signature made Tue 13 Aug 2024 16:29:24 CEST
gpg:                using RSA key 30EDB907C8601385C[redacted]
gpg: Good signature from "Dirk Broemmel <d.broemmel@fz-juelich.de>" [ultimate]
Author: Dirk Brömmel <d.broemmel@fz-juelich.de>
Date:   Tue Aug 13 16:29:24 2024 +0200

    Signed with GPG

commit c422a0a0b0d13d238460dbb7fdcfc6698521a6d6
Good "git" signature for d.broemmel@fz-juelich.de with ED25519 key SHA256:xic8b2q3BJ4aq[redacted]
Author: Dirk Brömmel <d.broemmel@fz-juelich.de>
Date:   Tue Aug 13 16:22:44 2024 +0200

    Signed with ssh

commit 75114cab1835b5ce0818563fff139a2a21d95ec7
gpgsm: Signature made 2024-08-13 14:19:28 UTC
gpgsm:                using rsa4096 key D4EFB3A1D7ED65946F4DD12B53FB5D4A3E0322D2
gpgsm: Note: non-critical certificate policy not allowed
gpgsm: Note: non-critical certificate policy not allowed
gpgsm: Note: non-critical certificate policy not allowed
gpgsm: Good signature from "/CN=Dirk Broemmel/OU=JSC/O=Forschungszentrum Juelich GmbH/C=DE/GN=Dirk/SN=Broemmel"
gpgsm:                 aka "d.broemmel@fz-juelich.de"
Author: Dirk Brömmel <d.broemmel@fz-juelich.de>
Date:   Tue Aug 13 16:19:28 2024 +0200

    Signed w/ x.509
```

Usage of Git(Hub|Lab)

CLAs & DCOs

Your code has a(n outgoing) license and you have (external) contributors. Now what?

⟶ You might want to ensure you can include content and keep your license.

This is about ensuring necessary rights are transferred to your project.

- CLA: Contributor License Agreement (an incoming license)
- DCO: Developer Certificate of Origin

Either requirement needs to be included/stated in repo.

🔗contributoragreements.org/ca-cla-chooser/

🔗developercertificate.org/

Usage of Git(Hub|Lab)

CLAs & DCOs

Choice may depend on your code's (future?) license. It may depend on whether you are (really!) dealing with individuals or institutions. To quote:

- CLAs are more formal and legally binding, while DCOs are more informal and rely on the community's trust and good faith.
- CLAs require contributors to sign a legal agreement, which can be a barrier to entry for some contributors.
- DCOs, on the other hand, require only a simple sign-off line, which is easier for contributors to understand and comply with.

osr.finos.org/docs/bok/artifacts/clas-and-dcos

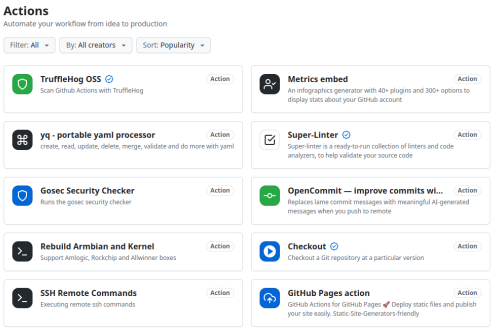
IANAL…see your trusted lawyer for advice, speak to your institution

Management tooling does exist (mostly on GitHub, see us for GitLab)**. Merge request may be conditional on CLA/DCO being present.**

Integration and not reinventing the wheel

Market Place in GitHub

- Find countless actions, developed by others, to include in your workflow.
- You can add them in your workflows with keyword **uses**
- For specifying parameters **with**
- Examples that you might already use, and can be helpful:
  - checkout, **actions/checkout@v4**
  - python, setup-python
  - auto commit, git-auto-commit
- You can also create your own actions!




```yaml
steps:
- uses: actions/checkout@v4
- uses: actions/setup-python@v5
  with:
    python-version: '3.10'
```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Integration and not reinventing the wheel

Integrating external YAML-files in GitLab-CI

- Don’t repeat yourself, include `.yml` files created by you or others
- Add **include** with project, remote, local, template, depending on where the files are located
- Can utilize or create components in a CI/CD catalog, with possibility of specifying parameters and share within GitLab instance
- Supports the use of inputs and rules

```yaml
include:
  - component: $CI_SERVER_FQDN/$CI_PROJECT_PATH/jube-benchmark
    inputs:
      stage: continuous_benchmarking
      benchmark_system: jusuf
      compute_project: ctsma
```

```yaml
include:
  # stages needed: "test" and later ".post"
  # Add as URL to work with other Gitlab-Instances than Jugit
  - remote:
      "https://jugit.fz-juelich.de/j.fritz/continuous-integration/-/raw/main/linter.gitlab-ci.yml"
  - remote:
      "https://jugit.fz-juelich.de/j.fritz/continuous-integration/-/raw/main/sast.gitlab-ci.yml"
  - template: "Security/Secret-Detection.gitlab-ci.yml"
```

Integration and not reinventing the wheel

Integration into messengers

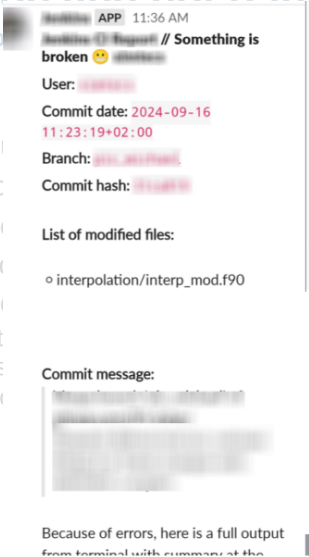
- Some groups collaborate through team chat applications like slack, rocketchat, matrix
- Getting notifications from GitHub or GitLab activity can be practical
- Feasible to receive details about CI success or failures
- Chat platforms provide integrations
- For more customized reports:
  - gh actions that provide support like action-slack-notify or slack-GitHub-action
  - Needs a token or webhook for permission to post on the chat
  - Interact via curl

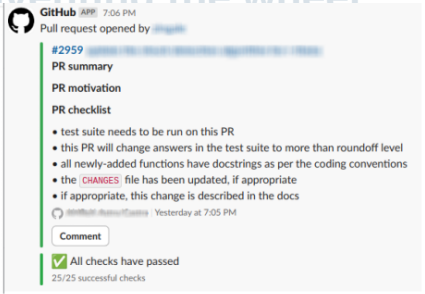
Integration and not reinventing the wheel

Integration into

- Some gro
- Getting nc
- Feasible t
- Chat platf
- For more
  - gh act
  - Needs
  - Intera

, matrix





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Combining Repositories

Git submodules

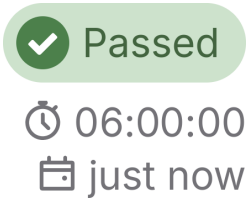
- In Git it is possible to have a repository within a repository while keeping commits separated
- A potential way to handle libraries, dependencies
- In GitHub workflows, one can build project with explicit call to `git submodule update --init` or option with checkout action
- In GitLab pipelines, one can set variable GIT_SUBMODULE_STRATEGY to recursive
- Access tokens if content from other non-public repo needs to be used
- CI can also be used to update submodule

```
- name: Get submodules
  run: |
    git submodule update --init
    cd external/Microphysics
    git fetch; git checkout development
    cd ../amrex
    git fetch; git checkout development
```

```
variables:
  GIT_SUBMODULE_STRATEGY: recursive
```

That’s it

Thank you for your attention. Feel free to ask questions now and later this week!



CONTINUOUS INTEGRATION
Goodbye

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