GitHub Actions CI/CD workflows

START HERE

`on: push`
Run on every push

`runs-on: ubuntu-latest`
Pick a runner

`uses: actions/checkout@v4`
Get the code

`run:` *`<command>`*
Run a shell command

`needs:` *`<job>`*
Run after another job

`if: github.ref == 'refs/heads/main'`
Run conditionally

`${{ secrets.`*`<NAME>`*` }}`
Read a secret

`strategy.matrix`
Fan out over versions

CONCEPTS

Workflows live in .github/workflows/*.yml; each file holds jobs, each job runs steps on one fresh runner.

Workflow one YAML file, triggered by events
- **Job** own runner, parallel unless needs
  - **Step** run: command or uses: action

Jobs do not share a filesystem: pass data with outputs or artifacts.

Pin third-party actions to a full commit SHA; tags can be moved.

TRIGGERS

`on: push`
Run on pushes

`on: pull_request`
Run on pull requests

`on: [push, pull_request]`
Several events at once

`on.push.branches: [main, 'release/**']`
Only these branches

`on.push.tags: ['v*']`
Run on version tags

`on.`*`<event>`*`.paths: ['src/**']`
Only when these files change
A skipped workflow leaves a required check pending.

TRIGGERS (cont.)

`on.pull_request.types: [opened, synchronize]`
Limit PR activity types

`on.workflow_dispatch`
Allow manual runs
Only fires from the default branch.

`on.workflow_dispatch.inputs.`*`<name>`*
Manual run parameters

`on.schedule: - cron: '0 3 * * 1'`
Run on a cron schedule (UTC)

`on.workflow_call`
Make workflow reusable

`on.pull_request_target`
PR event with base-branch secrets
Never check out and run untrusted PR code with it.

JOBS

`jobs.`*`<id>`*`.runs-on: ubuntu-latest`
Choose the runner

`needs: [`*`<job>`*`, `*`<job>`*`]`
Wait for other jobs

`if: github.event_name == 'push'`
Condition on a job or step

`if: always()`
Run even after failure

`if: failure()`
Only after an earlier failure

`timeout-minutes:` *`<n>`*
Cancel a job or step after n min
Job default is 360.

JOBS (cont.)

`continue-on-error: true`
Do not fail the run on error

STEPS

`- uses:` *`<owner>`*`/`*`<repo>`*`@`*`<ref>`*
Run an action

`with: {` *`<input>`*`:` *`<value>`*`}`
Pass inputs to an action

`- run:` *`<command>`*
Run a shell command

`run: |`
Multi-line script

`- name:` *`<text>`*
Label a step in the log

`id:` *`<step_id>`*
Name a step to read its outputs

`env: {` *`<VAR>`*`:` *`<value>`*`}`
Environment for a step

MATRIX & CONTAINERS

`strategy.matrix.`*`<key>`*`: [a, b]`
One job per value

`${{ matrix.`*`<key>`*` }}`
Read the current value

`strategy.fail-fast: false`
Let other legs finish
Default is true: one failure cancels the rest.

`services.`*`<id>`*`.image:` *`<image>`*
Sidecar such as a database

EXPRESSIONS & CONTEXTS

`${{` *`<expression>`*` }}`
Evaluate an expression

`github.event_name`
Event that triggered the run

`github.ref / github.ref_name`
Full ref / short branch or tag

`github.sha`
Commit SHA of the run

`vars.`*`<NAME>`*
Configuration variable

`needs.`*`<job>`*`.outputs.`*`<name>`*
Output of a needed job

`steps.`*`<id>`*`.outputs.`*`<name>`*
Output of an earlier step

`hashFiles('**/package-lock.json')`
Hash of files, e.g. cache key

`toJSON(`*`<v>`*`) / fromJSON(`*`<s>`*`)`
Convert to and from JSON
fromJSON on an output builds a dynamic matrix.

DATA & SECRETS

`secrets.`*`<NAME>`*
Read a repository secret

`secrets.GITHUB_TOKEN`
Automatic per-run token

`echo "k=v" >> "$GITHUB_OUTPUT"`
Set a step output

DATA & SECRETS (cont.)

`echo "K=v" >> "$GITHUB_ENV"`
Set env for later steps

`jobs.`*`<id>`*`.outputs.`*`<name>`*`: ${{ steps.`*`<id>`*`.outputs.`*`<name>`*` }}`
Expose step output to other jobs

PERMISSIONS & CONCURRENCY

`permissions: contents: read`
Least-privilege GITHUB_TOKEN
Naming any scope sets the rest to none.

`permissions: id-token: write`
Allow OIDC to cloud providers

`concurrency.group:` *`<name>`*
One run per group at a time

`concurrency.cancel-in-progress: true`
Cancel superseded runs

`env:` *`<VAR>`*`:` *`<value>`*
Workflow-wide variable

REUSE, CACHE & ARTIFACTS

`uses: actions/cache@v4`
Cache dependencies

`uses: actions/upload-artifact@v4`
Keep files from a run

RECIPES

Minimal CI

```
# .github/workflows/ci.yml
name: CI
on: [push, pull_request]
jobs:
  test:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/
checkout@v4
      - run: make test
```

Test on a matrix

```
strategy:
  fail-fast: false
  matrix:
    os: [ubuntu-latest,
windows-latest]
    node: [20, 22]
runs-on: ${{ matrix.os }}
```

Output from step to job

```
- id: v
  run: echo "ver=1.2" >>
"$GITHUB_OUTPUT"
- run: echo
"${{ steps.v.outputs.ver }}"
```

Cancel stale runs

```
concurrency:
  group:
${{ github.workflow }}-
${{ github.ref }}
  cancel-in-progress: true
```

Deploy only from main

```
deploy:
  needs: test
  if: github.ref == 'refs/
heads/main'
  environment: production
```