

CI for ASAP Applications: Using Github Actions for Rapid Development



Haniye Kashgarani
University of Wyoming



Mentors: Supreeth Suresh, Cena Brown



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Motivation

What is CI:

- Continuous Integration (CI) refers to the process of automatically building and testing code every time a team member commits changes to version control system.

Life without CI:

- Integration Hell
- Late Bug Detection
- Slow Feedback Loop
- Unclear Understanding of Project State
- Slow Delivery

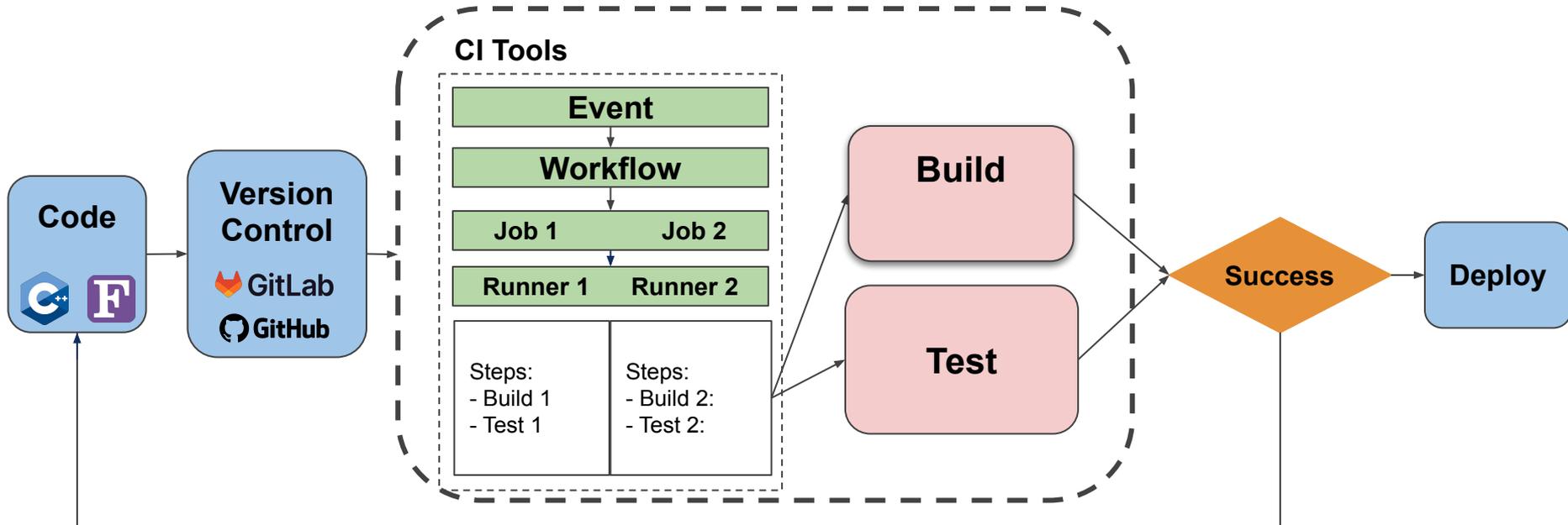
CI Benefits for Parallel Applications

Application Scalability And Performance Group: Leverage the parallel power of GPUs and CPUs with MPI communication for higher performance.

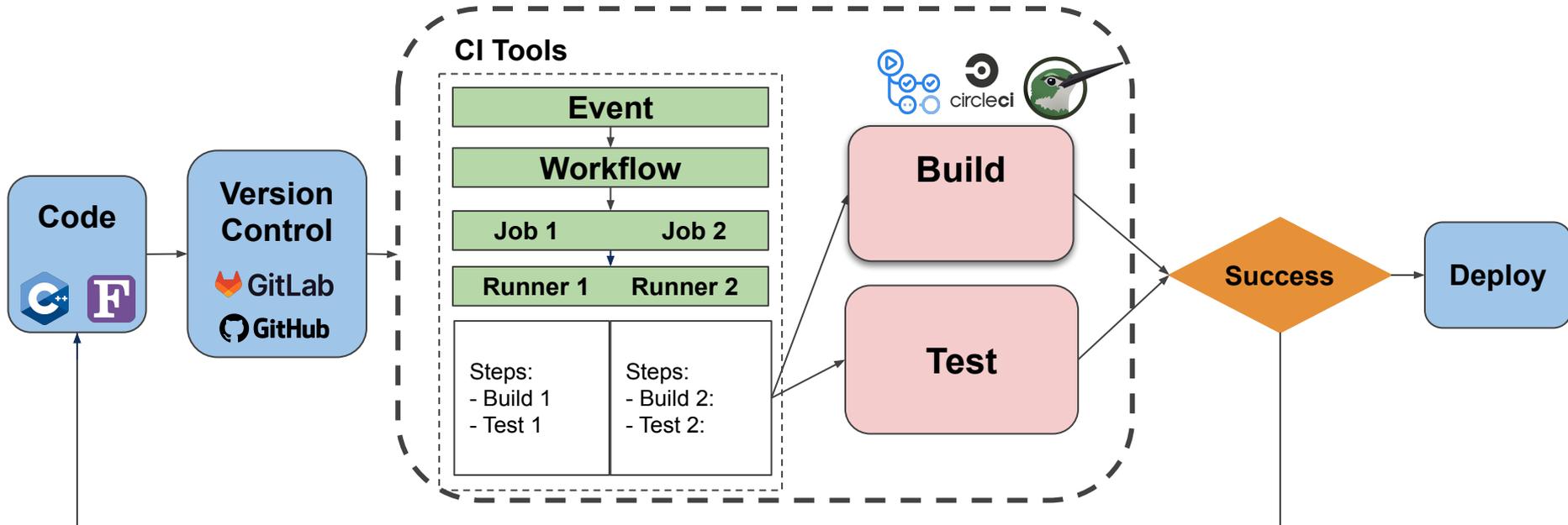
CI for CUDA and MPI applications:

- Dependency management
- Library versions: Dealing with CUDA and OpenMPI versions
- GPU compatibility
- Frequent automated testing
- Early detection of bottlenecks
- Speedy Development

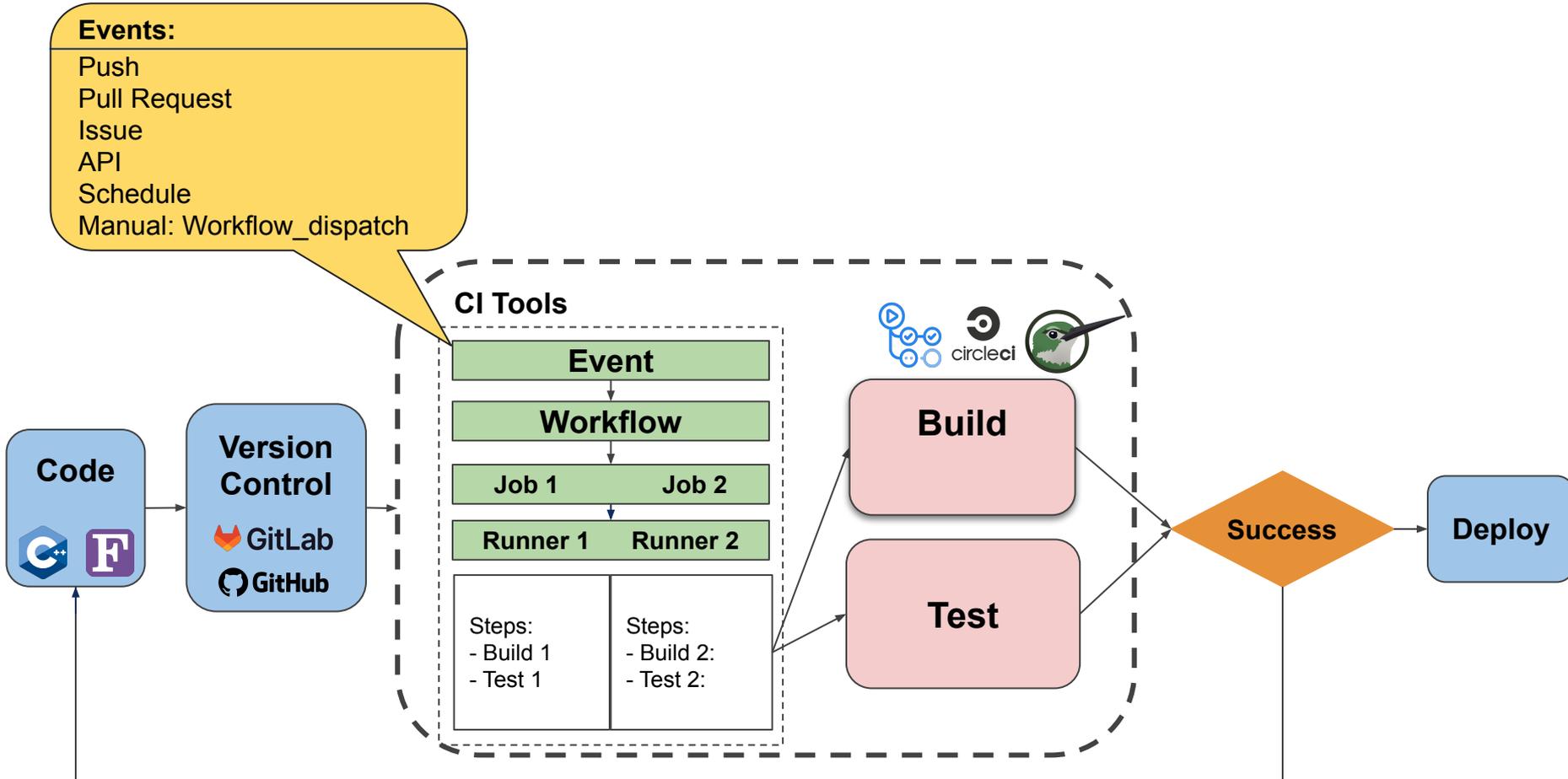
CI Pipeline



CI Pipeline



CI Pipeline



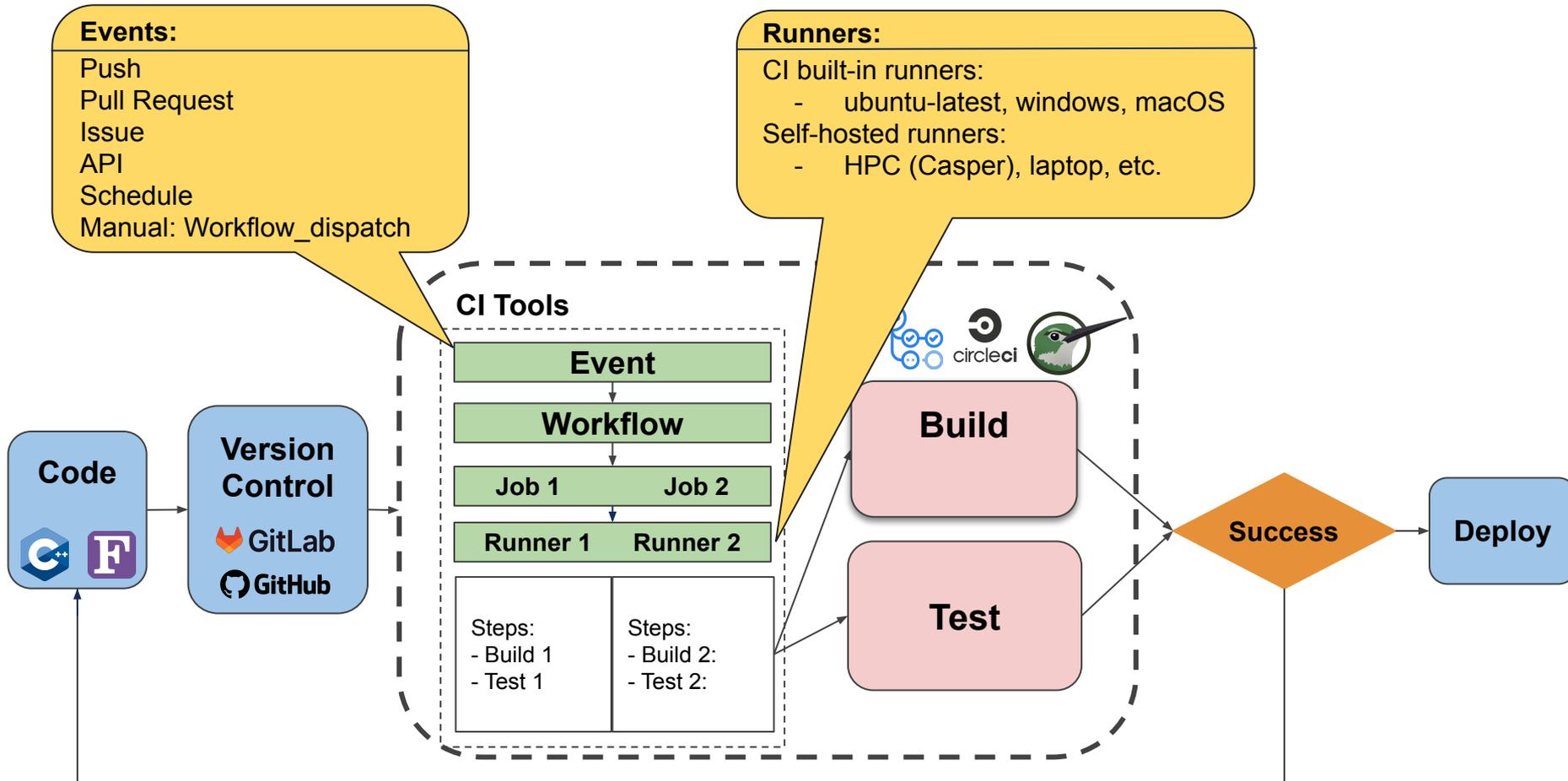
CI Pipeline

Events:

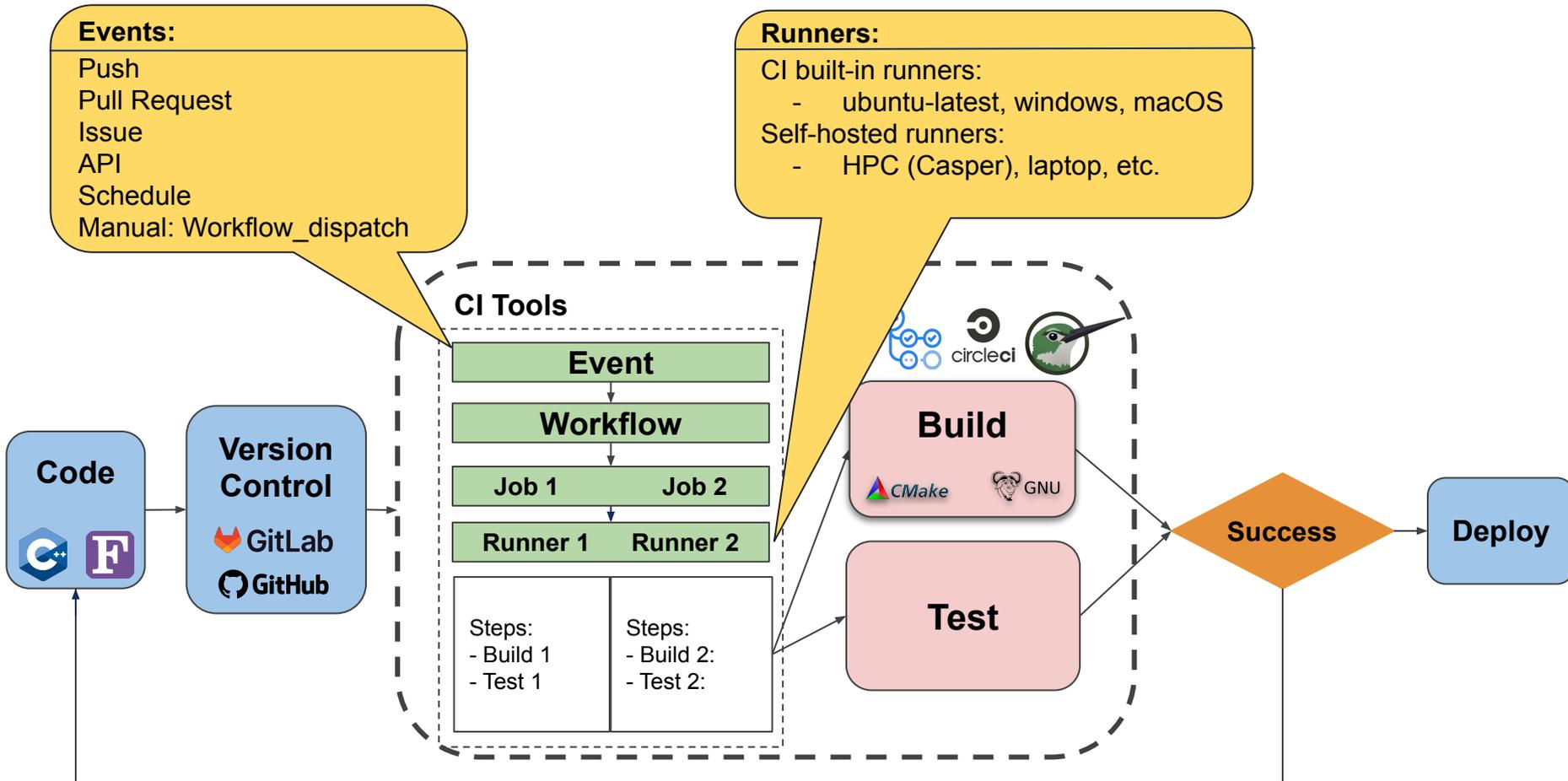
Push
Pull Request
Issue
API
Schedule
Manual: Workflow_dispatch

Runners:

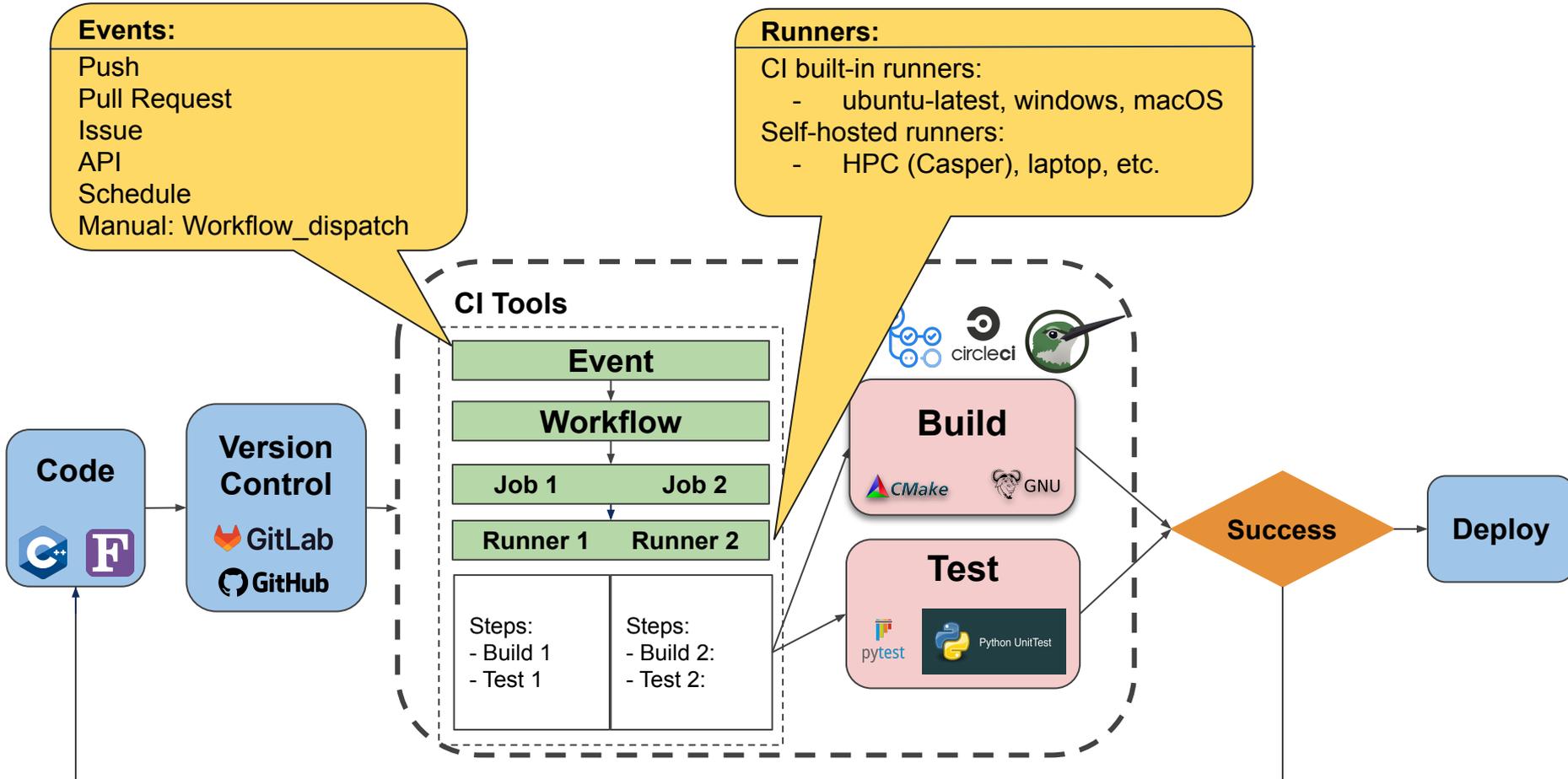
CI built-in runners:
- ubuntu-latest, windows, macOS
Self-hosted runners:
- HPC (Casper), laptop, etc.



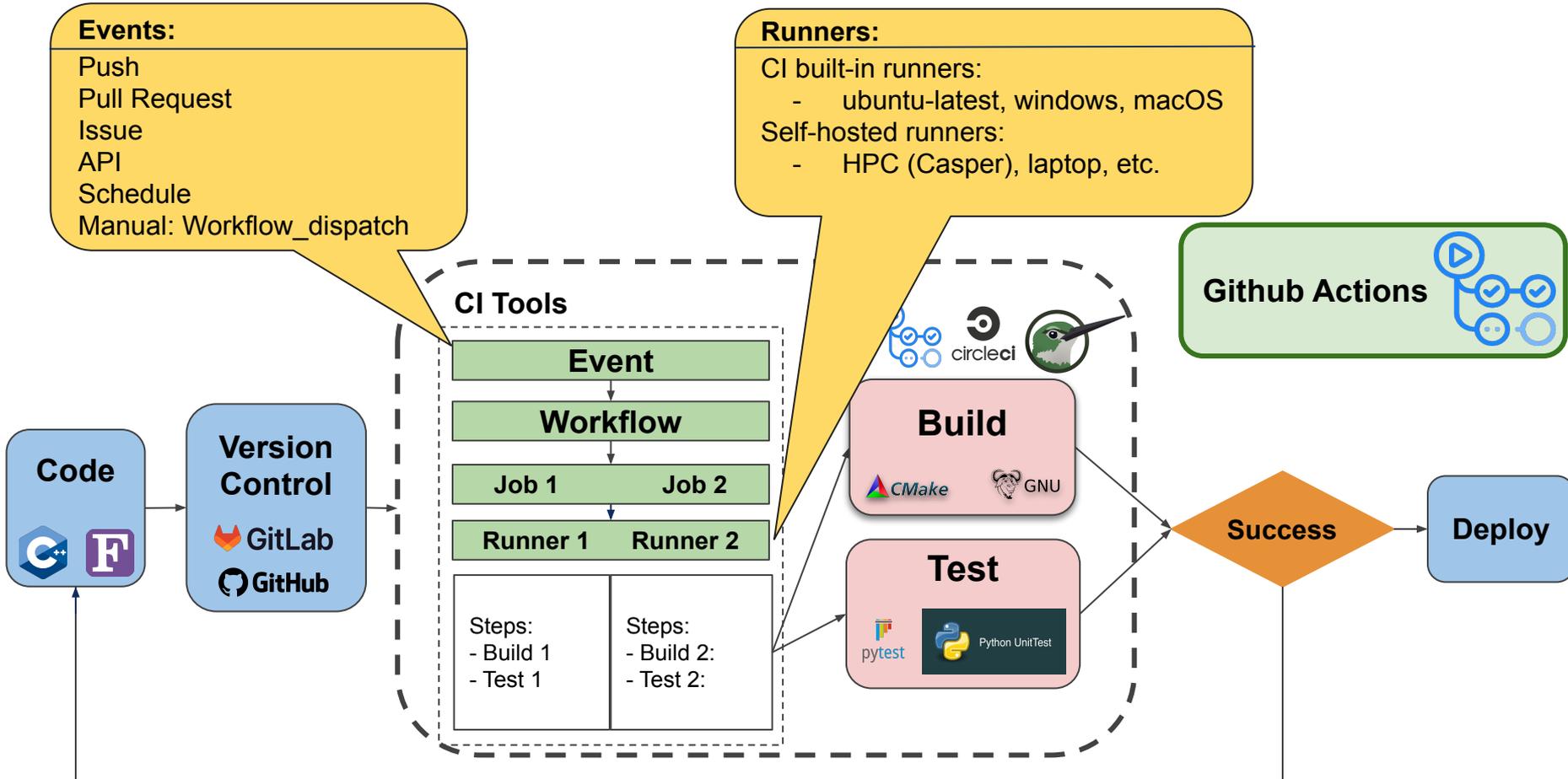
CI Pipeline



CI Pipeline



CI Pipeline



Github Actions

The screenshot shows the GitHub interface for the repository 'Siparcs2023_CI_CD'. The navigation bar at the top includes links for Code, Issues, Pull requests, Actions, Projects, Wiki, Security, and Insights. The repository name is 'Siparcs2023_CI_CD' with a 'Public' badge. Below the repository name are buttons for 'Edit Pins', 'Watch' (3), 'Fork' (0), and 'Starred' (1). The main content area shows the file tree for the 'main' branch. A callout box with an orange border and a pointer to the '.github/workflows' directory contains the text: 'A workflow is defined in a .yml file within the .github/workflows directory in the repository.' The file tree lists several folders and files, including '.circleci', '.github/workflows', 'Autoconfig', 'CMake', 'Makefile', 'docker', 'README.md', and 'env.sh'. The right sidebar contains 'About' information (no description, 1 star, 3 watching, 0 forks) and 'Releases' information (no releases published).

File/Folder	Commit Message	Commit Time
.circleci	Update config.yml	last month
.github/workflows	Delete .MPIStencil_MPI_OpenACC.yaml.s...	3 weeks ago
Autoconfig	remove tmp	3 weeks ago
CMake	remove tmp	3 weeks ago
Makefile	remove tmp	3 weeks ago
docker	Update Dockerfile	last month
README.md	Update README.md	last month
env.sh	Create env.sh	3 weeks ago

Github Actions

Events

Workflow files can define one or more jobs

Runner Label

```
container:  
  image: node:14.16
```

Each job consists of a set of steps that perform individual tasks such as running a script or a command.

```
1  name: matrixMult_Fortran_Autoconfig  
2  
3  on:  
4    push:  
5      branches:  
6        - main  
7    pull_request:  
8      branches:  
9        - main  
10   workflow_dispatch:  
11  
12  jobs:  
13    Makefile:  
14      runs-on: ubuntu-latest  
15      steps:  
16        - uses: actions/checkout@v3  
17  
18        - name: Navigate to directory and autoconfig  
19          run: |  
20            cd Autoconfig/matrixMult/FORTRAN/  
21            pwd  
22            autoconf  
23            ./configure  
24            make
```

Github Actions

The screenshot displays the Github Actions interface. At the top, a navigation bar includes links for Code, Issues, Pull requests, **Actions** (highlighted with an orange box), Projects, Wiki, Security, and Insights. Below the navigation bar, the left sidebar shows the 'Actions' section with a 'New workflow' button and a list of workflow names: 'All workflows', 'Check Dockerfile', 'matrixMult_CUDA', 'matrixMult_Fortran', 'matrixMult_OpenACC', 'matrixMult_OpenACC_Fortr...', 'MPIStencil_MPI_CPU', 'MPIStencil_MPI_oneThread', 'MPIStencil_MPI_OpenACC', 'simple_workflow_singularity', and 'Management'. The main content area is titled 'All workflows' and includes a search bar for 'Filter workflow runs'. It shows '260 workflow runs' and a table of workflow runs with columns for Event, Status, Branch, and Actor. Three workflow runs are visible, all with a status of 'Scheduled' and a 'Queued' icon, indicating they are ready to be executed.

Event	Status	Branch	Actor
● matrixMult_OpenACC_Fortran	Scheduled	matrixMult_OpenACC_Fortran #8:	16 hours ago *** Queued
● simple_workflow_singularity	Scheduled	simple_workflow_singularity #5:	16 hours ago *** Queued
● matrixMult_OpenACC	Scheduled	matrixMult_OpenACC #9: Scheduled	16 hours ago *** Queued

Self-hosted Runners

Built-in runners: No GPU software and hardware support, no MPI communication support

Self-hosted runners:

- Login to HPC: `ssh username@casper.ucar.edu`
- Follow step-by-step instructions provided in the repository's settings
- Prepare your environment and Run the provided `run.sh` by github
`execcasper -A NTDD0005 -l walltime=05:00:00 -l select=1:ncpus=1:mpiprocs=1:ngpus=1:mem=50GB -l gpu_type=v100`
- Add labels to yml file: `casper, self-hosted, Linux, X64`
- Trigger an event
 - **Push**
 - **Pull Request**



Documentation

The screenshot shows the GitHub repository settings page for 'Runners'. The 'Settings' tab is selected in the top navigation bar. A green button labeled 'New self-hosted runner' is highlighted with an orange box. The 'Runners' section displays a table of existing runners:

Runners	Status
<code>casper36</code> (self-hosted) Linux X64 casper	● Offline ...
<code>casper-cena</code> (self-hosted) Linux X64	● Offline ...

The 'Runners' tab is also highlighted with an orange box in the left sidebar.

Runners

New self-hosted runner

Host your own runners and customize the environment used to run jobs in your GitHub Actions workflows. [Learn more about self-hosted runners.](#)

Runners	Status
 casper36 self-hosted Linux X64 casper	● Offline ...

Code Issues Pull requests **Actions** Projects Wiki Security Insights Settings

← MPIStencil_MPI_OpenACC

 **changes #2** Re-run all jobs ...

Summary

Jobs

-  Build_Makefile
-  Build_Autoconfig
-  Build_CMake

Run details

-  Usage
-  Workflow file

Triggered via push last month

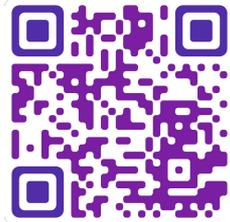
	Status	Total duration	Artifacts
 haniyeka pushed <code>-o- d083c32</code> <code>main</code>	Success	3h 30m 7s	-

MPIStencil_MPI_OpenACC.yaml
on: push

 Build_Makefile	2m 11s
 Build_Autoconfig	2m 14s
 Build_CMake	1m 55s

Documentation and Examples

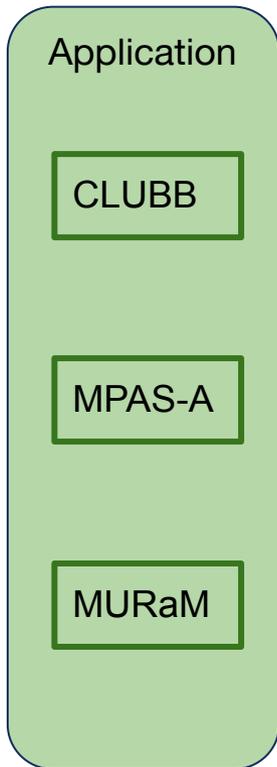
https://github.com/NCAR/Siparcs2023_CI_CD/



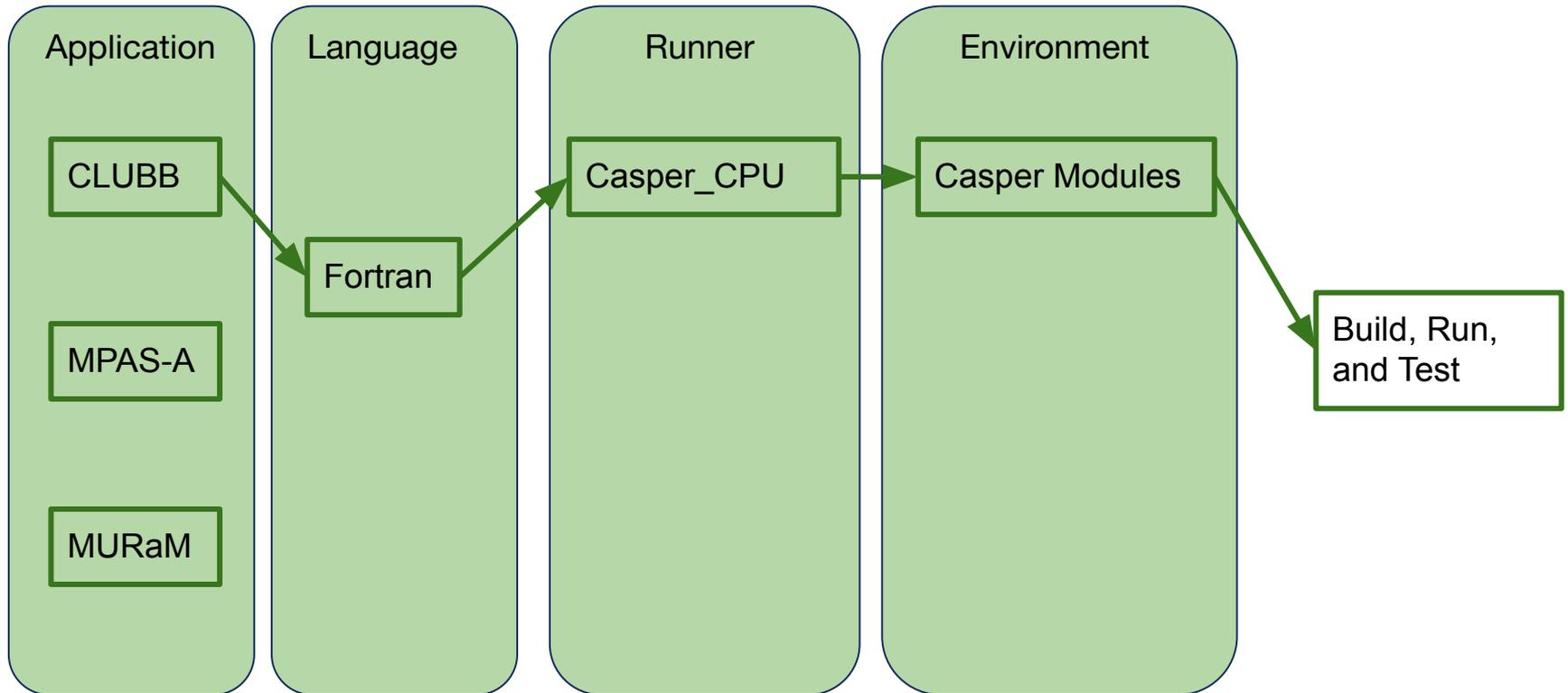
📄 DockerCheck.yaml
📄 MPIStencil_MPI_CPU.yaml
📄 MPIStencil_MPI_OpenACC.yaml
📄 MPIStencil_MPI_oneThread.yaml
📄 matrixMult_CUDA.yaml
📄 matrixMult_Fortran.yaml
📄 matrixMult_OpenACC.yaml
📄 matrixMult_OpenACC_FORTRAN.yaml
📄 simple_workflow_docker.yaml

▶ Autoconfig
▶ CMake
▶ Docker Image: haniyeka carl_fftw_...
▶ Github Action Notes
▶ Github Actions
▶ Makefile
▼ Setting up Self hosted Runners
Setting up Self-hosted Runners
Setting Up Casper Runners for GitHub Actions
Example of Github workflow
Utilizing Self-hosted Runners and Containers
Using singularity image
Using docker image

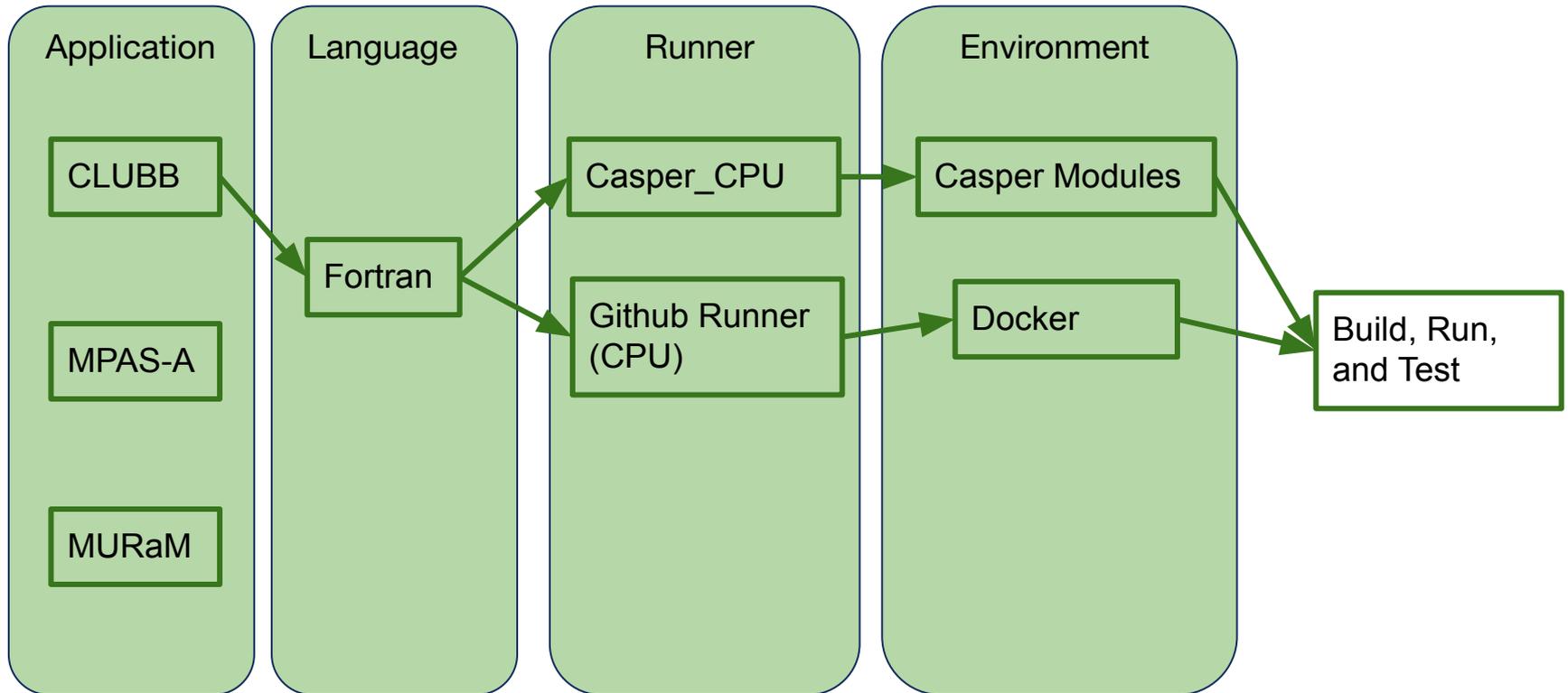
ASAP Applications



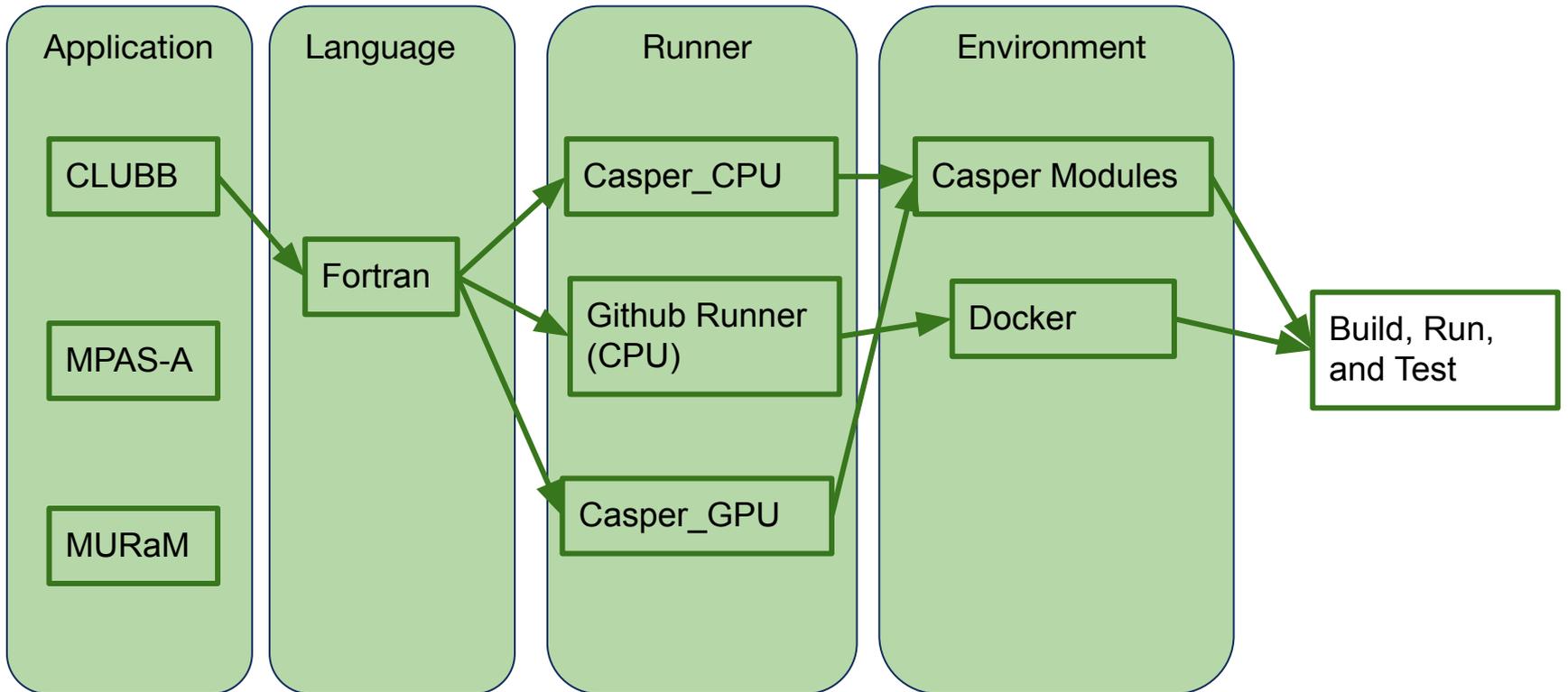
ASAP Applications



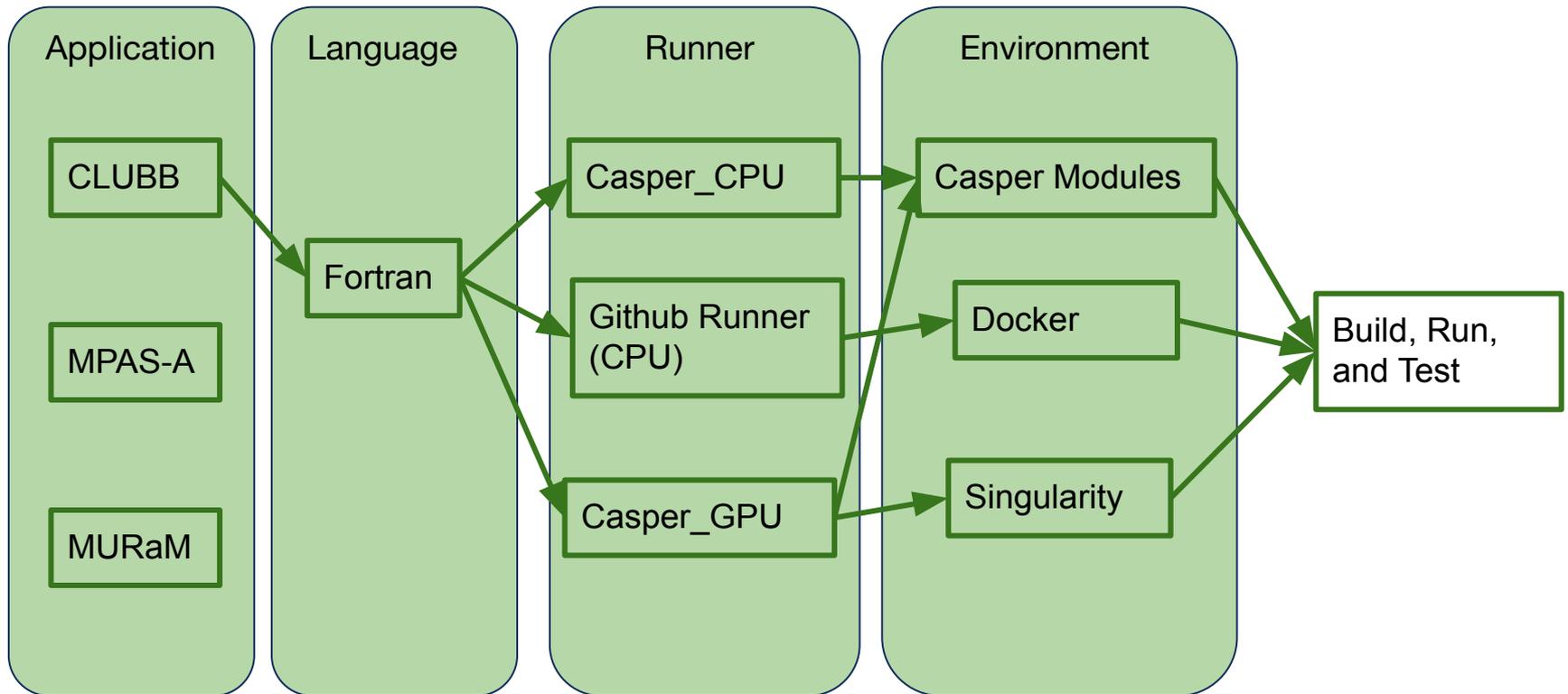
ASAP Applications



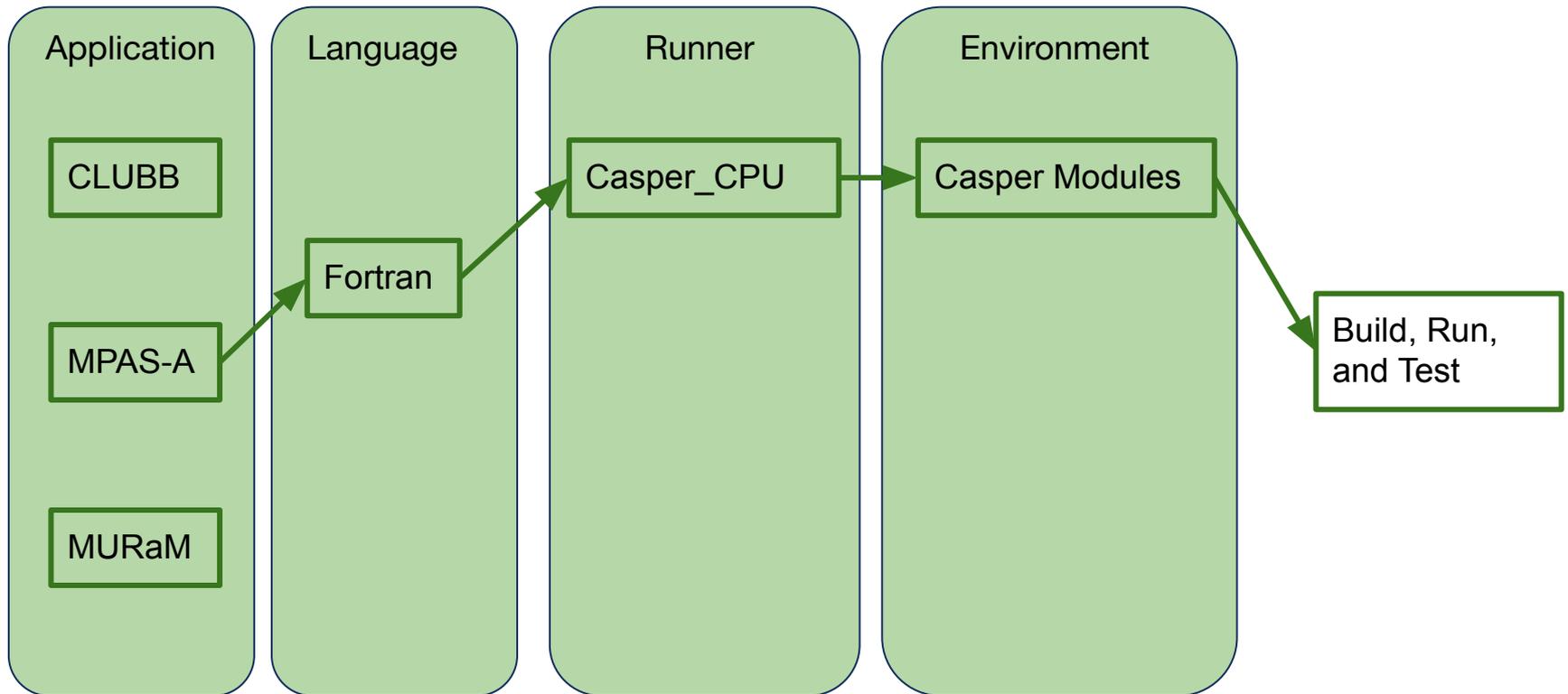
ASAP Applications



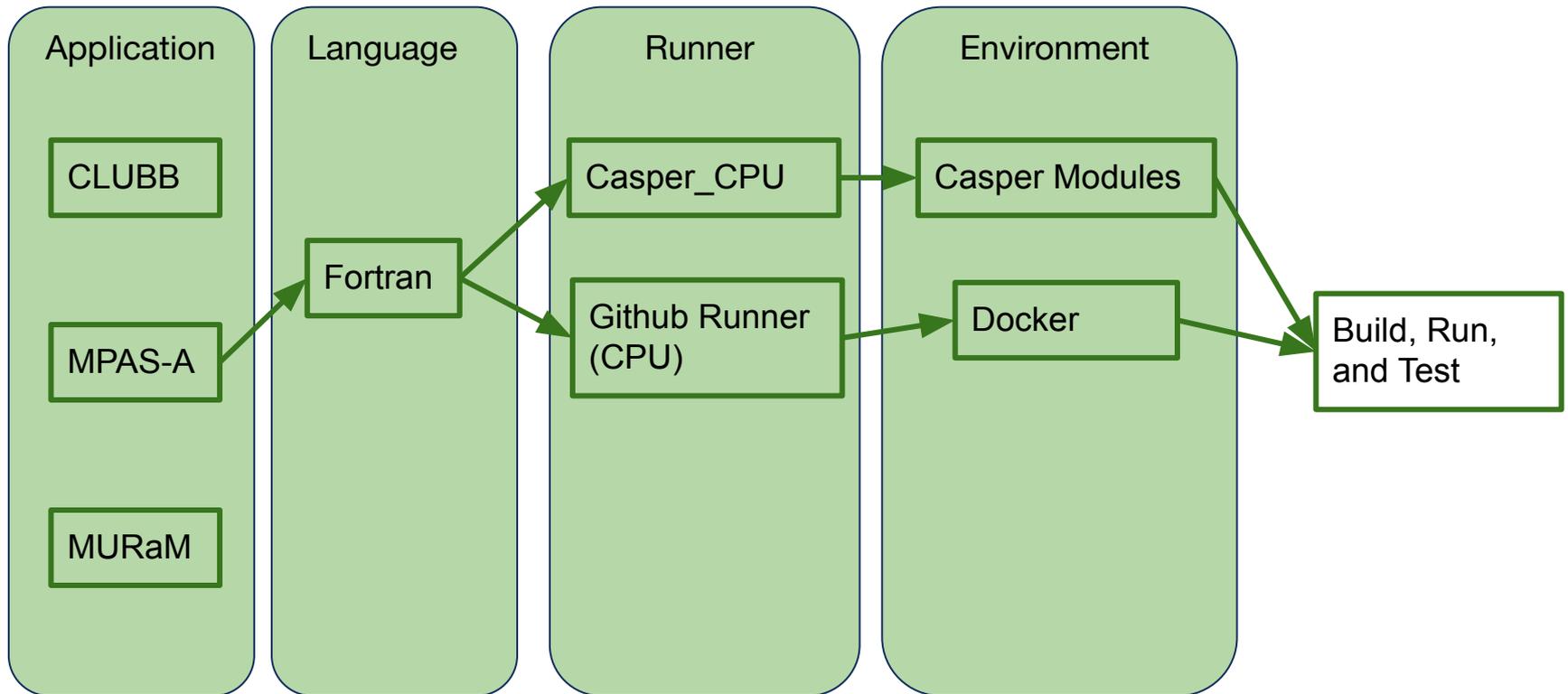
ASAP Applications



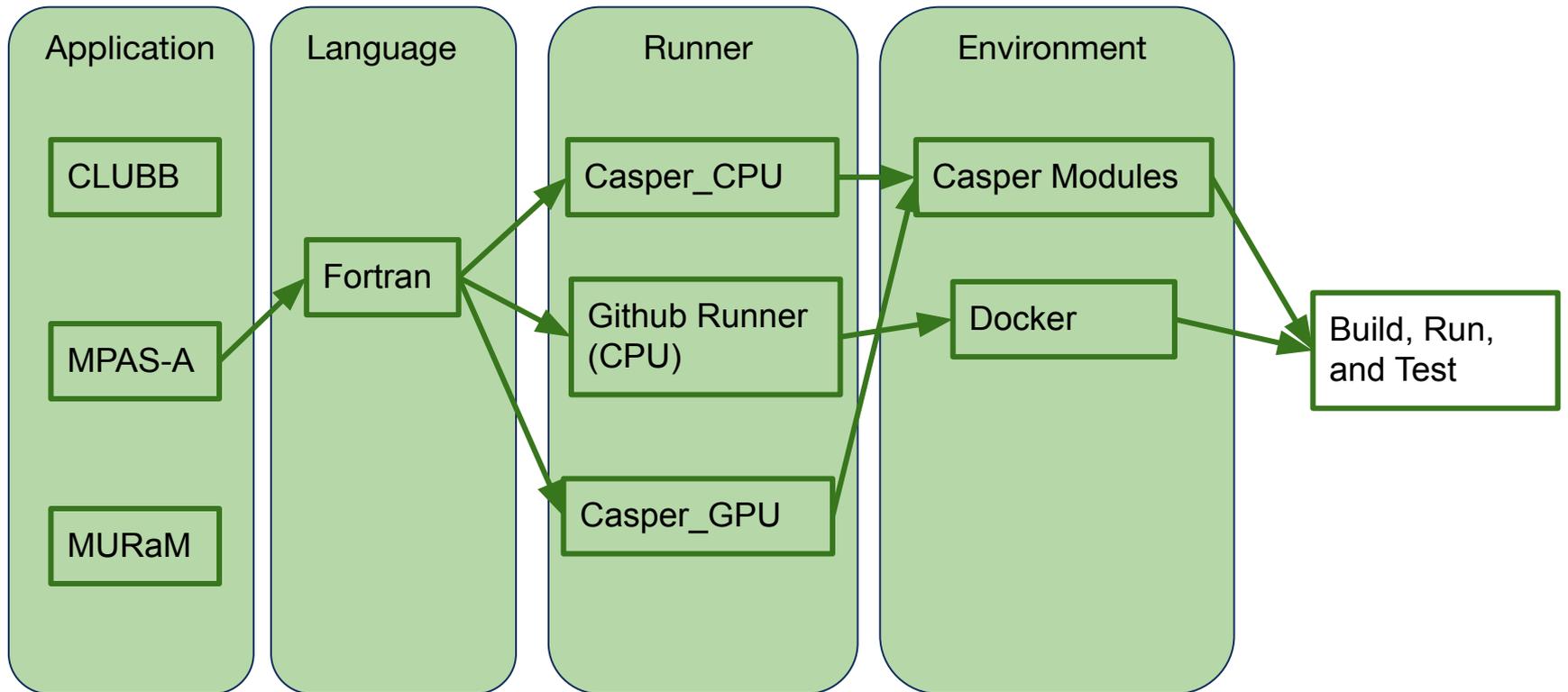
ASAP Applications



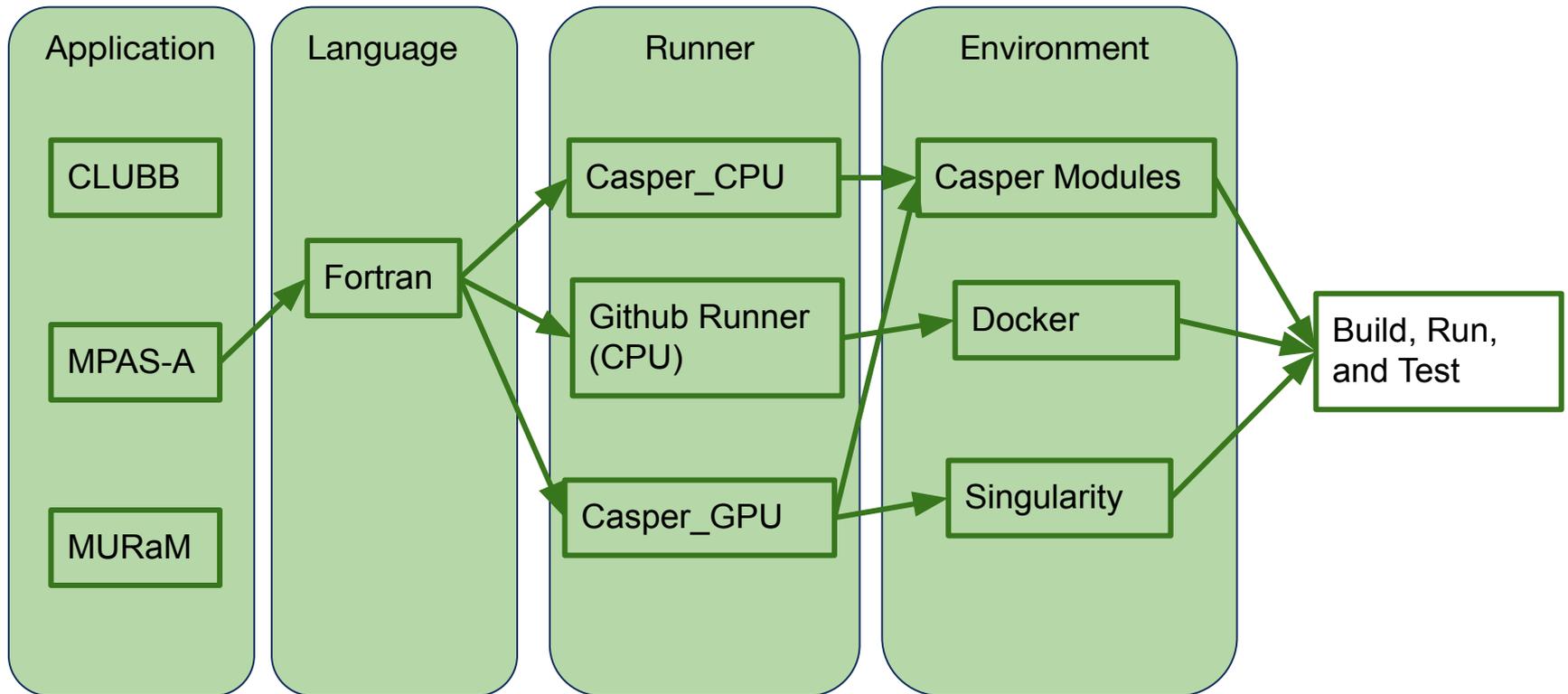
ASAP Applications



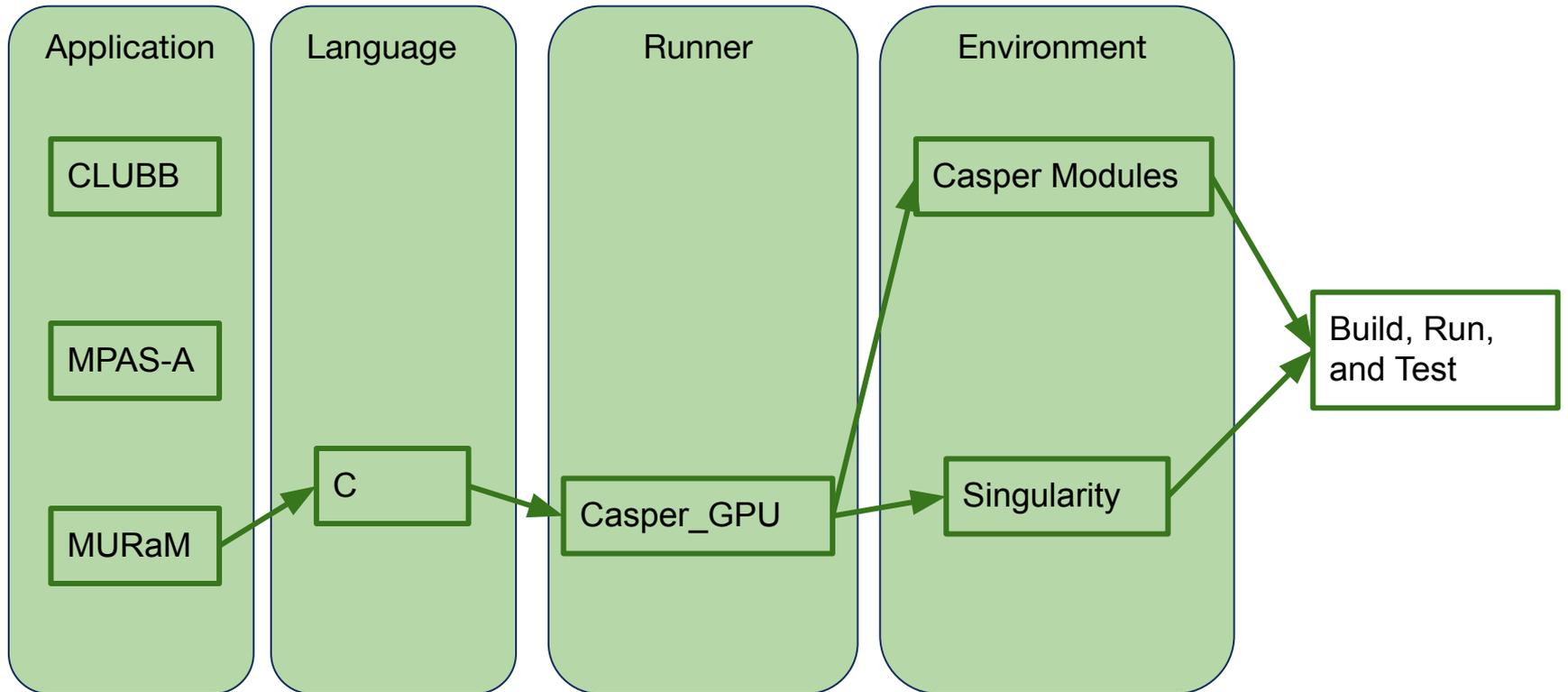
ASAP Applications



ASAP Applications



ASAP Applications



Summary of Achieved Goals

- Documentation and Examples
- Focus on implementing CI for multiple ASAP applications
 - CLUBB
 - MURaM
 - MPAS-A

Thank you!

Mentors: Supreeth Suresh,
Cena Brown

Carl Ponder - NVIDIA

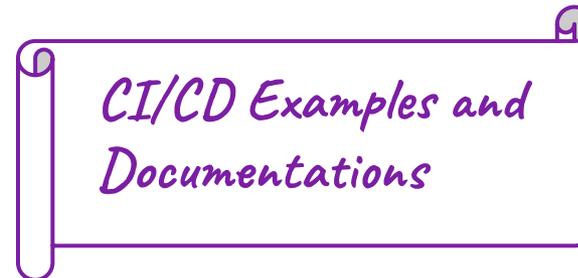
ASAP Team!

SIParCS Team!

SIParCS 2023 Interns!

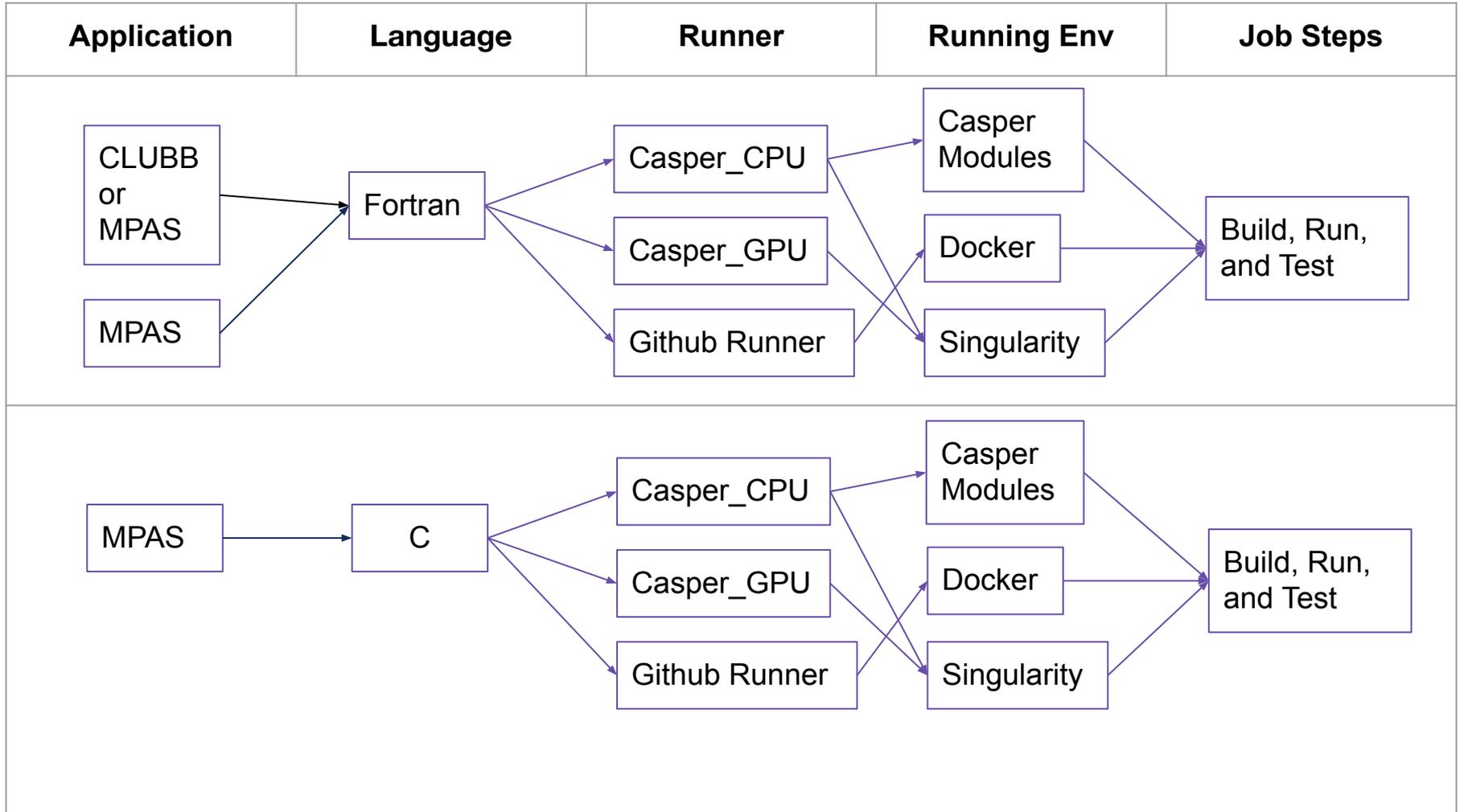


Questions?

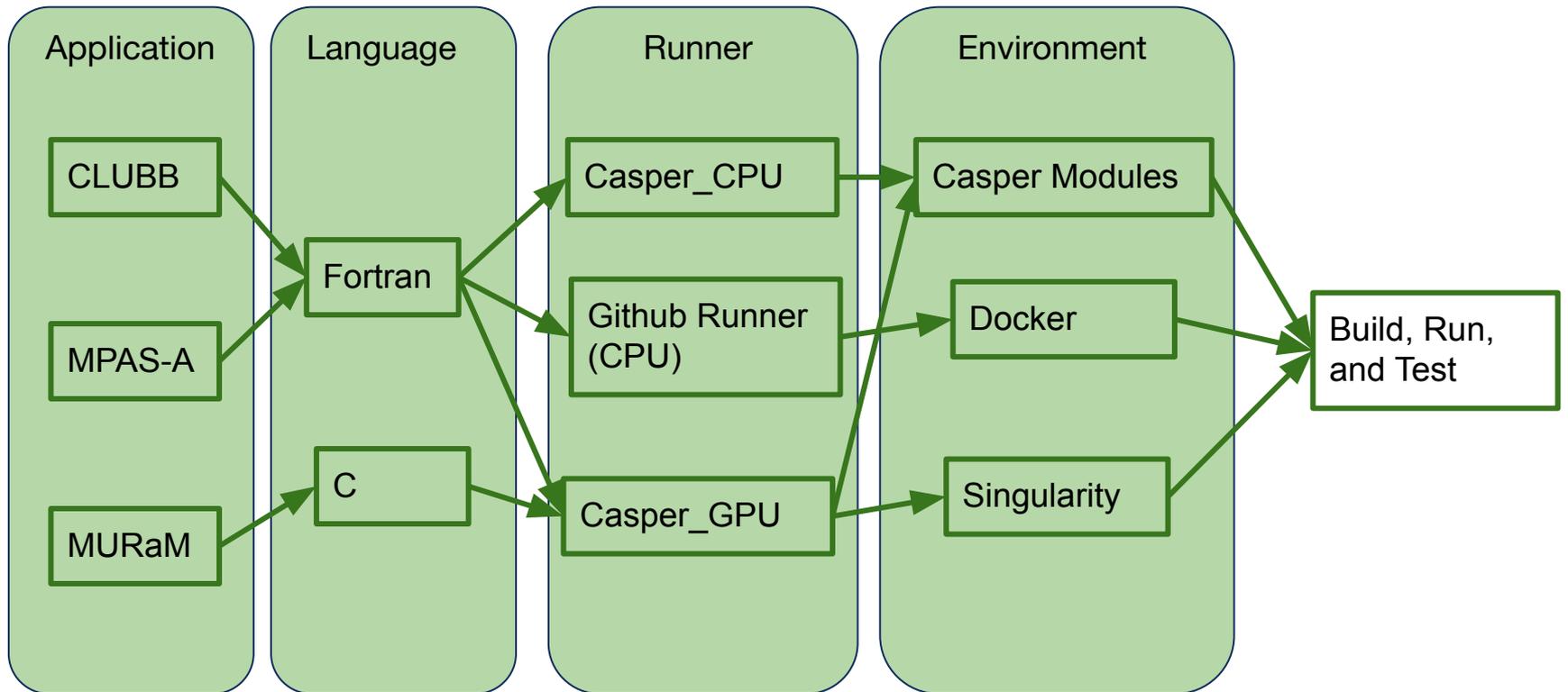


hkashgar@uwyo.edu

Workflows



ASAP Applications



Application	Language	Runner	Environment
CLUBB	Fortran	Github Runner	Docker Container
		Casper CPU	Casper Modules
		Casper GPU	Singularity Container
			Casper Modules
MPAS-A	Fortran	Github Runner	Docker Container
		Casper CPU	Casper Modules
		Casper GPU	Singularity Container
			Casper Modules
MURaM	C	Casper GPU	Singularity Container
			Casper Modules