

CI/CD for statistical software engineering

BERRY

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PSI2025 Session: Statistical Software Engineering

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ADDPLAN

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Continuous Integration (CI)

- **Frequent Code Integration:** Developers regularly merge code changes into a shared repository, often multiple times a day.
- **Automated Builds and Tests:** Each integration triggers automated builds and tests to quickly detect errors and integration issues.
- **Early Bug Detection:** CI helps catch bugs early in the development cycle, reducing the cost and effort to fix them.
- **Improved Collaboration:** CI encourages team collaboration by keeping everyone's code up to date and compatible.
- **Faster Delivery:** By automating testing and integration, CI accelerates the development process and improves software quality.

Continuous Integration (CI): Pipelines

Pipelines - Recent

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New pipeline

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Recently run pipelines

Pipeline	Last run
<div>facts-master</div>	<div>#20250522.8 • Improve DE allocation graphs when ...</div> <div>Individual CI for master</div> <div>5h ago26m 14s</div> <div></div>
<div>facts-7.1</div>	<div>#20250331.1 • Update DR graph labels to be unique</div> <div>Individual CI for release/FACTS-7.1</div> <div>31 Mar21m 52s</div> <div></div>
<div>facts-7.0</div>	<div>#20230407.1 • Fix miscellaneous issues in PT design...</div> <div>Individual CI for release/FACTS-7.0</div> <div>7 Apr 202320m 12s</div> <div></div>
<div>facts-6.5</div>	<div>#20221202.3 • Properly update Setup.vdproj</div> <div>Individual CI for release/FACTS-6.5</div> <div>2 Dec 202219m 21s</div> <div></div>
<div>facts-6.4</div>	<div>#20211012.2 • Fix array out of bounds exception w...</div> <div>Individual CI for release/FACTS-6.4</div> <div>12 Oct 202121m 22s</div> <div></div>
<div>facts-6.3</div>	<div>#20200812.2 • Correctly update FACTS 6.3.1 AZ spe...</div> <div>Individual CI for release/FACTS-6.3</div> <div>12 Aug 202019m 36s</div> <div></div>
<div>facts-6.2</div>	<div>#20191003.1 • Ensure manifest gets generated</div> <div></div> <div>3 Oct 201918m 56s</div> <div></div>

Continuous Integration (CI): Pipeline Builds

Azure DevOps berryconsultants / facts / Pipelines / facts-master					
Runs Branches Analytics					
✓	#20250428.8 • Attempt to fix build error	✓	28 Apr	22m 25s	
✗	#20250428.7 • Merge branch 'master' of https://bitbucket.org/berryc...	✗	28 Apr	22m 21s	
✓	#20250428.6 • Merge branch 'master' of https://bitbucket.org/berryc...	✓	28 Apr	21m 45s	
✓	#20250428.5 • Merge branch 'master' of https://bitbucket.org/berryc...	✓	28 Apr	22m 12s	
✓	#20250428.4 • Merge branch 'master' of https://bitbucket.org/berryc...	✓	28 Apr	21m 45s	
✓	#20250428.3 • Start DE engine consolidation process by changing lan...	✓	28 Apr	25m 4s	
✓	#20250428.2 • Only display operational QOIs in ME on utility endpoint	✓	28 Apr	24m 28s	
✓	#20250428.1 • Update results graph names to refer to QOIs rather tha...	✓	28 Apr	24m 59s	
✓	#20250426.1 • Remove erroneous check in Per Dose. QOIs graph prev...	✓	26 Apr	21m 54s	

Continuous Integration (CI): Pipeline Build Steps

The screenshot displays the Azure DevOps web interface for a pipeline run. The browser tabs show 'FACTS 7.1 - Release-8 - Pipeline' and 'Pipelines - Run 20250331.1 logs'. The address bar shows the URL: `dev.azure.com/berryconsultants/facts/_build/results?buildId=4240&view=logs&j=fd490c07-0b22-5182-fac9-6d67fe1e939b&t=0a4209...`. The breadcrumb navigation is: `berryconsultants / facts / Pipelines / facts-7.1 / 20250331.1`. The left sidebar shows the pipeline steps for run #20250331.1:

Step	Duration
Initialize job	1s
Checkout...	1m 13s
NuGet install	2s
NuGet restore	9s
Add EnableOu...	2s
Build FAC...	5m 17s
Build FAC...	1m 35s
Run tests	5m 5s
Create Windo...	1s
Create Engin...	13s
Copy FACTS ...	11s
Copy report g...	1s
Publish FACT...	22s
Copy FLFLL t...	10s
Publish FLFLL...	18s

The main area shows the 'Run tests' step with a green checkmark and the title 'Run tests'. A 'View raw log' button is visible. The log output shows a series of test results, all passing:

```
462 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(0.5d,0.25d,False) [11 ms]
463 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(0.5d,1.5d,False) [< 1 ms]
464 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(0.5d,1.6d,True) [< 1 ms]
465 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(2.5d,2.75d,False) [< 1 ms]
466 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(2.5d,1.5d,True) [< 1 ms]
467 Passed DoseComboHelper_CorrectlyFlagsWhetherDoseComboShouldMoveAfterStrengthChange(2.5d,1.4d,True) [< 1 ms]
468 Passed DoseComboHelper_PopulatesCandidateControlDoseCombosCorrectly [3 ms]
469 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(True,1.5d,0,"Please set dose combo strength to be stri
470 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(True,1.5d,1,"Please set dose combo strengths to be dis
471 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(True,1.5d,1.75d,null) [< 1 ms]
472 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(True,1.5d,0.5d,null) [< 1 ms]
473 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(False,1.5d,0,null) [< 1 ms]
474 Passed DoseComboHelper_WhenDoseComboUpdated_ReturnsExpectedValidationMessage(False,1.5d,1,null) [< 1 ms]
475 Passed DoseComboHelper_WithEmptyCurrentAllowedDoseCombos_OrdersAllowedDoseCombosByLevel [2 ms]
476 Passed DoseComboHelper_WithEmptyCurrentDoseCombos_PopulatesDoseCombosCorrectly(0) [5 ms]
477 Passed DoseComboHelper_WithEmptyCurrentDoseCombos_PopulatesDoseCombosCorrectly(1) [< 1 ms]
478 Passed DoseComboHelper_WithNonEmptyCurrentAllowedDoseCombos_OrdersAllowedDoseCombosByLevel [20 ms]
479 Passed DoseComboHelper_WithNonEmptyCurrentDoseCombos_PopulatesDoseCombosCorrectly(0) [2 ms]
480 Passed DoseComboHelper_WithNonEmptyCurrentDoseCombos_PopulatesDoseCombosCorrectly(1) [< 1 ms]
481 Passed TestCompareTo [4 ms]
482 Passed TestConstructor [< 1 ms]
483 Passed TestDoseStrength [1 ms]
484 Passed TestEquals [1 ms]
485 Passed TestGetACStrength [2 ms]
486 Passed TestName [2 ms]
487 Passed TestPropertyNames [< 1 ms]
```


Continuous Integration (CI): Pipeline Build Artifacts

Pipelines - Run 20250522.8 arti

dev.azure.com/berryconsultants/facts/_build/results?buildId=4410&view=artifacts&pathAsName=false&type=publishedArtifacts

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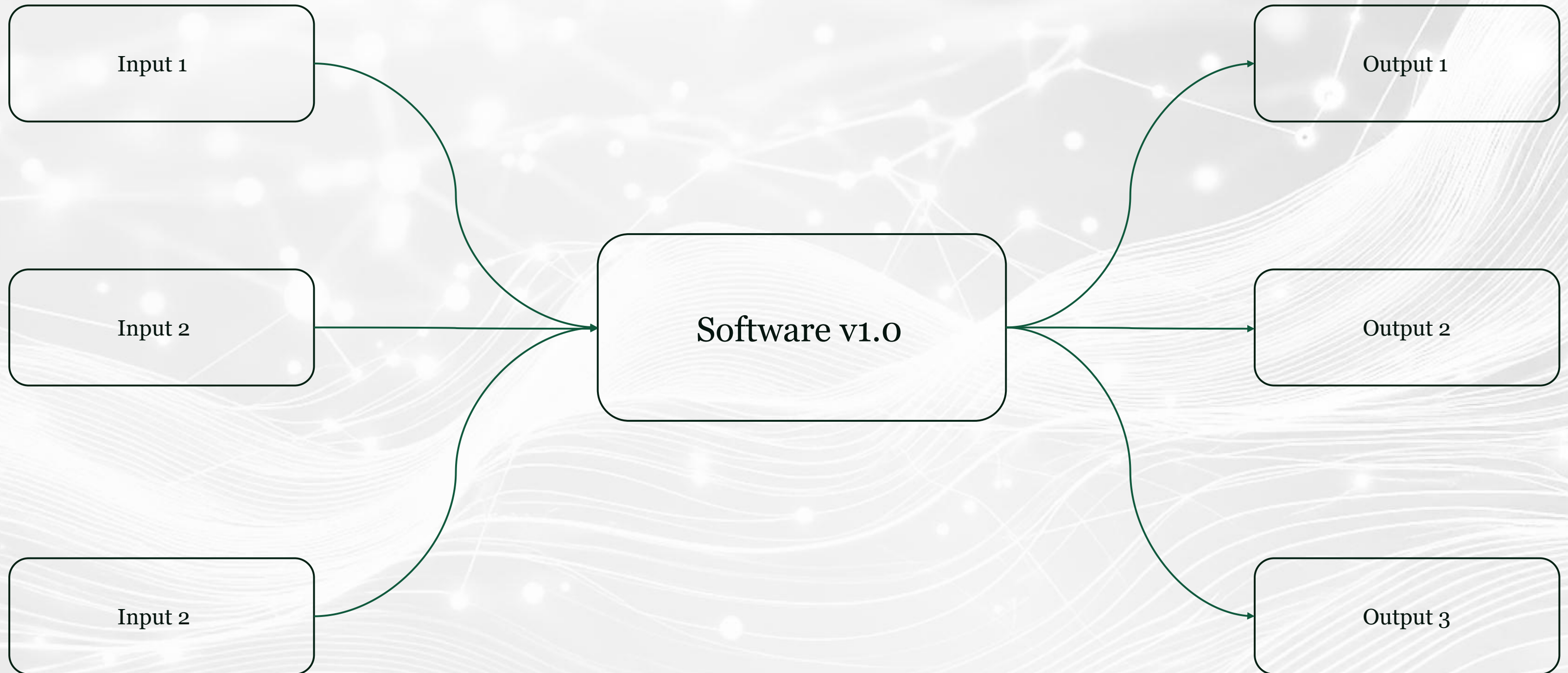
Project settings

Artifacts

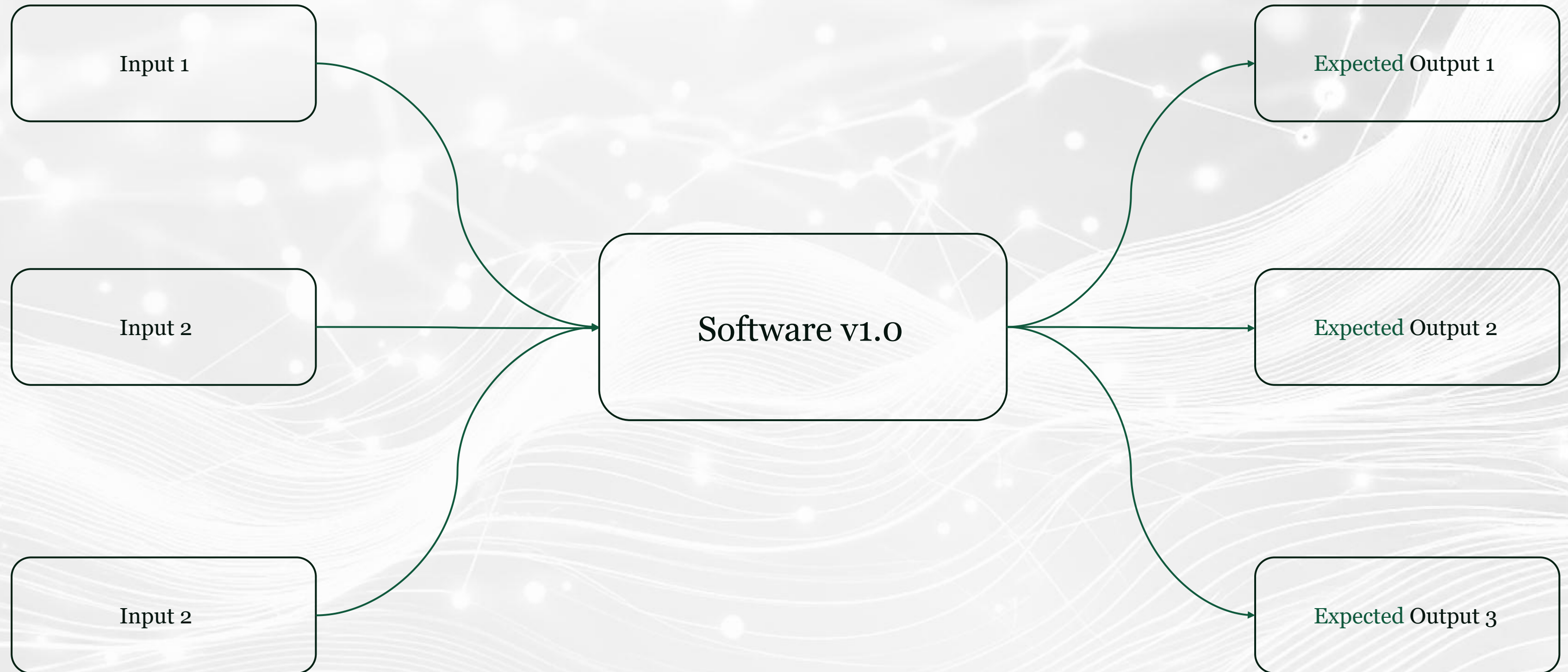
PublishedConsumed

Name	Size
> facts-master-build_20250522.8	327 MB
> facts-master-desktop-app-deployer_20250522.8	2 MB
> facts-master-flfl_20250522.8	303 MB
> facts-master-installer_20250522.8	133 MB
> facts-master-linux-engines_20250522.8	294 MB
> facts-master-windows-engines_20250522.8	165 MB

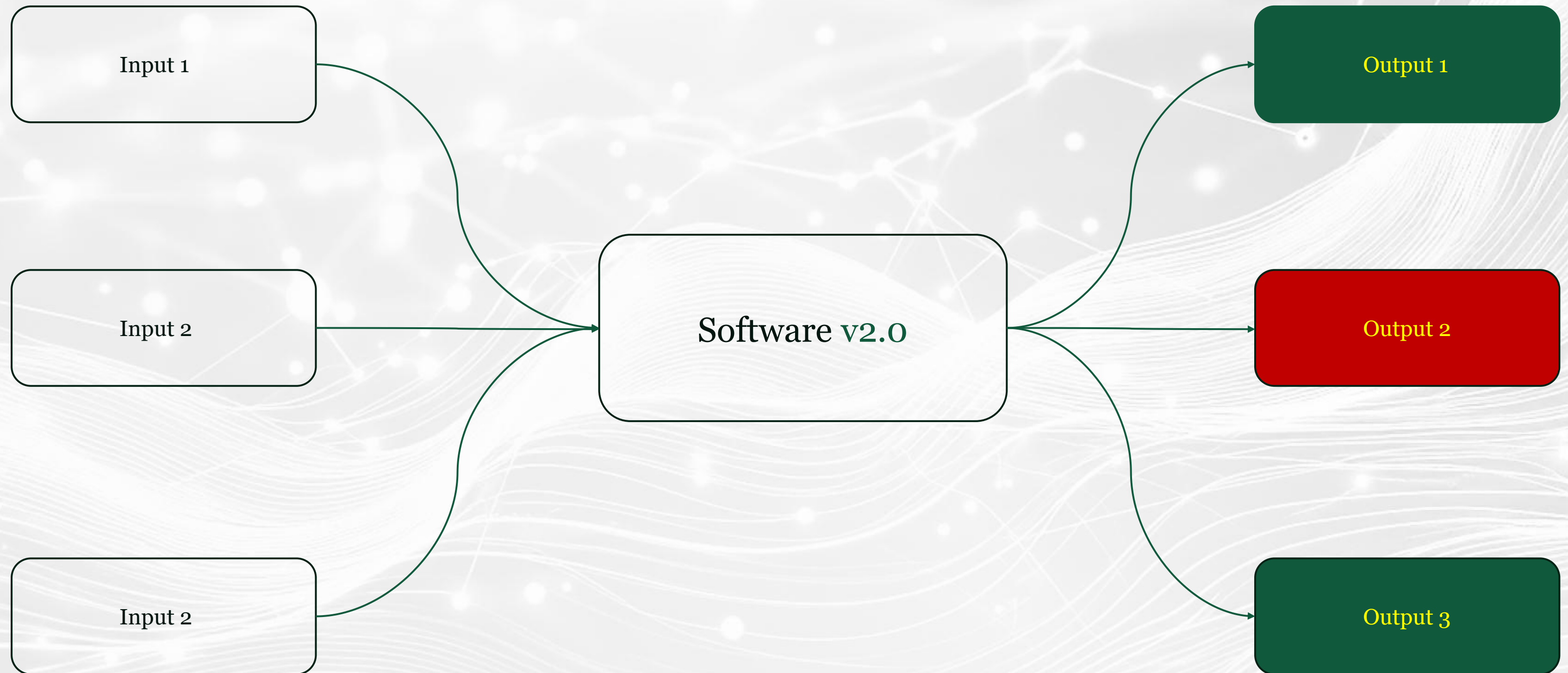
Continuous Integration (CI): End-to-End (E2E) testing



Continuous Integration (CI): End-to-End (E2E) testing



Continuous Integration (CI): End-to-End (E2E) testing



Continuous Delivery (CD)

- **Automated Release Process:** CD ensures that code changes are automatically prepared for a release to production after passing CI.
- **Production-Ready Builds:** Every code change that passes tests is considered deployable, ensuring a consistently shippable product.
- **Manual or Triggered Deployment:** Releases can be deployed to production at any time with minimal effort, often by a single click or command.
- **Faster Time to Market:** CD shortens the release cycle, enabling more frequent and reliable software updates.
- **Reduced Deployment Risk:** Frequent, smaller updates lower the chances of large-scale failures and make rollback easier if issues occur.

Continuous Delivery (CD): Release Pipelines

The screenshot displays the Azure DevOps web interface for a project named 'facts'. The left sidebar contains a navigation menu with options: Overview, Pipelines, Environments, Releases (selected), Library, Task groups, and Deployment groups. The main content area is titled 'FACTS 7.1' and shows a list of releases. The 'Releases' tab is active, displaying a table with columns for 'Created' and 'Stages'. The table lists three releases: Release-8, Release-7, and Release-6, each with a 'Package a...' button. The 'Releases' tab is selected, and the 'Created' column is sorted. The 'Stages' column shows the status of the release stages.

Release	Created	Stages
Release-8	31/03/2025, 11:25:28	Package a...
Release-7	31/01/2025, 15:43:09	Package a...
Release-6	09/12/2024, 16:11:49	Package a...

Continuous Delivery (CD): Release Pipeline Steps

The screenshot displays the Azure DevOps web interface for a release pipeline. The browser address bar shows the URL: `dev.azure.com/berryconsultants/facts/_releaseProgress?_a=release-environment-logs&releaseId=899&environmentId=8893`. The breadcrumb navigation indicates the path: `berryconsultants / facts / Pipelines / Releases / FACTS 7.1 / Release-8`. The left sidebar shows the 'facts' project with a list of items: Overview, Pipelines, Pipelines, Environments, Releases, Library, Task groups, and Deployment groups. The main content area shows the 'Package and deploy FACTS release' step, which is marked as 'Succeeded'. Below this, the 'Deployment process' is shown as 'Succeeded'. The 'Logs' tab is active, displaying a list of tasks and their durations.

Task	Status	Duration
Download artifact - _facts-7.1 - facts-7.1-build_2025033...	succeeded	11s
Download artifact - _facts-7.1 - facts-7.1-flfll_20250331.1	succeeded	8s
Download artifact - _facts-7.1 - facts-7.1-installer_2025...	succeeded	8s
Download artifact - _facts-7.1 - facts-7.1-windows-engi...	succeeded	4s
Download artifact - _facts-7.1 - facts-7.1-desktop-app-...	succeeded	1s
Download artifact - _facts-7.1 - facts-7.1-linux-engines_...	succeeded	6s
Code sign FACTS MSI installer	succeeded	2s
Code sign FACTS EXEs	succeeded	4s
GIT clone facts-docs	succeeded	4m 23s
Create Examples.zip	succeeded	2s
Create Documents folder	succeeded	7m 8s
Create Documents.zip	succeeded	1s
Copy zipped files to FACTS installer folder	succeeded	1s
Copy Linux engine EXEs to FLFL folder: C:\agent\work...	succeeded	<1s

Continuous Delivery: Release Cycles

- Issues we faced:
 - FACTS releases were previously relatively bulky, non-deterministic and rare.
 - Bulky releases take longer to validate, both internally and externally. We wanted a **quicker validation process**.
 - A non-deterministic release schedule makes it harder for IT teams to deploy FACTS across their organization. We wanted a **predictable release schedule**.
 - FACTS releases were relatively rare (once a year). We wanted to provide **more frequent value**.
- Our aim: 4 releases a year, every 3 months.



The background features a light gray network of dots and lines, with a series of white, wavy, concentric lines on the right side. The word "BERRY" is centered in a dark green, stylized font.

BERRY

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