How CI/CD Enhances the Development of R Packages in the Pharmaverse

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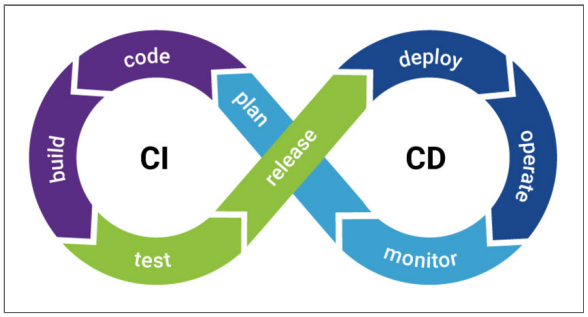
What is CI/CD?

- Continuous Integration (CI): Frequent merging of several small changes into a main branch
- Continuous Delivery (CD): Repeatable deployment process when deciding to deploy

  CI/CD bridges the gaps between development and operation activities and teams by **enforcing automation** in building, testing and deployment of applications. CI/CD services compile the incremental code changes made by developers, then link and package them into software deliverables



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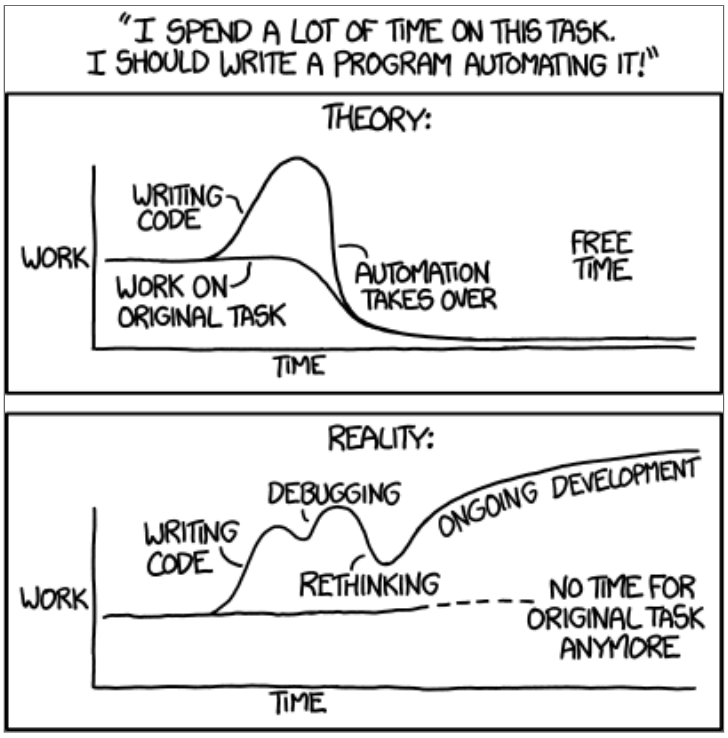
Does it help?



...Yes! Yes, it does!!

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How does CI/CD help R packages?

- Catch issues (bugs) early on
- User base on multiple OSes and multiple R versions
- Faster turnaround on Code Review
- Multiple Contributors on your R Package
- Enforce style conventions and preferences
- Measure test coverage for new code
- Keep docs up-to-date
- And we can just keep going!

  We covered a lot of custom CI/CD actions for R packages in the R/Pharma Workshop in 2022: **Intro to CI/CD for R Packages**

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Two Case Studies

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Case Study - admiral

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About admiral

- Provide an open source, modularized toolbox that enables the pharmaceutical programming community to develop ADaM datasets in R.
- ADaM is one of the required standards for data submission to FDA (U.S.) and PMDA (Japan) for clinical trials
- Links
  - **CDISC**
  - **https://github.com/pharmaverse/admiral**
- **Issue 1:** Checking ADaM Template code
- **Issue 2:** Common CI/CD workflows for the `admiral` family of packages

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Issue 1 - How to Check our Template Code

- Create a reference files to build common ADaM datasets that shows users how to implement our functions
- Way less text than a Vignette - Code is ready to go and build a dataset
- Where we store this code is not checked by R-CMD
- How to ensure code stays up to date with deprecated functions or unforeseen bugs get in from functions working together?
- CI/CD for the win!

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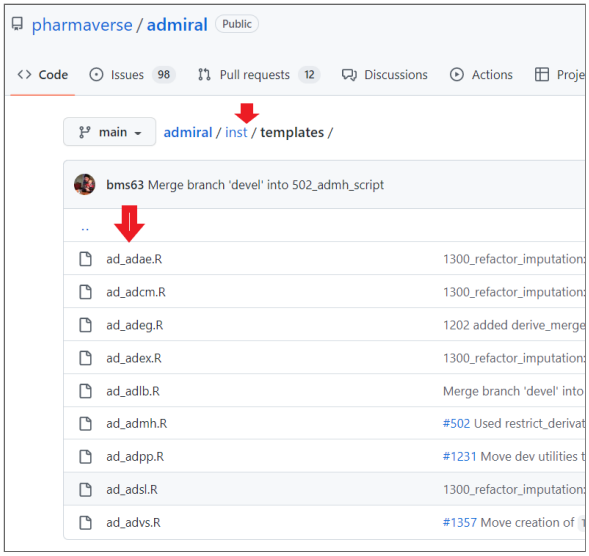
pharmaverse / admiral
Public
Code
Issues 98
Pull requests 12
Discussions
Actions
main
admiral / inst / templates /
bms63 Merge branch 'devel' into 502_admh_script
..
ad_adae.R
ad_adcm.R
ad_adeg.R
ad_adex.R
ad_adlb.R
ad_admh.R
ad_adpp.R
ad_adsl.R
ad_advs.R

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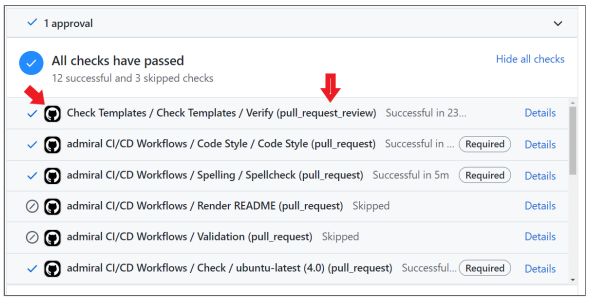
Solution 1 - CI/CD for Templates

- Dedicated CI/CD workflow that executes the Template code
- Once a Code Review is completed the `Check Template` Workflow is executed
- If any errors or warnings are detected the CI/CD check fails and the contributor must fix the error or warning.

  .github/workflows/check-templates.yml



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Issue 2 - admiral upstream and downstream dependencies

- As you can imagine there can be a lot of different types of ADaMs!
- Extension packages focus on specific disease areas like oncology
- The `admiral` family has a package for developers, template R package repo and dummy data
- Eek!! How to keep this all in line!

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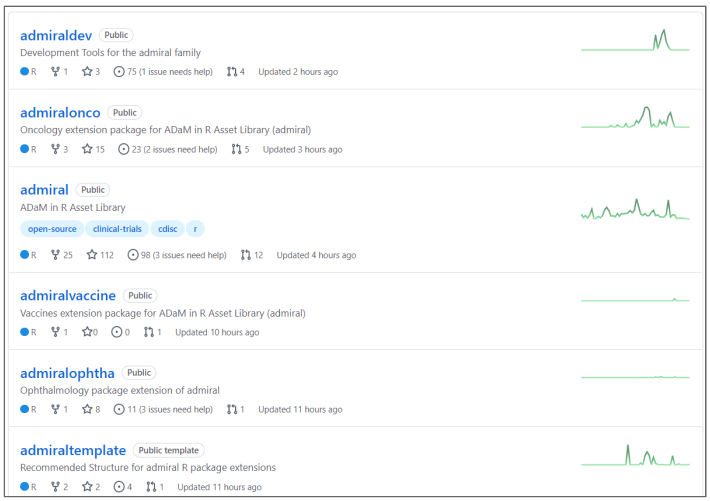
admiraldev Public
Development Tools for the admiral family
R 1 3 75 (1 issue needs help) 4 Updated 2 hours ago
admiralonco Public
Oncology extension package for ADaM in R Asset Library (admiral)
R 3 15 23 (2 issues need help) 5 Updated 3 hours ago
admiral Public
ADaM in R Asset Library
open-source clinical-trials cdisc r
R 25 112 98 (3 issues need help) 12 Updated 4 hours ago
admiralvaccine Public
Vaccines extension package for ADaM in R Asset Library (admiral)
R 1 0 0 1 Updated 10 hours ago
admiralophtha Public
Ophthalmology package extension of admiral
R 1 8 11 (3 issues need help) 1 Updated 11 hours ago
admiraltemplate Public template
Recommended Structure for admiral R package extensions
R 2 2 4 1 Updated 11 hours ago

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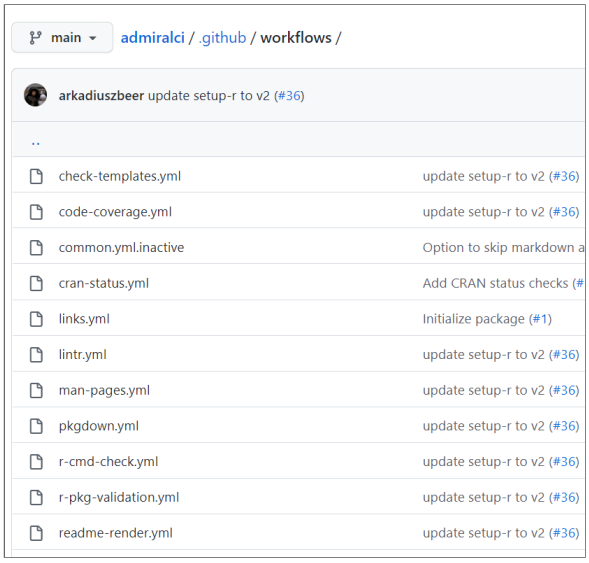
Solution 2 - Common CI/CD workflows for admiral upstream and downstream dependencies

- Using `admiralci`, we have a common set of CI/CD workflows
- Developers moving between packages are familiar with these workflows
- Common documentation between packages for CI/CD workflows - easy to maintain and provide to new contributors



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Case Study - NEST

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About NEST

- A collection of R packages for creating TLGs/TFLs and exploratory clinical trials data visualization
- `tern` for creating TLGs
- `teal` for creating exploratory web applications for analyzing clinical trial data
- Links
  - **rtables**
  - **NEST GitHub Organization**

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Use Case 1 - Integration Testing

- An in-development package must be tested against the latest versions of upstream dependencies
- Monorepo emulation via a git branch naming strategy is achieved by using
  - the **staged.dependencies R package**
  - and the **staged.dependencies GitHub Action**
- Testing as a cohort can be done at any stage (eg. development, pre-release, release)

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Use Case 2 - Web Application Testing & Deployment

- Analysts create Shiny web apps via the `teal` framework for analyzing data
- Apps are tested via a CI pipeline that uses the **`shinytest2`** R package
- Apps deployed to an Posit Connect Server instance via a CD pipeline
  - With the help of the **`rsconnect`** and **`connectapi`** R packages

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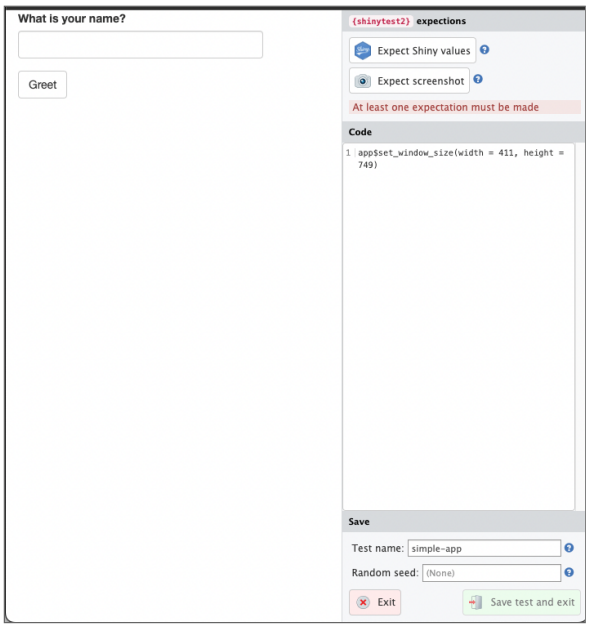
What is your name?
Greet
{shinytest2} expections
Expect Shiny values
Expect screenshot
At least one expectation must be made
Code
1 app$set_window_size(width = 411, height = 749)
Save
Test name: simple-app
Random seed: (None)
Exit
Save test and exit

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Use Case 3 - Validating R Packages

- R packages are validated by an internal validation team that uses CI/CD pipelines to automatically
  - accept new package submissions via a form
  - running tests against the new package to ensure package integrity
  - enforcing criteria to ensure that the package meets regulatory requirements
- Also validated externally via an open source project called **thevalidatoR**

Validation Report

teal.code (v0.2.0)

Server: https://github.com **Repository**: insightsengineering/teal.code
Reference: refs/tags/v0.2.0
Commit SHA: 6d2083bcd8cfe4bdf2191b9ffb177eb0325ae2de

Fri Oct 14 01:33:23 AM 2022

Contents

1 Context

This report was generated via the GH-action insightsengineering/validatoR (gh-action ID: __insightsengineering_thevalidatoR). It produces automated documentation of the installation of this package on an open source R environment, focussing on:

- Installation environment description
- Testing coverage
- Traceability matrix of specifications (documented behaviours) and testing
- Risk assessment benchmarks

This report is fully automated, so is limited to assess whether unit tests and documentation are present and can execute without error. An assessment would be required that the tests and documentation are meaningful. Validation aims to be system independent as the underlying workflow is based on the "composite" type of Github Action.

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Additional Materials

- Further Reading
  - GitHub Actions
  - GitLab CI
- Advanced Examples
  - r-lib/actions
  - {admiralci}
  - Docker
- Presentation built with Quarto
- R/Pharma 2022 CI/CD Workshop
- This Presentation

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