Codespaces for Open science

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PIFSC/ESD/ARP

Everything you Need to Know to Get Started Today!

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What are Codespaces?

What are Codespaces?

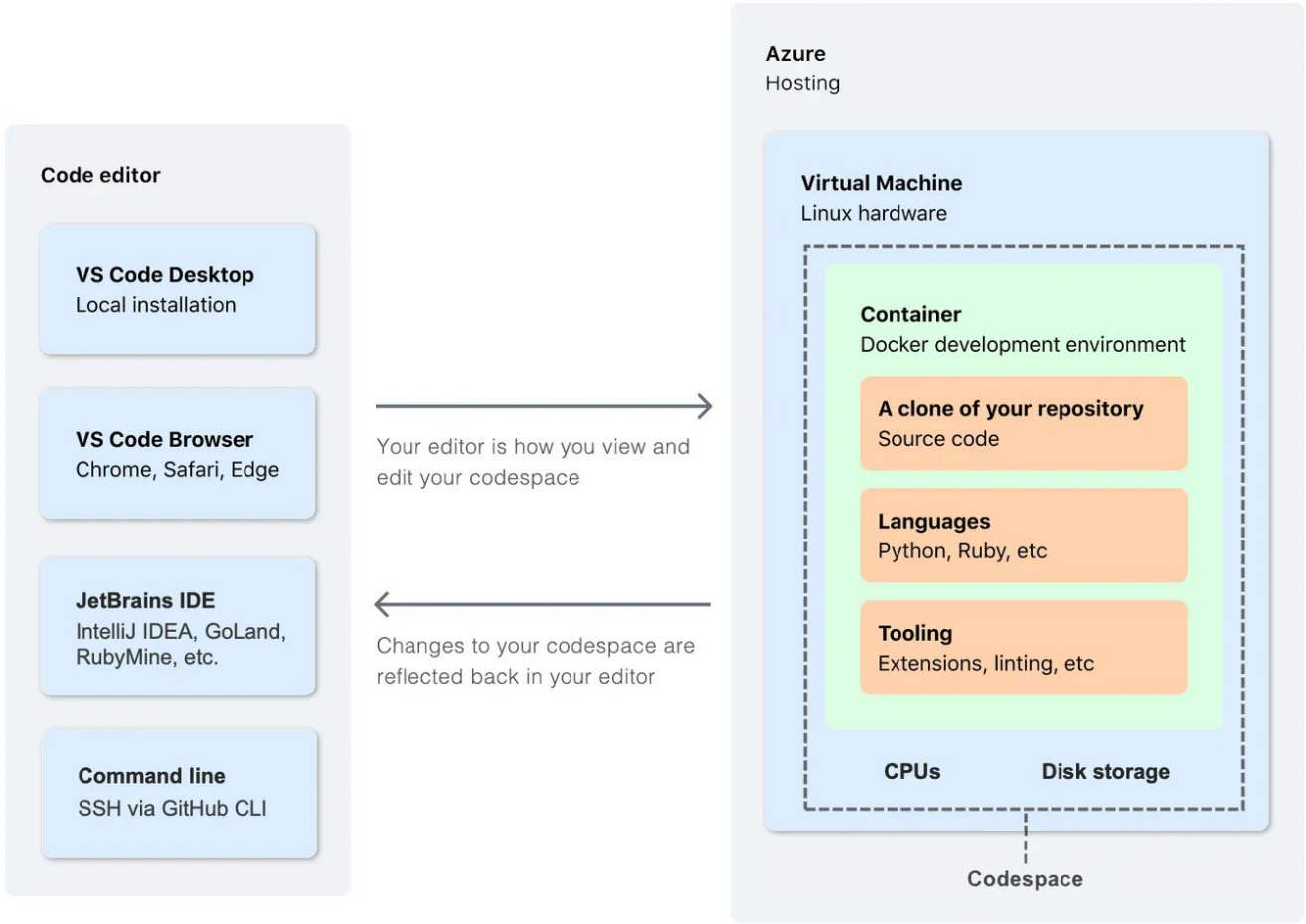
Your Code 💻 **+ Your Favorite Tools** 🧰

Your Code 💻 + Your Favorite Tools 🧰 In the Cloud ☁️

The Details: Github Codespaces

Cloud based environment

- Service by Github
- Connects to your Github Code Repository
- Runs on Virtual Machine in a containerized setup(using Docker)
- Fully customizable
  - from machine resources,
  - container setup,
  - access
  - & more



Link: https://github.com/features/codespaces

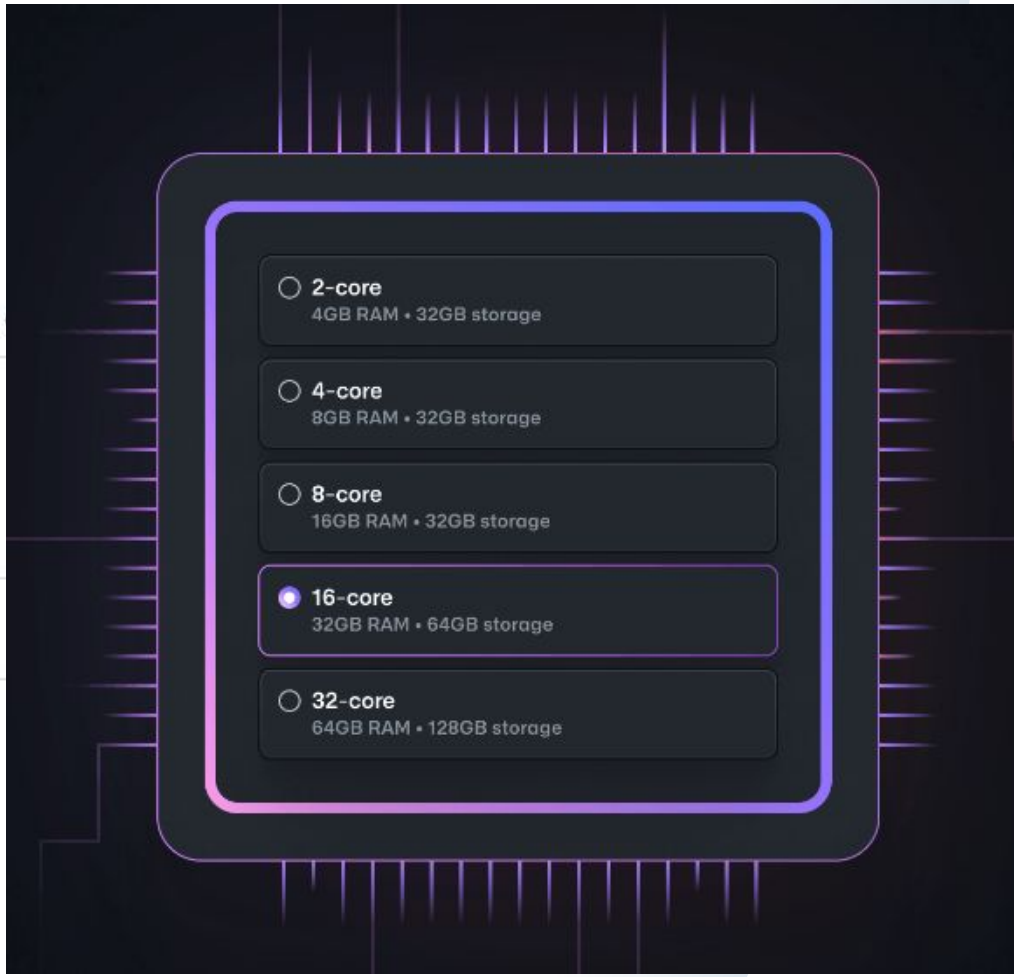
The Details: Cost & Options

Free & Paid Options Available

Monthly included storage and core hours for personal accounts

The following storage and core hours of usage are included, free of charge, for personal accounts:

Account plan	Storage per month	Core hours per month
GitHub Free for personal accounts	15 GB-month	120
GitHub Pro	20 GB-month	180



Link: About billing for GitHub Codespaces

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Why Codespaces?

The Benefits of Codespaces

Github Codespaces: Benefits

Benefits of GitHub Codespaces

Reasons for choosing to work in a codespace include:

- **Use a preconfigured development environment** - You can work in a development environment that has been specifically configured for the repository. It will have all of the tools, languages, and configurations you need to work on that project. Everyone who works on that repository in a codespace will have the same environment. This reduces the likelihood of environment-related problems occurring and being difficult to debug. Each repository can have settings that will give contributors a ready-to-use, fit-for-purpose environment, and the environment on your local machine will be unchanged.
- **Access the resources you need** - Your local computer may not have the processing power, or storage space, you need to work on a project. GitHub Codespaces allows you to work remotely on a machine with adequate resources.
- **Work anywhere** - All you need is a web browser. You can work in a codespace on your own computer, on a friend's laptop, or on a tablet. Open your codespace and pick up from where you left off on a different device.
- **Choose your editor** - Work in the browser in the VS Code web client, or choose from a selection of desktop-based applications.
- **Work on multiple projects** - You can use multiple codespaces to work on separate projects, or on different branches of the same repository, compartmentalizing your work to avoid changes made for one piece of work accidentally affecting something else you're working on.
- **Pair program with a teammate** - If you work on a codespace in VS Code, you can use Live Share to work collaboratively with other people on your team. For more information, see "Working collaboratively in a codespace."
- **Publish your web app from a codespace** - Forward a port from your codespace and then share the URL, to allow teammates to try out the changes you've made to the application before you submit those changes in a pull request.
- **Try out a framework** - GitHub Codespaces reduces the setup time when you want to learn a new framework. Just create a codespace from one of the quickstart templates.

- Free
- Fast
- Quick to set up
- Simple to use
- Easy to collaborate
- Consistent
- Isolated (containerized)
- Full control of VM:
  - start, stop, restart, suspend-resume, delete, and so on
- And Great for Reproducibility
  - For Science/Research
  - Workshops
  - Dev/test environments
  - and more

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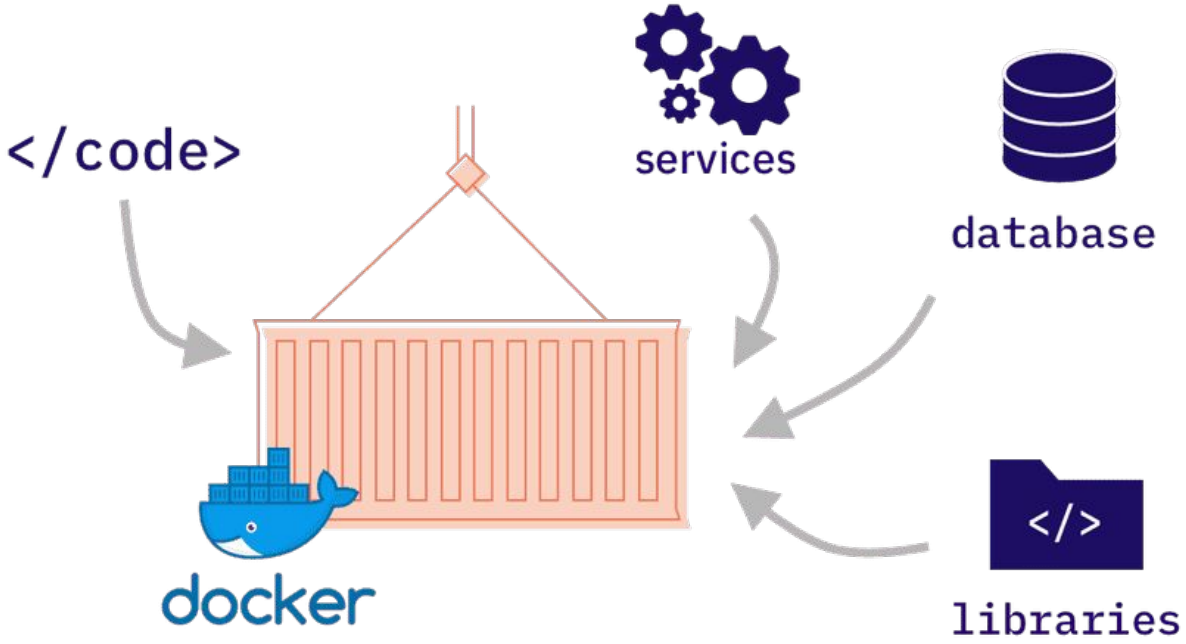
How do Codespaces work?

With the Magic of Containers!

What is a Container?

"lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings"



With Containers we have:

- Consistency
- Portability
- Scalability
- Resource efficiency
- Version control
- Collaboration
- Security

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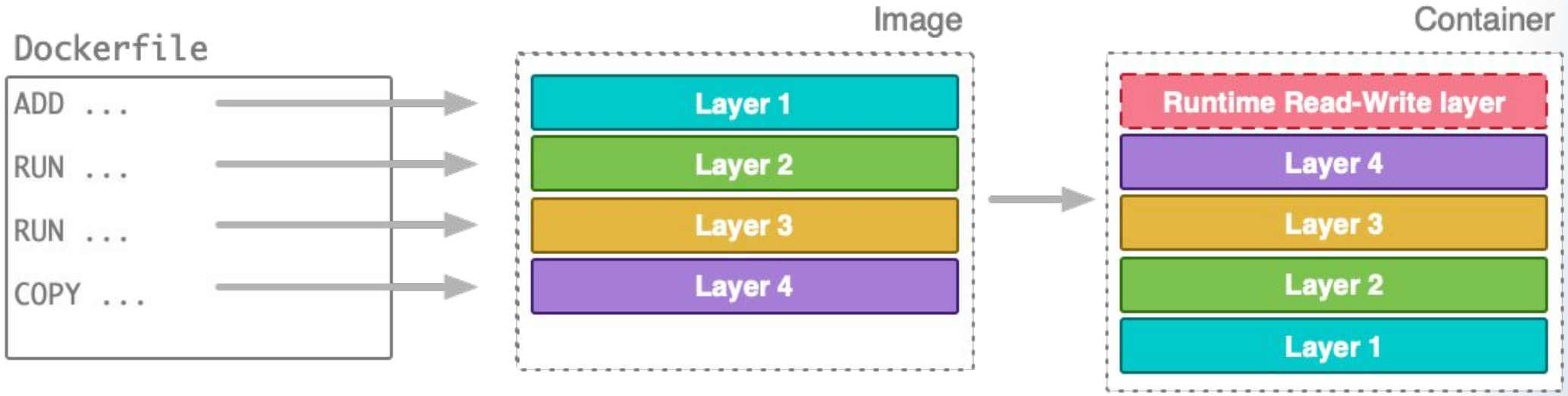
Containers



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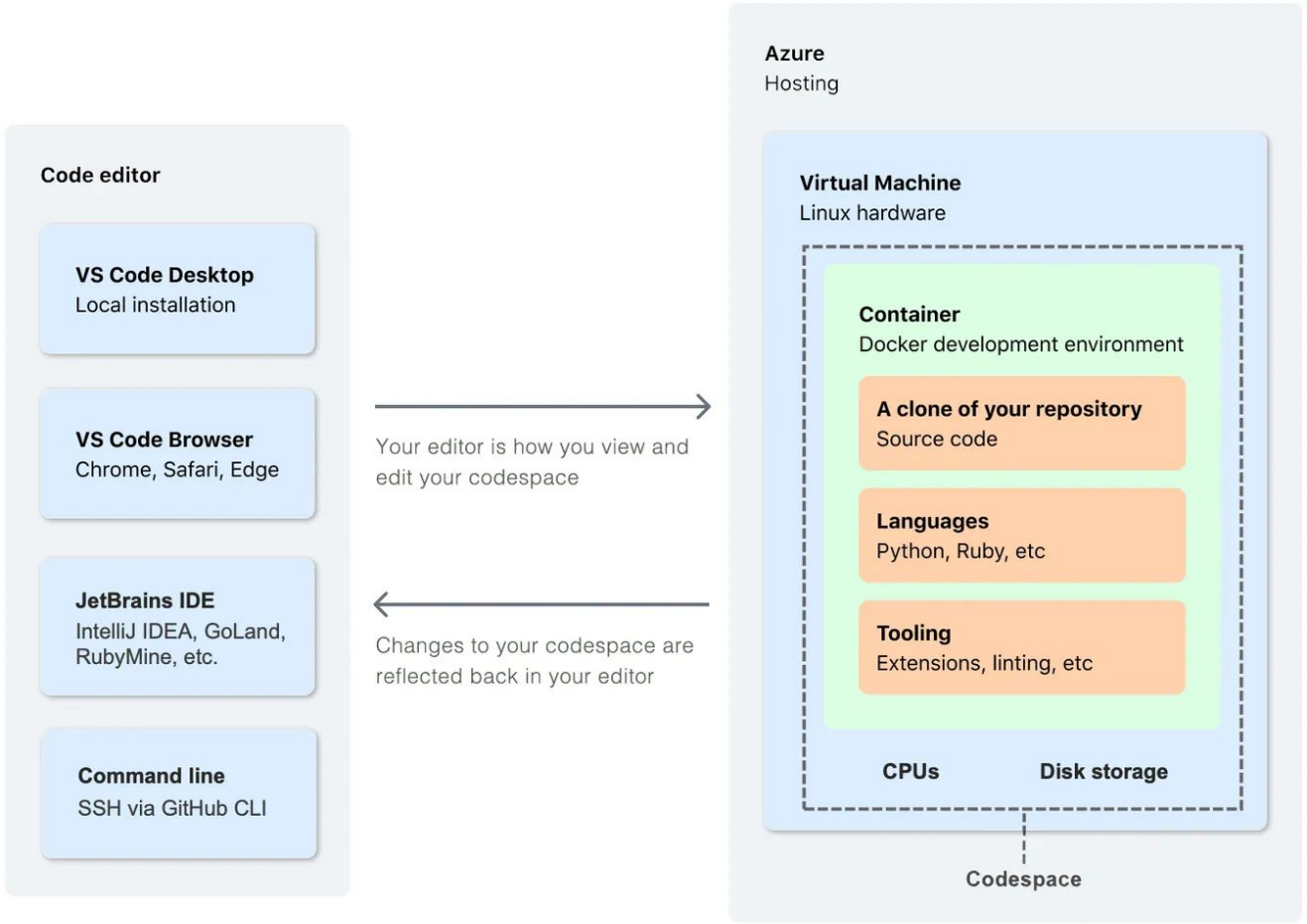
Github Codespaces: DevContainer

```
{
 "name": "Kaleidocode",
 "image": "ghcr.io/kaleideocode/dev_image:latest"

 // Automatically forward ports for Express and MySQL
  "forwardPorts": [3000, 3306],

  "settings": {
   "terminal.integrated.shell.linux": "/bin/bash"
  },

 // After setup, install deps from package.json
  "postCreateCommand": npm install,

 // Install and enable VS Code extensions
  "extensions": [
   "dbaeumer.vscode-eslint",
   "mutantdino.resourcemonitor",
   "GitHub.copilot"
  ],
```

Github Codespaces: The Details



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Github Codespaces: Quickstart

Codespaces Templates

Choose a template

Start a codespace from a template and get to developing with the power of a virtual machine in the cloud.

Blank
By github
Start with a blank canvas or import any packages you need.
Use this template

React
By github
A popular JavaScript library for building user interfaces based on UI components.
Use this template

.NET
By github
A full-stack web application template written in C# leveraging the power of .NET 8.
Use this template

Ruby on Rails
By github
A full-stack web framework for building dynamic websites that deliver a rich user experience.
Use this template

Jupyter Notebook
By github
JupyterLab is the latest web-based interactive development environment for notebooks, code, and data.
Use this template

Express
By github
Express is a minimal and flexible Node.js web application framework.
Use this template

Next.js
By github
Next.js is a React framework that gives you building blocks to create web applications.
Use this template

Django
By github
Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design.
Use this template

Flask
By github
Flask is a lightweight web application framework.
Use this template

Preact
By github
A fast 3kB alternative to React with the same modern API.
Use this template

- docker-existing-docker-compose
- docker-existing-dockerfile
- docker-in-docker
- docker-outside-of-docker-compose
- docker-outside-of-docker
- dotnet-fsharp
- dotnet-mssql
- dotnet-postgres
- dotnet
- go-postgres
- go
- java-postgres
- java
- javascript-node-mongo
- javascript-node-postgres
- javascript-node
- jekyll
- kubernetes-helm-minikube
- kubernetes-helm
- markdown
- miniconda-postgres
- miniconda
- php-mariadb
- php
- postgres

Links: https://github.com/codespaces
https://github.com/codespaces/templates

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Open Science Codespaces: Templates

Open Science Codespaces

Quick & Easy Cloud Working Environments(Codespaces). This repo setups Github Codespaces for R/RStudio, python and more. These can be used for

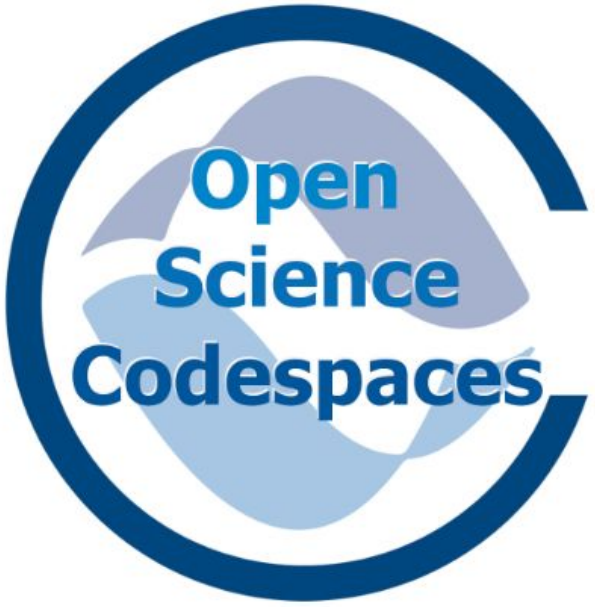
- Reproducible Science Setups
- Workshops
- Portable Development
- and more!

Contact

- Michael.Akridge@noaa.gov

List of Codespaces

1. R Codespaces
   - RStudio
   - Tidyverse
   - Verse
   - Geospatial
   - Shiny Server
   - Environmental Data Summary (EDS) Codespace
2. Python Codespaces
   - Python Streamlit App Example | Data Explorer & Viz Tool
   - Other Python Codespaces
3. Resources, Links & More Info



Link: https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces

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Open Science Codespace Templates

R Codespaces

Just click the button below to quickly start a codespace:

Codespace	QuickStart Link	Description
RStudio	Open in GitHub Codespaces	Adds RStudio Server. Install R from source and set RSPM as default CRAN mirror
RStudio Tidyverse	Open in GitHub Codespaces	Adds tidyverse packages & devtools. R packages for data science
RStudio Verse	Open in GitHub Codespaces	Adds tex & publishing-related package to tidyverse
RStudio Geospatial	Open in GitHub Codespaces	Adds geospatial packages
RStudio Shiny Server	Open in GitHub Codespaces	Adds shiny server

Link: https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces

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Github Codespaces Walkthrough & Demo

Github Codespaces Walkthrough: How to Demo

- How to create a codespace
- How to start/stop a codespace
- How to check your codespace usage
- How to add/install packages to your R Codespaces
- How to an a codespace to an existing project
- and more!

Link: https://github.com/MichaelAkridge-NOAA/Open-Science-Codespaces

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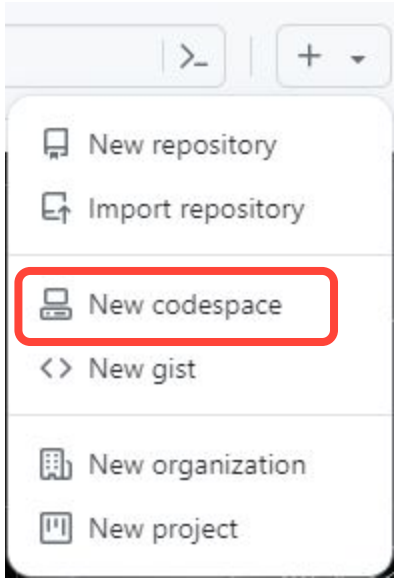
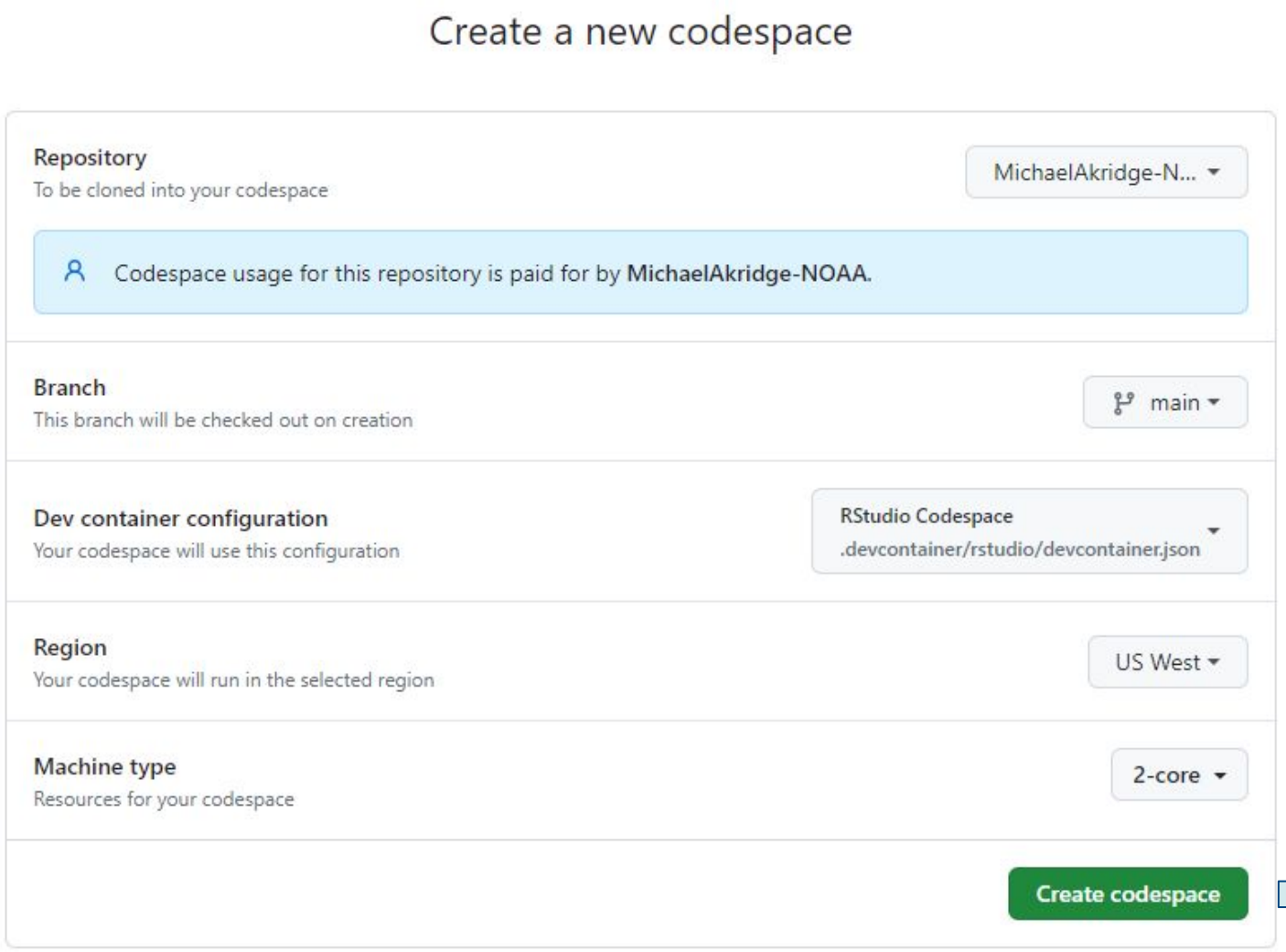
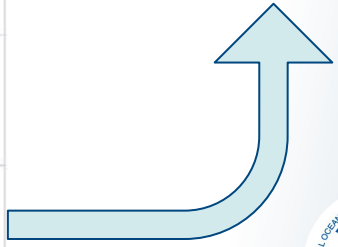
How to Create a Codespace





Setting up your codespace



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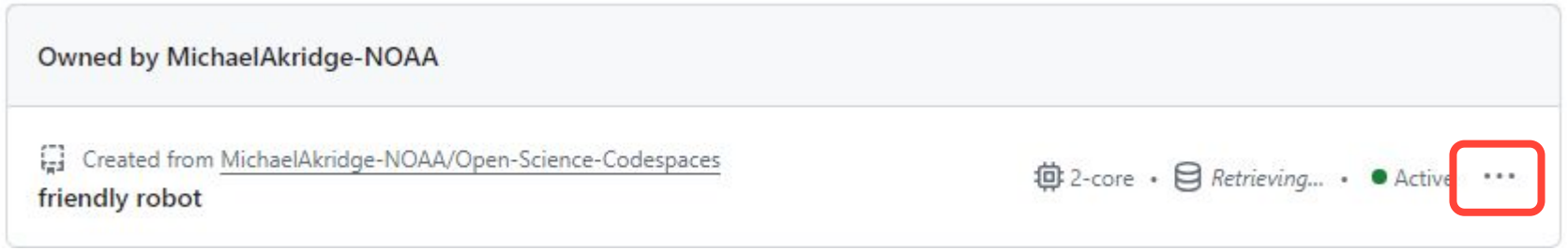
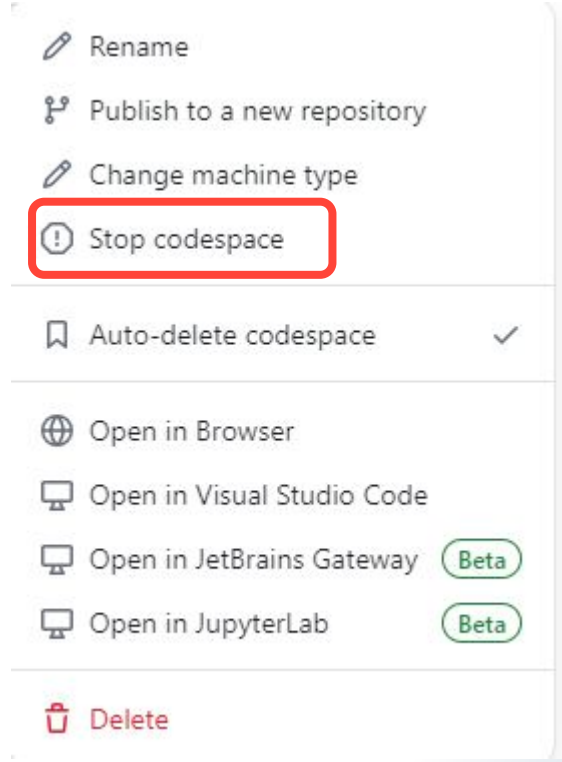
How to Stop/Start/Delete Codespace

https://github.com/codespaces





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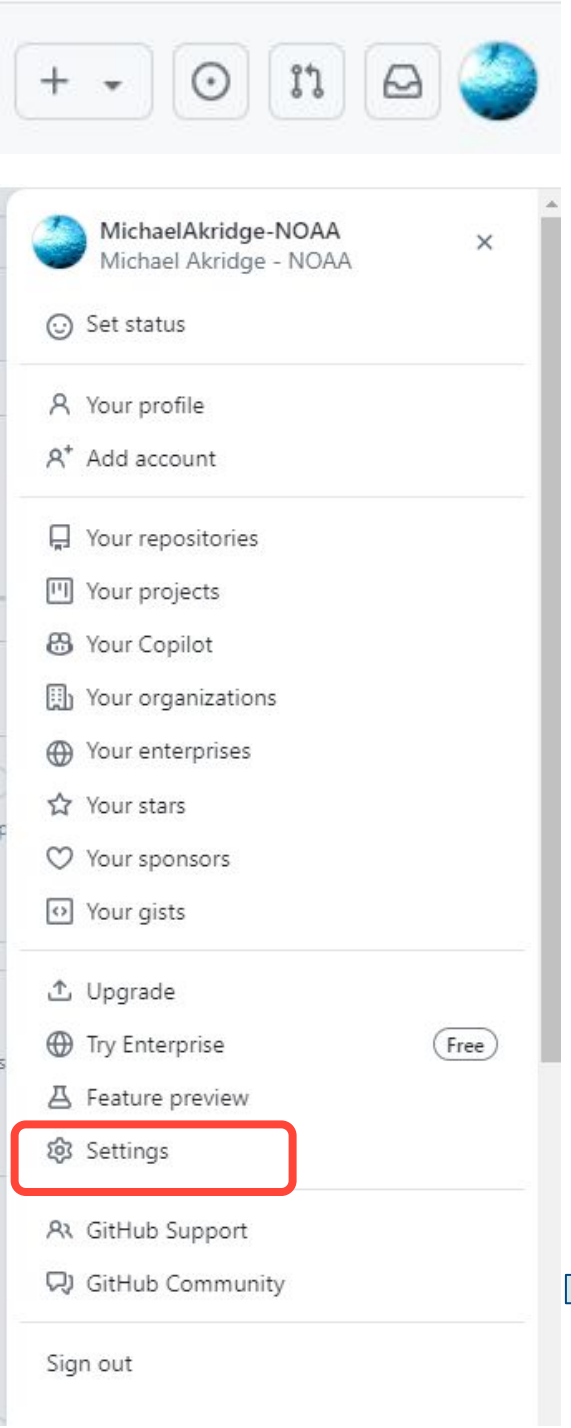
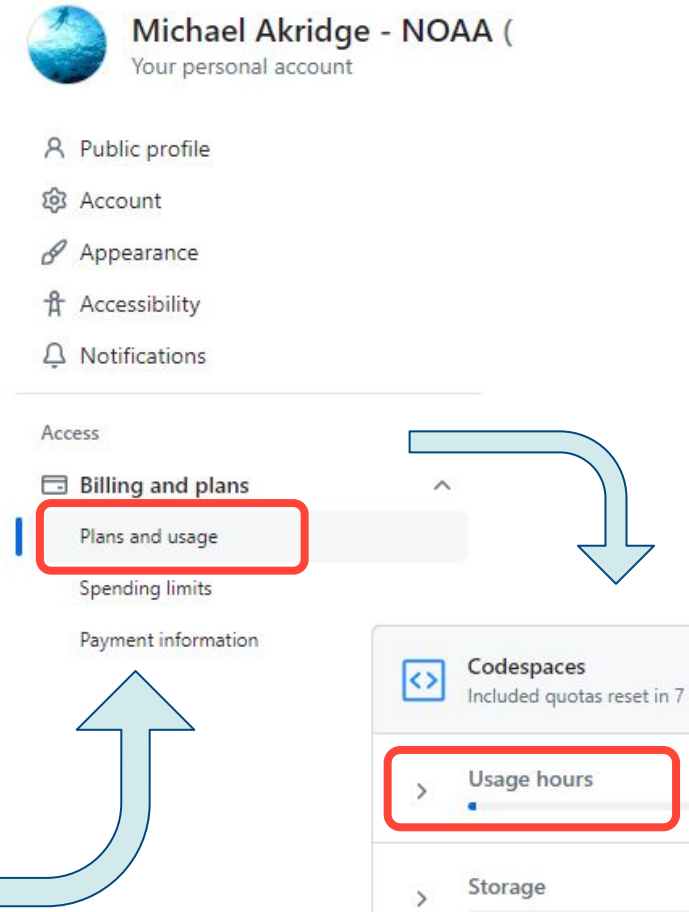
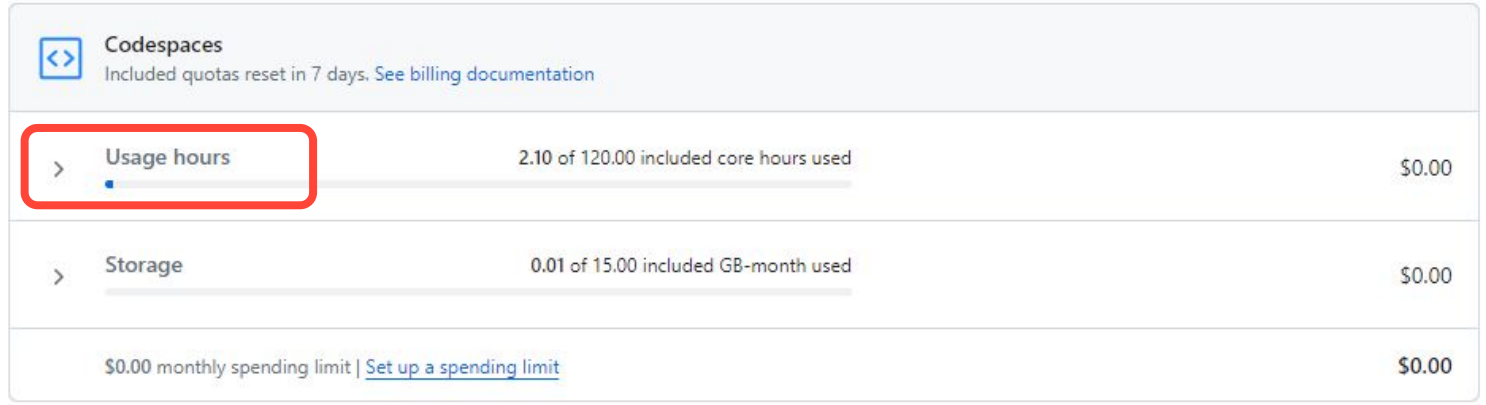
How to Check Your Usage







How to Add/Install Packages to your R Codespace

If possible, Use or Create an Image with Packages Already Installed

https://rocker-project.org/images/

2 Images

2.1 The versioned stack

image	base image	description	pulls
rocker/r-ver	ubuntu	Install R from source and set RSPM as default CRAN mirror	docker pulls 5.3M
rocker/rstudio	rocker/r-ver	Adds RStudio Server	docker pulls 26M
rocker/tidyverse	rocker/rstudio	Adds tidyverse packages & devtools	docker pulls 15M
rocker/verse	rocker/tidyverse	Adds tex & publishing-related package	docker pulls 1.5M
rocker/geospatial	rocker/verse	Adds geospatial packages	docker pulls 784k
rocker/binder	rocker/geospatial	Adds requirements to run repositories on mybinder.org	docker pulls 102k
rocker/shiny	rocker/r-ver	Adds shiny server	docker pulls 3M
rocker/shiny-verse	rocker/shiny	Adds tidyverse packages	docker pulls 1.1M
rocker/cuda	rocker/r-ver	Adds CUDA support to rocker/r-ver	docker pulls 43k
rocker/ml	rocker/cuda	Adds CUDA support to rocker/tidyverse	docker pulls 71k
rocker/ml-verse	rocker/ml	Adds CUDA support to rocker/geospatial	docker pulls 42k

R Codespaces

Just click the button below to quickly start a codespace:

Codespace	QuickStart Link	Description
RStudio	Open in GitHub Codespaces	Adds RStudio Server. Install R from source and set RSPM as default CRAN mirror
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RStudio Verse	Open in GitHub Codespaces	Adds tex & publishing-related package to tidyverse
RStudio Geospatial	Open in GitHub Codespaces	Adds geospatial packages
RStudio Shiny Server	Open in GitHub Codespaces	Adds shiny server

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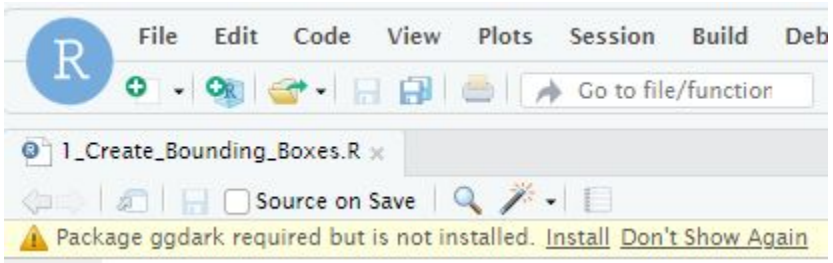
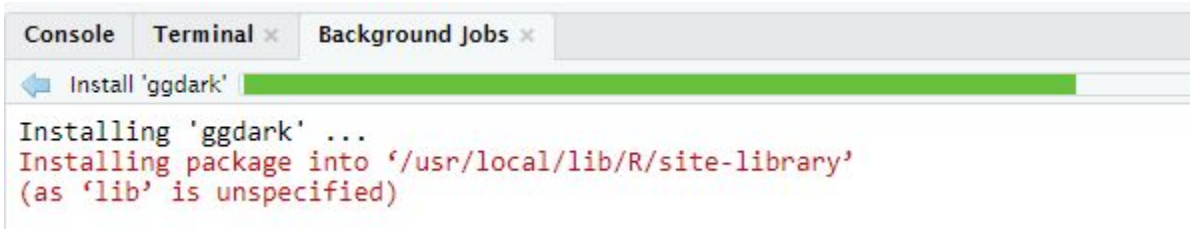
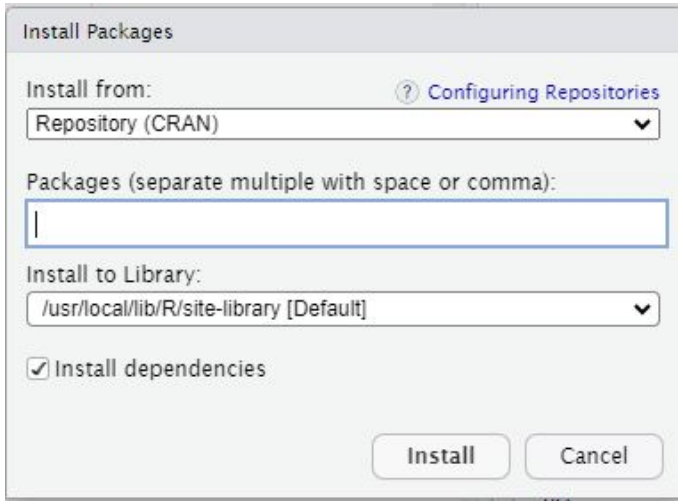
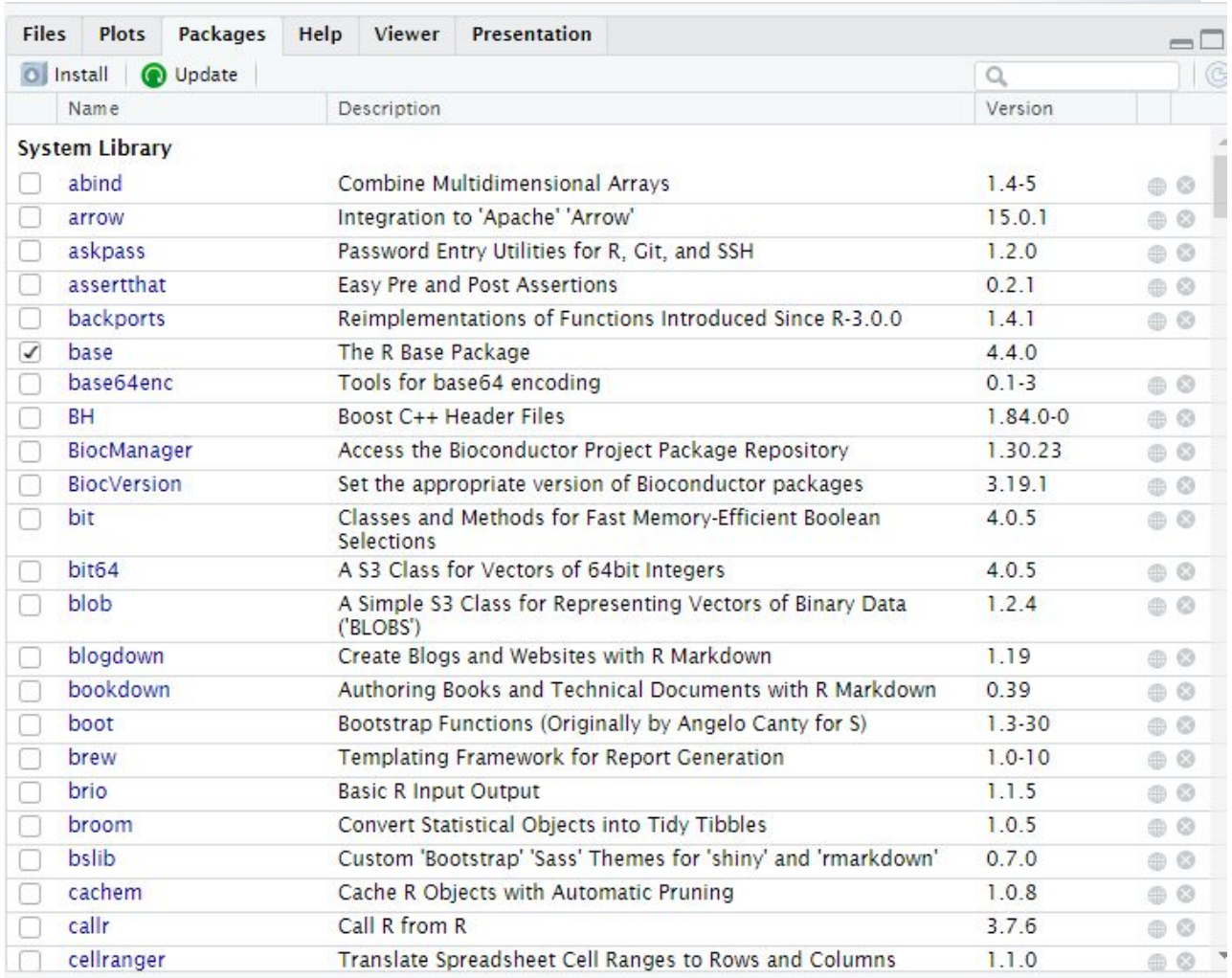
How to Add/Install Packages to your R Codespace

Example 00: Via RStudio in the Codespace as normal









How to Add/Install Packages to your R Codespace

Example 01: Add to them to your Devcontianer File via Features

```
// Features to be used in the dev container
 "features": {
   "ghcr.io/rocker-org/devcontainer-features/r-packages:1": {
     "packages": "cli, rlang, tidyverse, devtools, data.table, ggplot2,
dplyr, shiny, rmarkdown, knitr, testthat, roxygen2, plotly",
     "installSystemRequirements": true
   }
```

'Features' are self-contained units of installation code and development container configuration. Features are designed to install atop a wide-range of base container images.

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How to Add/Install Packages to your R Codespace

Example 02: Extend an Image & Add them to your Dockerfile

```
# Install R packages needed for basic setup

RUN R -e "install.packages(c('plotly', 'reticulate'), dependencies = TRUE)"
```

Dockerfile is a text document containing all the commands required to assemble an image.

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How to Add/Install Packages to your R Codespace

Example 02a: Add them to your Dockerfile via an install.R script

#Add to Docker File

```
# Copy install.R file to the Docker image
COPY install.R /usr/local/bin/install.R

# Install R packages using the install.R script
RUN Rscript /usr/local/bin/install.R
```

 # Example install.R File

```
list.of.packages <- c("plotly", "reticulate")

install.packages(list.of.packages)
```

Dockerfile is a text document containing all the commands required to assemble an image.

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How to Add/Install Packages to your R Codespace

And more! Use whatever best fits your workflow and project

Renv: The renv package helps you create reproducible environments for your R projects.

```
#  Using 'renv'- install.R File

install.packages("renv")
renv::init()
renv::install(c("plotly", "reticulate"))
renv::snapshot()
```

https://rstudio.github.io/renv/articles/renv.html

Pak: A Fresh Approach to R Package Installation

```
#  Using 'pak' - install.R File

install.packages("pak")

pak::pkg_install(c("plotly", "reticulate"))
```

https://pak.r-lib.org/

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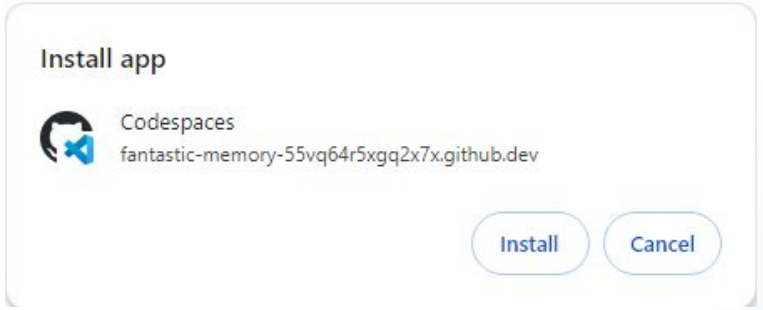
Github Codespaces: Tips & Tricks

- Starting with a good base image will save start(build) time
- A codespace will automatically stop after 30mins of inactivity to save resources. It can be restarted at any point
- You can pre-build a codespace for faster startup for users (but takes up storage)
- To use a cloud codespace locally there is a VS code extension (https://marketplace.visualstudio.com/items?itemName=GitHub.codespaces)
- For shiny & other app testing, you can open up ports to the public to share with testers
- You can install a desktop shortcut to your codespace. click -> 



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Thanks! Questions?

More info:

- https://github.com/features/codespaces
- GitHub Codespaces overview

Helpful Links:

- GitHub Codespace Templates
- https://github.com/devcontainers
- Awesome-devcontainers
- rocker-project.org

Get Started Today!

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