Julia tools for ECCO-hackweek

A brief introduction

Gael Forget, 2024/10/13, Pasadena

Presentation Outline

- New to Julia?
  - *Why We Use Julia (10 years later)?*
  - *Julia for beginner notebooks*
- Setting up for Hackweek
  - *Notebook lineup (more on Tuesday)*
  - *Julia packages*
- quick demo on OSS
  - *Jupyter, with Julia kernel 1.11.0*
  - *One notebook as example*

Why We Use Julia, 10 Years Later

14 February 2022 | **The Julia Community**

Exactly ten years ago today, we published "Why We Created Julia", introducing the Julia project to the world. At this point, we have moved well past the ambitious goals set out in the original blog post. Julia is now used by hundreds of thousands of people. It is taught at hundreds of universities and entire companies are being formed that build their software stacks on Julia. From personalized medicine to climate modeling, novel materials and even space mission planning — everywhere you look, the Julia community is pushing the boundaries of human discovery. Some lines of code in a git repository give an open source project its form, but a community gives it life. We continue to be impressed every day by the breadth of knowledge and kindness of spirit of the people who have gravitated to Julia. Below, we collate the stories of some of the members of the Julia community (both old and new) in a shared reflection on the past 10 years.

1. Keno Fischer (@keno)

Julia for Beginner Notebooks

From JuliaEO23, JuliaEO24 (Julia Earth Observation workshops)

- https://github.com/AIRCentre/JuliaEO/blob/main/notebooks/hands_on_sessions/Julia_for_beginners/Julia_for_beginners.ipynb

- https://github.com/AIRCentre/JuliaEO24/blob/main/notebooks/Julia_Language_Context_and_Basic_Concepts/Introduction_to_Julia.ipynb

Guidelines	Install, Pkg, Julia basics
Visualise the ECCO model grid	Grids, Tiles, Maps, Sections, Projections, Polygons
Explore standard ECCO diagnostics	Zonal Means, Global Means, Time Series, Maps
Visualize and Compute ECCO transports	Transports, streamfunction, Meridional Transports, Transect Throughflows
Track the global observing system	Ocean-OPS, Argo, drifters, OceanRobots.jl
Explore Argo data and compare to ECCO	obtaining data, formatting, sampling ECCO, cost funtions
Explore SST data and compare to ECCO	OISST data, SST in ECCO, Anomaly Maps, Time Series, Marine Heat Waves
Explore SLA data and and compare to ECCO	Altimetry, PODAAC, ECCO, GRACE, cost funtions
Explore NSLCT data and compare to ECCO	Sea Level Change Team, observations, projections
Use the MITgcm.jl interface	setup, build, run, parameters, inputs, outputs
Run ECCO from Julia	configuration, HPC, diagnostics, perturbations, adjoint runs
Tracking particles in the Ocean	Pathways, Water Masses, Drifters, Floats, Plastics
Automatic Differentiation and Optimization	Adjoint, Automatic Differentiation, Optimization, Line Search
Interface to Models in Various Languages	MITgcm, Other Models, Automated Workflows

Guidelines to Set Up Julia

Here we focus only on setting up the environment for Julia tutorials on OSS and p-cluster.

For more general information about Julia, please take a look at the main docs and https://julialang.org.

1. Install Julia

The standard method to install julia in a linux environment is as follows, from a terminal window :

```
curl -fsSL https://install.julialang.org | sh
```

1.1 OSS

To be able to use the latest versions of packages :

```
git clone https://github.com/ECCO-Hackweek/ecco-2024
source ecco-2024/book/tutorials/Julia_ECCO_and_more/setenv_julia.csh
```

note: this will by-pass the Julia verison pre-installed in `/opt/julia-1.10.5/bin/julia`

1.2 p-cluster

To activate the change in your current session :

Contents

Julia packages for ECCO-Hackweek

▼ Data (Julia)

- Climatology.jl 📖 : accessing, reading, displaying, and analyzing climate data sets stars 13
- OceanRobots.jl 📖 : analysis and simulation of data generated by ocean robots stars 23
- ArgoData.jl 📖 : Argo data processing and analysis stars 18

▶ Data (Julia, 2)

▼ Models (Julia)

- ClimateModels.jl 📖 : uniform interface to climate models of varying complexity stars 40
- MITgcm.jl 📖 : framework to interact with MITgcm (setup, run, output, plot, ...) stars 28
- MeshArrays.jl 📖 : gridded Earth variables, global domain decomposition, and C-grid support stars 41

▼ Models (Julia, 2)

- IndividualDisplacements.jl 📖 : trajectory simulations for point particles in the Ocean and Atmosphere stars 30
- PlanktonIndividuals.jl 📖 : simulation of plankton communities and their interaction with environmental factors stars 30

+ newly created **ECCO.jl** which we can now start building together this week