

JuliaCall: an R package for seamless integration between R and Julia

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Software

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Summary

R is a widely used software and computing environment for statistics, which provides a variety of statistical techniques and packages (R Core Team, 2018). Many R packages provide interfaces to other computer languages to bring new functionalities to R or to accelerate computations, such as `Rcpp` (Eddelbuettel & François, 2011) and `V8` (Ooms, 2019). The package `JuliaCall` provides an R interface to `Julia`, which is a computer language for high-performance scientific computing (Bezanson, Edelman, Karpinski, & Shah, 2017). `JuliaCall` embeds `Julia` in R, and provides functions to evaluate `Julia` commands, to call `Julia` functions, to transmit data objects between R and `Julia`, and so on. It also provides many utilities for user convenience. For example, `JuliaCall` gives detailed error messages for the embedded `Julia`. It also provides `Julia` package management functions such as installation and loading, and utility functions to get the documentation of `Julia` functions. `JuliaCall` can also be used in R Markdown document as the engine of `Julia` language, see Section 2.77 in Xie, Allaire, & Golemund (2018).

Some R packages wrap `Julia` packages based on `JuliaCall` to provide new functionalities or performance improvements to some existing packages in R. `autodiffR` (Li, 2018a) provides automatic differentiation to R functions by wrapping `ForwardDiff.jl` and `ReverseDiff.jl`. `convexjlr` (Li, 2018b) is an R package for Disciplined Convex Programming (DCP) providing a high level wrapper for `Convex.jl`. `diffeqr` (Rackauckas, 2018) solves differential equations in R using `DifferentialEquations.jl`. `FixedEffectjlr` (Loulliche, 2018) estimates large fixed effects models in R by providing an interface to `FixedEffectModels.jl`.

Besides `JuliaCall`, some other packages also provide interfaces between R and `Julia`: R packages `XRJulia`, `RJulia`, and the `Julia` package `RCall.jl`. The package `XRJulia` connects to `Julia` from R (Chambers, 2017). It uses JavaScript Object Notation (JSON) format to transmit data, while `JuliaCall` copies objects in memory between R and `Julia`. It has performance disadvantages compared to `JuliaCall`. Table 1 depicts the times needed to transmit a 500×500 matrix full of ones from R v3.5.2 to `Julia` v1.0.3 using `JuliaCall` v0.16.4 and `XRJulia` Github master b6224fa at the time of writing (there is no released version of `XRJulia` to support `Julia` v1.0 yet). The times are measured by R package `microbenchmark` with 1000 evaluation times. The script with the benchmark code and setup instructions can be found in the `paper` directory in `JuliaCall` Github repository. In the header of the table, “lq” means lower quantile and “uq” means upper quantile. From Table 1, it can be seen that `JuliaCall` has a speed advantage of transmitting data between R and `Julia`. The package `RJulia` (Gong, Haverty, Keys, & Maechler, 2017) also embeds `Julia` in R, but its functionality is quite limited, has not been updated for more than one year, and does not support `Julia` v1.0 and v1.1 at the time of writing. `RCall.jl` is a `Julia` package which embeds R in `Julia`. It is a

dependency for JuliaCall, and JuliaCall utilizes RCall.jl's type conversion between R and Julia. JuliaCall integrates well with RCall.jl, and it is the default for JuliaCall to load RCall.jl in the embedded Julia automatically at starting. With JuliaCall and RCall.jl, it is easy to use R from Julia and Julia from R.

Table 1: Time measurements for XRJulia and JuliaCall to transmit a 500×500 matrix from R to Julia.

Time in ms	min	lq	mean	median	uq	max
XRJulia	24.680699	30.65626	39.29180	33.98684	38.83510	454.6484
JuliaCall	9.790442	11.79500	16.39797	12.55267	13.90892	406.0156

Users can get stable releases of JuliaCall from [CRAN](#), and the latest development version from [JuliaCall Github repository](#). Documentation can be found in the package as well as on [CRAN](#). Bug reports and other feedback can be submitted to [GitHub issue page](#).

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