

Using Rcpp* packages for easy and fast extension of R with C++



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Outline

- 1 Short presentation of Rcpp* packages
 - Rcpp : extending R with C++
 - RcppGSL for fast random draws
 - RcppArmadillo for high-performance linear algebra

- 2 Build of R package using Rcpp
 - Usefull functions
 - Example of package using Rcpp



Rcpp R package

- **Rcpp** is an R package to extend R with C++ code
- Main advantage : C++ is fast, it accelerates R (see next sections)
- Written by **Dirk EDDELBUETTEL** and **Romain FRANCOIS**
- <http://www.rcpp.org/>

Simple Rcpp example

C++ code (in file Code/addition.cpp)

```
#include <Rcpp.h>
using namespace Rcpp;
// [[Rcpp::export]]
int addition(int a, int b) {
  return a + b;
}
```

R code

```
Rcpp::sourceCpp("Code/addition.cpp")
addition(2, 2)
```

```
## [1] 4
```



Rcpp advantages

Thanks to `Rcpp::sourceCpp()`

- Compile the C++ code
- Export the function to the R session
- Direct interchange of R objects (including S3, S4) between R and C++
- ... (many more, see `vignette("Rcpp-package")`)



GSL and RcppGSL



GNU Scientific Library

- Numerical library for C and C++ programmers
- Reliable random number generator algorithms
- Thoroughly tested and fast random number distributions
- Linear algebra (matrices and vectors)
- <https://www.gnu.org/software/gsl/>

RcppGSL

- Interface between R and GSL
- Using Rcpp to interface R and C
- <http://dirk.eddelbuettel.com/code/rcpp.gsl.html>



GSL random number distributions

- GSL v2.6 includes **38 random number distributions** (see [GNU GSL](#))
- It's easy to implement additional random number distributions from the GSL base distributions (e.g. truncated normal distribution)
- For comparison, R API includes "only" 24 random number distributions (see [Writing R Extensions](#))
- Random draws are faster with GSL than with R (eg. `gsl_ran_gamma()` vs. `R::rgamma()`)



Armadillo and RcppArmadillo

Armadillo

- C++ library for linear algebra and scientific computing
- Provides high-level syntax and functionality : speed and ease of use
- Classes for vectors, matrices and cubes
- Matrix operations, matrix decomposition, linear model solver, etc.
- <http://arma.sourceforge.net/>



RcppArmadillo

- Interface between R and Armadillo
- Using Rcpp to interface R and C++
- <http://dirk.eddelbuettel.com/code/rcpp.armadillo.html>



Licenses

- Licenses : GNU General Public License, Apache License 2.0 for Armadillo
- Free software licenses : we can use, modify and redistribute these softwares



How to build an R package around C++ functions

- `Rcpp.package.skeleton()` to generate a new Rcpp package (modifying `DESCRIPTION` and `NAMESPACE`)
- `Rcpp::compileAttributes()` scans the C++ files and generates the `RcppExports.cpp` file to make the functions preceded by `// [[Rcpp::export]]` available in R.
- Implement R functions that checks the conformity of user-defined parameters, calls functions in C++ and returns the results in an easy-to-use format.

jSDM R package

jSDM 0.1.0  Get started Reference Articles Change log  

jSDM R Package

Package for fitting joint species distribution models (jSDM) in a hierarchical Bayesian framework (Warton *et al.* 2015). The Gibbs sampler is written in C++. It uses Rcpp, Armadillo and GSL to maximize computation efficiency.

System requirements

Make sure the GNU Scientific Library (GSL) is installed on your system.

Installation

Install the latest stable version of jSDM from CRAN with:

```
install.packages("jSDM")
```

Or install the development version of jSDM from GitHub with:

```
devtools::install_github("ghislainv/jSDM")
```

References

Warton, D.I., Blanchet, F.G., O'Hara, R.B., Ovaskainen, O., Taskinen, S., Walker, S.C. & Hui, F.K. (2015) So many variables: Joint modeling in community ecology. *Trends in Ecology & Evolution*, **30**, 766–779.

Links

Download from CRAN at
<https://cloud.r-project.org/package=jSDM>
Browse source code at
<https://github.com/ghislainv/jSDM>
Report a bug at
<https://github.com/ghislainv/jSDM/issues>

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Dev status

build 
CRAN 0.1.0 
DOI [10.5281/zenodo.3253460](https://doi.org/10.5281/zenodo.3253460)
downloads 231/month 

- <https://ecology.ghislainv.fr/jSDM>
- Made with Rcpp* packages



... Thank you for attention ...



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