

Package ‘RcppExamples’

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Title Examples using Rcpp to interface R and C++

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Description Examples for Seamless R and C++ integration The Rcpp package contains a C++ library that facilitates the integration of R and C++ in various ways. This package provides some usage examples.

Note that the documentation in this package currently does not cover all the features in the package. It is not even close.

It does however provide a few example based on both the (deprecated) ‘classic’ API and the current Rcpp API which supercedes it. As such, it can help in porting from the older API to the newer API.

Depends R (>= 2.11.0), Rcpp (>= 0.9.9), RcppClassic

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Suggests RUnit

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R topics documented:

RcppExamples-package	2
RcppDataFrame	3
RcppDate	4
RcppExample	5
RcppParams	8
RcppResultSet	10
RcppVector	11
Index	14

RcppExamples-package *Examples for the Rcpp R/C++ Interface library*

Description

This package shows some simple examples for the use of **Rcpp**. Both the older ('classic') and new API are documented.

It can also serve as a working template to create packages that use **Rcpp** to interface C++ code or libraries.

Details

The **Rcpp** package provides a number of C++ classes that ease access to C++ from R. This comprises both passing parameters to functions, as well as returning results back from C++ to R.

Two APIs are supported. The first is an older API which was first introduced mostly in 2006 and extended in 2008. This interface is used by a few other packages and will be supported going forward. A second and newer API that was started in 2009 offers more functionality.

The **RcppExamples** package provides some simple examples for use of **Rcpp**. At this point the documentation is not complete in the sense of not covering all accessible classes. However, several basic use cases are illustrated,

Author(s)

Dominick Samperi wrote the initial versions of Rcpp (and RcppTemplate) during 2005 and 2006. Dirk Eddelbuettel made some additions, and became maintainer in 2008. Dirk Eddelbuettel and Romain Francois have been extending Rcpp since 2009.

RcppDataFrame

Rcpp::DataFrame example for Rcpp

Description

A DataFrame can be passed C++ and can be instantiated as a corresponding C++ object using the Rcpp API.

This example shows (in the corresponding C++ code) how to access, modify and create a data frame.

Details

Usage of Rcpp::DataFrame is fully defined in the respective header file.

The C++ source file corresponding to the this function does the following (inside of a try/catch block):

```
// construct the data.frame object
Rcpp::DataFrame DF = Rcpp::DataFrame(Dsexp);

// and access each column by name
Rcpp::IntegerVector a = DF["a"];
Rcpp::CharacterVector b = DF["b"];
Rcpp::DateVector c = DF["c"];

// do something
a[2] = 42;
b[1] = "foo";
c[0] = c[0] + 7;                               // move up a week

// create a new data frame
Rcpp::DataFrame NDF =
Rcpp::DataFrame::create(Rcpp::Named("a")=a,
Rcpp::Named("b")=b,
Rcpp::Named("c")=c);

// and return old and new in list
return(Rcpp::List::create(Rcpp::Named("origDataFrame")=DF,
Rcpp::Named("newDataFrame")=NDF));
```

Author(s)

Dirk Eddelbuettel and Romain Francois

Examples

```
## Not run:
RcppDataFrame()

## End(Not run)
```

RcppDate

C++ classes for interfacing date and datetime R objects

Description

RcppDate, RcppDatetime, RcppDateVector and RcppDatetimeVector are C++ classes defined in their respective header files. They are part of the 'classic' Rcpp API. These classes pass scalars and vectors of R objects of types Date and POSIXct, respectively, to C++ via the .Call() function interface.

Member functions are provided to query the dimension of the vector or matrix object, convert it in a corresponding C representation.

R objects of type Date, and hence the RcppDate and RcppDateVector objects, are internally represented as an integer counting days since the epoch, i.e. January 1, 1970. Similarly, R objects of type POSIXct and the RcppDatetime and RcppDatetimeVector objects, are internally represented as seconds since the epoch. However, R extends the POSIX standard by using a double leading to microsecond precision in timestamps. This is fully supported by Rcpp as well.

The new API currently has the classes Rcpp::Date, Rcpp::Datetime, Rcpp::DateVector and Rcpp::DatetimeVector which are preferred for new developments, but currently less documented.

Details

Usage of the RcppDate, RcppDatetime (and their vector extensions) in C++ is fully defined in the respective header files RcppDate.h and RcppDatetime.h.

As example, consider a call from R to C++ such as

```
# an R example passing one type of each class to a function
# someFunction in package somePackage
val <- .Call("someFunction",
            Sys.Date(),      # current date
            Sys.time(),     # current timestamp
            as.Date("2000-02-25")
            + 0:5,          # date vector
            ISOdatetime(1999,12,31,23,59,0)
            + (0:5)*0.250, # datetime vector
            PACKAGE="somePackage")
```

At the C++ level, the corresponding code to assign these parameter to C++ objects is can be as follows::

```
SEXP someFunction(SEXP ds, SEXP dts,
                  SEXP dvs, SEXP dtvs) {

  RcppDate      d(ds);
  RcppDatetime  dt(dts);
  RcppDateVector dv(dvs);
  RcppDatetimeVector dtv(dtvs);
}
```

Standard accessor functions are defined, see `RcppDate.h` and `RcppDatetime.h` for details.

Objects of these types can also be returned via `RcppResultSet`.

Author(s)

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References

Writing R Extensions, available at <http://www.r-project.org>.

See Also

`RcppResultSet`.

Examples

```
# set up date and datetime vectors
dvec <- Sys.Date() + -2:2
dtvec <- Sys.time() + (-2:2)*0.5

# call the underlying C++ function
result <- RcppDateExample(dvec, dtvec)

# inspect returned object
result
```

RcppExample

Rcpp R / C++ interface example

Description

`RcppExample` illustrates how the older Rcpp R/C++ interface class library is used. It provides fairly complete coverage for the older ‘classic’ API.

Usage

```
RcppExample(params, nlist, numvec, nummat, df, datevec, stringvec, fnvec, fnlist)
## S3 method for class 'RcppExample'
print(x,...)
```

Arguments

params	A heterogeneous list specifying method (string), tolerance (double), maxIter (int).
nlist	a list of named numeric values (double or int).
numvec	a numeric 1D vector (double or int).
nummat	a numeric 2D matrix (double or int).
df	a data frame.
datevec	a vector of Date's.
stringvec	a vector of strings.
fnvec	an R function with numeric vector argument.
fnlist	an R function with list argument.
x	Object of type RcppExample.
...	Extra named parameters.

Details

The C++ representation of data frames are not passed back to R in a form that R recognizes as a data frame, but it is a simple matter to do the conversion. For example, the return value named PreDF (see return values below) is not seen as a data frame on the R side (thus the name "pre-data frame"), but it can be converted to a data frame using `df <- data.frame(result$PreDF)`.

The `print.RcppExample()` function is defined so that we can control what gets printed when a variable assigned the return value is entered on a line by itself. It is defined to simply list the names of the fields returned (see `RcppExample.R`).

Value

RcppExample returns a list containing:

method	string input paramter
tolerance	double input paramter
maxIter	int input parameter
n1FirstName	first name in nlist
n1FirstValue	first value in nlist
matD	R matrix from an RcppMatrix<double> object
stlvec	R vector from a vector<double> object
stlmat	R matrix from a vector<vector<double> > object
a	R matrix from C/C++ matrix

RcppParams

C++ class for receiving (scalar) parameters from R

Description

RcppParams is a C++ class defined in `Rcpp.h` that receive any number of scalar parameters of types in a single named list object from `R` through the `.Call()` function.

The parameters can be of different types that are limited to the `R` types `numeric`, `integer`, `character`, `logical` or `Date`. These types are mapped into, respectively, the corresponding C++ types `double`, `int`, `string`, `bool` and `Date` (a custom class defined by `Rcpp`).

RcppParams is part of the old Rcpp API, and should be replace by `Rcpp::List` which is more flexible and can be used for both inputs and outputs. RcppParams is retained for backwards compatibility, but should be avoided in new projects and replaced in old projects.

Arguments

`params` A heterogeneous list specifying method (string), tolerance (double), `maxIter` (int) and `startDate` (`Date` in `R`, `RcppDate` in C++).

Details

Usage of RcppParams from `R` via `.Call()` is as follows:

```
# an R example passing one type of each class to a function
# someFunction in package somePackage
val <- .Call("someFunction",
             list(pie=3.1415, magicanswer=42, sometext="foo",
                 yesno=true, today=Sys.date()),
             PACKAGE="somePackage")
```

At the C++ level, the corresponding code to assign these parameter to C++ objects is

```
SEXP someFunction(SEXP params) {
  RcppParams par(params);
  double p   = par.getDoubleValue("pie");
  int magic  = par.getIntValue("magicanswer");
  string txt = par.getStringValue("sometext");
  bool yn    = par.getBoolValue("yesno");
  RcppDate d = par.getDateValue("today");
  // some calculations ...
  // some return values ...
}
```

As the lookup is driven by the names given at the R level, order is not important. It is however important that the types match. Errors are typically caught and an exception is thrown.

The class member function `checkNames` can be used to verify that the SEXP object passed to the function contains a given set of named object.

Value

`RcppExample` returns a list containing:

<code>method</code>	string input parameter
<code>tolerance</code>	double input parameter
<code>maxIter</code>	int input parameter
<code>startDate</code>	Date type with starting date
<code>params</code>	input parameter list (this is redundant because we returned the input parameters above)

Author(s)

Dominick Samperi wrote the initial versions of Rcpp (and RcppTemplate) during 2005 and 2006. Dirk Eddelbuettel made some additions, and became maintainer in 2008. Dirk Eddelbuettel and Romain Francois have been extending Rcpp since 2009.

References

Writing R Extensions, available at <http://www.r-project.org>.

See Also

`RcppExample`.

Examples

```
# set up some value
params <- list(method='BFGS',
               tolerance=1.0e-5,
               maxIter=100,
               startDate=as.Date('2006-7-15'))

# call the underlying C++ function
result <- RcppParamsExample(params)

# inspect returned object
result
```

RcppResultSet

C++ class for sending C++ objects back to R

Description

RcppResultSet is a C++ class defined in RcppResultSet.h that can assign any number of C++ objects to R in a single named list object as the SEXP return value of a .Call() function call. It is part of the classic API.

The C++ objects can be of different types that are limited to types double, int, string, vectors of double or int (with explicit dimensions), matrices of double or int (with explicit dimensions), STL vectors of double, int or string, STL ‘vector of vectors’ of types double or int (all with implicit dimensions), the internal types RcppDate, RcppDateVector, RcppStringVector, RcppVector of types double or int, RcppMatrix of types double or int as well RcppFrame, a type that can be converted into a data.frame, and the R type SEXP.

Where applicable, the C++ types are automatically converted to the corresponding R types structures around types numeric, integer, or character. The C++ code can all be retrieved in R as elements of a named list object.

The new API has more generic templated functions.

Details

Usage of RcppResultSet from C++ is fully defined in RcppResultSet.h. An example for returning data to R at the end of a .Call() call follows.

At the C++ level, the corresponding code to assign these parameter to C++ objects is can be as follows (taken from the C++ source of RcppExample):

```
SEXP r1;
RcppResultSet rs;

rs.add("date", aDate); // RcppDate
rs.add("dateVec", dateVec); // RcppDateVec
rs.add("method", method); // string
rs.add("tolerance", tol); // numeric
rs.add("maxIter", maxIter); // int
rs.add("matD", matD); // RcppMatrix
rs.add("stlvec", stlvec); // vector<double> or <int>
rs.add("stlmat", stlmat); // vector< vector <double> >
// or <int>
rs.add("a", a, nrows, ncols); // double** (or int**) with
// two dimension
rs.add("v", v, len); // double* (or int*) with
// one dimension
rs.add("stringVec", strVec); // RcppStringVector
rs.add("strings", svec); // vector<string>
rs.add("InputDF", inframe); // RcppFrame
```

```
rs.add("PreDF", frame); // RcppFrame

r1 = rs.getReturnList();
return(r1);
```

As the R level, we assign the returned object a list variables from which we select each list element by its name. lookup is driven by the names given at the R level, order is not important. It is however important that the types match. Errors are typically caught and an exception is thrown.

The class member function `checkNames` can be used to verify that the SEXP object passed to the function contains a given set of named object.

Author(s)

Dominick Samperi wrote the initial versions of Rcpp (and RcppTemplate) during 2005 and 2006. Dirk Eddelbuettel made some additions, and became maintainer in 2008. Dirk Eddelbuettel and Romain Francois have been extending Rcpp since 2009.

See Also

RcppExample.

Examples

```
# example from RcppDate
# set up date and datetime vectors
dvec <- Sys.Date() + -2:2
dtvec <- Sys.time() + (-2:2)*0.5

# call the underlying C++ function
result <- RcppDateExample(dvec, dtvec)

# inspect returned object
result
```

RcppVector

C++ classes for receiving R object in C++

Description

RcppVector, RcppMatrix and RcppStringVector are C++ classes that can pass vectors (matrices) of R objects of appropriate types to C++ via the `.Call()` function interface. They are part of the 'classic' Rcpp API.

The vector and matrix types are templated and can operate on R types `integer` and `numeric`.

The RcppVectorView and RcppMatrixView are slightly more lightweight read-only variants.

Member functions are provided to query the dimension of the vector or matrix object, convert it in a corresponding C representation, and also to convert it into a corresponding STL object.

The new API has classes `NumericVector`, `NumericMatrix`, `CharacterVector` (and also an alias `StringVector`).

The files `RcppVectorExample.cpp` and `RcppMatrixExample.cpp` provide examples for both the classic and new APIs.

Details

Usage of `RcppVector`, `RcppMatrix` and `RcppStringVector` in C++ is fully defined in the respective header files.

As example, consider a call from R to C++ such as

```
# an R example passing one type of each class to a function
# someFunction in package somePackage
val <- .Call("someFunction",
            rnorm(100),          # numeric vector
            sample(1:10, 5, TRUE) # int vector
            search(),           # character vector
            as.matrix(rnorm(100),10,10), # matrix
            PACKAGE="somePackage")
```

At the C++ level, the corresponding code to assign these parameter to C++ objects is can be as follows (taken from the C++ source of `RcppExample`):

```
SEXP someFunction(SEXP nvec, SEXP ivec,
                 SEXP svec, SEXP nmat) {

    RcppVector<double> nv(nvec);
    RcppVector<int>    iv(ivec);
    RcppStringVector sv(svec);
    RcppMatrix<double> nm(nmat);
}
```

These C++ objects could then be queried via

```
int n = nv.size();
int d1 = nm.dim1(), d2 = nm.dim2();
```

to retrieve, respectively, vector length and matrix dimensions.

Moreover, the `stlVector()` and `stlMatrix()` member functions can be used to convert the objects into STL objects:

```
vector<int> ivstl = iv.stlVector();
vector< vector< double > > = nm.stlMatrix();
```

Author(s)

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See Also

RcppExample.

Examples

```
# set up some value
vector <- (seq(1,9))^2

# call the underlying C++ function
result <- RcppVectorExample(vector)

# inspect returned object
result
```

Index

*Topic **interface**

- RcppDataFrame, 3
- RcppDate, 4
- RcppExample, 5
- RcppParams, 8
- RcppResultSet, 10
- RcppVector, 11

*Topic **package**

- RcppExamples-package, 2

*Topic **programming**

- RcppDataFrame, 3
- RcppDate, 4
- RcppExample, 5
- RcppParams, 8
- RcppResultSet, 10
- RcppVector, 11

`print.RcppExample (RcppExample)`, 5

- RcppDataFrame, 3
- RcppDate, 4
- RcppDateExample (RcppDate), 4
- RcppDatetime (RcppDate), 4
- RcppDatetimeVector (RcppDate), 4
- RcppDateVector (RcppDate), 4
- RcppExample, 5
- RcppExamples (RcppExamples-package), 2
- RcppExamples-package, 2
- RcppMatrix (RcppVector), 11
- RcppMatrixExample (RcppVector), 11
- RcppMatrixView (RcppVector), 11
- RcppParams, 8
- RcppParamsExample (RcppParams), 8
- RcppResultSet, 10
- RcppStringVector (RcppVector), 11
- RcppStringVectorExample (RcppVector), 11
- RcppVector, 11
- RcppVectorExample (RcppVector), 11
- RcppVectorView (RcppVector), 11