

# Package: cppally (via r-universe)

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**Title** A 'C++20' API for R

**Version** 0.1.0.9000

**Maintainer** Nick Christofides <nick.christofides.r@gmail.com>

**Description** A header-only 'C++20' API for manipulating R data structures from 'C++'. Provides 'C++20' concepts specific to R, custom scalar and vector classes with built-in NA handling, automatic object protection, 'SIMD' (single-instruction-multiple-data), parallelisation, and a streamlined system for registering 'C++' functions, including templates, to R. Full API reference and documentation are available at <<https://nicchr.github.io/cppally/>>.

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**URL** <https://nicchr.github.io/cppally/>

**BugReports** <https://github.com/NicChr/cppally/issues/>

**Depends** R (>= 4.5.0)

**Suggests** bench, bit64, brio, callr, cli, cpp11, decor, desc, devtools, fs, glue, knitr, pkgload, purrr, readr, rmarkdown, roxygen2, rstudioapi, stringr, testthat (>= 3.0.0), usethis, vctrs, withr

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cpp_register	<i>Generates wrappers for registered C++ functions</i>
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### Description

Register C++ functions to be callable from R. C++ functions decorated with `[[cppally::register]]` will be registered (including template functions).

### Usage

```
cpp_register(
  path = ".",
  quiet = !is_interactive(),
  extension = c(".cpp", ".cc")
)
```

### Arguments

path	Path to package root directory.
quiet	If TRUE suppresses output from this function.
extension	The file extension to use for the generated src/cppally file. Options are either '.cpp' (the default) or '.cc'.

### Value

The paths to the generated R and C++ source files.

### See Also

[cpp\\_source](#)

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`cpp_source`*Compile C++20 code*

---

## Description

cpp11-style helpers to compile cppally code outside of a cppally-linked package context.

`cpp_source()` compiles and loads a single C++ file for use in R, either from an expression or a cpp file. This may include multiple C++ functions.

`cpp_eval()` evaluates a single C++ expression and returns the result. For example `cpp_eval('get_threads()')` will run the C++ function `cppally::get_threads()` and return the number of OMP threads currently set for use. For expressions no return result, the call is evaluated and returns NULL invisibly.

## Usage

```
cpp_source(  
  file,  
  code = NULL,  
  env = parent.frame(),  
  clean = TRUE,  
  quiet = TRUE,  
  debug = FALSE,  
  preserve_althread = FALSE,  
  check_factors = FALSE,  
  check_data_frames = FALSE,  
  copy_on_modify = FALSE,  
  cxx_std = Sys.getenv("CXX_STD", "CXX20"),  
  dir = tempfile()  
)
```

```
cpp_eval(  
  code,  
  env = curr_env(),  
  clean = TRUE,  
  quiet = TRUE,  
  debug = FALSE,  
  preserve_althread = FALSE,  
  check_factors = FALSE,  
  check_data_frames = FALSE,  
  copy_on_modify = FALSE,  
  simplify = TRUE,  
  cxx_std = Sys.getenv("CXX_STD", "CXX20")  
)
```

## Arguments

`file` C++ file.

code	For <code>cpp_source()</code> - If file is NULL then a string of C++ code to compile. This can include the contents of a cpp file which can contain multiple <code>[[cppally::register]]</code> tagged functions. For <code>cpp_eval</code> - This can be a character vector of single-line expressions.
env	Environment where R functions should be defined.
clean	Should files be cleaned up after sourcing? Default is TRUE.
quiet	Should compiler output be suppressed? Default is TRUE.
debug	Should C++ code be compiled in a debug build? Default is FALSE.
preserve_altrep	Should ALTREP vectors be preserved by avoiding materialisation where possible? Default is FALSE.
check_factors	Should factor levels be validated when using <code>r_factors</code> objects? Default is FALSE. When TRUE, factor levels are checked once on <code>r_factors</code> construction to ensure they are valid, reducing the chance of R crashing when passing factors with invalid levels.
check_data_frames	Should data frames be validated when constructing <code>r_df</code> objects from SEXP? Default is FALSE.
copy_on_modify	Should copy-on-modify be used everywhere? Default is FALSE.
cxx_std	C++ standard to use. Should be $\geq$ C++20.
dir	Directory to store the source files. The default is a temporary directory via <code>tempfile()</code> which is removed when <code>clean = TRUE</code> .
simplify	Applies to <code>cpp_eval</code> . A list of results is returned unless <code>length(code) == 1</code> and <code>simplify = TRUE</code> .

### Value

`cpp_source()` invisibly compiles the C++ code and registers the `[[cppally::register]]` tagged functions to R.

`cpp_eval()` returns the results of the evaluated C++ expressions.

### See Also

[cpp\\_register](#)

### Examples

```
library(cppally)
library(bit64)

cpp_eval('print("hello world!")')

# Default values of all cppally scalars
cpp_eval(c(
  'r_lgl()',
  'r_int()',
  'r_dbl()',
```

```

    'r_int64()',
    'r_str()',
    'r_raw()',
    'r_cplx()',
    'r_date()',
    'r_psxct()'
  ))

cpp_source(code = '
  #include <cppally.hpp>
  using namespace cppally;

  [[cppally::register]]
  r_dbl add(r_dbl x, r_dbl y){
    return x + y;
  }
', debug = TRUE)
add(1, 2)
add(2, NA)

### ALTREP ###

# cppally also supports lazy ALTREP materialisation as an opt-in feature.
# To opt-in, set `preserve_altrep = TRUE`

cpp_source(
  code = '
  #include <cppally.hpp>
  using namespace cppally;

  [[cppally::register]]
  r_int last_altrep_unaware(r_vec<r_int> x){
    r_int out;
    r_size_t n = x.length();

    if (n > 0){
      out = x.get(n - 1);
    }
    return out;
  }
', debug = TRUE
)

cpp_source(
  code = '
  #include <cppally.hpp>
  using namespace cppally;

  [[cppally::register]]
  r_int last_altrep_aware(r_vec<r_int> x){
    r_int out;
    r_size_t n = x.length();

```

```

    if (n > 0){
      out = x.get(n - 1);
    }
    return out;
  }
', debug = TRUE,
  preserve_aitrep = TRUE
)

library(bench)
mark(last_aitrep_aware(1:10^5)) # No materialisation
mark(last_aitrep_unaware(1:10^5)) # Materialises full vector

### Copy-on-modify ###

# cppally supports copy-on-modify as an opt-in feature
# It is disabled by default because it incurs a major performance penalty
# and has been deemed not worth it even for the safety benefits
# That being said, if you prefer absolute safety over speed then you can
# enable it globally via `cppally::use_copy_on_modify()` or
# via the arg `copy_on_modify` if using `cpp_source()`

cpp_source(
  code = '
#include <cppally.hpp>
using namespace cppally;

[[cppally::register]]
r_vec<r_int> reverse(r_vec<r_int> x){
  x.rev(); // in-place reverse
  return x;
}
', copy_on_modify = TRUE
)

x <- c(1L, 2L, 3L)
reverse(x)
x # x was preserved and not updated by reference (as expected)

x <- sample.int(10^5)
mark(reverse(x)) # Memory allocated, therefore x was copied before reversing

# The cppally preferred approach is to allocate a fresh vector or copy the
# existing vector
cpp_source(
  code = '
#include <cppally.hpp>
using namespace cppally;

[[cppally::register]]
r_vec<r_int> cppally_reverse(r_vec<r_int> x){
  r_vec<r_int> out = shallow_copy(x);
  out.rev();

```

```

        return out;
    }
    ', copy_on_modify = FALSE
)

mark(
  r_reverse = rev(x),
  cppally_copy_on_modify_reverse = reverse(x),
  cppally_no_copy_on_modify_reverse = cppally_reverse(x)
)

```

---

document	<i>A wrapper around devtools::document() to support cppally package development</i>
----------	---

---

### Description

A wrapper around devtools::document() to support cppally package development

### Usage

```
document(pkg = ".", roclets = NULL, quiet = FALSE)
```

### Arguments

pkg	See ?devtools::document
roclets	See ?devtools::document
quiet	See ?devtools::document

### Value

Invisibly updates roxygen documentation, compiles C++ code and exports cppally tagged functions to R.

---

load_all	<i>A wrapper around devtools::load_all() specifically for cppally</i>
----------	---

---

### Description

A wrapper around devtools::load\_all() specifically for cppally

### Usage

```
load_all(path = ".", debug = FALSE, ...)
```

**Arguments**

path	Path to package.
debug	Should package be built without optimisations? Default is FALSE which builds with optimisations.
...	Further arguments passed on to pkgload::load_all()

**Value**

Invisibly registers cppally tagged functions and compiles C++ code.

---

use\_check\_data\_frames *Adds the CPPALLY\_CHECK\_DATA\_FRAMES flag to Makevars*

---

**Description**

Adds a flag to Makevars which enables stricter validation on data frames at the point of r\_df construction. This ensures that column lengths are always valid, avoiding potential R crashes downstream.

The default behaviour is NOT to validate column lengths, enabling faster r\_df creating from SEXP.

**Usage**

```
use_check_data_frames()
```

**Value**

Invisibly adds the CPPALLY\_CHECK\_DATA\_FRAMES flag to Makevars.

---

use\_check\_factors *Adds the CPPALLY\_CHECK\_FACTORS flag to Makevars*

---

**Description**

Adds a flag to Makevars which enables stricter validation on factor levels at the point of r\_factors construction. This avoids creating r\_factors objects with invalid levels and avoiding potential R crashes.

The default behaviour is NOT to validate factor levels, which is naturally faster when calling C++ functions that take r\_factors inputs.

**Usage**

```
use_check_factors()
```

**Value**

Invisibly adds the CPPALLY\_CHECK\_FACTORS flag to Makevars.

---

use\_copy\_on\_modify      *Adds the CPPALLY\_COPY\_ON\_MODIFY flag to Makevars*

---

### Description

Adds a flag to Makevars which enables copy-on-modify behaviour like in R. This ensures you can never modify object B's data by modifying object A (unless you do it manually via `r_vec : data()`).

The default behaviour is that `r_vec : set()` always modifies-in-place with no checks to shared or referenced objects. This default behaviour is generally much faster.

#### Parallelisation:

Adding this global flag effectively kills most parallelisation. To achieve copy-on-modify we have to check whether the `r_sexp` object being modified is referenced anywhere else at each and every call to `set()`. This check (via `r_sexp : is_exclusive()`) is not thread-safe and therefore most cppally parallelisation is disabled once `CPPALLY_COPY_ON_MODIFY` is set.

### Usage

```
use_copy_on_modify()
```

### Value

Invisibly adds the `CPPALLY_COPY_ON_MODIFY` flag to Makevars.

---

use\_cppally      *Helper for developing packages with cppally*

---

### Description

use this style helper to add the necessary setup to a new package to help users get started with writing C++ code.

### Usage

```
use_cppally()
```

### Value

Invisibly sets up the necessary conditions for developing a package with cppally.

---

`use_preserve_altrep_flag`*Adds the CPPALLY\_PRESERVE\_ALTREP flag to Makevars*

---

**Description**

Adds a flag to Makevars which enables lazy materialisation of ALTREP vectors.

**Usage**`use_preserve_altrep_flag()`**Value**

Invisibly adds the CPPALLY\_PRESERVE\_ALTREP flag to Makevars.

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