

# NEWS for R version 4.0.0 alpha (2020-03-26 r78078)

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NEWS

*R News*

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## CHANGES IN 4.0.0

### SIGNIFICANT USER-VISIBLE CHANGES:

- `matrix` objects now also inherit from class `"array"`, so e.g., `class(diag(1))` is `c("matrix","array")`. This invalidates code incorrectly assuming that `class(matrix_obj)` has length one.  
S3 methods for class `"array"` are now dispatched for `matrix` objects.
- There is a new syntax for specifying *raw* character constants similar to the one used in C++: `r"(...)"` with `...` any character sequence not containing the sequence `'\'`. This makes it easier to write strings that contain backslashes or both single and double quotes. For more details see `?Quotes`.
- R now uses a `'stringsAsFactors = FALSE'` default, and hence by default no longer converts strings to factors in calls to `data.frame()` and `read.table()`.  
A large number of packages relied on the previous behaviour and so have needed/will need updating.
- The `plot()` S3 generic function is now in package **base** rather than package **graphics**, as it is reasonable to have methods that do not use the **graphics** package. The generic is currently re-exported from the **graphics** namespace to allow packages importing it from there to continue working, but this may change in future.  
Packages which define S4 generics for `plot()` should be re-installed and package code using such generics from other packages needs to ensure that they are imported rather than rely on their being looked for on the search path (as in a namespace, the base namespace has precedence over the search path).

### REFERENCE COUNTING:

- Reference counting is now used instead of the **NAMED** mechanism for determining when objects can be safely mutated in base C code. This reduces the need for copying in some cases and should allow further optimizations in the future. It should help make the internal code easier to maintain.  
This change is expected to have almost no impact on packages using supported coding practices in their C/C++ code.

**MIGRATION TO PCRE2:**

- This version of R is built against the PCRE2 library for Perl-like regular expressions, if available. (On non-Windows platforms PCRE1 can optionally be used if PCRE2 is not available at build time.) The version of PCRE in use can be obtained *via* `extSoftVersion()`: PCRE1 (formerly known as ‘PCRE’) has versions  $\leq 8$ , PCRE2 versions  $\geq 10$ .
- Making PCRE2 available when building R from source is strongly recommended (preferably version 10.30 or later) as PCRE1 is no longer developed: version 8.44 is ‘likely to be the final release’.
- PCRE2 reports errors for some regular expressions that were accepted by PCRE1. A hyphen now has to be escaped in a character class to be interpreted as a literal (unless first or last in the class definition). ‘\R’, ‘\B’ and ‘\X’ are no longer allowed in character classes (PCRE1 treated these as literals).
- Option `PCRE_study` is no longer used with PCRE2, and is reported as `FALSE` when that is in use.

**NEW FEATURES:**

- `assertError()` and `assertWarning()` (in package **tools**) can now check for *specific* error or warning classes *via* the new optional second argument `classes` (which is not back compatible with previous use of an unnamed second argument).
- `DF2formula()`, the utility for the data frame method of `formula()`, now works without parsing and explicit evaluation, starting from Suharto Anggono’s suggestion in [PR#17555](#).
- `approxfun()` and `approx()` gain a new argument `na.rm` defaulting to `true`. If set to `false`, missing `y` values now propagate into the interpolated values.
- Long vectors are now supported as the `seq` argument of a `for()` loop.
- `str(x)` gets a new `deparse.lines` option with a default to speed it up when `x` is a large `call` object.
- The internal traceback object produced when an error is signalled (`.Traceback`), now contains the `calls` rather than the `deparse()`d calls, deferring the deparsing to the user-level functions `.traceback()` and `traceback()`. This fulfils the wish of [PR#17580](#), reported including two patch proposals by Brodie Gaslam.
- `data.matrix()` now converts character columns to factors and from this to integers.
- `package.skeleton()` now explicitly lists all exports in the ‘`NAMESPACE`’ file.
- New function `.S3method()` to register S3 methods in R scripts.
- `file.path()` has some support for file paths not in the session encoding, e.g. with UTF-8 inputs in a non-UTF-8 locale the output is marked as UTF-8.
- Most functions with file-path inputs will give an explicit error if a file-path input in a marked encoding cannot be translated (to the native encoding or in some cases on Windows to UTF-8), rather than translate to a different file path using escapes. Some (such as `dir.exists()`, `file.exists()`, `file.access()`, `file.info()`, `list.files()`, `normalizePath()` and `path.expand()`) treat this like any other non-existent file, often with a warning.
- There is a new help document accessed by `help("file path encoding")` detailing how file paths with marked encodings are handled.
- New function `list2DF()` for creating data frames from lists of variables.
- `iconv()` has a new option `sub = "Unicode"` to translate UTF-8 input invalid in the ‘to’ encoding using ‘<U+xxxx>’ escapes.
- There is a new function `infoRDS()` providing information about the serialization format of a serialized object.

- S3 method lookup now by default skips the elements of the search path between the global and base environments.
- Added an argument `add_datalist(*, small.size = 0)` to allow the creation of a 'data/datalist' file even when the total size of the data sets is small.
- The backquote function `bquote()` has a new argument `splice` to enable splicing a computed list of values into an expression, like `,@` in LISP's backquote.
- The formula interface to `t.test()` and `wilcox.test()` has been extended to handle one-sample and paired tests.
- The `palette()` function has a new default set of colours (which are less saturated and have better accessibility properties). There are also some new built-in palettes, which are listed by the new `palette.pals()` function. These include the old default palette under the name "R3". Finally, the new `palette.colors()` function allows a subset of colours to be selected from any of the built-in palettes.
- `n2mfrow()` gains an option `asp = 1` to specify the aspect ratio, fulfilling the wish and extending the proposal of Michael Chirico in [PR#17648](#).
- For `head(x, n)` and `tail()` the default and other S3 methods notably for *vector* `n`, e.g. to get a "corner" of a matrix, has been extended to `array`'s of higher dimension thanks to the patch proposal by Gabe Becker in [PR#17652](#). Consequently, optional argument `addrownums` is deprecated and replaced by the (more general) argument `keepnums`. An invalid second argument `n` now leads to typically more easily readable error messages.
- New function `.class2()` provides the full character vector of class names used for S3 method dispatch.
- Printing `methods(...)` now uses a new `format()` method.
- `sort.list(x)` now works for non-atomic objects `x` and `method = "auto"` (the default) or `"radix"` in cases `order(x)` works.
- Where they are available, `writeBin()` allows long vectors.
- New function `deparse1()` produces one string, wrapping `deparse()`, to be used typically in `deparse1(substitute(*))`, e.g., to fix [PR#17671](#).
- `wilcox.test()` enhancements: In the (non-paired) two-sample case, `Inf` values are treated as very large for robustness consistency. If exact computations are used, the result now has "exact" in the `method` element of its return value. New arguments `tol.root` and `digits.rank` where the latter may be used for stability to treat very close numbers as ties.
- `readBin()` and `writeBin()` now report an error for an invalid `endian` value. The affected code needs to be fixed with care as the old undocumented behavior was to swap endian-ness in such cases.
- `sequence()` is now an S3 generic with an internally implemented default method, and gains arguments to generate more complex sequences. Based on code from the **S4Vectors** Bioconductor package and the advice of Hervé Pagès.
- `print()`'s default method and many other methods (by calling the default eventually and passing `...`) now make use of a new optional `width` argument, avoiding the need for the user to set and reset `options("width")`.
- `memDecompress()` supports the RFC 1952 format (e.g. in-memory copies of `gzip`-compressed files) as well as RFC 1950.
- `memCompress()` and `memDecompress()` support long raw vectors for types `"gzip"` and `"zx"`.
- `sweep()` and `slice.index()` can now use names of dimnames for their `MARGIN` argument (`apply` has had this for almost a decade).

- New function `proportions()` and `marginSums()`. These should replace the unfortunately named `prop.table()` and `margin.table()`. They are drop-in replacements, but also add named-margin functionality. The old function names are retained as aliases for back-compatibility.
- Functions `rbinom()`, `rgeom()`, `rhyper()`, `rpois()`, `rnbinom()`, `rsignrank()` and `rwilcox()` which have returned integer since R 3.0.0 and hence NA when the numbers would have been outside the integer range, now return double vectors (without NAs, typically) in these cases.
- `matplot(x,y)` (and hence `matlines()` and `matpoints()`) now call the corresponding methods of `plot()` and `lines()`, e.g. when `x` is a "Date" or "POSIXct" object; prompted by Spencer Graves' suggestion.
- `stopifnot()` now allows customizing error messages via argument names, thanks to a patch proposal by Neal Fultz in [PR#17688](#).
- `unlink()` gains a new argument `expand` to disable wildcard and tilde expansion. Elements of `x` of value "~" are now ignored.
- `mle()` in the `stats4` package has had its interface extended so that arguments to the negative log-likelihood function can be one or more vectors, with similar conventions applying to bounds, start values, and parameter values to be kept fixed. This required a minor extension to class "mle", so saved objects from earlier versions may need to be recomputed.
- The default for `pdf()` is now `useDingbats = FALSE`.
- The default fill colour for `hist()` and `boxplot()` is now `col = "lightgray"`.
- The default order of the levels on the y-axis for `spineplot()` and `cdplot()` has been reversed.
- If the `R_ALWAYS_INSTALL_TESTS` environment variable is set to a true value, R CMD INSTALL behaves as if the '--install-tests' option is always specified. Thanks to Reinhold Koch for the suggestion.
- New function `R_user_dir()` in package `tools` suggests paths appropriate for storing R-related user-specific data, configuration and cache files.
- `capabilities()` gains a new logical option `Xchk` to avoid warnings about X11-related capabilities.
- The internal implementation of **grid** units has changed, but the only visible effects at user-level should be
  - a slightly different print format for some units (especially unit arithmetic),
  - faster performance (for unit operations) and
  - two new functions `unitType()` and `unit.psum()`.

Based on code contributed by Thomas Lin Pedersen.

- When internal dispatch for `rep.int()` and `rep.len()` fails, there is an attempt to dispatch on the equivalent call to `rep()`.
- Object `.Machine` now contains new `longdouble.*` entries (when R uses long doubles internally).
- `news()` has been enhanced to cover the news on R 3.x and 2.x.
- For consistency, `N <- NULL; N[[1]] <- val` now turns `N` into a `list` also when `val` has length one. This enables `dimnames(r1)[[1]] <- "R1"` for a 1-row matrix `r1`, fixing [PR#17719](#) reported by Serguei Sokol.
- `deparse(...)`, `dump(...)`, and `dput(x, control = "all")` now include control option "digits17" which typically ensures 1:1 invertibility. New option `control = "exact"` ensures numeric exact invertibility via "hexDigits".
- When loading data sets via `read.table()`, `data()` now uses 'LC\_COLLATE=C' to ensure locale-independent results for possible string-to-factor conversions.

- A server socket connection, a new connection type representing a listening server socket, is created via `serverSocket()` and can accept multiple socket connections via `socketAccept()`.
- New function `socketTimeout()` changes the connection timeout of a socket connection.
- The time needed to start a homogeneous ‘PSOCK’ cluster on ‘localhost’ with many nodes has been significantly reduced (package **parallel**).
- New `globalCallingHandlers()` function to establish global condition handlers. This allows registering default handlers for specific condition classes. Developed in collaboration with Lionel Henry.
- New function `tryInvokeRestart()` to invoke a specified restart if one is available and return without signaling an error if no such restart is found. Contributed by Lionel Henry in [PR#17598](#).
- `str(x)` now shows the length of `attributes` in some cases for a data frame `x`.
- `Rprof()` gains a new argument `filter.callframes` to request that intervening call frames due to lazy evaluation or explicit `eval()` calls be omitted from the recorded profile data. Contributed by Lionel Henry in [PR#17595](#).
- The handling of `#{F00-bar}` and `#{F00:-bar}` in ‘Renviron’ files now follows POSIX shells (at least on a Unix-alike), so the first treats empty environment variables as set and the second does not. Previously both ignored empty variables. There are several uses of the first form in ‘etc/Renviron’.
- New `classes` argument for `suppressWarnings()` and `suppressMessages()` to selectively only suppress warnings or messages that inherit from particular classes. Based on patch from Lionel Henry submitted with [PR#17619](#).

#### Windows:

- `Rterm` now works also when invoked from MSYS2 terminals. Line editing is possible when command `wipty` is installed.
- `normalizePath()` now resolves symbolic links and normalizes case of long names of path elements in case-insensitive folders ([PR#17165](#)).
- `md5sum()` supports UTF-8 file names with characters that cannot be translated to the native encoding ([PR#17633](#)).
- `Rterm` gains a new option ‘--workspace’ to specify the workspace to be restored. This allows equals to be part of the name when opening *via* Windows file associations (reported by Christian Asseburg).
- `Rterm` now accepts `ALT+xxx` sequences also with NumLock on. Tilde can be pasted with an Italian keyboard ([PR#17679](#)).
- R falls back to copying when junction creation fails during package checking (patch from Duncan Murdoch).

#### DEPRECATED AND DEFUNCT:

- Make macro ‘F77\_VISIBILITY’ has been removed and replaced by ‘F\_VISIBILITY’.
- Make macros ‘F77’, ‘FCPIFCPLAGS’ and ‘SHLIB\_OPENMP\_FCFLAGS’ have been removed and replaced by ‘FC’, ‘FPICFLAGS’ and ‘SHLIB\_OPENMP\_FFLAGS’ respectively. (Most `make` programs will set ‘F77’ to the value of ‘FC’, which is set for package compilation. But portable code should not rely on this.)
- The deprecated support for specifying C++98 for package installation has been removed.
- R CMD `config` no longer knows about the unused settings ‘F77’ and ‘FCPIFCPLAGS’, nor ‘CXX98’ and similar.

- Either PCRE2 or PCRE1  $\geq$  8.32 (Nov 2012) is required: the deprecated provision for 8.20–8.31 has been removed.

#### C-LEVEL FACILITIES:

- `installChar` is now remapped in `Rinternals.h` to `installTrChar`, of which it has been a wrapper since R 3.6.0. Neither are part of the API, but packages using `installChar` can replace it if they depend on `'R >= 3.6.2'`.
- Header `'R_ext/Print.h'` defines `'R_USE_C99_IN_CXX'` and hence exposes `Rvprintf` and `REvprintf` if used with a C++11 (or later) compiler.
- There are new Fortran subroutines `dblpri`, `realpri` and `intpri` to print a scalar variable (`gfortran` 10 enforces the distinction between scalars and length-one arrays). Also `labelpri` to print just a label.
- `R_withCallingErrorHandler` is now available for establishing a calling handler in C code for conditions inheriting from class `error`.

#### INSTALLATION on a UNIX-ALIKE:

- User-set `'DEFS'` (e.g., in `'config.site'`) is now used for compiling packages (including base packages).
- There is a new variant option `'--enable-lto=check'` for checking consistency of BLAS/LAPACK/LINPACK calls — see `'Writing R Extensions'`.
- A C++ compiler default is set only if the C++11 standard is supported: it no longer falls back to C++98.
- PCRE2 is used if available. To make use of PCRE1 if PCRE2 is unavailable, configure with option `'--with-pcre1'`.
- The minimum required version of `libcurl` is now 7.28.0 (Oct 2012).
- New make target `distcheck` checks that: R can be rebuilt from the tarball created by `dist`; the tarball build passes `check-all`; the build installs and uninstalls; and the source files are properly cleaned by `distclean`.

#### UTILITIES:

- `R --help` now mentions the option `--no-echo` (renamed from `--slave`) and its previously undocumented short form `-s`.
- `R CMD check` now optionally checks `configure` and `cleanup` scripts for non-Bourne-shell code (`'bashisms'`).
- `R CMD check --as-cran` now runs `\donttest` examples (which are run by `example()`) instead of instructing the tester to do so. This can be temporarily circumvented during development by setting environment variable `_R_CHECK_DONTTEST_EXAMPLES_` to a false value.

#### BUG FIXES:

- `formula(x)` with `length(x) > 1` character vectors, is deprecated now. Such use has been rare, and has ‘worked’ as expected in some cases only. In other cases, wrong `x` have silently been truncated, not detecting previous errors.
- Long-standing issue where the X11 device could lose events shortly after startup has been addressed ([PR#16702](#)).
- The `data.frame` method for `rbind()` no longer drops `<NA>` levels from factor columns by default ([PR#17562](#)).
- `available.packages()` and hence `install.packages()` now pass their `...` argument to `download.file()`, fulfilling the wish of [PR#17532](#); subsequently, `available.packages()` gets new argument `quiet`, solving [PR#17573](#).

- `stopifnot()` gets new argument `exprObject` to allow an R object of class `expression` (or other ‘language’) to work more consistently, thanks to suggestions by Suharto Anggono.
- `conformMethod()` now works correctly in cases containing a “&& logic” bug, reported by Henrik Bengtsson. It now creates methods with “missing” entries in the signature. Consequently, `rematchDefinition()` is amended to use appropriate `.local()` calls with named arguments where needed.
- `format.default(*,scientific = FALSE)` now corresponds to a practically most extreme `options(scipen = n)` setting rather than arbitrary `n = 100`.
- `format(as.symbol("foo"))` now works (returning “foo”).
- `postscript(..,title = *)` now signals an error when the title string contains a character which would produce corrupt PostScript, thanks to [PR#17607](#) by Daisuko Ogawa.
- Certain Ops (notably comparison such as `==`) now also work for 0-length data frames, after reports by Hilmar Berger.
- `methods(class = class(glm(..)))` now warns more usefully and only once.
- `write.dcf()` no longer mangles field names ([PR#17589](#)).
- Primitive replacement functions no longer mutate a referenced first argument when used outside of a complex assignment context.
- A better error message for `contour(*,levels = Inf)`.
- The return value of `contourLines()` is no longer `invisible()`.
- The Fortran code for calculating the `coefficients` component in `lm.influence()` was very inefficient. It has (for now) been replaced with much faster R code ([PR#17624](#)).
- `cm.colors(n)` etc no longer append the code for `alpha = 1`, “FF”, to all colors. Hence all eight `*.colors()` functions and `rainbow()` behave consistently and have the same non-explicit default ([PR#17659](#)).
- `dnorm` had a problematic corner case with `sd == -Inf` or negative `sd` which was not flagged as an error in all cases. Thanks to Stephen D. Weigand for reporting and Wang Jiefei for analyzing this; similar change has been made in `dlnorm()`.
- The optional `iter.smooth` argument of `plot.lm()`, (the `plot()` method for `lm` and `glm` fits) now defaults to 0 for all `glm` fits. Especially for binary observations with high or low fitted probabilities, this effectively deleted all observations of 1 or 0. Also, the type of residuals used in the `glm` case has been switched to “pearson” since deviance residuals do not in general have approximately zero mean.
- In `plot.lm`, Cook’s distance was computed from unweighted residuals, leading to inconsistencies. Replaced with usual weighted version. ([PR#16056](#))
- Time-series `ts(*,start,end,frequency)` with fractional `frequency` are supported more consistently; thanks to a report from Johann Kleinbub and analysis and patch by Duncan Murdoch in [PR#17669](#).
- In case of errors `mcmapply()` now preserves attributes of returned “try-error” objects and avoids simplification, overriding `SIMPLIFY` to `FALSE`. ([PR#17653](#))
- `as.difftime()` gets new optional `tz = "UTC"` argument which should fix behaviour during daylight-savings-changeover days, fixing [PR#16764](#), thanks to proposals and analysis by Johannes Ranke and Kirill Müller.
- `round()` does a better job of rounding “to nearest” by *measuring* and “to even”; thanks to a careful algorithm originally prompted by the report from Adam Wheeler and then others, in [PR#17668](#).  
`round(x,dig)` for *negative* digits is much more rational now, notably for large  $|dig|$ .



- Inheritance information on S4 classes is maintained more consistently, particularly in the case of class unions (in part due to [PR#17596](#) and a report from Ezra Tucker).
- `is()` behaves more robustly when its argument `class2` is a `classRepresentation` object.
- The warning message when attempting to export a nonexistent class is now more readable; thanks to Thierry Onkelinx for recognizing the problem.
- `choose()` misbehaved in corner cases where it switched `n - k` for `k` and `n` was only *nearly* integer (report from Erik Scott Wright).
- `mle()` in the `stats4` package had problems combining use of box constraints and fixed starting values (in particular, confidence intervals were affected).
- Operator `?` now has lower precedence than `=` to work as documented, so `=` behaves like `<=` in help expressions ([PR#16710](#)).
- `smoothEnds(x)` now returns `integer` type in *both* cases when `x` is `integer`, thanks to a report and proposal by Bill Dunlap [PR#17693](#).
- The `methods` package does a better job of tracking inheritance relationships across packages.
- `norm(diag(c(1,NA)), "2")` now works.
- `subset()` had problems with 0-col dataframes (reported by Bill Dunlap, [PR#17721](#)).
- Several cases of integer overflow detected by the ‘undefined behaviour sanitizer’ of `clang` 10 have been circumvented. One in `hyper()` may change the generated value for large input values.
- `dotchart()` now places the y-axis label (`ylab`) much better, not overplotting labels, thanks to a report and suggestion by Alexey Shipunov.
- A rare C-level array overflow in `chull()` has been worked around.
- Some invalid specifications of the day-of-the-year (*via* `%j`, e.g. day 366 in 2017) or week plus day-of-the-week are now detected by `strptime()`. They now return `NA` but give a warning as they may have given random results or corrupted memory in earlier versions of R.
- `socketConnection(server = FALSE)` now respects connection timeout also on Linux.
- `socketConnection(server = FALSE)` no longer leaks a connection that is available right away without waiting (e.g. on ‘localhost’).
- Socket connections are now robust against spurious readability and spurious availability of an incoming connection.
- `blocking = FALSE` is now respected also on the server side of a socket connection, allowing non-blocking read operations.
- `anova.glm()` and `anova.glmList()` computed incorrect score (Rao) tests in no-intercept cases. (André Gillibert, [PR#17734](#))
- `summaryRprof()` now should work correctly for the `Rprof(*,memory.profiling=TRUE)` case with small chunk size (and “`tseries`” or similar) thanks to a patch proposal by Benjamin Tyner, in [PR#15886](#).
- `xgettext()` ignores strings passed to `ngettext()`, since the latter is handled by `xngettext()`. Thanks to Daniele Medri for the report and all the recent work he has done on the Italian translations.

#### BUG FIXES (Windows):

- `Sys.glob()` now supports all characters from the Unicode Basic Multilingual Plane, no longer corrupting some (less commonly used) characters ([PR#17638](#)).
- `Rterm` now correctly displays multi-byte-coded characters representable in the current native encoding (at least on Windows 10 they were sometimes omitted, [PR#17632](#)).



- `scan()` issues with UTF-8 data when running in a DBCS locale have been resolved ([PR#16520](#), [PR#16584](#)).
- `RTerm` now accepts enhanced/arrow keys also with `ConPTY`.
- R can now be started *via* the launcher icon in a user documents directory whose path is not representable in the system encoding.
- `socketConnection(server = FALSE)` now returns instantly also on Windows when connection failure is signalled.
- Problems with UTF-16 surrogate pairs have been fixed in several functions, including `tolower()` and `toupper()` ([PR#17645](#)).

#### CHANGES in previous versions

- Older news can be found in text format in files ‘NEWS.0’, ‘NEWS.1’, ‘NEWS.2’ and ‘NEWS.3’ in the ‘doc’ directory. News in HTML format for R versions 3.x and from 2.10.0 to 2.15.3 is available at ‘doc/html/NEWS.3.html’ and ‘doc/html/NEWS.2.html’.