NEWS for R version 4.1.2 (2021-11-01)



CHANGES IN R 4.1.2

C-LEVEL FACILITIES:

- The workaround in headers 'R.h' and 'Rmath.h' (`using namespace std;`) for the Oracle Developer Studio compiler is no longer needed now C++11 is required so has been removed. A couple more usages of `log()` (which should have been `std::log()`) with an `int` argument are reported on Solaris.
- The undocumented limit of 4095 bytes on messages from the S-compatibility macros `PROBLEM` and `MESSAGE` is now documented and longer messages will be silently truncated rather than potentially causing segfaults.
- If the `R_NO_SEGV_HANDLER` environment variable is non-empty, the signal handler for SEGV/ILL/BUS signals (which offers recovery user interface) is not set. This allows more reliable debugging of crashes that involve the console.

DEPRECATED AND DEFUNCT:

- The legacy S-compatibility macros `PROBLEM`, `MESSAGE`, `ERROR`, `WARN`, `WARNING`, `RECOVER`, ... are deprecated and will be hidden in R 4.2.0. R's native interface of `Rf_error` and `Rf_warning` has long been preferred.

BUG FIXES:

- `.mapply(F,dots,.)` no longer segfaults when `dots` is not a `list` and uses `match.fun(F)` as always documented; reported by Andrew Simmons in PR#18164.
- `hist(<Date>,...)` and `hist(<POSIXt>,...)` no longer pass arguments for `rect()` (such as `col` and `density`) to `axis()`. (Thanks to Sebastian Meyer's PR#18171.)
- \Sexpr{ch} now preserves `Encoding(ch)`. (Thanks to report and patch by Jeroen Ooms in PR#18152.)
- Setting the RNG to `"Marsaglia-Multicarry"` e.g., by `RNGkind()`, now warns in more places, thanks to André Gillibert's report and patch in PR#18168.
- `gray(numeric(),alpha=1/2)` no longer segfaults, fixing PR#18183, reported by Till Krenz.

- Fixed `dnbinom(x,size=<very_small>,..,log=TRUE)` regression, reported by Martin Morgan.
- `as.Date.POSIXlt(x)` now keeps `names(x)`, thanks to Davis Vaughan's report and patch in PR#18188.
- `model.response()` now strips an `"AsIs"` class typically, thanks to Duncan Murdoch's report and other discussants in PR#18190.
- `try()` is considerably faster in case of an error and long call, as e.g., from some `do.call()`. Thanks to Alexander Kaever's suggestion posted to R-devel.
- `qqline(y = <object>)` such as `y=I(.)`, now works, see also PR#18190.
- Non-integer `mgp par()` settings are now handled correctly in `axis()` and `mtext()`, thanks to Mikael Jagan and Duncan Murdoch's report and suggestion in PR#18194.
- `formatC(x)` returns length zero `character()` now, rather than `""` when `x` is of length zero, as documented, thanks to Davis Vaughan's post to R-devel.
- `removeSource(fn)` now retains (other) `attributes(fn)`.



CHANGES IN R 4.1.1

NEW FEATURES:

- `require(`*pkg*`,quietly = TRUE)` is quieter and in particular does not warn if the package is not found.

DEPRECATED AND DEFUNCT:

- Use of '`ftp://`' URIs should be regarded as deprecated, with on-going support confined to `method = "libcurl"` and not routinely tested. (Nowadays no major browser supports them.)
- The non-default `method = "internal"` is deprecated for '`http://`' and '`ftp://`' URIs for both `download.file` and `url`.
- On Windows, `method = "wininet"` is deprecated for '`http://`', '`https://`' and '`ftp://`' URIs for both `download.file` and `url`. (A warning is only given for '`ftp://`'.)
  For '`ftp://`' URIs the default method is now `"libcurl"` if available (which it is on CRAN builds).
  `method = "wininet"` remains the default for '`http://`' and '`https://`' URIs but if `libcurl` is available, using `method = "libcurl"` is preferred.

INSTALLATION:

- `make check` now works also without a LaTeX installation. (Thanks to Sebastian Meyer's PR#18103.)

BUG FIXES:

- `make check-devel` works again in an R build configured with '`--without-recommended-packages`'.
- `qnbinom(p,size,mu)` for large `size/mu` is correct now in a range of cases (PR#18095); similarly for the `(size,prob)` parametrization of the negative binomial. Also `qpois()` and `qbinom()` are better and or faster for extreme cases. The underlying C code has been modularized and is common to all four cases of discrete distributions.

- `gap.axis` is now part of the `axis()` arguments which are passed from `bxp()`, and hence `boxplot()`. (Thanks to Martin Smith's report and suggestions in PR#18109.)
- `.First` and `.Last` can again be set from the site profile.
- `seq.int(from,to,*)` and `seq.default(..)` now work better in large range cases where `from-to` is infinite where the two boundaries are finite.
- `all.equal(x,y)` now returns `TRUE` correctly also when several entries of `abs(x)` and `abs(y)` are close to `.Machine$double.xmax`, the largest finite `numeric`.
- `model.frame()` now clears the object bit when removing the `class` attribute of a value via `na.action` (PR#18100).
- `charClass()` now works with multi-character strings on Windows (PR#18104, fixed by Bill Dunlap).
- `encodeString()` on Solaris now works again in Latin-1 encoding on characters represented differently in UTF-8. Support for surrogate pairs on Solaris has been improved.
- `file.show()` on Windows now works with non-ASCII path names representable in the current native encoding (PR#18132).
- Embedded R on Windows can now find R home directory via the registry even when installed only for the current user (PR#18135).
- `pretty(x)` with finite `x` now returns finite values also in the case where the extreme `x` values are close in size to the maximal representable number `.Machine$double.xmax`. Also, it's been tweaked for very small ranges and when a boundary is close (or equal) to zero; e.g., `pretty(c(0,1e-317))` no longer has negative numbers, currently still warning about a very small range, and `pretty(2^-(1024 -2^-1/(c(24,10))))` is more accurate.
- The error message for not finding vignette files when weaving has correct file sizes now. (Thanks to Sebastian Meyer's PR#18154.)
- `dnbinom(20,<large>,1)` now correctly gives 0, and similar cases are more accurate with underflow precaution. (Reported by Francisco Vera Alcivar in PR#18072.)



CHANGES IN R 4.1.0

FUTURE DIRECTIONS:

- It is planned that the 4.1.x series will be the last to support 32-bit Windows, with production of binary packages for that series continuing until early 2023.

SIGNIFICANT USER-VISIBLE CHANGES:

- Data set `esoph` in package **datasets** now provides the correct numbers of controls; previously it had the numbers of cases added to these. (Reported by Alexander Fowler in PR#17964.)

NEW FEATURES:

- '`www.omegahat.net`' is no longer one of the repositories known by default to `setRepositories()`. (Nowadays it only provides source packages and is often unavailable.)
- Function `package_dependencies()` (in package **tools**) can now use different dependency types for direct and recursive dependencies.

- The checking of the size of tarball in `R CMD check --as-cran <pkg>` may be tweaked via the new environment variable `_R_CHECK_CRAN_INCOMING_TARBALL_THRESHOLD_`, as suggested in PR#17777 by Jan Gorecki.
- Using `c()` to combine a factor with other factors now gives a factor, an ordered factor when combining ordered factors with identical levels.
- `apply()` gains a `simplify` argument to allow disabling of simplification of results.
- The `format()` method for class `"ftable"` gets a new option `justify`. (Suggested by Thomas Soeiro.)
- New `...names()` utility. (Proposed by Neal Fultz in PR#17705.)
- `type.convert()` now warns when its `as.is` argument is not specified, as the help file always said it *should*. In that case, the default is changed to `TRUE` in line with its change in `read.table()` (related to `stringsAsFactors`) in R 4.0.0.
- When printing list arrays, classed objects are now shown *via* their `format()` value if this is a short enough character string, or by giving the first elements of their class vector and their length.
- `capabilities()` gets new entry `"Rprof"` which is `TRUE` when R has been configured with the equivalent of `--enable-R-profiling` (as it is by default). (Related to Michael Orlitzky's report PR#17836.)
- `str(xS4)` now also shows extraneous attributes of an S4 object `xS4`.
- Rudimentary support for vi-style tags in `rtags()` and `R CMD rtags` has been added. (Based on a patch from Neal Fultz in PR#17214.)
- `checkRdContents()` is now exported from **tools**; it and also `checkDocFiles()` have a new option `chkInternal` allowing to check Rd files marked with keyword `"internal"` as well. The latter can be activated for `R CMD check` via environment variable `_R_CHECK_RD_INTERNAL_TOO_`.
- New functions `numToBits()` and `numToInts()` extend the `raw` conversion utilities to (double precision) `numeric`.
- Functions `URLencode()` and `URLdecode()` in package **utils** now work on vectors of URIs. (Based on patch from Bob Rudis submitted with PR#17873.)
- `path.expand()` can expand '`~user`' on most Unix-alikes even when `readline` is not in use. It tries harder to expand '`~`', for example should environment variable `HOME` be unset.
- For HTML help (both dynamic and static), Rd file links to help pages in external packages are now treated as references to topics rather than file names, and fall back to a file link only if the topic is not found in the target package. The earlier rule which prioritized file names over topics can be restored by setting the environment variable `_R_HELP_LINKS_TO_TOPICS_` to a false value.
- `c()` now removes `NULL` arguments before dispatching to methods, thus simplifying the implementation of `c()` methods, *but* for back compatibility keeps `NULL` when it is the first argument. (From a report and patch proposal by Lionel Henry in PR#17900.)
- `Vectorize()`'s result function's environment no longer keeps unneeded objects.
- Function `...elt()` now propagates visibility consistently with `..n`. (Thanks to Lionel Henry's PR#17905.)
- `capture.output()` no longer uses non-standard evaluation to evaluate its arguments. This makes evaluation of functions like `parent.frame()` more consistent. (Thanks to Lionel Henry's PR#17907.)

- `packBits(bits,type="double")` now works as inverse of `numToBits()`. (Thanks to Bill Dunlap's proposal in PR#17914.)
- `curlGetHeaders()` has two new arguments, `timeout` to specify the timeout for that call (overriding `getOption("timeout")`) and `TLS` to specify the minimum TLS protocol version to be used for `https://` URIs (*inter alia* providing a means to check for sites using deprecated TLS versions 1.0 and 1.1).
- For `nls()`, an optional constant `scaleOffset` may be added to the denominator of the relative offset convergence test for cases where the fit of a model is expected to be exact, thanks to a proposal by John Nash. `nls(*,trace=TRUE)` now also shows the convergence criterion.
- Numeric differentiation *via* `numericDeriv()` gets new optional arguments `eps` and `central`, the latter for taking central divided differences. The latter can be activated for `nls()` via `nls.control(nDcentral = TRUE)`.
- `nls()` now passes the `trace` and `control` arguments to `getInitial()`, notably for all self-starting models, so these can also be fit in zero-noise situations via a `scaleOffset`. For this reason, the `initial` function of a `selfStart` model must now have `...` in its argument list.
- `bquote(splice = TRUE)` can now splice expression vectors with attributes: this makes it possible to splice the result of `parse(keep.source = TRUE)`. (Report and patch provided by Lionel Henry in PR#17869.)
- `textConnection()` gets an optional `name` argument.
- `get()`, `exists()`, and `get0()` now signal an error if the first argument has length greater than 1. Previously additional elements were silently ignored. (Suggested by Antoine Fabri on R-devel.)
- R now provides a shorthand notation for creating functions, e.g. `\(x) x + 1` is parsed as `function(x) x + 1`.
- R now provides a simple native forward pipe syntax `|>`. The simple form of the forward pipe inserts the left-hand side as the first argument in the right-hand side call. The pipe implementation as a syntax transformation was motivated by suggestions from Jim Hester and Lionel Henry.
- `all.equal(f,g)` for `function`s now by default also compares their `environment(.)`s, notably via new `all.equal` method for class `function`. Comparison of `nls()` fits, e.g., may now need `all.equal(m1,m2,check.environment = FALSE)`.
- `.libPaths()` gets a new option `include.site`, allowing to *not* include the site library. (Thanks to Dario Strbenac's suggestion and Gabe Becker's PR#18016.)
- Lithuanian translations are now available. (Thanks to Rimantas Žakauskas.)
- `names()` now works for `DOTSXP` objects. On the other hand, in '`R-lang`', the R language manual, we now warn against relying on the structure or even existence of such dot-dot-dot objects.
- `all.equal()` no longer gives an error on `DOTSXP` objects.
- `capabilities("cairo")` now applies only to the file-based devices as it is now possible (if very unusual) to build R with Cairo support for those but not for `X11()`.
- There is optional support for tracing the progress of `loadNamespace()` — see its help.
- (Not Windows.) `l10n_info()` reports an additional element, the name of the encoding as reported by the OS (which may differ from the encoding part (if any) of the result from `Sys.getlocale("LC_CTYPE")`.

- New function `gregexec()` which generalizes `regexec()` to find *all* disjoint matches and all substrings corresponding to parenthesized subexpressions of the given regular expression. (Contributed by Brodie Gaslam.)
- New function `charClass()` in package **utils** to query the wide-character classification functions in use (such as `iswprint`).
- The names of `quantile()`'s result no longer depend on the global `getOption("digits")`, but `quantile()` gets a new optional argument `digits = 7` instead.
- `grep()`, `sub()`, `regexp` and variants work considerably faster for long factors with few levels. (Thanks to Michael Chirico's PR#18063.)
- Provide grouping of `x11()` graphics windows within a window manager such as `Gnome` or `Unity`; thanks to a patch by Ivan Krylov posted to R-devel.
- The `split()` method for class `data.frame` now allows the `f` argument to be specified as a formula.
- `sprintf` now warns on arguments unused by the format string.
- New palettes `"Rocket"` and `"Mako"` for `hcl.colors()` (approximating palettes of the same name from the **viridisLite** package).
  Contributed by Achim Zeileis.
- The base environment and its namespace are now locked (so one can no longer add bindings to these or remove from these).
- `Rterm` handling of multi-byte characters has been improved, allowing use of such characters when supported by the current locale.
- `Rterm` now accepts `ALT+ +xxxxxxxx` sequences to enter Unicode characters as hex digits.
- Environment variable `LC_ALL` on Windows now takes precedence over `LC_CTYPE` and variables for other supported categories, matching the POSIX behaviour.
- `duplicated()` and `anyDuplicated()` are now optimized for integer and real vectors that are known to be sorted via the ALTREP framework. Contributed by Gabriel Becker via PR#17993.

GRAPHICS:

- The graphics engine version, `R_GE_version`, has been bumped to `14` and so packages that provide graphics devices should be reinstalled.
- Graphics devices should now specify `deviceVersion` to indicate what version of the graphics engine they support.
- Graphics devices can now specify `deviceClip`. If `TRUE`, the graphics engine will never perform any clipping of output itself.
  The clipping that the graphics engine does perform (for both `canClip = TRUE` and `canClip = FALSE`) has been improved to avoid producing unnecessary artifacts in clipped output.
- The **grid** package now allows `gpar(fill)` to be a `linearGradient()`, a `radialGradient()`, or a `pattern()`. The `viewport(clip)` can now also be a grob, which defines a clipping path, and there is a new `viewport(mask)` that can also be a grob, which defines a mask.
  These new features are only supported so far on the Cairo-based graphics devices and on the `pdf()` device.

- (Not Windows.) A warning is given when a Cairo-based type is specified for a `png()`, `jpeg()`, `tiff()` or `bmp()` device but Cairo is unsupported (so `type = "Xlib"` is tried instead).
- `grSoftVersion()` now reports the versions of FreeType and FontConfig if they are used directly (not *via* Pango), as is most commonly done on macOS.

C-LEVEL FACILITIES:

- The *standalone* '`libRmath`' math library and R's C API now provide `log1pexp()` again as documented, and gain `log1mexp()`.

INSTALLATION on a UNIX-ALIKE:

- `configure` checks for a program `pkgconf` if program `pkg-config` is not found. These are now only looked for on the path (like almost all other programs) so if needed specify a full path to the command in `PKG_CONFIG`, for example in file '`config.site`'.
- C99 function `iswblank` is required – it was last seen missing ca 2003 so the workaround has been removed.
- There are new `configure` options '`--with-internal-iswxxxxx`', '`--with-internal-towlower`' and '`--with-internal-wcwidth`' which allows the system functions for wide-character classification, case-switching and width (`wcwidth` and `wcswidth`) to be replaced by internal ones. The first has long been used on macOS, AIX (and Windows) but this enables it to be unselected there and selected for other platforms (it is the new default on Solaris). The second is new in this version of R and is selected by default on macOS and Solaris. The third has long been the default and remains so as it contains customizations for East Asian languages.
  System versions of these functions are often minimally implemented (sometimes only for ASCII characters) and may not cover the full range of Unicode points: for example Solaris (and Windows) only cover the Basic Multilingual Plane.
- Cairo installations without X11 are more likely to be detected by `configure`, when the file-based Cairo graphics devices will be available but not `X11(type = "cairo")`.
- There is a new `configure` option '`--with-static-cairo`' which is the default on macOS. This should be used when only static cairo (and where relevant, Pango) libraries are available.
- Cairo-based graphics devices on platforms without Pango but with FreeType/FontConfig will make use of the latter for font selection.

LINK-TIME OPTIMIZATION on a UNIX-ALIKE:

- Configuring with flag '`--enable-lto=R`' now also uses LTO when installing the recommended packages.
- `R CMD INSTALL` and `R CMD SHLIB` have a new flag '`--use-LTO`' to use LTO when compiling code, for use with R configured with '`--enable-lto=R`'. For R configured with '`--enable-lto`', they have the new flag '`--no-use-LTO`'.
  Packages can opt in or out of LTO compilation *via* a '`UseLTO`' field in the '`DESCRIPTION`' file. (As usual this can be overridden by the command-line flags.)

BUILDING R on Windows:

- for GCC $\geq$ 8, `FC_LEN_T` is defined in '`config.h`' and hence character lengths are passed from C to Fortran in *inter alia* BLAS and LAPACK calls.

- There is a new text file '`src/gnuwin32/README.compilation`', which outlines how C/Fortran code compilation is organized and documents new features:
  - R can be built with Link-Time Optimization with a suitable compiler – doing so with GCC 9.2 showed several inconsistencies which have been corrected.
  - There is support for cross-compiling the C and Fortran code in R and standard packages on suitable (Linux) platforms. This is mainly intended to allow developers to test later versions of compilers – for example using GCC 9.2 or 10.x has detected issues that GCC 8.3 in Rtools40 does not.
  - There is experimental support for cross-building R packages with C, C++ and/or Fortran code.
- The R installer can now be optionally built to support a single architecture (only 64-bit or only 32-bit).

PACKAGE INSTALLATION:

- The default C++ standard has been changed to C++14 where available (which it is on all currently checked platforms): if not (as before) C++11 is used if available otherwise C++ is not supported.
  Packages which specify C++11 will still be installed using C++11.
  C++14 compilers may give deprecation warnings, most often for `std::random_shuffle` (deprecated in C++14 and removed in C++17). Either specify C++11 (see 'Writing R Extensions') or modernize the code and if needed specify C++14. The latter has been supported since R 3.4.0 so the package's '`DESCRIPTION`' would need to include something like

  ```
  Depends: R (>= 3.4)
  ```

PACKAGE INSTALLATION on Windows:

- `R CMD INSTALL` and `R CMD SHLIB` make use of their flag '`--use-LTO`' when the '`LTO_OPT`' make macro is set in file '`etc/${R_ARCH}/Makeconf`' or in a personal/site '`Makevars`' file. (For details see 'Writing R Extensions' §4.5.)
  This provides a valuable check on code consistency. It does work with GCC 8.3 as in Rtools40, but that does not detect everything the CRAN checks with current GCC do.

PACKAGE INSTALLATION on macOS:

- The default personal library directory on builds with '`--enable-aqua`' (including CRAN builds) now differs by CPU type, one of

  ```
  ~/Library/R/x86_64/x.y/library
  ~/Library/R/arm64/x.y/library
  ```

  This uses the CPU type R (and hence the packages) were built for, so when a '`x86_64`' build of R is run under Rosetta emulation on an '`arm64`' Mac, the first is used.

UTILITIES:

- `R CMD check` can now scan package functions for bogus `return` statements, which were possibly intended as `return()` calls (wish of PR#17180, patch by Sebastian Meyer). This check can be activated via the new environment variable `_R_CHECK_BOGUS_RETURN_`, true for `--as-cran`.

- `R CMD build` omits tarballs and binaries of previous builds from the top-level package directory. (PR#17828, patch by Sebastian Meyer.)
- `R CMD check` now runs sanity checks on the use of '`LazyData`', for example that a '`data`' directory is present and that '`LazyDataCompression`' is not specified without '`LazyData`' and has a documented value. For packages with large LazyData databases without specifying '`LazyDataCompression`', there is a reference to the code given in 'Writing R Extensions' §1.1.6 to test the choice of compression (as in all the CRAN packages tested a non-default method was preferred).
- `R CMD build` removes '`LazyData`' and '`LazyDataCompression`' fields from the '`DESCRIPTION`' file of packages without a '`data`' directory.

ENCODING-RELATED CHANGES:

- The parser now treats '`\Unnnnnnnn`' escapes larger than the upper limit for Unicode points ('`\U10FFFF`') as an error as they cannot be represented by valid UTF-8.
  Where such escapes are used for outputting non-printable (including unassigned) characters, 6 hex digits are used (rather than 8 with leading zeros). For clarity, braces are used, for example '`\U{0effff}`'.
- The parser now looks for non-ASCII spaces on Solaris (as previously on most other OSes).
- There are warnings (including from the parser) on the use of unpaired surrogate Unicode points such as '`\uD834`'. (These cannot be converted to valid UTF-8.)
- Functions `nchar()`, `tolower()`, `toupper()` and `chartr()` and those using regular expressions have more support for inputs with a marked Latin-1 encoding.
- The character-classification functions used (by default) to replace the system `iswxxxxx` functions on Windows, macOS and AIX have been updated to Unicode 13.0.0.
  The character-width tables have been updated to include new assignments in Unicode 13.0.0. This included treating all control characters as having zero width.
- The code for evaluating default (extended) regular expressions now uses the same character-classification functions as the rest of R (previously they differed on Windows, macOS and AIX).
- There is a build-time option to replace the system's wide-character `wctrans` C function by tables shipped with R: use `configure` option '`--with-internal-towlower`' or (on Windows) '`-DUSE_RI18N_CASE`' in '`CFLAGS`' when building R. This may be needed to allow `tolower()` and `toupper()` to work with Unicode characters beyond the Basic Multilingual Plane where not supported by system functions (e.g. on Solaris where it is the new default).
- R is more careful when truncating UTF-8 and other multi-byte strings that are too long to be printed, passed to the system or libraries or placed into an internal buffer. Truncation will no longer produce incomplete multibyte characters.

DEPRECATED AND DEFUNCT:

- Function `plclust()` from the package **stats** and `package.dependencies()`, `pkgDepends()`, `getDepList()`, `installFoundDepends()`, and `vignetteDepends()` from package **tools** are defunct.
- Defunct functions `checkNEWS()` and `readNEWS()` from package **tools** and `CRAN.packages()` from **utils** have been removed.

- `R CMD config CXXCPP` is defunct (it was deprecated in R 3.6.2).
- `parallel::detectCores()` drops support for Irix (retired in 2013).
- The `LINPACK` argument to `chol.default()`, `chol2inv()`, `solve.default()` and `svd()` has been defunct since R 3.1.0. It was silently ignored up to R 4.0.3 but now gives an error.
- Subsetting/indexing, such as `ddd[*]` or `ddd$x` on a `DOTSXP` (dot-dot-dot) object `ddd` has been disabled; it worked by accident only and was undocumented.

BUG FIXES:

- Many more C-level allocations (mainly by `malloc` and `strdup`) are checked for success with suitable alternative actions.
- Bug fix for `replayPlot()`; this was turning off graphics engine display list recording if a recorded plot was replayed in the same session. The impact of the bug became visible if resize the device after replay OR if attempted another `savePlot()` after replay (empty display list means empty screen on resize or empty saved plot).
- `R CMD check` etc now warn when a package exports non-existing S4 classes or methods, also in case of no "methods" presence. (Reported by Alex Bertram; reproducible example and patch by Sebastian Meyer in PR#16662.)
- `boxplot()` now also accepts `call`s for labels such as `ylab`, the same as `plot()`. (Reported by Marius Hofert.)
- The help page for `xtabs()` now correctly states that `addNA` is setting `na.action = na.pass` among others. (Reported as PR#17770 by Thomas Soeiro.)
- The `R CMD check <pkg>` gives a longer and more comprehensible message when '`DESCRIPTION`' misses dependencies, e.g., in `Imports:`. (Thanks to the contributors of PR#17179.)
- `update.default()` now calls the generic `update()` on the formula to work correctly for models with extended formulas. (As reported and suggested by Neal Fultz in PR#17865.)
- The horizontal position of leaves in a dendrogram is now correct also with `center = FALSE`. (PR#14938, patch from Sebastian Meyer.)
- `all.equal.POSIXt()` no longer warns about and subsequently ignores inconsistent `"tzone"` attributes, but describes the difference in its return value (PR#17277). This check can be disabled *via* the new argument `check.tzone = FALSE` as suggested by Sebastian Meyer.
- `as.POSIXct()` now populates the `"tzone"` attribute from its `tz` argument when `x` is a logical vector consisting entirely of `NA` values.
- `x[[2^31]] <-v` now works. (Thanks to the report and patch by Suharto Anggono in PR#17330.)
- In log-scale graphics, `axis()` ticks and label positions are now computed more carefully and symmetrically in their range, typically providing *more* ticks, fulfilling wishes in PR#17936. The change really corresponds to an improved `axisTicks()` (package **grDevices**), potentially influencing **grid** and **lattice**, for example.
- `qnorm(<very large negative>,log.p=TRUE)` is now correct to at least five digits where it was catastrophically wrong, previously.
- `sum(df)` and similar `"Summary"`- and `"Math"`-group member functions now work for data frames `df` with `logical` columns, notably also of zero rows. (Reported to R-devel by Martin "b706".)

- `unsplit()` had trouble with tibbles due to unsound use of `rep(NA,len)`-indexing, which should use `NA_integer_` (Reported to R-devel by Mario Annau.)
- `pnorm(x,log.p = TRUE)` underflows to `-Inf` slightly later.
- `show(<hidden S4 generic>)` prints better and without quotes for non-hidden S4 generics.
- `read.table()` and relatives treated an "NA" column name as missing when `check.names = FALSE` PR#18007.
- Parsing strings containing UTF-16 surrogate pairs such as `"\uD834\uDD1E"` works better on some (uncommon) platforms. `sprintf("%X",utf8ToInt("\uD834\uDD1E"))` should now give `"1D11E"` on all platforms.
- `identical(x,y)` is no longer true for differing `DOTSXP` objects, fixing PR#18032.
- `str()` now works correctly for `DOTSXP` and related exotics, even when these are doomed.
  Additionally, it no longer fails for `lists` with a `class` and "irregular" method definitions such that e.g. `lapply(*)` will necessarily fail, as currently for different **igraph** objects.
- Message translation domains, e.g., for errors and warnings, are now correctly determined also when e.g., a **base** function is called from "top-level" function (i.e., defined in `globalenv()`), thanks to a patch from Joris Goosen fixing PR#17998.
- Too long lines in environment files (e.g., '`Renviron`') no longer crash R. This limit has been increased to 100,000 bytes. (PR#18001.)
- There is a further workaround for FreeType giving incorrect italic font faces with cairo-based graphics devices on macOS.
- `add_datalist(*,force = TRUE)` (from package **tools**) now actually updates an existing '`data/datalist`' file for new content. (Thanks to a report and patch by Sebastian Meyer in PR#18048.)
- `cut.Date()` and `cut.POSIXt()` could produce an empty last interval for `breaks = "months"` or `breaks = "years"`. (Reported as PR#18053 by Christopher Carbone.)
- Detection of the encoding of 'regular' macOS locales such as '`en_US`' (which is UTF-8) had been broken by a macOS change: fortunately these are now rarely used with '`en_US.UTF-8`' being preferred.
- `sub()` and `gsub(pattern,repl,x,*)` now keep attributes of `x` such as `names()` also when `pattern` is `NA` (PR#18079).
- Time differences (`"difftime"` objects) get a replacement and a `rep()` method to keep `"units"` consistent. (Thanks to a report and patch by Nicolas Bennett in PR#18066.)
- The \RdOpts macro, setting defaults for \Sexpr options in an Rd file, had been ineffective since R 2.12.0: it now works again. (Thanks to a report and patch by Sebastian Meyer in PR#18073.)
- `mclapply` and `pvec` no longer accidentally terminate parallel processes started before by `mcparallel` or related calls in package **parallel** (PR#18078).
- `grep` and other functions for evaluating (extended) regular expressions handle in Unicode also strings not explicitly flagged UTF-8, but flagged native when running in UTF-8 locale.
- Fixed a crash in `fifo` implementation on Windows (PR#18031).
- Binary mode in `fifo` on Windows is now properly detected from argument `open` (PR#15600, PR#18031).



CHANGES IN R 4.0.5

BUG FIXES:

- The change to the internal table in R 4.0.4 for `iswprint` has been reverted: it contained some errors in printability of 'East Asian' characters.
- For packages using '`LazyData`', `R CMD build` ignored the '`--resave-data`' option and the '`BuildResaveData`' field of the '`DESCRIPTION`' file (in R versions 4.0.0 to 4.0.4).



CHANGES IN R 4.0.4

NEW FEATURES:

- File '`share/texmf/tex/latex/jss.cls`' has been updated to work with LaTeX versions since Oct 2020.
- Unicode character width tables (as used by `nchar(,type = "w")`) have been updated to Unicode 12.1 by Brodie Gaslam (PR#17781), including many emoji.
- The internal table for `iswprint` (used on Windows, macOS and AIX) has been updated to include many recent Unicode characters.

INSTALLATION on a UNIX-ALIKE:

- If an external BLAS is specified by '`--with-blas=foo`' or *via* environment variable `BLAS_LIBS` is not found, this is now a configuration error. The previous behaviour was not clear from the documentation: it was to continue the search as if '`--with-blas=yes`' was specified.

BUG FIXES:

- `all.equal(x,y)` now "sees" the two different `NA`s in factors, thanks to Bill Dunlap and others in PR#17897.
- `(~ NULL)[1]` and similar formula subsetting now works, thanks to a report and patch by Henrik Bengtsson in PR#17935. Additionally, subsetting leaving an empty formula now works too, thanks to suggestions by Suharto Anggono.
- `.traceback(n)` keeps source references again, as before R 4.0.0, fixing a regression; introduced by the PR#17580, reported including two patch proposals by Brodie Gaslam.
- `unlist(plst,recursive=FALSE)` no longer drops content for pairlists with list components, thanks to the report and patch by Suharto Anggono in PR#17950.
- `iconvlist()` now also works on MUSL based (Linux) systems, from a report and patch suggestion by Wesley Chan in PR#17970.
- `round()` and `signif()` no longer tolerate wrong argument names, notably in 1-argument calls; reported by Shane Mueller on R-devel (mailing list); later reported as PR#17976.
- `.Machine` has `longdouble.*` elements only if `capabilities("long.double")` is true, as documented. (Previously they were included if the platform had `long double` identical to `double`, as ARM does.)
- `p.adjust(numeric(),n=0)` now works, fixing PR#18002.

- `identical(x,y)` no longer prints "Unknown Type .." for `typeof(x) == "..."` objects.
- Fix (auto-)`print()`ing of named complex vectors, see PR#17868 and PR#18019.
- `all.equal(<language>,<...>)` now works, fixing PR#18029.
- `as.data.frame.list(L,row.names=NULL)` now behaves in line with `data.frame()`, disregarding names of components of `L`, fixing PR#18034, reported by Kevin Tappe.
- `checkRdaFiles(ff)$version` is now correct also when `ff` contains files of different versions, thanks to a report and patch from Sebastian Meyer in PR#18041.
- macOS: Quartz device live drawing could fail (no plot is shown) if the system changes the drawing context after view update (often the case since macOS Big Sur). System log may show "CGContextDelegateCreateForContext: invalid context" error.



CHANGES IN R 4.0.3

NEW FEATURES:

- On platforms using `configure` option '`--with-internal-tzcode`', additional values `"internal"` and (on macOS only) `"macOS"` are accepted for the environment variable `TZDIR`. (See `?TZDIR`.)
  On macOS, `"macOS"` is used by default if the system timezone database is a newer version than that in the R installation.
- When `install.packages(type = "source")` fails to find a package in a repository it mentions package versions which are excluded by their R version requirement and links to hints on why a package might not be found.
- The default value for `options("timeout")` can be set from environment variable `R_DEFAULT_INTERNET_TIMEOUT`, still defaulting to 60 (seconds) if that is not set or invalid.
  This may be needed when child R processes are doing downloads, for example during the installation of source packages which download jars or other forms of data.

LINK-TIME OPTIMIZATION on a UNIX-ALIKE:

- There is now support for parallelized Link-Time Optimization (LTO) with GCC and for 'thin' LTO with `clang` *via* setting the '`LTO`' macro.
- There is support for setting a different LTO flag for the Fortran compiler, including to empty when mixing `clang` and `gfortran` (as on macOS). See file '`config.site`'.
- There is a new '`LTO_LD`' macro to set linker options for LTO compilation, for example to select an alternative linker or to parallelize thin LTO.

DEPRECATED AND DEFUNCT:

- The `LINPACK` argument to `chol.default()`, `chol2inv()`, `solve.default()` and `svd()` has been defunct since R 3.1.0. Using it now gives a warning which will become an error in R 4.1.0.

BUG FIXES:

- The code mitigating stack overflow with PCRE regexps on very long strings is enabled for PCRE2 < 10.30 also when JIT is enabled, since stack overflows have been seen in that case.

- Fix to correctly show the group labels in `dotchart()` (which where lost in the `ylab` improvement for R 4.0.0).
- `addmargins(*,..)` now also works when `fn()` is a local function, thanks to bug report and patch PR#17124 from Alex Bertram.
- `rank(x)` and hence `sort(x)` now work when `x` is an object (as per `is.object(x)`) of type `"raw"` *and* provides a valid `` `[` `` method, e.g., for `gmp::as.bigz(.)` numbers.
- `chisq.test(*,simulate.p.value=TRUE)` and `r2dtable()` now work correctly for large table entries (in the millions). Reported by Sebastian Meyer and investigated by more helpers in PR#16184.
- Low-level socket read/write operations have been fixed to correctly signal communication errors. Previously, such errors could lead to a segfault due to invalid memory access. Reported and debugged by Dmitriy Selivanov in PR#17850.
- `quantile(x,pr)` works more consistently for `pr` values slightly outside [0,1], thanks to Suharto Anggono's PR#17891.
  Further, `quantile(x,prN,names=FALSE)` now works even when `prN` contains `NA`s, thanks to Anggono's PR#17892. Ditto for ordered factors or `Date` objects when `type = 1` or `3`, thanks to PR#17899.
- Libcurl-based internet access, including `curlGetHeaders()`, was not respecting the `"timeout"` option. If this causes unanticipated timeouts, consider increasing the default by setting `R_DEFAULT_INTERNET_TIMEOUT`.
- `as.Date(<char>)` now also works with an initial `""`, thanks to Michael Chirico's PR#17909.
- `isS3stdGeneric(f)` now detects an S3 generic also when it it is `trace()`d, thanks to Gabe Becker's PR#17917.
- `R_allocLD()` has been fixed to return memory aligned for long double type PR#16534.
- `fisher.test()` no longer segfaults when called again after its internal stack has been exceeded PR#17904.
- Accessing a long vector represented by a compact integer sequence no longer segfaults (reported and debugged by Hugh Parsonage).
- `duplicated()` now works also for strings with multiple encodings inside a single vector PR#17809.
- `phyper(11,15,0,12,log.p=TRUE)` no longer gives `NaN`; reported as PR#17271 by Alexey Stukalov.
- Fix incorrect calculation in `logLik.nls()` PR#16100, patch from Sebastian Meyer.
- A very old bug could cause a segfault in `model.matrix()` when terms involved logical variables. Part of PR#17879.
- `model.frame.default()` allowed `data = 1`, leading to involuntary variable capture (rest of PR#17879).
- `tar()` no longer skips non-directory files, thanks to a patch by Sebastian Meyer, fixing the remaining part of PR#16716.



CHANGES IN R 4.0.2

UTILITIES:

- `R CMD check` skips vignette re-building (with a warning) if the '`VignetteBuilder`' package(s) are not available.

BUG FIXES:

- Paths with non-ASCII characters caused problems for package loading on Windows PR#17833.
- Using **tcltk** widgets no longer crashes R on Windows.
- `source(*,echo=TRUE)` no longer fails in some cases with empty lines; reported by Bill Dunlap in PR#17769.
- `on.exit()` now correctly matches named arguments, thanks to PR#17815 (including patch) by Brodie Gaslam.
- `regexpr(*,perl=TRUE)` no longer returns incorrect positions into text containing characters outside of the Unicode Basic Multilingual Plane on Windows.



CHANGES IN R 4.0.1

NEW FEATURES:

- `paste()` and `paste0()` gain a new optional argument `recycle0`. When set to true, zero-length arguments are recycled leading to `character(0)` after the `sep`-concatenation, i.e., to the empty string `""` if `collapse` is a string and to the zero-length value `character(0)` when `collapse = NULL`.
  A package whose code uses this should depend on '`R (>= 4.0.1)`'.
- The `summary(<warnings>)` method now maps the counts correctly to the warning messages.

BUG FIXES:

- `aov(frml,...)` now also works where the `formula` deparses to more than 500 characters, thanks to a report and patch proposal by Jan Hauffa.
- Fix a dozen places (code, examples) as `Sys.setlocale()` returns the new rather than the previous setting.
- Fix for adding two complex **grid** units via `sum()`. Thanks to Gu Zuguang for the report and Thomas Lin Pedersen for the patch.
- Fix `parallel::mclapply(...,mc.preschedule=FALSE)` to handle raw vector results correctly. PR#17779
- Computing the `base` value, i.e., 2, "everywhere", now uses `FLT_RADIX`, as the original '`machar`' code looped indefinitely on the ppc64 architecture for the `longdouble` case.
- In R 4.0.0, `sort.list(x)` when `is.object(x)` was true, e.g., for `x <-I(letters)`, was accidentally using `method = "radix"`. Consequently, e.g., `merge(<data.frame>)` was much slower than previously; reported in PR#17794.
- `plot(y ~ x,ylab = quote(y[i]))` now works, as e.g., for `xlab`; related to PR#10525.
- `parallel::detect.cores(all.tests = TRUE)` tries a matching OS name before the other tests (which were intended only for unknown OSes).
- Parse data for raw strings is now recorded correctly. Reported by Gabor Csardi.



CHANGES IN R 4.0.0

SIGNIFICANT USER-VISIBLE CHANGES:

- Packages need to be (re-)installed under this version (4.0.0) of R.
- `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 <= 8, PCRE2 versions >= 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 `call`*s* 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, typically via a `xtfrm()` method.
- 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 `${FOO-bar}` and `${FOO:-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 suppress only warnings or messages that inherit from particular classes. Based on patch from Lionel Henry submitted with PR#17619.
- New function `activeBindingFunction()` retrieves the function of an active binding.
- New `"cairoFT"` and `"pango"` components in the output of `grSoftVersion()`.
- New argument `symbolfamily` in cairo-based graphics devices and new function `cairoSymbolFont()` that can be used to provide the value for that argument.

Windows:

- `Rterm` now works also when invoked from MSYS2 terminals. Line editing is possible when command `winpty` 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 >= 8.32 (Nov 2012) is required: the deprecated provision for 8.20–8.31 has been removed.
- Defunct functions `mem.limits()`, `.readRDS()`, `.saveRDS()`, `.find.package()`, and `.path.package()` from package **base** and `allGenerics()`, `getAccess()`, `getAllMethods()`, `getClassName()`, `getClassPackage()`, `getExtends()`, `getProperties()`, `getPrototype()`, `getSubclasses()`, `getVirtual()`, `mlistMetaName()`, `removeMethodsObject()`, `seemsS4Object()`, `traceOff()`, and `traceOn()` from **methods** have 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 `dblepr1`, `realpr1` and `intpr1` to print a scalar variable (`gfortran` 10 enforces the distinction between scalars and length-one arrays). Also `labelpr` 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
  - R can be rebuilt from the tarball created by `make dist`,
  - the build from the tarball passes `make check-all`,
  - the build installs and uninstalls,
  - the source files are properly cleaned by `make 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.

PACKAGE INSTALLATION:

- There is the beginnings of support for the recently approved C++20 standard, specified analogously to C++14 and C++17. There is currently only limited support for this in compilers, with flags such as '`-std=c++20`' and '`-std=c++2a`'. For the time being the `configure` test is of accepting one of these flags and compiling C++17 code.

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 Daisuke 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 an 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 `rhyper()` 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 the 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#17735)
- `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.
- `data(package = "P")` for `P` in **base** and **stats** no longer reports the data sets from package **datasets** (which it did for back compatibility for 16 years), fixing PR#17730.
- `x[[Inf]]` (returning `NULL`) no longer leads to undefined behavior, thanks to a report by Kirill Müller in PR#17756. Further, `x[[-Inf]]` and `x[[-n]]` now give more helpful error messages.
- `Gamma()` family sometimes had trouble storing link name PR#15891

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 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`'.