Package 'MazamaCoreUtils'

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Type Package

Version 0.5.3

Title Utility Functions for Production R Code

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Description A suite of utility functions providing functionality commonly needed for production level projects such as logging, error handling, cache management and date-time parsing. Functions for date-time parsing and formatting require that time zones be specified explicitly, avoiding a common source of error when working with environmental time series.

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URL https://github.com/MazamaScience/MazamaCoreUtils

BugReports https://github.com/MazamaScience/MazamaCoreUtils/issues

Depends R (>= 4.0.0)

Imports devtools, digest, dplyr, futile.logger, geohashTools, lubridate, magrittr, purrr, rlang (>= 1.1.0), rvest, stringr, tibble, xml2

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Contents

`APIKeys` *API keys for data services.*

Description

This package maintains an internal set of API keys which users can set using `setAPIKey()`. These keys will be remembered for the duration of an R session. This functionality provides an abstraction layer in dependent packages so that data access functions can test for and access specific API keys with generic code.

Format

List of character strings.

See Also

getAPIKey

setAPIKey

showAPIKeys

`createLocationID` *Create one or more unique locationIDs*

Description

A locationID is created for each incoming `longitude` and `latitude`. Each locationID is unique to within a certain spatial scale. With `algorithm = "geohash"`, the `precision` argument determines the size of a geohash grid cell. At the equator, the following grid cell sizes apply for different precision levels:

```
precision   (maximum grid cell X axis, in m)
        5   ± 2400
        6   ± 610
        7   ± 76
        8   ± 19
        9   ± 2.4
       10   ± 0.6
```

Invalid locations will be assigned a locationID specified by the user with the `invalidID` argument, typically `NA`.

Usage

```
createLocationID(
  longitude = NULL,
  latitude = NULL,
  algorithm = c("geohash", "digest"),
  precision = 10,
  invalidID = as.character(NA)
)
```

Arguments

`longitude`	Vector of longitudes in decimal degrees E.
`latitude`	Vector of latitudes in decimal degrees N.
`algorithm`	Algorithm to use – either `"geohash"` or `"digest"`.
`precision`	`precision` argument used when encoding with `"geohash"`.
`invalidID`	Identifier to use for invalid locations. This can be a character string or `NA`.

Details

When the "geohash" algorithm is specified, the following code is used to generate each locationID:

```
  locationID <-
    geohashTools::gh_encode(latitude, longitude, precision)
```

When the "digest" algorithm is specified, the following code is used:

```
# Retain accuracy up to ~.1m
locationString <- paste0(
  sprintf("%.7f", longitude),
  "_",
  sprintf("%.7f", latitude)
)
# Avoid collisions until billions of records
locationID <- digest::digest(locationString, algo = "xxhash64")
```

See the references for details on either algorithm.

Value

Vector of character locationIDs.

Note

The "geohash" algorithm is preferred but the "digest" algorithm is retained because several existing databases use the "digest" algorithm as a unique identifier.

References

https://en.wikipedia.org/wiki/Decimal_degrees

https://www.johndcook.com/blog/2017/01/10/probability-of-secure-hash-collisions/

https://michaelchirico.github.io/geohashTools/index.html

Examples

```
library(MazamaCoreUtils)

longitude <- c(-122.5, 0, NA, -122.5, -122.5)
latitude <- c( 47.5, 0, 47.5, NA, 47.5)

createLocationID(longitude, latitude)
createLocationID(longitude, latitude, precision = 7)
createLocationID(longitude, latitude, invalidID = "bad")
createLocationID(longitude, latitude, algorithm = "digest")
```

createLocationMask *Create a mask of valid locations*

Description

A logical vector is created with either TRUE or FALSE for each incoming longitude, latitude pair with TRUE indicating a valid location. This can be used to filter dataframes to retain only records with valid locations.

lonRange and latRange can be used to create a valid-mask for locations within a rectangular area.

removeZeroZero will invalidate the location 0.0, 0.0 which is sometimes seen in poorly QC'ed datasets.

NA values found in longitude or latitude will result in a mask value of FALSE.

Usage

```
createLocationMask(
  longitude = NULL,
  latitude = NULL,
  lonRange = c(-180, 180),
  latRange = c(-90, 90),
  removeZeroZero = TRUE
)
```

Arguments

longitude	Vector of longitudes in decimal degrees E.
latitude	Vector of latitudes in decimal degrees N.
lonRange	Range of valid longitudes.
latRange	Range of valid latitudes.
removeZeroZero	Logical indicating whether locations at 0.0, 0.0 should be marked as invalid.

Value

Vector of logical values.

Examples

```
library(MazamaCoreUtils)

createLocationMask(
  longitude = c(-120, NA, -120, -220, -120, 0),
  latitude = c(45, 45, NA, 45, 100, 0)
)

createLocationMask(
  longitude = c(-120:-90),
```

```
  latitude = c(20:50),
  lonRange = c(-110, -100),
  latRange = c(30, 40)
)
```

---

dateRange *Create a POSIXct date range*

Description

Uses incoming parameters to return a pair of POSIXct times in the proper order. The first returned time will be midnight of the desired starting date. The second returned time will represent the "end of the day" of the requested or calculated enddate boundary.

Note that the returned end date will be one unit prior to the start of the requested enddate unless ceilingEnd = TRUE in which case the entire enddate will be included up to the last unit.

The ceilingEnd argument addresses the ambiguity of a phrase like: "August 1-8". With ceilingEnd = FALSE (default) this pharse means "through the beginning of Aug 8". With ceilingEnd = TRUE it means "through the end of Aug 8".

So, to get 24 hours of data staring on Jan 01, 2019 you would specify:

```
> MazamaCoreUtils::dateRange(20190101, 20190102, timezone = "UTC")
[1] "2019-01-01 00:00:00 UTC" "2019-01-01 23:59:59 UTC"
```

or

```
> MazamaCoreUtils::dateRange(20190101, 20190101,
                             timezone = "UTC", ceilingEnd = TRUE)
[1] "2019-01-01 00:00:00 UTC" "2019-01-01 23:59:59 UTC"
```

The required timezone parameter must be one of those found in OlsonNames.

Dates can be anything that is understood by lubrdiate::parse_date_time() using the Ymd[HMS] orders. This includes:

- "YYYYmmdd"
- "YYYYmmddHHMMSS"
- "YYYY-mm-dd"
- "YYYY-mm-dd H"
- "YYYY-mm-dd H:M"
- "YYYY-mm-dd H:M:S"

Usage

```
dateRange(
  startdate = NULL,
  enddate = NULL,
  timezone = NULL,
  unit = "sec",
  ceilingStart = FALSE,
  ceilingEnd = FALSE,
  days = 7
)
```

Arguments

startdate	Desired start datetime (ISO 8601).
enddate	Desired end datetime (ISO 8601).
timezone	Olson timezone used to interpret dates (required).
unit	Units used to determine time at end-of-day.
ceilingStart	Logical instruction to apply ceiling_date to the startdate rather than floor_date
ceilingEnd	Logical instruction to apply ceiling_date to the enddate rather than floor_date
days	Number of days of data to include.

Value

A vector of two POSIXcts.

Default Arguments

In the case when either startdate or enddate is missing, it is created from the non-missing values plus/minus days. If both startdate and enddate are misssing, enddate is set to now (with the given timezone), and then startdate is calculated using enddate - days.

End-of-Day Units

The second of the returned POSIXcts will end one unit before the specified enddate. Acceptable units are "day","hour", "min", "sec".

The aim is to quickly calculate full-day date ranges for time series whose values are binned at different units. Thus, if unit = "min", the returned value associated with enddate will always be at 23:59:00 in the requested time zone.

POSIXct inputs

When startdate or enddate are already POSIXct values, they are converted to the timezone specified by timezone without altering the physical instant in time the input represents. This is different from the behavior of parse_date_time (which powers this function), which will force POSIXct inputs into a new timezone, altering the physical moment of time the input represents.

Parameter precedence

It is possible to supply input paramters that are in conflict. For example:

```
dateRange("2019-01-01", "2019-01-08", days = 3, timezone = "UTC")
```

The `startdate` and `enddate` parameters would imply a 7-day range which is in conflict with `days = 3`. The following rules resolve conflicts of this nature:

1. When `startdate` and `enddate` are both specified, the `days` parameter is ignored.
2. When `startdate` is missing, `ceilingStart` is ignored and the first returned time will depend on the combination of `enddate`, `days` and `ceilingEnd`.
3. When `enddate` is missing, `ceilingEnd` is ignored and the second returned time depends on `ceilingStart` and `days`.

Examples

```
library(MazamaCoreUtils)

dateRange("2019-01-08", timezone = "UTC")
dateRange("2019-01-08", unit = "min", timezone = "UTC")
dateRange("2019-01-08", unit = "hour", timezone = "UTC")
dateRange("2019-01-08", unit = "day", timezone = "UTC")
dateRange("2019-01-08", "2019-01-11", timezone = "UTC")
dateRange(enddate = 20190112, days = 3,
          unit = "day", timezone = "America/Los_Angeles")
```

---

dateSequence *Create a POSIXct date sequence*

Description

Uses incoming parameters to return a seqeunce of `POSIXct` times at local midnight in the specified `timezone`. The first returned time will be midnight of the requested `startdate`. The final returned time will be midnight (*at the beginning*) of the requested `enddate`.

The `ceilingEnd` argument addresses the ambiguity of a phrase like: "August 1-8". With `ceilingEnd = FALSE` (default) this pharse means "through the beginning of Aug 8". With `ceilingEnd = TRUE` it means "through the end of Aug 8".

The required `timezone` parameter must be one of those found in `OlsonNames`.

Dates can be anything that is understood by `lubrdiate::parse_date_time()` using the `Ymd[HMS]` orders. This includes:

- `"YYYYmmdd"`
- `"YYYYmmddHHMMSS"`
- `"YYYY-mm-dd"`
- `"YYYY-mm-dd H"`
- `"YYYY-mm-dd H:M"`
- `"YYYY-mm-dd H:M:S"`

All hour-minute-second information is removed after parsing.

Usage

```
dateSequence(
  startdate = NULL,
  enddate = NULL,
  timezone = NULL,
  ceilingEnd = FALSE
)
```

Arguments

startdate	Desired start datetime (ISO 8601).
enddate	Desired end datetime (ISO 8601).
timezone	Olson timezone used to interpret dates (required).
ceilingEnd	Logical instruction to apply ceiling_date to the enddate rather than floor_date

Value

A vector of POSIXcts at midnight local time.

POSIXct inputs

When startdate or enddate are already POSIXct values, they are converted to the timezone specified by timezone without altering the physical instant in time the input represents. Only after conversion are they floored to midnight local time

Note

The main utility of this function is that it respects "clock time" and returns times associated with midnight regardless of daylight savings. This is in contrast to 'seq.Date(from, to, by = "day")' which creates a sequence of datetimes always separated by 24 hours.

Examples

```
library(MazamaCoreUtils)

dateSequence("2019-11-01", "2019-11-08", timezone = "America/Los_Angeles")
dateSequence("2019-11-01", "2019-11-07", timezone = "America/Los_Angeles",
             ceilingEnd = TRUE)

# Observe the handling of daylight savings
datetime <- dateSequence("2019-11-01", "2019-11-08",
                         timezone = "America/Los_Angeles")

datetime
lubridate::with_tz(datetime, "UTC")

# Passing in POSIXct values preserves the instant in time before flooring --
#   midnight Tokyo time is the day before in UTC
jst <- dateSequence(20190307, 20190315, timezone = "Asia/Tokyo")
jst
```

```
dateSequence(jst[1], jst[7], timezone = "UTC")
```

`getAPIKey` *Get API key*

Description

Returns the API key associated with a web service. If `provider == NULL` a list is returned containing all recognized API keys.

Usage

```
getAPIKey(provider = NULL)
```

Arguments

`provider`	Web service provider.

Value

API key string or a list of provider:key pairs.

See Also

APIKeys

setAPIKey

showAPIKeys

`html_getLinks` *Find all links in an html page*

Description

Parses an html page to extract all `<a href="...">...</a>` links and return them in a dataframe where `linkName` is the human readable name and `linkUrl` is the `href` portion. By default this function will return relative URLs.

This is especially useful for extracting data from an index page that shows the contents of a web accessible directory.

Wrapper functions `html_getLinkNames()` and `html_getLinkUrls()` return the appropriate columns as vectors.

Usage

```
html_getLinks(url = NULL, relative = TRUE)

html_getLinkNames(url = NULL)

html_getLinkUrls(url = NULL, relative = TRUE)
```

Arguments

url	URL or file path of an html page.
relative	Logical instruction to return relative URLs.

Value

A dataframe with `linkName` and/or `linkUrl` columns.

Examples

```
library(MazamaCoreUtils)

# Fail gracefully if the resource is not available
try({

  # US Census 2019 shapefiles
  url <- "https://www2.census.gov/geo/tiger/GENZ2019/shp/"

  # Extract links
  dataLinks <- html_getLinks(url)

  dataLinks <- dataLinks %>%
    dplyr::filter(stringr::str_detect(linkName, "us_county"))
  head(dataLinks, 10)

}, silent = FALSE)
```

---

html_getTables *Find all tables in an html page*

Description

Parses an html page to extract all <table> elements and return them in a list of dataframes representing each table. The columns and rows of these dataframes are that of the table it represents. A single table can be extracted as a dataframe by passing the index of the table in addition to the url to `html_getTable()`.

Usage

```
html_getTables(url = NULL, header = NA)

html_getTable(url = NULL, header = NA, index = 1)
```

Arguments

url	URL or file path of an html page.
header	Use first row as header? If NA, will use first row if it consists of <th> tags.
index	Index identifying which table to to return.

Value

A list of dataframes representing each table on a html page.

Examples

```
library(MazamaCoreUtils)

# Fail gracefully if the resource is not available
try({

  # Wikipedia's list of timezones
  url <- "http://en.wikipedia.org/wiki/List_of_tz_database_time_zones"

  # Extract tables
  tables <- html_getTables(url)

  # Extract the first table
  # NOTE: Analogous to firstTable <- html_getTable(url, index = 1)
  firstTable <- tables[[1]]

  head(firstTable)
  nrow(firstTable)

}, silent = FALSE)
```

---

initializeLogging *Initialize standard log files*

Description

Convenience function that wraps common logging initialization steps.

Usage

```
initializeLogging(logDir = NULL, filePrefix = "", createDir = TRUE)
```

Arguments

logDir	Directory in which to write log files.
filePrefix	Character string prepended to log files.
createDir	Logical specifying whether to create a missing logDir or issue an error message.

---

lintFunctionArgs *Lint a source file's function arguments*

Description

This function parses an R Script file, grouping function calls and the named arguments passed to those functions. Then, based on a set of rules, it is determined if functions of interest have specific named arguments specified.

Usage

```
lintFunctionArgs_file(filePath = NULL, rules = NULL, fullPath = FALSE)

lintFunctionArgs_dir(dirPath = "./R", rules = NULL, fullPath = FALSE)
```

Arguments

filePath	Path to a file, given as a length one character vector.
rules	A named list where the name of each element is a function name, and the value is a character vector of the named argument to check for. All arguments must be specified for a function to "pass".
fullPath	Logical specifying whether to display absolute paths.
dirPath	Path to a directory, given as a length one character vector.

Value

A tibble detailing the results of the lint.

Linting Output

The output of the function argument linter is a tibble with the following columns:

file_path path to the source file

line_number Line of the source file the function is on

column_number Column of the source file the function starts at

function_name The name of the function

named_args A vector of the named arguments passed to the function

includes_required True iff the function specifies all of the named arguments required by the given rules

Limitations

This function is only able to test for named arguments passed to a function. For example, it would report that `foo(x = bar, "baz")` has specified the named argument `x`, but not that `bar` was the value of the argument, or that `"baz"` had been passed as an unnamed argument.

Examples

```
## Not run:
library(MazamaCoreUtils)

# Example rule list for checking
exRules <- list(
  "fn_one" = "x",
  "fn_two" = c("foo", "bar")
)

# Example of using included timezone argument linter
lintFunctionArgs_file(
  "local_test/timezone_lint_test_script.R",
  MazamaCoreUtils::timezoneLintRules
)

## End(Not run)
```

`loadDataFile` *Load R data from URL or local file*

Description

Loads pre-generated R binary (".rda") files from a URL or a local directory. This function is intended to be called by other `~_load()` functions and can remove internet latencies when local versions of data are available.

If both `dataUrl` and `dataDir` are provided, an attempt will be made to load data from the source specified by `priority` with the other source used as a backup.

Usage

```
loadDataFile(
  filename = NULL,
  dataUrl = NULL,
  dataDir = NULL,
  priority = c("dataDir", "dataUrl")
)
```

Arguments

filename	Name of the R data file to be loaded.
dataUrl	Remote URL directory for data files.
dataDir	Local disk directory containing data files.
priority	First data source to attempt if both are supplied.

Value

A data object.

Examples

```
## Not run:
library(MazamaCoreUtils)

filename = "USCensusStates_02.rda"
dir = "~/Data/Spatial"
url = "http://data.mazamascience.com/MazamaSpatialUtils/Spatial_0.8"

# Load local file
USCensusStates = loadDataFile(filename, dataDir = dir)

# Load remote file
USCensusStates = loadDataFile(filename, dataUrl = url)

# Load local file with remote file as backup
USCensusStates =
  loadDataFile(filename, dataDir = dir, dataUrl = url, priority = "dataDir")

# Load remote file with local file as backup
USCensusStates =
  loadDataFile(filename, dataDir = dir, dataUrl = url, priority = "dataUrl")


## End(Not run)
```

---

logger.debug *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate DEBUG level log statements.

Usage

```
logger.debug(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.error *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate ERROR level log statements.

Usage

```
logger.error(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.fatal *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate `FATAL` level log statements.

Usage

```
logger.fatal(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.info *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate `INFO` level log statements.

Usage

```
logger.info(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.isInitialized *Check for initialization of loggers*

Description

Returns TRUE if logging has been initialized. This allows packages to emit logging statements only if logging has already been set up, potentially avoiding ‘futile.log‘ errors.

Usage

```
logger.isInitialized()
```

Value

TRUE if logging has already been initialized.

See Also

logger.setup

initializeLogging

Examples

```
## Not run:
logger.isInitialized()
logger.setup()
logger.isInitialized()

## End(Not run)
```

---

logger.setLevel *Set console log level*

Description

By default, the logger threshold is set to FATAL so that the console will typically receive no log messages. By setting the level to one of the other log levels: TRACE, DEBUG, INFO, WARN, ERROR users can see logging messages while running commands at the command line.

Usage

```
logger.setLevel(level)
```

Arguments

level	Threshold level.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Set up console logging only
logger.setup()
logger.setLevel(DEBUG)

## End(Not run)
```

`logger.setup` *Set up python-style logging*

Description

Good logging allows package developers and users to create log files at different levels to track and debug lengthy or complex calculations. "Python-style" logging is intended to suggest that users should set up multiple log files for different log severities so that the `errorLog` will contain only log messages at or above the `ERROR` level while a `debugLog` will contain log messages at the `DEBUG` level as well as all higher levels.

Python-style log files are set up with `logger.setup()`. Logs can be set up for any combination of log levels. Accepting the default `NULL` setting for any log file simply means that log file will not be created.

Python-style logging requires the use of `logger.debug()` style logging statements as seen in the example below.

Usage

```
logger.setup(
  traceLog = NULL,
  debugLog = NULL,
  infoLog = NULL,
  warnLog = NULL,
  errorLog = NULL,
  fatalLog = NULL
)
```

Arguments

`traceLog`	File name or full path where `logger.trace()` messages will be sent.
`debugLog`	File name or full path where `logger.debug()` messages will be sent.
`infoLog`	File name or full path where `logger.info()` messages will be sent.
`warnLog`	File name or full path where `logger.warn()` messages will be sent.
`errorLog`	File name or full path where `logger.error()` messages will be sent.
`fatalLog`	File name or full path where `logger.fatal()` messages will be sent.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.trace logger.debug logger.info logger.warn logger.error logger.fatal

Examples

```
## Not run:
library(MazamaCoreUtils)

# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow lot statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.trace *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate TRACE level log statements.

Usage

```
logger.trace(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logger.warn *Python-style logging statements*

Description

After initializing the level-specific log files with `logger.setup(...)`, this function will generate `WARN` level log statements.

Usage

```
logger.warn(msg, ...)
```

Arguments

msg	Message with format strings applied to additional arguments.
...	Additional arguments to be formatted.

Value

No return value.

Note

All functionality is built on top of the excellent **futile.logger** package.

See Also

logger.setup

Examples

```
## Not run:
# Only save three log files
logger.setup(
  debugLog = "debug.log",
  infoLog = "info.log",
  errorLog = "error.log"
)

# But allow log statements at all levels within the code
logger.trace("trace statement #%d", 1)
logger.debug("debug statement")
logger.info("info statement %s %s", "with", "arguments")
logger.warn("warn statement %s", "about to try something dumb")
result <- try(1/"a", silent=TRUE)
logger.error("error message: %s", geterrmessage())
logger.fatal("fatal statement %s", "THE END")

## End(Not run)
```

---

logLevels *Log levels*

Description

Log levels matching those found in **futile.logger**. Available levels include:

FATAL ERROR WARN INFO DEBUG TRACE

Usage

```
FATAL
```

Format

An object of class `integer` of length 1.

`manageCache` *Manage the size of a cache*

Description

If `cacheDir` takes up more than `maxCacheSize` megabytes on disk, files will be removed in order of access time by default. Only files matching `extensions` are eligible for removal. Files can also be removed in order of change time with `sortBy='ctime'` or modification time with `sortBy='mtime'`.

The `maxFileAge` parameter can also be used to remove files that haven't been modified in a certain number of days. Fractional days are allowed. This removal happens without regard to the size of the cache and is useful for removing out-of-date data.

It is important to understand precisely what these timestamps represent:

- `atime` – File access time: updated whenever a file is opened.
- `ctime` – File change time: updated whenever a file's metadata changes e.g. name, permission, ownership.
- `mtime` – file modification time: updated whenever a file's contents change.

Usage

```
manageCache(
  cacheDir = NULL,
  extensions = c("html", "json", "pdf", "png"),
  maxCacheSize = 100,
  sortBy = "atime",
  maxFileAge = NULL
)
```

Arguments

`cacheDir`	Location of cache directory.
`extensions`	Vector of file extensions eligible for removal.
`maxCacheSize`	Maximum cache size in megabytes.
`sortBy`	Timestamp to sort by when sorting files eligible for removal. One of `atime|ctime|mtime`.
`maxFileAge`	Maximum age in days of files allowed in the cache.

Value

Invisibly returns the number of files removed.

Examples

```
library(MazamaCoreUtils)

# Create a cache directory and fill it with 1.6 MB of data
CACHE_DIR <- tempdir()
write.csv(matrix(1,400,500), file=file.path(CACHE_DIR,'m1.csv'))
write.csv(matrix(2,400,500), file=file.path(CACHE_DIR,'m2.csv'))
write.csv(matrix(3,400,500), file=file.path(CACHE_DIR,'m3.csv'))
write.csv(matrix(4,400,500), file=file.path(CACHE_DIR,'m4.csv'))
for (file in list.files(CACHE_DIR, full.names=TRUE)) {
  print(file.info(file)[,c(1,6)])
}

# Remove files based on access time until we get under 1 MB
manageCache(CACHE_DIR, extensions='csv', maxCacheSize=1, sortBy='atime')
for (file in list.files(CACHE_DIR, full.names=TRUE)) {
  print(file.info(file)[,c(1,6)])
}

# Or remove files based on modification time
manageCache(CACHE_DIR, extensions='csv', maxCacheSize=1, sortBy='mtime')
for (file in list.files(CACHE_DIR, full.names=TRUE)) {
  print(file.info(file)[,c(1,6)])
}
```

---

packageCheck *Run package checks*

Description

When multiple developers are working on a package, it is crucially important that they check their code changes *often*. After merging changes from multiple developers it is equally important to check the package *thoroughly*.

The problem is that frequent checks should be quick or developers won't do them while thorough checks are, by nature, slow.

Our solution is to provide shorthand functions that wrap `devtools::check()` and pass it a variety of different arguments.

Usage

```
check(pkg = ".")

check_fast(pkg = ".")

check_faster(pkg = ".")

check_fastest(pkg = ".")
```

```
check_slow(pkg = ".")

check_slower(pkg = ".")

check_slowest(pkg = ".")
```

Arguments

pkg	Package location passed to `devtools::check()`.

Details

The table below describes the `args` passed to `devtools::check()`:

```
 check_slowest()  | manual = TRUE, run_dont_test = TRUE
                  | args = c("--run-dontrun", "--use-gct")
  check_slower()  | manual = TRUE, run_dont_test = TRUE
                  | args = c("--run-dontrun")
    check_slow()  | manual = TRUE, run_dont_test = TRUE
                  | args = c()
         check()  | manual = FALSE, run_dont_test = FALSE
                  | args = c()
    check_fast()  | manual = FALSE, run_dont_test = FALSE
                  | build_args = c("--no-build-vignettes")
                  | args = c("--ignore-vignettes")
  check_faster()  | manual = FALSE, run_dont_test = FALSE
                  | build_args = c("--no-build-vignettes")
                  | args = c("--ignore-vignettes", "--no-examples")
 check_fastest()  | manual = FALSE, run_dont_test = FALSE
                  | build_args = c("--no-build-vignettes")
                  | args = c("--ignore-vignettes", "--no-examples", "--no-tests")
```

Value

No return.

See Also

check

`parseDatetime` *Parse datetime strings*

Description

Transforms numeric and string representations of Ymd[HMS] datetimes to `POSIXct` format.

Y, Ym, Ymd, YmdH, YmdHM, and YmdHMS formats are understood, where:

Y four digit year

m month number (1-12, 01-12) or english name month (October, oct.)

d day number of the month (0-31 or 01-31)

H hour number (0-24 or 00-24)

M minute number (0-59 or 00-59)

S second number (0-61 or 00-61)

This allows for mixed inputs. For example, 20181012130900, "2018-10-12-13-09-00", and "2018 Oct. 12 13:09:00" will all be converted to the same `POSIXct` datetime. The incoming datetime vector does not need to have a homogeneous format either – "20181012" and "2018-10-12 13:09" can exist in the same vector without issue. All incoming datetimes will be interpreted in the specified timezone.

If `datetime` is a `POSIXct` it will be returned unmodified, and formats not recognized will be returned as `NA`.

Usage

```
parseDatetime(
  datetime = NULL,
  timezone = NULL,
  expectAll = FALSE,
  isJulian = FALSE,
  quiet = TRUE
)
```

Arguments

`datetime`	Vector of character or integer datetimes in Ymd[HMS] format (or POSIXct).
`timezone`	Olson timezone used to interpret dates (required).
`expectAll`	Logical value determining if the function should fail if any elements fail to parse (default `FALSE`).
`isJulian`	Logical value determining whether `datetime` should be interpreted as a Julian date with day of year as a decimal number.
`quiet`	Logical value passed on to `lubridate::parse_date_time` to optionally suppress warning messages.

Value

A vector of POSIXct datetimes.

Mazama Science Conventions

Within Mazama Science packages, datetimes not in `POSIXct` format are often represented as decimal values with no separation (ex: 20181012, 20181012130900), either as numerics or strings.

Implementation

`parseDatetime` is essentially a wrapper around `parse_date_time`, handling which formats we want to account for.

Note

If `datetime` is a character string containing signed offset information, *e.g.* "-07:00", this information is used to generate an equivalent UTC time which is then assigned to the timezone specified by the `timezone` argument.

See Also

`parse_date_time` for implementation details.

Examples

```
library(MazamaCoreUtils)

# All y[md-hms] formats are accepted
parseDatetime(2018, timezone = "America/Los_Angeles")
parseDatetime(201808, timezone = "America/Los_Angeles")
parseDatetime(20180807, timezone = "America/Los_Angeles")
parseDatetime(2018080718, timezone = "America/Los_Angeles")
parseDatetime(201808071812, timezone = "America/Los_Angeles")
parseDatetime(20180807181215, timezone = "America/Los_Angeles")
parseDatetime("2018-08-07 18:12:15", timezone = "America/Los_Angeles")
parseDatetime("2018-08-07 18:12:15-07:00", timezone = "America/Los_Angeles")
parseDatetime("2018-08-07 18:12:15-07:00", timezone = "UTC")

# Julian days are accepeted
parseDatetime(2018219181215, timezone = "America/Los_Angeles",
              isJulian = TRUE)

# Vector dates are accepted and daylight savings is respected
parseDatetime(
  c("2018-10-24 12:00", "2018-10-31 12:00",
    "2018-11-07 12:00", "2018-11-08 12:00"),
  timezone = "America/New_York"
)

badInput <- c("20181013", NA, "20181015", "181016", "10172018")

# Return a vector with \code{NA} for dates that could not be parsed
parseDatetime(badInput, timezone = "UTC", expectAll = FALSE)

## Not run:
```

```
# Fail if any dates cannot be parsed
parseDatetime(badInput, timezone = "UTC", expectAll = TRUE)

## End(Not run)
```

`setAPIKey` *Set APIKey*

Description

Sets the API key associated with a web service.

Usage

```
setAPIKey(provider = NULL, key = NULL)
```

Arguments

`provider`	Web service provider.
`key`	API key.

Value

Silently returns previous value of the API key.

See Also

getAPIKey

showAPIKeys

`setIfNull` *Set a variable to a default value if it is NULL*

Description

This function attempts to set a default value for a given target object. If the object is `NULL`, a default value is returned.

When the target object is not `NULL`, this function will try and coerce it to match the type of the default (given by `typeof`). This is useful in situations where we are looking to parse the input as well, such at looking at elements of an API call string and wanting to set the character numbers as actual numeric types.

Not all coercions are possible, however, and if the function encounters one of these (ex: `setIfNull("foo", 5)`) the function will fail.

Usage

```
setIfNull(target, default)
```

Arguments

target	Object to test if NULL (must be length 1).
default	Object to return if target is NULL (must be length one).

Value

If target is not NULL, then target is coerced to the type of default. Otherwise, default is returned.

Possible Coercions

This function checks the type of the target and default as given by typeof. Specifically, it accounts for the types:

- character
- integer
- double
- complex
- logical
- list

R tries to intelligently coerce types, but some coercions from one type to another won't always be possible. Everything can be turned into a character, but only some character objects can become numeric ("7" can, while "hello" cannot). Some other coercions work, but you will lose information in the process. For example, the *double* 5.7 can be coerced into an *integer*, but the decimal portion will be dropped with no rounding. It is important to realize that while it is possible to move between most types, the results are not always meaningful.

Examples

```
library(MazamaCoreUtils)

setIfNull(NULL, "foo")
setIfNull(10, 0)
setIfNull("15", 0)


# This function can be useful for adding elements to a list
testList <- list("a" = 1, "b" = "baz", "c" = "4")

testList$a <- setIfNull(testList$a, 0)
testList$b <- setIfNull(testList$c, 0)
testList$d <- setIfNull(testList$d, 6)
```

```
# Be careful about unintended results
setIfNull("T", FALSE) # This returns `TRUE`
setIfNull(12.8, 5L)   # This returns the integer 12


## Not run:
# Not all coercions are possible
setIfNull("bar", 5)
setIfNull("t", FALSE)

## End(Not run)
```

`showAPIKeys` *Show API keys*

Description

Returns a list of all currently set API keys.

Usage

```
showAPIKeys()
```

Value

List of provider:key pairs.

See Also

getAPIKey

setAPIKey

`stopIfNull` *Stop if an object is NULL*

Description

This is a convenience function for testing if an object is `NULL`, and providing a custom error message if it is.

Usage

```
stopIfNull(target, msg = NULL)
```

Arguments

target	Object to test if NULL.
msg	Optional custom message to display when target is NULL.

Value

If target is not NULL, target is returned invisibly.

Examples

```
library(MazamaCoreUtils)

# Return input invisibly if not NULL
x <- stopIfNull(5, msg = "Custom message")
print(x)

# This can be useful when building pipelines
y <- 1:10
y_mean <-
  y %>%
  stopIfNull() %>%
  mean()

## Not run:
testVar <- NULL
stopIfNull(testVar)
stopIfNull(testVar, msg = "This is NULL")

# Make a failing pipeline
z <- NULL
z_mean <-
  z %>%
  stopIfNull("This has failed.") %>%
  mean()

## End(Not run)
```

---

stopOnError *Error message generator*

Description

When writing R code for use in production systems, it is important to enclose chunks of code inside of try() blocks. This is especially important when processing user input or data obtained from web services which may fail for a variety of reasons. If any problems arise within a try() block, it is important to generate informative and consistent error messages.

Over the years, we have developed our own standard protocol for error handling that is easy to understand, easy to implement, and allows for consistent generation of error messages. To goal is

to make it easy for developers to test sections of code that might fail and to create more uniform, more informative error messages than those that might come from deep within the R execution stack.

In addition to the generation of custom error messages, use of `prefix` allows for the creation of classes of errors that can be detected and handled appropriately as errors propagate to other functions.

Usage

```
stopOnError(
  result,
  err_msg = "",
  prefix = "",
  maxLength = 500,
  truncatedLength = 120,
  call. = FALSE
)
```

Arguments

`result`	Return from a `try()` block.
`err_msg`	Custom error message.
`prefix`	Text string to add in front of the error message.
`maxLength`	Maximum length of an error message. Error messages beyond this limit will be truncated.
`truncatedLength`	Length of the output error message.
`call.`	Logical indicating whether the call should become part of the error message.

Value

Issues a `stop()` with an appropriate error message.

Note

If logging has been initialized, the customized/modified error message will be logged with `logger.error(err_msg)` before issuing `stop(err_msg)`.

The following examples show how to use this function:

```
library(MazamaCoreUtils)

# Arbitrarily deep in the stack we might have:

myFunc <- function(x) {
  a <- log(x)
}
```

```
# Simple usage

userInput <- 10
result <- try({
  myFunc(x = userInput)
}, silent = TRUE)
stopOnError(result)

userInput <- "ten"
result <- try({
  myFunc(x = userInput)
}, silent = TRUE)
stopOnError(result)


# More concise code with the '%>%' operator

try({
  myFunc(x = userInput)
}, silent = TRUE) %>%
stopOnError(err_msg = "Unable to process user input")

try({
  myFunc(x = userInput)
}, silent = TRUE) %>%
stopOnError(prefix = "USER_INPUT_ERROR")


# Truncating error message length

try({
  myFunc(x = userInput)
}, silent = TRUE) %>%
stopOnError(
  prefix = "USER_INPUT_ERROR",
  maxLength = 40,
  truncatedLength = 32
)
```

`timeRange` *Create a POSIXct time range*

Description

Uses incoming parameters to return a pair of `POSIXct` times in the proper order. Both start and end times will have `lubridate::floor_date()` applied to get the nearest `unit`. This can be modified

by specifying ceilingStart = TRUE or ceilingEnd = TRUE in which case lubridate::ceiling_date() will be applied.

The required timezone parameter must be one of those found in OlsonNames.

Dates can be anything that is understood by lubrdiate::parse_date_time() including either of the following recommended formats:

- "YYYYmmddHH[MMSS]"
- "YYYY-mm-dd HH:MM:SS"

Usage

```
timeRange(
  starttime = NULL,
  endtime = NULL,
  timezone = NULL,
  unit = "sec",
  ceilingStart = FALSE,
  ceilingEnd = FALSE
)
```

Arguments

starttime	Desired start datetime (ISO 8601).
endtime	Desired end datetime (ISO 8601).
timezone	Olson timezone used to interpret dates (required).
unit	Units used to determine time at end-of-day.
ceilingStart	Logical instruction to apply ceiling_date to the startdate rather than floor_date
ceilingEnd	Logical instruction to apply ceiling_date to the enddate rather than floor_date

Value

A vector of two POSIXcts.

POSIXct inputs

When startdate or enddate are already POSIXct values, they are converted to the timezone specified by timezone without altering the physical instant in time the input represents. This is different from the behavior of parse_date_time (which powers this function), which will force POSIXct inputs into a new timezone, altering the physical moment of time the input represents.

Examples

```
library(MazamaCoreUtils)

timeRange("2019-01-08 10:12:15", 20190109102030, timezone = "UTC")
```

`timeStamp` *Character representation of a POSIXct*

Description

Converts a vector of incoming date times (as `POSIXct` or character strings), into equivalent character representations in one of several formats appropriate for use in naming files or labeling plots.

When `datetime` is not provided, defaults to `lubridate::now()`.

The required `timezone` parameter must be one of those found in `OlsonNames`.

Formatting output is are affected by both `style`:

- `"ymdhms"`
- `"ymdThms"`
- `"julian"`
- `"clock"`

and `unit` which determines the temporal precision of the generated representation:

- `"year"`
- `"month"`
- `"day"`
- `"hour"`
- `"min"`
- `"sec"`
- `"msec"`

If `style == "julian" && unit = "month"`, the timestamp will contain the Julian day associated with the beginning of the month.

Usage

```
timeStamp(datetime = NULL, timezone = NULL, unit = "sec", style = "ymdhms")
```

Arguments

`datetime`	Vector of character or integer datetimes in Ymd[HMS] format (or POSIXct).
`timezone`	Olson timezone used to interpret incoming dates (required).
`unit`	Units used to determine precision of generated time stamps.
`style`	Style of representation, Default = "ymdhms".

Value

A vector of time stamps.

POSIXct inputs

When `startdate` or `enddate` are already `POSIXct` values, they are converted to the timezone specified by `timezone` without altering the physical instant in time the input represents. This is different from the behavior of `parse_date_time` (which powers this function), which will force `POSIXct` inputs into a new timezone, altering the physical moment of time the input represents.

Examples

```
library(MazamaCoreUtils)

datetime <- parseDatetime("2019-01-08 12:30:15", timezone = "UTC")

timeStamp()
timeStamp(datetime, "UTC", unit = "year")
timeStamp(datetime, "UTC", unit = "month")
timeStamp(datetime, "UTC", unit = "month", style = "julian")
timeStamp(datetime, "UTC", unit = "day")
timeStamp(datetime, "UTC", unit = "day", style = "julian")
timeStamp(datetime, "UTC", unit = "hour")
timeStamp(datetime, "UTC", unit = "min")
timeStamp(datetime, "UTC", unit = "sec")
timeStamp(datetime, "UTC", unit = "sec", style = "ymdThms")
timeStamp(datetime, "UTC", unit = "sec", style = "julian")
timeStamp(datetime, "UTC", unit = "sec", style = "clock")
timeStamp(datetime, "UTC", unit = "sec", style = "clock") %>%
  stringr::str_replace("T", " ")
timeStamp(datetime, "America/Los_Angeles", unit = "sec", style = "clock")
timeStamp(datetime, "America/Los_Angeles", unit = "msec", style = "clock")
```

---

timezoneLintRules *Rules for timezone linting.*

Description

This set of rules is for use with the `lintFunctionArgs_~()`. functions. It includes all time-related functions from the **base** and **lubridate** packages that are involved with parsing or formatting datetimes and helps check whether the appropriate timezone arguments are being explicitly used.

```
timezoneLintRules <- list(
  # base functions
  "as.Date" = "tz",
  "as.POSIXct" = "tz",
  "as.POSIXlt" = "tz",
  "ISOdate" = "tz",
  "ISOdatetime" = "tz",
  "strftime" = "tz",
  "strptime" = "tz",
```

```
  "Sys.Date" = "DEPRECATED", # Please don't use this function!
  "Sys.time" = "DEPRECATED", # Please don't use this function!
  # lubridate functions
  "as_datetime" = "tz",
  "date_decimal" = "tz",
  "fast_strptime" = "tz",
  "force_tz" = "tzone",
  "force_tzs" = "tzone_out",
  "interval" = "tzone",
  "local_time" = "tz",
  "make_datetime" = "tz",
  "now" = "tzone",
  "parse_date_time" = "tz",
  "parse_date_time2" = "tz",
  "today" = "tzone",
  "with_tz" = "tzone",
  "ymd" = "tz",
  "ymd_h" = "tz",
  "ymd_hm" = "tz",
  "ymd_hms" = "tz",
  # MazamaCoreUtils functions
  "dateRange" = "timezone",
  "timeRange" = "timezone",
  "parseDatetime" = "timezone"
)
```

Usage

```
timezoneLintRules
```

Format

A list of function = argument pairs.

`validateLonLat` *Validate longitude and latitude values*

Description

Longitude and latitude are validated to be parseable as numeric and within the bounds -180:180 and -90:90. If validation fails, an error is generated.

Usage

```
validateLonLat(longitude = NULL, latitude = NULL)
```

Arguments

longitude	Single longitude in decimal degrees E.
latitude	Single latitude in decimal degrees N.

Value

Invisibly returns TRUE if no error message has been generated.

---

validateLonsLats *Validate longitude and latitude vectors*

Description

Longitude and latitude vectors validated to be parseable as numeric and within the bounds -180:180 and -90:90. If validation fails, an error is generated.

Usage

```
validateLonsLats(longitude = NULL, latitude = NULL, na.rm = FALSE)
```

Arguments

longitude	Vector of longitudes in decimal degrees E.
latitude	Vector of latitudes in decimal degrees N.
na.rm	Logical specifying whether to remove NA values before validation.

Value

Invisibly returns TRUE if no error message has been generated.

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