

Package ‘squarebrackets’

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Type Package

Title Methods as an Alternative to the Square Brackets Operators

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Description Methods as an alternative to the Square Brackets Operators.

These methods have the following properties.

- 1) Programmatically friendly.
- 2) Class consistent.
- 3) Explicit copy semantics.
- 4) Careful handling of names and other attributes.
- 5) Performance aware.
- 6) Supported immutable classes include
atomic, factor, list, (sf-) data.frame/tibble.
- 7) Supported mutable classes include
mutable_atomic, views of lists, and (sf-) data.table/tidytibble.

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Description

squarebrackets: Methods as an Alternative to the Square Brackets Operators

Goal & Properties

Among programming languages, 'R' has perhaps one of the most flexible and comprehensive sub-setting functionality, provided by the square brackets operators (`[`, `[<-`).

But in some situations the square brackets operators are occasionally less than optimally convenient (see [squarebrackets_inconveniences](#)).

The Goal of the 'squarebrackets' package is not to replace the square-brackets operators, but to provide **alternative** sub-setting methods and functions, to be used in situations where the square bracket operators are inconvenient.

These alternative sub-setting methods and functions have the following properties:

- **Programmatically friendly:**
 - Name-based arguments instead of position-based arguments.
 - Unlike base `[`, it's not required to know the number of dimensions of an array a-priori, to perform subset-operations on an array.
 - Missing arguments can be filled with `NULL`, instead of using dark magic like `base::quote(expr =)`.
 - No Non-standard evaluation.
 - Functions are pipe-friendly.
 - No (silent) vector recycling.
 - Extracting and removing subsets uses the same syntax.
- **Class consistent:**
 - sub-setting of multi-dimensional objects by specifying dimensions (i.e. rows, columns, ...) use `drop = FALSE`. So matrix in, matrix out.
 - The functions deliver the same results for `data.frames`, `data.tables`, `tibbles`, and `tidytables`. No longer does one have to re-learn the different brackets-based sub-setting rules for different types of data.frame-like objects. Powered by the subclass agnostic 'C'-code from 'collapse' and 'data.table'.
- **Explicit copy semantics:**
 - Sub-set operations that change its memory allocations, always return a modified copy of the object.
 - For sub-set operations that just change values in-place (similar to the `[<-` and `[[<-` methods) the user can choose a method that modifies the object by **reference**, or choose a method that returns a **deep copy**.
- **Careful handling of names and other attributes:**

- Sub-setting an object by index names returns ALL indices with that name, not just the first.
- Data.frame-like objects (see supported classes below) are forced to have unique column names.
- Attributes of data.frame-like objects (see supported classes below) are always preserved when sub-setting.
- For other object types, the user can specify whether to preserve Attributes, or use R's `[]` attribute behaviour (i.e. drop most attributes). This is to ensure compatibility with R-packages that create their own attribute behaviour for sub-setting.
- **Concise function and argument names.**
- **Performance aware:**
Despite the many checks performed, the functions are kept reasonably speedy, through the use of the 'Rcpp', 'collapse', and 'data.table' R-packages. Most of the heavy lifting in this package is done by the 'collapse' package.

Supported Classes

'squarebrackets' only supports S3 classes, and only those that primarily use square brackets for sub-setting (hence the name of the package).

Supported [immutable classes](#):

`atomic`, `factor`, `list`, `data.frame` (including `tibble` and `sf-data.frame`).

Supported [mutable classes](#):

[mutable_atomic](#), `data.table` (including `tidytable` and `sf-data.table`).

There are, of course, a lot of classes which are not supported by 'squarebrackets'.

Most notably, certain types of list(-like) classes are not supported (note that regular immutable lists are fully supported):

- Environments are not supported.
- Mutable list-like classes, such as the various 'collections' classes from the 'collections' package, are not supported (their sub-setting method is not based on square-brackets).
- Locked list-like classes, such as the deferred list from the 'deflist' package, are not supported.

Methods and Functions

GENERIC METHODS

The main focus is on the generic methods.

There are 2 types of generic methods:

- generic methods for non-recursive objects (`atomic`, `factor`, etc.); these all start with `sb_`.
- generic methods for recursive objects (`list`, `data.frame`, etc.); these all start with `sb2_`.

The available generic methods are the following:

- [sb_x](#), [sb2_x](#): extract, exchange, or duplicate subsets.

- `sb_rm`, `sb2_rm`: un-select/remove subsets.
- `sb_set`, `sb2_set`: modify (transform or replace) subsets of a [mutable object](#) using [pass-by-reference semantics](#).
- `sb_mod`, `sb2_mod`: return a **copy** of an object with modified (transformed or replaced) subsets.
- `sb2_coe`: Coercively transform subsets of recursive objects.
- `sb_before`, `sb_after`, `sb2_before`, `sb2_after`: insert new values before or after an index along a dimension of an object.
- `sb2_rec`: accesses recursive subsets of lists.
- `sb_setRename`, `sb2_setRename`: change the names of a [mutable object](#) using [pass-by-reference semantics](#).
- `sb_currentBindings`, `sb2_currentBindings`: list or lock all currently existing bindings that share the share the same address as the input variable.

So for example, use `sb_rm()` to remove subsets from atomic arrays, and use `sb2_rm()` to remove subsets from recursive arrays.

SPECIALIZED FUNCTIONS

Additional specialized sub-setting functions are provided:

- `idx1`: translate given indices/subscripts to flat/linear integer indices, for the purpose of copy-on-modify substitution.
- `setapply`: apply functions over mutable matrix margins using [pass-by-reference semantics](#).
- `ma_setv`: Find & Replace values in [mutable_atomic](#) objects using [pass-by-reference semantics](#).
This is considerably faster and more memory efficient than using `sb_set` for this.
- The `dt_`-functions for `data.table`-specific `[]`-operations.
- `sb_str`: extract or replace a subset of characters of a single string (each single character is treated as a single element).
- `sb_a`: extract multiple attributes from an object.

HELPER FUNCTIONS

And finally, a couple of helper functions for creating ranges, sequences, and indices (often needed in sub-setting) are provided:

- `n`: Nested version of `c`, and short-hand for `list`.
- `sub2coord`, `coord2ind`: Convert subscripts (array indices) to coordinates, coordinates to flat indices, and vice-versa.
- `match_all`: Find all matches, of one vector in another, taking into account the order and any duplicate values of both vectors.
- Computing indices:
`idx_by` to compute grouped indices.
`idx_ord_`-functions to compute ordered indices.
- Computing sequences:
`seq_rec2` for the recursive sequence generator (for example to generate a Fibonacci sequence).
`seq_names` to create a range of indices from a specified starting and ending name.

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References

The badges shown in the documentation of this R-package were made using the services of: <https://shields.io/>

aaa1_squarebrackets_immutable_classes

Supported Immutable S3 Classes, With Auto-Coercion Rules

Description

The sb_ generic methods support the following immutable S3 classes:

- atomic classes (atomic vectors, matrices, and arrays);
- [factor](#);
- [list](#);
- [data.frame](#) (including the classes `tibble`, `sf-data.frame` and `sf-tibble`)

Auto-Coercion Rules**Atomic**

[coercion_through_copy](#): YES

Atomic objects are automatically coerced to fit the modified subset values, when modifying through copy.

For example, replacing one or multiple values in an integer vector (type `int`) with a decimal number (type `dbl`) will coerce the entire vector to type `dbl`.

Factor

[coercion_through_copy](#): NO

Factors only accept values that are part of their levels, and thus do not support coercion on modification. There is no mechanism for changing factors by reference at all.

Replacing a value with a new value not part of its levels, will result in the replacement value being NA.

List

[coercion_through_copy](#): depends

Lists themselves allow complete change of their elements, since lists are merely pointers.

For example, the following code performs full coercion:

```
x <- list(factor(letters), factor(letters))
sb_mod(x, 1, rp = list(1))
```

However, a recursive subset of a list which itself is not a list, follows the coercion rules of whatever class the recursive subset is.

For example the following code:

```
x <- list(1:10, 1:10)
sb_rec(x, 1, rp = "a") # coerces to character
```

transforms recursive subsets according to the - in this case - atomic auto-coercion rules.

Data.frames when replacing/transforming whole columns

[coercion_through_copy](#): YES

A data.frame is actually a list, where each column is itself a list. As such, replacing/transforming whole columns, so `row = NULL` and `filter = NULL`, allows completely changing the type of the column.

Note that coercion of columns needs arguments `row = NULL` and `filter = NULL` in the [sb_mod](#) and [sb_set](#) methods; no auto-coercion will take place when specifying something like `row = 1:nrow(x)` (see next section).

Data.frames, when partially replacing/transforming columns

[coercion_through_copy](#): NO

If rows are specified in the [sb_mod](#) and [sb_set](#) methods, and thus not whole columns but parts of columns are replaced or transformed, no auto-coercion takes place.

I.e.: replacing/transforming a value in an integer (int) column to become 1.5, will not coerce the column to the decimal type (dbl); instead, the replacement value 1.5 is coerced to integer 1.

The `coe` argument in the [sb_mod](#) method allows the user to enforce coercion, even if subsets of columns are replaced/transformed instead of whole columns.

Specifically, the `coe` arguments allows the user to specify a coercive function to be applied on the entirety of every column specified in `col` or `vars`; columns outside this subset are not affected.

This coercion function is, of course, applied before replacement (`rp`) or transformation (`tf()`).

Examples

```
# Coercion examples - lists ====
x <- list(factor(letters), factor(letters))
print(x)
sb2_mod(x, 1, rp = list(1)) # first element fully changed.

x <- list(1:10, 1:10)
print(x)
sb2_rec(x, 1, rp = "a") # coerces first element to character
print(x)
```

```
#####
```

```
# Coercion examples - data.frame-like - whole columns ====
```

```
obj <- data.frame(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
```

```

)
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_mod(
  obj, vars = is.numeric,
  tf = sqrt # SAFE: row=NULL & filter = NULL, so coercion performed
)

#####

# Coercion examples - data.frame-like - partial columns ====

# sb_mod():
obj <- data.frame(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)

sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  coe = as.double, tf = sqrt # SAFE: coercion performed
)

```

aaa2_squarebrackets_mutable_classes

Supported Mutable S3 classes, With Auto-Coercion Rules

Description

The `sb_` generic methods support the following Mutable S3 classes:

- [mutable_atomic](#) (this vector class supports any dimension, thus also matrices and arrays);
- [data.table](#) (including the classes `tidytable` and `sf-data.table`);
- **Views of Lists:** Though lists themselves are treated as immutable, lists can contain mutable objects, and so modification by reference of mutable views of lists is support by the 'square-brackets'.

The mutable version of the `list` class would be, for example, the various [collections](#) classes from the 'collections' package, and the [fastmap](#) class from the 'fastmap' package; both of these use their own sub-setting method which is **not** based on square brackets operators, and thus not covered by this package.

Environments are also not covered by this package.

Auto-Coercion Rules

Coercion Semantics

The mutable classes support "copy-on-modify" semantics like the immutable classes, but - unlike the immutable classes - they also support "pass-by-reference" semantics.

The `sb_mod` method modify subsets of an object through a **deep copy**.

The `sb_set` method and `dt_setcoe` function modify subsets of an object **by reference**.

These 2 copy semantics - "pass by reference" or "modify copy" - have slightly different auto-coercion rules.

These are explained in this section.

Note that the `sb_before` and `sb_after` methods usually allow coercion for all classes.

mutable_atomic

`coercion_through_copy`: YES

`coercion_by_reference`: NO

Mutable atomic objects are automatically coerced to fit the modified subset values, when modifying through copy, just like regular atomic classes.

For example, replacing one or multiple values in an integer vector (type `int`) with a decimal number (type `dbl`) will coerce the entire vector to type `dbl`.

Replacing or transforming subsets of mutable atomic objects **by reference** does not support coercion. Thus, for example, the following code,

```
x <- 1:16
sb_set(x, i = 1:6, rp = 8.5)
x
```

gives `c(rep(8, 6) 7:16)` instead of `c(rep(8.5, 6), 7:16)`, because `x` is of type integer, so `rp` is interpreted as type integer also.

data.table, when replacing/transforming whole columns

`coercion_through_copy`: YES

`coercion_by_reference`: YES

A `data.table` is actually a list made mutable, where each column is itself a list. As such, replacing/transforming whole columns, so `row = NULL` and `filter = NULL`, allows completely changing the type of the column.

Note that coercion of columns needs arguments `row = NULL` and `filter = NULL` in the `sb_mod` and `sb_set` methods; no auto-coercion will take place when specifying something like `row = 1:nrow(x)` (see next section).

data.table, when partially replacing/transforming columns

`coercion_through_copy`: NO

`coercion_by_reference`: NO

If rows are specified in the `sb_mod` and `sb_set` methods, and thus not whole columns but parts of columns are replaced or transformed, no auto-coercion takes place.

I.e.: replacing/transforming a value in an integer (`int`) column to become 1.5, will not coerce the column to the decimal type (`dbl`); instead, the replacement value 1.5 is coerced to integer 1.

The `coe` argument in the `sb_mod` method allows the user to enforce coercion, even if subsets of columns are replaced/transformed instead of whole columns.

Specifically, the `coe` arguments allows the user to specify a coercive function to be applied on the entirety of every column specified in `col` or `vars`; columns outside this subset are not affected.

This coercion function is, of course, applied before replacement (rp) or transformation (tf()).

Views of Lists

[coercion_by_reference: depends](#)

Regular lists themselves are not treated as mutable objects by 'squarebrackets'.

However, lists are not actually really objects, merely a (potentially hierarchical) structure of pointers.

Thus, even if a list itself is not treated as mutable, subsets of a list which are themselves mutable classes, are mutable.

For example, if you have a list of data.table objects, the data.tables themselves are mutable.

Therefore, the following will work:

```
x <- list(
  a = data.table(cola = 1:10, colb = letters[1:10]),
  b = data.table(cola = 11:20, colb = letters[11:20])
)
mypointer <- x$a
sb_set(mypointer, col = "cola", tf = \(x)x^2)
```

Notice in the above code that mypointer is not a copy of x\$a, since they have the same address.

Thus changing mypointer also changes x\$a.

In other words: mypointer is what could be called a "view" of x\$a.

Notice also that sb_set(x\$a, ...) will not work, since sb_set() requires **actual variables**, similar to in-place functions in the style of `myfun()<-`.

The auto-coercion rules of Views of Lists, depends entirely on the object itself.

Thus if the list subset is a data.table, mutable matrix, coercion rules of data.tables apply.

And if the list subset is a data.table, coercion rules of mutable matrices apply., etc.

Examples

```
# Coercion examples - mutable_atomic ====

x <- as.mutable_atomic(1:16)
sb_set(x, i = 1:6, rp = 8.5) # 8.5 coerced to 8, because `x` is of type `integer`
print(x)

#####

# Coercion examples - data.table - whole columns ====

# sb_mod():
obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_mod(
  obj, vars = is.numeric,
  tf = sqrt # SAFE: row=NULL & filter = NULL, so coercion performed
```

```

)

# sb_set():
sb2_set(
  obj, vars = is.numeric,
  tf = sqrt # SAFE: row=NULL & filter = NULL, so coercion performed
)
str(obj)

#####

# Coercion examples - data.table - partial columns ====

# sb_mod():
obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)

sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt
  # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  coe = as.double, tf = sqrt # SAFE: coercion performed
)

# sb_set():
obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_set(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt
  # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
print(obj)

obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj)
obj <- sb2_coe(obj, vars = is.numeric, v = as.numeric)
str(obj)
sb2_set(obj,
  filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # SAFE: coercion performed by sb_coe(); so no warnings
)
print(obj)

#####

# View of List ====

```

```
x <- list(
  a = data.table::data.table(cola = 1:10, colb = letters[1:10]),
  b = data.table::data.table(cola = 11:20, colb = letters[11:20])
)
print(x)
mypointer <- x$a
address(mypointer) == address(x$a) # they are the same
sb2_set(mypointer, col = "cola", tf = \(\mathbf{x})\mathbf{x}^2)
print(x) # notice x has been changed
```

aaa3_squarebrackets_indx_args

Index Arguments in the Generic Sub-setting Methods

Description

There are 6 types of arguments that can be used in the generic methods of 'squarebrackets' to specify the indices to perform operations on:

- **i**: to specify flat (i.e. dimensionless) indices.
- **row**, **col**: to specify rows and/or columns in tabular objects.
- **idx**, **dims**: to specify indices of arbitrary dimensions in arrays.
- **rcl**: to specify rows (first dimension), columns (second dimension), and layers (third dimension), in arrays that have exactly 3 dimensions.
- **lvl**: specify levels, for factors only.
- **filter**, **vars**: to specify rows and/or columns specifically in data.frame-like objects.

In this help page, **x** refers to the object to be sub-setted.

Argument i

class: atomic
class: factor
class: list

Any of the following can be specified for argument **i**:

- **NULL**, only for multi-dimensional objects or factors, when specifying the other arguments (i.e. dimensional indices or factor levels.)
- a vector of length 0, in which case no indices are selected for the operation (i.e. empty selection).
- a **strictly positive integer** vector with indices.
- a **logical vector** (without NAs!), of the same length as **x**, giving the indices to select for the operation.

- a **character** vector of index names.
If an object has multiple indices with the given name, ALL the corresponding indices will be selected for the operation.
- a **function** that takes as input `x`, and returns a logical vector, giving the element indices to select for the operation.
For atomic objects, `i` is interpreted as `i(x)`.
For lists, `i` is interpreted as `lapply(x, i)`.

Using the `i` arguments corresponds to doing something like the following:

```
sb_x(x, i = i) # ==> x[i]
```

For a brief explanation of the relationship between flat indices (`i`), and the dimension indices (`row`, `col`, etc.), see the Details section in [sub2ind](#).

Arguments row, col

class: atomic matrix
class: data.frame-like

Any of the following can be specified for the arguments `row` / `col`:

- NULL (default), corresponds to a missing argument, which results in ALL of the indices in this dimension being selected for the operation.
- a vector of length 0, in which case no indices are selected for the operation (i.e. empty selection).
- a **strictly positive integer** vector with dimension indices to select for the operation.
- a **logical** vector (without NAs!) of the same length as the corresponding dimension size, giving the indices of this dimension to select for the operation.
- a **character** vector of index names.
If an object has multiple indices with the given name, ALL the corresponding indices will be selected for the operation.

NOTE: The arguments `row` and `col` will be ignored if `i` is specified.

Using the `row`, `col` arguments corresponds to doing something like the following:

```
sb_x(x, row = row, col = col) # ==> x[row, col, drop = FALSE]
```

Arguments idx, dims

class: atomic array
class: recursive array

`idx` must be a list of indices.

`dims` must be an integer vector of the same length as `idx`, giving the dimensions to which the indices given in `idx` correspond to.

The elements of `idx` follow the same rules as the rules for `row` and `col`, EXCEPT one should not

fill in NULL.

NOTE: The arguments `idx` and `dims` will be ignored if `i` is specified.

To keep the syntax short, the user can use the `n` function instead of `list()` to specify `idx`.

Using the `idx`, `dims` arguments, corresponds to doing something like the following, here using an example of a 4-dimensional array:

```
sb_x(x, n(1:10, 1:5), c(1, 3)) # ==> x[1:10, , 1:5, , drop = FALSE]
```

Arguments `rc1`

class: atomic array

The `rc1` argument is only applicable for atomic arrays with exactly 3 dimensions.

If the user knows a-priori that an array has 3 dimensions, using `rc1` is more efficient than using the `idx`, `dims` arguments.

The `rc1` argument must be a list of exactly 3 elements, with the first element giving the indices of the first dimension (rows), the second element giving the indices of the second dimension (columns), and the third element giving the indices of the third and last dimension (layers); thus `rc1` stands for "rows, columns, layers" (i.e. the 3 dimensions of a 3-dimensional array).

For each of the aforementioned 3 elements of the list `rc1`, any of the following can be specified:

- NULL, corresponds to a missing argument, which results in ALL of the indices in this dimension being selected for the operation.
- a vector of length 0, in which case no indices are selected for the operation (i.e. empty selection).
- a **strictly positive integer** vector with dimension indices to select for the operation.
- a **logical** vector (without NAs!) of the same length as the corresponding dimension size, giving the indices of this dimension to select for the operation.
- a **character** vector of index names.
If an object has multiple indices with the given name, ALL the corresponding indices will be selected for the operation.

By default `rc1` is not a list but simply NULL, to be used when specifying the other arguments (either `idx`, `dims` or `i`).

To keep the syntax short, the user can use the `n` function instead of `list()` to specify `rc1`.

Using the `rc1` argument corresponds to doing something like the following:

```
sb_x(x, rc1 = n(NULL, 1:10, 1:5)) # ==> x[, 1:10, 1:5, drop = FALSE]
```

Argument `lvl`

class: factor

For this argument, the names of the levels of `x` can be given, selecting the corresponding indices for the operation.

Arguments filter, vars

class: data.frame-like

filter must be a one-sided formula with a single logical expression using the column names of the data.frame, giving the condition which observation/row indices should be selected for the operation. For example, to perform an operation on the rows for which column height > 2 and for which column sex != "female", specify the following formula:

```
~ (height > 2) & (sex != "female")
```

If the formula is linked to an environment, any variables not found in the data set will be searched from the environment.

See also `tinycodet::form` for conveniently creating formulas without environments, thus reducing the possibility of memory leaks.

vars must be a function that returns a logical vector, giving the column indices to select for the operation.

For example, to select all numeric columns, specify `vars = is.numeric`.

Argument inv

all classes

Relevant for `sb_mod`, `sb_set`, `sb2_coe`, and `idx1`.

By default, `inv = FALSE` which translates the indices like normally.

When `inv = TRUE`, the inverse of the indices is taken.

Consider, for example, an atomic matrix `x`;

using `sb_mod(x, 1:2, 1:2, tf = tf)` corresponds to something like the following:

```
x[1:2, 1:2] <- tf(x[1:2, 1:2])
x
```

and using `sb_mod(x, 1:2, 1:2, inv = TRUE, tf = tf)` corresponds to something like the following:

```
x[-1:-2, -1:-2] <- tf(x[-1:-2, -1:-2])
x
```

NOTE

The order in which the user gives indices when `inv = TRUE` generally does not matter.

The order of the indices as they appear in the original object `x` is maintained, just like in base 'R'.

Therefore, when replacing multiple values where the order of the replacement matters, it is better to keep `inv = FALSE`, which is the default.

For replacement with a single value or with a transformation function, `inv = TRUE` can be used without considering the ordering.

Out-of-Bounds Integers, Non-Existing Names/Levels, and NAs

- Integer indices that are out of bounds (including `NaN` and `NA_integer_`) always give an error.
- Specifying non-existing names/levels (including `NA_character_`) as indices is considered a form of zero-length indexing.
- Logical indices are translated internally to integers using [which](#), and so NAs are ignored.

Disallowed Combinations of Index Arguments

One cannot specify `i` and the other indexing arguments simultaneously; it's either `i`, or the other arguments.

The arguments are evaluated in the following order:

1. Argument `i`
2. Argument `lvl` (for factors) or argument `rc1` (for 3-dimensional arrays)
3. The rest of the indexing arguments.

One cannot specify `row` and `filter` simultaneously. It's either one or the other. Similarly, one cannot specify `col` and `vars` simultaneously.

In the above cases it holds that if one set is specified, the other is set is ignored.

Drop

Sub-setting with the generic methods from the 'squarebrackets' R-package using dimensional arguments (`row`, `col`, `lvl`, `idx`, `dims`, `filter`, `vars`) always use `drop = FALSE`.

To drop potentially redundant (i.e. single level) dimensions, use the [drop](#) function, like so:

```
sb_x(x, row = row, col = col) |> drop() # ==> x[row, col, drop = TRUE]
```

First, Last, and Shuffle

The indices are counted forward. I.e. 1 is the first element, not the last.

One can use the [last](#) function to get the last N indices.

One can use the [first](#) function to get the first N indices.

To shuffle elements of indices, use the [sample](#) function.

aaa4_squarebrackets_duplicates
On Duplicates

Description

The `sb_x` method is the only method where providing duplicate indices actually make sense. For the other methods, it doesn't make sense.

Giving duplicate indices usually won't break anything; however, when replacing/transforming or removing subsets, it is almost certainly not the intention to provide duplicate indices.

Providing duplicate indices anyway might lead to unexpected results.

Therefore, for the methods where giving duplicate indices does not make sense, the `chkdup` argument is present.

This argument controls whether the method in question checks for duplicates (TRUE) or not (FALSE).

Setting `chkdup = TRUE` means the method in question will check for duplicate indices, and give an error when it finds them.

Setting `chkdup = FALSE` will disable these checks, which saves time and computation power, and is thus more efficient.

Since checking for duplicates can be expensive, it is set to FALSE by default.

aaa5_squarebrackets_PassByReference
Regarding Modification By Reference

Description

This help page describes how modification using "pass-by-reference" semantics is handled by the 'squarebrackets' package.

This help page does not explain all the basics of pass-by-reference semantics, as this is treated as prior knowledge.

All functions/methods in the 'squarebrackets' package with the word "set" in the name use pass-by-reference semantics.

Advantages and Disadvantages

The main advantage of pass-by-reference is that much less memory is required to modify objects.

But at least 2 things should be taken into consideration when modifying an object by reference.

First, the coercion rules are slightly different: see [squarebrackets_mutable_classes](#).

Second, if 2 or more variables refer to exactly the same object, changing one variable also changes the other ones.

I.e. the following code,

```
x <- y <- mutable_atomic(1:16)
sb_set(x, i = 1:6, rp = 8)
```

modifies not just x, but also y.

This is true even if one of the variables is locked (see [bindingIsLocked](#)).

I.e. the following code,

```
x <- mutable_atomic(1:16)
y <- x
lockBinding("y", environment())
sb_set(x, i = 1:6, rp = 8)
```

modifies both x and y without error, even though y is a locked constant.

Mutable vs Immutable types

With the exception of environments, most of base R's data types are treated as immutable:

Modifying an object in 'R' will make a copy of the object, something called 'copy-on-modify' semantics.

However, almost any of base R's datatypes can be modified by reference, through R's own 'C' API, or through 'C++' code (like via 'Rcpp'), thus treating these objects as mutable, even though they are not "supposed" to be mutable.

Modifying a base 'R' object by reference can be problematic.

Since 'R', and also most R-packages, treat these objects as immutable, modifying them as-if they are mutable may produce undesired results.

To prevent the issue described above, 'squarebrackets' only supports pass-by-reference semantics on objects that are actually supposed to be mutable.

In relation to this restriction, 'squarebrackets' adds a new class of objects, [mutable_atomic](#), which are simply atomic objects that have the permission to be modified by reference.

Lock Binding

The [lockBinding](#) function locks a binding of an object, preventing modification.

'R' also uses locked bindings to prevent modification of objects from package namespaces.

The pass-by-reference semantics of 'squarebrackets' in principle respect this, and disallows modification of objects by reference.

However, [lockBinding](#) does not lock the address/pointer of an object, only one particular binding of an object.

This problematic; consider the following example:

```
x <- mutable_atomic(1:16)
y <- x
lockBinding("y", environment())
sb_set(x, i = 1:6, rp = 8)
```

In the above code, `x` and `y` share the same address, thus pointing to the same memory, yet only `y` is actually locked.

Since `x` is not locked, modifying `x` is allowed.

But since `sb_set()/sb2_set()` performs modification by reference, `y` will still be modified, despite being locked.

To remedy the issue as explained above, 'squarebrackets' provides the `sb_currentBindings` method. This method can do multiple things. One of which is to look at the address of some object `x`, find all **currently existing** bindings in the **caller environment** sharing the same address as `x`, and locking all these bindings.

Warning:

The `sb_currentBindings` method only locks **currently existing** bindings in the **caller environment**; bindings that are created **after** calling `sb_currentBindings` will not automatically be locked.

Thus, every time the user creates a new binding of the same object, and the user wishes it to be locked, `sb_currentBindings` must be called again.

Protected Addresses

To prevent an accidental pass-by-reference modification of objects in the base environment, all addresses of all exported objects in the base environment (`baseenv`) are stored in the option `squarebrackets.protected` whenever 'squarebrackets' is **loaded**, either directly or indirectly.

Needless to say, the user should never touch this option.

Input Variable

Methods/functions that perform in-place modification by reference can be thought of as similar to functions in the style of `some_function(x, ...) <- value`, in the sense that the variable **must actually exist as an actual variable**.

Thus things like any of the following,

```
sb_set(1:10, ...), sb2_set(x$a, ...), or sb_set(base::letters),
```

will not work.

Views of Lists

Regular lists themselves are not treated as mutable objects by 'squarebrackets'.

However, lists are not actually really objects, merely a (potentially hierarchical) structure of pointers.

Thus, even if a list itself is not treated as mutable, subsets of a list which are themselves mutable classes, are mutable.

For example, if you have a list of `data.table` objects, the `data.tables` themselves are mutable.

Therefore, the following will work:

```
x <- list(
  a = data.table(cola = 1:10, colb = letters[1:10]),
  b = data.table(cola = 11:20, colb = letters[11:20])
```

```
)
mypointer <- x$a
sb_set(mypointer, col = "cola", tf = \(\x)x^2)
```

Notice in the above code that mypointer is not a copy of x\$a, since they have the same address. Thus changing mypointer also changes x\$a. In other words: mypointer is what could be called a "view" of x\$a.

Protection

Due to the properties given in this help page so far, something like the following will not work:

```
# letters = base::letters
sb_set(letters, i = 1, rp = "XXX")
```

The above won't work because:

1. addresses in baseenv() are protected;
2. immutable objects are disallowed (you'll have to create a mutable object, which will create a copy of the original, thus keeping the original object safe from modification by reference);
3. locked bindings are disallowed.

Despite the checks made by this package, the user should never actively try to modify a **locked** or **protected** object by reference, as that would defeat the purpose of locking an object.

Examples

```
# the following code demonstrates how locked bindings,
# such as `base::letters`,
# are being safe-guarded

x <- list(a = base::letters)
mypointer <- x$a # view of a list
address(mypointer) == address(base::letters) # TRUE: point to the same memory
bindingIsLocked("letters", baseenv()) # base::letters is locked ...
bindingIsLocked("mypointer", environment()) # ... but this pointer is not!

if(requireNamespace("tinytest")) {
  tinytest::expect_error(
    sb_set(mypointer, i = 1, rp = "XXX") # this still gives an error though ...
  )
}

is.mutable_atomic(mypointer) # ... because it's not of class `mutable_atomic`
```

```

x <- list(
  a = as.mutable_atomic(base::letters) # `as.mutable_atomic()` makes a copy
)
mypointer <- x$a # view of a list
address(mypointer) == address(base::letters) # FALSE: it's a copy
sb_set(
  mypointer, i = 1, rp = "XXX" # modifies x, does NOT modify `base::letters`
)
print(x) # x is modified
base::letters # but this still the same

# Word of warning:
# the safe-guard in 'squarebrackets' is good, but definitely not perfect.
# Do not actively try to break things; you might actually succeed.

```

aaa6_squarebrackets_technical

Additional Technical Details

Description

Atomic

[require unique names: NO](#)

The atomic vector is the most basic class type.

Matrices and Arrays are just atomic vectors with dimension attributes.

All elements in an atomic vector class must have the same atomic type ("logical", "integer", "numeric", "complex", "character" and "raw").

Factor

[require unique names: NO](#)

Factors have the property that they can only store values that are defined in their "levels" attribute; other values are not allowed, and thus result in NAs.

Thus [sb_mod](#) does not coerce replacement values for factors. This is quite different from the atomic vector classes, which can store any value (provided they are of the same atomic type).

List

[require unique names: NO](#)

Lists are recursive objects (i.e. they can be nested), and they do not actually store values but rather store reference to other objects.

Therefore [sb2_rec](#) method can be used to access recursive subsets of a list, no matter how deep/low in hierarchy it is in the list.

Data.frame-like

[require unique names: YES](#)

The data.frame-like objects quite different from the previously named classes.

And the different data.frame-like classes also differ from each other quite a bit - especially in terms of sub-setting.

The 'squarebrackets' R-package attempts to keep the data.frame methods as class agnostic as possible, through the class agnostic functionality of the 'collapse' and 'data.table' R-packages.

These 3 things cause some oddities in how data.frame-like classes are treated differently from the other classes:

- Whole-columns will be auto-coerced when replaced/transformed by `sb_mod`, but partial columns will not be auto-coerced by default.
- The `sb_x` and `sb_rm` methods always automatically conserve all attributes (though names and dimensions are adjusted accordingly, of course), they are never stripped, unlike the other classes.
- Giving a data.frame-like object with non-unique column names to the `sb_`-methods returns an error. Also, duplicating columns with `sb_x` will automatically adjust the column names to make them unique.

aaa7_squarebrackets_inconveniences

Examples Where the Square Bracket Operators Are Less Convenient

Description

This help page shows some examples where the square bracket operators (`[`, `[<-`) are less than optimally convenient, and how the methods provided by 'squarebrackets' can be helpful in those cases.

Array with Unknown Number of Dimensions

In order to perform subset operations on some array `x` with the square brackets operator (`[`, `[<-`), one needs to know how many dimensions it has.

I.e. if `x` has 3 dimensions, one would use:

```
x[i, j, k, drop = FALSE]
```

```
x[i, j, k] <- value
```

But how would one use the `[` and `[<-` operators, when number of dimensions of `x` is not known a-priori?

It's not impossible, but still rather convoluted.

The methods provided by 'squarebrackets' solve this by using name-based arguments, instead of position based arguments.

Different Rulesets for data.frame-like Objects

The `data.frame`, `tibble`, `data.table`, and `tidytable` classes all inherit from class "data.frame".

Yet they use different rules regarding the usage of the square bracket operators.

Constantly switching between these rules is annoying, and makes one's code inconsistent.

The methods provided by 'squarebrackets' use the same sub-setting rules for all data.frame inherited classes, thus solving this issue.

Annoying Sub-setting By Names

When selecting names for sub-setting, only the first occurrences of the names are selected for the sub-set;
and when un-selecting/removing names for sub-setting, the syntax is very different from selecting names.

The methods provided by 'squarebrackets' uses the same syntax for both selecting and removing sub-sets.

Moreover, selecting/removing sub-sets by names always selects/removes all sub-sets with the given names, not just the first match.

Copy Semantics

'R' adheres to copy-on-modification semantics when replacing values using [`<-`].
But sometimes one would like explicit control when to create a copy, and when to modify using pass-by-reference semantics.

The 'squarebrackets' package provides the [sb_mod](#) method to return a copy of an object with modified subsets, and the [sb_set](#) method to modify using pass-by-reference semantics.

Regarding Other Packages

There are some packages that solve some of these issues.

But using different packages for solving different issues for the same common theme (in this case: solving some inconveniences in the square bracket operators) leads to inconsistent code.

I have not found an R-package that provides a holistic approach to providing alternative methods to the square brackets operators.

Thus this 'R' package was born.

class_mutable_atomic *Mutable Atomic Classes*

Description

The `mutable_atomic` class is a mutable version of atomic classes.

It works exactly the same in all aspects as regular atomic classes, with only one real difference:

[sb_set](#) accepts `mutable_atomic`, but does not accept regular `atomic`.

See [squarebrackets_PassByReference](#) for details.

Like `data.table`, [`<-`] performs R's default copy-on-modification semantics.

For modification by reference, use [sb_set](#).

Exposed functions (besides the S3 methods):

- `is.mutable_atomic()`: checks if an object is atomic.

- `as.mutable_atomic()`: converts a regular atomic object to `mutable_atomic`.
- `couldb.mutable_atomic()`: checks if an object could be `mutable_atomic`.
An objects can become `mutable_atomic` if it is one of the following types:
[logical](#), [integer](#), [double](#), [character](#), [complex](#), [raw](#).
`bit64::integer64` type is also supported, since it is internally defined as [double](#).

Usage

```
mutable_atomic(data, names = NULL, dim = NULL, dimnames = NULL)

as.mutable_atomic(x, ...)

is.mutable_atomic(x)

couldb.mutable_atomic(x)

## S3 method for class 'mutable_atomic'
x[...]

## S3 replacement method for class 'mutable_atomic'
x[...] <- value

## S3 method for class 'mutable_atomic'
format(x, ...)

## S3 method for class 'mutable_atomic'
print(x, ...)
```

Arguments

<code>data</code>	atomic vector giving data to fill the <code>mutable_atomic</code> object.
<code>names, dim, dimnames</code>	see setNames and array .
<code>x</code>	an atomic object.
<code>...</code>	method dependent arguments.
<code>value</code>	see Extract .

Value

For `as.mutable_atomic`:

Converts an atomic object (vector, matrix, array) to the same object, but with additional class "`mutable_atomic`", and the additional attribute "`typeof`".

For `is.mutable_atomic`:

Returns TRUE if the object is atomic, has the class "`mutable_atomic`", has the correctly set attribute "`typeof`", **and** has an address that does not overlap with the addresses of base objects.

`is.mutable_atomic` returns FALSE otherwise.

For `couldb.mutable_atomic`:

Returns TRUE if the object is one of the following types:

[logical](#), [integer](#), [double](#), [character](#), [complex](#), [raw](#).

`bit64::integer64` type is also supported, since it is internally defined as [double](#).

Returns FALSE otherwise.

Warning

Always use `mutable_atomic()` or `as.mutable_atomic` to create a mutable object, as they make necessary checks.

Circumventing these checks may break things.

Examples

```
x <- mutable_atomic(
  1:20, dim = c(5, 4), dimnames = list(letters[1:5], letters[1:4])
)
x

x <- matrix(1:10, ncol = 2)
x <- as.mutable_atomic(x)
is.mutable_atomic(x)
print(x)
x[, 1]
x[] <- as.double(x) # notifies the user a copy is being made
print(x) # "typeof" attribute adjusted accordingly, and class still present
```

dt

Functional Forms of data.table Operations

Description

Functional forms of special `data.table` operations - ALL programmatically friendly (no Non-Standard Evaluation).

- `dt_aggregate()` aggregates a `data.table` or `tidytable`, and returns the aggregated copy.
- `dt_setcol()` coercively transforms columns of a `data.table` or `tidytable` using [pass-by-reference semantics](#).
- `dt_setrm()` removes columns of a `data.table` or `tidytable` using [pass-by-reference semantics](#).
- `dt_setadd(x, new)` adds the columns from `data.table/tidytable new` to `data.table/tidytable x`, thereby modifying `x` using [pass-by-reference semantics](#).
- `dt_setreorder()` reorder the rows and/or variables of a `data.table` using [pass-by-reference semantics](#).

Usage

```
dt_aggregate(x, SDcols = NULL, f, by, order_by = FALSE)

dt_setcof(
  x,
  col = NULL,
  vars = NULL,
  v,
  chkdup = getOption("sb.chkdup", FALSE)
)

dt_setrm(x, col = NULL, vars = NULL, chkdup = getOption("sb.chkdup", FALSE))

dt_setadd(x, new)

dt_setreorder(x, roworder = NULL, varorder = NULL)
```

Arguments

<code>x</code>	a <code>data.table</code> or <code>tidytable</code> .
<code>SDcols</code>	atomic vector, giving the columns to which the aggregation function <code>f()</code> is to be applied on.
<code>f</code>	the aggregation function
<code>by</code>	atomic vector, giving the grouping columns.
<code>order_by</code>	Boolean, indicating if the aggregated result should be ordered by the columns specified in <code>by</code> .
<code>col, vars</code>	see squarebrackets_indx_args . Duplicates are not allowed.
<code>v</code>	the coercive transformation function
<code>chkdup</code>	see squarebrackets_duplicates . for performance: set to <code>FALSE</code>
<code>new</code>	a <code>data.table</code> or <code>tidytable</code> . It must have column names that do not already exist in <code>x</code> .
<code>roworder</code>	a integer vector of the same length as <code>nrow(x)</code> , giving the order in which the rows are to be re-order. Internally, this numeric vector will be turned into an order using order , thus ensuring it is a strict permutation of <code>1:nrow(x)</code> .
<code>varorder</code>	integer or character vector of the same length as <code>ncol(x)</code> , giving the new column order. See <code>data.table::setcolorder</code> .

Details

`dt_setreorder(x, roworder = roworder)` internally creates a new column to reorder the `data.table` by, and then removes the new column.
The column name is randomized, and extra care is given to ensure it does not overwrite any existing columns.

Value

For `dt_aggregate()`:
The aggregated data.table object.

For the rest of the functions:
Returns: VOID. These functions modify the object by reference.
Do not use assignments like `x <- dt_setcoe(x, ...)`.
Since these functions return void, you'll just get NULL.

Examples

```
# dt_aggregate on sf-data.table ====

if(requireNamespace("sf")) {
  x <- sf::st_read(system.file("shape/nc.shp", package = "sf"))
  x <- data.table::as.data.table(x)

  x$region <- ifelse(x$CNTY_ID <= 2000, 'high', 'low')
  d.aggr <- dt_aggregate(
    x, SDcols = "geometry", f= sf::st_union, by = "region"
  )

  head(d.aggr)
}

#####

# dt_setcoe ====

obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_set(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
str(obj)
obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
dt_setcoe(obj, vars = is.numeric, v = as.numeric) # integers are now numeric
str(obj)
sb2_set(obj,
  filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # SAFE: coercion performed; so no warnings
)
str(obj)

#####

# dt_setrm ====
```

```

obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj)
dt_setrm(obj, col = 1)
str(obj)

obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
str(obj)
dt_setrm(obj, vars = is.numeric)
str(obj)

#####

# dt_setadd ====

obj <- data.table::data.table(
  a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10])
)
new <- data.table::data.table(
  e = sample(c(TRUE, FALSE), 10, TRUE),
  f = sample(c(TRUE, FALSE), 10, TRUE)
)
dt_setadd(obj, new)
print(obj)

#####

# dt_setreorder====

n <- 1e4
obj <- data.table::data.table(
  a = 1L:n, b = n:1L, c = as.double(1:n), d = as.double(n:1)
)
dt_setreorder(obj, roworder = n:1)
head(obj)
dt_setreorder(obj, varorder = ncol(obj):1)
head(obj)

```

idx1_dim

Compute Flat Integer Indices (for Copy-On-Modify Substitution)

Description

The `idx1()` method translates the given indices/subscripts to flat/linear integer indices.

This function can be used inside the regular square brackets operators (without commas; as stated,

these are linear indices).

For example like so:

```
my_indices <- idx1(x, ...)
x[my_indices] <- value
```

thus allowing the user to benefit from the convenient index translations from 'squarebrackets', whilst still using R's default copy-on-modification semantics (instead of the deep copy semantics and [pass-by-reference semantics](#) provided by 'squarebrackets').

idx1() supports any x that is a vector, matrix, or array, regardless if x is atomic or recursive.

idx1_dim() translates indices for a specific dimension (handy for data.frames).

Use it for example like so:

```
rows <- idx1_dim(x, 1:10, 1)
cols <- idx1_dim(x, c("b", "a"), 2)
x[rows, cols] <- value
```

Usage

```
idx1_dim(
  x,
  slice,
  margin,
  inv = FALSE,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

idx1(x, ...)

## Default S3 method:
idx1(
  x,
  i,
  inv = FALSE,
  ...,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'matrix'
idx1(
  x,
  row = NULL,
  col = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)
```

```
## S3 method for class 'array'
idx1(
  x,
  idx = NULL,
  dims = NULL,
  rcl = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)
```

Arguments

<code>x</code>	vector, matrix, or array; both atomic and recursive objects are supported.
<code>slice</code>	works the same as arguments <code>row</code> and <code>col</code> .
<code>margin</code>	a single integer, specifying the dimension for <code>slice</code> .
<code>chkdup</code>	see squarebrackets_duplicates . for performance: set to <code>FALSE</code>
<code>...</code>	further arguments passed to or from other methods.
<code>i, row, col, idx, dims, rcl, inv</code>	See squarebrackets_idx_args . Duplicates are not allowed.

Value

A vector of flat/linear integer indices.

Examples

```
# atomic ====

x <- 1:10
x[idx1(x, \ (x)>5)] <- -5
print(x)

x <- matrix(1:20, ncol = 4)
colnames(x) <- letters[1:4]
x[idx1(x, 1:2, c("a", "b"))] <- -5
print(x)

x <- array(1:27, dim = c(3,3,3))
x[idx1(x, n(1:2, 1:2), c(1,3))] <- -10
print(x)

x <- array(1:27, dim = c(3,3,3))
x[idx1(x, rcl = n(1:2, 1:2, NULL))] <- -10
print(x)

#####
```

```
# recursive ====

x <- as.list(1:10)
x[idx1(x, \ (x)x>5)] <- -5
print(x)

x <- matrix(as.list(1:20), ncol = 4)
colnames(x) <- letters[1:4]
x[idx1(x, 1:2, c("a", "b"))] <- -5
print(x)

x <- array(as.list(1:27), dim = c(3,3,3))
x[idx1(x, n(1:2, 1:2), c(1,3))] <- -10
print(x)

x <- data.frame(
  a = sample(c(TRUE, FALSE, NA), 10, TRUE),
  b = 1:10,
  c = rnorm(10),
  d = letters[1:10],
  e = factor(letters[11:20])
)
rows <- idx1_dim(x, 1:5, 1, inv = TRUE)
cols <- idx1_dim(x, c("b", "a"), 2)
x[rows, cols] <- NA
print(x)
```

idx_by

Compute Grouped Indices

Description

Given:

- a sub-set function `f`;
- the complete range of indices `r` of some object `x`;
- and a grouping factor `grp`;

the `idx_by()` function takes indices `f(r)` **per group** `grp`.

The result of `idx_by()` can be supplied to the indexing arguments (see [squarebrackets_idx_args](#)) of:

[sb_x/sb2_x](#), [sb_rm/sb2_rm](#), [sb_mod/sb2_mod](#), [sb_set/sb2_set](#), or [sb2_coe](#),
to perform **grouped** subset operations.

Usage

```
idx_by(f, r, grp, parallel = FALSE, mc.cores = 1L)
```

Arguments

- f** a subset function to be applied per group on *r*.
The function must accept a character or integer vector as input, and produce a character or integer vector as output.
For example, to subset the last element per group, specify:
`f = last`
- r** an integer or character vector, giving the complete range of indices of an object.
For example: `colnames(x)`, `1:nrow(x)`, etc.
- grp** a factor giving the groups. Make sure its order corresponds to *i* and *r*, otherwise it makes no sense.
- parallel, mc.cores**
see [BY](#).

Value

A vector of indices of the same type as *r*.

Examples

```
# vectors ====
(a <- 1:20)
(grp <- factor(rep(letters[1:5], each = 4)))

# get the last element of `a` for each group in `grp`:
i <- idx_by(last, seq_along(a), grp)
sb_x(cbind(a, grp), row = i)

# data.frame ====
x <- data.frame(
  a = sample(1:20),
  b = letters[1:20],
  group = factor(rep(letters[1:5], each = 4))
)
print(x)
# get the first row for each group in data.frame `x`:
row <- idx_by(first, 1:nrow(x), x$group)
sb2_x(x, row)
# get the first row for each group for which a > 10:
x2 <- sb2_x(x, filter = ~ a > 10)
row <- na.omit(idx_by(first, 1:nrow(x2), x2$group))
sb2_x(x2, row)
```


Description

Computes ordered indices. Similar to [order](#), except the user must supply a vector, a list of equal-length vectors, a data.frame or a matrix (row-wise and column-wise are both supported), as the input.

For a vector `x`, `idx_ord_v(x)` is equivalent to `order(x)`.

For a data.frame or a list of equal-length vectors `x`, with `p` columns/elements, `idx_ord_df(x)` is equivalent to `order(x[[1]], ..., x[[p]])`.

For a matrix (or array) `x` with `p` rows, `idx_ord_m(x, margin = 1)` is equivalent to `order(x[1,], ..., x[p,], ...)`.

For a matrix (or array) `x` with `p` columns, `idx_ord_m(x, margin = 2)` is equivalent to `order(x[, 1], ..., x[, p], ...)`.

Note that these are merely a convenience functions, and that these are actually slightly slower than [order](#) (except for `idx_ord_v()`), due to the additional functionality.

Usage

```
idx_ord_v(
  x,
  na.last = TRUE,
  decr = FALSE,
  method = c("auto", "shell", "radix")
)

idx_ord_m(
  x,
  margin,
  na.last = TRUE,
  decr = FALSE,
  method = c("auto", "shell", "radix")
)

idx_ord_df(
  x,
  na.last = TRUE,
  decr = FALSE,
  method = c("auto", "shell", "radix")
)
```

Arguments

<code>x</code>	a vector, data.frame, or array
<code>na.last, method</code>	see order and sort .
<code>decr</code>	see argument decreasing in order
<code>margin</code>	the margin over which to cut the matrix/array into vectors. I.e. <code>margin = 1</code> will cut <code>x</code> into individual rows, and apply the order on those

rows.
And margin = 2 will cut x into columns, etc.

Value

See [order](#).

Examples

```
x <- sample(1:10)
order(x)
indx_ord_v(x)
indx_ord_m(rbind(x, x), 1)
indx_ord_m(cbind(x, x), 2)
indx_ord_df(data.frame(x, x))
```

indx_x	<i>Exported Utilities</i>
--------	---------------------------

Description

Exported utilities.
Usually the user won't need these functions.

Usage

```
indx_x(i, x, xnames, xsize)

indx_rm(i, x, xnames, xsize)
```

Arguments

- i See [squarebrackets_indx_args](#).
- x a vector, vector-like object, factor, data.frame, data.frame-like object, or a list.
- xnames names or dimension names
- xsize length or dimension size

Value

The subsetted object.

Examples

```
x <- 1:10
names(x) <- letters[1:10]
indx_x(1:5, x, names(x), length(x))
indx_rm(1:5, x, names(x), length(x))
```

match_all*Match All, Order-Sensitive and Duplicates-Sensitive*

Description

Find all indices of vector haystack that are equal to vector needles, taking into account the order of both vectors, and their duplicate values.

It is essentially a much more efficient version of:

```
lapply(needles, \(i) which(haystack == i))
```

Like `lapply(needles, \(i) which(haystack == i))`, NAs are ignored.

Core of the code is based on a suggestion by Sebastian Kranz (author of the 'collapse' package).

Usage

```
match_all(needles, haystack, unlist = TRUE)
```

Arguments

needles, haystack

vectors

unlist Boolean, indicating if the result should be a vector (TRUE, default), or a list (FALSE).

Value

An integer vector, or list of integer vector.

If a list, each element of the list corresponds to each value of needles.

When needles and/or haystack is/are empty or fully NA, `match_all()` returns an empty integer vector (if `unlist = TRUE`), or an empty list (if `unlist = FALSE`).

Examples

```
n <- 200
haystack <- sample(letters, n, TRUE)
needles <- sample(letters, n/2, TRUE)
indices1 <- match_all(needles, haystack)
head(indices1)
```

ma_setv

Find and Replace Present Values in mutable_atomic Objects By Reference

Description

The `ma_setv(x, v, rp)` function performs the equivalent of `x[which(x == v)] <- rp` but using [pass-by-reference semantics](#).

This is faster than using `sb_set(x, i = which(x == v), rp = rp)`.

Inspired by `collapse::setv`, but written in 'C++' through 'Rcpp', with additional safety checks.

Usage

```
ma_setv(x, v, rp, invert = FALSE, NA.safety = TRUE)
```

Arguments

<code>x</code>	a mutable_atomic variable.
<code>v</code>	non-missing (so no NA or NaN) atomic scalar to find.
<code>rp</code>	atomic scalar giving the replacement value.
<code>invert</code>	Boolean. If FALSE (default), the equivalent of <code>x[which(x == v)] <- rp</code> is performed; If TRUE, the equivalent of <code>x[which(x != v)] <- rp</code> is performed instead.
<code>NA.safety</code>	Boolean. just like in which , NA and NaN results in <code>x==v</code> should be ignored, thus <code>NA.safety</code> is TRUE by default. However, if it is known that <code>x</code> contains no NAs or NaNs, setting <code>NA.safety</code> to FALSE will increase performance a bit. NOTE: Setting <code>NA.safety = FALSE</code> when <code>x</code> does contain NAs or NaNs, may result in unexpected behaviour. for performance: set to FALSE

Value

Returns: VOID. This function modifies the object by reference.

Do not use assignment like `x <- ma_setv(x, ...)`.

Since this function returns void, you'll just get NULL.

Examples

```
x <- mutable_atomic(c(1:20, NA, NaN))
print(x)
ma_setv(x, 2, 100)
print(x)
```

n	<i>Nest</i>
---	-------------

Description

The `c()` function concatenates vectors or lists into a vector (if possible) or else a list. In analogy to that function, the `n()` function **ne**sts objects into a list (not into an atomic vector, as atomic vectors cannot be nested). It is a short-hand version of the [list](#) function. This is handy because lists are often needed in 'squarebrackets', especially for arrays.

Usage

```
n()
```

Value

The list.

Examples

```
obj <- array(1:64, c(4,4,3))
print(obj)
sb_x(obj, n(1:3, 1:2), c(1,3))
# above is equivalent to obj[1:3, , 1:2, drop = FALSE]
```

sb2_coe	<i>Method to Coercively Transform (Recursive Subsets of) an Object</i>
---------	--

Description

This is an S3 Method to completely transform subsets of recursive objects with explicit coercion.

Note that when `x` is a `data.table`, one can coercively transform columns by reference (which is more memory efficient), using [dt_setcoe](#).

Usage

```

sb2_coe(x, ...)

## Default S3 method:
sb2_coe(x, i, inv = FALSE, ..., v, .lapply = lapply)

## S3 method for class 'array'
sb2_coe(
  x,
  idx = NULL,
  dims = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  v,
  .lapply = lapply
)

## S3 method for class 'data.frame'
sb2_coe(x, col = NULL, vars = NULL, inv = FALSE, ..., v)

```

Arguments

x	a recursive object (list-like or data.frame-like).
...	further arguments passed to or from other methods.
i, col, vars, idx, dims, inv	See squarebrackets_idx_args . An empty index selection returns the original object unchanged.
v	the coercive transformation function to use.
.lapply	the generic methods use lapply for list- and data.frame-like objects to compute <code>tf()</code> on every list element or dataset column. The user may supply a custom <code>lapply()</code> -like function in this argument to use instead. For example, to perform parallel transformation, the user may supply <code>future::future_lapply</code> . The supplied function must use the exact same argument convention as lapply , otherwise errors or unexpected behaviour may occur.

Value

A copy of the coercively transformed object.

Examples

```

obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_set(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
print(obj)
obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))

```

```
obj <- sb2_coe(obj, vars = is.numeric, v = as.numeric)
str(obj)
sb2_set(obj,
  filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # SAFE: coercion performed; so no warnings
)
print(obj)
```

sb2_rec

Access Recursive Subsets

Description

The `sb2_rec()` method allows the user to access recursive subsets of lists.

The `sb2_rec()` method also allows replacing or transforming a recursive subset of a list, using R's default in-place semantics, by specifying the `rp` argument.

Usage

```
sb2_rec(lst, rec, rp)
```

Arguments

<code>lst</code>	a list, or list-like object.
<code>rec</code>	a vector of length <code>p</code> , such that <code>lst[[rec]]</code> is equivalent to <code>lst[[rec[1]]]</code> ... <code>[[rec[p]]]</code> , providing all but the final indexing results in a list. When on a certain subset level of a nested list, multiple subsets with the same name exist, only the first one will be selected when performing recursive indexing by name, due to the recursive nature of this type of subsetting.
<code>rp</code>	optional. If specified, performs <code>lst[[rec]] <- rp</code> , using R's default in-place semantics.

Value

If `rp` is not specified: Returns the recursive subset.

If `rp` is specified: Returns nothing, but replaces the recursive subset with `rp`, using R's default in-place semantics.

Examples

```
lst <- list(
  A = list(
    A = list(A = "AAA", B = "AAB"),
    A = list(A = "AA2A", B = "AA2B"),
    B = list(A = "ABA", B = "ABB")
```

```

),
B = list(
  A = list(A = "BAA", B = "BAB"),
  B = list(A = "BBA", B = "BBB")
)
)

#####

# access recursive subsets ====

sb2_rec(lst, c(1,2,2)) # this gives "AA2B"
sb2_rec(lst, c("A", "B", "B")) # this gives "ABB"
sb2_rec(lst, c(2,2,1)) # this gives "BBA"
sb2_rec(lst, c("B", "B", "A")) # this gives "BBA"

#####

# replace with R's default in-place semantics ====

# replace "AAB" using R's default in-place semantics:
sb2_rec(
  lst, c("A", "A", "B"),
  rp = "THIS IS REPLACED WITH IN-PLACE SEMANTICS"
)
print(lst)

#####

# Modify View of List By Reference ====

x <- list(
  a = data.table::data.table(cola = 1:10, colb = letters[1:10]),
  b = data.table::data.table(cola = 11:20, colb = letters[11:20])
)
print(x)
mypointer <- sb2_rec(x, "a")
address(mypointer) == address(x$a) # they are the same
sb2_set(mypointer, col = "cola", tf = \"(x)x^2\")
print(x) # notice x has been changed

```

sb_before

Methods to Insert New Values Before or After an Index Along a Dimension

Description

The `sb_before()/sb2_before()` method inserts new values before some position along a dimension.

The `sb_after()/sb2_after()` method inserts new values after some position along a dimension.

Use `sb_before(x, ...)`/`sb_after(x, ...)` if `x` is a non-recursive object (i.e. atomic or factor).
 Use `sb2_before(x, ...)`/`sb2_after(x, ...)` if `x` is a recursive object (i.e. list or data.frame-like).

`sb2_before.array()` and `sb2_after.array()` use a altered version of `abind::abind` (see references below), which has been modified to work on recursive arrays (i.e. dimensional lists).

Usage

```
sb_before(x, ...)

sb_after(x, ...)

## Default S3 method:
sb_before(x, new, pos = 1, .attr = NULL, ...)

## Default S3 method:
sb_after(x, new, pos = length(x), .attr = NULL, ...)

## S3 method for class 'array'
sb_before(x, new, margin, pos = 1, .attr = NULL, ...)

## S3 method for class 'array'
sb_after(x, new, margin, pos = dim(x)[margin], .attr = NULL, ...)

## S3 method for class 'factor'
sb_before(x, new, pos = 1, .attr = NULL, ...)

## S3 method for class 'factor'
sb_after(x, new, pos = length(x), .attr = NULL, ...)

sb2_before(x, ...)

sb2_after(x, ...)

## Default S3 method:
sb2_before(x, new, pos = 1, .attr = NULL, ...)

## Default S3 method:
sb2_after(x, new, pos = length(x), .attr = NULL, ...)

## S3 method for class 'array'
sb2_before(x, new, margin, pos = 1, .attr = NULL, ...)

## S3 method for class 'array'
sb2_after(x, new, margin, pos = dim(x)[margin], .attr = NULL, ...)

## S3 method for class 'data.frame'
sb2_before(x, new, margin, pos = 1, .attr = NULL, ...)

## S3 method for class 'data.frame'
```

```
sb2_after(x, new, margin, pos = collapse::fdim(x)[margin], .attr = NULL, ...)
```

Arguments

x	see squarebrackets_immutable_classes and squarebrackets_mutable_classes .
...	further arguments passed to or from other methods.
new	the new value(s). The type of object depends on x: <ul style="list-style-type: none"> • For atomic objects, new can be any atomic object. However, if one wished the added values in new to be named, ensure new is the same type of object as x. For example: use matrix with column names for new when appending/inserting columns to matrix x. • For factors, new must be a factor. • For lists, new must be a (possible named) list. • For data.frame-like objects, new must be a data.frame.
pos	a strictly positive single integer scalar (so no duplicates), giving the position along the dimension (specified in margin), before or after which the new values are added.
.attr	a list, giving additional potentially missing attributes to be added to the returned object. By default, concatenation strips attributes, since the attributes of x and new may not be equal or even compatible. In the attr argument, the attributes of the merged object can be specified. Only attributes that are actually missing AFTER insertion will be added, thus preventing overwriting existing attributes like names. One may, for example, specify .attr = sb_a(x) or .attr = sb_a(new). If NULL (the default), no attributes will be added post-insert. If speed is important, NULL is the best option (but then attributes won't be preserved).
margin	a single scalar, giving the dimension along which to add new values.

Value

Returns a copy of the appended object.

References

Plate T, Heiberger R (2016). *abind: Combine Multidimensional Arrays*. R package version 1.4-5, <https://CRAN.R-project.org/package=abind>.

Examples

```
# atomic objects ====

x <- matrix(1:20 , ncol = 4)
print(x)
new <- -1 * x
sb_before(x, new, 1)
sb_after(x, new, 1)
sb_before(x, new, 2)
sb_after(x, new, 2)
```

```
#####

# factors ====

x <- factor(letters)
new <- factor("foo")
sb_before(x, new)
sb_after(x, new)

#####

# lists ====

x <- as.list(1:5)
new <- lapply(x, \(x)x*-1)
print(x)
sb2_before(x, new)
sb2_after(x, new)

#####

# recursive arrays / dimensional lists ====

x <- matrix(c(as.list(1:20), as.list(letters[1:20])) , ncol = 8) |> t()
dimnames(x) <- list(letters[1:8], letters[1:5])
print(x)
new <- matrix(c(as.list(-1:-20), as.list(letters[26:7])) , ncol = 8) |> t()
sb2_before(x, new, 1)
sb2_after(x, new, 1)
sb2_before(x, new, 2)
sb2_after(x, new, 2)

#####

# data.frame-like objects ====

x <- data.frame(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
new <- data.frame(e = 101:110)
sb2_before(x, new, 2)
sb2_after(x, new, 2)
new <- x[1,]
sb2_before(x, new, 1)
sb2_after(x, new, 1)
```

Description

`sb_currentBindings(x, action = "list")`

lists all **currently existing** objects sharing the same **address** as `x`, in a given environment.

`sb_currentBindings(x, action = "checklock")`

searches all **currently existing** objects sharing the same **address** as `x`, in a given environment, and reports which of these are locked and which are not locked.

`sb_currentBindings(x, action = "lockbindings")`

searches all **currently existing** objects sharing the same **address** as `x`, in a given environment, and locks them using [lockBinding](#).

See also [squarebrackets_PassByReference](#) for information regarding the relation between locked bindings and pass-by-reference modifications.

`sb2_currentBindings()` is an alias for `sb_currentBindings()`, and exists just for consistency with the other `sb_`/ `sb2_` methods.

Usage

```
sb_currentBindings(x, action = "list", env = NULL)
```

```
sb2_currentBindings(x, action = "list", env = NULL)
```

Arguments

<code>x</code>	the existing variable whose address to use when searching for bindings.
<code>action</code>	a single string, giving the action to perform. Must be one of the following: <ul style="list-style-type: none"> • <code>"list"</code> (default). • <code>"checklock"</code>. • <code>"lockbindings"</code>.
<code>env</code>	the environment where to look for objects. If <code>NULL</code> (default), the caller environment is used.

Value

For `sb_currentBindings(x, action = "list")`:

Returns a character vector.

For `sb_currentBindings(x, action = "checklock")`:

Returns a named logical vector.

The names give the names of the bindings,

and each associated value indicates whether the binding is locked (TRUE) or not locked (FALSE).

For `sb_currentBindings(x, action = "lockbindings")`:

Returns VOID. It just locks the currently existing bindings.

To unlock the bindings, remove the objects (see [rm](#)).

Examples

```
x <- as.mutable_atomic(1:10)
y <- x
lockBinding("y", environment())
sb_currentBindings(x)
sb_currentBindings(x, "checklock") # only y is locked

# since only y is locked, we can still modify y through x by reference:
sb_set(x, i = 1, rp = -1)
print(y) # modified!
rm(list= c("y")) # clean up

# one can fix this by locking ALL bindings:
y <- x
sb_currentBindings(x, "lockbindings") # lock all
sb_currentBindings(x, "checklock") # all bindings are locked, including y
# the 'squarebrackets' package respects the lock of a binding,
# provided all bindings of an address are locked;
# so this will give an error, as it should:

if(requireNamespace("tinytest")) {
  tinytest::expect_error(
    sb_set(x, i = 1, rp = -1),
    pattern = "object is locked"
  )
}

# creating a new variable will NOT automatically be locked:
z <- y # new variable; will not be locked!
sb_currentBindings(x, "checklock") # z is not locked
sb_currentBindings(x, "lockbindings") # we must re-run this
sb_currentBindings(x, "checklock") # now z is also locked

if(requireNamespace("tinytest")) {
  tinytest::expect_error( # now z is also protected
    sb_set(z, i = 1, rp = -1),
    pattern = "object is locked"
  )
}

rm(list= c("x", "y", "z")) # clean up
```

sb_mod

Method to Return a Copy of an Object With Modified Subsets

Description

This is an S3 Method to return a copy of an object with modified subsets.
 Use `sb_mod(x, ...)` if `x` is a non-recursive object (i.e. atomic or factor).

Use `sb2_mod(x, ...)` if `x` is a recursive object (i.e. list or data.frame-like).

For modifying subsets using R's default copy-on-modification semantics, see [idx1](#).

Usage

```
sb_mod(x, ...)

## Default S3 method:
sb_mod(
  x,
  i,
  inv = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'matrix'
sb_mod(
  x,
  row = NULL,
  col = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'array'
sb_mod(
  x,
  idx = NULL,
  dims = NULL,
  rcl = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'factor'
sb_mod(
  x,
  i = NULL,
  lvl = NULL,
```

```

    inv = FALSE,
    ...,
    rp,
    chkdup = getOption("squarebrackets.chkdup", FALSE)
  )

sb2_mod(x, ...)

## Default S3 method:
sb2_mod(
  x,
  i,
  inv = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE),
  .lapply = lapply
)

## S3 method for class 'array'
sb2_mod(
  x,
  idx = NULL,
  dims = NULL,
  i = NULL,
  inv = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE),
  .lapply = lapply
)

## S3 method for class 'data.frame'
sb2_mod(
  x,
  row = NULL,
  col = NULL,
  filter = NULL,
  vars = NULL,
  inv = FALSE,
  coe = FALSE,
  ...,
  rp,
  tf,
  chkdup = getOption("squarebrackets.chkdup", FALSE),
  .lapply = lapply
)

```

Arguments

x see [squarebrackets_immutable_classes](#) and [squarebrackets_mutable_classes](#).

...	further arguments passed to or from other methods.
i, lvl, row, col, idx, dims, rcl, filter, vars, inv	See squarebrackets_indx_args . An empty index selection returns the original object unchanged.
rp	an object of somewhat the same type as the selected subset of x, and the same same length as the selected subset of x or a length of 1.
tf	the transformation function.
chkdup	see squarebrackets_duplicates . for performance: set to FALSE
.lapply	the generic methods use lapply for list- and data.frame-like objects to compute <code>tf()</code> on every list element or dataset column. The user may supply a custom <code>lapply()</code> -like function in this argument to use instead. For example, to perform parallel transformation, the user may supply <code>future::future_lapply</code> . The supplied function must use the exact same argument convention as lapply , otherwise errors or unexpected behaviour may occur.
coe	Either FALSE (default), TRUE, or a function. The argument <code>coe</code> is ignored if both the <code>row</code> and <code>filter</code> arguments are set to NULL. See Details section for more info. for performance: set to FALSE

Details

Transform or Replace

Specifying argument `tf` will transform the subset.

Specifying `rp` will replace the subset.

One cannot specify both `tf` and `rp`. It's either one set or the other.

Note that the `tf` argument is not available for factors: this is intentional.

Argument `coe`

For data.frame-like objects, `sb_mod()` can only auto-coerce whole columns, not subsets of columns.

So it does not automatically coerce column types when `row` or `filter` is also specified.

The `coe` arguments provides 2 ways to circumvent this:

1. The user can supply a coercion function to argument `coe`.
The function is applied on the entirety of every column specified in `col` or `vars`; columns outside this subset are not affected.
This coercion function is, of course, applied before replacement (`rp`) or transformation (`tf()`).
2. The user can set `coe = TRUE`.
In this case, the whole columns specified in `col` or `vars` are extracted and copied to a list.
Subsets of each list element, corresponding to the selected rows, are modified with `rp` or `tf()`, using R's regular auto-coercion rules.
The modified list is then returned to the data.frame-like object, replacing the original columns.

Note that coercion required additional memory.

The larger the data.frame-like object, the larger the memory.

The default, `coe = FALSE`, uses the least amount of memory.

Value

A copy of the object with replaced/transformed values.

Examples

```
# atomic objects ====

obj <- matrix(1:16, ncol = 4)
colnames(obj) <- c("a", "b", "c", "a")
print(obj)
rp <- -1:-9
sb_mod(obj, 1:3, 1:3, rp = rp)
# above is equivalent to obj[1:3, 1:3] <- -1:-9; obj
sb_mod(obj, i = \(\x)x<=5, rp = -1:-5)
# above is equivalent to obj[obj <= 5] <- -1:-5; obj
sb_mod(obj, col = "a", rp = -1:-8)
# above is equivalent to obj[, which(colnames(obj) %in% "a")] <- -1:-8; obj
sb_mod(obj, 1:3, 1:3, tf = \(\x) -x)
# above is equivalent to obj[1:3, 1:3] <- (-1 * obj[1:3, 1:3]); obj
sb_mod(obj, i = \(\x)x<=5, tf = \(\x) -x)
# above is equivalent to obj[obj <= 5] <- (-1 * obj[obj <= 5]); obj

obj <- matrix(1:16, ncol = 4)
colnames(obj) <- c("a", "b", "c", "a")
print(obj)
sb_mod(obj, 1:3, 1:3, tf = \(\x) -x)
# above is equivalent to obj[1:3, 1:3] <- -1 * obj[1:3, 1:3]
sb_mod(obj, i = \(\x)x<=5, tf = \(\x) -x)
# above is equivalent to obj[obj <= 5] <- -1:-5; obj
sb_mod(obj, col = "a", tf = \(\x) -x)
# above is equivalent to obj[, which(colnames(obj) %in% "a")] <- -1:-8; obj

obj <- array(1:64, c(4,4,3))
print(obj)
sb_mod(obj, list(1:3, 1:2), c(1,3), rp = -1:-24)
# above is equivalent to obj[1:3, , 1:2] <- -1:-24
sb_mod(obj, i = \(\x)x<=5, rp = -1:-5)
# above is equivalent to obj[obj <= 5] <- -1:-5

#####

# lists ====

obj <- list(a = 1:10, b = letters[1:11], c = 11:20)
print(obj)
sb2_mod(obj, "a", rp = list(1L))
# above is equivalent to obj[["a"]] <- 1L; obj
sb2_mod(obj, is.numeric, rp = list(-1:-10, -11:-20))
# above is equivalent to obj[which(sapply(obj, is.numeric))] <- list(-1:-10, -11:-20); obj

#####
```

```

# recursive arrays / dimensional lists ====
obj <- c(as.list(1:10), as.list(letters[1:10])) |> array(dim = c(5, 4)) |> t()
print(obj)
sb2_mod(obj, list(1:3), 1, rp = list(FALSE))
# above is equivalent to obj[1:3, ] <- list(FALSE)

#####

# data.frame-like objects - whole columns ====

obj <- data.frame(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_mod(
  obj, vars = is.numeric,
  tf = sqrt # SAFE: row=NULL & filter = NULL, so coercion performed
)

#####

# data.frame-like objects - partial columns ====

obj <- data.frame(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)

sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  coe = as.double, tf = sqrt # SAFE: coercion performed
)
sb2_mod(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  coe = TRUE, tf = sqrt # SAFE: coercion performed
)

```

Description

This is an S3 Method to un-select/remove subsets from an object.

Use `sb_rm(x, ...)` if `x` is a non-recursive object (i.e. atomic or factor).

Use `sb2_rm(x, ...)` if `x` is a recursive object (i.e. list or data.frame-like).

Usage

```
sb_rm(x, ...)  
  
## Default S3 method:  
sb_rm(  
  x,  
  i,  
  ...,  
  rat = getOption("squarebrackets.rat", FALSE),  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
## S3 method for class 'matrix'  
sb_rm(  
  x,  
  row = NULL,  
  col = NULL,  
  i = NULL,  
  ...,  
  rat = getOption("squarebrackets.rat", FALSE),  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
## S3 method for class 'array'  
sb_rm(  
  x,  
  idx = NULL,  
  dims = NULL,  
  rcl = NULL,  
  i = NULL,  
  ...,  
  rat = getOption("squarebrackets.rat", FALSE),  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
## S3 method for class 'factor'  
sb_rm(  
  x,  
  i = NULL,  
  lvl = NULL,  
  drop = FALSE,  
  ...,  
  rat = getOption("squarebrackets.rat", FALSE),  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
sb2_rm(x, ...)  
  
## Default S3 method:  
sb2_rm(  
  x,  
  i,
```

```

    drop = FALSE,
    ...,
    rat = getOption("squarebrackets.rat", FALSE),
    chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'array'
sb2_rm(
  x,
  idx = NULL,
  dims = NULL,
  i = NULL,
  drop = FALSE,
  ...,
  rat = getOption("squarebrackets.rat", FALSE),
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

## S3 method for class 'data.frame'
sb2_rm(
  x,
  row = NULL,
  col = NULL,
  filter = NULL,
  vars = NULL,
  ...,
  chkdup = getOption("squarebrackets.chkdup", FALSE)
)

```

Arguments

x	see squarebrackets_immutable_classes and squarebrackets_mutable_classes .
...	further arguments passed to or from other methods.
i, lvl, row, col, idx, dims, rcl, filter, vars	See squarebrackets_indx_args . An empty index selection results in nothing being removed, and the entire object is returned.
rat	Boolean, indicating if attributes should be returned with the sub-setted object. See Details section for more info. for performance: set to FALSE
chkdup	see squarebrackets_duplicates . for performance: set to FALSE
drop	Boolean. <ul style="list-style-type: none"> • For factors: If drop = TRUE, unused levels are dropped, if drop = FALSE they are not dropped. • For lists: if drop = TRUE, and sub-setting is done using argument i, selecting a single element will give the simplified result, like using [[]]. If drop = FALSE, a list is always returned regardless of the number of elements.

Details

One the rat argument

Most [- methods strip most (but not all) attributes.

If rat = FALSE, this default behaviour is preserved, for compatibility with special classes. This is the fastest option.

If rat = TRUE, attributes from x missing after sub-setting are re-assigned to x. Already existing attributes after sub-setting will not be overwritten.

There is no rat argument for data.frame-like object: their attributes will always be preserved.

NOTE: In the following situations, the rat argument will be ignored, as the attributes necessarily have to be dropped:

- when x is a list, AND drop = TRUE, AND a single element is selected, AND sub-setting is done through the i argument.
- when x is an atomic matrix or array, and sub-setting is done through the i argument.

Value

A copy of the sub-setted object.

Examples

```
# atomic objects ====

obj <- matrix(1:16, ncol = 4)
colnames(obj) <- c("a", "b", "c", "a")
print(obj)
sb_rm(obj, 1:3, 1:3)
# above is equivalent to obj[-1:-3, -1:-3, drop = FALSE]
sb_rm(obj, i = \ (x)x>5)
# above is equivalent to obj[!obj > 5]
sb_rm(obj, col = "a")
# above is equivalent to obj[, which(!colnames(obj) %in% "a")]

obj <- array(1:64, c(4,4,3))
print(obj)
sb_rm(obj, n(1, c(1, 3)), c(1, 3))
sb_rm(obj, rcl = n(1, NULL, c(1, 3)))
# above 2 lines are equivalent to obj[-1, c(-1, -3), drop = FALSE]
sb_rm(obj, i = \ (x)x>5)
# above is equivalent to obj[!obj > 5]

#####

# factors ====

obj <- factor(rep(letters[1:5], 2))
sb_rm(obj, lvl = "a")
# above is equivalent to obj[which(!obj %in% "a")]

#####
```

```

# lists ====

obj <- list(a = 1:10, b = letters[1:11], c = 11:20)
print(obj)
sb2_rm(obj, "a")
# above is equivalent to obj[which(!names(obj) %in% "a")]
sb2_rm(obj, 1) # obj[-1]
sb2_rm(obj, 1:2)
# above is equivalent to obj[seq_len(length(obj))[-1:-2]]
sb2_rm(obj, is.numeric, drop = TRUE)
# above is equivalent to obj[!sapply(obj, is.numeric)] IF this returns a single element
obj <- list(a = 1:10, b = letters[1:11], c = letters)
sb2_rm(obj, is.numeric)
# above is equivalent to obj[!sapply(obj, is.numeric)] # this time singular brackets?
# for recursive indexing, see sb2_rec()

#####

# recursive arrays / dimensional lists ====
obj <- c(as.list(1:10), as.list(letters[1:10])) |> array(dim = c(5, 4)) |> t()
print(obj)
sb2_rm(obj, list(1:3), 1)
# above is equivalent to obj[-1:-3, ]

#####

# data.frame-like objects ====

obj <- data.frame(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
print(obj)
sb2_rm(obj, 1:3, 1:3)
# above is equivalent to obj[-1:-3, -1:-3, drop = FALSE]
sb2_rm(obj, filter = ~ (a > 5) & (c < 19), vars = is.numeric)

```

sb_set

Method to Modify Subsets of a Mutable Object By Reference

Description

This is an S3 Method to replace or transform a subset of a [supported mutable object](#) using [pass-by-reference semantics](#)

Use `sb_set(x, ...)` if `x` is a non-recursive object (i.e. [mutable_atomic](#)).

Use `sb2_set(x, ...)` if `x` is a recursive object (i.e. [data.table](#)).

Usage

```
sb_set(x, ...)  
  
## Default S3 method:  
sb_set(  
  x,  
  i,  
  inv = FALSE,  
  ...,  
  rp,  
  tf,  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
## S3 method for class 'matrix'  
sb_set(  
  x,  
  row = NULL,  
  col = NULL,  
  i = NULL,  
  inv = FALSE,  
  ...,  
  rp,  
  tf,  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
## S3 method for class 'array'  
sb_set(  
  x,  
  idx = NULL,  
  dims = NULL,  
  rcl = NULL,  
  i = NULL,  
  inv = FALSE,  
  ...,  
  rp,  
  tf,  
  chkdup = getOption("squarebrackets.chkdup", FALSE)  
)  
  
sb2_set(x, ...)  
  
## Default S3 method:  
sb2_set(x, ...)  
  
## S3 method for class 'data.table'  
sb2_set(  
  x,  
  row = NULL,  
  col = NULL,  
  filter = NULL,
```

```

vars = NULL,
inv = FALSE,
...,
rp,
tf,
chkdup = getOption("squarebrackets.chkdup", FALSE),
.lapply = lapply
)

```

Arguments

- x** a **variable** belonging to one of the [supported mutable classes](#).
- ...** further arguments passed to or from other methods.
- i, row, col, idx, dims, rcl, filter, vars, inv**
See [squarebrackets_idx_args](#).
An empty index selection returns the original object unchanged.
- rp** an object of somewhat the same type as the selected subset of x, and the same same length as the selected subset of x or a length of 1.
- tf** the transformation function.
- chkdup** see [squarebrackets_duplicates](#).
for performance: set to FALSE
- .lapply** the generic methods use [lapply](#) for list- and data.frame-like objects to compute `tf()` on every list element or dataset column.
The user may supply a custom `lapply()`-like function in this argument to use instead.
For example, to perform parallel transformation, the user may supply `future.apply::future_lapply`.
The supplied function must use the exact same argument convention as [lapply](#), otherwise errors or unexpected behaviour may occur.

Details

Transform or Replace

Specifying argument `tf` will transform the subset. Specifying `rp` will replace the subset. One cannot specify both `tf` and `rp`. It's either one set or the other.

Note that there is no `sb_set()` method for factors: this is intentional.

Value

Returns: VOID. This method modifies the object by reference.

Do not use assignments like `x <- sb_set(x, ...)`.

Since this function returns void, you'll just get NULL.

Examples

```
# mutable_atomic objects ====

gen_mat <- function() {
  obj <- as.mutable_atomic(matrix(1:16, ncol = 4))
  colnames(obj) <- c("a", "b", "c", "a")
  return(obj)
}

obj <- obj2 <- gen_mat()
obj
sb_set(obj, 1:3, 1:3, rp = -1:-9)
obj2
obj <- obj2 <- gen_mat()
obj
sb_set(obj, i = \(\x)x<=5, rp = -1:-5)
obj2
obj <- obj2 <- gen_mat()
obj
sb_set(obj, col = "a", rp = cbind(-1:-4, -5:-8))
obj2

obj <- obj2 <- gen_mat()
obj
sb_set(obj, 1:3, 1:3, tf = \(\x) -x)
obj2
obj <- obj2 <- gen_mat()
obj
sb_set(obj, i = \(\x)x<=5, tf = \(\x) -x)
obj2
obj <- obj2 <- gen_mat()
obj
sb_set(obj, col = "a", tf = \(\x) -x)
obj2

gen_array <- function() {
  as.mutable_atomic(array(1:64, c(4,4,3)))
}
obj <- gen_array()
obj
sb_set(obj, list(1:3, 1:2, c(1, 3)), 1:3, rp = -1:-12)
obj
obj <- gen_array()
obj
sb_set(obj, i = \(\x)x<=5, rp = -1:-5)
obj

#####

# data.table ====

obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
```

```

sb2_set(
  obj, filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # WARNING: sqrt() results in `dbl`, but columns are `int`, so decimals lost
)
print(obj)

obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
obj <- sb2_coe(obj, vars = is.numeric, v = as.numeric)
str(obj)
sb2_set(obj,
  filter = ~ (a >= 2) & (c <= 17), vars = is.numeric,
  tf = sqrt # SAFE: coercion performed by sb_coe(); so no warnings
)
print(obj)

obj <- data.table::data.table(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
str(obj) # notice that columns "a" and "c" are INTEGER (`int`)
sb2_set(
  obj, vars = is.numeric,
  tf = sqrt # SAFE: row=NULL & filter = NULL, so coercion performed
)
str(obj)

```

sb_setRename

Method to Change the Names of a Mutable Object By Reference

Description

This is an S3 Method to rename a [supported mutable object](#) using [pass-by-reference](#) semantics.

This method takes extra care not to modify any objects that happen to share the same address as the (dim)names of x.

I.e. the following code:

```

x <- mutable_atomic(1:26)
names(x) <- base::letters
y <- x
sb_setRename(x, newnames = rev(names(x)))

```

will not modify base::letters, even though names(x) shared the same address.

Thus, sb_setRename() can be used safely without fearing such accidents.

Use sb_setRename(x, ...) if x is a non-recursive object (i.e. [mutable_atomic](#)).

Use sb2_setRename(x, ...) if x is a recursive object (i.e. [data.table](#)).

Usage

```

sb_setRename(x, ...)

## Default S3 method:
sb_setRename(x, newnames, ...)

## S3 method for class 'array'
sb_setRename(x, newnames, newdimnames, ...)

sb2_setRename(x, ...)

## S3 method for class 'data.table'
sb2_setRename(x, old, new, skip_absent = FALSE, ...)

```

Arguments

x	a variable belonging to one of the supported mutable classes .
...	further arguments passed to or from other methods.
newnames	atomic character vector giving the new names. Specifying NULL will remove the names.
newdimnames	a list of the same length as dim(x). The first element of the list corresponds to the first dimension, the second element to the second dimension, and so on. The components of the list can be either NULL, or a character vector with the same length as the corresponding dimension. Instead of a list, simply NULL can be specified, which will remove the dimnames completely.
old	the old column names
new	the new column names, in the same order as old
skip_absent	Skip items in old that are missing (i.e. absent) in names(x). Default FALSE halts with error if any are missing.

Value

Returns: VOID. This method modifies the object by reference.
Do not use assignment like names(x) <- sb_setRename(x, ...).
Since this function returns void, you'll just get NULL.

Examples

```

# mutable atomic vector ====
x <- y <- mutable_atomic(1:10, names = letters[1:10])
sb_setRename(x, rev(letters[1:10]))
print(x)

#####

```

```

# mutable atomic matrix ====
x <- mutable_atomic(
  1:20, dim = c(5, 4), dimnames = n(letters[1:5], letters[1:4])
)
print(x)
sb_setRename(
  x,
  newdimnames = lapply(dimnames(x), rev)
)
print(x)

x <- mutable_atomic(
  1:20, letters[1:20], dim = c(5, 4), dimnames = n(letters[1:5], letters[1:4])
)
print(x)
sb_setRename(
  x, newnames = rev(names(x)),
  newdimnames = lapply(dimnames(x), rev)
)
print(x)

#####

# data.table ====

x <- data.table::data.table(
  a = 1:20,
  b = letters[1:20]
)
print(x)
sb2_setRename(x, old = names(x), new = rev(names(x)))
print(x)

```

Description

The `sb_a()` function subsets extracts one or more attributes from an object.

The `sb_str()` function subsets characters of single string, or replace a subset of the characters of a single string with the subsets of the characters of another string. In both cases, a single string is treated as a iterable vector, where each single character in a string is a single element. The `sb_str()` function is considerably faster than doing the equivalent operation in base 'R' or even 'stringi'.

Usage

```
sb_str(str, ind, rp.str, rp.ind)
```

```
sb_a(x, a = NULL)
```

Arguments

<code>str</code>	a single string.
<code>ind</code>	an integer vector, giving the positions of the string to subset.
<code>rp.str, rp.ind</code>	similar to <code>str</code> and <code>ind</code> , respectively. If not specified, <code>sb_str()</code> will perform something like <code>str[ind]</code> treating <code>str</code> as an iterable vector. If these ARE specified, <code>sb_str()</code> will perform something like <code>str[ind] <- rp.str[rp.ind]</code> treating <code>str</code> and <code>rp.str</code> as iterable vectors.
<code>x</code>	an object
<code>a</code>	a character vector of attribute names. If <code>NULL</code> (default), ALL attributes are returned.

Value

The sub-setted object.

Examples

```
x <- matrix(1:10, ncol = 2)
colnames(x) <- c("a", "b")
attr(x, "test") <- "test"
sb_a(x, "test")
sb_a(x)

x <- "hello"
sb_str(x, 5:1) # this gives "olleh"
sb_str(x, c(1:5, 5)) # this gives "helloo"
sb_str(x, c(2:5)) # this gives "ello"
sb_str(x, seq(1, 5, by = 2)) # this gives "hlo"
sb_str(x, 1:4, "world", 1:4) # this gives "worlo"
```

sb_x

Method to Extract, Exchange, or Duplicate Subsets of an Object

Description

This is an S3 Method to extract, exchange, or duplicate (i.e. repeat x times) subsets of an object.

Use `sb_x(x, ...)` if `x` is a non-recursive object (i.e. atomic or factor).

Use `sb2_x(x, ...)` if `x` is a recursive object (i.e. list or data.frame-like).

Usage

```

sb_x(x, ...)

## Default S3 method:
sb_x(x, i, ..., rat = getOption("squarebrackets.rat", FALSE))

## S3 method for class 'matrix'
sb_x(
  x,
  row = NULL,
  col = NULL,
  i = NULL,
  ...,
  rat = getOption("squarebrackets.rat", FALSE)
)

## S3 method for class 'array'
sb_x(
  x,
  idx = NULL,
  dims = NULL,
  rcl = NULL,
  i = NULL,
  ...,
  rat = getOption("squarebrackets.rat", FALSE)
)

## S3 method for class 'factor'
sb_x(
  x,
  i = NULL,
  lvl = NULL,
  drop = FALSE,
  ...,
  rat = getOption("squarebrackets.rat", FALSE)
)

sb2_x(x, ...)

## Default S3 method:
sb2_x(x, i, drop = FALSE, ..., rat = getOption("squarebrackets.rat", FALSE))

## S3 method for class 'array'
sb2_x(
  x,
  idx = NULL,
  dims = NULL,
  i = NULL,
  drop = FALSE,
  ...,
  rat = getOption("squarebrackets.rat", FALSE)
)

```

```
## S3 method for class 'data.frame'
sb2_x(x, row = NULL, col = NULL, filter = NULL, vars = NULL, ...)
```

Arguments

- | | |
|--|---|
| x | see squarebrackets_immutable_classes and squarebrackets_mutable_classes . |
| ... | further arguments passed to or from other methods. |
| i, lvl, row, col, idx, dims, rcl, filter, vars | See squarebrackets_idx_args .
Duplicates are allowed, resulting in duplicated indices.
An empty index selection results in an empty object of length 0. |
| rat | Boolean, indicating if attributes should be returned with the sub-setted object.
See Details section for more info.
for performance: set to FALSE |
| drop | Boolean.
<ul style="list-style-type: none"> • For factors: If drop = TRUE, unused levels are dropped, if drop = FALSE they are not dropped. • For lists: if drop = TRUE, and sub-setting is done using argument i, selecting a single element will give the simplified result, like using [[]]. If drop = FALSE, a list is always returned regardless of the number of elements. |

Details

One the rat argument

Most [- methods strip most (but not all) attributes.

If rat = FALSE, this default behaviour is preserved, for compatibility with special classes. This is the fastest option.

If rat = TRUE, attributes from x missing after sub-setting are re-assigned to x. Already existing attributes after sub-setting will not be overwritten.

There is no rat argument for data.frame-like object: their attributes will always be preserved.

NOTE: In the following situations, the rat argument will be ignored, as the attributes necessarily have to be dropped:

- when x is a list, AND drop = TRUE, AND a single element is selected, AND sub-setting is done through the i argument.
- when x is an atomic matrix or array, and sub-setting is done through the i argument.

Value

Returns a copy of the sub-setted object.

Examples

```
# atomic objects ====

obj <- matrix(1:16, ncol = 4)
```

```

colnames(obj) <- c("a", "b", "c", "a")
print(obj)
sb_x(obj, 1:3, 1:3)
# above is equivalent to obj[1:3, 1:3, drop = FALSE]
sb_x(obj, i = \ (x)x>5)
# above is equivalent to obj[obj > 5]
sb_x(obj, col = c("a", "a"))
# above is equivalent to obj[, lapply(c("a", "a"), \ (i) which(colnames(obj) == i)) |> unlist()]

obj <- array(1:64, c(4,4,3))
print(obj)
sb_x(obj, n(1:3, 1:2), c(1,3))
sb_x(obj, rcl = n(1:3, NULL, 1:2))
# above 2 lines are equivalent to obj[1:3, , 1:2, drop = FALSE]
sb_x(obj, i = \ (x)x>5)
# above is equivalent to obj[obj > 5]

#####

# factors ====

obj <- factor(rep(letters[1:5], 2))
sb_x(obj, lvl = c("a", "a"))
# above is equivalent to obj[lapply(c("a", "a"), \ (i) which(obj == i)) |> unlist()]

#####

# lists ====

obj <- list(a = 1:10, b = letters[1:11], c = 11:20)
print(obj)
sb2_x(obj, 1) # obj[1]
sb2_x(obj, 1, drop = TRUE) # obj[[1]]
sb2_x(obj, 1:2) # obj[1:2]
sb2_x(obj, is.numeric) # obj[sapply(obj, is.numeric)]
# for recursive indexing, see sb2_rec()

#####

# recursive arrays / dimensional lists ====
obj <- c(as.list(1:10), as.list(letters[1:10])) |> array(dim = c(5, 4)) |> t()
print(obj)
sb2_x(obj, list(1:3), 1)
# above is equivalent to obj[1:3, ]

#####

# data.frame-like objects ====

obj <- data.frame(a = 1:10, b = letters[1:10], c = 11:20, d = factor(letters[1:10]))
print(obj)
sb2_x(obj, 1:3, 1:3) # obj[1:3, 1:3, drop = FALSE]

```



```
sb2_x(obj, filter = ~ (a > 5) & (c < 19), vars = is.numeric)
```

seq_names

Generate Integer Sequence From a Range of Names

Description

Generate integer sequence from a range of names.

Usage

```
seq_names(names, start, end, inv = FALSE)
```

Arguments

names	a character vector of names. Duplicate names, empty names, or a character vector of length zero are not allowed.
start	the name giving the starting index of the sequence
end	the name giving the ending index of the sequence
inv	Boolean. If TRUE, the indices of all names except the names of the specified sequence will be given.

Value

An integer vector.

Examples

```
x <- data.frame(
  a = 1:10, b = letters[1:10], c = factor(letters[1:10]), d = -1:-10
)
ind <- seq_names(colnames(x), "b", "d")
sb2_x(x, col = ind)
```

seq_rec2

Generate Recursive Sequence Through Repeated Arithmetic Infix Operations

Description

This is a recursive sequence generator.

The function is essentially a highly generalized version of a Fibonacci sequence generator.

Starting with 2 initial values, each next value i is generated by either one of 2 formulas:

1. $x[i] = (s[1] + m[1] * x[i-1]) \%inop\% (s[2] + m[2] * x[i-2])$
2. $x[i] = (m[1] * (x[i-1] + s[1])) \%inop\% (m[2] * (x[i-2] + s[2]))$

where `%inop%` is the arithmetic infix operator chosen,

and m and s are each a numeric vector of length 2.

The order of $x[i-1]$ and $x[i-2]$ can also be swapped.

Usage

```
seq_rec2(
  inits = c(0L, 1L),
  n = 10L,
  s = c(0L, 0L),
  m = c(1L, 1L),
  inop = "+",
  form = 1L,
  rev = FALSE
)
```

Arguments

<code>inits</code>	a numeric (double or integer) vector of length 2, giving the initial values. Any numbers are allowed, even negative and/or fractional numbers. Note that numbers given must give valid results when passed to function <code>f()</code> .
<code>n</code>	a single integer, giving the size of the numeric vector to generate. NOTE: it must hold that $n > 2$.
<code>s, m</code>	numeric vectors of length 2 to be used in the formula.
<code>inop</code>	a single string, giving the arithmetic infix operator to be used. Currently supported: "+", "-", "*", "/". For a fibonacci sequence, <code>inop = "+"</code> .
<code>form</code>	either 1 or 2, indicating which formula to be used (see Description section above).
<code>rev</code>	reverse the order of $x[i-1]$ and $x[i-2]$. For example, using <code>form = 1</code> : <ul style="list-style-type: none"> If <code>rev = FALSE</code> (default), it holds: $x[i] = (s[1] + m[1] * x[i-1]) \%inop\% (s[2] + m[2] * x[i-2])$. If <code>rev = TRUE</code>, it holds: $x[i] = (s[1] + m[1] * x[i-2]) \%inop\% (s[2] + m[2] * x[i-1])$

Details

The default values of the arguments give the first 10 numbers of a regular Fibonacci sequence.
 See examples for several number series created with this function.
 This function is written in C++ using Rcpp for better performance.

Value

A sequence of numbers.

Note

Do not supply NAs or NaNs to this function, as it cannot handle them.

Examples

```
seq_rec2() # by default gives Fibonacci numbers
seq_rec2(inits = 2:1) # Lucas numbers
c(1, seq_rec2(c(1, 2), inop = "*")) # Multiplicative Fibonacci
seq_rec2(m = c(2L, 1L)) # Pell numbers
seq_rec2(inits = c(1, 0), m = c(0L, 2L)) # see https://oeis.org/A077957
seq_rec2(m = c(1L, 2L)) # Jacobsthal numbers
```

 setapply

Apply Functions Over Mutable Atomic Matrix Margins By Reference

Description

The `setapply()` function applies a functions over the rows or columns of a `mutable_atomic` matrix, through [pass-by-reference semantics](#).

For every iteration, a copy of only a single row or column (depending on the margin) is made, the function is applied on the copy, and the original row/column is replaced by the modified copy through [pass-by-reference semantics](#).

The `setapply()` is a bit faster and uses less memory than [apply](#).

Usage

```
setapply(x, MARGIN, FUN)
```

Arguments

<code>x</code>	a <code>mutable_atomic</code> matrix. Arrays are not supported.
<code>MARGIN</code>	a single integer scalar, giving the subscript to apply the function over. 1 indicates rows, 2 indicates columns.
<code>FUN</code>	the function to be applied. The function must return a vector of the same type of <code>x</code> , and the appropriate length (i.e. <code>length ncol(x)</code> when <code>MARGIN == 1</code> or <code>length nrow(x)</code> when <code>MARGIN == 2</code>).

Value

Returns: VOID. This function modifies the object by reference.
Do NOT use assignment like `x <- setapply(x, ...)`.
Since this function returns void, you'll just get NULL.

Examples

```
# re-order elements matrix by reference ====
x <- mutable_atomic(1:20, dim = c(5,4))
print(x)
setapply(x, 1, FUN = \(x)x[c(4,1,3,2)])
print(x)

# sort elements of matrix by reference ====
x <- mutable_atomic(20:1, dim = c(5,4))
print(x)
setapply(x, 2, FUN = sort)
print(x)
```

sub2ind

Convert Subscripts to Coordinates, Coordinates to Flat Indices, and Vice-Versa

Description

These functions convert a list of integer subscripts to an integer matrix of coordinates, an integer matrix of coordinates to an integer vector of flat indices, and vice-versa.
Inspired by the `sub2ind` function from 'MatLab'.

- `sub2coord()` converts a list of integer subscripts to an integer matrix of coordinates.
- `coord2ind()` converts an integer matrix of coordinates to an integer vector of flat indices.
- `ind2coord()` converts an integer vector of flat indices to an integer matrix of coordinates.

- `coord2sub()` converts an integer matrix of coordinates to a list of integer subscripts; it performs a very simple (one might even say naive) conversion.
- `sub2ind()` is a faster and more memory efficient version of `coord2ind(sub2coord(sub, x.dims), x.dims)` (especially for up to 5 dimensions).

All of these functions are written to be memory-efficient.

The `coord2ind()` is thus the opposite of [arrayInd](#), and `ind2coord` is merely a convenient wrapper around [arrayInd](#).

Note that the equivalent to the `sub2ind` function from 'MatLab' is actually the `coord2ind()` function here.

Usage

```
sub2coord(sub, x.dim)

coord2sub(coord)

coord2ind(coord, x.dim, checks = TRUE)

ind2coord(ind, x.dim)

sub2ind(sub, x.dim, checks = TRUE)
```

Arguments

<code>sub</code>	<p>a list of integer subscripts.</p> <p>The first element of the list corresponds to the first dimension (rows), the second element to the second dimensions (columns), etc.</p> <p>The length of <code>sub</code> must be equal to the length of <code>x.dim</code>.</p> <p>One cannot give an empty subscript; instead fill in something like <code>seq_len(dim(x)[margin])</code>.</p> <p>NOTE: The <code>coord2sub()</code> function does not support duplicate subscripts.</p>
<code>x.dim</code>	an integer vector giving the dimensions of the array in question. I.e. <code>dim(x)</code> .
<code>coord</code>	<p>an integer matrix, giving the coordinate indices (subscripts) to convert.</p> <p>Each row is an index, and each column is the dimension.</p> <p>The first columns corresponds to the first dimension, the second column to the second dimensions, etc.</p> <p>The number of columns of <code>coord</code> must be equal to the length of <code>x.dim</code>.</p>
<code>checks</code>	<p>Boolean, indicating if arguments checks should be performed.</p> <p>Defaults to TRUE.</p> <p>Can be set to FALSE for minor speed improvements.</p> <p>for performance: set to FALSE</p>
<code>ind</code>	an integer vector, giving the flat position indices to convert.

Details

The S3 classes in 'R' use the standard Linear Algebraic convention, as in academic fields like Mathematics and Statistics, in the following sense:

- vectors are **column** vectors (i.e. vertically aligned vectors);
- index counting starts at 1;
- rows are the first dimension/subscript, columns are the second dimension/subscript, etc.

Thus, the orientation of flat indices in, for example, a 4 by 4 matrix, is as follows:

	[,1]	[,2]	[,3]	[,4]
[1,]	1	5	9	13
[2,]	2	6	10	14
[3,]	3	7	11	15
[4,]	4	8	12	16

The subscript [1,2] refers to the first row and the second column. In a 4 by 4 matrix, subscript [1,2] corresponds to flat index 5.

The functions described here thus follow also this convention.

Value

For sub2coord() and ind2coord():

Returns an integer matrix of coordinates (with properties as described in argument coord).

For coord2ind():

Returns an integer vector of flat indices (with properties as described in argument ind).

For coord2sub():

Returns a list of integer subscripts (with properties as described in argument sub)

Note

These functions were not specifically designed for duplicate indices per-sé.

For efficiency, they do not check for duplicate indices either.

Examples

```
x.dim <- c(10, 10, 3)
x.len <- prod(x.dim)
x <- array(1:x.len, x.dim)
sub <- list(c(4, 3), c(3, 2), c(2, 3))
coord <- sub2coord(sub, x.dim)
print(coord)
ind <- coord2ind(coord, x.dim)
print(ind)
all(x[ind] == c(x[c(4, 3), c(3, 2), c(2, 3)])) # TRUE
```

```
coord2 <- ind2coord(ind, x.dim)
print(coord)
all(coord == coord2) # TRUE
sub2 <- coord2sub(coord2)
sapply(1:3, \(i) sub2[[i]] == sub[[i]]) |> all() # TRUE
```

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